Groundwater

GLOBE		Associated SDG	Type(s) of activity/ies
Sphere	**Protocols**		
Atmosphere	Precipitations	6 (Clean water and sanitation) 7 (Affordable and non-polluting energy) 12 (Responsible production and consumption) 13 (Climate action) 14 (Underwater life) 15 (Life of Terrestrial Ecosystems)	Exploratory
Biosphere	Land cover. Phenology. Tree height.		
Pedosphere	Infiltration. Humidity. Temperature		
Hydrosphere	Water temperature. pH. Alkalinity. Electrical conductivity. Transparency. S		
Bundle	Agriculture ENSO Oceans Rivers and lakes Water cycle. Water quality Soils Meteorology		

Overview

To explore the water cycle in tropical, temperate, and cold zones, and the fundamental role of groundwater in the hydrological cycle, students conduct a simulation experiment with simple materials that allows them to observe the behavior of water well.

Time

1 or 2 classes

Prerequisites

Basic knowledge of ecosystems, ecology, conservation, and meteorology.

School Level

Elementary and high school students.

Purpose.

- *Clarify certain scientific concepts, such as the hydrological cycle and groundwater, more concisely and understandably for the target audience. This will help students better understand the significance of the experiment and its connection to real-world issues.*
- *Include specific instructions and details for the experiment, such as the exact measurements for the gravel and sand layers and the amount of contaminants to add, to ensure consistent and accurate results across all groups.*
- *Provide more context and background information on the negative impacts of human activities on the natural water cycle and potential solutions or actions that can mitigate these impacts. This will help students understand the importance of preserving and protecting our freshwater resources.*

- Understand the natural water cycle and the alterations produced by human activities.

- Analyze their connection to the water cycle and the need to mitigate the negative impacts produced by human activities.

Student Outcomes:

- Design a simple simulation model of a freshwater well.

- To bring the student closer to the understanding of the water cycle.

- Analyze the impact of human activities on the natural water cycle.

Introduction

Groundwater is a natural freshwater resource located at the surface level in the earth's crust. They are usually found in impermeable geological formations called aquifers. Groundwater plays a fundamental role in human activity and the maintenance of ecosystems.

The Food and Agriculture Organization of the United Nations (FAO) defines this type of water as water located below the earth's surface and occupying the pores and fissures of rocks.

Groundwater is housed in sites where the water is kept at a constant temperature similar to the area where it is found. These places are called aquifers and are geological formations made up of different porous and impermeable layers that allow freshwater storage underground.

In particular cold regions, this type of water is expected in a frozen state. On the other hand, in arid or semi-arid regions, groundwater is the only source of fresh water in the area.

Another critical point about groundwater is its fundamental role in the hydrological cycle. On the one hand, rainwater seeps into rivers and lakes and can reach the

surface as springs. On the other hand, another part of this resource seeps into the earth's surface and reaches aquifers, where it can remain for years. In addition, part of this groundwater flows through the soil and reaches the oceans, thus maintaining a balance in the water cycle.

Guiding Research Questions

Where does the water that falls from the sky in the form of rain or snow come from?

How do human activities affect the water cycle?

Scientific Concepts

- Water cycle
- Human uses of water
- Water availability
- Water quality
- Ecology

Material and Tools

- One clean spray bottle (like any cleaning product spray bottle)
- 1-liter plastic bottle
- One cylindrical stick or a fat marker pen
- One piece of plastic netting
- Scissors
- Gravel
- Soil
- Tape
- Contaminants: lemon juice, soap, dye, salt.

What to Do and How to Do It

Beginning

- Generally, water for human consumption is captured in reservoirs or wells, depending on whether it is surface water or groundwater.

- With this experiment, students will understand how a well works and how groundwater contamination occurs.

- First, the groups must build their well, test if and how it is contaminated, and determine their location.

- To begin, divide the students into five groups.

Development

Perform the following experiment to simulate a freshwater well.

Preparation:

1. **Construction of the well**

Carefully cut the plastic bottle in half. We will use the bottom part.

Wrap the plastic mesh around the stick, holding it tightly with adhesive tape (without sticking to the post).

Place the stick with the mesh inside the bottle, close to the wall, not in the center.

Add gravel (ensuring the stick is kept straight) up to over half of the bottle (about 3/4).

On top of the gravel, add a layer of sand (about one finger thick).

Now comes the tricky part! Carefully remove the stick, leaving the rolled-up mesh inside the container.

Add 200 ml of water from the side very slowly until the gravel is covered, but not the sand.

The sprayer is placed inside the hole of the rolled mesh.

The sprayer is operated several times to check that it works.

Keep squeezing the sprayer so the water inside is extracted and collected in a glass. What color is it?

1. **Contaminate the well**

You will need to contaminate the well constructed by the students. To do this, carefully add the following to each well:

Group 1: a glass of water and lemon juice (will simulate acid rain).

Group 2: a glass of clean water (will affect that the groundwater has not been contaminated).

Group 3: a glass with water and dissolved salt (simulates seawater, contamination by sea intrusion).

Group 4: add the dye on the sand layer (mimics soil contamination with fertilizers and pesticides). Very slowly, pour a glass of clean water to wash away the stain.

Group 5: a glass of soapy water (simulates water contaminated by household detergents).

For the third time, you can add water to the wells - this time only clean water - so that the students can check that, despite this, the water still comes out slightly contaminated; this way, they will realize that once an aquifer is contaminated, it is very complicated to decontaminate and restore it.

Observation:

Students should extract the groundwater with the sprayer. What is the water like now? (In the case of salt water and lemon water, students should lightly wet their fingers and taste the flavor).

Students should determine whether or not their well is contaminated and, depending on the type of contaminant, indicate its location.

Closing

Questions for reflection:

Which type of water is easier to contaminate: surface water from lakes, rivers, seas, or groundwater?

What types of elements can contaminate groundwater?

Which type of water is easier to clean: surface water or groundwater?

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