



1. What does this mean?

Every kid starts out as a natural-born scientist,
and then we beat it out of them.



A few trickle through the system with their wonder
and enthusiasm for science intact.

- Carl Sagan

What is the purpose of science?

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- **The purpose of science is to provide testable explanations for events in the natural world, and then to use data to find patterns and make predictions**

Steps of the Scientific Method

- **Review with your group**

Steps of the Scientific Method

- **Observation -> Curiosity -> Questions**
- **Form Hypotheses**
- **Conduct Controlled Experiments**
- **Collect and Analyze Data**
- **Draw Conclusions**

Logistics

- **Scientific Method Video:**

<https://www.youtube.com/watch?v=Jj9iNphbY88&feature=youtu.be>

Steps of the Scientific Method

- **Observation** -> **Curiosity** -> **Questions**

**Make observations of the
following picture.**



**Observations are not the same
as inferences.**

- **Discuss in your groups.**



Steps of the Scientific Method

- **Observation:** the act of noticing and describing events or processes in a careful, orderly way
- **Inference:** a logical interpretation based on prior knowledge

Steps of the Scientific Method

- **Observation -> Curiosity -> Questions**

Scientific Questions

- **Must be testable:**
 - **Have results that you can measure or be able to design an experiment around**

Scientific Questions

- **Most of the time in biology it is about relationships:**
 - **How does *this* affect *that*?**
 - **What will happen when *this* happens to *that*?**

Steps of the Scientific Method

- **Observation -> Curiosity -> Questions**
- **Form Hypotheses**

Hypotheses

- **If... this is done in the experiment**
- **Then... this will happen**
- **Because... scientific explanation.**

Hypotheses

- **A tentative scientific explanation *that can be tested***

How will the match affect the candle if it is placed on the wick?



What will happen to the water if the diver lands in the pool?



Which direction will the tree fall if a notch is made in one side?



Steps of the Scientific Method

- **Observation -> Curiosity -> Questions**
- **Form Hypotheses**
- **Conduct Controlled Experiments**

Controlled Experiments

- An experiment in which only one variable is changed



Variables

**Independent
Variable**



Influences
CHANGE
in the

**Dependent
Variable**



Variables

INDEPENDENT VARIABLE



What I CHANGE



DEPENDENT VARIABLE

What I OBSERVE



CONTROLLED VARIABLE

What I KEEP THE SAME

Variables

- **Independent variable:** the variable that is deliberately changed by the scientist
- **Dependent variable:** the variable that changes due to the independent variable, is observed and measured

Variables

- **Controlled variable:** conditions that are held constant during an experiment
- **Control group:** an experimental trial that does not experience changes in the independent variable

Practice Variables

- **On the following slides work with your group to identify all of the variables in the experiments**

Practice Variables

- Gru thinks that a special juice will increase the productivity of minions. He creates two groups of 50 workers and assigns each group the same task (stapling a set of papers). Group A is given the special juice. Group B is not given the special juice. After an hour, Group A made 1,587 stacks, Group B made 2,113 stacks.
- Identify the **control group**, **IV**, and **DV**, and possible controlled variables.
- What should Gru's conclusion be?



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Practice Variables

- Shaggy notices that his shower is covered in a strange green slime. Scooby tells him that coconut juice will get rid of the green slime. Shaggy decides to try this by spraying half of the shower with coconut juice. He sprays the other half of the shower with water. After 3 days of there is no change in the green slime on either side of the shower.
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Practice Variables

- Jerry believes that mice exposed to radio-waves will become extra strong. He puts 10 mice near a radio for 5 hours and compared these to 10 mice that were not exposed. His test required the mice to push a brick out of the way of their food. 8 out of 10 of the radio-waved mice were able to push the brick away. 7 out of 10 of the unexposed mice were able to do the same.
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Steps of the Scientific Method

- **Observation -> Curiosity -> Questions**
- **Form Hypotheses**
- **Conduct Controlled Experiments**
- **Collect and Analyze Data**

What are two kinds of data?

**Identify the following slides as
quantitative or qualitative**















Data

- **Quantitative: numbers from measuring**
- **Qualitative: descriptions from observation**

Steps of the Scientific Method

- **Observation:** the act of noticing and describing events or processes in a careful, orderly way

Curiosity: wondering about what was noticed

Question: forming a testable question about what was noticed

- **Form Hypotheses:** a tentative scientific explanation that can be tested
- **Controlled Experiment:** an experiment in which only one variable is changed
- **Collect and Analyze Data:** qualitative (descriptive) and/or quantitative (numerical) data can be collected
- **Draw Conclusions:** state what data means for the idea, and for future tests

Scientific Method

- On the next slide there are 4 words
- In your groups write these words in order of significance from **MOST -> LEAST**

Scientific Method

- **Theory**
- **Hypothesis**
- **Observation**
- **Law**

Scientific Method

- **What does each word mean?**

Theory

- **A highly tested, reliable, significant explanation of events in the natural world**
 - supported by copious data
 - unifies repeated observations and hypotheses
 - leads to accurate predictions
- ***EXPLAINS THE HOW/WHY***

Law

- Accepted as a universally accurate explanation about a phenomena
- *EXPLAINS THE WHAT*

Theories and Laws

- ***ARE MEANINGFUL IN SCIENCE***
- **An idea is not elevated to a theory or law until there is a plethora of statistically significant data to support it**