EXPEDITIONARY LEARNING

Grade 3: Module 4: Unit 2: Lesson 8

Independent Research: The Challenges to Having Enough Clean Water for Everyone

Long-Term Targets Addressed (Based on NYSP12 ELA CCLS)	
I can conduct a research project to become knowledgeable about a topic. (W.3.7) I can determine the main idea of an informational text. (W.3.2) I can retell key ideas from an informational text. (W.3.2)	
Supporting Learning Targets	**Ongoing Assessment**
• I can ask and answer questions about the text I choose in order to build my knowledge about one specific challenge related to having enough clean water for everyone. • I can identify key facts and details about my challenge topic.	• Asking and Answering Questions recording form, with text attached

Agenda	Teaching Notes
1. Opening A. Engaging the Reader: Share Tracking My Progress (5 minutes) B. Unpacking Learning Targets (5 minutes) 2. Work Time A. Launching Independent Research (10 minutes) B. Researching with Research Buddies (30 minutes) 3. Closing and Assessment A. Sharing within Research Teams (5 minutes) B. Sharing across Research Teams (5 minutes) 4. Homework	• This lesson formally launches students' research. This research is designed for students to be fairly independent, in the sense that the teacher is not guiding every step of the research process. Students are driving their own inquiry process, asking their own questions, and choosing from a sampling of articles to read to build their knowledge. However, these research lessons include multiple structures to scaffold students' work, and students are not doing the research by themselves. • As detailed in the unit overview, some texts are provided to students in this series of lessons. However, there are two other critical factors. First, provide additional texts for students using the suggestions in the unit overview. Secondly, students should independently gather information that is connected to their research topic. Students can do this by reviewing the additional texts provided by you. They can search the Table of Contents to determine if that particular text would have information about their research topic. They can also scan the titles of the additional resources provided. The important aspect is that students are gathering resources and information with some independence—based on their questions. • If there is ready access to technology or if the school's media specialist is available, consider planning lessons to guide students in finding additional texts or web-based materials to support their research in Lessons 8–10. • In this lesson, students begin working with a research buddy. The lesson asks students to recall their work in partnerships from Module 3A (when they read *Peter Pan*). If students did not experience that module, remind them about how partnerships work together: We sit next to each other and read on our own, but we have someone next to us to help us if we are stuck. We can talk to someone about what we have read. • In advance: Review Launching Research Teams (for teacher reference in supporting materials). This is a more detailed note outlining the research process students will undertake in the next few lessons. • As stated in the teaching note at the end of Lesson 7, assign students to one of the three research topics: demand for water, access, or pollution. Within each of these research teams, assign students to a research buddy. This buddy will be their main working partner. Students will use their research teams at the end of lessons to share what they have discovered (see Unit 2 Overview for details). • Prepare research texts: eight copies of each text in each of the three categories. See Launching Research Teams for details.

Agenda	Teaching Notes (continued)
	• Some students might finish reading their research article early. So be sure that there are texts available from the recommended text list. Consider placing a stack of the recommended texts in a basket or other container and place in the whole group area so students can easily access it. • Identify one area of the classroom for each of the three research topics. • Prepare a chart paper or paper for display on the document camera for the closing: What did you learn today about your topic?

Lesson Vocabulary	Materials
specific, identify	• Launching Research Teams (for teacher reference) • Tracking My Progress, Mid-Unit 2 recording forms (one per student, from Lesson 7) • Equity sticks • Independent research directions (one per student) • Research texts in folders: eight copies of each text (for Lessons 8, 9, and 10) • Asking and Answering Questions recording form • Water journal (one per student) • Independent Reading recording form (one per student)

Opening	Meeting Students' Needs
A. Engaging the Reader: Share Tracking Your Progress (5 minutes) • Gather students in the whole group area. Distribute their **Tracking Your Progress, Mid-Unit 2 recording forms** from their mid-unit assessment. Tell students that before they get started today on their independent research, they will take a moment to reflect upon their progress with a partner. • Using **equity sticks**, assign students to partnerships. Ask students to remain in the whole group area but to sit next to their new partner. • Give students a few minutes to share their tracking progress forms. As students are sharing, circulate among the students and listen to their reflections. • After students have had a few minutes to share, refocus students' attention. Share a few specific things you heard from students as they were talking together. This could sound like: "I heard many of you talking, giving specific examples about how you met the target. Using specific details is important when you think about how you are meeting a target." • Emphasize to students why they use and reflect on learning targets in their work. This could sound like: "The reason we have learning targets is to help focus our learning together and give each of us specific things we can do to deepen our learning. Let's now take a look at our targets for today."	
B. Unpacking Learning Targets (5 minutes) • Invite one or two students to share the targets for today. • Ask students to talk to a person next to them: * "Based on these targets, what will we be doing today?" • Give students a moment to think and share together. • Then, invite one or two partnerships to share their thinking. If students haven't brought it up, remind them that the targets are things they have worked on in other lessons. • Explain to students that the targets are new in the sense that today they will apply their work to their own independent research.	

Work Time	Meeting Students' Needs
A. Launching Independent Research (10 minutes) • Remind students that they selected a particular challenge they wanted to know more about in the previous lesson. Tell students that for the next few lessons, they are going to get to find out more about one of these challenges on their own. They will have a research buddy to support their reading. • Ask them: * "How did you and your partner work together as you read ?" • Give students time to think, then talk together, recalling their partnerships in Module 3A. • Use equity sticks to call on a few students to share their thinking with the whole group. Listen for students to recall that they talked with their buddy about what they read, about hard words, and to find details about characters. • Assign students their research challenge team and buddy. Ask students to move and sit facing their research buddy. Ask: * "What kinds of questions do you have about your water challenge? What do you want to learn about this challenge?" • Give buddies a minute to talk together. • Then invite a few students to share: * "What questions did your partner have?" * "What did your partner say s/he wants to learn?" • Then, display the **independent research directions**. Invite a few volunteers to read aloud the steps. • Once the steps have been read aloud, ask students to consider: * "How do these steps relate to the reading work we have been doing all year long?" • Give them a moment to talk to their partner again. • Using equity sticks, cold call a few students to share out. Guide students to notice that the pattern: "Read," "Write," "Think," and "Talk" are the basic steps in this research process. Explain that this document will be with them while they are working to support their independent work. • Explain that each research team will have a **folder** with a variety of informational **research texts** (eight copies of each text) about their water challenge and that their first task will be to think about which text they want to read.	• Strategic partnerships is the first support for struggling learners in this research process. As outlined in the module overview and the unit overview, students should be in supportive partnerships. • Struggling learners also benefit from visual symbols on their Independent Research Directions. Students will use this document throughout the next three lessons. Placing symbolic representation on the directions will provide an easy reference. (For example, place a pair of glasses symbol next to the phrase "preview the text," or a next to the Asking and Answering Questions recording form, or two faces talking to each other next to "talk to your buddy" etc.).

Work Time (continued)	Meeting Students' Needs
B. Researching with Research Buddies (30 minutes) • Assign an area in the classroom in which each of the research teams can work. Students will be only working with their research buddy once they select their text, but for ease in conferring, have the research teams gathered in the same general area. Be sure that there is a research folder for each team at one of the tables in their area. Spread the texts out so that students can preview them. Invite students to move with their research buddy to select a text. • Give students a few minutes to preview their texts. Circulate around the tables. Guide partners with their text selection. When students are previewing the texts, guide them with the following types of prompts: * "Check the title of the text. Does it sound like this might answer some of your questions?" * "Scan the text. Are the graphics and photos interesting and do they provoke your curiosity?" * "Talk to your partner about what the text might be about." • Once each pair of students has selected a text, ask them to review the Independent Research Directions and get their **Asking and Answering Questions recording forms** out before they start reading. After students have settled with their texts and had a minute to review the directions, focus their attention whole group. Using thumbs-up, check for understanding of directions: thumbs-up if they are clear on next steps, thumbs-down if not. • Scan the room and confer with students who have questions. • As students read their texts with their research buddies, circulate and confer with partnerships. Ask questions about their process in order to assess how they are doing with their text. Examples of questions could be: * "Let's look at your recording form—what have you captured so far?" * "Tell me a specific detail you have learned in this text about your water challenge ... why did you select that detail to record?" * "How's it going with your text? Tell me what you are finding out about your challenge ... can you show me where you found that information?" • The goal here is to get a sense of what information students are learning from the texts they are reading.	• Guide struggling learners as they select texts. Support them in choosing from the texts supplied, or the texts you have gathered, a text that will be easier for them to navigate; i.e., text features that are more obvious and support making meaning, text that is less complex, text that is shorter, etc. • Once partnerships have selected a text, support struggling learners by having them read a smaller chunk of the text first and recording their key details. • Confer with these partnerships first during the research time. Provide support by guiding their work. Read a passage aloud and ask them to tell you the key details they heard. Direct them to write that down. Give them a focus question to think about as they read the next section on their own. This focus question should relate to the text they are reading, and help them to find information in the text.

Work Time (continued)	Meeting Students' Needs

• As needed, pull smaller groups if you see that students are struggling with a specific article. Support them:
  * Check to see what they do understand from the article.
  * Read a short passage aloud and ask specific questions about the key details in the passage.
  * Unpack vocabulary together, supporting them to collaboratively figure out the word in context.
  * Provide a brief mini lesson about finding details in the text.
• There are a few options for students who might finish early.
  1. Research buddies may select another text from the research folder to begin reading.
  2. They can each choose to read their independent reading book.
  3. They can each select a text from the recommended text list to read together or on their own.
	• Provide specific time periods for struggling learners within the 30-minute timeframe. For example, explain to students that in 10 minutes you are going to check on them again and they should be at a specific point in their reading, ready to talk about the details they have found.

Closing and Assessment	Meeting Students' Needs
A. Sharing within Research Teams (5 minutes) • Bring students back together in the whole group area and ask research buddies to find another pair of buddies within their same research team. Display on chart paper or document camera the following question: What did you learn today about your topic? Give students a few minutes to share with each other in their foursomes.	
B. Sharing across Research Teams (5 minutes) • After students share with their foursomes, ask research buddies to stand up and find a new pair who has a different research topic. Have them sit back down together in their new group. Ask students to share the same question with their new foursome, hearing new learning about another topic. • Once students have shared, invite students to put their recording forms with the text attached in their **water journals**. Collect these journals to review at the end of the day.	
Homework	**Meeting Students' Needs**
• Share with someone in your family what you learned today as a result of your research. Tell them about the most interesting specific details you learned about your topic. Ask someone in your family: "What do you know about this challenge?" • Continue to read your independent reading book and complete the **Independent Reading recording form**.	

EXPEDITIONARY LEARNING

Grade 3: Module 4: Unit 2: Lesson 8
Supporting Materials

Independent Research Questions

1. Review the informational texts in the folder. Choose a text that you want to read today.
2. Preview the text: Look at the text features of that text (headings, bold words, pictures, captions, call out boxes).
3. Using your Asking and Answering Questions recording form, think about what questions you have right now. Record those questions.
4. On your own, or with your research buddy, read the text all the way through.
5. Think about what you have read and learned.
6. Talk to your buddy about what you have read and learned.
7. Reread the article for key details and facts that help you understand your specific water challenge more. On your recording form, write these key details.
8. Talk to your research buddy about the most important information about your topic. On your recording form, write that information.

If you and your buddy finish the text you chose before the end of work time, there are a few options for you:

1. Choose a new article from the research folder to begin reading.
2. Read your independent reading book.
3. Choose a book from the ones gathered in the whole group area. Scan the Table of Contents to see whether that book might have information about your research topic.

Asking and Answering Questions
Recording Form

Part 1	Part 2		
My Initial Question	**Key Details from the Text**	**Text Location**	**New Questions or Thinking**

Part 3: Quick Write

What is the most important information for people to know about this topic?

Asking and Answering Questions
Recording Form – Student Sample

Part 1	Part 2		
My Initial Question	**Key Details from the Text**	**Text Location**	**New Questions or Thinking**
How does water become so polluted?	Animal manure washes with the rainwater and then pollutes the stream.	Muddy Waters Paragraph 5	How many farmers do what Reed did to try to keep their manure from going into streams?
What happens when water is polluted?	Manure makes algae grow. That blocks the light for plants. Plants die.	Paragraph 7	XXXX
XXXXX	Not enough oxygen in the water can make the fish die, too. It can be a dead stream or lake.	Paragraph 7 Picture and caption	Can you see the dead zone just by looking at it?
XXXXX	Sediment pollution makes water murky and makes it smell and taste bad.	Paragraph 9	Can water be cleaned once the algae are in there?

Part 3: Quick Write

What is the most important information for people to know about this topic?

Farms can cause pollution in the water. The waste from the animals washes off the fields into streams and lakes. This can even make a dead zone in the stream.

Research Teams

Lessons 8, 9, and 10 are dedicated to students conducting a short research project. The intent of these lessons is to give students the opportunity to build their knowledge about one particular challenge to clean water with greater independence. Research gives students the opportunity to apply the reading skills they have built all year.

While this research is intended to be independent, students are in three research teams about the topics of access, pollution, and demands for water. The number of students within each team will depend on the number of students in the class. This design is based on twenty-four students, three teams, eight students per team. If the class is bigger, consider creating small teams within the three research topics. Within those research teams, students will have a research buddy. Research buddies are a support structure. Students will use their buddies to talk together about the text they are reading. The buddy structure is similar to their Peter Pan reading partnership from Module 3. This structure encourages inquiry about their topics through their discussion and work together. The bigger research teams allow students to further build their knowledge by checking in with other research buddy pairs about what they discovered.

During the work time for research, circulate and confer strategically. Start with one research team at a time, pulling the whole group together for more modeled practice if needed. Monitor how students are working through the text together. Try to spend 10 minutes per group conferring and checking for understanding.

Ask students questions about their reading, specifically questions that require them to find details in their text and require them to tell you what new knowledge they are building about their topic. Ask students to identify specific passages in the text that surprised them or that raised a new question.

Preparing Texts for Research Teams

Directions: Information regarding texts for student research can be found below. Print eight copies of each article and place in appropriate folder so that there are enough copies for each person in that team. Add additional articles that you have selected from your library or your own resource searching in these folders. Students will choose one of the articles to read in each lesson.

A. Some texts are not web-based; those are provided in the supporting materials:

- **Access:** *A World Thirsty for Clean Water* By: Aftalo-Calderon, Brigitte, Faces (07491387), 07491387, Mar2007, Vol. (L820)
  "Crisis in East Africa," *Scholastic News*, Edition 4, 2006 (L910)
  "Water Pump" (provided in supporting documents separately)
- **Pollution:** "3 Big Pollutants" (provided in supporting documents separately)
  "Keep Earth's Water Clean," *Weekly Reader*, Edition 2, 2004 (L950)
  "Where are these pollutants coming from?" (provided in supporting documents separately)
  "Toxic Water is Poisoning the People of Bangladesh" By: Tucker, Libby, *Science World, 4/17/2006, Vol. 62 Issue 13*
- **Demands For Water:** "A Dwindling River," *Scholastic Super Science*, 2003 (L830)
  "Dry Times," *Scholastic News*, Edition 4, 2003 (L870)
  "Dry Run," *Current Science*; Weekly Reader, 2007 (L950)

B. Most texts are listed in the chart below.

Launching Research Teams
For Teacher Reference

Title	Citation
A Dwindling River	"A Dwindling RIVER" By: Jango-Cohen, Judith, *Scholastic SuperScience*, 1010144X, Oct2007, Vol. 19, Issue 2
Toxic Water is Poisoning the People of Bangladesh	"Toxic Water is Poisoning the People of Bangladesh" By: Tucker, Libby, *Science World, 4/17/2006, Vol. 62 Issue 13*
A River at Risk	"A River at Risk" *Scholastic News* -- Edition 4, 07360592, 2/18/2013, Vol. 75, Issue 16
A World Thirsty for Clean Water	*A World Thirsty for Clean Water* By: Aftalo-Calderon, Brigitte, Faces (07491387), 07491387, Mar2007, Vol. 23, Issue 7
Crisis in East Africa	"Crisis in East Africa" By: Harvey, Mary, *Scholastic News* Edition 4, 07360592, 4/17/2006, Vol. 68, Issue 22
Dry Run	"Dry Run" By: Geiger, Beth, *Current Science* 00113905, 9/7/2007, Vol. 93, Issue 1
Dry Times	"Dry Times" By: Smith, Natalie, *Scholastic News* Edition 4, 07360592, 9/17/2012, Vol. 75, Issue 3
Keep Earth's Water Clean	Keep Earth's Water Clean. *Weekly Reader* Edition 2. 4/2/2004, Vol. 73 Issue 23, p1–3. 3p. 8
Let's Get Physical	"Let's Get Physical!" *Junior Scholastic*, 00226688, 3/12/2007, Vol. 109, Issue 14
Muddy Waters	"Muddy Waters" By: Jozefowicz, Chris, *Current Science*, 00113905, 2/26/2010, Vol. 95, Issue 12
Water Worries	"Water Worries" *Weekly Reader News* Edition 3. 4/23/2010, Vol. 79 Issue 22, p3–3. 1p

Title of Text/Website	Best Links
USGS Website	http://ga.water.usgs.gov/edu/ http://ga.water.usgs.gov/edu/watercycle-kids.html http://ga.water.usgs.gov/edu/photo-gallery.html
NY State Department of Environmental Conservation	http://www.dec.ny.gov/about/865.html http://www.dec.ny.gov/education/63069.html NY Watershed Map http://www.dec.ny.gov/lands/26561.html Watersheds, Lakes and Rivers http://www.dec.ny.gov/education/51515.html
EPA Kids Page	http://water.epa.gov/aboutow/owow/kids.cfm
Water Education	http://www.watereducation.org/doc.asp?id=1022
FOSS Science Water	(http://fossweb.schoolspecialty.com/delegate/ssi-foss-ucm/ucm?dDocName=D1424929)
The Water Project	http://thewaterproject.org/resources/the_water_cycle.asp.

Water World

Water World

How kids are helping to solve the world's water shortage

In the dusty yard outside their school, children cling to a new red, green, and yellow merry-go-round as it spins round and round. The younger kids laugh and hang on tight as an older boy runs to give the wheel another push. It may sound like a scene you'd see at any playground, but these children in Africa aren't just enjoying a period of recess. Each spin on their merry-go-round is also pumping up valuable water for their entire community from a well deep underground.

When you turn on your faucet at home or school, you expect clean water to pour out. But more than a billion people around the world, especially in Africa and Asia, struggle to get enough clean water for drinking, cooking, cleaning, and bathing. "The minimum amount of water required to meet these basic household needs is 20 to 50 liters (5 to 13 gallons) per person per day," says Sandra Postel, director of the Global Water Policy Project in Massachusetts. That's not much when you consider that the average person in the U.S. uses roughly 378 L (100 gal) per day—more water than anywhere else in the world.

With water covering 70 percent of Earth's surface, why isn't there enough to go around? Almost all of this water is found in oceans; it is not freshwater that people can drink.

webextra

Get involved: World Water Day is March 22, 2007. Find out more about this year's theme, "Coping with Water Scarcity," at: www.unwater.org/wwd07/finishindex.html

EARTH FRESHWATER RESOURCES

As for the tiny fraction of drinkable water, it takes a lot of money and effort to build and maintain enough pipes, sewers, and water treatment plants to deliver it to all the citizens of a country. "The problem has more to do with poverty and governments' lack of will to provide access to water for everyone," says Postel.

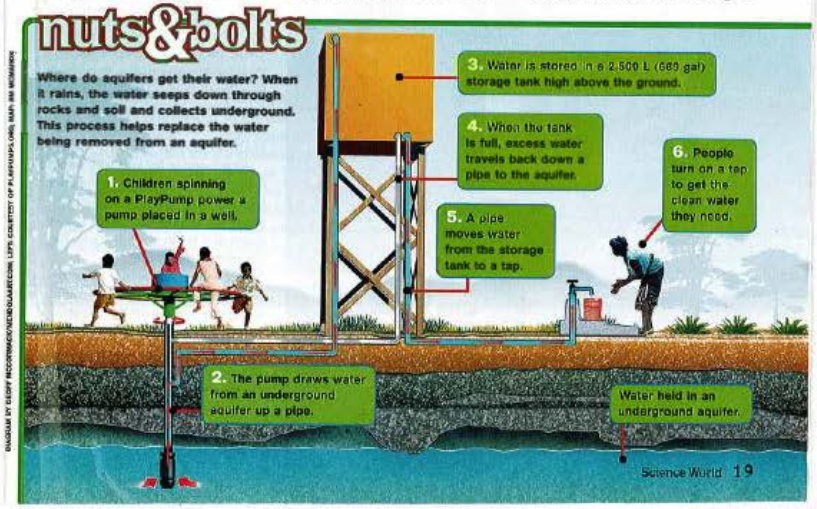
KID POWER

By drilling into the ground, people can tap into a hidden resource—water held between underground layers of rock or soil. These *aquifers* contain 40 percent more freshwater than all lakes, rivers, and streams combined. Reaching this groundwater may require a hole to be drilled as deep as 305 meters (1,000 feet) below Earth's surface. This well can provide safe, reliable water to people who live far from any streams or lakes.

The merry-go-round used by students in South Africa is part of the PlayPump water system. It relies on kid-power to draw water up a pipe from a drilled well (*see Nuts & Bolts, below*). You don't have to be very strong to get the water flowing, says Marissa Valdez, a program manager for the nonprofit organization PlayPumps International in Washington, D.C. "One woman could draw up water with just a few spins of the merry-go-round." But when kids take a turn on one of the more than 800 PlayPump systems installed in Africa (*see map, p. 18*), they get the added bonus of having fun.

nuts&bolts

Where do aquifers get their water? When it rains, the water seeps down through rocks and soil and collects underground. This process helps replace the water being removed from an aquifer.



Three Big Pollutants

For the waterbodies listed as IMPAIRED in the *National Water Quality Inventory*, top pollutants causing problems are dirt, bacteria, and nutrients.

1 Dirt

That's right, dirt. Dirt was listed as a leading cause of pollution in our rivers and streams. When rain washes dirt into streams and rivers, it smothers the little critters in the stream and kills any fish eggs clinging to rocks. Dirt can also clog the gills of fish, suffocating them. Have you ever walked into a pond or lake and noticed huge swirls of muck rising up and clouding your view of the bottom? Well, if the plants that use the sun to make food (yes, that's right, **photosynthesis**) can't get enough sunlight because the water is murky, they die.

Where does all this dirt come from?

Most of the dirt washing into lakes and streams comes from activities that remove trees and shrubs and leave the earth exposed. This exposed earth includes fields that have just been plowed, construction sites that have been bulldozed, and areas that have been logged or mined. Bare patches in your lawn or ballfield can also contribute to the problem. Some of the dirt polluting streams comes from the stream banks. The problem is that fast-moving water erodes the banks of streams. The water moves faster because the vegetation that would slow it down has been replaced with pavement and buildings.

What's being done to control dirt?

The solution is to stop the dirt from getting into the stream in the first place by disturbing the land as little as possible. Farmers are using different methods to grow their crops so they leave less earth exposed, and they plant grasses in fields that aren't being used. Construction workers are putting up silt fences and hay bales to trap the dirt and contain it while they build. Developers can design new home sites that leave more natural areas and less pavement to reduce the amount of earth they disturb.

2 Bacteria

Bacteria are a big water quality problem in our nation's waters. Not all bacteria are harmful (yogurt contains live bacteria cultures!), but the presence of some indicator bacteria is a clue that other germs and viruses that can make you sick might be in the water too.

Where do the bacteria come from?

The major sources of bacteria are **combined sewers** (which can overflow in a rainstorm and dump untreated sewage directly into our waters) and runoff of animal waste (including wild animal droppings!) from farmland and city streets.

What's being done to control bacteria?

Cities and towns are improving their sewage systems to keep untreated sewage from overflowing. Farmers are developing better ways to manage livestock manure. Dog owners are picking up after their pets (yes, dog waste pollutes too).

3 Nutrients

Nutrients were listed as the number one cause of water quality pollution in our lakes, ponds, and reservoirs. They caused impairment in more than 3.8 million acres! (That's more than 2.9 million football fields!) The two most common nutrients are nitrogen and phosphorus, which cause algae to grow and can turn the water green.

Where do nutrients come from?

The major sources of nutrients are runoff of fertilizers and animal waste from farms and cities (lawn fertilizers can wash away in heavy rain), sewage treatment plants, and failing **septic systems**.

What's being done to control nutrients?

Farmers are learning new ways to apply fertilizers and manage livestock. Homeowners are being educated about maintaining their lawns and septic systems. Cities and towns are fixing their sewage treatment plants.

6

"Three Big Pollutants." United States Environmental Protection Agency. EPA, n.d. Web. http://water.epa.gov/learn/resources/bigpollutants.cfm

PlayPumps:
A New Invention Turns Work into Play

For kids in many rural parts of Africa, the colorful PlayPump is the first playground equipment they've ever seen. When they give a push and jump onboard for their first ride, smiles of wonder break out on their faces.

The fun of whirling in a circle is just part of the amazement. This incredible invention doesn't just change their playtime, it changes their lives.

As the merry-go-round spins, it pumps clean water up from deep underground and stores it in a huge tank. People are welcome to come and help themselves to the water.

In rural Africa, clean water is a luxury. Most people don't have plumbing in their homes. Instead, they often must walk long distances to wells and haul heavy containers of water back.

Patricia Molope, 17, explains that before her South African village got a PlayPump, people would pay a taxi driver to take them to a far-off well. "Sometimes the taxi drivers were busy, and we would have to go without bathing in order to save our water. It was too far to walk there. But now we have our own clean water in our village, and life is better."

The exhausting chore of carrying water traditionally falls to women and girls. Hauling water for miles—and hours—each day is such a big job, it sometimes prevents girls from being able to attend school.

Thanks to the PlayPump, getting water is quick and easy—and even boys join in. The pumps have become a center of social activity where kids and adults gather to visit while collecting water.

Two sides of each tank carry educational messages that remind people about good health practices like battling germs through hand-washing. The other two sides carry advertisements, which help pay for the pump's upkeep.

So far, more than 800 PlayPumps are operating in schools and communities in four African countries, providing water for almost two million people. The pumps are made by a South African company called Outdoor Fabrication and Steelworks. Another company, Roundabout Outdoor, trains local teams who maintain the pumps. Each system costs U.S. $14,000.

PlayPumps:
A New Invention Turns Work into Play

Twelve-year-old Siyabulisiwe Khumalo lives in a South African community called Diepsloot. She says, "I have seen many kinds of water pumps where I grew up in the farmlands, but never one that stores the water. When I grow up, I want to be an inventor so I can invent clever things like the PlayPump that will help my community."

Fast Facts:

- Many toilets use more water in one flush than most rural families in Africa have for one day of cleaning, cooking, drinking, and bathing.
- The average distance an African villager must walk to a water source is five miles (eight kilometers).
- A five-gallon (19-liter) container can weigh about 40 pounds (18 kilograms), and many women and girls suffer injuries carrying so much weight every day.
- A child dies somewhere in the world every 15 seconds from a water-borne illness.
- The PlayPump can pump up to 370 gallons (1,400 liters) of clean water an hour.

Ngs Staff/NatGeoCreative.com

Where Are These Pollutants Coming From

Where are These Pollutants coming from?

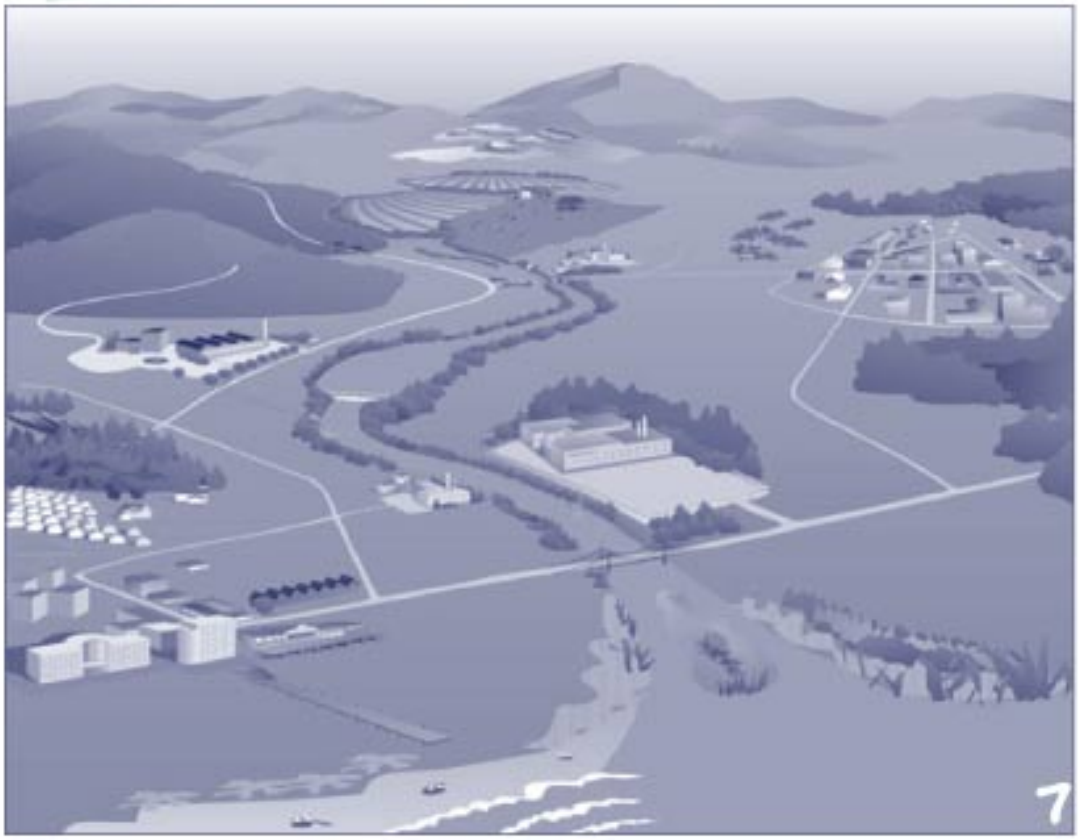
True or false? Factories are the major source of pollutants in our waters.

False. Thirty years ago that statement was true, but since then we've made a lot of progress cutting down on pollution from factories and sewage treatment plants. Although these can still pollute in some areas, today most of the problems in our waters comes from **polluted runoff** draining into rivers, lakes, and bays after a rain storm. Rain washing over the landscape carries dirt, oil, fertilizer, pesticides, animal waste and many other substances off streets and farms and into our waters.

As we pave over natural areas to make parking lots, driveways and roads (known as **impervious** surfaces) the rainwater doesn't slowly soak into the ground like it used to. Instead it's channeled into gutters, culverts, and storm drains. These tend to be convenient places for people to illegally dump used motor oil, trash, and yard waste. These pollutants then are whisked directly into our streams, wetlands, bays, and lakes.

Areas where water can slowly soak into the ground are described as **pervious**. Pervious areas include lawns, fields, wooded areas, and even brick walkways and gravel driveways that allow rainwater to soak in.

And there's more. All over the country, streams have been straightened and physically altered to flow in a certain direction; some have been lined with concrete. This makes water rush faster after a rainstorm (increasing erosion) and makes it difficult or impossible for plants and aquatic



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"Where Are These Pollutants Coming From?" United States Environmental Protection Agency. 6 Mar 2012. Web. http://water.epa.gov/learn/resources/where.cfm.

A World Thirsty for Clean Water

The water in the village where Maria and her family live is bad. Her younger brother got so sick from drinking it that he almost died. Maria's job is to collect clean water, and her family depends on it. She walks six miles to the river and back — twice a day! Seven-year-old Maria no longer attends school. She has no choice.

Can you imagine missing school because you had to spend all day collecting water? You probably don't even think about water. In the United States, as in any other developed country, water is safe and plentiful. But for millions of people from developing countries, finding clean water remains a major problem.

Unclean or unsafe water is dangerous to your health. Unlike clean, potable water that doesn't contain any pollutants, unsafe water has not gone through a purification process. It carries contaminants — bacteria. viruses, fungi, minerals, or man-made chemicals — that can cause serious disease. Countries with the least access to safe water are among the poorest in the world and are located in Asia and sub-Saharan Africa. These nations visually lack the means to build or buy specialized machines that purify water. As a result, their populations are left with no other choice but to use unsanitary water.

Unsafe water remains the most common cause of sickness and death in poor countries. Illnesses due to bad water are called "water-related diseases." Diarrheal disease is the most serious one. It spreads through water infected with human or animal feces. Individuals become sick by drinking such water or eating food washed with it.

Diarrheal diseases affect mostly children, particularly children under the age of five. Every year, more than a million children die after being exposed to water infected with feces. In general, children are more vulnerable than adults to water-related diseases because children's bodies are not fully developed, so they have less resistance to serious illness. Also, in proportion to their weight, children eat more, drink more, and breathe more than adults do, making the contaminants swallowed or breathed in more dangerous.

What happens when children get sick? They miss school and the opportunity to learn. Later on, when they are grownups. they may have difficulty finding a good job. They'll get poorer, their families will get poorer, and their country will get poorer. And so on it goes.

But there is some good news. The world is now taking action. International aid organizations, including the United Nations and the World Bank, are lending money for projects that clean water in some of the poorest areas of the world. Aid groups have pledged to cut the number of people living with unclean water in half by 2015. One important way to achieve this objective is through education.

Everyone needs to be aware of this worldwide problem, and everyone can be part of the solution. This includes you. Don't wait: Start spreading the news today.

PHOTO (COLOR): Clean water — plentiful here in the United States, but a rarity in too many places throughout the world.
PHOTO (COLOR): Dirty water carries diseases and Is a primary source of health problems in many places.
~~~~~~~~~
By Brigitte Aftalo-Calderon
Brigitte Aftalo-Calderon divides her time between the United States and France. Before becoming a writer, she worked for the World Bank, an international organization that specializes in lending money to poor countries.
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EARTH

Dry Run

Will the drought gripping the U.S. Southwest ever end?

By Beth Geiger

Who pulled the plug on Lake Powell in southern Utah? A chalk-white "bathtub ring" marks the level that the water once reached, 30 meters (100 feet) above the current surface.

And why are so many Las Vegas residents ripping up their lawns? The grass removed in the last several years would cover almost 1,500 football fields.

The disappearing water and grass are just a few signs of the severe drought that has parched much of the southwestern United States since 1999. The question now is: When will the drought end, or—as some experts believe—will it become permanent?

DRY SUBJECT

A *drought* is a long period of abnormally low precipitation. "It can occur anywhere, any year, even in a rain forest," says Mark Svoboda, a climatologist with the National Drought Mitigation Center.

A drought usually is caused by a shift in ocean temperature thousands of miles away. Most climatologists believe that cooler-than-average Pacific Ocean temperatures near the equator cause droughts in the U.S. Southwest. That cooling of Pacific Ocean water, called *La Niña*, occurs every three to five years. It changes the direction that moisture-carrying storms travel, diverting them from the Southwest. "La Niña starves the U.S. Southwest of winter moisture," says Gregg Garfin, a University of Arizona climatologist.

Rocky Anderson, the mayor of Salt Lake City, Utah, shows off his home's drought-resistant front yard.

The Atlantic Ocean seems to be contributing to the current dry spell too, adds Garfin. The northern Atlantic has been warmer than normal, further diverting storms away from the Southwest.

THIN RINGS

How bad is this drought? Bad! says Malcolm Hughes, an expert in *tree rings* and climate at the University of Arizona. A tree adds a layer of new tissue to its trunk every year. Because trees grow more slowly during drought years, their new growth rings are thinner then.

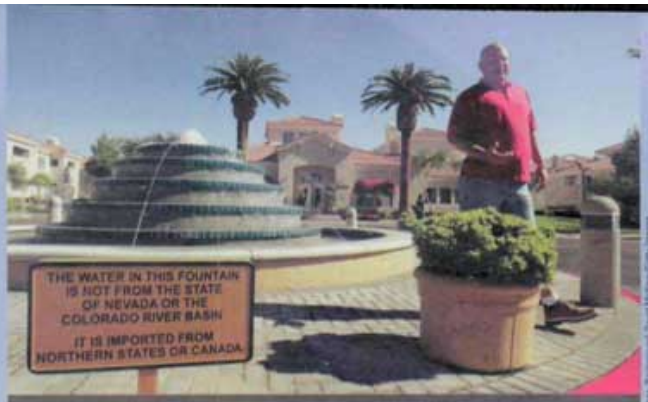
Measuring tree rings, Hughes has traced the Southwest's climate back more than 1,000 years. So far, he says, the worst drought occurred in the 1580s. "But this one may be going beyond that," he told *Current Science*. For example, between May 2005 and May 2007, most of Arizona received from 25 to 80 percent below the normal precipitation.

Droughts are nothing new to the Southwest. But cities as big as Phoenix and Las Vegas are. Even before the drought set in, residents acted as if there was enough water to go around, though there wasn't. "The average Las Vegas home was putting 73 gallons of water on each square foot of lawn every year," says Doug Bennett, conservation manager for the Southern Nevada Water Authority.

Bennett's agency has helped Las Vegans kick some of their wasteful habits. It pays home owners to tear out water-sucking grass and replace it with desert plants. The program has saved 64 billion liters (17 billion gallons) of water—enough

to fill more than 190,000 Olympic-sized swimming pools—since 2000.

Measures like that have enabled Las Vegas and other southwestern cities to cope so far with the drought. But what if it never ends? What if a drier climate becomes the norm?



Las Vegas property owners are importing water to run fountains and nourish plants.

THE NEW NORMAL

A recent study says that's just what will happen. The study, led by Richard Seager of the Lamont-Doherty Earth Observatory in New York, was published in April.

Seager compared 19 *computer models* that forecast how global warming will affect the Southwest's climate. A computer model is a computer program that analyzes how various factors—for example, wind patterns, air temperature, and rainfall—influence one another. Eighteen of the 19 computer models said the same thing: "On average, by the end of the century, people in the Southwest will see a 10 to 20 percent reduction in rainfall compared with the present," explains Yochanan Kushnir, one of Seager's coauthors. "There is remarkable agreement between the different models."

Global warming, says Seager, will change a wind pattern called the *Hadley Cell*. The Hadley Cell is a conveyor belt for air that connects the tropics with subtropical regions. Air within the Hadley Cell rises in the tropics, dropping moisture as it gains altitude. The dried-out air moves north (and south) of the equator, then descends in subtropical regions such as the American Southwest. Global warming will cause the Hadley Cell to widen and move farther north, making the Southwest even drier.

Global warming will have a second effect. Warm air holds more water than cool air, so global warming will pull moisture from the soil. Dry soil heats up quickly, further warming the air above it. The Southwest is particularly susceptible to that effect because it has much less vegetation than other regions; vegetation shades the soil and holds moisture in the ground.

SUMMER SHOWERS

Some scientists say the computer models may not account for summer thunderstorms that bring rain to the Southwest and could help make climate change there more bearable. "I think we have to be cautious with modeling studies," says Svoboda.

But, says Garfin, though Seager's findings may not account for every detail, his conclusion is basically right: Far worse conditions lie ahead. A warmer, drier climate in the Southwest in the future will be tougher on ecosystems and water supplies than ever.

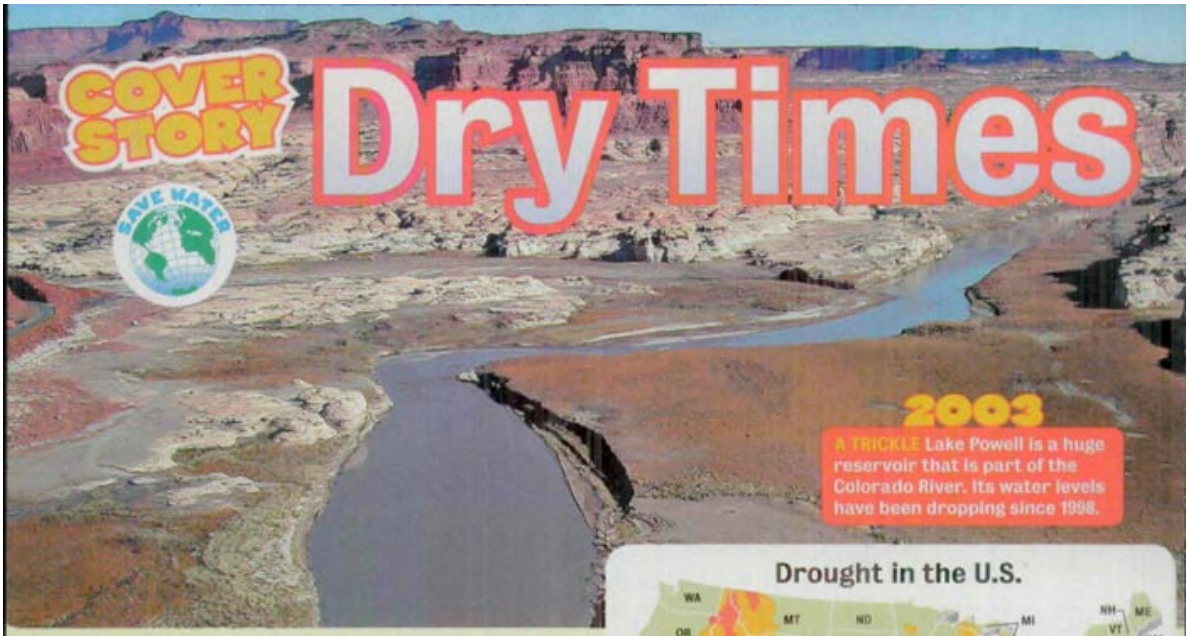
"The drought of the future," he says, "isn't going to be your father's drought." CS

The colors on this map of Arizona indicate the percentage of precipitation each region received during the last two years compared to the yearly average.

The long drought in the American Southwest has lowered the level of Lake Powell by 30 meters (100 feet).

COVER STORY

Dry Times



Parts of the U.S. are struggling with serious water issues

For residents of many parts of the southern United States, rain would be a welcome sight. Parts of the Southwest and the Southeast are very thirsty for water.

Officials in the Southeast recently put emergency water-saving rules in place. In Siler City, North Carolina, residents were ordered to reduce water use by 50 percent. Georgia's Governor Sonny Perdue declared October "Take A Shorter Shower Month." Residents of Atlanta, Georgia's capital, aren't allowed to water their lawns.

These areas are experiencing a serious **drought**. Population growth is making the drought worse. This growth puts a burden on freshwater supplies.

Experts are working on long-term solutions to these water woes. In the meantime, Americans everywhere are thinking about how to conserve one of the most precious natural resources—fresh water.

Booming Areas

Large numbers of people are moving to, and raising families in, the Southeast and Southwest. Georgia's population increased by 26 percent between 1990 and 2000. The number of people in the Southwest is growing even faster. Nevada's population grew by 66 percent between 1990 and 2000.

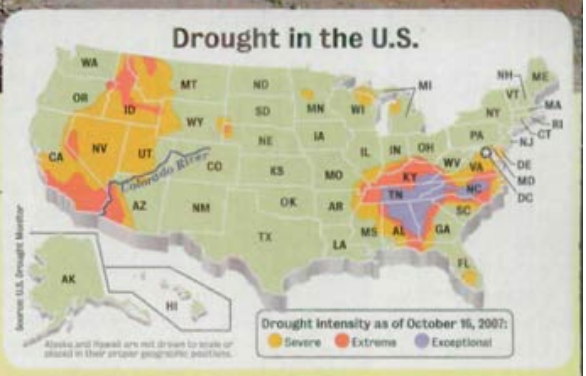
Eric Kuhn of the Colorado River Water Conservation District says this growth poses a serious problem. "The demand for water exceeds the supply available during dry periods," he says.

Why So Dry?

Droughts are natural disasters. No one can tell for sure when droughts will begin or end. The lack of rainfall in the Southeast this year was a surprise. The Southwest has had below average rainfall for several years.

But rain alone won't help refill the Southwest's rivers, lakes, and reservoirs. Scientists think this region is also drier due to global warming.

The Colorado River is the main source of water for seven Western states. Experts have estimated that by 2050, the Colorado River's flow will have been reduced by 18 percent, due to global warming. Melting snow from the Rocky Mountains feeds the river. Scientist say that warmer air is causing some of this snow to evaporate before it melts.



What's that word?

drought: (drout) ***noun.*** An extended period of much less rainfall or snowfall than expected.

Dry Times

2002

SHRINKING Lake Powell with more water, but still less than normal.

Solving the Problem

Solving the water crisis will require both conservation and long-term planning. In the Southeast, officials from Florida, Alabama, and Georgia are discussing how to divide their limited supply of water fairly and use it wisely.

In the Southwest, scientists are working on more effective ways to water crops. Farmers there need lots of water for their thirsty plants. One idea is to deliver water straight to plants' roots. That requires less water than typical **irrigation** methods. Some officials are also working on solutions that involve turning Pacific Ocean water into fresh water.

Kids Can Help

Even if you don't live in a drought-stricken area, wasting water isn't wise. Many areas are naturally dry. People need to conserve water to make sure there's enough for everyone.

Just ask the fourth-grade class at S.Y. Jackson Elementary in Albuquerque, New Mexico. Last month, the class attended a children's water festival. There, students learned where the region's water comes from and why they need to conserve it. "Water is very valuable in New Mexico," says Michelle Nguyen, 10. "This is very dry land, so we have to conserve water."

Classmate Lindsey Shepherd's family has been quick to put water-saving measures into practice. "We used to take 15-minute showers. Now we take five-minute [showers], and we don't keep the water running when we brush our teeth," says Lindsey, 10 (*see Water Wisdom*).

The students say knowledge about the issue has made their families more wise about water use. "Some people just don't know to care," says Jacob Hyde, 9.

—Elizabeth Carney

DRY DOCKED Before its water level dropped, Lake Lanier in Georgia used to keep this boat afloat.

What's that word?

irrigation: (ir-uh-gay-shuhn) ***noun.*** The supply of water to crops by artificial means, such as channels or pipes.

Water WISDOM

ALL ABOUT WATER These fourth-grade students from Vista Grande Elementary in Rio Rancho, New Mexico, recently attended a water festival.

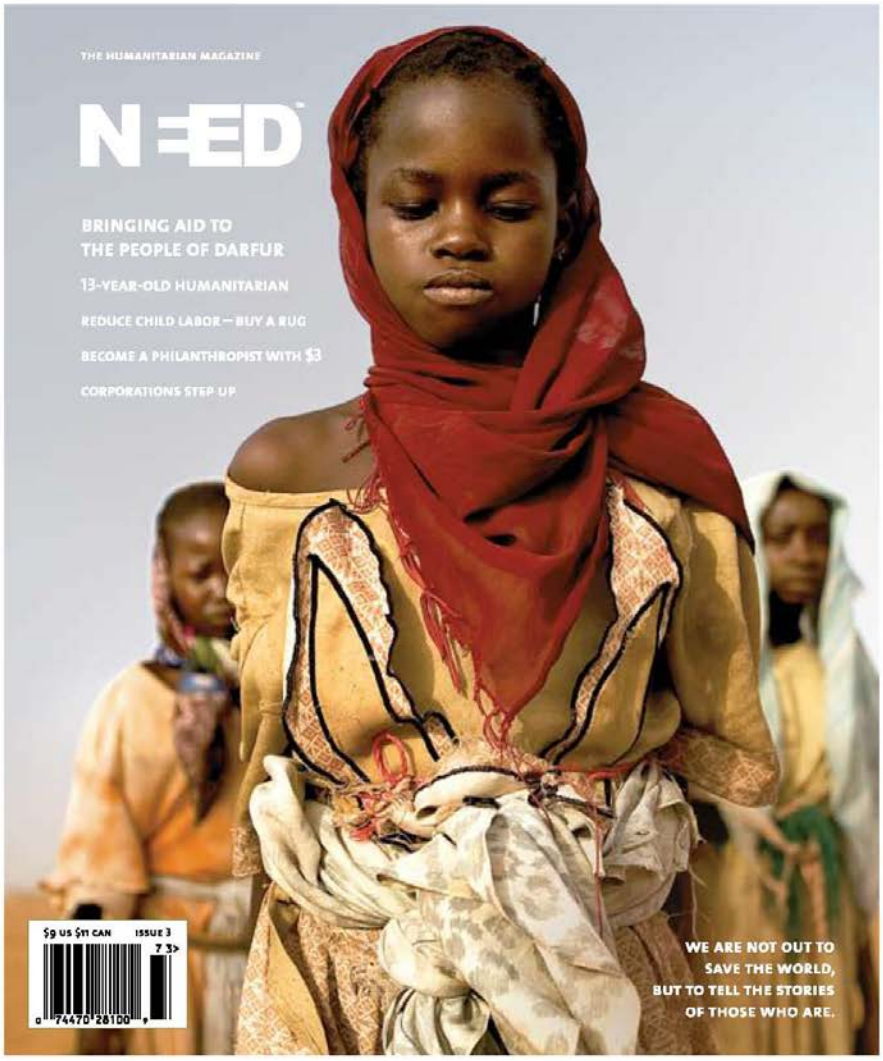
Fresh water isn't only used for drinking. In fact, in a typical U.S. household, water is used mostly for bathing and showering. Other water-using activities are cooking, drinking, cleaning, and flushing the toilet. You and your family can conserve water with these easy tips:

- Limit showers to no more than five minutes.
- Turn off the tap when you wash dishes or brush your teeth.
- Search your sinks, toilet, and shower for leaks, and ask an adult to repair any that you find.
- Only run dishwashers and washing machines when they're full.

BACK TO YOU

- **What other ways can you think of to help protect the environment?** Plot on a graph the number of hours that you use electricity during each day of the week.

NEED: Future Clean Water Solutions



NEED: Future Clean Water Solutions

FUTURE | CLEAN WATER SOLUTIONS

WRITER: JOHN REISINGER
PHOTOGRAPHER: SCOTT HARRISON

It is easy to take something for granted when it is always there. In places rich with clean water resources there are watered lawns, clean cars and long showers. Comprehending the global need for water is difficult when wells are abundant and public waterworks are aptly funded – the tap turns; the water comes out. It is unimaginable to even think of walking great distances every day to throw a bucket into a swamp and call what comes out drinking water.

More than a billion people in the world are currently in need of clean drinking water. The need is so vast that no single solution will work in every case; therefore, there is room for various creative solutions. More than 2.2 million people die each year from preventable diseases caused by contaminated water. The need for clean water will continue to grow as the global population increases.

In the developing world, wells are too expensive for impoverished villages to afford because they require skilled workers and specialized heavy equipment. To top it all off, subterranean water is not always available, and surface water is generally not safe to drink. Other innovations are necessary, and tremendous steps are being taken to bring water to these communities.

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A BOY IN SOUTHWESTERN ETHIOPIA DIGS A HOLE TO FIND WATER IN A SANDY RIVERBED. IT HAD RAINED THE DAY BEFORE, SO HE WAS ABLE TO GATHER SOME MUDDY WATER TO HAUL BACK TO HIS VILLAGE.

NEED: Future Clean Water Solutions

PRIOR TO "CHARITY: WATER" SPONSORING A WELL IN 2006, THIS ALGAE-FILLED SWAMP WAS THE WATER SOURCE FOR MORE THAN 4,000 PEOPLE LIVING IN THE COMMUNITY OF BULGETA, ETHIOPIA.

THIS WATER HOLE IS ABOUT AN HOUR SOUTH OF RWANDA'S CAPITAL, KIGALI. EVERY DAY PEOPLE GATHER MUDDY WATER FROM THIS RAVINE IN 5-GALLON FUEL CANS AND HAUL IT SEVERAL MILES BACK TO THEIR VILLAGES. COW FECES AND URINE MAKE THIS WATER DEADLY, BUT THE CHARCOAL TO BOIL THE WATER FOR SANITATION IS TOO EXPENSIVE FOR MOST VILLAGERS WHO LIVE ON LESS THAN $1 A DAY.

NEED: Future Clean Water Solutions

LIKE 200 MILLION PEOPLE WORLDWIDE, THIS CHILD IS INFECTED WITH SCHISTOSOMIASIS (PARASITES) BECAUSE OF THE CONTAMINATED WATER HE DRINKS IN SOUTHERN ETHIOPIA. THIS CONDITION CAN DAMAGE THE LIVER, LUNGS, INTESTINES AND BLADDER, RESULTING IN A BLOATED BELLY AND SWOLLEN FEET.

NEED: Future Clean Water Solutions

"CHARITY: WATER" FUNDED THIS NEW WELL, BUILT IN 2006, THAT SERVES THE COMMUNITY OF BULGETA, ETHIOPIA. A WELL CAN PUMP MORE THAN A MILLION GALLONS OF SAFE, CLEAN WATER PER YEAR, WHICH IS ENOUGH WATER TO FILL MORE THAN 7 MILLION 16.9-OUNCE BOTTLES.

CHARITY: WATER

Travel to impoverished regions of Africa like Scott Harrison did, and the need for clean water becomes obvious. "More than one in six people on the planet don't have access to safe water. It's an emergency to those billion people. Eighty percent of diseases [in the Third World] come from bad water and inadequate sanitation," Harrison states. "When I saw ... what that looked like in the developing world – 13-year-old girls that [were] not in school but instead [were] breaking their backs to haul muddy water three miles uphill to their villages – it's hard to sit idly by."

Harrison had to do something. He formed charity: (yes, all lowercase, with the colon included), a nonprofit dedicated to "stimulating greater global awareness about extreme poverty, educating the public, and provoking compassionate and intelligent giving." Its first campaign called "charity: water" has multiple fundraising initiatives including the sale of bottled water and well sponsorships. "We ask people to sponsor a well or a part of one. Kids, youth groups, churches, hotels and landscape companies – anyone can join us in providing clean water to these

NEED: Future Clean Water Solutions

villages in need. Then, we ask people to tell our story to engage their peers," says Harrison.

"Charity: water" receives donations that are used to fund 168 clean water well projects in these countries: Malawi, Uganda, Central African Republic, Liberia, Rwanda and Ethiopia. "Our projects normally also have a sanitation and hygiene piece to them, and training committees to maintain their new water source is key," states Harrison.

He continues, "Many people have embraced the notion that water is a basic human right and offered to help do something about those without access to it. ... The response exceeds our expectations. ... We simply can't raise too much awareness."

BIOSAND FILTERS

In some areas of the world, water is readily accessible, but it is dirty, so it needs a filter. Standard filters are expensive, complex and heavily reliant on expert maintenance. Because of these factors, they do not translate well for Third World use. A revolutionary filtration system is needed.

Enter the BioSand Water Filter. Dr. David Manz at the University of Calgary created and donated the design of this filter to be utilized by any nonprofit that could put it to good use. Organizations like Living Water International and Samaritan's Purse are building BioSand Water Filters in areas of need around the world.

This filter is constructed out of gravel, sand, PVC pipe and sheet metal, all of which are readily available at a low cost anywhere around the world. As water passes slowly through the sand, a biological zone is formed at the top. This zone, called a "schmutzdeke," is filled with bacteria that eat other bacteria and viruses, purifying the water as it moves down through the sand.

CLEAN WATER FLOWS FROM THE BIOSAND WATER FILTER (BACKGROUND) IN EL SALVADOR. PHOTO | COURTESY OF SAMARITAN'S PURSE

NEED: Future Clean Water Solutions

| FUTURE |

Pour a glass of dirty water inside the pipe, and clean drinking water will come out the other end. Its genius lies in its simplicity.

"The Pantanal area of Brazil is home to one of the largest swamps in the world. The size of Colorado, this swamp is the main source of drinking water for Pantanal communities," says Stan Patyrak, assistant vice president of Living Water International. In an area where the main source of travel is by boat, drilling water wells is extremely difficult due to the inaccessible nature of the area. "BioSand Filters have had a special impact in areas like this, as they require very little and simple maintenance," Patyrak says.

The average cost for each filter is $100 USD per household. This one-time expense includes construction, installation and monitoring of the filter plus important health and hygiene training. Samaritan's Purse has built nearly 70,000 of these filters all over the world. "The BioSand Water Filter removes between 95 and 99.5 percent of microbial contaminants as well as 100 percent of worms and parasites. ... The water flowing out of the filter is clear, good-tasting and free from ... the pathogens responsible for diarrhea diseases," states Scott Drennen, representative of Samaritan's Purse.

Bernard Mzololo is a resident of the remote Kwale district of Kenya where clean drinking water was not readily available. Each day members of his family would trek up to 12 miles one way to access water. After receiving their filter from Samaritan's Purse, "My family isn't sick anymore with stomach problems," Mzololo says. "Before we had the water filter, they would get diarrhea and suffer for a long time."

A GIRL FROM THE PANTANAL AREA OF BRAZIL HOLDS GLASSES OF WATER TO SHOW THE BEFORE AND AFTER EFFECTS OF THE BIOSAND WATER FILTER. PHOTO | COURTESY OF LIVING WATER INTERNATIONAL

PLAYPUMPS INTERNATIONAL

When water is abundant, the BioSand Filter is an excellent solution. Unfortunately, there are some places where surface water is nonexistent. In those situations, the PlayPump is ideal. Created by PlayPumps International, it has the ability to draw water from more than 300 feet below the surface.

The PlayPump is far more than a simple well. Water is not pumped with a labor-intensive, old-fashioned hand lever. Instead, it harnesses the energy of playing children. Disguised as a brightly colored merry-go-round installed near schools, the PlayPump can produce up to 370 gallons

NEED: Future Clean Water Solutions

CHILDREN ARE HAVING FUN ON THE MERRY-GO-ROUND THAT IS OTHERWISE KNOWN AS A PLAYPUMP.
PHOTO | COURTESY OF PLAYPUMPS INTERNATIONAL

of water an hour. The water is stored in a tank capable of holding more than 600 gallons. Turn the spigot at the base of the pump, and out flows clean drinking water – enough to easily serve over 2,500 individuals.

With the water harvested from the pump, schools have been able to create large-scale food gardens that improve the schools' meal program. "Even if we can provide just one balanced meal to the children who come from the poorest homes, we know they stand a chance," says Mrs. Ghazi, principal at Basa Primary School. "Each row of vegetables is under the guardianship of a particular class, and the children take tremendous pride in clearing their patch of weeds and watering their precious plants."

Each element of the PlayPump system is meticulously designed. The water tank serves as a billboard to the outlying community. Two sides of the tank are used for public service announcements many of which have HIV/AIDS prevention messages. The remaining two sides of the tower are rented out to advertisers. Marissa Valdez, program manager of PlayPumps International, explains, "Revenues from the sale of the advertising space cover the cost to maintain the PlayPump systems so that the community does not incur any cost." These pumps have creative solutions built right in.

Palesa Mkhabela, 12, attends a school with a PlayPump and dreams of becoming a doctor. He says, "When I become a doctor and can help other people, I will always remember that health starts with clean water."

WATERPARTNERS INTERNATIONAL

Communities in the developing world know what they need. Some need a well, filter or pump, but with any of these solutions, the success of microfinance has proven its value. Microcredit allows a community to literally own a project. Using this proven system, WaterPartners International (WPI) has come up with a strategy, referred to as WaterCredit. This approach helps individuals and communities in developing countries implement sustainable solutions for clean drinking water.

WPI works from a simple set of ideas. They provide microloans to villages that do not have the means to obtain them. According to WPI's Web site, "These loans help finance the upfront cost of water and sanitation systems. Giving people the credit tools they need and allowing them to repay the loans over time empowers them to solve their own water supply needs."

"In terms of ownership and self-sufficiency, the community or individual owns the water project from the time it is installed," comments Nicole Wickenhauser, communications manager for WaterPartners International. "Our partner organizations provide the training and technical expertise needed for the owners to properly and independently operate, maintain and repair the water connection throughout its life."

Those who have received loans have shown incredible responsibility. According to Wickenhauser, "Loan repayments typically run one to three years.

NEED: Future Clean Water Solutions

BECAUSE OF MICROCREDIT, THESE GIRLS HAVE CLEAN WATER IN HONDURAS. PHOTO | COURTESY OF WATERPARTNERS INTERNATIONAL

NEED: Future Clean Water Solutions

In Bangladesh and India the repayment rates have been [more than] 90 percent."

Gandhamani, from India, is a great example of how access to clean water can improve the quality of life. She was able to use a WaterCredit loan in order to have access to clean water at her home. Besides having clean drinking water, she also uses the water for her garden and her banana trees, which provides extra income for her family. As an added benefit, she no longer has to spend time hauling water over long distances, which allows her to spend more time with her family.

GANDHAMANI RECEIVED A WATERCREDIT LOAN FOR CLEAN DRINKING WATER. PHOTO | COURTESY OF WATERPARTNERS INTERNATIONAL.

ETHOS WATER

Along with several proven solutions that provide clean drinking water, consumers can have a positive impact on the world's water crisis. Ethos Water provides consumers with the opportunity to donate to clean water projects in the developing world by merely buying a bottle of water. "For each bottle of Ethos Water purchased in the US, 5 cents is contributed to the Ethos Water Fund at the Starbucks Foundation," states Peter Thum, founder of Ethos Water. "The mission of Ethos Water is to help children around the world get clean water and to raise awareness of the world water crisis."

Since its inception in 2002, Ethos Water has committed over $4.2 million USD in grants to its beneficiaries. Thum notes, "Our ability to deliver upon this mission has grown from humble beginnings as a regional start-up company in 2002 to national distribution and sales since Starbucks acquired the brand in 2005 and undertook to scale our social mission." Ethos Water can be found at Starbucks locations, as well as other retail establishments.

In the village of Cholusnate, Honduras, the residents were forced to gather runoff water during the rainy season. Throughout the dry months of the year, women and children had to trek more than a mile to obtain water. Yet the water that was collected was contaminated. Ethos Water donated funds for a WPI team fix the problem in Cholusnate. Thum reported that the money given was used to build latrines, train plumbers and create a complete water system that sustains the village through the dry season.

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PETER THUM SPENDS TIME WITH THE CHILDREN OF THE RURAL VILLAGE OF PINJAUAN IN WESTERN SUMATRA. ETHOS WATER SUPPORTED MERCY CORPS TO INSTALL PLUMBING, TOILETS AND HAND-WASHING FACILITIES AT THE SCHOOL SO THEY NO LONGER HAVE TO USE A NEARBY RICE FIELD AS THEIR 'LATRINE FACILITY.' PHOTO | COURTESY OF ETHOS WATER

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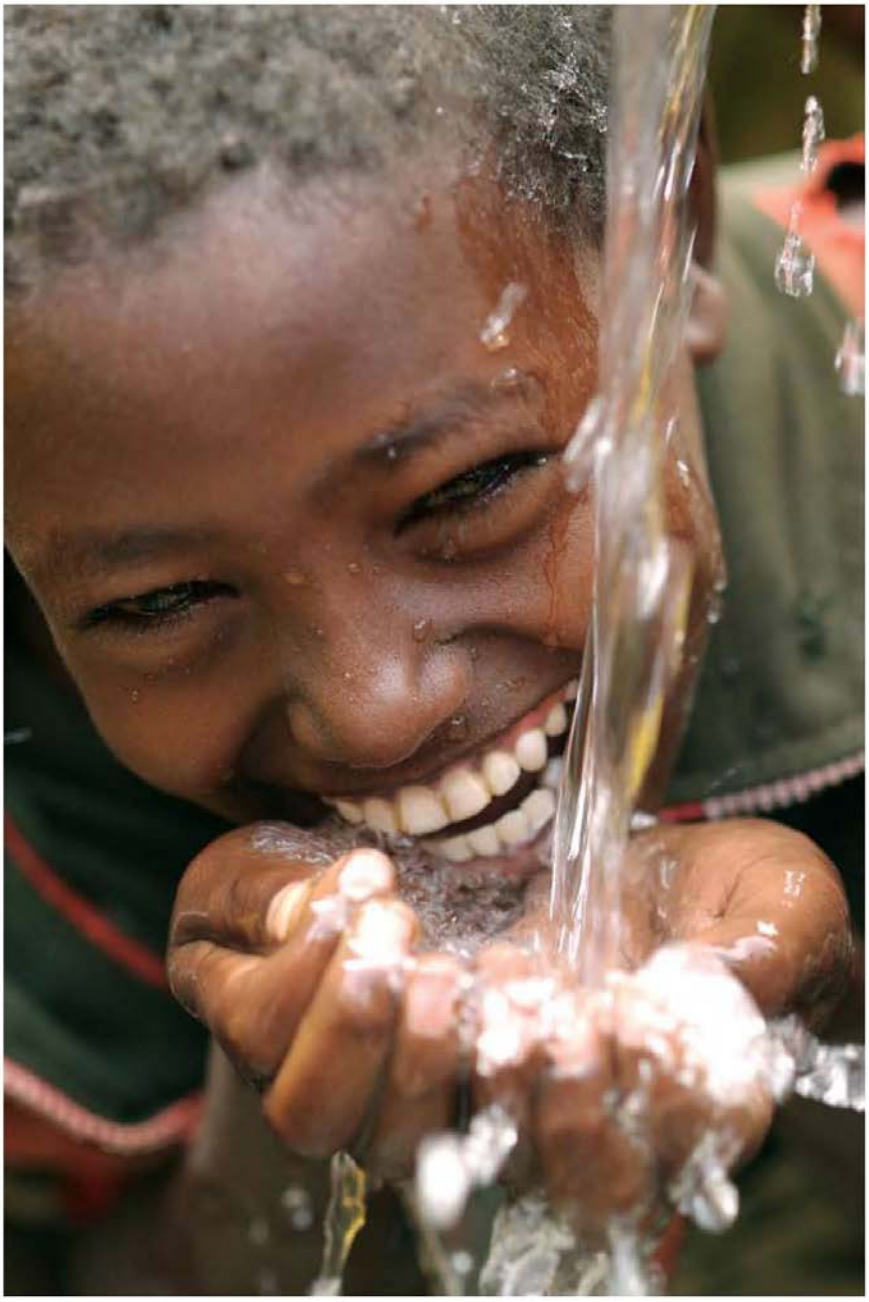

A CHILD ENJOYS CLEAN DRINKING WATER FROM THE NEW WELL IN BULGETA, ETHIOPIA.

NEED: Future Clean Water Solutions

The urgency of the water crisis is undeniable. However, with the ingenuity of individuals, communities and organizations, sustainable solutions are implemented because access to safe drinking water is a basic human right. NEED

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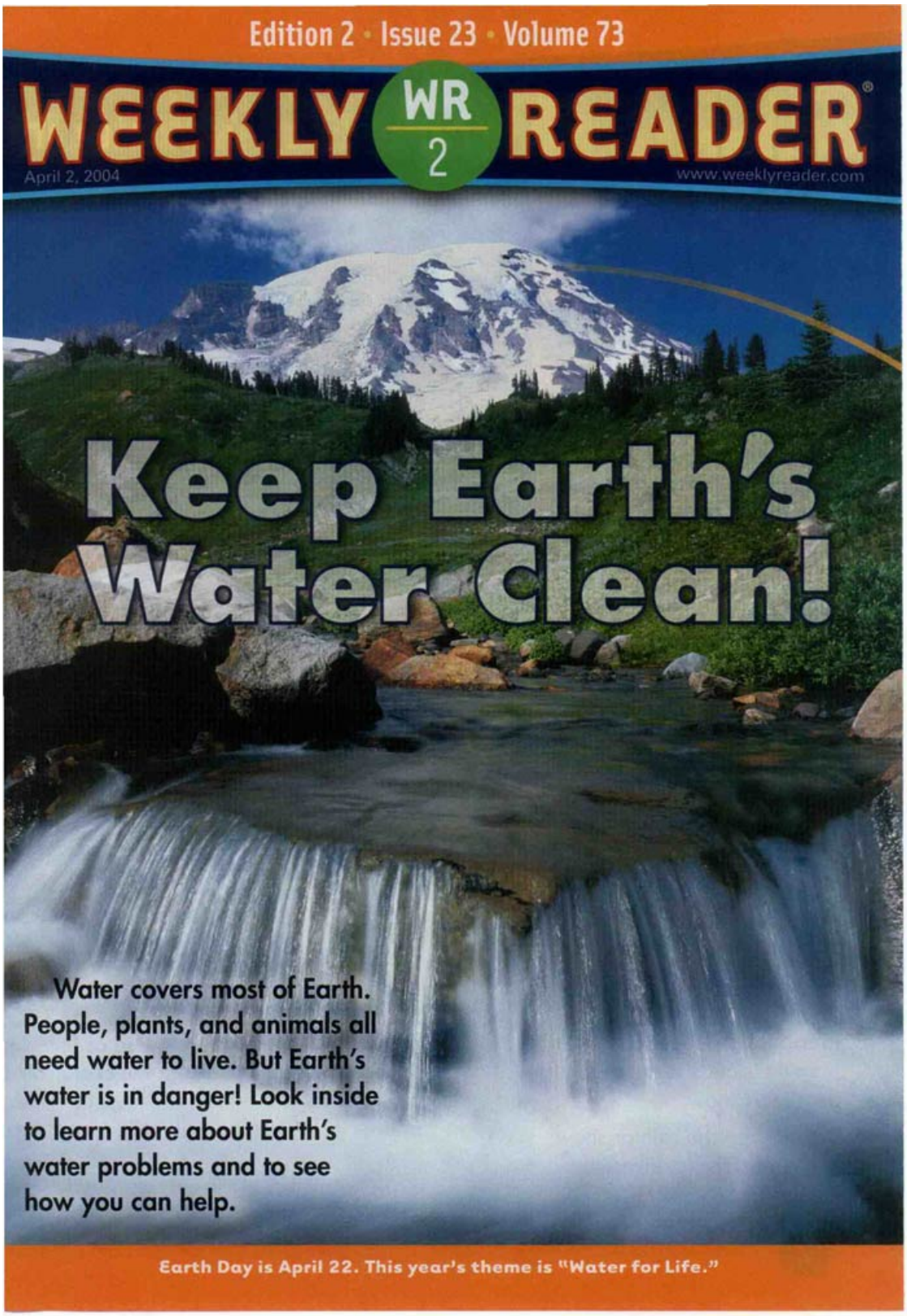
| ON THE COVER |

YOUNG GIRLS LEAVE AN INTERNALLY DISPLACED PERSONS (IDP) CAMP IN ABU SHOUK, NORTH DARFUR, TO GATHER FIREWOOD. SINCE 2003 OVER 200,000 SUDANESE PEOPLE HAVE BEEN KILLED AND OVER 2 MILLION DRIVEN FROM THEIR HOMES INTO CAMPS IN DARFUR AND THE NEIGHBORING COUNTRY OF CHAD.

PHOTO | RON HAVIV - VII

Reisinger, John. "Future Clean Water Solutions." NEED 2007: 2-15. Print.

Keep Earth's Water Clean



Keep Earth's Water Clean

Water Is Always Moving

Earth has only a certain amount of water. Earth's water is used again and again in the **water cycle.** The water cycle has four parts.

1. **Evaporation**—The sun warms water in rivers, lakes, and oceans. Soon the water turns into a **vapor,** or gas, and floats into clouds in the sky.
2. **Condensation**—Water vapor in clouds cools and turns back into a liquid.
3. **Precipitation**—The liquid falls from the clouds to the ground as rain or snow.
4. **Collection**—The rain or snow ends up in rivers, lakes, and oceans again.

Why Is Earth's Water in D

Much of the wo
Polluted water ho
trash in it. Those t
many ways. F
get into wa
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a cycle, i
into the
ground
water v
wrong
can be
and plar

Here, an African penguin is covered in oil that spilled into the ocean.

This is whe
penguins
look like.

Word Wise

recycle (ree-SIGH-kuhl)—to use again

Make a Splo

You can help keep Earth's water clean too! Everything you do affects Earth's water in some way. Take a look at these tips.

- Use as little wate
- Put chemicals an
the proper place
or down a drain
- Pick up trash you
ground and don

Keep Earth's Water Clean

anger?

r on Earth is **polluted.** harmful chemicals or gs can get into water in example, chemicals can if a factory dumps them Because water travels in an carry those chemicals ean, the air, and the rash can get into our en people dump it in the ces. Trash in the water ry harmful to animals

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THINKING CUE

Besides water, what are some things you could care for on Earth Day?

Give Water a Hand

Earth Day is April 22. On Earth Day, many people help clean up parks, rivers, and beaches. Groups of volunteers from schools, churches, and neighborhoods join to help our Earth. Some people pick up trash, and others plant trees. Many people work to save water from pollution. What will you do this Earth Day?

The plastic rings from six-packs can be dangerous to animals because their heads, necks, and legs can become tangled in the holes.

You and your family can help keep Earth's water clean too!

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Toxic Water is Poisoning the People of Bangladesh

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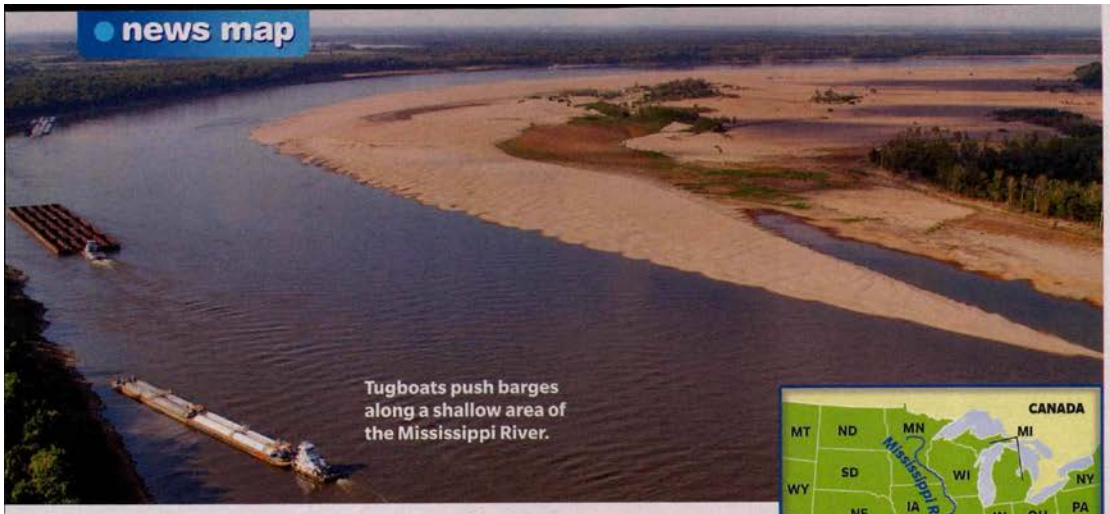
A River At Risk

news map



Tugboats push barges along a shallow area of the Mississippi River.

A River at Risk

Water levels on the Mississippi River are falling

Boats on the Mississippi River may soon have trouble getting very far. The river is a superhighway for shipping goods within the U.S. and to the rest of the world. But last month, its water levels fell to their lowest point in years. That threatened to shut down some parts of the Mississippi.

Water Woes

The water levels began to drop last summer, when more than half the country suffered through a severe drought. Dry conditions continue, causing the river to get even shallower.

One big trouble spot is the area between St. Louis, Missouri, and Cairo, Illinois. Water levels there have dropped about 20 feet since this time last year.

The low water levels have hurt many businesses. Boats tow or push big barges filled with coal, oil, steel, and other goods along the Mississippi. More than half the corn and wheat **exported** from the U.S. is shipped down the river. Then it gets carried through the Gulf of Mexico to other countries.

But the barges are now carrying lighter loads so they won't get stuck in shallow water. As a result, companies have to make more trips to transport the same number of goods. That drives up the price of food and other items.

Helping River Traffic

The U.S. Army Corps of Engineers manages America's water resources. Since December, the Corps has been removing huge rocks from the bottom of the river. This has allowed ships to safely pass through the shallow water. But the engineers say more rainfall is the only lasting solution.

Word to Know

exported (EHK-spor-tid) *verb.* sent from one country to another and then sold

MAP QUIZ

Use the map to answer the following questions.

1. The Mississippi River flows ___ from St. Louis, Missouri, to Cairo, Illinois.
Ⓐ northeast Ⓒ southeast
Ⓑ northwest Ⓓ southwest

2. The river flows into the Gulf of Mexico from ___.
Ⓐ Minnesota (MN)
Ⓑ Texas (TX)
Ⓒ Louisiana (LA)
Ⓓ Mississippi (MS)

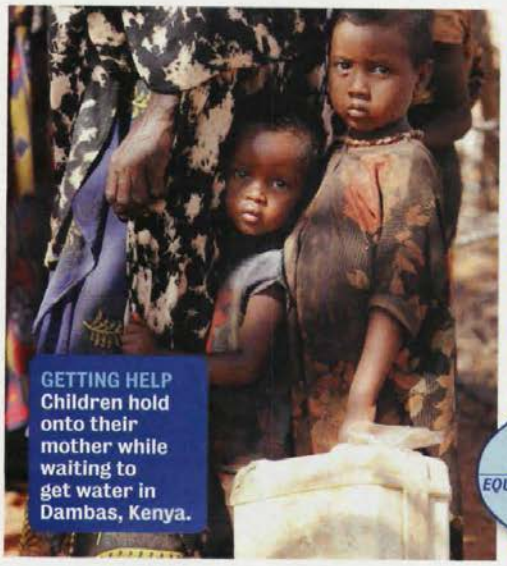
3. The Mississippi River begins in Canada.
Ⓐ true Ⓑ false

4. St. Louis is about ___ miles from Cairo.
Ⓐ 150 Ⓒ 350
Ⓑ 250 Ⓓ 450

LES STONE/CORBIS; JIM MCMAHON/"MAPMAN" (MAP)

6 SCHOLASTIC NEWS EDITION 4 • FEBRUARY 18, 2013 • www.scholastic.com/sn4

NEWS MAP



GETTING HELP Children hold onto their mother while waiting to get water in Dambas, Kenya.

Crisis in East Africa

This region is suffering from a severe drought

Many people in East Africa are facing hunger and thirst due to a devastating drought. More than 7 million people throughout the region are in desperate need of food and water.

International charities are sending food and water to East Africa. But United Nations (UN) officials say much more aid is needed immediately.

With no water, crops haven't been able to grow. Large fields that should produce food have turned into dust.

"I've a family of four, and I used to support my family by tilling the land," Waricha Chema, a farmer in Ethiopia, told a British news agency. "Because of the drought, I don't have anything to harvest from my land."

Meanwhile, cattle and other farm animals are dying because they have nothing to eat. When the farmers lose their animals, they lose a main source of food and income.

UN officials say the lack of rain is due in part to worldwide climate changes. Deforestation, the removal or destruction of trees, is also a factor.

East Africa's food shortage will be a long-term problem, officials warn. Even if rain comes soon, it will take time for crops to grow again.

Children worldwide can help by raising money for international charities. A number of groups are aiding **famine** victims in the area, including Christian Aid, Concern Worldwide, and Doctors Without Borders.

—Mary Harvey

TRAVEL QUIZ

Read the map and the map key and answer the following questions. Fill in the circle next to each correct answer.

1. Which of these East African nations is one of the five that is most affected by the drought?
   Ⓐ Kenya Ⓑ Sudan
2. What is the capital of Kenya?
   Ⓐ Nairobi Ⓑ Khartoum
3. Southern Sudan has mostly what kind of vegetation?
   Ⓐ grass and brush Ⓑ brush-grass and forest-woodland
4. Which East African nation is farthest east?
   Ⓐ Sudan Ⓑ Somalia
5. Djibouti's land is dry.
   Ⓐ true Ⓑ false

What's that word?
famine: (fam-uhn) *noun.* A serious lack of food.

A Dwindling River

A Dwindling

As water demands rise, the Colorado River is running dry

Eleanor Sterling, a scientist at the American Museum of Natural History

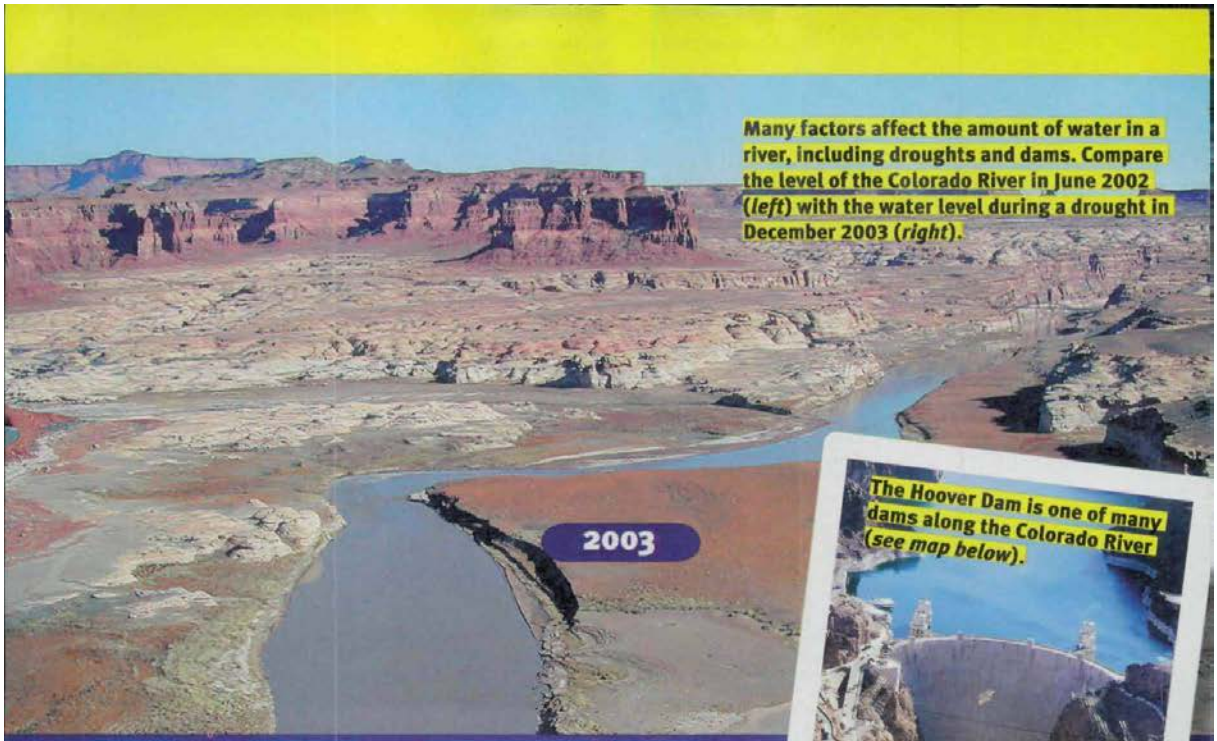
About 100 years ago, the Colorado River raged southward toward the Gulf of California (*see map, p. 7*). Where the two bodies of water met, great walls of water sprayed high into the sky. This amazing water show no longer happens. These days, the Colorado River often dries up before it even reaches the gulf.

Like many of the world's sources of fresh water, the Colorado River is shrinking. People are draining away huge amounts of this water for personal use, such as drinking and bathing. Water is also used to grow crops and raise livestock, and in industrial processes. For instance, fresh water is used to manufacture goods like T-shirts and computers.

As the world's population expands, the demand for water is rising. Freshwater sources are now being drained more quickly than natural processes like rain can refill them. As a result, many parts of the world are facing water shortages. "Ensuring that everyone has enough fresh water will be one of the major issues facing us this century," says

6 SUPERSCIENCE

A Dwindling River



Many factors affect the amount of water in a river, including droughts and dams. Compare the level of the Colorado River in June 2002 (*left*) with the water level during a drought in December 2003 (*right*).

The Hoover Dam is one of many dams along the Colorado River (*see map below*).

RIVER

Eleanor Sterling. She is a scientist in charge of the exhibition *Water: H_2O = Life* at the American Museum of Natural History in New York City, which highlights water's many forms and uses.

Water Pressure

Roughly 70 **percent** of Earth's surface is covered in water. So how can there be a water shortage? Most of the water on Earth is salty. Less than 3 percent of it is fresh water, and only a tiny fraction of that is available for use.

In addition, freshwater sources are not spread evenly around the planet. Water shortages are greatest in **arid** regions like southern Africa and the southwestern United States. To make matters worse, the human populations in many of these regions are increasing.

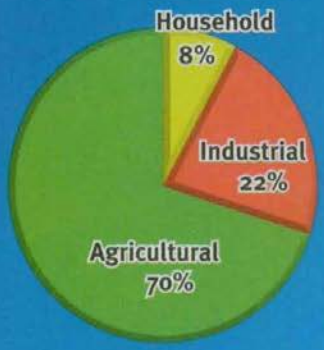
Phoenix, Arizona, is one of these regions. The city and surrounding areas are home to roughly 3 million people. Thousands of people move there each year. Yet the city—located in the middle of the Sonoran Desert—receives less than 25 centimeters (10 inches) of rain a year. That's only one third of the national average.

JOHN C. DOHRENWEND (COLORADO RIVER LEFT, RIGHT); K. FREY AMNH–CBC (ELEANOR STERLING); AARON MAYES/LAS VEGAS SUN/AP IMAGES (HOOVER DAM); MAP BY JIM MCMAHON

A Dwindling River

Percent of Worldwide Water Use, by Activity

Household activities, like bathing and washing dishes, make up less than 10 percent of fresh water used. Which type of activity uses the most water?

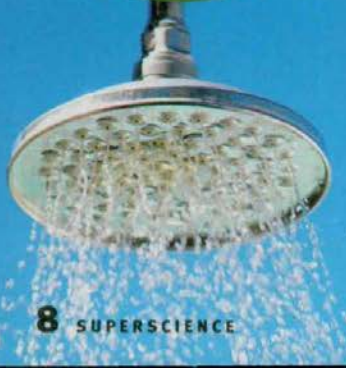


GRAPH SOURCE: WORLD BUSINESS COUNCIL FOR SUSTAINABLE DEVELOPMENT (2005)

Percent of Household Water Use, by Activity

The graph below shows how water is generally used in households in an industrialized country like the United States. What is one way you could reduce water usage in your household?

GRAPH SOURCE: ENVIRONMENT CANADA (2005)



8 SUPERSCIENCE

During sprinkler irrigation, some water is lost to evaporation.

Watering the Desert

How do people survive in the dry Southwest? **Groundwater** provides one source of fresh water. But there is not enough groundwater to meet the area's needs. The bulk of the water is taken from the Colorado River.

This 2,334 kilometer (1,450 mile)-long river supplies water to several big cities, including Las Vegas and San Diego. In all, it delivers fresh water to about 30 million people. The river also **irrigates** 14,973 square kilometers (3.7 million acres) of farmland.

Southwest Distress

The demand for water is taking a toll on the river. Except in heavy flood years, dams and canals capture every drop of the Colorado River for use. As the region's population grows, the river is becoming unable to meet the demand for water.

Overuse of the Colorado River is threatening the water supply for homes, as well as for ranchers and farmers. But the drying river has also put wild plants and animals at risk. The Colorado River **Delta** was once brimming with wildlife. But little water reaches the delta now. As a result, many plants, bobcats, beaver, deer, shrimp, and several species of fish have lost a home.

Water Solutions

"To tackle the problem of water shortages, the focus should be on conservation—how to live with less of it," says Sterling.

Researchers are trying to help reduce water use by coming up

Words to Know

Percent—number out of 100. For example, 70 percent means 70 out of every 100.

Arid—very dry due to little rainfall

Groundwater—water that soaks into the ground and is stored there

Irrigate—supply water to grow crops

Delta—area where a river enters a body of water and deposits sediment

Evaporation—the changing of a liquid, like water, into a gas

NOAH CLAYTON/GETTY IMAGES (IRRIGATION SPRINKLER); COBBIS/VEER (SHOWERHEAD); DIGITAL VISION PHOTOGRAPHY/VEER (KIDS)

with new ways to irrigate crops. "In the Southwest, large amounts of water [used to water crops] are lost to **evaporation**," says Sterling. So scientists are developing new irrigation methods that deliver water directly to plants' roots. This means less water would be lost to evaporation.

Personal Decisions

Sterling says that individuals also can make a difference when it comes to saving water. For instance, instead of dumping leftover drinking water down the drain, use it to water plants. Another water-saving tip: Don't leave the water running when you are brushing your teeth or washing dishes, says Sterling.

Other ways to conserve water are more surprising. Water is used to manufacture computer chips in cell phones, cameras, laptops, and toys. So Sterling recommends purchasing no more of these items than you need. In addition to saving money, you'll be helping to protect the planet's water supply.

—Judith Jango-Cohen

check it out

Earth's surface is nearly three-quarters water. So why should you care about saving a few gallons here or there? Every drop counts. Even in places where it rains a lot, water conservation ensures there is enough for humans and wildlife alike.

Water: H_2O = Life **is a new exhibition opening November 3, 2007, at the American Museum of Natural History. In it, you can explore the mystery and necessity of water—and learn how you can help conserve this vital resource. To learn more, ask your teacher, or visit www.amnh.org or http://ology.amnh.org.**

Kids!

SPEAK UP ABOUT THE ENVIRONMENT!

The Kids' Environmental Report Card lets your voice be heard!

With the Kids' Environmental Report Card, Science Explorations presents a fun and easy way to explore and speak up about the planet's environmental issues. Go to www.scholastic.com/reportcard to:

- ✓ **add your voice** to weekly survey questions
- ✓ **write** a letter to a policymaker
- ✓ **e-mail** a museum scientist with your questions about the environment
- ✓ **learn** more about key issues
- ✓ **chat** with other kids about environmental topics

In April, we'll publish a special Earth Day report to show the world what kids are thinking about the planet and how to protect it.

In your opinion, which of the following is the most important environmental issue facing the world today?

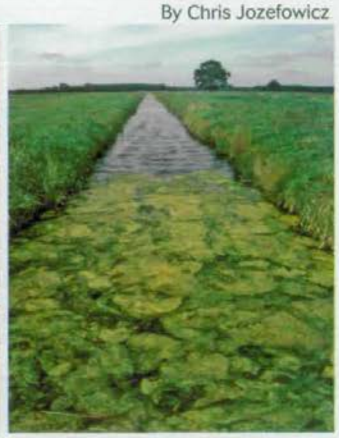
A. Water resources
B. Energy resources
C. Wildlife conservation
D. Global climate change

GO TO www.scholastic.com/reportcard TO VOTE!

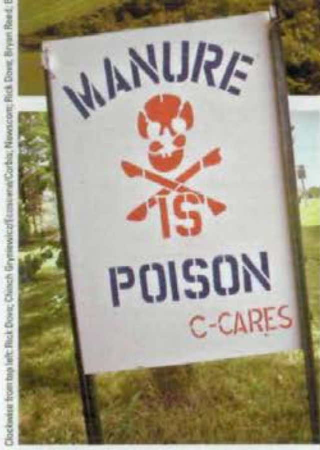
Muddy Waters

EARTH

By Chris Jozefowicz



Left: The waste from huge hog farms such as this one, when used to fertilize fields, is often washed into nearby streams. Right: a waterway overgrown with algae



Clockwise from top left: Rick Dove; Chinch Gryniewicz/Ecoscene/Corbis; Newscom; Rick Dove; Bryan Reed; Benny Sieu/MCT/Newscom

Muddy Waters

Keeping pollution down on the farm

Bryan Reed likes to see poop piling up indoors. Reed, who runs a farm in southern Iowa, used to let his herd of cows roam outdoors. But the rain liquefied their droppings into a muddy mess. Though the land could absorb a lot of that mess, the biggest rainstorms washed some of it into a nearby stream. "The grass couldn't filter out enough before it got to the stream," he says.

So Reed recently moved his 215 cows into an enormous building. "The building keeps the rainfall from getting to the manure," Reed says. "I can store it inside until I can safely apply it to the fields."

"The biggest thing for me is not being a slob," he adds. "I don't want to negatively affect people downstream."

Reed's effort is one small solution to a very big problem. Uncountable tons of soil and manure are washing off farmland into the waterways of the United States.

"Agricultural pollution is the largest source of water pollution in the nation," says Nancy Stoner, a water quality expert at the Natural Resources Defense Council. "There really isn't any question about that."

NUTRIENTS AND SOIL

Farms release two major types of pollution, says Stoner. "The first is *nutrient pollution*." Nutrients are elements, such as nitrogen and phosphorous, that promote the growth of plant life. They come from manure and synthetic fertilizer.

"The second type is *sediment pollution*," Stoner adds. Sediment is small particles of sand, clay, and other components of soil.

What's wrong with nutrients and soil? Excess nutrients promote the overgrowth of algae and plankton in rivers, lakes, and oceans. That overgrowth blocks sunlight and depletes gases and other resources in the water. In overgrown waterways, plants and small animals can find fewer places to live and predators have trouble hunting. In extreme cases, the overgrowth leads to *hypoxia*, a lack of oxygen. "Dead zones" that can't support fish and other aquatic animals appear.

The nitrogen in nutrient pollution also reacts with oxygen to form *nitrate*, a chemical that can cause health problems in people when drinking water contains too much of it. Nitrate filtration is not a standard procedure in many water treatment facilities.

Sediment pollution turns water murky, which disrupts plant growth and limits what animals can see. It also makes drinking water smell and taste bad and increases water-filtering costs.

1000L

Muddy Waters

NONPOINT POLLUTION

Controlling farm pollution isn't as easy as capturing the emissions from cars and factories. Farm pollution is a type of *nonpoint source pollution*—pollution that has no defined source and is difficult to control. It's washed from a large area of land to a common location, such as a river, a lake, or a bay. (*Point source pollution* can be traced to specific outlets.)

Farmers have always struggled to control what runs off their fields, says Wendy Powers, a professor of animal agriculture at Michigan State University. Farms are at nature's mercy—they get hit with heavy rains and large snowmelts. "It's not like a factory that has a waste discharge pipe," she says. "Agriculture has open fields."

Some farming practices are contributing to the problem, she adds. Too many farm animals are raised in some regions of the country to give city dwellers ready access to fresh meat. The manure piling up at such farms is more than the local fields can handle. And the containment ponds where some of that manure is stored often leak.

RUNOFF CONTROL

Efforts to control farm runoff involve steps such as those Reed has taken on his Iowa farm. In addition to moving his cows indoors, he recently began *no-till farming*. He no longer prepares the soil for crops by plowing and turning it. Now the soil remains locked into the fields. He has also added an underground drainage system to parts of his field, that funnels excess water directly to his stream.

An ideal farm, says Powers, uses manure as fertilizer, prevents waste runoff, and finds a way to balance the nutrients added as fertilizer with those that come from manure. In most cases that job is too big for one farm, so groups of farms have to team up. "It's better to look at crops and animals as an integrated system," Powers says. Farmers grow crops, feed some of those crops to livestock, and use the manure to fertilize the next crops. It's a form of natural recycling.

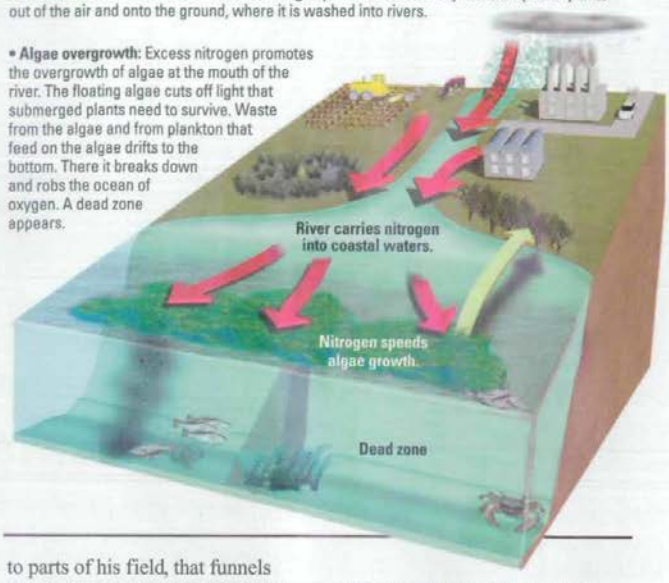
Reed admits that the improvements he has made have been expensive. But he's 35 years old and sees many years of farming in his future. Some of his older neighbors can't afford long-term, expensive investments, he explains. "It's going to take some younger people to make the commitment," he says. "I look at what my dad and my grandpa did when I grew up. What we're doing today is light-years better for the environment."

Attempts to limit farm pollution are succeeding, but the scope of the problem is still large, says Powers. "We'll never get to zero pollution," she admits. "But we already know the right things to do." **CS**

Dead in the Water

When farms, cars, and factories pollute a river with nutrient waste, a dead zone—an oxygen-free area where most marine life cannot survive—may develop at the mouth of the river. Here is the path that one nutrient—nitrogen—takes.

- **Nitrogen sources:** Rain and irrigation water carry nitrogen-based fertilizer and nitrogen-rich manure into rivers. Rain also rinses the nitrogen pollution released by cars and power plants out of the air and onto the ground, where it is washed into rivers.
- **Algae overgrowth:** Excess nitrogen promotes the overgrowth of algae at the mouth of the river. The floating algae cuts off light that submerged plants need to survive. Waste from the algae and from plankton that feed on the algae drifts to the bottom. There it breaks down and robs the ocean of oxygen. A dead zone appears.



Left: Bryan Reed's herd of cattle lives indoors. Right: fish killed by hog manure that polluted the Neuse River in North Carolina

Independent Reading Recording Form
Homework

Name:

Date:

Title of Book:	
Pages Read:	

Read your independent reading book. Follow the direction in each section.
Use this chart to keep track of what you read.

Where	Who	What

Words

4. Write one word that struck you because it was a precise word. This could be a verb, or it could be a good adjective, or a describing word.

I think this word is precise because _____

Independent Reading Recording Form
Homework

5. Write down any word or words you found that you are unsure about.

Words	I think this means