

Looking at the mouths of plants through a microscope

Introduction, the mouths of plants and breathing on a mirror

In the 'Air forms clouds' experiment you have learned how air can move water upwards from the land surface to form clouds. In this experiment we will see where the majority of this water is coming from, namely the mouths of plants. The mouths of plants are called stomata and are located on the leaves.

In this experiment we will study what the mouths of plants look like and where exactly on the leaf they are located.

When plant breath during the day, they inhale carbon dioxide and exhale oxygen and water vapor. Like plants, humans also exhale water vapor.

We can make the exhaled water visible by breathing onto the surface of a mirror. The water becomes visible on the mirror surface like clouds form in the sky.

Test it yourself, take a deep breath and then exhale very close to a mirror surface. What do you see?



The mouths of plants are about 1000x smaller than our mouths so we cannot see them with the naked eye. With a microscope we can actually see them as this instrument can magnify objects in its field of view up to 1000x. In this experiment you will use a microscope to look at the mouths of plants.

The microscope

Imagine you have a special machine called a microscope. It's like a magic eye that helps you see things really, really close up, things you can't see with just your eyes.

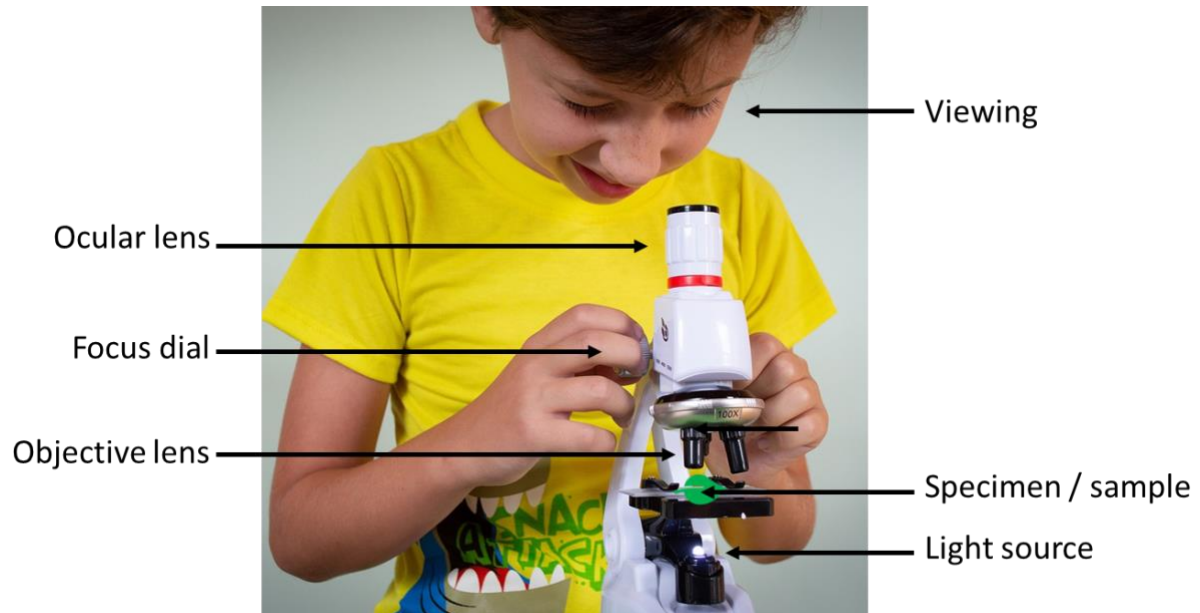


Image by Victoria from Pixabay

Now, this microscope works by shining from below upwards through tiny things you want to see, like bugs or cells. Here's how it works:

- **Light Source:** First, there's a little light at the bottom of the microscope. It's like a tiny flashlight that shines bright light. Some microscopes have a special lens above the light source (called condenser) that helps focus the light.
- **Table:** This is the flat surface with a hole that allows for mounting your sample or specimen.
- **Specimen / sample:** You put the thing you want to look at, like a bug or a tiny piece of a leaf, on a little glass slide. The light passes through this slide and the thing on it.
- **Objective Lens:** Next, the light goes through another special lens called the objective lens. This lens makes the thing you're looking at appear much bigger, like zooming in on a picture.
- **Ocular Lens:** The light now goes through the eyepiece, which is where you look into the microscope. This lens makes the thing you're looking at even bigger, so you can see all the tiny details.
- **Focus dial:** The focus dial allows to move the table up and down to obtain a sharp image.
- **Viewing:** When you look through the eyepiece with a single eye, you can see the thing you're examining, like a bug or a tiny cell, but super close up! You can adjust the focus to make it clearer and see even more details. Make sure you close the other eye!

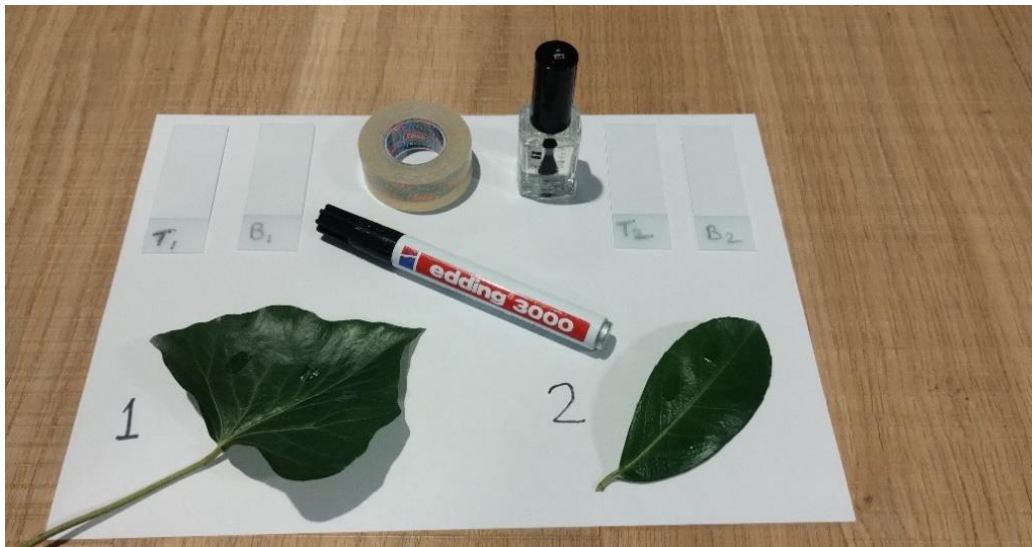
So, it's like having a little light, some special lenses, and a magnifying glass all put together to help you see really tiny things up close. It's like a tiny adventure into a world we can't usually see with just our eyes!

Preparing the materials

For your experiment you need the following materials, as shown on the picture below:

- Some freshly picked leaves of two different plants. Preferably somewhat big leaves that have a smooth waxy surface;
- Four clean glass microscope slides;
- Transparent sellotape;
- Transparent nail varnish;
- Marker pencil.

Make sure you organize all material before starting the preparation.



Making microscope slides with plant samples from the top and bottom of a leaf

You will use clear nail varnish to show the mouths of the plants. By coating a small part of the leaf with nail varnish, the tiny mouths will leave imprints in the nail varnish. After letting the nail varnish dry, the imprints will remain in the nail varnish. With the sellotape you can remove the dried nail varnish from the leaf and mount it on a glass slide for viewing. In this experiment you will compare the top and bottom of the leaves, so please take imprints from both sides!

You prepare the samples as follows:

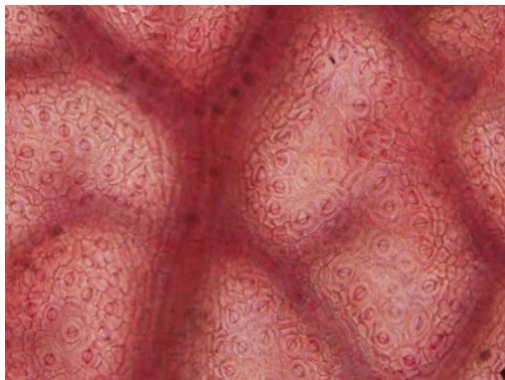
- Mark the slides with the labels T1, B1, T2, B2 to indicate the top (T) and bottom (B) imprint of the leaves of species 1 and 2;
- Apply on a small (1x1 cm) thin layer of varnish on each side of a leaf of each species;
- Let this dry for at least 10 minutes;
- Stick the sellotape on the dried nail varnish and remove the sellotape;
- The spot of dried nail varnish should now be stuck to the sellotape;
- Stick the sellotape with nail varnish on the correct (top or bottom of species 1 or 2) slide.

Looking at the sample

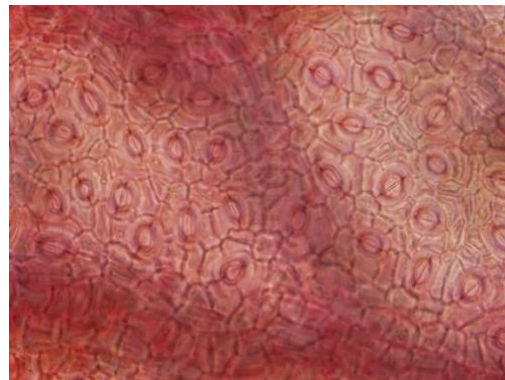
Now you have the imprints of the different leaves and leaf sides mounted on the glass slide and it is time to use the microscope for viewing by following these steps:

- Start with a sample of the bottom (B) of a leaf;
- Select the lens with the lowest magnification, this is typically the smallest lens;
- Mount the slide on the microscope table;
- Make sure the light is turned on;
- Move the slide so that the nail varnish sits about the hole in the table;
- Look through the eye piece (ocular) with one eye and rotate the focus dial until obtain a sharp image;
- Look at the image and confirm if you can see the mouths of the plant (see example below on the left);
- If you do not have a clear image, keep rotating the focus dial until you can see an image similar to the one shown here;
- If you have a clear image, you can select a lens with high magnification so get a closer view;
- For this you need to re-focus to see the mouth in more detail, just turn slowly the focus dial until the image is sharp (image below on the right);
- Now that you saw one side of the leaf, repeat these steps with the sample of the top of the same leaf;
- Were the bottom and top images the same? What are the differences from one side to another?
- Write down your findings and repeat all steps to the other leaf;
- Where do you see the mouths of the plants?

Low magnification



High magnification



Conclusion

Using the microscope, you have seen the mouth of the plants. Plants use these to inhale carbon dioxide for photosynthesis. At the same time, they also exhale water vapor. This is the source of water in the clouds. Almost all plants have these mouths on the bottom of their leaves. Only a few plants also have their mouths on the top of their leaf. It is still not well understood why only so few plants have stomata on both sides of the leaf. This is still a research question that we are trying to answer. Perhaps you have an idea why?