

## 1.1 INTRODUCTION TO EARTH SYSTEMS

### KEY TERMS

**Earth system** – the collective interacting parts or subsystems that make up the whole Earth

**spheres** - the different parts of the planet Earth

**biosphere** – the part of the Earth system that includes all living things on Earth

**geosphere** – the solid Earth

**crust** – the Earth’s surface, the part made of rocks and soil

**hydrosphere** – all of the water on Earth

**atmosphere** – the gaseous region above the Earth’s surface

This course is focused on studying our planet Earth. What do you think of when you think of Earth? Do you think of the people on it? Do you think of the oceans and the mountains? Or do you think of the plants and animals? What about the clouds in the sky or the stars in the heavens? All of these different parts of the Earth are connected, making up the whole **Earth system**.

The Earth system is generally divided into four different parts called **spheres** which we will be studying in this course.

1. **The biosphere.** The biosphere includes everything that is living on Earth, from plants and fish to me and you.
2. **The geosphere.** All of the rocks, minerals, and soil are included in the geosphere. This is the solid portion of the Earth from the **crust** to the core.
3. **The hydrosphere.** Any water that is on the Earth is in the hydrosphere.
4. **The atmosphere.** The atmosphere is the area above the Earth’s surface that is filled with gases. This is the part of the Earth where you find clouds and weather changes.

However, to understand the different parts of the Earth we also need to understand the Universe that surrounds our planet. The Sun, the Moon, and the stars also affect the Earth so are important to understanding the Earth system.

These different parts of the Earth and the Universe surrounding the Earth all interact with each other. When one changes it often causes another one to change. Scientists find it important to observe these changes to better understand our planet. This is why we study the Earth system.

## MATCHING

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Match the term in the first column with its description in the second column.

- |       |                 |   |
|-------|-----------------|---|
| _____ | 1. earth system | a) the Earth's surface                                  |
| _____ | 2. biosphere    | b) the gaseous region above the Earth's surface         |
| _____ | 3. hydrosphere  | c) all the living parts of the Earth system             |
| _____ | 4. atmosphere   | d) the connected different parts that make up the Earth |
| _____ | 5. geosphere    | e) the solid portion of the Earth                       |
| _____ | 6. crust        | f) all of the water in the Earth system                 |

## WHICH SPHERE?

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Listed below are different examples of parts of the Earth system. In the blank provided write which part of the Earth system the object belongs to.

- | biosphere | geosphere | hydrosphere | atmosphere |
|-----------|-----------|-------------|------------|
| _____     | 1. trees  |             |            |
| _____     | 2. lakes  |             |            |
| _____     | 3. rocks  |             |            |
| _____     | 4. people |             |            |
| _____     | 5. clouds |             |            |
| _____     | 6. dirt   |             |            |
| _____     | 7. air    |             |            |
| _____     | 8. oceans |             |            |

## 1.2 THE SCIENTIFIC METHOD

### KEY TERMS

**hypothesis** – an educated guess usually in the form of an “if – then” statement

**theory** – a hypothesis that has been tested thoroughly

**law** – a statement about nature to which no exceptions have been found



Before we begin our journey of the Earth, we have to start thinking like a scientist. Scientists are always trying to figure out the world around them. Why is the Sun yellow? How does the Moon stay in its orbit? To answer these kinds of questions they follow a method of problem solving called the scientific method. It is a method of recognizing a problem and trying to figure it out in an organized way. This involves following a series of steps. The steps of the scientific method are:

1. **Ask a Question:** Identify the problem you want to study and state it as a question. For example, why or how does something happen?
2. **Do Background Research:** Gather what information is already known about the problem. Ask questions and see what you can find out through research at the library and on the internet through appropriate, educational websites.
3. **Form a Hypothesis:** A **hypothesis** is an “educated guess”. It is a suggested explanation to our observations of nature. It is usually stated in the form of “if I do this, then this will happen.”
4. **Test the Hypothesis:** Create and perform an experiment to test the hypothesis.
5. **Record Observations:** During the experiment, carefully record everything you observe. This is called gathering data. It is important to record all the data you collect.
6. **Analyze the Data:** First organize the data in a way that makes sense. Then try to figure out what the data means.
7. **Draw Conclusions:** Explain what the meaning of the data. Determine whether the hypothesis is true, partly true, or false. Look for sources of error in your experiment.
8. **Communicate Results:** It is important to communicate your results to other scientists. That way they know what you have already tested and can learn from your experiments. Students do this by writing lab reports; scientists write articles about their results.

New information found during the process may cause a scientist to back up and repeat steps at any time. Since every experiment is different, a scientist may not need to use every step every time.



A **theory** is a hypothesis that has been tested repeatedly and thoroughly. It has not been proven to be absolutely true but all scientific evidence that has been found thus far supports the theory.

A **law** is a statement about nature to which no exceptions have been found. A theory has been tested and tested until it has been established that nature will always follow the same pattern. Theories and laws are generally widely accepted as truth in the scientific community. However, new evidence could always be found to change a theory or a law.

## PUTTING THE STEPS OF THE SCIENTIFIC METHOD IN ORDER

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*Sally wants to determine if her dog is really colorblind. Sally has heard this before but wants to know if it is true. Sally follows the scientific method to form a hypothesis, test the hypothesis, and draw conclusions. Put her steps in order by numbering them from 1 to 8. Write the number in the blank to the left of the step.*

\_\_\_\_\_ Draw Conclusions: Sally concluded that her data supported her hypothesis that dogs can differentiate between colors. Whether dogs can see colors exactly as we see them or whether they have a different way of telling them apart would require more research.

\_\_\_\_\_ Test the Hypothesis: Sally came up with an experiment using different balls identical in shape and size but differently colored. She took pictures of the balls in black and white to see how they would appear to an animal that can't see colors. She then trained the dog which was which to determine if her dog could tell the difference.

\_\_\_\_\_ Background Research: After searching on the internet, Sally found several experiments indicating that dogs might not really be colorblind.

\_\_\_\_\_ Communicate Results: Sally wrote a lab report and turned it in to her science teacher so that the other students would know what she had found.

\_\_\_\_\_ Ask a Question: Are dogs colorblind?

\_\_\_\_\_ Analyze the Data: Sally's dog could tell the difference between differently colored balls that would look the same in black and white. This means that her dog has some way of telling the different colors apart.

\_\_\_\_\_ Form a Hypothesis: Dogs are able to tell the difference between at least some colors.

\_\_\_\_\_ Observations: Sally found that with a little training her dog could identify the color of ball that she told him to fetch. Her dog could even identify colors that looked the same in the black and white photos.



## IDENTIFYING THE STEPS OF THE SCIENTIFIC METHOD

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*Below is an example of how a student follows the steps of the scientific method to test the affect of sugar water on bean plant growth. The student's method is broken down into parts. Each part represents one step of the scientific method. Write which step of the scientific method the example is illustrating in the blank. The steps of the scientific method are listed below for your review.*

Ask a Question                  Form a Hypothesis                  Record Observations                  Draw Conclusions  
Background Research      Test the Hypothesis                  Analyze the Data                  Communicate Result

1. The student designs an experiment where different plants are watered with pure water, 25 grams of sugar per liter of water, 50 grams of sugar per liter of water, and 75 grams of sugar per liter of water. Each plant is given the same amount of water daily. The plants are watered and allowed to grow for one month.  
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2. The student communicates her results in a written report of her research.  
\_\_\_\_\_
3. The student asks a question: Does sugar effect the growth of bean plants?  
\_\_\_\_\_
4. The student concludes that her hypothesis was correct and 50 grams of sugar per liter produces the healthiest, biggest bean plants but she decides she would need to repeat the experiment to make sure they are getting the same amount of sunlight every day.  
\_\_\_\_\_
5. The student records how tall each plant is, how green their leaves are, how big the leaves are, if there is any wilting of leaves, and if any bean pods are growing.  
\_\_\_\_\_
6. The student searches books in the library about growing plants to decide what the optimal amount of sugar might be for each plant.  
\_\_\_\_\_
7. The student organizes her data by which plants are the biggest and healthiest to the smallest. She finds that the biggest and strongest plants are those that were watered with the water containing 50 grams of sugar.  
\_\_\_\_\_
8. The student forms a hypothesis that 50 grams of sugar per liter of water will grow the healthiest, largest plants.  
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