

Invertebrate Diversity -- Teacher Preparation Notes

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Equipment and Supplies for 15 students:

Containers to display the invertebrates in:

3 medium sized containers such as Gladware's Soup & Salad size (3 cups)

1 large sized containers such as Ziploc's large Rectangular Container (9.5 cups)

1 plastic tray or plate

Magnifying glasses or hand lenses (5-10)

Rulers (1-2)

Dechlorinated tap water²

Gloves for each student if desired

Purchase from local pet store (approximate prices)

Crayfish (1-2) \$1.79 for 2

Crickets (5) \$0.10-0.20 each

Mealworms (5) \$0.10-0.20 each

Earthworms (5) \$2.59 for 24

Mystery Snails (1-2) \$1.95 each

The set of animals above is enough for one class of approximately 15 students. You can reuse the animals all day but, depending on how many classes you teach, you may want to buy replicate sets to ensure freshness and mobility for each class. If you do not have students use gloves, make sure they wash their hands after handling the animals.

Set up 5 containers of animals in 3 stations (If you have more than 15 students you will want to have two replicate sets of stations). Have a hand lens or magnifying glass available at each station.

1. You should set out five crickets in 1-2 containers. Crickets are best viewed in a plastic bag that is expanded to full volume (either the bag they come in from the pet store or a plastic storage bag). However, you cannot keep them in a sealed bag overnight and must store them in a different covered container with a screen on top. Alternatively, you can display the crickets in a plastic container. Poke air holes in the bottom of 1-2 medium containers, place the crickets in the containers, put the lid, and place it upside down. Be careful the crickets don't jump away during transfer.
2. Place 5 mealworms in a medium container. Place 5 earthworms on a damp paper towel on the tray or plate. Have 1 or 2 rulers available at this station. When the students are not actively observing the earthworms it is **very** important to keep them moist by covering them with a wet paper towel.
3. Place 1-2 crayfish in a large uncovered container filled with dechlorinated tap water. Place 1-2 snails in a medium uncovered container filled with dechlorinated tap water. If you can find a container that is tall and skinny, it would be better than one that is short and wide. A tall and skinny container will minimize the time the snail can spend with its foot on the bottom of the container, out of view of the students. It is important that the students do not touch the snails until everyone has observed them. Touching the snails tends to make them hide in their shells and it takes 45-60 minutes for them to reemerge.

¹ These teacher preparation notes and the related student handout are available at http://serendip.brynmawr.edu/sci_edu/waldron.

² You can dechlorinate tap water by leaving it out in the open containers overnight or by adding a commercial dechlorinator used for aquarium water. Alternatively, you can ask for extra from the pet store.

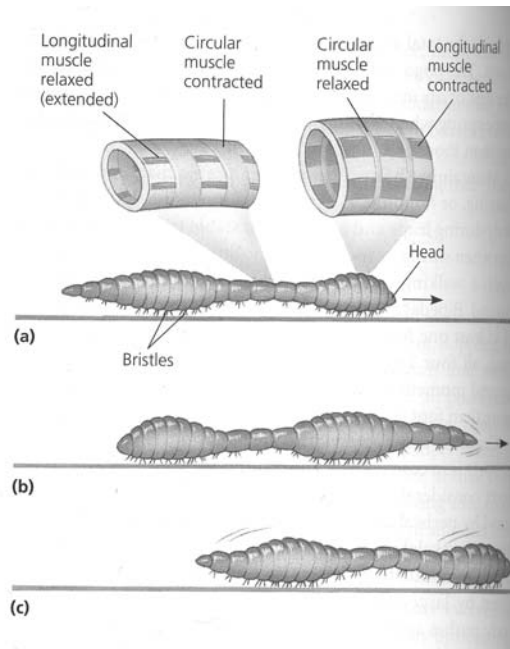
Suggestions for Discussion

Name	Earthworm	Snail	Cricket	Mealworm	Crayfish
Phylum	Annelida	Mollusca	Arthropoda	Arthropoda	Arthropoda
Symmetry	Bilateral	*	Bilateral	Bilateral	Bilateral
Other aspects of body form	segmentation visible, clitellum	tentacles, mouth, eyes on stalks	legs, wings, eyes, antennae	legs, segmentation visible	eyes, abdomen, legs, chelipeds (claws)
How does the animal move?	hydrostatic skeleton; alternating shortening and elongating of different segments	waves of muscular contraction in the muscular foot	wings and legs	Legs on the front of the body	Swims backwards with tail, walks forward on legs

* A snail is asymmetrical, since the bilaterally symmetric embryo twists as the snail develops. However, the snail retains one of the most important characteristics of **bilaterally symmetric** animals, namely a concentration of sensory organs at the head end of the animal, which allows the animal to gather information about the environment it is moving toward. In contrast, radial symmetry is observed in organisms like jellyfish or hydra which drift slowly through the environment or are sessile; radial symmetry is associated with sensory organs distributed around the circumference which receive sensory information from all directions.

The following figure from Biology 6th Edition by Campbell and Reece may be helpful for clarifying student observations concerning **earthworm locomotion**.

FIGURE 49.27 Peristaltic locomotion in an earthworm. A hydrostatic skeleton, two sets of muscles (one elongating the body, the other shortening it), and bristles holding to the substrate enable an earthworm to crawl over moist ground or burrow through it. Contraction of longitudinal muscles thickens and shortens the worm, while contraction of circular muscles constricts and elongates it. **(a)** As the worm crawls forward, body segments at its head and in front of the tail are short and thick (longitudinal muscles contracted; circular muscles relaxed) and anchored to the ground by bristles. Behind the head and at the tail, segments are thin and elongated (circular muscles contracted; longitudinal relaxed). **(b)** The head has moved forward because circular muscles in the head segments have contracted. Segments behind the head and in front of the tail are now thick and anchored, thus preventing the worm from slipping backward. **(c)** The head segments are thick again and anchored in their new position. The rear segments have released their hold on the ground and have been pulled forward.



For the **comparison between earthworms and mealworms** and for discussion question 3, you may want to make a contrast between phylogenetic categories and common usage, non-phylogenetic categories such as worms (animals with one dimension much longer than the other two). A phylogenetic category, such as a phylum, groups animals that share a common evolutionary ancestor. Evolutionary relatedness is judged based on characteristics that often are not obvious from the outside, so animals that look similar but have very different internal

anatomy may be grouped in different phyla (e.g. flatworms, roundworms, and segmented worms). In contrast, animals that have very different external appearance may be grouped in the same phylum (including larval forms such as mealworms and caterpillars obviously grouped with adult insects in Arthropod phylum). If your students have studied homology and analogy, you may want to link the discussion of phylogenetic categories to homology (due to shared evolutionary ancestors) vs. similar appearance due to analogy (due to convergent evolution).

You may want to contrast the type of development in mealworms/Darkling beetles (complete metamorphosis) versus in crickets (incomplete metamorphosis). Complete metamorphosis is observed in insects where the larval stages look completely different from the adult (e.g. mealworms or caterpillars) and the transformation from the largest larva to adult occurs in a pupa; the larval stages are specialized for eating and growing and the adult stage is specialized for dispersal and reproduction. Incomplete metamorphosis is observed in insects like crickets where the young resemble the adults, although they lack wings; each molt produces a larger insect with more nearly adult body proportions, and the final molt produces an insect with wings and mature reproductive organs.

For additional morphological and ecological information and tips on keeping the animals alive in your classroom see the following websites:

Cricket, *Acheta domestica* <http://insected.arizona.edu/home.htm> (click on “Using live insects in elementary classrooms”, then click on Information or Rearing sheets)

Mealworm, larvae of *Tenebrio molitor* <http://insected.arizona.edu/home.htm>

Mystery snail, *Pomacea bridgesi* <http://www.applesnail.net/> (mystery snails are a common type of apple snail sold in pet stores)

Crayfish http://www.carolina.com/life_science/crayfish.asp

Earthworm <http://www.carolina.com/tips/04pdfs/Jan04tips.pdf>