It's in our hands.

Degradability Experiment

Biodegradability is an indicator for assessing substances in terms of their impact on our environment. A material, substance or product can only be described as biodegradable if microorganisms are able to break the material down into its basic elemental components such as carbon, oxygen, hydrogen, etc. In our scientific experiment, we will test two different materials - a wood-based and a petroleum-based fabric – in regards to their degradability and compare them with each other.

I. Analyzing the initial conditions

1. ENVIRONMENTAL DATA

Measure **room or outdoor temperature** (± 0.5°C) and record it on data sheet "preliminary analysis"

2. SOIL ANALYSIS

Soil fulfils numerous important tasks. One square meter of soil about thirty centimeters in depth can be inhabited by up to eighty earthworms, fifty isopods, a million nematodes and ciliates, a billion fungi and a trillion bacteria! The number and composition of these "inhabitants" is structured according to a specific order and is determined by the oxygen content of the soil. Breaking down organic material these soil dwellers top priority. And that is exactly why we are now going to take a closer look at the soil!

a) Testing soil composition by hand

Take a small amount of soil, add a little water, and roll it out between your fingers to about half the thickness of a pencil. Based on how shapable, sticky and grainy the soil feels, you can categorize the soil sample:

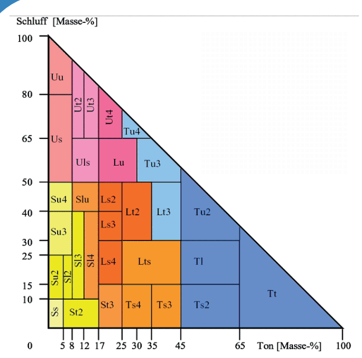
Texture	Classification
very shapeable, can be rolled out thinly, very sticky	clay
somewhat shapeable, grains not palpable, velvety, floury texture	silt
not shapeable, crumbly and grainy	sand

Record the percentages of each of the three types in your sample on the data sheet.

Worth knowing

In the lab we can, of course, determine the composition of our soil much more accurately than by hand. There, the quantities of the individual components are examined by sieving the sample, among other things. In the process, the larger sand grains are separated from one another. In the so-called hydrometer analysis, the sample is suspended in water. Because clay and silt particles sink to the bottom at different rates based on their size, we can draw conclusions about the sample's composition. The distribution of grain sizes can also be determined using a laser in a process called laser granulometry.

After the relative proportions of the sample have been determined, the sample can be classified. For this purpose, a so-called soil texture triangle is used (on the right, the version used in German-speaking countries). For example, if a sample consists of 6 % clay, 18 % silt and 76 % sand, it is "officially" slightly loamy sand (abbreviation Sl2).



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2. SOIL ANALYSIS

b) pH value of the soil and determining the salt content

Determine the pH value of the soil with one of the two indicator strips. To do this, dissolve the soil sample and immerse the indicator paper in the liquid. The pH value can be determined by comparing the coloration to the provided colorscale.

At the same time, the salt content can be determined. Salts are formed by the combination of a positive ion (e.g. Na^+) with a negative chlorine ion (Cl^-). In moist soil, the salts dissolve back into their ionic components. Therefore, if you measure the amount of (free) chlorine present, you can determine the salt content.

You will need:

- Soil sample
- 1 measuring cups
- 2 small cups
- 2 indicator strips
- Round filter
- Destilled water
- Table spoon
- Funnel (optional)

How it works

1. Place a 25 ml soil sample *(use measuring cup)* in the container
2. Add 50 ml of distilled water *(measuring cup)* to the soil sample in the cup and stir the soil into the water.
   (A suspension is created since the soil does not dissolve in the water but "hangs" in it).
3. Either hold the filter or place it inside the funnel and carefully pour the suspension through, into the second cup, ensuring that none of it flows past the filter.
4. Immerse the pH indicator strip in the filtered liquid for 3 seconds, remove it and read the result after 15 seconds. Look at the discoloration of the indicator strip and compare it with the provided color scale.
5. Immerse the chlorine indicator strip in the filtered liquid for 3 seconds, remove it, and read the result after 15 seconds. Check the discoloration of the indicator strip and also compare it with the relevant color scale ("free chlorine").

Good to know

No specific unit (such as meters, litres or joules) is assigned to the ***pH value****. It is a "dimensionless" parameter. It indicates the inverse concentration of hydrogen ions: the lower the number, the higher the concentration of hydrogen ions and the stronger the acid.*

Free (unbound) chlorine *is measured in parts per million (ppm). This unit indicates a ratio: Just like a per cent is a proportion of 1/100, and a thousandth is a proportion of 1/1,000, a part per million is a proportion of 1/1,000,000. In this case, it is a ratio by weight: if the chlorine content of the filtered liquid is 1 ppm (part per million), one-millionth of its weight consists of chlorine. The free, unbound chlorine is a result of the salt dissolving. In addition, there is chlorine that is bound, for example, to other minerals. The total amount of chlorine is given under "Total Chlorine".*

d) Moisture content and weight of the soil

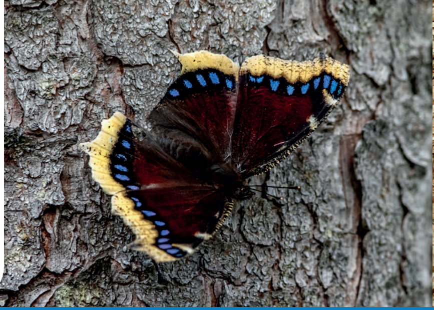
To assess the soil as accurately as possible,
further data is collected:

- **Moisture content** of the soil *(using the Soilmeter from the material box)*
- Determine **the weight reduction** of a 50 g soil sample. Weigh the sample accurately, allow it to dry for three days, and then weigh again. Then saturate it with water and weigh it again.

Upload the results to the website!

e) Microscopic examination of the soil

To complete the soil analysis, view and photograph a small amount of soil under a cell phone microscope. Assess its condition according to the **preliminary analysis sheet** and upload a photo.



3. MATERIAL ANALYSIS

Now it's time to take a closer look at our featured materials.
More precisely, to explore them with all our senses:

a. Softness of material samples

Test the texture of both samples with your fingers. In doing so, you can rely entirely on your individual senses and your experience with touch-based sensations. To do so, rate the materials on a scale from 1 to 5, 1 being the softest, 5 being the least soft.
Our fingertips can sense tiny protrusions 0.006 millimetres in size. Fun fact: a dot of Braille is 167 times higher. Our skin owes its sophisticated sensory system to several sensory cells that, like surface sensors, transmit stimuli to the spinal cord. Together with other sensory organs, such as our eyes and ears, they are comparable to outposts of our brain.

b. macroscopic and microscopic examination

Two different materials may look similar at a first glance. But a closer look may reveal differences. On the one hand, we will explore what stands out upon closer direct inspection, and on the other hand, we will examine the two materials with the handheld microscope from our material box.
Macroscopic: visible to the "naked" eye | Microscopic: only visible with e.g. a magnifying glass or a microscope#

The following questions may be helpful:

- Are both samples the same shade of white?
- Are the materials matte or glossy?
- Are the two materials the same or similar in structure?
- Are the materials pure white when viewed under the microscope, or are there areas that have a different coloration?
- How strongly are the materials structured when viewed under the microscope?

c. Shape retention - dry and wet

We will put the two material samples to the test by examining them under tension. We will also observe whether, the materials tend to return to their initial shape after the tension is released.

The term "shape retention" is often generally used synonymously with "durability". From a scientific point of view, shape retention provides information on the extent to which a material can retain its shape despite pressure or heat. Thus, this term describes the resistance to deformation due to heat and pressure.

d. Tear resistance - dry and wet

We wil go a bit further and subject our materials to the tear test. How much force do we have to use before the materials tear? Do we have to apply the same force to both of them?

The tensile strength is the tensile stress at the moment the test specimen tears. Like the elongation at break, it is also determined in a tensile test.

e. Weight dry | Weight wet

f. Water repellent or water absorbent

Fabric that is water repellent remains dry (on the outside). The material does not absorb water.
This property can be observed by checking whether liquid beads off the surface or not.

To use your material samples wisely, proceed as follows:

Step 1:

- Compare the softness of both samples
- Examine samples macroscopically and microscopically
- Test both samples for shape retention while dry
- Test both samples for rear resistance while dry

Step 2:

- Weigh both samples while dry
- Test the degree to which both samples repel water
- Saturate both samples with water and weigh them
- Test both samples for shape retention while wet
- Test both samples for tear resistance while wet

Degradability Experiment

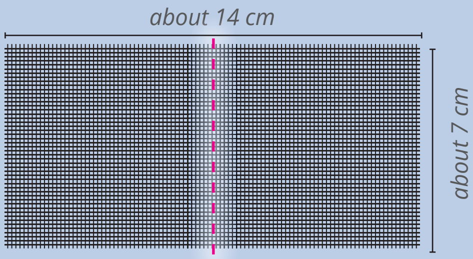
All the preliminary analyses have now been completed and uploaded to the website https://schoolproject.itsinourhands.com/
We can now turn our attention to our "core experiment", the heart of our school project, the experiment on the degra-dability of the material samples.

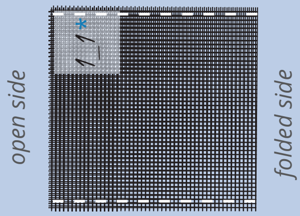
After a few steps, we will be able to bury the samples in the ground or prepared soil- preferably outdoors on the school grounds, if there is an appropriate space available!

II. Preparations for the degradability test

1. PREPARING THE SAMPLES

For the **sample sachets**, make 20 small bags 7 x 7 cm in size cut out from the insect netting (to be found in the material box). Use a needle and thread (also found in the material box) for this.



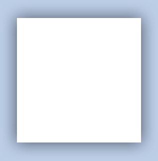


In summary you will need
- 10 sachets with a wood-based sample
- 10 sachets with a petroleum-based sample

Make sure that you don't mix up the samples! For this purpose, use the numbered plastic strips by sewing them onto the sachets.

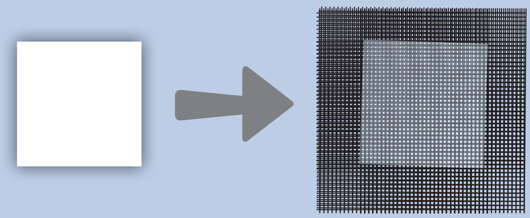
Fold a piece of the netting in half and sew it together at the edges so you get a sachet with one open side!

Cut **THE FABRIC SAMPLES** into 4 x 4 cm squares using the enclosed template and place them into the numbered sample pockets.



1. Switch on the scale from your experiment box, check it for any contaminants and clean if necessary.
2. Weigh the material sample *(wait until the value is displayed consistantly for 10 seconds)*.
3. Enter the weight in your testing sheet.

Then place the material samples individually (only one material sample per sachet) into the labelled sample sachets using spoon tweezers in such a way that there are no overlaps, folds, etc. and place them on a white sheet.



Carefully place a 4 x 4 cm material sample into a sachet so that it is wrinkle free.

2. BURYING THE SAMPLES IN THE SOIL

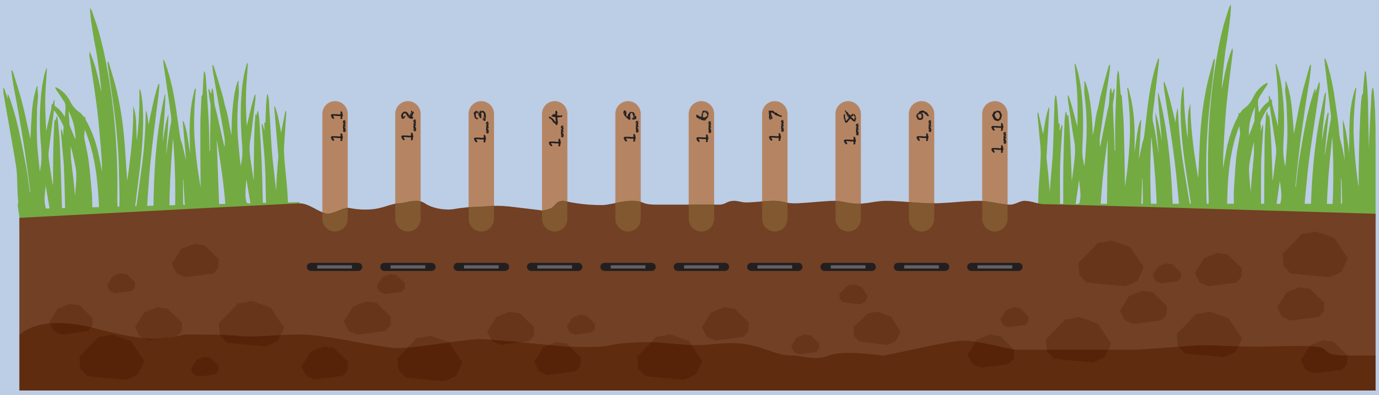
Depending on where or in what the samples are buried, different experimental setups are needed.

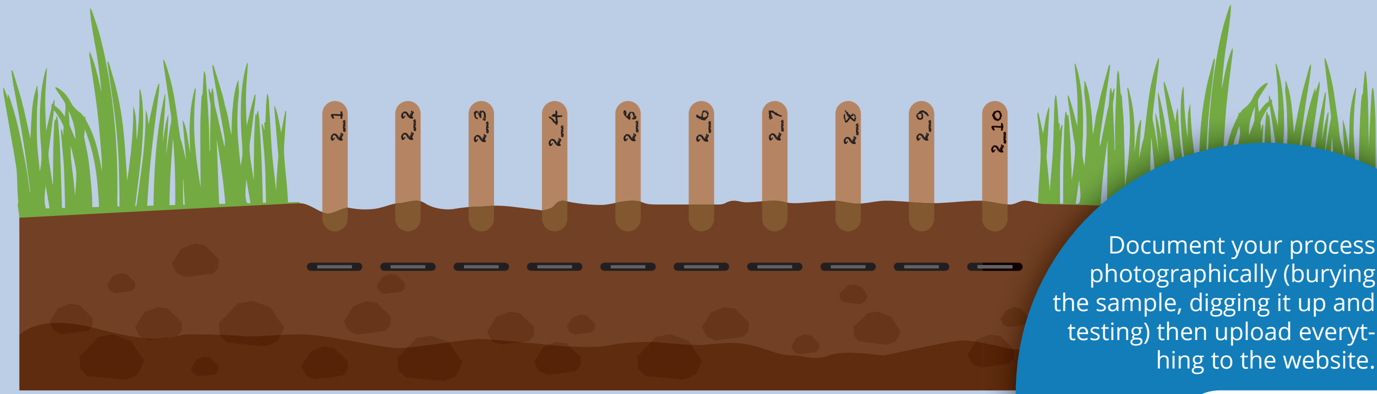
a) Outdoors

If the experiment can be carried out outdoors **the sachets are placed next to each other in the ground.** The exact position of each individual bag is marked with a labelled craft stick. If possible, set up your samples in **two rows**, one row with wood-based samples and a clearly **separate second row** with the petroleum-based samples.

Here's an example how you should mark your **wood-based** samples:
1_1 For the first sample you dig up
1_2 For the sample to be dug up in the second week, etc.

For the **petroleum-based** samples
2_1 For the first sample you dig up
2_2 For the sample to be dug up in the second week, etc.





Document your process photographically (burying the sample, digging it up and testing) then upload everything to the website. **!**

1. Dig a roughly. 3 centimeter deep layer of soil

2. Place the individual sachets at a sufficient distance from each other (at least 2 cm) and moisten them with water.

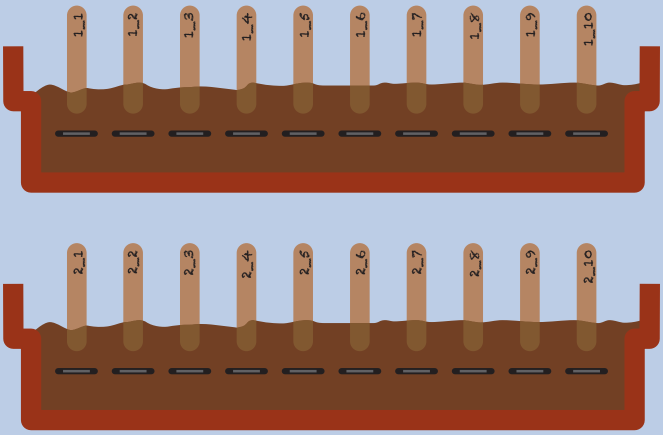
3. Insert the marked craft sticks from left to right in the corresponding order behind the sachets to a depth of approx. 1 cm.

4. Then loosely cover the sachets and fill in the remaining soil (without compressing it).

b) Indoors

If no outdoor area is available, you can use flower boxes or flower pots. In any case, two individual containers must be used so that the two different fabric types can be analyzed separately.

Flower boxes (long and shallow)

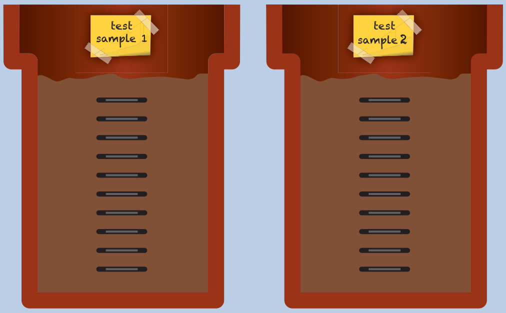


In this version, the sample material sachets are arranged horizontally, next to each other, exactly as they would be placed outdoors.

Filling the flower boxes:

1. Fill in a layer of soil approx. 3 cm high.
2. Place the samples side by side on the soil, leaving gaps of approx. 1-2 cm between each pair, and moisten lightly with water.
3. Fill in another 2 cm layer of soil on top of the samples. Allow the soil to fall in - do not press firmly - only lightly pat the soil with your hand!
4. Finally, moisten the top layer of soil.
5. Place the containers in a dark space (like a cupboard) and cover them with a lid (do not seal tightly). If no lid is used, add approx. 90 ml of water per 1-litre sample container after a period of 7 days. For the flowerbed, a quantity of approx. 400 ml of water should be used.

Flower pots (round and tall)



If you are working with flower pots, the sample material sachets are placed one below the other.

Filling the flower pots:

1. Fill in a layer of soil about 1 cm high.
2. Place the first material sachet on the soil and add a little water.
3. Fill in one more cm of soil.

Repeat these steps in the same way until all the sachets have been buried.

ATTENTION: The soil must be filled without compression - drop it in and press lightly with your hand.

Important:
The soil should never dry out completely, so make sure to add water regularly. This can also be done at shorter intervals than seven days. The only important thing is that it is done at the same interval and with the same amount of water each time.

It's in our hands.

What does the data reveal?

Numbers and data play an essential role in (pre-)scientific research. Collecting numerical data points and subsequently putting them in relation to each other allows us to measure the frequency of a phenomenon. Moreover, making data comparable enables us to evaluate the facts in an evidence-based manner. This is precisely why it is so important to record the results of our experiment and compare them internationally with data collected by other participants.

III. Analyzing the retrieved material samples

General instructions for properly retrieving the samples
The samples are retrieved at regular intervals of one (1) week. Only one sample of each material is retrieved at a time (e.g. 1_1 and 2_1). The other samples should remain untouched in the soil until their respective retrieval dates. Use a tool such as a spatula-spoon for excavation.

1. Gently shake the retrieved sample sachet to remove any adhering soil. Then place it on the corresponding field of the "Datasheet Indivual Samples"
2. Now carefully remove the material sample from the sachet with the spoon tweezers.
3. Take a photo of the freshly dug up, undried sample.
4. Let the sample dry for 3 hours at room temperature
5. Before reweighing, the sample itself should be checked and, if necessary, be freed from any debris by carefully shaking it.
6. The samples can now be weighed with the scales as described above.
7. Carefuly document the result in your data sheet.
8. Take a picture of the dried sample.
9. The examined sample can now be discarded.

! **These should be repeated weekly with the remaining samples until there are no left.**

This can happen as soon as two weeks later (at higher temperatures) or, if the ambient or outside temperature is lower, it can also take longer!

If the ground is frozen, the process is slowed down!

In general, the longer a sample remains buried, the more accurate and more representative the result.

Record all **observations** you make during the experiment (e.g., discoloration of samples, slower degradation, etc.) in the provided protocol sheets.

Continuous **photo documentation** of burying the samples, digging them up, and all your results can be uploaded in the upload section of the website.

Finally, the results should be summarized in writing and visually in a **project report.**