The Scientific Method: The Parts of an Experiment Detailed

There are seven parts to a properly conducted experiment. Below is a basic description of each part, as well as an example of each part from a fictional experiment. Use the information given as a model for what each part of your experiment should look like.

*Please note: The information (including the research paragraphs) is completely made up and should not be referenced should you choose to conduct a similar experiment.*

**1. Question** (Sometimes called Purpose)

* What is the question that you hope to answer by doing the experiment? This should be written as a cause and effect statement with the independent variable (the thing being changed) and the dependent variable (the thing being measured) clearly identified. *Do not use judgment statements like “better” or “best” in the question.*
* **Example: Does the cost of a paper towel have an effect on the amount of water the towel will absorb?**

**2. Research and Background Information**

* Students should have some knowledge about the materials to be used in their experiment in order to make an educated guess about the outcome. This information can come from books, videos, the Internet, or expert interviews. The information included in the summary should pertain to the experiment in some way. The student should summarize the information they have read into 1-2 paragraphs written in their own words. *Information copied directly from a book or Internet page will not be accepted!!*
* **Example: Paper towels were first developed in the late 1950’s. The Scott’s paper company was the first to introduce the product. A mistake at the factory caused several rolls of paper to be produced that were too thick to be used as writing paper. Rather than losing money on the imperfect product, Scott’s decided to try to sell the paper as “an absorbent paper with many household uses.” Soon schools and other institutions were using the product as a replacement for towels that needed to be washed.
 While the first paper towels to be produced were made entirely out of paper fibers, over the years many companies have introduced new materials to increase the absorbency of the towels. Several companies have begun weaving expanding polymers into the paper fibers. These polymers soak up more water than paper fibers alone. Unfortunately, they are expensive to produce, which has led to an increase in the cost of paper towels.**

**3. Hypothesis**

* This is a statement that tells what you expect the outcome of your experiment to be. Just like the question, it is written as a cause and effect statement. In fact, the wording of the hypothesis is nearly identical to the wording of the question. The biggest difference is that the hypothesis begins with the words “I think” or “I predict”.
* **Example: I think that the cost of paper towel will have an effect on the amount of water the towel will absorb.**

**4. Materials List**

* This is a very specific and detailed list of all the items needed to conduct the experiment. The list must include brand names and the exact amounts of each of the items used. You must have enough materials to repeat the experiment three times. If cost is a variable in the experiment, then the cost should be included too.
* **Example:
5: Scott’s brand paper towels (7 cents each)
5: Bounty brand paper towels (5.5 cents each)
5: Meijer brand paper towels (4 cents each)
1: 500mL graduated container
1: gallon of tap water
1: pair of scissors
1: ruler
1: stopwatch
1: data recording sheet and pencil**

**5. Experimental Procedure**

* This is a step-by-step breakdown of how the experiment was conducted. The information must be detailed enough that someone else could replicate your experiment. Remember, **you must repeat the entire experiment at least 3 times.** *The procedure must include 2-4 pictures or diagrams to show how the experiment was set up, so have your camera ready!*
* **Example:
Step 1: Measure the length and width of one square of each brand of paper towel.
Step 2: Using the scissors, trim all 15 towels so that they are exactly the same size.
Step 3: Fill the 500mL container up to the 500mL mark with tap water.
Step 4: Place one Scott’s brand towel into the 500mL container of water, and begin the stopwatch.
Step 5: After 30 seconds, carefully pull the towel out of the container.
Step 6: Hold the towel above the container for 15 seconds, allowing the excess water to drip back into the container. Do not wring out the towel.
Step 7: Shut off the stopwatch, and set the towel aside.
Step 8: Note the water level in the container. Calculate the amount of water absorbed by the towel by subtracting the amount remaining from the 500mL you began with.
Step 9: Using tap water, refill the container to the 500mL mark.**

**Step 10: Repeat steps 3-8 with the remaining Scott’s brand towels.
Step 11: Calculate the average absorbency rate for the Scott’s brand by adding together the amount of water absorbed in each trial, and then dividing the sum by the number of trials performed.
Step 12: Repeat steps 3-11 using the other two brands of towels.**

**6. Results**

* This is the data that was collected during the experiment. Remember, at least three trials of the experiment must be conducted. Here the student reports what was measured or observed. The “raw” data should be presented in table form with a column for each trial of the experiment, as well as one to show the averaged data. The averaged data should then be presented as a graph. This part of the experiment also includes a one-sentence summary known as the “Results Statement” that tells what the data shows.
* **Example:**

**Amount of Water Absorbed**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Brand of Towel** | **Trial 1** | **Trial 2** | **Trial 3** | **Trial 4** | **Trial 5** | **Average** |
| Scotts (7 cents) | 40ml | 42ml | 37ml | 40ml | 41ml | 40ml |
| Bounty (5.5 cents) | 29ml | 32ml | 30ml | 25ml | 26ml | 28ml |
| Meijer (4 cents) | 15ml | 17ml | 19ml | 14ml | 18ml | 17ml |

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**Results Statement: As you can see from the data table and graph above, the cost of the paper towel does have an effect on the amount of water the towel absorbed.**

*Please note that the data reported is numerical in nature. If you are making observations rather than measurements, you must come up with a “grading system” that converts your observational data into numbers. See your teacher for help with this before the data is due.*

**4. Conclusion**

* This is a two-sentence statement that tells the results of your experiment and what the relationship between your variables was. The first sentence of the conclusion always begins with the words **“Based on the results of this experiment,”** then the format is just like the question and hypothesis. The second sentence of the conclusion explains how the variables are related.
* **Example: Based on the results of this experiment, the cost of a paper towel does have an effect on how much water the towel will absorb. The higher the cost of the paper towel, the more water the towel absorbed.**

**Scientific Method Project – Poster Board Display Grading Rubric**

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| --- | --- | --- | --- |
| **Graded Element** | **Excellent – full points** | **Adequate – partial points** | **Unacceptable – zero points** |
| **Due Date**(5 points) | * All parts of the project were turned in on time
 | * Project was not turned in on time, but was turned in before Dec. 4th
 | * Project was not turned in
 |
| **Title**(5 points) | * Creative, original title included
* Bold, colorful lettering that stands out from the display
 | * Title copied from packet
* Lettering somewhat different from the rest of the board
 | * Lettering the same as the rest of the display
* Title does not stand out
* Title is missing from the display
 |
| **Scientific Question**(5 points) | * Question written in correct scientific format as a cause and effect statement
* Independent and dependent variables clearly identified
* Question labeled on the display poster
 | * Question written as a cause and effect statement but format is incorrect
* Question identifies only one variable
* Question is not labeled on the poster
 | * Question is not written as a cause and effect statement
* Question does not identify either variable
* Question is not present on the poster
 |
| **Research and Background Information**(10 points) | * 2 paragraphs written in the student’s own words
* Paragraphs follow grammatical rules and are thoroughly edited (less than 3 errors)
* Paragraphs contain mainly information relevant to the topic of the experiment
 | * Less than 2 complete paragraphs written in the student’s own words
* Editing of paragraph is incomplete (3-5 errors)
* Paragraphs contain some information relevant to the topic of the experiment
 | * Information from books or Internet is copied rather than summarized in student’s own words
* Paragraphs are poorly edited (more than 5 errors)
* Information presented is not relevant to the topic of the experiment
* Research information is not present
 |
| **Hypothesis**(5 points) | * Hypothesis is written in correct scientific format and as a cause and effect statement
* Independent and dependent variables clearly identified
* Hypothesis labeled on the display poster
 | * Hypothesis is as a cause and effect statement but format is incorrect
* Hypothesis identifies only one variable
* Hypothesis is not labeled on the display poster
 | * Hypothesis is not written as a cause and effect statement
* Hypothesis does not identify either of the variables
* Hypothesis is not present on the display board
 |
| **Materials List**(5 points) | * Every item needed to conduct the experiment is listed
* Exact amounts of every item are included
 | * One-two items needed to conduct the experiment are not listed
* Exact amounts of every item are included for some but not all items
 | * Three or more items needed to conduct the experiment are not listed
* Exact amounts of items are not included when required to perform the experiment
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|  |  |  |  |
| --- | --- | --- | --- |
| **Experimental Procedure**(5 points) | * Step by step directions for conducting the experiment are included
* Directions are detailed enough to allow for replication of the experiment
* Directions have been thoroughly edited (less than 3 errors)
* Steps are numbered in correct sequence
* Numerous pictures (3-5) that clearly illustrate the steps of the experiment are included
 | * Step by step directions for conducting the experiment are included, but one or two steps are missing or incomplete
* Directions are lacking one or two specific details necessary to replicate the experiment
* Editing of the directions is incomplete (3-5 errors)
* One or two numbered steps are out of sequence
* Fewer than 3 pictures to illustrate the steps of the experiment are included
 | * Directions are not written in a step by step format, or more than three steps are missing or incomplete
* Directions are lacking more than three specific details necessary to replicate experiment
* Directions are poorly edited (more than 5 errors)
* Three or more steps are out of sequence or steps are not numbered
* Pictures are missing, or do not illustrate the steps of the experiment
* Procedure is not present
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| **Results**(10 points) | * Data from at least 3 trials of the experiment are included on the table
* Accurate averaged data is present on the data table
* Averaged data is presented as a graph
* A correctly written results statement is on display near the data table and graph
 | * Data from only two trials of the experiment are included on the table
* Averaged data is present on the data table but is not accurate
* Averaged data is present as a graph, but the graph contains errors
* Results statement is present but is not in the correct format
 | * Either the trial data or the averaged data is missing from the data table
* Graph of averaged data is not present
* Results statement is not present
 |
| **Conclusion**(5 points) | * Conclusion written in correct scientific form as a cause and effect statement
* Conclusion includes a statement explaining the relationship between the variables
* Conclusion is labeled on the poster
 | * Conclusion is present but the format is not correct
* Conclusion inaccurately reports the relationship between the variables
* Conclusion is not labeled on the poster
 | * Conclusion is not present on the poster
* Conclusion does not include a statement explaining the relationship between variables
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| **Neatness and Creativity of Poster**(5 points) | * No tape or glue is visible
* All parts securely fastened to the poster
* All parts are neatly arranged
* Colorful and attractive
* Contains numerous interesting graphics and details
 | * Tape or glue minimally visible
* One or two parts of the poster are loose
* One or two parts are misaligned
* An obvious attempt to incorporate color and graphics was made
 | * Obviously visible glue or tape
* More than 2 parts of the poster are loose
* Items are haphazardly arranged
* Poor or no use of color and/or graphics
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