At-home design experiments

All experiments and outcomes are in principal ‚quasi-scientific', because they are designed and executed with a desired specific, artificial outcome in mind. These ‚design-experiments' are primarily oriented on visual aesthetics, that aim to show an unobstructed close-up view of Physarum polycephalum in the designed environment.

Moreover, these experiments are not repeated often enough under completely consistent conditions for real scientific hypotheses or insights to be concluded.

The aim of the experiments was to first test and observe the slime mold's behaviour inside the petri-dish, in order to later sustainably transplant it to the final sculpture.

(1) Moisture

lab context: Agar

The Biolab standard is a 100ml distilled water x 2g ‚Agar agar' (Agartine - plant based gelatine) solution.

vs.

natural habitat: Residual moisture and humidity

The natural condition for the slime mold is residual moisture - hidden to the naked human eye - inside fallen logs, tree branches, piles of leaves and soil.*

**Because of this, the slime mold is more commonly found in wet areas and during the rainier fall months.*

Design experiment (1)

simulating rain

Point of reference: The natural condition of how the organism receives moisture, is from wet, decaying biomass.

How: Provide moisture by simulating rain and spraying the organism with (distilled) water.

Overall time frame: **Inoculated*:** 2 July 2020
First spores: 18 July 2020
Plasmodial stage: 16 days

Times sprayed per day: 1-2 times; irregularly

Observations: The structure is more pronounced and vein-like, indicating that the conditions are not ideal but sufficient for plasmodial survival.

Aim: To replace Agar as means to supply moisture, because it is a breading ground for other, unwanted bacteria and mold to grow.

Outcome: Slime mold survived for 16 days, similar to plasmodial survival in a petri-dish with Agar base.

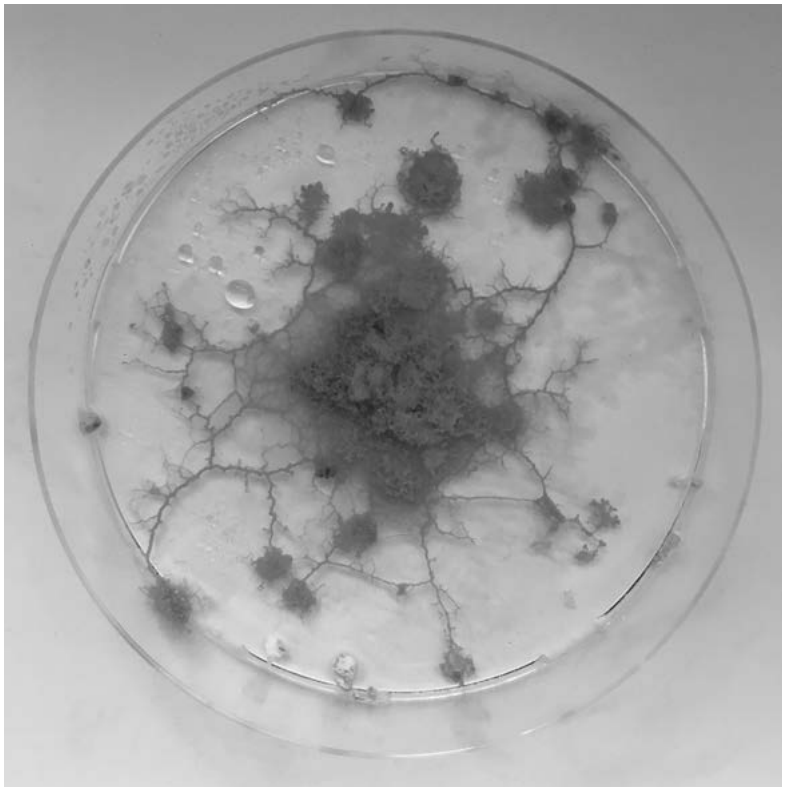
Hypothesis: When regularly sprayed/kept moist, the slime mold can survive without Agar base.

Implication for sculpture: Moisture can be supplied by keeping the environment wet through spray ‚rain' simulation.

petri-dish day: 1

**Inoculation: The method of transferring the organism to a new petri-dish, see page 85*

distilled water



petri-dish day: 6

Design experiment (2)
moisture pods

How: Sculpt an uneven surface with holes/pods to pour Agar into as ‚moisture pods' for the slime mold to draw needed moisture from.

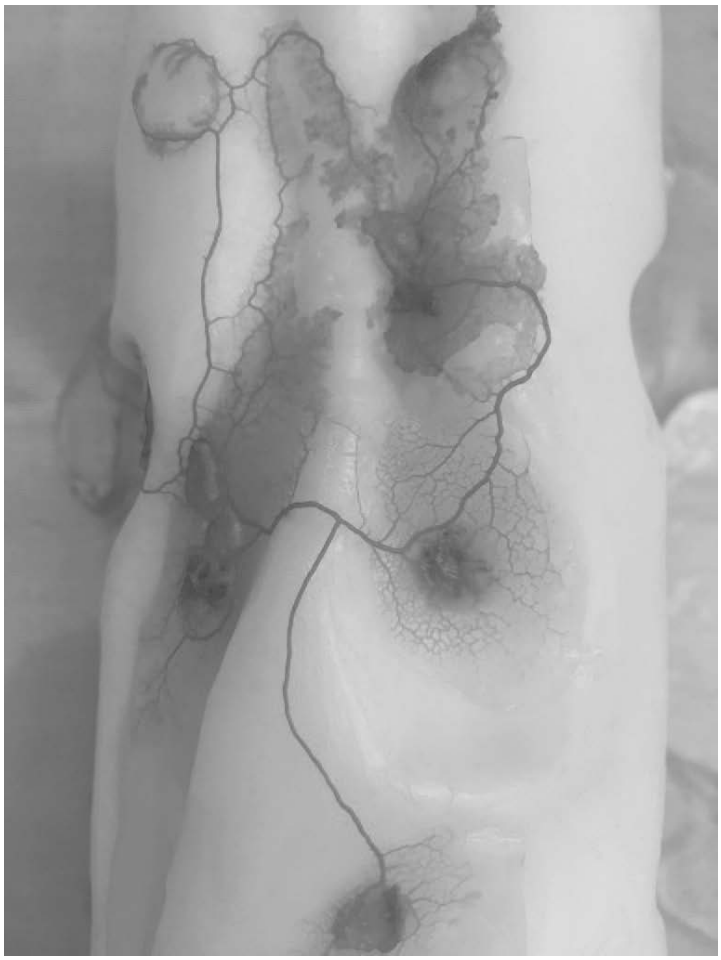
Aim: To see if Physarum polycefalum looks or behaves differently in spots with or without the Agar, and find out how the Agar base can be configured.

Overall time frame: 7 days

Observations: Physarum polycefalum does not appear to favour the Agar pods, neither does it appear to draw moisture exclusively from these areas.

Hypothesis: Instead of being dependant on growing directly on top of Agar, the slime mold is hydrated by the evaporating Agar, which supplies humidity to the entire space through the air.

Implication for sculpture: A permanent Agar base is not an absolute necessity to keep the organism hydrated.



vein network on wax object with Agar-pods

**Because of unfavourable, high summer heat, the experiment had to take place at around 27°C, which gave the following interesting implication on the slime mold's behaviour: Even in this heat it did not exclusively cling to the moisture pods.*

(2) ‚Food'

lab context: Oat flakes*

The Biolab standard are oat flakes, from which the slime mold ‚eats' only the bacteria and yeasts on the flakes.

vs.

natural habitat: Microorganisms, bacteria, fungi, yeasts

The natural ‚food-source' of the slime mold are bacteria, yeasts, and fungi responsible for decomposition, found on decaying tree logs/wood and rotting leafs.

**Oat flakes used: Alnatura Hafer Flocke, Feinblatt 500g*

Design experiment (1)
retreating food

Point of reference: In the natural habitat, Physarum polycephalum migrates when areas do not provide optimal food resources anymore.

How: No longer ‚feeding' the slime mold with oat flakes*.

Aim: To question to what extent oat flakes are an absolute necessity and to retreat the human influence/direct human care.

Overall time frame: up to 20 days, repeated many times over the course of 5 months.

Observations: The slime mold migrates out of the dish to new terrain. Even when the petri-dish grows other mold, sometimes small patches of Physarum polycephalum remain active in the plasmodial stage.

Hypothesis: Physarum polycephalum is a very resilient organism. After a starting base of oat flakes has been supplied it can sustain itself, if necessary escaping the petri-dish to new ground.

Implications for sculpture: Transfer onto the sculpture should start off with a healthy, strong base of Agar and oat flakes, after which the slime mold can do without oat flakes for at least several days.

By stopping the continued intensive care of the organism, the control over its life cycle is released back towards a more natural unpredictability.

nature habitat vs. lab petri-dish

no more oat flakes after day: 12

**Physarum polycefallum only ‚eats' the invisible bacteria on the flake's surface and leaves a pile of damp mush of oats behind.*

Design experiment (2)
no food at all

How: Never ‚feeding' the slime mold with oat flakes.

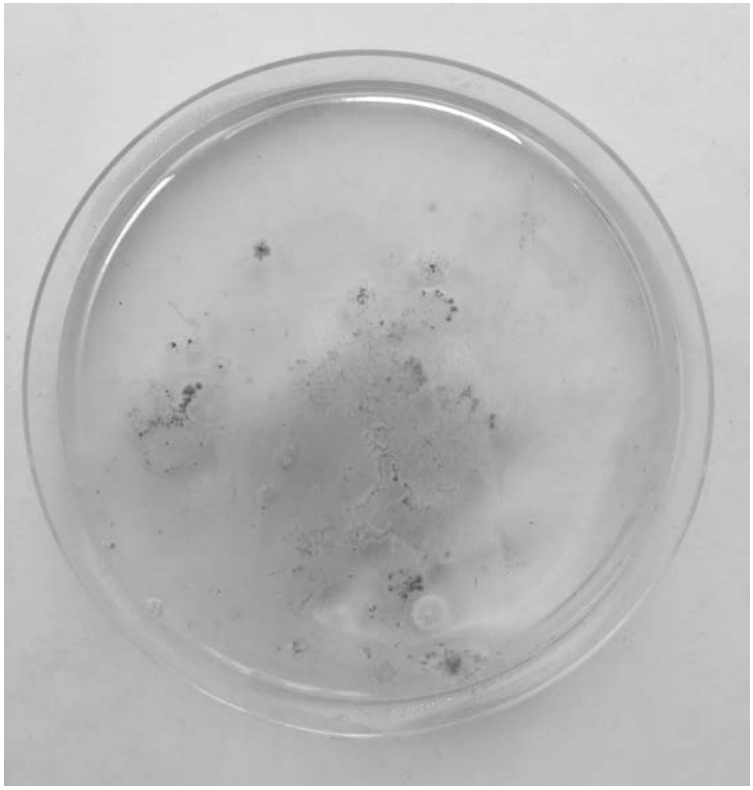
Aim: To test, to what extent the direct supply of ‚food' can be fully omitted from the outset, primarily for visual purposes of the sculpture.

Overall time frame: 6 days

Observations: In 3 cases of using different stages of plasmodium (from fresh to aged), the slime mold was not able to thrive without a food source. It was also not strong enough to forage or move out of the petri-dish.

Hypothesis: When freshly inoculated into a new dish, the slime mold needs atleast some initial source of ‚food' to grow.

Implications for sculpture: The slime mold either needs oat flakes supplied on the sculpture or a transfer starting from a nutrient-rich oat flake + Agar base.



no oat flakes after day: 4

Design experiment (3)
other food sources

Point of reference: The natural decaying wood habitat of the slime mold.

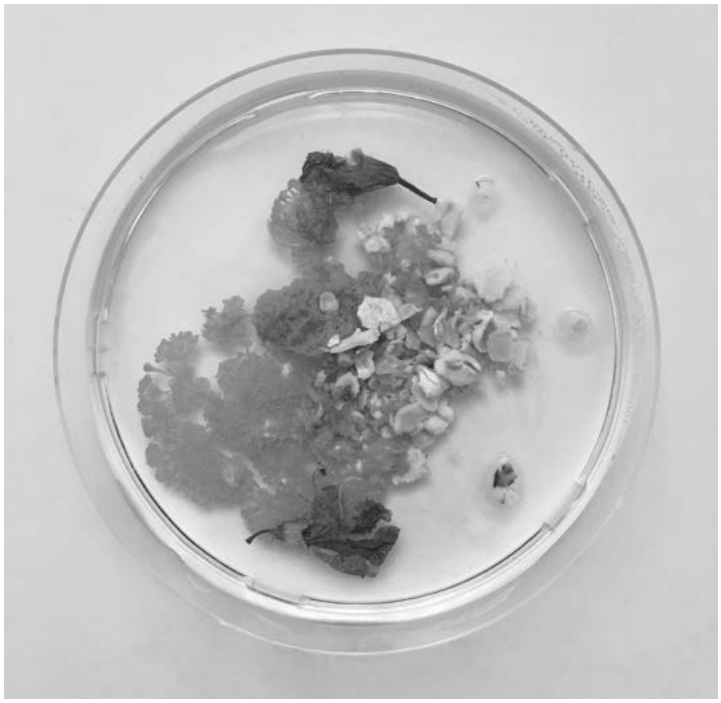
Aim: See, how the slime mold reacts to other natural (food) objects and the microbial palettes attached to them.

Overall time frame: 6 days

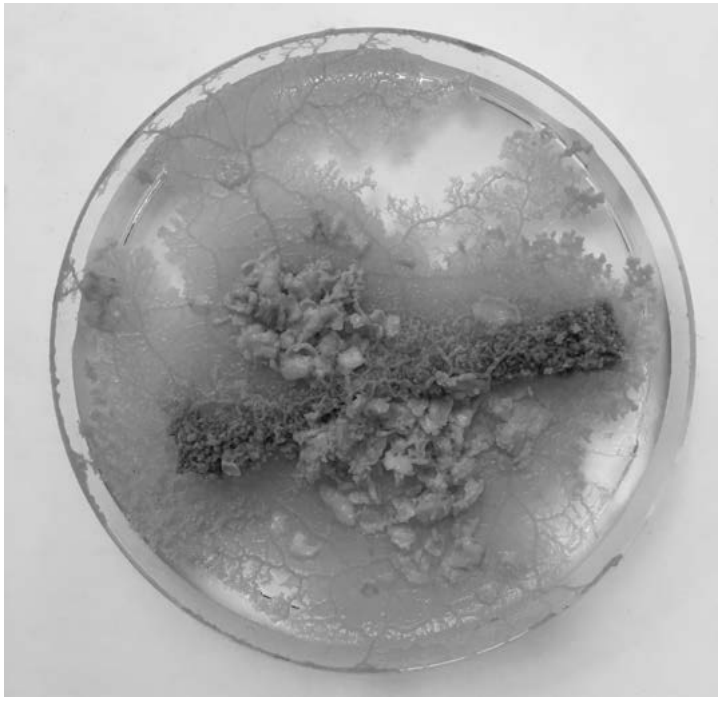
Observations: The organism quickly devours the natural objects.

Hypothesis: Physarum polycephalum is highly drawn to natural matter.

Implications for sculpture: A natural assortment of microbes and bacteria found on natural matter like branches or flowers is an alternative means to coerce the organism.



flowers after day: 1



twig after day: 2

Design experiment (4)
bacterial transfer

Point of reference: Previous experiment on ‚foreign matter' and the natural microbial wood habitat of the slime mold.

How: Test the hypothesis, that microorganisms and bacteria can transfer to a wax object when the latter is placed in the exact same wooded environment a slime mold would naturally grow.

Aim: Supply the bacteria/food source invisibly on the artificial wax structure, when ‚transitionally charged' from the actual, original habitat.

Timeline: **Time frame in woods:** 5 days (19 - 23 August)
Time in terrarium: 2 days
Overall time frame: 7 days; *(The transfer phase was cut short/discontinued due to Corona/travel reasons.)*

Observations: The transfer was significantly slower than with the previously tested natural objects. No difference between ‚charged' and ‚non-charged' wax objects. No catalyst effect was detected. No indication for bacterial transfer given.

Hypothesis: A short ‚charging' period in the woods is not sufficient for the outdoor transfer of local microbes and bacteria onto the wax object.

Implications for sculpture: No bacterial transfer by leaving the wax-branch out in the woods.

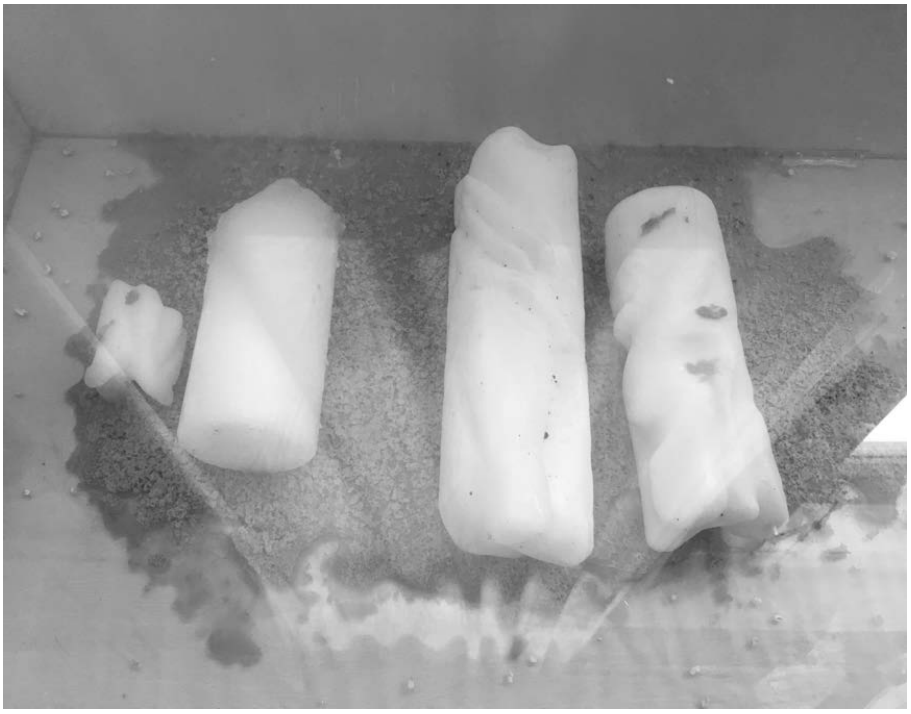
Implications for possible future renditions (as extension into ecological art):
Results might differ when exposed over an extended period of several months or even years.

presumed natural habitat: macro view

presumed habitat: intermediate view

presumed habitat: close-up view

top view: ‚charged' wax objects



close-up view: far left: object without outdoor transfer but direct inoculation onto object
left: object without outdoor transfer and no inoculation onto object

far right: object with outdoor transfer but direct inoculation onto object
right: object with outdoor transfer and no inoculation onto object

(3) Space + Surface

lab context:

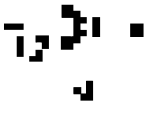
The petri-dish has a contained circular, flat plane. It is small, isolated, homogeneous and stripped of everything that is nonessential to sustain the organism's plasmodial growth and life. Therefore, the parameters as simulated by humans, are clearly visible.

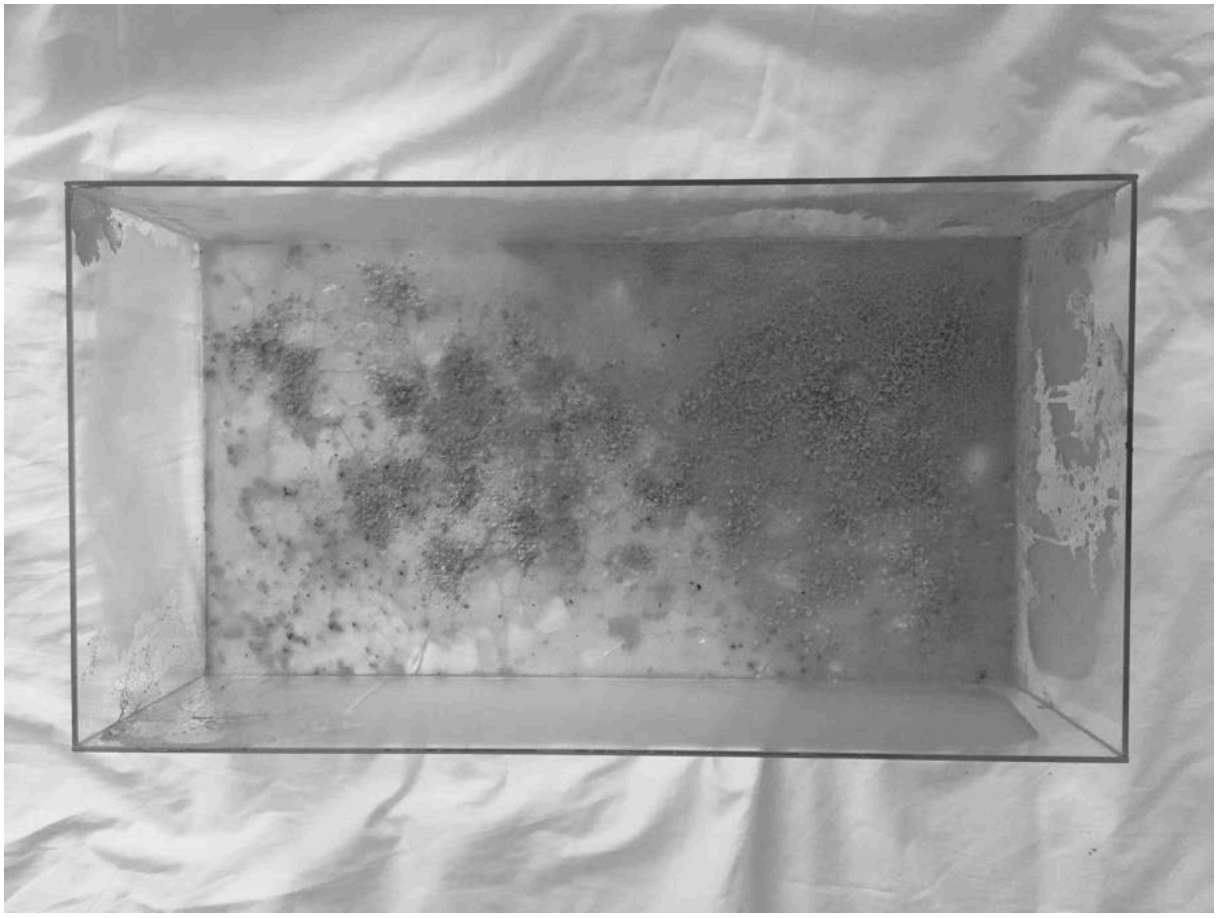
vs.

natural habitat:

The open tree-habitat of decaying woods is characterised by uneven surfaces, cracks, bumps and elevations. The surface is an organic ‚obstacle course' over which the organism sustains its life.

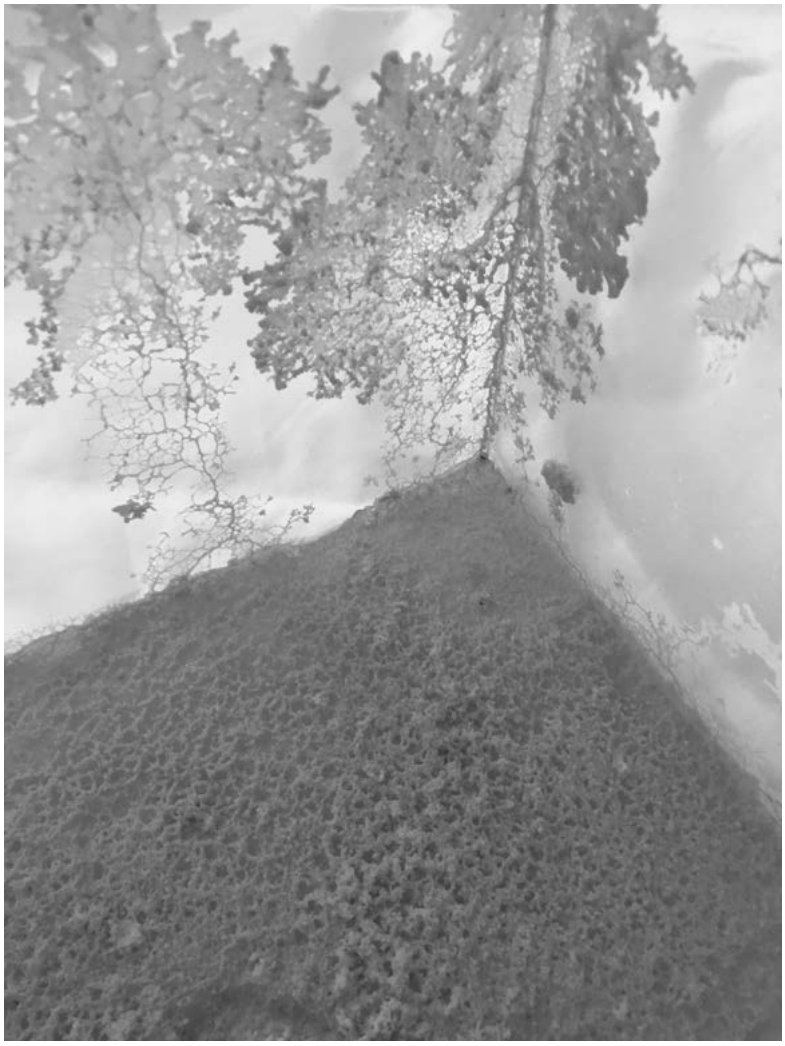
Set-up

nature habitat  vs. lab petri-dish

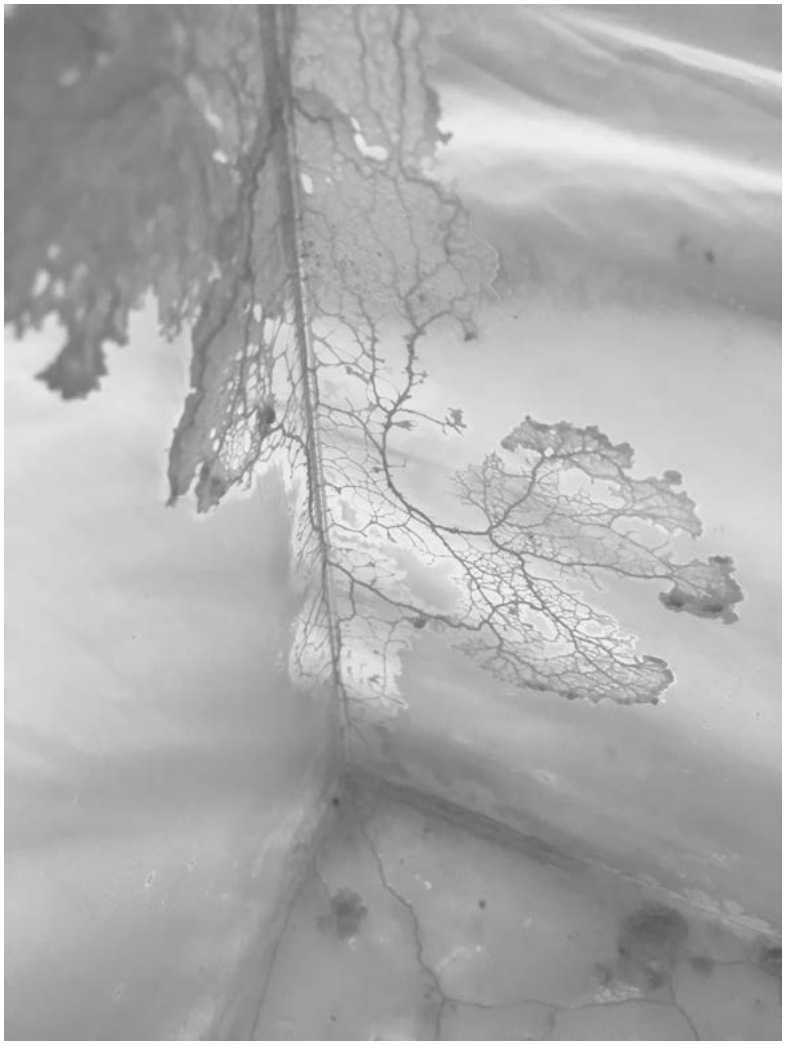


terrarium after day: 8

*See page 72



terrarium after day: 11



terrarium after day: 11

Session 1

Terrarium fully covered: **8 days**
Time frame for coverage: **26 June - 4 July**
Spores: **10th July**
Total: **15 days**

Session 2

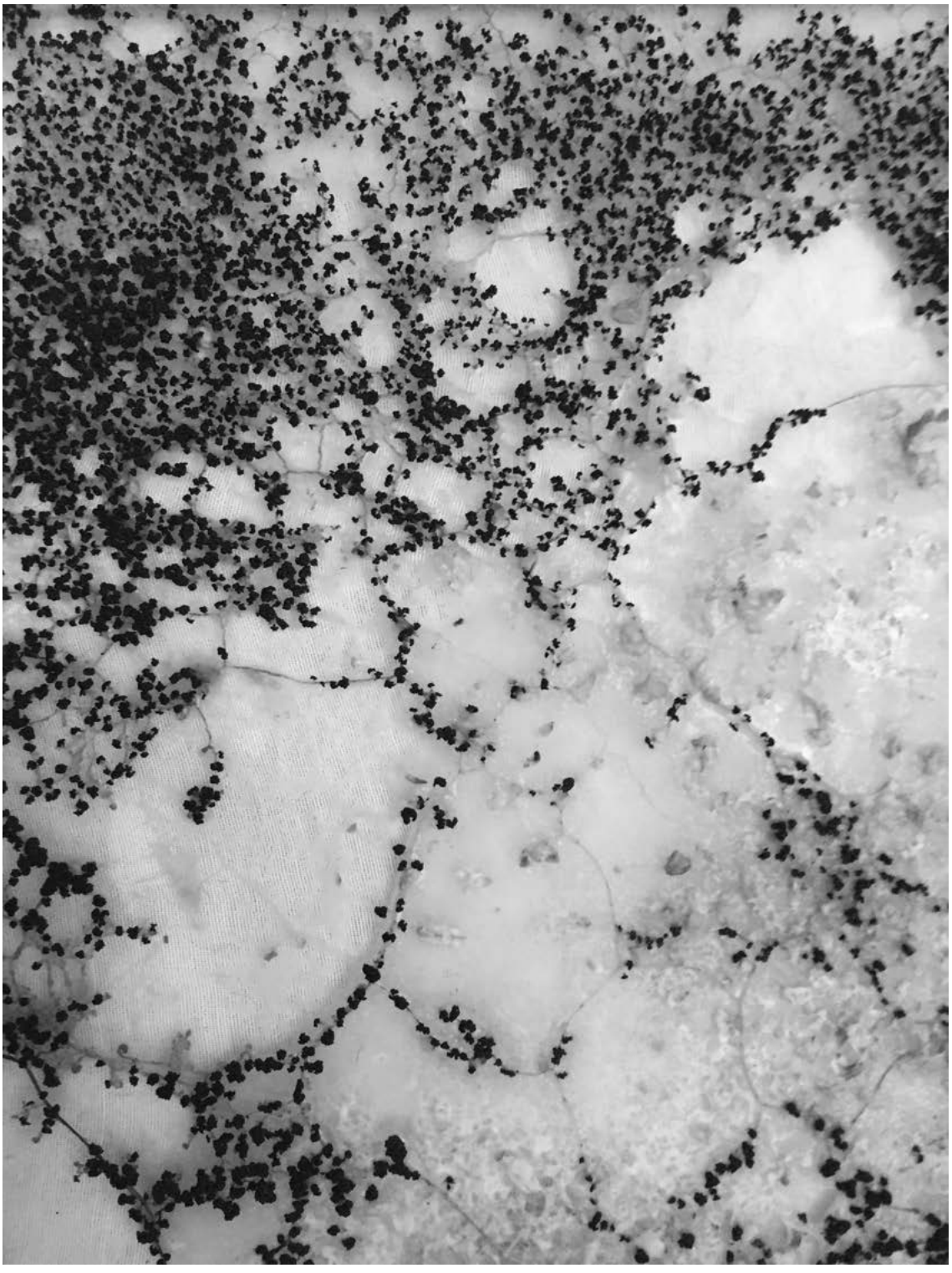
Terrarium fully covered: **6 days**
Time frame for coverage: **20 July - 26th July**
Spores: **30th July**
Total: **10 days**

Session 3

Terrarium fully covered: **4 days**
Time frame for coverage: **19 August - 23rd August**
(additional mold problems due to high temperatures up to 27°C)
Spores: **30th July**
Total: **11 days**

Session 4

Terrarium fully covered: **10 days**
Time frame for coverage: **7 October - 17 October**
(initially colder: 18-19°C, then warmer: 22°C)
Spores: **21st October**
Total: **14 days**



Physarum polycephalum built spores on day: 15

Design experiment (2)
On wax

Point of reference: The vision for the sculpture requires the slime mold to live and build networks on a wax surface.

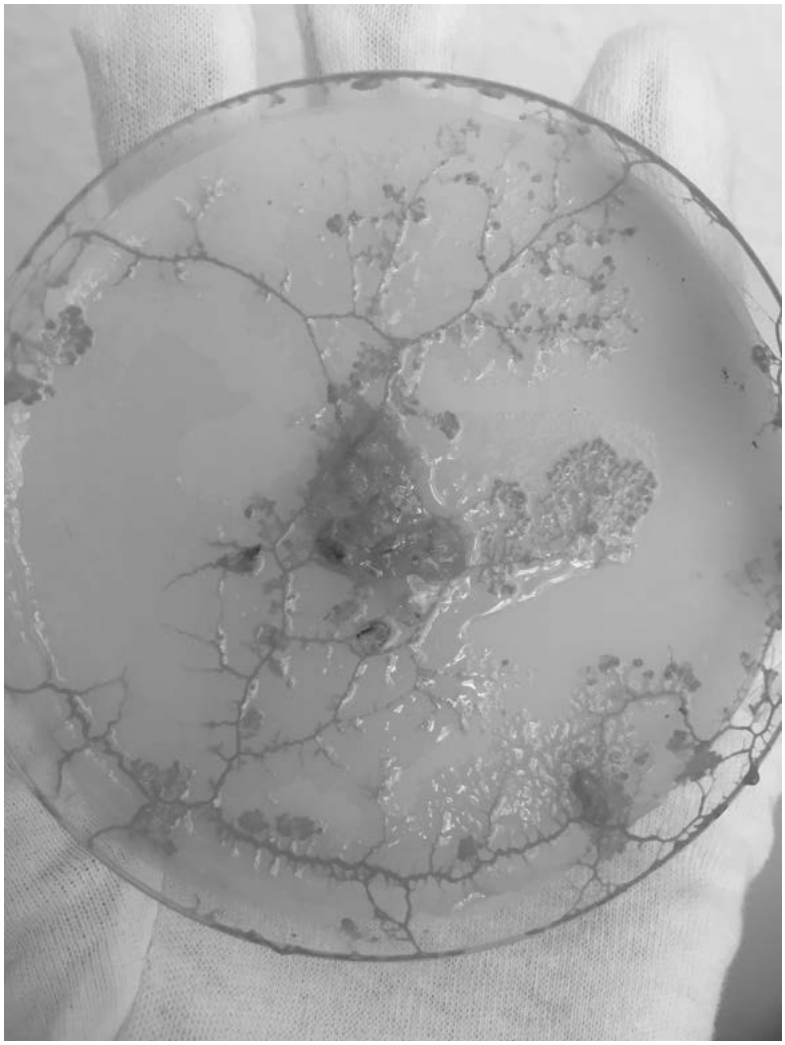
How: Wax was poured into the petri-dish as Agar replacement. Additionally, moisture was supplied by sprayed distilled water.

Overall time frame: 5 days

Observations: The traces that are usually visible like veins on the Agar become more like a transparent, wet-looking slime substance on top of the wax.
The slime mold spreads across the petri-dish similar to when on Agar base.
The organism is more likely to dry out, with a very high occurrence of spores being formed. Without Agar, less probability for molds or bacterial infections.

Hypothesis: The transparent slime traces build a second layer on top of the wax. After ‚living' on wax, the slime mold is more likely to build spores.

Implications for sculpture: It is presumed, that Physarum polycephalum will be able to thrive on a wax object/terrain.



Physarum polycephalum on wax in petri-dish day: 2

Design experiment (3)
open airflow

Point of reference: In the natural habitat, the slime mold lives in unrestricted airflow.

How: Remove the prepared and covered twig from the terrarium.

Overall time frame: 3 hours

Observations: Within 2 hours, the plasmodium begins to recede, until it is entirely evaporated 3 hours after being removed from the terrarium.

Hypothesis: Heavy, unrestricted airflow is not supportive to the slime mold. Instead, the humidity which builds up due to contained airflow is crucial for the plasmodium to sustain itself.

Implications for sculpture: The slime mold can only grow inside a contained area, in which consistent low airflow can be controlled and humidity provided.

twig covered in plasmodium

receding plasmodium after 2 1/2 hours in fresh air

(4) temperature and light

lab context: It is presumed, that slime molds passed on in captivity, are all continually kept at room temperature over extended periods*, during which they experience a range of temperatures from approx. 16°C up to 30°C. During this time they are also frequently exposed to light and not kept in complete darkness.

vs.

natural habitat: The organism grows in the lower levels of shaded woodland on top of logs, where no direct sunlight disturbs its growth and it is generally dark(er).

**For this project alone the slime mold was continuously kept in its plasmodial stage for 5 months, during which temperatures changed from 18°C - 29°C*

Observations
temperature

Observed ranges:
Summer months: 20.8°C - 26.7°C
Fall months: 17.4°C - 20.9°C

Overall time frame: 2-3 weeks in summer; 2-3 weeks during fall

Observations: Temperatures above 24°C invite too many other molds and bacteria. Inoculations below 19°C are more unsuccessful; the slime mold does not grow or branch out.

Humdity inside the terrarium ranged from 93% to 99% humidity.

Hypothesis: Over time, the slime mold has been unintentionally and slowly habituated away from its natural condition to now need warmer temperatures than it did in the natural environment.

Implications for sculpture: Supply a temperature of 20°C - 21°C for the slime mold.

unusually low temperature and humidity measurements

Design experiment (1)
light exposures

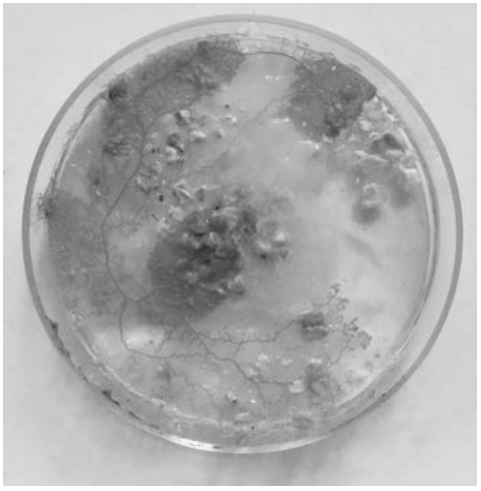
How: 3 petri-dishes are inoculated simultaneously and kept in 3 different light exposures, ranging from (1) in direct sunlight, (2) shaded by box covered with cloth and (3) complete darkness in drawer.

Overall time frame: 7 days

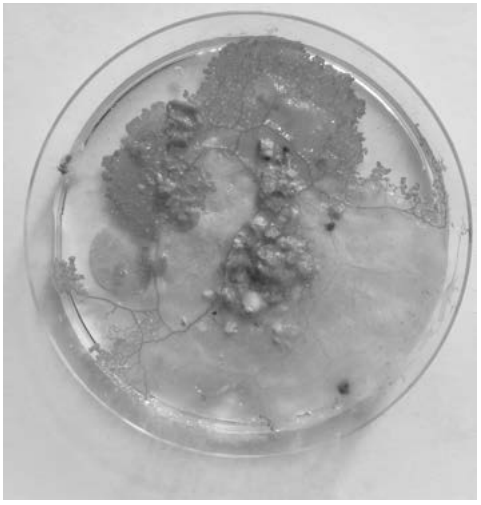
Observations: Between the (3) completely dark and (2) shaded petri-dishes, no difference in structure or colouration could be detected. The petri-dish exposed to direct sunlight (1) exhibited a discolouration of the yellow, turning to a faded and grey-ish tone.

Hypothesis: It is not necessary for this specific slime mold to be kept in darkness, possibly because it has been habituated towards elevated light exposure.

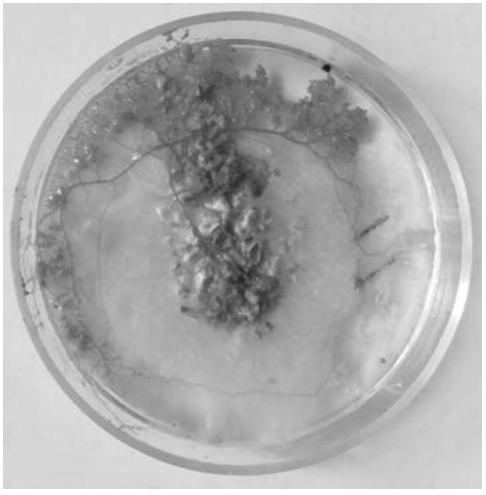
Implications for sculpture: Try to avoid direct sunlight with as little light as possible. But it is not detrimental, if the slime mold is exposed to some light, i.e. the space does not need to be kept especially dark.



kept in complete darkness for 7 days



kept in medium shade for 7 days



kept in sun for 7 days

(5) Care

In the lab context of the petri-dish, the organism is kept isolated, protected and under surveillance. ‚Care'* is given by transferring fresh parts of the plasmodium to new petri-dishes, a method called: inoculation. The exact procedure of inoculation can influence the appearance of Physarum polychefalum.

The following is an investigation into the different structures, network-patterns and colourations of the plasmodial stage. It is an inquiry into the question, to what degree the human-care influence can manifest on a visual level.

Incolulation method (1)

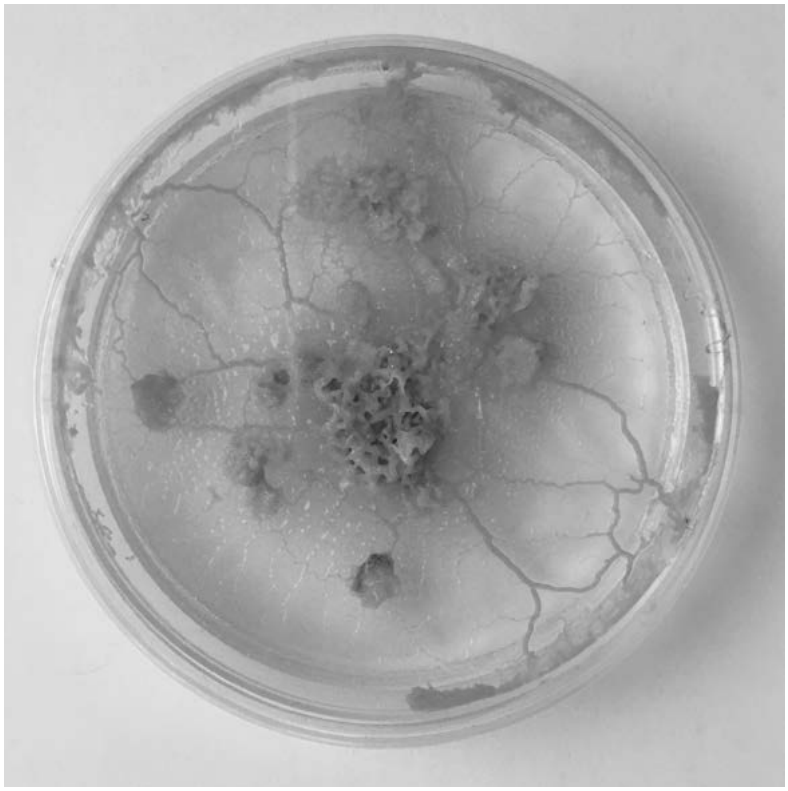
Slime mold with oat flakes

How: Inoculate ‚fresh' plasmodium with a chunk of the old oat flakes from previous petri-dish.

Observation: Initially, the organism spreads fast and stays ‚strong'. The old oat flakes continue to deteriorate, hereby leaving less fresh space.

Outcome: The old oat flakes increasingly obstruct a clear view of the slime mold structure and make the petri-dish less presentable.

Implications for sculpture: Least preferred inoculation method.



after inoculation day: 3

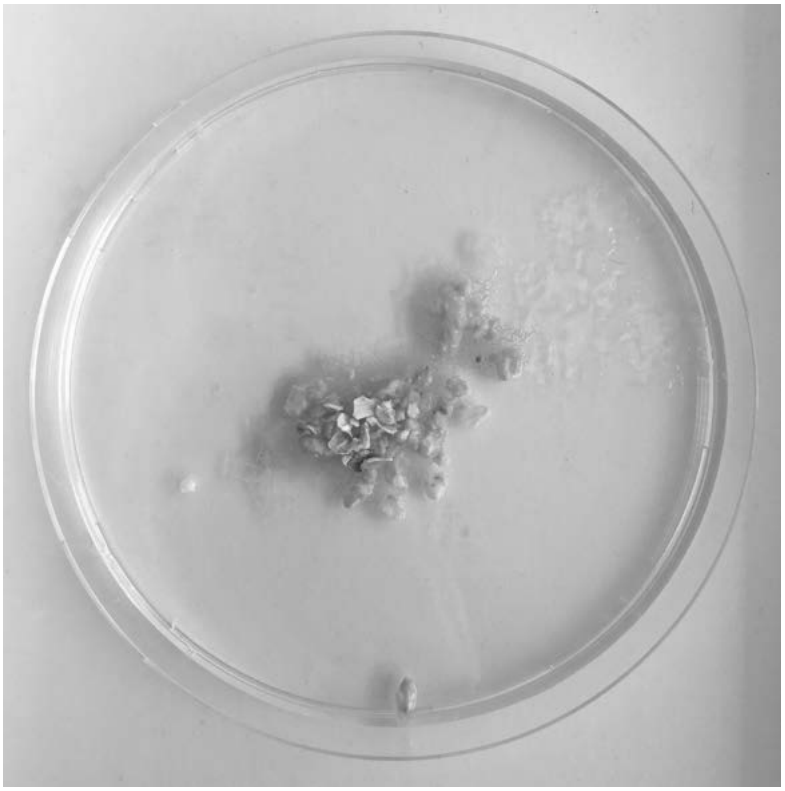
Incolulation method (2)
‚fresh' slime mold

How: Inoculate ‚fresh' plasmodium by scraping from the top of the organism growing on top of oats in an aged petri-dish.

Observation: Smaller quantities of Physarum polycephalum can be gathered, which make successful inoculation in new dish less probable.

Outcome: The slime mold seems ‚weaker': it grows slower and seems more vulnerable to bacterial infections.

Implications for sculpture: Non-preferred inoculation method, because it is too difficult to get sufficient quantity scraped together and uncertain, if it will grow well in the new dish.



after inoculation day: 1

Incolulation method (3)

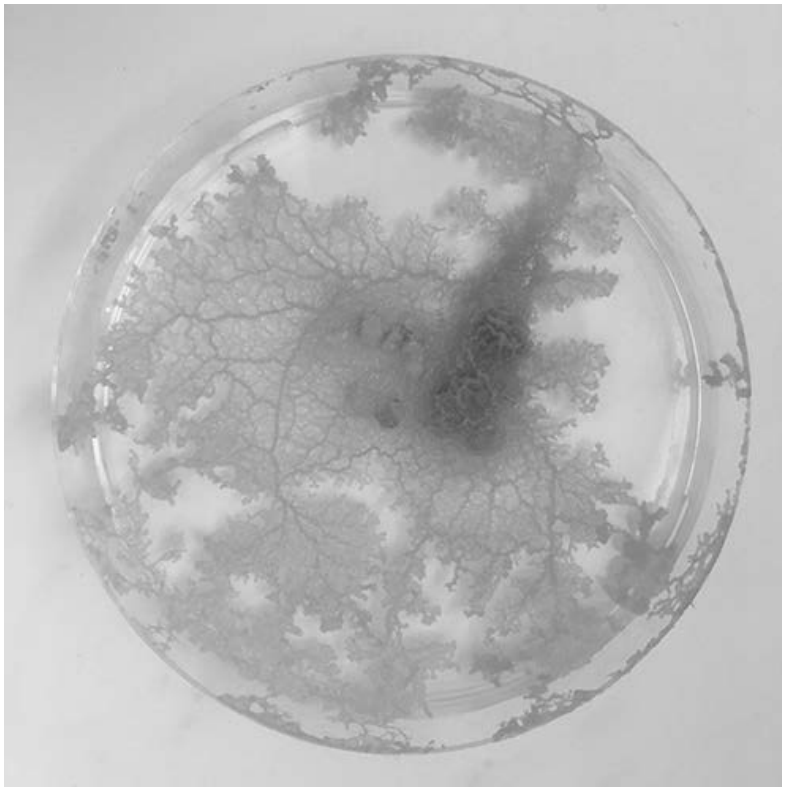
‚medium fresh' slime mold

How: Inoculate ‚medium fresh' plasmodium by scraping the veins that are on the Agar (not the oat flakes) or taking the plasmodium from the outer walls of the petri-dish.

Observation: The plasmodium takes to the fresh petri-dish and continues to grow there.

Outcome: Most frequently/consistently used method of inoculation over the months.

Implications for sculpture: Solid method of inoculation.



ready to be inoculated from

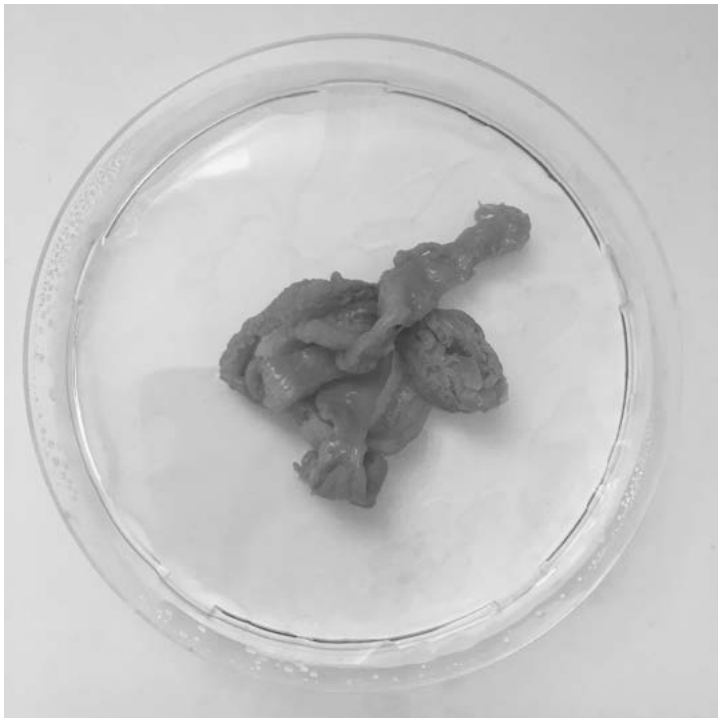
Incolulation method (4)
‚old' slime mold

How: Inoculate ‚old/aged' slime mold by using the already orange parts, that have grown out of the dish and become a blob-like mass.

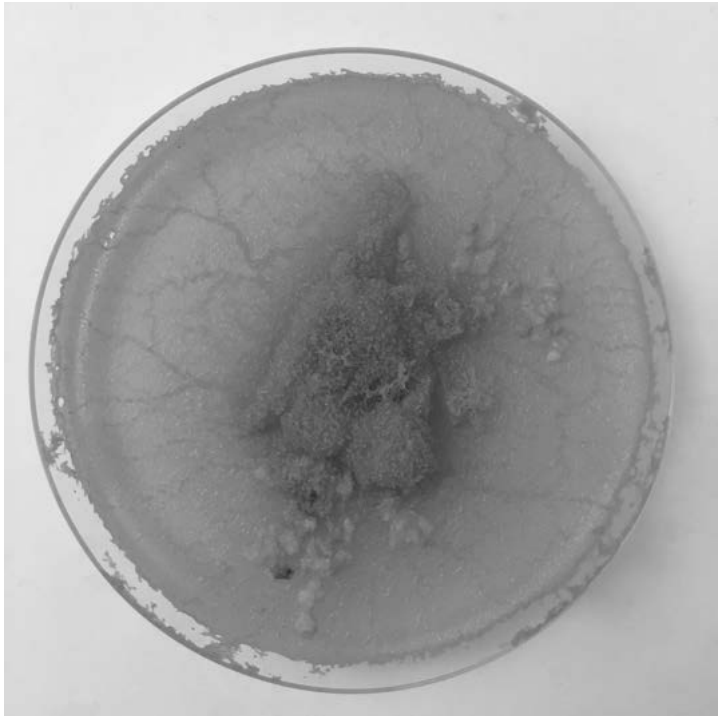
Observation: In a period of 2 weeks this created highly interesting results, as the blob-like structures of ‚old' slime mold would retain their shape inside the fresh petri-dish and fresh plasmodium would grow over and around it.

Outcome: This created especially interesting structures and even colouration (dark brown/black), but could not consistently be recreated later.

Implications for sculpture: Possible method of inoculation with uncertain results.



freshly inoculated



after inoculation day: 1

Set-up

nature habitat vs. lab petri-dish

after inoculation day: 2

Set-up

nature habitat vs. lab petri-dish

voluntary transfer day: 2

**Physarum polycephalum leaves a trace of excretions on the surfaces it has been on, comparable to a snail's slime trace. Exact interdependencies - namely the full nature of the trace-substance - are not yet fully scientifically understood.*