Winter Under a Microscope

In a Nutshell

Students will become field biologists using microscopes to examine microscopic characteristics of diverse winter macroscopic organisms.

Grade 4 - 6
Season Winter
Location Visitor Center

Literature Connections

Hidden Worlds: Looking Through a Scientist's Microscope by Stephen Kramer
Looking Through a Microscope by Linda Bullock (1040L)
Snowflake Bentley by Jacqueline Briggs Martin (AD830L)

Pre-Activities

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

On-site Activities

Students will collect winter 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 apparent under a 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
Discover Nature in Winter by Elizabeth Lawlor
Guide to Nature in Winter by Donald Stokes

Winter Under a Microscope
Pre-Visit Activities

Materials

- Microscope diagram
- Field microscopes- at least one per group of 3 students
- Hand lenses- one per student
- prepared "mystery slide" sets
- Photographs or slides that illustrate: tree bud, plant seed, pollen grain, insect antennae, fish scale (if staff does not want to draw examples in the dry erase board)

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. Using photographs, slides, or hand drawn illustrations give the following examples:

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

Field Microscopes vs. Lab Microscopes

Generally, a field microscope is less powerful (provides less magnification) than most lab microscopes, they do not have multiple lenses, and only need a source of natural light. Field microscopes might be designed to collect light using a prism (like the ones the students will be using) or may use battery powered light. Generally, field microscopes are smaller and easier to transport; which is helpful to quickly identify species "in the field."

Define, for students, the parts of the microscope and how to properly use the microscope. Refer to the microscope diagram. The metal clips on each side of the stage hold down the slide. (*Note…the clips will not be used during their field trip)

- To focus the view, direct students to *gently* move the microscope cylinder 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.
- Avoid touching the viewing lens at the top of the cylinder. Be careful not to pull the entire cylinder out of the microscope.

Pass out the microscope parts worksheet to students. The worksheet may be done as a class or individually. Once completed, go over answers using the key and highlighting on the diagram.

Identifying Mystery Slides

Divide students into teams of 3 or less. Inform students they will be in these same teams during their field visit to the national wildlife refuge. Give each team a microscope and mystery slide. Each member of the team should practice bringing the specimen into view. When every member of each team has had a chance to look at their slide, ask each team to guess what they think is on their slide. You may either give each team the answer right away, or, for extra challenge describe the differences between slides and see if they can figure out what they have with a few clues.

1. Butterfly Antennae
The clubbed, scaled end is characteristic of butterfly feathery. Moth antennae are usually feathery. There are no hairs like this seen on the grasshopper leg.

2. Paper Wasp Nest
The wasp's paper show 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 scales cover the wing of the dragonfly.

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

6. Grasshopper Leg
Small, spiny hairs cover the leg. These hairs create the "prickly" feeling when you hold a grasshopper in your hand. These hairs help the grasshopper climb and hold on to prairie grasses.

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 warm winter clothes (jackets, boots, snow pants, gloves, hats) as there will be outside activities.

Winter Under a Microscope
On-site Activities

Materials

- Field Microscopes- one per group of 3 students
- Hand lens- one per student
- 6 collecting kits: Ziploc bag containing collecting card with a collecting list, tweezers, & a Petri dish
- Data sheet- one per student
- Colored pencils- at least one package per group
- 4 compound microscopes
- Set of labeled compound microscope slides (salt, pollen, mouth smear, paramecium)
- Whistle

Introduction

Inside Visitor Center (20 minutes)

Welcome students to Minnesota Valley National Wildlife Refuge. Gather the students together. Ask students to regroup in the same teams they were assigned for the microscope pre-activity back in the classroom. Pass out one collection kit per team. Each kit contains tweezers, a Petri dish for specimens, and the collection list (a tree bud, seed or seed holder, moss/lichen, bark, and at least one item of their choice). Remind students when collecting specimens they will only need to gather enough to look at under a microscope and not to take more than they need. Emphasize to students to be gentle with the plants they are collecting from; despite winter, the plants are still ALIVE. Provide students with time to explore the prairie and woodlands. Instruct students to meet back at the Visitor Center when the whistle blows.

Specimen Collecting and Viewing

On refuge, (40 minutes without snowshoes, 60 minutes with snowshoes)

NOTE: If students have not used snowshoes in the past and will be using them during their collection, briefly introduce snowshoeing concepts including the parts of a snowshoe, how they make walking in snow easier, and how to properly wear them. Show students how to strap on the snowshoes. Lead them outside and demonstrate how to properly stand,

walk, and turn. Provide students time to practice to get comfortable using the snowshoes.

Back in the classroom provide teams at least 10 minutes to look at and observe, under the microscope, the specimens they collected. Suggest to 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). 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 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 doing it correctly. By adjusting the focus slightly they can examine different sections of the specimen.

Drawing Specimens

On refuge, (30 minutes)

Pass out sheets of paper and colored pencils for students to draw an eye image and a microscope image of at least one specimen they collected and viewed. Ask students to compare and contrast the differences they observe through the two views using their art skills.

As incentive to do their best work on their drawing worksheet, provide students with the opportunity to use even more detailed microscopes. In a separate space set up four compound microscopes, each with one slide specimen for viewing. Rotate eight students, two at each microscope, through in 7-10 minute intervals. A staff or volunteer should begin each rotation with the directions below to ensure students use the microscopes properly.

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).

Wrap-Up Management Connection

Inside the classroom, (30 minutes)

Review the topic of why 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 in 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 instead?

Winter Under a Microscope
Rainy Day Hike Alternatives

Materials

- Field Microscopes- at least one per team of 3 students
- Data sheet - one per student
- Petri dish – one per team
- Tweezers – one per team
- Colored pencils- at least one package per team
- 4 compound microscopes
- Set of labeled compound microscope slides (salt, pollen, mouth smear, paramecium)
- Set of 5 mystery specimens – one per team

Introduction

Inside Visitor Center (20 minutes)

Welcome students to Minnesota Valley National Wildlife Refuge. Gather the students together. Ask students to regroup in the same teams they were assigned for the microscope pre-activity back in the classroom.

Pass out one set of mystery specimens per team as well as tweezers, colored pencils and a Petri dish. Emphasize to students to be gentle with the specimens so they remain in good condition for other classes.

Suggest to 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). 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 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

On refuge, (30 minutes or more)

Pass out a data sheet and colored pencils to each student. Instruct them to draw an eye image and a microscope image of each mystery 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 for each specimen. Lastly they should make a guess as to the identity of the item.

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 up four compound microscopes, each with one labeled slide specimen for viewing. Rotate eight (two at each microscope) students through in 7-10 minute intervals. A staff or volunteer should begin each rotation with the directions below to ensure students use the microscopes properly.

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).

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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).

Wrap-Up Management Connection

Inside the classroom, (30 minutes)

Have each student team share their descriptions for each item, one by one. After all teams have made their guesses, reveal the identity of each specimen.

Review the topic of why 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 in 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 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

Mystery Specimen List

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

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.

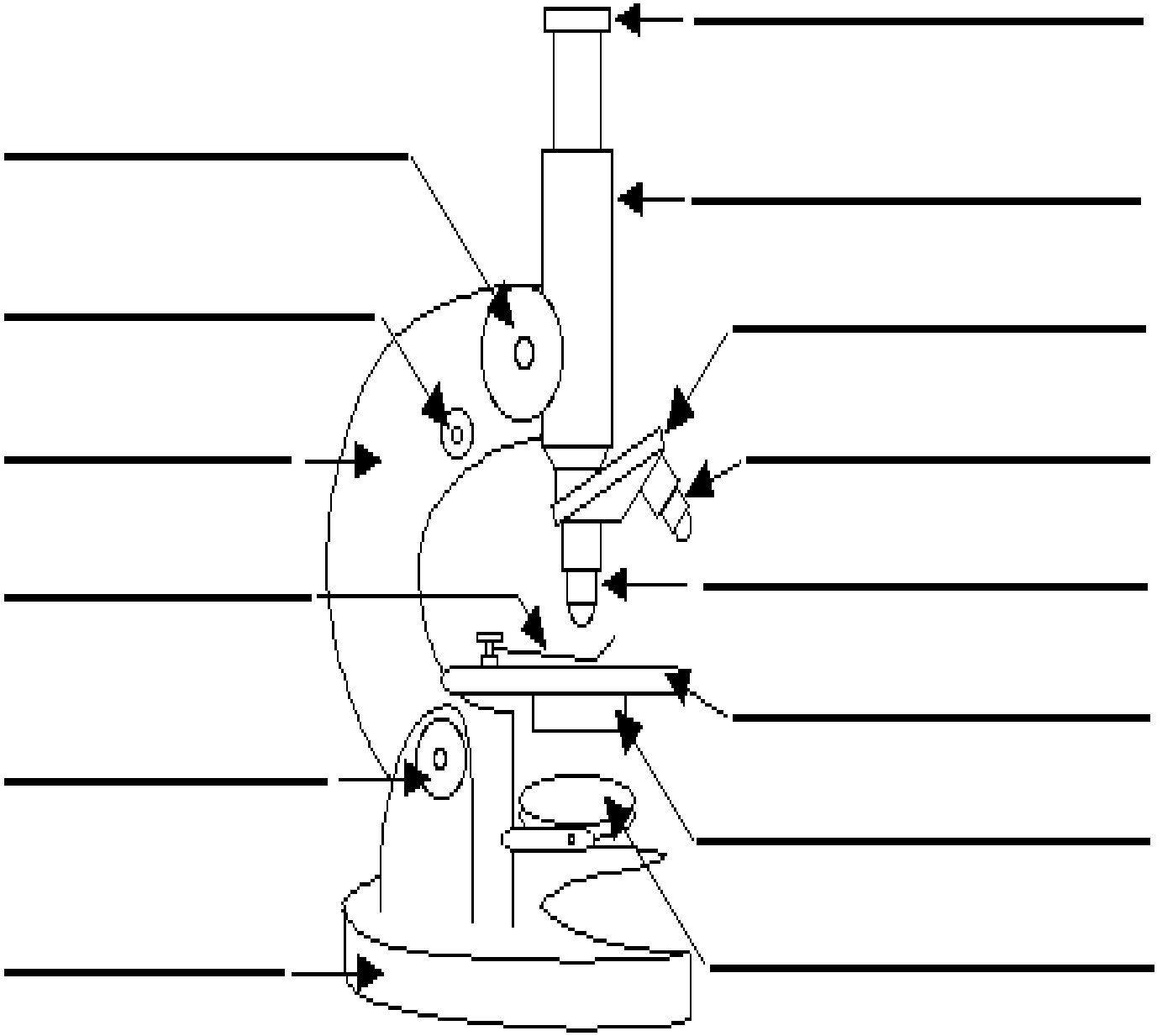
mirror (or light source) - this directs light upwards onto the slide.

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

stage - the platform on which a slide is placed.

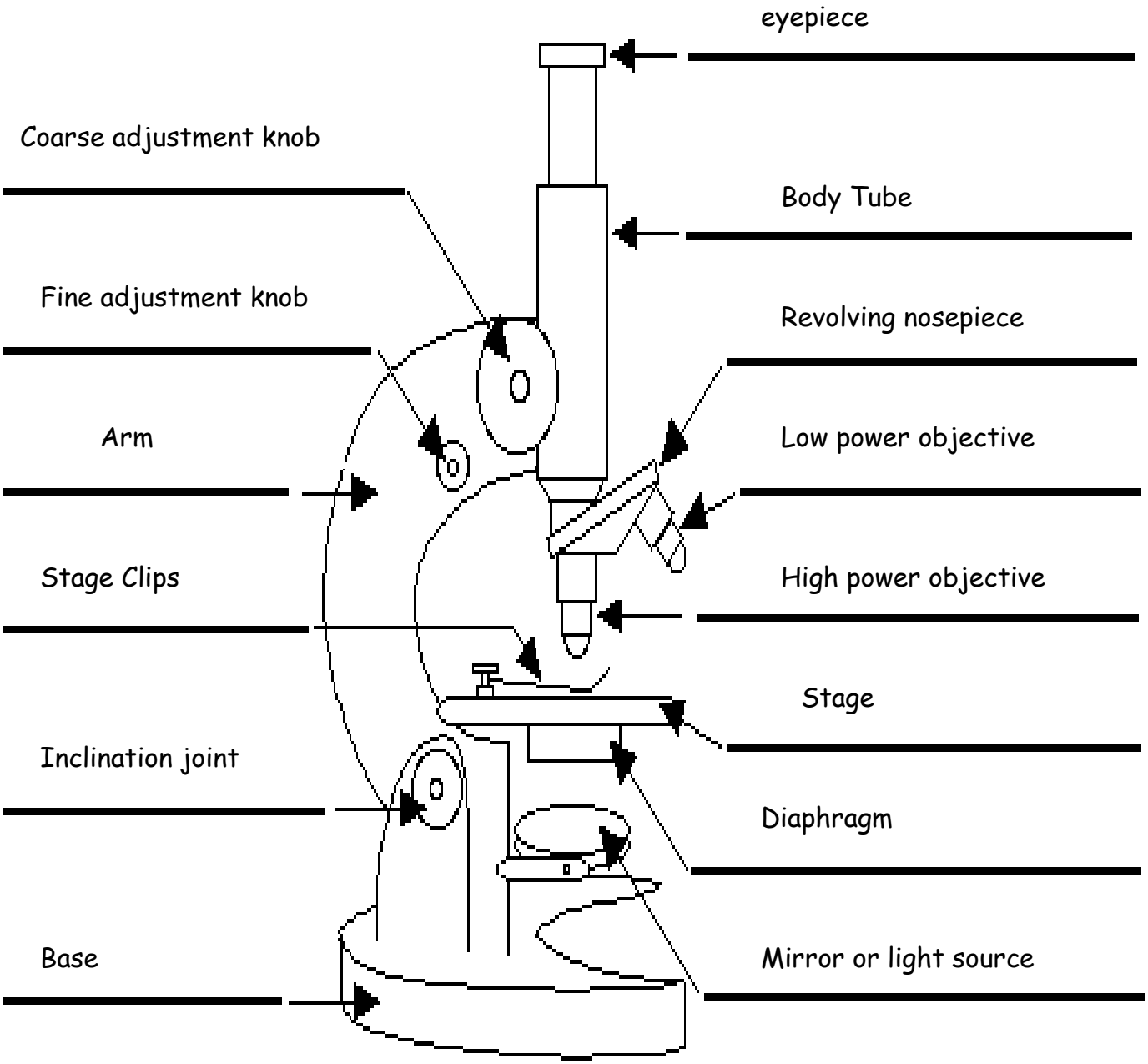
stage clips - metal clips that hold a slide securely onto the stage.

Label the parts of the microscope



KEY

Label the parts of the microscope



Eyes only	Under a microscope
1. What is it?	1.
2. What is it?	2.
3. What is it?	3.
4. What is it?	4.