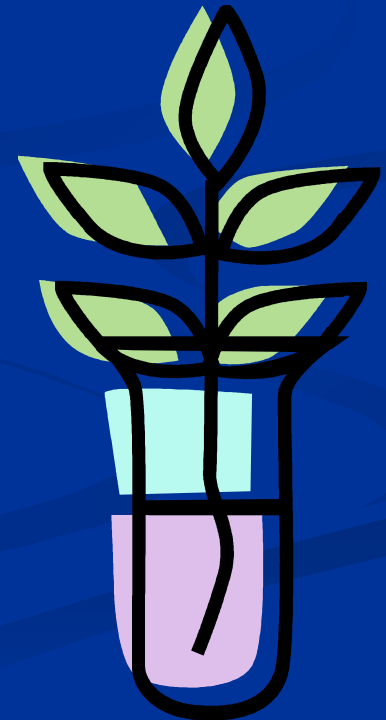
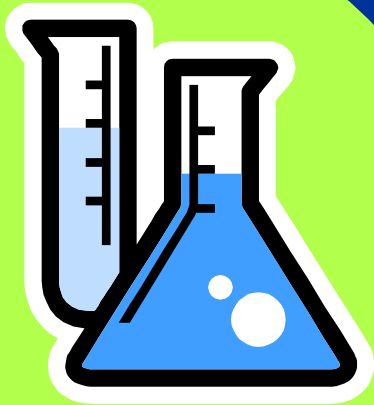


Introduction to Science: The Scientific Method

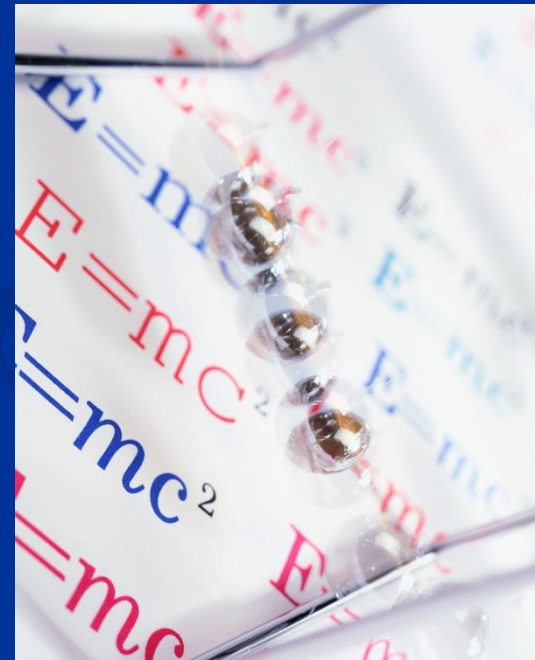
What is Science?

- The knowledge obtained by observing natural events and conditions in order to discover facts and formulate laws or principles that can be verified or tested.



What is the Scientific Method?

- Step-by-step way in which scientists answer questions.
- 1. Ask a question.
- 2. Research the topic.
- 3. Form a hypothesis.
- 4. Test the Hypothesis.
- 5. Gather Data.
- 6. Analyze Results.
- 7. Draw Conclusions.
- 8. Communicate Results.



State the Problem/Ask a Question

- The problem identifies what you want to find out.
- Develop a clear statement defining the problem
- Make sure your problem is narrowed/specific enough.
- State the problem in the form of a question.

Research

- Write down all information you already know
- Do research in books/internet on the topic you are investigating
- Record the information you discover

What is a hypothesis?

- An explanation that is based on prior scientific research or observations and that can be tested.
- “Educated Guess”
- “If... then... because” Statement



How do you test a hypothesis?

- Develop a test to support or not support your hypothesis. (This is your experiment).
 - Will usually be run multiple times
 - Must have only 1 independent/manipulated variable (the factor being tested)

How do you test a hypothesis?

- Use a Controlled Experiment
 - An experiment that tests only one factor at a time by using a comparison of a control group and an experimental group.
- Control Group
 - The group that the scientist changes nothing in. The Control group is used for comparison.
- Experimental Group
 - The group that the scientist has changed something. It is the variable in the experiment where you want to see how this condition affects something.

What is a variable?

- A variable is something that can change, either naturally or on purpose.
 - Independent/manipulated Variables
 - Dependent/responding Variables

Two Types of Variables

Independent/manipulated

- variables that are purposely changed or manipulated in an experiment
- the factor that you wish to test
- usually expressed after the word "if" in the hypothesis
- could be thought of as the "cause" in a cause and effect relationship

Example

The activity level (resting, walking, running)

Dependent/responding

- variables that may change as a result of the independent variable
- the factor you measure to gather results
- usually expressed after the word "then" in the hypothesis
- could be thought of as the "effect" in a cause and effect relationship

Example

The person's heart rate

Identify the Variables

independent
variable

1. If a student chooses to not study, then they will earn a poor grade.

independent
variable

2. If you drink Gatorade before a soccer game, then you will score more goals.

dependent
variable

independent
variable

3. If you increase the mechanical advantage of a pulley system used to move an object, then the input force becomes less.

dependent
variable

What are constants?

- They are what the scientist kept the same in both the control group and the experimental group.

How can you gather data?

■ Make Observations.

- Any use of the senses to gather information.

■ Qualitative Observations

- Anything that you see, smell, touch, taste, or hear.
- Ex. Blue, bitter, fizzing sound.

■ Quantitative Observations

- Any observation that can be measured.
- Must include a number.
- Ex. 5 centimeters long

Remember your data includes your observations **NOT** your inferences!



How can you analyze results to determine patterns?

- Record Data
 - Write observations and measurements
 - Be consistent when you are checking your experiments and recording the results
 - Create tables or charts (Data Tables and Pie Charts)
- Create graphs from collected Data (Line Graphs, Bar Graphs)
 - Complete all necessary mathematical calculations



Let's try!

After watching Monty Python: [She's a Witch clip](#), examine how the scientific method is used to solve the problem presented. Answer the questions in your notebook in complete sentences.

- 1. What is the problem?
- 2. What is the hypothesis?
- 3. Describe how the experiment was set up?
- 4. Which group was the control group? The experimental group?
 - Control: _____ Experimental: _____
- 5. Why give that antibiotic to a small group of people first?
- 6. What is the independent variable in this experiment? (Which factor is being tested?)
 - Independent Variable: _____
- 7. What is the dependent variable in this experiment? (Which factor is being measured/observed?)
 - Dependent Variable _____
- 8. How could this experiment have been designed better?
- Bonus: What is the reason for using a placebo?

How can you draw conclusions?

- Answer the following questions in paragraph form (Always explain in detail using scientific vocabulary.):

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Framework (purpose/hypothesis)	The student response addresses and restates the hypothesis/problem and clearly supports or refutes it and explains the role of the test in making the decision.
Conclusion Evidence (data/observations/concepts/analysis/evidence)	The student response demonstrates clear connections between data, observations and concepts are consistently supported by specific evidence
Error	The student response identifies sources of error and explains effect on results.
Writing	The student response contains no errors in mechanics, grammar, and usage, and the meaning is clear. No first person is used.

What is in a conclusion?

- Restate the basics of your experiment, including what you were trying to accomplish or prove. (refer to the purpose and restate your hypothesis)
- Reference some specific results (you do not have to give detail on every single result, but use some of them as examples in your explanation)
- What flaws have occurred or could have occurred? Here, you want to state variables that could have impacted your results.
- Sum it up! Sum up your conclusion and reveal whether your experiment supported or disproved your hypothesis.
- Implications! Use your results to explain how this experiment could be used in future studies or research (apply it to real life situations).
- Read it out loud! You want to confirm that it all makes sense! Check your grammar and punctuation!

What is the difference between a scientific theory and a scientific law?

■ Theory

- An explanation that ties together many hypotheses and observations.
- Supported by repeated trials.
- May help with further predictions.
- Tells why it happens.

■ Law

- A summary of many experimental results and observations.
- Tells how things work
- Only tells what happens, it does not explain why.