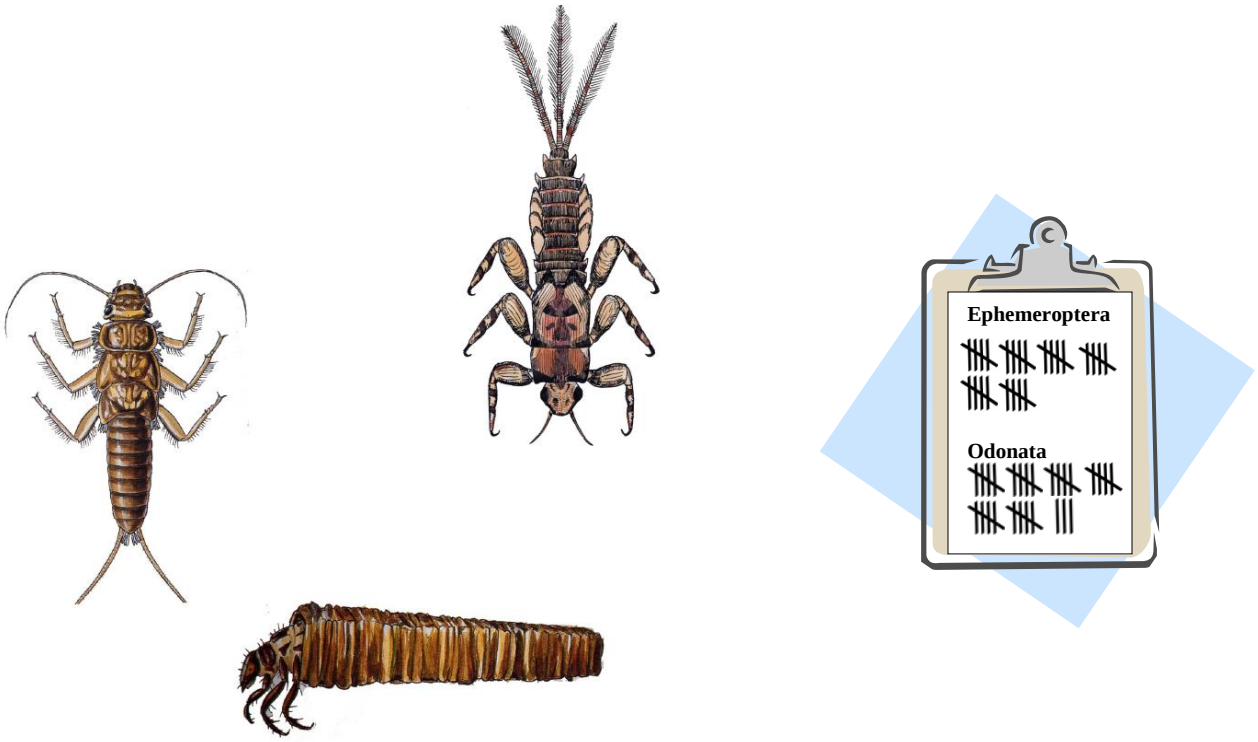
Who Lives in the Water?

Students explore diversity and adaptation to aquatic environments by observing aquatic macroinvertebrates collected in a stream.



This lesson is a part of Stream Side Science, a series of lesson plans developed for and assessed by teachers. Stream Side Science is effective at teaching students about water science by using hands on stream monitoring and classroom activities.

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UtahStateUniversity
WATER QUALITY EXTENSION

Revised June 2012

Who Lives in the Water?

Duration:
Classroom
20 minutes
Outdoors
50 minutes
+travel time

Setting:
Classroom
Outdoors

Purpose:

To investigate the diversity in a specific area through observation and charting.

Summary:

In this exercise, students will collect and observe macroinvertebrates in an aquatic system. They will record and summarize their findings.

Background:

For background information see the macroinvertebrate section of the Utah Stream Team Manual for information about macroinvertebrates and natural and human influence on macroinvertebrate populations.

Materials:

- Kick nets*
- Plastic pans*
- Transfer pipettes*
- Magnifying glasses*
- Copies of student worksheet
- Macroinvertebrate keys and photos*
- Copies of macroinvertebrate sampling instructions
- Bucket
- Pencils
- Clipboards
- Plastic petri dishes*
- Waders

* For information on equipment for loan or for purchase, contact USU Water Quality Extension at (435) 797-2580 or www.extension.usu.edu/waterquality

If you wish to preserve samples:

- Ethanol or isopropyl alcohol (70% alcohol, 30% water)
- Small glass vials*

Classroom Activity:

1. Tell your students this activity will focus on the diversity of macroinvertebrates found in an aquatic ecosystem.
   a. Ask the students to define the term aquatic macroinvertebrate. *(An organism that is large enough to see with the naked eye, and has no backbone.)*
   b. Ask the students to define the term diversity. *(The number of different species found in an area.)*

c. Have students compare two different stream types (e.g., a small fast moving stream versus a large slow stream). Ask students what adaptations organisms would need to allow them to live in each environment. Why would the adaptations differ? *(Examples include: external conditions such as climate; the degree to which a system is isolated from other areas; different types of physical habitats; condition of the water, including chemical conditions, temperature, clarity, velocity, depth, food availability, and presence of predators).*

2. Review common macroinvertebrates found in your area with the students. Be sure they are familiar with the keys they will be using in the field. If you would like a larger, laminated version of the key provided in the Resource pages, please contact USU Water Quality Extension at (435) 797-2580.

3. Review instructions for sampling and processing macroinvertebrates with your students before they go into the field.

Field Activity:

1. Set up stations for sampling macroinvertebrates (if possible set up enough stations to have about five students at each). These areas should be easily accessible and should represent different conditions, such as different substrates (pebble, cobble, or silt), different flow conditions (running water or still backwater), or areas with leaf and woody debris.

Each station should include:

- Sampling instruction sheets (it helps to laminate these!)
- Waders
- Kick net
- Plastic pan
- Transfer pipettes
- Magnifying glasses
- Petri dishes
- Macroinvertebrate keys

Safety First!
Always consider safety factors when working near water.

2. Demonstrate with two students how to safely collect samples with a kick net.

3. Divide the students into groups. Provide each group with clipboards, pencils, and student worksheets. Each group will sample at a different station.

Remind the student to observe the behaviors and adaptations of the macroinvertebrates. How do they move? How do they eat? Are they adapted for one area over another?

4. At each station, the students will put the samples into plastic pans and sort them with transfer pipettes and petri dishes.

5. Have the students follow the instructions for sampling and sorting macroinvertebrates on the macroinvertebrate sampling sheet.

6. Have the students record their results onto the macroinvertebrate worksheet. You can choose to have one record keeper per group, or have each student record all the information.

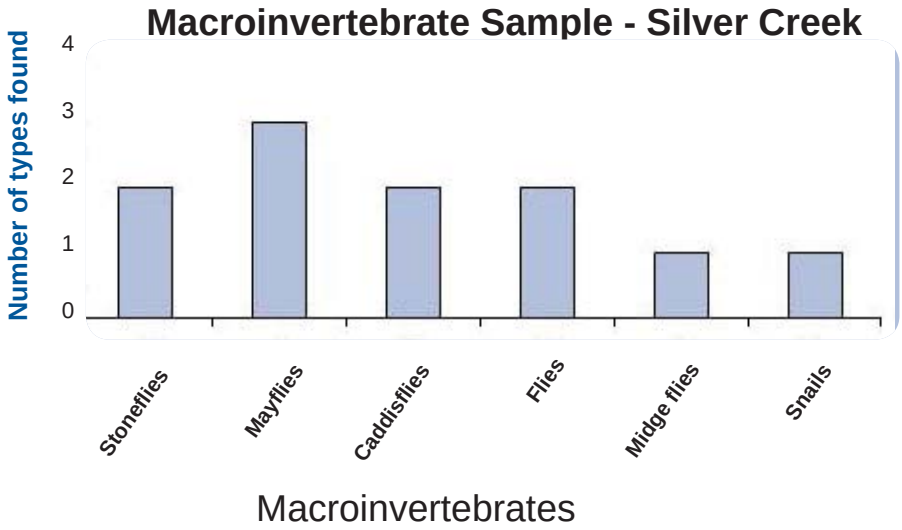
7. You may want to preserve some macroinvertebrates to keep in the classroom. To do this, place the macroinvertebrate into a glass vial or collection bottle and fill with 70% alcohol and 30% water.

ACTIVITY EXTENSIONS:

- Use other water sources or other locations along a single river or stream to compare results (see the activity Wetland versus Stream Macroinvertebrates).
- Sample the same stations on multiple dates to compare results.
- Research factors that would contribute to a decline in the diversity of macroinvertebrates (refer back to the activity What's in the Water? and/or see the activity Missing Macroinvertebrates).

Applying the Data:

- Have the students calculate the diversity for each area they sampled. The simplest method is to count the number of different types of organism in each sample. See the Further Discussion section below for other thoughts on diversity calculations.
- Have students present data in tables or graphs (see example below).
- Compare results from different sites.



This graph shows the diversity of macroinvertebrates at Silver Creek.

Further Discussion:

1. What habitats had the greatest diversity? What habitats had the lowest diversity? Why?

More diverse aquatic habitats provide more niches or microhabitats that specialized organisms may inhabit. Therefore, cobble bottomed streams may have more types of organisms living in them than a silt bottomed backwater. Keep in mind, however, that many other factors may affect the diversity you observe. The absence or presence of predators can greatly affect diversity and food availability may restrict certain types of organisms. In addition, many aquatic organisms are susceptible to water pollutants or even to increases in water temperature. In these situations, so-called "pollution tolerant" species may be all you will see. Refer to the Missing Macroinvertebrates lesson plan for more specifics on pollution tolerance.

2. How might water pollution affect the diversity you observed?

Typically, in polluted water, many sensitive species will disappear. Often these systems will still have a high abundance of organisms, and may even have higher total abundance of organisms than "pristine" systems, but the number of different types of species is greatly reduced.

3. How do adaptations of the insects allow them to inhabit different niches in an aquatic ecosystem?

The organisms you collect display an array of adaptations to their unique environment. For example, most organisms you collect in fast moving water either have clawed feet for holding on, have a very streamlined body, or may have some means of attaching to the rocks. Organisms found in soft silt in quiet waters may experience low oxygen conditions. You may find "blood worms," which are dipteran fly larvae. The red color is from hemoglobin, which helps these organisms trap oxygen when there isn't much around.

4. Would you expect to find similar degrees of diversity and similar adaptations to similar habitats in other parts of the world?

Probably, all else being equal, you might expect the same level of diversity in similar situations. The level of diversity is one ecological measure that scientists use worldwide to compare systems.

5. Would you expect to find the exact same species (types) of organisms?

The actual species present would probably be very different, and would reflect the evolutionary history of that particular continent or region.

6. What is the best way to express diversity in an ecosystem?

There are many different diversity indices (a numeric value representing diversity). The simplest diversity index is simply the number of species found at a site. Other more complicated diversity indices weigh the index according to the number of individuals found for each species.
For example, a class collects two samples with 10 species each. However, Sample 1 had 91 individuals of one species and only 1 individual of each other species while sample 2 had 10 individuals of each species. Are these equally diverse?

Notes

Macroinvertebrate Worksheet

Name: _____ Group #: _____
Date: _____ Site ID: _____

MACROINVERTEBRATES	TALLY OF TYPES OF INDIVIDUALS
Ephemeroptera (mayflies)	
Odonata (dragonflies and damselflies)	
Plecoptera (stoneflies)	
Trichoptera (caddisflies)	
Diptera (flies)	
Megaloptera (fishflies and dobsonflies)	
Coleptera (beetles)	
Amphipoda (shrimp and scuds)	
Ispoda (sow bugs)	
Decapoda (crayfish)	
Catropoda (snails)	
Pelecypoda (mussels and clams)	
Oligochaeta (all segmented worms except leeches)	
Hirudinea (leeches)	
Other	

Macroinvertebrate Sampling

Time – 40 minutes
Persons – 2
Materials -
- kick net
- plastic pan
- transfer pipettes
- plastic petri dishes
- magnifying glasses
- dichotomous key
- ruler

OPTIONAL
- 5 gallon bucket for decanting
- waders

Step 1 - Choose your sample site

Select sampling reaches that are safe and easily accessed by everyone in your group. A riffle will offer the best variety of organisms.

Step 2 - Collect your sample

If you are sampling in flowing water:
1. Wade into the stream and place your net so the mouth of the net is perpendicular to and facing the flow of water.
2. Stand upstream of the net and disturb the stream bottom with your feet and hands.
3. Carefully pick up and rub stones directly in front of the net to remove attached organisms. The stream bottom material and organisms will be carried by the current into the net. If the rocks are lodged in the stream bottom, rub them vigorously, concentrating your effort on any cracks or indentations.
4. After removing all large stones, disturb the sand and gravel to a depth of about 3 inches by raking and stirring with your hands.
5. Continue this process until you can see no additional animals or organic matter being washed into the net.

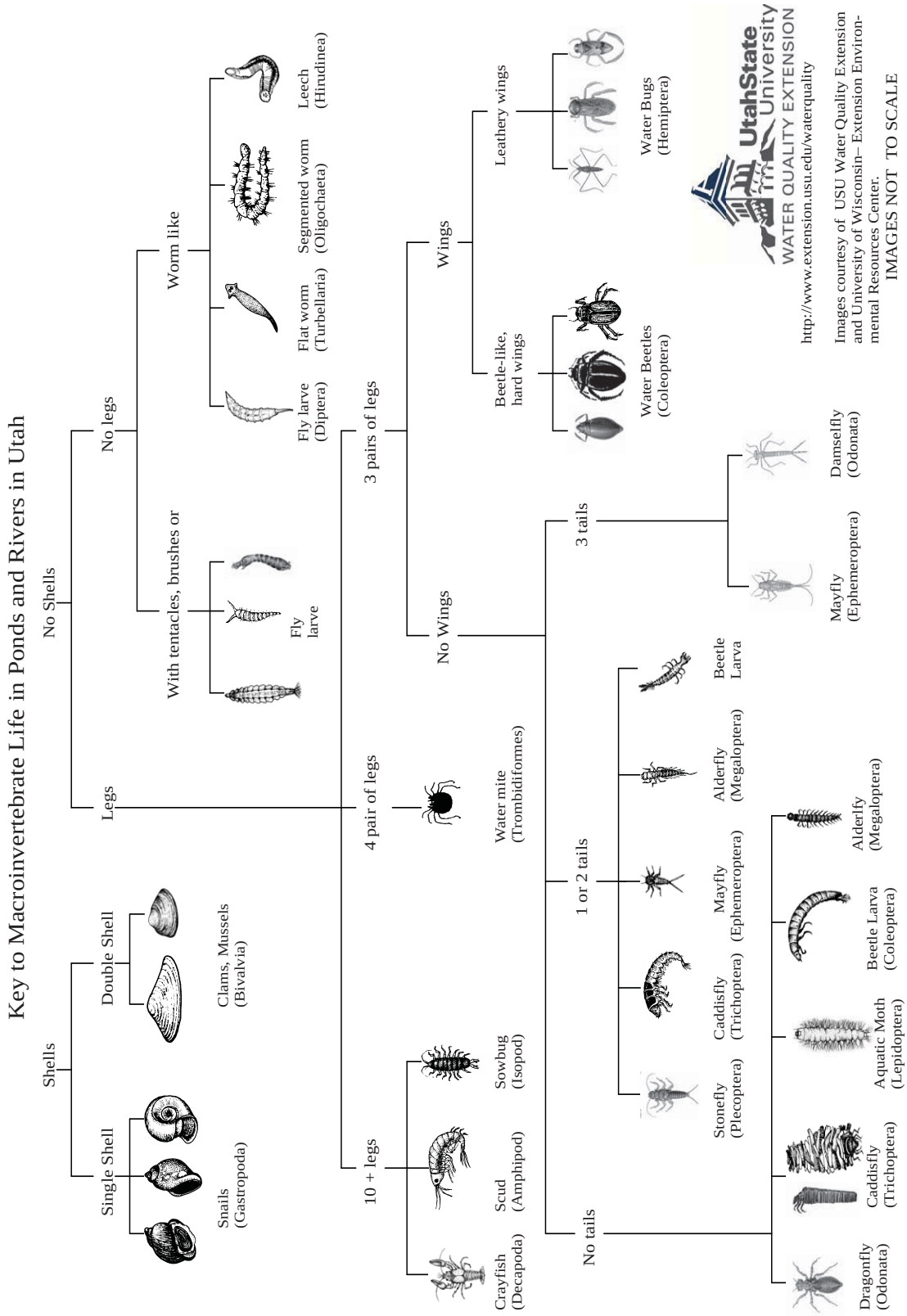
If you are sampling in pools or highly-vegetated areas:
1. Scoop material from the stream bottom with the net. Try to scoop up as little sediment as possible as this will make it difficult to sort the macroinvertebrates.
2. Push and pull the net through aquatic vegetation.
3. Hand pick organisms from sticks and other structures.
4. Continue until you have at least 100 organisms.

Step 3 - Empty your sample

1. Hold your sampling net over a plastic pan and use a bucket of stream water to wash the material into the pan.
2. If your sample contains a lot of rocks or debris, stir the sample in the pan to suspend the animals, then pour the suspended material back into your net. Rinse the debris from the pan, then wash the animals in the net back into the pan.

Macroinvertebrate Sampling (Continued)

Step 4 – Sort out 100 macroinvertebrates.

1. Pour most of the water from the pan, so that the materials and animals are no longer floating. Distribute the material evenly in the bottom of the pan.
2. Take a ruler and divide the material in half. Remove one half of the material from the pan.
3. Redistribute the material again over the bottom of the pan and divide this material again with a ruler.
4. Continue this process until you have a sample with about 100 organisms total.
5. Add some stream water back into the pan for easier sorting.
6. Sort and identify the macroinvertebrates. Use petri dishes to group similar organisms.
7. Keep track of the number of types of organisms on the macroinvertebrate worksheet. For example, if you collect two mayflies, but they have distinct differences, record that you have two types of mayflies.

Key to Aquatic Invertebrates in Utah