***Chapter 2-Earth’s Systems and Water Resources***

***Lesson 4-Interaction of Earth’s Systems***

***Slide 1-Narrative: Explain***

***Describing the Interaction of Earth’s Systems***

1. Earth's four major systems are the **geosphere**, the **hydrosphere**, the **atmosphere**, and the **biosphere**.
2. These systems continually interact with one another.
3. Humans are part of the biosphere.
4. Humans live on the surface of the geosphere, drink water from the hydrosphere, and breathe oxygen from the atmosphere.
5. Your existence depends on all of Earth's systems.

***Video:***

1. Earth’s systems constantly interact with each other. Materials produced by one system are used by others.
2. Volcanic eruptions send large amounts of dust, ash, and gas into the atmosphere.
3. Minerals from deep underground can spread miles away from the volcano.
4. Plant and animal life is plentiful in regions of the ocean.
5. Plants produce the oxygen in the water that fish and other animal life needs to survive.
6. Moving water can erode the banks of a river.
7. Eventually, the river may change course or form a lake as the water moves the land around it.
8. Rocks and soil provide a place for plants to anchor themselves with their roots.
9. Plants can wear down rocks over time.
10. No system acts alone.
11. Each one interacts with and depends on all the others.

***Text:***

1. Many other interactions occur between these systems.
2. The atmosphere is made of gases like nitrogen, oxygen, and carbon dioxide.
3. Oxygen is vital for almost all life on Earth, but there would be no oxygen without certain life forms.
4. Plants produce oxygen gas in the process of **photosynthesis**.
5. In this process, plants directly interact with the atmosphere in two specific ways.
6. Plants take in carbon dioxide from the atmosphere and use energy from the Sun to transform carbon dioxide gas into food, releasing oxygen gas as a byproduct.
7. As a result, plants play a vital role in creating oxygen you breathe and controlling the levels of carbon dioxide in the atmosphere.
8. Animals interact significantly with the atmosphere through a process called respiration.
9. **Respiration** is the process by which oxygen is delivered to the cells and waste in the form of carbon dioxide is removed.
10. In other words, you breathe in oxygen from the air and replace it with carbon dioxide.
11. These examples show the interaction of just two of Earth’s major systems: the biosphere and the atmosphere.
12. However, you can describe many interactions between all of Earth’s systems.
13. For example, an interaction between the geosphere and the hydrosphere can be seen in geographical features like the Grand Canyon.
14. Over millions of years, it is suspected the Colorado river **eroded** away the sandstone banks, creating a gorge on Earth’s surface that is approximately 280 miles long and from 4 to 18 miles wide!
15. You can describe interactions between Earth’s systems wherever they come into contact.
16. Carbon dioxide in the atmosphere is constantly absorbed into rock in the geosphere and into the oceans in the hydrosphere.
17. Water from the oceans, lakes, and rivers **evaporates** and enters the atmosphere, which then precipitates back down to the surface as rain or snow.
18. **Glaciers** in the hydrosphere can even create entirely new areas of land.
19. Some regions such as Cape Cod in Massachusetts are almost entirely made of sand and gravel deposits left behind from the glaciers from the last ice age.
20. Glaciers and ice sheets can pick up rocks and sediment on Earth's surface and move them thousands of miles.
21. This happened during the last ice age.
22. Moving glaciers can crush and weather rocks forming small particles of sand.
23. Glaciers also produced some of the largest lakes in the world.
24. The Great Lakes of North America are thought to have been carved out by giant glaciers towards the end of the last ice age.
25. These are just a few examples of interactions that occur between Earth’s systems.

***Slide 3-Narrative: Practice***

1. How do humans interact with the geosphere? Explain your reasoning.

Humans interact with the geosphere in many ways. A few examples include drilling for oil and natural gas, mining for gold and other metals, and digging canals for shipping and transportation.

1. How does the geosphere interact with the atmosphere? Explain your reasoning.

The geosphere interacts with the atmosphere in many ways. Wind from the atmosphere can erode landmasses. Mountain ranges can hinder the motion of clouds and affect weather patterns in the atmosphere.

1. Hurricanes are intense storms that can cause major destruction. Which of Earth’s systems interact during the formation of a hurricane?

The formation of a hurricane is an interaction between the hydrosphere and the atmosphere; warm water from the hydrosphere evaporates and creates a spinning air mass in the atmosphere.

1. How might a hurricane interact with the geosphere?

A hurricane can bring heavy rain and severe flooding, which can cause erosion of beaches and marshy land. High winds can contribute to the erosion of rock formations.

***Slide 4-Peer Model: Explain***

1. **Earthquakes** are caused by **tectonic plates**.
2. Earth’s crust is made up of pieces called plates that fit together like a jigsaw puzzle.
3. As these plates slowly move, some of them collide with great force.
4. That collision causes an earthquake.
5. Earthquakes can be very powerful or barely noticeable.
6. An earthquake can cause changes in the landscape, such as creating mountains and volcanoes.
7. When plates come together, mountains may form.
8. Tectonic plates can also separate from each other.
9. If this happens in the ocean, trenches will form.
10. This makes the ocean deeper.
11. This is an example of how the **geosphere** and **hydrosphere** interact with each other.

***Video:***

1. A canyon can be carved out by a fast moving river.
2. Erosion is the process when a body of water gradually deteriorates the surrounding land.
3. Deteriorate means to wear away at something.
4. Water is a part of the hydrosphere.
5. When a river comes up against the land, it starts to erode part of the rock, the geosphere, very slowly over a long period of time.
6. The hydrosphere and the geosphere interact with each other through erosion, where water wears away the rock to create deep gorges.

***Key Words:***

1. **hydrosphere** – the collection of all the water found on Earth that includes oceans, seas, lakes, and rivers
2. **geosphere** – all the solid land on Earth's surface and all the soft and molten rock beneath the surface that includes landmasses
3. **atmosphere** – the layer of gas that surrounds all the systems of Earth
4. **biosphere** – the collection of all living things and the ecosystems they live in
5. **earthquake** – the shaking and vibration of Earth's crust due to the movement of Earth's plates
6. **erosion** – a process by which air and water pick up and move pieces of rock, sand, and sediment
7. **glacier** – a mountain of snow and ice that can grow or melt
8. **photosynthesis** – the process through which plants use water and carbon dioxide to create their food, grow, and release excess oxygen into the air
9. **respiration** – the process in which living organisms produce energy, usually involving oxygen and/or carbon dioxide
10. **evaporate** – when a liquid turns into vapor
11. **tectonic plates** – very large slabs of the outer shell of Earth that can slide (very slowly) over the inner layers of Earth

***Slide 5-Peer Model: Check-In***

* 1. Over time river water causes erosion of land, which forms a canyon.
  2. When the river water forms a canyon over time, what two spheres of Earth interact?

The hydrosphere (the river) and the geosphere (the land being formed into a canyon).

***Slide 6-Peer Model: Practice***

1. The interactions of tectonic plates can cause earthquakes.
2. When the plates collide, mountains can form.
3. When the plates separate, ocean trenches can form.
4. A volcano is part of the geosphere. Imagine that a volcano erupts. How do you think it will impact the atmosphere?

The volcano might send ash and dangerous gases into the atmosphere. This will change the contents of the atmosphere. It may affect the atmosphere many miles away.

***Slide 7-21st Century: Explain***

1. The four spheres on Earth are the geosphere, the hydrosphere, the atmosphere, and the biosphere.
2. In general, Earth’s landmasses make up the **geosphere** (the top level of the geosphere is called the lithosphere).
3. Earth’s water makes up the **hydrosphere**.
4. Earth’s air makes up the **atmosphere**.
5. And Earth’s living things make up the **biosphere**.
6. These four spheres are closely connected.
7. They are always interacting within and between each other.
8. Learning how these four spheres interact will help you have a better understanding of the environment and the world around you.
9. There are a lot of interactions between the spheres of Earth in this process.
10. When pressure builds inside a volcano, an eruption occurs.
11. Lava, gases, ash, and rock spill out.
12. The volcano may cause mudslides, avalanches, or floods.
13. All of these can destroy plants, which are food sources for animals.
14. Ash and harmful gases can make it hard to breathe and can pollute the water.
15. An erupting volcano is an event in Earth’s geosphere.
16. But an erupting volcano affects the other three spheres, too.
17. It affects the hydrosphere by causing floods and polluting water.
18. You can model this interaction as geosphere --> hydrosphere.
19. It affects the atmosphere by the release of ash and harmful gases into the air.
20. You can model this interaction as geosphere → atmosphere.
21. It affects the biosphere by destroying plants and their habitats.
22. You can model this interaction as geosphere → biosphere.
23. Humans are part of the biosphere.
24. Like volcanoes, humans can also have harmful effects on Earth’s other spheres.
25. When people burn fossil fuels, too much carbon dioxide ends up in the atmosphere.
26. This leads to global warming and climate change.
27. This can be modeled as biosphere → atmosphere.

***Slide 9-21st Century: Practice***

1. A hurricane is a large rotating storm that forms over warm waters.
2. Hurricanes have high winds: at least 74 miles per hour.
3. Hurricane Andrew came ashore in southern Florida in 1992.
4. Hurricane Andrew’s strong winds and rain ruined many buildings in South Florida, including homes and businesses.
5. Andrew caused floods and resulted in widespread beach and soil erosion.
6. Some of the ocean water filled freshwater lakes.
7. This destroyed the habitats of freshwater species.
8. Also, there were a few tornadoes that resulted from Hurricane Andrew.
9. Some interactions of different parts of Earth during a hurricane:

* atmosphere (hurricane) → geosphere (beach and soil erosion)
* atmosphere (hurricane) → biosphere (loss of human homes)
* atmosphere (hurricane) → hydrosphere (moving saltwater into freshwater areas)
* atmosphere (hurricane) → atmosphere (tornado)