

Incredible Journey

This Activity is modified from a Project WET curriculum guide. www.projectwet.org

Investigative Question: How are trees a part of the water cycle?

Goal: Students simulate the movement of water within the water cycle, focusing on our region and tree ecology.

Objectives

Knowledge: Students describe the movement of water in the water cycle. Students determine what fraction of time was spent at each station/state of water. Students identify the ecological interactions between trees and water. Students simulate and describe a complex water cycle in which living things play an important role, including an explanation of the specific role of water in helping trees survive.

Skills: Students record their movements in the game in a data table, working cooperatively to collect data (comparing results for accuracy as it is collected), and then representing the data as fractions. Students add fractions with like denominators. Students recognize and describe fractions as parts of a whole (in the form of the number of turns at a station out of all turns).

Value: Students appreciate that clean, healthy water is necessary for all living things. They learn how water moves through their region, and understand that it may get “stuck” in certain forms or that it may move on to influence a new place.

Virginia SOL: Math (2016): 3.2, 3.5. Science (2018) 3.7

Materials:

- Large dry erase board and markers
- Pipe cleaners
- 8 station signs with supports
- 8 different colors of pony bead
- 8 cardboard cube “dice” with labels to direct students
- (optional) Map of the area with water sources labeled
- Student data sheets

Set Up

- Create station signs and “dice”. Use your imagination. Station signs can be as simple as the letter and title, or much more elaborate. Small square boxes, wooden cubes, or even a spinner can be used as “dice”
- Set up the station signs in a rough circle. See Appendix A for labels and descriptions
 - o At each station, put a container of beads (You may want to place certain colors at certain stations i.e. green goes with trees).
 - o At each station place the station “dice”
- Draw the first few columns of the datasheet on the dry erase board. (figure on right)

	1	2	3
Solid			
Liquid			
Gas			



Instructional Strategy:

1. Divide students into teams of 2-3. Give each student or team a data sheet, clipboard, and pencil and ask students to write team member names on the sheet.
2. Introduce the game: Students *teams* will be playing the part of a drop of water as it moves through a water cycle. Ask students to describe the water cycle and illustrate their description on the board. At each stage, ask students to provide the water's state of matter. (For example: When water evaporates, it is a gas. When it condenses, it is a liquid.)
3. Each student group travels together through the game; team members need to take turns rolling the dice, but they all record the same information as their teammates.
 - This game has 12 turns. How many numbered columns are in the data table? (point to the example) Each column has a space for students to record data for one turn.
 - Student groups will be sent to a station. At that station will be a die and a container of beads. One team member should roll the die. *As soon as* the die is rolled, all teammates need to pick up a bead and place it on their pipe cleaner. The pipe cleaner and beads is one way to record their journey.
 - They then read the roll of the die. The first word will tell them their state of matter. Model recording the station and state in the data sheet on the dry erase board: Write the station letter in the row representing the state of matter and then placing an X in the other two boxes for that turn. (B liquid is shown) The datasheet is a second way to record the journey and should reflect the same stations as the pipe cleaner.
 - The team reads the rest of the roll, discovering where they go next on their water cycle journey.
 - Review the stations/stops of the cycle so that students know where each is located.
 - Point out that it is possible that they may “stay” at a station for several turns. Ask them to describe what they should do (take another turn at that station). It is also possible that they may move back and forth between stations, and may not visit every station. That is OK – we want to see where the water goes!
 - Have the students reiterate the steps of a turn (roll, add bead, record station and state, read and move), modeling it as per their instructions.
4. Distribute one pipe cleaner to each student. Have the students knot one end to secure beads.
5. Remind the students that they are moving as a team. When their team has taken all 12 turns, they are finished with the game. After tying the ends of their pipe cleaners off to make a loop, they can then draw or describe the journey their drop took in the space provided on the datasheet (encourage them to think of it as the diary of a water droplet).
6. Spread your student teams out to the eight game stations (Clouds, Animals, Chesapeake Bay, Shenandoah River, Lake Frederick, Blue Ridge Mountains, Groundwater, and Trees).
7. When all students have completed 12 turns, discuss their journeys, connecting the reality of the gameplay to the living things missing from the original water cycle.
 - Ask students to share their cycle with the rest of the group. Did every team have the same cycle? Did they all go to each station? Did any of the groups get “stuck” either in a particular location or in a back and forth between two stations? Bring out the original water cycle illustration: what did this game show you about the water cycle? What was missing from our original cycle? Why do living things, like trees need water? (transport food energy and waste around the body, to give plants shape and rigidity – without water they can wilt)
 - Tell students that we'll now be looking at exactly how many turns out of the entire game they spent at each station. (Note: these instructions are an *introduction* to fractions – amend the activity based on student knowledge.) Model by having all groups count how many turns they spent in station A (all students in a team should have the same response). Select one group and write their response on the dry erase board. Explain: when talking about parts of a whole, in this case – how many turns out of a whole game – we can use fractions. In a fraction, the number of parts goes on the top (the numerator), a line is drawn under it that means “out of” (draw the line), and you write how

	1	2	3
Solid	X		
Liquid	B		
Gas	X		



many parts it takes to make a whole on the bottom. In this case, how many turns did it take to play a whole game (write the 12 under the line)? Have all groups record the fraction of time spent at each station on the data sheet.

- Depending on time and prior knowledge, model adding the fractions by counting the number of turns spent in trees AND in animals to get the fraction spent in living things. Have student complete the remainder of the data sheet.
8. Wrap up: Ask groups to share the fraction of the game they spent “in” living things. This is not often represented as part of the water cycle, but is it important to think about? Have students offer explanations as to why or why not.

Possible Extensions:

- The datasheets can be used to create a wide variety of representations – from graphs to models.
- Twelfths were chosen because 12 has so many factors and therefore the student responses could easily be simplified into proper halves, thirds, quarters, and sixths for more advanced fraction practice.
- All of the group journeys could be considered together for a more robust amount of data. How does doing so change how much time water spent in each location?
- Use the journey logs as the basis for a writing exercise. This could either be nonfiction or a fictional “journal”, either of which could involve research into local waterways.

Incredible Journey Student Data Sheet Group members _____

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At each turn, record the letter of station next to solid, liquid or gas. Put an X in the empty boxes for that turn. Draw or describe your journey here:

	1	2	3	4	5	6	7	8	9	10	11	12
Solid												
Liquid												
Gas												

What fraction of the 12 turns did you spend at each station? (Use your data or beads to help you figure it out.)

Clouds A	Trees B	Chesapeake Bay C	Shenandoah River D	Groundwater E	Animals F	Lake Frederick G	Blue Ridge Mountains H
$\frac{?}{12}$							

What fraction of turns did you spend in living things?	What fraction of turns did you spend in surface water?	What fraction of turns did you spend in each state?		
(trees + animals)	(Bay + River + Lake)	Solid	Liquid	Gas

Dice and Station Labels

Station A: Clouds (Mountains, Bay, groundwater, lake, S. River, stay) (get here from 8



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places: 2 tree, 1 bay, 1 river, 2, animals, 1 lake, 1 mtns)

9. (Solid) You fall as snow onto the Blue Ridge Mountains. Settle softly on the BLUE RIDGE MOUNTAINS.
10. (Solid) You fall as sleet into the Chesapeake Bay. Go to the CHESAPEAKE BAY.
11. (Liquid) You fall as rain and are soaked deep into the ground. Go to GROUNDWATER.
12. (Liquid) You fall as rain into Lake Frederick. Go to LAKE FREDERICK.
13. (Solid) You fall as hail on a bare ground, roll downhill and become part of Opequon Creek where you melt. Keep going and flow to the SHENANDOAH RIVER.
14. (Gas) You stay in the clouds, a bit of water vapor clinging to a dust particle. STAY.

Station B: Trees (2 clouds, 1 animal, 3 stay) (get here from 7 places: 1 bay, 1 river, 1 groundwater, 1 lake, 3 mountains)

- (Liquid) You rise and fall in the sap of a sugar maple tree. STAY.
- (Liquid) A White Pine sapling uses you over and over to move nutrients from its roots through its trunk. STAY.
- (Liquid) When the Morel mushroom you are in decomposes, a Tulip tree's roots take you in. STAY.
- (Liquid) A hungry hickory horned devil caterpillar eats the Black Walnut tree leaf you are in. Go to ANIMALS.
- (Gas) You move through a big sweetgum tree, travelling up to its big broad leaves and are transpired into the air. Go to CLOUDS
- (Gas) Even with the waxy coating on its needles to keep you in, you still evaporate out of a broken branch on a pitch pine. Go to CLOUDS

Station C: Chesapeake Bay (1 clouds, 1 tree, 1 animal, 2 stay, 1 groundwater) (get here from 3 places: 1 clouds, 2 river)

- (Solid) During a very cold winter you freeze to the side of a boat. STAY
- (Liquid) You are one of the countless water molecules in the Bay and you stay there. STAY
- (Liquid) You get stuck in the gills of a very small ghost crab until a killdeer flies by and gobbles it up. Go to ANIMALS.
- (Gas) You evaporate into the air. Go to CLOUDS.
- (Liquid) You are taken up by a Bald Cypress tree. Go to TREES
- (Liquid) You sink deep into the ground. Go to GROUNDWATER.

Station D: Shenandoah River (lake, 2 Bay, tree, clouds, animal) (get here from 4 places: 1 clouds, 2 groundwater, 1 mountains)

- (Gas) You evaporate up past the Box Elder trees and into the clouds. Go to CLOUDS.
- (Liquid) A sycamore tree sucks you up through its roots. Go to TREES
- (Liquid) You flow downstream and into Lake Frederick. Go to Go to LAKE FREDERICK.
- (Liquid) A thirsty opossum drinks you up! Go to ANIMALS.
- (Liquid) You flow downstream past the roots of Eastern Cottonwood Trees, through Harpers Ferry and Washington DC. Go to CHESAPEAKE BAY.
- (Solid) A spring storm breaks the ice on the side of the river and you get washed all the way to the Chesapeake Bay! Go to CHESAPEAKE BAY.

Station E: Groundwater (2 river, lake, 2 stay, 1 tree) (get here from 5 places: 1 clouds, 1 bay, 2 lake, 1 mountains)

- (Liquid) Lots of rain pushes you up out of the ground and into a lake. Go to



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LAKE FREDERICK.

- (Liquid) You become part of an underground stream in a secret limestone cave. STAY.
- (Liquid) You become slowed down in an underground body of water called an aquifer. STAY.
- (Liquid) You flow out from underground into the Shenandoah River. Go to SHENANDOAH RIVER.
- (Liquid) You bubble out of the ground at Rattlesnake Springs and flow through Spout Run into the Shenandoah River. Go to SHENANDOAH RIVER.
- (Gas) The deepest root of a Shagbark Hickory tree takes you up, up, up to its leaves and you are then evaporated into the air. Go to TREES

Station F: Animals (2 Mountains, 2 clouds, 2 stay) (get here from 4 places: 1 trees, 1 bay, 1 river, 1 lake)

- (Gas) The opossum high up in a red oak tree exhales you from its lungs into the air as vapor. Go to CLOUDS.
- (Liquid) Back in the mountains, the bobcat urinates to mark its territory and you end up on the ground. Go to BLUE RIDGE MOUNTAINS.
- (Liquid) After digesting its food, the hickory horned devil caterpillar leaves you as scat on the ground. Go to BLUE RIDGE MOUNTAINS.
- (Liquid) You become attached to a red blood cell in the hickory horned devil caterpillar. STAY.
- (Liquid) You become attached to a red blood cell in the bobcat. STAY.
- (Gas) When the killdeer's eggs hatch at Blandy Farm you evaporate off the damp shell. Go to CLOUDS.

Station G: Lake Frederick (2 ground water, animal, tree, clouds, stay) (get here from 3 places: 1 clouds, 1 river, 1 groundwater)

- (Liquid) A thirsty bobcat sneaks out at night to drink you up from the lake. Go to ANIMALS.
- (Liquid) You are trapped in the mud at the bottom of the lake and slowly sink down...down...down... Go to GROUNDWATER.
- (Liquid) You are trapped in the mud at the bottom of the lake and slowly sink down...down...down...Go to GROUNDWATER.
- (Liquid) You are absorbed by a red maple and help it make food. Go to TREES.
- (Gas) It's a hot summer day and the water evaporates into the air. Go to CLOUDS.
- (Solid) You get caught in the muck around a willow tree's roots and freeze there for the winter. STAY.

Station H: Blue Ridge Mountains (3 trees, river, ground water, clouds) (get here from 3 places: 1 clouds, 2 animals)

- (Liquid) A young sassafras tree absorbs you through its roots and uses you to make its leaves flat and stiff so that they can soak up lots of the Sun's energy. Go to TREES
- (Liquid) You flow downhill and become part of a stream that flows into the Shenandoah river. Go to SHENANDOAH RIVER.
- (Liquid) You soak down into the soil and filter into to the groundwater. Go to GROUNDWATER.
- (Gas) A Pawpaw tree's roots absorb you. You travel up to its great big leaves and are transpired into the air. Go to CLOUDS.
- (Liquid) An American chestnut tree's roots take you in. You travel up the trunk and are stored in its seed. Go to TREES
- (Liquid) You are absorbed by a White Oak tree's roots. Go to TREES



Station A: Clouds (Mountains, Bay, groundwater, lake, S. River, stay) (get here from 8 places: 2 tree, 1 bay, 1 river, 2, animals, 1 lake, 1 mtns)

(Solid) You fall as sleet into the Chesapeake Bay. Go to the CHESAPEAKE BAY.

(Liquid) You fall as rain into Lake Frederick. Go to LAKE FREDERICK.

(Gas) You stay in the clouds, a bit of water vapor clinging to a dust particle. STAY.

(Liquid) You rise and fall in the sap of a sugar maple tree. STAY.

(Solid) You fall as snow onto the Blue Ridge Mountains. Settle softly on the BLUE RIDGE MOUNTAINS.

(Liquid) You fall as rain and are soaked deep into the ground. Go to GROUNDWATER.

(Solid) You fall as hail on a bare ground, roll downhill and become part of Opequon Creek where you melt. Keep going and flow to the SHENANDOAH RIVER.

Station B: Trees (2 clouds, 1 animal, 3 stay) (get here from 7 places: 1 bay, 1 river, 1 groundwater, 1 lake, 3 mountains)

(Liquid) A White Pine sapling uses you over and over to move nutrients from its roots through its trunk. STAY.

(Liquid) When the Morel mushroom you are in decomposes, a Tulip tree's roots take you in. STAY.

(Liquid) A hungry hickory horned devil caterpillar eats the Black Walnut tree leaf you are in. Go to ANIMALS.

(Gas) You move through a big sweetgum tree, travelling up to its big broad leaves and are transpired into the air. Go to CLOUDS

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Station C- Chesapeake Bay (1 clouds, 1 tree, 1 animal, 2 stay, 1 groundwater) (get here from 3 places: 1 clouds, 2 river)

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(Liquid) You get stuck in the gills of a very small ghost crab until a killdeer flies by and gobbles it up. Go to ANIMALS.

(Gas) You evaporate into the air. Go to CLOUDS.

(Liquid) You are taken up by a Bald Cypress tree. Go to TREES

(Liquid) You sink deep into the ground. Go to GROUNDWATER.

(Gas) You evaporate up past the Box Elder trees and into the clouds. Go to CLOUDS.

(Liquid) You flow downstream and into Lake Frederick. Go to Go to LAKE FREDERICK.

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Station E – Groundwater (2 river, lake, 2 stay, 1 tree) (get here from 5 places: 1 clouds, 1 bay, 2 lake, 1 mountains)

Station D – Shenandoah River (lake, 2 Bay, tree, clouds, animal) (get here from 4 places: 1 clouds, 2 groundwater, 1 mountains)

(Liquid) A sycamore tree sucks you up through its roots. Go to TREES.

(Liquid) A thirsty opossum drinks you up! Go to ANIMALS.

(Solid) A spring storm breaks the ice on the side of the river and you get washed all the way to the Chesapeake Bay! Go to CHESAPEAKE BAY.

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(get here from 4 places: 1 trees, 1 bay, 1 river, 1 lake)

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(Liquid) Back in the mountains, the bobcat urinates to mark its territory and you end up on the ground. Go to BLUE RIDGE MOUNTAINS.

(Liquid) After digesting its food, the hickory horned devil caterpillar leaves you as scat on the ground. Go to BLUE RIDGE MOUNTAINS.

(Liquid) You become attached to a red blood cell in the hickory horned devil caterpillar. STAY.

(Liquid) You become attached to a red blood cell in the bobcat. STAY.

Station G – Lake Frederick (2 ground water, animal, tree, clouds, stay) (get here from 3 places: 1 clouds, 1 river, 1 groundwater)

(Liquid) You are trapped in the mud at the bottom of the lake and slowly sink down...down...down... Go to GROUNDWATER.

(Liquid) You are absorbed by a red maple and help it make food. Go to TREES.

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(Liquid) A young sassafras tree absorbs you through its roots and uses you to make its leaves flat and stiff so that they can soak up lots of the Sun's energy. Go to TREES.

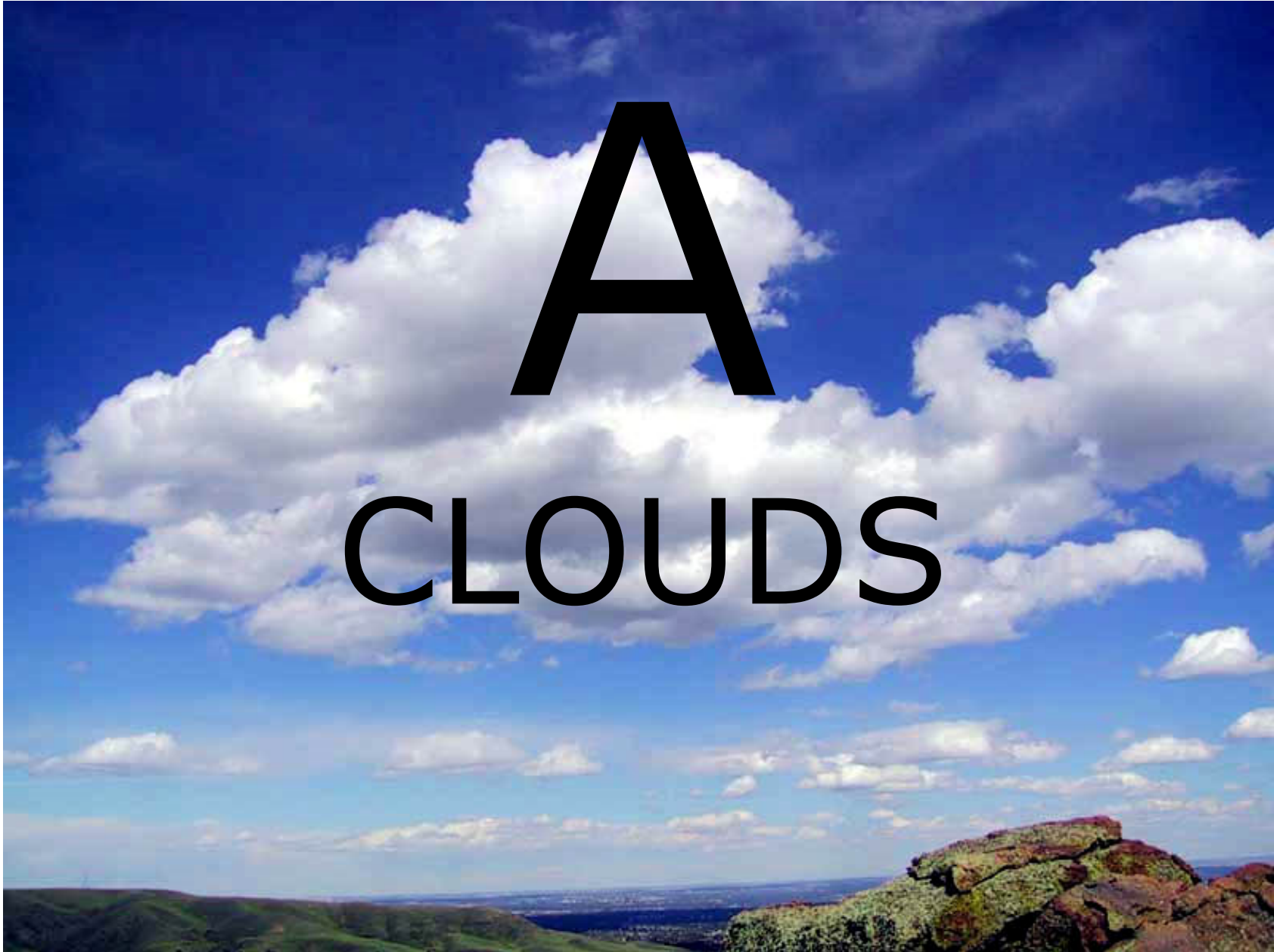
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(Liquid) An American chestnut tree's roots take you in. You travel up the trunk and are stored in its seed. Go to TREES

(Liquid) You flow downhill and become part of a stream that flows into the Shenandoah river. Go to SHENANDOAH RIVER.

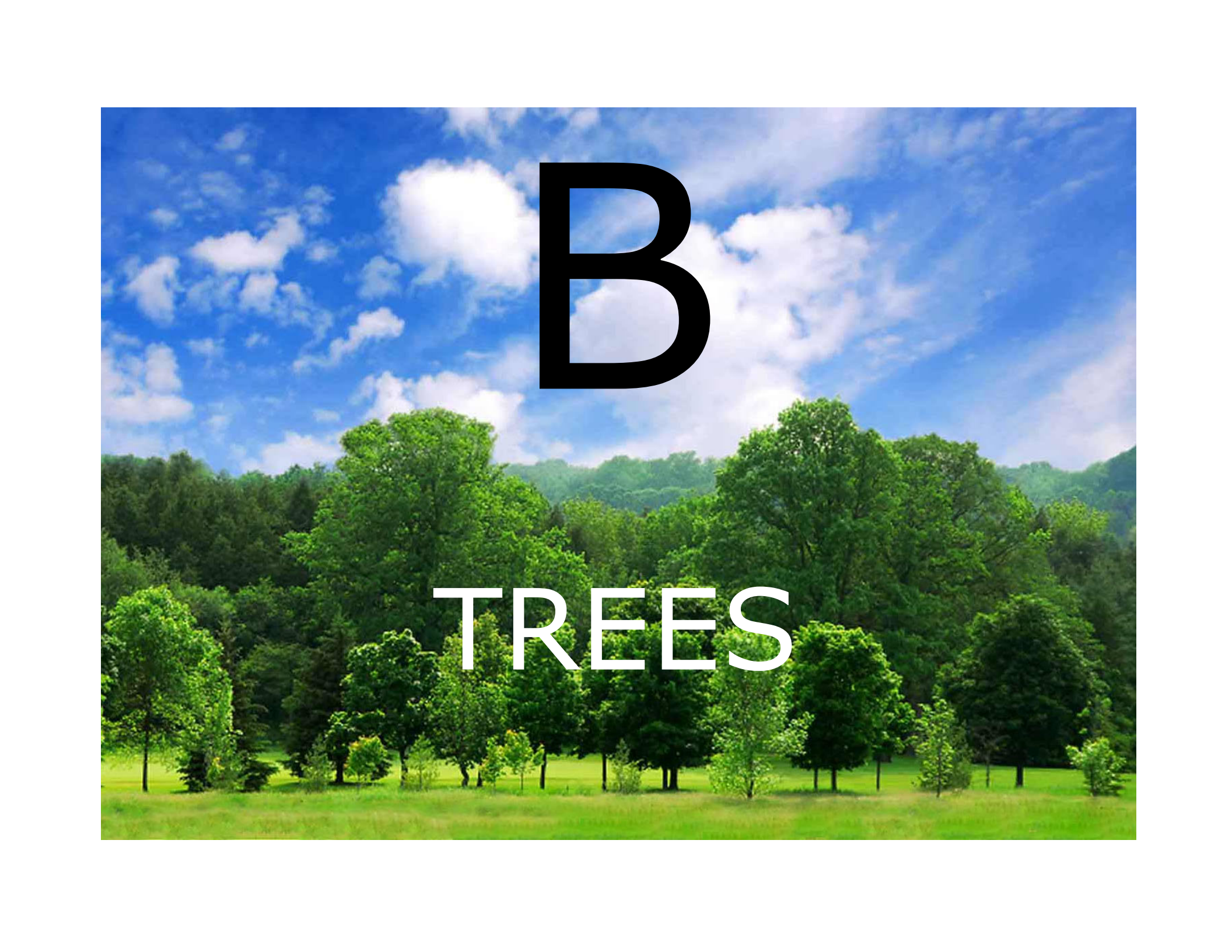
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A

CLOUDS



B

TREES



C
CHESAPEAKE BAY



D

SHENANDOAH
RIVER

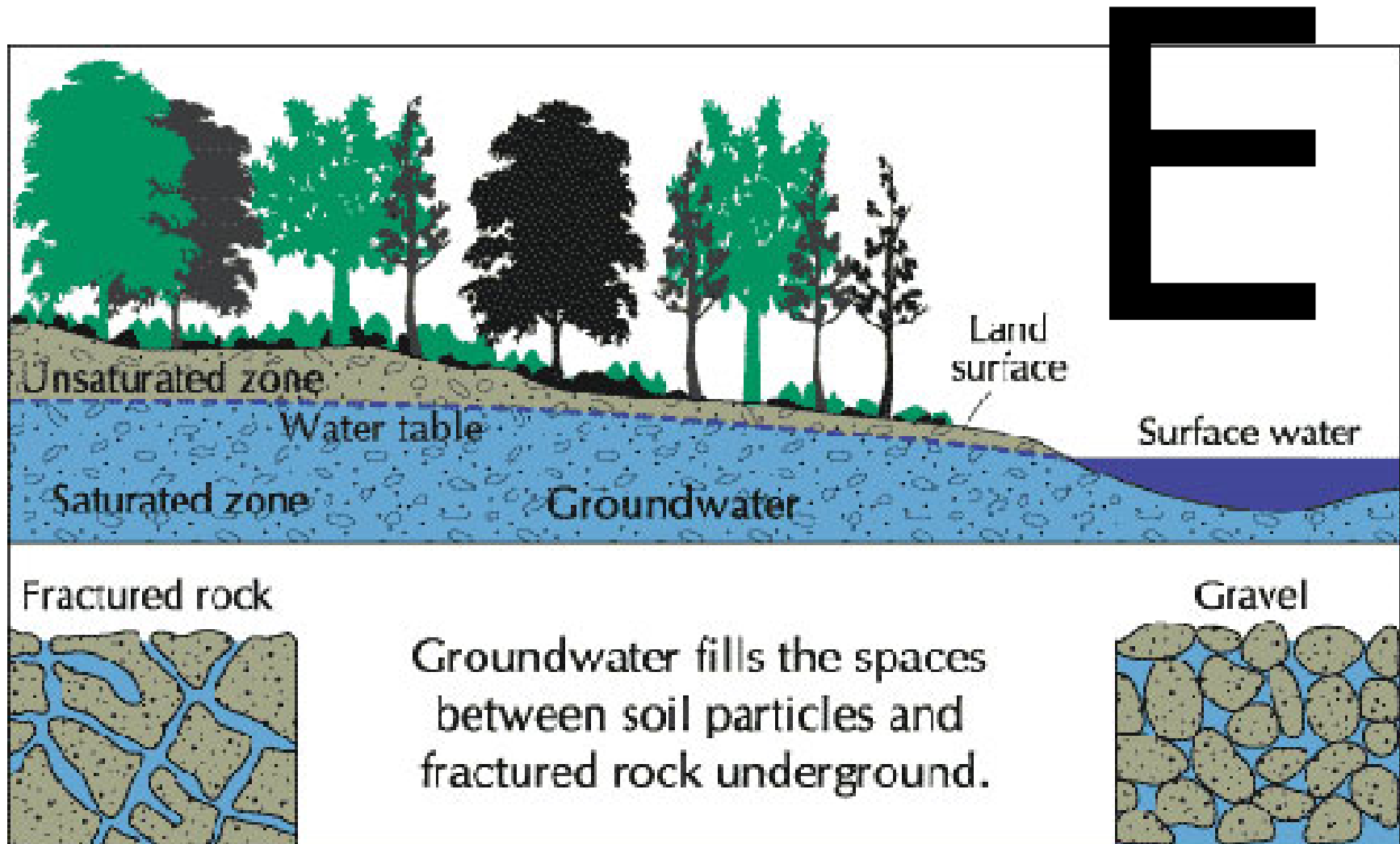


Image compliments of US Geological Survey, adapted by The Groundwater Foundation.

GROUNDWATER




F

ANIMALS

A scenic view of Lake Frederick, featuring a large blue letter 'G' overlaid on the sky. The lake is in the foreground, surrounded by lush green trees and a clear blue sky with some wispy clouds. The water reflects the surrounding greenery and the sky. The overall atmosphere is peaceful and natural.

G

LAKE FREDERICK

A scenic view of the Blue Ridge Mountains, showing rolling hills and valleys covered in dense green forest. The sky is a pale blue with some light clouds. A large, bold, black letter 'H' is overlaid in the center of the image.

H

BLUE RIDGE
MOUNTAINS