resource room

Inquiry-based Learning with Wood Bugs

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"I was looking for a way to focus on the decomposition portion of the food chain using native decomposers and detrivores. Millipedes were fascinating, but hard to find. Instead, we kept finding hundreds of wood bugs, even in my backyard. Creating a classroom activity with wood bugs results in completely engaged students; their subsequent questions lead to all aspects of life sciences. "

THEME:

Wood bugs: A doorway to place-based inquiry

GRADE LEVEL:

Grades 1 – 4, but could extend to Grades 7 and higher

ACTIVITY:

Pre-activity:

- Students create "I wonder" questions about wood bugs
- Field trip to explore wood bugs OR:
- Create a classroom wood bug habitat and explore wood bugs in the classroom

Post-activity:

- Students answer their "I wonder" questions

Introduction

In forests, decomposers (bacteria and fungi) and detrivores (millipedes, slugs, snails and others) recycle fallen plant matter back into the soil. Looking in lush, moist places, among and or under logs and leaves is a great way to find mushrooms, banana slugs and millipedes. In second growth forests, you might also find introduced (non-native) detrivores: wood bugs and European earthworms.

Eventually, too many students looking under logs cause the logs to disintegrate and lose moisture; in turn, detrivores become scarce. Similarly, school ground forests also end up losing most of their undergrowth and leaf litter, due to trampling of the grounds. In this moisture-impoverished environment, it becomes nearly impossible to find decomposers and detrivores.

If field trips to moist lush areas or forests are not possible, an alternative is to bring the detrivores into the classroom—and "wood bugs" are an easy choice.

Trampled ground and disintegrated stump

Why Wood Bugs?

Wood bugs are non-native, plentiful, easy to maintain and easy to find compared to millipedes and slugs. And unlike the European earthworm, they have not been identified as invasive species that are harmful to local ecosystems (http://bcinvasives.ca/).

What's in a Name?

The minute students see a wood bug, they will start calling it by familiar names: Roly poly, pill bug, wood louse. But what do we mean by "wood bug?" Wood bugs belong to a very large group of crustaceans, classified as Isopoda, or more familiarly, isopods. Most isopods live in the ocean or fresh water. The common wood bugs found in BC belong to the sub-order Oniscidea, a branch of isopods that has successfully colonized land. The commonly found in moist terrestrial habitats in BC are Oniscus asellus, Porcellio scaber, and Armadillidium vulgare.

Oniscus asellus.

Porcellio scaber, aka "roly-poly". This species of isopod rolls up into a ball. The bumps have various sensory and possibly respiratory functions.

Inquiry with Wood Bugs: Start with questions

Inquiry-based learning starts with developing a student's ability to ask questions about the phenomena they experience through their senses. "It places student questions, ideas and observations at the centre of the learning experience" (edu.gov.on.ca, 2013).

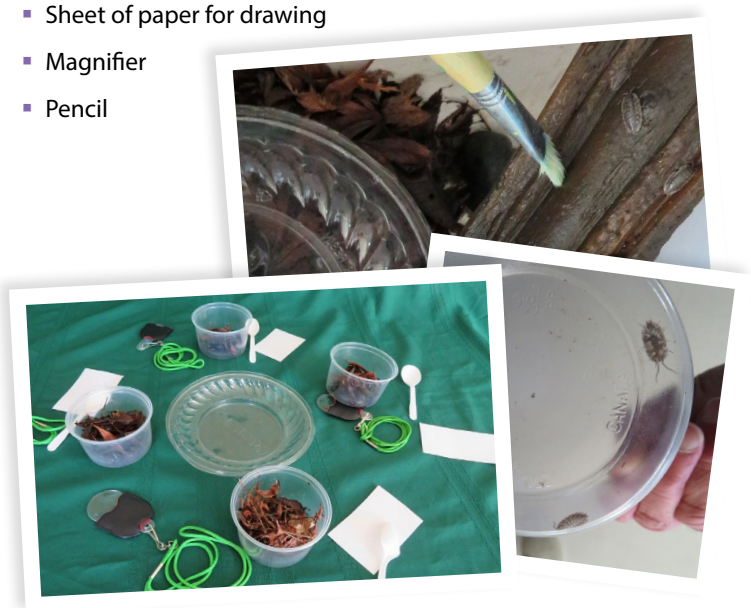
Encouraging students to come up with "I wonder…" questions about wood bugs is a powerful place from which to begin project-based and constructivist learning. The resulting questions, when developed into an inquiry process, can uncover the fascinating natural history of wood bugs and address the Big Ideas Science from to K – 7.

Materials

- Wood bug habitat (see section: Building a wood bug habitat)
- Spray bottle with water to keep leaves moist as needed
- Paint brush or spoon to transfer one or more wood bugs into each container

Equipment for each student:

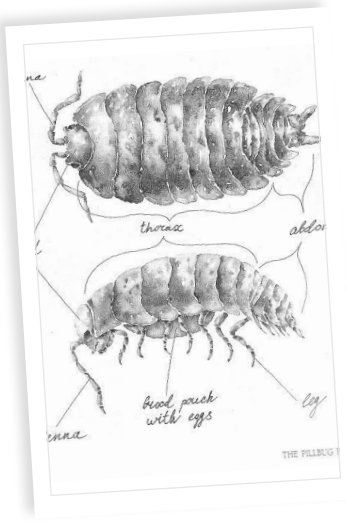
- Transparent container for each student (e.g. food grade tubs from the store or plastic water glasses)
- One larger container to store leaves for class
- Small piece of paper to help catch escaped wood bugs
- Sheet of paper for drawing
- Magnifier
- Pencil



Materials for each student. Transparent containers allow students to look through wood bugs and see more external and internal structures.

Procedure

- Ask students what makes up a forest. As they call out "trees, shrubs, streams, etc." draw a simple forest on the board
- Find out what they know about what happens to fallen logs and leaves and plant matter in the fall
- Introduce detrivores and their role. Where do they get their energy? How do they recycle matter? How does the energy flow?
- **Briefly introduce wood bugs:**
  - Not a bug – a crustacean
  - Related to shrimp and lobsters – where do those live?
  - Wood bugs breathe through simple lungs that need to be very moist, therefore need moisture in the air
  - Keep them under leaves provided
  - You can handle them gently, but not for long or they will run out of air
  - There are wood bugs that do not roll and ones that do
  - Ask if there are other names
- **Provide instructions to students:**
  - You will each get your own wood bugs in a container with leaves – the leaves are there to keep the bugs moist so they can breathe
  - To find your wood bugs among leaves, you can carefully empty your container of leaves until you just have wood bugs left. Put leaves in the leaf container provided.
  - Treat wood bugs with respect – handle gently, remember they need moisture to breathe, so don't leave them out of their leafy shelters for very long
  - Use the small sheet of paper to catch a runaway wood bug and place it back in its container
  - Draw your wood bug as you SEE it – not as you think it looks (Note to teacher: You may need to draw a simple wood bug on the board and point out some features
- Enlist helpers to hand out the materials to each student
- Allow students to experience and draw their wood bugs (about 20 minutes)
- Have misting water bottle available to moisten any leaf piles that are drying out
- Once students are finished drawing, enlist helpers to collect the wood bugs and all materials. Ensure all runaway wood bugs are also collected.

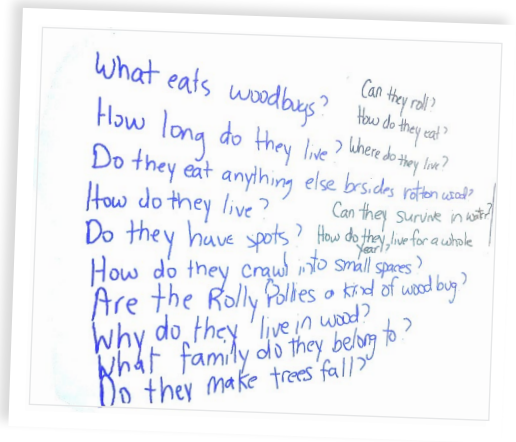


Pill bug diagram (Burnett, 1992, with permission)

Discussion

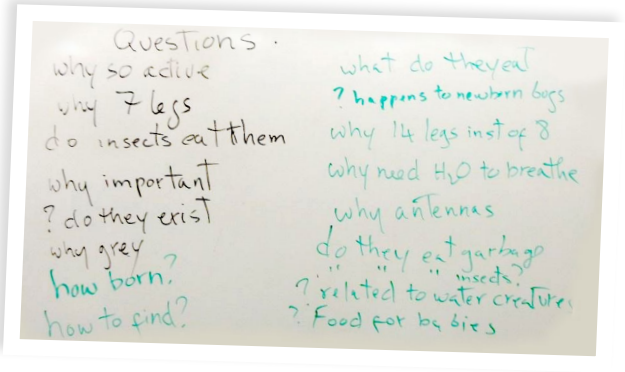
Open the discussion by asking students to share what they noticed. Then:

- Ask students what they wonder about wood bugs
- Brainstorm as many questions as come up
- Write all questions on the white board
- See if anyone can answer any of the questions
- Encourage discussion and all ideas

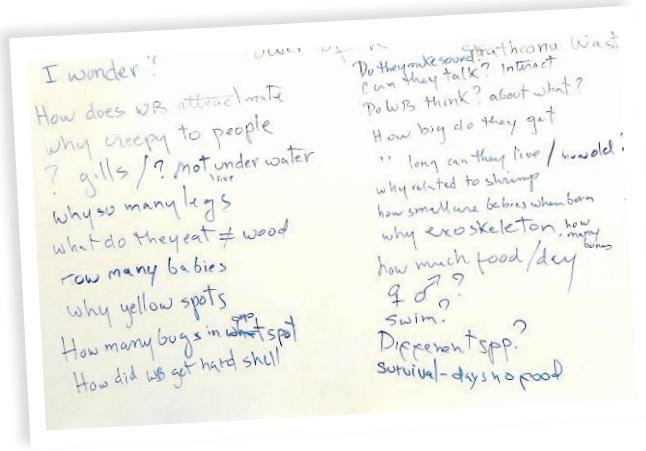


Making Connections

If desired, make connections to a specific lesson, e.g. human litter, lunch packaging, waste, food chains, ecology, morphology or evolution. Otherwise proceed to next step, "Turning Questions into Inquiry".



Grade 2/3 questions



Grade 3 questions

Turning Questions into Inquiry

Moving students from curiousity to inquiry is a process that will be unique to each class. Some common elements can be prescribed as follows.

Centre the learning experience around students' questions, ideas and observations. At all times, a respectful classroom culture is key. All students must feel comfortable contributing their ideas to the process.

Inquiry-based learning can progress along a spectrum, starting with teacher-led inquiry projects and progressing to student-led inquiry.

Below is a general procedure for follow-up on the wood bug classroom session.

- Invite students to sort their questions on their observations into categories, e.g. features, function, life cycle, interactions/habitat
- Choose which question/s to work on
- Choose whether to work in groups or as a class
- If in groups, divide the students into small groups
- Have each group share information – what they saw, what they think
- Have students/group record what they would like to know next
- Decide where to find information:
    - Books
    - Online
    - On a field trip
    - In a class project, for example:
        - Build a wood bug home /terrarium
        - Design an experiment to see what they prefer to eat
        - Design an experiment to see what type of food or shelter they prefer
    - Observe and record wood bug behaviour and make conclusions
    - Check conclusions against what is known
    - Write a report on findings
    - Decide if findings lead to more questions
    - Repeat the inquiry process as needed

Grades 1 - 4 questions sorted by Big Ideas for Life Sciences

Grade	Features	Function	Lifestyle
1/2	▪ Why seven legs? ▪ Are there males and females? ▪ Why do they have bumps? ▪ Why do they have yellow spots? ▪ Why are the eyes on their head?	▪ Do they only eat rotten wood? ▪ Do they eat dead animals and humans? ▪ How many times a day do they poop? ▪ How far/fast can they run in two minutes? ▪ How do they live? ▪ How do they crawl into small spaces? ▪ How do they eat? ▪ How do they get water under a log?	▪ How long do they live? ▪ How many eggs do they lay? ▪ How long for the eggs to hatch? ▪ How do they live for a whole year? ▪ Why do they look like kings (the big ones)?
3/4	▪ Why 14 legs instead of 8? ▪ Why do they have antennas? ▪ Why are they grey? ▪ Why do they have yellow spots? ▪ Can you tell male from female? ▪ Why do they have an exoskeleton - how many bones? ▪ Why do they have gills if they are not underwater?	▪ What do they eat? ▪ Why do they need water (moisture) to breathe? ▪ Do they eat garbage? ▪ Can they swim? ▪ Do wood bugs think? About what? ▪ Do they make a sound? Can they talk? Interact?	▪ How does a wood bug attract a mate? ▪ How are they born? ▪ What happens to the newborn babies? ▪ How do they feed babies? ▪ How small are the babies when born? ▪ Why do parents go away from babies? ▪ How big do they get? ▪ How long can they live? Or how old?

Other questions lead to the Big Ideas on evolution (when did wood bugs become a thing?) or chemistry (what are the yellow spots?).

Finding Wood Bugs

Wood bugs congregate under damp logs or rocks in second growth forests or in urban gardens. To avoid collecting in the forests and disturbing the processes of decomposition, you can create a wood bug colony in a moist, shady area in your backyard (away from strawberry plants!).

One or more pieces of wood and leaf litter should be enough to create the colony. The advantage of this method is that you can return the detrivores to where they established a colony and repeatedly borrow them for class sessions.

Other predators and detrivores may join the wood bugs in a self-sustaining, moist microhabitat.

Creating a source of wood bugs.

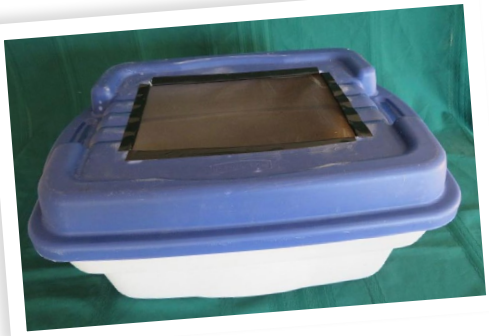
Millipedes (dark brown and pink) and a centipede (orange) joined the wood bugs under the log.

Building a Wood Bug Habitat

Once a source of wood bugs has been found or established, a habitat can be set up to ensure a supply even in very cold or very hot weather. These instructions will get you started, but you can experiment with ideal food sources, shelter material, moisture levels, number of wood bugs in order to create the ideal habitat.

- Use any plastic container with a snugly fitting lid
- Drill air holes in the lid only, or drill a large opening and affix window screen mesh using strong tape (e.g. Gorilla Tape).
- Create a substrate as food and shelter using:
    - Leaf litter (rinse well to eliminate spiders and ear wigs)
    - Small pieces of wood (not pressure treated nor painted)
    - Add a well-wrung cloth (if desired to supply moisture)
    - Spray lightly with water to ensure everything is moist, but not too wet
- Gently brush wood bugs off the bug source (using a paint brush)
- Ensure you have more than one wood bug per student
- A large tote with screen window at the top allows observation of the wood bugs without disturbing
- See-through mesh allows air in and allows wood bug observation

Using this arrangement also allows room for experiments with different food sources, shelter types or other wood bug preferences.



Sturdy plastic container with mesh on lid.

See-through mesh allows air in and allows wood bug observation.

Appendix: Wood Bug Adaptations to Living on Land

Wood bugs have developed many strategies to avoid drying out on land. Some of these adaptations show up in the visible features and behaviour of wood bugs and are reflected in students "I wonder" questions. They include:

- Reduction in size compared to marine relatives
- Make-up of cuticle including minerals (calcium) and sclerotized (hardened) proteins
- Choice of moist habitats
- Nocturnal habits
- Conglobation: Rolling up to avoid moisture loss (e.g. P. scaber).
- Aggregation or clustering under shelters to reduce moisture loss (e.g. O. asellus).
- Growth via molting of cuticle in two phases: The posterior part of the cuticle is shed first (top photo), followed by the anterior part a day later (bottom).
- Respiration through abdominal appendages (pleopods) with inwardly folded surface forming simple lungs.
- Ingestion of liquid water by the mouth and rear appendages (uropods) and of water vapour through the cuticle.
- Internal water conducting systems via capillary tubes.
- Excretion of diluted ammonia (waste) through the uropods
- Marsupium pouch to carry eggs and young, kept moist, in conditions similar to sea water via water absorption.
- Parental care for developing eggs and young is provided by seeking ideal conditions: moisture and nutrition.
- Giving birth to fully formed, miniature replicas of themselves called Manca.

Wood bug moulting; anterior part shed 24 hours later.