

Point to the Source



This three-part lesson utilizes the stream simulator, pollution identification cards, and a non-point pollution game to explain the causes and effects of different types of pollution in rivers, streams, and watersheds. Participants will be broken up into three groups and will rotate stations every 15 minutes. They will engage in hands on activities, inquiry, and partner work in order to better understand the relationship between human activities and their local rivers. At one station participants will learn about the impacts that different everyday activities can have on local water systems and ways to avoid them. At another station they will learn how to distinguish between point and non-point source pollution. At the third station participants will identify different sources of chemical, thermal, and organic pollution. They will discuss the effects that these kinds of pollution have on river ecosystems, and some of the endangered species they affect. After the participants have been to all three stations they will come back together and discuss what they have learned about the effects of pollution in rivers. The goal of this lesson is get the participants to think more critically about their actions, and how they affect aquatic ecosystems.

Levels: Grade 5

Subjects Areas

- Scientific Inquiry
- Social Science
- Life Science

Group Size: 20-28

Concepts

- Water pollution comes from many different sources and destroys aquatic habitats

Materials:

- See stations

Time: 45-60 minutes

Key Terms:

Point and non-point source pollution, chemical, thermal, and organic pollution

OR State Standards

- SS.05.GE.07 Understand how physical environments are affected by human activities
- SS.05.GE.07.02 Describe how human activity can impact the environment.
- SC.05.LS.06.02 Identify conditions that might cause a species to become endangered or extinct.

OBJECTIVES

By the end of this activity, participants will be able to:

1. Define point and non-point sources of pollution
2. Name three categories of water pollution, at least 3 ways that they can get into water systems, and 1 affects they have on the ecosystem.
3. Name at least one way that they can prevent (non-point sources) of pollution at home.

RATIONALE

Actively protecting our rivers, lakes, and watersheds is important because they provide sources of water for drinking, irrigation, energy, and food production. Pollution in rivers comes from many different sources so it is important to tackle the issue on an individual, community, government, and global level. The Willamette River is also home to many endangered species such as Chinook salmon, Western pond turtle, Oregon chub, and the Bull trout. This lesson guides students toward a better understanding of different kinds of pollution and how they as individuals can help reduce their negative effect on rivers. It is important for the new generation of decision makers to have a better understanding of the changes that need to be made in order to preserve what we have left.

BACKGROUND

The Willamette River is 187 miles in length, and more than 70% of Oregon's population lives in the Willamette River watershed (YSAT Enterprises, 2009). Pollution is one of the main contributors to the destruction of aquatic ecosystems, resulting in those areas becoming unfit for many living organisms to survive. Rivers and watersheds are shared resources (part of the commons) that people depend on for drinking, recreation, agriculture and species diversity. That is why it is so important for people to understand the impacts that they have on these

habitats.

Water pollution is any chemical, physical, or biological change in the quality of the water that has a harmful effect on any living thing that drinks, uses, or lives in it (Lenntech, 2009).

This includes: **Point source pollution** refers to pollutants that are produced from a single stationary location (MiMi, 2009). **Non-point source pollution** is introduced indirectly into a water system and cannot be traced back to a single source. These include: storm drain runoff, pesticides and nutrient runoff from farmlands, lawns, and gardens that are washed into nearby water systems.

Non-point pollution is particularly important for people of all ages to understand because it is a type of pollution that is more difficult for an organization or government to control. Individuals can make decisions in their lives that can help reduce their impact. These may include not pouring chemicals down the drain, not using fertilizers on lawns and gardens, as well as picking up their pet's waste off the street so that it is not washed into storm drains or ground water systems.

Three categories of water pollution are addressed in this lesson: chemical, thermal, and organic.

Chemical pollution is the introduction of toxic substances into an ecosystem (ex: acid rain, contamination of water supplies from factories or pesticides) and can be harmful to species living in aquatic habitats. **Organic pollution** is oversupplying an ecosystem with nutrients (ex: fertilizer inflow, human and animal waste) and can be harmful to humans and aquatic life, and bacterial populations can increase using up all of the oxygen in the water making it unfit for species to survive. **Thermal pollution** refers to water temperatures above or below the normal condition (ex: power plant turbines that heat water, or dams that increase water levels). Higher water temperatures reduce the amount of oxygen in the water making it difficult for aquatic life to breath (Project Wild Aquatic, 2006). This lesson connects the effects of water pollution to some of the endangered species living in the Willamette River, including the Western pond turtle, Oregon chub, Bull trout, and Chinook salmon (Middle Fork Willamette Watershed Council, 2009).

The federal government, along with state governments have been working on improving the quality of water in the United States. These



initiatives include: the Federal Pollution Control Amendments of 1972, the Clean Water Act of 1977, and the Water Quality Act of 1987.

The Willamette River is on the Clean Water Act 303 (d) list for violations of water quality standards. This includes bacteria, mercury, and temperature (YSAT Enterprises, 2009). On a local level there are organizations such as the Middle Fork Willamette Watershed Council whose mission is to: "Work together as a community to restore and sustain the ecological integrity and economic viability of the Middle Fork Willamette Watershed and to promote local control of our future by providing effective voluntary solutions to watershed issues" (Middle Fork Willamette Watershed Council, 2009). The Middle Fork Willamette is located in the southeast portion of the Willamette watershed flowing from the Cascade Range. The Middle Fork Willamette watershed is about 1,355 square miles. It includes the communities of Oakridge, Westfir, Lowell, Dexter, Fall Creek, Jasper, and parts of South Springfield, and Pleasant Hill (Middle Fork Willamette Watershed Council, 2009).

ACTIVITY DESCRIPTION

Introduction (about 3 minutes)

Explain that in this lesson participants will learn about different types of water pollution, the categories that they fall under, and how they affect their local rivers and the species that live there. They will also learn about ways to prevent pollutants from getting into aquatic ecosystems and why it is important. Explain that at the end of each activity they will rotate to the next station.

Split up the Class (1 minute)

Have the participants count off in threes. Make sure they hold the number on their hand so they don't forget. One of the facilitators should be assigned as a 'timekeeper'. The timekeeper should give each station a five minute and two minute warning before it is time to rotate.

Station #1: Point to the Source (15 minutes)

Materials:

Point and non-point pollution cards
Definition cards

Overview:

In this activity participants will learn the difference between point and non-point sources of pollution by using the pollution identification cards.

Learning Objective:

By the end of this activity, participants will be able to define point and non-point source pollution.

Activity Description:

Step 1: (Less than 1 minute)

Explain to the participants that: by the end of this activity you will be able to identify the differences between point and non-point sources of pollution.

Step 2: (4 minutes)

Facilitator: Ask the students:

Q: Can anyone tell me what water pollution is?

A: Any chemical, physical, biological change in the quality of water that has a harmful effect on any living thing that drinks, lives in, or uses it in any way

A: The contamination of ground water, rivers, lakes, wetlands, estuaries, and oceans that can threaten the health of humans and aquatic life
- Facilitator may choose which definition they like better

Q: Can anyone tell me what point or non-point sources of pollution are? And how can you tell the difference?

Pause and wait 5 seconds for response.

Ask for 2 volunteers to read the definitions of point and non-point pollution out loud to the group.

Step 3: (2 minutes)

Explain that in this part of the activity participants will be put into pairs.

Each group will receive a pollution identification card and asked to determine if the picture on the card represents point or non-point pollution

During this time the facilitator should go around the group and make sure that the students understand the activity.

Step 4: (4 minutes)

Go around the circle and ask the participants to share what type of pollution their card has, if it is a point or non-point and why?

Once everyone has shared – ask the participants to return all of the cards

Assessment: (3 minutes)

Facilitator

Q: Who can tell me what the two kinds of pollution are that we learned about in this activity?

A: Point and non-point

Q: Can anyone tell me the difference between point and non-point sources of pollution?

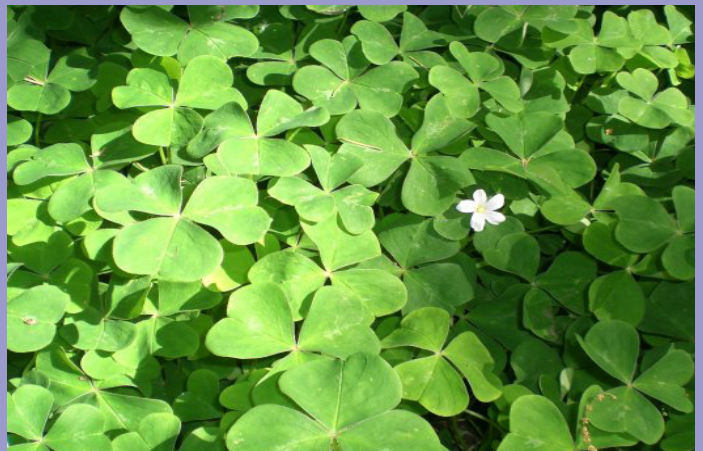
A: Point: Pollutants that come from a single stationary source. **YOU CAN POINT TO THE SOURCE!!**

Non-point: Pollutants that are indirectly introduced into a water system and cannot be traced back to a single source.

If there is time: Ask the students:

Q: Using the information that we learned today, can anyone think of any other sources of point or non-point pollution?

A: Point: Chemical runoff from factories and mills,



boats, oil spills, sewer pipes, etc.

Non-point: Runoff from roads and parking lots, lawns, houses, cars, golf courses, animal waste, agriculture, methane from cows, etc.

Less than 1 minute:

Thank the participants and ask them to quickly rotate to the next station

Make sure that all of the pollution cards have been returned.

Station #2: Where Does it Come From? (15 minutes)

Partly adapted from Project Wild Aquatic: "What's in the Water?" pages 140-144

Materials: (See attached resources)

Stream simulator

Animal cut outs

Pollution balls

Towels

Overview: In this activity participants will use the stream simulator to learn 3 categories of water pollution (chemical, organic, and thermal pollution), how they get into rivers and streams, as well as their effects on the ecosystem.

Learning Objective:

By the end of this activity participants will be able to name 3 categories of water pollution, at least 3 ways that they can get into rivers and streams, and at least 1 way that pollution can effect the ecosystem.

Activity Description:

Step 1: (Less than 1 minute)

Before the activity begins explain the ground rules of the stream simulator. Including 'hands in' (at this time the participants are allowed to build the town in the stream simulator) and 'hands out' (at this time the participants must take their hands out of the simulator and take one step back to reduce distractions).

Step 2: (3 minutes)

Explain to the participants that: by the end of this activity you will be able to name 3 categories of water pollution, at least 3 ways that they can get into rivers and streams, and at least 1 way that they effect the ecosystem.



Facilitator:

"The three categories of water pollution are"

Write on the board:

Chemical pollution

Organic pollution

Thermal pollution

Ask the participants:

Q: Can anyone tell me what chemical pollution is? And how it might be harmful to species living in or close to rivers and streams?

A: It is the introduction of toxic substances into an ecosystem (ex: Acid rain, contamination of water supplies from pesticides, factories, etc.)

- They kill aquatic life such as birds, fish, and vegetation

- Many are toxic to fish and harmful to humans

Q: Can anyone tell me what organic pollution is? And how it might be harmful to species living in or close to rivers and streams?

A: Oversupplying an ecosystem with nutrients. (ex: fertilizer inflow, human and animal waste)

Bacterial populations increase and use up all of the oxygen in the water causing fish and other aquatic life to die.

They are toxic to fish and harmful to humans

Q: Can anyone tell me what thermal pollution is? And how it might be harmful to species living in or close to rivers and streams?

A: Temperatures that vary above or below normal conditions.

Ex: water that is used by power plants and is put back in rivers or streams is at a higher temperature than normal. This reduces the amount of oxygen in the water making it difficult for aquatic life to survive.

Ex: Dams can increase water levels, lowering the

temperature of the water. This can cause damage to aquatic habitats.

Step 3: (3 minutes)

Ask the participants to think about their town, and where these kinds of pollution may come from. Have them build a model of their town, make sure that features such as: A road (with a car), a factory/mill, a farm, a house, a lawn/garden, sewer pipe, trees, etc. are all included. (This may include features not found near river, in order to include all sources)

Have participants place endangered species cut outs in their natural habitat
Chinook salmon, Oregon chub, Bull trout, Western pond turtle
Other species of the Willamette (optional):
American dipper, Bald eagle

Make sure that each student gets a chance to place something in the stream simulator

Step 4: (6 minutes)

1. Ask: what kind of pollution comes from a house? a factory? etc.
Answers will depend on what features are included in stream simulator
Example: chemical pollution can come from houses when people pour cleaning products down the drain.
2. Can anyone tell me what category it falls under?
Example: This would fall under chemical pollution.
3. What effect does this kind of pollution have on river ecosystems? What species are affected?
Example: These chemicals are toxic to aquatic life such as Chinook salmon and can be harmful to humans.

As each volunteer answers these questions: Hand them some "pollution balls" (small white styrofoam balls, and small wooden balls/ or anything that floats in water to represent pollution)

Ask them to place the "pollution balls" in the simulator at whatever location they identified as the source.

As they place pollution balls in the stream simulator have a participant remove the endangered species that the pollution affects.
Example: Chemical pollution affects Chinook

salmon- as pollution balls go into stream simulator one of the Chinook salmon cut outs is removed

The goal is that the participants will be able to see how pollution changes the river. An increase in pollution means a decrease in the amount of species that are able to live there.

Assessment: (2 minutes)

Have participants look at the river:

Q: Now what do you see? Are there still species living there? If not what has replaced them?

A: No species- instead there is water pollution

Q: Would you want to live in a river filled with pollution?

A: No

Q: What are the 3 categories of water pollution that we learned about today?

A: Chemical, organic, thermal

Q: How do these affect the river? Where do they come from? What species are affected?

A:

- Chemical pollution: Kills aquatic life such as birds, fish, and vegetation.

Many are toxic to fish and harmful to humans (fertilizers and detergents)

- Organic pollution: If too much organic waste is released, the bacterial populations increase and use up all the oxygen in the water causing fish to die.

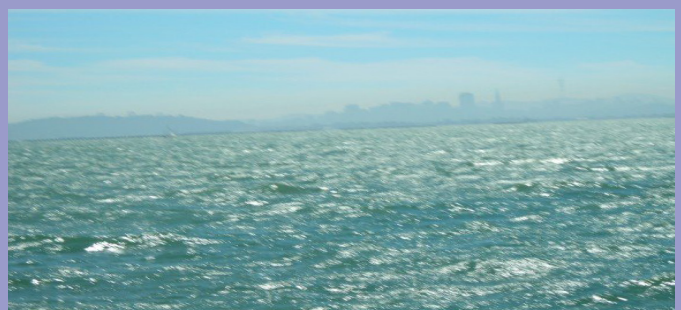
- Thermal pollution: Reduces the amount of oxygen in the water making it difficult for aquatic life to survive.

Dams increase water levels lowering the temperature of the water. This can cause damage to aquatic habitats

Less than 1 minute

Thank the participants and ask them to quickly rotate to the next station

Make sure all pollution balls and stream simulator objects are returned.



Station #3: What's Wrong with This Picture? (15 minutes)

Adapted from the United States Environmental Protection Agency: "What's Wrong with This Picture?"

Materials: (See attached resources)

Non-point pollution scenario picture

8.5x11 Paper for drawing

Markers

Overview:

In this activity participants will identify human activities/ sources of non-point pollution that are harmful to aquatic ecosystems and how their effects can be minimized.

Learning Objective:

By the end of this activity, participants will be able to name at least one way that they can prevent non-point sources of pollution at home.

Step 1: (less than 1 minute)

Explain that there are many different activities in our everyday lives that can be harmful to aquatic ecosystems. There are also ways that we can reduce our impact, what are they?

The goal of this activity is to get the participants thinking about how activities in our everyday lives can negatively impact the environment, as well as ways that they can reduce their impact.

Step 2: (7 minutes)

Show them the picture and ask:

Q: Can you identify 3 things in this picture that is harmful to the environment?

-Discuss how these particular activities can be harmful to the environment

A:

1. Person using fertilizers in their garden
 - The nitrogen and phosphorus in fertilizers can be washed into storm drains and then into rivers where they can create algae blooms (over growth of aquatic plants can smother other species living in the river)
 - These blooms use up all of the oxygen in the water making it difficult for fish and other organisms to breath
 - They can also be harmful to humans and other animals that drink or eat from the contaminated river

2. Person dumping motor oil into storm drain

- Can kill aquatic plants and animals

3. Person throwing away grass clippings

- If you throw them away they will end up in landfills that are already overcrowded

4. Person throwing trash on the sidewalk

- Trash that is dropped on the street can be washed into storm drains and other water systems such as rivers

- A lot of the trash that is dropped on the street is made from plastic which takes hundreds of years to break down.

- Marine animals can mistake trash for food and get sick or tangled in it

5. Removing vegetation along stream bank

- Trees and vegetation are important for erosion control and shelter for animals

- The dirt and soil that gets washed into the river (due to lack of vegetation) makes the water dirty and can smother aquatic plants

- Soil in the water can clog fish gills and off light to underwater plants that need sunlight to grow

Q: What could these people do differently instead?

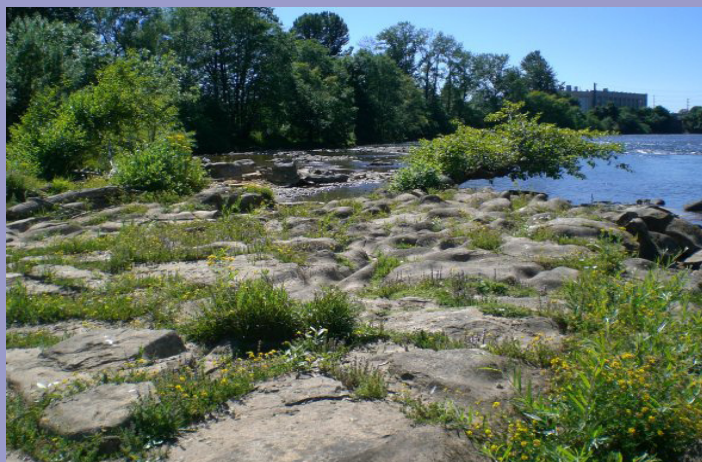
1. Fertilizer

Instead plant native grasses and plants that need less maintenance and water

Use organic fertilizers

2. Dumping oil/chemicals down storm drain

Put oil or chemicals in appropriate container and take it to a service station (they will know what to do with it)





3. Throwing away grass clippings

Instead: create a compost pile in your yard

Leave the clippings on the lawn in order to put nutrients back into the ground and reduce erosion

4. Throwing trash on the ground

Instead: if you see trash on the ground pick it up!
(as long as it is not harmful to your health)

If it is harmful tell an adult or someone who knows how to properly dispose of it

Public trash cans- USE THEM!!

5. Removal of vegetation along riverbank

Instead help your community plant trees, native plants and grasses to reduce erosion.

Step 3: (5 minutes)

Have them draw this same scene but with improved environmental consideration

They only need to draw 3 of the scenarios

- Trashcan on the street
- No dumping sign on the street near storm drain
- Woman planting native plants and grasses (woman without fertilizers)
- Compost pile for grass clippings

Any other improvements that they think of

Assessment: (2 minutes)

Go around the circle and have each participant share what changes they made to this picture and discuss why these changes are important.

Lesson Wrap Up: Bring the class back together after everyone has completed all three stations, and have them discuss, from memory, what they learned in each activity: Definitions of point and non-point pollution. Chemical, thermal, and organic pollution, how they get into streams and rivers and the effects they have on the ecosystem. Lastly, different ways they can reduce (non-point) pollution and why it is important to do so.

Additional Materials

Stream simulator set up/ take down instructions under additional resources

Point and non-point pollution identification cards

Pollution definition cards

Non-point pollution scenario picture

Markers/paper

Pollution balls

Animal picture cut outs



ADAPTED FROM / ADDITIONAL RESOURCES

Activity: "What's in the Water?" page 140-144 (grade level 5-8)
Project Learning Tree, Project Wild Aquatic. 2006.

Activity: "What's Wrong with This Picture?"

United States Environmental Protection Agency, "Non-point Source Pollution Awareness What's Wrong with This Picture?." EPA United States Environmental Protection Agency. 14 October 2008. United States Environmental Protection Agency. 30 May 2009 <<http://www.epa.gov/owow/nps/kids/whatwrng.html>>.

Directions for Stream Simulator

<http://xstreamteam.pbworks.com/Directions-for-Stream-Simulator>

Information on the Environment, "Water Pollution." Information Material. ENFO. 24 Feb 2009 <<http://www.enfo.ie/leaflets/bs11.htm>>.

Lenntech, "Water Pollution FAQ." Lenntech water treatment and purification. Lenntech. 24 Feb 2009 <<http://www.lenntech.com/Water-Pollution-FAQ.htm>>.

Middle Fork Willamette Watershed Council, "Welcome to the Middle Fork Willamette Watershed Council!" Middle Fork Willamette Watershed Council. Middle Fork Willamette Watershed Council. 11 Mar 2009 <<http://www.mfwwc.org/mfwwc.html>>.

"Point Source Pollution." MiMi.hu. 1 Jun 2009 <http://en.mimi.hu/environment/point_source_pollution.html>.

YSAT Enterprises. "The River." Willamette RiverKeeper. 09/02/2009. Willamette RiverKeeper. 9 Feb 2009 <<http://www.willamette-riverkeeper.org/river1.htm#pollution>>.
<http://www.willamette-riverkeeper.org/river1.htm#pollution>

Toth, Nancy. "Implementing an Agricultural Chemical Removal Project ." 9 Feb 2009 <http://www.ucowr.siu.edu/proceedings/2007%20Proceedings/2007_Abstracts/PDF/12.2%20Toth.pdf>

http://www.ucowr.siu.edu/proceedings/2007%20Proceedings/2007_Abstracts/PDF/12.2%20Toth.pdf

Animal cut outs:

<http://iccdpa.org/images/NPS-diagram.gif>

http://www.diannekrumel.com/pic/chinook_salmon.jpg

<http://drvector.blogspot.com/2008/05/in-for-penny-in-for-pound.html>

http://www.oregonencyclopedia.org/entry_images/OLN1222982200preview.jpg

http://www.krisweb.com/krisweb/krisweb/html/krisweb/bulltrout/bull_trout.jpg

<http://www.ackerlunds.com/httpdocs/skagitbaldeagle.html>

<http://fishandgame.idaho.gov/ifwis/ibt/site.aspx?id=188>

Developed by:

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June 2, 2009

2009 Environmental Leadership
XStream Team
Lesson 4

Non-Point Pollution

Non-point: Pollutants that are indirectly introduced into a water system and cannot be traced back to a single source.



Point Source Pollution

Point Source: Pollutants that are produced from a single stationary location.

YOU CAN POINT TO THE SOURCE!!!!



Point source: Identification cards



Oil spill



Paper mill along the Willamette River



Sewer pipe dumping into the Willamette River



Runoff from an abandoned mine

Non-point source: Identification cards



Animal waste



Fertilizers, herbicides, and pesticides used in gardens and farms



Oil, grease, and toxic chemical runoff from streets



Sediment from eroding stream banks

<http://www.notimeforpoop.com/notimeforpoop%20logo.jpg>

http://www.cityofdenton.com/images/solidwaste/pollution_pesticides.jpg

[http://www.duncanville.com/images/Storm%20Drain%20\(sediment\).jpg](http://www.duncanville.com/images/Storm%20Drain%20(sediment).jpg)

http://www.nature.org/wherewework/northamerica/states/arkansas/images/delta_erosion.jpg

Chinook salmon



Western Pond turtle



Oregon chub



Bull trout



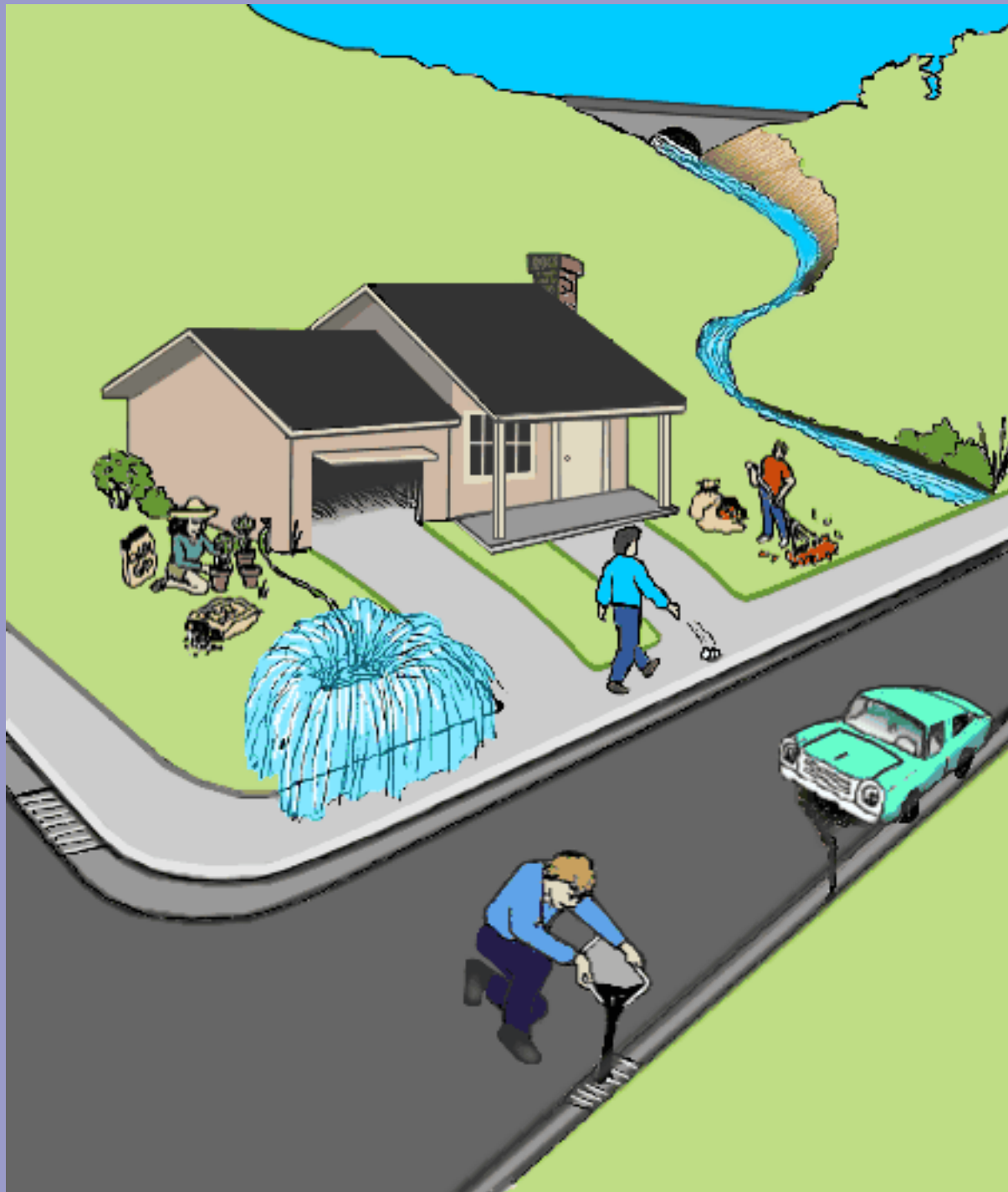
(Optional Species- not endangered)
Bald eagle



American dipper



What's Wrong with This Picture?



<http://www.epa.gov/owow/nps/kids/images/wrong->