
THE
SCIENTIFIC
METHOD

What is the Scientific Method?

- The process by which all “scientists” investigate is called the scientific method

- Most often scientific investigations answer some questions but they also raise a great number of new questions.

- The Scientific Method allows scientists to solve complicated problems by breaking them down into a series of smaller steps

Key steps

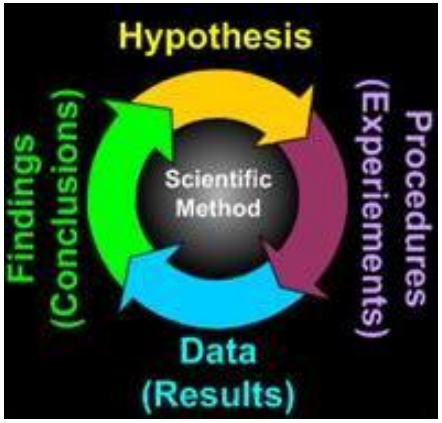
- Scientists use observations, hypotheses and deductions to propose explanations of natural phenomena in the form of theories
- Predictions from these theories are tested by experiment.
- If a prediction turns out to be correct, the theory survives.
- The scientific method is essentially an extremely cautious means of building a supportable, evidence based understanding of the natural world.

Key steps in the Scientific Method

1. Recognize/State the Problem

   Ask a question

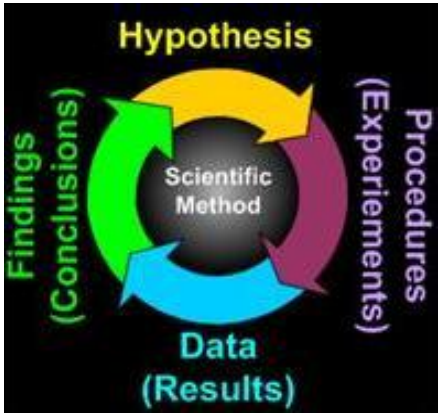
   make sure the question is clear and specific.



Key steps in the Scientific Method

1. Recognize/State the Problem
2. Develop a Hypothesis –

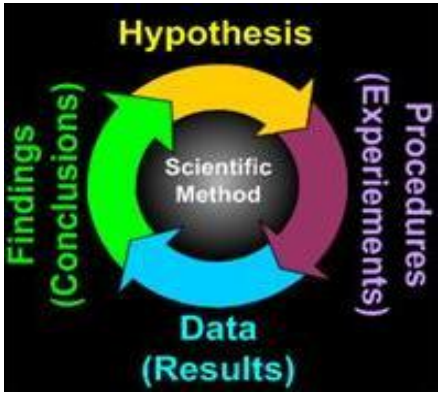
(an educated guess about the possible answer to a problem)



Hypotheses are written in an "if and then" format and consist of a problem and a testable prediction.

Key steps in the Scientific Method

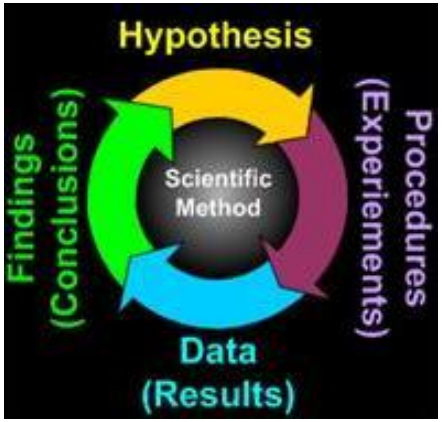
1. Recognize/State the Problem
2. Develop a Hypothesis
3. Design an Experiment
    a. Identify the control group
    b. Identify the experimental group
    c. Identify the dependent variable
    d. Identify the constant factors
    e. Include a large sample size
    f. Specify the number of groups involved
    g. Describe the group treatments (ie summarize the procedure)



Key steps in the Scientific Method

4. Collect data :

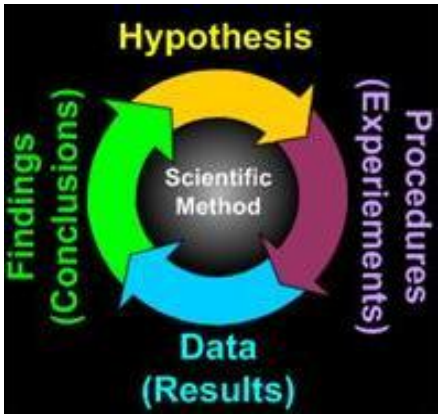
From the observations and or previous research



Key steps in the Scientific Method

5. Interpret results:

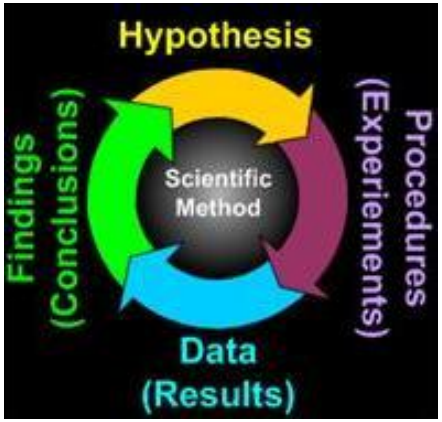
analyze the data use charts, graphs, tables, drawings, photos etc.



Key steps in the Scientific Method

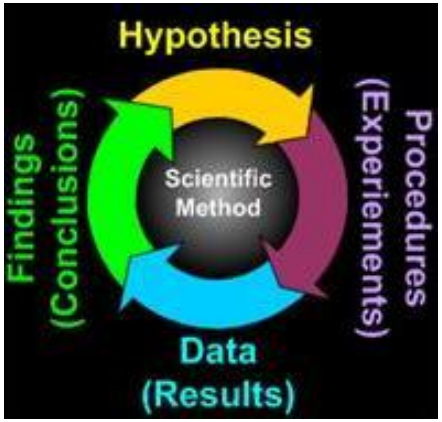
6. **Make conclusions:**

   This should answer the question. Does your data support or not support your hypothesis



Key steps in the Scientific Method

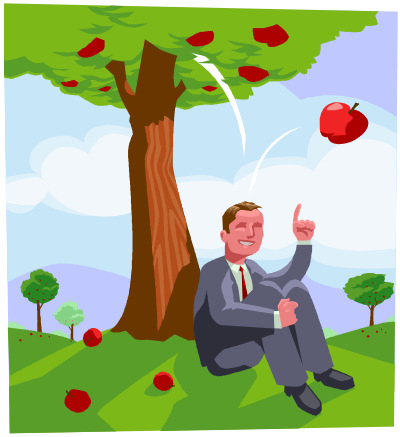
1. Recognize/State the Problem
2. Develop a Hypothesis
3. Design an Experiment
4. Collect data
5. Interpret results analyze the data
6. Make conclusions
7. Develop New Questions

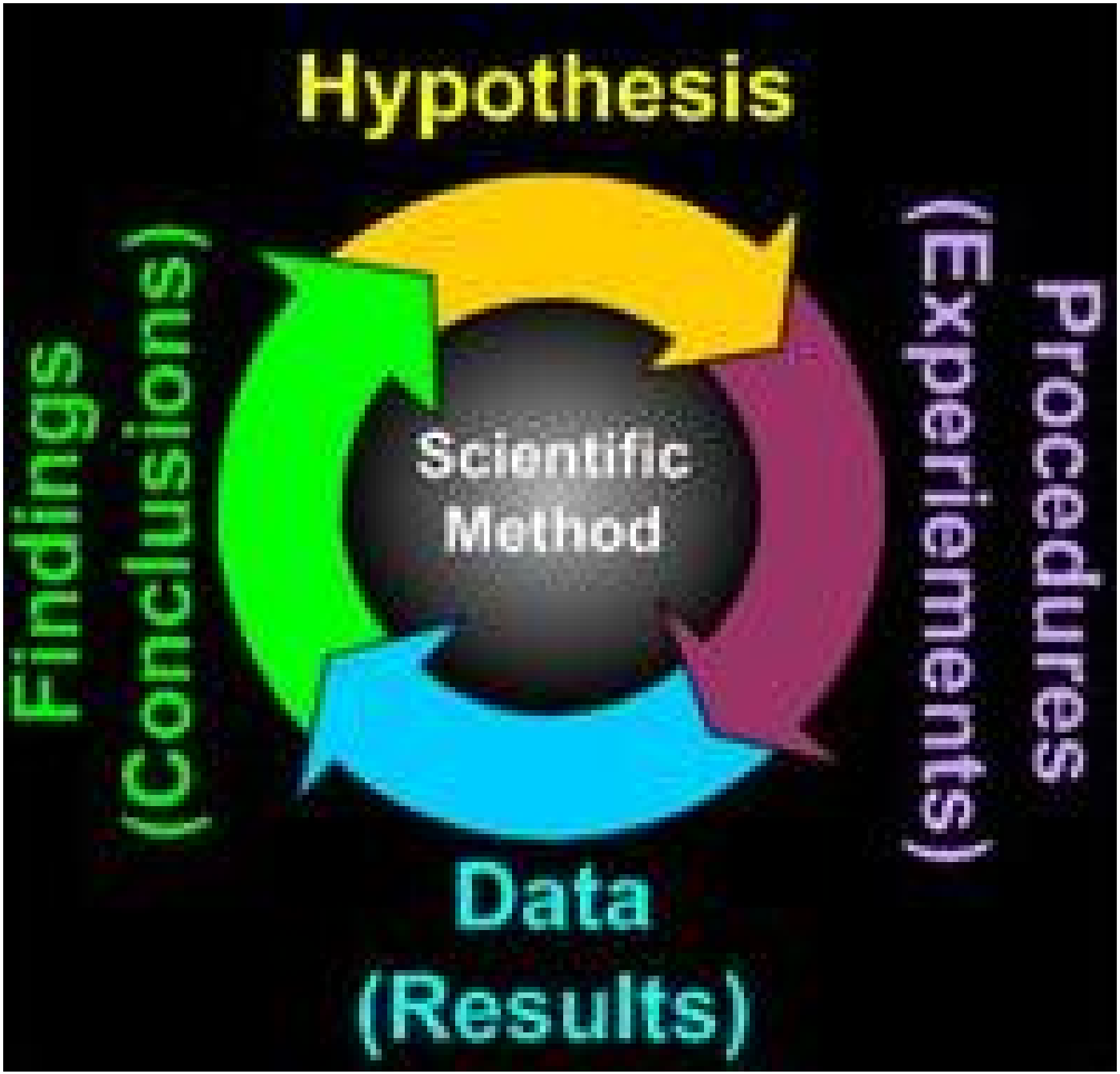


Theory vs. Law

- A hypothesis which continues to be **supported through many years of further research** by many different scientists, becomes accepted as fact and is termed a **THEORY** (ie: the theory of evolution)

- if a theory is **true for centuries** and remains true everywhere, then it may be elevated to a **LAW** (ie: Law of Gravity).




Hypothesis
Procedures
(Experiments)
Data
(Results)
Findings
(Conclusions)
Scientific
Method

Medical Science

Scientific Method	High Cholesterol
Problem	Patient has high cholesterol
Hypothesis (prediction)	If I give patients with cholesterol a certain chemicals then it will dissolve cholesterol deposits.
Test	Give 100 patients these chemicals, give 100 patients placebo.
Observe result	Same number lower their cholesterol as placebo patients.
Revise hypothesis?	Try different combo of chemicals.
New test?	Re-run medical test. Observe results.
Scientific Theory	The chemical we tested reduces cholesterol.

Everyday Science

Scientific Method	Car Repair
Problem	Engine won't turn over.
Hypothesis (prediction)	If the battery is dead, then the engine won't turn over.
Test	Replace battery.
Observe result	Engine now turns over.
Revise hypothesis?	Not needed.
New test?	Not needed.
Scientific Theory	Cars won't work without a charged battery.

A valid scientific experiment must include the following characteristics

1. **Control group**:

   group which does not receive the experimental treatment, provides a basis for comparison

2. **Independent variable**:

   (experimental variable) one factor which is tested

   "What you change"

3. Dependent variable:

Factor being observed/measured as it responds to the experimental variables

"What you observe"

4. Constant factors:

A single factor is investigated at a time; all other variables are kept constant (controlled variables)

5. Large sample size

Ensures reliable results

6. Repeatable:

Other researchers can perform the experiment in order to validate/ confirm results; detailed procedure required

Example:

1. A farmer has heard that free range chickens result in lower fat poultry than chickens raised in small cages. Design an experiment to test this idea.

Example:

Question:

Do free range chickens produce lower fat poultry than caged chickens?

Example:

Hypothesis:

If chickens are raised free range then they will result in lower fat poultry than cage raised chickens

Experimental Design

a. **Control group:**

caged chickens

b. Experimental group

free range chickens

Experimental Design

c. Independent variable

cage size

d. Dependent variable

fat content

Experimental Design

e. **Constant factors**

type of food, amount of water, amount of sunlight, type of chickens, sex of chickens

f. **Group size**: 10-10,000 chickens

g. **Number of groups**: 2

POGIL

Process Oriented Guided-Inquiry Learning

Complete the following POGILs in Groups of 2:
→ SCIENTIFIC INQUIRY

→ EXPERIMENTAL VARIABLES

Keep in Mind…
- Work as a team to develop the answers to the questions
- Everyone should record their answers into their own POGIL sheet