Outdoor School at Home

Calapooia Watershed Council

Title: Macroinvertebrates
Grade: 6
Duration: 55-60 minutes
Location: Home/Backyard/Park

Materials:

- Macroinvertebrate ID Guide (provided online)
- Journals/Paper
- Markers/Colored Pencils
- Clay/Playdough (optional)
- Pipe Cleaners/cotton swabs, sticks/etc. (optional)
- Pasta noodles (optional)
- Glue (optional)
- 1-2 Dice (optional)

Lesson Preparation:

- Print out or have the Macroinvertebrate ID Guide, Worksheet, and Simulation available on a computer/tablet.
- Print and cut out macroinvertebrate names for lesson use. Put it aside for the lesson.
- Ensure paper and writing materials are available for the students.
- Have crafting materials set up and available

Objectives: Students will

- Identify two important roles macroinvertebrates play in an ecosystem by discussing their ideas.
- Present the natural history of a macroinvertebrate species by sharing information they recorded in their journals.
- Determine water quality by running a stream simulation with macroinvertebrate species
- Brainstorm two ways humans can improve or preserve the local water quality

Introduction (5 minutes)	**Hook:** Have students imagine that they have been shrunk down to size of a quarter, and that they live underwater. ● Ask students how they might survive living in an underwater habitat ● Have a few students share their ideas ● Ask students about their food, shelter, mobility, etc.

Body (45 minutes)	● After the students have shared their ideas, tell students that their ideas are actually put into use every day by organisms that live underwater. ● The organisms that we are going to investigate today are **macroinvertebrates**. ○ Ask students if they know what macroinvertebrates are ○ If an explanation is needed, break down the term into: ■ Macro - something that is visible to the eye (doesn't require microscope) ■ Invertebrates - an organism lacking a backbone ● Ask students why it might be important to learn about macroinvertebrates? Discuss what an **indicator species** is. ○ See Background Information on definition ○ Have students discuss and share their answers ○ Some topics students might cover: Food web, food chain, water filtration, pollution ● After the discussion share with students that for us to better understand these macroinvertebrates, we need to study them for an up close look. ○ Hand out the Macroinvertebrate ID Guide or open it on your computer ■ Have each student choose 2-4 macroinvertebrates from the guide ■ Have students record information from the guide and mold/sketch each macroinvertebrate using the provided craft materials - Students should sketch and take notes in their journal of their macroinvertebrate(s) - Have students research more macroinvertebrates if they want to ● After the students have finished learning about their macroinvertebrates, have the students present their findings ○ Ask students about the macros diet, how they might move, where they might live, etc. ○ Ask students about their pollution tolerance ■ This will vary from Very Sensitive (needs clean waters) to Tolerant (can survive in polluted waters) ■ Refer to Background Information below ● Share with students now that they have learned more about

	macroinvertebrates, we can now use them as bioindicators. ○ Using the stream visual and macroinvertebrate names, have the student select 6 macroinvertebrate names and place them on the stream visual (names drawn from a hat or upside down so student can't see during selection) ○ Roll dice to see how many macroinvertebrates of each species were found - record this next to each macroinvertebrate that was selected ○ **OR** use the online stream simulation and ID Guide to "collect" macroinvertebrates ■ https://www.biologysimulations.com/macroinvertebrates ○ Using the Macroinvertebrate worksheet, have the student(s) record their information and calculate the health of the stream ○ Have students present their results and how they determined stream health ○ Repeat this activity for different results!
Closing (5 Minutes)	● Have students turn to a partner and/or discuss two reasons why macroinvertebrates are important to us as humans ○ Allow them to share their ideas ○ Follow up with questions such as, how do we help our macroinvertebrate populations?, What could be happening to our water if we only find tolerant macroinvertebrate species?, etc.

Background Information:

Indicator Species: an organism whose presence, absence or abundance reflects a specific environmental condition. Indicator species can signal a change in the biological condition of a particular ecosystem, and thus may be used as a proxy to diagnose the health of an ecosystem.

Macroinvertebrates are organisms that are large (macro) enough to be seen with the naked eye and without a backbone (invertebrate). They inhabit all types of running waters, from fast-flowing mountain streams to slow-moving muddy rivers. Examples of aquatic macroinvertebrates include insects (in their adult, larval or nymph form), mollusks, crustaceans and worms (Viklund, 2011). Most of them live part or most of their life cycle attached to submerged rocks, logs, and vegetation or else in soft sediment.

Aquatic macroinvertebrates serve multiple functions in freshwater ecosystems. In addition to their role as primary consumers processing live organic material, they also serve as detritivores, consuming decomposing organic matter; predators, consuming macroinvertebrates and other small organisms; and prey, serving as food for fish, amphibians, reptiles, aquatic birds, and mammals. Many species of aquatic macroinvertebrates have evolved highly specialized feeding structures and behaviors in order to adapt to different food sources and competition within the aquatic environment. As a result, aquatic ecologists have categorized the many species of aquatic macroinvertebrates into four functional feeding groups (Cummins 1973) which can be used to describe how aquatic ecosystems function: shredders, collectors, grazers (or scrapers), and predators.

- **Shredders** are responsible for processing coarse particulate organic matter (CPOM). CPOM is greater than 1 mm in size and typically derived from allochthonous sources, such as woody debris, leaves, and other vegetation from the neighboring riparian corridor. Examples of shredders in the Southwest include the caddisfly (*Heteroplectron californicum)* and the stonefly (*Zapada cintipes)*.
- **Collectors/Filter Feeders** filter and collect smaller particles of organic matter (FPOM) found in the water column and bottom sediments. FPOM can range in size from 0.01-1.0 mm and usually arrives in water columns and benthic sediments as a result of CPOM being broken up by shredder species. Examples of collector species include the beetle (*Zaitzevia parvula)* and the Dipteran (true flies) (*Antocha monticola)*.
- **Grazers** are found on rocks and woody debris, feeding on periphyton, detritus, and submerged aquatic plants. Most gastropods (snails) are grazer species; other grazers in the Southwest include the caddisfly (*Helicopsyche borealis*) and the beetle (*Optioservus quadrimaculatus*).
- **Predators** prey on animal tissue. The primary food sources for this group are other Glen Canyon National Recreation Area aquatic macroinvertebrates. Many southwestern dragonflies, such as the riffle darner (*Opolonaeschna armata*) and Pacific spiketail (*Cordulegaster dorsalis*), are voracious predatory species.

Macroinvertebrates are used as **bioindicators** that can reflect characteristics of a water body based on the type and number of macroinvertebrates found living within that system. Chemical water tests are limited because they only tell us what's in the water at the specific moment the sample is collected. They don't give an indication of what was in the water an hour ago, yesterday or last week. Every day, macroinvertebrates are surrounded by water and any pollutants that may be in the water. If pollutants were in the water last week or yesterday, the quantity and diversity of macroinvertebrates present would reflect this in the water quality.

Different types of macroinvertebrates have different requirements to survive. Some require cooler temperatures, relatively high dissolved oxygen levels or certain habitats. Other macroinvertebrates may be able to survive in less-than-ideal conditions — where there are low dissolved oxygen levels or more sediment — or where the water temperature is warmer.

An important thing to remember for this lesson is that there aren't any "bad" macroinvertebrates, but the population present may indicate that there are poor stream conditions in which only the tolerant macroinvertebrates can survive.

https://environment.arlingtonva.us/streams/macroinvertebrates/

https://www.nature.com/scitable/knowledge/library/bioindicators-using-organisms-to-measure-environmental-impacts-16821310/

Dragonfly Nymph

Habitat: Slow moving streams, ponds, or lakes

Diet: Predator - Feeds on other small aquatic invertebrates such as daphnia and mosquito larvae

Facts:

- Eaten by birds, fish, and larger aquatic insects
- Undergoes a partial metamorphosis to become a flying adult

Tolerance: Somewhat Sensitive

Damselfly Nymph

Habitat: Slow moving streams, ponds, or lakes

Diet: Predator - Feeds on small aquatic organisms such as daphnia and mosquito larvae

Facts:

- Eaten by fish, birds, and other aquatic insects
- Molt several times to eventually become a flying adult

Tolerance: Somewhat Sensitive

Mayfly

Habitat: Cleaner water in rivers, lakes, ponds, streams, and wetlands

Diet: Scraper - Feeds on algae and biofilm, eats what it can find

Facts:

- Important food source for fish, amphibians, birds, and water beetles
- Hides under rocks when being hunted
- Terrestrial fly in adult form
- Adult mayflies only live for a few hours to a few days

Tolerance: Very Sensitive

Stonefly

Habitat: Clean, Fast moving rivers and streams with a high oxygen content

Diet: Shredder - Feed on algae, leaves, and decaying vegetation

Facts:

- Food source for fish and larger invertebrates
- Shed exoskeletons as they grow into flying adults
- Stoneflies can live in the aquatic stage for 1-3 years

Tolerance: Very Sensitive

Backswimmer

Habitat: Still water in a pond or lake, Slow moving stream or river

Diet: Predator - small insects, fish, snails, crustaceans, and tadpoles

Facts:

- Backswimmers breathe air
- They can indicate polluted water since they don't rely on the water for oxygen
- Swim upside down

Tolerance: Tolerant

Water Boatman

Habitat: Still water in a pond or lake, Slow moving stream or river

Diet: Opportunistic - Feeds mainly on plants and algae, but can also eat insects and other aquatic organisms

Facts:

- Breathes through skin when young, and then through trapped air bubbles as it grows
- Develops wings as an adult to fly and mate

Tolerance: Tolerant

Dobsonfly

Habitat: Very clean water along the bottom of streams and rivers, near riffles

Diet: Predator - feeds on aquatic insects

Facts:

- Completes a full metamorphosis to become a flying adult
- Does not eat during adult life stage
- Attracted to light
- Female dobsonfly bites can be painful
- Eaten by many species of fish

Tolerance: Very Sensitive

Alderfly

Habitat: soft mud, sand, or stone crevices in streams, rivers, lakes, ponds, and wetlands

Diet: Predator - Feeds on clams, insects, crustaceans, and larvae

Facts:

- Food source for fish species
- Some alderfly species have a tube-like appendage that is used as a snorkel when there are low oxygen levels

Tolerance: Somewhat Sensitive

Water Penny

Habitat: Clean, fast moving waters in a river or stream

Diet: Scraper - Feeds on biofilm, plant debris, and algae along rocks

Facts:

- Water Pennies can indicate a high amount of dissolved oxygen
- Lay eggs on undersides of rocks
- Adults are land beetles
- Eaten by freshwater trout and some insects

Tolerance: Very Sensitive

Riffle Beetle

Habitat: Clean, Oxygen-rich, Fast-moving bodies of water in rivers or streams

Diet: Shredder - Feeds on plant materials and diatoms

Facts:

- Undergoes a complete metamorphosis from larval form to adult beetle form
- Eaten by many different species of fish

Tolerance: Very Sensitive

Whirligig Beetle

Habitat: Ponds, wetlands, lakes, streams on the water's surface or below

Diet: Predator/Scavenger - Feeds on smaller insects and adults can scavenge for food along the water's surface

Facts:

- Breathes air, and does not rely on dissolved oxygen in the water
- Eaten by larger beetles and fish
- Adults swim on the water's surface in social groups

Tolerance: Tolerant

Caddisfly

Habitat: Cool flowing water in rivers and streams, Temperate ponds and lakes

Diet: Opportunistic- feeds on plant materials, algae, and sometimes insects

Facts:

- Eaten by many different fish species
- Some caddisflies produce silk to make nets that catch food materials
- Some caddisfly species build protective cases out of sediments and vegetative matter

Tolerance: Very Sensitive

Midge

Habitat: Stagnant or moving water bodies, clean and polluted waters

Diet: Filter Feeder - Feeds on algae, debris, and insect larvae

Facts:

- Adults look similar to mosquitoes but are smaller
- Many species burrow into the sediment and create silk cases
- Adult stage looks similar to a mosquito, but has “fuzzy” antennae

Tolerance: Tolerant

Crane Fly

Habitat: Under plant debris and algae in ponds, wetlands, rivers, and streams

Diet: Shredder - Feeds on algae, debris, and small insects

Facts:

- Adults look similar to mosquitoes, but are larger and harmless
- Adults are also known as “mosquito hawks”
- Adults are a food source for spiders, birds, and other insects

Tolerance: Somewhat Sensitive

Crayfish

Habitat: Rivers, streams, ponds, and lakes

Diet: Predator/Scavenger - Feeds on plants, insects, snails, and dead organisms

Facts:

- There is only one native crayfish species in Oregon, the Signal Crayfish
- Young crayfish stay attached to their mother for up to 2 weeks after hatching
- Food source for fish, aquatic mammals, birds, and humans

Tolerance: Somewhat Sensitive

Flatworm

Habitat: Under rocks, plants, and debris in ponds, lakes, streams, rivers, ditches, and puddles

Diet: Scavenger/Parasite - Feeds on bacteria, protozoans, small invertebrates, and plant matter

Facts:

- Hermaphroditic - can reproduce asexually
- Flatworms can regenerate if cut down the middle or if a small end is cut off

Tolerance: Tolerant

Leech

Habitat: Lakes, ponds, streams, rivers, wetlands in the sediment or aquatic vegetation

Diet: Parasite - Feeds on blood and decaying matter

Facts:

- Every continent on earth has leech species, except for Antarctica
- Eaten by fish, turtles, and birds
- Not all Leeches feed on blood, some eat plants

Tolerance: Tolerant

Gilled Snail

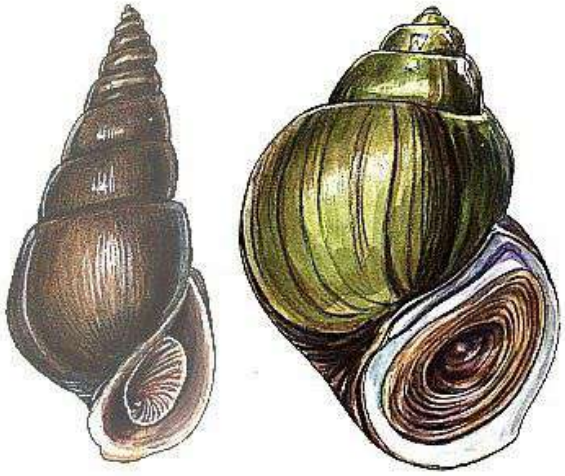
Habitat: On or under rocks in cool, clean, running water

Diet: Scraper - Feeds on algae and decaying plants

Facts:

- Eaten by fish, ducks, and leeches
- Requires oxygen-rich water to survive
- Opening on the right side of shell
- Obtain oxygen from the water through their gills

Tolerance: Very Sensitive



Lunged Aquatic Snail

Habitat: Substrate in streams, rivers, ponds, lakes

Diet: Scraper - Feeds on algae, plants, and sometimes dead animal matter

Facts:

- Eaten by fish, birds, and turtles
- Opening on the left side of shell
- Lunged snails are Hermaphroditic (male and female)
- Some snails collect air from the water's surface to breathe

Tolerance: Tolerant

Sowbug

Habitat: The bottom of streams, ponds, rivers, lakes

Diet: Scavenger - Feeds on dead animal matter and decaying plants

Facts:

- Sowbugs grow throughout their lifetime, shedding exoskeletons
- Eaten by a variety of vertebrates and invertebrates
- Can live in streams recovering from sewage pollution

Tolerance: Somewhat Sensitive

Scud

Habitat: Shallow areas of running or still water, usually in the substrate, avoiding light

Diet: Shredder - feed on any vegetation or animal matter

Facts:

- Scuds swim on their sides or upside down
- Eaten by fish, birds, and amphibians
- Females have a pouch that carries eggs and hatchlings until they shed their exoskeleton

Tolerance: Somewhat Sensitive

Water Mite

Habitat: Open, clear pools, sometimes found in pool bottoms

Diet: Predator - Attacks insects, fish, and other animals

Facts:

- Some water mite larvae are parasites to Water Boatmans
- Water Mites have swimming hairs on their legs that helps propel them through water

Tolerance: Somewhat Sensitive

Water Strider

Habitat: Almost any calm aquatic habitat including ponds, lakes, ditches, marshes, and rivers

Diet: Predator - Feeds on insects and spiders that fall onto the water's surface

Facts:

- Eaten by fish and birds
- A water strider's legs have tiny hairs that are water repellant and trap air to keep it on the water's surface

Tolerance: Tolerant

Clam/Mussel

Habitat: Steams, rivers, and permanent standing water in lakes and wetlands

Diet: Filter Feeder - phytoplankton, bacteria, plant matter, and other microorganisms

Facts:

- Eaten by fish, birds, and mammals
- Clams and Mussels help improve water quality by straining out particles and pollutants in the water
- Some mussels can filter up to 10 gallons of water a day

Tolerance: Somewhat Sensitive

SENSITIVITY TO POLLUTION

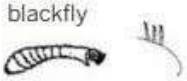
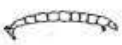
Sensitive / Intolerant

	# found	score
caddisfly 		3
mayfly 		3
riffle beetle 		3
stonefly 		3
water penny 		3
dobsonfly 		3
Sensitive TOTAL =		

Somewhat Sensitive

	# found	score
clam/mussel 		2
crane fly 		2
crayfish 		2
damselfly 		2
dragonfly 		2
scud 		2
fishfly 		2
alderfly 		2
mite 		2
Somewhat Sensitive TOTAL =		

Tolerant

	# found	score
aquatic worm 		1
blackfly 		1
leech 		1
midge 		1
snail 		1
mosquito larva 		1
Tolerant TOTAL =		

\+ ☐ Sensitive total
\+ ☐ Somewhat sensitive total
☐ Tolerant total
= ☐ **Water Quality Rating**

☐ Excellent (>22) ☐ Good (17-22)
☐ Fair (11-16) ☐ Poor (<11)

Adapted from: Environmental Services City of Portland

Notes:

_____

_____

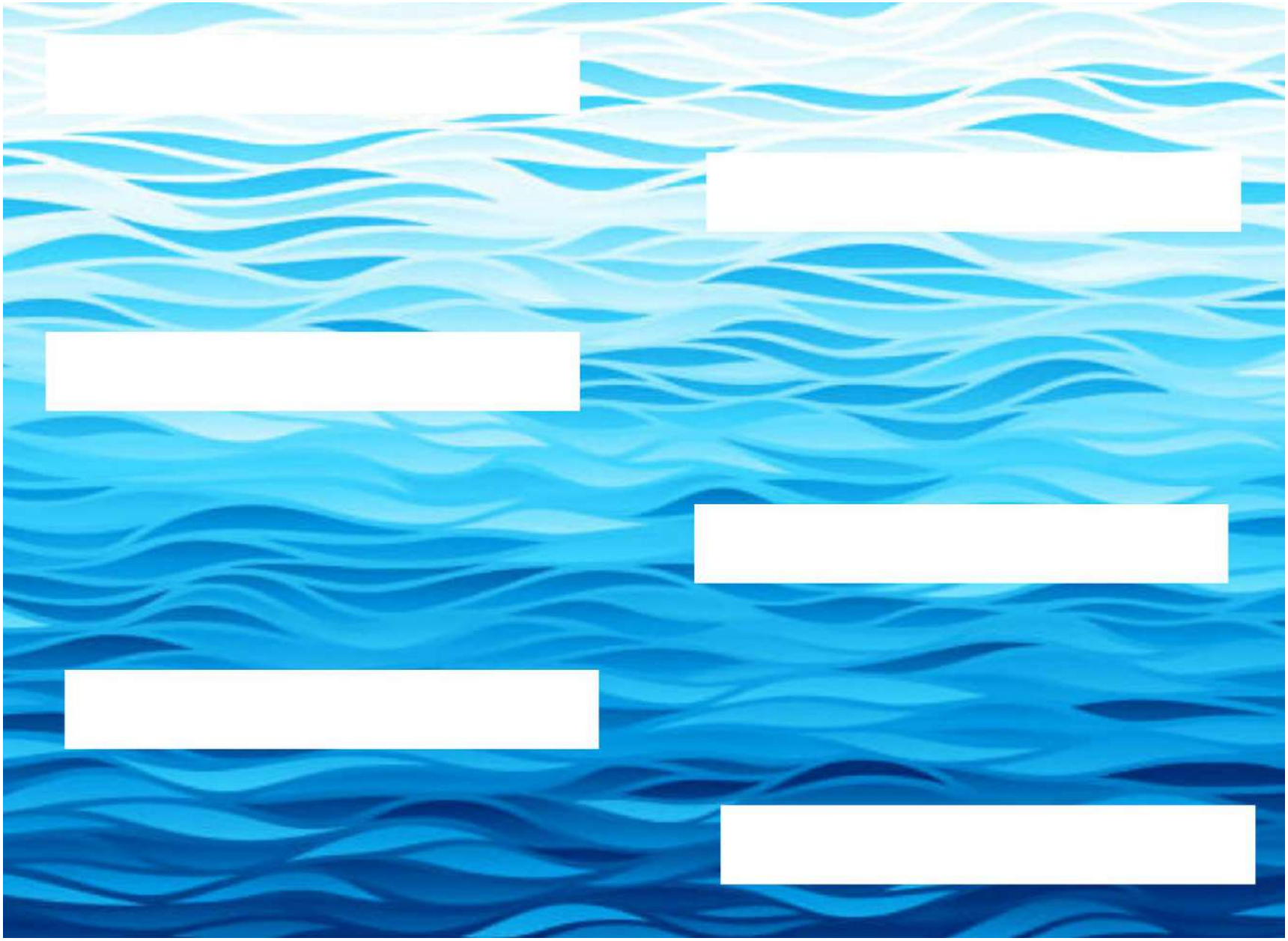
_____

_____

_____

_____

Stream Name: _____



Stream Name: _____

Signal Crayfish	Whirligig Beetle	Lunged Snail	Water Mite	Alderfly
Flatworm	Midge Larvae	Water Strider	Cranefly	Damselfly Nymph
Water Penny	Leech	Scud	Riffle Beetle	Dragonfly Nymph
Caddisfly	Gilled Snail	Sowbug	Mayfly	Stonefly
Dobsonfly	Water Boatmen	Backswimmer		

Directions:

1. Print out both sheets
2. Cut out Macroinvertebrate Names
3. Place names upside down or in a bowl for student to select during simulation
4. Selected names are placed on the stream image
5. Roll dice or select numbers 1-6 randomly and assign a number to each macroinvertebrate in the stream (# macros "caught")
6. Student will fill in the numbers and species on worksheet