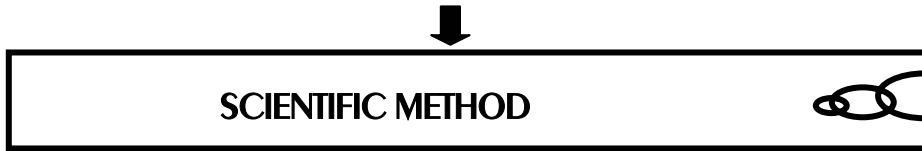


HOW DO WE MAKE SCIENTIFIC DISCOVERIES???  
HOW ARE PROBLEMS SOLVED???



FORMAL METHOD  
FOR DOING SCIENCE

STEPS:

☺ based on rational thinking

1

OBSERVATION

☺ based on experimentation

- A. Initial Observation
- B. Information gathering/Research
- C. Title of the Project
- D. State the Purpose of the Project
- E. Identify Variables
  - I. Independent
  - II. Dependent

**Example:** You have just created a new type of fertilizer for improved growth of roses, and now you would like to find out the optimal amount to use. Your experiment would involve testing several different concentrations of your new fertilizer on rose plants. For this experiment, the amount of fertilizer would be your independent variable because it is what you are controlling; what you can change. The dependent variable would be the resulting growth of each rose plant. Growth is affected by the change in concentration of fertilizer. Furthermore, a control for this experiment would be growth of a rose plant that had NO fertilizer.

2

HYPOTHESIS

- A. Reword your question(s) into a statement that **CAN BE TESTED BY AN EXPERIMENT!**
- B. Make a list of your predictions (answers) for each of your hypotheses.
- C. Design an experiment to test each hypothesis.
  - I. Step-by-step procedure
  - II. Control
  - III. Select only **ONE** thing to change (vary) in each experiment – Things that can be changed are you **INDEPENDENT VARIABLES!**
  - IV. Decide how you will measure the amount of change
- D. Gather all necessary materials and equipment.

3

## CONTROLLED EXPERIMENTS

- A. Perform each experiment (remember . . . test only ONE variable at a time!!)
- B. Record all observations and measurements made. **WRITE EVERYTHING DOWN!!** It is better to have too much information, than not enough.
- C. Perform any calculations needed.
- D. Summarize your results.
  - I. tables
  - II. graphs
  - III. formal written observations

4

## CONCLUSIONS

- A. Use your summarized data to prove or disprove your hypothesis.
- B. Summarize any difficulties/problems you had while performing your experiments.
- C. Based on your results, do you need to change any procedures??? Repeat any experiments???
- D. List other things you have learned.

### TYPES OF ERRORS:

#### A. Experimental errors

- I. Measurement method unreliable?
- II. misuse of an instrument
- III. incorrect measurement
- IV. independent variable has no affect on the system

#### B. Random errors

- I. result in non-reproducible data that does not make sense (experimental results cannot be duplicated)
- II. Can occur because you inadvertently do something different in each run of the experiment.