WYLAND FOUNDATION

Mobile Learning Experience Teacher's Guide

Prepared by: The Wyland Foundation

WYLAND FOUNDATION

Dear Educator,

Thank you for your interest in the Wyland Clean Water Mobile Learning Experience, presented by the Wyland Foundation, National Van Lines and our partners in conservation. This 1,000 square foot, bio-diesel powered mobile exhibit was designed by a unique team of educators, scientists, and conservationists representing top public, private, and non-profit organizations around the country. It is designed to excite and enlighten people of all ages about the conservation of wildlife and marine habitats. This booklet provides a comprehensive overview for bringing the exhibit into your school or community event.

The exhibit experience may be divided into the following three components:

- In-class activities to understand the role of watersheds in our lives
- Instructions for hosting the Clean Water Mobile Learning Experience, from exhibit floor plan and set-up times to on-board activities and training tools for docent volunteers
- Activities and on-line surveys to measure what everyone learned

Take advantage of these opportunities to make the most of your MLE Program experience

	Phase 1 Activity	Phase 2 Activity	Phase 3 Activity
	1-2 Hours	*1 Hour*	*1-2 Hours*
Pre-Visit In Class Activity	Choose one of provided activities		
Exhibit Day		Rotate Classes of 30	
Post-Event Learning/Assessment			Teacher Survey/Student Quizzes

Please review all of the sections in this exhibit guidebook. Used together, the pre-event activities, event tools and tips, and post-event surveys will provide an informative, engaging learning experience for everyone. Be sure to watch the video of the Mobile Learning Experience exhibits in action at www.wylandfoundation.org. If you have questions, please contact the Wyland Foundation at 1-800-WYLAND-0 or via email at cleanwater@wylandfoundation.org.

Best Fishes,

Wyland

Wyland

Founder and President

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Table of Contents

An Educational Resource for Teachers

This Teacher's Guide is appropriate for all intermediate grades (4-8). This guide will be most useful when accompanied by a visit with the Mobile Learning Experience, but is a valuable resource on its own. Teachers are strongly encouraged to adapt activities included in this guide to meet the specific needs of the grades they teach and their students. Activities developed for this guide support National Standards for Art, Social Studies, and Geography; Next Generation Science Standards; and Common Core Standards for Mathematics and English. Not all standards are referenced in this guide due to space constraints.

Water: A limited resource

I am the lakes and the oceans.
I am the clouds and the rain.
I am a river, and I run through everything.
Touch me and you touch an entire world.

Water makes life possible. It nourishes the plants we eat and the trees we sit under. It provides a habitat for an endless number of living things. Water connects us all. The same drop of water that flows through the Amazon may end up raining on your town someday. The arctic water that a whale swam through could be in your bathtub. Every living thing depends upon water.

About 70 percent of the world is covered with water, yet only a very small portion of that is accessible freshwater. Most of our freshwater is locked up in icecaps and glaciers or hidden underground. Although some scientists speculate that Earth may receive small amounts of new water from meteors, the amount of water on our planet is relatively fixed and gets used over and over again through the water cycle.

Humans, plants, and animals have existed on that set amount of water for a long time, so everything is fine, right? Maybe, or maybe not when you consider the rising world population, a higher demand for water, and the increase in the amount of water that is so polluted it is unsuitable for use. To add to the problem, freshwater isn't spread evenly across the planet. Some places like North America have decent water supplies that replenish (if they aren't overtaxed), but others such as Saudi Arabia and parts of Africa are very dry and face constant water shortages. Even in the United States water is becoming an issue. States are beginning to argue with each other and file lawsuits to determine who owns the rights to water that flows across several state lines.

Because of gravity, water runs downhill from high points like mountains and hills to lower points in lakes, rivers, ponds, and wetlands. Eventually, all water drains into the world's ocean. In every area of Earth, the highest points of land form boundaries from which water runs downhill. Each area the water drains into is called a watershed. You can think of it as a big bowl with the high edges being the boundaries of the watershed. Smaller watersheds are contained in larger watersheds, like a stack of bowls that fit inside each other.
Watersheds, rivers, and the ocean aren't bound by town, state, or even country lines. For example, the Colorado River watershed includes Wyoming, Colorado, Utah, Nevada, New Mexico, Arizona, California, and Mexico

and covers about 244,000 square miles. Once the water reaches the ocean, currents drive it to other parts of the world, so water truly does connect us all!

Rivers play an important role in the Earth's water system. They are often referred to as the arteries or lifeblood of watersheds because they bring essential water, sediments and nutrients from one area to the next. They are a source of food and drinking water and provide homes for many types of fish, reptiles, amphibians, birds, and mammals.

Rivers begin at mountains or hills as the result of snow melting or a natural spring bubbling up from the ground. These small amounts of water collect to create streams that later merge forming a river. The Colorado River begins its 1,450 mile journey up in the Rocky Mountains of Colorado and Wyoming and gains speed as water is added from tributaries. As rivers flow swiftly, the water carries a large amount of material that causes erosion. Over millions of years this process forms canyons like the famous Grand Canyon shaped by the eroding forces of the mighty Colorado River.

Most rivers flow to the ocean or another large body of water. In the case of the Colorado River and many other big rivers in our country, water is diverted for use before it reaches its terminus. With the diversion of water comes the diversion of sand, gravel, and silt that many of us depend on for recreation.

Everything that exists in a watershed affects the quality of the water in the watershed. If water runs through a mountain forest, it will pick up leaves, dirt, or pine needles. If it runs through a pasture where cows graze, it will pick up bacteria or pollution from the waste cows create. If it runs through a city or a neighborhood with a lot of people, it will pick up things people use, such as food wrappers, plastic water bottles, or lawn fertilizers. If it runs through factory or farm areas, it will pick up chemicals, pesticides, oil, fertilizers, or other pollutants.

Storm drains and catch basins are the openings along the sides of highways, street gutters by sidewalks, and often

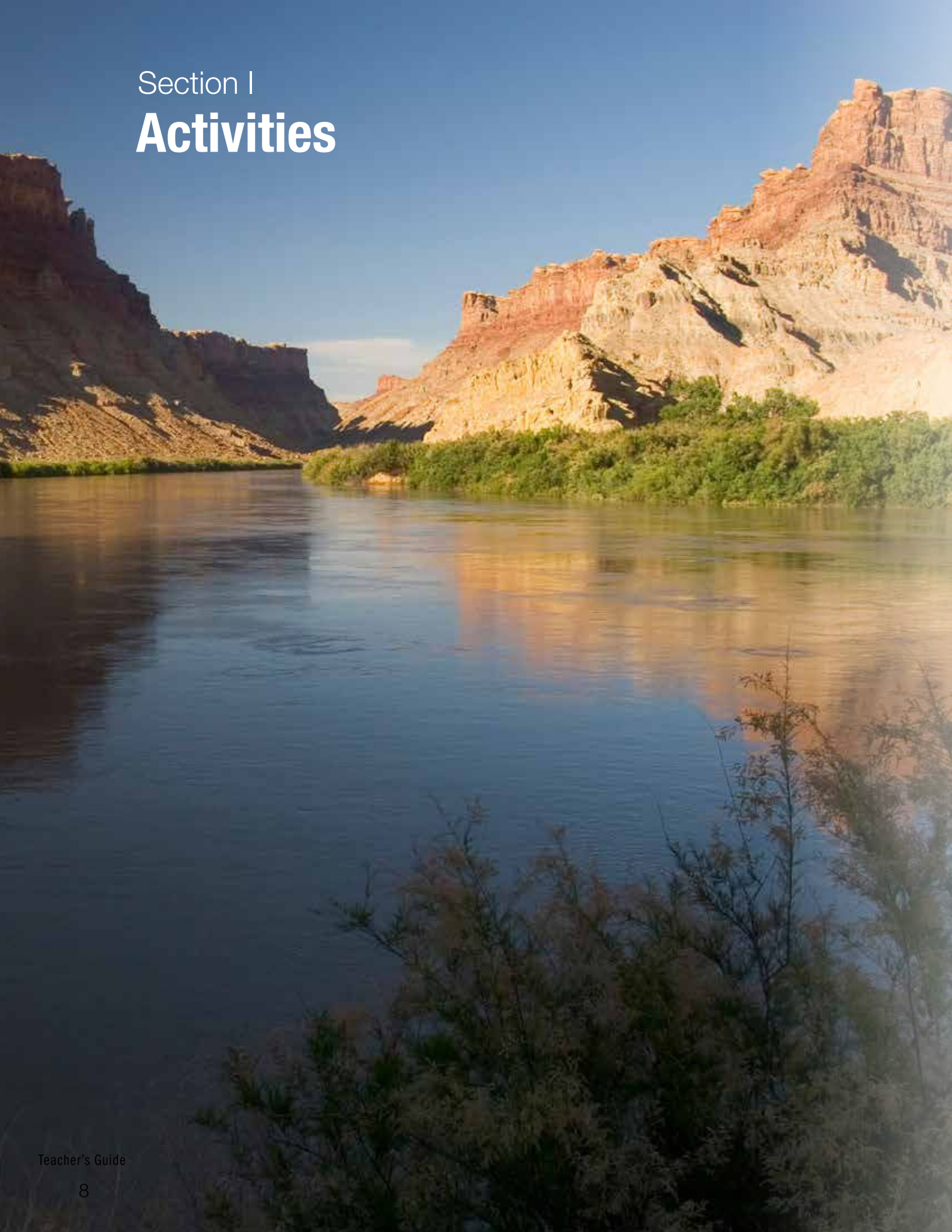
the drains you see in parking lots. They are designed to capture runoff water. They lead directly to rivers, lakes, and the ocean. Most storm drains do not clean or filter the water they carry, so any pollutants the water has collected go straight into water bodies where they can harm plants and wildlife.

This type of water pollution is called non-point pollution as it comes from more than one source and more than one place. It is the most prevalent type of water contamination because it can affect areas far from the original source and is difficult to control. From motor oil to fertilizers to pesticides to trash, individuals are responsible for the bulk of non-point pollution that enters our waterways. Our individual efforts can significantly reduce non-point pollution.

It is easier to make a difference than you might think. The choices you make about simple actions you do each day add up. Use water wisely, use less electricity, put trash in its place and recycle or re-use everything that you can. Tell others what you know. If we start thinking of water and aquatic habitats as the precious and valuable resources they are, then we can begin to make a difference. Contained within this guide are many specific ways you can help. For more information, visit www.wylandfoundation.org

Section I

Activities



Water Cycle Art

Activity 1

Objective:

Students will observe the different stages of the water cycle to learn why water is a limited, non-renewable resource. They will demonstrate their understanding of the process by creating an artistic representation of the water cycle.

Materials:

❏ Air tight, watertight containers (1 per group of 4-5 students) such as "disposable" plastic ware 6-8 cup containers or large glass jars with plastic wrap to tape tightly around the top
❏ Container filled with 2-3 cups hot water (not hot enough to burn) for each group
❏ Cooler filled with 1-2 cups of ice for each group
❏ 3 pieces of white, construction, or watercolor paper for each student
❏ 1 large piece of light colored construction paper for each student
❏ Variety of watercolor paint cakes
❏ Watercolor brushes
❏ Containers with water for rinsing brushes
❏ Paper towels or rags for blotting brushes
❏ Cut up sponges
❏ Clean, empty spray bottles (travel size bottles are ideal)
❏ Glue sticks
❏ Pencils or black felt-tip pens
❏ Scissors
❏ Masking tape

Teacher Prep Notes:

This activity can also be done as a demonstration to reduce the amount of materials and time needed. Some students may feel a little unsure about creating an artistic representation of something rather than a "realistic" representation. Reassure them that everyone's art is individual and there is no "right" and "wrong" in art.

Background:

The water on earth is on a journey that never ends. Each drop is used over and over again! It travels the world by changing form during the water cycle. Here's how the Water Cycle works: Heat from the sun or other sources turns water on the Earth's surface into an invisible gas called water vapor through a process called EVAPORATION. The gas eventually cools through a process called CONDENSATION and forms clouds. As it cools, the water in clouds becomes heavy and sticks together to form droplets. These droplets then fall back to Earth as rain or snow known as PRECIPITATION. Some of the water soaks into the ground and collects into pools underground called aquifers. Some of the water is used by plants and then released through their leaves in a process called transpiration. Some of the water runs off the land through rivers and streams and collects in larger water bodies such as lakes, wetlands, and oceans where it evaporates and starts the cycle all over again.

Key Words

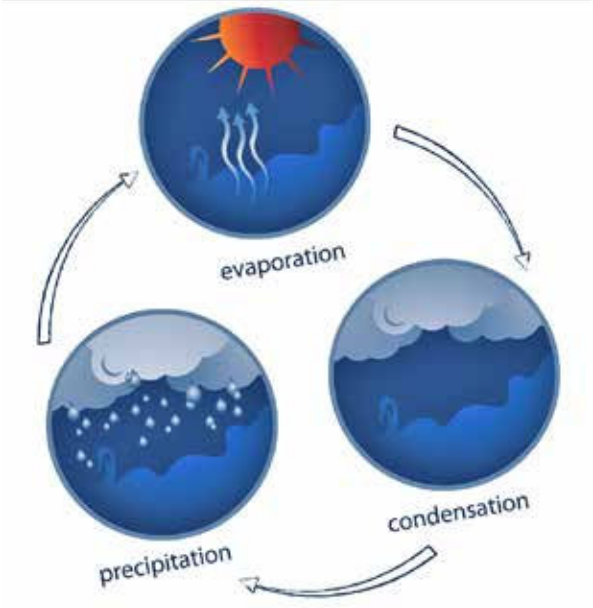
Evaporation Heat from the sun or other sources turns water on the Earth's surface into an invisible gas called water vapor.

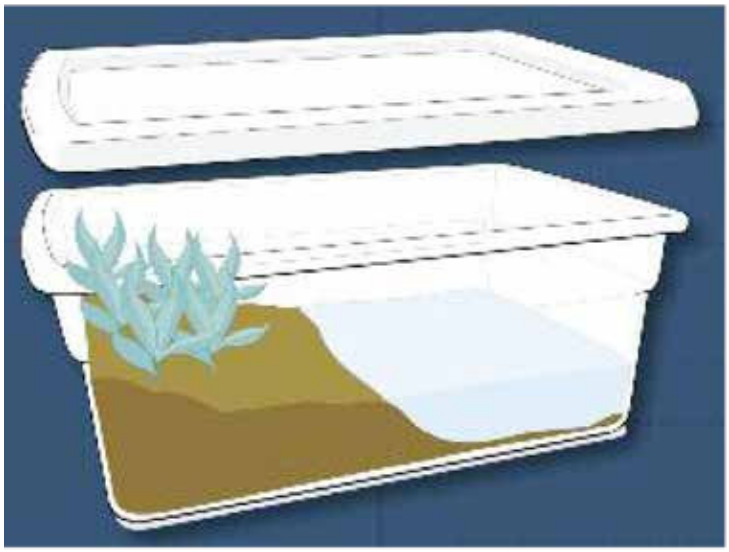
Condensation Water vapor cools and begins to come together in liquid form again as clouds.

Precipitation The water in clouds cools, clumps together and becomes so heavy that it falls to earth.

To Do (part one): Classroom Discussion

Lead a discussion on water. Ask students what they know about water. Where does it come from? What happens when rain falls? Where does it go? Is there a limit to how much water is on the planet or do we get more somehow? Write answers on the board. Introduce the term Water Cycle and draw the parts of the water cycle on the board as students mention or describe them. Tell students that they will be creating their own artificial water cycles. As the experiment progresses, create notes and a diagram on the board based on the students' observations.





1. Students should carefully pour hot water into their container, approximately one or two inches. They should make a mark of the water level on the container with a piece of tape or a permanent marker.

2. When evaporation is observed within the shoeboxes (when the water level in the boxes goes down), ask students what has happened to the water. Discuss the process of evaporation as a class and have students give examples of how they have seen this process in their everyday lives.

3. Students should place ice on the lid of their container. When condensation is observed (water collects on the lid of the container), discuss the process of condensation and the formation of clouds. Ask students if they have seen condensation occur before.

4. When precipitation has been observed (water droplets begin to fall from the lid), discuss this step of the water cycle.

Ask students to review the steps of the water cycle. Tell students that water is a limited resource. All the water we have on earth now is all the water we will ever have. The water that falls to the bottom of the container as precipitation will evaporate once again and start the cycle over.

To Do (part two): Watercolor Activity

Pass out watercolor supplies and let students know they will be creating an artistic representation of the water cycle.

1. Students should fold each of the smaller pieces of paper in half and cut a large circle out of each.

They can put scraps in a bin to be used for other art projects, like a collage. The use of circles represents the continuous nature of the water cycle.

2. Ask students to think about how they would communicate the process of evaporation without words and instruct them to create a watercolor painting on one of their circles to show the process of evaporation.

3. Students will use sponges to paint another circle, this one representing condensation.

4. On the third circle have students create an artistic representation of precipitation by using fingers, flicking paintbrushes, and spraying watercolor from squirt bottles.

5. Have students incorporate their three art circles into one large work of art. They should arrange their three circles to illustrate the flow of water from one stage to the next in the water cycle and label each stage (they could do this by painting arrows, placing them in a painted circle, painting a landscape and placing the circles appropriately or other creative means).

Once the activity is over,
ask students the following questions:

- How did the water cycle model demonstrate that water is a limited, non-renewable resource?
- What water cycle process is responsible for the paint drying on your paper?
- How much liquid can a sponge hold? Does it have a saturation point where it can't hold any more liquid? What happens then? How does this relate to clouds and condensation?
- What similarities are there between the circle shape you used in your artwork and the water cycle?

Taking it Further: Create a Model

Have students turn their water cycle models into terrariums by adding soil and plants. Students can observe and learn about transpiration (when plants release water) in this closed environment. Can they create a small sustainable ecosystem? Have them document what they add and subtract to their ecosystem until it has a perfect balance. How difficult is this task?

Every Drop Counts

Activity 2

Objective:

Students will compare amounts of saltwater, freshwater, and available freshwater on Earth and will identify ways that water is important to the planet and their daily lives. They will log their household's indoor water usage and commit to make one change to help save water.

Materials:

- ❑ Water usage tally chart for each student
- ❑ Large map or globe
- ❑ Pencils and erasers
- ❑ Empty gallon container
- ❑ Colored pencils, markers, or crayons
- ❑ A round object that can be cut for demonstration (such as pie tin or paper plate)
- ❑ Large piece of paper
- ❑ Knife

Teacher Prep Notes:

This activity must be conducted in two parts as students will need to take home their water usage tally sheet overnight. Make enough copies of the tally sheet for each student. Display a world map in the classroom during the activity for students to refer to. As a class discuss ways to save water.

To Do (part one): Classroom

Lead a discussion about the importance of water. Ask students what water does for the planet (grows plants, creates habitats, creates weather, etc.). Then ask students why it is necessary that people have freshwater (drink, shower, laundry, etc.). Brainstorm these needs with the class and write them on the board.

Ask for a volunteer to identify some bodies of water (oceans, lakes, rivers) on the map. Students can come up and point to these areas. Ask students if the body of water contains salt or fresh water. Is there more freshwater or salt water covering our planet? Is water a limited resource or does our planet get more of it somehow?

Demonstration:

Show students the limited amount of available freshwater by using a visual aid: Choose something round and easy to cut such as an apple, pie, paper plate, etc. to represent all the water on earth. Cut out a section to represent 3% – just a small sliver. This sliver represents all the freshwater on earth. The rest is saltwater in the ocean and not useful to us in terms of our survival.

Take the small section and cut out about 70% to represent water trapped in glaciers and ice caps – also water we cannot use. Put aside the larger piece. This is the remaining water we have in lakes, rivers, ground water and aquifers that is available for us to use.

Only 1% of all the water on the planet!

Hold up a gallon/liter container and ask students how many gallons/liters they think their household uses in a day. Log each student's guess. Hand out the water worksheet for them to take home and complete.

To Do (part two):

When students bring back their completed water usage tally sheets, divide them into groups of 4-5 students. As a group, students will calculate their water usage and discuss what (if anything) surprised them about their household's water use. Ask a group representative to share the data they collected and what they learned. Have students brainstorm ways to save water and think about what commitments they could make to save water. Students can make a personal pledge online by logging onto www.wylandfoundation.org website and click "Take the Challenge." Record how many gallons/liters your class could save with your new commitments.

Water is a limited resource

Key Words

Aquifer An underground bed or layer of earth, gravel, or stone that water can move through.

Taking it further:

Have students tally water use over a week and graph their usage. Calculate the class average of daily home water usage. The average American home uses approximately 29,300 gallons of water a year (not including outdoor uses such as irrigation). How does the class average measure up to the national average? Recalculate the class average using the amount of water saved in the individual pledges. Have students figure out how much water could be saved if everyone made the same pledges as your classroom.

Water Usage Tally Chart

	Daily Frequency	x	Usage	=	Consumption
 **Shower or Bath:** 10-minute shower or half-full Bath		x	30 Gallons/ 114 liters	=	
 **Toilet:** 1 toilet flush		x	5 Gallons/ 19 liters	=	+
 **Faucet:** 1 minute running faucet		x	3 Gallons/ 11 liters	=	+
 **Laundry:** 1 load		x	41 Gallons/ 155 liters	=	+
 **Dishwasher:** 1 load		x	15 Gallons/ 57 liters	=	+
					=

Calculate your water usage at home by using this tally sheet. The gallons/liters indicated in the "usage" column are meant to be used as a guide and are based on average number in a range from EPA WaterSense, h2oconserve and other reliable sources. These estimates are based on more inefficient appliances.
Your actual water usage may be different.

Total_____

Water's Extreme Journey

Activity 3

Objective:
Students will learn what a watershed is and how water flows through it. They will investigate non-point pollution, how it enters a watershed, and the resulting impacts.

Materials:
❑ Colored pencils or markers in blue, red, brown, and green
❑ Watershed map. Find your regional map at www.epa.gov/surf or www.usgs.gov
❑ Plastic spray bottles (clean and filled with water)
❑ Foil turkey pans or paint tray liner for each group of 3-5 students
❑ Various objects to build the landscape of the model such as newspaper, brown paper bags, cardboard, cups, toilet paper rolls, foam pieces, mesh wire, balloons, etc.
❑ 1 bowl or tray for every 3–4 students (at least 3" deep and 6" wide)
❑ Lots of newspaper
❑ Masking tape
❑ Scissors
❑ Flour
❑ Water
❑ White glue
❑ Acrylic paints, must be non-water soluble
❑ Paint trays (egg cartons, ice cube trays, small cups, etc.)
❑ Variety of paintbrushes
❑ Sponges
❑ Containers with clean water to rinse brushes and sink
❑ Labels

Recipe for PaperMaché
Blend 2 parts flour to 1 part water and add a couple drops of white glue. Adjust as needed until the consistency is similar to pancake batter.

Teacher Prep Notes:
Your students can create your local watershed or an imaginary watershed for this activity. Decide ahead of time what you'd like them to do and collect a variety of maps and images for students to use as references. If you choose to have students create a large watershed, such as that of the Colorado River, you may want to have each group of students create a different section and put the sections together before applying the paper mache. If the class is combining models, consider setting a scale for the model ahead of time. Use the scale on the maps as a guide for what will work well in the space you have available.

Background:
Point pollution is pollution that comes from one source that is easily identified, such as an oil spill. Though point pollution can be devastating, non-point pollution is actually a bigger problem and on a daily basis accounts for more pollution in watersheds. Below is a list of some types of Non-point pollution and where they may originate.

Non Point Pollution:
Trash/Plastics - There are many types of garbage that enter our waterways. Animals eat the trash and fall ill. Some types of trash release toxic chemicals into the environment as they disintegrate. Others, such as plastic, break down into tiny polymers that never fully decompose.

Sediments: When soil or sediments are washed into bodies of water they clog the water and make breathing hard for aquatic animals and plants. Sediments can come from a variety of sources such as construction sites, clear cutting of forests, or people's yards.

Fertilizers/Waste/Sewage: Sewage and fertilizers contain nutrients such as nitrates and phosphates that cause extreme growth of plants like algae that live in waterways. Overfed plants bloom then die off using up dissolved oxygen as they decompose, leaving no oxygen for aquatic life.

Organic Pathogens: Living organisms such as bacteria or viruses can cause illnesses ranging from typhoid to dysentery to respiratory diseases. These pathogens enter waterways from untreated sewage, storm drains, septic tanks, farms, and boats that dump untreated sewage in lakes or the ocean.

Chemicals/Petroleum/Oil: Industrial chemicals, household cleaners, pesticides, oil, antifreeze, and more enter watersheds through runoff from streets, roads, and parking lots.

To Do:
Introduce the term "Watershed" as an area of land that water travels through from the highest spot to the lowest spot, which is usually the sea. The water "sheds" from the high elevations down to the low elevations. Small watersheds exist inside much larger ones, like bowls that fit inside one another. Everyone lives in a watershed.

The Colorado River watershed

To Do (continued): Pass out copies of a watershed map to the students and place one map on the overhead projector. Ask the students to trace major rivers in blue. Are there other rivers on the map? Color them blue as well. Point out the mountains and other high elevations to students. Have the students trace the dotted line around the high boundaries of the watershed with green.

Model Building Activity:
Tell the students they will be working in groups to build 3D models of a watershed and will see how human-introduced items get into watersheds. Organize the students into groups and have them create a simple sketch of the watershed they are going to build. They should decide which materials they will use and who will be responsible for each part. Give each group of students a pan and the materials needed to create the landscape of their watersheds. They can crumple newspaper, stack items, build a framework out of cardboard, use mesh wire (chicken wire) or balloons for support. Once students have their foundation ready, they will cover the entire project with a few layers of paper maché. Allow models to dry. Once models are dry, have students paint using non water-soluble types such as acrylics and allow to dry again. It is important that the entire model has a base coat of paint so it doesn't fall apart.

Once models are completely dry have students spray their models with the spray bottles to make it "rain" and observe what happens. Introduce the different types of man made pollution that can affect a watershed. Brainstorm with students the potential sources for each type of pollution. Have students add items or symbols to their watershed models to represent some human elements such as cities, farms, construction sites, and industry. Students may create these elements out of paper or clay. If time is short, you can use labels. Ask students to consider the human elements that they added and the pollutants they might bring. What if it rained on their watershed now? What would happen to the pollution? (pollutants run into the waterways and drain to the sea). Students can sprinkle sugar free chocolate drink mix on the model in places pollution would be. Spray water on the model again to see the path pollutants take in the watershed they created.

Key Words

Watershed: An area of land that water travels through from the highest spots to the lowest collection spot.

Non-point pollution: Harmful substances that enter the watershed through rain runoff from many different places and many different sources.

Point pollution: Harmful substance(s) that enter the watershed by one source that can be easily identified, such as an oil spill from a ship.

Too Much of a Good Thing

Activity 4

Objective:

Students will learn what an estuary is and explain how it functions in a watershed. Students will describe how upstream activities can contribute to nonpoint source pollution and nutrient loading in an estuary. Students will conduct an experiment on nutrient loading and undertake a water runoff audit on campus.

Materials:

- ❑ Copy of handout one for each student
- ❑ Copy of handout two for each student
- ❑ Copy of handout three for each student
- ❑ Classroom set of scissors
- ❑ Large map of United States
- ❑ Per lab group: four glass or clear plastic jars; water from a local pond, creek, or aquarium; liquid or granule fertilizer; optional water quality test kit

Teacher Prep Notes:

This activity requires collecting water from a local waterway or aquarium to supply each lab group with enough water to fill four jars.

It also requires supervising students as they conduct a water runoff audit on campus plus requesting the cooperation of maintenance staff for a student-led interview.

Background:

An estuary forms where a river meets the sea. Fresh water flowing downstream mixes with salt water flowing in with the tides. In this highly dynamic system, biological productivity is high. So too is the system's vulnerability. Activities that occur in the river's watershed influence the health of the river and in turn, the health of the estuary.

For example, eutrophication is a natural process that can be accelerated by human activity. Eutrophic water is nutrient-rich, marked by an abundance of nutrients, such as nitrates and phosphates, and algae, and a scarcity of oxygen. Excess fertilizers from agricultural and recreational activity, and even residential landscaping practices can flow downstream as runoff, reaching a river and ultimately, an estuary and coastal water. Sewage, industrial waste, and the burning of fossil fuels can also contribute to eutrophication.

While nitrates and phosphates promote the growth of algae and phytoplankton, too much of these nutrients will alter the system's balance. The algae and phytoplankton reproduce rapidly and limit the penetration of sunlight.

This is turn affects the plants growing beneath the water's surface which can no longer photosynthesize. They die, as do the algal blooms. Bacteria decompose the dead plant material and in the process, use and deplete the dissolved oxygen in the water. Organisms suffocate, and a dead zone replaces what was once a highly productive estuary.

According to NOAA, nutrient pollution is the single largest pollution problem affecting the nation's coastal waters, quite possibly exacerbating the effects of ocean acidification. Blooms of cyanobacteria often occur with eutrophication. Cyanobacteria can taint drinking water supplies and deplete oxygen. Some release cyanotoxin, which is harmful to marine life and damaging to commercial fisheries.

Key Words

Watershed: Dead zone: An area in a body of water where low oxygen levels cause animals to suffocate and die.

Decomposition: The breaking down of organic matter, like a dead plant or animal, into its chemical and mineral components.

Estuary: A coastal body of water created where a river or stream empties into the ocean or a bay and mixes with salt water.

Eutrophication: A natural or human-caused process involving the addition of nutrients into a body of water and excessive growth of phytoplankton.

Nonpoint source pollution: Pollution that comes from a wide range of sources rather than single "point" such as a discharge pipe.

Nutrient loading: The amount of nutrients delivered to a body of water by way of a river or stream.

Photosynthesis: The process by which plants and algae convert light energy to chemical energy stored in carbohydrates.

Phytoplankton: Microscopic drifting algae that, like plants, photosynthesize and generate oxygen in the process.

Watershed: The region of land that drains water into a particular watercourse.

To Do (part one):
Display a map of the United States and have students locate various rivers on it. Lead a discussion about where most rivers drain. Where rivers meet ocean, what kind of mixing of water occurs? What does the coast look like where a river's journey ends?

Distribute Handout One and ask students to read the paragraph, study the two images, and be ready to discuss the questions.

To Do (part two):
Have students think about the consequences of contaminated river water reaching an estuary. Explain that sometimes things other than pollutants cause problems. Nutrients, such as fertilizer or soap, can run off the land, flow into a river or stream, and drain into an estuary. There it can promote heavy algae growth.

Distribute Handout Two and have students read the case study. Have them cut out the parameter cards and, depending on their grade level, work independently, in a small group, or as part of the entire class, to arrange them in correct sequential order. Discuss formation of a dead zone.

Set up the nutrient loading and eutrophication demonstration. This can be arranged as one teacher-led activity or several student-led small group activities (each based on use of four jars). Pour the collected water samples into the jars. For each set, label the first jar "baseline," the second "ten," the third "twenty," and the fourth "thirty." Add drops or granules of fertilizer to each jar based on these counts. Place the jars on a windowsill where there is sunlight. Challenge students to create a hypothesis and then record their observations each day for three days. If students have access to water quality test kits, have them take daily readings of dissolved oxygen, nitrate, and phosphate. Discuss results.

To Do (part three):
Distribute Handout Three. As a group, tour the school grounds to gain familiarity with campus water use and patterns of flow, including potential runoff. Look specifically at landscaped areas, playing fields, and parking lots. Have students record observations on their handout.

Meet for a pre-arranged interview with maintenance staff. Assign students to ask the questions appearing on Handout Three, and have each student record the responses they hear on their handout.

Taking it Further:

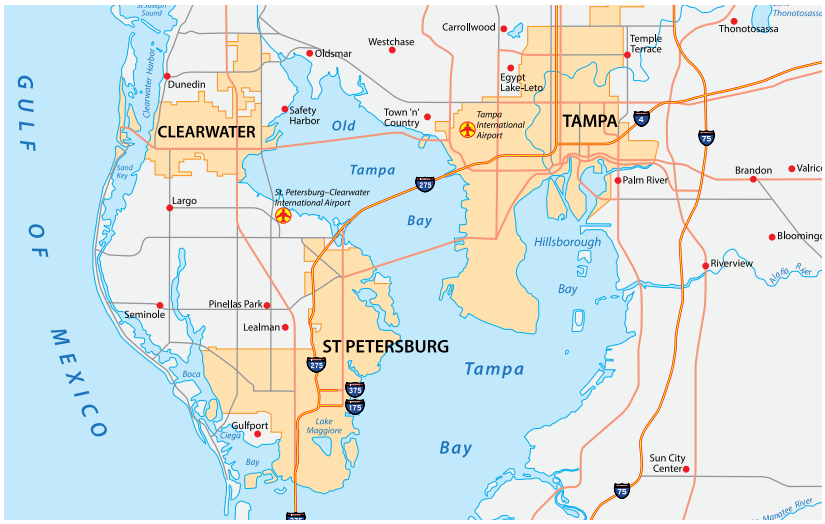
If warranted, have students create a list of recommendations to redirect or eliminate water runoff on the school campus..

HANDOUT ONE: Estuaries

An estuary forms where a river or stream empties into the ocean or a bay. Freshwater flows downstream and mixes with salt water brought in with the tides. Estuaries occur in many of the world's bays. They include the Chesapeake Bay on the East Coast, Tampa Bay in Florida, and San Francisco Bay in California. Study these two maps. Locate the rivers, estuary, and coast shown on each.

San Francisco Bay

Tampa Bay



Discussion questions

Where rivers meet ocean, what kind of mixing of water occurs?

What does the coast look like where a river's journey ends?

HANDOUT TWO

Read the following case study.

The Neuse River is located in North Carolina. It begins its journey near Durham. It ends its journey at the Albermarle-Pamlico Sounds, an estuary on the Atlantic coast. The Neuse River Estuary is critical habitat for fish and shellfish, including blue crab and oyster.

The river flows past farmland, industrial lands, and suburban developments. By the time it reaches the coast, it is loaded with high amounts of nitrates, nitrogen, and phosphate. Wastewater discharges into the river and land use changes in general appear to be the culprits.

This nutrient loading results in nuisance blooms of algae. The algae as well as phytoplankton reproduce rapidly and limit the amount of sunlight in the water. Plants growing along the estuary floor no longer are able to photosynthesize. They die. The algal blooms eventually die as well. Bacteria decompose the dead plant material and in the process, use and deplete the oxygen in the water. Organisms in the estuary mudflats and open water suffocate. Fishkills occur and a dead zone replaces what was once a highly productive estuary.

Cut out the parameter cards and arrange them in the right order

Estuary animals ↓	Aquatic plants ↓
Nutrients → estuary	Nutrients → river
Bacteria ↑	Algae and phytoplankton ↑
Algae and phytoplankton ↓	Dead zone is created
Oxygen ↓	

HANDOUT THREE

Campus Runoff Audit

Sketch a plan view of the administration building, parking lot, driveway, and street.

Observations:

Discussion questions:

Does the school have an irrigation system? _____

How moist is the soil beneath the lawn or playing field? _____

Where do you think water on campus flows in a rainstorm?

Are cisterns in place to catch rainfall? _____

Are there rain gutters? If yes, are they directed to planted or paved areas? _____

Do you see any low-lying landscaped areas where runoff and rainwater collect and soak into the ground? _____

Does the landscaping use plants that are adapted to the local climate? _____

Do you see any signs of leaks or drips?

Maintenance Staff Interview:

1. Does the school have an irrigation system? If so, how type of system is it? Does it get evaluated (for example,

if sprinklers miss their mark, are they adjusted?) _____

_____

3. Does the school use fertilizers on lawns and playing fields? How are application rates determined? _____

_____

4. What practices are in place to reduce the amount of water running off campus? _____

_____

The next 10 years may be the most important, and the next 10,000 years the best chance our species will have to protect what remains of the natural systems that give us life.

— Dr. Sylvia Earle

Rollin' Down The River

Activity 5

Objective:
Students will learn about the different human uses of water and how difficult apportioning a water resource can be. They will become water, trying to make it to the end of the river in a game filled with water usage scenarios.

Materials:
- ❑ Dice (one per stop along the river)
- ❑ Large room or playing field
- ❑ Highlighters
- ❑ Chalk or rope
- ❑ Map of your local watershed

Teacher Prep Notes:

Make copies of your local watershed map you'll be using for the activity. If you are short on time or have younger students, you may wish to create the scenarios for the river sites yourself instead of having the students create them in class (*see EPA website*).

Background:

Freshwater is consumed by plants, animals and humans. The water that we are drinking today is the same water that the dinosaurs drank! The water that exists on this planet today is all we have. so the decisions we make will influence the future supply. Less than 1% of all the water on the planet is freshwater that we can access for human consumption.

With populations increasing, demands on our water supply are growing. More people mean an increase in agriculture and farming for food, homes and landscaped yards to live in, more industry to produce the items we use, more reservoirs to hold drinking water and more golf courses and theme parks to entertain us. Is there a point at which a region can no longer support population growth with current water supplies?

Some regions such as the Colorado River Basin are currently facing these water issues. Who has the right to the river water? If there is a shortage, what types of water use should be cut first? Can a region really close its doors to new development? These are the questions that cities, states, and the courts are struggling to answer.

To Do:
Look at a map of your local watershed and pick one major river for this activity. On the map identify and highlight the headwaters, outlet or mouth, and 6-8 places along the river to be stopovers in the activity such as towns, agricultural fields, industrial sites, dams, and major cities. You can also create your own sites if information is not readily available.

As a class, generate six scenarios for each stopover (one scenario for each number on the die). Make sure some of the scenarios advance players. Write each site's scenarios on a piece of paper to be referenced during the game.

Scenario examples—Agriculture/Farming site

 = new water saving equipment mandated for farmers—move to next site

 = huge storm causes a flood—take one friend to the next site

 = heat wave causes water to evaporate—return to the headwaters

 = broken irrigation system—wait one roll

 = due to drought, Governor orders water diverted to city for drinking water—flow to nearest city and wait three rolls

 = farmers implement mixed crop practices that save water—move to next site

Once the parts of the river are identified, lay out the wavy line of the river on the floor with chalk or rope. Designate the headwaters at one end of the line and the outlet at the opposite end. Along the line, designate the various sites that you generated and label with chalk or a piece of paper. Each site on the river will have one die.

Students will role a die and become water on a journey from the headwaters of the river down to the outlet at the river mouth. Students will encounter various scenarios that detour or accelerate their journey downstream. Students are challenged to make it to the river mouth and reflect on ways to conserve water in their own lives. Students will take turns rolling the dice. How many students actually make it to the outlet?

Taking it Further:

Split students into small groups and have them research the different water users of the Colorado River or your local water source. Each group will represent a specific water user (farmers, cities, environmentalist, industry leader, etc.) in a water rights negotiation meeting. Establish a set amount of available water and assign each group the amount of water they need to function. The amount of water needed should exceed the amount of water available. Students will have a meeting and negotiate a plan for fair usage for all.

Trash To Treasure

Activity 6

Objective:

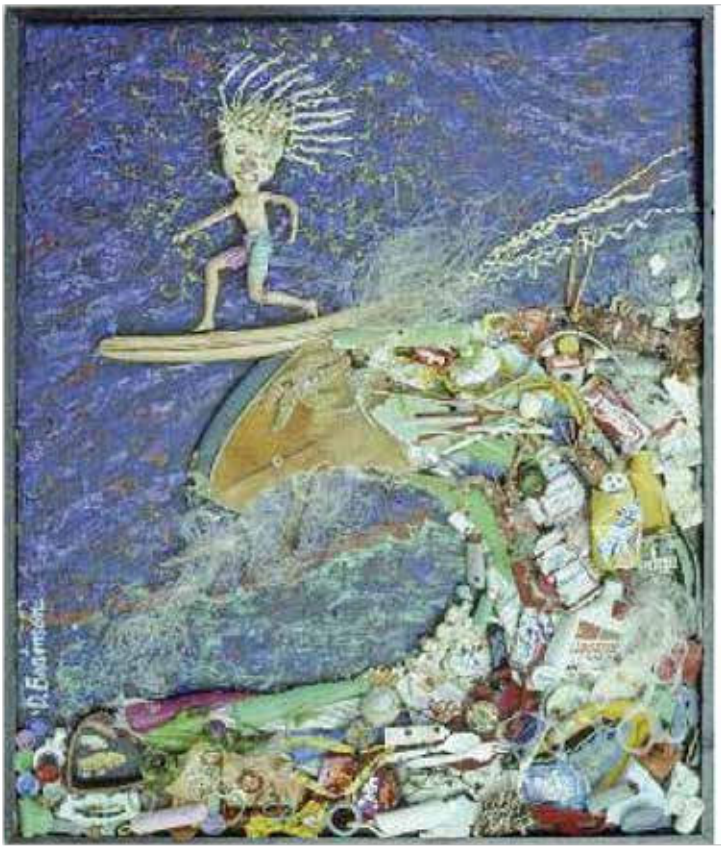
Students will learn about the threats litter presents to aquatic ecosystems by organizing and participating in a community clean-up. Students will collect and evaluate data on what they find. A school-wide exhibit will feature art created from "found objects". And posters will display the students' scientific research results and suggestions for helping reduce litter.

Materials:

- ❑ Pencils, erasers, and a variety of markers
- ❑ Clipboards
- ❑ Trash tally cards
- ❑ Garbage bags
- ❑ Plastic gloves (check with students about latex allergies)
- ❑ Bins to separate materials that can be cleaned and used for sculpture
- ❑ Dish soap, water, and towels for cleaning items
- ❑ Large piece of heavy cardboard or plywood for base of art
- ❑ Hot glue guns (for adult use) and cartridges or another strong adhesive from a home improvement store. (Be careful with these products and make sure to wear rubber gloves).
- ❑ String, variety of tape, zip ties, rubber bands,clamps, clothes pins or other things for attaching and holding pieces while glue dries or for additional reinforcement.
- ❑ Scissors
- ❑ Poster board
- ❑ Clear contact paper
- ❑ Glue—we suggest wood glue, tacky glue, white glue, and glue sticks
- ❑ Any additional media you would like students to use in artwork such as plaster of Paris, clay, etc.

Teacher Prep Notes:

This activity will take several class sessions to complete. First decide where to do the clean-up and get the appropriate permissions for the date you'd like, then schedule your classroom activities. Go to www.wylandfoundation.org and click on the "Teacher Resources" section and "Beach Clean-ups" for tips on organizing a clean-up and to download the trash tally card.



It's amazing what you discover while collecting trash in or along a watershed. Artwork was created from items found during a 20-minute walk along a California beach. ©David Bramsen

To Do (part one): "Cleanup Day"

Let the students know that the class will be doing a clean-up to collect trash and data. Ask students for ideas on how to collect the data. Discuss how scientists might tackle the situation—for example, assigning teams with a tally card to clean certain areas or assigning teams certain categories of items to clean and gather across the site. Have the class vote for their preferred method. Hold the clean-up event. When students are done collecting, sort the trash into three categories: items to be used for art, recyclables, and trash. Before leaving the area, have students take notes on anything they observe that might be contributing to the litter problem (overflowing trash cans, no recycle bins, nearby road traffic, storm drain outlet, etc.) and discuss as a group.

To Do (part two):

Back in the classroom, have students tally the data and create a bar graph displaying the quantity and types of litter collected. In teams, students will research and discuss the impact of one or two litter items on the quality of water, the plants, and the animals that live in the ecosystem. They will also discuss potential sources of the litter and how

it made it to the clean-up site. Using their findings they will create a public poster that identifies the problem and encourages the people to help. Students can easily use markers directly on a poster board or they can print out images & text that they glue onto the board. When poster is complete, cover the board with clear contact paper for protection before displaying outside.

For the collaborative art piece, gather the items set aside for artwork. You or the students should wash and dry the items before using in the art piece. You may opt to create a sculpture of an animal, place, figure, or an abstract sculpture. Discuss with the class a plan for how to achieve this, and make a sketch before starting the project. Have one group at a time work on the art while other groups are working on their posters for the exhibit. The idea is to cover the plywood with items found during the cleanup and/or with representative items brought in. There are no rules for this project, except to keep it safe.

Set up the artwork and posters in a place where students from other classrooms, administrators, and parents can visit them. Students can conduct guided tours of the exhibit, maybe during an open house.

Once the activity is over, ask students the following questions:

• What are some ways trash hurts the ecosystem?

• Did you discover any of the contributing factors to the trash problem?

• What could be done to help limit the amount of trash?

• How does your "trash to treasure art" help convey a message?

Data: Facts or pieces of information.

Taking it Further:

Have students design a study to determine the source of the litter problems. They should present the conclusions of their study and suggestions to the governing agency responsible for the area where the clean-up was held. To learn more about protecting water quality in your area visit www.waterkeeper.org

Key Words

Exhibit: To present something such as art or information for the public to view

Ecosystem: Living things, the physical environment they live in and how they function together

Resources

Websites:

www.wylandfoundation.org
Art and science activities relating to clean water.

www.teva.com/water
Test the health of your local waterway.

www.kohler.com/savewater
Ideas for water conservation at home.

www.waterkeeper.org
Get involved with local Waterkeepers, citizen advocates who patrol and protect their waterways in 172 communities around the world.

www.hamline.edu/gse/cgee_site
K-12 classroom projects and media products.

www.usc.edu/org/cosee-west/quickscience
Lesson plans, information, and science contest.

www.americanrivers.org
River facts and ways to get involved.

www.epa.gov/teachers/water.htm
A collection of lesson plans and background on a variety of water topics.

www.drinktap.org/consumerdnn/
Statistics about national water consumption.

www.respectthebeach.org
A collection of lesson plans from the Surfrider Foundation as well as a watershed education video called "Sea to Summit."

www.projectwet.org
Lesson plans, maps, books and student supplements on a variety of water topics and water bodies.

www.un.org/waterforlifedecade
The United Nations Water for Life site has fact sheets, detailed information on worldwide water issues and a kid's corner.

www.ryanswell.ca
Empowers children and adults to share Ryan's vision of a world where everyone has access to clean water.

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Visit www.mffeducation.org to learn more.

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National Education Standards Alignment Matrices

Mobile Learning Experience Teacher's Guide

Science

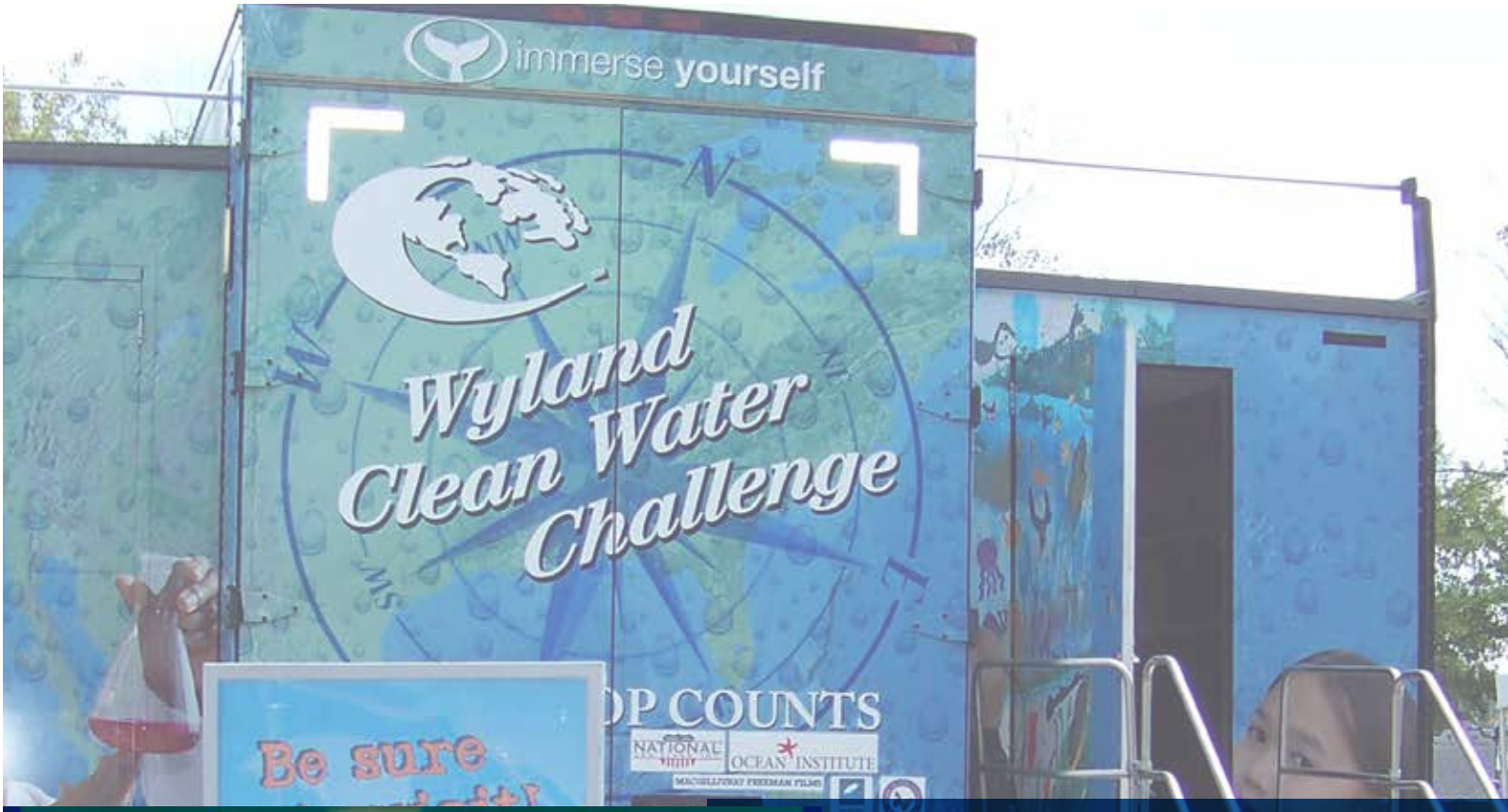
National Science Education Standards
Alignment Matrix

	A. Science as Inquiry	B. Physical Science	C. Life Science	D. Earth & Space Science	E. Science & Technology	F. Science in Personal & Social Perspectives	G. History & Nature of Science
1. Water Cycle Art	●	●		●			
2. Every Drop Counts	●					●	●
3. Water's Extreme Journey	●	●		●		●	
4. Rolling Down the RIver		●			●	●	
5. Trash to Treasure	●		●			●	

Visual Arts

National Visual Arts Standards
Alignment Matrix

	1. Understanding and applying media, techniques, and processes	2. Using knowledge of structures and functions	3. Choosing and evaluating a range of subject matter, symbols, and ideas	4. Understanding the visual arts in relation to history and cultures	5. Reflecting on and assessing the characteristics and merits of their work and the work of others	6. Making connections between visual arts and other disciplines
1. Water Cycle Art	●	●			●	●
2. Every Drop Counts						
3. Water's Extreme Journey	●	●				●
4. Rolling Down the RIver						
5. Trash to treasure	●	●	●		●	●



Get Water Wise.

TAKE THE WYLAND CLEAN WATER PLEDGE

Make a commitment now to save water and reduce pollution. The Wyland Foundation has provided this simple series of commitments that you can make to reduce your overall impact on the environment. Once you've made your pledges, we'll show you how significant your impact can be over the course of year. You'll save money, energy, and the resources to help make a brighter future for everyone. It's that easy!! Take the pledge aboard the Clean Water Mobile Learning Experience or from your classroom, home, office, or mobile device at www.wylandfoundation.org.

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