

LESSON 3 Pollution “The Suspect”

Lesson at a Glance

This lesson engages students in considering sources of pollution for Hawai‘i’s beaches, focusing on Claude the Crab and his problem with pollution. Students examine maps of the local field trip site (Claude’s Home), and hypothesize about the source of point source pollution and the many sources of non-point source pollution.

Lesson Duration

Two 45-minute periods

Essential Question(s)

How is pollution and the sources of pollution defined?

Key Concepts

- Pollution is anything in the air, soil, or water that degrades the environment.
- Point source pollution can be traced to a specific source, such as a local factory.
- Non-point source pollution cannot be traced to one specific source, and usually comes from many sources, such as car emissions.

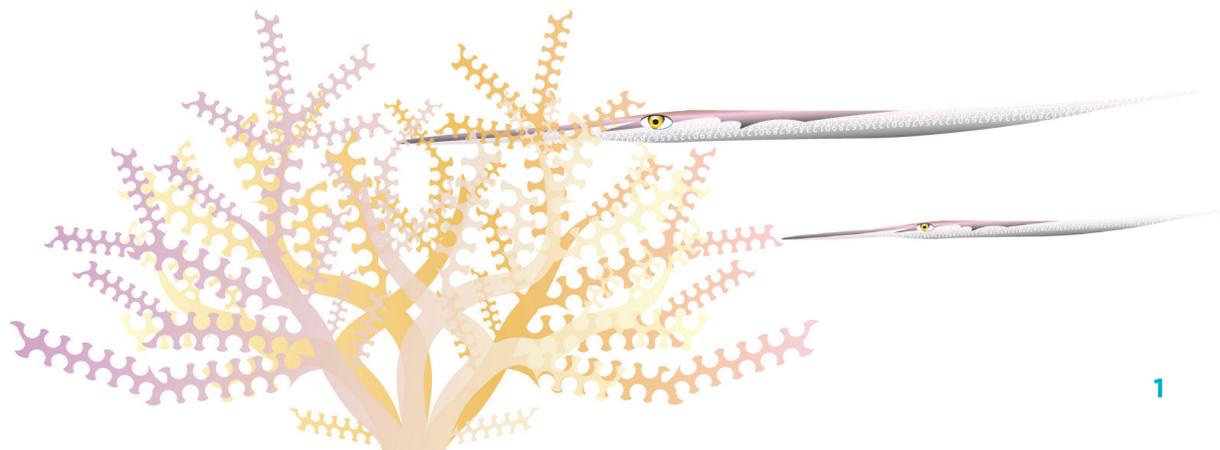
Instructional Objectives

- I can make observations and inferences about possible sources of pollution on Hawai‘i’s beaches.
- I can differentiate between point source pollution and non-point source pollution.

Related HCPSIII Benchmark(s):

Science: SC.4.1.2
Differentiate between an observation and an inference.

Science: SC.4.2.1
Describe how the use of technology has influenced the economy, demography, and environment of Hawai‘i.



Assessment Tools

Benchmark Rubric:

Topic		Scientific Knowledge	
Benchmark SC.4.1.2		Differentiate between an observation and an inference	
Rubric			
Advanced	Proficient	Partially Proficient	Novice
Explain the difference between an observation and an inference and give examples	Differentiate between an observation and an inference	Provide examples of observations and inferences	Define an observation and an inference
Topic		Science, Technology, and Society	
Benchmark SC.4.2.1		Describe how the use of technology has influenced the economy, demography, and environment of Hawai'i	
Rubric			
Advanced	Proficient	Partially Proficient	Novice
Explain how the use of technology has influenced the economy, demography, and environment of Hawai'i and suggest ways to conserve the environment	Describe how the use of technology has influenced the economy, demography, and environment of Hawai'i	Give examples of how the use of technology has influenced the economy, demography, and environment of Hawai'i	Recognize that the use of technology has influenced the economy, demography, and environment of Hawai'i

Assessment/Evidence Pieces

Lesson

- Student Worksheet *Beach Observations*
- Student writing at the end of the lesson

Materials Needed

Teacher	Class	Group	Student
<ul style="list-style-type: none"> • Teacher Reading: <i>The Case of Claude the Crab</i> • Map of your field trip site, including likely sources for beach pollution 	<ul style="list-style-type: none"> • None 	<ul style="list-style-type: none"> • None 	<ul style="list-style-type: none"> • Student Worksheet: <i>Beach Observations</i> • Student Reading: <i>Types of Pollution</i>

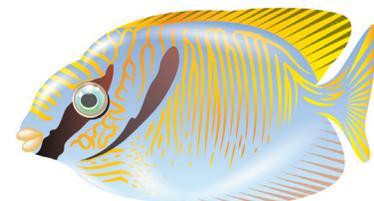
Instructional Resources

Teacher Reading: *Point and Non-Point Source Pollution*

Teacher Reading: *The Case of Claude the Crab*

Student Reading: *Types of Pollution*

Student Worksheet: *Beach Observations*



Student Vocabulary Words

pollution: anything in the air, soil, or water that degrades the environment.

point source pollution: pollution that can be traced to a specific source.

non-point source pollution: pollution that cannot be traced to a specific source.

Lesson Plan

Lesson Preparation

- Read the Science Background provided in the Unit’s Overview, Teacher Readings *Point and Non-point Source Pollution* and *The Case of Claude the Crab*.
- Review and make copies of Student Worksheet *Beach Observations* and Student Reading *Types of Pollution*, one per student.
- Download Google Earth software from <http://earth.google.com>. Click on the Download Google Earth Free button at the top far right side of the webpage. Follow the download instructions. Identify a map of your region (by using the search feature, for example, type in *Kailua*, HI), including the beach, and paste the map into beach site observations. Make copies of regional map, one per student.
- Identify potential point source pollution and non-point source pollution sources using information available by county, from http://www.scorecard.org/env-releases/counties-in-state.tcl?fips_state_code=15
- Take photographs or use images found on the internet of observed pollution on the beach. You can use these photographs or images from the internet in the discussions of point source and non-point source pollution, and on a bulletin board display. You may find that much of the pollution that you observe on the beach consists of plastic or pieces of plastic (*beach confetti*). Even if it is difficult to comprehend what the plastic used to be (*a six-pack holder? A plastic bag?*), take photographs for the students.
- Create one or more class bulletin board(s) that includes evidence of beach pollution in Hawai’i. Students can bring in items that they found on the beach to be tacked on the bulletin board as evidence. Caption each piece of evidence with the location where it was found. If digital cameras are available, take photographs and also post them on the bulletin board. These will be helpful in later lessons when students are asked to compare their expectations of beach pollution to what they actually observe.
- Students should begin a beach detective science notebook.

I. *What is Pollution?*

- A. Reread *The Case of Claude the Crab* to students. Remind students that they will help Claude the Crab by learning more about beaches in the classroom, and then during a field trip in later lessons.
- B. For now, students will concentrate on learning more about pollution. Write the word *pollution* on the board.
 - 1) Ask students if they could identify any pollution in the story. Write down their answers on the board around the word *pollution*.
 - 2) Develop a class definition for the word *pollution*. Tell students that they will return to this definition as they learn more about pollution.
- C. Create one or more class bulletin board(s) that include evidence of beach pollution in Hawai’i. Students can bring in items that they found on the beach to be tacked on the bulletin board as evidence. Caption each piece of evidence with the location it was found. If digital cameras are available, take photographs and also post them on the bulletin board. These will be helpful in later lessons when students are asked to compare their expectations of beach pollution to what they actually observe. Make sure to include the class definition of *pollution* on your bulletin board.

II. *What are Point Source and Non-point Source Pollutions?*

- A. Have students take pictures of observed pollution or if you took photographs, you may wish to pass them around the classroom. Teacher may also choose to use magazine clippings or pictures from the internet.
- B. Place a piece of chart paper up on the board with the table below on it to record student responses. Have students pose questions based on their observations of the photos and record them in the table on the chart paper under the investigative questions column. Ask students “How do you think you can find the answers to these questions? Can you categorize these questions?” Make a table to capture the students’ observations, inferences, and investigative questions.

Observations vs. Inferences about Beach Pollution

Investigative Questions	Observations	Inferences

- C. At this time, teach students about point source pollution and non-point source pollution. Hand out the Student Reading *Types of Pollution*. Read through the chart in the reading material and discuss. During your discussion write the terms *Point Source Pollution* and *Non-Point Source Pollution* on the board, along with the definitions. Talk about each type of pollution and possible examples of sources for this pollution. Talk about how some of those pollutants end up on the beach and in the ocean. Refer to Teacher Reading on *Point Source and Non-Point Source Pollution* for any additional information you would like to provide to the class.
- D. Give students a map of your area surrounding a beach, using *Google Earth* or other sources and also a copy of Student Worksheet *Beach Observations*. Take a moment to orient the students with the map. Go over and point out major land marks. Discuss the maps legend if there is one. Then using the list of suggested potential sites of pollutions from the student worksheet, mark these sites on the map. Then complete the chart. (See directions on the worksheet for further clarification.)
- E. Tell students that what they have done was to make observations about potential sources of point source and non- point source pollutions. They have also made inferences about what types of pollution might be occurring at these locations. Ask students if they know for sure. Lead them to the conclusion that, to be sure, they need to make more observations, collect evidence, or conduct tests. Ask what the process is called for making observations, collecting evidence and running tests. Answer should be experimental procedure, which was introduced in Lesson 2.
- F. Ask students whether they, their friends, or members of their family have contributed to point- source pollution. If so, what could they do to reduce their pollution?

III. *Check for Understanding*

- A. Return to the original class definition of *pollution*. Ask students whether the definition is correct. If they think it is incorrect, ask them how they could modify the definition to make it correct. It is important that students know that not all pollution can be seen (i.e. chemicals in run-offs). Some pollution is invisible, but harmful all the same.
- B. Check for understanding of the terms *pollution*, *non-point source pollution*, and *point source pollution* in Hawai'i by asking students to write a paragraph or paragraphs explaining what pollution is, the different types of pollution and how they affect the beach habitat where Claude the crab lives.

- C. Lead a discussion concerning personal responsibility for pollution by asking the following questions: How do they contribute to pollution? What do they think happens to their trash when they throw it away? How can students prevent pollution? What can they do about pollution while they are at the beach?

Extended Activities

1. Interview long-time Hawai'i residents within your family, or in your neighborhood, about:
 - a. the beaches in Hawai'i when they were little.
 - b. the beaches in Hawai'i now.
 - c. the streams in Hawai'i now.
2. Compare and contrast data from the past to the present and create a timeline.



LESSON 3 Teacher Reading

Point and Non-Point Source Pollution

Pollution is anything that is in the air, soil, or water and degrades (or lowers) the quality of the environment.

Air pollution is created by cars, which release carbon dioxide. In Hawai‘i, volcanic activity also contributes to air pollution, which sometimes reduces the visibility over the islands, causing a smog-like condition called *vog* (the shortened term for *volcanic emissions*). Hawaiian *vog* contains sulfur dioxide, a poisonous gas. When inhaled in small quantities in the air, sulfur dioxide can irritate the mucous membranes. Sulfur dioxide can also combine with moisture in the air to create acid rain. Acid rain is particularly damaging to people who use rain catchment systems, because the acidity in rain water can cause the release of lead into catchment water, which is then taken into the body.

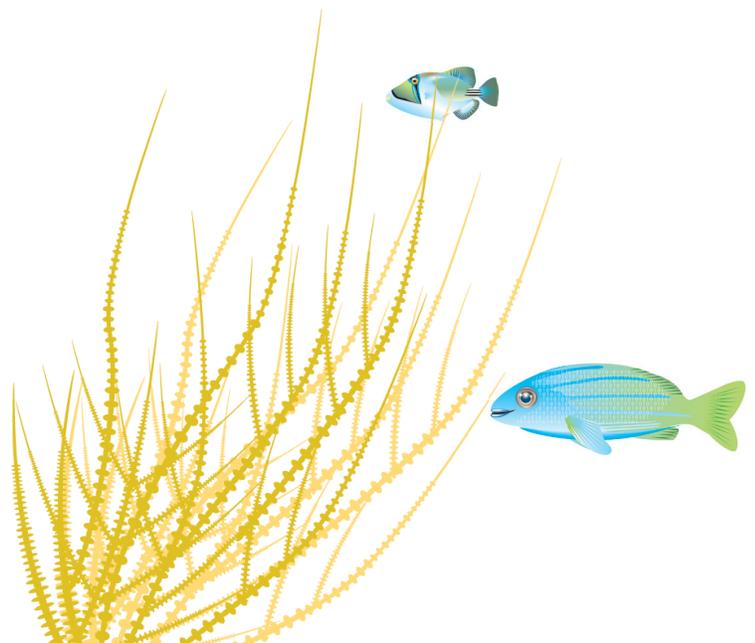
Soil pollution is created when pollution leaches into the soil from the surrounding air and water. Soil pollution can include lead, from leaded gasoline, as well as feces from animals, such as hogs and cattle.

Water pollution is created by agriculture, which leaches pesticides and fertilizers into the groundwater, and raises the levels of phosphates and nitrates in the water. Water pollution is also created by sewage from humans and animals.

Pollution of all sorts is categorized as point source pollution, if the source of the pollution can be identified, or non-point source pollution, if the source of the pollution is from multiple locations which can't be identified.

Source for the above information was obtained from

http://www.scorecard.org/env-releases/cap/county.tcl?fips_county_code=15001#air_rankings



LESSON 3

Teacher Reading

The Case of Claude the Crab

It was a hot, muggy day, and I was sitting sleepily at my desk when in rushed the largest crab I had ever seen. He introduced himself quickly as Claude Crab, and told me he desperately needed to hire a private detective. Of course, my first question was what crime he needed investigated. Immediately, he started talking very fast and clicking his claws together in obvious panic. When I could finally get him calmed down so I could understand him, I started to get the picture...

The crime was attempted murder. This poor crab's home was being destroyed, and he was in grave danger of being killed! He did not have any idea what was going on, or why someone would want to kill him. Claude was sure that he had no personal enemies, and certainly none capable of the magnitude of destruction he was describing.

Then, he gave me the first clue. He said that every day, the beaches and ocean waters became more crowded with dead objects that he did not recognize. He described many shapes, colors, and textures: He said that none of the objects were good to eat, and all they did was clutter up the beach. But, the most dangerous, by far, were these funny loops of some strange, thin stuff that was almost invisible. Once you had gotten caught in it, it was almost impossible to get free. He was sure that someone was laying traps for him!

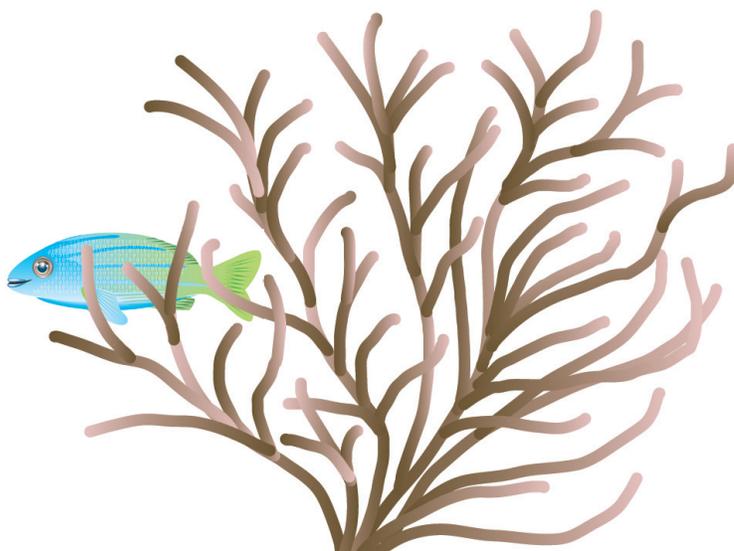


The second clue was his story of how some days the very ocean waters turned poisonous with strange colors and disgusting flavors. He said that on those days, he had no choice but to stay out of the water and go hungry until the poisons had dissipated. The water burned his gills too much to go in.

Furthermore, he said that he was not the only one in danger from these criminals. All his friends in the ocean were in danger. The fish, the seals, the dolphins, and the birds were all fighting for their lives against an enemy that they did not understand. He made a rather eloquent plea for my help.

After making suitable arrangements for payment and travel expenses (of course), I thanked Claude and assured him that I would get to work on his investigation first thing in the morning. I would find the villain and save him and his friends!

As soon as he left, I began to regret my bold promises. This was obviously far too big a job for me to handle alone...



LESSON 3 Beach Observations

The Neighborhood Around the Beach

***Directions for Labeling the Map:** Not all clues for an investigation are found at the scene of the crime. Use the map provided by your teacher of the area surrounding the beach to fully investigate and identify all the sources that could have an impact on your beach. Following is a partial list of potential sites.*

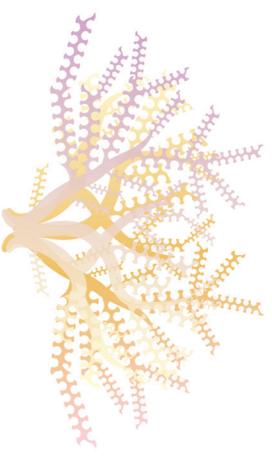
farms	storm drains	beach parks
golf courses	canals	construction sites
streams	boat harbors	industry
soil erosion	landfills	

Mark any potential sources of pollution on the map provided. Use different colors or symbols to identify sites.



Directions for Filling out the Chart: Using the following chart, list each site on the map that you labeled as a possible source of pollution. In the pollutants column, explain the ways it may affect the beach environment. In the last column, note whether it is point source or non-point source pollution.

Possible Sources of Pollution	Effects of Pollutants	Point or Non-point source?



LESSON 3 Types of Pollution

Pollution Chart	
Type of Pollution	Description
Point Source: Originating from a single, identifiable source that can be monitored	
Smoke stacks from power plants	Chemicals released in the air
Industrial businesses that use hazardous materials	Various chemicals and heavy metals, oil, gasoline
Kahe power plant thermal discharge	Above ambient temperature seawater used in the cooling system and released into the ocean
Municipal Sewage Discharge	Treated wastewater effluent released into the ocean
Non-Point Source: Multiple sources that collectively make their way into the environment, usually through surface runoff and are hard to monitor	
Car washing	Soaps and brake dust
Pet waste	Cat and dogs as well as feral animals
Littering	Improperly disposed trash
Illegal dumping	Improperly disposed items like cars, electrical equipment, lumber etc
Agriculture	Animal waste, fertilizers, pesticides, herbicides that is carried with runoff
Sediments	From construction sites that gets carried with runoff

