Overview

Students take a journey as water molecules moving throughout the tree water cycle.

Objectives

By the end of this activity, students will be able to:

- Describe the main parts of the water cycle in and around a tree.
- Become familiar with proportions of water in each part of the cycle, depending on seasons and location.

Subjects

Science

Grade level

K-6

Length of activity

20-30 min

Activity location

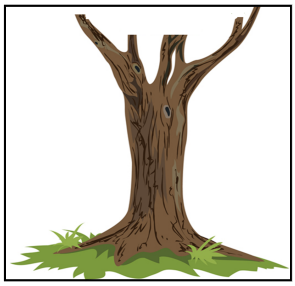
Outside or inside

Materials

Large and small water cycle station cards (attached), brown lunch bags, small slips of paper, pencils.

A Tree's Water Cycle

Introduction



The main parts of the water cycle include: **evaporation, condensation, and precipitation**. Trees are part of this water cycle, exchanging water with the soil and atmosphere, in a process called **transpiration**. The movement of water from the liquid phase at the earth's surface to the gas phase in the atmosphere is accomplished through evaporation and transpiration. Water is transpired from plants through the trunk, into the leaves and out through the **stomata**. Together, the processes of evaporation and transpiration together are called **evapotranspiration.**

The tree water cycle changes throughout the year, especially in the mid elevation range of the Southern Sierra Nevada mountains (5000-6000 ft elevation). Scientists with the Southern Sierra Critical Zone Observatory (SSCZO) (czo.ucmerced.edu/research) have studied evapotranspiration and determined that trees grow year round in this area, and are not limited by temperature or lack of water depending on seasons. The area encompassing the CZO is called the **rain-snow transition zone**, where winter storms can dump either snow or rain (or both) due to winter temperatures remaining close to freezing (0° C). Trees at higher elevations do not grow very much in the winter due to cold temperatures. Conversely, trees at lower elevations are limited in growth by lack of water and high temperatures in the summer.

Materials

- Print out attached large and small tree water cycle cards. Glue sets of cards on corresponding colors of cardstock. Laminate all cards.
- Label brown paper bags, 1 each of the 6 water cycle stations (roots, atmosphere, soil, trunk and limbs, leaf, and groundwater.

- Cut out small scraps of paper for students to record their journey.

Activity Description

- Set up water cycle station cards in a circle, placing the corresponding brown bag at each location.
- Break up class into equal groups and have them line up behind each card, facing the center of the circle.
- Review the main parts of the water cycle.
- Tell students they are pretending to be water molecules, going throughout the water cycle in and around a single tree.
- Explain that each station is a part of the tree's water cycle, and read off each of the 6 stations.
- Inside the bag are small cards with possible places their water molecule can go. For instance, if they are standing at the soil station, they might pick a roots, atmosphere or groundwater card out of the bag.
- Demonstrate by taking out a card from the bag, put it back in the bag, and go to the end of the line of the card you picked out. Record where you go on the slip of paper.
- When you are ready, tell them to start. After a few minutes, you will see the length of the lines change. What usually happens, is the soil, trunk and limbs, and roots lines will become long and the others will be short.
- When this occurs, have the students stop. Explain or ask them what has happened to the length of the lines. Ask them why this has happened. Explain that there are not an equal # of cards in each bag. The proportion of water in each part of the tree water cycle is not balanced. Most of the water is contained in the soil, trunk, limbs and roots.
- Go back to picking cards for a few more minutes.
- Wrap up as a group by discussing their journeys using the provided answer key.
- Conclusions— This activity has been created specific to the Southern Sierra Nevada mountains. These processes are typical of the summer season and are highly variable. The cycle is not a one way street, water can flow up or down a tree, although the majority of water flows upwards from the roots to the leaves.

Extensions

- Ask students to discuss what they think could change parts of the cycle (season, temperature, climate change, drought, etc.)
- Have students research what types of trees live in the Southern Sierra Nevada mountains. Do these trees live at different elevations? How are these trees different from what you see growing where you live?

Answer Key

The answer key below is a simplified representation of the tree water cycle. Tailor your answers to your area, what season you are in, and what age group you are working with.

Leaf – (atmosphere, trunk)

Trunk - When water falls on a leaf, it can be absorbed into the leaf tissues through the **stomata**. Water absorbed by the leaf can then travel through the limbs into the trunk. There is a very small amount of water that travels this way. Water already available in the leaf transports sugars created during **respiration** through the limbs into the trunk, and down to the roots via **phloem**.

Atmosphere - During photosynthesis, water gets released into the atmosphere from the leaves. This part of the hydrologic cycle is called **transpiration**, and can account for 10% of the water cycle. Therefore, it is an important part of measuring a water balance.

Water drops via precipitation can also hit a leaf during a rainstorm, and re-evaporate into the atmosphere. This is called **canopy interception**.

Atmosphere – (leaf, soil)

Leaf - Water can come from the atmosphere in the form of precipitation, hit a leaf, and re-evaporate by the process of interception. A small amount of this water can be absorbed back into the leaf tissue through the stomata.

Soil - Water can hit the ground during a rain storm and be absorbed into the soil.

Soil – (roots, atmosphere, groundwater)

Roots - Water in the soil can be absorbed by tree roots.

Atmosphere - Water in the soil can be transported back into the atmosphere through evaporation.

Groundwater – Water in the soil can infiltrate into the groundwater.

Groundwater – (soil, roots)

Soil – Groundwater can move upwards into the soil by capillary forces.

Roots – Some tree species with vast root systems can reach deep into the ground below the soil layer into the groundwater.

Roots – (soil, groundwater, trunk/limbs)

Soil – Water can be expelled from roots back into the soil by a process called root exudation.

Trunk/limbs – The majority of water absorbed by tree roots will move up the tree trunk and limbs through the Xylem.

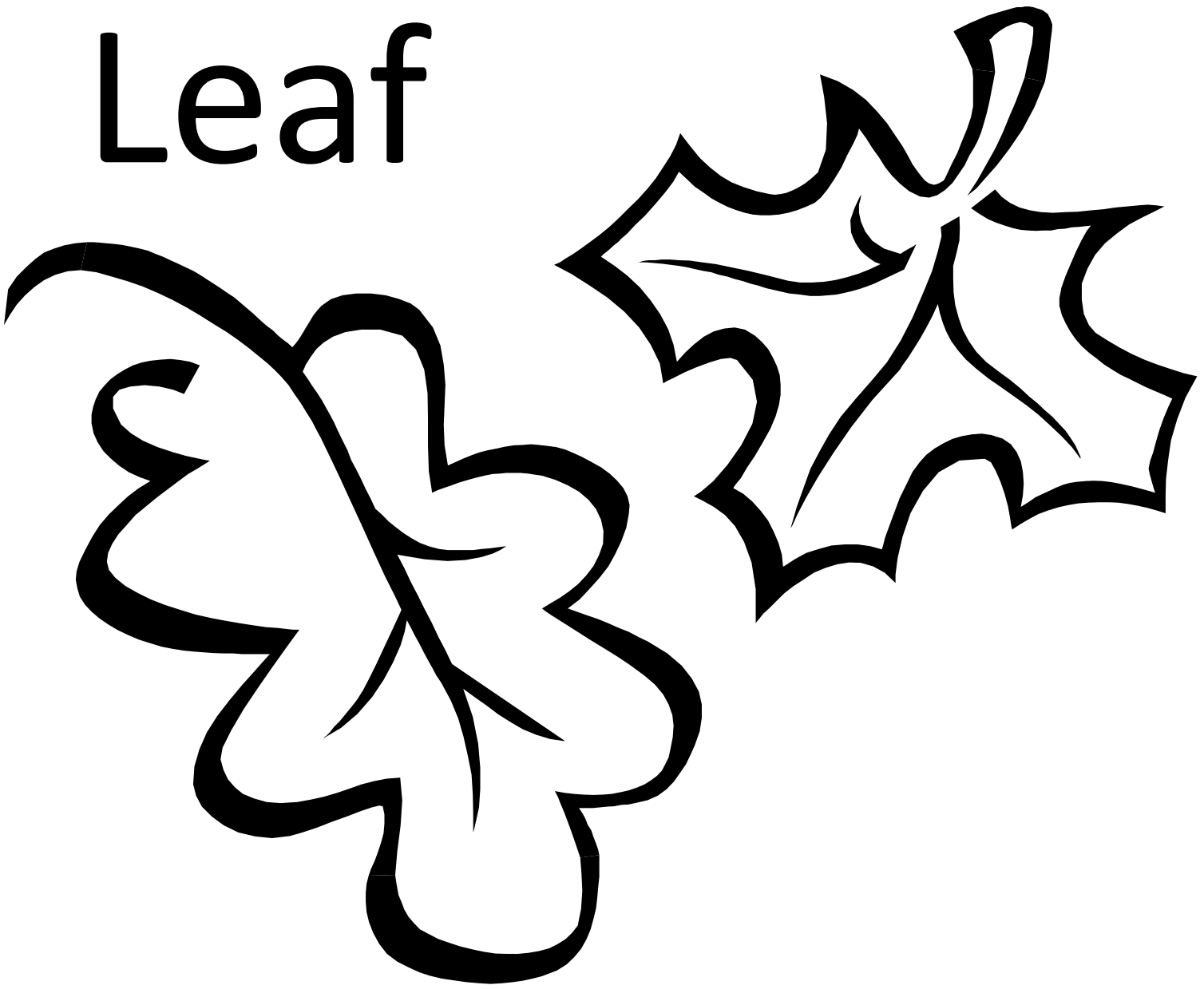
Groundwater – A very small amount of water released from tree roots could bypass the soil and go directly into the groundwater.

Trunk/limbs – (leaf, roots)

Leaf – Water from the trunk travels up into the limbs and eventually to the leaves through the Xylem tissues.

Roots – Water flowing downwards from the trunk and limbs towards the roots moves through the Phloem, carrying nutrients and sugars with it.

Leaf

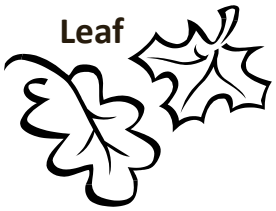


Corresponding Leaf Cards

Back all cards with green cardstock

10 total cards

Card proportions: 8 atmosphere, 1 leaf, 1 trunk and limbs




Atmosphere


Atmosphere


Atmosphere


Atmosphere


Atmosphere


Atmosphere


Atmosphere


Atmosphere

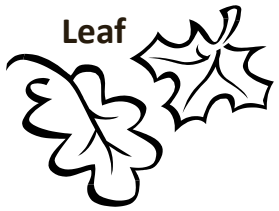
Trunk and limbs

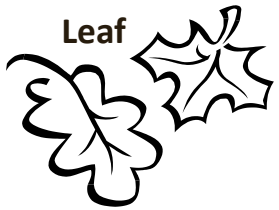
Corresponding trunk and limbs Cards

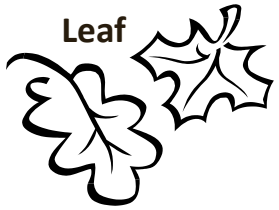
Back all cards with orange cardstock

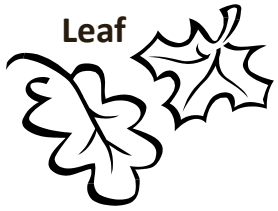
10 total cards

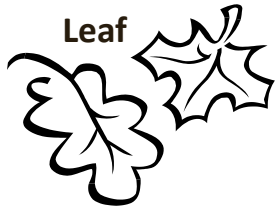
Card proportions: 6 leaf, 3 roots, 1 trunk and limbs

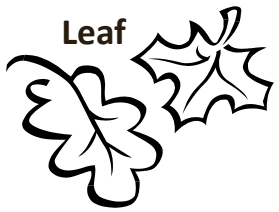


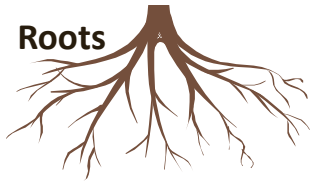


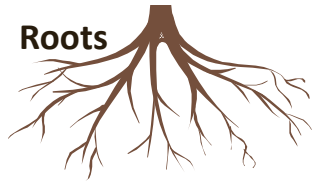


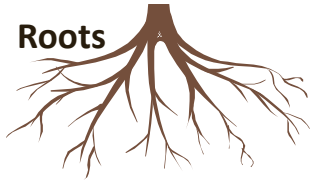




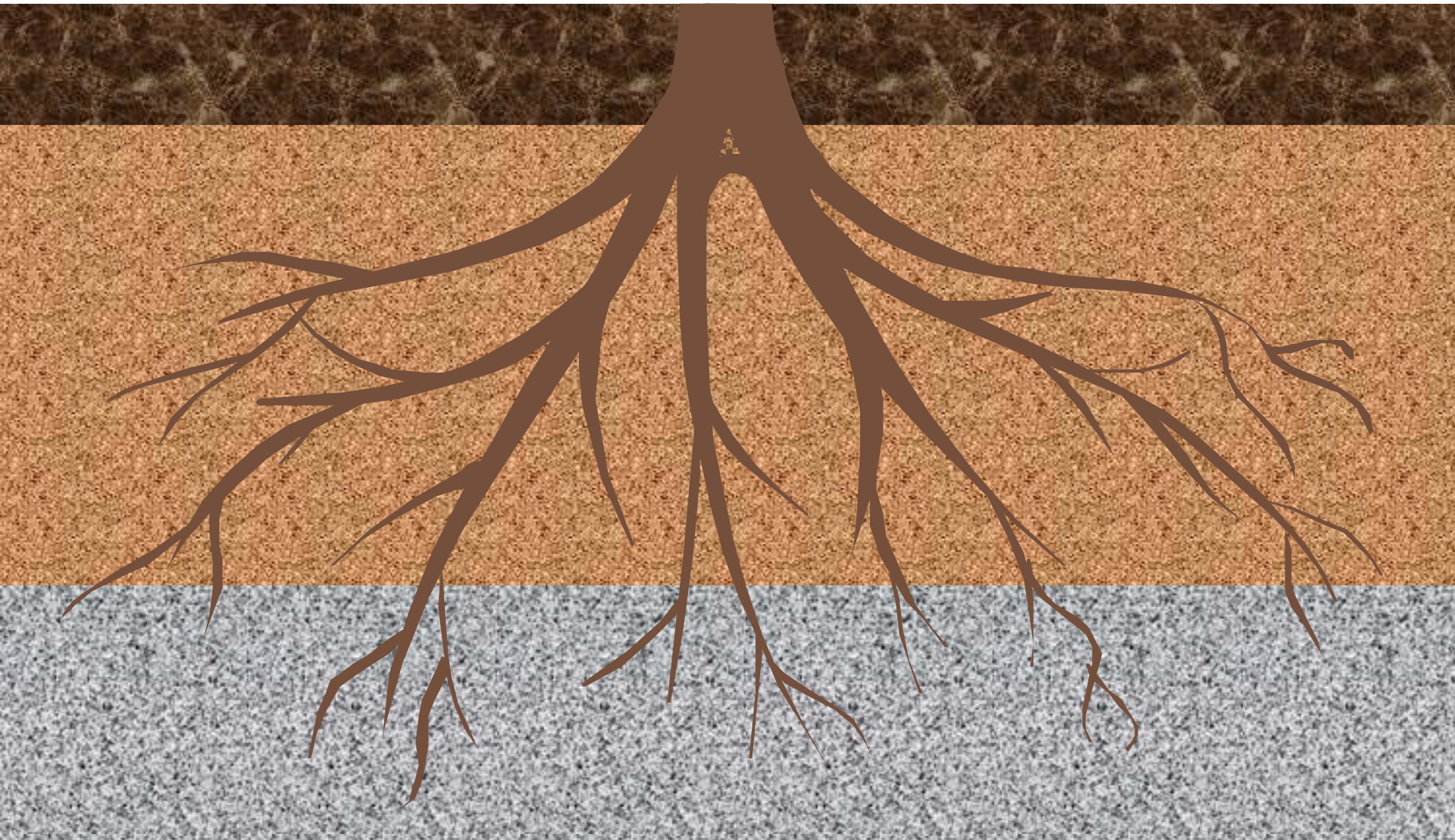








Roots

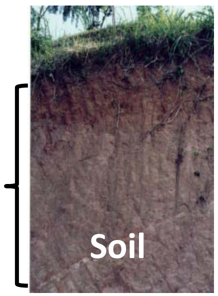


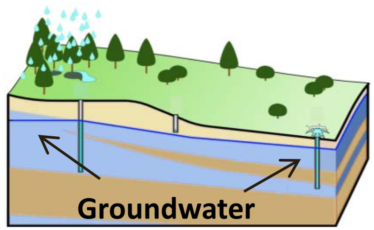
Corresponding roots Cards

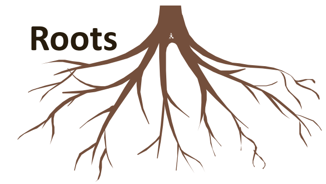
Back all cards with purple cardstock

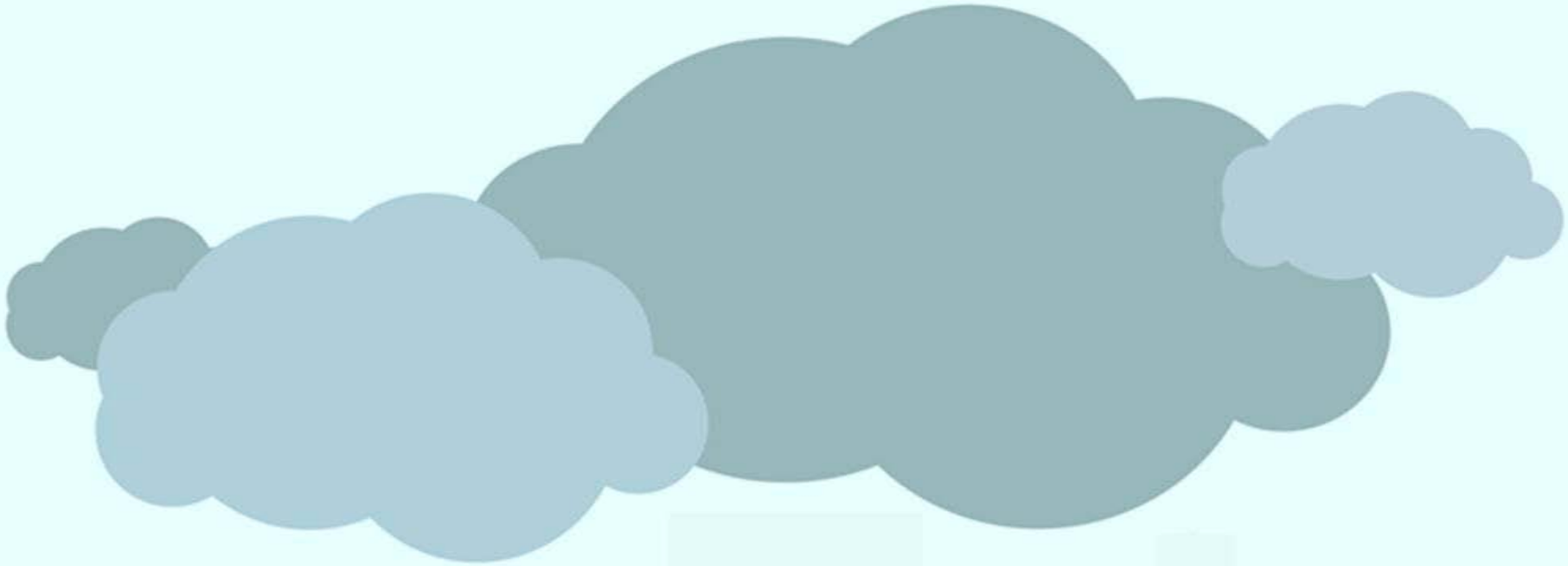
10 total cards

Card proportions: 7 trunk and limbs, 1 soil, 1 groundwater, 1 roots









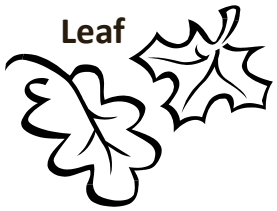
Atmosphere

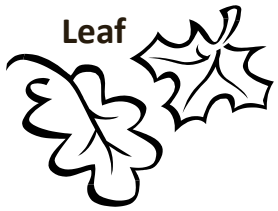
Corresponding atmosphere Cards

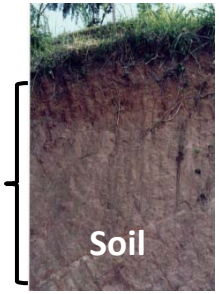
Back all cards with blue cardstock

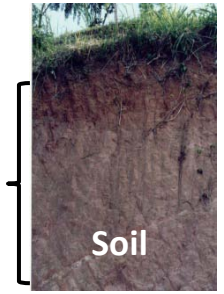
10 total cards

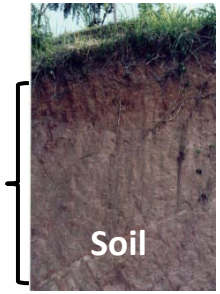
Card proportions: 7 soil, 1 trunk and limbs, 2 leaf

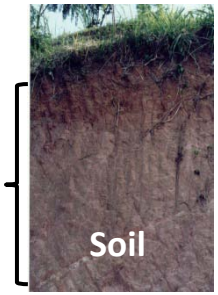


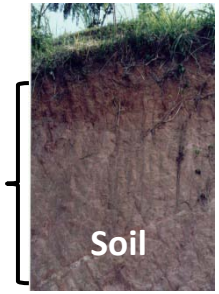


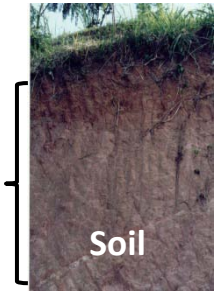


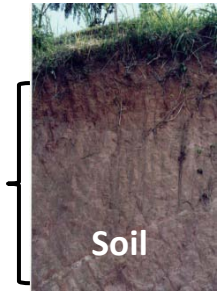












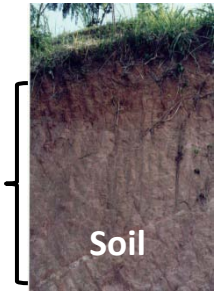
Soil

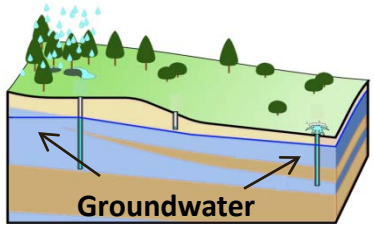
Corresponding soil Cards

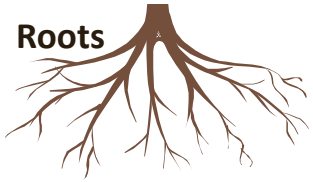
Back all cards with red cardstock

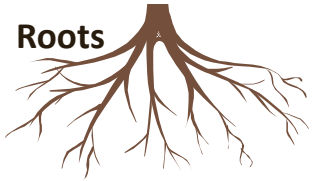
10 total cards

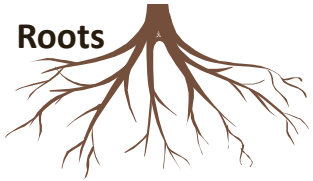
Card proportions: 2 atmosphere, 1 soil, 1 groundwater, 6 roots

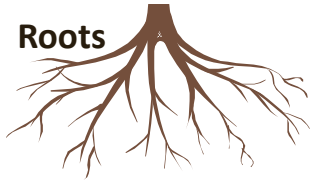


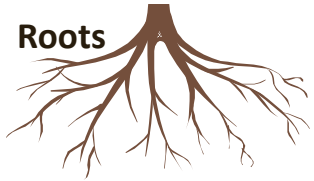


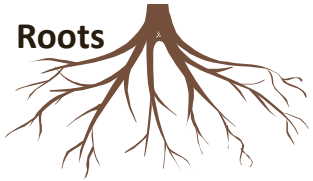


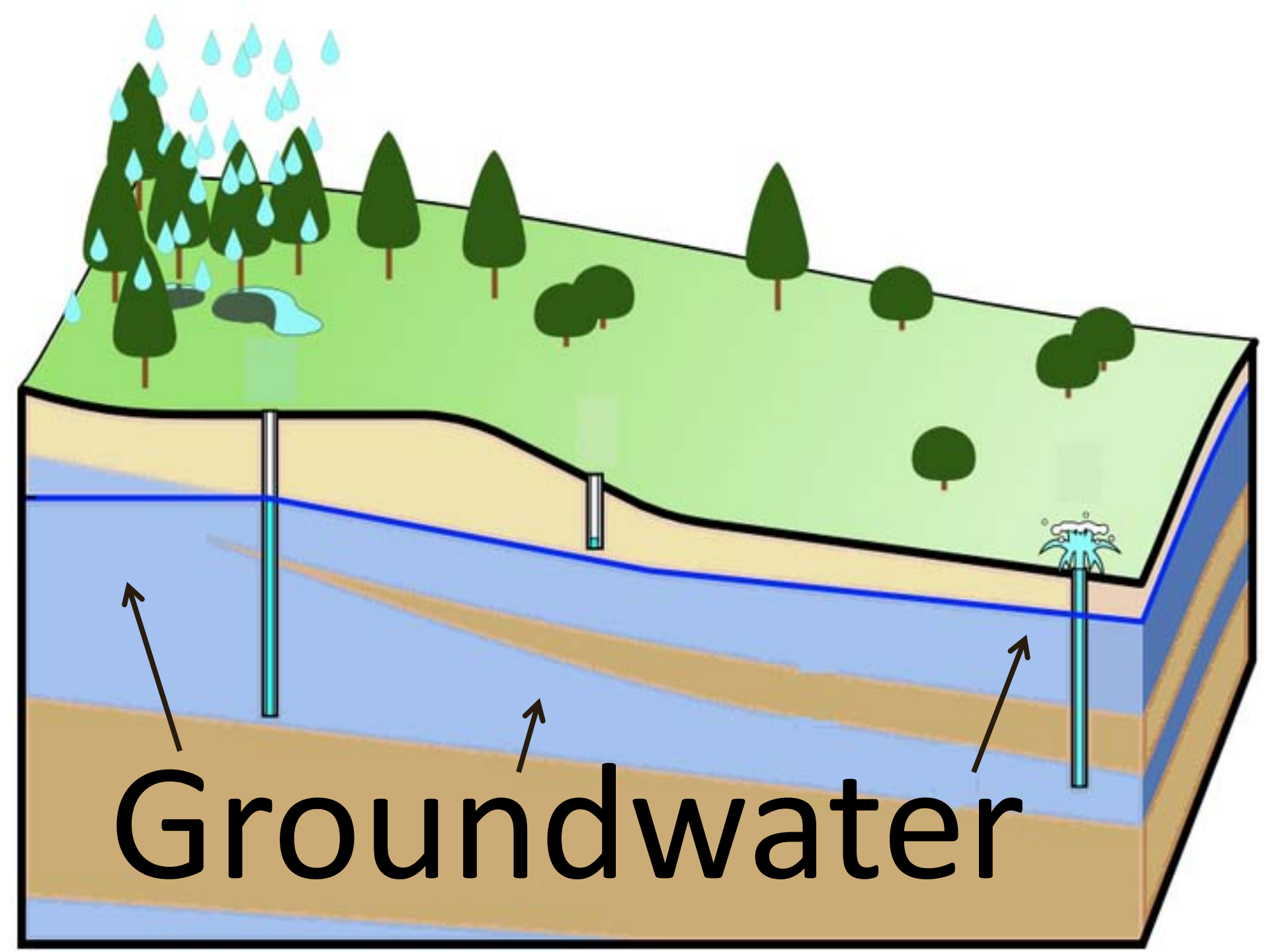











Groundwater

Corresponding groundwater Cards

Back all cards with red cardstock

10 total cards

Card proportions: 5 soil, 2 groundwater, 3 roots