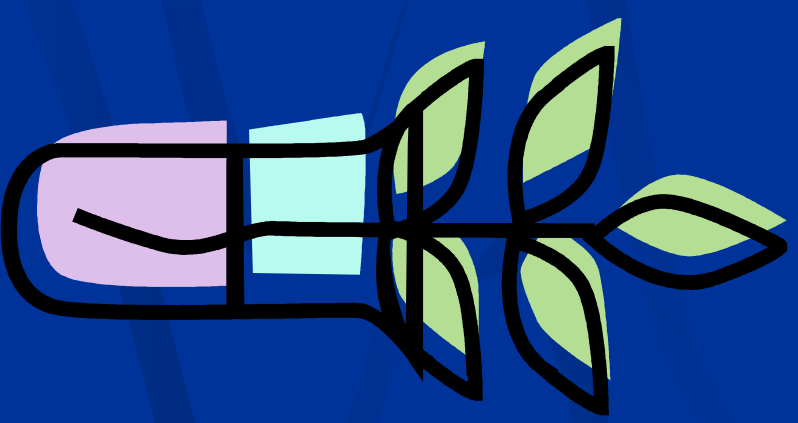


Introduction to Science: The Scientific Method



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 Physical Science?

- The scientific study of non-living matter.
 - Chemistry
 - The study of all forms of matter, including how matter interacts with other matter.
 - Physics
 - The study of energy and how it affects matter.



What is the Scientific Method?

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



State the Problem/Questions

- 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:
 - How does _____ affect _____?
 - What is the effect of _____ on _____?



Research

- Write down all information you already know
- Do research in books on the topic you are investigating
- Ask experts on the subject you are researching
- If you find an answer to your problem/question you do not need to move on



What is a hypothesis?



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



How do you test a hypothesis?

- Develop an experiment that will support or not support your hypothesis.
- Must be run multiple times (many trials)
 - Must have only 1 independent variable (the factor being tested)
 - Must include 2 setups (groups)
 - Experimental setup (group)
 - Control setup (group)

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.
- In an experiment it is a factor that is different from one group to another.
- Independent variable (a cause)
 - The factor that the scientist has changed in order to test the hypothesis (on purpose). It is the cause
- Dependent Variable (the effect)
 - The result of what the scientist changed. It is the effect of what happened in the experiment.

What are constants?

- They are items or conditions that the scientist kept the same in both the control group and the experimental group.
- Conditions that are **THE SAME** in both the experimental and control 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



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



How can you draw conclusions?

- Answer the following questions in paragraph form (*Always explain in detail using scientific vocabulary.*):
 - Do your results / data support your hypothesis? Why or why not?
 - What are ways you can improve your data?
 - What would you do differently if you were to repeat the experiment?



What is in a conclusion?

- You restate the purpose of your experiment
- You indicate what the results were. Use numbers!!! Example: “On average after 3 trials,”
- You explain why those results were given. Here you think about what you found out in your research.
- You consider any improvements to your procedure. This is error analysis.
- You ask a new question – what do you want to do next?





Let's try!

- Six bean plants are to be tested to see what happens if light is taken away. The all have the same type of container, the same amount of soil, and they will receive the same amount of water. Three will be placed in a sunlit window and 3 will be placed in a dark closet for 2 weeks.

- 1. What is the question?
- 2. Research.
- 3. Form a Hypothesis.
- 4. Test your hypothesis.



Let's try continued...

- 4a. What is the control group?
- 4b. What is the experimental group?
- 4c. What is the independent variable?
- 4d. What is the dependent variable?
- 4e. What are the constants?
- 5. Gather data.
- 5a. What are some Qualitative observations you can make?
- 5b. What are some quantitative observations you can make?



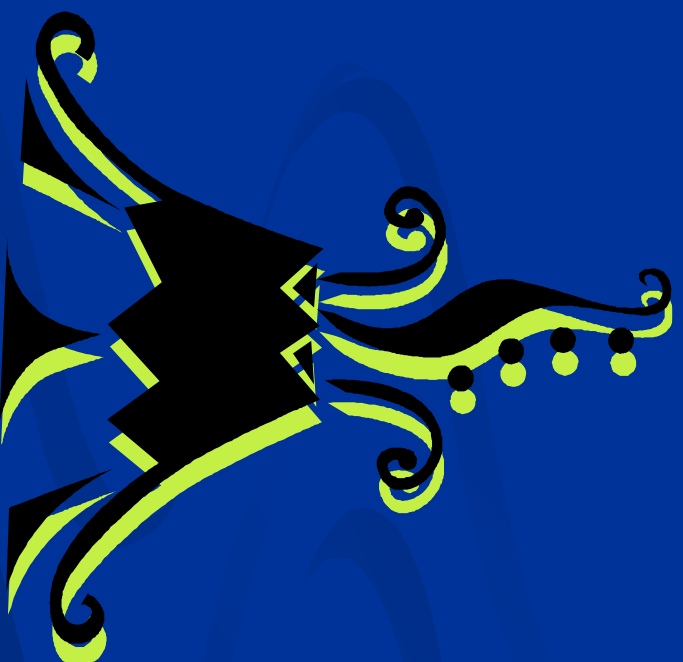
Let's try continued...again.

- 6. Analyze results.
- 6a. How can you show your results?
- 7. Draw Conclusions?
- 7a. How do you write a conclusion paragraph?



What are scientific models?

- Model
 - A representation of an object or system.
 - Physical Models
 - Mathematical Models
 - Conceptual Models



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.

