# Journey Through the Spheres of the Earth:

## Exploring the interaction of Earth's Spheres

By: Judy McDonald and Christina Daschke

## Focus on Inquiry

The student will investigate Earth's five spheres through a hands-on activity in which they collect data and construct explanations through a lab simulating how interactions occur on the planet from one sphere to another.

## Lesson Content Overview

Students will discuss picture examples of the five Spheres, collect data to generate their own bar graph, and experience interactions between the five Spheres on Earth. Students will be able to identify and differentiate impacts and interactions between the Biosphere, Hydrosphere, Geosphere, Cryosphere, and Atmosphere.

| Duration | Setting | Grouping | PTI Inquiry Subskills |
|---|---|---|---|
| 70 minutes | Classroom | 2-4 students | 1.3, 3.3, 3.5, 3.7, 4.2, 7.3 |

| Lesson Components | Estimated Time | Inquiry Subskills Used | Technology Used | Level of Student Engagement | Brief Description |
|---|---|---|---|---|---|
| ***Engage*** | 10 minutes | 1.3, 3.7 | Computer for video | 1 | Begin by watching the video of "Nature's Masterpiece." |
| ***Explore*** | 15 minutes | 3.5, 3.7, 4.2 | none | 3 | Students collect data as they journey through the Spheres of Earth at five stations. |
| ***Explain*** | 15 minutes | 3.3, 3.5 | none | 3 | Students will fill in a graphic organizer, graph their results, and answer questions about their journey. |
| ***Expand/Elaborate*** | 20 minutes | 7.2, 7.3, | Computer to make video or make a poster | 2 | Students will use pictures from magazines or draw their own to make a poster to come up with example interactions between the 5 spheres. If technology is available, students will then create a video using movie maker of photos of their choice representing images of Earth's Spheres. |
| ***Evaluate*** | 10 minutes | 7.3 | none | 1 | Exit slip, will check for student understanding. |

**Level of Student Engagement**

| | | |
|---|---|---|
| 1 | Low | Listen to lecture, observe the teacher, individual reading, teacher demonstration, teacher-centered instruction |
| 2 | Moderate | Raise questions, lecture with discussion, record data, make predictions, technology interaction with assistance |
| 3 | High | Hands-on activity or inquiry; critique others, draw conclusions, make connections, problem-solve, student-centered |

## Next Generation Science Standards – Inquiry

NGSS Practice 1: Asking Questions and Defining Problems
NGSS Practice 2:Developing and Using Models
NGSS Practice 4: Analyzing and Interpreting Data
NGSS Practice 6: Constructing explanations
NGSS Practice 8: Obtaining, Evaluating and Communicating Information

## Next Generation Science Standards – Content

**5-ESS2-1** Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.

## Florida Science Standards – Nature of Science

**SC.6.N.3.4** Identify the role of models in the context of the sixth grade science benchmarks.

## Florida Science Standards – Content

**SC.6.E.7.4**: Differentiate and show interactions among the geosphere, hydrosphere, cryosphere, atmosphere, and biosphere.

# Materials and Advance Preparation

## Materials List

**Class set:**

- 1 or 2 Sphere stations labels (5 - 10 station labels)
- 1 or 2 Dice at each station (5 - 10 dice total)
- 1 or 2 sets of Instruction cards at each station (5 – 10 instruction cards)
- Class set of Data collection worksheet (1 paper per group or student, as preferred)

**Student Materials:**

- Data collection table
- Defining Spheres Venn diagram
- Graph for data
- Check Understanding worksheet

## Blackline Masters

1. **Blackline Master #1: Sphere Stations and Instruction Cards**
2. **Blackline Master #2: Data Collection Table**
3. **Blackline Master #3: Defining the Spheres Venn Diagram**
4. **Blackline Master #4: Graph your Data**
5. **Blackline Master #5: Checking Understanding**
6. **Blackline Master #6: Interaction between Spheres Project Rubric**

## Advance Preparation

1. Print out station labels and instruction cards enough for 1 or 2 sets at each station. **(Blackline Master 1)**
2. Prepare station labels, instruction cards, and dice around the room identifying your Earth Spheres Stations
3. Make copies of **Blackline Master # 2, 3, 4, 5** for each student.
4. Make copies of **Blackline Master #6** as needed for the Elaborate portion of the lesson.

# Lesson Information

### Learning Objectives

1. Students will be able to use the data collected in this lesson to correctly describe interactions between Earth's 5 Spheres.
2. Students will be able to explain how one or more spheres can affect another sphere.
3. Students will be able to model the interactions between the different spheres of the Earth.

### Prior Knowledge Needed by the Students

- Some familiarity with the water cycle and weather-related differences.

### Background Information

The 5 spheres are: geosphere (land), hydrosphere (water), atmosphere (air), biosphere (living things), and cryosphere (frozen water). All the spheres interact with other spheres. For example, rain (hydrosphere) falls from clouds in the atmosphere to the geosphere and forms streams and rivers that provide drinking water for wildlife and humans as well as water for plant growth (biosphere). River action erodes banks (geosphere) and uproots plants (biosphere) on the riverbanks. Flooding rivers wash away soil. Water (hydrosphere) precipitates onto the ground (geosphere) and then freezes into glaciers (cryosphere) which move eroding away the land (geosphere). There are many different cycles and processes on earth that demonstrate how these spheres interact; for example the water cycle, the carbon cycle, and processes such as photosynthesis and cellular respiration. Understanding these biogeochemical cycles, processes, as well as how the spheres interact allow us to predict how changes to one system will impact other systems.

## Lesson Procedure

***Engage***

1. To introduce the lesson watch a short video of nature images representing various aspects of the different Earth Spheres.
   **Nature's Masterpiece**

2. Some questions you might ask students include:
   1. **What were things that you saw in the video?** Tornado, Volcano, Hurricane, Canyons, Butterfly, Forrest, Bird, Northern Lights, Waterfall, Horses, Plateaus, Mountain Glaciers, Earth, Surfer

   **2. In the video what stands out in your mind about each picture of Earth?** There are lots of different parts of Earth including living and non-living things. Every place on Earth is different with different climates and weather patterns.

   **3. Explain how you think these pictures relate to each other?** Surfer needs water to surf, horses need land to walk on, waterfalls need water to flow, and canyons are made of rocks.

   **4. How might the events and organisms in the pictures affect one another?** Tornado can affect my house, hurricanes can destroy the beaches, volcanoes can destroy towns, and animals need water to live.

   **5. If you were to group the pictures, how would you group them?** Horses, butterflies, flowers, birds are all animals that are living. Mountains, Plateaus, volcanoes, and canyons all have rocks and are not living. Hurricanes and tornadoes are weather systems. Waterfalls, coastal regions, and ocean all have water.

***Explore***

1. Create each of the 5 stations around the room each with the appropriate station label: Atmosphere, Cryosphere, Biosphere, Hydrosphere, and Geosphere. You will put the 1 instruction card and 1 di at each of the stations. *To provide more space and opportunities for your students to work at each station, consider placing 2 instruction cards and 2 dice at each designated station rather than 1.* **(Blackline Master 1)**
2. Distribute the data collection sheet **(Blackline Master 2)** and go over the directions at the top of the sheet.
3. Model how to do two or three die tosses and how to record that data on the lab sheet. Discuss what to do if they toss the same station more than once (they write down each toss every time). Emphasize to students that dice should stay on top of the desks and off the floor.
4. Assign students to the starting stations randomly and evenly. Make sure students push in their chairs and stow their book bags so that tripping hazards are reduced.
5. Remind the students that they are representing a human experiencing interactions between two of Earth' Spheres at each station and that they should record the movements on the data sheet.
6. Begin the first round of data collection (consider putting a countdown timer on your SmartBoard; for example: http://www.classtools.net/education-games-php/timer). Circulate around the room to make sure that students are properly recording their data.
7. When the 15 minutes are up ask students to clean up the stations and make sure that they have their data collection chart filled out.

***Explain***

1. Distribute the Defining Spheres Venn diagram (**Blackline Master #3**) and Graph your Data (**Blackline Master #4**) sheet.
2. Have students Define Spheres in their own words using the Venn diagram provided in the shared spaces in the Venn diagram have them write examples of interactions from their data table.

3. Have students create a bar graph representing the data collected while on their journey around Earth. They should be recording how many times they visited each sphere.
4. Questions you could ask as the students are working on the graph:
   1. Does your graph have a title that represents the information you are providing?
   2. Is your X and Y axis labeled correctly?
   3. Does your graph have a scale?
   4. Does your graph have a key?

***Expand***

1. Students will be creating a model by making a poster to represent interaction among the different spheres. Use magazines to cut out pictures or have students draw their own representations of interactions between the spheres. Have students choose their favorite sphere and find or draw pictures of how it interacts with the other spheres. The rubric on **Blackline Master #6** can be used for scoring this project.
2. If technology is available have the students research and find pictures to make their own video representing images of Earth's spheres. Students can use any movie maker technology and add music to their images to create a video similar to the engage video. The rubric on **Blackline Master #6** can be used for scoring this project.

***Evaluate***

***FORMAL EVALUTION***

1. Checking for Understanding handout (Ticket out the Door: 5 questions) (**Blackline Master #5**)
   Answer Key: 1. A 2. D 3. D 4. C 5. A
2. Grade lab sheet

***INFORMAL or OPTIONAL EVALUTIONS***

1. Grade the poster created in the expand section.
2. Grade the video created in the expand section if technology is available.

***WRAP UP.***

*Bring the lesson to a conclusion by having the students share their posters or videos they created.*

## Supplementary Resources

***Teachers***

Earth's Spheres. (n.d.). Retrieved January 27, 2017, from http://www.cotf.edu/ete/ESS/ESSspheres.html

***Students***

Earth's Spheres. (n.d.). Retrieved January 27, 2017, from http://www.cotf.edu/ete/ESS/ESSspheres.html

Crash Course Kids. (2015, April 14). Four Spheres Part 1 (Geo and Bio): Crash Course Kids #6.1. Retrieved January 27, 2017, from https://www.youtube.com/watch?v=VMxjzWHbyFM

Crash Course Kids. (2015, April 16). Four Spheres Part 2 (Hydro and Atmo): Crash Course Kids #6.2. Retrieved January 27, 2017, from https://www.youtube.com/watch?v=UXh_7wbnS3A

**CITATION OF SOURCES.**

Bartee, K. (Director). (2016, September 7). *Nature's Masterpiece* [Video file]. Retrieved January 27, 2017, from http://edcanvas-videos.s3.amazonaws.com/5182d3f0777b11e68858db1294c784d0/52/ed6070777b11e698b0d92153b05474.mp4

Clker-Free-Vector-Images. (2012, April 2). Earth-globe-world-america. https://pixabay.com/en/earth-globe-world-america-23593/

Wikimedia Commons (n.d.). Glacier Picture. Retrieved from: https://commons.wikimedia.org/wiki/Glacier

__✓__ Yes, I cited all materials and resources used in this lesson.

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Lesson authors' signatures

**Blackline Master #1**

## Station Labels

| |
|---|
| **Atmosphere** |
| **Biosphere** |
| **Geosphere** |
| **Hydrosphere** |
| **Cryosphere** |

# Instruction Cards for Stations

| Atmosphere | |
|---|---|
| **If you roll a:** | **Then do this:** |
| 1 | You breathe in Nitrogen, Oxygen and other gases; STAY |
| 2 | You get caught in a Thunderstorm; GO TO THE HYDROSPHERE |
| 3 | It's raining frogs from a tornado; GO TO THE BIOSPHERE |
| 4 | Ice Storm! Take cover! ; GO TO THE CRYOSPHERE |
| 5 | You are driving and a mudslide from excessive rain blocks the road; GO TO THE GEOSPHERE |
| 6 | You hike up a high mountain and notice you are short of breathe; STAY |

| Biosphere | |
|---|---|
| **If you roll a:** | **Then do this:** |
| 1 | Your mom has another baby; STAY |
| 2 | You watch as deer drink from the stream; GO TO HYDROSPHERE |
| 3 | You are ice fishing and fall through the ice; GO TO CRYOSPHERE |
| 4 | You are flying on a plane to visit Grandma; GO TO THE ATMOSPHERE |
| 5 | You bury your old dog Fido; GO TO GEOSPHERE |
| 6 | You get a new puppy; STAY |

| Geosphere | |
|---|---|
| **If you roll a:** | **Then do this:** |
| 1 | You decided to go cave exploring; STAY |
| 2 | You are at the Hawaiian Islands and an undersea volcano emerges; GO TO THE HYDROSPHERE |
| 3 | You visit the Redwood Forests; GO TO THE BIOSPHERE |
| 4 | You climb mountain glaciers in New Zealand; GO TO THE CRYOSPHERE |
| 5 | You watch Mt. Vesuvius erupt ash into the air; GO TO THE ATMOSPHERE |
| 6 | Earthquake! Get in the door frame! ; STAY |

| Hydrosphere | |
|---|---|
| **If you roll a:** | **Then do this:** |
| 1 | You are drinking well water; STAY |
| 2 | You are offshore fishing and hit an iceberg; GO TO THE CRYOSPHERE |
| 3 | You are caught in a Hurricane; GO TO THE ATMOSPHERE |
| 4 | You are fishing in a river for salmon; GO TO THE BIOSPHERE |
| 5 | You go and visit the Grand Canyon; GO TO THE GEOSPHERE |
| 6 | You are swimming in the Ocean; STAY |

| Cryosphere | |
|---|---|
| **If you roll a:** | **Then do this:** |
| 1 | A new Ice Age! ; STAY |
| 2 | You watch as the polar ice caps melt; GO TO THE HYDROSPHERE |
| 3 | You put dry ice into your Halloween punch; GO TO THE ATMOSPHERE |
| 4 | You visit Antarctica and see Penguins in their natural habitat; GO TO THE BIOSPHERE |
| 5 | As you drive there are potholes from the winters of ice on the road; GO TO THE GEOSPHERE |
| 6 | While visiting the North Pole you get caught in an ice storm; STAY |

**Blackline Master #2**

# Data Collection Worksheet

You are a human interacting with the different Spheres of Earth. Begin at your first Sphere station (write that down in row 1 in the table below). Roll the dice to find out where you go to next. Read the directions on the dice to find out what interaction occurs between you and the Sphere and where you go next. Fill out this information in the table. Repeat this until the time is up or you roll 15 times (whichever comes first).

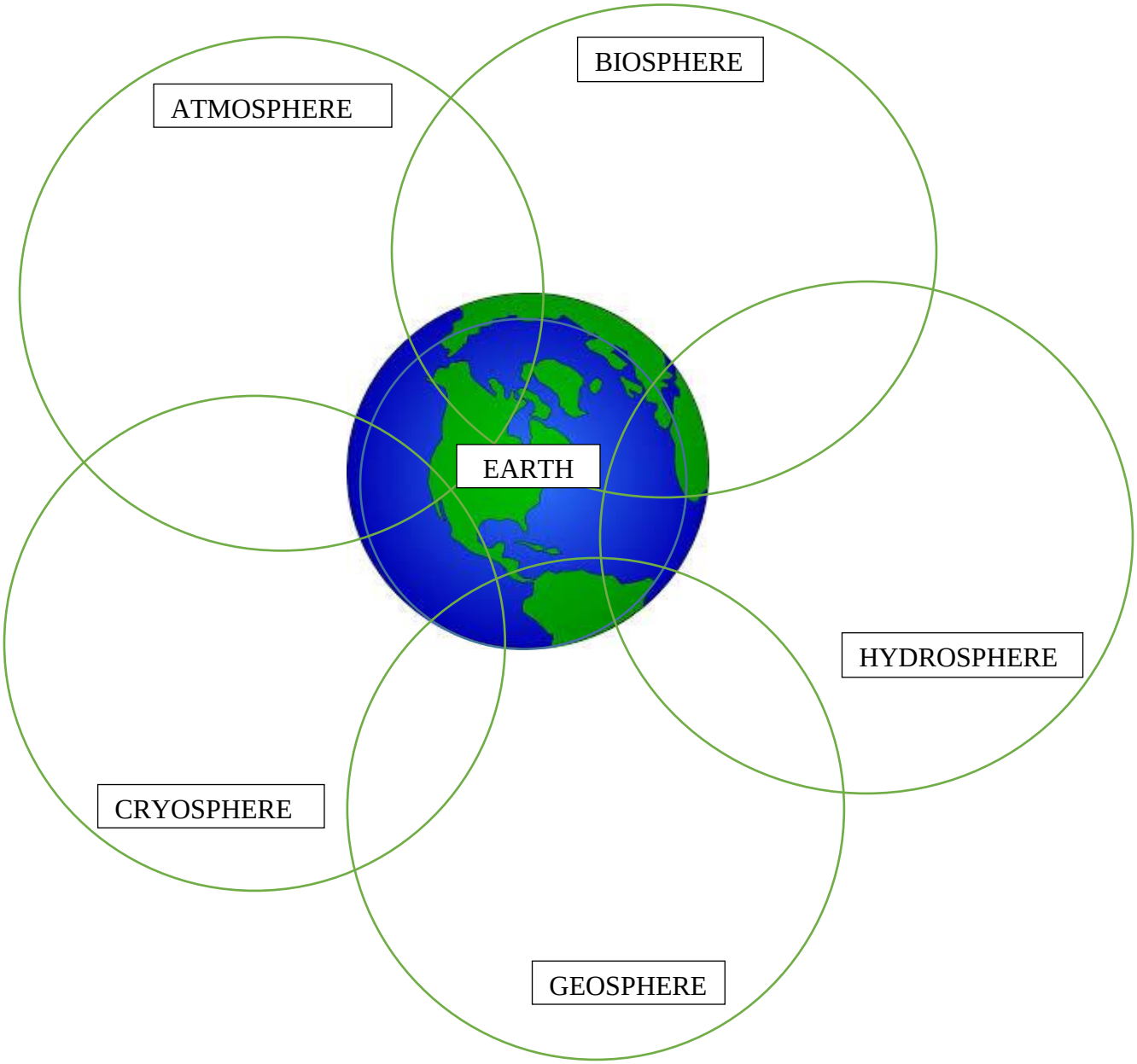
| | Sphere | What happens | Sphere Destination |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| 6. | | | |
| 7. | | | |
| 8. | | | |
| 9. | | | |
| 10. | | | |
| 11. | | | |
| 12. | | | |
| 13. | | | |
| 14. | | | |
| 15. | | | |

**Blackline Master #3**

# Defining Spheres Venn Diagrams

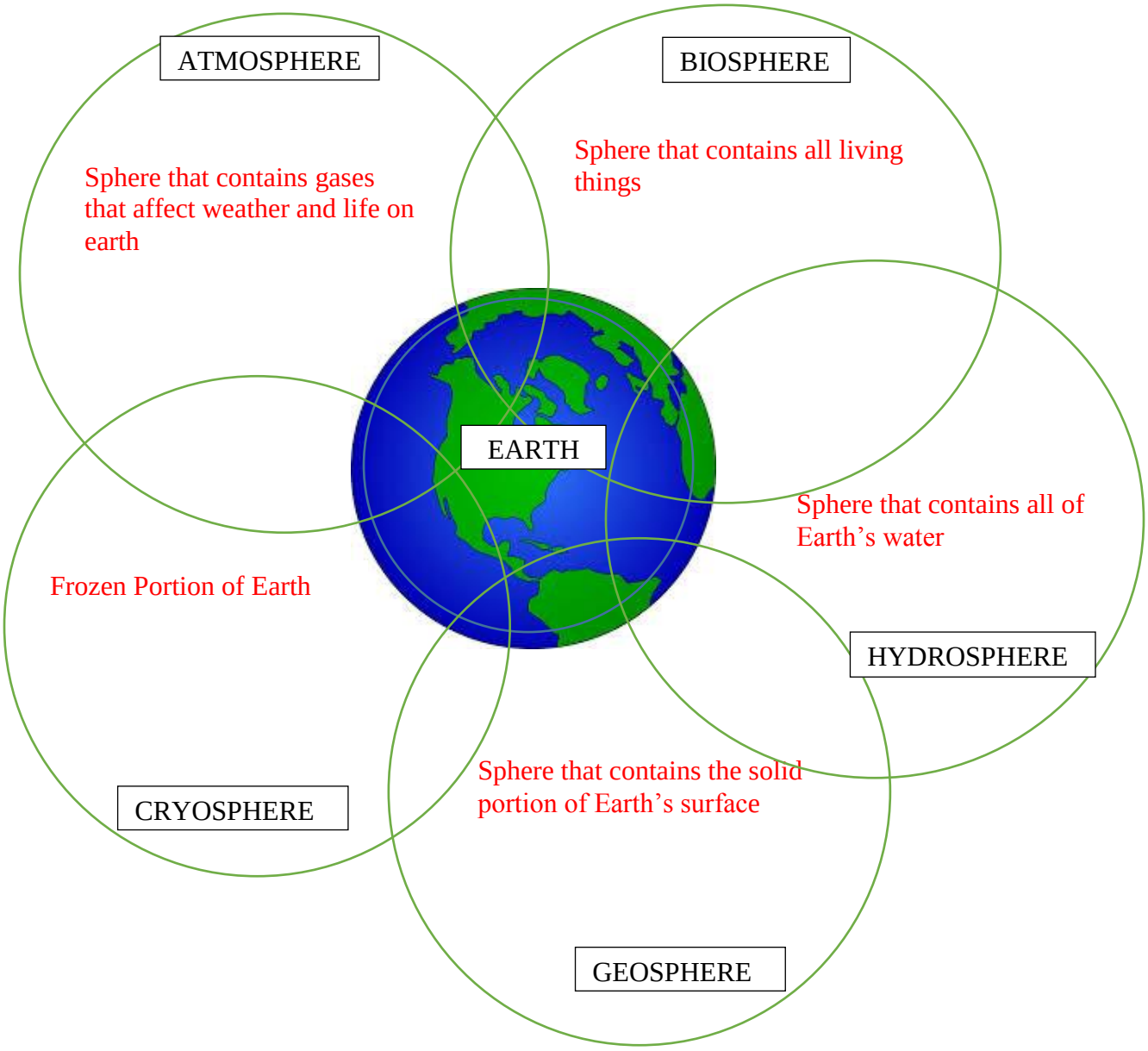
**Name:**_____**Date:**_____**Period:**_____

1. Define each sphere **(in your own words explain what that sphere represents on Earth**) in their circle and in the shared areas write in the examples that represent the interaction you collected on your data table.



# Answer Key

1. Define each sphere **(in your own words explain what that sphere represents on Earth**) in their circle and in the shared areas write in the examples that represent the interaction you collected on your data table.



**Blackline Master #4**

# Graph Your Data

**Use your data table to create a bar graph to show your journey and record how many times you visited each of the spheres.**

Title:_____

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1. Which sphere did you visit the most? Which sphere did you visit the least?

_____

_____

2. What are some of the similarities that you experienced between the different spheres?

_____

_____

3. Looking at your data table which interaction from column 2 represents an interaction between more than 3 spheres? -

_____

_____

4. Give your own example of an interaction that would affect 3 or more spheres.

_____

_____

5. Predict what you think would happen to the interactions of the spheres if you were to take away one whole entire sphere.

_____

_____

# Answer Key

**Graph: Use your data table to create a bar graph to show your journey and record how many times you visited each of the spheres.**

Title:_____

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|---|---|---|---|---|---|---|---|---|---|---|---|
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1. Which sphere did you visit the most? Which sphere did you visit the least? answers will vary based on the roll of the dice.

2. What are some of the similarities that you experienced between the different spheres? The cryosphere and the hydrosphere are both dealing with water.

3. Looking at your data table which interaction from column 2 represents an interaction between more than 3 spheres? Offshore fishing and you hit an iceberg; fishing is biosphere, iceberg is cryosphere, boating is in hydrosphere.

4. Give your own example of an interaction that would affect 3 or more spheres. A horse in a field running; horse and grass are biosphere, soil and ground are geosphere, the horse is breathing in oxygen which is atmosphere.

5. Predict what you think would happen to the interactions of the spheres if you were to take away one whole entire sphere. If the atmosphere were taken away, then the biosphere couldn't exist because we need oxygen and plants need carbon dioxide. It would also affect the hydrosphere, the water cycle wouldn't occur without the atmosphere.

**Blackline Master #5**

Name _____ Date _____ Period _____

## Checking for Understanding: Earth's Spheres

1. In the picture below, a slow moving mass of ice has gradually weathered and eroded rock away in a mountain valley. The landscape of rock has greatly changed.

Which sphere was affected in the transformation?

   a. geosphere: because the cryosphere scraped rock away as it slowly moved
   b. geosphere: because the hydrosphere scraped rock away as it slowly moved
   c. biosphere: because the hydrosphere flooded the valley eliminating trees and plants
   d. biosphere: because the cryosphere flooded the valley eliminating trees and plants

2. In 1815 a volcano erupted spewing billions of tons of ash into the sky. This ash "cloud" caused global annual temperatures to drop below normal, causing "a year without a summer" in 1816. Which sphere did this ash "cloud" affect to cause these changes?

   a. hydrosphere: because the water in the ash absorbed the suns radiation
   b. hydrosphere: because the ice in the ash caused the sun's radiation to reflect off
   c. atmosphere: because the ash allowed more radiation than normal to reach the surface
   d. atmosphere: because the ash blocked more radiation than normal, not allowing it to reach the surface

3. Which of the following situations interactions involving all five of Earth's spheres?

   a. A polar bear floats on an iceberg.
   b. An alligator on the lake shore eats a bird.
   c. A farmer in the rainforest growing coffee beans.
   d. A glacier flows overland taking rocks and trees with it as it melts.

4. What spheres are interacting if a lengthy and severe drought affects Florida?

   a. Cryosphere is eliminated, which affects the biosphere.
   b. Cryosphere is eliminated, which affects the geosphere.
   c. Hydrosphere is eliminated, which affects the biosphere.
   d. Hydrosphere is eliminated, which affects the geosphere.

5. Majority of earthquakes occur at transform boundaries. What sphere is responsible for the sudden jump of the Earth's crust?

   a. geosphere because the rock is sliding past each other
   b. biosphere because humans mine into mountains causing the rock to crack
   c. hydrosphere because the weight of moving water causes the rock to crack
   d. cryosphere because as the ice melts it cracks through the ice and into the rock

Answer Key
Name _____ Date _____ Period_____

**Checking for Understanding: Earth's Spheres**

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Which sphere was affected in the transformation?
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   b. hydrosphere: because the ice in the ash caused the sun's radiation to reflect off
   c. atmosphere: because the ash allowed more radiation than normal to reach the surface
   d. atmosphere: because the ash blocked more radiation than normal, not allowing it to reach the surface

3. Which of the following situations shows an interaction involving all five of Earth's spheres?
   a. A polar bear floats on an iceberg.
   b. An alligator on the lake shore eats a bird.
   c. A farmer in the rainforest growing coffee beans.
   d. A glacier flows overland taking rocks and trees with it as it melts.

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**Blackline Master #6**

# Interactions Between Earth's Spheres Project Rubric

| CATEGORY | 4 | 3 | 2 | 1 |
|---|---|---|---|---|
| **Graphics - Relevance** | All graphics are related to the topic and make it easier to understand. All borrowed graphics have a source citation. | All graphics are related to the topic and most make it easier to understand. All borrowed graphics have a source citation. | All graphics relate to the topic. Most borrowed graphics have a source citation. | Graphics do not relate to the topic OR several borrowed graphics do not have a source citation. |
| **Labels** | All spheres and interactions of importance on the poster/video are clearly labeled with labels that are easy to read. | Almost all spheres and interactions of importance on the poster/video are clearly labeled with labels that are easy to read. | Several spheres and interactions of importance on the poster/video are clearly labeled with labels that are easy to read. | Labels are too small to view OR no important spheres or interactions were labeled. |
| **Content - Accuracy** | At least 7 accurate interactions between spheres are displayed on the poster/video. | 5-6 accurate interactions between spheres are displayed on the poster/video. | 3-4 accurate interactions between spheres are displayed on the poster/video. | Less than 3 accurate interactions between spheres are displayed on the poster/video. |
| **Attractiveness** | The poster/video is exceptionally attractive in terms of design, layout, and neatness. | The poster/video is attractive in terms of design, layout and neatness. | The poster/video is acceptably attractive though it may be a bit messy. | The poster/video is distractingly messy or very poorly designed. It is not attractive. |