The Value of Living Systems Beyond a Price: New Dynamic Potential for Sustainable Technologies Between Citizens and Plants

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Tesi di Doppia Laurea sotto il Progetto POLITONG

Laurea Magistrale in DESIGN SISTEMICO
Dipartimento di Architettura e Design A.A 2018/2019

POLITECNICO
DI TORINO

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Lavoro svolto presso:

TONGJI UNIVERSITY
COLLEGE OF DESIGN AND INNOVATION
同济大学设计创意学院

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Mediato da:

CSR Platform
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PREMESSA

Questo volume presenta il lavoro di tesi dell'autrice di un progetto di doppia laurea POLITONG.
Iniziato da una formazione di Design Sistemico al Politecnico di Torino e sviluppato sotti lil campo di Product Service System Design presso la Tongji University, College of Design and Innovation a Shanghai in Cina.

Si tratta di due contesti universitari strutturalmente differenti.
Infatti, la scala di rilevanza di un sistema solitamente considerata nelle due istituzioni è diversa, rispettivamente anche la mole e il raggio di ricerca necessariamente svolto.
Questo emerge dalla differente strutturazione dei corsi:
Politecnico di Torino: Progetto di semestre con integrati corsi teorici per supportare il progetto
Tongji University: Corsi progettuali o teorici da 4-6 settimane.

Il successo del lavoro è stato reso possibile grazie alla supervisione dedicata in loco della relatrice estera Prof. Susu Nousala e svolto supportato per integrazione dal gruppo di ricerca Creative Systemic Research Platform di cui l'Autrice è membro e con cui continuerà il progetto in applicazioni e ricerca.

La tematica è stata anticipata al mondo in una publicazione congiunta tra l'autrice e i due relatori alla Conferenza Internazionale LEUS 2019 (International Conference on Landscape Ecology and Urban Sustainability) tenutasi a Hohhot, Inner Mongolia, Cina 12-13 Gennaio 2019 [1] [12].

Seguono una breve spiegazione del gruppo CSRP, gli abstract, l'introduzione, un riassunto personale indicativo del corpo di ricerca e progetto e conclusioni in italiano a precedere l'intero lavoro in inglese nel formato generalizattio a livello statale cinese per tutte le facoltà.

GLI ABSTRACT

ITALIANO	INGLESE	CINESE
ITALIANO	ENGLISH	中文

ABSTRACT in Italiano

Come si può notare osservando la nostra società, attualmente, l'argomento sulle labbra di tutti, le corporazioni e i capi dei governi, compresi i comuni cittadini, è la "sostenibilità". Questo termine è spesso usato e abusato per attirare l'attenzione, ma può essere meglio compreso solo definendo la struttura contestuale dell'intenzione di raggiungere uno stato o un processo sostenibile [1].

I problemi fondamentali evidenziati in questa ricerca: mostrano la mancanza di comprensione tra la vita umana e il mondo naturale. Questa mancanza di comprensione sta creando un gap generazionale, evidente attraverso la tendenza della crescita della popolazione e la migrazione verso le città. I nostri giovani devono ancora imparare le relazioni tra la vita e altri sistemi viventi. Questo è il risultato di essere almeno la terza generazione che è migrata dalla campagna alla città. La domanda è: chi trasmetterà le conoscenze, le esperienze e la cultura alle popolazioni future e come?

La percezione e la comprensione del valore della natura si sta perdendo. In particolare, che le piante fornirniscono i nostri bisogni di base, le quali sono i principali produttori al mondo e la nostra principale fonte di cibo. Se perdiamo la conoscenza e l'esperienza di ottenere le cose naturalmente e il riconoscimento di questo principio su una scala più ampia, allora ogni gruppo di generazioni di età non sarà in grado di sostenersi dalle risorse naturali rimanenti. Il nostro sostentamento risultante continuerà a rimanere insostenibile in relazione all'intera biosfera vivente.

Le piante sono organismi che precedono l'essere umano, sono altrettanto altamente adattive e reattive come noi umani (se non più). L'unica differenza è che non possiamo provvedere a noi stessi senza di loro. Anche se volessimo affidarci esclusivamente a soluzioni

tecnologiche, abbiamo ancora bisogno di fonti naturali per qualsiasi processo di sintesi che possiamo pianificare o considerare come soluzione (per esempio, in termini di fornitura di cibo, la carne prodotta in laboratorio dalle cellule).
Per risolvere i problemi dell'umanità sono molte le soluzioni emergenti già esistenti in natura sta a noi riconoscerle e applicarle. Per via dell'elevata reattività e relazione delle piante con i sistemi viventi, esse possono essere considerate come le fornitrici delle tecnologie più sostenibili per risolvere i nostri problemi [1]

Il processo e le considerazioni mostrate nel seguente scenario progettuale e di ricerca sono spiegati attraverso esperienze e approcci multidisciplinari, transdisciplinari, multiculturali e multigenerazionali, i quali sono necessari per evidenziare i modi fondamentali di plasmare le relazioni a lungo termine tra cittadini e piante. Questo approccio apre nuovi potenziali dinamiche per ristabilire punti di vista quando si considerano i processi viventi delle piante come una combinazione di più tecnologie sostenibili. Questo modo di pensare è applicabile a qualsiasi scala e contesto e richiede nuovi approcci all'apprendimento, creando a sua volta nuovi paradigmi educativi [1].

Parole chiave: sostenibilità; tecnologie sostenibili; piante; cittadini; conoscenza generazionale; pensiero sistemico; cognizione; processi educativi; processi della vita; sistemi naturali; permacultura

ABSTRACT in Inglese

As can be noticed by observing our society, currently, the topic on everybody's lips, corporations' and governments' heads including common citizens', is "sustainability". This term is often over used and abused to capture attention, but it can only be better understood by defining the contextual structure of the intention for achieving a sustainable state or process [1].

The core problems highlighted in this research: show the lack of understanding between human life and the natural world. This lack of understanding is creating a generational gap, evident through the trend of population growth and migration towards cities. Our youth have yet to learn the relations between life and other living systems. This is the result of being at least the 3rd generation that migrated from the countryside to the city. The question is who will transmit the knowledge, experiences and culture to the future population and how?
The perception and understanding of the value of Nature is being lost. In particular what plants can provide our basic needs, which are the primary producers in the world and our primary source of food. If we lose the knowledge and experience of obtaining things naturally, and the recognition of this principle on a wider scale, then every age group of generations will not be able to sustain themselves from the remaining natural resources. The result being our sustainment will continue to remain unsustainable in relation to the entire living biosphere.
Plants are organism that pre-date human, as such are just as highly adaptive and reactive (if not more so), as we humans. The only difference is that we cannot provide for ourselves without them. Even if we want to solely rely on technological solutions, we still need natural sources for any synthesising process we may planning or considering as solutions, (for example, the lab grown meat from cells in terms of food provision).

Many emerging solutions that could solve humanities issues are actually already existing in nature. Since plants have high levels of reactivity and relationships with living systems, they themselves can be considered as the providers of the most sustainable technologies to solve our problems [1].

The process and considerations shown in the following research and project scenario are explained through multidisciplinary, transdisciplinary, multicultural and multigenerational experiences and approaches, that are necessary for highlighting fundamental ways of shaping long-term relations between citizens and plants. This approach opens new dynamic potentials for re-establishing points of view when considering plants' living processes as a combination of multiple sustainable technologies. This thinking is applicable at any scale and context, and will require new approaches to learning, creating in turn, new educational paradigms [1].

Keywords: sustainability; sustainable technologies; plants; citizens; generational knowledge; systemic thinking; cognition; educational processes; life processes; natural systems; permaculture

ABSTRACT in Cinese

通过观察我们的社会可以注意到，目前，每个人、公司集团和政府首脑（包括普通公民）在谈论的话题是“可持续性”。这一术语经常被过度使用和滥用以引起公众关注，但只有通过定义实现可持续状态或进程的意图的语境结构，才能理解这一术语[1]。

本研究突出的核心问题是：人类生活与自然世界之间缺失理解。这种理解的缺失正在造成一个代际差距，从人口增长和向城市流动的趋势中可以明显看出。我们的年轻人还需要学会生活和其他生物生活系统之间的关系。这是至少第三代人从农村迁到城市的结果。问题是，谁将把知识、经验和文化传播给未来的人口，以及如何传播？

对提供我们基本需求的自然，尤其是植物——是世界上的主要生产者也是我们的主要食物来源——价值的认知，正在丧失。如果我们失去了从自然界自然地获得事物的知识和经验，认知需要更广泛地应用这一原则，那么，每一个世代的不同年龄群体将无法在剩余自然资源中持续。结果是，就整个生物圈而言，我们想要持续的愿望，终将不可持续。

植物是在人类出现之前就存在有机物，因此与我们人类一样具有高度的适应性和反应性。唯一不同的是，离开它们我们就无法生存。即使我们认为可以依赖于技术解决问题，但是任何我们列出的解决方案，依旧需要一种自然资源来进行合成过程，例如，在食物供应方面，实验室中由细胞培植出的食用肉。

人类问题的新兴解决方案实际上已经存在于自然界中，由于植物具有高度的反应性和与生存系统的关系，它们可以被视为解决我们问题的最可持续技术的提供者[1]。

以下研究和项目方案中所示的过程和考虑因素通过多学科、跨学科、多文化和多代的经验和方法加以解释，这些经验和方法对于突出塑造公民和植物之间长期关系的基本途径是必要的。将植物的生长过程作为多重可持续技术组合的提供者，重新开辟了动态思路的潜力。这种思路适用于任何规模和背景，需要新的学习方法，进而创造新的教育范式[1]。

关键词：可持续性；可持续技术；植物；公民；世代知识；
系统化思维；认识；教育范式；生长过程；自然系统；
朴门（永续）农艺

INDICE ESTESO

TESTO: AGGIUNTO, ORIGINALE
TRADUZIONI: PARZIALE, COMPLETA, TITOLO

INDICE ESTESO

CREATIVE SYSTEMIC

RESEARCH PLATFORM

BREVEMENTE: CSRP TEAM

La Creative Systemic Research Platform è un gruppo di ricerca incentrato sui emergenti processi bottom-up. Il pensiero sistemico risponde con applicazioni creative basate su Pop UP Learning che portano alla comprensione dei sistemi e alle strutture della conoscenza. La pratica vuole supportare le dinamiche relazionali del patrimonio urbano / rurale intangibile e delle reti culturali.

Il Team è cresciuto e cambiato nel tempo sostenendo progetti di scale differenti. Grazie al stabilirsi di membri principali e dell'estensione esponenziale delle reti degli stakeholder coinvolti, l'identità visiva evolve da una definizione di gruppo pop-up a un'identità integrata.

CSR Platform
Creative Systemic Research Platform

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CSRP: Prima, durante e dopo questa tesi, che ne contribuisce la transizione.
CSRP: Before, during and after this thesis, which contributes to the transition.

The Creative Systemic Research Platform is a research group that focuses on emergent bottom up processes. Systemic thinking answers with Pop UP Learning based creative applications leading to systems understanding and knowledge structures. The practice wants to supports relationship dynamics of the the urban / rural intangible heritage and cultural networks.

The Team has grown and changed in time sustaining projects of differents scales. Due to the establishment of core members and exponential extension of the stakeholders' networks involved the visual identity evolves from a pop up group definition to an integrated identity.

CAPITOLO 1

INTRODUZIONE

1 CAPITOLO 1: INTRODUZIONE

I.1.1 OBIETTIVI DI RICERCA

(1.1 Research Objectives) 1

Si deve dichiarare che questa tesi è orientata nel campo del design e il contenuto della ricerca esaminato si concentra sulla comprensione degli attuali problemi ambientali globali, il loro impatto e le tendenze a livello di cittadini comuni, (intendendo persone comuni che vivono nelle città). Ha lo scopo di trovare scenari di casi nella quotidianità della vita comune, per cui le azioni progettuali siano integrative, disegnate con la capacità di influenzare i comportamenti e contribuire, se estesi in spazio e tempo, ad alleviare gli impatti globali [1].

Molti termini emergono discutendo problemi ambientali globali chiave, come "sostenibilità", "sviluppo", "limiti", "equità", così come i concetti di "flusso di equilibrio" e "bisogni di base della vita", come precedentemente discusso da Sučić [1] per citarne alcuni.
Altri termini frequenti relativi ai generi di problemi globali riconosciuti e accettati dai cittadini comuni sono il Cambiamento Climatico e l'Inquinamento dell'Aria. Si includono anche Cambiamenti Climatici Estremi come ondate di calore, inondazioni e siccità, le quali influenzano e alterano l'approvvigionamento alimentare, le infrastrutture abitate, le condizioni di salute e le reazioni degli ecosistemi. Relativamente alle risposte degli ecosistemi, un altro problema emergente è la perdita della biodiversità che sta compromettendo l'equilibrio fornito dalle relazioni funzionali conosciute tra le creature viventi coinvolte e il loro stesso mantenimento e sopravvivenza. Tutte queste parole chiave e concetti citati in precedenza hanno portato a impatti e risultati di problemi economici basati su ambienti umani, che a loro volta minacciano le risorse, come discusso da Sučić [1].

Le risposte attuali sono evidenti grazie a istituzioni leader come le Nazioni Unite (UN), il Club di Roma, il Centro della Resilienza di Stoccolma che potenzia i punti di attenzione e le necessità con i “Nine Boundaries” (Nove Confini) [2] che possono essere gestiti lavorando sui 17 Obiettivi Globali delle Nazioni Unite per lo sviluppo sostenibile [3] [1].

La questione attuale su cui concentrarsi al momento sta nel come raggiungere e mantenere gli sforzi investiti per questi obiettivi? Le istituzioni possono iniziare molto nel cambiamento per mitigare gli impatti ma non sono così efficaci e ben posizionate nel guidare il mantenimento a lungo termine di questi obiettivi. Chi manterrà questi sforzi per la generazione di persone che arriveranno quando l’istituzione dell’iniziazione probabilmente non esiterà più?

1. Nine planetary boundaries (PB). The dotted area represents the safe operating space: the greater the human-caused perturbation, the greater the risk of large-scale abrupt, and irreversible Earth system changes [2].

2. The 17 UN Global Goals for Sustainable Development [3]

“L’obiettivo è trovare porte o occasioni di transizione per attivare comportamenti sostenibili e processi di cambiamento delle scelte nei singoli cittadini comuni, quindi gruppi, e mantenerli attivi, progressivi e disponibili per le generazioni future. Grazie alla comprensione dei processi attraverso le esperienze, è possibile identificare le potenziali risorse naturali come tecnologie naturali per reagire positivamente ai nostri problemi globali [1]. “

Per sostenere i bisogni primari della vita, chiari moduli dei fondamenti devono diventare conoscenze condivise comuni. Pertanto, i programmi educativi sulla comprensione della sostenibilità devono essere stimolati nei sistemi educativi generali. I nuovi approcci educativi devono abbracciare concetti chiave basati sul pensiero sistemico che richiede formazione del pensiero critico, pensiero associativo per riconoscere relazioni esistenti e relazioni longitudinali a partire dai bisogni, dai comportamenti e dagli effetti relativi alla vita quotidiana dei cittadini. Se si considera importante costruire generazioni più resilienti, dobbiamo mantenere la cognizione / consapevolezza dei principi della natura e formarci sul pensiero sistemico.

Non è che si debba aggiungere strumenti educativi, ma in realtà occorre cambiare l'approccio educativo.

In parole semplici, questo progetto di ricerca è alla ricerca di opzioni per integrare la comprensione della sostenibilità in circostanze limitate del cittadino attraverso il focus / l'interfaccia delle piante che forniscono / sono fornitornitrici di relazioni funzionali. Consentendo così di produrre attivamente comportamenti sostenibili attraverso la consapevolezza, la conoscenza e la produzione di effetti desiderati, che devono essere in grado di essere assorbiti da qualcos'altro più e più volte.

I.1.2 METODOLOGIA DI RICERCA

(1.2 Research methodology) *3*

In questo capitolo si spiegano gli strumenti di ricerca di azione e teorici/orientativi per aiutare nella lettura del percorso.

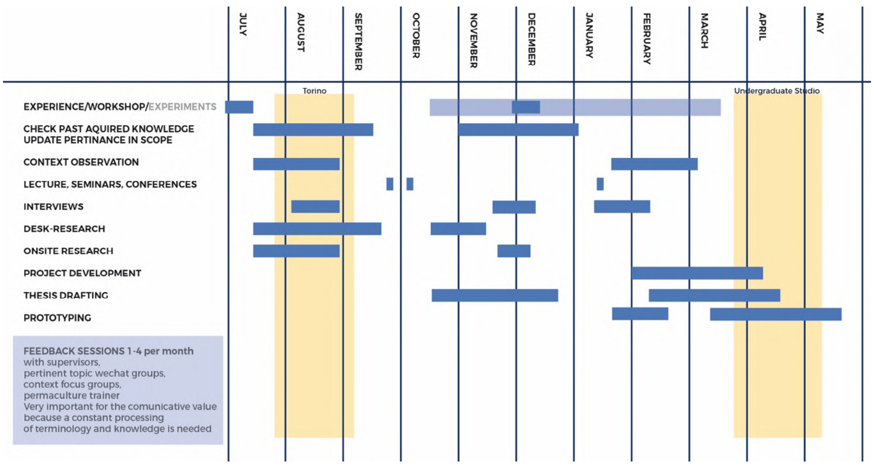
I.1.2.1 Strumenti d'azione

(1.2.1 Action Tools) *3*

L'approccio di ricerca basato sul contesto attivo porta ad affrontare un atteggiamento di lavoro transdisciplinare. La ricerca ha portato ad una rilevanza in una varietà di campi da considerare per la comprensione di una più ampia pertinenza di immagine, campi che da uno scopo di ricerca di design sono finiti per integrare antropologia, biologia, botanica, agricoltura, permacultura, psicologia, ingegneria, pianificazione urbana, scienze socio -culturali e conoscenza dell'educazione.

Casi di studio di test pratici spiegati nel capitolo 3, riscontrati e realizzati nelle fasi di esperienza / workshop / esperimenti mostrati nella figura 3, sono stati trovati o costruiti con l'intento di comprendere la comprensibilità della ricerca e la pertinenza dei risultati del progetto che contribuiscono alla raccolta di dati qualitativi e alle creazioni di feedback loop. Altri strumenti molto importanti sono le interviste e le discussioni sulla base dei contesti, perché ciò che conta veramente in questa ricerca è la percezione e l'applicazione dei cittadini, poiché le regole e le politiche non dicono molto sui comportamenti, ma enfatizzano ciò che potrebbe essere fatto che non è stato ancora realizzato. Le interviste e le discussioni basate sul contesto sono state fondamentali soprattutto nel contesto cinese poiché creava un accesso ai dati in una forma comprensibile e risparmiando tempo e qualità che non sarebbero accessibili da un processo di traduzione da documenti. Questi sono integrati nella letteratura supportata da riferimenti accessibili, che vogliono dare prospettive diverse e mostrare come, in base alla posizione della persona nel loro contesto conosciuto, le priorità siano diverse e la capacità di rispondere ai problemi globali sia diversa.

Una parte importante riguarderà gli studi di permacultura, le pratiche, le applicazioni di progettazione, i principi e le metodologie spiegati e de-strutturati in letteratura e poi estrapolati per scopi progettuali di strumenti di innovazione educativa che mirano a comprendere, avviare e applicare sostenibilità / sostenibilità tecnologie / approcci / attitudini che considerano gli effetti in una più ampia linea temporale.



3. Workload timetable

I.1.2.1 Strumenti teorici-orientativi

(1.2.2 Orientator / Theorical tools) 4

Per affrontare lo scopo e l'attitudine della ricerca è necessario fornire al lettore una terminologia e strumenti di base per navigare le dinamiche tra i diversi campi considerati nella letteratura e le loro relazioni. Segue: Definizione del pensiero sistemico dal libro di F. Capra e P. L. Luisi The Systems View of Life, A Unified Vision [4] [5] [6]; Parametri contestuali trasposizione di strumenti visivi con una selezione terminologica di movimenti illustrata dall'autrice e discussa nel documento introduttivo su questa tesi [1]; Approccio sistemico è l'approccio progettuale insegnato al Politecnico di Torino Laurea magistrale in Design sistemico che modella i requisiti dei risultati della ricerca per le definizioni degli obiettivi del progetto [7] [8]; Modello ontologico per Sistemi Viventi Complessi Adattivi (CAS) sviluppato per spiegare le dinamiche di resilienza che richiedono una comprensione longitudinale [9] [10].
Seguono i capitoli con le relative parole chiave.

I.1.2.2.1 Pensiero sistemico

(1.2.2.1 Systems Thinking) 5

Systems thinking, il persiero sistemico è contestuale che è l'opposto del pensiero analitico.

Keywords: from parts to the whole; from the object to the relations; from measuring to mapping; from quantity to quality; from structures to processes; from objectives to epistemic science; from Cartesian certainty to approximate knowledge.

Parole chiave: dalle parti al tutto; dall'oggetto alle relazioni; dalla misurazione alla mappatura; dalla quantità alla qualità; dalle strutture ai processi; dagli obiettivi alla scienza epistemica; dalla certezza cartesiana alla conoscenza approssimativa.

I.1.2.2.2 Parametri contestuali

(1.2.2.2 Contextual Parameters) 5

Contextual parameters keywords: actors; citizens, green, range of action; range of effect; scales; spatial movement; layers; context; levels, elements; hierarchies.

Parole chiave dei parametri contestuali: attori; cittadini, verde, raggio d'azione; raggio di effetto; scala; movimento spaziale; strati; contesto; livelli, elementi; gerarchie.

I.1.2.2.3 Approccio Sistemico

(1.2.2.3 Systemic Approach) 10

Vi è presentato un diagramma che mostra i principali principi attuati nella metodologia dell'Approccio sistemico applicata nel design al Politecnico di Torino, questa è l'ultima versione aggiornata emersa dal progetto di Sistemi Aperti e presentata alla difesa della tesi dei studenti che hanno continuato il progetto Amedeo Mascitti e Alessandro Maccagno [30].

I.1.2.2.4 Modello ontologico per Sistemi Viventi Complessi Adattivi (CAS)

(1.2.2.4 Ontological Model for Living Complex Adaptive Systems) 11

Fondamentale di questo modello è la terminologia usata per definirne le componenti e comportamenti.

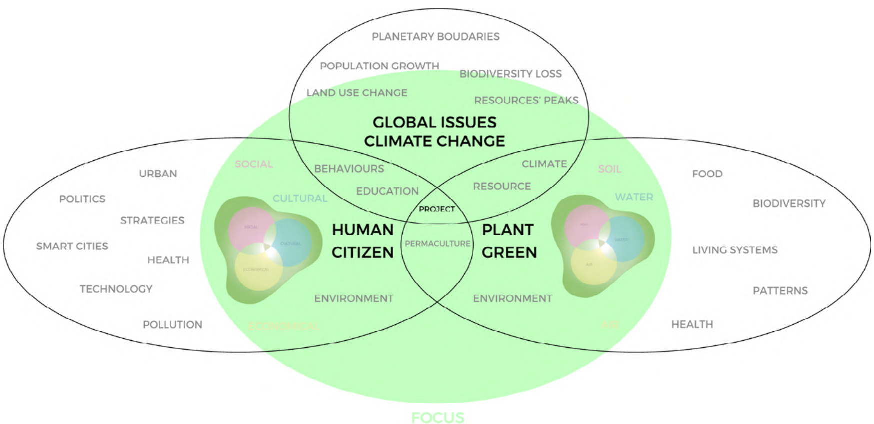
CAS keywords: terminology; longitudinal behavior; evolution in time; status quo; sustaining forces; constraining forces; systems robustness – diversity & redundancy; systems capacity –knowledge & ability, systems adaptability – flexibility & creativity; uses.

Parole chiave CAS: terminologia; comportamento longitudinale; evoluzione nel tempo; status quo; forze sostenenti; forze vincolanti; robustezza dei sistemi: diversità e ridondanza; capacità dei sistemi - conoscenza e capacità, adattabilità dei sistemi - flessibilità e creatività; usi.

I.1.3 UTILITÀ DELLA RICERCA:IL PROBLEMA GENERALE DELLA PERCEZIONE DEI SISTEMI AMBIENTALI

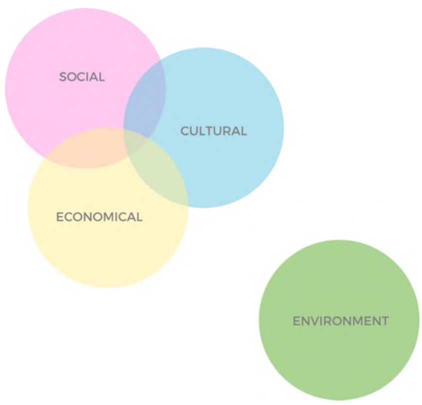
(1.3 Research Usefulness: The General Proble of Environmental Systems Perception) 13

Come è già stato discusso dal Sučić [1], il problema generale della percezione del sistema degli esseri umani urbani che si concentra sui sistemi economici, sociali e culturali, è che stanno emergendo segni e cambiamenti ambientali che non possono essere posizionati in nessuno di questi tre sistemi. Poiché abbiamo imparato a valutare la nostra vita in base alle relazioni con i prodotti e a misurarla in base al numero di beni e al tipo di selezioni che facciamo, siamo distratti da ciò che significa la vita. Questo orientamento del possesso definisce il nostro livello di vita all'interno dei nostri sistemi economici, sociali e culturali. Criticamente, fino a poco tempo fa si è prestata poca attenzione agli effetti prodotti da i nostri prodotti, beni e selezioni. Non abbiamo mai veramente sviluppato un modo per considerare questi processi finché non si iniziano a riscontrare alcune relazioni tra le nostre scelte comportamentali e i fenomeni ambientali [1].

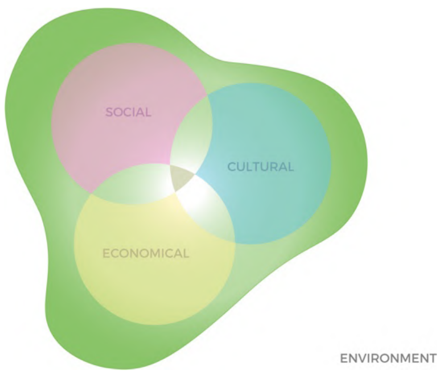


12. These convergences are going to emerge in the project outcomes [1]

In questo contesto, Ambiente significa la totalità delle condizioni circostanti, che include il resto del sistema Natura più grande. Ciò implica che ogni avvio nei nostri tre sistemi si attiva nell'ambiente, verrà elaborato dai tre sistemi e influenzerà nuovamente l'ambiente. Pertanto, l'ambiente è dentro e fuori i nostri tre sistemi. Infatti, l'ambiente incarna / integra questi sistemi: ambienti economici, sociali e culturali, che sono strati (layer) dell'ambiente su scala umana, che è solo una parte compresa nella più ampia biosfera / ambiente ecologico che include le relazioni tra molte altre specie viventi della natura. "Possiamo influenzare l'ambiente ecologico ma non possiamo dominarlo come fa un calcolo matematico nella prospettiva economica contemporanea. L'economia è solo il risultato numerabile dei processi di transizione. Non possiamo decidere una quantità di denaro che vogliamo e quindi gestire tutto il resto della vita per raggiungerlo. Ma di sicuro possiamo identificare ciò di cui abbiamo bisogno per la vita e come questo possa provvedere alle vite future, trasmettere la conoscenza e l'esperienza a queste (cultura dell'educazione), il processo di fornitura coinvolge e fornisce altre vite (integrazione sociale) e il la valutazione di quanto bene o male stiamo distribuendo per la vita è l'economia [1]. "



14. Environment System: New perceived system rising under human attentions that needs to be considered [1].



13. Needed integration for the environment system perception which has a cyclic movement from inside towards outside and vice versa [1].

Questo problema di mis-integrazione emerge dai problemi successivi riscontrati nella letteratura di ricerca. In termini di design, dal momento che la disciplina del design intende proporre soluzioni ai problemi e ai bisogni umani, come afferma Lou Yongqi nell'epilogo "abbiamo bisogno di una nuova generazione di designer - persone addestrate a comprendere l'ecologia, l'ambiente e i sistemi virtuali che forniscono comunicazione e feedback appropriati ." "Abbiamo anche bisogno di principi e approcci completamente nuovi. Come con qualsiasi strategia, l'implementazione è la chiave. In nessun altro momento nella storia umana l'attivismo progettuale è stato così necessario. Se non interveniamo, lo squilibrio continuerà a diffondersi [11]."

La posizione dell'autorice verso l'avvio di una risoluzione a questo problema, introdotta alla conferenza LEUS 2019 [12], ritiene che per ottenere una condizione equilibrata per la vita umana a lungo termine, l'obiettivo deve essere che il paradigma educativo debba reintegrare la consapevolezza della posizione dell'essere umano nella biosfera. Ciò implica un'iniziazione in cambiamenti comportamentali, ma anche della cultura vivente basata su comprensibili e replicabili principi [12].

RIASSUNTO PERSONALE

PERSONAL SUMMARY

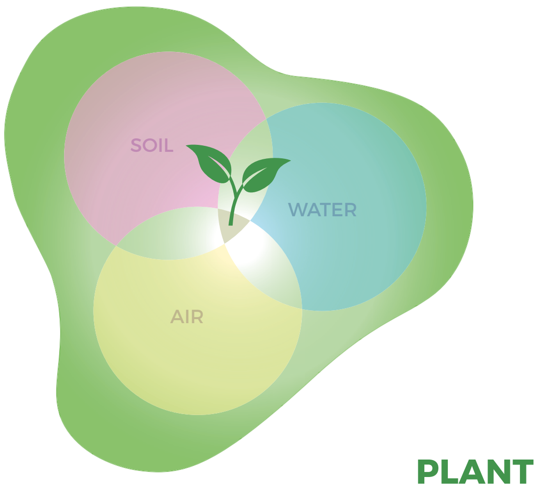
RIASSUNTO PERSONALE

Domanda d'interesse:
Qual è la comprensione della sostenibilità a livello di cittadino comune individuale e cosa possiamo fare individualmente per contribuirvi?

La ricerca svolta tra teoria e pratica fa emergere la mancanza di esperienze condivise che si relazionino ai problemi ambientali che ci troviamo ad affrontare.
Il raggio di scala considerata è ampio in quanto si è riconosciuta l'estensività degli effetti in spazio e tempo di azioni individuali diffuse.
Per via della mancanza di un pensiero che consideri la consequenzialità di azioni e eventi (pensiero sistemico) da cui possono emergere risorse di creatività per sviluppare una popolazione diversificata e resiliente e supportare la caratteristica di longitudinale del comportamento di quest'ultima. La sfera in cui è cruciale lavorare in questo senso è nel sistema educativo il quale consente di costruire la base della nostra civilizzazione e quindi una cognizione generazionale comune.

La sensibilità sviluppata dall'autrice tramite il training di permacultura e la capacità di applicare il pensiero sistemico ha permesso di rilevare le consequenziali relazioni dei dati riscontrati nelle esperienze accumulate durante il periodo di osservazione/contemplazione della ricerca, ha consentito di riconoscere punti focali da presentare per allenare la percezione della consequenzialità e la comprensione del suo sostentamento.

Il punto focale investigato e prototipato in questa tesi è l'insieme delle condizioni necessarie per il sostentamento di una pianta, la vita umana dipende dalla vita vegetale che provvede per tutti i sistemi viventi con le loro intrinseche relazioni funzionali e processi vitali. Infatti, queste funzioni e processi, se riconosciuti, si possono considerare risorsa di soluzioni tecnologiche da convogliare nella risoluzione di problemi ambientali e per via della natura rigenerativa di questi individui (piante) nei confronti dei cicli vitali, da attribuirvi il titolo di riconoscimento di “tecnologie sostenibili”.

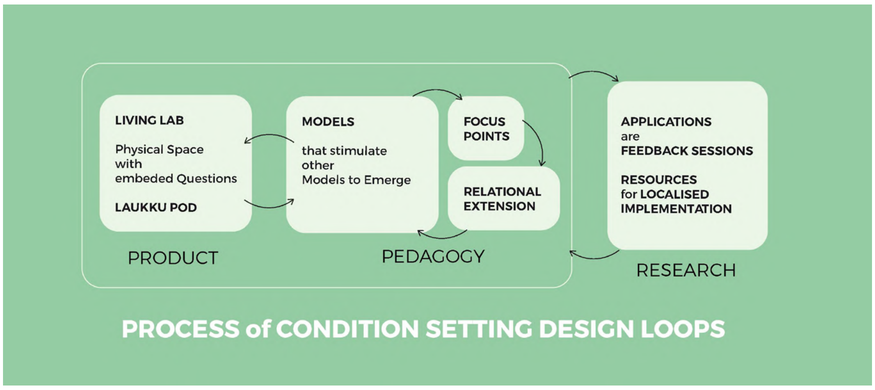


I tre cicli: Aria, Acqua e Suolo: devono convergere in un flusso di equilibrio che sostengono la continuità vita. I processi vitali delle piante contribuiscono alla rigenerazione dei cicli di risorse stessi.

La consequenzialità è prestabilita dal set di condizioni presenti o progettate da cui gli effetti emergono.
Questa è la cognizione base per poter applicare “strategie” di cultura permanente.
Infatti, nella progettazione permaculturista il disegno punta ad ottenere un set di condizioni predisposto a rigenerarsi: processo di trasformazione/evoluzione autonoma/indipendente dall’azione umana esterna.
Lo stesso principio comportamentale va ricercato nei modelli educativi, infatti, la varietà di provenienza (individui con diversi background esperienziali) su un’area di focus produce riconoscimento di associazioni che stimolano creatività in soluzioni applicabili in scala individuale (più facilmente diffondibile meno esaustive a livello energetico) e poi consentono lo sviluppo di riprodurre per scale maggiori.

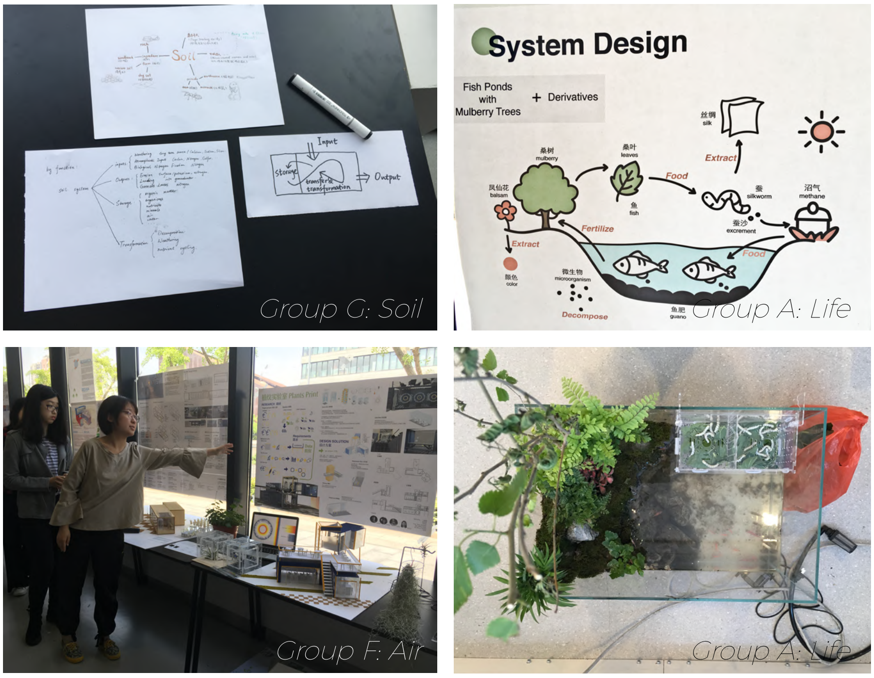
A livello progettuale questa tesi si è inserita all'interno del gruppo di ricerca Creative Systemic Research Platform (CSRP), unendosi da un punto di partenza di comunanza, che era già convergente, trovando le condizioni per proliferare e rispondere a domande comuni nel team. Il network del gruppo già era in cerca di proposte innovative tecnologiche per rispondere a quesiti di sostenibilità, in particolare la creazione di esperienze educative che ne sollecitino la comprensione e praticabilità. Infatti, il primo stakeholder interessato era la Huangpu High School of Design & Innovation fungendo da scenario orientativo per proporre una forma fisica di riferimento a scopi sperimentali (Laukku Pod) che stimolasse esperienze educative per gli studenti.

Laukku Pod è il progetto di prodotto fisico di un laboratorio vivente supportato dalla ricerca per individuare punti focali efficaci e applicazione di modelli educativi. Questa tesi stabilisce la necessità di una forma di progettualità alimentata nel tempo (R&S) identificando un modello di progetto rigenerativo composto da tre corpi principali, un prodotto, modelli pedagogici e ricerca da osservazione di feedback.



246. Loop di progettazione per l'impostazione di condizioni nel progetto R & S e schema di processi continuativi coinvolti.
Design di Jelena Sučić

Infatti non si tratta di disegnare esperienze ma modelli di focus da cui disegnare esperienze, non solo da parte del ricercatore/designer/osservatore addetto, ma anche gli individui coinvolti a rispetto al focus. Cosa che accadde con la prima applicazione svolta con gli studenti del Prof. Jeff Ding all'interno del corso Design Studio 3 di un mese del secondo anno di Bachelor in Environmental Design presso la Tongji University, College of Design&Innovation.



Breve selezione di modelli disegnati dagli studenti del Design Studio

Questo processo risultante di ricerca individuale condivisa, i cui confronti stimolano associazioni tra individui nel gruppo arrivando a riscontrarne le consequenzialità (estensione olistica) che contribuiscono alla costruzione di una cognizione comune.
L'aspetto individuale si riferisce alla dinamica introspettiva o indipendente dei individui coninvolti e la condivisione è data dal momento e area di focus del gruppo.
La cognizione comune è la summa di esperienza costruita dal momento in cui ci si rende conto di essere tutti sulla stessa barca e che per permanere e andare avanti tutti

devono essere allineanti sull'obiettivo principale per saper reagire agli imprevisti e prendere il timone.
Le considerazioni di questa tesi fanno emergere, grazie soppratutto all'osservazione dell'alta reatività e creatività delle piante come modelli esemplari di adattamento diversificato, mettono le basi per valorizzare il percepito il quale spesso non riesce a trovare un linguaggio consapevole cognitivo per esprimersi e farsi comprendere.
Il concetto chiave qui è la necessità di creare condizioni affichè si depositino tracce per mantenere la percezione da confrontare con altri individui per attribuirvi un linguaggio.

Grazie ai punti chiave precedentemente citati, le considerazioni emergenti di questa tesi rendono l'osservazione, che alta reattività e creatività delle piante come modelli esemplari di adattamento diversificato, possono gettare le basi per migliorare la percezione che spesso non riesce a trovare una coscienza consapevole linguaggio per esprimersi e farsi capire. di creare le condizioni affinché le tracce possano essere depositate per mantenere la percezione da confrontare con altre persone per attribuire loro una lingua.

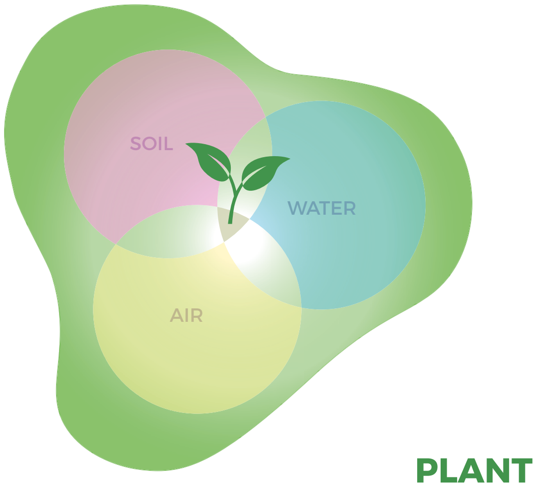
PERSONAL SUMMARY

Interest Question:
What is the understanding of sustainability at the level of the individual common citizen and what can we do individually to contribute to it?

The research carried out between theory and practice makes it clear that what emerges is the lack of shared experiences that relate to the environmental problems we face.
The radius and scale of the problem being considered is wide. It has been recognized by the extensiveness of the effects in space and time and the widespread individual actions.
Because of the lack of a thought and consideration of the consequentiality of actions and events (systemic thinking), from where can emerge resources of creativity to develop and become diversified and resilient for the population creating the longitudinal characteristic of the latter's behavior. In this sense, the sphere in which this work is crucial is in the educational system, allowing us to build the basis of our civilization in a way that supports a common generational cognition.

The sensitivity developed by the author through permaculture training and the capacity to apply systemic thinking, allowed for the detection of the consequential relationships within the data, exposing the accumulated experiences during the period of observation / contemplation of the research, recognizition of focal points to be presented to train the perception of consequentiality and the understanding of its sustenance.

The focal point investigated and prototyped in this thesis is the set of conditions necessary for the sustenance of a plant, human life depends on the vegetative life that provides for all living systems with their intrinsic functional *relationships and vital processes. In fact, these functions and processes, if recognized, can be considered a resource of technological solutions to be channeled into the resolution of environmental problems and because of the regenerative nature of these individuals (plants) in relation to life cycles, to be given the title of recognition of " sustainable technologies ".*



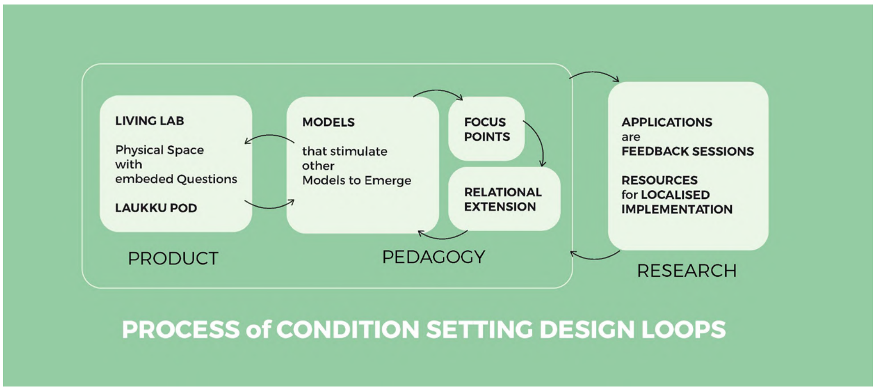
The three cycles: Air, Water and Soil; that must converge in an equilibrium flow that sustain life continuity. The vital processes of plants contribute to the regeneration of the resource cycles themselves.

The consequentiality is predetermined by the set of present or planned conditions from which the effects emerge.
This is the basic cognition to be able to apply "strategies" of permanent culture.
In fact, in the permaculture design the design aims to obtain a set of conditions predisposed to regenerate: a process of transformation / evolution autonomous / independent of external human action.
The same behavioral principle must be sought in educational models, in fact, the variety of provenance (individuals with different experiential backgrounds) on a focus area produces recognition of associations that stimulate creativity in solutions that can be applied on

an individual scale (more easily spread less exhausting in energy level) and then allow the development to reproduce at major scales.

At the project level, this thesis was inserted within the Creative Systemic Research Platform (CSRP) research group, joining from a starting point of commonality, that had already converged, finding the conditions to proliferate and respond to common questions in the team. The group's network was already looking for innovative technological proposals to answer sustainability questions, in particular the creation of educational experiences that encourage understanding and practicability. In fact, the first stakeholder concerned was the Huangpu High School of Design & Innovation, acting as an orientation scenario for proposing a physical form of reference for experimental purposes (Laukku Pod) that stimulated educational experiences for students.

Laukku Pod is the physical product project of a living laboratory supported by research to identify effective focal points and application of educational models. This thesis establishes the necessity of a form of design fed in time (R&D) identifying a model of regenerative project composed of three main bodies, a product, pedagogical models and research by observation of feedback.



246. Design loops for the condition setting in the R&D project continuing processes involved scheme. Design by Jelena Sučić

In fact it is not a matter of drawing experiences but focus models from which to draw experiences, not only on the part of the researcher / designer / observer involved, but also the individuals in comparison with the focus (which is what emerged when the first application was carried out with the students of Prof. Jeff Ding in the Design Studio 3 course of one month of the second year of Bachelor in Environmental Design at Tongji University, College of Design & Innovation) .

**For the immages refer to previously:* "Breve selezione di modelli disegnati dagli studenti del Design Studio"
Or the full visual collection in the main body.
"Short selection of models designed by Design Studio students"

This process is the result of shared individual research, whose comparisons stimulate associations between individuals in the group coming to find the consequentiality (holistic extension) that contribute to the construction of a common cognition.
The individual aspect refers to the introspective or independent dynamics of the individuals involved and the sharing is given by the moment and focus area of the group.
Common cognition is the sum of experience built from the moment you realize you are all in the same ship and that to stay and move forward everyone must align on the main objective to be able to react to the unexpected and take the helm.

Thanks to the previously mentioned key points, the emergent considerations of this thesis makes the observation, that high reactivity and creativity of plants as exemplary models of diversified adaptation, can lay the foundations for enhancing the perceived which often does not succeed to find a cognitive conscious language to express itself and make itself understood. The key concept here is the need for creating conditions so that traces can be deposited to maintain the perception to be compared with other individuals to attribute a language to them.

CAPITOLO 6

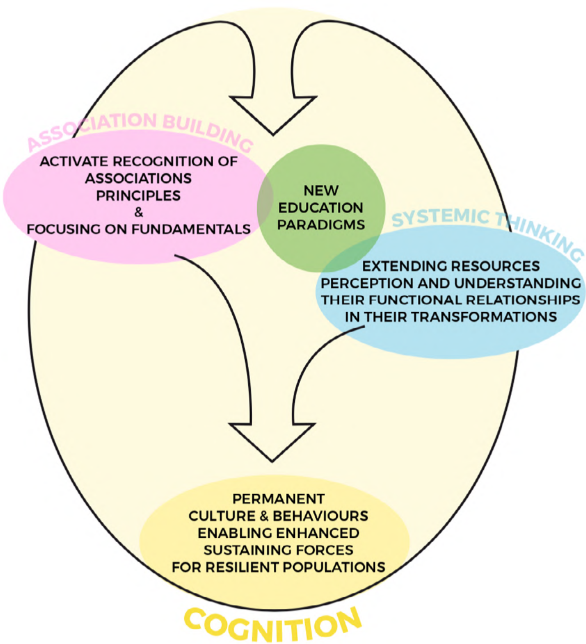
CONCLUSIONI

6 CAPITOLO 6: CONCLUSIONI

I.6.1 LEGGENDO L'APPROCCIO SISTEMICO

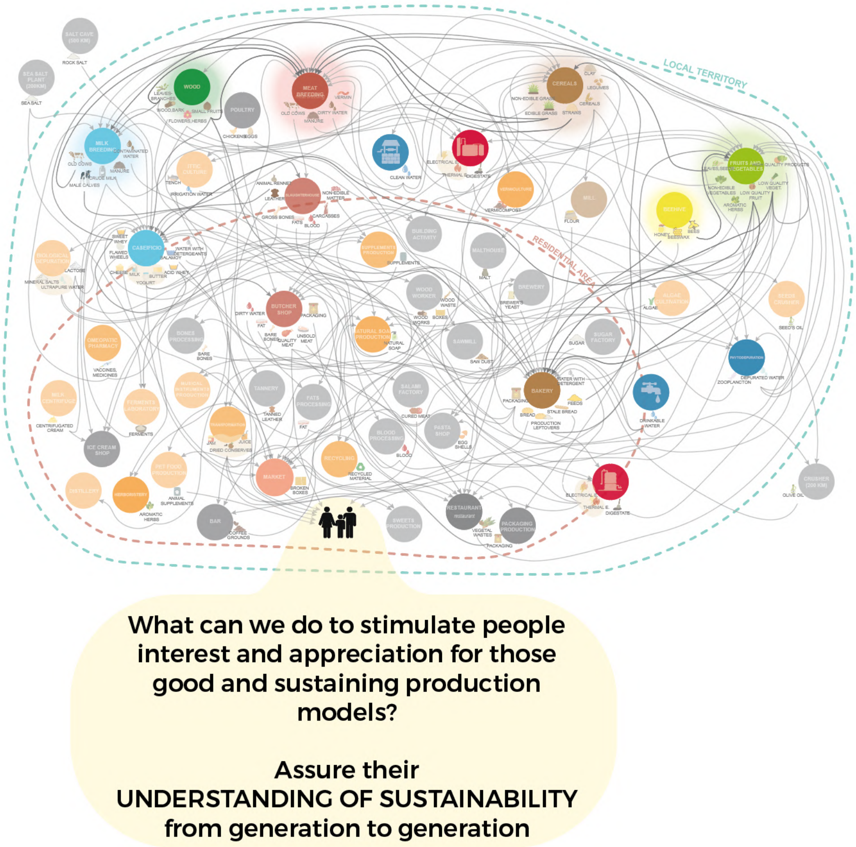
(6.1 Reading the Systemic Approach)

Questa ricerca mirava a lavorare su paradigmi educativi che stimolassero la costruzione di associazioni e il pensiero sistemico, il quale permette di estendere la comprensione della consequenzialità dietro alla domanda, dov'è il design centrato sull'uomo (4.4)? Quali sono i comportamenti (se ce ne sono) che vengono condotti in comune con la cognizione per allinearsi e consentire il mantenimento di molteplici generazioni future di popolazioni selvatiche e la persistenza della loro continua coesistenza. Questa ricerca riguarda l'**apprendimento** specifico e il **riepilogo delle azioni e il loro ciclo di effett**i. Questo apprendimento ha un comportamento costante nel tempo, che a sua volta ha la capacità di arricchire un corpo o un sistema comune. In questo caso molti esempi di scala più piccola, che sono replicabili e i cui effetti sono riscontrabili anche a scale più grandi e livelli maggiori del Pianeta TERRA.



247. Systemic Cognition Loop.. Design di Jelena Sučić

Prendendo l'esempio dal Macro-Sistema dal Progetto di Sistemi (2.1.2) di buoni modelli di produzione progettati per cambiare i paradigmi a favore di una produttività più localmente sostenibile per il futuro benessere delle persone, ma tali soluzioni non saranno in grado di durare lungo se necessitano di essere in relazione con persone che non capiscono tutti i benefici. Non ci si può aspettare che si sostenga solo dicendo e lasciando credere che questo è buono. Dov'è l'inclusione e la manutenzione? Soprattutto quale sarà la credenza del bene e la priorità per le prossime generazioni?

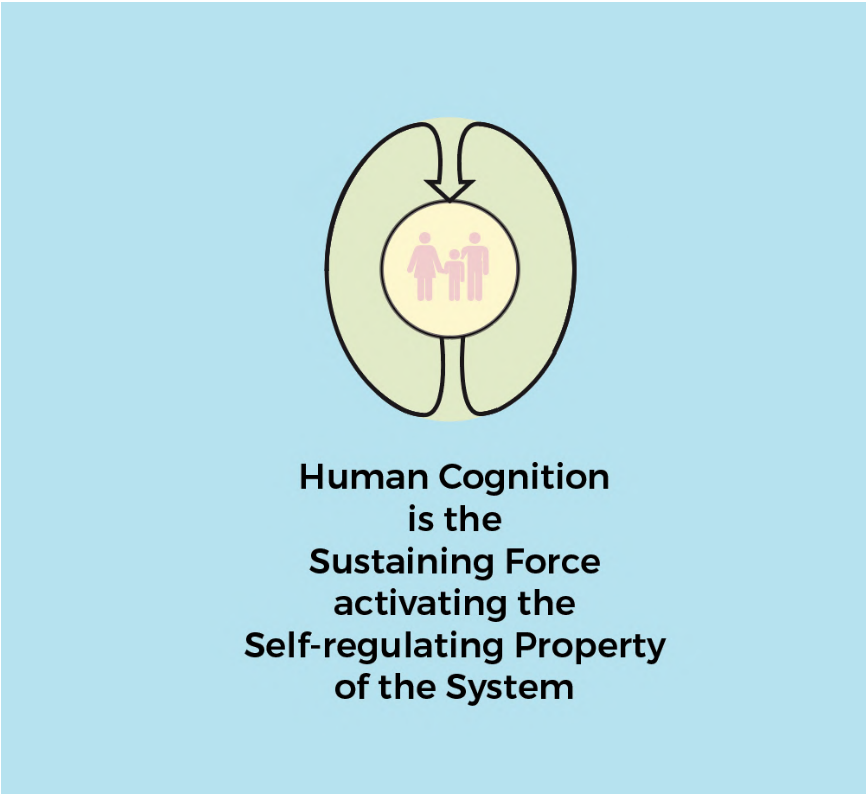


"Cosa possiamo fare per stimulare l'interesse e apprezzamento delle persone per quei buoni e sostenibili modelli di produzione?"

"Assicurare la loro COMPRESNSIONE DELLA SOSTENIBILITÀ di generazione in generazione"

248. Domanda dal principale sotto sistema (gli individui) attuatori del Macro-sistema (figura 21). Da Jelena Sučić

Questa tesi ha cercato di trovare porte per stimolare forze sostenitrici per consolidare sistemi sostenibili, potenzialmente provenienti da ogni individuo, persino dai cittadini.
Il benessere dell'intero è definito dalle esigenze, dalle scelte e dai comportamenti che producono la produzione di tutte le creature viventi che condividono lo stesso ecosistema con accesso limitato di risorse. Al fine di distribuire e produrre risorse accessibili per una condizione di vita equilibrata condivisa, una cognizione comune deve essere mantenuta e alimentata nel tempo con differenziazione e trasmissione delle esperienze che consentano di manifestare la resilienza della popolazione. I semi devono essere trovati e lasciati perchè la prossima generazione li cresca per le loro esigenze del ciclo di vita, ma anche per le future vite in arrivo.



"La Cognizione Umana è Forza Sostenitrice attivatrice della Proprietà Auto-regolativa del Sistema"

249. La principale forza di supporto nel sistema autoregolante orientato verso l'uomo. Da Jelena Sučić

6.2 CSR PLATFORM E LAUKKU POD

(6.2 CSR Platform and Laukku Pod) *269*

Come spiegato nella sezione descrittiva di Laukku Pod, questa tesi contribuisce alla sua ricerca e progettazione nel progetto R&S di Laukku Pod con i risultati ottenuti attraverso il processo di ricerca e sviluppo della stessa (all'interno della piattaforma CSR attraverso il processo e il supporto di una rete di persone coinvolte e stakeholder interessati). Il processo di R & S suscitò interesse non solo per i focus tematici ma anche per il linguaggio (dato / trovato / ricercato). Questo ritrovamento permette e produce una comprensione più ampia per un numero maggiore di persone, mostrando diversi livelli di paradigmi attraverso spiegazioni, per consentire livelli e strati di scambi di conoscenze (dal basso / dall'alto). La trasmissione di fine scambio vuole estendersi nel tempo e preservare contenuti per le esigenze della futura generazione, grazie a tecnologie digitali e sistemi interconnessi provenienti da contesti diversi (geografici, culturali, ...) per l'amplificamento di opportunità di conoscenza e di scambi.

L'applicazione per il caso della scuola superiore Huangpu non si è verificata nel periodo di questa tesi a causa di diversi ritardi nella costruzione della nuova sede e problemi burocratici, ma è confermata per il prossimo semestre a partire da settembre 2019. Un altro aspetto dello sviluppo della piattaforma CSR con la scuola superiore sarà nello sviluppo di processi sperimentale di percorsi formativi, non solo rivolti agli studenti per l'apprendimento e comprensione ma anche per estendere la conduttività nella trasmissione di conoscenza per gli insegnanti, stimolando la costruzione di associazioni per attivare relazioni sistemiche nei processi di memorizzazione dell'apprendimento negli studenti. Azionando il comportamento del processo di apprendimento come un'evoluzione aperta.

250. Primo prototipo di Laukku Pod alla fine della presentazione finale del 5 Maggio 2019 del corso Design Studio 3. Ph. Jelena Sučić

6.3 A proposito di complessità e persistenza

(6.3 About complexity and persistence) *270*

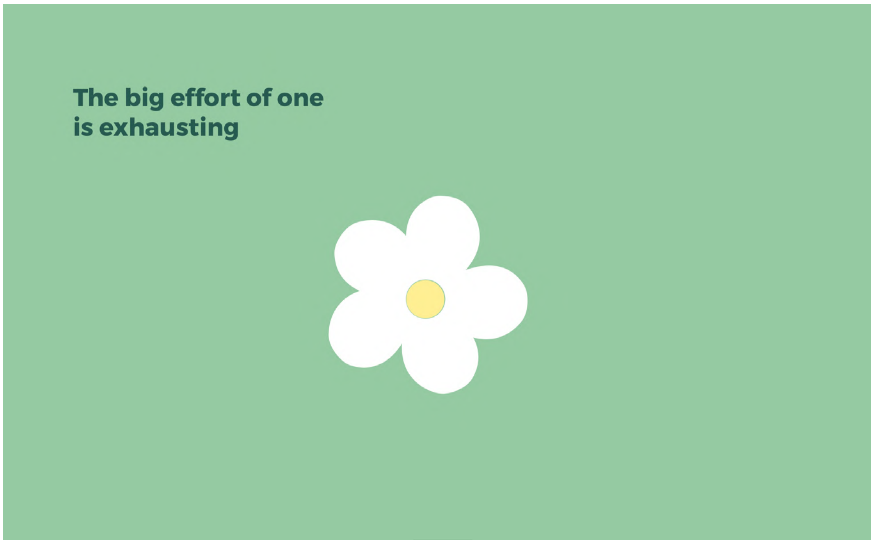
Nel caso in cui non fosse ancora percepito, questa tesi parla di complessità. Poiché l'autrice mira a comunicare con cittadini comuni di qualsiasi livello e contesto con questi contenuti, è la ragione intenzionale per cui il lettore non troverà questa parola spesso. Secondo una prospettiva comune riferirsi a cose come "complesse" definisce e fa percepire l'argomento di discussione "off-limits" qualcosa in cui il pubblico non può entrare o oltrepassare il confine perché troppo complesso per essere compreso. C'è la percezione del termine "complessità" che si comporta come un "muro intangibile", che non può essere toccato o visto ma viene percepito.

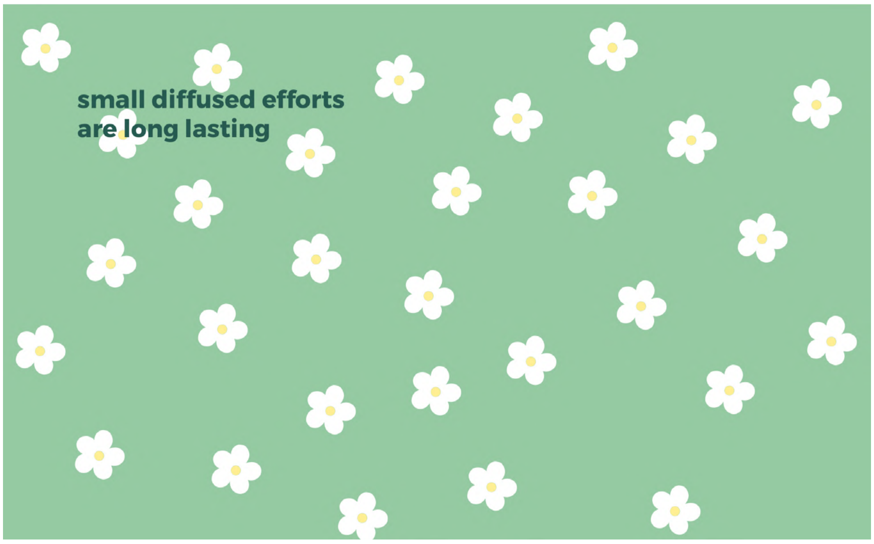
Niente è non fronteggiabile, dobbiamo solo aiutare a capire che siamo parte attiva di esso, anche se non la principale. Pertanto, poiché l'umanità punta alla sostenibilità, quelle persone che affrontano la complessità e la sua comprensione, come i ricercatori e le università hanno il dovere di fornire strumenti e comunicare con punti focali dove andare, per consentire l'accesso al esercizio dinamico del ciclo cognitivo per chi non vi è ancora partecipe al fine di avviare un processo di adattamento più reattivo, grazie alla diversificazione delle piccole azioni, per mitigare gli effetti delle principali questioni globali considerate. L'attitudine del comportamento elitario di università e ricercatori nei confronti delle conoscenze acquisite, acquisizioni che potrebbero e dovrebbero essere un servizio apprezzato dalle città e le comunità, impedisce la diversificazione di azioni risolutive, che posticipano e lasciano accumulare gli effetti degli eccessi (problemi che diventano necessità).

Ciò che i focus di permacultura fanno emergere in relazione con le città e la natura è che la natura è ancora presente nelle città ma non è considerata. Più persone capiscono male e non considerano, più saranno i problemi che richiederanno soluzioni, ma senza comprenderne le origini, che aumenterà il rischio di non mantenere il lavoro

per la natura che è integrato nella città di generazione in generazione. Continueremo a provare a correggere i sintomi, con grandi nuove tecnologie sviluppate per cose che potrebbero essere bilanciate con sforzi meno estenuanti in termini di energia, tempo e risorse.
Tutti i nuovi pensieri e tecnologie, se basati sulla comprensione dei principi dei loro comportamenti, diventano una risorsa per mitigare le azioni e gli effetti della loro diversificazione. Per questo motivo, specialmente negli ambienti urbani, dove c'è alta concentrazione di opportunità innovative nelle risoluzioni, una base di focus fondamentali (comportamenti dei cicli) dell'esistenza di vita deve essere avviata e mantenuta attiva, fin dalla giovane età, attraverso il ciclo di istruzione delle persone (istituzionale sistema scolastico) che è la base della nostra civiltà.
Per permettere che ciò avvenga, i paradigmi pedagogici devono cambiare le loro priorità e atteggiamenti. Come già spiegato, esperienze diversificate amplificano le associazioni in strati e livelli di conoscenza, la cui importanza è rafforzata dal riconoscimento di relazioni funzionali (pensiero sistemico) e dalle loro estensioni, che consentono il mantenimento e alimentazioni di una solida cognizione comune per un'esistenza sostenibile.

Per concludere, esperienze diversificate abilitate da una nuova pedagogia basata su principi della natura e relazioni funzionali, stimolano la visualizzazione di soluzioni innovative che rispondono ai requisiti di sostenibilità.
Le grandi singole azioni hanno un impatto ma non durano a lungo (effetto yo-yo).
Le piccole azioni fatte da molti, diffuse hanno maggiori probabilità di essere rigenerative e le risorse meglio distribuite nello spazio e nel tempo mitigando i ritmi / velocità delle forze vincolanti.





251. Coclusione simbolica disegnata da Jelena Sučić

Per qualsiasi domanda e impressione sentitevi liberi di contattare l'Autrice su s.jelena@me.com

The Value of Living Systems Beyond a Price: New Dynamic Potential for Sustainable Technologies Between Citizens and Plants

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presentato alla Difesa dell Tesi
presso la Tongji University

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presented at the Thesis Defence
at Tongji University

硕士学位论文

超越价格的生命系统价值：
市民与植物可持续技术的新动态潜力

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二〇一九年六月

超越价格的生命系统设计：市民与植物可持续技术的新动态潜力

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A dissertation submitted to
Tongji University in conformity with the requirements for
the degree of Master of Art

The Value of Living Systems Beyond a Price: New Dynamic Potential for Sustainable Technologies Between Citizens and Plants

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June, 2019

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ABSTRACT

As can be noticed by observing our society, currently, the topic on everybody's lips, corporations' and governments' heads including common citizens', is "sustainability". This term is often over used and abused to capture attention, but it can only be better understood by defining the contextual structure of the intention for achieving a sustainable state or process [1].

The core problems highlighted in this research: show the lack of understanding between human life and the natural world. This lack of understanding is creating a generational gap, evident through the trend of population growth and migration towards cities. Our youth have yet to learn the relations between life and other living systems. This is the result of being at least the 3rd generation that migrated from the countryside to the city. The question is who will transmit the knowledge, experiences and culture to the future population and how?

The perception and understanding of the value of Nature is being lost. In particular what plants can provide our basic needs, which are the primary producers in the world and our primary source of food. If we lose the knowledge and experience of obtaining things naturally, and the recognition of this principle on a wider scale, then every age group of generations will not be able to sustain themselves from the remaining natural resources. The result being our sustainment will continue to remain unsustainable in relation to the entire living biosphere.

Plants are organism that pre-date human, as such are just as highly adaptive and reactive (if not more so), as we humans. The only difference is that we cannot provide for ourselves without them. Even if we want to solely rely on technological solutions, we still need natural sources for any synthesising process we may planning or considering as solutions, (for example, the lab grown meat from cells in terms of food provision).

Many emerging solutions that could solve humanities issues are actually already existing in nature. Since plants have high levels of reactivity and relationships with living systems, they themselves can be considered as the providers of the most sustainable technologies to solve our problems [1].

The process and considerations shown in the following research and project scenario are explained through multidisciplinary, transdisciplinary, multicultural and multigenerational experiences and approaches, that are necessary for highlighting fundamental ways of shaping long-term relations between citizens and plants. This approach opens new dynamic potentials for re-establishing points of view when considering plants' living processes as a combination of multiple sustainable technologies. This thinking is applicable at any scale and context, and will require new approaches to learning, creating in turn, new educational paradigms [1].

Keywords: sustainability; sustainable technologies; plants; citizens; generational knowledge; systemic thinking; cognition; educational processes; life processes; natural systems; permaculture

摘 要

通过观察我们的社会可以注意到，目前，每个人、公司集团和政府首脑（包括普通公民）在谈论的话题是“可持续性”。这一术语经常被过度使用和滥用以引起公众关注，但只有通过定义实现可持续状态或进程的意图的语境结构，才能理解这一术语[1]。

本研究突出的核心问题是：人类生活与自然世界之间缺失理解。这种理解的缺失正在造成一个代际差距，从人口增长和向城市流动的趋势中可以明显看出。我们的年轻人还需要学会生活和其他生物生活系统之间的关系。这是至少第三代人从农村迁到城市的结果。问题是，谁将把知识、经验和文化传播给未来的人口，以及如何传播？

对提供我们基本需求的自然，尤其是植物——是世界上的主要生产者也是我们的主要食物来源——价值的认知，正在丧失。如果我们失去了从自然界自然地获得事物的知识和经验，认知需要更广泛地应用这一原则，那么，每一个世代的不同年龄群体将无法在剩余自然资源中持续。结果是，就整个生物圈而言，我们想要持续的愿望，终将不可持续。

植物是在人类出现之前就存在有机物，因此与我们人类一样具有高度的适应性和反应性。唯一不同的是，离开它们我们就无法生存。即使我们认为可以依赖于技术解决问题，但是任何我们列出的解决方案，依旧需要一种自然资源来进行合成过程，例如，在食物供应方面，实验室中由细胞培植出的食用肉。

人类问题的新兴解决方案实际上已经存在于自然界中，由于植物具有高度的反应性和与生存系统的关系，它们可以被视为解决我们问题的最可持续技术的提供者[1]。

以下研究和项目方案中所示的过程和考虑因素通过多学科、跨学科、多文化和多代的经验和方法加以解释，这些经验和方法对于突出塑造公民和植物之间长期关系的基本途径是必要的。将植物的生长过程作为多重可持续技术组合的提供者，重新开辟了动态思路的潜力。这种思路适用于任何规模和背景，需要新的学习方法，进而创造新的教育范式[1]。

关键词：可持续性；可持续技术；植物；公民；世代知识；系统化思维；认识；教育范式；生长过程；自然系统；朴门（永续）农艺；

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Chapter 1: Introduction

1.1 Research objectives

It has to be declared that this thesis is oriented in the design field and the research content examined focused on the understanding the current global environmental problems and their impact and tendencies at the common citizens level, (intending common people living in cities). It aims at finding case scenarios in common daily life routines, where design integrative project actions have the capacity to effect behaviours and contribute widely to alleviate global impacts.

'The goal is in finding **doorways** or **transition occasions** to activate sustainable behaviours and choice changes process in single common citizens, then groups, and maintain them active, progressive and available to future generations.

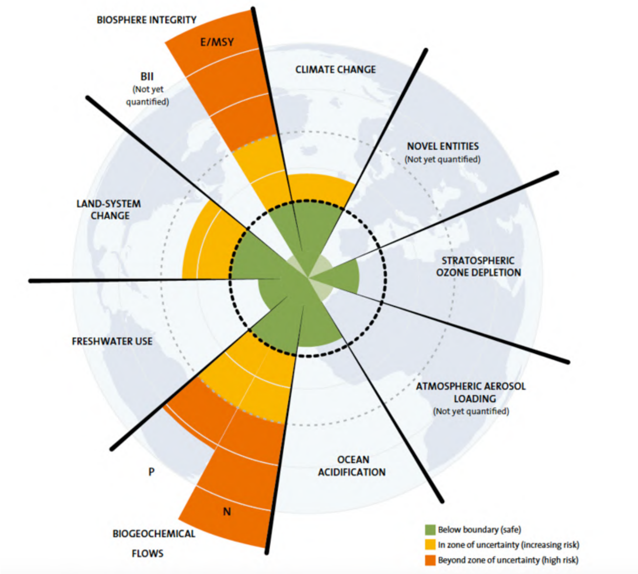
Thanks to understanding processes through experiences, it is possible to identify potential natural resources as natural technologies to react positively towards our global issues [1].'

Many terms have emerged as key global environmental problems, such as "sustainability", "development", "limits", "equity", as well as the concepts of "equilibrium flow" and "basic needs of life" as previously discussed by Sučić [1] to name a few.

Other frequent terms relating to global issues kinds are Climate Change and Air Pollution, recognised and accepted by common citizens, but there are also Extreme Weather Changes with heat waves, floods and droughts, which affect food provisions, living infrastructures, health and ecosystems reactions. Relatively to ecosystems responses another emergent issue is the Biodiversity Loss which is compromising the equilibrium provided by the known functional relationships between the living creatures involved and their own sustainment and survival. All of these previously mentioned key words and concepts have led to impacts and outcomes of Economic issues based in human environments, which in turn, threaten resources, as discussed by Sučić [1].

Current responses are evident through leading institutions such as the United Nations (UN), Club of Rome, Stockholm Resilience Centre enhance attention points and needs with the Nine Boundaries [2] which may be managed by working on the UN 17 Global Goals for Sustainable Development [3] [1].

The current question that needs focus now is, how to achieve and maintain the efforts invested for these goals? Institutions can initiate a lot in change for mitigating impacts but they are not so effective and well placed in driving longer term maintainance of these goals. Who will maintain these efforts for the generation of people that will arrive when the institution of the initiation is probably not in existance anymore?



1. Nine planetary boundaries (PB). The dotted area represents the safe operating space: the greater the human-caused perturbation, the greater the risk of large-scale abrupt, and irreversible Earth system changes [2].

2. The 17 UN Global Goals for Sustainable Development [3]

In order to sustain the basic needs of life clear modules of the fundamentals have to become shared common knowledge. Therefore, educational curricula about sustainability understanding has to be stimulated in the educational systems. New educational approaches need to embrace key concepts based on systemic thinking which requires training critical thinking, associational thinking to recognise existing relationships and longitudinal relationships starting from citizen’s individual daily life needs, behaviours and relative effects. If we want/might consider important (to) built more resilient generations we have to maintain the cognition/awareness of nature principles and train on systemic thinking.

Is not that we have to add educational tools but we actually have to change also the educational approach.

In simple words, this research project is looking for options **in integrating sustainability understanding** in constrained citizen's circumstances through the **focus/interface** of **plants** providing/as providers of **functional relationships**. Enabling so to **actively produce sustainable behaviours** by **awareness,** knowing and producing **desired effects**, which **must be** able to be **absorbed** by something else over and over again.

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1.2 Research methodology

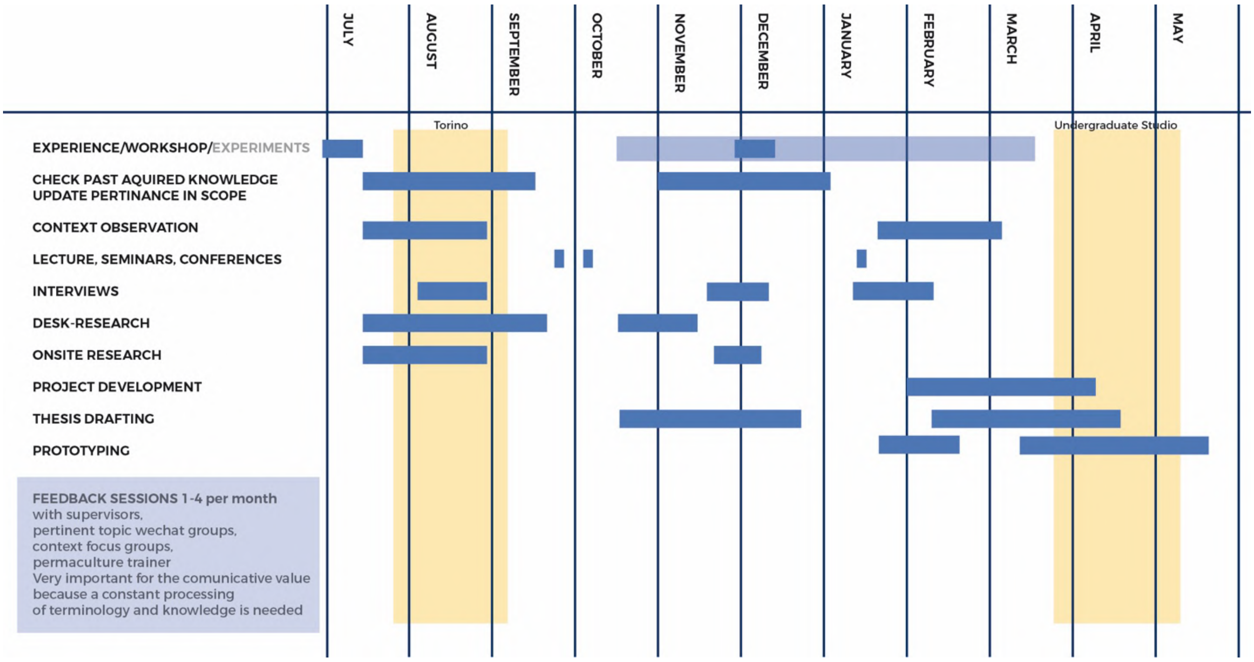
The research methodology has required different tools, active for sourcing but also a basic theoretical one that set the basis for orienting in why all the actions were relevant for the research body.

1.2.1 Action tools

The active context based research approach lead to face a transdisciplinary work attitude. The research brought to a relevance in variety of fields to be considered for an understanding of a bigger picture pertinence, fields that from a design research aim ended to integrate anthropology, biology, botany, agriculture, permaculture, psychology, engineering, urban planning, socio-cultural sciences and education knowledge.

Practical Test Study Cases, found and done in the phases of experience/workshop/experiments showen in **figure 3**, have been found or built aiming to understanding research comprehensibility and project outcomes relevance which contribute in qualitative data collection and feedback loops creations. Other very important tools are interviews and context base people's discussions, because what really counts in this research relevance is citizens perception and application, since, rules and policies do not tell much about behaviours, only enhance what might be done that is not been accomplished yet. The interview and context-based discussions were fundamental especially in the Chinese context since was creating a data access in a comprehensible form and saving time and quality that would not be accessible from a process of translating documents. These are integrated in the literature supported by accessible references, which want to give **different perspectives** and show how according to the position of the person in their known context the priorities are different and the ability of responding to global issues is different.

A big part is going to relate/refer to permaculture studies, practices, design applications, principles and methodologies explained and de-structured in the literature and then extrapolated for educational innovation tools project purposes which aim in helping understand, initiate and apply sustainability/sustainable technologies/approaches/attitudes that consider effects in a wider spatial-timeline.



3. Workload timetable

1.2.2 Orientator / Theorical tools

To face the research aim and attitude is necessary to provide to the reader some basic terminology and tools to navigate the dynamics between the different considered fields in the literature and their relations. Follows: **Systems thinking** definition from F. Capra and P. L. Luisi book *The Systems View of Life, A Unified Vision*; **Contextual parameters** visual tool transposition with a terminology selection of movements done by the author and discussed in the introduction paper about this thesis [1]; **Systemic Approach** is the design approach taught at Politecnico di Torino Msc Degree in Systemic Design which shapes the research findings requirements for project aims definitions ; **Ontological Model for Living Complex Adaptive Systems** (CAS) model developed for explaining Resilience Dynamics which require a longitudinal understanding .

1.2.2.1 Systems thinking

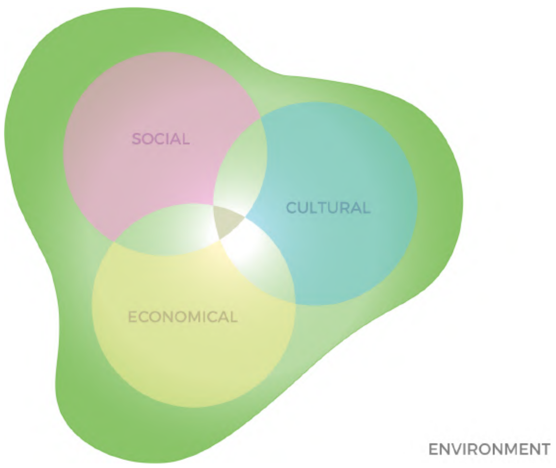
As Capra and Luisi explain [4] Systems thinking is the kind of dynamics through which the entire research has to be read and consist in a shift of perspective that moves **from the parts to the whole** and backwards. This because a considered system has its properties which cannot be replied by the single elements if separated from others being part of the system. The systemic properties cannot emerge if the single elements are taken under consideration by separating, meaning isolating the parts. Therefore, the focus on perspective moves **from the object to the relations** between the objects. Because of this shift, in order to express the relations in the system the communication tools move **from measuring to mapping** and since the communicative outcome are network maps, in which are present embedded quantitative elements enhancing the qualitative relations, the outcomes focus move **from quantity to quality**. The mapping action needs to refer on structures but the apotheosis of the qualities emerge in the processes that build, maintain, change the structures, **from structures to processes**. By focusing on processes the expectation of scientific knowledge under systems oriented attitude changes, independent from human closed definition, becoming **from objective to epistemic science.** Epistemology has as objective the knowing process understanding. Because processes have a longitudinal time factor which implies unexpected influential actions affecting the considered system from outside or from unknown, the scientific paradigm has to move **from** the mechanistic **Cartesian certainty** fixed in a chosen moment **to** accepting **approximate knowledge** that projects in future continuity [5].
'Systems thinking does not concentrate on basic building blocks but rather basic principles of organisation. Systems thinking is "contextual," which is opposite of analytical thinking. Analysis means taking something apart in order to understand it; systems thinking means putting it into the context of a larger whole. [6]'

1.2.2.2 Contextual parameters

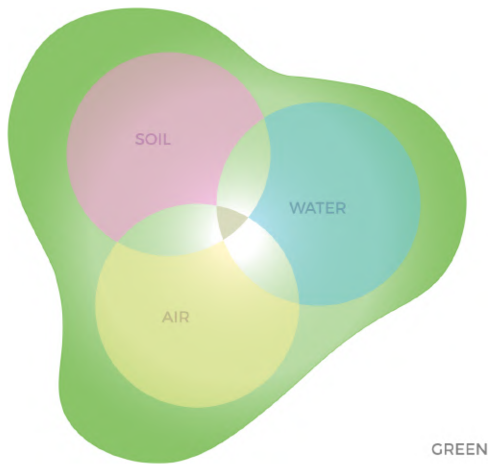
The definition of contextual parameters responds to the need of a guide tool and terminology to follow the position in the several meaningful focusing moments in the research. These might help in following the systems relations and properties, especially by scaling down in embedded systems from the whole considered scope. Since the research relevance context movement has a wide perspective and we are dealing with open systems which are not always cognitively build, as for example climate change, for the practical goals in small dimensions we have to train the movements necessary for the comprehension of the whole picture to focused happenings [1].

The language is important to describe, in written form, the positioning of actors' actions and to follow the movements of their effects in different scales, layers and levels. Being able in this way to have a vision of a bigger involvment of relations.

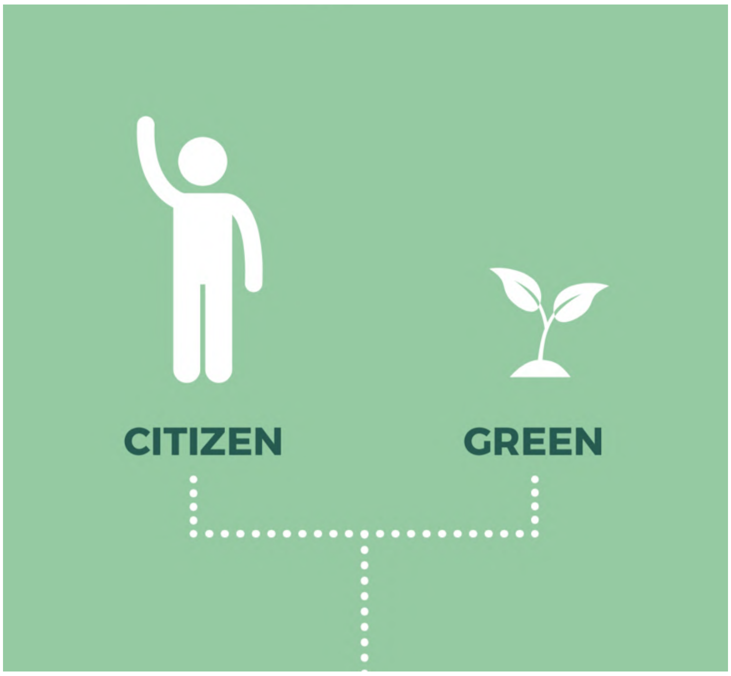
The main considered **actors** are Citizens and Green. Green because is already in a considerable strict relation with the three main nature cycles air/atmosphere, water, soil. By re-establishing a more aware relationship with Green, Citizens are per consequence relating with the three mentioned nature systems.



4. As the Citizens perceived systems are Social, Cultural and Economical starting from the Environment and being included by it. Graphic and Design: Jelena Sučić [1]



5. Green starts from the three natural source systems Soil, Water and Air and includes them in its growth processes. Graphic and Design: Jelena Sučić [1]



7. Two main actors citizens & green. Graphic and Design: Jelena Sučić.[1]

6. Two ranges of the actors: Range of Action and Range of Effect. Graphic and Design: Jelena Sučić. [1]

The **range of action** is highly focused meanwhile the **range of effect** has many factors that will determine the effects diffusion. For example: putting a seed in the soil is a very circumscribed action but the process of its growth it will be directed by factors as space, sunlight, nutrients, water, wind, circumstances will show if the yield is healthy, big, weak, seeds spread, nourishing other organisms, how many of them, etc [1].

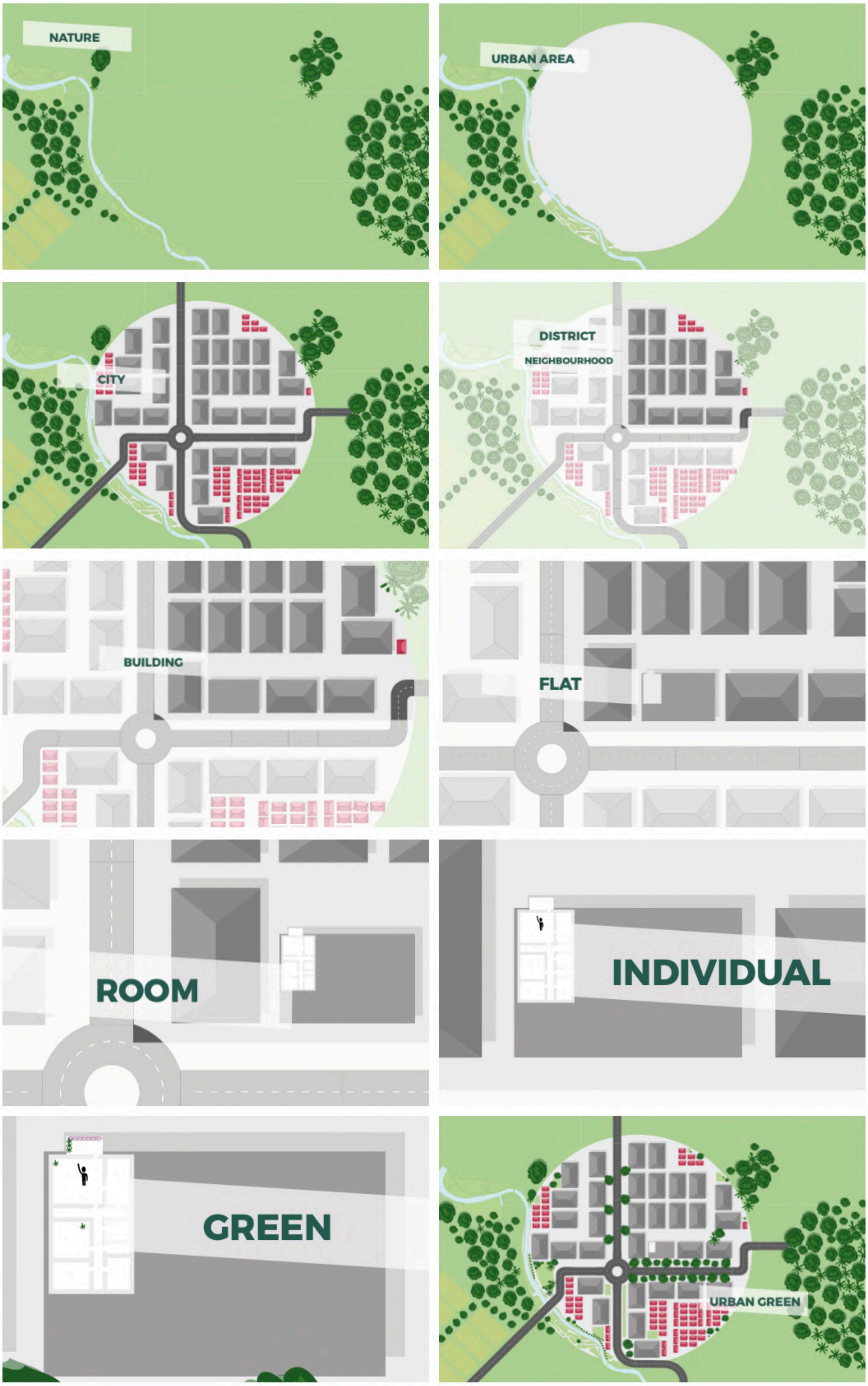
To enhance actions relevance, even if small the comprehension/consideration of the whole picture is necessary. To navigate in a given context we need to define it therefore to recognise its relevance with other conditions or relation with contexts. Once we want to position a condition (individual element) or context (group of elements), it has to be kept in mind that we are stopping in a moment in time.

Scales define a **spatial movement** and considers spaces/dimension/radius of action towards its effects spaces/dimension/radius as showed in the exemplary sequence of illustrations under **figure 8**.

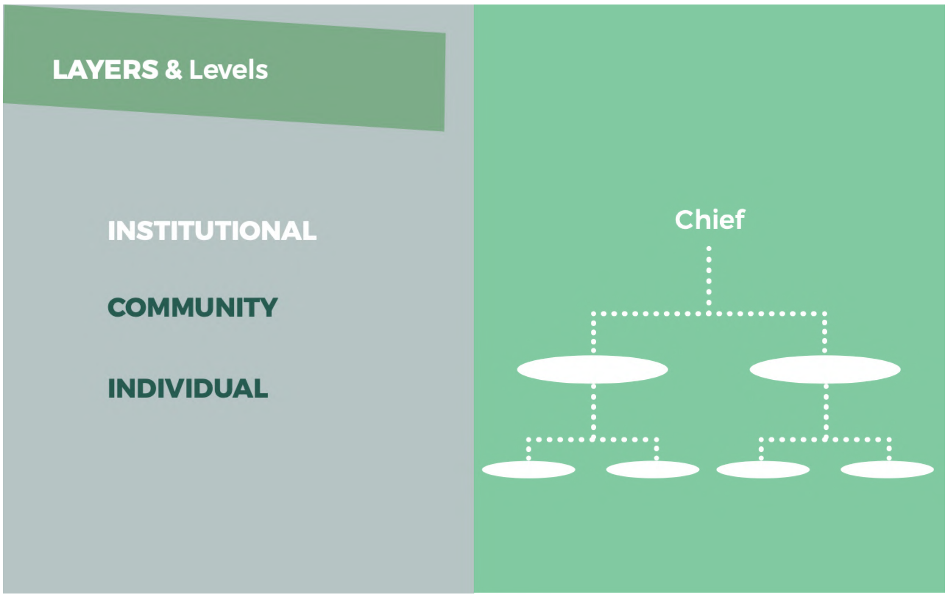
Layers are focus topics considered in the scale which define **contexts** from different perspectives present inside the scale dimension and according to the layer, we are referring to its impact in the space and read that is different from others. Inside the layer there are **elements** with different **levels** of relevance, break down of their **hierarchies**, as explained briefly with the example under **figure 9**.

Some recognisable dynamics are: institutional (governances), perceptional (citizens) and naturalistic (permaculture).

Layers are practically creating groups according to the considered context definitions. By defining our considered context in this way, we can understand and follow what are the groups and how their building is affecting the others' environments in the scale of pertinence. Therefore, also the impact of the single elements in the group towards the including and surrounding environment of them [1].



8. Sequence of illustrations of the scaling spatial movement Graphic and Design: Jelena Sučić. [1]



9. Some examples of identifiable layers and levels movement dynamics per relevance. Graphic and Design: Jelena Sučić.[1]

‘The word environment is very often used as a synonym of ecology, but there is a little detail in the etymology of the particle ‘eco’ from Greek ‘οἶκος’ means ‘house’ intending the English word ‘home’. By defining a space ‘home’ we are declaring a **sense of belonging** towards it. In fact “Ecology is the branch of biology which studies the interactions among organisms and **their** environment”[1].’

Considering environmental issues or ecological issues on a city scale, the most powerful acting layer is the institutional one of the governance and their high-level departments chiefs. By interviewing these highly politically positioned people (see 2.2 Urban Scale) adapting for climate changes is the main vision of city policies and on the same time the main complains for acting are lack of education and resources, money and people. Well since climate change issues the priority, on what are the actual resources going? [1]

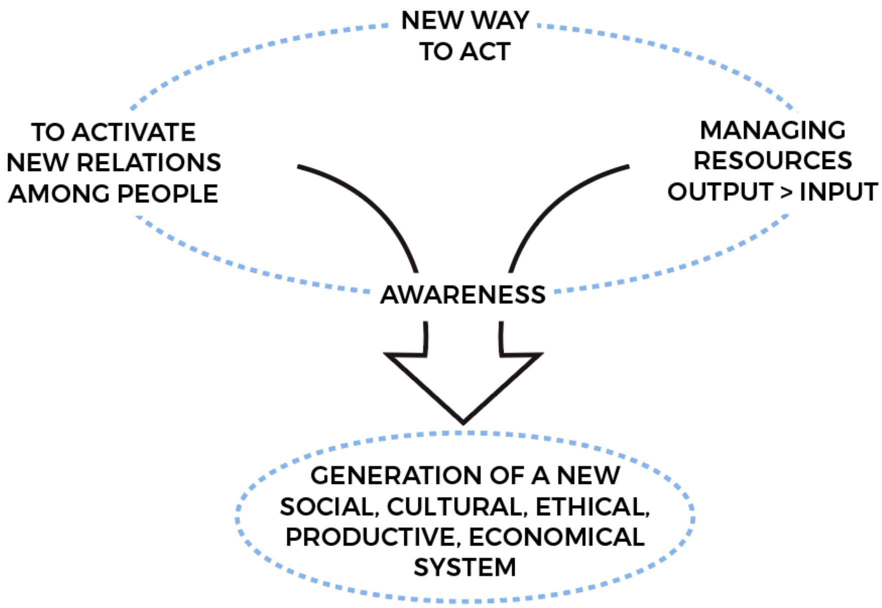
1.2.2.3 Systemic Approach

The Systemic Approach is the theoretical method applied in the graduate program Msc Systemic Design at Politecnico di Torino, is been defined by Prof. Luigi Bistagnino with the body of Politecnico di Torino. The defined approach is based on nature’s way of working and focuses through a holistic perspective, defining also the ‘systemic’ which implies ‘systems thinking’. The relative literature that has been developed towards this approach has evolved in time with supportive definitions, broken also in sections, from the first books and case studies

[7] defining it to the recent applications in scaling cases “micro to macro” [8]. What does comport gets extremely clarified and applied during the Open Systems semester project (see example 2.1.2 Open Systems Semester Project 2017).

The design aims in proposing solutions that allow the continous absortions and trasformations of things providing for the activies of systems considered relations, therefore, setting conditions for constant movements in contexts’ scales. Follows a diagram showing the main actuating priciples in the Systemic Approach methodology applied in design at Politecnico di Torino, this is the last updated version emerged from the Open Systems project and presented at the thesis defence that has continued it.

The research for a systemic design looks for new ways to act that have to contribute activating new relations between people and their activities which have and provide integrated resources management solutions aiming zero waste. What rises in these processes and their effects is the awareness that to generate new and sustainable systems at any layer a collaborational network is needed.

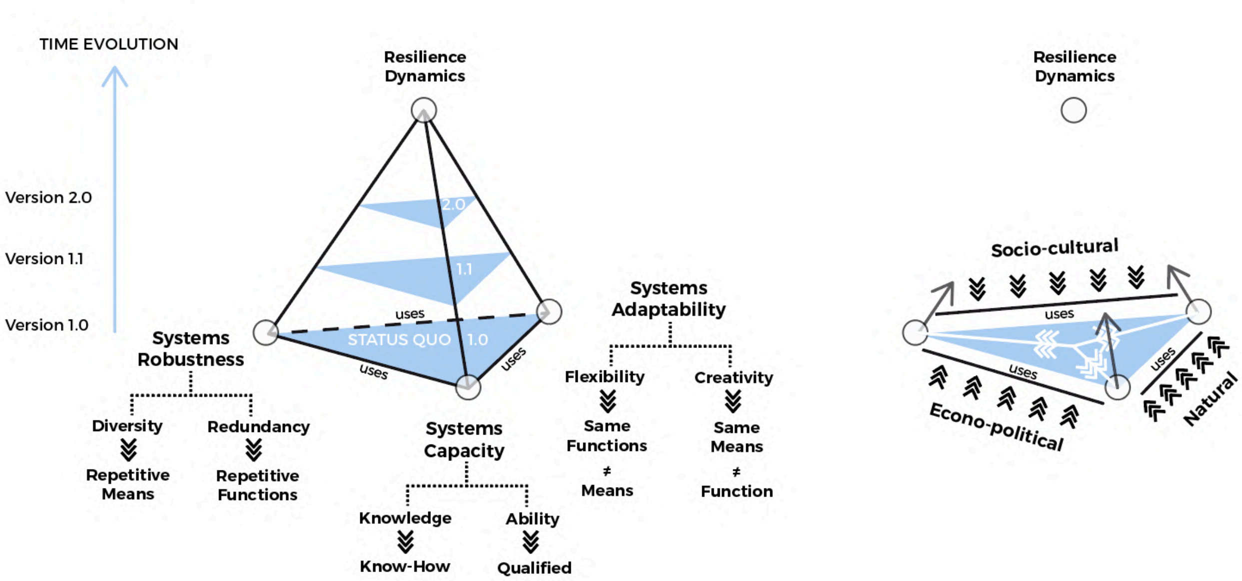


10. Graphical transposition by Jelena Sučić of the last presented Systemic Approach model at Alessandro Maccagno and Amedeo Mascitti thesis defence in 26th February 2018

1.2.2.4 Ontological Model for Living Complex Adaptive Systems

This Ontological Model is a work in progress analytic tool outcome from fieldworks trying to identify what are the properties that define systems changes and their evolution in time. The most recent documentation about this research process is conducted by Susu Nousala and Kim Blanca Galindo which apply from multidisciplinary fields and teamworking [9] [10].

The most important aspect of this model in this thesis research is the identified **terminology** to refer to systems dynamics properties that helps in evaluating the properties that allow resilience evolutions to happen. Follows an illustrated joint version from the author of the last documented model structure in submitted paper [9].



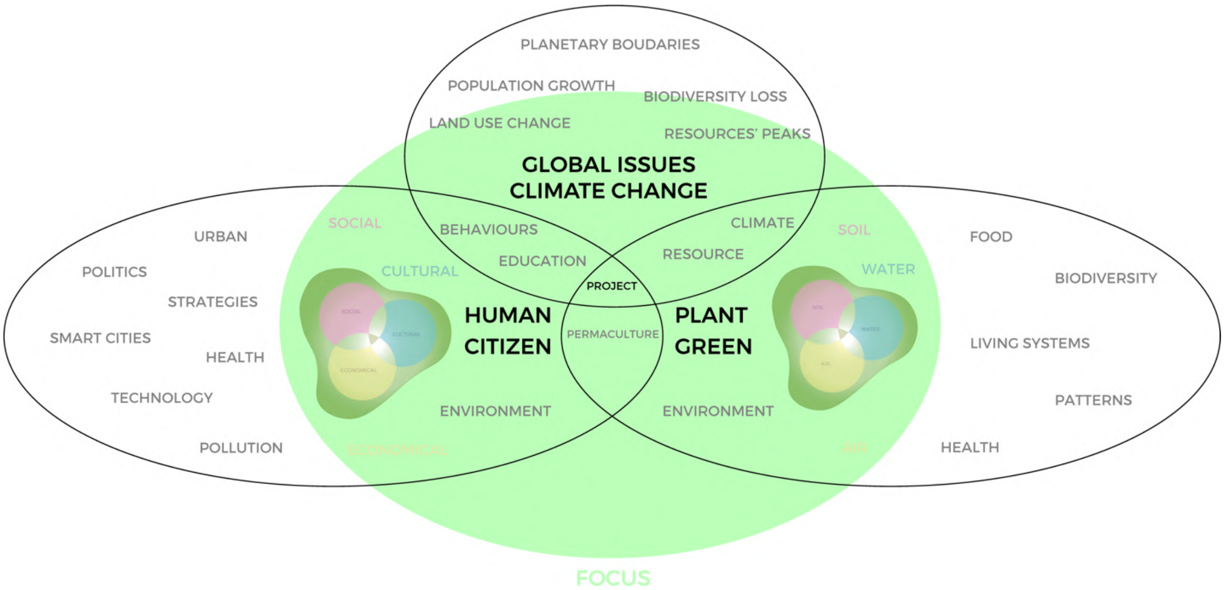
11. Ontological Model graphical redefinition designed by Jelena Sučić

Since the ontological model expresses dynamics which have a **longitudinal behaviour** definition the systems change analysing has to be expressed with **evolution in time**. The analysed moment of the system is represented by the **status quo** version (blue layer surface) in the pyramid constrained escalation development. The tetrahedral pyramid form building is generated by two group of forces. **Sustaining forces** and **Constraining forces**. Sustaining forces are identified in the three base vertexes of the pyramid and are what define **robustness**, **capacity** and **adaptability** of the system. **Diversity**, **redundancy**, **knowledge**, **ability**, **flexibility** and **creativity** are the resilience tools of the **sustaining forces**. What defines the blue surface boundary (triangle) are the **uses** that the sustaining forces could apply in the action space limitation imposed by the **constraining forces**. Constraining forces are defined by the properties of Econo-political, Socio-cultural, and Natural Environments which involve also the willing biological and physical forces of their properties. In the graphical focus of the base triangle behaviour we see the sustaining forces possible application extension which gets constrained till the edges by the constraining forces which makes converge the sustaining forces in vertexes for the next escalation in time for actuating the next required resilience.

This model extends suportatively the **contextual paramenters** which are occupation focuses in the blue triangle status quo moment, and the **systemic approach** is what defines the matter and energy flows implications in the status quo triangle fources. The ontological model integrates these two and drives the in a time and space change, it fullfills the missing **longitudinal aspect expression** in the first two.

1.3 Research usefulness: The General Problem of Environmental Systems Perception

As is been already discussed by the Sučić [1] the general problem of urban humans' system perception which is focused on economic, social and cultural systems, is that are emerging environmental signs and changes that cannot be positioned in any of these three systems. Since we learned to value our life according to relations with products and measure it by number of possessions and kind of selections we do we got distracted by what life means. These possession orientation defines our level of life inside our economic, social and cultural systems. Critically, until till recent time little consideration have been given to the effects of our products, possessions, selections. We have never really developed a way to consider this processing until we start to see some relations between our behavioural choices and environmental phenomena [1].



12. These convergences are going to emerge in the project outcomes [1]

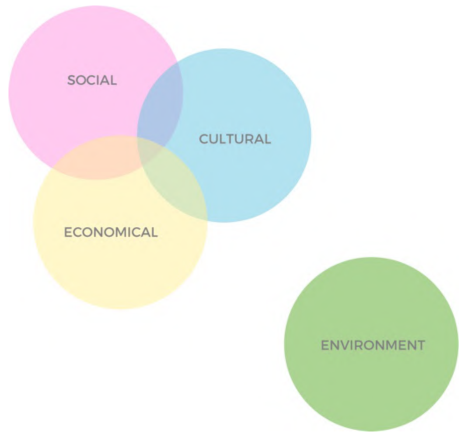
In this context, Environment means the totality of surrounding conditions, which includes the remainder bigger Nature system. This entails that every initiation in our three systems is going to activate in the environment, it will be processed by the three systems and will affect the environment again. Therefore, the environment is inside and outside our three systems. Therefore, the environment embodies/integrates these systems: Economic, Social and Cultural environments, which are Human scale environment layers, which is only a component part of the bigger Biosphere/ecological environment which included the relationships between many others living species of Nature.

'We can affect the ecological environment but we cannot dominate it as does a mathematical calculation in contemporary economic perspective.

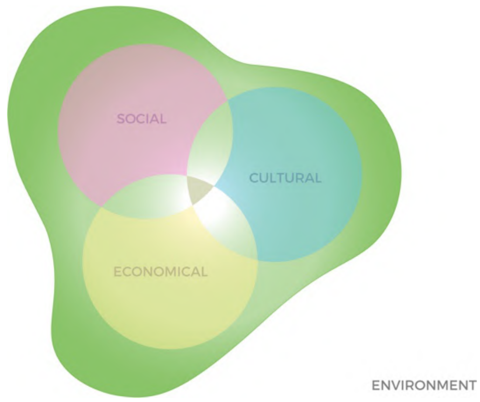
Economy is only the countable outcome of transition processes.

We cannot decide a quantity of money we want and then manage all the rest of life to achieve it.

But for sure we can identify what do we need for life and how this is going to provide for future lives, transmit the knowledge and experience to these (education building culture), the provision process involves and provides other lives (social integration) and the evaluation of how good or bad we are providing for life is economy [1].'



14. Environment System: New perceived system rising under human attentions that needs to be considered [1].



13. Needed integration for the environment system perception which has a cyclic movement from inside towards outside and vice versa [1].

.

This problem of mis-integration which emerges from the subsequent issues in the research literature. In terms of design, since the design discipline is meant to propose solutions for human problems and needs, as declares Lou Yongqi in the epilogue ‘we need a new breed of designers–people trained to understand the ecology, the environment, and the virtual systems that provide appropriate communication and feedback’. ‘We also need entirely new principles and approaches. As with any strategy, implementation is key. At no other time in human history has design activism been so necessary. If we do not intervene, the imbalance will continue to spread [11].’

The author’s position towards initiating a resolution to this problem, as introduced at LEUS 2019 conference [12], considers that to gain a **balanced condition** for the long term human life, the aim must be that the **education paradigm** has to reintegrate the awareness of human being’s position in the biosphere. This implicates an initiation in **behavioural change** but also **living culture** based on understandable and replicable **principles** [12].

Chapter 2: Literature
for Project Aims and Perspective Understanding

2.1 Author's Background

Since this thesis is applying systemic thinking, which implies a longitudinal view and requires research, accumulated observations and analysed observations through time, it is important to notice the dynamics of some elements and experiences accumulated in author's background without which the sensitivity would not be mature enough to be feeling capable to face these global topics with design resolutions.

2.1.1 Innovation Design Semester Project 2016/2017

From this semester project is not important the final outcome but what emerged during the research process. The focus topic where the students were asked to innovate was food in green areas of Turin city. A question is being answered through research is: "Why do people feel they need to stay in green spaces?". During site researches in green areas with some little group knowledge of plants, are been recognised for example dandelions, which made identify public green as food resource itself. By investigating this aspect, the high historical and cultural aspects of the local context emerged and so how did the public green service born in the city and how did developed and managed till now.

2.1.1.1 Green perception

The people's necessity to be in touch with green for a walk or other recreative activities, has unconscious reasons as explained by science. First of all, humans have a physical predisposition dictated by the reading structure of our sight organ. Its orientation is based on three light spectrum colours, red, green and blue (RGB). The retina is furnished by three cone classes of three visual pigments with different peaks of spectral sensitivity. Receptor cones are not distributed homogeneously, indeed, green readers are the majority. In this regard, green results to be the colour on which we are mostly sensitive and attentive. Moreover, green colour is omnipresent in the environment and it is the colour of the first terrestrial life forms. These primordial elements have accompanied human being during its evolutional process and contributed to its sustainment. Indeed, mankind had to dedicate particular attention on the variety of green hues in order to recognise food resources and dangers in its habitat.

From the anthropological point of view, the research of touch with the vegetation answers to the need of finding a bond with the past and a personal integrity. The chance to relate with elements present since origins instils a sense of stability and control.

The vision of colours as green, blue and purple transmit a sense of freshness read in elements like leaves, seas and sky. At the psychological level the perception of richness in the vegetation translates in an equivalent water quantity. The acquired cognition of the abundance of this primary good for human's sustainment ensures a sense of existential safety. [13] [14] [15] [16]

15. Graphical transposition by Jelena Sučić of the three mentioned perception layers.

2.1.1.2 Health and landscape

Having certainties ease the reaching of mental wellbeing states which affect also on the physical level as emerges in the studies conducted by Herriot Watt University. [17] Another study done by Bern University and Institute for social and preventive medicine observed six factors on which the wellbeing and health of individual can be implemented in urban society.

These factors operate on environmental, aesthetical, physical, psychical, social and pedagogical levels. [18]

The beneficial effects of green presence in urban environments is stressed also by the World Health Organization (WHO) of population's physical, mental and social fronts [19] [20] [21].

16. Graphical transposition by Jelena Sučić of the six mentioned factors by Bern University study.

2.1.1.3 Phytoalimurgia

Phytoalimurgia is a scientific approach of applied botany under the ethnobotany branch, it illustrates alimentation possibilities from wild edible plants. In Piedmont a particular study was done by the naturalistic physician Oreste Mattirolo, who dedicated his time in teaching botany. During the First World War, he became the president of Agricultural Academy of Turin and because of the wartime conditions he wondered about the possible consequences on the agricultural production. For this reason, he started to research and taste all the edible spontaneous plants available in Piedmont. In 1918, he presented the research at the Academy in a book considered now a treasure of botanical knowledge and territorial traditions. This patrimonial memory is being updated after 80 years by Bruno Gallino with new discoveries and 230 coloured photographic references collected by Giorgio Pallavicini [22].

These two volumes list edible pieces from the Piedmontese spontaneous flora per physiological aspects, seasonal properties, medicinal and nutritional properties. The last aspects emerge particularly with the attached recipes per plant usages which refer also to villages of the territories where the relative plant's value was meaningfully recognised.

Other more recent documentary work of regional plants is been conducted by the authors Giovanni Appendino, Luciano Riccardo e Renzo Salvo in the collection "Erbe spontanee" composed of 10 volumes [23].

Valeria Fossa, referent of the Torino Botanical Garden, confirms the existence of this lists per every Italian region, a nice found example it the notebook of Parco Naturale Regionale Oglio Nord in Lombardy which illustrates spontaneous herbs with the intent of giving cultural contents and knowledge for the park visitors about food resources considered very important in 1800 for the families [24]. She declares also that the topic is turning under interest especially in local scales, actually the Orto Botanico with Borgo Medievale in Valentino Park have built an itinerary about it [25] [26] and a lot of studies are done by a Slow Food and Università del Gusto with the local sourced food thematic [27].

2.1.1.4 Torino historically green city and Torino municipal green service

The following summaries are all been explained in a seminar lecture by Dr. Alberto Vanzo. [28]

Torino area has a geological predisposition for being green which is given by the presence of 4 rivers and one hill. The structured urban green is being composed by Savoia Italian royal family, which was based in Torino and was for a period the capital city of Italy during its monarchy period. From here the bases for a landscaping culture in the territory is started. The formalisation of this culture began from "Conte" (Duke) Sambuy (1837-1909) ascent in Municipal Committee in 1867 becoming Assessor and afterwards Major of the city. He was aware and convinced of the city gardens and green areas importance also for their artistic value. Most of those were built but not maintained which was meaning a wasted cost. Therefor he established the municipal Garden Service with Roda brothers in 1870.

Torino has experienced a shift from aesthetic/artistic urban green in food/functional urban green during the World War II (Orti di Guerra 1940-'42).

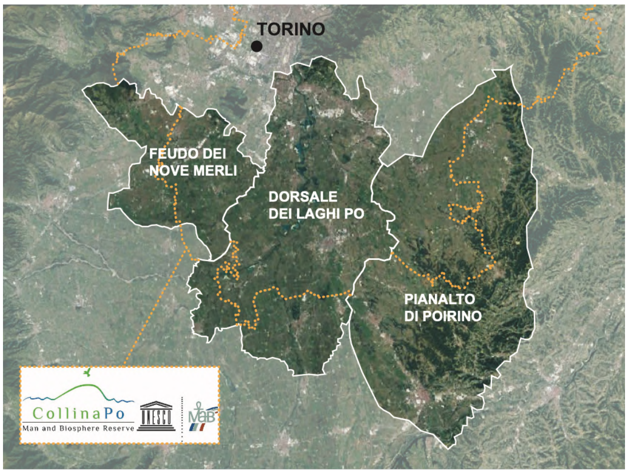
Thanks to the accurate proposition of Giuseppe Ratti, President of "Associazione Orticola del Piemonte", started the education program "Scuola di Apprendisti Giardinieri" (School of Gardener's Apprentice) for municipal public service purpose in 1952 and officially depending under the Municipality in order to ensure and maintain this revolutionary initiative.

Sambuy's and Ratti's structured service initiatives built Turinese green culture but also City's Green fame through these innovative periods. [29] The last recognised big public results of the green service action were the green fittings done during the Winter Olympics 2006. After this event resources got cut drastically.

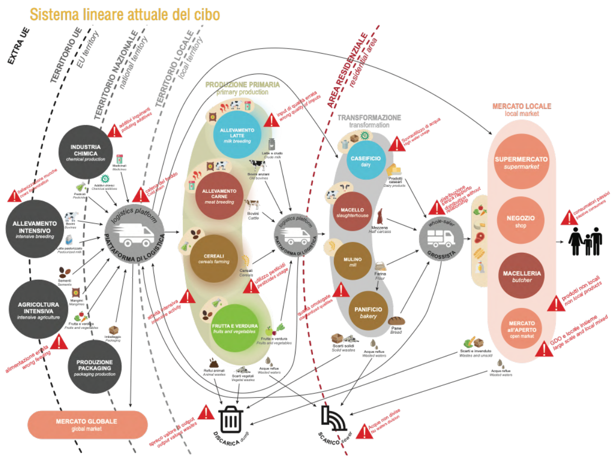
From a focused interview with Dr. Alberto Vanzo, who was the the head of Turin's Municipal Green service. The outcomes allowed to rise awareness about strength and weaknesses of the city's green management service and the existing maintenance issues, human resources and other resources need in this context. As well as creativity does help the green management group to arrange in theirs constraints. Examples: Lack of resources: prioritisation in other municipal services which overalls resource capacity is generally scarce for the actually requirements; Winter season: flowerbeds with colourful winter cabbages; Green areas' appeal: use waste material to build integrated sculptures; Municipally not acceptable maintenance proposed strategies: using sheets to maintain grass height in delimitate parks (ex: Parco della Tesoriera); Lack of citizens green education: no fruit trees because considered principally causing dirt.

2.1.2 Open Systems Semester Project 2017

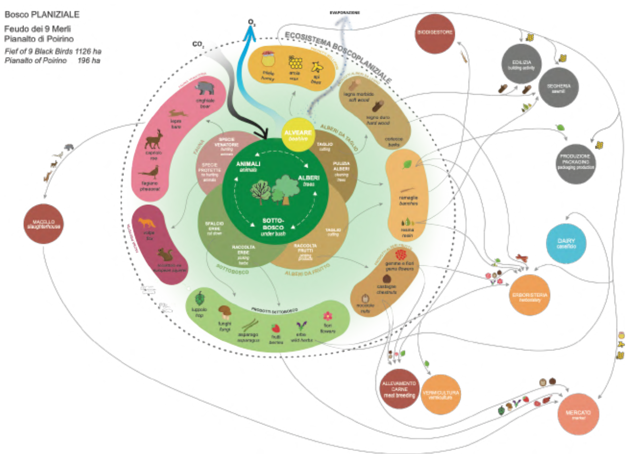
Open Systems course spring semester project 2016/2017 under MSc Master Degree Course in Systemic Design, Politecnico di Torino, conducted by Prof. L. Bistagnino, Prof E. Comino, Prof. B. Pedone, Prof. P.P. Peruccio. The author Jelena Sučić was part of the class project. 54 students were asked to redesign the basic **productions chains: fruits&vegetables**, **cereals**, **milk** and **mea**t in the South Rural area of Torino in a much sustainable way than the actual situation. By analysing the local territory and valorising its proprieties and traditions we were able to propose long-term production modules for that specific territories. For achieving this we had to acknowledge by ourselves about permaculture, bio-dynamic agriculture, synergetic farming and other analogue practices. Through the research and the acquired knowledge, the resources flow with the activities systems could be designed in the way to create functional relations and transforming outputs in inputs. The whole production modules were redesigned based on some researched permaculture principles, the territorial contexts, cultural traditions, local resources availability, local diet models, seasonality, etc. Crucial conclusion emerges from this entire research, out of the fact that the nowadays cultural, social, economical paradigms have to change in order to reach sustainable conditions, but especially the integration of production lines with forest systems. Most powerful cognition was aquired by recognising the potential relevance behind context importance/influences/predispositions (observation), life cycles, functional relationships, permaculture principle. Brief Selection of tables presented already in Appendix B in paper [1].



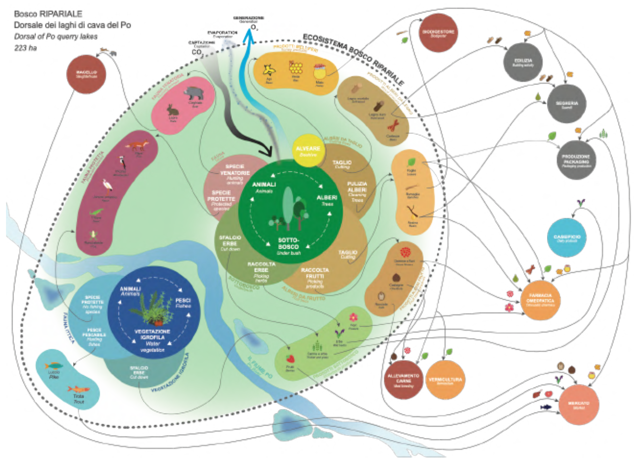
20. Three territories location in Italy, including Unesco MAB Collina Po area [30].



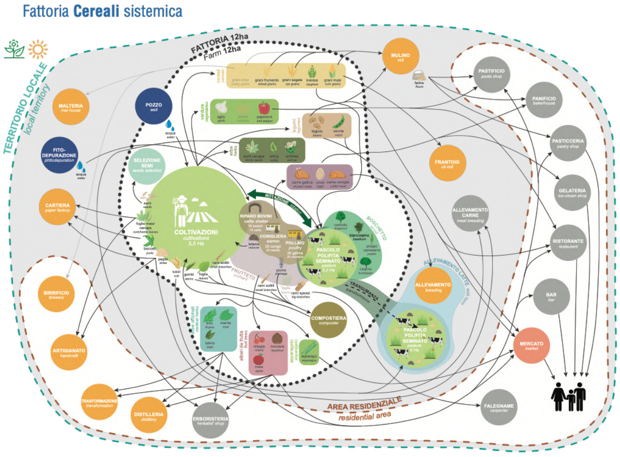
19. Actual production linear system, matter flows and criticalities [30].



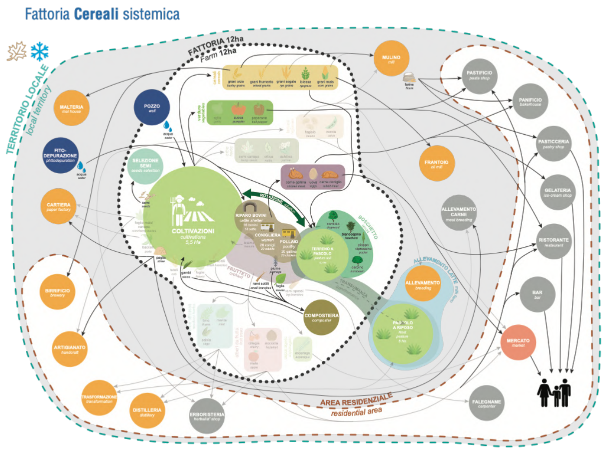
18. Plain Forest system model, Feudo dei nove Merli and Pianalto di Poirino. Designed by the Open Systems class 2016/2017



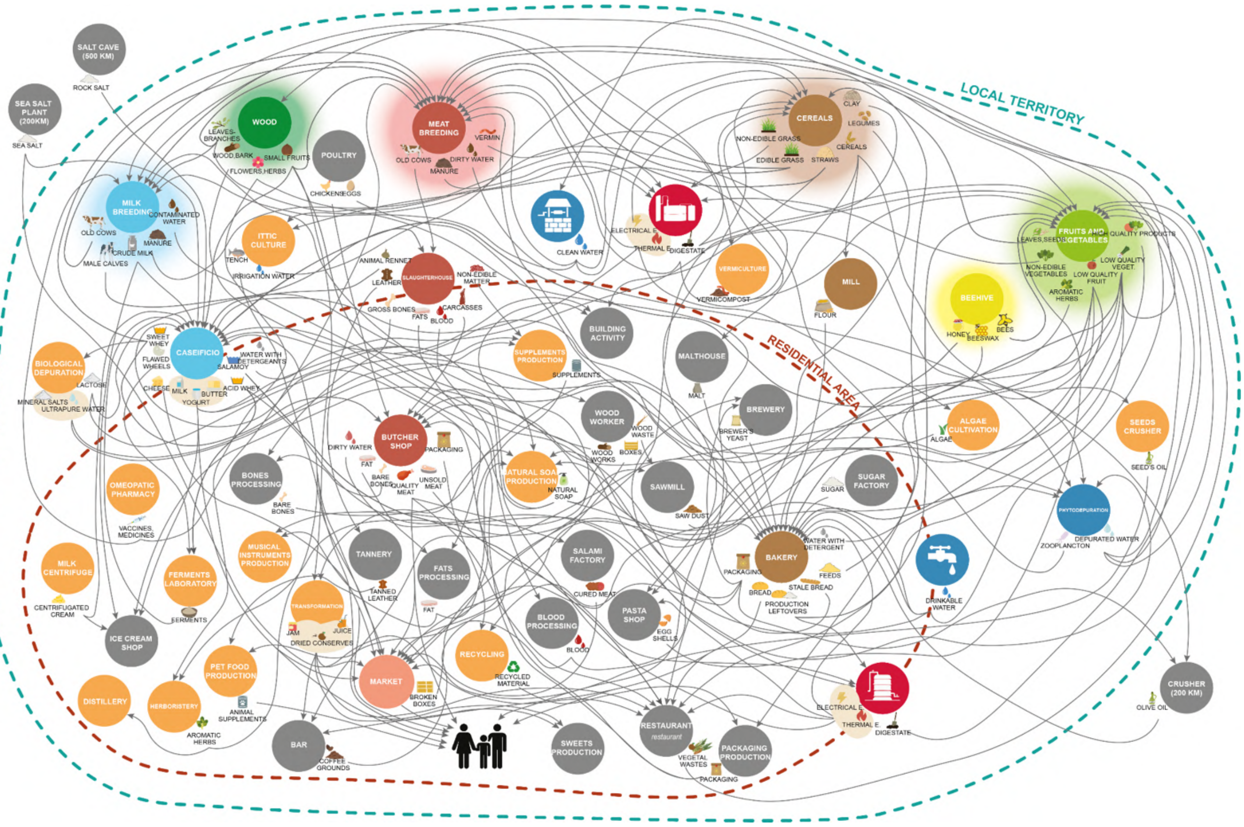
17. Riparian Forest system model, Dorsale dei Laghi Po. Designed by the Open Systems class 2016/2017



23. Sample of systemic farm mainly Cereal Producing. Spring-summer season [30]



22. Sample of systemic farm mainly Cereal Producing. Autumn-winter season [30]



21. Macro-system of relationship design in the Local territory. The apparent chaos in lines is actually stands for stability given by the strict integration of actors' roles and resources supply [30].

The Semester Project was presented further at the first UNESCO MAB Youth Forum committed to Sustainable Development in September 2017 [31] [32] [33] and at the event Green Grain during the week of Torino World Design Capital (WDC) 2017 [34]. The work has been developed further as a thesis by two colleagues, Alessandro Maccagno and Amedeo

Mascitti: ‘Systemic Design project regarding the food supply chain of Pianalto di Poirino, Dorsale dei laghi del Po e Feudo dei Nove Merli territories; with constructed economical models and systemic farms. [30]’

2.1.3 Design by components Semester Project 2017/2018: WiBreath

The **WiBreath** project was an interesting outcome by combining the applied maker and open source philosophies in home context. The study and experience were important during this project, the author and her group mates have selected the home activity: opening windows. By asking themselves what does bring people to do this? They discovered an invisible thing but perceivable: **Air**. Feelings of heavy or smelly air, temperature, are all perceptions that make us take action to manage the condition. We reached the new emerging topic of indoor air pollution. By investigating what are its elements, sources and effects, we built an awareness of how much do impact the effects (outputs) of our daily actions (inputs) and activities and how with little resolute expedients the impact can drastically be defeated/mitigated. Our project WiBreath does not solve problems but it is a monitoring system which respond with possible suggestion that the inhabitant can apply to manage the situation according to the conditions. In this way there is a rational action in users’ response, raising so the awareness of their behaviours by recognising the effects. What the monitoring systems shows also is the relation of outside conditions (much wider and opener system) and inside conditions (much smaller and closer system) and how the exchange between these contributes in enhancing and mitigating, meaning balancing, each other’s air conditions.

All this scenario shows how a little less impactive result in human’s behaviour it has actually a huge meaning, if we consider, that there are several millions of people behaving the same way during a certain activity and in a certain environment. By considering all these dynamics and scales we identify high value in adaptation capacities and education [35].

WiBreath

24. WiBreath video presentation frame [35]

The dynamics emerging from the research of this project helps to understand the human centred design re-definition focus relevance (4.4).

2.1.4 China perspective: first impressions Spring Semester 2018

One authors concern, coming obviously from the raised awareness of the just accomplished semester project (WiBreath), was the Shanghai air pollution situation. The relative research process permitted to have clear the fact that in terms of health, the pollutants themselves are not the problem but rather the time exposure under a certain concentration. In order to guarantee changes in time exposure many of the found good practices have been applied during the stay but also finding in plants (2.3.6.2) being low impact and expense contributors in changing and balancing the air state in the room/living place.

With the acquired knowledge of the so classified air cleaning plants and by wandering in the city, was possible to recognise the usage of focused air cleaning plants and some permaculture principle applied in the Shanghainese urban greening, from this the question remained raised if there were applied consciously, in part or by chance.

Another good occasion of understanding the local context in sustainability terms was attending the course about Sustainable Development in China at the International School, given by the following professors, Prof. WANG Hongtao, Prof. NIU Dongjie, Prof. Bin Xu, which gave an overview and some data references of China’s states, strategies and policies (2.2.2).

2.2 Urban Scale

The following literature elements want explore mainly governance layer, which is the one from where common citizen aspect changes and active involvement in facing environmental issues and sustainability promotion at city context. Topic’s spheres that are going to be touched are in terms of policy, urban planning, green management services, parks management and citizens contributions.

2.2.1 Torino Interviews

Focused interviewing in a well-known green context as explained in the author’s **2.1 Background** section. Every interviewed person is going to be a thematic sub-layer given by the institutional context of the person’s role. The leading question is about ‘**Urban Green Sustainability**’.

Follows resume of relevant aspects emerged from the interviewed figures in Torino City context, already mentioned in the appendix in [1] for contextualisation purpuses, enhancing considerable positive and critical aspects.

2.2.1.1 Assessore Alberto Unia

Assessore Alberto Unia is the new head of Environmental Administration of Torino. The city is recognising now the need of a strategical plan of the urban greening, the Vision is to manage the Climate Change, research required for the introduction of new more resistant plants, lack of money and people for the maintenance, Green Print project for mapping all the city green in order to understand the present resources for implementing where and in the way is needed, usability of green areas and recreational green. Social aspect to valorise and citizens education. The city has always worked on this but it seems to be enough for help and integration. Geological predisposition, the city already has a developed green system but never been strategically applied. It is historically and traditionally always dedicated to gardening, so much that Torino was the first city establishing a City Gardening School, an education program to rise gardeners for the city service. [36][30]

2.2.1.2 Michela Cacalano

Michela Cacalano, Representative of Torino ProGIreg, an EU international project explains the research aims of these experiments based on Natural Based Solution (NBS) which are working on Innovative usages of the urban green and developing Solutions for urban regeneration, three big aspects are:

1. ‘New soil’ concept (analogue to the brownfield practice)
2. “Verde diffuso”/ ‘Diffused Green’ (aquaponics, green rooftops, …)
3. Cross activities: citizens involvement and sensitisation (social component) [37]

2.2.1.3 Urbanist Luciano Viotto

Luciano Viotto is a representative of Torino Città Metropolitana, institution that deals with regulator plans and their approvals, he provided last regulations about urban greening and signalised a lack of interdisciplinary approach from the several offices for developing sustainable strategies. The questioned topic has touched Mr. Viotto on a individual level and he shared his personal application with his synergic orchard at his second house and how he and his wife, particularly his wife are contributing to an initiative DIST-ORTO at Cavallerizza

Reale [38] for trasmitting the synergic approach with the aim in educating and building something together with the community in the city.

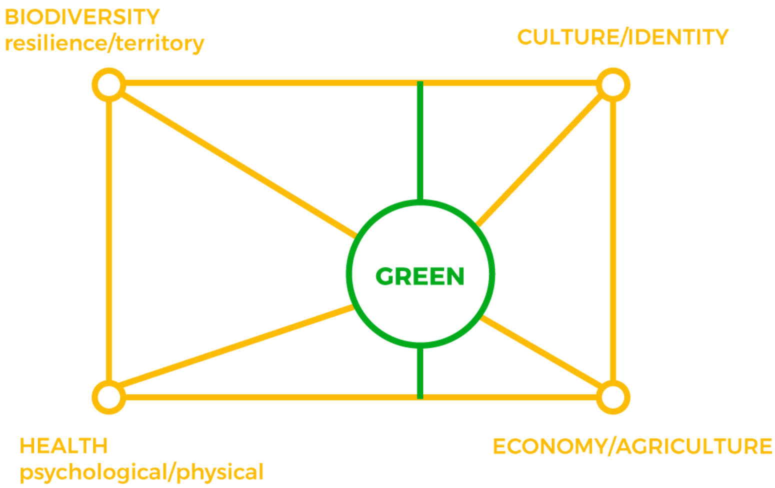
2.2.1.4 Emilio Soave

Emilio Soave of Pro Natura Torino Association, he is a veteran expert of Torino’s Green History in all its aspects. This entity works practically trying to remedy on municipalities failures or inattentions, also thought from citizens perspectives. The city closing parks to prevent security issues for the citizens. Trees have a big cultural and traditional value, indeed there is a green service office dedicated only on Trees’ management, where at the moment there is in charge person with a totalitarian and not integrative approach on change, old architectural culture perspective of symmetry. This one has to stay under the directives of the Ministry of Cultural Heritage because some historical trees and boulevards are protected. This create ‘un-reaction’ effects and another factor that contribute on this are plants species illnesses. The example was: five horse chestnuts with white flowering have been cut from a boulevard area and not replaced because that specie is vulnerable to ‘Cameraria Orhidella’, citizens ask to replace them with anything because of the emptiness and the sun exposure. What did the City? Nothing. Why? Because lack of knowledge, adaption and of course money and human resources to be able to choose to react. An adaptable solution is given by our figure, that considers all the pre-explained blocking factors: substitute with horse chestnuts of the same family, but the once with pink flowers which is not vulnerable.

2.2.1.5 Dr. Ippolito Ostellino

Dr. Ippolito Ostellino, ex member of Torino Internazionale Association and ex coordinator of the group about ‘Green Infrastructure’, which was one of the topics that wanted to define a strategical plan for the metropolitan green, inside of Torino Strategica project which was involving all 38 municipalities of the Torino Metropolitan Area. All the association was working on metropolitan strategic plans which stopped after the new politicians entrance in Torino City Administration. Explicative materials were produced and are still available online. [39] The booklet about the green infrastructure is highly communicative in contextualised and shared approaches, values, priorities, cultural landscape, actual situation, resources, … [40]. It integrates EU commission guide lines which want to define greening from the sustainability point of view giving this new name Green Infrastructure.[41][42]

A summary is given by the following explained schema from Dr. Ostellino: it's all in a golden rectangle and these elements will favour natural ecosystem to do their duties: Ecosystemic Services.



25. Graphical transposition by Jelena Sučić of the theories and elements shared by Dr. Ostellino about the plans intended to be applied through the Torino Strategica project

Other crucial points from his perspective as naturalist and manager of Parchi Collinari Collina Po and other green structures in the metropolitan area were:

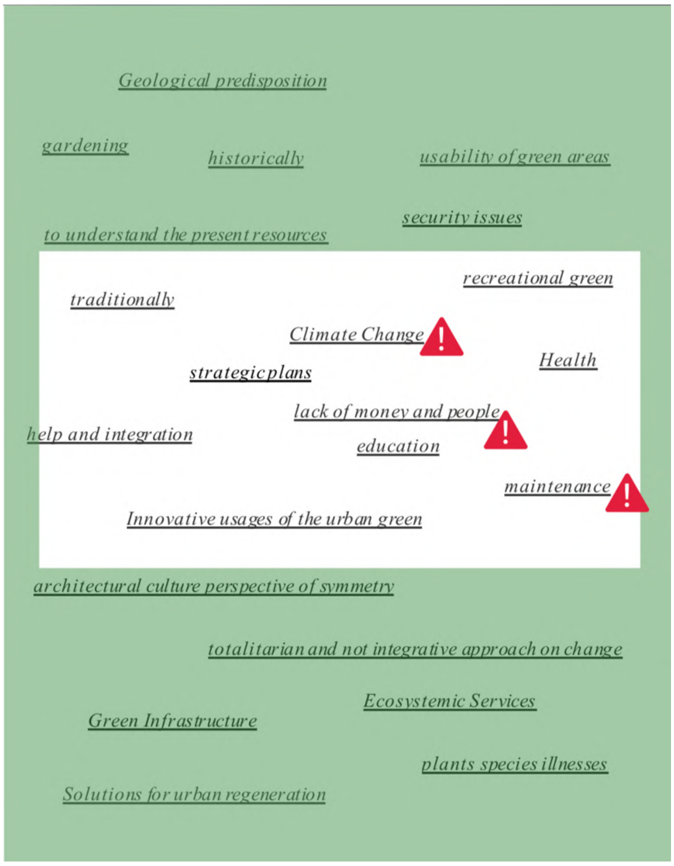
a. Small (actions, strategies in greening) but multiplied many times is much more manageable in terms of dimensions but for achieving long term efficiency a 'middle facilitator organism' is needed, 'Island effect' has to be avoided;
b. Architectonical order culture: linear, in contrast with the diversity order of Nature;
c. Italian political culture with self-blocking predisposition;
d. Italian environmental legislation problems from the base: not really reactive;
e. Absence of naturalists, biologists, geologists, which are experts of nature systems in green political action groups, are considered only, agronomists, gardeners, which are professions of nature transformation. There is a fundamental problem in recognising the difference, and how integration of both is needed;
f. Citizens Hierarchical not understanding of Nature presence:
   – in function: human leisure activity grass dedicated area and the grass area of spontaneous ecosystems (not kept short);

– in time: people exist on Earth since 200,000 years while insects exist since 500,000,000 years;

- in kind: we are only one of the species under the Animalia kingdom, which is only one of five and we all have to live in the same Earth, environment, home.

2.2.1.6 Summary

These are all examples of what comes out from experts' voices about Sustainable Urban Greening in Torino, Italy, context. So many point emerged, only by asking about this topic, allowing comparisons with other realities from desk-research. These findings commonalities and differences showed how these differences could be sources of solutions in other urban contexts.



26. Words grouping by persistence from the Torino Interviews

In figure 26 are shown three levels in prioritisation the main concerns of the interviewed. The three indenfied main and persistent facts under attention are marked with a red triangle. Lack of money, people, education and maintenance issues are constantly present in every gorvermental concern but the new fact under people attentions are the alterations produced by climate change effects.

Will follow explanations of critical situation at urban scales enhanced by big cities as Shanghai and Singapore, in relation with considered climate change addressed issues they will show the fact that governances alone cannot sustain all the required management and they are all looking for ways to integrate actively citizens in maintanance processes.

The conclusion that accurs is that every strategic plan, urban planning action needs to be maintained, in order to be maintained integration of variety is needed and cultivated education in population.

2.2.2 Shanghai and China action plans

All those global issues as Climate Change and Air Pollution, expressed in heat waves, floods and droughts which affect health conditions are also major concerns for China. Because of these five year action plans strategies have been establish achiving improvements at every cycle. Chinese governance has established the new moto of “Beautiful China” willing to recover the beauty and the health of its country by gaining back its blue skies and preserving the life on earth in harmony.

Controling actions can be actuated in different scales with integrative and accurate plans with long term visions. All the applied efforts are actually recovering actions of not well considered activities in their potential collateral effects.

2.2.2.1 Sponge City Concept

As explained during Prof. Wang Hongtao’s lectures (2.1.4 China perspective), China has uneven water sources distribution and safety in the Country which is completely incompatible in relation with the arrangement of population, arable land and mineral resources [43][44].

The south China has more resources than the north China, and the east more than the west.

Therefore, in general we have a scarcity problem in reaching with drinking water quality the population needs satisfaction. The perspective becomes even worse in terms of seeing a long-lasting availability of useable water.

The research and the management of water has and produces many effects. The scarcity in the north brings people to excavate even more deeper looking for underground water, process that creates impact on the environment like altering the structures of the ground making it unstable and the water cycle system. The process is becoming also an economical issue because they are reaching some unimaginable depths by looking for water and the time needed as well the technological effort it is exhausting in term of costs.

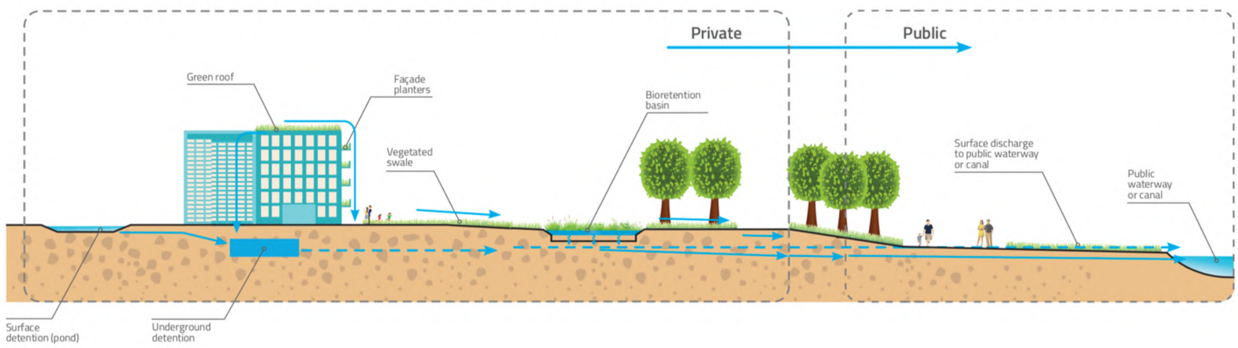
Because of the effects of the Global Warming and the Climate Changes the south area of China has a problem of emerging floods. Floods that caused in last twenty years an economical loss for the country especially between 2000-2014 where was registered a loss of almost 2 trillion RMB.

These are effects caused in part from the ‘reacting’ behaviors of the water cycle system because the water from the precipitation or melting ice that does not sink into the ground or evaporate into the air runs off into our precious water bodies.

It is now counted that about two thirds of the world’s annual runoff is lost by seasonal floods and is not available for human use. The remaining one-third is reliable runoff, which is the amount of runoff that we can generally count on as a stable source of water. A ‘contribution’ from cities to that two thirds of water loss are the urban structures like one simple example would be the covered earth by tarmac and concrete, materials that makes really difficult for water to infiltrate the ground. So, the actual urban structures do not allow the water taking its regenerative cycle process [44].

During Prof. Wang’s lecture is been illustrated also that there are many projects that are trying to solve these problems by working on local scale, like the ‘Sponge City Concept’ where they are trying syntactically to take maximum advantage of raining water by creating green areas and basins that could absorb and contain the water in order to limit runoffs. The project program was developed in a short time and includes: “the basic research and demonstration projects focusing on LID and other stormwater management concepts and practices such Sustainable Urban Design System (SUDS), Water Sensitive Urban Design (WSUD), Low Impact Urban Design and Development (LIUDD) have been carried on for more than ten years in China [45].”

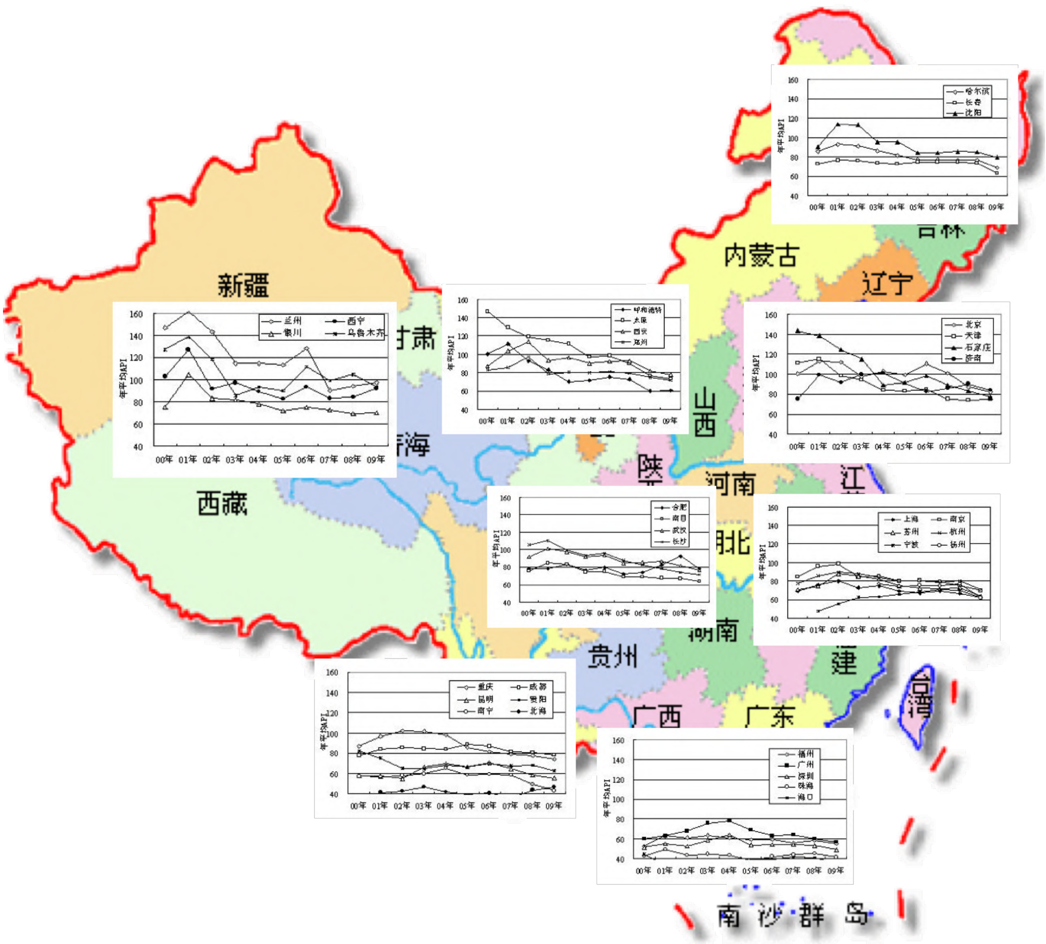
Follows an illustration showing the swales application for water ritention from Singapore’ ABC Waters: Sustainable Stormwater management guide book[46]. Singapore is actually a leader in greening and watermanagement strategies and China looks a lot to Singapore, more about Singapore greening at chapter 2.2.3 “Greening Singapore” Case.



27. 'An example of how ABC Water design features can be integrated within a building development to slow down runoff [46]'.

2.2.2.2 Considerations starting from Shanghai Clean Air Action Plan (2013-2017)

Localise the sources and develop local strategies and plans is fundamental. It is enough to scale from China air pollution main problems to Shanghai ones and becomes immediately obvious that the priorities are different. As explained during Prof. Bin Xu's lecture (2.1.4 China perspective), China common problems and sources are PM_{10} and SO_2 from coal burning activity for electric energy production and, especially in the north, for winter heating needs. Relatively to the north area, an impactive natural phenomena causes also problems defined by the geological presence of deserts, Sandstorms. Acid rains were considered a huge problem but in last five years the presence of this phenomenon makes almost disappear the attention on it. Of course, automobile related air pollution in large cities is a must of attention, the fast development of these cities enhanced economical possibilities and lifestyle needs like having personal cars. This problem persists in Shanghai too as well as PM_{10} which is a general problem in China and is considered a measure of improvement comparisons between cities as showed in the following graphs.



28. Graph showing PM10 decreasing data distribution in China, picture extrapolated from lectures slides of Prof. Bin Xu [47].

The city conditions are favourable for photochemical smog manifestations and the high dynamic of urban construction and demolishment for reconstruction makes emerge also $PM_{2.5}$ and PM_{10} as highly problematic pollutants in terms of dust emissions control. SO_2 is not highly problematic in Shanghai mostly because the heating coal consuming activity has never developed so much as in the north, despite NO_2 management becomes priority and the high density of polluting activities and indoor spaces makes emerge the indoor air management as a problem [47].

Relatively to its local air problem priorities, Shanghai has developed its own action plan. Shanghai Clean Air Action Plan (2013-2017) [48] is structured by defining three main points: Targets, Main Tasks and Supporting measures. The targets are simple, till 2017 the proportion of heavily polluted days in a year has to drastically decrease, air quality shall improve and annual average concentration has to be reduces by around 20% lower than the measurements in 2012. Tasks include actions relative to energy production and consumption optimisation. Energy structures may be eased to be adjusted, replaced with efficiency aims, mixing kind of energy consumption, to diminish concentrated emissions of the same kind and enhanced renewable energy production and consumption especially for boilers and furnaces. All the coal-fired and gas-fired facilities have to keep efficiently working all their environmental facilities relating to de-dusting, desulfurization and denitrification. Adjustments and pollution control have to be done relatively to industrial structures. 'The production capacity expansion on labor intensive manufacturing industry is to be restricted. Major pollution control on SO_2, NO_x, dust, VOCs shall be included as part of EIA review on construction projects, with consideration of regional/industrial pollution emission situation and lagging enterprise elimination. The special air pollution emission limits shall be set up to control industries like coal-fired power plants, iron and steel, petrochemical, concrete, nonferrous and chemical industries [48].' In order to enhance industrial restructuring a blacklist of enterprises which may be washed out or rectified shall be published every year. These helps also in terms of transparency as emitter and visualise where to prioritise actions. All the enterprises identified with high risk on Hg, VOCs, dioxin emission shall be adjusted with new processing or shut down.

Green transportation implementation where the urban transportation system has to be distributed rationally according to public traffic demand but prioritising mixed public transport accessibility like buses, scooters and trains. The walking and cycling infrastructure has to be increased as well in order to allow people use less energy consuming and air impactive mobilities. Disseminate and encourage new and clean energy moved vehicles in private purchasing and public transportation industries like buses, taxis and sanitation. For example, the newly added new energy buses in public transport is to account in percentage more than 60%. There was a vehicle labelling according to the emissions standards and the yellow label and the old vehicles that are high polluting, have limited driving range. In with 2015 was planned even to remove 180,000 yellow-labeled from circulation.

There is the need to optimise spatial distribution, in this the purpose is a strict examination relatively new plans where the 'Urban planning shall be formulated scientifically with consideration of environmental resources, ecological land proportion, urban population scale, urban road space per capita and so on [48].' Green building criteria has to be disseminate and implemented. As in terms of green materials application like water-based coatings, strict compulsory energy saving standards by applying new technologies, such as solar water heating systems, ground source heat pumps (GSHP), air source heat pump (ASHP), building-integrated PV (BIPV), combined cooling heat and power (CCHP) and so on. Into pre-conditions for project construction approval, in construction sites dust control is to be strengthened by integrating control scenarios on dust, fume, VOCs. Have to be installed dust online monitoring systems in all the key construction sites located in downtown areas, suburban areas, new towns, big residential communities, Hongqiao Business District, Disney District and Lingang New Town. A very interesting and specific action to strengthen road dust control is focused on truck transporting demolitions residues. 'The transport of bulk materials, such as brickrubbish, shall be standardized by sealing up trucks and preventing fallout. Till 2014, mechanical cleaning on city expressways, highways are to be conducted no less than once per week and no less than twice per day in high polluting days. Till 2015, the cleansing rate in downtown areas reaches 75% above and 45% above in suburban areas. Till 2017, the rate in downtown reaches 78% above and 48% in suburban areas [48].'

For the urban greenery development and wood conservation Shanghai has established also specific quantities to cover in combination by implementing *Shanghai Major Ecological Network Plan* where is already expected the enhancement of wood and green spaces suburban and urban areas, disseminating roof greening and facade greening. Till 2015 are planned 3000 hectares newly built urban green space, 4000 hectares eco public woods reaches and 90 hectares in vertical greening. From 2015 till 2017, newly built urban green space has to reach 4600 hectares and vertical greening 150 hectares [48].

29. Shanghai surrounding tree plantation. Photogram from a video taken from the high-speed train railway. Shanghai-Beijing. Ph.: Jelena Sučić, 25th May 2018

This strategy is probably in relation with the Sponge City Concept applied in Shanghai's greening for preventing floods. In this point air, green and water system enter in relation to preserve each other. Agricultural pollution action is also a wide focus considered. The only indoor relative control action is about cooking fume. Several supporting measures are developed, the environmental authorities will work closely with the other relevant departments in formulating stimulating policies in investment, finance, tax, pricing, trade, science and technology so as to facilitate air pollution control. Law enforcement and stricter punishments for violators. Upgrade of emergency reaction abilities and strengthen scientific research to achieve a better efficiency in control actions. Further involving public participation by environmental publicity and education, and encouraging by enhancing government information transparency are some of the applications or intentions of supporting air control action strategies. As conclusion air pollution is not only something that we passively endure but also something that we unconsciously cause with our behaviours. Behaviours that are leaded by our needs, lifestyle requirements but also from the extended offer of possible consuming activities without well taught limitations. So the solutions stay behind the slow process of changing our behaviours and understanding their impacts.

2.2.3 “Greening Singapore” Case

As explained by Dr. Tan Puay Yok during the given lecture at Tongji University, Singapore has a five decades greening history as political action. What differentiates singapore’s green from other is that is been consciously decided and cognitively built to be the identifying or diferentiating charactheristic from the souranding countries. This move was especially meant to enhance and make clear that Singapore is not Malasya anymore, after Singapore became indipendent. When the separation happened, Singapore had to deal with several problems and constraints. The simple fact that geographically speaking is only a small island with a high and diverse population was already a challenge, how to provide for the population and how to build united for the new nation needs. The reaction direction towards needs' conditions was enhanced by the already existing socio-economical problems and challenges. At the time of Singapore’s proclamation on 9th August 1965, they had the biggest concentration of “slums” in South-Asia and the 60% of the population in the 1960s was leaving in the central region which is the 16% of land area. This concentration was affected by having a population of 130,000 people leaving in squalid and insanitary conditions throughout municipal areas. They had access only to standpipe water and the most primitive sanitation.

30. Tongji University poster for the lecture in 28th September 2018

As made clear by Prof. Tan Puay Yok during his lecture, in spite of other pressinng needs of national development: housing, economic development, defence, education, racial tentions, environmental clean up, etc. the top-down vision of prioritising greening action was identified by the Prime Minister Lee Kuan Yew, who at the time declared ‘…I searched for some dramatic way to distinguish ourselves from the other Third World Contries” and “settled for a clean and green Singapore.” To enhance the importance of this for the nation the Prime called a meeting in 1978, ‘He gave a two-hour lecture to all the important people present including the Ministers, Permanent Secretaries, etc. and at the end he pointed to the Permanent Secretary of Finance and said “Look, just give them the money. If I put a polythene bag over your head you’d suffocate”. And he was using this as an analogy to explain the importance of added perforated concrete help the aeration of trees.’ In conclusion there was a shared comand, that all the agencies have to help and contribute and collaborate economically to the greening action for the wellbeing of the nation.

From 1963, legal framework and planing policies have kept evolving and adapt, so as the landscape provisions and planning guidelines, which consider:

- Green buffer and peripheral tree planting requirement;
- Dedicated planting verges along public roads;
- Landscape Replacement Policy;
- Site Coverage and Communal Open Space Requirement.

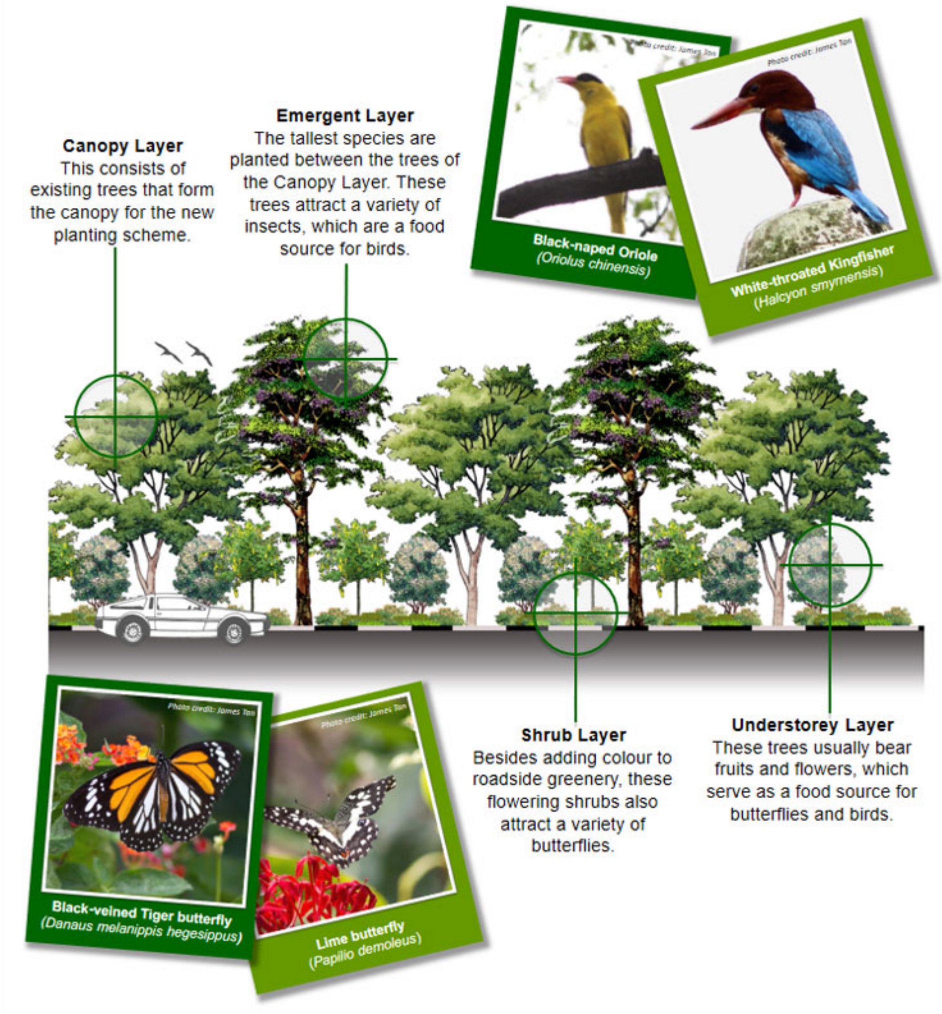
By following the evolution and by understanding step by step the criticalities dedicated institutions emerged and scaled in dimension enhancing their operating capacity. Dedicated manpower under the institutions go to developing manpower, enhancing the specialist knowledge in the institutional capacity and focusing on R&D for research operations, conservation and botany.

The three key factors that allowed the Singapurian greening becoming so identifying are:

1) A top-down vision and political support: *Destination*;
2) Legal framework and planning policies: *Vehicle*;
3) Dedicated institutions: *Driver.*

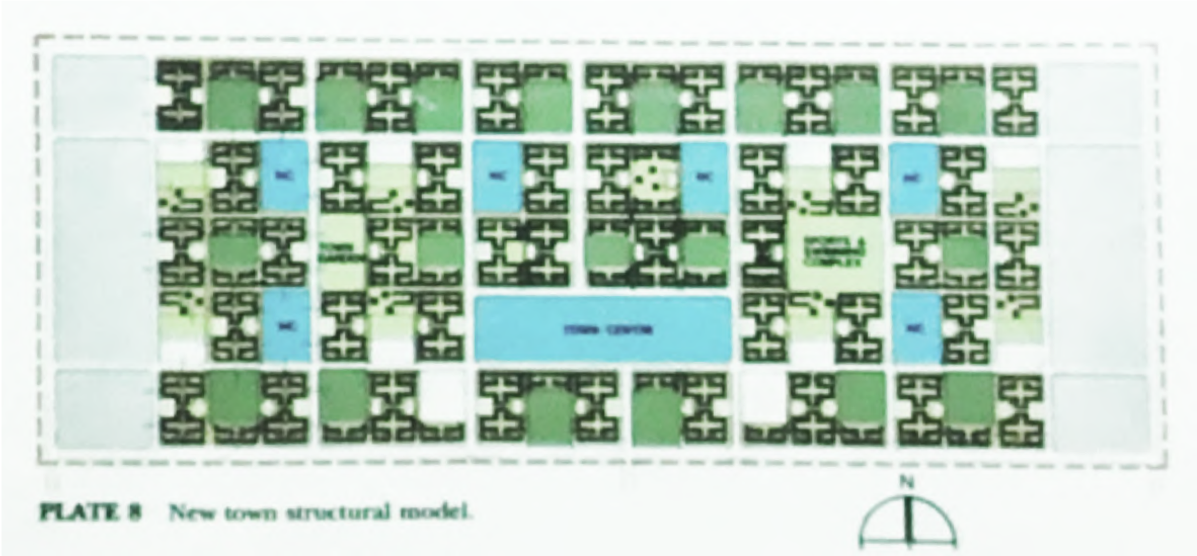
There are six consequetial key active programs that made become Singapore so green.

The first had the aim of greening the urban area rapidly by planting trees and has been activated in two ways, one is by instaurating a political symbolic day dedicate for planting trees every year on 16th of June since 1963, the second is a planning of roadside tree planting, with species introduction and evaluation, contributing for pervasive sense of greenery in Singapore. The trees introduction in all areas happened through a definition of a “road code” from 1970s. This allowed to have a tree coverture on more than 90% Singapore roads. This planting tree action has produced the effect, of an emerging layer of trees which create the space for a new layer of trees to imitate forest layers and this allowed an enhancement of the biodiversity as explained in the Nature Ways route [49] and briefly illustrated in figure 31 .



31. 'The Nature Ways are planned to include four important layers. These green corridors help create a greater appreciation of the rich biodiversity in our City in a Garden [49].'

The second is about Parks abd Open Spaces planning in the city, aiming to provide with a hierarchical differentiation of parks access to population till at least for the 90% of it in within 10 minutes walk by 2030. The aim of giving a daily chance to citizens to be in touch with living nature made also require a open space creation integrated with the populated buildings. As shown in figure 32 table of the presentation slides sourced of [50].



32. 'PLATE 8. New town structural model [50]'

The third program is called “Skyrise Greenery” and has started from early 2000s with relative policies. The applications and progress of installations is been applied fast covering 61 ha record of 2014 and the policy target is to reach 200 ha coverture by 2030.

The fourth program which requires a longer term monitoring as emerges from Nature Ways above is about Urban Biodiversity Enhancement. In 2009 An Action Plan with Strategies is been defined by the government [51]. There are five leading strategies:

- Strategy 1: Safeguard Our Biodiversity;
- Strategy 2: Consider Biodiversity Issues in Policy and Decision-making;
- Strategy 3: Improve Knowledge of Our Biodiversity and the Natural Environment;
- Strategy 4: Enhance Education and Public Awareness;
- Strategy 5: Stregthen Partnerships with All Stakeholders and Promote International Collaborations.

It is remakable the fact that strategies 3 and 4 do not necessary need to be contributed or imposed from above (government) but can be contributed by individual or smaller groups initiatives too. The alignement of the two has interesting opportunities emerging in the fifth program.

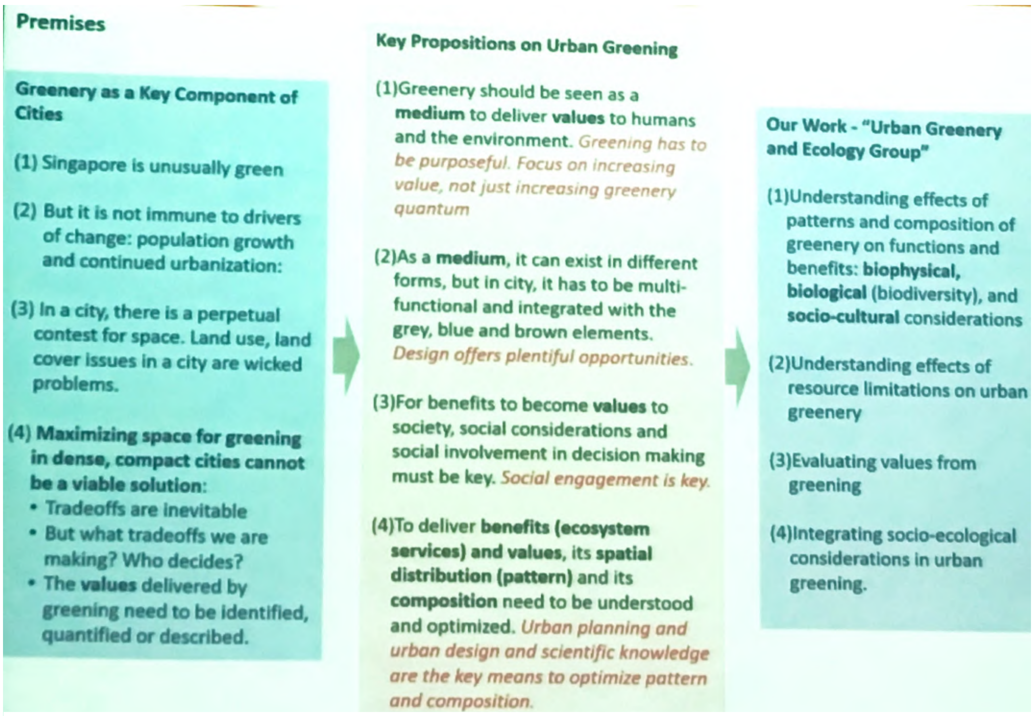
Strategy 5 showes the interest of open comparisons with/from outside to enhance the recognisement of opportunities of how apply consequentially for strategies 1,2,3,4.

The fifth program is about Community Gardening, as mentioned already above, there is interest in opening opportunities where the greening action do not have necessarily rely on the government only. The reason why the government supports citizens initiatives, a part for the goals in strategies 3 and 4, is not for food provision but mainly for health reasons. Reasons were already mentioned in 2.1.1.1 Green Perception and 2.1.1.2 Health and Landscape.

Last program is the ABC Waters Programm applying the Sponge City Concept (WSUD, SUDS, LID) already mentioned about the Chinese contextg in 2.2.2.1 Sponge City Concept.

In conclusion Prof. Tan Puay Yok explained what are the premises and opportunities for Singapore Greening future as shown in the picture of the concluding slide in figure 33 By summarising the main concern about Singaporian Green is the resource limitation in terms of space puts Singapore in a difficult condion to balance since the population is growing and the economy with it which requires built infrustractures which seams leading cuts on green areas.

For sure is remarkable that Singapore’s obsession with greening over five decades made them achieve incredible results, unfortunatly this does not make it immune to land use and land cover change drivers as population growth and urbanisation, to deal with these challenges fresh appraoches are needed and Urban Ecology frames and guides for research seam responding towards city’s needs. Main references used for this lecture [52] [53] [54] [55] [56].



33. Premises and Key propositions on Singapore's Urban Greening from Dr. Tan Puay Yok lecture to conclude about the topic.

2.2.4 Ecosystemic services briefly

Ecosystem services were already mentioned and applied several times in the literature till this point therefore is required a brief introduction on what comports from an urban point of view.

As described in a twenty years excursus paper about by Robert Costanza et al. ‘Ecosystem services are defined as the functions and processes of ecosystems that benefit humans, directly or indirectly, whether humans perceive those benefits or not. Given this definition, is there a difference between ecosystem services and benefits? Potschin and Haines-Young (2017) use this distinction: ‘The difference between a service and a benefit in the cascade model is that benefits are the things that people assign value to.’ Perhaps the distinction being sought here is between perceived and unperceived (or poorly perceived) benefits [57].’

A classification is organised by Constanza et al. as follows:

Table 1
Classification of ecosystem services and functions used in: (Costanza et al., 1997).

#	Ecosystem service*	Ecosystem functions	Examples
1	Gas regulation	Regulation of atmospheric chemical composition	CO_2/O_2 balance, O_3 for UVB protection, and SO_x levels
2	Climate regulation	Regulation of global temperature, precipitation, and other biologically mediated climatic processes at global or local levels	Green-house gas regulation, DMS production affecting cloud formation
3	Disturbance regulation	Capacitance, damping, and integrity of ecosystem response to environmental fluctuations	Storm protection, flood control, drought recovery, and other aspects of habitat response to environmental variability mainly controlled by vegetation structure
4	Water regulation	Regulation of hydrological flows	Provisioning of water for agricultural (e.g., irrigation) or industrial (e.g., milling) processes or transportation
5	Water supply	Storage and retention of water	Provisioning of water by watersheds, reservoirs, and aquifers
6	Erosion control and sediment retention	Retention of soil within an ecosystem	Prevention of loss of soil by wind, runoff, or other removal processes, storage of silt in lakes and wetlands
7	Soil formation	Soil formation processes	Weathering of rock and the accumulation of organic material
8	Nutrient cycling	Storage, internal cycling, processing, and acquisition of nutrients	Nitrogen fixation, N, P, and other elemental or nutrient cycles
9	Waste treatment	Recovery of mobile nutrients and removal or breakdown of excess or xenic nutrients and compounds	Waste treatment, pollution control, detoxification
10	Pollination	Movement of floral gametes	Provisioning of pollinators for the reproduction of plant populations
11	Biological control	Trophic-dynamic regulations of populations	Keystone predator control of prey species, reduction of herbivory by top predators
12	Refugia	Habitat for resident and transient populations	Nurseries, habitat for migratory species, regional habitats for locally harvested species, or over wintering grounds
13	Food production	That portion of gross primary production extractable as food	Production of fish, game, crops, nuts, fruits by hunting, gathering, subsistence farming, or fishing
14	Raw materials	That portion of gross primary production extractable as raw materials	The production of lumber, fuel, or fodder
15	Genetic resources	Sources of unique biological materials and products	Medicine, products for materials science, genes for resistance to plant pathogens and crop pests, ornamental species (pets and horticultural varieties of plants)
16	Recreation	Providing opportunities for recreational activities	Eco-tourism, sport fishing, and other outdoor recreational activities
17	Cultural	Providing opportunities for non-commercial uses	Aesthetic, artistic, educational, spiritual, and/or scientific values of ecosystems

* We include ecosystem “goods” along with ecosystem services.

34. Classification of ecosystem services and functions used in: (Costanza et al., 1997) [57]

Analogies of these services can be found in Permaculture (2.3.2 and following) which bases its design on setting relationships between functions and in new focuses of their needs as done by BCNEcologia [58].

2.2.5 “Mediator”: How to communicate the alignment for the “Greenway”?

From governances’ perspective (top-down) many kind of guidelines have been planned and exposed. The already mentioned EU Commission’s Green Infrastructure, Chinese Action Planes, provide terminologies, practices and intentions. It happens that some external entities contribute as by researching calculating tools as done by the Institute for Sustainable Urban Development under the project Grabs [59], of the outstanding in sustainability practices city of

Malmö in Sweden with “The Green Space Factor” and “The Green Points System” but how to transmit them to the common citizen level and understanding? An interesting strategy behind the terminology can be found in Barcelona by the “Agencia d’Ecologia Urbana”, with the so defined “New Urbanism Model” under the name “Ecosystemic Urbanism” [58]. BCNEcologia is actually a public consortium dedicated to rethink cities in key of sustainability and under the mentioned terminology the explain projects but also tools as are the Ecosystemic Services in a comprehensible way for citizens understanding.

Under **citizens understanding** there are also some **emerging misleading effects’ perceptions** of greening actions from institutional dimensions that make appear greening a problem for the society at the economical layer. The Green’s fashion factor that makes appear thing expensive and especially on architectural building in urban area’s creating gentrification effects [60].

A typical case, that can clarify this, is the Milan Vertical Forest of Arch. Boeri which maintenance expenses are unaffordable by common citizens and makes this building exclusive [61] [62]. This case make mark out also the nowadays ambiguity about the word “green”. Green can be just the aesthetical aspect of vegetation, but this term is also overused to define something “sustainable”. Well the maintenance costs of the building do not suit to the sustainability meaning. There also those so called Green Technologies, as for example the mentioned ProGIreg tools (see 2.2.1.2 Michela Cacalano), what does that mean to people or what do we aim with this term?

The definition that comes out of this research thesis orientates to the **vegetation biological behaviour** which is **cyclic** and **functional** to other bodies explained well under 2.3 Nature Principles.

There are many initiatives applied and applicable by citizens as what mentioned in the 5th green program mentioned in the Singapore case (2.2.3) about community gardens. Community Gardens and ochards, cultivating crops in small boxes as little school projects help in providing observation moments where to learn and appreciate the outcomes. The author has experienced some of them as explained in Chapter 3: Test Cases. but can these (bottom-up) initiatives be considered aligned with the above intentions: adapt for climate change, efficient and sustainable resources usage,…?

2.2.5.1 Green Light-Year Project

The Green Light-Year project is an example of a bottom up initiative ermerged from the simple idea of Huan Ni to apply her job experience of low carbon emission regulations at home by putting solar pannels on her balcony. The story and development of the effects of this action is explained in Pdf introducation provided by Huan Ni (Helen Ni) in prevision to visit her house and neighbours involved.

'Green Light-Year's story originates from an experience with real Climate Change. In the summer of 2013 when Helen and her husband moved to their new property, the abnormally hot summer made their front balcony burn, so she started to look for solutions that provided shade. Eventually, in 2014, she found a good material solar plant and became China's first civil user of CIGS (a semiconductor material composed of copper, indium, gallium, and selenium) solar cell home power plant, which attracted not only the media, but also an ever-growing number of neighbours. Helen found out that there was a huge demand for families to learn from a good example of a green lifestyle and parents are happy to bring their kids to join green initiatives, at home or near their home, to feel and experience sustainable development-related examples. When the total number of visitors to her home reached 800, Helen decided to set up an environmental NGO, so that a dedicated team could manage all visitor information and visits. Helen transformed her home into an environmental technology "museum." The visitors bring their children to experience solar energy, an EV car and charging station (the first shared personal charging station of Minhang District, which can also earn her money), an aquaponics system (combining aquaculture and hydroponics), and a vertical farm that uses kitchen waste as compost to realize zero waste of wet garbage.'

What can be seen in this Low Carbon oriented neighborhood are small gardening and farming arrangements, integrating hydroponics, aquaculture systems, Phyto-depuration applications, composting systems, solar energy sourcing. In their daily activities' inhabitants explain their energy consumption concerns, indoor air pollution management and their little precautions, tricks to manage these situations in terms of resources and costs. There are a community that experienced what brings the awareness about the effects we produce with our behaviours and how the change of those can mitigate their impact in their environment [63].

During the tour, day 11th December 2019, three homes arrangements were shown, Helen's and two more neighbors, follows a selection of pictures with details of small strategies applied.

35. Helen Ni's house, her aquaponic system presented in a slide at the Green Hub 29th Sep. 2018 and pictures of details Ph. Jelena Sučić 11th Dec. 2018.

In this selection are visible the front view with the solar panels and green occupation, on the terrace green distribution with the automatised watering system, indoor explanation of the applied cheap and effective DYI air filtering systems and wet waste composting.

Next selection is from the house of another neighbor who has also installed solar panels but with integrated the drainpipe connected with the hydroponic system. This balcony has also a pond which in the beginning was muddy but by growing in Chinese phyto-depurative plants they clean it and the pond became a water storage for the water distribution system. They built different layers for planting.

36. Second home in the neighbourhood. Ph. Jelena Sučić 11th Dec. 2018

The last home is been visited is considered the one with the most beautiful garden, since most of the terrace area is used for gardening. The owner is a mother with two children which for a school project have designed their aquaponic system at home with Helen as technical support in the project. The fish tank is a channel along the wall of the house and the cultivated area.

37. A fruit tree by another neighbour. Ph Jelena Sučić 11th Dec. 2018

38. Last visited neighbour. Ph Jelena Sučić 11th Dec. 2018

The visit ended at the community center where the discussion continued, the biggest concerns emerged where the alienation effect present before Helen's initiative, for which she had to ask permission to all her neighbors in her building with whom she never talked. This permission asking become a doorway to consider the benefits of other options, try them, and having support from the community which before was talking only about compound problems eventually in an admin WeChat group. The benefits of this small action started to spread and so the consideration to extend the urban farming activity beyond the own perimeter. What emerged from following this initiative is that the administration entity of the compound is an external entity and the maintenance service of the green common space is delivered to a third external service. The main problem of this is that the green management service uses pesticides too and by not knowing the kind and not being able to stop their use, the common spaces cannot be considered safe for food farming and neither as a children playground, so the interaction opportunities get limited by major forces.

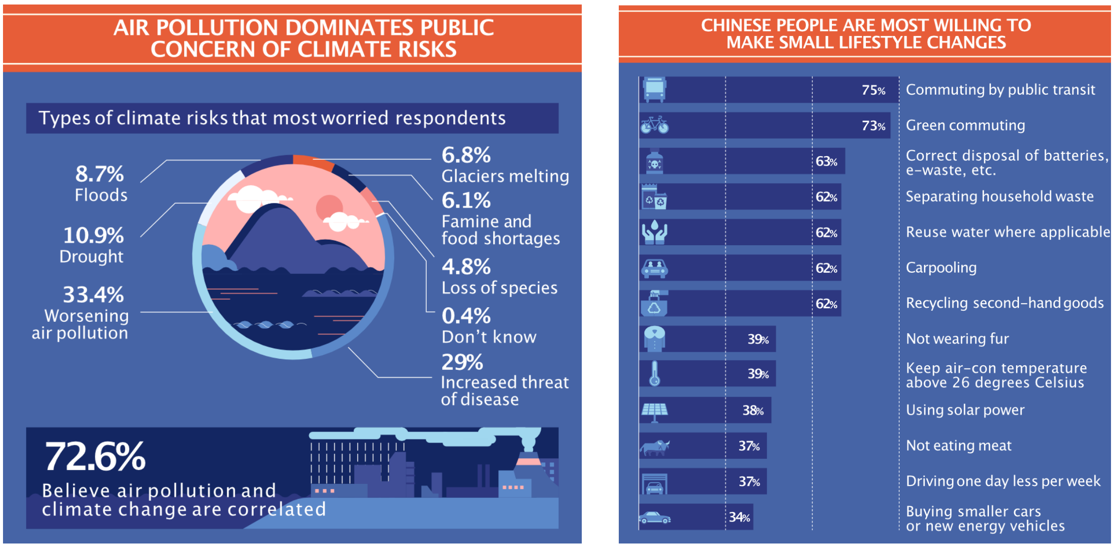
In conclusion, Huan Ni and her NGO Team are collaborating with schools and other programs to contribute in installing these behaviours and testimony with their experience that is possible to aim for sustainability on a daily basis.

39. Group photos of the visit in front of her house and last visited neighbour sent by Huan Ni after on the organised WeChat group

2.2.6 Citizens Emergence

The city urban population-culture of life systems usual flows are “threaten” by emergent environmental issues. For example, as well explaines in the article written by Li Jing for China Dialog: “Does Chinese public care about climate change?”, which is based on conducted surveys at Chinese national level by Governments, China Centre for Climate Change Communication and Innovative Green Development Program (iGDP). From the results shown in figure 40 we can have a overview of the general understanding and prioritisation under citizens attention relatively to Climate Change, but also a first response, in their opinion, about how to react and contribute in lowering these effects by applying small changes in their lifestyle in some options [1].

Climate Change might be a **filter topic** to explain the perceivable effects emergence under individual citizen's basis and their understanding relevance [1].



40. LI Jing's diagrams showing percentages of public's opinions about climate risks and responses of some activities on which citizens are willing to make small changes [64].

Protecting ourselves, our health, are emerging needs relatively to air pollution demosntrated by the appearance of air cleaners and filtering masks on the market. More natural solutions are also hunted by people, because the first ones are energy consuming and producing constant waste. Adopted natural solutions are basically good practices outdoor (commuting options) and indoor (examples of home activities in WiBreath project [35]) which can include also plants arrangements for example air cleaning aimed plants of which more can be found in 2.3.6.2 Air cleaning plants.

'Something that it has to be kept in mind is that the "naturalistic approaching" on problems from citizens has two possible roots. One is the cultural background, meant as family origins and living experience. The second is a societies trend, coming from the promotion of healthy life, healthy food which it can be dated in terms of booming on public level at EXPO 2015 in Milan with the moto 'Feeding the Planet, Energy for Life!'[1].'

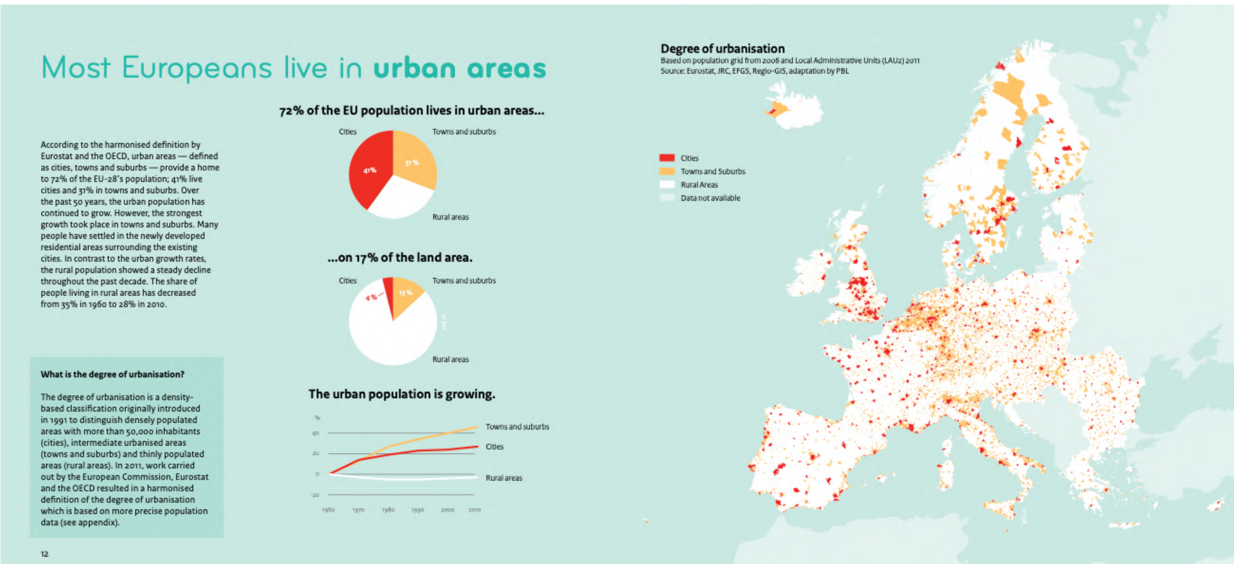
'Natural oriented living is an established basic shared culture, maintained and developed in time. Its long-term maintenance is possible because nature processes are permanently cyclic, generation after generation/from generation to generation [1].'

2.2.6.1 Population Growth

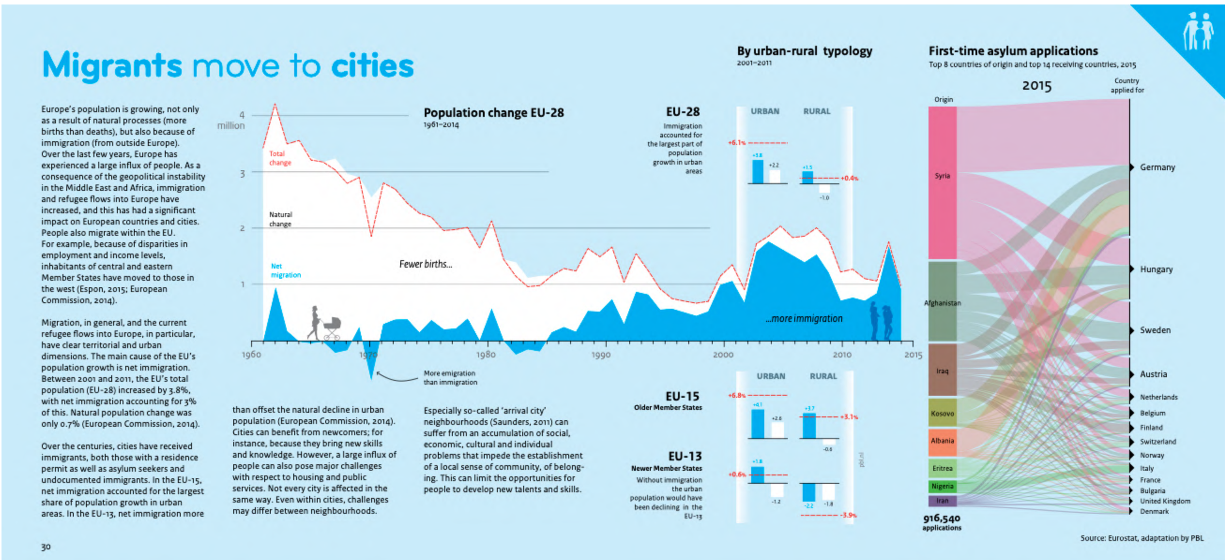
Population growth is a constant phenomena espacially in cities and urban areas. Birth and Immigration are the main feeders of this. Considering Europe and China immigration is the main source, people moving towards cities for better job opportunities, services coverture, etc… Which contribute and enhances the Use of Land changes, polluting activities and exploitation of resources. These are caused by keeping the same production paradigms. It is already been calculated that we cannot keep going in the actual ways persisting from the modern for long [1] .

As Sučić found already [1], United Nations calculated that these days 55% of the world population lives in urban areas and is predicted to raise to 68% by 2050. They also expect the count of megacities (more than 10 million inhabitants) to reach 43 cities by 2030. In Europe 72% of the population lives in urbanised areas. There are expectations of increase of this percentage, especially because of the immigration flows. These trends are visible also in China with a more intence rhythm than in Europe, caused by its developing dynamism [1].

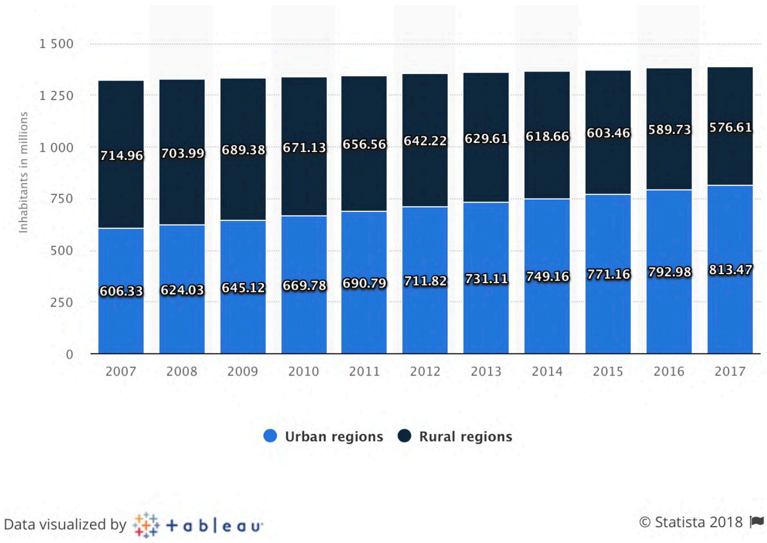
Follows the referenes of the extrapolated visual data.



41. Data visualisation showing European population density extrapolated from the document: Cities in Europe. PBL Netherlands Environmental Assessment Agency [65]



43.. Data visualisation showing European Migration compensation in population extrapolated from the document: Cities in Europe. PBL Netherlands Environmental Assessment Agency [65]



42. Trend of the Urban and rural population movements of China from 2007 to 2017 (in million inhabitants) [66]

These trends are testimoning more coming generation of people living detached from nature life and the awareness of what are basic living requirements, if they will be mantained the same nowadays production and educational paradigms priorities. Interesting is to consider the immigration towards cities has the positive effect of stimulating jobs variety in city context, enhancing diversification or fragmentation and positions creation to assigne functional roles in the city network system. A collateral effect of this movement is that distracts from what are human basic needs. Citizens are still humans and have the same fundamental needs. There is the impression that the city system provides for the citizens but its source of distribution comes actually from outside the urban boundary. If more humans are becoming citizens, leaving the land work, who will produce and how will be produced the resources for the life city systems? [1]

2.2.7 Vision of Climate Change

Climate change could be considered also a collection of influetial phenomena contributing to trying to visualise visions of what to expect as next lanscape shaping changes and future cities given by imagination. As points out Paul Dobraszczyk in the article [67] artists may help scientist visualising future challenges thanks to critical thinking about environmental issues and applied creative intelligence. What to aspect for the future is a lot about imagination for prediction stimulated by facts and constant repetition of changing phenomena recognition or a reminder from news, researches and reports as for example the report done by the Intergovernmental Panel on Climate Change (IPCC) in 2014 and all the United Nations Climate Change Conferences as the particularly significant last one COP24 Katowice 2018 (Emergences from Greta Thunberg Case).

About this visualised predictions it has to paid attention to the perspective which are mostly considered from a human point of view. The visualisations of future landscapes shaped by climate change phenomena are based on people understanding, we as people realise them because we recognise the cause of impactful effects we are producing with our human behaviours. All those visions have an anthropic perspective and so the probability of the future landscapes is based on us, but we do not know if other living systems are contributing to this impact too and if their reactions and behaviours are changing. These are variables that we may consider alterating our future visions.

44. “St Mary Woolnath – Rich Pickings”, digital image from the series Flooded London, 2008 [67]

To explain better the perspective change, considering as example the figure 44, it is a vision about a flooded London area from below the water. There are some predispositions that allow to consider this vision, the oceans raise water levels, the fact of being a city along a huge river and the constant augmenting count of alarms and actuall floodings in the world cities. From an anthropocentric perspective the continuity of this phenomena could mean, death of human spieces, evolution of human ability to live in water, cities might become “floating Venices” with residues of skyscrapers as landmarks or the human being will move to another planet. Moving perscpective to fishes or seeweeds with the happening of this predicted vision means that they are gaining more space and resources accesses to spread in the biosphere. If this happens back on a human perspective still existing on the biosphere the main resource of food might become fish and seeweeds. It is also known from scientific research that especially in a pond condition if seeweeds and algees take over to much of the space, their photosynthesis processes might unbalance the oxygen and carbon dioxide ratio in water unallowing fishes to breath as they used to, causing that of weak spieces in adaptation. This cascade of assumptions can continue as long our creativity is stimulated by recognised phenomena.

In conclusion, even for this we can have the best understanding of the possible conditions with recognisable impact effects sources projecting the future scenarios based on approximate knowledge, stimulated by assumption and built with assosiations, there is still space for unaspected influences of change.

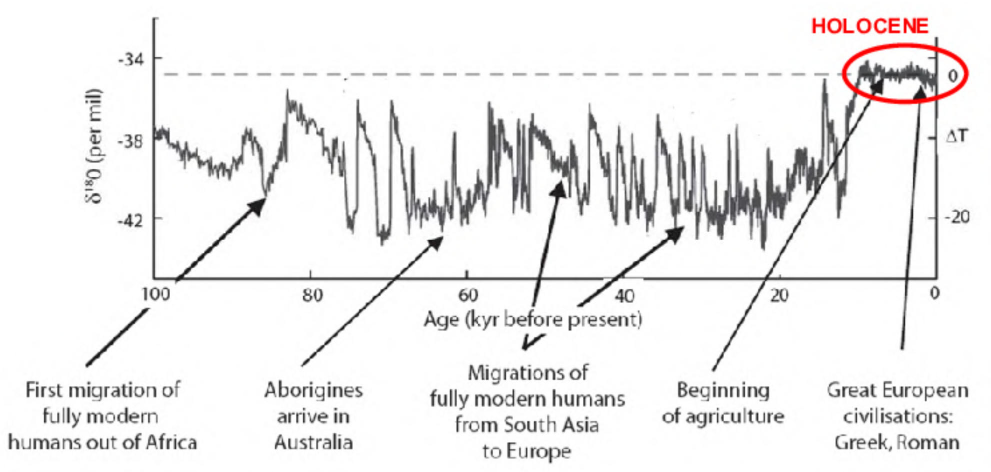
2.2.7.1 Bigger Vision by Scaling: Holocene

As already explained in the paper [1] by considering the 1.5°C alarm of the IPCC special report, which quantity is an average, its effects are perceived differently by populations according to the location and seasons comparison between consequtive years.

Several example of perceived climatic changes effects are reoprted in [1]. One resounding in extreems of visible effects was the autumn cherry blossoming in Japan which was caused by a series of typhones which have destabilise the seasonal time perception at the point to deviate even the trees hormon deciding blooming time.

45. Young Blooming Cherry Tree, Tokyo, Imperial Palace Gardens, 31st October 2018. Ph. Jelena Sučić

After pointing attention on people's climate changes effects perception, if we consider the rappresentation of Earth' glacial cycle curve changes in time, there were many drastical temperature changes till the Holocene periond marked in the following graph, which includes when agriculture started and so the fastening of our development. It is when the biosphere has established and found constant balanced conditions as noticed by Christian Berg [68] during a lecture in D&I Tongji University (6th November 2018).



46. 'The last glacial cycle of 18O (an indicator of temperature) and selected events in human history. The Holocene is the last 10,000 years. Adapted from Young and Steffen (2009) [69]'

The trend of this graph can be a year scale or a human lifes scale representation of the drastical changes perceived by a common citizen. This association can be stimulated by the fact the weather forecasts are keeping to warn of "heat waves" for sensitive people ranges.

During the entire human existing history, there is never been such long stable era as the one in which are now, the Holocene. Which seams, because of climate changes allarms, starting to be compromised by our unconsidered excesses [1].

'We are still in a lucky era, which we do not have to abuse of.

The diffusion of **small actions** and relative effects has a more powerful amortisation result than few highly concentrate ones.

Therefore, a common goal or ideal with common individual actions are needed and finding the common relations and thoughts between people/individuals contributes in building the sense of **community belonging** which is important to align people for the common goal [1].'

2.3 Nature Principles

Lack of resources outcome of the urban scale evokes to explore what does that really mean from the natural point of view. Follow introductions of relational systems from strict scientific biology point of view to the associated things from human nature experienced point of view (difficult to simpler).

2.3.1 The emergence of systems thinking starts from biology

Systems thinking emerged from biology studies in a process started from the late nineteenth century, where vitalists and biologists started to recognise that the mechanistic paradigm, that has leaded scientific methodology since the seventeenth century with the Cartesian method [70], was not enough to describe how life works. It cannot be denied, the contribution given by the mechanistic reductionism in studying organisms structures, theirs elements and element's functions as for cell biology and microbiology that allowed then to discover i.e. the gene. It should be noted that the contributions from the field of biology refer to chemical and physical layers at a biological scale. Vitalists affirmed [71] that there is an immaterial or force or entity that was missing in the laws defined by physics and chemistry in order to understand life. This missing ingredient is been defined by the work of **organicistic biologists** where the main **concept of organisation** was explored. Ross Harrison identified [72] the organisation aspects of configuration and relationship, which made coin the concept of "**pattern of organisation**" meaning "configuration of ordered relationships". Lawrence Henderson was a biochemist that initiate the usage of the word "system" to refer to living organisms and social systems and introduced so the meaning of systems as intended nowadays, 'an integrated whole whose essential properties arise from the relationship between its parts, and "systems thinking" the understanding of a phenomenon within the context of a larger whole [73]'. In fact, the Greek rooted meaning of the word "**system**" is *syn* + *histanai* = "to place together". Which corresponds to understand things by putting them into a context to establish the nature of their relationships. Who allowed in the end to peace vitalist and mechanist was the biologist Joseph Woodger, he declared that 'organisms could be described completely in terms of their chemical elements, "plus **organising relationships**" [74]. This process allowed to define the contemporary concepts of "**self-organisation**" and "**patterns**" for describing and understanding life, which in total express whole's "**complexity**" and it's "**emergent properties**" defined also as "**systemic properties**".

Is not by chance, that the basis for defining general systems theories were given by biologists. Two decades before Ludwig von Bertalanffy, who is considered the initiating father of conceptualising the **general systems theory** and the **opens systems** emerged by studying living organisms. It is interesting to note that there was already a Russian biologist Alexander Bogdanov that defined a general systems theory under the name of Tektology (tekton=builder) meaning the science of structures and aiming to be the "universal science of organisation" [75]. In Bertalanffy's work, there were already underlined problems in definitions as communication and control in animals and machines. Four decades after, this new science got the name "**cybernetics**", coined by Norbert Wiener's interdisciplinary group including the firstly formed as biologist Gregory Bateson [76]. Cybernetics derives from *kybernetes* = "steersman", behind there is the association with the **self-regulating** action of the wheel maneuver mechanism and responds with **feedbacks**: in effects. What is interesting to notice is that this new discipline was not investigated by biologist nor ecologist but by mathematicians, neuroscientist, social scientists, engineers and on a certain point even designers, with the introduction of cybernetics in Ulm School of Design's curricula by Tomas Maldonado [77]. Thanks to all these multidisciplinary investigations, systems dynamics started to be recognised emerging in every discipline, even in physics and humanities thanks to the terminology base given by the Gestalt psychology. By evolving through all these diverse fields and their integrations, cybernetics got the capacity to generalise and been defined the **science of the complex systems** or **feedback science**. The evolution happened by recognising that **communication and control** that in the beginning were considered common only to animals and machines, actually have been found also in other organisms and these two could be putted under the general idea of **organisation patterns**. Organisation patterns that have self-organising abilities, applying control and responding with feedbacks that have a notion of message. These are concept tools and terminologies that help describing the **behaviour** of **communities** and **networks**. The recognition process of these two started by following the food matter flow or "feeding relationships", which, nowadays, are defined as "food chains" or "food web". The two terms **community** and **network** have the same behavioural organisation patterns but referring to different contexts. Communities, refers to the relations between a group of individuals, and networks refer to the integrated connections of functional elements. These are embedded in the considered **(eco)system** [78].

To conclude this intrinsic background the core understanding to keep in mind is that: a **system** per definition is a group of interconnected functional elements with a common purpose which are individually subsystems of the first considered one [79] [80] [81]. Which tend to create or reproduce multileveled structures and layers inside and outside the first considered system. This movement shows the key characteristic being the hierarchal nature of systems which is firstly typically recognised in living organisms and then in every imaginable context.

2.3.1.1 “Skeleton of Science” basis for Scale of Layer Relevance.

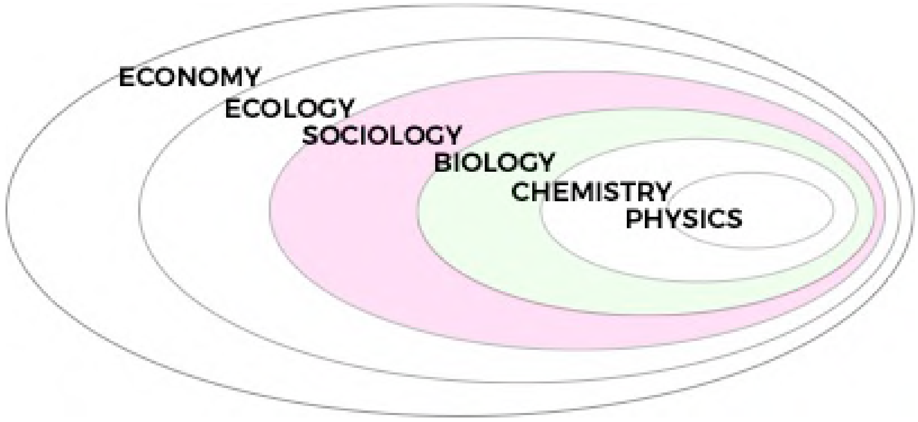
In order to clarify the hierarchical priority of systems and layer relevace for their dimensional properties, K. Boulding tried by considering empirical approaches to give an organisation through general systems theory. By identifing general models and hierarchies from individual behaviours to groupings [82].

If we take the general terminology used in our society to refer to contextual situations sometimes mights seam that the difference between scales, layers and levels introduced in the methodology with the contextual parameters (1.2.2.2) may are unclear. If we start from a biological context, the individual lives studies, which if we want to understand why and how do they work from the individual body you find all the parts and some have mechanical processes and some have chemical processes. Therefore, on the biological scale, dimension of an individual body, layers that might be considered are, for example, physiological and chemical. As matter of fact there is the field of bio-chemistry which moves from studiend life process on a chemical scale and looks for the effects of their alterations at the body scale. If we move in the detail of cells and molecules we start to want to find the source of their effects from the atoms relations and behaviours to end to deal into physics scale that is all about energy transmision and forces applications. Let us turn back at the individual life body, when we start to consider two bodies or a group of individuals, these by interacting produce social behaviours. These interactions happen in a spatial environment, which can be defined by physical boudaries or usage occupation space which are defined in ecological layer. According to the social groups occupations the ecosystems get defined and because often occupy the same space boundaries we have subecosystems in the main considered ecosystem. “Biosphere” is a term attributed firstly by the Austrian geologist Eduard Suess (1831-1914) to describe the entire space Earth with its entire coverture layer of life [83]. There is another layer, that the author wants to stress the meaning perspective considered in this thesis relatively to the term “economy” which etymology from the two Ancient Greek words: οἶκος (*oîkos*, “house”) and νέμω (*némō*, “distribute, allocate”) [84] points on a spatial boundary where happens a distribution to provide for the needs of the defining existence in the considered space.

The economical layer refers to the resources movements of matter and energy that sustain life in the ecosystems.

Summary of definitions: *physics* life forces; *chemistry* life matter; *biology* individual life; *sociology* groups lives; *ecology* biosphere life; *economy* biosphere resources.

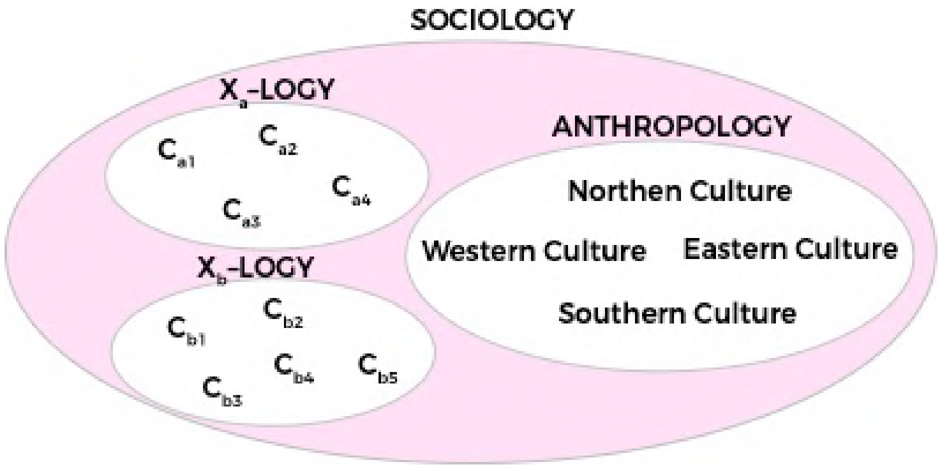
Follows a graphical description of the layers scale of pertinence figure 47 .



47. Scale of Layer Pertinence defined and graphically described by Jelena Sučić

Another layer often mentioned in our society is the anthropological, which needs to be clearly positioned as a sublayer of the sociatal layer. The word part “anthrop” derives from the Ancient Greek ἄνθρωπος (*ánthrōpos*) which means “man, mankind, human, humanity” [85].

Anthropology refers to the human social activities and relations and their differentiations in cultural contexts. The scaling order shown in figure 48 positions the anthropological layer as a sublayer of the sociological, for instance any creature kind its own “X-logy” that humans haven’t defined yet with a name and each of them has a variety in cultural sublayers. For example, in anthropology we might consider four main cultures defined by their position orientation that gives them some properties and characteristic but then scaling down the scope we might encounter differences as by national boundaries, bioregions, language usage, historical backgrounds which become sublayers of the wider scope.



48. Anthropological position in the Scale of Layer Pertinence defined and graphically described by Jelena Sučić

To conclude, resources move between ecosystems lived by social communities of different bio-origins differentiated by chemical properties activated by physical forces.

2.3.2 Introduction of pertinence through Permaculture

As already announced in the introduction paper for this thesis, the language/discipline under the Permaculture name which started as a methodology, today is a human tool that helps us remind how reintegrate nature in our anthropic perspective of life [1].

As in the 1970s, this term was coined by Bill Mollison and his student David Holmgren, it is started the definition and documentation of natural multifunctional relationships in relation with human settlements, of plants, animals, insects, soil, water, infrastructure and so on. Before this moment and after, other analogue experiences collections were experimented by people and documented under names as Natural Farming, Biodynamics, Organic Gardening, Bio-intensive and many others introduces in the PDC course (2.3.2.1), that share mainly the same principles usages but at different scale and layer focuses [1].

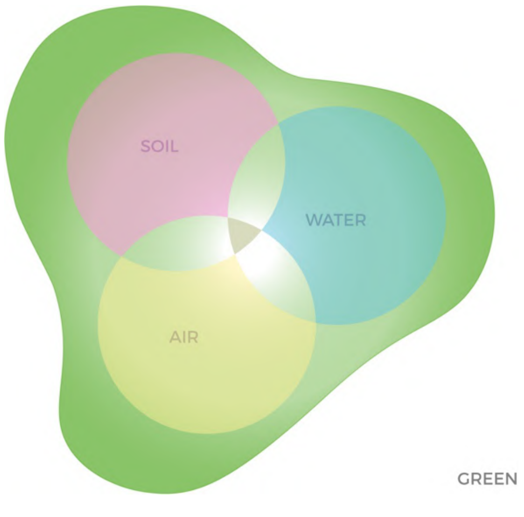
‘**Permaculture**’ has two embeded meanings. The first one, refers to ‘**permanent agriculture**’ because it deals with the management of primary human needs resources production and mantainance. The second embeded one is ‘**permanent culture**’ which has a human perspective and behavioral effects corelation, refers to accumulated culture through time about how to cognitively coexist with nature thanks to appropriate human choices and applied approaches towards this aim. These have to contribute feeding and responding to the knowledge building and future needs with its sustainment challenges.[1]

Permaculture meaningful role in this thesis process is the understanding that '**Permaculture is integration design of human needs with natural processes** and because of its **biological and ecological base permitting the widely comprehension of the sustainability concept** [1].'

By consider that sustainability is mainly intended as a "fight against waste", to manage this issue a reminder of possibilities is needed, in fact aiming **Zero Waste** in biological is possible because of the life cycle process. The contintinuity criteria of this cycles helps in understanding the meaning of **pollution**. As found by Sučić [1] and defined by Mollison 'Pollution is a product not used by something else; it is an over-abundance of a resource [86]' basically is a resource not absorbed by the (eco)system [1].

From *documented experience* can be defined *measurable parameters* to help recognise behaviours in future experiences. The documentation process defines the language to us about nature behavioural experiences, share and compare them with the existing knowlede.

Focusing on plants behaviours allow to assure bases, since are **primary producers** providing (food, oxygen, materials, shelter, …) and working in strict relationship with the three natural/matter flow systems and with living organisms from all Nature Kingdoms [1].

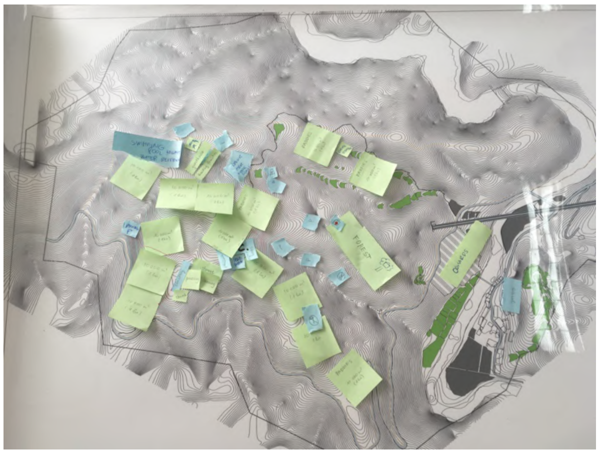


49. Green meaning the Plants Community or Vegetation starts from and contributes to the three natural sources systems Soil, Water and Air. Graphic and Design: Jelena Sučić

2.3.2.1 Permaculture Design Certificate course 2018

Permaculture Design and the Systemic Approachhave the same attitude in resolution because both are based on observation of Nature's work which builds relationships and cyclic flows of resources. After the little awareness gained during the Open Systems project (2.1.2) of Permaculture capacity, which made face the author the need of understanding natural processes and find the occasion to take part to a 12 days Permaculture Training period based in Shanghai with Wayne Weiseman [87] [88].

The period had mainly three kind of phases, lectures providing tools in Shanghai and in two other locations where we had field practice and observation. First practice area in Dingjiaping, a village destroyed by the construction ho the highspeed train in Hunan mountains, the intent of the village was to desing a new village as a eco-village for the inhabitants, this situation became our study case where we trained analysis of elements, mapping, sector planning, data collection trough experiences and observations on the site. The second location was on an organic farm in Diashian Lake where we trained on a homestead scale with a higher focus in polyculture relations design.



50. Pictures of the PDC course period.

This course and Wayne's pedagogy attitude allowed the author to enter in a language dynamic to describe experiences, document them and making them accessible in terms of understanding to common citizens, and use comprehended principles as design bases where to develop creativity in resolutions. The skills, observation training, knowledge acquired, case experiences learned and cultivated after this training period are many and cannot be explained all in the literature or test cases, but a relevant selection follows in the next subchapters from the key permaculture methods and resources in design applications.

	6/28/2018	6/29/2018	6/30/2018	7/1/2018	7/2/2018	7/3/2018	7/4/2018	7/5/2018	7/6/2018	7/7/2018	7/8/2018	7/9/2018	7/10/2018	7/11/2018
hour	Thursday	Friday	Saturday	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Monday	Tuesday	Wednesday
Session Title / Theme	**Arrival Day**	**Intro to Permaculture**	**Leave SH**	**Eco-Village D1**	**Eco-Village D2**	**Eco-Village D3**	**Return to SH**	**Zones, Patterns, Climate**	**The Built Environment**	**Plants & Trees**	**Soils Biodynamics**	**Gardening Technique**	**Useful Structures & Water Systems**	**Departure Day**
Morning Location		Inner Shanghai	Shanghai	Dingjiaping	Dingjiaping	Dingjiaping	Dingjiaping	Inner Shanghai	Inner Shanghai	Dianshan Lake	Dianshan Lake	Dianshan Lake	Dianshan Lake	
6:00				Morning Walks	Morning Walks	Morning Walks				Observation Exercise				
7:00		Breakfast	Breakfast	Breakfast	Breakfast	Breakfast	Breakfast	Breakfast	Breakfast	Breakfast	Breakfast	Breakfast	Breakfast	W to Airport
8:00			Train Leaves	Class Time	Class Time	Class Time			Invisible Structures	International Permaculture & Your Permaculture Practice		Healthy use of animals in permaculture systems	Alternative Energy and Greenhouse Designs	
9:00		Permaculture Ethics and Principles		Walk Time	Walk Time	Walk Time	Depart to HH	The Zone System	The Built Environment	Plants and Trees, Agroforestry	Soils			Wayne Departs
10:00				Outdoor Lecture	Outdoor Lecture	Outdoor Lecture				Food Forests Lawton Film, Polycultures, Succession	Soil Organic Matter	Gardening & Farming Systems		
11:00				Walk Time	Walk Time	Walk Time	Arrive HH	Climate			Biodynamic Agriculture in Context			
12:00		Lunch	Lunch	Lunch	Lunch	Lunch	Lunch	Lunch	Lunch	Lunch			Lunch	
13:00		Concepts, Themes, & Methods of Design		Walk Time	Walk Time	Lecture	Train Leaves HH	Climate / Microclimate	The Built Environment	Polycultures, Succession, Plant Guilds	Lunch	Lunch	Rainwater collection (from recycled materials)	
14:00				Outdoor Lecture	Outdoor Lecture	Lecture	Travel				Biodynamic World View	Sheet mulching beds, Seed Saving, Propogation, Grafting		
15:00	Wayne Arrives		Arrive in Huaihua	Observations	Observations	Design	Travel			Plant Walk (w/Ms Kang)			Wastewater	
16:00			Arrive in DJP	Observations	Design	Design	Travel	Plants & Trees and their Energy Transactions			Biodynamic Practice			
17:00			Introductions	Walk Time	Walk Time	Lecture	Travel							
18:00	Dinner	Dinner	Site Orientations	Dinner	Dinner	Dinner	Dinner	Dinner	Dinner	Plant Guild Exercise		Dinner	Dinner	
19:00	Welcome & Introduction	Rest	Dinner	Movies	Design Facilitation	Design Facilitation	Travel	Polyfaces	Strategies of an Alternative Nation		Dinner		Closing	
20:00	Orientation by Philip		Rest	Discusssions	Design Facilitation	Movies	Arrive SH	GI Film Screening		Dinner				
21:00				Rest	Rest	Rest	Rest	Rest		Movie	Rest			
22:00									Rest	Rest				
Evening Location	Inner Shanghai	Inner Shanghai	Dingjiaping	Dingjiaping	Dingjiaping	Dingjiaping	Inner Shanghai	Inner Shanghai	Dianshan Lake	Dianshan Lake	Dianshan Lake	Dianshan Lake	Inner Shanghai	

Course Fee free? (dinner?)

Notes:
- Last train from Dianshan Lake to Shanghai is at 10PM, Last train from Xujingdong to Shanghai is at 10:45PM
- For those staying on the farms (not returning to respective homes in the evening) there may be additional activities, movies, conversations planned for deeper learning
- In consideration of those returning to Shanghai in the evening, most of the technical content is focused between 9 and 6 PM where possible, with more general permaculture content being taught earlier mornings and evenings, movies are also shown at these times when possible as they can be viewed at your convenience.
- We will coordinate cars, buses, train schedules, lodging accomodations etc. to make sure everyone's needs are addressed in an economical way (ride shares / room shares)
- Lodging accomodations are available onsite for Chinese citizens, nearby for Chinese and Foreign citizens at B&Bs for roughly RMB 70~400 per night depending on your preference for room style, room sharing and bed/floor options.
- Course fees include lunch. Do not include travel or lodging

Subjects to be covered during Hunan Trip - more details will be announced (homework can be assigned for those unable to attend, but wanting to learn)

Measuring Tools - A-Frame & Transit	Water	Water and Earth Works
Mapping Contours in the field	Keyline Design	Clay Model of Earth Works
Observation and Pattern Understanding	Sepp Holzer Movies	Built environment and practices relating to temperate climates
Observation Exercise	Greening the Desert and Swales (Lawton)	Aquaculture & Aquaponics

Course Fees	RMB	Course Fees	RMB		
1 day	1100	5 days	3500	*Hunan Trip will count as 4 days and fees include local transport, lodging, and food, further travel expenses are just under RMB700 each way.	
2 day	2000	6 days	3600	9 days	4050
3 day	2850	7 days	3850	10 days	4500
4 day	3200	8 days	4000	more than 10 days add 400 for each additional day	

51. Permaculture Itinerary Training period and contents table 28th June till 10th July 2018

'**Wayne Weiseman** is certified by the Permaculture Institute of Australia and the Worldwide Permaculture Network as an instructor of the Permaculture Design Certificate course. He is the director of Kinstone Academy of Applied Permaculture (KAAP) in Fountain City, Wisconsin, the Permaculture Project LLC, and the Permaculture Design-Build Collaborative LLC, full service, international consulting and educational businesses promoting the ideas of eco-agriculture, renewable energy resources, and eco-construction methods. For many years he has managed a land-based, self reliant community project combining organic crop/food production, ecologically built shelters, renewable energy, and appropriate technologies [87].'

His recently involved in projects in China to build a Farmer School and an Eco-Village in Dingjiaping Village in Hunan with Rainbow of Hope Project organisation [89], and during his visits are organized also Permaculture Training Courses for the PDC.

All the materials, slides, pictures, videos, book references, etc. were given in the end of the course and are going to be used, with extra integrations, in the following subchapters to introduce a selection of the considered potentials.

52. Wayne Weiseman's slide defining Permaculture in the introduction lecture.

2.3.2 Permaculture Ethics

Mollison defines Permaculture an ethical system valuing positivism and cooperation [86]. Three ethics are defined which can be summarised in a single one as follows:

1) “Care of Earth”: includes all living and non-living things, plants, animals, land, water, air.
2) “Care of People”: promote self-reliance and community responsibility and access to resources necessary for existance.
3) “Give Away Surplus”: pass on anything surplus to our needs (labor, money, information) for the above aims.

About the third Mollison’s ethic, Weiseman adapts the perspective in “Return of Surplus Contribute Time, Money & Energy To Achieve Ethics 1&2” which includes setting limits to population and consumption. Since the third point is based on the System yield which refers to the total sum of surplus energy produces by the design of storage, conservation, reusage or conversion activities. There is energy in surplus once the systems itself has availability for all its needs fo growth, reproduction and maintanace. The reason why is important to distribute surplus is because if unused results pollution which requires more work to invest for the management of it [90].

The general ethic that collects the aboved mentioned ones that can be called “Life Ethic”, as Mollison explaines, ‘all living organism are not only means but ends. In addition to their instrumental value to humans and other living organisms, they have an **intrinsic** worth [90].”

By projecting in longterm as Wayne points out, is that any ethical decision implies taking responsibility for oue own existence (human existence) which means also of our children. What does stay at the base to maintain future survival and life systems existence is in **cooperation** and **not competition** [90].

In conclusion, if we take “Care of Earth”, which provides for life and human basic needs, we “Care for Us”.

2.3.3 Permaculture Principles

Permaculture principles have been defined in several ways in the last 30 years by extrapolating from recognitions done by the different currents and influenced by the knowledge building from experiences.

What enconters is a bit a mix layers and levels in declaring this principles and the main two layers involved are about the required **human attidudes** and the **conditions** to set for a phenomenon to happen. This differentiation is already been introduced by Toby Hemenay with his selection of principles listed in figure 53 that he splits in the two groups:

A) Core Principles for Ecological Design;

B) Principles Based on Attitudes. [92]

A. Core Principles for Ecological Design

1. Observe. Use protracted and thoughtful observation rather than prolonged and thoughtless action. Observe the site and its elements in all seasons. Design for specific sites, clients, and cultures.
2. Connect. Use relative location, that is, place the elements of your design in ways that create useful relationships and time-saving connections among all parts. The number of connections among elements creates a healthy, diverse ecosystem, not the number of elements.
3. Catch and store energy and materials. Identify, collect, and hold useful flows. Every cycle is an opportunity for yield, every gradient (in slope, charge, temperature, and the like) can produce energy. Reinvesting resources builds capacity to capture yet more resources.
4. Each element performs multiple functions. Choose and place each element in a design to perform as many functions as possible. Beneficial connections between diverse components create a stable whole. Stack elements in both space and time.
5. Each function is supported by multiple elements. Use multiple methods to achieve important functions and to create synergies. Redundancy protects when one or more elements fail.
6. Make the least change for the greatest effect. Understand the system you are working with well enough to find its "leverage points" and intervene there, where the least work accomplishes the most change.
7. Use small-scale, intensive systems. Start at your doorstep with the smallest systems that will do the job and build on your successes. Grow by "chunking"—that is, developing a small system or arrangement that works well—and repeat it, with variations.
8. Optimize edge. The edge—the intersection of two environments—is the most diverse place in a system and is where energy and materials accumulate or are translated. Increase or decrease edge as appropriate.
9. Collaborate with succession. Living systems usually advance from immaturity to maturity, and if we accept this trend and align our designs with it instead of fighting it, we save work and energy. Mature ecosystems are more diverse and productive than young ones.
10. Use biological and renewable resources. Renewable resources (usually living beings and their products) reproduce and build up over time, store energy, assist yield, and interact with other elements. Favor these over nonrenewable resources.

B. Principles Based on Attitudes

11. Turn problems into solutions. Constraints can inspire creative design, and most problems usually carry not just the seeds of their own solution within them but also the inspiration for simultaneously solving other problems. "We are confronted by insurmountable opportunities."—Attributed to Pogo (Walt Kelly).
12. Get a yield. Design for both immediate and long-term returns from your efforts: "You can't work on an empty stomach." Set up positive feedback loops to build the system and repay your investment.
13. The biggest limit to abundance is creativity. The designer's imagination and skill usually limit productivity and diversity before any physical limits are reached.
14. Mistakes are tools for learning. Evaluate your trials. Making mistakes is a sign you're trying to do things better. There is usually little penalty for mistakes if you learn from them.

53. Toby Hemenway Principles subdivision [92]

The developed Mollisian permaculture design principles definition are intended to be universally applicable, while practices may vary from place to place. Mollison's definition of principles differs from law and rules [91].

> *'Let us look at the sets of principles that govern these systems.*
> *These principles, rules and directives are based on the*
> *study of natural systems. A principle is a basic truth, a rule of conduct,*
> *a way to proceed. A law is a statement of fact backed up by a*
> *set of hypotheses which have proved to be correct or tenable. Now I*
> *have evolved a set of directives which say: "Here is a good way to*
> *proceed." It doesn't have anything to do with laws or rules, just*
> *principles'*
>
> Bill Mollison, 1981

What is characteric of principles is that produce relative behaviours and the manifestastion of this behaviours manifests through a spectrum of thousants possible technics put in practice which limit in applications is given by our **imagination capacity**.

To clarify the two possible meanings intended of principles, follows a categorisation from the author of Holmgren's and Weiseman's lists in two groups between **Ecological Properties** and **Human Phylosophy** from a perspective of being integral part of the whole nature world. Principles of ecological conditions become design tools for a permaculture system thanks the aware human position in the biosphere.

2.3.3.1 David Holmgreen's Permaculture Principles

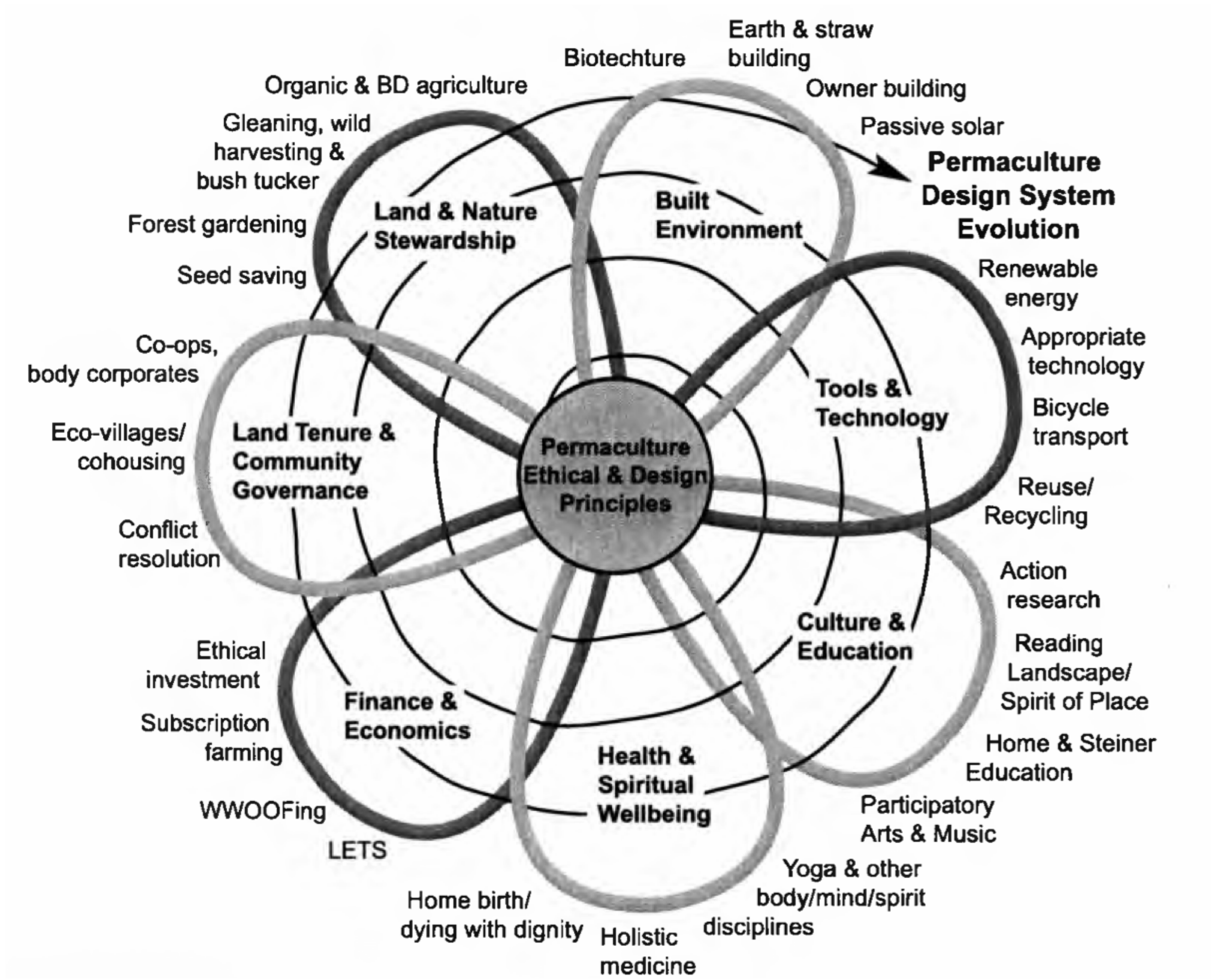
David Holmgreen the co-founder of the Permaculture discipline hut after the first definition done with Bill Mollison through the book Permaculture One, moves to contribute in defining more the second meaning of the term, "permanent-culture", which is mainly focused on the human perspective and attitude towards needs.

As can be perceived from the 12 Holmgren's Principles are all expressed in terms of human actions and attitudes using some ecological propertiers but the actuator is still the human one.

From the first definition of permaculture as permanent agriculture which was describing as citated already in his book 'integrated, evolving system of perennial or self-perpetuating plant and animal species useful to man' [93]. The second meaning exist because by using the first appliances produce effects in the human behaviours and culture of life according to the contexts and needs. In the further individual work, Holmgren maps in his permaculture flower figure 55 an entire specturm of emerging examples and activities contributing in cultivating a permanent culture.

54. Holmgren's permaculture principles [94]

The Permaculture flower designed by Holmgren wisdoms the human centred perspective in terms of provision in todays societal requirements/demands.



55. Permaculture Flower [95]

2.3.3.2 Wayne Weiseman's Permaculture Principles

Wayne Weiseman has an accumulated experience with plants polycultures and utilities since his young age of 11 years initiated thanks to the transfer of knowledge and interest of his grandmother at the time. This early start gave him the chance to accumulate a lot of experience, build a knowledge through observation and trying different disciplines that he would relate to the natural world. His process has touched Bill Mollison, Dave Jacke, Toby Hemenwey and the Fathers of initial definitions that allowed the permaculture concept to appear which are Masanobu Fukuoka and Rudolf Steiner who's work is been defined under the name of Biodynamics by his students afterwards.

Wayne's list of principles [90] that he teaches in his courses does not classify the two layers has Hemenways does, because his attitude in the pedagogy does not separate human from nature and the reason why is that if humans apply the "phylosophical" priciples means **that they are aware** of their integrated position and influent action in the biosphere.

Follows the list of principle with the description of their meanings, the author is going to differenciate them between the defined before **Ecological Properties** and **Human Phylosophy**.

What the reader might encounter is that those principles classified as ecological properties have attached an explanaition that refers to the human use of the ecological property applied at a human layer.

Relative Location: Components placed in a system are viewed relatively, not in isolation.
Everything is connected to everything else: Recognize functional relationships between elements.
Every function is supported by many elements (redundancy): Good design ensures that all important functions can
withstand the failure of one or more element.
Every element is supported by many functions: Each element we include is a system, chosen and placed so that it
performs as many functions as possible.
Local Focus: "Think globally-act locally". Grown your own food, cooperate with neighbors. Community efficiency,
not self-sufficiency.
Diversity: As a general rule, as sustainable systems mature they become increasingly diverse in both space and time.
What is important is the complexity of the functional relationships that exist between elements, not the number of
elements.
Biological Resources: We know living things reproduce and build up their availability over time, assisted by their interaction with other compatible elements. Use and reserve biological intelligence.
One calorie in/one calorie out: Do not consume or export more biomass than carbon fixed by the solar budget.
Stocking: Finding the balance of various elements to keep one from overpowering another over time. How much of an element needs to be produced in order to fulfill the needs of the whole system?
Stacking: Multi-level functions for single element. Multi-level garden design, i.e., trellising, forest garden, vines, groundcovers, etc.
Succession: Recognize that certain elements prepare the way for the system to support other elements in the future, i.e., succession planting.
Use onsite resources: Determine what resources are available and entering the system on their own. Maximize their use.
Edge effect: Ecotones are the most diverse and fertile area in a system. Two ecosystems come together to form a third
which has more diversity than either of the other two, i.e., edges of ponds, forests, meadows, currents, etc.
Energy recycling: Yields form system designed to supply onsite needs and/or needs of local region.

Small scale: Intensive systems start small and create a system that is manageable and produces a high yield.
Make least change for greatest effect: The less change that is generated, the less embedded energy is used to
endow the system.
Planting strategy:1st-natives, 2nd-proven exotics, 3rd-unproven exotics- carefully on small scale with lots of observation.
Work within nature: Aiding the natural cycles results in higher yield and less work. A little support goes a long way.
Appropriate technology: The same principles apply to cooking, lighting, transportation, heating, sewage treatment, water and other utilities.
Law of return: Whatever we take, we must return. Every object must responsibly provide for its replacement.
Stress and harmony: Stress here may be defined as either prevention of natural function, or of forced function. Harmony may be defined as the integration of chosen and natural functions, and the easy supply of essential needs.
The problesm is the solution: We are the problem, we are the solution. Turn constraints into resources.
Mistakes are tools for learning
The yield of a system is theoretically unlimited: The only limit on the number of uses of a resource possible is the limit of information and imagination of the designer.
Dispersal of yield over time: Principle of seven generations. We can use energy to construct these systems providing that in their lifetime they store or conserve more energy that we use to construct them or to maintain them.
A policy of responsibility (to relinquis power): The role of successful design is to create a self-managed system.
Principles of disorder: Order and harmony produce energy for other uses. Disorder consumes energy to no useful end. Tidiness is maintained disorder.
Chaos has form but is not predictable. The amplification of small fluctuations.
Entropy: In complex systems disorder is an increasing result. Entropy and life-force is a stable pair that maintains the universe to infinity.
Metastability: For a complex system to remain stable there must be small pockets of disorder.
Entelechy: Principle of genetic intelligence, i.e., the rose has thorns to protect itself.
Observation: Protracted and thoughtful observation rather than protracted and thoughtless labor.
We are surrounded by insurmountable opportunities.
Wait one year.
Hold water and fertility as high (in elevation) on the landscape as possible.

2.3.4 Scale of Permanence for Permaculture Design

The scale of permanence refers to the hierarchical prioritarisation in permaculture design practices, which applications can differ in spatial scale and time scale. The prioritarisation has evolved in definitions and elements from the first definition done by Yeomans [96], the widely spread done by Mollison and Holmgren in their book Permaculture One [97], the most considered one nowadays of Dave Jacke [98] and the extended of Wayne Weiseman emerged from the village case study during the 2.3.2.1 Permaculture Design Certificate course 2018 which has the condition of not being only one home scale site but a group of homes of a community.

	Yeomans' Scale	Permaculture One's Scale	Jacke's Scale	Wayne's Scale & Last Update
1	Climate	Climate	Climate	Climate
2	Landform	Landform	Landform	Landform
3	Water Supply	Water Supply	Water (*in general*)	Water (in general)
4	Farm Roads	Farm Roads	*Access & Circulation*	Access & Circulation
5	Trees	*Plant systems*	*Vegetation & Wildlife*	Vegetation & Wildlife
6	Permanent Buildings	*Microclimate*	Microclimate	Microclimate
7	Subdivisional Fences	Permanent Buildings	Buildings *& Infrastucture*	Buildings & Infrastucture
8	Soil	Subdivisional Fences	*Zones of Use*	Zones of Use
9		Soil	Soil (*Fertility & Management)*	Soil (Fertility & Management)
10			*Aesthetics*	Aesthetics, *Culture*
11				*Culture, Economy, Social, Political*
12				*Education*
13				*Health Care*
	Legenda:	Persistence	*Addition change*	*Emerged by scaling up*

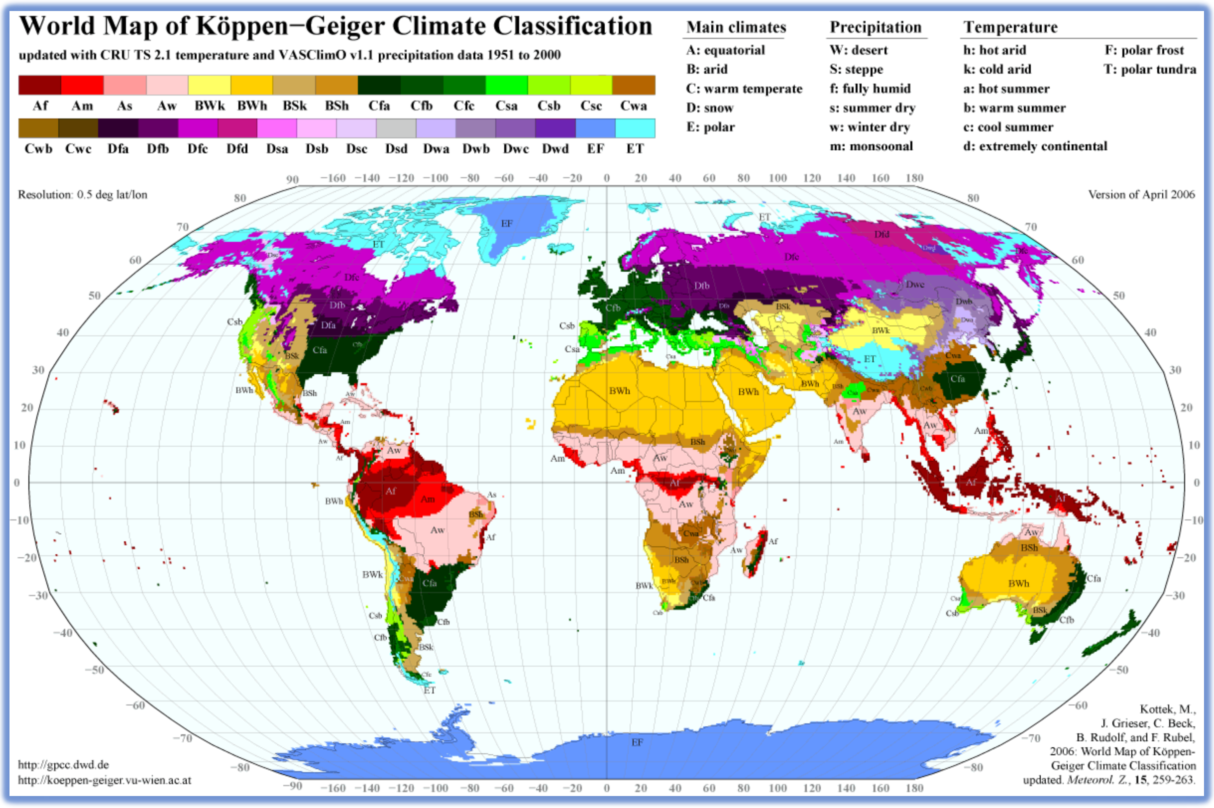
56. Table of scales comparisons extension of [98]

These evolutions in time and scale of relevance has made emerge other layers relatively more people are in relation with eachother more human layers relevance ask for attention, but on the base are found the base systems that allow and shape life to happen.

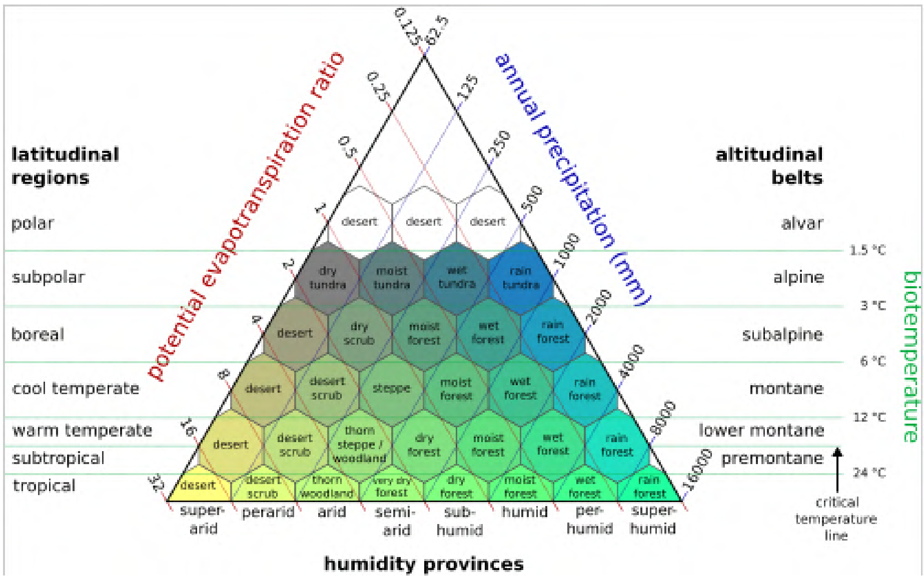
Follows exploded explanations of ecological properies and technics appliable to emulate the relative required principles, following the todays most common scale of permanence which is Jacke's Scale as categories.

2.3.4.1 Climate

Climate and weather conditions are influenced by the context in terms of position, forms, occupation, matter/materials. There are different distribution and definition of climates and weather changes predispositions as shown in figure 58 and classified per types in figure 59

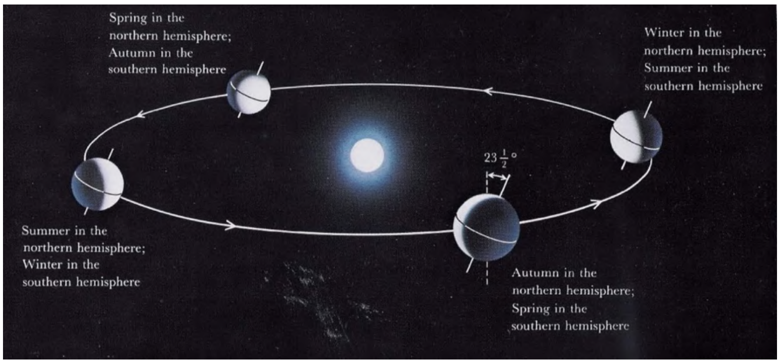


58. Köppen-Geiger World Map Climate Classification

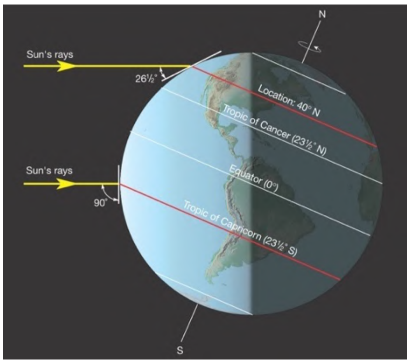


57. Characteristics defining the different climates

For the design is important to consider weather patterns, if snow is a possibility and average rainfalls in the site area. The position which relates to the sun direction source which establish also the seasonal cycles as explained in figure 59-60 and where does hit and what kind of surface.



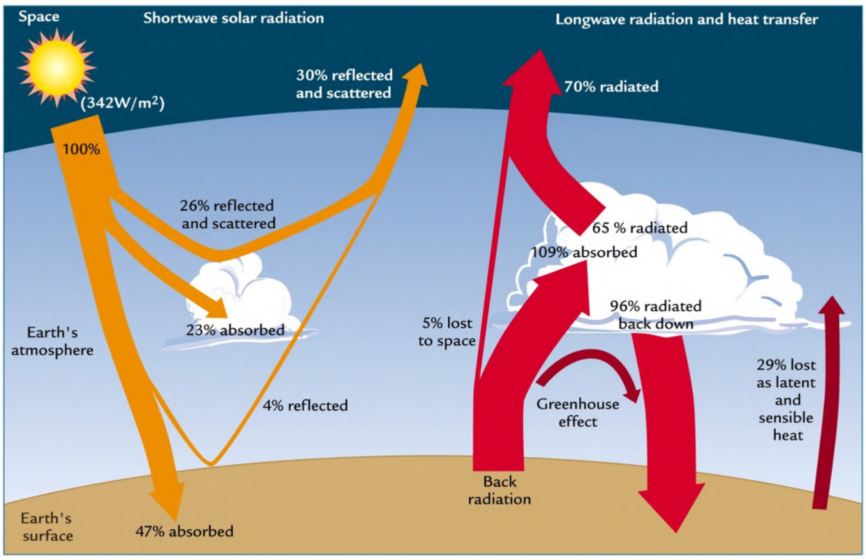
60. 'Cause of the Earth's Seasons [99]'
Earth globe orientation in relation with sunlight source-oriented position



59. Sunlight ray inclination influence [99]

In the wide scale of the atmospheric behaviours the first kind of hitting matter and surfaces are clouds and earth which have matter properties that influence the absorption and refraction of solar radiations. As explained in figure 61 the sun produces two kinds of radiations differentiated in shortwaves and longwaves, which reflect and get absorbed differently from the materials occupations that encounter and the effects produces change in time exposure under the two waves.

Solar radiation is the primary source of energy that allows movements on earth to happen.



61. Solar radiation kinds and behaviours [100]

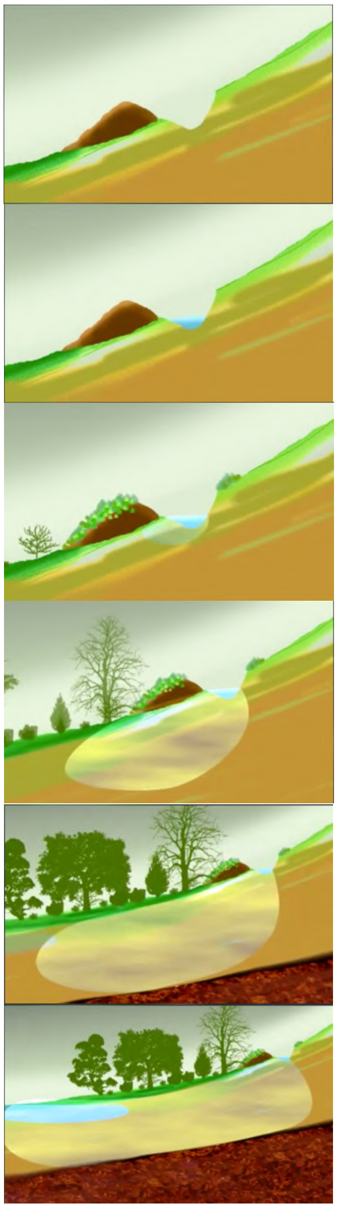
2.3.4.2 Landform

The forms of land are what give direction and rhythm to water movements as will be shown in the Water cycle figure 64 water follows the landscape forms. Typical practices adopted by permaculturists are creation of holes becoming ponds or pools, channels with the characteristic of the slopes/swales and terraces with the aim of slowing down water and direct it to storage areas and/or let it infiltrate deeply in the ground.

2.3.4.2.1 Slope & Swales

By having or creating slopes, it allows to use the gravity force as an advantage and energy saving strategy to direct the water movement. By shaping the landscape water can be directed where is needed and in the required rhythm for the aimed distribution of it. The swale structure is composed by a ditch on a slope and in the lower side in front of the ditch there is a soft contour corresponding as the positive mould of the ditch hole. Because of the gravity force allowed by the slope pendency the water that flows through the landscape remains blocked in the ditch and acquires time to penetrate in the ground to continue the descent along the landscape. By penetrating the soil structure behaves like a sponge and contributes the water distribution in the landscape underground till it does not encounter an impenetrable layer which would contribute to direct the water till the end of the slope action and emerge back over the surfaces because the water absorption capacity of the ground is fulfilled. Swales are a passive water harvesting technic applicable in many scales. This explanation and the following sequence arrive from the DVD Harvesting Water in the section The Swale Plume.

This technic is a clear example explained in 1.2.2.3 Contextual Parameters of a small range of action and the wide spread of positive effects.

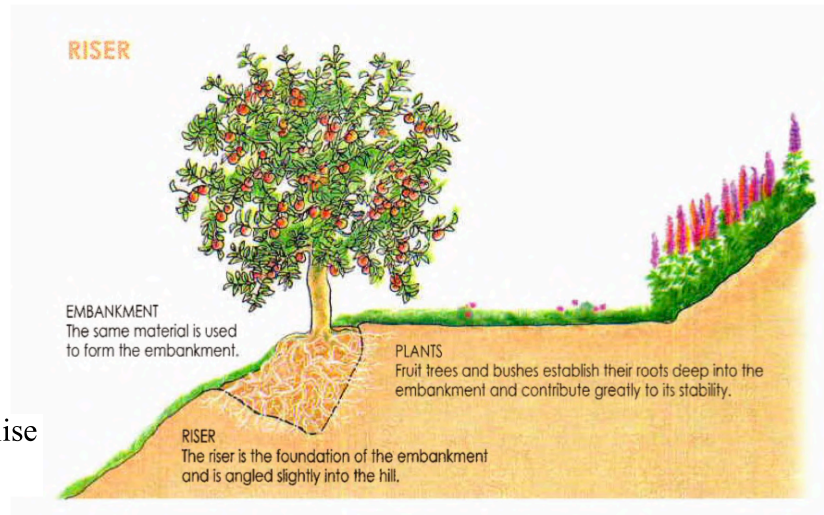


62. Swale action and effect range process

2.3.4.2.1 Terraces

After swales functioning explanation, it can be recognized that terraces are the extended scale of the same principle using the water gravity response. This technic has provided for hundreds of years civilizations agricultural productions. Is still discussed if the first ones applying this technic were Incas or populations of the nowadays China, for sure is obvious through observation that the rice-based culture and rice paddies technic has shaped almost permanently the Asian landscapes for this provision purpose. The basic rule of this technic to work is the landform inclinations. As the master of terrace systems Sepp Holzer, who's farm is in the Alps, explains that, this technic was mainly applied in steep environments and the creation of this steps was allowing to prevent soil erosion which is the main concern of mountain villagers. Containing the erosion action by slowing the water run mountain populations could preserve fertility and water for their food productions. What is the most influential part of this application is the gradient of the terrace. They might seem flat but actually they have a slight inclination towards the mountain or hill not more than 15-20 % of gradient which keeps the water on the terrace and gives the time to penetrate in the topsoil to be distributed for the plants [101].

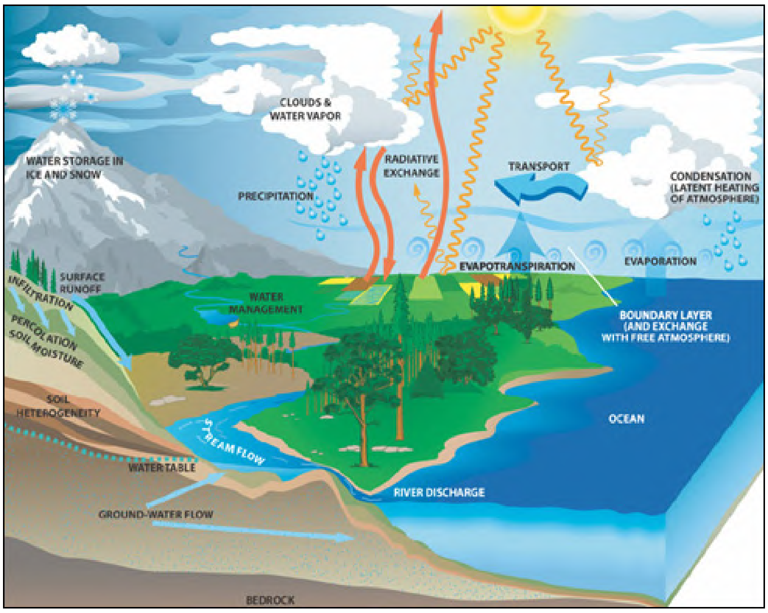
In order to maintain the given shape to the landscape plants and trees roots structure contributes in the maintenance and prevent landslides and rockfalls as explained in the "riser" technic, figure 63, applied in Holzer's work [101]. In this system emerges already the **multifunctional relationships** necessary for the sustainment of a built ecosystem. The form and its properties have relational functions to the hosting elements and creatures in the considered environment.



63. Sepp Holzer's technic to stabilise the "embankment" [101]

2.3.4.3 Water

Water is present in three forms vapour, liquid and solid in the biosphere, and it keeps change and move trough processes shown in the diagram figure 64. These movements are all powered by the sun's heating energy which affects according to the structural properties of the context [1].



64. "Credit: NASA GSFC Water and Energy Cycle web site. This diagram shows the relationship between Physical Oceanography, Biological Oceanography, and Water Cycle. Feedbacks between Physical Oceanography and Water Cycle are Evaporation minus Precipitation and Fresh water transports (i.e. Goldsborough Circulation). Biological in the ocean is affected by the water cycle via the Mixed Layer Depth and Run off from land. Finally, feedback between Physical and Biological Oceanography include the sea-ice and haline environments [102]."

Because of the strict relation with the structural proprieties of the land matter and shapes and atmospheric presences, which dictate waters movement by gravity forces and thermic pressures that determine water condensations and moisture in the air.

Water states are the primary media that move matter on Earth.

2.3.4.4 Access & Circulation

For defining the accesses and circulations is required a first mapping activity relatively of what are the resources already available in the location the design action is planned to happen. Questions on which to answer are many: where is it, how is oriented, where does the sunlight come from, winds direction, water sources, existent living fauna, animal trails, presents of roads or paths, etc.

It is important to make clear the predisposition of the place and what are the possible critical points to consider. Because ones are resources that do not require big manipulations and seconds have to respond to the considered needs and create the conditions to make that happen. Is crucial from a human attitude considering the ecological functions to be aware of the possibility to design with smallest changes for the greatest effects.

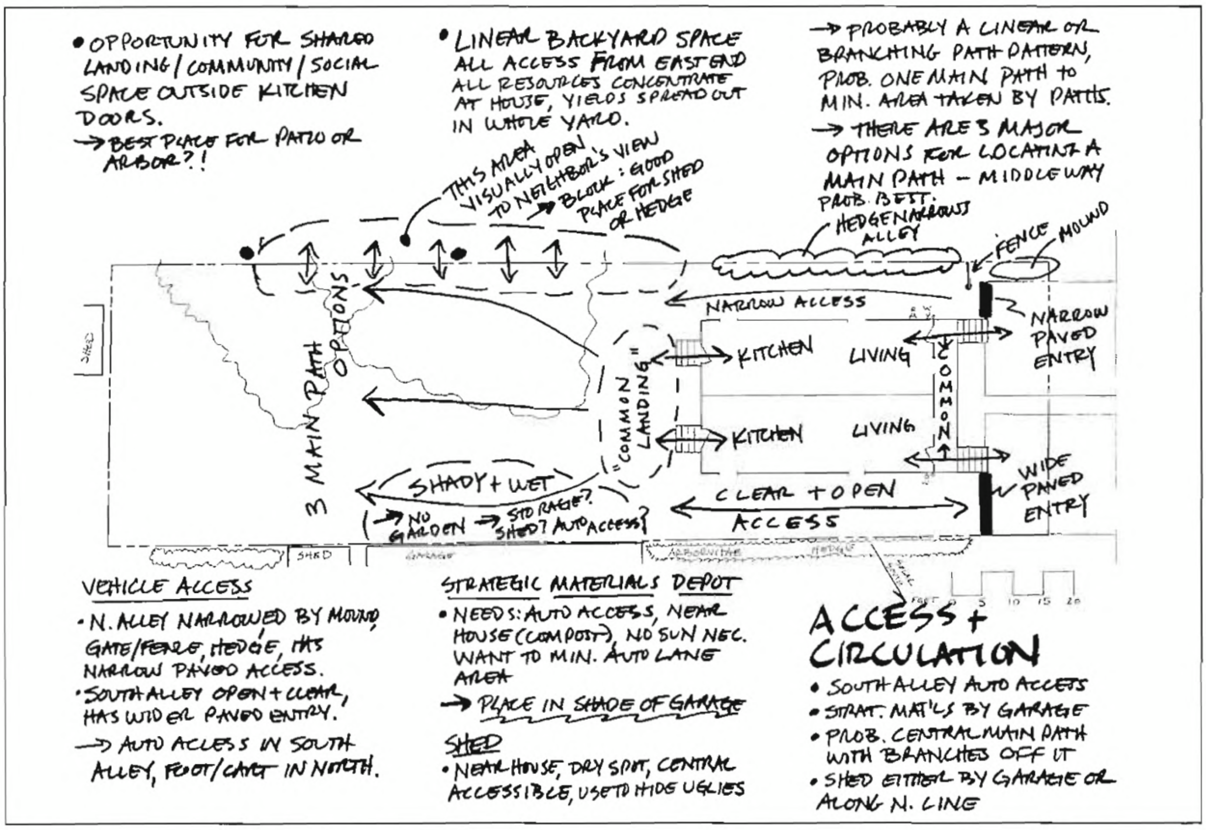


FIGURE 3.19. Access and circulation analysis and assessment at our case-study site. *Field sketch by Dave Jacke.*

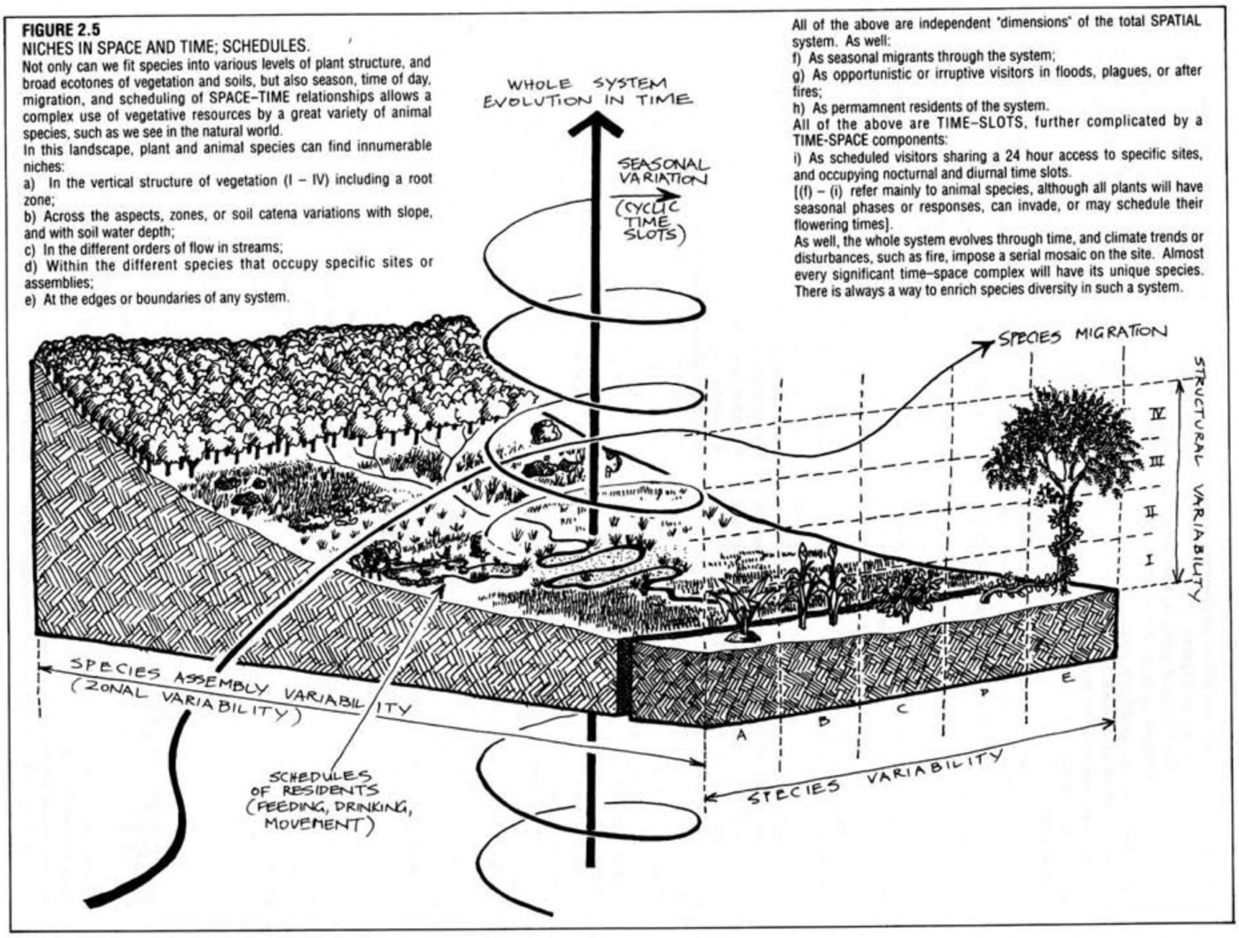
65. Example of Access and circulation analysis of a site by Dave Jacke [103]

2.3.4.5 Vegetation and animals

After having mapped accesses and circulations is possible to work on the life building system starting from the bioregional predispositions in local, native plants and animals and build polycultures “**guilds**” that can sustain each other including people. Since we are designing with life at this point is important to enhance the concept of **niches in space and time** which become more effective by applying the **edge effect** principle with **functional pattern designs**.

2.3.4.5.1 Niches in Space and Time

As well explained by Bill Mollison [104] permaculture designs with and for niches in space and time, horizontally and vertically. A **niche** is an unoccupied space in a period which can be designed on purpose to be left or occupied. The occupation of it involves a conceptual planning of a sequence of elements that might take place, what might define their permanence are different characteristics of the element if there are plants or animals, if they are influenced by seasonal variations, their life cycles duration, etc.



66. 'Niches in Space and Time: Scheduled [105]'

Plants have three kinds of life cycles: perennials, biannual and annual. These determine their permanence, perennials can take place permanently, when the shorter can move in space and time, with or without the human choice. Because biannual and annual have a reproduction strategy based on seeds diffusion and seeds and fruits are attractive food for the fauna. For example, birds, bees and butterflies, birds looking for food, ingest it and expel them with manure deposition in another place which if empty and the fertility conditions permit the start of a new cycle we have a new life cycle starting, bees and butterflies move pollens that remain on their bodies meanwhile they were attracted from flowers nectar. The presence of these is seasonal but they come because they are niches to host them for their purposes and the functions of the ecosystem.

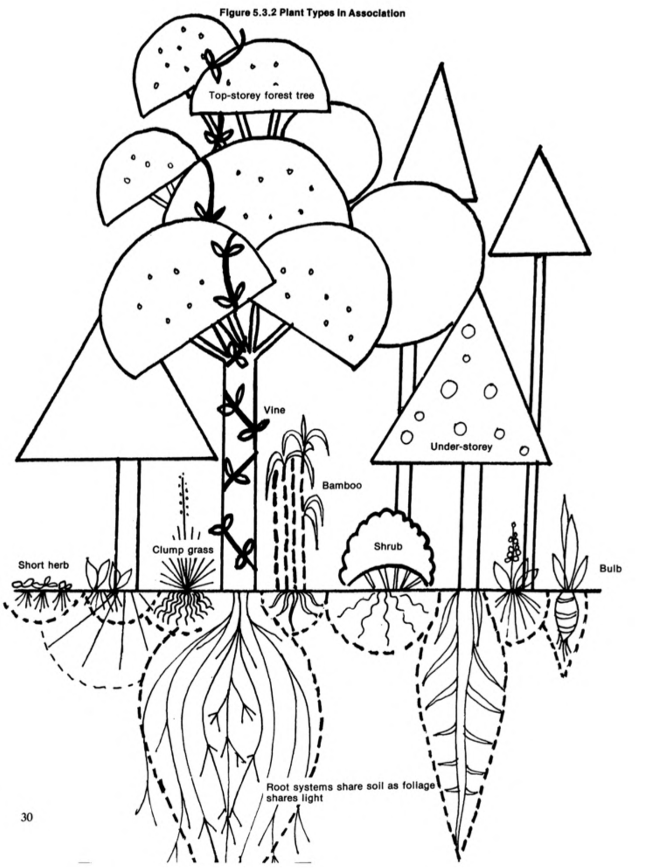
To create **nesting** occasions in time there are many technics and choices that produce the required **stacking functions** for that to happen. No element takes place for itself but provide functional services for itself and the others.

To create changing conditions in space one tool is the variety of plants themselves and their properties. These allow to build **polycultures** of seven **layers** as explained by Weiseman [106]

His considered categories are:

- Trees
- Shrubs
- Grasses
- Herbaceous species
- Ground covers
- Vines
- Mosses
- Lichens

These have different time and space occupations, if they grow more or less, if are perennial or not, if they produce fruits, if they climb on other plants, if they cover the ground preventing the moisture to escape from the soil, if they shade providing microclimatic zones, and because of this kind of qualities the properties of different functions and abilities in take place and roles in the system. Another example of properties to consider are plants hidden qualities of being liked more or less by animals and other creatures. This makes plants functioning tools to attract or repel their presence the so-called catch crop function.



67. Plants layers above and below the ground [107]

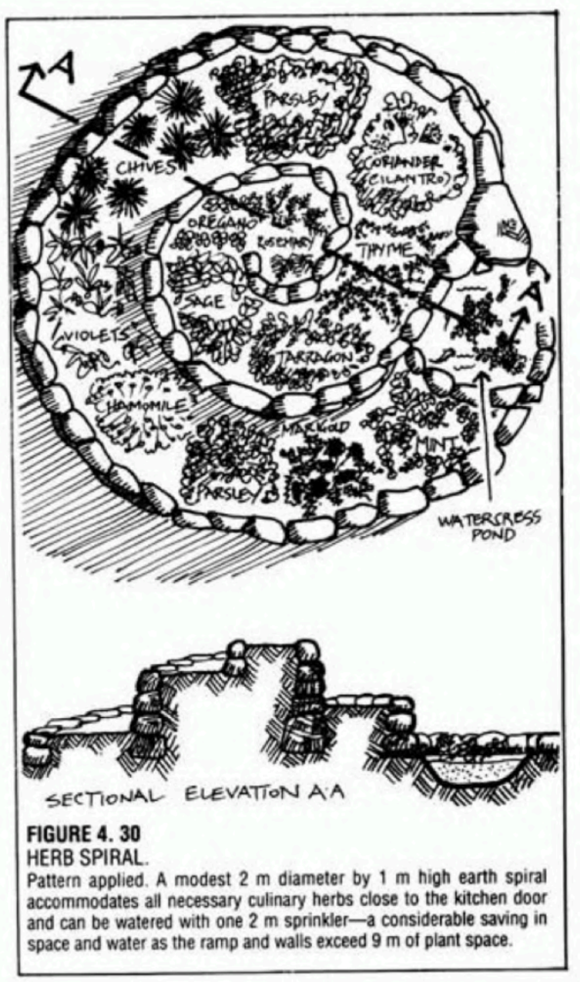
2.3.4.5.2 Patterns and Edges

In the disposition game of design, patterns recognition and their application are a very powerful tool to set conditions for functional relationships to happen. The creation of edges is part of patterns application, every edge is a boundary between two ecosystems, which existence creates the effect of providing relational conditions, making become the edge area a “nucleus” of a third ecosystem that includes the two related ones.

Technics to define patterns to apply can be summarised in three dimensions as done by Mollison in figure 69, which has as a general core model a spiral based movement. If we look it on a plane perspective and we want to organise the system in a grid the generative matrix produces different shapes as shown in figure 70. The tassels that we obtain out of it can be combined many ways in order to obtain edges and boundaries (figure 71) which allow the build action of different layers and levels with accessible paths as shown in figure 72. Every pattern creates a predisposition to sustain different function of plants in space and time. Creating edges allow also a much denser disposition of plants as clearly explained quantitatively in the illustrative example under figure 73

Some more focused examples of settable conditions are explained in the sequence of picture in figure 74 which basic model elements come from the matrix grid.

For example, the common design of kitchen herbs spiral (figure 68) is meant to stay next to the kitchen making accessible every plant, its structure provides a good drainage and water collection-access with the watercress pond, and the distribution in different elevations allows light access to every plant in the spiral system.



68. Herb Spiral [107]

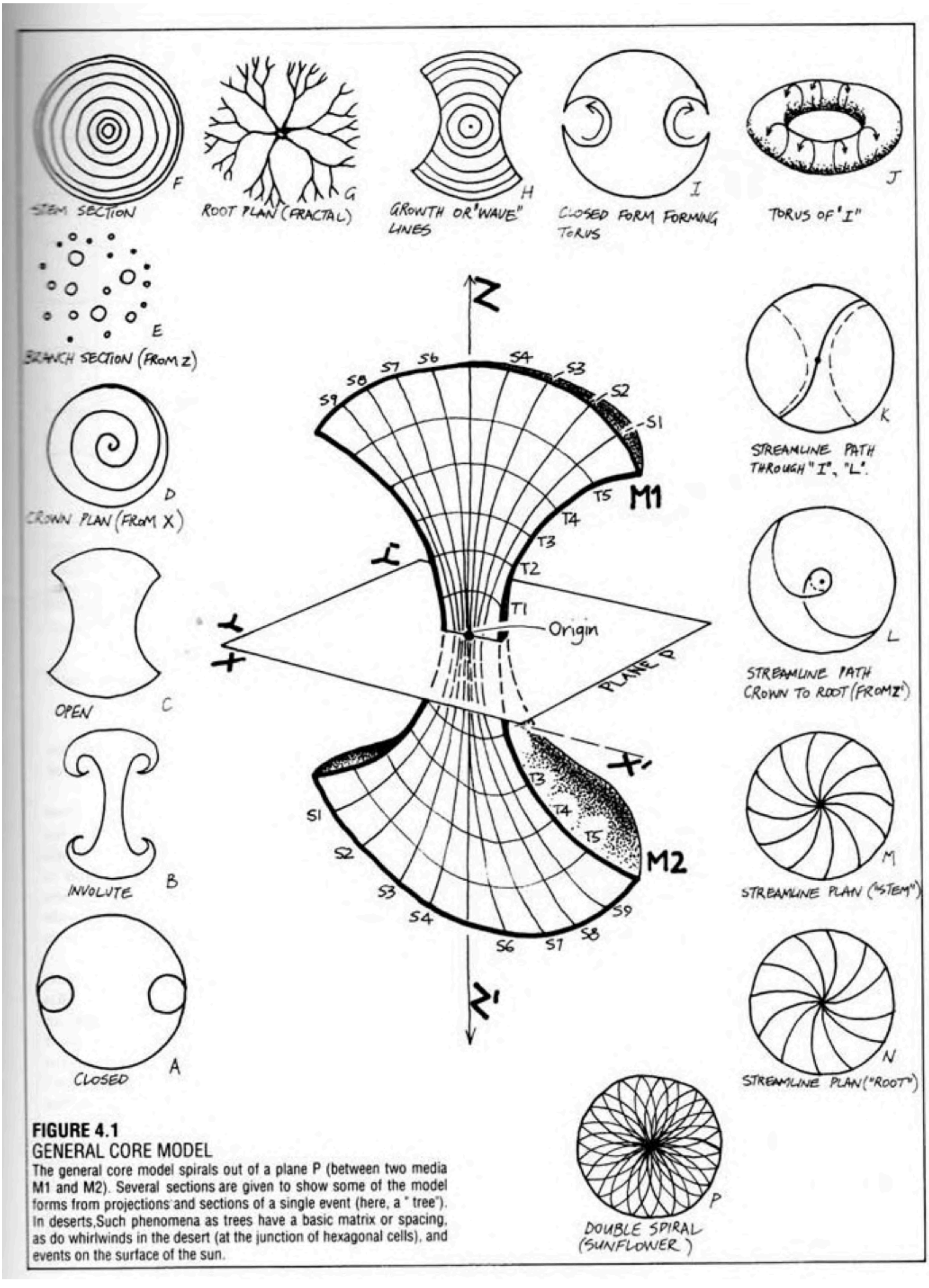


FIGURE 4.1

GENERAL CORE MODEL

The general core model spirals out of a plane P (between two media M1 and M2). Several sections are given to show some of the model forms from projections and sections of a single event (here, a " tree"). In deserts,Such phenomena as trees have a basic matrix or spacing, as do whirlwinds in the desert (at the junction of hexagonal cells), and events on the surface of the sun.

69. General Core Model [108]

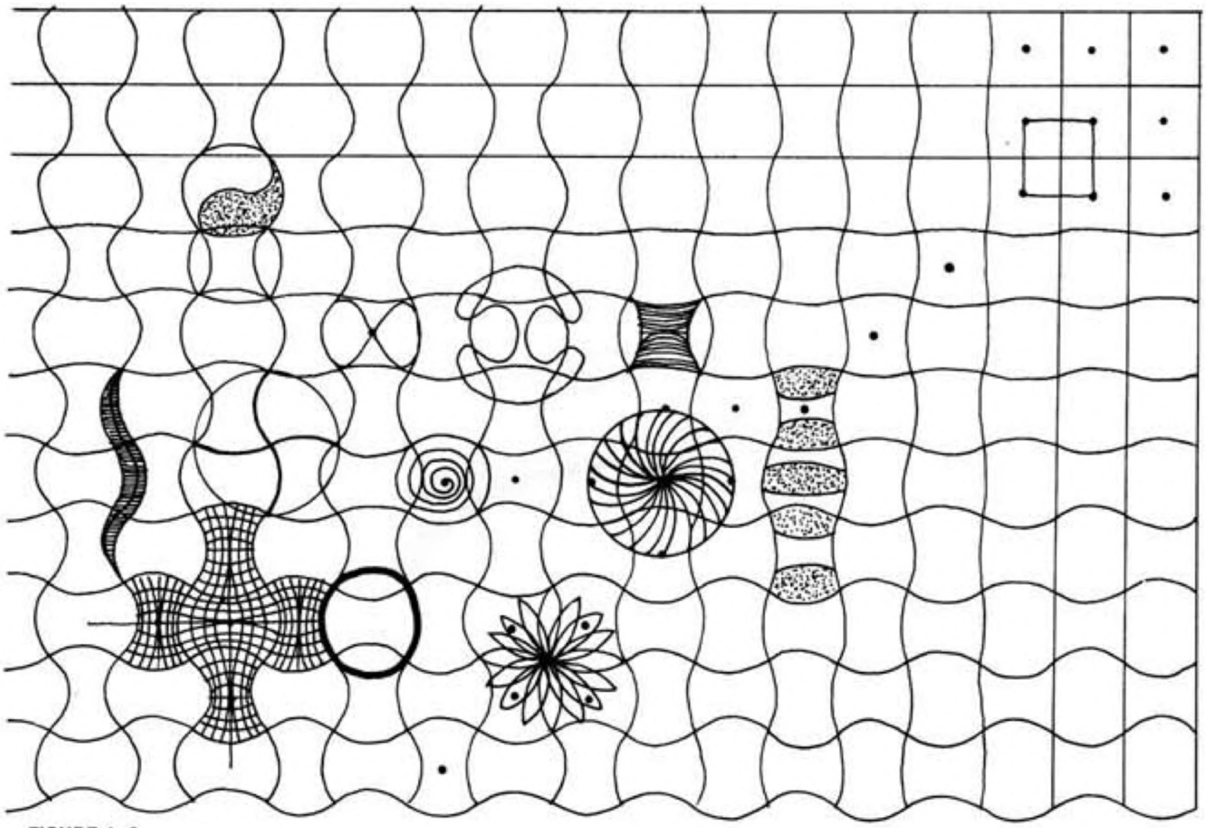


FIGURE 4. 2
PATTERN MATRIX OF TESSELATED PATTERNS.
Underlying many natural distributions (e.g. trees in a desert, heat or convection cells) and forming many patterns (such as honeycomb and cracks in mud) are matrices or grids based on approximate squares, hexagons, or intersecting sine waves.

70. Pattern matrix of tesselated patterns [109]

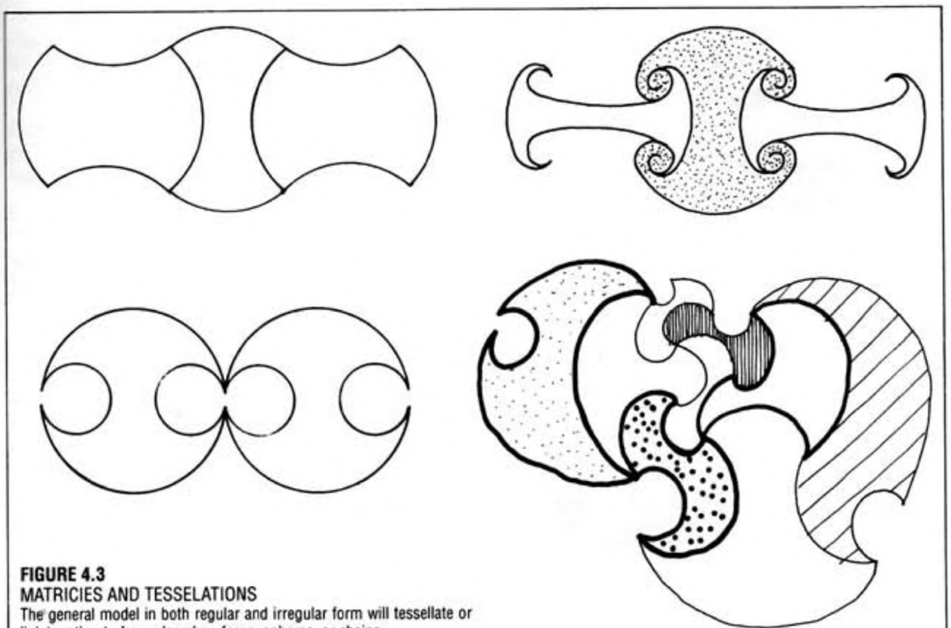


FIGURE 4.3
MATRICIES AND TESSELATIONS
The general model in both regular and irregular form will tessellate or link together to form closed surfaces, spheres, or chains.

71.Matricies and tesselations [109]

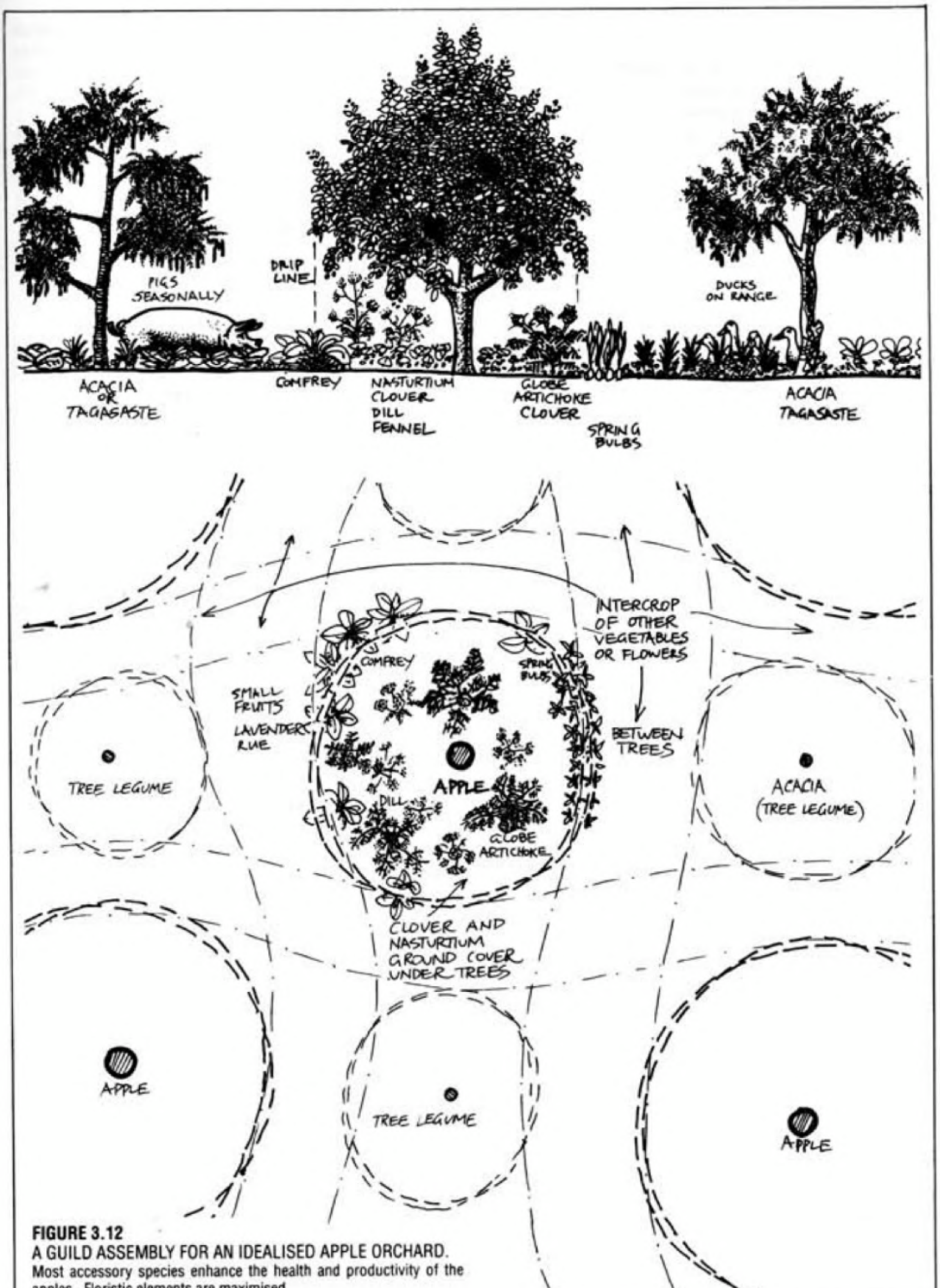
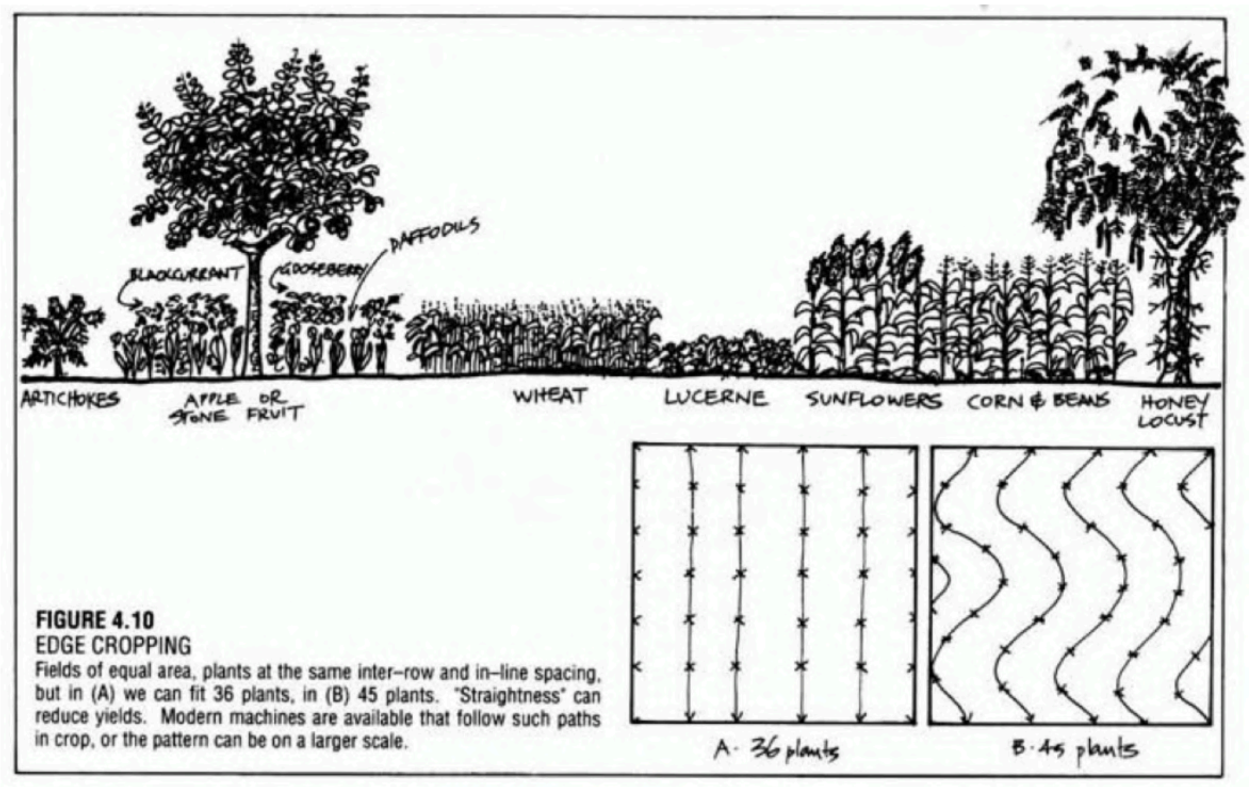
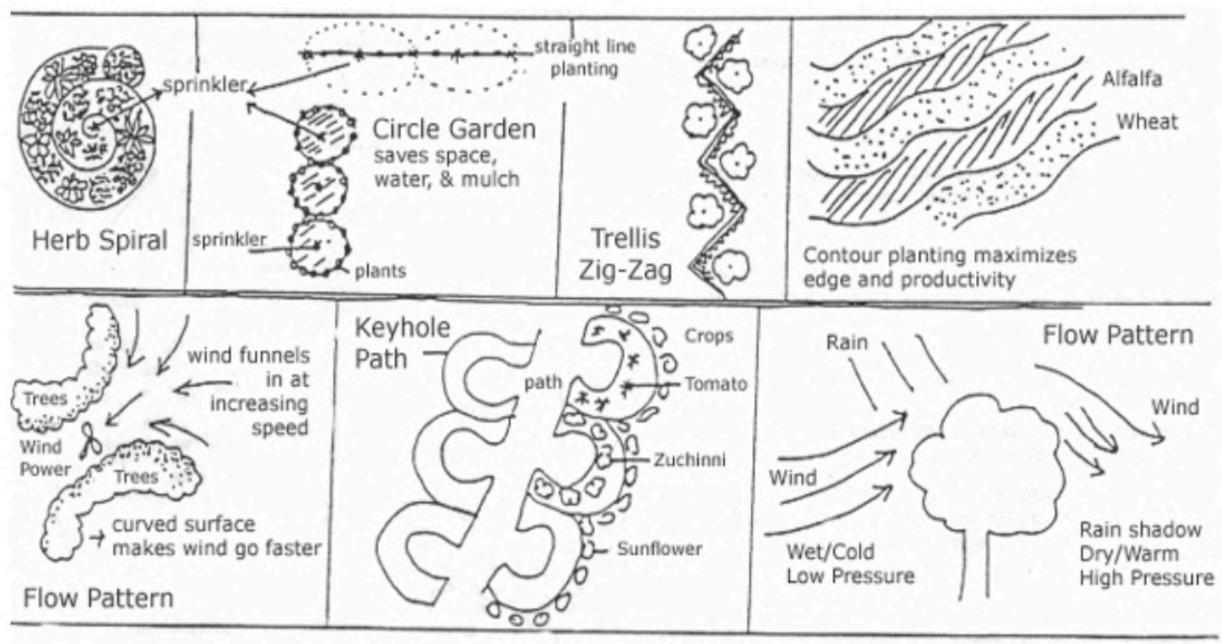


FIGURE 3.12
A GUILD ASSEMBLY FOR AN IDEALISED APPLE ORCHARD.
Most accessory species enhance the health and productivity of the apples. Floristic elements are maximised.

72. Pattern grid application for a Guild Assembly [110]



73. Edge cropping [111]

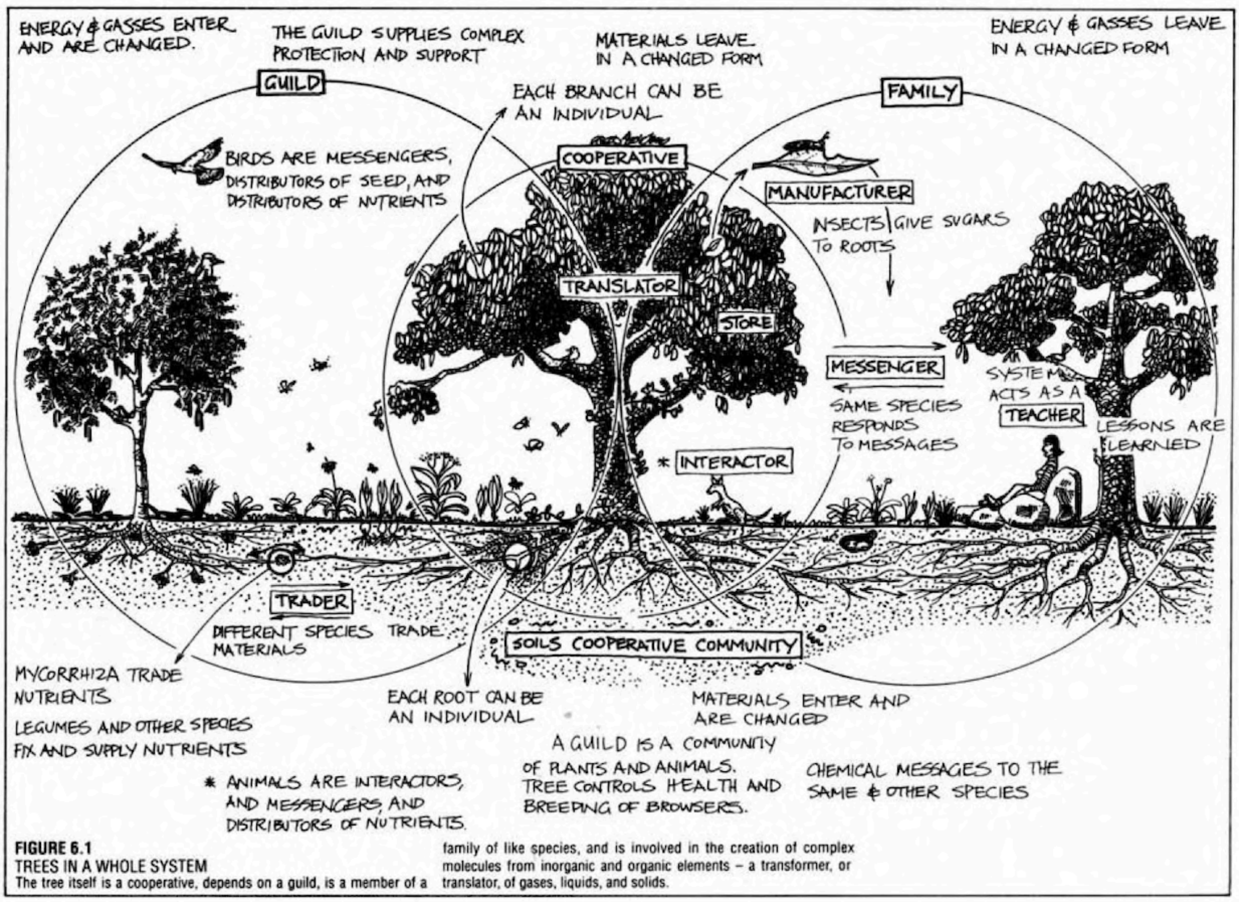


74. Edge effects and harmonics in patterns [112]

2.3.4.5.3 Plant Guilds

Guilds are polycultural systems build on a base of plants multifunctional relationships which spacing and products provide for all a series of other creatures.

Mollison's schematic explanation (figure 75) of this ecosystem helps to understand the existence of cross-species communities and the relevance of matter and energy flows thanks to their living and being together.



75. Trees in a whole system

Designing for optimal species integrations, which is the guilds design aim, is important to have clear scales, layers and levels, longitudinal understanding and organisation in time and space occupation in the site, local biomes predispositions, their life cycles duration and seasonal occupations and changes in state (size, blooming, fruiting, leaves fall…). All of this moments and elements have properties that provide series of functions that have to be considered and positioned in the system. It is also true that it will not be possible to consider and predict all the possible functions and position them all, probably most of them will emerge spontaneously from the set conditions but planning many of them by listing the relevant aspects and functions for human and ecological purposes already creates a network of functional relationships in time with people and the considered creatures, as done in the fifteen frameworks modules of guilds by Wayne Weiseman and his colleagues D. Halsey, B. Buddock [113].

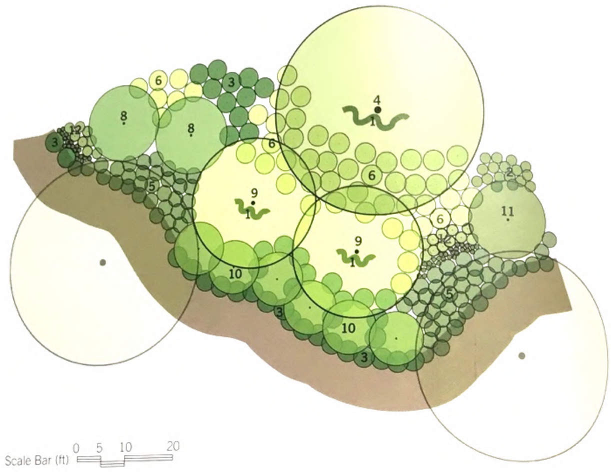


TABLE 7.1 FRUIT AND NUT GUILD PLANT LIST

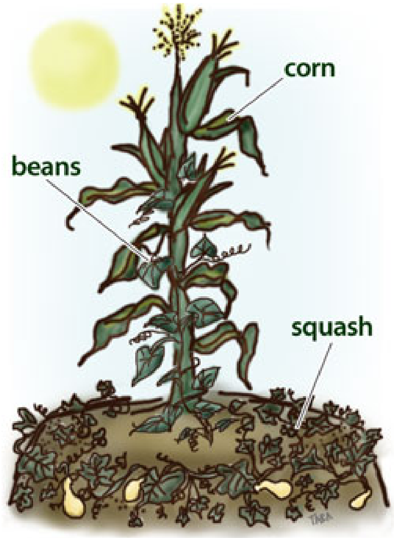
ID	Common Name	Scientific Name	Plant Type	Height	Spread	Ecological Function	Human Use/Crop
1	Groundnut	*Apios americana*	Vine	5'	3'	Nitrogen Fixer	Container Garden, Food, Medicine
2	Fennel	*Foeniculum vulgare*	Biennial	4'	2'	Insecticide, Insectary, Dynamic Accumulator	Dye, Food, Essential Oil, Insect Repellent, Medicine
3	Spearmint	*Mentha spicata*	Perennial	2'	4'	Aromatic Pest Confuser, Insectary	Container Garden, Food, Essential Oil, Medicine
4	Ginkgo	*Ginkgo biloba*	Deciduous Tree	60'	40'	Soil Builder, Erosion Control	Medicine, Soap
5	Canadian Wild Ginger	*Asarum canadense*	Perennial	1'	3'	Soil Builder, Erosion Control	Food, Medicine
6	Comfrey	*Symphytum officinale*	Perennial	3'	4'	Domestic Animal Forage, Chemical Barrier, Insecticide, Insectary, Mulch Maker, Dynamic Accumulator, Water Purifier	Biomass, Compost, Food, Medicine
7	Violet	*Viola odorata*	Annual	9"	9"	Insectary	Container Garden, Food, Essential Oil, Medicine
8	Hardy Almond	*Prunus dulcis*	Perennial	15'	15'	Mulch Maker, Edge Species, Soil Builder	Nuts, Oil
9	Asian Pear	*Pyrus pyrifolia*	Perennial	25'	25'	Mulch Maker, Insectary	Fruit, Medicine
10	Raspberry	*Rubus* spp.	Perennial	5'	10'	Wildlife Food, Insectary	Fruit, Edible Greens, Medicine, Tea
11	Fig	*Ficus* spp.	Perennial	15'	15'	Insectary, Cools Environment in Hot Places	Fruit, Medicine
12	Caraway	*Carum carvi*	Perennial	2'	2'	Insectary	Essential Oil, Culinary Herb, Medicine, Food
13	Licorice	*Glycyrrhiza glabra*	Perennial	2'	2'	Nitrogen Fixer, Dynamic Accumulator	Medicine, Candy, Flavoring, Food

76. Example of a Fruit and Nut Guild and the Table list of the included plants [113]

2.3.4.5.3 Example in a cultural module: Three Sisters, Small Scale module.

Three Sisters horticultural technic is a clear example form Native American culture of the power hidden in diversity. Not only for their structural predisposition in providing functions but also in terms of variety in nutrients provision for human and other creatures nutrition [114].

The classic trio of plants types is composed by a maize, a bean and a squash or pumpkin. The corn requires a lot of nutrients, especially nitrogen to grow tall and rich in yield, the height provides shadow for the squash, the stalk becomes meanwhile the growing support for beans which in exchange provide nitrogen to the corn because of their nitrogen fixing properties given by their type of roots.



77. Three Sisters module [114]

Maize needs a consistent quantity of water to grow so does squash to fruit. Squashes with their big leaves and staying at low level, they cover the ground preventing the moisture in the soil to escape from sun exposure, creating so a cooler and moist microclimate below and because of the shading action prevents also other plants to grow underneath, which might steel provided nutrients for the corn. On the same time this preventing action provides instantaneous mulch and contributing extra by its own leaves. These plants are all flowering plants which attract pollinators for their needs, in particularly corn and squash need pollinators to fruit and move their pollens from male flowers to female ones. As final result a part of their yield production, this integration does not exploit totally nutrients from the soil but lets the regeneration to happen also because when they end their life cycles in this combination they have contributed to collect and keep in that place moisture, mulch and organic matter. This can be defined as a “companion-based” horticulture adopted a lot nowadays in small scale farming very popular in Europe called Synergistic Gardening defined by Emilia Hazelip which is based on Masanobu Fukuoka’s Natural Farming [115].

2.3.4.5.4 Plant functionalities

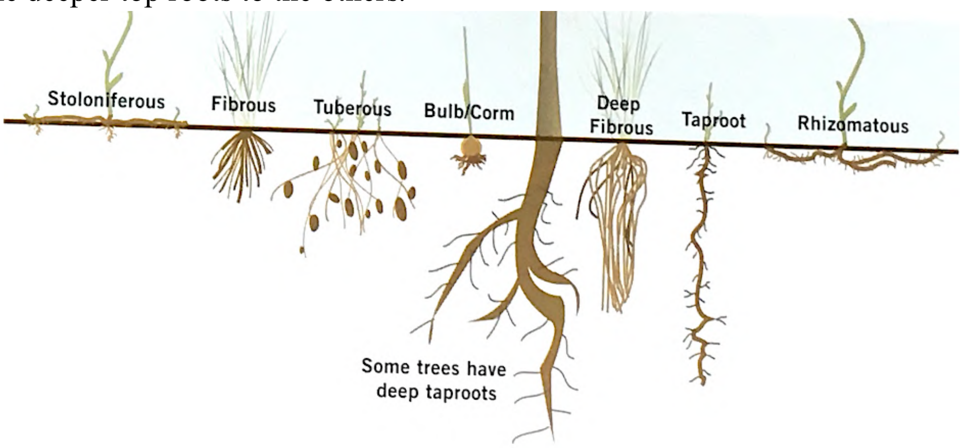
As announced in the guilds building and the example in the Three Sisters module, plants can have multiple functions in the system, also after their individual life cycles. Ideally during the design choosing the **identified functions** have to be **5 at least** for redundancy purposes. This means that if one of the functions stops to exist because of a negative feedback in the system, example a plant species dies for unexpected reasons or simply because its life cycles has ended, the considered plant has still 4 functional relationships on which rely for its sustainment in the system.

Some Functions and Benefits of Plant Guilds

- Animal forage
- Air cleaner
- Carbon sequestration
- Fortress
- Flood management
- Wildlife habitat
- Insectary
- Mulch maker
- Nitrogen fixer
- Nurse
- Nitrogen scavenger
- Biomass
- Cleanser/scourer
- Compost
- Container garden
- Cut flower
- Dried flower
- Dye
- Food
- Fruit
- Protein
- Roughage
- Carbohydrates
- Vitamins, minerals
- Spice
- Storage, cache
- Essential oil
- Fiber
- Aromatics/fragrance
- Hanging basket
- Insect repellent
- Medicine
- Oil, wax, resin, or polish
- Ornamental
- Soap
- Wood
- Animal feed

78. List of considerable functions of plants in the system [116]

These functions can be split in two categories as shown in the list of the guild system, between 'Ecological Functions' and 'Human Uses'. Another ecological functionality not mentioned in this list be in the relative guilds plants yes is the property of the kind of root of the roots involved in the system. Planning the plants placement by partitioning the soil with a variegation of root types permits closer proximity between plants and mineral and water distribution from the deeper top roots to the others.



79. Root Types. Illustration by Kellen Kirchberg [117]

A good starting point where to start consider and play with plants functionalities and properties is the Jacke's list of 'Forest Gardening "Top 100" Specie […]' providing examples for every layer considered in guilds design.

2.3.4.5.5 Animal functions in the system and criticalities

Out of the occasional animals coming spontaneously through the system, for example, birds and squirrels, insects as bees and butterflies and so on. We might consider to raise domestic animals as chickens, gees, goats, etc, for multifunctional purposes. In order to do that is necessary to have clear all the functions we are aiming for their presence, their behaviours and needs characteristic and being able to provide for that, by setting the conditions in the systems to host all of these. For example, chickens have all the intrinsic characteristics shown in figure 90. Plus, these have to be kept in mind for the buildings and infrastructures and their zones of usage criteria, because the foraging system of it can be set but they still require a shelter that can be closed at night and the owner needs to go pick up the eggs every day. The same criteria is applicable on smaller scales as for example in aquaponic systems, fishes need food everyday which has to be provided. This aspect integrates actively humans in a role of maintenance function for the system.

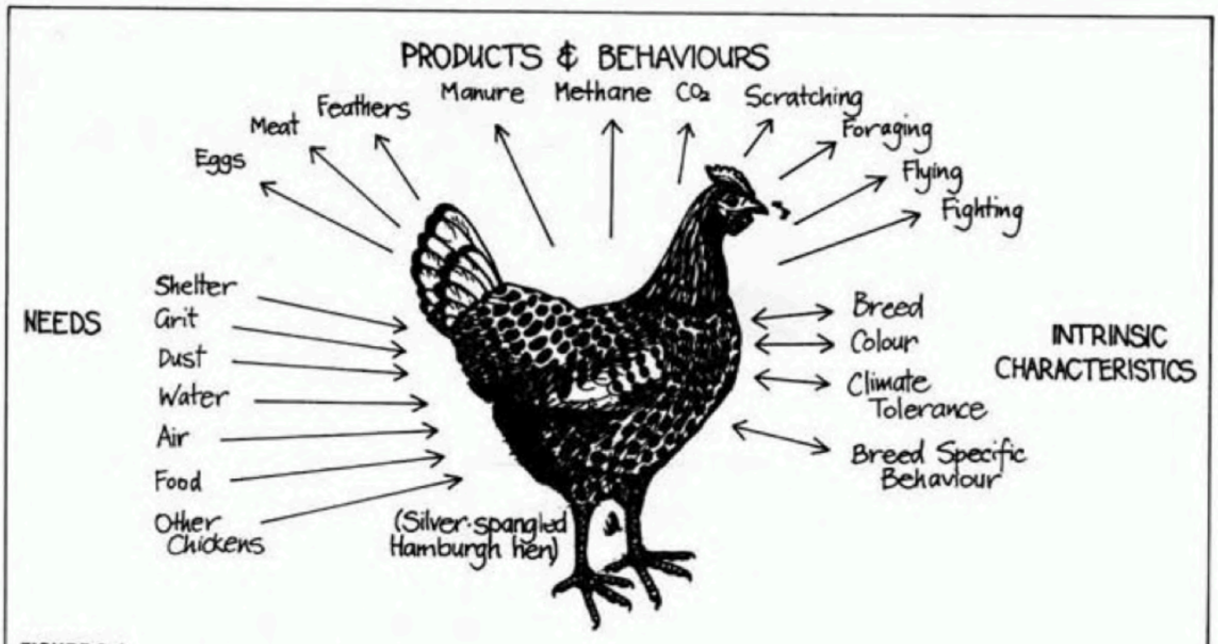


FIGURE 3.1
PRODUCTS AND BEHAVIOURS OF A HEN.
Analysis of these inputs and outputs are critical to self-governing design. A deficit in inputs creates *work*, whereas a deficit in output use creates *pollution*.

80. Products and Behaviours of a Hen [120]

2.3.4.6 Buildings & Infrastructures

The phases considering buildings and infrastructure respond to the building of the house in case is not present yet and other infrastructure as might be a poultry hub or other shelters, fences or collecting channels or tanks. What counts in this design phases is not only the definition of the functionality attributed to the spaces but how and with what materials this spaces are going to defined and built. At this stage is valuable the creativity of the designer to recognise the resources in place, forms, position and materials qualities as resources and with these clear apply the **appropriate technology**, as explained by Weisman in his principles, to build the most efficient, low impact and consumption in utilities and materials, which might be sustained by the local resources and their reproducibility. Best cases are when the materials used are local, natural, so degradable (examples: mud bricks, straw, wood, stone) and the structures integrated with the landscape, acquiring multiple functions and using passive forces.

They are many technics explained in variety of books proposing different perspective of functionality, under names as Earthship [121], Building with Earth [122], Green Building [123], Ecohouse [124], Sustainable Solar Housing [125], …

There are many examples of Natural Buildings on the web but a wide examples spectrum in highly natural based materials and integration can be found in Mollison’s book Permaculture TWO, follows some representative examples in next figures [126].

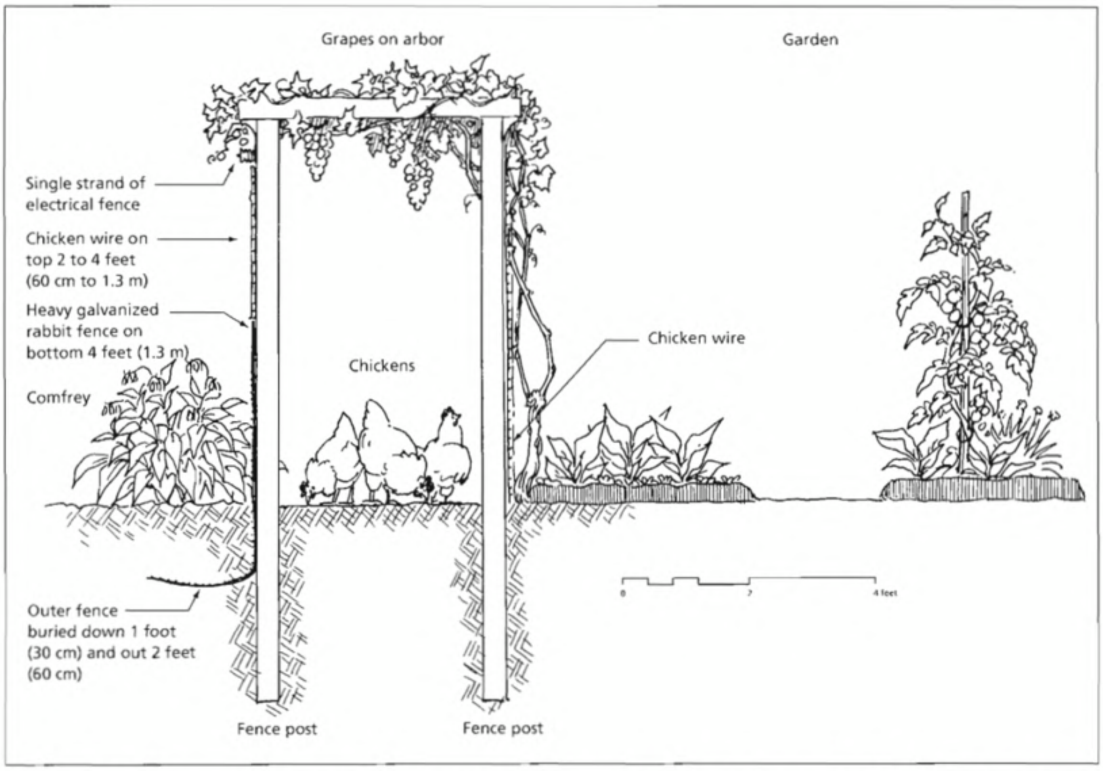
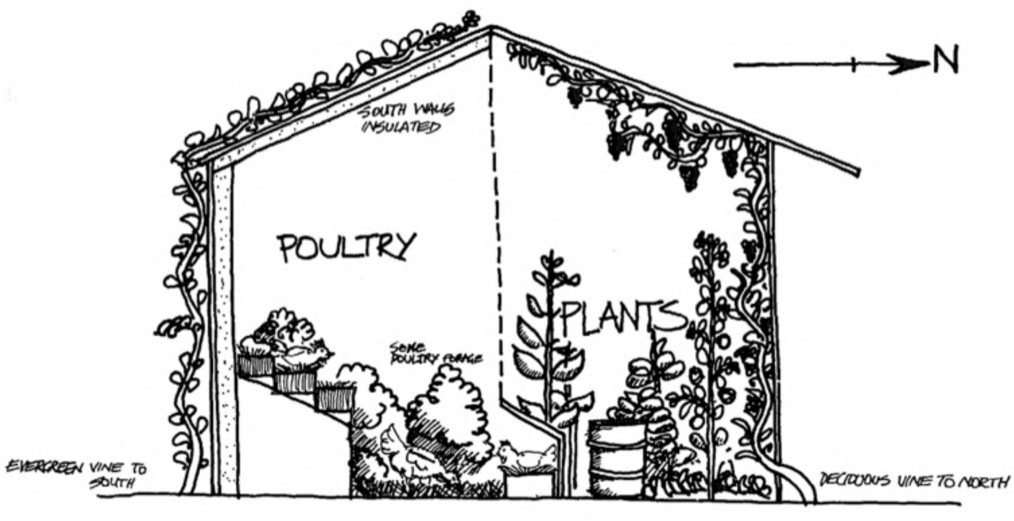


FIGURE 1.3. A "chicken moat" such as this surrounding your garden can perform multiple functions, including the exclusion of large varmints such as rabbits, woodchucks, and deer, as well as holding back rhizomatous weeds from outside the garden. Planting comfrey or other dynamic accumulators outside the moat allows the chickens to graze the comfrey through the fence while preventing the birds from killing it. The plants also absorb runoff laden with chicken manure for cycling back into the garden or the birds. See the text for a full discussion of functions and design details. This idea comes from Joe Jenkins of western Pennsylvania.

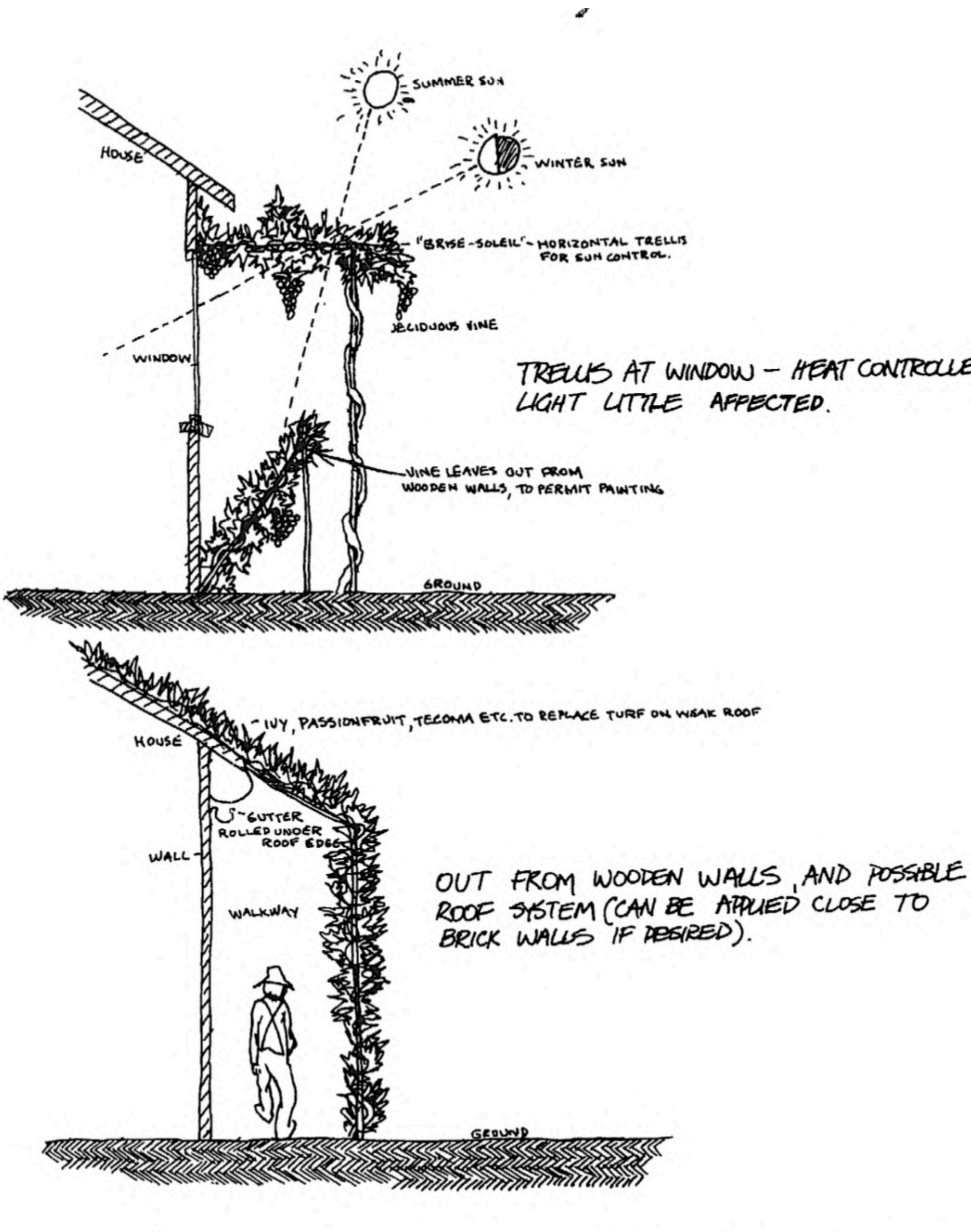
81. Chickens integrating solution example 1 [127]



CHICKEN HEATED GLASSHOUSE. FIG. 8.3.

82. Chickens integrating solution example 2 [126]

Examples of Buildings and Infrastructures from Mollison's book Permaculture TWO [126]



WALL TRELLIS FOR INSULATION FROM WIND AND HEAT. FIG. 6·15

Examples of Buildings and Infrastructures from Mollison's book Permaculture TWO [126]

4

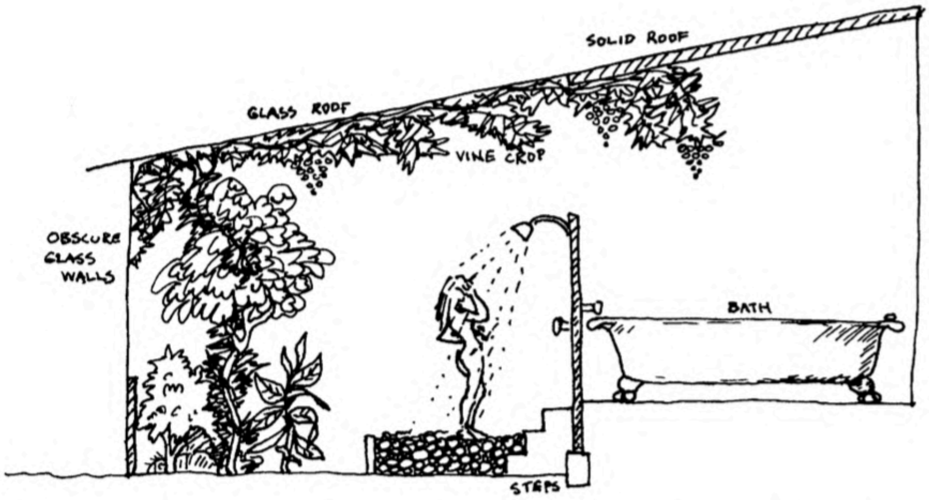
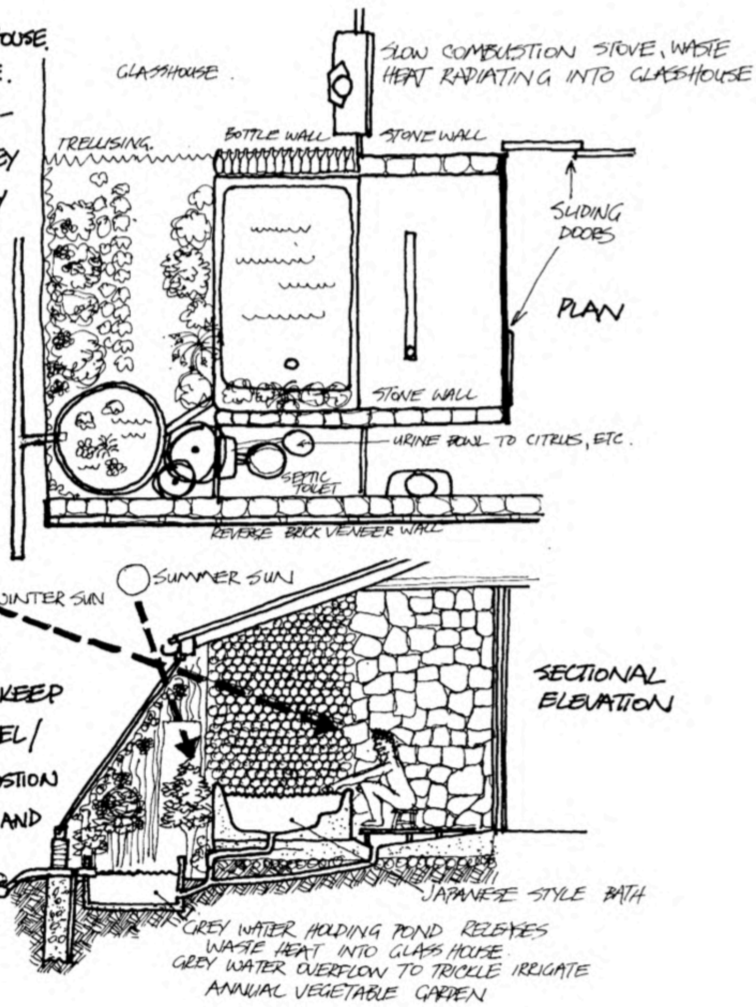


FIG. 6·13: BATHROOM GLASSHOUSE. SHOWER OVER PEBBLE BED KEEPS PLANTS MOIST. CAN BE ATTACHED TO EXISTING BATHROOM AS 'HOT' OR 'COLD' GLASSHOUSE.

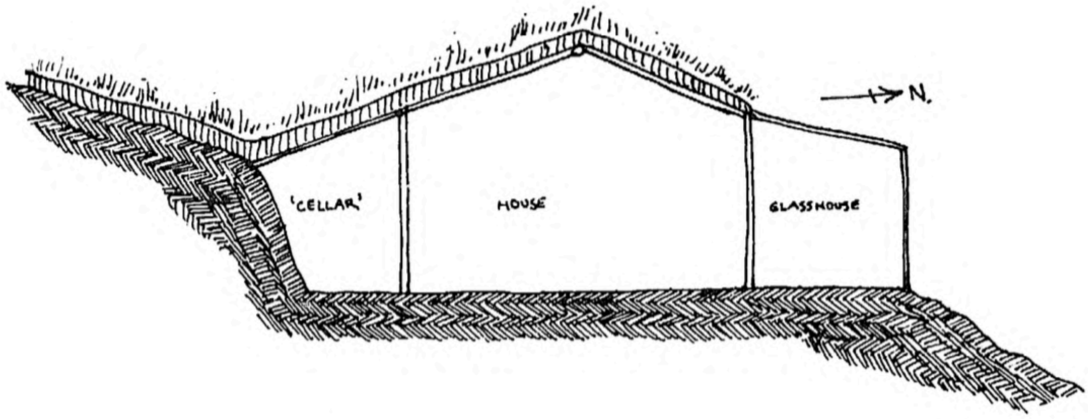
FIG. 6·14: BATHROOM/GLASSHOUSE. JAPANESE STYLE BATH IN GLASSHOUSE. WASTE HEAT FROM ALL SOURCES RELEASED IN GLASSHOUSE (STOVE, GREY WATER FROM BATH, DRAIN, LAUNDRY AND KITCHEN). HIGH THERMAL MASS HEAT STORAGES: WATER (BATH, HOLDING POND, BOTTLE WALL), STONE AND COVERED CONCRETE (BATH, FLOOR, WALLS). GLASSHOUSE IS TRELLISED AND PLANTED FOR PRIVACY. [JAPANESE STYLE BATHING—RINSE, SOAP UP, RINSE BEFORE SITTING IN BATH—KEEPS WATER CLEAN AND SAVES WATER. BATH COVERED TO KEEP IN HEAT PROVIDED BY SOLAR PANEL/ SOLAR POND (FIG. 7·15)/SLOW COMBUSTION STOVE AND/ INCIDENT RADIATION AND POSSIBLE ELECTRIC BOOST.]



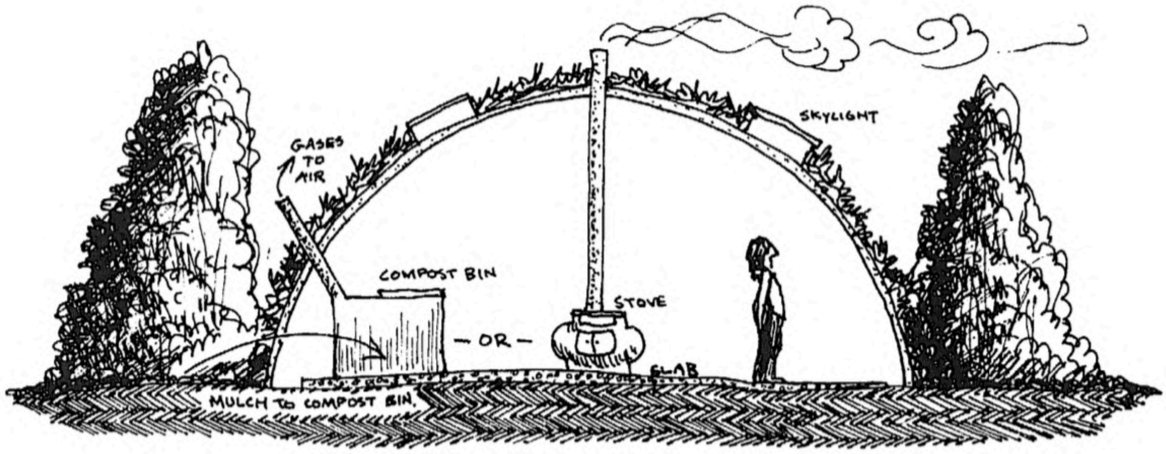
100

Examples of Buildings and Infrastructures from Mollison's book Permaculture TWO [126]

Here, plants are used as integral parts of the house structure. Fig. 6.9 was designed for a field shelter for domestic animals, but would also be a feasible tropical home. Only very light structural members are necessary. Fig. 6.12 (after Dornach) has the further refinement that a fully enclosed and vented compost box provides background heat. Materials dry-stored in autumn, and "charged" at 3 week intervals in a box of this type would "burn" at about 66°-82°C until composted, rather like a slow fire. Again, placement in a glasshouse or animal shelter is of use.



PLANT HOUSE 2 (SECTION). CONTINUOUS TURF ROOF WITH GLASSHOUSE FRONT, FERNHOUSE AND CELLAR AT REAR. FIG. 6·11



PLANT HOUSE 3 (SECTION). METAL, CONCRETE, PLASTIC OR WOODEN DOME WITH IVY OR TURF COVER, PLANT WALL SHELTERS. (AFTER DOERNACH.) FIG. 6·12

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Examples of Buildings and Infrastructures from Mollison's book Permaculture TWO [126]

6.4

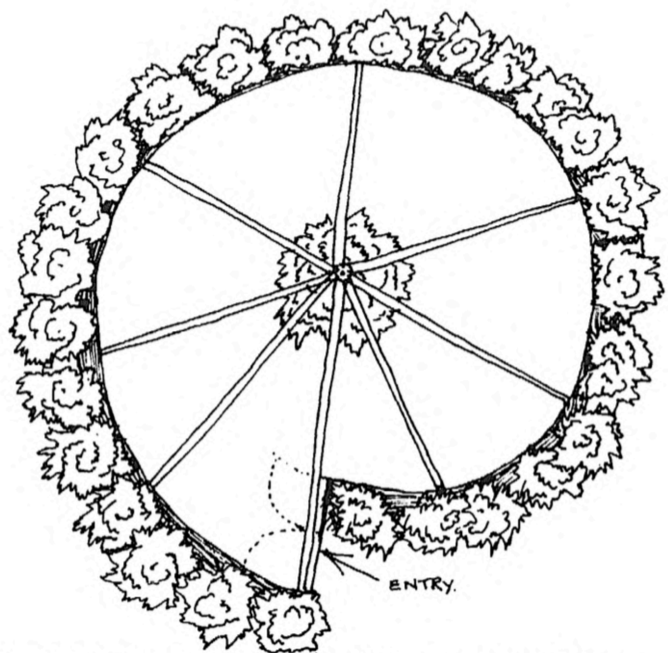

FIG. 6·9: PLANT HOUSE 1 (PLAN). SLAB ON GROUND, SPIRAL OF BAMBOO, POPLAR, CENTRED ON EXISTING TREE, POLE, OR LARGE POPLAR STAKE. WALLS WOVEN AND IVY-COVERED TO ROOF. CHEAP LIVESTOCK SHELTER.

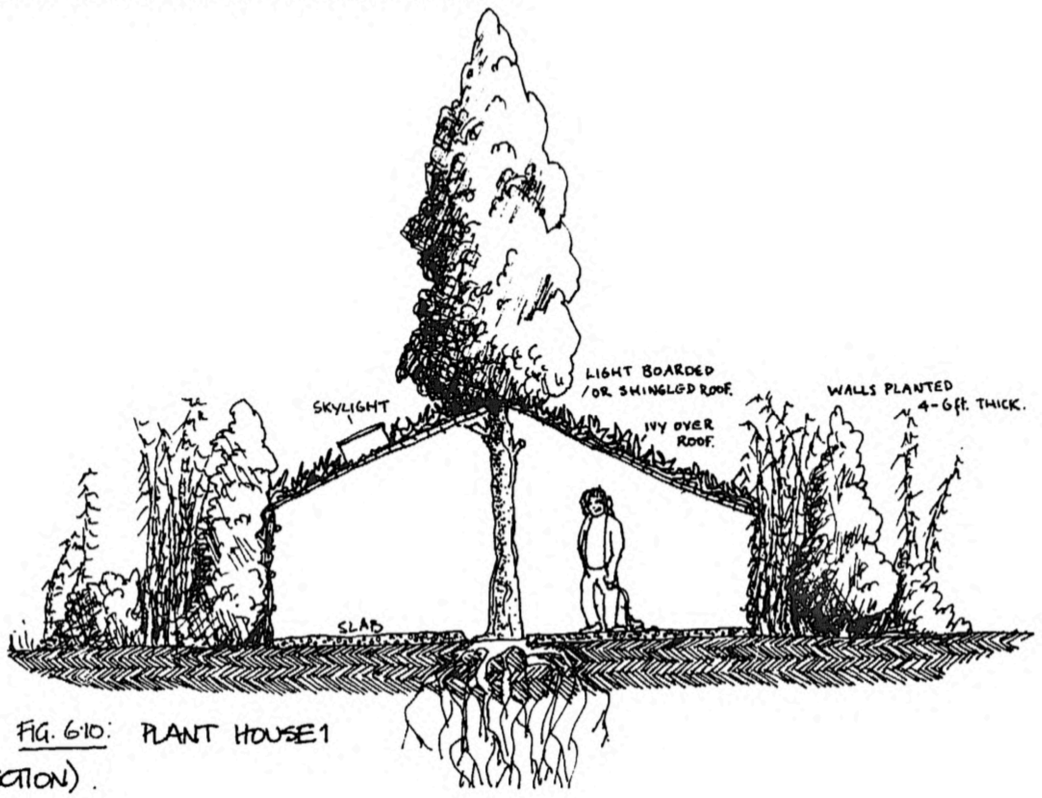

FIG. 6·10: PLANT HOUSE1 (SECTION).

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2.3.4.7 Microclimate

Microclimate are smaller scale contexts of consideration where the properties in terms of position, forms, occupation and matter/materials provide a set of conditions that produce different climatic phenomena inside the bigger one. The shading action of plants already provides microclimatic conditions. Buildings and infrastructures are also forms taking position in an area with a specific sun exposure pattern, made with materials having specific radiant and reflective properties/qualities. Greenhouses are a classical example of built space where to create microclimates. Every built environment has the potential of creating microclimate.

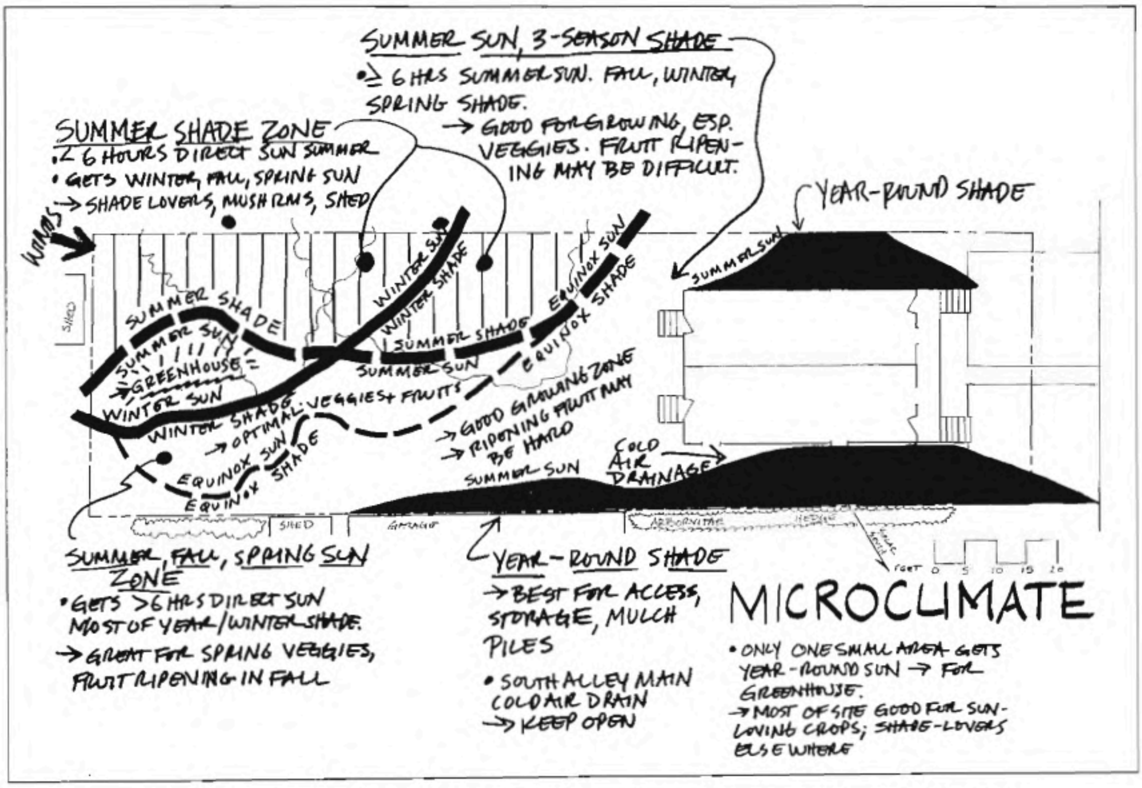


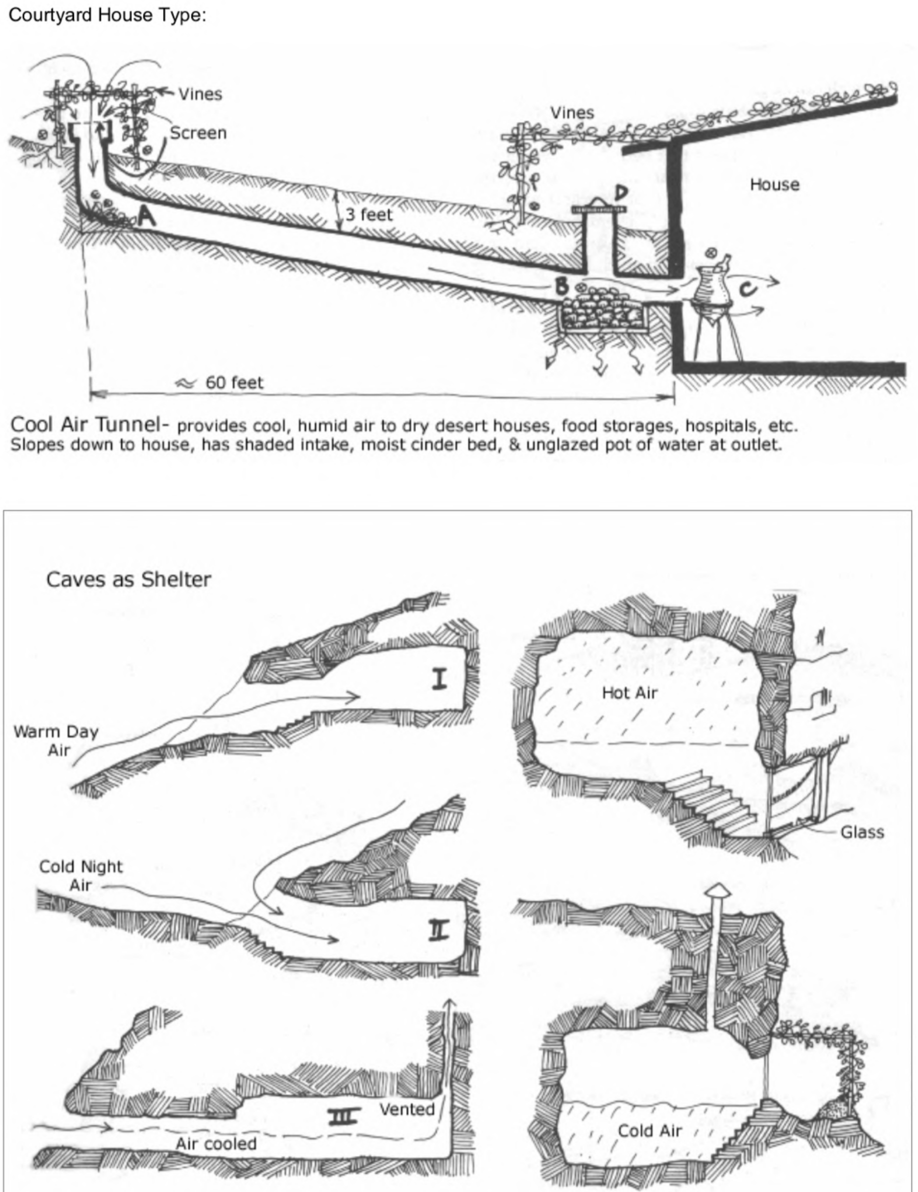
FIGURE 3.21. Microclimate analysis and assessment for our design case study. *Field sketch by Dave Jacke.*

83. Analyse of a site for potential microclimates creations [128]

2.3.4.7.1 Air movement "Chimney Effect"

The "chimney effect" or "stack effect" is the basic physics principle that determines air movements. An aspect of air behaviour to keep in count is that cold air is dense and sinks, hot air is light and rises this difference in temperatures is what causes pressures between areas in the landscape that creates movements. The element in the air that causes density is the moisture, the behaviours visible by boiling water of evaporation and condensation are a smaller and faster version of what happens in the atmosphere. Classical examples can be experienced in the build environment with the chimney, windows and corridors openings or geothermal heating systems use the same principle. Nowadays, this principle is a must in sustainable architecture practices because off its energy saving quality, it actually an ancient conception but very efficient and this is turning to be recognised better in urban environments [131].

Follow few visual examples of air behaviours.



84. Air behaviours in closed spaces [130]

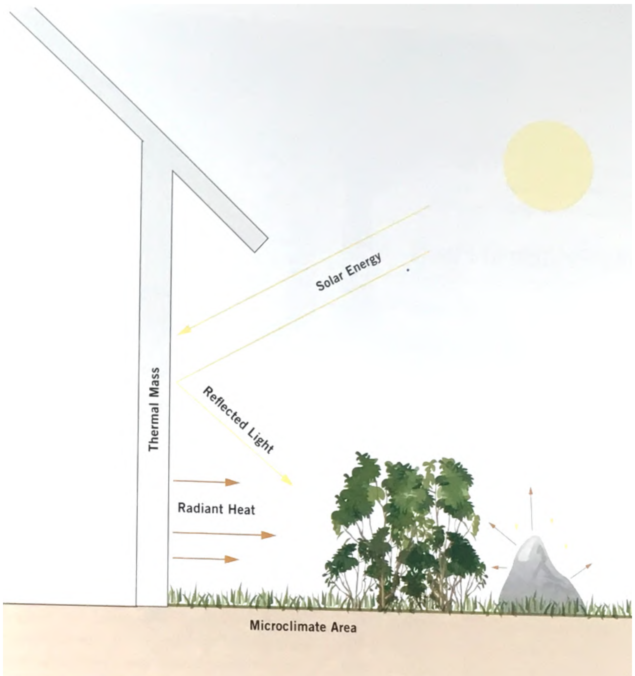
2.3.4.7.2 Edges managing winds and climate

The edge effect is also a basic principle to consider for winds and climate changes. Since the place is defined by its position, its forms and materials that react and interact with sun exposure. The positioning and material thermic properties are design tools to apply technics in climate and wind management.

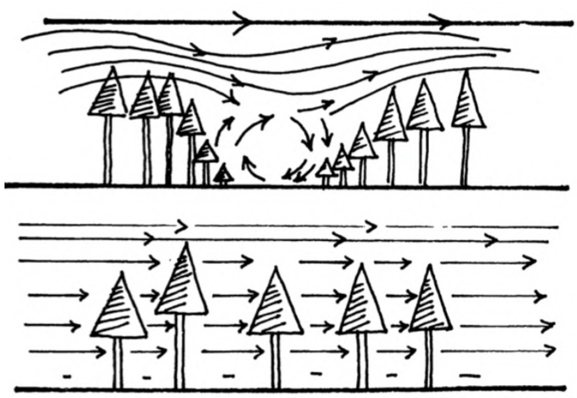
There were already traces of these aspects in the before treated subchapters when talking about patterns and plants layering which predispositions allow the creation of microclimatic areas.

Every material has a different reflective or radiant ability, for example, water itself, has a high reflective action but very slow radiant ability, which provides us with a long range of heat accumulation and movement. Water is actually a very good material to work for night passive heating purposes as well as stones, diffused stones in the landscape do the function of suntraps and if near a water pond the effect enhances [131].

Follows a breve selection of focused illustration explaining the possible alterations, which applications can be considered.



86. Radiant and reflected energy by thermal masses: walls, plants, ground, stones [132]



85. Air flow in a Regeneration Area Under a Screen of Old Trees, arrow indicate intensity as well as direction of air currents [133]

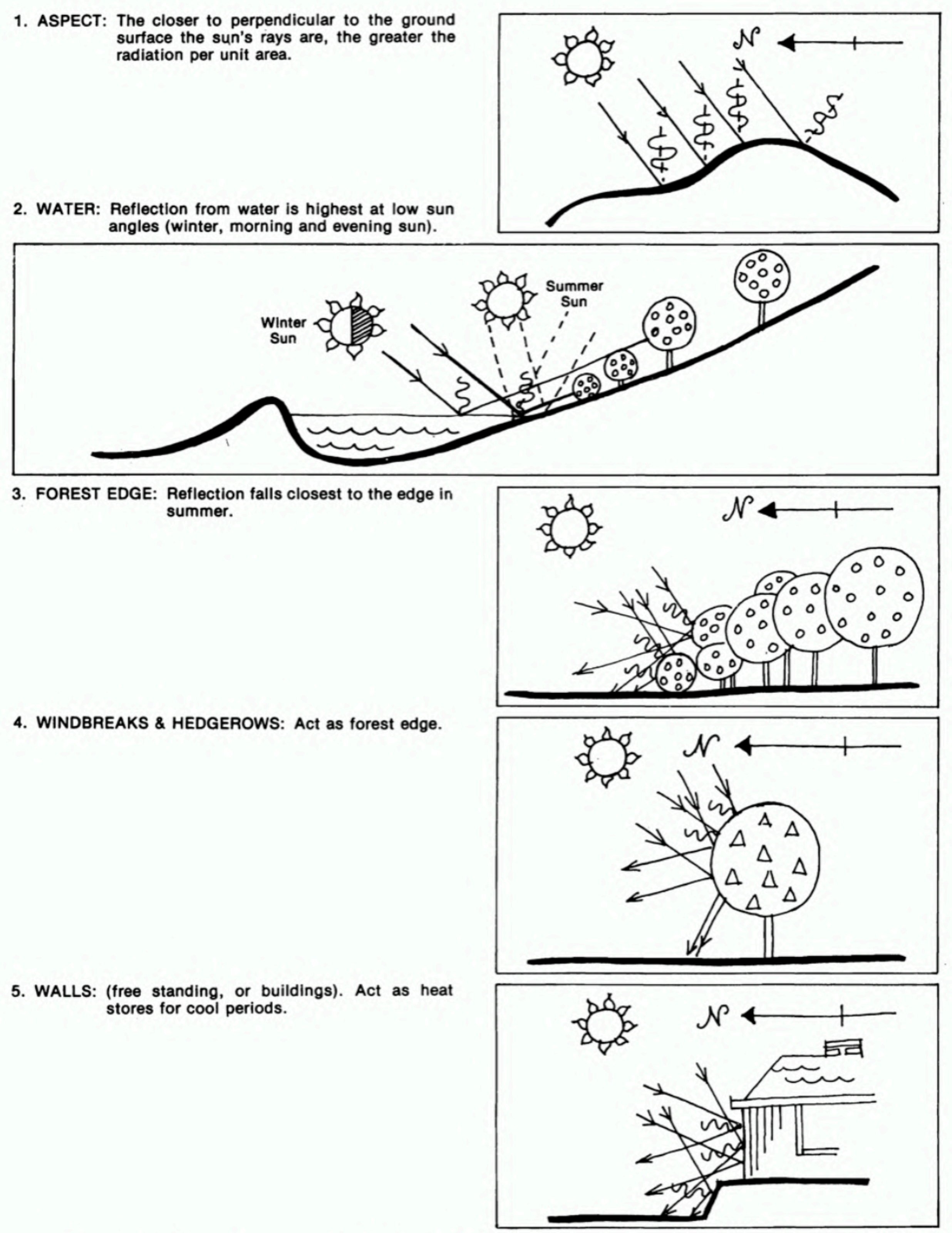
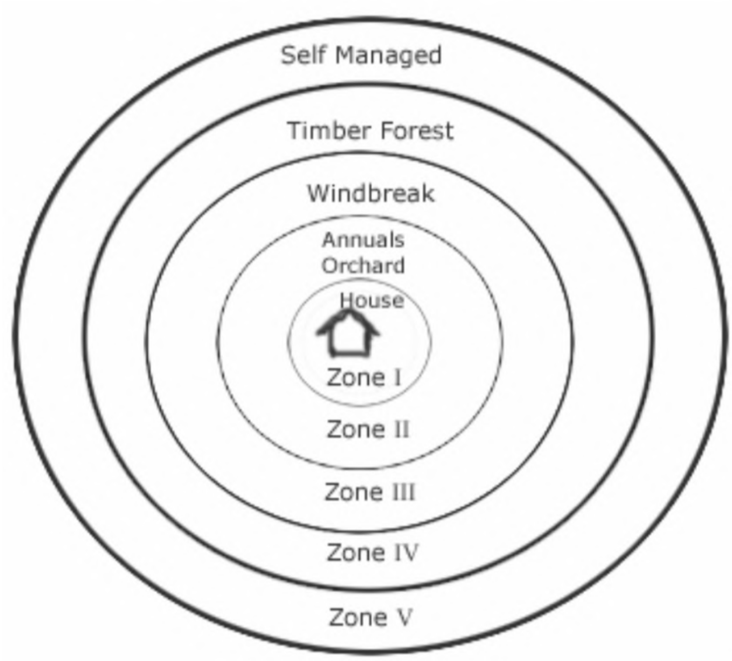


Figure 6.3.6.1 Elements Useful for Increasing Radiation and Raising Temperatures at a Particular Locality
Arrows indicate sun angle and reflection; sinuous lines are radiated heat.

2.3.4.8 Zones of use

The definition of zones of use is strictly related to the human integrated activities in the ecosystem of the settlement.

The main criteria guiding the disposition of the spatial relationships and its integrated activity zones and functions is the time requirement of the human presence, so the frequency of needs that find responses in resources in the zones. For example, the house building is the centre of main human activities, so the most frequented. Functions that covers are , for example, the shelter where to sleep and process most of the products of the yield from the polyculture systems.



87. Zones orientated in an ideal radius representing distances [134]

Two factor questions to answer relatively to the decision of where to position what are:

1) How many times do we need to visit the plant, animal or structure?
2) How many times do plants, animals structures need us to visit them? [134]

All the perspectives of needs have to be considered to set the best conditions for a sustainable long-term maintenance activity. More is considered and managed in the beginning there longer is going to last.

Zoning is not a rule but a choice we have to face for management purposes.

The following table in the figure gives examples of activities and their requirements to consider.

TABLE 3.3:
SOME FACTORS WHICH CHANGE IN ZONE PLANNING AS DISTANCE INCREASES.

Factor or Strategy	ZONE I	ZONE II	ZONE III	ZONE IV
Main design for:	House climate, domestic sufficiency.	Small domestic stock & orchard.	Main crop forage, stored.	Gathering, forage, forestry, pasture.
Establishment of plants	Complete sheet mulch.	Spot mulch and tree guards.	Soil condition-ing and green mulch.	Soil conditioning only.
Pruning and trees	Intensive cup or espallier trellis.	Pyramid and built trellis.	Unpruned and natural trellis.	Seedlings, thinned to selected varieites.
Selection of trees	Selected dwarf or multi-graft.	Grafted varieties and plants managed.	Selected seedlings for later grafts. by browse.	Thinned to selected varieties, or
Water provision	Rainwater tanks, bores wind pumps. reticulation.	Earth tank and wells, bores,	Water storage fire control.	Dams, rivers, in soils, dams.
Structures	House/green-house, storage integration.	Greenhouse and barns, poultry sheds.	Feed store, field shelter.	Field shelter grown as hedgerow and woodlot
Information	Stored or generated by people.	In part affected by other species.	As for II.	Arising from natural processes.

88. Some Factors which might influence the zone planning choices [135]

2.3.4.9 Soil & Fertility

For everybody interested to understand and use soil properties as resource for production, the book "Secrets of the soil" can be considered as the "Bible of Soil" based on Rudolf Steiner's work [136]. In it are explored al the possible considerable soil life potential and existing relationships, which cannot be explained all in this thesis because they touch layers and levels not relevant at this stage of scoping. The following examples extrapolated from different sources are going to be already enough to enhance the importance of soil and its fertility, its composition and fertility building technics.

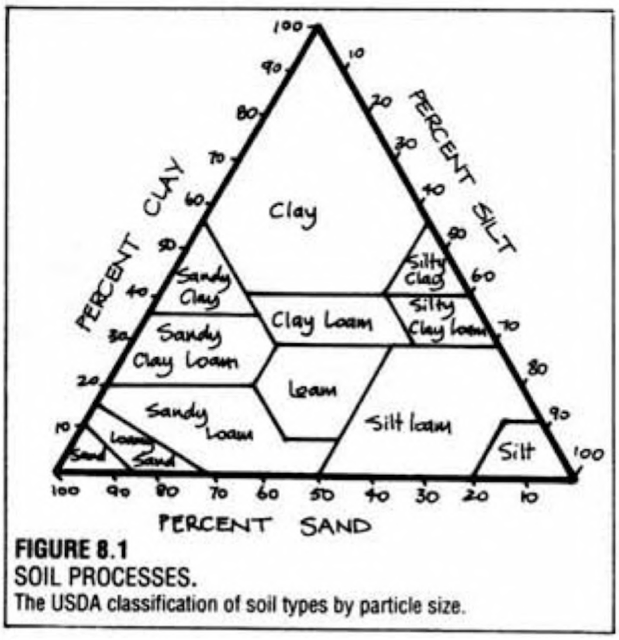
2.3.4.9.1 Soil composition

The soil composition is not homogeneous and has different criteria to classify it. One is shown in the pyramid in figure 89 which orientates on percentages of clay, silt and sand. According to the proportions soil gains different qualities in this case the classification is based on particles size which provides the following qualities:

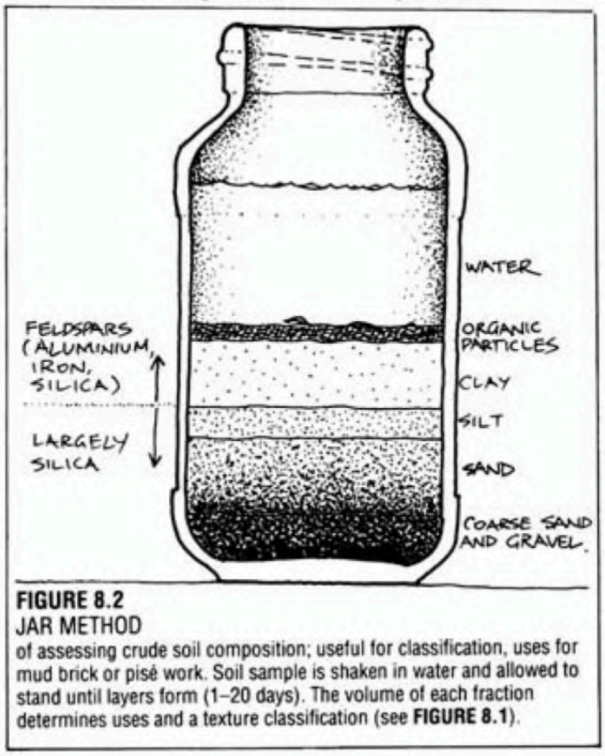
CLAY
thin granularity
high mineral source
high water retention

SILT
medium granularity
medium mineral source
medium water retention

SAND
big granularity
low mineral source
high water drainage



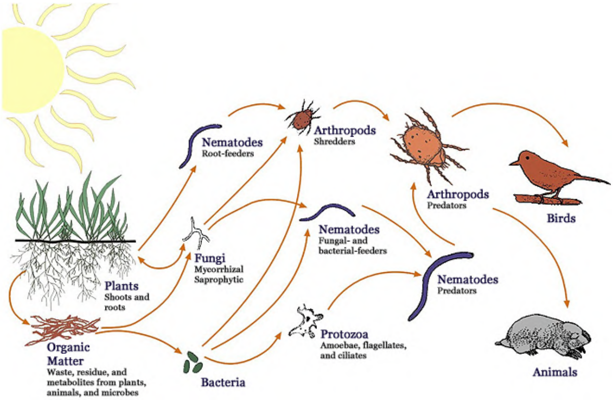
89. Soil composition processes [137]



90. Jar Method, verifying soil qualities [137]

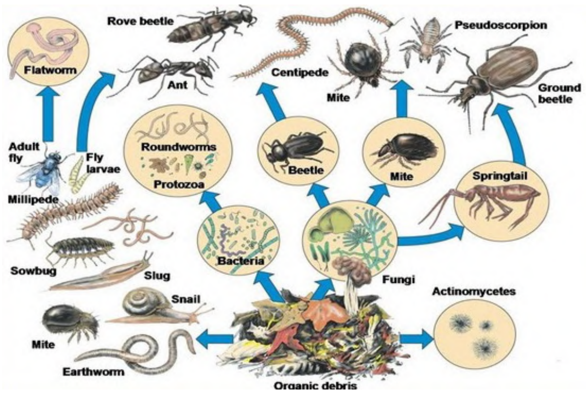
A classical analogue test to verify the presence concentration of these is by shaking about 5-10 minutes a jar with a sample of your soil with water and let it deposit it will stratify and the possible layers that can be found are explain the figure 90. As it can be seen in the jar organic particles or commonly called **organic matter** is only a little percentage of soil but is the richest in diversity. According to FAO 'Organic matter includes any plant or animal material that returns to the soil and goes through the decomposition process. In addition to providing nutrients and habitat to organisms living in the soil, organic matter also binds soil particles into aggregates and improves the water holding capacity of soil. Most soils contain 2-10 percent organic matter [138].' It has to be considered also that 'most soil organic matter originates from plant tissue. Plant residues contain 60-90 % moisture (H_2O). The remaining dry matter consists of carbon (C), oxygen (O), hydrogen (H) and small amounts of sulphur (S), nitrogen (N), phosphorus (P), potassium (K), calcium (Ca) and magnesium (Mg). Although present in small amounts, these nutrients are very important from the viewpoint of soil fertility management. However, even in small amounts, organic matter is very important [139].'

Another important aspect to consider is that soil is hosting a own ecosystem where millions of creature, including plants roots, have their food resources.



91. Kinds of creatures living in the soil web

© *NRCS Soil Biology Primer.* [140]

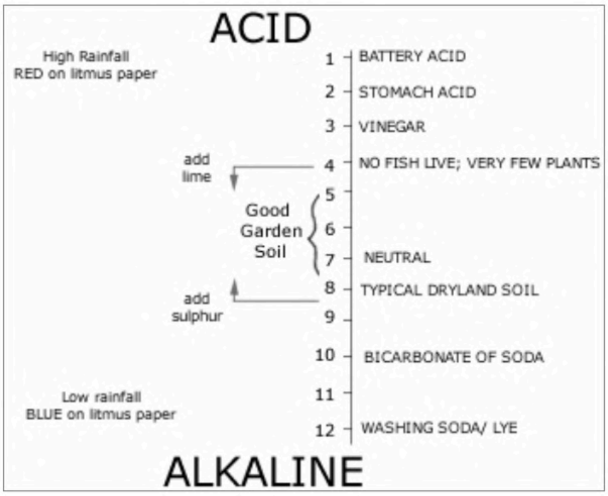


92. Example of creatures living in and of organic debris in the soil ecosystem [141]

2.3.4.9.2 Indicators of Soil Health

As summarised by Weiseman there are indicators of conditions that serve for soil's health listed in the following list:

- Earthworks and the presence of organisms;
- Colour of organic matter;
- Presence of plant residues;
- Condition of plant roots;
- Degree of surface compaction;
- Soil tilth and friability;
- Signs of erosion;
- Water holding capacity;
- Degree of water infiltration;
- Movement of water in the soil profile;
- Regeneration of groundwater reserves
- pH (acidity)
- Nutrient holding capacity [142].



93. pH scale relatively to soil qualities by Bill Mollison [143]

For example, the pH measurement is a good indicator of the kind of mineral composition in the soil, for example, sulphur concentrations contribute to the acidity of the soil, its presence sets a predisposition of plants that like acidic soil as for example blueberries and potatoes. There are also different sources that contribute to the acidity of the soil which come from the root emissions of other plants, like pines, and from the SO_2 deposition on/in soil by the rains of our emissions, particularly from coal burning activity for energy production purposes.

Nitrogen rich soil:
Chickweed *(Stellaria media)*
Stinging nettle *(Urtica dioica)*
Annual nettle *(Urtica urens)*
Cow parsley *(Anthriscus sylvestris)*
Hogweed *(Heracleum sphondylium)*
Elderberry *(Sambucus nigra)*
Common orache *(Atriplex patula)*
Goosegrass *(Galium aparine)*
Shepherd's purse *(Capsella bursa-pastoris)*
Fat hen *(Chenopodium album)*
Mugwort *(Artemisia vulgaris)*
Nitrogen poor soil:
Sweet vernal grass *(Anthoxanthum odoratum)*
Sheep's fescue *(Festuca ovina)*
Mouse-ear hawkweed *(Hieracium pilosella)*
Corn chamomile *(Anthemis arvensis)*
Broad-leaved thyme *(Thymus pulegioides)*

Alkaline soil:
Meadow clary *(Salvia pratensis)*
Pheasant's eye *(Adonis aestivalis)*
Forking larkspur *(Consolida regalis)*
Salad burnet *(Sanguisorba minor)*
Betony *(Stachys officinalis)*
Sanicle *(Sanicula europaea)*
Blue moor grass *(Sesleria varia)*

Acid soil:
Sheep's sorrel *(Rumex acetosella)*
Bracken *(Pteridium aquilinum)*
Heather *(Calluna vulgaris)*
Bilberry *(Vaccinium myrtillus)*
Corn chamomile *(Anthemis arvensis)*
Creeping soft grass *(Holcus mollis)*
Wavy hair grass *(Avenella flexuosa)*
Mat grass *(Nardus stricta)*

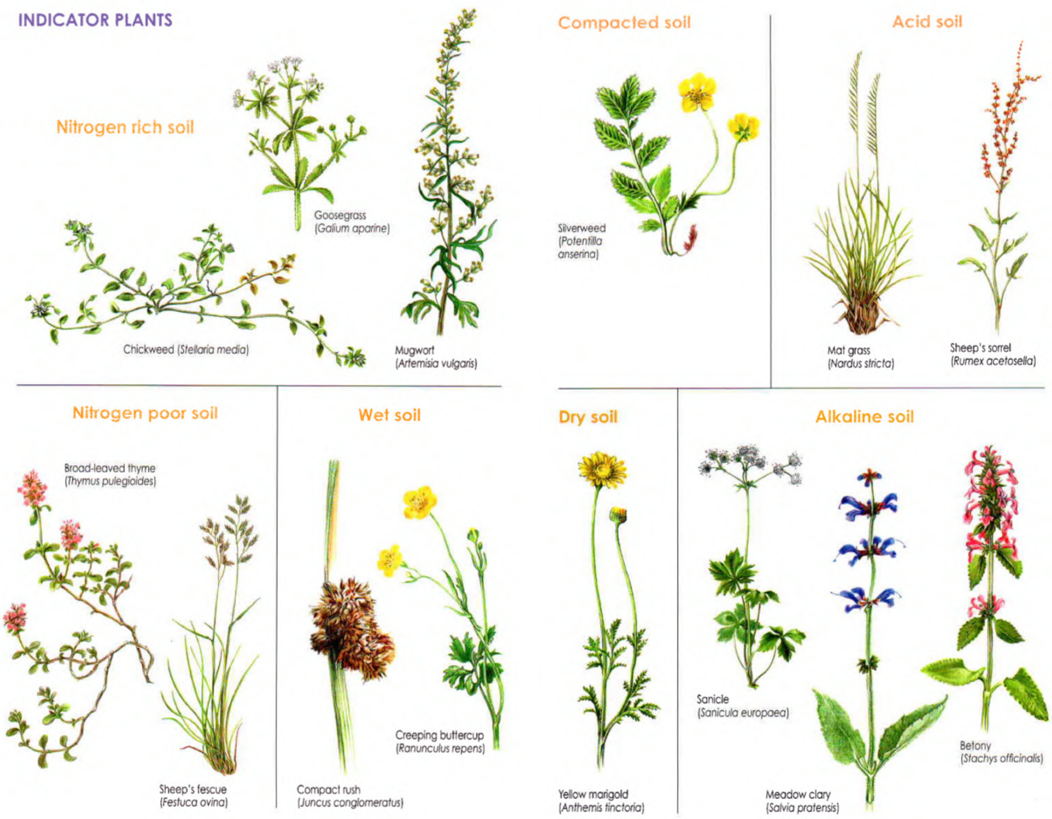
Dry soil:
Bugloss *(Lycopsis arvensis)*
Whitlow grass *(Erophila verna)*
Broad-leaved thyme *(Thymus pulegioides)*
Golden marguerite *(Anthemis tinctoria)*

Wet soil:
Wood club rush *(Scirpus sylvaticus)*
Purple moor grass *(Molinia caerulea)*
Corn mint *(Mentha arvensis)*
Creeping buttercup *(Ranunculus repens)*
Coltsfoot *(Tussilago farfara)*
Soft rush *(Juncus effusus)*
Compact rush *(Juncus conglomeratus)*

Compacted soil:
Field horsetail *(Equisetum arvense)*
Dandelion *(Taraxacum officinale)*
Greater plantain *(Plantago major)*
Silverweed *(Potentilla anserina)*

94. List of plant indicators

As announced with these examples, the presence of certain plants is indicator of soil conditions, Sepp Holzer provides us with a short list in the alpine context where he is from: figure 94-95. [144].

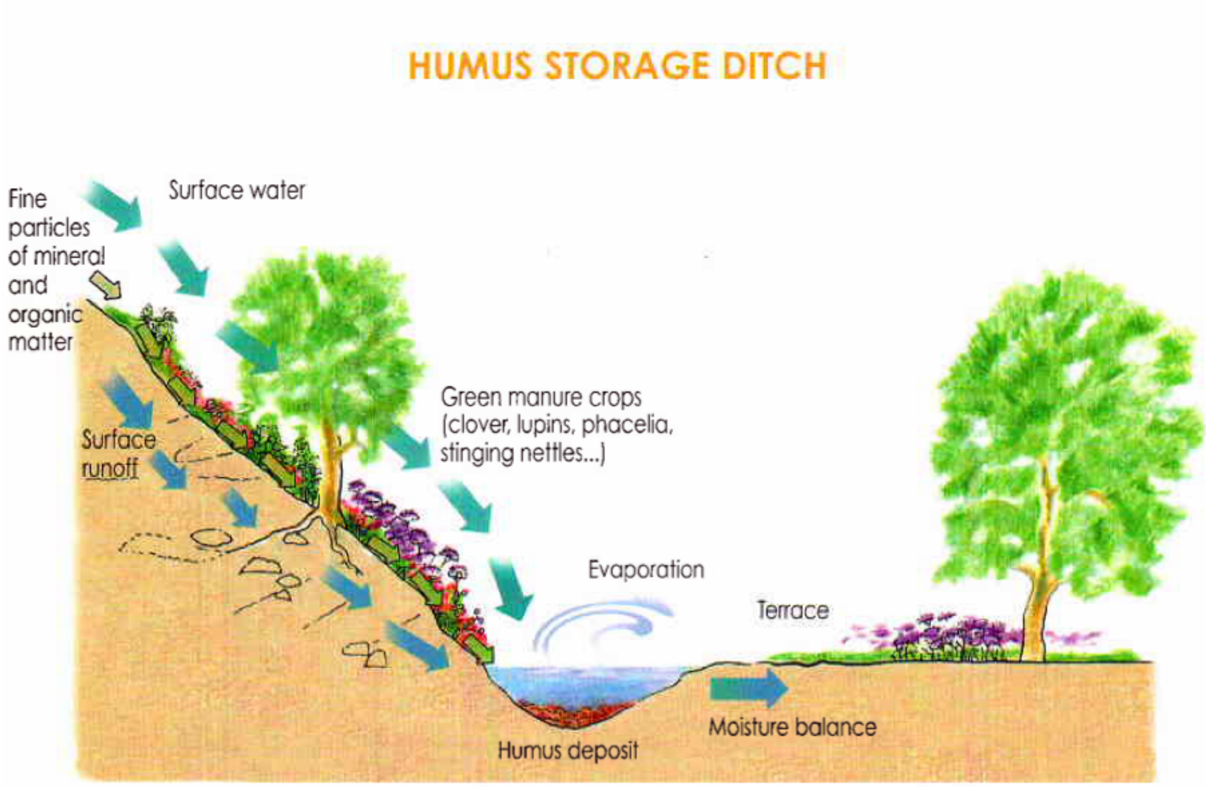


95. Briefly illustrated list of indicator plants

In any case, to allow diversity to spread in a small area, the diversity of nutrient has to be built with technics of low maintenance and cycling property.

2.3.3.4.2 Terraces fertility management

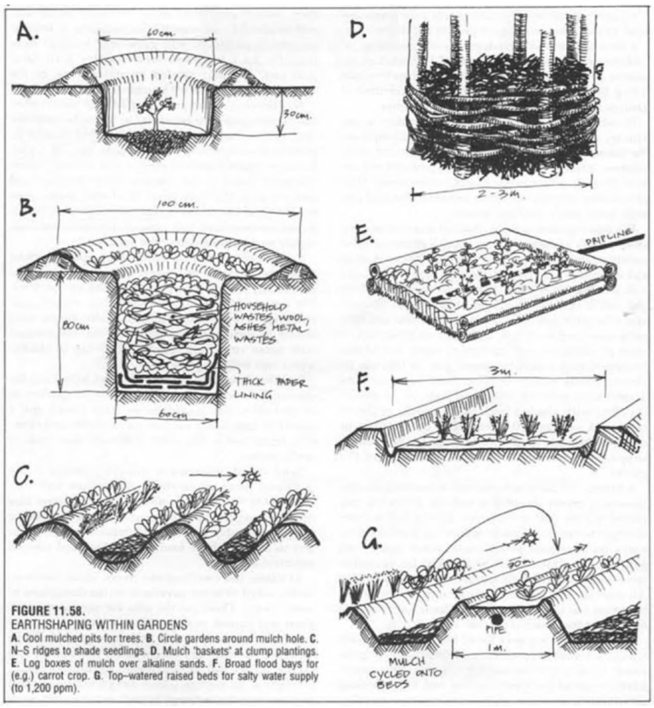
Since the last mentioned is Holzer, already highly recognised in his terracing technics another functionality of those technics is their humus storing ability. The humus storage ditch technic uses the water run off movement that with it collects mineral particle and organic matter as shown in the following figure.



96. Humus Storage Ditch [145]

2.3.3.4.3 Working with soil: Mulching and Composting

Using the terraforming as mentioned above is already a good collaboration with soil, the next collaboration is in contributing in its fertility building. The technics are many but can be categorised in to kinds **mulching** and **composting**. Mulching is nothing more than composting on the soil surface by spreading organic matter of "green manure" which includes: leaves, straw, cardboard and plants as clover, lupins and mustards, very often these plants in the function attribution of their existence in the systems is to "chop and drop" them as green manure. The mulch acts as a protective ground cover which prevents soil erosion and drying out contributing to maintain a humid microclimate and water resource to the plants.



97. Mulching uses according to the landform purpose technic [146]

Composting is a soil integrated method, the characteristics of which technic will be adopted can have a slow digestion process, typical for pile composting outdoors which decomposing action is based on internal heat creation. Two others are if the process involved is **anaerobic** based which, counting on microbes and bacteria activity that usually involves a fermentation process, or **aerobic** based which uses nematodes eating and digesting activity to process and decompose the organic matter in a form of which plants can absorb nutrients. The most common technics applying this to principles in a small scale are called Bokashi Compost Bin and Earthworm Compost Bin.

The Bokashi technic is anaerobic and uses the fermentation process of bacteria, the process is really fast and is able to decompose also meat and dairy products, the only disadvantage is that once the process is done the product cannot be used immediately for plants because the bacteriological activity creates a very acidic environment in which they thrive.

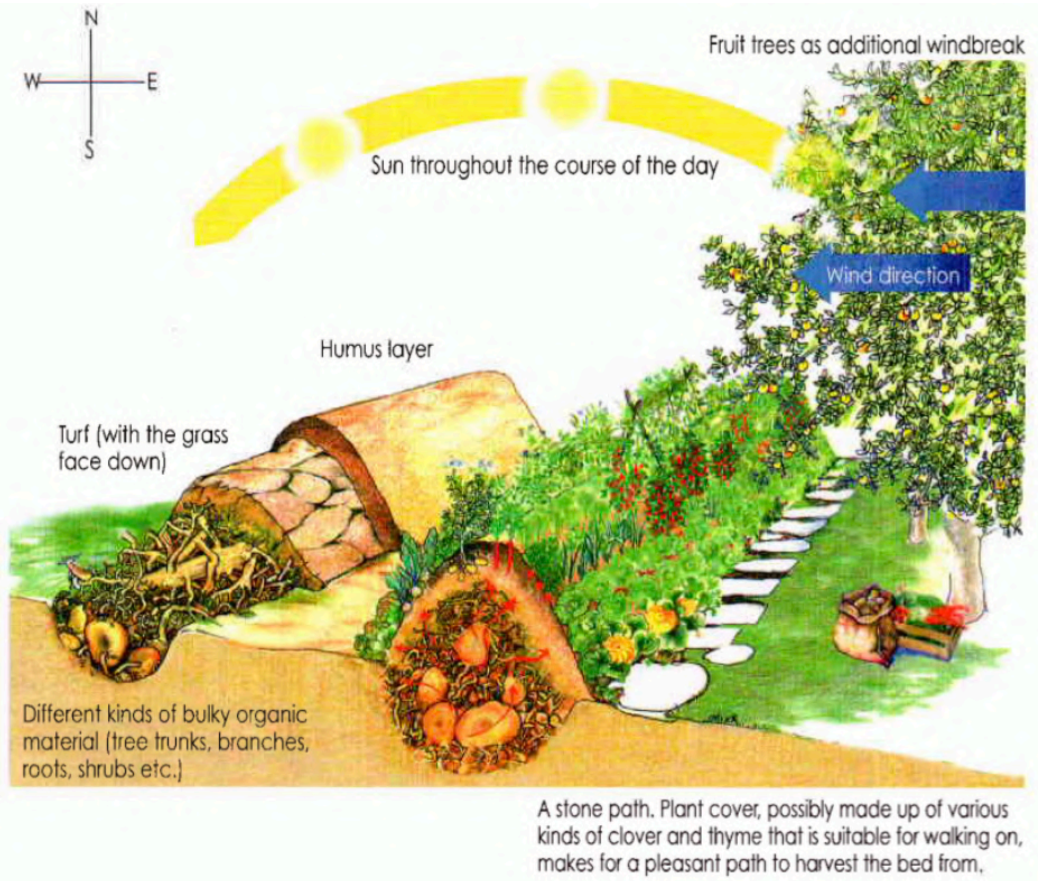
The Earthworm composting technics include worms as main decomposer. Their digested product is ready to be used and their activity is easily integrable in vase systems as demonstrated by several examples in the entire garden system based on **vermicompost** at Olomana Gardens by Glenn Martinez.

99. PVC tube cutting © Olomana Gardens by Gleen Martinez

98. PVC tube is a food reservoir for worms in the soil © Olomana Gardens by Gleen

More in detail about how does worm compost bin work can be seen in the **test case 3.3.1** done in the workshop with ZeroWasteShanghai group by the author.

Another very good example of integrated decomposing activities is what does the **Hugelkultur** technic do, explained through the example of Holzer's use of it in raised beds form.



100. Raised beds by integrating hugelkultur technic by Sepp Holzer

The hügelkultur technic, even if is not called like that by Holzer himself, is a long decomposing process based on woody material that creates volume, the wood retains water which plants can absorb and meanwhile their rotting action under water exposure relies nutrients for plants and other organisms present in the soil. The decomposition and cultivation happens simultaneously and the raised form allow a better distribution of plants according to their light needs, the height makes it even more comfortable the harvesting process. This formation contributes also to manage winds and create microclimatic areas with more favourable conditions.

Every element finds its role integrated with many functions for the ecosystem.

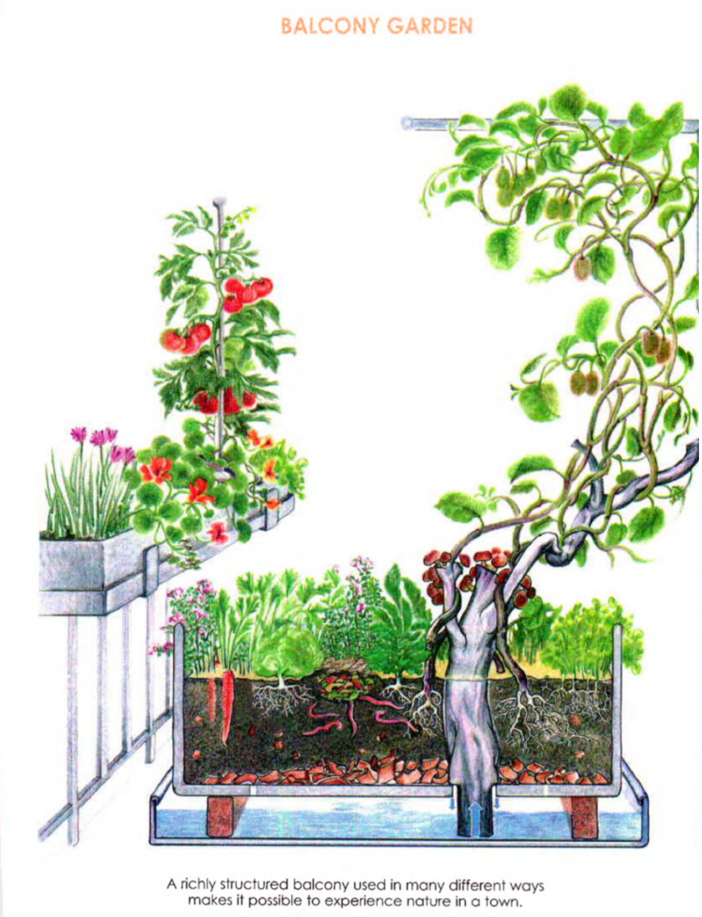
2.3.4.10 Aesthetic

Aesthetic function and attiribution to nature is a cultural fact of humans appreciation. It defines forms in which people feel confortable to be in relation with natural environment. Recognisable patterns, colors and flowers, dedicated places for contemplation are all elements that make people take time to contemplate the magnificents beauty of Mother Nature.

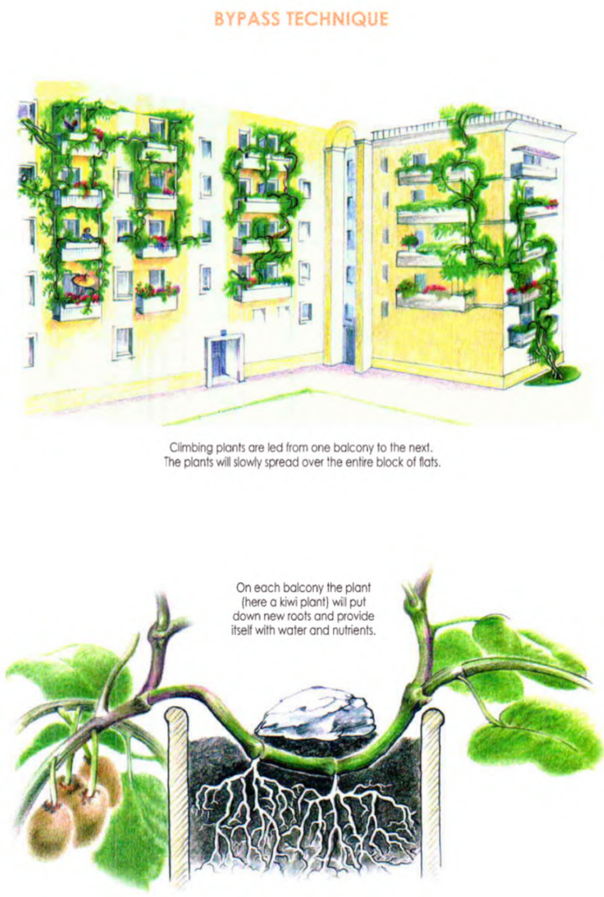
2.3.5 Permaculture in Urban

101. Urban gardens potential explained by Sepp Holzen

Permaculture methods and attitudes are scalable and adaptable at every context. The adaptability is given by the permacultural integrative behaviour towards needs. Is not necessary to think big to work with nature a part of gardens which might seem still big realities which space is disappearing in cities also a balcony or a windowsill with few culinary herbs is enough to experience nature changes and provisions.



103. Sepp Holzen's suggestion example for life integration



102. Sepp Holzen's suggestion example kiwi plant shared provision

Considering what we have, how these can provide for us and how we can set the conditions of di provision to regeneratively happen is already a behaviour that aligns us to a long-term vision and the culture permanence of it. Many are the considerations that can be done and for some of them the effort is very small requiring, but what really counts and remains impressed of them is experiencing the changes, the growth, the tastes, the utilities we can have and keep having by allowing their maintenance to happen. Permaculture is not only about self-sufficiency as mainly identified, but especially in an urban environment, is more about understanding permanency, what does require and how does occur the sustainment of a permanence.

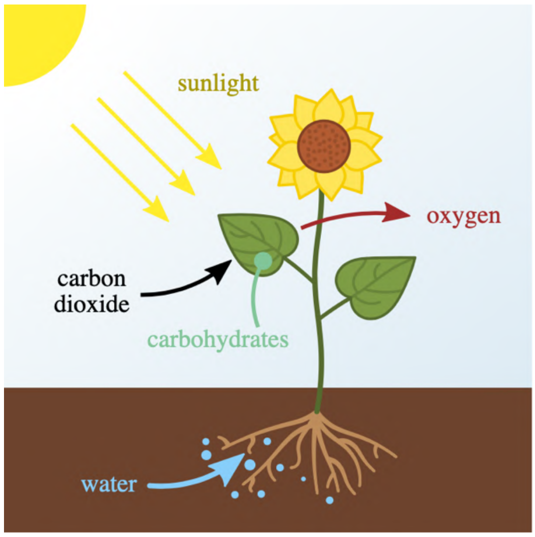
Holzer enhances [147] the importance of gardens and gardening activities in cities mainly with the concern of children growth detached from nature. Nowadays emerging urban issues as climate change, air pollution, water scarcity, space scarcity, food safety, etc, that citizens are starting to feel as threat of their permanence, makes questioning about how to reinvent the provision for our healthy sustainment? And especially how to respond to future needs of our children, how they might possibly live in the future, and how they might face and reinvent their future if they never learned recognise the basics for life?

2.3.6 More about Plants Processes as Resources

Aspects to consider about functionalities from plants as indivduals are: photosynthesis process, which involve negative ions production, their different utilities as already introduced in their ecological functions which provide ecosystemic services and permaculture practices and what uses humans can do out of their properties. Another use is their properties studies to find sources of reinterpretation in the technological world.

2.3.6.1 Photosynthesis

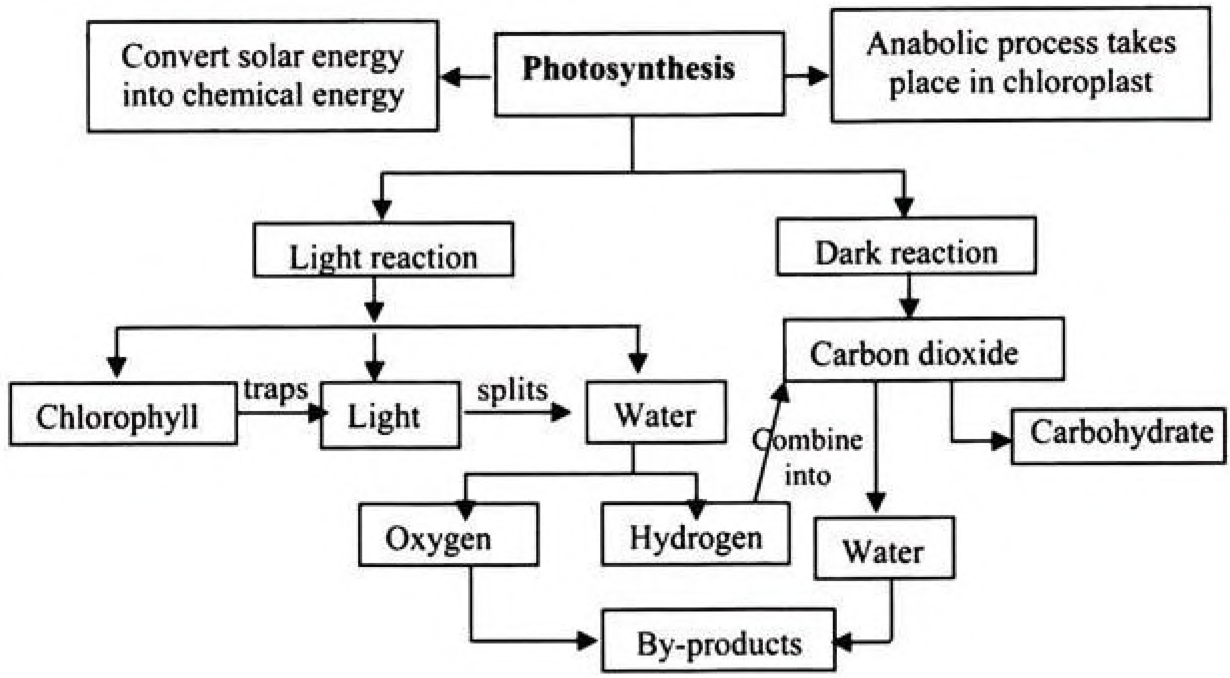
Photosynthesis is the commonly associated respiration process of plants but is actually also a food providing process that produce glucose (carbohydrates). This is contributed by chloroplasts, where the entire photosynthesis process takes place, in them is contained chlorophyll which is the pigment that gives to plants the green colouration. There is also a subcategory of chloroplast which take place in the stomatal cells with the name “stomatal guard cells” which manage the stomatal opening. Stomata are the leaves’ epidemic pores which are the accesses and exits for carbon dioxide, oxygen and water (from evapotranspiration process).



104. Energy from sunlight, water absorbed by the roots and carbon dioxide from the atmosphere produce glucose and oxygen by photosynthesis. ©At09kg : originalWattcle : vector graphics [CC BY-SA 4.0 (https://creativecommons.org/licenses/by-sa/4.0)] [148]

2.3.6.1.1 Classical Photosynthesis process

The normally considered photosynthesis process is the ancestral photosynthesis type which is the most common, in biochemistry is defined C_3, there is also C_4 which behaves the same, the only difference is only in a capacity terms of CO_2 quantity absorption. C_4 typical in grasses. An evolution found in some intermediate plants is their ability to adopt their modus between the two types according to the environmental circumstances [149]. What counts in all these is the light quantity orientation (day/night) for activating the several processes as schematised in the following figure.



105. Photosynthetic process [150].

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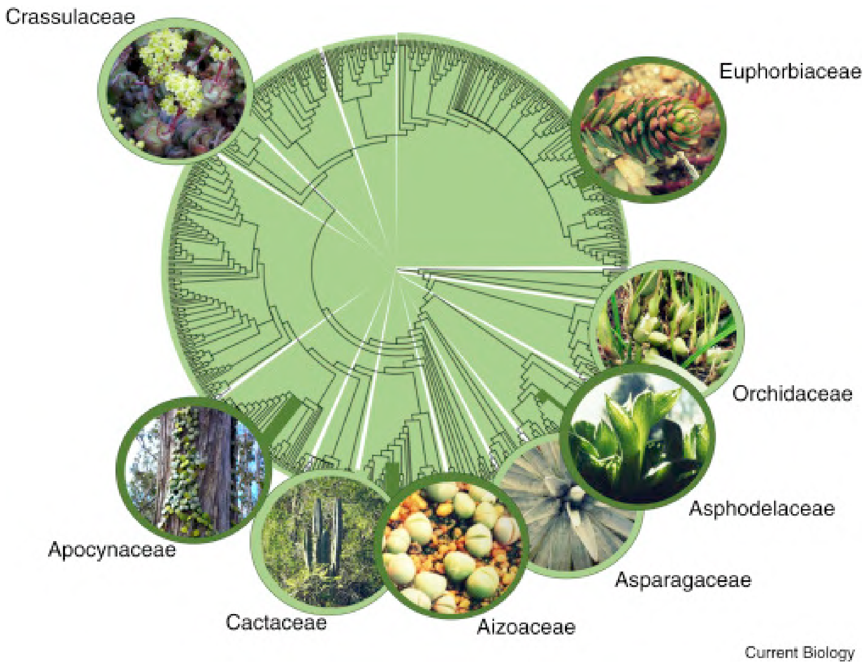
2.3.6.1.2 Crassulacean Acid Metabolism (CAM)

The CAM process is an evolution for extreme adaptation in very dry, hot and highly light exposed conditions. The aim of these process is in water conservation and by as saving water strategy has the result of a slow growth process. This photosynthesis is typical of crassulacean plants which is the biggest family under the commonly used category name “succulents”, families map in figure 106 [151].



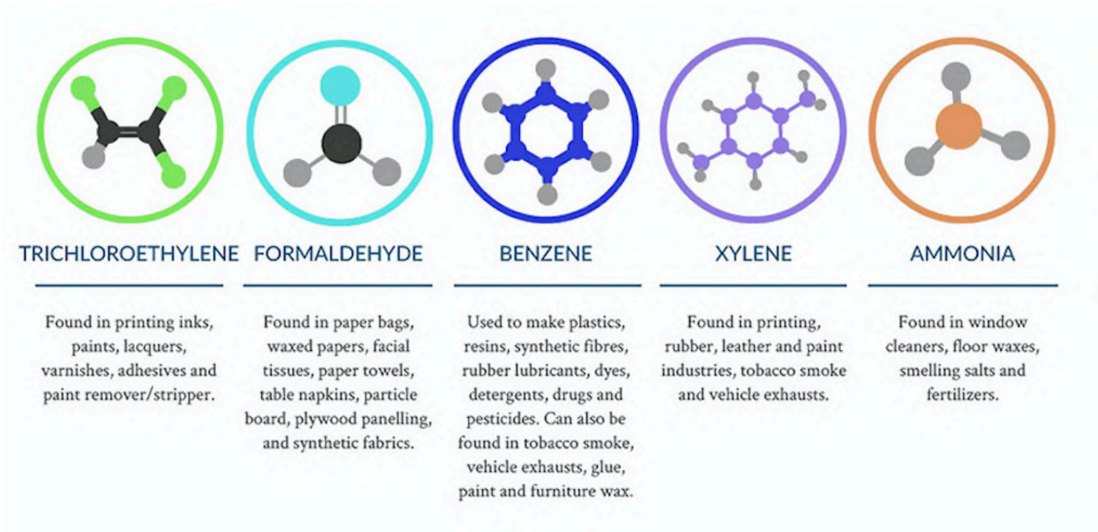
106. ‘Phylogenetic distribution of some major succulent plant groups across the angiosperms. Phylogeny based on data from Smith et al. (2011) [151]’

On contrary to a common believe, succulents do not stay in totally arid places, the rainfall may be infrequent but the bioregion must have a relatively fixed recurrence in water availability. These plants occur also on fog’s or dew’s moisture as water resource. Because of the water saving attitude which gives correspondence in energy saving for their photosynthesis, which exists also to respond to low concentrations in CO_2 in the environment, succulents CO_2 fixation and storage happens by night. At night when the temperatures drop and so also the moisture in the air they can open their stomates, maintained closed during the burning day to limit evapotranspiration processes, capture, transform and accumulate preventively some extra CO_2 [152]. From human needs perspective it is considerably useful notice that the oxygen emission of these plants happens by night and not during the day as other plants.

2.3.6.2 Air cleaning plants

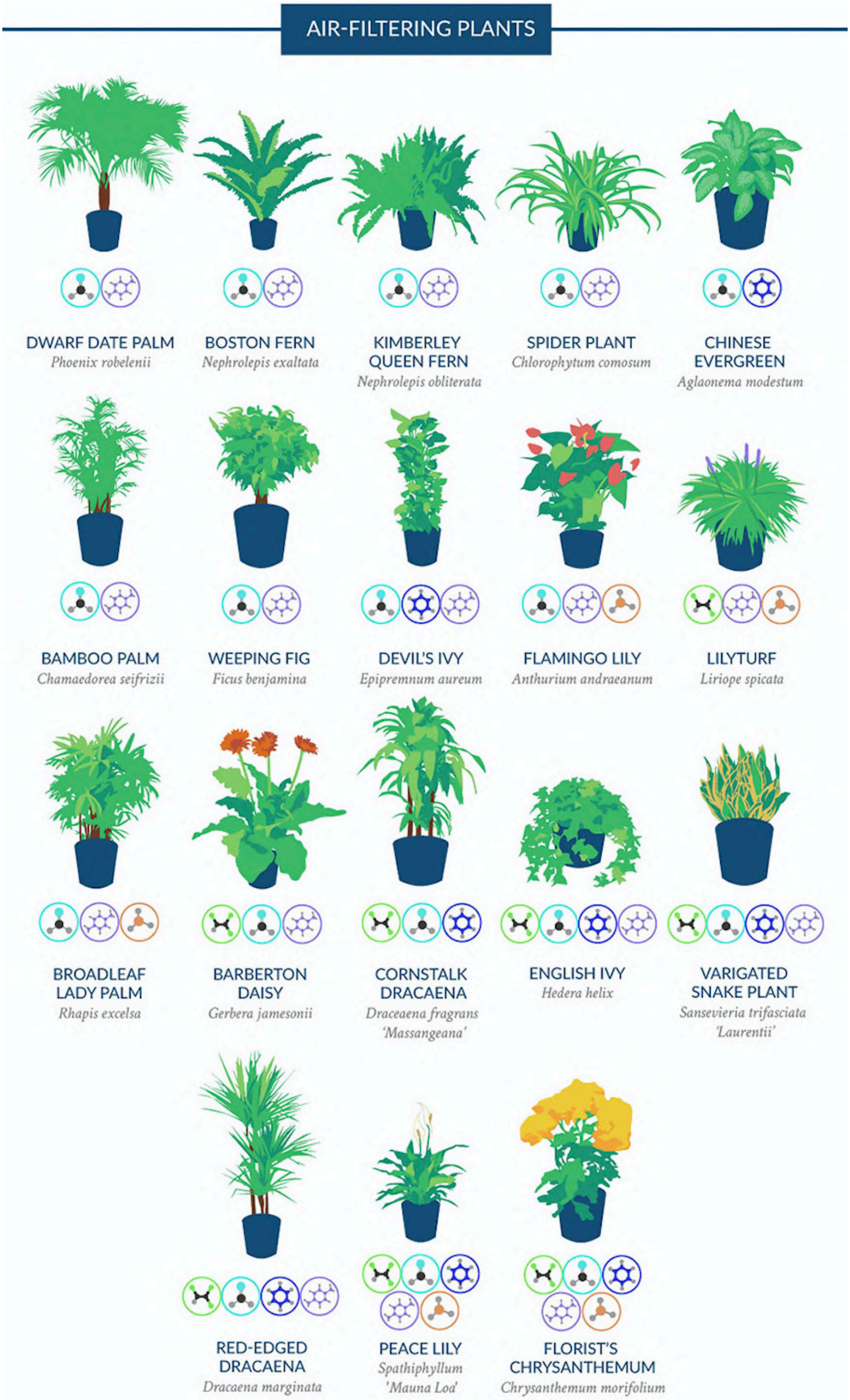
Using air cleaning focused plants to manage the air quality conditions of our environments is a very common start to integrate plants citizens aesthetics functions with a more useful one as air management contidions. They are many accesseable lists on the web which mostly derivate from NASA reported selections and researches [153].

Some lists encounterable in reference [154] [155] indicate also pollutant absorption plants predisposition, as carbon monoxide or some VOCs (benzene, xylene, ammonia, trichloroethylene, formaldehyde) which are commonly found and emitted from some domestic materials as paint and cleaning products, which long exposures may affect our health.
CO_2 balancing concentration is something that every plant can do since they feed themselves out of it. They are the only ones that produce oxygen and are able to provide a balancing condition to the CO_2 emissions produced by all other creatures in the world.



107. Visualisation of considered pollutants by NASA study [154]

Another very concerned air pollutant is Particulate Matter (PM) already explained in Chinese case (2.2.2.2), which is basically dust made of different materials in very small dimensions. These do not get absorbed and metabolised by plants as the other volatile compounds already mentioned, but there is a phenomenon caused by the photosynthetic process of plants which is the **negative air ions** (NAI) production. The NAI emissions are unipolar ions that electrically charge volatile fine particles and make them precipitate on a nearby surface contributing so to clean faster the atmospheric environment from these fluctuations that compromise human health if inhaled in high concentrations for long period of time, and which effects depend on people's endurance [156]. Another series of indoor air plant benefits explanation as energy savings and healthy environments is given by the researcher Kamal Meattle in in the TED talk 'How to grow fresh air'[157].



108. Illustrations of air filtering plants from NASA research criteria [154]

2.3.6.3 Plants infracommunication: Neurobotany

As it can be read already from the figure relatively to 'Trees in a whole system' (2.3.4.5.3) plants communicate between each other through the soil web channel and the atmospheric channel as well explored by Stefano Mancuso and František Baluška under umbrellas of Neurobotany and Neurobiology.

They emit chemical signals in the air according to the circumstance which allow them to communicate with their sybling about dangers and meteorological changes from a place to another and they adopt their strategies for protection. These chemical traces are a language that unfortunately people cannot understand directly, only with detecting tools but of sometimes we can see the effects of these comunications as flower or leaves closing actions. In researching about this language is been discovered that every genus has a different chemical frequence, which is identifiable as a own language, which can be understood by closer genuses based plants as does behave the understandign between close dialects [158]

Plants have senses and intelligence as explained well in Brillian Green [159] even if they do not have a brain but the sounding activity o re-elaboration of what we cosider the fucntioning brain work is the same as plants roots system. Plants are decentralised living systems, every element, root, branch leave has a own working and generative function that comunicates with the other parts of the entire body.

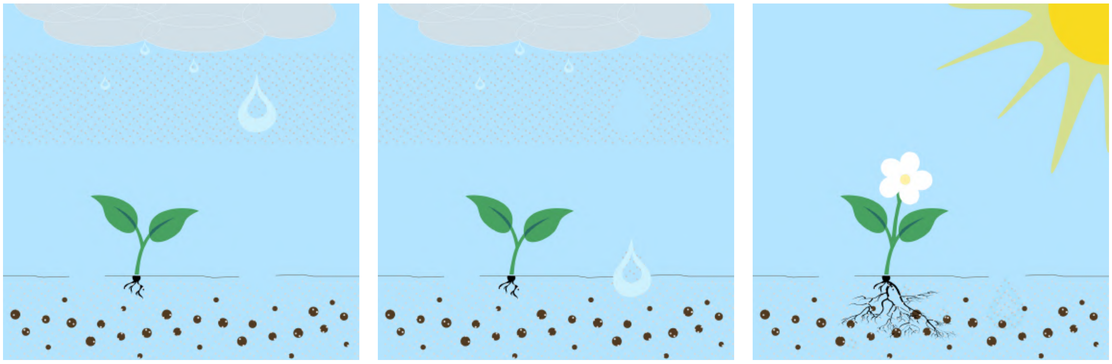
Roots are better sounding technology in terms of efficiency than what a robot can do. Relatively to this there are studies working analysing these relations systems of plants and how do work on bio-chemical - physical layers which are inspiring for reinventing robotics approaches as is been done with the Plantoid Project [160].

In conclusion, plants can do much more than people commonly consider they are able to.

2.3.7 Climate Change Effective Principles by Using Plants

Since this thesis uses the topic of Climate Change as a filter to enhance the relevance and potential of working with plants to respond at its spreaded issues as commonly associated effects by the public are **air pollution** affecting health, heat flows exchange and **floods** causing soil erosion, water losses and built infrastructure damages and **extreem weather** changes.

An example to start understand the potential of small spread actions to mitigate climate change effects, follows in the next illustration which shows the **cyclic cascade effect** by focusing on dust flutuations in a micro scale. This effect is explained by Wayne Weiseman and the figure illustration is based on his explanation [161] [1].



The Dust in the air phenomena defined as Pollution is a mixture of Particular Matter which is composed by several potential minerals and organic matter for the soil.

When it rains the water drops by falling capture the particles with them to the ground. The surface structure is going to direct the rain fall deposition or flow circulation.

The rain drops penetrate in to the structure of the soil bringing the minerals and organic matter with them enriching the soil. Plants root systems looking for the water are going to absorb some of these.

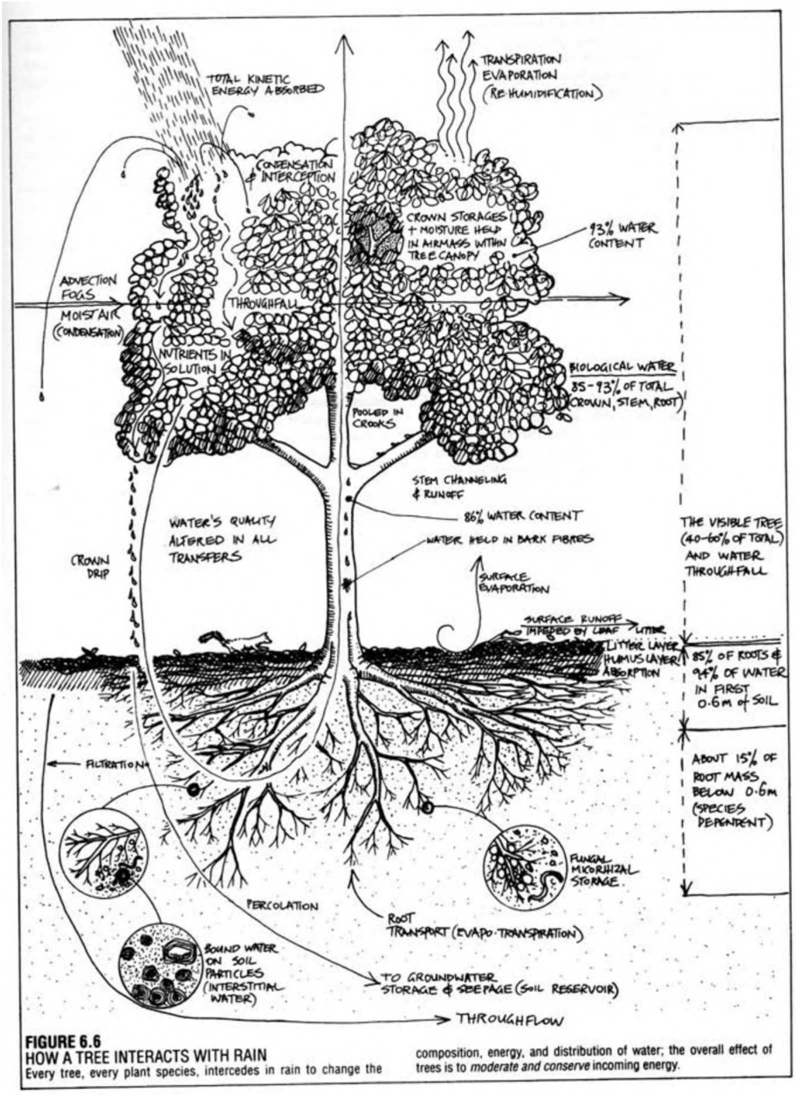
109. Illustration sequence of the cyclic cascade effect starting from dust as air pollutant in a micro scale. Graphic and Design: Jelena Sučić [1].

If we manage already to allow this happen as much as possible we are contributing to the alleviation/mitigation of climate change effects relatively to air pollution. To recognise the effectiveness of these illustrated cascade a refreshment of common relative cycles may help and follows.

2.3.7.1 Hydrologic cycle and Forest interception

The perceived temperature and humidity change effects are resulting from the constant moisture exchanges between the air, water and soil spheres. The water presence recovering in depth land layers is part of the cycle process we have to contribute improving in small and bigger scales and especially in the urban scale, to avoid letting it run off and directly deposit in the oceans, where is required more sun energy exposure (because of the salt) to bring back that run off water in the cycle movement stages [1].

The forest system structures are resources of inspiration for slowing water run offs. For example, forests intercept the rainfall through its layers levels. The rain drops get slowed down by falling on leaves and branches because of their material properties an forms , till they end into the ground. Structures applying retaining forces are soil structural qualities, leaves, branches, different heights and shapes. Their presence interferes with the gravity force (falling) working on liquid water state and with the sunlight evaporating exposure effect (heat makes raise vapour), the evapotranspiration process. The water state change caused by the mentioned actuating forces is faster in bare land or cities because of a lack in layers structure differentiation.



110. Focus tree interaction with rain by Bill Mollison

The forest system is cooler then cities because of its retainig layer differentiation, which affects the climate creating its own microclimate, improves the air quality because of the plants photosynthesis process.

The forest is a provider of shelter and food for creatures, its root system stabilises the ground, prevents soil erosion and landslides and is able to slows down winds [1].

Floods and **droughts** basically happen because the ecosystem structure was not able to retain the water arrival opportunities and distribute its movement. For this reason, permaculture design principles work a lot with the **landform** and vegetation diversification layering. The ‘water attraction factor’ is about what does initiate the **condensation process,** it happens when the vapour water particles in the atmosphere suddenly hit towards a cooler temperature sphere as the is forest sphere compared with the city sphere. In synthesis, forests are rain attractors [1].

2.3.7.2 Modern Agriculture Industry

Agricultural processe have a large impact on the planet [162] as understood already during the Open System project relative research emerge all the actual linear production system critical issues of resources supply for intensive monocultural production models. These are based on chemical industries (chemical processes emissions, greenhouse gases emissions, an energy requirements), not local suppliers (transportation and logistics effects), production processes are focused on few products but on massive quantities, seeds and treatments are designed as a package, composed of sterile seed, pesticides to protect the outcome of the seed (contribute to kill the balancing effect of biodiversity), chemical fertilisers (synthesis of N, K, P, in a form that the plants are not able to absorb properly, causing an excessive presence of them becoming pollution), soil exploitation and inefficient watering systems (ample flat land from which always the same nutrients get absorb by the crop conducting to the condition to prevent self-recovering), are just some of the main effects [1].

The monocroping attitude has the urgent effect of decimating species, in the vegetal world is been estimated that 60.000 species are risking to extinct. Today, people depend for the 90% of their needs on only 20 species of plants which genetical diversity is compromised and keeps declining because of constant narrowing selection processes [163]. The other pushing factor for the global market paradigms pretending to provide quantity standards, which are “defined” qualities and safety parameters (medical safety controls make enhance the ‘cleaning’ process of pesticides). As last the ‘abundance’ life standards rooted in the so called developed countries asks more than what is actually necessary motivate the market requests and initiate a wasting process [1].

2.3.7.3 Lifestyle

The choices and adaptations that dermine our lifestyles affect all the above-mentioned processes’ effects . The purpose and managing way of our diet, our land use, corresponds to the direction and production of **resources** through **behaviours**. For example, transportation needs and present options dictate our decisions and behaviour, and so, the relative effects. As noticed already under 2.2.6 Citizen's Emergence. Food choices do the same, many studies found effects and consequences contributing to climate change and how their guidance can contribute in developing sustainable behaviours and stimulating sustainable production requirements as explained by Kate Whiting [164][165]. Slow Food Movement, for example, has nutrition need as focus and works on building awareness in consumers about their food choise and how what they chose to eat makes them choose also all the behaviours and effects of the production chains and its climate change relations. Lead by the Movements, an interesting concept is emerged from Carlo Petrini's though, founder of Slow Food, which is about being a "co-producer". 'A co-producer is a consumer who knows and understands problems of food production: quality, economics and processing requirements, the culinary aspect. It's not just someone who consumes. It's that they want to know. [166]'.

To conclude, most effects depend exclusively on consumers/common citizens education, so our behavioural choices are very influential on the global effects [1].

2.4 Education Needs

As highlighted already from the governances is considered a persistent lack of education for citizens to be integrated in action planes aims and propositions. From above there is a perception of no possible collaboration with the populations and from below citizens are criticising government and institutions for not doing much for solving problems and providing for the city.

It has to be considered the fact that the level of language applied in institutional layers does not match with the general know-how level of groups of people which are composed by common citizens with different knowledge levels and backgrounds.

2.4.1 Emergences from Greta Thunberg Case

Greta Thunberg is a young Swedish student that at the age of 15 started to strike for the Climate. The beginning of her solo strike action was in August for two full weeks in front of the Swedish Parliament, then became every Friday strike by extending the message through posts on social media from which youth started to join her. Her declaration is that she is going to stop striking when Sweden will reduce to yearly 15% amount of national carbon emissions [167].

111. Thunberg during her Friday climate change protest. Photograph: Hanna Franzen/EPA [167]

Interesting is to notice Greta's background, a part for her syndrome condition which is not stopping her to react, is that she and her father, as reported by The Guardian, are descendants of Svante Arrhenius, 'the Nobel-prize-winning scientist who in 1896 first calculated the greenhouse effect caused by carbon dioxide emissions. Thunberg's father was named after him, and said much of Arrhenius's work has stood the test of time, but not everything. "He thought we'd be [at today's levels of warming] in 2,000 years' time," said Svante Thunberg [167]'.

The lack of active response towards Climate Change issues by the global leaders is the motivation that made her and other youth, as Toby Thorpe form Australia, arrive to give speeches at UN summit in COP24 in Katowice in Poland where the general reaction was harsh and heartfelt.

Follow extrapolated pieces of the speech reported by Lifegate and CNN [168] [169]:

'Our biosphere is being sacrificed so that rich people in countries like mine can live in luxury*. It is the sufferings of the many which pay for the luxuries of the few.'*

'Until you start focusing on what needs to be done rather than what is politically possible, there is no hope.'

*'**And if solutions within the system are so impossible to find, maybe we should change the system itself**. We have not come here to beg world leaders to care. You have ignored us in the past and you will ignore us again. We have run out of excuses and we are running out of time. We have come here to let you know that change is coming, whether you like it or not. The real power belongs to the people. Thank you.'*

The speech enhances that the equity is been sacrificed for the setting of the nowadays running human global system, which is starting to feel the consequences since the other biosphere systems are starting to react unexpectedly and affecting the human system. With this speech is been asked to the powerful people to change perspective, move their efforts on a different focus which is not purely political and economic growth but lives rhythms balancing oriented for today and the future coming generations. Since is 50 years that climate issues are discussed and concluded with aims to reach at the leading levels but still they do not produce enough effects to fulfill the established terms, as during the Paris Agreement, which the IPCC report showed that the mitigating actions are out of the feasible time target and so that it has to be more. The invitation behind is that people cannot only wait that the chiefs do something to solve, but they also have to act as much they can figure out in their individual choices to mitigate the issue. That is the kids' intent, go out and make hear that as individuals we are not alone, everybody can do something, it is our choice to do it.

The next speech was at the World Economic Forum in Davos in Switzerland. Where the main focus was about taking **responsibilities** and being conscious of the effects our choices can produce. The invitation behind is to **change the choice option** to the less harmful impact that this might produce. Few bits of the speech reported by WEF [170].

*'We are at a time in history, she says, in a calm, flat, yet compelling voice, "**where anyone with a conscience," must recognize their role in a kind of change that affects everything in our current societies**. "The bigger the carbon footprint, the bigger the platform, the bigger responsibility to lead."'*

*'"I often hear adults say: 'We need to give the next generation hope'," she concluded. "But I don't want your hope. I want you to panic. I want you to feel the fear I do**. Every day**. And **want you to act.** I want you to behave like our house is on fire. Because it is."'*

113. Quote posted on the WEF linkeding page.

112. Quote posted in the WEF speech report [170]

The last speech Greta gave to MPs at Houses of Parliament in UK reported by The Guardian [171]

as main quote refers about missed timing by the leaders *'You did not act in time'*. The speech introduce by giving examples of what might happen and could be done within her life cycle time, what happened before her that is bringing her and youths on the streets and what might never happen because of the compromised future. This speech had a particular detail which was a constant asking:

'Is my microphone on? Can you hear me?'
...
'Did you hear what I just said? Is my English OK? Is the microphone on?
Because I'm beginning to wonder.'
…
'I hope my microphone was on. I hope you could all hear me.'

Beginning to wonder because in the past six months or more she is traveling around the world repeating the message, as the other youths in their own countries, which does not seem producing an active response from the leaders. These questions want to verify where is their attention moving now.

The speech ends questioning **how to solve the climate crisis** and where is/are the answer/s:

*'Many people say that **we don't have any solutions to the climate crisis**. And **they are right**. Because how could we? How do you "solve" the greatest crisis that humanity has ever faced? How do you "solve" a war? How do you "solve" going to the moon for the first time? **How do you "solve" inventing new inventions?***

***The climate crisis is both the easiest and the hardest issue we have ever faced**. The easiest because **we know what we must do**. We must stop the emissions of greenhouse gases.*

The hardest because our current economics are still totally dependent on burning fossil fuels, and thereby destroying ecosystems in order to create everlasting economic growth.

"So, exactly ***how do we solve that?****" you ask us – the schoolchildren striking for the climate.*

And we say: "No one knows for sure. But we have to stop burning fossil fuels and restore nature and many other things that we may not have quite figured out yet."

Then you say: "That's not an answer!"

So we say: "We have to start treating the crisis like a crisis – and act even if we don't have all the solutions."

"That's still not an answer," you say.

Then we start talking about circular economy and rewilding nature and the need for a just transition. Then you don't understand what we are talking about.

We say that all those solutions needed are not known to anyone and therefore we must unite behind the science and find them together along the way. *But you do not listen to that. Because those answers are for solving a crisis that most of you don't even fully understand. Or don't want to understand.*

You don't listen to the science because you are only interested in solutions that will enable you to carry on like before. *Like now. And those answers don't exist any more. Because you did not act in time.*

*Avoiding climate breakdown will require cathedral thinking****. We must lay the foundation while we may not know exactly how to build the ceiling.***

Sometimes we just simply have to find a way. The moment we decide to fulfil something, we can do anything. And I'm sure that the moment we start behaving as if we were in an emergency, we can avoid climate and ecological catastrophe. ***Humans are very adaptable: we can still fix this****. But the opportunity to do so will not last for long.* ***We must start today. We have no more excuses*** [171].*'*

Solutions effectiveness cannot be verified in advance, aims to address to solutions can be given by scientific predictions based on relevant researches because the research allows to identify the best aim conditions set which alteration might very likely change the constant behaviour of the issue, in this considered case the raising greenhouses emissions. There are many solutions that can be addressed for the defined aim, and these can be applied on different layers at different levels and might have a different diffusion scale. What does actually produce the change perception is the sum of the action based produced effects in a period of time. The relevance of the change emerges after a time permanence in effects producing actions.

The **foundation** has to have **set common aims** in **effects production** and the building is given by the **variety in actions** that **set the conditions** for the established effects production.

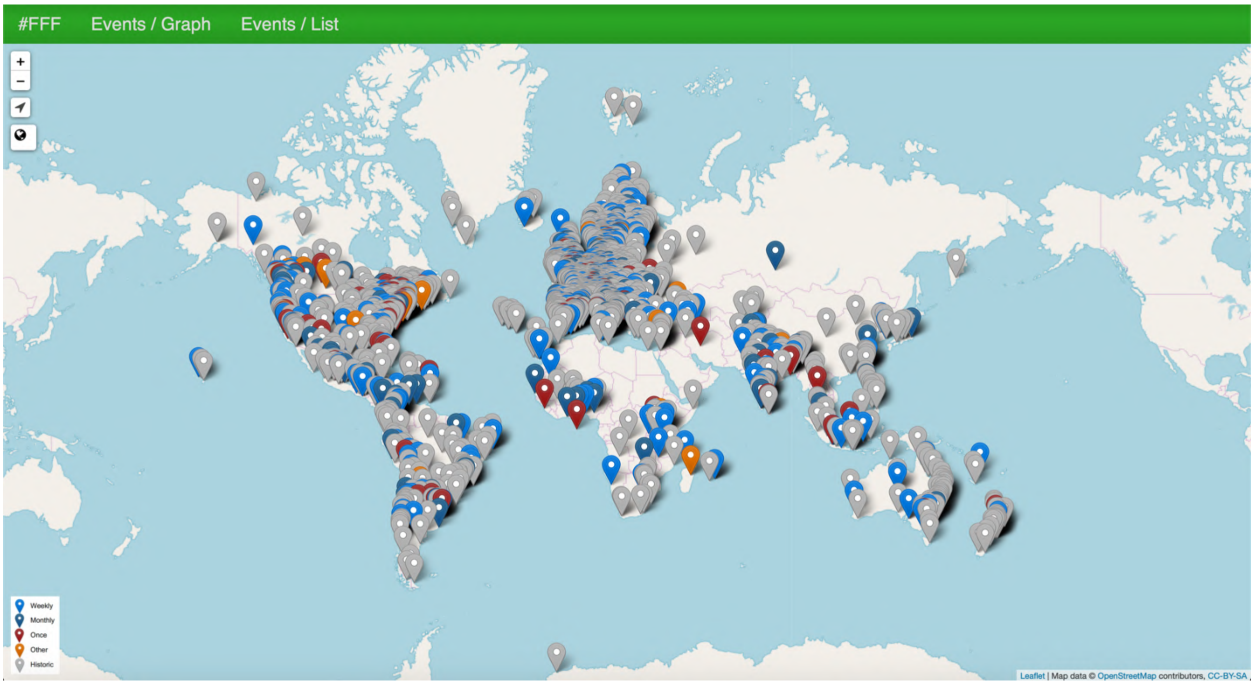
It does not really matter the quantity of the effects production but its **persistence**.
Global leaders and big industries have huge power to produce big effects but very often for big effects long time is required to set the conditions to activate them (policy changes, technology changes, the research to build the powerful technology…). The time and energy needs are still not an excuse, these are the figured options and they to be activated as much they can be. It has

to be clear and present in people mind that is not only about big solutions, there are also small actions that produce small effects but they do not require much energy, time and high education, and can be done by every individual every day. If the choice of these falls in the aimed effect production (of transportation media, food sources, energy sources, …) every day the impact in a year or more becomes relevant and makes gain time for all.

The verdict "solved" will not arrive in short time especially if the behavioural "crime" is been accumulated in centuries. So, everybody that has the will power of changing the common considered choices for the ones producing the aimed effects is has to be proud being able to provide precious time for the health of future.

2.4.1.1 FridaysForFuture: School Strikers 15 March 2019

Since November strikes started to spread in different forms and in many countries in the beginning emerged especially Australia, the United Kingdom, Belgium, the US and Japan [172]. Today they are striking actions diffused in the world and continuing to appear. An official website to join in this common cause is been build and supported by social media platforms could guide and map all in one place the initiated actions.



114. FFF Map

The motivation of this strikes is introduced from the official website:

"Why are kids striking?

School children are required to attend school. But with the worsening Climate Destruction this goal of going to school begins to be pointless. - Why study for a future, which may not be there?

- *Why spend a lot of effort to become educated, when our governments are* not listening to the educated? [172]"

These strikes are giving support to all those that are taking action in their ways and possibilities for the common aim, and hearing of not being alone is what motivates people to continue put their effort in choosing the best option in their daily life, not only for them in that moment but for the humanity in the biosphere for the next generations of their existence.

Greta is one of many youths that are fully in the provided education systems which are not responding enough to provide for youth needs and their future in relation with the biosphere.

What the school strikes made notice again to the world is that 'you are never too small to make a difference'.

Summarized these strikes are all small actions but widely spread which started to have a perceivable impact. The same effect and impact can be achieved with every small choice cultivated in time.

115. Screen of the next Climate Strike Event on Facebook

2.4.2 Environmental programs in schools

Environmental issues are felt and are starting to be perceived important at the point of being integrated in educational curricula. Many strategies were initiated as integrated classes in the traditional curricula schedule as in nature science, geography, history. Extracurricular activities are organised by schools with external entities, under different names as environmental science, environmental education, ecological sciences, that might have focused topics as biodiversity, food, air pollution, extreme climate/weather changes, transportation etc.

All these programs and curricula intents attitude prioritises still just an explicative form of how to talk about environmental issues but none of these does practically focus on a critical process analyse understanding about where does issues start from or sensitise an investigative approach for resolutive responses. Follow examples of found curricula.

2.4.2.1 Pearson School: Environmental Science

Pearson School has developed a curriculum for environmental science since 2011 with textbook having student's and teacher's version. The curriculum title is "Environmental Science Your World, Your Turn" and has adaptations per State requirements in the US (as Florida has an integration with biology studies program) as shown in a section of the list the

National

Title	Alignment Criteria	Grade
Environmental Science: Your World, Your Turn	Next Generation Science Standards	9-12
Environmental Science: Your World, Your Turn	Common Core Standards for Literacy in Science and Technical Subjects	9-12

California

Title	Alignment Criteria	Grade
Environmental Science: Your World, Your Turn	Next Generations Science Standards/California Environmental Principles and Concepts	9-12

Delaware

Title	Alignment Criteria	Grade
Environmental Science: Your World, Your Turn	Delaware Science Standards and Grade Level Expectations	9-12

Florida

Title	Alignment Criteria	Grade
Environmental Science: Your Turn, Your World, Florida Edition	Florida Biology I Standards	9-12
Environmental Science: Your World, Your Turn	Florida Course Standards and Access Points for Environmental Science	9-12

116. Environmental Science Your World, Your Turn list of correlations in the US [173]

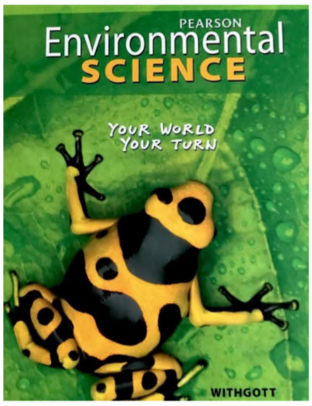
following figure.

The alignment criteria have two main directions identified under the national section, un defining what does this science refer to and how to talk about it.

Follows a split about these two lines, on the left the science contents and on the right the pedagogy aims of this curriculum.

A Correlation of

Environmental Science
Your World, Your Turn



To the

Next Generation Science Standards

Disciplinary Core Ideas
Science & Engineering Practices
and Crosscutting Concepts

Table of Contents

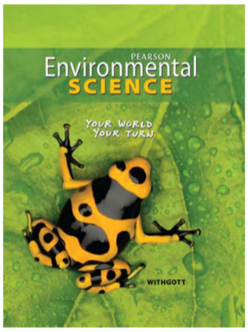
Unit 2: Ecology	
Chapter 4: Population Ecology	
4.1 Studying Ecology	DCI: LS2.A: Interdependent Relationships in Ecosystems; LS2.B: Cycles of Matter and Energy Transfer in Ecosystems; LS2.C: Ecosystem Dynamics, Functioning, and Resilience; LS3.B: Variation of Traits SEP: Asking Questions and Defining Problems; Developing and Using Models; Planning and Carrying Out Investigations; Analyzing and Interpreting Data; Constructing Explanations and Designing Solutions; Obtaining, Evaluating, and Communicating Information CCC: Cause and Effect; Scale, Proportion, and Quantity; Energy and Matter; Stability and Change

117. The book reference, the units of the book and an example referring to chapters and their content aims [174]

A Correlation of

Pearson

Environmental Science
Your World, Your Turn
Withgott, ©2011



To the

Common Core Standards for Literacy in Science and Technical Subjects

Grades 9-12

ALWAYS LEARNING PEARSON

INTRODUCTION

This document demonstrates how ***Environmental Science: Your World, Your Turn* ©2011** meets the Common Core Standards for Literacy in Science and Technical Subjects, grades 9-12. Correlation page references are to the Student and Teacher's Editions and cited at the page level.

Real Issues. Real Data. Real Choices.

Pearson's ***Environmental Science: Your World, Your Turn*** is based on real, current, and relevant content that brings the world of environmental science to life. All while making it personal and actionable for every student.

Exploring Real Issues through an Integrated Case-Study Approach

Opening every chapter, and integrated throughout the text and support materials both online and in print, the Central Case provides a consistent and engaging path for teaching core environmental science principles.

Based on the Most Current Data Available

A science program is only as good as the data. ***Environmental Science: Your World, Your Turn*** provides the most up-to-date data available from a wide-range of trusted sources. Maps, graphs, yesterday's news articles...and more.

Motivates Students to Make Choices

Environmental Science: Your World, Your Turn empowers students to draw their own conclusions and encourages them to think and act on both local and global levels. They will build the critical thinking skills that they will need long after the class ends.

118.The book reference and the introduction of pedagogy aims [175]

As can clearly be read in in the introduction part, the curriculum collects all the last updated data and environmental issues for discussions' development providing extension of materials also on an online platform. The case studies are defined per chapter in the book, on which recognise and set conditions for finding best choice solution from students understanding, willing to engage with critical thinking and exploration. Practical experiences where to apply critical thinking and solutions is not mentioned in these curricula.

2.4.2.2 Environmental education program in Italy

The project for establishing a mandatory environmental education curriculum in Italian school is a quite recent notice. The first time that an active intention emerged was in June 2016 when the sub-secretary of the "Ministero dell'Ambiente" (Environment ministry) Barbara Degani has delivered to MIUR, the project written in collaboration with the "Ministero dell'Istruzione" (Education Ministry) of guidelines to set the conditions of environmental education as mandatory matter in schools' curricula. Working on education settings for comprehending the environments since young ages is a policy with a long-term vision space. Is been understood that to preserve the natural and cultural patrimony we have today, its importance and behavioural activity has to be observed and understood since early life stages. Environmental education is been identified as a tool to sensibilise citizens and communities, is a good base to build the civic education and so prone to a **sustainable civilisation** [176].

There were already established projects active, integrated in the schools curricula courses and that the way it starts also the new project in order to build a stable requirements from schools for environmental education. The first initiative of launched courses by ISPRA started in academic year 2017/2018 and got extended in offer in year 2018/2019.

119. A kind of projects initiated in schools thanks to external entities are small gardens where students grow culinary herbs, very often supported by the local green management service (Torino) [176]

The curricula are conducted by ISPRA research team for free and the

There is a candidature where schools management teams and directors have to apply and choose between the options according to what does fit better to the school's educational aims.

The initiative programs include lectures, projects and experimental activities and thematic excursions [177]. Follow the lists of the topic initiatives in Italian.

Iniziative attivate nell'anno 2017-18

120. ← List of topics of passed initiatives [178]

1. Una giornata in città: alla scoperta del nostro ambiente
2. La straordinaria vita del Pianeta Blu
3. Analizza...l'Ambiente
4. Posidonia spiaggiata, una risorsa ambientale
5. Conosciamo il mare in cui ci tuffiamo
6. Adattiamoci (ma non troppo!) ai cambiamenti climatici
7. Ecosistema spiaggia

121. ↓ List of this year initiatives projects, divided per School Age categories. There are 3 more programs comparing to the past year [179]

ISPRA
Istituto Superiore per la Protezione e la Ricerca Ambientale

Sistema Nazionale per la Protezione dell'Ambiente

II. ELENCO DELLE INIZIATIVE DI EDUCAZIONE AMBIENTALE PER LO SVILUPPO SOSTENIBILE – ANNO SCOLASTICO 2018/2019

SCUOLE PRIMARIE

1. La straordinaria vita del "Pianeta Blu"
2. Posidonia spiaggiata, una risorsa ambientale
3. Una giornata in città: alla scoperta del nostro ambiente
4. Geo-logica-Mente

SCUOLE PRIMARIE / SECONDARIE DI PRIMO GRADO

5. Analizza... l'Ambiente
6. Adattiamoci ai cambiamenti climatici
6.a Abitiamoci (modulo complementare)
7. Oggi disegno la Natura!
8. Gocce di civiltà in un mare di plastica

SCUOLE SECONDARIE DI SECONDO GRADO

9. L'ambiente non ha confini: competenze, istituzioni e programmi internazionali nel settore ambientale

TUTTI I LIVELLI SCOLASTICI

10. Ecosistema Spiaggia

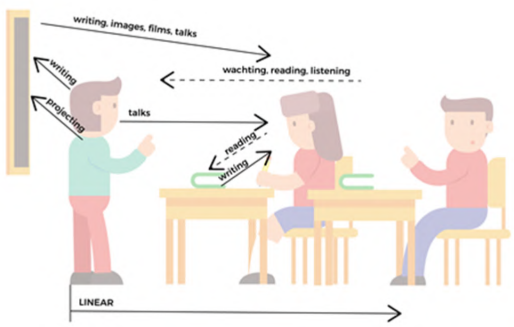
2.4.3 Education Paradigm

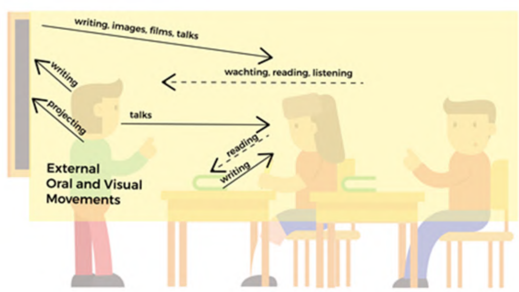
When you ask governances about environmental issues the very common concern and consideration is that there is a lack of education in citizens. From this fact opinion rises a question which is: Why?

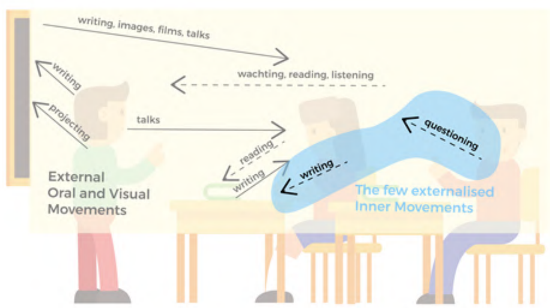
Recently, responses in compensating this lack are emerging and trying to stabilise in the institutional education systems, as explained in the before mentioned cases, many studies and researches are been done to answer at this question and have tried to develop projects and propose solutions for this response.

This thesis wants to contribute in providing this answer and the first step is in analysing the problem to find the solution, by following the permaculture principle “the problem is the solution”. By considering the general condition, that every student nowdays still experiences, of the actual educational system, which is the given base structure to the learning process of youth at schools. Because of the hierarchical level difference, whom level’s is in charge of educating is higher than of those who are going to be educated, there is a tendency of unbalaced feedback occasions for understanding.

What happens is that the institutional educational format in classroom has a predominance of **linear movements** and the kinds of media used are exclusively visual and oral which allow only few layers to find matchings [1].







122. Illustrated sequence of the information media in a classroom, showing the predominately linear movement and top-down visual and oral kinds. Illustration sequence by Jelena Sučić .[1]

There are only few **inner movements** recognisable possible in this structure:

‘I. Writing/drawing notes that activates a tactile movement and externalise the absorption of the lecture and re-elaboration of the information in an own understandable pattern;

II. Questioning does externalise as well the lecture absorption but in an active oral movement stimulated by an internal elaboration aiming for a feedback that can organise or align the information patterns. [1]’

The lack of layers differentiation is what might aswer to the reason of why some students do not get understanding the matter taught in this ‘traditional’ way. For those that get things with the traditional path, how long will they keep them in mind to apply this knowledge?

To raise students’ **knowledge levels** and their **permanece**, developing more dynamic contexts may help in stimulating more **differentiated externalised inner movements** permitting the proccess of **knowledge patterns building** in each individual. This externalisation expresses the system of **feedback loops** which build the structural dimensions of relationships in our brain and communication processess as defined by **cybernetics** [1].

The machine’s information is build step by step by humans from a synthesis process, ‘action that is tried to be done also with educational programs which have the defect of dealing with uncontrollable open systems (people’s mind) that have life and experiences also outside the classroom (influenced by untraceable environmental circumstances), therefore outside the educator’s observation range [1]’.

Lives are filled with experiences which need to be deciphered in a language in order to be externalised. Languages can use different media, body movements, sounds, energy, words, images and emotions, to recognise the referring experience of a used language, there is need to find **associations in some principles**, that match with our **knowledge patterns**. The **associational thinking**, especially if multiplied, is a training that we do not exercise much in our current life modern days mental elaboration processes.

‘Sometimes some good educators do explain by changing from the high level of language of that matter to an example in daily life/common level of language or by giving example of same principles in different contexts. This association movement catches the attention of the “new entries” in the matter and permits the escalation to the higher level. This same movement is required when a high levelled group of people in a matter meets, but their background experience of how they acquired that knowledge is different.[1]'

123. Graphical explanation of Knowledge Levels inside a project context under the Creative Systemic Research Platform Team. Design: Prof Susu Nousala, Graphic Design: Jelena Sučić. [1]

Generational perspectives have to be kept in consideration during the elaboration process of transmitting experiences and knowledges. The different experiencing of highest in age generations levels is determinated by the lived context, because the culture of perceiving might have changed in time, therefore the language of explaining the acquired knowledge.

The language has always to adapt according to the context, the cultural environment, age of the audience, knowledge background experiences.

To assure understanding moments, continuous exchange moments in layers and levels have to be stimulated. In order to do that setting conditions for experiences to "learn by doing", as done by Waldorf (2.4.3.1) and Finnish (game based [180]) education systems, which allows a stimulation in levels and layers based on individual sensitivity. Finding relations between things is a complex and dynamic process, which requires time, experiences, emotions, a lot of observations and considerations, the different layerings is what makes them permeate longer in our memory. Allt the mentioned actions include fractions of time in longitudinal cyclic developments being part of a group dynamic [1].

The inefficiency provided by the criticalities of the general education paradigm require to find another answer. Education paradigms shift are needed, to fulfil a better differentiated layering spectrum. If not "traditional order" shall exercise dynamism of creating openings (associations) from to catch the elements in different ways and then abilitate their integration in the aligned traditional language.

‘Linear (instruction) is short-term, you lose a term, you lose the reliability of the information. Dynamic (network of associations) is long-lasting, you lose an association, the network will keep the principle on which you can build again [1]’.

Education systems are the main source for to find tools to define aimed actions in their life duration and pass the knowledge to the next coming youth.

‘The empirical observation is what allows our **intuition** to find a focal point of research in any specific discipline/field [1]’

2.4.3.1 Waldorf Education

Waldorf education is the same as saying Rudolf Steiner education. Steiners pedagoy aims to a wide curricula perspective with field integrations and is based on building immersive experiences where observe out of them to mark down for the next considerations.

In fact, waldorf educated students do not have textbooks tille the sixth grade, the only book they have is a journal were to document their experiences, and what they learned from them.

What gets taught first is communicate experience, verbally and literally, in order to build their knowledge base and organisation sensitivity. After a solid own defined base students can read from textbooks other knowledge organisations and recognise their own patterns in the foreign ones [181].

The same base is found in permaculture methodology which is a constant cycle of: observe, take note, elaborate/design, act/produce, observe results and again. David Holmgren explains this aspect in his methodology see 2.4.3.3.

2.4.3.2 Project Based Learning PBL

Another education method base on the phylosophy “learning by doing” is the Project Based Learning. According to the schools that define it sometimes is define as “experiential learning" or "discovery learning” method, but what does characterise it, as states Robert Schuetz [182], can be summarised in seven elements:

- ‘Focuses the student on a big open-ended question, challenge, or problem to research and respond to and/or solve.

- Brings what students should academically know, understand, and be able to do into the equation.

- Is inquiry-based.
- Uses 21st-century skills such as critical thinking, communication, collaboration, and creativity, among others.
- Builds student choice into the process.
- Provides opportunities for feedback and revision of the plan and the project.
- Requires students to present their problems, research process, methods, and results [182].'

As Schuetz enhances by quoting the Swiss psychologist Jean Piaget 'knowledge is a consequence of experience' [182]. Experience is contextualized and the first thing PBL actually does is providing a "big open-ended question" which provides a contextualisation, on students is the **scoping action** of applying their knowledge or building it according to the identified project requirements which are established by choices guided from feedbacks and revision sessions.

This is the same process that leads people in the real world (outside school) to reach their objectives, react progressively to situation and so on.

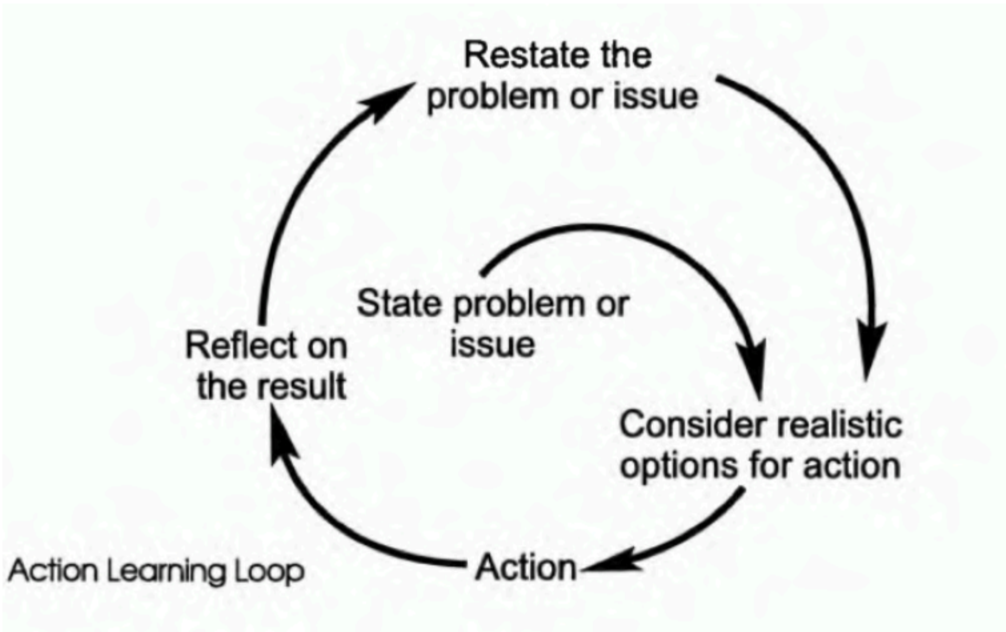
Today, is a very popular applied method because oriented on practice and STEM and STEAM education programs are leaders in its application.

2.4.3.3 Holmgren: Action Learning Loop

In order to have a sustainable education system it has to be stimulated the set of conditions for a self-generative learning process. What the Waldorf method does is stimulating conxtexts recognision and by pushing the documentation process elaborate cognitively the experiences which will activate a relationship building process for new contextes. The same attidude is the base of permaculture (permanent agriculture) design and knowledge and culture building (permanent culture), the cycles of nature give rhythm to the happening phenomena that we observe and recognising the relationship between the properties allows to set rythms for this continuity.

Permaculture practices show that you can learn as many technics you can but maybe non of them is appropriate for your context, therefore, is important to focus on the priciples basing the activation of those practicle techincs for the wanted effect. Therefore, is important learn to follow processes, recognise their elements and properties and their pattern behaviours to be able to reinvent/reinterpret their disposition in a constrained context for the interested effects production.

David Holmgren explains this foundation under his **design thinking guidelines** which are under his first principle "Observe and Interact", which behaves as an **Action Learning Loop** in a defined context. This Loop is consequentially the **foundation that sets the conditions for a self-regulating system**, which the purpose of the fourth human principle defined by Holmgren "Apply Self-regulation and Accept Feedback" [183].



124. Action Learning Loop by D. Holmgren [183]

By setting conditions for loop movements, we allow sustaining process to happen.

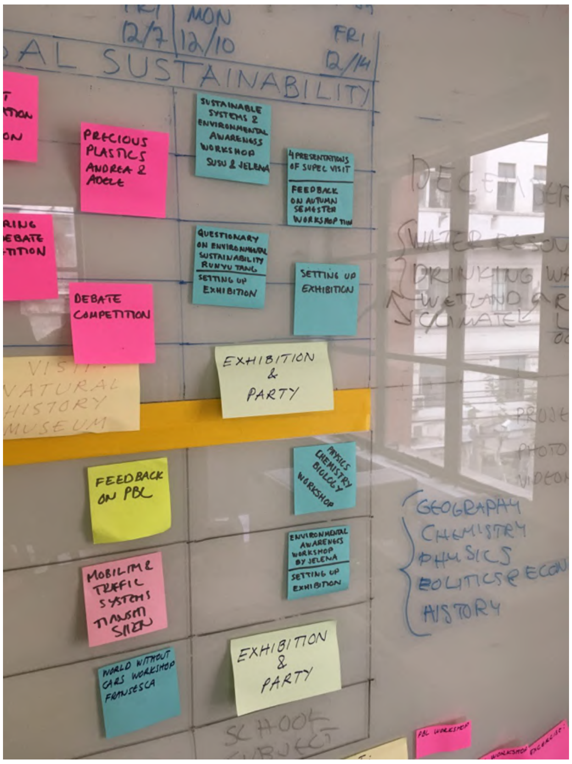
Chapter 3: Test Case Studies

3.1 Definition of Test Cases

The test cases done by the author are practical activities investigating for small regenerative opportunities. These got verified and experienced relatively to research outcomes to recognise criticalities and functions practicability in urban context at individual human scale capacity. There are going to be explained three categories in each the experiences will be chronologically ordered and split per topic. At the end of each case follows the relative outcomes discussion.

3.2 Youth context understanging bases

In this category are going to be explained two lectures in the Design and Innovation Courses curricula at Tongji Huangpu School of Design and Innovation that gave the occasion to relate with high school students and collecting data about their perception of green and what of it is under their consideration in terms of functionalities.



125. Picture of the Huangpu high school schedule board planning Innovation courses with the two lectures in program. Ph. Jelena Sučić

Innovation course classes are integrated moments in the traditional (Chinese Curriculum) classes schedule aiming to create moments for soft skills building as social interaction and cooperation. The Innovation curricula manifest as PBL courses proposing topics for discussions (Problem Based Learning) and projects (Project Based Learning) as Sustainability, New Technologies like 3DPrinting, coding for Game Design, Arts & Design, Future Problem Solving, Business Thinking & Entrepreneurship and creative workshops related to the subject based courses (Chinese Curriculum).

The Innovation Courses sessions of the month of December had as thematic Sustainability.

3.2.1 "Sustainability" lecture by Prof. Susu Nousala

This lecture was a session of 2 teaching hours (45min = 1 teaching hour) on Monday 10th December 2018. The students involved in this session were 36 from the first year. The sustainability topic in this session was introduced with a theoretical part about **Limits to Growth** of Club of Rome and **Creative Systemic Thinking** which followed with a practical moment in the second part through a team game about **resources** management and tools and constraints designed by Prof. Nousala. This game-based workshop is been upgraded with an adaptation including a green factor constraint to create the conditions for a discussion about this topic with the students in the end of the session.

The students were divided in 5 groups and each group was provided with different sets of materials but all had the same quantity of "green material". Each group was asked to build the tallest and most stable structure they could by maintaining as much green material possible.

Following pictures were token by Jelena Sučić.

127. Group 3 thinking on what to do with their resources

128. Group 1 concerned about what can they do with their little resources

126. Group 2 testing stability of structures

In the middle of the process, where students were strugleling about how to fix the structure arrives the the "new technology" provided by Professor Nousala.

At this point the building action started and so the creative solutions and interpretations of the rules to take form.

Different strategies were actuated as shown in the following pictures.

129. Prof. Nousala providing the tool to Group 4 which was happy to receive this new resource


131. Group 2 has verified and fixed their stability issues


130. Group 3 has decided to have a green basement and build height


132. Group 5 has organised a manufacturing roles chain division


133. Group 4 working together to sustain their construction

At the end of the construction time an “unaspected happening” checked if the structures were able to sustain the weight of a selected object. Not all of the structures passed the sustaining test even if the height was managed well.

To sumarise, students got a set of resources and a set of conditions and had to figure out what could they do/create out of it.

The last discussed resource management was about the green area. The students were the government of their city and had to decide what to do with their resources to provide for their citizens.

Group 5: ‘We will use it to show Advertisement on screen, to show and earn money, because is a big space and we can earn money from advertisement to do more recycling things. With some plants as green wall.’

Group 4: ‘Floating garden with flowers, plants, fruits, is a sterile environment of nature over the building.’

Group 3: ‘Build a garden and a house with flowers and fruits’

Group 2: ‘Make high buildings and have vertical gardens’

Group 1: ‘To show citizens and show that we are city of green with trees, vegetables, grains, farms, we have a lot of resources for green even if not a lot for building.’

The record is available on request, this is a breve summary of the discussion outcomes.

3.2.1.1 Discussion

Interesting noticeable outcome of the discussion was that the prevalent answer was oriented on showing that they have green and the importance of its present but there were just little outcomes considering what are the green components and their uses. It emerged a higher consideration in green uses and components from the groups that had less infrastructure than green in their resources.

3.2.2 "Plants as Sustainable Technologies" lecture by Jelena Sučić

After the lecture at the 10th the author is been asked to give a lecture about this thesis for the 13th December 2018.

The class of students was from the 2nd grade, which had already some biology in traditional classes curricula, the planned session was of 45min involving 48 students. The announcing time was short to prepare a highly practical workshop, but was enough to set a consideration moment for stimulating inner movements by students about this topic.

The lecture presentation is been adapted for the case with practical examples token from author's tests and Huan Ni's case in order to make recognise green as something very close and approachable by everybody and everywhere.

The classroom disposition was with islands of tables, where students would split in groups by taking their place. Each island was provided with paper and some lists of plants to help students to start at the moment of the exercise.

The session is been divided in two moments:

1) 20 minutes introduction;
2) 25 for the exercise.

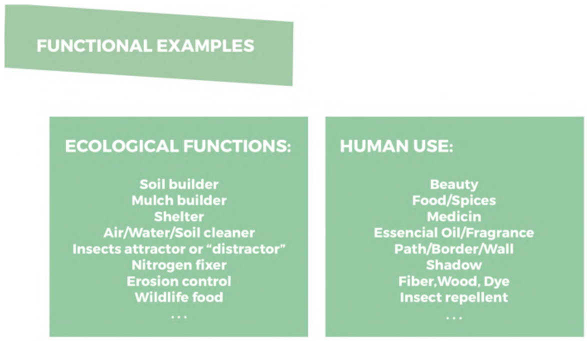
The lecture has introduced:

- The general problem of mis-integration relatively to the environment in human perspective (1.3) with examples of what does demonstrate this found in chapters (2.2.1.6 Summary, Climate Change, Shanghai and China, Citizens Emergence);

134. Beginning of the introduction. Ph. Tiina Laurila

- Green perception and Health factors;
- Contextual Parameters, to introduce a system thinking approach;
- Perspective shift in order to make them start recognise resources through examples as the elements required for plants life with what they relate since plants are primary producers;
- Introduction to functional relationships, lists of possible functions.

136. Slide Perspective Shift, invitation to observe and recognise: Garlic Flower. Photo Malmö 24th May 2017. Ph. Jelena Sučić



135. Slide Functional Examples: Ecological Functions and Human Uses

At the moment of the exercise students were asked to have a vision, identify a purpose. In order to enter in this choice dynamics, to prevent the "blank page" effect, were provided the lists of plants between the tables on which was asked to sign if they like them or not, if they know them and to add plants they know and like. This moment created discussions in the groups to vote the listed plants.

Providing lists with known and liked plants with mixed un-liked and unknown plants, made emerge which are the mostly considered and put/stress attention on those there are not.

The next step was once you identified and choose plants you like, list all the possible functions per each considered plant. The execution of the tasks had several interpretations of way to do it. Some worked as groups and some individually, some wrote and some draw their ideas about plants and their considerations.

Plants like don' t like don' t know ?

小胡萝卜 Small Carrots ?

玉米 Maize

长豆角 Long Beans ?

刀豆 Sword bean ?

茴香 Fennel

毛豆 Green Soybean ?

秋葵 Okra ?

圣女果 Cherry Tomatoes ?

四季豆 Snap bean ?

… clover ?

Plants like don' t like don' t know ?

卷心菜 cabbage

大蒜苔 Garlic moss

西红柿 Tomatoes

小嫩南瓜 Little Tender Pumpkin

荸荠 water chestnut

野生百合 Wild lily root

紫薯 Purple Sweet Potato

高山梨 Pears

野生椿芽 Wild Chinese toon ?

野生竹笋 Wild Bamboo shoot

… duckweed

大麦 rice. 好

Plants like don' t like don' t know ?

木耳菜 Malabar spinach

西芹 Celery

香菜 coriander

成熟南瓜 Pumpkin

红萝卜 Red turnip ?

胡萝卜 Carrot

白萝卜 white turnip

高山娃娃菜 baby Chines cabbage

生菜 Romaine Lettuce

茼蒿菜 Chrysanthemum

… mulberries

3 group

1 don't like berries
only strawberries
don't like pumpkin
the sweet taste is wired

2 drawings
1) pumpkin with written STAFF only because one of them was wearing an orange jacket with that
2) I think a baby cabbage

Plants like don' t like don' t know ?

瓠瓜 Calabash Gourd

空心菜 Water spinach

不辣青椒 Green pepper

上海青 Shanghai Green Leafy

苋菜 Amaranthus tricolor

黄瓜 Cucumber

嫩南瓜 Tender Little Pumpkin ?

苦瓜 Balsam pear

茄子 Eggplant

丝瓜 Towel gourd

… sorrel

clover

蕃茄 Tomato

鸡毛菜

草头

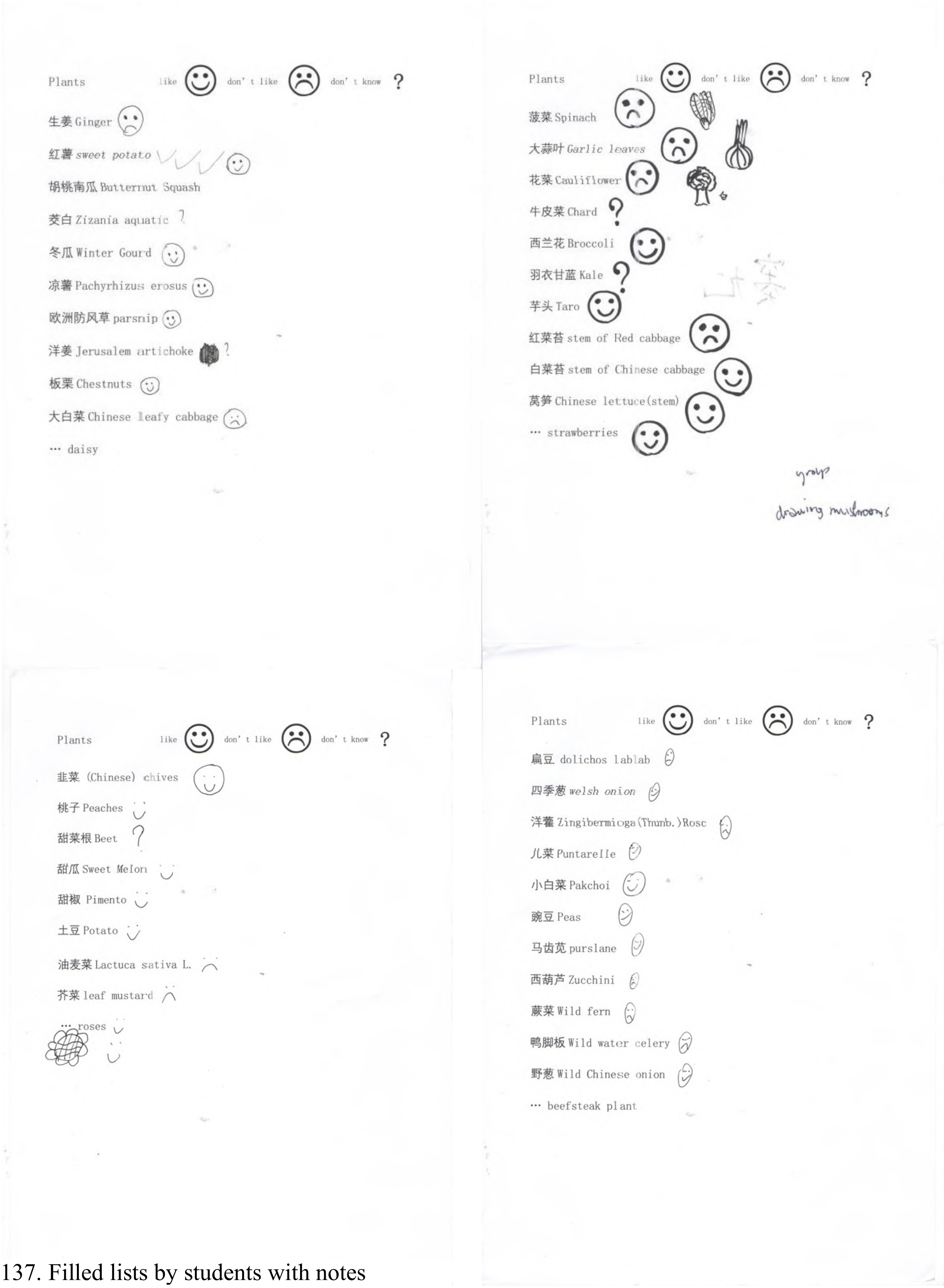
芦蒿

荠菜

马兰头

蚕豆

芹菜



Plants like don' t like don' t know ?

生姜 Ginger
红薯 sweet potato
胡桃南瓜 Butternut Squash
茭白 Zizania aquatic ?
冬瓜 Winter Gourd
凉薯 Pachyrhizus erosus
欧洲防风草 parsnip
洋姜 Jerusalem artichoke ?
板栗 Chestnuts
大白菜 Chinese leafy cabbage
… daisy

Plants like don' t like don' t know ?

菠菜 Spinach
大蒜叶 Garlic leaves
花菜 Cauliflower
牛皮菜 Chard ?
西兰花 Broccoli
羽衣甘蓝 Kale ?
芋头 Taro
红菜苔 stem of Red cabbage
白菜苔 stem of Chinese cabbage
莴笋 Chinese lettuce(stem)
… strawberries

group
drawing mushrooms

Plants like don' t like don' t know ?

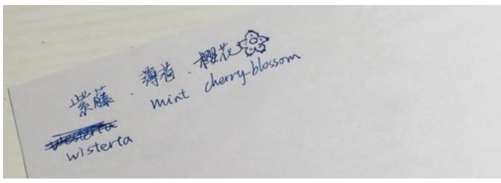
韭菜 (Chinese) chives
桃子 Peaches
甜菜根 Beet ?
甜瓜 Sweet Melon
甜椒 Pimento
土豆 Potato
油麦菜 Lactuca sativa L.
芥菜 leaf mustard
… roses

Plants like don' t like don' t know ?

扁豆 dolichos lablab
四季葱 welsh onion
洋藿 Zingibermioga (Thunb.) Rosc
儿菜 Puntarelle
小白菜 Pakchoi
豌豆 Peas
马齿苋 purslane
西葫芦 Zucchini
蕨菜 Wild fern
鸭脚板 Wild water celery
野葱 Wild Chinese onion
… beefsteak plant

137. Filled lists by students with notes

138. Students considering, listing, drawing. Ph. Tiina Laurila



139. Pictures and scans of some detailed working and listing. Ph. Jelena Sučić

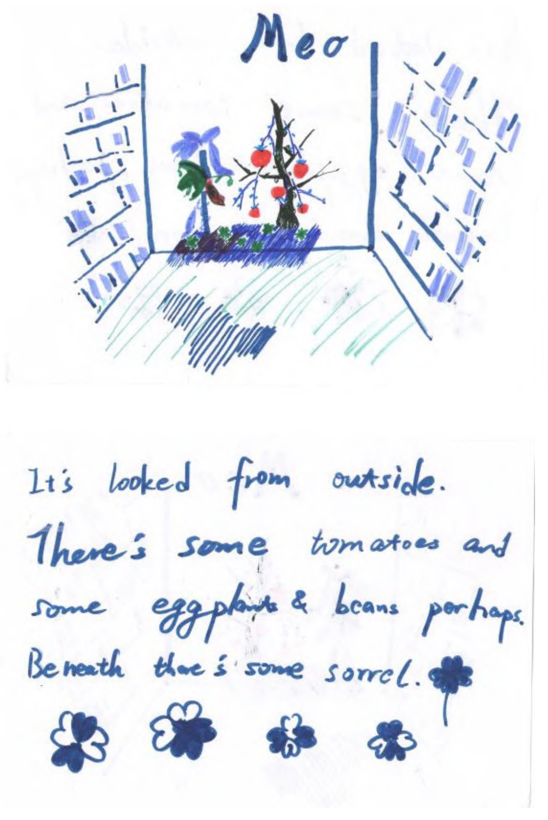
By going in table to table there were different perspectives, unfortunately could not all be recorded by photographs because they were many students to follow and some of them brought home their thoughts on paper. Another tool used to try keep on track was voice recording which was supported by the presence of the microphone. What were discussed were mainly tastes, and aesthetics, since are the firsts functions on which we may have consideration and express appreciation in uses. Interesting was to notice different tendencies comparing to European tastes as that carrot is not liked because too sweet (was the explanation of the group) and appreciation for purslane which at the age these students in Europe is not even considered as an edible plant.

The provided list was given from Fred of Rainbow of Hope which has a mixture of plants of local Chinese uses and western tastes.

Conclude that a group of students did a nice focus on their beloved sunflower, which was added in the lists by themselves, which is beautiful big and their seeds are delicious and they got in depth and figured out more than 10 possible uses and functions of the sunflower.

3.2.2.1 Discussion

This lecture and the exercise outcomes contribute to provide a perception to answer at the question: How much are still plants considered in their functions and variety by todays youth? As already introduced by the brief comparison with European tastes the cultural context (China) and living environment (City center) differentiate and contrain the consideration ability. What allowed extentions are individual experiences and references. For example, the drawing of a hydroponic system where students could experiment and grow plants (as sunflower and other chinese namese mentioned by the students) was a memory of a middleschool project. Meo's drawing had a series of refrences between psychology (colour), gardens in traditional chiense paintings (scene). Meo was particularly inspired from the lecture and wanted to express her intentions in trying to grow something at home and in her room, on a certain moment the director Tiina Laurila came in our discussion and extended the interest asking about her future intentions, Meo's answer transliterated from the voice record was: ‘ I like psychology, phylosophy and design in the future I would like to



140. Meo's drawing and description

combine them because, phylosophy defines the way of design and psychology helps in communicating’.

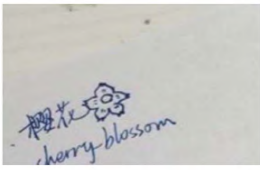
Was an intense 45 min of interactions and thoughts, the first moment of mind openings and astonishment by the students was at the Perspective Shift slide, when they had the chance to recognise garlic out of the bulb for cooking function, when they discovered that the purple beautiful flower was garlic an echo of ‘Wooh…’ spread in the classroom. This picture was the attention catch moment where students’ interests raised looking for more.

The language difference was a barrier more picture relations might help more in the alignment of understanding and plants recognition. Another barrier was Mandarin and Shanghainese plants name differences, so the recognition layers involved were four: three languages and the appearance one. Because of the short time preannouncing the lecture the figure relation provision was not thorough, since provided few pictures from a Chinese vegetable book’s description [184], the NASA cleaning plants and few more from posts with uses as the pest control list. The looking aspect was then considered the main tool of communications, since many students draw their plants, fruits and vegetables instead of writing their names.

The written Chinese names are collected in the next figure where Mockian helped in translating a part from the local names.

The name written with the blue marker should refer to the Chinese celery which is one of the plants grown in the explained hydroponic system by the student.

mango



樱花 sakura

大麦is not rice, It's barley

Rice should be 水稻 or 米饭

Wisteria ia a faboacea, flowering plant, nitrogen fix

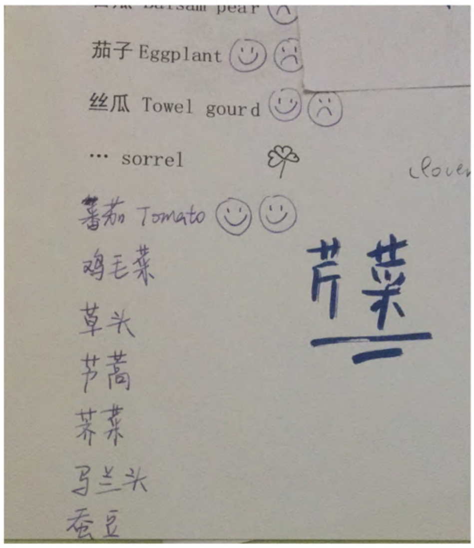
This one is a "shanghaiese" food

草头…… I don't know this word either might be a localism word

And 马兰头 might be a localism word too

蚕豆 is broad bean

西芹 means western celery this down is chinese celery

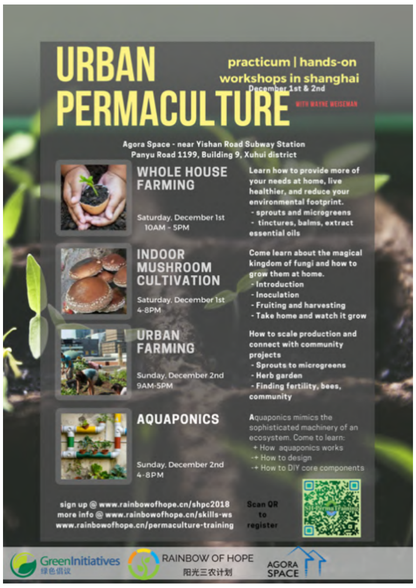


141. Collection of names and translation file, thanks to Mockian Fu

3.3 Hands-on in practice

The Author took part at a selection of workshops in Shanghai. By sounding the activities and initiatives present in this urban area it is been possible to understand the already considered topics in the urban environment and experiment their practicability in terms of diffusion chances.

142. Post picture: ZeroWasteShanghai



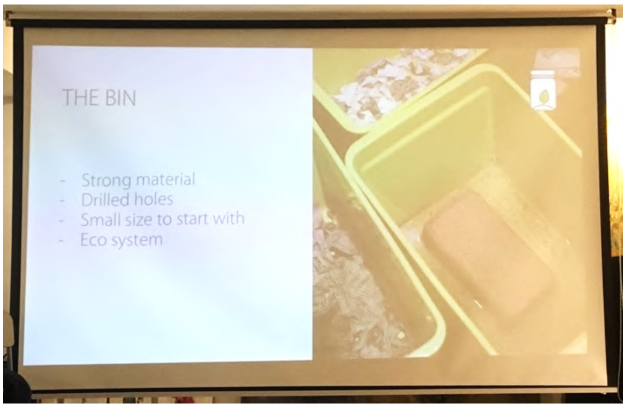
143. Post picture: Permaculture with Wayne Weiseman

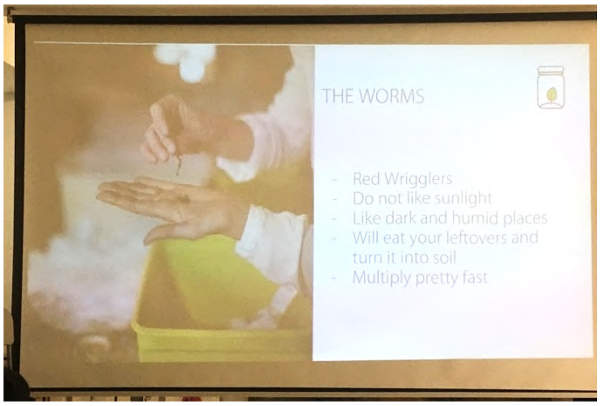
3.3.1 Compost Bin by ZeroWasteShanghai

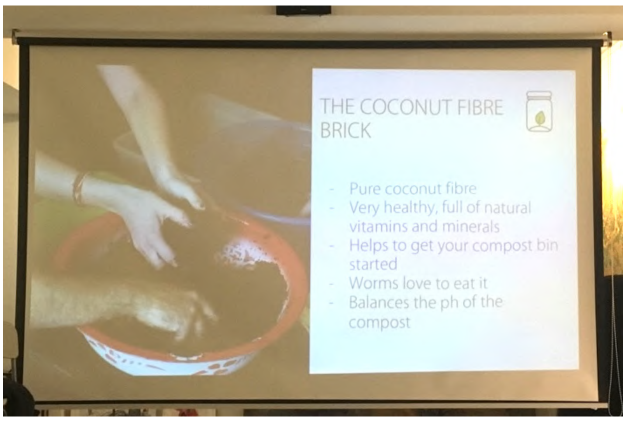
This workshop was facilitated by Alizee of ZeroWasteShanghai that provides with a starter kit in the experience of an urban compost bin process. The course is introduced by facts and data (from Watchworld, Forbes, Ted about waste and consumption in the world, in China and Shanghai which want to indicate why we should apply this kind of small actions. Solutions may be found in: technology, policy, consumer behaviours and composting. There are explained also the human health impact caused by the actual consumption, waste and their degradation processes. If we consider that the daily waste production is 40% organic waste and, in fact, dry waste and wet waste have different processes and their mixtures produces impactful effects in the environment.

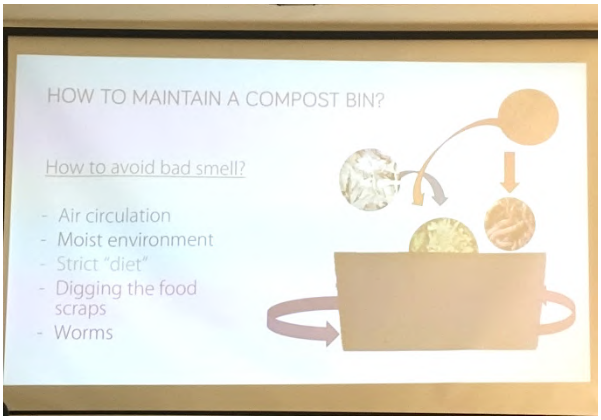
Composting diverts wet waste from the waste stream allowing to manage better dry waste and meanwhile self-produce healthy soil for plants.

144. Intro step by step for the initiation process of the bin by ZeroWasteShanghai









To support the activity, a WeChat group allowing a connection with the community is been done and an orientation tool with FAQ is been provided. Follow two sample pages of the tool.

ZERO WASTE SHANGHAI

Compost bin FAQ

What can I put in the compost bin and what can't I put in there?

Can go:

- Vegetable scraps
- Fruits peels and scraps (banana peels take a long time to rot)
- Egg shells
- Linen, silk
- Paper, receipts, newspaper

Browns: leaves, hay & straw, paper & cardboard, woody prunings, eggshells, tea bags, sawdust.

Greens: vegetable peelings, fruit peelings, grass clippings, coffee grounds, fresh manure, green plant cuttings, annual weeds, young hedge trimmings.

Does not belong in your compost bin:

- Fats and oils, dairy products, meats and fish, bones, magazines, cornstarch cups and plates, fatty food waste, human and pet feces, pernicious weeds, treated wood, whole eggs.

Are worms necessary?

For urban composting, I'd say "yes it is necessary". Because we live in a limited space, we want our food scraps to rot away fast. Worms allow us to speed up the process and turn our food scraps into soil in a few months time.

What if the worms leave the box?

If you see your worms on the walls of your compost bin, or if you see them trying to escape through the holes it could mean a couple of things:

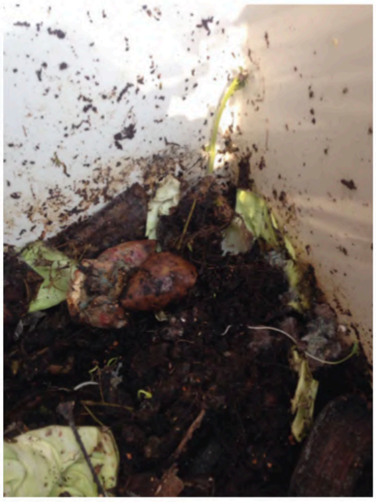
- There are too many worms in your bin → Time to share the bounty!
- Too wet & humid → drain the compost juice by adding more holes
- Too hot & dry → take your compost bin out of the direct sun and sprinkle water on top to make it more moist

I can't see my worms?

Worms like dark and humid places so you will most likely see them at the bottom of your compost bin. Their skin is very sensitive to (sun) light, which is

ZERO WASTE SHANGHAI

I have sprouts/ mushrooms/ white moist in my compost. Yes when you compost seeds, they actually might start to sprout instead. No problem, just turn the soil with sprouts and burry it under the soil.



Healthy compost bin

Too wet looks like this:

3.3.1.1 Composting process at home

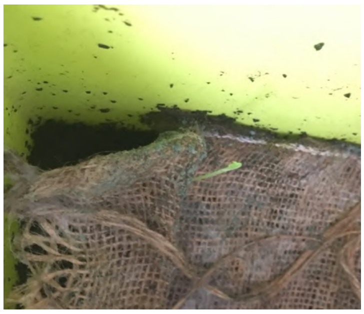
Basically, by deciding to compost we got worms as pets which we have to feed, provide for their environment conditions (moist and dark) and so alimenting a micro-ecosystem. In fact, things that happened are different kind of molds appearing to decompose certain things, germination and bugs' eggs hatching. None of these things is wrong, worms are not alone, there are also other creatures feeding themselves from our scraps. The hemp cloth aim is actually preventing eventual nested flies to blow in our face immediately.

145. Compost bin in the student room. Ph. Jelena Sučić

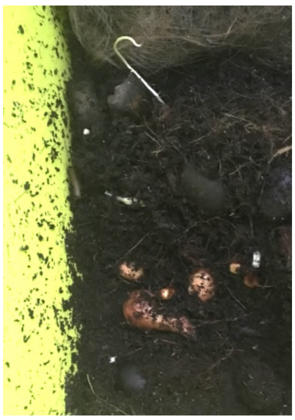
Follows a sequence of pictures with different scenarios in the bin, variety of moulds and growing activities. Ph. Jelena Sučić

150. 6th Dec 2018

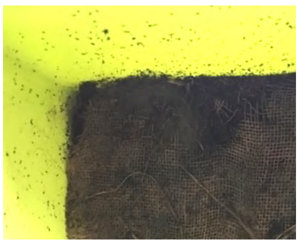
151. 21st Jan 2019



147. 8th Mar 2019.



146. 2nd May 2019, by digging to provide new scraps for the worm colony, new ginger roots have been spotted growing in the bin



149. In absence of food the hemp cloth started to be decomposed by the worms, 26th Apr

148. After two months of no feeding, worms are found on the walls looking for food. 21st Apr 2019.

3.3.1.2 Discussion

What makes mainly realise following this process is witnessing this transformation of matter, that is done by many other creatures we would not consider their existence much before, and that all those eggs and moulds arrive from what we put inside the compost bin, which means that probably instead of growing there we would eat them without knowing and decompose through our digestion system.

The only big management problem about this activity indoors is the proliferation of unidentifiable flying insects which escape from the aeration spots and would mainly end walking on the room window. The source of this invasion was actually from the bin and was possible to verify by covering with a transparent plastic the area to slow their dispersion action. The management action moved to a daily routing of killing most bodies possible at the window for some weeks. From the bin most of them were attached, on the window were single bodies.

154. Bin covered with plastic

153. Detail of the insects below the plastic

152. Beginning of finding them walking on the window

The compost ecosystem in a closed environment is an interesting source of studying insects' behaviour and lifecycles. To keep in mind this condition for future purposes by focusing on insects.

3.3.2 Urban Permaculture by Wayne Weiseman

These two days had a huge focus on how extend plants lifecycles and seasons and all a series of technics and strategies for planting and conserving. There are two aspects of conservation, one is relative to the seeds, not all the seeds we can collect from a plant have to grow till the entire capacity of the plant genus, especially indoors they can be grown in winter as fresh greens. From here practices of sprouting in jars and microgreens become the fresh extension of plants existence and function in small and closed environments. The second aspect is in extending the availability of grown crops in time, through fermentation and dehydration, these were explained with slides and examples, by describing their health benefits. In the second session was about how to grow in small and urban spaces and what else can provide us with food. Composting, hydroponics and aquaponics technics as self-watering pots strategies were explained for this purpose. In practice is been done mushroom cultivation in general and indoors with a hands-on moment preparing mushroom logs and a ready log to start understand the required conditions of their environment (moist and not exposed to direct sunlight). Another practical thing is been done is the process of doing compost tea, which is a strategy to recover nutrients naturally in indoor pots.

3.2.2.1 Microgreens and Jar sprouting

These are two different processes that often get confused. The microgreens have the chance to root in something and produce the first leaves, sprouting in jars uses water only to let the seeds germinate. The procedure for jar sprouting is based on letting soak water as much the seeds can for the first 24h then rinse every day with some water, shake and let it leak out of the jar by letting it inclined 45° down. After they soak water the first time their volume will double or triple, in the shown jar there is a mixture of alfalfa and fenugreek seeds.

155. After two fingers of water the volume size doubled

156. Sprouting started and sprouts ready to eat

Microgreens trails have many designs and they can be grown with different growing media. For our practice is been used soil but the set was providing paper, is very common to find coconut fibre suggested instead of soil. There are many varieties of seeds from which grow micro, most popular are: sunflower, buckwheat, radish, alfalfa, but on this trial, there were also turnip, water spinach, pine willow, fenugreek and white peas. The author tried them all on one trail. Unfortunately, at home, the moisture management with a spray bottle did not work well so the result was not thriving but this issue inspired in testing a self-watering system from scratch (two yogurt vases one with holes and one with gravel to distribute water) which made grow and allow tasting.

158. Growing greens in self-watering system; Buckwheat, White peas dancing in the pot with sunflowers applauding.

157. Tested samples; Equipment; Author's trail; Some green of the trail

3.2.2.2 Mushrooms

Mushrooms are not plants, which makes them out of the main focus of this thesis but it is important to notice their niche potential in the house context. Fungi are decomposers and what they do during their cultivation is breaking down cellulose. In order to have mushrooms we need Time, Mycelium and a substrate medium which can be out of any cellulose base by product. In the workshop we had cotton husk, straw, saw dust and wood chips. Most common spawns to use for this practice to begin are of shitake mushrooms and oysters. In the equipment there were shitake, yellow and black oysters. Two phases were provided to be tested at home, growing mushrooms from mycelium and growing mycelium from spawn in order to do the entire cultivation process.

At home the author did not initiate intensively the spawn because could not cook them, but the mycelium could not be postponed much. Mycelium from the spawn still grows slowly because of the limited moisture.

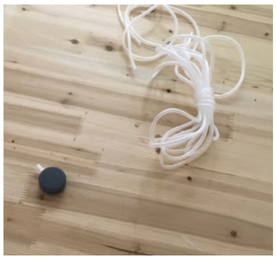
159. Fungi terminology; Equipment; Logs

160. Home logs, with some slushes of yellow oyster

3.2.2.3 Compost tea

Compost tea is a technic fundamental for indoor conditions. Its process allows the transfer of nutrients in another medium body manageable in reduced spaces and depths availabilities. This technic requires a bucket with water, where the nutrients will be released, a mass of compost wrapped in a cloth that has to be suspended in water and the stimulation for the nutrients release is oxygen provided by one of those systems for aquariums.

To obtain a good compost tea the oxygen exposure has to last 24 hours. After that the obtained tea can be sprayed or poured on plants.



161. Compost tea and detail of the aquarium porous stone for oxygenation

Alternative solutions for natural nutrients provision are necessary for small scales farming, as also aquaponics and especially hydroponics (which does not have fish manure as resource). Other liquid forms that provide the possibility of distributing nutrients are the "compost liquid" (what leaks out of the worm compost bin) and "liquid kelp". These preps are recommended once a month after a year from potting, because the existing nutrients in the used soil will be already absorbed by the plants.

3.2.2.4 Discussion

Many are the practicable options applicable in urban contexts and small-scale places. The mentioned are some and there are more experiences in the next section. What emerges from the practices of starting from seeds and spawn is that the condition set is fundamental and their alteration or mis-match are crucial for the success and continuity of the production cycles. The attention points are not many, only moisture, medium structure and light exposure. Moisturising is the most tricky because tendentially requires constant provision and attention to assure balance (mis-balance of water presence is what mainly compromise initial stages of growth) , meanwhile the growing medium and light (climate) are pre-setting.

3.4 Practice in “student room”

In this section follows a series of self-guided applications and experiments which might be considered extensions of Hands-on in practice but in the authors student room constraints.

3.4.1 Air cleaning action

The entire high consideration of plants initiating this thesis was caused by the sum of arriving in Shanghai on March 2018 after a project about Air Pollution management, not willing to buy an air-purifier, being convinced to manage the own environment with learned good practices and focused plants. The plants choice derives from the already mentioned lists in the research. The first acquirement was a Spider Plant and after looking for a bigger vase and finding a more furbished flower market joined to it a blooming Aloe and a Snake Plant in April. The watering was managed with a basin where the author would put them soaking few hours in an approximate average of once a month or by noticing plants changes. The indicative behaviour was the loss of green in the Spider plant leaves which will recover after “bathing”.

163. The Air Cleaning Plant Trio at the Window. Ph. Jelena Sučić April 2018

162. The Air Cleaning Plant Trio with babies at the Window. Ph. Jelena Sučić April 2019

3.4.1.1 Discussion

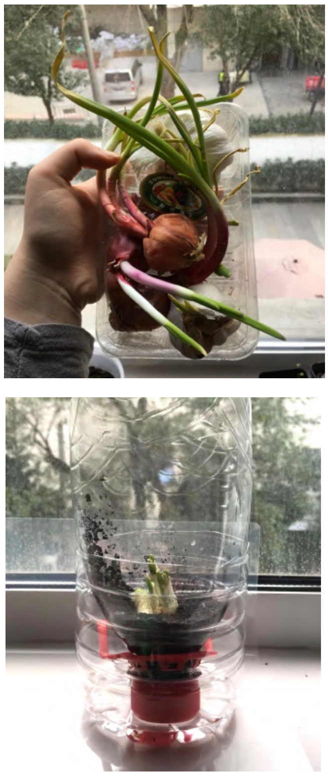

164. Trio having a bath

By being just arrived in a country with a completely different culture the language communication was an issue. Therefore, the observation of details in the plants research was fundamental to assure the choice of the meant plant in the acquiring process.

The “bathing” technic for watering, initially considered just the less “messy” one, allowed to experience and recognise the capillarity action with soil in that context.

Later on, with the Permaculture training this principle and water behaviour would be recognised in the bigger scales. The vegetation spread is possible because of the soil structure and the water capillary ability in that structure. In fact, plants water assimilation is all based on water capillarity action.

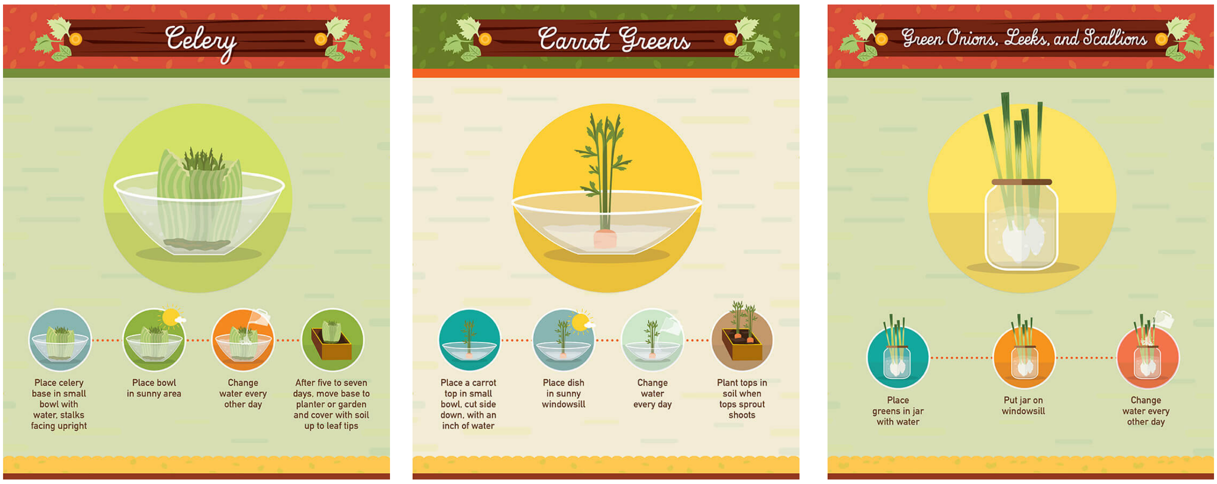
3.4.2 Re-grow


165. Regrowing greens at home

By being in a foreign country with a completely different language system, plants and seeds provision and their accuracy becomes difficult. Luckily, there are some commonly known vegetables like onions and garlic that often grow their greens spontaneously without any soil or water addition. Chives are sold always with still the roots on which can easily re-grow. These made emerge the consideration of looking for supermarket, market food sells as resources of cultivating plants able to regrow.

In fact, by searching on the web plants that can regrow from scraps there are plenty of infographics and video explaining possibilities. Most common regrowing plants are herbs from cuttings, chives, green onions leaks, celery, bok choy, potato and carrot greens. Many seeds can be found already in our food, bell peppers for example have 500 seeds in each, but growing from seeds is harder, as already notices in the microgreens experience, because it is a delicate life stage to manage. The aim in this was providing grown plants fast and since these plants had to be useful had to respond to personal diet orientations.

A small selection of infographics provided by Food Revolution Network to initiate this topic [185].



166. Infographics about re-growing celery, carrot greens and bulb-based greens: green onions, leaks and scallions [185]

Bulb-based greens were already regrowing and this water jar system made realise how to extend the green freshness in conservation without using the fridge ad letting regrow the used. These were tested direcly in soil in the “Micro-integrated Plants System” (3.4.3).

Two kinds of mints and basil were tryied to regrow, because of the long while happened before potting the cuttings, basil did not make it but the mints yes, one more than the other. The first actually regrown vegetable was celery followed by cabbage and two varieties of carrots.

Celery in warm water showed new leaves the day after and growed for a while in water then by moving in soil it stayed for a while and then started to rotten.

Green and red Cabbage are been tested from the node (rosette) ,with the same logic of celery, and from leaves. Both ways rooted from the thicker part of the used body parts. Later the green new heads were transpanted in soil, kept growing a while and become weaker after. The new red head instead got cut and tried to root in water before, it last till the bottom was in touch with water, when the touch with water stopped it dryied out.

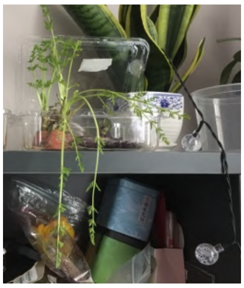
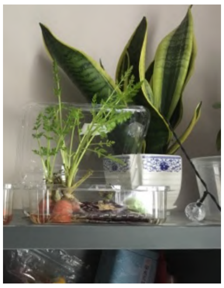
New carrot greens came out in two days from cut and water laying, by growing were also signalising visibly the water absence.

Follows a selction of pictures relatively to these experimented processes.

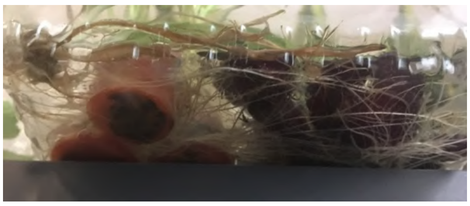




170. Mints phases, from initial regeneration and final blooming

168. Water asking carrot, before and after. 9th February 2019

167. Cabbages and carrots regrowing


169. Celery, beginning and end



3.4.2.1 Discussion

What emerges from these experienced experiments is that resources are everywhere, we just have to learn how to care of them.

Scraps can be the continuation of an interrupted cycle and if not still become organic matter for composting and feeding the soil web which will provide the nutrients for the next coming life cycles. The ability of plants to continue from an interruption, which if not would be discarded, has a huge potential in saving energy in growth processes. Since the growth energy required starting from seeds is bigger and longer. Considering this regenerative ability at different stages seams having a set predisposition depending on the three kinds of life cycles appurtenance: perennials, annuals, biannuals. Perennials are easier to regrow from cuttings than from seeds, by being perennial they have a regenerative predisposition from roots. Annuals are mostly regenerated from seeds, their cycles are shorter and their ability to survive along all seasons is low, but what can be notices is that annual plants, especially the fruting onne, provide tendentially big seeds, big seeds mean high energy storage to start the next cycles. Annuals that do not fruit as potatos, have high regenerative root bodies defined by their thickness. This concentration is what allows to conserve the energy to grow again when favourable conditions are encountered. The root structure is what defines the robustness of biannual plants as are carrots, cabbages and celery. Their growing strategy is in occupying space and volume to ground well in the soil to survive in the first year, in order to bloom the second year. Because of this by cutting them they will tend to grow aiming to reach the final stage of blooming and releasing seeds.

For next tests attention has be on water freshness, for the regrowing technics in water. Water changes were not done in these experiments, but let absorbed and added when gone (see carrots above). Absortion was constant the issue was in the bodies integrity which because of the constant water contact would start to rotten.

3.4.3 Micro-integrated Plant System

The first experimental pot indoors had the aim of verifying some critical aspects for a long-term sustaining plant system in priority order:

1) Watering from below as is the way plants are used to provide themselves. Criticalities:
   a) Access form and provision of the pot structure: siphon system;
   b) Soil weight gaining. Once the soil absorbs the water in its structure, the water weight creates pressure that makes it fall down and compact, risking to obstruct the water

access. If the soil compacts its structure is not suitable to retain and distribute water for the roots.

2) Nutrition for space occupancy in time. Criticalities:
   a) An initial volume of soil has a quantity of nutrients, if not provided with extra solution after a while, as might be one year, the plants will not have nutrients anymore, so their sustainment would be problematic;
   b) The plants grow in height and in depth (roots), respectively to the sizes the root system will occupy all the available space in their life time, if these do not have a reasonable depth for their size their growth quality might be compromised.
3) Variety of plants preferring different conditions but sharing the same one, same soil, same watering, main difference in involved plants their photosynthesis process common plants with classical process and succulents (CAM). Criticalities:
   a) Plants behaviours, nutrients and water needs diversity;
   b) Indoor conditions, aiming to balance the O_2 and CO_2 ration in a closed environment since seems to be the most crucial aspect of animal coexistence with plants in an enclose environment as demonstrated by the big study case Biosphere 2 in Arizona [186].

On Taobao is found a pot already considering the watering action from below in which could be tested the water access and circulation (gravel addition). Next step, aims keeping the soil open and light by mixing vermiculate (puffed rock). Ideally for having the richest nutrition value since the beginning we might use vermicompost but unfortunately is not available in the local market and the initiated compost bin did not produce enough for this purpose yet. For this case is been used organic potting soil purchased on Taobao.com.

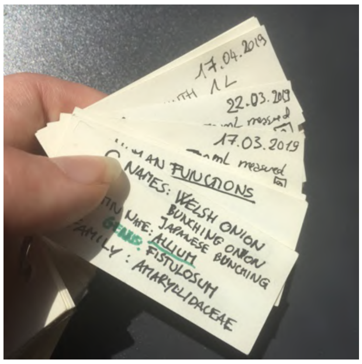
For the first plants selection and combination the established guideline included: diversity in behaviours (photosynthesis, root type, life stage, dimensions) and functions (ornament, medicine, food, shadow, water distribution, and mulching as mint demonstrated to do spontaneously if not used). The herb species and variety decision were inspired from a past experience of buying a mint (April 2018) that after some days turned to be heavily invaded by aphids. By trying to save and recover the plant, the conducted research for this purpose found as main solution garlic macerate (heavy solution for a student room space) and plant garlic bulbs in the soil for prevention and early stages. Aphids are really common to

171. Mint trying to recover from aphids after a total cut and garlic bulbs greening in. 22nd April 2018

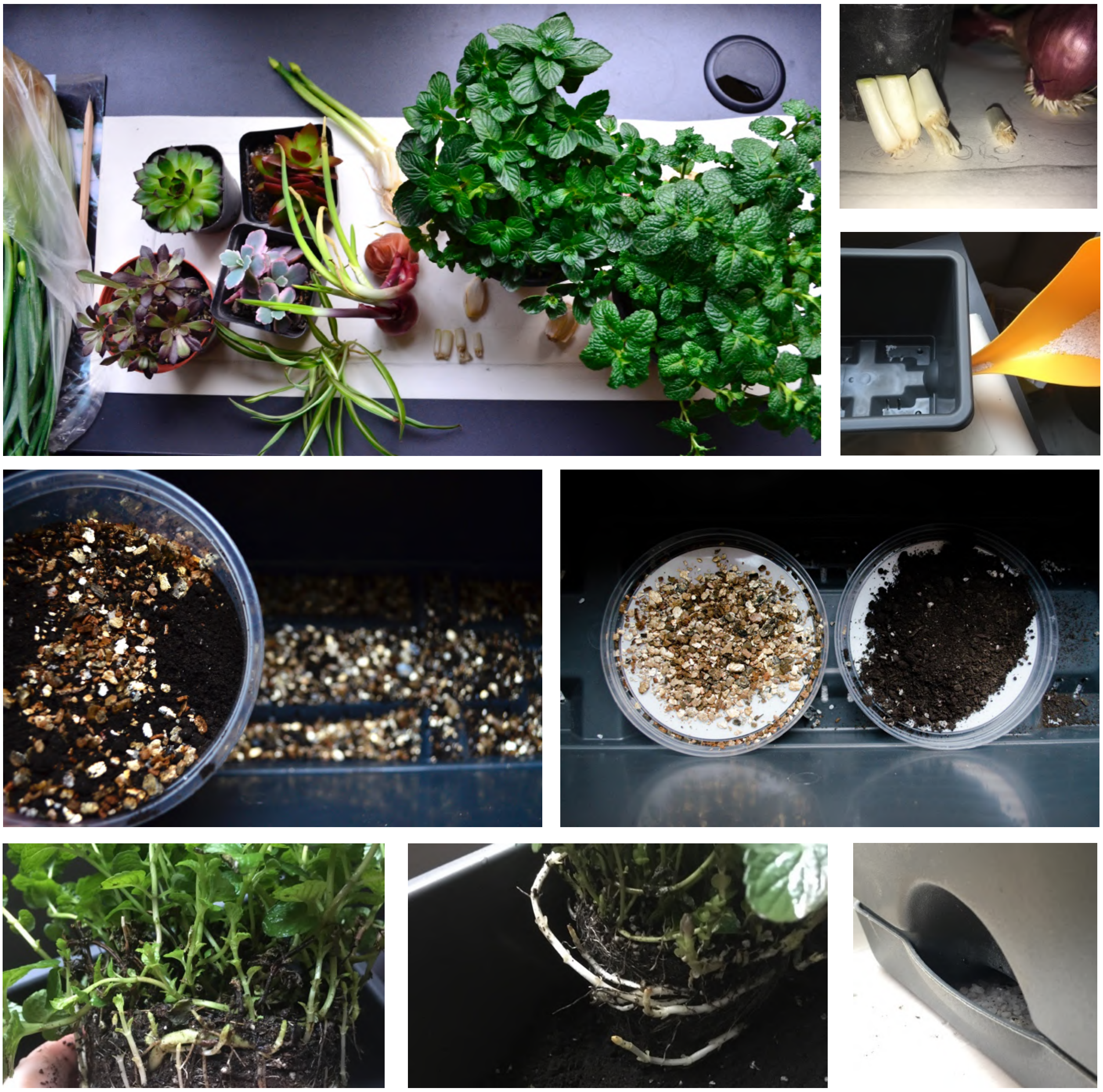
encounter in enclosed systems because of lacking diversity. In permaculture diversity is a preventive strategy of “overtaking situations” called “pests” or “invasions”. Therefore, in this system there are two varieties of mint surrounded by garlic bulbs.

The surface provided by the pot of 19 cm x 50 cm is occupied half by mints the rest are garlic bulbs, onions, chives and welsh onion cuttings, baby spider plant, four succulents including also a houseleek (semprevivum tectorum) which has the same properties of aloe but in smaller doses. This is also from authors memory and experience of using its juice to cure ear inflammations.

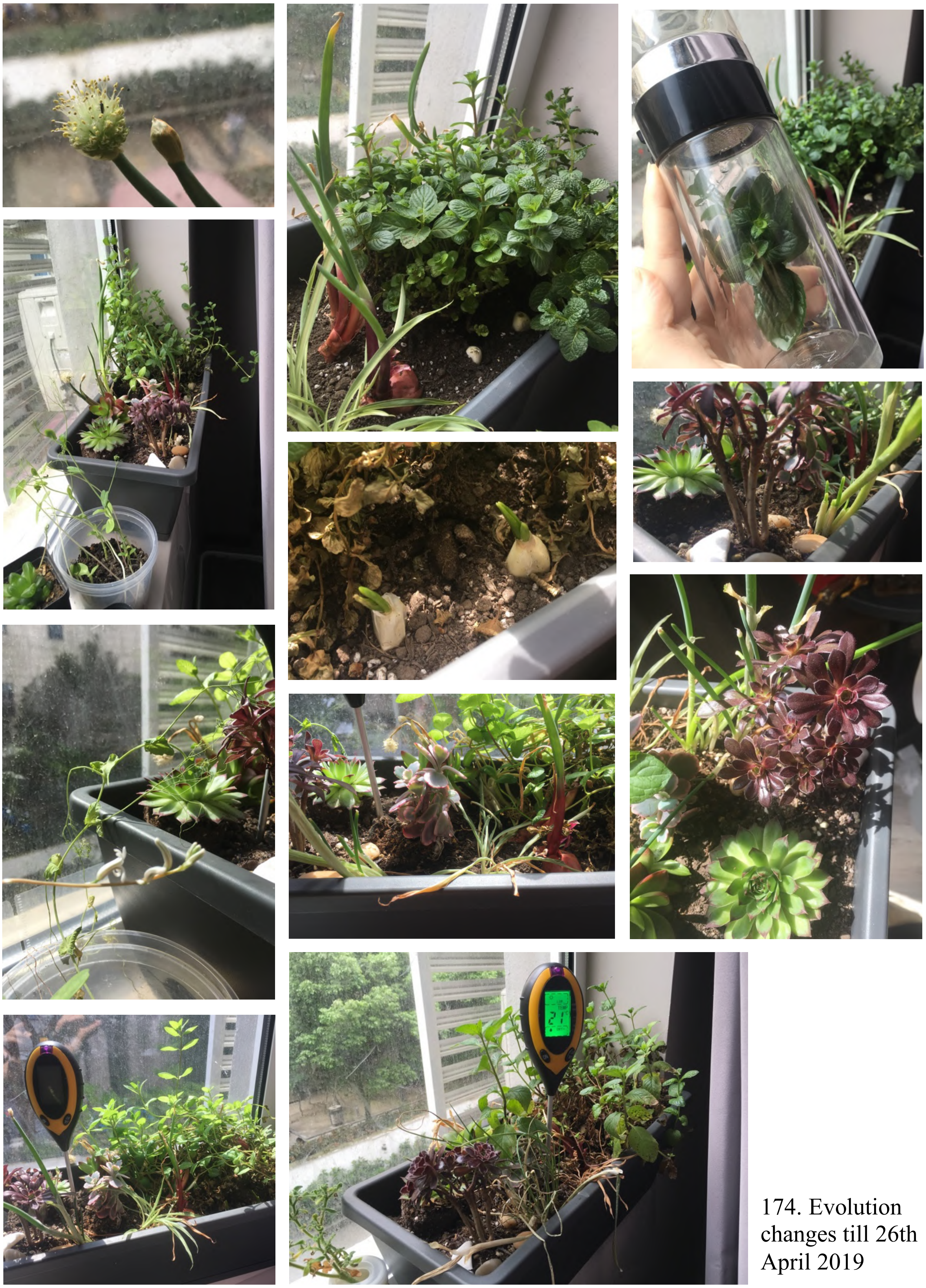
The observations were done through photo documentation and a little diary note with the plants name involved in the space, their functionalities, the uses moments of them, as for example mint cutting for infusions, condiment in yogurt seasoning and salads. In it were marked down watering days and quantities. When it arrived is been used also a soil multisensory to verify pH changes, water presence, temperature and light intensity in the area. Many changes happened in this period of time (as babies dying and different green onion cuttings coming in), relatively, follows a brief photographic excursion witnessing the initial elements setup, overviews and details overtime. The timeframe considered is from 17th January 2019 till 26th April 2019.



172. Little handwritten diary



173. Setup from the first day. 17th January 2019



174. Evolution changes till 26th April 2019

3.4.3.1 Discussion

Is never been reached the condition of water absortion till the top soil area, more experiments with the soil texture might be done to enhance the capillarity action. Nevertheless, plants' roots were able to find the water. The water tank area is closed and makes the water movement less controlable, therefore for future experiments there should be a basin structure so that also the gravity force can contribute the movement of the capillarity action.

Relatively to soil nutrients the timespan and equipment was not enough to capture feedbacks. The soil sensor showed pH changes which might derivate by the water quality, from the tap or the filtered water.

The surface occupation area gave occasion of interesting feedbacks of plants relations between each other and the soil, water, atmospheric conditions. For qualifying data better monitoring conditions must be set.

The lives involved in this area showed that if the conditions are not the best/ideal does not mean that they cannot grow in that circumstances. They demonstrated that plants have different adaptation and persistence strategies.

Chapter 4: Research findings

4.1 From global scale to the individual scale

Every global and and bigger scale considerable issues tackled in the literature as Climate Change, Air Pollution and Resources Peaks, find their causes in a spread of accumulated effects from individual common behaviours. Therefore, the design project cannot be just a vision proposition for a bigger scale, that has to be activated by taking a high level position in a governantive layer. The Author is an individual, not enough highly positioned to impose any vision, but by moving in a wide scale spectrum of relevance and their layers and levels, was possible to understand how much possible is to contribute mitigate global problems from a individual citizen condition. By clarifying that the mentioned issues are Nature based and they are not human system's problems only, but that they manifest outside, intending the natural environment, which affect the antrophic enviroment and this impact is contributed by the anthropic behaviours effects themselves. There is a cyclic movement from inside towards outside and vice versa as explained in 1.3 Research usefulness: The General Problem of Environmental Systems Perception.

The Project has to based on applied **Nature Principles** and use the **Education discipline** as a tool by developing new paradigms which must have a seminal attitude in applications. Education practices have already the characteristic of being seminal, as plants are with their seeds. Is known that it cannot be counted how much and which parts of the taught matter is been absorbed by the individuals and applied and maintained under consideration after/later, as is not a guarantee that every seed is going to start and finish a life cycle.

As emerges from Greta Thunberg's case (2.4.1) there is a crisis going on and the coming youth are the ones that will have to face its resolutions since there is been procrastination from the leaders. Nobody has the perfect solutions but everyone needs to keep trying to create balancing conditions.

The **learning process creates occasions** for **open-ended evolutions** that might contribute to activating changes able to mitigate or enhance impactful effects.

In order to keep these evolutions happening youth have to be provided or being enabled to build a package of knowledge resources that provides for life understanding and alimentation.

4.2 Considerations from Permaculture Design practices

Permaculture is all about observation, understanding and putting in practice. It grounds people by providing educational moments and tools to build a starting set for a self-educating system supported by a community with the same set but with different experiences which become resources of knowledge and educational purposes for the individual. What the pioneers of Permaculture practices did is mainly giving a language to relate to nature matter under human capacity.

By considering applications in smaller scales, or maybe should be defined “**micro-scales**” according to the considered target in this research, which are individual citizens in their everyday life with spatially limited conditions, flats/rooms, operating on a balcony or a shelf, the prioritasation scales down in requirements.

Because indoors is the main available condition where to operate for the citizen and since the relations that wanted to be created are with plants, their life cycle basic needs have to be recognised and prioritise their presence understanding.

4.2.1 Extrapolation from Scale of Permanence

Since the focus is in small spaces tendentially closed and life kind focus is plants lives the properties of this context make realise that there is a different relevance to consider.

From the orientator tool of the scale of permanence (2.3.4) we can estrapolate that:

- Climate (1) and Microclimate (5) have different action and effects range scales but both behave in the atmosphere, activated by the Sun presence;
- The Landform (2) which is the second major influencer after the Sun action of the Climate, because of its structure diversity dictates the Water (3) movements in its different stages (solid, liquid, gasouse) in the landscape. Water is what brings Life conditions with its movement;
- Landforms (2) structure differentiation and holding capacity is the same holding function found in the earth Soil (9) layer, which is the one that mainly interest at small scales and by focusing on plants life, infact can be identified that soil has two main functions holding and fertility;
- Access & Circulation (6) is the understanding part of energy and matter flows present in the considered contexts and how to provide their mainenace efficiently. Tools for humans to manage and maintain conditions in the considered ecosystem are definition

of Zones of Uses (8), Building & Infrastructure (7) Aesthetics and Culture (10) appreciation;

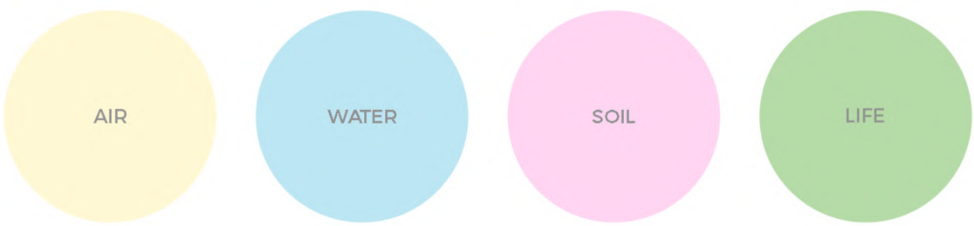
- The just explained point is about Human Life and its considering behaviours in and environment but the same is done also by Vegetation & Animals (6), People, Plants and Animals establish relationships in the shared ecosystems with their behaviours, which include their consumption, occupation/diffusion, then their impact effects in time.

The last two extrapolations explain that out of the first three, **Climate, Water, Soil** sumarising the life actuator bodies, there is also the **Life** body activating itself in relation with the actuators.

Estrapolated essential outcomes, emerging by focusing on a plant or a little group of them in a individual citizen capability of application, makes encounter the need of understanding the three cycles of resources required for plants to exist are the set of conditions given by **air, water** and **soil**, which are reflected in environmental terms as **atmosphere**, **hydrosphere** and **lithosphere** which are hosting the **biosphere** populations.

4.2.1 Summarised Focuses

The identified main cycles providing for Life at Plant's relevance are the Air Cycle, Water Cycle and Soil Cycle. In order to to sustain life have to be understood Air, Water and Soil main behaviours and principles, so their relationships. Life cycle relatioships are dependent on air, water and soil, but on the same time the life behaviours according to the uses shapes and influences three main cycles behaviours.



175. Four main identified Cycles: Air, Water, Soil, Life.

Summary of attention points influencing cycles behaviours:

- Attention points establishing **Air** behaviours:

- **Composition**: substances and bodies moving in the air have different properties that might influence its qualities;
- **Climate**: is fluenced by the **Sun Actions** (light and heat) in the **Context** which **qualitie**s change given by the existing relations in terms of:
  - **Position;**
  - **Forms;**
  - **Occupations;**
  - **Matter/Materials.**
- The **Air Flows** are caused by the existing **Pressures** defined in **Temperature Differences (Chimney Effect).** In simplified terms **cold air** is **dense & sinks, hot air** is **light & rises.** These behaviours are influenced by air composition and climatic context definitions.

❖ Attention points establishing **Water** behaviours:

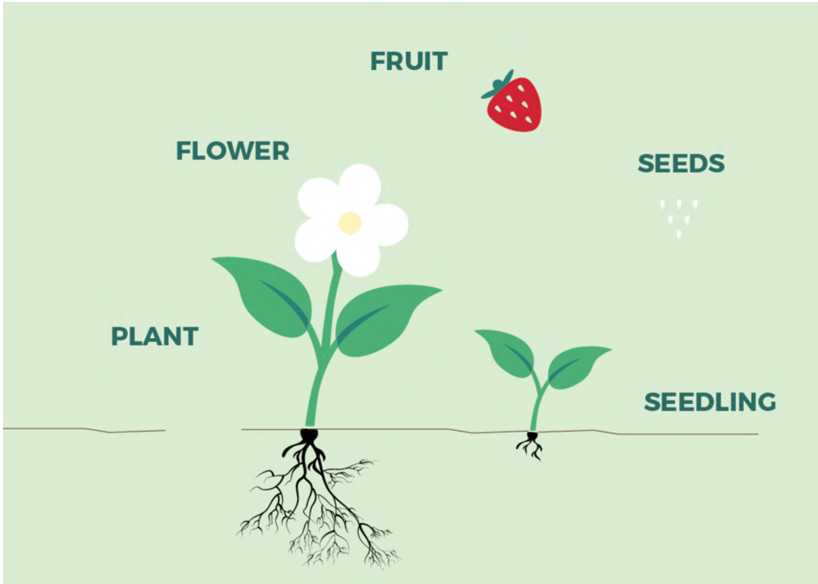
- **Water States** have different properties defining water movement according if the bodies are **gasous** (moving in the atmoshere, influenced by air behaviours criteria), **liquid** and **solid** (moving and staying on and in the lithosphere). In fact, because of these three states water creates **exchanging movements** between air and soil;
- **Gravity Force** combined with Landform properties is a **passive force** that leads water liquid state downwards and the Landform or Pathway structure (small scale considering) is what establishes the **direction** and **rhythm** of the **water flow**.
- **Capillarity Action** allows the **water movement to turn up in liquid state** because of water density properties in relation with the **physical properties of the conducting material structures.**

❖ Attention points establishing **Soil** behaviours:

- Two main functions **holding media** and **fertility**:
  - The holding function especially in relation with the water movement is determined by the properties of the soil components kinds (clay, silt, sand, see 2.3.4.9.1).
  - The holding function leads to the fact that soil holds life (plants roots, worms, insects, microbe, fungi,…). The diversity of organisms relate and transform in different forms the soil matter (organic matter) providing conditions for high fertility.

❖ Attention points establishing Life behaviour:

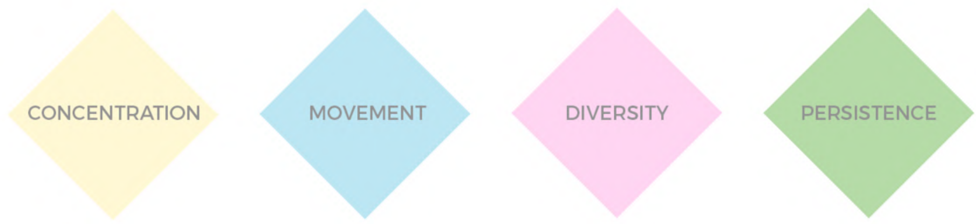
- According to the considered life kind there are **different life stages** of it and each stage has different behaviours and requirements, respectively criticalities to consider, if we consider a plant the main life stages of their cycles are as syntetised in the following illustration;



176. Synthesis of life stages components. Illustrated by Jelena Sučić

- Life kinds diversity combined with their stages and rythms is what establishes **their space occupation in time**, above and below the surface;
- Life kinds differ in their **methabolic processes** which consequetially require different needs and produce different effects that have impact on others living processes;
- The individual life element is in relationship with the others in a considered group/community. More functions the individual can provide to others more this one will be supported by the ocommunity: **functional relationships**;
- The cyclic **regenerative strategies** of spieces are supportative to **maintaine** its functionality in the ecosytem **avoiding high stress** conditions that might compromise the found balanced equilibrium flow which could become the end of life persistence in the considered envriroment.

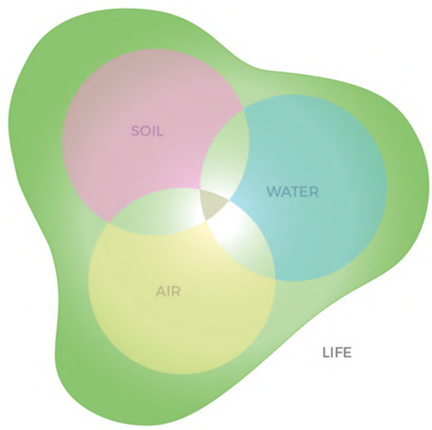
In synthesis, these four cycles have as main characteristics in their behaviour of being: concentrated, moving, diversified and persistent.



177. Main Characteristics of Cycles Behaviours: Concentration, Movement, Diversity and Persistent

Life cycle is what adresses the uses and distribution of Air, Water and Soil Cycles and on the same time is dependent on these three cycles. In the kind of life we consider, maybe the dependents on soil of human's life is not immediate to recognise. What helps in this recognision process, if the reader agrees, is that human lives are dependent on plant lives. Can be discussed that plants do not need soil to stay, grow and live, as demostrated by acquaponics, hydroponics, air plants and water plants, but they still need nutriets diversity (fertility) which best provider are the soil living metabolisms. This fact might make consider that the most important lives are the soil inhabitants (decomposers) but these still need oxygen and death matterx to live. In fact, their main source of food are plants death bodies (organic matter main component) which life cycles have migrated in seeds somewhere else or regenerated seasonally (perennials).

To conclude, follows the rappresentation of these cycles relationships.



178. Relationships of the Four Cycles

4.3 Education for the Biosphere/Planet

There are existing practices as shown in the literature, in peramculture and test cases but are not integrated enough in the educational systems which are the base of a ethic civilasation. Is not only about telling things, or putting few seeds in the ground its about understanding the entire potential of the living process in time and what comports the totality of development phases and using this congnition to contribute to the integrate change action.

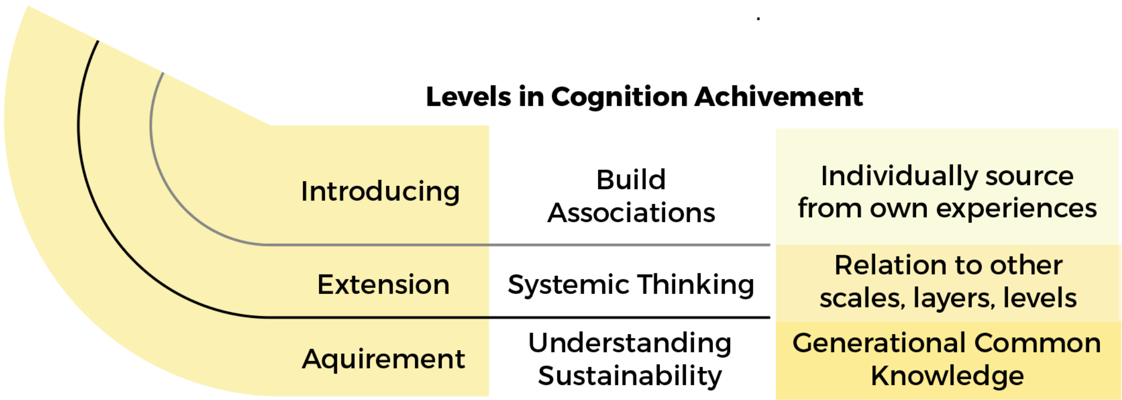
Since the education systems is the main source of a **common knowledge**, in order to coverge our efforts in a **common aim** which is looking for sustainability as declared also by goverments, the education system has to provide knowledge and experience from which have a ground of innovation potential.

If the society aims towards sustainability than has to training in thinking systemically. The consequentiality in space and time diffusion given by the relationships of resources, life needs (inpunts choices), behaviours (metabolisation process) and produced effects (outputs), in favour or not to others (impact diffusion).

4.3.1 Aquiring Cognition

In order to aquire congnition, the learning process has to be based on experiece, because people are more likely to recognise things and learn heuristically. People are like the apostol that could not belive that Jesus was in front of him after his death till he putted his finger in Jesus hand's stigmata. Till we do not experience we do not belive and consider that existece. For this reason, the **Action Learning Loop** explained by Holmgren and all those action, experience, project, context based learning approaches are so effective, they impress in memories with multiple layers and persist because of found associations in the individual experience. **Building Associations** is a scaling/transfering action to compare same principles/aims in other contextual resolutions. Associations are the base line for recognising relationships and their functional networks which converge in the consequentiality of **systems thinking**. Recognising systems their maintenance criteria given by their behaviours and needs is what helps to **understand life systems sustainability.**

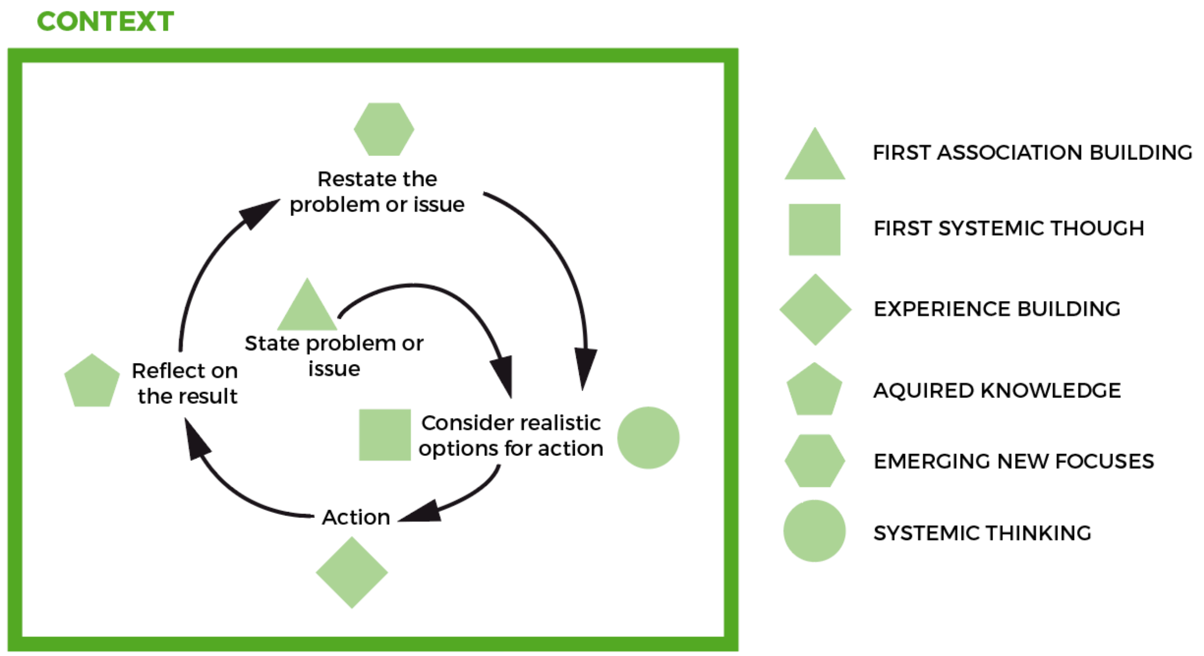
The **learning process never stops**, there is also the common say "Learning Never Ends" and what demonstrates that is the learning loop rappresentation combined with the three identified levels of **Cognition Achivement.**



179. Levels in Cognition Achievement. Graphic and Design: Jelena Sučić

In an observed **Context** identified **Problems or issues** are focuses in observed conditions. In order to define a thing as a problem, it has to happen a first association that enters in relationship with something inside the context or inside the individual experience of the observer. A **problem is an identified prevention of a function** that is compromising the sustaining ability of the considered system.

Considering realistic options for action is what relates to the systems involved, by realising the possible effects of the choosen action and the feasiablity of the observer in activating the needed effects. The **Action** is what produces the experience, and the **result reflection**, is **acquired knowledge of effectiveness**. Once we enter in relation with a context in which we experience and aquire knowledge the consideration/attention on it rises and so can **emerge new focuses**/problems/issues. More we relate with a context more the capacity of extending the relations perception rises gaining so **holistic understanding in time**.



180. Integrated definition of the Action Learning Loop. Integration Design: Jelena Sučić

4.3.2 The Potential Creativity in Cognition

If we consider Humberto R. Maturana and Francisco J. Varela work in defining biological cognition and the coined autopoiesis term to explain biological intelligence [187] ,by moving towards the human layer there is a Maturana's saying 'the Art and Science of Understanding' can refer to human understanding of consequentiality (action-effect relation) [1]. Once a system (e.g. a person) is aware of its existence and the effects of its behaviours in relation with other systems by understanding the elements that compose it, their properties and capacities, thanks to this gained holistic cognition, the system become able to reinvent and adapt itself for a choosen purpose.

This is the base that identifies learning process as an open-ended evolution, thanks to the **observations** and **built associations** which **aliment creativity** and **empower reinvention** and adaptation to happen.

By aquiring cognition of principles from education activities enables own system's self-reinvention (individual) adapting in the system (a whole). Thanks to the alimented creativity people can adapt, change and so evolve their behaviours towards more conscious effects.

An attidute that can be though to **stimulate creativity expansion**, is learning to think for **at least five functions** for the meant intention/action instead of only one.

As permaculture dimostrates to aim for sustainability we have to learn how air, water and soil behave design the set of conditions to let them selfsustain at any scale. This attidude gives more longterm chances of sustain/persist contributing to the resilience dynamics of the considered ecosystems.

4.4 Where is Human Centred Design? Re-positioning

By focusing on plants and their behaviours as resources emerged that **design discipline at human relevance**, if wants to aim for sustainability goals **has to move its focus** from human needs and human behaviours **to human effects production**., research and experiences gave the bases to evolve in a practical principle with a cyclic movement of built cognitions bases as its been presented during the LEUS 2019 conference in a poster by the author [12].

Every identified human need asks for resources (inputs), the need satisfaction produces behaviours (metabolism) which process implies **unconsidered effects** (outputs) which are not the meant need activating the behaviour. In the end we keep producing exponential effects that do not get consciously distributed, becoming what people call "waste" , "pollution". Waste and pollution are identified as problems which require solutions, therefore produce **new needs**, installing respectively behaviours with their consequential effects, which might become problematic or restoring. This cycle will **continue to behave** in this sequece looking for balance and establishing hopefully an **equilibrium flow**, becoming able to **define a life sustainable**.

181. Cycle explaining where is the Human Centered Design aiming for sustainability discussed in the poster at the LEUS 2019. Design by Jelena Sučić [12]

A small example of how powerful is an individual human action, repeated by many (becoming so a group of people) is given by disposable cups. The world complains about plastic pollution and waste management problems, if we consider that there are people that every day buy a take away cup of coffee by Starbucks before getting to their office, this daily routine means that per year a person trows 365 cups, there are already quite a volume to manage. The office host 10 workers, all of them take their take away morning coffee or tea. This group of 10 people produces 3650 unusable cups. The coffeeshop is at the first floor of the office building, it workers already know the entire team of the office and what they usually order. One of the office one day realise that can have its coffee in its domestic mug/portable cup by asking to serve the coffee in it so that can bring the mug with the office. The one likes having coffee from a own cup, so keeps to bring the same cup to serve him the coffee. Result, in one year by using the same re-usable cup, this worker makes drop the count of wasted cups of the office at 3258. Three more of the office liked the idea of using their own comfort cup so at the next year the yearly wasted cups from the office drop to 2190. Less wasted cups we gain in time means less cups to manage, so less energy, resources and time to invest in this management then the past years, which means more enerGy, resouces and time to invest in managing other problematic effects.

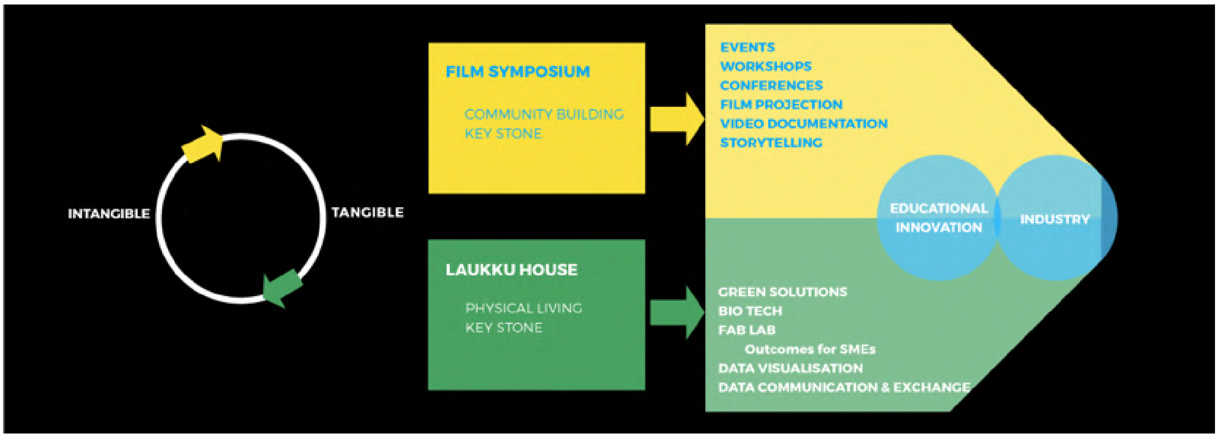
Why is important to state this perspective? Because the emerging constraints summarised in phenomena like Climate Change impose an extension in human environments consideration, which is inside a bigger shared environment, the biosphere, and because the high level of activities it produces the impact does not remain absorbed by the biosphere but continues existing and returns in another shape/accumulation to the human environment. A very good example is found by considering **air pollution**, we do not perceive it till it does not affect us back, (coughing, ichy eyes, …) as explained well in the WiBreath experience (2.1.3).

This point is so relevant because of the three point mentioned before in this chapter. What is re-establishing the awareness/cognition to humanity of being part of nature is because of effect ranges showing relations. We do not know if human behaviours are the main cause of that but we found the relationships that may contribute to the manifestation of the identified effects.

Chapter 5: Project

5.1 Introduction to the Project Contextualisation

This thesis research wants to support the relevance of a bigger and long-term series of research project conducted by the Creative Systemic Research Platform Team [188] [189]. The CRS Platform has currently two main project streams. One wants physically to activate the **intangible community building process** through the form of **Film Symposium** which include several elements. The author, member of the CSR Platform, aliments and initiates the sphere under the name **Laukku House** working on a **physical Life Lab** [1].



182. Graphical explanation of the two macro currents of projects planned by the CSRPlatform Team. Design: Prof Susu Nousala; Graphic and Design: Jelena Sučić.

The questions that this sphere raises and wants to answer on are about **sustainability issues** and respond to the need of **its understanding**, which leads to **recognising resources**, their **behaviours**, their **uses** and visualising **managements options**.

Life is a behaviour which needs **resources to sustain** its lifecycles. The extreme conditions as catastrophises, climate issues and changes, closed/constrained environments, are what make search for different solutions in managing resources in uses and availability.

As emerges from the research, **plants** are the best creatures in managing resources they have high **robustness**, **capacity** and **adaptability**, and since they are the only creatures producing oxygen have a grounded strict relationship with all the living creatures in this planet. People cannot mis-consider their existence too much, as it seems happening through the way humanity is managing resources. Laukku House project sphere deals with human green lifestyle requirements and with the term “green” is meant “sustainability” determined from plants perspective and their living processes as models to follow.

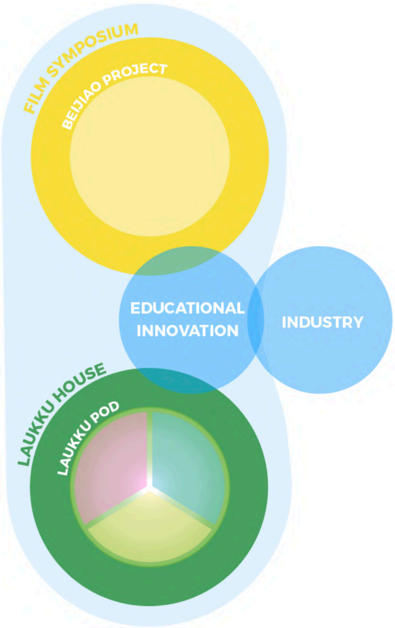
183. Conceptual slide used in CSR Platform team presentations in China

5.2 Laukku Pod Project

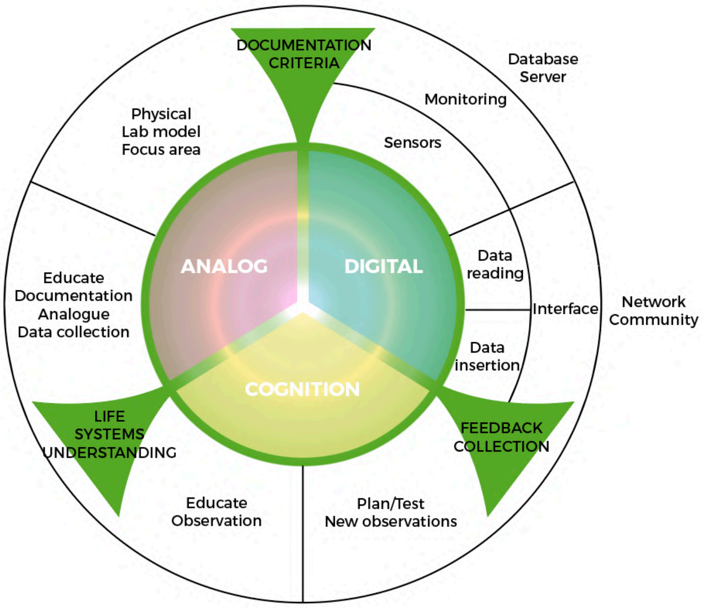
The initial core field project inside Laukku House sphere is the Laukku Pod Project, which is a Life Lab focused on Plants Lives. The research and experiences in this lab format aim in ‘**collecting and providing tangible results and data** for future generations from and for any background [1]’ in order to support their sustaining capacity.

By building research networks on documented small and dense living ecosystems behaviours are provided tools able **to innovate in contents and structures of educational systems**. The **scalability** of the documented results is what can contribute to **recognise associations** for **paradigms shifts** in **order to respond to peaks of resources and climate change issues**. The documentation is based on **creating and recognising functional**

relationships between plants, plants and the identified main resources cycles (4.2.2), plants and all other organisms.



184. Laukku Pod project position in the CSR Platform research spheres. Illustrated by Jelena Sučić



185. Laukku Pod research projects components. Illustrated by Jelena Sučić

Laukku Pod is a **R&D project** aiming to develop as explained in the introduction paper about this thesis [1] from a physical structure as a base, which can refer to a closed or open environment, that can be provided to the user or can be self-defined. It starts by being an experimental space where to observe a coexistence with plants and consider nature behaviours out of the anthropic perspective. Wants to support observation and interaction with monitoring sensors connected to a digital platform of users where the research results and documentation are shared. The service system can provide the documentation structure and tools to **allow any user to design experiences**, contribute and refer to already done researches. There is a team working on **plant systems modules based on natural principles**, extrapolated well by permaculture, and documentations as to provide starting points for who wants experiment with plants for their different functions. There are several conditions that might affect the developments of the ecosystem, that can be installed anywhere in the world and at every scale, and paying attention to them by documenting will permit us to prevent not meant alterations in the future settings. The building action of an ecosystem, even if just small like a wardrobe or a box, makes face the **balancing action of managing resources and energy**, which especially in long terms allows to understand the **sustaining ability of a system** and its provision of robustness.

The physical lab model, is not only a space to investigate/experiment on Life questions through plants as an interface of it, but also opens the chance/door to consider micro-farming, gardening activities indoors on individual citizens scale/capacity [1].

5.2.1 Team's Guiding Concepts

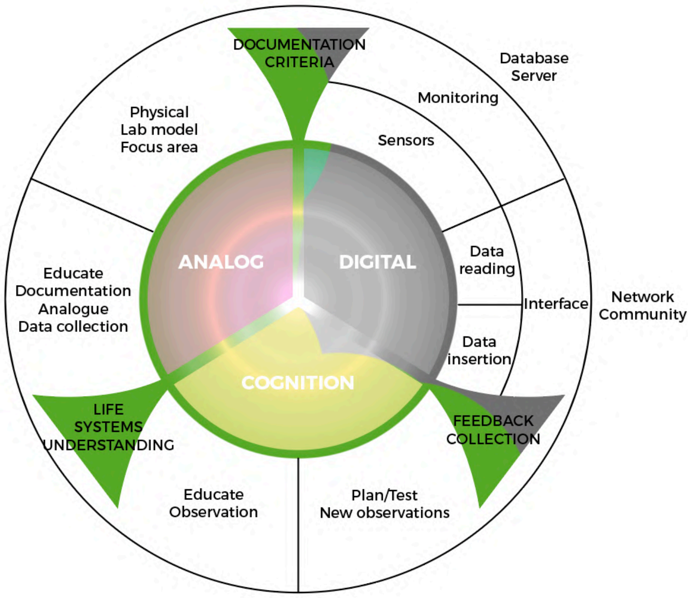
To read better the development process and understand the identified components in figure 185 there are some guiding concepts established at the beginning in team to align everybody's contributions. Every team member has different background and has accumulated meaningful experiences to identify constraints to consider in the process that might conditionate the outcomes, as in case of catastrophe, transfers and extremely cold and dark environments. Follows a list of concepts criteria:

- Closed, own climate;
- Modularity, scalability;
- Flatpack able to fit in shipping containers;
- Moveable;
- Providing functions;
- Low maintenance;
- Accessible;
- Research;
- Education "learning by doing";
- Diversity;
- Documentation systems, Monitoring, Data collection;
- Network, data sharing, experience sharing.

5.2.2 Author's systemic contributions in the project.

This thesis is a baseline research that contributes to the components of life systems understanding, the importance of contributing in defining paradigms for education and cognition processes in relation with plants' lives field and through these explore ways of transferring acquired knowledge about their behaviours, firstly analogue in order to understand how to transfer in digital forms, to extend access on knowledge for future purposes. The digital translation field is project field of other CSRP team members.

In this research is covered the ground of cognition and its focuses as explained well in chapter 4. In order to answer on how to define analogue documentation and the learning methods of it requires a physical space of experimentation. Small examples of it are found in chapter 3 and its extension will be explained through the Prototyping process (5.3.2-5.3.4).



186. Author's project fields coverture. Illustrated by Jelena Sučić

In this considered project phase, the last-mentioned part converges with the physical lab conceptualisation and prototyping of the entire Laukku Pod project research aims.

5.3 Project

As is been stated in the findings, the conducted research has broken down the aspects of the constantly mentioned environmental issues in the society and arrived to making emerge the points where change, innovation, has to be pushed in activation. The stimulating actions want to start from **education applications** and a **physical experimental space** suitable in urban contexts constraints answering to the guiding concepts. What shaped the final results of the explained research project phases are the constraints dictated by **first case scenario**, which environment is looking for this kind of field applications to introduce in their education system.

5.3.1 First Case Scenario: Huangpu Highschool

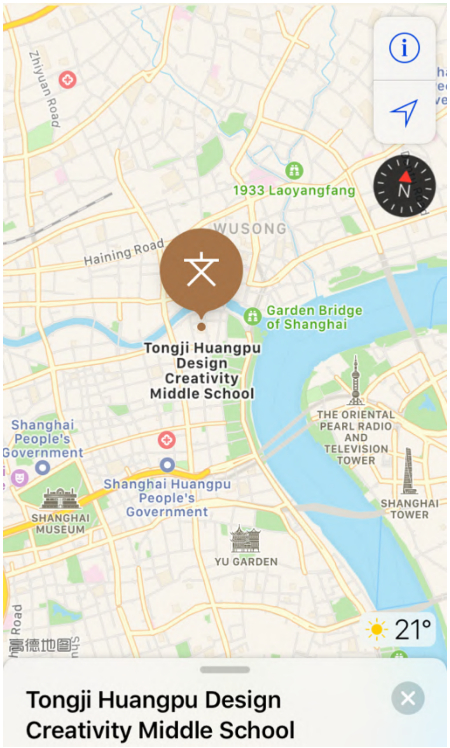
The Tongji affiliated International Highschool, Tongji Huangpu School of Design & Innovation, has expressed its interest in starting and developing a Research program about Green Technologies inside the high school structure for students' interdisciplinary applications. The particular curricular structure is been already introduced in chapter 3.2. The high school is extending its spaces in another building where are aiming in establishing an integrated new research department. In fact, the initial prototyping intention was in helping to set this research lab within the new space of the high school for alimenting their aim in practical educational curricula addressed towards sustainability. In the end the first intended prototyping did not take place during the time of this thesis because of building construction delays, accessibility and new emergent policies to deal with.

This first faced case scenario of Huangpu High School has contributed in confirming the existing need of dealing with these topics at in the educational environment and in defining physical constraints to consider in design process/development/choices.

5.3.1.1 Architectural constraints

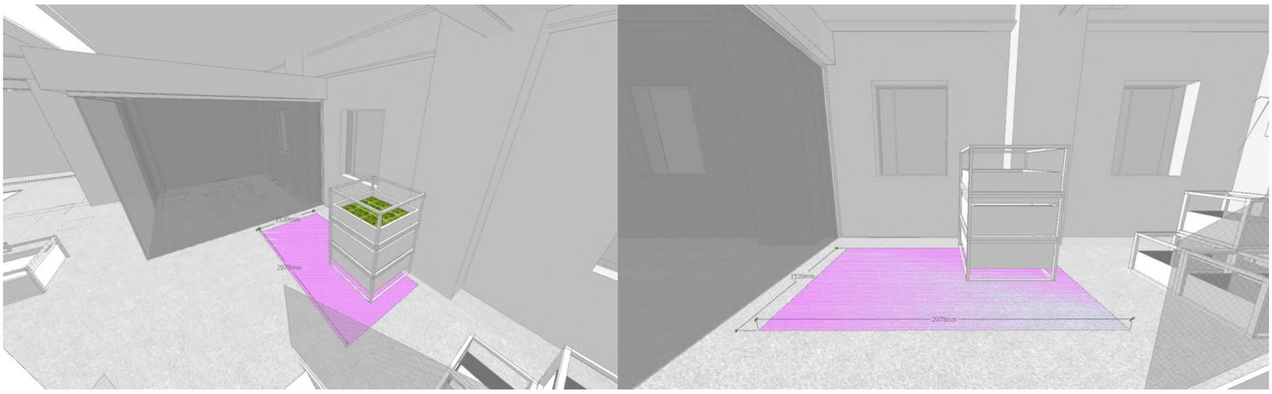
A clear problem to work with nature for this high school is the fact that it does not have outdoor space access, plus is located in the very central area of Shanghai. So, was a real need to bring nature and green in the school.

The building where the lab position was intended, was an old building which is passed under restauration and adaptation process.



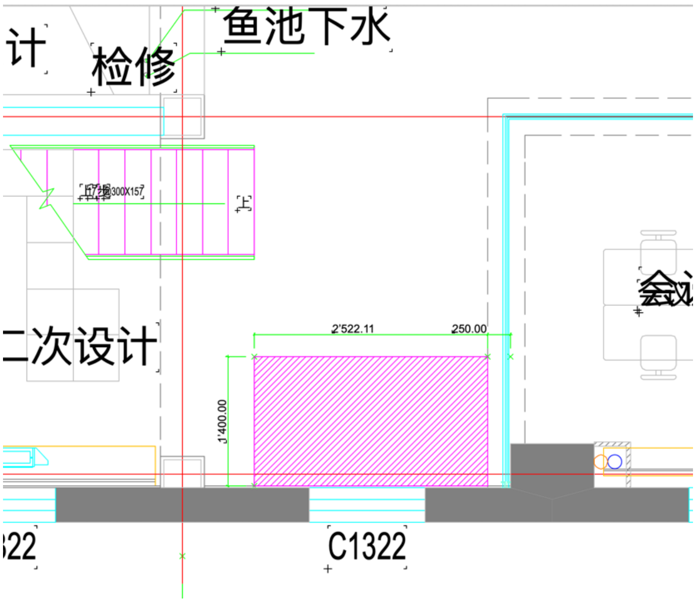
187. Huangpu Highschool location

The first intention was oriented to build the lab elements in a shipping container dimension, because of the modular requirements of the lab concept. By facing this first possible location emerged many uncertainties to deal that made reconsider the module dimensions. In fact, during the physical lab definition, when the team was keeping to trying understanding how to make the best use of the space, in order to provide most green occupation possible for students' experimentations, after the first provided drawings of the defined space for this aim in the new building, (see figures 188) questions about details to make the best use of the space, made emerge incongruences.



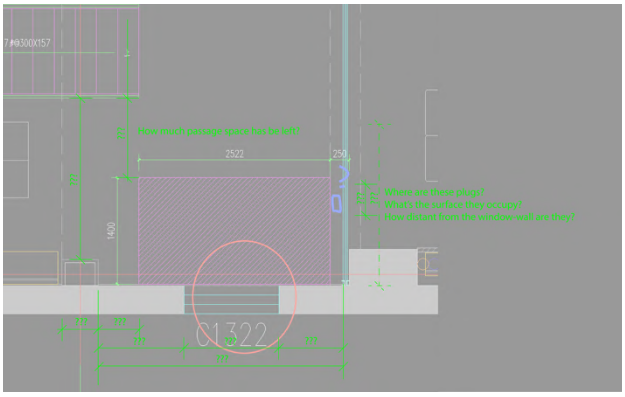
188. First given drawings: rendering with the indication in pink of the provided area: 1539 mm x 2978 mm

By asking details of the walls spacing in perimeter changes, window access criteria a new drawing arrived with the defined area space with a cut of almost 50 cm in length comparing to the first, which is a significant difference for construction purposes. The building was under construction and because of that was still influenced by possible changes. So, counting on these provided dimensions was unreliable, and the design strategy had to rely on another space understanding.

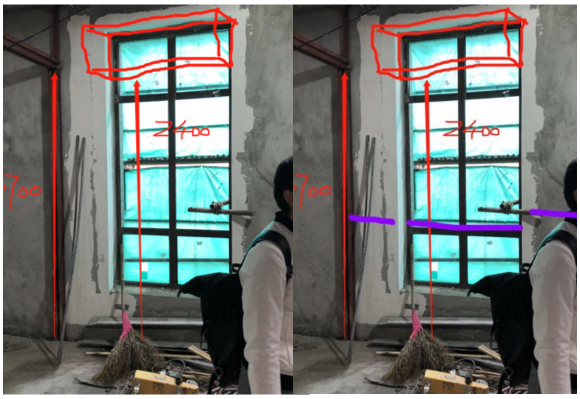


189. Detail of the provided CAD drawing showing the assigned area.

190. Critical measure for the space availability definition identified from site provided pictures



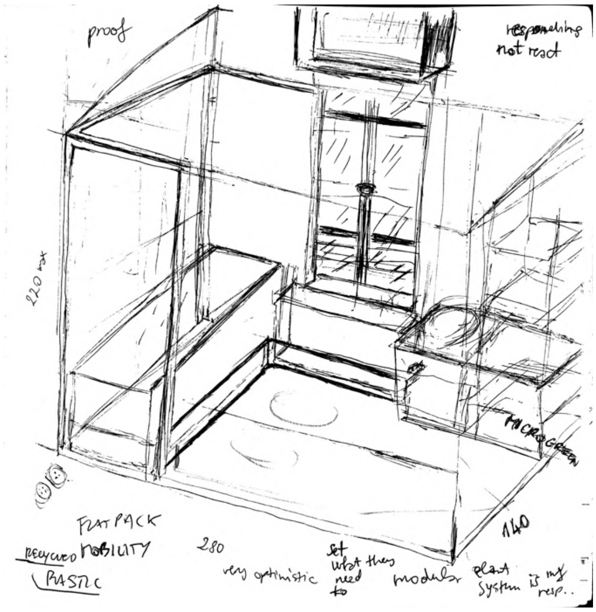
191. Questioned measures



192. Provided height limitations and asked further measures around the window access

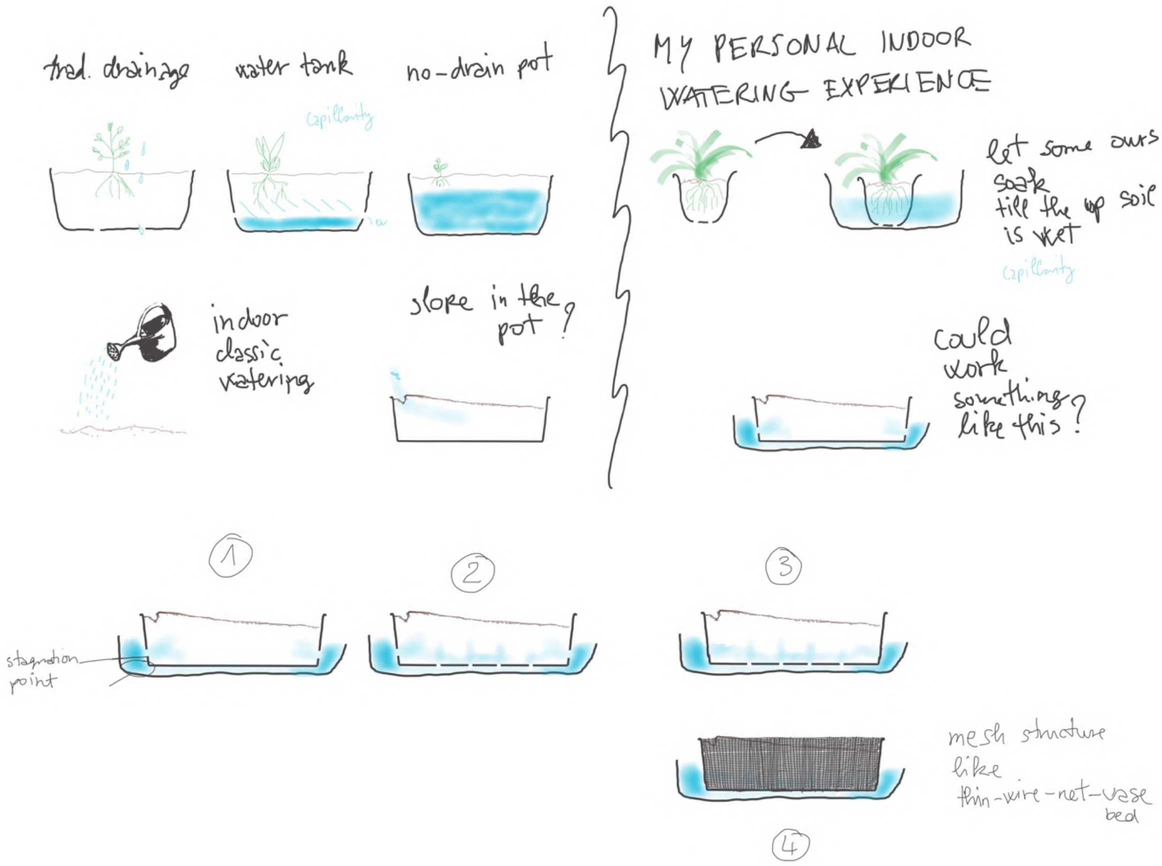
5.3.2 Physical Life Lab

Before facing the spatial constraints given by the first scenario, many ideas and definitions of what the lab box might, had to provide came through different contexts but always considering an environment defined by the lab box itself. Entering in a space to create inner onwn space made change the perspective. In the end because of the uncertainty given by the old building under restauration conditions, the aim of having a lab space where to enter had to be redefined. The research process had to identify the minimum necessary for a plant life base lab physical setting. In this phase, is been possible to realise that is not necessary to have and work in an enclosed space but just to have access in order to relate to the enclosed plant system.



193. Sketch of trying to define the maximum space usage and occurring internal elements. Sketch by Jelena Sučić

To understand better all the criticalities of a plant enclosed systems is been discussed further with Wayne Weiseman whose experience was fundamental to establish selection and construction criteria, part of these were already mentioned in the Test Cases.



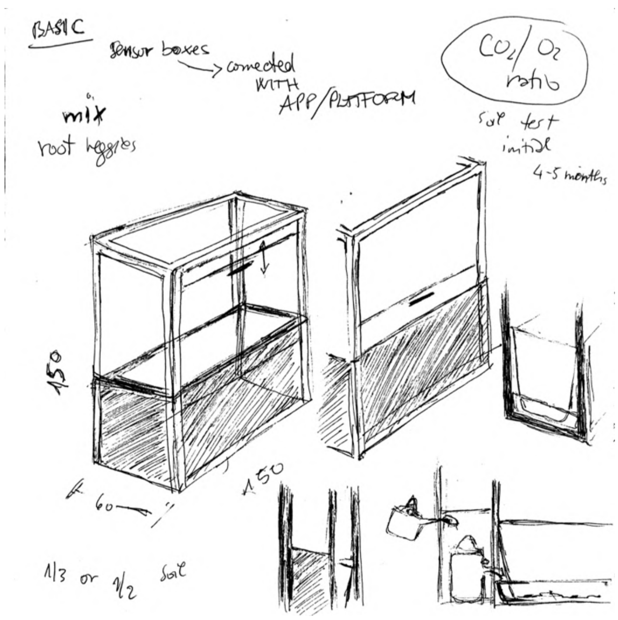
194.Conceptual sketches discussing watering access options and structure criteria. Sketches by Jelena Sučić

The main discussed things where occupation parameters, especially for the long permanence and growth occupation (depth), and the watering system, which was aiming to imitate the main plants water access in nature from underground.

The dimensions were starting to take the shape of a showcase with a window.

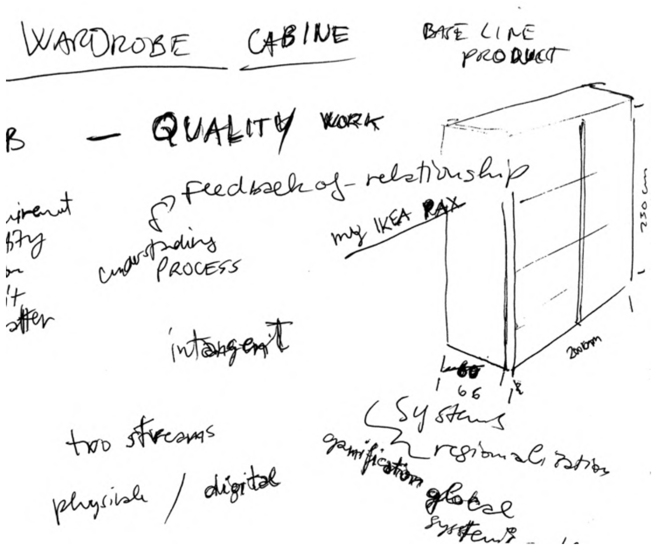
The question that defined the final considerable dimension is: How much bigger an object can be to occupy reasonably space in a room?

A wardrobe!



195. Sketch identifying basics. by Jelena Sučić

The dimension of a wardrobe is a modular space occupation in a room, which becomes more accessible the relational idea of where to position this lab even for an individual living in urban/city context. What helped in defining the dimensions for being suitable for the green lab purpose and proportioned as a wardrobe is the association of author's experience of having an IKEA PAX wardrobe model with branches detail on the glass coverture.



197. Sketch of the wardrobe memory and sizes. By Jelena Sučić

196. Inspiration picture of the PAX wardrobe. Ph. Iva Sucic-Krolo

5.3.3 Design concept

The main purpose of the lab is to provide educational and experimental controlled practice space for monitoring the understanding of living green systems and processes in their sustainment. For this reason, the shaping organisation of the wardrobe dimension model had to aim zero electricity dependence.

Counting on solutions requiring electricity to run would mean a constant investment of energy and resources from outside. The electricity access has to be designed in future stages, according to the experimentations requirement and considering to design a self-producing electricity system combined with the pod system. This might become a priority once the digital sphere of the Laukku Pod project will set the monitoring interest that will require constant sensors recordings.

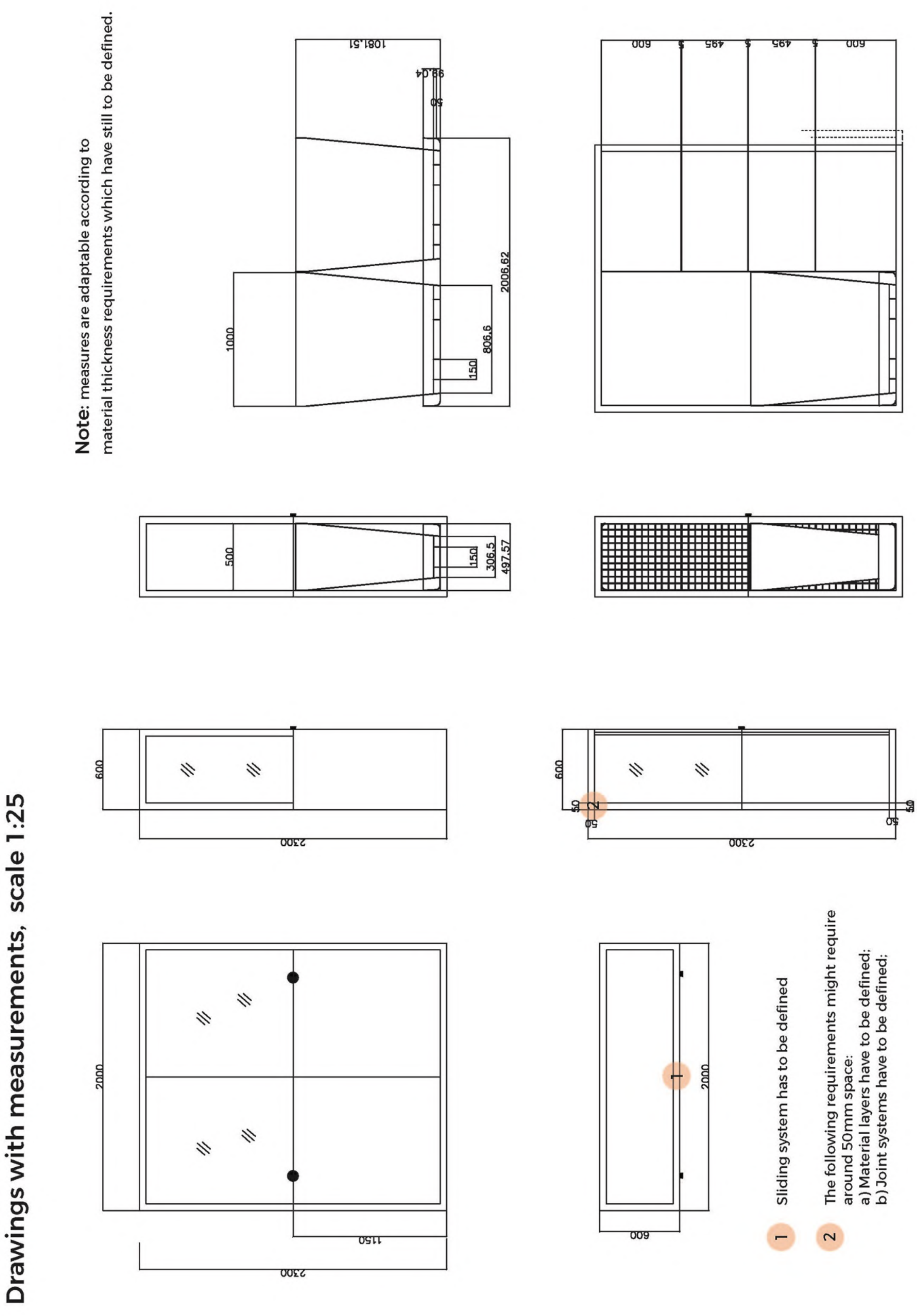
What permaculture experience teaches is that there are many passive forces which conditions to act can be set to provide for the system. In the research five aspects are identified that the first lab model has to be able to provide for:

- Permanent stay: Plants occupational growth (width, depth, height) plants nutrients absorption rhythms (recovering nutrients access);
- Watering: efficient distribution, not requiring external energy input for its provision every day;
- Light access & differentiation: use external sources passively (sunlight access, other lights already present in the external environment), different life activities have different light shades requirements, light differentiation defines the spacing for activities (plant life stages, plant components as roots (light sensitive), worms (light sensitive), mushrooms (no direct + plus moisture);
- Insulation: the lab has to be able to preserve its own microclimate (greenhouse), by staying inside another climate is under its influence;
- Host other activities relatively to the plant sustainment and their stages (microgreens, seedlings, composting).

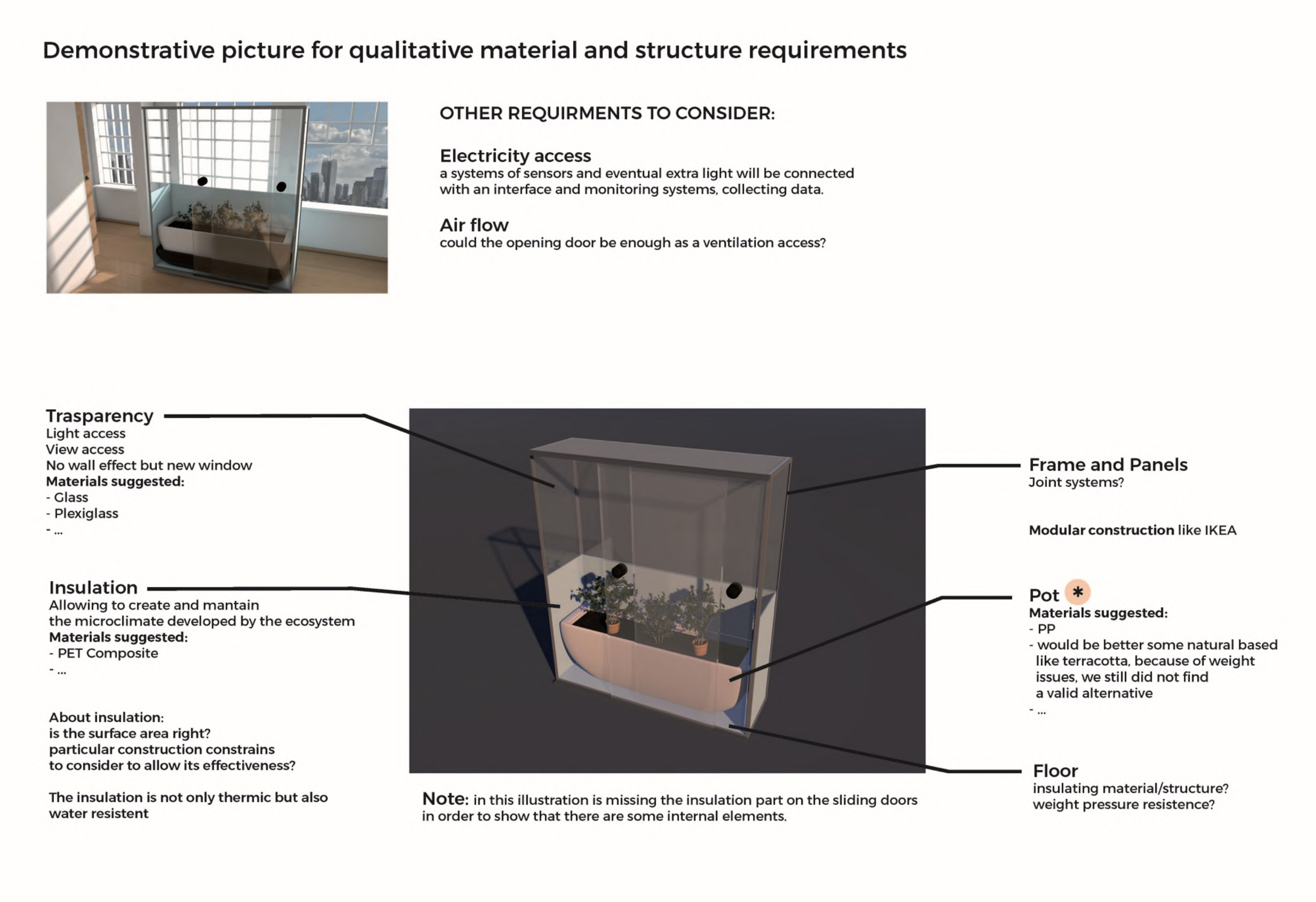
The design had to provide sections by light orientation and according to activities space occupation. The most requiring in space is the "life permanence area", for which we conveyed with Wayne that the soil depth has to be 1/3 or ½ of the total height of the space. In fact, the first definition of the permanent area is a vase with a siphon structure at the bottom tall as the haft of the lab height with a basin area designated to the water access and distribution. This detail helped to define the light coverture area and where was possible to enhance the insulation capacity of the pod.

In the drawings the above haft is framed transparent material and below with insulation. The meant material to experiment for the insulation is a PET composite. The shelfs are designed with a grid structure in order to allow most light possible to access through the systems and create differentiation layers.

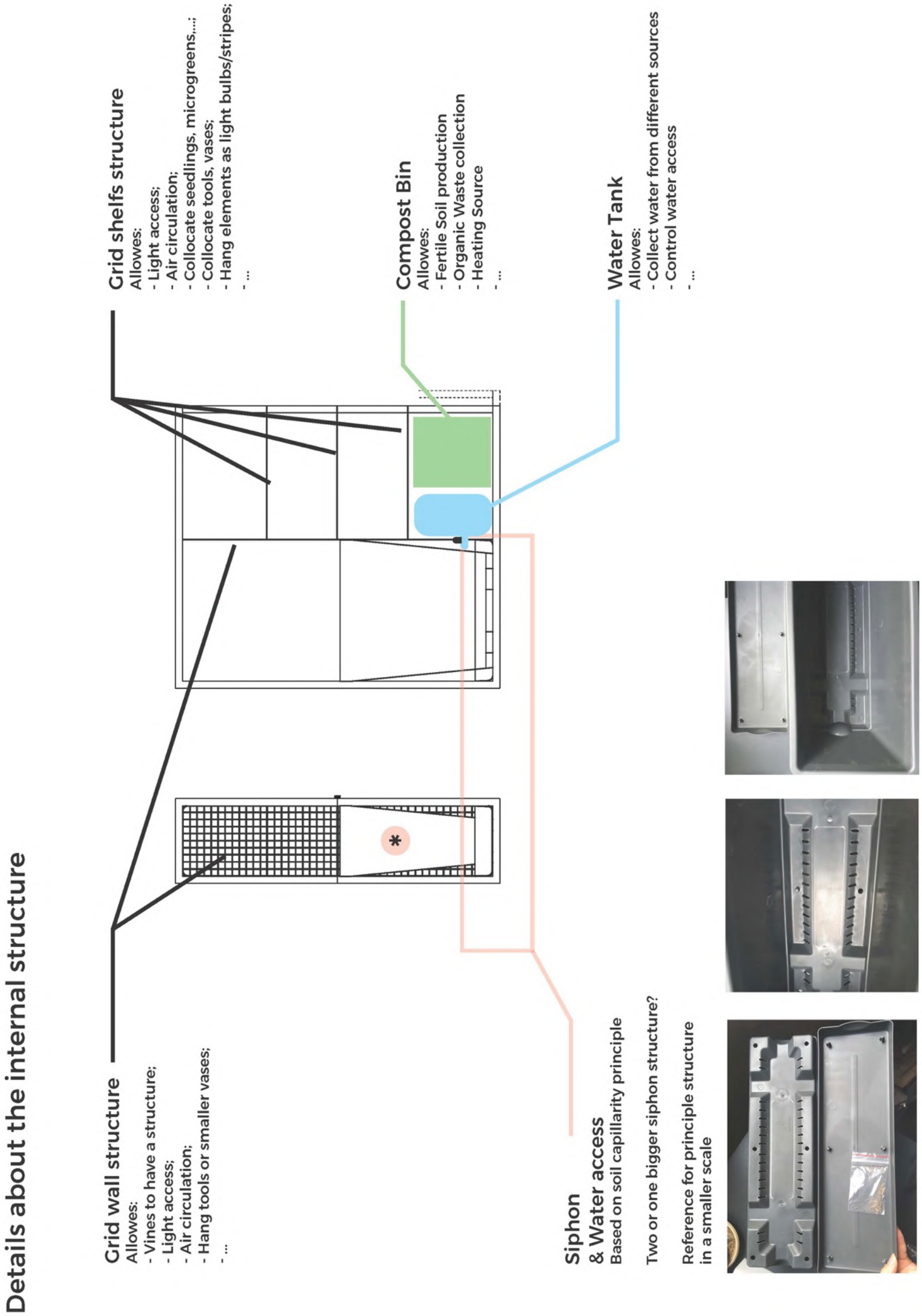
In the next pages follow the drawings discussion tables for the meeting with the engineer Thanade Panchand and his team in Bangkok. The CAD drawings were transferred in 1:25 scale of a A3 sheet format.



198. Measurement drawings, with notes of discussion relatively to materials, joints choice and thickness. Drawings by Jelena Sučić



199. Material quality discussion points of requirements. Render images by WENRUI Fu



200. Details about the components internals structure and requirements. By Jelena Sučić

5.3.4 Prototyping Process

During the prototyping phase and the engineering process of the lab model by Thanade's team, in the contract collaboration agreements process emerged a new policy that implies a certification declaring the safety of introduces products especially from outside China. This would enhance the costs and extended time required to make accessible the lab model in the school and actually start the research collaboration and experimentations. CSRP team had to find another construction company with whom collaborate to build this first model in China, in short time and in the budget constraints.

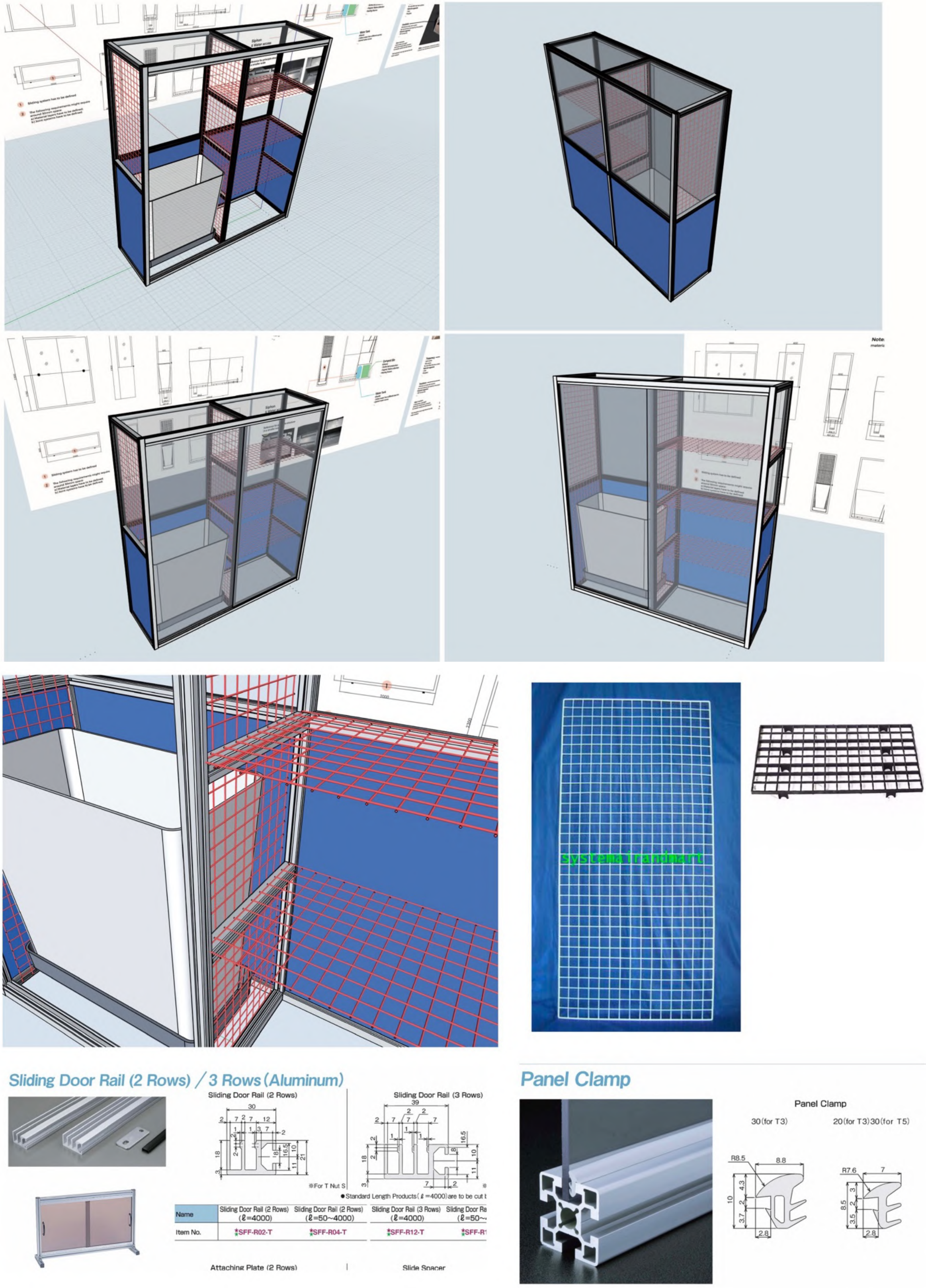
The time was short, because the prototyping of the first experimentations with the lab model were programmed in the entire month of April with an undergraduate Design Studio course at Tongji University College of Design and Innovation in collaboration with Prof. Jeff Ding, director of Shanghai FabLab O.

5.3.4.1 Model prototype adaptations and Design evolution

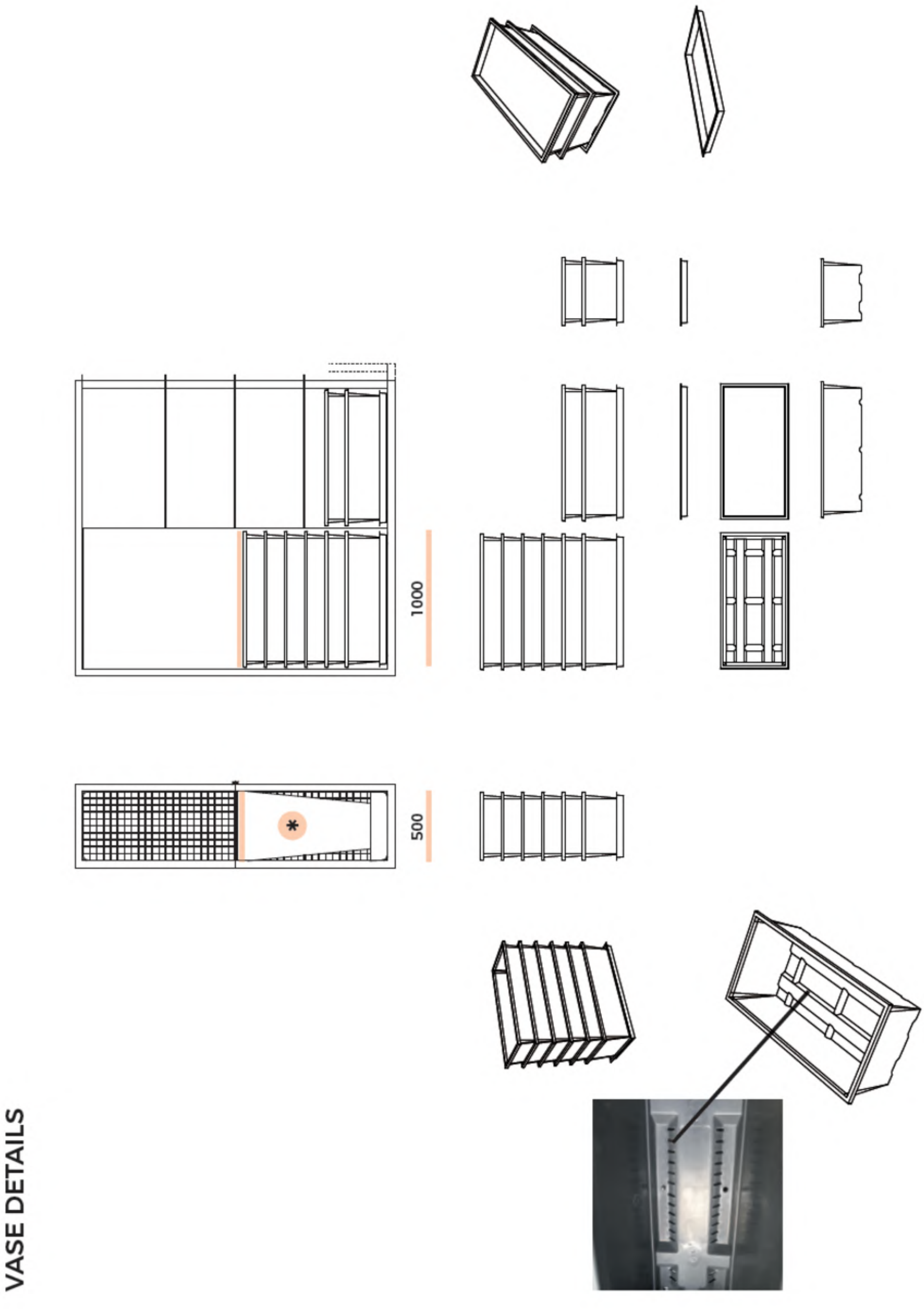
The found company that would build the lab model within the time and budget is a model company in Kunshan. The fact that there are a model company made us have limitations in material selections. There were two appointments one in Shanghai to discuss the possibilities and prices the second at the company to confirm the material choices and fix details. At the first meeting, the discussion tables were there with the extension of the engineering material done by Thanade's team and an update of the big vase structuring.

201. Model company meeting 9th March 2019. Ph. Susu Nousala

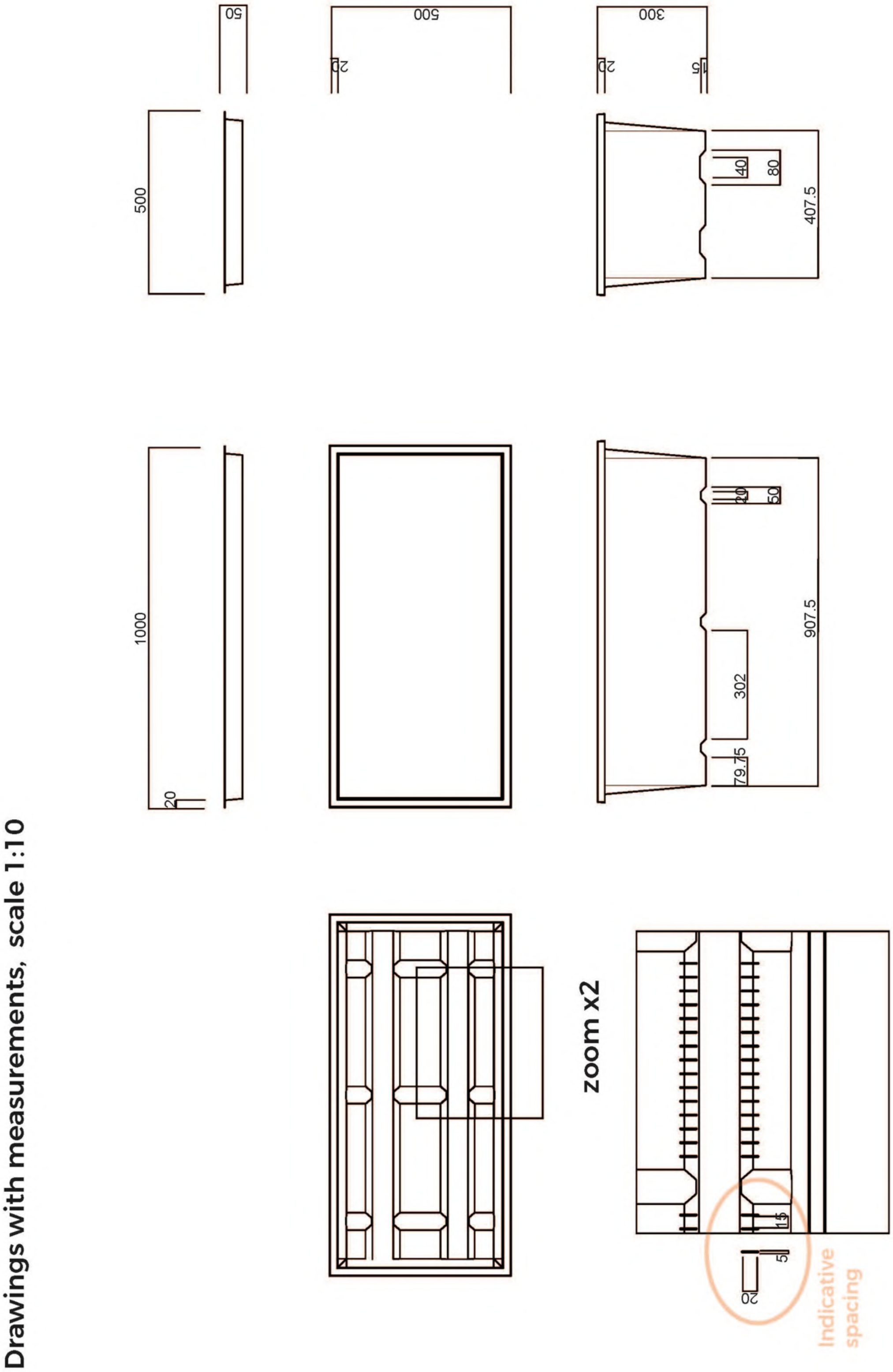
Since the weight of a big vase is difficult to manage, its structure is been re-designed willing to experiment a layering system. The same concept is used for compost bins for worms' migration and separation from mature compost and degradable material. For the plants the hollow structure would be access for the depth and water capillary action to work and in case of moving needs the soil separation would make it more manageable. Since has the same concept of earthworm compost bin the same module can be used for both purposes. It can even be considered to substitute vase elements with mature compost element to update the nutrients value in the vase area. This part in the end is not been built in this phase because of the mould time requirements and expenses.



202.Engineered details provided by Thanade's team



203. New vase design drawings. Design by Jelena Sučić



204. Vase module details, the signed scale is for A3 printing sheet result, vase with siphon structure, the covering element has double function: cap and basin as showen in the precedent figure. Drawings by Jelena Sučić

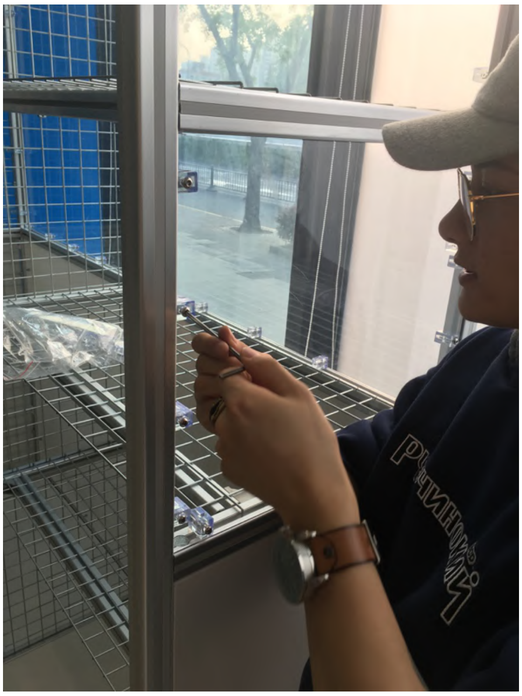
205. Meeting at the factory, WENRUI Fu, Sasu Mikkanen and Mr. Chen at the factory; Mr. Chen watching the discussed drawings; CSRP signing the construction contract. Ph. Jelena Sučić 26th March 2018

Because of the encountered constraints priorities and materials have changed. The used materials in the end are ABS, aluminium alloy and acrylic for the transparent part. The high insulation requirement got postponed and the sliding door did not separate in light obstructing material in the lower part. Since this model was initiating its life in Shanghai the cold temperatures are not that frequent and the partial coverture is enough to create light layers in the lab area.

The requirement of being buildable is been respected, in fact, all pieces can be assembled with a screwdriver.

Unfortunately, the delivery has delayed for several more days then the stipulated 10 days in the signed contract due to mismanagement situations on the companies responsabilitiy. This late delivery has a bit compromised the effectiveness of the lab model presence in the month course integration. The lab prototype is been delivered on 15th April 2019 at the Tongji space Design Square were the design studio course was hold.

206. Map provided for the delivery by the manager Dan Zhu

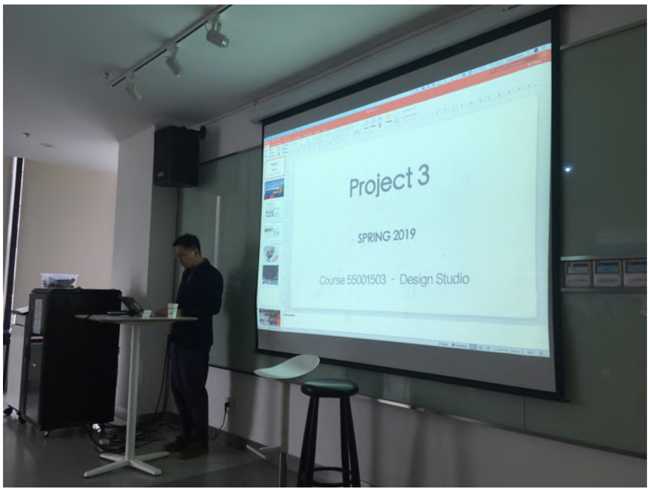


207. Installed Lab model, with assemblage executed by WENRUI Fu and light access details. Ph. Jelena Sučić

5.3.5 First scenario application: Undergraduate Design Studio

The project design studio was involving a class of 36 students from Environmental Design second year.

The guideline story behind the course is “We are going to MARS”. The hidden questions that this story wants to stimulate through the creative process of this project is about how would be live on another planet and how could we sustain our lives there.



208. Prof. Ding preparing to introduce the project of the month. Ph. Jelena Sučić

Student got briefed as summarised:

STEAM POD

This assignment is aim to have students understand the modular space development by using standardized containers. Students are divided as teams to develop the STEAM educational platform for the Tongji Affiliate Middle School in Jiading.

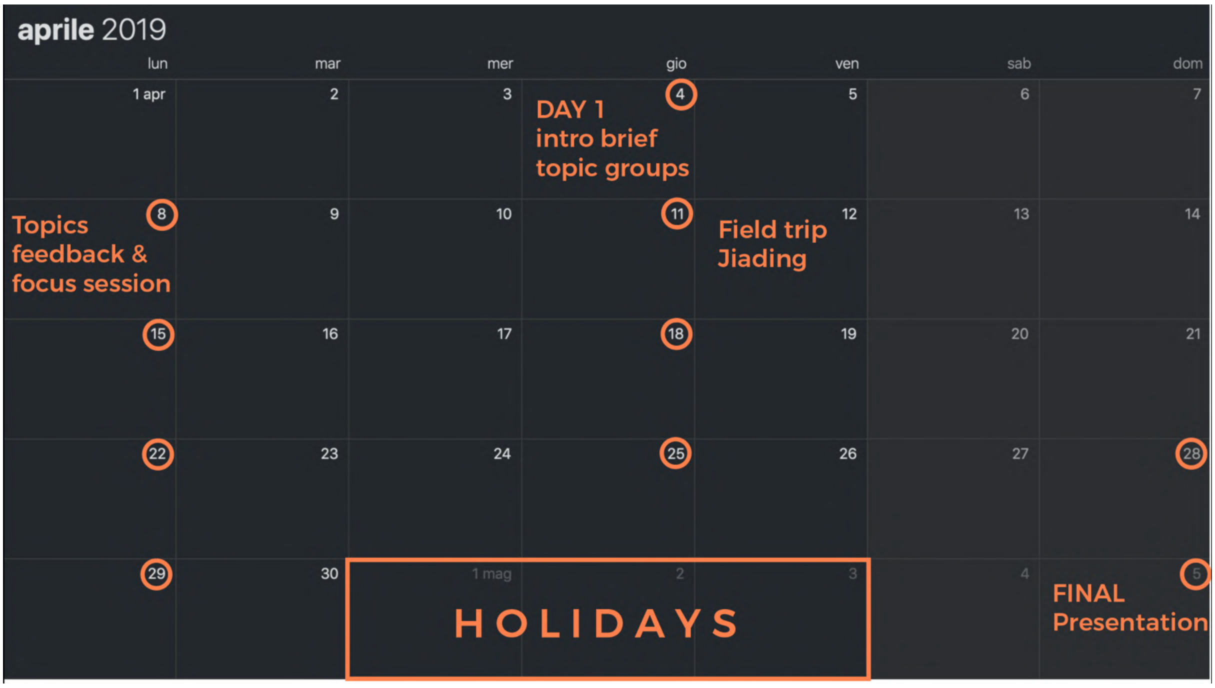
Each team will address one of the four research topics under the sustainable theme: Atmosphere, Water, Soil and Life.

The research process and outcome will be the foundation for teams to build their system, the results will be (but not limited) the following:

One to one scale-built system inside the pod;
The functionality: the classroom, the exhibition space and the lab,1:250 scale model, the plans, sections, etc.;
The curriculum for middle school class;

There are two big components in which students were asked to deal with, the first one is the architectural aspect modulated in shipping containers aiming to host classes of the middle school the second is the content for the STEAM education curricula and its sustainability in the enclosed space. The first component was supported by Prof. Jeff Ding and his team the second by the research team CSR Platform Prof. Susu Nousala, Jelena Sučić and Marco Cataffo.

The Project take place since the 4th of April till the 5th of May, follows the scheduled calendar.



209. Scheduled of the course: all the circled days are official class days ad took place in the morning session

5.3.5.1 Class structuring

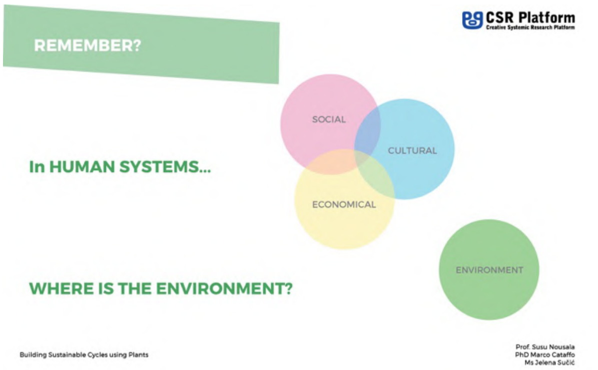
CSRP Team had the role of facilitating the STEAM content definition aiming to guide in sustainability understanding, to the course students and in the asked curricula proposition for the middle school project. Structuring contributions the team provided are the guiding topics definition, results from this thesis research (chapter 4), grouping definition, two lectures (introduction to topics and topics focus) and supporting with feedback sessions during the entire month.

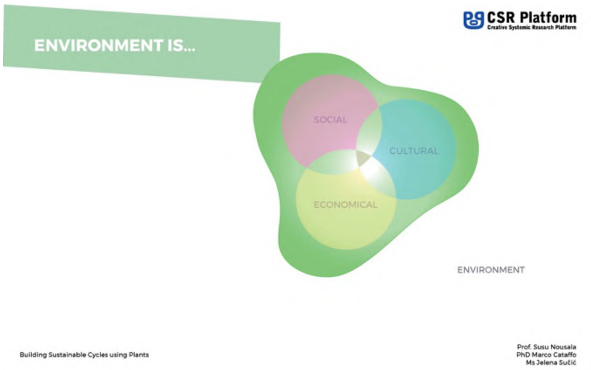
5.3.5.1.1 Introduction day

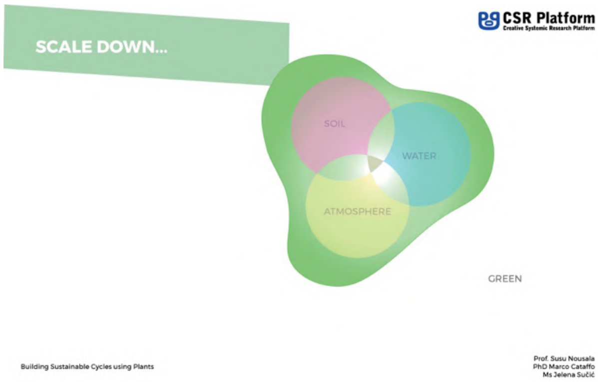
At the first day after Prof Ding's project introduction followed the topics introduction conducted by Jelena Sučić. Summary of contents:

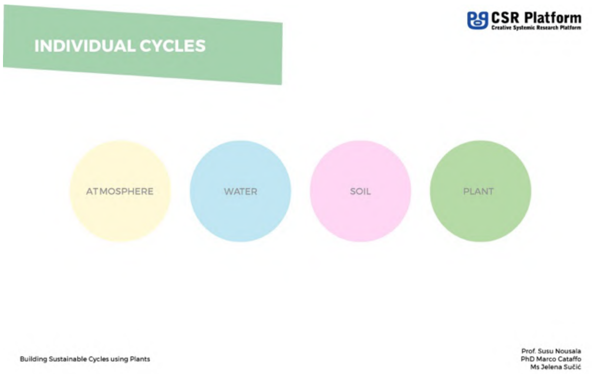
- Introduction on why are we talking about this: General Problem of Environment mis-integration, studies, global environmental issues, human predispositions, lifestyle choices;
- Importance of scale (sequence from contextual parameters) in relation with choices and actions impact effects;
- Perspective Shift: from Human Environment to Plant Environment.
- Topics: Four cycles: Air, Water, Soil, Life (plant focus);

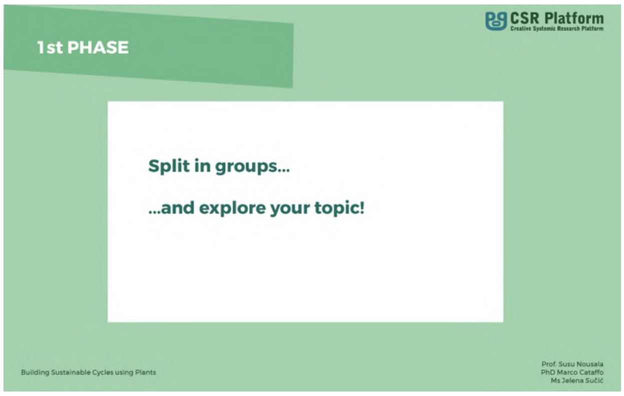
- Grouping and first immersion assignment.

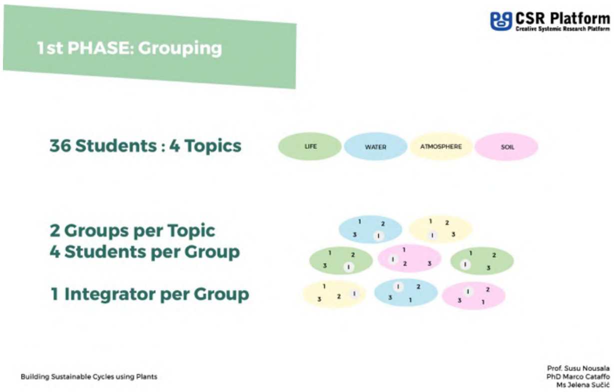








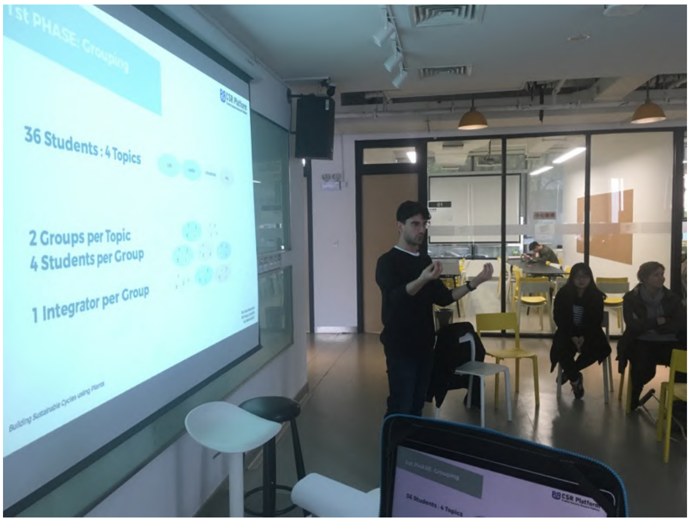




210. Slides introducing the topics done by Jelena Sučić

Students were split in groups two per each topic, the grouping technic applied aimed in creating heterogenous groups to avoid the effect of letting stay together the students that always work together. Students numeration happen d 1 to 4 and then in each group of 8 a split with A and B people. After that each group got a permanent exhibit table where a lottery technic assigned them the topic. After this division is been explained the Integrator role by Marco Cataffo and the documentation process followed by the first warmup assignment.

211. Prof. Nousala dividing in groups. Ph. Jelena Sučić

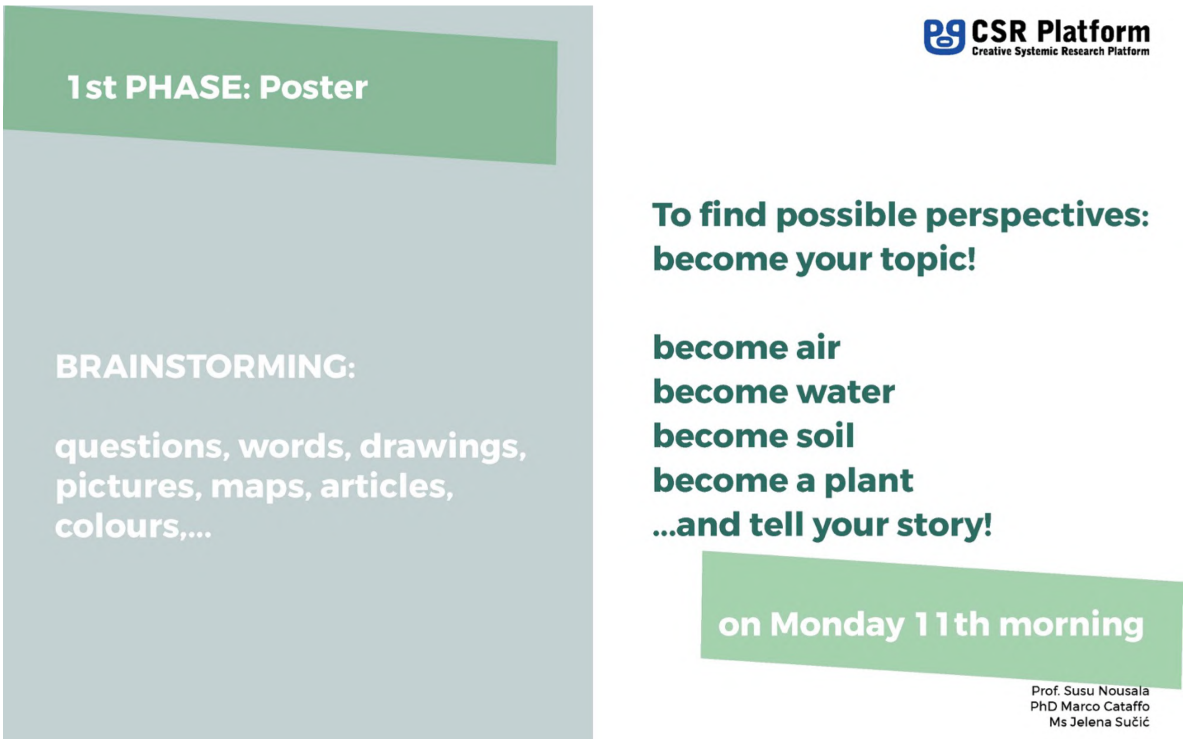


212. Marco Cataffo explaining the Integrators role and the documentation process. Ph. Jelena Sučić

The Integrators had the role of documenting the group process and communicate with other groups in order to extend the perspectives and recognise possible integrations and support between groups.

For the assignment students were asked to define their topics by trying to become their cycle elements and describe their behaviour. This phase had the aim to verify the general awareness about these topics and the ability of students to extend their perspectives in order to understand different aspects. Because of the language barrier, this phase was very important to give time to students to scope and gain language tools on which everybody could align and build on extensions in specific terminologies.

Students were asked to present their idea in a class feedback session the next class in order to start sharing ideas, align common understanding and visualise perspective in a brainstorm poster.

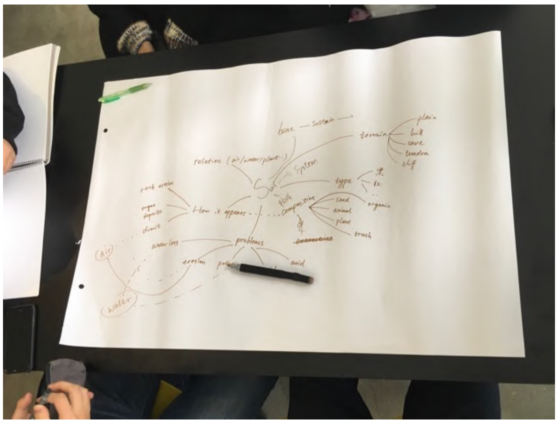


213. Slides defining the assignment. By Jelena Sučić

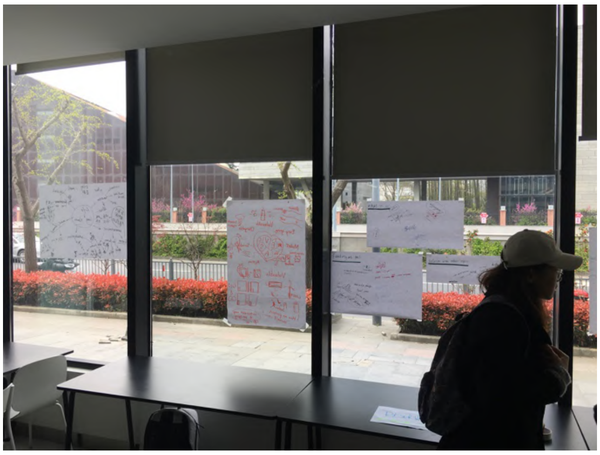
The brainstorming session started after the introduction showing already the strength and weaknesses on facing the assigned topics, including the spontaneous feeling of searching on the web for information. Follows a selection of class dynamics and final results of the morning session.

First brainstorming session dynamics and outcomes 4th April 2019

First brainstorming session dynamics and outcomes 4th April 2019



214. Moments of students discussing within and between groups, questioning with facilitators, marking thoughs, research online, documentation on computers of the discussion process, attitudes, difficulties, doubts. Ph. Jelena Sučić

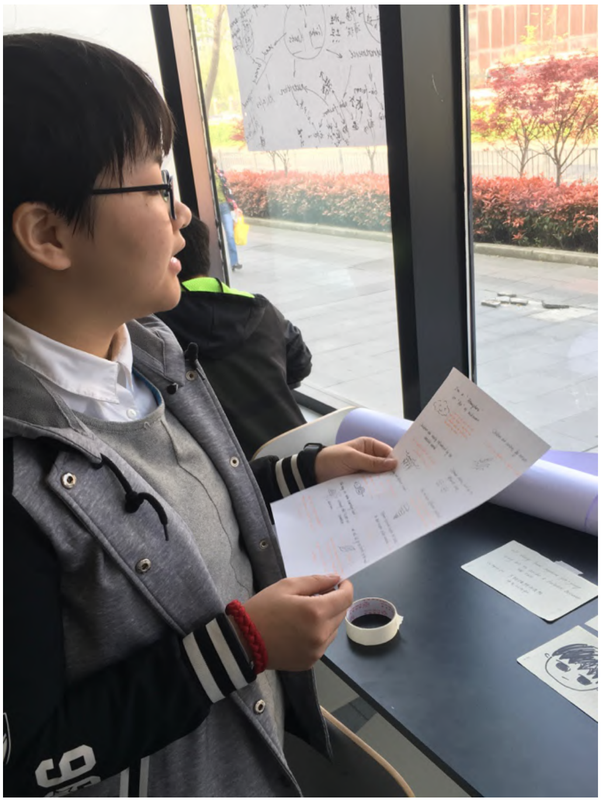


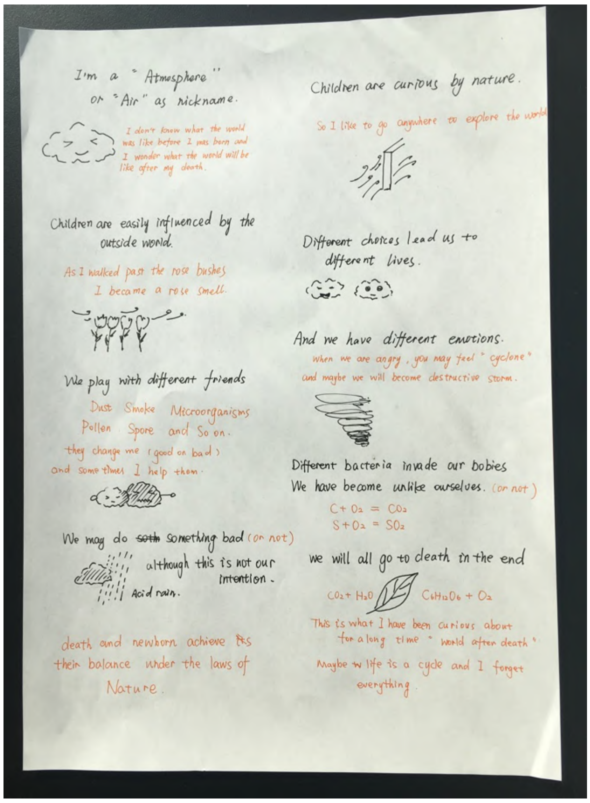
215. Students hanging their first flow of outcomes. Ph. Jelena Sučić

5.3.5.1.2 Focusing day: 8th April

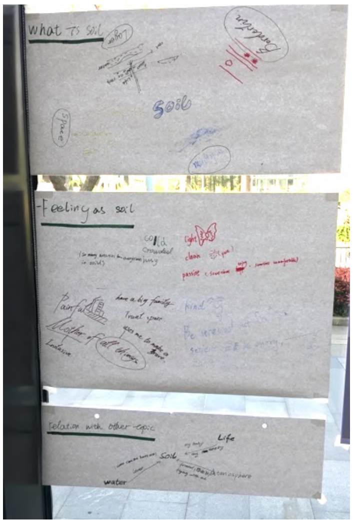
This day session was divided in two parts, the group presentations and the focusing lecture. Many interesting perspectives emerged from students' posters presentation, highly focuses (group F: life cycle of the tree behind their exposure window), broad, many in relation within the own element and some with the others, some of the expressed considerations met part of the focuses found later in the lecture. Follow a selection of students first exposure with some details to explore.

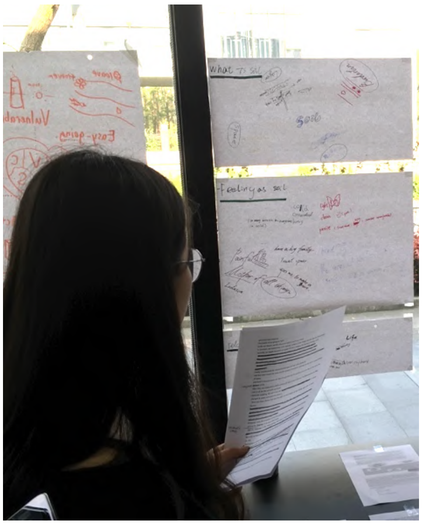
Poster session dynamics and outcomes 8th April 2019

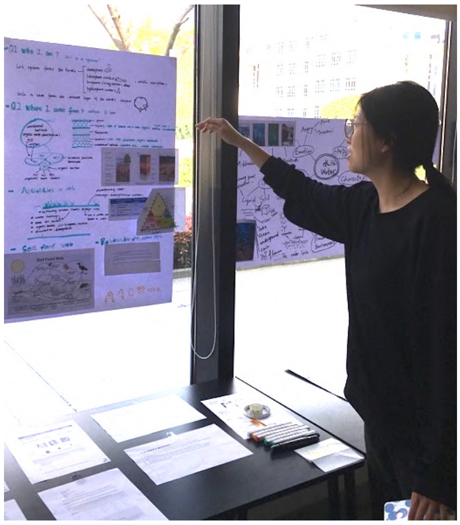


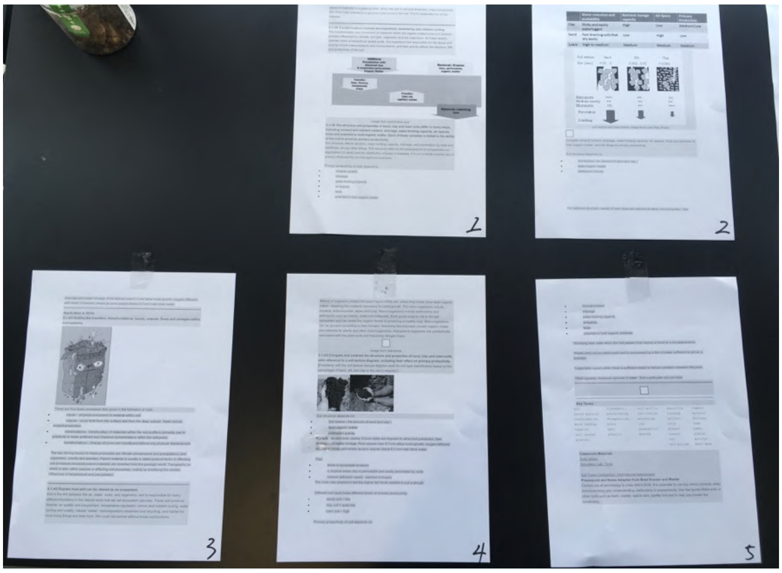


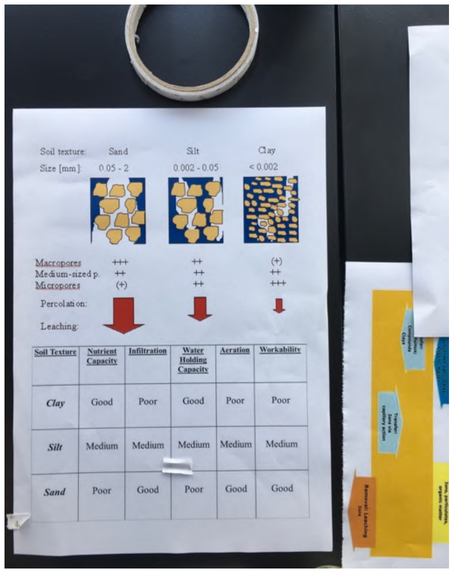
Poster session dynamics and outcomes 8th April 2019

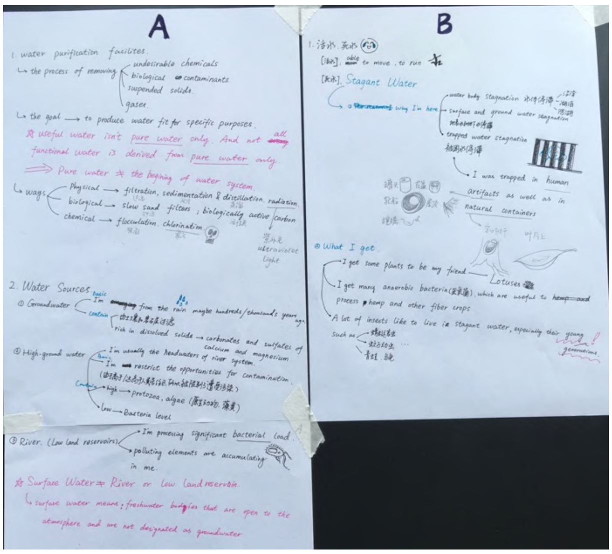


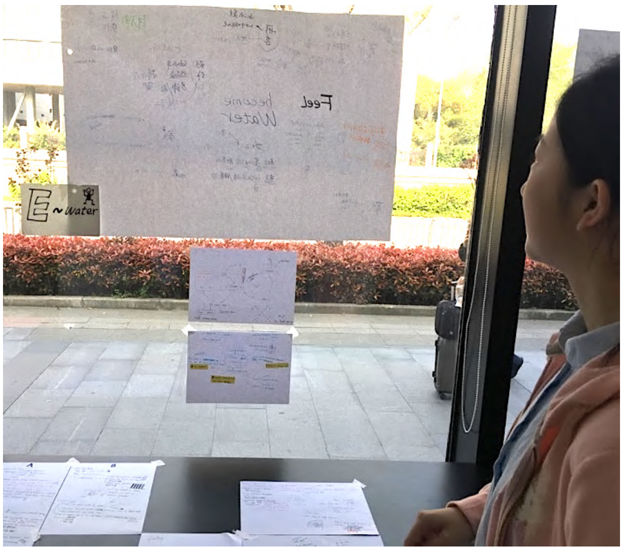




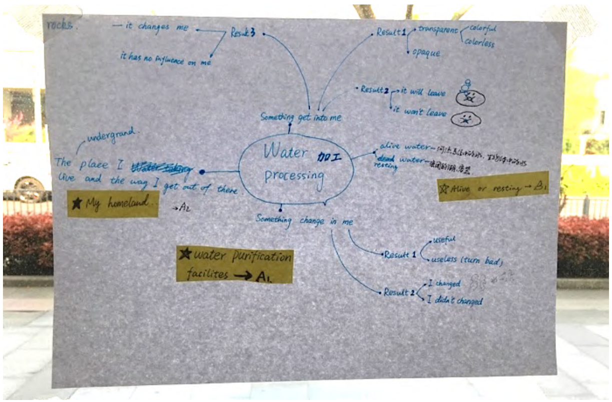


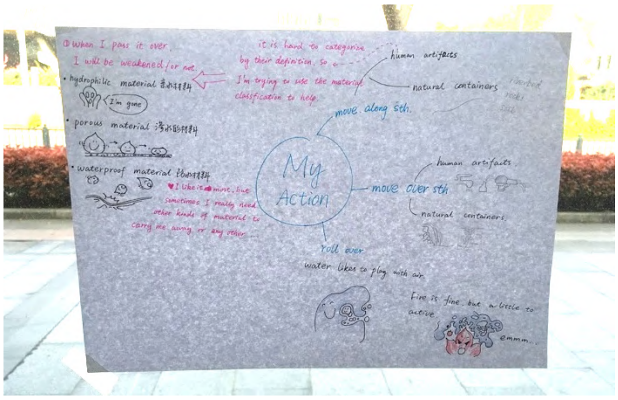


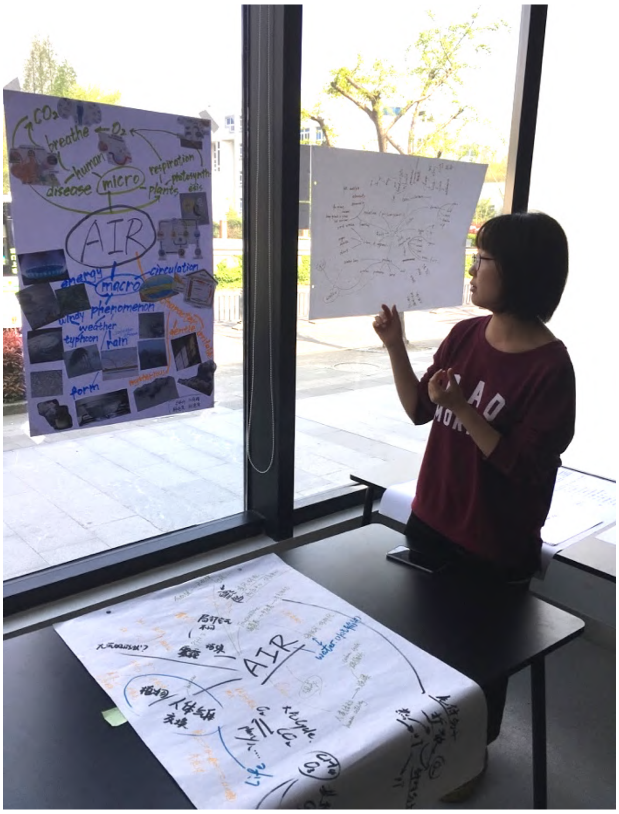


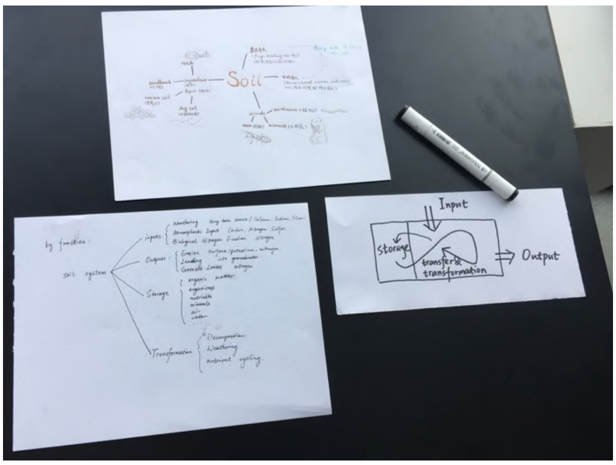


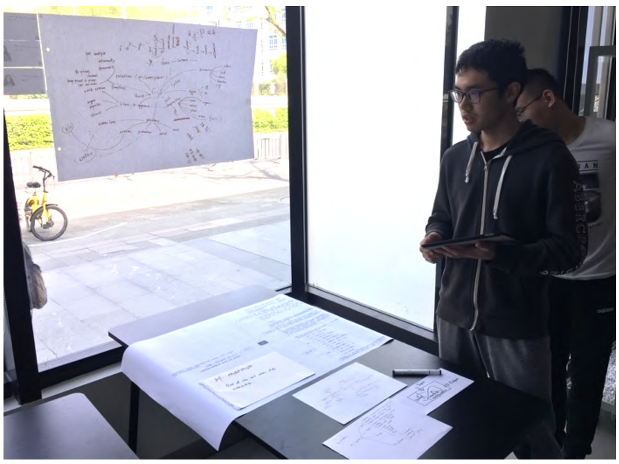
Poster session dynamics and outcomes 8h April 2019

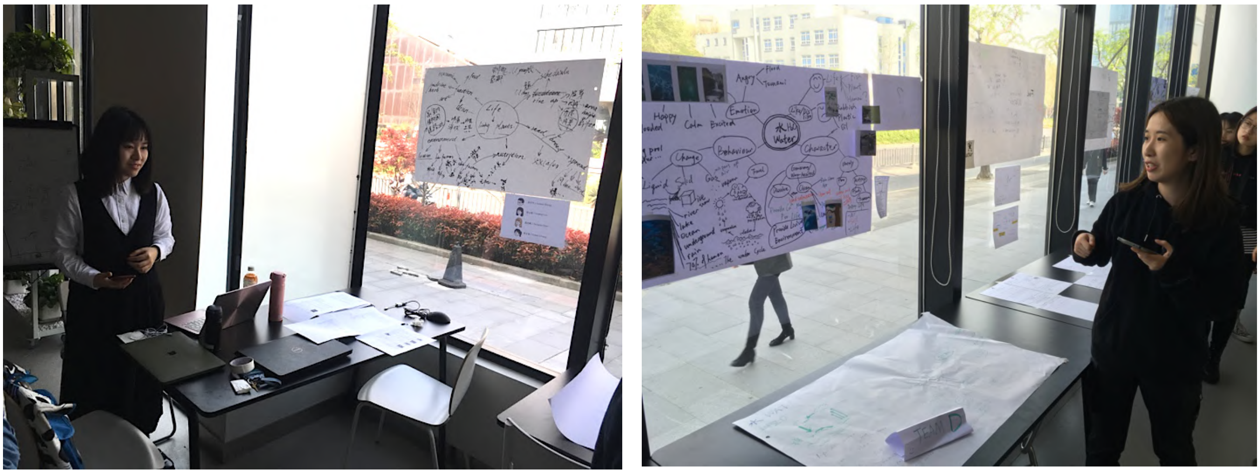












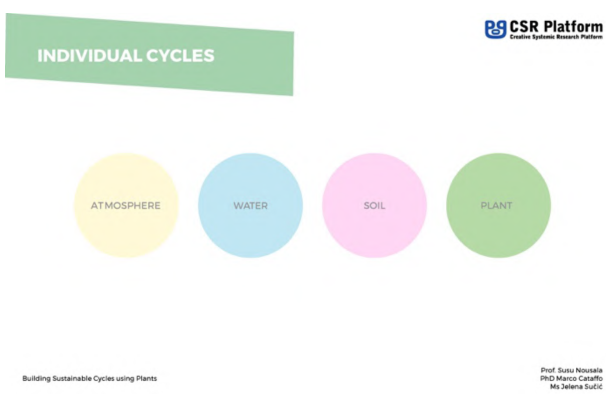
216. Students first exposure of their topics understanding. Ph. Jelena Sučić

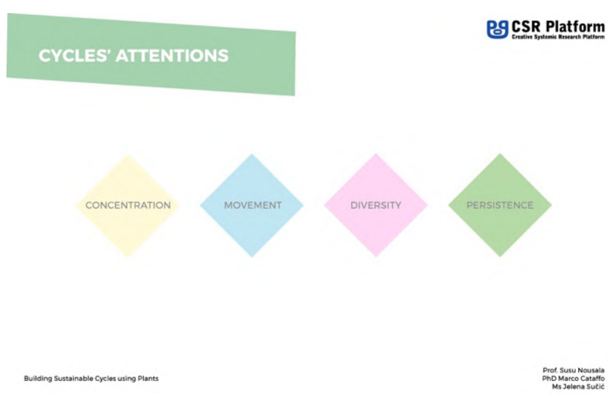
After gaining a general understanding between all of us and recognising that some fundamental points were already found by students researches it was possible to help them find practical focuses on their topics through the lecture. The lecture structure included:

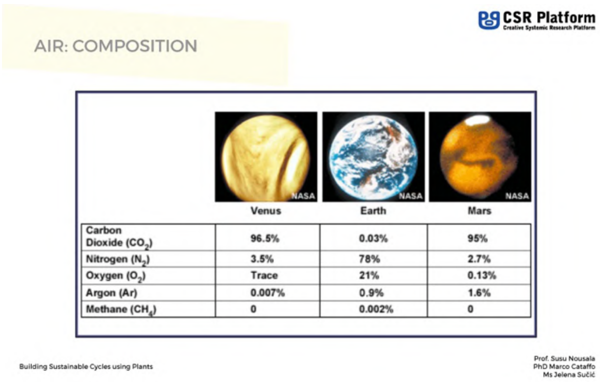
217. Focus lecture starting. Ph. Marco Cataffo

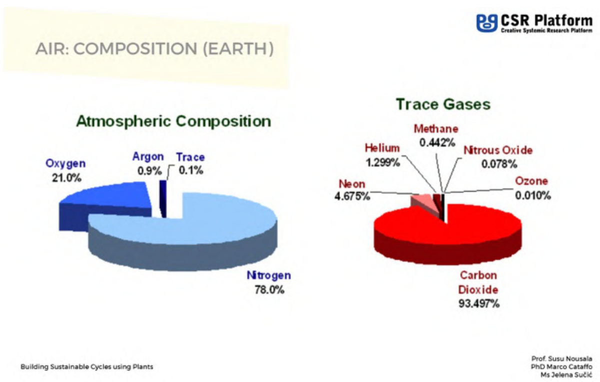
- A review of the environment system perception issue;
- The scaling movement with addition of the concepts' layers and levels;
- Attention on the main characters in the cycles behaviour followed by the focuses of their main functioning behaviours;
- Conclusion with design aims and attitudes in order to claim sustainable solutions achievements.

Follow the slides relatively behaviour focuses and design attitudes.






AIR: COMPOSITION
CSR Platform
Venus
Earth
Mars
Carbon Dioxide (CO_2) 96.5% 0.03% 95%
Nitrogen (N_2) 3.5% 78% 2.7%
Oxygen (O_2) Trace 21% 0.13%
Argon (Ar) 0.007% 0.9% 1.6%
Methane (CH_4) 0 0.002% 0
Building Sustainable Cycles using Plants
Prof. Susu Nousala
PhD Marco Cataffo
Ms Jelena Sučić


AIR: COMPOSITION (EARTH)
CSR Platform
Atmospheric Composition
Oxygen 21.0%
Argon 0.9%
Trace 0.1%
Nitrogen 78.0%
Trace Gases
Methane 0.442%
Helium 1.299%
Nitrous Oxide 0.078%
Neon 4.675%
Ozone 0.010%
Carbon Dioxide 93.497%
Building Sustainable Cycles using Plants
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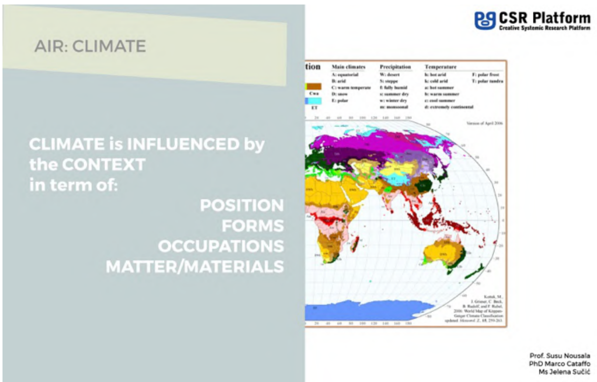
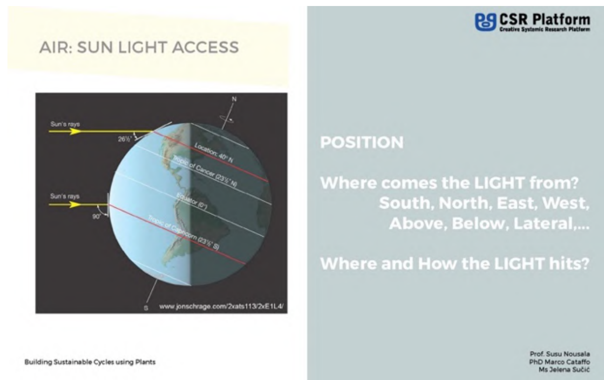
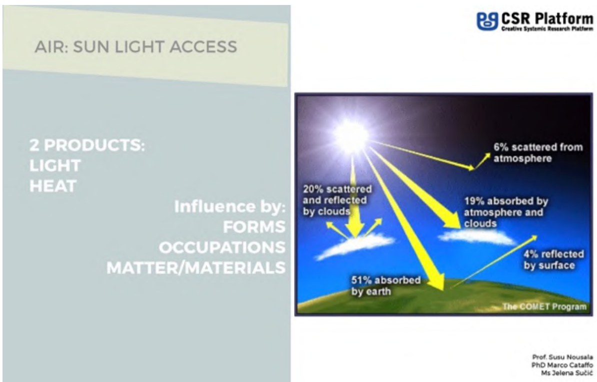
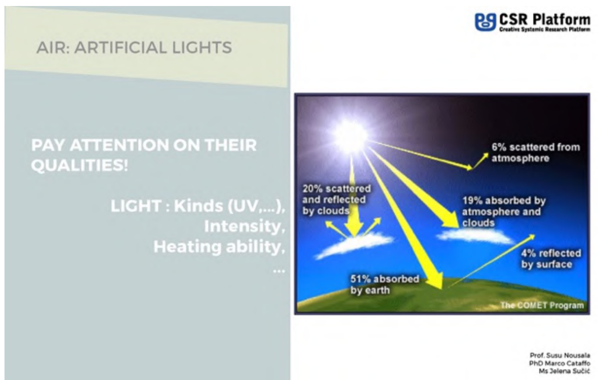
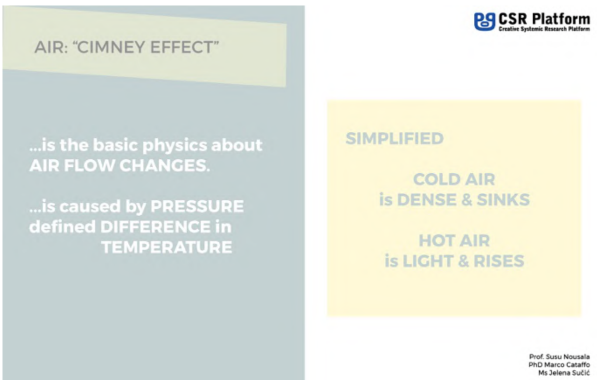
PhD Marco Cataffo
Ms Jelena Sučić

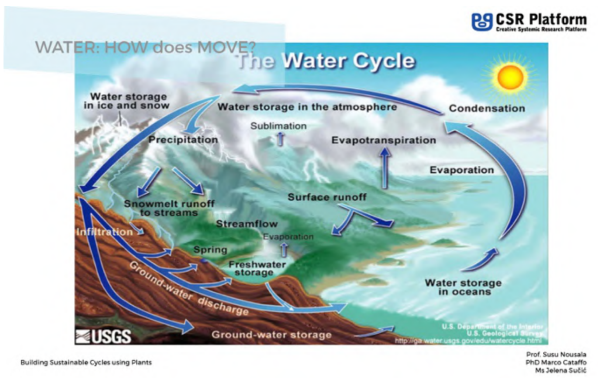

AIR: CLIMATE
CSR Platform
CLIMATE is INFLUENCED by
the CONTEXT
in term of:
POSITION
FORMS
OCCUPATIONS
MATTER/MATERIALS
Prof. Susu Nousala
PhD Marco Cataffo
Ms Jelena Sučić

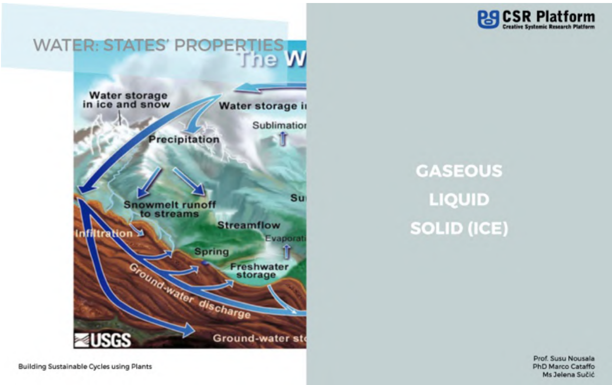

AIR: SUN LIGHT ACCESS
CSR Platform
POSITION
Where comes the LIGHT from?
South, North, East, West,
Above, Below, Lateral,...
Where and How the LIGHT hits?
Building Sustainable Cycles using Plants
Prof. Susu Nousala
PhD Marco Cataffo
Ms Jelena Sučić

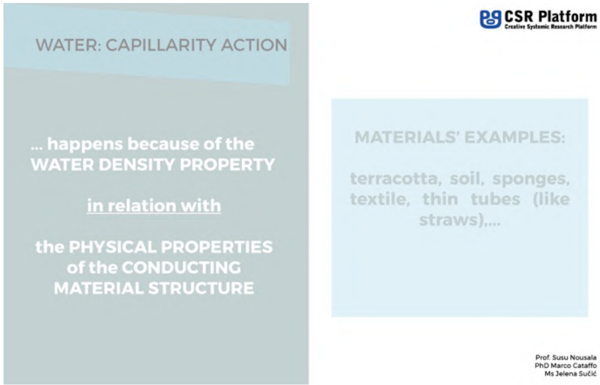

AIR: SUN LIGHT ACCESS
CSR Platform
2 PRODUCTS:
LIGHT
HEAT
Influence by:
FORMS
OCCUPATIONS
MATTER/MATERIALS
6% scattered from atmosphere
20% scattered and reflected by clouds
19% absorbed by atmosphere and clouds
4% reflected by surface
51% absorbed by earth
The COMET Program
Prof. Susu Nousala
PhD Marco Cataffo
Ms Jelena Sučić

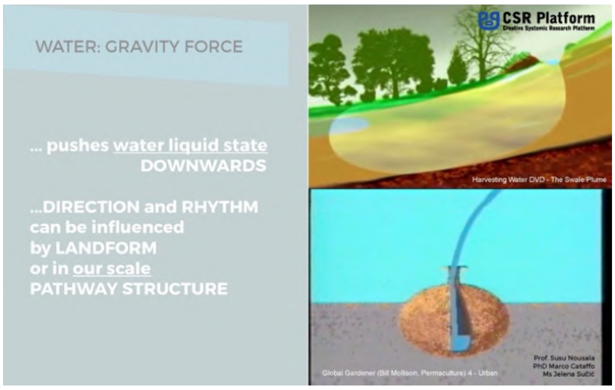

AIR: ARTIFICIAL LIGHTS
CSR Platform
PAY ATTENTION ON THEIR
QUALITIES!
LIGHT : Kinds (UV,...),
Intensity,
Heating ability,
...
6% scattered from atmosphere
20% scattered and reflected by clouds
19% absorbed by atmosphere and clouds
4% reflected by surface
51% absorbed by earth
The COMET Program
Prof. Susu Nousala
PhD Marco Cataffo
Ms Jelena Sučić

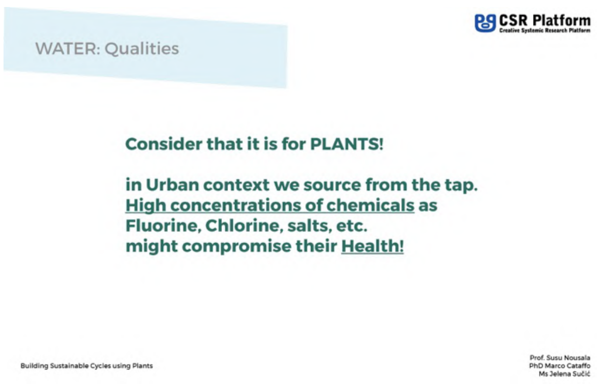

AIR: "CIMNEY EFFECT"
CSR Platform
...is the basic physics about
AIR FLOW CHANGES.
...is caused by PRESSURE
defined DIFFERENCE in
TEMPERATURE
SIMPLIFIED
COLD AIR
is DENSE & SINKS
HOT AIR
is LIGHT & RISES
Prof. Susu Nousala
PhD Marco Cataffo
Ms Jelena Sučić

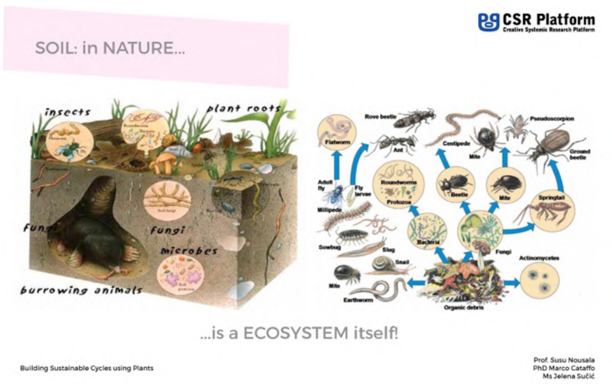

WATER: HOW does MOVE?
CSR Platform
The Water Cycle
Water storage in ice and snow
Water storage in the atmosphere
Condensation
Sublimation
Precipitation
Evapotranspiration
Evaporation
Snowmelt runoff to streams
Surface runoff
Streamflow
Infiltration
Spring
Freshwater storage
Ground-water discharge
Water storage in oceans
Ground-water storage
USGS
Building Sustainable Cycles using Plants
Prof. Susu Nousala
PhD Marco Cataffo
Ms Jelena Sučić

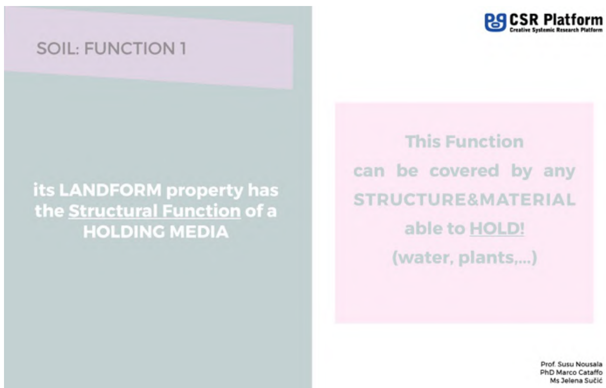

CSR Platform
Creative Systemic Research Platform
WATER: STATES' PROPERTIES
Water storage in ice and snow
Water storage i
Sublimation
Precipitation
Snowmelt runoff to streams
Streamflow
Infiltration
Spring
Freshwater storage
Ground-water discharge
USGS
Ground-water st
GASEOUS
LIQUID
SOLID (ICE)
Building Sustainable Cycles using Plants
Prof. Susu Nousala
PhD Marco Cataffo
Ms Jelena Sučić

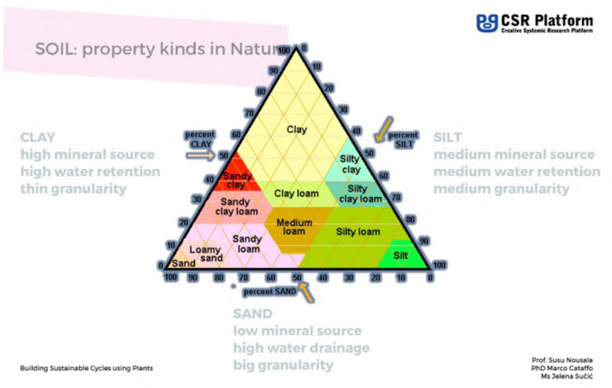

CSR Platform
Creative Systemic Research Platform
WATER: CAPILLARITY ACTION
... happens because of the
WATER DENSITY PROPERTY
in relation with
the PHYSICAL PROPERTIES
of the CONDUCTING
MATERIAL STRUCTURE
MATERIALS' EXAMPLES:
terracotta, soil, sponges, textile, thin tubes (like straws),...
Prof. Susu Nousala
PhD Marco Cataffo
Ms Jelena Sučić

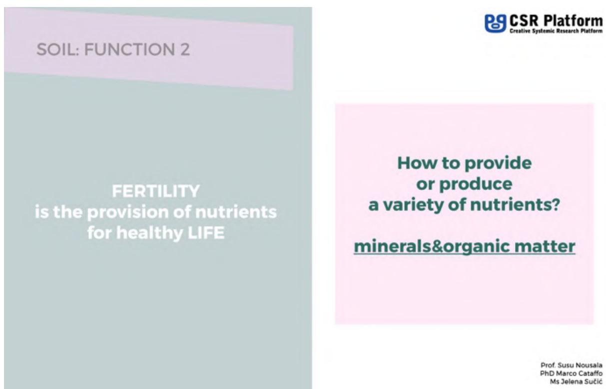

CSR Platform
Creative Systemic Research Platform
WATER: GRAVITY FORCE
... pushes water liquid state
DOWNWARDS
...DIRECTION and RHYTHM
can be influenced
by LANDFORM
or in our scale
PATHWAY STRUCTURE
Harvesting Water DVD - The Swale Plume
Global Gardener (Bill Mollison, Permaculture) 4 - Urban
Prof. Susu Nousala
PhD Marco Cataffo
Ms Jelena Sučić

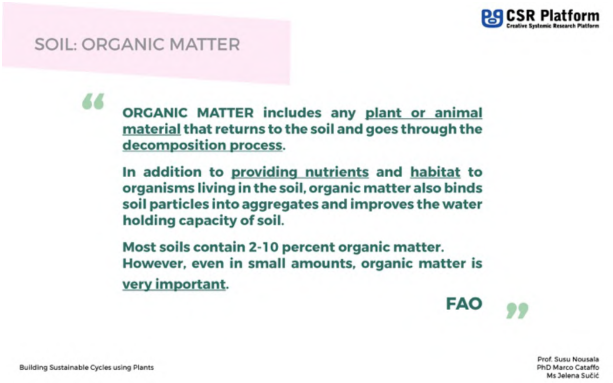

CSR Platform
Creative Systemic Research Platform
WATER: Qualities
Consider that it is for PLANTS!
in Urban context we source from the tap.
High concentrations of chemicals as
Fluorine, Chlorine, salts, etc.
might compromise their Health!
Building Sustainable Cycles using Plants
Prof. Susu Nousala
PhD Marco Cataffo
Ms Jelena Sučić

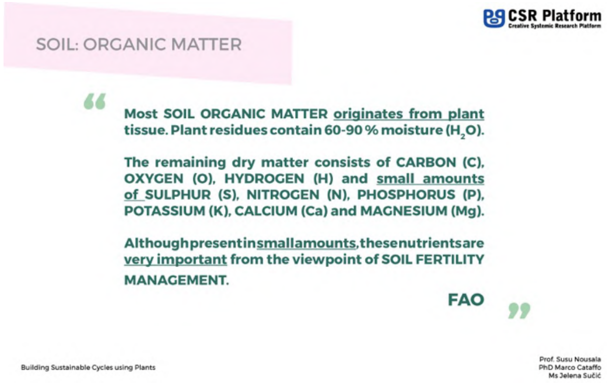

CSR Platform
Creative Systemic Research Platform
SOIL: in NATURE...
insects
plant roots
fungi
microbes
burrowing animals
...is a ECOSYSTEM itself!
Building Sustainable Cycles using Plants
Prof. Susu Nousala
PhD Marco Cataffo
Ms Jelena Sučić

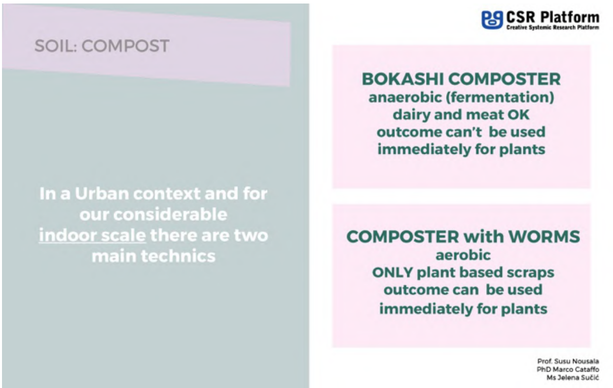

CSR Platform
Creative Systemic Research Platform
SOIL: FUNCTION 1
its LANDFORM property has
the Structural Function of a
HOLDING MEDIA
This Function
can be covered by any
STRUCTURE&MATERIAL
able to HOLD!
(water, plants,...)
Prof. Susu Nousala
PhD Marco Cataffo
Ms Jelena Sučić


CSR Platform
Creative Systemic Research Platform
SOIL: property kinds in Nature
CLAY
high mineral source
high water retention
thin granularity
SILT
medium mineral source
medium water retention
medium granularity
percent CLAY
percent SILT
percent SAND
Clay
Silty clay
Sandy clay
Clay loam
Silty clay loam
Sandy clay loam
Medium loam
Silty loam
Sandy loam
Loamy sand
Sand
Silt
SAND
low mineral source
high water drainage
big granularity
Building Sustainable Cycles using Plants
Prof. Susu Nousala
PhD Marco Cataffo
Ms Jelena Sučić

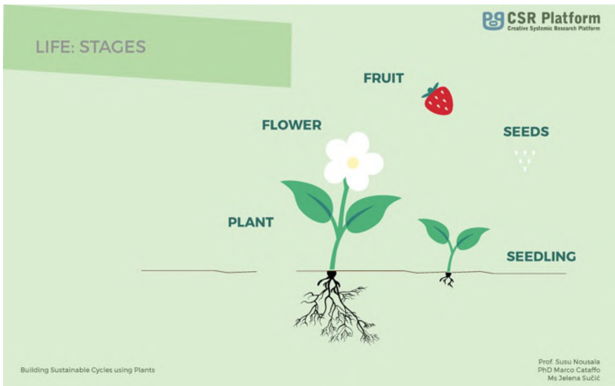

CSR Platform
Creative Systemic Research Platform
SOIL: FUNCTION 2
FERTILITY
is the provision of nutrients
for healthy LIFE
How to provide
or produce
a variety of nutrients?
minerals&organic matter
Prof. Susu Nousala
PhD Marco Cataffo
Ms Jelena Sučić

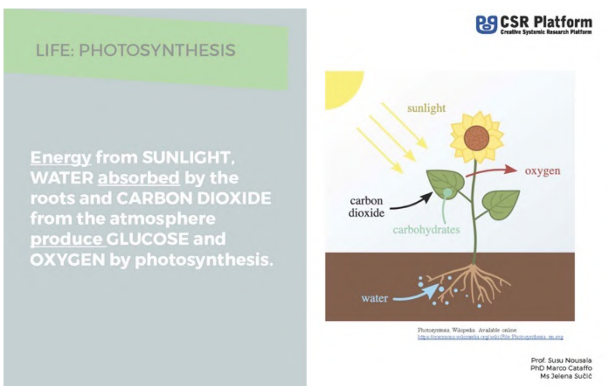

SOIL: ORGANIC MATTER
CSR Platform
Creative Systemic Research Platform
ORGANIC MATTER includes any plant or animal material that returns to the soil and goes through the decomposition process.
In addition to providing nutrients and habitat to organisms living in the soil, organic matter also binds soil particles into aggregates and improves the water holding capacity of soil.
Most soils contain 2-10 percent organic matter. However, even in small amounts, organic matter is very important.
FAO
Building Sustainable Cycles using Plants
Prof. Susu Nousala
PhD Marco Cataffo
Ms Jelena Sučić

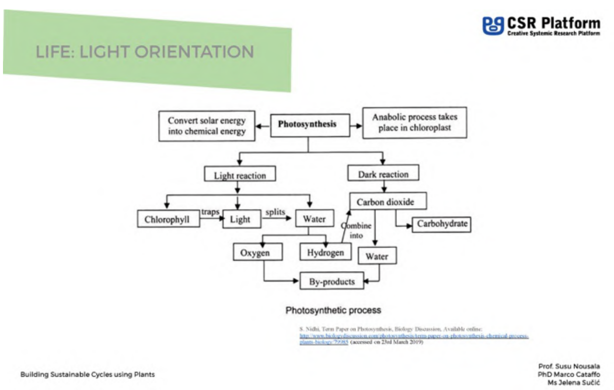

SOIL: ORGANIC MATTER
CSR Platform
Creative Systemic Research Platform
Most SOIL ORGANIC MATTER originates from plant tissue. Plant residues contain 60-90 % moisture (H_2O).
The remaining dry matter consists of CARBON (C), OXYGEN (O), HYDROGEN (H) and small amounts of SULPHUR (S), NITROGEN (N), PHOSPHORUS (P), POTASSIUM (K), CALCIUM (Ca) and MAGNESIUM (Mg).
Althoughpresentinsmallamounts,thesenutrientsare very important from the viewpoint of SOIL FERTILITY MANAGEMENT.
FAO
Building Sustainable Cycles using Plants
Prof. Susu Nousala
PhD Marco Cataffo
Ms Jelena Sučić

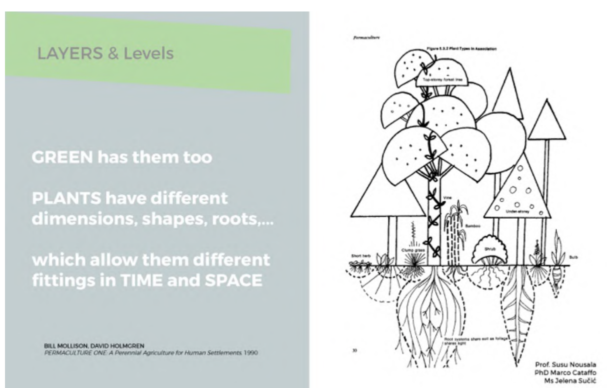

SOIL: COMPOST
CSR Platform
Creative Systemic Research Platform
In a Urban context and for our considerable indoor scale there are two main technics
BOKASHI COMPOSTER
anaerobic (fermentation)
dairy and meat OK
outcome can't be used immediately for plants
COMPOSTER with WORMS
aerobic
ONLY plant based scraps
outcome can be used immediately for plants
Prof. Susu Nousala
PhD Marco Cataffo
Ms Jelena Sučić


SOIL: ALTERNATIVES
CSR Platform
Creative Systemic Research Platform
HYDROPONICS/SPRAYS
LIQUID COMPOST
COMPOST TEA
LIQUID KELP
AQUAPONICS
FISH MANURE
Building Sustainable Cycles using Plants
Prof. Susu Nousala
PhD Marco Cataffo
Ms Jelena Sučić


LIFE: STAGES
CSR Platform
Creative Systemic Research Platform
FRUIT
FLOWER
SEEDS
PLANT
SEEDLING
Building Sustainable Cycles using Plants
Prof. Susu Nousala
PhD Marco Cataffo
Ms Jelena Sučić


LIFE: PHOTOSYNTHESIS
CSR Platform
Creative Systemic Research Platform
Energy from SUNLIGHT, WATER absorbed by the roots and CARBON DIOXIDE from the atmosphere produce GLUCOSE and OXYGEN by photosynthesis.
sunlight
oxygen
carbon dioxide
carbohydrates
water
Prof. Susu Nousala
PhD Marco Cataffo
Ms Jelena Sučić

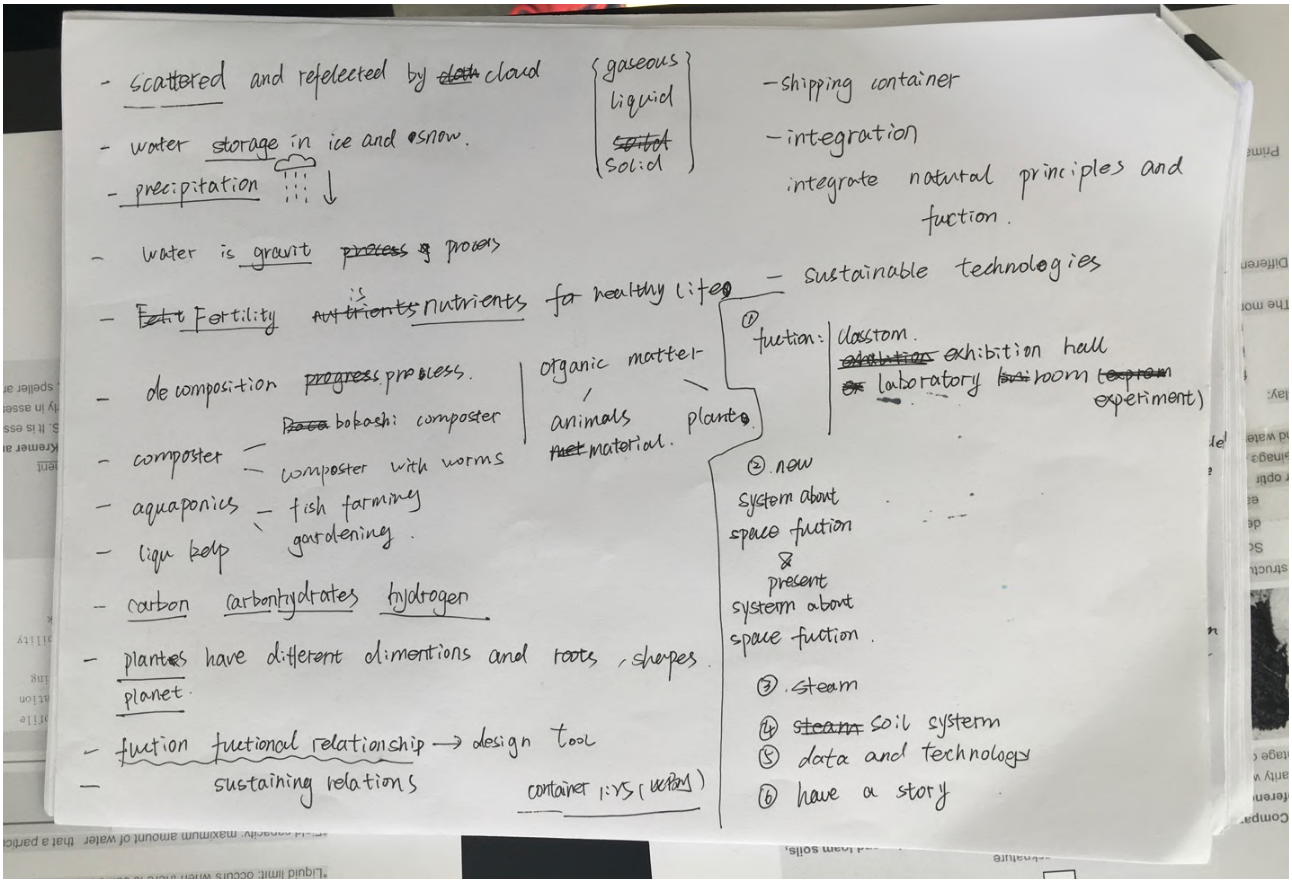

LIFE: LIGHT ORIENTATION
CSR Platform
Creative Systemic Research Platform
Convert solar energy into chemical energy
Photosynthesis
Anabolic process takes place in chloroplast
Light reaction
Dark reaction
Chlorophyll
traps
Light
splits
Water
Carbon dioxide
Combine into
Carbohydrate
Oxygen
Hydrogen
Water
By-products
Photosynthetic process
Building Sustainable Cycles using Plants
Prof. Susu Nousala
PhD Marco Cataffo
Ms Jelena Sučić


LAYERS & Levels
GREEN has them too
PLANTS have different dimensions, shapes, roots,...
which allow them different fittings in TIME and SPACE
BILL MOLLISON, DAVID HOLMGREN
PERMACULTURE ONE: A Perennial Agriculture for Human Settlements 1990
Prof. Susu Nousala
PhD Marco Cataffo
Ms Jelena Sučić

218. Slides focusing on topics done by Jelena Sučić

220. During the focusing lecture. Ph. Marco Cataffo

219. Detail of some met focuses. Ph Jelena Sučić



221. Notes of a student after the lecture. Ph. Jelena Sučić

5.3.5.1.3 Supporting the Process

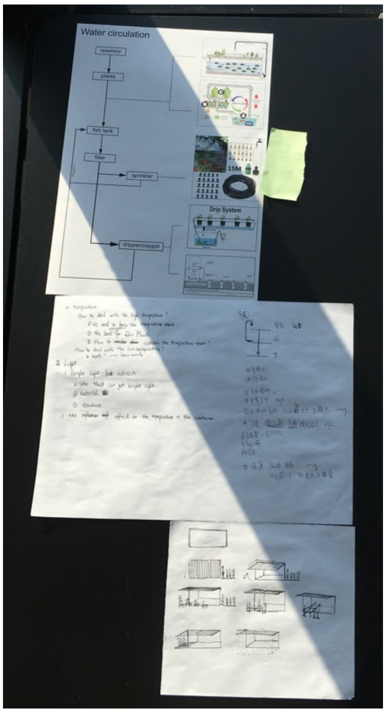
The biggest students concern about the course was on the container module infrastructure which took most of students' attention time. The presence to support with the lab content systems development was guaranteed during the lectures days to facilitate the resolution process and according to the questions providing them with focused materials from this research and author's experience to solve the encountered criticalities as for example aquaponics requirements and compost process.

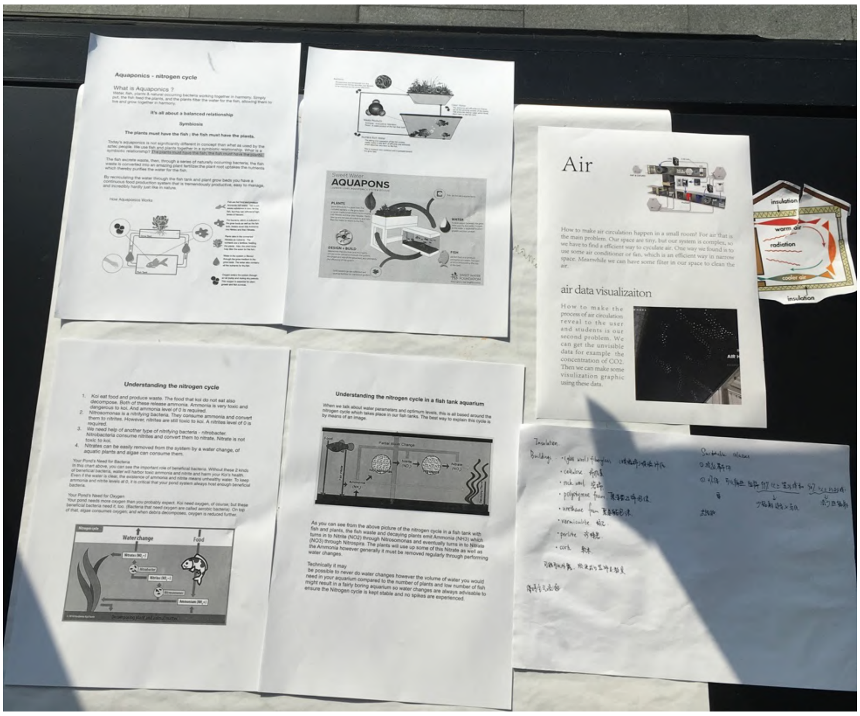
From the focus lecture the research process of the students evolved and so the development of their ideas which started to require tests and prototypes for a better understanding and demonstration of feasibility in smaller scale for the bigger meant one.

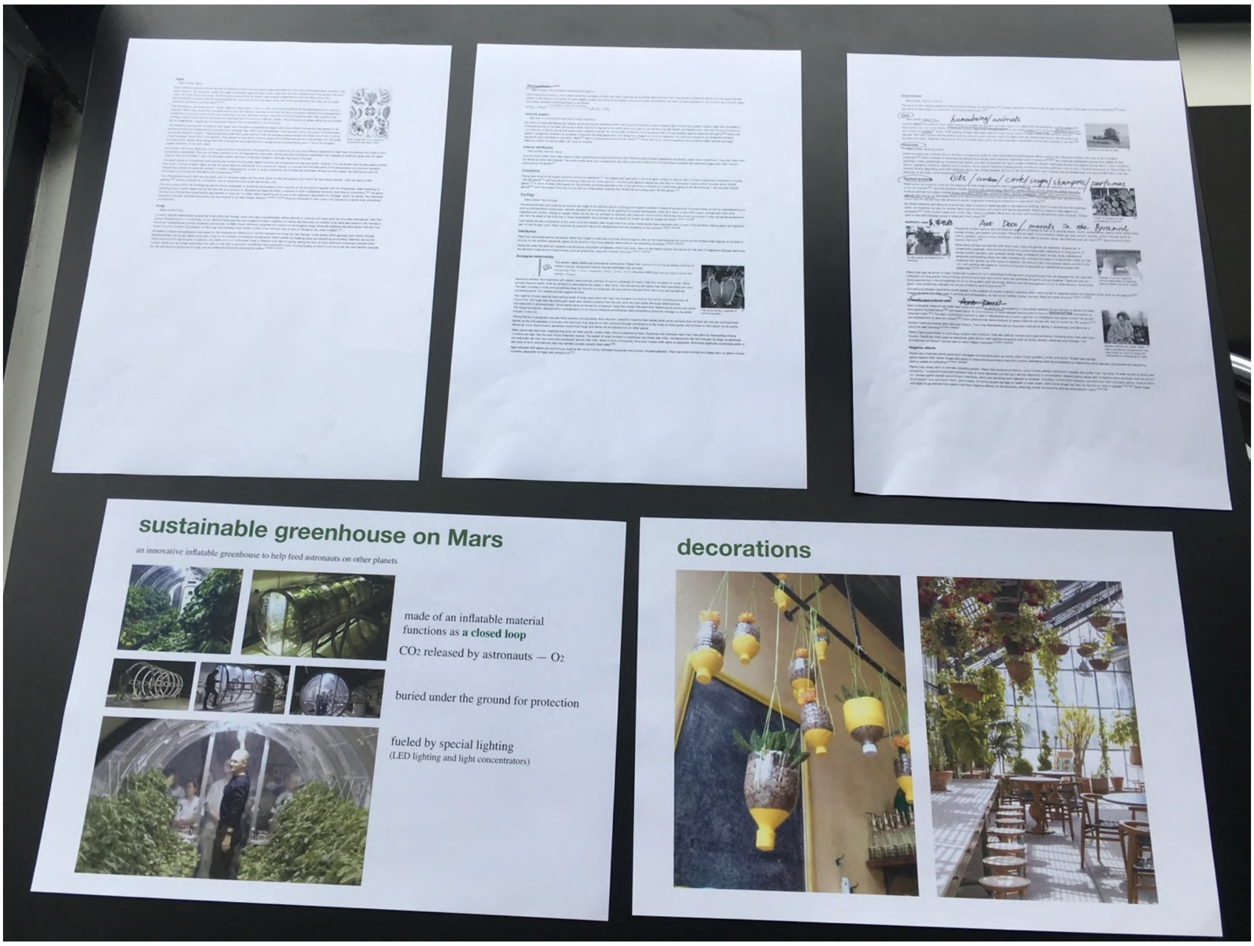
Follows a photographic excursion of the process in the lectures' days' time.

Supporting the class process 11th April 2019

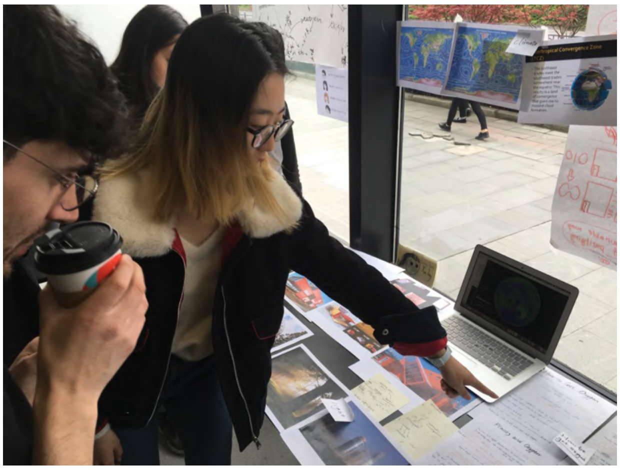
Supporting the class process 11th April 2019

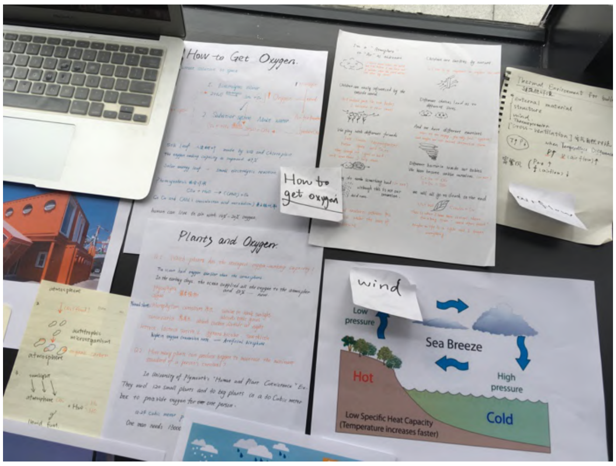


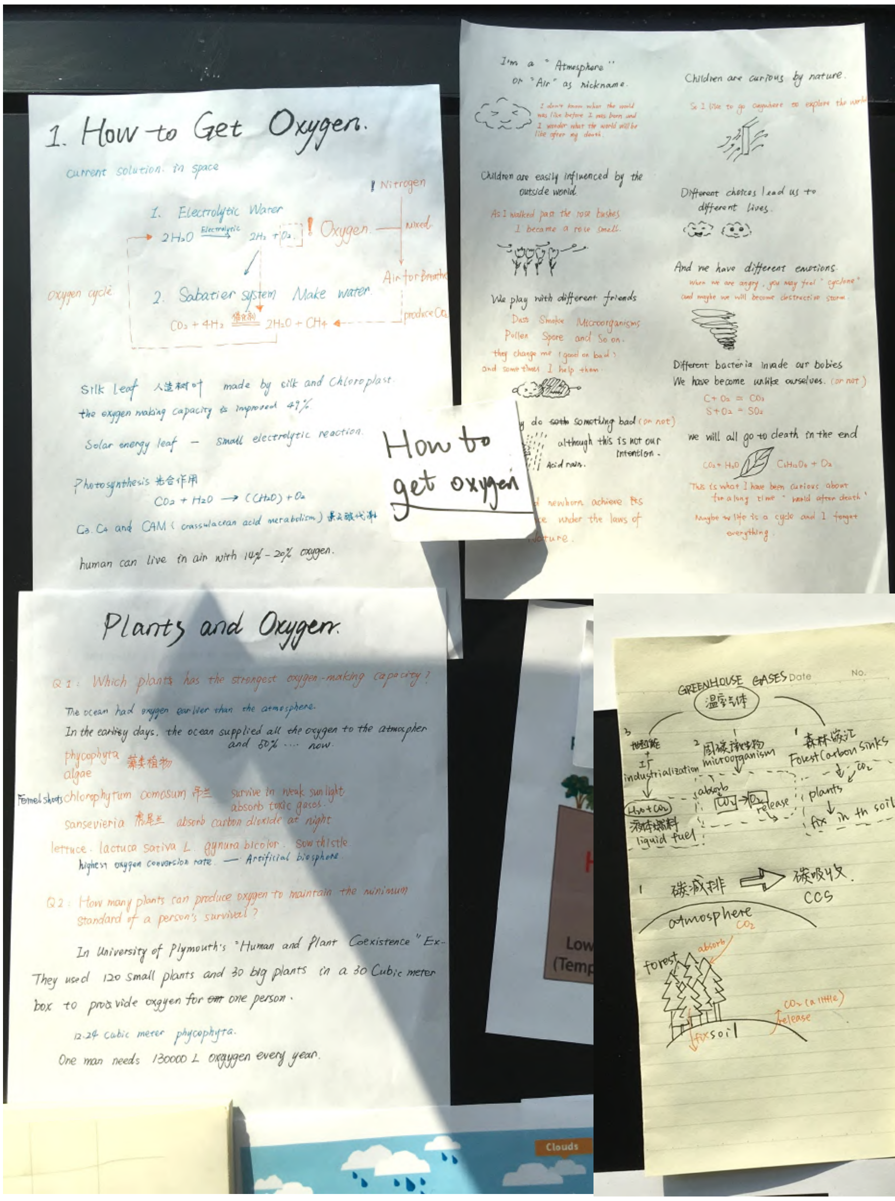


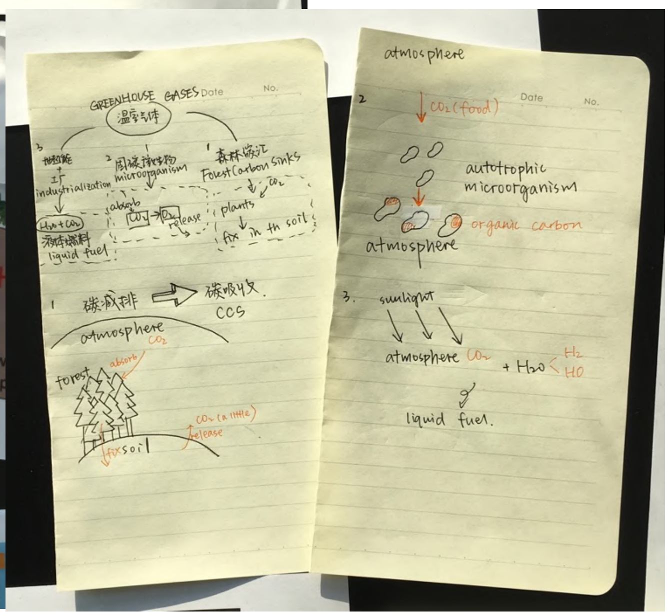


Supporting the class process 11th April 2019

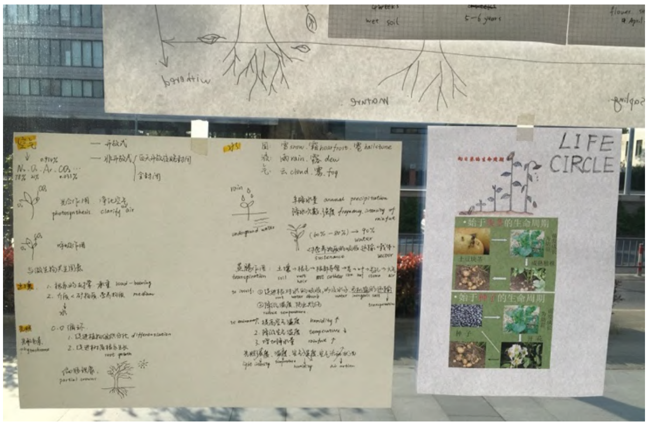








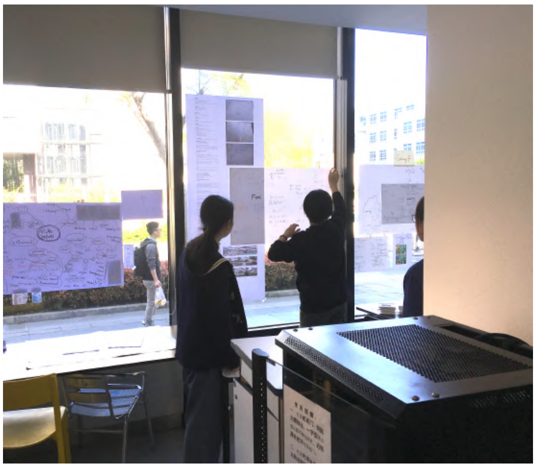
Supporting the class process 11th April 2019

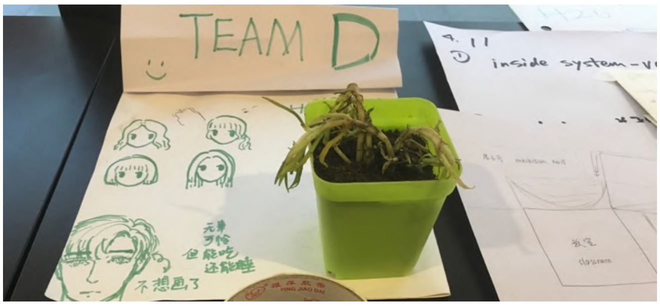


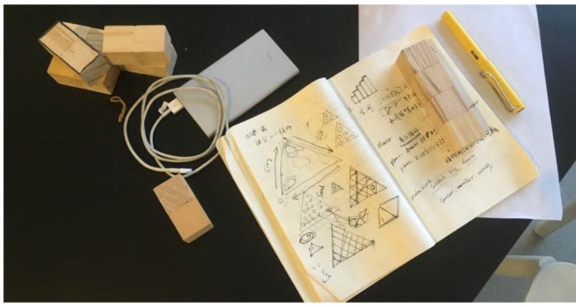
222. Progress and support on 11th April. Ph. Jelena Sučić

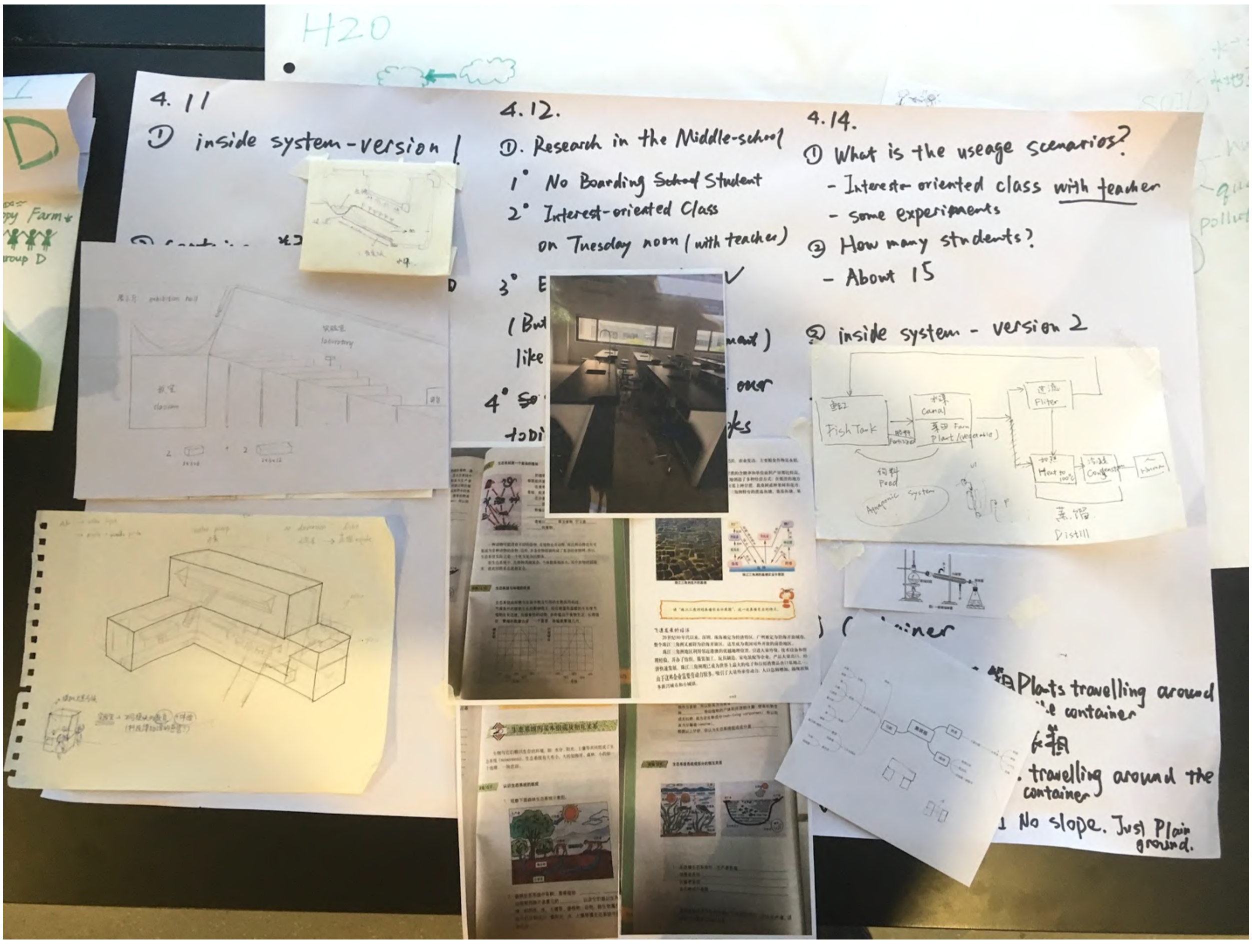
At this stage the students questioning started to find focuses, was time to clarify misunderstandings as the difference between a functional lab structure and a thematic installation on which several groups had difficulties in differing. After this session started to be clearer the functional aims of the given topics for the curricula definition purposes and why were asked prototypes and experiments of their concept focuses. In fact, the next day they had a field trip at the case scenario middle school place, in order to perceive and orient in the actual context. By recognising the available resources (e.g. space, sun exposure and orientation, etc) and interviewing students and teachers about their interests and concerns. This allowed students to find more functional aspects and criticalities contributing in defining the feasibility of their projects' integration in the middle school system. Students were asked to maintain using the poster tool for communication, exchange and visualising evolving process purposes.

Process including data collections from the field, plants and sensors arrival 15th April

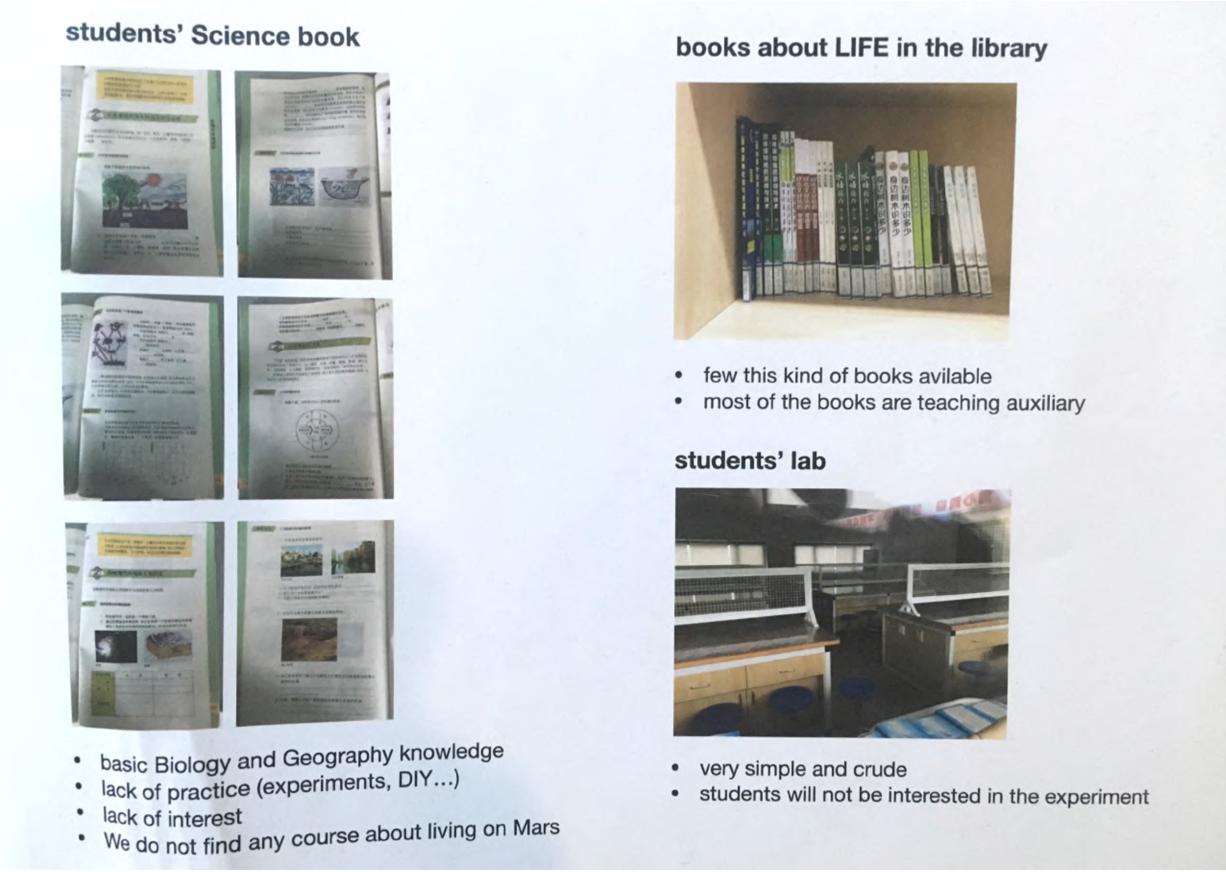


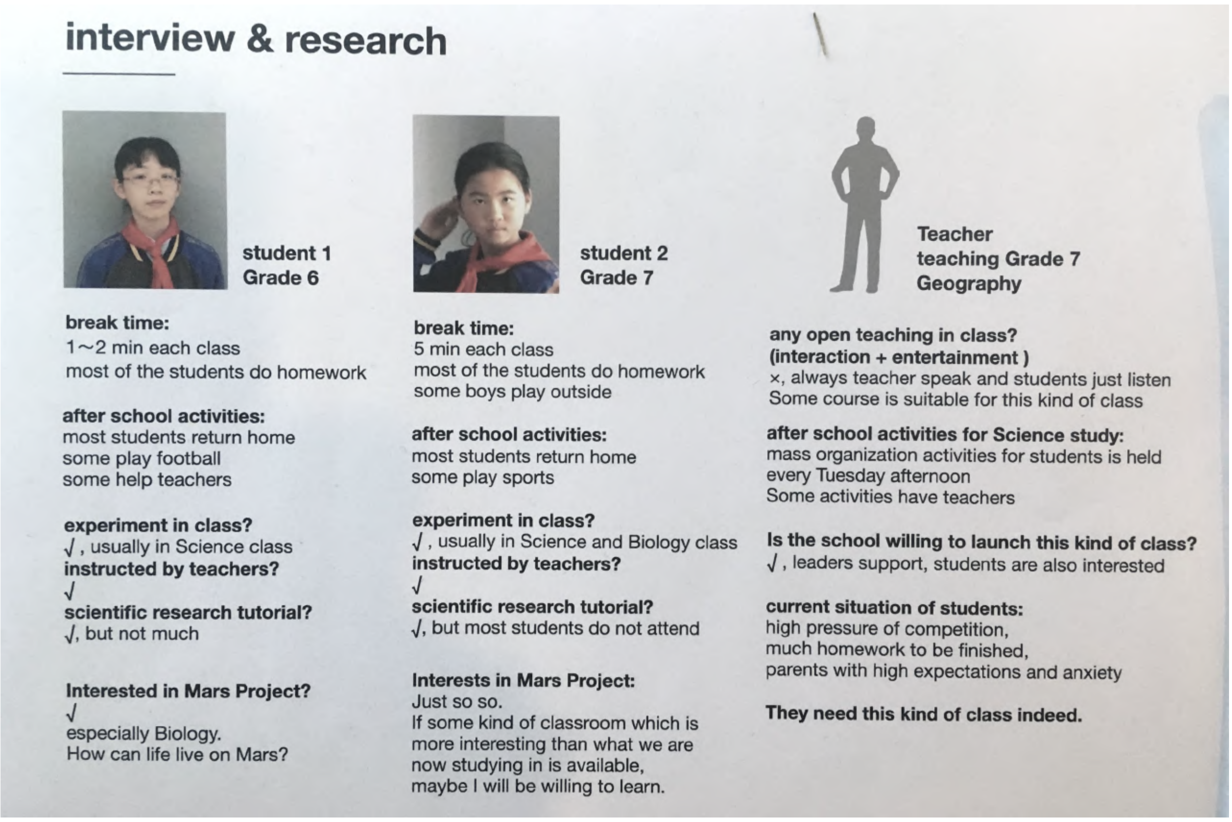




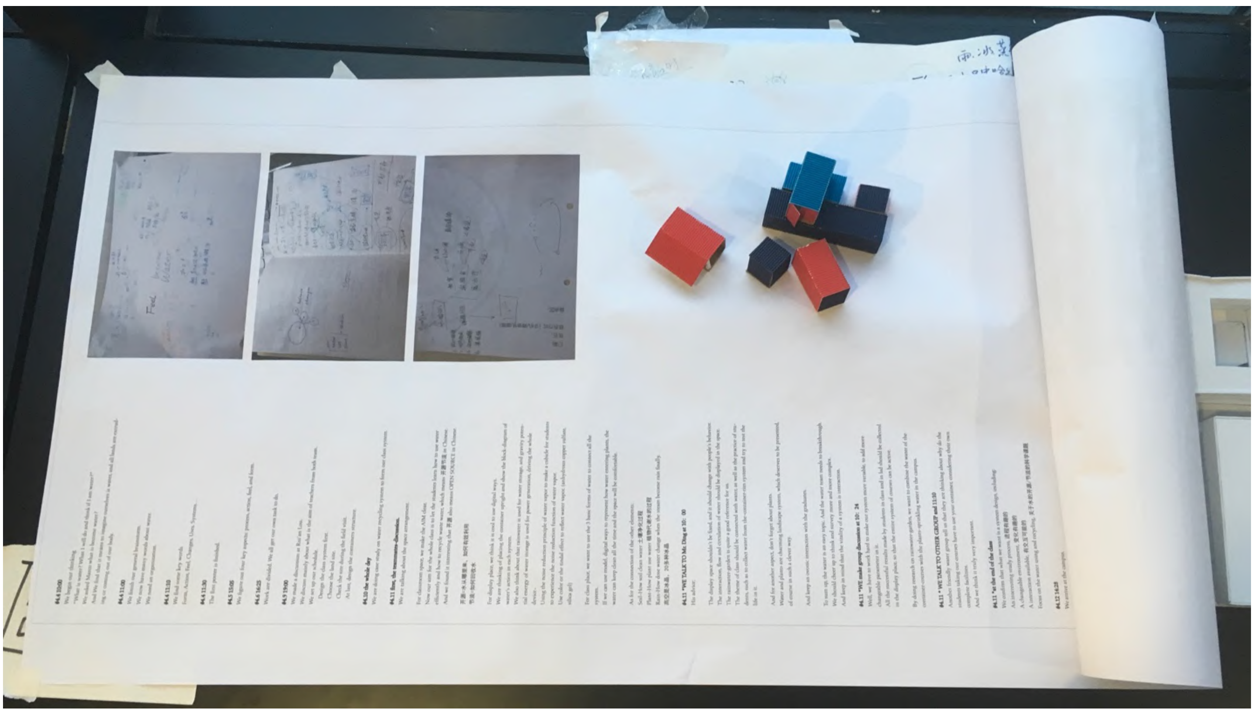


Process including data collections from the field, plants and sensors arrival 15th April

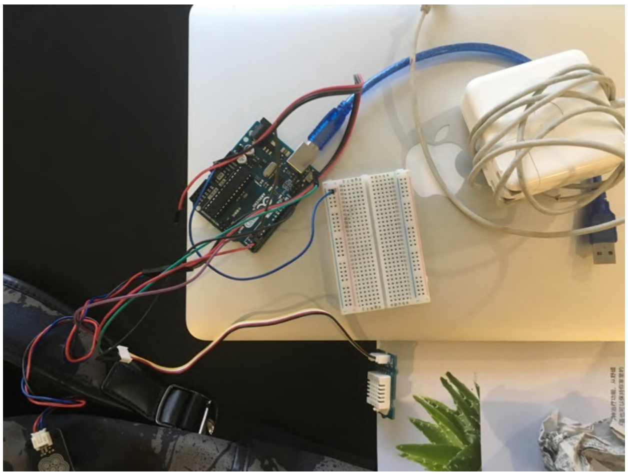




Process including data collections from the field, plants and sensors arrival 15th April



Process including data collections from the field, plants and sensors arrival 15th April

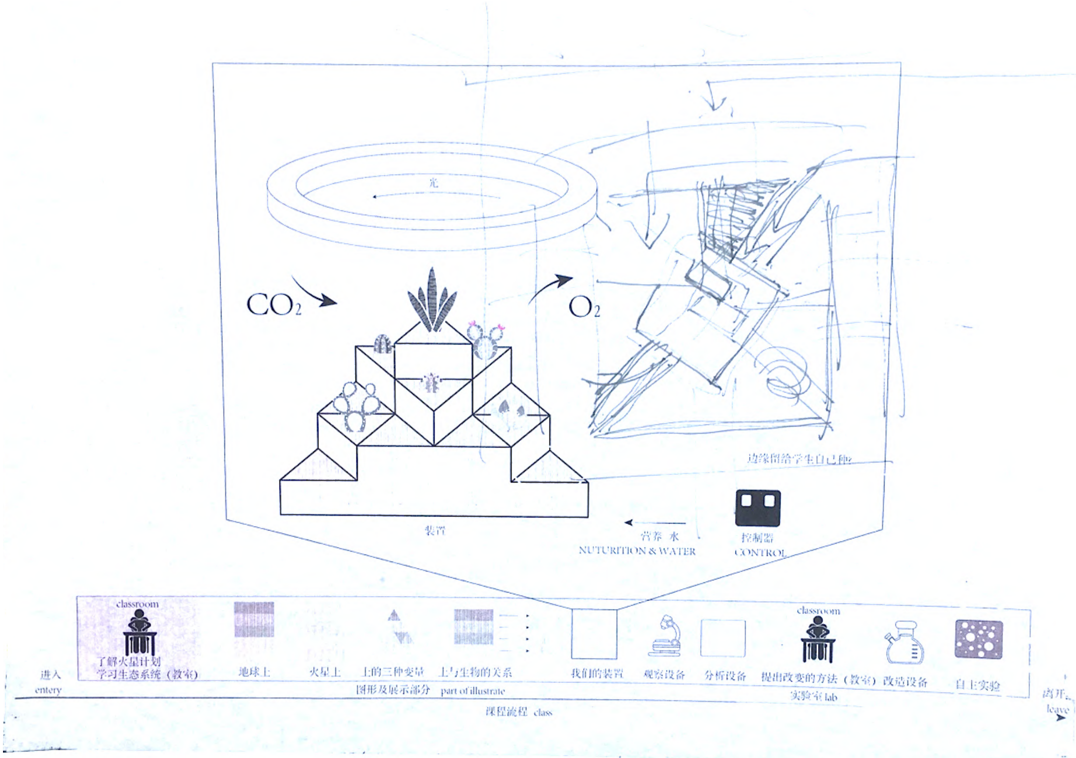


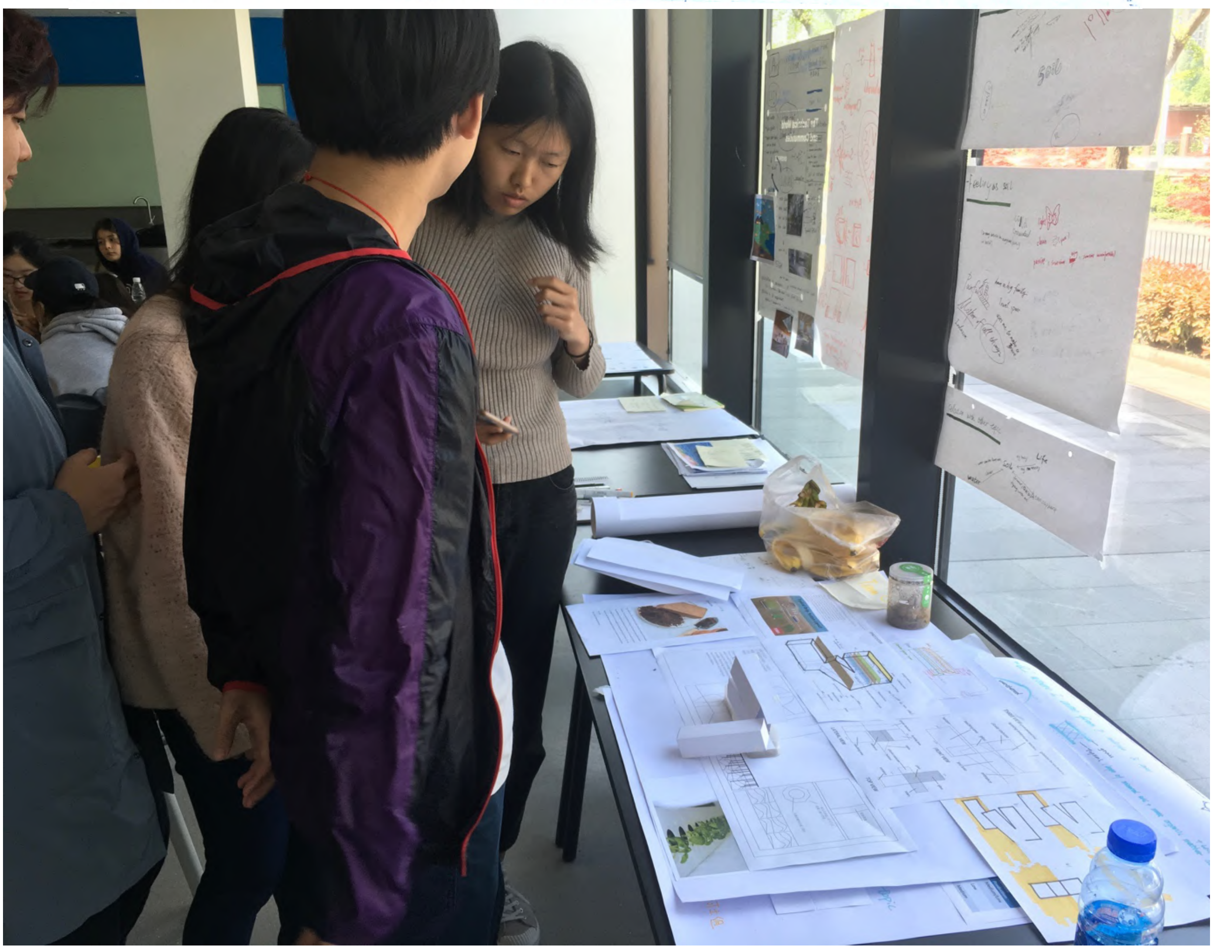
223. Process including data collections from the field, plants and sensors arrival 15th April. Ph. Jelena Sučić

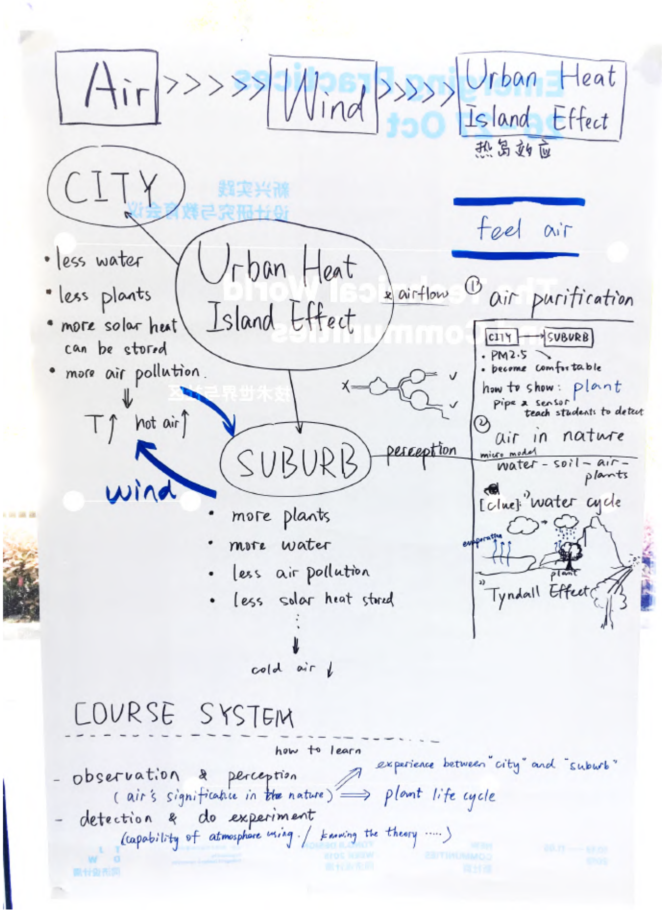
Chosen plants started to appear with more defined concepts of students' interpretations and systems definition. In the following lecture even, started to appear the consideration of using fishes in their systems. Unfortunately, the first arrival died because of a to small container for its breathing activity and movement. Also, specific composting materials started to be exposed.

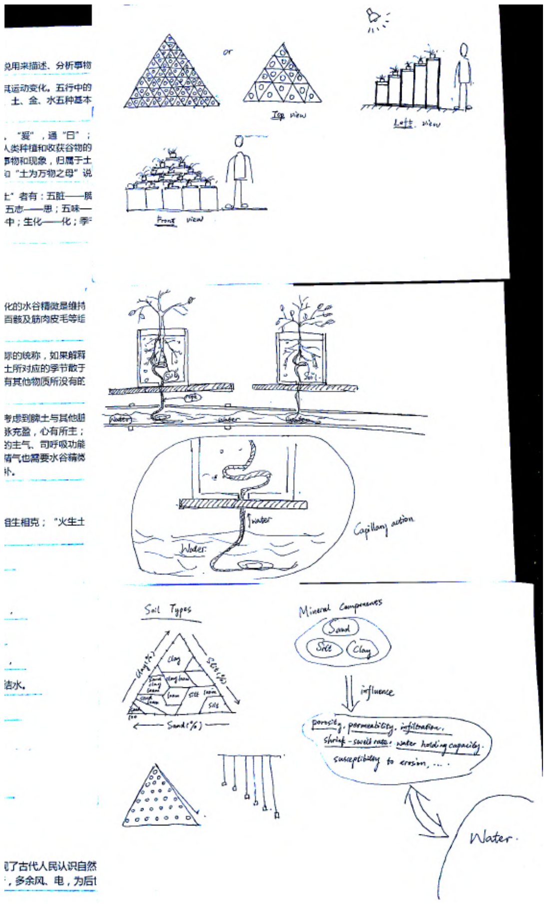
Progress, fishes trial, 18th April

Progress, fishes trial, 18th April







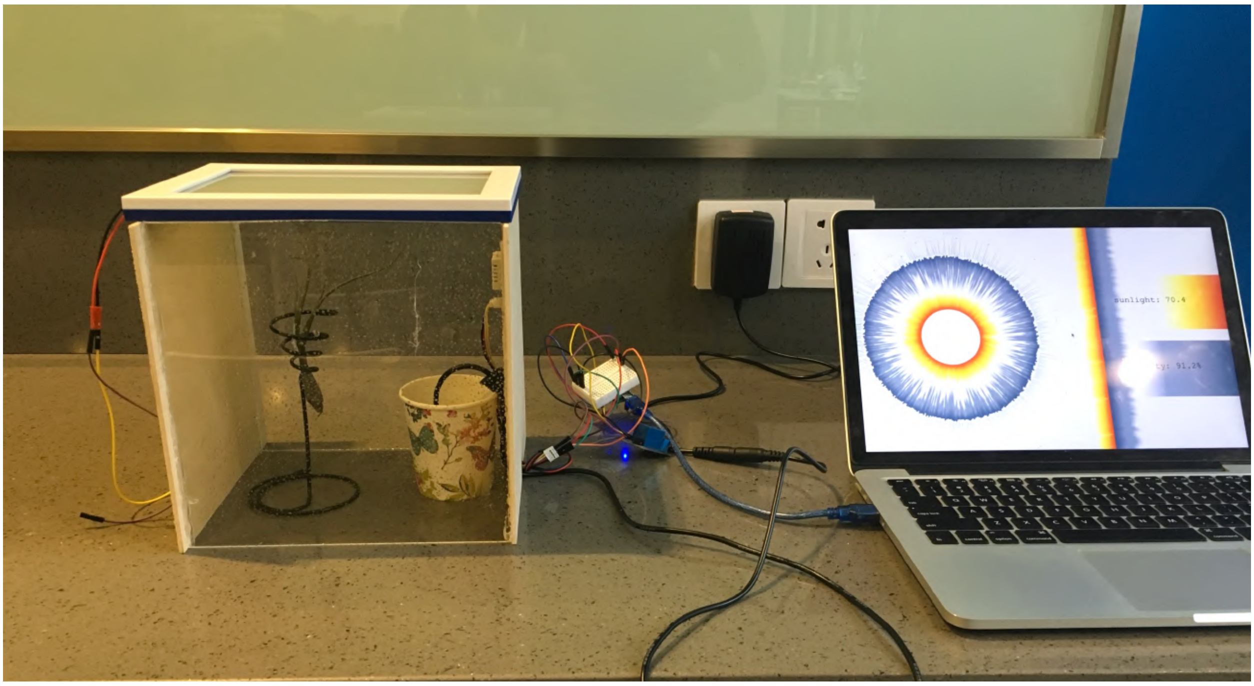


224. Progress, fishes trial 18th April 2019. Ph. Jelena Sučić

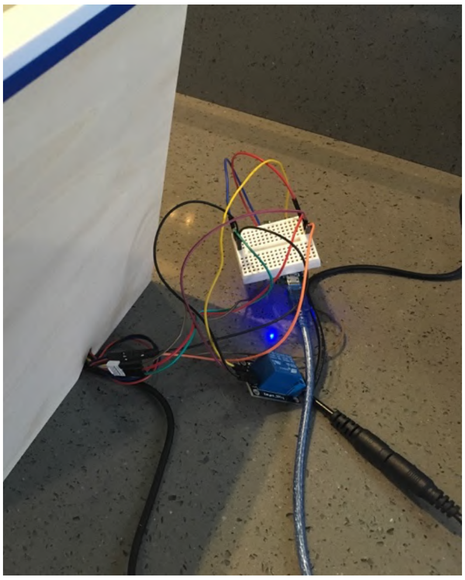
From this point during the weekend physical prototype started to be built by some groups and others kept focusing on the containers' models. Therefore, after the 22nd of April the photographic documentation of the process diminishes in contents.

Process, concepts definition and prototyping. 22nd April

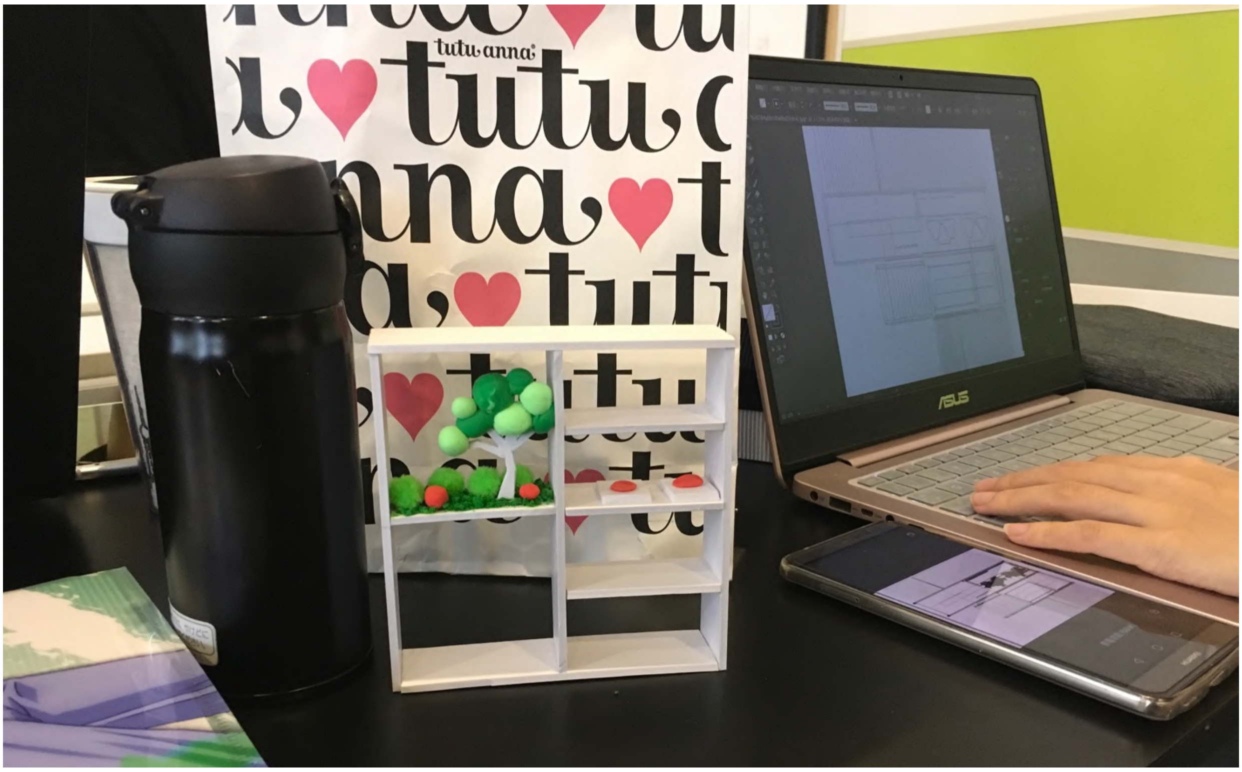

Process, concepts definition and prototyping. 22nd April



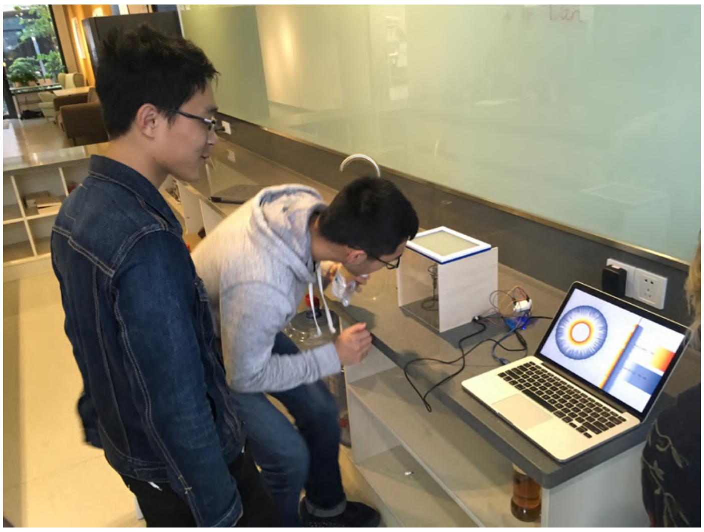
Process, concepts definition and prototyping. 22nd April

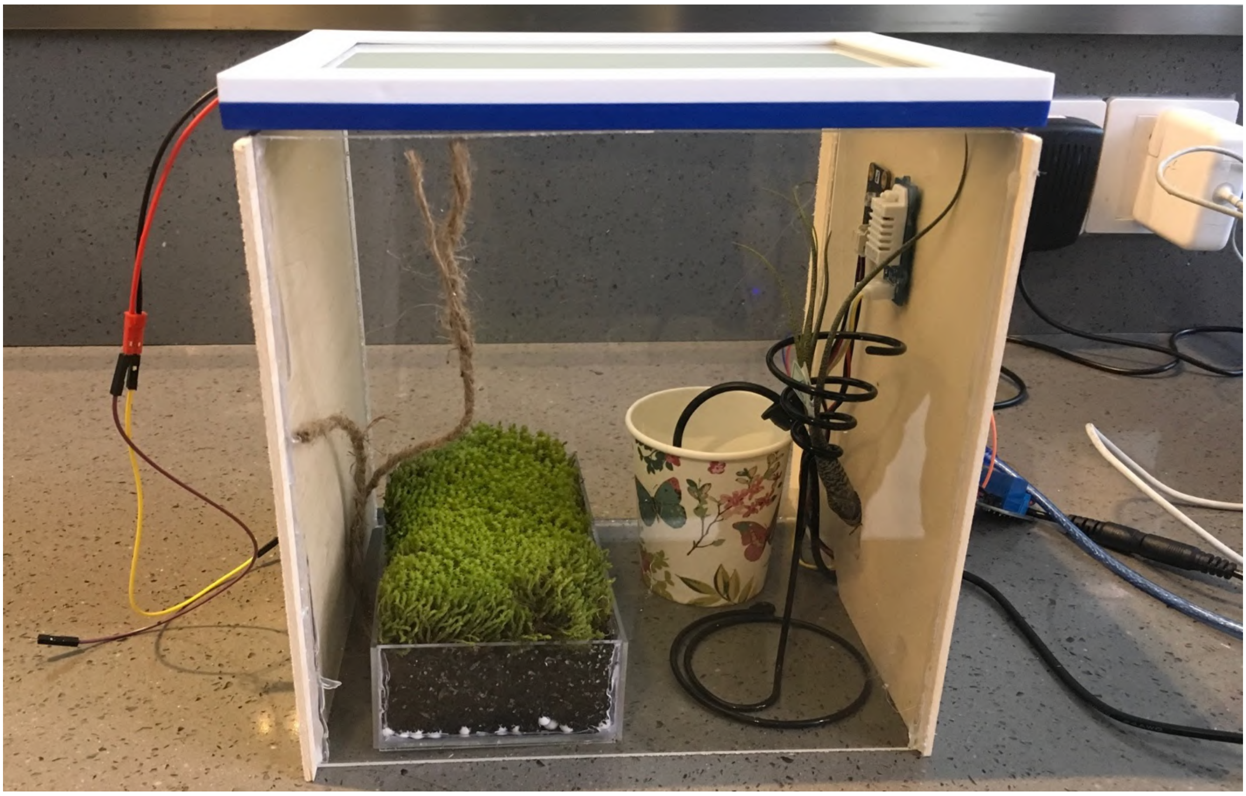


Process, concepts definition and prototyping. 22nd April

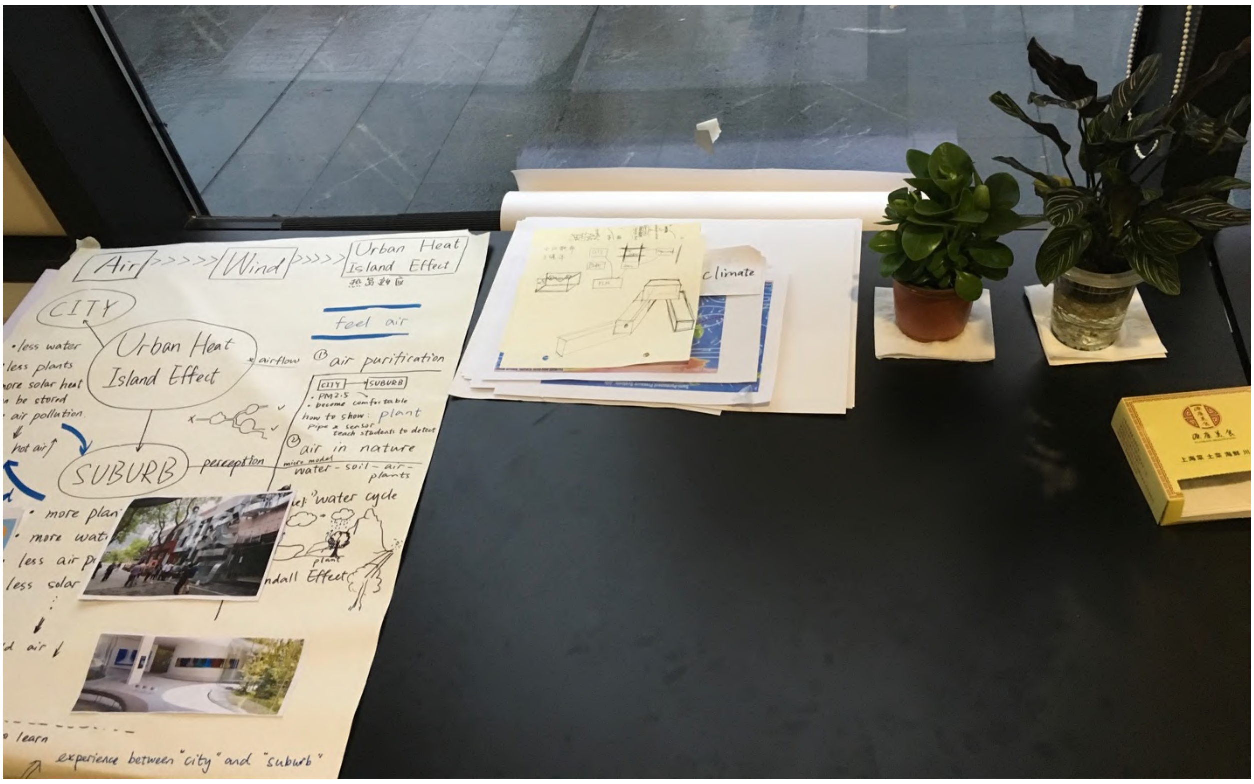


Process, concepts definition and prototyping. 22nd April



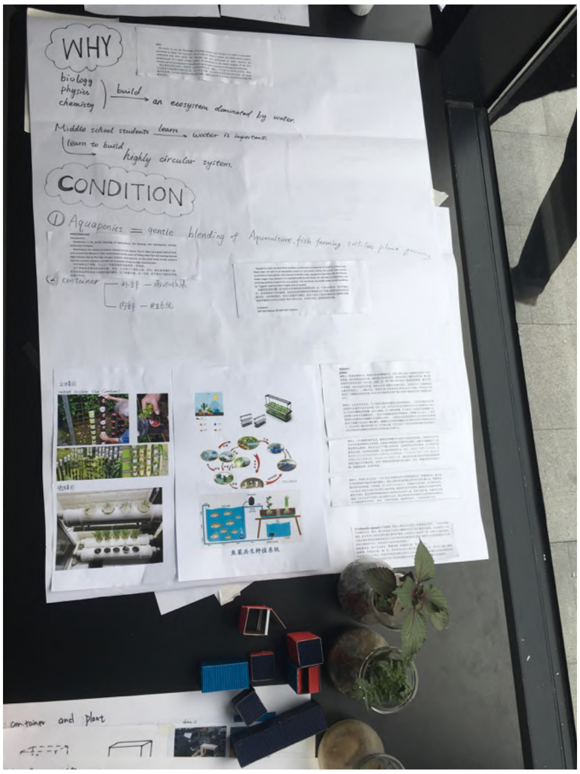


Process, concepts definition and prototyping. 22nd April

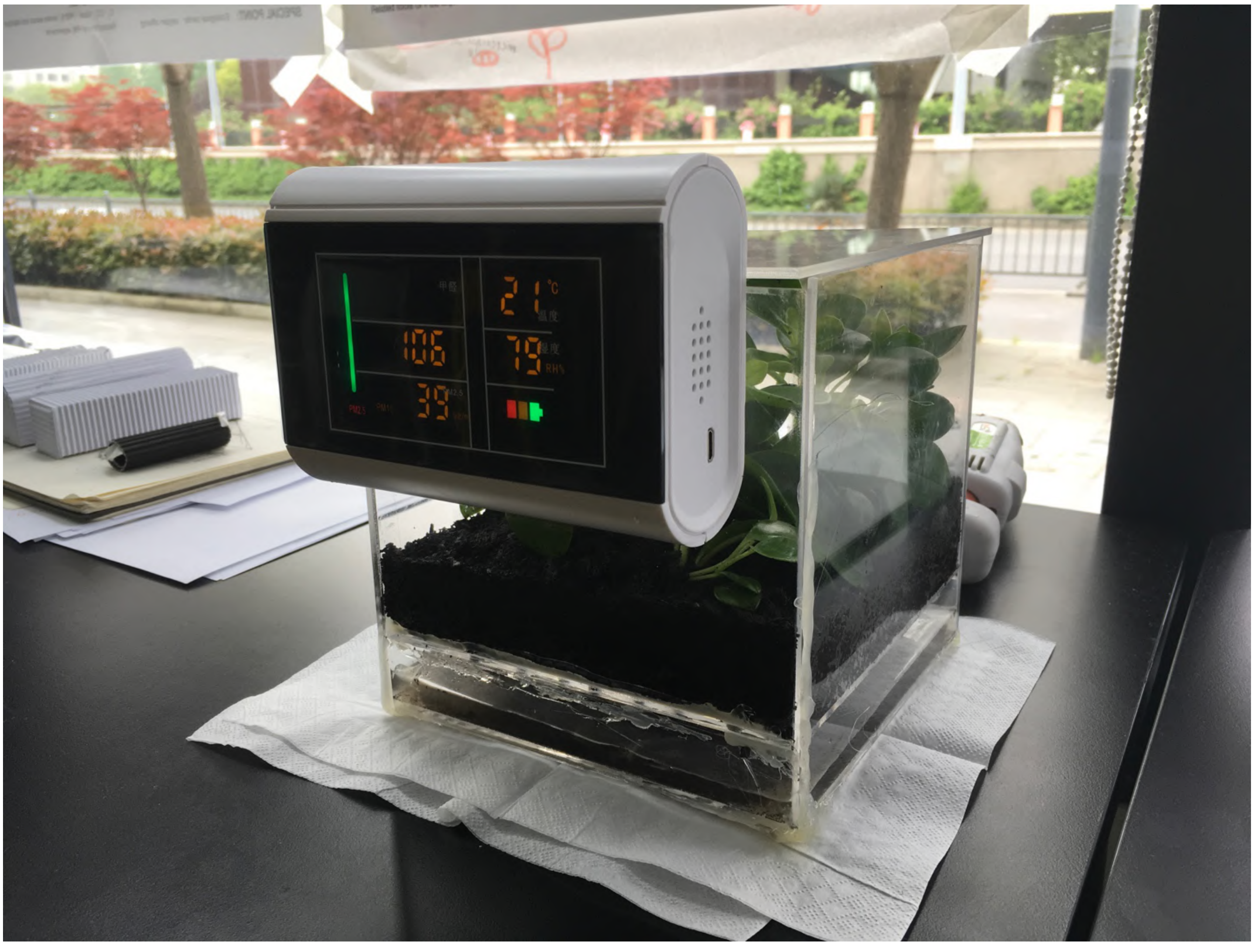


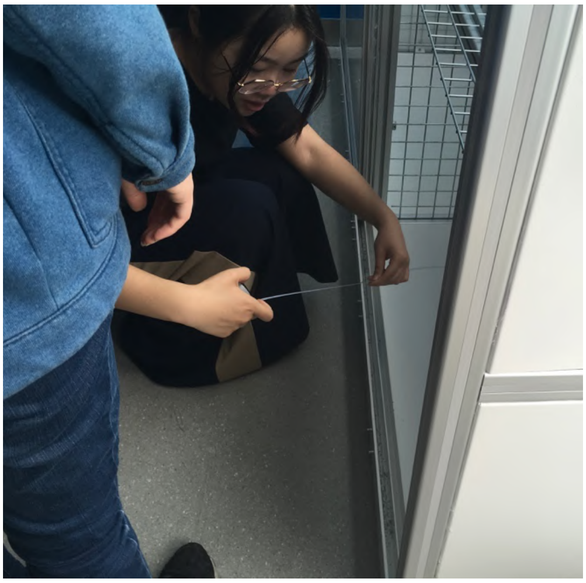
225. Process, concepts definition and prototyping. 22nd April. Ph. Jelena Sučić

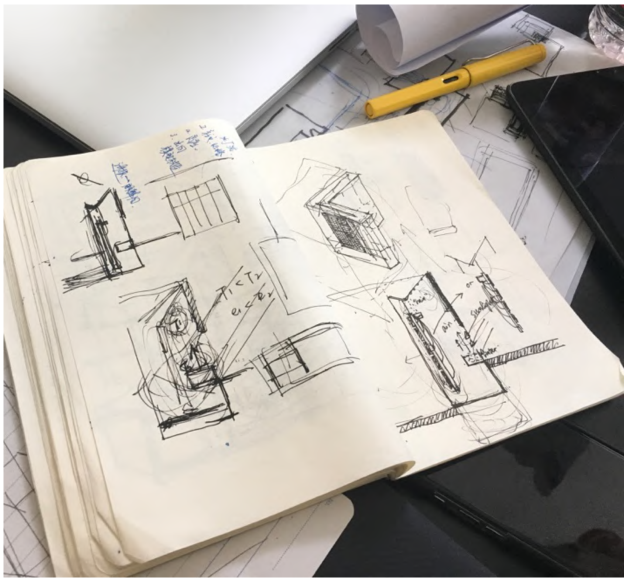
Prototyping and concepts definition found on 25th April



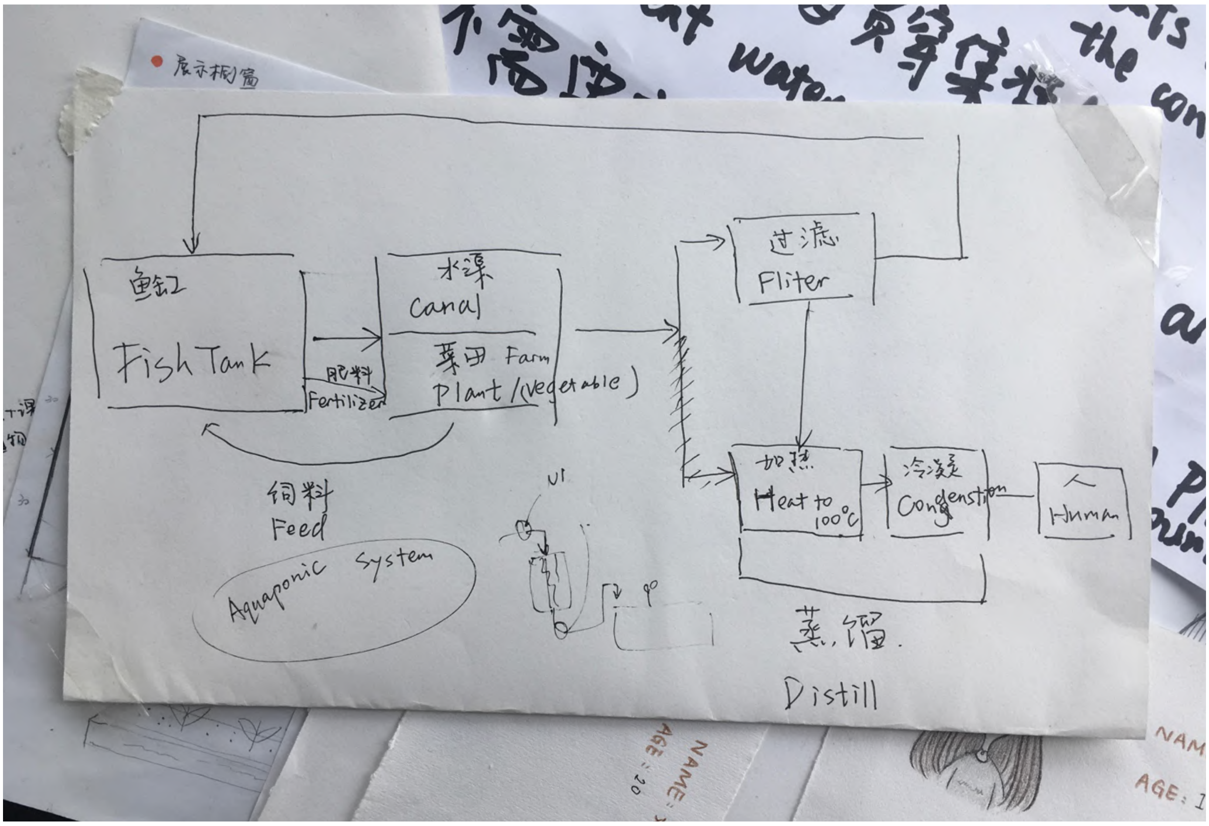
Prototyping and concepts definition found on 25th April

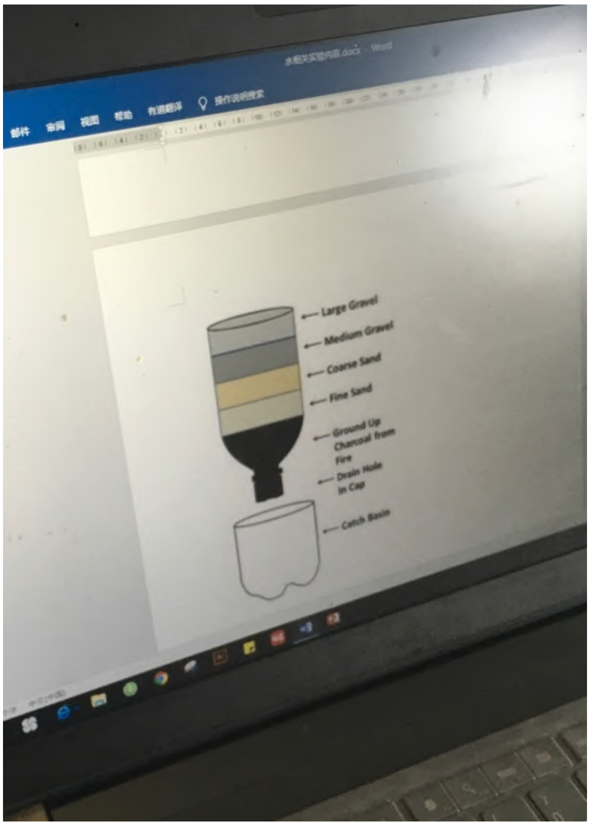


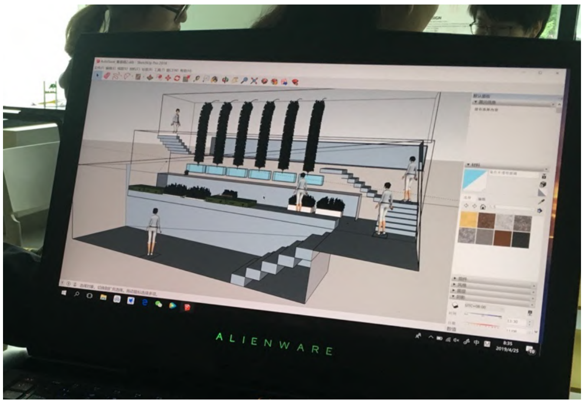


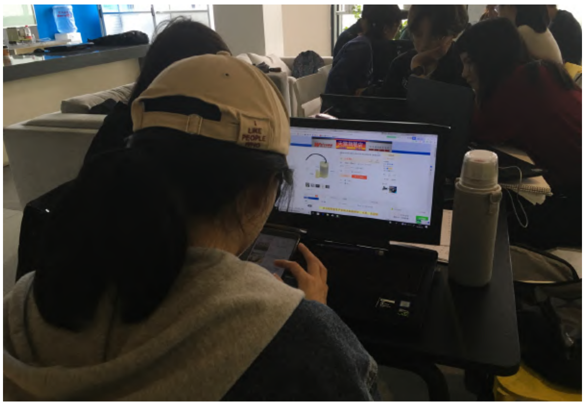


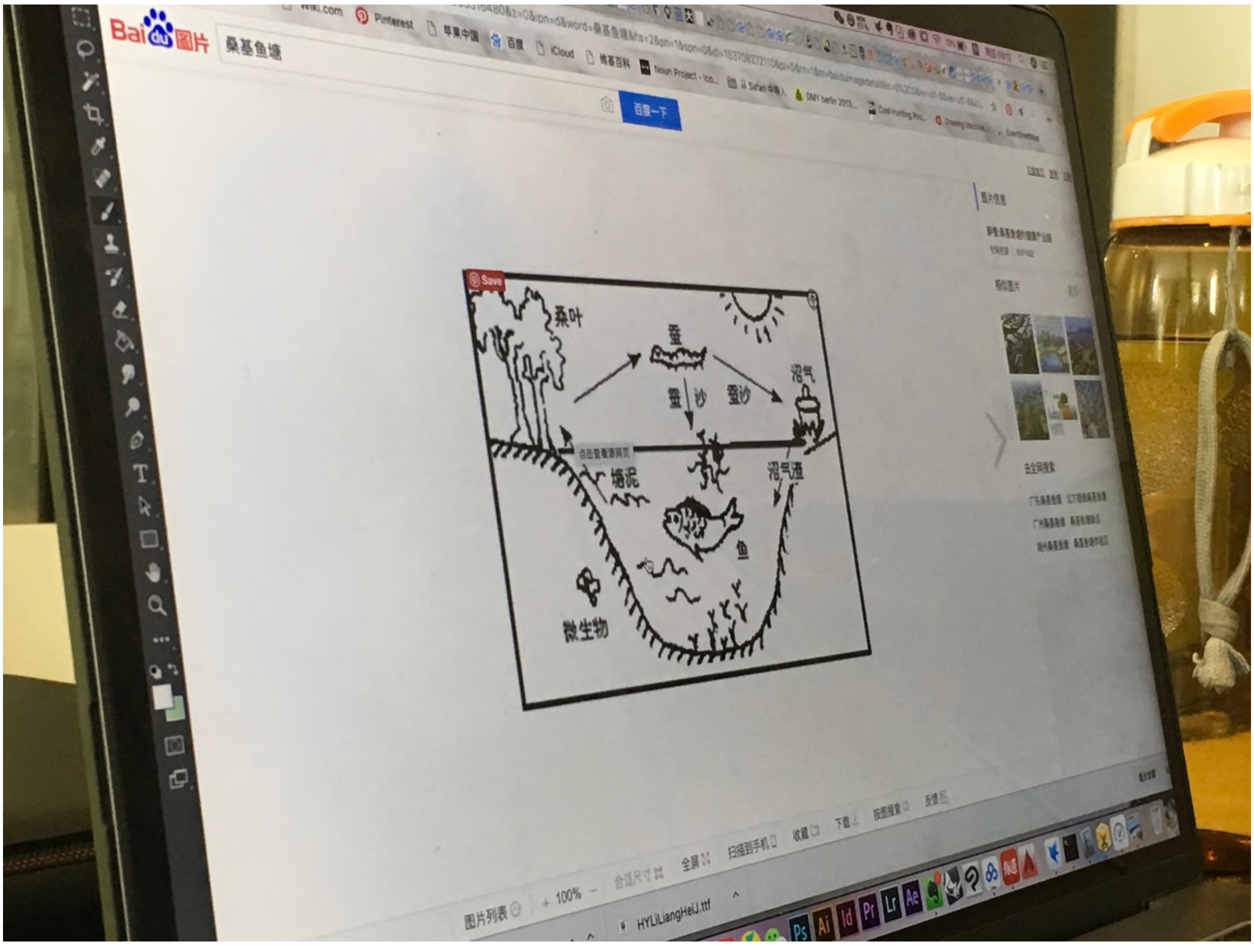
Prototyping and concepts definition found on 25th April





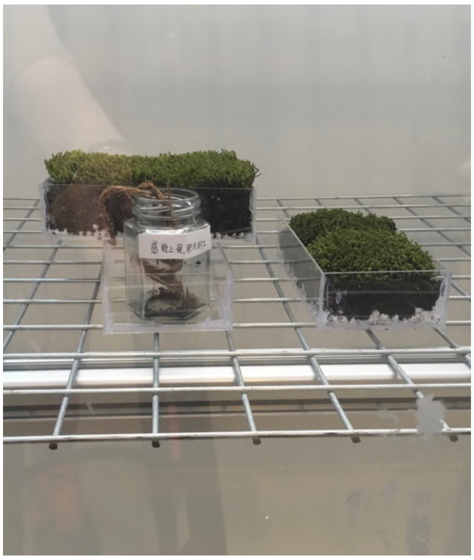






226.Prototypes and concepts definition found on 25th April. Ph. Jelena Sučić

First curricula and design definitions 28th April



First curricula and design definitions 28th April

1. 1

为自己的沙拉派对做准备

Prepare for our salad party

课程目标：学会基础种植技术与操作，体验种植基本莴苣类蔬菜、亚洲甘蓝类蔬菜

| 前期

品种选择（口味、色彩、形态）
备选品种：叶用甜菜、菠菜、生菜、芝麻菜、小松菜、甜菜根、马齿苋、亚洲甘蓝……

FIRST

Variety selection (taste, color, shape)
Alternatives: chard, spinach, lettuce, arugula, komatsu, beetroot, purslane, Asian kale...

| 中期

1/ 让种子发芽
种子：水 =1：3 或 4，瓶口盖纱布，皮筋固定，放在暗处，8-12 小时泡胀，倒去水，清洗，容器 微斜放置几天即可

2/ 播种
整土、放种、筛土进行覆盖、标签、浇水、薄膜覆盖、放入温室

3/ 堆肥（概念学习）
湿润落叶，堆积，翻动，挤压，静置

SECOND

1/ let the seeds germinate
Seeds: water = 1:3 or 4, bottle cap gauze, rubber band fixed, placed in the dark, 8-12 hours swelling, pour water, cleaning, container slightly tilted for a few days

2 / sow
Whole soil, put seeds, screen soil cover, label, water, film cover, put in the greenhouse

3/ composting (concept learning)
Wet fallen leaves, pile up, turn over, squeeze, stand still

| 后期

采摘、清洗、切、调味、装盘、分享、派对

LAST

Picking, cleaning, cutting, seasoning, serving, sharing, party

1. 2

园丁窗外起芳菲

Plant flowers outside the teacher's window

课程目标：学会基础育种操作，体验植物对人心情的影响

| 前期

品种选择（养殖难度、成熟形态与景观）
备选品种：日本水芹 高 65cm，白花

FIRST

Variety selection (breeding difficulty, mature morphology and landscape)
Alternative variety: Japanese water hemlock with white flowers and height of 65cm

| 中期

器材准备（育苗盘、海绵、固定板）
器材灭菌（学习并操作高温灭菌锅）
播种、发芽
施肥（了解肥料中不同元素分别起的作用）
移植

SECOND

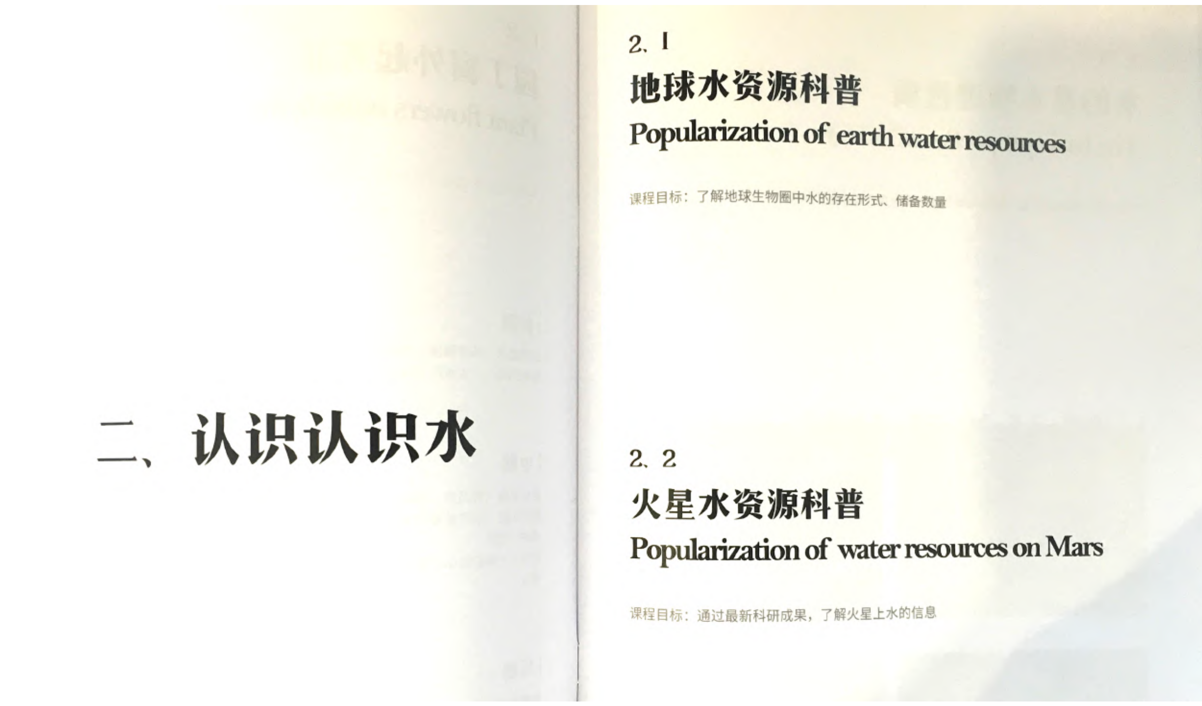
Equipment preparation (seedling tray, sponge, fixed plate)
Equipment sterilization (learn and operate high temperature sterilizer)
Sowing and germinating
Fertilization (understand the role of different elements in fertilizer)

| 后期

放置到老师办公室，及基础教室周围、学习室等处。把课程成果进行展示的同时，让同学们感受到植物对环境的改善。

LAST

Put it in the teacher's office, around the basic classroom, study room, etc.At the same time, let the students feel the improvement of plants to the environment.



二、认识认识水

2. 1

地球水资源科普

Popularization of earth water resources

课程目标：了解地球生物圈中水的存在形式、储备数量

2. 2

火星水资源科普

Popularization of water resources on Mars

课程目标：通过最新科研成果，了解火星上水的信息

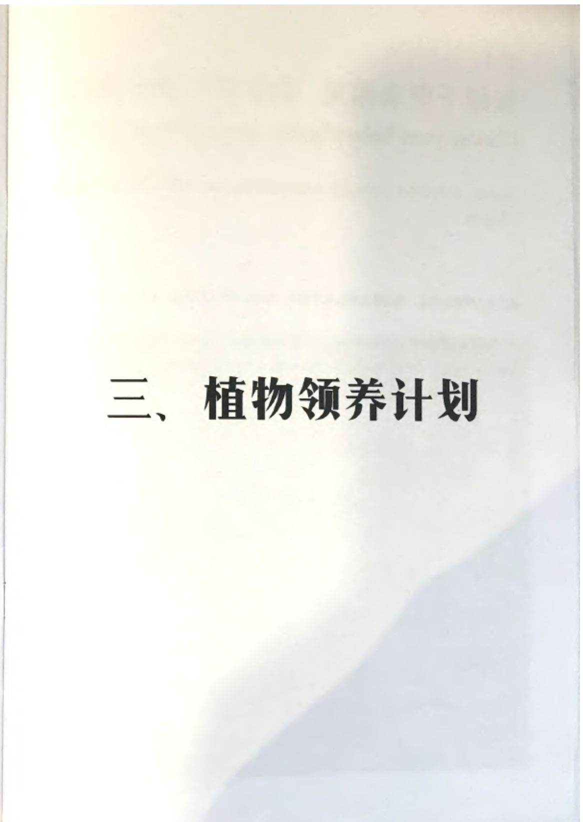
First curricula and design definitions 28th April


2、3

水的基本物理性质

The basic properties of water

课程目标：简单的实验，解释科学原理，对纯水的基本性质有直观了解


三、植物领养计划


3、1

有缘千里来相见

Choose your baby plants

课程目标：在问卷选择的过程中，明确自己所希望的产出，确保整个种植过程中一直保持有兴趣的状态

通过单人问卷的形式，得出各自想领养的植物，再根据植物进行分组，3-4 人一组。

Through the form of single person questionnaire, each wants to adopt the plant, and then according to the plant , divide them in groups of 3 or 4 people.

案例学习


3、2

搭建小组立体菜园

Set up a group garden

课程目标：学习小组合作、学习并掌握立体菜园系统的构建

First curricula and design definitions 28th April

四、如何获得水

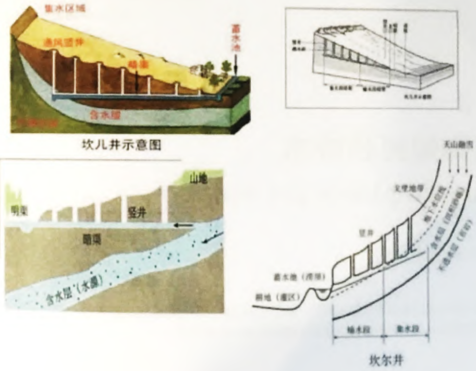
4、1

雨水蓄水

Rainwater storage

课程目标：了解雨水蓄水工程

例如：案例学习——坎儿井



坎儿井示意图

坎尔井

4、2

从植物中获得水

Get water from plants

学习课堂与立体菜园的第一次结合

4、3

植物如何获得水

How do plants get water

课程目标：学习毛细作用

1/ 进行植物通过根部吸水失水实验，观察外部液体与植物吸水失水的关系
2/ 探究植物体内水分的运输速率与叶面积大小关系的实验

4、4

如何妥善储存你所获得的水

How do you store your water properly

课程目标：为了之后进行有关水的实验，为了保证水中成分不发生较大变化

原理：
避免水样的生物化学作用
缓解化合物或络合物的氧化还原反应
减少被测组分的挥发损失
减少结晶或沉淀等的析出

First curricula and design definitions 28th April

五、如何净化水

5、1

了解净水方式及净水器发展史

Learn about water purification methods and the history of water purifiers

课程目标：基础知识储备

5、2

尝试自制初级净水器

Try making primary water purifier

课程目标：在对多层过滤净水原理了解后进行操作

5、3

化学物理的净水方法学习

Chemical and physical methods of water purification

课程目标：基础知识储备

氯消毒、臭氧消毒、铝离子、铁离子、蒸馏、紫外线

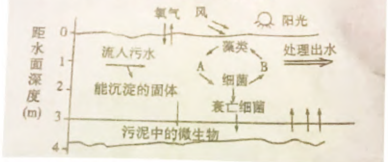
5、4

生物的净水方式学习（一）

Biological ways to purify water（1）

构建藻类与细菌共生的水中“清道夫”

(2009・广州调研)图示为利用自然生态系统净化污水的一种大面积、敞开式污水处理池塘(即氧化塘)。



5、5

生物的净水方式学习（二）

Biological ways to purify water（2）

课程目标：依托现实场景，在实践中解决问题，符合 STEAM 教育理念。培养学生建立景观与生物，科学逻辑与艺术感知之间的联系

1/ 认识净水植物

2/ 分析基地环境

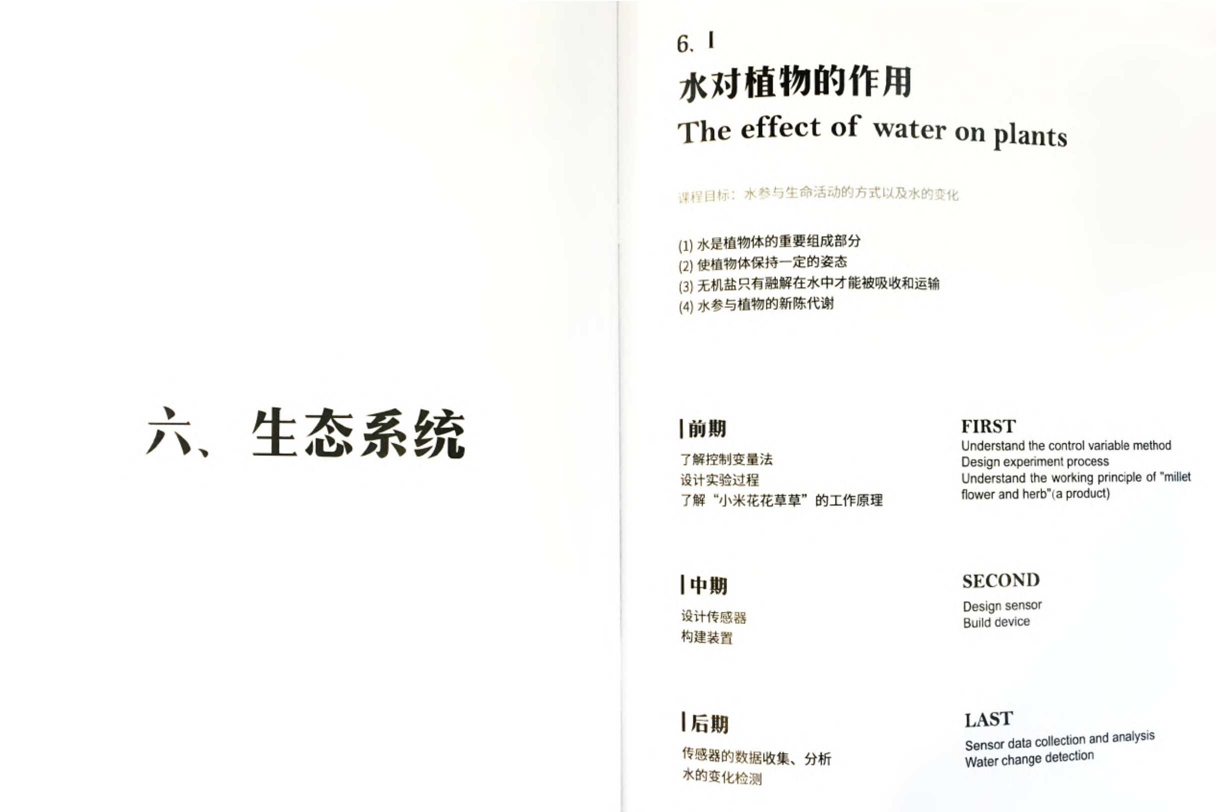
3/ 植物净水搭配（根据不同净水植物的生长季节和适宜地理位置，进行植物搭配）

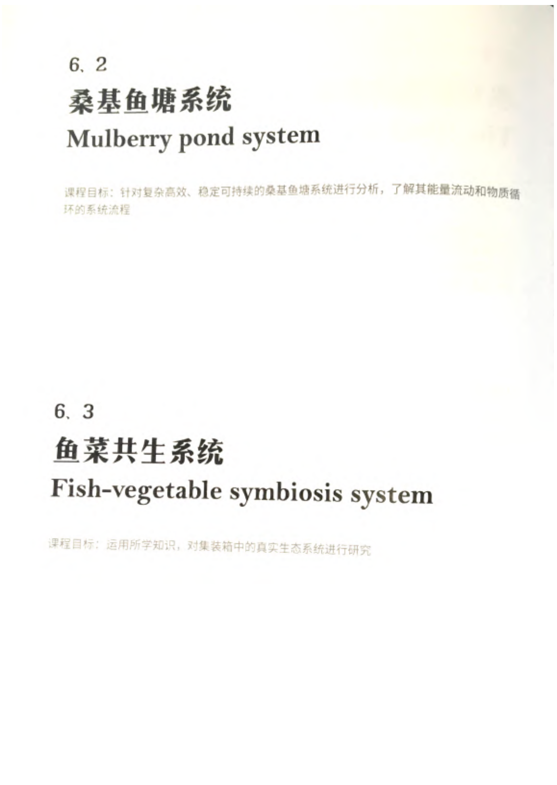
1/ Know water purification plants

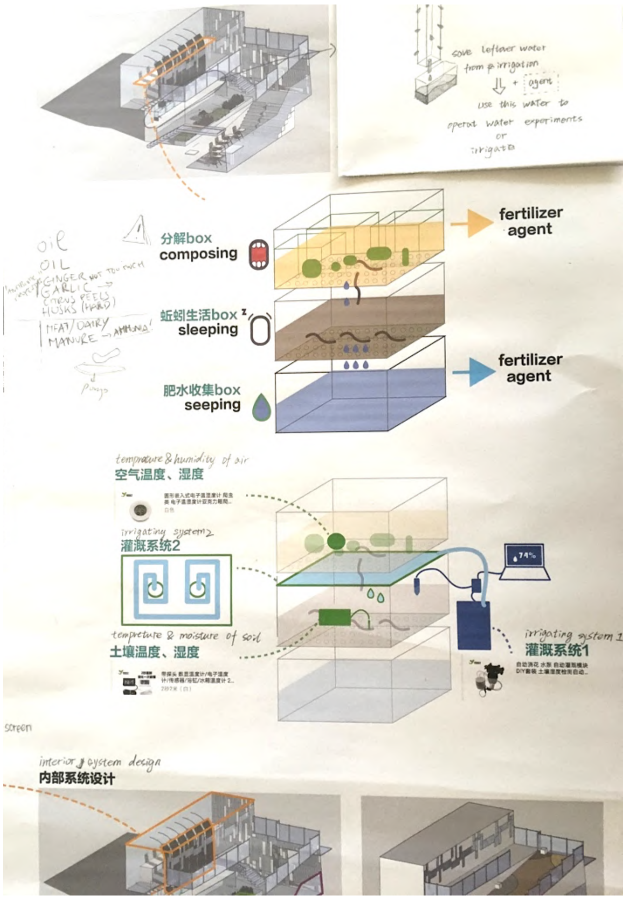
2/ Analysis of base environment

3/ Plant water purification collocation (plant collocation is carried out according to the growth season and suitable geographical location of different water purification plants)

First curricula and design definitions 28th April

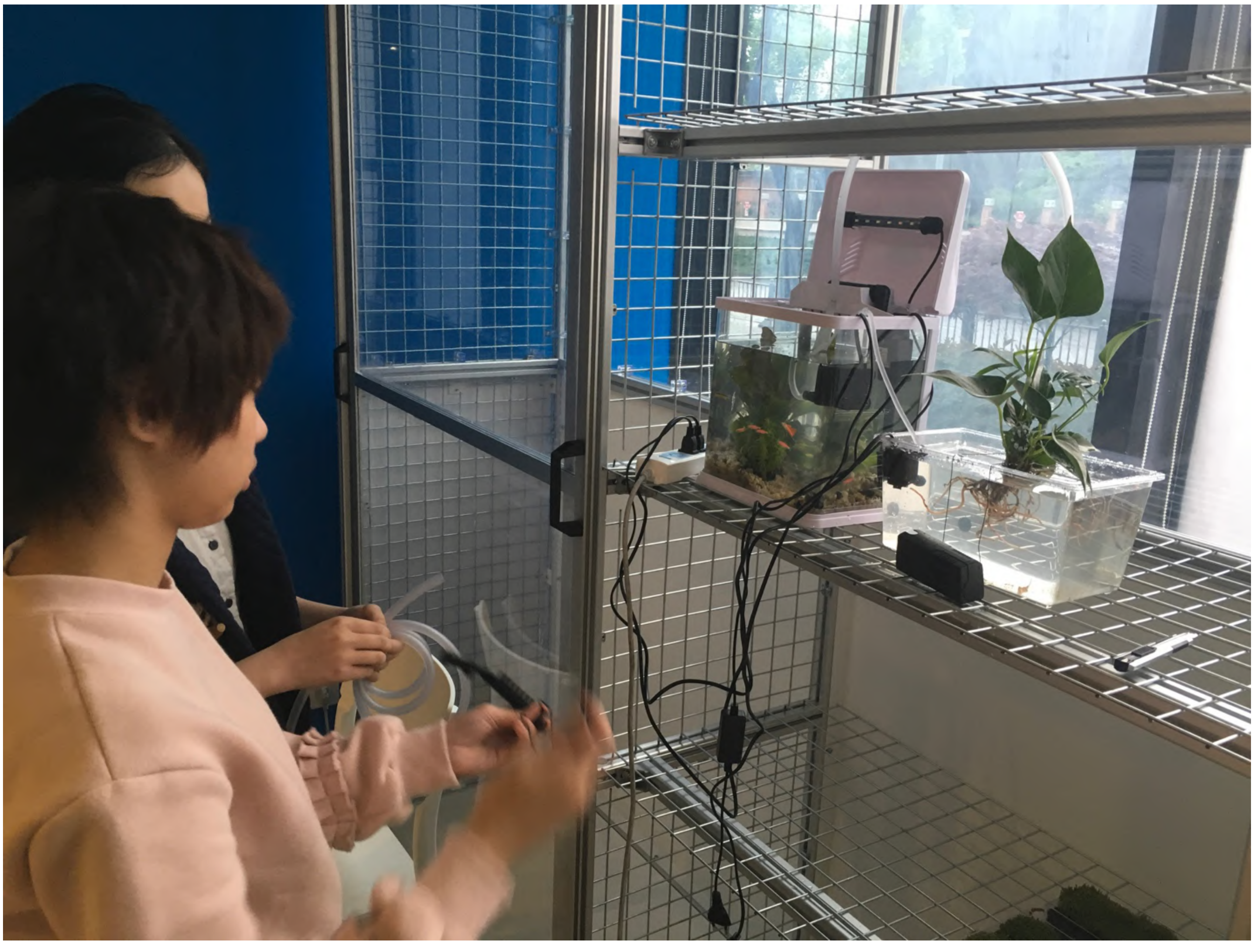






227. First curricula and design definitions 28th April. Ph. Jelena Sučić

Prototypes setting initiation 29th-30th April



Prototypes setting initiation 29th-30th April

228. Prototypes setting initiation 29th-30th April. Ph. Jelena Sučić

5.3.5.1.4 Final presentation

As is been introduces already in 5.3.5 students were asked to present three aspects:

1. One to one scale-built system prototype inside the pod;
2. The functionality: the classroom, the exhibition space and the lab,1:250 scale model, the plans, sections, etc.;
3. The curriculum for middle school class.

Different results occur from practical, mechanical experimentation systems to monitoring and communicating interpretation systems.

The presentation was given per groups in front of each table station with a jury of four external guests: Tiina Laurila, Cheng Yi Heng, Petra Johnson and Stephanie DeBoer. Their backgrounds, including engineering and visual arts, were different from the course context which offered a different perspective on the results stimulating interesting discussions and suggestions.

229. Jury listening. Ph. Jeff Ding

Before showing the results through a photographic excursion, follows an introduction of contents per each group:

Group A, Life: They recognised since the beginning the uses and functionality of plants, founding a focus in fabrics and dying which research lead them to the ancient Chinese farmers technic of the Mulberry pond system which, as explained by the students, involves silkworms eating mulberry leaves, silkworms providing food for the fishes and fishes fertilizing the water for the mulberry tree. The entire lab concept and curricula is based on the reproduction of this system and considering space for integration of other elements.

Group B, Air: This group started from a very broad definition of air and its feelings. In the research process they found the wind phenomenon as main interest and studied the urban heat island effect as expression of condition of winds movement cause by the chimney effect expressed by the pressure given by the created temperature difference. The entire system is developed experientially in the build construction using all the passive forces applicable: sun exposure, material properties in refraction qualities and shapes, space distribution (levels and layers). Which enhance the importance of water presence in gaseous state in the air for the wind's manifestation and temperature changes. The two main layers are paths of reconstructed "city conditions boxes" in the below area and "forest boxes" in the above are between which could be perceived and measured the air quality changes. Forest boxes had a self-watering system as shown in the representative model with a rubber plant.

Group C, Soil: From what in the beginning wanted to be just a big installation stair case showing the soil layers as concept after several consultations the group result embodied the soil character in the construction (only group proposing an underground floor) which by going up through the floors they extend the stages of soil relations. From the soil building through composting, developing a compartment system of boxes sharing the same "worm house" between which worms could migrate to eat but the fertile content would not mix with others so that each student or group of students would be able to compare the soil qualities obtained with others which depend on the kind of products given to the worms. The soil testing extends in using the box of produced soil to grow plants and so compare the quality of growths between the produced soils. Part of the activities involve nutrients extrapolation thanks to water, which is collected by the infrastructure and filtered thanks to plant systems and others in the circuit till its tested to assure the usability for students' purposes. The underground floor is a multimedia classroom for introductions with VR facilities.

Group D, Water: They have firstly focused on water shapes and behaviours attributing characters to these. Their research made them find hydroponics and aquaponic systems which include filtering actions with plants. The entire thing developed in a rain collection system distributed through the entire construction including a collecting pool above with transparent bottom. The small concept model was presented with a series of filtering material to clean rainwater and Cl excesses in tap water. The created circulatory movement allows electricity generation and provides for plants and fishes. In the system is actable also the water distillation process.

Group E, Water: This group expressed a really wide perspective in initial stages of the research process interpreting water feelings and emotions according to their behaviours including also very technical aspects as water qualities. Aquaponics become a major point of interest but which facing made them understand several criticalities in this kind of system. Thanks to the vision extension of extra provided materials and attention marks in the facilitation process, the students realised the potential behind water qualities differentiation according to the kind of living creature hosting the water environment and how the water exchange between those at different rhythms which become the main prototyped experimentation. This group was the only one redefining the STEAM lab space as a "Water Club" where everybody who was interested in water topics could join and not being only a school facility for internal uses.

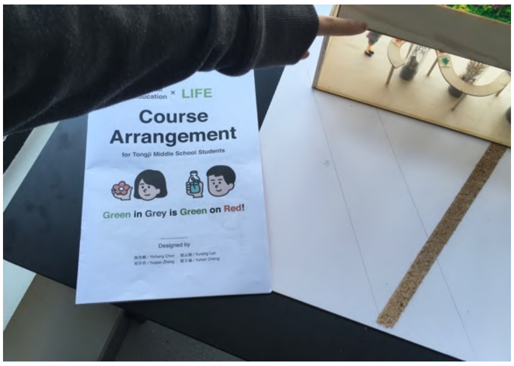
Group F, Life: From something very focused as the life cycle of the tree behind their window they ended in proposing something very broad and general focusing mostly on the classroom disposition changes allowing different experimentations to happen also from the traditional courses as plants sectioning. They presented as example of experimentations a conceptual model of a hydroponic system with rain water collection and filtration of it.

Group G, Air: They entered very practically in the topic defining it in micro and macro scale components and behaviours finding at the first shot good attention points to consider further in their process. In the research of representing at best air behaviour in relation with life they found air plants, that do not need soil to live, and air cleaning plants selection. In the facilitating process is made them notice the existing of another kind of photosynthesis, the CAM, which is typical of some their selected plants. The group was already oriented in using monitoring sensors and communicating but they were struggling to find changing factors to monitor in order to show behaviours and this made them realise the solution. The entire communication system embodied the construction and the spaces functionalities by having as a main core an Atrium of plants monitored independent environments still in relation with the bigger one. The observed plants are different and because of their differences in a same timeframe they would behave and produce air conditions differently. It emerged the concept of “Plant prints”.

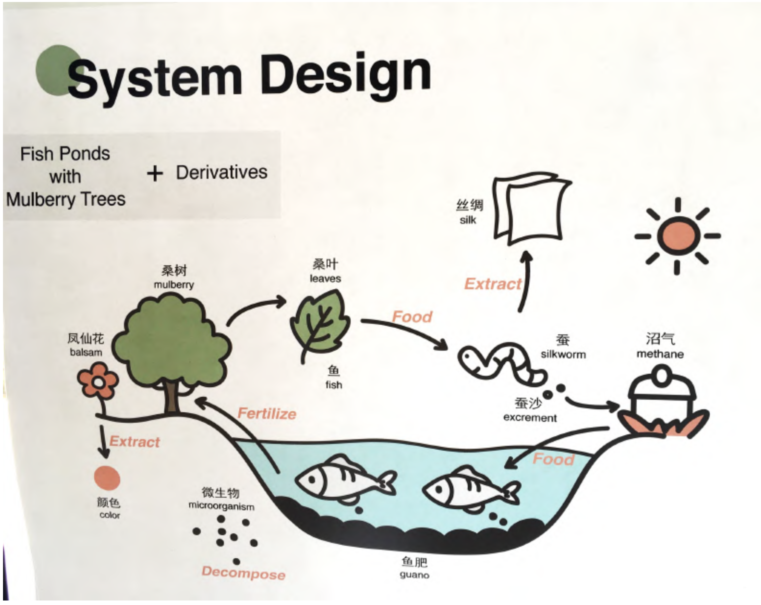
Group H, Soil: The soil composition pyramid is what mostly intrigued this group, the different properties of soil kinds were their focus area. The main leading question was about how to explain the importance in soil differences and through which media was possible to investigate it. Many ideas were questioned in the process as the contemporary growth differences of the same kind of plant in different soils, soils water retaining capacity visualization etc. In the end the main concept prototype of the proposed system integrated several already considered ideas and extended with the water relationship in the air, thanks to the groups exchange moments. The main driving force of the system is the sun access and refraction effect allowing condensation to happen in the living wall, the wall is composed by different soil blocks contents and a plant very sensitive to water presence. These in order to read differences in water retention capacities between different soils and signalized by the plant. The group presented the curricula in an animated visualisation format.

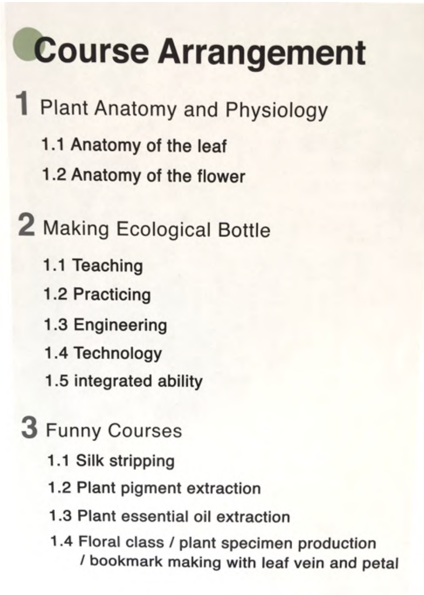
5.3.5.1.5 Photographic excursion per group

Group A

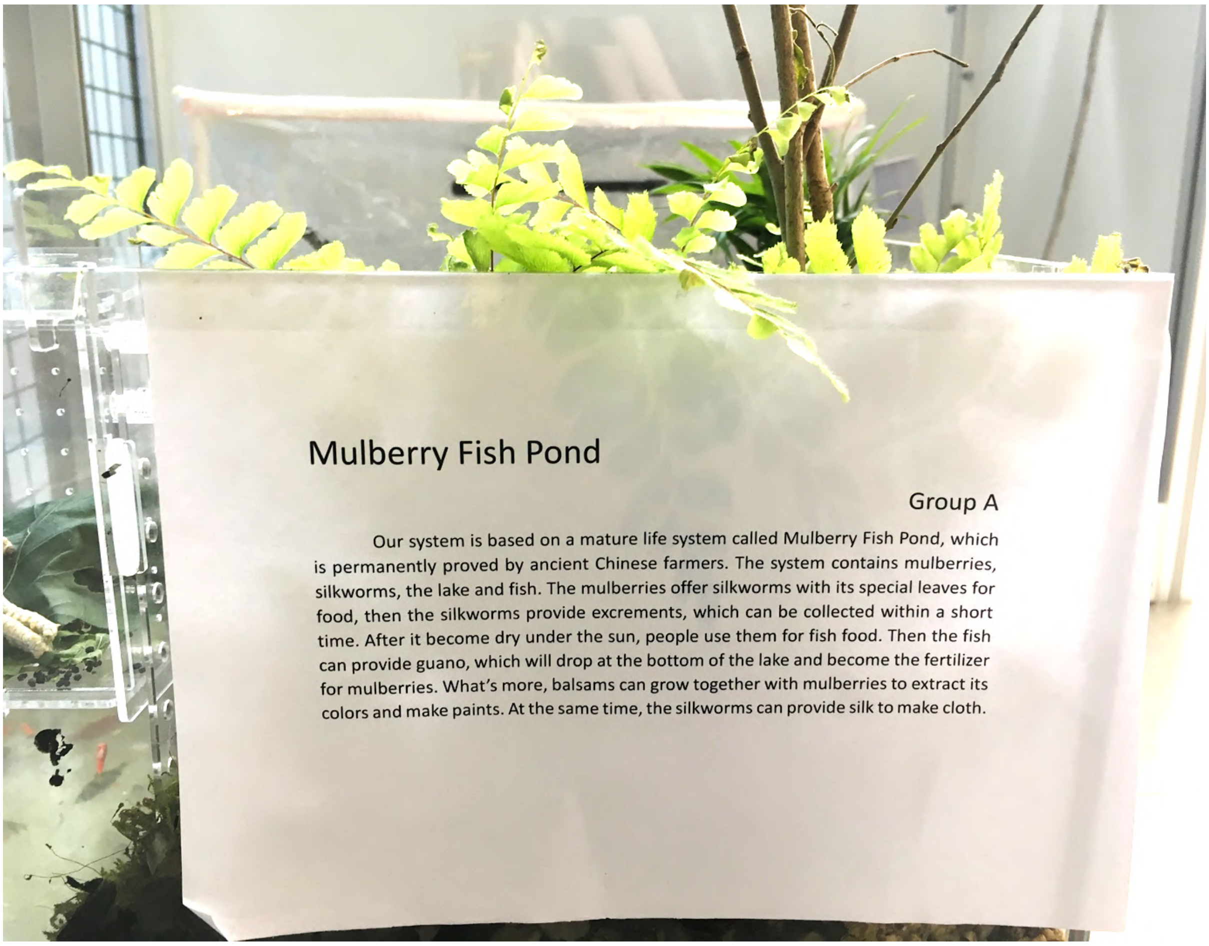


Group A


System Design
Fish Ponds with Mulberry Trees
+ Derivatives
丝绸
silk
Extract
桑树
mulberry
桑叶
leaves
Food
凤仙花
balsam
蚕
silkworm
沼气
methane
鱼
fish
蚕沙
excrement
Fertilize
Extract
Food
微生物
microorganism
颜色
color
Decompose
鱼肥
guano

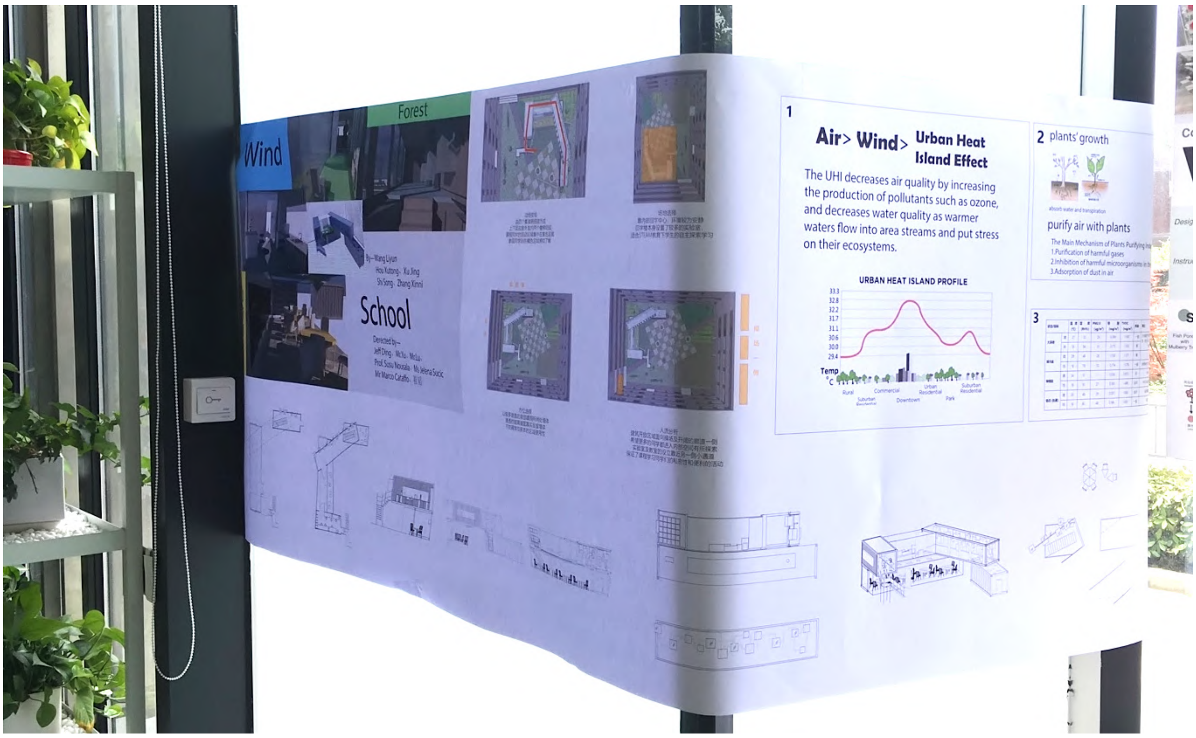

Course Arrangement
1 Plant Anatomy and Physiology
1.1 Anatomy of the leaf
1.2 Anatomy of the flower
2 Making Ecological Bottle
1.1 Teaching
1.2 Practicing
1.3 Engineering
1.4 Technology
1.5 integrated ability
3 Funny Courses
1.1 Silk stripping
1.2 Plant pigment extraction
1.3 Plant essential oil extraction
1.4 Floral class / plant specimen production / bookmark making with leaf vein and petal

Group A

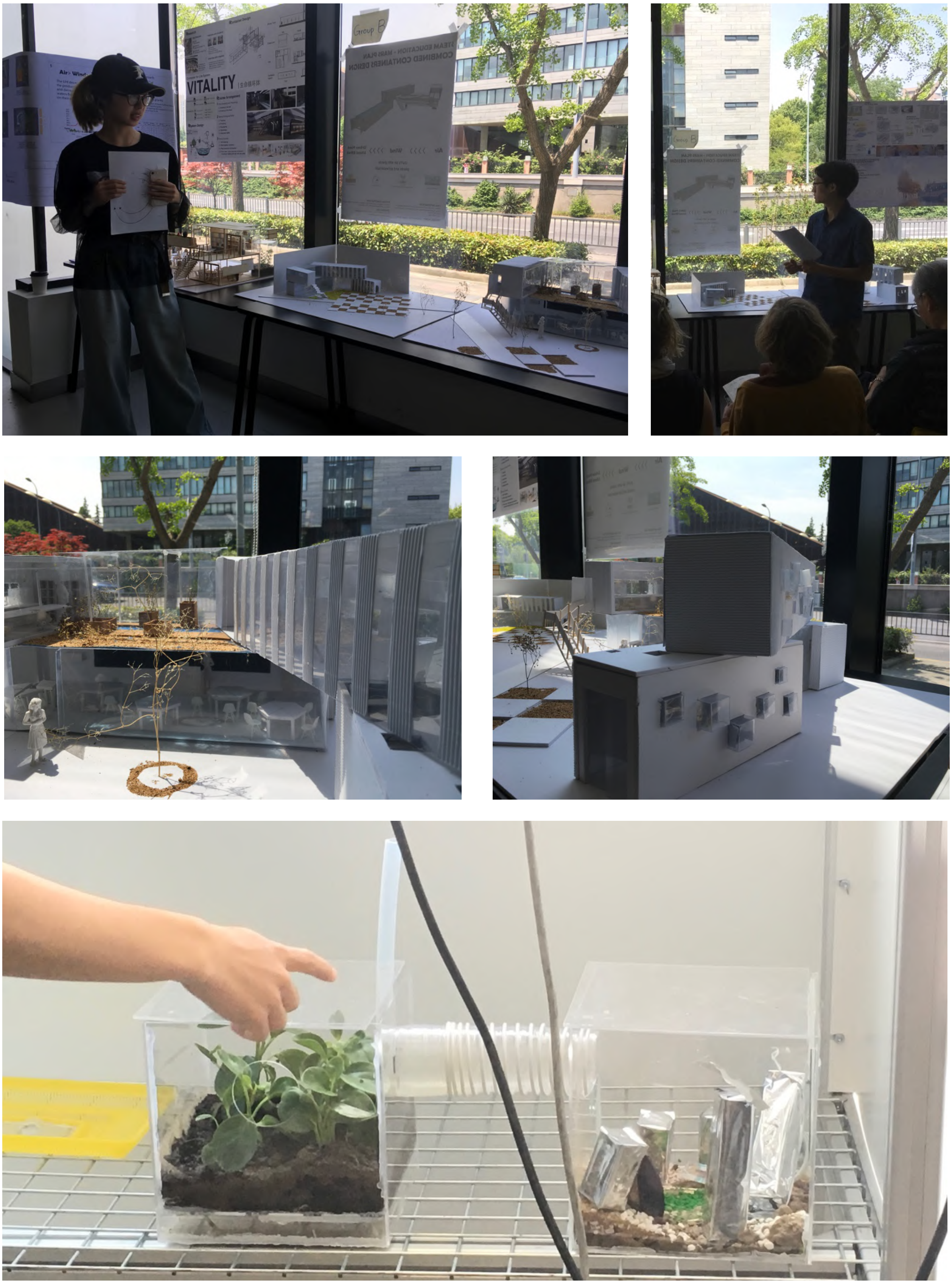


230. Group A, Life. 5th May 2019. Ph. Jelena Sučić

Group B



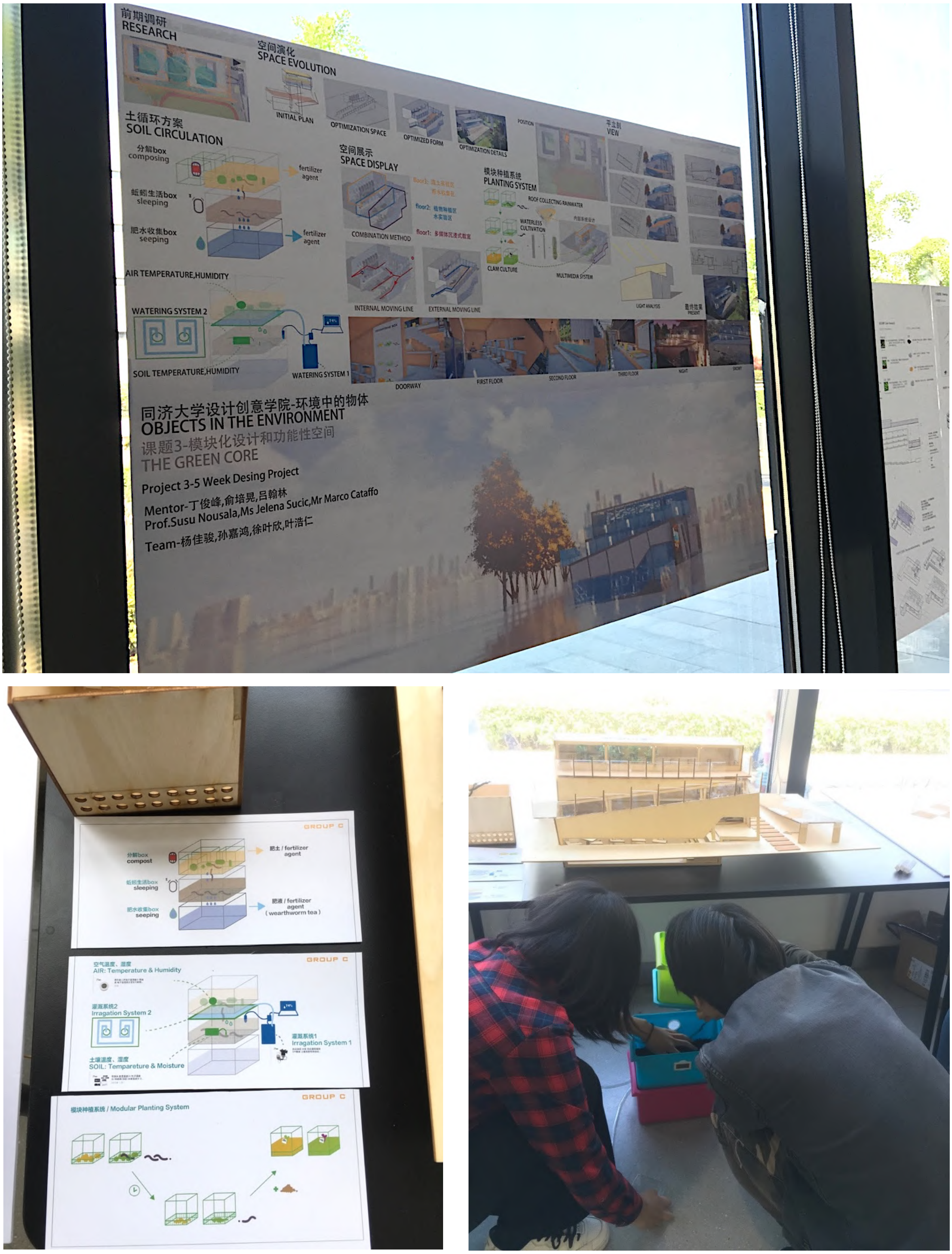
Group B



231. Group B, Air. 5th May 2019. Ph. Jelena Sučić

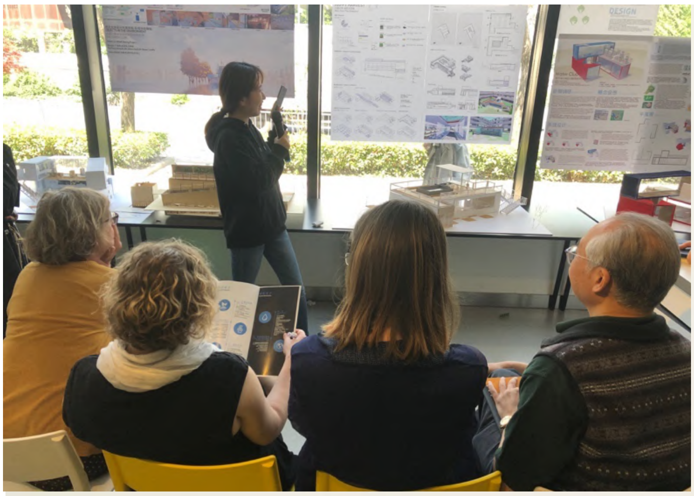
Group C

Group C

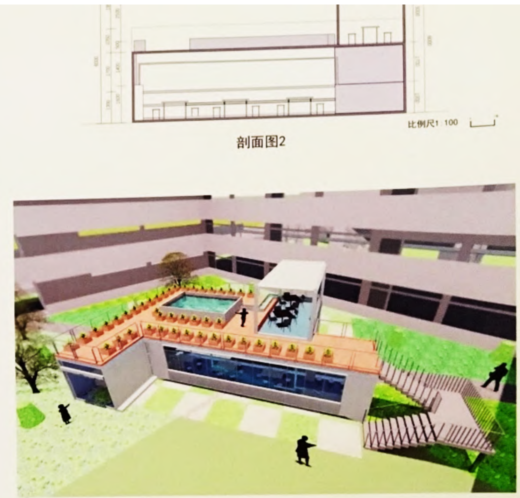


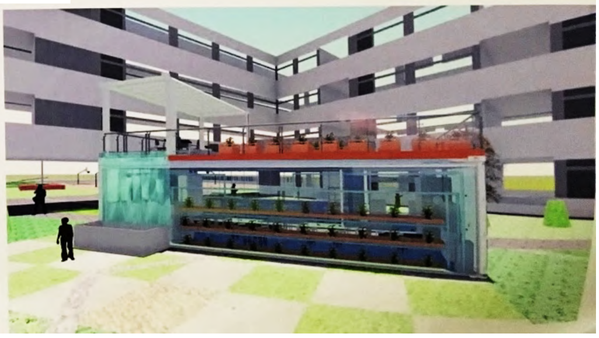
232. Group C, Soil. 5th May 2019. Ph. Jelena Sučić

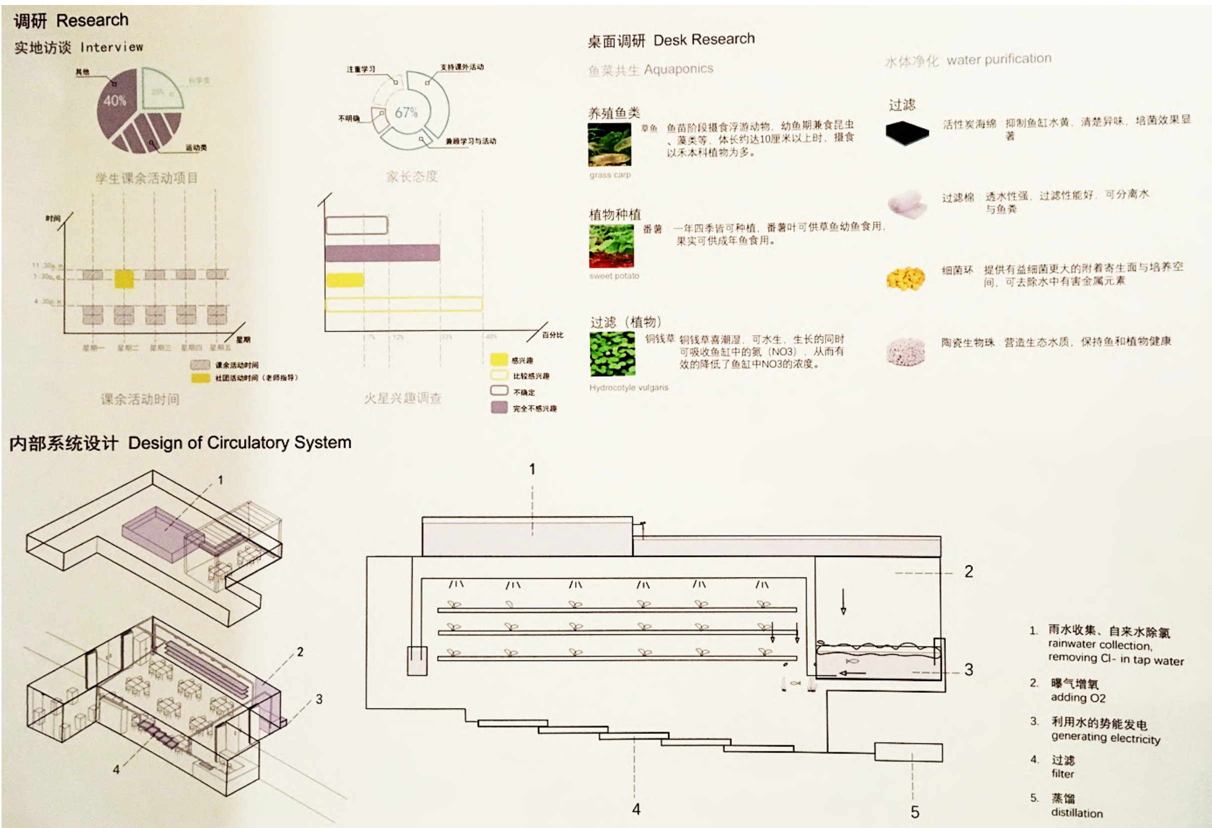
Group D



233. Ph. Jeff Ding

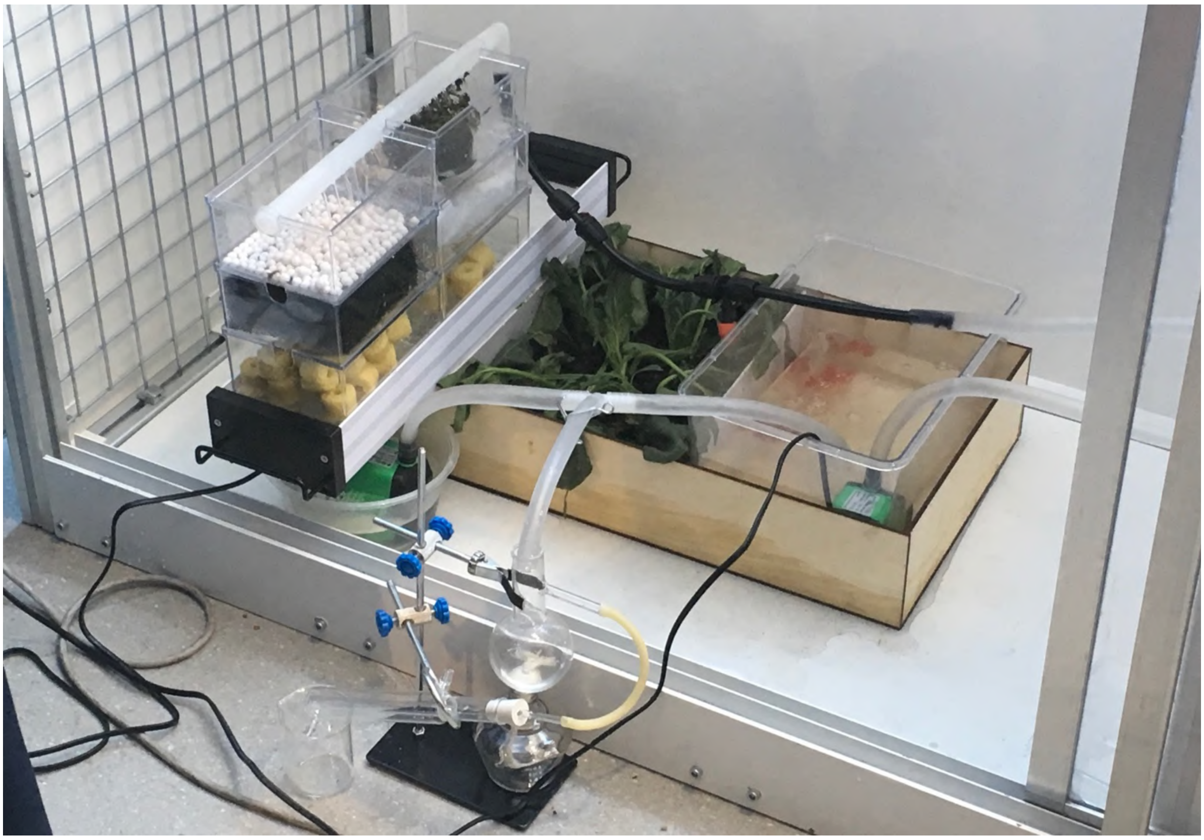




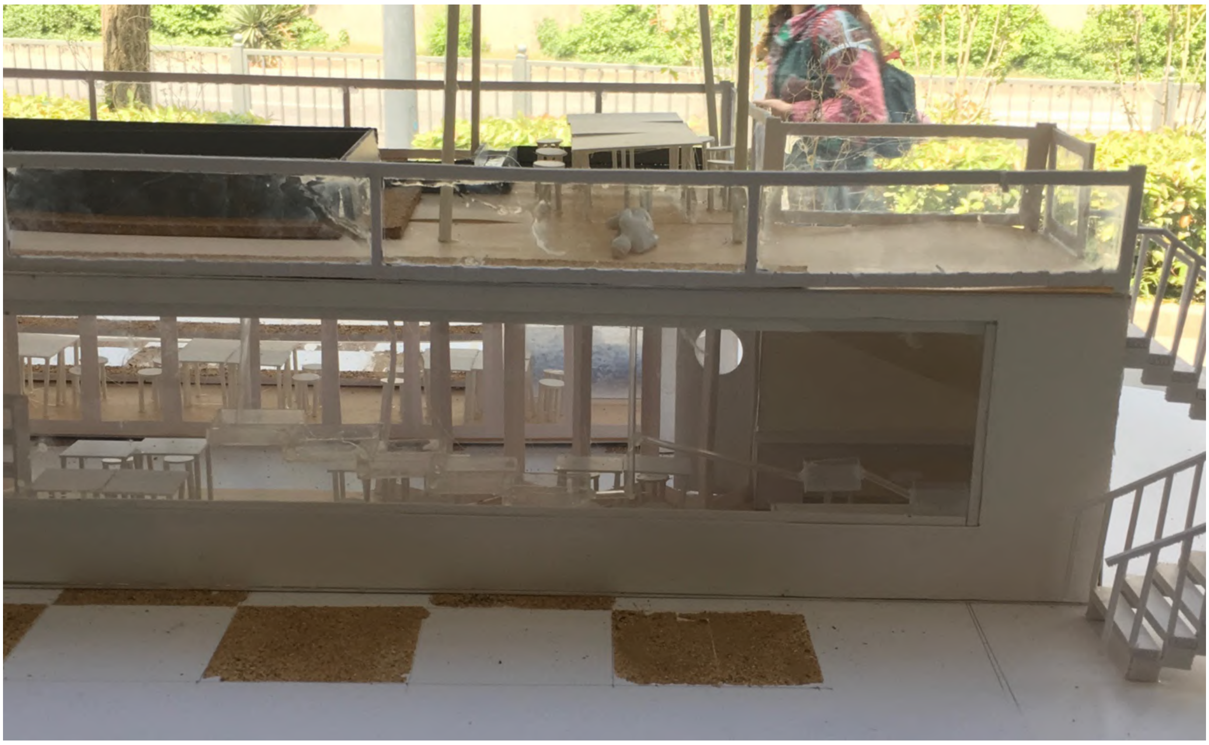


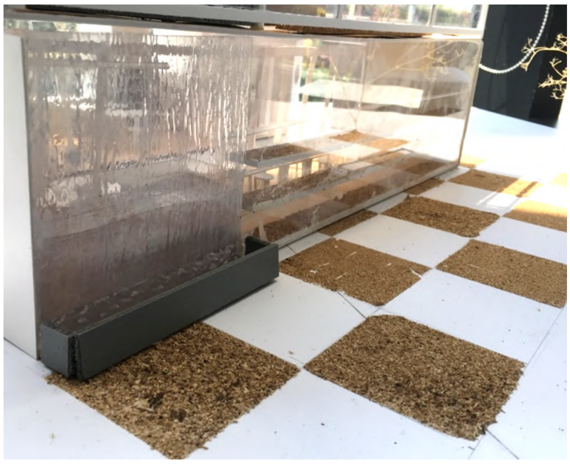
Group D

STEAM stands for Science, Technology, Engineering, Arts and Mathematics. STEAM education is a comprehensive education that integrates science, technology, engineering, art and mathematics.
STEAM
WATER
课程简介
Course introduction
一、土壤与生命
SOIL AND LIFE
1.1土的构成
The composition of the soil
粒度成分、矿物成分、液相成分……
1.2动物与土
The relationship between animals and soil
环节动物、节肢动物、软体动物……
1.3土与植物
The relationship between plants and soil
贮存水分和矿物质养分的载体
二、植物的生长
THE GROWTH OF PLANTS
2.1植物生长需要的条件
Conditions required for plant growth
水分,空气,矿物质养分，阳光
2.2植物必要的无机元素
Essential inorganic elements of plants
氮、磷、钾……
2.3环境变化的影响
The effect of environmental changes on plants
自然状态下生长的植物和室内的植物
三、鱼的生活
THE LIFE OF FISH
3.1不同环境中的鱼
Fish in different environments
淡水，湖泊，海洋……
3.2室内养鱼需要的条件
Conditions required for indoor fish farming
过滤系统，养鱼密度，饲料选择……
3.3鱼与植物
The relationship between fish and plants
提供无机盐，提供氧气……
课程简介
Course introduction
四、水
THE WHATER
4.1水的循环
The cycle of water
自然界的水循环
雨水收集
4.2不同生命对水的需求
Different kinds of life require water
不同植物的需求
生活在水里的鱼
人的需求
4.3水的净化
Water purification
物理净化-实验：活性炭，细菌环…
植物净化：铜钱草
4.4水的不同形态
Different forms of water
固，液，气
蒸馏实验
五、鱼菜共生系统
FISH AND VEGETABLE SYMBIOSIS SYSTEM
5.1鱼菜共生系统的原理
Principles of the fish and vegetable symbiosis system
氨氮、亚硝酸盐的分解利用
5.2调研与组装
Research and assembly
根据实际装置调研
分析，制作自己的系统



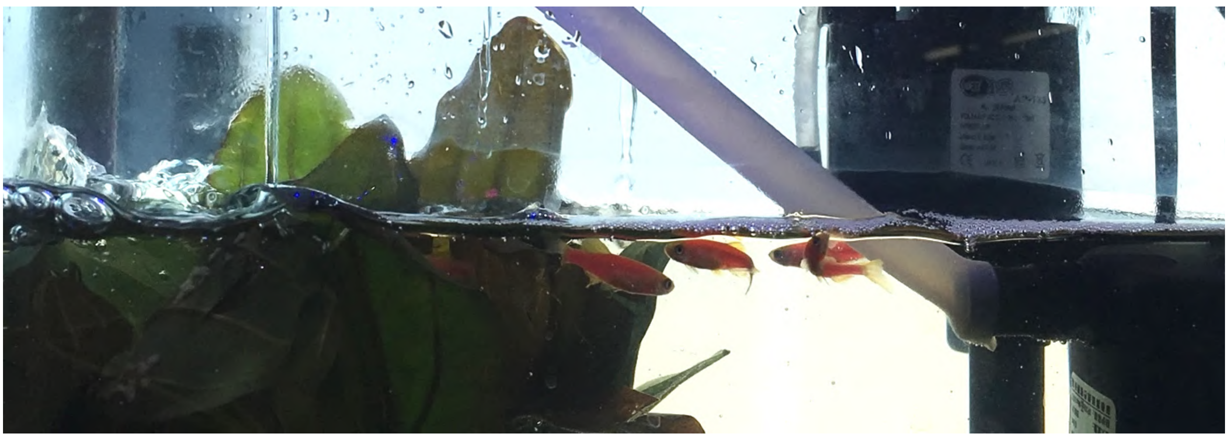
Group D



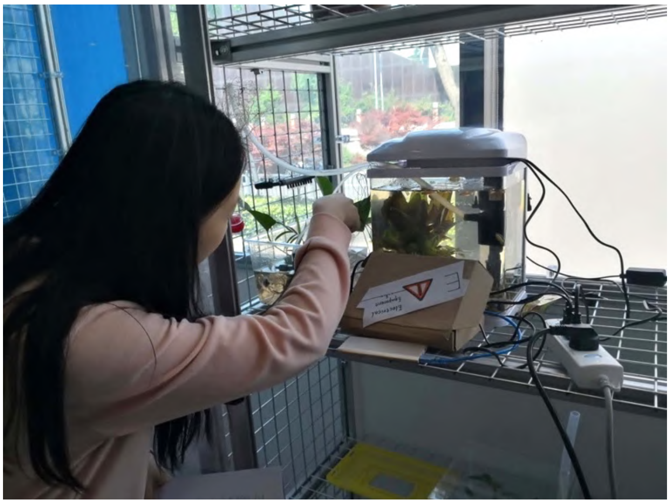


234. Group D, Water. 5th May 2019. Ph. Jelena Sučić

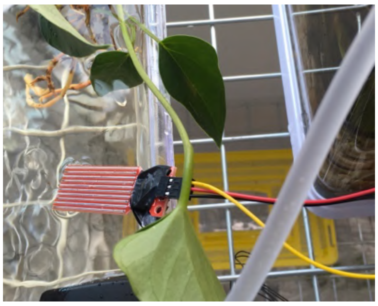
Group E

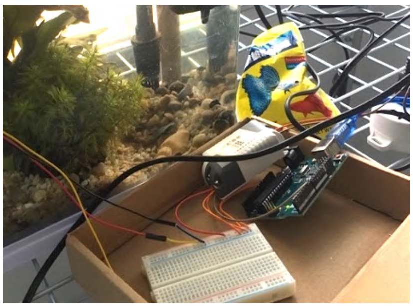


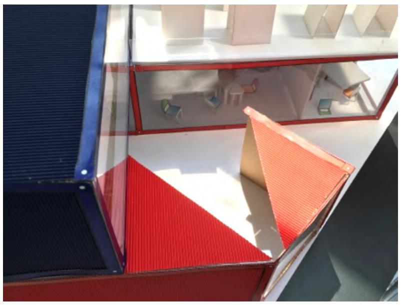
Group E

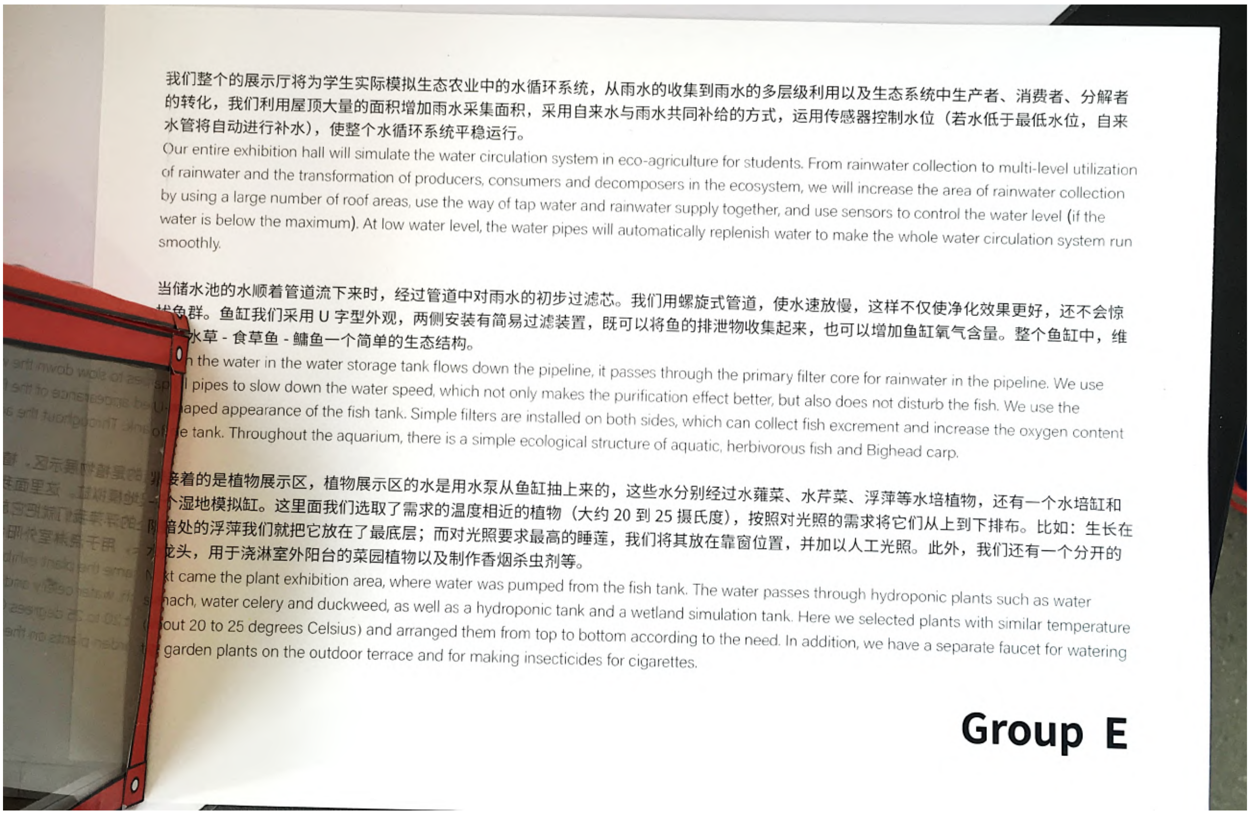

235. Ph. Tiina Laurila


236. Ph. Tiina Laurila









我们整个的展示厅将为学生实际模拟生态农业中的水循环系统，从雨水的收集到雨水的多层级利用以及生态系统中生产者、消费者、分解者的转化，我们利用屋顶大量的面积增加雨水采集面积，采用自来水与雨水共同补给的方式，运用传感器控制水位（若水低于最低水位，自来水管将自动进行补水），使整个水循环系统平稳运行。

Our entire exhibition hall will simulate the water circulation system in eco-agriculture for students. From rainwater collection to multi-level utilization of rainwater and the transformation of producers, consumers and decomposers in the ecosystem, we will increase the area of rainwater collection by using a large number of roof areas, use the way of tap water and rainwater supply together, and use sensors to control the water level (if the water is below the maximum). At low water level, the water pipes will automatically replenish water to make the whole water circulation system run smoothly.

当储水池的水顺着管道流下来时，经过管道中对雨水的初步过滤芯。我们用螺旋式管道，使水速放慢，这样不仅使净化效果更好，还不会惊
鱼群。鱼缸我们采用 U 字型外观，两侧安装有简易过滤装置，既可以将鱼的排泄物收集起来，也可以增加鱼缸氧气含量。整个鱼缸中，维
水草 - 食草鱼 - 鳙鱼一个简单的生态结构。

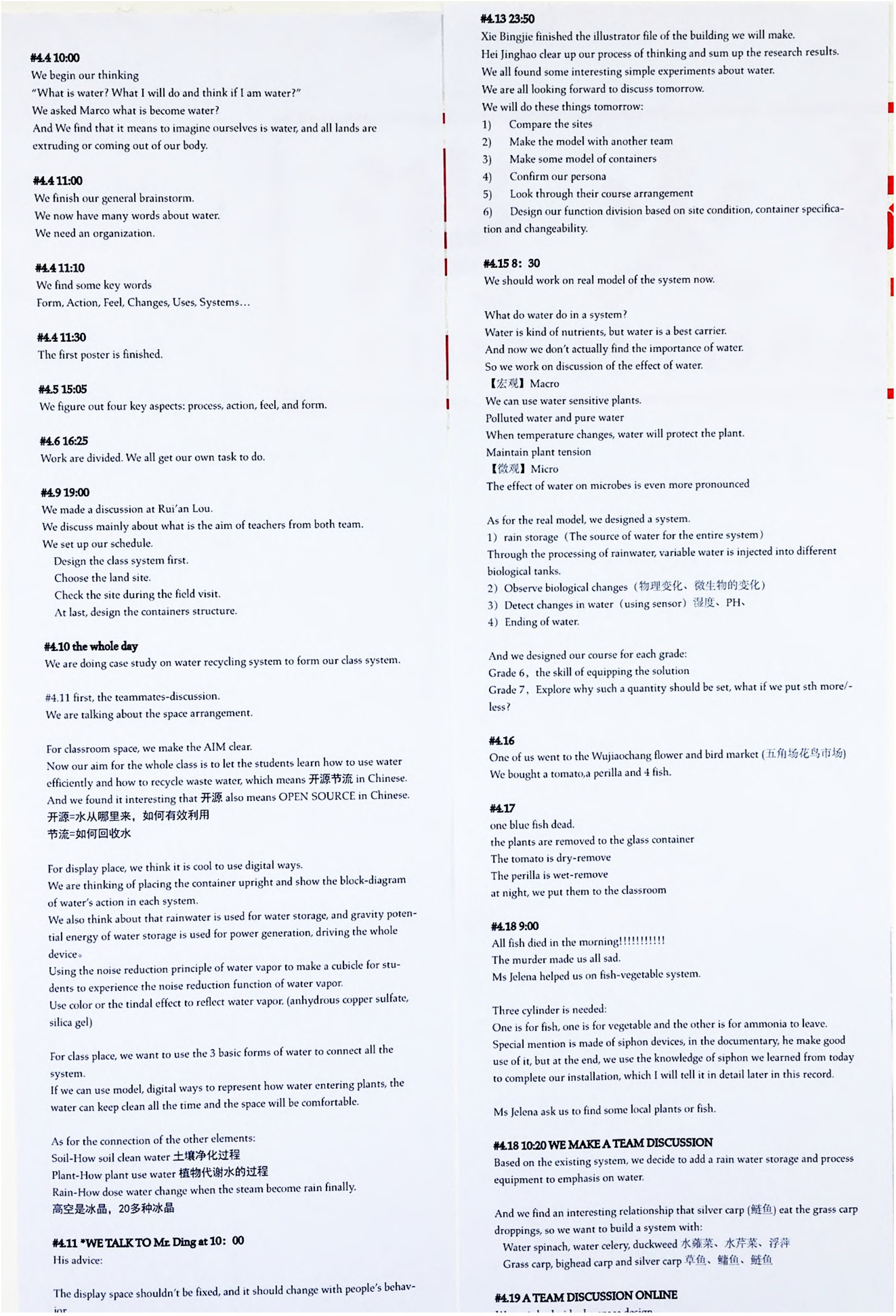
n the water in the water storage tank flows down the pipeline, it passes through the primary filter core for rainwater in the pipeline. We use
l pipes to slow down the water speed, which not only makes the purification effect better, but also does not disturb the fish. We use the
aped appearance of the fish tank. Simple filters are installed on both sides, which can collect fish excrement and increase the oxygen content
e tank. Throughout the aquarium, there is a simple ecological structure of aquatic, herbivorous fish and Bighead carp.

接着的是植物展示区，植物展示区的水是用水泵从鱼缸抽上来的，这些水分别经过水蕹菜、水芹菜、浮萍等水培植物，还有一个水培缸和
个湿地模拟缸。这里面我们选取了需求的温度相近的植物（大约 20 到 25 摄氏度），按照对光照的需求将它们从上到下排布。比如：生长在
暗处的浮萍我们就把它放在了最底层；而对光照要求最高的睡莲，我们将其放在靠窗位置，并加以人工光照。此外，我们还有一个分开的
龙头，用于浇淋室外阳台的菜园植物以及制作香烟杀虫剂等。

xt came the plant exhibition area, where water was pumped from the fish tank. The water passes through hydroponic plants such as water
nach, water celery and duckweed, as well as a hydroponic tank and a wetland simulation tank. Here we selected plants with similar temperature
out 20 to 25 degrees Celsius) and arranged them from top to bottom according to the need. In addition, we have a separate faucet for watering
garden plants on the outdoor terrace and for making insecticides for cigarettes.

Group E

Group E



#4.4 10:00
We begin our thinking
"What is water? What I will do and think if I am water?"
We asked Marco what is become water?
And We find that it means to imagine ourselves is water, and all lands are extruding or coming out of our body.

#4.4 11:00
We finish our general brainstorm.
We now have many words about water.
We need an organization.

#4.4 11:10
We find some key words
Form, Action, Feel, Changes, Uses, Systems…

#4.4 11:30
The first poster is finished.

#4.5 15:05
We figure out four key aspects: process, action, feel, and form.

#4.6 16:25
Work are divided. We all get our own task to do.

#4.9 19:00
We made a discussion at Rui'an Lou.
We discuss mainly about what is the aim of teachers from both team.
We set up our schedule.
Design the class system first.
Choose the land site.
Check the site during the field visit.
At last, design the containers structure.

#4.10 the whole day
We are doing case study on water recycling system to form our class system.

#4.11 first, the teammates-discussion.
We are talking about the space arrangement.

For classroom space, we make the AIM clear.
Now our aim for the whole class is to let the students learn how to use water efficiently and how to recycle waste water, which means 开源节流 in Chinese.
And we found it interesting that 开源 also means OPEN SOURCE in Chinese.
开源=水从哪里来，如何有效利用
节流=如何回收水

For display place, we think it is cool to use digital ways.
We are thinking of placing the container upright and show the block-diagram of water's action in each system.
We also think about that rainwater is used for water storage, and gravity potential energy of water storage is used for power generation, driving the whole device。
Using the noise reduction principle of water vapor to make a cubicle for students to experience the noise reduction function of water vapor.
Use color or the tindal effect to reflect water vapor. (anhydrous copper sulfate, silica gel)

For class place, we want to use the 3 basic forms of water to connect all the system.
If we can use model, digital ways to represent how water entering plants, the water can keep clean all the time and the space will be comfortable.

As for the connection of the other elements:
Soil-How soil clean water 土壤净化过程
Plant-How plant use water 植物代谢水的过程
Rain-How dose water change when the steam become rain finally.
高空是冰晶，20多种冰晶

#4.11 *WE TALK TO Mr. Ding at 10：00
His advice:

The display space shouldn't be fixed, and it should change with people's behavior

#4.13 23:50
Xie Bingjie finished the illustrator file of the building we will make.
Hei Jinghao clear up our process of thinking and sum up the research results.
We all found some interesting simple experiments about water.
We are all looking forward to discuss tomorrow.
We will do these things tomorrow:
1) Compare the sites
2) Make the model with another team
3) Make some model of containers
4) Confirm our persona
5) Look through their course arrangement
6) Design our function division based on site condition, container specification and changeability.

#4.15 8：30
We should work on real model of the system now.

What do water do in a system?
Water is kind of nutrients, but water is a best carrier.
And now we don't actually find the importance of water.
So we work on discussion of the effect of water.
【宏观】Macro
We can use water sensitive plants.
Polluted water and pure water
When temperature changes, water will protect the plant.
Maintain plant tension
【微观】Micro
The effect of water on microbes is even more pronounced

As for the real model, we designed a system.
1）rain storage（The source of water for the entire system）
Through the processing of rainwater, variable water is injected into different biological tanks.
2）Observe biological changes（物理变化、微生物的变化）
3）Detect changes in water（using sensor）湿度、PH、
4）Ending of water.

And we designed our course for each grade:
Grade 6，the skill of equipping the solution
Grade 7，Explore why such a quantity should be set, what if we put sth more/-less?

#4.16
One of us went to the Wujiaochang flower and bird market (五角场花鸟市场)
We bought a tomato,a perilla and 4 fish.

#4.17
one blue fish dead.
the plants are removed to the glass container
The tomato is dry-remove
The perilla is wet-remove
at night, we put them to the classroom

#4.18 9:00
All fish died in the morning!!!!!!!!!!!
The murder made us all sad.
Ms Jelena helped us on fish-vegetable system.

Three cylinder is needed:
One is for fish, one is for vegetable and the other is for ammonia to leave.
Special mention is made of siphon devices, in the documentary, he make good use of it, but at the end, we use the knowledge of siphon we learned from today to complete our installation, which I will tell it in detail later in this record.

Ms Jelena ask us to find some local plants or fish.

#4.18 10:20 WE MAKE A TEAM DISCUSSION
Based on the existing system, we decide to add a rain water storage and process equipment to emphasis on water.

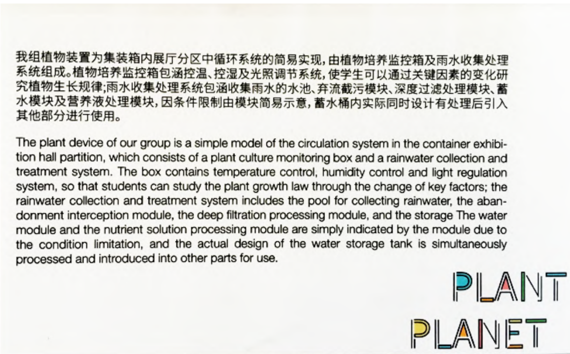
And we find an interesting relationship that silver carp (鲢鱼) eat the grass carp droppings, so we want to build a system with:
Water spinach, water celery, duckweed 水蕹菜、水芹菜、浮萍
Grass carp, bighead carp and silver carp 草鱼、鳙鱼、鲢鱼

#4.19 A TEAM DISCUSSION ONLINE

237. Group E, Water. 5th May 2019. Ph. Jelena Sučić

Group F

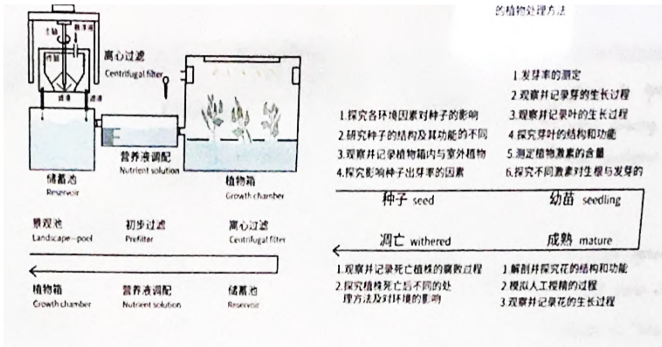
239. Ph. Jeff Ding



我组植物装置为集装箱内展厅分区中循环系统的简易实现，由植物培养监控箱及雨水收集处理系统组成。植物培养监控箱包涵控温、控湿及光照调节系统，使学生可以通过关键因素的变化研究植物生长规律;雨水收集处理系统包涵收集雨水的水池、弃流截污模块、深度过滤处理模块、蓄水模块及营养液处理模块，因条件限制由模块简易示意，蓄水桶内实际同时设计有处理后引入其他部分进行使用。

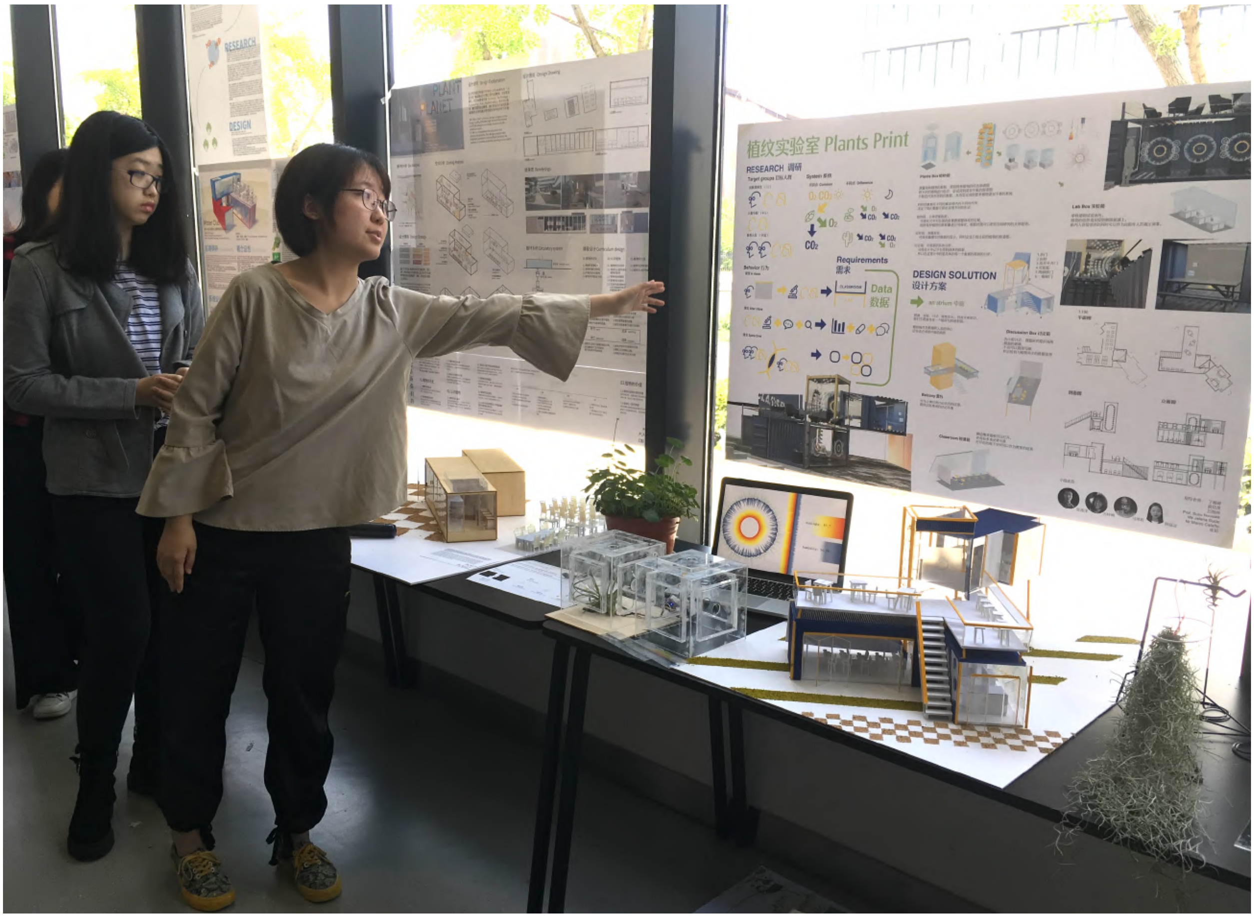
The plant device of our group is a simple model of the circulation system in the container exhibition hall partition, which consists of a plant culture monitoring box and a rainwater collection and treatment system. The box contains temperature control, humidity control and light regulation system, so that students can study the plant growth law through the change of key factors; the rainwater collection and treatment system includes the pool for collecting rainwater, the abandonment interception module, the deep filtration processing module, and the storage The water module and the nutrient solution processing module are simply indicated by the module due to the condition limitation, and the actual design of the water storage tank is simultaneously processed and introduced into other parts for use.

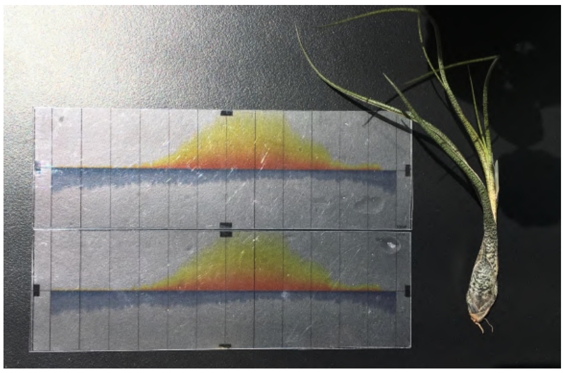
PLANT
PLANET



238. Group F, Life. 5th May 2019. Ph. Jelena Sučić

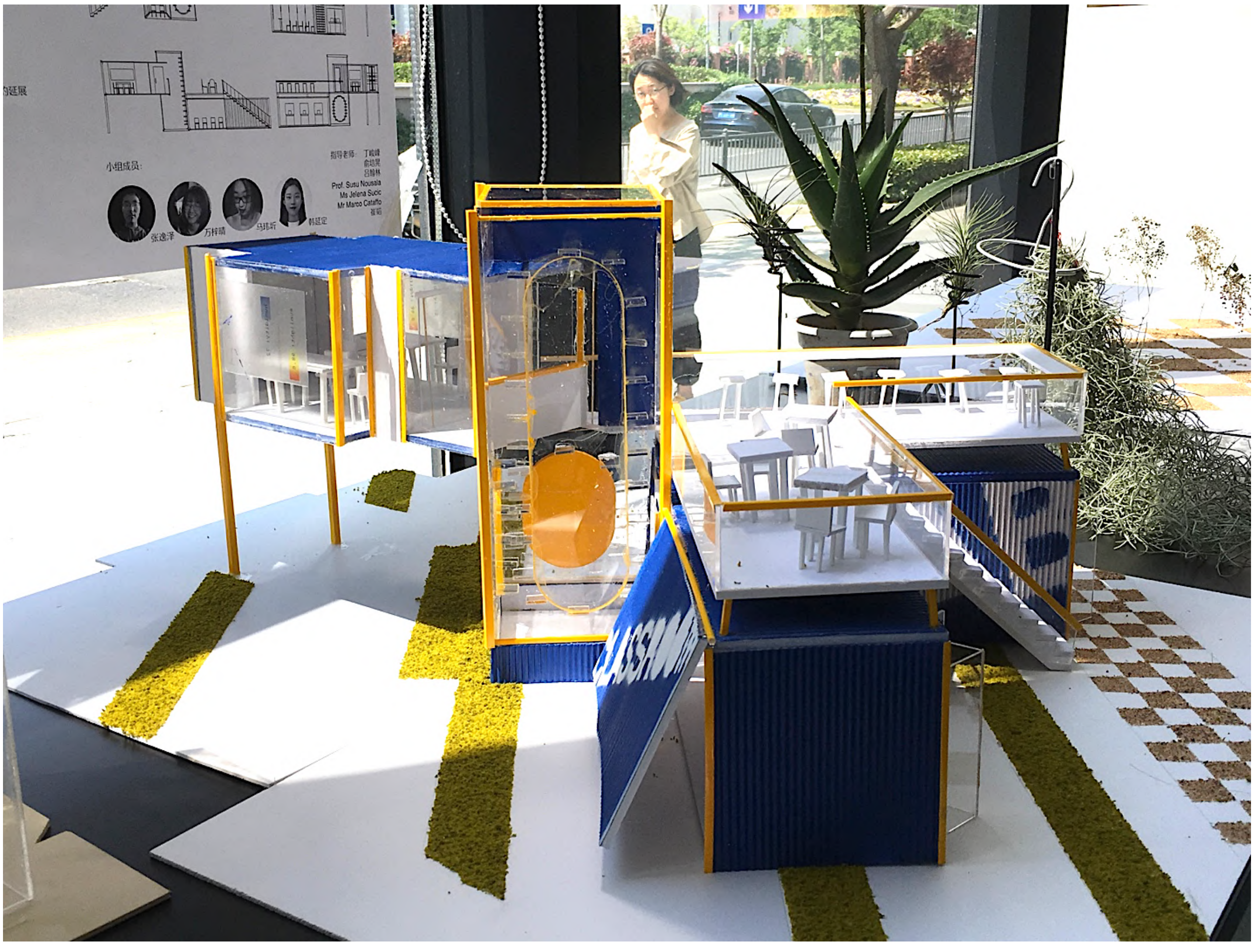
Group G

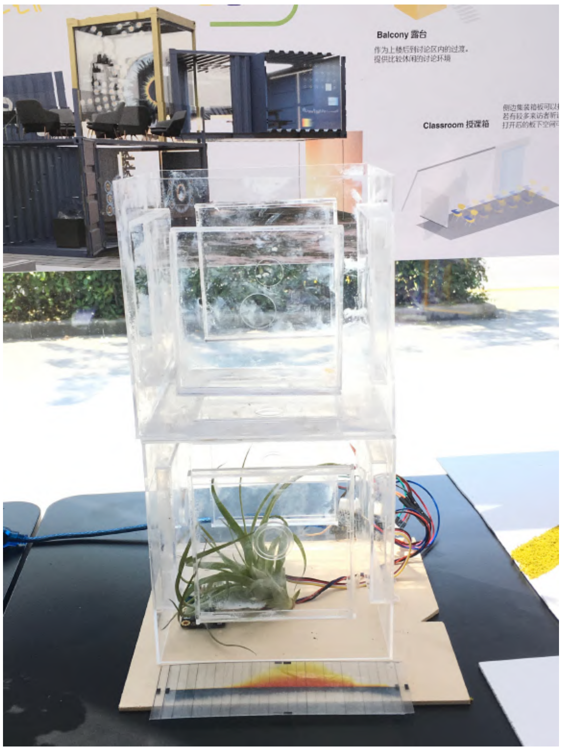


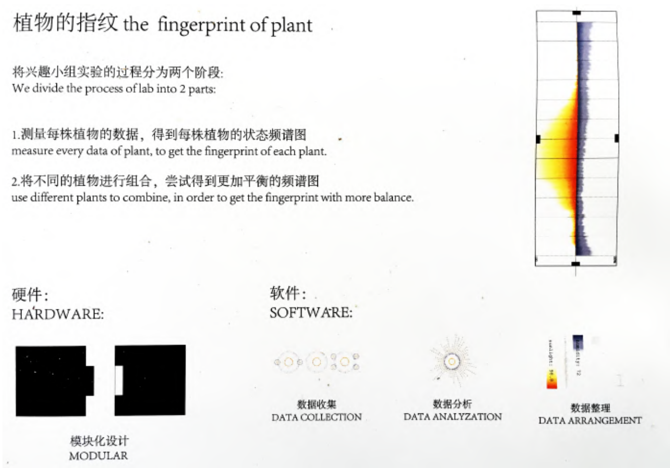


240. Ph. Jeff Ding

Group G







241. Group G, Air. 5th May 2019. Ph Jelena Sučić

Group F

242. Group F, Soil. 5th May 2019. Ph Jelena Sučić

5.3.5.2 Focus Results in the Process

The main general focus in this application was in verifying the effectiveness of the found key elements and language for integration and sustainability understanding in this thesis. Respectively, reading in this classroom environment about how much is still present the cognition about nature in this group of city students. Consequentially, verifying and stimulate their interest once the topics question is raised, attracting attention and if said things do persist in students' consideration during the process.

Verifying beneficial effects of the framing of the cycles' topic component in the design studio pedagogy structure.

Relatively to the research base, there was the option of setting them immediately (contents of focus lecture), but because of the language barrier in terms of pedagogy effectiveness, students were asked to express their knowledge and impression about the topics and eventually extend with a first research base. This phase had the aim of making them build some basic notions and meeting some English terminology, that they would not know before, in order to enable their recognition/association process towards the focused explanations and the further feedback occasions. About the terminology, is been tried intentionally to use words that might help the reaching of all the possible elements of the topic, as for example, the word "atmosphere" interchanged with "air", to ease the association with climate and the sunlight.

The internal content thematic of the project design studio, made face and interdisciplinary need to refer with science and biology to be able to propose functional design and architectural options. Students referencing could not base on what is been already done (typical design) but move out of the comfort-zone of "build known" (under design label). Since students have not engaged much with nature in their lives, the applications and interpretations of found functional principles would enhance condition settings for meaningful purposes in creativity. This responds to the fact that the project aim wants to stimulate integrating occasions for sustainable life purposes (learning since early ages about nature behaviour and resources) which require persistence in creative answers to adapt in changes that are faced during life stages.

5.3.5.3 Brief Conclusion

Was interesting to notice that per each cycle topic emerged trends.

Air, for example, was the less physically touchable and visible behaviour to read because tendentially people see and perceives only the effects of air behaviours. Nevertheless, was the most abstract cycle to perceive it produced very creative results.

Water groups were very influenced by the already overdesigned hydroponics and aquaponics experiences from which made them face the criticality of animals as fishes and recognising differentiations of elements, which were found in the end of the understanding process.

Soil groups have split in the two aspects of soil kinds draining structures and fertility building on which they respectively focused and they looked at the other respective focuses in their own focuses (mineralisation in the soil kinds and water drainage in compost).

Life (plant focused) had the difficulty of being perceived to broad, therefore, the final outcomes were to general or very specific as the farming technic of the silkworm. It happened a scission between life processes (individual) and lives functions (differentiation).

To conclude in terms of results benefits, more students were having feedback sessions with the facilitators and other groups (integrators) there more their scoping gained criteria to develop strong system behaviours. In the process students understood the fundamental integrated existence of the four cycles, but they did not reach the point to build groups within groups for integration purposes, probably for the short time, but was still possible to read that there was exchange of information and support, especially through the group's curricula definition. The main met difficulty demonstration was that they have never faced other creatures need so never recognised the sustainability factors.

5.4 What Next?

There are many aspects that can and want to be continued after the delivery of the phase documented in this thesis. The permanent plant system and vase system were planned but because of different delays, program changes and new emerging occasions (undergraduate design studio) is not been created in this time. The educational curricula of functional lectures of practical sustainability understanding emerged from the thesis research and accumulated experiences with the test cases.

5.4.1 Permanent Plant System and Vase System

The next planned stage is in defining plants groups as modules to learn seeing their relationships and feedback but the research showed that was critical to understand first plants provision processes, which criticalities doubled with the fact that their living environment had to be completely designed in and enclosed space.

The actual pod got the occasion of being a constrained space one to one scale for students' investigations and interpretation, for this reason, author's designed experimentations for the inside post-ponded their happening. Another reason of this is given by the renouncing of the drawing's vase productions because of costs and time requirement. To test the working effectiveness of the designed principles are found modular ready-made transportation containers which do not have the same stacking mechanism as meant in the drawings. Because of that, the passive watering system has to be reconsidered, by extending the soil capillary absorption with ropes meant for the purpose.

243. Ready-made sample materials for the permanent soil building vase system.
Ph. Jelena Sučić

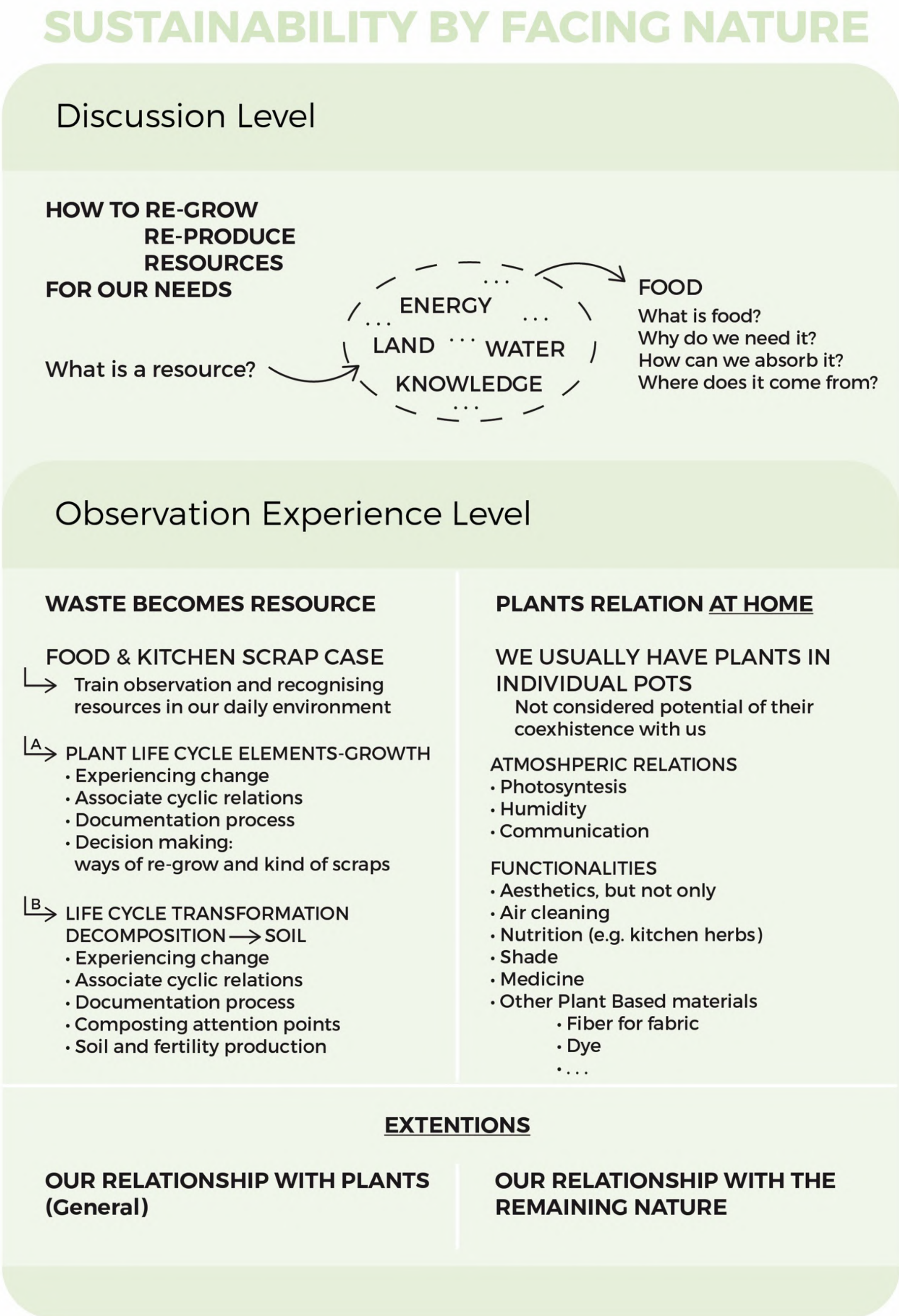
5.4.2 Educational Curricula

The research process of this thesis made identify aspects and experiences that can be integrated in daily citizens lives once the attention on them is raised.

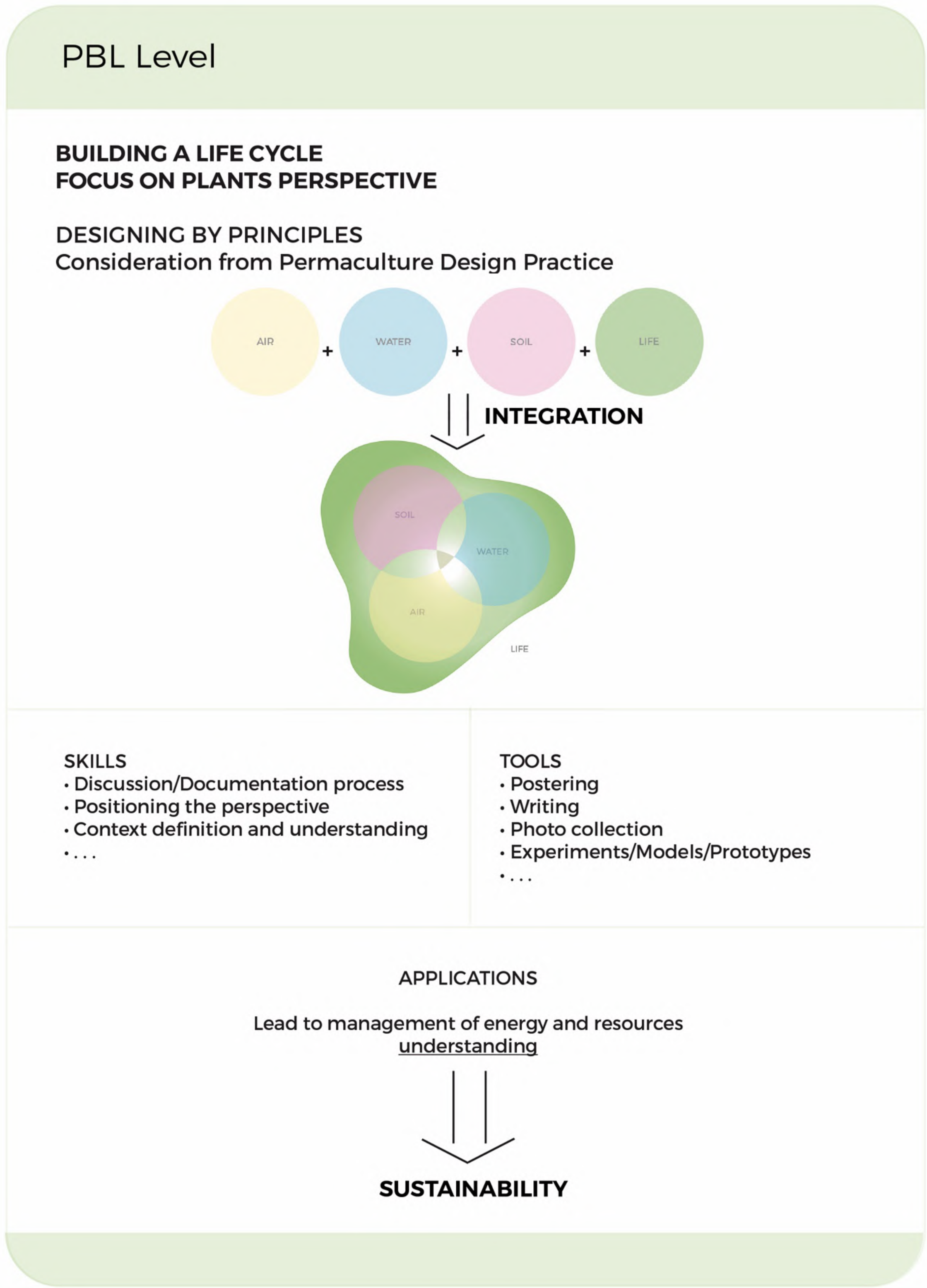
The first application scenario was an occasion for prototyping pertinent criteria of the learning experience and processes, supported by the feedbacks found in the test cases and during the course itself. It is been identified a skeleton of content for possible experiences and questions to discuss for **the aim in training the ability of recognising principles and resources and scale them in different contexts in order to enhance adaptability with boosted robustness and capacity**.

The entire process is based on associations findings, relations definition (systemic thinking), in order to understand the sustainability of the involved elements game in the considered context or system. By creating conditions of actions to fix knowledge through experience is set the Action Loop Learning process that can be continued individually.

In the next pages follows the skeleton scheme of the curricula to develop. It can be recognised that the undergraduate design studio content is under the PBL Level.



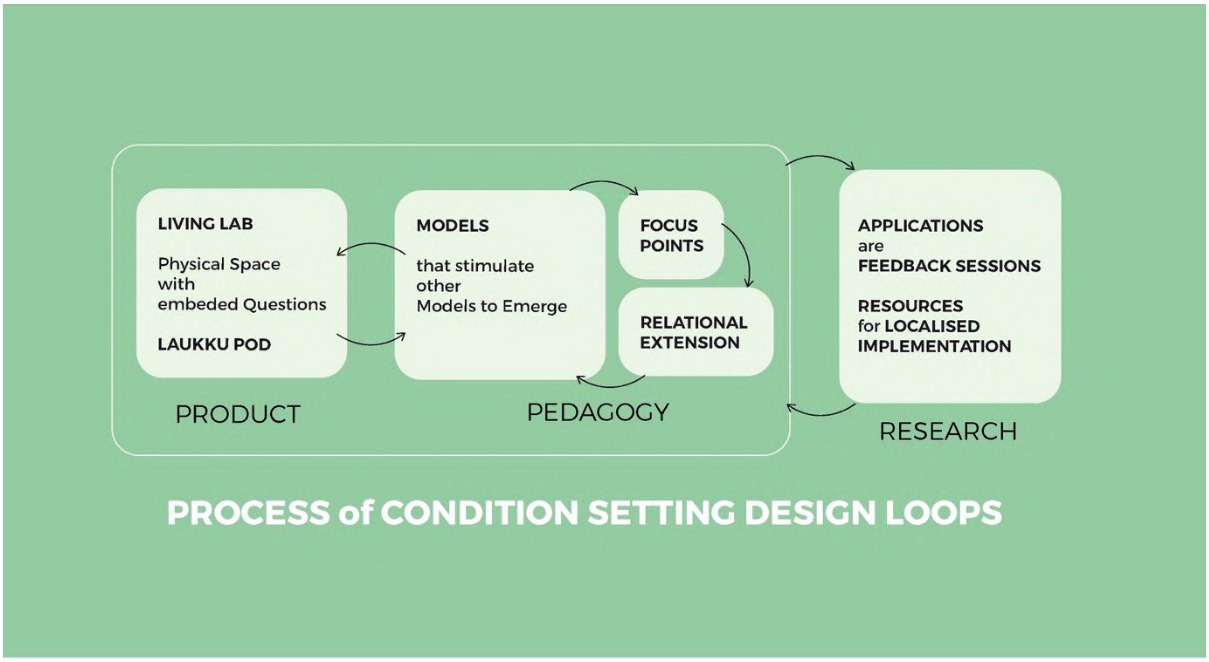
244. First part of the curricula skeleton, not prototyped with a group of people. Design by Jelena Sučić



245. Second part of the curricula skeleton, prototyped with design studio group. Design by Jelena Sučić

5.5 Summary of the designing elements/components

This R&D project is an on-going regenerative process stimulating design loops to happen in order to continue the extensive capacity of the cognition levels identified concept. Since the application of the found components models respond in an applied context the outcomes will be shaped and differentiated according to the precondition found in the context and stimulated by the given product and pedagogy models. The given conditions are open to receive from individuals further questions and applications generated by the stimulating process embed in the models showing the open-ended behaviour of the individual learning process. The high adaptability of the models, especially if applied a group moment sphere feeds the aim in developing shared diversity and common knowledge becoming resource for a more resilient population. What can be considered a disadvantage and hard is the tracking of the outcoming process because of the different layers involved during each individuals' learning process which are not always able to be externalised with a comprehensible medium. Here comes the balancing observative behaviour of the research component importance. The tracking processes and their outcomes transposition have to be designed in order to provide comprehension among the observants. Every application provides feedbacks which are resources for designing fitting implementations of providable modules and product elements for focused outcome responses enhancing the replicability of the models in different contexts and scales.

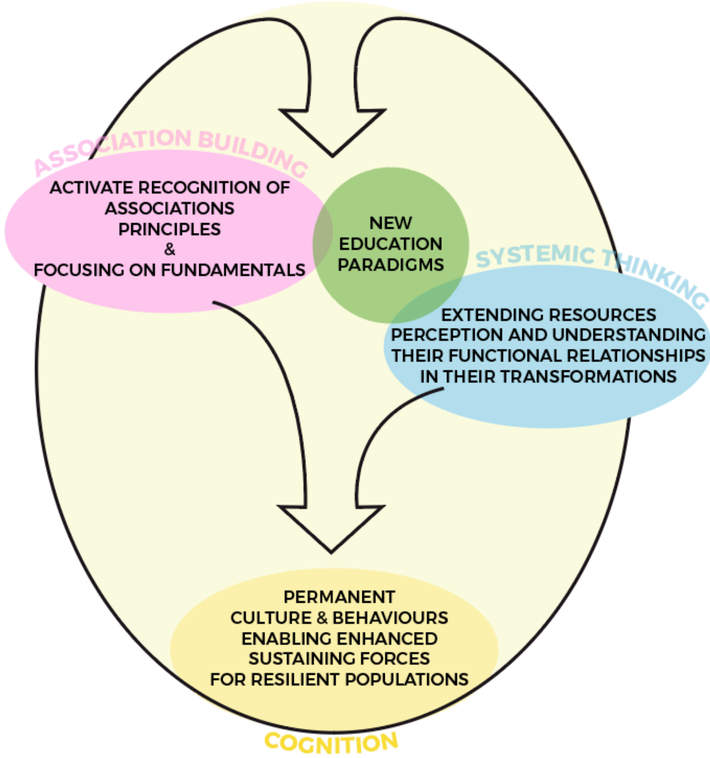


246. Design loops for the condition setting in the R&D project continuing processes involved scheme. Design by Jelena Sučić

Chapter 6: Conclusion

6.1 Reading the Systemic Approach

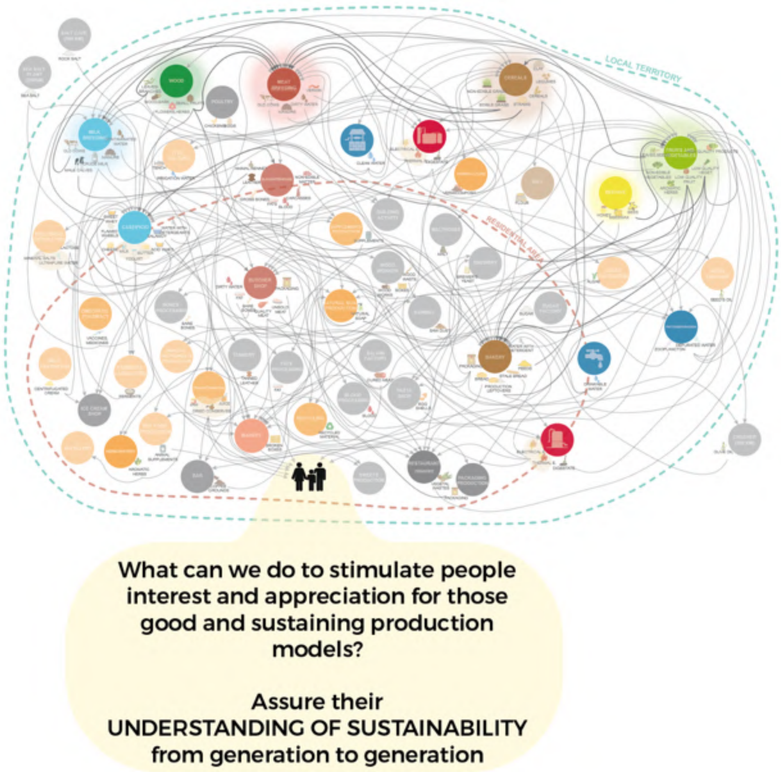
This research aimed at working on education paradigms that stimulate association building and systemic thinking, that allowed extensions in understanding what the consequentiality of the question, where is human-centred-design (4.4)? What are the behaviours (if any) that are being conducted in common with cognition to align and enable sustainment of multiple future generations of wildlife populations and the persistence of their continuing coexistence. This research is about the specific **learning** and **summary of actions and their effects loop**. This learning has a constant behaviour over time, that in turn, has the capacity to enrich a common body or system. In this case many multiple smaller scale examples which of also applicable to a larger scale and level, also known as Planet EARTH.



247. Systemic Cognition Loop. Design by Jelena Sučić

By taking the example of the Macro-System design from Open Systems Project (2.1.2) of good production models designed for changing the paradigms for more locally sustainable productivity for the future well being of people, but those solutions will not be able to last long if need to be in relation with people that do not understand all the benefits. It cannot be expected to be sustained only by telling and letting believe that this is good. Where is the **inclusion** and **mantainance**? Especially what is going to be the believe of good and be priority for next generations?

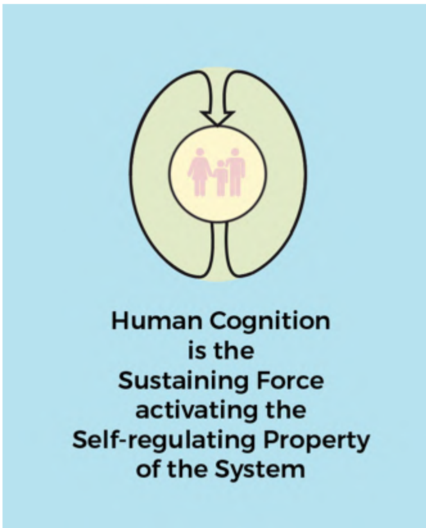
This thesis tried finding doorways to stimulate sustaininig forces for established sustainable systems, potentially sourced from each individual, even from citizens.



248. Question from the main subsystem (individuals) actuating the Macro-system (figure. 21). By Jelena Sučić

The well being of the whole is defined by the needs choices and behaviours effects production of all the living creatures sharing the same ecosystem that has limited resources access. In order to distribute and produce accessable resources for a shared equilibrated living condition a common congnition has to be mantained and alimented in time with experience differentiation and trasmission that allow population resilience to manifest.

Seeds have to be found and let for the next generation to grow them for their life cycle needs but also for the future coming ones.



249. The main Sustaining Force in the Self-regulating Human Oriented system. By Jelena Sučić

6.2 CSR Platform and Laukku Pod

As explained in the Laukku Pod section description this thesis contributes with its research and design in the R&D Laukku Pod project (within the CSR Platform through the process and support of a network of involved people, and stakeholders interested) the results obtained through the R&D process. The process of R&D met interests were not only thematic focuses but also provided a (given/found/researching) language for it. This encounter can and does produce a wider understanding for larger numbers of people by showing different paradigms levels through explanations, to allow levels and layers of knowledge exchanges (bottom/top). The exchange end transmission wants to extend in time and preserve in contents for future generation's needs, thanks to digital technologies and interconnected systems from different contexts (geographical, cultural, …) for knowledge opportunities enhancement and exchanges.

250. First Laukku Pod prototype at the end of 5th May's presentation. Ph. Jelena Sučić

The Huangpu Highschool case scenario application did not happen within the period of this thesis because of several delays with construction and bureaucratic issues but is confirmed to start for the coming semester starting in September 2019. Another aspect of the CSR Platform development with the high school will be the educational curricula experimental process, that will not only be for students in learning for understanding but also for extending conductivity in knowledge transmission for teachers, in stimulating associations building to activate systemic relations in students learning memorising processes. Initiating the **behaviour** of **learning** as **open-ended evolution**.

6.3 About complexity and persistence

In case it was not perceive yet, this thesis talks about complexity. Since the author aims to communicate with common citizens from any level and background with these contents, is the intentional reason why the reader will not find this word that often. According to common perspective referring to things as "complex" defines and makes perceive the discussion topic "off-limits" something in which the public cannot enter or pass the border because too complex for them to be understood. There is the perception of the term "complexity" behaving as an "intangible wall", which cannot be touched or seen but is perceived.

Nothing is unfaceable, we have just to help understand that we are active part of it even if not the main of it. Therefore, since humanity is aiming for sustainability, those people that deal with complexity and its understanding, as researchers and universities have the duty to provide tools and communicating with focuses where to go, to allow access on training the cognition loop dynamic for who is not in it yet in order to initiating a faster adaptation process, thanks the diversification of small actions, to mitigate the effects of the main considered global issues. Universities and researchers elitist behaviour's attitude towards the acquired knowledge, which acquisition might be an **appreciated service** for the city and communities, prevents diversification in **resolutive actions** to happen, which postpone and let accumulate **effects' excesses** (problems which become needs) resolution.

What permaculture focuses make emerge in relation with cities and nature is that nature is still present in cities but is not considered. More people mis-understand and do not consider it, so then, more problems will require solutions, but without understanding the source of them, which will add to the risk of not maintaining work for nature that is integrated within city over generation. We will just keep trying fixing symptoms, with big new developed technologies for things that could be balanced with less exhausting efforts in energy, time and resources.

All new thoughts and technologies if based on the source of understanding the principles of their behaviours, becomes a resource for mitigating actions and effects of their diversification. For this reason, especially in city environments, where is high concentration of innovating opportunities in resolutions, a base of **fundamental focuses** (cycles behaviours) of **life existence** has to be **initiated** and **maintained active, from a** young age, through **people's education cycle** (institutional school system) which is the **base of our civilisation**.

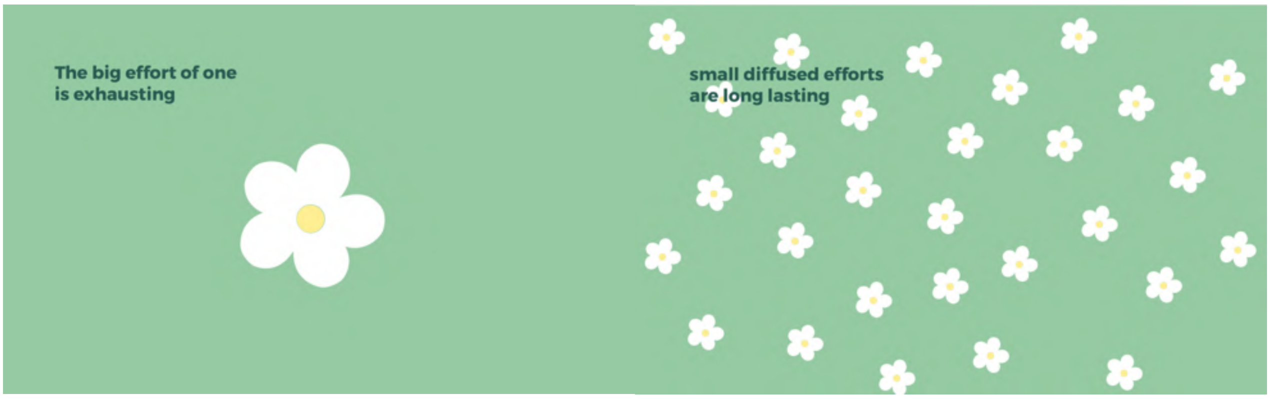
In order to allow that to happen **pedagogical paradigms have to change** their priorities and attitudes. As explained already, **diversified experiences amplify associations in knowledge layers and levels**, which importance is **enhanced** by the **recognition of functional**

relationships (systemic thinking) and their extensions, that **allow the maintenance and alimentations of a solid common cognition for a sustainable existence**.

To conclude, diversified experiences enabled by new pedagogy based on nature principles and functional relationships stimulate the visualisation of innovative solutions responding to sustainability requirements.

Big single actions have an **impact** but are **not long lasting** (yo-yo effect).

Small actions done by **many**, **diffused** are more likely to be **regenerative**, **resources** are better **distributed** in space and time **mitigating** the rhythms/velocity of **constraining forces**.



251. Symbolic conclusion designed by Jelena Sučić.

For any question and impression please feel free to contact the Author at s.jelena@me.com

List of Reference

[1] Jelena Sučić; Susu H. Nousala; Pier Paolo Peruccio. Introduction to: The Value of Living Systems Beyond a Price. *Art and Design,* 2019, 2(3), 66-96, DOI: 10.31058/j.ad.2019.22009

[2] Jorgen Randers, Johan Rockström, Per Espen Stoknes, Ulrich Golüke, David Collste and Sarah Cornell, *Transformation* is feasible, How to achieve the Sustainable Development Goals within Planetary Boundaries, A report to the Club of Rome, for its 50 years anniversary 17 October 2018, Stockholm Resilience Center, October 2018.Available online: https://www.stockholmresilience.org/research/new-planetary-boundaries.html (accessed on 10th November 2018)

[3] The Global Goals for Sustainable Development. Available online: https://www.globalgoals.org (acceded on 10th November 2018)

[4] F. Capra, P. L. Luisi, The systems view of life, A unified vision, Cambridge University, 2014

[5] F. Capra, P. L. Luisi, The systems view of life, A unified vision, Cambridge University, 2014: 63-83

[6] F. Capra, P. L. Luisi, The systems view of life, A unified vision, Cambridge University, 2014: 66

[7] L.Bistagnino, Systemic Design, Design Sistemico, Progettare la sostenibilità produttiva e ambientale, Italy: Bra: Slow Food edition, 2°edition ebook, 2011.Availability online: http://www.systemicfoundation.org

[8] L. Bistagnino, microMACRO: micro relazioni come rete vitale del sistema economico produttivo, Milano: Edizioni Ambiente, 2014

[9] Susu Nousala*, Kim Blanca Galindo, David Romero, Pedro Aibeo, From Fieldwork to an Ontological Model: Understanding Resilience Dynamics in Living Complex Peri-Urban Adaptive Systems, MDPI Sustainability Journal, Special Issue "Smart Cities and Urban Design", submitted 16th April 2019

[10] Kim Galindo, Dushantha Nalin K. Jayakody, Shivali Malhotra and Areti Mourka The Physics of Virtual Networks, "Human Culture, and Cab Sharing", International Conference on Emerging Technologies of Information and Communications (ETIC 2019), Bhutan, March, 2019.

[11] Yongqi Lou, Designing Interactions to Counter Threats to Human Survival, The Journal of Design, Economics and Innovation, Tongji University and Tongji University Press in Cooperation with Elsevier, Vol. 4, Issue 4, Winter 2018.

[12] Jelena Sučić, General Problem of Environmental Systems Perception: Where is the Humans-Centred-Design?, International Conference on Landscape Ecology and Urban Sustainability (LEUS 2019), Hohhot, Inner Mongolia, China 12th-13th January 2019

[13] Pantone, Color Psychology how does affect us. Available online: https://www.pantone.com/color-psychology-how-does-color-affect-us (accessed on 21st October 2016)

[14] Pantone, How do we see. Available online: https://www.pantone.com/how-do-we-see-color (accessed on 21st October 2016)

[15] Scienza Mente, Perchè l'occhio umano percepisce più il verde degli altri colori? Available online: http://www.scienzamente.com/i-sai-perche/perche-locchio-umano-percepisce-piu-il-verde-degli-altri-colori/4946/ (accessed on 22nd October 2016)

[16] Trumpy Olga Viviana, I colori che vediamo, 1°anno corso SSIS 2006/2007 Laboratorio di Didattica della fisica, Università di Genova. Available online: http://www.fisica.unige.it/~tuccio/SSIS/2007_Trumpy-Colori.pdf

[17] Heriot Watt, Health and Wellbeing in the Built Environment. Available online : https://www.hw.ac.uk/study/uk/postgraduate/health-wellbeing-built-environment.htm (accessed on 29th October 2016)

[18] A. Abraham, K. Sommerhalder, H. Bolliger-Salzmann, T. Abel, Landschafts Gesundheit: Potential einer Verbindung zweier Konzepte, Universität Bern, 2007. Available online : *http://boris.unibe.ch/73684/1/Abraham%20LandschaftGesundheit%202007.pdf* (accessed on 29th October 2016)

[19] Francisco Gómez[1]; José Jabaloyes[2]; Luis Montero[3]; Vicente De Vicente[4]; and Manuel Valcuende[5], Green Areas, the Most Significant Indicator of the Sustainability of Cities: Research on Their Utility for Urban Planning, Journal of Urban Planning and Development (137), Issue 3, September 1 2011. DOI: 10.1061/(ASCE)UP.1943-5444

[20] Lifegate, Quanto fa bene il verde. Available online: http://www.lifegate.it/persone/stile-di-vita/quanto_fa_bene_il_verde (accessed on 29th October 2016)

[21] WHO, Health Indicators of sustainable cities in the Context of the Rio+20 UN Conference on Sustainable Development, Initial findings from a WHO Expert Consultation: 17-18 May 2012. Available online: http://www.who.int/hia/green_economy/indicators_cities.pdf?ua=1 (accessed on 29th October 2016)

[22] GALLINO B. Phytoalimurgia Pedemontana : come alimentarsi con le piante selvatiche / Oreste Mattirolo, Blu, Peveragno, Italia, 2001

[23] Luciano Riccardo, Giovanni Appendino, Renzo Salvo, Erbe di città. Erbe spontanee su marciapiedi, muri, bordi strade nelle città, Boves: Araba Fenice, 2012;

[24] I quaderni del Parco Volume 9, *Le piante selvatiche commestibili, Con note sulle loro proprietà medicinali e ricette di cucina. Available online:* www.areaparchi.it/pdf/quad9.pdf (accessed on 4th November 2016)

[25] Borgo Medievale Torino. Available online: http://www.borgomedievaletorino.it/mostra.php?id=178 (accessed on 5th November 2016)

[26] Borgo Medievale Torino. Available online: http://www.borgomedievaletorino.it/contenuto2.php?pag=173 (accessed on 5th November 2016)

[27] MINERDO B.,(a cura di 2016), Erbe spontanee a tavola, , Italy: Bra: Slow Food

[28] Dott. Agr. Alberto Vanzo, Forza della tradizione–Storia del Servizio Giardini della Città dei Torino e delle Opere dei Giardinieri Comunali, INCONTRI CON IL PAESAGGIO 2016-2017, Corso di laurea magistrale interateneo in Progettazione delle aree verdi e del paesaggio, a cura di Prof. Marco Devecchi, Prof. Carlo Tosco e Prof.essa Bianca Maria Rinaldi, 15th December 2016

[29] A. Vanzo, Giardini d’artista sotto la Mole: Storia del Servizio Giardini di Torino e delle opere dei giardinieri – Tra tradizione e smart city, Available online: http://www.comune.torino.it/verdepubblico/2016/altrenews16/giardini-dartista-sotto-la-mole-un-libro-racconta.shtml5

[30] Mascitti, Amedeo and Maccagno, Alessandro, Applicazione dell'Approccio Sistemico in tre territori siti UNESCO a sud di Torino = Systemic Approach applied ot three UNESCO sites located on south of Turin. Rel. Pier Paolo Peruccio, Luigi Bistagnino, Giuseppe Pedone. Politecnico di Torino, Corso di laurea magistrale in Design Sistemico, 2018. Available online: https://webthesis.biblio.polito.it/6701/

[31] Al 1° MAB Youth Forum anche una ricerca degli studenti del Politecnico di Torino

Con una studio sulla zona dei laghi di cava a sud di Torino, area inclusa nella Riserva della Biosfera CollinaPo *(22 Settembre 17)*. Available online : http://www.areeprotettepotorinese.it/news-dettaglio.php?id=43912
(Accessed on 23rd of March 2019)

[32] UNESCO OFFICE IN VENICE. Available online:
http://www.unesco.org/new/en/venice/natural-sciences/environment-sustainable-development/2017-mab-youth-forum/background/
(Accessed on 23rd of March 2019)

[33] 2017 MAB YOUTH FORUM committed to sustainable development. Available online:
http://www.unesco.org/new/en/venice/natural-sciences/environment-sustainable-development/2017-mab-youth-forum/
(Accessed on 23rd of March 2019)

[34] Il parco del Po torinese partner tecnico dell'evento sull'HERITAGE territoriale e il design eco-friendly presso Grinto Village e Cascina Le Vallere, strutture nella Riserva di Biosfera UNESCO MaB CollinaPo
http://www.areeprotettepotorinese.it/iniziativa.php?id=53063
(Accessed on 23rd of March 2019)

[35] WiBreath. Available online: https://wibreath.wixsite.com/wibreath

[36] Città di Torino, Verde Pubblic, Available online:
http://www.comune.torino.it/verdepubblico/index.shtml

[37] ProGIreg project, Available online:
http://www.comune.torino.it/verdepubblico/2018/altrenews18/parte-il-progetto-europeo-progireg-le-tecnologie-n.shtml

[38] Cavallerizza Reale. DIST-ORTO. Available online:
https://cavallerizzareale.wordpress.com/2016/04/22/24-aprile-2016-dist-orto-chiama-il-dist-orto/ (accessed on 5th May 2019)

[39] Torino Metropoli 2025, Terzo piano strategico. Available online: http://www.torinostrategica.it

[40] Quaderno Infrastruttura Verde: CORONA VERDE 2015, Available online:
http://www.torinostrategica.it/pubblicazioni/corona-verde-2025/

[41] European Commission, Green Infrastructure (GI) — Enhancing Europe's Natural Capital, Brussels, 6.5.2013 COM(2013) 249 final, Available online:
http://ec.europa.eu/environment/nature/ecosystems/docs/green_infrastructures/1_EN_ACT_part1_v5.pdf

[42] The Multifunctionality of Green Infrastructure, Available online:
http://ec.europa.eu/environment/nature/ecosystems/docs/Green_Infrastructure.pdf

[43] WANG Hongtao, Research Gate. Available online:https://www.researchgate.net/profile/Hongtao_Wang9 (accessed on 23rd March 2019)

[44] DENG TINGTING, *In China, the water you drink is as dangerous as the air you breathe*, The Gardian, 2 June 2017. Available online: https://www.theguardian.com/global-development-professionals-network/2017/jun/02/china-water-dangerous-pollution-greenpeace (accessed on 17th September 2018)

[45] Xiaoning Li, Case Studies of Sponge City Program in China, 10 October 2017, p. 4

[46] Active, Beautiful, Clean Waters Design, 4th Edition, Singapore: PUB, 2018. P. 12

Available online: https://www.pub.gov.sg/Documents/ABC_Waters_Design_Guidelines.pdf (accessed on 1st April 2019)

[47] Bin Xu, Research Gate. Available online: https://www.researchgate.net/profile/Bin_Xu3 (accessed on 23rd March 2019)

[48] Shanghai Clean Air Action Plan. Available online: http://www.sepb.gov.cn/hb/fa/cms/shhj/YWB/detail_login.jsp?channelId=5107&docId=86288 (accessed on 20th May 2018)

[49] National Parks. Available online : https://www.nparks.gov.sg/gardens-parks-and-nature/nature-ways (accessed on 4th April 2019)

[50] Tan, K.J., C.T Loh, S.A. Tan, and W.C. Lau. 1985. "Physical Planning and design. " In Housing a Nation: 25 Years of Public Housing in Singapore, edited by A.K. Wong, S.H.K. Yeh, Singapore. Housing and Development Board, 106. Singapore: Maruzen Asia

[51] Conserving our Biodiversity, Singapore's National Biodiversity Strategy and Action Plan, Singapore: National Parks Board, 2009. Available online: https://www.nparks.gov.sg/~/media/nparks-real-content/about-us/nparkbookletfinal4sep.ashx (accessed on 4th April 2019)

[52] Tan, P.Y. 2016. Greening Singapore: past successes emerging challenges, in: Fifty Years of Urban Planning in Singapore, ed. Heng C.K., 177-195. Singapore: World Scientific

[53] Tan, P.Y., Feng, Y.Q., Hwang, Y.H. 2016. Deforestation in a tropical compact city Part a: understanding its socio-ecological impacts. Smart and Sustainable Built Environment 5(1). Doi: 10.1108/SASBE-08-2015-0022

[54] Tan P.Y, Wang, J; Sia, A. 2013. Perspective on five decades of the greening of Singapore. Cities. 32: 24-32.

[55] Tan P.Y. 2017. Perspectives on Greening of Cities Through an Ecological Lens. In P.Y. Tan & C. Y. Jim (Eds.), Greening Cities: Forms and Functions (pp. 15-39). Singapore: Springer Singapore.

[56] Tan, P. Y., & Jim, C. Y. 2017. Concluding Remarks. In P. Y. Tan & C. Y. Jim (Eds.), Greening Cities: Forms and Functions (pp. 359-366). Singapore: Springer Singapore.

[57] R. Costanza, R. de Groot, L. Braat, I. Kubiszewski, L. Fioramonti, P. Sutton, S. Farber, M. Grass, Twenty years of ecosystem services: How far have we come and how far do we still need to go?, Elsevier, 2017. https://doi.org/10.1016/j.ecoser.2017.09.008

[58] Agencia d'Ècologia Urbana de Barcelona. Available online: http://www.bcnecologia.net/en (accessed on 23rd September 2018)

[59] A. Kruuse, The GRaBS Expert Paper 6: The Green Space Factor and the Green Points System, Town and Country Planning Association, April 2011. Available online: http://www.malmö.se/download/18.d8bc6b31373089f7d980008924/1491301018437/greenspacefactor_greenpoints_grabs.pdf

[60] T. Matthews, J. Byrne, If planners understand it's cool to green cities, what's stopping them?, The Conversation AU, March 9, 2016. Available online: https://theconversation.com/if-planners-understand-its-cool-to-green-cities-whats-stopping-them-55753 (accessed on 10th August 2018)

[61] F. Balocco, Il verde e il bio: ottimi, ma per pochi, Natura e Società , nr. 2 , June 2018, p. 1. Available online : http://www.pro-natura.it/files/redazione/natura-e-societa/2018-2.pdf (accessed on 12th August 2018)

[62] S. Boeri, Vertical Forest, Milan, Italy, 2009-2014. Available online: https://www.stefanoboeriarchitetti.net

[63] Wei Xuanyi. Environmental Enthusiast Promotes Low-Carbon Lifestyle. Available online: https://mp.weixin.qq.com/s/ruVk_WWLz1cAcPVGAaQtCw (accessed on 5th December 2018).

[64] LI Jing, Does the Chinese public care about climate change?, China Dialogue, 21.09.2018. Available online: https://www.chinadialogue.net/article/show/single/en/10831-Does-the-Chinese-public-care-about-climate-change- (accessed on 29th September 2018)

[65] Nabielek K. et al. (2016), Cities in Europe. PBL Netherlands Environmental Assessment Agency, The Hague. ISBN: 978-94-91506-97-0. Available online: https://www.pbl.nl/sites/default/files/cms/publicaties/PBL-2016-Cities-in-Europe-2469.pdf (accessed on 18th November 2018)

[66] Urban and rural population of China from 2007 to 2017 (in million inhabitants) (Created with Highcharts 5.0.14) Available online: https://www.statista.com/statistics/278566/urban-and-rural-population-of-china/ (accessed on 18th November 2018)

[67] Paul Dobraszczyk, How Imagination Will Save Our Cities, Nautilus. March 7, 2019. Available online : http://nautil.us/issue/70/variables/how-imagination-will-save-our-cities (accessed on 10th March 2019)

[68] Christian Berg, Available online: https://www.christianberg.net, (accessed on 28th November 2018)

[69] *(PDF) Planetary Boundaries: Exploring the Safe Operating Space for Humanity*. Available online: https://www.researchgate.net/publication/42766179_Planetary_Boundaries_Exploring_the_Safe_Operating_Space_for_Humanity (accessed Dec 02 2018)

[70] Emily R. Grosholz, Cartesian Method and the Problem of Reduction, Clarendon Press; 1 edition (March 14, 1991)

[71] F. Capra, P. L. Luisi, The systems view of life, A unified vision, Cambridge University, 2014. 63

[72] F. Capra, P. L. Luisi, The systems view of life, A unified vision, Cambridge University, 2014. 64

[73] F. Capra, P. L. Luisi, The systems view of life, A unified vision, Cambridge University, 2014. 64-65

[74] F. Capra, P. L. Luisi, The systems view of life, A unified vision, Cambridge University, 2014. 84-86

[75] Biography Gregory Bateson, newworldencyclopedia Available online: http://www.newworldencyclopedia.org/entry/Gregory_Bateson (accessed on 19th March 2019)

[76] Gregory Bateson, Steps to an Ecology of Mind, Collected Essays in Anthropology, Pschiatry, Evolution and Epistemology, North Vale, New Jersey, London: Jason Aronson Inc., 1897

[77] T. Maldonado, Design, Nature and Revolution: toward a Critical Ecology, Harper & Row, 1972

[78] F. Capra, P. L. Luisi, The systems view of life, A unified vision, Cambridge University, 2014.

[79] Jay W. Forrester, Principles of Systems, Wright-Allen Press, 1968

[80] Donella Meadows, Thinking in Systems, Chelsea Green Publishing, 2008

[81] Alcocer-Cuarón C, Rivera AL, Castaño VM. Hierarchical structure of biological systems: a bioengineering approach. *Bioengineered*. 2013;5(2):73-9.

[82] K. Boulding, General Systems Theory - The Skeleton of Science, Management Science, 2, 3 (Apr. 1956) pp.197-208 and was reprinted in General Systems, Yearbook of the Society for General Systems Research, vol. 1, 1956.

[83] F. Capra, P. L. Luisi, The systems view of life, A unified vision, Cambridge University, 2014. 67

[84] Etymology of Economy. Available online: https://en.wiktionary.org/wiki/economy (accessed on 30th March 2019)

[85] Etymology of Anthropology. Available online: https://en.wiktionary.org/wiki/anthropology (accessed on 30th March 2019)

[86] Bill Mollison's Permaculture Design Certificate Course, Course Outline, Section 2: Principle of Natural Systems and Design, Permaculture Institute: 2

[87] W. Weiseman, D. Halsey, B. Buddock, Integrated Forest Gardening, The Complete Guide to Polycultures and Plant Guilds in Permaculture Systems, Chelsea Green Publishing, White River Junction, Vermont, 2014. ISBN: 978-1-60358-497-5.

[88] Permaculture Project. Available online: http://www.permacultureproject.com
(accessed on 5th January 2019)

[89] Rainbow of Hope. Available online: http://www.rainbowofhope.cn/permaculture-training (accessed on 5th January 2019)

[90] Wayne Weiseman, Principles and Methodologies of Permaculture, PDC materials.

[91] Wayne Weiseman, Introduction by The Permaculture Project LLC, Patterns, Principles, Practice and the Genius of Place. 29th June 2018

[92] T. Hemenway, Gaia's Garden (2), A Guide to Home-Scale Permaculture, Vermont: Chelsea Green Publishing, 2009

[93] D. Holmgreen, Permaculture, Principles & Pathways Beyoung Sustainability, Hampshire, UK: Permanent Publications, 201: xix

[94] D. Holmgreen, Permaculture, Principles & Pathways Beyoung Sustainability, Hampshire, UK: Permanent Publications, 201: viii

[95] D. Holmgreen, Permaculture, Principles & Pathways Beyoung Sustainability, Hampshire, UK: Permanent Publications, 201: xx

[96] P. A. Yemans, The Challenge of Landscape: The Development and Practice of Keyline. Sydney: Keyline Publishing Party, LtD. 1958: 22-28

[97] B. Mollison, D. Holmgren, Permaculture ONE: A Perennial Agriculture for Human Settlements, Tagari Publications ed. 1990, 1st 1978: 36

[98] Dave Jacke, The Scale of Permanence, Dynamics Ecological Design, June 2004

[99] Sky Lecture overheads. Available online:
http://www.phys.utk.edu/daunt/Astro/Overheads/Sky/SkyBox.html (accessed on 7th April 2019)

[100] GEOG 207: CLIMATE QUEST, LECTURE 1 -- WHAT DRIVES CLIMATE? WHY DOES CLIMATE VARY FROM PLACE TO PLACE? , Illustrations from Ruddiman, 2001, *Earth's Climate,*

Past and Future. Available online: http://web.sonoma.edu/users/f/freidel/global/207lec1images.htm (accessed on 7th April 2019)

[101] S. Holzer, Sepp Holzer's Permaculture, A Practical Guide to Small Scale, Integrative Farming and Gardening, Vermont: Chelsea Green Publishing, 2010: 24-30

[102] NASA Earth Science: Water Cycle. Available online: https://pmm.nasa.gov/education/articles/earth-observatory-water-cycle-overview (accessed on 5 December 2018).

[103] D. Jacke, Edible Forest Gardens, Ecological Vision and Theory for Temperate Climate Permaculture (Vol 2),Vermont: Chelsea Green Publishing, White River Junction, 2005 : 203

[104] B. Mollison, D. Holmgren, Permaculture ONE: A Perennial Agriculture for Human Settlements, Tagari Publications, ed. 1990, 1st 1978: 26-28

[105] B. Mollison, D. Holmgren, Permaculture ONE: A Perennial Agriculture for Human Settlements, Tagari Publications, ed. 1990, 1st 1978: 30

[106] W. Weiseman, D. Halsey, B. Buddock, Integrated Forest Gardening, The Complete Guide to Polycultures and Plant Guilds in Permaculture Systems, Vermont: Chelsea Green Publishing, White River Junction, 2014: 118

[107] B. Mollison, Permaculture: A Designers' Manual, Tagari publication, 2nd ed. 2002, 1st ed. 1988: 140

[108] B. Mollison, Permaculture: A Designers' Manual, Tagari publication, 2nd ed. 2002, 1st ed. 1988: 101

[109] B. Mollison, Permaculture: A Designers' Manual, Tagari publication, 2nd ed. 2002, 1st ed. 1988: 73-75

[110] B. Mollison, Permaculture: A Designers' Manual, Tagari publication, 2nd ed. 2002, 1st ed. 1988: 61

[111] B. Mollison, Permaculture: A Designers' Manual, Tagari publication, 2nd ed. 2002, 1st ed. 1988: 80

[112] Bill Mollison's Permaculture Design Certificate Course, Course Outline, Section 2: Principle of Natural Systems and Design, Permaculture Institute: 6

[113] W. Weiseman, D. Halsey, B. Buddock, Integrated Forest Gardening, The Complete Guide to Polycultures and Plant Guilds in Permaculture Systems, Vermont: Chelsea Green Publishing, White River Junction, 2014: 215-282

[114] MT.PLEASANT, Jane. Food Yields and Nutrient Analyses of the Three Sisters: A Haudenosaunee Cropping System. **Ethnobiology Letters**, [S.l.], v. 7, n. 1, p. 87–98, nov. 2016. ISSN 2159-8126. Available online: https://ojs.ethnobiology.org/index.php/ebl/article/view/721/413 (accessed on 19 Apr. 2019) doi:http://dx.doi.org/10.14237/ebl.7.1.2016.721.

[115] The Gardeners Calendar, Three Sisters Planting. Available online: http://www.the-gardeners-calendar.co.uk/Guides/Story.asp?nid=2679 (accessed on 19th April 2019)

[116] E. Hazelip, L'arte di coltivare lasciando fare alla terra, Produzione vegetale attraverso l'autofertilità del suolo, Libera Scuola di Agricoltura Sinergica "Emilia Hazelip" agg. 29/4/2006. Available online: https://www.silentevolution.net/docs/Dispensa-Agricoltura-Sinergica.pdf (accessed on 28th April 2017)

[117] W. Weiseman, D. Halsey, B. Buddock, Integrated Forest Gardening, The Complete Guide to Polycultures and Plant Guilds in Permaculture Systems, Vermont: Chelsea Green Publishing, White River Junction, 2014: 35

[118] W. Weiseman, D. Halsey, B. Buddock, Integrated Forest Gardening, The Complete Guide to Polycultures and Plant Guilds in Permaculture Systems, Vermont: Chelsea Green Publishing, White River Junction, 2014: 53

[119] D. Jacke, Edible Forest Gardens, Ecological Vision and Theory for Temperate Climate Permaculture (Vol 1),Vermont: Chelsea Green Publishing, White River Junction, 2005 :Appendix One

[120] B. Mollison, Permaculture: A Designers' Manual, Tagari publication, 2nd ed. 2002, 1st ed. 1988: 35

[121] Michael Reynolds, Earthship, How to build your own, Volume I and II. ISBN: 0-9626767-0-5 and ISBN: 0-92626767-1-3

[122] Gernot Minke, Building with Earth, Design and Technology od a Sustainable Architecture, Basel: Birkhäuser, 2006

[123] Jerry Yudelson, Green Building A to Z, Understanding the Language of Green Building, Canada: New Society Publishers, 2007

[124] Sue Roaf, Ecohouse: a Design Guide, Architectural Press Elsevier, third edition, 2007

[125] Robert Hastings, Maria Wall, Sustainable Solar Housing, London: Cromwell Press, Volume 1 and 2, 2017

[126] B. Mollison, Permaculture TWO: Practical Design for Town and Country in Permanent Agriculture, Tagari Publications, 1979

[127] D. Jacke, Edible Forest Gardens, Ecological Vision and Theory for Temperate Climate Permaculture (Vol 2),Vermont: Chelsea Green Publishing, White River Junction, 2005 : 25

[128] D. Jacke, Edible Forest Gardens, Ecological Vision and Theory for Temperate Climate Permaculture (Vol 2), Vermont: Chelsea Green Publishing, White River Junction, 2005: 205

[129] Mazran Ismail & Abdul Malek Abdul Rahman, Stack Ventilation Strategies In Architectural Context: A Brief Review Of Historical Development, Current Trends And Future Possibilities, IJRRAS 11 (2) , May 2012. Available online: https://www.arpapress.com/Volumes/Vol11Issue2/IJRRAS_11_2_14.pdf (accessed on 5th April 2019)

[130] Bill Mollison's Permaculture Design Certificate Course, Course Outline, Section 2: Principle of Natural Systems and Design, Permaculture Institute, p. 38

[131] S. Holzer, Sepp Holzer's Permaculture, A Practical Guide to Small Scale, Integrative Farming and Gardening, Vermont: Chelsea Green Publishing, 2010: 35-46

[132] W. Weiseman, D. Halsey, B. Buddock, Integrated Forest Gardening, The Complete Guide to Polycultures and Plant Guilds in Permaculture Systems, Vermont: Chelsea Green Publishing, White River Junction, 2014: 51

[133] B. Mollison, D. Holmgren, Permaculture ONE: A Perennial Agriculture for Human Settlements, Tagari Publications ed. 1990, 1st 1978: 43

[134] Bill Mollison's Permaculture Design Certificate Course, Course Outline, Section 2: Principle of Natural Systems and Design, Permaculture Institute, p. 4

[135] B. Mollison, Permaculture: A Designers' Manual, Tagari publication, 2nd ed. 2002, 1st ed. 1988: 50

[136] P. Tompkins & c. Bird, Secrets of the Soil, New Solutions for Restoring our Planet, Anchorage: Earthpulse Press, 2002

[137] B. Mollison, Permaculture: A Designers' Manual, Tagari publication, 2nd ed. 2002, 1st ed. 1988: 186-187

[138] FAO, Organic Matter, Preface. Available online: http://www.fao.org/3/a0100e/a0100e02.htm (accessed on 1st April 2019)

[139] FAO, Organic Matter, Chapter 1: Introduction. Available online : http://www.fao.org/3/a0100e/a0100e04.htm (accessed on 1st April 2019)

[140] Interaction between Species. Available online : http://lifeunderyourfeet.org/en/soileco/intro/biogeochemistry.asp (accessed on 1st April 2019)

[141] Pengertian Fungsi Sistem Organ, dan Organisme, Posts in Biology, Class 7, Middle School Lessons, Indonesia: Tugas Sekolah, 14 Januari 2019, available online: https://tugassekolah.co.id/2019/01/pengertian-dan-fungsi-sistem-organ-dan-organisme.html (accessed on 1st April 2019)

[142] W. Weiseman, D. Halsey, B. Buddock, Integrated Forest Gardening, The Complete Guide to Polycultures and Plant Guilds in Permaculture Systems, Vermont: Chelsea Green Publishing, White River Junction, 2014: 54

[143] Bill Mollison's Permaculture Design Certificate Course, Course Outline, Section 7: Soils, Permaculture Institute, p. 16.

[144] S. Holzer, Sepp Holzer's Permaculture, A Practical Guide to Small Scale, Integrative Farming and Gardening, Vermont: Chelsea Green Publishing, 2010: 15-17

[145] S. Holzer, Sepp Holzer's Permaculture, A Practical Guide to Small Scale, Integrative Farming and Gardening, Vermont: Chelsea Green Publishing, 2010: 31-32

[146] B. Mollison, Permaculture: A Designers' Manual, Tagari publication, 2nd ed. 2002, 1st ed. 1988: 372

[147] S. Holzer, Sepp Holzer's Permaculture, A Practical Guide to Small Scale, Integrative Farming and Gardening, Vermont: Chelsea Green Publishing, 2010: 191-204

[148] Photosynthesis, Wikipedia. Available online: https://commons.wikimedia.org/wiki/File:Photosynthesis_en.svg (accessed on 23rd March 2019)

[149] Mohammad Pessaraki (ed.), Handbook of Photosynthesis, 2nd ed. Boca Raton, FL: CRC Press Taylor & Francis Group, 2005: Section VIII, Photosynthesis in Different Plant Parts.

[150] S. Nidhi, Term Paper on Photosynthesis, Biology Discussion, Available online: http://www.biologydiscussion.com/photosynthesis/term-paper-on-photosynthesis-chemical-process-plants-biology/79985 (accessed on 23rd March 2019)

[151] Howard Griffiths, Jamie Males, Succulent plants, Current Biology, Volume 27, Issue 17, 2017. R890-R896. Available online: http://www.sciencedirect.com/science/article/pii/S0960982217302907

[152] Mohammad Pessaraki (ed.), Handbook of Photosynthesis, 2nd ed. Boca Raton, FL: CRC Press Taylor & Francis Group, 2005: Section XII, Photosynthesis and Its Relationship with Other Plant Physiological Processes.

[153] B.C.Wolverton, Anne Johnson, Keith Bounds, Sverdrup Technology, Interior Landscape Plants for Indoor Air Pollution Abatement Final Report, NASA John C. Stennis Space Centre Science and Technology Laboratory, September 15, 1989.Available online:

https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/19930073077.pdf (accessed on 3 December 2017).

[154] Bored Panda, NASA Reveals A List Of The Best Air-Cleaning Plants For Your Home. Available online: https://www.boredpanda.com/best-air-filtering-houseplants-nasa (accessed on 3 December 2017).

[155] Greenme, Inquinamento domestico: 15 piante da appartamento che depurano l'aria della casa Available online : https://www.greenme.it/abitare/accessori-e-decorazioni/3618-inquinamento-domestico-15-piante-da-appartamento-depurano-aria (accessed on 17th March 2018)

[156] Jiang, Shu-Ye et al. "Negative Air Ions and Their Effects on Human Health and Air Quality Improvement." *International journal of molecular sciences* vol. 19,10 2966. 28 Sep. 2018, doi:10.3390/ijms19102966

[157] Kamal Meattle, How to grow fresh air, TED, 21 mar 2009. Available online: https://www.youtube.com/watch?time_continue=244&v=gmn7tjSNyAA (accessed on 4th August 2018)

[158] F. Baluška, S. Mancuso, D. Volkmann (Eds.), Communication in Plants, Neuronal Aspects of Plant Life, Heidelberg: Springer, 2006

[159] S. Mancuso, A. Viola, Brilliant Green, The Surprising History and Science of Plant Intelligence, Washington: Island Press, 2015

[160] Plantoid Project. Available online: https://www.plantoidproject.eu/ (accessed on 5th December 2018)

[161] W. Weiseman, D. Halsey, B. Buddock, Integrated Forest Gardening, The Complete Guide to Polycultures and Plant Guilds in Permaculture Systems, Chelsea Green Publishing, White River Junction, Vermont, 2014: 126-127

[162] Prospects for the Environment, Agriculture and the environment, FAO. Available online: http://www.fao.org/3/y3557e/y3557e11.htm (accessed on 10th January 2019)

[163] Aliotta Giovanni, Biodiversità e agri-cultura: storia naturale e culturale delle piante, Aracne, 2008, Available online:http://www.aracneeditrice.it/pdf/9788854820043.pdf (accessed on 29th September 2018): 11

[164] Kate Whiting, The unbelievably simple way to cut greenhouse gas emissions in half, WEF, 26 Nov 2018. Available online: https://www.weforum.org/agenda/2018/11/want-to-save-the-world-become-a-flexitarian/ (accessed on 27th November 2018)

[165] Marco Springmann, Michael Clark, Daniel Mason-D'Croz, Keith Wiebe, Benjamin Leon Bodirsky, Luis Lassaletta, Wim de Vries, Sonja J. Vermeulen, Mario Herrero, Kimberly M. Carlson, Malin Jonell, Max Troell, Fabrice DeClerck, Line J. Gordon, Rami Zurayk, Peter Scarborough, Mike Rayner, Brent Loken, Jess Fanzo, H. Charles J. Godfray, David Tilman, Johan Rockström & Walter Willett, Options for keeping the food system within environmental limits, Nature 2018, https://doi.org/10.1038/s41586-018-0594-0. Available online: https://www.nature.com/articles/s41586-018-0594-0.epdf?referrer_access_token=IcRVAEZpHyH6RgWRAhQFkNRgN0jAjWel9jnR3ZoTv0M2ZckU8PFAjFp2beHrcOXhHVPwiboHFjCLaVoEktOYmqcrfV1G1lqapCFip0ADdu-n86tsHijzPAdDrq0ZzbhQFP2rU2oupM-D_MMivh4GMtS4J-lu_C42-IR9zoAK23L1YfNATuRr9jhIc_mfKdgjk2XDJAHTkswfBpUtgAxiZM7p3qT4yQCK01j3U4Ec3Io%3D&tracking_referrer=www.bbc.co.uk (accessed on 27th November 2018)

[166] Petrini, C. 2007. Slow food nation. New York: Rizzoli Ex Libris.

[167]'Our leaders are like children,' school strike founder tells climate summit, The Guardian, Tue 4 Dec 2018 11.10 GMT. Available online: https://www.theguardian.com/environment/2018/dec/04/leaders-like-children-school-strike-founder-greta-thunberg-tells-un-climate-summit#img-1 (accessed on 18th December 2018)

[168] E. Rigitano, COP24, the speech by 15-year-old climate activist Greta Thunberg everyone should listen to, Lifegate, 17 DEC 2018. Available online: https://www.lifegate.com/people/news/greta-thunberg-speech-cop24 (accessed on 18th December 2018)

[169] J.Sutter and L. Davidson, Teen tells climate negotiators they aren't mature enough, CNN Updated 1438 GMT (2238 HKT) December 17, 2018. Available online: https://edition.cnn.com/2018/12/16/world/greta-thunberg-cop24/index.html (accessed on 18th December 2018)

[170] James Workman, “Our house is on fire.” 16 year-old Greta Thunberg wants action World Economic Forum Annual Meeting 2019, 25 Jan 2019. Available online: https://www.weforum.org/agenda/2019/01/our-house-is-on-fire-16-year-old-greta-thunberg-speaks-truth-to-power/ (accessed on 26th January 2019)

[171] 'You did not act in time': Greta Thunberg's full speech to MPs, The Guardian, Tue 23 Apr 2019 14.15 BST, Available online: https://www.theguardian.com/environment/2019/apr/23/greta-thunberg-full-speech-to-mps-you-did-not-act-in-time?from=timeline&isappinstalled=0, (accessed on 25th Aprile 2019)

[172] FridayForFuture. Available online: https://www.fridaysforfuture.org (accessed on 15th March 2019)

[173] Pearson School. Available online: https://www.pearsonschool.com/index.cfm?locator=PSZoS4&PMDbSiteId=2781&PMDbSolutionId=6724&PMDbSubSolutionId=&PMDbCategoryId=814&PMDbSubCategoryId=24827&PMDbSubjectAreaId=&PMDbProgramId=67721&elementType=correlations (accessed on 23rd January 2019)

[174] Pearson, Environmental Science Your World, Your Turn, To the Next Generation Science Standards Disciplinary Core Ideas Science & Engineering Practices and Crosscutting Concepts, Pearson School, 2011. Available online: http://assets.pearsonschool.com/correlations/NA_NGSS_Environmental_Science_2011.pdf (accessed on 23rd January 2019)

[175] Pearson, Environmental Science Your World, Your Turn Withgott, ©2011 To the Common Core Standards for Literacy in Science and Technical Subjects Grades 9-12, Pearson School, 2011. Available online: http://assets.pearsonschool.com/correlations/NTL_CCSS_Environmental%20Science-YWYT_2011_Lit%20in%20Sci_Gr9-12_Final.pdf (accessed on 23rd January 2019)

[176] Rudi Bressa, Educazione ambientale a scuola. Dal prossimo anno forse obbligatoria, Lifegate, published on 05 JunE 2016. Available online: https://www.lifegate.it/persone/news/educazione-ambientale-scuola (accessed on 23rd January 2019)

[177] ISPRA, Educazione ambientale per le scuole: il Programma di iniziative dell’ISPRA. Available online : http://www.isprambiente.gov.it/it/formeducambiente/educazione-ambientale/progetti-ed-iniziative-1/educazione-ambientale-per-le-scuole-il-programma-di-iniziative-dell2019ispra (accessed on 23rd January 2019)

[178] ISPRA, Iniziative attivate nell'anno 2017-18. Available online : http://www.isprambiente.gov.it/it/formeducambiente/educazione-ambientale/progetti-ed-iniziative-1/iniziative-attivate-nellanno-2017-18 (accessed on 23rd January 2019)

[179] ISPRA, Iniziative Di Educazione Ambientale Per Lo Sviluppo Sostenibile Anno Scolastico 2018 – 19. Available online: http://www.isprambiente.gov.it/it/formeducambiente/educazione-ambientale/progetti-ed-iniziative-1/copy3_of_ProgrammainiziativeeducazioneambientaleISPRA_201819.pdf (accessed on 23rd January 2019)

[180] Early childhood education and care, Finnish national agency for education. Available online: https://www.oph.fi/english/education_system/early_childhood_education (accessed on 23rd January 2019)

[181] Waldorf Method of Teaching, Teachnology. Available online: http://www.teach-nology.com/teachers/methods/waldorf/ (accessed on 23rd January 2019)

[182] Robert Schuetz, Project-Based Learning: Benefits, Examples, and Resources, Schoology, June 01, 2018. Available online: https://www.schoology.com/blog/project-based-learning-pbl-benefits-examples-and-resources (accessed on 25th January 2019)

[183] D. Holmgreen, Permaculture, Principles & Pathways Beyoung Sustainability, Hampshire, UK: Permanent Publications, 2011: 13-23

[184] G. Harrington, Growing Chinese Vegetables in Your Own Backyard: A Complete Planting Guide for 40 Vegetables and Herbs, from Bok Choy and Chinese Parsley to Mung Beans and Water Chestnuts, Storey Publishing, 2009: ix-xvi

[185] Food Revolution Network. Infographic: 19 Foods You Can Regrow from Scraps. Available online: https://foodrevolution.org/blog/reduce-food-waste-regrow-from-scraps/ (accessed on 3rd January 2019)

[186] Biosphere 2. Available online: http://biosphere2.org (accessed on 18th December 2019)

[187] H. R. Maturana, F. J. Varela, Autopoiesi e Cognizione, La realizzazione del vivente, Saggi Marsilio, Venice, 3rd edition; ISBN 88-317-4778-9

[188] CSR Platform, WeChat. Available online: https://mp.weixin.qq.com/s/pOS6d0UKjFPc_Hzqc2V2gQ

[189] Creative Systemic Research Platform. Available online: https://creativesystemic.com/

Acknowlegment

I thank **Life** for giving me strength and ability to complete this study.

There are several people without whom this thesis would not have been at all possible and whom I need to thank

First of all, I would like to express my deepest sense of gratitude and thank my family for believing in my choices, especially my mother. My Mutti, you understood and believed with enthusiasm and positivism in this process the most.

Thanks to my dear Victor, for cheering me up whenever possible and helping me accepting situations that he also encountered when he did his double degree project in another continent on the other side of the world far from everything known and familiar.

Thanks to my far biggest supporters and fans, my sister Katarina, my felt sister Alexandra and my felt Peruvian family, all my friends and colleagues who did not give up because of distances or communication barriers to keep in touch.

I have to thank my Chinese friends who allow me to access to their communication world and culture, especially my dear friend Fangzhou.

Wayne Weiseman is a person without whom I would not be able to recognise and access the doors for achieving a deeper understanding of Nature and Life fundamentals and their relational extensions. Thank you for providing me through your pedagogy the Permaculture language and comprehension.

I am grateful to the Creative Systemic Research Platform Team for being part of my process and thanks to Marco for join us for a month where our comparison, exchange and support made realise the extended potential in importance of our research fields for the future civilasations. Thanks, for the concept definition in words: Learning as Open-ended Evolution.

Finally, I take this opportunity to express my profound gratitude to the existing relationship under the international project named POLITONG between Politecnico di Torino and Tongji University which allowed to find the deep cultural exchange I was looking for. Particularly, thanks for providing the set of conditions to direct me to meet Prof. Susu Nousala.

Susu, thank you for having crossed my way, took me with you and accompanied through this process, for your continuous guidance, advice and encouragement. it would not happen without you.

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