Clean and Conserve
Activity Guide for Educators

Clean and Conserve Education Program

Project WET® Water Education for Teachers

ECOLAB®

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Project WET Foundation
Vision: Every child understands and values water through action-oriented education, ensuring a sustainable future.
www.projectwet.org

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Clean and Conserve

Activity Guide for Educators

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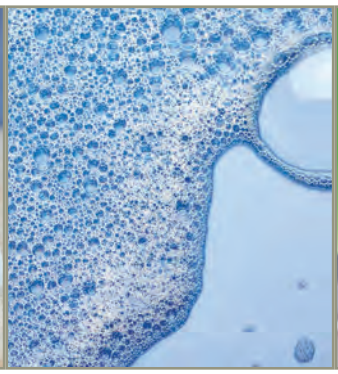

The world's water and health challenges require all of us to realize that the way we live affects the lives of others. It's important for everyone to understand how personal water use affects a wider community and how hand washing helps stop the spread of germs. Learning basic facts about water conservation and good hygienic practices can help instill good habits in everyday life, resulting in a cleaner, healthier world for all of us.

To help children develop these habits, the Ecolab Foundation has partnered with the Project WET Foundation to create the ***Clean and Conserve*** Education Program, including this Activity Guide for Educators. With five activities focused on water conservation and hygiene education, the program is designed to create champions for a sustainable, healthy future. This partnership is a vital component of Ecolab's Solutions for Life program, and helps broaden our efforts to conserve water and improve hygiene around the world through partnerships, global philanthropy and employee volunteerism.

Since its inception, the Ecolab Foundation has supported youth and education initiatives through schools and non-profit organizations. The ***Clean and Conserve*** Education Program is an extension of this commitment. We want to inspire our youth from an early age to be advocates within their own families, schools and communities for healthy environments and water conservation. Through the ***Clean and Conserve*** Education Program, our goal is to empower more than two million people to conserve water and make the world a healthier place.

The work we do at Ecolab matters. Every day, we help make the world cleaner, safer and healthier, protecting people and vital resources. Ecolab is committed to leveraging our expertise and passion to educate youth and, ultimately, inspire them to champion change in their communities through the ***Clean and Conserve*** curriculum. Thank you for joining us on this mission.

Douglas M. Baker, Jr.
Chairman and CEO, Ecolab

Kris Taylor
Vice President, Ecolab Foundation

About the Project WET Foundation

What is Project WET?

Since 1984, Project WET has been dedicated to reaching children, parents, teachers and community members with action-oriented water education to enable every child to understand and value water, ensuring a sustainable future. Project WET ("WET" stands for "Water Education for Teachers") is active in all 50 U.S. states and more than 65 countries worldwide.

A U.S. 501(c)(3) organization, the Project WET Foundation helps people of all ages understand water resources through engaging, action-oriented water education. By promoting water literacy and awareness, the Project WET Foundation gives people tools to address both current and future water issues. With a strong network of public and private partners, the Project WET Foundation has been recognized with a U.S. Water Prize, and its materials are recommended by the National Science Teachers Association (NSTA). Some of the largest corporations in the world are working with the Project WET Foundation to develop customized employee training and community engagement programs.

The Project WET Foundation's educational materials cover the entire spectrum of water, including water quality, wetlands, water conservation, watersheds, WASH (water, sanitation and hygiene), oceans, water and natural disasters, water history, ground water, storm water and more. Project WET publishing brands include:

- Project WET (Water Education for Teachers)
- Clean and Conserve (with Ecolab)
- Kids in Discovery Series (KIDS),
- WOW! The Wonders of Wetlands
- Discover a Watershed series
- Healthy Water, Healthy People
- Healthy Water, Healthy Habits, Healthy People
- Conserve Water
- Native Waters
- The WaterCourse

What does Project WET do?

Project WET achieves its mission of worldwide water education by:

- publishing water resource education materials that are appropriate for many different age groups, instructional applications and cultures and offer comprehensive coverage of the broad topic of water.
- providing training workshops to educators at all levels, formal and non-formal, on diverse water topics so that those educators can reach children with objective, experiential, science-based water education.
- organizing and inspiring community water events, including water festivals and ActionEducation™ projects.
- building a worldwide network of educators, water resource professionals, NGO, water scientists and other experts to advocate for the role of water education in solving complex water issues.

How can I learn more about Project WET and water education?

Please visit the Project WET website at www.projectwet.org, or connect with the Project WET Foundation on Facebook, Twitter or Pinterest. For instant access to engaging water education activities for children, visit Project WET's interactive website DiscoverWater.org. To order additional resources, visit the Water Education Store at store.projectwet.org.

Photo © Project WET Foundation

Photo © sl_photo–Shutterstock

Activity Format

A snappy, thought-provoking teaser introduces the activity. This can be presented as an ice breaker.

Age Level:
Suggests appropriate age levels.

Subject Areas:
Disciplines to which the activity applies.

Duration:
Preparation time: The approximate time needed to prepare for the activity. NOTE: Estimates are based on first-time use. Preparation times for subsequent uses should be less.

Skills:
Skills applied in the activity.

Vocabulary:
Significant terms defined in the activity.

Standards:
Lists correlated Common Core State Standards and Next Generation Science Standards (NGSS) for grades 3-8 for the given activity. For additional grade-level and state-specific standards visit www.projectwet.org/cleanandconserve.

Summary
A brief description of the concepts, skills and affective dimensions of the activity.

Objectives
The qualities or skills students should possess after participating in the activity. NOTE: Learning objectives, rather than behavioral objectives, were established for Project WET activities. To measure student achievement, see Assessment.

Materials
Supplies needed to conduct the activity. Describes how to prepare materials prior to engaging in the activity. Student Copy Pages and Teacher Resource Pages are also indicated.

Making Connections
Describes the relevance of the activity to students and presents the rationale for it.

Background
Relevant information about activity concepts or teaching strategies.

Procedure
Warm Up
Prepares everyone for the activity and introduces concepts to be addressed. Provides the instructor with preassessment strategies.

The Activity
Provides step-by-step directions to address concepts. The primary component of each step is presented in boldfaced type. NOTE: Some activities are organized into "parts." This divides extensive activities into logical segments. All or some of the parts may be used, depending on the objectives of instruction. In addition, a few activities provide Options. These consist of alternative methods for conducting the activity.

Wrap Up
Brings closure to the lesson and includes questions and activities to assess student learning.

ActionEducation™
(select activities)
Education that empowers students, teachers and community members to take positive and appropriate action to solve a local water resource issue.

Assessment
Presents assessment strategies related to the objectives of the activity.

Presenter Tips
Useful pointers on how to customize the activity for a specific audience or at a water festival.

Extensions
Provides additional activities for continued investigation into concepts addressed in the activity. Extensions can also be used for further assessment.

Resources
Lists references from the background information in an activity, including resources for additional information.

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Healthy Personal Hygiene

What is the simplest way to help stop the spread of disease?

Age Level:
6 and up

Subject Areas:
Physical Science, Health

Duration:
Warm Up: 10 minutes
Activity: 20 minutes
Wrap Up: 15 minutes

Skills:
Gathering information (observing, listening); Analyzing (identifying components and relationships among components, identifying patterns); Applying (planning, designing, problem solving, developing and implementing investigations and action plans)

Vocabulary:
communicable disease, direct contact, exposure, germs, hygiene, indirect contact, influenza, microorganism, transmission

Standards:
Common Core State Standards:
CCSS.ELA-Literacy.RST.6-8.3; CCSS.ELA-Literacy.RST.6-8.4; CCSS.ELA-Literacy.RST.6-8.7; CCSS.ELA-Literacy.WHST.6-8.1e; CCSS.ELA-Literacy.WHST.6-8.2d; CCSS.ELA-Literacy. HST.6-8.2f; CCSS.ELA-Literacy.WHST.6-8.4
NGSS: N/A
For additional grade-level and state-specific standards visit www.projectwet.org/cleanandconserve.

Summary
Students learn how germs can spread through contact with people and objects, and how the use of proper personal hygiene habits can stop germ transmission.

Objectives
Students will:
- describe how some common communicable diseases are spread.
- describe how germs may be spread through touch.
- identify ways to prevent spreading germs.

Materials
Warm Up
- *Whiteboard, chalkboard or flipchart paper*
- *Markers or chalk*

Activity
- *Glitter*
- *Fluorescent gel (optional)*

Making Connections
Home is a place to find shelter, food and comfort. The human body is a perfect "home" for thousands of microbes seeking to take up residence. Many are helpful in keeping the body healthy, but some can make us ill. Everyone has had a cold, influenza or a stomach virus. Each year, common infectious diseases spread across the country and around the world, affecting millions of people. Students know that many diseases are contagious—just a handshake or a sneeze away. Understanding illnesses and their causes, transmission and symptoms empowers students to develop healthy personal habits that can help prevent disease.

Background
Microorganisms are tiny, single-celled organisms found everywhere in the world—even in our bodies. There are many types of microorganisms including bacteria, fungi, viruses and parasites. Some microorganisms can be harmful to humans while others are beneficial. For example, some bacteria help our body's immune system fight illness.

Germs are infectious microorganisms that can make you sick. Germs, and the diseases that they cause, can be spread by direct and indirect contact. Direct contact transmission involves touching a person or their bodily fluids, with germs passing directly from one person to another. Indirect contact transmission refers to situations in which a person is infected through contact with a contaminated surface. Some germs, including many that cause sanitation- and hygiene-related diseases, can

survive on everyday objects for a long time.

An infected person can spread germs by expelling water droplets from the lungs through saliva or mucus when coughing and sneezing or through water in urine or feces. The movement of germs from one person to another is the basis of infection by communicable diseases.

One way you can learn to avoid getting a disease is to understand how it is spread. Common ways diseases are spread include:

- direct contact (touching a person or their bodily fluids, with germs passing directly from one person to another).
- indirect contact (touching a contaminated surface).
- airborne transmission (breathing in contaminated dust particles or airborne germs that can remain alive in air for long periods).
- fecal-oral transmission (consuming contaminated food or water, and other indirect contact that spreads germs from feces).

We can keep our bodies healthy and free of illness-causing germs by using healthy personal hygiene habits. Parents, teachers and the medical community stress the importance of preventive measures to avoid the spread of germs and to help our bodies stay clear of communicable diseases such as colds or influenza. These precautions include the following:

- sneezing or coughing into the upper sleeve or elbow or into a tissue.
- washing hands frequently with soap and water, especially after going to the restroom and before eating.
- resisting the urge to chew your fingernails.
- avoiding shared eating utensils, food or beverages.
- when sick, staying home from school, work and other public places where people are in close contact with each other.
- properly cleaning surfaces and utensils that food touches.

Procedure

Warm Up

Open the discussion by asking students to estimate how many objects and people they touch in a day. On the blackboard, ask students to name some objects they have touched that day. When the list has several items, read each and ask students to raise their hands if they have touched it. Ask students if it is possible that some of them touched the same objects, such as benches, books, papers and pencils. How many people have touched common items, such as the classroom door?

The Activity

1. **Divide the class into groups of 10-12 students.** There should be no more than 12 students per group. Pull aside two to three volunteers from each group and put a small amount of glitter on one of their hands. Explain that the glitter represents germs from a cough or sneeze and that the germs are a secret. Instruct them not to tell the other students about the "germs" on their hands.
2. **Instruct the groups of students to stand in a tight circle within their groups.** Tell all students to put their hands straight out in front of them.
3. **Have students cross their arms right over left and grab the hands of another student who is NOT next to them.** Students should grab the hands of two different people. They will likely have to walk into the circle and stand shoulder-to-shoulder in order to reach the hands of another student. Once everyone has grabbed another student's hand, the students should represent a giant human knot in their circles.

Photo © Project WET Foundation

What is a sneeze?

A sneeze is not necessarily a sign of illness, but when a person has a cold or respiratory infection, the effects (swollen and irritated tissues) that the germs create can be a source of irritation that causes you to sneeze.

Being exposed to germs does not necessarily mean a person will become ill. A person's immune system can keep the body healthy by preventing many types of illness-causing germs from invading and multiplying in the body.

4. **Explain that the students must unwind themselves into a circle WITHOUT LETTING GO OF EACH OTHER'S HANDS.** Once the groups have unwound themselves into a circle, instruct students to look at their hands.

5. **How many students have glitter on their hands? Have the volunteers reveal their "secrets."** Have all students with glitter on their hands stand on one side of the room and students without glitter stand on the opposite side.

6. **Tell students that the glitter represents germs. Ask students if they know how many students had "germs" on their hands before the activity started.** Compare this to how many students now have glitter on their hands. What if these were illness-causing germs? How many students now have been exposed to potential illness (how many had glitter on their hands after the knot)?

7. **Ask students how else germs can spread from one person to another.** Reflect on the list of items that the students made during the ***Warm Up***. How do germs get from their hands to their mouth? Discuss the difference between direct contact (e.g., shaking hands with the sneezer) and indirect contact (e.g., handling a pencil the sneezer touched after sneezing).

8. **Have students look at their clothes and body to see if "germs" (glitter) transmitted to their body without their knowledge.** What should students do to prevent the spread of germs? (Wash their hands; properly clean surfaces that food touches; sneeze, cough and yawn into their elbow or handkerchief and not into their hands).

9. **Have students practice using the proper hand washing techniques shown on page 9 by taking the time to wash their hands at the conclusion of the activity.** Ask students to observe how the use of soap helps remove the glitter from their hands.

Wrap Up

- Return to the list of surfaces and objects the class created in the ***Warm Up.*** Do students think these items are likely locations for spreading germs through indirect contact? Why or why not?

ActionEducation™

- Lead this activity in your home or with another group such as a scouting troop or after-school program to educate family members and friends about healthy habits.
- Have students put glitter on their hands at a community event and then shake hands with community members. Students can then teach

people in their community about how to avoid spreading germs (wash your hands).

The WaterStar recognition program encourages students and educators to contribute to a positive water future by learning about water and taking appropriate local action.

Report what you've learned and done at www.projectwet.org/waterstar.

Assessment

Have students:

- describe how germs can be spread through physical contact (steps 5-8).
- differentiate between direct and indirect contact (step 7).
- identify five locations or objects where germs are likely to be found (***Warm Up***).
- identify ways to prevent spreading germs through contact (step 8 and ***Wrap Up***).

Presenter Tips

For walk-up festivals: Put glitter or flourescent gel on your hands or objects at the booth. Shake hands with visitors as they walk up and/or have them touch objects with the glitter or flourescent gel on them. Discuss the transmission of germs to their hands. If possible have them wash their hands on site with a portable hand washing station or provide hand wipes or sanitizer.

For younger children: Instead of using the human knot as an activity, have children walk around and shake hands or form a circle and all hold hands. Talk about the transmission of germs. Then break the students into three groups. The first group does not wash their hands, the second group washes without any instructions and the third group receives proper hand washing instructions. Compare the results and then provide instructions to all groups and have everyone wash their hands together.

Extensions

Teach students the Hand Washing Song. Practice singing the songs using the proper hand washing gestures shown on page 9.

Have students work in small groups to create their own hand washing songs or raps.

Have students in your class put glitter on their hands and shake hands with other students during break times. They can then teach other students about how easily germs are spread.

Resources

Websites

Centers for Disease Control and Prevention. Healthy Living. Topics on how to stay healthy are discussed on this website. http://cdc.gov/HealthyLiving. (Accessed December 2, 2014.)

Mayo Clinic. Germs: Understand and protect against bacteria, viruses and infection. Mayo Clinic.com. A definition and description of germs including descriptions on bacteria, viruses and fungi. www.mayoclinic.com/health/germs/ID00002. (Accessed December 2, 2014.)

Mayo Clinic. Healthy Lifestyle. This website discusses medical topics on how to stay healthy. www.mayoclinic.com/health/HealthyLivingIndex/HealthyLivingIndex. (Accessed December 2, 2014.)

Mount Sinai Hospital Department of Microbiology. FAQ: Methods of Disease Transmission. Department of Microbiology. Answers to frequently asked questions about disease transmission including descriptions of different types of transmission. http://microbiology.mtsinai.on.ca/faq/transmission.shtml. (Accessed December 2, 2014.)

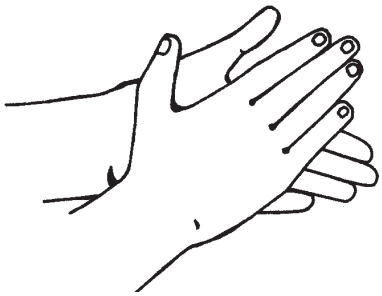
World Bank. Handwashing Facilities in Schools. This website discusses the importance of hand washing for students. http://water.worldbank.org/shw-resource-guide/promotion/school-sanitation-and-hygiene. (Accessed December 2, 2014.)

The Hand Washing Song

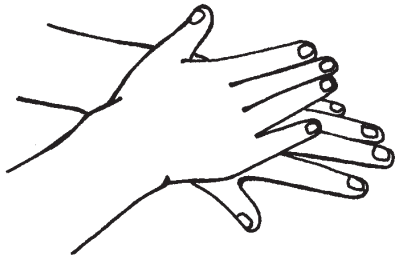
Sing this to the tune of "Frère Jacques" ("Are You Sleeping?"). This song lasts 20 seconds, so it can be sung while washing your hands.

Lather with soap
Rub your palms together
Now the backs
Of your hands
Interlace your fingers
Cleaning in between them
Now the thumbs
Clean your nails

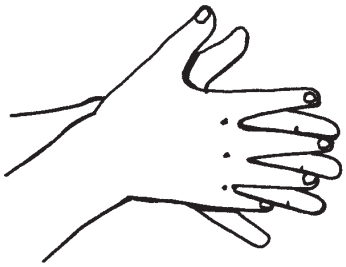
How to Wash Your Hands



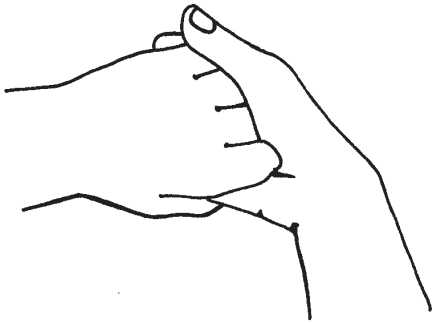
1. Apply soap to wet hands and wrists.



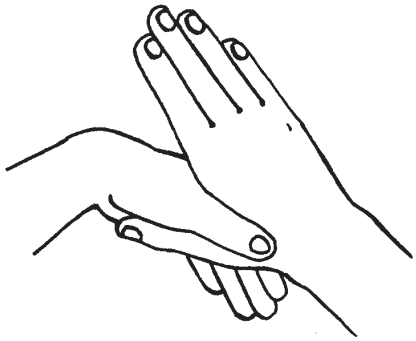
2. Vigorously scrub the backs of both hands.



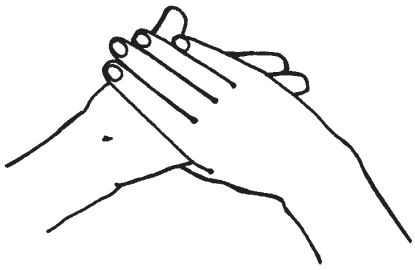
3. Vigorously rub hands together, palms together and fingers interlaced.



4. Interlock fingers and scrub the backs of fingers on both hands.



5. Vigorously scrub each thumb with opposite hand.



6. Rub the tips of thumb and fingers against the palm of opposite hand and vice versa.

Repeat all steps in the process until hands are clean and for a minimum of 20 seconds. Rinse hands with clean water and wave hands until dry or use a clean paper towel.

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Surface Sanitation Solutions

How does what you do on the outside keep you healthy on the inside?

Age Level:
Ages 8 and up

Subject Areas:
Health, Life Science

Duration:
Warm Up: 10 minutes
Activity: 20 minutes
Wrap Up: 15 minutes

Skills:
Gathering information (calculating, observing, listening); Interpreting (relating, summarizing); Applying (planning, designing)

Vocabulary:
contagious, direct contact, exposure, germs, indirect contact, influenza, microorganism, surface sanitation, transmission

Standards:
Common Core State Standards:
CCSS.ELA-Literacy.RST.6-8.3; CCSS.ELA-Literacy.RST.6-8.4; CCSS.ELA-Lit eracy.RST.6-8.7; CCSS.ELA-Literacy.WHST.6-8.1e; CCSS.ELA-Literacy.WHST.6-8.2d; CCSS.ELA-Literacy.WHST.6-8.2f; CCSS.ELA-Literacy.WHST.6-8.4
NGSS: N/A
For additional grade-level and state-specific standards visit www.projectwet.org/cleanandconserve.

Summary
Students learn to identify and prevent common water- and hygiene-related diseases by identifying preventative methods of surface germ transmission.

Objectives
Students will:
- develop awareness about the frequency with which they come in contact with other people and surfaces.
- identify ways to reduce the chances of becoming infected with an illness.
- demonstrate how, through both indirect and direct contact with people, one person can expose many others to germs.

Materials
Warm Up
- *Copies of **Germ Transmission and Prevention Cards—Student Copy Page** (page 14)*

Activity
- *Area for "Surface Sanitation" tag game*

Making Connections
We are not able to see germs on the surfaces that we touch every day. All of us touch things like doorknobs, computer keyboards and checkout counters as well as other people many times throughout any given day. Every time we do, germs on our hands may be left behind, and we may pick up new germs that others have left. Food also touches counter surfaces, plates and utensils where germs can be. Most germs are not harmful, but some can cause infectious diseases. Understanding that germs may be spread through simple contact with other people, surfaces and objects can encourage healthy habits, such as frequent hand washing and cleaning food surfaces properly.

Background
The human body is home to a tremendous diversity of microorganisms, most of them beneficial. In fact, if it were not for one type of microorganism, bacteria, people could not exist. Microorganisms digest food and produce substances such as vitamin K that help blood clot. They form the body's first line of defense because they normally out-compete pathogenic microbes (harmful viruses, bacteria, parasites and fungi) on the skin or in the mouth.

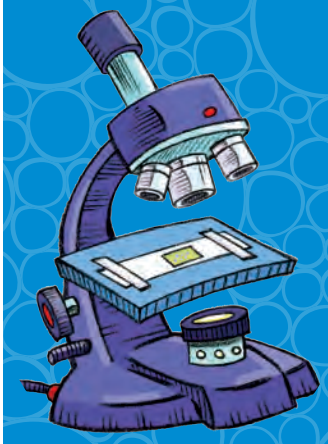
However, these pathogens—also known as germs—can sometimes invade and continue to grow within a person's body, causing an infection. An infection can become a disease if the body does not fight off the infection and the germs begin to damage the body's tissues. Some of

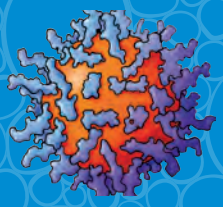
the symptoms we associate with diseases—fever, headache, rashes, vomiting—are caused not only by the germs themselves but also by the way the body responds to try to fight them.

Germs can be spread through direct or indirect contact. When someone is infected by touching a person with a contagious illness or inhaling germs that are emitted when an infected person sneezes or coughs, that is known as direct contact. Indirect contact happens when a germ can survive outside of a person's body long enough to infect someone else. For example, a student who sneezes into his or her hands and then opens the classroom door leaves germs that could spread to the next student who comes into the room. Door handles and other frequently touched surfaces such as those below represent some of the most likely places for germs to spread through indirect contact:

- stair handrails
- surfaces on any form of public transportation (buses, subways, etc.)
- shared furniture including chairs, tables and desks
- kitchen items such as dishes, cups, forks, spoons, knives or trays
- money
- mobile telephones and other electronics with buttons or touchscreens
- computer equipment
- community school supplies such as pens and pencils
- playground equipment

What are Germs?





Germs are disease-causing microorganisms, single-celled organisms so tiny that a microscope is necessary to see them. Microorganisms are essential to life and are found everywhere: in air, food, plants, animals, soil and water and on just about every surface, including inside your body. Germs can be bacteria, parasites, fungi and viruses.

Population density is also an important factor in the spread of colds and influenza. Pathogens can spread more easily when people are in close contact with each other. For example, as every teacher knows, a classroom full of students is an ideal setting for spreading germs!

Fortunately, our bodies have many ways to combat infection. For example, nasal passages and other parts of the respiratory system are lined with tiny hairs that trap microorganisms, and friendly bacteria in the mouth and large intestine can prevent the growth of pathogens. If the body is invaded by pathogens, the immune system can then mount various attacks.

When discussing infectious diseases, it is important to emphasize that students should not be afraid to touch surfaces or to come into contact with other people. By using simple methods such as the following, students can prevent spreading germs:

- frequently washing hands with soap and water.
- cleaning eating utensils and plates thoroughly with soap and water.
- cleaning surfaces that people frequently touch.
- covering the mouth and nose with an arm instead of a hand when sneezing, coughing or yawning.
- not sharing food or drinks.
- keeping hands away from the mouth, nose and eyes.
- avoiding close contact with people who have infectious illnesses.

Procedure

Warm Up

Open the discussion by asking students to name some contagious diseases and list them on the board. How many students have had a cold, the flu or a stomach virus in the last year? What were some of the symptoms? Ask students how they think they became sick.

Ask if students know what germs are. (Germs are microorganisms that cause disease.) Explain that infectious diseases such as colds and flu are spread

through germs. Emphasize that there are both harmful and beneficial microorganisms. Discuss the fact that one disease-causing germ will probably not make you ill, but once these germs multiply in your body, you can experience symptoms of the disease. Where are some places germs are found?

Have students divide into two teams. The teams are going to play a guessing game on the methods of germ transmission. Divide the ***Germ Transmission and Prevention Cards—Student Copy Page*** evenly to each team. Each team should receive two cards with actions and one blank card. Instruct students not to look at the other team's cards. Each team will take a turn acting out the action while the other team tries to guess the action. After each action discuss how the action either prevents or spreads germs.

After acting out the supplied actions each team should come up with their own Surface Sanitation action for the blank card. After the teams have come up with their Surface Sanitation actions, have each team act it out while the other team guesses.

The Activity

1. **Establish a defined area where your students can play a game of tag to simulate how diseases are spread through a community.**
2. **Ask for one volunteer to be "it."** Explain that this student will be a germ ready to infect other people.
3. **Ask for three more volunteers. Gather all volunteers, including the student who has been identified as "it."**
4. **Explain to this group that they will be sharing a secret. Each of the three students will be given a different role.** Each role represents a healthy habit that can prevent germs from being transmitted. Therefore, each of these students must be tagged three times before becoming "ill."
5. **Assign roles to the volunteers and answer any questions from the students.** Use the healthy surface sanitation habits below or create your own for this activity.

- Role 1: You cleaned the surfaces that food touches in your house.
- Role 2: You cleaned the plates and utensils for food before eating with them.
- Role 3: You washed all fruits and vegetables with clean water before eating.

6. **Explain to the group that if a student is tagged by the student who is "the germ," he or she must leave the playing area and sit on the sidelines.** You may wish to create an area designated as a "health clinic" or "doctor's office" where children who are tagged must sit out.
7. **Time the game so that it lasts three to five minutes. After time expires, gather the group.**
8. **Ask students to raise their hands if they did not become sick after the first time they were tagged.** Repeat the question, asking students to raise their hands if they did not become sick after the SECOND time they were tagged. Have the "healthy surface sanitation" students reveal their secret to the class (that is, the healthy habit that protected them from being tagged by the disease).
9. **Ask students who went to the doctor's office how it felt to sit down while their classmates continued to play.** (They will likely respond it was not fun. Remind them that being ill is not fun either!)
10. **Ask students to identify other healthy hygiene habits that help prevent the spread of disease.**
11. **Repeat the game, this time asking for three new volunteers to come up with their own healthy surface sanitation habits.**
12. **Discuss the idea of population density and illness. Ask students if they are more likely to touch something with germs on a public bus or in their family car. Why do they think this is?**
13. **Adapt the game to demonstrate how population density affects the spread of disease. Reduce the tag playing area.** Population density (number of people per foot

Washing hands with soap and water frequently can help prevent the spread of germs picked up from surfaces.

or meter of space) can influence the transmission of disease. With students condensed in a smaller playing area, an urban population is simulated. How did the decreased space between players influence the outcome of the game? Option: Repeat the game with a larger playing field and compare the results.

14. **Ask students why people tend to get colds more often in winter than in summer.** In what season are people more likely to be indoors and in proximity to others? Is it easier for microorganisms to travel among people when they are close together or far apart? Students can simulate indoor living conditions and the transfer of disease by further reducing the size of the area. How does this influence the outcome?

Wrap Up

Discuss the results of the tag game. How do healthy habits protect against disease? Have the class prepare and conduct a presentation about healthy habits for other students. Students may wish to play the game with friends and family.

ActionEducation™

Identify places in the community, school or at home that could be a potential source of indirect contact with germs. Have students create a poster of a healthy habit needed to prevent disease there. Hang these posters near the identified locations to raise awareness about the spread of germs and the steps that can be taken to avoid illness. An example of this is a poster that says "Wash your hands before you eat!" hung in a cafeteria or restaurant.

WATERSTAR

The WaterStar recognition program encourages students and educators to contribute to a positive water future by learning about water and taking appropriate local action.

Report what you've learned and done at www.projectwet.org/waterstar.

Assessment

Have students:

- understand how germs are involved in disease transmission (***Warm Up*** and steps 5-10)
- identify healthy habits to prevent disease (step 6 and 12).
- understand the relationship between population density and rate of germ transmission (steps 13-14).

Presenter Tips

For walk-up festivals: Play the ***Warm Up*** guessing game with participants. Have a fact sheet on germs and ways to prevent transmission.

For younger children: For the ***Warm Up*****,** use pictures of the actions on the ***Germ Transmission and Prevention Cards—Student Copy Page*** or act out the actions yourself and have students guess the action. For the Activity leave out steps 13-14.

Extensions

Invite a public health nurse to speak to the class about communicable diseases.

For older students: Have students compare the growth of bacteria from washed and unwashed hands. Order petri dishes from a biological supply company. Have one group of students wash their hands and press their thumbs into the agar of separate petri dishes; have a second group do the same, but without washing their hands. Cover the petri dishes and incubate at 90 degrees F (32°C) for 48 hours. Compare results. Dispose of petri dishes properly.

Resources

Websites

Centers for Disease Control and Prevention. Stop Germs. http://www.cdc.gov. (Accessed November 14, 2014.)

Mayo Clinic. Infectious diseases. MayoClinic.com. A definition of infectious diseases. http://www.mayoclinic.com. (Accessed November 14, 2014.)

National Institutes of Health. Understanding Emerging and Re-emerging Infectious Diseases. http://science.education.nih.gov/. (Accessed January 5, 2015.)

World Health Organization. Influenza. http://www.who.int/mediacentre/factsheets/fs211/en/. (Accessed December 9, 2014.)

Germ Transmission and Prevention Cards–Student Copy Page

Washing Fruits and Vegetables

Opening Doors

Cleaning Floors

Cleaning Household Surfaces

Create your own surface sanitation action with your team and draw it here.

What type of surface might have germs on it?

Create your own surface sanitation action with your team and draw it here.

How can you prevent the spread of germs from a surface?

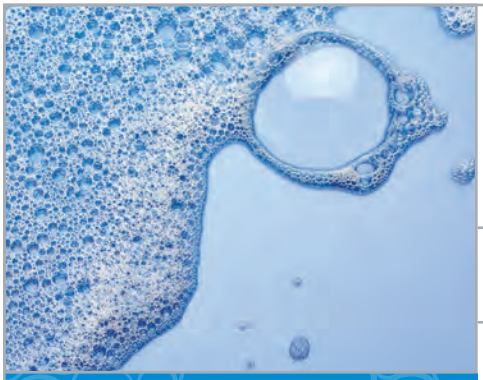


Photo © Jesus Keller–Shutterstock

Soap Science

What is the secret to soap's success? Is it the bubbles? Or could there be more to soap than meets the eye?

Age Level:
Ages 8 and older

Subject Areas:
Health, Life Science, Physical Science

Duration:
Warm Up: 10 minutes
Activity: 25 minutes
Wrap Up: 10 minutes

Skills:
Gathering information (observing, listening, calculating); Organizing information (graphing, arranging, classifying); Analyzing information (identifying component and relationships among components, identifying patterns, comparing); Applying learned information (predicting)

Vocabulary:
dissolve, emulsifier, emulsion, hydrophilic, hydrophobic, soluble

Standards:
Common Core State Standards:
CCSS.ELA-Literacy.RST.6-8.3; CCSS.ELA-Literacy.RST.6-8.4; CCSS.ELA-Literacy.RST.6-8.7; CCSS.ELA-Literacy.WHST.6-8.1e; CCSS.ELA-Literacy.WHST.6-8.2d; CCSS.ELA-Literacy.WHST.6-8.2f; CCSS.ELA-Literacy.WHST.6-8.4
NGSS: 3-PS2-3; 3- PS2-4; 5-PS1-3; 5-PS1-4; MS-PS1-1; MS-PS2-5
For additional grade-level and state-specific standards visit www.projectwet.org/cleanandconserve.

Summary
Students learn how soap works together with water to clean dirt and germs from surfaces while exploring the most effective combinations of soap, water and time spent washing.

Objectives
Students will:
- identify the different components of a soap molecule.
- demonstrate soap's hydrophobic and hydrophilic properties.
- describe how soap works with water to remove dirt from a surface.

Materials
Warm Up
- *Magnets with polar and non-polar ends*
- *Whiteboard or chalkboard*
- *Water*
- *Food coloring*
- *Vegetable oil*
- *Liquid soap*
- *Glass or other clear container*
- *Spoon or stirring rod*

Activity
- *Blue and red construction paper or cards*
- *Copy of **Soap Science—Teacher Copy Page** (page 21)*
- *Copies of **Soap Science—Student Copy Page** (page 22)*

Making Connections
We use soap every day for washing our hands, dishes, clothes and surfaces, but do you know how soap actually works to remove dirt? Soap contains very specific properties that make it effective for cleaning many different surfaces, including our body. Understanding the science behind soap will help students understand the importance of using soap when cleaning.

Background
People have been making soap to remove grease and dirt from surfaces for thousands of years. In fact, the earliest evidence of soap-making dates back to ancient Babylon in about 2800 B.C.! Today, there are many types of soap—anti-bacterial, detergent, bar soap, liquid soap—but all soaps remove dirt, grease and germs through the same chemical process that they did in ancient Babylon. Soap attaches to a water molecule and a dirt molecule simultaneously, removing the dirt from a specific surface. The chemistry of the soap molecule is what allows it to do this so effectively.

Soap consists of long molecules with two components: a hydrophilic head and a hydrophobic

tail. The hydrophilic head of the molecule is attracted to water while hydrophobic tail is repelled by water molecules, but attracted to grease and dirt.

Oil and dirt do not dissolve in water, meaning water and oil will separate from each other. However, soap allows water and oil to mix and suspend in each other by attaching to both substances, a process called emulsion. Because soap can create an emulsion of water and oil, soap is an emulsifier.

When cleaning with soap, friction from the motion of rubbing hands together or wiping a clean towel back and forth on a counter pulls more dirt and grease free from the surface, as more soap comes in contact with dirt and water. Rinsing washes away the suspended dirt and grease, along with the germs.

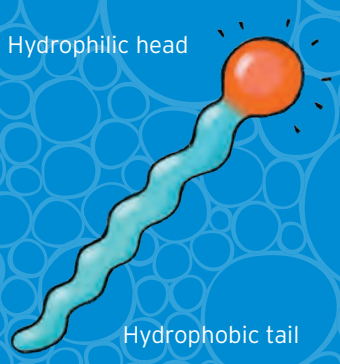
Procedure

Warm Up

Show students two magnets. Ask them if these magnets will stick together, oppose each other or both. Give a quick demonstration of how magnets attract each other and repel each other depending on the side of the magnet. Explain that this is how soap works: One end of a soap molecule is attracted to dirt and repels water while the other end repels dirt and is attracted to water.

Ask students if they have ever tried to mix oil and water. If they have, ask them what happened. Did they mix, or, in other words, was the oil soluble in water? Tell students you will be giving them a demonstration of what happens when water and oil meet.

Hydrophobic literally means "water repelling," and **hydrophilic** means "water loving." A soap molecule's hydrophobic end repels water but is attracted to grease and dirt. The hydrophilic end is attracted to water and repels grease and dirt.



Pour vegetable oil into a glass or clear container that has water with food coloring in it and stir (the food coloring makes it easier to see the water). The two liquids will separate. Explain that water molecules and oil molecules are attracted to themselves (water to water and oil to oil) and therefore separate when they are in the same container.

Show students a drawing of a soap molecule (draw it on the board or show them in the book or KIDS booklet). Explain that the soap molecule's two ends (the hydrophilic head and the hydrophobic tail) have special properties: The hydrophilic head attaches to water, while the hydrophobic tail simultaneously attaches to dirt. This chemical process is what allows soap to clean the dirt and germs on surfaces. Ask students what they think would happen if soap was added to the oil and water mixture, and note that you will revisit this experiment after the activity.

Photo © VASilyeV A.S.–Shutterstock

A glass with blue-colored water and oil shows how oil and water separate when mixed together.

The Activity

1. **Tell the students they are going to become soap, water and dirt molecules on a surface that needs to be cleaned, by acting out several rounds of cleaning that surface.** Each round will offer variations in the amount of soap, water, dirt and time spent washing.
2. **Designate an area of the floor as a surface that needs to be cleaned.** Ask students to name several surfaces that need to be cleaned regularly (table, doorknob, hand, etc.). With a surface in mind, mark off the area with chairs or rope.
3. **Explain to students that the only molecules that**

can move freely through the designated surface area and beyond are the students who are acting as water molecules. Ask students if they know why the water molecules can move freely. (Water is able to leave the surface freely because it is a rinsing agent and flows over the surface.) The other substances (soap molecules and dirt molecules) must remain in the surface area unless they are attached to a water molecule.

4. **Show students the cards representing water (blue), soap (blue and red) and dirt (red).**

5. **Remind students of the magnets in the *Warm Up*.** Like the magnets, students may only pair up with other students that have the same color on their card when in the designated area. For example, blue water can pair with the blue side of soap and red dirt can pair with the red side of soap but blue and red cannot pair together. In other words:

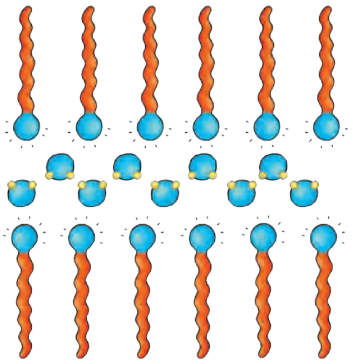
   a. The red (hydrophobic) end of soap wants to be near red (dirt)
   b. Blue (water) repels the red (hydrophobic) end of soap and can't be near it
   c. Blue (water) is attracted to the blue (hydrophilic) end of soap and wants to be near it
   d. Red (dirt) repels the blue (hydrophilic) end of soap

Round 1: Dirt and Water

1. **Divide the class in half. Half of the students will be dirt molecules and half of the student will be water molecules.** Give the students representing dirt a red card to hold in front of them. Give the students representing water a blue card. Use the ***Soap Science—Teacher Copy Page*** to help keep track of student counts.

2. **Have the "dirt" students stand in the area designated as the surface to be cleaned.** Explain that water is going to flow through and over the surface for 20 seconds, the time recommended to wash your hands. Remind students that if they have cards with matching colors, they can pair together but those with different-colored cards may not.

3. **Ask students to count the number of students representing dirt in the designated area.** Record this number on the board or ***Soap Science—Student Copy Page***.



Soap molecules align with the hydrophilic head toward water and the hydrophobic tail toward dirt.

4. **Tell the water molecules to enter the designated surface area and walk around, gently bumping into the other molecules for 20 seconds as though cleaning the surface.** After 20 seconds ask the water molecule students (blue) to leave the surface area because they are done rinsing. They may take any other molecules of the same color they have attached to during this time with them.

5. **Have students count the number of dirt students remaining.** Record this number on the board or ***Soap Science—Student Copy Page***.

6. **Ask students why dirt didn't leave the surface area.** What do they need to make the surface clean? (Soap!)

Round 2: Dirt and Soap

1. **Explain you are going to repeat this activity with soap, so the water students become soap molecules.** Take the blue cards from the water students and give them the soap cards (red and blue). Now half of the class is "dirt" and the other half is "soap." You can switch roles for all students or simply change out the water cards for soap cards. Half of the students should have blue and red cards and half should have red cards.

2. **Repeat the activity, with the dirt students starting in the designated surface area.** Remind students

that if they have cards with matching colors they can pair together, but those with different-colored cards may not.

3. **Ask them to count the number of students representing dirt in the designated area.** Record this number on the board or *Soap Science—Student Copy Page*.

4. **Tell the soap molecules to enter the designated surface area and walk around, gently bumping into the other molecules for 20 seconds as though cleaning the surface.** After 20 seconds ask students to stop. Because there is no water, students may not leave the surface area. How many students have paired together? Did soap attract the dirt? Which end attracted dirt? (The hydrophobic [red] end of soap is attracted to dirt.)

5. **Have students count the number of dirt students remaining.** Record the number on the board or *Soap Science—Student Copy Page*.

6. **Ask students why there is still "dirt" on the surface even though you added soap.** (Everyone is still on the designated surface because they were not "rinsed" away by water molecules.)

Round 3: Dirt, Water and Soap for 20 seconds

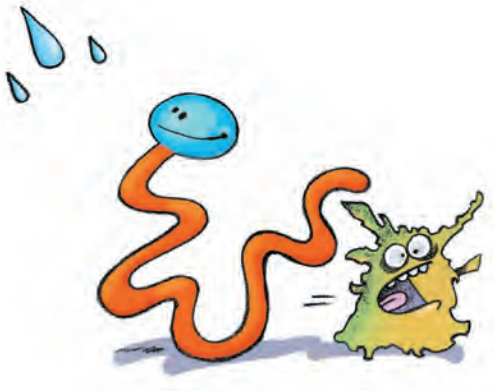
1. **Collect all cards from students and have them count off by threes.** Explain that now you will use soap and water to remove dirt from the surface.

2. **Give all "one" students a blue card and explain they will represent water molecules. Give all "twos" a blue and red card and explain they will represent soap molecules. Give all "threes" a red card and explain they will represent dirt molecules.** Note: It is important that group "three," the dirt group, does not have more students than the other two groups.

3. **Ask the dirt students to start in the designated surface area.** Remind students that if they have cards with matching colors, they can pair together but those with different-colored cards may not. Soap students can pair with both red and blue because they have both colors.

4. **Ask students to count the number of students representing dirt in the designated area.** Record this number on the board or *Soap Science—Student Copy Page*.

5. **Tell the soap and water molecules to enter the designated surface area and walk around, gently bumping into the other molecules for 20 seconds as though cleaning the surface.** After 20 seconds ask the water molecule students (blue) to leave the surface area because they are done rinsing. They may take any other molecules they have attached to during this time with them.



6. **Have students count the number of dirt students remaining.** Record the number on the board or *Soap Science—Student Copy Page*. Did the soap and water mixture remove all of the dirt? Why?

7. **Ask students to explain how the structure of soap allowed this to happen.** Remind them of the diagram and magnets from the *Warm Up*.

Round 4: Dirt, Water and Soap for 10 seconds

1. **Explain that the amount of time spent cleaning is also important and that students will now test variations in time.**

2. **Repeat steps 2-5 from Round 3, but only allow students to mingle in the designated area for 10 seconds.**

3. **Have students count the number of dirt students remaining.** Record the number on the board or *Soap Science—Student Copy Page*. Did the soap and water mixture remove more or less dirt than the previous round?

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Round 5: Dirt, Water and Soap for 5 seconds

1. **Repeat steps 2-5 from Round 3, except only allow students to mingle in the designated area for 5 seconds.**
2. **Have students count the number of dirt students remaining.** Record the number on the board or *Soap Science–Student Copy Page.* Did the soap and water mixture remove more or less dirt than the previous rounds?
3. **Have students copy the results of each round onto the student copy page (or examine the results already there).** They should subtract the AFTER numbers from the BEFORE numbers to find out which method was most effective. The most effective method will have the highest number (meaning it removed the most dirt).
4. **If age appropriate, have students express the results on the** *Soap Science–Student Copy Page* **as a bar graph to visually represent the results.**

Wrap Up

- Revisit the oil and water mixture from the ***Warm Up*.** Ask students what they think will happen when you mix soap in with the water and oil? Ask them to reflect on the activity. How will soap connect water and oil?
- Add some liquid soap to the container with water and oil and stir. What happened to the mixture? Explain that soap is an emulsifier. Emulsifiers bring substances together instead of allowing them to separate apart. Another example of an emulsifier is the egg in mayonnaise. The oil and vinegar would separate without the egg.
- Discuss the fact that these properties apply to soaps and detergents and not to hand sanitizing gels. Hand sanitizing gels use a different process of sanitizing.

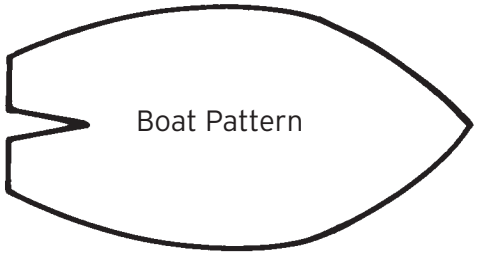
Assessment

Have students:

- describe the different components of a soap molecule (***Warm Up***).
- demonstrate the importance of soap in cleaning (***Activity Rounds***).
- demonstrate soap's hydrophobic and hydrophilic properties (***Activity Rounds***).
- explain how soap acts as an emulsifier for oil and water (***Warm Up*** and ***Wrap Up***).

Presenter Tips

For walk-up festivals: Perform the ***Warm Up*** and ***Wrap Up*** portions of the activity with participants.



Additional option: Cut out two boat shapes from a piece of cardboard (see pattern above). In the rear of each boat, cut out a small notch. Place a chip of bar soap in the notch of one boat. Place the boats in a tray of water and describe what happens.

What caused the boat to move? (Hint: Place a drop of water on the table. What happens to it when you put a soap chip in it?) Design a better shape for the boat so that it will move faster and in a straight line. Experiment with different shapes of boats, placement of the soap chip and size of the soap chip. Be sure to change the water in-between groups of students.

Ask participants to explain how soap's structure makes the boat move forward. (Soap breaks water's bonds to itself, thus breaking the surface tension, propelling the boat forward as the water molecules move.)

For small groups or walk-up stations: Have bowls of water present. Wipe a small amount of oil onto a glass, hand or other surface. Ask for volunteers to use water to wash off the oil. (It shouldn't all come off.) Add soap to the surface or hands and have the volunteer try again. What happened to the oil? How do students think this happened? You can also do this at a hand washing station.

For younger children: Some of the vocabulary may be too advanced for young children. Referring to the water-loving and dirt-loving ends of the soap may be easier to grasp. Color coding is also recommended when teaching younger children. The oil and water portion of the ***Warm Up*** may be a bit advanced for young children, so using only the magnets to explain the attractions is recommended.

Alternatively, you could divide the children into four groups and place a small amount of vegetable oil on each child's hands. The first group would not wash their hands.The second group would wash their hands with just cold water. The third group would wash with just warm water, and the fourth with soap and warm water. Compare the results and ask the children which method worked best. At the end, provide proper hand washing instructions and have all of the children wash with warm water and soap.

For a touch-free activity: If students directly touching and bumping into other students is not appropriate, have students acting as the soap molecule use colored string to represent their hydrophilic and hydrophobic ends. Students can then touch the strings and not each other.

Extension:

Have students calculate the percent of dirt molecules that were removed in each round. If all dirt students remained after a round, what percent of dirt was removed? (Zero percent!) What percent remained? (100 percent.) Discuss the various ways that the data could be visualized (e.g., as a pie chart for each round or as a bar chart to compare the different rounds). Create the graphs if time allows, either by hand or using a computer.

Resources

Websites

American Cleaning Institute. Soaps & Detergents: Chemistry. http://www.cleaninginstitute.org/clean_living/soaps__detergents_chemistry.aspx. (Accessed December 11, 2014.)

Helmenstine, Anne Marie Ph.D. How Soap Cleans: Soap is an Emulsifier. http://chemistry.about.com/od/cleanewrchemistry/a/how-soap-cleans.htm (Accessed December 11, 2014.)

National Science Foundation. Science 360 video. "It's a Wash: The Chemistry of Soap."A video that explain why soaps works. http://science360.gov/obj/tkn-video/81074969-11e0-4a2e-b674-8fc8886fd9c3 (Accessed December 11, 2014.)

Planet Science. Soap - how does it get things clean? http://www.planet-science.com/categories/under-11s/chemistry-chaos/2011/06/soap---how-does-it-get-things-clean.aspx (Accessed December 11, 2014.)

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Soap Science–Teacher Copy Page

	Round 1: Dirt and Water	Round 2: Dirt and Soap	Round 3: Dirt, Water and Soap for 20 seconds	Round 4: Dirt, Water and Soap for 10 seconds	Round 5: Dirt, Water and Soap for 5 seconds
			Number of Students		
Water Card: Blue	1/2 of Students Actual number:____	None	1/3 of Students Actual number:____	1/3 of Students Actual number:____	1/3 of Students Actual number:____
Soap Card: 1/2 Blue & 1/2 Red	None	1/2 of Students Actual number:___	1/3 of Students Actual number:____	1/3 of Students Actual number:____	1/3 of Students Actual number:____
Dirt Card: Red	1/2 of Students Actual number:____	1/2 of Students Actual number:___	1/3 of Students Actual number*:___ *should be equal to or less than soap or water	1/3 of Students Actual number*:___ *should be equal to or less than soap or water	1/3 of Students Actual number*:____ *should be equal to or less than soap or water
Expected Result	No dirt removed.	No dirt removed.	All dirt removed.	Most dirt removed.	Some dirt removed.
Explanation	Water alone is not enough to remove the dirt.	The soap attaches to the dirt, but there is no water to wash it away.	The soap attaches to the dirt and the water attaches to the soap, washing it all away.	There is not enough time to remove all the dirt.	There is not enough time to remove all the dirt.

Soap Science—Student Copy Page

	Round 1: Dirt and Water	Round 2: Dirt and Soap	Round 3: Dirt, Water and Soap for 20 seconds	Round 4: Dirt, Water and Soap for 10 seconds	Round 5: Dirt, Water and Soap for 5 seconds
Variable	*No Soap*	*No Water*	*Time*	*Time*	*Time*
BEFORE: Number of "Dirt" students on surface					
AFTER: Number of "Dirt" students on surface					
Difference in Dirt (BEFORE - AFTER = Difference)					

Photo © Alexander Kirch–Shutterstock

Conserve Water

Imagine you have one glass of water and six friends who want some. How are you going to divide it up?

Age Level:
Ages 8 and older

Subject Areas:
Earth Science, Environmental Science, Geography, Health, Life Science, Mathematics

Duration:
Warm Up: 10 minutes
Activity: 30 minutes
Wrap Up: 10 minutes

Skills:
Gathering information (calculating, recording); Organizing information (estimating, charting, manipulating materials); Interpreting information (summarizing, relating, identifying cause and effect)

Vocabulary:
conservation, potable water, surface water, water use

Standards:
Common Core State Standards: CCSS.ELA-Literacy.RST.6-8.3; CCSS.ELA-Literacy.RST.6-8.4; CCSS.ELA-Literacy.RST.6-8.7; CCSS.ELA-Literacy.WHST.6-8.1e; ELA-Literacy.WHST.6-8.2a; CCSS.ELA-Literacy.WHST.6-8.2d; CCSS.ELA-Literacy.WHST.6-8.2f; CCSS.ELA-Literacy.WHST.6-8.4; CCSS.ELA-Literacy.WHST.6-8.6; CCSS.ELA-Literacy.WHST.6-8.10
NGSS: 3-LS4-4; 5-ESS2-1; 5-ESS2-2; 5-ESS3-1; MS-LS2-1; MS-LS2-4; MS- LS2-5; MS-ESS3-1; MS-ESS3-3
For additional grade-level and state-specific standards visit www.projectwet.org/cleanandconserve.

Summary
By allocating a limited water supply, students learn how their water use affects others in their community.

Objectives
Students will:
- assess which daily activities require water.
- allocate a limited water supply with their peers.
- calculate gallons of water used in daily activities.
- identify ways to conserve water in their daily actions.
- recognize that individual conservation actions add up to significant collective water savings.

Materials
Warm Up
- *Water*
- *Globe or world map*
- *1,000-ml beaker*
- *Salt*
- *100-ml graduated cylinder or beaker*
- *10-ml cylinder or small cup*
- *Eyedropper or glass stirring rod*
- *Small metal bucket or cup*

Activity
- *Paper or plastic cups (1 per student plus extras)*
- *Markers*
- *Water jugs—one per group*
- *Copies of **Household Water Use Cards—Student Copy Page*** (1 card per student)
- *Copies of **Group Daily Water Use Worksheet—Student Copy Page** (1 per group)*
- *2 identical containers, labeled "Round One" and "Round Two," large enough to hold the total of one cup of water per group*

Making Connections
Everyone uses water every day for drinking, cleaning and cooking. However, the amount of fresh water available is limited. By reflecting on their own water use and working together to allocate this limited but renewable resource, students can create a culture of water conservation that benefits the entire community.

Background
Ironically, on a planet extensively (71 percent) covered with water, water is one of the main limiting factors for life on Earth. The reason for this is that the majority of water is contained in oceans or frozen in glaciers and ice caps and is not available for human consumption. The Water Availability Table on page 25 summarizes the major factors affecting the amount of available water on Earth.

On a global scale, only a small percentage of water is available for human consumption, but this percentage actually represents a large amount per individual. If all the clean, fresh water were distributed equally among people, there would be about 1.6 million gallons (six million liters) per person. This is less than one percent (only about .003 percent) of the total water on Earth. The good news is that this tiny percentage of water is constantly being refreshed through the water cycle and this amount of fresh water is always available.

The paradox is that water is plentiful for some people and places, but scarce for others. There are approximately seven billion people and counting living on planet Earth. Each one of these people needs water daily for drinking, cooking and cleaning. Moreover, water issues are local. While one part of the world is flooding, another part may be in drought. Rainforests are places of plentiful water, but deserts have little water. People have learned to live and thrive with the available fresh water. To ensure there is enough water for everyone to meet basic needs, people must carefully manage, protect and learn to use water in a manner that allows all members of a community to have enough water.

Procedure

Warm Up

Note: For simplicity, metric measurements have been used.

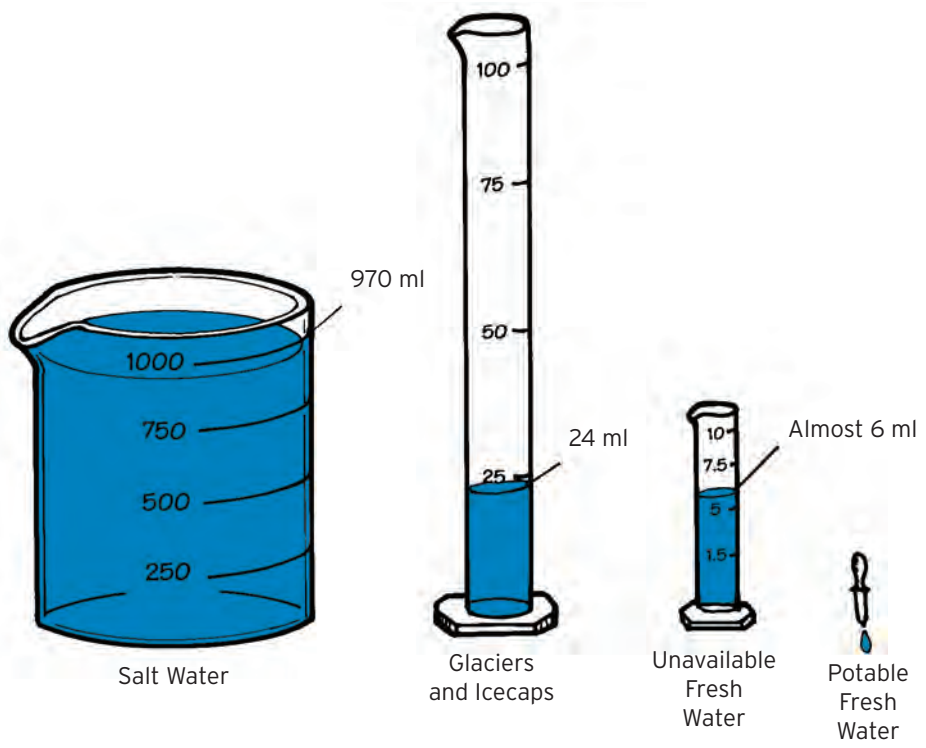
1. Show the class a liter (1,000 ml) of water and tell them it represents all the water (100 percent) on Earth.
2. Ask students where they believe most of the water on Earth is located. Refer to a globe or map. Discuss the important difference between salt water and fresh water (the presence of salt, or salinity, makes salt water unfit for human consumption).
3. Ask students to estimate how many milliliters of water they think would represent all of the fresh water on Earth.
4. Pour 30 ml of the water into a 100-ml graduated cylinder or beaker. This represents Earth's fresh water, about three percent of the total. Put salt into the remaining 970 ml to simulate salt water found in oceans.
5. Ask students what is at Earth's north and south poles (ice!). Have students estimate what percentage of Earth's fresh water is stored in its frozen state. Almost 80 percent of Earth's fresh water is frozen in ice caps and glaciers. Remind students that the North Pole is frozen sea ice while the South Pole is Antarctica (a continent) covered in an ice sheet. Pour 6 ml of fresh water into a small cup or cylinder. The water in this cylinder (around 0.6 percent of the total) represents non-frozen fresh water. Only about 1.5 ml of this water is surface water; the rest is underground.
6. Use an eyedropper or a glass stirring rod to remove a single drop of water (0.03 ml). Release this one drop into a small metal bucket

Conservation Actions

- Turn off the faucet after use.
- Turn off the faucet while brushing your teeth—only turn it on while rinsing.
- Fix any leaky water tanks or faucets.
- Use rain water for cleaning or watering gardens instead of tap water.
- Install low-flow toilets in new bathrooms.
- Use a receptacle or fill the sink to wash dishes instead of letting the water run.
- Take shorter showers.
- Run the dishwasher and washing machine only when they are full.
- Water the lawn in the morning or evening to minimize evaporation.
- When you are washing your hands, turn off the water while you lather.

Flow Rates for Household Appliances and Fixtures*	
Kitchen Faucet	2.5 gallons per minute
Bathroom Faucet	1-2 gallons per minute (depending on efficiency)
Shower	2.5 gallons per minute
Toilet	1.6 gallons per flush (older models are 3 g/flush)
Washing Machine	25 gallons per load on large setting (water efficient uses 15 g/load)
Dishwasher	12 gallons per load (water efficient uses 4 g/load)
Garden Hose	2 gallons per minute

Sources: U.S. Geological Survey, http://water.usgs.gov/edu/qa-home-percapita.html *and Southwest Florida Water Management District* http://www.swfwmd.state.fl.us/conservation/thepowerof10/.



or cup. Make sure the students are very quiet so they can hear the sound of the drop hitting the bottom of the bucket or cup. This represents clean, fresh water that is not polluted or otherwise unavailable for use, about .003 percent of the total. This precious drop must be managed properly. Discuss the results of the demonstration. At this point many students will conclude that a very small amount of water is available to humans. However, this single drop is actually a large volume of water on a global scale.

Activity

Part 1

Before the Activity, fill jugs with water. Make sure there is NOT enough water in the jugs to fill all of the cups in the class (some students will be left without water).

1. **Have students sit in a circle, and give each student a cup. Tell students they may not drink until everyone has water.**
2. **Ask students to reflect on how they use water.** Students should name daily actions that require clean water.
3. **Have the first student pour out as much water as he or she wants from a water jug and pass the jug to the next student in line.** The first student may be decided by closest birthday or at random. (For young students, the teacher may need to pour the water into cups and ask students to say when to stop.)
4. **Because of the limited amount of water in the jug, there might not be enough to go around. Ask students (those who received water and those who did not) how they feel.** Tell them that sometimes there is not enough water available to meet everyone's needs.
5. **Ask students what they could do to make sure everyone gets water. Have them think of what they would do differently the next time.**
6. **Pour the water back into the jug. Have them repeat the activity and put their ideas into action.**

Part 2

Before the Activity, make copies of the ***Household Water Use Cards—Student Copy Page*** *so*

Water Availability Table		
Total water (100%) on Earth divided among all people (based on a world population of 6.9 billion people)	=	202.9 billion liters/person
Minus the 97% of each share (196.813 billion liters) that contains salt (oceans, seas, some lakes and rivers) 202.9 billion liters minus 196.813 billion liters	=	6.087 billion liters/person
Minus the 80% of this 6.087 billion liters that is frozen at the poles (4.869 billion liters) 6.087 billion liters minus 4.869 billion liters	=	1.218 billion liters/person
Minus the 99.5% of the 1.218 billion that is unavailable (too far underground, polluted, trapped in soil, etc.) (1.212 billion) 1.218 billion liters minus 1.212 billion liters	=	6.0 million liters/person

Most recent estimates indicate that there are approximately 370 quintillion gallons (3.7×10^{20}) of water on Earth.

that there is at least one card per student.

1. **Divide students into groups of six people.** Tell students to keep their empty cups. Give each group one "group cup" in addition to their individual cups and the ***Group Daily Water Use Worksheet—Student Copy Page.***

2. **Give each person in the group one action card from the *Household Water Use Cards—Student Copy Page*.** If a group has fewer than six people, students can have two actions. Actions are:

   a. Brushing teeth
   b. Washing hands
   c. Washing dishes
   d. Showering
   e. Flushing the toilet
   f. Washing clothes

3. **Students should look at their *Household Water Use Card* and note how many gallons of water the average person in the U.S. uses for their activity.** Have student share with the other members of their group their assigned water use and gallons from their card. Let students think about how their daily use compares with the average use of a person on the card.

4. **Tell students to look at their cup. Explain that each cup represents 100 gallons. Instruct students to divide their cups into 10 sections and mark off 10 even marks with a marker.** Explain that each mark represents 10 gallons. Have student label each marker as illustrated in the diagram.

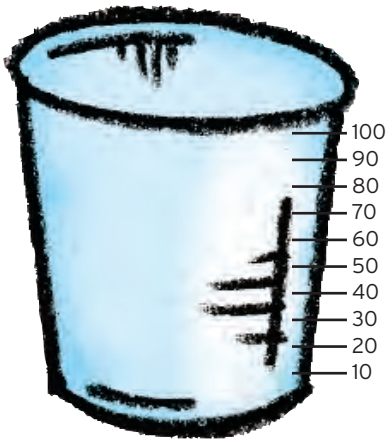
5. **With a marker, have students draw a line on their cups representing the number of gallons the average American uses for their action from the number on their card.** Each student in the group should also record the number of gallons used from their card on the ***Group Daily Water Use Worksheet—Student Copy Page.***

6. **Give each group a jug of water. Each student should pour water to the line they drew on their cup (designating the amount of water for the activity they have been assigned).**

7. **Have each group pour their water into one communal group cup.** As a group, everyone's action represents a single person's water use for specific activities in a day. Have someone in the group draw a line on the group cup at the combined water line.

8. **Tell students that on average, a person in the U.S. uses 88 gallons of water per day. Have students note where on the cup 88 gallons is.** Did the group use 88 gallons? If not what water uses might be missing (drinking water, watering the lawn, etc.)?

9. **Dump the water from the group cup into the bucket labeled "Round One."** After all groups have dumped their water, note the water line on the bucket. Set this bucket aside until the end of the activity (or cover it so that students can no longer dump water into this bucket).



100 Gallons

Part 3

1. **Have groups brainstorm ways they can conserve water with their respective actions.** How much water could they conserve using their conservation actions?

2. **Ask students to draw a new line on their cup representing less water use if they thought of ways to conserve water with their assigned action.** Be sure to emphasize that some actions (such as drinking water) may not have a conservation action for health reasons.

3. **Repeat step 6 from *Part 1* using conservation actions.** Did the group use less water during this round using conservation actions? How much water did they save individually? Have each person calculate his or her individual savings and fill it in on the ***Group Water Use Worksheet—Student Copy Page.***

Photo © elwynn–Shutterstock

4. **Ask students to pour the water from their cups into the group cup with the line on it from *Part 1*.** How much water did the group save? Have the group estimate the amount of water saved as a group by calculating the totals on the ***Group Water Use Worksheet***. If appropriate have each group calculate the percentage of water they saved using conservation methods.

5. **Dump the water from the group cup into the "Round Two" bucket at the front of the room.** Ask each group to report their gallons saved and record the numbers on the board.

6. **After all groups have dumped their water, note the water line on the bucket. Compare this to the "Round One" bucket.** How much water did the class save? Add up the gallons the entire class saved. How does this compare to the gallons saved by each person? By each group?

7. **Have the class estimate the percentage of water saved by looking at the amount before and after.** You can also calculate percentages using all of the groups' data.

8. **Ask each group to report their results and conservation actions.** Record the conservation actions of each group on the board. Use the ***Water Conservation Actions—Teacher Resource Page*** table as a reference and bring up any actions students didn't list.

Wrap Up

Have students summarize the importance of sharing water and other resources. Ask each student to list one conservation action they will take that week to reduce water consumption.

ActionEducation™

Have students perform a water audit at home by estimating gallons of water used over 24 hours. Students should record actions that required water and the amount of time/uses of water. Next, students can implement conservation actions and record their actions again. Ask them to compare their water use on days they conserved water versus days they were not mindful about it. (Use the table "Flow Rates for Household Appliances and Fixtures" on page 24 as a guideline or measure the amount of water flow per minute from your school or home faucets using a bucket or other vessel.)

WATERSTAR

The WaterStar recognition program encourages students and educators to contribute to a positive water future by learning about water and taking appropriate local action. Report what you've learned and done at www.projectwet.org/waterstar.

Assessment

Have students:

- determine the proportion of Earth's available fresh water. (***Warm Up***)
- list the ways they use water in their daily lives. (***Part 1 and Part 2***)
- allocate a limited water supply so that everyone has water. (***Part 1***)
- recognize ways to conserve water in their daily actions. (***Part 1 and Part 3***)

Presenter Tips

For walk-up festivals: Perform the ***Warm Up*** of the activity. It can also be set up ahead of time with labels/sign explaining each amount.

For younger children: Do not have younger children estimate percentages.

Resources

Websites

The United States Geological Service. Water Use in the United States. A resource about water uses in the U.S. http://water.usgs.gov/edu/wateruse.html. (Accessed January 27, 2015.)

The United States Geological Service. How much is your daily indoor water use? A tool to calculate indoor water use. http://water.usgs.gov/edu/sq3.html. (Accessed January 27, 2015.)

Environmental Protection Agency. Water. Information on water including drinking water in the world. http://water.epa.gov/. (Accessed January 29, 2015.)

Household Water Use Cards–Student Copy Page

Washing Your Hands — 10 gallons/day

Running a faucet for 30 seconds while you soap and lather your hands uses approximately 1 gallon of water. A person who washes his or her hands 10 times per day uses 10 gallons of water!

How can you reduce the amount of water used without reducing hand washing?

Brushing Your Teeth — 8 gallons/day

Running the faucet for two minutes while you brush your teeth uses 4 gallons of water. If you brush your teeth twice per day, this is 8 gallons of water used!

How can you reduce the amount of water you use to brush your teeth while still keeping a healthy dental routine?

Doing Laundry — 25 gallons/day

One load of laundry uses 25 gallons of water. If someone does not fill the machine full before doing laundry the result is more loads of laundry. A person who does one load of laundry in a day uses 25 gallons of water.

How can you reduce the amount of water you use for laundry? How can you reduce the number of loads of laundry in your house? How much water does a water-saving washing machine use?

Showering — 25 gallons/day

A 10-minute shower uses 25 gallons of water.

How long is your shower? Do you have water-efficient shower heads or a shower timer?

Flushing the Toilet — 16 gallons/day

Everyone needs to use the toilet! Each time you flush a standard toilet, it uses 1.6 gallons of water. If you flush 10 times a day, you will use 16 gallons of water. How many times a day do you flush?

Do you know any methods to reduce the amount of water that your toilet uses?

Washing Dishes — 12 gallons/day

People wash dishes by hand in the sink with a faucet and by using a dishwasher. One load in the dishwasher uses approximately 12 gallons of water. If a family does not fill the dish washer full before running it, this results in more loads and more water use.

How can you reduce the number of dishwasher cycles in your house? How much water does a water-saving dishwasher use?

Group Daily Water Use Worksheet–Student Copy Page

Action	Round 1: Average Water Use (from card)	Conservation Action	Round 2: Your Water Use (conservation actions)	Gallons Conserved (Difference = Round 1 - Round 2)
Brushed Teeth				
Took a Shower				
Washed Hands				
Flushed Toilet				
Washed Laundry				
Washed Dishes				
Total Water Use (add the numbers from each column)				

Total Water Use Part 1	
Total Water Use Part 2	
Water Savings (Round 1 minus Round 2)	

Water Conservation Actions–Teacher Resource Page

Action	Conservation Actions
Brushed Teeth	• Turn off faucet while brushing teeth • Use a cup to catch water while wetting brush and use this water for rinsing
Took a Shower	• Time showers to make them shorter • Install water-efficient showerheads • Turn off the water while lathering with soap and shampoo, then rinse
Washed Hands	• Turn off faucet while lathering
Flushed Toilet	• Fill a liter bottle with rocks or sand and put it in the toilet tank so that the toilet uses less water • Install water-efficient toilets
Washed Laundry	• Only run washer with full loads • Use water-efficient washing machines
Washed Dishes	• Only run washer with full loads • Use water-efficient dishwashers • Use a receptacle or fill the sink to wash dishes (instead of letting the water run)

Photo © Arseniy Krasnevsky–Shutterstock

Healthy Natural Environments

We all live in a watershed. Can we live upstream and downstream at the same time?

Age Level:
Ages 8 and older

Subject Areas:
Geography, Earth Science, Environmental Science, Mathematics

Duration:
Warm Up: 10 minutes
Activity: 30 minutes
Wrap Up: 10 minutes

Skills:
Analyzing information (comparing and contrasting); Organizing information (plotting data, graphing); Interpreting (relating, summarizing, inferring, drawing conclusions); Applying (designing); Presenting (demonstrating)

Vocabulary:
downstream, headwaters, main stem, precipitation, rain water, runoff, tributary, water flow, watershed

Standards:
Common Core State Standards: CCSS.ELA-Literacy.RST.6-8.3; CCSS.ELA-Literacy.RST.6-8.4; CCSS.ELA-Literacy.RST.6-8.7; CCSS.ELA-Literacy.WHST.6-8.1e; CCSS.ELA-Literacy.WHST.6-8.2a; CCSS.ELA-Literacy.WHST.6-8.2d; CCSS.ELA-Literacy.WHST.6-8.2f; CCSS.ELA-Literacy.WHST.6-8.4; CCSS.ELA-Literacy.WHST.6-8.6; CCSS.ELA-Literacy.WHST.6-8.10
NGSS: 3-ESS2-1; 3-ESS2-2; 4-ESS2-1; 5-LS2-1; 5-ESS2-1; MS-LS2-3; MS-ESS2-2; MS-ESS2-4; MS-ESS3-4
For additional grade-level and state-specific standards visit www.projectwet.org/cleanandconserve.

Summary
In this whole-body activity, students investigate how water moves through a watershed and learn how individual decisions affect the health of that watershed.

Objectives
Students will:
- demonstrate the movement of water through a watershed.
- compare and contrast the amount of water flowing through a river and its watershed based on climate (seasonal variations) and weather (precipitation).
- understand how water moves trash and debris through a watershed.
- create a hydrograph based on simulation data.

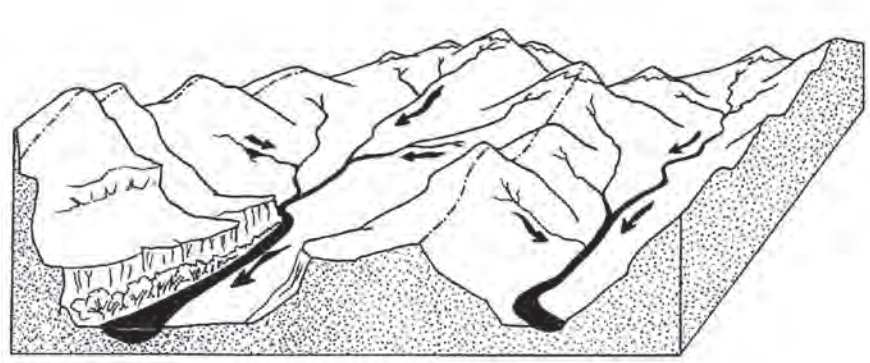
Materials
Warm Up
- *Wax paper or aluminum foil*
- *Water*
- *Glass or eyedropper*
- *Block (to elevate paper)*

Activity
- *Containers with beads, pea gravel, beans, marbles or similar objects (separated by color)*
- *Large bucket or other large container to collect beads or other objects*
- *Optional: signs on sticks with pictures representing sun, light rain and heavy rain (one of each)*
- *Optional: four chairs*
- *Copies of **Graph It!—Student Copy Page***

Making Connections
Children may have heard the term "watershed" but may not understand what it means or how water flows through it. Understanding water's movement promotes awareness of the relationship between water quality, landscape and individual and collective decision-making, including proper trash management.

Background
Often referred to as drainages, basins or catchments, watersheds are the gathering ground of a river system. A watershed is an area of land that drains water toward a common river. Within its boundaries, a watershed includes all of the land, air, soil, surface and ground water, plants and animals, mountains and deserts, cities and farms and people, culture, stories and traditions.

Beginning at the highest elevations of a watershed, runoff (water from rain, melting snow and ice) collects to form rivulets



Water flows from high points to low points throughout a watershed.

that merge into small headwater streams. As headwater streams flow downhill from the sides of the watershed, they gather more water and eventually join to become tributary streams. These tributaries flow into the main stem of a river that, with exceptions such as closed basins, eventually flows to the sea.

During winter in cold climates, precipitation is stored as snowpack (accumulated snow that is condensed and compressed by its own weight). In some mountainous areas, snowpack can reach higher than 20 feet. Very little water will flow into streams at this time; what flow there is generally comes from ground water, springs or periodic snowmelts.

With the arrival of spring and warmer temperatures, the snowpack begins to melt. For several weeks this water—often referred to as the "spring melt" or "spring runoff"—saturates the ground and fills streams. Streamflow will depend on how much snow is present and how fast the temperature rises. If enough runs off at once, flooding can occur at low elevations in the river's floodplain (low area along a river's channel).

Rivers rise as the temperature warms and melted snowpack accumulates downstream. Springs and ground water that have been recharged by melted snow discharge into streams that are also replenished by summer rainstorms. In the dry season, less water flows into rivers and through the streets. However, during the rainy season and heavy rain storms, rain water may carry large amounts of water through a watershed and into rivers, lakes and oceans.

In cities, water from precipitation may collect in gutters and flow downhill through the streets. As the water moves downhill it collects more water from other streets and gutters. Whatever materials are on the streets or in the gutters (e.g., litter, twigs, leaves, oil, road dust) can also be picked up with the water. While some substances decompose, settle out or are filtered by soil, other matter continues to travel long distances downstream into rivers or even all the way to the ocean.

What is a watershed?

A **watershed**, also called a basin, drainage or catchment, is an area of land drained by a river and its tributaries to a common outlet, which may be a closed basin, a larger stream, a lake, wetland, estuary or ocean. (A closed basin is a water body from which water leaves only through evaporation or percolation; there is no surface outlet from this pond or depression, as in the Great Salt Lake, Utah.) Within its boundaries, a watershed includes all of the land, air, surface and ground water, plants and animals, mountains and deserts, cities and farms and people, including their stories and traditions.

Procedure

Warm Up

Ask students if they know what a watershed is. Provide them with the definition.

Once they understand what a watershed is, ask them if they know how water flows in a watershed. (Water flows from high to low in a watershed). Tell students they are going to demonstrate how water flows in a watershed using the following materials: wax paper or aluminum foil, water, a glass or eyedropper and tray to catch the water. Divide students into small lab groups and provide those materials to each. (Optional: Instead of a student investigation, this can be a demonstration.)

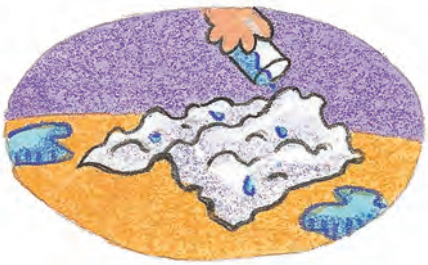
Following the steps shown in the "Water on the Move" diagram, guide students through each

Water on the Move

Place a drop of water on a flat sheet of wax paper. Does it run off the paper? If water falls on a flat surface, it may not run off or drain.

In what direction does water flow? Using a piece of wax paper, raise one end. Drop water from a cup onto the paper. It should flow downhill.

How are watersheds divided? Fold your wax paper in the center into a tent. Drip water from a cup onto the peak. Down which side does the water drain? Left, right or both? The peak represents the boundary between two watersheds, and the water flows down whichever side it falls on. Watersheds are divided at their highest points.



Are large watersheds made up of smaller watersheds? Loosely crumple your wax paper. Drop water onto the peak again. Does the water follow a crease or line as it flows? Does it pool in spots? What watershed features could these represent? Large watersheds may contain smaller watersheds.

step, performing it with them as you go.

Use the following questions to guide their investigation or the demonstration:

- Where does water originate in a watershed? (Precipitation.)
- What happens when rain, snow or sleet falls on level ground? (Water infiltrates [soaks into the ground] or puddles.)
- What happens when rain falls on a slope? (It moves from the highest to the lowest point.)
- What primary force moves water in a watershed? (Gravity.)
- Discuss student results.

The Activity

Part 1

1. **Explain to students that they will be modeling the movement of water during different precipitation events.** Note that they will see how water is constantly changing as seasons change and weather affects it.
2. **Assemble students in a branching formation that represents streams/tributaries and rivers in a watershed.** (See *River Watershed—Teacher Resource Page* on page 37). Students at the top of the "hill" should stand on a chair or arrange students on a slope to simulate the downhill flow of water. There should be four students at the headwaters (standing on chairs) to represent different creeks or river tributaries.
3. **Headwaters streams: At the top of the hill, have two or three students form a short line (fingertip to fingertip, close enough to easily pass beads) leading down the slope.**
4. **Tributary streams: Starting at the headwaters, assemble a line of students leading down slope to represent each of the four tributary streams. These tributaries should touch fingertips and "flow" toward each other, but not connect as a whole yet.**
5. **Main stem of river: Have the remainder of the students line up fingertip to fingertip in a line starting at the river headwaters and connecting the remaining tributaries as the main stem winds downhill.** Explain that these new students represent the river and that all tributaries flow toward it and connect. Have everyone touch fingertips.
6. **At the top of each headwater stream, place a bucket of beads.**
7. **At the bottom of the main stem, place an empty large bucket or other container to receive the beads, representing the sea.**
8. **To help students understand what will happen during this activity, ask students at the top of the headwaters streams to take one bead and hand it to the person below them.** Have

Photo © HodagMedia–Shutterstock

The Wisconsin River flows into the Mississippi River in Iowa, adding to the main stem of the Mississippi River.

students continue to pass the bead "downstream" until it travels down through the tributaries, the main stem and is deposited in the bucket, representing the mouth of a sea at the bottom. PLEASE INSTRUCT STUDENTS TO ONLY PICK UP ONE BEAD AT A TIME. GRABBING A FISTFUL OF BEADS WILL STOP THE SIMULATION AS THIS WILL CORRUPT THE DATA.

9. **Explain to students that they will now simulate the flow of water through a watershed during a rain storm.** Tell students you will announce various scenarios and they will pass beads accordingly: Light rain (pass one bead at a time), Heavy rain (quickly pass two or three beads at a time), Sun (pass beads VERY slowly). Alternatively you can simulate the melting of snow throughout the year; spring snowmelt is highest with the most flow (quickly pass two or three beads at a time) and winter is lowest with little flow (pass beads slowly).

10. **Begin the scenarios below. Allow each scenario to last one minute (less for small groups). Remove the "sea" bucket after each simulation and set aside to count when finished.** (Optional: Make large signs with symbols for sun, light rain and heavy rain. Attach these signs to sticks and hold these signs up to indicate each scenario. This is especially helpful for large groups.)

    a. Light rain (pass one bead at a time)

    b. Sun (pass beads VERY slowly)

    c. Heavy rain (pass several beads at a time)

11. **At the one-minute mark, all students must stop passing beads. Students may hold onto the beads in their hands and use in the next simulation.** (For smaller groups of students, you may reduce the time to 30 seconds)

12. **Have students look at the bucket representing the sea. What do they notice?** They should answer that the water from all the different tributaries or streams ends up there (represented by different colors of beads or objects).

13. **After the simulations, designate students to count the number of beads in the large bucket for each precipitation event. Record this data on the *Graph It!—Student Copy Page*.**

14. Beads from this bucket may then be returned to the containers at the headwaters of the main stem and tributaries. You may wish to wait and have students graph all data after completing *Part 2*.

Part 2

1. **Add items representing trash such as paper, wrappers, crayons or plastic tops into ONLY TWO of the starting buckets.**

2. **Repeat step 10 from *Part 1*, but tell students they should also pass the trash items in addition to the beads.**

3. **Have students look at the bucket representing the sea again. What do they notice? Is there trash in the sea? (Yes.)** Ask students if all the streams had trash in them (They should say no.) Even though

only two of the streams had trash in them, trash from any part of the watershed (including cities) can end up polluting the water.

4. **After the simulations, designate one student to count the number of beads in the large bucket at the mouth of the main stem. Designate a second student to count the trash items. Record this data on the** *Graph It!—Student Copy Page*.

5. **Does the amount of trash in the sea correlate to the amount of water moving through the watershed?** (Does the amount of trash increase with the amount of water flow?) Discuss why this could happen.

6. **Discuss ways to prevent trash from entering the watershed.** Behaviors include recycling to reduce trash; ensuring trash is placed in bins with lids; picking up trash from the street to prevent the movement of trash in water runoff.

Photo © Vladimir Melnikov—Shutterstock

Tributaries flow into the main stem of a watershed emptying water, sediment and pollutants into the river.

Wrap Up

- Have students describe their location in the watershed simulation. Based on their experience, what is the function of a headwaters stream? What is the importance of a tributary? What is the role of the main stem in the watershed?
- Have students review the hydrograph they produced. How do the seasons and weather influence the flow of water through the watershed?

ActionEducation™

Have students research recycling and trash management in your community. What can be recycled locally and what should be properly disposed of in a designated trash receptacle? Organize a playground or community clean-up to collect trash that might otherwise enter the watershed through runoff. Before recycling or disposing of the trash they pick up, have students take pictures of what they collected. Use the pictures to create signs reminding their fellow students to protect their watershed by making good decisions about where to put their trash.

WATERSTAR

The WaterStar recognition program encourages students and educators to contribute to a positive water future by learning about water and taking appropriate local action.

Report what you've learned and done at www.projectwet.org/waterstar.

Assessment

Have students:

- reflect on the amount of water entering the watershed during a rainstorm. (***Part 1***)
- assess how water moves trash into water sources. (***Part 2***)
- understand how to prevent trash from moving into water sources. (***Part 2***)
- demonstrate the movement of water through a watershed. (***Part 1 and Part 2***)
- compare and contrast the amount of water flowing through a watershed based on precipitation or season. (***Part 1***)
- compare the amount of water and pollutants flowing through a watershed based on water flow. (***Part 2***)
- create a hydrograph based on simulation data. (***Part 1 and Part 2***)

Presenter Tips

For younger children: Complete the ***Warm Up*** and ***Part 1*** without the graphing component. Alternatively, you could also complete the hydrograph component as a class.

For walk-up festivals: Ask participants if they know what a watershed is. After defining it with them, perform the steps in the ***Warm Up*** shown in "Water on the Move" to demonstrate how water flows from high to low in a watershed.

Extensions

Have students create other scenarios on the river affecting water flow. For example, construct a dam on a tributary stream by placing a bucket between students. Capture water in the dam during the spring runoff and release it later in the summer. Discuss how dams are used to capture water during periods of high flow and then release it slowly for purposes such as irrigation and hydroelectric power generation throughout the rest of the year.

Have different weather events occur in different tributaries. How does a rain event involving a single tributary affect the river? How do hot and dry conditions in primary or secondary tributaries affect the main stem?

Choose a spot along a local waterway to observe streamflow seasonally and see how it changes.

Compare the hydrograph from simulation to a hydrograph produced using actual data.

Resources

Books and Journals

Bodzin, Alec and Louise Shive. 2004. "Watershed Investigations." Science Scope, 27 (7), 21-23.

Endreny, Anna Henderson. 2010. "Urban 5th Graders Conceptions during a Place-Based Inquiry Unit on Watersheds." Journal of Research in Science Teaching, 47 (5), 501-517.

Jason Academy. 2004. Earth Science: River Systems Teacher & Student Manual and CD-ROM. Needham Heights, MA: Jason Academy.

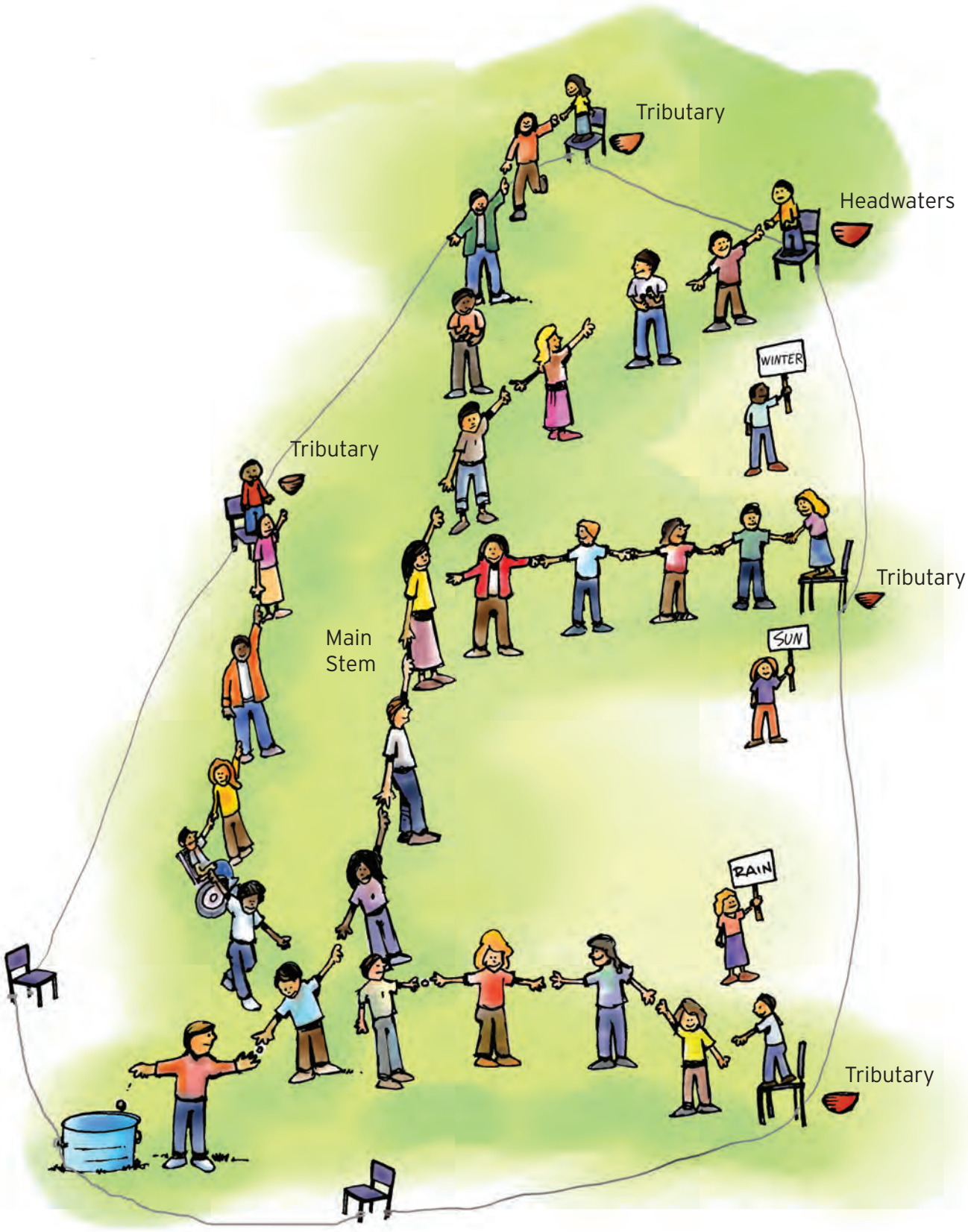
Websites

United States Environmental Protection Agency. Surf Your Watershed. By entering location parameters, students and teachers can see the watershed in which they live. http://cfpub.epa.gov/surf/locate/index.cfm. (Accessed January 9, 2015.)

United States Environmental Protection Agency. What is a Watershed? A definition and description of a watershed. www.epa.gov. (Accessed February 22, 2013.)

United States Geological Survey. Science in Your Watershed. Using maps, students and teachers can see their local watershed and find items of interest that pertain to it. http://water.usgs.gov/wsc/. (Accessed January 9, 2015.)

River Watershed–Teacher Resource Page



Graph It!—Student Copy Page

Directions
In the chart below, record the class simulation streamflow data for each season.

	Part 1	Part 2	
Weather	Number of beads	Number of beads	Number of trash pieces
Light Rain			
Sun			
Heavy Rain			

Hydrograph for Class Simulation of Blue River Flow
Now, graph your results below for water flow (number of beads). The number of beads includes an "equivalent" measure in cubic feet per second (cfs), which is the measure used for water in motion. (1 cubic foot per second = 7.4805 gallons flowing by a particular point in 1 second.)

Water Flow

250 beads/min = 2,500 cfs

225 beads/min = 2,250 cfs

200 beads/min = 2,000 cfs

175 beads/min = 1,750 cfs

150 beads/min = 1,500 cfs

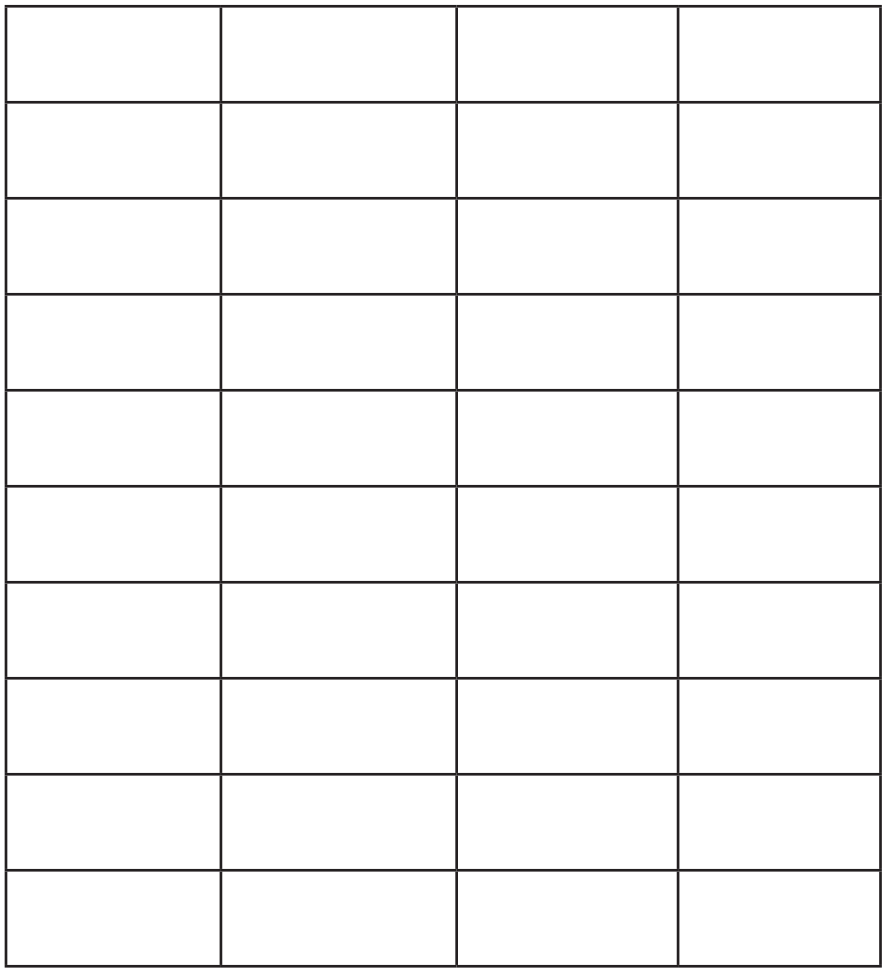
125 beads/min = 1,200 cfs

100 beads/min = 1,000 cfs

75 beads/min = 750 cfs

50 beads/min = 500 cfs

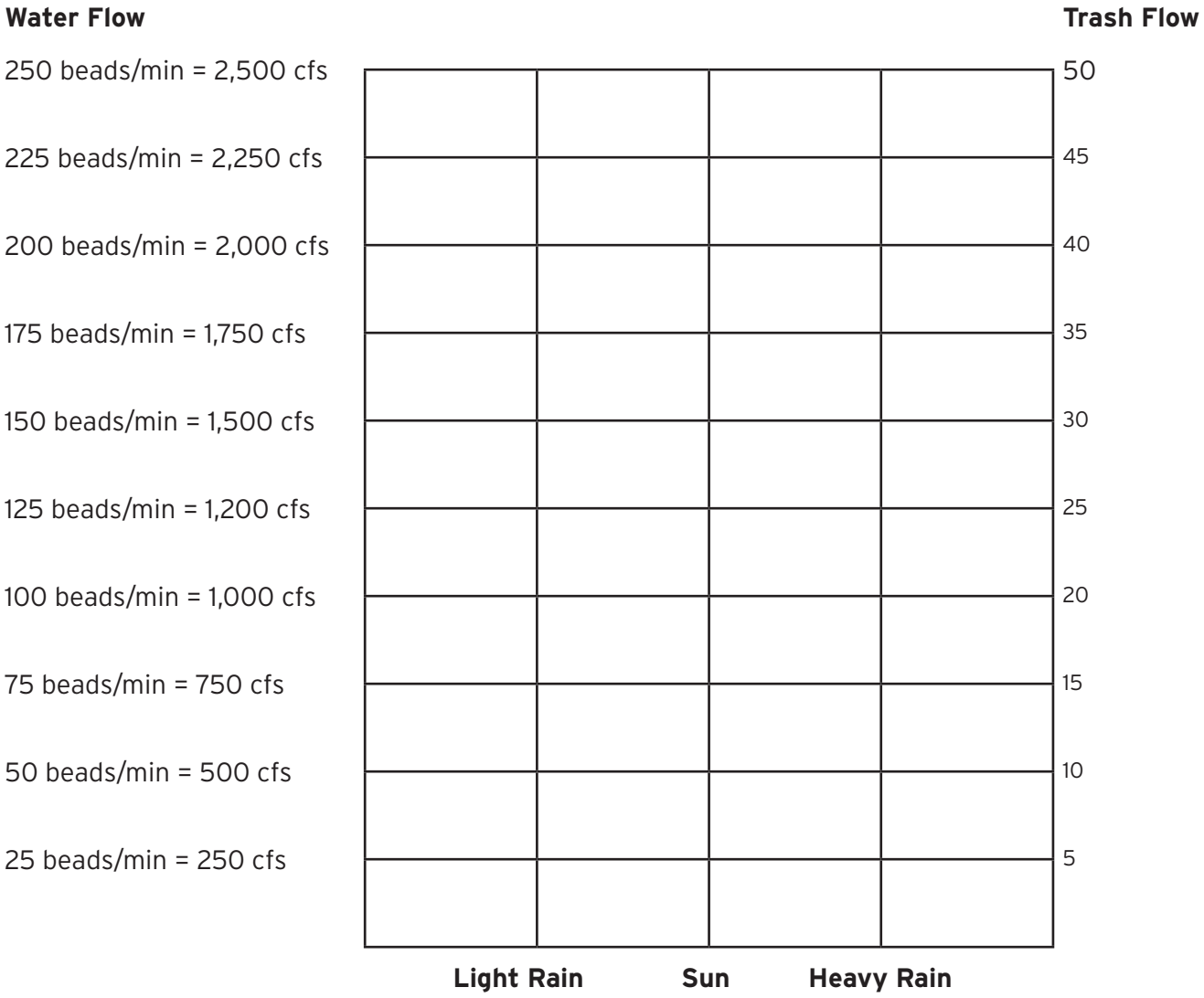
25 beads/min = 250 cfs



Light Rain **Sun** **Heavy Rain**

Hydrograph, Part 2

Using the hydrograph below, graph your results for water flow (number of beads) using the left side axis as a measurement. Graph your numbers for trash flow (number of items of trash) using the right side axis. Use different color or dotted lines to distinguish between the two data sets.



Glossary

Communicable disease. A disease that can be spread from one person to another through direct contact with bodily fluids such as saliva or mucus or through indirect contact on contaminated surfaces. Common communicable diseases include colds and influenza.

Contagious. Able to be spread from one person or organism to another by direct or indirect contact.

Direct contact. The spreading of germs from one person to another through touching, sneezing, coughing, etc.

Dissolve. To cause one or more compounds to break apart and become absorbed in a liquid solution, such as mixing salt or sugar into water.

Downstream. In the direction of a stream's current.

Emulsifier. An additive that encourages the suspension of one liquid in another.

Emulsion. A fine dispersion of minute droplets of one liquid in another in which it is not soluble.

Exposure. The condition of being affected by or experiencing something; the condition of being exposed to something (like a disease).

Germs. A microscopic organism that causes illness in humans and/or animals.

Headwaters. The source of a stream or river.

Hydrophilic. "Water loving"; readily dissolving or absorbing in water.

Hydrophobic. "Water fearing"; repelling, tending not to combine with or unable to dissolve in water.

Hygiene. Conditions or practices conducive to maintaining health and preventing disease, especially through cleanliness.

Indirect contact. The spreading of germs from one person to another through touching a surface contaminated with germs.

Influenza. A highly contagious viral infection that attacks the respiratory system (nose, throat and lungs) and can result in fever, body aches and inflammation of the mucous membranes. Commonly called "the flu."

Main stem. The main course of a river or stream into which other smaller rivers or streams (tributaries) flow.

Microorganism. Microscopic organisms such as bacteria, fungi, viruses and parasites found everywhere in the world (including in human bodies) that are too small to be seen without a magnifying device.

Potable. Suitable or safe for drinking.

Precipitation. Water falling, in a liquid or solid state, from the atmosphere to Earth (e.g., rain, snow).

Rain water. Water in liquid form dropped from clouds as precipitation.

Runoff. Precipitation that flows over land to surface streams, rivers and lakes.

Soluble. Able to be dissolved in a liquid.

Surface sanitation. Proper cleaning of surfaces that come into contact with food and/or are commonly touched by many people.

Surface water. Water above the surface of the land, including lakes, rivers, streams, ponds, flood water and runoff.

Transmission. The passing of a communicable disease from one person or thing to another.

Tributary. A stream that contributes its water to another larger stream or body of water.

Water conservation. The use of water-saving methods to reduce the amount of water needed for homes, lawns, farming and industry in order to preserve water supplies for optimum long-term economic and social benefit.

Water flow. The movement of water through or past something; usually expressed as a volume unit per time.

Watershed. The land area from which surface runoff drains into a stream channel, lake, reservoir or other body of water; also called a basin, drainage or catchment.

Water use. The total volume of fresh water used to produce the goods and services consumed by an individual, community or business; also called a water footprint.

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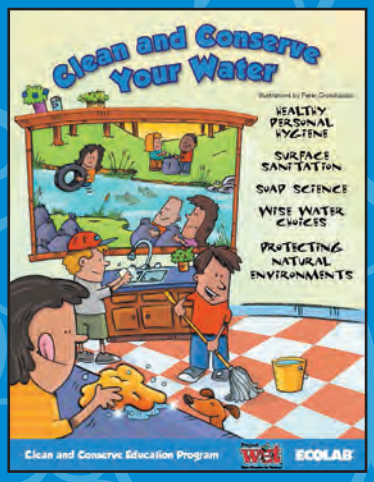
Companion Publication



Clean and Conserve Your Water Kids in Discovery Series (KIDs) activity booklet. Children ages eight to 12 learn about hygiene and water conservation in a full-color, illustrated activity booklet.

Download at www.projectwet.org/cleanandconserve

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