The Scientific Method

It is a way to ask and answer scientific questions by making <u>observations</u> and doing <u>experiments</u>.

The Scientific Method

Problem

Identify the problem (question)

Collect information

Form a hypothesis

Procedure

Test the hypothesis

Experimental Design

Observations & Data

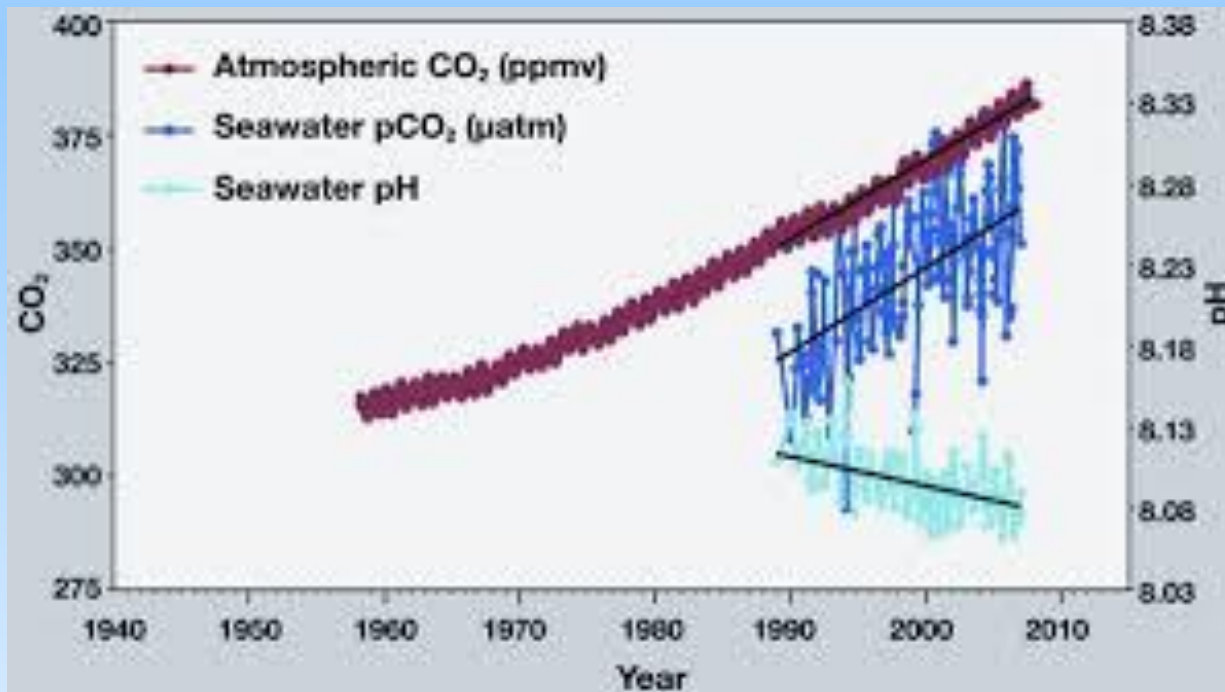Make observations

Assemble tables and graphs

Conclusions

Support or reject hypothesis based on data

Report and publish results

Step # 1 - State The Problem and Develop a testable question

Problem: What are the effects of climate change on coral?

Testable Question: How does the increase in acidity of the oceans due to climate change affect the growth of coral?

Step # 2 - Make a Hypothesis

A hypothesis is a possible answer to a scientific question or problem.

It should be structured as an "If….then….because…." statement.

Example:

If the acidity of the oceans increase then their growth rate will decrease because the acidity dissolves the calcium compounds that create the skeleton of the coral structure.

Step # 3 Design an Experiment

An <u>experiment</u> is a carefully created situation that will test a <u>hypothesis</u>. It will need to have:

      a. <u>experimental</u> groups

      b. <u>independent</u> (manipulated) variable

      c. <u>dependent</u> (responding) variable

      d. <u>control</u> group

      e. constants / variables that are kept constant in each of the trials

a.Experimental Groups

The members of the experiment that will be receiving some sort of <u>special testable treatment</u> during the experiment.

Example: Set up an experimental group of coral. This group will be placed in the same environment where the acidity of the water will be manipulated.

b. Independent (manipulated) Variable

It is the one thing that is <u>purposely changed</u> by the investigator.

Example:

In the coral experiment acidity of the water is the independent variable. In the experiment it is the <u>one thing</u> that have been chosen to test.


OCEAN ACIDIFICATION

HOW WILL CHANGES IN OCEAN CHEMISTRY AFFECT MARINE LIFE?

CO_2 absorbed from the atmosphere

$CO_2 + H_2O + CO_3^{2-} \rightarrow 2\,HCO_3^-$

carbon dioxide | water | carbonate ion | 2 bicarbonate ions

consumption of carbonate ions impedes calcification

ACID OCEAN

c.Dependent (responding) Variable

The one thing that you are going to <u>measure</u> or <u>count</u> in an experiment.

<u>Example:</u>

Measure the size of the coral

every week to see how well they are

growing or shrinking.

Present day | Acidified conditions
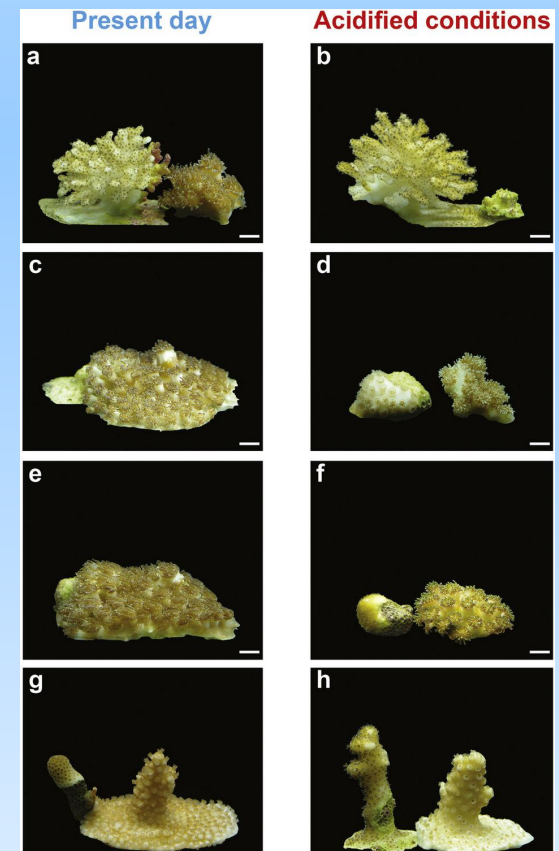
d. Control Group

It refers to the members of the experiment that <u>will not be</u> receiving any sort of <u>special</u> treatment during the experiment.

Example:

 Set up a control group of plants. This group <u>will not receive</u> any change in acidity.

e. Constants

All the things in the experiment that need to be <u>kept the same</u> for all the members of the experiment. It is the only way to know if the results that you get are due to the independent <u>variable</u> in the experiment.

Example:

1. <u>Type of coral</u>

2. <u>Temperature</u>

3. <u>Amount of sunlight</u>

4. <u>Containers</u>

5. <u>Amount of water</u>

Step # 4 Make Observations

- <u>Observations</u> are made when the experimenter uses their <u>senses</u> to gather information during the experiment. It is sometimes called <u>qualitative</u> data.

- <u>Data</u> is collected when any measurements are made during the experiment. It is sometimes called <u>quantitative</u> data.

- A data table is used to organize both quantitative and qualitative data.

Independent Variable	Dependent Variable

Step # 5 Conclusion

It states whether or not the data <u>supports</u> or <u>refutes </u>the hypothesis. It should also provide explanations for the observations

Example:

In most coral species the growth declined in more acidic seawater and in many trials the size of the corals decreased. The matrix in which the live coral cells lives slowly eroded away due to the chemical reaction with the acidity. The acidity of the water may also have damaged the cells that generate the coral structures.

FLORIDA KEYS

1980   2010

Try this for practice.

Identify a testable question for a topic you are interested in related to the course.

Write a hypothesis for your question.