The Scientific Method

- a generalized sequence of steps used to investigate a problem

Step 1.

Define the problem. Make sure that only one question is being asked.

Step 2.

Research the problem. Use all available resources to collect data on the subject being covered. Access libraries, internet, books, magazines, personal interviews, etc.

Step 3.

Develop a testable hypothesis. Make it a short definite statement. " If 'A' (your guess), then 'B' (its consequence)."

EG "If crabs need water to survive, then crabs will actively seek out wet areas."

Because science proceeds by disproving rather than proving, what is really tested is a null hypothesis. This is just the hypothesis reworded such that the original guess does not apply.

EG "If crabs do not need water to survive, then crabs will not actively seek out wet areas."

S-T+S

Step 4.

Develop a controlled experiment.

An important feature of any scientific experiment is control. That is, holding all factors constant except for the one being tested. A controlled experiment is one that contains only one experimental variable.

The experimental variable is the one thing being tested. All other variables must be held constant.

Step 5.

Analyze the data and draw a conclusion.

The conclusion may or may not support the hypothesis.

Step 6.

Replication - Why once is never enough !

Additional experimentation must then take place to build documentation concerning the problem. Each repetition of an experiment is called a replicate. How many trials will it take before you can be reasonably sure of your conclusion?

THE SCIENTIFIC METHOD

The Scientific Method is an organized way for scientists (or anyone!) to answer questions and develop solutions. There are usually six parts to it.

- **PURPOSE/QUESTION** – What do you want to learn? An example would be, "What doorknob in school has the most germs ?" or "Do girls have faster reflexes than boys?" or "Does the color of a light bulb affect the growth of grass seeds?"

- **RESEARCH** – Find out as much as you can. Look for information in books, on the internet, and by talking with teachers to get the most information you can before you start experimenting.

- **HYPOTHESIS** – After doing your research, try to predict the answer to the problem. Another term for hypothesis is 'educated guess'. This is usually stated like " If I...(do something) then... (this will occur)"

  An example would be, "If I grow grass seeds under green light bulbs, then they will grow faster than plants growing under red light bulbs."

- **EXPERIMENT** – The fun part! Design a test or procedure to find out if your hypothesis is correct. In our example, you would set up grass seeds under a green light bulb and seeds under a red light and observe each for a couple of weeks. You would also set up grass seeds under regular white light so that you can compare it with the others. If you are doing this for a science fair, you will probably have to write down exactly what you did for your experiment step by step.

- **ANALYSIS** – Record what happened during the experiment. Also known as 'data'.

- **CONCLUSION** – Review the data and check to see if your hypothesis was correct. If the grass under the green light bulb grew faster, then you proved your hypothesis, if not, your hypothesis was wrong. It is not "bad" if your hypothesis was wrong, because you still discovered something!

A few other terms you may need to know:

INDEPENDENT VARIABLE

This is the part of your experiment that you will test (vary) to answer your hypothesis. In the example above, the independent variable would be the different colors of the light bulbs.

DEPENDENT VARIABLE

This is what occurs in response to the changing independent variable. In our example the Dependent Variable is how much the grass seeds grow.

CONTROL

A good experiment includes a part of the experiment where you do not include the Independent Variable. In our example, grass seed that is growing under the usual white (uncolored) bulb would be your control. The control lets you compare your results at the end of your experiment.