

## How to live in a log

### *Betsy Beetle Lesson 1*

By Heather Bird Jackson



### Objective

Students will identify characteristics of betsy beetles that enable them to live in dead wood.

**This lesson addresses the following LOUISIANA STATE GRADE-LEVEL EXPECTATIONS FOR GRADE 2. It can easily be applied to objectives for other grade levels.**

- Identify physical characteristics of organisms (LS-E-A4)
- Match the appropriate food source and habitat for a variety of animals (LS-E-A1)
- Identify the components of a variety of habitats and describe how organisms in those habitats depend on each other (LS-E-C1)

### Science as Inquiry objectives

- Ask questions about objects and events in the environment (SI-E-A1)
- Use the five senses to describe observations (SI-E-A3)
- Recognize that a variety of tools can be used to examine objects at different degrees of magnification (SI-E-B3)

- Use a variety of appropriate formats to describe procedures and to express ideas about demonstrations or experiments (e.g., drawings, journals, reports, presentations, exhibitions, portfolios) (SI-E-A6)

### Background for teachers

*Odontotaenius disjunctus*, commonly called the betsy beetle, is an important decomposer in the eastern United States. Not only do they break down wood into nutrient rich compost, but their large galleries provide shelter for numerous organisms. For example, I have found five-lined skink mothers guarding their eggs in betsy beetle galleries. Other creatures reside in the betsy beetle's moist frass-lined galleries including earthworms, roaches, mites, potato bugs, and numerous other beetles. In a study of Florida black bear diet, betsy beetles were found to be the most common animal eaten by the bears. The Louisiana black bear similarly depends on beetles in wood as an important source of protein while pregnant.



Figure 1. A five-lined skink female guards her eggs from within the gallery of a betsy beetle.

If you have any questions or ideas concerning the use of betsy beetles in the classroom, feel free to contact me at [hjacks1@lsu.edu](mailto:hjacks1@lsu.edu). You may also find help on my website at: <http://www.heatherbirdjackson.com> where I have more information on and pictures of betsy beetles.

### Materials

- SOAR (Scope-on-a-Rope), available from Adrienne Lopez at [alopez@lsu.edu](mailto:alopez@lsu.edu) or 225-578-7780.
- Optional: a large section of wood
- All of the pictures in this lesson plan are available in pdf format at: [www.heatherbirdjackson.com](http://www.heatherbirdjackson.com)
- A betsy beetle. Here's how to get one:
  - 1) You can order betsy beetles through Carolina Biological ([www.carolina.com](http://www.carolina.com)). They call them Bess Bugs and sell 12 at a time for \$36.95 (as of July 2007).
  - 2) You can step into a nearby forest and collect them yourself (assuming you live in eastern United States). You will need to obtain permission from the landowner, of course, and please limit your destruction of dead wood, since it is an important resource to many forest creatures. Betsy beetles are common in Louisiana. They love decayed hardwood, oak

especially. You'll know a betsy beetle lives in a log when you see a large pile of coarse sawdust underneath the log (Figure 2). Check first under the log. Sometimes they fall out or hang out underneath. If not, then use a screwdriver or a hatchet to carefully remove bark and wood until the gallery is exposed. Follow the gallery until you find the beetle. Most times of the year you should find two beetles (mom and dad). In the summer you may find larvae, and in the fall (August and September) you may find red beetles. The red beetles are the freshly eclosed (hatched) adults whose exoskeleton is not fully developed. Make sure to collect plenty of decayed wood (their food). I have kept them for up to two years in shoebox-sized Tupperware containers (Figure 2). Keep the container stocked with decayed wood. These beetles are sensitive to dehydration, so keep a spray bottle near the containers and use it when needed. The wood should be kept moist.



Figure 2. A. "Sawdust" left at the entry to a passalid gallery. B. Passalid houses.

- 3) If the first two options fail, you can use the preserved specimens which can be borrowed from Adrienne Lopez, SOAR coordinator at [alopez@lsu.edu](mailto:alopez@lsu.edu), 225-578-7780

NOTE: Though betsy beetles have large mandibles, they are incredibly gentle creatures. The mandibles are for wood, not for you. Don't worry about bites.

## Introduction for Students

Ask students to think of animals that live in logs, or show them pictures of squirrel, mouse, rabbit, lizards, and snakes, all of which often live in logs. Why would they live there? (Protected, warm, dry). Snakes and mice, etc... don't make holes in logs, they can't chew the log and snakes don't have claws – who makes the holes in the logs for them?

Using 1x lens and stand-and-view set up, show the students the beetle in its cage. Show them where the beetle is in the cage (probably under some wood, or even better, in a gallery in the wood- see Figure 3). Show them the galleries (tunnels) in the wood – this beetle makes tunnels in the wood. Other animals, such as the five-lined skink (a lizard-see Figure 1) often live in the tunnels that this beetle makes.



Figure 3. Two views of the same gallery. The black shiny abdomen of a betsy beetle can be seen inside the piece of wood.

Take the beetle out. Notice how strong its legs are, and how hard it is to remove from a gallery.

If students are unfamiliar with insects, then show them the features that make a beetle an insect (6 pairs of legs are the main requirement). A beetle is different from other insects because of its hard exterior wing (called elytra). The beetle's hard exterior wings provide it with more protection, while it is still able to fly with its clear interior wings (hidden under the exterior wings). This key innovation has allowed beetles to become so diverse that they comprise almost one fourth of the described species on the planet.

Use the 30x lens to observe features of beetle. For better focus, remove the attachment at the head of the lens so that the lens may be closer to the body of the beetle. Ask students to identify features that might help the beetle to make tunnels (most notable are its mandibles or jaws).

Students may notice the interesting shape of their antennal segments. They may notice that the beetle moves the antennae frequently. *Question: What does the beetle use the antennae for?* The antennae are used to smell! The beetle is trying to smell you and everything else.

They may notice reddish hairs on their legs and head (Figure 4B). *Question: Why would a beetle have hair?* Hairs are probably used just like the hair on our skin: to make our skin more sensitive to touch.

Students may notice tiny mites living around the head of the beetle (Figure 4). Not all beetles have mites. *Question: What are the mites doing there? Why would they live on this beetle?* Answers may vary. The real answer is not known. We have found seven species of mite that live on betsy beetles. Some may be parasitic (i.e. they steal nutrients from the beetle), but most are probably there for the ride from one log to another. Some mites eat the other mites.

If you have one, pull out a section of wood. Show how hard it is. Discuss the challenges associated with life in wood. What are the advantages and disadvantages when compared to life on plants? Create a table on the board listing the advantages and disadvantages of life in wood.

Advantages	Disadvantages
<ul style="list-style-type: none"> <li>• Protection from predators</li> <li>• Shelter from cold and storms</li> <li>• Wood retains moisture</li> <li>• Safe place to lay eggs</li> <li>• Wood is available year round, plants are often seasonal</li> </ul>	<ul style="list-style-type: none"> <li>• So hard to chew! A lot of time would be wasted trying to build a house.</li> <li>• Dark, hard to see</li> <li>• Wood is hard to digest</li> <li>• Other creatures want to live in their gallery</li> <li>• Bears know where to find them. Bears like to tear open wood and snack on betsy beetles (and ants and termites).</li> </ul>

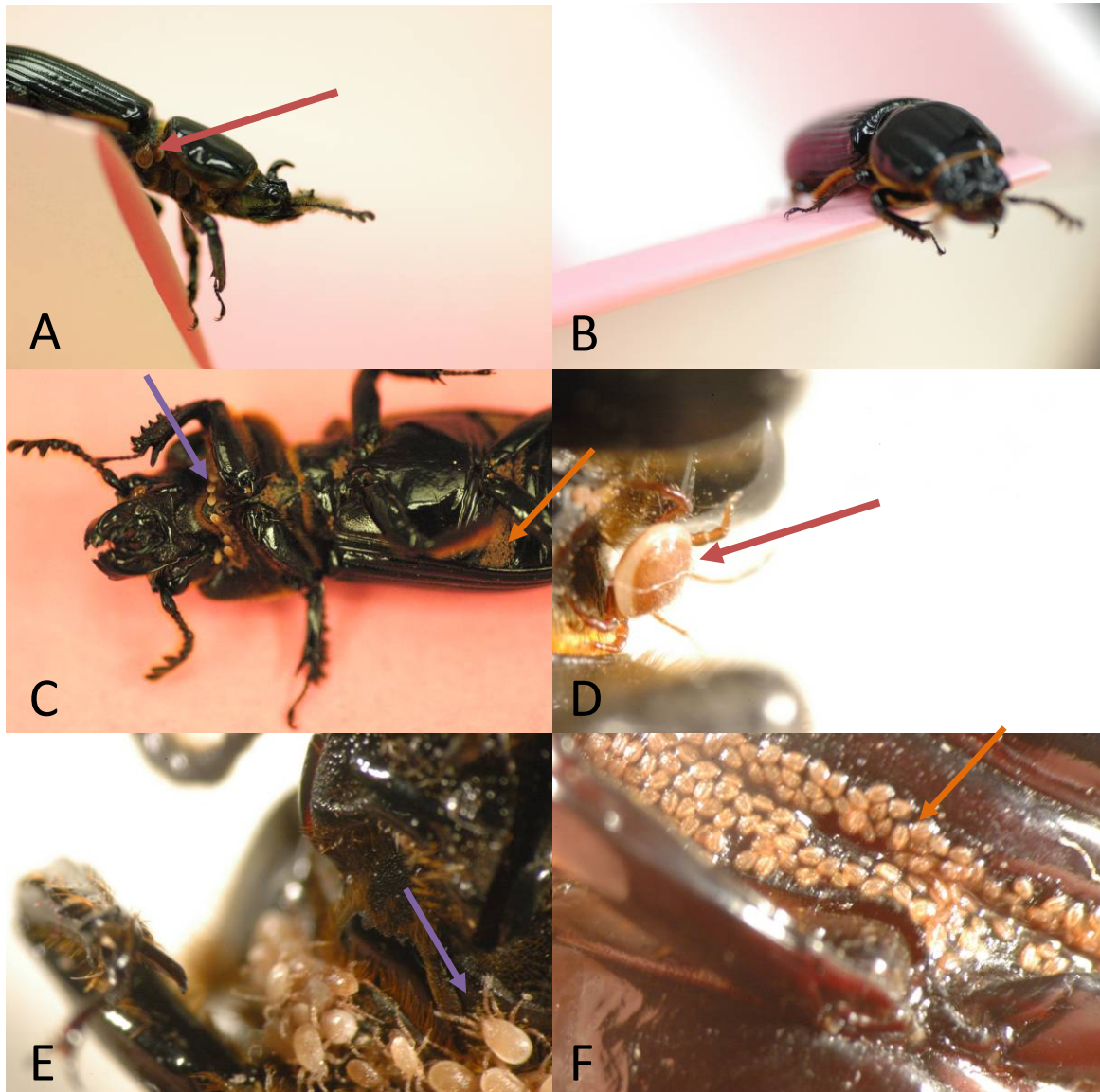


Figure 4. Betsy beetle at different magnification. A-C are taken with a macro lens on a camera, while D-F are at approximately the magnification available with the 30X lens. Arrows: Pink = largest mite found on betsy beetles. They crawl all over the beetle and sometimes jump off. Purple: medium-sized mites that congregate at the junction between head and thorax. Orange: tiny mites. A) Profile of betsy beetle displays a prominent horn, black shiny eyes, antennae with three long segments at the end, protruding mandibles (jaws), skinny tarsi (feet) protruding from the leg, striations (stripes) on the back of the abdomen, and a large mite. B) The focus in this picture is on the bright orange hairs growing from the mid-leg. Notice also the thick, jagged front leg that helps the beetle to dig (also prominent in picture C). C) Underside of beetle shows the

prominent mandibles, the thick forelegs with a sharp hook at the end (tibial spur), and two different kinds of mites. D) The same mite seen in picture A, sitting on the junction between the thorax and abdomen (same place as in picture A). E) Medium-sized mites seen underneath the head in picture C. The leg pictured is the front leg and an antenna is barely visible at the top of the picture. Note the rough texture of the underside of the head, and the sharp tibial spur. F) Tiny mites congregated at the base of the hind legs.

*Question: In what ways does the betsy beetle seem prepared for life in wood?*

Possible answers:

- Dark color blends with shadows (see Figure 3)
- Large, powerful mandibles can chew wood
- Slow movements are adapted for movement within galleries where there are few predators
- Slow movements are adapted for an animal that does not have to chase its prey.
- Flattened shape makes it possible to fit in to tight spaces.
- Thick forelegs assist in digging (many burrowing beetles have similar forelegs).

Explain to students that betsy beetles have an additional feature that we can't see. In their digestive system, betsy beetles house tiny organisms (bacteria, protozoa, yeast), that can digest difficult materials in wood for them. Furthermore, after wood is excreted in the gallery, the tiny organisms continue to digest it. The beetles can then consume this already digested wood to gain more nutrition. This is called an "external rumen", much like the rumen in a cow that allows the cow to digest difficult materials (cellulose) in grass.

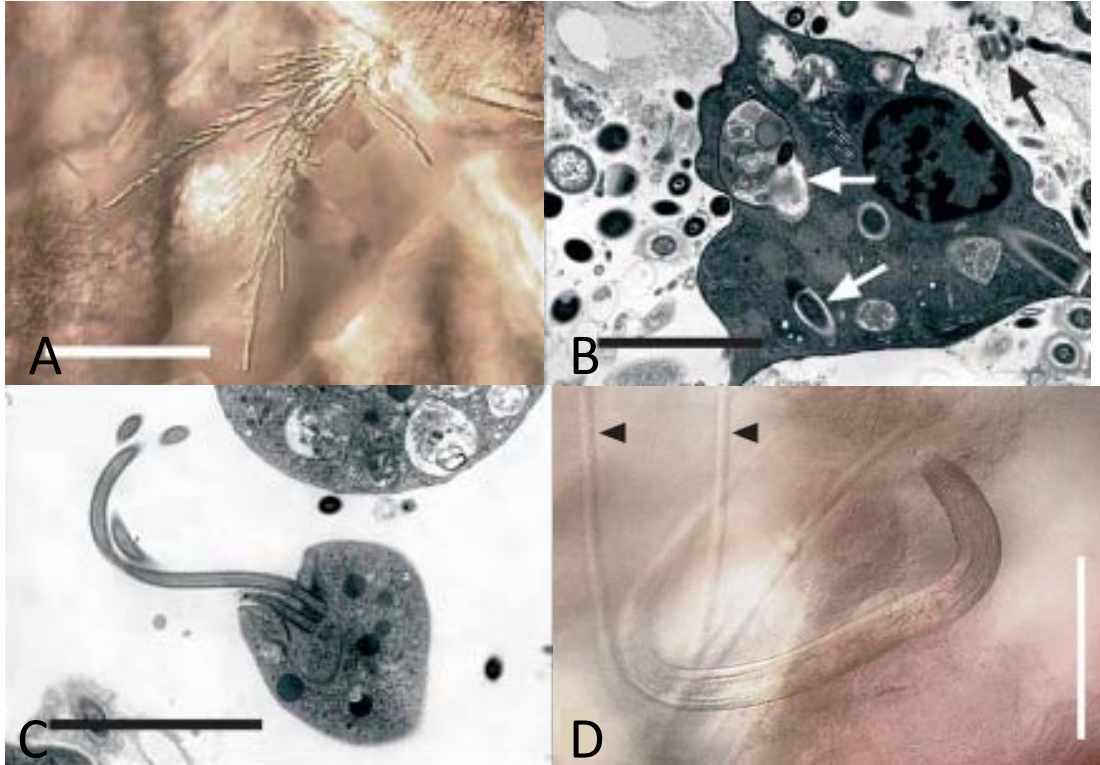


Figure 5. Microscopic organisms living in the betsy beetle gut. A) *Pichia stipitis*, a fungus believed to help the betsy beetle digest wood sugar (xylose). B) The large dark gray triangular organism is a protist. The white arrows point to its digestive pouches in which a number of bacteria are being consumed by the protist. C) A different protist, this one with a flagella (a

tail-like structure that enables it to swim). D) The large organism is a nematode, a small worm-like animal, while the black arrows point to Trichomycetes, another type of fungus. All pictures are taken from Nardi et al 2006. *Communities of microbes that inhabit the changing hindgut landscape of a subsocial beetle. Arthropod Structure and Development 35:57-68* and are used with the permission of coauthor M. Blackwell.

## Activity

Have students draw a betsy beetle. Ask them to label the features that make life in wood easier. Ask them to invent at least one feature that will improve its ability to live in dead wood. You might want to brainstorm these ideas with them. Additional features might include slippery substance to prevent mites from attaching to them, bioluminescent substances to light up the inside of the log, poisonous chemicals to repel bears, etc... I wouldn't limit them to biologically realistic scenarios. Let them get creative. Besides, if we can think of it, nature probably has it.

Optionally, students can draw their own creature that will live in wood (or some other habitat of their choice). What features would they give this creature to enable it to live in a hard, dark place?