Science Research Project Inquiry Guide

Real World Uses

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Science Research Question:

The Science Research Question is made up of two components; the Manipulated or **Independent** Variable (the one thing that will be changed) and the Responding or **Dependent** Variable (the one thing you are measuring based on the change). The Science Research Question needs to be measurable. A suggested format for the Science Research Question is:

When I change _____, what happens to _____?

If you are studying plants, an example of a Science Research Question could be:

When I change the amount of fertilizer, what happens to the height of the plant?

Independent Variable:

The Independent Variable is the **one** thing that will be changed in the experiment. When graphing the data from the experiment, it is recorded on the X-axis. If you are studying plants, examples of Independent Variables could be the following:

- Amount of water used
- Type of water used (e.g. salt vs. fresh)
- Amount of fertilizer used

A sample Independent Variable could be: *The Independent Variable in the experiment is the amount of water that will be used to water the plants. The **experimental groups** will receive 10mL of water in one cup, and 20mL of water in another cup, and the **control** cup will receive no water.* 10 trials of each group should be conducted for reliability and validity (10 cups with 10mL of water, 10 cups with 20mL of water and 10 cups with no water).

- Starting in the 2010-2011 school year and beyond, teachers should be saying the words *Independent Variable* in place of Manipulated Variable.

Dependent Variable:

The Dependent Variable is what will be measured based on the one change in the experiment. When graphing the data from the experiment, it is recorded on the Y-axis. If you are studying plants, examples of Dependent Variables could be the following:

- Height of the plants

- Number of leaves
- Size of the flowers

A sample Dependent Variable could be: *The Dependent Variable in the experiment is the height of the plants. The height of the plants will be measured and recorded in **metric units** and will be influenced by the Manipulated (Independent) Variable.*

- Starting in the 2010-2011 school year and beyond, teachers should be saying the words *Dependent Variable* in place of Responding Variable.

Materials List:

The Materials List is a specific list of items that are necessary to conduct the experiment. The Materials List can be thought of as a "grocery" list and needs to include the **size**, **quantity**, and **unit of measure** of each item and should include any additional details that are specific to the materials that a scientist should be mindful of. Unit of measure should be recorded in metric measurements.

An example and non-example of a material list could be the following:

Materials List	**Materials List**
Non-Example	*Example*
Water	**Water**: 10mL in one cup, 20mL in one cup (amount used in watering daily)
Seeds	**Seeds**: 25 radish seeds in each cup
Cup	**Cup**: 3-500mL, clear plastic cups

Set-Up Conditions:

The Set-Up Conditions are all of the things that will be kept constant that might affect the outcome of the experiment. The Set-Up Conditions can also be referred to as the **constants** or **controls** because they are all the things that you will keep the same in order to conduct a fair trial in both the control and experimental groups. The Set-Up Conditions should be in list form.

If studying plants, the Set-Up conditions could be the following:

If you decide to change **only** the amount of water given to the radish plant (Independent Variable), then you must keep everything else constant. These would include:

- ✓ Same temperature (How will temperature be the same?)
- ✓ Same soil type (specify soil type)
- ✓ Same soil amount (specify how much soil per cup or plant)
- ✓ Same amount of sunlight (How will sunlight be the same?)
- ✓ Same growing location (describe the location)

- ✓ Same size cups to plant seeds (specify size of cups)

This is not an exclusive list, it is provided as a guide to what the Set-Up Conditions should look like.

Directions:

The Directions are a step-by-step list of what you did with each item in the materials list, in the exact order in which they were done. The key to the Directions is that someone should be able to read your directions and replicate **exactly** what you did throughout the experiment. **Be sure to have established a control group (e.g. seeds not receiving any changes-no water) and an experimental group (e.g. seeds receiving various amount of water).** The experiment should be conducted a minimum of 10 times and emphasize that increasing the number of trials will provide more valid data.

Directions	**Directions**
Non-Example	*Example*
1. water plants	1. gather materials necessary to conduct the experiment
2. measure plants	2. measure and add 250mL of soil to each of the three sets of cups
3. repeat steps 1 and 2	3. spread 25 radish seeds on top of the soil in each of the three sets of cups

This is not an exclusive Direction list, it is provided as a guide to what the Directions should look like.

Predictions:

The Predictions are a list of three possible outcomes (**increase, decrease, no affect**) of the experiment. Each possible outcome that could happen can be called a prediction. List the predictions for the experiment.

An example if you were studying plants could be:

Increasing *the amount of water will* ***increase*** *the height of the radish plant.*

Increasing *the amount of water will* ***decrease*** *the height of the radish plant.*

Increasing *the amount of water will have* ***no affect*** *on the height of the radish plant.*

After students make their three predictions, they should identify (circle) which prediction they think is most likely to happen.

- The word *Hypothesis* is removed from the elementary vocabulary based upon elementary standards.

Real World Uses Relating to Research:

Based on research (Internet, books, reference materials, newspapers, etc), identify who in the real world might find the results from the experiment useful. Identify when, where, why or how they may use the information from the experiment. Link the Real World uses to current events that are happening during the time of the experiment. This information should be written in paragraph form.

Data Collection:

The Data Collection is where the results from the experiment are recorded using metric measurements. The Data Collection chart is used to organize the results from the experiment and will be used when creating a graph. Data needs to be collected from the ***control group*** (the group in which there is no change of the independent variable) applied and from the two **experimental groups** (groups in which there is an independent variable applied). When the results of the experiment are all recorded, find the average of the results. The average of the results will be used when creating the graph. **The experiment should be conducted a minimum of 10 times and <u>emphasize that increasing the number of trials will provide more valid data.</u>**

Example of a data collection chart:

Data Collection *(metric measurement)*											
Item(s) Tested	**Trials** (Increasing the number of trials will provide more valid data)										
	1	2	3	4	5	6	7	8	9	10	Avg
Control Group- no water											
Experimental Group 1- 10mL of water											
Experimental Group 2- 20mL of water											

Graph:

When setting up the graph, decide which type of graph would be appropriate to display the data from the experiment. **Most** experimental data can be displayed using a bar graph; sometimes a line graph could be used when displaying data over a period of time. For example, if the experiment is measuring plant growth over a month long period, a line graph would be appropriate.

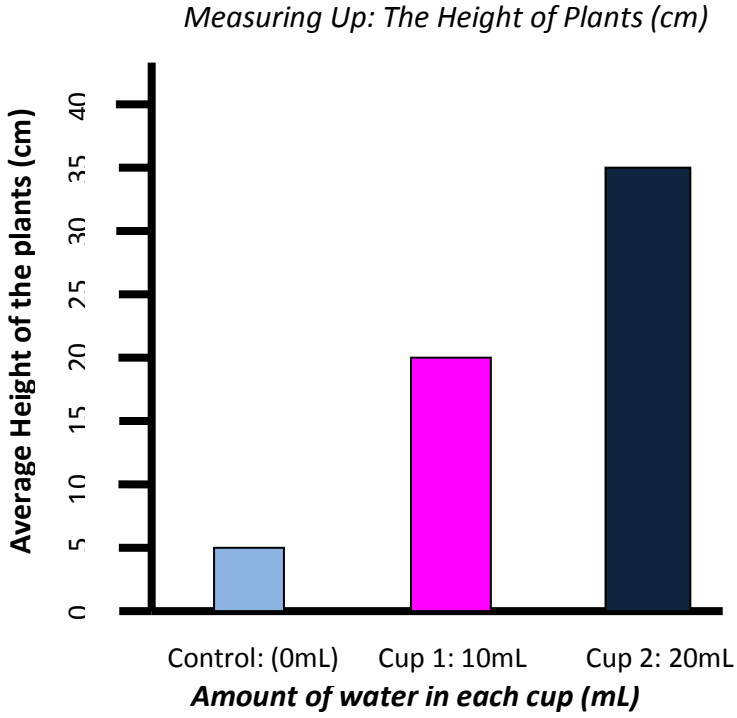
The Manipulated Variable is recorded on the X-axis, along the bottom of the graph and the Responding Variable is recorded on the Y-axis, vertically on the left hand side of the graph.

Acceptable graphs **must** include a **descriptive title**; **labels on both the X-axis and Y-axis**; **appropriate units provided on each axis**; and the **scale needs to be appropriate for the data being displayed**.

Use the Math text book as a resource for setting up graphs (if necessary).

An example of a graph could be:

Graph: Should reflect average of trials



Information recorded on this graph is not actual data; it is an example of what elements are required in creating a graph that accurately displays the data from the experiment.

Results:

This statement describes what happened in the experiment. Explain as much as possible what happened in the experiment. Focus the Results statement on factual information from the graph. *What does the graph show?* When writing the Results Statement, integrate mathematical terms such as *twice as much*, *one-third as much*, or *no significant difference*.

Avoid words that cannot be measured such as *healthier, better,* or *greener.*

Avoid saying "I proved." No single experiment ever proves anything.

Explanation:

This is a summary of findings that evaluate the experimental procedures for their effectiveness and determine possibilities for further study.

Science Journal

The science journal is an ongoing record from day 1 that contains each phase of the scientific process along with anecdotal records of observations and further wonderings. Each page should contain the date and specific details of record keeping either in the form of summary statements, numbers or diagrams. The science journal can be in the form of a spiral bound notebook, composition book or folder with notebook paper. Components that should be found within the science journal are the same as the requirements on the Science Showcase Rubric; research question, predictions, independent variable, dependent variable, set-up conditions, materials list, directions, data collection, graph, results, explanation, and real world uses.