Colorado Reader

AG in the Classroom—Helping the Next Generation Understand Their Connection to Agriculture

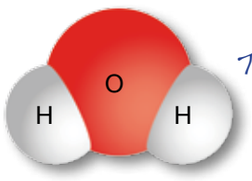
Colorado Foundation for Agriculture ~ www.growingyourfuture.com

2012
The Year of Water

So what's the buzz?

A bunch of people got together to plan a celebration for some of Colorado's major water projects—including the 100th anniversary of the building of the Rio Grande Reservoir and the 75th anniversary of the legislation that founded the Colorado Water Conservation Board, the Colorado River Conservation District and the Northern Colorado Water Conservancy District—projects that have helped shape what Colorado is today. Along the way, they decided it would be really cool to celebrate all things Colorado and water. If you're going to have a party for the coolest molecule on Earth, why not have it all year long?

Water is really pretty amazing stuff—two hydrogen atoms and one oxygen atom make the famous H_20 molecule—but we sometimes take water for granted. In particular, we tend to forget how scarce and important clean, freshwater is.



The coolest molecule on Earth!

Water on Earth

- 97% Salt Water
- 2% Polar Ice Caps, Glaciers and Permanent Snow fields
- 1% Available Freshwater

Let's step back to look at the 'big picture'—a big step, like all the way to the moon. When humans first saw Earth from space, they nicknamed Earth 'the blue planet' since the surface of earth is primarily water, or more precisely, ocean water. And that ocean is salty, too salty for us to drink.

If we could measure all the water on Earth, salt water is about 97 percent of the total. Where else could we look for water? There's a bunch of water frozen in polar ice caps, glaciers and permanent snow fields—about 2 percent of the water on the planet. That leaves approximately 1 percent available for the 7 billion of us people, plus all the animals and plants. A portion of that 1 percent is in the ground.

To give you an idea of how important water is to humans, the adult human brain is about 75 percent water. Bones are about 22 percent water. If we try to go without water for very long we die. The food we eat takes water to grow. Most of the energy we use requires water in its production.

Why is it scientists try to determine if there is water on other planets? Because without water, life as we know it simply isn't possible.

Freshwater is important and it's scarce, but it's also cool stuff. Let's step back from the moon and take a close look at the molecule again. How many substances can you think of that naturally occur in the environment as a liquid, solid and gas? How many things can you think of that expand and become less dense when they freeze? Why is that important? *(Hint—think about ice and lakes.)*

Water is one of our most precious resources and Colorado plays a crucial role in providing and protecting water for 18 states and Mexico. The party is on for 2012—The Year of Water *(Find out more at water2012.org.)*

The Water Cycle

Let's start with where water comes from. Almost no water is made or 'used up' on Earth. However, it may change states (vapor, liquid or solid) or get contaminated, but it's still in the environment. In other words, the water that comes out of your faucet could be the same molecules that dinosaurs swam in, or Columbus sailed on. Crazy, isn't it?

Most of the water on earth is in the oceans. The oceans make for a nice solar collector, and the sun's rays warm the oceans and other surface water causing evaporation—"water vapor"—which rises into the atmosphere. (It's also interesting that water vapor from the ocean is no longer salty.)

The water vapor forms clouds. When cooled and condensed, the water returns to Earth as rain or snow. The rain or snowmelt then begins its journey back toward the oceans by moving through streams, lakes and rivers, or by moving through the ground.

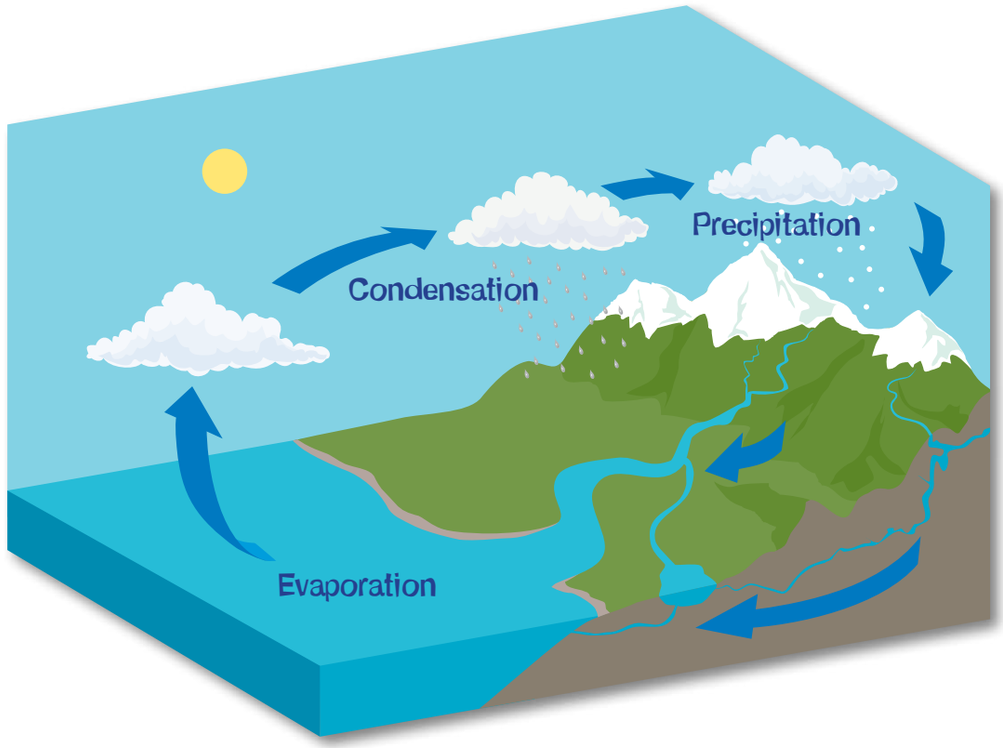
This cycle of evaporation, condensation and precipitation powered by the sun goes on continually, sustaining the cycle of life.

Evaporation

The largest sources of evaporation on the planet are oceans. Can you name five other sources of evaporation?

1. _____
2. _____
3. _____
4. _____
5. _____

Most of the snowfall in Colorado is produced by storms that originate in the Pacific Ocean. When the moist, dense air travelling east reaches the Rocky Mountains, it rises and cools causing the moisture to condense and fall as snow.

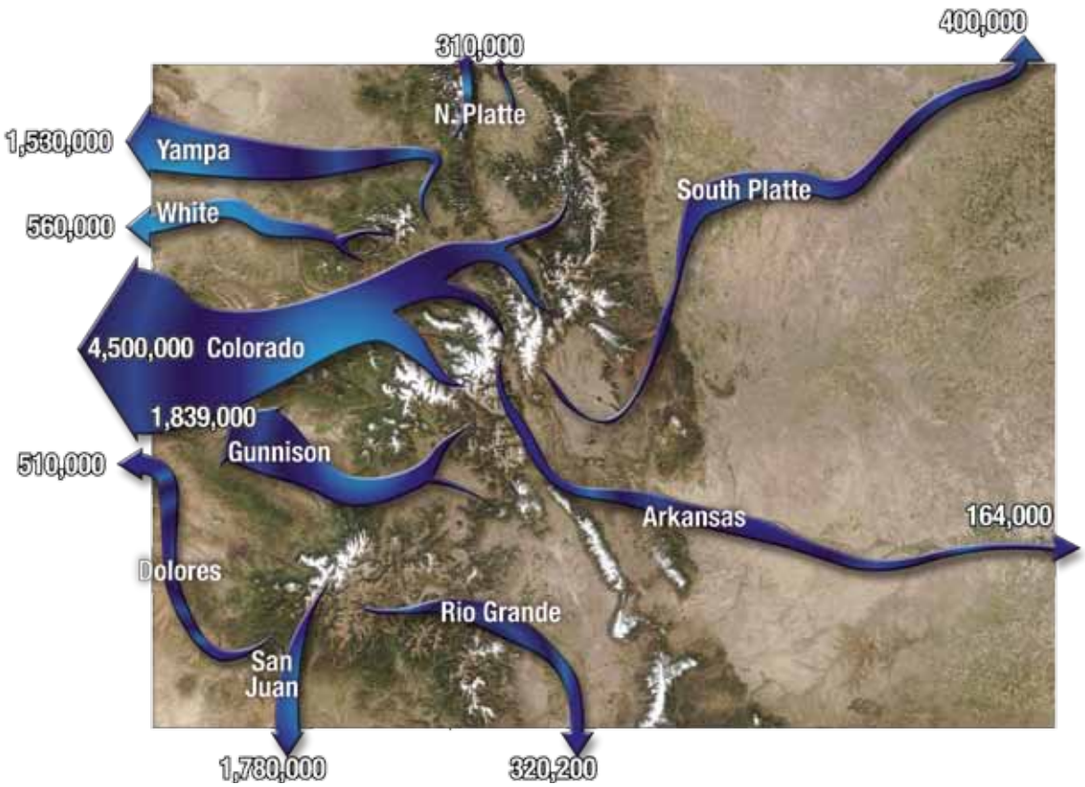


Streams of Life

Colorado plays a very special role in the water cycle. The snow that falls in our mountains provides most of the water we use, as well as water for 18 states and Mexico. Our state is nicknamed the 'Headwaters State' because of the rivers that get their start in our mountains. The image at right represents some of the rivers in Colorado and the average volume of water that flows out of the state each year. The bigger the arrow, the greater the flow. The numbers are measurements of this flow in acre feet (see page six for an explanation of acre feet).

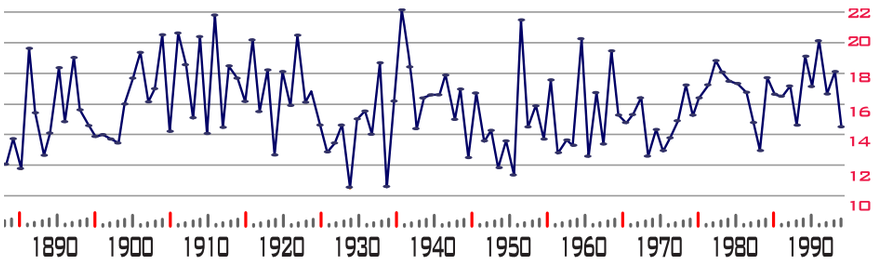
List the eight rivers that carry the most water to other states:

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____



North Catamount Reservoir is west of Colorado Springs and holds water from the Blue River system, providing water to the city, as well as recreation opportunities and wildlife habitat. The chart below plots average precipitation—measured in inches—in Colorado. Some years are very dry while others are relatively wet.

Average Annual Precipitation for Colorado



Why do we have reservoirs?

We mentioned earlier that we are celebrating the 100th anniversary of the construction of the Rio Grande Reservoir. Why is that important?

Many of us think of reservoirs for their recreational or scenic value. We like to go boating, swimming, fishing or maybe hiking nearby, but their primary purpose is to store water when it is plentiful so it can be used at a later time.

Most of Colorado's water comes from the mountains as the snow melts. We need a way to 'hold' that water so it can be used throughout the year. For example, farmers use some of the water to grow crops. They have the greatest need for irrigation water during the hot, dry summer months. If there were no reservoirs, the water would travel downsteam and out of the state before it could be used. The same thing happens in your home. You need water all year, not just when it rains or the snow melts.

Some years, snowfall and rain is below average. We call this a drought. During times of drought, water managers can release some of the 'extra' water they have stored in reservoirs from previous years. These releases of water aren't only for cities and farms, water managers can control flows to benefit fish populations, or create better conditions for rafters and kayakers.

If you can have drought years, you can also have wet years. Another function of reservoirs is flood control. Water managers can reduce the release of water to prevent flooding downstream—protecting lives, property and habitat.

Some reservoirs also use the release of water to power turbines to create electricity. This is called hydroelectric power and makes up about 4 percent of the electricity generated in Colorado.

Reservoirs and the system of rivers, streams, ditches and pipelines that carry water are critical to Colorado.

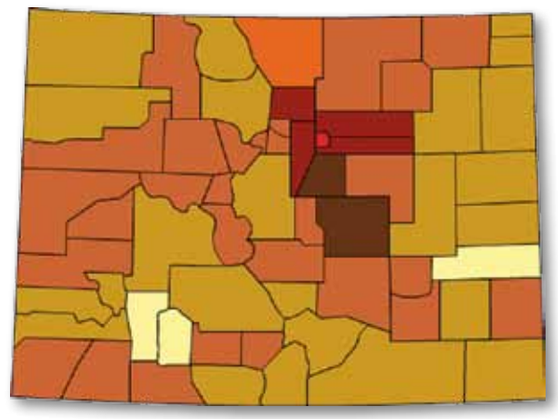
Moving mountains…or at least their water

In Colorado, about 70 percent of our water comes from snow and rain that falls in the mountains. Most of that water is headed west. The portion of the state that drains to the west is called the West Slope. On the opposite page, compare the size of the flow of Colorado River with the size of the flow of the South Platte River.

Now look at the map on the right. Most of the population in Colorado is on the east side of the state—East Slope—where average precipitation is about 13 inches a year. The ridge of mountains that divides the East Slope from the West Slope is called the Continental Divide.

Back in the early part of the last century, some visionary Coloradans recognized that future generations—you and I—would need some of that 'West Slope' water to be moved to the 'East Slope'. In water language, these transfers of water from one river basin to another are called transbasin diversions. There are 26 major transbasin diversions in Colorado, but by far the largest is the Alva B. Adams tunnel southwest of Loveland. More than 231,000 acre feet (see page 6) of Colorado River water flow through Adams Tunnel every year headed toward the Eastern Plains.

The Adams Tunnel is part of Colorado Big-Thompson Project. On page one we mentioned the Northern Colorado Water Conservancy District, now known simply as Northern Water. They're celebrating their 75th anniversary in 2012. Northern Water, in conjunction with the United States Bureau of Reclamation, administers the Colorado-Big Thompson Project.



The map at left shows Colorado's counties. The darker areas are more densely populated with the bright red area (Denver County) being the most populous.

Do you live on the East Slope or the West Slope?_____

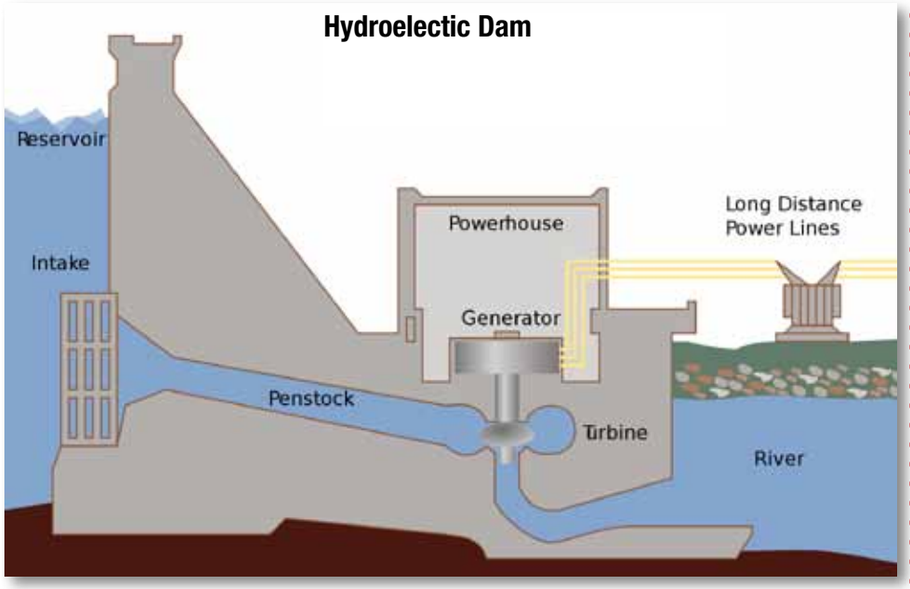
Which major river is closest to your home?_____

Colorado's climate varies tremendously. Average annual snowfall in Cubres in the southern mountains is nearly 300 inches while less than 30 miles away in Manassas, the average is less than 25 inches.

Water and Energy

The sun's energy powers the water cycle. We power our homes, businesses and vehicles with energy generated, in part, by water. Let's take a look at water and electricity generation.

We mentioned hydropower earlier. This is a process where water and gravity can be turned into electricity. The water stored by a hydroelectric dam is released so it turns a hydraulic turbine, creating mechanical energy. This mechanical energy is used by a hydroelectric generator to create electricity.



About 4 percent of electricity comes from hydropower. Most of our electricity comes from coal-fired power plants, about 65 percent of the total. Coal is burned to heat water to create steam (water vapor) that, under pressure, turns a turbine to create the mechanical energy for a generator. The process doesn't 'destroy' any water, but we say it consumes water because some of the water is lost to the atmosphere. In other words, some of our supply of water becomes unavailable for other uses.

Steam Turbine

Coal-fired generation plants do not all use the same technology in terms of water use. One way to compare the consumption of water is to measure how much water is used to create 1 megawatt hour of electricity. The range for coal-fired power plants is 250 to 687 acre feet per megawatt hour.

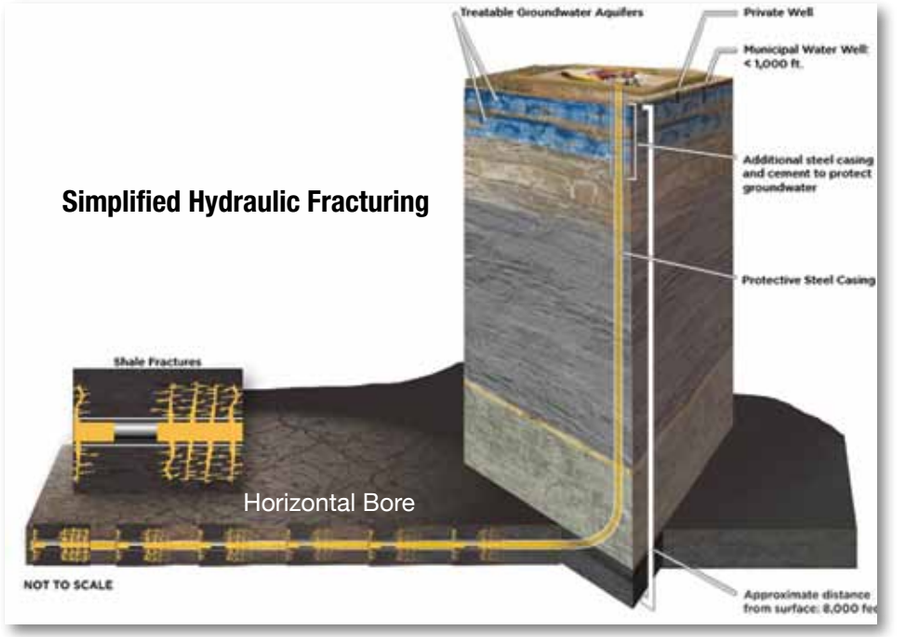
Many of us think of solar power as not requiring water, but some large-scale technologies use water in the generation process. Concentrated solar power uses reflectors to focus the energy from the sun to heat water to create steam to turn a turbine. Consumption range for solar power is 5 to 865 acre feet per megawatt hour.

Concentrated Solar Power

Electricity, of course, isn't the only type of power we use every day. Oil and natural gas are used to generate power. Wells are built to extract natural gas and oil from the ground. Different technologies are used to accomplish this feat. One of the hot topics in the news in Colorado has been the use of a drilling method called hydraulic fracturing, or fracking for short.

A well is drilled. The hole that is drilled is called a well bore. The well bore is lined with steel pipe and the oil or gas is pumped to the surface through that pipe. Concrete can be used to line part of the bore to protect groundwater.

When the well bore is complete, water and other fluids, along with sand, are injected into the bore under very high pressure to fracture surrounding rock formations. The sand particles help keep the fractures open so oil and gas will flow more freely. The process of fracking may be repeated several times in different sections of the well. When complete, most of the fluid is returned to the surface for disposal or reuse.



Fracking is not a new process but the increase in use of this process has created concerns. One is the potential for contamination of groundwater drinking supplies. Potential sources of contamination are the fluids injected into the ground. Naturally occurring pollutants could also be released as a result of the process. This is a concern because groundwater is the sole source of water for homes, irrigation and livestock in many rural areas.

Another concern is where will the water needed for fracking be found? Each well can require more than a million gallons of water. To reduce the need for water, some wells are now fracked using a system that recirculates water and other fluids used in the fracking process.

Water managers will need to determine who gets the water that flows through their basin or is in aquifers. This will be especially critical in drought years. Will the farmer growing your food, the city water department providing water to your home or the oil company producing energy to heat your home and run your car receive the water? Colorado must also honor compacts with other states to be sure pre-determined amounts of water flow out of the state. The demand and allocation of this resource is complicated.

Water Grows Food

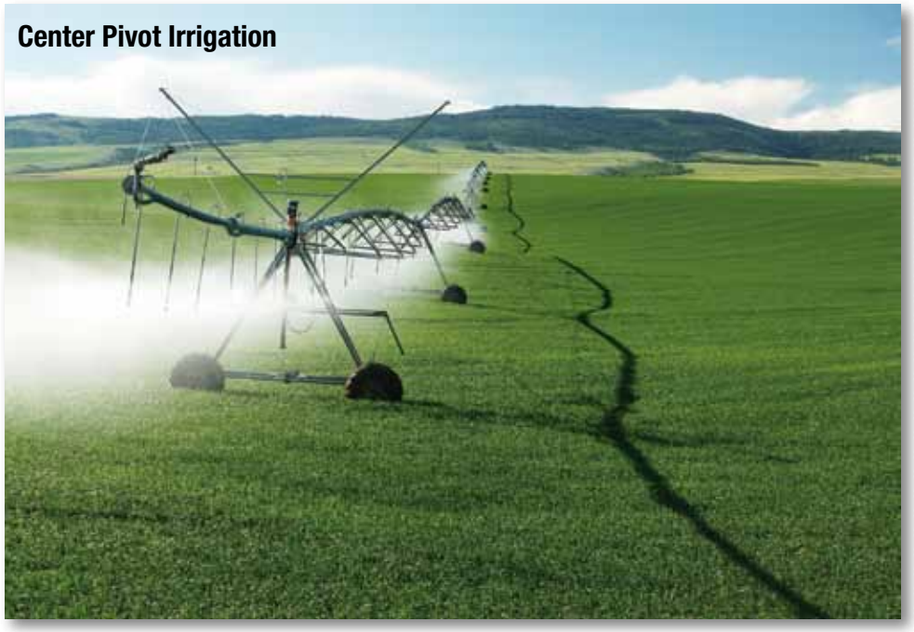
In the Western United States, most of our freshwater supply goes to agriculture to produce the food, fiber and fuel we all consume. It's no great surprise that it takes water to grow vegetables or produce dairy products—milk after all is 85-90 percent water. It's also no great surprise that we use water to prepare food. But it may surprise you that on a global level, we need to figure out how to grow twice as much food as we grow now, and with less water and land.

By the year 2050, experts expect world population to increase by 40 percent, requiring twice as much food to sustain the population. Global water supplies aren't going to increase as more demand is placed on them. Similarly, the availability of high-quality farm ground isn't going to increase without destroying valuable forests.

So how will we feed a growing world? This is a question that brings heated debate, but most agree that improved irrigation practices on the farm will play a role, as well as improvements in plant and animal performance.

Not all crops or farms lend themselves to the same types of irrigation practices. One of the many management decisions farmers make is the selection of crops and practices best suited to their ground. Farming is a long-term commitment to the land, often passing from generation to generation.

Center Pivot Irrigation



Household Drip Irrigation

One of the many innovations to come from our state was center pivot irrigation. In 1949, Frank Zybach of Strasburg, Colorado applied for a patent on the "Zybach Self-Propelled Sprinkling Apparatus," providing the genesis of the modern center pivot sprinkler. His original concept was to create a way to irrigate uneven fields and to save labor, but an opportunity was created to use water more efficiently.

These sprinkler irrigation systems are the large lengths of pipe on wheels that generally move in a circle around a fixed center. The large water-carrying pipes have sprinklers to water the crops. A farmer can control how much water is pumped from the sprinkler and how fast the machine moves through its rotation. Speed and volume of water delivery can be adjusted in response to the needs of the plants.

Just as you release water vapor when you breathe, plants do, too. A plant absorbs water from the soil and moves it from the roots, through the stems and leaves. Some of this water is returned to the atmosphere by the leaves. Similar to evaporation, the process of plants returning water to the atmosphere is called transpiration. About 10 percent of the water in the atmosphere comes from transpiration.

It takes between 4,000 and 18,000 gallons of water to produce a hamburger. Estimates vary due to different conditions of raising cattle and to the extent of the production chain of water that is used.

Heat, humidity, wind, soil moisture/type and plant type all contribute to determining the amount of transpiration. For example, one acre of corn gives off about 3,000-4,000 gallons of water per day. If a farmer knows the rate of transpiration for his corn and the amount of water needed for healthy growth, he or she can adjust their center pivot system to provide what the crop needs.

Another technology used to improve water efficiency is drip irrigation. Large scale drip systems are often underground, providing slow, even applications of water to the plant root zone. The idea is to provide only what the plant needs and reduce waste from runoff and evaporation. Home garden applications often feature small emitters that regulate the flow of water.

Researchers are working to improve irrigation systems, however that is only part of the story. Plant scientists are developing crops that grow more food with less water and land.

Corn has been grown in North America for more than 5,000 years. Yields were relatively unchanged at about 30 bushels per acre (a bushel is a measure of dry volume equal to eight gallons) through the 1920s (estimated world population 1.8 billion). By the year 2000 (estimated world population 6.1 billion), average yields in the U.S. exceeded 150 bushels per acre. Some of this gain came from an increase in the use of chemical fertilizers, but over the last 20 years, fertilizer use has declined as yields continue to grow—thanks to better genetics, chemistry and management.

Animal agriculture has also made improvements. A study published in the *Journal of Animal Science* documented that a pound of beef produced in 2007 required 12 percent less water than in 1977. How? Improved animal genetics and feeding practices. During the same period, ranchers were producing 13 percent more beef with 30 percent fewer animals.

Advancements in agriculture have already prevented the starvation of countless millions of people. The question now is: "Where will the next innovations come from that will sustain the world?"

Putting Water to Work

The map at right shows Colorado's 64 counties. Fill in the name of your county on the map. Then draw a line from each of Colorado's top ten agricultural counties (below, measured in dollars of agricultural output) to the county on the map.

1. Weld
Cattle, dairy products, poultry, wheat, corn, nursery products, sheep, hay, vegetables

2. Yuma
Cattle, corn, wheat, hay, dry beans, hogs

3. Morgan
Cattle, wheat, corn, proso millet, hay

4. Logan
Cattle, wheat, corn, hay, proso millet

5. Kit Carson
Cattle, wheat, corn, proso millet, sunflowers

6. Prowers
Cattle, wheat, hay, corn, sorghum

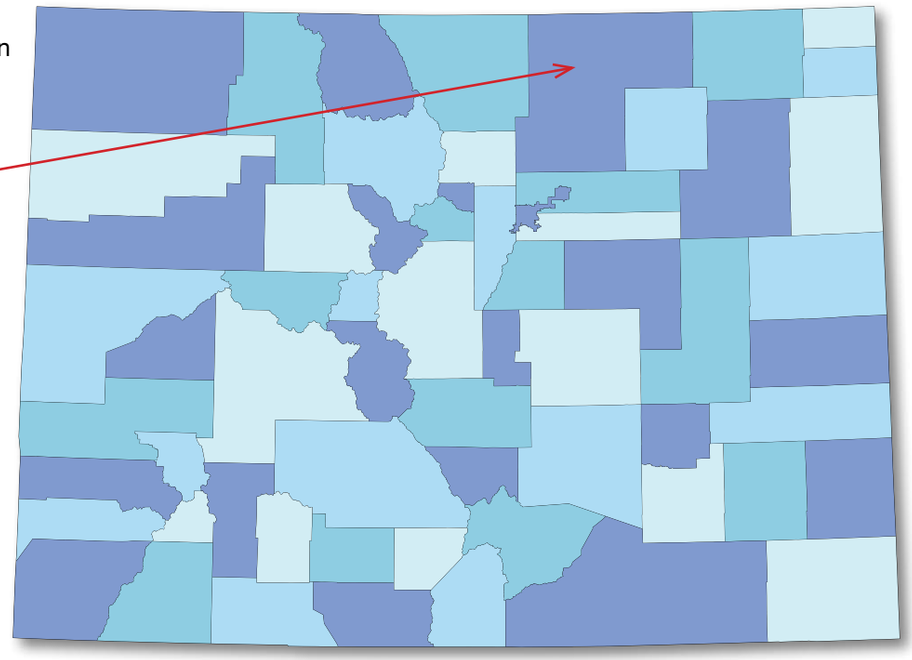
7. Adams
Nursery products, proso millet, sunflowers

8. Phillips
Wheat, corn, proso millet

9. Washington
Wheat, proso millet, corn, cattle, hay

10. Larimer
Dairy products, cattle, nursery products, wheat, corn, hay, vegetables

Agriculture contributes more than $7 billion dollars to the Colorado state economy annually.



Top 10 Agricultural Commodities in Colorado

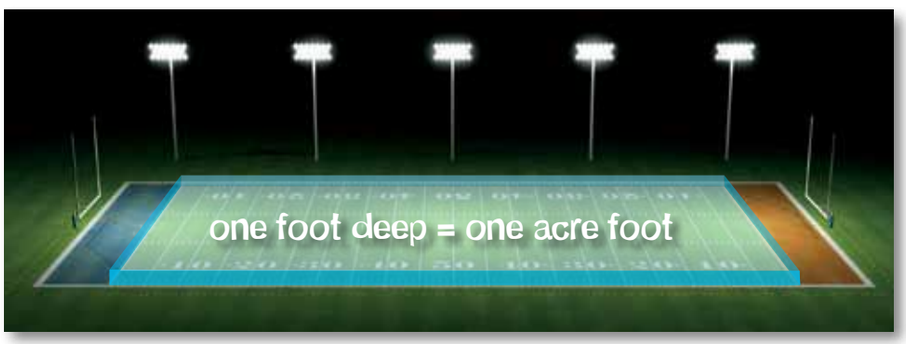
1. Cattle & Calves
2. Corn for Grain
3. Wheat
4. Dairy Products
5. Hay
6. Greenhouse & Nursery
7. Hogs
8. Potatoes
9. Sheep & Lambs
10. Poultry/Eggs

Big Shoes to Fill

An acre foot sounds like a very large shoe size, but it's not. It's a common measurement of the volume of water in large scale water systems—reservoirs and rivers, for example.

Let's start with the term 'acre.' Originally, an acre was the amount of land that could be plowed in one day with a yoke of oxen pulling a wooden plow—not a very useful definition for most of us. Then surveyors developed a defintion that said an acre was one 'chain' by one 'furlong'. A good definition, but since most of us don't measure in chains and furlongs, we need to know that a chain is equal to 66 feet and a furlong is 660 feet.

1 acre = 66 feet x 660 feet = 43,560 square feet



To make things a little more interesting, an acre no longer has to be a chain by a furlong, it just has to have 43,560 square feet. Conveniently, a football field, not including the end zones, is approximately one acre.

So an acre foot is the amount of water to cover one acre of land to a depth of one foot. But since most of us use gallons to measure liquids:

1 acre foot = 325,853 gallons

In the western U.S., the average household uses between one half and one acre foot per year, but let's get a better handle on how much water that is.

On average, Americans use about 80-100 gallons of fresh water per day. What if you had to carry that water home every day from the neighbor's faucet? What would it weigh? (Hint: water weighs 8.3 lb./gallon)

90 gallons x _____ = _____ lb.

You may never need to carry your water home, but many people around the world do. Would it change how much water you use if you had to carry it?

Rain is usually measured in inches of depth. What if we had a rain storm at the football field and measured 1 inch of rain—how many gallons would that be? 27,154 gallons. Where does all that water go? What if our one acre was a parking lot—where would all that water go? Would anything wash along with the water?

While we're on the topic of rain, what does a cloud weigh? What does air weigh? At sea level, air has a weight (or pressure) of about 14.5 pounds per square inch. Cloud droplets float because they are less dense than air. It turns out that a cumulus cloud one kilometer square, located two kilometers above the ground, would weigh more than 2.2 billion pounds! For a complete explanation, visit http://ga.water.usgs.gov/edu/watercycleatmosphere.html

Who owns the water?

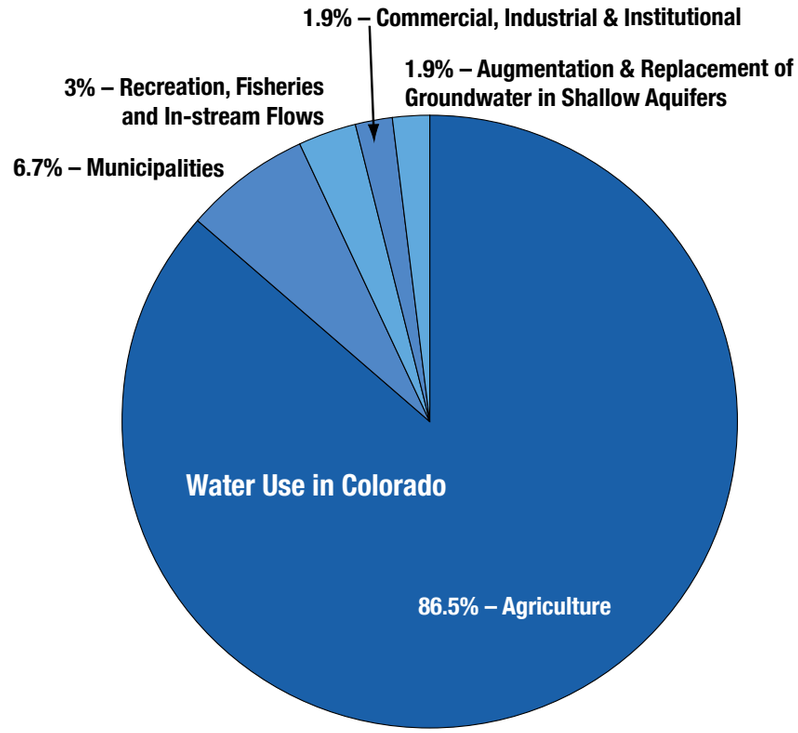
Who owns the water can be a more complicated question than you might think. The simple answer is “we all do.” Water is a public resource, but the right to use the water is similar to a private property right—a water right can be bought, sold or rented. The right to use water is not connected to a specific piece of property, but is connected to a specific water system—a river or ditch for example.

Colorado has a legal platform called the “prior appropriation doctrine” and a system of laws and water courts to govern the system. An appropriation is the act of diverting water from its source and putting it to beneficial use. The concept goes back to the Gold Rush days and was designed to prevent newcomers from encroaching on existing miners’ use of water and and to stop hoarding and misuse.

In simplified terms, the doctrine says that those with the oldest water rights have first priority to use water from a system and that the water has to be put to beneficial use. The chart at right shows the distribution of water rights to different uses in Colorado. This chart does not include the water that flows out of Colorado to other states. The water that flows out of Colorado is governed by a system of agreements called ‘compacts’. These agreements govern Colorado’s water commitments to other states.

The chart shows one ‘slice’ used for augmentation and replacement of groundwater from shallow aquifers. Because water moves through the small spaces in the ground—aquifers—pumping water from a well can actually have the effect of removing water from a stream. Augmentation and replacement is the practice of using surface water to offset the use of groundwater.

Most of us take for granted that there will be water to use, but the demand for water outpaces the supply. Our system helps distribute water in a fair and orderly way. It also helps water managers plan for future needs of a growing state.



Can you name three things that would be a beneficial use of water?

1. _____
2. _____
3. _____

Personal Footprints

We said an acre foot wasn’t a shoe size, but you do have a water ‘footprint’. You may have heard of a carbon footprint. A carbon footprint is an estimate of the total set of greenhouse gas emissions caused by an organization, event, product or person. In a similar way, your water footprint is an estimate of the amount of fresh water used by an organization, event, product or person.

We all need to use water every day. When we run the shower, it’s about 2 gallons per minute. Most people use about a gallon per day washing their hands and face. Toilet flushes account for about 3 gallons per day. That all seems pretty straight forward, but what about things we use that we don’t usually associate with water?

For example, the United States Geological Survey estimates that it takes about 150 gallons of water to grow the ingredients and produce one loaf of bread. So if we wanted to, we could research the water used to make things like cotton for T-shirts or jeans. You might find it interesting that it takes about 24 gallons of water to produce 1 lb. of plastic. The manufacture of a bottle for water uses more water than the water inside the bottle. Because fresh water supplies can be scarce, thinking about our personal decisions and their impact on water supplies can help us better understand our world.

List five things you use water for …and guess how many gallons per day…and per year

1. _____
2. _____
3. _____
4. _____
5. _____

Handy facts…

Brush your teeth? - 2 to 5 gallons

Wash the car? - 50 gallons

Use the dishwasher? - 8 to 15 gallons

Flush the toilet? - 1.5 to 4 gallons (each flush)

Take a shower or bath? - 17 to 24 gallons

Run the washing machine? - 35 to 50 gallons (each load)

For more about calculating your water footprint, visit http://ga.water.usgs.gov/edu/sc1.html, http://environment.nationalgeographic.com/environment/freshwater/water-footprint-calculator/ or http://www.waterfootprint.org. And yes, there’s a free ‘app’ for that, visit the itunes store.

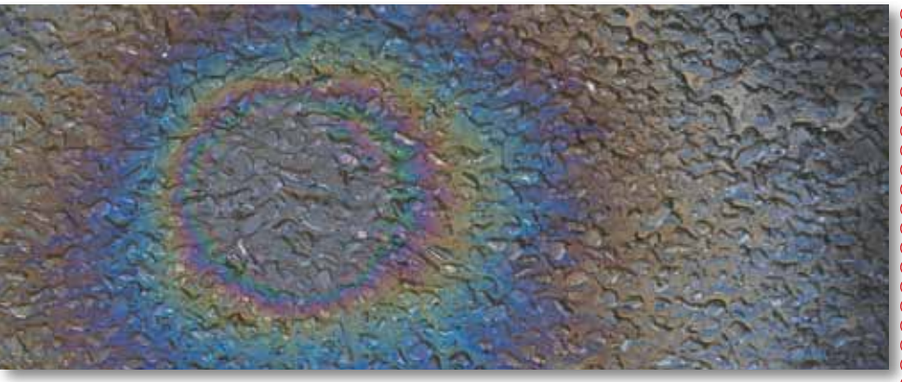
When it rains, it drains.

With millions of people—not to mention countless animals and plants—dependent on water that flows from Colorado's mountains, we have a special responsibility to protect water.

When snow falls in the high country, it's remarkably clean thanks to the evaporative qualities of the water cycle. As it melts and begins its journey toward the ocean, it can encounter both human-made and natural pollutants that make it unsuitable for different uses.

One of the biggest threats to clean water is runoff pollution, sometimes called nonpoint source pollution. With runoff pollution, we're not dealing with a single source of pollution making a big problem, but many small sources of pollution adding up to be a big problem.

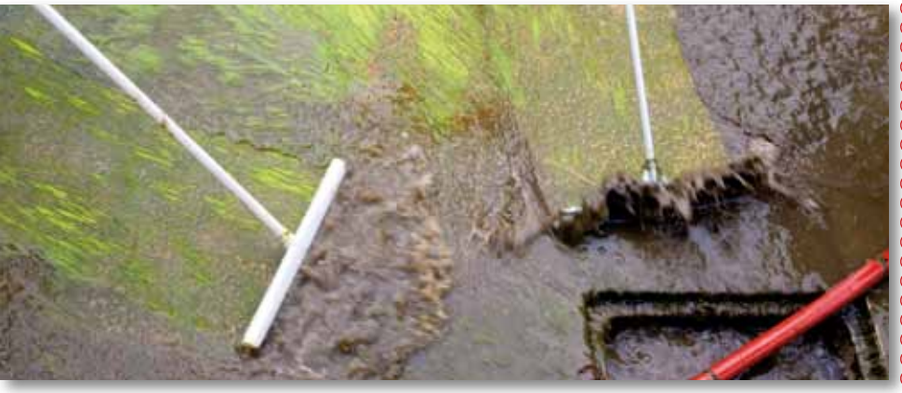
As an example, let's consider a large parking lot. First, the parking lot is usually paved, which means it doesn't absorb much water when it rains or snows. Instead, water flows to storm drains which lead to nearby creeks, streams and lakes. The problem is what the water may wash away as it moves.



Oil, as seen above, may leak from vehicles in the parking lot a few drips at a time. One car dripping a small amount of oil may not seem like a big deal, but when you figure thousands of cars a day, it can add up to be a big problem. Plus it's not just one parking lot we're worried about, but all of the parking lots in the area. A single quart of motor oil can pollute up to 250,000 gallons of water. One gallon of spilled gasoline can pollute up to 750,000 gallons of water. Still not thinking this is a big problem? The EPA estimates Americans spill 180 million gallons of used oil into lakes, streams and rivers every year.

The parking lot most likely has other pollutants as well. Litter, pet waste, rubber from tires and metal from brake wear all contribute to the problem.

Of course parking lots aren't the only problem area either. Any non-absorbing surface—sidewalks, roofs, roads—increases runoff. Even your household can be a problem. The improper use or disposal of household chemicals can contribute to nonpoint source pollution.



Keep it Clean
with H_2O Jo & Flo

Runoff pollution is definitely a bummer, but the cool thing is that it's something you can help prevent everyday. After all, this type of pollution is created by many sources. Part of the solution is for all of us to make small contributions to protecting water that add up to making a big impact.

Help prevent winter runoff pollution…

1. Don't litter.
2. Clean up pet wastes.
3. Shovel, snow-blow, plow and/or sweep the snow. These are all effective in removing snow and minimizing ice buildup.
4. Apply de-icer before snow storms to prevent snow and ice buildup. This also makes shoveling more effective.
5. If leftover salt crystals are still visible after salt has been applied, then you've used too much. Sweep up the leftover salt and re-use it, or dispose of it in the trash

To find out how you can help Flo and Jo protect our water everyday, visit http://npscolorado.com.

Watershed Defenders

Everybody likes a good comic book every now and then. You can follow the adventures of the Watershed Defenders at growingyourfuture.com. Download past issues to see our heros battle their arch-nemesis, the Contaminator. If you enjoy the Watershed Defenders, be sure to check out Major Ag, a superhero protecting food and fiber in Colorado.

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: Colorado Department of Public Health and Environment ~ Water Quality Control ~ NPS Program.

2012 The Year of Water Reader

Teacher's Guide

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

Check out some of these websites for more information water.

www.water2012
This is the official site of 2012 The Year of Water. Activities, including educational resources, calendar of events and more. This is a good site to start learning about water.

United States Geological Survey or USGS
USGS collects and provides information needed to understand the nation's water resources and provides access to water data, publications, and maps. Send your students to the education page and click on the hydrology primer for some good information!
www.usgs.gov/education.html

Colorado Foundation for Water Education or CFWE
CFWE focuses on water education with a goal of promoting a better understanding Colorado's water resources by providing balanced and accurate information and education.
www.cfwe.org

Colorado Foundation for Agriculture or CFA
Where have we heard that name before? The web site contains pdf files of activity books, past readers, e-lessons and more. It's a useful site to visit any time for any agricultural topic. Water topics abound.
www.growingyourfuture.com

Additional sites containing pertinent information:
www.npscolorado.com

www.groundwater.org

www.watereducation.org

Comments, questions, suggestions and feedback about Colorado Readers are welcome.
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2012 ~ The Year of Water

Activities and information about water in Colorado will abound this year. Celebrations, information, discussions and activities will bring water to the forefront of our thinking. The intended impact of declaring 2012 The Year of Water is to educate students, teachers and the public about this natural resource. As your students travel through this reader they will see that water is essential and permeates every facet of our lives. Simply, we cannot live without water.

Colorado is a headwater state and as such we have the privilege of first dibs on some of this resource. Water flowing from melting mountain snowpack is fresh and clean. As it tumbles down mountain slopes it picks up and carries things from the environment. That's one of the reasons water goes to water treatment plants before it flows into pipes that bring it to our faucets. This year, as in recent years, the mountains are providing more things for water to carry downstream. Trees that have died from the bark beetle infestation are falling. This frees up more than just tree debris. Roots that held soils, minerals and rocks in place are displaced and become free to flow down the streams, creeks and rivers.

Water that flows through developed areas, areas under construction or roadways picks up more things. There is an impact on this resource when people use cars and other motorized equipment. We're not going to give up using tools and equipment that help us accomplish tasks. We can, at least, use and maintain them wisely. The goal is to minimize our impact on the environment and water in particular. A little effort by all of us can have a huge impact. People and animals who live downstream from us will appreciate the effort.

Answers and activities...

Page 1

Activity: Have students use the numbers showing all the water on earth to build a pie chart. The little bitty sliver of available freshwater is what everyone on earth shares.

Page 2

Fact: Oceans are the largest source for evaporation on the planet. What other sources are there for evaporation?

Lakes, rivers, streams, creeks, ponds, reservoirs, sprinklers, swimming pools, puddles...essentially evaporation can occur anywhere that water is found ...including water in a forgotten cup sitting on the garden fence. And we would be remiss not to mention the impact of people. We sweat. What happens to the excess moisture we generate?

The rivers that carry the most water to other states are:

Colorado River
San Juan River
Yampa River
White River
Dolores River
South Platte
Rio Grande River
North Platte River
Arkansas River
Note: The Gunnison River flows into the Colorado River which then flows into out of the state.

Science activity:
Build a mini-water cycle.
Materials: a large glass container with a lid; gravel; peat moss; potting soil; small plants (native to Colorado)
Method: put a one-inch layer of gravel on the bottom of the glass container. Add a layer of peat moss and then a layer of soil. Put a variety of plants in the soil, water lightly and put the lid on the container.
Result: The plants will take up moisture from the soil and release it through their leaves (transpiration). The water molecules will condense on the glass and "rain" back into the soil.

Science Activity:
Salt Water.
Conduct this experiment to show that salt does not evaporate from the ocean with the water.
Materials: tablespoon of salt, spoon, glass of water
Method: stir a tablespoon of salt into a glass of water until it dissolves. Set the glass on a table or window sill. Let the water evaporate.
Result: What happened to the water? What happened to the salt?

Page 3
Ask: Name two functions of reservoirs.
Answers: storage, flood control, recreation

The average annual precipitation in Colorado chart plots averages. Ask students what they think the weather was like in the early 1940s when the average precipitation was 22 inches. Also have students discuss what the weather must have been like when the average precipitation was repeatedly less than 12 inches during the 1930s.
Do students know name of an event that occurred in the 1930s? (The Dust Bowl).

Have students make a statement about the climate conditions during the 1990s.

Students are asked to make a comparison between water basins and population density areas in Colorado.
Ask: How does water affect population density?

Page 4
Water and Energy
The prefix "hydro" shows up on this page. The meaning of hydro is water.
Ask: what do you think is the meaning of the following words?
hydropower (water power)
hydrology (the scientific study of the properties of water)
hydroponics (growing plants in water)
hydrophobia (fear of water).

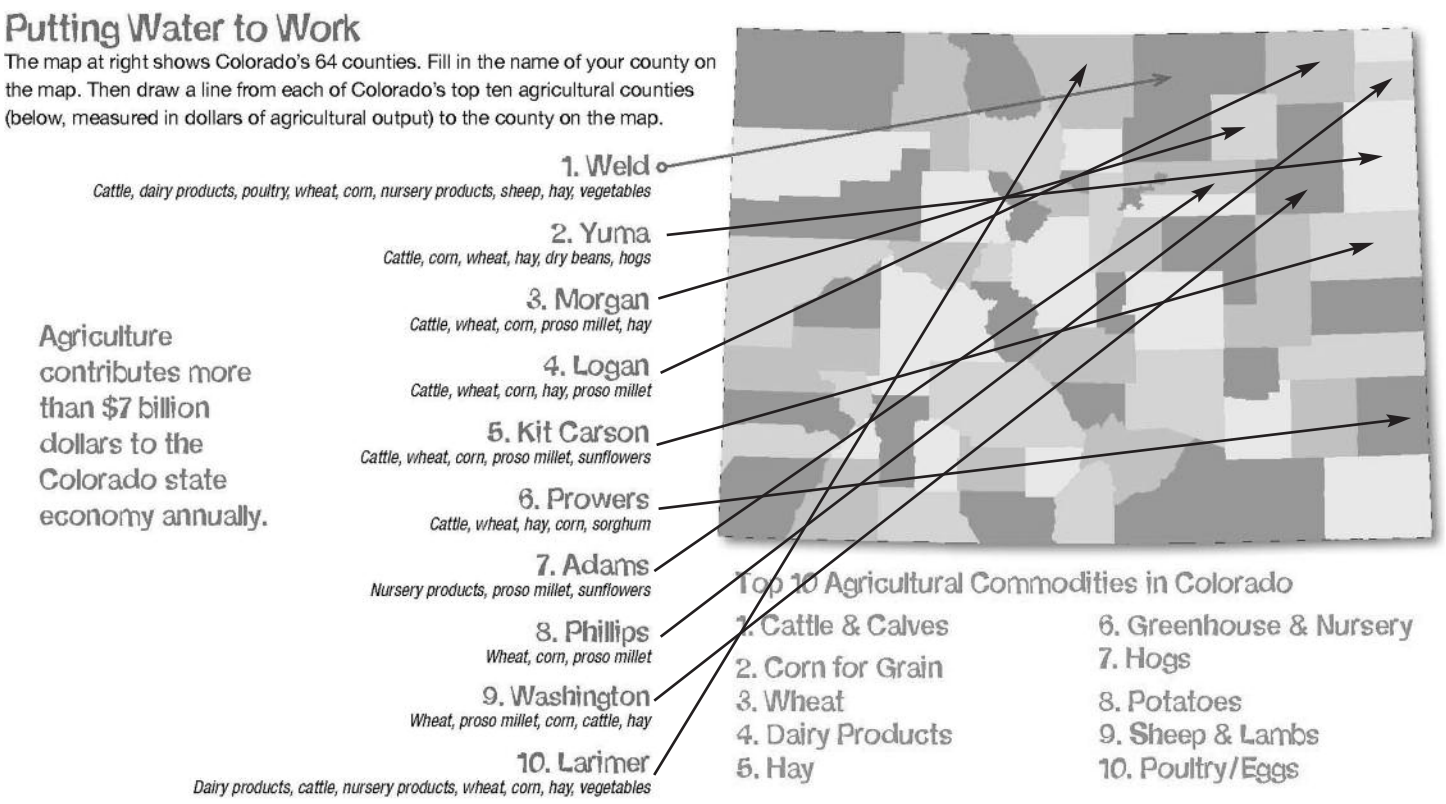
Quick math question: About 4 percent of electricity comes from hydropower. What percent of electricity comes from sources other than hydropower?

True or <u>False</u>: Water is destroyed, used up, just like the fossil fuels of coal, gas and oil when it used to generate power. *(The answer is FALSE. Water is consumed but not destroyed. Consumed water will return within the water cycle.)*

Another prefix is mega.
Mega = one million or 10^6

Water management is an area of critical importance to society. *Ask* your students if they understand why it is important to have well educated and fair minded people in charge of this resource.

The question water managers will need to answer is "who gets the water". Demands for water come from agriculture, mining, municipalities, individuals. Every one needs water, including wildlife. Water is a limited



resource. Gold is a metal that has a value attached. People rushed to Colorado to try to find it. Water is today's gold. Only more so. Gold is not needed for survival; water is.

Page 5

This information continues the theme of water use and demand for the resource. Agriculture requires the greatest amount of our freshwater supply. That makes sense, since, in addition to drinking water, we all need to eat.

People involved in agriculture have the challenge of making more with less. Of import is the availability of high-quality farm ground.

Development has consumed some of the previously available land. Land is also lost to desertification. This is the degradation or loss of land caused by a variety of factors. These factors can include climate change and human activities. Arid, semi-arid (Colorado) and sub-humid areas experience desertification. Historically, this degradation of land has impacted civilizations around the world. It is one of the causes of deforestation. When land is no longer productive because the land is exhausted people have looked for and found productive land in forested areas.

Those things created as a result of human activities can be reversed over time with actions taken based on an understanding of the causes. Sustainable agriculture is considered one potential solution.

The last sentence on this page is a question: "Where will the next innovations come from that will sustain the world?" The answer to that question is that those innovations will come from today's students; perhaps one of the students using this reader.

Page 6

The county map points out the top ten agriculture counties. *Ask* What is the relationship between the top agriculture counties in the state and the location of the major rivers in the state?

Interestingly, just like with population, the counties with the most agriculture are found on the East Slope. And the water? On the West Slope. This has resulted in or is a result of transbasin diversion projects that carry water from the West Slope to front range reservoirs for storage and use by municipalities and agriculture.

Research: Have students research an answer to the question: Which came first? Did agriculture on the East Slope result in the building transbasin diversion projects or did building transbasin diversion projects result in being able irrigate the East Slope areas? Students can supply a written report in which the questions who, what, when, where, why and how are answered.

Acre foot measures volume. The term acre foot refers to water. It is redundant to say acre foot of water; nothing else is referenced using acre feet.

Furlongs are interesting. About the only time this word is used in conversation is when horse racing is the subject. A furlong is equal to 1/8 of a mile or 220 yards.

The chain mentioned is a measuring instrument for surveying. It's made of 100 linked pieces of iron or steel. A chain of 100 links is 66 feet. (This is different from an engineer's chain which measures 100 feet).

Answer: 90 gallons of water x 8.3 pounds = 747 pounds.
Heavy.

More math: You have two 2-1/2 gallon containers. How much will both these containers, filled with water, weigh?
2-1/2 x 2 = 5 gallons
5 gallons x 8.3 pounds = 41-1/2 pounds

And keep the math challenge going: Show two different ways to find the answer to the question "How many trips will you need to make to the neighbor's faucet to bring 90 gallons of water home?" You have two 2-1/2 gallon containers.

1. 747 pounds divided by 41.5 pounds = 18 trips
2. 90 gallons divided by 5 gallons = 18 trips

Math: Write a formula for how the answer 27,154 gallons was found, knowing that the question was how many gallons of water fell on the football field when it rained 1 inch. You know that 1 acre foot = 325,853 gallons.
Answer:
1 inch is 1/12 of one foot.
1/12 of 325,853 gallons = 27,164 gallons

Type of water use	Estimate water use	Actual No. of times used	Amt. of time using	Amt. of water used
Drinks				
Washing hands				
Flushing toilet				
Bath				
Shower				
Washing dishes				
Other				
TOTALS				

Research/Science project.
Write an explanation of how a cumulus cloud weighing 2.2 billion pounds stays aloft.

Page 7

The word beneficial means promoting a favorable result; enhancing well-being; advantageous. Beneficial use of water can include irrigating crops, supplying drinking water, providing adequate water to support aquatic life, etc.

Activity: Classroom and Home Use of Water
This exercise requires total classroom participation. The time frame (one day, one week, etc.) for recording water use is at your discretion. (You might consider conducting the survey more than once to determine if your students are practicing water conservation after learning more about water.)

Use a table (similar to the one on the preceeding page) to record results.

Research on-line the amounts of water used for various tasks. Your class can brainstorm the usage they want to record. In lieu of doing that research, use the following amounts for these activities.
Bath, 50 gallons
Shower, 35 gallons
Shower with low-flow showerhead, 20 gallons
Brushing teeth with water running, 1 gallon
Brushing teeth turning water off, 1/2 gallon
Washing hands/face, 1 gallon
Flushing toilet, 4 gallons
Getting a drink, 1/4 gallon
Washing dishes in a sink, 25 gallons
Washing dishes in a dishwater, 10 gallons
Washing clothes, 45 gallons

Page 8

Keep it clean.
Brainstorm with your students things that can be done at school, in the neighborhood and at home to help limit non-point source pollution that can result in keeping water clean.

Vocabulary

There are many new, compound words used in this edition. Your decision is whether to have students read the *Reader* then define words or define words then read the *Reader*.

Students will encounter some words for the first time. Perhaps more important than looking up definitions is to have students break the words into syllables. Identify prefixes and suffixes and learn their meanings. Have students determine if the word is a noun, verb, adjective, adverb or if it has multiple definitions and uses.

Here is a selection of words from the *Reader*.

augmentation
beneficial
compacts
complicated
concentrated
condensation
conjunction
conservancy
conservation
consume
consumption
contaminate
contamination
distribution
diversion
doctrine
drought
efficiency
emissions
evaporation
extract
fertilizer
fracture
generate
generation
generator
genesis
genetics
hoarding
hydraulic
hydroelectric
hydropower
inject
innovations
irrigation
kilometer
mechanical
pollutants
pollution
precipitation
priority
reservoir
sustain
sustainability
transbasin
transpiration
yield

Colorado Academic Standards

Reading Standard 1 Students read and understand a variety of materials.
Writing Standard 3 Students write and speak using conventional grammar, usage, sentence structure, punctuation, capitalization, and spelling.
Benchmarks • Knowing and using subject/verb agreement; • Knowing and using correct modifiers; • Knowing and using correct capitalization, punctuation, and abbreviations; and • Spelling frequently used words correctly using phonics rules and exceptions.

Science
Standard 2 Physical Science: Students know and understand common properties, forms, and changes in matter and energy.
Benchmark 4 • Matter exists in physical states (solid, liquid, gas) and can change from one state to another
Benchmark 5 • There are different types and sources of energy (for example: light, heat, motion)
Standard 3 Life Science: Students know and understand the characteristics and structure of living things, the processes of life, and how living things interact with each other and their environment.
Benchmark 2 • Green plants need energy from sunlight and various raw materials to live, and animals consume plants and other organisms to live.
Standard 4 Earth and Space Science: Students know and understand the processes and interactions of Earth's systems and the structure and dynamics of Earth and other objects in space. Students know and can demonstrate understanding that:
Benchmark 2 • Natural processes change Earth's surface (for example: weathering, erosion, mountain building, volcanic activity, earthquakes and floods)
Benchmark 3 • Many of Earth's resources can be conserved, recycled and depleted
Benchmark 5 • Most of Earth's surface is covered by water, most of the water is saltwater in the oceans, and that freshwater is found in rivers, lakes, underground sources and glaciers
Benchmark 6 • Water exists on Earth in different states (solid, liquid, gas) and changes from one state to another (for example: evaporation, condensation and precipitation).

Math
Standard 1 Students develop number sense and use numbers and number relationships in problem-solving situations and communicate the reasoning used in solving these problems.
Benchmark 1 • Demonstrate meanings for whole numbers, and commonly-used fractions and decimals (for example, 1/3, 3/4, 0.5, 0.75), and representing equivalent forms of the same number through the use of physical models, drawings, calculators, and computers.
Benchmark 3 • Use numbers to count, to measure, to label, and to indicate location.
Benchmark 5 • Use number sense to estimate and justify the reasonableness of solutions to problems involving whole numbers, and commonly-used fractions and decimals (for example, 1/3, 3/4, 0.5, 0.75).
Standard 5 Students use a variety of tools and techniques to measure, apply the results in problem-solving situations, and communicate the reasoning used in solving these problems.
Benchmark 1 • Know, use, describe and estimate measure of length, perimeter, capacity, weight, time, and temperature.
Benchmark 2 • Compare and order objects according to measurable attributes (for example, longest to shortest, lightest to heaviest).
Benchmark 3 • Demonstrate the process of measuring and explaining the concepts related to units of measurement
Standard 6 Students link concepts and procedures as they develop and use computational techniques, including estimation, mental arithmetic, paper-and-pencil, calculators, and computers, in problem-solving situations and communicate the reasoning used in solving these problems.
Benchmark 1 • Demonstrate conceptual meanings for the four basic arithmetic operations of addition, subtraction, multiplication, and division.

2012 ~ The Year of Water
EVALUATION ~ 2012

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 of your students understand the importance of water? _____

How many of your students can explain the water cycle? _____

How many of your students understand how water is used to generate power? _____

How many of your students understand the importance of water to agriculture and growing crops? _____

Comments:

_____

_____

_____

_____

_____

_____

_____

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 more activities like _____

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School _____ Grade Level _____

Subject Area (s) _____

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Send your evaluation to CFA, P.O. Box 10, Livermore, CO 80536
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You are invited!

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Agriculture in the Classroom

HELPING ALL GENERATIONS UNDERSTAND THEIR CONNECTION TO AGRICULTURE