CLOSER THAN YOU THINK

GRADE LEVEL 4-5

ANTARCTICA EDUCATOR GUIDE


Photo: BBC NHU

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60 minute Lesson

Standards (NGSS):

5-ESS2-1 Earth's Systems

Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.

From the Film:

The film highlights the extremely important role that whales play in Antarctica's ecosystem and the interconnectedness of the natural systems. The presence or absence of whales directly affects the populations of phytoplankton as well as other microorganisms. We also learn the history of commercial whaling and the significant reduction in whale populations as a direct result.

Lesson Overview:

Students will understand that all things are connected and a change in one aspect of the Earth's ecosystem creates a domino like effect that can stimulate a change in another.

Select 1/5th of the class, and designate them as scientists. The remaining students will act as various parts of Antarctica's ecosystem. The Antarctica groups will create a motion rule of their system, which only they are aware of, but they all must follow as they move about the classroom. These movements should mimic living things or bodies of water in Antarctica. Their movement represents how interdependent systems can affect one another in positive ways, and the scientists must observe carefully to identify the rule. Scientists can also test different parts of the system by removing or replacing parts to see how their actions alter the system.

After the game, they will discuss their findings, systems and scientists, and recall humanity's influence on each of the variables.

Materials:

- System handouts, pp. 52-55
- Scientist Activity Sheet, p. 56 *(one per student selected)*

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EDUCATOR PREP:

Print enough copies of the ***Scientist Activity Sheets*** for 1/5th of your students to be able to use. Print the diagrams of systems and have one pack per group of four students.

EDUCATOR GUIDE:

1. Inform students that we will experience a model of Antarctica's ecosystem. Begin the lesson by surveying students' knowledge of systems by asking them the following questions:

What are some systems that you can think of?

Encourage the class to list as many as they can, including body systems (cardiovascular, digestive and respiratory), natural systems (water cycle, nutrient cycle, and rock cycle), mechanical systems (cars, factories, appliances). As students offer their answers, capture them on the whiteboard or on a piece of chart paper.

What do these systems have in common? How are they similar and different?

Consider student answers as a way to assess their background understanding of systems and how elements of systems work together.

2. Inform students that even though each of these systems are different, their basic framework is the same in that many pieces work together for the benefit of the whole.

3. Introduce the "spheres", small, interconnected systems that govern the natural world and ecosystems like Antarctica. The biosphere represents all the Earth's living things. The hydrosphere is all the water of the world, solid, liquid and gaseous. The lithosphere encompasses all the solid rock of the Earth and lastly the atmosphere, all the air on Earth. Inform students that when these spheres interact, they are called events.

4. Challenge students to identify which of the "spheres" were highlighted within the film. Ask students to give examples of systems present within Antarctica's ecosystem and encourage the students to think on the "events" that have or could occur in Antarctica when the spheres interact.

Photo of a working whaling station in Spitsbergen, Norway, 1907.

Photo: Freshwater and Marine Image Bank

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Why would understanding a system be important?

Use student answers to this question as a baseline assessment on how students think about or don't think about systems and why or how we can use systems in descriptive and prescriptive way. Answers may include the idea that systems help us to understand relationships or create logical steps that happen in a given order.

5. Inform students they will model Antarctica's ecosystem, and some students will be role playing as scientists. Designate 1/5th of the students as the scientists and ask them to step outside of the room.

6. The remaining students will represent the systems within Antarctica. Instruct them to come up with a motion rule that everyone within the system must follow as they move around the room. These movements should mimic living things or bodies of water in Antarctica. For example, each person within the system could identify two other people in the system to follow or remain in between them at equal distance, similar to a line of penguins. Or they could all choose different geometric shapes that their movements will follow.

7. Instruct the systems group that during the game, they should always remain moving and following the chosen motion rule, like wind moving across the landscape. If at any point an individual within the system is unable to follow the rule they should stop and remain still.

8. Allow the system students to practice for 1-2 minutes after they have identified their motion rule.

9. As the system students practice their rule, step out of the room and go over the rules for the scientists.

10. Inform the scientists that their goal is to identify the rule of the system inside the classroom. To help the scientists understand the system they may remove systems. Every 3 minutes the scientists may also pause the system to ask yes or no questions to the students within the system. Encourage students to use the ***Scientist Activity Sheet*** to record and discuss their observations with each other when the game is not paused.

11. Bring the scientists back into the classroom and start the game.

12. The game should be played until the motion rule is revealed. Scientists should use the scientist notepad to capture their thoughts while playing the game. If the scientists think they have figured out the game, they may pause the game, but may not ask any questions.

Educator Notes:

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13. When the scientists describe the rule, they must use their observations to substantiate their guess. Instead of telling them if they are right or wrong, encourage them to provide evidence that disproves an incorrect guess or if the scientists guess correctly, confirm with the participants. At this point, end the game and move on to class discussion.

14. Following the game, facilitate a whole group discussion about what it was like to be a part of system that could be influenced outside of their control and the intricacies of a system when observed. Ask students the following questions as a reflection first in their notebooks and then shared with the larger group to drive their discussion:

How is this game similar or different from what you know scientists do to learn about these systems?

Use student answers to these questions as a baseline or formative assessment about what students know about how scientists work and the scientific method.

What things did the scientists group do that was most helpful in revealing the pattern?

Student answers will vary, but may include something along the lines of observing different patterns that gave some ideas about what could be going on, thinking of a pattern and trying to see if it fit, changing something to see how it affected the movement of their classmates.

How did guesses that did not end up being right help the scientists get to the right answer?

Answers that are not correct, in this case, helped scientists to try different models and to tweak until they find the one that fits the movement.

15. Referring back to the film inform students the cyclic nature of how the biosphere (all the living things) influence and are influenced by the climate, the land, the air and even other living things like humans. Use student responses to highlight the complexity of the systems within the natural world. Some great examples of this are climate change, decreasing sea ice, whaling and the subsequent ban on whaling.

16. Inform students that the role of whales within Antarctica's ecosystem and the consequence of whaling affects the entire system, the same way that the removal of a person in the game affected the rest of the system.

Whales perform many ecosystemic services, not only to Antarctica but to the Earth's ecosystem. Marine organisms react as carbon sinks, whales specifically hold the equivalent of 30,000 trees worth of carbon. They acquire this carbon from eating krill, and help fertilize the photosynthetic plants, that use CO_2, with their poop.

A powerful flood destroyed this bridge in Sidi Ouaaziz, Morocco. This singular weather event is a result of the interaction of several "spheres."

Photo: Shutterstock / Migel

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17. Conclude the lesson by explaining to students that whaling has occurred in many different cultures dating as far back as 600 BCE. Commercial whaling began during the 11th century and from that time 1.5 million whales were processed for soap and margarine.

The whales that took a huge hit were the southern right whales, named because they were the right whales to hunt, that had their numbers decrease from 35,000 to 35. In 1986 a commercial whaling ban was instituted and since that time whale numbers have begun to increase.

18. Have students reflect on the experience in their notebooks using the following prompts:

Thinking about the game and what you learned about whales, how do scientists try to understand the effect of whaling in Antarctica?

Use student responses as a way to assess their learning from the lesson. They should explain how the scientists in the game used observations about how the students interacted to try to figure out the motion rule. In the same way, actual scientists observe not just whales, but all of the animals that interact with whales to understand the effect that whaling has on Antarctica's ecosystem.

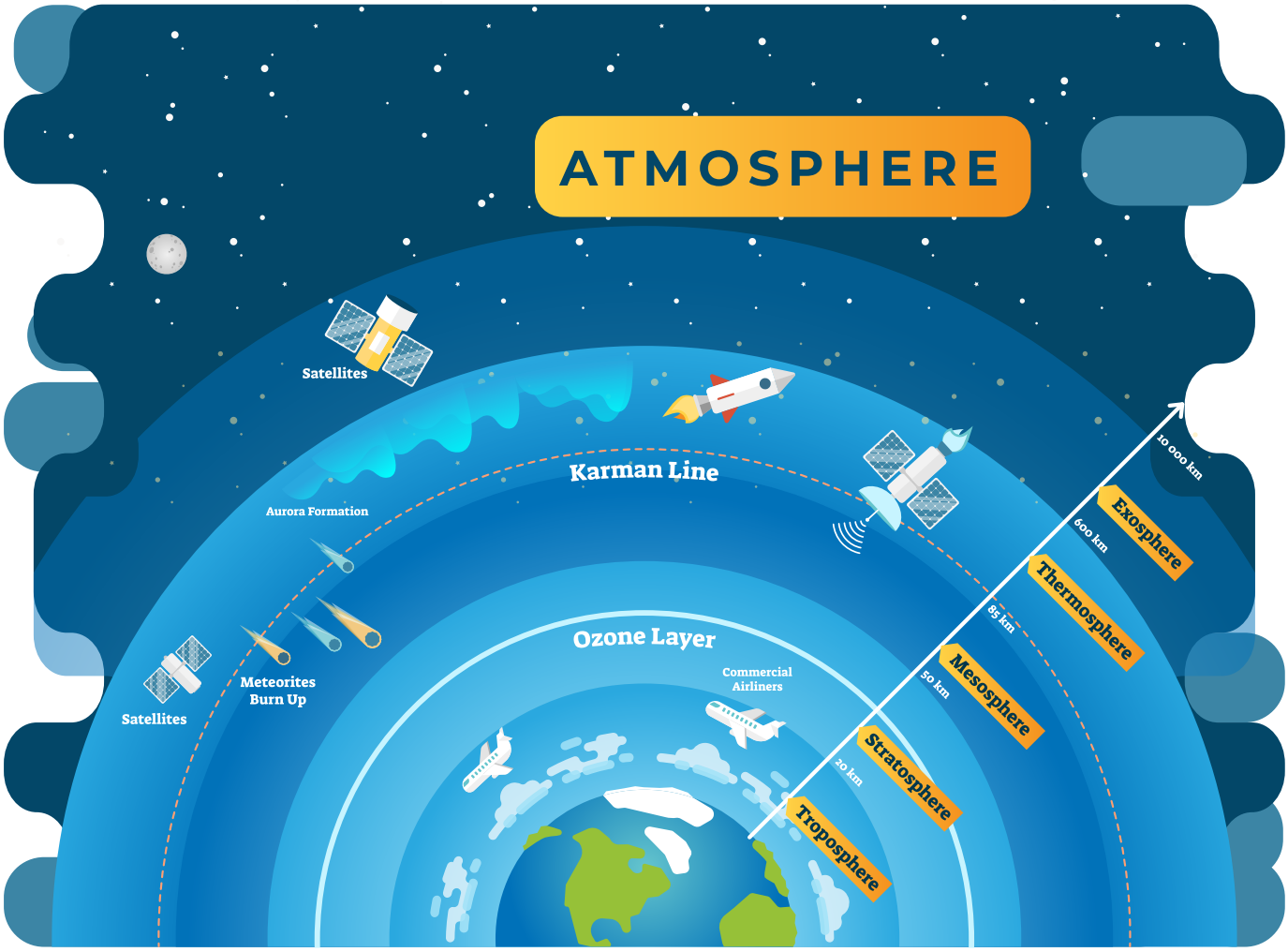
Can you think of another example where humans have done something to such an extent that it has had such a big impact on the planet?

There are limitless examples of humans harming an ecosystem through overfishing, polluting, hunting, exterminating pests...etc. Student responses should reflect an understanding that one action can cause many other things to happen.

Educator Notes:

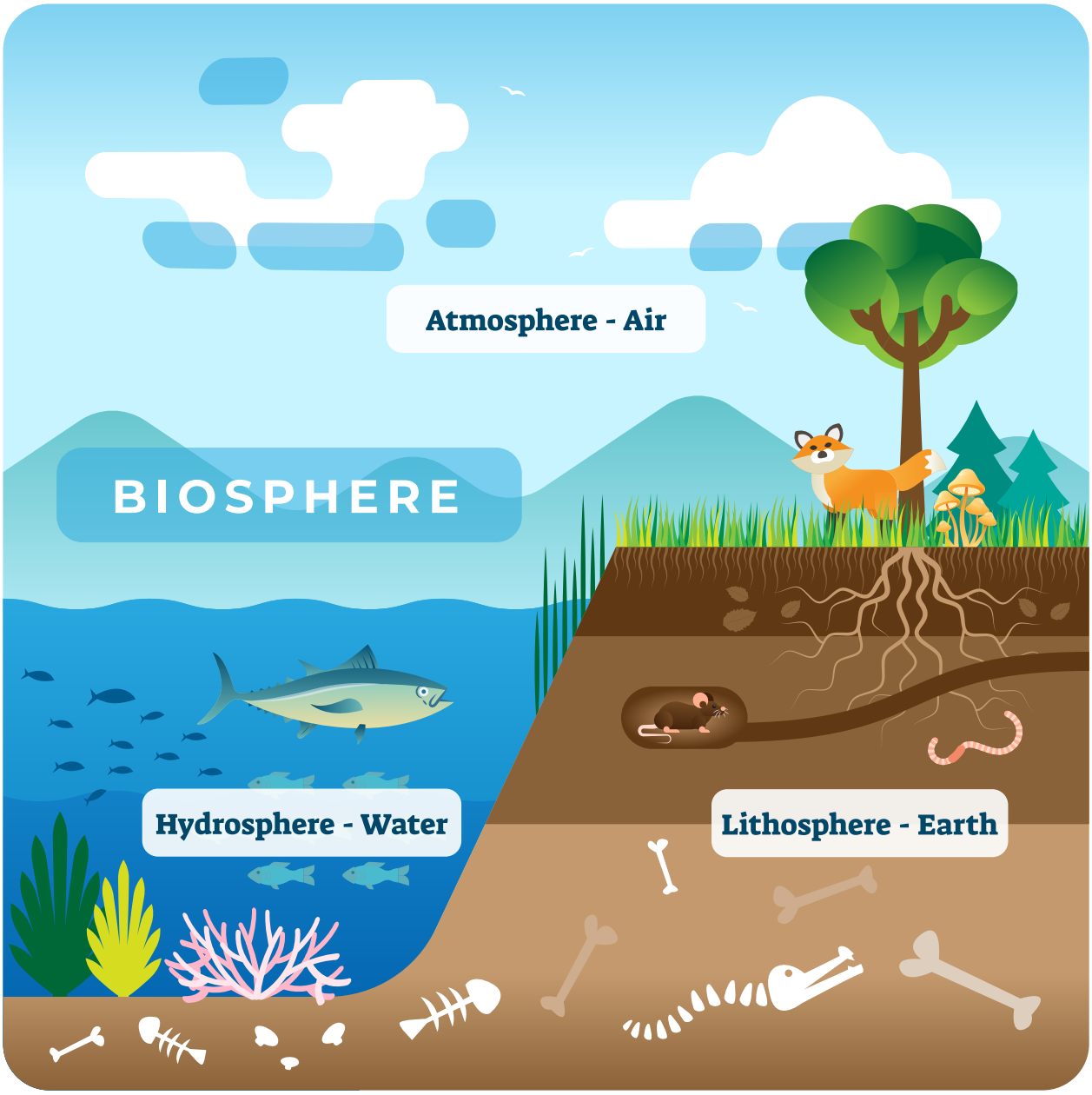
Connections: Atmosphere

Spheres are interconnected systems that describe how parts of our planet work together to make the whole. The **atmosphere** represents all the air surrounding the Earth.



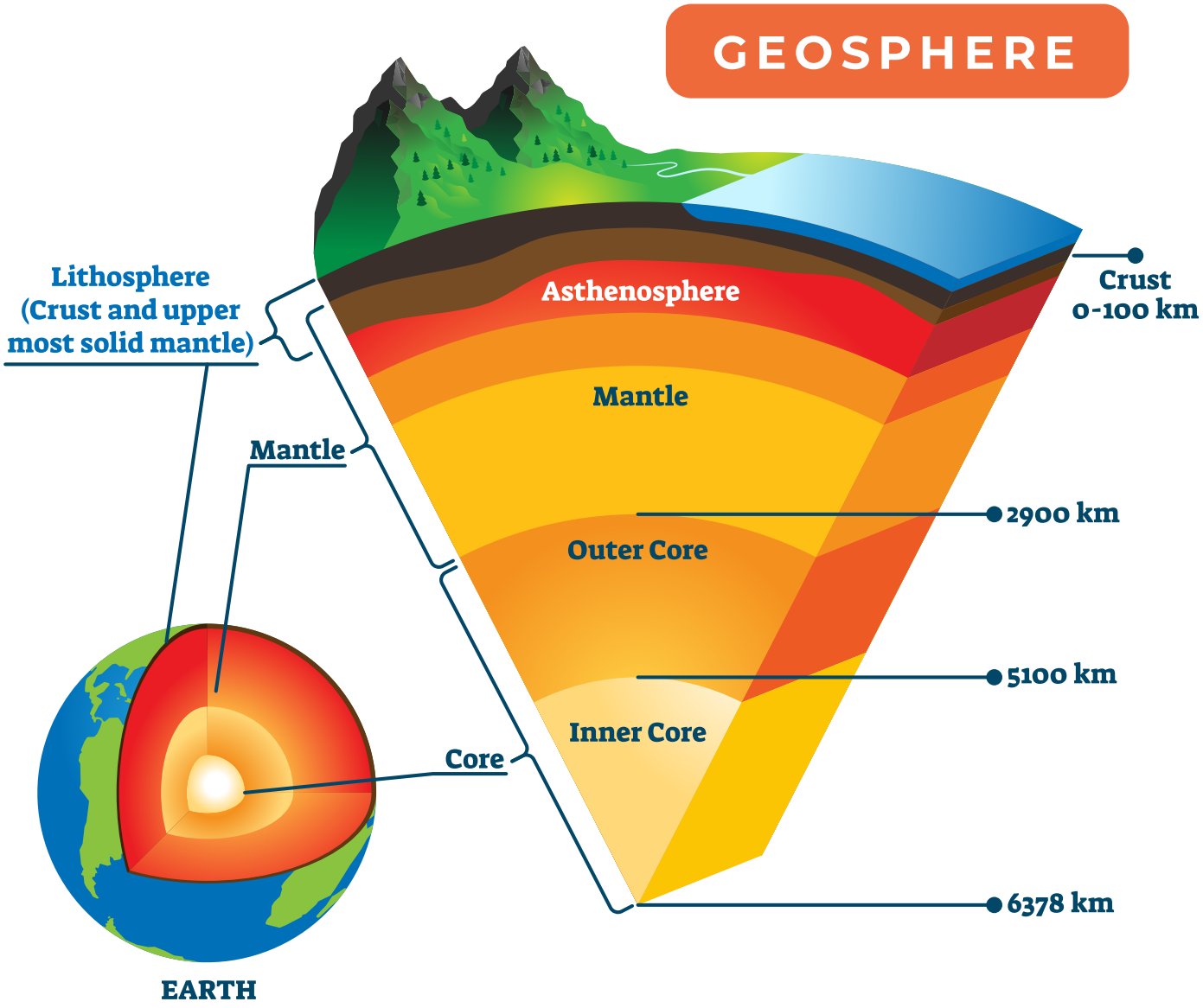
Connections: Biosphere

Spheres are interconnected systems that describe how parts of our planet work together to make the whole. The **biosphere** represents all the Earth's living things.



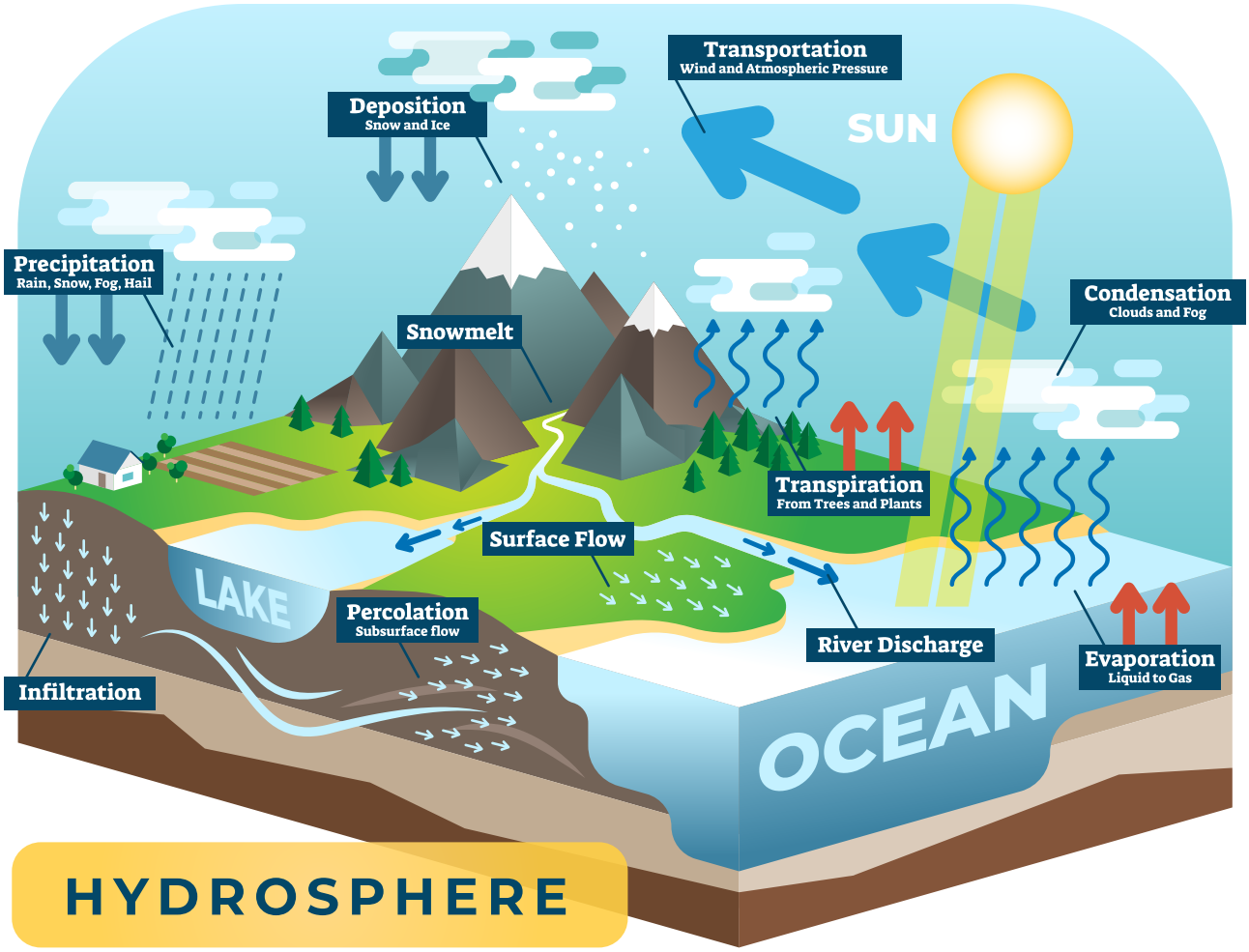
Connections: Geosphere

Spheres are interconnected systems that describe how parts of our planet work together to make the whole. The **geosphere** encompasses all the solid and molten rock of the Earth.



Connections: Hydrosphere

Spheres are interconnected systems that describe how parts of our planet work together to make the whole. The **hydrosphere** is all of the Earth's water; solid, liquid, and gaseous.



Scientist Notepad

Goal:

Attempts:

Observed Patterns:

Rules: "If this, then that." / *Example: "**If** I stand in the middle of the system, **then** Joseph stops moving.*