Chapter 1 Earth Science: The Nature of Science

**Objectives:**

1. List the steps used in scientific investigation. This means I can define, identify, and compare & contrast the following:
   * observation (both qualitative & quantitative) vs. inference
   * hypothesis, independent variable, dependent variable, constant, data, conclusion
   * controlled experiment, control group, experimental group.

Observation vs. Inference

Observation:

1. Using one of the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to make understand the world around you.

* + 1. Sight, touch, hearing, smell, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (NOT in science class!)
    2. \_\_\_\_\_\_\_\_\_\_\_\_!!! Example: There is one TV in the room.

1. Types of observations:
   1. Qualitative: Description based on observations or “relative” comparison; \_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

* 1. Quantitative: Measured & numerical; \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Recorded as \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_in an experiment.
   1. Data = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Inference

* 1. Logical interpretation/explanation.
  2. Using reasoning to make sense of what you are observing

* 1. BASED on observations
  2. Example: You entered the classroom and a new adult was by my desk. You might infer that I \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_or that the new adult is a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
  3. Clues You Are Making an Inference; I think.., Like…, Because…
  4. Used in writing the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_of a lab report.

Observation and Inference Formative Assessment

|  |  |  |
| --- | --- | --- |
| How many legs? | What do you see? | Who is in this picture? |
| Can you build these shelves? Explain. | Does the square have curved sides? | What do you see? |
| Describe height of soldiers? Which tallest? | Eskimo Face Illusion  What do you see? | Make Your Own Observation About This Classroom.  Make Your Own Inference About This Classroom |

Scientific investigation = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ investigation. Usual Parts:

* Question/Problem:
  + 1. State/Identify a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_or \_\_\_\_\_\_\_\_\_\_\_\_\_\_ (What you want to know/understand/find out)
* Gather \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Form a hypothesis ; \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ for an observation.

* + 1. Must be Must be \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
    2. Usually in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_format.
    3. NOT a “guess”. NOT simply a prediction.
* Test hypothesis with an experiment
* Data: Record \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Conclusion: NOW analyze – \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  1. Based on \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  2. Decide if hypothesis was \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_or not.
  3. NOTE: A hypothesis is NOT “proven” – it is supported.

# **Experiment Requirements**

* **Variable:** A quantity that can vary & can affect the experiment outcome
  1. **Independent variable:**
     + 1. What the scientist\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ changes.
       2. Must have only \_\_\_\_\_\_\_\_\_\_ independent variable.
       3. It is what you are “testing”. Usually the \_\_\_\_\_\_\_\_part of hypothesis.
  2. **Dependent variable**: ­­­­­­­­­­­\_\_\_\_\_\_\_\_\_\_\_\_\_\_ outcome;
     1. The outcome “depends” on what the independent variable causes.
     2. It is usually the \_\_\_\_\_\_\_\_\_\_\_\_\_\_ part of the hypothesis.
  3. **Constants**: All other variables are kept the same for each test.

**\*\*Try Practice Problem #1**

**\*\*\*Answer Questions #1-3**

* **“Controlled” Experiment:** Experiment that contains 2 set-ups, with ONLY ONE factor/variable different between the set-ups.

1. **Control Group:** \_\_\_\_\_\_\_\_\_\_\_\_\_ to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to. May be the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ condition w/o the independent variable.
   * 1. Used for comparison to the experimental group.
     2. Helps determine the effect of the independent variable in the experimental group.
2. **Experimental Group:** The group **containing** the independent variable – what you are testing.

**\*\*Try Practice Problem #1**

**\*\*\*Answer Questions #4-5**

**I Have My Data (Recorded Observations) & Conclusion, Now What?**

1. **Report** Those Findings!!
   1. Very Important Step
2. **Why?**
   1. Credit - so YOU get the credit & not someone else
   2. Peers Check Work
   3. Repeat Experiments
   4. Build Off Your Work

**\*\*Try Practice Problem #1**

**\*\*\*Answer Question #6**

**PRACTICE PROBLEMS**

**Practice #1 Marshmallow Muscles (Scientific Method Practice)**

* Larry was told that a certain muscle cream was the newest best thing on the market and claims to double a person’s muscle power when used as part of a muscle-building workout.
* Interested in this product, he buys the special muscle cream and recruits Patrick and SpongeBob to help him with an experiment.
* Larry develops a special marshmallow weight-lifting program for Patrick and SpongeBob.
* He meets with them once every day for a period of 2 weeks and keeps track of their results.
* Before each session Patrick’s arms and back are lathered in the muscle cream, while Sponge Bob’s arms and back are lathered with the regular lotion.

1. **What is the independent variable?**
2. **What is the dependent variable?**
3. **List 2 constants**

* **The data from Larry’s experiment is shown in the table below.**

|  |  |  |
| --- | --- | --- |
| **Time** | **Patrick** | **Bob** |
| Initial Amount  (Marshmallows lifted) | 18 | 5 |
| After 1 week  (Marshmallows lifted) | 24 | 9 |
| After 2 weeks  (Marshmallows lifted) | 33 | 17 |

1. **Which person is the experimental group? How do you know?**
2. **Which person is in the control group? How do you know?**
3. **What should Larry’s conclusion be based on the results in the table above? EXPLAIN.**

**PRACTICE #2 Analyzing Data Practice - Mice**

An experiment studies the effects of an experimental drug on the number of offspring a mother mouse has. 10 female mice are given the drug and then impregnated. The number of mice in their litters is compared to the litters of mice that did not take the drug.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Number of Babies in litter** | | | | | | | | | | |
| Group A (Drug) | 5 | 6 | 4 | 8 | 5 | 3 | 7 | 12 | 12 | 8 |
| Group B  (No Drug) | 4 | 4 | 6 | 6 | 5 | 6 | 4 | 7 | 5 | 3 |

1. Write a hypothesis the experiment tested. (Remember the format for a hypothesis.)
2. Based on the data, was the hypothesis supported or refuted? Explain, supporting your answer with data.
3. Identify the following:
   1. Independent variable
   2. Dependent variable
   3. Control group
   4. A quantitative observation.
4. Practice “Synthesis” question. Explain how the Independent variable, dependent variable and control group are related in THIS experiment – be specific.