INVESTIGATION 5:
BESS BEETLES

PURPOSE

IN BESS BEETLES, STUDENTS WILL

- Observe and describe the structures of bess beetles.
- Observe and describe the behaviors of bess beetles.
- Investigate the pulling strength of bess beetles.
- Record observations and share them with other students.
- Monitor and record observations of bess beetles over time.
- Evaluate whether an investigation might harm the animal being studied.
- Design, conduct, and present an investigation of their choice.

STRAND

Life Science

SCIENCE CONCEPTS

- Bess beetles are insects, with six legs, three body parts, antennae, and a variety of other structures.
- Bess beetles need water, food, air, and space.
- The structures found on different kinds of organisms show some similarities and some differences.
- An organism's structures have functions that help it survive in its habitat.
- We must take care not to harm animals as we learn about them.

INVESTIGATION 5 BESS BEETLES

INVESTIGATION 5: BESS BEETLES

INQUIRY QUESTIONS

PART 1

BESS BEETLES AT HOME

- What structures do bess beetles have?
- What does a bess beetle need in its habitat?

Time: 40–50 minutes

PART 2

COMPARING CRAYFISH AND BEETLES

- How are the structures of the beetle and crayfish alike and how do they differ?

Time: Two 45-minute sessions

PART 3

THE BEETLE PULL

- How much mass can a beetle pull?
- What is important to consider when planning investigations of animals?

Time: 40–45 minutes

PART 4

CHOOSING YOUR OWN INVESTIGATION

- What else can I learn about the structures and functions of plants and animals?

Time: 4–6 sessions

INVESTIGATION SUMMARY

Students observe bess beetles and learn how to handle them carefully. They become familiar with beetle structures and behaviors. They are introduced to the habitat that will provide for the needs of the beetles in the classroom.

Students observe and record a beetle's structures and behaviors. Using a Venn diagram, they compare crayfish and beetle structures. Finally, they discuss the functions of the various structures they observe.

Students attach loads to the beetles, using a dental-floss harness. They discover how much mass a beetle can pull and compare the load to the mass of the beetle itself. Students discuss what is important to consider when planning investigations of animals to ensure no harm comes to the animals.

Students look over a list of questions about plants and animals to decide which could be answered by research and which could be investigated directly. Each student or small group chooses a question or an idea from the project folder to pursue as a project.

SCIENCE STORIES

- *A Snail's Journey*
- *Crayfish, Snails, and Kids*
- *The Food Web*
- *A Chance Encounter*

See the Science Stories folio.
If students conducted Investigation 4: Meet the Land Snail, they have already read these stories.

INTERDISCIPLINARY EXTENSIONS

Language Extensions

- Read *The Life of Bess Beetles*.
- Prepare oral presentations.

AT A GLANCE

SCIENCE CONTENT	ASSESSMENT OPPORTUNITIES
• Bess beetles are insects, with six legs, three body parts, antennae, and a variety of other structures. • Bess beetles need water, food, air, and space.	**Teacher Observation** Informal notes *Assessment Chart for Investigation 4*
• The structures found on different kinds of organisms show some similarities and some differences.	**Student Sheet** Students compare the structures of the bess beetles to those of crayfish. *Comparing Beetles and Crayfish*
• An organism's structures have functions that help it survive in its habitat. • We must take care not to harm animals as we learn about them.	**Teacher Observation** Assess students' ideas on how the beetles' feet function to help it survive in its natural habitat. *Assessment Chart for Investigation 4*
• Using questions and ideas for projects they suggested throughout the module, students choose a project to research or investigate.	**Performance Assessment** Students conduct research or investigations to learn more about plants and animals. *Assessment Chart for Investigation 4*

INTERDISCIPLINARY EXTENSIONS	TECHNOLOGY/HOME CONNECTION
Math Extension • Problem of the week.	**FOSS Website www.fossweb.com** Check the website for interactive simulations, to write questions to a scientist, for teaching tips, and to talk with other classes using FOSS. **Home/School Connection** Students will need some extra time at home to work on their projects and get them ready to present to the class.

BACKGROUND FOR THE TEACHER

"We selected the bess beetle as an alternative organism to the land snail because it fits the FOSS criteria."

This fifth investigation is for teachers and students in states where the land snail, *Helix aspersa*, is considered a pest and is not allowed in the state. We selected the bess beetle as an alternative organism to the land snail because it fits the FOSS criteria. An organism considered for FOSS must be safe for students to handle, easy to care for, able to survive well in classroom environments, and large enough for students to make detailed observations. It must exhibit structures or behaviors of interest to students. Studying the organism must provide opportunities for student concept development in life science. It is a bonus when the organisms are native or naturalized in the region, so that students might find them in the local environment. While the land snail is still recommended for those states where the organism is already naturalized, for other states we recommend using the bess beetle.

One out of every four animals in this world is a beetle. Poke around in a field, under the surface of the ground, in trees, gardens, rotten stumps, or woodpiles, and you are likely to run into a beetle of some sort. We may know them as hungry munchers of grain supplies or house foundations, but they serve vital roles in the food web as scavengers and decomposers. In the classroom, they take on the starring role in students' investigations into structure and function.

Bess beetles, formally known as *Odontotaenius disjunctus*, are classified in the insect order called Coleoptera. Coleoptera is the largest order of organisms, including over 350,000 species. With so many opportunities you are sure to know several. Ladybird beetles, fireflies, scarabs, and darkling beetles (the mealworm adult stage) are all Coleoptera. They all have hard, shell-like forewings, or **elytra,** from which their name is derived. In Greek, *koleos* means "sheath," and *ptera* means "wing." This unique structure functions as a tough protector of the beetle's delicate hind wings and soft abdomen. When the beetle decides to fly, the hind wings unfold and do their job. At rest they tuck themselves back under the hard elytra. These tough elytra also protect beetles as they squeeze through narrow passageways and burrow into decaying wood or sandy soil.

Adult beetles are up to 4 cm long (about 1.5"), shiny black with a series of grooves running the length of the elytra. Students will observe the usual six legs and three body parts common to all insects. Some students may identify four body parts on their beetles; in fact, Coleoptera have two thoracic segments. Like a knight in articulated

armor, the thorax of this beetle has two sections, allowing its hard body to move more freely.

If you look for information on bess beetles, you'll find that they have several aliases. Betsy beetle, bessbug, patent leather beetle, and passalid beetle are all names for a beetle commonly found in decaying logs from Texas to Florida and as far north as Canada. They are considered beneficial organisms, important in recycling dead wood. There are only two species of passalids in the U.S., while over 500 species of passalids can be found in the tropics.

A bess beetle has tiny, gold-colored fringe on its legs and on the edges of its body. The exact function of the fringe is unclear, although it may help keep the beetle clean. Protruding from the beetle's head is a small horn. Most noticeable to students are the beetle's strong mandibles and feathery antennae. The mandibles allow the beetle to chew through the hardwood that serves as both food and shelter. It will rarely bite the hand that holds it. In the unlikely event it does, it is more of a surprising nip than a bite. Antennae "drive" the beetle. Students will observe the beetle using antennae to explore the air. It is assumed that they use their antennae to sense odors in the environment—decaying wood or other beetles of the same species—but this has not been well studied.

Bess beetles are somewhat social insects, with colonies living together in decaying stumps and logs. They prefer hardwood—oak, elm, and other deciduous trees—that is well decayed and falls apart easily. The beetles chew their way through the wood, making tunnels, or galleries, as they go. In the classroom, a layer of decayed wood in a high-walled basin and a daily spray of water is all they need.

All beetles go through several stages of development called **metamorphoses.** Life starts as an egg. The wormlike larva emerges from the egg. The larva is the stage in which the insect eats continuously and grows. Next the larva enters a resting stage, the pupa. Finally, the pupa changes into the hard-shelled adult.

Unfortunately, maintaining a reproducing colony is not easy. One difficulty is distinguishing the males from females, hard to do based on external observations, although females tend to be a bit larger. Another difficulty is keeping adult pairs in an undisturbed container so they can construct a family burrow system. Bess beetles are very sensitive to air movement, almost more so than light, so every time the decaying hardwood is replenished, the beetles will be disturbed.

"They are considered beneficial organisms, important in recycling dead wood."

Bess beetles live in pairs within the colony and share housekeeping and larval care over long periods of time. They delicately carry eggs through the tunnels in their mandibles. Larvae eat a well-chewed mixture of beetle feces and wood. When the larvae pupate, which may take up to a year, they are moved to a separate chamber for their protection. All this keeps the beetles very busy for the 14–16 months of their adult life.

When adult bess beetles are disturbed, they produce a squeak by rubbing their forewings (elytra) against their abdomens. Students will be able to hear this **stridulating.** Stridulating is apparently used for communication between members of the colony, and it is especially useful because most of the beetle's life is spent in darkness. Studies suggest that the sounds for defense are different than the sounds for courtship. The larvae also make sounds, using a different mechanism.

"Eating fungus that grows on decaying wood, providing care for larvae, communicating through sounds—these are all fascinating features of bess beetles."

Bess beetles chew wood, which is indirectly a food source. Unlike termites, bess beetles don't have symbiotic bacteria in their guts that help them digest the cellulose in the decaying wood they ingest. Bess beetles process wood in their digestive systems, and then a fungus grows on the beetles' feces. It is this fungus that gives beetles nourishment.

Eating fungus that grows on decaying wood, providing care for larvae, communicating through sounds—these are all fascinating features of bess beetles. But they have another interesting feature—they have coevolved with at least one kind of mite. Mites are commonly found hitchhiking on the bodies of the bess beetle. Some of these mites are found only on bess beetles, suggesting a relationship that has evolved along with the organisms. It's not clear that the beetles benefit from the mites, but because of their exoskeletons, they aren't harmed in any way. It may be that the mites live on secretions given off by the beetles, or they may just get protection from the beetle while they share the decaying wood. The mites are not known to damage the beetles, don't bite or harm students, and do not leave the classroom habitat basins. Should they get on a student's hand, the mites are easily brushed off.

Hardy, easy to maintain, harmless, and fascinating, bess beetles have the characteristics for a successful classroom critter.

TEACHING CHILDREN ABOUT BESS BEETLES

Students may be afraid of this large beetle at first, and we recognize that the aversion to this organism may be shared by adults as well. You may find it a personal challenge to handle the beetle with confidence and aplomb. It is critical that you set the example, however, displaying at least the appearance of enthusiasm and delight. Reach right in that first day and demonstrate with confidence how to pick up and hold the beetle carefully and securely. Show that it is safe and fun to place the beetle in the palm of your hand and to feel it walk across your hand. Then, as soon as students are absorbed in observations, wash and dry your hands, and enjoy students' discoveries, secure in the knowledge that your positive launching of the investigation will produce a good number of beetle enthusiasts who will be your beetle handlers from this point on.

Third and fourth graders are excellent observers and good at comparison. In this investigation students observe beetle structures and compare them to the structures of the crayfish they observed in detail in Investigation 3. The first critical look at structures involves organizing observations to get a bigger picture of organism structures. Students look for structures shared by both organisms. This early experience with comparative anatomy helps students see universality and uniqueness in organism structures.

Structures have functions that help organisms survive in their habitats. When students have experience with two (or more) organisms, they will discover that both organisms share a number of functions (feeding, moving, vision, feeling, protection, and so forth), but the structures that provide those functions can be different. This big idea should be discussed thoroughly to help students appreciate the universality of life on the one hand, and the diversity and individuality of specific kinds of organisms on the other hand.

MATERIALS

PART 1: BESS BEETLES AT HOME

FOR EACH GROUP

- 1 Bess beetle *
- 1 Plastic cup
- 1 Cup lid
- 1 Paper towel *
- Δ 2 Hand lenses

FOR THE CLASS

- 2 Basins, 6-liter
- 2 Basin covers
- • Paper towels *
- • Notebook paper for recording *
- 1 Water mister
- • Rotting hardwood *
- ❑ • Student sheet no. 31 called *Bess Beetle Log*

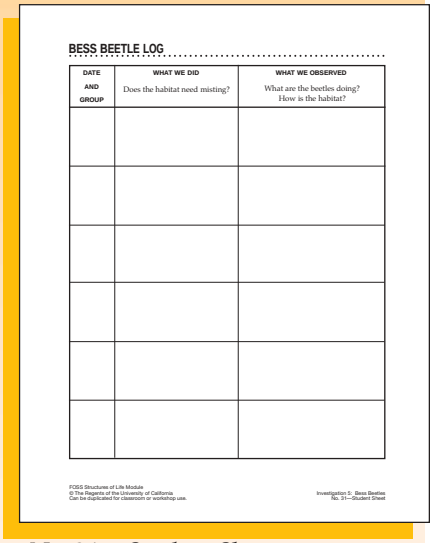
FOR ASSESSMENT

- ❑ • *Assessment Chart for Investigation 4*

* Supplied by the teacher

❑ Use the duplication master to make copies.

Δ FOSS Measurement kit item



BESS BEETLE LOG

DATE AND GROUP	WHAT WE DID Does the habitat need misting?	WHAT WE OBSERVED What are the beetles doing? How is the habitat?

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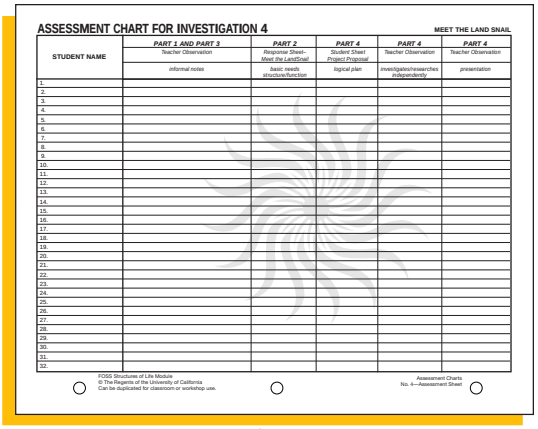
Investigation 5: Bess Beetles
No. 31—Student Sheet

No. 31—Student Sheet



ASSESSMENT CHART FOR INVESTIGATION 4

MEET THE LAND SNAIL

STUDENT NAME	PART 1 AND PART 3 Teacher Observation informal notes	PART 2 Response Sheet—Meet the Land Snail basic needs structure/function	PART 4 Student Sheet Project Proposal logical plan	PART 4 Teacher Observation investigates/researches independently	PART 4 Teacher Observation presentation
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32.					

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Assessment Charts
No. 4—Assessment Sheet

No. 4—Assessment Sheet

GETTING READY

PART 1: BESS BEETLES AT HOME

1. SCHEDULE THE INVESTIGATION

This part will take **40–50 minutes.**

2. PLAN ASSESSMENT: INFORMAL OBSERVATION

The assessment chart designed for Investigation 4 can be used for this investigation. Keep *Assessment Chart for Investigation 4* with you so you can make notes about students as needed. Assessment for this part is informal observation.

3. ORDER BESS BEETLES

You will need one bess beetle for each group of four students, with at least two additional beetles to replace any that arrive damaged.

You can order bess beetles from Delta Education. Otherwise, check your regional biological supplier for bess beetles, also known as passalid beetles or *Odontotaenius disjunctus.* They are fairly common throughout the eastern United States, inhabiting decayed hardwood stumps and logs.

4. GATHER HARDWOOD

Decayed hardwood supplies the beetles' food and shelter. Oak, elm, and many other deciduous trees are good choices, while conifers are *not* their favorites. The bess beetles will live in the two clear basins. Gather enough rotten wood to fill each basin about 5–8 cm (2–3") deep.

NOTE: *A bit of leaf litter from under the hardwood trees is a good addition to the habitat.*

5. PREPARE HABITAT

When the beetles arrive, add them to the two basins of wood. Give them a good spray of water and put on the basin covers. Plan to spray the basin daily. The beetles will be fine over the weekends without water.

6. DISTRIBUTE THE BEETLES

Just before conducting Part 1, place a beetle in a cup for each group. If you have enough beetles, provide a cup and beetle for each pair of students.

7. READ *THE LIFE OF BESS BEETLES*

Plan to read aloud the story called *The Life of Bess Beetles* during a reading period sometime after completing this part. This story starts on page 30 of this folio.

GUIDING THE INVESTIGATION

PART 1: BESS BEETLES AT HOME

1. INTRODUCE THE BESS BEETLES

Tell students that they have new organisms living in their classroom—bess beetles. Ask students if they have ever seen a beetle before, and ask what they know about their structures. Tell them,

Let's start our investigations by getting a little more information about bess beetle structures. Let's take a few minutes to observe these beetles and become familiar with them.

NOTE: *Students should wash their hands after handling the bess beetles.*

2. DISCUSS CARE AND RESPECT

Caution students that, like all living organisms, the beetles must be treated with care and respect. Let them know that they *can* nip, but rarely do and always in order to protect themselves. Have students give suggestions for holding and treating the beetles carefully. Beetles can be held safely or viewed in a cup or on a cup lid.

Let students know that they may also notice a second organism with their bess beetle. This other organism, called a mite, is harmless to the beetle and to humans, and is often found riding on the beetle.

MATERIALS FOR STEP 3:

- *1 Beetle in a cup*
- *1 Cup lid*
- *1 Paper towel*
- *2 Hand lenses*
- *Notebook paper*

NOTE: *If you have enough bess beetles, provide a beetle to each pair of students.*

3. GET TO KNOW THE BEETLES

Organize students into collaborative groups. Have the GETTERs from each group get a cup with a beetle, a cup lid, hand lenses, and a paper towel. Students may want to put the beetle on the cup lid or on the paper towel, or just let the beetle walk on the table. Remind the class that the role of the STARTER is to make sure each person in the group gets a close look at the bess beetle. The REPORTER will keep notes on the group's observations. Let the observations begin.

4. KEEP THE OBSERVATIONS MOVING

Visit the groups as they get to know their beetles and focus their observations with questions. Ask,

- *How do the beetles move?*
- *How do they feel on your arm or finger?*
- *Do they make sounds?* [Yes.]

5. DISCUSS OBSERVATIONS

After another 5–10 minutes, ask the GETTERs to return the beetles to the cups and leave them on the table. Ask the REPORTERs from each group to share a few observations.

6. IDENTIFY BESS BEETLES AS INSECTS

Often students are the first to identify their beetles as a kind of insect, offering as evidence the number of legs or body parts. If not, ask students what they know about the structures of insects. Verify that insects have six legs, three body parts (a head, thorax, and abdomen), and antennae. Ask,

- *What evidence do we have that these bess beetles are a kind of insect?*

7. PLAN FOR BESS BEETLE HOUSING

Ask,

- *What do we need to know about bess beetles in order to keep them in our classroom?*

Write students' suggestions on the board. They might mention

- Food: what, how much, and how often?
- Water: how much and what should it be in?
- Air: what temperature do they need?
- Space: how much room do they need?
- Shelter: do they need places to hide?

8. INTRODUCE HABITAT

Hold up the two clear basins and covers. Tell students that bess beetles live together. Half will live in each terrarium.

9. PLAN FOR BESS BEETLE CARE

Tell students that the natural habitat for bess beetles is rotting logs of hardwood trees like elms and oaks. The decaying wood provides both food and shelter for the beetles. Let them know what kind of wood you have provided and where it came from. Explain that bess beetles are found from Texas to Florida and as far north as Canada. They will do well in the warm climate of your classroom.

Bess beetles get their moisture from damp wood. The only care they need is a daily spray of water on the wood.

NOTE: *Students may rightly claim that these beetles have **four** body parts. Entomologists describe the bess beetle as having several thoracic segments.*

MATERIALS FOR STEP 8:

2 Basins with decaying hardwood
2 Basin covers
1 Water mister

MATERIALS FOR STEP 10:
- *Bess Beetle Log sheets*

10. ASSIGN GROUPS TO CARE FOR THE BESS BEETLES

Show students the *Bess Beetle Log* sheet that will be posted near each bess beetle habitat. Assign four groups to each habitat. Write each group's identification on the log sheet for the dates it will observe the habitat. Have students who are assigned for the first day return the beetles to the habitats and spray the wood. Keep one *Bess Beetle Log* sheet by each basin. Make additional copies as needed.

Point out that there is space on the log for students' observations. However, the beetles may spend most of the time in underground tunnels and will not be visible. Student should first observe any changes to the habitat, any sounds the beetles make, or any evidence of movement. Then they can gently remove each piece of wood to find the beetles. If possible they should locate the beetles without picking them up. When they are finished with their observations, they should replace the beetles and wood the way they were.

WORD BANK

bess beetle
insect
thorax
abdomen
head
mite
terrarium

CONTENT/INQUIRY

- Bess beetles have six legs, three body parts, two antennae, two jaws, and a horn.
- Bess beetles need water, food (wood), space, and air in their habitat.
- *Student questions?*

WRAPPING UP PART 1

11. MAKE WORD BANK ENTRIES

Add new words to the class word bank.

- bess beetle
- insect
- thorax
- abdomen
- head
- mite
- terrarium

12. MAKE CONTENT/INQUIRY CHART ENTRIES

Add new concepts to the content/inquiry chart.

- *What structures do bess beetles have?* [Bess beetles have six legs, three body parts, two antennae, two jaws, and a horn.]
- *What do we need to know about bess beetles in order to keep them in the classroom?* [Bess beetles need water, food (wood), space, and air in their habitat.]

Add student questions to the chart, and project ideas to the folder.

13. READ *THE LIFE OF BESS BEETLES*

Later in the week, read aloud *The Life of Bess Beetles*. The story is in the Language Extensions in this folio.

MATERIALS

PART 2: COMPARING CRAYFISH AND BEETLES

FOR EACH GROUP

- 1 Bess beetle *
- 1 Plastic cup
- 1 Cup lid
- 1 Paper towel *
- Δ 2 Hand lenses
- • Student sheets no. 11 called *Crayfish Structures* (from Investigation 3, Part 1) (optional)
- ❑ 4 Student sheets no. 32 called *Bess Beetle Observations*
- ❑ 4 Student sheets no. 33 called *Comparing Beetles and Crayfish*

FOR THE CLASS

- 2 Bess beetle habitats
- 1 Water mister
- • Rotting hardwood *
- • Flashlights (optional) *
- 1 Sheet of chart paper (optional) *
- • Notebook paper *

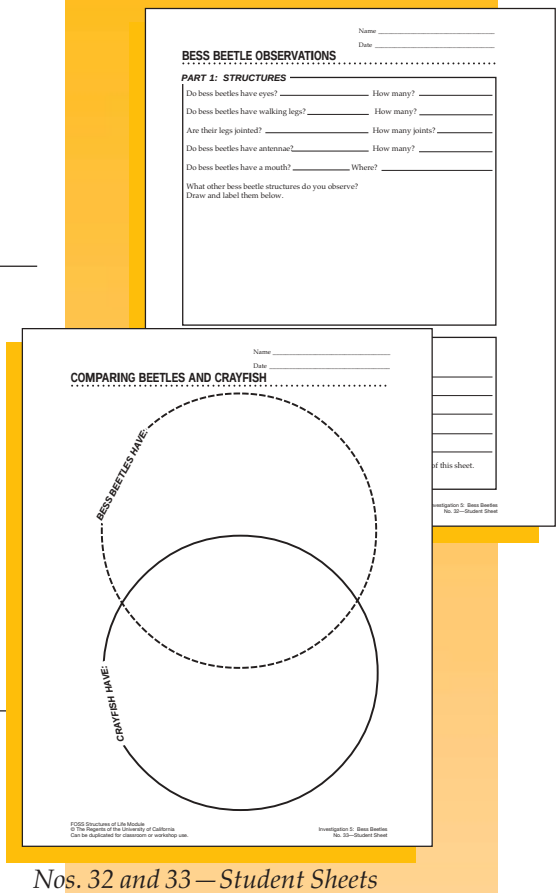
FOR ASSESSMENT

- • *Assessment Chart for Investigation 4*
- ❑ • Student sheet no. 20 called *Response Sheet—Meet the Land Snail* (optional)

* Supplied by the teacher

❑ Use the duplication master to make copies.

Δ FOSS Measurement kit item



Nos. 32 and 33—Student Sheets

No. 20—Student Sheet

GETTING READY

PART 2: COMPARING CRAYFISH AND BEETLES

1. SCHEDULE THE INVESTIGATION

This part will take **two 45-minute sessions.**

2. PLAN ASSESSMENT: STUDENT SHEET

Students fill in a Venn diagram in Step 9 to compare their observations of crayfish and bess beetle structures. Give students a + if they identify four or more differences and four or more similarities.

3. PLAN ASSESSMENT: RESPONSE SHEET (OPTIONAL)

You could use *Response Sheet—Meet the Land Snail* for a closer look at students' understanding of how an organism's structure may help it survive in its habitat. Even though students may not have had direct experience with land snails, they should be able to transfer their experience from the bess beetles and crayfish to the land snails. See page 13 of the Assessment folio for more details and a scoring guide. Plan to spend time discussing the sheets with students after you have reviewed them.

4. DISTRIBUTE THE BEETLES

Just before conducting this part, place a beetle in a cup for each group. If you have enough beetles, provide a cup and beetle for each pair of students.

5. READ SCIENCE STORIES

There are three short science stories that would be good for students to read and discuss at the end of this part. If you plan to use the *Response Sheet—Meet the Land Snail,* have students read these stories before completing the response sheet. If you are unable to provide students with direct experiences with land snails, they can gather information from the readings. The stories are *A Snail's Journey; Crayfish, Snails, and Kids;* and *The Food Web.* For background information and follow-up activities, see the Science Stories folio.

GUIDING THE INVESTIGATION

PART 2: COMPARING CRAYFISH AND BEETLES

1. REVIEW BESS BEETLE STRUCTURES

Ask students to recall bess beetle structures.

- *Which bess beetle structures did you find most interesting?*

Call on several students to share their observations.

2. RECORD BESS BEETLE STRUCTURES

Ask students to work again to observe and record the structures of the bess beetles. Show them a copy of the *Bess Beetle Observations* sheet and ask students to fill in *only part 1* of the sheet.

Have GETTERs get the beetles for their groups. Let them work at their own pace to observe structures.

3. LOOK FOR ADDITIONAL STRUCTURES

Offer suggestions for additional investigations for teams that finish quickly.

- Tell students that the legs and wings of the beetle are attached to the thorax. Each segment of the thorax has a pair of legs. Ask students to look closely to identify the thorax of the beetle.
- When students get to the question about the beetle's mouth, point out the supply of rotting hardwood and invite each group to take a small pile back to their table to offer to the beetle.
- If you have flashlights available, point them out to students at this time. Students can use them to look for additional structures, including the horn on the beetle's head.

Have students draw and label additional structures in the space provided on the student sheet.

4. REVIEW BEHAVIOR

Ask students to recall some of the interesting crayfish behaviors they have observed. They may recall flipping, pincer threats, territoriality, feeding, and many other things. Remind students that behaviors are things animals do in certain situations.

MATERIALS FOR STEP 2:

- *1 Beetle in a cup*
- *1 Cup lid*
- *2 Hand lenses*
- *4* ***Bess Beetle Observations*** *sheets*
- *1 Paper towel*

MATERIALS FOR STEP 3:

- *Rotting hardwood*
- *Flashlights (optional)*

5. OBSERVE AND RECORD BEETLE BEHAVIORS

Ask students to observe beetle behaviors. They should fill out part 2 of the *Bess Beetle Observations* sheet, and record any additional behaviors on the back. They could add to their drawing of the beetle in part 1.

6. LOOK FOR ADDITIONAL BEHAVIORS

Ask students to look for additional behaviors if they finish part 2 and complete their drawing quickly.

- *What happens if the beetle encounters a balled-up paper towel? Will it climb it?*
- *How do the beetles respond to light?*
- *How do the beetles respond to moving air?*
- *How do bess beetles eat?*
- *How do they make that sound?* [By rubbing their hard forewings against their abdomens.]

POSSIBLE BREAKPOINT

7. INTRODUCE THE VENN DIAGRAM

Draw a large Venn diagram on the chalkboard or chart paper. If students are not familiar with the term, introduce the circles as a **Venn diagram,** used for comparing two things.

Call two students to stand by you—Maria and Sam. Label one circle "Maria" and the other "Sam." Ask the class,

- *What is one difference between Maria and Sam?*

Write a few of the differences, such as shoe size or hair color, in each circle. Each observation should identify something unique about the person, such as "Maria has black hair; Sam has red hair," rather than "Maria's hair is darker."

Explain that the area where the circle overlaps is for recording similarities. Ask students to identify things Maria and Sam have in common, such as two ears or white socks. Write these in the intersecting area.

8. COMPARE STRUCTURES OF BEETLES AND CRAYFISH

Tell students they will be using a Venn diagram to record their comparisons of bess beetle and crayfish structures. In the beetle circle they record structures that are unique to the beetle (six legs). In the crayfish circle they record structures that are unique to the crayfish (pincers). If a structure is common to both animals, they write it in the intersecting area (hard exoskeleton).

9. MAKE VENN DIAGRAM OF STRUCTURES

Distribute a *Comparing Beetles and Crayfish* sheet to each student. Suggest that students refer to their *Crayfish Structures* and *Bess Beetle Observations* sheets to review beetle and crayfish structures. Challenge them to identify five or more unique structures for each organism and five or more similarities between the animals.

10. DISCUSS CRAYFISH STRUCTURES AND FUNCTIONS

Explain that each structure often has one or more **functions** that help the animal survive in its habitat. A function is how a structure works or how it is used by the animal. Give the example of the crayfish's pincers. Ask,

- *How does the crayfish use its pincers? How do they help the crayfish?*

Use students' responses to define the function of the pincer as a feeding structure, a digging structure, a defensive structure (protection), and an offensive structure (fighting other crayfish). Ask students to speculate on the function of other crayfish structures they have observed. Add student responses to a T-table of crayfish structures and functions.

11. WRITE ABOUT BEETLE STRUCTURES AND FUNCTIONS

Ask students to think of any one structure of the beetle that they observed. Have them imagine how the beetle might use that structure to help it survive in its habitat. Have students write their responses on the back of the Venn diagram or on a separate sheet of paper.

MATERIALS FOR STEP 9:

- 4 ***Comparing Beetles and Crayfish*** *sheets*
- 4 ***Crayfish Structures*** *sheets (optional)*
- 4 ***Bess Beetle Observations*** *sheets (completed)*

STRUCTURE	FUNCTION
pincer	fighting protection digging feeding
tail flaps	moving protection
antennae	sensing

MATERIALS FOR STEP 11:

- *Notebook paper*

WRAPPING UP PART 2

WORD BANK

Venn diagram
function

CONTENT/INQUIRY

- Organisms have some similar structures and some differences.
- An organism's structures have functions that help it survive in its habitat.
- *Student questions?*

12. MAKE WORD BANK ENTRIES

Add new words to the class word bank.

- Venn diagram
- function

13. MAKE CONTENT/INQUIRY CHART ENTRIES

Add new concepts to the content/inquiry chart.

- *How do the structures of the beetle and crayfish compare?* [The organisms have some similar structures and some differences.]
- *What functions do an organism's structures serve?*

  [An organism's structures have functions that help it survive in its habitat.]

Add student questions to the chart, and project ideas to the folder.

14. READ SCIENCE STORIES

This is a good time to have students read three short science stories—*A Snail's Journey; Crayfish, Snails, and Kids;* and *The Food Web.* See the Science Stories folio for more information.

15. ASSESS PROGRESS: RESPONSE SHEET (OPTIONAL)

Distribute a copy of *Response Sheet—Meet the Land Snail* to each student. This assessment can be completed during class or at home. Be sure to discuss the sheet after reviewing students' responses.

MATERIALS

PART 3: THE BEETLE PULL

FOR EACH GROUP

- 1 Bess beetle *
- 2 Plastic cups
- 4 Pieces of paper *
- 1 Paper towel *
- 12 Paper clips, jumbo
- Δ 1 FOSS balance with two cups

FOR THE CLASS

- Additional jumbo paper clips *
- Masking tape *
- Dental floss, 2 m *
- 1 Scissors *
- 1 Jump rope (optional) *
- Notebook paper *

FOR ASSESSMENT

- *Assessment Chart for Investigation 4*

* Supplied by the teacher

Δ FOSS Measurement kit item

GETTING READY

PART 3: THE BEETLE PULL

1. SCHEDULE THE INVESTIGATION

This part will take **40–45 minutes.**

2. PLAN ASSESSMENT: TEACHER OBSERVATION

Students speculate on the function of the bess beetle feet in Step 11. Any reasonable suggestions that relate to the beetles' habitats are acceptable, such as

- Bracing themselves as they tear off wood from logs for food.
- Digging tunnels through wood.
- Pushing aside or carrying wood in their tunnels.
- Climbing over, under, and through logs.

If a student proposes two or more functions, give him or her a +.

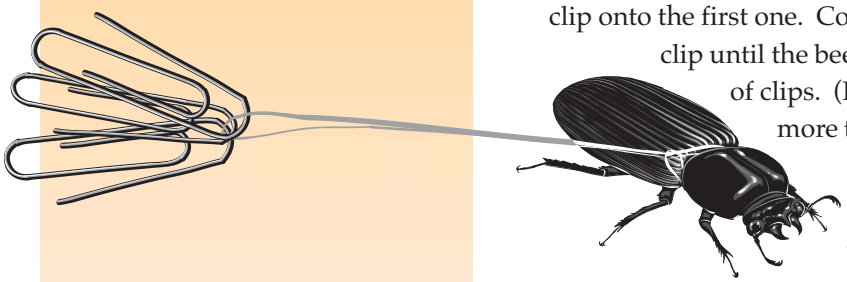
3. CONSTRUCT THE HARNESSES

Cut a 20–25 cm (8–10") length of dental floss for each bess beetle. Fold each in half and tie off the ends.

4. PRACTICE WITH A BEETLE

Secure a paper towel to a desktop with small pieces of tape at each corner. The paper towel will give the beetle a rough surface to grab as it walks. Practice placing the dental-floss harness on a beetle. Gently hold a beetle as you place the entire floss loop under the body, between the front and middle pairs of legs (between the two segments of the thorax). Thread the tied end through the loop and gently tighten the slipknot so the beetle can't walk out of the harness. The beetle can walk around with the loop hanging behind it.

Open one end of a jumbo paper clip slightly and slip it in the floss loop. As the beetle begins to walk pulling the clip, chain a second clip onto the first one. Continue adding paper clips to the first clip until the beetle either stops walking or you run out of clips. (It is not unheard of to have a beetle pull more than 30 jumbo paper clips!)



Practice removing all the clips from the loop and removing the harness from the beetle.

5. PREPARE YOUR MODELS

You can use a jump rope and student volunteer to model how to make a harness with a loop and slipknot. Use the rope instead of dental floss, tie the ends to make a loop, put it around the waist of a student, and use a slipknot to tighten the harness.

NOTE: *This procedure has been used successfully by hundreds of teachers with their students. It does not harm the beetle. If you have any reservations about putting a harness on a beetle or having students do it, however, don't do this part.*

NOTE: *Another demonstration strategy is to use the overhead projector as the platform on which to harness a beetle.*

GUIDING THE INVESTIGATION
PART 3: THE BEETLE PULL

1. PROPOSE AN INVESTIGATION

By now, students have experienced the strong grasping power of the beetles' feet when they try to remove them from clothing or a finger. Ask,

- *How strong is a bess beetle? Do you think a beetle could pull something equal to its own weight?*
- *How can we find out?*

Listen to students' ideas for investigating the beetle's "pull power."

2. INTRODUCE THE BEETLE HARNESS

Show students the dental-floss loop that you have prepared. Demonstrate how to tape a paper towel to the table. Then demonstrate how to attach a loop to a beetle. Drawings on the board will help as you demonstrate with a beetle.

a. Have one person in the team hold the beetle gently.

b. Place the entire loop under the beetle at the joint in the thorax.

c. Thread the tied ends through the loop and gently pull them through. This makes a slipknot. It doesn't have to be tight.

d. Open up one end of a paper clip slightly. Hook it through the loop. If the beetle can carry one paper clip, add one more clip to the first one. The first paper clip will serve as the attachment for all the other paper clips.

If you have a jump rope handy, you can model this procedure again, using the jump rope as a loop and a student volunteer who will play the role of the beetle.

3. EVALUATE THE INVESTIGATION

Explain that, as scientists, students must consider the well-being of the animals they are studying. Have students evaluate how they should conduct the investigation. Ask,

- *What can we do to ensure that no harm will come to the beetle?*

Let students share their thoughts. In this case, a beetle will simply refuse to go any farther if a load is too heavy to move, and it will not be denied food, water, or rest in its habitat. Let students know that they can stop the investigation anytime they

MATERIALS FOR STEP 2:

1 Paper towel
1 Masking-tape strip
1 Bess beetle
1 Dental-floss harness
1 Cup of 12 jumbo paper clips

feel the beetle is being harmed. After agreeing that the investigation is not harmful to the beetles, go on to the next step.

MATERIALS FOR STEP 4:
4 Pieces of paper

4. RECORD THE PROCEDURE

Tell students that scientists must describe their investigations so that they, or another scientist, can repeat the same investigation. Help students restate the question.

- *Can a beetle pull its own weight?*

Ask students to take a blank sheet of paper and write the question they are investigating and a brief description of the procedure they will use to answer it. The description can include words, drawings, or both. As students work on their descriptions, remind them to label their drawings. They can share their procedures with a group member when they are done, to see if they have left out any parts.

MATERIALS FOR STEP 5:
1 Paper towel
- *Masking tape*

5. DISTRIBUTE PAPER TOWELS AND TAPE

After reviewing the investigation procedures, let the GETTERs get a paper towel and piece of masking tape. Remind STARTERs to make sure everyone helps set up the towel, attach the loops, or add the paper clips.

MATERIALS FOR STEP 6:
1 Beetle in a cup
1 Dental-floss harness
1 Cup of 12 jumbo paper clips

6. DISTRIBUTE BESS BEETLES AND FLOSS LOOPS

Let GETTERs get a beetle in a cup and a harness. When the harness is on, GETTERs can get a cup of paper clips from the materials station. Invite students to begin, placing the paper clips on the hook slowly, until the bess beetle doesn't move. Establish a time limit. Groups may want to conduct a few trials.

7. VISIT GROUPS

As students work, visit the groups to help with the harnesses and to monitor their progress. Remind students to add the paper clips one at a time, checking to see that the beetle can pull the mass before they add another paper clip. Most groups will use all their paper clips and ask for more. You can decide to stop the investigations at 12 clips and have groups do several trials, or provide more jumbo paper clips if available.

8. REPORT THE RESULTS

About 20 minutes before the end of the session, give the signal to end the investigating. Ask groups to remove the paper clips and count the number that the beetle could pull. Have them record this number on their sheet. Have them gently remove the harness and return the beetle to the cup. Ask REPORTERs to post their results on the board.

9. BALANCE THE BEETLES

Ask,

- *Can a beetle carry its own weight? What will we need to do to find out?*

If students do not suggest it, point out that they will need to compare the mass of the beetle to paper clips. Suggest using a balance. If the class is unfamiliar with the FOSS balance, demonstrate how to level the beam to start. (Put an empty cup on each end of the beam. Move the white slider on the beam until the beam is level.) Once the balance beam is level, place a beetle in one cup, and add paper clips, one at a time, to the other side until the balance beam is again level.

Let GETTERs get a balance and help students get started. They should record their results on their sheet.

MATERIALS FOR STEP 9:

1 FOSS balance
2 Cups

10. REPORT RESULTS

Ask REPORTERs to share their group's experiences. The beetle's mass will equal one or two clips. As a class, decide which number to use. Point out that, if a beetle equals one paper clip, every paper clip it can carry is like carrying another beetle on its back.

11. BRING IT BACK TO FUNCTION

Remind the class that most structures and behaviors help the beetle survive in its habitat. Ask students to imagine the life of the bess beetle. Bess beetles live in the dark tunnels under and inside big, rotting logs. Ask,

- *How might pulling power or strength help a beetle survive?*
- *How do the feet function to help it survive?*

Have students discuss their answers with their group members, and share a few ideas with the class. They can record their ideas on their sheet.

12. EVALUATE IDEAS FOR FURTHER INVESTIGATIONS

Ask students to brainstorm other questions that they would like to investigate with bess beetles. Record their questions in the project folder.

Review animal well-being after students suggest a few ideas.

- *Could any of these investigations harm the bess beetle?*
- *How should investigations be conducted so that no harm is done to the bess beetle?*

Discuss each idea with these questions in mind, eliminating those that may be harmful.

WORD BANK

balance

CONTENT/INQUIRY

- The feet of the bess beetle strongly grasp rough surfaces. They can pull on wood as the beetle makes tunnels or tears wood to eat it.
- Scientists must conduct their investigations so that no harm is done to animals.
- *Student questions?*

WRAPPING UP PART 3

13. MAKE WORD BANK ENTRIES

Add any new words to the class word bank.

- balance

14. MAKE CONTENT/INQUIRY CHART ENTRIES

Add new concepts to the content/inquiry chart.

- *What functions do the beetles' feet serve?* [The feet of the bess beetle strongly grasp rough surfaces. They can pull on wood as the beetle makes tunnels or tears wood to eat it.]
- *What is important to think about when deciding on an investigation to do with animals?* [Scientists must conduct their investigations so that no harm is done to animals.]

Add student questions to the chart, and project ideas to the folder.

15. READ SCIENCE STORY

This is a good time for students to read the science story called *A Chance Encounter.* See the Science Stories folio for more information.

16. DEALING WITH BEETLES AT THE END OF THE MODULE

There are a number of options for dealing with the beetles at the end of the module. The organisms might find a permanent home in your classroom. You will need to provide containers for permanent habitats if the kit will be used by another teacher. Or you might pass the organisms on to the next user of the kit. Some students might be interested in taking the beetles home (be sure to obtain parental permission ahead of time). Or you can check with your district to see if there is a plan for reuse of FOSS living organisms. Sometimes the biological supplier will accept the beetles back.

MATERIALS

PART 4: CHOOSING YOUR OWN INVESTIGATION

FOR EACH GROUP

- Additional materials as requested by students (optional) *
- Poster board (optional) *

❑ 4 Student sheets no. 21 called *Project Ideas* (optional)

❑ 4 Student sheets no. 22 called *Project Proposal*

❑ 4 Student sheets no. 23 called *Presentation Guidelines*

FOR THE CLASS

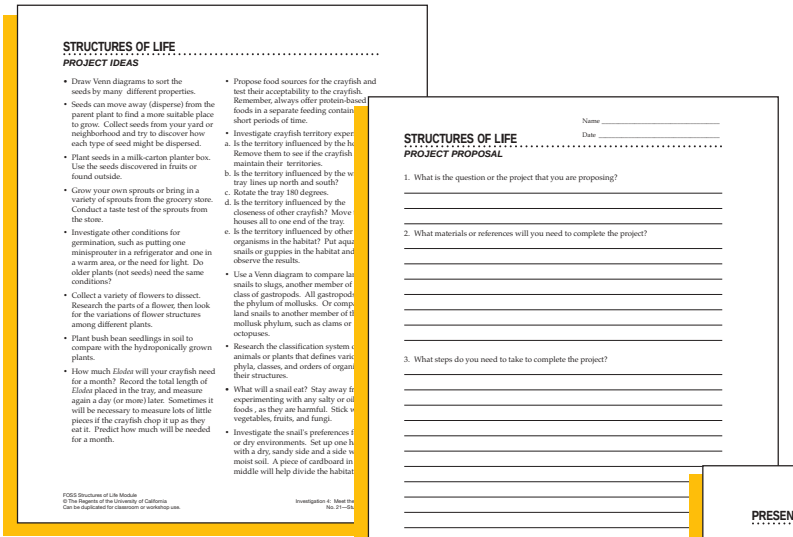
- Materials available from the Structures of Life kit
- Classroom organisms

FOR ASSESSMENT

- *Assessment Chart for Investigation 4*

* Supplied by the teacher

❑ Use the duplication master to make copies.



No. 21—Student Sheet

No. 22—Student Sheet

No. 23—Student Sheet

GETTING READY

PART 4: CHOOSING YOUR OWN INVESTIGATION

1. WHY DO PROJECTS?

Throughout the module students have engaged in degrees of guided inquiry. The projects allow students to follow their own interests and give you some insight into how well they have internalized the inquiry process. For this part, students can conduct an investigation using materials, or go to the library to find new information to present to the class.

2. SCHEDULE THE INVESTIGATION

This part will take several sessions. Plan 1–2 weeks for students to plan and conduct their investigations (several science sessions plus time to work at home if necessary). They will need more time if you want them to design posters for their presentations.

Plan one or two sessions for students to present their projects to the class. Schedule about 5 minutes per presentation—3 minutes for the presentation, 1 minute for questions, and 1 minute for the next student to take the stage.

3. PLAN ASSESSMENT: PERFORMANCE OBSERVATION

See pages 14 and 15 of the Assessment folio for scoring guides.

4. MAKE A PROJECT IDEAS SHEET

Now is the time to pull out the project ideas folder the class has been keeping throughout the module. List students' ideas on a sheet of chart paper, along with the student questions from the content/inquiry chart, and ideas proposed in the science extensions at the end of each investigation.

5. PLAN FOR TEAMS TO WORK TOGETHER

You may wish to have each student do a project and present it to the class. Given time and equipment constraints, however, you may want students to work in pairs or groups. This decision may depend on the size of your class.

As students propose their projects, keep in mind how many containers, seeds, organisms, and so forth are in the kit and available in your classroom, so you can make sure everyone gets the necessary equipment. Some students may need to modify their project or to choose something else.

6. PLAN FOR ADDITIONAL MATERIALS

Students can conduct very successful and interesting investigations if you limit materials to those available in the Structures of Life kit. When students decide what their projects will be, decide whether you can supply them with any additional materials. Some students may want to bring materials from home or to conduct investigations like those done in class with animals they have at home.

7. KEEP A MASTER LIST OF PROJECTS

Keep a list of student teams and their projects. Students will fill out *Project Proposal* sheets, which will include all the materials they think they will need.

8. DISTRIBUTE MATERIALS

You need to keep track of all the materials students use from the Structures of Life kit to make sure all items are returned after the projects are completed. The *Project Proposal* sheet should help you do this. You can distribute materials in the usual way by putting out all materials at the materials station and letting students get what they need. Or you may wish to organize materials for specific projects in large zip bags.

9. PLAN FOR PRESENTATIONS

You might have students make a poster to use as a visual aid in their presentations. They should include the question they were investigating, drawings of the steps they took to answer the question, and the answer to their question.

The *Presentation Guidelines* sheet is meant to help students prepare. The guidelines help them focus their presentations and avoid rambling on or not having anything to say.

We suggest that you give individuals or teams 3 minutes to make their presentations. You can hold up colored cards to help them with time management. Hold up a green card for the first 2 1/2 minutes, a yellow card for the last 30 seconds, and a red card when the time is up. When the red card flashes, students must complete their sentence and end their presentation. You may want to add 1 minute for questions.

We have found that this technique helps students focus their presentations. Videotaping presentations is also very helpful. By reviewing the tapes students can work on improving their presentations.

GUIDING THE INVESTIGATION

PART 4: CHOOSING YOUR OWN INVESTIGATION

MATERIALS FOR STEP 1:

4 ***Project Ideas*** *sheets (optional)*

1. CONSIDER PROJECTS

Distribute the *Project Ideas* sheet to help students decide what they would like to investigate. Tell students that the object of doing a project is to tackle questions they still have about structures of life, and to learn something new that they can share with the class.

Tell students whether you want them to work individually, in pairs, or in groups. Then let students decide what project they would like to do.

2. IDENTIFY PROJECTS FOR RESEARCH OR INVESTIGATION

Review the project ideas by reading quickly through the list. Ask students to decide whether a question could be answered by direct investigation (observation) or by research at the library or on the Internet. Some questions may involve a little of both.

MATERIALS FOR STEP 3:

4 ***Project Proposal*** *sheets*

3. BEGIN PROJECT PROPOSALS

Have students fill out the *Project Proposal* sheet. They should write the question they are planning to investigate and a list of materials they think they will need, then give their proposal to you.

As students let you know what they want to do, guide them to make sure that they are proposing something that is realistic, respects the organisms, and will benefit the class. Also make sure that you have adequate equipment in the kit to supply each project or that you are willing to bring in additional materials. Keep a master list of students and projects.

Some students may choose an investigation that will follow changes in plants or animals over the course of days or weeks. In this case, they could present their investigation with the rest of the class, but plan to schedule a follow-up presentation later so they can present their results.

4. COMPLETE PROJECT PROPOSALS

Have students complete their project proposals by listing the steps they will take to complete their investigation. When they have thought this through and recorded their thinking, they can get started.

5. MONITOR INVESTIGATION PROGRESS

Let students work as independently as possible to complete their projects. Frequently remind them about the time they have left to complete each step. Remind them to practice their presentations and to time them to make sure they will fit into 3 minutes (if you have chosen to use this form of presentation). Give students copies of *Presentation Guidelines* to help them plan.

6. PRESENT PROJECTS TO THE CLASS

Remind students of the guidelines you have set for the presentations. Have each student or group give their presentation. Videotape the presentations if possible.

WRAPPING UP PART 4

7. REVIEW PRESENTATIONS

Students need feedback about their presentations in order to improve their performance for the next time. Review videotapes if you have them, or write a short note to each team about what they did well and a suggestion for improvement the next time they do a presentation.

MATERIALS FOR STEP 5:

*4 **Presentation Guidelines** sheets*

INTERDISCIPLINARY EXTENSIONS

LANGUAGE EXTENSIONS

- **READ *THE LIFE OF BESS BEETLES***
  After students have observed the bess beetles in class, read this story to them. The story is unfinished. Have students complete the story by adding what they know about the care of bess beetles in the classroom, and other questions they have about the beetles.

  THE LIFE OF BESS BEETLES
  Did you know that one out of every four animals in the world is a beetle? Beetles crawl. Beetles fly. Beetles dig. Beetles live all over the world, except in the very cold Antarctic. Bess beetles are a kind of beetle that is common in the eastern United States. They can be found as far north as Canada and south from Texas to Florida.

  Bess beetles are also called betsy beetles, patent leather beetles, and passalid beetles. Whichever name you choose, they all have the same structures. A bess beetle is an insect, so it has three body parts: a head, thorax, and abdomen. Each part has a strong covering. Every beetle has two pairs of wings. The hard, black, outer wings are called the *elytra.* Under the elytra are two more wings. These delicate wings fold up neatly when the bess beetle is not flying. On its head, it has a small horn, two long antennae, and two strong jaws, called mandibles. Beautiful gold fringe covers the edges of the body and two of its legs.

  Look inside an old log and you might find a group of bess beetles. A rotting stump from an elm or oak tree is their favorite place to live. Bess beetles are wood recyclers. They chew up the soft, damp wood, making tunnels as they chew. Then a fungus grows on the wood. The beetle eats the fungus that grows right inside their tunnels. Through this process bess beetles break down wood.

  Bess beetles live in a large group, but they stay in pairs to make a family. Bess beetles begin life as eggs. The parents carry the eggs through the tunnels in their mandibles. When an egg hatches, a squirmy larva emerges. The larva looks like a small worm or caterpillar. Both parents chew wood to feed to the young larva. The larva eats and grows and then goes into a resting stage, called the pupa. After time, a beetle emerges from the pupa. Young beetles stay with the family to help feed the younger brothers and

sisters. A family may live its whole life in the dark tunnels, never seeing any light.

Bess beetles have lots to say. Turn a bess beetle over and look closely when it makes sounds. Often you will see the elytra rubbing against the abdomen. Some sounds warn of danger. Some sounds help the beetles find each other in the darkness.

Bess beetles are easy to keep in a classroom...

Now finish the story by telling how you care for bess beetles in your classroom. Include observations you have made about the bess beetles or any questions you have about them.

- **PREPARE ORAL PRESENTATIONS**
  Team students up to practice the oral presentation of their projects. Peers can provide effective coaching on timing, voice projection, and keeping the presentation simple.

MATH EXTENSION

- **PROBLEM OF THE WEEK**
  Explorers just discovered a new animal in the forests of the Amazon River! Never before has anyone in the world seen this organism. They have e-mailed the following information to your class. How do you think the crail looks?

  Feet: In 9 jumps, you can make 18 footprints. (In a jump, all the feet touch the ground.) The crail can make 27 footprints.

  Legs: The crail's legs are half as long as its tail.

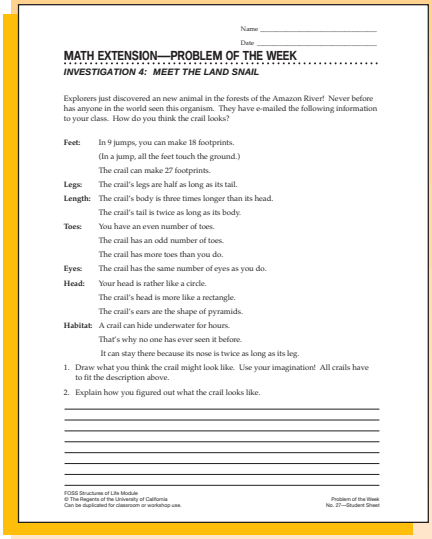
  Length: The crail's body is three times longer than its head. The crail's tail is twice as long as its body.

  Toes: You have an even number of toes. The crail has an odd number of toes. The crail has more toes than you do.

  Eyes: The crail has the same number of eyes as you do.

  Head: Your head is rather like a circle. The crail's head is more like a rectangle. The crail's ears are the shape of pyramids.

  Habitat: A crail can hide underwater for hours. That's why no one has ever seen it before. It can stay there because its nose is twice as long as its leg.



Name _____

Date _____

MATH EXTENSION—PROBLEM OF THE WEEK

INVESTIGATION 4: MEET THE LAND SNAIL

Explorers just discovered an new animal in the forests of the Amazon River! Never before has anyone in the world seen this organism. They have e-mailed the following information to your class. How do you think the crail looks?

Feet: In 9 jumps, you can make 18 footprints.
(In a jump, all the feet touch the ground.)
The crail can make 27 footprints.

Legs: The crail's legs are half as long as its tail.

Length: The crail's body is three times longer than its head.
The crail's tail is twice as long as its body.

Toes: You have an even number of toes.
The crail has an odd number of toes.
The crail has more toes than you do.

Eyes: The crail has the same number of eyes as you do.

Head: Your head is rather like a circle.
The crail's head is more like a rectangle.
The crail's ears are the shape of pyramids.

Habitat: A crail can hide underwater for hours.
That's why no one has ever seen it before.
It can stay there because its nose is twice as long as its leg.

1. Draw what you think the crail might look like. Use your imagination! All crails have to fit the description above.
2. Explain how you figured out what the crail looks like.

Problem of the Week
No. 27—Student Sheet

No. 27—Student Sheet

1. Draw what you think the crail might look like. Use your imagination! All crails have to fit the description.
2. Explain how you figured out what the crail looks like.

Notes on the Problem. The problem calls for students to bring several pieces of data together to solve a problem. They need to work with a simple fraction (1/2), multiply by 2 and 3, divide by 9, identify odd and even numbers, and understand simple geometric shapes (circle, rectangle, and pyramid). However, every problem can be solved with manipulatives.

Students could work with paper and scissors to cut body parts that agree with the descriptors. They could fold paper strips into halves and thirds to determine other proportions. They could use graph paper, counting squares to generate the shape of the crail.

Students could draw human footprints and crail footprints to determine that the crail has three feet.

Feel free to add or modify any of the directions to fit the mathematical concepts that students are presently learning.

HOME/SCHOOL CONNECTION

Families can help students with their projects in several ways. They might provide materials to help students construct equipment for their project, or they might want to help students work on a presentation poster at home. Families can also help students practice their presentations. Students should ask family members to time the presentations, check to make sure they are facing the audience (rather than the poster) when they speak, and urge them to speak loudly and clearly. Family members might also ask questions to help students prepare for questions that might be asked in the classroom.

Be sure students take home *Presentation Guidelines* so family members can help them practice for their class presentations.

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