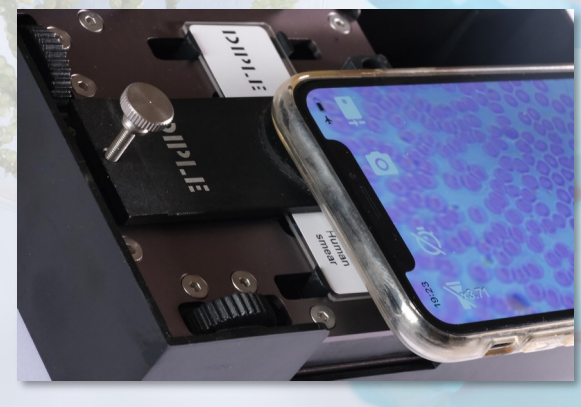
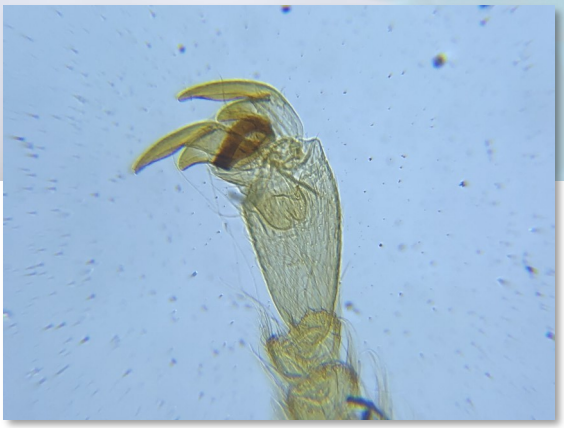
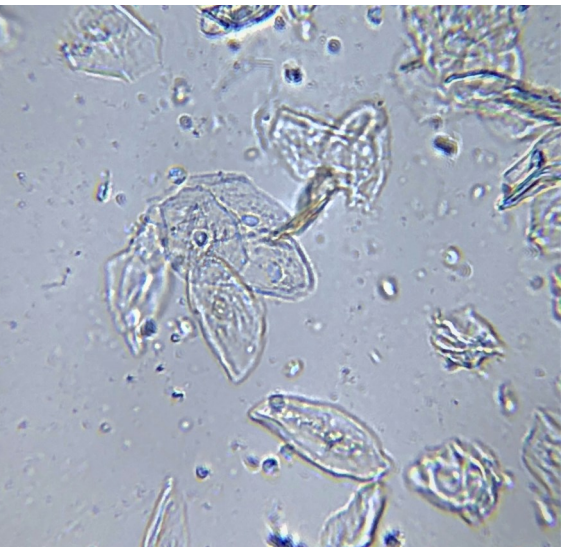
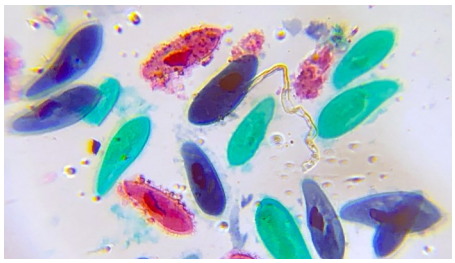


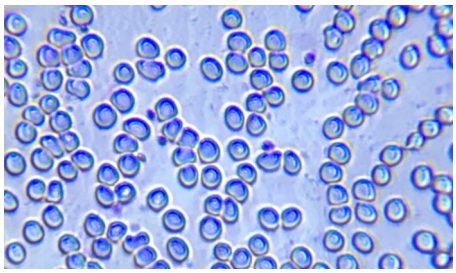



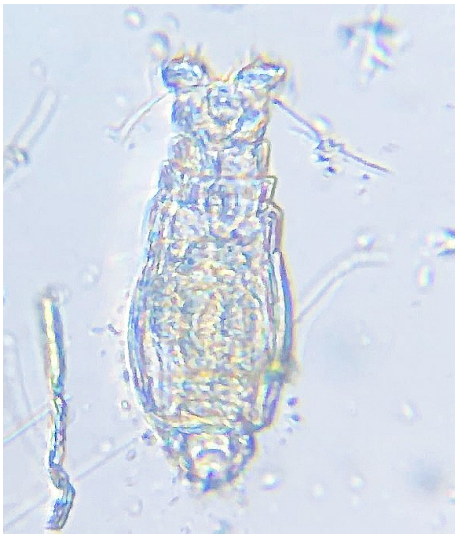
# DIPLE

Microscopy workshops and experiments









SMO
SMART MICRO OPTICS

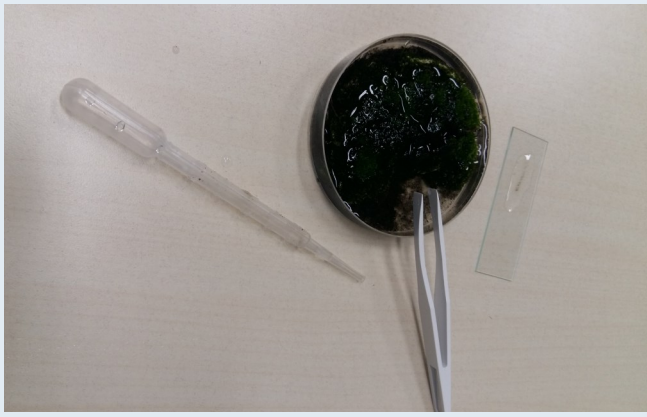
**MOSS**

**Difficulty:** medium-hard

**Duration:** 45 minutes

**Materials:**

- Fresh moss
- Petri dish or a small dish
- Tweezers
- Pipette
- Blips Labkit



**Observed subjects:**

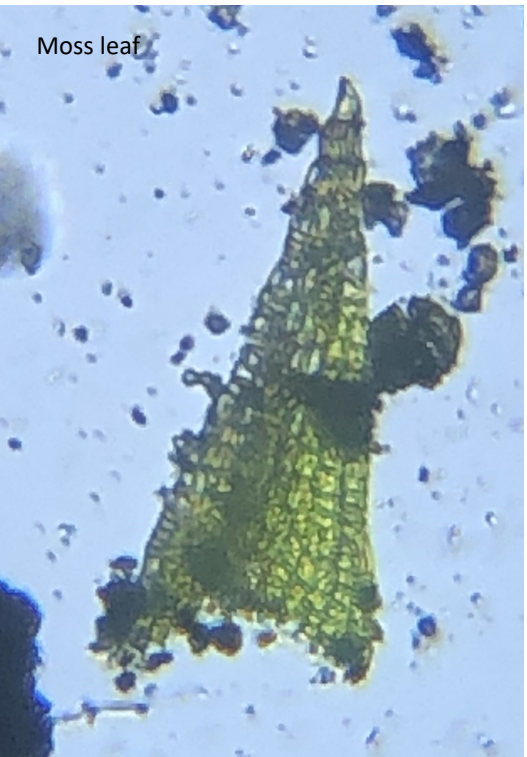
- Tardigrades, rotifers, plant cells, nematodes, ciliated protists

**Procedure:**

1. Collect the roots of moss and also some soil.
2. To keep the moss moist, you should add a little water: one millimeter of water in the Petri dish is more than enough. If part of the water is left to evaporate in the disc, the microorganisms inside it will end up concentrating all in a restricted space, thus becoming easier to observe. Keep everything warm, at temperatures of 25-30° the microorganisms proliferate, at higher temperatures they die. In general it is enough to keep the moss moist, indoors and sheltered and it should keep providing subjects to be observed for days. For the observations, remember to collect also a little soil or bits of moss in the pipette: many microorganisms feed on its leaves.
3. Put your sample on a plain slide, together with a drop of water. To keep the sample thin, you can add a cover slip.

**Description:**

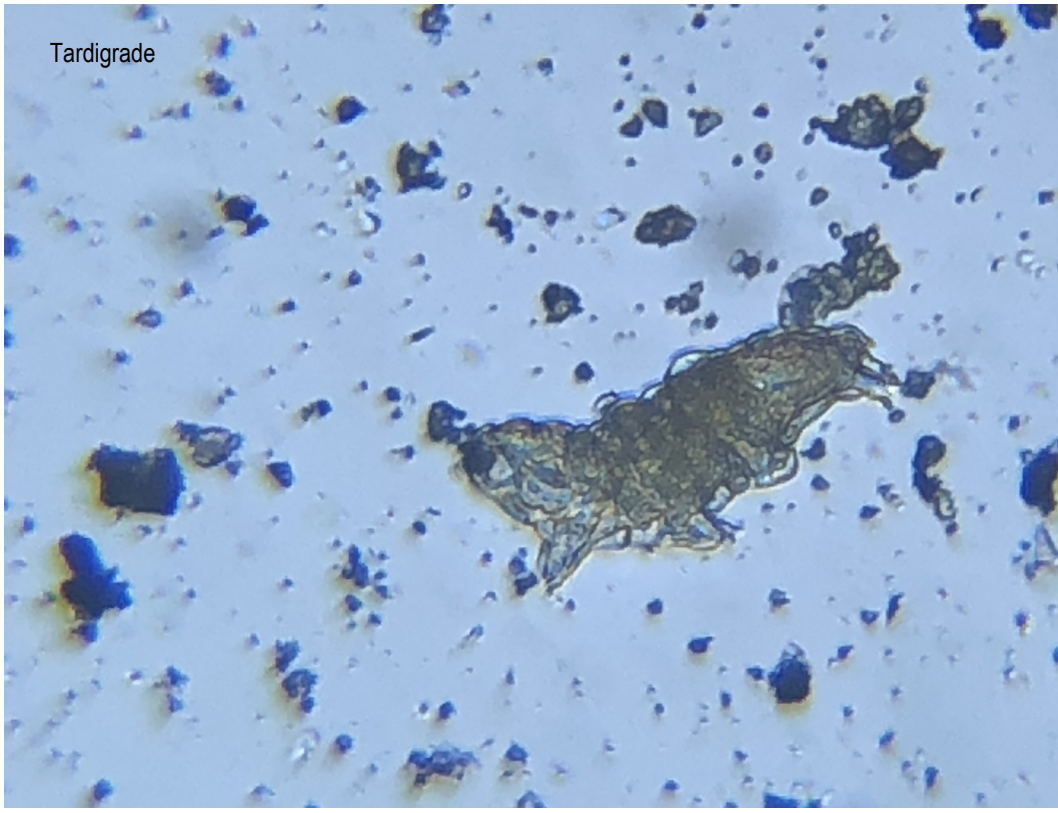
Moss, one of the most common subjects of microscope observations, must be taken when it has a bright green color and it must never dry out. Ideally, you should collect and put it in a Petri dish when it is still wet .




Even the single leaves of moss, in certain points, are thin enough to allow the observation of their individual cells. In the soil on the roots of moss, as mentioned, there are nematodes: they are microscopic, thin, transparent worms, which stir frantically when they are removed from the soil. There are thousands of species, but those collected this way are probably parasites of the moss roots.

Another interesting subject that can be observed in the veil of water that covers moss are rotifers. These animals move in a way similar to leeches, crawling and using two kinds of suckers (one in the head and one in the foot) while when they stop to feed, they extract two coronas from their head that create a water current which delivers food in suspension to their mouth. They are a good indicator to understand if the collected moss is fine or not: if they are not found, probably nothing else will.

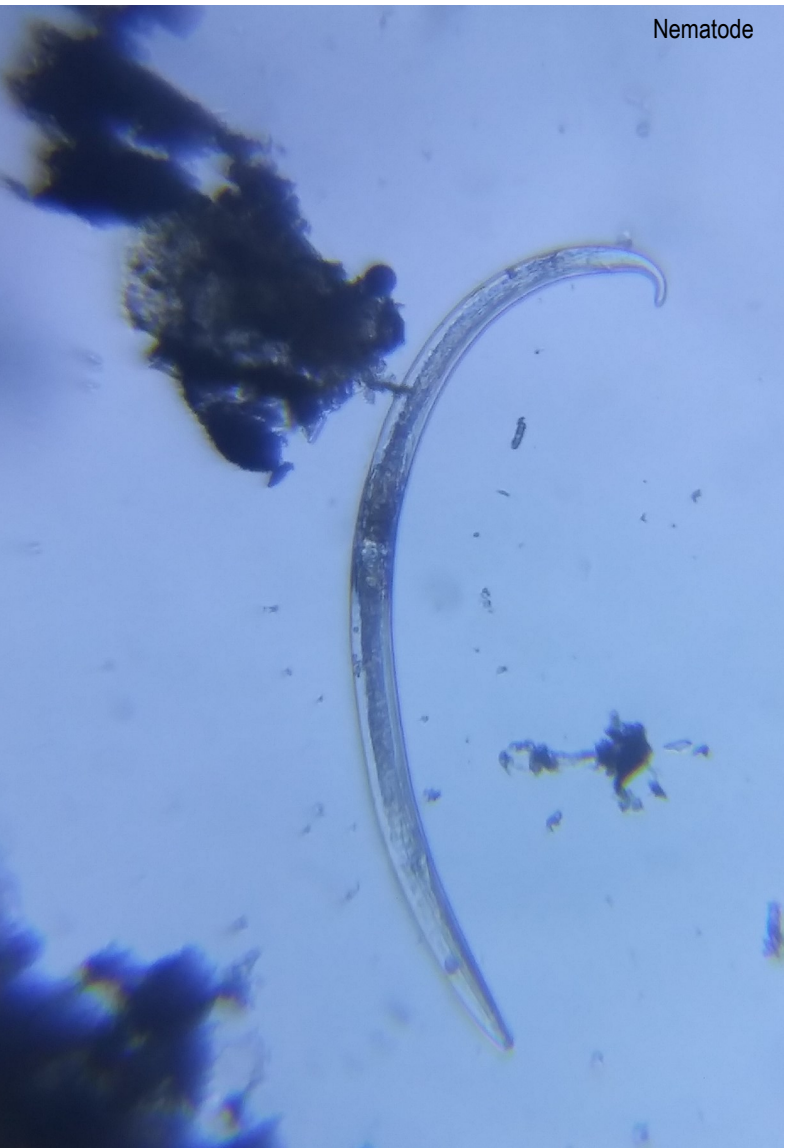
**Tardigrades**, animals now known also by the general public for their plump appearance, for their extraordinary resistance and for having survived in open space, are the “most wanted” subject of the microscopic observations of moss. However, they are not very easy to find. You have to be patient, but when you meet one, you can’t go wrong: they are significantly larger than the other organisms found on moss, and have an unmistakable appearance, with their stocky body and their eight legs.

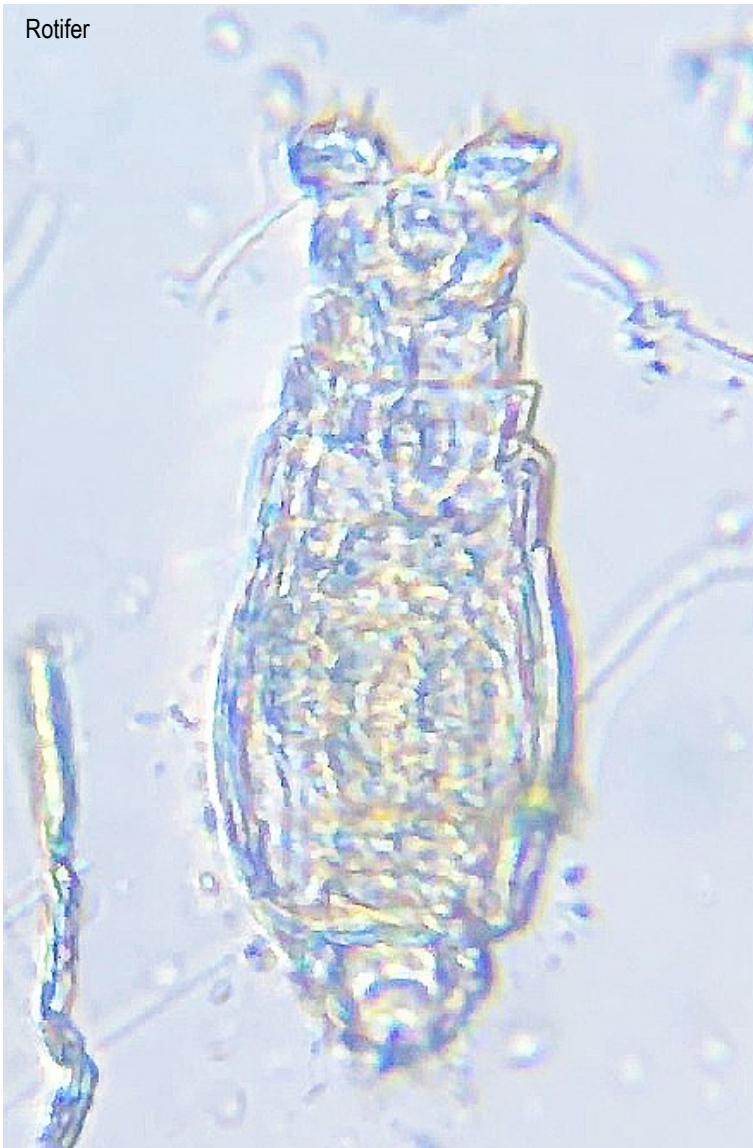

Tardigrade

They are particularly clumsy on the microscope slide, so don’t be afraid: if you find one, it is very difficult for it to disappear from your field of vision.

Many other microorganisms can be found in moss, but identifications are usually really difficult.

In any case, the vast majority of the round or slightly elongated corpuscles that swim with great speed in the water of the slide is made of ciliated protists, who quickly swim in the water using their ciliated structures.


Nematode


Rotifer

**BACKWATER**

**Difficulty:** easy

**Duration:** 15 minutes

**Materials:**

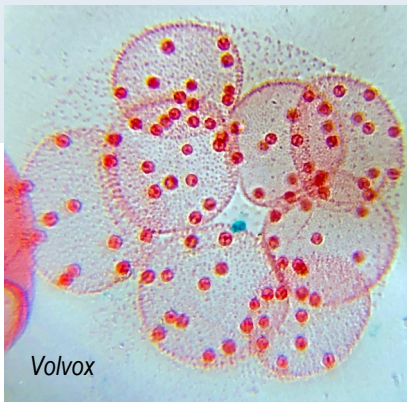
- Backwater or infused hay
- Petri dish or a small dish
- DIPLE Red, Grey or Black

**Observed subjects:**

- Algae, ciliated protists, other microorganisms

**Procedure:**

1. Take a sample of stagnating backwater and keep it in an open jar, in a warm environment
2. Place a drop of water with a pipette on a plain slide. You can add a cover slip to keep the sample thin.


Volvox

**Description:**

The infusion of hay, the water from saucers and any type of stagnant water for a few days and with organic residues can provide material suitable for microscopic observation.

In general, a slightly yellowish or even turbid color can be the indicator for the presence of microorganisms. In any case, a saucer water, not too recent and not crystalline, usually contains interesting subjects to be observed under a microscope.


Spirogyra

In this case, the observations that can be made are several and include algae of various kinds, many ciliates and small animals such as crustaceans or insect larvae. There are large quantities of **ciliated protists**, of various shapes and sizes, which swim quickly in the water.

Particularly elegant is ***Vorticella***, a type of ciliate that instead remains anchored to the substrate by means of a peduncle, a few microns wide and about one hundred microns long. It is a filtering organism: from the movement of the cilia on the body, as for the rotifers, a stream of water is created, and it brings nutrients to their mouth.

There is no shortage of amoebae, easily recognizable for their iridescent and irregular shape, and the colonies of ***Volvox***, single-celled algae which, by grouping, create elegant spherical structures (it is often possible to observe other small structures inside them, the "daughter" colonies).

Particularly beautiful is ***Spirogyra***, a type of filamentous alga. Inside of it, you can recognize the chloroplasts necessary for photosynthesis, arranged in a typical spiral structure.

**FRESH WATER**

**Difficulty:** easy

**Duration:** 15 minutes

**Materials:**

- Fresh water from streams or lakes
- Petri dish or a small dish
- DIPLE Red, Grey or Black

**Observed subjects:**

Insect larvae, crustaceans, many microorganisms

**Procedure:**

1. Take a sample of turbid fresh water and keep it in an open jar, in a warm environment
2. Place a drop of water with a pipette on a plain slide. You can add a cover slip to keep the sample thin.

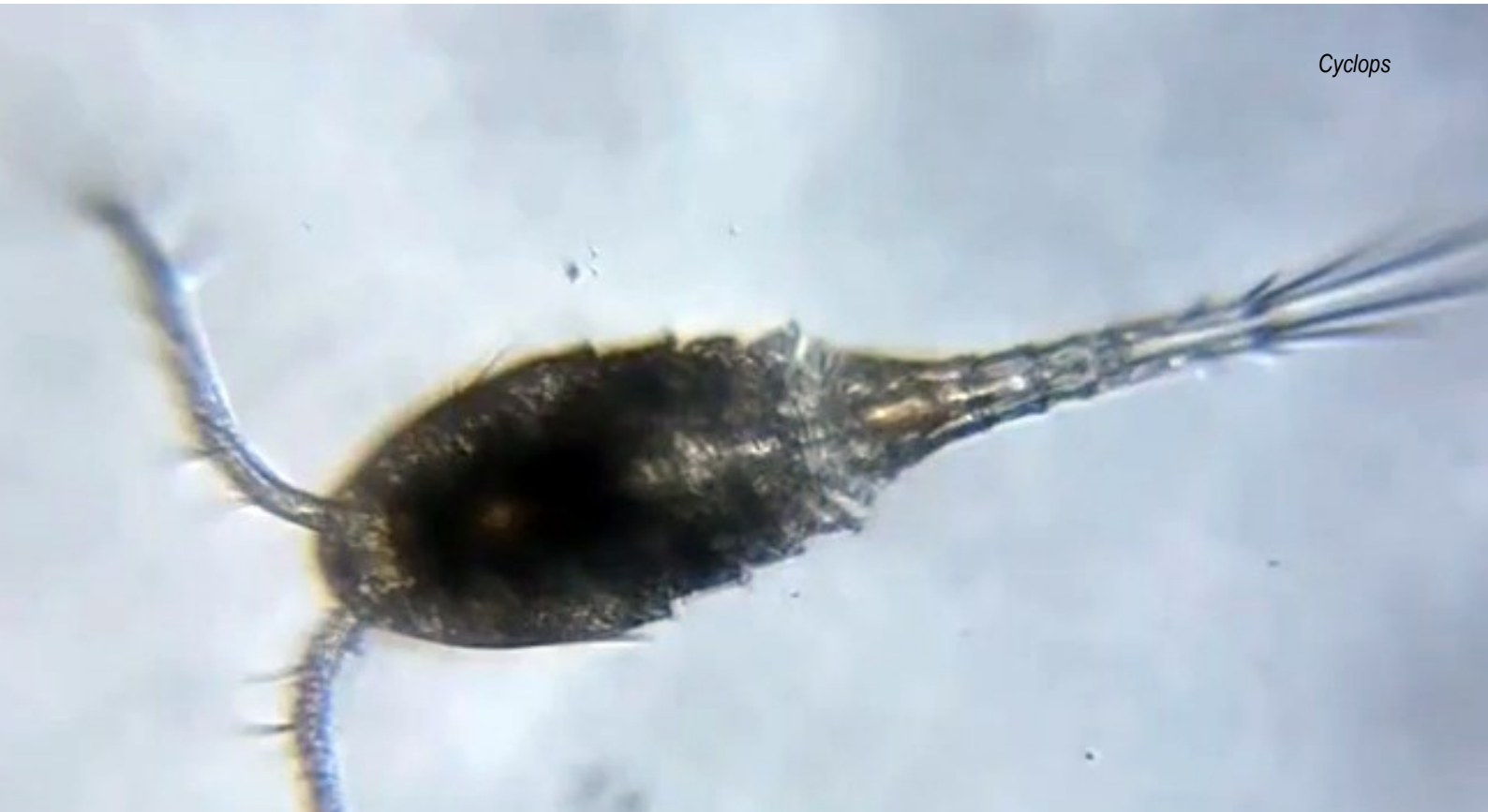
**Description:**

The water of lakes, rivers or simple pools offers a great variety of microorganisms suitable for observation under a microscope.

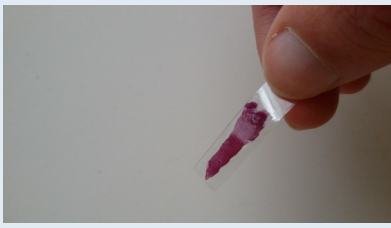
Obviously it is more difficult to recover it in cities, but even the simple trickle that drains into the manhole offers a fair level of biodiversity, if its water is not polluted or altered in any way.

In general, the same rules apply to stagnant water: it is better if it is not excessively moving, it is better taking samples from those places where there is little current.

Slightly cloudy waters, or waters containing organic residues are usually the suitable solution for finding microorganisms. In this case, **insect larvae** dominate it (especially in rivers).



*Cyclops*



**ONION SKIN**

**Difficulty:** easy

**Duration:** 15 minutes

**Materials:**

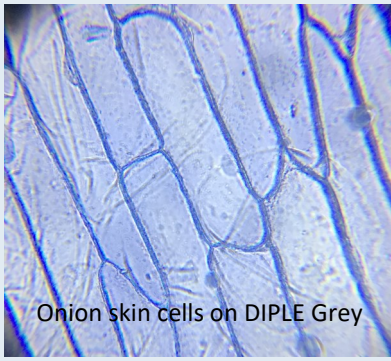
- **1 onion**
- **Tweezers**
- **Methylene blue (optional)**
- **DIPLE Red, Grey or Black**

**Observed subjects:**

Plant cells

**Procedure:**

1. Use the tweezers to take a thin sample of an internal layer of the onion, where two layers divide;
2. Place a small sample (few millimeters per side) on a plain slide with a drop of water;
3. (optional) color the sample with methylene blue (see dedicated box for details);
4. Add a cover slip to keep the sample thin.



Onion skin cells on DIPLE Grey

**Description:**

This is an very simple experience that allows you to observe the regular structure of plant cells very clearly. You must take a thin sample from an internal layer of the onion where two layers divide. If the sample has been made correctly and it is thin enough, the ordered structure of the onion cells will be clearly viewable. A simple variant involves coloring the sample with methylene blue, which colors the cell membranes and makes the cell nuclei perfectly distinguishable, which will appear as tiny spherical structures inside the cells.

**MOUTH CELLS**

**Difficulty:** medium

**Duration:** 20 minutes

**Materials:**

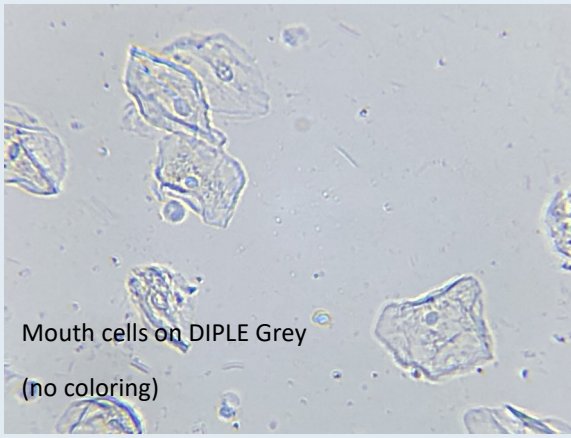
- Cotton swab
- Methylene blue
- DIPLE Grey or Black

**Observed subjects:**

Human cells

**Procedure:**

1. use a sterile swab to scrape the inside of your cheek for a few seconds
2. Rub the swab onto a plain slide
3. Add a small drop of water and color the sample with methylene blue
4. Wait for 3-5 minutes for the dye to color the subject



Mouth cells on DIPLE Grey

(no coloring)

Mouth cells on DIPLE Grey

(methylene blue coloring)

**Description:**

This experiment allows you to observe your own cells, directly taken from your body. Some cells of the mouth mucosa, with this procedure, detach from the inner wall of the mouth and remain on the surface of the swab. After few minutes of waiting, necessary to allow the cells to color, the sample can be observed under a microscope. Methylene blue colors both cell membranes and cell nuclei. The cells will appear as irregular structures, generally rounded, slightly bluish, with a single dark blue dot inside them, which is the cell nucleus.

**POTATO STARCH GRAINS**

**Difficulty:** easy

**Duration:** 15 minutes

**Materials:**

- 1 potato
- knife
- Iodine (optional)
- DIPLE Red, Grey or Black

**Observed subjects:**

Potato starch

**Procedure:**

1. Scratch the pulp of a potato with a kinfe
2. Add a little quantity of the sample on a plain slide
3. Add a little water and color the sample with iodine (optional)
4. Add a cover slip to keep the sample thin

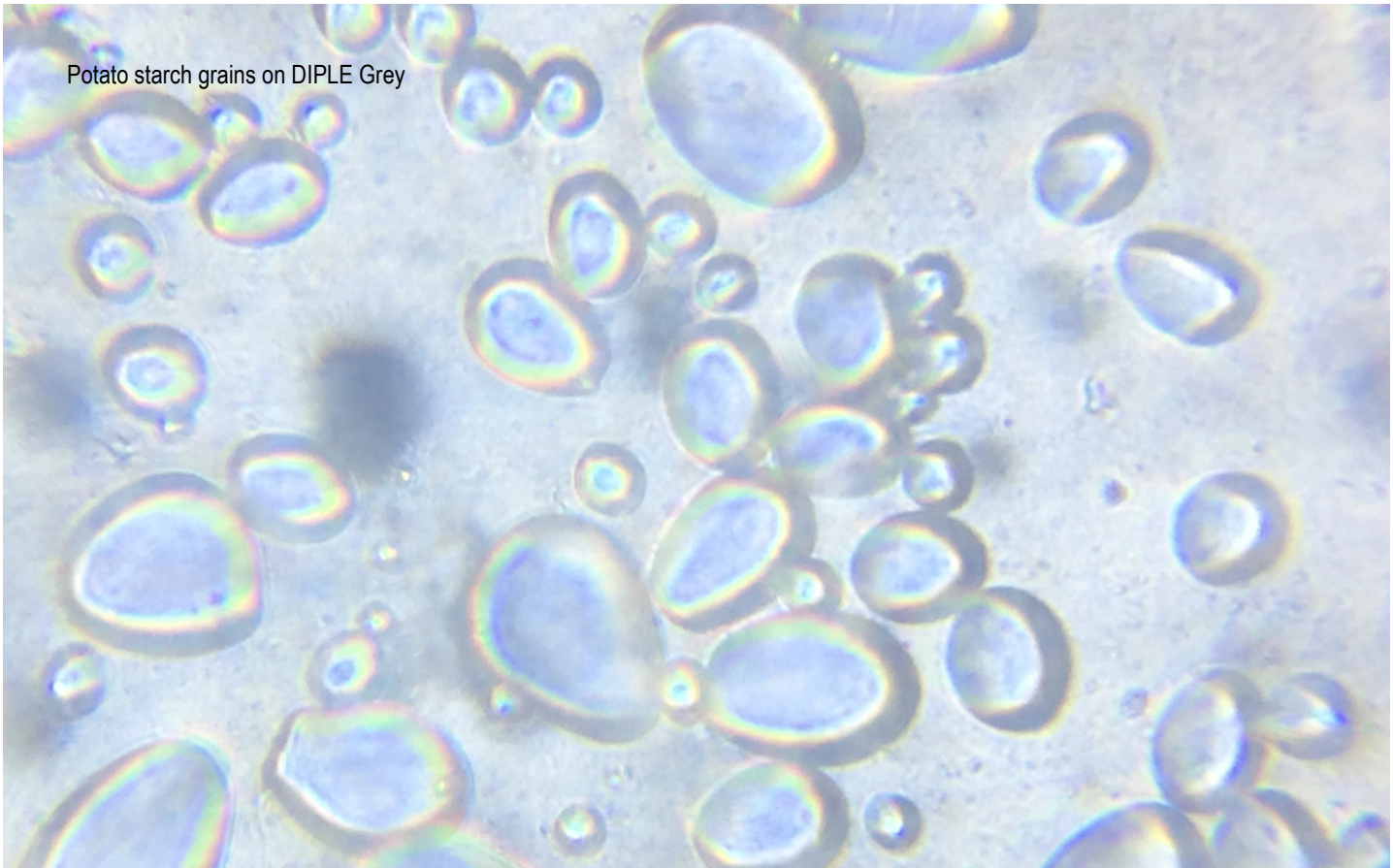
**Description:**

Starch is a typical reserve substance of plants, made up of glucose and water. It is solid and insoluble, and can be observed by scratching the pulp of a potato and placing the obtained granules on a slide together with a droplet of water.

In order to distinguish well their internal structure (they are formed by concentric structures around an aggregation center), it is better to use a dye. In this case, the most suitable product for coloring is iodine.

The dye is very powerful, and must be diluted 1:15 in water. Once in contact with the sample, the starch will immediately acquire a blue-violet color, and the individual granules will be observable under a microscope.

If distributed well on the slide, the individual granules will also reveal their internal concentric structures.



Potato starch grains on DIPLE Grey

**FRESH BLOOD**

**Difficulty:** medium

**Duration:** 10 minutes

**Materials:**

- Sterile lancets
- DIPLE Grey or Black

**Observed subjects:**

Human red blood cells

**Procedure:**

1. Sting your finger with a sterile lancet
2. Place a droplet of water on a plain slide

**Description:**

To observe one's own red blood cells it is not necessary to use a dye such as methylene blue or iodine, just use fresh blood, place it on a plain slide and observe it immediately (after a few minutes the blood cells deteriorate).

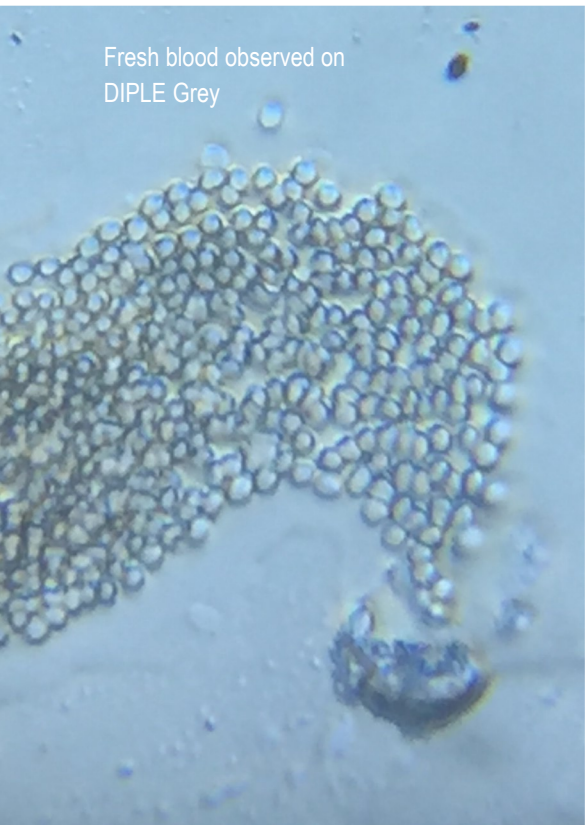
This experience can only be done wit sterile and medical disposable lancing needles, and the used slide must also be carefully disinfected. Sting your finger with the lancet and let out a droplet of blood.

Once the droplet of blood is placed on the slide (very little blood is needed) it is necessary to proceed to immediate observation.

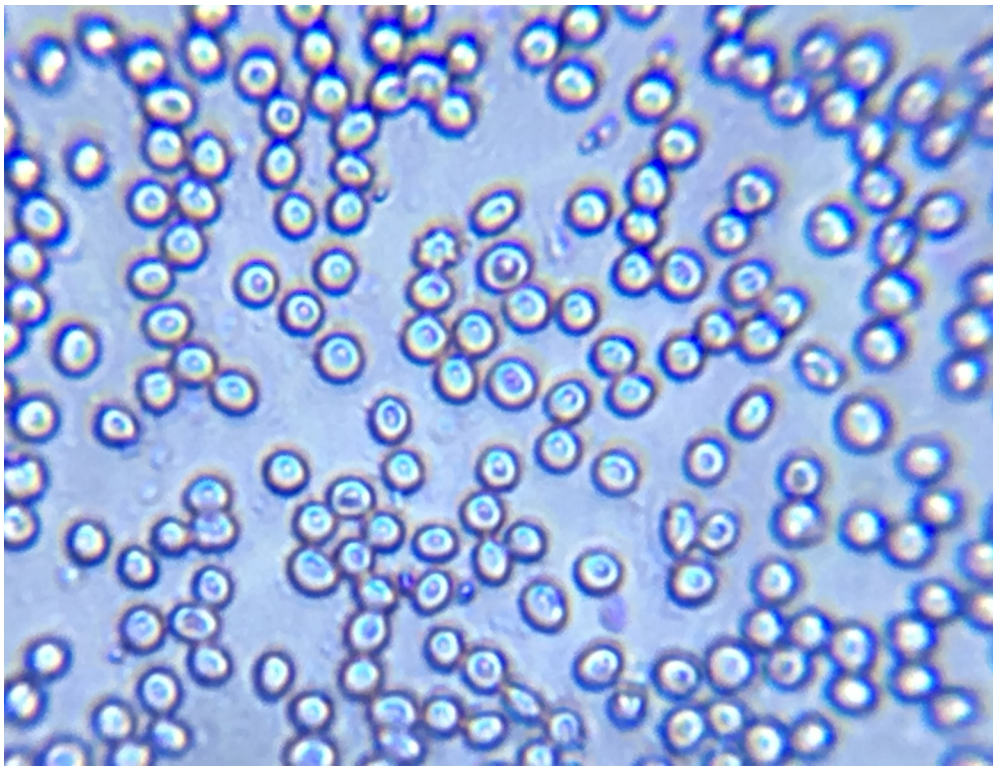
The red blood cells are perfectly distinguishable and observable at a few hundred magnifications.

They appear transparent or bluish and not the classic red color we are used to.

Using the DIPLE fine adjustment screw it is also possible to check the slightly flattened shape in the center of the individual cells.



Fresh blood observed on DIPLE Grey



**PET HAIR OR GOOSE FEATHERS**

**Difficulty:** easy

**Duration:** 10 minutes

**Materials:**

- Pet hair of goose feathers
- Water or vegetable oil
- DIPLE Red, Grey or Black

**Observed subjects:**

Animal hair or bird feathers

**Procedure:**

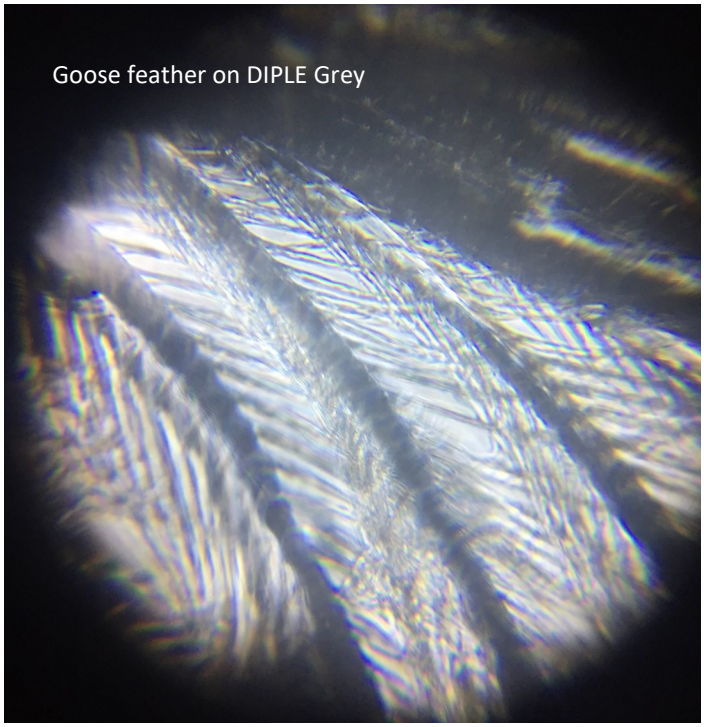
1. Place a thin sample of hair or a small, single feather on a plain slide. If the feather is too big, use only a piece of it which includes the central axis (called rachis).
2. Add a drop of water or of vegetable oil to keep the sample thin.
3. Add a cover slip to keep the sample thin.

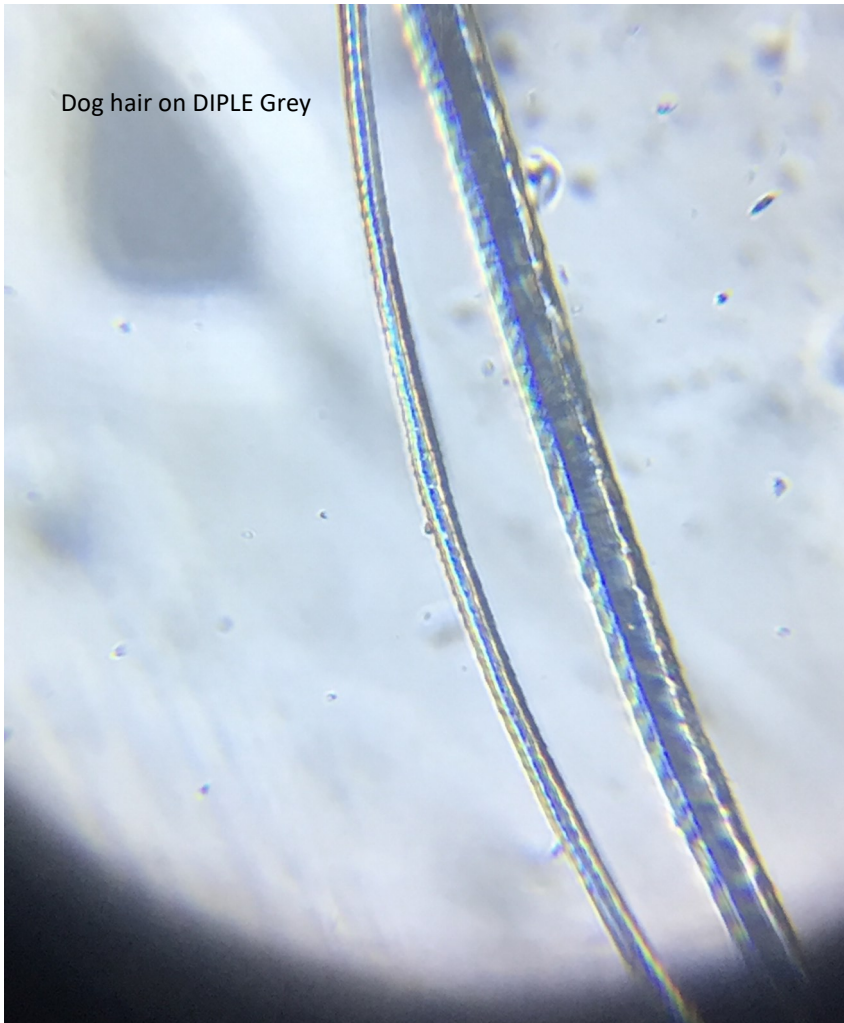
**Description:**

Dog and cat hair are interesting and easy-to-find organic samples, obviously they are always available for those who own a pet; goose feathers are very common too, since with them the paddings of many types of coats, duvets and pillows are made.

Some small feathers can be extracted with tweezers from the inside pockets of the coats without having to unstitch them, and in the same way, for cushions, often some small feathers emerge spontaneously through the fabric. As small it may be, it already represents a more than valid sample to observe.

Since these are usually water-repellent subjects, a small drop of vegetable oil can be used on the slide instead of water, to obtain a thinner and better observable sample.


Goose feather on DIPLE Grey


Dog hair on DIPLE Grey

**YOGURT BACTERIA**

**Difficulty:** medium

**Duration:** 30 minutes

**Materials:**

- Fresh yogurt
- DIPLE Grey or Black

**Observed subjects:**

Yogurt bacteria (*Lactobacillus acidophilus* and *Streptococcus termophilus*)

**Procedure:**

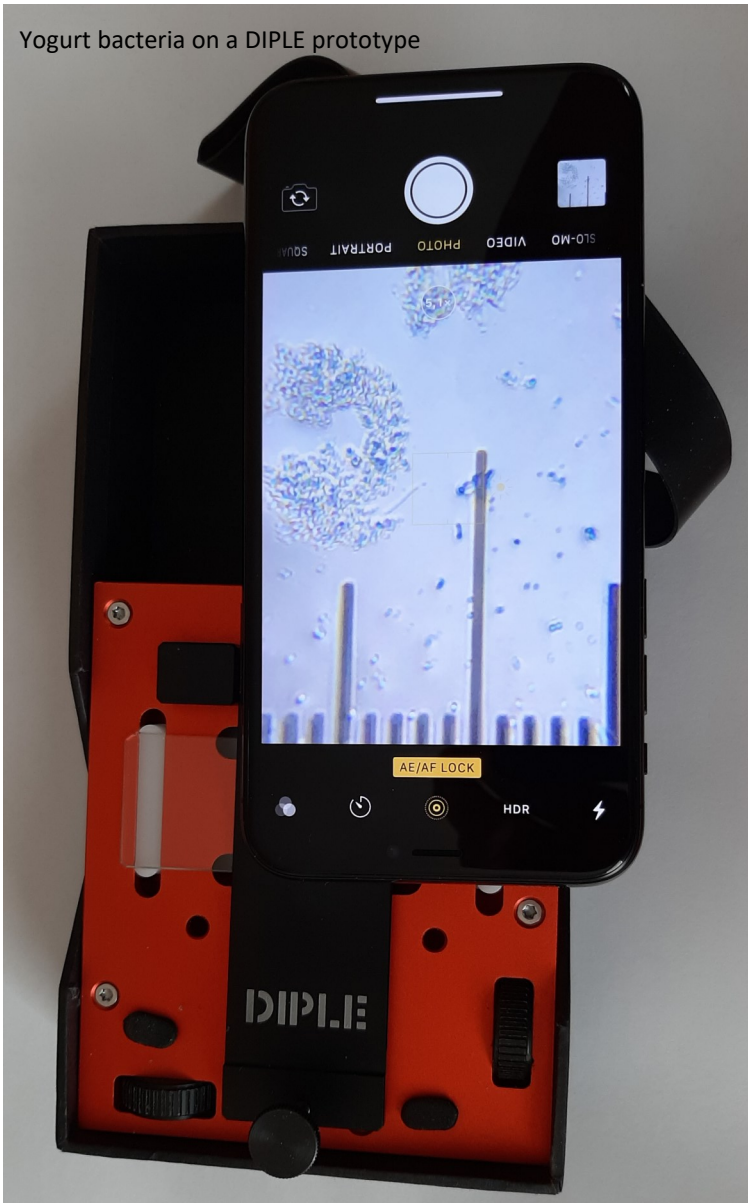
1. Dilute some fresh yogurt with water (ratio 1:1)
2. Place a drop of diluted yogurt on a plain slide
3. Color the sample with methylene blue (optional) and keep the sample thin with a cover slip

**Description:**

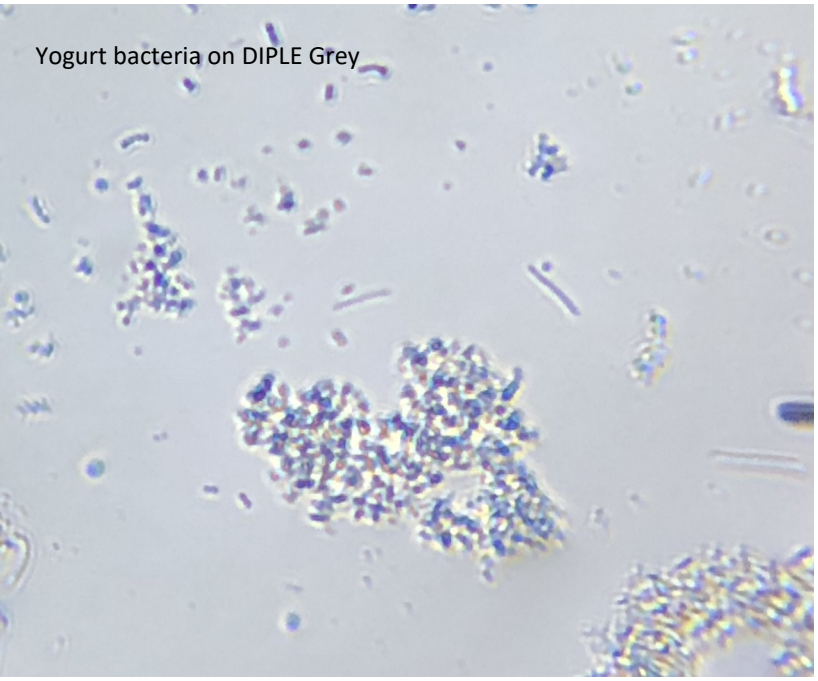
Yogurt isproduced by the fermentation of milk caused by bacteria. The fermentation of lactose produces lactic acid, which acts on milk protein to give yogurt its texture and flavor.

Yogurt bacteria are easily observed by diluting a little fresh yogurt in water and placing it on a plain slide. It is possible, but not essential, to color the sample with methylene blue.
There are mainly two types of bacteria: the rod-shaped *Lactobacillus acidophilus*, and the small and rounded *Streptococcus termophilus*, usually gathered in short chains.

Yogurt bacteria on a DIPLE prototype




Yogurt bacteria on DIPLE Grey



**BACTERIA OF THE SHOWER DRAIN**

**Difficulty:** medium

**Duration:** 20 minutes

**Materials:**

- Organic samples from shower drains or sinks
- Tweezers
- DIPLE Red, Grey or Black

**Observed subjects:**

Bacteria from the shower drain

**Procedure:**

1. Remove the filter from your shower
2. Collect a small sample of organic matter with slimy consistence
3. Place the sample on a plain slide
4. Add a cover slip to keep the sample thin

**Description:**

Other samples that are easy to observe and that do not require complex preparations are the microorganisms coming from the drains of showers and sinks. They can be collected with tweezers, removing the filter and collecting the accumulations of dirt found there.

A very small amount of this materials may be sufficient to observe bacteria and other microorganisms in large quantity. The sample should be placed on the slide with a drop of water, covered with a slide cover to keep the sample thin and easy to observe.

At high magnification, a certain number of bacilli should be observed, rod-shaped bacteria that populate in large numbers the so-called “biofilm”, that thin gelatinous patina that accumulates in domestic drains.

**ENGINE EXHAUST**

**Difficulty:** medium—NOT SUITABLE FOR SCHOOL KIDS

**Duration:** 10 minutes

**Materials:**

- Samples from an engine exhaust
- Protective gloves
- DIPLE Grey or Black

**Observed subjects:**

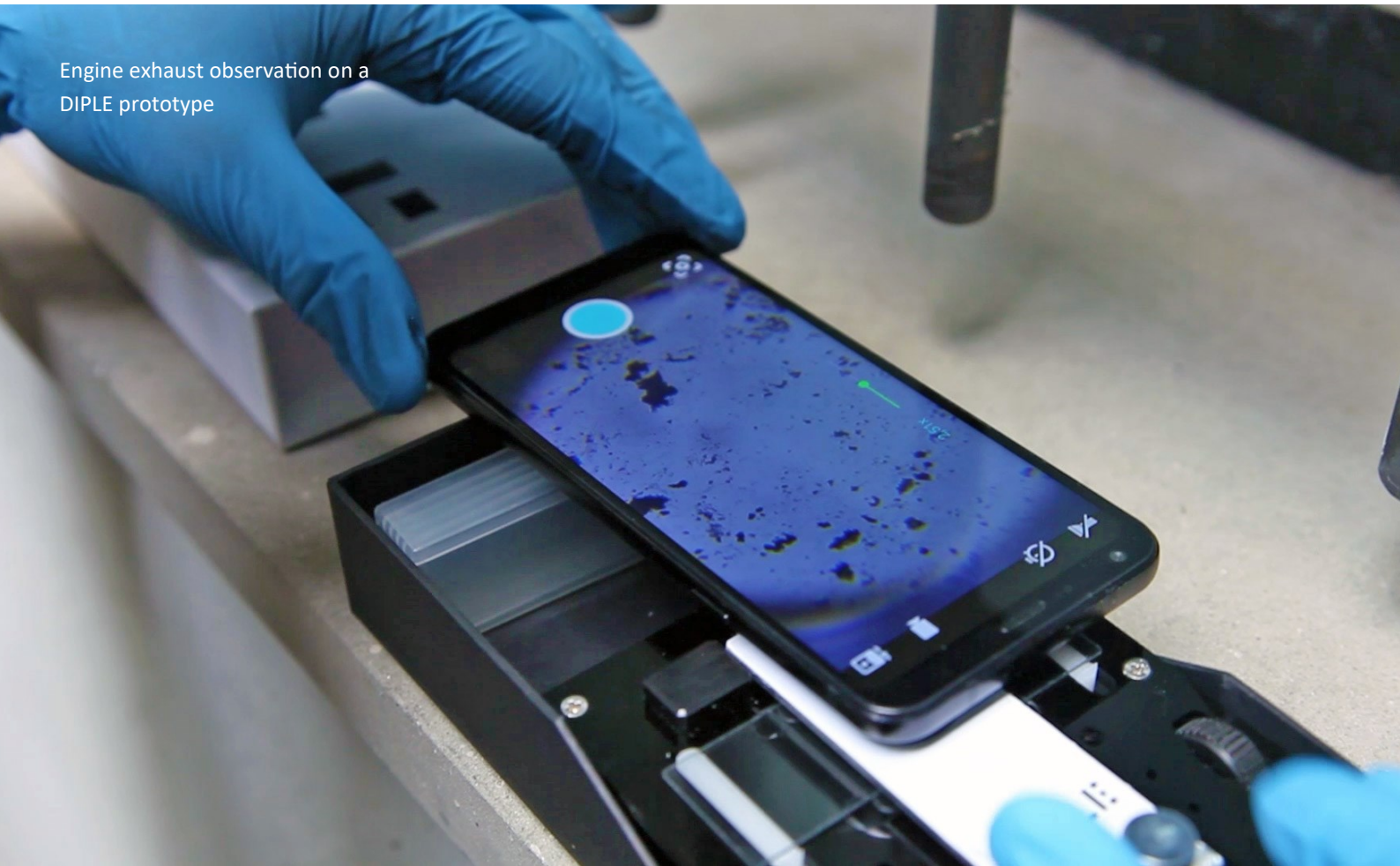
PM10 particles

**Procedure:**

1. Place a plain slide in front of an exhaust pipe of a car with running engine. Temperatures can be very high: wear protective gloves.
2. Collect a small sample of exhaust
3. Place the sample on a plain slide

**Description:**

You can get an idea of the great amount of particulate emitted by fossil fuel engines by observing it on the microscope. There are lots of particles with different sizes, ranging from few nanometers up to 100 µm. Currently, average $CO_2$ emissions of diesel cars and petrol cars are about 120 g $CO_2$/km, so you can get a clear insight of these emissions by observing them directly. Exposing a plain slide for few seconds to the emissions of en exhaust pipe can give you a basic insight on the proportions of these emissions.



Engine exhaust observation on a DIPLE prototype

**SMALL CRUSTACEANS**

**Difficulty:** medium

**Duration:** 30 minutes

**Materials:**

- *Daphnia* or *Artemia salina* specimens
- DIPLE Red

**Observed subjects:**

*Daphnia* and *Artemia salina* crustaceans, in their early development stages

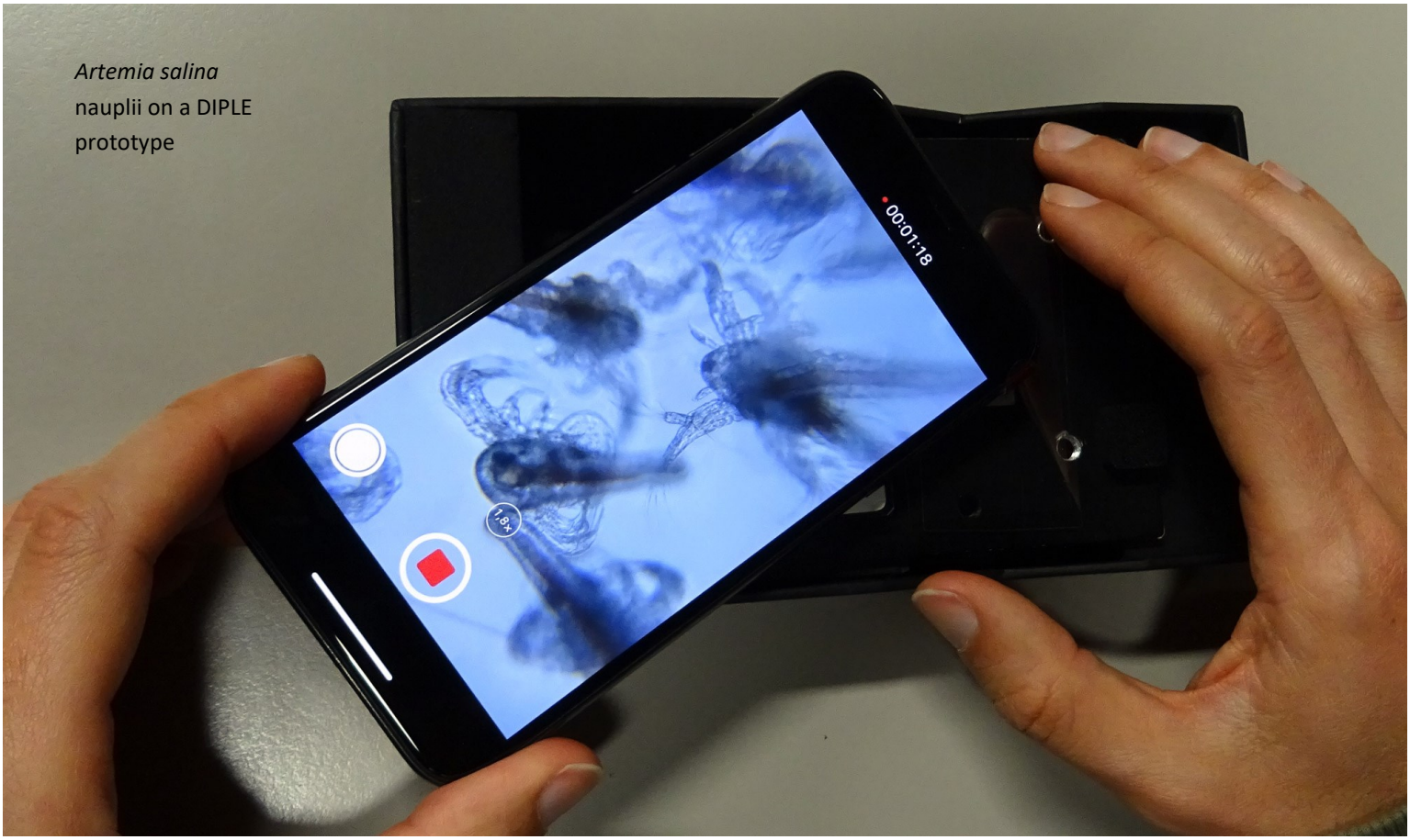
**Procedure:**

1. Place a small drop of water with your live specimens on a plain slide
2. Place a cover slip on the slide to keep the sample thin

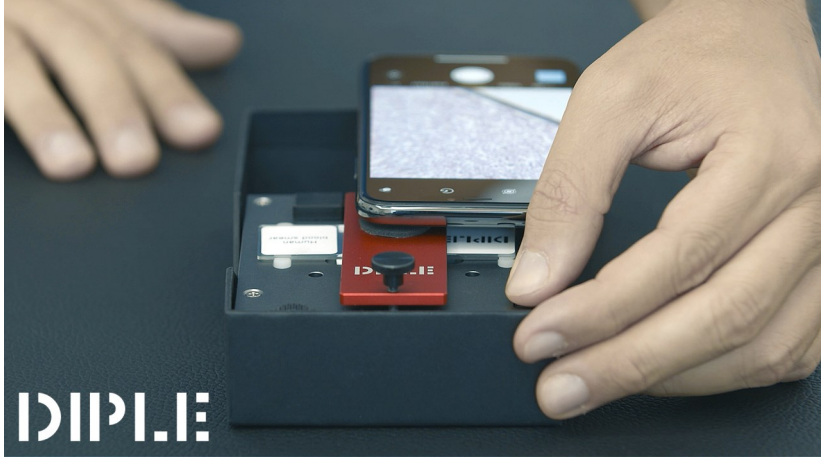
**Description:**

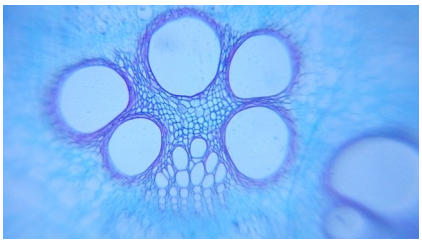
Some small crustaceans, that are part of the plankton and are often sold alive in aquarium shops as food for fish, are very nice animals to observe under a microscope. They are commonly called “sea monkeys”, and are transparent, relatively large and easy to observe under a microscope. The best known species belong to the genus ***Daphnia***, easily recognizable due to their typical rounded shape. In many species the carapace is completely or almost completely translucent, making these animals perfect for microscopic observation. It is possible to see their hearts beat. Even at low magnifications, it is possible to observe their feeding mechanism, the movement of the immature young within the mother’s body, the eyes moved by the ciliary muscles and the blood corpuscles pumped into the circulatory system by the heart.

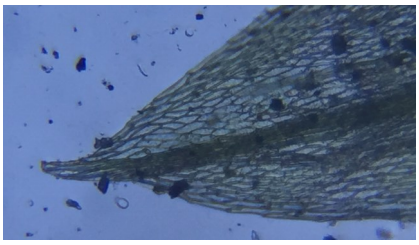
A very easy species to observe under low magnification microscopy is ***Artemia salina***, a crustacean that is among the most classic foods for aquarium fish. One of its youth stages, the nauplius, is sold in large quantities to aquarists. A drop of water on the plain slide, loaded with these animals, is enough to observe their frenetic movement and their elongated body structure and lateral appendages on their heads. In their growth then the specimens develop limbs vaguely similar to those of the crustaceans which are more familiar to us, such as prawns.

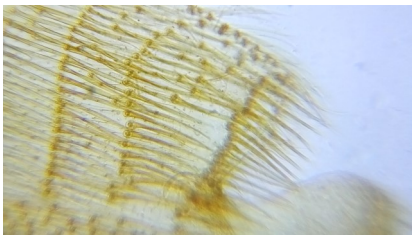


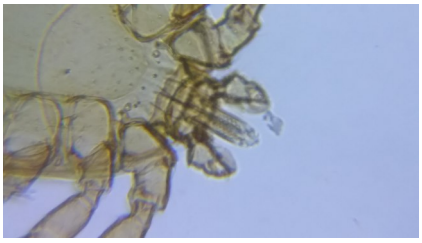

*Artemia salina* nauplii on a DIPLE prototype

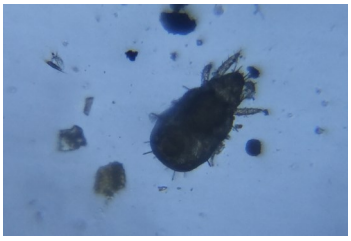


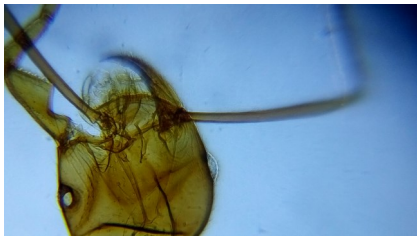













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