



# SOIL, WATER, AND AIR STEWARDSHIP

Think about the world right outside your classroom. What do you see? Maybe grass, a few trees, a parking lot full of cars, and other buildings off in the distance?

Nearly everything you can see was made from natural resources.

Just like us, plants and animals need natural resources to live! Natural resources are our treasures to protect. Agriculture depends on them – and we depend on agriculture.

**SUN** – The sun is a source of energy for all life. Plant leaves capture sunlight to make food, or energy, to grow. Farm animals eat plants. By eating food from plants and animals, the sun gives us energy too.

**SOIL** – The soil beneath our feet is as important as the air we breathe and the water we drink. Soil holds water and nutrients plants need. Animals and people depend on plants for food, so we need soil too.

**WATER** – Plants drink water just like we do! Plant roots absorb water from the soil. Farm animals also need plenty of clean water to grow and stay healthy.

**AIR** – Plants and animals need clear air to live. Plants take in carbon dioxide that we breathe out. Animals and humans breathe in oxygen that plants release.



## WHAT IS A NATURAL RESOURCE?

A natural resource is something that exists freely in nature. They are not created by humans, but humans do use their supplies to survive and function. There are two types of natural resources: nonrenewable and renewable.

**Nonrenewable resource:** cannot be easily replace once destroyed; examples include fossil fuels, rocks, and minerals

**Renewable resource:** replenishes itself natural; examples include animals, plants, air, soil, and water

Natural resources are all connected in one way or another. If something happens to one, it will affect the supply or quality of all the others.

We can protect and preserve our natural resources through **stewardship**. A steward is someone who takes responsibility for how they use and protect the environment. They utilize practices that help conserve our natural resources so generations in the future can use and enjoy them.

# SOIL - MORE THAN DIRT!

We interact with soil every day, even when we aren't thinking about it! We walk on it, we dig into it, we build with it, and we grow things in it. But what is soil? Is it just dirt that gets under our fingernails and stains our clothes when we play in it? No! Soil is a mixture of minerals, dead and living organisms, air, and water. Soil is one of our most useful natural resources.

Soils are **limited natural resources**. That means that while they are renewable because they are constantly forming, they do so at an extremely slow rate. One inch of topsoil can take hundreds or even thousands of years to develop.

A few ways soil can be negatively impacted are:

- **Erosion** – The wearing of soil by water, wind, and human actions.
- **Urban development** – Moving soil around or removing the soil to construct buildings and roads.
- **Contamination** – When harmful objects, chemicals, or substances pollute the soil in a way that causes harm to other living things or destroys the soil ecosystem.
- **Compaction** – The pressing together of soil particles causing the soil to become hard and usually very dry.

## WHAT ARE THE LAYERS OF SOIL?

Soil is made up of distinct horizontal layers; these layers are called horizons. Using the descriptions below, can you identify the soil layers? Write the letter of the Horizon name next to each soil layer in the graphic.

**A Horizon** - The layer called topsoil; it is found below the O horizon and above the E horizon. Seeds germinate and plant roots grow in this dark-colored layer. It is made up of humus (decomposed organic matter) mixed with mineral particles.

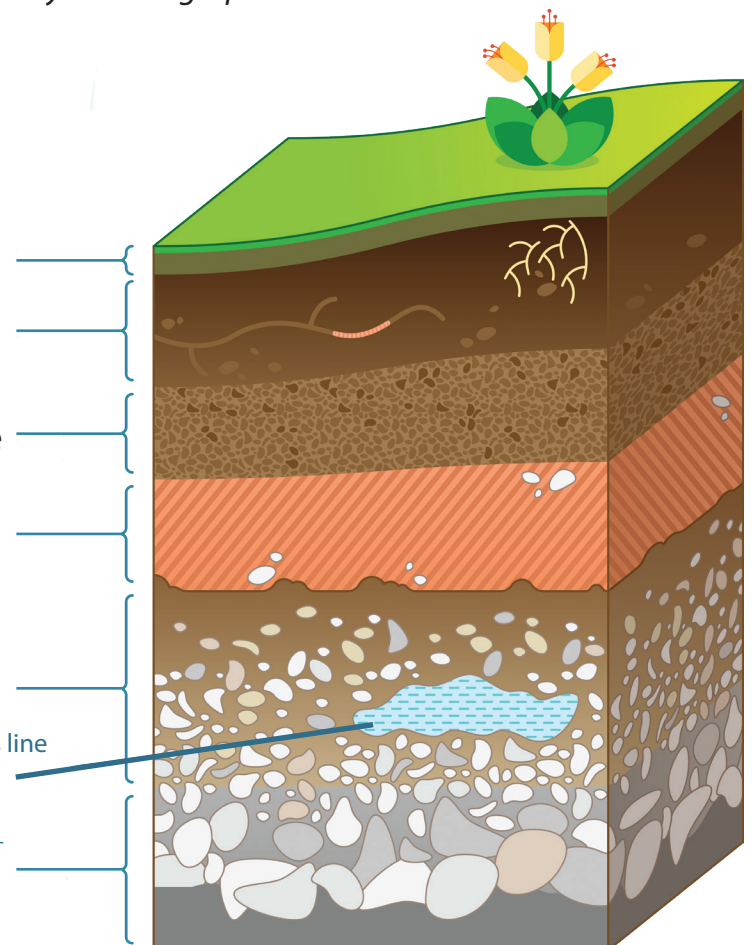
**B Horizon** - Also called the subsoil - this layer is beneath the E Horizon and above the C Horizon. It contains clay and mineral deposits (like iron, aluminum oxides, and calcium carbonate) that it receives from layers above it when mineralized water drips from the soil above.

**C Horizon** - Also called regolith; the layer beneath the B Horizon and above the R Horizon. It consists of slightly broken-up bedrock. Plant roots do not penetrate into this layer; very little organic material is found in this layer.

**E Horizon** - This eluviation (leaching) layer is light in color; this layer is beneath the A Horizon and above the B Horizon. It is made up mostly of sand and silt, having lost most of its minerals and clay as water drips through the soil (in the process of eluviation).

**O Horizon** - The top, organic layer of soil, made up mostly of leaf litter and humus (decomposed organic matter).

**R Horizon** - The unweathered rock (bedrock) layer that is beneath all the other layers.



# WATER - ESSENTIAL FOR ALL LIFE

You have probably heard the phrase, “Water is essential for all life.” And that is 100% true! Life on earth cannot be sustained without water. We rely on it to hydrate and clean our bodies, nourish our crops and our gardens, cook food, keep our animals healthy, for use in many industrial applications, and SO MUCH MORE. Water is considered a **renewable resource** because it is restored again and again by the water cycle.

In Colorado, we are in a unique position as a “headwater state.” Hawaii is the only other headwater state. There are no rivers that flow into Colorado. Nearly all of our water supply comes from the rain and snow that falls throughout the year. Amazingly, the water that falls in Colorado supports millions of people in our state, plus 17 other states and Mexico!

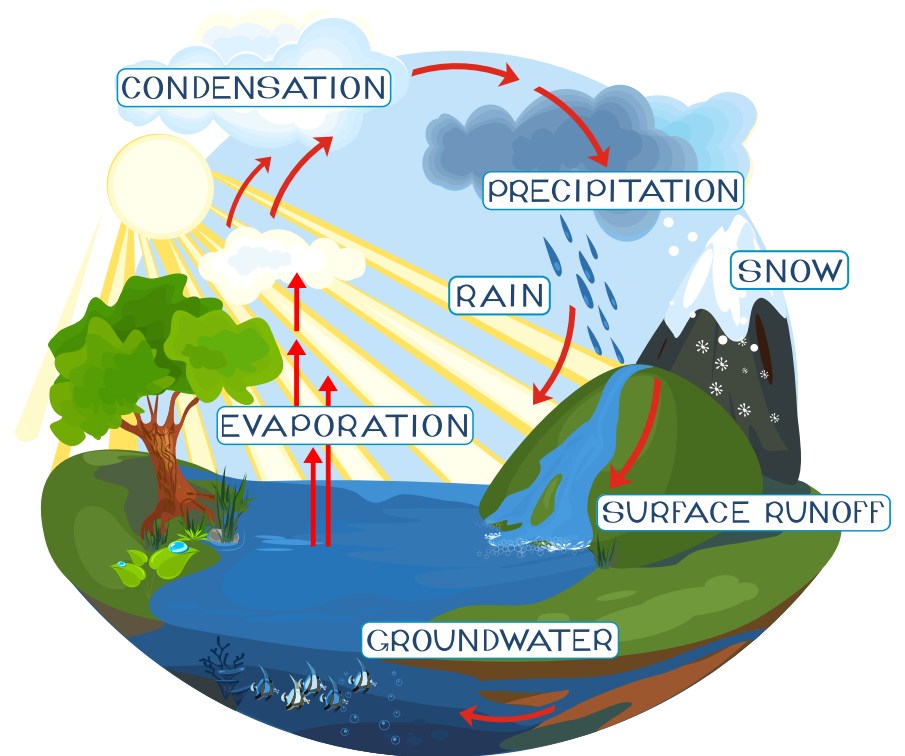
Statewide the annual average precipitation is only 17 inches. However, the mountains receive closer to 60 inches. The natural environment – all the living and non-living things in our ecosystem – uses 85 percent of the precipitation. That leaves only 15 percent of the water for the many ways we use water.

How does Colorado make sure everyone gets their share of the water? One way is through the **Colorado Water Plan**. The Colorado Water Plan was developed in 2015 to look ahead and develop solutions to meet the future water needs of a growing population, while still supporting the existing water uses Coloradans value and rely on. It is like a road map to support healthy watersheds, the environment, recreation and tourism, thriving cities, and viable agriculture.

Colorado’s population is estimated to double from the current five million residents today to ten million by 2050. This means we must be working today to figure out the best ways to sustain that many people in the future!

WHAT  
DO YOU  
CALL A  
MELTED  
SNOWMAN?

Answer: Water



THE WATER CYCLE

**NAME FOUR WAYS YOU USED WATER TODAY.**

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**WHAT IS ONE WAY YOU CAN HELP CONSERVE WATER IN YOUR HOME?**

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**IF YOU COULD ADD ONE IDEA TO THE COLORADO WATER PLAN TO HELP FUTURE GENERATIONS, WHAT WOULD IT BE?**

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# AIR - FRESH AIR

There's no way around it – plants, animals, and humans rely on air every moment of every day! Air is essential to all life and it's important we keep our air clean. When the air is clean, we can breathe more easily and be more active. Plants grow better and animals can thrive when they aren't breathing in pollutants.

Air pollution is the presence of a substance in the air which has harmful or poisonous effects. Pollution in the air is harmful to humans and animals, and it can damage the environment. We can't always see pollution right in front of us, but have you ever noticed a brown haze hanging in the sky? That is air pollution. Unfortunately, we cannot get around some air pollution because we, as humans, do a lot of things that cause it. We drive cars, run factories, burn fossil fuels, and so much more that can negatively affect our environment. But there are ways each of us can minimize how much air pollution we are responsible for!

Here's a few tips on how you and your family can reduce air pollution:

1. Conserve energy by turning off lights, using the furnace or A/C only when needed, using appliances minimally.
2. Carpool, use public transportation, walk, or bike whenever possible.
3. Make sure your parents aren't letting their cars idle before driving.
4. Use environmentally safe cleaning products.
5. Recycle! Plastic, glass, aluminum, and paper goods are all easily recycled.
6. Carry around and refill a reusable water bottle every day instead of drinking from single-use plastic water bottles.

## WHAT'S IN THE AIR WE BREATHE?

In this experiment, you will learn about pollutants in the air.

### MATERIALS:

- Wooden Block or Brick (or other heavy object)
- Clear plastic wrap (enough to cover brick)
- Duct Tape
- Petroleum Jelly
- Blank White Paper

### PROCEDURE:

1. Secure the piece of plastic to a wooden block, brick, or other heavy object using the duct tape.
2. Coat the top of the plastic with a smooth, thin layer of petroleum jelly.
3. Identify an outdoor location that is mostly open with decent air circulation (on a fence post is preferable to on the ground).
4. Let the plastic sit for at least 24 hours (avoid rainy/snowy days).
5. Bring the brick inside. Remove the plastic and lay it on the blank white paper.
6. Examine the plastic for any particles collected.
7. Optional: Create multiple plastic/block sensors and place them in different locations – at home/at school, indoor/outdoor. Then compare the particles collected by each.

### QUESTIONS TO ANSWER:

1. What do you observe on the plastic? Make a list, describing them as well as possible.
2. Are you surprised by the amount of particles/pollution that were collected?
3. Where do you think these particles are coming from?
4. How do you think air quality of the area you put your brick/plastic could be improved?

# LET'S ASK KATE



**COLORADO**  
Department of Agriculture



**Colorado Commissioner of Agriculture Kate Greenberg**

Kate Greenberg was appointed to serve as Colorado's Commissioner of Agriculture by Governor Jared Polis in December 2019. As Commissioner, Kate provides leadership and direction to the Colorado Department of Agriculture and its 300 employees. Commissioner Greenberg has worked in agriculture for more than 12 years, from boots-on-the ground experience to advocating for family farmers. While she currently spends much of her time on Colorado's Front Range and traveling the state, she still calls Durango, Colorado home.

## **Q: WHAT IS STEWARDSHIP AND WHY IS IT IMPORTANT TO COLORADO AGRICULTURE?**

*Commissioner Greenberg:* Being a steward of something means to take care of it. People are stewards of all kinds of special things, like

friends and family, pets, homes, schools and other things they care about. Agriculture is an important part of our lives. Farmers and ranchers provide the food we eat, the fabric for our clothing, and help keep our environment healthy. The success of agriculture is something that touches all of us, and it's affected by the weather, laws, prices, the support of consumers and many other factors. It's very important for people to be stewards of agriculture in our state of Colorado because we all want and need healthy food, soil and water today and in the future.

## **Q: WHAT DO YOU MEAN WHEN YOU SAY "SOIL HEALTH"? DOES A DOCTOR CHECK THE SOIL?**

*Commissioner Greenberg:* There are many experts--sometimes called soil scientists--who are focused on the health of the earth's soil. Soil is a living, active natural resource that agriculture relies on to grow and raise food and other products. Soil needs care and attention to stay healthy, just like you. We know that certain practices, like keeping the ground covered, changing crops from season to season, and actively managing grazing by livestock can help keep Colorado's soil healthy and strong. When it's healthy, soil has more nutrients, it can hold more water (which helps

save water), and it can even play a part in keeping our earth cool. There is a lot going on in the soil under our feet!

## **Q: WHAT ARE COLORADO FARMERS AND RANCHERS DOING TO BE GOOD STEWARDS OF OUR NATURAL RESOURCES?**

*Commissioner Greenberg:* Farmers and ranchers have been excellent stewards of our natural resources for hundreds of years and that continues today. The way they act as stewards has changed over the generations, just like life has changed. They are more concerned than ever before with taking care of our state's water, soil and air because that's important to agriculture and to all who eat. At the Colorado Department of Agriculture, we are working with farmers and ranchers to create a new Colorado Soil Health Program that will help farmers and ranchers find ways to build new ways to improve water, soil and air quality. We also help farmers and ranchers develop renewable energy on their land to save money and help the environment.

## **Q: HOW CAN STUDENTS GET INVOLVED IN AGRICULTURE?**

*Commissioner Greenberg:* There are many fun and delicious ways to support agriculture! One good way to start is to look for and talk to your family about eating foods that are grown or raised in Colorado--many of these have a "Colorado Proud" label on them. Visiting local markets and farms is a fun experience and another place to find Colorado foods. Help with a community garden, plant your own garden, or join an ag-focused club like 4-H or FFA. And keep learning about agriculture. Knowledge is power, and the more people who know about agriculture, the stronger it will be!

# CLIMATE SMART AGRICULTURE

Farmers and ranchers use many climate smart agriculture practices. These practices reduce the negative impact on the environment. They keep the soil healthy, conserve water use, and reduce air pollution. The goals of climate smart agriculture are:

## **INCREASE PRODUCTIVITY:**

Producing food, fuel, and fiber for our world requires the use of natural resources and comes at a cost to our environment. If we can increase the productivity and efficiency of our farming practices, the overall environmental impact of producing food (per calorie) will be less.

**ENHANCE RESILIENCE:** Although lessening climate change is important, our climate is changing. Measures to enhance the resilience of livestock and crops to climate change are necessary to continue to produce food for a growing population.

**REDUCE EMISSIONS:** Science and technology are helping us identify ways we can change farming practices to reduce greenhouse gas emissions.

Take a look at these climate smart agriculture practices Colorado farmers and ranchers are using.

**Minimum Tillage or No-Till** – Farmers till their fields to loosen soil and make it better for seeds to start growing. Loose soil is more at risk to wind and water erosion. Tilling turns the soil over allowing carbon that was stored in the soil to be released into the atmosphere. Depending on the soil type, many farmers are able to reduce (minimum till) or eliminate (no-till) the number of times they disturb the soil before seeds are planted. Minimum or no tillage helps preserve the microorganisms that live in the soil. The organic matter from previous years helps hold the soil in place. It also helps preserve the moisture in the soil and decrease carbon emissions.

**Precision agriculture** – Farmers and ranchers use technology to be more productive while using fewer inputs. This is called precision agriculture. Global Positioning System (GPS) technology allows farmers to vary the amount of water and fertilizer added to a field depending on the needs of the plants in each area of the field. Drones are also used to treat specific areas of the field for weeds, pests, and apply nutrients. This technology increases productivity and efficiency of crop production leading to a higher yield.



Photo by Jennifer Nichols

**Cover crops** – Farmers can plant cover crops after harvest. The growing plant roots help hold the soil in place during winter and early spring. Wind and water erosion can be greatly reduced. Cover crops can also absorb extra nutrients in the soil (like nitrogen). This prevents them from running into watersheds. Cover crops can increase soil health, water retention, and even yield. Healthy soil decreases greenhouse gas emissions by increasing soil carbon storage.

**Rotational grazing** – Cattle, sheep, or horses graze (eat) on grasses and other forages in pastures and fields. To prevent soil erosion or compaction, ranchers rotate their animals to different pastures or different areas within one pasture. This practice helps more plants grow and improves the quality of the soil.

**Selective breeding** – Selective breeding is the process by which humans select plants and animals with desired traits to propagate. These desired traits could include growth rate and milk production in livestock or time from seed to harvest and cold tolerance in plants. The opposite of selective breeding is natural selection where plants and animals reproduce only by “survival of the fittest” rather than humans helping to select helpful traits. In terms of food production, plants and animals would be less productive without selective breeding. Selective breeding enhances our resilience to climate change.

**Crop rotation** – Crop rotation is a farming practice where farmers change the crop they grow on a piece of land each year. In Colorado, it is common for farmers to rotate crops like corn and wheat. This practice helps to control weeds and reduces pests. Rotating crops also improves the crop yields, or the amount of a crop that is harvested from one field. When crops are planted in rotation, less nutrients in the form of fertilizers are needed for plants to grow. Reducing fertilizer use reduces greenhouse gas emissions.

**Irrigation** - Farmers use efficient irrigation techniques, like center pivot sprinklers or even subsurface (underground) drip irrigation. Irrigation is the application of controlled amounts of water to plants. In Colorado, most farmers are in areas where they don’t get enough rain fall to support certain crops, so they must add water to the ground with irrigation.

**Recycling water** – Many farmers are able to recycle the water they use for multiple uses. For example, on a dairy farm, water is used to clean the area where the cows are milked and the equipment to milk the cows. That same water is then used to flush the manure out of the barns. Next, it is blended with irrigation water to nourish crops being grown in the field. Those crops are often time used as feed for the dairy cows. It is a complete cycle!

## FUN WITH WORDS

Stewardship is a big word. You might not have even heard of it before. Let’s have a little fun with this word.

List all of the new words that can be spelled using only the letters in stewardship.

### Stewardship

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# STEWARDSHIP CHALLENGE

We have already discussed many ways in which we can be a steward of Earth's natural resources. There are other more ways farmers and ranchers are working to reduce the impact on natural resources and improve our climate - some haven't even been thought of or invented yet! We need your help. The future of our planet relies on you!

Your challenge is to think of a way to steward our natural resources. It can be something you could do in your

school or at home. Or even think outside the box for way that helps farmers and ranchers. It could be a different farming practice, a new technology, a special tractor or piece of equipment, anything you can think of that will help be a better steward. Keep in mind the three climate smart agriculture goals described on the previous page. Use the space below to draw or describe your idea. Share your idea with your classmates and family.

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