

Wonderful Water

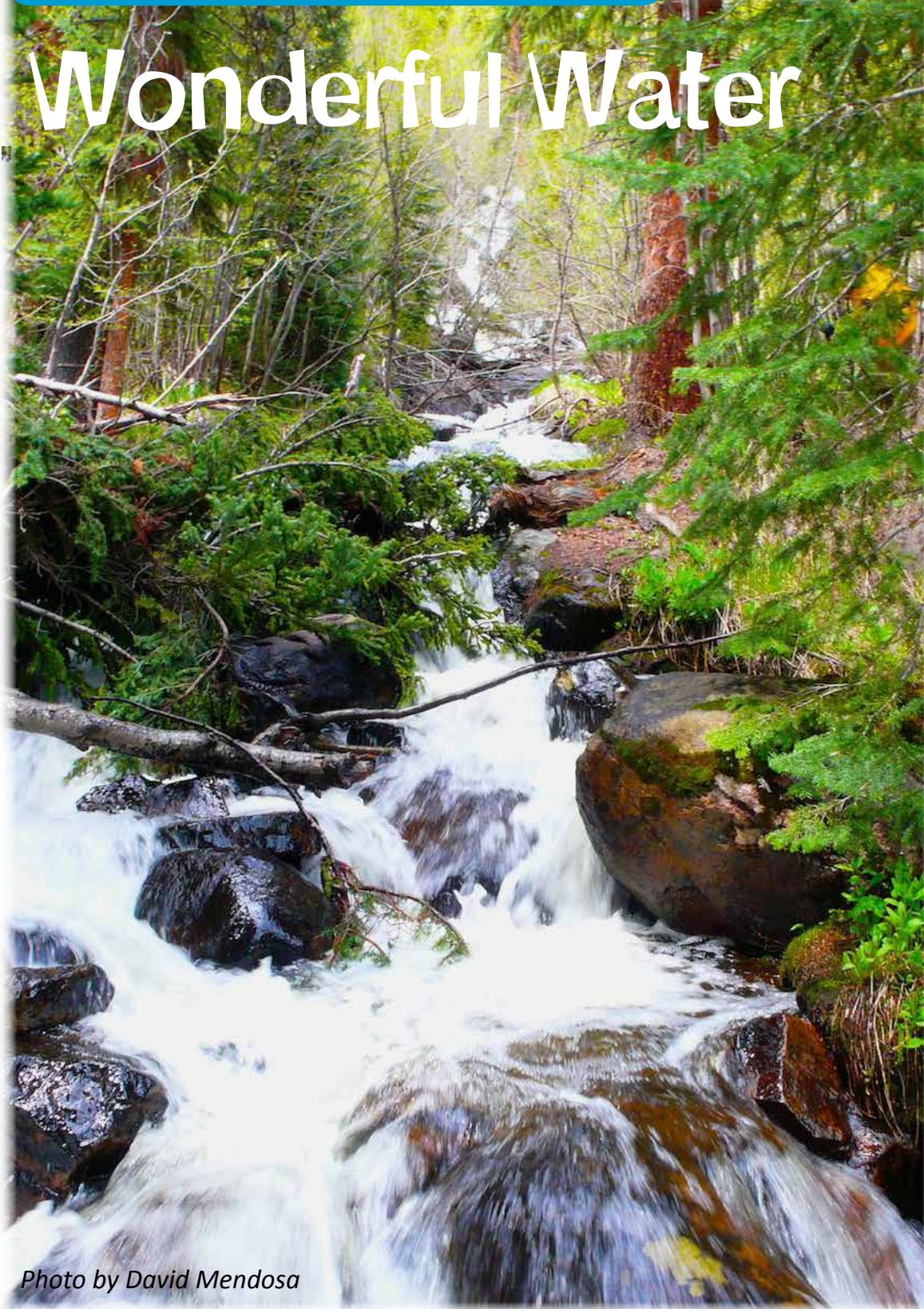


Photo by David Mendosa

Water is one of the most important needs of living things. It is second only to the air we breathe. In fact, some scientists believe that life began in water. Today, our space explorations have found signs that water exists not only on Earth but throughout the universe. If this is so, it may be that living things exist or have existed on other planets or moons.

Water is a molecule that consists of two hydrogen atoms and one oxygen atom. When these atoms are heated to a high temperature, they join to form water. The scientific way to write this molecule is "H₂O." Since most of the water on earth was created when the earth was forming, the water you are drinking today may have been drunk by a dinosaur or may have been a part of Cleopatra's bath water!

Water occurs naturally in three forms that people see every day.

- It can be vapor - as the steam from your breath or cooking, or unseen as humidity in the air.
- It can be liquid - as a beverage or a lake, stream, river or ocean.
- It can be solid - as ice or snow.

On Earth water is found on the surface as in oceans, lakes, rivers and streams. Water is also found below the surface of the ground. This water is called groundwater.

Exploring Groundwater



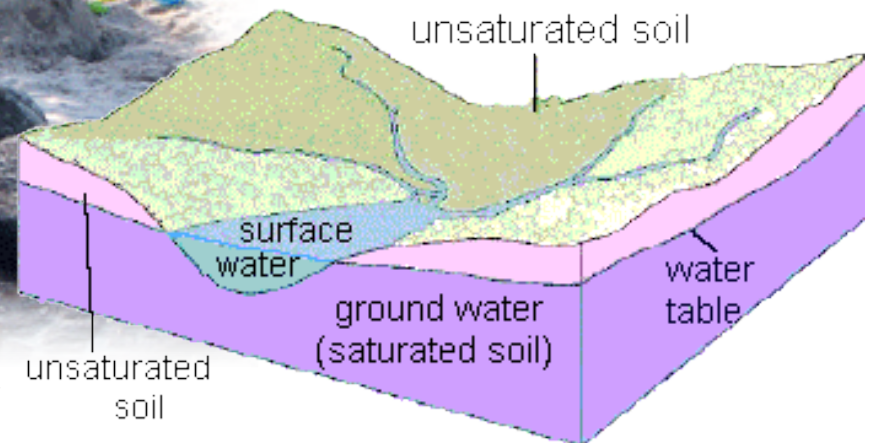
Photo courtesy of The Play Works 2016 - playworks.com.au

This student probably thinks there is some kind of magic happening here ... he pulled down a lever and out of the ground below his feet comes clear, cool fresh water. Many people may not realize that there is a huge amount of water in aquifers below the earth's surface. We call this water 'groundwater'. In fact, there is a hundred times more water in the ground than there is in all the world's rivers and lakes.

Groundwater is found almost everywhere - beneath hills, mountains, plains and deserts. It is not always easy to get out of the ground. Nor is it fresh (clean) enough for use without treatment. Groundwater is sometimes difficult to locate and measure.

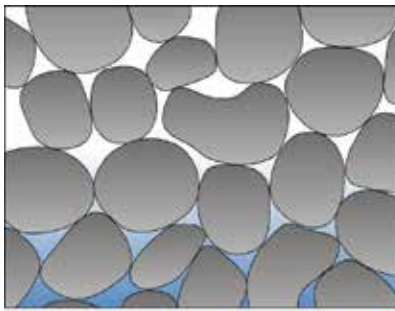
Groundwater may occur close to the land surface, as in a marsh or in wetlands. It may lie many hundreds of feet below the surface, as in some arid areas of the West. Water at very shallow depths might be just a few hours old from coming down as precipitation; at moderate depth, it may be 100 years from when it came down as precipitation; and at great depth or after having flowed long distances from its place of entry, water may be several thousands of years old.

Groundwater is a part of the water cycle. Part of the precipitation that lands on the ground's surface seeps into the ground. This water continues downward through the soil until it reaches rock material that is

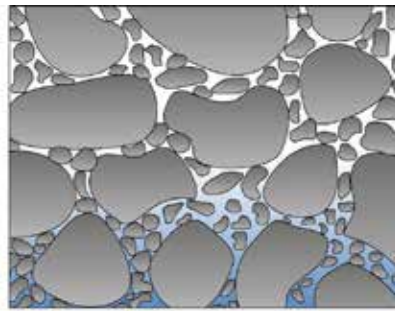


saturated with water. Water in the saturated groundwater system moves slowly and may eventually travel into streams, lakes, and oceans.

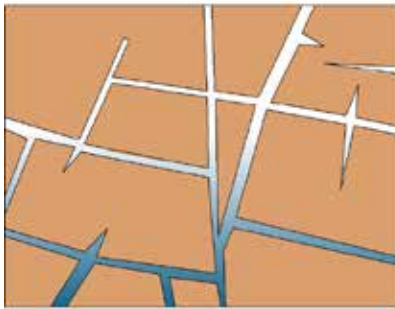
Above is a simplified diagram showing how the ground is saturated below the water table (the purple area). The ground above the water table (the pink area) may sometimes be wet, but it does not stay wet. The dirt and rock in this unsaturated zone contain air and some water. It supports the vegetation on the Earth. The saturated zone below the water table has water that fills the tiny spaces (pores) between rock particles and the cracks (fractures) of the rocks.



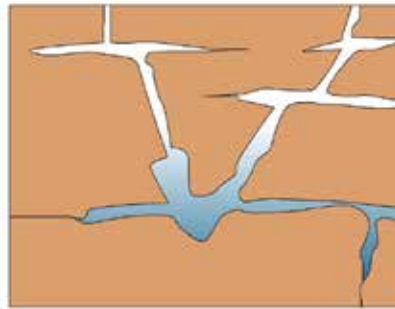
Well-sorted sedimentary material
(Alluvium of the South Platte River)



Poorly sorted sedimentary material
(Dawson, Denver, Arapahoe aquifers)



Fractured crystalline rocks
(Pikes Peak Granite)



Soluble rock-forming material
(Leadville Limestone)

creating spaces that can fill with water. And some bedrock, such as limestone, are dissolved by water -- which results in large cavities that fill with water. Thus bedrock has varying amounts of spaces in it where groundwater accumulates.

Why is there groundwater?

A couple of important factors are responsible for the existence of groundwater:

(1) Gravity

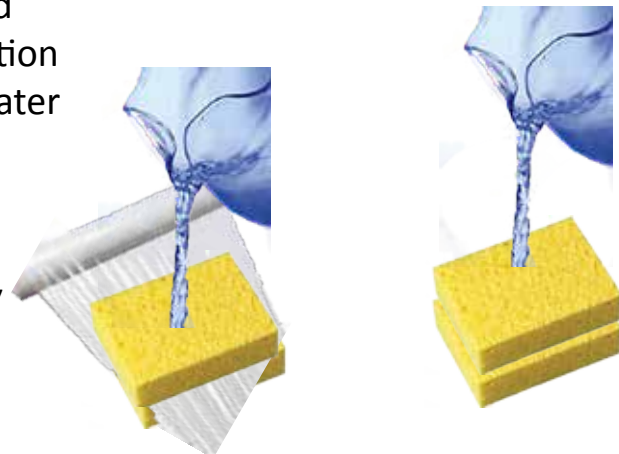
Nothing surprising here - gravity pulls water toward the center of the Earth. That means that water on the surface will try to seep into the ground below it.

(2) The Rocks Below Our Feet

The rock below the Earth's surface is the bedrock. The Earth's bedrock is made up of many types of rock, such as sandstone, granite, and limestone. Bedrock is often broken and fractured (porous),

Try as it might, gravity doesn't pull water all the way to the center of the Earth. Deep in the bedrock there are rock layers made of dense material, such as granite, or material that water has a hard time traveling through, such as clay. These layers are underneath the porous rock layers and, thus, stop the downward movement of water. Since it is more difficult for the water to go any deeper, it tends to pool in the porous layers and flow in a more horizontal direction across the aquifer towards a water body, like a river or a lake.

Draw arrows on the top sponge in each picture to show which direction the water will flow when the top sponge is saturated with water.



Experiment

Visualize it this way: get two sponges and lay one on top of the other. Pour water (precipitation) on top and it will seep through the top sponge downward into the bottom sponge. If you stopped adding water, the top sponge would dry up and, as the water dripped out of the bottom sponge, it would dry up too. Now, put a piece of plastic wrap between the sponges, creating your "confining layer" (making the bottom sponge an impermeable rock layer that is too dense to allow water to flow through it). Now when you pour water on the top sponge, the water will seep downward until it hits the plastic wrap. The top sponge will become saturated, and when the water hits the plastic wrap it won't be able to seep into the second sponge. Instead, it will start flowing sideways and come out at the edges of the sponge (horizontal flow of groundwater). This happens in the earth all the time -- and it is an important part of the water cycle.

Aquifers - Underground Reservoirs

The area where groundwater is saturated in the rock and soil is called the water table. The saturated zone beneath the water table is called an aquifer. Aquifers are huge storehouses of water.

Groundwater is one of our most valuable resources—even though you never see it or even realize it is there. As you may have read, most of the void spaces in the rocks below the water table are filled with water.

Wells can be drilled into the aquifers and water can be pumped out. Precipitation eventually adds water (recharge) into the porous rock of the aquifer. The rate of recharge

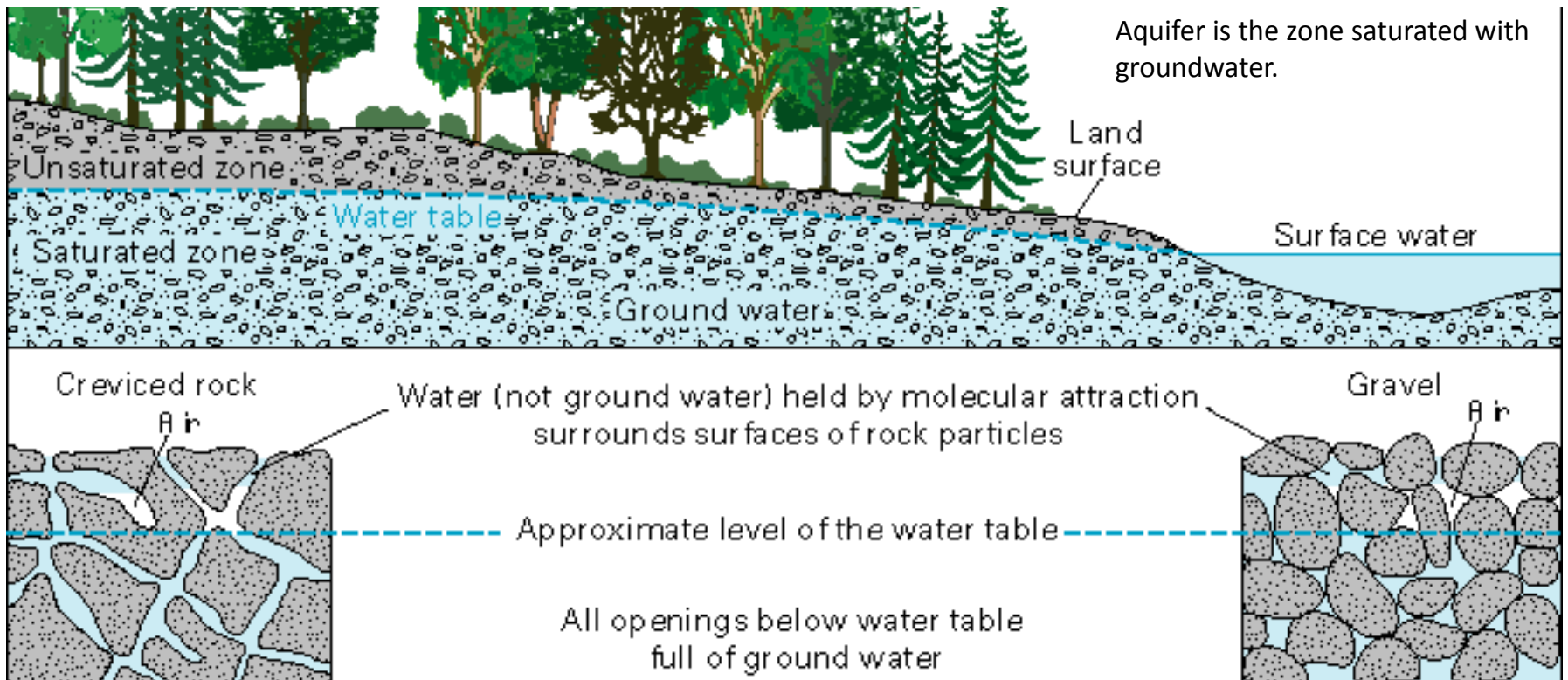
is not the same for all aquifers. How much an aquifer is being recharged must be considered when pumping water from a well. Pumping too much water too fast lowers the water in the aquifer. This will cause a well to yield less and less water and even run dry. In fact, pumping your well too much can even cause your neighbor's well to run dry if you both are pumping from the same aquifer.

In the diagram below, you can see how the ground below the water table (the blue area) is saturated with water. The “unsaturated zone” above the water table (the greenish area) still contains water (after all, plants’ roots live in this area), but it is not totally

saturated with water. You can see this in the two drawings at the bottom of the diagram, which show a close-up of how water is stored in between underground rock particles.

The pores and cracks in rocks at great depths are closed or greatly reduced in size because of the weight of overlying rocks.

Ground water is important for crops and livestock in Colorado. Farmers are careful stewards of groundwater and they help recharge the system when water runs through and off of their fields.



Conserving Water Tips

Whether it is surface water or groundwater it is important that we all work to conserve this vital resource.



Conserve water so birds will have water to drink.

Indoor Tips Kitchen

1. When washing dishes by hand, don't let the water run. Fill one basin with wash water and the other with rinse water.
2. Dishwashers typically use less water than washing dishes by hand. Now, Energy Star dishwashers save even more water and energy.
3. If your dishwasher is new, cut back on rinsing. Newer models clean more thoroughly than older ones.
4. Designate one glass for your drinking water each day, or refill a water bottle. This will cut down on the number of glasses to wash.
5. Soak pots and pans instead of letting the water run while you scrape them clean.
6. Use the garbage disposal sparingly. Instead, compost vegetable food waste and save gallons every time.
7. Wash your fruits and vegetables in a pan of water instead of running water from the tap. Then use this water for your house plants.
8. Don't use running water to thaw food. For water efficiency and food safety, defrost food in the refrigerator.
9. Install an instant water heater near your kitchen sink so you don't have to run the water while it heats up. This also reduces energy costs.
10. Keep a pitcher of drinking water in the refrigerator instead of running the tap. This way, every drop goes down you and not the drain.
11. Reuse leftover water from cooked

or steamed foods to start a nutritious soup, it's one more way to get eight glasses of water a day.

12. Cook food in as little water as possible. This also helps food retain more nutrients.
13. Select the proper pan size for cooking. Large pans may require more cooking water than necessary.
14. If you accidentally drop ice cubes, don't throw them in the sink. Drop them in a house plant instead.



Conserve water so wildflowers can grow.

Laundry Room

16. When doing laundry, match the water level to the size of the load.
17. Washing dark clothes in cold water saves water and energy, and helps

your clothes retain their color.



Conserve water so farmers can grow your food.

Bathroom

18. If your shower fills a one-gallon bucket in less than 20 seconds, replace the shower head with a WaterSense® labeled model.
19. Shorten your shower by a minute or two and you'll save up to 150 gallons per month.
20. Time your shower to keep it under 5 minutes. You'll save up to 1,000 gallons per month.
21. Toilet leaks can be silent! Be sure to test your toilet for leaks at least once a year. Put food coloring in your toilet tank. If it seeps into the bowl without flushing, there's a leak. Fix it and start saving gallons.
22. When running a bath, plug the bathtub before turning on the water. Adjust the temperature as the tub fills.
23. If your toilet flapper doesn't close properly after flushing, replace it.
24. Turn off the water while you brush your teeth and save up to 4 gallons a minute. That's up to 200 gallons a week for a family of four.
25. Consider buying a dual-flush toilet. It has two flush options: a half-flush for liquid waste and a full-flush for solid waste.
26. Turn off the water while washing your hair and save up to 150 gallons a month.
27. When washing your hands, turn the water off while you lather.
28. Take 5-minute showers instead of baths. A full bathtub requires up to 70 gallons of water.

29. Install water-saving aerators on all of your faucets.
30. Drop tissues in the trash instead of flushing them and save water every time.
31. Install WaterSense® labeled toilets, sink faucets, urinals and shower heads.
32. One drip every second adds up to five gallons per day! Check your faucets and shower heads for leaks.
33. While you wait for hot water, collect the running water and use it to water plants.



Conserve water so wildlife will have water to drink.

General Indoor

34. Turn off faucets tightly after each use.
35. When the kids want to cool off, use the sprinkler in an area where your lawn needs water the most.
36. Monitor your water bill for unusually

high use. Your bill and water meter are tools that can help you discover leaks.

37. Reward kids for the water-saving tips they follow.
38. Avoid recreational water toys that require a constant flow of water.
39. Grab a wrench and fix that leaky faucet. It's simple, inexpensive, and you can save 140 gallons a week.
40. Be a leak detective! Check all hoses, connectors, and faucets regularly for leaks.
41. We're more likely to notice leaky faucets indoors, but don't forget to check outdoor faucets, pipes, and hoses.
42. At home or while staying in a hotel, reuse your towels.
43. Run your washer and dishwasher only when they are full. You can save up to 1,000 gallons a month.
44. See how your water use stacks up to others by calculating your daily water use.



Conserve water so fish will have a place to swim.

Outdoor Tips Lawn Care

45. Adjust your lawn mower to the height of 1.5 to 2 inches. Taller grass shades roots and holds soil moisture better than short grass.
46. Leave lawn clippings on your grass, this cools the ground and holds in moisture.
47. Aerate your lawn periodically. Holes every six inches will allow water to reach the roots, rather than run off the surface.
48. If walking across the lawn leaves footprints (blades don't spring back up), then it is time to water.
49. Let your lawn go dormant (brown) during the winter. Dormant grass only needs to be watered every three to four weeks, less if it rains or snows.
50. Remember to weed your lawn and

garden regularly. Weeds compete with other plants for nutrients, light and water.

51. While fertilizers promote plant growth, they also increase water consumption. Apply the minimum amount of fertilizer needed.
52. Catch water in an empty tuna can to measure sprinkler output. 3/4 to 1 inch of water is enough to apply each time you water.



Conserve water so everyone will have water to drink.

General Outdoor

53. Winterize outdoor spigots when temperatures dip below freezing to prevent pipes from leaking or bursting.
54. For more immediate hot water and energy savings, insulate hot water pipes.
55. Use a commercial car wash that recycles water. Or, wash your car on the lawn, and you'll water your grass at the same time.
56. Use a hose nozzle or turn off the water while you wash your car. You'll save up to 100 gallons every time.
57. Wash your pets outdoors, in an area of your lawn that needs water.
58. When cleaning out fish tanks, give the nutrient-rich water to your non-edible plants.
59. When you give your pet fresh water, don't throw the old water down the drain. Use it to water your trees or shrubs.
60. Use a broom instead of a hose to clean patios, sidewalks and driveways, and save water every time.
61. Know where your master water shut-off valve is located. Were a pipe to burst, this could save gallons of water and prevent damage.
62. Encourage your workplace and school to also conserve water.

**Farmers and ranchers
also work to
conserve water.**

Some of the things they do to conserve water are:

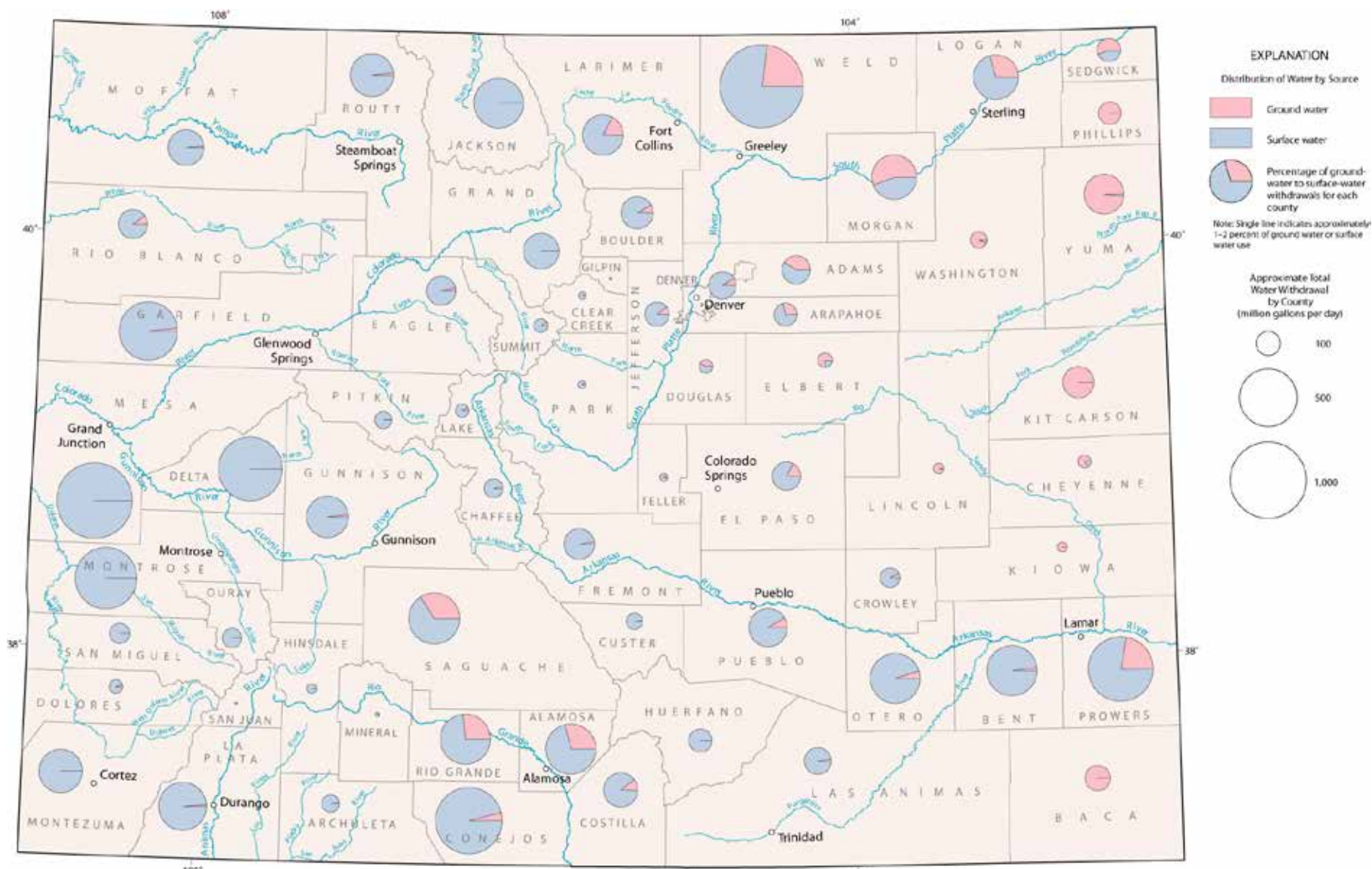
- The big sprinkler systems you see spraying water on the crops can cut water use in half.
- Farmers use water sensors in the fields to help them determine when a crop needs water.
- They can use their phones or computers to turn on or off their sprinklers. So if it rains, they can shut down the sprinklers.
- Drip irrigation is another way to put water directly where the crop needs it. There is very little loss of water to evaporation with drip systems.
- Dairies and livestock feeders recycle water in a variety of ways. Water is used to wash cows, then it is used to wash the pens, then it is used to water crops.

Conservation by the numbers

1. If each member of your family uses 100 gallons of water per day, how many gallons of water do you use in a 30 day month? Show your work.
2. If each member of your class uses 100 gallons of water per day, how many gallons of water would your class use in 365 days (one year)? Show your work.
3. If each member of your class used 10 gallons less water per day, how many gallons of water would your class save in a year? Show your work.
4. If everyone in your school used 10 gallons less water per day, how many gallons of water would your school save in a year? Show your work.

Bonus Questions

5. About 5,540,000 people live in Colorado. If every one one of these people saved one gallon of water a day for 365 days (one year), how many gallons of water would be conserved in one year? Show your work.
6. If everyone saved 5 gallons a day, how many gallons would be saved over a year? Show your work.



The map above shows use of groundwater and surface water. Study the map above and decide whether the statement is true or false. Put "T" on the line after the statement if it is true, put "F" on the line if the statement is false.

- The size of the circles on the map indicates the amount of water used in an area, with the larger circles mean more water withdrawn. _____
- The pink represents the percent of surface water being used in an area. _____
- There is more groundwater being used in the western part of the state. _____
- The blue represents the percent of surface water being used in an area. _____
- Kit Carson County uses no groundwater. _____
- Most of Mesa County's water comes from surface water. _____
- About 1/4 of Weld County water comes from groundwater. _____

The Colorado Reader publication and Ag in the Classroom are projects of the Colorado Foundation for Agriculture. Educational projects are produced in cooperation with the Colorado Department of Agriculture, other state and federal agencies, Colorado commodity groups, Colorado agricultural associations, state universities and colleges and interested individuals. Colorado Readers are provided free to educators requesting them. For more information contact: Bette Blinde, Colorado Foundation for Agriculture, P.O. Box 10, Livermore, CO 80536 or phone 970 881.2902. Financial support for this reader has been provided by: Central Colorado Water Conservancy District, Northern Water, West Greeley Conservation District, Colorado Farm Bureau, City of Greeley Conservation and Colorado Livestock Association.

WATER READER TEACHER'S GUIDE

AG IN THE CLASSROOM - HELPING THE NEXT GENERATION UNDERSTAND THEIR CONNECTION TO AGRICULTURE

RESOURCES

Government Agencies

Colorado Water Conservation Board
<http://cwcb.state.co.us/Pages/CWCBHome.aspx>

Colorado Division of Water Resources
<https://cdnr.us/#/division/DWR>

Colorado Department of Natural Resources
<https://cdnr.us/#/start>

Water Festivals & Events

City of Aurora
<https://www.auroragov.org/>

City of Boulder
<http://www.keepitcleanpartnership.org/pollution-prevention/teachers/operation-water-festival/>

City of Fort Collins
<http://www.fcgov.com/utilities/community-education/youth/water-festival>

City of Greeley
<https://www.facebook.com/GreeleyWaterFest?sk=wall&filter=3>

Western Colorado (Grand Junction)
<https://www.facebook.com/cowaterfestival?fref=nf>

City of Denver
<http://www.denverwater.org/EducationOutreach/WaterFestival/Teachers/>

Cities of Northglenn, Thornton, Westminster
<http://youthwaterfestival.blogspot.com/>

Independent Websites

Project WET (Water Education for Teachers)
<http://www.coloradowaterwise.org/>

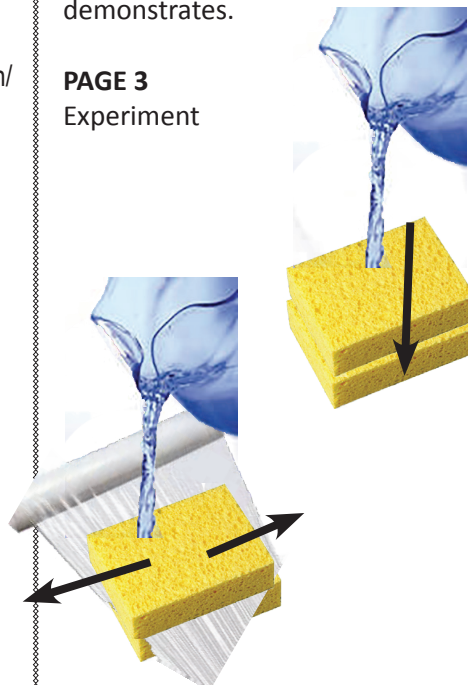
Colorado Foundation for Water Education
<https://www.yourwatercolorado.org/>

Colorado Alliance for Environmental Education (CAEE)
<https://www.caee.org/>

Water is crucial for things living on Earth. Have your students brainstorm all the ways they use water. Have them make a list. Be sure to talk about all the ways water might be used in manufacturing, or to create the food we eat. Ask your students how they might be able to protect this resource. Keeping water from becoming polluted is one of best ways to protect it.

This reader explores groundwater. Ask your students to list some sources of surface water. Lakes, rivers, streams and oceans are examples of surface water. We don't see groundwater so it is harder for people to understand what it is. It is not large pools of water under the ground, it is all the water that fills in the gaps around rocks under the ground. This water not only moves downward but it can also move sideways. That is what the experiment on page 3 demonstrates.

PAGE 3 Experiment



PAGE 4 We call the saturated ground beneath the water table an aquifer. Aquifers can be large or small. You can download a map of major aquifers at: <https://water.usgs.gov/ogw/aquifer/map.html>

PAGE 5 & 6 Provides a list of 62 water conservation tips. See if your students can come up with more ways to save water.

PAGE 7 Conservation by the numbers

1. Answers will vary. A family of 4 x 100 gallons = 400 gallons per day x 30 days = 12,000 gallons per month.
2. Answers will vary. Assuming a class of 25 students x 100 gallons each day = 2,500 gallons per day x 365 days = 912,500 gallons per year.
3. 25 students x 10 gallons = 250 gallons saved each day x 365 = 91,250 gallons saved in a year.
4. Answers will vary but if there are 300 students in a school and they all save 10 gallon, then 3,000 gallons will be saved each day. 3,000 x 365 = 1,095,000 gallons saved.
5. 5,540,000 people x 1 gallon = 5,540,000 gallons per day saved x 365 days = 2,022,100,000 gallons saved in a year.
6. 2,022,100,000 x 5 gallons = 10,110,500,000 gallons saved

Comments, questions, suggestions and feedback about the Colorado Reader are welcome.

Contact: Colorado Reader Publisher:
Colorado Foundation for Agriculture
Bette Blinde, Director
P.O. Box 10
Livermore, CO 80536,
Phone (970) 881-2902
bblinde@growingyourfuture.com

PAGE 8:

This map shows through pie charts the amount of water used from surface sources and ground water sources. The larger the circle, the more water being used. Have your students study the key. Ask them: What does the pink color mean? What does the blue color mean? What does the size of the circle mean? Then have them answer the questions below the map as true or false.

1. The size of the circles on the map indicates the amount of water used in an area, with the larger circles meaning more water withdrawn. TRUE
2. The pink represents the percent of surface water being used in an area. FALSE
3. There is more groundwater being used in the western part of the state. FALSE
4. The blue represents the percent of surface water being used in an area. TRUE
5. Kit Carson County uses no groundwater. FALSE
6. Most of Mesa County's water comes from surface water. TRUE
7. About 1/4 of Weld County water comes from groundwater. TRUE

More Information:

Groundwater use in Colorado dates back to before the turn of the 20th century. Nineteen of Colorado's 63 counties rely solely on ground water for potable supplies and domestic uses. Ground water withdrawals by private wells and public water supply systems serve an estimated twenty percent of the state's population. Agriculture is the largest user of groundwater, primarily for irrigation. However, groundwater is also used to meet nearly all livestock and rural domestic water needs.

More Colorado groundwater information can be found:
<http://coloradogeologicalsurvey.org/water/groundwater/>

An atlas of Colorado groundwater can be found:
<http://coloradogeologicalsurvey.org/water/groundwater-atlas/>

Here is a link to best management practices for water conservation:
<http://coloradowaterwise.org/BestPractices>

Here is the link to Colorado's Water Plan:
<https://www.colorado.gov/cowaterplan>

This reader helps you achieve the following standards with your students:

Colorado Academic Standards

SCIENCE Standard 3: Earth System Science: GLE-4. Evaluate evidence that Earth's geosphere, atmosphere, hydrosphere, and biosphere interact as a complex system; Describe how humans are dependent on the diversity of resources provided by Earth and Sun.

GLE-6. 1. Complex interrelationships exist between Earth's structure and natural processes that over time are both constructive and destructive. 2. Water on Earth is distributed and circulated through oceans, glaciers, rivers, groundwater, and the atmosphere.

SOCIAL STUDIES GLE-4.

2. Geography: 1. Use several types of geographic tools to answer questions about the geography of Colorado;

Core Curriculum State Standards

ELA-LITERACY

CCSS.ELA-Literacy.CCRA.L.4

Determine or clarify the meaning of unknown and multiple-meaning words and phrases by using context clues, analyzing meaningful word parts, and consulting general and specialized reference materials, as appropriate.

CCSS.ELA-Literacy.CCRA.R.1

Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.

CCSS.ELA-Literacy.CCRI.R.1

Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text.

CCSS.ELA-Literacy.CCRI.R.3

Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text.

CCSS.ELA-Literacy.CCRF.R3a

3. Know and apply grade-level phonics and word analysis skills in decoding words.

a. Use combined knowledge of all letter-sound correspondences, syllabication patterns, and morphology (e.g., roots and affixes) to read accurately unfamiliar multisyllabic words in context and out of context.

CCSS.ELA-Literacy.CCRF.R4

Read with sufficient accuracy and fluency to support comprehension.

It is time to sign up to attend the Food, Fiber & More Summer Agriculture Institutes. Three locations:

Rifle - June 12 - 16

Fort Collins - June 19 - 23

Denver - June 26 - 30

3 Continuing Education Credits

Scholarships Available

go to: www.growingyourfuture.com

Wonderful Water

Evaluation ~ 2017

Colorado Reader ~ Agriculture in the Classroom

Please take a few minutes to evaluate your students' knowledge of this topic.

There is an area for additional comments.

Your comments help us improve future Colorado Reader issues. Thank you!

How many students used this reader? _____

How many or what percentage of your students can describe five ways they can conserve water? _____

How many or what percentage of your students can describe the three states of water? _____

How many or what percentage of your students can describe why it is important to conserve water? _____

How many or what percentage of your students know what H₂O means? _____

How many or what percentage of your students can describe what groundwater is? _____

Additional Comments _____

How many or what percentage of your students understand what an aquifer is? _____

How many of your students understand know one thing that causes groundwater to occur? _____

How many or what percentage of your students understand that groundwater can move downward and sideways through the ground? _____

SUBMIT THIS EVALUATION FOR A CHANCE TO WIN A \$100 VISA CARD!

Please rate:	Good		Average		Poor
Student Activities Throughout Reader	5	4	3	2	1
Teacher's Guide	5	4	3	2	1
Reading Level	5	4	3	2	1

I would like to see mor activities like: _____

School _____ Grade Level _____

Subject Area (s) _____

Name _____ Phone _____

Email _____

Learning about our food system can be fun!

Food, Fibe & More - Agric-Culture in the Classroom Summer Institute is a 3-credit courses held in June. Institute participants come away from the course better prepared to help their students understand their connection to agriculture. This a relaxed in and out-of-the classroom course. It's a great way to learn creative ways to integrate agriculture and natural resource topics into the curriculum while reinforcing Colorado Content Standards. You even get to spend a day working on a farm or ranch. Scholarships are available.



Connecting Land & People is an E-newsletter keeps you informed on resources, programs and grants available to Colorado educators. It is distributed three times a year— September, December and March. Sign up to receive this newsletter at www.growingyourfuture.com.



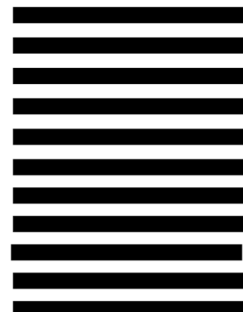
NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY MAIL

FIRST-CLASS MAIL PERMIT NO. 1 LIVERMORE, CO

POSTAGE WILL BE PAID BY ADDRESSEE

**COLORADO FOUNDATION FOR AGRICULTURE
PO BOX 10
LIVERMORE, CO 80536-9901**



EVALUATION ~ 2016 — 2017

Colorado Reader

Agriculture
in the
Classroom

HELPING ALL GENERATIONS UNDERSTAND THEIR CONNECTION TO AGRICULTURE