2011

Water, Science, and Civics: Engaging Students with Puget Sound, An Interdisciplinary Curriculum Recommended for Grades 9-12

Facing the Future, Western Washington University

Water, Science, and Civics:
Engaging Students with Puget Sound

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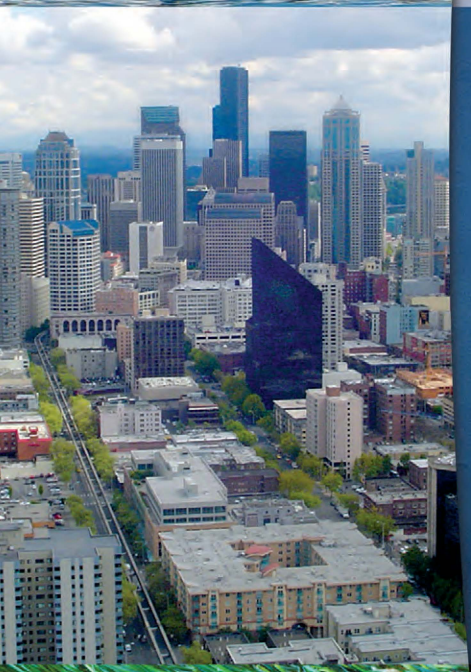

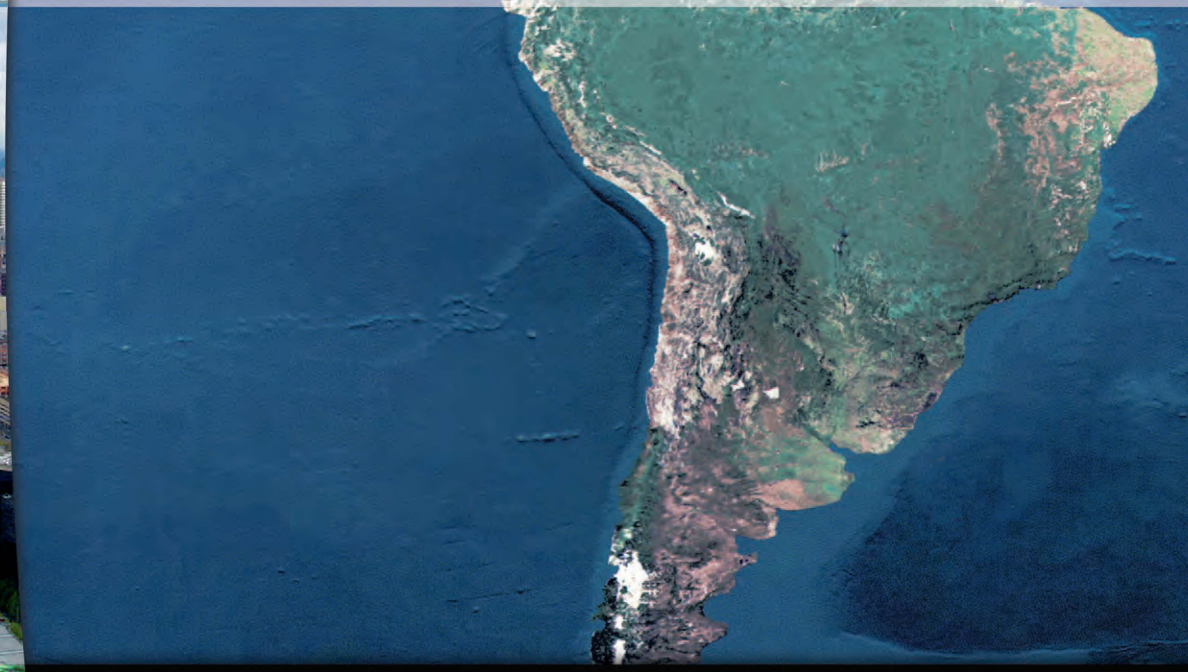

1-Week Curriculum Unit

Facing THE Future™

Water, Science, and Civics:

Engaging Students with Puget Sound

An Interdisciplinary Curriculum
Recommended for Grades 9–12

Facing THE Future™

Water, Science, and Civics:
Engaging Students with Puget Sound

Facing the Future is a nonprofit organization whose mission is to engage students in learning by making academics relevant to their lives. We empower students to think critically, develop a global perspective, and participate in positive solutions for a sustainable future.

We develop and deliver standards-based hands-on lessons, student textbooks, curriculum units, and professional development opportunities for educators that promote critical thinking on global issues, sustainability and positive solutions. *Facing the Future* curriculum is in use in all 50 U.S. states and over 100 countries by teachers and students in grades K-12, in undergraduate and graduate classes, and across multiple subject areas. In 2010, *Facing the Future* reached more than 1,500,000 students through its programming.

For more information, visit www.facingthefuture.org.

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Introduction for Educators

Imagine a classroom where students are mastering social studies and science content as they:

- create digital public service announcements that educate the local community about how to decrease water pollution
- propose solutions at town hall meetings to keep Puget Sound healthy

Water, Science, and Civics engages students in these types of lessons. Not only do students master standards, but they also develop 21st century skills related to digital literacy, media literacy, critical thinking, problem solving, collaboration with peers, and taking multiple perspectives. They become thoughtful leaders who participate in problem-solving activities similar to ones they will encounter as active citizens in the future.

Recent research suggests that student engagement can help support student achievement now and in the future. Students who are engaged are more likely to excel in the classroom.[1] Learning core content that helps them make real world connections can highly motivate students.

The series of five lessons in *Water, Science, and Civics* will lead your students through an exploration of the significance of Puget Sound both as a body of water and the geographic region that surrounds it. Students will learn specifically about the services the Sound provides for humans economically, socially, and environmentally. They will engage in activities that range from understanding the scientific impacts of human behavior on the Sound to considering the many points of view involved in Puget Sound pollution prevention. The culminating lesson is an action project in which students create solutions to reduce pollution in their local community.

Included in each lesson are ideas for **discussion questions**, **background readings**, and **additional resources**. All lessons are **SMARTBoard compatible** and have a number of integrated technology components including **Google Maps** and **PowerPoint**. Though the lessons are designed as a comprehensive unit, each lesson can also stand alone. The lessons were pilot tested and reviewed by Washington educators and are aligned to science, social studies, language arts, technology, and sustainability standards

Teaching your students about local and global issues that impact their lives can encourage them to create effective solutions. *Water, Science, and Civics* will help you do just that in a uniquely engaging way as students learn core social studies and science skills.

JOHN DURBAN

1 Center for Comprehensive School Reform and Improvement (April 2007). "Using Positive Student Engagement to Increase Student Achievement," http://www.centerforcsri.org/index.php?option=com_content&task=view&id=446&Itemid=5.

Unit at a Glance

Grade Level: 9-12

Unit Length: 1 week, plus time to create digital public service announcements

Subject Areas

- Science
- Social Studies
- Technology
- Language Arts

Key Concepts

- Ecosystem services
- Media literacy
- Point and nonpoint source pollution
- Stormwater runoff
- Sustainability
- Watershed
- Sustainable development

Washington State Standards Addressed

- Science GLEs
- Social Studies GLEs
- Technology GLEs
- Language Arts GLEs
- Integrated Environmental and Sustainability Learning Standards

Table of Contents

Lesson 1

A Sound Introduction

An introductory slideshow

activity challenges students to determine connections among various images of Puget Sound. Students distinguish different types of ecosystems included in the region. In a mapping activity, students learn about physical features of the region while identifying their own location within the region.

JESSEE STANLEY


LAURA SKELTON

Objectives

Students will:

- Recognize a variety of Puget Sound ecosystems
- Identify their location within the Puget Sound region, using an on-line mapping tool

Inquiry/Critical Thinking Questions

- What different types of ecosystems comprise the Puget Sound region?
- What kinds of species live in and around Puget Sound?
- How are we as individuals a part of the Puget Sound region?

Subject Areas

- science (environmental, biology)
- social studies (geography, civics)
- technology

Time Required

30 minutes

Key Concepts

ecosystem—an environment and the living organisms within that environment, interacting together as a functioning unit

Additional Vocabulary

sound—an inlet from the sea; typically a long, fairly narrow, and deep body of water

Washington State Science Standards Addressed

9-12 APPA: Science affects society and cultures by influencing the way many people think about themselves, others, and the environment. Society also affects science by its prevailing views about what is important to study and by deciding what research will be funded.

Washington State Social Studies Standards Addressed

(Grades 9/10) 3.2.1 Analyzes and evaluates human interaction with the environment across the world in the past or present.

(Grade 11) 3.2.1 Analyzes and evaluates human interaction with the environment in the United States in the past or present.

(Grade 12) 3.1.1 Analyzes information from geographic tools, including computer-based mapping systems, to draw conclusions on an issue or event.

Washington State Integrated Environmental and Sustainability Standards

Standard 1: Ecological, Social, and Economic Systems

Standard 2: The Natural and Built Environment

Standard 3: Sustainability and Civic Responsibility

CHRISTIE HEYER

Washington Technology Standards

(Grades 9-12) 1.3.2 Locate and organize information from a variety of sources and media.

Materials/Preparation

Photo Slideshow: *How are these images connected?*

Internet access for Google Maps

Activity

Introduction (15 minutes)

1. Tell students that you are going to show a series of photos and will be asking them to determine what these pictures have in common.
2. Show the photos, by PowerPoint or document camera, slowly enough that students can take brief notes.
3. Give students a minute to think about what these pictures have in common. Then, have them partner with a classmate to exchange ideas.
4. Show the photos a second time.
5. Give student pairs another minute to discuss what element(s) might be in common among the photos.
6. If no one has guessed it, explain that these are all photos of the Puget Sound region, the area where we live.
7. Ask students to identify some of the different ecosystems pictured. You may want to have students first recall what an ecosystem is. *(An ecosystem includes an environment and the living organisms within that environment.)* The pictures show marine, freshwater, and terrestrial ecosystems, as well as artificially constructed ecosystems such as farms, sports fields, and neighborhoods.

Discussion Questions

1. What surprised you?
2. Which images did you find most interesting? Why?
3. What other images would you add?
4. How would you describe Puget Sound in your own words?

Mapping Puget Sound (15 minutes)

1. Ask if any volunteers can describe a body of water known as a "sound."
2. Share the following definition with the class: *A sound is an inlet from the sea. Sounds are typically long, fairly narrow, and deep bodies of water.*
3. Ask students to identify whether the water in a sound would be salt water or fresh water. *(Because a sound is an inlet of the sea, it is salt water or marine. The rivers and streams that lead into the sound, however, are freshwater.)*

DAVE WILTON

4. Ask students to share what they already know about Puget Sound. Have they seen it? What does it look like? Could they point to it right now? What cities are located around the Sound?
5. If they are not sure about its location, let students know that Puget Sound is a body of water that lies between the Cascade Mountains (to the east) and the Olympic Mountains (to the west). People often also use the term "Puget Sound" to identify the region that surrounds and includes the Sound. *(In fact, we are in the Puget Sound region right now.)*
6. Have students follow these instructions to view their exact location within the region using an online mapping program.
   a. Click on the "Google Maps" link, or go to maps.google.com.
   b. Type in your current address.
   c. Zoom out slowly until you can see the entire Puget Sound region, including the San Juan Islands to the north and Tacoma to the south.
7. **Option:** Ask students to identify additional features of the area where they live. Use the "Satellite" feature in Google Maps for this task. Then, ask students to reflect on how these features may impact the Sound.
   a. Are there any streams nearby that connect to Puget Sound?
   b. How large is the buffer area between the Sound and the built environment (buildings, roads, etc.)?
   c. How much of the area around your home appears to be natural habitat or parks?
   d. Are there farms nearby?
   e. Are there many roads or only a few?

Discussion

1. Are you relatively close to or far from Puget Sound?
2. Even if you don't live right on Puget Sound, are there other bodies of water near you? How do they connect to the Sound?
3. How do you think your actions might affect Puget Sound and the people and other species that live in the region?
4. How might the actions of other people in the region impact the place where you live?

PUGET SOUND ENERGY

Technology Extension

Use any of the following mapping tools to further explore the Puget Sound and your relative location within the region. Identify the Olympic and Cascade mountain ranges and major cities along the Sound (including Tacoma, Seattle, and Everett).

- **Google Earth:** http://bit.ly/ju5PZp
  Type in your address and identify your location. "Add Placemark" to place a yellow thumbtack on your location on the map.
- **Interactive maps** from Puget Soundkeeper Alliance: http://bit.ly/lSgEds
- **Interactive map** of Western Washington: http://bit.ly/lmUCNr

How are these images connected?

FROM TOP LEFT HAND CORNER TO BOTTOM RIGHT: KIM RAKOW BERNIER, MALCOLM SURGENOR, JESSE STANLEY, LAURA SKELTON, JESSE STANLEY, LAURA SKELTON, LAURA SKELTON, JESSE STANLEY, STEVE BIBER, SHEEBA JACOB, WENDY CHURCH

Lesson 2

Ecosystem Services & Sustainability

Students discover the importance of ecosystem services in the Puget Sound region. Working in small groups, students critically analyze how various ecosystem services support environmental, social, or economic systems in the Sound.

KARL VOELKER

JESSE STANLEY

Objectives

Students will:

- Brainstorm ecosystem services provided by Puget Sound's ecosystems
- Determine how ecosystem services provided by Puget Sound support the region's sustainability

Inquiry/Critical Thinking Questions

- How do ecosystem services support environmental, economic, and social systems?
- How can our actions impact the ability of Puget Sound to provide ecosystem services?

Subject Areas

- social studies (geography, civics)
- science (environmental, biology)

Time Required

30 minutes

Key Concepts

ecosystem services—resources and processes supplied by nature

sustainability—the ability of people to meet their needs now without compromising the ability of people to meet their needs in the future

Additional Vocabulary

environment—physical surroundings; environments can be natural or manmade/built

society—a group of people that share common interests or common culture

economy—the way a community, region, or country makes and uses money, goods, and services

Washington State Science Standards Addressed

9-12 APPA: Science affects society and cultures by influencing the way many people think about themselves, others, and the environment. Society also affects science by its prevailing views about what is important to study and by deciding what research will be funded.

9-11 ES2D: The Earth does not have infinite resources; increasing human consumption impacts the natural processes that renew some resources and it depletes other resources including those that cannot be renewed.

Washington State Social Studies Standards Addressed

(Grades 9/10) 3.2.1 Analyzes and evaluates human interaction with the environment across the world in the past or present.

(Grade 11) 3.2.1 Analyzes and evaluates human interaction with the environment in the United States in the past or present.

(Grade 12) 3.2.1 Evaluates how human interaction with the environment has affected economic growth and sustainability.

R KLISE

Washington State Integrated Environmental and Sustainability Standards

Standard 1: Ecological, Social, and Economic Systems

Standard 2: The Natural and Built Environment

Standard 3: Sustainability and Civic Responsibility

Materials/Preparation

Teacher Master: *Ecosystem Services*

Activity

Steps

1. Ask students if they can come up with a definition for the term "ecosystem services." *(Ecosystem services are resources and processes supplied by nature. They might include clean drinking water, decomposition of wastes, habitat for wildlife, and weather moderation.)*
2. Divide students into groups of 3-4.
3. Ask each group to create a list of 10 or more potential ecosystem services that are provided by ecosystems in the Puget Sound region (including all of the land and water resources in the area).
   - **Note:** Refer to the teacher master *Ecosystem Services* if you need ideas. These include marine, freshwater, and terrestrial ecosystem services.
4. For each ecosystem service listed, ask student groups to determine how they or other persons might benefit from that service. Encourage them to think of ways they might enjoy these services either directly or indirectly.
5. Now ask them to consider how each ecosystem service is linked to the sustainability of the region. *(Sustainability means that the needs of the present can be met without limiting the ability of people to meet their needs in the future.)* Remind

ZESHAN KHAN

students that sustainability refers not only to the health of the environment but also to the health of people/societies and economies. In a sustainable community, all 3 sectors—environment, economy, and society—are thriving.

- **Note:** If students are not familiar with the terms *environment*, *society*, and *economy*, go over the definitions provided at the beginning of this lesson with them.

6. On the board, draw a large Venn diagram with 3 overlapping circles: environment, economy, and society. See an example diagram of the three overlapping sectors of sustainability at the end of this lesson.

7. Ask a volunteer from each group to share 1 ecosystem service from their list, indicate where it falls in the sustainability Venn diagram, and explain their reasoning. For example, if a particular service contributes to environmental sustainability, then students should write it in the "environment" circle. If an ecosystem service contributes to sustainability in more than 1 category, it should be listed where those categories overlap.

- **Option:** Go through an example together with students. Take the ecosystem service of providing food, for example.
  - **i.** Ask students to think about what kinds of foods are provided by Puget Sound ecosystems. *(Fish, shellfish, berries, etc.)*
  - **ii.** Next, ask them to consider how this might help sustain the environment. *(Wildlife are supported by this food.)*
  - **iii.** Does it help sustain people or societies? *(People eat the food.)*
  - **iv.** Does it help sustain local economies? *(People earn a livelihood from farming or catching fish and shellfish.)*
  - **v.** Write the word "food" in the area of the Venn diagram where it best fits. *(In this example, it would fit in the center because it supports all 3 sustainability sectors.)*

8. Share student ideas and ask students to respectfully challenge other groups when they disagree about how an ecosystem service has been categorized.

KLH49

Discussion Questions

1. In your opinion, does an ecosystem service need to directly benefit humans to be valuable? Explain why or why not.
2. How do ecosystem services support the sustainability of a region or community?
3. Which ecosystem service provided by the Puget Sound is most important to you, and why?
4. What do you think might happen to our community if these ecosystem services are not protected?
5. What activities or events could impact ecosystem services in Puget Sound, either positively or negatively?

Communications Extension

Use information and ideas generated from this activity to come up with a 1-sentence "catch phrase" (or marketing slogan) that could encourage people to get involved in protecting and enhancing Puget Sound.

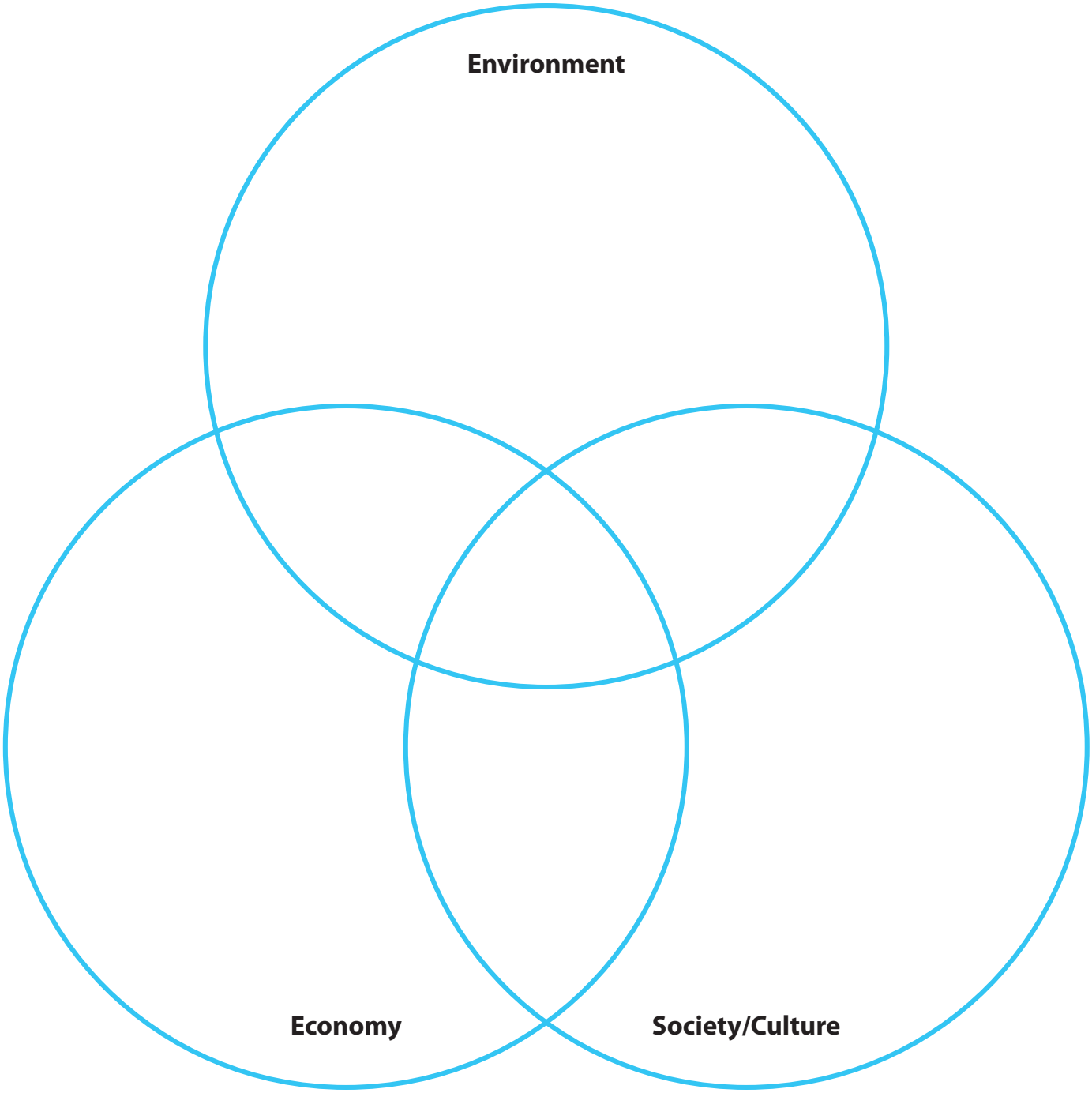
- **Option:** Incorporate one of these slogans into a video in Lesson 5.

Teacher Master: Ecosystem Services

- **food**
- **fiber/timber**
- **water for drinking**
- **waterways for boats**
- **hydroelectric power**
- **flood and storm protection**
- **wetlands for water purification**
- **shoreline stabilization/erosion control**
- **places for hiking, camping, and outdoor recreation**
- **waterways for kayaking and canoeing**
- **spiritual/cultural meaning from nature and wildlife**

List adapted from Puget Sound Partnership: http://www.psp.wa.gov/aa_ecosystem.php

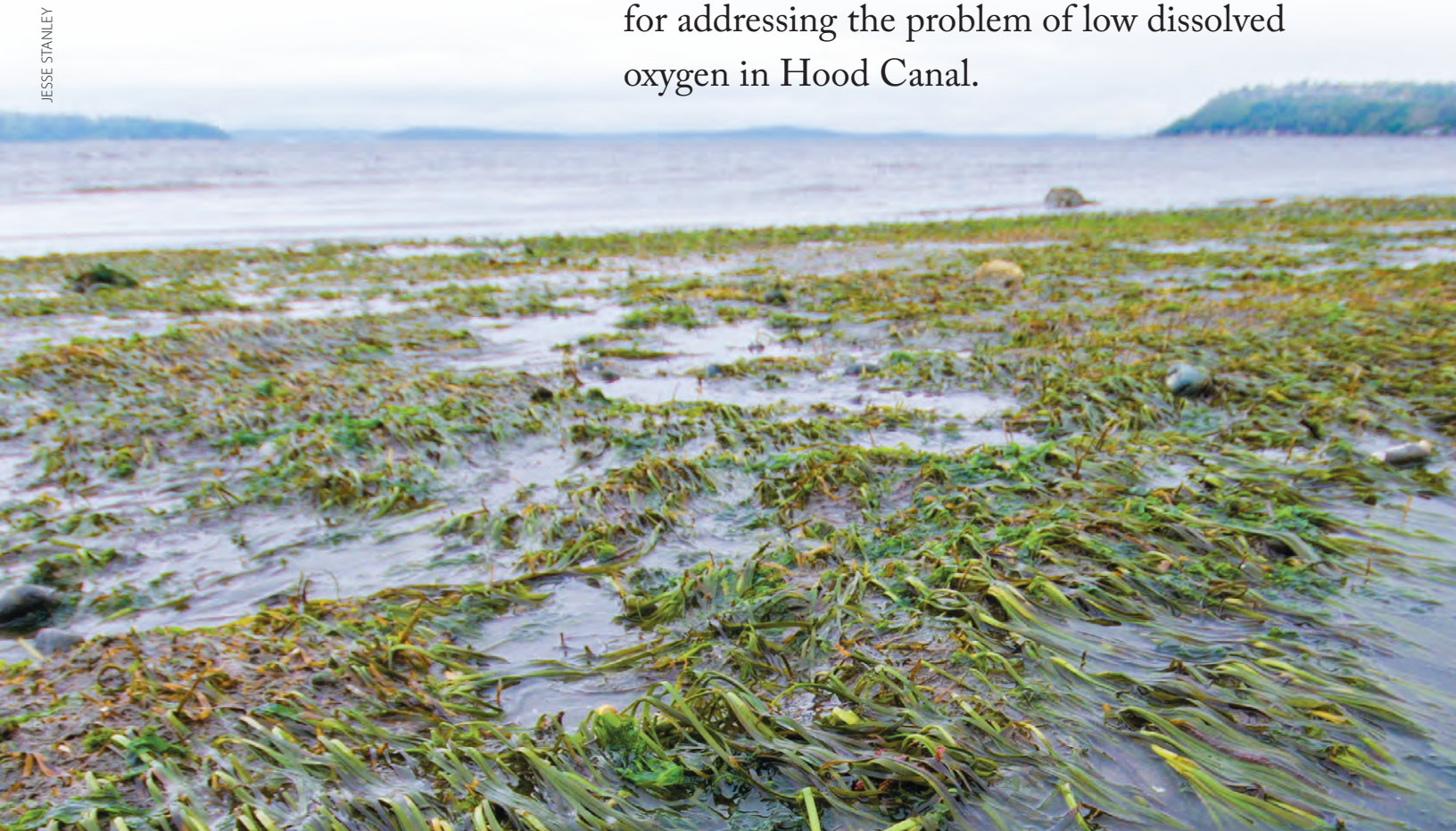
Three Sectors of Sustainability



Lesson 3

Nonpoint Source Pollution in Puget Sound

Students learn to distinguish between point and nonpoint source pollutants while they learn about real pollutants in Puget Sound. Students then learn about how nutrient pollution is affecting South Puget Sound. They develop research questions and strategies for addressing the problem of low dissolved oxygen in Hood Canal.



JESSE STANLEY

LAURA SKELTON

Objectives

Students will:

- Differentiate between point and nonpoint source pollution
- Understand how nonpoint source pollution reaches Puget Sound through stormwater runoff
- Formulate research questions to investigate the issue of low dissolved oxygen in South Puget Sound

Inquiry/Critical Thinking Questions

- What pollutants are found in Puget Sound, and how do they relate to human activities in surrounding neighborhoods?
- How does nonpoint source pollution reach Puget Sound?
- How do excess nutrients affect water quality?
- How could students help to identify and reduce sources of nonpoint source pollution?

Subject Areas

- social studies (geography, civics)
- science (environmental, biology, chemistry)

Time Required

45 minutes

Key Concepts

point source pollution—harmful substances released from an identifiable source

nonpoint source pollution—harmful substances released from many different sources that cannot be individually identified

stormwater runoff—unfiltered water that reaches natural bodies of water by flowing over impervious surfaces

Additional Vocabulary

nutrient—an element essential for the growth of organisms (e.g., nitrogen, phosphorous, potassium)

dissolved oxygen—gaseous oxygen diffused in water; often expressed as milligrams of oxygen per liter of water (mg/L)

hypoxia—a condition of low dissolved oxygen in a body of water

Washington State Science Standards Addressed

9-12 INQA: Scientists generate and evaluate questions to investigate the natural world.

9-12 APPB: The technological design process begins by defining a problem in terms of criteria and constraints, conducting research, and generating several different solutions.

9-12 APPF: It is important for all citizens to apply science and technology to critical issues that influence society.

AARON CARUANA

9-11 PS2H: Solutions are mixtures in which particles of one substance are evenly distributed through another substance. Liquids are limited in the amount of dissolved solid or gas that they can contain. Aqueous solutions can be described by relative quantities of the dissolved substances and acidity or alkalinity (pH).

9-11 LS2C: Population growth is limited by the availability of matter and energy found in resources, the size of the environment, and the presence of competing and/or predatory organisms.

Washington State Social Studies Standards Addressed

(Grades 9/10) 2.4.1 Analyzes and evaluates how people across the world have addressed issues involved with the distribution of resources and sustainability in the past or present.

(Grades 9/10) 3.2.1 Analyzes and evaluates human interaction with the environment across the world in the past or present.

(Grades 9/10) 5.2.1 Creates and uses research questions that are tied to an essential question to focus inquiry on an idea, issue, or event.

(Grade 11) 3.2.1 Analyzes and evaluates human interaction with the environment in the United States in the past or present.

(Grades 11/12) 3.1.1 Analyzes information from geographic tools, including computer-based mapping systems, to draw conclusions on an issue or event.

Washington State Integrated Environmental and Sustainability Standards

Standard 1: Ecological, Social, and Economic Systems

Standard 2: The Natural and Built Environment

Standard 3: Sustainability and Civic Responsibility

Optional Background Reading

- Teri King, "Low Dissolved Oxygen Levels in Hood Canal," Washington Sea Grant Program, http://bit.ly/jryUmG—Hypoxia in the Hood Canal impacts water quality.
- Sandra Hines, "Spicy Puget Sound: Fish Swim in 'Big, Dilute Latte,' Research Shows," *University Week,* December 4, 2008, http://bit.ly/lRaiTl—Spices detected in Puget Sound's waters after Thanksgiving show how our activities directly impact the Sound.

Materials/Preparation

Handout: *Puget Sound Pollutants,* 1 for each student pair

PowerPoint: Puget Sound Pollution

Handout: *How to Address Hypoxia in South Puget Sound,* 1 for each student

KY KNOORD

Activity

Introduction (15 minutes)

1. Ask students if they think that Puget Sound is pure and pristine, or if they think it is polluted in any way. *(Pollution can (and does) end up flowing into the Sound.)*
2. Ask students what sorts of activities and/or substances might end up polluting Puget Sound. *(Sometimes trash and other pollutants are emptied directly into the Sound. Other times toxic substances—including lawn pesticides, soap, heavy metals, and motor oil—travel over long distances and eventually end up washing into the Sound.)*
3. Write headings for 2 columns on the board: *nonpoint source* and *point source.*
4. As students list activities, write them on the board under the heading where they belong, either point source or nonpoint source. *(Point source pollution comes from a single identifiable source, such as a discharge from a factory pipe. Nonpoint source pollution comes from many different sources that cannot be individually identified; it is typically carried by rainfall to nearby bodies of water. Point source pollution comes from factories/industrial discharges, ships, and sewage treatment plants. Most other pollutants will be categorized as nonpoint.)*
5. Ask students to formulate possible definitions for point source pollution and nonpoint source pollution, based on the activities/substances they see in the 2 columns. They may also use the words themselves ("point and nonpoint") as clues to their meanings.
6. Group students into pairs.
7. Give each student pair a copy of the handout *Puget Sound Pollutants,* or use a projection device to display the images.
8. Ask students to consider all of the images displayed. Tell them that you will be asking them to sort the images into 2 categories: point source and nonpoint source pollution.
9. Have each pair sort the images, placing them into 2 groups, or by labeling each picture either "point source" or "nonpoint source."
10. Have each student pair list 1 pollutant under the heading where they think it belongs.
11. If anyone disagrees with a pair's selection, allow students to voice their differences of opinion.
12. Let students know that nonpoint source pollution accounts for most of the pollution that reaches Puget Sound.

KEN McCOWN

Inquiry Activity (30 minutes)

1. Ask students how they think pollutants get into our runoff to begin with. *(Nonpoint source pollution is not dumped directly into Puget Sound. Instead, it typically involves rain water that picks up pollutants and carries them into storm drains or culverts, which then empty into rivers and streams, which eventually empty into Puget Sound.)*
2. Let them know that 1 indicator used to assess the health of a body of water is dissolved oxygen. Because aquatic organisms like fish and shellfish need oxygen to survive, measuring dissolved oxygen for a body of water tells us how well it can support life. Very low dissolved oxygen levels can create "dead zones" absent of aquatic organisms.
3. Also, let students know that you are going to go through a case study of South Puget Sound. Hood Canal in South Puget Sound has low dissolved oxygen levels, and scientists are working to determine what activities are causing the low dissolved oxygen.
4. Before you start the PowerPoint (PPT), ask students what the word "nutrients" means. *(Nutrients are good, right? Sure, we need nutrients like vitamins and minerals to survive, grow, and reproduce. But, like many good things, moderation is key. As the PPT explains, excess nutrients are actually considered pollution.)*
5. Provide each student with a copy of the handout *How to Address Hypoxia in South Puget Sound* so they can read and answer questions alongside the PPT.
6. Go through the PPT, 1 slide at a time. Use the questions and information in the "Notes" section for each slide to guide the inquiry.
7. Provide students with 5-10 minutes to finish the handout *How to Address Hypoxia in South Puget Sound.*
8. Ask students to share their answers to question 5 from the handout.

Discussion Questions

1. How does the health of the Sound affect your life? How does it affect your community or neighborhood?
2. What examples of nonpoint source pollution have you seen in your neighborhood? *(Pet waste, litter, and motor oil could all be carried away by runoff.)*
3. If scientists already know so much about hypoxia in South Puget Sound, why do you think it is still happening?
4. What could you do in your neighborhood to help prevent pollution from reaching Puget Sound through stormwater runoff?

Science Extension

Measure the level of dissolved oxygen for a stream in your neighborhood. If your results indicate low dissolved oxygen levels, set up an observation study to determine possible contributing factors. Then, tackle 1 of these contributing factors. Water quality test kits can be obtained from:

- UW SoundCitizen: http://bit.ly/itVcbe
- World Water Monitoring Day: http://bit.ly/kTXZrs

Technology Extension

Go to the interactive maps from Puget Soundkeeper Alliance (http://bit.ly/lSgEds) and click on "Human Impact." Then use the "Layer Control" to locate the following sources of human impacts on the Puget Sound:

- dams
- environmental cleanup site
- Federal Superfund site
- hazardous waste site
- highway stormwater outfall
- King County combined sewer overflow

Zoom in until you can see which of the listed human impacts are happening near your location.

Use the information from the map to answer the following questions:

1. What seem to be the major human impacts on Puget Sound in your area?
2. What particular activities (industries, behaviors, etc.) might be contributing to these impacts?
3. How do you think each of these impacts might affect water quality in the Sound?
4. What possible solutions could prevent these human impacts?

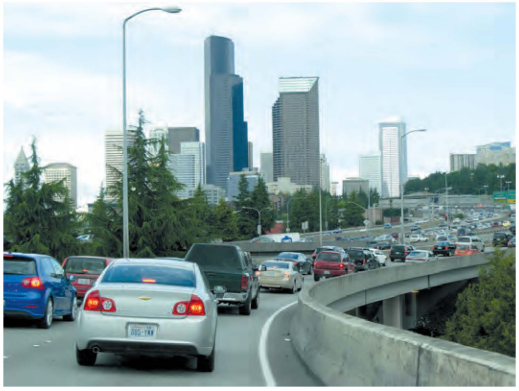
Additional Resources

- **Website:** http://bit.ly/lwymjr
  The Northwest Association of Networked Ocean Observing Systems (NANOOS) and the National Estuarine Research Reserve System provide real-time water quality data for shellfish growers in Washington, Alaska, and Oregon. Water quality indicators, including dissolved oxygen, are measured at various sites throughout Puget Sound.
- **Website:** http://bit.ly/lDyqZS
  The University of Washington's Ocean Remote Chemical Analyzer website presents water quality data from locations throughout Hood Canal.

STOCKSNAPPER

- **Video:** Underwater video of low dissolved oxygen event in Hood Canal
  http://bit.ly/leYWP8
  This 5-minute video, filmed by the Washington Department of Fish and Wildlife, documents the effects of hypoxia on fish and other underwater species.
- **Website:** http://bit.ly/m73Lyq
  NANOOS provides diagrams and videos to explain how hypoxia affects the Pacific Northwest.
- **Website:** http://on.doi.gov/jtDDaX
  This U.S. Geological Survey (USGS) site serves as a primer on dissolved oxygen.

Puget Sound Pollutants



FROM TOP LEFT HAND CORNER TO BOTTOM RIGHT: LAURA SKELTON, KLH49, R KLISE, KARL VOELKER, AARON CARUANA, STOCKSNAPPER, KY KNOORD, NO CREDIT, JON ROSS

Teacher Master: Puget Sound Pollutants


Storm drain runoff: nonpoint

Lawn chemicals: nonpoint

Pet waste: nonpoint


Roadway runoff (motor oil, brake dust): nonpoint


Factory/oil refinery: point


Home car wash: nonpoint


Stormwater outlet: nonpoint


Parking lot runoff: nonpoint


Soil erosion/ sediment: nonpoint

FROM TOP LEFT HAND CORNER TO BOTTOM RIGHT: LAURA SKELTON, KLH49, R KLISE, KARL VOELKER, AARON CARUANA, STOCKSNAPPER, KY KNOORD, NO CREDIT, JON ROSS

Name Date

How to Address Hypoxia in South Puget Sound

1. Think of one research question that could help address the problem of hypoxia in Puget Sound.

2. How could you set up an experiment to answer your research question?

3. What resources would you need to research the answer?

4. What are some challenges in identifying and determining specific causes of the hypoxia in South Puget Sound? List two.

a)

b)

5. Based on what you know already, what recommendations would you make to decrease the amount of hypoxia (for example, publicity campaigns or legislation)? *List two things you could do and two things you think the government could do.*

What I Can Do	What the Government Can Do

Lesson 4

Town Hall Meeting

Students take on perspectives of different stakeholder groups involved in determining how to decrease the amount of pollution in Puget Sound. Stakeholder groups are encouraged to form alliances in order to reach consensus on a plan that will be the best for the entire community.

LAURA SKELTON

JOHN DURBAN

Objectives

Students will:

- Take on perspectives of community stakeholders
- Understand interconnected economic, social, and environmental factors related to keeping Puget Sound healthy
- Formulate realistic solutions for cleaning up or preventing Puget Sound pollution
- Recognize that Puget Sound pollution prevention is a multi-faceted effort that involves consideration of multiple perspectives

Inquiry/Critical Thinking Questions

- How does pollution of Puget Sound impact people, environments, and economies in the surrounding area?
- What are solutions to improving the health of Puget Sound?
- What are pros and cons of different approaches to reducing Puget Sound pollution?

Subject Areas

- science (environmental, biology)
- social studies (global studies, contemporary world problems, economics, civics)

Time Required

60 minutes

Key Concepts

watershed—an area of land where all of the water that is under it or drains off of it goes into the same place

stormwater runoff—unfiltered water that reaches bodies of water by traveling over impervious surfaces

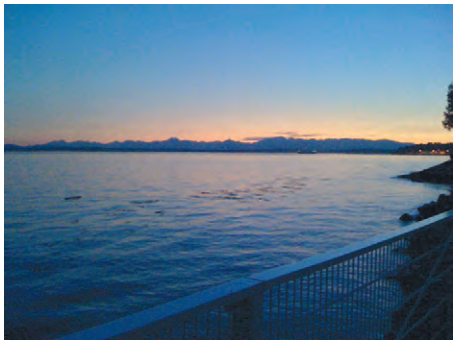
sustainable development—practices in agriculture, economic development, health care, and education that lead to progress and meet the needs and desires of the current generation without decreasing the ability of future generations to meet their needs

Additional Vocabulary

impervious surfaces—structures such as pavements that are covered by impenetrable materials like asphalt, concrete, and stone; water can move *on top* of impervious surfaces but not *through* them

Washington State Science Standards Addressed

9-12 APPE: Perfect *solutions* do not exist. All technological *solutions* involve trade-offs in which decisions to include more of one quality means less of another. All *solutions* involve consequences, some intended, others not.



SAARA AHMED

9-11 LS2F: The *concept* of *sustainable development* supports adoption of policies that enable people to obtain the resources they need today without limiting the ability of future *generations* to meet their own needs. Sustainable processes include substituting renewable for nonrenewable resources, recycling, and using fewer resources.

Washington State Social Studies Standards Addressed

(Grades 9/10) 5.1.1 Analyzes consequences of positions on an issue or event.

(Grades 9/10) 5.1.2 Evaluates the precision of a position on an issue or event.

(Grades 9/10) 5.3.1 Evaluates one's own viewpoint and the viewpoints of others in the context of a discussion.

(Grade 11) 5.4.1 Evaluates and interprets other points of view on an issue within a paper or presentation.

(Grade 11) 5.1.2 Evaluates the depth of a position on an issue or event.

(Grade 12) 5.4.1 Evaluates positions and evidence to make one's own decisions in a paper or presentation.

Washington State Integrated Environmental and Sustainability Standards

Standard 1: Ecological, Social, and Economic Systems

Standard 2: The Natural and Built Environment

Standard 3: Sustainability and Civic Responsibility

Optional Background Reading

Sandi Doughton, "Runoff Turns Elliott Bay into Murky Stew," *Seattle Times,* January 19, 2011, http://bit.ly/l1EjDC—After several days of heavy rainfall, stormwater runoff turns Elliott Bay a murky brown color.

Materials/Preparation

Handout: *Puget Sound Quiz,* 1 per student pair

Handout: *Town Hall Scenario,* 1 per student

Handout: *Keeping the Sound Healthy,* 1 per group of 4-5 students

STEVE BIBER

Activity

Introduction (10 minutes)

1. Explain to students that they are going to take a short Puget Sound quiz with a partner to see if they know specific facts related to the Sound.
2. Hand each student pair a *Puget Sound Quiz*.
3. Have pairs answer the questions.
4. Review the answers with them.[1]
   1. There are over 4 million people living in Puget Sound. Approximately how many cars, buses, and trucks are registered to owners in Puget Sound?
      a. 3.2 million **c. 5.8 million**
      b. 1.1 million **d.** 8.4 million
   2. When drivers of cars, buses, and trucks hit their brakes, dust grinds off the brake pad and gets mixed with stormwater into water. Copper from this dust can harm fish and aquatic life. How many pounds of copper wash into Puget Sound each year through stormwater?
      a. 32,000 pounds **c.** 12,000 pounds
      b. 70,000 pounds **d.** 5,000 pounds
   3. How many lakes, streams, and rivers in Puget Sound are impacted by poor water quality?[2]
      a. 245 **c. 549**
      b. 805 **d.** 715
5. Ask students if any of the facts surprised them.

Steps (50 minutes)

1. Tell students that contaminants that were banned from use 30 years ago can still be found today in underwater sediments of the Puget Sound.[3]
2. Distribute 1 *Town Hall Scenario* to each student. Read through this scenario with the class.
3. Divide the class into 7 equivalently sized groups. Each student group will take on the role of a particular stakeholder group in the Puget Sound.
4. Distribute a different *Keeping the Sound Healthy* handout to each group. There are 7 in total.
5. Explain to students that at this town hall meeting, any solutions to pollution prevention should focus on "sustainable development." *(Sustainable development includes practices in agriculture, economic development, health care, and education that lead to progress and meet the needs and desires of the current generation without decreasing the ability of future generations to meet their needs).*

1 Lisa Stiffler, "Tapping the Brakes on Copper Brake Pads," *Sightline Daily*, February 11, 2010, http://bit.ly/krNC4h.
2 Puget Sound Starts Here, "Problem Below the Surface: Numbers Prove It," accessed May 24, 2011, http://bit.ly/ldO8mu.
3 State of Washington Department of Ecology, "Saving Puget Sound," accessed February 4, 2011, http://1.usa.gov/jh2W9p.

WENDY CHURCH

6. Give students 10-15 minutes to read through the worksheet and respond to the questions with their group members. Each group will present their proposed plan to prevent pollution in Puget Sound
7. Explain to students that today you represent a government official in Puget Sound. As a government official, you will choose the plan from the group with the most points. They will receive 1 point for clearly articulating their plan in a compelling manner. They will receive additional points for reaching consensus, or agreement, with other groups.
8. Allow each group to explain their perspective and share their position in just a few minutes.
   - **Option:** Give students in the audience a chart in which they can record each group's name and their "big idea" to clean up Puget Sound as each group presents.
9. As teams present, give each team 1 point for clearly articulating their plan in a compelling manner. Mark the points somewhere visible, like a board where everyone can see them.
10. After each group has presented, give students 5-10 minutes to form an alliance with at least 1 other group. As a result of their alliance, they must reach consensus on a plan to deal with Puget Sound pollution. This likely means that 1 or both groups will compromise. Let students know that they will need to articulate why the alliance was created; they must have a sound reason for doing so.
11. After groups have had enough time to form alliances with 1 or more groups, ask each allied group to present its revised position. Each group should choose a representative to present its plan and explain why they allied with the groups they did.
12. As groups present, award points based on the number of stakeholders they were able to form valid alliances with. Give teams 1 point for each group they include in an alliance. (Therefore, if 1 group can achieve consensus with 2 other groups, those 3 groups would each get 2 points for this step.)
13. Announce which plan you, as a government official, have decided to go forward with. (This is the plan with the largest alliance backing it. If there are 2 equal-sized alliances, choose the plan that was articulated the most clearly and persuasively.)

SAARA AHMED

Discussion Questions

1. Who do you think should be responsible for decreasing the amount of pollution in Puget Sound? Citizens? The Government? Oil refinery companies? Cruise ship companies? Building developers?
2. Was it difficult to form an alliance with certain groups? Why?
3. Are there any other groups who should have attended the town hall meeting? Why?
4. What is another possible approach to pollution prevention that none of the groups mentioned?
5. What government policies do you think could be adopted to prevent pollution from reaching the Sound?
6. How can considering sustainable development help when thinking of solutions?

Additional Resources

- **Video:** "Poisoned Waters"
  This documentary tracks how both industrial polluters and everyday consumers are polluting our waterways. A specific focus is on the Puget Sound and the Chesapeake Bay.
  http://to.pbs.org/jmVl2H
  (1 hour, 56 minutes)
- **Video:** "Watershed Address"
  The Watershed report was created through Friends of the Cedar River Watershed. It is meant to inspire the next generation of watershed stewards. Students of the Watershed Report present positive green trends in Seattle's schools, government buildings, and businesses.
  http://bit.ly/m3mipL (9 minutes)
- **Website:** http://bit.ly/kg7sE4
  People for Puget Sound is a citizen's group that protects and restores the health of the Sound through education and action. They offer a number of programs that citizens can get involved in, ranging from habitat restoration to lobbying elected representatives around issues affecting the Sound.

Puget Sound Quiz

1. There are over 4 million people living in Puget Sound. Approximately how many cars, buses, and trucks are registered to owners in Puget Sound?

a. 3.2 million **b.** 1.1 million **c.** 5.8 million **d.** 8.4 million

2. When drivers of cars, buses, and trucks hit their brakes, dust grinds off the brake pad and gets mixed with stormwater into water. Copper from this dust can harm fish and aquatic life. How many pounds of copper wash into Puget Sound each year through stormwater?

a. 32,000 pounds **b.** 70,000 pounds **c.** 12,000 pounds **d.** 5,000 pounds

3. How many lakes, streams, and rivers in Puget Sound are impacted by poor water quality?

a. 245 **b.** 805 **c.** 549 **d.** 715

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Town Hall Scenario

According to the Washington Department of Ecology, millions of pounds of toxic pollution enter Puget Sound every year. A number of aquatic species—including fish, birds, and barnacles —have become endangered because of this pollution. Government officials, large companies, tribal groups, concerned citizens, and nongovernmental organizations have all been asked to attend a town hall meeting in order to determine what next steps to take in order to protect the health of the Sound. **Your group has been asked to present a well-articulated, compelling plan to help decrease pollution in the Sound.**

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Name Date

Keeping the Sound Healthy

Group 1: Association of Puget Sound Tribal Groups

Tribal groups like yours have lived in the Puget Sound area for over 11,000 years. Rivers, lakes, and seas have all been important to your tribes' survival throughout this time. Your communities continue to depend largely on cod, salmon, and shellfish for food and also for economic and spiritual reasons.[1] To some tribes, salmon is considered sacred because this natural resource helps them to survive. In recent years, species including the Chinook salmon have become endangered. Fish depletion has happened as a result of an increase in commercial fishing and because of habitat destruction.

Historically, your tribes used to catch fish with spears, hook lines, and baskets. When commercial fishing was introduced, salmon decreased because fishermen could catch more fish through larger fishing operations.

Based on a court case in 1974, *United States* v. *Washington,* tribal groups in the Puget Sound were given the right to co-manage fishery resources with the State of Washington. Since then, you have been able to collaborate on the timing of salmon fishing seasons and the goals for hatchery production (the spawning, incubation, and hatching of fish in artificial environments). This court case was also meant to assure tribes they could catch half of the harvestable surplus that runs through their areas, as a means of subsistence and survival.[2]

Another factor leading to a decrease in fish populations has been the destruction of salmon habitat in the Sound through creation of dams, forest removal, and water pollution. Forests near streams and rivers are important because they shade streams, provide food for smaller fish, and create still water areas where salmon can reproduce.[3] When these natural habitats are destroyed, different species may become endangered. Today, the Puget Sound chinook salmon population is just 10% of historic numbers.[4] There have also been toxic levels of the chemical PCB (polychlorinated biphenyls) found in fish.[5] The chemical

SHEEBA JACOB

is found in products such as paint and enters the Sound through stormwater pollution.

Shrinking salmon populations mean less food for tribal communities, less income for tribal fishermen, and a decrease in biodiversity in the Sound. You believe that in order to improve fish population numbers—and to protect the biodiversity of Puget Sound—the concerns of the many tribes must be addressed.

1. What do you think should be done to improve the health of Puget Sound?
2. What stakeholders can support you in keeping the Sound healthy?
3. Aside from the general public, who will benefit from this plan?

1 Northwest Indian Fisheries Commission, "About Us—Fisheries Management," accessed February 1, 2011, http://bit.ly/iDxL5l.
2 Northwest Indian Fisheries Commission, "About Us—Fisheries Management," accessed February 1, 2011, http://bit.ly/iDxL5l.
3 John Retherford, "Salmon and the Health of North West Indigenous Cultures," accessed February 1, 2011, http://scr.bi/mm6p20.
4 Jessica Ferrell, "NMFS Proposes Billion Dollar Recovery Plan for Puget Sound Chinook Salmon," Marten Law Newsletter, February 15, 2006, http://bit.ly/jgxzhe.
5 Department of Ecology, "Washington State toxics Monitoring Program: Contaminants in Fish Tissue from Freshwater Environments in 2004 and 2005," accessed May 9, 2011, http://1.usa.gov/jZz1iD.

Name Date

Keeping the Sound Healthy

Group 2: Cruise Line Association

The cruise line industry in Seattle has had much success over the last several years. In 2010, the business made $425 million for the region and provided over 4,000 local jobs in Seattle. These jobs provide a stable income for local citizens. Surprisingly, cruise trips have increased when the economy as a whole has not been doing so well! Over 900,000 passengers traveled on these cruise lines in 2010.[1] The local economy benefits enormously from the cruise line business. The 900,000 tourists who board the ships at the piers in Seattle typically come early and stay overnight at hotels and dine at local restaurants.

You realize that cruise ships contribute to water pollution in Puget Sound. Based on a report by the Environmental Protection Agency, the average cruise ship emits the following directly into Puget Sound waters:[2]

- 21,000 gallons of sewage
- 170,000 gallons of wastewater from sinks, showers, and laundry
- More than 25 pounds of batteries, fluorescent lights, medical wastes, and expired chemicals

In recent years, you have agreed to follow certain requirements for your cruise ships based on a Memorandum of Understanding (MOU) between the Port of Seattle, the Department of Ecology, your Cruise Line Association, and other interested parties. This understanding relates to cruise line wastewater management. Certain guidelines forbid cruise ship operators from dumping any untreated wastewater or solid waste in waters within the Puget Sound area.

You have worked with the city of Seattle to take steps towards becoming "greener." Some of your cruise lines have invested millions of dollars in creating an advanced wastewater purification system on ships to decrease the amount of polluted water

LAURA SKELTON

released into to the Sound. You've also worked with port authorities to make sure that when boats dock at ports they use lower amounts of sulfur fuel to decrease air pollution.

Restoring Puget Sound's health is important. At the same time, you don't want to spend so much money on pollution prevention that it makes cruise travel more expensive for your customers. A decrease in sales would have a huge impact on the local economy. You do believe there is potential to decrease pollution through green education campaigns for both your passengers and staff. Determining ways to keep Puget Sound healthy while also increasing sales will be the challenge.

1. What do you think should be done to improve the health of Puget Sound?
2. What stakeholders can support you in keeping the Sound healthy?
3. Aside from the general public, who will benefit from this plan?

1 Port of Seattle, "Port of Seattle Sets New Cruise Ship, Passenger Records in 2010," accessed January 30, 2011, http://bit.ly/lxsy1g.

2 EPA, "Cruise Ship Discharge Assessment Report," EPA report link, accessed January 29, 2011, http://1.usa.gov/mmgYEy.

Name Date

Keeping the Sound Healthy

Group 3: Concerned Citizens for Puget Sound

Certain populations of Orca whales have become endangered in Puget Sound.[1] Harbor seals in Puget Sound have significantly higher levels of toxic chemical contamination than those living in the water off Canada's coast just to the north.[2] The number of marine birds in the Sound has decreased by 47% in the last thirty years.[3]

Human activities have had a large effect on the health of Puget Sound. Some of these activities generate nonpoint source pollution from suburban and urban areas.

A growing population in the Sound has decreased the amount of wildlands—including prairies and forests—and increased the amount of pavement and buildings.[4] Rain and snowmelt typically soak into forest and prairie soils, but when these ecosystems are converted into built environments, storm drains carry water from buildings and streets to nearby waterways. In fact, impervious surfaces such as roads produce five times more stormwater runoff than a forest.[5]

Often, this water runoff is polluted with chemicals and oil. The pollution can come from a variety of sources: lawn fertilizers, car washes at home, improperly discarded toxins like paint and motor oil, pet waste, and eroded soil. Once this polluted water enters rivers and streams through storm drains, it threatens aquatic life within the Sound.[6]

You believe the key to decreasing pollution in Puget Sound is to educate people in the region about the impacts of pollution and the daily decisions they can make to prevent pollution. You've seen successful education programs in other cities like Washington, DC; there, conservation organizations have partnered with homeowners to teach them how to build rain gardens and install rain barrels in order to reduce stormwater runoff.[7] While big stormwater management projects are expensive, local ones such as community education campaigns or turning existing roofs into green

LAURA SKELTON

roofs that filter stormwater can effectively prevent pollution. This type of care could provide you, your children, their children, and the greater Puget Sound community with a higher quality of life.

1. What do you think should be done to improve the health of Puget Sound?
2. What stakeholders can support you in keeping the Sound healthy?
3. Aside from the general public, who will benefit from this plan?

1 NOAA Fisheries: Office of Protected Services, 'Killer Whale: Orcinus Orca," accessed May 25, 2011, http://1.usa.gov/lrp52a.
2 People for Puget Sound, "Some Facts about Puget Sound," accessed January 30, 2011, http://bit.ly/kuRKCo.
3 Puget Sound Partnership, "Marine Birds," accessed May 5, 2011, http://bit.ly/iVta91.
4 Robyn Carmichael et al., "Public Stormwater Outfalls to Puget Sound," People for Puget Sound, April 2009, http://bit.ly/mh6aUt.
5 EPA, "Protecting Water Quality from Urban Runoff," accessed January 27, 2011, http://1.usa.gov/l6WIyU.
6 Pierce County Public Works and Utilities, "What is Nonpoint Source Pollution?" accessed January 26, 2011, http://bit.ly/jRwt36.
7 EPA, "RiverSmart Homes: Getting Smart about Runoff in Washington, DC," accessed January 27, 2011, http://1.usa.gov/klP89l.

Name Date

Keeping the Sound Healthy

Group 4: Northwest Environmental Council

You are a regional government organization working to ensure that Puget Sound is healthy to support both wildlife and human communities. You do so in a number of ways. You distribute money to different organizations working to protect the Sound, including state, local, and tribal groups. In recent years, you have given money to groups that have carried out studies to research the following questions:[1]

- Where is pollution in the Sound coming from?
- What are the effects of contaminants on Puget Sound salmon?
- How can citizens protect watersheds and wetlands while still supporting population growth?

Your work also involves holding large companies accountable for water pollution. For example, oil spills from ships traveling to oil refineries in the Sound have been a major concern; if they spill their oil, ecosystems in the Sound could be devastated. You believe it's the responsibility of large companies that pollute waters to clean them up; that's why you think polluters should be fined. You offer incentives to companies that have taken steps to reduce their pollution. For example, if a company develops programs that prevent future environmental pollution, you offer to reduce or waive certain penalties issued to the company for prior pollution. You also provide training and tools to help these companies learn about what they need to do to meet environmental requirements to keep the Sound healthy.[2]

There are eighteen major watersheds in Puget Sound. The land and water covers over 1.6 million acres. Within this area, there are 211 fish species, 100 seabird species, and thirteen marine mammals.[3] The Sound has a tremendous value, and you want to do everything in your power to ensure that it continues to be an incredible place. By rewarding organizations working to protect the Sound and penalizing companies who continue to pollute, you believe pollution in Puget Sound can be significantly reduced.

JESSE STANLEY

1. What do you think should be done to improve the health of Puget Sound?
2. What stakeholders can support you in keeping the Sound healthy?
3. Aside from the general public, who will benefit from this plan?

1 EPA, "Puget Sound Protection Efforts Get Nearly $13 Million Boost from EPA Science Grants," EPA News Release, September 8, 2010, http://1.usa.gov/lVY4oj.
2 EPA, "Compliance," accessed March 11, 2011, http://1.usa.gov/ioQg97.
3 State of Washington Department of Ecology, "Saving Puget Sound," accessed January 26, 2011, http://1.usa.gov/lBubPb.

Name Date

Keeping the Sound Healthy

Group 5: Oil Refinery Representatives

600 oil tankers and 3,000 oil barges come through the Puget Sound annually. They carry approximately 15 billion gallons of oil to five oil refineries.[1] These refineries process 561,000 barrels of crude oil each day.[2] This crude oil becomes gas, diesel oil, and jet fuel that citizens use for transportation. 64.7 million gallons of gasoline are consumed every day on the West Coast of the United States alone.[3] Oil is an extremely important natural resource to people in the Sound and around the country.

Economically, the oil industry has had a significant impact on Washington State. In 2009, oil refineries provided 30,000 jobs; these jobs contributed 1.7 billion dollars in personal income that year.[4] Environmental groups have pressured you by advocating for new laws that would make oil refineries pay for water pollution created by oil barges, tankers, and refineries. This tax would come to approximately $350 million per year.[5] You do not see the need for such a large tax, especially because you are working with other groups to prevent future oil spills.

You understand the impact that oil spills have had on Puget Sound. You've worked with the Department of Ecology to identify key pollution prevention practices and priorities for the refineries. Your refineries have taken steps to decrease oil leaks and spills. They have also worked to reduce point source pollution and wastewater flow.[6]

Additionally, you have taken preventive measures when oil is transferred from ships to the refineries since oil transfers are the cause of a large number of spills. One process, known as pre-booming, transfers large volumes of oil from ships to refineries through a container so less oil is likely to leak into waters. You have agreed that whenever more than 100 gallons of oil are transferred, you will implement pre-booming.[7]

You believe the precautions you have taken thus far will decrease the amount of oil that spills from your ships. Point source pollution will also

WYATT WELLMAN

decrease from your refineries. Increased taxes will not only hurt the oil industry; almost everyone will be affected by higher gas prices.[8] Balancing environmental priorities with economic priorities is the most important thing to do at this time.

1. What do you think should be done to improve the health of Puget Sound?
2. What stakeholders can support you in keeping the Sound healthy?
3. Aside from the general public, who will benefit from this plan?

1 "Congress Authorizes Oil Spill Prevention, Fishing Vessel Safety Upgrades," *Environment News Service,* October 4, 2010, http://bit.ly/ka37JA.
2 "The Economic Contribution of Washington State's Petroleum Refining Industry in 2009," Washington Research Council Economic Profile, August 2010, http://bit.ly/kIX9Eu.
3 Western States Petroleum Association, "Energy Facts," accessed February 4, 2011, http://bit.ly/mDjbxF.
4 "The Economic Contribution of Washington State's Petroleum Refining Industry in 2009," Washington Research Council Economic Profile, August 2010, http://bit.ly/kIX9Eu.
5 Erik Smith, "Olympia's Next Big War—A Steep Hike in Oil Taxes for Puget Sound Cleanup," *Washington Wire,* February 2, 2010, http://bit.ly/lsT8tJ.
6 "Water Pollution Prevention Opportunities in Petroleum Refineries," Washington State Department of Ecology, November 2002, http://1.usa.gov/iTclyo.
7 Washington State Department of Ecology, "Q & A: BP Deepwater Horizon Oil Spill in Gulf of Mexico," accessed February 4, 2011, http://1.usa.gov/m4lztl.
8 Erik Smith, "Olympia's Next Big War—A Steep Hike in Oil Taxes for Puget Sound Cleanup," *Washington Wire,* February 2, 2010, http://bit.ly/lsT8tJ.

Name Date

Keeping the Sound Healthy

Group 6: Office of Economic Development, Seattle

You work at the Office of Economic Development in Seattle. The goal of this office is to make Seattle a place where there are jobs available for everyone. For example, by cooperating with and supporting local businesses and restaurants, you increase both employment opportunities and tourism. In one year, over 8 million tourists visited the area and the local economy made over $4 billion from these visitors.[1] This is the type of growth that supports Seattle as a city. In addition to the tourist industry, your office supports employment related to film and music, maritime industries (fishing, water transportation, ship building, etc.), and global health.

You understand that stormwater runoff in Seattle is a major concern and that businesses contribute to this pollution. Businesses you work with have the potential to decrease their stormwater footprint, but you know it will require some training for them to understand how to do so. You have worked with a few government organizations to support this plan. For example, Seattle Public Utilities provides a number of programs for business owners to learn about how they can reduce pollution. They offer inspections for these businesses and work with them to prevent pollutants from entering private and public storm drains. Seattle Public Utilities also supports businesses in maintaining best management practices such as:[2]

- moving waste away from storm drains
- having a spill kit readily available to deal with any kind of spill, including oil spills
- covering soil to prevent erosion

You have also worked with the Office of Sustainability and the Environment to learn more about green building construction in order to reduce stormwater runoff. While you see the value in businesses using these types of buildings, you know it could be expensive to create them.

ZESHAN KHAN

But you are in favor of some initial steps, such as creating green roofs on buildings that would decrease stormwater pollution.

You know there is a connection between the health of Puget Sound and economic growth over the next several decades. If species start to disappear or water quality becomes worse, this could have a huge consequence on any type of growth. Therefore, decisions businesses make on how to prevent pollution will be crucial.

1. What do you think should be done to improve the health of Puget Sound?
2. What stakeholders can support you in keeping the Sound healthy?
3. Aside from the general public, who will benefit from this plan?

1 Office of Economic Development, City of Seattle, "Tourism," accessed March 11, 2011, http://1.usa.gov/mwk7wK.
2 Seattle Public Utilities, City of Seattle, "Pollution Control," accessed March 11, 2011, http://1.usa.gov/lierfO.

Name Date

Keeping the Sound Healthy

Group 7: Housing Development Company

The population in Puget Sound is approximately 3.5 million. By the year 2020, this number is projected to increase to 5.2 million people.[1] In order to comfortably meet the needs of people living in the area, your development company works hard to ensure new housing options are readily available. The amount of urban areas where residential development is permitted has increased from 77% during the 1980s to over 85%.[2] This has required clearing forests, farmland, and other habitats to make room for new homes in the area. In the last forty years, over 1.7 million acres of forest have been converted for development purposes.[3]

You understand the impact development can have on natural resources and the health of the Sound. You know that new development increases the number of roads, sidewalks, parking lots, and rooftops, and that these types of surfaces increase the amount of stormwater runoff because storm drains carry water from buildings and streets to nearby waterways. However, the reality is, people need homes. You believe there are solutions that can help prevent pollution while allowing the region to accommodate new and expanding businesses and homes. One of the major ways your industry could support Puget Sound's long-term health is through a number of low-impact development techniques. Your company has implemented the following practices to protect the Sound from the harmful effects of stormwater runoff:[4]

- creating pervious roads and sidewalks by adding grass and gravel that allow water to filter through; this practice helps filter out some of the pollutants before they reach the Sound
- developing a rooftop rainwater collection system that collects stormwater and prevents a large amount of runoff from picking up contaminants and emptying them into the Sound

JESSE STANLEY

- replanting substantial portions of vegetation on newly developed sites, allowing runoff to flow directly into these planted areas

You believe that using these low-impact development techniques will be a highly effective way to decrease post-construction pollution. You understand that the more you can develop land in ways that reflect how nature usually retains water, the less flooding, pollutants, and stormwater runoff you will create.[5]

1. What do you think should be done to improve the health of Puget Sound?
2. What other stakeholders can support you in keeping the Sound healthy?
3. Aside from the general public, who will directly benefit from this plan?

1 Stewardship Partners, "Low Impact Development," accessed April 27, 2011, http://bit.ly/ixjaA6.
2 B-Sustainable Information Commons, "Goal: Responsible Land Use," accessed April 27, 2011, http://bit.ly/krbFdY.
3 Ibid.
4 Puget Sound Action Team, "How Can We Protect Puget Sound as We Grow?" accessed April 27, 2011, http://bit.ly/jHoe38.
5 Ibid.

Lesson 5

Make a Sound Impact!

Students develop strategies to prevent pollution and improve water quality in Puget Sound. They create digital public service announcements (PSAs) to inform others how they can be part of solutions.

LAURA SKELTON

LAURA SKELTON

Note: Teachers in Puget Sound with students 13 years and older interested in having their students submit a digital public service announcement to the *Facing the Future* video contest can do so between June 14, 2011 and November 28, 2011. For more information about guidelines, how to post videos, and other details, please visit http://www.facingthefuture.org/PugetSoundContest/tabid/529/Default.aspx.

Objectives

Students will:

- Create a short video or digital story to educate others about 1 issue that impacts the health of Puget Sound and one action that addresses the issue in order to bring about positive change
- Understand economic, social, and environmental factors related to keeping Puget Sound healthy

Inquiry/Critical Thinking Questions

- What are ways to improve the health of Puget Sound?
- How does the health of the Sound impact people, environments, and local economies?
- How can media be used to influence people to take action against pollution?

Subject Areas

- science (environmental)
- social studies (civics)
- language arts (communication)
- technology

Time Required

Two 45-minute class periods to outline and plan video, in addition to time to create video

Key Concepts

point source pollution—harmful substances released from an identifiable source such as a factory or wastewater treatment plant

nonpoint source pollution—harmful substances released from many different sources such as lawn fertilizers or motor oils, and that cannot be individually identified

watershed—an area of land where all of the water that is under it or drains off of it goes into the same place

stormwater runoff—unfiltered water that reaches natural bodies of water by flowing over impervious surfaces

media literacy—the ability to access, analyze, evaluate, and create messages in a variety of forms that communicate information

Washington State Science Standards Addressed

9-11 LS2F: The *concept of sustainable development* supports adoption of policies that enable people to obtain the resources they need today without limiting the ability of future generations to meet their own needs. Sustainable processes include substituting renewable for nonrenewable resources, recycling, and using fewer resources.

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Washington State Social Studies Standards Addressed

(Grades 9/10) 3.2.1 Analyzes and evaluates human interaction with the environment across the world in the past or present.

(Grades 9/10) 5.1.2 Evaluates the precision of a position on an issue or event.

(Grade 11) 3.2.1 Analyzes and evaluates human interaction with the environment in the United States in the past or present.

(Grade 12) 3.2.1 Analyzes and evaluates human interaction with the environment in the United States in the past or present.

Washington State Language Arts Standards Addressed

(Grade 9) 3.1.1 Applies skills to plan and organize effective oral communication and presentations.

(Grade 9) 3.3.1 Applies skills and strategies for the delivery of effective oral communication and presentations.

Washington State Technology Standards Addressed

1.2.1 Communicate and collaborate to learn with others.

2.3.2 Select and use online applications.

2.4.1 Formulate and synthesize new knowledge

Washington State Integrated Environmental and Sustainability Standards

Standard 1: Ecological, Social, and Economic Systems

Standard 2: The Natural and Built Environment

Standard 3: Sustainability and Civic Responsibility

Optional Background Reading

- Lance Dickie, "Cleaning up Washington Waterways – the Mess Is Ours," *Seattle Times,* January 20, 2011, http://bit.ly/ktkSNZ—This editorial speaks to how it is the responsibility of citizens to help clean up pollution in the Sound.

Materials/Preparation

Handout: *Make a Sound Impact!,* 1 per student or student group

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Activity

Note: *This lesson can be taught independently of lessons 1–4. If you did not already teach lesson 1 ("A Sound Introduction"), you can briefly introduce students to Puget Sound by sharing the introductory part of lesson 1 with them.*

Introduction (10 minutes)

1. Have students brainstorm all the different words that come to mind when they hear the name "Puget Sound."
2. Share the following facts about Puget Sound:
   - Contaminants that were banned from use 30 years ago can still be found today in underwater sediments of Puget Sound.
   - Certain populations of Orca whales are endangered in Puget Sound.[1]
   - Millions of pounds of toxic pollution enter the Puget Sound on a yearly basis.
   - Puget Sound has a number of different kinds of beaches: mud, gravel, rock, and sand.
   - In recent years, shellfish production in Washington State has generated nearly $100 million in sales.[2]
   - The tourism industry brings billions of dollars to Seattle each year.[3]
3. Share a public service announcement with your students for them to analyze. A number of such announcements can be found on the following websites:
   - Student PSAs can be found on www.schooltube.com. Type in "student PSA" to find these videos.
   - The Ad Council, which has created PSAs since 1942, features many different examples on their website: http://bit.ly/mFEVVj.
   - EPA has hosted water quality video contests with a focus on environmental stewardship: http://1.usa.gov/kwR45q.
   - American Public Transportation ads: http://bit.ly/jFDSDI.
4. After having them review an ad, ask students the following questions:
   - What is the overall message of the video?
   - What audience is the PSA reaching?
   - What persuasive techniques are used to convince people of the overall message?
   - Do you find this PSA convincing?

1 NOAA Fisheries: Office of Protected Services, "Killer Whale: Orcinus Orca," accessed May 25, 2011, http://1.usa.gov/lrp52a.

2 Pacific Shellfish Institute, "Washington State Shellfish Production & Restoration—Environmental and Economic Benefits & Costs," accessed May 5, 2011, http://bit.ly/kSsnh4.

3 Office of Economic Development, City of Seattle, "Tourism," accessed March 11, 2011, http://1.usa.gov/mwk7wK.

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5. Explain to students that PSAs can take on many different forms: print media, radio, and television.

Steps (60 minutes)

1. Ask students the following question: If you wanted to deliver a message related to keeping Puget Sound healthy, how would you do it?
2. Explain that PSAs persuade viewers (or listeners) to take an action or to adopt a specific point of view on an issue, cause, or service.
3. Tell students they will have the opportunity to create their own public service announcement to persuade others why they should keep Puget Sound clean. This video will take a digital format.
4. Ask students why they would want to convince others to care about the health of Puget Sound.
5. Ask students what kind of positive impact a digital PSA could have (i.e., a digital PSA could reach a larger audience because many people can view the message if it's available on the internet).
6. Inform students about some persuasive strategies they can use to convince people of their message. For example:
   - appeal to the audience's emotions
   - build trust and credibility
   - build a sense of urgency
   - use logic and numbers to support the argument
   - **Option:** Visit the ReadWriteThink website from IRA/NCTE to inform students about these and other strategies they can use to create their PSA: http://bit.ly/kcihYg.
7. Have students brainstorm a list of possible topics for a PSA about keeping Puget Sound healthy (topics could include: decreasing stormwater runoff, saving endangered species, upholding tribal traditions, holding certain groups accountable for keeping the Sound clean, educating people about the importance of a clean Sound).
   - **Option:** Create a rubric with students to help them effectively produce a PSA.
8. Explain to students that they can either create the PSA on their own or they can work with others.
9. Pass out a copy of the handout *Make a Sound Impact!* to each group or individual. This handout will guide them in creating their own PSAs.
10. Explain that page 2 of the handout will help them to storyboard their PSA. Storyboards explain what each scene in

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their PSA will include (words, images, music, etc.) The more they can create a detailed explanation of what their video will look like within their storyboard, the clearer the message in their PSA will be.

11. After they have completed the handout, explain that they will work in their groups (or individually) both in and out of class to create digital videos or stories.

Note: There are a variety of tools students can use to create the video PSA: cell phones, flip cameras, digital cameras, and video cameras. If students don't have a means to record videos, they can create digital stories using still photographs and computer programs such as Microsoft Photo Story, Windows Movie Maker, and Apple iMovie. Digital stories can incorporate text, music, and images to create a compelling PSA.

The following links offer detailed instructions for:

Creating a digital story

- Windows Movie Maker
  http://bit.ly/k8U3OD
- iMovie
  http://bit.ly/l4acqP
- Puget SoundOff
  http://bit.ly/lDxXgY

Creating a video

- Flip Video tips on how tell a good story
  http://bit.ly/jFvJzE
- Flip Video tips on how to shoot a good story
  http://bit.ly/j4MF96
- Puget SoundOff ideas on how to use a video camera effectively
  http://bit.ly/ioxaHj

Additional Resources

- **Website:** http://bit.ly/mPWutl
  People for Puget Sound features "Sound Citizen Voices." This part of the website focuses on what people are saying about the Sound and why it's important to them. Students may gather ideas from this site for the theme of their video. They can also add their perspective on why the Sound is important.
- **Website:** http://bit.ly/jxhbqd
  YTech is a program created through the YMCA in which young people create digital media, engage in civic debate, and learn skills and confidence to compete in the 21st century.

Name(s) Date

Make a Sound Impact! page 1

Directions: Complete the following outline. This outline will help you create your own public service announcement (PSA).

Issue your PSA will address:

_____

Three facts about the issue:	References:

Why should people care about the issue?

_____

_____

What persuasive techniques will you use to convince your audience they should care about the issue?

_____

_____

_____

_____

_____

What format are you going to use for your PSA?

- ☐ Video (i.e., Flip Video, video camera, cell phone)
- ☐ Digital story using photos and voice to tell a story (i.e., Movie Maker, iMovie)

Name(s) Date

Make a Sound Impact! page 2

Title of your video:

Scene	Script for scene	Words/graphics/images to appear during scene
Scene 1:		
Scene 2:		
Scene 3:		
Scene 4:		
Scene 5:		
Scene 6:		
Scene 7:		
Scene 8:		
Scene 9:		
Scene 10:		

Water, Science, and Civics:
Engaging Students with Puget Sound