INVESTIGATE

14 LESSON

Habitat Analysis

Students analyze data from a coastal habitat scenario, plan a presentation and decide on steps to improve the health of the habitat, and present their projects.

OBJECTIVES

Analyze data to reach conclusions

Develop action plans for addressing coastal restoration issues

SUBJECT
Ecology, Geology, Environmental Science, Hydrology

PREREQUISITE
#1: Coastal Journey

VOCABULARY
colony forming unit (cfu)
concentration
macrophyte
ravine
stream
stream flow
turbidity

MATERIALS
data charts
pencils

TIME/DURATION
90 minutes

SETTING
Indoors

This Great Lakes in My World 9-12 activity is aligned to the Common Core State Standards (as available). This alignment is available on your Great Lakes in My World 9-12 USB flash drive in the "Standards" folder and on-line at http://www.greatlakes.org/GLiMWstandards.

BACKGROUND

Collecting data can be an interesting and worthwhile endeavor for students. However, the real interest and potential for critical thinking is in understanding what the data means. This activity allows students to practice analyzing and synthesizing data related to beach health, especially when done in conjunction with Lesson #16: Adopt-a-Habitat. Teachers can also seek out other citizen science data collection projects in their local community. This activity can serve as a way to get students to interpret data and understand how to look for trends and possible cause-and-effect relationships.

pH: refers to the acidity of the water. Lower number means more acidic, higher number means more basic. Values in the range of 6.5 to 8.5 are normal.

Dissolved Oxygen (DO): a measure of oxygen content in the water. Oxygen is critical for the survival of fish and other wildlife in the water. Decreases in DO stress the ecosystem. There may be natural fluctuations in the DO level due to seasonal variations in temperature; however, pollution can also impact the DO of the water. Bacteria, algae, and other organic matter consume oxygen, causing DO levels to drop. DO levels below 5 mg/L will cause ecosystem stress; 1-2 mg/L will result in fish kills.

E. coli/Fecal Coliform/Enterococcus Bacteria: These bacteria are used as indicators to determine if fecal matter is present in the water and to evaluate if a body of water supports safe recreational use. Beach monitoring typically involves testing for E. coli and sometimes fecal coliform to determine if the water is safe for swimming. Enterococci is another bacteria that is used as an indicator. Enterococci is traditionally used to monitor marine bathing water, but it is also suitable to use as an indicator for freshwater. The U.S. EPA recommends the posting of beach advisories if a measurement of E. coli exceeds 235 cfu/100 mL. If enterococci levels are above 61 cfu/100mL, this could also lead to a beach advisory. Elevated bacteria levels can be due to a few full diapers on the beach, bird droppings, or sewage discharges after a heavy rainfall.

Phosphate and Nitrate (or Phosphorus and Nitrogen): concentration of nutrients such as phosphorus and nitrogen influence the growth rates of organisms in the water. If there is an excessive amount of nutrients, particularly phosphorus,

algal blooms can appear. Algae is slimy and smells bad. Some types of algae can release toxins, as well. Algal blooms result in decreased DO content. Excessive nutrients can come from sewage treatment plants or agricultural (fertilizer or animal waste) runoff. The U.S. EPA recommends that the total amount of phosphorus should not exceed 0.05 mg/L in a stream at a point where it enters a lake or reservoir, or 0.025 mg/L within the lake or reservoir. The recommended levels of nitrogen and nitrogen compounds (nitrate, nitrite, ammonia) are site specific and depend on the type of habitat.

PROCEDURE

Divide the class into two groups: ravine/tributary and beach.

RAVINE/TRIBUTARY GROUP

1. Give the students the following scenario: A local high school has adopted a nearby stream that flows into a Great Lake. This stream is a ravine system tributary. The students made four visits throughout the fall and spring, looking at the shoreline and the surrounding area, the types and quantity of aquatic species, the quality of the water and the presence of pollution. They are ready to analyze their data and create an action plan to create positive change at this ravine site.

2. Give the students the data in the journal pages. Data on water quality and macroinvertebrate populations was collected during each visit, on separate charts. Have them compare the visits based on the data and use the journal questions to make note of their observations. As a class, discuss the data. *This may include noticing problems with increased water temperature, decreased populations or increased pollution following precipitation events.*

3. Introduce the idea of taking action to help the beach. Divide students into smaller groups and have each group pick one problem on which they will focus their attention. *Problems might include litter along the shoreline or in the water, lack of educational signage, storm water runoff from a parking lot. What type of project can students create that will address these issues?*

4. Have students develop an action project to address the issue, including a presentation of results to each other in the "roles" of city officials.

BEACH GROUP

5. Give students the following scenario: A local high school has adopted a nearby beach. Students have made four visits throughout the fall and spring looking at the shoreline and surrounding area, the type and amount of litter, and the presence of E. coli bacteria. They are ready to analyze their data and create an action plan to create positive change at their beach.

6. Give students the data in the journal pages. Data on litter condition and water quality was collected each time, on separate charts. Have them compare the visits based on the data and use the journal questions to make note of their observations. As a class, discuss the data. *This may include noticing problems with overflowing trash cans, consistent seagull waste, and a possible sewage overflow on the second visit.*

7. Introduce the idea of taking action to help the beach. Divide students into smaller groups and have each group pick one problem on which they will focus their attention. *Problems might include overflowing trash cans, consistent seagull waste, possible sewage overflows, lack of educational signage, stormwater runoff from the paved parking lot.* What type of project can students create that will address these issues?

8. Have students develop an action project to address the issue, including a presentation of results to each other in the "roles" of city officials.

WRAP-UP

9. Have each group take turns presenting their action project while the other group role-plays the group hearing the results.

10. After both groups have presented, use the rubrics from the student pages to evaluate the presentations. Did the students prefer presenting or hearing the presentation? What did the other group do well? What could they do better? If your classroom were to really arrange a meeting, what other things should be considered?

EXTENSION

A. Students take results from their habitat analysis and create an action plan to help a coastal habitat.

B. Use this activity as a model for presenting actual data to community decision-makers.

C. Have the students participate in the Alliance for the Great Lakes' ongoing Adopt-a-Beach™ program: http://www.greatlakesadopt.org or participate in the International Coastal Cleanup, which occurs on the third Saturday of every September: www.oceanconservancy.org.

ASSESSMENT

See rubric on page 125.

RESOURCES

Please see Resource List for additional information related to conservation and restoration, native and invasive species and more.

NAME

14
LESSON
STUDENT PAGE

Habitat Analysis

VOCABULARY

colony forming unit (cfu)
concentration
macrophyte
ravine
stream
stream flow
turbidity

BACKGROUND

Collecting data can be an interesting and worthwhile endeavor. However, the real interest and potential for critical thinking is in understanding what the data means. This activity can serve as a way to interpret data and understand how to look for trends and possible cause-and-effect relationships. Following this lesson you will be able to analyze and synthesize data relating to coastal habitat health.

DATA SET #1 (RAVINE/TRIBUTARY)

1. Description of the stream (name, location of the stream's headwaters, length, where it flows, where it empties):

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GENERAL CONDITIONS

	1st Visit 9/22	2nd Visit 9/25	3rd Visit 9/30	4th Visit 10/02
Air temperature (degrees Celsius)	28	25	21	22
Recent precipitation event (date)	none	9/25	9/27	10/01
Recent precipitation event (description)	n/a	Mild rainstorm	Light rain	Heavy rainstorm
Current sky conditions	Sunny	Cloudy	Cloudy, Windy	Partly cloudy

WATER QUALITY MONITORING

	1st Visit 9/22	2nd Visit 9/25	3rd Visit 9/30	4th Visit 10/02
Depth of stream (feet)	60.2	64.4	62.8	63.1
Stream flow	Mild	Moderate	Moderate	Rapid
pH	6.3	6.4	7.1	7.5
Dissolved oxygen content (mg/L)	14.0	12.7	13.4	13.1
E. coli (cfu/100 mL)	0	100	0	0
Fecal coliform (cfu/100 mL)	300	200	100	400
Phosphate (mg/L)	78	71	79	75
Nitrate (ppm) (mg/L)	54	51	54	53
Water temperature (degrees Celsius)	24	20	21	24
Odor	Odorless	Foul	Odorless	Odorless
Turbidity	Slightly cloudy	Cloudy	Opaque	Slightly cloudy

MACROINVERTEBRATE (AQUATIC INSECT) POPULATION MONITORING

	1st Visit 9/22	2nd Visit 9/25	3rd Visit 9/30	4th Visit 10/02
Caddis fly	600/2000	685/2000	659/2000	670/2000
Damselfly	203/2000	198/2000	271/2000	350/2000
Stonefly	145/2000	167/2000	206/2000	109/2000
Scuds	179/2000	225/2000	203/2000	235/2000
Clams and mussels	366/2000	105/2000	200/2000	130/2000
Gilled snails	290/2000	200/2000	190/2000	162/2000
Riffle beetles	147/2000	178/2000	165/2000	136/2000
Crayfish	120/2000	225/2000	60/2000	130/2000
Mayfly	18/2000	17/2000	6/2000	78/2000
Other:	None	None	None	None
Other:	None	None	None	None

STREAM HABITAT TYPE MONITORING

	1st Visit 9/22	2nd Visit 9/25	3rd Visit 9/30	4th Visit 10/02
Woody debris or snags	4/20	3/20	4/20	3/20
Vegetated banks	3/20	3/20	3/20	5/20
Sand and fine sediment	6/20	4/20	5/20	4/20
Cobble (hard substrate)	3/20	4/20	4/20	3/20
Aquatic plants (macrophytes)	4/20	6/20	4/20	5/20

DATA SET #2 (BEACH)

2. Description of the beach (location, length or size of shoreline, adjacent body of water)

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GENERAL CONDITIONS

	1st Visit 9/22	2nd Visit 10/14	3rd Visit 4/22	4th Visit 5/14
Air Temperature (degrees Celsius)	28	20	18	22
Recent precipitation event (date)	9/20	none	4/21	5/12
Recent precipitation event (description)	Severe rain	n/a	Rain	Severe rainstorm
Current sky conditions	Cloudy	Partly sunny	Sunny	Cloudy

WATER QUALITY MONITORING

	1st Visit 9/22	2nd Visit 10/14	3rd Visit 4/22	4th Visit 5/14
Current wave height (feet)	2.3	2.6	2.7	3.1
Intensity of the waves	Calm	Calm	Somewhat intense	Intense
pH	7.6	7.9	7.3	7.8
Dissolved Oxygen Content (mg/L)	14.1	15.2	14.7	14.9
E. coli - water (cfu/100 mL)	100	0	50	400
Fecal Coliform (cfu/100 mL)	700	75	300	1500
Enterococcus (cfu/100 mL)	50	14.9	20	90
E. coli - sand (cfu/100 mL)	9	10	7	6
Water temperature (degrees Celsius)	23	17	16	17
Odor	Foul	No odor	No odor	Rotten egg smell
Turbidity	Cloudy	Pretty clear	Slightly cloudy	Opaque

POTENTIAL POLLUTION SOURCE **COMBINED SEWER OUTFALL_____**

	1st Visit 9/22	2nd Visit 10/14	3rd Visit 4/22	4th Visit 5/14
Flow rate	Medium	n/a	Low	Medium
Water color	Brown	n/a	Light brown	Brown
Characteristics	Smelly	n/a	n/a	n/a
E. coli - water (cfu/100 mL)	1900	n/a	600	800
Fecal coliform (cfu/100 mL)	5000	n/a	1000	1500
Enterococcus (cfu/100 mL)	1000	0	200	120
E. coli - sand (cfu/100 mL)	10	4	7	9
Algae in the water near the shore (amount)	Low	Moderate	Moderate	Moderate
Algae in the water near the shore (type)	Black Brush	Staghorn	Greenspot	Greenspot
Algae in the water near the shore (color)	Black	Green	Green	Green
Algae on the beach (amount)	Low	Low	Low	Moderate

WILDLIFE ON THE BEACH POPULATION MONITORING

	1st Visit 9/22	2nd Visit 10/14	3rd Visit 4/22	4th Visit 5/14
Geese (living)	47	22	19	36
Gulls (living)	28	32	26	22
Dogs (living)	1	5	7	4
Other:	n/a	n/a	n/a	n/a
Common loon (dead)	2	0	1	0
Herring gull (dead)	0	3	2	1
Ring-billed gull (dead)	1	0	0	0
Double-crested Cormorant (dead)	0	0	0	0
Horned grebe (dead)	0	1	0	0
Fish (dead)	2	3	2	1
Other:	n/a	n/a	n/a	n/a

LITTER MONITORING

	1st Visit 9/22	2nd Visit 10/14	3rd Visit 4/22	4th Visit 5/14
Litter condition	Fair	Moderate	Moderate	Moderate
Trash cans (quantity)	8	8	8	8
Animal waste (source)	Dog	Seagull	Seagull/dog	Dog
Restrooms	Fair	Fair	Fair	Fair
Cigarette filters	45	32	28	36
Food wrappers and containers	22	31	36	42
Caps and lids	33	39	40	37
Straws and stirrers	21	20	29	26
Plastic beverage containers	35	38	39	22
Balloons	0	3	1	0
Other:	n/a	n/a	n/a	n/a
Other:	n/a	n/a	n/a	n/a

HABITAT ANALYSIS

3. Describe your observations as you analyze the data. Identify possible issues at this coastal site.

ACTION PROJECT

4. In small groups, identify one problem that you would like to investigate. Describe that issue here:

5. What are the possible causes of this issue?

6. What actions can you take to address this issue?

7. On a separate page or on a computer, develop an action plan for your site. Then, create a presentation to describe your action plan.

WRAP-UP QUESTIONS

8. Did you prefer presenting or hearing the presentation?

9. What did the other group do well?

10. What could they do better?

11. If your classroom were to really arrange a meeting, what other things should be considered?

RUBRIC

ELEMENTS	☆☆☆☆	☆☆☆	☆☆	☆
DATA ANALYSIS: Student thoroughly reads the journal pages that include all data from habitat site visits. Student notes his/her observations of the data and summarizes their findings (i.e. potential reasons for increases or decreases in quantity of bacteria in a water sample).	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components
ACTION PROJECT: Student works in a group to investigate one problem associated with the coastal habitat. Student develops an action plan to address the problem. Student role play as a city official or community stakeholder. Groups highlight what the problem is, where it is coming from and who is involved. As a class, students identify possible solutions to the problem. Students evaluate each other and discuss what should be considered if a meeting were really to be arranged.	Addresses all of the components	Missing one of the components	Missing two components	Missing three or more components