Name Per

| UNIT | NOTES | |
|---|---|---|
| 1 | 1.4 | *Introduction to Science* |

## Objectives

- Define science
- List the steps of the scientific method
- Define and contrast observation and inference
- Record observations of an event
- Create inferences from an observation
- Define and contrast theory and law

## The BIG Idea

- Science is a system of acquiring knowledge based on the scientific method and research.

## Key Concepts

- Scientific investigation is how scientists gather information
- The scientific method is a process.

### Science is a system

- The word "science" has many, many definitions. However, we will focus on one general definition. Science is the _____ effort to _____ the history of the _____ _____ and how the natural world _____ with observable _____ _____ that supports these ideas.
- Whew! That can be a hard definition to understand. So, in short, science is a system (the process) of people trying to understand how the world works. And, we support our ideas of how the world works with evidence.
- People who study their environments are called _____.
- The terms science and scientist are used to define several jobs and fields.
- For example, this year in science, we will study and explore _____ and _____ sciences.
    - Earth science focuses on the science of our planet. This includes the study of minerals, _____, oceans, volcanoes, and the _____. Scientists often refer to earth science as

_____ or _____. Scientists who study geology are called _____.

- Life science focuses on the science of living organisms. Scientists often to refer to life science as _____. Scientists who study biology are called _____.

- There are many other types of sciences, too.
  - _____ science is the opposite of life science. It focuses on the non-_____ side of science. Sciences that are classified as physical science include _____, _____, and _____.
- Scientists study their environment by asking _____.
- Scientists then find answers to these questions by using _____, _____, and the _____ _____.
- We often refer to these three things as _____, the process of collecting _____.


What is science? _____
_____
_____
_____

## Scientific investigation is how scientists gather information

- The two most important forms of investigation are _____ and _____.
- An experiment is an organized _____ to study something under controlled conditions.
- For example, a scientist who finds a rock by the river might notice that it is lighter in color where it is chipped. This scientist might design an experiment to determine why the rock is a different color on the inside.
- Observing is the act of noting and _____ an _____, _____, or anything else detected with an _____ or with the _____.

- Observing is when you use one or more of your five sense to gather information about the world around you.
- Hearing a dog bark, counting twelve green seeds, and smelling smoke are all observations.
- An observation must be _____ and _____—an exact report of what your senses detect.
- This can be very difficult for some people to do. (Which is why we will be practicing it a lot very soon!)
- Let's look at this image. What observations can we make about what we see in this picture?

- Read the following statements. Put an "X" next to the statements that are observations.
    - ___ There is a chicken on the road.
    - ___ The chicken is crossing the road to get food.
    - ___ There is a road in the picture with a solid line and a dashed line in the middle of it.
    - ___ It is a very hot day in the picture.
    - ___ The chicken escaped from a farm.
- You can see through these examples what it means to be very factual and accurate when making observations. If you do not know something for sure OR if you are making a guess about something, then it is not an observation.
- In fact, when you are explaining or interpreting an observation, you are making an _____.
- For example, the statement "the chicken is crossing the road to get food," is an inference. Why? If you are not 100% absolutely certain that it is true, then you cannot call it an observation.

- When you form an inference about an observation, it is best to use what is called _____ _____. This states that all things being _____, the _____ explanation is often the best one.
- In other words, keep your inferences simple and realistic. For example, let's make an inference on this observation: *there is a chicken in the road*. The following are examples of inferences using Ockham's Razor:
    - The chicken is crossing the road.
    - The chicken is running.
    - The chicken is finding food.
    - The chicken is escaping danger.
- All of these are good examples of a simple inference. They are simple and realistic. Here is what you would get if you did not use Ockham's Razor (bad examples of inferences):
    - The chicken is a robot designed to attack farmers.
    - The chicken is crossing the road because there is a mad Colonel Sanders trying to make it into the next KFC meal.
    - The chicken is an alien and it is planning to attack the earth.
    - The chicken is about to be run over by a huge semi.


What are the two most important ways scientists investigate?

_____

Which of your senses did you use to make an observation about the picture? _____


How are an observation and an inference different? _____

_____

_____

_____

## The scientific method is a process

- The scientific method, also known as scientific _____, is the standard process scientists use to find out more about an observation, idea, or event.
- While the process can vary between scientists, they typically do the following:
    1. _____ and _____. (Also know as the purpose)
    2. Determine what is known through _____.
    3. Pose a _____.
    4. Investigate or _____.
    5. Interpret results or _____.
    6. Form a _____ and _____ results.
- The scientific method is referred to as a _____. Often a scientist will find that their conclusions do not match their hypothesis. Therefore, they will repeat most of the process to see if there were errors. This also means that you change your hypothesis and repeat the process!
- Let's look at each step in more detail.
    1. **Observe and ask a question**
        - This is pretty straightforward. You saw something and now you ask a question about it. (Water takes a long time to freeze. If salt is added to water, will it freeze faster?)
    2. **Determine what is known through research**
        - When beginning an inquiry, scientists find out what is already known about a question. They study _____ from other scientific investigations, read journals, talk with other scientists, and collect _____.
    3. **Pose a hypothesis**
        - Forming hypotheses and making predictions are two other skills involved in scientific investigation.
        - A hypothesis is a tentative explanation for an _____ or scientific problem that can be tested by further investigation. Many hypotheses are

written as If-Then statements. (Example: If salt is added to water, *[then]* the water will freeze faster.)

- A prediction is an expectation of what will be _____ or what will happen. All predictions are _____ because you do not know if it is true or not. (Example: Adding salt to the water will make the water freeze faster.)

### 4. Investigate or experiment

- An experiment is an organized _____ to study something under _____ conditions.
- An experiment that is controlled is an experiment in which all factors except _____ are kept _____. (Example: In this experiment, we will have three containers. 1 – 100 mL water with 10mg salt, 2 – 100mL water with 20mg of salt, 3 – 100mL water with no salt.)
- In our example, we also see what we call _____. In this experiment, the manipulated variable is the amount of salt added to each container. Other factors, such as the amount of water in each container, the size of the container, and the temperature each container will be exposed to, are constant.
- All of this information would be explained in the _____ of the experiment. Here is what the procedure would look like for this experiment.

1. Fill 3 250mL beakers with 100mL of water at 40° F.
2. Add 10g of salt to Container 1; stir.
3. Add 20g of salt to Container 2; stir.
4. Add no salt to Container 3.
5. Place the 3 containers in a freezer.
6. Check the containers every 15 minutes. Record the temperature of the water in each container. Record the appearance of the water in each container.

## 5. Interpret Results or Analyze

- As scientists investigate, they analyze their evidence, or _____, and begin to draw conclusions.
- Analyzing data involves looking at the evidence gathered through _____ or _____ and trying to identify any _____ that might exist in the data.
- Let's look at the data from our experiment.

**Temperature of Water in 15-minute intervals**

| Time/Cont. | #1 | #2 | #3 | Notes |
|---|---|---|---|---|
| **0 min** | 40° F | 40° F | 40° F | Look the same. |
| **15 min** | 35° F | 35° F | 35° F | Container 3 is all slushy, other containers are still water. |
| **30 min** | 30° F | 30° F | XX | #1 and #2 are slushy. Could not record temperature of #3; it is all ice. |

- What patterns do we notice in the data? We see that every _____ minutes, the temperature of the water is dropping by _____ degrees.
- Patterns aren't always about numbers. For example, we can easily tell that there is a relationship between salt water and the rate at which something freezes.
- What can we determine from our observations? Is the salt making the water freeze faster or slower?
- How does this information compare with the hypothesis?
- As we can see, our hypothesis is _____. So, we need to redo the experiment and _____ our _____ to reflect the data. (Example: If salt is added to water, *[then]* it will take longer to freeze.) If we find the same data and results, and our hypothesis reflects these results, then we know our hypothesis is true!

### 6. Form a conclusion and share results

- Now we can form our conclusion. (Example: Water with salt takes longer to freeze than water without salt.)
- We can share these results with other scientists. They can test our findings. If they get the same results as we did, then we know that our conclusion is correct. Now, we can call our conclusion a _____. (We'll get into what exactly this very soon! It's not what you think it means!)

- We're not done quite yet! We must _____ these steps many times (even if we believe we have the correct conclusion). We must do this to ensure that we made no _____ and that we get the same _____.


Using the numbers 1-6, put the following steps of the scientific method in the correct order.

___ Investigate or experiment
___ Form a conclusion and share results
___ Interpret results or analyze data
___ Pose a hypothesis
___ Observe and ask a question
___ Determine what is known through research

## A theory is different from a law

- There is a lot of confusion by people on what a theory is in science. This is due to the definition commonly used for theory. In everyday life a theory is a **guess**. In science, it has a much different meaning.
- In science, a theory is a set of _____ that have been recorded many times by many different people. It also can be used to explain several events or ideas, not just one.
- For example, there is the theory of relativity. It's a very simple theory and we can talk later about what it is. But more importantly, we can record what it says, observe its effects, and so on. Many, many people have made these observations and every time the results have been the same. Therefore, we have a theory!

- The same applies to the theory of evolution, the theory of relativity, the big bang theory…. (again, we're not guessing about these things, but experiments and observations have been done by several people and the same conclusions have been met.)
- A scientific law is a statement of _____ meant to explain an _____ or _____ of _____. It usually explains only one _____ or one _____.
- All scientific laws must be _____ and _____ (they must be the same everywhere in the universe) and _____.
- Scientific laws can be expressed through mathematical equations. For example, the equation listed here that of Newton's law of gravitation. $F = G\frac{m_1 m_2}{r^2},$


Define theory. _____
_____
_____

Define law. _____
_____
_____

Sources: McDougal Littell "Earth Science" © 2006.
Prentice Hall "The Nature of Science" © 1993.