Rainfall Simulation

Skill: Science

Objectives:

- Students will learn the importance of groundwater and its role in recharging aquifers
- Students will learn differences in water activity on different types of ground surfaces
- Students will understand the importance of grasses and grasslands in recharge zones
- Students will learn how water can become polluted
- Students will learn basic principles of water erosion
- Students will understand the components of wildlife habitat

Time Frame: 20-30 minutes

Lesson Preparation

Set up rainfall simulator by placing the four land plots on the top shelf and placing the labeled containers on the bottom shelf. From left to right, the labeled containers should be placed Ground Water, Run Off Water, Ground Water, Run Off Water, etc. Prime each

Vocabulary

- Aquifer
- Well
- Spring
- Groundwater
- Runoff Water
- Hypothesis
- Impervious Surface
- Turf Grass
- Overgrazed Rangeland
- Native Grasses
- Erosion

Materials

- Rainfall Simulator Frame
- Impervious surface plot
- Turf Grass plot
- Over-Grazed Rangeland plot
- Native Grass plot
- Four tubs with holes (depends on the simulator model) or a watering can
- 4, ½-gallon containers labeled “Run Off Water”
- 4, ½-gallon containers labeled “Ground Water”
- Dishwashing Soap
- Water
Lesson Activity

Water is important to all living things. Without water, life would die. Water is needed by all plants and animals. We use water for many purposes: to drink, to wash with, to cook with, for play, and for transportation. Our lives would be very different if we did not have water.

In Oklahoma, where do we get a large supply of our water? From aquifers. An aquifer is a large underground lake. Because this water is underground, we have to drill a hole in the ground, called a well, and pump out the water for our use. This is a man-made way of using this water. There is a natural way of getting water out of an aquifer. Water can come to the surface through a naturally occurring crack or hole in the Earth’s surface. This is called a spring. Some springs are very small. Others are very large and powerful.

If we get a large amount of our drinking water from the ground, how did it get there? The only way that an aquifer can be filled with water, or recharged, is for water to soak into the ground. As water soaks into the ground, it is filtered by the layers of limestone rock that it soaks through. When this water reaches the aquifer, it is very clean water.

Because groundwater, water soaking into the ground, is the only way that an aquifer can be recharged, this is why we need to be
concerned with where our water goes. We have talked a little about groundwater, let’s look at another kind of water, **runoff water**. We get runoff water when water does not soak into the soil. This water goes somewhere else: a ditch, storm drains, a river or stream, or it just sits in a puddle. While some of this water might runoff to some place where it can soak into the soil, it is hard to determine if enough of this water does soak in to become groundwater. For the purposes of this demonstration, we will say that runoff water does not recharge the aquifer.

*Let’s take a look at the four different land plots on our rainfall simulator.*

Each land plot is very different from the other. When it rains on these types of land, water will do one of two things - it will either run off or it will soak in and become groundwater. As we look at each plot of land, let’s come up with a **hypothesis** or guess about what water will do on each plot of land.

The first type of land we have is an **impervious surface**. Does anyone have an idea what the word impervious means?

An **impervious surface** means that it will not allow water or other fluids to pass through it. Can anyone think of an example of an impervious surface?

Some examples of impervious surfaces are sidewalks, roads, building foundations, and even a plastic bottle. **Is wood an impervious surface?** Wood is not an impervious surface. Water can soak into wood, causing it to warp and even rot. There are ways to help make wood more impervious. Painting wood is one way to help make it more impervious. **As we look at this impervious surface, what do you think water will do when it falls on it?** Will it runoff or will it soak into the ground?

Our second plot of land is turf grass. This could represent someone’s yard at their house, a playground at school, or even a park. This grass is usually short. Because of where this grass is usually located, a lot of people walk on it, sometimes packing down the soil, making it hard.

**When it rains on turf grass, where do you think that the water will go?** Will it runoff or will it soak into the ground?

As we look at this land, let’s think about wildlife for a moment. Some things that most all crea-
tures need to live is sunlight and oxygen. **What are some other requirements for life?** Three other requirements for life include water, food, and shelter.

**As we look at the turf grass in front of us, is this good habitat for wildlife?** Turf grass is a good wildlife habitat. It does provide the basic requirements for life: food, shelter and water. **What types of wildlife might you see on this type of land?** You might see birds, squirrels, raccoons, and deer.

Let's take a look at our third type of land. This is an example of an over grazed rangeland. **Who can tell me what “over grazed” means?** Land can become over grazed when there are more animals on the land than there is food and habitat for those animals.

As an example, consider your school cafeteria. Suppose that your class went to lunch one day and the cafeteria staff said that they only had three sandwiches to feed you whole class. **What would happen?** You would eat all of the sandwiches, but you would still be hungry.

This is what has happened on this over grazed land. The animals ate all of the food that was there. In this case, the food for animals is plants and other animals. **If there is no food, what will happen to the wildlife there?** They will either become weak from lack of food or even die from starvation. The weak animals will be easy prey for predators. Once the food is gone, these animals might even go in search of more food.

**So as we look at this over grazed range land, is this good wildlife habitat?** No, it is not. **Will the water runoff or will it soak into the ground on this type of land?**

Our last type of land is filled with **native grasses.** These tall grasses have been in this area of hundreds of years have adapted to the climate conditions of Oklahoma. Examples of these types of grasses include bluestem, little bluestem, switchgrass and Indiangrass, the official state grass of Oklahoma. These grasses have a very deep root system, which helps to keep them anchored in the ground.

**Do you think that these types of grasses provide good wildlife habitat?** Yes, these grasses provide excellent wildlife habitat. A person might see a wide variety of wildlife on this type of land. All of the basic requirements for life are met.

**What will happen when it rains on these native grasses?** Will the water runoff or will it
soak into the ground?

On each of our four plots of land, we were concerned with whether water ran off or soaked into the ground.

Why are we concerned that water soak into the ground? Groundwater is important because water soaking into the ground is the only way to recharge the aquifer.

NOTE: If using watering cans to make it rain, select a student to pour the water for each type of land. If using the tubs mounted on the top of the rainfall simulator, pour the water into the tubs yourself. Most likely, students will not be able to reach the tubs.

Let’s test your hypothesis and see if you predicted what will happen when we make it rain on each type of land. Let’s start with the Impervious Land. I need some help each time by getting you guys to shout “Make It Rain!” before we pour the water. On my count of 3, you say it! 1, 2, 3! “Make It Rain!”

What is happening to the rain when it falls on the impervious land? The water runs off the top into the runoff water tub below.

Why did the water runoff? The water would not soak into the ground because it is too hard for the rain to penetrate through it.

Does this type of land help to recharge the aquifer? No, it doesn’t. While they do not allow water to soak into the ground and recharge the aquifer, they are important to our quality of life. We walk on impervious surfaces, we drive on them, we build our houses on them. It is important to make sure that as we build more impervious surfaces that we have a balance with those types of land that help put water into the ground.

As we look at the water that was collected as run off, we notice some suds on top of the water.

What might these suds represent? These suds represent oil, gas and chemicals that might have been dropped on an impervious surface. When it rains, water can pick up these substances, thus polluting the water.
Rainfall Simulation, cont.

Where did the water go when it rained on our turf grass? (If done correctly, some water should go into the run off container. The majority of the water should flow into the groundwater container.) It looks as though the majority of the water went into the ground. Is this good? Why or why not? This is good because water going into the ground to recharge the aquifer. But if we look in our Run Off Container, we did end up with some run off water. If you remember, earlier I said that these types of land usually get a lot of people walking on them. As they walk on them, they pack down the soil. In some cases, the soil might be packed down so much that it might resemble an impervious surface. This would cause the water to run off.

These grasses also have a shallow root system. How do you think the shallow roots impact where the water goes? Think of the root system like a sponge. The larger the sponge, the more water it can hold. Since we have a shallow root system, we have a small sponge. It can only hold so much water. Once the sponge (root system) is full of water, the remaining water runs off. That is why we collected some run off water.

Our third plot of land was the over grazed range land. Where did the water go? (If done correctly, water should have flowed into the groundwater container and the run off container. The water in the run off container should have particles of soil in the water).

Let's look at the run off water. We did get quite a bit of run off water. But what do you notice about this run off water? What you see in this water is soil. Because there was no grass protecting the soil, erosion took place. Erosion is the process of water washing away soil. Erosion can also occur when wind blows the soil away. When it rained, there was nothing protecting the soil. Each raindrop that fell acted like a tiny missile. As each drop hit the ground, it "exploded", causing soil to be moved. Because of the large amount of rain that was falling, a large amount of soil was moved. We did not get any erosion on the turf grass plot because the blades of grass acted as a cushion as the raindrops fell.

Is erosion a good or a bad thing? Erosion is a bad thing. It washes the good soil away and we don't have it anymore. Also, it takes Mother Nature about 500 years to make a one inch thick layer of soil. We are getting some ground water, however. There is some benefit to the aquifer, but because of the large amount of soil being lost to erosion, this type of land is not good to have.

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Rainfall Simulation, cont.

What happened to the water on our Native Grass plot? (If done correctly, the largest majority of the water should have gone to the groundwater container. Very little water, if any, should be in the run off container.) All of our water was soaked into the ground. Very little, if any, water ran off. These native grasses have a deep root system. They act like a very large sponge. A very large sponge can hold a lot of water. Because of this, more water is able to soak into the ground. This is the water that will recharge the aquifer. This is good. This is what we want, a lot of water soaking into the ground when it rains.

Let’s Clean Up and Review

- Which type of land gave us the most groundwater?
- Which type of land gave us the most runoff water?
- Why is it important that water soak into the ground?
- What is the only way that an aquifer can be recharged?
- What can you do to reduce pollution in our water?
- What is erosion? How can erosion be prevented?

Oklahoma Aqua Times Related Lessons:

- Groundwater Activity
- Wells and the Water Table
- Groundwater Leaching
- Infiltration: Groundwater Flow Model 1
- Infiltration: Groundwater Flow Model 2

Lesson adapted from:

4-H₂O For You: Outdoor Water Conservation, Texas A&M AgriLife Extension Service, Guadalupe County