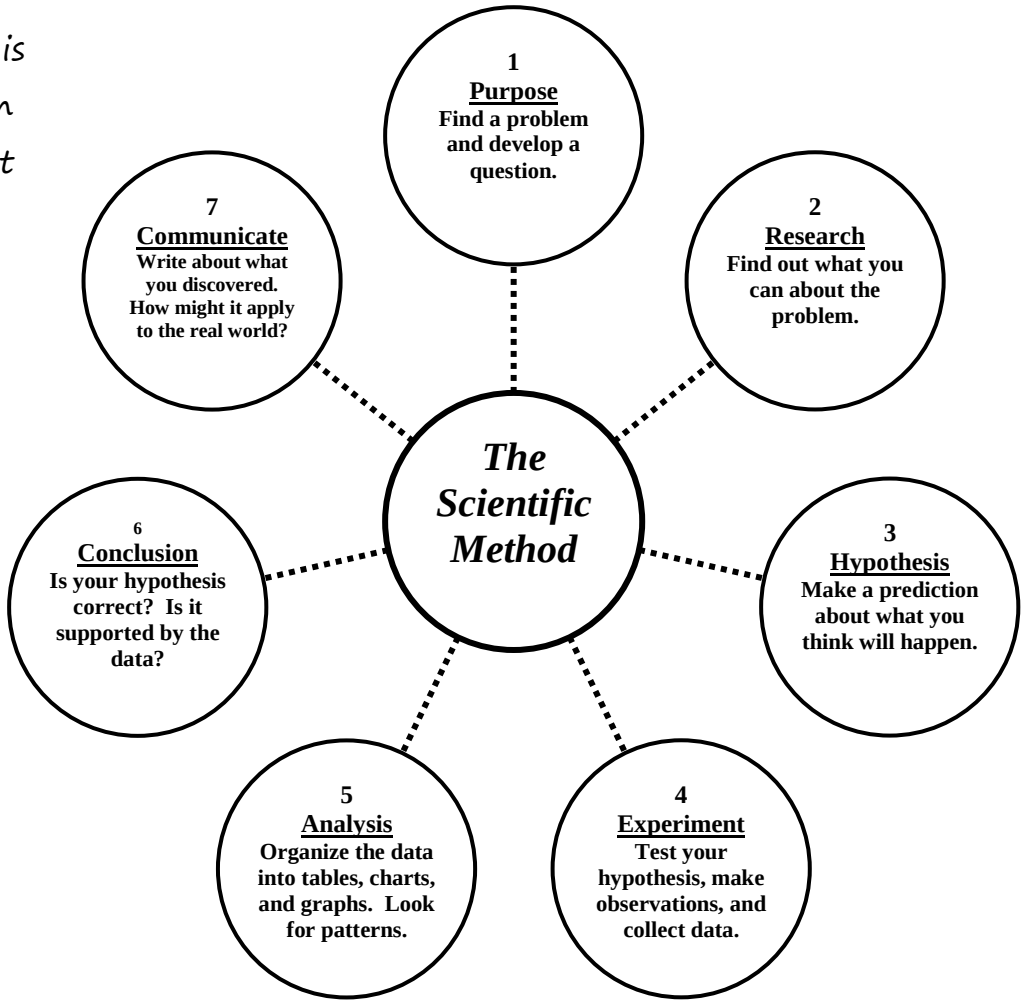
Science Fair Packet

1. Why should I do a science project?

When you do a science project, you are conducting an investigation or experiment to find out something that you didn't know before. You are being a scientist. Guess what? You have been a scientist all your life. You observe, infer, and predict all the time. It is how you learn about the world around you and how it works. From the time you started kindergarten, you have been learning the processes necessary to plan and conduct an investigation. Each year you have learned more about these scientific processes and now it is time to put them all together and show what you have learned!

2. The Scientific Method – A Little Review

The Scientific Method is used as a guide to plan and conduct a fair test or investigation. The scientific Method can be found in several formats, with various numbers of steps, but here is what you need to know.



3. What makes a good science project?

A science project is an investigation (experiment) that you plan and conduct. It is based on a question that you want to investigate. Even though you can learn from building a model, making a collection, or conducting a poll (survey), they do not test anything, nor do they put the Scientific Method to work, so they would not be a good choice for a science project. Here are some points to remember in designing a good science project.

- The topic is something in which you are interested.
- Your project seeks to answer a question.
- Data can be collected that has numerical measurements.
- A change in a variable can be observed and measured.
- The materials needed for the investigation can be easily found.
- There will be enough time to do the investigation 3 times or more.
- The investigation can be done with only a little help from parents, teachers, or friends.
- The question can be **safely** investigated.
- The investigation should not injure or scare animals or people.

4. Choosing a topic and creating the question to investigate.

A great science project experiment always starts with a great question. The best way to choose a topic to investigate is to think about what interests you. What are you curious about? Make a list of five topics that you find interesting. Look at your list and then write a question from each topic that you might want to explore. The question you create should be something that you can test by measuring a change in a variable. Which question from your list is the most interesting to you? This should be the question that you want to investigate. Remember that not all topics can be explored through an investigation. For example, you might be very interested in learning about Jupiter, but it would be very difficult to create a question about Jupiter that you can investigate with an experiment.

One way to frame your question is like this:

How does _____ affect _____?

Here's an example using this frame.

How does the type of soil affect plant growth?

Another way to frame your question is like this:

What is the effect of _____ on _____?

An example would be:

What is the effect of the type of soil a seed is planted in on plant growth?

5. Forming a Hypothesis

A hypothesis is a prediction created in a very specific form. In order to create a good hypothesis, you should first do some research on your topic and question. Read books, articles, and magazines related to your question. Talk to some experts. For instance, if your question is about plants, call or go to a garden center or landscaping business and talk with someone who works with plants. Once you have learned as much as you can about your topic, you can write a good hypothesis. The hypothesis is a prediction that you make about what you think will occur in your investigation, backed up by some of the research you have done.

The proper way to frame your hypothesis is in an "If____then___" statement that shows cause and effect.

If (I do this), *then I predict* (this will happen), *because* (your logical reasoning for thinking what will happen).

Here's an example:

If *I plant bean seeds in clay, sand, and potting soil,* ***then*** *I predict that the bean plants will sprout and grow taller in the potting soil* ***because*** *potting soil has more of the nutrients that a plant needs.*

6. Developing a Plan to Investigate the Question

Now that you have a question to investigate and have formulated a hypothesis on what you think will happen, it's time to design the experiment that will allow you to investigate the question. Your question and hypothesis have already provided you with some idea on how you will structure your experiment. Now you need to think about four important components; **(A) identifying the variables, (B) describing the steps in the experiment, (C) creating an accurate materials list,** and **(D) designing a log book or other way to record observations and measurements.**

(A) Identifying the variables: Variables are any factors that can change or be changed in an experiment. The INDEPENDENT/MANIPULATED VARIABLE (the cause) is the variable that you change. In an experiment to investigate whether different types of soil have an effect on the growth of bean seeds, the INDEPENDENT variable would be the different types of soil. The DEPENDENT/RESPONDING VARIABLE (the effect) is what happens as a result of the experiment. It's the part that you gather observations and collect measurements (data) about. In the bean seed experiment, the height that the bean sprouts grow would be the DEPENDENT variable.

The CONTROLLED VARIABLE or VARIABLES would be what is consistent (the same) for what is being tested. In the bean experiment, the size of the container, the amount of soil that the seeds are planted in, the number of seeds planted in each container, the amount of water that each container gets, and the amount of sunlight that each container receives, would all be controlled variables. The controlled variables help you to conduct a fair test.

(B) The Steps/Procedure: A procedure is a list of steps that you will perform during the experiment. As a scientist, you need to create a very detailed list of steps so that you can perform the experiment again exactly the same way or someone else could follow your steps to perform the experiment. Here are some important points to remember.

- Number and describe each step in as much detail as possible.
- The procedure should indicate how the variable is being manipulated, how to measure the response, and when and how data is to be recorded.
- If specific amounts are being used, these should be indicated in the steps, using metric measurements.
- Include as many trials of the experiment as possible. More trials will provide you with more data on which to base your conclusions. You should aim for a minimum of 3 trials. More is better!
- Plan to take pictures at every step of the experiment. These will be used later for your display board and in your log book.

(C) Materials List: A well-thought out materials list will be helpful in gathering what is needed for the experiment and to be able to perform the experiment during the remaining trials.

- The list should be in a column format.
- All amounts (*quantities*) and measurements (*sizes*) should be included. Instead of just listing bean seeds, you should list something like: 9 lima bean seeds of equal size.
- Include all equipment used to conduct the experiment.
- Take some pictures of your materials before you begin the experiment. These can be used in your log book.

(D) Log Book: As scientists conduct experiments, they record their observations and measurements in a log book. Most scientists record their data in charts, tables, or graphs because they are easy to read and maintain over time. Recording data this way will also help you analyze the information after the experiment has been completed. As you conduct the experiment, record all numerical measurements made. You can also record written descriptions of your observations or any problems you may experience. Entries in the log book should be handwritten. You can also include your own scientific drawings and pictures of the procedures. Be sure to record your data for each trial that you conduct. A useful data table will have a title, columns for the variables (with titles for the columns) and units listed.

Growth of Bean Plants

Day Number	Height in cm		
	Clay	Sand	Potting Soil
1	0cm	0cm	0cm
5	1cm	.5cm	2cm
10	4cm	2cm	8cm
15	5cm	2cm	11cm
20	5cm	died	15cm

7. Conducting the Experiment and Collecting the Data:

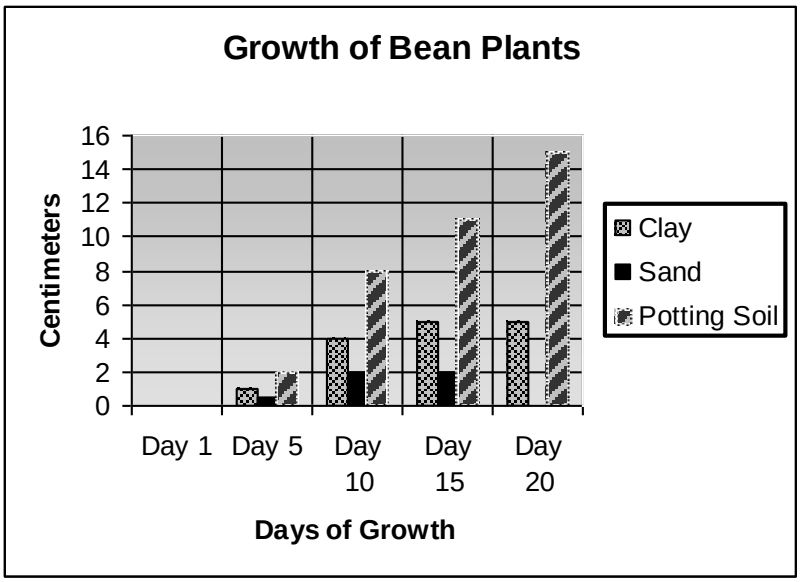
Now that you have all of the important steps in the investigation process completed, it's time to actually conduct the experiment. Gather your materials, get adult supervision, if necessary, and get started. Follow your Procedures (Steps) exactly as you have written them. Be sure to take plenty of pictures and record observations and measurements. Remember that you are not finished after just one time. You need to conduct the experiment 3 times or more and record your data in your log book during each trial.

8. Analyzing the Data

The experiment and all the trials have been completed. Now it's time to take a close look at the data you collected and try to understand what it all means. Look for patterns and trends. If you gathered numerical data (measurements), it might be helpful to look at the data by figuring the "mean" and/or the "median." The mean is the average of the data you collected. If you listed all measurements in order from smallest to largest, the median would be the middle number in the list. In the example of the bean experiment, you would need to figure the mean and median for the plants in each type of soil over the various trials that were conducted. This would also be a good time to determine what type of graph that you should use to organize your data and then put the graph together. There are computer programs, like EXCEL, that will create graphs for you once you input the data. If you choose to make

your own graph, using graph paper will help to keep your data neatly spaced and organized. Be sure to put a title on your graph and label the x axis and the y axis.

- **Bar Graph:** Good choice when comparing two or more groups. The x axis (horizontal axis) is where you label what is being measured, (like plant A, B, and C) and the y axis (vertical axis) is where you show the unit being measured, (like height in centimeters).



- **Line Graph**: The right choice when showing changes over time. Place the dependent variable on the y axis (vertical axis) and the independent variable on the x axis (horizontal axis). If you want to show the results for multiple trials on one line graph, you can make each set of points and its connecting line a different color or shape.
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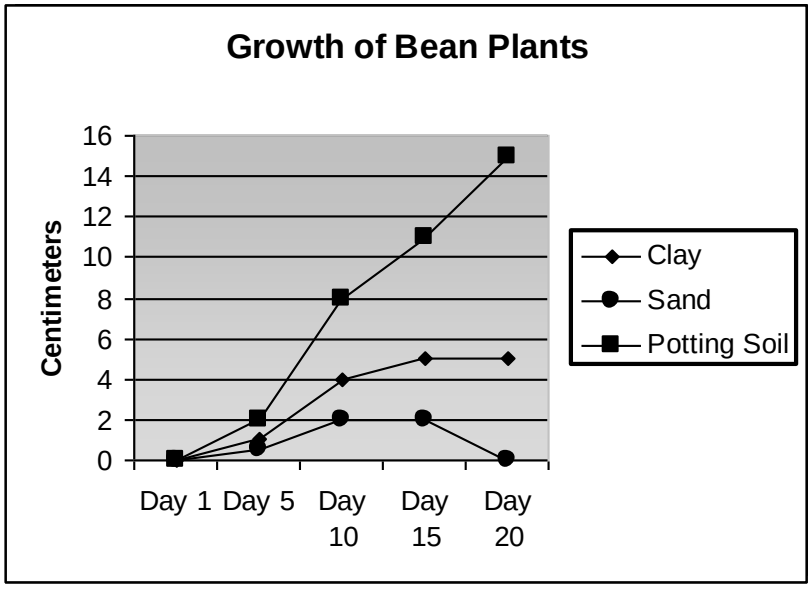
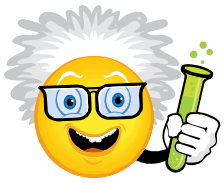


9. Formulating a Conclusion:



The purpose of the CONCLUSION is to answer your original question by using the patterns and trends that you noted from the data you collected and analyzed. The CONCLUSION is written in paragraph form and usually begins with a statement about whether the results support your HYPOTHESIS. It is not important that your hypothesis is correct but that you explain why you got the results you did. You should provide a summary of the results, including averages or data for each trial and tell what was significant (what really stands out) about the results. Tell about any problems or difficulties that you had in doing the experiment and what you might do differently. Be sure to include what you learned from the experiment and any real life applications.

10. Presenting the Project – Creating a Display

Sharing the results of your experiment (investigation) is an important part of the Scientific Method. You will do this for the science fair by creating a display board and also including your Log Book. Some teachers may also require a research paper. After all the work put into planning and conducting an experiment, adequate time and thought should be given to creating a display that communicates your work in a meaningful and attractive way. Here are some important tips for creating a project display.

- The display board should be attractive, but not distracting. Too many colors and too much stuff will detract from the display.
- Organize the information as sequentially as possible.
- If possible, use a computer to type and print your information. Otherwise, print in your very best handwriting. Be sure that it is large enough to be easily read.
- Do not place your name on the front of the display.
- When mounting papers to the display, glue sticks and spray adhesive are less messy than glue and will give you neater results.

- All visuals to be posted, whether they are hand-drawn, computer printed, or photographs, should be done by you, the student. Make sure the images you use are not copyrighted.
- Be creative with borders, fonts and images. Remember that illustrations should be informative, not just decorative.
- Loose equipment or other apparatus should not be brought to display. Pictures or drawings should be used instead.
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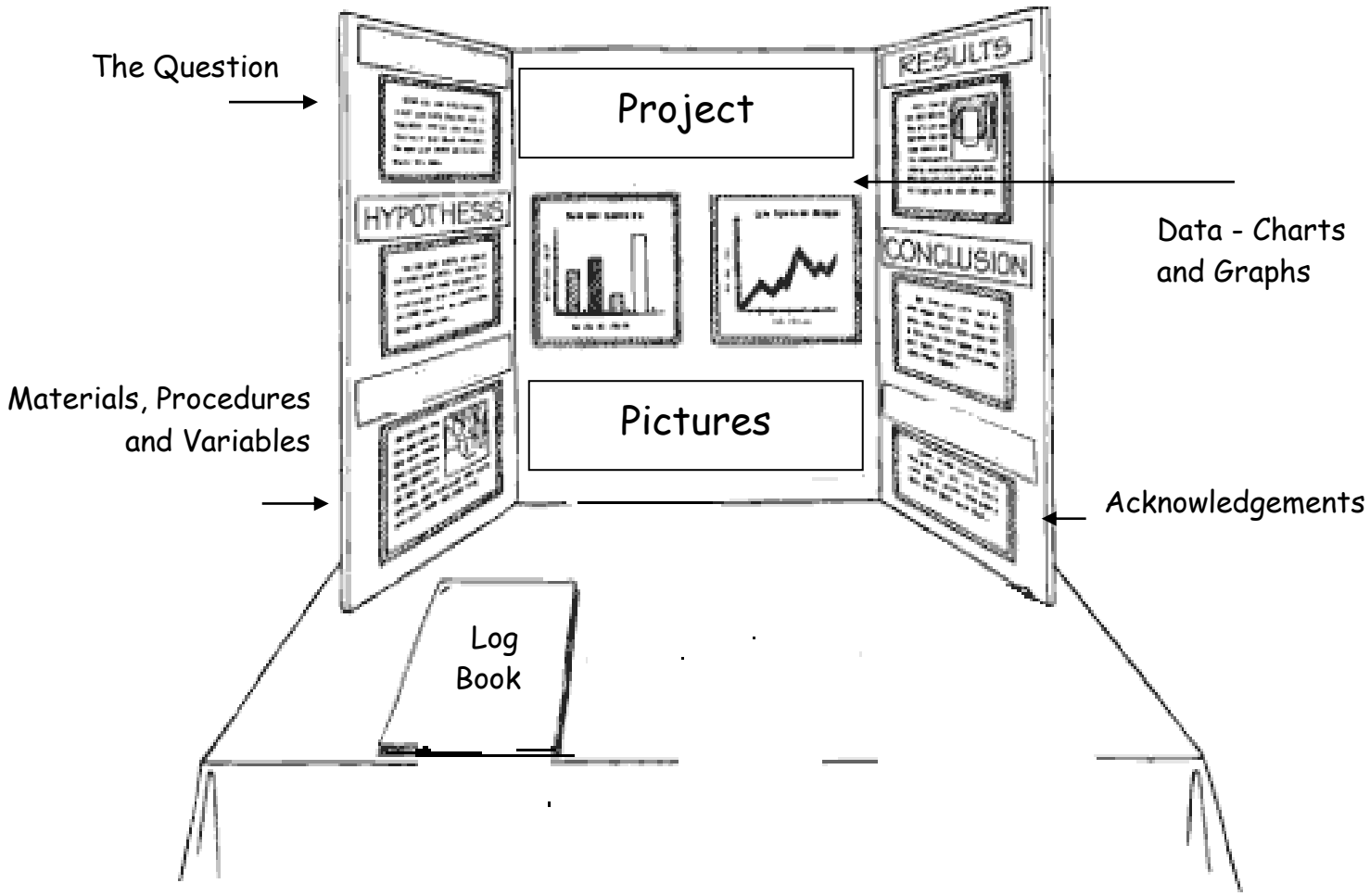
It will be helpful to make a sketch of what you want your display to look like before you begin to put it together. Here are the components that you should have on your display.

1. **Title:** A creative and "catchy" title is good.
2. **The Question** – Sometimes referred to as The Problem
3. **The Hypothesis** – Written in a statement
4. **The Variables**
5. **The Materials**
6. **The Procedure**
7. **The Results** – Usually in the form of charts and graphs
8. **The Conclusion**
9. **Pictures** that you have taken during the experiment.
10. **Acknowledgements** – Give credit to anyone who helped you

Here's an example of a Project Display.



OPTIONAL: Research Report/Background Paper

The Research Report is not required by every teacher for elementary science projects. If you have followed the previous steps in planning and conducting your experiment, then you will already have all the information necessary to create a research report if you are required to do one. You will want to include the project's question, hypothesis, procedure, data, conclusions, any related research, and a bibliography. Research can include general information about the topic you explored or an overview of materials that you read that helped you gain background to design your experiment. It is best to create an outline or other organizer and then write a rough draft. After proofreading and making edits, use your computer and printer to create a neat report. If you don't have a computer to use, be sure to write the report in your neatest handwriting. Your teacher will give you his or her specific requirements for the research report.

Name_____

My Science Project Plan

1. Here are five topics in which I am interested in exploring.
   A.
   B.
   C.
   D.
   E.

2. Here's one question about each topic that I would be interested in investigating.
   A.
   B.
   C.
   D.
   E.

3. This is the question that I chose to investigate.

4. Some books that I read about my topic are:

Title: **Author:**

_____

_____

_____

_____

_____

5. Some people I talked to about my topic are:

_____

_____

_____

6. These are some important points that I learned about my topic.

- _____
- _____
- _____
- _____
- _____
- _____

7. My Hypothesis

If _____, then I predict that _____

because _____.

8. The Variables:

Independent/Manipulated	Dependent/Responding	Controlled

9. Here's my MATERIALS LIST (Include Amounts)

10. The Steps/Procedures: Number and List Each Step

11. Here's the type of data table or chart that I will use in collecting and recording my data.

12. Tell what type of graph you will use to display your results. Why did you choose this type of graph?