2007 – 2008

Water Education

FREE PROGRAMS AND MATERIALS FOR TEACHERS

satellite image of global water temperatures

San Diego County Water Authority

Programs align with State standards

SAN DIEGO COUNTY WATER AUTHORITY

WATER EDUCATION 200

Who are we?

The San Diego County Water Authority is a public agency serving the San Diego region as a wholesale supplier of water. We work through our 24 member agencies to provide a safe, reliable water supply for more than 3 million residents. A map of our service area and list of our member agencies are located on the back of this brochure.

San Diego County is a semiarid region receiving an average of about 10 inches of precipitation per year. Local rainfall provides only a small fraction of the water needed for this area's homes and businesses. The vast majority of the water used in the county is imported from two main sources: the Colorado River and rivers in Northern California. The Water Authority receives water via the Colorado River Aqueduct and the California Aqueduct. We then distribute that water to our member agencies through several large, underground pipelines collectively referred to as the San Diego Aqueducts. Our member agencies provide that imported water – along with local supplies – to local homes and businesses.

What's up with the push for conservation?

Periodic droughts are a reality in San Diego. So are droughts in the Sierras and Rocky Mountains, where most of our water supplies originate. Because of the potential for drought and our limited local water sources, conservation has always been a way of life in San Diego County. But conservation is especially important now. Why? Because California is experiencing its driest conditions in recent history, and environmental concerns may further limit our imported water supplies. As a resident, you can help by joining the "20-Gallon Challenge" to cut back your water usage by 20 gallons per day. As a teacher, you can help even more by providing your students with the knowledge they need to become wise water users.

Why do teachers praise our school programs?

Each year, thousands of teachers benefit from

education programs provided or supported by the Water Authority. Our programs are in demand because they are aligned with the state standards and are designed and carried out by staff who are knowledgeable about the needs of teachers and students.

The 20 Gallon challenge
Save Water Now

The Water Authority's programs teach students about our semiarid environment, the history and future of water development in California and San Diego in particular, our water sources, water conservation, and preserving our natural resources. In addition to helping teachers meet their educational goals, these programs also help students prepare for their adult life as partners in the Water Authority's mission to ensure a safe, reliable water supply for the San Diego region. We have something for everyone: workshops, curriculum, assemblies, classroom presentations, mini-grants, and other special programs and materials for grades K-12.

Most of our programs are provided FREE of charge to schools within our service area. To learn more about each of our programs, read the descriptions in this brochure or visit www.sdcwa.org/education.

San Diego County Water Authority

If you have any questions, please contact our education staff:

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7 - 2008

TABLE OF CONTENTS

Educational Resources on the Web

SanDCREEC
environmental education programs
www.creec.org/region9a/

S.D. Science Alliance
consortium of educators, scientists and businesses that support K-12 education
www.sdsa.org

Water Education Foundation
water education materials
www.watereducation.org

Department of Water Resources
water facts, water education
www.publicaffairs.water.ca.gov/education

California School Garden Network
school garden ideas, curriculum, and grants
www.csgn.org

Water Conservation Resources on the Web

The Water Conservation Garden
water-wise demonstration garden
www.thegarden.org

The Landscape Watering Calculator
online calculator computes individualized watering requirements
http://apps.sandiego.gov/landcalc

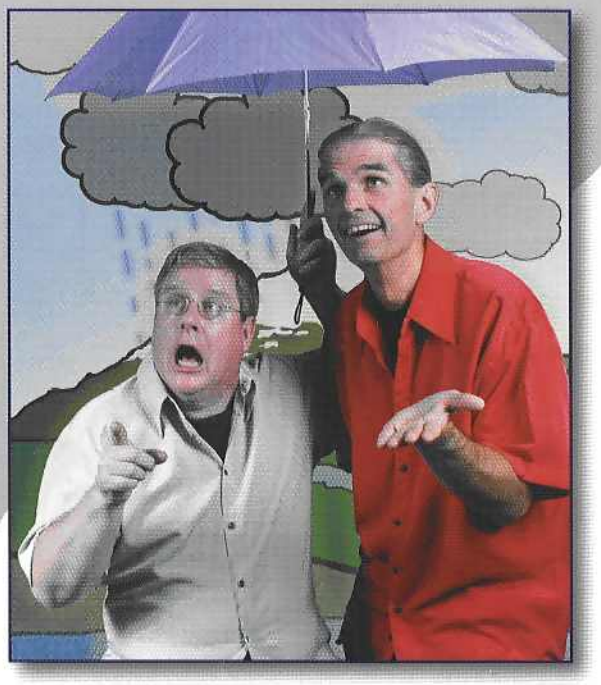
The California Friendly Garden Guide
searchable plant database and other useful features
www.bewaterwise.com

San Diego County Water Authority
20-Gallon Challenge information
www.sdcwa.org
(click on 20-Gallon Challenge logo)

San Diego County Water Authority
other water conservation programs
www.sdcwa.org
(click on conservation photo)

H_2O, Where Do You Go? (K-6th grade)

A musical science show about water



What happens when you combine science, music, and comedy? You get "H_2O, Where Do You Go?" — The Water Authority's assembly program produced by "Razzle Bam Boom." Topics include the importance of water, how we get most of our water from far away places, and why everyone should care about conserving water. Length of the program is about 40 minutes. Each teacher receives a class set of an educational "cootie catcher" that reinforces concepts presented in the assembly.

Location: At your school

Cost: We pay the fee, so it is FREE for your school.

Please Note: Minimum audience size is 200 for each performance.

To Schedule: To book a performance, consult the calendar dates at www.showsthatteach.com to check available dates. Then email donna@showsthatteach.com listing your three top booking dates, possible show times, and your contact information that includes email, phone, and school address. Type "booking request" in the SUBJECT line of your email.

Traveling Library (K-6th grade)

Library display and 3rd-grade classroom presentations

This program focuses on the librarian as a resource for students and teachers by providing participating schools with:

- Three weeks to enjoy a free-standing library display consisting of three interactive panels and a selection of over 100 books, including Spanish titles. Reading and interest level of the books range from kindergarten through sixth grade.
- Seven free books for the school's library.
- Third-grade classroom presentations that adhere to the state frameworks. Students learn how the Kumeyaay of the past dealt with San Diego County's semiarid climate and how we deal with it today. A Native American drought story and stick-dice game culminate the presentation.

Location: At your school

Cost: FREE

To Schedule: Due to the popularity of this program, we recommend reserving early. Only the librarian may reserve this program. To schedule, ask your school librarian to fill out the request form at the back of this brochure. For more information, contact Ivan Golakoff at 858-522-6719 or igolakoff@sdcwa.org.

Weather & Water in San Diego (5th grade)

Classroom presentation

Why doesn't San Diego get more rain? What types of weather events have an impact on our climate? Do the ocean and the water cycle play a part? Where does our water come from? Why is it important to conserve water?

These are some of the questions that will be answered during the Water Authority's fifth-grade classroom presentation. This 60-minute presentation adheres to the fifth-grade science standards and utilizes lecture, visuals, scientific demonstrations, and hands-on activities. Teachers are given class sets of a 16-page booklet, "The Story of Drinking Water."

Location: In your classroom

Cost: FREE

To Schedule: All fifth-grade presentations at your school must be scheduled for the same date. Exceptions may be made for schools with more than one track or with more fifth-grade classes than can be visited in one day. Please check with the other fifth-grade teachers at your school and select one teacher to coordinate the presentations. Fill out the request form at the back of this brochure to schedule presentations for your school.

Splash Science Mobile Lab (4th-6th grade)

A field trip that comes to your school!

The County Office of Education, in collaboration with the San Diego County Water Authority, offers this award-winning program. Geared toward grades four through six, the curriculum concentrates on six teaching stations:

- Microscopes
- Research
- Life in an estuary
- Water quality testing
- Storm drain pollution model
- Conservation

Golden Bell Award Winner

Delivered in an innovative manner, the curriculum encompasses computer analysis, hands-on experimentation, observation, and group problem solving. The lab can accommodate up to four classes per day.

Location: At your school

Cost: $525 paid to the San Diego County Office of Education. Check with your local water agency for possible assistance with funding. (See back of brochure for a list of local water agencies.)

To Schedule: Call the San Diego County Office of Education at (858) 292-3696.

Xeriscape Gardening (K-12th grade)

This five-hour workshop will present the seven basic principles of Xeriscape gardening and includes an instructional tour of the Water Conservation Garden at Cuyamaca College in El Cajon. This innovative, four-acre garden features numerous plants and displays demonstrating design, maintenance, irrigation, and edible plants. Participants receive a binder with curriculum materials, plant identification information, children's gardening guide, and ideas about starting a garden at your school.

Choice of Dates: **10/08/07, 11/13/07, 1/08/08, 2/12/08, 3/11/08, 4/08/08, 5/13/08**

Location: The Water Conservation Garden at Cuyamaca College

Cost: FREE

To Register: Download the registration form at www.sdcwa.org/education, or contact Ivan Golakoff at (858) 522-6719 or igolakoff@sdcwa.org.

Regional Water Quality Testing Program (6th-12th grade)

This hands-on program centers around a water-testing kit containing equipment and supplies for the following tests: temperature, pH, DO, BOD, nitrates, turbidity, TDS, hardness, and microbiology.

Each teacher receives a set of GIS watershed maps, a teacher's manual, a student workbook, and a San Diego water history book. The water-testing kit can be checked out for use after attending the workshop. This program meets the state science framework for ecology, biology, chemistry, and geology. It also meets investigation and experimentation requirements.

Choice of Dates: **October 15, 2007 and January 14, 2008**

Location: Mission Trails Regional Park

Cost: FREE

To Register: Download the registration form at www.sdcwa.org/education, or contact Ivan Golakoff at (858) 522-6719 or igolakoff@sdcwa.org.

Water Curriculum Workshop (K-12th grade)

A wonderful assortment of water-education curriculum awaits you at this workshop presented by the Metropolitan Water District and sponsored by the Water Authority. Enthusiastic instructors give you hands-on training, free materials, and a free lunch too! Read descriptions of the included curriculum on this page.

Choice of Dates: **November 8, 2007 and January 17, 2008**
Each date includes a morning session for K-5th grade and an afternoon session for 6-12th grade.

Location: San Diego County Water Authority Kearny Mesa office

Cost: FREE

To Register: Download the registration form at www.sdcwa.org/education, or contact Ivan Golakoff at (858) 522-6719 or igolakoff@sdcwa.org.

Morning Session

All About Water (K-3rd grade)

Interdisciplinary Curriculum

The activities and science experiments in this teacher's guide integrate math, science, art, music, and language arts and provide an understanding of California's water supply. Topics include water quality, water distribution, water conservation, and the water cycle.

Admiral Splash (4th-5th grade)

Social Studies/Science Curriculum

Guided by Admiral Splash, students learn about California's water systems, where our water comes from, how it is distributed and treated, and how to conserve. This kit contains a teacher's guide, a video, a wall map of California's water system, and a class set of workbooks, tests, and home information leaflets.

Water Ways (5th grade)

Social Studies Curriculum

This activity-oriented unit examines the role of water during three historical periods: Pre-Columbian, Colonial, and the Westward Movement. Activities include making a rain stick, tracking Lewis and Clark's Expedition, and more. The program comes complete with a teacher's guide and a set of 35 consumable student booklets.

Afternoon Session

Water Times (6th grade)

Interdisciplinary Curriculum

This newspaper-style curriculum integrates science, social studies, language arts, and math. It's engaging, challenging, and relevant to the lives of sixth graders; and creates an awareness and stewardship of water in an exciting way. Includes a teacher's guide and set of consumable student newspapers.

Water Works (6th-12th grade)

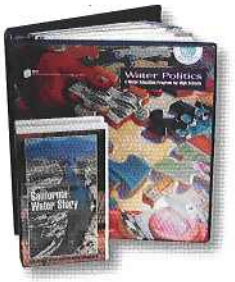
School-to-Career Curriculum

Increase student awareness of career tracks in the water industry with this problem-solving program developed jointly by the Water Authority and the Metropolitan Water District. The program features a two-part video; a set of multi-disciplinary activities; a set of career profiles; and a CD containing video interviews, an interactive game, and more.

Water Quality: the Qualities & Science of Water (7th-12th grade)

Science Curriculum

This program is a hands-on, inquiry-based approach to the water quality issues faced by the water industry and society. The activities emphasize various topics such as watershed management, total dissolved solids, and MTBE. This unit is in a binder format with teacher guide, student and basic lab materials, lesson extensions, and glossary.



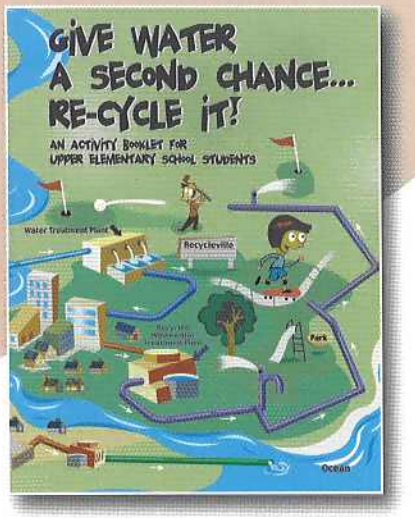
Water Politics (9th-12th grade)

Government/Economics/ Environmental Science Curriculum

This unit consists of case studies relating to contemporary water issues. Through critical thinking and role-playing activities, students investigate the role of various agencies and special interest groups. The teacher's guide includes: lesson plans, a copy of student materials, a video, a California's Water Resources map, and accompanying worksheets and material for each case study.

Give Water a Second Chance ... Re-Cycle It! (5th grade)

Science activity booklet



This colorful, 16-page booklet teaches students how water is recycled and why water recycling is important. Jam-packed with cool graphics and activities, this consumable booklet will keep your students thoroughly engaged.

Cost: FREE

Quantity: One per student

To Order: Fill out the request form at the back of this brochure. Quantities are limited and will be filled on a first-come, first-served basis.

HELP History Video Series (3rd-4th grade)

Video series in VHS or DVD

This video series will wet your students' thirst for knowledge about local and state history.

- **San Diego County: History and Growth - Third Grade**
  In this short video, historical photos are woven into a story designed to motivate third grade students to learn more about the communities in which they live. Students learn that water played a major role in the development of San Diego, and that contributions of people of all races have helped to shape San Diego's unique history.
- **California: A Changing State - Fourth Grade**
  This video series follows the adventures of five students as they explore the history and geography of California. Through the use of special effects, their stories are told in five short videos, each addressing a different era. The videos also show how water played a key role in the development of California.

Cost: FREE

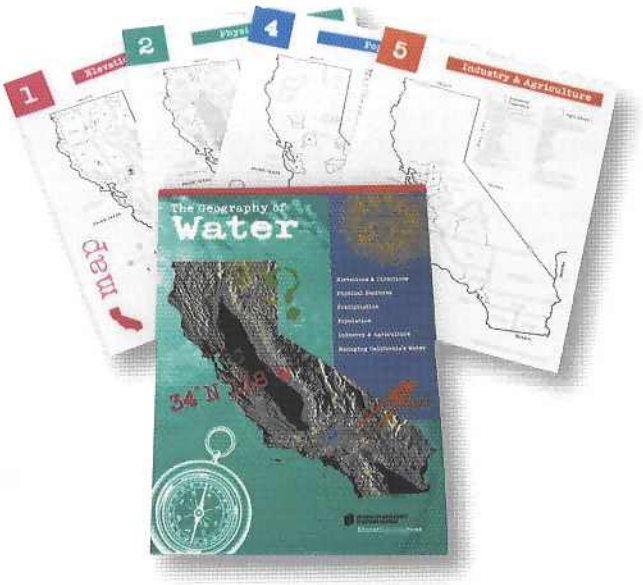
Quantity: One per school

To Order: Each school in the county was provided with a copy of each video in 2007. If your school has not received a copy or if your copy has been misplaced, contact Ivan Golakoff at 858-522-6719 or igolakoff@sdcwa.org.

POSTERS, & MAPS

Geography of Water (4th-8th grade)

Map study curriculum



Featuring California's geography, this unit contains seven mapping activities that lead to a better understanding of the role water has played in California's development. Topics include: elevations, physical features, precipitation, population, industry & agriculture, moving and using California's water, and San Diego's geography with local water perspectives.

Cost: FREE

Quantity: One per teacher

To Order: Fill out the request form at the back of this brochure.

San Diego: World in Harmony (7th-12th grade)

Environmental curriculum

This multi-agency effort is the most comprehensive environmental curriculum ever produced for this region. It earned an A rating from the State Department of Education. Through a series of multi-disciplinary activities, the curriculum addresses 15 environmental issues and offers 75 hands-on activities in science, social studies, math, language arts, and history.

Cost: FREE

Quantity: One per teacher

To Order: Fill out the request form at the back of this brochure.

Assorted Videos (K-12th grade)

The Metropolitan Water District, of which the San Diego County Water Authority is a member, has a great selection of videos available for loan. For a complete list, visit MWD's website at www.mwdh2o.com and click on the link under "Education." Then click on "Teacher Resources." Next click on "Resources." Lastly, click on "Video Tapes."

Cost: Videos are loaned out for free, you pay return postage

Quantity: Up to 2 videos at a time

To Order: Contact Metropolitan Water District "Education Programs" at 213-217-6926 or rdonnelly@mwdh2o.com.

Posters, Maps, & Booklets (K-12th grade)

Don't miss out on these freebies! For a list of available items, visit Metropolitan Water District's website at www.mwdh2o.com and click on the link under "Education." Then click on "Teacher Resources." Next click on "Resources." Lastly, choose a link in the "Educational Materials" section.

Cost: FREE

Quantity: One per teacher or a class set, depending on item

To Order: Contact Metropolitan Water District "Education Programs" at 213-217-6926 or rdonnelly@mwdh2o.com.

OTHER PROGRAMS

Youth Merit Patch Program

The patch program is designed for youth groups ages 6-15 such as Boy Scouts, Girl Scouts, and Camp Fire Boys and Girls. The program consists of requirements designed to teach children about their water supply and conservation. Upon completion, each group member will receive an embroidered patch.

Cost: FREE

To Participate: Contact Susan Bohlander at 858-522-6721 or sbohlander@sdcwa.org. More information is available online at www.sdcwa.org/education.

Mini-grant Program (all grades)

The Water Authority offers mini-grants of up to $300 to teachers for the development of school-based Xeriscape gardens. Grants are accepted and processed throughout the year.

Cost: FREE

To Apply: Download the application form at www.sdcwa.org/education, or contact Ivan Golakoff at (858) 522-6719 or igolakoff@sdcwa.org.

Reuben H. Fleet Science Center Exhibit (all grades)

This interactive model demonstrates where our water comes from and how it is transported, treated, and distributed. Compare water usage in a traditional house with one that has been retrofitted with conservation fixtures.

Cost: There is an entrance fee to the Fleet Science Center. For hours and admission fee information, call (619) 238-1233.

Science Fair Awards (7th-12th grade)

The Water Authority offers awards of $100–$300 for outstanding water-related entries at the Greater San Diego Science and Engineering Fair. Prizes will be awarded to winners in both junior and senior divisions and presented to the students at a Water Authority board meeting.

NOTE: LaMotte, the maker of our water science testing kits, is a useful resource for Science Fair testing equipment. Contact LaMotte at www.lamotte.com or call (800) 344-3100 for their catalog and additional information.

Cost: The Greater San Diego Science and Engineering Fair charges a small fee to participate.

To Enter: All projects entered in the Greater San Diego Science and Engineering Fair will automatically be considered for the Water Authority's awards.

REQUEST FORM 2007-2008

Complete this form and FAX (858) 268-7841 or mail to: Education Programs, San Diego County Water Authority, 4677 Overland Ave., San Diego, CA 92123. OR request programs using online forms at www.sdcwa.org/education.

San Diego County Water Authority

Please print using blue or black ink.

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❑ Mr.
❑ Mrs.
❑ Ms
❑ Miss

First Name _____ Last Name _____

Today's Date _____ Email _____

Phone # (____)_____ ext _____ Best times to call _____

School _____ District _____

Position: ❑ Classroom teacher ❑ Resource teacher ❑ Librarian ❑ Other _____

Teachers, please provide the following additional information:

Grade level(s)_____ Subject(s)_____

Please put a check mark in the box for each curriculum you desire. If you check a box, also fill in the associated blanks. The curriculum will be mailed to you.

❑ **Geography of Water (map study curriculum for 4th-8th grade)**
Number of classes____ Total number of students____

❑ **Give Water a Second Chance ... Re-Cycle It! (science activity booklet for 5th grade)**
Number of classes____ Total number of students____

❑ **San Diego: World in Harmony (environmental curriculum for 7th-12th grade)**
Number of classes_____ Total number of students_____

For these two programs, check the box only if you will be coordinating the program for your school. If someone else is coordinating the program, that person should send in a request form.

❑ **Weather and Water in San Diego (classroom presentation for 5th grade)**
First choice month _____ Second choice month_____
Number of classes_____
Total number of students_____
(Water Authority staff will contact the coordinator to schedule the presentations.)

❑ **Traveling Library Program (library display and 3rd-grade presentation)**
Note: Only the librarian may request the Traveling Library
First choice month _____ Second choice month_____
Number of 3rd-grade classes_____
(Water Authority staff will contact you to schedule the Traveling Library.)

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For workshops and other programs not listed above, check the program description in the brochure for contact information.

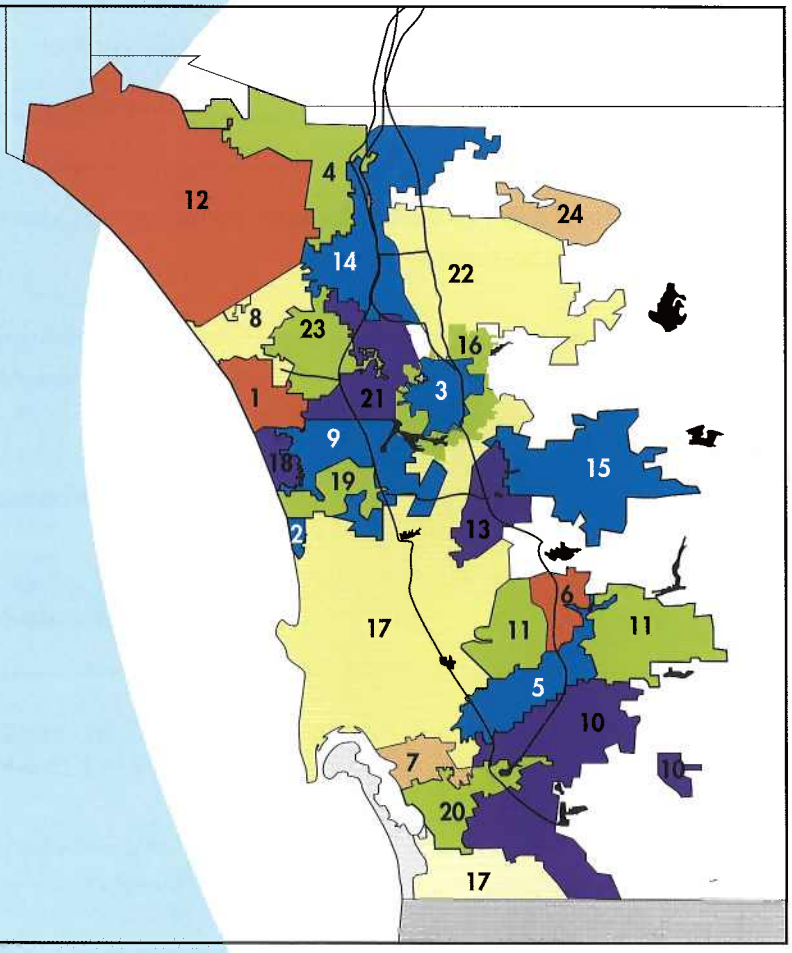
The Water Authority is a public agency serving the San Diego region as a wholesale supplier of water. The Water Authority works through its 24 member agencies to provide a safe, reliable water supply to support the region's $150 billion economy and the quality of life of more than 3 million residents.

Member Agencies

1	Carlsbad MWD	760-438-2722
2	City of Del Mar	858-755-3294
3	City of Escondido	760-839-4657
4	Fallbrook Public Utility District	760-728-1125
5	Helix Water District	619-466-0585
6	Lakeside Water District	619-443-3805
7	City of National City*	619-420-1413
8	City of Oceanside	760-435-5800
9	Olivenhain MWD	760-753-6466
10	Otay Water District	619-670-2777
11	Padre Dam MWD	619-258-4600
12	Camp Pendleton Marine Corps Base	760-725-1061
13	City of Poway	858-668-4401
14	Rainbow MWD	760-728-1178
15	Ramona MWD	760-789-1330
16	Rincon del Diablo MWD	760-745-5522
17	City of San Diego	619-533-7555
18	San Dieguito Water District	760-633-2840
19	Santa Fe Irrigation District	858-756-2424
20	South Bay Irrigation District*	619-420-1413
21	Vallecitos Water District	760-744-0460
22	Valley Center MWD	760-749-1600
23	Vista Irrigation District	760-597-3100
24	Yuima MWD	760-742-3704

A member of the San Diego County Board of Supervisors also serves as a representative to the Water Authority board of directors

**The Sweetwater Authority is a service organization for the city of National City and the South Bay Irrigation District.*



San Diego County Water Authority

San Diego County Water Authority
4677 Overland Avenue
San Diego, CA 92123-1233
t 858.522.6700
f 858.268.7841
www.sdcwa.org

2008 POSTER CONTEST

WATER IS LIFE...

MAKE EVERY DROP COUNT

Contest Deadline

April 18, 2008

Category 1: Grades K-3

Category 2: Grades 4-6

Prizes for the 1st, 2nd & 3rd Place winners

&

Certificates for all

See other side for contest rules

For more information call:

Pam Rega

Water Conservation Specialist

Otay Water District

(619) 670-2291

Teachers: Please help with the screening process. Send no more than six posters per classroom. Certificates are available for all students who enter the contest. Let us know how many you will need.

WATER EDUCATION

Grades K thru 6
from the Otay Water District

Borrow a LEARN ABOUT WATER Kit

AVAILABLE FOR THE FOLLOWING TOPICS

- Water Cycle
- Water Pollution
- Source/Delivery of Drinking Water
- Water Conservation

EACH KIT INCLUDES

- Background Information
- Standards-based, grade appropriate lesson plans for all grades
- Materials to teach each lesson
- Videos
- Books
- Workbooks

Water Awareness Poster Contest

Encourage your students to enter our annual poster contest.

- Prizes for 1st , 2nd & 3rd Place winners
- All participants receive certificates

Mini Grant Program

- Funding up to $300 for the development of water related projects and activities
- funding for half the cost of the Splash Science Lab
- Call (619)670-2291 for grant application

Education for Educators

PROJECT WET EDUCATOR WORKSHIP

- date to be announced
- includes a 500+ page curriculum.

XERISCAPE GARDENING TEACHER WORKSHIP

- held at the Water Conservation Garden
- provides curriculum, ideas and materials.

San Diego County Water Authority will pay for release time for teachers who attend workshops.

TEACHER INSERVICE: available for educators wishing to receive Metropolitan or County Water Authority developed materials and programs.

FREE Field Trip
Grades 3-6

THE WATER CONSERVATION GARDEN

- Participate in a hands-on workshop
- Learn about water-wise gardening

limited funding available for transportation

For more information, to reserve a Kit or schedule a Field Trip:

Pam Rega ~ (619) 670-2291 ~ prega@otaywater.gov

WATER EDUCATION

Borrow a LEARN ABOUT WATER Kit

Kit includes the following programs

GEOGRAPHY OF WATER: a map study featuring California's geography

SAN DIEGO: WORLD IN HARMONY: an environmental curriculum, developed for San Diego.

WATER WORKS: SCHOOL-TO-CAREER EDUCATION PROGRAM: designed to increase student awareness of career tracks in the water industry.

WATER TIMES: a water-education newspaper for 6th graders who live in Southern California

BOOKS: A variety of age appropriate water related books

VIDEOS: on various water related topics

Grades 6 thru 8
from the Otay Water District

Water Awareness Poster Contest

Encourage your students to enter our annual poster contest.

- Prizes for 1st , 2nd & 3rd Place winners
- All participants receive certificates

Mini Grant Program

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- Call (619) 670-2291 for a grant application.

Education for Educators

PROJECT WET EDUCATOR WORKSHIP

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- includes a 500+ page curriculum.

XERISCAPE GARDENING TEACHER WORKSHIP

- held at the Water Conservation Garden
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San Diego County Water Authority will pay for release time for teachers who attend workshops.

TEACHER INSERVICE: available for educators wishing to receive Metropolitan or County Water Authority developed materials and programs.

REGIONAL WATER QUALITY TESTING PROGRAM:
A kit containing all the materials for hands-on field water quality testing.
Kit can be checked out from Otay upon completion of a one-day workshop.
San Diego County Water Authority will pay for release

FREE Field Trip Grades 6-8

THE WATER CONSERVATION GARDEN

- Learn about water-wise gardening
- Tour can be designed to correlate with the objectives of your class

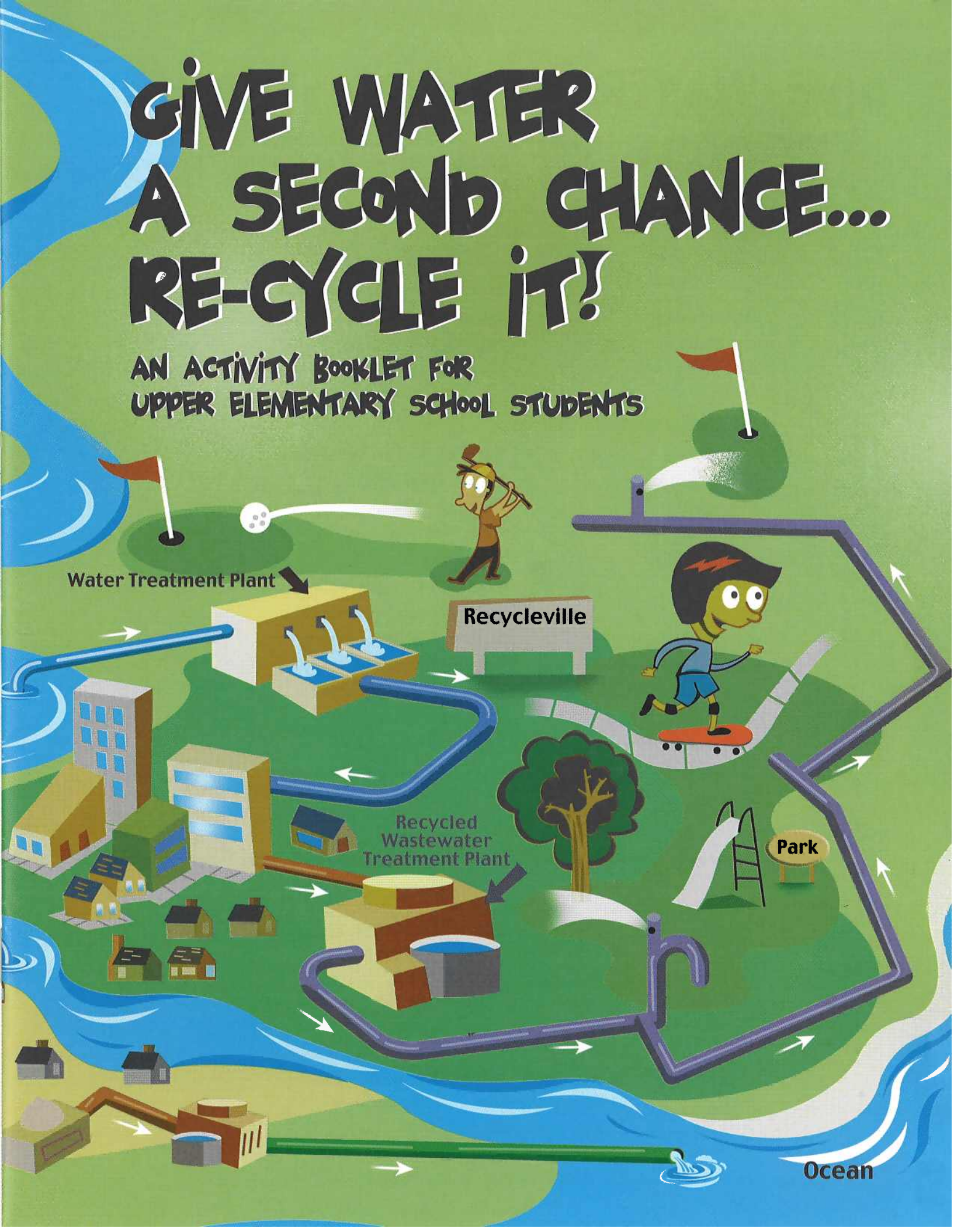
limited funding available f or transportation

For more information, to reserve a Kit or schedule a Field Trip:

Pam Rega ~ (619) 670-2291 ~ prega@otaywater.gov

GIVE WATER A SECOND CHANCE... RE-CYCLE IT!

AN ACTIVITY BOOKLET FOR UPPER ELEMENTARY SCHOOL STUDENTS



GIVE WATER A SECOND CHANCE... RE-CYCLE IT!

AN ACTIVITY BOOKLET FOR UPPER ELEMENTARY SCHOOL STUDENTS

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Published by the Water Education Foundation and the WateReuse Association California Section.

Water Education Foundation Mission Statement
The Water Education Foundation is a nonprofit impartial, tax-exempt organization whose mission is to create a better understanding of water issues and help resolve water problems through educational programs.

WateReuse Association California Section Mission Statement
To promote responsible stewardship of California's water resources by maximizing the safe, practical and beneficial use of recycled water and by supporting the efforts of the WateReuse Association.

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The WateReuse Association (national organization)

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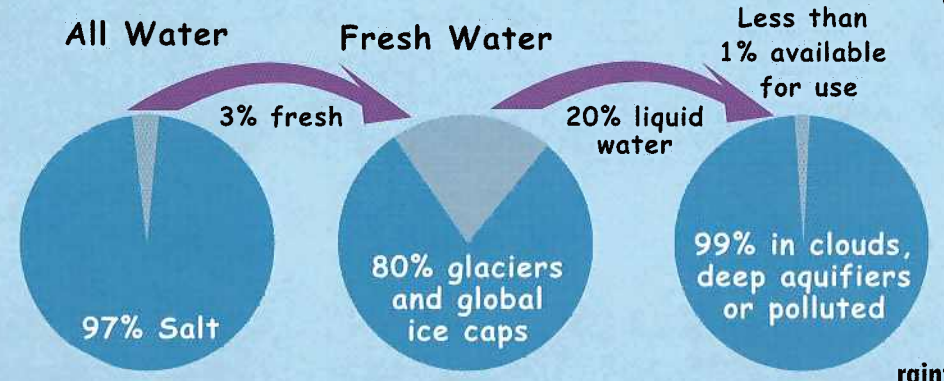
INTRODUCTION

The water you drank today when you were thirsty may have been locked away in glaciers for thousands of years, or been the same water that Cleopatra took a bath in, or supported Columbus' ships on the seas. Or maybe it rained down on a rainforest ten years ago, or was slurped up by a Tyrannosaurus rex millions of years ago. There is the same amount of water on Earth now as there was when the planet first cooled enough to let the first great rains fall billions of years ago. It keeps moving in an endless cycle called the water cycle.

Earth is called the "blue planet" because when it is viewed from space, the oceans that cover over 70% of our planet give it that beautiful blue color. Over 97% of all the world's water is in the oceans and is much too salty to drink. Of the 3% that is fresh water, most of that (80%) is locked up in glaciers and the polar ice caps. Most of the fresh water that isn't frozen solid is unavailable to us for drinking. It is either in underground aquifers, in the atmosphere, in plants and animals, or polluted. Less than 1% (actually .003%) of all the water on Earth is available to us for drinking. Since we have such a limited supply, we should take good care of it!



Water is always moving, changing form. We call this the water, or hydrologic, cycle. Water is the only substance that naturally exists in solid, liquid and gas form on Earth. The heat from the sun gives water molecules energy to evaporate up into the atmosphere. Evaporation can be from oceans, the land, from rivers, lakes and streams. Plants give off water vapor into the atmosphere in a process called transpiration. Animals, including humans, also sweat (perspiration) and breathe out water vapor that goes up into the atmosphere.

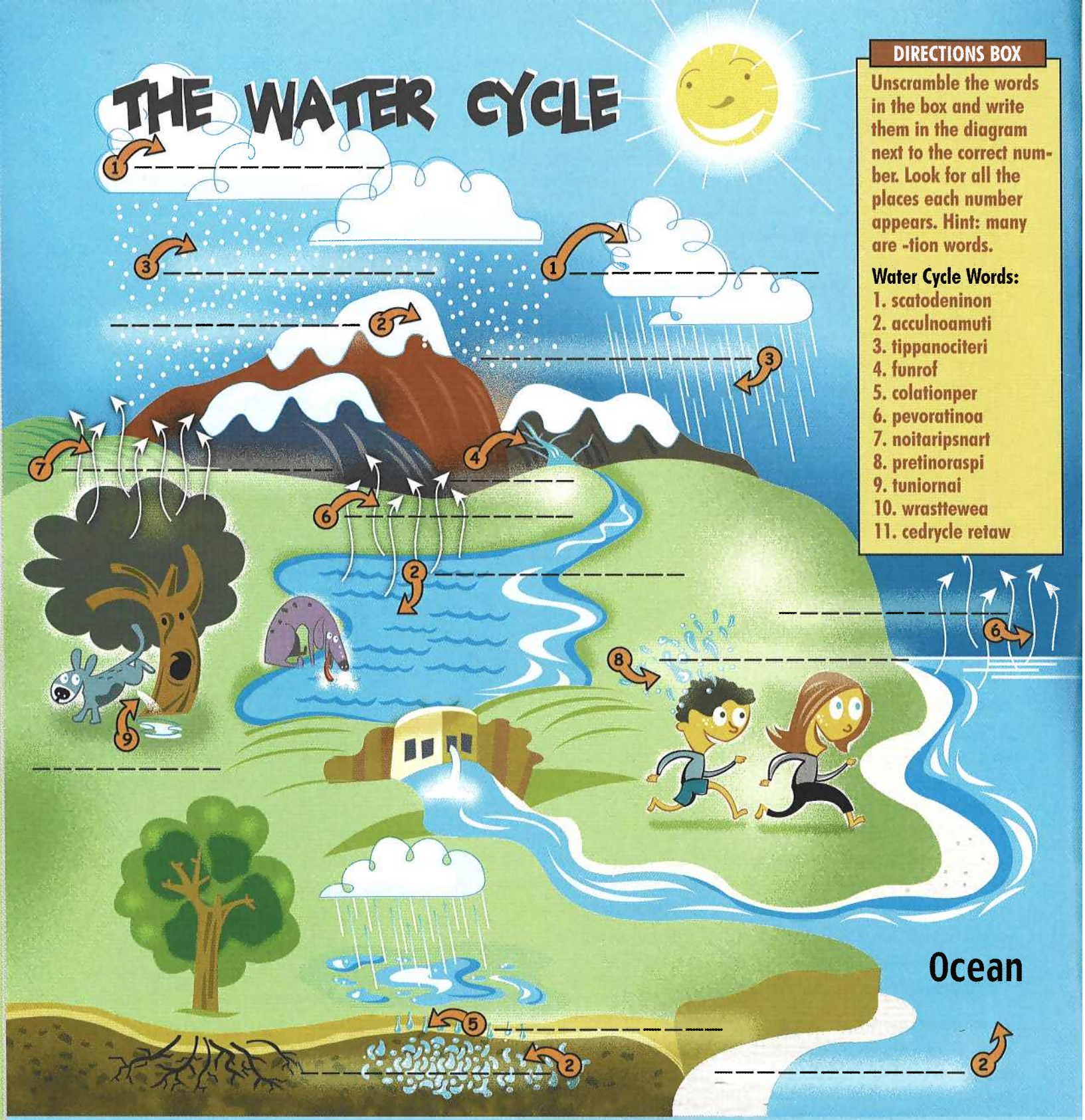
In the atmosphere, water vapor droplets condense into clouds; tiny droplets cling to dust particles to form larger droplets. Condensation is the process of turning water vapor back into liquid water. When the air cools, there is less heat energy to keep the droplets in the clouds, and gravity pulls the droplets to earth as precipitation. Precipitation can be rain, snow, hail or sleet.

Precipitation falls on the ocean, on rivers and lakes, in the mountains and the valleys, on forests and fields, and on cities. Snow and ice collect on mountaintops and on glaciers, sometimes staying there for many years. Precipitation that falls on the land, continues to be pulled downward by gravity. It tumbles down mountains and hills, forming streams that come together to form rivers (runoff). Rivers can collect in lakes (accumulation) or flow directly to the ocean. This water is called surface water. The area that collects rainfall from the ridges of mountains to the low areas it drains into is called a watershed. Since water always drains from high places to low places, every place is in a watershed.

Not all water runs into streams and rivers and flows into the ocean. If the ground that the precipitation falls on is porous (has spaces between the dirt particles where water can seep and flow), water can percolate (sink) into the ground. The water that sinks into the ground (percolation or infiltration) and into the cracks in rocks is called groundwater. Groundwater sometimes seeps back out of the earth and becomes surface water flowing in springs. Groundwater is also part of the water cycle.

Water treatment plants remove pollutants and germs, making water safe for us to drink. And after we use it, wastewater is treated again before it is released back into the water cycle. But since there is only so much water on earth, and there are more and more people, wouldn't it be cool if we could find a way to use it again before we put it back into the water cycle? Water is too precious to be used just once! Give water a second chance ... Recycle it!

THE WATER CYCLE



DIRECTIONS BOX

Unscramble the words in the box and write them in the diagram next to the correct number. Look for all the places each number appears. Hint: many are -tion words.

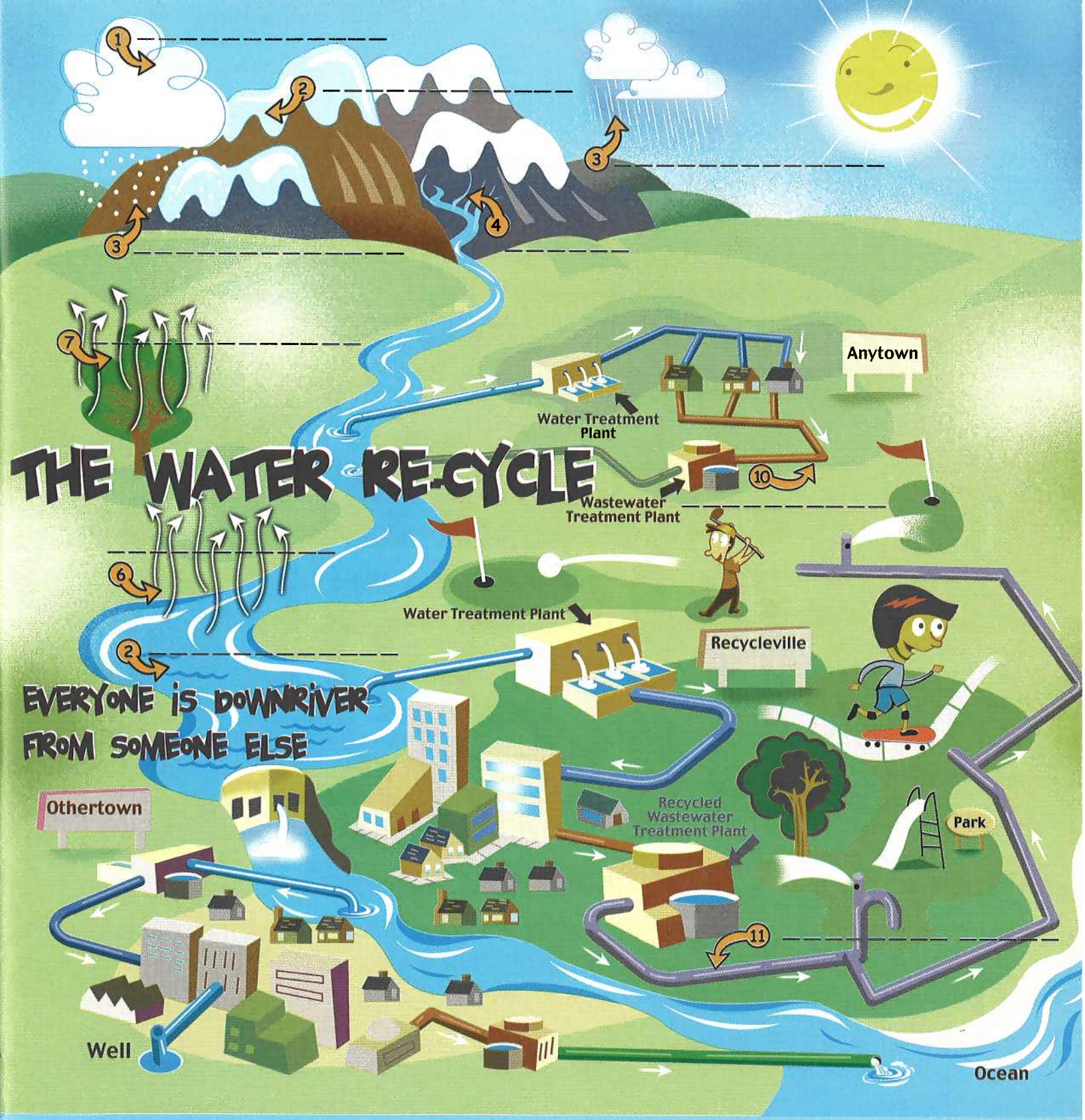
Water Cycle Words:

1. scatodeninon
2. acculnoamuti
3. tippanociteri
4. funrof
5. colationper
6. pevoratinoa
7. noitaripsnart
8. pretinoraspi
9. tuniornai
10. wrasttewea
11. cedrycle retaw

All living things need water. Water in the ground and in streams and rivers can be taken up by plants. Animals can drink the water. Plants transpire water molecules out of their leaves. Animals eliminate water in urine, sweat and in their exhaled breath. This water evaporates up into the atmosphere along with water evaporated from the ground and from water bodies like rivers, lakes and oceans, and the water cycle continues on.

Water molecules are in constant motion in this cycle. The engine that supplies the energy for this constantly turning water cycle is the sun.

In towns and cities, water treatment plants pull water out of wells, lakes and rivers and treat it to make it safe for people to drink, cook with and bathe in. Water from the ocean can also be treated for drinking in a process that removes the salts. This is called desalination.

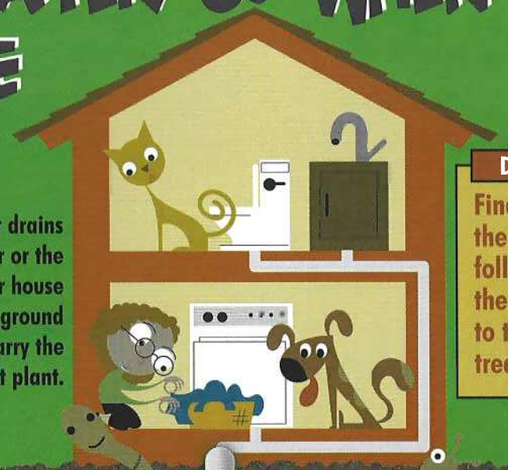


Water that has been used in homes and businesses goes into pipes under the ground that carry it to a wastewater treatment plant. Wastewater, also called sewage, is cleaned there, and the pollutants are removed before the water is discharged into a river or the ocean.

Cleaned wastewater can be used again. If it is in a river, the next city downriver can pump it out of the river, treat it so it is clean enough to drink and use it again. People can also recycle water by treating cleaned wastewater even more and using it for irrigating farms, parks, golf courses, schoolyards and for industrial uses. Wastewater cleaned to this high level is called recycled water; this is very popular in areas that have little local rainfall. Nature recycles water in the water cycle; people recycle water too when they treat wastewater and use water again and again.

WHERE DOES WATER GO WHEN IT GOES DOWN THE DRAIN?

When you flush the toilet, or the water drains out of the clothes washer or the shower or the sink, where does it go? Pipes in your house carry the water into pipes under the ground and streets called sewer pipes, which carry the wastewater to the wastewater treatment plant.



DIRECTIONS BOX

Find the path that the wastewater follows as it leaves the house and flows to the wastewater treatment plant.

What would happen if wastewater didn't get treated? Wastewater in cities would collect in big nasty, yucky, gunky, smelly ponds that would eventually seep into groundwater or drain into creeks that would carry the polluted water to rivers. More sewage would flow into the river as it passed more communities. Most of us live downriver from someone else ...

would you want to drink that water? No way! Cities . . . do treat river water before delivering it to homes, but the more pollution in the river water, the more expensive it is to treat. However, in smaller communities, where there are no sewer systems, wastewater from homes can be treated by septic systems. Septic systems are like miniature wastewater treatment plants for homes. They use microorganisms to break down waste and gunk before the water moves into groundwater aquifers.

By the time the water in the Mississippi River gets to Louisiana, it has been used about seven times.

WASTEWATER TREATMENT PLANTS—WATER LAUNDRIES

Primary (first) treatment:
Large stuff is screened out. Floating fats, oils, grease, plastic and soap scum are skimmed off. Solids sink down (sometimes a chemical called alum is used to get the solids to stick together). Sludge is hauled away. Some sewage sludge is treated to kill any bacteria or viruses and is mixed with other components to become fertilizer.

Secondary (second) treatment:
Air is bubbled through the water to add oxygen. Oxygen helps microbes live so they can consume the organic stuff in the water. Sediment and microbe poop sink to the bottom of the tank. Sometimes secondary water is disinfected with chemicals like chlorine to kill germs. Secondary treated wastewater is clean enough to be released to a river or the ocean, or can be used to surface irrigate orchards and vineyards.

Tertiary (third) treatment:
Water is filtered through anthracite, sand, membranes or cloth to remove any remaining particles and chemicals. Chlorine or other chemicals are added to disinfect the water (kill bacteria and viruses). Tertiary treated wastewater can also be released to a river or the ocean. Tertiary treated wastewater is "recycled water" and it can be used to irrigate parks, playgrounds and other landscaping, to flush toilets in some office buildings, and for some industrial uses.

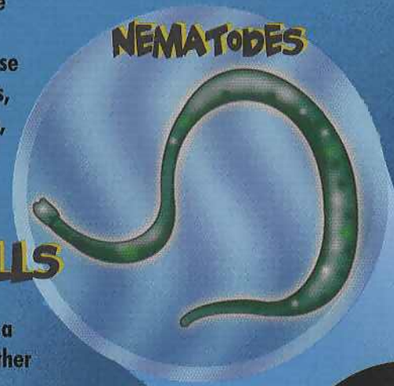
Don't drink from purple pipes! Purple pipes contain recycled water, not drinking water.

The largest item ever screened out of the City of San Diego's wastewater was the front end of a car. It was a VW Beetle!

MARVELOUS MICROBES: OUR FABULOUS FRIENDS IN THE MICROSCOPIC SPOTLIGHT

Microbes have a very important role to play in cleaning up wastewater so it can be reused. In the secondary stage of wastewater treatment, these tiny organisms break down organic materials (tiny garbage bits, poop pieces, bacteria, viruses and chemicals) to help clean up the water. These microorganisms are the same ones that are found in streams and rivers, but here they are concentrated together. Microbes, like all living things, need oxygen to use the food they eat to get energy to live. (Continued at the top of page 8.)

MICROBES MADE OF MANY CELLS



NEMATODES are tiny round worms that can sometimes be seen without a microscope. They bite and tear apart their food (bacteria, algae, and other microbes). They lay eggs which hatch into more nematodes.

http://www.micrographia.com/specbiol/helmint/nematod/nema0100.htm
http://en.wikipedia.org/wiki/Nematode

ROTIFERS are also multicellular organisms. They have a "foot" at the end of their bodies that secretes a sticky substance that allows them to attach to objects. They have two discs of rotating hair-like structures called cilia that create currents that swoop bacteria and organic matter into their mouths.

http://www.ucmp.berkeley.edu/phyla/rotifera/rotifera.html
http://ebiomedia.com/gall/rotifers/rotifer11.html

WATER BEARS are tardigrades, which means "slow walker." If you watch these little creatures they seem to have six or eight legs that move them along. They eat bacteria, viruses, algae and other organisms by holding onto them and sucking out their inner contents. Water bears can survive extreme cold and lack of water … for up to 10 years!

http://brainew.com/e/ezboard.cgi/db=alife_debate&action=read&dbf=200312290000
http://nai.arc.nasa.gov/news_stories/news_detail.cfm?article=tardigrades.cfm

These microbes may be only one cell or several cells, but they all are so tiny that you need a microscope to see them. Here are some of the helpful critters that clean up our water. After you read about them, look at the websites listed and see what they look like in "real life."

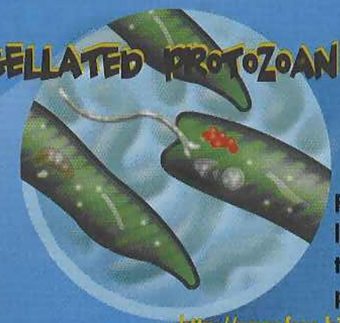
Descriptions of Microbes: Here are some websites that have pictures of different kinds of microbes.

http://www.geocities.com/wwtp2004/resources/microbes.htm?200610
http://www.microbeworld.org/htm/aboutmicro/microbes/types_start.htm

ONE CELL MICROBES

FILAMENT BACTERIA are often curly and can wiggle very fast so that they can escape the other microbes that like to eat them. They eat hazardous chemicals and often clump together with waste products from the other microbes, falling to the bottom of the tank in clumps called floc.

http://lig.cox.miami.edu/Faculty/Dana/monera.html
http://www.beyondbooks.com/lif72/2a.asp



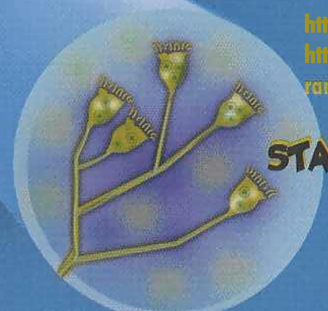
FLAGELLATED protozoan get their name from the whip-like tail on the end of their bodies. The flagellum helps them move quickly to capture bacteria and other food particles.

http://www.fcps.k12.va.us/StratfordLandingES/Ecology/mpages/euglena.htm
http://staff.jccc.net/pdecell/protista/euglena.html

PARAMECIUM have tiny hairs called cilia all over them. The waving cilia help the paramecium swim and also create a current to sweep their favorite food, bacteria, into their food opening.

http://www.biologycorner.com/worksheets/paramecium_color.html
http://micro.magnet.fsu.edu/moviegallery/pondscum/protozoa/paramecium/index.html

Oleophilic (oil loving) bacteria clean cooking oil and motor oil out of wastewater. These same bacteria can be used to clean up oil spills in the ocean.



STALKED CILIATES have fibers that attach them to one place. Their bodies are branched like trees and have cup-like structures on the ends that use cilia to sweep food toward them. They like to eat bacteria and algae.

http://www.environmentalleverage.com/Stalked%20Ciliates.htm
http://www.ebsbiowizard.com/web_gallery_stalks/pages/ASB_Stalked_Ciliates.htm

GIVE WATER A SECOND CHANCE

No matter where you live, water is a precious resource. Many areas of the country have periods of drought (not enough precipitation). All of us must use our water wisely. One way to make sure we have enough is by recycling our wastewater. This dirty water can be cleaned in wastewater treatment plants so it can be used again in many different ways.

Recycled water can be used for irrigating landscapes in parks, golf courses and beside freeways. It can be used to flush toilets, to fill decorative fountains and ponds, in recreational lakes and in industrial processes.

Recycled water that has been treated to drinking water standards can be pumped into the ground to prevent salt water from seeping inland into fresh water aquifers. It can also be put in ponds where it can percolate into the ground to replenish groundwater aquifers. Recycled water can also be used to create wetlands and make natural environments better for fish, wildlife and aquatic insects to live in.

When recycled water gets extra advanced treatment, it can be added to aquifers or reservoirs that store water. This blended water can eventually go through a water filtration plant and get turned into drinking water again.

DIRECTIONS BOX

Draw circles around the twelve ways that recycled water is used in this scene.

Wastewater Recycling Plant

Droughts occur often in many parts of the country … recycled water can help us get through these dry times. Recycled water helps us S - T - R - E - T - C - H our water supply. Using recycled water for the many things discussed in this section helps us save potable water for drinking and other uses inside our homes.

Remember: so far, recycled water has not been approved for drinking. So don't drink from purple pipes!

Residential Building

Car Wash

Office Building

Factory

Some communities are building apartments and office buildings with two sets of plumbing pipes. One set for drinkable (potable) water and one for recycled water that is used for flushing toilets and irrigating landscaping.

WHAT'S THE PROBLEM?

There are many advantages to recycling wastewater, but are there any problems?

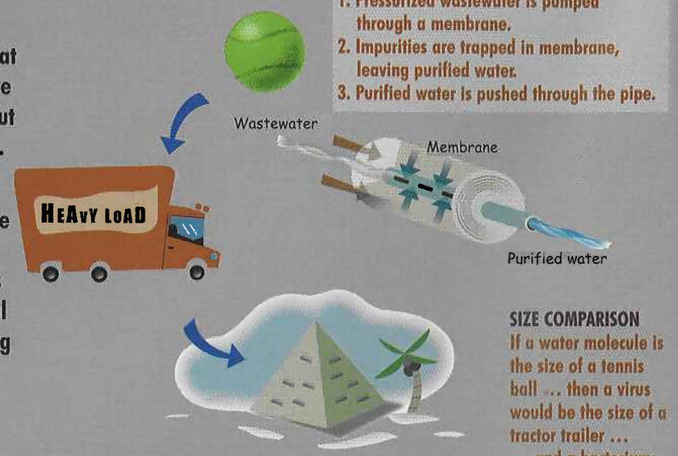
Without knowing the facts, some people worry that children playing in parks irrigated with recycled water might get sick from germs in the recycled water. In decades of using recycled water for irrigating parks, this has never happened. Chlorine and other chemicals are added to recycled water to disinfect it, or kill microbes that might cause disease. Treatment plant operators make sure that they add enough disinfectant to keep people safe, but not so much that the chlorine would be harmful to plants.

If recycled water is safe, then why is it carried in purple pipes and marked "non-potable" (not for drinking)? There are many levels of treatment for recycled water. Recycled water treated to tertiary standards produces water that is fine for landscape irrigation, toilet flushing in commercial buildings and industrial uses like carpet dyeing or making bricks. It is possible to treat wastewater all the way to drinking water standards, but this takes additional steps that cost more money.

Scientists and water quality experts worry about the leftover molecules (in the urine in the wastewater) from medicines like aspirin or antibiotics remaining in recycled water that returns to the environment. Some people also dump unused medicines down the toilet. Scientists estimate this amount to be 2-50 parts per trillion which is about the same thing as one grain of sand in an Olympic-sized swimming pool. Until recently, we didn't even have test equipment that could detect amounts this small. The water industry has developed new technology to remove these medicines and they are being added to some new recycled water plants.

Too much salt can damage some sensitive crops and grasses on golf courses or parks. Recycled water contains more salt than drinking water, but is generally not enough to harm plants. Some communities remove salts, as well as bacteria and viruses from recycled water using a process called "reverse osmosis." Wastewater is forced through a roll of membranes with very tiny holes that only allow water molecules through, leaving impurities behind. (see diagram). This is a very expensive process, but it produces high quality water.

Unused medicines should NOT be flushed down the toilet! They can be taken to pharmacies for safe disposal.



HERE'S HOW REVERSE OSMOSIS WORKS.
1. Pressurized wastewater is pumped through a membrane.
2. Impurities are trapped in membrane, leaving purified water.
3. Purified water is pushed through the pipe.

SIZE COMPARISON
If a water molecule is the size of a tennis ball ... then a virus would be the size of a tractor trailer ... ... and a bacterium would be the size of one of the pyramids in Egypt.

Because reverse osmosis is a very expensive process, some communities work instead to keep excess salt out of the system in the first place. One way they do that is by asking people not to use certain kinds of water softeners that use rock salt to make water "soft."

Water that has lots of minerals in it, mostly calcium and magnesium, is called "hard." (Perhaps because it is hard to get soap to get sudsy in "hard" water.) The minerals are not harmful; in fact, they are the same minerals that are in daily vitamin pills. But minerals can leave behind white spots on glasses or shower doors. Some people use water softeners to get rid of the "hard" minerals by adding salt. Sodium ions (remember that table salt is sodium chloride) replace the calcium and magnesium ions to make water "soft."

Some water softeners in homes and businesses discharge salt into the sewer system. This salt can cause problems in communities that recycle wastewater. To keep plants from being "a-salted" (get it?) by too much salt, these communities encourage citizens to not use self-regenerating water softeners that homeowners must pour bags of rock salt into each month. There are other kinds of water softeners called "exchange tank systems" that don't discharge any salt into the sewer system and are not a problem for water recycling.

SALTS, SOAP AND SUDS
TRY THIS OUT

(adapted from "Home Experiments" by Professor Bassam Shakhashiri, University of Wisconsin-Madison, Chemistry Department)

How does "hard" water interfere with washing clothes and your hands? Why do some people use water "softener" machines?

DIRECTIONS BOX

Materials for this experiment:
500 milliliters (2 cups) distilled water
5 milliliters (1 teaspoon) Epsom salts (magnesium sulfate)
2 empty, clean 2-liter plastic soft-drink bottles with screw caps
Liquid dishwashing detergent (not the kind used in dishwashing machines)

Label one of the bottles #1 and one #2.
Put 250 milliliters (1 cup) of distilled water in each of the plastic bottles.
Add 5 milliliters (1 teaspoon) Epsom salts to the #2 bottle; swirl to dissolve.
Put 3 drops of liquid dishwashing detergent in each bottle; seal bottles with caps.
Shake both bottles vigorously.

Which bottle had more suds? _____ Explain why. _____

_____

_____

Take the labels off the bottles and ask another student to guess which bottle has hard water in it.

Suds are formed when bubbles of air get trapped inside a film of liquid made of water and detergent. The detergent forms a sort of framework that holds the water in the liquid film. The bubbles float away dirt in clothes or on your hands. "Hard" minerals in the Epsom salts combine with detergent to form scum rather than bubbles and interfere with the way soap or detergent cleans. The scum can leave white deposits on pans and shower doors.

Still curious?

See what happens when you don't add detergent to the bottles.
How about your water? Is it hard? Design an experiment to find out.

If your family uses a water softener, ask if it uses salt.
Call your local wastewater agency and see if your community uses recycled water.

One of the largest amounts of wastewater flowing into sewers and wastewater treatment plants in the United States is during Super Bowl halftime when everyone gets up to go to the bathroom and flushes all at once!

GLOSSARY

Accumulation	Water that collects in ponds, lakes, or the ocean
Aquifer	Underground storage place for water in spaces between sand, dirt or rock
Biosolids	Processed waste material (or sludge) from wastewater. Can be used for fertilizer
Condensation	Water moving from gas form to a liquid form, as in when clouds release rain
Desalination	The process of removing salts from water
Evaporation	The process of changing water from a liquid to a gas
Microbes	Microscopic organisms that can be used in recycled water treatment plants to help clean water of impurities and pollution
Non-potable	Water that is not pure enough for drinking
Organic matter	Tiny garbage bits, poop pieces, bacteria and viruses
Percolation	Water soaking into the ground, can be stored in aquifers
Perspiration	Sweat; Water given off from the skin during exercise
Polluted	Containing impurities and/or chemicals that can be harmful to people and wildlife
Potable	Water that is drinkable
Precipitation	Rain, snow, sleet
Recycled water	Wastewater that is cleaned to remove impurities so it can be reused
Runoff	Precipitation that does not soak into the ground, but runs over the surface and collects in streams and rivers
Transpiration	Release of water molecules into the air from the leaves of plants
Wastewater	Water that has been used for washing, flushing toilets and many other purposes; also called sewage
Water cycle	There is a limited amount of water on Earth which keeps moving around and around through the processes of evaporation, condensation, precipitation and accumulation
Watershed	The area that collects rainfall from the ridges of mountains to the low areas

ANSWERS

Activity #1

The Water Cycle and Water Re-Cycle

1. Condensation
2.. Accumulation
3. Precipitation
4. Runoff
5. Percolation
6. Evaporation
7. Transpiration
8. Perspiration
9. Urination
10. Wastewater
11. Recycled water

Activity #4

Recycled water can be used in the following ways (counter-clockwise from the recycled water plant):

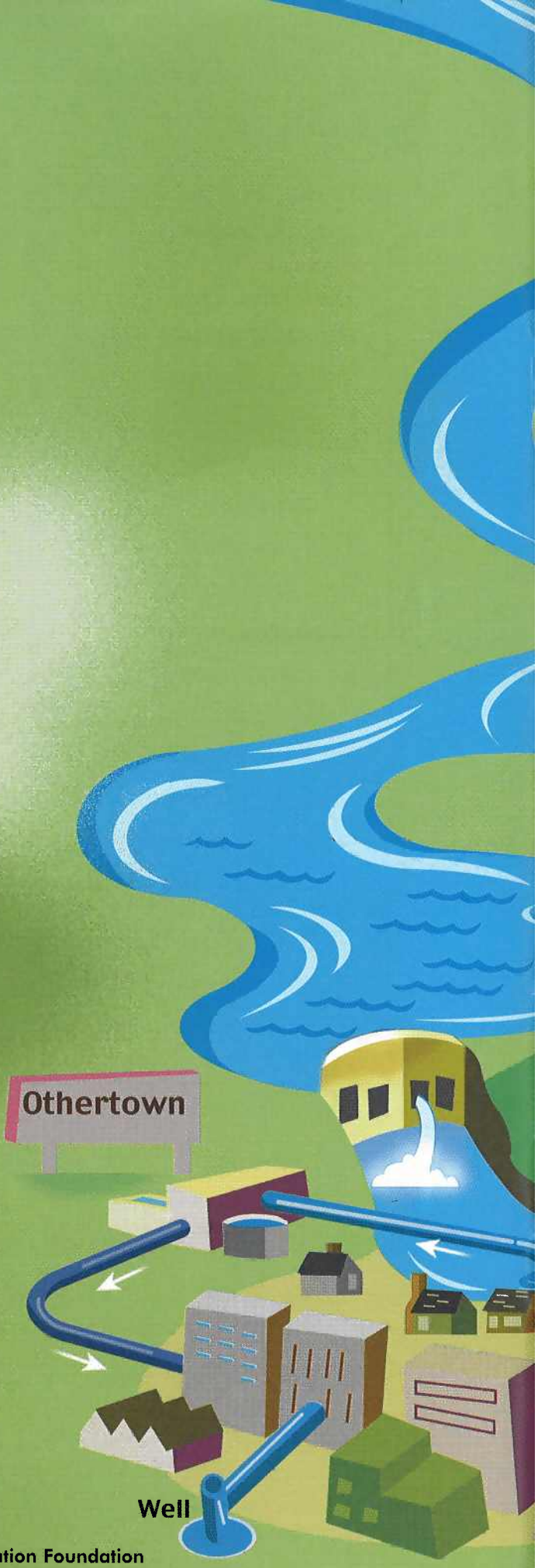
Farm irrigation
Creating ponds and wetlands
Irrigation of orchards
Irrigation of golf courses
Public fountains and water features
Industrial processes
Irrigation of landscaping around office buildings
Flushing toilets in office buildings
Watering freeway landscaping
Irrigating parks
Filling ponds in parks
Car washes

Activity #5 Salts, Soap and Suds

Bottle #1 had more suds because #2 had salts in it, which makes the water harder, and less likely to form bubbles.

ATTENTION CALIFORNIA TEACHERS

Correlations to the California State Department of Education's Subject Area Standards are available on request from the Water Education Foundation. Call 916-444-6240.



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