Teach Microscope Skills With WOWBugs:

Put Life In Your Life Science Class — Right From The Start!

This first laboratory experience for an introductory life science course teaches microscope, observational, measuring, and drawing skills while students work with a little insect that is large enough to be seen by the naked eye, but small enough to fit into view under a microscope.

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Grade level: 5 – college

Subject(s): Life Science, Biology, Natural History, Entomology, Zoology

Topics: Using a microscope; Handling and observing living materials; Preparing a dry-mount microscope slide; making a scientific drawing

Estimated class time: 60 minutes

Fits in unit: Introduction to Laboratory/Microscope Use/Observational skills/Scientific illustration

Materials (for each student, pair, or group)	**Source (Catalog numbers are from Carolina Biological Supply Co. Catalog)**
To be dispensed to each student, pair, or group by the instructor: About 5 WOWBugs from a *Melittobia digitata* culture	RG-14-4570
Microscope (e.g. dissecting or compound microscope, Magiscope®, or Wonderscope™)	Magiscope® RG-59-4911 Wonderscope™ RG-59-4917
Concavity (culture) microscope slide	RG-63-4400 or RG-63-2970
Standard (flat) microscope slide	RG-63-1920 or RG-63-2950
Plastic cover slip 22x22 mm	RG-63-2900
Small plastic culture tube or glass shell vial	1 dram shell vial RG-71-5051 or 12x75mm polystyrene culture tube RG-73-1350
White pipe cleaner	Obtained locally
Sheet of unlined white paper	Obtained locally
Cotton ball	Obtained locally
Roll of transparent tape	Obtained locally
Plastic petri dish or equivalent round container	Obtained locally
Toothpick	Obtained locally
“Pinch” of cornstarch or all-purpose flour	Obtained locally
Transparent ruler fragment (about 5-8 cm, divided into mm units)	Make by photocopying a transparent ruler (e.g., RG-70-2605) repeatedly onto a transparency sheet and cutting out individual ruler fragments
Pencil	Obtained locally
Laboratory notebook	Obtained locally

Pre-Class Teacher Preparation

1. Before class, the instructor should review:
    - Basic microscope operation, including identification of important parts of the particular microscopes the students will be using
    - Proper WOWBug handling and transfer techniques
    - Slide-making techniques for a dry-mount slide
    - Drawing/labeling fundamentals
2. Order WOWBug culture 10-14 days before anticipated use
3. Assemble materials
4. Make transparent rulers by photocopying the last page of this activity,

Objectives/Goals:

As an outcome of this activity, students will:

1. Learn the parts of the microscope and how they work
2. Discover how to manipulate materials under a microscope
3. Recognize how to measure a microscope's field of view under various magnifications
4. Find out how to handle a small living organism, i.e. WOWBugs
5. Practice observational skills with a living organism
6. Practice estimating and measuring skills under a microscope
7. Learn to do a scientific drawing

Practice with Guidance: Lesson Outline

This activity will introduce you to the harmless little WOWBug, known scientifically as *Melittobia digitata.* What does it look like? What does it do? How big is it? Today, we'll be trying to answer these questions. We'll also have a little fun examining one of the consequences of small body size. Along the way, we'll use the WOWBug as a model to learn how to use the microscope and how to measure things we see under its magnification. We'll learn how to make and label a scientific drawing. We'll also begin learning about scientific investigations.

1. Observe living WOWBugs and learn how to manage them.

When a scientist encounters a new organism, the first thing he or she usually does is to observe its behavior and learn how to handle it. Because WOWbugs are black, they are easiest to watch on a white background. Your teacher will dispense about 5 WOWBugs onto your white paper. What happens when they are released? How do they move? Do they fly? Do they have wings?

Taking turns with your partner(s), gently nudge or brush the WOWBugs with a pipe cleaner to keep them confined to the paper. Do any of them "play possum" when they are delicately prodded from behind? Do any of them hop? How do they respond when you invert a vial over them? Based on this behavior, figure out the best way to move them all into the vial for temporary storage. Tightly cap the vial with a lid or cotton ball (there will be plenty of air in the vial for their survival).

2. Ask a meaningful question that can be answered by observation and data collection.

The most basic meaningful questions about any living thing have to do with what it is, what it looks like, and what it does. Thus, upon encountering a new organism, another important task for a scientist is to measure and describe its appearance and behavior.

This task is sometimes more complex than it sounds. Based on what you have seen, do you think you could accurately measure a moving WOWBug directly with a ruler? Why or why not? What about drawing it? What tools would make that job easier?

3. Master the tools you'll need.

What tools would help you measure a WOWBug? Draw it accurately? What things would be helpful to know? What skills would be useful? Work together as a class or team for a moment to think about and list possible answers to these questions.

Become familiar with your microscope. A microscope would almost certainly be useful. But what kind? There are compound microscopes and there are dissecting microscopes, and they are used for different purposes. Furthermore, to use any microscope effectively, you have to know how. So let's start here. Your instructor will provide practical guidance about microscopes in general, and your microscopes in particular. With a little practice, by the end of this lab session, you should be able to:

1. Identify the parts of the microscope and describe the functions of each part.
2. Prepare a slide or sample and place it properly on the microscope stage.
3. Bring the image into focus under low power, then under successively higher powers.
4. Adjust the light as appropriate to examine your slide or sample.

Following your instructor's directions, obtain your microscope and review its use. Which kind of microscope is it? Does light shine down on the slide or sample from the top? Or does it shine up through the specimen? Which light direction would work best for a very thick specimen? For a very thin one? What is the highest and lowest magnification that can be made with your microscope?

Use the transparent ruler to practice microscope skills. We'll be using this ruler to measure the WOWBugs, so it's important to practice working with it.

Center the transparent ruler on the microscope stage so that the millimeter marks go across the widest part of the viewing circle (called the "field of view"). Adjust the microscope to its lowest magnification. What magnification is this? (Remember that magnification is the product you get by multiplying the powers of the eyepiece lens and the objective lens; magnification is written with an X that means "times.")

Look through the eyepieces and adjust the focus until you can see the ruler clearly. Count the number of millimeter lines you can see across the widest part of the field of view. Record your answer: The diameter of the field of view = ___ mm at ___X magnification.

Move the ruler until you can see the WOWBug drawing. In which direction does it move under the microscope, relative to the direction you move it with your hands? Looking through the eyepiece, which way does the head point? Looking at the ruler on the stage, which way does the head point? Explain the general rule about the way things appear under your microscope, relative to their actual position.

Re-center the ruler, and tape the ends of the ruler onto the microscope stage so it will stay put. Now change the magnification. If you worked carefully, you should still be able to see the ruler. (If not, back

up to the lower magnification and make necessary adjustments.) How many millimeter lines can you see now? Record your answer: The diameter of the field of view = ___ mm at ___X magnification.

Repeat this process for each magnification of your particular microscope. What happens to the size of the measuring lines? How might this affect the accuracy of your measurements at a particular magnification?

Learn to make and maneuver a dry-mount slide. Clearly, if we are going to measure and observe a WOWBug, we'll need some way to hold it in view under the microscope. There are two general ways to put material on a slide — wet (immersed in water or another liquid) or dry (either loose or glued down). Which type of mount would make more sense for an aquatic organism? What would you expect would happen if you made a wet mount of a living WOWBug?

Most slides (particularly ones to examine very tiny and/or thin materials) are just made with a flat piece of glass. However, special slides with a indentation in the center can be used to hold slightly larger, thicker specimens. These slides – called well slides or depression slides – are perfect for viewing WOWBugs.

Usually, for both wet and dry mounts, a small flat piece of glass called a cover slip is used to protect or confine the specimen on the slide. However, WOWBugs are apt to crawl out from under an unsecured cover slip, so we'll use a flat slide as a "super cover slip."

Often in biology, living organisms are so active that they must be both confined and slowed down in some way if they are to be viewed under a microscope. We'll use a bit of flour or cornstarch. When the insect feels "dusty" it usually will stop and attempt to clean itself. (This behavior is called grooming.)

Place a concavity (depression) slide on the white paper. For "dust," dip a toothpick vertically into the flour. Tap a few specks into the well of the slide. Look at it under low power of the microscope. There should be only scattered bits and tiny piles. Too much flour could harm the WOWBug.

Move the slide. Can you move a flour pile around and still keep it in the field of view? Can you center it over the ruler? What is its diameter? Record your answer: The diameter of the flour pile = ___ mm at ___X magnification.

Practice a bit more, if necessary, until you feel confident with this skill.

Now, lay the slide back on the white paper. With the pipe cleaner, transfer one WOWBug into the well of the slide. Quickly place a flat slide on top of the depression slide, confining the insect inside. Tape the ends of the two slides to hold everything together.

4. Use your tools and skills to get answers.

Place the dry mount slide onto the microscope stage. Focus on the insect under the lowest magnification. If it is moving around, practice keeping it in the field of view. Move the slide slowly and smoothly while you look through the eyepiece.

Look carefully at the WOWBug. Are you seeing its back (dorsal view) or its belly (ventral view)? *Hint:* Can you see all of its wings? If so, it is crawling across the depression slide. Can you see the full length of its legs? If so, it is crawling on the cover slip. Rarely, you might be able to see one in side (lateral) view.

Observe grooming behavior At first, the insect will probably spend its time exploring its new surroundings. Soon, however, the WOWBug will stop moving and begin to clean dust from its legs or antennae. How does it do this? What parts of its body does it use?

While it stops to groom itself, you may have a chance to view the WOWBug under all the other magnifications. This will help you make an accurate scientific drawing.

Prepare a scientific drawing. Scientists rely on accurate drawing to communicate information. They know also that drawing helps develop a habit of careful observation, which is valuable to scientists and non-scientists alike.

Start by drawing a circle that represents the circular field of view. An easy way is to simply trace around a petri dish or similar round container. Select the magnification at which you can see the entire WOWBug in greatest detail (the one in which it nearly fills the field of view). What magnification is this? ____ X.

Draw the WOWBug in the circle, making it the same size relative to the circle as it is relative to the field of view. Include just as much detail as you can easily see with this magnification. You may have to adjust the focus to see various parts more clearly. Title your drawing "Female WOWBug, Melittobia digitata." (Scientists use underlining, or italics, to show that the genus and species names are in Latin or Greek.) Record whether it is a dorsal, ventral, or lateral view.

Your instructor may also provide additional information and guidelines to identify structures shown in your drawings.

Measure your WOWBug. If your insect has slowed down enough while grooming, you may be able to measure it by simply moving the slide until the tip of one end of the WOWBug is right in the center of a millimeter mark on the taped-down ruler. Count the number of millimeter marks to the other end of the WOWBug (not including its antennae).

For a drawing to be meaningful, it must give the viewer an idea of the organism's size. Record your measurement on your drawing. Actual body length = ___ mm.

If your insect is moving too quickly to measure, you can measure another one from your vial in this alternative way: Carefully use the pipe cleaner to place a WOWBug on a flat glass slide. Gently place a light plastic cover slip over it. Put the slide on the microscope stage over the taped-on ruler, and slide it about until the pinned-down WOWBug is aligned with the ruler marks. After viewing it long enough to measure its body length, carefully remove the cover slip. Put the WOWBug back into the vial, and replace the cap.

5. Clean Up and Reflect on What You've Done

Follow your teacher's instructions for cleaning up. You'll need to take apart your well slide, transfer the WOWBug back into the vial and recap it, and put away your supplies and your microscope.

Practice with Independence/Homework:

Besides the questions in the body of this activity and any your instructor may give you, think about these.

1. Read through the activity again, paying particular attention to the "big picture." Write a paragraph that describes the five basic steps in this activity. Choose a different animal or plant and think of a question that might be asked about it. Describe how these same steps could be used to answer that question

2. Write a paragraph that explains what you learned about proper microscope care and operation. Tell why compound microscopes and dissecting microscopes are used for different purposes.

3. Learn more about *Melittobia digitata.* What characteristics of the WOWBug did you observe that made you know it is an insect? What kind of insect might it be? State your evidence. Why are WOWBugs special? (See the references at the end of this activity, or visit www.wowbugs.com for some answers).

4. Learn more about grooming behavior. Do all animals groom? Why would grooming be important to a WOWBug? How might body size affect the nature and importance of grooming?

Assessment

- In addition to the homework suggested above, students can reasonably be required to:
- Write about and sketch what they observed.
- Answer all questions in the activity.
- Compare and contrast their findings with those of their classmates.
- Work together to explain their findings and suggest ways to improve their techniques.
- Calculate a microscope's viewing field at different magnifications.
- Describe procedures for preparing samples of other items they may wish to view under the microscope.

National Science Education Standards

Meets the following:

Science as Inquiry

Ability necessary to do scientific inquiry

- Use appropriate tools and techniques to gather, analyze, and interpret data.
- Develop descriptions, explanations, predictions, and models using evidence.
- Communicate scientific procedures and explanations.
- Use mathematics in all aspects of scientific inquiry.

Understandings about scientific inquiry

- Different kinds of questions suggest different kinds of scientific investigations. Some investigations involve observing and describing objects, organisms, and events; some involve collecting specimens; and some involve discovery of new objects.
- Mathematics is important in all aspects of scientific inquiry.

- Technology used to gather data enhances accuracy and allows scientists to analyze and quantify results of investigations.

Life Science

Regulation and behavior

- Behavior is one kind of response an organism can make to an internal or environmental stimulus.

Science and Technology

Understandings about science and technology

- Technology is essential to science, because it provides instruments and techniques that enable observations of objects and phenomena that are otherwise unobservable due to factors such as size.

Inquiry Ideas and Cross-Curriculum Suggestions

Extensive guided and open-ended inquiry activities and cross-curriculum teaching suggestions are detailed in the book, *WOWBugs: New Life for Life Science*, which is available from Carolina Biological Supply Company or from the publisher. See particularly Chapter Three: Structure and Function in Living Systems, which includes several activities on WOWBug anatomy, scale and accuracy in scientific drawings, and the relationships between insect body size and seeming athletic ability.

Useful Resources

Matthews, R. W. 1997. Weird wonderful WOWBugs. *Carolina Tips,* 60, 9-11.
Matthews, R. W., et al. 1996. *WOWBugs: New Life for Life Science.* Riverview Press, Athens, GA 30604. 320 pp.
Matthews, R. W., et al. 1997. Insects as teaching tools in primary and secondary education. *Annual Review of Entomology* 42: 269-289.
Matthews, R. W. et al. 2009. Biology of the parasitoid wasp *Melittobia* (Hymenoptera: Eulophidae)). *Annual Review of Entomology* 54:
The WOWBug: Getting a Closer Look, Lesson 2. In: *Organisms — From Macro to Micro*. Smithsonian Institution/The National Academies, National Science Resources Center, 2005
WOWBug Biology Video and Teachers' Activity Guide. 1996, 2003. 17 minutes. Riverview Press.

Internet:
www.WOWBugs.com