

MACRO-INVERTEBRATE INDICATORS

1-
5TH

OBJECTIVES

- Explore the concept of "indicator species."
- Understand that aquatic organisms are an indicator of an ecosystem's water quality.

BACKGROUND INFORMATION

Pollutants accumulate in a watershed as a result of various human driven and natural events. These pollutants, while sometimes inevitable, drastically alter the state of the ecosystem. If we can determine the type of pollutant and its cause, then we can identify the source of the pollutant and take preventative measures to reduce any further contamination.

One of the most effective methods in detecting declining trends in water quality are through biological surveys of aquatic macro-invertebrates (small animals without backbones that live underwater). Because different species have different tolerance levels to pollution, they respond rapidly to changes in water quality.

To evaluate the health and productivity of a stream, biologists look at the types of macro-invertebrate species that live there. If many pollution-intolerant organisms, such as stonefly or caddisfly nymphs, are present, then water quality is probably good. Although the presence of certain species is an indicator of good water quality, the absence of these species does not necessarily indicate poor water quality. Other factors besides pollution may account for their absence.

MATERIALS

- 2 Plastic Bags per Group with colored candies
 - Bag #1 contains candy of all colors
 - Bag #2 contains only a few candies of two colors
- Graph Paper (found at the end of the lesson)
- Colored Pencils
- Pictures of the Macro-invertebrates in this lesson

ANTICIPATORY SET

Watch the video "From Nymph to Wings" (under Resources) and discuss with your students how lots of juvenile insects start their life underwater, then emerge from the water and fly away as adults- like the Dragonfly in the video!

Next, watch the video "Aquatic Macro-invertebrates" to see first-hand how a diverse community of macro-invertebrates in a stream is an indicator of good water quality.

STREAM SAMPLE: GRAPHING

1. Ask your students to imagine that they are scientists studying the water quality of a local stream in your community. They have collected two samples of water from two different locations along the stream.
2. Distribute two bags of colored candies to each group. Be sure they are labelled Bag #1 and Bag #2.
 - a. Bag #1 should contain a variety of all the candy colors.
 - b. Bag #2 should contain only a few candies of two colors only.
3. Using the "Count your Macro-Invertebrates" page at the end of this lesson, have each group work together to tally the candies in the appropriate data table based on color. Remind them not to mix up the candies in their bags!
4. After completing the data tables, students should work together to answer the two reflection questions at the bottom of the page.
5. Inform your class that each color represents a different type of macro-invertebrate. Each type of Macro-Invertebrate can tolerate different levels of pollution. Students will then use colored pencils to fill in the bar graph for Bag #1 and Bag #2 based on the quantities they recorded on their data tables.
6. Upon completing their two graphs, move onto the next section, "Real World Connections."

REAL WORLD CONNECTIONS

Using colorful markers, write the following descriptions on a large piece of paper for the class to see.

- **Red** and **Orange** = CANNOT Tolerate ANY Pollution (only lives in clean water)
- **Yellow** and **Green** = Somewhat Tolerant of SOME Pollution
- **Blue** and **Purple** = Can Tolerate ANY Level of Pollution (can live in polluted OR clean water)

YOUNGER STUDENTS:

To conclude this lesson, have your students work in their groups to discuss which bag represented a healthy ecosystem and why?

- Remember- the more diversity of species in your ecosystem, the healthier it is. If their ecosystem only had **Blue** and **Purple**, the ecosystem is likely polluted.
- If the ecosystem only contains **Red** and **Green**, it is likely that this ecosystem is very clean. Yellow and Green insects can live in some pollution, but they will also live in clean water. In other words, they can tolerate some pollution.

OLDER STUDENTS:

To conclude this lesson, have your students work in their groups to discuss which bag represented a healthy ecosystem and why?

- Students will work in groups to select and research one of the Macro-Invertebrates in this lesson. Questions each group can answer include:
 - What type of water body might you find this type of macro-invertebrate?
 - What adaptation might this species have that allow it to be successful in this type of water body? Does this species have any limitations?
 - Create a model of this organism and label it's body parts.
 - Present about your organism to the class!

RESOURCES

- Bugs Don't Bug Me, Retrieved from <https://extension.usu.edu/waterquality/files-ou/Publications/Bugs-dont-bug-me.pdf>
- National Geographic Video: From Nymph to Wings, Retrieved from <https://www.youtube.com/watch?v=OlFXSe0wyUs>
- NYSDEC Video: Aquatic Macro-Invertebrates, Retrieved from <https://www.youtube.com/watch?v=HtE70kzYDPM>

TEKS

Science, Adopted 2021:

- 1st: (a) 1Ai, 1E, 5. (b) 1A, 1C, 1E, 1F, 1G, 2A, 2B, 3B, 3C, 4A, 5A, 5F, 5G, 11A, 11B, 12C, 13A.
- 2nd: (a) 1Ai, 1E, 5. (b) 1A, 1C, 1E, 1F, 1G, 2A, 2B, 3B, 3C, 4A, 5A, 5F, 5G, 12A, 13B, 13D.
- 3rd: (a) 1Ai, 1E, 5. (b) 1A, 1C, 1E, 1F, 1G, 2A, 2B, 3B, 3C, 4A, 5A, 5F, 5G, 11B, 13A.
- 4th: (a) 1Ai, 1D, 5. (b) 1A, 1C, 1E, 1F, 1G, 2A, 2B, 3B, 3C, 4A, 5A, 5F, 5G.
- 5th: (a) 1Ai, 1E, 5. (b) 1A, 1C, 1E, 1F, 1G, 2A, 2B, 3B, 3C, 4A, 5A, 5F, 5G, 12A, 12C, 13A.



THE MEADOWS CENTER
FOR WATER AND THE ENVIRONMENT
TEXAS STATE UNIVERSITY

TEXAS STREAM TEAM

512.245.1346

txstreamteam@txstate.edu

www.TexasStreamTeam.org

06/2023

Name: _____

Date: _____

Count Your Macro-Invertebrates!

- Count the candies in Bag #1, and record the number of each color in the table.
- Repeat for Bag #2.
- Answer the reflection questions at the bottom of the page.
- Turn to the next page and create a bar graph for each bag you counted!

Bag #1		Bag #2	
Candy Color	Quantity	Candy Color	Quantity
RED		RED	
ORANGE		ORANGE	
YELLOW		YELLOW	
GREEN		GREEN	
BLUE		BLUE	
PURPLE		PURPLE	

How are Bag #1 and Bag #2 different?

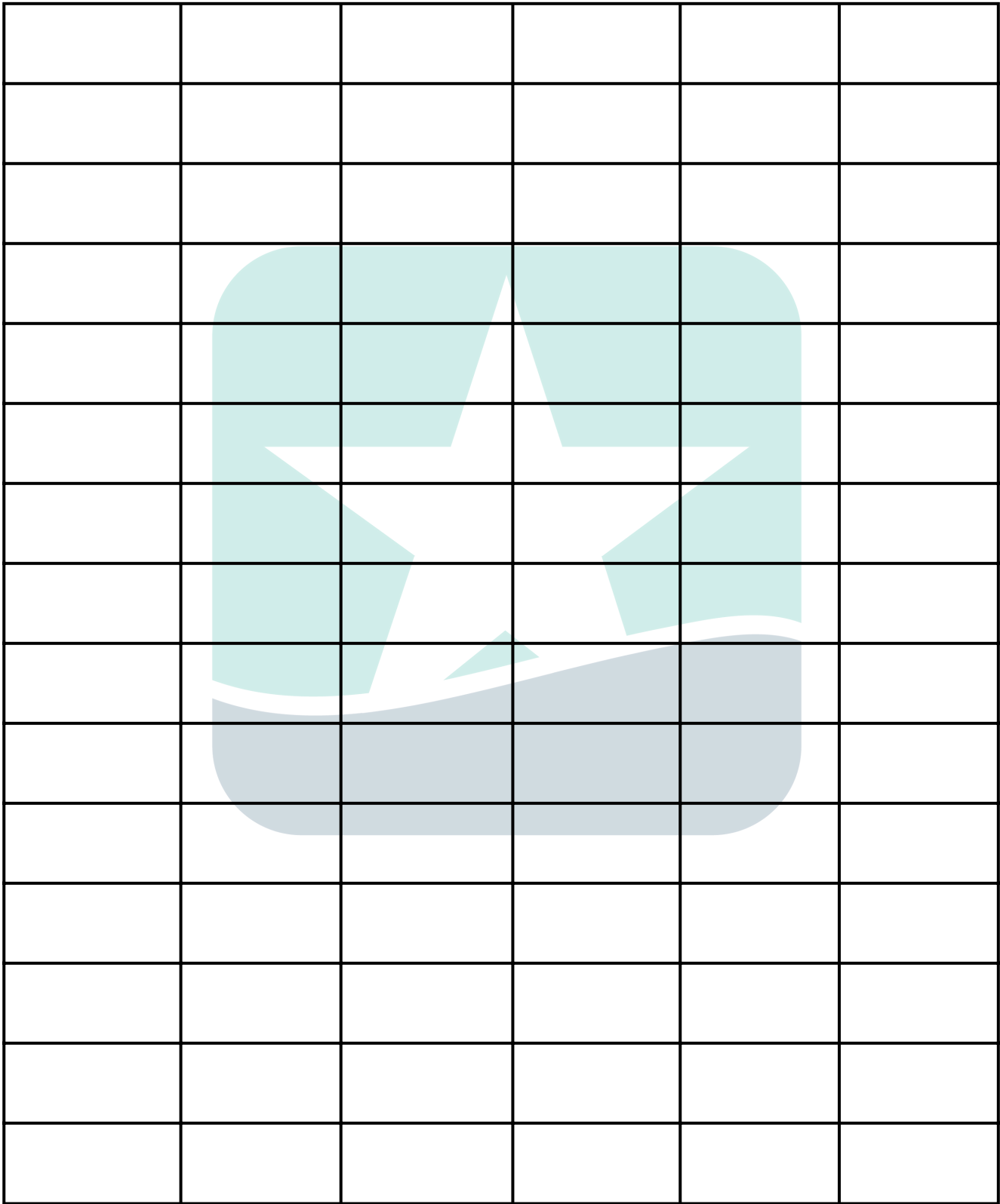
Which Bag do you think represents a healthy ecosystem? Why?

Name: _____

Date: _____

Macro-Invertebrate Population of Bag #1

Amount



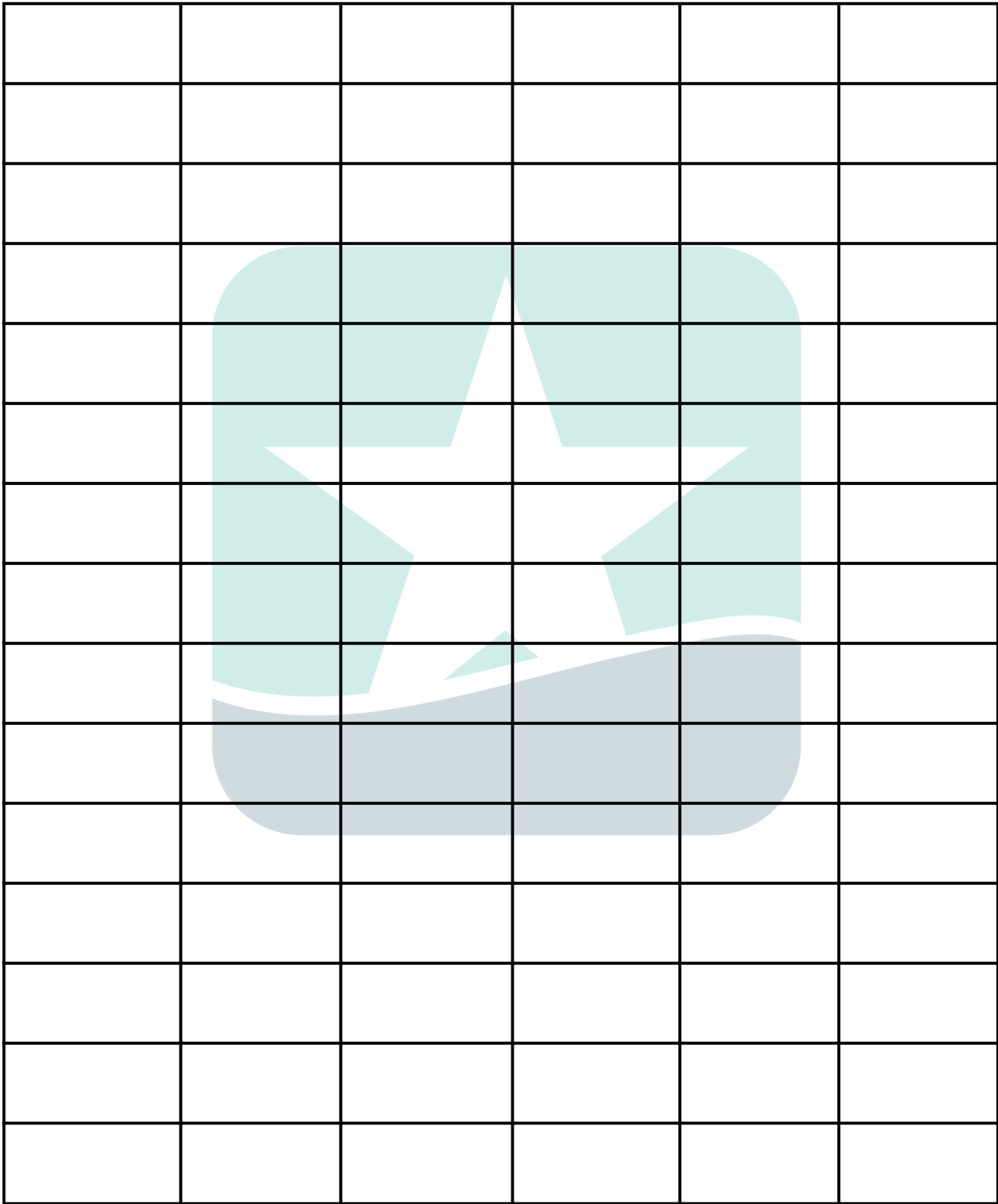
Stonefly Nymph Mayfly Nymph Dragonfly Nymph Water Strider Aquatic Worm Leech

Name: _____

Date: _____

Macro-Invertebrate Population of Bag #2

Amount



Stonefly Nymph Mayfly Nymph Dragonfly Nymph Water Strider Aquatic Worm Leech

Name: _____

Date: _____

Macro-Invertebrates Images

Found in Clean Water Only



Stonefly Nymph

Has two "tails" and
a long, slender body.

Mayfly Nymph

Has three "tails" and
a shorter body.



Found in Clean, or Slightly Polluted Water



Dragonfly Nymph

Has a rounded body
and large eyes.
This is a baby Dragonfly!

Water Strider

Moves on top of the
water's surface. Has
two long legs in the back!



Found in Clean, Slightly, or Very Polluted Water



Aquatic Worm

Long, slender body with
segments. Can be found
burrowing in sediment!

Leech

Has a suction mouth,
and found in shallow,
warm water.

