WATER QUALITY

SERVICE LEARNING PROGRAM

STUDENT-CENTERED
SCIENCE INVESTIGATION FOR
4TH, 5TH & 6TH GRADE LEVELS

Erase the Waste

BROUGHT TO YOU BY THE CALIFORNIA WATER BOARDS

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Arnold Schwarzenegger
Governor

Dear Educator:

We would like to help educate your students about a major environmental and public health issue now facing California: polluted runoff. The pollution is created when trash and everything else left on the ground is washed or thrown into stormdrains. Unlike the sewer system, where contaminated water flows through treatment plants, stormwater runoff is carried untreated by stormdrains directly into local creeks, rivers, and the ocean. The stormwater pollution is creating unhealthy waterways and growing environmental problems for local communities.

The California Water Boards, local agencies, and others are working hard to reduce polluted runoff and its harmful effects. Public education is one important way to reach that goal, along with cleaning up problem sites, and requiring public and private entities – including school districts – to become more involved in reducing polluted stormwater runoff. To this end, we are asking teachers and students to become involved in helping to restore and protect California's water quality.

The Water Boards are comprised of the State Water Resources Control Board in Sacramento and nine regional water boards throughout the state. The boards serve collectively as the state agency responsible for ensuring the quality of California's water. Toward this end, the Water Boards have developed the enclosed water quality units of study specifically for 4th through 6th grade levels. These instructional tools use the educational process known as "service learning," integrating inquiry-based learning with real-world, hands-on experiences. The lessons aim to improve the water running off of school campuses and from adjacent communities. Called the Water Quality Service Learning Program, the curriculum meets specific grade-level state standards while increasing students' awareness of polluted runoff and how it impacts local waterways and the environment. Of added value, the program was designed to support the Education and the Environment Initiative passed by the California legislature in 2003, a unified strategy to bring education about the environment into California schools.

Additionally, the Water Boards created a Web-based learning tool, featuring an online mentor. Log onto www.waterlessons.org for additional resources and support, including an archived training session.

It is our goal to offer every elementary school student in California the opportunity to learn about local environmental science issues and, more importantly, to take an active role in improving local waterways. Based upon field tests conducted in the Los Angeles Unified School District, we believe our Water Quality Service Learning Program – an unprecedented effort in California – can help achieve that. It is with this hope that we offer you this guide. With your involvement, we can help youth become environmental stewards and ensure cleaner and healthier California waterways for years to come. We can also help promote standards-based learning through a very rich and rewarding student-centered environmental science program.

Sincerely,

Tam M. Doduc

Tam M. Doduc, Chair

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INTRODUCTION

WHAT IS SERVICE LEARNING?

Service learning, as defined by the National Service Learning Partnership, "is a teaching method that engages young people in solving problems within their schools and communities as part of their academic studies or other types of intentional learning activities. Service learning helps students master important curriculum content by making meaningful connections between what they are studying and its many applications. Service learning also helps young people develop a range of service skills, from acts of kindness and caring, to community stewardship, to civic action."

Service learning differs from community service in that a student's community service project may teach valuable skills, but not necessarily offer any connection to content standards. Examples of service learning:

- Students create a trash reduction campaign after studying the amount of trash that ends up in a local body of water and its impact on humans and the water cycle.
- Students present posters and a presentation to younger students about what they have learned after studying how water runoff from their campus impacts living organisms and the environment.

The Water Quality Service Learning Program uses specific science content standards as the basis for academic learning. It also incorporates key elements of quality service learning, including: integrated learning, community service, collaboration, student voice, civic responsibility, reflection, and evaluation.

KEY ELEMENTS OF QUALITY SERVICE LEARNING

Ideally, when developing a quality service learning project aligned to specific content standards, all of the following key elements should be included:

1. INTEGRATED LEARNING

Service learning projects support the academic curriculum and vice versa.

2. SERVICE TO THE COMMUNITY

Service learning projects bring together students, teachers and community partners to provide meaningful service that meets community needs.

3. COLLABORATION

A quality service learning project incorporates many partners ("stakeholders") in its design and implementation, including students, parents, community-based organizations, teachers, school administrators, and service recipients. All partners benefit from the project and contribute to its planning and implementation.

4. STUDENT VOICE

Students participate actively in every step of the project, including identifying community needs and issues, choosing and planning the project, reflecting on it at each stage, evaluating it, and, most importantly, celebrating its success to reinforce a "job well done."

5. CIVIC RESPONSIBILITY

By participating in a service learning project, young people learn that they can have a positive effect on their community and that their voice counts.

6. REFLECTION

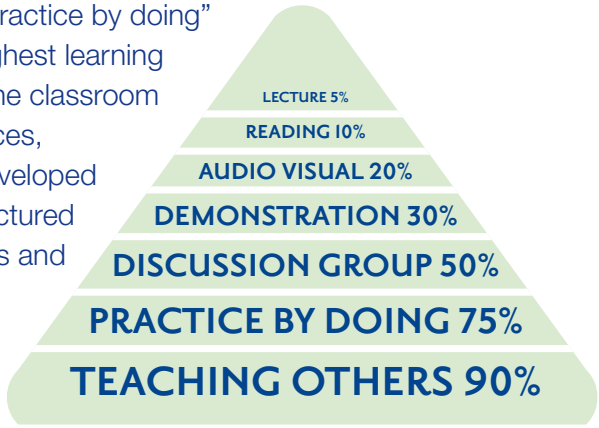
Service learning incorporates important reflection time before, during, and after the project to draw links between the social and personal aspects of the project and the academic curriculum.

7. EVALUATION

Evaluation conducted by all partners, including the students, districts, and communities, measures progress towards the learning and service goals of the project.

WHY IS SERVICE LEARNING MORE EFFECTIVE?

Service learning primarily uses the methods of "practice by doing" and "teaching others," both of which yield the highest learning retention rates. By integrating what's learned in the classroom with outside-the-classroom community experiences, students retain more. "The Learning Pyramid" developed by the NTL Institute of Alexandria, Virginia and pictured here, shows various curriculum teaching methods and the learning retention rates resulting from each method.



AVERAGE LEARNING RETENTION RATES

THE CASE FOR ENVIRONMENTAL EDUCATION

Just as service learning has been proven an effective way for students to learn, develop valuable skills, and retain concepts, utilizing environmental education in the classroom as a "connecting thread" or context for other academic disciplines has also been shown to be educationally beneficial.

In its 2002 publication, Education & The Environment / Strategic Initiatives for Enhancing Education in California, the California Department of Education made several important points about the key to excellence in education. "A main element, generally agreed on, is that integrating subjects aids learning. For that reason, integrated education and cross-subject instructional materials have proliferated."

The report concludes that environmental education can be used effectively to connect many subjects within curriculum. "[It] pulls together the existing curriculum into a sensible and tangible whole. Learning parallels the 'real world' by combining academic disciplines (English and language arts, mathematics, science, history and social science, visual and performing arts) in investigating the local environment, defining and assessing issues, and creating and communicating solutions."

Environmental education also:

- Emphasizes depth of understanding over breadth, as determined by a joint study published in 2000 by two major environmental education organizations.[1] The study showed that students involved in environmental education efforts improve math and reading scores, perform better in science and social studies, are more fully able to transfer their familiar learning into unfamiliar contexts, and learn to "do science," rather than just "learn about science."
- Utilizes group work, a skill critical in higher grades and in the workforce. In 1999, the National Business Education Association noted that it seeks "employees who can work in teams, create analytical reports, interpret data, and make decisions," all skills developed through environmental service learning.

[1] The National Environmental Education & Training Forum and the North American Association for Environmental Education.

- Cultivates critical-thinking and problem-solving skills as students measure what they learn in the classroom against real-world situations, a continuous feedback loop that promotes flexibility, teamwork and leadership.
- Nurtures community involvement and active citizenship – the backbone of our democratic government. The Western Governors' Association has declared, "Beginning with the nation's youth, people need to understand their relationship with the environment. They need to understand the importance of sustaining and enhancing their surroundings for themselves and future generations. If we are able to achieve a healthy environment, it will be because citizens understand that a healthy environment is critical to the social and economic health of the nation." Environmental service learning projects strengthen students' relationship to community, and make them want to be active participants in creating meaningful change.

A March 2000 study[2] funded by the California Department of Education paired eight conventionally structured California schools with eight demographically similar schools that had reorganized their curriculum to use the environment as an integrating context for learning. These latter schools used proven educational practices, but emphasized the local community and natural surroundings as the primary venue for learning. Students in the schools using the environment-based model earned higher scores on standardized tests than their counterparts in more traditional settings.

EDUCATION AND THE ENVIRONMENT INITIATIVE

In October 2003, the Governor signed into law the Education and the Environment Initiative (Pavley, Chapter 665, Statutes of 2003). This landmark law, now referred to as the Education and the Environment Initiative (EEI), provides a comprehensive framework for bringing environment-based education to students across California. The major components of this "unified education strategy" include:

- development of California's first ever environmental principles and concepts;
- design, development and dissemination of a standards-based model curriculum to teach the environmental principles and concepts to students in kindergarten through 12th grade;
- incorporation of the environmental principles and concepts into the State Board of Education's criteria for adopting science, mathematics, English/language arts, and history/social sciences textbooks; and,
- reorientation of the state's existing environmental education programs to support learning of the environmental principles and concepts.

The California Environmental Protection Agency and the California Integrated Waste Management Board are actively engaged in the implementation of the EEI (the Water Boards have ensured that this service learning program closely follows this initiative). This important work is occurring in close collaboration with California's State Board of Education, Department of Education, Office of the Secretary for Education, and the Resources Agency. The government agencies that are collaborating in the EEI have been joined by a broad-based group of partners from business and industry, educational institutions, nongovernmental organizations, and professional organizations to ensure its successful implementation.

[2] Lieberman, G., & Hoody, L. (2000). *California Student Assessment Project: The Effects of Environment-based Education on Student Achievement.* San Diego California: State Education & Environment Roundtable.

The environmental principles examine the interactions and interdependence of human societies and natural systems. The nature of these interactions is summarized in the environmental principles and concepts that are presented below.

Principle I

The continuation and health of individual human lives and of human communities and societies depend on the health of the natural systems that provide essential goods and ecosystem services. As a basis for understanding this principle:

- **Concept a.** Students need to know that the goods produced by natural systems are essential to human life and to the functioning of our economies and cultures.
- **Concept b.** Students need to know that the ecosystem services provided by natural systems are essential to human life and to the functioning of our economies and cultures.
- **Concept c.** Students need to know that the quality, quantity, and reliability of the goods and ecosystem services provided by natural systems are directly affected by the health of those systems.

Principle II

The long-term functioning and health of terrestrial, freshwater, coastal, and marine ecosystems are influenced by their relationships with human societies. As a basis for understanding this principle:

- **Concept a.** Students need to know that direct and indirect changes to natural systems due to the growth of human populations and their consumption rates influence the geographic extent, composition, biological diversity, and viability of natural systems.
- **Concept b.** Students need to know that methods used to extract, harvest, transport, and consume natural resources influence the geographic extent, composition, biological diversity, and viability of natural systems.
- **Concept c.** Students need to know that the expansion and operation of human communities influences the geographic extent, composition, biological diversity, and viability of natural systems.
- **Concept d.** Students need to know that the legal, economic, and political systems that govern the use and management of natural systems directly influence the geographic extent, composition, biological diversity, and viability of natural systems.

Principle III

Natural systems proceed through cycles that humans depend upon, benefit from, and can alter. As a basis for understanding this principle:

- **Concept a.** Students need to know that natural systems proceed through cycles and processes that are required for their functioning.
- **Concept b.** Students need to know that human practices depend upon and benefit from the cycles and processes that operate within natural systems.
- **Concept c.** Students need to know that human practices can alter the cycles and processes that operate within natural systems.

Principle IV

The exchange of matter between natural systems and human societies affects the long-term functioning of both. As a basis for understanding this principle:

- **Concept a.** Students need to know that the effects of human activities on natural systems are directly related to the quantities of resources consumed and to the quantity and characteristics of the resulting byproducts.
- **Concept b.** Students need to know that the byproducts of human activity are not readily prevented from entering natural systems and may be beneficial, neutral, or detrimental in their effect.
- **Concept c.** Students need to know that the capacity of natural systems to adjust to human-caused alterations depends on the nature of the system as well as the scope, scale, and duration of the activity and the nature of its byproducts.

Principle V

Decisions affecting resources and natural systems are based on a wide range of considerations and decision-making processes. As a basis for understanding this principle:

- **Concept a.** Students need to know the spectrum of what is considered in making decisions about resources and natural systems and how those factors influence decisions.
- **Concept b.** Students need to know the process of making decisions about resources and natural systems, and how the assessment of social, economic, political, and environmental factors has changed over time.

THE TIME TO ACT IS NOW

It is against the backdrop of these environmental principles and concepts and service learning studies that the California Water Boards have decided to bring integrated environmental learning into classrooms in California. We believe that this will not only result in higher student achievement, but also result in cleaner, healthier California waterways in the future. The time to act is now.

4TH GRADE

LIFE SCIENCE WATER QUALITY UNIT

OVERVIEW

At the beginning of the Water Quality Unit, students are asked to observe their school grounds – mapping where water comes from, where it goes, any pollution left on the ground, and more. Based on their observations, discussions, and their review of the one-page information sheet focused on water quality, students develop ideas about what might be happening on their campus and what they want to investigate further. Student groups come up with a testable question, and set up an investigation that includes data collection and relates to water quality.

While collecting data, students continue to build content knowledge and context with more readings relating to water ecosystems, including watersheds and their living (biotic) and non-living (abiotic) components, beneficial soil and water microorganisms, and how water flowing across their campus may contribute to whether an organism survives or not. After making observations and taking data, students present their findings and their evidence-based conclusions to the class. Students demonstrate what they have learned by creating a diagram of the living and non-living components of a water ecosystem, and how human activities affect the survival of those components. Then, students reflect on what they have learned and share their thoughts through the writing of a news article.

In the final step of the Water Quality Unit, students use their reflections to make informed choices and develop a service project to help their community. As a class, or in student groups, the Water Quality Project workbook is used to guide students through project development and follow through.

California Grade 4 Standards

The unit lessons are designed to help students master the following standards:

Life Science Strand

3. Living organisms depend on one another and on their environment for survival.

a. Students know ecosystems can be characterized by their living and nonliving components.

Learning Objectives

Learning objectives in the context of the Environmental Principles and concepts.

Students will:

- Categorize the components of natural systems as living and non-living.
- Describe the living and non-living components from terrestrial, freshwater, coastal, or marine ecosystems that have similar roles.
- Recognize that the living and nonliving components of an ecosystem and the interactions among them produce the resources that are required for the survival of the living components of the ecosystem.
- Identify that the needs of humans are met by using resources (goods and ecosystem services) from natural systems.

California Grade 4 Standards	Learning Objectives
b. Students know that in any particular environment, some kinds of plants and animals survive well, some survive less well, and some cannot survive at all.	• Recognize that living things meet their needs by using resources (goods and ecosystem services) from the environment around them. • Recognize that some resources within an ecosystem are finite in supply; others are less limited. • Explain how the health of an ecosystem affects the ability of plants and animals to survive in any particular environment. • Provide examples of how the health of an ecosystem influences the quality, quantity, and reliability of the goods and ecosystem services it produces. • Recognize that changes to the environment caused by humans and other animals influence the survival of some kinds of plants and animals. • Identify that some changes to the environment caused by humans and other animals affect the cycles and processes that occur naturally in ecosystems and in turn affect the survival of some kinds of plants and animals. • Provide examples of how human practices have altered the cycles and process that occur naturally in terrestrial, freshwater, coastal and marine ecosystems.
d. Students know that most microorganisms do not cause disease and that many are beneficial.	• Give examples of microorganisms. • Describe the roles of microorganisms in natural systems. • Recognize that microorganisms are involved in many natural systems processes that are used by humans and human communities and that such processes are considered “ecosystem services” (e.g., processes involving microorganisms such as fermentation, decomposition, etc.). • Describe the role of ecosystem services involving microorganisms in human communities and societies (e.g., waste treatment).

Investigation and Experimentation

6. Scientific progress is made by asking meaningful questions and conducting careful investigations. Students should develop their own questions and perform investigations.
   - **a.** Differentiate observation from inference (interpretation) and know scientists’ explanations came partly from what they observe and partly from how they interpret their observations.
   - **b.** Measure and estimate the weight, length, or volume of objects.
   - **c.** Formulate and justify predictions based on cause-and-effect relationships.
   - **d.** Conduct multiple trials to test a prediction and draw conclusions about the relationships between predictions and results.
   - **e.** Construct and interpret graphs from measurements.
   - **f.** Follow a set of written instructions for scientific investigation.

UNIT IMPLEMENTATION IDEAS

Work with another grade level (4th – 6th) or classroom to complete parts of the Unit.

- Choose specific areas of the school to conduct the Schoolyard Review. Get together and compare data and maps.
- Have students partner across grade levels to conduct the Schoolyard Review.
- Have classrooms share their observations for increased data collection and to check validity.
- Have groups partner with groups from another class to conduct their investigations, sharing the time in gathering data. Combine data for their conclusions.
- Create or share a service learning project.

SCHOOLYARD REVIEW

PART I – 60 minutes

OVERVIEW

Student teams are given a map of one portion of the school to investigate. Students make water related observations and indicate their findings on the map and instruction sheet. After presenting their findings to the class, students generate questions about what they found.

Standards: 3a, 6f

Materials

- Schoolyard Review worksheet – 1 per group
- Photocopy a school map, enlarged as much as possible, and divide it into different areas. Schools usually have a map of their campus that can be used, but be sure to white out or cover any unnecessary information before photocopying. A simple, hand drawn map can be used as well.
- Green, blue, purple, black, and red markers or colored pencils – 1 set per group

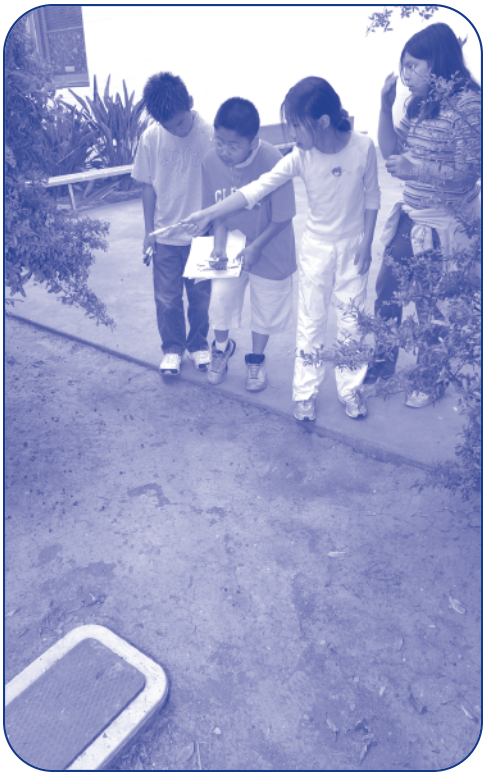
Vocabulary Words

- Catch basin
- Downspout
- Rain gutter
- Stormdrain

Helpful Hints

- Plan ahead for proper adult supervision for each group of students "mapping" around the school. This might be a great opportunity for parents or school staff to be involved in this core instructional program.
- Outline a walking route around the school to help point out key items pertaining to the questions on the Schoolyard Review (rain gutters, drains, etc.) and any safety hazards.
- If necessary, take time to orient students on how to read a map of the school from a "bird's eye view." **It is essential that students are able to read their map.**

PROCEDURE



1. Explain to students that they will use their maps to investigate different areas of their schoolyard, to mark what they have found and answer questions along the way.
2. Divide the students into working groups.
   Have groups assign a:
   a. Reader: reads the instructions and questions to be answered
   b. Recorder: records the answers to the questions
   c. Artist: draws what they observe on their map
   d. Timekeeper: makes sure the group stays focused and on time
   e. Reporter: reports the findings of the group to the class
3. Pass out markers/colored pencils, maps of the school areas, and a Schoolyard Review worksheet. Each group is assigned a different area to study.
4. Help student groups to read their map and familiarize themselves with their designated area.
5. Go through the Schoolyard Review worksheet and demonstrate what the student groups will be looking for and how to mark their map.
6. Ask students what is meant by “harmful” referring to question 4 on their Schoolyard Review worksheet. These items, which may include motor oil, fertilizers, pesticides, or trash, can hurt humans, as well as the environment.
7. As a class, walk to one area of the school to point out examples of what they will be looking for and how they should mark these items on their map, including down spouts, sprinklers, rain gutters, and anything else that may not be familiar.
8. Give groups a deadline before sending them to their different locations.
9. When students return to the classroom, tape each map section together to make one complete map of the school. Affix to the wall or white board.
10. Have each group’s reporter share their group’s findings by using the answers on their worksheet and the map of their area.

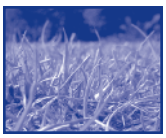
GUIDED QUESTIONS

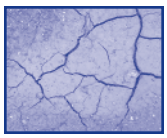
- What are different sources of water on our campus?
- How do you know they are a “source?”
- Where did you find trash and other harmful things?
- Where do you think water travels on our campus?
- What did you learn as a result of your observations?
- What questions did you have about what you observed?

SCHOOLYARD REVIEW

In your designated area, observe what's around you. Use the colored markers/pencils to mark these observations on your map.

1. **Look for places where water can get into the ground.**
   Use green dots ::: to show these places on your map.


☐ grass


☐ bare dirt


☐ gardens


☐ tree wells

What other places did you find? _____

2. **Look for sources of water.**
   Use a blue waterdrop ♦ to show these places on your map.


☐ faucets


☐ drinking fountains

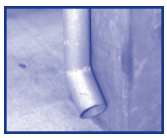

☐ sprinklers

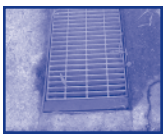

☐ hoses

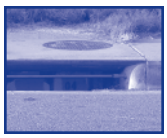
What sources did you find? _____

3. **Look for places where water travels.**
   Use a purple square ■ to show these places on your map.


☐ gutters


☐ down spout


☐ drain

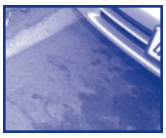

☐ catch basin

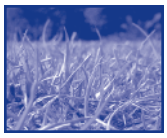
What other places did you find? _____

4. **Look for trash and other things that could be harmful to water.**
   Use a red X to show these items on your map.


☐ lunch trash


☐ candy wrappers


☐ motor oil


☐ lawn/field care products

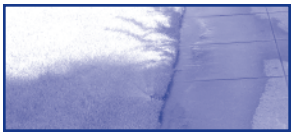
What kinds of trash and other harmful things did you find in your area? _____

_____

5. Look for areas where water is wasted.
Use a black star ★ to show these areas on your map.

☐ leaky faucets and sprinklers

☐ clogged drains



☐ water sprayed on concrete

What other areas did you find? _____

6. Write one question you have about what you observed.

_____

_____

WHAT IS THE QUALITY OF YOUR WATER?

PART 2 – 60 minutes

OVERVIEW

Students read a one-page information sheet about water quality. Based on what they learn, groups design an investigation using one question relating to what they observed on their schoolyard.

Standards: 3b, 6a

Materials

- Information Sheet A – What is the Quality of Your Water? – 1 per student
- Completed Schoolyard Review worksheets
- Our Investigation worksheet – 1 per group
- Pencils

Vocabulary Words

- Community
- Environment
- Groundwater
- Investigation
- Organism
- Toxic
- Ecosystem
- Fertilizer
- Hazardous waste
- Land pollution
- Prediction

Other Resources

See Teacher Resources, page 116 for additional activities that relate to water quality.

Helpful Hints

- As students read this and other Information Sheets, they should underline all the words that they think are associated with water and living organisms.
- Students can create a list of their words, adding definitions as they progress through the unit, using their own first-hand experience to define the terms and then supporting their definitions with textbook definitions.
- Refer to "Leading Students to Develop Their Own Questions and Perform Investigations" on page 21, for guidelines to assist students in developing testable questions and conducting investigations that relate to water quality.
- Set up times for students to make their observations and collect data. The data collection times will depend on the investigations they choose.

PROCEDURE

1. Have each student read Information Sheet A – What is the Quality of Your Water?
2. Have student groups discuss what they read and the ways in which it relates to what they observed on their schoolyard. Each group can report their main points to the class as part of a group discussion.
3. In their groups, have students review their notes from the Schoolyard Review and create a list of questions they have about water quality related to their campus.
4. Guide students to develop "testable" questions. See page 21 for guidelines.
5. Using the Our Investigation worksheet, have groups:
   a. Create one question to pursue for their investigation. It should:
      i. Focus on water quality
      ii. Be measurable over time: 1 – 4 weeks
   b. Figure out what it will measure
      i. What kind of observations can you make to answer the question?
   c. Tools and supplies
      i. What tools and supplies are needed to conduct the investigation?
   d. Procedure
      i. What steps are needed to conduct the investigation?
   e. Predict what they think they will find during the investigation
      i. How are the observations going to support the prediction?
      ii. How is the investigation set-up going to support the prediction?

GUIDED QUESTIONS

- What makes up a community?
- What makes up an ecosystem?
- How does pollution affect the ecosystem of streams and rivers?
- What land pollution did you observe on your schoolyard?
- In what ways is water wasted at our school?
- Where does water flow into the street at our school?
- Where does water seep into the ground at our school?
- What question do you have about water quality at our school?
- What will your investigation measure?
- What steps are needed to conduct your investigation? Can you summarize the steps in a few sentences?
- What do you predict is the answer to your question?

WHAT IS THE QUALITY OF YOUR WATER?

Did you know that almost every living thing on Earth needs and depends on its environment for survival? People, plants, animals, and other living organisms live and interact with each other as part of a community. Every member of that community interacts with its physical environment. Together, a community and its physical environment make up an ecosystem.

The health of an ecosystem affects the ability of people, plants, and animals to survive. The environment of California has 200,000 miles of rivers and streams, 1,100 miles of coastline, more than 10,000 lakes, and more than 1 million acres of bays and estuaries.

Unfortunately, most of these rivers and other water environments have become polluted. For example, when it rains in cities, rainwater picks up many materials that have been left on the ground, including car oil, car grease, garden pesticides, pet droppings, and most of all, trash! All this "land pollution" gets carried by the rainwater into a water or "stormdrain" system that leads to streams and rivers. Even when it is not raining, wasted water from hoses, sprinklers, and faucets send polluted water into drains that lead to streams and rivers.

How does this affect the living organisms that live there?

Rainwater seeping into the soil or washing off hard surfaces can carry harmful chemicals such as garden fertilizers, pesticides, and hazardous wastes such as paint that is left on the ground. These toxic substances pollute groundwater or wash into streams, rivers, and lakes harming the living organisms that live there.

How does this affect our need for healthy drinking water?

The everyday activities of people have an impact on our water ecosystems. Whether we are wasting water, creating more trash instead of recycling, or simply leaving toxic substances on the ground, our actions determine the quality of our water.

Think about the following questions:

- Do you remember the last time you saw trash on the ground? Where did it come from? Where will it go? If it isn't in a trashcan, what is going to happen to it?
- What about the wasted water? How does extra water that flows over hard surfaces impact the organisms living in local rivers and streams?
- How is the quality of the rivers and streams in your area? Think about this when you see trash on the ground or water rushing into the street. Is it harmful to our water and environment?

TEACHER INFORMATION

Leading Students to Develop Their Own Questions and Perform Investigations

Within the unit, students are asked to come up with a testable question (a question that can be answered scientifically) and set up an investigation. The following are steps and examples for guiding student-led experimentation.

1. Gain knowledge

Through the use of the Schoolyard Review, students gain knowledge about their schoolyard. The Schoolyard Review is designed to help students observe where water flows at their school, recognize and identify the influence of land pollution, wasted water, and the presence of harmful substances.

Students continue to gain information by reading Information Sheet A about water quality issues in California, and relating their observations to what they read, thus driving students to investigate the issues further.

2. Develop a testable question

Students use what they observed and what they have learned to formulate testable questions relating to water quality. After completing the Schoolyard Review, ask students how what they observed may impact local water quality. Use these answers to help develop testable questions.

The testable question can be written in the form of "How does _____ affect _____?" The blanks represent the independent variable (first blank) and dependent variable (second blank).

Variables are the factors in an investigation that could affect results. They are the things that could vary from one sample to the next. Work with students to choose an "independent" variable – the one variable that changes. The "dependent" variable changes as a result of, or in response to, the change in the independent variable.

Some sample testable questions:

- How does the number of students using the trashcan at lunch affect the amount of trash in the street outside the school?
- How does the number of waste water sources at the school affect the amount of water that flows into the street from our school?
- How does the number of students dropping their trash on the ground affect the amount of trash that goes into the street next to the school?
- How does the location of where "hosing" is happening affect the amount of water and topsoil going into the street?
- How does the amount of lawn watering affect the amount of water and topsoil going into the street?
- How does the amount of trash found on the ground affect the amount found in the street outside the school?

3. Make a prediction

Discuss with the students what they can investigate to find the answer to their questions. Use what they learned from Information Sheet A to help formulate ideas for investigations.

After listing ideas, have students write a statement of what they think may happen in the investigation based on what they have observed and learned so far.

Sample predictions:

- I predict that on days when less students drop their trash on the ground, there will be less trash that goes into the street next to the school.

- I predict that three out of the five sources of water at the school (faucets, hoses, sprinklers, downspouts, and drinking fountains) will contribute to the amount of water that flows into the street from our school.
- I predict that on days when more students drop their trash on the ground there will be more trash that goes into the street next to the school.
- I predict that when the grounds manager hoses next to grass or permeable areas, less water will go into the street than when he/she hoses next to large concrete areas.
- I predict that the longer the grounds manager runs the sprinklers or hoses, the more water will go into the street.
- I predict that on the days when more trash is found on the ground, more trash will be found in the street outside the school.

4. Design an investigation

How will your students test whether their predictions are right? Facilitate a group discussion that leads students to figure out what they can measure that will lead to an answer to their question. The investigation should involve gathering data over time.

Example questions and measuring tools:

- I predict that on days when less students drop their trash on the ground, there will be less trash that goes into the street next to the school.

  Audit the number of students that use the trashcan at lunch and later audit the amount of trash found in the street closest to the lunch area.

- I predict that three out of the five sources of water at the school (faucets, hoses, sprinklers, downspouts, and drinking fountains) will contribute to the amount of water that flows into the street from our school.

  Audit the different sources of water for leakage and water flow.

- I predict that on days when more students drop their trash on the ground, there will be more trash that goes into the street next to the school.

  Audit the number of students using the trashcan and later the amount of trash in the street closest to the lunch area.

- I predict that when the grounds manager hoses next to grass or permeable areas, less water will go into the street than when he/she hoses next to large concrete areas.

  Audit the location and direction of water flow when the grounds manager is using the hose.

- I predict that the longer the grounds manager runs the sprinklers or hoses, the more water will go into the street.

  Audit the time and amount of water going into the street when the grounds manager is using the hose and sprinklers.

- I predict that on the days that more trash is found on the ground, more trash will be found in the street outside the school.

  Audit the amount of trash on the ground at school and later in the street outside the school.

5. Design procedures

Have students develop and follow a specific method/protocol that helps assure reliability and validity of their results. Help them consider, if necessary, how to:

- Do a procedure the same way every time
- Consider the independent variable in planning data collection
- Use tools and supplies that are available
- Be accurate

6. Design a recording system

Help students design the most appropriate way to record the data they are gathering. They should use this method consistently to ensure they are accurate. This will help in analyzing the data more effectively. Recording systems include:

- Date and time of observation
- Space for written observations
- Space for illustrations and drawings
- Columns for separating information
- Using tally marks for counting
- A place for questions or thoughts to be followed up in the future

7. Data analysis and conclusion

Students describe their results in the clearest way possible. In Part 5, students use the Our Conclusion worksheet to restate their question and prediction and write a summary of the data they collected. The summary should be a statement that is supported by evidence and identifies the pattern or trend of the data collected during the investigation.

Students are also asked to graphically display their data to show whether the data supports their prediction or not. Show students a variety of graphs, tables, and charts to determine which would be the best one to use. Explain that the graph, table, or chart is a picture of the information they gathered. Graphs, tables, and charts make it easier to make comparisons and draw conclusions. Ask students to name some places where they have seen graphs – in newspapers, magazines, TV news, etc. Show samples of the basic types of graphs, tables, and charts:

- Pictograph
- Bar graph
- Charts and tables
- Circle graph
- Line graph

If students are measuring the sources of the land pollution found, they could use a bar graph. The bottom of the graph would show the sources and the side would have amounts. The bars would indicate the amounts of trash found for each source. The highest bar would indicate the source of the most land pollution found.

Finally, the Our Conclusion worksheet asks students to explain what they found out about water quality at their school and how their data does or does not support their prediction. This is an ideal time to discuss why they made the prediction that they did, or how they may conduct their investigations differently, if given the chance to "do it again."

8. Communicate results

In Part 7, students are asked to reflect on what they have learned and write a news article about water quality issues. This is the method used for students to communicate their results connecting their investigations to the schoolyard or community. It includes their thoughts about what they have learned about water quality, and any concerns they may or may not have.

These articles will be used as a way to formulate ideas for their service learning project.

OUR INVESTIGATION

Name(s): Date:

Testable Question

Our question about water quality on campus is:

How does _____

affect _____?

Investigation

We are going to measure:

Tools and Supplies

The tools and supplies we need for our investigation:

Procedure

The steps we need to take to conduct the investigation:

Prediction

We predict that:

INVESTIGATION SET-UP

PART 3 – 45 minutes

OVERVIEW

Student teams set up their investigations. Students use a data sheet to make observations and collect their first data.

Standards: 6a, 6c

Materials

- Depends on each team's investigation
- Data Collection sheet

Vocabulary Words

- Data

Helpful Hints

- Spend time with each group to help them devise their investigations. Have them utilize the Data Collection sheet and record additional information in a science journal.
- The Data Collection sheet is designed to help students organize their information. If necessary, groups can design their own data collection sheets.

PROCEDURE

1. Working in their teams, students set up their investigations.
2. After the initial set-up, have student teams use the Data Collection sheet to collect their first data and record observations and measurements as needed. The Data Collection sheet will help students organize their information. If necessary, work with student groups to redesign their data collection sheet to better suit the needs of their investigation.

GUIDED QUESTIONS

- What should be included on the Data Collection sheet?
- What do you expect to find after your first data collection?
- What do you expect to find after several data collections?

PART 3

DATA COLLECTION

Name(s): Date:

Observation 1

Questions or thoughts:

Observation 2

Questions or thoughts:

Observation 3

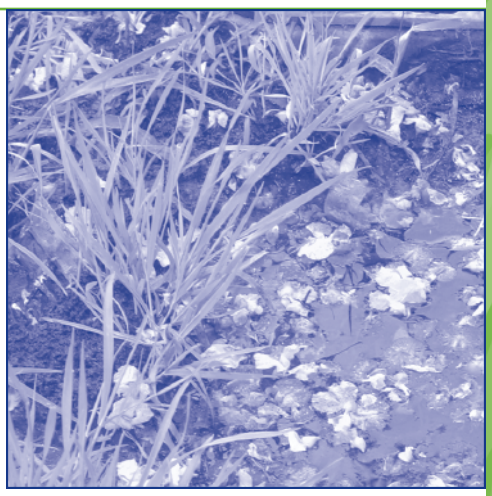
Questions or thoughts:

Observation 4

Questions or thoughts:

A LIVING WATER ECOSYSTEM

PART 4 – 45 minutes



OVERVIEW

After teams have collected data at least twice, students read a one-page information sheet about the living (biotic) and non-living (abiotic) components of a watershed and water ecosystem, and the factors that affect the survival of those components. Students take what they learn and relate it to the data they are collecting. Students continue to observe and record data.

Standards: 3a, 3b, 6a, 6b, 6c, 6d

Materials

- Information Sheet B – A Living Water Ecosystem – 1 per group

Vocabulary Words

- Contamination
- Invertebrate
- Watershed

Other Resources

See Teacher Resources, page 116 for additional activities that relate to watersheds.

Helpful Hints

- Provide additional information about the local watershed.
- Watersheds can be as small as a leaking sprinkler head to as large as an entire city basin. Show students the smaller watersheds that can be found around the schoolyard.
- Help students investigate where the water flowing off their schoolyard leads.
- Provide students with information about a local body of water – lake, river, stream, or ocean. To locate your closest body of water, consult a local map. Go to www.epa.gov/surf/ to find the name of your watershed.
- If possible, take a field trip to the local waterway to observe how humans may be impacting it.

PROCEDURE

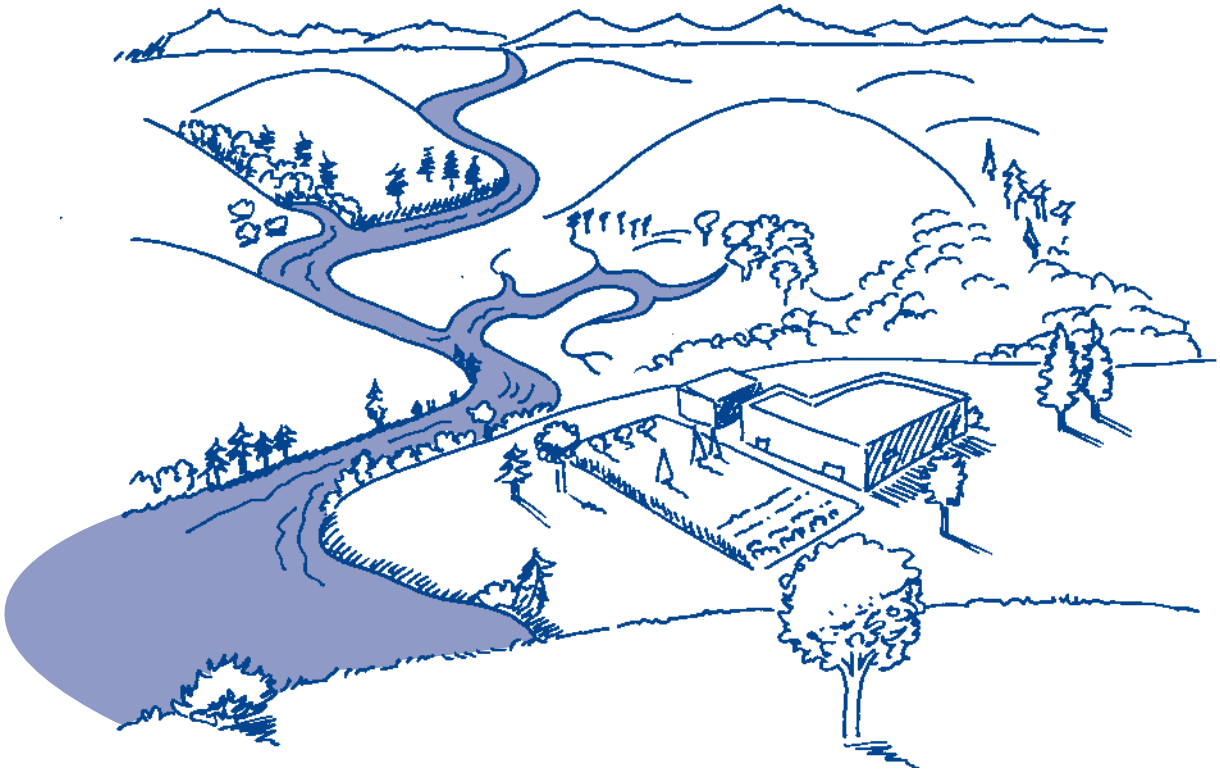
1. Have each student read Information Sheet B – A Living Water Ecosystem
2. Have student groups discuss what they read and the ways in which it relates to their investigations. Each group can report their main points to the class as part of a group discussion.
3. Looking at the illustration on Information Sheet B, have students figure out how water moves in their watershed community. Have them investigate further to confirm their ideas.
4. Have students investigate the pathway that water takes from their campus to the nearest body of water.

GUIDED QUESTIONS

- What are the living and non-living components of our watershed?
- Where are there watersheds within our schoolyard?
- What does a living organism need to survive within an ecosystem?
- What water services or goods do you depend on?
- What is the closest body of water to our school?
- Is that body of water connected to another body of water?
- Based on your investigations, what impact does campus runoff have on your local water system?
- How do you know?

A LIVING WATER ECOSYSTEM

Your community, whether it is in a city or rural town, is part of a watershed. A watershed is the land area that directs water to a drainage system or river. It helps supply water to our community by allowing it to seep into the ground or channel it into streams, rivers, and other bodies of water. Gravity moves water through the watershed from higher to lower areas.



A watershed includes living (biotic) components such as people, wildlife, plants, and insects; as well as non-living (abiotic) components, including rock, soil, water, and air. Both components belong to the environment of a watershed community.

Look around. What are the living and non-living components of your watershed?

Your watershed directs water into another system of living and non-living components – a water ecosystem. It is the non-living components that make up the environment for the living organisms – water, sunlight, rocks, soil, and air – and allow them to survive. Without these non-living components, living organisms would not survive.

Humans depend on the services of a water ecosystem. Water ecosystems provide us with water, food, recreation, and more. Humans are responsible for protecting these ecosystems. However, pollution can harm these ecosystems and damage their ability not only to provide us with goods, but also maintain the balance of a functioning ecosystem.

For example, large rivers in California such as the Sacramento, American, Feather, and lower San Joaquin provide major fish spawning habitats for salmon, steelhead trout, and striped bass. Young fish depend on small invertebrates – mostly insects and tiny shrimp – for food. When "land pollution," field pesticides, and erosion from construction sites, run off through a watershed and enter streams and rivers, they kill or seriously harm these food sources and the young fish. These sources of contamination decrease the amount of oxygen the fish have to breathe, reduce the amount of sunlight used to grow the plants they need for food, and finally, cover the available rocks and soil the fish need to lay and cover their eggs. Every non-living component is impacted by this contamination and therefore impacts the living components.

Where is the water from your schoolyard going? To a nearby river, stream, lake or ocean? The watersheds of most cities and school grounds contain up to 90 percent hard surfaces such as rooftops, concrete playgrounds, streets, and parking lots where water collects quickly and runs off into the street. This not only prevents water from seeping into the ground to replenish underground supplies of fresh water but sends "land pollution" directly into our rivers and the ocean.

Think about the following questions:

- What are you observing during your data collection? Do hard surfaces have an impact?
- What about the "land pollution?" What impact on your local water ecosystem do you think it may have?

INVESTIGATION CONCLUSION

PART 5 – 45 minutes

OVERVIEW

After teams have collected enough data, students develop evidence-based conclusions about what they observed.

Standards: 6a, 6b, 6e

Materials

- Our Conclusion worksheet – 1 per group

Vocabulary Words

- Graph

Helpful Hints

- Provide a variety of graphing examples to assist students in determining which type of graph would best show data results.

PROCEDURE

1. Have student groups use the Our Conclusion worksheet to compare the results of their investigation against their predictions.
2. Have student groups determine what claims they can make and if they still need to collect additional information.
3. Work with student groups to determine what type of graph would best organize and represent their data.
4. Have each group share their findings by using the answers on their Our Conclusion worksheet and the graph of their data.

GUIDED QUESTIONS

- If you were to repeat the study, what would you do differently?
- Which predictions were accurate and which were not? How do you know?
- How does your data support your prediction? If it doesn't, why not?
- What did you find out about water quality at your school?

OUR CONCLUSION

Name(s): Date:

Question

1. The question we asked:

Prediction

2. The prediction we made:

Results

3. Write a brief summary of the data you collected.

Graph

4. Create a graph of the results and attach it to the worksheet.

Conclusion

5. What is the answer to your question?

What Did You Find Out?

6. What did you find out about water quality at your school?

7. How does your data support your prediction? If it doesn't, why not?

BENEFICIAL MICRO-ORGANISMS AT WORK

PART 6 – Two 60 minute sessions

OVERVIEW

Students read a one-page information sheet about microorganisms. After reading the information, the class will discuss the components of a water ecosystem and how they rely on each other for survival. Each student draws a water ecosystem and includes one source of pollution indicating how it may have an impact based on what they learned during their investigations.

Standards: 3a, 3b, 3d

Materials

- Information Sheet C – Beneficial Microorganisms at Work – 1 per student
- Poster paper
- Drawing/writing materials
- Information Sheets A & B

Vocabulary Words

- Algae Bacteria
- Contamination
- Decomposition
- Fungus
- Microorganisms
- Natural Attenuation
- Wetland

Other Resources

See Teacher Resources, page 116 for additional activities that relate to water ecosystems.

Helpful Hints

- When discussing an ecosystem, it is important that students visualize the connections between the different components.
- Use pictures of water environments to help students diagram the different components of a water ecosystem. They should include non-living (abiotic) components: sun, water, air, rock, and soil; and living (biotic) components: plants, fish, insects, microorganisms, amphibians, etc.
- When students are working independently on their own diagrams, allow them use of Information Sheets A and B as resources.

PROCEDURE

1. Have each student read Information Sheet C – Beneficial Microorganisms at Work.
2. As a group, discuss what they read and the importance of microorganisms as one of the living components of an ecosystem.
3. As a class or in student groups, illustrate the different components of a water ecosystem.
4. To represent their understanding of living organisms in a water ecosystem and their link to water quality, have students work independently to illustrate a water ecosystem. Have them include one type of land pollution as part of their diagram and describe how it will affect the water organisms and which may or may not survive. For each component of the water ecosystem, students should indicate whether it is a living or non-living component.

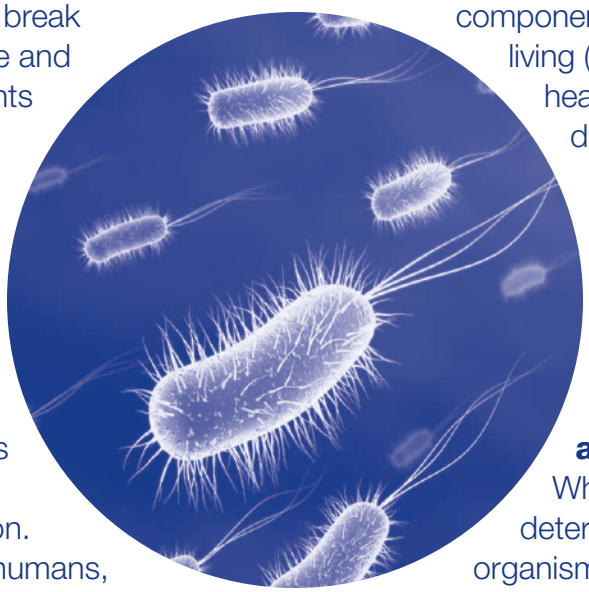
GUIDED QUESTIONS

- How are microorganisms beneficial?
- How are wetlands beneficial?
- What components of a water ecosystem are living (biotic)?
- What components of a water ecosystem are non-living (abiotic)?
- How do humans impact a water ecosystem?
- How does human impact on a water ecosystem determine whether a living organism will survive?

BENEFICIAL MICROORGANISMS AT WORK

Microorganisms are found everywhere in our watershed. They are found in the air, soil, and water and are one of the many living components of our ecosystem. They are called microorganisms because they are so tiny that it would take a microscope to see them.

The majority of microorganisms do not cause disease; in fact most are quite beneficial. For example, microorganisms such as bacteria, fungi, and algae break down plant and animal waste and turn it into food for other plants and animals. This is called decomposition. We depend on decomposition to keep ecosystems healthy.



These beneficial microorganisms can also help remove pollutants in rivers, streams and groundwater through a process called self-purification. These living organisms, like humans, eat and digest the contaminants using them for food and oxygen. However, in order for this method to work, the source of the pollution must be reduced or removed.

Wetlands are also used to improve water quality. Wetlands are a water ecosystem – a land area covered by shallow water that provides habitats for a wide range of plants and animals. Wetland plants and microorganisms consume and filter waste materials and pollutants from the water that flows through the wetland. The plants and microorganisms change the pollutants into nutrients that they can use to grow. The plants then provide shelter and food for wetland birds and animals. Resources within the wetland work together.

The functions of an ecosystem are at work everyday! Natural resources such as a wetland or stream are limited within an ecosystem. It is important that every component – living (biotic) and non-living (abiotic) – is healthy. The health of an ecosystem will determine whether some kinds of plants and animals will survive, or not survive.

How does the water that flows across the school playground affect the ecosystem? What are the factors that will determine whether a living organism will survive? What can be done to ensure that enough of our water stays clean and is allowed to provide a healthy environment for all living organisms, including you?

REFLECTION

PART 7 – 30 minutes

OVERVIEW

Students reflect on what they have learned and write a news article about water quality issues. They connect their investigations to their own activities in school and the community.

Standards: 6a, 6c

Materials

- Completed worksheets
- Information Sheets A, B, & C
- Newspapers/Internet (optional)
- Paper
- Pencils

Vocabulary Words

- May include all vocabulary words

Helpful Hints

- The goal of the final article is for students to reflect on what they have observed and learned, and share their thoughts about it. Reflection is an important part of the service learning process.
- Help students to formulate their articles to include the results of their investigation, how the results link to water quality and one thing that can improve water quality at their school or in their community.

PROCEDURE

1. As a class, have students reflect on what they have learned using the guided questions.
2. Have students write a news article for a local or school newspaper to present their thoughts on water quality and solutions. Give guidelines to include information on how their investigations and the evidence they collected influenced their ideas about water quality.
3. Invite students to present their thoughts to the class and share their ideas to improve water quality.

GUIDED QUESTIONS

- What did you learn from your experience?
- How did your conclusions differ from your expectations?
- How can your knowledge about water help you make good choices about water quality?
- Why is clean fresh water important?
- What is an idea you have for improving water quality at your school or in your community?

SETTING UP A SERVICE LEARNING PROJECT

PART 8 – Two to three 45-minute planning sessions

OVERVIEW

Following the instructions in their Water Quality Project booklets, students work together to plan and carry out water quality community service projects.

Materials

- Water Quality Project booklets – 1 per student/group

Vocabulary Words

- Task
- Timeline

Helpful Hints

- Student voice is an important component to service learning. However, to save time, you may want to determine what projects might work best for your class to help guide student discussions. A list of project ideas can be found in Teacher Resources.
- Create Water Quality Project booklets for each student or group. The template can be copied and stapled together to form the booklets.
- Become the "Project Manager," to help guide students through their project.

PROCEDURE

1. Distribute a Water Quality Project booklet to each student/group. Have them put their name on the cover.
2. Use the students' reflection articles to begin a discussion that leads to planning their service learning project, and how these efforts may help resolve a water quality problem on their campus or in their community.
3. Using their booklets, have student groups follow the guidelines to complete the first worksheet, listing the problems they found and ideas that might resolve the problems. Have groups share their findings as you list them on the board. As a class, pick the top three ideas.
4. Have students fill out one Look Closer worksheet for each of the top three ideas. Have them share their findings and decide which one seems most practical and most exciting to them. Using the booklets, have students develop possible names for their project. As a class, decide or vote on a final name.
5. Have student groups use their booklets to brainstorm the tasks necessary to implement their project.
6. Help students organize the tasks. Use a large sheet of mural paper and organize the tasks using a technique called webbing:
   a. Place the name of the project in the center and circle it.
   b. Write each suggested task, circle it, then connect it to the center.
   c. Tasks associated with these main tasks should be circled and connected to the task.
7. As a class, use the timeline worksheet in the booklets to assign tasks and create a timeline.
8. Have students use the Get Support For Your Project worksheet to brainstorm who might be able to support the project or provide helpful ideas or resources.
9. Help students follow the task list to implement their project.
10. After completion, have students write to the California Water Boards about their project and its success.
11. Share your accomplishments with a local reporter, or through a school display or assembly.
12. Wrap up the unit with a celebration. Work with the students to come up with celebration ideas, such as a pizza party, picnic, or ice cream social. Or, make t-shirts for everyone who participated with We Made A Difference on the back.

GUIDED QUESTIONS

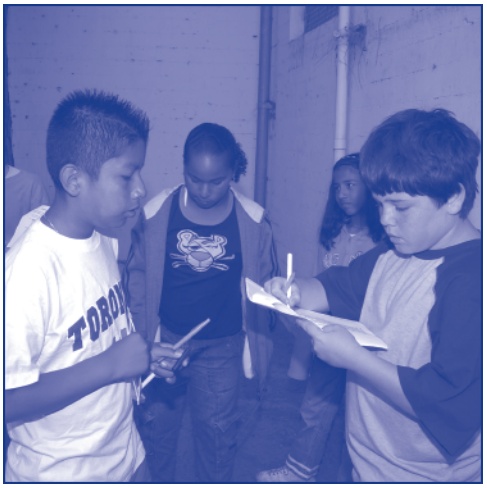
- What were the most successful parts of the project?
- What was the least successful part?
- What did you learn from your experience?
- What would you do differently next time and why?
- Who or what was influenced by your action?
- Would you like to get involved in another environmental service project? Why or why not?

5TH GRADE

5TH GRADE

EARTH SCIENCE
WATER QUALITY UNIT

OVERVIEW



At the beginning of the Water Quality Unit, students are asked to observe their school grounds – mapping where water comes from, where it goes, any pollution left on the ground, and more. Based on their observations, discussions, and their review of the one-page information sheet focused on water quality, students develop ideas about what might be happening on their campus and what they want to investigate further. Student groups come up with a testable question, and set up an investigation that includes data collection and relates to water quality.

While collecting data, students continue to build content knowledge and context with more readings relating to water, including where the water in their community comes from, where it goes, and how water flowing across their campus is part of the water cycle. After making observations and collecting data, students present their findings and their evidence-based conclusions to the class. Students demonstrate what they have learned by creating a diagram of the water cycle that includes their campus, some form of land pollution and demonstrates their understanding of water, how it moves between oceans and land, and how human activities affect its health and usefulness. Then, students reflect on what they have learned and share their thoughts through the writing of a news article.

In the final step of the Water Quality Unit, students use their reflections to make informed choices and develop a service project to help their school and community. As a class, or in student groups, the Water Quality Project workbook is used to guide students through project development and follow through.

California Grade 5 Standards

The unit lessons are designed to help students master the following standards:

Learning Objectives

Learning objectives in the context of the Environmental Principles and concepts.

Earth Science Strand	**Students will:**
3. Water on Earth moves between the oceans and land through the processes of evaporation and condensation.	
a. Students know most of Earth's water is present as salt water in the oceans, which cover most of Earth's surface.	• Identity that humans are living things and clean fresh water is essential to their survival. • Recognize that because most of Earth's water is salt water located in the oceans, the vast majority of water is not available for human consumption. • Provide examples of the goods that are produced by freshwater, coastal, and marine ecosystems (e.g., clean fresh water, oxygen, food, energy resources).
b. Students know when liquid water evaporates, it turns into water vapor in the air and can reappear as a liquid when cooled or as a solid if cooled below the freezing point of water.	• Describe the roles of evaporation, liquefaction, and freezing in the water cycle. • Describe the role of the water cycle, evaporation, liquefaction, and freezing in the functioning of natural systems. • Provide examples of the roles these cycles and processes play in human life and human communities.

California Grade 5 Standards	Learning Objectives
c. Students know water vapor in the air moves from one place to another and can form fog or clouds, which are tiny droplets of water or ice, and can fall to Earth as rain, hail, sleet, or snow.	• Identify the role of precipitation (rain, hail, sleet, or snow) in terrestrial, freshwater, coastal, and marine ecosystems. • Provide examples of how humans and human communities directly and indirectly depend on precipitation (rain, hail, sleet, or snow) and the water cycle (e.g., agricultural systems, water delivery systems). • Provide examples of how human activities can influence the quantity, distribution, and chemical characteristics of precipitation.
d. Students know that the amount of fresh water located in rivers, lakes, underground sources, and glaciers is limited and that its availability can be extended by recycling and decreasing the use of water.	• Identify sources of fresh water and describe the reservoirs of Earth's water. • Recognize that water moves from one reservoir to another over time. • Describe the ways in which humans, human communities, and their practices use water. • Recognize that the supply of fresh water is limited at any given time and discuss how some resources within an ecosystem are finite in supply while others are less limited. • Explain potential consequences when the quantity, distribution, or chemical characteristics of water are changes (e.g., contamination of an aquafier can compromise the use of the groundwater supply by humans and other organisms). • Describe how changes to the quantity, distribution, and chemical characteristics of water in natural systems can influence the functioning of terrestrial, freshwater, coastal, and marine ecosystems (e.g., acid precipitation affecting the growth of trees).
e. Students know the origin of the water used by their local communities.	• Identify sources of fresh water in their local community. • Describe the process by which water is supplied to students' homes and their community. • Describe the ways in which humans use water in their local community. • Provide examples of how human activities can influence the quantity, quality, and reliability of water supplies. • Explain how changes to the quantity, quality, and reliability of water supplies can influence humans, human communities, and their practices.

Investigation and Experimentation

6. Scientific progress is made by asking meaningful questions and conducting careful investigations.

a. Classify objects in accordance with appropriate criteria.

b. Develop a testable question.

c. Plan and conduct a simple investigation based on a student-developed question and write instructions others can follow to carryout the procedure.

f. Select appropriate tools and make quantitative observations.

g. Record data by using appropriate graphic representations and make inferences based on those data.

h. Draw conclusions from scientific evidence and indicate whether further information is needed to support a specific conclusion.

i. Write a report.

UNIT IMPLEMENTATION IDEAS

Work with another grade level (4th – 6th) or classroom to complete parts of the Unit.

- Choose specific areas of the school to conduct the Schoolyard Review. Get together and compare data and maps.
- Have students partner across grade levels to conduct the Schoolyard Review.
- Have classrooms share their observations for increased data collection and to check validity.
- Have groups partner with groups from another class to conduct their investigations, sharing the time in gathering data. Combine data for their conclusions.
- Create or share a service learning project.

SCHOOLYARD REVIEW

PART I – 60 minutes

OVERVIEW

Student teams are given a map of one portion of the school to investigate. Students make water related observations and indicate their findings on the map and instruction sheet. After presenting their findings to the class, students generate questions about what they found.

Standards: 3d, 3e, 6a

Materials

- Schoolyard Review worksheet – 1 per group
- Map of school area – photocopy a school map, enlarged as much as possible, and divide it into different areas. Schools usually have a map of their campus that can be used, but be sure to white out or cover any unnecessary information before photocopying. A simple hand drawn map can be used as well.
- Green, blue, purple, black, and red markers or colored pencils – 1 set per group

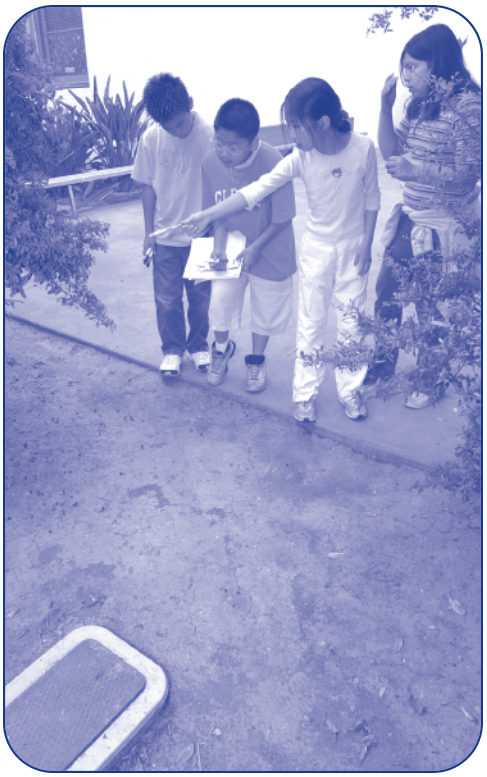
Vocabulary Words

- Catch basin
- Down spout
- Rain gutter
- Stormdrain

Helpful Hints

- Plan ahead for proper adult supervision of students "mapping" around the school. This might be a great opportunity for parents or school staff to be involved in this core instructional program.
- Outline a walking route around the school to help point out key items pertaining to the questions on the Schoolyard Review (rain gutters, drains, etc.) and any safety hazards.
- If necessary, take time to show students how to read a map of the school from a "bird's eye view." **It is essential that students are able to read their map.**

PROCEDURE



1. Explain to students that they will use their maps to investigate different areas of their schoolyard, to mark what they have found, and answer questions along the way.
2. Divide the students into working groups. Have groups assign a:
    a. Reader: reads the instructions and questions to be answered
    b. Recorder: records the answers to the questions
    c. Artist: draws what they observe on their map
    d. Timekeeper: makes sure the group stays focused and on time
    e. Reporter: reports the findings of the group to the class
3. Pass out markers/colored pencils, maps of the school areas, and a Schoolyard Review worksheet. Each group is assigned a different area to study.
4. Help student groups to read their map and familiarize themselves with their designated area.
5. Go through the Schoolyard Review worksheet and demonstrate what the student groups will be looking for and how to mark their map.
6. Ask students what is meant by “harmful” referring to question 4 on their Schoolyard Review worksheet. These items, which may include motor oil, fertilizers, pesticides, or trash, can hurt humans, as well as the environment.
7. As a class, walk to one area of the school to point out examples of what they will be looking for and how they should mark these items on their map, including down spouts, sprinklers, rain gutters, and anything else that may not be familiar.
8. Give groups a deadline before sending them to their different locations.
9. When students return to the classroom, tape each map section together to make one complete map of the school. Affix to the wall or white board.
10. Have each group’s reporter share their group’s findings by using the answers on their worksheet and the map of their area.

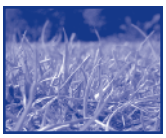
GUIDED QUESTIONS

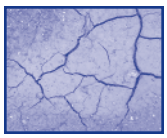
- What are the different sources of water on our campus?
- How do you know they are a “source?”
- Where did you find trash and other harmful things?
- Where do you think the water travels on our campus?
- What did you learn as a result of your observations?
- What questions did you have about what you observed?

SCHOOLYARD REVIEW

In your designated area, observe what's around you. Use the colored markers/pencils to mark these observations on your map.

1. **Look for places where water can get into the ground.**
   Use green dots ::: to show these places on your map.


☐ grass


☐ bare dirt


☐ gardens


☐ tree wells

What other places did you find? _____

2. **Look for sources of water.**
   Use a blue waterdrop ♦ to show these places on your map.


☐ faucets


☐ drinking fountains

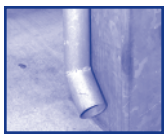

☐ sprinklers

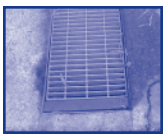

☐ hoses

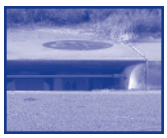
What sources did you find? _____

3. **Look for places where water travels.**
   Use a purple square ■ to show these places on your map.


☐ gutters


☐ down spout


☐ drain

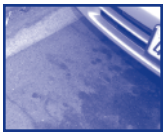

☐ catch basin

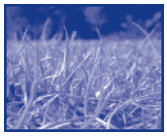
What other places did you find? _____

4. **Look for trash and other things that could be harmful to water.**
   Use a red X to show these items on your map.


☐ lunch trash


☐ candy wrappers


☐ motor oil


☐ lawn/field care products

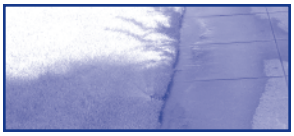
What kinds of trash and other harmful things did you find in your area? _____

_____

5. Look for areas where water is wasted.
Use a black star ★ to show these areas on your map.

☐ leaky faucets and sprinklers

☐ clogged drains



☐ water sprayed on concrete

What other areas did you find? _____

6. Write one question you have about what you observed.

_____

_____

WHAT IS THE QUALITY OF YOUR WATER?

PART 2 – 60 minutes

PART 2

OVERVIEW

Students read a one-page information sheet about water quality. Based on what they learn, groups design an investigation using one question relating to what they observed on their schoolyard.

Standards: 3a, 3d, 3e, 6a, 6b, 6c, 6f

Materials

- Information Sheet A – What is the Quality of Your Water? – 1 per student
- Completed Schoolyard Review worksheets
- Our Investigation worksheet – 1 per group
- Pencils

Vocabulary Words

- Fertilizer
- Glacier
- Groundwater
- Hazardous waste
- Investigation
- Land pollution
- Pesticide
- Prediction
- Toxic

Other Resources

See Teacher Resources, page 116 for additional activities that relate to water quality.

Helpful Hints

- As students read this and other Information Sheets, they should underline all the words that they think are associated with water.
- Students can create a list of their water words, adding definitions as they progress through the unit, using their own first-hand experience to define the terms, and then supporting their definitions with textbook definitions.
- Refer to "Leading Students to Develop Their Own Questions and Perform Investigations" on page 50, for guidelines to assist students in developing testable questions and conducting investigations that relate to water quality.
- Set up times for students to make their observations and collect data. The data collection times will depend on the investigations they choose.

PROCEDURE

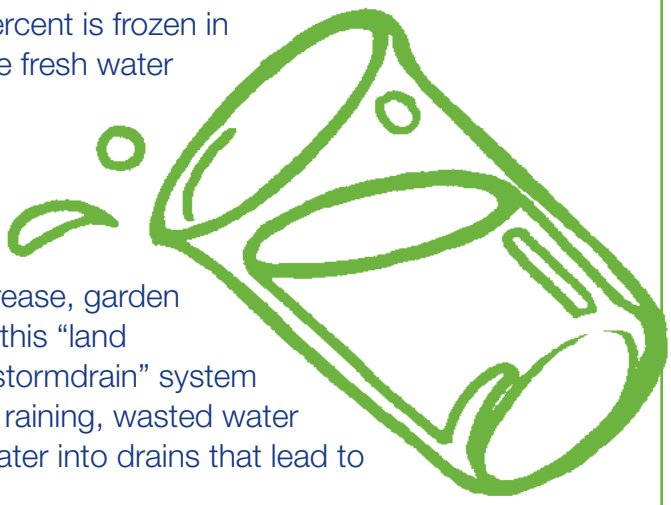
1. Have each student read Information Sheet A – What is the Quality of Your Water?
2. Have student groups discuss what they read and the ways in which it relates to what they observed on their schoolyard. Each group can report their main points to the class as part of a group discussion.
3. In their groups, have students review their notes from the Schoolyard Review and create a list of questions they have about water quality related to their campus.
4. Guide students to develop "testable" questions. See page 50 for guidelines.
5. Using the Our Investigation worksheet, have groups:
   a. Create one question to pursue for their investigation. It should:
      i. Focus on water quality
      ii. Be measurable over time: 1 – 4 weeks
   b. Figure out what it will measure
      i. What kind of observations can you make to answer the question?
   c. Tools and supplies
      i. What tools and supplies are needed to conduct the investigation?
   d. Procedure
      i. What steps are needed to conduct the investigation?
   e. Predict what they think they will find during the investigation
      i. How are the observations going to support the prediction?
      ii. How is the investigation set-up going to support the prediction?

GUIDED QUESTIONS

- Where is most of the fresh water on Earth?
- In what ways do we use fresh water?
- How does fresh water get polluted?
- What kind of land pollution did you observe on your schoolyard?
- In what ways is water wasted at our school?
- Where does water flow into the street at our school?
- Where does water seep into the ground at our school?
- What question do you have about water quality at your school?
- What can you measure as part of an investigation to answer your question?
- What steps are needed to conduct your investigation? Can you summarize the steps in a few sentences?
- What do you predict is the answer to your question?

WHAT IS THE QUALITY OF YOUR WATER?

Did you know that in California, there are 200,000 miles of rivers and streams, 1,100 miles of coastline, more than 10,000 lakes, and more than 1 million acres of bays and estuaries? These waterways provide us with much of the fresh water we need to survive – water for drinking, growing food, manufacturing goods, and more! This is important to know because even though most of the earth's surface is water, only one percent of it is fresh usable water. Ninety-seven percent is saltwater, and two percent is frozen in the polar ice caps and in glaciers. We depend on the fresh water we get from our streams and rivers.



Unfortunately, most of these rivers and waterways have become polluted. For example, when it rains in cities, rainwater picks up many materials that have been left on the ground including car oil, car grease, garden pesticides, pet droppings, and most of all, trash! All this "land pollution" gets carried by rainwater into a water or "stormdrain" system that leads to streams and rivers. Even when it is not raining, wasted water from hoses, sprinklers, and faucets send polluted water into drains that lead to streams and rivers.

Also, rainwater seeping into the soil can carry harmful chemicals such as garden fertilizers, pesticides, and hazardous wastes such as paint into the groundwater. These toxic substances pollute groundwater that provides many people with the fresh water that they need for use in their homes or to water crops.

The activities of people everyday have an impact on our water systems. Whether we are wasting excess water, creating more trash instead of recycling, or overusing or misusing dangerous substances such as fertilizers and paints, our actions determine the quality of our water.

Think about the following questions:

- Do you remember the last time you saw trash and other land pollution on the ground? Where did it come from? Where will it go? If it isn't in a trashcan, what is going to happen to it?
- What about all the water that is wasted? How does extra water that flows over hard surfaces impact local rivers and streams?
- How is the quality of the rivers and streams in your area? Think about this when you see trash on the ground or water rushing into the street. Is it harmful to our water and environment?

TEACHER INFORMATION

Leading Students to Develop Their Own Questions and Perform Investigations

Within the unit, students are asked to come up with a testable question (a question that can be answered scientifically) and set up an investigation. The following are steps and examples for guiding student-led experimentation.

1. Gain knowledge

Through the use of the Schoolyard Review, students gain knowledge about their schoolyard. The Schoolyard Review is designed to help students observe where water flows at their school, recognize and identify the influence of land pollution, wasted water, and the presence of harmful substances.

Students continue to gain information by reading Information Sheet A about water quality issues in California, and relating their observations to what they read, thus driving students to investigate the issues further.

2. Develop a testable question

Students use what they observed and what they have learned to formulate testable questions relating to water quality. After completing the Schoolyard Review, ask students how what they observed may impact local water quality. Use these answers to help develop testable questions.

The testable question can be written in the form of "How does _____ affect _____?" The blanks represent the independent variable (first blank) and dependent variable (second blank).

Variables are the factors in an investigation that could affect results. They are the things that could vary from one sample to the next. Work with students to choose an "independent" variable – the one variable that changes. The "dependent" variable changes as a result of, or in response to, the change in the independent variable.

Some sample testable questions:

- How does the number of students using the trashcan at lunch affect the amount of trash in the street outside the school?
- How does the number of waste water sources at the school affect the amount of water that flows into the street from our school?
- How does the number of students dropping their trash on the ground affect the amount of trash that goes into the street next to the school?
- How does the location of where "hosing" is happening affect the amount of water and topsoil going into the street?
- How does the amount of lawn watering affect the amount of water and topsoil going into the street?
- How does the amount of trash found on the ground affect the amount found in the street outside the school?

3. Make a prediction

Discuss with the students what they can investigate to find the answer to their questions. Use what they learned from Information Sheet A to help formulate ideas for investigations.

After listing ideas, have students write a statement of what they think may happen in the investigation based on what they have observed and learned so far.

Sample predictions:

- I predict that on the days when less students drop their trash on the ground, there will be less trash that goes into the street next to the school.

- I predict that three out of the five sources of water at the school (faucets, hoses, sprinklers, downspouts, and drinking fountains) will contribute to the amount of water that flows into the street from our school.
- I predict that on days when more students drop their trash on the ground there will be more trash that goes into the street next to the school.
- I predict that when the grounds manager hoses next to grass or permeable areas, less water will go into the street, than when he/she hoses next to large concrete areas.
- I predict that the longer the grounds manager runs the sprinklers or hoses, the more water will go into the street.
- I predict that on the days when more trash is found on the ground, more trash will be found in the street outside the school.

4. Design an investigation

How will your students test whether their predictions are right? Facilitate a group discussion that leads students to figure out what they can measure that will lead to an answer to their question. The investigation should involve gathering data over time.

Example questions and measuring tools:

- I predict that on the days when less students drop their trash on the ground, there will be less trash that goes into the street next to the school.

  Audit the number of students that use the trashcan at lunch and later audit the amount of trash found in the street closest to the lunch area.

- I predict that three out of the five sources of water at the school (faucets, hose, sprinklers, downspouts, and drinking fountains) will contribute to the amount of water that flows into the street from our school.

  Audit the different sources of water for leakage and water flow.

- I predict that on days when more students drop their trash on the ground, there will be more trash that goes into the street next to the school.

  Audit the number of students using the trashcan and later the amount of trash in the street closest to the lunch area.

- I predict that when the grounds manager hoses next to grass or permeable areas, less water will go into the street than when he/she hoses next to large concrete areas.

  Audit the location and direction of water flow when the grounds manager is using the hose.

- I predict that the longer the grounds manager runs the sprinklers or hoses, the more water will go into the street.

  Audit the time and amount of water going into the street when the grounds manager is using the hose and sprinklers.

- I predict that on the days that more trash is found on the ground, the more trash will be found in the street outside the school.

  Audit the amount of trash on the ground at school and later in the street outside the school.

5. Design procedures

Have students develop and follow a specific method/protocol that helps assure reliability and validity of their results. Help them consider, if necessary, how to:

- Do a procedure the same way every time
- Consider the independent variable in planning data collection
- Use tools and supplies that are available
- Be accurate

6. Design a recording system

Help students design the most appropriate way to record the data they are gathering. They should use this method consistently to ensure they are accurate. This will help in analyzing the data more effectively. Recording systems include:

- Date and time of observation
- Space for written observations
- Space for illustrations and drawings
- Columns for separating information
- Using tally marks for counting
- A place for questions or thoughts to be followed up in the future

7. Data analysis and conclusion

Students describe their results in the clearest way possible. In Part 5, students use the Our Conclusion worksheet to restate their question, prediction, and write a summary of the data they collected. The summary should be a statement that is supported by evidence and identifies the pattern or trend of the data collected during the investigation.

Students are also asked to graphically display their data to show whether the data supports their prediction or not. Show students a variety of graphs, tables, and charts to determine which would be the best one to use. Explain that the graph, table, or chart will be a picture of the information they gathered. Graphs, tables, and charts make it easier to make comparisons and draw conclusions. Ask students to name some places where they have seen graphs – in newspapers, magazines, TV news, etc. Show samples of the basic types of graphs, tables, and charts:

- Pictograph
- Bar graph
- Charts and tables
- Circle graph
- Line graph

If students are measuring the sources of the land pollution found, they could use a bar graph. The bottom of the graph would show the sources and the side would have amounts. The bars would indicate the amounts of trash found for each source. The highest bar would indicate the source of the most land pollution found.

Finally, the Our Conclusion worksheet asks students to explain what they found out about water quality at their school and how their data does or doesn't support their prediction. This is an ideal time to discuss why they made the prediction that they did, or how they may conduct their investigations differently, if given the chance to "do it again."

8. Communicate results

In Part 7, students are asked to reflect on what they have learned and write a news article about water quality issues. This is the method used for students to communicate their results connecting their investigations to the schoolyard or community. It includes their thoughts about what they have learned about water quality, and any concerns they may or may not have.

These articles will be used as a way to formulate ideas for their service learning project.

OUR INVESTIGATION

Name(s): Date:

Testable Question

Our question about water quality on campus is:

How does _____

affect _____?

Investigation

We are going to measure:

Tools and Supplies

The tools and supplies we need for our investigation:

Procedure

The steps we need to take to conduct the investigation:

Prediction

We predict that:

INVESTIGATION SET-UP

PART 3 – 45 minutes

OVERVIEW

Student teams set up their investigations. Students use a data sheet to make observations and collect their first data.

Standards: 6f

Materials

- Depends on each team's investigation
- Data Collection sheet

Vocabulary Words

- Data

Helpful Hints

- Spend time with each group to help them devise their investigations. Have them utilize the Data Collection sheet, and record additional information in a science journal.
- The Data Collection sheet is designed to help students organize their information. If necessary, groups can design their own data collection sheets.

PROCEDURE

1. Working in their teams, students set up their investigations.
2. After the initial set-up, have student teams use the Data Collection sheet to collect their first data and record observations and measurements as needed. The Data Collection sheet will help students organize their information. If necessary, work with student groups to redesign their data collection sheet to better suit the needs of their investigation.

GUIDED QUESTIONS

- What should be included on the Data Collection sheet?
- What do you expect to find after your first data collection?
- What do you expect to find after several data collections?

PART 3

DATA COLLECTION

Name(s): Date:

Observation 1

Questions or thoughts:

Observation 2

Questions or thoughts:

Observation 3

Questions or thoughts:

Observation 4

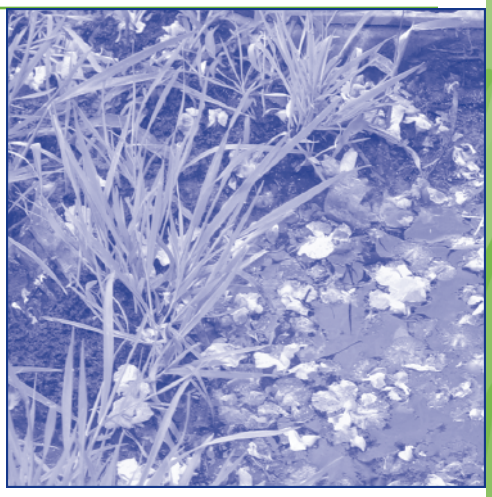
Questions or thoughts:

WHERE DOES YOUR WATER COME FROM?

PART 4 – 45 minutes

OVERVIEW

After teams have collected data at least twice, students read a one-page information sheet about the origin of their water, and the two systems for water disposal. Students take what they learn and relate it to the data they are collecting. Students continue to observe and record data.



Standards: 3c, 3e, 6f

Materials

- Information Sheet B – Where Does Your Water Come From? – 1 per group

Vocabulary Words

- Reservoir
- Sanitary sewer system
- Stormdrain
- Stormwater
- Wastewater treatment plant

Other Resources

See Teacher Resources, page 116 for additional activities that relate to the California water system.

Helpful Hints

- Contact your local water utility for information about the main source of water specific to your community.
- Help students investigate where the water goes after it leaves the campus.
- Provide students with information about a local body of water – lake, river, stream, or ocean. To locate your closest body of water, consult a local map. Go to www.epa.gov/surf to find the name of your watershed.
- If possible, take a field trip to the local waterway to observe how humans may be impacting it.

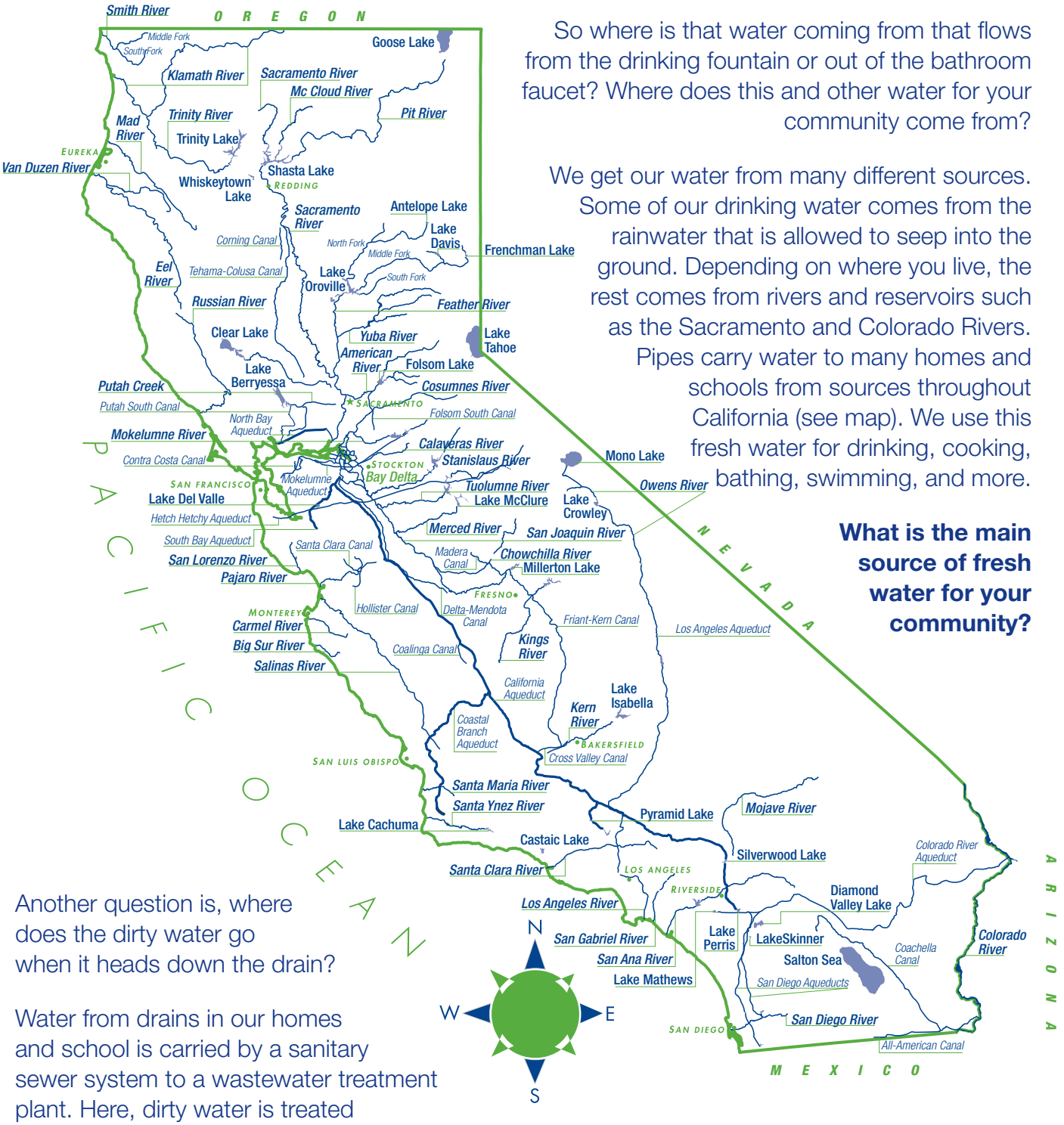
PROCEDURE

1. Have each student read Information Sheet B – Where Does Your Water Come From?
2. Have student groups discuss what they read and the ways in which it relates to their investigations. Each group can report their main points to the class as part of a group discussion.
3. Looking at the map on Information Sheet B, have students identify where some of the main sources of water for their region of California may come from. Provide resource material from the local water utility to have students investigate further to confirm their ideas.
4. To find out where water that flows across their campus goes, have students use a local map to identify the pathway that water may take from their campus to the nearest body of water.

GUIDED QUESTIONS

- What is the origin of the fresh water for your community?
- Is it piped in from a reservoir or does it come from a groundwater source?
- What is the closest body of water to our school?
- Where, if at all, does that body of water flow to?
- What impact is what you are observing having on your local water system? How do you know?

WHERE DOES OUR WATER COME FROM?



So where is that water coming from that flows from the drinking fountain or out of the bathroom faucet? Where does this and other water for your community come from?

We get our water from many different sources. Some of our drinking water comes from the rainwater that is allowed to seep into the ground. Depending on where you live, the rest comes from rivers and reservoirs such as the Sacramento and Colorado Rivers. Pipes carry water to many homes and schools from sources throughout California (see map). We use this fresh water for drinking, cooking, bathing, swimming, and more.

What is the main source of fresh water for your community?

Another question is, where does the dirty water go when it heads down the drain?

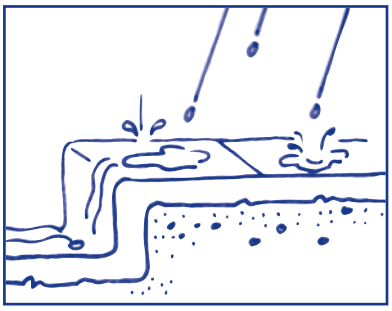
Water from drains in our homes and school is carried by a sanitary sewer system to a wastewater treatment plant. Here, dirty water is treated (or cleaned) before it is directed into rivers or the ocean.

WHERE DOES OUR WATER COME FROM? (continued)

However, did you know that there is another system of drains for rainwater? Most people don't know that when it rains, this stormwater is sent quickly off of city streets to prevent flooding. It is carried off by an underground system of stormdrains that lead directly to the nearest body of water, such as a river, lake, or stream. The problem is, this water is never cleaned before it arrives there.

Into what body of water – river, stream, lake, or ocean – is the water from your schooyard going?

Many cities and school grounds contain up to 90 percent hard surfaces such as rooftops, concrete playgrounds, streets, and parking lots where water collects quickly and runs off into the stormdrain system. This not only prevents water from seeping into the ground to replenish underground supplies of fresh water, but problems occur when stormwater picks up land pollution and delivers it to our rivers and the ocean untreated.



Think about the following questions:

- What are you observing during your data collection? Do hard surfaces have an impact?
- What about the "land pollution?" What impact on your local water system do you think it may have?

INVESTIGATION CONCLUSION

PART 5 – 45 minutes

OVERVIEW

After teams have collected enough data, students develop evidence-based conclusions about what they observed.

Standards: 6g, 6h, 6i

Materials

- Our Conclusion worksheet – 1 per group

Vocabulary Words

- Graph

Helpful Hints

- Provide a variety of graphing examples to assist students in determining which type of graph would best show data results.

PROCEDURE

1. Have student groups use the Our Conclusion worksheet to compare their results of their investigation to their predictions.
2. Have student groups determine what claims they can make and if they still need to collect additional information.
3. Work with student groups to determine what type of graph would best organize and represent their data.
4. Have each group share their findings by using the answers on their Our Conclusion worksheet and the graph of their data.

GUIDED QUESTIONS

- If you were to repeat the study, what would you do differently?
- Which predictions were accurate and which were not? How do you know?
- How does your data support your prediction? If it doesn't, why not?
- What did you find out about water quality at your school?

OUR CONCLUSION

Name(s): Date:

Question

1. The question we asked:

Prediction

2. The prediction we made:

Results

3. Write a brief summary of the data you collected.

Graph

4. Create a graph of the results and attach it to the worksheet.

Conclusion

5. What is the answer to your question?

What Did You Find Out?

6. What did you find out about water quality at your school?

7. How does your data support your prediction? If it doesn't, why not?

HOW DOES WATER CYCLE?

PART 6 – Two 60 minute sessions

OVERVIEW

Students read a one-page information sheet about the water cycle. After reading the information, the class will discuss different ways that water cycles. Each student draws the water cycle and illustrates how their schoolyard is included and where there is impact on the water cycle based on what they learned during their investigations.

Standards: 3a, 3b, 3c, 3d, 3e

Materials

- Information Sheet C – How Does Water Cycle? – 1 per student
- Poster paper
- Drawing/writing materials
- Information Sheets A & B

Vocabulary Words

- Condensation
- Evaporation
- Groundwater
- Precipitation
- Runoff

Other Resources

See Teacher Resources, page 116 for additional activities that relate to the water cycle.

Helpful Hints

- When discussing cycles it is important that students visualize the unending circle.
- After reading the Information Sheet, depending on the level of comprehension, you can ask students to figure out one way that water cycles. They can begin with clouds and rain, or for a more difficult level, water from a drinking fountain. Be sure that if they start out at one place, that they end at that same place – to complete the cycle. For example:
  - Drinking fountain to drain
  - Drain to sewer pipe
  - Sewer pipe to wastewater treatment plant
  - Wastewater treatment plant to river
  - River to ocean

(continued) ▸

  - Ocean to clouds
  - Clouds to rain
  - Rain to river
  - River to reservoir
  - Reservoir to water pipes
  - Water pipes to drinking fountain
- If students have trouble linking the water cycle to their school, have them look at their Schoolyard Review and their indications of where water comes from and where it goes.
- When students are working independently on their own diagrams, allow them to use Information Sheets A and B as resources.

PROCEDURE

1. Have each student read Information Sheet C – How Does Water Cycle?
2. As a group, discuss what they read and the important steps in the water cycle – evaporation, condensation, and precipitation.
3. As a class or in student groups, illustrate different ways that water cycles.
4. To represent their understanding of the water cycle and its link to water quality, have students work independently to illustrate the water cycle and include their schoolyard as one of the steps. Have them include some form of land pollution as part of their diagram and where it is introduced in the cycle. For each step of the process, students should write a paragraph explaining what is happening.

GUIDED QUESTIONS

- Why is the majority of Earth's water not available for humans to drink?
- Liquid water changes to water vapor through what process?
- What are rain, sleet, and snow called as part of the water cycle?
- How is the sun part of the water cycle?
- What are some examples of how humans depend on the water cycle for their needs?
- How do humans impact the water cycle?

HOW DOES WATER CYCLE?

While observing your school grounds, you probably noticed that during a sunny day water that landed on a concrete surface soon disappeared. Or, water that landed on grass seeped into the soil. Perhaps on a rainy day you observed the flow of water moving across the parking lot and into the street. All this movement of water is part of its cycle.

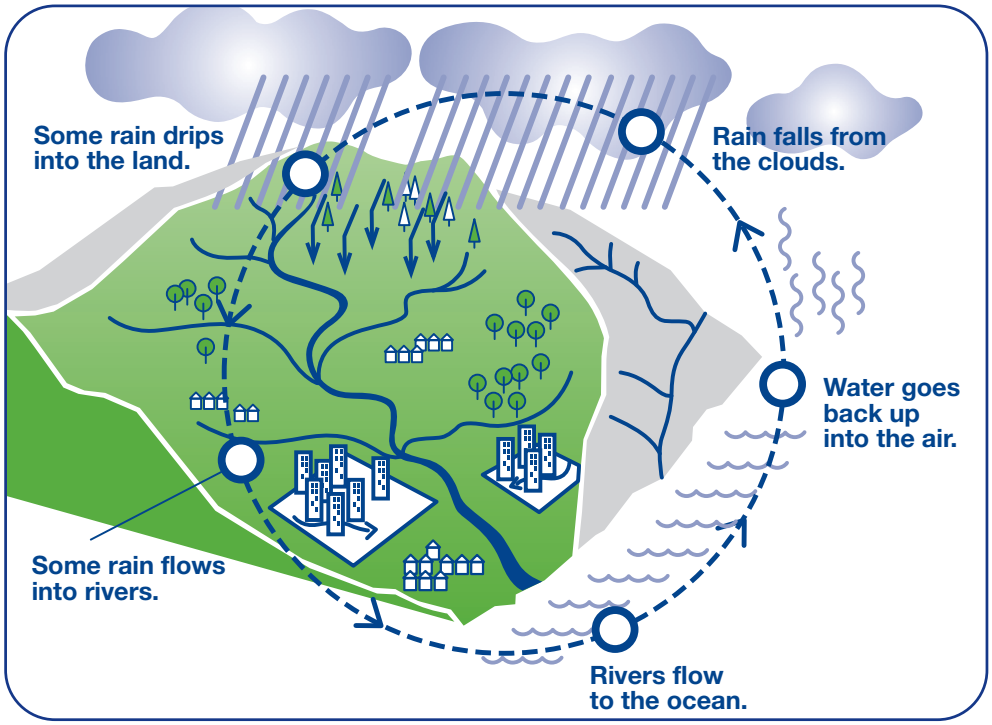
Most of the Earth's water supply is salt water. Only a tiny fraction of Earth's water is usable fresh water. People depend on fresh water for their everyday health and uses. This water is limited, but it never runs out because water is constantly moving and renewed by the water cycle.

Every day the sun warms salty ocean water, causing water particles to evaporate and enter the air as water vapor, leaving behind the salt. Water from rivers, lakes, plants, and other sources also give off water vapor. High in the atmosphere, water vapor condenses into tiny liquid drops of water, forming clouds. Finally, droplets of fresh water fall to Earth as rain or snow, called precipitation.

When water reaches the Earth, it will either seep into the ground to become groundwater, run off the land and return to lakes or the ocean, or if fallen on a hard surface, evaporate back into the air – all part of the cycle of water.

The water cycle is at work everyday! In fact, rain water that falls in San Francisco today, may someday become snow falling in the mountains over Alaska. The water you use to brush your teeth today may someday end up watering someone's garden.

Where does the water that flows across the school playground go? At what stage is it in the water cycle? What can be done to ensure that enough of that water stays clean and is allowed to make its way through the cycle naturally?



REFLECTION

PART 7 – 30 minutes

OVERVIEW

Students reflect on what they have learned and write a news article about water quality issues. They connect their investigations to their own schoolyard or community.

Standards: 6a, 6h, 6i

Materials

- Completed worksheets
- Pencils
- Paper
- Information Sheets A, B, & C
- Newspapers/Internet (optional)

Vocabulary Words

- May include all vocabulary words

Helpful Hints

- The goal of the final article is for students to reflect on what they have observed and learned, and share their thoughts about it. Reflection is an important part of the service learning process.
- Help students to formulate their articles to include the results of their investigation, how the results link to water quality, and one thing that can improve water quality at their school or in their community.

PROCEDURE

1. As a class, have students reflect on what they have learned using the guided questions.
2. Have students write a news article for a local or school newspaper to present their thoughts on water quality and solutions. Give guidelines to include information on how their investigations and the evidence they collected influenced their ideas about water quality.
3. Invite students to present their thoughts to the class and share their ideas to improve water quality.

GUIDED QUESTIONS ▸

GUIDED QUESTIONS

- What did you learn from your experience?
- How did your conclusion differ from your expectations?
- How can your knowledge about water help you to make good choices about water quality?
- Why is clean, fresh water important?
- What is an idea you have for improving water quality at our school or in your community?

SETTING UP A SERVICE LEARNING PROJECT

PART 8 – Two to three 45-minute planning sessions

OVERVIEW

Following the instructions in their Water Quality Project booklets, students work together to plan and carry out water quality community service projects.

Materials

- Water Quality Project booklets – 1 per student/group

Vocabulary Words

- Task
- Timeline

Helpful Hints

- Student voice is an important component to service learning. However, to save time, you may want to determine what projects might work best for your class to help guide student discussions. A list of project ideas can be found in Teacher Resources.
- Create Water Quality Project booklets for each student or group. The template can be copied and stapled together to form the booklets.
- Become the "Project Manager," to guide students through their project.

PROCEDURE

1. Distribute a Water Quality Project booklet to each student/group. Have them put their name on the cover.
2. Use the students' reflection articles to begin a discussion that leads to planning their service learning project, and how these efforts may help resolve a water quality problem on their campus or in their community.
3. Using their booklets, have student groups follow the guidelines to complete the first worksheet, listing the problems they found and ideas that might resolve the problems. Have groups share their findings as you list them on the board. As a class, pick the top three ideas.
4. Have students fill out one Look Closer worksheet for each of the top three ideas. Have them share their findings and decide which one seems most practical and most exciting to them.

(continued) ▸

Using the booklets, have students develop possible names for their project. As a class, decide or vote on a final name.

5. Have student groups use their booklets to brainstorm the tasks necessary to implement their project.
6. Help students organize the tasks. Use a large sheet of mural paper and organize the tasks using a technique called webbing:

   a. Place the name of the project in the center and circle it.

   b. Write each suggested task, circle it, then connect it to the center.

   c. Tasks associated with these main tasks should be circled and connected to the task.
7. As a class, use the timeline worksheet in the booklets to assign tasks and create a timeline.
8. Have students use the Get Support For Your Project worksheet to brainstorm who might be able to support the project or provide helpful ideas or resources.
9. Help students follow the task list to implement their project.
10. After completion, have students write to the California Water Boards telling about their project and its success.
11. Share your accomplishments with a local reporter, or through a school display, or assembly.

12. Wrap up the unit with a celebration. Work with the students to come up with celebration ideas, such as a pizza party, picnic, or ice cream social. Or, make t-shirts for everyone who participated with We Made A Difference on the back.

GUIDED QUESTIONS

- What were the most successful parts of the project?
- What was the least successful part?
- What did you learn from your experience?
- What would you do differently next time and why?
- Who or what was influenced by your action?
- Would you like to get involved in other environmental service projects? Why or why not?

6TH GRADE

LIFE SCIENCE WATER QUALITY UNIT

OVERVIEW

At the beginning of the Water Quality Unit, students are asked to observe their school grounds – mapping where water comes from, where it goes, any pollution left on the ground, and more. Based on their observations, discussions, and their review of the one-page information sheet focused on water quality, students develop ideas about what might be happening on their campus, and what they want to investigate further. Student groups come up with a testable question, and set up an investigation that includes data collection and relates to water quality.

While collecting data, students continue to build content knowledge and context with more readings relating to water ecosystems, including watersheds and their biotic and abiotic factors, the producers, consumers, and decomposers of freshwater biomes and how water flowing across their campus contributes to an ecosystem's ability to support organisms. After making observations and taking data, students present their findings and their evidence-based conclusions to the class. Students demonstrate what they have learned by creating a diagram of the biotic and abiotic factors of a freshwater ecosystem, and describe how human activities affect the ability of those factors to thrive. Then, students reflect on what they have learned and share their thoughts through the writing of a news article.

In the final step of the Water Quality Unit, students use their reflections to make informed choices and develop a service project to help their community. As a class, or in student groups, the Water Quality Project workbook is used to guide students through project development and follow through.

California Grade 6 Standards

The unit lessons are designed to help students master the following standards:

Ecology – Life Science Strand

5. Organisms in ecosystems exchange energy and nutrients among themselves and with the environment.

c. Students know populations of organisms can be categorized by the functions they serve in an ecosystem.

d. Students know different kinds of organisms may play similar ecological roles in similar biomes.

Learning Objectives

Learning objectives in the context of the Environmental Principles and concepts.

Students will:

- Give examples of the functions (producer, consumer, and decomposer) populations of organisms serve in an ecosystem.
- Identify humans as consumers within ecosystems.
- Describe the effects of human practices on the transfer of matter through natural systems.
- Recognize different biomes.
- Identify the characteristics of various biomes.
- Provide examples of different organisms playing similar ecological roles (herbivores, carnivores, omnivores, and decomposers) in similar biomes.

California Grade 6 Standards

e. Students know the number and types of organisms an ecosystem can support depends on the resources available and on abiotic factors, such as quantities of light and water, a range of temperatures, and soil composition.

Learning Objectives

- Identify abiotic factors that affect ecosystems.
- Classify components of ecosystems as either living (biotic) or non-living (abiotic).
- Explain the effects of changing biotic and abiotic factors on an ecosystem (e.g., the effects of changing; quantities of light or water, and soil composition on plant growth; range of temperatures on the species composition of animals and plants).
- Provide examples of how human practices and rates of consumption affect the biotic and abiotic components (e.g., the availability of resources) in a natural system, thus influencing the number and types of organisms an ecosystem can support.

Investigation and Experimentation

7. Scientific progress is made by asking meaningful questions and conducting careful investigations. Students should develop their own questions and perform investigations.

a. Develop a hypothesis.

b. Select and use appropriate tools and technology to perform tests, collect data, and display data.

c. Construct appropriate graphs from data and develop qualitative statements about relationships between variables.

d. Communicate the steps and results from an investigation in written reports and oral presentations.

e. Recognize whether evidence is consistent with a proposed explanation.

UNIT IMPLEMENTATION IDEAS

Work with another grade level (4th – 6th) or classroom to complete parts of the Unit.

- Choose specific areas of the school to conduct the Schoolyard Review. Get together and compare data and maps.
- Have students partner across grade levels to conduct the Schoolyard Review.
- Have classrooms share their observations for increased data collection and to check validity.
- Have groups partner with groups from another class to conduct their investigations, sharing the time in gathering data. Combine data for their conclusions.
- Create or share a service learning project.

SCHOOLYARD REVIEW

PART I – 60 minutes

OVERVIEW

Student teams are given a map of one portion of the school to investigate. Students make water related observations and indicate their findings on the map and instruction sheet. After presenting their findings to the class, students generate questions about what they found.

Standards: 5e, 7b

Materials

- Schoolyard Review worksheet – 1 per group
- Map of school area – photocopy a school map, enlarged as much as possible, and divide it into different areas. Schools usually have a map of their campus that can be used, but be sure to white out or cover any unnecessary information before photocopying. A simple hand drawn map can be used as well.
- Green, blue, purple, black, and red markers or colored pencils – 1 set per group

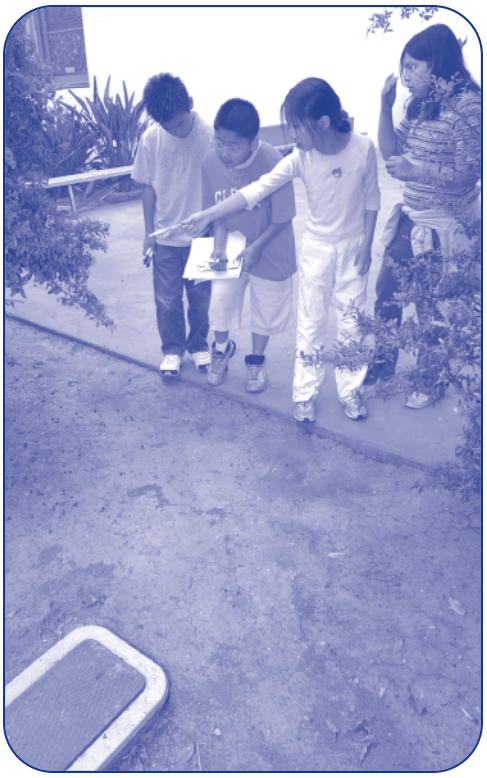
Vocabulary Words

- Catch basin
- Downspout
- Rain gutter
- Stormdrain

Helpful Hints

- Plan ahead for proper adult supervision for each group of students "mapping" around the school. This might be a great opportunity for parents or school staff to be involved in this core instructional program.
- Outline a walking route around the school to help point out key items pertaining to the questions on the Schoolyard Review (rain gutters, drains, etc.) and any safety hazards.
- If necessary, take time to orient students on how to read a map of the school from a "birds eye view." **It is essential that students are able to read their map.**

PROCEDURE



1. Explain to students that they will use their maps to investigate different areas of their schoolyard, to mark what they found, and answer questions along the way.
2. Divide the students into working groups. Have groups assign a:
   a. Reader: reads the instructions and questions to be answered
   b. Recorder: records the answers to the questions
   c. Artist: draws what they observe on their map
   d. Timekeeper: makes sure the group stays focused and on time
   e. Reporter: reports the findings of the group to the class
3. Pass out markers/colored pencils, maps of the school areas, and a Schoolyard Review worksheet. Each group is assigned a different area to study.
4. Help student groups to read their map and familiarize themselves with their designated area.
5. Go through the Schoolyard Review worksheet and demonstrate what the student groups will be looking for and how to mark their map.
6. Ask students what is meant by "harmful" referring to question 4 on their Schoolyard Review worksheet. These items, which may include motor oil, fertilizers, pesticides, or trash, can hurt humans, as well as the environment.
7. As a class, walk to one area of the school to point out examples of what they will be looking for and mark these items on their map, including down spouts, sprinklers, rain gutters, and anything else that may not be familiar.
8. Give groups a deadline before sending them to their different locations.
9. When students return to the classroom, tape each map section together to make one complete map of the school. Affix to the wall or white board.
10. Have each group's reporter share their group's findings by using the answers on their worksheet and the map of their area.

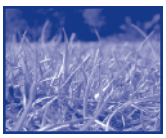
GUIDED QUESTIONS

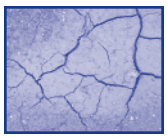
- What are the different sources of water on our campus? How do you know they are a "source?"
- What did you learn as a result of your observations?
- Where did you find trash and other harmful things?
- Where do you think water travels on our campus?
- What questions did you have about what you observed?

SCHOOLYARD REVIEW

In your designated area, observe what's around you. Use the colored markers/pencils to mark these observations on your map.

1. **Look for places where water can get into the ground.**
   Use green dots ::: to show these places on your map.


☐ grass


☐ bare dirt


☐ gardens


☐ tree wells

What other places did you find? _____

2. **Look for sources of water.**
   Use a blue waterdrop ♦ to show these places on your map.


☐ faucets


☐ drinking fountains

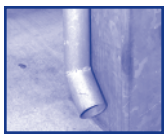

☐ sprinklers

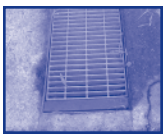

☐ hoses

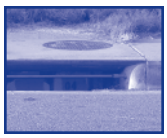
What sources did you find? _____

3. **Look for places where water travels.**
   Use a purple square ■ to show these places on your map.


☐ gutters


☐ down spout


☐ drain

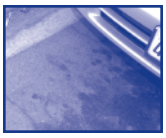

☐ catch basin

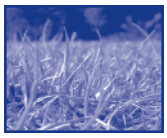
What other places did you find? _____

4. **Look for trash and other things that could be harmful to water.**
   Use a red X to show these items on your map.


☐ lunch trash


☐ candy wrappers


☐ motor oil


☐ lawn/field care products

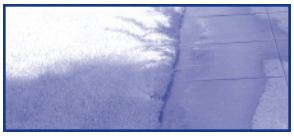
What kinds of trash and other harmful things did you find in your area? _____

_____

5. Look for areas where water is wasted.
Use a black star ★ to show these areas on your map.

☐ leaky faucets and sprinklers

☐ clogged drains



☐ water sprayed on concrete

What other areas did you find? _____

6. Write one question you have about what you observed.

_____

_____

WHAT IS THE QUALITY OF YOUR WATER?

PART 2 – 60 minutes

OVERVIEW

Students read a one-page information sheet about water quality. Based on what they learn, groups design an investigation using one question relating to what they observed on their schoolyard.

Standards: 5c, 5e, 7a, 7b

Materials

- Information Sheet A – What is the Quality of Your Water? – 1 per student
- Completed Schoolyard Review worksheets
- Our Investigation worksheet – 1 per group
- Pencils

Vocabulary Words

- Community
- Ecosystem
- Environment
- Fertilizer
- Groundwater
- Hazardous waste
- Investigation
- Land pollution
- Organism
- Pesticide
- Pollution
- Prediction
- Toxic

Other Resources

See Teacher Resources, page 116 for additional activities that relate to water quality.

Helpful Hints

- As students read this and other Information Sheets, they should underline all the words that they think are associated with water and living organisms.
- Students can create a list of their words, adding definitions as they progress through the unit, using their own first-hand experience to define the terms, and then supporting their definitions with textbook definitions.
- Refer to "Leading Students to Develop Their Own Questions and Perform Investigations" on page 79 for guidelines to assist students in developing testable questions and conducting investigations that relate to water quality.
- Set up times for students to make their observations and collect data. The data collection times will depend on the investigations they choose.

PROCEDURE

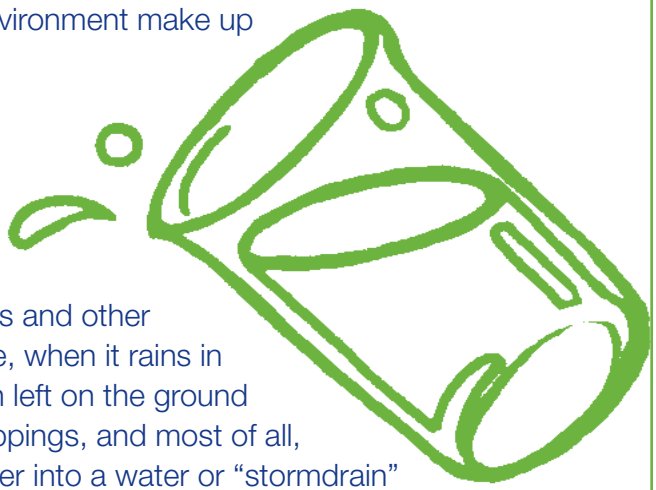
1. Have each student read Information Sheet A – What is the Quality of Your Water?
2. Have student groups discuss what they read and the ways in which it relates to what they observed on their schoolyard. Each group can report their main points to the class as part of a group discussion.
3. In their groups, have students review their notes from the Schoolyard Review and create a list of questions they have about water quality related to their campus.
4. Guide students to develop "testable" questions. See page 79 for guidelines.
5. Using the Our Investigation worksheet, have groups:
   a. Create one question to pursue for their investigation. It should:
      i. Focus on water quality
      ii. Be measurable over time: 1 – 4 weeks
   b. Figure out what it will measure
      i. What kind of observations can you make to answer the question?
   c. Tools and supplies
      i. What tools and supplies are needed to conduct the investigation?
   d. Procedure
      i. What steps are needed to conduct the investigation?
   e. Hypothesize what will happen during the investigation
      i. How are the observations going to support the hypothesis?
      ii. How is the investigation set-up going to support the hypothesis?

GUIDED QUESTIONS

- What makes up a community?
- What makes up an ecosystem?
- How does pollution affect the ecosystem of streams and rivers?
- What kind of land pollution did you observe on our schoolyard?
- In what ways is water wasted at our school?
- Where does water flow into the street at our school?
- Where does water seep into the ground at our school?
- What question do you have about water quality at our school?
- What can you measure as part of an investigation to answer your question?
- What steps are needed to conduct your investigation? Can you summarize the steps in a few sentences?
- What is the explanation for the answer to your question?

WHAT IS THE QUALITY OF YOUR WATER?

Did you know that almost every living thing on Earth needs and depends on its environment for survival? People, plants, animals, and other living organisms live and interact with each other as part of a community. Every member of that community interacts with its physical environment. Together, a community and its physical environment make up an ecosystem.



The number and types of organisms an ecosystem can support depends on the health and condition of its resources. The environment of California has 200,000 miles of rivers and streams, 1,100 miles of coastline, more than 10,000 lakes, and more than 1 million acres of bays and estuaries. Unfortunately, most of these rivers and other water environments have become polluted. For example, when it rains in cities, rainwater picks up many materials that have been left on the ground including car oil, car grease, garden pesticides, pet droppings, and most of all, trash! All this "land pollution" gets carried by the rainwater into a water or "stormdrain" system that leads to streams and rivers. Even when it is not raining, wasted water from hoses, sprinklers, and faucets send polluted water into drains that lead to streams and rivers.

How does this affect the living organisms that live there?

Rainwater seeping into the soil or washing off hard surfaces can carry harmful chemicals such as garden fertilizers, pesticides, and hazardous wastes such as paint that are left on the ground. These toxic substances pollute groundwater or wash into streams, rivers, and lakes harming the living organisms that live there.

How does this affect our need for healthy drinking water?

The everyday activities of people affect the health and condition of our water ecosystems. Whether we are wasting excess water, creating more trash instead of recycling, or simply leaving toxic substances on the ground, our actions determine the quality of our water.

Think about the following questions:

- Do you remember the last time you saw trash and other land pollution on the ground? Where did it come from? Where will it go? If it isn't in a trashcan, what is going to happen to it?
- What about the wasted water? How does extra water that flows over hard surfaces impact the environment and the ability of organisms to live in local rivers and streams?
- How is the quality of water in your area? Think about this when you see trash left on the ground or water rushing into the street. Is it harmful to our water and environment?

TEACHER INFORMATION

Leading Students to Develop Their Own Questions and Perform Investigations

Within the unit, students are asked to come up with a testable question (a question that can be answered scientifically) and set up an investigation. The following are steps and examples for guiding student-led experimentation.

1. Gain knowledge

Through the use of the Schoolyard Review, students gain knowledge about their schoolyard. The Schoolyard Review is designed to help students observe where water flows at their school, recognize and identify the influence of land pollution, wasted water, and the presence of harmful substances.

Students continue to gain information by reading Information Sheet A about water quality issues in California, and relating their observations to what they read, thus driving studens to investigate the issues further.

2. Develop a testable question

Students use what they observed and what they have learned to formulate testable questions relating to water quality. After completing the Schoolyard Review, ask students how what they observed may impact local water quality. Use these answers to help develop testable questions.

The testable question can be written in the form of "How does _____ affect _____?" The blanks represent the independent variable (first blank) and dependent variable (second blank).

Variables are the factors in an investigation that could affect results. They are the things that could vary from one sample to the next. Work with students to choose an "independent" variable – the one variable that changes. The "dependent" variable changes as a result of, or in response to, the change in the independent variable.

Some sample testable questions:

- How does the number of students using the trashcan at lunch affect the amount of trash in the street outside the school?
- How does the number of waste water sources at the school affect the amount of water that flows into the street from our school?
- How does the number of students dropping their trash on the ground affect the amount of trash that goes into the street next to the school?
- How does the location of where "hosing" is happening affect the amount of water and topsoil going into the street?
- How does the amount of lawn watering affect the amount of water and topsoil going into the street?
- How does the amount of trash found on the ground affect the amount found in the street outside the school?

3. Make a hypothesis

Discuss with the students what they can investigate to find the answer to their questions. Use what they learned from Information Sheet A to help formulate ideas for investigations.

After listing ideas, have students write an if-then statement of what they think may happen in the investigation based on what they have observed and learned so far.

Sample hypotheses:

- If a greater number of students use the trashcan at lunch, then there will be a decrease in the amount of trash that ends up in the street outside the school.
- If three out of the five sources of water at the school (faucets, hoses, sprinklers, downspouts, and drinking fountains) are found to waste water, then they will contribute to the amount of water that flows into the street from our school.

- If more students drop their trash on the ground, then there will be more trash that goes into the street next to the school.
- If the grounds manager hoses next to grass or permeable areas, less water will go into the street than if he/she hoses next to large concrete areas.
- If the grounds manager keeps the sprinklers or hoses on for a long period of time, then more water will go into the street.
- If there is more trash found on the ground on a given day, then there will be more trash found in the street outside the school on that day.

4. Design an investigation

How will your students test whether their predictions are right? Facilitate a group discussion that leads students to figure out what they can measure that will lead to an answer to their question. It should involve gathering data over time.

Example questions and measuring tools:

- I predict that on days when less students drop their trash on the ground, there will be less trash that goes into the street next to the school.

  Audit the number of students that use the trashcan at lunch and later audit the amount of trash found in the street closest to the lunch area.
- I predict that three out of the five sources of water at the school (faucets, hoses, sprinklers, downspouts, and drinking fountains) will contribute to the amount of water that flows into the street from our school.

  Audit the different sources of water for leakage and water flow.
- I predict that on days when more students drop their trash on the ground, there will be more trash that goes into the street next to the school.

  Audit the number of students using the trashcan and later the amount of trash in the street closest to the lunch area.
- I predict that when the grounds manager hoses next to grass or permeable areas, less water will go into the street than when he/she hoses next to large concrete areas.

  Audit the location and direction of water flow when the grounds manager is using the hose.
- I predict that the longer the grounds manager runs the sprinklers or hoses, the more water will go into the street.

  Audit the time and amount of water going into the street when the grounds manager is using the hose and sprinklers.
- I predict that on the days that more trash is found on the ground, the more trash will be found in the street outside the school.

  Audit the amount of trash on the ground at school and later in the street outside the school.

5. Design procedures

Have students develop and follow a specific method/protocol that helps assure reliability and validity of their results. Help them consider, if necessary, how to:

- Do a procedure the same way every time
- Consider the independent variable in planning data collection
- Use tools and supplies that are available
- Be accurate

6. Design a recording system

Help students design the most appropriate way to record the data they are gathering. They should use this method consistently to ensure they are accurate. This will help in analyzing the data more effectively. Recording systems include:

- Date and time of observation
- Space for written observations
- Space for illustrations and drawings
- Columns for separating information
- Using tally marks for counting
- A place for questions or thoughts to be followed up in the future

7. Data analysis and conclusion

Students describe their results in the clearest way possible. In Part 5, students use the Our Conclusion worksheet to restate their question, prediction, and write a summary of the data they collected. The summary should be a statement that is supported by evidence and identifies the pattern or trend of the data collected during the investigation.

Students are also asked to graphically display their data to show whether the data supports their prediction or not. Show students a variety of graphs, tables, and charts to determine which would be the best one to use. Explain that the graph, table, or chart is a picture of the information they gathered. Graphs, tables, and charts make it easier to make comparisons and draw conclusions. Ask students to name some places where they have seen graphs – in newspapers, magazines, TV news, etc. Show samples of the basic types of graphs, tables, and charts:

- Pictograph
- Bar graph
- Charts and tables
- Circle graph
- Line graph

If students are measuring the sources of the land pollution found, they could use a bar graph. The bottom of the graph would show the sources and the side would have amounts. The bars would indicate the amounts of trash found for each source. The highest bar would indicate the source of the most land pollution found.

Finally, the Our Conclusion worksheet asks students to explain what they learned about water quality at their school and how their data does or doesn't support their prediction. This is an ideal time to discuss why they made the prediction that they did, or how they may conduct their investigations differently, if given the chance to "do it again."

8. Communicate results

In Part 7, students are asked to reflect on what they have learned and write a news article about water quality issues. Students use this method to communicate their results connecting their investigations to the schoolyard or community. It includes their thoughts about what they have learned about water quality, and any concerns they may or may not have.

These articles will be used as a way to formulate ideas for their service learning project.

OUR INVESTIGATION

Name(s): Date:

Testable Question

Our question about water quality on campus is:

How does _____

affect _____?

Investigation

We are going to measure:

Tools and Supplies

The tools and supplies we need for our investigation:

Procedure

The steps we need to take to conduct the investigation:

Hypothesis

The explanation for what you predict will happen:

If

then,

INVESTIGATION SET-UP

PART 3 – 45 minutes

OVERVIEW

Student teams set up their investigations. Students use a data sheet to make observations and collect their first data.

Standards: 7b

Materials

- Depends on each team's investigation
- Data Collection sheet

Vocabulary Words

- Data

Helpful Hints

- Spend time with each group to help them devise their investigations. Have them utilize the Data Collection sheet and record additional information in a science journal.
- The Data Collection sheet is designed to help students organize their information. If necessary, groups can design their own data collection sheets.

PROCEDURE

1. Working in their teams, students set up their investigations.
2. After the initial set-up, have student teams use the Data Collection sheet to collect their first data and record observations and measurements as needed. The Data Collection sheet will help students organize their information. If necessary, work with student groups to redesign their data collection sheet to better suit the needs of their investigation.

GUIDED QUESTIONS

- What should be included on the Data Collection sheet?
- What do you expect to find after your first data collection?
- What do you expect to find after several data collections?

PART 3

DATA COLLECTION

Name(s): Date:

Observation 1

Questions or thoughts:

Observation 2

Questions or thoughts:

Observation 3

Questions or thoughts:

Observation 4

Questions or thoughts:

A LIVING WATER ECOSYSTEM

PART 4 – 45 minutes

OVERVIEW

After teams have collected data at least twice, students read a one-page information sheet about the living and non-living components of a watershed and water ecosystem, and the factors that affect the survival of those components. Students take what they learn and relate it to the data they are collecting. Students continue to observe and record data.

Standards: 5c, 5e, 7b

Materials

- Information Sheet B – A Living Water Ecosystem – 1 per group

Vocabulary Words

- Abiotic factor
- Biotic factor
- Contamination
- Decomposition
- Dissolved Oxygen
- Invertebrate
- Microorganism
- Photosynthesis
- Runoff
- Sediment
- Watershed

Other Resources

See Teacher Resources, page 116 for additional activities that relate to watersheds.

Helpful Hints

- Provide additional information about the local watershed.
- Watersheds can be as small as a leaking sprinkler head to as large as an entire city basin. Show students the smaller watersheds that can be found around the schoolyard.
- Help students investigate where water goes after it leaves their campus.
- Provide students with information about a local body of water. To locate your closest body of water, consult a local map. Go to www.epa.gov/surf to find the name of your watershed.
- If possible, take a field trip to the local waterway to observe how humans may be impacting it.

PROCEDURE

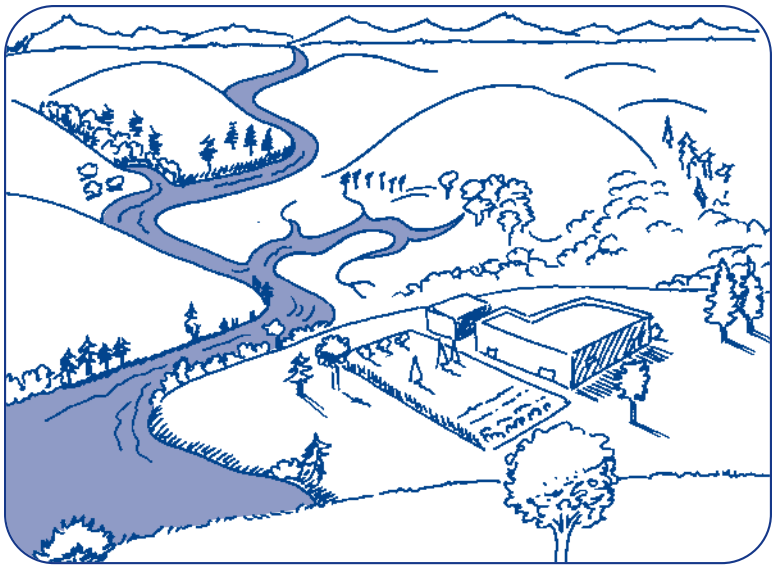
1. Have each student read Information Sheet B – A Living Water Ecosystem.
2. Have student groups discuss what they read and the ways in which it relates to their investigations. Each group can report their main points to the class as part of a group discussion.
3. Looking at the illustration on Information Sheet B, have students figure out how water moves in their watershed community. Have them investigate further to confirm their ideas.
4. Have students investigate the pathway water takes from their campus to the nearest body of water.

GUIDED QUESTIONS

- How do biotic factors differ from abiotic factors?
- What are the biotic and abiotic factors of your watershed?
- Where are there watersheds within our schoolyard?
- When abiotic factors are impacted in a water ecosystem, how does this affect the biotic factors?
- What water services or goods do you depend on?
- What is the closest body of water to our school?
- Where, if at all, does that body of water flow to?
- What impact is what you are observing having on your local water system? How do you know?

A LIVING WATER ECOSYSTEM

Your community, whether it is in a city or rural town, is part of a watershed. A watershed is the land area that directs water to a drainage system or river. It helps supply water to our community by allowing it to seep into the ground or channel it into streams, rivers, and other bodies of water. Gravity moves water through the watershed from higher to lower areas.



A watershed includes living components or biotic factors such as people, wildlife, plants, and insects; as well as non-living components or abiotic factors, including sunlight, oxygen, temperature, and soil. Both components belong to the environment of a watershed community.

Look around. What are the biotic and abiotic parts of your watershed?

Your watershed directs water into another system of living and non-living components – a water ecosystem. It is the abiotic factors that make up the environment for the living organisms – water, sunlight, rocks, soil, and air – and allow them to thrive. Without these, living organisms would not survive.

Humans depend on the products of a water ecosystem. Water ecosystems provide us with goods and services, including drinking water, recreation, and food. In fact, about 9,000 different species of fish are harvested for food from our water systems. Humans are responsible for protecting these ecosystems. However, pollution can harm these ecosystems and damage their ability not only to provide us with goods, but also maintain the balance of a functioning ecosystem. For example, large rivers in California such as the Sacramento, American, Feather, and lower San Joaquin, provide major fish spawning habitats for salmon, steelhead trout, and striped bass. Young fish depend on small invertebrates – mostly insects and tiny shrimp – for food. When land pollution, field pesticides, and erosion from construction sites run off through a watershed and enter streams and rivers, they kill or seriously harm these food sources and the young fish. This is just one way the condition of the ecosystem is harmed.

Let's take a closer look at how abiotic factors are affected.

Water: All living things need water to carry out their life processes. Contaminated water from land pollution not only affects the water habitat for fish and other animals but also plants and algae.

These organisms use water along with sunlight and carbon dioxide to make food as part of photosynthesis. Other living things eat the plants and algae to obtain energy.

Sunlight: Because sunlight is necessary for photosynthesis, it is an important factor for plants, algae, and other living things. If plants or algae do not receive sunlight, they cannot grow. When dirt, sand, and oil that build up on city streets get washed into streams, it decreases the amount of light able to penetrate the water, reducing the amount of light for plants and algae to grow.

Oxygen: Fish, plants, and other water organisms need oxygen to survive. They obtain dissolved oxygen from the water around them. Dissolved oxygen refers to the oxygen stored between water molecules in a river or lake. The amount of oxygen in water is critical to the health of any river system. Runoff of oxygen-demanding organic matter such as sewage, lawn clippings, and leaves can cause excessive decomposition by microorganisms, using up too much oxygen in the process, and decreasing the amount of dissolved oxygen available for other living organisms.

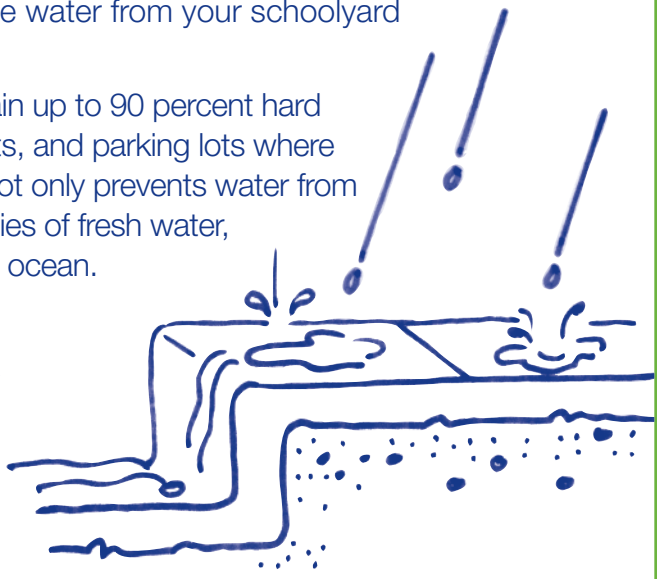
Temperature: Temperature of the water can also affect oxygen levels. Cold water can hold more dissolved oxygen than warm water. Water temperature can rise when runoff that flows over hot asphalt and concrete pavement drains into the water system. This not only lowers the amount of oxygen available for living organisms, but causes serious problems for organisms adapted to certain water temperatures and already stressed by other contaminants in urban runoff.

Rock and gravel: Rock and gravel provide necessary habitats for living organisms. Fish and amphibians also use them as a spawning ground for laying and hatching their eggs. Runoff of "land pollution" and sediments can cover the available rocks and gravel needed for the fish to lay and cover their eggs.

When affected by "land pollution" and other runoff, all these abiotic factors decrease the availability of resources available to the living organisms within a water ecosystem. Every non-living component is impacted and therefore impacting the living components.

What is happening in your community? Where is the water from your schoolyard going? To a nearby river, stream, lake, or ocean?

The watershed of most cities and school grounds contain up to 90 percent hard surfaces such as rooftops, concrete playgrounds, streets, and parking lots where water collects quickly and runs off into the street. This not only prevents water from seeping into the ground to replenish underground supplies of fresh water, but sends "land pollution" directly into our rivers and the ocean.



Think about the following questions:

- What are you observing during your data collection? Do hard surfaces have an impact?
- What about the "land pollution?" What impact on your local water ecosystem do you think it may have?

INVESTIGATION CONCLUSION

PART 5 – 45 minutes

OVERVIEW

After teams have collected enough data, students develop evidence-based conclusions about what they observed.

Standards: 7c, 7d, 7e

Materials

- Our Conclusion worksheet – 1 per group

Vocabulary Words

- Graph

Helpful Hints

- Provide a variety of graphing examples to assist students in determining which type of graph would best show data results.

PROCEDURE

1. Have student groups use the Our Conclusion worksheet to compare the results of their investigation against their predictions.
2. Have student groups determine what claims they can make and if they still need to collect additional information.
3. Work with student groups to determine what type of graph would best organize and represent their data.
4. Have each group share their findings by using the answers on their Our Conclusion worksheet and the graph of their data.

GUIDED QUESTIONS

- If you were to repeat the study, what would you do differently?
- Which predictions were accurate and which were not? How do you know?
- How does your data support your prediction? If it doesn't, why not?
- What did you find out about water quality at your school?

OUR CONCLUSION

Name(s): Date:

Question

1. The question we asked:

Prediction

2. The prediction we made:

Results

3. Write a brief summary of the data you collected.

Graph

4. Create a graph of the results and attach it to the worksheet.

Conclusion

5. What is the answer to your question?

What Did You Find Out?

6. What did you find out about water quality at your school?

7. How does your data support your prediction? If it doesn't, why not?

THE ACTIVE WORLD OF FRESHWATER BIOMES

PART 6 – Two 60 minute sessions

PART 6

OVERVIEW

Students read a one-page information sheet about microorganisms. After reading the information, the class will discuss the components of freshwater biomes and how producers, consumers, and decomposers work within the water ecosystem. Each student draws a freshwater ecosystem or biome and includes one source of pollution indicating how it may have an impact based on what they learned during their investigations.

Standards: 5c, 5d, 5e

Materials

- Information Sheet C – The Active World of Freshwater Biomes – 1 per student
- Poster paper
- Drawing/writing materials
- Information Sheets A & B

Vocabulary Words

- Adaptation
- Algae
- Amphibian
- Aquatic
- Biome
- Consumer
- Crustacean
- Decomposer
- Freshwater
- Producer

Other Resources

See Teacher Resources, page 116 for additional activities that relate to freshwater ecosystems.

Helpful Hints

- This activity can be used as a starting point for further study of energy flow in ecosystems and how the energy pyramid works, using a freshwater ecosystem as your example.
- When discussing an ecosystem and the producers, consumers and decomposers that function within them, it is important that students visualize the connections between the different roles.
- Use pictures of different freshwater biomes to help students diagram the different components of a freshwater ecosystem.

(continued)

They should include abiotic parts: sun, water, air, rock, and soil; and biotic parts: plants, fish, insects, microorganisms, amphibians, etc.

- When students are working independently on their own diagrams, allow them use of Information Sheets A and B as resources.

PROCEDURE

1. Have each student read Information Sheet C – The Active World of Freshwater Biomes
2. As a group, discuss what they read and the roles of organisms in a freshwater biome.
3. As a class or in student groups, illustrate the different components of a freshwater ecosystem.
4. To represent their understanding of living organisms in a water ecosystem and their link to water quality, have students work independently to illustrate a water ecosystem. Have them include one type of land pollution as part of their diagram and describe how it will affect the abiotic factors and therefore the consequences to organisms. Have students label the producers, consumers and decomposers.

GUIDED QUESTIONS

- What are the two basic regions of aquatic biomes?
- What determines whether a water biome is freshwater or marine?
- What is the source of energy for most ecosystems?
- What is the difference between a producer and a consumer?
- How are humans consumers in an ecosystem?
- What is one of the most important producers in a freshwater biome?
- How do organisms of a freshwater biome adapt to their environment?
- What parts of a freshwater biome are biotic?
- What parts of a freshwater biome are abiotic?
- What are two abiotic factors that affect organisms in a river?
- How do humans impact the ecosystems of a freshwater biome?
- How do the conditions of the abiotic factors of a freshwater ecosystem determine the number and types of organisms it can support?

THE ACTIVE WORLD OF FRESHWATER BIOMES

Water ecosystems exist all over the world. We can classify them by their similar characteristics including specific types of organisms, location, and climate. These distinct groupings are called biomes. Water ecosystems fall into two kinds of major aquatic biomes – freshwater and marine.

Freshwater and marine biomes cover nearly 75 percent of the Earth's surface. Freshwater is defined as having a low salt concentration – usually less than 1 percent. Plants and animals in freshwater regions are adapted to the low salt content and would not be able to survive in the ocean. These regions include ponds, lakes, streams, and rivers.

Ponds and lakes are bodies of standing fresh water surrounded by land. Lakes tend to be larger and deeper, while ponds are often shallow enough that sunlight can reach the bottom allowing plants to grow. Streams and rivers are moving bodies of fresh water that usually originate in mountains and come from melting ice or groundwater. They move in one direction and eventually flow into the ocean. Water temperatures are cooler and the oxygen level of streams and rivers is higher.

Within ecosystems, organisms are broken down into three main roles: producer, consumer, and decomposer. Each of these roles is extremely important in the ecosystems of freshwater biomes, as each contributes to the condition and health of the water system.

Producers are organisms that can make all of their own food in an ecosystem. The main producers of a freshwater biome are the plants and algae. When energy enters the ecosystem as sunlight, plants and algae capture the sunlight and store it as food energy. Through the process of photosynthesis, they provide oxygen and food for animals. Algae are one of the most important producers of food for living organisms.

In the fast-running current of streams and rivers, the producers are adapted with special structures that keep them from being carried away by the water. Some plants have strong roots that keep them anchored to the soil, while others have stems that bend easily with the movement of the water. Certain mosses are able to cling to rocks. Plants that live in ponds and lakes have different adaptations. They stretch to meet the sunlit water near the top, and include structures that allow them to float on the surface.

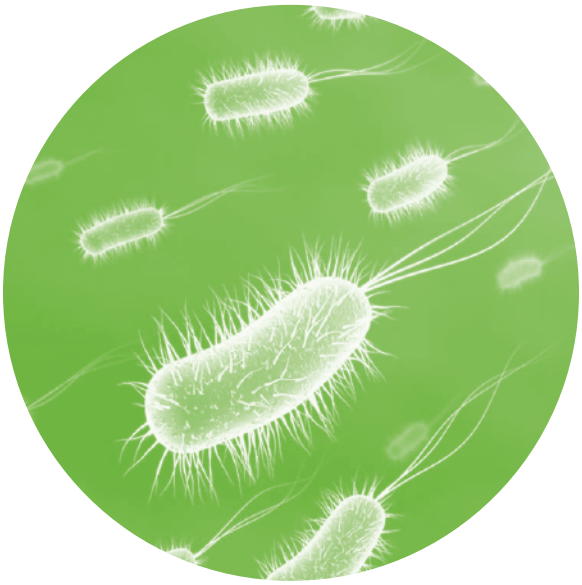
Consumers of an ecosystem cannot make their own food. They depend on producers for their food and energy. The consumers of a freshwater biome include snails, insects, crustaceans, amphibians, fish, and aquatic birds.

Consumers have adaptations as well. Animals, like fish, that absorb oxygen directly from the water have a flat, thin body allowing for increased surface area. Their streamlined bodies also help with swimming and allow them to rest by nosing into a river current. Others have suction-cup like structures on their bodies that allow them to hold on to rocks and the river bottom in fast moving waters. Others are adapted to the calm, still water of lakes and ponds by being able to grab and store oxygen. Some are so lightweight they can skid across the top of the water in search of food.

Decomposers of an ecosystem are microorganisms, like bacteria and fungus, which are responsible for breaking down plant and animal waste and turning it into food for other plants and animals. Decomposers provide an important role in the maintenance of a freshwater biome.

The functions of water biomes are at work everyday! Natural resources such as freshwater biomes are limited. It is important that every component – living and non-living is healthy.

How does the water that flows across the school playground affect local freshwater ecosystems and their biomes? What are the factors that will determine whether populations of organisms will be able to function and support the ecosystem? What can be done to ensure that enough of our water stays clean and is allowed to provide a healthy environment for all living organisms, including you?



REFLECTION

PART 7 – 30 minutes

OVERVIEW

Students reflect on what they have learned and write a news article about water quality issues. They connect their investigations to their own activities in school and the community.

Standards: 7d, 7e

Materials

- Completed worksheets
- Pencils
- Paper
- Information Sheets A, B, & C
- Newspapers/Internet (optional)

Vocabulary Words

- May include all vocabulary words

Helpful Hints

- The goal of the final article is for students to reflect on what they have observed and learned, and share their thoughts about it. Reflection is an important part of the service learning process.
- Help students to formulate their articles to include the results of their investigation, how the results link to water quality, and one thing that can improve water quality at their school or in their community.

Procedure

1. As a class, have students reflect on what they have learned using the guided questions.
2. Have students write a news article for a local or school newspaper to present their thoughts on water quality and solutions. Give guidelines to include information on how their investigations and the evidence they collected influenced their ideas about water quality.
3. Invite students to present their thoughts to the class and share their ideas to improve water quality.

GUIDED QUESTIONS

- What did you learn from your experience?
- How did your conclusions differ from your expectations?
- How can your knowledge about water help you to make good choices about water quality?
- Why is clean fresh water important?
- What is an idea you have for improving water quality at your school or in your community?

SETTING UP A SERVICE LEARNING PROJECT

PART 8 – Two to three 45-minute planning sessions
Project length determined by project

OVERVIEW

Following the instructions in their Water Quality Project booklets, students work together to plan and carry out water quality community service projects.

Materials

- Water Quality Project booklets – 1 per student/group

Vocabulary Words

- Task
- Timeline

Helpful Hints

- Student voice is an important component to service learning. However, to save time, you may want to determine what projects might work best for your class to help guide student discussions. A list of project ideas can be found in Teacher Resources.
- Create Water Quality Project booklets for each student or group. The template can be copied and stapled together to form the booklets.
- Become "Project Manager" to guide students through their project.

PROCEDURE

1. Distribute a Water Quality Project booklet to each student/group. Have them put their name(s) on the cover.
2. Use the students' reflection articles to begin a discussion that leads to planning their service learning project, and how these efforts may help resolve a water quality problem on their campus or in their community.
3. Using their booklets, have student groups follow the guidelines to complete the first worksheet, listing the problems they found and ideas that might resolve the problems. Have groups share their findings as you list them on the board. As a class, pick the top three ideas.
4. Have students fill out one Look Closer worksheet for each of the top three ideas. Have them share their findings and decide which one seems most practical and most exciting to them. Using the booklets, have students develop possible names for their project.

(continued) ▸

As a class, decide or vote on a final name.

5. Have student groups use their booklets to brainstorm the tasks necessary to implement their project.
6. Help students organize the tasks. Use a large sheet of mural paper and organize the tasks using a technique called webbing:
   a. Place the name of the project in the center and circle it.
   b. Write each suggested task, circle it, then connect it to the center.
   c. Tasks associated with these main tasks should be circled and connected to the task.

7. As a class, use the timeline worksheet in the booklets to assign tasks and create a timeline.
8. Have students use the Get Support For Your Project worksheet to brainstorm who might be able to support the project or provide helpful ideas or resources.
9. Help students follow the task list to implement their project.
10. After completion, have students write to the California Water Boards telling about their project and its success.
11. Share your accomplishments with a local reporter, or through a school display or assembly.
12. Wrap up the unit with a celebration. Work with the students to come up with celebration ideas, such as a pizza party, picnic, or ice cream social. Or, make t-shirts for everyone who participated with We Made A Difference on the back.

GUIDED QUESTIONS

- What were the most successful parts of the project?
- What was the least successful part?
- What did you learn from your experience?
- What would you do differently next time and why?
- Who or what was influenced by your action?
- Would you like to get involved in another environmental service project? Why or why not?

WATER QUALITY SERVICE LEARNNG PROJECT

WORKBOOK

WORKBOOK

OUR PROJECT
WORKBOOK

Name(s):

_____

_____

_____

PROJECT IDEAS

Identify and choose a project that will help improve the water quality on your campus or in your neighborhood.

Be creative! Projects can be as simple as creating posters to tell other students or people in your neighborhood to keep trash off the ground. Or, they can be more complex, such as creating a waste reduction program at your school. The water quality project you select is up to you. You have the power to create change!

SO, WHICH PROJECT SHOULD YOU DO?

Follow the instructions to complete the worksheet below to help you decide.

1. **What problem areas did you find at your school or in your neighborhood? (Hint: Where were there red X's on your school map?) List them on the chart.**
2. **What can be done to teach others about the problems? What can be done to eliminate or reduce the problems? List these ideas next to each of the problems.**

Problem Areas We Found	Solution Ideas

LOOK CLOSER

Look at each idea carefully. Use the worksheets below to explore the top three ideas by answering the questions below for each one. If you are unable to answer any of the questions, you may need to do some research to find the answer.

Water Quality Project Idea #1:

1. **How would this project help the water quality at our school or in our neighborhood?**

2. **Are there others working on this problem? Other classes? The school? Businesses? Organizations?**

3. **What resources or help are needed to complete this project (money, skills, time, tools, etc.)?**

4. **Can we accomplish the project in the amount of time we have to do it?**

5. **How will we know if our solution worked?**

LOOK CLOSER

Water Quality Project Idea #2:

1. **How would this project help the water quality at our school or in our neighborhood?**

2. **Are there others working on this problem? Other classes? The school? Businesses? Organizations?**

3. **What resources or help are needed to complete this project (money, skills, time, tools, etc.)?**

4. **Can we accomplish the project in the amount of time we have to do it?**

5. **How will we know if our solution worked?**

LOOK CLOSER

Water Quality Project Idea #3:

1. **How would this project help the water quality at our school or in our neighborhood?**

2. **Are there others working on this problem? Other classes? The school? Businesses? Organizations?**

3. **What resources or help are needed to complete this project (money, skills, time, tools, etc.)?**

4. **Can we accomplish the project in the amount of time we have to do it?**

5. **How will we know if our solution worked?**

Which Project Should We Choose?

Look at the different project ideas. Based on the questions you answered, select the best water quality project that you can do and that will make a difference in your school or neighborhood.

Once you have decided, choose a name for your project.

Possible project names:

Discuss these suggested project names with the rest of your class or group.
Take a vote on which name to use.

WHAT TASKS ARE INVOLVED?

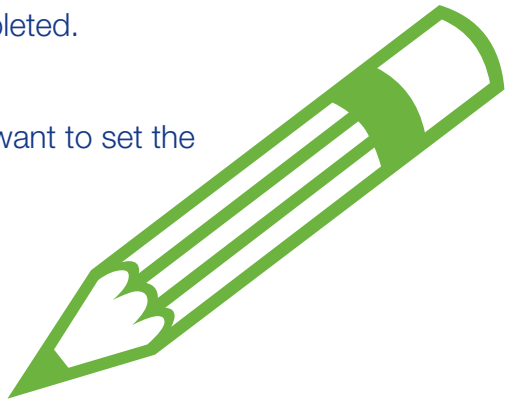
Use the space below to list all the steps you can think of to complete your project. Will you need further research? Do you need to contact other people to help you? Also, remember that you will need to work with your teacher to get the school principal's approval. All these things should be included on your task list.

List of tasks:

ORGANIZE YOUR TASKS AND CREATE A TIMELINE

1. **Use the task list you filled out to organize your tasks:**
   a. Group together similar tasks.
   b. Put the tasks in order of when they need to be completed.
   c. Write who is responsible for each task.
   d. Create a timeline to accomplish the tasks. You may want to set the completion date and work backwards.
   e. Assign a completion date for each task.

2. **Fill out the worksheet below to help you follow-up and make sure tasks are completed.**



Name of Project: _____

Task	Person(s) Responsible	Due Date	Additional Information

GET SUPPORT FOR YOUR PROJECT

Tell others about your project and get their support.

Can you and others in your class make a presentation about your project? Who can you invite? How about the principal, front office workers, maintenance staff, parents, and members of the local community? Or, consider making a presentation at your next school assembly.

List below those people who would be interested in knowing about your project and especially those who can help you:

Names	**How To Contact Them**

For your presentation, tell your audience what you have learned about the environment and about the information you obtained while conducting your schoolyard review and investigation. Share what you have learned and why it is important. Then, explain about your water quality project. They may have ideas or resources to help you. More importantly, tell them how they can help!

NOW GO DO IT!

Use this page to keep notes about how your project is going, and things you want to remember.

NOW THAT YOUR PROJECT IS COMPLETE!

Evaluate your project by answering the following questions:

1. **What were the most successful parts of the project?** _____

2. **What was the least successful part?** _____

3. **What did you learn from your experience?** _____

4. **What would you do differently next time and why?** _____

5. **Who or what was influenced by your actions?** _____

6. **Would you like to get involved in another environmental service project like this? Explain why or why not.**

YOU MADE IT ~ A DIFFERENCE, THAT IS!

The California Water Boards encourage students to get involved. We would love to hear from you about your water quality project and what you accomplished. Please write or email us at the addresses below.

Public Affairs Office
California Water Boards
1001 I Street
P.O. Box 100
Sacramento, CA, 95812
info@waterboards.ca.gov

TEACHER RESOURCES

RESOURCES

GLOSSARY OF TERMS

Abiotic Factor – A non-living part of an ecosystem.

Adaptation – The behaviors and physical characteristics of species that allow them to successfully live in their environments.

Algae – Simple, one-celled or many-celled plants that grow in sunlit water, capable of photosynthesis.

Amphibian – A class of cold-blooded vertebrates that include frogs, toads, or salamanders.

Aquatic – Living mostly or all the time in water.

Bacteria – The microscopic single-celled organisms that derive nourishment from dead or decaying matter.

Biome – A group of ecosystems with similar organisms, location, and climate.

Biotic Factor – A living part of an ecosystem.

Catch Basin – The opening in a curb or gutter that catches water and directs it to stormdrains.

Community – The different organisms that live and interact with each other in an area.

Condensation – The conversion of vapor (gas) into water (liquid).

Consumer – An organism that obtains energy by feeding on other organisms.

Contamination – The introduction into water, air, and soil of microorganisms, chemicals, toxic substances, wastes, or wastewater in a concentration that makes the medium unfit for its intended use.

Crustacean – A member of the subphylum of the arthropods characterized by mandibles, antennae, and modified appendages. They include lobsters, crayfish, crabs and shrimp.

Data – Recorded observations from investigations or experiments.

Decomposer – An organism that breaks down wastes and organic matter.

Decomposition – The breakdown or decay of organic matter through the digestive processes of microorganisms.

Dissolved Oxygen – Gaseous oxygen (o2) dissolved in an aqueous solution.

Downspout – A vertical pipe used to drain water from a roof.

Ecosystem – A dynamic set of living organisms (plants, animals, microorganisms) all interacting among themselves and with the environment in which they live (soil, air, climate, water, light).

Environment – An organism's living (biotic) and non-living (abiotic) surroundings that affect and influence its development and survival.

Estuary – The mouth or lower course of a river where the river current meets the sea's tide.

Evaporation – The conversion of water (liquid) into a vapor (gas).

Fertilizer – Nutrients used by plants for growth.

Freshwater – Water that is not salty.

Fungus – Any of a major group of spore-producing organisms that include molds, mildew, and mushrooms.

Glacier – A huge mass of ice and snow that moves slowly over the land.

Graph – A way to organize or represent quantities mathematically.

Groundwater – The freshwater that fills the cracks and pores beneath the earth's surface, which supply wells and springs.

Gutter – A channel for draining off water.

Hazardous Waste – Products that contain chemicals that are harmful to humans and the land.

Invertebrates – Animals without backbones.

Investigation – The process of using inquiry and examination to gather facts and information in order to solve a problem or answer a question.

Land Pollution – The trash dropped on the land, such as gum, food wrappers, cans, paper, and plastic bags. It also includes pet waste, and oil dripped from cars.

Microorganism – A form of life too small to be seen by the naked eye.

Organism – Any living thing.

Pesticide – Chemicals used to kill pests. Pests may include ants, termites, mice, rats, and agricultural pests.

Photosynthesis – The process of constructive metabolism in which green plants utilize the energy of sunlight to manufacture carbohydrates from carbon dioxide and water in the presence of chlorophyll.

Polluted Runoff – Sometimes referred to as nonpoint source pollution is caused by rainfall or snowmelt moving over and through the ground picking up pollutants along its journey to lakes, rivers, wetlands, coastal waters, and even our underground sources of drinking water. Some of these pollutants are natural and others are man-made. In urban areas, polluted runoff is referred to as stormwater pollution or stormwater runoff.

Pollution – A change in the environment that eventually affects living things.

Precipitation – Water deposited on the earth as hail, mist, fog, rain, sleet, or snow.

Prediction – A guess based on information and experience.

Producer – Species that carry out photosynthesis, thereby producing trapped sunlight energy for the rest of the species in the community; members of the trophic level.

Rain gutter – A channel along the roof that collects and carries away rainwater.

Reservoir – A natural or artificial lake that stores water for human use.

Runoff – Water that flows over the ground because it cannot seep into the soil, evaporate, or transpire through plants. It finds its way into streams and rivers as surface flow, and may pick-up contaminants, such as trash and fertilizer, along the way.

Sanitary Sewer System – An underground system of pipes that carries waste water from homes and businesses to treatment plants where it is cleaned, solids and pollutants are removed, and the water is discharged into the ocean.

Sediment – Soil and rock materials removed by erosion and transported by water, wind, ice, and gravity.

Self Purification – The reduction of contamination concentrations in the environment through the use of natural processes.

Stormdrain – Above ground or below ground pipes and channels that transport stormwater to the ocean for flood control purposes.

Stormwater – Created when trash, cigarette butts, animal waste, pesticides, motor oil and other contaminants left on the ground are washed or thrown directly into storm drains. This toxic soup mixes with millions of gallons of rainwater and flows untreated into local creeks, rivers and the ocean – polluting our waterways, as well as degrading neighborhoods and other natural resources. In rural areas, stormwater is referred to as polluted runoff or nonpoint source pollution.

Task – An assigned piece of work to be finished within a certain time.

Timeline – The amount of time allowed for a project.

Toxic Substance – A chemical or mixture of chemicals that may cause harm to human health or to the environment.

Vertebrates – Animals with backbones.

Wastewater Treatment Plant – The set of structures where water goes through a purification process.

Water Pollution – The addition of any substance that has a negative effect on water and the living things that depend on water.

Watershed – The land area that directs water to a drainage or river system.

Wetland – An area of land that is covered by a shallow layer of water during some or all of the year.

WATER QUALITY SERVICE LEARNING PROJECT IDEAS

SCHOOL SITE PROJECT IDEAS

- Pick up and analyze trash. Where is the trash coming from? What trash can be recycled and what cannot? What is the most common trash item? What can be done to eliminate the source of this trash (i.e., if the majority of the trash is plastic straw wrappers, can we do a campaign to reduce juice box use and suggest using a thermos instead)?
- Organize a student litter patrol to make sure trash is kept in trashcans and not left on the ground, particularly after snacks and lunches. Make posters to remind all students to reduce litter.
- Start a recycling program for paper, cans, glass, etc. At the campaign start, check the amount of large trash bins filled each week by the school, and then create a measurable goal to monitor and reduce that amount each month. Students may separate, weigh, and recycle trash for cash, and generate money for school activities.
- Make posters on good water quality management tips and post them in classrooms and sites around the community. Create a way to measure the effectiveness of the posters.
- Work with school facility managers to remove concrete and add more trees/grass areas/a school garden to your campus to absorb water and prevent it from flowing into stormdrains.
- Organize a water conservation campaign to reduce the amount of water used at your school. At the beginning of the campaign, check the amount of water used by the school, and then create a measurable goal to monitor and reduce the amount each month.
- Reduce the water runoff from pavement by landscaping an area using native trees, shrubs, flowers, and grasses that do not require a lot of water.
- Hard soil doesn't absorb run off. Improve soil quality at the school by using mulch or another alternative such as ground cover in key areas. Monitor the results of your work.
- Teach other students, teachers, administrators, parents, residents, and businesses about the school watershed. Design a "watershed tour" of the campus. This could include: what a watershed is, components of a watershed, where water is coming from, and where it is going, etc.

COMMUNITY PROJECT IDEAS ▸

COMMUNITY PROJECT IDEAS

- If water quality problems are the result of off-campus practices, write a letter to the principal, mayor, and/or city representative to provide ideas about resolving the problem. Follow up with them to see what can be done to address the problem.
- Pick up and analyze trash. Where is the trash coming from? What trash can be recycled and what cannot? What is the most common trash item? What can be done to eliminate the source of this trash (i.e., if the majority of the trash is plastic bags, can we do a campaign to reduce plastic bag use and suggest using canvas bags instead)?
- Find out about a watershed project (e.g., citizen's water quality monitoring project, stream, or beach clean-up) in the community. Join your family or class in supporting and volunteering for these events.
- Design and distribute flyers or brochures about the ways community members can help improve water quality. Create a way to measure the impact of flyers and brochures distributed.
- Adopt a stream, river, or local park. Clean up a portion and help maintain it. Figure out where the main sources of trash and pollution originate from and work to alleviate the problem.
- Stencil signs next to stormdrains warning people not to dump litter or other items into stormdrains (this will likely require permission by the local governing jurisdiction).

ENVIRONMENTAL CURRICULUM RESOURCE TABLE

A Child's Place in the Environment – Caring for Aquatic Systems
www.acpe.lake.k12.ca.us/index.html
California Department of Education
Lake County Office of Education
1152 South Main Street
Lakeport, CA 95453
$65 plus $3 shipping and handling

Related subjects:
- Freshwater Ecosystems
- Water Cycle
- Watersheds
- Water Quality

Adopt-A-Watershed: Wade Into Watersheds
www.adopt-a-watershed.org
Adopt-A-Watershed
PO Box 2850
Hayfork, CA 96041
$130 includes complete curriculum kit

Related subjects:
- California's Water System
- Freshwater Ecosystems
- Water Cycle
- Watersheds
- Water Quality

Dipping Into Creeks
www.sacto-ucc.org
Sacramento Chapter of the Urban Creeks Council
4855 Hamilton Street
Sacramento, CA 95841
$20 plus $5 shipping and handling

Related subjects:
- Freshwater Ecosystems
- Water Cycle
- Watersheds
- Water Quality

Project WET Curriculum & Activity Guide
www.water-ed.org/projectwet.asp
California Project WET
Water Education Foundation
717 K Street, Suite 317
Sacramento, CA 95814
Phone: (916) 444-6240
Only available through a workshop

Related subjects:
- Water Cycle
- Watersheds
- Water Quality

Project WILD Aquatic
www.projectwild.org
Project WILD
555 Morningside Drive, Suite 212
Houston, TX 77005
Only available through a workshop

Related subjects:
- Freshwater Ecosystems
- Water Cycle
- Watersheds
- Water Quality

Water Wisdom
www.alameda-coe.k12.ca.us/apps/page.asp?Q=635&T=pages
Alameda County Office of Education
313 West Winton Avenue
Hayward, CA 94544-1198
$15.70 (ISBN 0-88067-002-9)

Related subjects:
- Water Cycle
- Watersheds
- Water Quality

WWW.WATERLESSONS.ORG

To assist teachers in the use of this Water Quality Service Learning Program, the California Water Boards created www.waterlessons.org – a Web-based distance learning tool. At www.waterlessons.org, teachers can access an online version of the Water Quality Service Learning Program and can receive technical assistance from a specially trained science teacher.

Other resources available at www.waterlessons.org include:

- Water quality fact sheets
- Links to other water quality related Web sites
- An archived teacher workshop that:
  - Demonstrates how units of study align with California Content Standards
  - Introduces teachers to water quality issues
  - Highlights the benefits of service learning for students
  - Explains the steps for conducting the water-related science investigation
  - Provides examples of service learning activities for students
- Online lesson plan builder to make your own personalized lesson plans in addition to the ready-to-use lesson plans in this Water Quality Service Learning Program
- Background information about the California Water Boards and the two year stormwater public education program, known as Erase the Waste, which included the creation of this Water Quality Service Learning Program

SPANISH LANGUAGE STUDENT PAGES

4TH GRADE

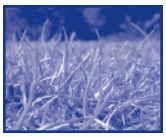
LIFE SCIENCE WATER QUALITY UNIT

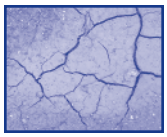
4 GRADO: UNIDAD DE CIENCIAS DE LA VIDA SOBRE LA CALIDAD DEL AGUA

INSPECCIÓN DEL PATIO DE LA ESCUELA

En tu área designada, observa todo lo que está a tu alrededor. Utiliza los marcadores/lápices de colores para marcar estas observaciones en tu mapa.

1. **Busca aquellos lugares en donde el agua puede pasar al suelo.**
   Usa puntos verdes ::: para marcar estos lugares en tu mapa.


☐ pasto


☐ tierra


☐ jardines


☐ alcorques

¿Qué otros lugares encontraste? _____

2. **Busca las fuentes de agua.**
   Utiliza una gota de agua azul ♦ para mostrar estos lugares en tu mapa.


☐ Grifos o llaves de agua


☐ bebederos

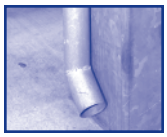

☐ rociadores

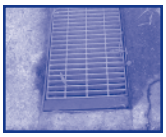

☐ mangueras

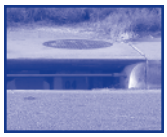
¿Qué fuentes encontraste? _____

3. **Busca aquellos lugares por donde el agua viaja.**
   Utiliza un cuadro violeta ■ para mostrar estos lugares en tu mapa.


☐ desagües


☐ tuberías


☐ cañerías de descarga

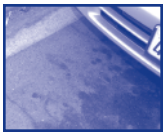

☐ cisterna de desagüe

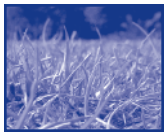
¿Qué otros lugares encontraste? _____

4. **4. Busca la basura y otras cosas que podrían ser dañinas para el agua.**
   Utiliza una X roja para mostrar estas cosas en tu mapa.


☐ basura de productos/ envoltura de comida


☐ envolturas de golosinas


☐ aceite de automóviles


☐ parques/jardines

¿Qué otros tipos de basura y elementos dañinos encontraste en tu área? _____

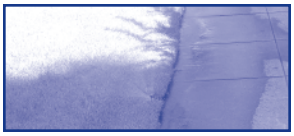
_____

INSPECCIÓN DEL PATIO DE LA ESCUELA (continuación)

5. Busca aquellas áreas en donde se desperdicia el agua. Utiliza una estrella negra ★ para mostrar estas zonas en tu mapa.

☐ Grifos/llaves de agua y rociadores que gotean

☐ desagües tapados



☐ agua derramada sobre el concreto

¿Qué otras áreas encontraste? _____

6. Escribe una pregunta que tengas con respecto a lo que observaste.

_____

_____

¿CUÁL ES LA CALIDAD DE TU AGUA?

¿Sabías que casi todas las cosas que tienen vida en la tierra necesitan y dependen de su medio ambiente para sobrevivir? Las personas, plantas, animales y los otros organismos vivos viven e interactúan entre sí como parte de una comunidad. Cada miembro de dicha comunidad interactúa con su medio ambiente. Una comunidad junto con su medio ambiente constituye un ecosistema.

La salud de un ecosistema afecta la capacidad para sobrevivir de las personas, plantas y animales. El medio ambiente de California tiene 200,000 millas de ríos y arroyos, 1,100 millas de costa marítima, más de 10,000 lagos y más de un millón de acres de bahías y estuarios.

Lamentablemente, la mayoría de estos ríos y otros medio ambientes acuáticos se han contaminado. Por ejemplo, cuando llueve en las ciudades, el agua de la lluvia arrastra muchas cosas que se han quedado en el suelo, tales como el aceite y grasa de los autos, los pesticidas del jardín, el excremento de las mascotas, y sobre todo ¡la basura! Toda esta "contaminación de la tierra" es arrastrada por el agua de lluvia hacia los sistemas de drenaje de aguas lluvias que luego es depositada en los arroyos y ríos. Aún cuando no llueve, el agua derramada de las mangueras, rociadores y grifos lleva al agua contaminada a las cañerías que van a los arroyos y ríos.

¿Cómo afecta esto a los organismos vivos que viven allí?

El agua de lluvia que se escurre en el suelo o que lava las superficies duras puede llevar químicos peligrosos como los fertilizantes de jardín, pesticidas y desechos peligrosos como la pintura que fue dejada en el suelo. Estas sustancias tóxicas contaminan el agua subterránea o llegan hasta los arroyos, ríos y lagos y dañan a los organismos vivos que viven allí.

¿Cómo afecta esto a nuestra necesidad de tener agua saludable para beber?

Las actividades diarias de las personas tienen un impacto en nuestros ecosistemas acuáticos. Ya sea al derrochar agua, crear más basura en lugar de reciclarla o simplemente dejar sustancias tóxicas en el suelo, nuestras acciones determinan la calidad de nuestra agua.

Piensa sobre las siguientes preguntas:

- ¿Recuerdas la última vez que viste basura en el suelo? ¿De dónde vino? ¿Adónde irá? Si no está en un bote de basura, ¿qué ira a pasar con esta basura?
- ¿Y el agua desperdiciada? ¿Cómo afecta esa agua adicional que corre por las superficies a los organismos que viven en los ríos y arroyos de la zona?
- ¿Cómo es la calidad de los ríos y arroyos en tu zona? Piensa en esto cuando veas basura en el suelo o agua que corre por las calles. ¿Es esto dañino para nuestras aguas y medio ambiente?

NUESTRA INVESTIGACIÓN

Nombre(s): _____ Fecha: _____

_____

Pregunta verificable

Nuestra pregunta sobre la calidad del agua en la escuela es:

¿Cómo _____

afecta _____?

Investigación

Vamos a medir: _____

_____

_____

Herramientas y materiales

Las herramientas y los materiales que necesitamos para nuestra investigación: _____

_____

_____

Procedimiento

Los pasos que debemos seguir para llevar adelante la investigación: _____

_____

_____

_____

_____

Predicción

Predecimos que: _____

_____

_____

_____

RECOLECCIÓN DE DATOS

Nombre(s): Fecha:

Observación 1

Preguntas o pensamientos:

Observación 2

Preguntas o pensamientos:

Observación 3

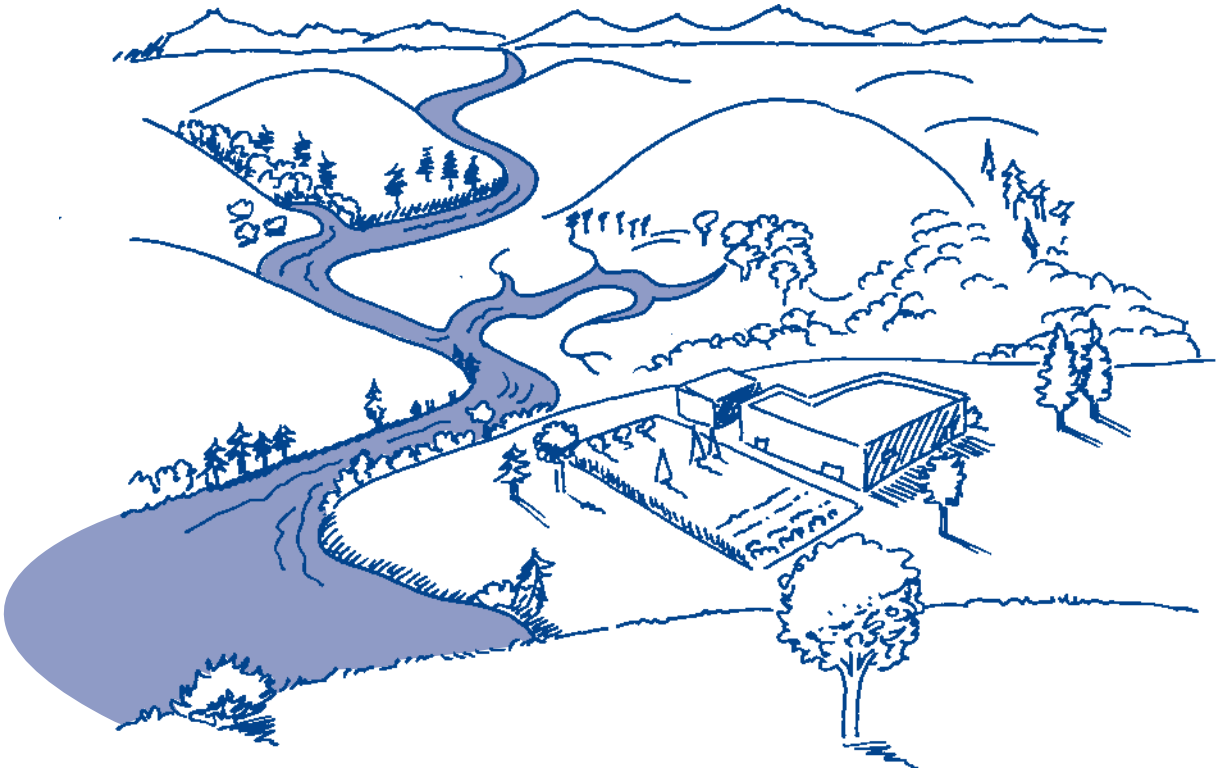
Preguntas o pensamientos:

Observación 4

Preguntas o pensamientos:

UN ECOSISTEMA ACUÁTICO VIVO

Tu comunidad, ya sea una ciudad o un pueblo rural, es parte de una cuenca de agua. Una cuenca de agua es la superficie del terreno que lleva el agua a un sistema de drenaje o un río. Ayuda a proveer agua a nuestra comunidad al permitir que se escurra en el suelo o que llegue por canales hasta los arroyos, ríos y otras masas de agua. La gravedad mueve el agua a través de la cuenca de agua desde las áreas más altas a las más bajas.



Una cuenca de agua incluye a los componentes vivos (bióticos) como las personas, la vida silvestre, las plantas y los insectos así como los componentes no vivos (abióticos), que son las rocas, el suelo, el agua y el aire. Ambos componentes pertenecen al medio ambiente de una comunidad de una cuenca de agua.

Mira a tu alrededor. ¿Cuáles son los componentes vivos y no vivos de tu cuenca de agua?

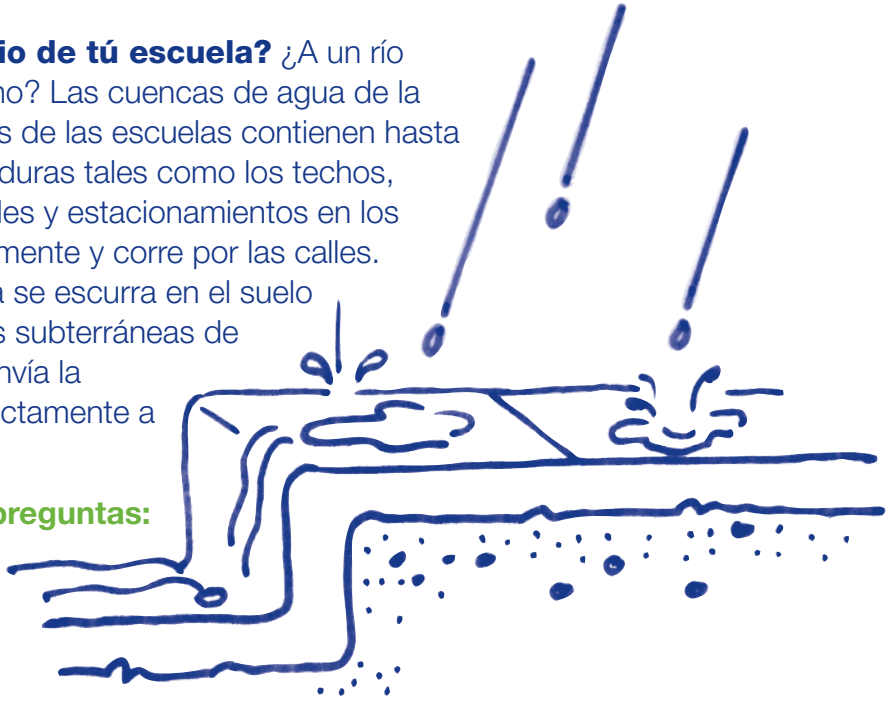
Tu cuenca de agua lleva el agua a otro sistema de componentes vivos y no vivos: un ecosistema acuático. Los componentes no vivos son los que constituyen el medio ambiente para los organismos vivos: agua, luz del sol, rocas, suelo y aire: y les permite sobrevivir. Sin estos componentes sin vida, los organismos vivos no sobrevivirían.

Los humanos dependen de los servicios de un ecosistema acuático. Los ecosistemas acuáticos nos brindan agua, alimentos, recreación y mucho más. Los humanos son responsables de

proteger estos ecosistemas. Sin embargo, la contaminación puede dañar a estos ecosistemas y su capacidad para proveernos de cosas, y para mantener el equilibrio de un ecosistema en funcionamiento.

Por ejemplo, los grandes ríos de California como el Sacramento, American, Feather y el bajo San Joaquín son un hábitat importante para el desove del salmón, la trucha arco iris y la lobina rayada. Los peces jóvenes dependen de los invertebrados pequeños para su alimentación, principalmente de los insectos y pequeños camarones. Cuando la "contaminación de la tierra", los pesticidas del campo y la erosión de los lugares de construcción se escurren a través de una cuenca de agua e ingresan a los arroyos y los ríos, matan o dañan gravemente a estas fuentes de alimento y a los peces jóvenes. Estas fuentes de contaminación disminuyen la cantidad de oxígeno que los peces tienen para respirar, reducen la cantidad de luz solar que sirve para alimentar a las plantas que ellos necesitan como alimento y finalmente cubren las rocas y suelo disponibles que los peces necesitan para poner sus huevos y cubrirlos. Cada componente no vivo recibe un impacto de esta contaminación y por lo tanto tiene un impacto en los componentes vivos.

¿Adónde va el agua del patio de tú escuela? ¿A un río cercano, arroyo, lago o al océano? Las cuencas de agua de la mayoría de las ciudades y patios de las escuelas contienen hasta un 90 por ciento de superficies duras tales como los techos, áreas de juego de concreto, calles y estacionamientos en los que el agua se recolecta rápidamente y corre por las calles. Esto no sólo impide que el agua se escurra en el suelo para reabastecer las provisiones subterráneas de agua dulce, sino que también envía la "contaminación de la tierra" directamente a nuestros ríos y al océano.



Piensa sobre las siguientes preguntas:

- ¿Qué estás observando durante la recolección de datos? ¿Tienen un impacto las superficies duras?
- ¿Qué sucede con la "contaminación de la tierra"? ¿Qué impacto crees tú que pueden tener las superficies duras en el ecosistema local de agua?

NUESTRA CONCLUSIÓN

Nombre(s): Fecha:

Pregunta

1. La pregunta que hicimos:

Predicción

2. La predicción que hicimos:

Resultados

3. Escribe un breve resumen de los datos recolectados.

Gráfico

4. Crea un gráfico de los resultados y adjúntalo a la hoja de trabajo.

Conclusión

5. ¿Cuál es la respuesta a tu pregunta?

¿Qué descubriste?

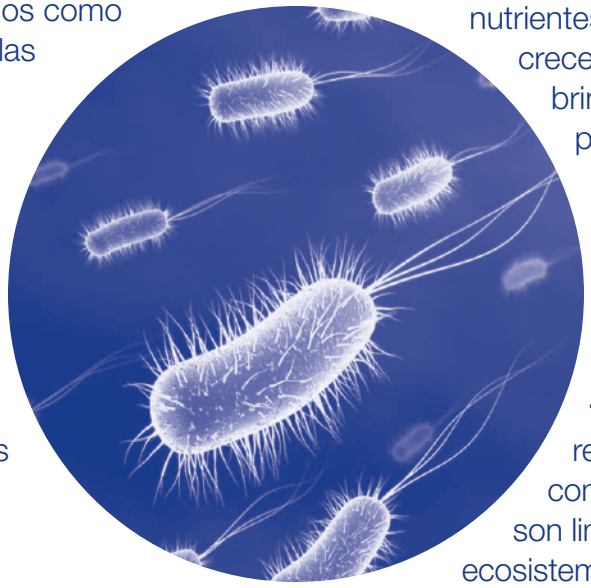
6. ¿Qué has descubierto con respecto a la calidad del agua en tu escuela?

7. ¿Cómo sustenta la información a tu predicción? Si no la sustenta, ¿por qué no?

MICROORGANISMOS BENEFICIOSOS TRABAJANDO

Los microorganismos se encuentran en todas partes en nuestra cuenca de agua. Están en el aire, el suelo y el agua y son unos de los muchos componentes vivos de nuestro ecosistema. Se llaman microorganismos porque son tan pequeños que se necesita un microscopio para verlos.

La mayoría de los microorganismos no causan enfermedades; en verdad, la mayoría son bastante beneficiosos. Por ejemplo, los microorganismos como las bacterias, los hongos y las algas descomponen los desechos de las plantas y animales y los transforman en alimento para otras plantas y animales. Esto se conoce como descomposición. Dependemos de la descomposición para mantener a los ecosistemas saludables.



Estos microorganismos beneficiosos también pueden ayudar a quitar los contaminantes de los ríos, arroyos y aguas subterráneas a través de un proceso llamado autopurificación. Estos organismos vivos, al igual que los humanos, comen y digieren los contaminantes y los usan como alimento y oxígeno. Sin embargo, para que este método funcione, la fuente de la contaminación deberá reducirse o desaparecer.

Los pantanos también se utilizan para mejorar la calidad del agua. Los pantanos son un ecosistema acuático: una superficie de tierra cubierta por aguas poco profundas que brindan un hábitat para una gran variedad de plantas y animales. Las plantas y microorganismos de los pantanos consumen y filtran los materiales de desecho y los contaminantes del agua que fluyen por el pantano. Las plantas y microorganismos transforman a los contaminantes en nutrientes que pueden usar para crecer. Las plantas luego brindan protección y alimento para los pájaros y animales del pantano. Los recursos del pantano trabajan en conjunto.

¡Las funciones de un ecosistema trabajan todos los días! Los recursos naturales tales como un pantano o un arroyo son limitados dentro de un ecosistema. Es importante que cada componente: vivo (biótico) y no vivo (abiótico): esté saludable. La salud de un ecosistema determinará si algunos tipos de plantas y animales sobrevivirán o no.

¿Cómo afecta al ecosistema el agua que fluye por el patio de la escuela? ¿Cuáles son los factores que determinarán si un organismo vivo sobrevivirá? ¿Qué se puede hacer para asegurar que haya una cantidad de agua limpia suficiente y para brindar un medio ambiente sano para todos los organismos vivos, incluso para ti?

5TH GRADE

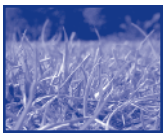
SCIENCE WATER QUALITY UNIT

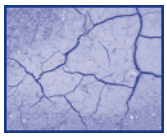
5 GRADO: UNIDAD DE CIENCIAS DE LA TIERRA SOBRE LA CALIDAD DEL AGUA

INSPECCIÓN DEL PATIO DE LA ESCUELA

En tu área designada, observa todo lo que está a tu alrededor. Utiliza los marcadores/lápices de colores para marcar estas observaciones en tu mapa.

1. **Busca aquellos lugares en donde el agua puede pasar al suelo.**
   Usa puntos verdes ::: para marcar estos lugares en tu mapa.


☐ pasto


☐ tierra


☐ jardines


☐ alcorques

¿Qué otros lugares encontraste? _____

2. **Busca las fuentes de agua.**
   Utiliza una gota de agua azul ♦ para mostrar estos lugares en tu mapa.


☐ Grifos o llaves de agua


☐ bebederos

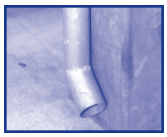

☐ rociadores

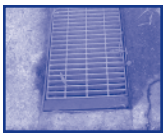

☐ mangueras

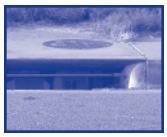
¿Qué fuentes encontraste? _____

3. **Busca aquellos lugares por donde el agua viaja.**
   Utiliza un cuadro violeta ■ para mostrar estos lugares en tu mapa.


☐ desagües


☐ tuberías


☐ cañerías de descarga

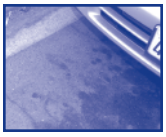

☐ cisterna de desagüe

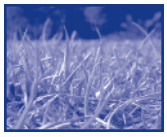
¿Qué otros lugares encontraste? _____

4. **4. Busca la basura y otras cosas que podrían ser dañinas para el agua.**
   Utiliza una X roja para mostrar estas cosas en tu mapa.


☐ basura de productos/ envoltura de comida


☐ envolturas de golosinas


☐ aceite de automóviles


☐ parques/jardines

¿Qué otros tipos de basura y elementos dañinos encontraste en tu área? _____

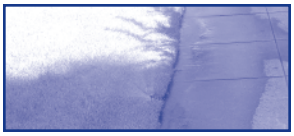
_____

INSPECCIÓN DEL PATIO DE LA ESCUELA (continuación)

5. Busca aquellas áreas en donde se desperdicia el agua. Utiliza una estrella negra ★ para mostrar estas zonas en tu mapa.

☐ Grifos/llaves de agua y rociadores que gotean

☐ desagües tapados



☐ agua derramada sobre el concreto

¿Qué otras áreas encontraste? _____

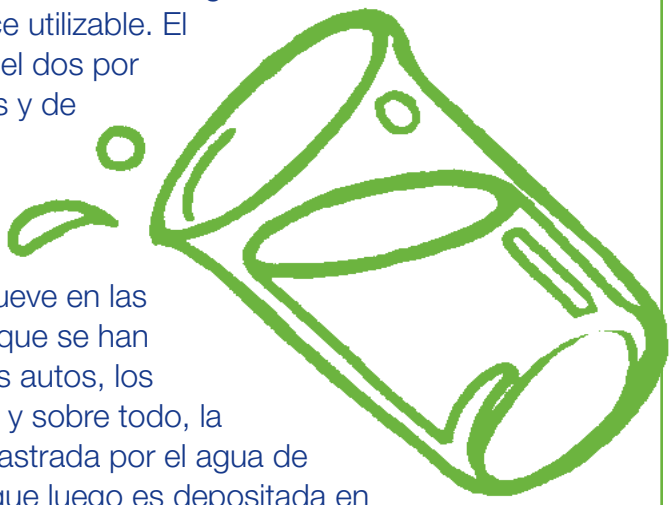
6. Escribe una pregunta que tengas con respecto a lo que observaste.

_____

_____

¿CUÁL ES LA CALIDAD DE TU AGUA?

¿Sabías que el medio ambiente de California tiene 200,000 millas de ríos y arroyos, 1,100 millas de costa marítima, más de 10,000 lagos y más de 1 millón de acres de bahías y estuarios? Estas vías fluviales nos brindan mucha del agua dulce que necesitamos para sobrevivir: el agua para beber, cultivar alimentos, fabricar productos ¡y mucho más! Es muy importante saber esto porque aunque la mayor parte de la superficie de la tierra está cubierta de agua, sólo el uno por ciento de toda esa agua es agua dulce utilizable. El noventa y siete por ciento del agua es agua salada y el dos por ciento es el agua congelada de los casquetes polares y de los glaciares. Dependemos del agua dulce que obtenemos de nuestros ríos y arroyos.



Lamentablemente, la mayoría de estos ríos y vías fluviales se han contaminado. Por ejemplo, cuando llueve en las ciudades, el agua de la lluvia arrastra muchas cosas que se han quedado en el suelo, incluidos el aceite y grasa de los autos, los pesticidas de jardín, el excremento de las mascotas, y sobre todo, la ¡basura! Toda esta "contaminación de la tierra" es arrastrada por el agua de lluvia hacia los sistemas de drenaje de aguas lluvias que luego es depositada en arroyos y ríos. Aún cuando no llueve, el agua derramada de las mangueras, rociadores y grifos lleva al agua contaminada a las cañerías que van a los arroyos y ríos.

Además, el agua de lluvia que se escurre en el suelo puede llevar productos químicos peligrosos a las aguas subterráneas tales como los fertilizantes de jardín, pesticidas y desechos peligrosos como la pintura. Estas sustancias tóxicas contaminan el agua subterránea que provee a las personas el agua dulce que necesitan para sus casas o para regar plantas.

Las actividades diarias de las personas tienen un impacto en nuestros sistemas de agua. Ya sea al desperdiciar agua, al crear más basura en lugar de reciclarla o usar mal o en exceso sustancias peligrosas como los fertilizantes y las pinturas, nuestras acciones determinan la calidad de nuestra agua.

Piensa en las siguientes preguntas:

- ¿Recuerdas la última vez que viste basura y otro tipo de contaminación en el suelo? ¿De dónde provino? ¿Adónde irá? Si no está en un bote de basura, ¿qué le va a suceder?
- ¿Qué sucede con el agua que se desperdicia? ¿Cómo afecta a los ríos y arroyos de la zona esa agua adicional que corre por las superficies duras como la calle?
- ¿Cómo es la calidad de los ríos y arroyos de tu zona? Piensa en esto cuando veas basura en el suelo o agua que corre por las calles. ¿Es esto dañino para nuestras aguas y medio ambiente?

NUESTRA INVESTIGACIÓN

Nombre(s): _____ Fecha: _____

_____

Pregunta verificable

Nuestra pregunta sobre la calidad del agua en la escuela es:

¿Cómo _____

afecta _____?

Investigación

Vamos a medir: _____

_____

_____

Herramientas y materiales

Las herramientas y los materiales que necesitamos para nuestra investigación: _____

_____

_____

Procedimiento

Los pasos que debemos seguir para llevar adelante la investigación: _____

_____

_____

_____

_____

Predicción

Predecimos que: _____

_____

_____

_____

RECOLECCIÓN DE DATOS

Nombre(s): Fecha:

Observación 1

Preguntas o pensamientos:

Observación 2

Preguntas o pensamientos:

Observación 3

Preguntas o pensamientos:

Observación 4

Preguntas o pensamientos:

¿DE DÓNDE PROVIENE NUESTRA AGUA?

Entonces, ¿de dónde proviene el agua de los bebederos o de la llave del baño? ¿De dónde provienen esta agua y otras aguas para tu comunidad?

Recibimos el agua de muchas fuentes diferentes. Parte de nuestra agua dulce proviene de las aguas de lluvia que pueden escurrirse en el suelo. Según el lugar donde vivas, el resto proviene de los ríos y reservorios como los Ríos Colorado y Sacramento. Las cañerías llevan agua que proviene de distintas fuentes de toda California a muchas casas y escuelas (ver mapa). Usamos esta agua dulce para beber, cocinar, bañarnos, nadar y mucho más.

¿Cuál es la fuente principal de agua dulce para tu comunidad?

Otra pregunta es ¿adónde va el agua sucia cuando entra a los drenajes?

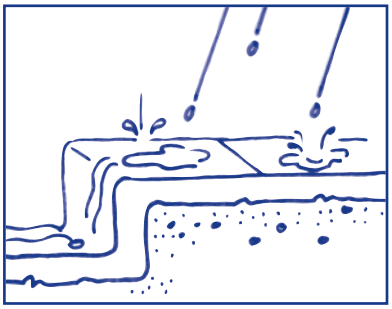
El agua de los desagües de nuestras casas y de la escuela es transportada por un sistema sanitario de drenaje a una planta de tratamiento de aguas residuales. Allí se procesan o se limpian las aguas sucias antes de que sean vertidas en los ríos o el océano.

¿DE DÓNDE PROVIENE NUESTRA AGUA? (continuación)

Sin embargo, ¿sabías que hay otro sistema de desagües para el agua de lluvia? La mayoría de las personas no saben que cuando llueve, el agua de lluvia es removida rápidamente de la ciudad para evitar inundaciones. Corren por un sistema subterráneo de drenajes de aguas lluvias que conducen a la masa de agua más cercana, como por ejemplo, un río, lago o arroyo. El problema es que estas aguas nunca se limpian antes de llegar a estos lugares.

¿En qué masa de agua: río, arroyo, lago u océano, se deposita el agua que se escurre del patio de la escuela?

La mayoría de las ciudades y de los patios de las escuelas contienen hasta un 90 por ciento de superficies duras como techos, patios de juegos de concreto, calles y estacionamientos en los que el agua se recolecta rápidamente y corre por los drenajes de aguas lluvias. Esto no sólo impide que el agua se escurra por el suelo para reabastecer las provisiones subterráneas de agua dulce, sino que ocurren problemas cuando el agua de lluvia recoge la contaminación de la tierra y la envía directamente a nuestros ríos y al océano sin tratamiento o sin ser procesada.



Piensa en las siguientes preguntas:

- ¿Qué estás observando durante la recolección de datos? ¿Tienen un impacto las superficies duras?
- ¿Qué sucede con la “contaminación de la tierra”? ¿Qué impacto crees tú que puede tener en el sistema de agua de tu comunidad?

NUESTRA CONCLUSIÓN

Nombre(s): Fecha:

Pregunta

1. La pregunta que hicimos:

Predicción

2. La predicción que hicimos:

Resultados

3. Escribe un breve resumen de los datos recolectados.

Gráfico

4. Crea un gráfico de los resultados y adjúntalo a la hoja de trabajo.

Conclusión

5. ¿Cuál es la respuesta a tu pregunta?

¿Qué descubriste?

6. ¿Qué has descubierto con respecto a la calidad del agua en tu escuela?

7. ¿Cómo sustenta la información a tu predicción? Si no la sustenta, ¿por qué no?

¿CÓMO ES EL CICLO DEL AGUA?

Al observar los terrenos de la escuela, has visto probablemente que durante un día soleado el agua que cayó sobre una superficie de concreto desapareció rápidamente. O, el agua que cayó sobre el pasto se escurrió por el suelo. Quizás, en un día soleado observaste que había agua corriendo por el estacionamiento y que llegaba a la calle. Todo ese movimiento de agua es parte de su ciclo.

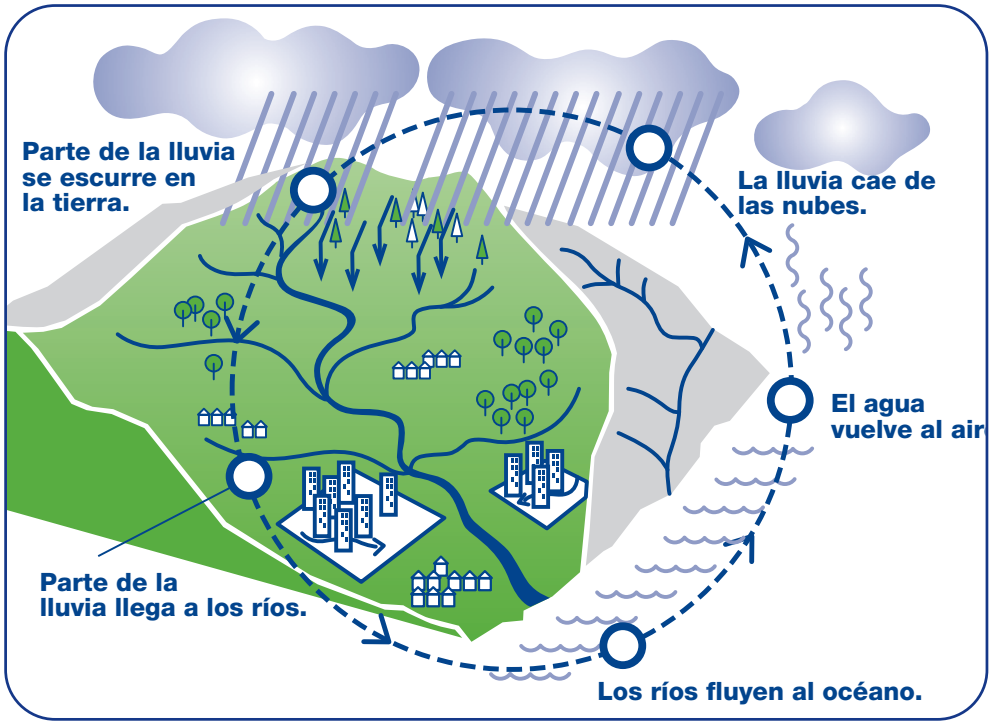
La mayor parte del agua de la tierra es agua salada. Solamente una pequeña fracción del agua de la tierra es agua dulce que se puede utilizar. Las personas dependen del agua dulce para la salud y uso diario. El agua es limitada, pero nunca se acaba porque está en constante movimiento y es renovada por el ciclo del agua.

Todos los días, el sol calienta el agua salada de los océanos y hace que las partículas de agua se evaporen y entren al aire como vapor de agua, quitándole así la sal. El vapor de agua también se desprende del agua de los ríos, lagos, plantas y de otras fuentes. Cuando el vapor de agua sube alto a la atmósfera, se condensa en pequeñas gotas líquidas de agua y se forman las nubes. Finalmente, caen pequeñas gotas de agua sobre la tierra en forma de lluvia o nieve y esto se llama precipitación.

Cuándo el agua llega a la tierra, se escurrirá por el suelo para convertirse en agua subterránea, se escurre por la tierra y regresa a los lagos o al océano, o si cae sobre una superficie dura, vuelve a evaporarse por el aire: todo es parte del ciclo del agua.

¡El ciclo del agua trabaja todos los días! En verdad, el agua de lluvia que cae en San Francisco hoy, puede convertirse algún día en nieve que cae en las montañas de Alaska. El agua que usas tú hoy para lavarte los dientes puede terminar algún día regando algún jardín.

¿Adónde va el agua que fluye por el patio de la escuela? ¿En que parte del ciclo del agua está? ¿Qué se puede hacer para asegurar que haya la cantidad de agua limpia suficiente y que pueda realizar su ciclo naturalmente?



6TH GRADE

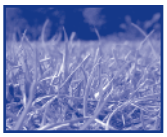
SCIENCE WATER QUALITY UNIT

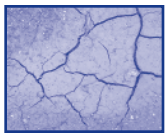
6 GRADO: UNIDAD DE CIENCIAS DE LA VIDA SOBRE LA CALIDAD DEL AGUA

INSPECCIÓN DEL PATIO DE LA ESCUELA

En tu área designada, observa todo lo que está a tu alrededor. Utiliza los marcadores/lápices de colores para marcar estas observaciones en tu mapa.

1. **Busca aquellos lugares en donde el agua puede pasar al suelo.**
   Usa puntos verdes ::: para marcar estos lugares en tu mapa.


☐ pasto


☐ tierra


☐ jardines


☐ alcorques

¿Qué otros lugares encontraste? _____

2. **Busca las fuentes de agua.**
   Utiliza una gota de agua azul ♦ para mostrar estos lugares en tu mapa.


☐ Grifos o llaves de agua


☐ bebederos

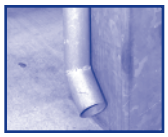

☐ rociadores


☐ mangueras

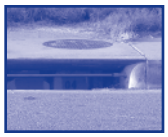
¿Qué fuentes encontraste? _____

3. **Busca aquellos lugares por donde el agua viaja.**
   Utiliza un cuadro violeta ■ para mostrar estos lugares en tu mapa.


☐ desagües


☐ tuberías


☐ cañerías de descarga

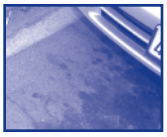

☐ cisterna de desagüe

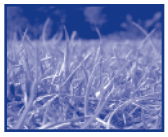
¿Qué otros lugares encontraste? _____

4. **4. Busca la basura y otras cosas que podrían ser dañinas para el agua.**
   Utiliza una X roja para mostrar estas cosas en tu mapa.


☐ basura de productos/ envoltura de comida


☐ envolturas de golosinas


☐ aceite de automóviles


☐ parques/jardines

¿Qué otros tipos de basura y elementos dañinos encontraste en tu área? _____

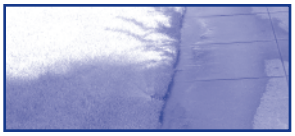
_____

INSPECCIÓN DEL PATIO DE LA ESCUELA (continuación)

5. Busca aquellas áreas en donde se desperdicia el agua. Utiliza una estrella negra ★ para mostrar estas zonas en tu mapa.

☐ Grifos/llaves de agua y rociadores que gotean

☐ desagües tapados



☐ agua derramada sobre el concreto

¿Qué otras áreas encontraste? _____

6. Escribe una pregunta que tengas con respecto a lo que observaste.

_____

_____

¿CUÁL ES LA CALIDAD DE TU AGUA?

¿Sabías que casi todas las cosas que viven en la tierra necesitan y dependen de su ambiente para sobrevivir? Las personas, plantas, animales y los otros organismos vivos viven e interactúan entre sí como parte de una comunidad. Cada miembro de dicha comunidad interactúa con su ambiente físico. Una comunidad junto con su medio ambiente físico constituye un ecosistema.

La cantidad y tipos de organismos que un ecosistema puede albergar dependen de la salud y estado de sus recursos. El medio ambiente de California tiene 200,000 millas de ríos y arroyos, 1,100 millas de costa marítima, más de 10,000 lagos y más de 1 millón de acres de bahías y estuarios. Lamentablemente, la mayoría de estos ríos y otros medio ambientes acuáticos se han contaminado. Por ejemplo, cuando llueve en las ciudades, el agua de la lluvia arrastra muchas cosas que se han quedado en el suelo, incluidos el aceite y grasa de los autos, los pesticidas de jardín, el excremento de las mascotas, y sobre todo, la ¡basura! Toda esta "contaminación de la tierra" es arrastrada por el agua de lluvia hacia los sistemas de drenaje de aguas lluvias que luego son depositadas en arroyos y ríos. Aún cuando no llueve, el agua derramada de las mangueras, rociadores y grifos lleva al agua contaminada a las cañerías que van a los arroyos y ríos.

¿Cómo afecta esto a los organismos vivos que viven allí?

El agua de lluvia que se escurre en el suelo o que lava las superficies duras puede llevar químicos peligrosos como los fertilizantes de jardín, pesticidas y desechos peligrosos como la pintura que fue dejada en el suelo. Estas sustancias tóxicas contaminan el agua subterránea o llegan hasta los arroyos, ríos y lagos y dañan a los organismos vivos que viven allí.

¿Cómo afecta esto a nuestra necesidad de tener agua saludable para beber?

Las actividades diarias de las personas tienen un impacto en nuestros ecosistemas acuáticos. Ya sea al derrochar agua, crear más basura en lugar de reciclarla o simplemente dejar sustancias tóxicas en el suelo, nuestras acciones determinan la calidad de nuestra agua.

Piensa sobre las siguientes preguntas:

- ¿Recuerdas la última vez que viste basura en el suelo? ¿De dónde vino? ¿Adónde irá? Si no está en un bote de basura, ¿qué ira a pasar con esta basura?
- ¿Y el agua desperdiciada? ¿Cómo afecta esa agua adicional que corre por las superficies a los organismos que viven en los ríos y arroyos de la zona?
- ¿Cómo es la calidad de los ríos y arroyos en tu zona? Piensa en esto cuando veas basura en el suelo o agua que corre por las calles. ¿Es esto dañino para nuestras aguas y medio ambiente?

NUESTRA INVESTIGACIÓN

Nombre(s): _____ Fecha: _____

_____

Pregunta verificable

Nuestra pregunta sobre la calidad del agua en la escuela es:

¿Cómo _____

afecta _____?

Investigación

Vamos a medir: _____

_____

_____

Herramientas y materiales

Las herramientas y los materiales que necesitamos para nuestra investigación: _____

_____

_____

Procedimiento

Los pasos que debemos seguir para llevar adelante la investigación: _____

_____

_____

_____

_____

Hipótesis

La explicación de lo que tú predices sucederá: _____

Si _____

entonces, _____

_____

_____

RECOLECCIÓN DE DATOS

Nombre(s): Fecha:

Observación 1

Preguntas o pensamientos:

Observación 2

Preguntas o pensamientos:

Observación 3

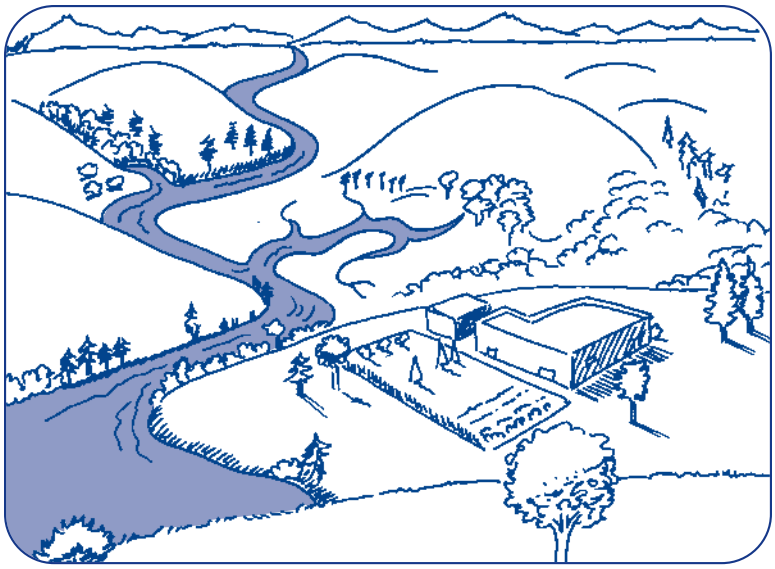
Preguntas o pensamientos:

Observación 4

Preguntas o pensamientos:

UN ECOSISTEMA ACUÁTICO VIVO

Tu comunidad, ya sea una ciudad o un pueblo rural, es parte de una cuenca de agua. Una cuenca de agua es la superficie del terreno que lleva el agua a un sistema de drenaje o un río. Ayuda a proveer agua a nuestra comunidad al permitir que se escurra en el suelo o que llegue por canales hasta los arroyos, ríos y otras masas de agua. La gravedad mueve el agua a través de la cuenca de agua desde las áreas más altas a las más bajas.



Una cuenca de agua incluye a los componentes vivos (bióticos) como las personas, la vida silvestre, las plantas y los insectos así como los componentes no vivos (abióticos), que son las rocas, el suelo, el agua y el aire. Ambos componentes pertenecen al medio ambiente de una comunidad de una cuenca de agua.

Mira a tu alrededor. ¿Cuáles son los componentes vivos y no vivos de tu cuenca de agua?

Tu cuenca de agua lleva el agua a otro sistema de componentes vivos y no vivos: un ecosistema acuático. Los componentes no vivos son los que constituyen el medio ambiente para los organismos vivos: agua, luz del sol, rocas, suelo y aire: y les permite sobrevivir. Sin estos componentes sin vida, los organismos vivos no sobrevivirían.

Los humanos dependen de los servicios de un ecosistema acuático. Los ecosistemas acuáticos nos brindan agua, alimentos, recreación y mucho más. Los humanos son responsables de proteger estos ecosistemas. Sin embargo, la contaminación puede dañar a estos ecosistemas y su capacidad para proveernos de cosas, y para mantener el equilibrio de un ecosistema en funcionamiento. Por ejemplo, los grandes ríos de California como el Sacramento, American, Feather y el bajo San Joaquín son un hábitat importante para el desove del salmón, la trucha arco iris y la lobina rayada. Los peces jóvenes dependen de los invertebrados pequeños para su alimentación, principalmente de los insectos y pequeños camarones. Cuando la “contaminación de la tierra”, los pesticidas del campo y la erosión de los lugares de construcción se escurren a través de una cuenca de agua e ingresan a los arroyos y los ríos, matan o dañan gravemente a estas fuentes de alimento y a los peces jóvenes. Esto es solamente una forma de como la condicion del ecosistema es dañado.

Miremos más de cerca cómo son afectados los factores abióticos.

Agua: Todos los seres vivos necesitan del agua para llevar adelante los procesos vitales. El agua contaminada con la contaminación de la tierra afecta tanto al hábitat acuático de los peces y otros animales como al de las plantas y algas. Estos organismos usan el agua con la luz del sol y el dióxido de carbono para producir alimentos como parte de la fotosíntesis. Otros seres vivos comen plantas y algas para tener energía.

Luz solar: Debido a que la luz solar es necesaria para la fotosíntesis, es un factor importante para las plantas, algas y otros seres vivos. Si las plantas o las algas no reciben la luz solar, no pueden crecer. Cuando la suciedad, la arena y el aceite que se acumulan en las calles de las ciudades llegan a los arroyos, arrastrados por la lluvia, disminuye la cantidad de luz que puede penetrar en el agua y reduce la cantidad de luz que las plantas y algas necesitan para crecer.

Oxígeno: Los peces, las plantas y otros organismos acuáticos necesitan del oxígeno para sobrevivir. Obtienen el oxígeno disuelto del agua que está a su alrededor. El oxígeno disuelto es el oxígeno que se almacena entre las moléculas de agua en un lago o río. La cantidad de oxígeno que hay en el agua es fundamental para la salud de todo sistema fluvial. El escurrimiento de sustancias orgánicas que demandan oxígeno como los desechos de aguas residuales, los recortes de los jardines y las hojas pueden hacer que los microorganismos realicen una descomposición excesiva, utilicen demasiado oxígeno en este proceso y disminuya la cantidad de oxígeno disuelto en el agua que hay disponible para los otros organismos vivos.

Temperatura: La temperatura del agua también puede afectar los niveles de oxígeno. El agua fría puede contener más oxígeno disuelto que el agua cálida. La temperatura del agua puede aumentar cuando las aguas que se escurren por el asfalto caliente y las aceras de concreto llegan al sistema de agua. Esto no sólo reduce la cantidad de oxígeno disponible para los organismos vivos, sino que causa problemas serios para los organismos adaptados a ciertas temperaturas del agua y ya están estresados por otros contaminantes urbanos que se escurren.

Piedras y grava: Las rocas y la grava forman los hábitat's necesarios para los organismos vivos. Los peces y los anfibios también los utilizan como sitios de desove para poner sus huevos y para que nazcan las crías. El escurrimiento de la "contaminación de la tierra" y los sedimentos pueden cubrir las rocas y la grava disponibles que los peces necesitan para poner sus huevos y cubrirlos.

Cuando los factores abióticos son afectados por la "contaminación de la tierra", todos estos factores abióticos disminuyen la disponibilidad de los recursos para los organismos vivos dentro de un ecosistema acuático. Cada componente no vivo recibe un impacto y por lo tanto tiene un impacto en los componentes vivos.

¿Qué está sucediendo en tu comunidad?
¿Adónde va el agua del patio de tu escuela? ¿A un río cercano, arroyo, lago o al océano?

La cuenca de agua de la mayoría de las ciudades y patios de las escuelas contienen hasta un 90 por ciento de superficies duras como techos, patios de juegos de concreto, calles y estacionamientos en los que el agua se recolecta rápidamente y corre por las calles. Esto no sólo impide que el agua se escurra en el suelo para reabastecer las provisiones subterráneas de agua dulce, sino que también envía a la "contaminación de la tierra" directamente a nuestros ríos y al océano.

Piensa en las siguientes preguntas:

- ¿Qué estás observando durante la recolección de datos?
  ¿Tienen un impacto las superficies duras?
- ¿Qué sucede con la "contaminación de la tierra"?
  ¿Qué impacto crees tú que puede tener en tu ecosistema de agua local?

NUESTRA CONCLUSIÓN

Nombre(s): Fecha:

Pregunta

1. La pregunta que hicimos:

Predicción

2. La predicción que hicimos:

Resultados

3. Escribe un breve resumen de los datos recolectados.

Gráfico

4. Crea un gráfico de los resultados y adjúntalo a la hoja de trabajo.

Conclusión

5. ¿Cuál es la respuesta a tu pregunta?

¿Qué descubriste?

6. ¿Qué has descubierto con respecto a la calidad del agua en tu escuela?

7. ¿Cómo sustenta la información a tu predicción? Si no la sustenta, ¿por qué no?

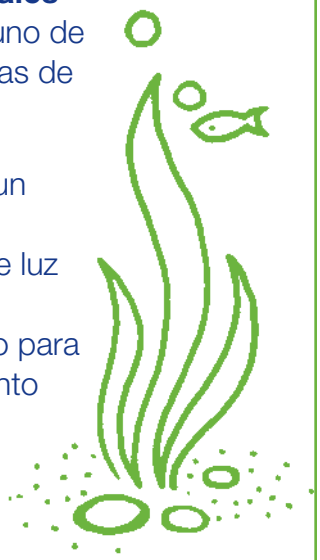
EL MUNDO ACTIVO DE LOS BIOMAS DE AGUA DULCE

Los ecosistemas acuáticos existen en todo el mundo. Podemos clasificarlos por sus características similares, por ejemplo, los tipos específicos de organismos, ubicación y clima. Las distintas agrupaciones se denominan biomas. Existen dos grandes clasificaciones de los biomas acuáticos: de agua dulce y marinos.

Los biomas de agua dulce y marinos cubren aproximadamente el 75 por ciento de la superficie terrestre. Se define al agua dulce a todas aquellas aguas que tienen una concentración baja de sal: generalmente menos del 1 por ciento. Las plantas y los animales de las regiones de agua dulce están adaptados a los contenidos de sal bajos y no podrían sobrevivir en los océanos. Estas regiones incluyen las lagunas, lagos, arroyos y ríos.

Las lagunas y lagos son masas de agua dulce estancada que están rodeadas de tierra. Los lagos son más grandes y profundos y las lagunas son menos profundas y la luz del sol puede llegar al fondo y allí crecen las plantas. Los arroyos y ríos son masas de agua en movimiento que en general se originan en las montañas y provienen del hielo que se derrite o de las aguas subterráneas. Se mueven en una sola dirección y a veces llegan al mar. Las temperaturas de las aguas son más bajas y el nivel de oxígeno de los arroyos y ríos es más alto.

Dentro de los ecosistemas, los organismos tienen tres papeles principales diferentes: productores, consumidores y los que descomponen. Cada uno de estos papeles es extremadamente importante en los ecosistemas de los biomas de agua dulce, y cada uno contribuye al estado y salud del sistema de agua.



Los productores son organismos que pueden producir todo su alimento en un ecosistema. Los productores principales de un bioma de agua dulce son las plantas y las algas. Cuando la energía ingresa a un ecosistema con la forma de luz solar, las plantas y las algas la capturan y la almacenan como energía para alimentarse. A través del proceso de la fotosíntesis, brindan oxígeno y alimento para los animales. Las algas son uno de los productores más importantes de alimento para los organismos vivos.

En las corrientes rápidas de los arroyos y ríos, los productores están adaptados con estructuras especiales que evitan que el agua los arrastre. Algunas plantas tienen raíces fuertes que las mantienen ancladas al suelo y otras tienen tallos que se doblan fácilmente con el movimiento del agua. Ciertos musgos pueden adherirse a las rocas. Las plantas que viven en las lagunas y lagos tienen adaptaciones diferentes. Se estiran para llegar al agua iluminada por el sol cerca de la parte superficial y algunas tienen estructuras que les permiten flotar en la superficie.

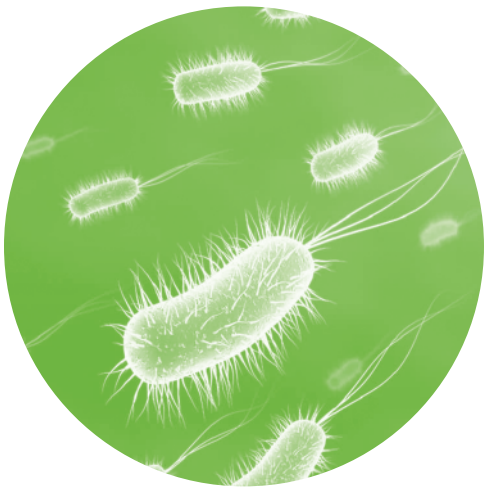
Los consumidores de un ecosistema no pueden producir su propio alimento. Dependen de los productores para su alimentación y energía. Los consumidores de un bioma de agua dulce son, por ejemplo, los caracoles, insectos, crustáceos, anfibios, peces y pájaros acuáticos.

Los consumidores también tienen adaptaciones. Los animales, como los peces, absorben el oxígeno directamente del agua y tienen un cuerpo chato y fino que les permite una mayor superficie corporal. Sus cuerpos hidrodinámicos también les ayudan a nadar y les permiten descansar al avanzar por la corriente de un río. Otros tienen estructuras similares a una copa de succión en sus cuerpos que les permiten adherirse a las rocas y al fondo del río en las aguas que se mueven rápidamente. Otros están adaptados a las aguas calmas y quietas de los lagos y lagunas y pueden captar y guardar el oxígeno. Algunos son tan livianos que pueden deslizarse por encima de la superficie del agua para buscar alimento.

Los que están encargados de **descomponer** en un ecosistema son microorganismos como las bacterias y los hongos que descomponen los desechos de los animales y de las plantas y transformarlos en alimento para otras plantas y animales. Ellos juegan un papel importante en el mantenimiento de un bioma de agua dulce.

¡Las funciones de los biomas acuáticos están en funcionamiento todos los días! Los recursos naturales como los biomas de agua dulce son limitados. Es importante que todos los componentes: vivos y no vivos estén saludables.

¿Cómo afecta el agua que fluye por el patio de la escuela a los ecosistemas de agua dulce de la zona y a sus biomas? ¿Cuáles son los factores que determinarán si las poblaciones de organismos podrán funcionar y apoyar al ecosistema? ¿Qué se puede hacer para asegurar que haya una cantidad de agua limpia suficiente y para brindar un medio ambiente sano para todos los organismos vivos, incluso para ti?



SPANISH LANGUAGE STUDENT WORKBOOK

LIBRO DE TRABAJO DE NUESTRO PROYECTO

Nombre(s):

_____

_____

_____

IDEAS PARA EL PROYECTO

Identifica y elige un proyecto que te ayude a mejorar la calidad del agua en el terreno de tu escuela o en tu vecindario.

¡Sé creativo! Los proyectos pueden ser tan simples como crear carteles para decirles a los otros estudiantes o personas en tu vecindario que no deben dejar basura en el suelo. O pueden ser más complejos, como crear un programa de reducción de los desechos en tu escuela. El proyecto sobre la calidad del agua que elijas, dependerá de ti. ¡Tú tienes el poder de crear el cambio!

ENTONCES, ¿QUÉ PROYECTO DEBERÍAS HACER?

Sigue las instrucciones para completar la hoja de trabajo a continuación para que te ayuden a decidir.

1. **¿Qué áreas de problemas encontraste en tu escuela o en tu vecindario? Sugerencia: ¿Dónde estaban las cruces rojas en el mapa de tu escuela?) Enuméralas en el cuadro.**
2. **¿Qué se puede hacer para enseñarle a otros sobre estos problemas? ¿Qué se puede hacer para eliminar o reducir los problemas? Haz una lista de las ideas al lado de cada uno de los problemas.**

Áreas problemáticas que encontramos	**Ideas de soluciones**

MIRA MÁS DE CERCA

Considera cada idea cuidadosamente. Usa las hojas de trabajo a continuación para explorar las tres ideas principales y responde a las preguntas a continuación para cada una de ellas. Si no puedes responder a ninguna de las preguntas, es posible que debas investigar un poco más la respuesta.

Idea del Proyecto sobre la calidad del agua Nº 1:

1. **¿Cómo ayudaría este proyecto a mejorar la calidad del agua en nuestra escuela o en nuestro vecindario?**

2. **¿Hay otras personas trabajando en este problema? ¿Otras clases? ¿La escuela? ¿Empresas? ¿Organizaciones?**

3. **¿Qué recursos o ayuda son necesarios para completar este proyecto (dinero, habilidades, tiempo, herramientas, etc.)?**

4. **¿Podemos lograr el proyecto en la cantidad de tiempo que tenemos para hacerlo?**

5. **¿Cómo sabremos si nuestra solución funcionó?**

MIRA MÁS DE CERCA

Idea del Proyecto sobre la calidad del agua Nº 2:

1. **¿Cómo ayudaría este proyecto a mejorar la calidad del agua en nuestra escuela o en nuestro vecindario?**

2. **¿Hay otras personas trabajando en este problema? ¿Otras clases? ¿La escuela? ¿Empresas? ¿Organizaciones?**

3. **¿Qué recursos o ayuda son necesarios para completar este proyecto (dinero, habilidades, tiempo, herramientas, etc.)?**

4. **¿Podemos lograr el proyecto en la cantidad de tiempo que tenemos para hacerlo?**

5. **¿Cómo sabremos si nuestra solución funcionó?**

MIRA MÁS DE CERCA

Idea del Proyecto sobre la calidad del agua Nº 3:

1. **¿Cómo ayudaría este proyecto a mejorar la calidad del agua en nuestra escuela o en nuestro vecindario?**

2. **¿Hay otras personas trabajando en este problema? ¿Otras clases? ¿La escuela? ¿Empresas? ¿Organizaciones?**

3. **¿Qué recursos o ayuda son necesarios para completar este proyecto (dinero, habilidades, tiempo, herramientas, etc.)?**

4. **¿Podemos lograr el proyecto en la cantidad de tiempo que tenemos para hacerlo?**

5. **¿Cómo sabremos si nuestra solución funcionó?**

¿QUÉ PROYECTO DEBERÍAMOS ELEGIR?

Mira las distintas ideas de proyecto. Según las respuestas que hayas dado, selecciona el mejor proyecto sobre la calidad del agua que puedas hacer y que pienses hará una diferencia en tu escuela o vecindario.

Una vez que hayas decidido, elige un nombre para tu proyecto.

Nombres posibles para el proyecto:

Habla sobre estos posibles nombres de los proyectos con el resto de tu clase o grupo. Realiza una votación para elegir el nombre.

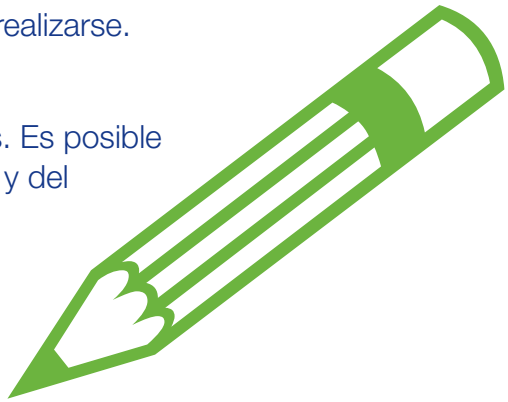
¿QUÉ TAREAS DEBERÁN REALIZARSE?

Usa el espacio a continuación para enumerar todos los pasos en los que puedas pensar para completar tu proyecto. ¿Necesitarás más información? ¿Necesitas comunicarte con otras personas para que te ayuden? Además, recuerda que necesitarás trabajar con tu maestro o maestra para recibir la aprobación del director o directora de la escuela. Todas esas cosas deberían estar incluidas en tu lista de tareas.

Lista de tareas:

ORGANIZA TUS TAREAS Y CREA UN PLAZO DE FINALIZACIÓN

1. **Utiliza la lista de tareas que hiciste para organizar tus tareas:**
   a. Agrupa las tareas similares.
   b. Ordena las tareas según el momento en que deban realizarse.
   c. Escribe quién es responsable de cada tarea.
   d. Crea un plazo de finalización para terminar las tareas. Es posible que debas mover hacia atrás la fecha de finalización y del trabajo.
   e. Asigna una fecha de finalización para cada tarea.



2. **Completa la hoja de trabajo a continuación para poder hacer un seguimiento y asegurarte que las tareas se realicen.**

Nombre del proyecto:

Tarea	Persona(s) Responsable	Fecha de finalización	Información adicional

BUSCA APOYO PARA TU PROYECTO

Diles a los demás sobre tu proyecto y busca su apoyo.

¿Puedes tú y tus compañeros de clase hacer una presentación del proyecto? ¿A quienes pueden invitar? Por ejemplo, al director o directora, las personas de la administración, el personal de mantenimiento, los padres y los miembros de la comunidad local. O ten en cuenta hacer una presentación en la próxima asamblea de la escuela.

Haz una lista a continuación de todas aquellas personas que podrían estar interesadas en conocer tu proyecto, especialmente aquellos que pueden ayudarte:

Nombres	**Cómo comunicarse con ellos**

Para tu presentación, dile a tu audiencia sobre lo que has aprendido sobre el medio ambiente y sobre la información que obtuviste mientras llevabas a cabo la revisión e investigación del patio de la escuela. Comparte lo que has aprendido y describe por qué es importante. Luego, explica tu proyecto de la calidad del agua. Ellos pueden tener ideas o recursos para ayudarte. Diles cómo pueden ayudarte.

¡AHORA VE A HACERLO!

Utiliza esta página para tomar nota sobre el progreso de tu proyecto y las cosas que deseas recordar.

¡AHORA QUE TU PROYECTO ESTÁ COMPLETO!

Evalúa tu proyecto por medio de las respuestas a tus preguntas:

1. **¿Cuáles fueron las partes más exitosas del proyecto?**_____

2. **¿Cuál fue la parte menos exitosa?** _____

3. **¿Qué aprendiste de tu experiencia?** _____

4. **¿Qué harías de modo diferente la próxima vez y por qué?** _____

5. **¿Quiénes o qué fue influenciado por tus acciones?** _____

6. **¿Deseas comprometerte en otro proyecto de servicio ambiental como este? Explica por qué o por qué no**

LO HAS LOGRADO: ¡HAS HECHO UNA DIFERENCIA!

California Water Boards desea que los estudiantes se comprometan. Nos encantaría tener noticias tuyas, sobre tu proyecto de la calidad del agua y sobre lo que has logrado. Por favor escribe o envíanos un correo electrónico a las siguientes direcciones:

Public Affairs Office
California Water Boards
1001 I Street
P.O. Box 100
Sacramento, CA, 95812
info@waterboards.ca.gov

SPANISH LANGUAGE GUIDED QUESTIONS

GUIDED QUESTIONS

4TH GRADE: LIFE SCIENCE WATER QUALITY UNIT

The following guided questions in Spanish correspond to the English versions throughout the Water Quality Service Learning Program. Use them to better communicate with your Spanish-speaking students.

Page 15: Schoolyard Review

- ¿Cuáles son las distintas fuentes de agua en nuestra escuela?
- ¿Cómo sabes que estas son una "fuente" de agua?
- ¿Dónde encontraste basura y otros objetos peligrosos?
- ¿Por dónde crees que el agua viaja a través de nuestra escuela?
- ¿Qué has aprendido como resultado de tus observaciones?
- ¿Qué preguntas tuviste con respecto a lo que observaste?

Page 19: What is the Quality of your Water?

- ¿Qué es lo que forma una comunidad?
- ¿Qué cosas constituyen un ecosistema?
- ¿Cómo afecta la contaminación a los ecosistemas de los arroyos y ríos?
- ¿Qué tipo de contaminación has podido observar en el patio de tu escuela?
- ¿De qué forma se desperdicia el agua en nuestra escuela?
- ¿Por dónde fluye el agua hacia la calle en nuestra escuela?
- ¿Por dónde se escurre el agua en el suelo en nuestra escuela?
- ¿Qué preguntas tienes sobre la calidad del agua en nuestra escuela?
- ¿En qué consistirá tu investigación?
- ¿Qué pasos o acciones son necesarias para llevar adelante tu investigación? ¿Puedes resumir estos pasos a seguir en unas pocas oraciones?
- ¿Cuál es la respuesta que predices a tu pregunta?

Page 25: Investigation Set-up

- ¿Qué deberá incluirse en la Hoja de Recolección de Datos?
- ¿Qué esperas encontrar luego de la primera recolección de datos?
- ¿Qué esperas encontrar luego de varias recolecciones de datos?

Page 28: A Living Water Ecosystem

- ¿Cuáles son los componentes bióticos y abióticos de nuestra cuenca de agua?
- ¿Dónde hay cuencas de agua dentro de nuestra escuela?
- ¿Qué necesita un organismo vivo para sobrevivir en un ecosistema?
- ¿De qué servicios del agua o productos con agua dependes tú?
- ¿Cuál es la masa de agua más cercana a nuestra escuela?
- ¿Está esa masa de agua conectada con otra masa de agua?
- Según tus investigaciones, ¿qué impacto tiene el escurrimiento del agua en el terreno de la escuela en tu sistema de agua local?
- ¿Cómo puedes saberlo?

Page 31: Investigation Conclusion

- Si tuvieras que repetir el estudio, ¿qué harías diferente?
- ¿Qué predicciones fueron exactas y cuáles no? ¿Cómo puedes saberlo?
- ¿Cómo sustenta tu información a tu predicción? Si no la sustenta, ¿por qué no?
- ¿Qué has descubierto con respecto a la calidad del agua en tu escuela?

4TH GRADE: LIFE SCIENCE WATER QUALITY UNIT GUIDED QUESTIONS CONTINUED

Page 34: Beneficial Micro-Organisms at Work

- ¿Cómo pueden ser beneficiosos los microorganismos?
- ¿Cómo pueden ser beneficiosas las tierras pantanosas?
- ¿Qué componentes de un ecosistema acuático son seres vivos (bióticos)?
- ¿Qué componentes de un ecosistema acuático son seres no vivos (abióticos)?
- ¿Cómo impactan los humanos a un ecosistema acuático?
- ¿Cómo determina el impacto humano en un ecosistema si un organismo vivo sobrevivirá?

Page 36: Reflection

- ¿Qué aprendiste de tu experiencia?
- ¿En qué se diferenciaron tus conclusiones de tus expectativas?
- ¿Cómo puede tu conocimiento sobre el agua ayudarte a hacer buenas elecciones con respecto a la calidad del agua?
- ¿Por qué es importante el agua dulce limpia?
- ¿Qué ideas tienes para mejorar la calidad del agua en tu escuela o en tu comunidad?

Page 38: Setting Up A Service Learning Project

- ¿Cuáles fueron las partes más exitosas del proyecto?
- ¿Cuál fue la parte menos exitosa?
- ¿Qué aprendiste de tu experiencia?
- ¿Qué harías de modo diferente la próxima vez y por qué?
- ¿Qué o quiénes fueron influidos por tu acción?
- ¿Deseas comprometerte en otro proyecto de servicio ambiental? ¿Por qué o por qué no?

GUIDED QUESTIONS

5TH GRADE: EARTH SCIENCE WATER QUALITY UNIT

The following guided questions in Spanish correspond to the English versions throughout the Water Quality Service Learning Program. Use them to better communicate with your Spanish-speaking students.

Page 46: Schoolyard Review

- ¿Cuáles son las distintas fuentes de agua en nuestra escuela?
- ¿Cómo sabes que estas son una "fuente" de agua?
- ¿Dónde encontraste basura y otros objetos peligrosos?
- ¿Por dónde crees que el agua viaja a través de nuestra escuela?
- ¿Qué has aprendido como resultado de tus observaciones?
- ¿Qué preguntas tuviste con respecto a lo que observaste?

Page 48: What is the Quality of Your Water?

- ¿Dónde está la mayor parte del agua dulce de la tierra?
- ¿De qué forma usamos el agua dulce?
- ¿Cómo se contamina el agua dulce?
- ¿Que tipo de contaminación del suelo has podido observar en el patio de tu escuela?
- ¿De qué forma se derrocha el agua en nuestra escuela?
- ¿Por dónde fluye el agua hacia la calle en nuestra escuela?
- ¿Por dónde se escurre el agua en el suelo en nuestra escuela?
- ¿Qué preguntas tienes sobre la calidad del agua en tu escuela?
- ¿Qué puedes medir como parte de una investigación para responder a tu pregunta?
- ¿Qué pasos son necesarios para llevar adelante la investigación? ¿Puedes resumir los pasos en unas pocas oraciones?
- ¿Cuál es la respuesta que predices para tu pregunta?

Page 54: Investigation Set-up

- ¿Qué deberá incluirse en la Hoja de Recolección de Datos?
- ¿Qué esperas encontrar luego de la primera recolección de datos?
- ¿Qué esperas encontrar luego de varias recolecciones de datos?

Page 57: Where Does Your Water Come From?

- ¿Cuál es el origen del agua dulce en tu comunidad?
- ¿Se entuba desde un reservorio o proviene de una fuente subterránea?
- ¿Cuál es la masa de agua más cercana a nuestra escuela?
- ¿Adónde, si es que existiera, fluye esa masa de agua?
- ¿Qué impacto puedes observar en tu sistema de agua local? ¿Cómo puedes saberlo?

Page 60: Investigation Conclusion

- Si tuvieras que repetir el estudio, ¿qué harías diferente?
- ¿Qué predicciones fueron exactas y cuáles no? ¿Cómo puedes saberlo?
- ¿Cómo sustenta tu información a tu predicción? Si no la sustenta, ¿por qué no?
- ¿Qué has descubierto con respecto a la calidad del agua en tu escuela?

5TH GRADE: EARTH SCIENCE WATER QUALITY UNIT GUIDED QUESTIONS CONTINUED

Page 63: How Does Water Cycle?

- ¿Por qué la mayor parte del agua de la tierra no sirve para que los humanos la puedan beber?
- ¿A través de qué proceso se transforma el agua líquida en vapor de agua?
- ¿Cómo se denominan a la lluvia, el hielo y la nieve en el ciclo del agua?
- ¿Qué función cumple el sol en el ciclo del agua?
- ¿Cuáles son algunos ejemplos de cómo los humanos dependen del ciclo del agua para sus necesidades?
- ¿Cuál es el impacto que tienen los humanos en el ciclo del agua?

Page 66: Reflection

- ¿Qué aprendiste de tu experiencia?
- ¿En que se diferenciaron tus conclusiones de tus expectativas?
- ¿Cómo puede tu conocimiento sobre el agua ayudarte a hacer buenas elecciones con respecto a la calidad del agua?
- ¿Por qué es importante el agua dulce limpia?
- ¿Qué ideas tienes para mejorar la calidad del agua en tu escuela o en tu comunidad?

Page 68: Setting Up a Service Learning Project

- ¿Cuáles fueron las partes más exitosas del proyecto?
- ¿Cuál fue la parte menos exitosa?
- ¿Qué aprendiste de tu experiencia?
- ¿Qué harías de modo diferente la próxima vez y por qué?
- ¿Qué o quiénes fueron influidos por tu acción?
- ¿Deseas comprometerte en otro proyecto de servicio ambiental? ¿Por qué o por qué no?

GUIDED QUESTIONS

6TH GRADE: LIFE SCIENCE WATER QUALITY UNIT

The following guided questions in Spanish correspond to the English versions throughout the Water Quality Service Learning Program. Use them to better communicate with your Spanish-speaking students.

Page 73: Schoolyard Review

- ¿Cuáles son las distintas fuentes de agua en nuestra escuela?
- ¿Cómo sabes que estas son una "fuente" de agua?
- ¿Dónde encontraste basura y otros objetos peligrosos?
- ¿Por dónde crees que el agua viaja a través de nuestra escuela?
- ¿Qué has aprendido como resultado de tus observaciones?
- ¿Qué preguntas tuviste con respecto a lo que observaste?

Page 77: What is the Quality of Your Water?

- ¿Qué es lo que forma una comunidad?
- ¿Que cosas constituyen un ecosistema?
- ¿Cómo afecta la contaminación a los ecosistemas de los arroyos y ríos?
- ¿Que tipo de contaminación has podido observar en el patio de tu escuela?
- ¿De qué forma se desperdicia el agua en nuestra escuela?
- ¿Por dónde fluye el agua hacia la calle en nuestra escuela?
- ¿Por dónde se escurre el agua en el suelo en nuestra escuela?
- ¿Qué preguntas tienes sobre la calidad del agua en nuestra escuela?
- ¿En qué consistirá tu investigación?
- ¿Qué pasos o acciones son necesarias para llevar adelante tu investigación? ¿Puedes resumir estos pasos a seguir en unas pocas oraciones?
- ¿Cuál es la respuesta que predices a tu pregunta?

Page 83: Investigation Set-up

- ¿Qué deberá incluirse en la Hoja de Recolección de Datos?
- ¿Qué esperas encontrar luego de la primera recolección de datos?
- ¿Qué esperas encontrar luego de varias recolecciones de datos?

Page 86: A Living Water Ecosystem

- ¿En qué difieren los factores bióticos de los abióticos?
- ¿Cuáles son los factores bióticos y abióticos de tu cuenca de agua?
- ¿Dónde hay cuencas de agua dentro de nuestra escuela?
- Cuando hay un impacto en los factores abióticos de un ecosistema acuático, ¿cómo afecta este impacto a los factores bióticos?
- ¿De qué servicios del agua o productos con agua dependes tú?
- ¿Cuál es la masa de agua más cercana a nuestra escuela?
- ¿Adónde, si es que existiera, fluye esa masa de agua?
- ¿Qué impacto puedes observar en tu sistema de agua local? ¿Cómo puedes saberlo?

6TH GRADE: LIFE SCIENCE WATER QUALITY UNIT GUIDED QUESTIONS CONTINUED

Page 89: Investigation Conclusion

- Si tuvieras que repetir el estudio, ¿qué harías diferente?
- ¿Qué predicciones fueron exactas y cuáles no? ¿Cómo puedes saberlo?
- ¿Cómo sustenta tu información a tu predicción? Si no la sustenta, ¿por qué no?
- ¿Qué has descubierto con respecto a la calidad del agua en tu escuela?

Page 92: The Active World of Freshwater Biomes

- ¿Cuáles son las dos regiones básicas de los biomas acuáticos?
- ¿Qué determina si un bioma acuático es de agua dulce o marina?
- ¿Cuál es la fuente de energía para la mayoría de los ecosistemas?
- ¿Cuál es la diferencia entre un productor y un consumidor?
- ¿Cómo son los humanos los consumidores en un ecosistema?
- ¿Cuál es uno de los productores más importantes en un bioma de agua dulce?
- ¿Cómo se adaptan los organismos de un bioma de agua dulce a su medio ambiente?
- ¿Qué partes de un bioma de agua dulce son bióticos?
- ¿Qué partes de un bioma de agua dulce son abióticos?
- ¿Cuáles son los dos factores abióticos que afectan a los organismos en un río?
- ¿Cómo impactan los humanos los ecosistemas de un bioma de agua dulce?
- ¿Cómo determinan las condiciones de los factores abióticos de un ecosistema de agua dulce la cantidad y diversidad de organismos que puede albergar?

Page 95: Reflection

- ¿Qué aprendiste de tu experiencia?
- ¿En que se diferenciaron tus conclusiones de tus expectativas?
- ¿Cómo puede tu conocimiento sobre el agua ayudarte a hacer buenas elecciones con respecto a la calidad del agua?
- ¿Por qué es importante el agua dulce limpia?
- ¿Qué ideas tienes para mejorar la calidad del agua en tu escuela o en tu comunidad?

Page 97: Setting Up a Service Learning Project

- ¿Cuáles fueron las partes más exitosas del proyecto?
- ¿Cuál fue la parte menos exitosa?
- ¿Qué aprendiste de tu experiencia?
- ¿Qué harías de modo diferente la próxima vez y por qué?
- ¿Qué o quiénes fueron influidos por tu acción?
- ¿Deseas comprometerte en otro proyecto de servicio ambiental? ¿Por qué o por qué no?

Erase the Waste

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