Aquatic Macro invertebrates Lesson Plan

NGSS Standards:

MSESS3-3. Apply scientific principles to design a method for monitoring and minimizing human impact on the environment.

3-LS4-3. Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.

MS-LS2-1. Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.

Objectives (What should students learn when they leave this station?):

- What an aquatic macroinvertebrate is along with examples
- The difference between complete and incomplete metamorphosis
- The importance of macroinvertebrates
- Methodology for collecting macroinvertebrates in the field
- Using macroinvertebrates for stream assessment
- Using identification guides to ID preserved and live macroinvertebrates

Engage:

Ask students if they know some of the names of the species that they encounter while at a creek. Kindly, remind them that there are more things in creeks than just fish and frogs.

Next, ask them what they think a macroinvertebrate is. Allow them to guess and guide them in the correct direction. Break the words down for them. Aquatic means the organism spends some or all of its life cycle in the water. “Macro” means it is large enough to see without a microscope (the opposite of “micro”). An invertebrate is an animal that lacks a vertebral/spinal column. So we have an animal without a vertebral column that is large enough to see with the naked eye and lives at least part of its life cycle in the water.

Go back to the examples students gave at the beginning of the activity and ask them to guess which of those examples are considered macroinvertebrates. Students will likely guess species such as crayfish, dragonflies, and leeches. However, some answers you get here will be vertebrates. Explain to students and help them to reason through why these are not considered macroinvertebrates.

Ask for questions here before you move on.

Explore:

Explain that some of these macroinvertebrates, such as crayfish, spend their entire lives in the water. Then ask the students to define and explain the process of metamorphosis. Guide them if necessary.

Handout out the worksheet showing different life cycles of macroinvertebrates. Ask students to get into groups and discuss how they think the complete and incomplete lifecycles differ from one another along with what they think is the importance of macroinvertebrates and why we should care about them? Monitor groups to make sure they don't get off track. Remind them of the definition of aquatic macroinvertebrates and try to encourage them to use knowledge that they gained in other lectures, such as the fish and food web lectures.

Explain:

Get all the groups back together and quiz them on what metamorphosis is. Then allow each individual group to share what they identified as differences between the two lifecycles. Guide them in identifying that in incomplete metamorphosis there are only 3 stages of development and the adult has similar morphological features as the young and these young are often called nymphs. While in complete metamorphosis there are 4 stages and the adult usually looks drastically different than the young. Show the class a preserved dragonfly nymph and an adult dragonfly in the display case. Then show them the preserved specimens of the young and adult hellgrammite in the display case. Ask them to guess which undergoes complete metamorphosis and which undergoes incomplete metamorphosis and explain why. Identify the dragonfly as an example of incomplete metamorphosis and the hellgrammite as an example of complete metamorphosis. Explain that these hellgrammites live in the water for several years. They build a pupa near shore and when the adult flies emerge… they may only live a week or two. The adults do not eat. They simply reproduce and lay eggs near the water. Hellgrammites are often called dobsonfly larvae. It follows that the adults are called dobsonflies.

Again, ask for questions

Ask students to now share why they thought macroinvertebrates are important. Be sure to stress their ecological significance. The students may have just come from a food web lecture or a fish lecture. Explain to them that many fish survive by eating macroinvertebrates. Taylor this part of the discussion to build on something the students already know. This way you will continue to keep them involved. Spend some time on ecological significance and try to demonstrate the interconnectivity of all things in an ecosystem. The second point of discussion is biological assessments. This is not an answer to expect from most groups, but it is a nice transition.

Explain how we can use macroinvertebrates to assess the quality of a stream. Describe how macros are divided into three groups – Group One Taxa, Group Two Taxa, and Group Three taxa. If you actually use the word taxa, be sure to explain what it means. Group One Taxa are only found in clean streams. Explain that by "clean" we don't mean clear or not dirty. We mean unpolluted or something along those lines. Group Three Taxa can survive in almost any quality of water – integrate the leech stereotype. Remind the students that just because an organism can live in almost any quality of water, they are not just associated with "dirty" water. Again, be careful using words like dirty and clean. They will likely mean different things to the students than they mean to us. Group Three organisms will live in clean water as well. However they are usually outcompeted by Group One Taxa in healthy waters. Then try to explain how Group Two Taxa are an intermediate group. Ask for questions. This is a confusing point. A lost student here will not understand the point of the exercise. Be sure everybody is onboard before you proceed. Conclude by explaining to the students how aquatic macroinvertebrates are collected from streams. Show them the kick seine and explain how it

works. Also, explain how simple dip nets can be used or kick seines can be made for the class to study on their own.

Elaborate:

Bioassesment Procedure:

- Prior to the students arriving, prepare the lab tables. Each student/chair should have a petri dish with a preserved specimen, forceps, and magnifying glass.
- As soon as you start explaining three groups, hand out the identification guides and demonstrate where each group is on the guide.
- Reiterate what each group means as stated above.
- Tell the students that each table will represent one stream. The specimens in front of them were just collected from these hypothetical streams.
- Explain the points system to the students: Group One Taxa get 3 points for each group that is identified. Group Two Taxa get two points. Group Three Taxa get one point each.
- Have the students start identifying the organisms in front of them using their guides. Have them keep track of the species they identify and their "streams" total number of points on their handout.
- Walk around and be available to help the students answer questions. Depending on time limits, you can stretch this out by offering little help or speed things up by helping more.
- Once everything has been identified, choose one table/stream to start. Have each student state what their specimen is and what group it belongs to. As they do this, keep a running tally on the board of how many members of each group you have.
- Repeat this with the other tables/streams
- Once all the tables/streams are on the white board, have the students tell you the number of assigned points for each group.
- Once every table/stream has been tallied, explain to them the significance of what just happened. Read to the scale for excellent, good, fair, and poor. Tell them what we typically find around here.
- Ask for questions.
- If live specimens are available, perform the same activity with them. Instead of individual Petri dishes each table will have one or two large bowls. If time is short, just have them look through the bowls and identify things.

Evaluate:

Quiz the students on the material you have just lectured on. Stress the importance of macroinvertebrates in all aquatic ecosystems and their usefulness to us for biological assessment.

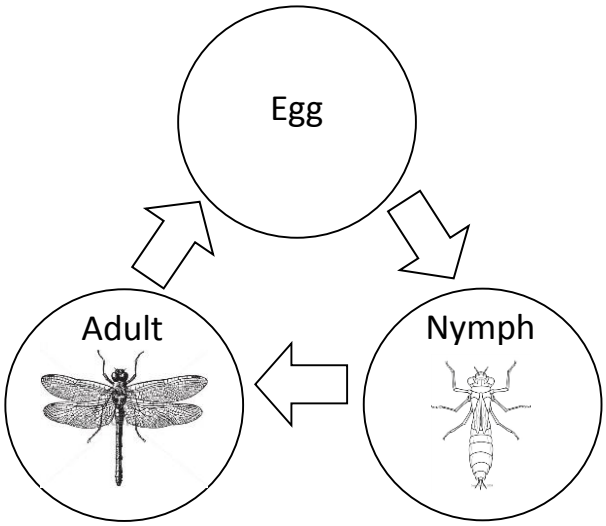
Name_____

AQUATIC MACROINVERTEBRATES

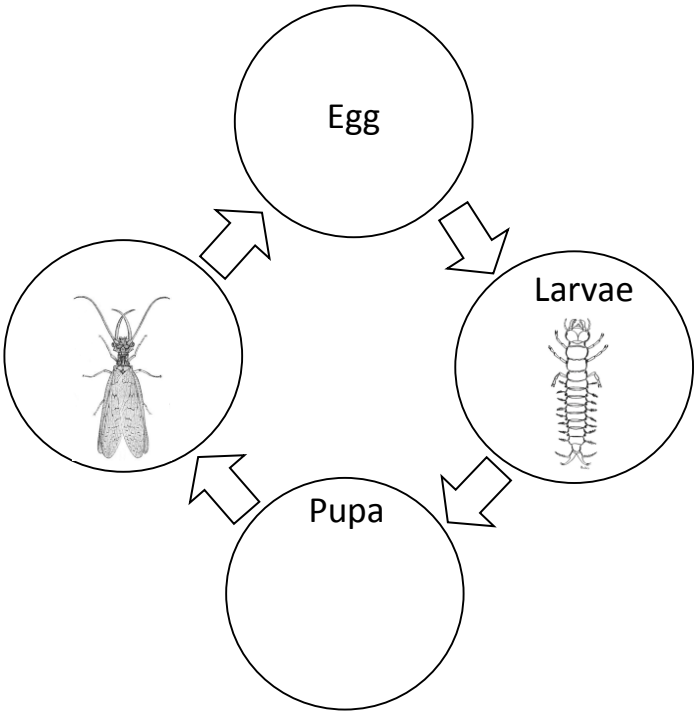
R C I U P E C O L O G Y R R Y K L O O
B S S L I A N S W O H S L C Q D A W Y
P Q L W A X Y P Q X J D E I T Q J X D
Y R Q D R A G O N F L Y D H P M L F M
K L O G C E N I E S A E B S C S B K K
L S Q C A D E T C E N N O C R E T N I
S L I D I Z F M E T Z F P H L B E R E
Y C Y S O T R K I T M M S C I S J L W
F L U L O M A F E H E I C O Y L D E X
L F F D H H I U V M F L A X E C U A H
V Y W Y S C P E Q Y T S P T U K A V P
J L I A A W D R A A S S E M Q H Q R M
O F P T J M Q R O E Q L X Z O C U A Y
S N I Z Z Z C P S M P T I L L C V L N
T O Z H X B R S R M A T Q A M T G Z H
N S X V Z H M O O W P T M X N M J V H
W B P I R E C C V L S S E A L Z K T C
V O L L N J N H T V F X U M F W U K D
J D I T X I Z D E L C Y C E F I L C I

aquatic	ecology	mayfly
bioassessment	identification	metamorphosis
clams	incomplete	nymph
complete	interconnected	scuds
crayfish	larvae	seine
dobsonfly	leeches	snails
dragonfly	lifecycle	

Aquatic Macroinvertebrates



Incomplete Metamorphosis



Complete Metamorphosis

How do these complete and incomplete metamorphosis lifecycles differ from one another? _____
_____

Why do you think macroinvertebrates are important? _____
_____

<u>"Macro" Identification</u>

The Ohio River is home to 1,000s of macro species. Can you name any?
Lets Identify some at your table

1) _____ 6) _____

2) _____ 7) _____

3) _____ 8) _____

4) _____ 9) _____

5) _____ 10) _____

Bioassesment

Did you know that macros can tell us about water quality?

GROUP 1 MACROS are clean water indicators. They get 3 points!

GROUP 2 MACROS are in between clean and poor. They get 2 points!

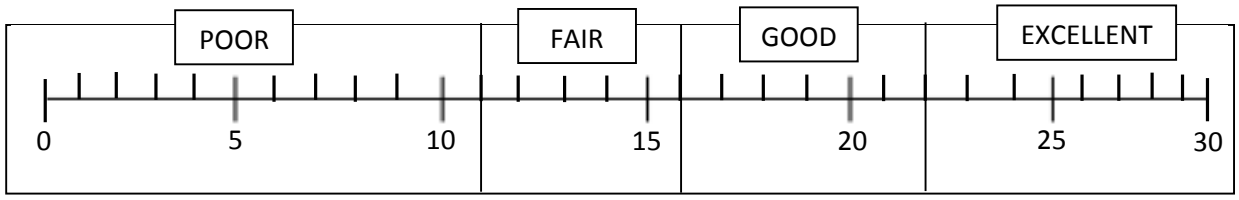
GROUP 3 MACROS are poor water indicators. They get just 1 point.

MACROINVERTEBRATE TALLY

GROUP 1 TAXA		GROUP 2 TAXA		GROUP 3 TAXA	
Water Penny Larvae		Damselfly Nymphs		Blackfly Larvae	
Mayfly Nymphs		Dragonfly Nymphs		Aquatic Worms	
Stonefly Nymphs		Crane Fly Larvae		Midge Larvae	
Dobsonfly Larvae		Beetle Larvae		Pouch Snails	
Caddisfly Larvae		Crayfish		Leeches	
Riffle Beetle Adults		Scuds			
Other Snails		Clams			
		Sow Bugs/Isopods			
Number of taxa present		Number of taxa present		Number of taxa present	
Times Index value of (3)=		Times Index value of (2)=		Times Index value of (1)=	

Cumulative Index Value _____

Biological Quality Assessment Scale



Add up all the numbers from the 3 columns. What is this total? _____

Now look at the scale below the table to determine the water quality of our stream.

How does your stream rate? _____ Are you surprised? _____

Now let's identify some live macros!

The Center for Ohio River

THOMAS MORE COLLEGE
TOGETHER IN PURSUIT OF TRUTH

How Can We Help Aquatic Macroinvertebrates?

At the Thomas More Biology Field Station you learned the importance of macroinvertebrates to stream health along with their ecological significance.

What if you collected samples of macroinvertebrates in a stream and they indicated through bioassesment that the stream was in poor health. What do you think are some things that could be done to promote stream health and thus increase the diversity of macroinvertebrates living in the stream? _____
_____
_____
_____

Scientist and conservationists have been thinking and researching this topic for many years. Some of the ideas and solutions that they came up with are listed below. Use the internet to research what each of these methods mean and how they will aid in promoting stream health.

Riparian Zones: _____
_____

Pervious Pavement: _____
_____

Green Roof: _____
_____

Fertilizer Management: _____
_____

YOU CAN MAKE A DIFFERENCE!