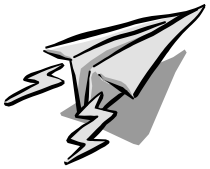
Name_____

Paper Airplanes & Scientific Methods

Scientific Inquiry refers to the many different ways in which scientists investigate the world. Scientific investigations are done to answer questions and solve problems. Many times investigations are said to follow a Scientific Method. Scientific methods are steps that are followed during an investigation to make sure that the information gained during the investigation is accurate and true. The steps usually followed are:

- A Question or Problem is Identified and Stated.
- Background Research or Literature Review is done to find out what is already known about the topic.
- A Hypothesis is formed – this is an educated guess about the result of the experiment based on the information learned during background research.
- A very detailed, step-by-step Procedure is developed to test the hypothesis. This is also called the Experimental Design or Methodology. It includes a list of Materials.
- The investigation is conducted and Data is Collected.
- The Data is Analyzed.
- Conclusions are Drawn. What does the data mean?
- Results are Communicated. Other scientists review the results of the investigation.

During this investigation, you will practice the steps listed above as well as different science skills, such as metric measurements. **Be sure to read everything in this handout** and refer to your textbook handout whenever you find it necessary.



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Part 1: Identify and State the Question or Problem.

You want to know which paper airplane design is best. The first thing you have to do is decide what ***best*** means. This is called an operational definition – the definition you will use during the investigation. For this investigation, we will define best as the plane that flies the farthest. We will not be concerned with height or loops or straight flight.

Now, as a group, decide what you would like to test: the length of the plane, the weight of the plane, the style of the plane, position of weights on the plane, or something else. Write a question that that states what your group would like to investigate:

_____

_____

Part 2: Background Research.

Find out what is already known about paper airplanes. There is research material available in the classroom on paper airplanes and flight. You may also use the Internet.

Spend a little time reading up on paper airplanes. Write 3 – 5 notes here:

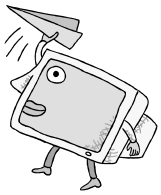
_____

_____

_____

_____

_____



Part 3: State a hypothesis.

Based on how we defined ***best*** and what you now know about paper airplanes, write a properly formatted hypothesis in future tense that states which type of paper airplane (that you are testing) will fly the greatest distance.

_____

_____

_____

Part 4: Write a Procedure.

When you design an experiment, you must first pick one thing to test, the length of the plane, the weight of the plane, the style of the plane, position of weights on the plane, and so on. This is called the Manipulated or Independent Variable – it is what ***you, the scientist*** will change or test.

IV = _____

Everything else that could possibly change, but doesn't is called a Constant Variable. Scientists control all the variables they can so that they can be sure that the results of the investigation are due to the change in the one variable that is tested.

You must decide what kind of data you will collect or what you will observe and measure. This is called the Responding or Dependent Variable.

DV = _____.

You need to repeat the experiment several times. These are called Trials. Multiple trials help make sure that your data in consistent. If you only do an experiment one time, you might get some very unusual data for many reasons. Repeating the experiment allows you to be confident in your findings.

A list of materials needed so that other scientists can repeat your experiment.

Lab Group Members_____

Period _____

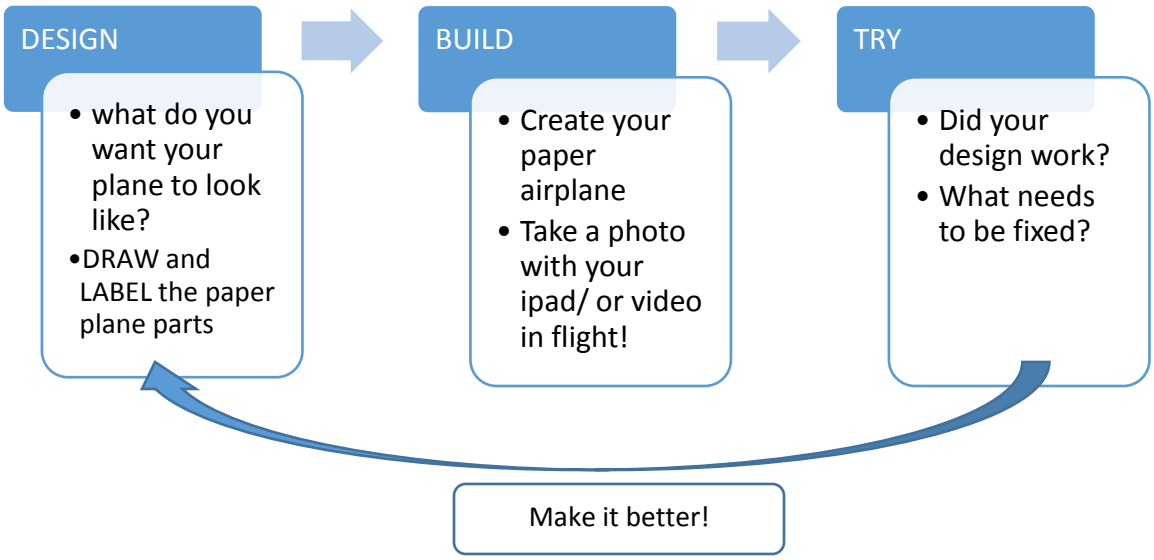
RULES:

- No throwing paper planes in classroom (ask to go in the hall or outside for model testing)
- The measurements must be metric measurements (cm or m)
- You must be able to bring the model plane to school for the final class competition.

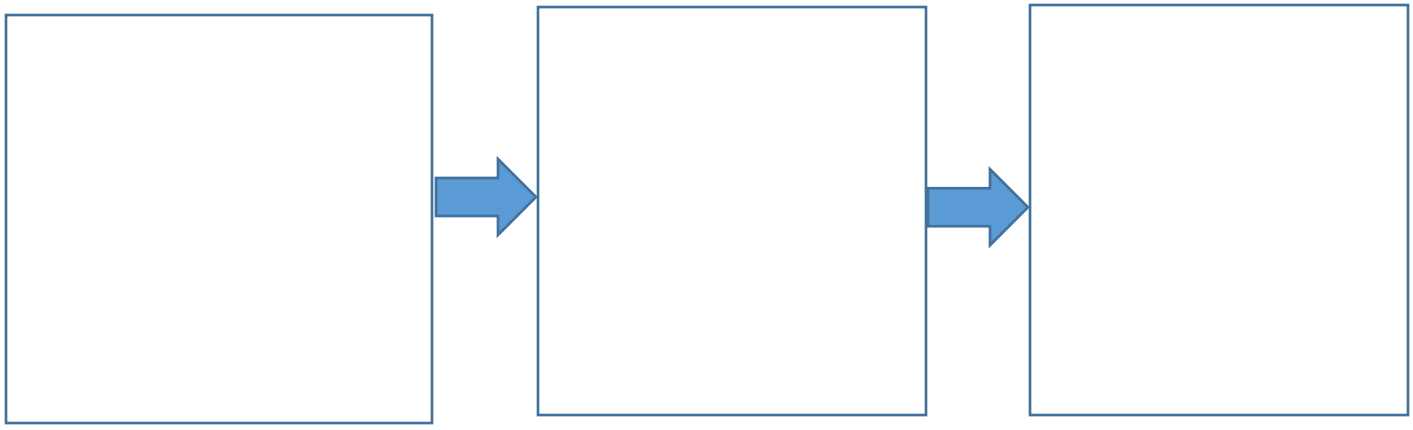
METHOD:

1. **Brainstorming Ideas- Design, Build, & Try:**

   Using the design process, draw and tryout out your model airplane. You must identify (label) the materials used in the sketch(es).



Design 1: Prototype Drawing | Plane Photo | Any Changes?



Lab Group Members_____

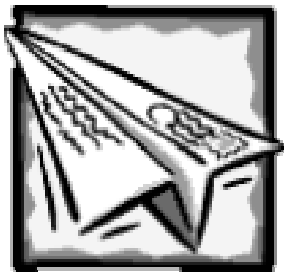
Period _____

The procedure for this investigation is partially done for you. Add any extra steps needed for your investigation.

List the Levels of IV here. (Type of plane and changes made to the plane).

1. Select 3 different paper airplanes.
   a. _____
   b. _____
   c. _____
2. Pick a spot to launch the planes each time.
3. Throw the first airplane.
4. Measure _____
5. Record the data.
6. Repeat 4 more times.
7. Throw the second airplane.
8. Measure _____
9. Record the data.
10. Repeat 4 more times.
11. Throw the third airplane.
12. Measure _____
13. Record the data.
14. Repeat 4 more times.

List all of your materials below:



Part 5: Collect & Record Data

The responding or dependent variable is the <u>Data</u> you collect. Data is frequently recorded in some type of chart or table. The chart has a place to show each specific manipulated / independent variable, a place to record measurements (data), and a place to show averages or other statistics.

You will use the chart below to record your data; each part of the chart is labeled for you.

Always show units of measurement

This is the Responding / Dependent Variable

This is the Manipulated / Independent Variable

These are the Levels of IV for the Manipulated / Independent Variable

_____ (____)	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Average Distance
1.						
2.						
3.						

Part 6: Analyze Data

After your data is collected and recorded, you have to make sense of it. You look for patterns, trends, and relationships. You are really asking yourself, "What does this data mean?" Making a graph is a good way to help analyze data. A graph makes a picture of the data and can help you visualize the patterns, trends, and relationships.

It is very important to use the right kind of graph when analyzing data. In this investigation, you *compared* different kinds of paper airplanes. Any time you are comparing data, a <u>Bar Graph</u> is the most appropriate type of graph to use.

All graphs have some things in common;

- The manipulated / independent variable is on the X-axis (bottom).
- The responding / dependent variable is on the Y-axis (side).
- Each axis is labeled to identify the variables.
- Units of measurement are included in the labels.
- The graph has a descriptive title.
- The information on the graph is spread out so that most of the graph is used.

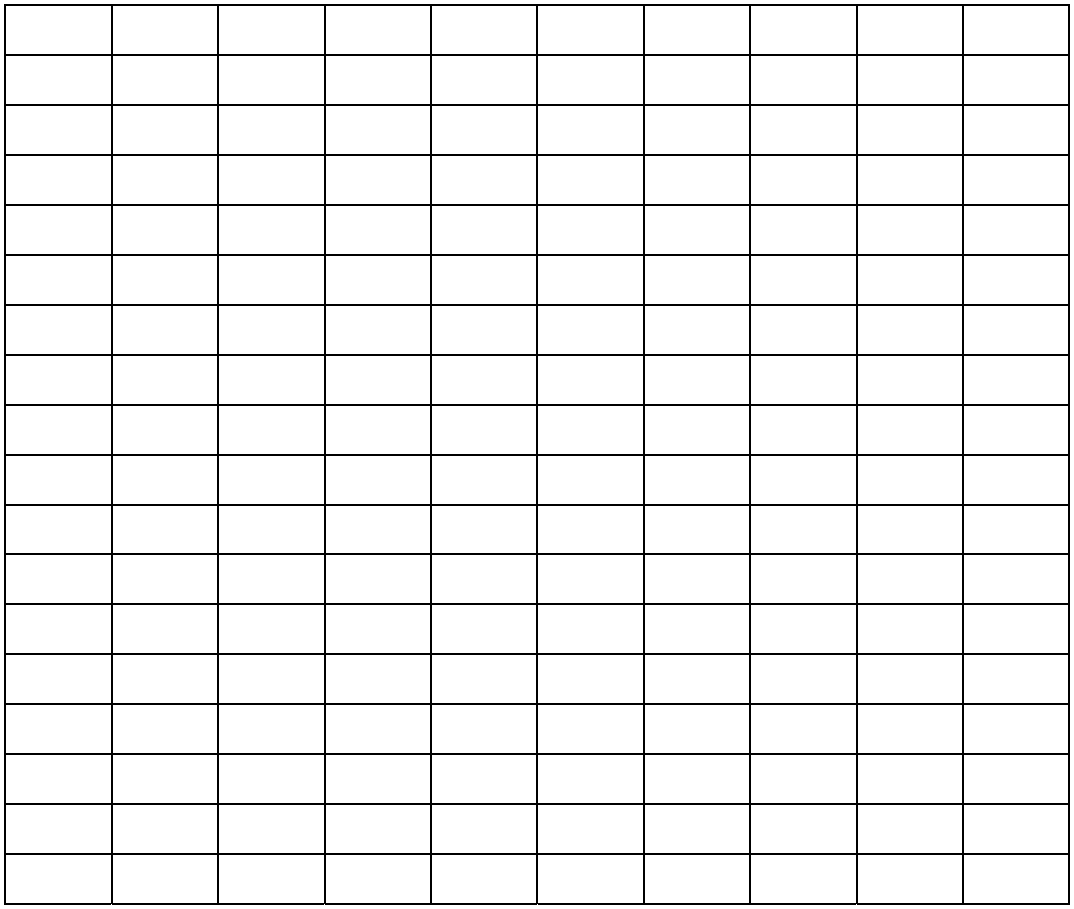
You will use the graph below to record your data; each part of the graph is labeled for you.

Graph Title → The Effect of _____

Label showing the Responding / Dependent Variable and the unit of measurement

_____

_____



Start numbering with "0"

0

Specific Manipulated / Independent Variable

_____

_____

General Manipulated / Independent Variable

Part 7: Draw Conclusions

A conclusion is a discussion of the data. The data is described and explained and the hypothesis is accepted or rejected. A hypothesis is never "right" or "wrong" – it is either supported by the data or it is not supported by the data.

The conclusion also discusses the usefulness of the results (why was the investigation practical?), how the investigation can be improved, and other questions raised during the investigation.

The conclusion for this investigation has been started for you. Fill in the blanks with your information.

The hypothesis, _____

is _____ (accepted / rejected). The data shows that (state properly formatted conclusion in past tense)

_____

_____

_____.

The results of this investigation are useful _____

_____

_____

_____

_____.

This investigation can be improved by _____

_____

_____

_____

_____.

Other questions that need to be answered are _____

_____

_____

_____

_____

_____.

Part 8: Communicate Results

Professional scientists must be able to share the results of their investigations with other scientists all over the world. The scientific community discusses investigations with each other, repeats them, refines them, compares them to what is already known, all in the effort to find what is really true and accurate.

Be prepared to spend 2 – 3 minutes discussing the results of your investigation with your scientific colleagues (classmates).