

CCS Energy and Water Management Program

Spring 2022 Focus- Teacher Guide

Spring 2022 Focus Activity Sheets:

- [Upper Level Activity Sheet \(PDF\)](#)
- [Lower Level Activity Sheet \(PDF\)](#)

ENERGY

- Energy is defined as the ability to do work and it is everywhere around us and can take on many different forms.
- All energy is produced by the use and transformation of resources found in nature. Modern technology can harvest natural resources and convert it into energy for us to use.
 - **A Nonrenewable resource** is a source of energy that is used up faster than it can be made by nature or that we cannot recreate (Nonrenewable energy sources take millions of years to develop). This means that once this form of energy is used, there is no more of that energy available for future use. For this reason, we say that nonrenewable resources are “unsustainable”- they cannot sustain future generations forever.
 - There are four main types of nonrenewable resources.
 - **Ask the class to name them:**
 - Coal
 - Natural gas
 - Oil (petroleum)
 - Nuclear
 - Nonrenewable energy use contributes to our greenhouse gas emissions, which are harmful to Earth as it causes global warming.
(Depending on class levels/interest you can go into more detail around greenhouse gases and climate change)
 - **A Renewable resource** is a source of energy that can refill itself naturally. Since renewable resources are not limited by how much we use, we call them “sustainable”- they can sustain future generations indefinitely. There are many renewable resources that we can use for energy. **Ask the class to name a few:**
 - **Solar (sun)**- the rays from the sun can be turned into electricity using solar cells on solar panels. Also, sun can heat a building directly.
 - **Wind (air)**- large wind turbines generate electricity from the power of the wind
 - **Geothermal (earth)**- Heat from the inside of the earth can be used to heat homes and buildings with the help of heat pumps. Also, the steam from inside the earth can be used to generate electricity.
 - **Hydropower/hydroelectric (water)**- Water from a dam or river can be used to spin turbines and generate electricity.

- **Others they might mention:**
 - Wave and Tidal Power- newer technology that uses the power of the ocean’s waves and tides to make energy.
 - Biomass Energy- We can harness the energy collected from plants by burning them (especially trees). Also, plants can be turned into fuel – ethanol and biodiesel.
- *Additional Resources:*
 - [Information on energy from the US Energy Information Administration](#)
 - [More on nonrenewable resources](#)
 - [More on renewable resources](#)

WATER

- Water is an important resource that we use every day. **Ask the class to name some of the ways we use water (anything they say needs water):**
 - Drink
 - Grow food
 - Clean
 - Make clothes
- The total amount of water on Earth always stays the same. This means that the water you drink today has been on Earth for billions of years, throughout the Jurassic age of dinosaurs and the Ice Age of woolly mammoths! This is because water can change states, but it can never disappear.
 - **Ask the class to name three states of water:**
 - Liquid (water)
 - Solid (ice)
 - Gas (water vapor)
- So, when water seems like it’s drying up, this doesn’t mean that it’s completely gone- the water has simply turned into water vapor that floats invisibly in the air. Think about steam coming out of a pot of boiling water- this is water vapor. Likewise, when liquid water freezes into ice (solid), the total amount of water stays the same.
- Even though there is plenty of water on Earth, the amount that is available and useable for humans is much smaller. In fact, only **1%** of the water on Earth is freshwater that can be accessed and used by people. Since there is only a little bit of water that people can use, we must take care of our water resources to make sure they stay clean and don’t disappear.
- *Additional Resources:*
 - [More on the three main states of water](#)
 - [States of Water](#)

WHERE DOES ENERGY AND WATER COME FROM IN CHARLOTTESVILLE?

Energy

In Charlottesville, most of our energy comes primarily from fossil fuels like coal and natural gas (which are our nonrenewable sources) and solar power (which is a renewable source).

- Learn about [Dominion Energy’s Virginia Solar Projects](#)

- Dominion [map of large-scale renewables](#) and [map of distributed generation in Virginia](#)

Additional Resources:

- [Solar 101: How Solar Energy Works Video](#)
- [Dominion’s webpage on “Making Energy”](#)
- [2016 Greenhouse Gas Inventory- City of Charlottesville](#)
- [US Energy Information Administration- Virginia State Profile and Energy Estimates](#)

Water

In Charlottesville, all our water (for drinking, bathing, washing dishes...) comes from surface water collected in reservoirs. A reservoir is basically a man-made lake where water is stored for people to use. We can store water from the reservoir using a dam along a river. This water is pumped out of the reservoir and sent to a treatment plant where it is purified to make it drinkable. Then, when people need to use the water, pipes carry it from the treatment plant into your home, school or other buildings.

There are 4 Main Reservoirs in Charlottesville and Albemarle County, **does anyone know what they are, and which ones supply the City of Charlottesville their drinking water?**

- [South Fork Rivanna Reservoir](#) (Supplies the City of Charlottesville & Albemarle County)
- [Ragged Mountain Reservoir](#) (Supplies the City of Charlottesville & Albemarle County)
- [Sugar Hollow Reservoir](#) (Supplies the City of Charlottesville & Albemarle County)- this reservoir feeds water direction via pipe to Ragged Mountain Reservoir and any spilling over the dam flows to the South Fork Rivanna Reservoir
- [Beaver Creek Reservoir](#) (Supplies Albemarle County)
- [Totier Creek Reservoir](#) (Supplies Albemarle County)

You can visit these reservoirs in Charlottesville and Albemarle County, and some of them have cool things for people to do, like hiking, kayaking, or having a picnic.

- Optional activity: navigate to <https://www.rivanna.org/> and explore the reservoirs of Charlottesville.

Potential Discussion Questions:

1. How many students have been to one of the reservoirs in Charlottesville?
2. Can you drink water straight out of the reservoir?
 - a. Answer: No, before you drink the water it needs to be processed at a treatment plant to remove anything that isn’t safe to drink (bacteria, viruses, dirt).
3. What are some ways you use water in your school?
 - a. Bathrooms, water the garden, drinking water

Additional Resources:

- [Charlottesville and Albemarle County Drinking Water Reservoirs](#)
- [Image of the City and Albemarle County’s Reservoirs and treatment plans](#)
- [Information on our Drinking Water](#)
 - [City of Charlottesville’s Drink Water Quality](#)

Information for the Upper Level Activity Sheet

ENERGY MATCHING GAME

Now that we have discussed a little around the differences between renewable and nonrenewable resources, lets discuss how these resources become the energy we use.

For example, how do you turn the wind into energy that can bring light to your light bulb? This is where technology comes into the picture. There are different types of technologies for different resources that allow us to capture the resource and turn it into energy for us to use. In this activity, try to match the resource to the technology that will make energy for our school, you can draw a line between the two columns. Find the correct word from the word bank and fill it in for each image. Then, as a class we will decide which resource is renewable (it can refill naturally) or non-renewable (it will someday run out).

Sun ---> Solar Panel

- Energy comes from the sun in the form of light, heat, and radiation (think sunburn). The sun rays are a form of energy that is captured by a solar cell on a solar panel which transforms it into electricity. The electricity travels through power lines to reach your home, school or other buildings.
- This is a renewable resource

Air ---> Wind Turbine

- Large wind turbines generate electricity from the power of the wind moving turbines and causing them to spin. This movement generates electricity which travels through power lines to your home, school or building.
- This is a renewable resource

Water ---> Hydroelectric/hydropower

- Similarly, to a wind turbine, hydroelectric technology utilizes turbines to generate energy. Water collected in dams or flowing in a river is diverted to spin large turbines as the water moves through these turbines (just like wind would move the wind turbines). The turbines capture the energy generated from their movement and convert it to useable energy forms like electricity and sent to your home, school or building.
- This is a renewable resource

Coal ---> Coal power plant

- Coal is mined (dug up) from the earth. This can be done by removing the tops of mountains, digging up strips of earth, or tunneling underground- all of which can be harmful for the environment. Once the coal is extracted, it is sent to a coal power plant where it is burned to heat up a boiler. The steam from the boiler is then transformed into usable energy such as electricity and sent to your home, school or building.
- This is a non-renewable resource

THE WATER CYCLE

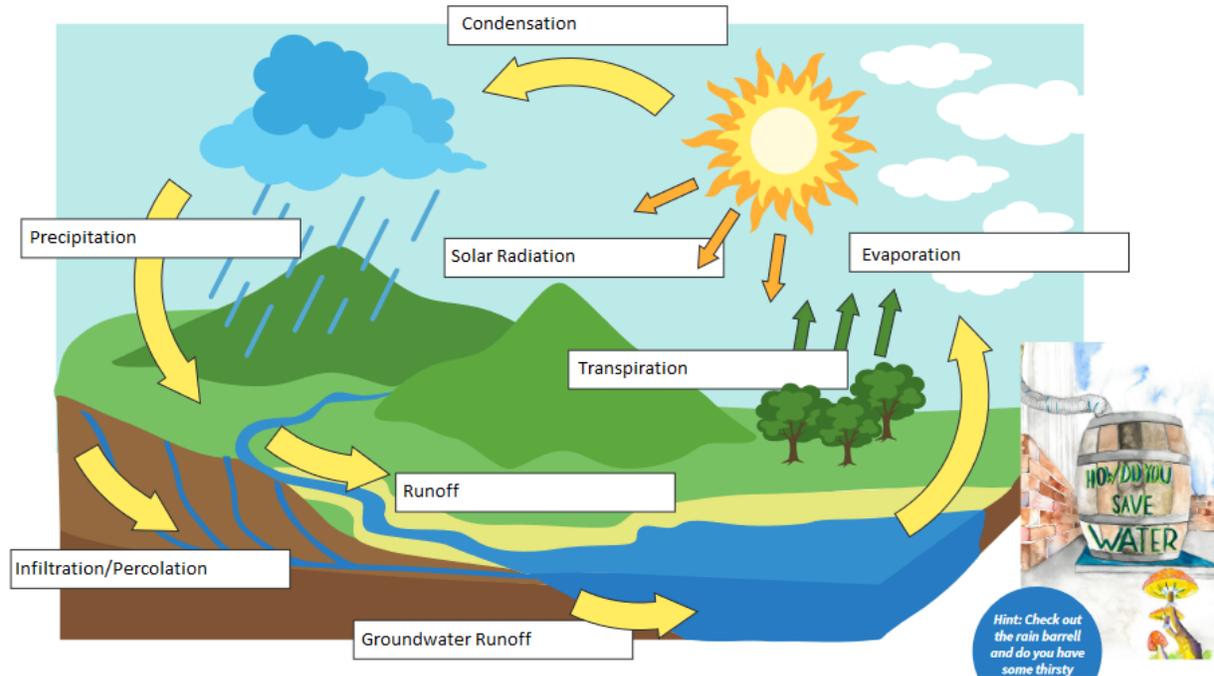
The water cycle describes the movement of water on Earth as it changes form. Water can be stored in different forms, like clouds in the sky, ice in glaciers and sea-water in the ocean by changing forms. For example, water can evaporate and transform from a liquid state to a gas. The way water moves through the world influences life on Earth. Plants, animals and people all depend on water to survive, so it's important we understand how the water cycle works. Even though water can move between forms and can be stored in different places or phases, it can never disappear completely. This means that the water cycle is a never-ending loop.

Depending on their understanding of the water cycle, you can have them go straight into filling out the diagram. If they need additional support, go over the definitions first.

- **Precipitation:** The air is full of water and these water droplets in clouds grow and become too heavy to stay in the air. These droplets fall to the ground in the form of precipitation (rain, sleet, snow, or hail).
 - *Discussion: Does the amount of rain that falls all over the world fall at the same rate? No, some areas get a lot of water and some areas get hardly any.*
- **Infiltration/Percolation:** Water that falls from precipitation soaks into the ground. A large amount of the world's freshwater is found underground! This water helps keep all plant life alive and can be utilized by humans.
- **Runoff:** Runoff means that water is "running off" the land surface. So, when it rains and this water doesn't soak into the ground, this water will often flow into rivers, lakes, and oceans.
 - *Discussion: Does anyone know where runoff from Charlottesville leads to? Rivanna River --> Chesapeake Bay --> Atlantic Ocean*
- **Groundwater Runoff:** Did you know that even water underground can runoff into rivers and oceans? Water can travel with the help of gravity and eventually reach rivers and oceans.
- **Solar Radiation:** This consists of light, heat, and UV rays that come from the sun and travel to earth. Solar radiation is important because it provides energy to the water cycle to help water change states.
- **Transpiration:** This step is like evaporation but with plants. Plants need sunlight, water and CO₂ to grow. In order to breathe CO₂, plants open tiny holes in their leaves that allow the air in. However, when they do this, they also let out some of the water that's inside their cells. Basically, water inside the plants evaporates out when they breathe in CO₂ releasing the water as a vapor.
- **Evaporation:** Energy from the sun causes the Earth to warm up and this heat energy on water like rivers, lakes, and oceans results in the temperature to rise and the water turns into a vapor "gas phase" rising into the air.
- **Condensation:** Condensation is the process of water vapor rising into the sky, where it starts to cool and turn back to a liquid, this liquid forms into clouds. Water vapor droplets start off very small at first- too small to see with the naked eye. When tiny water droplets bump into each other, they can grow larger and eventually create clouds.

Rainwater Harvesting call-out box:

- The water cycle shows water being recycled again and again. What is another great way you can help reuse rainwater?
 - ANSWER: you can use a rain barrel to capture rain water that would otherwise fall on the ground and turn into runoff. This water can be stored in the rain-barrel for a sunny day so you can use it to water your plants instead of using the hose.



Additional Resources:

- [More on the water cycle](#)
- [Water Cycle Video](#)
- [The Water Cycle by National Geographic Kids](#)
- [The USGS Interactive Water Cycle](#)



If you have questions or would like additional information or resources, please reach out to the City's Energy and Water Management Team: EnergyWaterTeam@charlottesville.gov

Information for the Lower Level Activity Sheet

ENERGY MATCHING GAME

Now that we have discussed a little around the differences between renewable and nonrenewable resources, let's discuss how these resources become the energy we use.

For example, how do you turn the wind into energy that can bring light to your light bulb? This is where technology comes into the picture. There are different types of technologies that allow us to capture these resources and turn it into energy for us to use. In this activity, try to match the resource to the renewable technology that will make energy for our school, you can draw a line between the two columns. Find the correct word from the word bank and fill it in for each image.

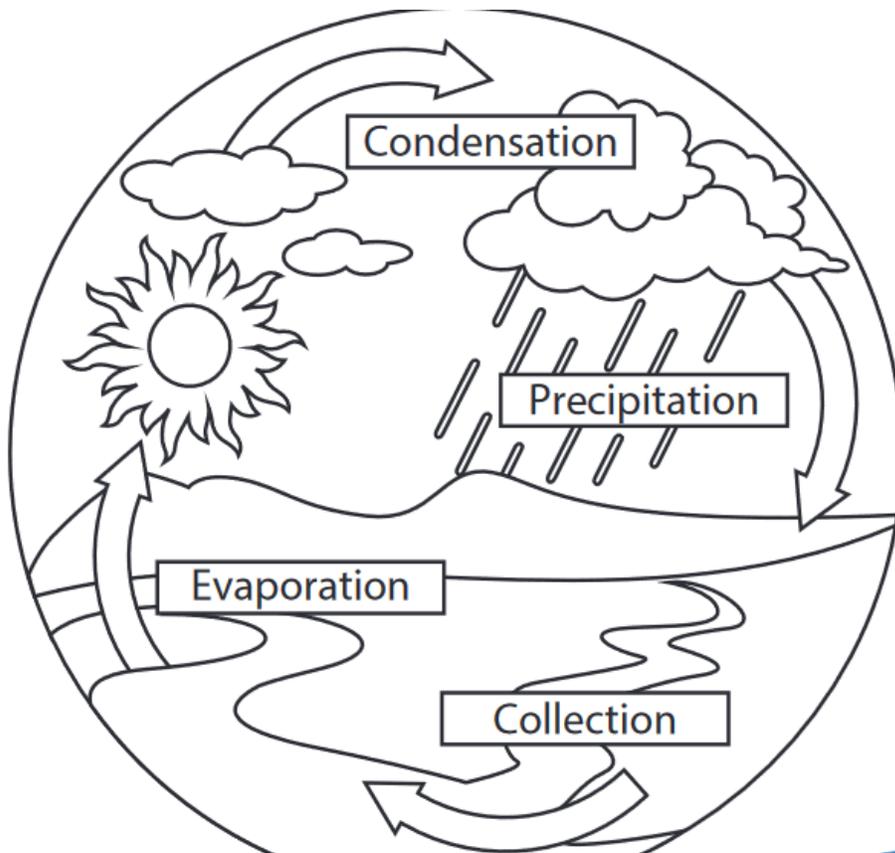
- **Sun ---> Solar Panel**
 - Energy comes from the sun in the form of light, heat, and radiation (think sunburn). The sun rays are a form of energy that is captured by a solar cell on a solar panel which changes it into electricity. The electricity travels through power lines to reach your home, school or other buildings
- **Air ---> Wind Turbine**
 - Large wind turbines make electricity from the power of the wind moving turbines and causing them to spin. This movement makes electricity which travels through power lines to your home, school or building.
- **Water ---> Hydroelectric**
 - Similarly, to a wind turbine, hydroelectric technology uses turbines to make energy. Water collected in dams or flowing in a river is directed to spin large turbines as the water moves through these turbines (just like wind would move the wind turbines). The turbines take the energy made from their movement and turn it to useable energy forms like electricity and sent to your home, school or building.

WATER CYCLE

The water cycle shows how water moves throughout the Earth. Water can't disappear completely, it only changes forms.

- Look at the box labeled "**Precipitation**".
 - **What is happening in this picture?** Raindrops fall from the clouds to the ground.
- In the next box, you see the word "**Collection**". This step shows where water is stored on earth.
 - **Can anyone think of a place where water could be stored? Hint: look at the picture, where is the water on the ground?** Water can be collected (stored) in rivers, lakes, ponds, oceans and even underground as groundwater! But the water doesn't stay here forever.
- Look at the box labeled "**Evaporation**". **What is happening here?** Water that is on the ground turns into water vapor in the air. This happens when sunlight heats up the water and changes it from a liquid to a gas. Remember, even though water vapor is invisible, this doesn't mean it disappeared!
- Look at the next box labeled "**Condensation**". In this step, water vapor turns into bigger water droplets that make up clouds.

- **What happens when the water droplets get really big? Hint: look at the next box after “Condensation”.** Once the water droplets get too big, they can’t stay in the clouds and they fall to the ground.
- Now, we’re back at step 1 and the water cycle repeats itself!



Discussion Questions:

1. What are some different types of precipitation? Hint: Think about what falls from clouds when it’s hot outside or when it’s cold outside.
 - ANSWER: rain, sleet, snow, hail
2. Is the amount of water on Earth today more than, less than, or the same as the amount of water 1000 years ago? What about 1000 years in the future?
 - ANSWER: same amount
3. True or False: You can breathe in water vapor that exists in the air
 - ANSWER: true! In fact, you’re breathing water vapor right now. We sometimes refer to this as humidity. Have you ever gone outside on a really humid day? It’s almost like you can feel the water in the air and it makes your skin and clothes sticky. This is because there is a lot of water vapor floating in the air. It’s okay to breathe this because the water vapor droplets are so tiny, they won’t hurt you.

Rainwater Harvesting call-out box:

- The water cycle shows water being recycled again and again. What is another great way you can help reuse rainwater?
 - ANSWER: you can use a rain barrel to capture rain water that would otherwise fall on the ground and turn into runoff. This water can be stored in the rain-barrel for a sunny day so you can use it to water your plants instead of using the hose.

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