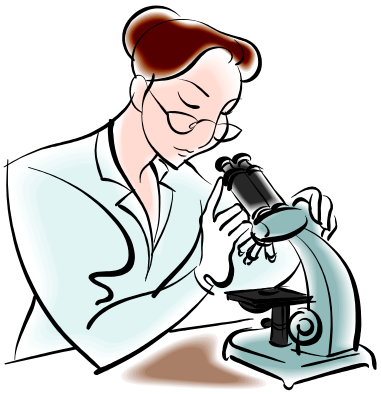
Nature Under a Microscope



In a Nutshell

Students will become field biologists using microscopes to examine microscopic characteristics of diverse macroscopic organisms from the natural world.

Grade 4 - 6
Season Fall, Winter, Spring
Location Bloomington Visitor Center & Rapids Lake Education Center

Learning Objectives
After participating in this activity, students will be able to:
- Understand how to operate a field microscope.
- Explain that microscopes provide a detail view of living and non-living things.
- Give at least one example of how microscopic details help scientists identify and understand the natural world.

Literature Connections
- ***Hidden Worlds: Looking Through a Scientist's Microscope*** by Stephen Kramer
- ***Looking Through a Microscope*** by Linda Bullock

Pre-Activities
Students will learn microscope terminology and how to properly use field microscopes while identifying “mystery slides.” This activity will prepare students to use field microscopes during their refuge fieldtrip.

On-site Activities
Students will collect flora and fauna specimens found on the refuge to examine under microscopes. Using a drawing activity with these specimens, students will compare the characteristics that can be seen with only the naked eye with those that can be seen under the microscope.

Classroom Connection
Encourage students to write poems or stories that correlate to the drawings of their collected specimens.

Teacher Resources
- ***Adventures with a Hand Lens*** by Richard Headstrom
- ***Adventures with a Microscope*** by Richard Headstrom
- ***Microscopes and Magnifying Lenses*** by Janice VanCleave

Nature Under a Microscope
Pre-Visit Activity

Materials

- Field Microscope diagram (1 per 2-3 students)
- "Mystery Slide" set: *1) butterfly or moth antennae, 2) paper wasp nest, 3) butterfly wing, 4) dragonfly wing, 5) snake skin*
- Pictures with magnified views of a *tree bud, plant seed, pollen grain, insect antennae, fish scale*
- Field microscopes (one per group of 3-4 students)

Introduction

Ask students why they think biologists use microscopes? Most people think the purpose of a microscope is to look at tiny organisms that we can not see with our own eyes. Actually, many field biologists use microscopes to examine microscopic (tiny) characteristics of many macroscopic (large) organisms. Show students the photographs one by one and see if they can guess what is represented in the pictures. Use the explanations below for each as to why a biologist might need to look more closely using a field microscope:

- **Tree Bud**: some tree species may only be identified by tiny characteristics not seen by the naked eye. What distinguishes one tree from another might be the number of scales covering a tree's bud or fine hairs on the underside of a leaf.
- **Plant seed/Pollen grain**: a field biologist may need to look at the shape of a plant's seed or grain of pollen to make a correct identification.
- **Insect** antennae: the shape of an insect's antennae may be the key feature to identify the species.
- **Fish scale**: to correctly identify the age of a fish, biologists will count growth rings found on a scale.

Field Microscopes vs. Lab Microscopes

Generally, a field microscope is less powerful (provides less magnification) than most lab microscopes because they do not have multiple lenses. Field microscopes only need a source of natural light (using a prism that collects it) in order to light up the viewing field, while lab microscopes need to be plugged in or have batteries. Generally, field microscopes are smaller and easier to transport; which is helpful to quickly identify species "in the field."

Hand out a copy of the field prism microscope diagram (1 per 2-3 students). Review the parts of the microscope and how to use them. Demonstrate the proper way to hold it (by the arm and base – TWO HANDS!), and how to position/tilt the microscope so that the prism catches the most light.

Now demonstrate how to focus by *gently* moving the microscope focus tube up (away from the slide) or down (closer toward the slide) until the specimen is in view. When the specimen is in view, bring it into clear focus with gentle, smaller adjustments closer or farther from the slide. Ask students to avoid touching the viewing lens at the top of the eye piece and be careful not to pull the entire cylinder, or the eye piece out of the microscope.


Eye Piece 10X
Stage Plate
With clips
Focus Tube
To focus: Slide
up and down
Arm
On hinge to adjust
light source
Objective 4X
Prism:
Light source
Base

Identifying Mystery Slides
Divide students into teams of 2-4 depending on the number of microscopes available. Give each team a microscope and a set of mystery slides. Each member of the team should practice bringing the specimen into view by moving the focus tube up and down as demonstrated.

Every member of each team should get the chance to look at each slide. Instruct them that as a team, they need to write down their best guess for the identity of each specimen. After the class has had a chance to view all 5 mystery slides, review and compare their guesses to the correct answers.

1. Butterfly or Moth Antennae: the clubbed, scaled end is characteristic of butterfly antennae. Moth antennae are usually feathery, with small protruding hairs.

2. Paper Wasp Nest: the wasp's nest paper shows rings of darker and lighter gray from the bark they chewed on and spit out to make their nest.

3. Butterfly Wing: to the naked eye, the wing appears covered in a powdery dust; but under a microscope, this dust is clearly overlapping scales.

4. Dragonfly Wing: clear, segmented scales cover the wing of the dragonfly.

5. Snake Skin: these scales protect the snake from injury as it moves across the ground. Diamond shaped scales are found on top of the snake. Rectangular belly scales increase traction so the snake can move across the ground

Wrap-up
Discuss with students that during their field trip to the national wildlife refuge, they will be collecting items in nature and bringing them back into the classroom to view through microscopes. Remind students to wear dress appropriately for the weather.

Nature Under a Microscope
On-site Activity

Materials

- Field Microscopes (1-2 per student team)
- Hand lens (2 per group for hike)
- Collecting kits: a ziploc bag containing a collecting list, tweezers, and petri dish
- Moss/Lichen pictures to show group the differences
- Compound microscopes
- Set of labeled, prepared slides for viewing under the compound microscopes (*these should be set up and focused for students to view during journaling time/wrap up*)

Introduction

Review what they learned in their pre-activity about why field biologists use microscopes, the important parts of the field microscopes, and the proper way to hold and adjust them.

Pass out one collection kit per team: a petri dish for specimens, the collection list (*a tree bud, seed or seed holder, moss/lichen, bark, and at least one item of their choice*) and tweezers. Remind students to collect items that can fit under the microscope. Emphasize that it is important to be gentle with the plants they are collecting from; despite winter, many of the plants are still ***alive***! Show the moss and lichen pictures and discuss with students the differences between the two so they what they're collecting on their hike.

Specimen Collecting

Students will go out with the group's chaperone to explore the prairie and forest to find and collect items from nature to bring back to the classroom. They will need about 20-30 minutes in the classroom to view their specimens and complete their journal page.

Specimen Viewing

Back in the classroom, teams will look at and observe the specimens they collected using the field microscopes and fill out their journal pages. **Instruct students to use the top of the Petri dish as the slide base under the microscope and that they will not be able to use the stage clips**. With tweezers from the kit, students should transfer one specimen at a time onto the lid.

Remind students the specimens they collected are not flat. Looking through a microscope at a 3-dimensional object can be tricky. Explain that they will only be able to focus in clearly on one part of the specimen at a time. **Reassure students that if parts of the specimens appear blurred, while other parts appear clear, they are doing it correctly**. By adjusting the focus slightly they can examine different sections of the specimen. Ask students draw at least one of their team's items in large a microscopic view, and to compare/contrast the differences they observe through the two views using their art skills (students can also use words to describe the item).

In a separate space set up the compound microscopes, each with one slide specimen for viewing. A staff member, chaperone, or volunteer should be stationed at these microscopes to help monitor their use-if set up properly, students shouldn't have to touch anything.

If you choose to teach students how to use the compound microscopes, see directions below:

How to Properly Use a Compound Microscope

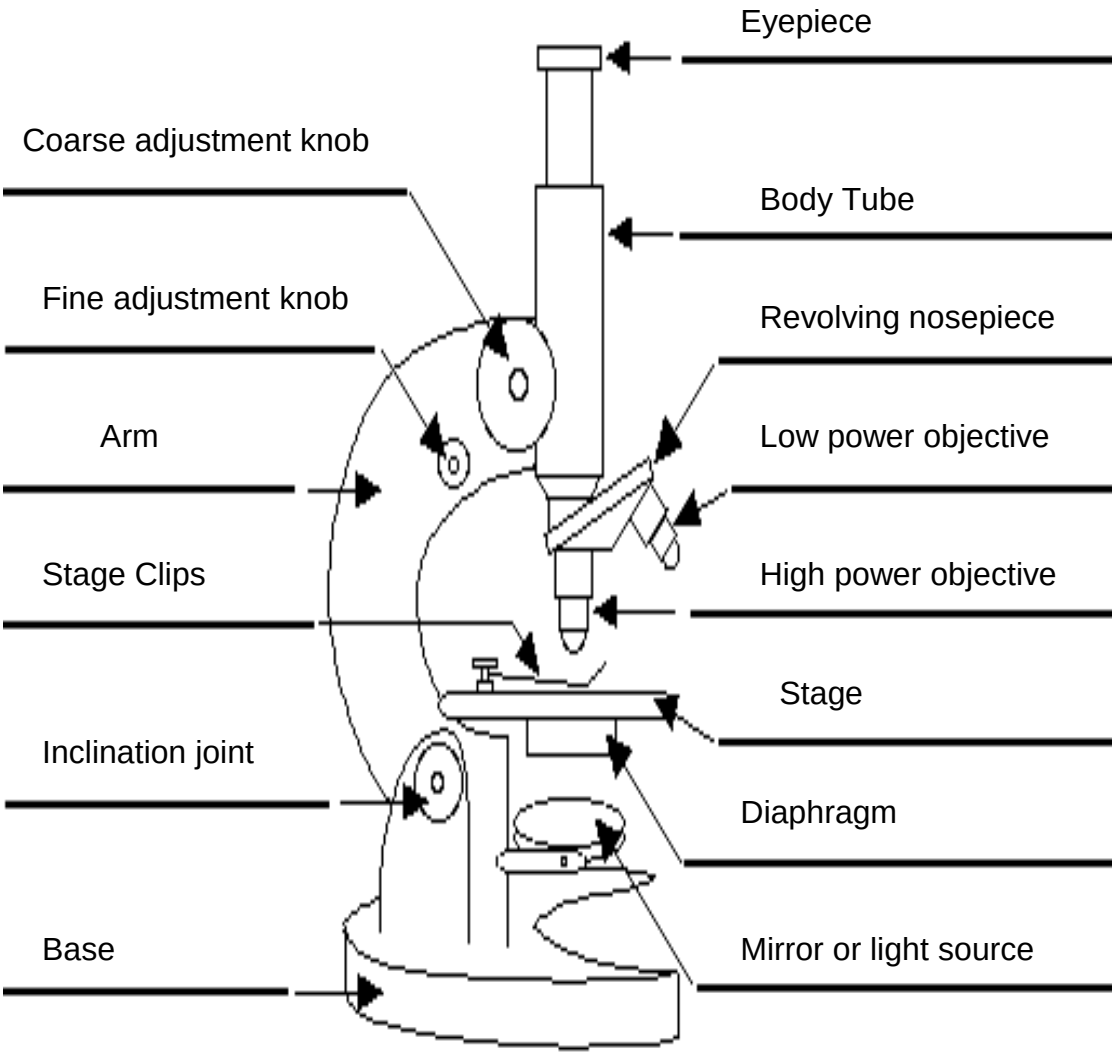
1. Begin by turning the base light on. The switch is located on the back of the base. Ask students to figure out how to turn on the upper light (press the switch to the right indicated by a double line) and then the lower or underside light (press the switch to the left indicated by a single line).

2. Demonstrate how to change the magnification lenses. Remind students to hold the microscope firmly by the arm. Note the different colored rings on each lens. A red ring indicates 4X magnification, a green ring indicates 10X magnification and a blue ring indicates 40X magnification. Ask students to always start with the lowest magnification (in this case red) with each slide sample.

3. Encourage students to keep both eyes open while viewing the slide to avoid eye strain. They should focus slowly, using the focusing knobs located on both sides of the arm, to avoid feeling dizzy. When the sample is in sharp focus, then they can switch to the next higher magnification. When they do this they will have to make another slight focusing adjustment. They can repeat this process if every time they move between magnifications.

4. Before students leave, ask that they return the microscopes to the 4X magnification (the red ring).

3-Stage Compound Microscope



Wrap-Up Management Connection
(10 min)
Review the question: Why do biologists use microscopes? Most people think the purpose of a microscope is to look at tiny organisms that we cannot see with our own eyes. Actually, many field biologists use microscopes to examine microscopic (tiny) characteristics of many macroscopic (large) organisms for identification and research.

Ask students to compare the field microscope with the compound microscope. Make a list comparing the two. Which did they think was easier to use? Which would be easier to take into the field? When might a biologist need to make a quick identification in the field? When might a biologist prefer to bring a sample back for an even closer look?

Nature Under a Microscope
Rainy Day Hike Alternatives

Materials

- Field Microscopes- at least one per student pair
- Student Journal Page - one per student
- Petri dish – one per team
- Tweezers – one per team
- Colored pencils- at least one package per team
- Compound microscopes
- Set of labeled compound microscope slides
- Variety of "mystery" specimens pre-collected and sorted into team sets

Introduction
(20 min)

Welcome students to Minnesota Valley National Wildlife Refuge. Before heading into the classroom, ask the teacher to pair students for this activity. Ask students to sit with their partner in the refuge classroom.

Briefly review with students the proper way to hold and adjust field microscopes.

Pass out the tweezers, colored pencils, a petri dish, and specimen set to each team. Emphasize to students to be gentle with the specimens so they remain in good condition for other classes.

Instruct students to use the top of the petri dish as the slide base under the microscope (they will not be able to use the stage clips). Transfer one specimen at a time onto the lid with the tweezers.

Remind students that these specimens are not flat. Looking through a microscope at a 3-dimensional object can be tricky. Explain to students they will only be able to focus in clearly on one part of the specimen at a time. Reassure students that if parts of the specimens appear blurred, while other parts appear clear, they are using the microscope correctly. By adjusting the focus slightly they can examine different sections of the specimen.

Drawing Specimens
(30 min)

Pass out a student journal page to each student. Instruct them to first draw an eye image and then a microscope image of each specimen. Ask students to compare and contrast the differences they observe through the two views using their art skills and write down a set of characteristics they can see for each specimen. What do they think the specimen is?

As incentive to do their best work, and complete as many drawings as time allows, provide students with the opportunity to use even more detailed microscopes. In a separate space set the compound microscopes with one labeled slide specimen for viewing per scope. Rotate

students through so they have the opportunity to see all the slides. A staff member, chaperone, or volunteer should be stationed at the microscopes to ensure students use them properly. See directions below:

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4. Before students leave, ask that they return the microscopes to the 4X magnification (the red ring).

Wrap-Up Management Connection
(10 min)

Have each student team share what they discovered about each specimen. What do they think they were looking at? After all teams have made their guesses, reveal the true identity of each specimen.

Why do biologists use microscopes? Most people think the purpose of a microscope is to look at tiny organisms that we cannot see with our own eyes. Actually, many field biologists use microscopes to examine microscopic (tiny) characteristics of many macroscopic (large) organisms for identification and research. What were some of the microscopic characteristics the students discovered that they would have missed using only their eyes to examine the specimens?

Ask students to compare the field microscope with the compound microscope. Make a list comparing the two. Which did they think was easier to use? Which would be easier to take in the field? When might a biologist choose to make a quick identification? When might a biologist prefer to bring a sample back for closer inspection instead?

Specimen Collecting List

1. **Leaf bud**
2. **Seed or seed holder**
3. **Moss/Lichen**
4. **Bark**
5. **At least one item of their choice**

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Microscope Vocabulary

arm - this attaches the eyepiece and body tube to the base.

base - this supports the microscope.

body tube - the tube that supports the eyepiece.

coarse focus adjustment - a knob that makes large adjustments to the focus.

diaphragm - an adjustable opening under the stage, allowing different amounts of light onto the stage.

eyepiece - where you place your eye.

fine focus adjustment - a knob that makes small adjustments to the focus (it is often smaller than the coarse focus knob).

high-power objective - a large lens with high magnifying power.

inclination joint - an adjustable joint that lets the arm tilt at various angles.

low-power objective - a small lens with low magnifying power.

mirror (or light source) - this directs light upwards onto the slide.

revolving nosepiece - the rotating device that holds the objectives (lenses).

stage - the platform on which a slide is placed.

stage clips - metal clips that hold a slide securely onto the stage.

KEY

Label the parts of the compound microscope