THE SCIENTIFIC METHOD

CAUSE AND EFFECT

Scientists observe everything in the world from the viewpoint of cause and effect. THERE IS NO MAGIC! Scientists believe that all events are the result of a collection of other earlier events. Take a split second. Watch something happen, like fireworks exploding, an alarm clock starts ringing or a leaf twisting once in the breeze. The events that happened before the split second that you watched are the 'causes'. The single event you saw during that split second is called the 'effect'. With the help of your family or classmates, pick a single, split second event. Try to name twenty or so other events that helped cause it.

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Each collection of causes will produce a predictable event! Gaining new knowledge about our world is simply understanding how and why the causes create a particular event. Over the years, scientists have developed a step by step method to investigate an event. It is called the 'scientific method'. The carefully studied event is called an 'experiment'. If care and honesty are used, the scientific method will help you study your experiment. You should be able to discover the correct cause and effect relationships. The following steps will lead you through the scientific method.

A. PICK A TOPIC. Before an event can be studied you must have some idea of what it is that you want to observe. Your topic might be 'acid rain'.

B. LIMIT YOUR TOPIC. You have very little time and resources. You will only be able to study an extremely small collection of events. You must, therefore, limit your experiment to one or two specific events. "I will study the effect of nitrate bearing acid rain on a brick."

C. STUDY, OBSERVE AND GATHER. Read about your limited topic. Observe related events. Gather existing information concerning your limited topic. Look for unexplained or unexpected events or results. Also, you might need to learn something about the field of mathematics known as statistics.

D. GENERALIZE. Organize what you know about your topic. Make lists of known causes for specific events Describe what generally happens when you observe related events.

E. THEORIZE, FORM A QUESTION AND PREDICT. Write a sentence that predicts what will happen if you do your experiment. This statement is called a theory. Your theory must agree with observations already studied. From your theory, put together the exact question you want to answer with your experiment. State what you think would happen if some of the causes of your event were changed. Causes that can change are called "variables". Some variables are turned on or off like a switch, others change in size like the temperature setting of an oven.

F. EXPERIMENT. Design and do a series of experiments. You must design each experiment so you can observe the results if one and only one variable is changed. Changing just one variable, allows you to determine that variable's effect on your chosen event. To see the real effect, you need to change the size of single variable several times. Be sure to include one or more experiments when none of the variables are changed on purpose. This is called the control experiment. The control is very important. It shows the normal results of your experiment if you don't try to change anything. Be careful, you may be able to keep many variables from changing, but some you usually can't do anything about. Some variables you have control over are room temperature, time of day, how far you stretch a spring, relative humidity and how hungry your human or animal subject is. Some variables that you can't do anything about are atmospheric pressure, how bright the sunshine is, the mood, skill, reflexes or previous dietary habits of yourself and/or subjects.

G. EXAMINE YOUR RESULT. Did your experiments give you the expected results? Why or why not? Be very honest! Reexamine your experiments. Was more than one variable changed at one time? Was your experiment done with the exact same steps each time? Are there other causes that you had not considered or observed? Were there errors in your observations? How large were the errors? If your physical skills were involved, how much better did you get at doing your job with each repeat? Remember that understanding errors and reporting that a suspected variable did not change the results can be valuable information.

H. DRAW CONCLUSIONS. What variables are important? Was your theory correct? Did you collect the proper data? Did you collect enough data? Does more work need to be done or is your experiment finished? If your theory didn't predict the correct results, yet all your errors are explained, you must return to steps C, D, and E.