

### Lesson 3: Macro Feeding Frenzie

#### Lesson Summary:

Students will be introduced to the feeding adaptations found in aquatic macroinvertebrates. After a short introduction students will play a game and do an activity to learn more about the functional feeding groups.

#### Materials:

- Lesson 4 PPT
- Colorful large beads-four colors such as blue, green, red, and orange
- String, yarn, or hemp
- Various items to represent feeding strategies and food such as:
  - Plastic knives and spoons
  - Paper towels, tissues, napkins, or Leaves
  - Pieces of wood or twigs
  - Cheese cloth or other net-like material
  - Micro pipettes
  - Couscous or another small grain
  - Large beans or marbles
  - Sandpaper
  - Small bowls
  - Mixing bowl with water
  - Marshmallows

#### Knowledge and Skills developed:

- Students will learn about the four functional feeding groups in macroinvertebrates.
- Students will learn about the different feeding mechanisms of macroinvertebrates.

#### Next Generation Science Standards

<b><u>Practices</u></b>	<b><u>Crosscutting Concepts</u></b>
<input type="checkbox"/> Asking questions	<input type="checkbox"/> Patterns
<input type="checkbox"/> Developing and using models	<input type="checkbox"/> Cause and effect: Mechanism / explanation
<input type="checkbox"/> Planning / carrying out investigations	<input type="checkbox"/> Scale, proportion, and quantity
<input type="checkbox"/> Analyzing / interpreting data	<input type="checkbox"/> Systems and system models
<input type="checkbox"/> Math / computational thinking	<input type="checkbox"/> Energy / matter: Flows, cycles, conservation
<input type="checkbox"/> Constructing explanations	X Structure and function
<input type="checkbox"/> Engaging in argument from evidence	<input type="checkbox"/> Stability and change
<input type="checkbox"/> Obtaining / evaluate / communicate	

## **Disciplinary Core Ideas and Concepts**

### **3-LS4.C: Adaptation**

- For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all.

## **Environmental Literacy Strands**

### **2. Physical, living and human systems**

- b. Structure, function, interaction and change in living systems. Explain the dynamic and interconnected nature of Earth's living systems

### **Teacher Background Information:**

Many different species of macroinvertebrates inhabit all the different areas of the waterways. Different areas of a stream will have a host of different factors (sunlight, speed, dissolved oxygen, etc.). For each combination of these factors is a specific niche, and for each niche there is a species of macroinvertebrate that calls this home. Aquatic insects have specialized adaptations for the aquatic environment and fit into functional feeding groups based on their body structures and mechanisms that they use to acquire food. Keep in mind that some fall into more than one group.

SHREDDERS use chewing mouthparts (mandibles) to bite into large pieces of organic material such as leaf litter and wood. Most also have an upper and lower lip to help keep food in their mouths. They prefer food that has been softened and pre-conditioned by microorganisms (fungi and bacteria), and often leave veins and other finer material behind for the eating pleasure of their fellow macroinvertebrates! Some, like the caddisfly, use gravel to make a home or case. Examples of shredders are crane fly larvae, case-building caddisfly larvae, stonefly nymphs, scuds, and sowbugs.

COLLECTORS dine on smaller organic particles, usually less than one millimeter in diameter. Sometimes fecal matter left from other organisms may be on the menu. They eat algae and fragments of animals and plants. When you pick up a rock, sometimes you feel mucous on it. You could be looking at a filtering collector, capturing particles by using a fan (black fly larvae) or spinning a net (free-living caddisfly) made of a sticky substance. These mechanisms help them strain and filter for food particles suspended in the water. Who will help decompose material on the stream bottom? Gathering collectors, such as mayfly nymphs and beetle larvae, are anatomically designed (mouths and appendages) to burrow and live in lower substrate. As they burrow through the bottom of the substrate they swallow sediment and fine detritus. Examples of collectors are mussels, brush-legged mayfly larvae, net-spinning caddisfly larvae, midges, and blackfly larvae.

GRAZERS or SCRAPERS eat algae from rock and stream surfaces. They use mouth parts with sharp angular edges, to scrape off the algae. Then other finger-like mouth parts sweep the algae into their mouth. Algae needs sunlight to grow so grazers are often found in more open, faster moving areas of the stream. Many have adapted with flat, streamlined bodies, or suction disks on their abdomens that keep them from being swept downstream in swift currents. Snails and some mayfly nymphs fall into

this category. Examples of scrapers include snails, flathead mayfly larvae, water pennies, beetle larvae, and stone case-building caddisfly larvae.

PREDATORS are perfectly adapted eating machines. Some capture other aquatic insects by grasping with forelegs, and biting and chewing with strong opposable mouthparts. Others use tube-like mouthparts to suck body fluids from their prey (piercers), or just swallow their meal whole and alive, using large, pointy jaws to attack and tear prey into smaller pieces if necessary (engulfers). Examples of predators are dobsonfly and fishfly larvae, crayfish, beetles, water bugs, dragonfly nymphs, and some stoneflies.

The detritus and microorganism supply is processed by different functional feeding groups in a series of steps. The first step is to break down the large leaf matter, called CPOM (coarse particulate organic matter), into fine particulate organic matter, or FPOM, this is accomplished by shredders, a group of macroinvertebrates with specially adapted anatomy, such as pinchers, to tear apart and eat the fibrous leaves.

As they feed on the CPOM, the FPOM produced floats downstream and eventually into the devices of collectors. Collectors filter the water in the stream for FPOM by using hairy gills or legs, or in other cases by spinning a web. Gatherer collectors obtain the FPOM from the stream bottom.

Aquatic insects are located in waterways according to what they eat. Shredders can be found in upper reaches of streams where there is abundant vegetation. Scrapers prefer open areas or after leaf fall, when sunlight can penetrate the stream and reach the larger substrate to photosynthesize algae. They are typically found in riffles with filtering collectors. Gathering collectors prefer slower areas where sediments are allowed to accumulate. Predators are on the prowl in all aquatic habitats.

### **Preparation:**

Stations will be created using various items to represent food in the stream that students will try to 'feed' upon by using various utensils that represent the different feeding strategies. Make sure there are enough materials for all students to participate at each station. You may also want to spread stations around the room to ensure enough space at each one. Use station labels provided at the end of this lesson.

- **Station 1-Shredder:** Set out several paper towels or leaves for students to shred at this station (2 plastic knives will be the best tool here); **Label as headwaters.**
- **Station 2-Collector:** Set out a bowl of water, with couscous or a tiny grain, and tiny marshmallows (both netting and pipettes will be the best tools here; spoons, or predators will also do well here); **Label as pools/bottom waters.**
- **Station 3-Grazer:** Set out several pieces of wood and twigs (sandpaper will be the best tool here); **Label as riffles.**
- **Station 4-Predator:** Set out a bowl of large beans (spoons will be the best tool here). **Label as run/all habitats**

Students will take colored beads based upon their feeding success. Color code beads so that they match certain areas of the stream, for example, blue=head waters, orange=riffles, green=runs and/or deep water, and red=pools.

- **3 beads-** Has the best tools for this food source (10+ food items, or about a thumbnail's worth of wood shavings at station 3).
- **2 beads-** Not the best tools but was able to collect some food (5-9 food items, or a pinky's worth of shavings at station 3).
- **0 beads-** Did not work at all.

### Introduction:

Let students know that while the leaf packs they created are out in the stream they are going to continue learning about macroinvertebrates. This lesson will introduce them to the different ways that macroinvertebrates are grouped based on how they eat.

### Procedure:

1. Ask the students to think about and discuss at tables what macroinvertebrates eat. Have them share out a couple of ideas.
  - Do all the macroinvertebrates share a single food source? Why? **Have students think about other animals that they are more familiar with such as birds. Macroinvertebrates do not all have the same diet, macroinvertebrates are grouped into four functional feeding groups, based on feeding adaptations, all of them feeding on different things. Thus, macroinvertebrates are not directly competing for a food source, allowing more types of organisms to live in the same area of the stream.**
2. Onto the board or poster paper write the four feeding groups: grazers, shredders, collectors, and predators; have the students brainstorm how each might eat based on the names of the group. Then have students think of adaptations that each feeding group might have to help them eat.
3. Use the Lesson 4 PowerPoint to go over the definition of each functional feeding group and to show students the different adaptations. Have students observe pictures and make predications about which group each macroinvertebrate would fall into.
4. Play "Macroinvertebrate Simon Says" to reinforce feeding groups by dividing students into six groups: Dragonflies, Crane flies, Blackflies, Mayflies, Stoneflies, and Caddisflies. Provide groups with macroinvertebrate identification cards to give them a visual representation of organisms. Explain the different feeding habits of each group, and assign them an action.
  - a) **DRAGONFLIES** are **predators**. They have long lower mouthparts (labium) that extend and unfold to catch prey. For their action, have the students put their hands to their mouths with their elbows tucked down in front of them. To mimic eating, have the students straighten their elbows and make an upward scooping action. Students can also hold hands out with one up high and one down low and clap them together in a large "chomping" motion.
  - b) **CRANEFLIES** are **collectors**. They wiggle around until they find a place to feed. The action

should be a wiggly walk.

BLACKFLIES are also **collectors**, but they collect with a large net-like feature on their head, which they use to gather food. They can lower it down to their mouths to eat. The action should be placing your hands above your head, and lowering them down to your mouth.

c) STONEFLIES are **shredders**. They wait for leaves or other debris to fall into the water and then they tear off small pieces to eat. The action should be similar to tearing up a piece of paper.

d) CADDISFLIES AND MAYFLIES are **grazers**. They scrape or graze algae off rocks and sticks. This action should be similar to scratching someone's back.

5. After all the groups have learned their actions, have them act out their part at the same time for one minute.
6. Then test the students on all of the feeding habits by playing "Simon Says" with the actions. (Example: Simon says act like a blackfly. Everyone should have their hands above their head.)
7. Tell students that they will now participate in an activity to demonstrate different feeding strategies, and attempt to eat depending upon these strategies and tools used by their assigned feeding group (cards handed out in step 4). Remind them that they practiced these strategies above in Macroinvertebrate Simon Says.
8. Assign tools to each macroinvertebrate feeding group:
  - **Shredders**: Receive 2 plastic knives each
  - **Collectors**: Receive cheese cloth or pipettes-distribute both within this group
  - **Grazers**: Sandpaper
  - **Predators**: Plastic spoons
9. Tell students they will have about 30 seconds to "feed" at each station with the goal of collecting as many items as they can. If they are successful at collecting **more than 10** of the item, they have one of the best feeding strategies for that food source and location, and collect 3 beads from that station. If they collect between 5-9, their feeding strategy worked, but the food source and location probably isn't the most ideal for their specific adaptation. Students should collect 2 beads. If they weren't able to collect any food, their feeding strategy did not work at all, and they are not adapted to eat this food source or in this location. Students do not get a bead.

Let students know that if they are eating wood with sandpaper they will need to measure by the amount of spoonfuls they get.

In each round, students cycle through all 4 stations with one tool. After each round have students switch feeding groups and tools. Run 2-4 rounds depending upon how much time you have-ideally students will be able to go through the stations using all 4 tools.

#### Discuss:

- What tools were most successful at station 1? Why? What sort of habitat is at station 1 that made this/these feeding strategies so successful? **Station 1 represents the headwaters where**

the most leaves and other materials from trees and plants tend to accumulate. You will find some of this debris throughout the stream but often many shredders are found here. So as you can imagine, as a shredder you need sharp tools to shred these plant materials that are much bigger than you are. Who has more blue beads than any other color? You were most successful in the head waters and other areas where leaves could accumulate.

- What tools were most successful at station 2? Why? What sort of habitat is at station 2 that made this/these feeding strategies so successful? Station 2 represents pools or slow moving water where spinning collectors that use net like material can catch food floating by, and gathering collectors can burrow into the ground to get food. So you can imagine that as a collector, you would need something to help you strain or suck up food as it floats by, or from the bottom of the stream. Who has more red beads than any other color? You were most successful in places like pools or other areas of slow water where you are able to avoid being swept away, or burrow into gravel and mud to collect food.
- What tools were most successful at station 3? Why? What sort of habitat is at station 3 that made this/these feeding strategies so successful? Station 3 represents riffles where the water is moving fast but also often exposed to sunlight as it goes over rocks. This helps algae and bacteria grow on the rocks for grazers to scrape off and eat. Who has more orange beads than any other color? You were most successful in places like riffles where you could hang onto rocks, scrape and eat algae that grows there.
- What tools were most successful at station 4? Why? What sort of habitat is at station 4 that made this/these feeding strategies so successful? Station 4 represents runs with fast moving water and all habitats because predators are able to swim fast, are strong and don't always have to have something to hang on to in order to eat, and move around to all the different habitats to eat. They are also able to swallow their prey whole, pierce it to suck out food, or grab onto it to tear it up and eat it. Predators can be successful in all aquatic habitats. Who has more green beads than any other color? You were successful all over the stream and able to eat anywhere.

**Resources:**

Macroinvertebrate Simon Says: Utah State University Water Quality Extension:

<http://www.extension.usu.edu/waterquality>

Invert Investigator: Kids in the Creek: <http://cascadiacd.org/files/documents/CD-KIC2InvertInvest.pdf>

# **Station 1:**

# **Headwaters**

**Station 1 represents the headwaters, where the most leaves and other materials from trees and plants tend to accumulate. You will find some of this debris throughout the stream but often many shredders are found here. So as you can imagine, as a shredder you need sharp tools to shred these plant materials that are much bigger than you are. Who has more blue beads than any other color? You were most successful in the head waters and other areas where leaves could accumulate.**

# **Station 2:**

## **Pools/bottom waters**

**Station 2 represents pools or slow moving water where spinning collectors that use net like material can catch food floating by, and gathering collectors can burrow into the ground to get food. So you can imagine that as a collector, you would need something to help you strain or suck up food as it floats by, or from the bottom of the stream. Who has more red beads than any other color? You were most successful in places like pools or other areas of slow water where you are able to avoid being swept away, or burrow into gravel and mud to collect food.**



# **Station 3:**

## **Riffles**

**Station 3 represents riffles where the water is moving fast but also often exposed to sunlight as it goes over rocks. This helps algae and bacteria grow on the rocks for grazers to scrape off and eat. Who has more orange beads than any other color? You were most successful in places like riffles where you could hang onto rocks, scrape and eat algae that grows there.**

# **Station 4:**

## **Runs/all aquatic habitats**

**Station 4 represents runs with fast moving water and all habitats because predators are able to swim fast, are strong and don't always have to have something to hang on to in order to eat, and move around to all the different habitats to eat. They are also able to swallow their prey whole, pierce it to suck out food, or grab onto it to tear it up and eat it. Predators can be successful in all aquatic habitats. Who has more green beads than any other color? You were successful in the runs, possibly all over the stream, and able to eat anywhere.**