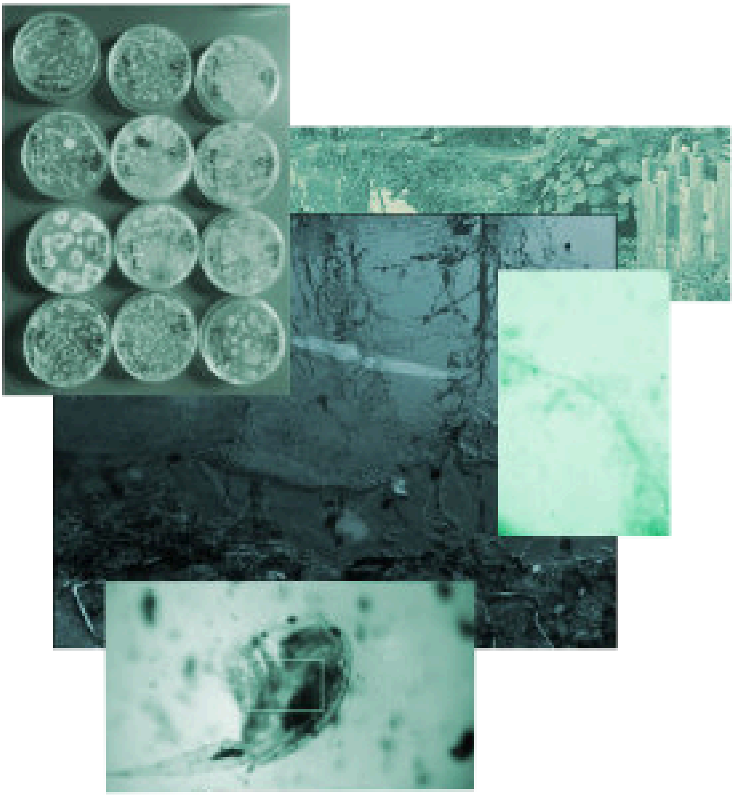
nd Rainwater Pond Rainwater Pond Rainwater Po

s Aquatic Ecosystems Class Aquatic Ecosystem



Negin Ehtesabian
Mindaugas Gapševičius
Jan Munske
Cosmo Schüppel
Dahye Seo
Alessandro Volpato

To all the critters
in our pond

This publication follows the procession surrounding a self-made Rainwater Pond, created to investigate the organisms in aquatic ecosystems through scientific and artistic means. The research was conducted during the class Life in an aquatic ecosystem, given at Bauhaus University Weimar, in the Wintersemester 2024/25, facilitated by Mindaugas Gapševičius & Alessandro Volpato. Participants of the class were: Dahye Seo, Cosmo Schüppel, Jan Munske and Negin Ehtesabian.

Life in an aquatic ecosystem set out to build rebuild a pond created in a previous semester, in the Campus Garden of Bauhaus University and to investigate its evolving ecosystem: Who lives there, which microbes colonized it first, what do their interactions look like and what are the effects of human intervention on the development of the ecosystem?

If you have a deeper interest in the class, all informations can be found on: *https://www.uni-weimar.de/kunst-und-gestaltung/wiki/GMU:Life_in_an_aquatic_ecosystem*

To understand how a pond gets created we need to talk about a central term of biological research: succession. Succession describes "observed sequences of vegetation (...) or animals (...) in time" (William, 1973) . In other words, describing the succession of an ecosystem means to describe how it changes over a defined period of time. In a succession, the different species of an ecosystem influence it in such a way, that its living conditions become favorable for them. "Succession is supposed to continue until the species combination best suited to the regional climate and the site are established" (William, 1973). In this process rivalries, symbiosis, extinctions, dominations and equilibriums are established.

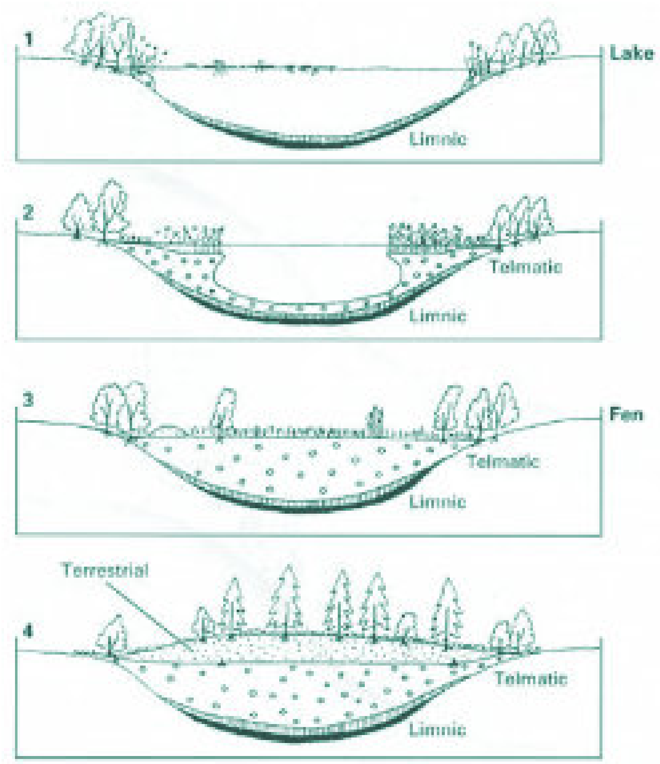
The natural succession of a pond– a body of water that lets light penetrate the bottom, is shallow enough for rooted water plants to grow throughout and that has no wave action on the shoreline (Biggs, 2005) – can be divided into four chapters: the oligotrophic stage, the mesotrophic stage, the eutrophic stage and the terrestrial stage.

This introductory text will discuss how ponds are formed without human intervention and how these process is reflected in the Storm Water Pond.

This process continues and finally the pond transform into marshy wetland, manifesting its terrestrial stage (Conti, 2025). As a wetland, the former pond-ecosystem gives room for terrestrial plants and animals to settle and the nutrition rich sediment turns to soil, hosting trees, shrubs and other higher plants.

In the beginning of a ponds life-cycle, a bare body of water is colonized by so called pioneer species. These species include algae and protozoans. At this stage the aquatic environment is mostly empty of nutritious and only species adapted enough to this environment find ways to survive. This nutrient low habitat is called oligotrophic. (Conti, 2025)

As more and more life settles in the pond, the nutrient levels rise and the pond transforms into its mesotrophic state. As nutrients rise, higher plants, such as pondweed, duckweed and other floating vegetation and filamentous algae, begin to transform the pond– accumulating nutrients and biomass (Conti, 2025). The more plants inhabitat the pond, the more animals are attracted to feed, find shelter and reproduce. (Missouri Botanical Garden, 2002) . These animals, again, feed the ecosystem with their biomass. Possible animals are insects, frogs, snails, birds and even small mammals. At this stage, a pond is describes as being in its eutrophic stage. In the next stage the biomass of the inhabitants are starting to fill the floor with sediments– letting the pond become more shallow. Plants start to dig their roots into the floor of the pond, continuing this process.



http://lakesalot.blogspot.com/2011/12/ecological-succession-in-lake-biomes.html

Watching a pond unfold, is watching it disappear. Although the process happens over more than a thousand years–outside of the frame of human observation–all actors in a pond eventually work towards the disappearance of their own species. The outcome is a process of continuous change, with a succession of species taking over the habitat of others. In an ecosystem only the species best adapted and specified to the conditions can settle and unfold. Meaning, when species change the conditions of the system, inhabitants are forced to adapt, or get extinct.

Looking upon the Storm Water Pond, we asked ourself how natural succession can be monitored in compressed time. Setting up a controlled habitat gives responsibility to the agent in control: How much shall be intervened? And how can be decided what species is aloud to live?

These existential questions followed us through the research presented in the following chapters.

Drury, William H., and Ian C. T. Nisbet. “SUCCESSION.” Journal of the Arnold Arboretum 54, no. 3 (1973): 331–68. http://www.jstor.org/stable/43781773.

Biggs, Jeremy; Williams, Penny; Whitfield, Mericia; Nicolet, Pascale; Weatherby, Anita (2005). "15 years of pond assessment in Britain: results and lessons learned from the work of Pond Conservation". Aquatic Conservation: Marine and Freshwater Ecosystems. 15 (6): 693–714. doi:10.1002/aqc.745. ISSN 1052-7613.

Conti, Paul, 2025 https://www.solitudelakemanagement.com/the-stages-of-lake-and-pond-succession/ (01.02.2025)

Missouri Botanical Garden, 2002 https://www.mbgnet.net/fresh/lakes/success.htm (01.02.2025)

The ecosystem of the pond we investigate is located in the Ilm Park, that is a 48-hectare landscape park on the edge of Weimar's Old Town. It was gained from nature and further shaped between 1778 and 1828. The park contains valuable trees, mostly local varieties (Some imported from southern Germany), but also some foreign trees, especially from North America; bushes were also planted.

Klassik Stiftung Weimar
Wikipedia, https://en.wikipedia.org/wiki/Park_an_der_Ilm

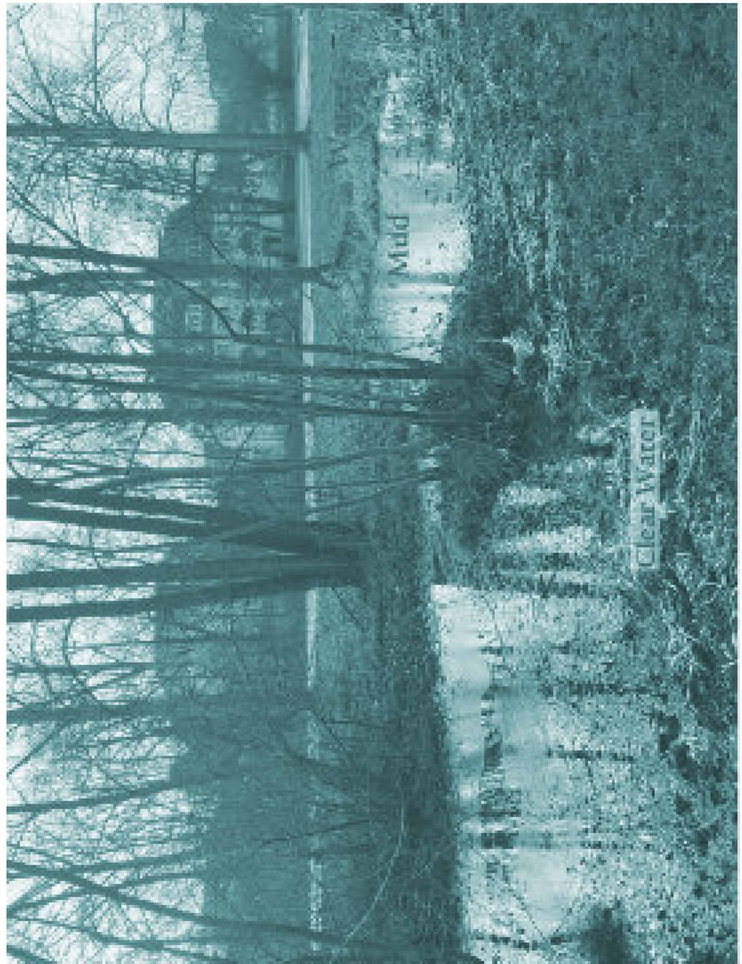
The aquatic ecosystem in Ilm Park, Weimar, is a rich and diverse environment that supports various organisms and ecological interactions.

The ponds in the Park are in two different categories: They are formed either by running water overflowing from underwater supplements into puddles or by rainwater collecting. The running water is clearer and deeper and it's surface is more open to the light. It has watergrass on the surface, and we have found Dracunculus medinensis worm and Cyclops in it.

In our research, we initially studied both ponds and compared them together.

We selected the rainwater pond for educational purposes and analyzed the microbiomes collected from various depth of the pond and at different times throughout the winter.

As temperatures dropped, we observed a decrease in algae count in all the samples collected from various areas of the pond.



In January, the pond had significantly more water than in autumn, which may contribute to increased algae growth, as they tend to rest and produce less in cold weather.

During winter, most leaves decomposed into organic matter, exposing the surface. This lack of cover no longer protects algae from excessive sunlight, cold, and small animals.

As a result, we observed that the number of algae around the edges and beneath plants is significantly higher than in other areas, such as the pond's center, which faces greater temperature fluctuations, freezing, direct sunlight, water currents, and less food. The muddy parts are too dark and thick for algae to thrive or receive adequate light.

Additionally, both the clear areas and muddy sections of the pond have fewer microbiomes in autumn and winter, both. Whereas, in general we found more organic matter and microbiomes in the shallow parts of the both pond, particularly around the edges, where the water is less clear.

In these areas, algae can likely settle during colder weather, as they have access to food that remains stable despite water currents, allowing them to thrive in an environment with more consistent temperatures.

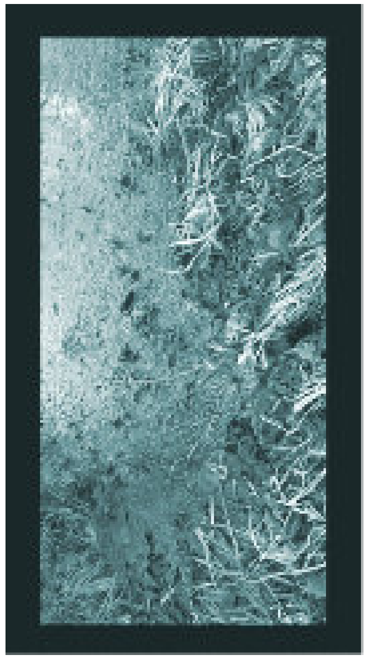
PH of both ponds are relatively similar and neutral.

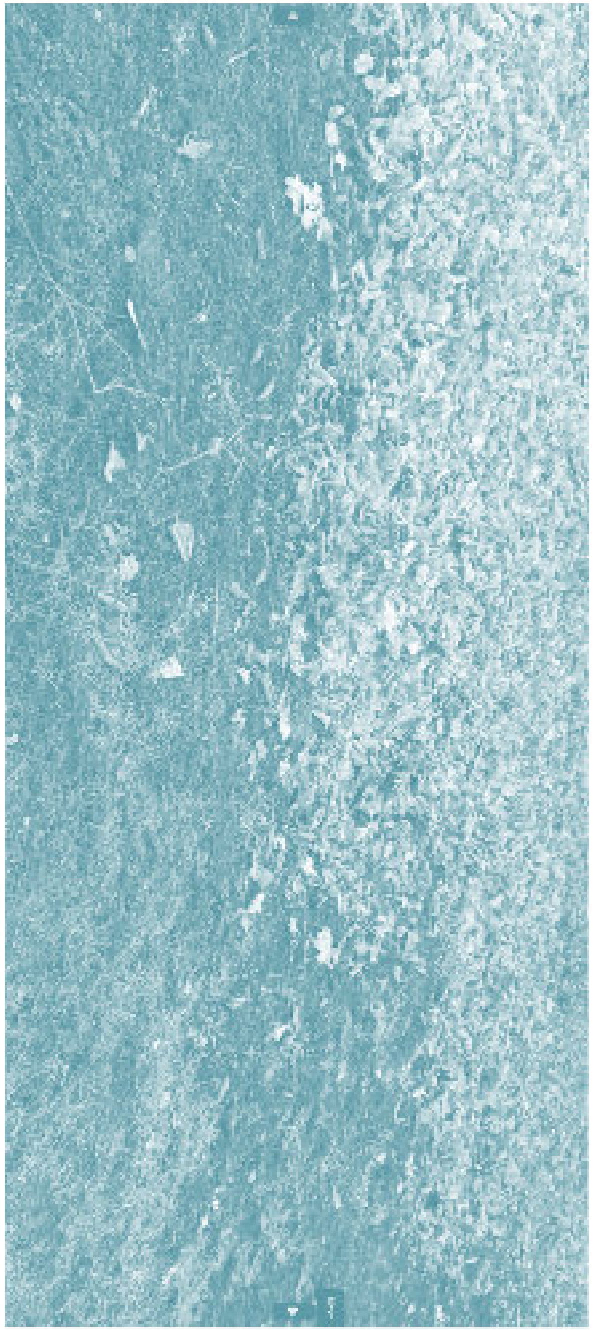
Plants

The abundant trees above the pond drop their leaves onto the water's surface, creating a richer, warmer, and safer environment for microbiomes, which contributes to higher algae concentrations.

Based on the leaf shape, there are many chestnut trees surrounding the pond. (American Chestnut; American or Allegheny chinkapin, also known as "dwarf chestnut"/ Castanea Pumila).

Furthermore, from the Hight and the smoothness of the Chestnut tree's barks, (The smoother, the younger) we can say they have been probably planted there since the park was built; maybe dislocated them from the southwestern Germany, because they generally belong to the warmth- and light-loving tree species. On the other hand, the fruit contains a lot of minerals and vitamins such as Magnesium, Copper, Iron, Potassium, Folate, Protein, Calcium.. .that are the best source for food.





Also, their seeds can naturally be rooted better in water, where the soil is so soft and they have time to make roots. So, we can observe more young Chestnut trees were used to be a part of the pond recently, compare to other areas that has been dried up long time ago.

The soil around the area is a dark built-up mud and light-weight, showing it has been a part of the pond before it dried up, while a tick layer of decomposed leaves is on top of it. You can almost observe the borders of the dried up bigger pond.

It has been likely connected to the other pond on the other side of the road, long time ago before it dried up.

Another observation is, a lot of common Sunburst Lichen on the tree barks and branches.

There is also different type of grass, such as Wood Meadow-Grass, Poa Parenesis, Vetiver-Grass, ...

Wildlife

There are a vast variety of wild life in Weimar, which a lot of them live in the parks and natural areas; Birds such as Eurasian Blue Tit, Carrion Crow, Eurasian Jay, Great Tit, Goldcrest, Hawfinch, common Merganser, Green Woodpecker, European robin, Mute Swan ...

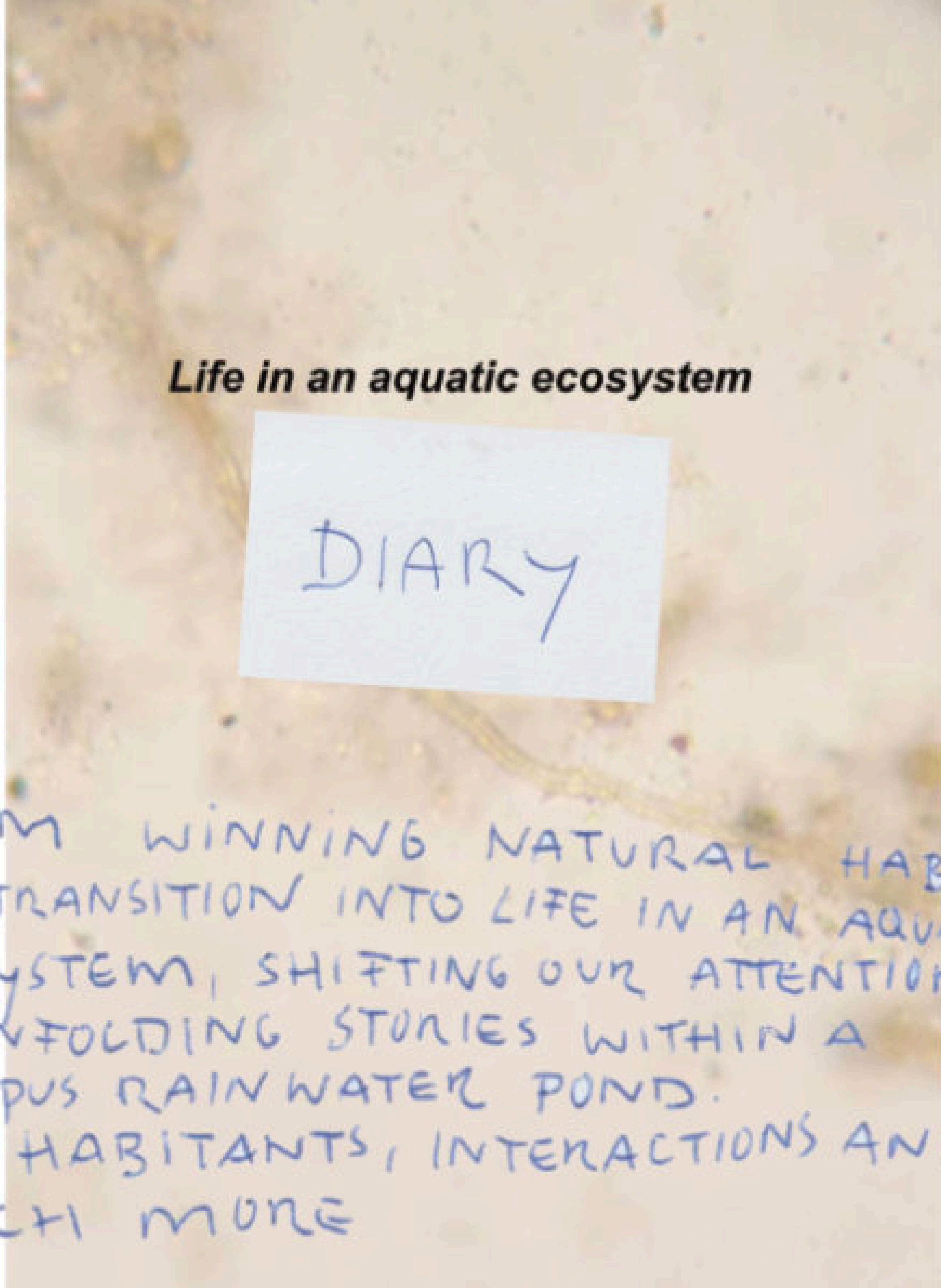
Small animals like Eurasian red Squirrel, European Toad; Insects, like European firebugs, Forest Bugs, Brown Marmorated Stink Bugs, Asian Lady Beetles, Black Oil Beetles, Common Blue butterflies, Common Carder Bumble Bees, and many more.

We observed several of them and checked the sound with the app BirdNet

https://ebird.org/region/DE-TH-WE/bird-list?yr=cur

https://www.inaturalist.org/places/weimar

Life in an aquatic ecosystem

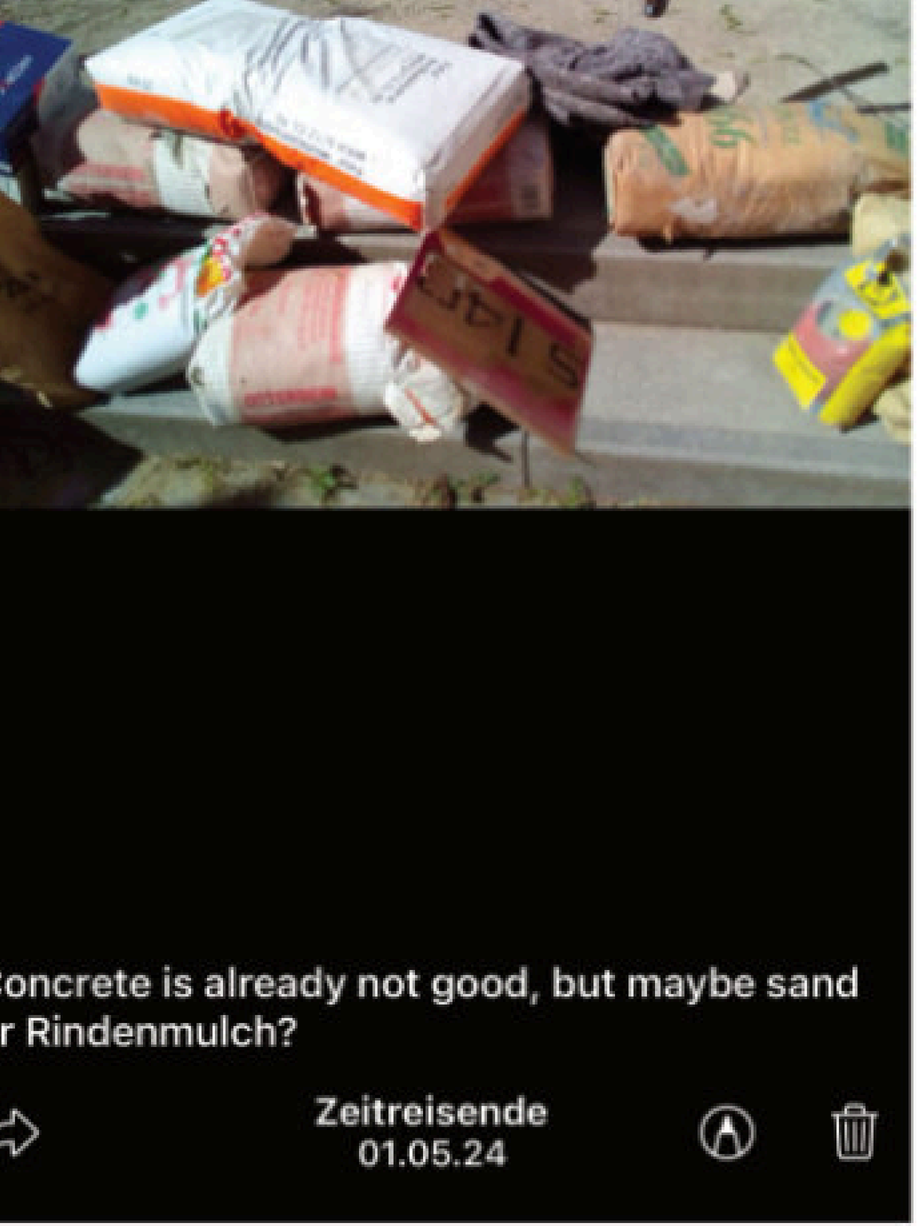


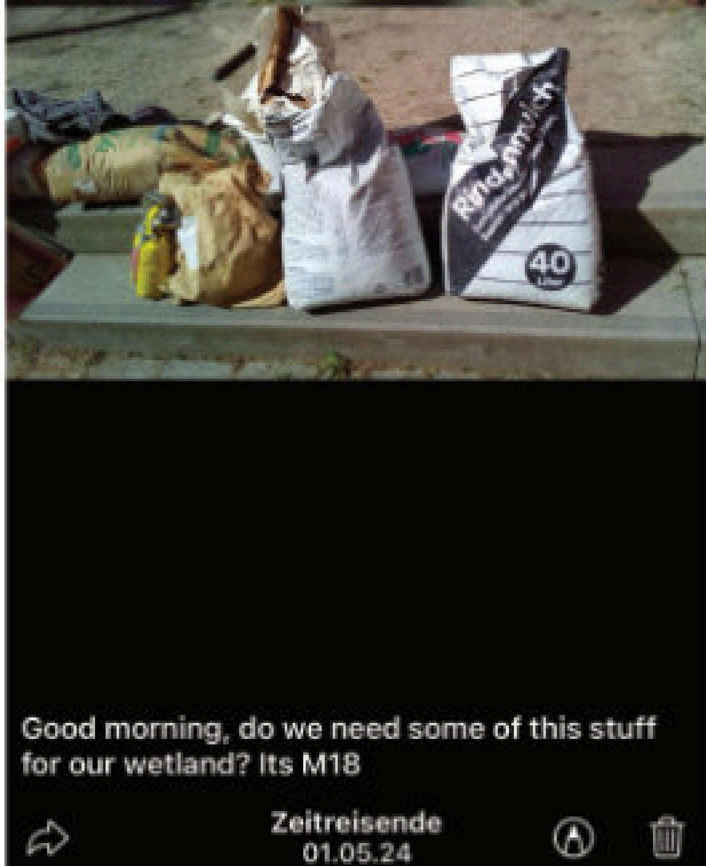
FROM WINNING NATURAL HABITATS, WE TRANSITION INTO LIFE IN AN AQUATIC ECOSYSTEM, SHIFTING OUR ATTENTION TO UNFOLDING STORIES WITHIN A CAMPUS RAINWATER POND.
ITS HABITANTS, INTERACTIONS AND MUCH MORE

THE STARTING POINT

POND VERSION 01
Photo after the workshop (first build)

WORKSHOP WITH OUTI WAHLROOS (FI). 25-27.04.202
TO ACKNOWLEDGE THE SERVICES WHICH
NATURE CAN OFFER HUMANS.





1.05.24

Equipment for pond building

All constructions are still in place! So are the plants

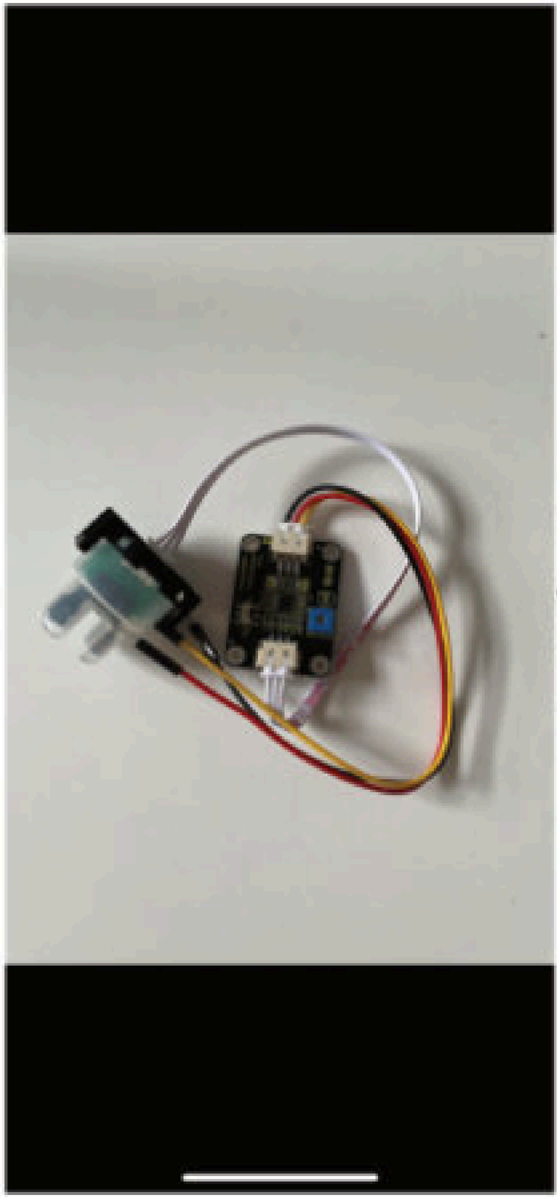
martha
05.05.24

On the left u can see our Tank. It collects the rainwater of the house next to the pond.
When this water overflows the tanks water runs into the stormwater pond.

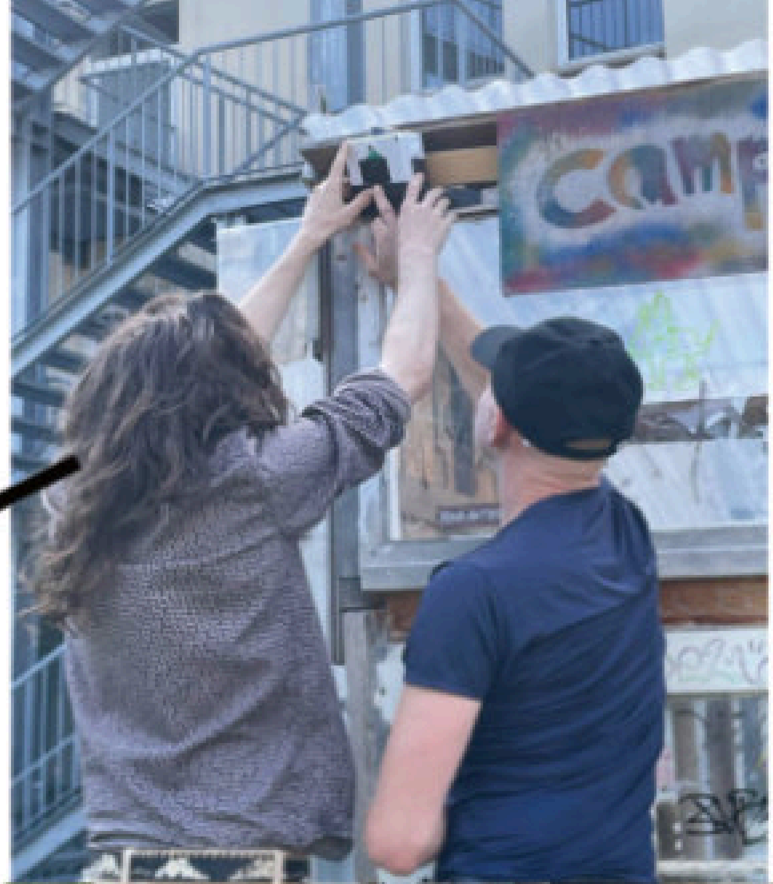
STORM WATER FIXING
WITH KLAUS AND JAN
GETTING TUBES AND:..

Unfortunately, the concrete water feeding system for the pond broke,
which left us with no choice but to find an alternative solution.
After assessing the situation, we decided to install a long tube connected to our stormwater tank,
which is part of the pond's lifeline system.
This new setup ensures that water continues to flow properly into the pond,
even during such unforeseen circumstances.

some pictures taken of happenings in **Pond 01**

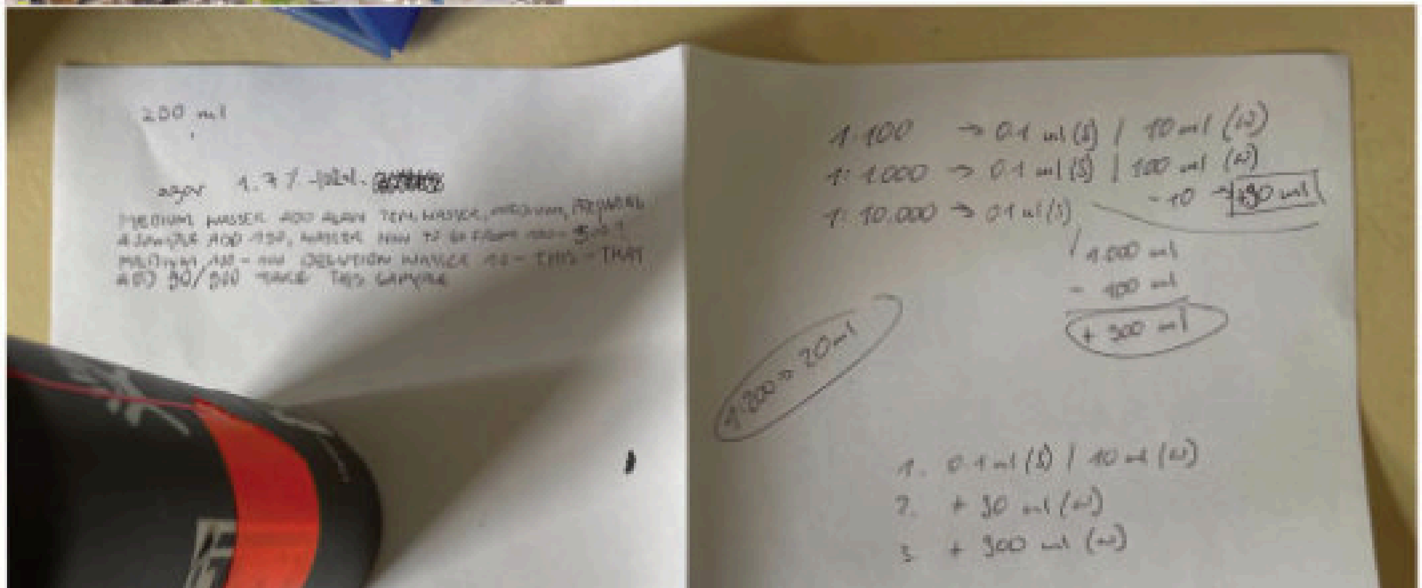


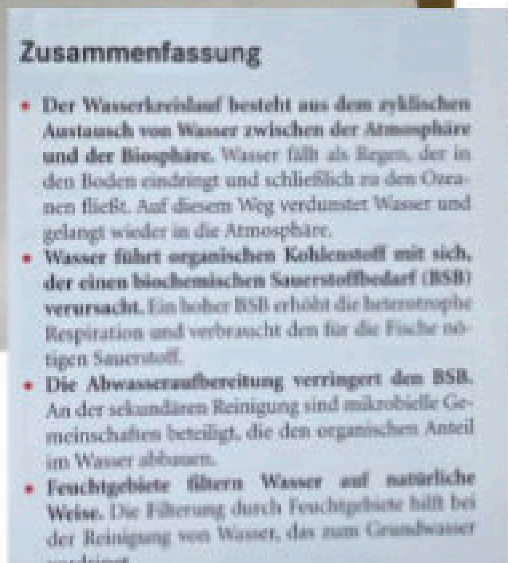
Cosmo Schüppel
And
Mindaugas Gapsevicius
Placing camera



Putting camera to take pictures of the pond everyday
And sending them via email to all people of intrest

WE WILL START WITH RAINWATER AND SEMI-CONTROLLED ENVIRONMENTS POPULATED BY SELECTED ORGANISMS.
PARTICULAR ATTENTION WILL BE PAID TO THE TRANSIET RELATIONSHIPS BETWEEN INDIVIDUAL SPECIES AND THEIR ENVIRONMENT.
WE TRACK CHANGES.





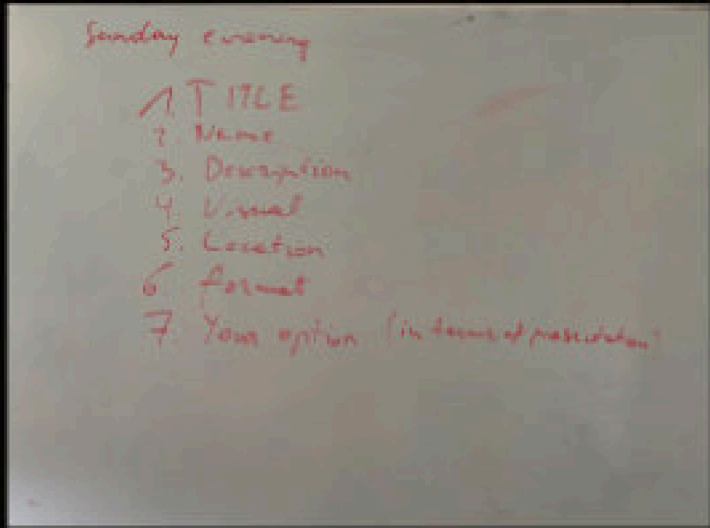
Zusammenfassung

- **Der Wasserkreislauf besteht aus dem zyklischen Austausch von Wasser zwischen der Atmosphäre und der Biosphäre.** Wasser fällt als Regen, der in den Boden eindringt und schließlich zu den Ozeanen fließt. Auf diesem Weg verdunstet Wasser und gelangt wieder in die Atmosphäre.
- **Wasser führt organischen Kohlenstoff mit sich, der einen biochemischen Sauerstoffbedarf (BSB) verursacht.** Ein hoher BSB erhöht die heterotrophe Respiration und verbraucht den für die Fische nötigen Sauerstoff.
- **Die Abwasseraufbereitung verringert den BSB.** An der sekundären Reinigung sind mikrobielle Gemeinschaften beteiligt, die den organischen Anteil im Wasser abbauen.
- **Feuchtgebiete filtern Wasser auf natürliche Weise.** Die Filterung durch Feuchtgebiete hilft bei der Reinigung von Wasser, das zum Grundwasser vordringt.

Biodiversity near the pond

Dear guys, please find the results/growth of your recent microbiological Experiment in the refridgerator of the biolab.

Klaus Joun
10.06.24



Mindaugas Gapševičius
13.06.24


Oktober 2024

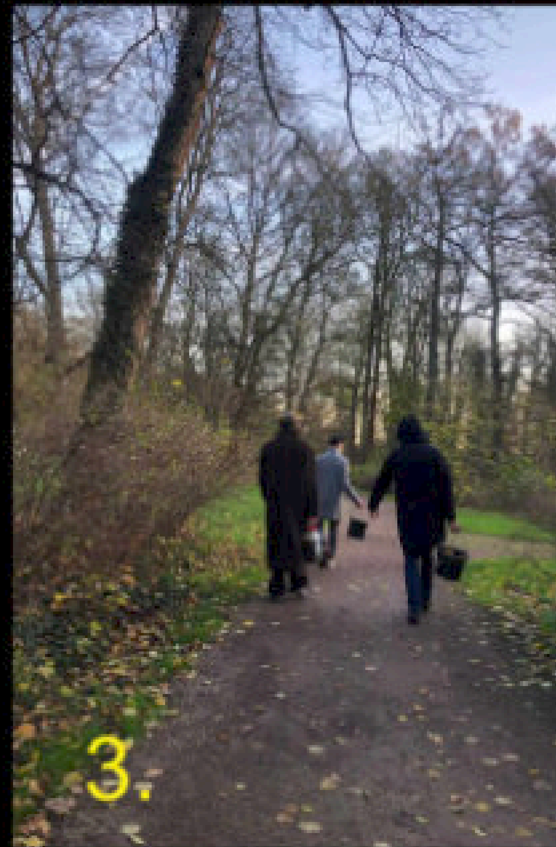

BENEATH THE BLADE
THE EARTH GIVES WAY,
A SILENT WITNESS TO
THE DAY.
EACH TURN,
A STORY,
BURIED DEEP,
OF ROOTS THAT HOLD,
AND STONES THAT SLEEP

18.10.2024
(WORKSHOP ON REDESIGNING
WETLAND)
13:30 - 18:30

Nov 18 2024


1.

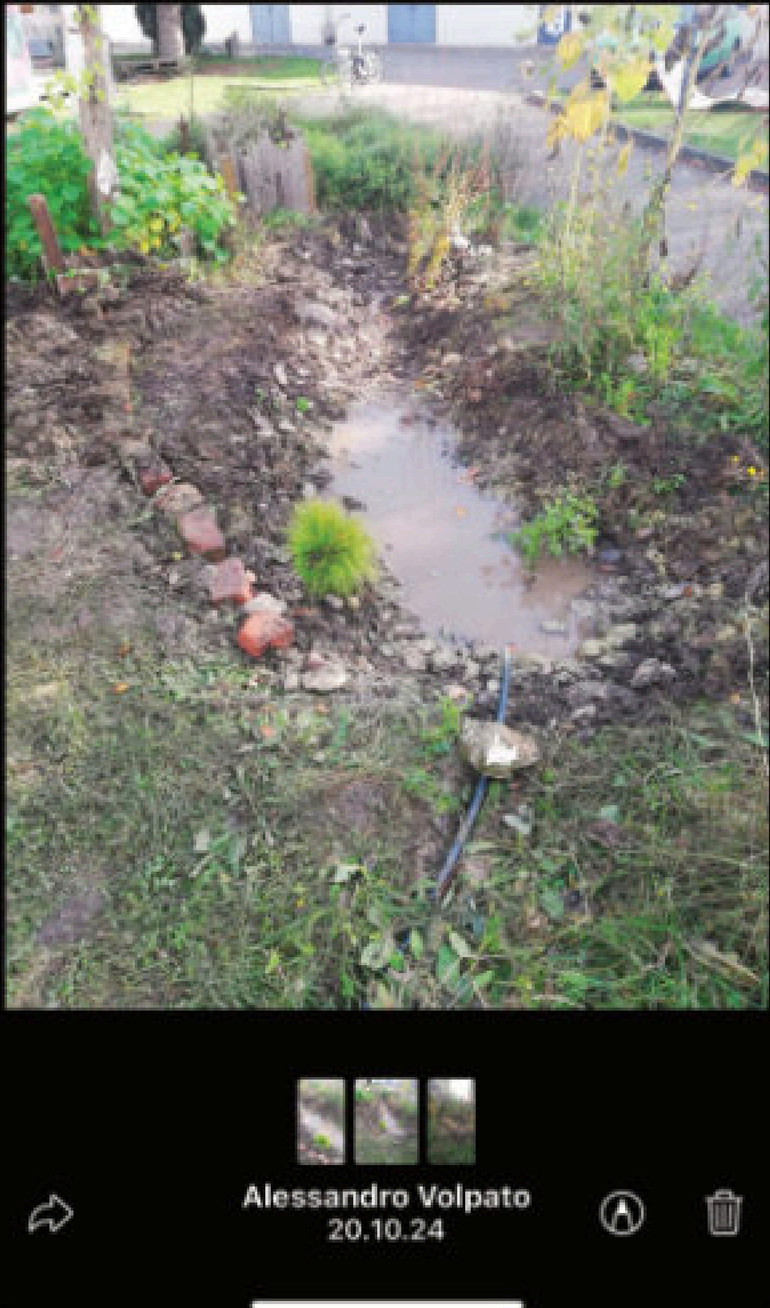

2.


3.

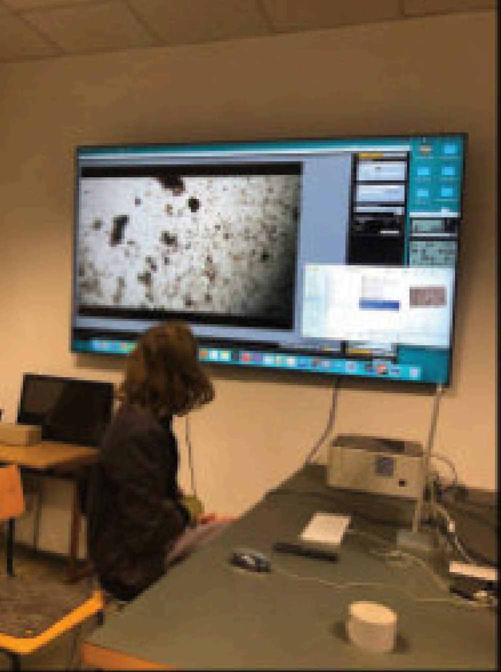
Collecting mud and water from a pond in Ilm park
Putting mud and water into our pond.

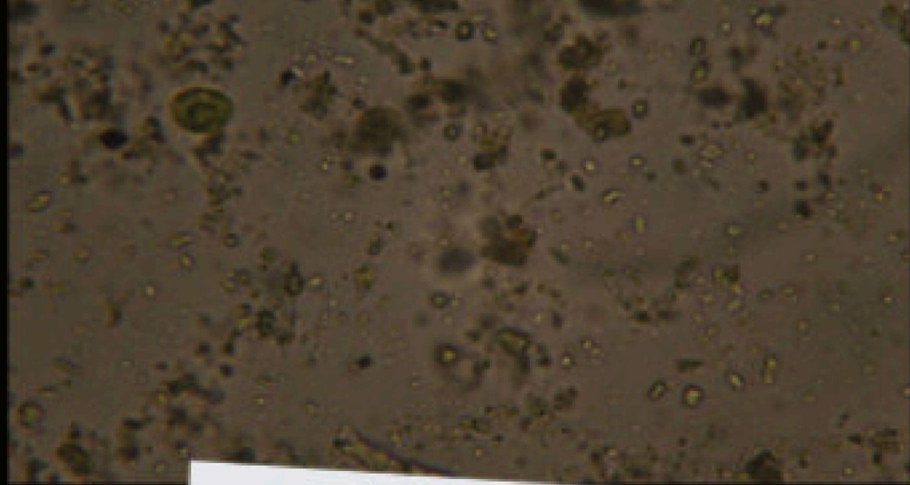
back at our pond

POND 02

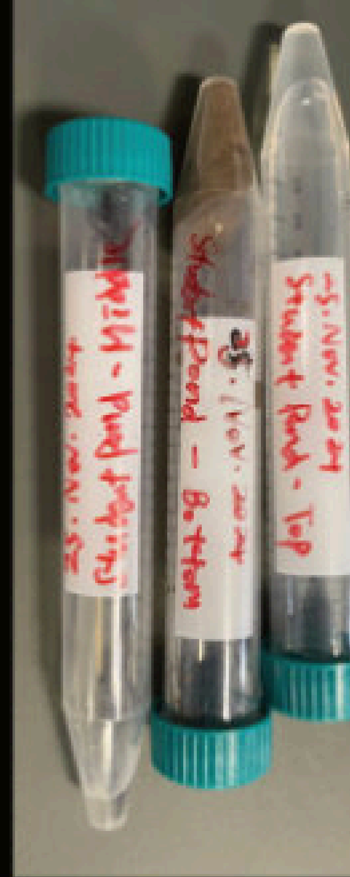


First pictures of the new made pond
This was needed because the pond was leaking

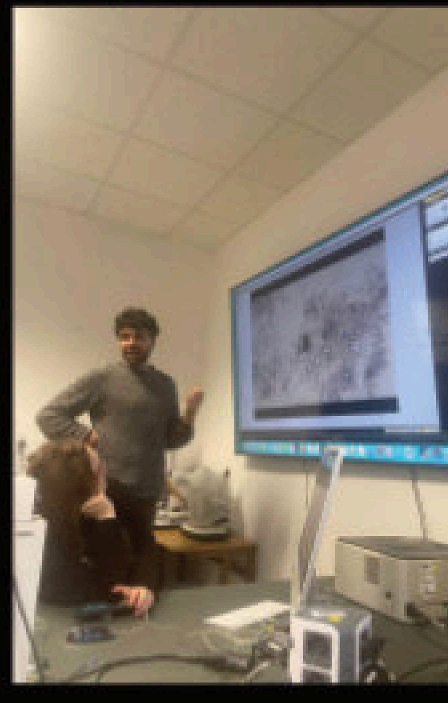




CHECKING IN BIOLAB



Collecting samples and investigating



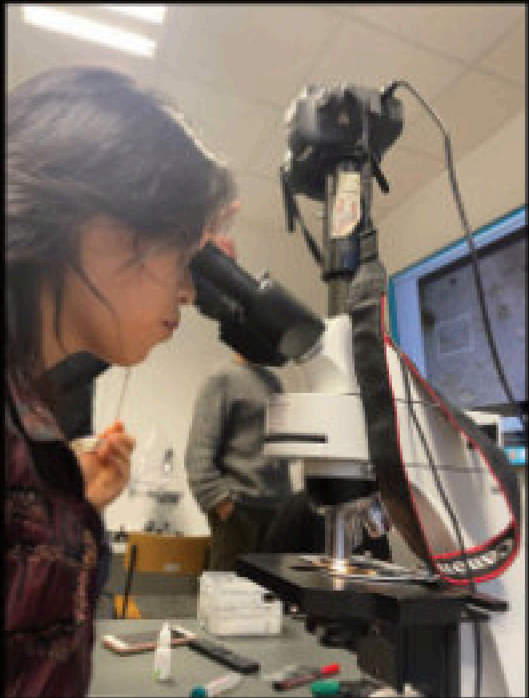
MONTAG 4. NOVEMBER   POND SAMPLES

1 MUDDY WATER FROM THE SITE (NEXT TO THE WATER) NEAR DUCKS
↳ ONLY SAND VISIBLE

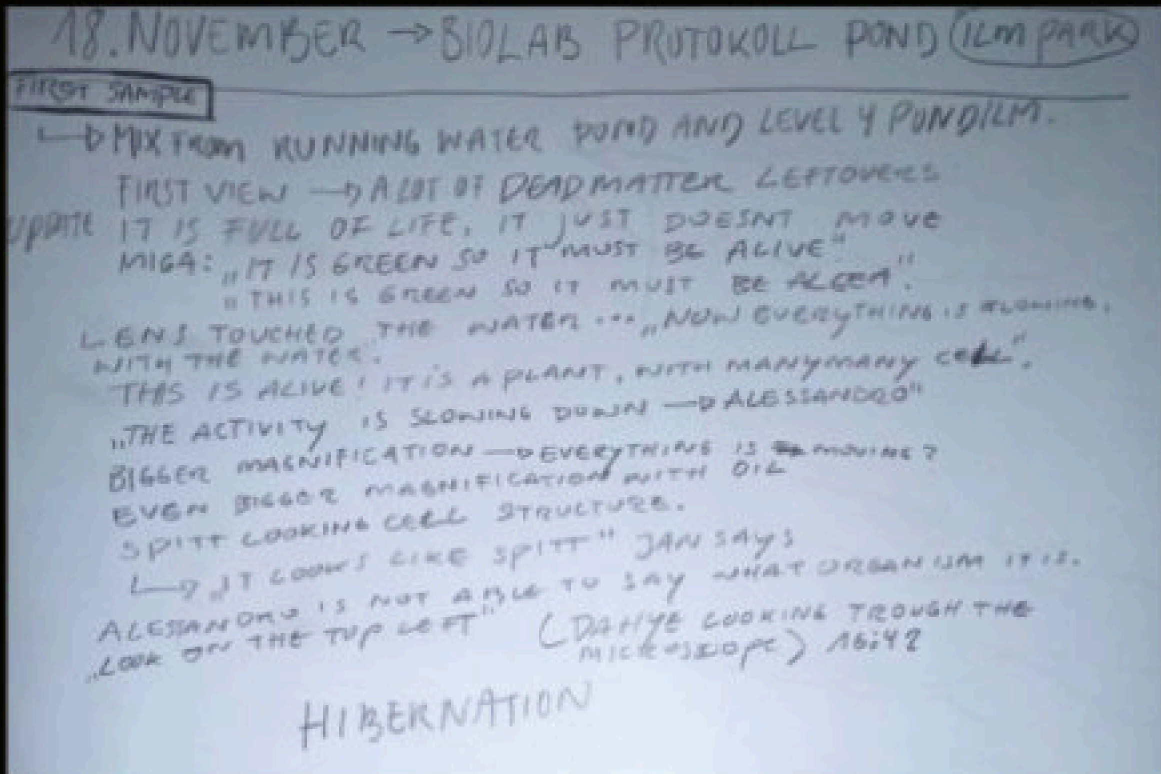
2 ~~WA~~ MUD FROM COSMO POND NEAR MAIN WATER BODY
↳ NO LIFE VISIBLE (FIRST VIEW)
TINY ALGEA IS AROUND
THERE IS SOME LIVING THERE (ORGANIC MATTER)

3 MATERIAL FROM THE OLD POND SHALLOW PART (MAKING A SOUP ADDING WATER)
↳ ONE GHOST ALGEA

4 EARTH SAND DEEPEST POINT OF THE POND
↳ NOT MOVING ALGEA VISIBLE
THERE IS ABSOLUTELY NOTHING MOVING (IT IS WINTER – MILD SLEEPY MODE)



Looking through the mikroskop



18. NOVEMBER → BIOLAB PROTOKOLL POND (ILM PARK)

FIRST SAMPLE

↳ MIX FROM RUNNING WATER POND AND LEVEL 4 POND ILM.

FIRST VIEW → A LOT OF DEAD MATTER LEFTOVERS

UPDATE IT IS FULL OF LIFE, IT JUST DOESNT MOVE

MIGA: „IT IS GREEN SO IT MUST BE ALIVE"

„THIS IS GREEN SO IT MUST BE ALGEA".

LENS TOUCHED THE WATER ... „NOW EVERYTHING IS FLOWING, WITH THE WATER".

THIS IS ALIVE! IT'S A PLANT, WITH MANYMANY CELL".

„THE ACTIVITY IS SLOWING DOWN → ALESSANDRO"

BIGGER MAGNIFICATION → EVERYTHING IS MOVING?

EVEN BIGGER MAGNIFICATION WITH OIL

SPITT LOOKING CELL STRUCTURE.

↳ „IT LOOKS LIKE SPITT" JAN SAYS

ALESSANDRO IS NOT ABLE TO SAY WHAT ORGANISM IT IS.

„LOOK ON THE TOP LEFT" (DAHYE LOOKING TROUGH THE MICROSKOPE) 16:42

HIBERNATION

18. NOVEMBER → BIOLAB PROTOKOLL POND (TEMPORARY)

1ST SAMPLE

→ MIX FROM RUNNING WATER POND AND LEVEL 4 POND(RM.

FIRST VIEW → A LOT OF DEAD MATTER LEFTOVERS

IT IS FULL OF LIFE, IT JUST DOESNT MOVE

MIGA: „IT IS GREEN SO IT MUST BE ALIVE"

„THIS IS GREEN SO IT MUST BE ALGEA".

LENS TOUCHED THE WATER ... „NOW EVERYTHING IS FLOWING WITH THE WATER.

THIS IS ALIVE! IT IS A PLANT, WITH MANYMANY CELL".

„THE ACTIVITY IS SLOWING DOWN → ALESSANDRO"

BIGGER MAGNIFICATION → EVERYTHING IS MOVING?

EVEN BIGGER MAGNIFICATION WITH OIL

SPITT LOOKING CELL STRUCTURE.

„IT LOOKS LIKE SPITT" JAN SAYS

↳ „IT LOOKS LIKE SPITT" ... WHAT ORGANISM IT IS.

ALESSANDRO IS NOT ABLE TO SAY WHAT ORGANISM IT IS.

„LOOK ON THE TOP LEFT" (DAHYE LOOKING TROUGH THE MICROSCOPE) 16:42

HIBERNATION

PROTOKOL 25. NOVEMBER POND [illegible]

→ TASKS: DAHYE MAKING SAMPLES, [illegible] ON THE COMPUTER
COSMO ON DIFFERENT MICROSCOPE [illegible]
JAN WRITING THE PROTOCOL AND [illegible]. MIGA [illegible]
ALESSANDRO [illegible]

PREVIEW: CHECKING CONNECTIONS, AND STRUGGLING WITH MAGIC

QUESTION: PUTTING TOGETHER THE DATA, TO GET AN UNDERSTANDING OF WHAT WE SEE. RELATE TO WHAT WE SEE TO WHAT WAS ALREADY UNDERSTOOD

SAMPLE 25 NOV STUDENT POND – MIDDLE → COSMO ON THE RIGHT

COMMENT: OH LOOK WHAT IS THERE, IT LOOKS LIKE [illegible]. [illegible] LOOKS LIKE CRYSTAL.
LIFE ... LIFE – LIFE [illegible] MAYBE [illegible]
[illegible]
WHAT KIND OF PLANTS? [illegible]

SAMPLE STUDENT POND – BOTTOM MUD
COSMO AND ALESSANDRO LOOKING AT IT THROUGH DIFFERENT MICROSCOPES

WHAT ARE WE LOOKING AT? THERE IS A LOT OF PARTICLES THERE IS A LOT

[illegible] LEFTOVERS OF ORGANIC MATTER
ALSO MINERAL CRYSTALS [illegible] LIKE LEAVES AND SHIT

[illegible] OF PLANTS, LEAVES, ROOTS – WHY CAN WE TELL? BECAUSE THE ORGANIC MATTER IS AROUND THE POND

LIGHT EFFECT (THE CAMERA IS AMPLIFYING [illegible])

WHAT MAKES PLANTS GREEN: [illegible] (CRYSTALS OR CELLS?)

HIGHEST MAGNIFICATION [illegible] WITH OIL DAHYE [illegible]. (IT HAS TO CLICK)

[illegible] TO TURN ON THE LIGHT TURN THE WHEEL [illegible] HIGH MAGNIFICATION USE PATIENCE. [illegible] CHECK THE EDGES WITH THE HIGH MAGNIFICATION [illegible]

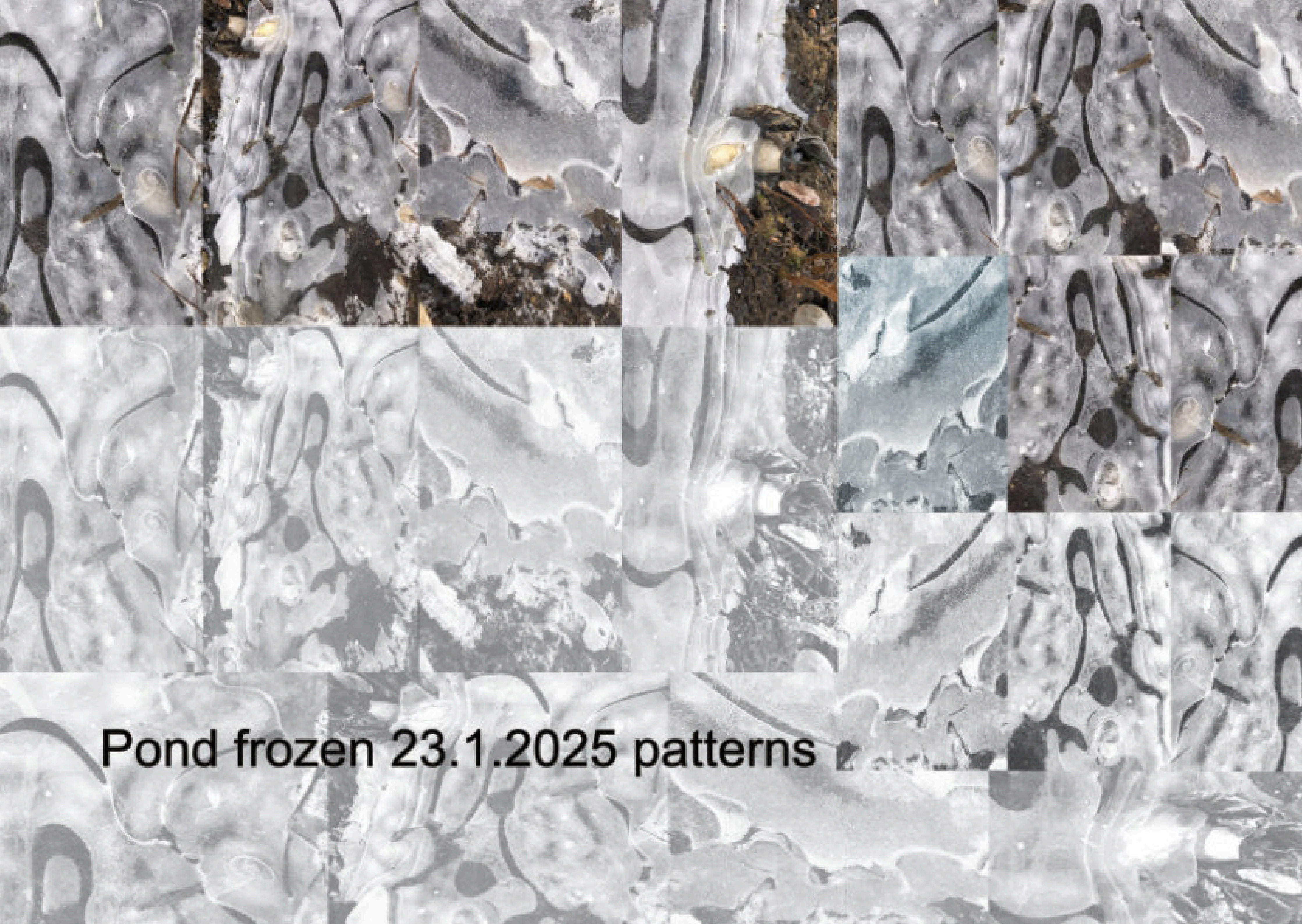
COSMO IS PUTTING POND WATER ON MY ARM. IT IS CALLED [illegible]

WHY IS THERE NOT SO MUCH LIFE YET?

Notes: from 18.nov.24, 25.nov

13.1.2025

Most recent picture of the pond. The top of the pond is frozen. These days are cold.


Pond frozen 23.1.2025 patterns

Observation of the our pond's Ecology on January 22, 2025

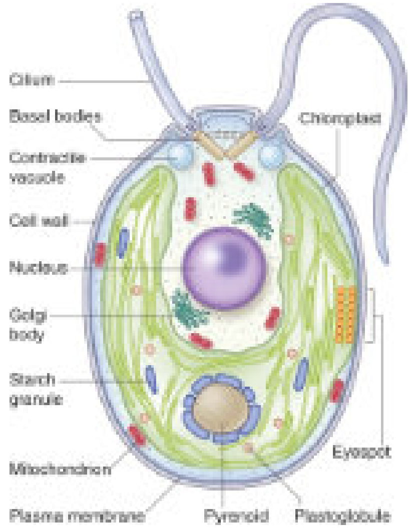
It was a cold day, and the water and soil of the pond were completely frozen. Using a stone, I broke through approximately 5 cm of ice to collect a water sample from the pond. Under the microscope, the movement of a single species was particularly active. According to Alessandro Vopato, it is identified as Chlamydomonas.

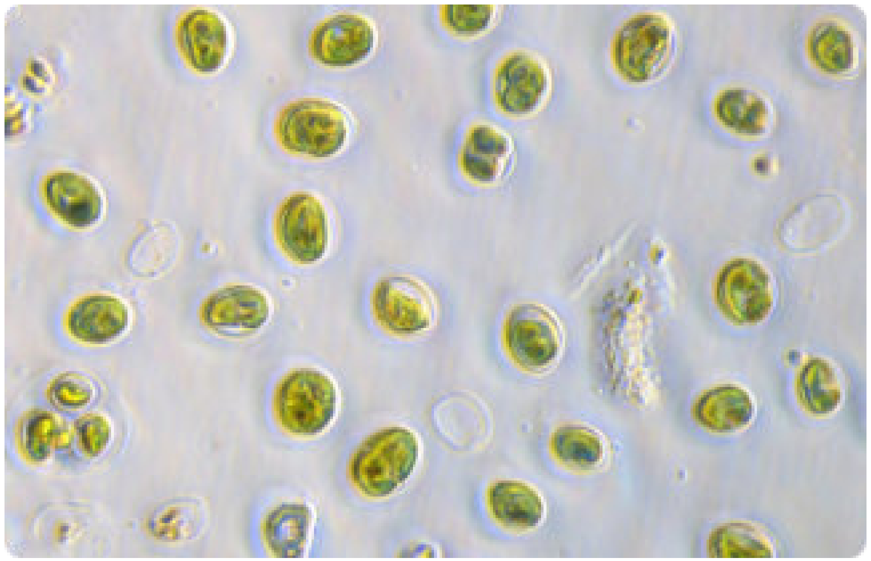
Chlamydomonas

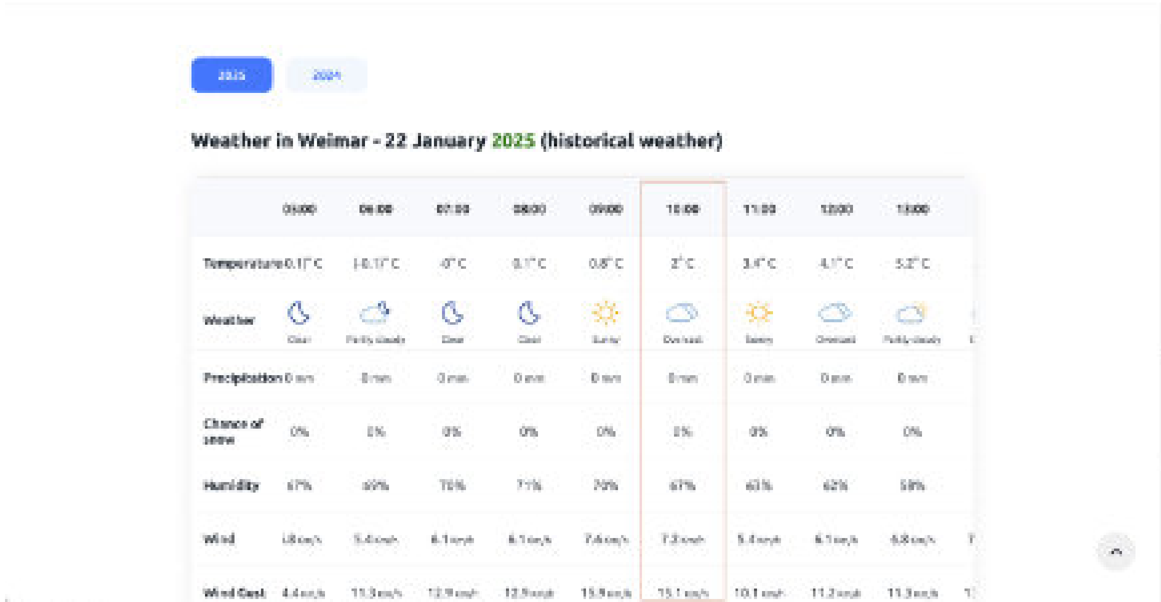
Chlamydomonas is a genus of unicellular green algae comprising approximately 150 species. These microscopic organisms are predominantly found in freshwater environments, such as ponds and lakes, but can also inhabit damp soils and even snow. They are characterized by their spherical or oval shape and possess two anterior flagella, which facilitate movement. A notable feature is their cup-shaped chloroplast, essential for photosynthesis.

In scientific research, Chlamydomonas, particularly the species Chlamydomonas reinhardtii, serves as a valuable model organism. It is extensively utilized to study various cellular processes, including photosynthesis, flagellar motility, and light perception. Research on this alga has significantly advanced our understanding of plant biology and cellular functions.

Under the microscope, Chlamydomonas exhibits active movement due to its flagella. Its adaptability allows it to thrive in diverse environments, making it a common subject of study in ecological and biological research.



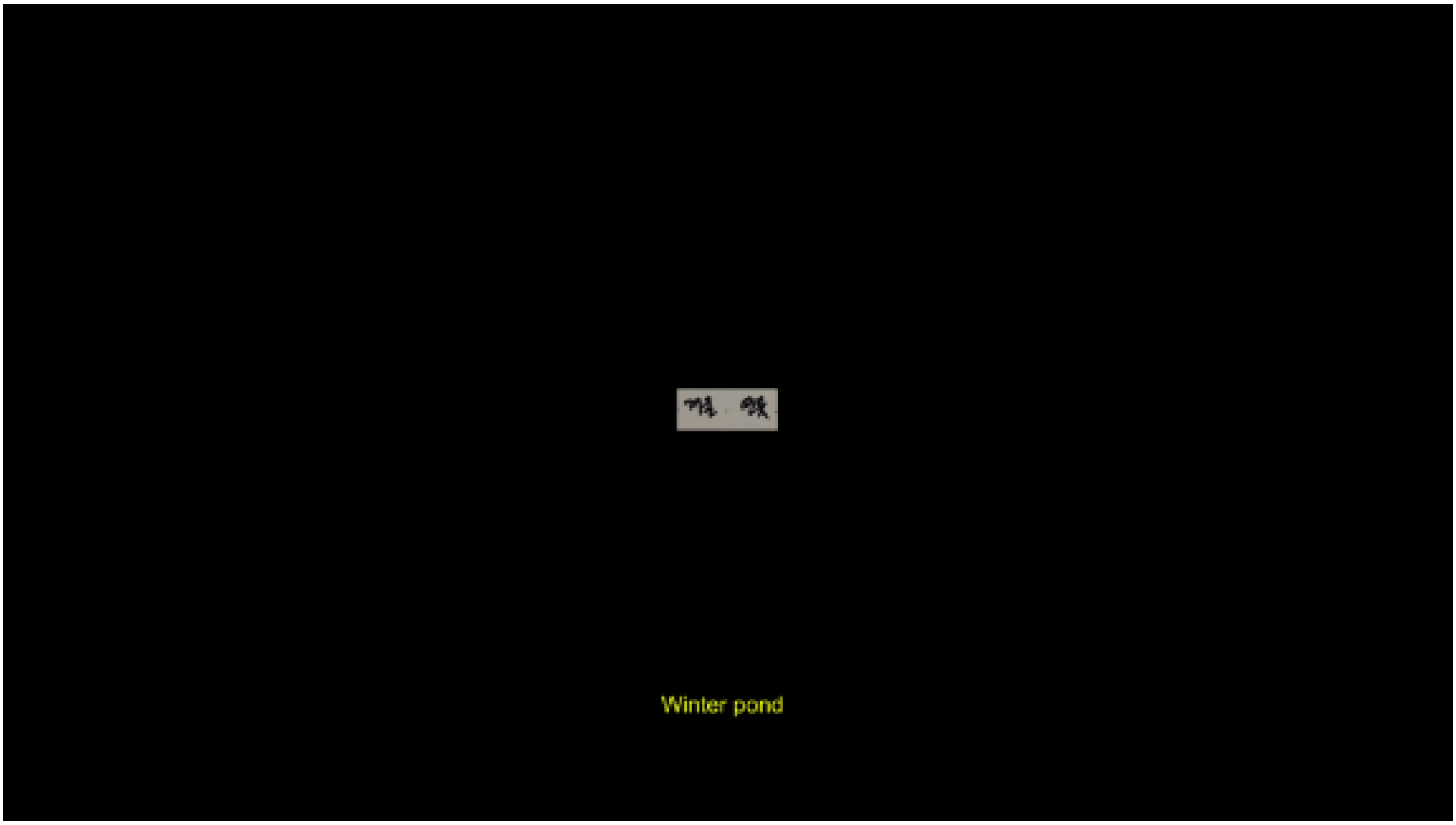


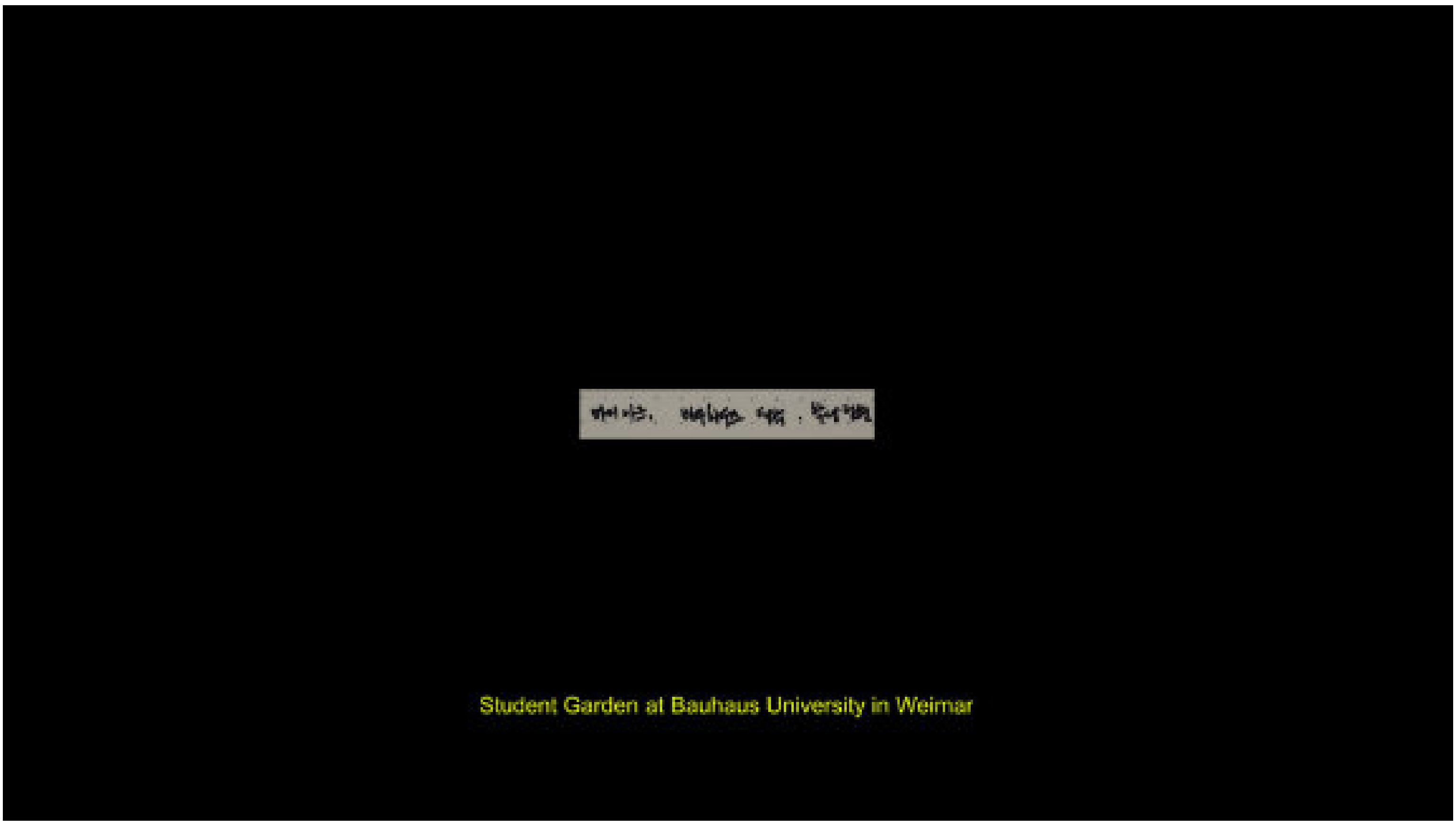


2025 2024

Weather in Weimar - 22 January 2025 (historical weather)

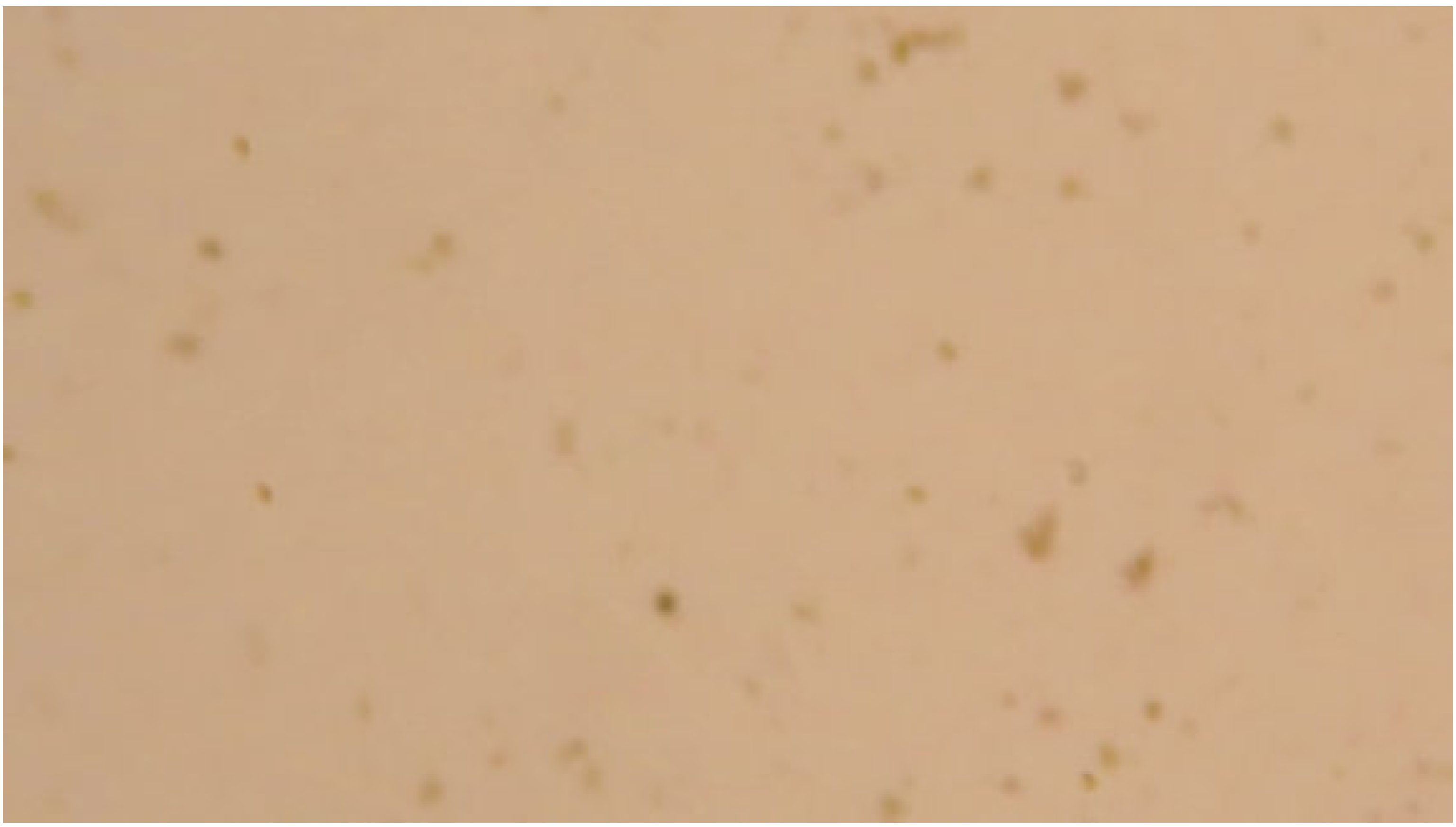
	05:00	06:00	07:00	08:00	09:00	10:00	11:00	12:00	13:00
Temperature	0.1°C	-0.1°C	-0°C	0.1°C	0.8°C	2°C	3.4°C	4.1°C	5.2°C
Weather	Clear	Partly cloudy	Clear	Clear	Sunny	Overcast	Sunny	Overcast	Partly cloudy
Precipitation	0 mm	0 mm	0 mm	0 mm	0 mm	0 mm	0 mm	0 mm	0 mm
Chance of snow	0%	0%	0%	0%	0%	0%	0%	0%	0%
Humidity	67%	69%	70%	71%	70%	67%	63%	62%	58%
Wind	4.8 km/h	5.4 km/h	6.1 km/h	6.1 km/h	7.6 km/h	7.2 km/h	5.4 km/h	6.1 km/h	6.8 km/h
Wind Gust	4.4 km/h	11.3 km/h	12.9 km/h	12.9 km/h	15.9 km/h	15.1 km/h	10.1 km/h	11.2 km/h	11.3 km/h

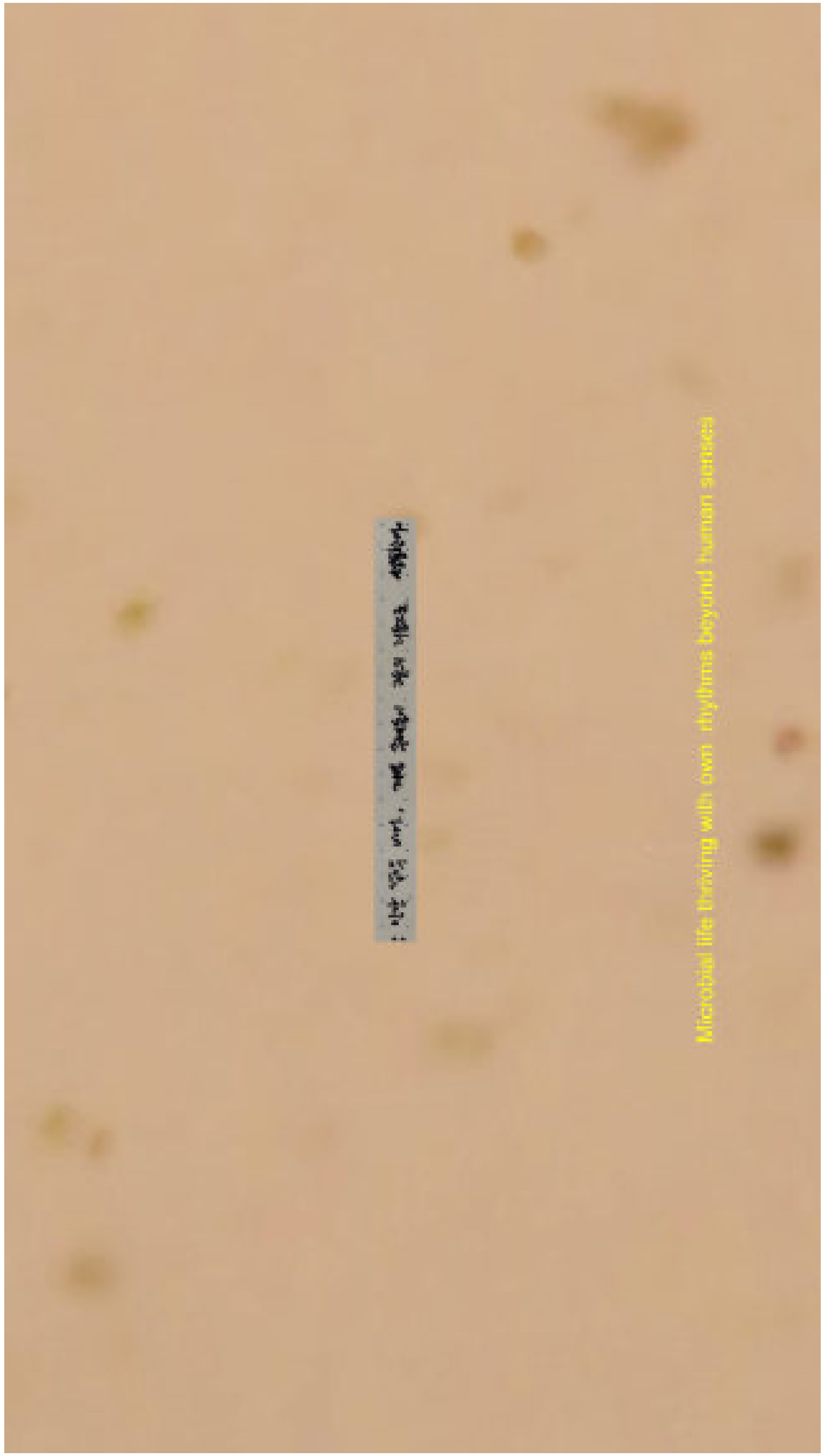

Winter pond


Student Garden at Bauhaus University in Weimar

The water and soil were frozen solid


Micro-landscape of a pond





Video Link : https://youtu.be/pK4iSMGivBQ

The class focused on the artistic exploration of interactions within ecosystems. We compared a natural pond in Ilm Park with a self-made pond (stormwater garden) on the university campus.

Throughout the course, we monitored how microbial populations in both ponds evolved and whether they converged over time.

Our primary tools included the bio-lab infrastructure, which enabled us to observe, explore, and monitor the microscopic environment of the ponds. We used pipettes, microliter pipettes, a microscope, a thermometer, a pH meter, and a conductivity meter. Additionally, we consulted weather forecasts and compared them with one year of recorded data. Sensory observations—using our eyes, fingers, nose, and ears—also played a role in our analysis.

The objective was to identify the key parameters necessary for monitoring differences and the evolution of the university pond.

Results

After reflooring the pond, water was present for much longer periods, and the pond never dried out through the Fall and Winter.

The artificial pond did not function in the same way as the natural pond.

Ecosystems require time to establish, possibly influenced by the cold winter.

A secondary succession was observed after disturbing and reshaping the self-made pond.

We attempted to track the population of microalgae (Chlamydomonas), the dominant organism in the pond. After transferring water from the Ilm park, we identified a small population of Chlamidomonas established in the pond.

We witnessed birds coming and drinking from the pond; spores, seeds and microbes are being introduced in this way.

We saw copepods in the Ilm park pond, but we haven’t seen any in our pond yet.

Also duckweed seems to establish itself after being transported from the Ilm park, before everything froze.

In parallel we developed individual artistic ideas based on how the pond was experienced from a personal emotional perspective. Such works are documented in the main page of this wiki

Discussion

Conducting the experiment in spring might have accelerated the process. However, conducting it in winter allowed us to observe an earlier phase, which provides a useful reference for comparison with future developments in spring. Next parameters to check are, for example, understanding how the water level raises and drops through different seasons. We also want to monitor the flora which is establishing in and around the pond.