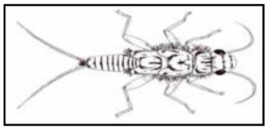
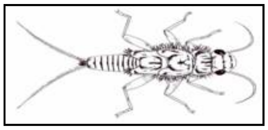
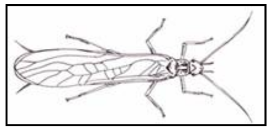
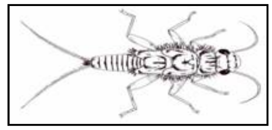
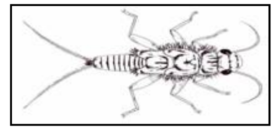
    

Appendix F: Discussion Questions

1. Why are aquatic macroinvertebrates important in a stream, river, or lake?

   Aquatic macroinvertebrates are important for several reasons. First, they are an important part of the food chain. Many other organisms, such as fish, birds, and other invertebrates depend on them as a food source. Also, some macroinvertebrates play a role in breaking down plant matter that falls into and/or grows in the stream. These insects either rip apart and eat plants, or they graze on the algae that grows on the streambed.

   Invertebrates are also used as an indicator of water quality. Because some invertebrates are sensitive to pollution, their absence in a stream system may indicate a pollution problem. This is not always the case because other factors can influence the absence of certain invertebrates. For example, stoneflies, an indicator of good water quality, can only survive in cold, clear, running water. We may not find stoneflies in large, slow rivers low in the watershed because the water temperature is naturally too warm for stoneflies. This does not mean the water quality is poor, only the natural system cannot support stoneflies.

2. Why do some types of organisms seem to be more sensitive to pollutants than others?

   This question doesn't have one simple answer, but it's an interesting opportunity to discuss the differences in these organisms.

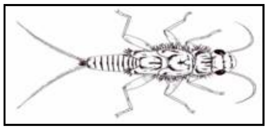
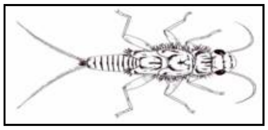
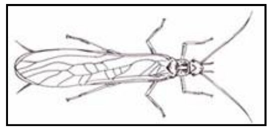
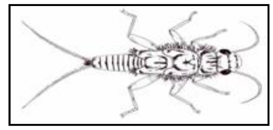
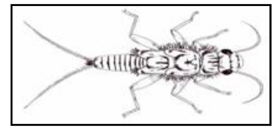
   More tolerant organisms may be those that evolved under more diverse conditions, and therefore are now able to handle a wider range of conditions. Animals that evolved under very unique or non-varying conditions may have very narrow ranges of tolerance to change.

3. What organisms depend on aquatic macroinvertebrates?

   Aquatic macroinvertebrates are an important part of the food chain. Other organisms such as fish, birds, some mammals and other invertebrates depend on them for their food supply. Some organisms, such as birds and fish depend directly on invertebrates because they eat them. However, other organisms such as large mammals depend on them indirectly because they eat the birds and fish that feed on invertebrates.

4. Do aquatic macroinvertebrates spend their whole life in the water?

   Some macroinvertebrates complete their life cycle in a few weeks; others may live for several years. Usually, just the larvae stage of an insect's life is spent in the water. These insects include mayflies, stoneflies, caddisflies, craneflies, and some water beetles. Most of them spend 1-2 years in the water as larvae and then only 1-14 days on land as adults. Some insects, such as the water boatmen and backswimmers, spend their whole lives in the water and do not undergo metamorphosis. Most non-insect macroinvertebrates, such as amphipods (scuds), gastropods (snails), and bivalves (clams and mussels) spend their entire life in the water.

5. What is metamorphosis?

Metamorphosis is a process in which an animal physically develops and changes in two or more distinct stages during its life cycle. Complete metamorphosis consists of 4 stages - egg, larva, pupa and adult. Examples of complete metamorphosis include a butterfly, a caddisfly, or blackfly. For insects that go through complete metamorphosis the larva and adult stages look very different. The larva stage is often worm or caterpillar like. An incomplete metamorphosis consists of only three stages – egg, larva, and adult. Examples, of an incomplete metamorphosis include a grasshopper, a stonefly or a mayfly. The larva often looks similar to the adult and may be called a nymph.

6. How do macroinvertebrates breathe in the water?

Different macroinvertebrates have developed several different adaptations for breathing. Invertebrates such as mayflies, stoneflies, and caddisflies have gills for obtaining dissolved oxygen directly from the water. Mosquito larva and some fly larva have slender breathing tubes that can extend past the water surface to obtain oxygen from the air. Other insects, like the waterboatmen, swim to the surface and trap an air bubble on the underside of their abdomen and obtain oxygen from this bubble. They must live in still or slow moving water in order to easily resurface for more air.

7. Why is it important for macroinvertebrates to have different feeding habits?

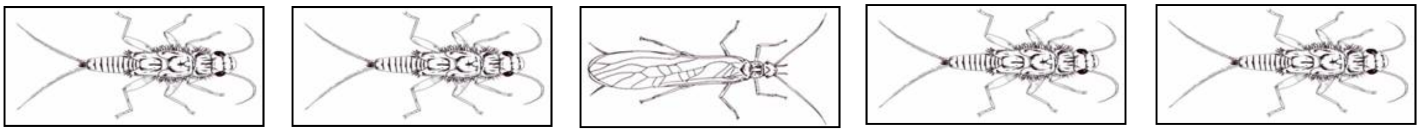
It is important to have different feeding habits so that one river system can support a wide variety of organisms. If all invertebrates were scrapers, a river could not support a large community. Also, some feeding groups benefit from the action of other feeding groups. As stoneflies shred large leaves, some leaf particles float downstream and may be caught in a caddisfly's net.

Invertebrates help break down and process plant and animal matter that fall into or grow in a stream. If there were no scrapers to eat algae, the streambed would become covered with algae and other water plants.

8. What are natural and human influences that cause changes in macroinvertebrate populations?

Macroinvertebrate populations can change naturally with the seasons.

Human influences that can cause changes include any type of development or land use in the watershed that impacts water quality. These activities can be logging, construction, agriculture, recreation, housing developments, or road building. It is important to remember that these activities are not always bad, however, when they are poorly managed they can have a negative impact the water quality.



9. Where do aquatic macroinvertebrates make their home in the water?

   Streams, rivers, and ponds are made up of different microhabitats. In a stream, these microhabitats include the substrate, the sediments below the substrate, the river channel, the top of large rocks in the river, the edge waters, and the emergent vegetation near the edge. Ponds have similar microhabitats. Different macroinvertebrates make their home in different microhabitats and have specific adaptations to live successfully in these microhabitats. Their specific habitats must have food available and offer places of refuge from predators. Mayflies are scrapers/grazers; they scrape algae off the top of rocks for their food source. They spend their time clinging to the tops of rocks to find food and crawling between rocks on the substrate for refuge. Caddisflies are filter feeders; they builts nets or use long hairs on their legs to filter food from the current. They also spend their time on top of and between rocks where they have access to flowing water. Dragonflies are predators and typically lie in wait to ambush their prey. They cling to the emergent vegetation and wait for smaller insects.

10. What is the difference between point source and non-point source pollution?

    Point source pollution is from a single source that can easily be identified or pinpointed as the source of pollution. Examples include an industrial factory, a feed lot, or a wastewater treatment plant. Non-point source pollution comes from a large area of land where there are many contributors to the same pollution. Examples include urban runoff, agricultural fields, and housing developments.

    Point source pollution is easy to regulate because it is easy to identify where the pollution is coming from and where it is entering the rivers or streams. It is also easy to measure the amount of pollution entering a waterbody from a point source. Non-point source, on the other hand, is very difficult to regulate.

11. What are functional feeding groups?

    Functional feeding groups refer to a characterization based on how an invertebrate obtains food. The functional feeding groups are:

    Shredders: These organisms eat large pieces of leaves and other vegetation by shredding them apart.

    Filter Feeders: These organisms filter small particles out of the current using nets or hairs on their legs.

    Grazers/scrapers: These organisms feed by scraping algae off of rocks.

    Collectors/gatherers: These organisms crawl around picking up small pieces of debris on the bottom of the stream.

    Piercers: These organisms pierce their food source (often large plant stems).

    Predators: These organisms eat other insects and /or animals.