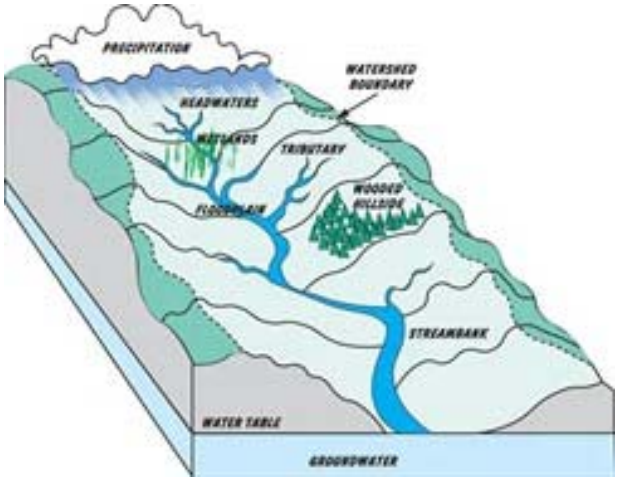
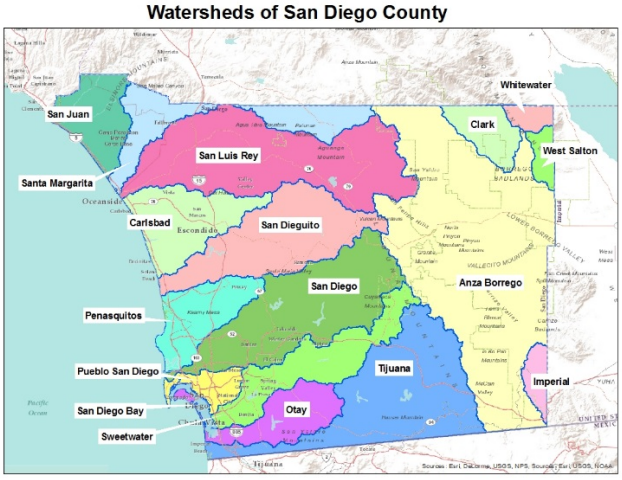
We Live in a Watershed!

Science Lessons and Field Trips

4-ESS2-Earth's Systems and 4-ESS3-Human Impacts

Teacher Lesson Packet





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4-ESS2-Earth's Systems and 4-ESS3-Human Impacts

Teacher Lesson Packet

These earth science lessons explore watersheds and water flow, and ways to reduce impacts of natural processes on humans. Students start in their schoolyard (Part 1) by locating and observing soil, water, plants, animals, and human impacts. They measure water soaking into soil, and observe the slope of various areas. During their field visit (Part 2), students see what a watershed looks like, how water flows, and evidence of erosion. Students may take measurements of water soaking into soil in natural areas, and compare it to their schoolyard. After the field visit (Part 3), students redesign an existing area of the schoolyard to keep it from flooding in the next storm event. Many lesson extensions and internet resources are provided.

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Guiding Questions

By the end of this unit students will be able to answer the following driving questions:

How does water flow through the schoolyard and a watershed?

How does water flow soil erosion?

How should we design our schoolyard to reduce the impacts of stormwater on humans and the earth?

Learning Outcomes

At the conclusion of these lessons, students will be able to:

Record detailed observations and begin to make connections to how water flows and affects erosion in their schoolyard (Part 1)

Students will be engaged in observing and/or measuring erosion and the influence of water on landforms and vegetation. (Part 2)

Students will use evidence from their observations in the schoolyard and on the field trip to redesign an area of the schoolyard to reduce the effects of stormwater and erosion on humans and natural resources. (Part 3)

These lessons are based on the following Next Generation Science Standards.

Disciplinary Core Ideas	**Crosscutting Concepts**	**Science and Engineering Practices**
4-ESS2: Earth's Materials and Systems 4-ESS2-1. Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation. 4-ESS2-2. Analyze and interpret data from maps to describe patterns of Earth's features.	Cause and Effect Patterns Models	2 = Developing and Using Models 3 = Planning and Carrying Out Investigations 4 = Analyzing and Interpreting Data
4-ESS3: Earth and Human Activity 4-ESS3-2. Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.	Cause and Effect	6 = Constructing Explanations and Designing Solutions 7 = Engaging in Argument from Evidence 8 = Obtaining, Evaluating, and Communicating Information

Vocabulary

Erosion: the movement of rocks and sediment by wind, water, ice, or waves

Groundwater: the supply of fresh water that fills the spaces between particles of sand and gravel under the earth's surface

Plot: a small piece of ground marked for a purpose such as gardening or scientific study

Runoff: the precipitation that does not soak into the ground and ultimately reaches streams, rivers, lakes or other bodies of water

Sediment: soil particles that are moved by water and wind, and settle to the bottom of streams and lakes

Storm drains: a large underground system that collects water and carries it to a stream, lake or ocean

Storm water: precipitation that flows over land surfaces, does not sink into the ground, and flows into storm drains, streams and the ocean

Watershed: an area of land that drains into a river, stream, lake, or ocean.

Part 1: Schoolyard-based Learning

Learning Objectives

Students will practice recording detailed observations in their science journal and begin to make connections to how water flows and affects erosion within their schoolyard.

Materials

Student Science Journal

Teacher/Student Background Readings

Hula hoops or metal coat hangers

Empty washed food cans, from 2 to 4 inches in diameter

Water in gallon jugs or other containers

Tennis ball

Computer/Projector

Engage: Sense of Place

This lesson offers experiences with crosscutting concepts of Cause and Effect, as well as Science and Engineering Practice 2 = Developing and Using Models (maps).

Teacher Background: What is a watershed?

Watersheds are land areas that funnel water to a common low point – usually a stream, lake, river or out to the ocean. When it rains, water flows down from areas of higher elevation following the natural shape of the land. Along the way, rainwater and urban runoff can collect and deposit trash, sediment, metals, fertilizers, pesticides and other pollutants into our local waterways. These pollutants degrade water quality, threatening property and the health of nearby residents and wildlife. Everyone lives within a watershed, and preventing pollution and contamination from entering our local waterways is everyone's responsibility.

[From http://www.sandiego.gov/thinkblue/public-education/watershed-coordination.shtml]

Watershed Mapping Activity

On the computer, pull up the watershed map of your local area, or project a printed watershed map. Ask students to locate where they live in the watershed. Website options include:

Illustration of San Diego Bay watershed, San Diego Watershed map here and https://drive.google.com/file/d/0B3B8XBM1M3WWQWVLMjJhNl81OUU/view

Information about the three watersheds that form the San Diego Bay Watershed, www.sdbay.sdsu.edu/education/watersheds.php

Six watersheds in the City of San Diego, at http://www.sandiego.gov/thinkblue/public-education/watershed-coordination.shtml,

with brochures about six watersheds: San Dieguito River, Los Penasquitos, Mission Bay (Rose and Tecolote Creeks), San Diego Bay, San Diego River, and Tijuana River watershed

Map for Escondido Creek, page 8 in http://www.sanelijo.org/sites/sanelijo.org/files/Publications/TGwater-wetlandsv07.pdf

Identify the parts of a watershed.

From the map, identify the main creek or river (main stem), tributaries, headwaters, and mouth. Identify the school and where it is located in the watershed relative to these geographic features. What happens to rain, when it falls in the headwaters? on the tributaries?

The main feature of a watershed is the major river all water drains into, which is called the main stem. The place where this river meets a larger river or the sea is called the river's mouth. Tributaries are the smaller rivers that flow into a larger river, adding water to it. The headwaters are found at the beginning of this river. A watershed boundary is the edge of a watershed, beyond this boundary water flows into another watershed.

[Adapted from watershed lesson, Project Wet, available at http://www.discoverwater.org/resources/Explore_Watersheds_Educator_Resources.pdf]

Online interaction that starts with entering zip code of the school, to identify the parts of a watershed and the common human impacts, http://www.discoverwater.org/explore-watersheds/.

Students will discuss what it means to live in a watershed.

Where is the school and where is your home, in the watershed?

How might people might affect the habitats and/or organisms that are found in and around the watershed?

For example: what will happen if we drop a piece of trash in our schoolyard. Where will the water take the trash eventually? Use the watershed map to trace the path the trash might take down the watershed and towards San Diego Bay / Pacific Ocean.

Explore: Schoolyard Safari

This lesson offers experiences with crosscutting concepts of Patterns, as well as Science and Engineering Practice 3 = Asking questions and defining problems.

Teacher preparation

Choose one of two methods to set up plots for soil and vegetation observations: (1) hula hoops or (2) metal coat hangers bent into a circle.

Materials

Science Journals

Hula Hoops or metal coat hangers, one for each group

Guiding questions

Start the lesson by encouraging students to think about what they already know/experienced. You can have students do this in groups (3-4 students per group), share out and write ideas on the board, or have students record their answers in their journal (depending on the needs/goals of the class). This can be done inside the classroom or outside in the garden/schoolyard habitat.

What surfaces cover the schoolyard? Where is there grass, other plants, bare soil, asphalt?

How does water interact with different surfaces? Do you ever notice… puddles? Wet or dry soil? Flooding? Flat areas? Slopes?

What happens to the soil, when there is water?

Preparation before taking students outside

Students will look for evidence of water affecting the ground in our garden and will do a small experiment by timing how long it takes water to soak into the ground in the schoolyard. Students will be placed in groups (suggested size 3-4) and assigned an area within the schoolyard (can be student or teacher's choice)

Roles may be assigned to group members, to record the observations, including recorders of soil and water, plants, animal and human impacts

Students will observe the soil, vegetation, water, and human impacts.

Before heading outside, lead students in a discussion about what good scientists do when observing.

Ask students to come up with their own ideas of what kind of information they will need to get the "whole picture" as to what happens in our schoolyard when water interacts with the land.

Five Senses: Seeing, Feeling, Hearing, Smelling, Tasting (only when safe!)

Details, details, details!

Write and draw ideas. Make diagrams with labels.

Ask students what they think they will observe in the vegetation and soil plots.

Students will record the following in their science journals:

Name or names (if doing group journal entry) of observers

Date and time

Location (can be general such as relative to a building on the school grounds or specific if a GPS instrument is available)

Weather conditions? (warm, cool, windy, calm, dry, raining)

Observations about the soil and water

Observations about plants and animals

Observations about human impacts

Schoolyard activity: Vegetation and soil plots

After students have set up their science journal, take students outside to the schoolyard area. Show students how to create a plot by placing a hula hoop or wire ring (coat hanger) to mark the edges of the plot. Encourage students to make as many observations as possible using the guiding questions discussed earlier.

Students are assigned a plot area to focus their attention on:

Observations about the soil and water

Observations about plants and animals

Observations about human impacts

Teachers walks around to the different groups, asks individual students and groups these questions, as the students are making observations:

About the Soil. Is the soil wet or not wet? Can you identify the source of the water? Is the soil loose or compacted? (If you cannot put a pencil down in the soil easily, it is compacted) Is the area flat or sloped? What direction does the slope face? Is there evidence of erosion? Describe or draw it.

About the Water. Did it rain recently? How do you know? Is there irrigation? What are the other water sources on or near your area?

About the Plants. How much of the area is covered by plants? Describe the plants…. Tall, short, waxy leaves, colors, textures, etc. Are any of them dead?

About the Animals. What kind of animals are present? Insects? Is there evidence of animals? What is the evidence? (bones, shells, scat, tracks, etc.)

About Human Impacts. Evidence of humans (trash, footprints, irrigation pipes) Evidence of impact on nature (disturbances, moved nature, etc.)

Back in the classroom

Student groups discuss their observations.

Each group decides what to share with the class for these categories: something they have never seen before, something that surprised them, and something they would like to tell the principal about.

Groups share these with the class.

Field trip introduction

Students identify where in the watershed the field trip site is located. If not taking a bus trip, teacher has selected a walk to nearby park or natural area, or one of the other alternative field trips.

Ask students what they think they will see differently about the soil and water in a natural area. Why would this be different from the schoolyard?

Explore: Water soaking into soils

This lesson offers experiences with crosscutting concepts of Cause and Effect, as well as Science and Engineering Practice 2 = Planning and carrying out experiments.

Teacher background

When rain hits the land, water either soaks into the ground to become groundwater, or runs off the land to become runoff. In this activity, your group will do a percolation test on various land surfaces around your school. A percolation test measures how long it takes for water to soak into the ground. This test will help you determine whether water that falls on your schoolyard becomes groundwater, runoff, or both.

Materials

Metal can (or other cylinder) with two open ends, such as 15-ounce vegetable or 10.5-oz soup can

Pitcher or empty jug for pouring water

Beaker or measuring cup

Stop watch

Classroom preparation

Before heading outside, lead students in a discussion about what they think will happen when they measure how long it takes for water to soak into the ground.

Will there be differences in different places in the schoolyard? Where will water soak more quickly? Slowly?

What else do they expect to observe about water and soil?

Before you go outside, decide who will be responsible for each task.

You will need students assigned to each of these jobs: a Timer, a Recorder, an Engineer (someone to twist the percolation can into the ground), a Tester (someone to pour the water), and an Observer to watch the water as it seeps into the ground or runs along the surface.

After the first test, switch jobs so everyone gets a chance to do everything.

Make a data chart with the class.

What observations will be made at each location?

Each group will apply the same amount of water and record the seconds for it to soak into the soil.

Activity in the schoolyard

Students will pour water into a can that is placed on a land surface and recording the amount of time that it takes for the water to soak into the ground.

As a class, list the things that should be kept constant in this experiment (size of container, amount of water). This includes 200 ml (or one cup) of water and pour it into the cylinder. Record amount of water in your data chart.

Each group will design their experiment.

Each group will first do this experiment in the areas they observed in the Schoolyard Safari. If there is time, assign groups to take additional water soaking tests in other areas of the schoolyard. If time, ask each group to collect data in more than one area (milliliters of water, seconds, number of times, soil description)

In the schoolyard, students will do the following:

Find various land surfaces around your schoolyard: grass, gravel, packed dirt, loose dirt, pavement etc. Record the location of each area you have been assigned, in the data chart in Science Journal.

Place the cylinder on a land surface. If possible, twist the percolation cylinder into the ground slightly so that water will not flow out the edges.

Measure 200 ml (or one cup) of water and pour it into the cylinder. Record amount of water in your data chart.

With a stopwatch, time how long it takes for all the water to soak into the ground. Record this in your data chart. If it takes more than 5 minutes for water to soak into the ground, stop the experiment and record "5 minutes."

Repeat steps 3-4 for each different surface area assigned to the group

Adapted from Save the Bay: San Francisco Bay Watershed Curriculum, http://www.savesfbay.org/sites/default/files/WatershedCurriculum.pdf.

Back in the classroom

Students/groups will prepare tables summarizing their data for different surfaces in the schoolyard, then display in bar graphs.

Student groups present their results to the class.

Encourage the students to share the details from their experience observing the plot.

Compare the evidence with what the students thought would happen, before they went outdoors.

Make sure groups get a chance to hear about other areas around the schoolyard so there is diversity. This can be done using group presentations, the jigsaw technique, or think-pair-share groups.

Explain: Water flow

This lesson offers experiences with crosscutting concepts of Patterns (ball rolling downhill), as well as Science and Engineering Practice 4 = Developing and Using Models (tennis ball to represent water flowing).

Teacher Background

Water flows from the schoolyard down the street or into storm drains. It carries trash, oil and rubber from cars, fertilizers and pesticides from landscaping, and more. Water in the storm drains is still part of the watershed, but reaches the ocean through large pipes rather than in the natural riverbed (such as the San Diego River).

Materials

Tennis ball for each group of 3-5 students, and some extras (as they sometimes roll into storm drains!)

Classroom preparation

Before heading outside, lead students in a discussion about what they think happens to rain water when it falls on the schoolyard.

Schoolyard activity

Teacher demonstrates how to roll the tennis ball slowly. Student groups will roll their tennis ball in designated areas of the schoolyard to observe how water flows from high areas to low areas (by gravity). The tennis ball is used as a model of where the water will flow.

Students should try different school locations that include both natural areas (school garden, park, soccer field, etc) and developed areas (blacktop, ramps, retaining walls, playground, etc).

Observe – Place the ball on the ground and watch where it rolls. Ask about why it gets stopped (eg: barriers), why it moves (eg: gravity, slope), and where it goes (eg: towards a gutter, pothole, drain, cover, etc.).

Understand – What color is the concrete on the ground, around the ball? Why is it different than the blacktop adjacent? Have you seen puddles after it rains? When the water evaporates it leaves behind dirt, dust, salts, and other particles. This changes the color.

Play a Game – Make a prediction where the ball will go next? Test your prediction or have students stand near gutters/drains and “catch” the ball before it gets away.

Back in the classroom

Discuss what students observed about the schoolyard.

Where are the low areas? Where are the higher areas? Which areas are relatively flat?

How the tennis ball is similar to rain falling on the schoolyard?

Recall - What happens to rainwater in these areas of the schoolyard?

Does it make a pool (low area) or flow elsewhere?

Where does the water flow off the schoolyard?

Where does it enter the storm drains (may be on the street)?

What happens to rain when it falls on large areas of the watershed?

When it rains, water flows down from areas of higher elevation following the natural shape of the land. Due to gravity, water flows downhill, from higher points to lower points.

If an area looked flat, was it really flat?

Although it is easiest to imagine watersheds in areas where there are hills or mountains, water flows downhill even in relatively flat areas.

Discuss how human actions affect the water.

What happens to trash that is laying on the ground, in the schoolyard, when it rains?

What chemicals are likely on the asphalt in the schoolyard? What will happen to them?

Part 2: Nature Field Trip

Learning Objectives

Students will be engaged in observing and/or measuring erosion and the influence of water on landforms and vegetation.

Students will explore human impacts on watersheds and how to reduce them.

Prepare for Field Trip

The “schoolyard safari” observation activity will help you sharpen your observation skills. Questions for students:

> What did you observe that you have not noticed before in our schoolyard?
>
> On the field trip, what do you expect to see in nature that is different than the schoolyard?
>
> What do you expect to observe, that is similar to the schoolyard?
>
> How do you want to record these? What will you write or sketch in your science journal?

Students should bring science journals, or paper on clipboards.

Field trip hosts would provide additional expectations (rules) for students’ behavior at the field site, and share them with teachers in advance.

Field Trip to a canyon, natural area, or nature center

Each field trip will be tailored to the natural area, the watershed and other earth science issues at that site, and the nature educator who leads the students on the field trip.

Field trips need to feature the science practices and concepts of water flow and erosion caused by water.

> Start by orienting the students to the watershed components: creek bottom or stream course, watershed boundaries (ridge line), steep and gradual slopes. Show students a map of the watershed, the headwaters, mouth, and students’ current location.

Field trip can highlight evidence of erosion, water flow, and sediment build-up.

> Show areas where water has soaked in and remains in the soil (creek bottom), allowing vegetation to grow. Contrast to steep slopes where the repeated erosion doesn’t allow plant roots to take hold.
>
> Show areas with vegetation that protects the soil surface from raindrops and heavy rainstorms, and areas where vegetation along streambanks prevents erosion and slows water flow.

Field trip can highlight sources of human-caused water and soil flow, and ask students to predict where it came from (generally irrigation of lawns and landscaping) and where it will move in the next water flow or storm.

Field trip provider can offer the opportunity for students to make the same observations on some field plots, that they made on the schoolyard plots.

Field trip host would designate 5-6 areas where the students can repeat the water soaking activity.

Teacher can be expected to bring the metal cans and measuring devices, and give direction to the students about roles and recording. Students will divide into small groups, mark the plots, and record observations in their journals.

Students have been asked to redesign an area of their schoolyard to increase water soaking in and decrease soil erosion.

Field trip providers can show different areas that have low and high stormwater retention and erosion. They can show management methods to control water flow and erosion (berms, trail waterbars, revegetation on slopes).

Alternative Activities to Field Trip or Extensions

Each group of students can make observations of the soil, water, and vegetation in three or four additional areas of schoolyard. Water flow (tennis ball) observations can be made in different student activity and parking lot areas of the schoolyard.

Students would compare and contrast the areas they observed, and then present to the class.

The class could group the soil (and surface) types and assign symbols to each (dots, stripes).

The class could identify vegetation groups (trees, shrub, grass, fully covering soil or partial cover), and assign colors to each. The symbols (soil) and colors (vegetation) would be drawn by the groups on a large map of the schoolyard.

Walk to Nearby Nature

The class can walk to a nearby natural area, empty lot, or park to make the same observations of plots, that would have been done on the field trip. To find the canyon nearest to you:

Start by locating your schoolyard on GoogleEarth, and look around the neighborhood for areas with natural vegetation and trails.

http://www.sandiego.gov/park-and-recreation/parks/oscp/maps.shtml

http://www.sandiego.gov/park-and-recreation/pdf/ospcmap.pdf

Map the Schoolyard

Make a map of the schoolyard area in your science journal. This can be copied from the school map showing buildings and boundaries.

Surface covering. Mark the permeable surfaces (covered by soil), and the impermeable surfaces (asphalt, concrete, or buildings).

Water sources. Mark the faucets, sprinklers, downspouts from the roofs of buildings.

Plants. Mark the trees, shrubs, and grass areas.

Student use. Mark the activities that students use, and write the types of activities.

School administration use. Mark parking lots, waste disposal, storage sheds, and other uses.

Identify the Human Impacts

Students can also make an inventory of erosion, water flow, and pollution sources in their schoolyard.

Where are the storm drains?

What trash and other human-generated objects are near the storm drains?

Where are the garbage collection bins? Where do the garbage trucks pick up the garbage?

When it rains, where does the water from the dumpster go?

What liquids are on the paved surfaces? water from irrigation? other sources?

Is there soil on any asphalt or concrete surfaces? Where did it come from? (this is evidence of erosion)

Is there pet waste from people walking their pets after school hours?

Is there any construction on or near the schoolyard? Are there any materials that might get into the water, when it rains?

Celebrate the Rain

Make plans to explore the schoolyard, on a future rainy day. On that next rainy day, students dress appropriately, divide into groups for different parts of the schoolyard. Students go outside to observe how water flows, and then indicate the following on their maps of the schoolyard [from Project Wet, Rainy Day Hike, 2011].

Patterns of water flow

Slopes, depressions, cracks in the sidewalk, erosion trails, rocks, building, gardens, trees

Compare how fast or slow water flows in different places

Ways that water alters and impacts the surface of the school grounds (eroding soil, piling up litter, washing away litter and soil)

Note water flowing from the roofs of buildings and downspouts

Chemicals such as oil on the surface ("rainbow" effect on puddles)

Virtual Field Trips

Rose Creek Canyon, one of two canyons in the Rose Creek watershed: http://fieldnotes.com/rcws-wf2_marian-bear-park.html and http://fieldnotes.com/rcws-wf1_rose_canyon.html

Penasquitos Creek, http://fieldnotes.com/flpc-2f1.html

Chollas Creek Watershed: http://youtu.be/A1KokzQaD2A

Part 3: Post-field Trip Activities

Learning Objective

Students will use evidence from their observations in the schoolyard and on the field trip to redesign an area of the schoolyard to reduce the effects of stormwater and erosion on humans and natural resources.

Elaborate: Back in the Schoolyard

This lesson offers experiences with comparing observations and understanding differences, and making claims based on evidence.

Discuss field trip observations

Teachers engage students in a discussion of what they learned/experienced from the field trip.

On a map, students identify where in the watershed the site is located.

> Ask students what they saw differently about the soil and water on the field trip, compared with the schoolyard.
>
> Why were there differences?

Lead a discussion in class or in the schoolyard with these guiding questions:

> Can you make a claim about how rainfall moves through the schoolyard?
>
> Where does water soak in and where does it run off?
>
> How does soil move in the schoolyard, as erosion?
>
> What evidence did they see of erosion in the field trip/watershed? Why does this matter?

How do humans affect erosion? How can we reduce the human impact?

> What human activities are there, in the schoolyard and in the natural area?
>
> How does presence of human activities affect the watershed we live in?

Elaborate: Schoolyard Habitat Design

This lesson offers experiences with project-based learning, making claims based on evidence, and communicating science information.

Project activity

In their original groups, students will redesign an existing area of the schoolyard to keep the schoolyard from flooding in the next storm event and meets three requirements:

Reduces the effects of erosion

Increases water retention from a storm event

Helps minimize impact on humans and the watershed

The design process will include the following steps:

Students will choose an area in the schoolyard that can best meet these requirements. Size should be about 3 meters square (about 10 ft x 10 ft).

Students map the current soil and vegetation using the same observation methods as the small plots in Part 1.

Students identify the slope and where the water will go during a storm.

Students make a map of how they would redesign their assigned areas to achieve the three requirements.

Evaluate: Expository Writing and Presentations

Students present their designs to the class. Provide evidence for why their design is effective in meeting the three requirements for the habitat area.

Extensions to the Lessons

Extension 1: Water Cycle

Review or teach the water cycle, and relate it to the geology of the watershed. The water cycle occurs in the air, on and under the ground. The watershed is the surface area where precipitation falls and flows.

Water cycle illustrations, http://water.usgs.gov/edu/watercycle-kids.html

Water cycle diagram, http://earthguide.ucsd.edu/earthguide/diagrams/watercycle/index.html

A quiz on the processes in the water cycle, http://earthguide.ucsd.edu/earthguide/diagrams/watercycle/watercycleq.html

5-minute video on the water cycle, http://studyjams.scholastic.com/studyjams/jams/science/weather-and-climate/water-cycle.htm

Extension 2: Soil Structure

Review or teach soil structure, and relate soil structure to water infiltration.

> Water in the soil is stored in the pores (air spaces) between soil particles. The amount of water that a soil can hold depends on the soil's depth, texture and structure.
>
> For example, much less water can be stored in sandy soils than clay soils. This is because sandy soils are made up of large soil particles with large pores between these particles. Water drains more easily through large pores than through small pores.

Extension 3: Water soaking into sand, loam, and clay soils

> Students can do a "perc test" or water soak rates in the classroom before going out to the schoolyard or field site. Use the same metal vegetable or soup cans, that have the top and bottom removed, and cover the bottom with a wire screen or mesh. Fill each with beach or playground sand, loamy soil from a garden, clay, or other soils, and set them on a grate or other wire screen. Follow the same instructions that include filling a 200 ml (one cup) of water on the soil and timing how long it takes to fully drain the water.

Extension 4: Follow a Raindrop

Create a comic strip of a raindrop, or a short dance.

> Imagine that you are a drop of rain falling on the roof of your school. Where would the water go?
>
> In each box draw what happens along the journey to the ocean.
>
> What might it encounter on its voyage from your school to the ocean?
>
> What might it say along the way?
>
> Is there anything that may be dangerous to this drop of water?
>
> Be creative and have fun!

Rain water has to travel over or through many different surfaces before it reaches the ocean. Water might travel through dirt, over a side walk and in a storm drain. On this journey this water might pick up trash, oil from road surfaces, fertilizers from lawns, and other things that may affect the water.

> Adapted from Save the Bay: San Francisco Bay Watershed Curriculum, http://www.savesfbay.org/sites/default/files/WatershedCurriculum.pdf

Extension 5: Erosion in a Bottle

Students can build a model that demonstrates runoff and erosion, using plastic soda bottles, different soils, and a few other supplies.

The models can be made either in the classroom or outdoors, and allow students to see first hand the effects of water flow and intensity on different soils.

Instructions for building and using the model at http://www.stormwater.ucf.edu/toolkit/vol3/Contents/pdfs/Student%20Worksheets/erosioninbottle.pdf

Extension 6: Talk with an Expert

Invite your maintenance supervisor or school garden coordinator, a master composter, a landscape architect, or a native plant specialist to talk with your class about the schoolyard. Ask them about how they manage water flow during storms, and how they minimize erosion and soil loss from the schoolyard. Students can ask questions in their exploration phase (Part 1) or in the design phase (Part 3).

Extension 7: Invite a Watershed Presentation

Invite one of the local environmental or educational organizations to give a presentation on erosion, stormwater, restoration, or other topics related to local watersheds.

Extension 8: Watershed Model

Students can make or use a physical watershed model, for hands-on experiences of water flow and pollution impacts.

Models are important and useful tools in science education.

Before using a model, talk to your students about the usefulness of models, but also the limitation of models.

After students have made a model, ask them some questions:

How does this model work the same as what you have seen in the schoolyard or on a field trip? How does the model work differently?

What are the strengths of this model? The weaknesses?

Option A: Make a watershed model

Directions for making simple watershed models are posted at:

http://www.windows2universe.org/teacher_resources/teach_watershed2.html

Very simple, http://serc.carleton.edu/eslabs/drought/2a.html

From San Diego Coastkeeper, https://docs.google.com/document/d/1ES9Ds0IrKxmfetB0rVvaSWVBz0SiQaJ-ctOC0tWWwGs/edit?pli=1

Option B: Buy a watershed model

Enviroscape has a watershed/nonpoint source model with urban and rural features, and common household items that are used to simulate pollutants and best management practices to reduce pollution.

> Cost about $1,000, http://www.enviroscapes.com/nonpoint-source.html. 10-minute video showing how this model is used, https://www.youtube.com/watch?v=1cEPz5qNLyg

Small 3-dimensional models that students build, Mountain Diorama kit, $22, http://scenearama.woodlandscenics.com/show/Item/SP4111/page/1

Option C: Borrow a watershed model

Invite an educator in to bring and demonstrate a watershed model (see classroom presentations chart below).

Invite the Splash Science Mobile Lab to visit your school. The San Diego County Office of Education offers the Splash Science Mobile Lab, which travels to school sites, more information at http://www.sdcoe.net/student-services/outdoored/Pages/splash-science-mobile-lab.aspx .

> There is a large molded watershed model, and the students pour water and other substances that represent pollutants to see how it flows down through the watershed.
>
> The Mobile Lab also has six hands-on stations showing water pollution affects the environment, humans, and wildlife. These stations have microscopes with live specimens, chemistry experiments, activities on state-of-the-art computers and much more.

Option 4: Online watershed model

The WikiWatershed® application has great potential but isn't fully available yet. WikiWatershed® is a suite of web-based tools designed to assist citizens (and students) in managing water resources. When fully developed, it will leverage open source software and will function as an open collaborative resource for the community. At http://wikiwatershed.org/ .

As "Wiki" implies, content will be primarily contributed, enhanced and maintained by the user community. The site will enable users to share geographically-tagged data, photos, videos, comments, educational curricula, simulation models and other tools on streams and rivers. Includes instructional videos and interactive models.

Student Reading

We all Live in a Watershed

A watershed is an area of land that drains into a specific body of water. That could be a river, stream or lake.

A watershed includes everything within its borders—all the land, air, plants, animals, mountains, and deserts. A watershed includes cities, farms, and even people, their stories and traditions. We all live in a watershed.

Water Flows Downhill

Due to gravity, water flows downhill, from higher points to lower points. Sometimes watersheds in areas have distinct hills or mountains. But water flows downhill even in relatively flat areas. Even small differences in elevation can create watersheds.

Naming the Watershed Features

The main features of a watershed are the rivers. Tributaries are the smaller rivers that flow into a larger river. All the water drains into a river, that is called the main stem.

The river begins at the headwaters. The river ends at the ocean, named the river's mouth.

A watershed boundary is the edge of a watershed. On the other side of that boundary, the water flows into another watershed.

What happens to the Rain?

Think about what happens when rain hits the land. What happens to the water as it falls to the ground? Imagine a rainstorm in a wooded area. Grass, leaves, soil, and vegetation act like a sponge, soaking the water into the floor of the forest.

Now imagine the same rainstorm on a road, or in a parking lot. These surfaces are solid, and water can't soak into the ground. As water flows on these solid surfaces, it gains speed and is able to pick up and carry nutrients, chemicals, and trash that might be on the land. Soil not protected by vegetation is easily eroded or washed away by fast moving water.

Adapted from Project Wet, "Explore Watersheds" lesson, posted at
http://www.discoverwater.org/resources/Explore_Watersheds_Educator_Resources.pdf

and San Francisco Bay Watershed Curriculum,
www.savesfbay.org/sites/default/files/WatershedCurriculum.pdf

References and Resources

Curriculum Materials

Project WET, water education curriculum, http://www.projectwet.org/. Simple watershed activities, http://www.discoverwater.org/explore-watersheds/. Six lessons, http://www.discoverwater.org/resources/Explore_Watersheds_Educator_Resources.pdf

The NGSS Crosscutting Concepts Make Science Learning 3D! http://www.classroomscience.org/the-ngss-crosscutting-concepts-make-science-learning-3d

Where Did the Water Go?: Watershed Study – Middle School Sample Classroom Assessment http://www.nextgenscience.org/sites/ngss/files/MS-ESS_Watershed_Study-Nov%202014.pdf'

Save the Bay: San Francisco Bay Watershed Curriculum, A Collection of Activities and Action Projects About the San Francisco Bay Watershed for Middle and High School Students. Includes making and using watershed models, maps, geology, ecology, human impacts, and action projects. 304 p, 2000, www.savesfbay.org/sites/default/files/WatershedCurriculum.pdf

Watershed lessons, features rivers in the Sacramento area and the Sierra Nevada http://www.sacsplash.org/sites/main/files/file-attachments/uploads__lesson01.pdf

EPA, Water Sourcebooks series with activities by grade level, on water cycle, drinking water and wastewater treatment, surface and groundwater resources, and wetlands and coastal waters, http://water.epa.gov/learn/kids/drinkingwater/wsb_index.cfm . Lessons for grades 3-5, http://water.epa.gov/learn/kids/drinkingwater/upload/The-Water-Sourcebooks-Grade-Level-3-5.pdf

Taking students outdoors, http://www.fossweb.com/delegate/ssi-wdf-ucm-webContent?dDocName=D567152

California's Education and The Environment Initiative, curriculum relevant to watersheds.

5.3.a. Earth's Water
5.3.b. Changing States: Water, Natural Systems, and Human Communities
6.2 b The Dynamic Nature of Rivers (http://californiaeei.org/curriculum/)

Videos

Video, what is a watershed? 1-minute, https://www.youtube.com/watch?v=QOrVotzBNto

Video about watersheds, 11 minutes, https://www.youtube.com/watch?v=LJ63xGJY4pM

Other Resources

San Diego Coastkeeper http://www.sdcoastkeeper.org/learn/swimmable/san-diego-water-quality.html. Click on your watershed. Example: Pueblo> Ambient> Temp

Caring for our Watersheds, action oriented group that started in Canada and is now global, http://caringforourwatersheds.com/

Watershed Detective Game, about sources of water quality and ways to reduce water pollution, http://caringforourwatersheds.com/games/watershed-detective/

Contacts for Field Trips

Nature education provider	Link to webpage with field trip information
Agua Hedionda Lagoon	http://lagoon.aguahedionda.org
Buena Vista Audubon Nature Ctr	http://www.bvaudubon.org/Education.htm
Friends of Rose Canyon	http://www.rosecanyon.org/
Living Coast Discovery Center	http://www.thelivingcoast.org/
San Diego Coastkeeper	http://www.sdcoastkeeper.org/learn/drinkable/project-swell.html
San Dieguito River Park	http://www.sdrp.org/wordpress/
San Diego River Park Foundation	http://sandiegoriver.org/cool_river.html
San Elijo Lagoon Conservancy	http://www.sanelijo.org/welcome-san-elijo-lagoon-conservancy
Tijuana River National Estuarine Research Reserve (State Parks)	http://trnerr.org/explorers/

Contacts for Classroom Presentations

Nature education provider	Links for classroom presentation information
Resource Conservation District of Greater San Diego County	http://www.rcdsandiego.org/watershed_education_program.aspx
San Diego County Office of Education Center, Splash Lab	http://www.sdcoe.net/student-services/outdoored/Pages/splash-science-mobile-lab.aspx
San Diego Coastkeeper	www.projectswell.org
I Love a Clean San Diego	http://ilacsd.org/

How do these lessons work with your students? Which ones did you try in the schoolyard? On a field trip? Is there too much (or too little) detail for you, as a teacher?

Please provide feedback and suggestions to Sandra Lebron, slebron@sdcoastkeeper.org, Crystal Howe, crystal@creec.org, or Anne Fege, afege@sdchildrenandnature.org