SENSE. The New European Roadmap to STEAM Education

D5.3 Self-experimentation toolkits and design principles for STEAM spaces

October 2024

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01/08/2024	V1	Michael Riebel	Creation of document outline
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Abbreviations and acronyms

Abbreviation or acronym used in this document	Explanation
EU	European Union
STEAM	Science, Technology, Engineering, Arts and Mathematics
STEM	Science, Technology, Engineering and Mathematics

Glossary

Term	Definition used or meaning in the SENSE. project	Reference or source for the definition, if applicable
Affordance	Affordance is a term developed by J.J.Gibson and describes the dynamic relationship of individuum and physical environment. An affordance of an object or space defines the action possibilities it offers to the user.	(Lobo, Heras-Escribano, and Travieso 2018), (Norman 2013)
Cabinet of Curiosities	A Cabinet of Curiosities is an encyclopedic collection of a wide range of artefacts, often amassed by members of the ruling elite for the purpose of universal nature studies but also as a sign of social status. They evolved since the 16th century and are viewed as the predecessors to modern museums and natural science collections. What defines a collection as a “Cabinet of	(Bredekamp 1995)

	Curiosities" is not the quantity of exhibits but the diversity of items included. However, a majority of collections tend to comprise natural artefacts. While they were often viewed as follies, contemporary scholars, namely the art historian Horst Bredekamp, describe them as foundational to modern science, paving the way for contemporary theories such as evolution.	
Hacking	Originally, "hacking" referred to the act of accessing someone else's computer system without permission to gather information or engage in illegal activities (Cambridge Dictionary). However, in recent years, the term has evolved to encompass a broader scope. It now describes the creative act of altering something—whether it be a physical product, a process, or even the human body—beyond its intended purpose. This type of hacking often involves inventing new, unexpected uses or aesthetics that appeal through their contrast to the original product.	n/a
Open-air schools	Open-air schools originated in Germany in the 19th century as a movement aimed at improving the health of students from disadvantaged backgrounds who were living in cramped and unhealthy conditions in large cities. By relocating classes to natural environments filled with fresh air and sunlight, these schools sought to provide a healthier learing environment. After the first school was erected on the outskirts of Berlin in 1905, the movement quickly gained	(Seaborne and Lowe 2022)

	international influence. It became an integral part of the Reform School movement, promoting a new relationship between pupils and nature and more student-centred, less hierarchical pedagogies.	
Open-plan (schools)	"Open-plan" generally refers to layout design principles that aim to minimise the amount of separating walls as much as possible, with different activities taking place in close proximity. After 1945, this principle was introduced in schools, which abandoned closed classrooms in favour of a larger area with many classes running in parallel. Especially in the 1970s, many schools (especially in the USA) adopted open-plan principles. With the return of more teacher-centred pedagogies in the 1980s, this trend was reversed. In recent years, the evolution of STEAM pedagogies has led to a renaissance of open-plan schools, especially in Scandinavian countries. One of the main advantages seen is the increased flexibility and support for project-based learning The debate surrounding open-plan versus celular school layouts remains contentious, with many traditional schools largely rejecting open-plan principles.	(Seaborne and Lowe 2022),

Rudolf Laban	Rudolf Laban (born Dec. 15, 1879, Bratislava, Austria-Hungary [now in Slovakia]—died July 1, 1958, Weybridge, Surrey, Eng.) was a dance theorist and teacher whose studies of human motion provided the intellectual foundations for the development of central European modern dance. Laban also developed Labanotation, a widely used movement-notation system.	Encyclopedia Britannica
Bruno Latour	Bruno Latour (born June 22, 1947, Beaune, France—died October 9, 2022, Paris) was a French sociologist and anthropologist known for his innovative and iconoclastic work in the study of science and technology in society. Latour broke away from the positivist view of scientific inquiry as a rational and largely asocial process capable of uncovering universally valid truths regarding the natural world. He instead described scientific knowledge as an artificial product of various social, political, and economic interactions, most of them competitive.	Encyclopedia Britannica
Pattern Language	Pattern language is a concept developed by Christopher Alexander to describe the built environment through a system of modular, spatial components ("Patterns") that evolved through social and cultural practice. Alexander sought to create a kind of architectural "grammar" as a base for a language that everyone could "speak", understand and apply.	Alexander 1978

Spatial literacy	Spatial literacy describes the awareness and knowledge of the complex relationship between the various components of the 3-dimensional physical environment and how it relates to human behaviour and perception.	Montello, Grossner, and Janelle 2014
Spatial agency	Spatial agency describes the ability to interact with the physical environment purposefully using the knowledge gained through spatial literacy.	Awan, Schneider, and Till 2011
Traditional classroom	A "traditional classroom" is a spatial typology that evolved in the 19th century. It describes a rectangular space within a school building, a group of students and typically one teacher. It features a display (for example, a blackboard) on the far end with rows of chairs and desks for the students directed towards it. It evolved from the need to support teacher-centred pedagogies spatially.	Gislason 2011

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The SENSE. project

There is a widespread understanding that the future of a prosperous and sustainable Europe depends to a large extent on the quality of science education of its citizens. A science-literate society and a skilled workforce are essential for successfully tackling global environmental challenges, making informed use of digital technologies, counteracting disinformation, and critically debunking fake news campaigns. A future-proof Europe needs more young people to take up careers in science-related sectors.

Research shows that interest in STEM subjects declines with increasing age. This effect is particularly pronounced among girls and young women; even those of them who take up science studies gradually forfeit their motivation. But despite all image campaigns and efforts to remove the awe of science only “one in five young people graduates from STEM in tertiary education” and only half as many women as men, according to the European Skills Agenda.

The disinterest in science is striking and evokes the question of its causes. Stereotypes and lack of female role models seem to be only a part of the explanation. Nor is there a lack of career prospects that could explain a reorientation despite initial interest.

SENSE. has identified two major problems in current science education that need to be addressed: a) A distorted teaching logic that progresses from abstract models to procedural applications (“reverse ontology”) and b) The inability to implement a learner-centred pedagogy linking students’ everyday knowledge to science-based knowledge, thus promoting motivation, self-directed and life-long learning.

SENSE. advocates for the development of a high-quality future-making education that is equally accessible to all learners and promotes socially conscious and scientifically literate citizens and professionals. SENSE. aims at radically reshaping science education for a future-making society. By promoting the integration of all human senses into exploring and making sense of the world around us we will challenge conventional ideas of science and science education. Considering the pitfalls of current science education practices and the advantages of artistic and aesthetic activity, this innovative approach also considers social inclusion and spatial design as core components for a new STEAM education paradigm. With ‘SENSE.STEAM’, future science learning will be moving away from the standardised classroom shapes and furniture layout entering new learning landscapes.

The project seeks to develop an accessible educational roadmap promoting socially conscious and scientifically literate citizens and professionals. It addresses outdated perceptions of current science education as well as gender stereotypes by integrating the arts, social inclusion and spatial design as its core components. SENSE. will establish 13 ‘STEAM Labs’ across Europe to develop and evaluate the

‘SENSE. approach’ to STEAM subjects alongside students, educators, teachers, businesses, and other stakeholders.

The ‘New European Roadmap to STEAM Education’ will take the shape of a STEAM learning companion to support tomorrow’s educators and learners – be it in the classroom, in a museum or on a drilling rig. A digital hub will be established, where practitioners from all ages and backgrounds across Europe will be able to access tried and tested educational practices to increase engagement within these subjects.

The SENSE. consortium

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Table of Contents

1. Introduction

1.1. Purpose and Limits of the Document

This document is slightly different from other deliverables of the SENSE.STEAM research project as it is neither a research or methodology report nor a policy recommendation document. It is conceptualised as a source of inspiration for educational practitioners. The underlying thinking for this toolkit is based on the findings from the labs, but it is our deliberate intention to expand on some of the aspects of STEAM spaces and, therefore, use external inspirations in parallel to the findings from the STEAM labs. While not every principle suggested in the toolkit has been tested in the labs, all ideas for the "experiments" are drawn from the intense discussions with stakeholders and facilitators.
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1.2. Intended readership

The report will be publicly available and, as such, be accessed by the stakeholders and beneficiaries, as outlined in Deliverable 3.3. However, as an "inspirational" document, it is predominantly directed at educational practitioners who seek to vary existing STEAM practices, aim to dive deeper into what "space" is, or want to look for new ideas for STEAM activities.

This document is not a step-by-step guide on "what to do." Instead, it serves as a starting point, offering a variety of ideas and principles along with some practical advice. Most experiments will need to be further developed to fit specific contexts and needs.

1.3. Structure of the Document

The toolkit is divided into three parts.

- Module 1 explains how the research consortium deals with the term "space".
- Module 2 highlights the relevance of the subject.
- Module 3 is a list of 10 "Experiments" that serve as inspiration for educational practitioners.

1.4. Relationship with other Deliverables

Much of the theoretical background for this deliverable is drawn from D.5.1, D5.2, D6.1, D6.2, D3.3 and D3.5 and presented in an abbreviated form for ease of dissemination.

The toolkit also relies on the reports for the STEAM labs (WP4) as issued to the research consortium.

And of course, this “toolkit” will be integrated into the final Roadmap (WP7), albeit in digital form.

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Jump!

Spatial Self ExperimentationToolkit

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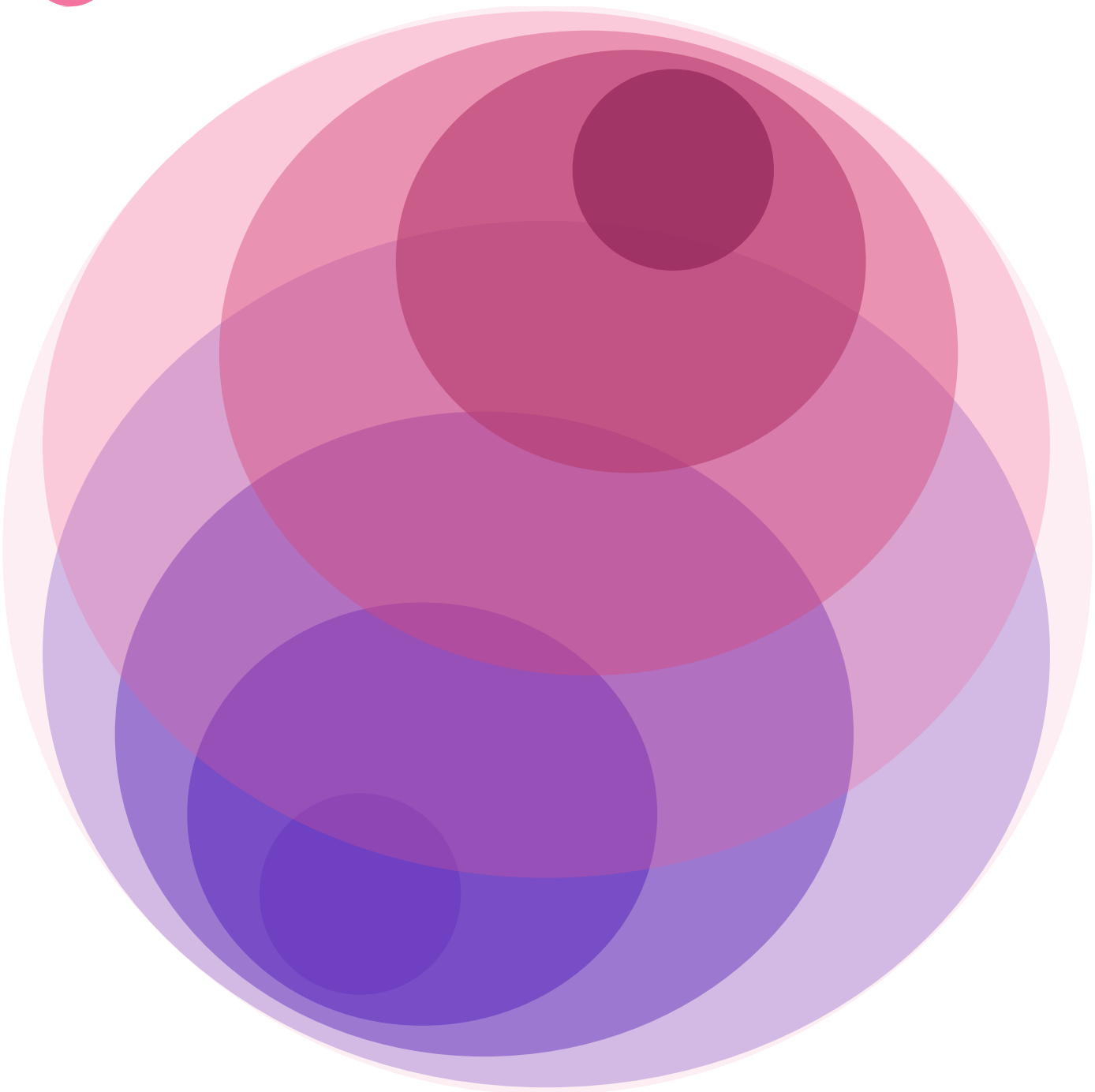


What is Space?

Spatial Self-Experimentation Toolkit
Module 1

Space is everything!

There are many things what “space” can mean.

We often mean a place with 4 walls around and a roof above. However, in the Sense. research project we think of “space” as potentially everything that surrounds us.

There is no difference in principle between an open landscape and a classroom for example. And of course a classroom can become a landscape and the landscape a classroom.

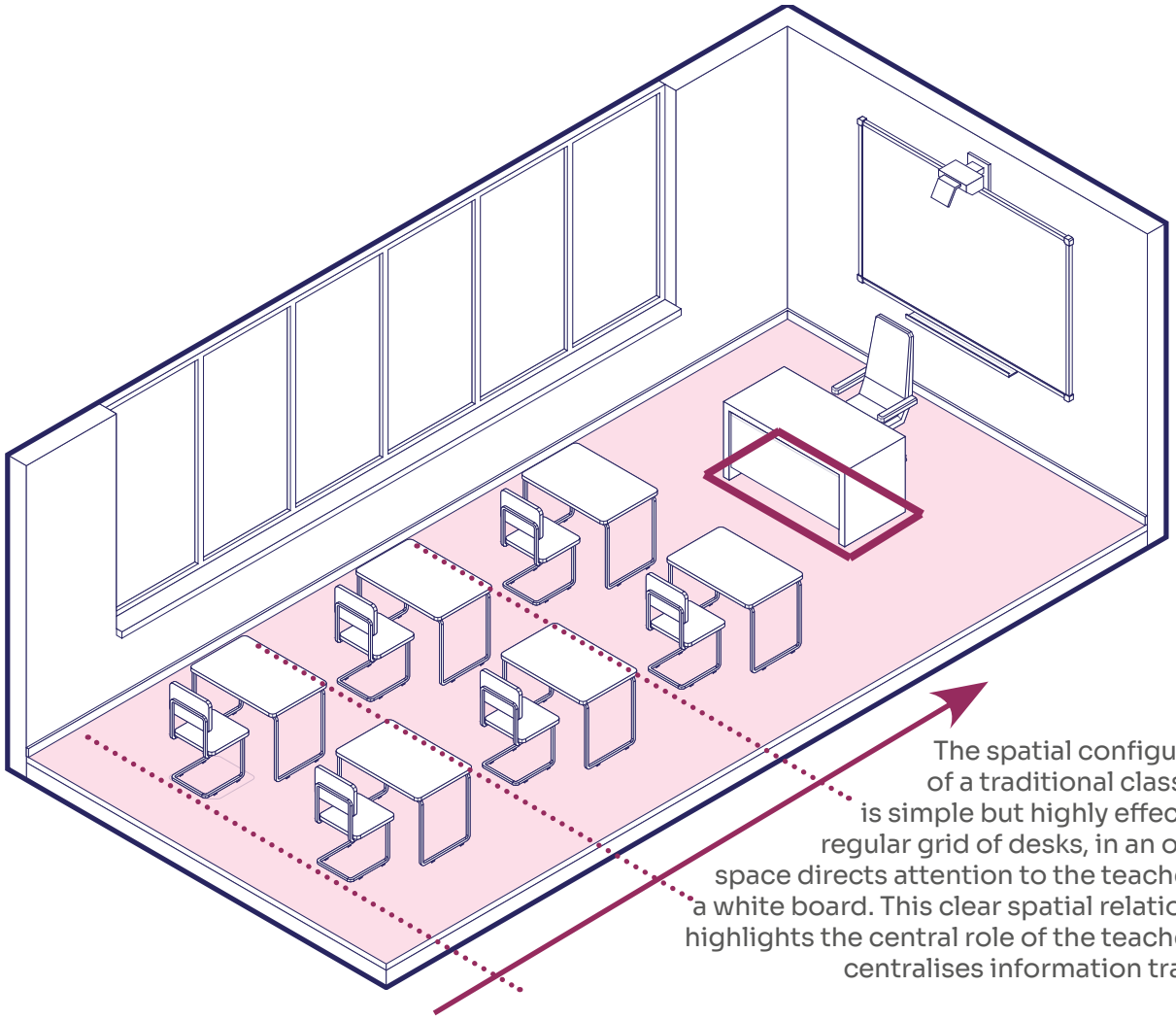
There is no place without space.

Space is the physical environment!

“space” is often understood as a description of all the components that surround us, including furniture, materials, light, colour, doors etc. In this sense, “space” serves as an umbrella term for what we commonly describe as the physical environment.

And yes, this document uses it this way, too. Because it is very useful. For instance, an educational “space” may refer to a classroom, complete with its defining features like desks, a blackboard, and the scent of boredom..

Space describes a geometric configuration

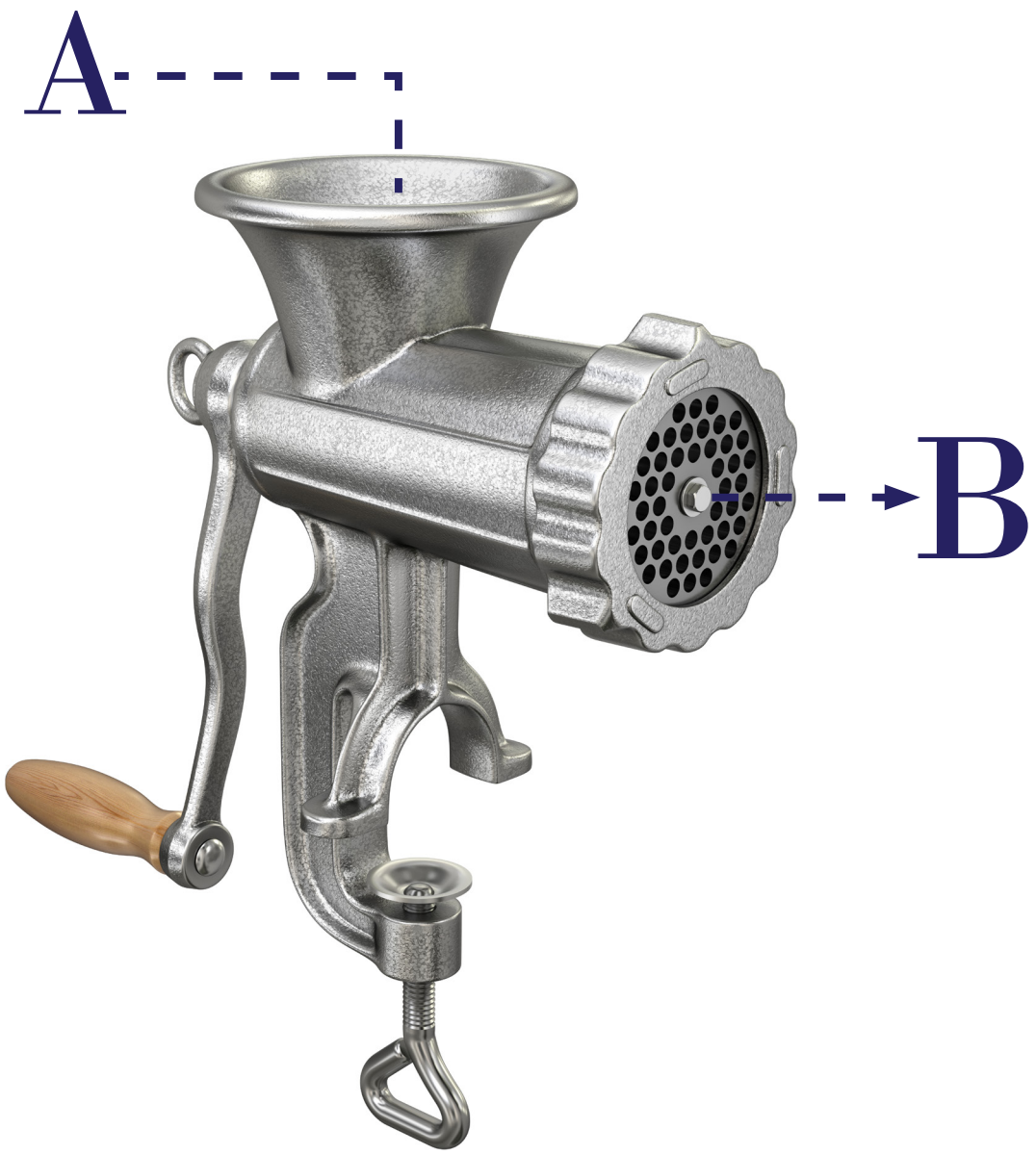


The spatial configuration of a traditional classroom is simple but highly effective: a regular grid of desks, in an oblong space directs attention to the teacher and a white board. This clear spatial relationship highlights the central role of the teacher and centralises information transfer.

However, for a more accurate understanding of the learning environment, we need to differentiate between space as a synonym for the "physical environment" (i.e. everything) and the more precise use to describe a "geometric configuration": How (and to what effect) do objects, walls, people relate to each other. How big is the space? What can you see from specific points? Where is the furniture placed?

Space is a relational category.

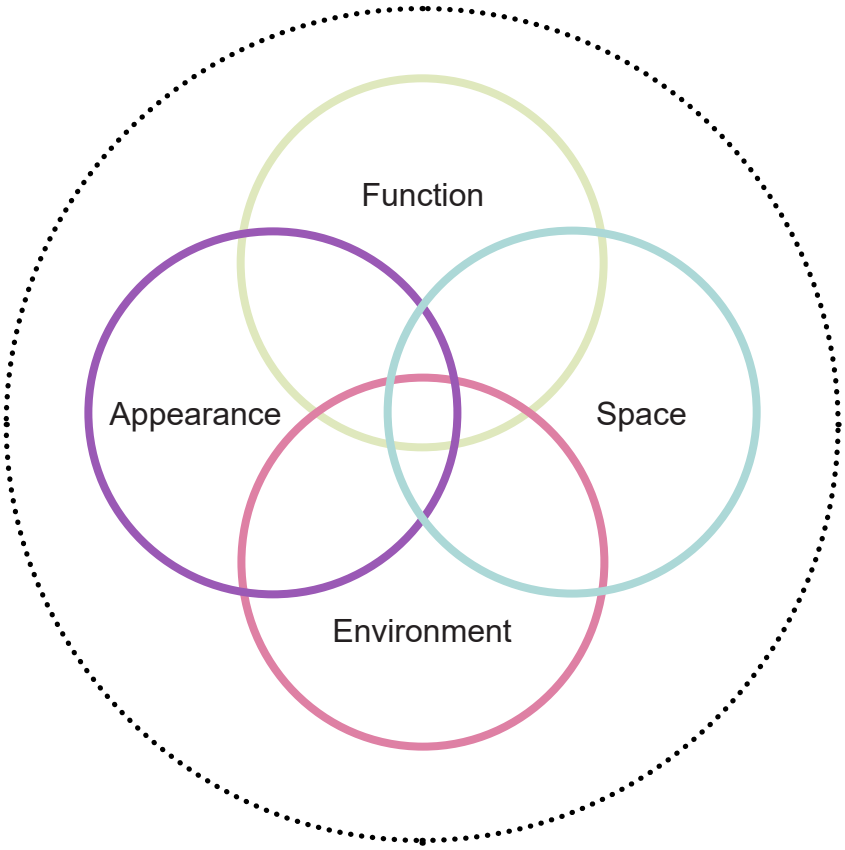
Space is NOT a machine



A common misunderstanding is that the impact of space is predictable, meaning there is standard recipe for creating a “good” learning environment, that will automatically lead to “good” outcomes. However, A does NOT always lead to B. Maybe it is B, but that is not certain. Space is not a machine.

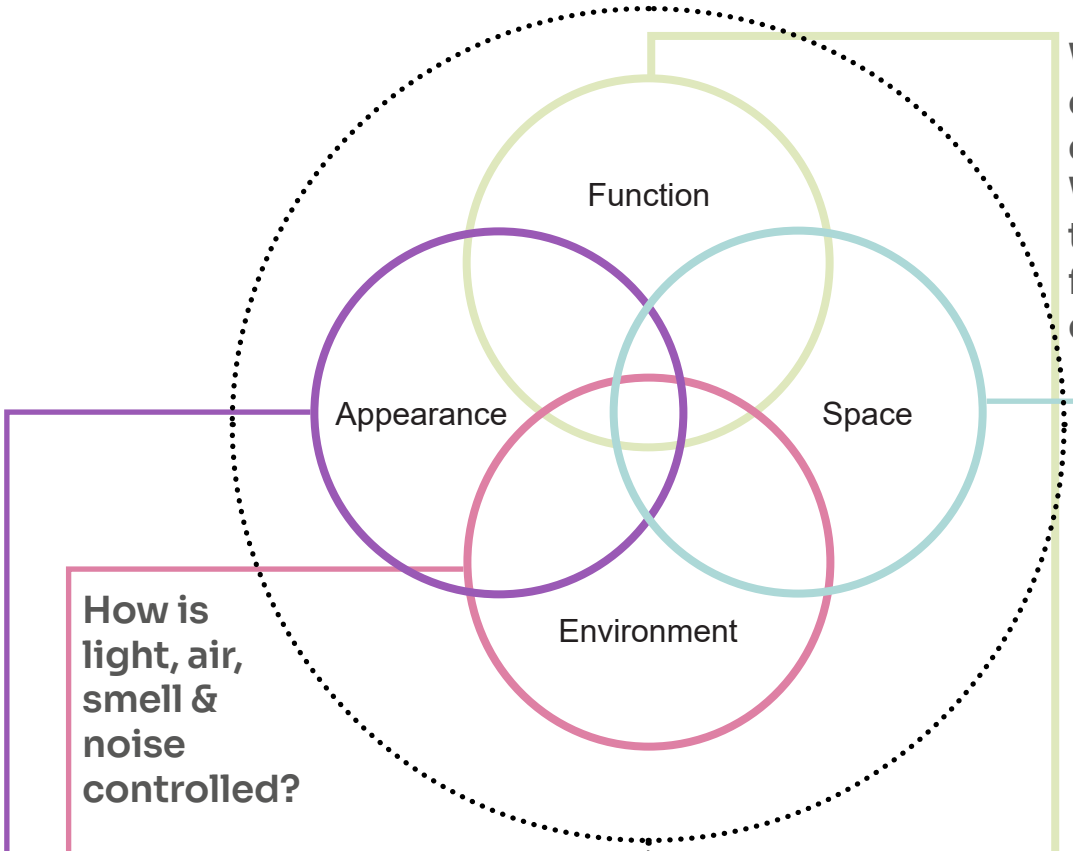
We have to disappoint you: There are no universal solutions for the design of learning environments.

Space can be analysed and discussed.



There are no golden rules: only golden conversations.

Ask the (relevant) questions!



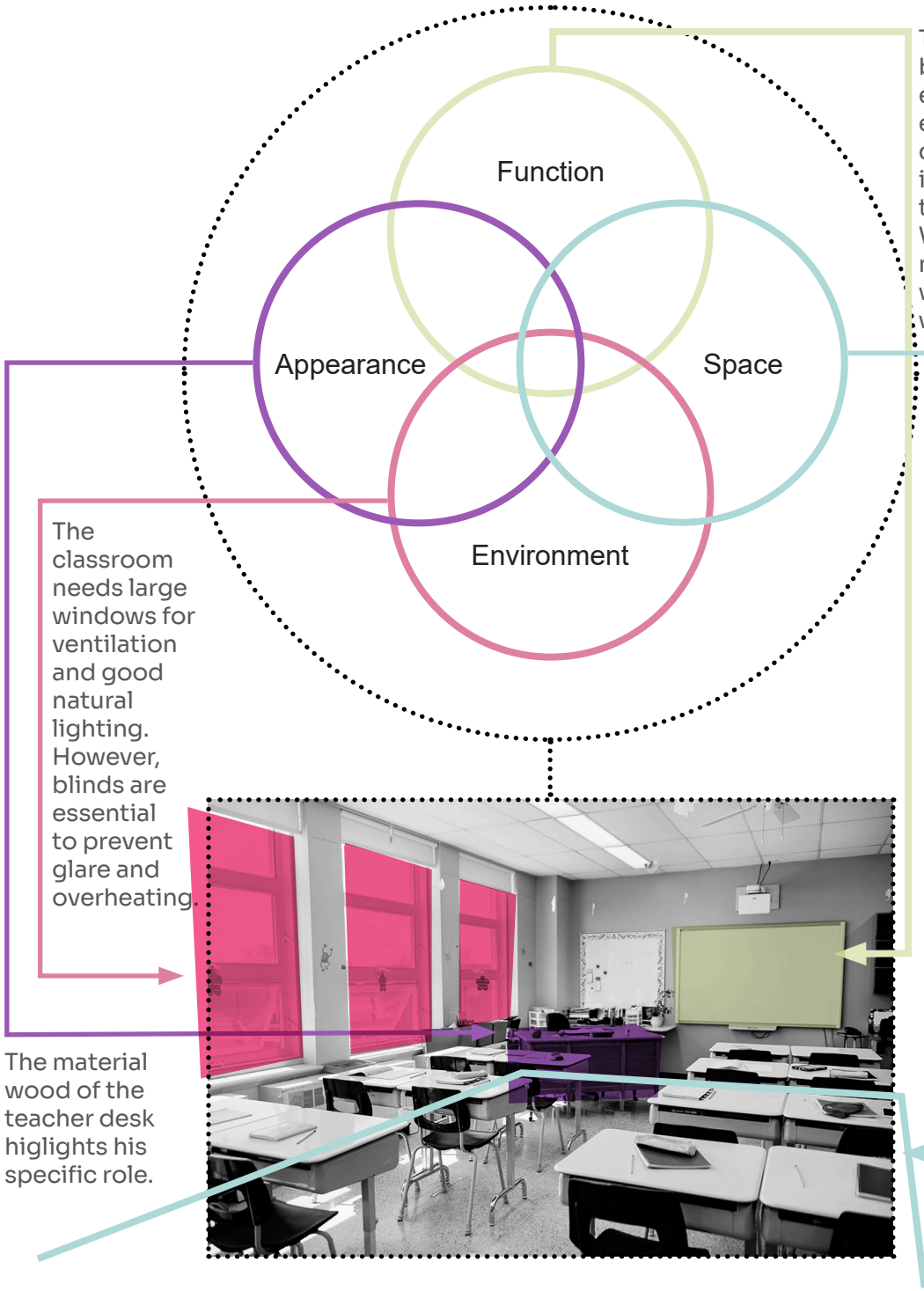
What equipment do I need? What are the required functions of each item?

What is the shape and height of the space and how are its elements (such as furniture and other equipment) arranged? Where and how will people move through the space?

How is light, air, smell & noise controlled?

How will the environ-ment look like? What emotions will it evoke?

It is all about informed decision making.



SENSE.

A three-step conversation always helps:

1) Define the STEAM-specific objective of your activity! What do you exactly want to achieve?

2) Which environmental conditions supports this objective best? What has the most STEAM impact?

3) What is the most important element in the physical environment? Everything is important, but clear priorities lead to the best outcomes and let you focus on what is really important.

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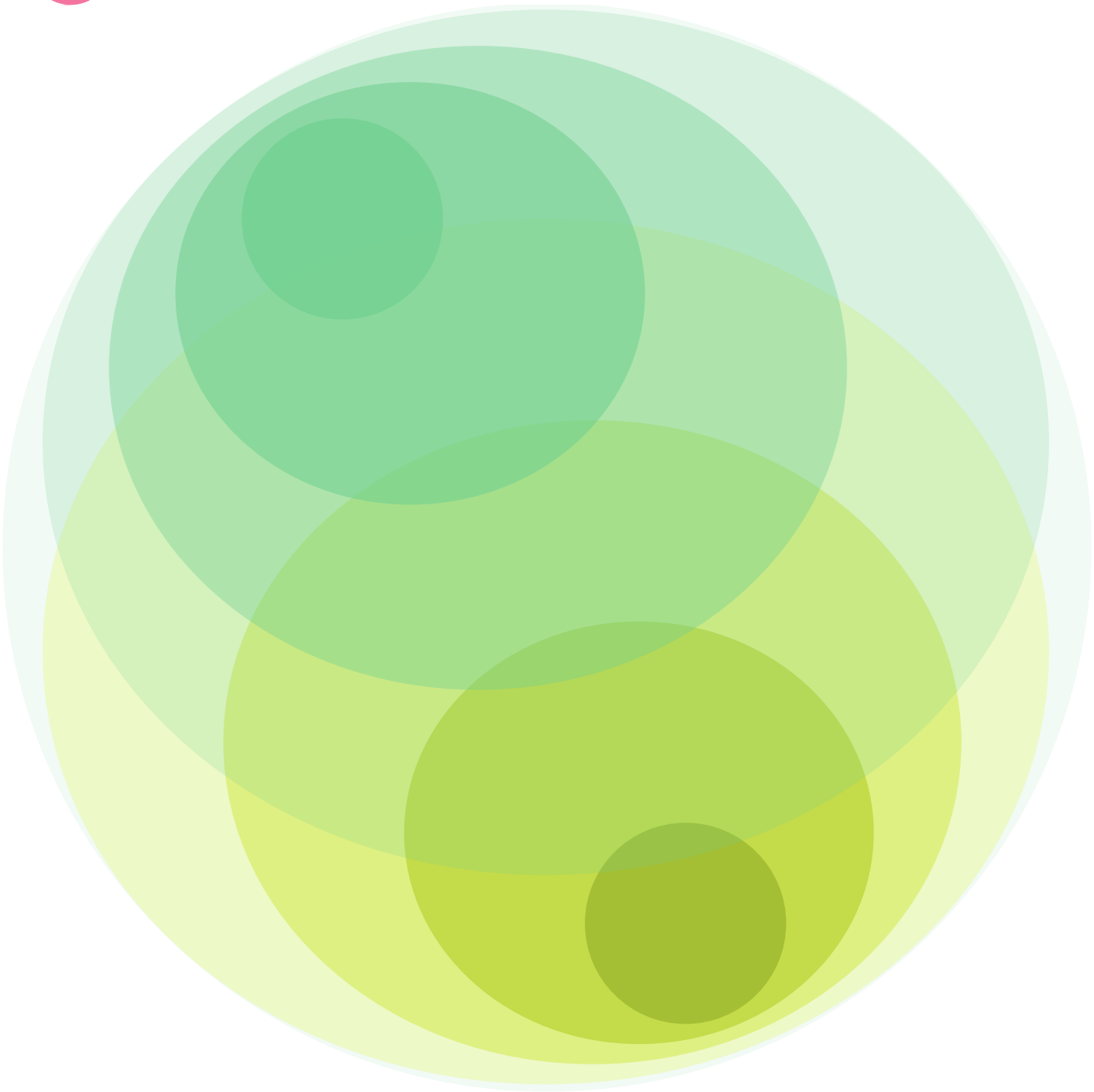

Why Space?

Spatial Self-Experimentation Toolkit
Module 2

Spatial thinking is a relevant skill

Improving three-dimensional imagination is a skill relevant to almost any profession. The discovery of DNA was not a result of chemical analysis but, first of all, an exercise in three-dimensional creativity.

Understanding space is a powerful tool for innovation.

The Brain Gym: Understanding space means understanding complexity

Navigating three dimensions can quickly become a mind-bogglingly complex task. Science, knowledge, innovation, art: they all deal with complex problems.

Understanding how spaces work, how things relate to each other, how complexity can be controlled: the big problems of this planet can not solved without it.

Spaces are frozen social conventions: lets break them!

The invention of the corridor created modern privacy. Thought about it? Here is another one: Why do toilet doors never open into living rooms? Thought about it?

The answers to those kind of questions will tell you a lot about you, me, us, the society and its social conventions, ingrained in the spaces we inhabit. Only if you are able to decode hidden conventions you can become truly innovative.

Spaces can be used in many ways!

Conventionally we think about spaces as functional environments that help achieve our goals – as supportive spaces. However, turning spaces into playful tools of experimentation lets us reflect ourselves and go beyond of what we think the world is.

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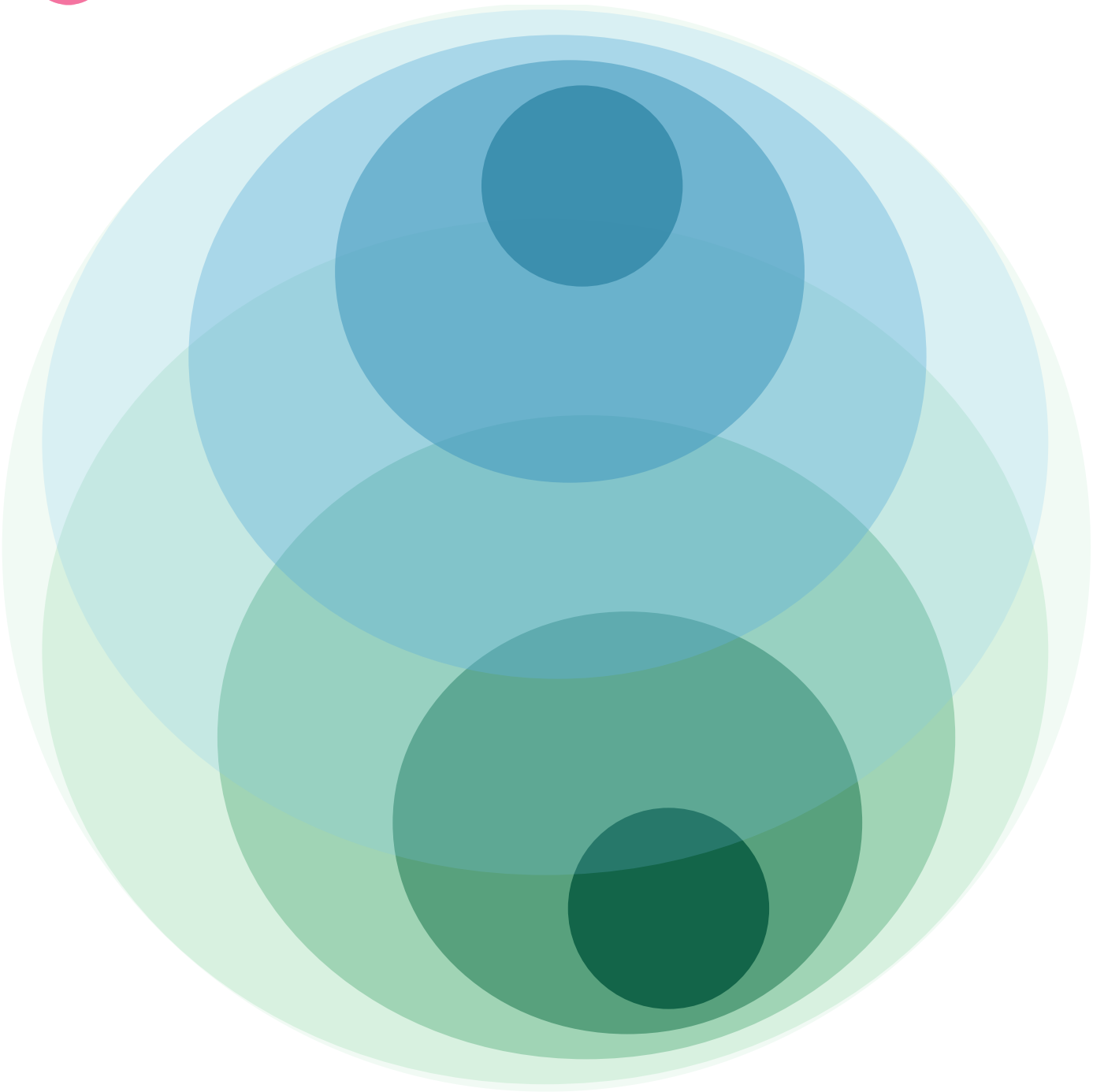


10 Experiments

Spatial Self-Experimentation Toolkit
Module 3

“We don’t want to wait – for new curricula to be written, for new schools, community centres and science and arts institutions to be built. We want to start now, and we invite you to start with us.“

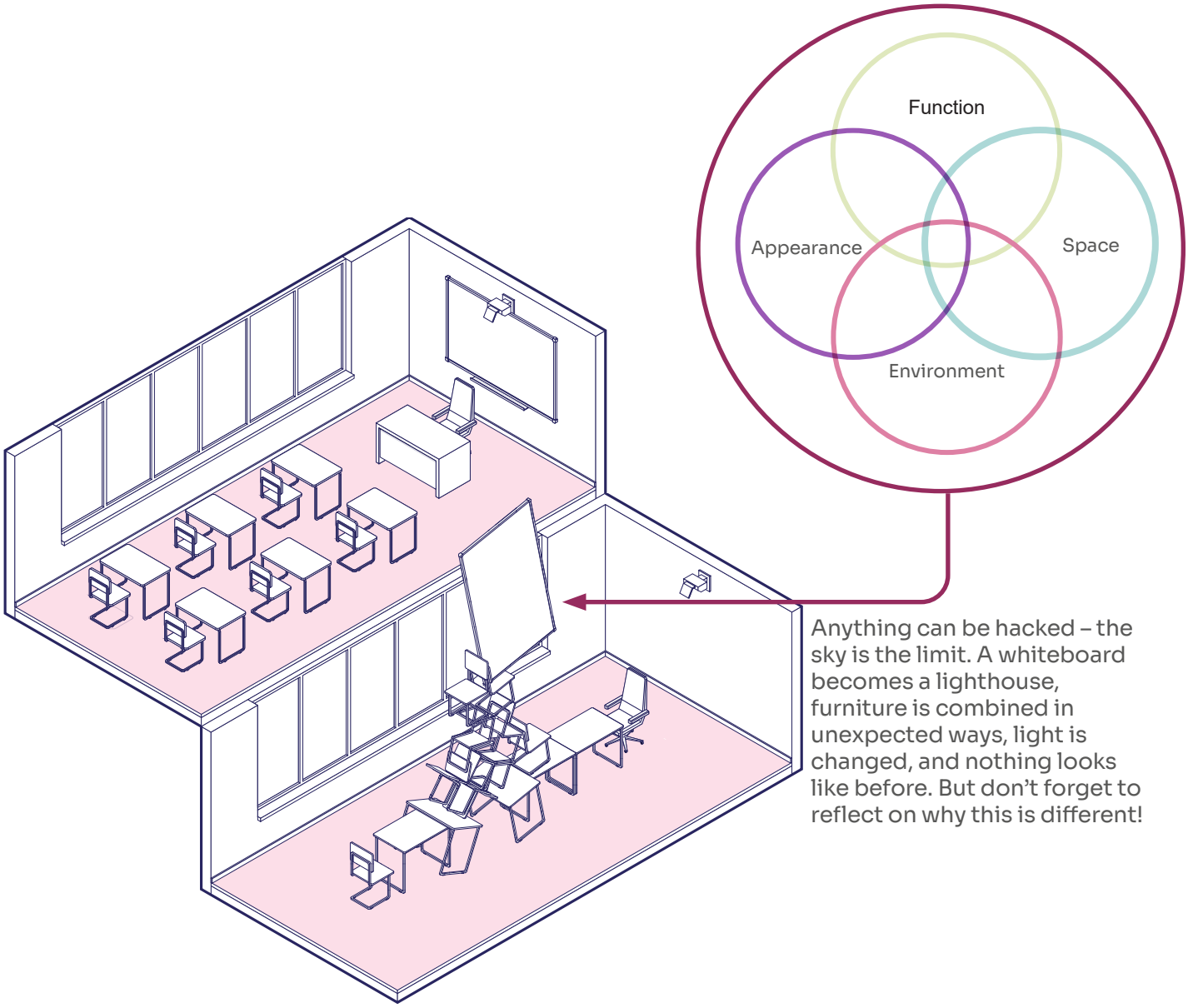
The following guide outlines ten “experiments” that should help explore how educational practitioners or, indeed, anyone can use the physical environment as an active tool to carry out STEAM-inspired activities or to induce some STEAM spirit into traditional educational practice.

It is a loose guide that draws much of its contents from one year of experimentation across 10 Labs during the EU-horizon financed research project SENSE.STEAM. It needs to be read in conjunction with Module 1 (What is Space?) and Module 2 (Why Space?).

Throughout the toolkit, you will find references to activities that were conducted in one of the research labs. For more information about these activities and the project as a whole, please visit the webpage:

https://sense-steam.eu/

Hack the Space



Anything can be hacked – the sky is the limit. A whiteboard becomes a lighthouse, furniture is combined in unexpected ways, light is changed, and nothing looks like before. But don't forget to reflect on why this is different!

"Cambio ergo cogito": I change therefore, I know. In this experimental exercise, we can either 'hack' the space we are usually in or find a space that is not originally intended for the activity we want to do. The only rule is: don't use anything as intended – and of course – go wild!

Hack the Space

Why?
Space affects and, to some degree, determines how we move and interact with each other. Understanding this complex relationship helps us understand the complexity that underlies the world around us and empowers us at the same time.

Hacking, i.e. the conscious changing and rearranging of the intended use, of a particular space, is important because it helps us decode this complex relationship. Reclaiming the physical environment and the humanisation of many spaces are among the many reasons space has been hacked in the past and present.

Using something in the "wrong" way implies that we deconstruct what the "right" way is.
And let's set the record straight: there is no right or wrong way – everything can be changed in whatever way needed and imagined.

How?
The "how" is easy: change everything around you as idiosyncratic as you want and have fun. But that is easier said than done. Before making changes, it is essential to understand why things are the way they are: change requires a solid grasp of the existing.

Understand, change, and reflect on what you are doing. This trichord is the secret behind this experiment.

"Hacking the space" often involves pushing the boundaries of social norms. Sometimes, this means making only minor adjustments, while it can be more significant at other times. It takes social courage to step outside learned behaviours. For instance, in the Hawkins\Brown labs, the initial half-hour was often filled with awkwardness as the facilitator encouraged participants to act beyond their usual spatial and social constraints. Making that leap can be challenging, but it is worthwhile.

Left: Scene from "The Educators" (2004)
In this film, a group of young revolutionists intrude into wealthy people's flats. Instead of stealing anything of value, they rearrange all furniture into grotesque sculptures. This radical spatial reconfiguration, stepping over so many social lines, instils more terror into the "victims" than an ordinary theft, as it questions deeply ingrained societal norms.
src.:https://media.outnow.ch/Movies/Bilder/2004/FettenJahreSindVorbei/movie.ws/02.jpg

Right: Hawkins\Brown Lab, Kinsale School/Cork/Ireland
Participants were asked to use "found objects" of all kinds to transform a space and explore the effects this has on shadow and light modulation.
src.: SENSE.

Further suggestions

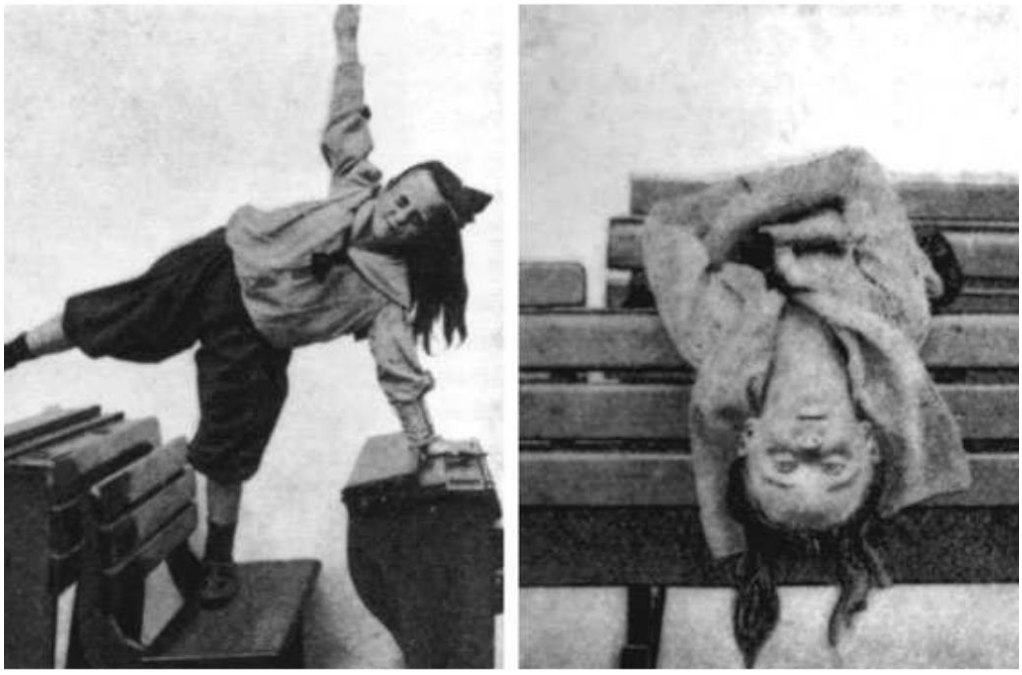
As a first step, you should ask yourself: How does the space I am in work? What does it want me to do? This can range from a simple analysis to a more profound examination; it's up to you.

Next, consider setting up the space differently from the usual arrangement to support your practice or create an unexpected change.

You might rearrange everything in the room, build a sculpture from the furniture, or use the tables for sitting and the chairs for eating.
You might rearrange everything in the room, create a sculpture from the furniture, or use tables for sitting and chairs for eating. Think about transforming your office into a living room or your classroom into a dining hall with a long table at the centre. Or, consider utilising an art gallery or even a supermarket. How could you adapt the space of a supermarket or a large parking lot?

Top: KAPUTT, Academy of Destruction, Hamburg 2018
In this "science theatre piece", students research the destruction of their used environment can be a creative act to create new unexpected constellations. "Hacking" becomes creating.
src.: Fundus Theatre Hamburg

Right: Claude Parent, Dining Room/ Villa Peupliers/ Neuilly (1960)
The French architect Claude Parent insisted on using a sloped floor in his house as a dining room, including wedges as "furniture" to match the slope. Parent's theory was that slanting or angling typically level architectural elements like floors—and, more generally, the ground—moved people into a deeper engagement with their physical environment.
src.: https://032c.com/magazine/the-supermodernist-architect-claude-parent



Left: School bench as gymnastic equipment, Erich Fischer (1910)
The German teacher Erich Fischer transformed school benches into sports equipment to allow students to exercise between lessons. While not intentionally subversive, this “Hack” turned a piece of furniture - the Prussian school bench - aimed at disciplining the body into a fun climbing frame for a liberating body experience.
src.: Hnilica, Sonja. “Schulbank Und Klassenzimmer – Disziplinierung Durch Architektur.” Sinnliche Bildung?, 2010, 141–62.

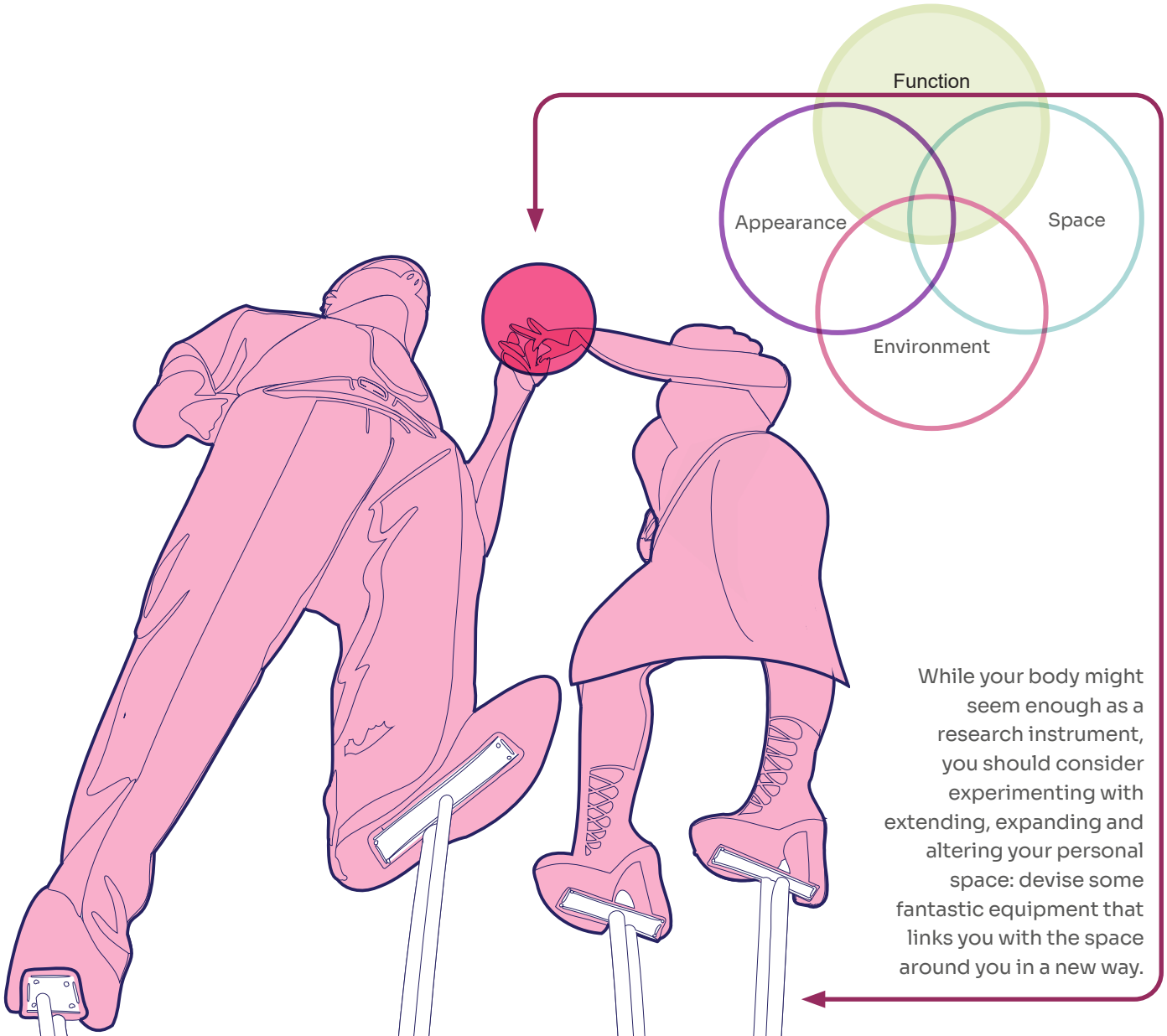
Once a decision has been made, if you work in a group, everyone can be asked to bring equipment such as lights or cushions, tablecloths or other furnishings. You can then move the furniture around and observe the resulting configuration.

The term ‘hacking’ is also used to describe the utilisation of a space with a different function for the purposes of practice. What other spaces could be considered for this purpose? One example is the kitchen, which could be used for a physics, chemistry or technology lesson. There are numerous processes and potentially numerous machines to be explored that provide learning opportunities.

Hacking spaces can be a chance to bring together usually separate areas. As part of the SENSE project, participants used an art museum, the Louvre in Paris, to learn about geometry and the physics of colour. Do you have a similar idea?

Any space can be “hacked”. One of the most famous historical examples is the use of 19th-century school benches for gymnastic exercises by the German teacher Erich Fischer to provide physical training for his pupils, thus turning the affordances of the school bench, i.e. the normative posture into its opposite.

My body Is My space



While your body might seem enough as a research instrument, you should consider experimenting with extending, expanding and altering your personal space: devise some fantastic equipment that links you with the space around you in a new way.

In this experiment, we use our bodies to create a new, interactive, and highly personal experience space by moving, extending, exploring and expanding all our senses, and by doing so, reordering the reality around us. Feel and understand that reality is what your body makes of it!

Why?

Space is a profoundly personal and embodied experience. Humans interact with one another and their physical environment in constantly evolving ways. To grasp the complexity of the environment—and the world at large—your body can serve as a finely tuned instrument.

Translating phenomena and scientific concepts into an embodied performance teaches participants two important lessons: first, how personal and relative your relationship with the world and other people is, and second, how you can engage with it using all of your senses.

This experiment is both an empowering and humbling experience.

How?

For this experiment, you will work either in a group or individually. The activities can take many shapes: a performance or a piece of body extension and live installation. The possibilities are endless.

The key is to start positioning your body, or a group of bodies, in space and to each other and observe and try out how you can react to others or the environment in different ways.

Try to use or create props that help redefine your relationship with the space around you; reflect, test and go with the flow.

Do the spatial arrangements really determine how our bodies relate to the space and each other? Often, they merely suggest a conventional pattern of bodies that can easily be changed and experimented with. By experiencing this, we can gain insights into how our bodies not only use spatial setups as they are but can also generate different dynamic spaces between us.

Props or specific spaces –for example, a dance studio with mirrors– can support this type of activity well. However, one thing needs to be clear: your body and how you use, move or extend it to communicate with the world is at the centre of this space-making experiment that has the power to transform any space into an exciting exploratory instrument.

Left: Rebecca Horn, "Finger Gloves" (1972)
Since the 1960s and 1970s, artists have been systematically exploring the complex relationship between space and the body.
src.: https://sarahendren.com/2022/10/14/prosthetics-attached-to-people/

Next Page Top:
Body extension experiment in STEAM lab Hawkins\Brown
How does extending the arms transform the physical and social space during dining? Because the participants' "arms" are too long, they have to collaborate to eat.
src.: SENSE.






Further Suggestions

In this experimental sequence, we will focus on how our bodies interact with each other and within the physical setup.

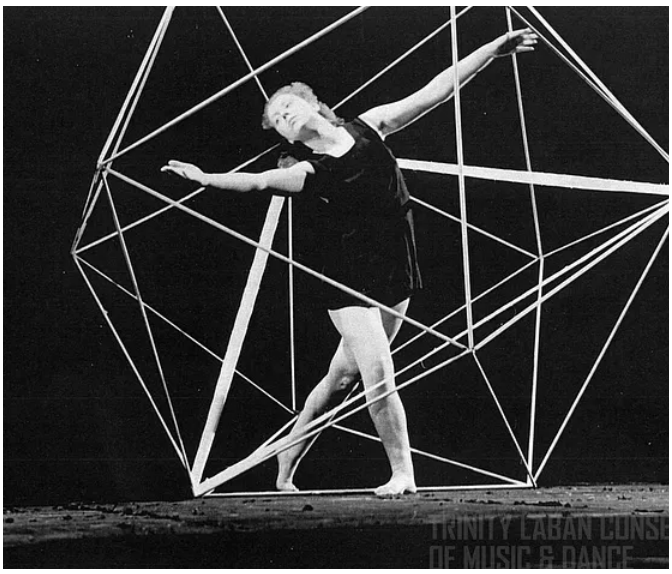
There are many ways to carry out this experiment. Get inspired by the world of performances, theatre, dance art installations, "Body Art" – a close observation of how people interact and position their bodies when they converse with each other might also be a good starting point.

There are several strands you might want to follow:

- Let participants create a "body extension" – that can be anything from gloves to stilts – and explore the environment, analysing how this changes perception. There are many things we can observe and reflect on. How does interaction change if we are on stilts? How does social space change if your arms are too long so you have to feed your neigh or simple things? If everyone wears rose-coloured glasses, is the world becoming a better place?
- Work in groups interactively and position the body to each other, analysing and reacting to each other's movements. Have a look at Laban's movement analysis. That is a great inspiration. One of the most common ways to change body constellations is to move from a unicentric to a polycentric arrangement and back again. For example, instead of everyone looking at the speaker in front of the class, people can gather around and work in groups. And then - who and where will be the centre when we return to one?
- Co-design a performance that aims to visualise a "theme" that can be a scientific theory or social field – using your bodies. There are many performances, for example, where participants emulate Einstein's ideas with their bodies.

Einstein is all about how speed, position and time are relative and depend on how objects relate to the observer. Discuss with the group how this could be visualised and experienced with your bodies. Everything is constantly moving but as soon as everyone moves at the same speed, nothing moves any more. Can you visualise this? Can everyone move precisely at the same speed?

Or, of course, mix all the three approaches! Your body can be a limitless source of inspiration.

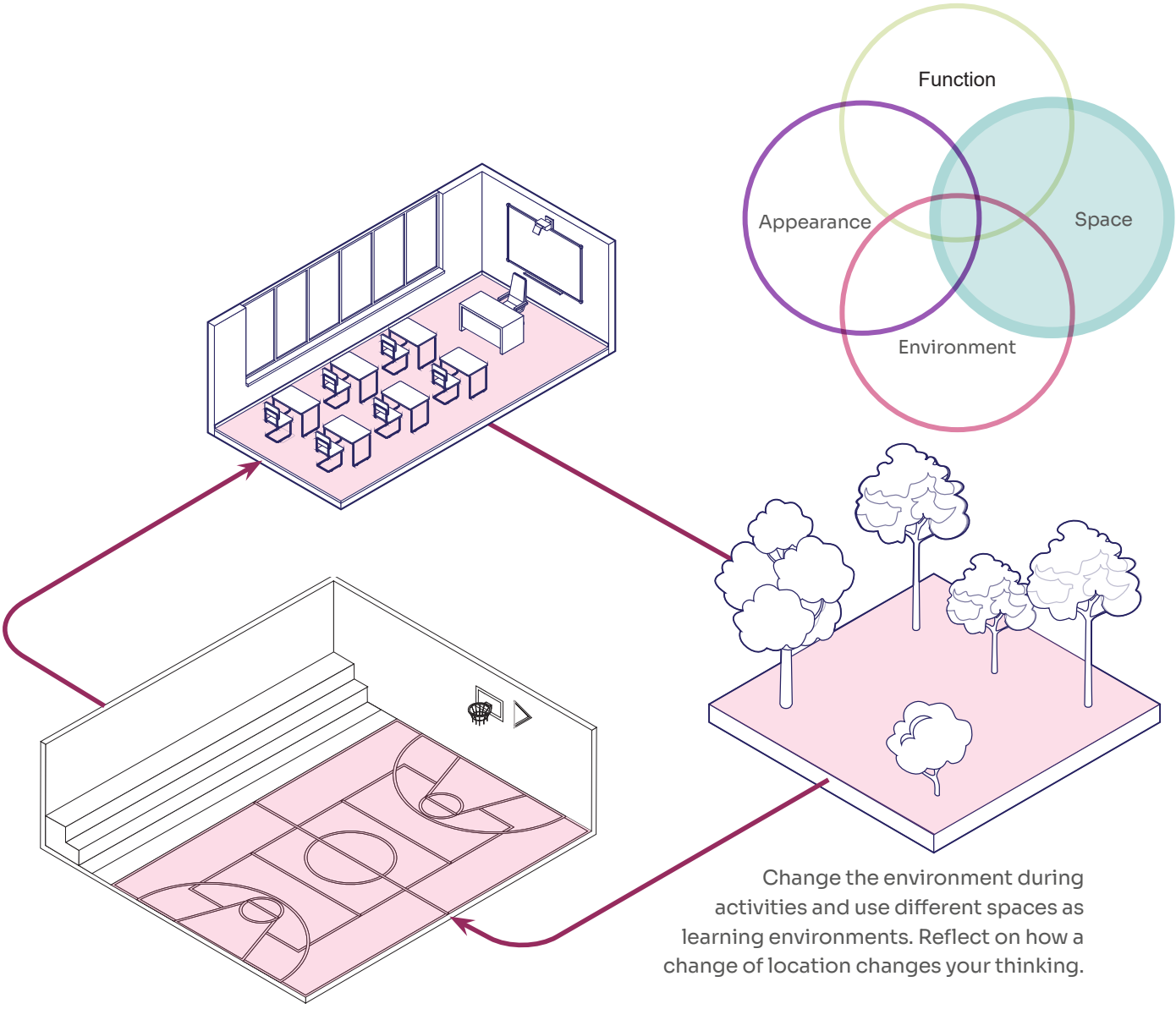


Top: STEAM Lab WECF
Bodies can become an experimental space of physical and social community. src.: SENSE.

Middle: Relativity (Rehearsed Reading), Upstairs at the Gatehouse, London (2024)
A performance, visualising elements of Albert Einstein. Performances are ideal "spaces" to test and embody physical theories. Einstein's theory of relativity deals with the relation of bodies, acceleration, and gravity, which is the perfect script for a performance. src.: https://theatreandtonic.co.uk/blog/relativity-upstairs-at-the-gatehouse-review

Bottom: Valerie Preston-Dunlop in an icosahedron at the Art of Movement Studio, Manchester, 1947–1949 (Laban Library and Archive)
Rudolf Laban's (1879-1958) systematic analysis of human movements is an excellent example of how the distinction between "art" and "science" becomes irrelevant. His ideas can serve as a valuable inspiration for STEAM.SENSE activities, allowing for the embodied exploration of both subjective and objective space.. src.: https://medium.com/@demzou.art/using-laban-movement-analysis-to-create-a-framework-of-interactions-research-theory-1375a573fcc3

Keep on Moving



Change the environment during activities and use different spaces as learning environments. Reflect on how a change of location changes your thinking.

People think differently in different environments. Try it: Let's start by doing the same activity in different surroundings. It is simple: take the things we need and leave, move and reflect on the change: it is the way, not the destination, that matters.

Why?

Action as research – that is an excellent start for a self-experimentation series. We know from cognitive research that people behave and think differently in different sized spaces. A tall space inspires creativity, and a confined space helps with focus. Many scientists incorporate walking as a means to stimulate their thinking, actively seeking different environments to gain fresh perspectives on ideas, thoughts, or problems.

A Stanford study from 2014 even found that moving improves creativity. Walking, thinking, creating, changing, inspiring, taking a break to ruminate together. These are familiar elements for thinkers, artists, academics and many more. So why is this not more widely used? So let's do it!

The experience of moving together and altering our spatial setup as we go can invigorate our usual group practices and foster improvisation. This activity will disrupt the norm and provide valuable insights into how our practices relate to our spatial surroundings.

How?

The principle behind this experiment is straight-forward. Begin by planning your activity as usual, then select a different space to conduct it in.

Keep these two key principles in mind:

- The spaces must be noticeably different from each another. If both spaces are similar, there is little benefit in switching from space A to B.
- The act of moving is crucial, as it "resets" your brain and allows for new impressions. This means that "moving" should be an integral part of the activity and should take place within (and not between) the sessions.

And finally, as with all of the experiments in this document, the spatial experience should be jointly reflected after each session.

STEAM Lab, University of Edinburgh
What might appear to be a leisurely autumn stroll is actually a group of participants in a lab activity walking from an indoor space to the garden. Gardening activity is an integral part of the STEAM lab to holistically reconnect home economics students with the natural source of food production.
The act of changing the environment from indoors to outdoors helped embody this link but also had a cathartic effect in getting the participants into the right, liberating mindset to engage with the natural environment.
src: SENSE.

Further Suggestions

This experiment doesn't require any extensive preparations beyond some basic precautions. It may be beneficial to identify which other rooms are available beforehand, but you can also leave this to chance.

Moving from one space to another can be particularly interesting if we play with different dimensions. For instance, we can choose a room that is significantly larger than usual, allowing participants to decide where and how they want to gather. We can present a variety of spaces for participants to pick from, even if those spaces are unrelated to the activity itself. For example, why not use a kitchen for a group discussion or bathroom stalls for focused work?

The act of moving can become a space in itself, like a long discussion while walking. Or this might happen in one space, ideally a large room: it is fun to answer questions just by moving around. People can go to different corners to indicate opinions, affinities or qualities. Or they can spread out on a spectrum from pro to con. Even people who wouldn't usually participate in a discussion will move and show where they stand. It might be nice to interview them afterwards and find out more about why they moved where they did.

STEAM Lab, Hawkins\Brown
In this lab activity in a school participants changed the environment during the session from indoors to outdoors to write the summary of their findings what they would like to improve in their school environment. While the students that stayed indoors remained much more abstract in their insights, the "outdoor" students had a much wider range of ideas, many of the much more concrete, with one group even coming back with a poem.
src.: SENSE>

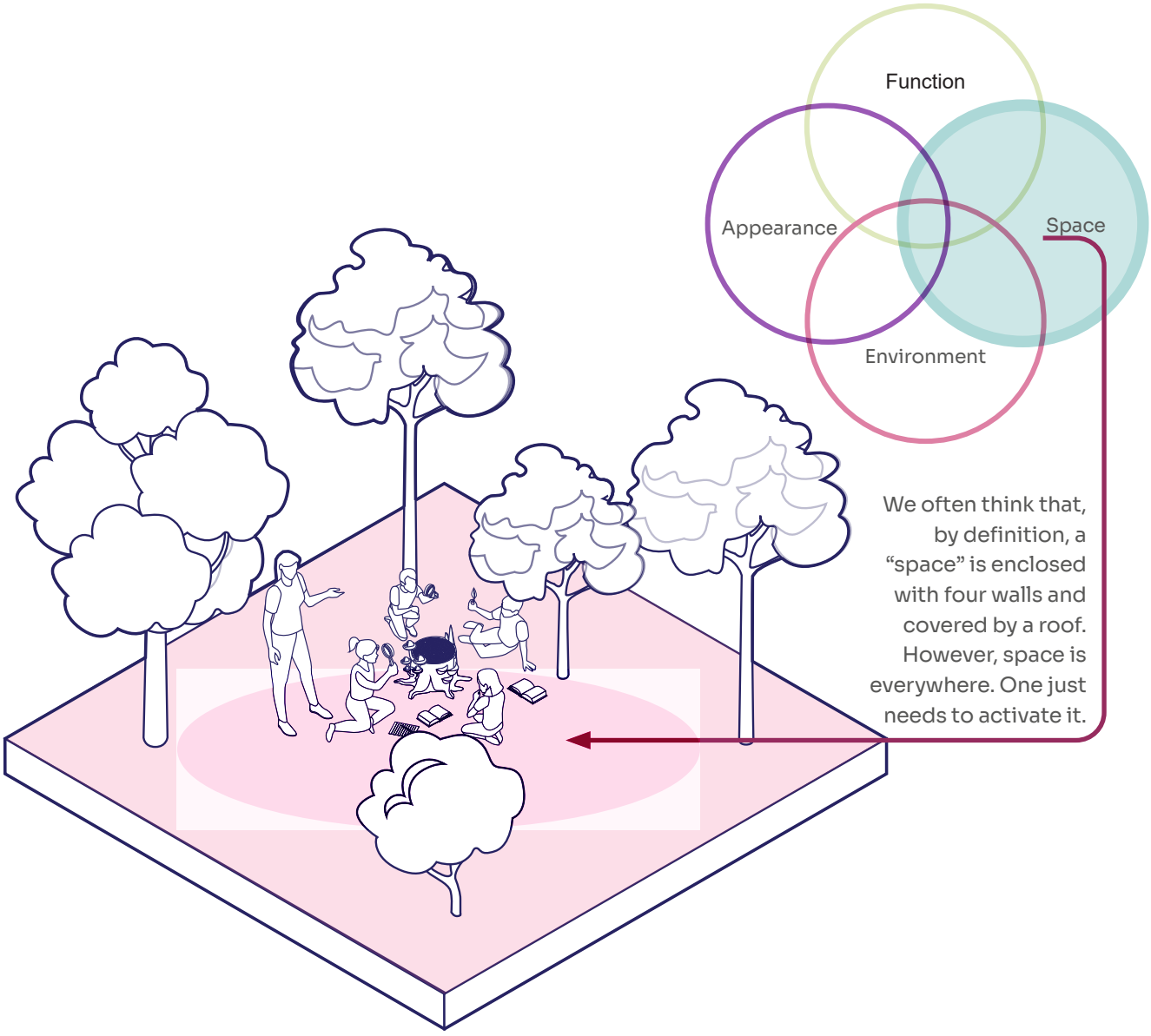
Many meetings and even whole conferences have been held while walking. Striding together also keeps people facing the same direction rather than looking at each other. A larger group will tend to break up into smaller groups. We can also think of our practice as a kind of guided tour, with everyone coming together here and there before the walk continues. Smaller groups can discuss as they walk and then come together to share their findings.

Try out different speeds of walking.

The same exercise can then be carried out in a smaller space, where whispering might suffice. Participants in a confined area will behave and think quite differently.

Keep on moving, keep on changing perspective, keep on relating!

Space without Walls



This experiment is straightforward: Swap an enclosed learning environment with a space without walls around – out in nature with all its sensory richness. The change will surprise you.

Why?

There are several reasons why open natural spaces can serve as inspiring learning environments. You might want a simple change in atmosphere, seek a healthy environment with an abundance of air and light, or look for hands-on science in direct interaction with the subject of inquiry. Most importantly, open-air learning environments foster a deeper relationship with nature through personal experiences, helping participants develop long-term, environmentally sustainable attitudes and practices.

The multi-sensory reconnection with nature is a central element of the SENSE.STEAM methodology. This approach promotes a holistic understanding of the world, emphasizing that humans are just one small part of a vast ecosystem

How?

The idea of teaching pupils in open-air conditions originated in the 19th century, with the first "Forrest School" set up in Berlin in 1904, which initiated a fast-growing international movement. Initially motivated by public health concerns to create a healthy place for working-class pupils, it is one of the constituting pillars of 20th century reform pedagogy, aiming at fundamental changes, going beyond just having a school in a healthier environment

And this is important for this experiment: In traditional schooling, natural spaces often seem to be only important as so called "natural science contents in the curriculum", i.e. available for direct exploration.

However, in this experiment, we want the natural world to become the setting for learning through sensory experiences, serving as a facilitating context for opening doors to sensual observation and attentiveness.

STEAM Lab University of Barcelona, River walk
This activity explored the river landscape with an emphasis on the air.
Artistic and scientific research come together in this community walk, which invites the public to walk along specific locations around the Besòs River, observing the air using creative imagination and sensory perception and using scientific knowledge, which measures it by other parameters and forces us to envision future alternatives.

The group gathered at the end of the walk to sit, share tea, discuss how the environment made them feel, how the bodies connected to the surroundings, and reflection thoughts, experiences, and memories. src.: SENSE.

A class in progress at Auguste Rollier's Sun Clinic at Leysin in the Swiss Alps (around 1930)
Open air schools have a long tradition since the beginning of the 20th century. Auguste Rollier was famous for his radical approach to cure TB through exposure to fresh air and sun. The children carried benches and books up the mountain, wearing only shorts and sandals, and set up school in the snow. src.: https://www.philipsteadman.com/blog/lessons-in-the-snow-lessons-on-the-beach/

Further Suggestions

Using nature as a learning environment is easier said than done – just think about the weather and other environmental hazards. This means planning and flexibility are essential. There is no such thing as "bad weather, only the wrong clothing and equipment. This is part of the experience: be adaptable and accept change. But be prepared!

Engaging with the outdoors stimulates our senses as we encounter the air, wind, temperature, humidity, sounds, and smells of the natural world. Unlike traditional indoor settings, the outdoors is unpredictable, offering random events all the time. And that's great. How do they relate to our practice? What impulses do they give us? Perhaps they can inspire a different understanding of what we are learning.

Initially, the more pragmatic solution might be moving a traditional learning environment into nature, i.e., using conventional classroom accessories like chairs and desks and choosing a "nature" subject. Or even less adventurous: go out into nature and bring the results and exhibits of this inquiry back indoors for further formalisation.

While this strategy could serve as a gentle introduction, we recommend more immersive experiences, such as:

- Spending an entire day or even a week in nature. Continuous exposure helps participants better appreciate environmental changes, leading to deeper learning.
- Make it your first task to create a natural classroom. How does this even look like? There are, of course, no rules.
  Change the location periodically to experience the quality of different settings.
  Create sensory experiences, such as blindfolding, to experience a more profound tactile experience of nature.
- Try out alternative ways of recording the

learning experience. Drawings, recordings, collages, smells etc..

While it may be tempting to reserve outdoor learning for “nature-related” subjects like ecology, we would encourage integrating any subject within a natural setting and reflecting on how the environment influences learning outcomes.

If you’re unsure where to begin, consider seeking inspiration from existing initiatives such as the forest school in the UK; other countries have similar movements.

Nothing seems to be more natural then teaching and learning in nature.

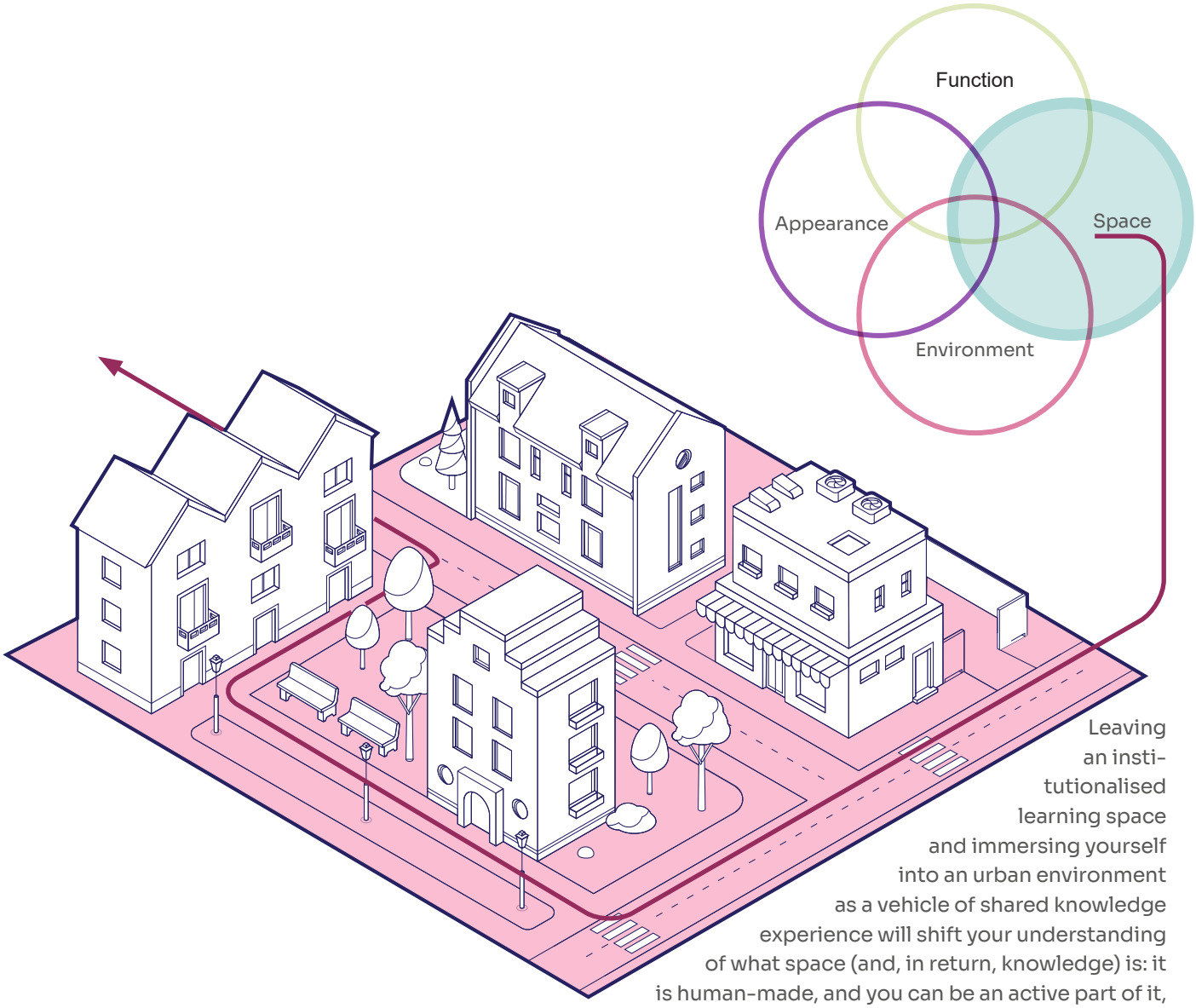
Examples of outdoor classrooms:

Top: STEAM Lab WECF
Building a “House for a Fairy”. src.: SENSE.

Middle: Improvised outdoor learning environment
src: The Leverett Education Foundation

Bottom: “Garden classroom” at the STEAM Lab University of Edinburgh.
src.: SENSE.

My Place Is My Space



Leaving an institutionalised learning space and immersing yourself into an urban environment as a vehicle of shared knowledge experience will shift your understanding of what space (and, in return, knowledge) is: it is human-made, and you can be an active part of it, using your enquiring spirit to benefit everyone.

This experiment asks you to engage with your "place" - that is, your neighbourhood, your city, your community. You and your fellow citizens will turn it into a giant interactive "space" to explore, understand and co-create knowledge jointly.

Why?

In many societies, learning is deeply integrated into the collective social practices of the community. Members of all ages actively exchange and generate knowledge together.

However, the increasing institutionalisation of education, particularly in Western cultures, has created segregated educational spaces such as schools, universities, colleges, and nurseries. In these environments, knowledge generation and inquiry often occur in isolation from everyday life, and their outputs are not used productively to benefit society.

While there are undoubtedly benefits to this "specialisation", it has also brought adverse effects: a disjoint between real life, socially exclusive structures in education and – most importantly – we don't use one of the most significant educational resources - the community as a whole, us and everyone else.

By shifting the educational environment back into the community - at least temporarily, this experiment aims to address the current limitations of education and promote a more inclusive and open form of science.

How?

Real change can only happen through the way we connect with one another and engage with our surroundings

The key strategy of this experiment is to take a group of participants out of a traditional educational environment into a shared urban space, ideally a neighbourhood that is familiar to the participants. This shift should be experienced as a deliberate process, highlighting a clear contrast from their previous environment.

For this approach to be successful, we need to follow participatory approaches of co-designing and co-creation. Participants need to be involved from start to end: what are we looking for, where are we going to, and how are we going to collect data and create knowledge?

This will ensure everyone is fully involved and engages with the group and the environment.

Though not essential, using smartphone apps or other tools (such as analogue (!) maps) to track movements and data can be beneficial. Collaborating with other stakeholders (such as local administration, civil society

STEAM Lab University of Barcelona, Heat walks
This citizen science project appeals to citizen collaboration to identify, in specific neighbourhoods, the urban public spaces — squares, streets, parks, etc. — most exposed to extreme heat in the metropolitan area of Barcelona, and to propose strategies to mitigate its effects. src.: SENSE.

groups, universities, schools, and community organizations) can enhance the impact and provide valuable insights.

There are multiple ways to carry out this experiment, depending on your location and context.

The most important factor is to consciously move out of an institutionalised space and immerse yourself in the urban environment

A simple approach could begin with a joint walk, reflecting on your observations and how these relate to your educational experience. This can serve as a first step in the process of co-designing an educational activity. For instance, you might notice a lack of recycling facilities. This observation can lead to a mapping exercise, followed by more active engagement with community members. Using the example of recycling bins, consider questions like: Are there better locations for these bins? Is there a need

Hawkins\Brown, Fusion Futures, London (2021)
This engagement project originated from a collaboration between Barbican Creative Learning, Culture Mile Learning, and the Foundation for Future London. Titled “Fusion Futures,” the project focuses on the essential ‘fusion’ skills needed in the 21st-century workforce. Students are paired with an artist facilitator and an industry representative to explore the unexpected connections between different fields.

As part of the project, students navigated the city using a trail composed of rhymes written by the collaborating poet, “Adila the Verbaliser”. For each hint they discovered, the students created a four-line poem, which culminated in a complete piece reflecting on the architectural features of Clerkenwell.
src.: Hawkins\Brown

for more bins? How does the recycling system actually work? Who uses the bins, and why are they often used incorrectly? Speak to the users, develop ideas, present your findings to local politicians, and organize initiatives to enhance recycling. This process generates data, improves the environment, and creates knowledge - There are many ways to utilise the neighbourhood!

You can approach this experiment with varying levels of intensity:

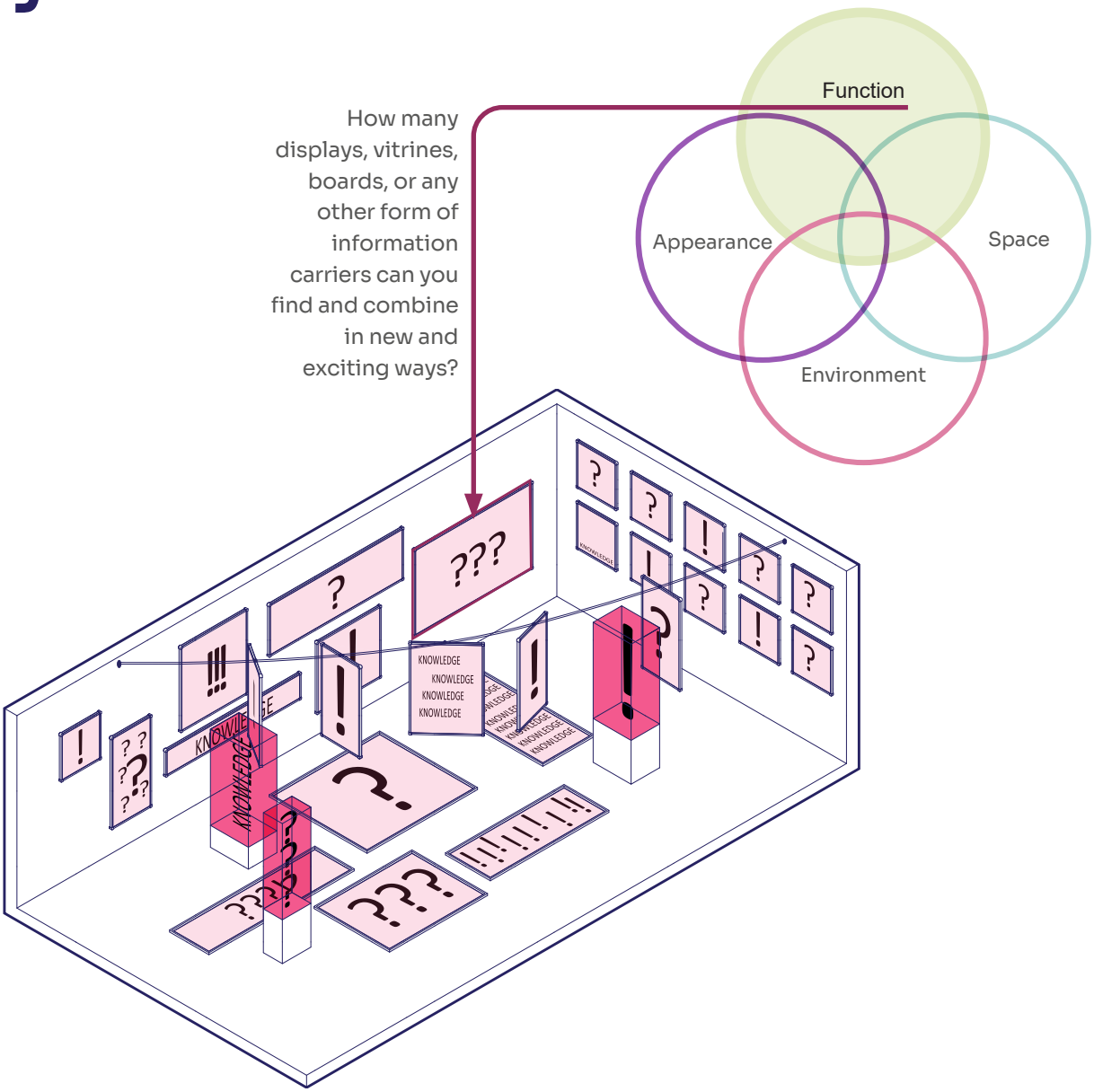
- Exploring without engaging – just observing and reflecting on the neighbourhood.
- Exploring with mapping or other forms of notation and a deeper focus on a theme that is relevant to the neighbourhood
- Deeper engagement with other community members and active dialogue across many stakeholders

All this has the potential to evolve into a proper “Citizen Science” project. Citizen science is an emerging practice in how science is performed that encourages citizens to get involved in research tasks. It is one of the cornerstones of open science and, at the same time, a way to explore new areas of interest for the wider community. It is considered a key strategy for the success of transformative science with more significant social commitment, facilitating cooperation with different stakeholders in civil society. It represents an opportunity for communities and citizen organisations to find new ways to thoughtfully engage in actions and policies on socially relevant issues

But initially, you might just take it easy: just stroll and create a shared experience.

ISALA, Street engagement in Brussels (2022)
Isala is the world’s largest citizen science project on women’s health studying the female microbiome and its influence on our health and wellbeing. Although this project is not necessarily an urban exploration project, it makes extensive use of urban spaces for discussion, engagement and knowledge creation.
src.: Isala/ars electronica

What We Know Has Many Dimensions



In this experiment, we use a space to present information in a three-dimensional arrangement instead of locking it away in a flat book. We will be an exhibition curator of our brains and see how this will create new and unforeseen connections.

What We Know Has Many Dimensions SENSE.

Why?

Knowledge creation is not linear – it never was and never will. In the STEAM.SENSE project, we try to reinstate the parallel, the crossover, the diagonal, and the multiple connectivity: knowledge generation is an act of creative, associative perception.

When Newton saw the apple falling, it was a moment of creative perception.

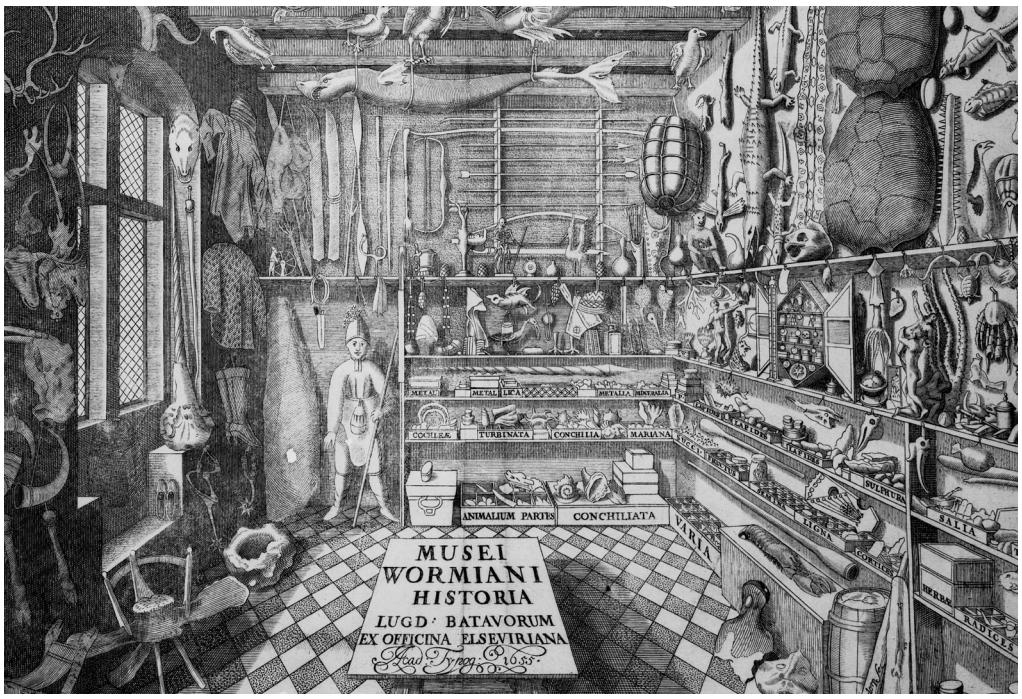
We often force our knowledge and thoughts into the 2-dimensional format of the written book with all its linearity. Although tools like whiteboards with post-its and graphics can promote innovative thinking, they still primarily utilize two dimensions. By embracing all dimensions to organize and relate our thoughts in a dynamic array of sensory interconnections, we open ourselves to unexpected connections and possibilities.

How?

Of course, we are talking about curating an exhibition. Exhibitions are great knowledge connectors. For instance, when we go into a museum, we never look at one exhibition exhibit only. We move through a relational space where many artefacts are visually talking to each other, allowing us to forge associations. Good exhibitions combine and create through relating artefacts within space.

So why not use this principle for an educational activity? But not to present a static final "result" of knowledge but to curate a constantly developing process or creative inquiry.

If many participants do this in one place in parallel, all exhibits will start to interact with each other, presenting a mace of intertwined thoughts. Take any theme: Explain Einstein, Roman history, or explore coding technologies, but display them in three-dimensional form.



"Musei Wormiani Historia", the frontispiece from the Museum Wormianum depicting Ole Worm's cabinet of curiosities/ (1655)

A Cabinet of Curiosities was an encyclopedic collection of notable objects, including rare and precious works of art made of a wide variety of materials. They evolved since the 16th century. The art historian Horst Bredekamp identified them as collections that "playfully profound" researched the world and inspired scientific discoveries such as the theory of evolution.
src.: Wikipedia

For this, you need: yes, boards, vitrines, displays, paper, clay (why not?) – Anything that can be used to create an exhibit piece is welcome! And yes, the ceiling and the floor are underused resources. Use them!

Display equipment is what you need. Space will come.

Further Suggestions

Humans have tried to explore and understand the world through a collage of natural phenomena and artefacts for centuries. For example, the famous Cabinets of Wonder presented an attempt to explain and capture nature through the combination of many exhibits. Historically, these cabinets were often dismissed as mere "follies," but many scholars now view them as sophisticated, creative, and even subversive predecessors to Darwin's ideas of evolution by simulating the complex nature of our ecosystems.

The first exercise might be for all participants to visit a museum and try to comprehend this as a three-dimensional vessel of artefacts that talk to each other. What do we learn from this? How would you rearrange it? What role do the visitors play? Do we find interesting meanings that evolve from spatial relationships?

The next task will be to create artefacts that represent what participants wish to display. For instance, if we continue with the coding example, how would you illustrate how programming a computer works? What would a "Loop" (a common coding element) look like when visualized in three dimensions? What are the components of a computer? Can an algorithm be employed to organize a space?

The process of artefact creation is an important translation process of immaterial ideas and thoughts into the physical world. That's where the

STEAM Lab Louvre
"Shaping Herbariums" The activity focused on creating images and producing colour from the direct printing of fresh plants. A first workshop involved reproducing the real shades of plants' colours as accurately as possible and representing them through observational drawing. Another session introduced the use of a traditional technique of hammering plants to create images of the very chromatic materiality of plants.
The activity was supported by a carefully curated display of the selected plants and final products displayed prominently, allowing participants to immerse themselves into the transformation process from nature to art.
src.: SENSE.

What We Know Has Many Dimensions SENSE.

Eröffnung der ersten großen Dada-Ausstellung
in den Räumen der Kunsthandlung Dr. Burchard, Berlin, am 5. Juni 1920.
links nach rechts: Hausmann, Hanna Höch, Dr. Burchard, Baader, W. Herzfelde, dessen Frau, Dr. Oz, George Grosz, John Heartfield.

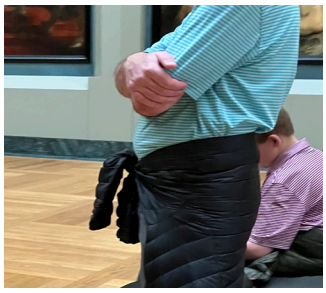
creative transformation of information leads to a deeper understanding.

You can start with easy exercises, like arranging information on large sheets of paper, boards etc. on a large display. Beginning with a two-dimensional medium is an easy way in.

In the next step, hang and display those 2-dimensional artefacts wherever you can, but arrange them consciously with visual relations in mind. The group can agree on one overarching strategy, or each participant can start with a personal curation strategy in parallel.

And then go wild: there is no limit to arranging things in 3 dimensions, adding artefacts all along the way.

But don't forget: change, develop and reflect – and discover. The active exploration of the exhibition is as important as creating the exhibition.



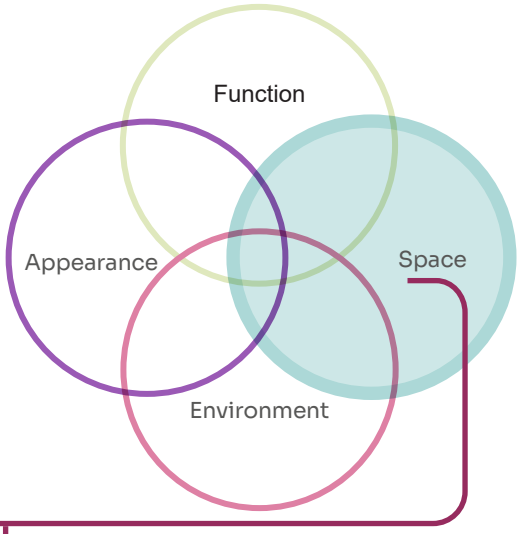
Left: Grand opening of the first Dada exhibition: International Dada Fair, Berlin, 5 June 1920.
This notable exhibition aimed to deconstruct the state of society after WWI with a subversive 3-dimensional collage, creating a dense network of grotesque associations
src.: Wikipedia

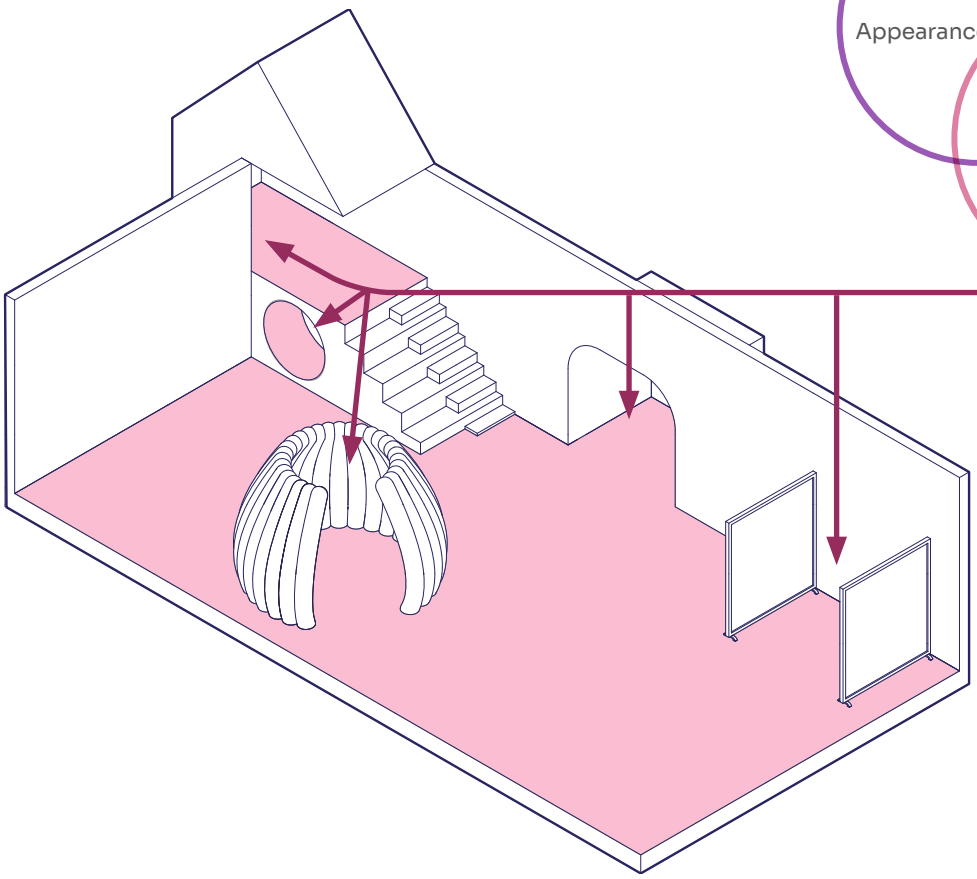
Right: STEAM lab Louvre
Participants were tasked to explore the museum, however, not to study the artworks, but to observe how visitors interacted with the paintings, particularly with their hands. This sparked a debate about the extent to which a museum disembodies the art experience.
src.: SENSE.

STEAM lab GEYC
Spontaneous collage as a comment on an activity that deals with gender stereotypes.

Often things and how they relate tell more than words.
src.: SENSE.

Togetherness and Privacy: The Niche





Subdividing a space with simple or - if possible - more elaborate means creates subspaces that allow for more choice, less hierarchy, and spatial diversity, as well as protection that facilitates inclusion.

What if we could decide more flexibly if we want to do our practice all together or on our own / in smaller teams? In this experiment we change the spatial setup, for example, of a classroom. We add smaller spaces that shelter and subdivide but never loose connection.

Togetherness and Privacy: The Niche SENSE.

Why?

This experiment aims to use spatial means to facilitate group working dynamics. Creating niches in a big space allows us to experience how important sight is for our educational practice.

Usually, the facilitator of an activity, the educator or teacher, can see all participants simultaneously. Certain forms of authority and control depend on this overview. If participants can choose if they want to stay in their niche, as in a semi-private, protected space, or work in the common area, this may promote independent, less controlled and maybe more innovative ways – questioning hierarchies at the same time. New learning processes – together and separately- can emerge just from a simple intervention into the spatial setup.

SENSE.STEAM-inspired activities often require an element of exposure by the participants, causing a feeling of discomfort to some. A niche can help here by providing a protected space, lowering the threshold of personal engagement. This is especially important for participants who – for many reasons - might not feel comfortable exposing themselves to the whole group and benefit from an amount of spatial encouragement or, like in the case of neurodiverse participants, protection. A niche can be a separating element which simultaneously facilitates inclusion.

How?

Using niche arrangements is most effective for learner-centered activities, which often involve group work alternating with central discussions, such as forums where each groups present their results. A niche is the ideal spatial typology to facilitate this type of activity. In this case, the spatial organisation of the learning environment goes hand in hand with the design of the activity.

However, it can also be the other way around: a differentiated “niche” setup can inspire the design of a STEAM activity.

“The Sitting Walls” Robert Blake and Elmwood Secondary School, Bridgwater (UK), (2012)
While a niche can be a very utilitarian tool for subdividing a larger space, it can also become a device that actively plays with light, shadow, and space, creating a cosy “cave-like” area that students enjoy, as it gives them an immediate sense of ownership.
src.: https://heinrichpalmer.co.uk/

Togetherness and Privacy: The Niche SENSE.

STEAM Lab University of Edinburgh
During the lab,, participants took ownership of the garden. Part of this spatial appropriation was for the students to create an arbour—a niche formed by hedges—which is both an exercise in understanding how nature works and an experience of the joy of feeling spatially empowered.

Additionally, a niche can also be an additional spatial offer that can be used within any educational activity without the intent of separating participants. However, sometimes and often unpredictable participants intuitively seek spatial separation – like "going to another room to discuss in a smaller round". Another room, however, has the significant disadvantage that it keeps participants fully isolated. A niche, in contrast, maintains the balance between spatial segregation and integration. This way, niches can lead to surprising results and unexpected group dynamics enriching any STEAM activity.

Further Suggestions

Browse the catalogues of furniture providers, especially for workplaces and universities, and you will discover that niche typologies are everywhere and can be purchased in any form, such as miniature houses, blow-up pods, or cave spaces. Niches are in vogue, but their use is often limited outside university and workplace cultures. For instance, schools rarely incorporate them into learning environments. If you don't want to spend money on furniture or remodelling existing buildings, you may be asked to deploy some creativity.

Use big screens, curtains on strings or partition walls. Be mindful that some niches may naturally receive more light than others and may require additional lighting. However, if you are already on the case, you might use more unconventional materials and forms to create niches, caves, nooks, and arbours – however you might call them - in any shape you and the group fancy. Determine: How long can the niches be in place? Is the room used by other groups, educators, and teachers, who must be asked beforehand? Would you like to limit the experiment to a week or a month? Ideally, you create niches which you can reuse, remodel, and adjust to your needs.

It should be a group effort to rebuild the spatial setup and create niches. In fact, making and arranging a niche can become a joint and joyful

Togetherness and Privacy: The Niche SENSE.

activity at the beginning of an activity, offering a suitable conduit for a discussion on how you want to collaborate as a group.

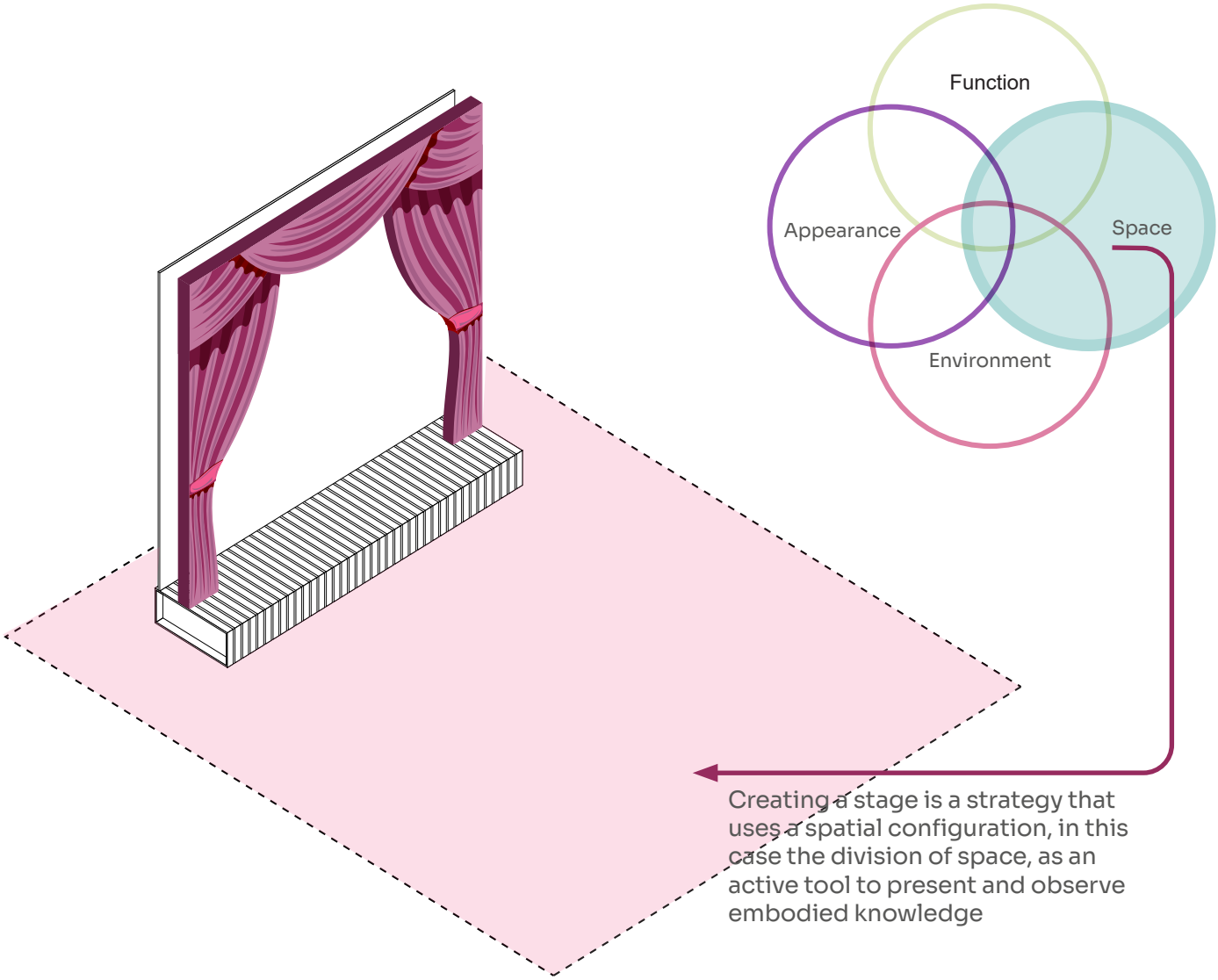
The key element of using the niche is establishing its relationship to the main space. Typically, niches are on edge, so the spatial flow of the main space remains uninterrupted. With this configuration, you are always on the safe side. Start with this. But there are no fixed rules. Other formations are worth trying out. A niche, for example, could be elevated on stilts, creating a nest or hive; another two great synonyms for niches. The sky is the limit.

The best thing is to stay flexible and use moveable pods or something similar. Start doing your usual practice in the new setting and stay attentive: Observe what works and what doesn't, when participants choose between being in or out of sight, together in the big group, or more withdrawn. Look for opportunities to reorganise learning processes incorporating the observed choices. This way, niches can serve as finely tuned instruments to orchestrate group dynamics.

You will see niches are natural winners!

Inflatable Pod, Glasgow Caledonian University
The material used in the construction of the inflatable pods allows light to pass through, making them feel less imposing despite their large size "Niches" come in many shapes and are often designed to be flexible. They are features in large open-plan arrangements of universities, for example, and have proven to be well-liked places of retreat. Again, the semi-permeable character is key to this success
src.: http://www.jiscinfonet.ac.uk

The Stage



In this experimental sequence we demarcate a certain area as our stage and play with the spatial division of presentation vs. observation, as well as with the theatre of evidence, that's always a part of learning.

Why?
A stage is a space that offers us choices: What do we want to put on stage? What special rules apply to the space which forms the stage? Working with a stage means highlighting the act of presenting, which is always a part of learning practices and experience. In traditional science education, we are usually focussed on the content of scientific and educational presentations. In STEAM, however, and even more in the SENSE approach, we are also interested in the aesthetic factors that support the creation of evidence and understanding. A stage is like a looking glass and a golden frame – supporting the showcase of everybody's expertise.

How?
Creating a stage doesn't have to be complicated. We can move some furniture out of the way and put tape on the floor to mark out an empty square, not too small. There, that's our stage. Fundamentally, a stage divides a space into one part that is primarily for presentation and another part that is primarily for observation. A stage does not become a stage because it consists of a podium or has a red curtain (although a podium and red curtain are pleasing and DO help). A stage is a stage because it is empty, to begin with, and it is up to us what we want to showcase. Everything we put on it - an object, a gesture, a statement - will have more meaning because we have chosen to put it there.

"Understanding Galvanisation"
At a school in Hamburg students had to translate their knowledge into scenarios which were then performed on stage. By doing so students had to make their knowledge communicable and translate an abstract scientific principle into a narrative which again had to be translated into a 3-dimensional space that would address all human senses. While the experiment helped the students understand a chemical process, its creative interpretation into a 3dimensional space showed them how science and creative processes can intertwined into a complex spatial arrangement.

Schulze Heuling, Lydia. 2021. "Promoting Student Interest in Science: The Impact of a Science Theatre Project". LUMAT: International Journal on Math, Science and Technology Education 9 (2):63–81. https://doi.org/10.31129/LUMAT.9.2.1489.

Further Suggestions

Before we present full performances on our little stage, let's embrace the magic of minimalism. For example, we can combine objects and statements randomly: One participant chooses a statement to make, and another chooses an object separately. By putting both - the object and the statement - on the same stage, something will happen between them. This can be funny or even enlightening.

Following this path, we can continue to use our stage for small experimental show-and-tells:

We can try to use random objects as models to demonstrate learning content.

We can try to demonstrate learning content without words.

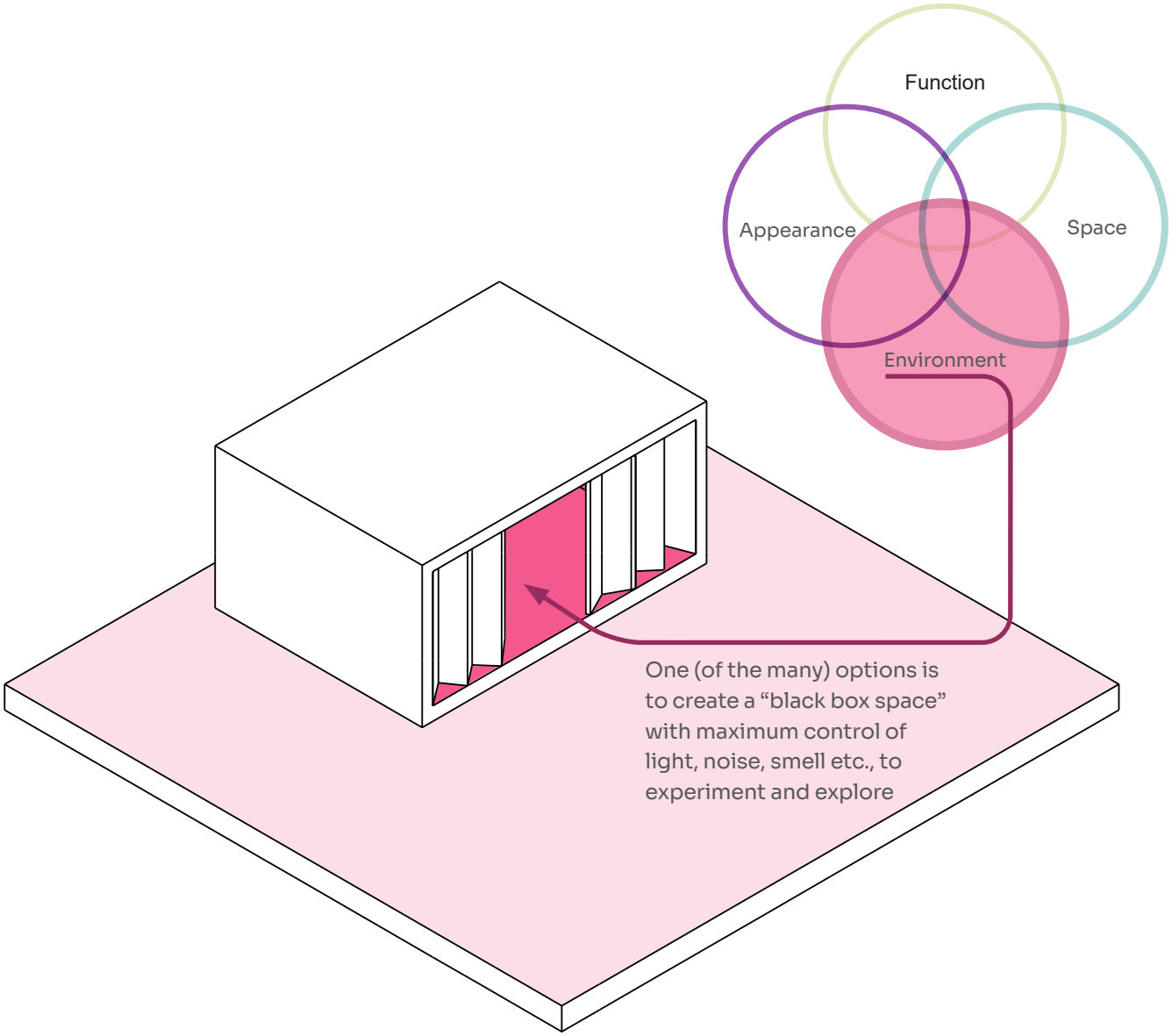
Fundus Theatre Hamburg
Since 2003, the research theatre as a scenic laboratory dedicated entirely to research between childhood, art and science. Formats and methods of performance art allow the researchers to access the theatre in their own way. The theatre thus becomes a forum for research for everyone, where we can experiment with new forms of knowledge and publicity - from kindergarten to graduate school.
src.: Fundus theatre Hamburg

A stage can be made from everything. It is a simple spatial strategy that turns human beings into observers, presenters and universal creative researchers.

Or could the learning content even be demonstrated in a way that affects the speakers themselves? The stage is a good place for self-experimentation to be witnessed by others.
What happens on our stage can also be timed in interesting ways: Imagine the room is dark, and the people on stage can only speak for as long as a burning match lights them. And then it's the next person's turn.

If our stage is big enough for all of us to be on, we can also use it as a heterotopian zone - a space that has slightly different rules than the space around it. For example, in our heterotopia, we might all have different roles from those in the surrounding classroom. This might correspond to a particular project we are working on; for example, in our heterotopian zone, we are all miracle seekers who come together to share their findings. As miracle searchers, we could be equals in our heterotopian zone, no longer divided into teachers and students.

The Sense Lab



In this experimental series, we create spatial conditions that allow us to control environmental factors that impact our sensual experience of the world around us: light, air, sound, smell etc. - similar to scientists who create lab spaces that enable maximum control.

Why?
It is essential to the SENSE.STEAM approach to connect learning to sensory experience. We often think there is a definite list of "5 senses". However, the exact number is a hotly contested subject. How many senses do we really have, and what can we call them? What about the sense of balance, pain, temperature.....?

If you're curious to explore this topic, you've come to the right experiment.

Combining arts and sciences allows us to explore the nature of our senses. The connections between our learning practices and our sensual perception are abundant.

This experiment strikes a delicate balance between the limits and nature of creative exploration and objective testing. How do scientists use subjective senses to make objective sense? How can we manipulate our perception by controlling the environment? And what objective knowledge can we learn from creating environments that bend and twist our senses with light, smell, air, sound, and texture?

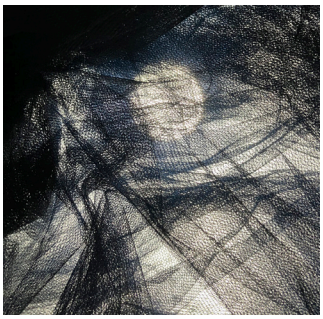
Feel the hot, smelly, soft and glaring impact of subjectivity colliding with scientific objectivity!

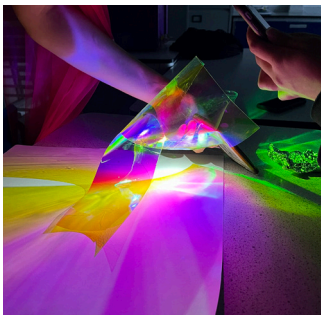
How?
Bruno Latour, the well-known French sociologist, once claimed that scientists only find out what they – subjectively - intend to find out, albeit in a very systematic – objective - manner.

The sense lab plays with this contradiction and creates a space with a very controlled environment, a black box (can be any size!) that allows for an exact play with light, air, noise or other environmental factors. In a word, the perfect lab.

By exploring the effects of, for example, light in a darkened space, we create a highly individual environment for systematic experimentation with shadows and colour reflection.

STEAM lab Hawkins\Brown, "Light and Shadow Hunting"
Hawkins Brown used a science lab at school to carry out experiments with light and different materials. The lab benches and good environmental control helped the participants engage focussedly and systematically, however, with quite a wide range of outputs. (See next page). src.: SENSE.





Analogue to the scientist, participants engage in the process of systematic testing, however, with a highly personalised outcome.

Participants should reflect on the creative process of intuitive choice.
Participants should also reflect on the scientific phenomena they explore.

Will they spot any connection?

And what role does the space play in this context?

Further Suggestions
We should not take the term “lab” too literally. We don’t have to build a new lab building. We can turn existing spaces into temporary labs. Take out or rearrange the furniture, hang fabric into the windows, make sure you can control the temperature and airflow. Make it yours!

Or go into an existing lab! Many schools have specialist spaces of this kind.

STEAM lab Hawkins\Brown, “Light and Shadow Hunting”
Left: Some of the outputs from the light experiments. The participants produced a wide variety of effects and imagery without having a defined brief. Most participants thoroughly enjoyed being in control of both the environment and the brief.

Right: The activity was carried out in different spatial settings. The participants who occupied a vast school hall were struggling with the lack of environmental control until a ray of sunlight and its reflections turned the tall space into an immersive sense lab.
src.: SENSE.

If that is not feasible, you can use the right equipment to conduct experiments, for example, with light. A strong torch that overpowers existing sources might do the job, too. A massive plastic bag can isolate smells. Headphones can cotrol sound.
If you don't have an environment that is usable for the envisaged experiments, you can also build a miniature lab. Take a cardboard box and create a "raree show", a little box for experimentation, a small world in itself. Creating a miniature lab can be a STEAM activity in itself: which shape do I give this simulated space? What equipment do I need? In one of the SENSE.STEAM labs this led to fascinating results of new worlds made from light, colour and shadow, creating many little worlds in an otherwise vast space that was hard to control.

Ask the participants: What happens to light and shadows if you fiddle with the light? Have you observed closely what type of shadows you produce? Can you explain these? (And why would you?) What kind and colour of light do the participants like? Could something be done to create this type of light in the room, for example, by using headlight foils in windows or around light bulbs?

Rooms also often have a particular smell. How does our room smell? For example, we can change the smell with freshly cut lemons, herbs, or other scents. What scents do the participants like? Does it change how they carry out other activities? Can participants take turns to create a pleasant smell

Top: Lucas Y Hernandez Kresta Garden House Madrid (2024)
This prototype of a Garden House could be easily used as a sense Lab that could be moved around and complement other activities or be at the centre of an activity, with participants moving in and out. src. Divisare

Bottom: STEAM lab Hawkins\ Brown, "Light and Shadow Hunting"
If the spatial conditions don't allow sufficient control, a miniature space will help. Building a mini lab can be much fun and evoke a feeling of empowerment and spatial agency. src.: SENSE.

for each session? Can you create new spaces with smell?

What is the sound of our room? What do we hear – listen closely.
We can try to add a new background sound to the room. Listening to the sound of the ocean or birds singing in the forest can change the atmosphere of our practice. Again, we can ask: What are the participants' preferences for a good learning atmosphere? Tape it, combine it, explore it. Line the walls and floor with fabric, and listen and feel how touch and sound changes.....

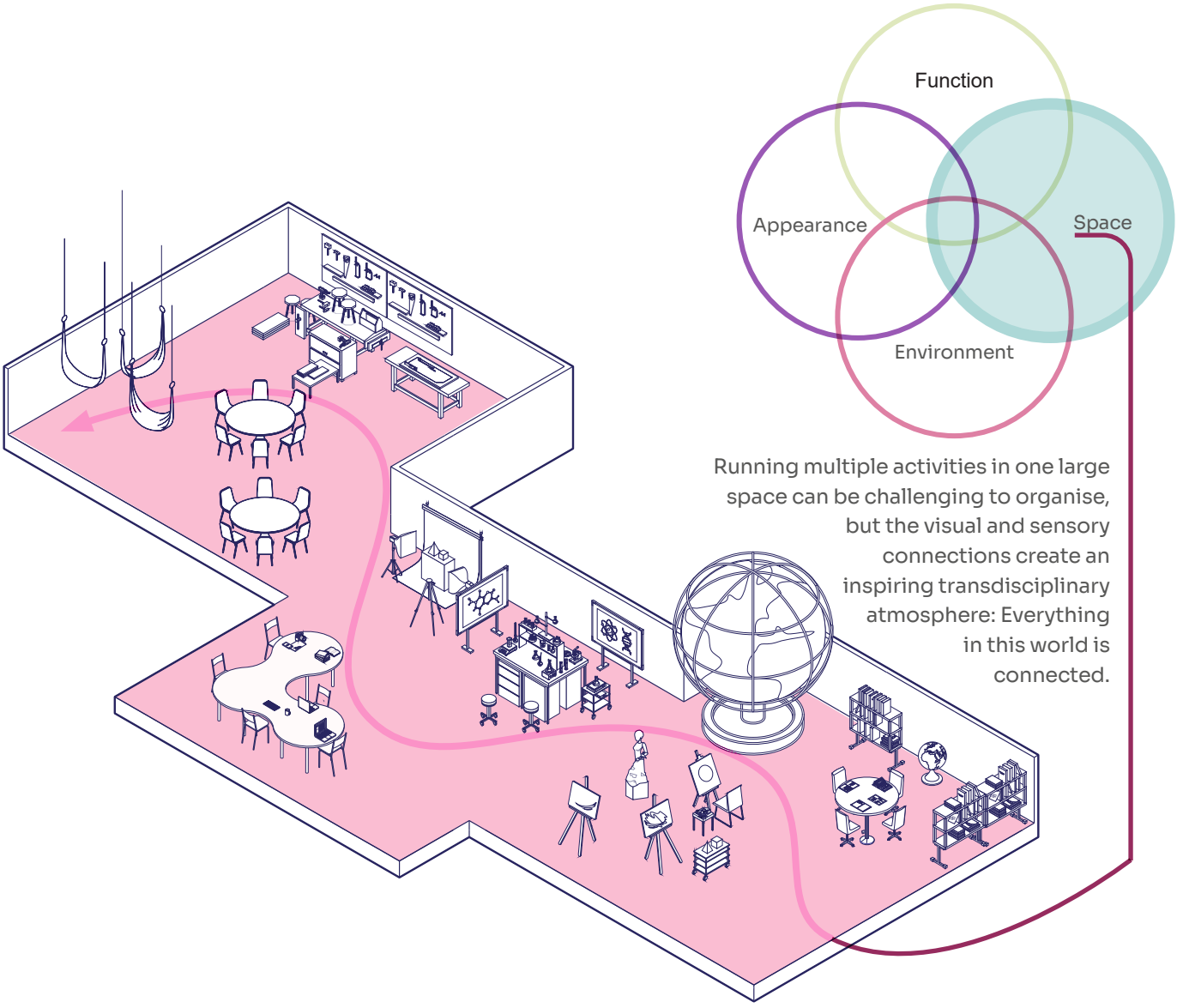
You'll discover numerous opportunities for exploration. The fascinating lesson here is that, over time, participants often become so absorbed in the process that they forget the original purpose of their experiments.

Do you think scientists always know what and why they are doing things?

There is no reason to believe that a lab cannot explore personal emotions and objective conditions at the same time.

STEAM lab Hawkins\Brown, "Light and Shadow Hunting", Kinsale Community School, Cork/Ireland
In this lab, participants received a vague brief: "Here is a light source and some materials. Now do something with it and observe how shadow and light create a wide range of effects." While participants mostly enjoyed the free flow of experimentation, they often returned to the question: "What has that got to do with science?". The facilitators then showed them an image of their lab alongside a stereotypical "lab image" (see below) with apparent parallels in the procedure. Both photos featured people engrossed in systematic exploration. This moment typically led participants to realise that creative and scientific exploration can be similar—not necessarily in their outcomes, but in their processes. Understanding this lies at the heart of what SENSE.STEAM tries to convey as a core message.
src.: Adobe Stock/SENSE.

The Da Vinci Studio



Running multiple activities in one large space can be challenging to organise, but the visual and sensory connections create an inspiring transdisciplinary atmosphere: Everything in this world is connected.

In this experiment, we will run a range of different activities deliberately in close proximity to each other in a large open space (such as the school hall or similar), with art next to microscopes next to acting. This way, we want to tear down the walls between the disciplines and mix an inspiring cocktail of art and science.

Why?
The separation between art and science as two distinct fields with little overlap is not old. Until the 18th century, science and art were viewed as intertwined, both enquiring about and researching the world's phenomena. Leonardo da Vinci was a painter and scientist. Only the artificial separation between the disciplines in the last 200 years has led to the current way of siloed science education, which STEAM tries to re-unite.

In today's society, artists and scientists don't share common spaces any more; they all work in specialised containers. And it is pretty simple: if you don't see each other, you can't inspire each other. For people to connect, they need mutual visibility and sensory exchange.

By removing this artificial separation and creating an atmosphere of cross-pollination, we want to recreate the atmosphere of a world where art and science are intertwined - like at the times of Leonardo da Vinci.[1]

How?
For this experiment, we need a large, flexible, and adaptable space that can accommodate a wide range of activities simultaneously. Many experimental schools, such as the Laborschule in Bielefeld or the UCL Academy in London, experiment with this kind of open-plan arrangement. Central to the success of this approach is

- to have the right flexible furniture that creates the right separation while maintaining the sensory connection between the activities. Even if it seems counter-intuitive, an element of positive disruption and interference is important.
- a pedagogical approach that promotes student-centred enquiry, facilitating independent self-organised work without needing a significant proportion of tutor-centred information transfer, which is challenging in large open spaces.

"Superstudio", UCL Academy, London (2014)
The UCL Academy is conceptualised as a "STEAM school", emphasizing project-based learning where students can integrate creative and technical subjects. Large "Superstudios" with flexible furniture that can cater for a wide range of simultaneous activities in one space are intended to offer an atmosphere of creative collaboration and inspiration. While these spaces are very popular with students, teachers face challenges in combining the traditional curriculum with the STEAM ambitions of the school in the lively Superstudios.
src.: SCABAL

[1]The term "Da Vinci Studio" was coined by Nair, Prakash, Randall Fielding, and Jeffery Lackney. The Language of School Design: Design Patterns for 21st Century Schools. Minneapolis, Minn.: Education Design Architects, 2020.

Further Suggestions

At this point one might argue that the "Da Vinci Studio is just about open-plan schooling, which has never worked anyway". Firstly, many countries, for example, New Zealand or Finland, are revisiting the model as an expression of a changed STEAM-leaning curriculum. Secondly, this experiment is NOT about open-plan schools in itself. It is about running activities of all kinds (commonly considered incompatible) in parallel and creating a buzzing atmosphere of exploration and inspiration.

Here are a few possible scenarios:

Do I know you?: Unfamiliar neighbours

This could be a warm-up exercise where, for example, an art activity takes place in a chemical laboratory, which is not necessarily suited but can be adjusted (see also the "Hack the Space" experiment. In parallel, the chemical experiments are conducted in the art space. Ideally, both activities leave some of the outputs in the respective specialist space and over time, both spaces become the expression of a true mixture of both "subjects" and, in some ways, more and more similar.

Laborschule (Laboratory School) Bielefeld/Germany (1974)

The Laboratory School in Bielefeld was founded in 1974 in collaboration with the University to test and promote an alternative educational and school governance models in a real-life setting. The school is attended by all age classes and includes a college that prepares students for university. The school's educational approach is student-centered and offers a diverse range of academic and vocational subjects, without relying on traditional performance grading scales. The school's governance is democratic, involving all students in the decision-making process. The building pioneered a radical open-plan design, co-locating a wide array of activities and subjects in a large space that is structured by furniture and different floor levels. The design aims at a holistic combination of all subjects, giving students a unifying spatial identity.
src.: Ministerium für Schule und Bildung Nordrhein-Westfalen

Everyone get together: messy co-location

Combine a range of activities in one room, each "doing their own thing in parallel". It is essential to give participants the freedom and time to wander around and "visit" each other. A "social point" where participants can hang out is essential to create opportunities for interaction. This social component is crucial for the success!

Everything in one place: the creative circuit training

A group of participants is tasked to develop a project that needs the input of many disciplines, for example, a new product, which requires design, imagination of future uses, research, technology, prototyping and testing. You should aim to provide the facilities for all this in one space with participants "rotating" through the facilities, driven by their needs and focussed on the process. A social space is crucial, too.

Multifunctional flexible makerspaces. Odyssea/ Athens (top) & Parliament Hill School/London (bottom)
Large flexible maker spaces have become the mainstay of STEAM education. This typology allows for a wide range of activities and the combination of arts and technical subjects. While the STEAM lab at Odyssea had no difficulties using their spaces for "non-technical" activities - the left image shows a discussion on gender portraits in the workshop - the use of this versatile typology has not yet entered the realm of traditional subjects - although it would (and surelly will!) be the perfect setting for future Da Vinci Studios.
src.: SENSE.