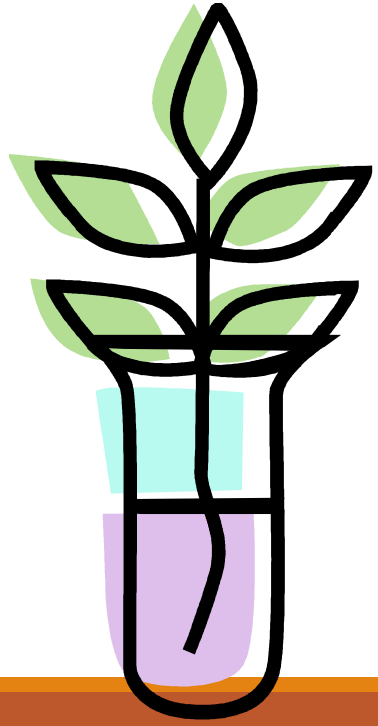
Introduction to Science: The Scientific Method

COURTESY OF: OMEGA SCIENCE

What is Science?

- knowledge obtained by **observing** natural events and conditions in order to discover **facts** and formulate **laws** or principles that can be **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 and record **Data**.
6. Analyze **Results.**
7. Draw **Conclusions.**
8. Change hypothesis/re-test
9. Communicate **Results.**

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 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).

- Must be repeated **multiple** times
- Must have only **1** independent **variable** (the factor being tested)
- Must include 2 setups
  - **Experimental setup**
  - **Control setup**

How do you test a hypothesis?

Use a Controlled Experiment

- An experiment that tests only **1** factor at a time by comparing 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. ***

In an experiment it is the factor that is **different** from one group to another.

Independent variable

- The factor that the scientist **has changed** (on purpose) to test the hypothesis It is the cause.

Dependent Variable

- The **result** of what the scientist changed. It is the effect of what happened in the experiment.

What are constants/controlled variables?

- what the scientist keeps 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

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?

How would you communicate results?

- Share data and information with others, such as scientists.
- Publish your findings in a book, magazine, journal, the internet.

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?