

INVESTIGATE

8 | Beach Mysteries

GRADE LEVEL

4-8

**summary**

Students learn about bacteria as an indicator of beach water quality for swimming. In groups they solve hypothetical problems associated with beaches. Then students write persuasive essays on the issue.

objectives

- Discuss the effect of harmful bacteria on swimming conditions at beaches.
- Diagram three reasons for beach contamination.
- Explain solutions for beach health problems.
- Write a persuasive essay about beach health.

prerequisite

Garbage Investigation, Litter Tag

vocabulary

Bacteria: single-celled organisms, free-living or parasitic, that break down the wastes and bodies of dead organisms, making their components available for reuse by other organisms

Sewage overflow: sewage that is discharged into waterways

Stormwater: water that accumulates on the ground during a rain event

setting

Classroom or beach

subjects

Environmental Science, Human Health, Social Studies, Language Arts

standards

This Great Lakes in My World activity is aligned to the Common Core State Standards and to state learning standards in:

Illinois
Indiana
Michigan
Minnesota
New York
Ohio
Pennsylvania
Wisconsin

This alignment is available on your Great Lakes in My World CD in the "Standards" folder and on-line at <http://www.greatlakes.org/GLiMWstandards>.

materials

- Healthy Beaches Action Guide (on cd) or visit <http://www.greatlakes.org/HealthyBeachesActionGuide>
- Journals
- Pencils
- Clipboards (if outside)

background

Beaches can bring great advantages to shoreline communities, providing recreation, gathering places and beauty. It is important to keep them clean and healthy. Although this activity is about beach closings, emphasize to students that the Great Lakes beaches can be wonderful places for swimming and recreation. However, based on the rise of beach closings due to bacteria issues, it is important that communities become informed about beach closings. The information in this activity should enable students and their families to better understand how to appreciate their beaches and keep them healthy so they can be enjoyed.

Beach Closings: Local health departments are forced to close beaches or declare “swimming bans” when bacteria levels are high. As monitoring programs start in communities, beach closings happen with increasing frequency. Leftover food may attract additional wildlife to the beach, resulting in increased animal droppings, which can lead to high bacteria levels in the water.

Closures are prompted because of the health risks posed by the bacteria, viruses, other germs and algae blooms, which come from sewage overflows, untreated stormwater runoff, animal waste, boating wastes and malfunctioning septic systems. Sewage treatment plants in some large cities were not originally built for the increased number of people that now live there. Each day a beach is closed, according to a 2004 study, *The Economic Costs of E. coli Beach Closings*, communities can lose thousands of dollars in revenue.

Recreational water quality monitoring: Beaches are run by governmental agencies that try to keep the shoreline safe for human use. In many cases these agencies monitor the water quality by testing bacteria levels. When levels are too high, areas that have monitoring programs will close the beaches.

Health Issues: When a beach is closed, everyone who uses nearshore areas for recreation – including divers and

swimmers – is at risk when bacteria are present. Bacteria and other germs in contaminated sand and water can cause vomiting, diarrhea, stomachaches, nausea, headaches, fever, giardiasis, rashes, and pink eye.

E. coli: *E. coli* is the bacteria used to determine if a beach should be closed. It is found in human and animal feces. *E. coli* is a common bacteria used for science experiments in thousands of schools and laboratories around the world. You have it living inside your intestines right now, as does every other human, and many other organisms. *E. coli* has hundreds of genetic variants; only a very few of these can make humans sick. The *E. coli* agencies search for in beach testing is not necessarily what makes humans sick, but it indicates the presence of fecal contamination (and possibly other pathogens that ARE harmful).

There is only one particular strain of *E. coli* harmful to human health, and it is relatively uncommon. However, *E. coli* is easy to test for and is an indicator of other potentially harmful bacteria that can exist under the same conditions. When *E. coli* is found in high levels, beaches are closed because bacteria harmful to human health may be present.

Algae: Excess nutrients, particularly phosphorus and nitrogen, can contribute to algae blooms, which may harbor potential human pathogens such as Salmonella. Algal blooms in water, if allowed to remain to the point of decay, can adversely impact water quality. Though small amounts of plant material are a natural part of coastal areas, large accumulations should be removed promptly by raking the plants ashore and moving them above the high water line.

procedure

1. Ask for a show of hands to find out how many students in your group swim regularly at a Great Lakes beach. Discuss as a class: Can beaches be dirty if there is no garbage to be seen? How? Take a few responses.
2. Are beaches in your area ever closed or do they have swimming bans? *This depends on whether or not your area has a recreational water quality monitoring program. Beaches in some areas are closed when bacteria levels exceed Environmental Protection Agency standards.*
3. Why does this happen? Create a list of ideas to assess students’ prior knowledge about why beaches close. *Note: If beaches are not monitored or closed in your area due to high bacteria levels, let students know that this happens in other areas of the Great Lakes.*
4. Use the background information to explain bacteria in general and *E. coli* in particular, and the health issues they present.

5. Have students work in small groups to solve beach mysteries on journal pages. Students may use the Alliance for the Great Lakes’ Prescription for a Healthy Beaches: <http://www.greatlakes.org/HealthyBeachesActionGuide> (or see copy on compact disc).

Answers to Beach Mysteries

- #1. How did the bacteria get there? *After the gulls have eaten, they may leave droppings behind on the beach. E. coli bacteria is found in human and animal waste. How can we help solve this problem? Don’t leave litter behind. Any litter can cause harm. Food-related litter can attract wildlife in greater numbers than might normally live at or near the beach. Wildlife waste may contribute to high bacteria levels at the beach.*

procedure continued

#2. How did the bacteria get there? *When a lot of precipitation (rain or snow) falls, the water treatment plant may not be able to process and clean all the water as quickly as it accumulates. If this happens, water treatment plants may release untreated sewage into the lake. E. coli may be found in the untreated sewage. This can cause elevated bacteria levels. As for the phone call, beach managers are often notified of sewage overflows.*

How can we help solve this problem? *Encourage your local municipality to make sure your water treatment facility is big enough to handle all of the water from your community. Do not contribute extra water to the system during a heavy rain. This may mean waiting to run your dishwasher or do your laundry.*

#3. How did the bacteria get there? *Dog waste may be contributing to E. coli or other bacteria in the water if the dog owners do not responsibly pick up after their pets. How can we help solve this problem? Always pick up after your pet. Encourage other animal owners to do the same.*

#4. How did the bacteria get there? *When rain reaches the ground during a rain event, it is called stormwater. As it accumulates, stormwater flows to the lowest point. In a Great Lakes community, this is often the lake. Stormwater carries bacteria and other pollutants from a variety of sources including animal waste from domestic and wild animals, as well as fertilizers. Stormwater flows from the surrounding surfaces (streets, parking lots, lawns, agricultural areas) over sand and into the lake. This can cause elevated levels of bacteria to be detected. Some communities funnel stormwater into the Great Lakes through pipes called outfalls, which can contribute to the bacteria levels. Nationally, stormwater is the most frequent cause of beach closings.*

How can we help solve this problem? *Encourage your community to incorporate "green spaces" such as rain gardens, wetlands, or a pond system near hard surfaces so the rain runoff can be absorbed and filtered instead of flowing directly into the Great Lakes. Other ideas include using hard surfaces that allow water to pass through (permeable paving) and planting native grasses in "green borders" around parking lots.*

6. Discuss the mysteries in a large group. Have students present their answers to each other.
7. Create! After students have solved the Beach Mysteries, have them create and label a diagram that shows at least three to four ways bacterial pollution can get to the beach. Students should include solutions to the problems in their diagrams
8. Discuss as a class: What are solutions to beach health issues? Have students share the responses in their diagrams. Remember that while monitoring can indicate that there is a problem, it doesn't identify or eliminate the source. Source elimination is the ultimate solution. How will students' knowledge of beach health issues change their future behavior at the beach?
9. As a follow-up, have students write a persuasive essay about human responsibility with regard to beach health. This can include the following:
 - a. Your area may or may not have a program for monitoring the recreational water quality for beach health purposes. Why should such a program exist in your community?
 - b. Humans can change their behaviors to improve water quality. What should or shouldn't people do to help improve water quality?

wrap-up

1. Play Mysterious Bacteria to finish the activity.
2. Students sit in a circle with their eyes closed. Choose one student to be the "beach bacteria." Tap this student on the shoulder and have everyone re-open his or her eyes. The student uses the knowledge from the activity to decide what source s/he is from (*sewage overflow, seagull waste, stormwater runoff*)
3. Have the students walk around the room, shaking hands with each other. When the "bacteria" student shakes hands, s/he squeezes the other students' hand, indicating the spread of the bacteria.
4. When a student is "contaminated," s/he dramatically falls to the ground, indicating sickness.
5. Other students can guess who the "bacteria" student is. If they are wrong, they are out of the game.
6. Once the student is identified, the other students can ask yes or no questions to determine the student's selected source of contamination.

7. After the game, explain that it is currently very difficult to determine the source of bacteria in the water, much like it was difficult to determine which student was the harmful bacteria and what their source was.

extension

1. Research the status of recreational water quality in your area by inviting a beach manager as a guest speaker to your classroom.
2. Have the students decide if they would like to take action to improve beach health in their community by:
 - Participating in the Alliance for the Great Lakes's Adopt-a-Beach™ program, which enables students to create positive change for their beaches through litter clean-up and monitoring and water quality monitoring.
 - Turning the persuasive essays regarding beach health into a class "letter to the editor" for your local paper.

assessment

Rubric on page 311

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FIRST NAME																				
LAST NAME																				

[1] **Facts:** A high level of bacteria is not detected at the beach. A flock of seagulls spot some food and wrappers left behind by humans. They land on the beach to eat and inspect the garbage. A boat sails by in the distance. Two kayakers paddle up to the shore, which startles the birds. They fly away. Several hours after the seagulls arrived, water samples are taken. When they come back from the lab, results show there is a high level of bacteria in the water near the beach.

Questions: How did the bacteria get there?

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How can we help solve this problem?

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[2] **Facts:** The beach is clean. A high level of bacteria is not detected. That night a huge rainstorm takes place. It rains hard all night long. You think it is a great night to stay in and do laundry and your dishes, so your family runs both the washing machine and the dishwasher. You listen to music while doing homework, then go to bed. The next day, the beach is closed because the beach managers have received a call from the water treatment plant. Based on the call, the beach managers know there will be high levels of bacteria in the water.

Questions: How did the bacteria get there?

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What did the mysterious phone call tell the beach managers about why the beaches should be closed?

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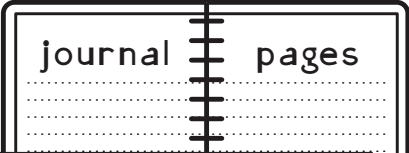
How can we help solve this problem?

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FIRST NAME																				
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[3] **Facts :** A few friends meet on the beach in the morning to walk their dogs. The dogs run along the shoreline and into the water, fetching sticks for an hour. A jet-ski zooms by in the distance and several motor boats pass by at high speeds. When the group with the dogs leaves, there is dog waste visible along the water's edge. The next day, the beach is closed because the beach managers have detected high levels of bacteria at the beach.

Questions: How did the bacteria get there?

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How can we help solve this problem?

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[4] **Facts :** During a walk around your neighborhood, you see dog waste on the ground, ants walking on the sidewalk and into the grass and hear birds singing in the trees. After it rains that night, the beaches are closed. You remember that the dog waste was not close to the beach, but in the grass across the street from it. It was not really a heavy rain, and you know that there was not a "sewage overflow," but there are still high levels of bacteria when the beach managers get the results back from a water sample they take after the rainy night.

Questions: How did the bacteria get there?

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How can we help solve this problem?

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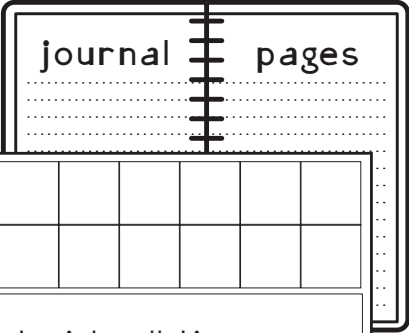
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FIRST NAME																				
LAST NAME																				

[5] Create and label a diagram that shows at least three ways bacterial pollution can get to the beach. Include solutions to the problems you indicate in the diagram.

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