So, _____,

You're Planning a Science Fair Project …

For the VIRSF at the University of Victoria

On April 15th and 16th 2012

An Introduction to the Scientific Method for Elementary Age Students

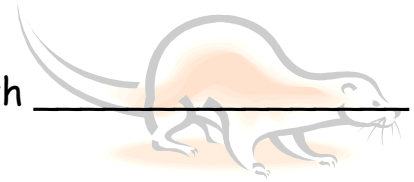
Before you 

You need to understand a few ideas. FILL IN THE BLANKS USING WORDS FOUND AT THE BOTTOM.

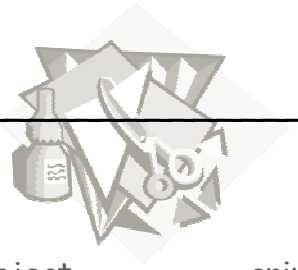
Most important, throughout your whole experiment, you must stay _____ !

If you work with _____ or _____ or _____ you need adult supervision.


If you work with _____ your experiment must be ETHICAL.



Regardless, your parents and your teacher must approve your _____ before you start.



chemicals electricity fire project animals safe

Unscramble the words to discover the order of the scientific method.

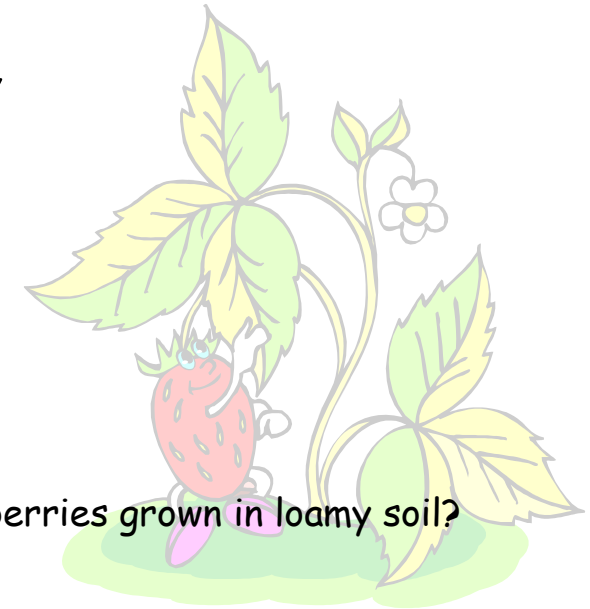
1. eryqu _____
2. iiiatnl aheecsrr _____
3. ppsroeu _____
4. yhhposiset _____
5. smteralia _____
6. tmodhe _____
7. bsvoratonise _____
8. aaiynlss _____
9. ssceruo fo rrreo _____
10. ccsnnlouio _____
11. frthure rechsear _____

Choose from:

analysis	conclusion	further research	hypothesis	initial research
materials	method	observations	purpose	query
		sources of error		

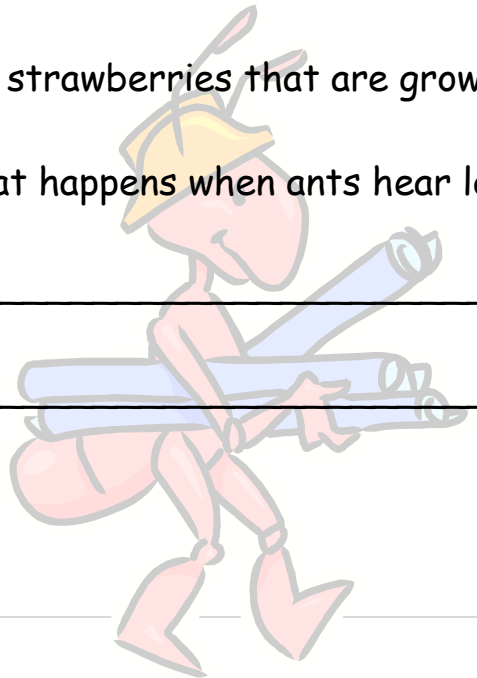
The Scientific Method:

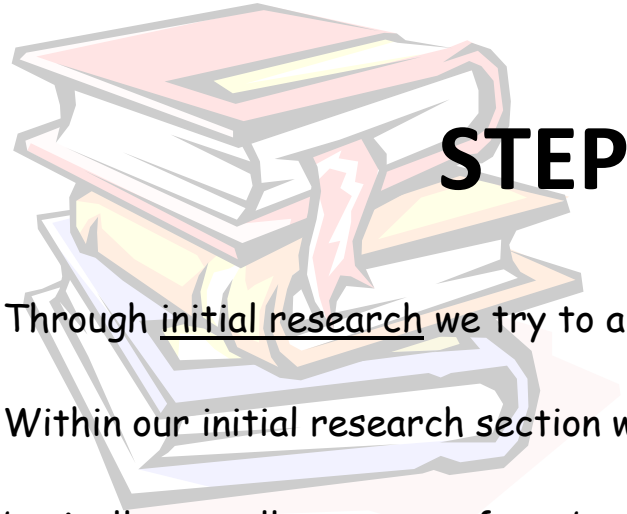
STEP 1: QUERY



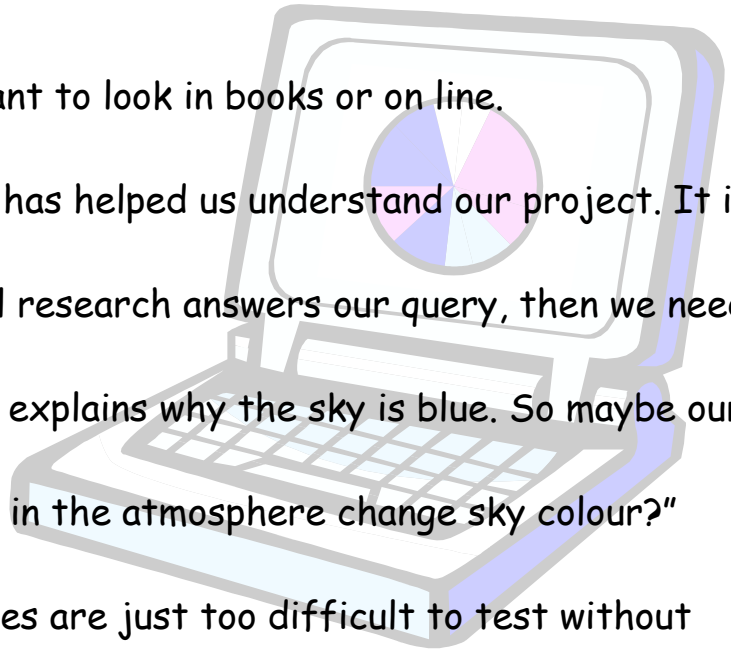
To query is to wonder what, when, where, why, or how about something.

1. Why is the sky blue?
2. Are strawberries that are grown in sandy soil smaller than strawberries grown in loamy soil?
3. What happens when ants hear loud noises?
4. _____
5. _____





STEP 2: INITIAL RESEARCH



Through initial research we try to answer our query. We might want to look in books or on line.

Within our initial research section we list other information that has helped us understand our project. It is basically a small summary of our background reading. If our initial research answers our query, then we need to make a new query. For example, we could find information that explains why the sky is blue. So maybe our new query might be, "Do high concentrations of greenhouse gases in the atmosphere change sky colour?"

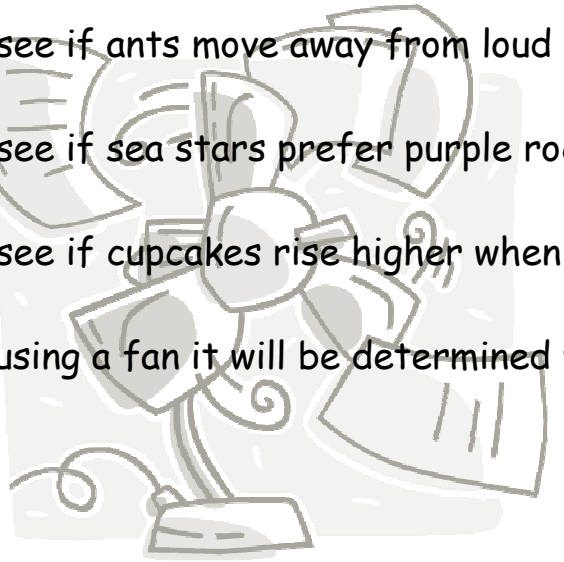
Remember – you will need to design an experiment and some queries are just too difficult to test without expensive, difficult to find, only available in labs equipment. If your query is one of these, then you need a new query.

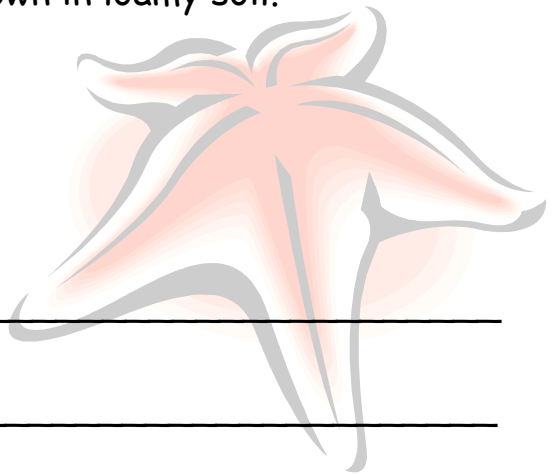
STEP 3: PURPOSE

Sometimes we cannot answer our query through our initial research. When this happens we design an experiment to try to figure out the answer.

Our purpose gives us a statement about what we will do:

1. To see if strawberries grown in sandy soil weigh less than strawberries grown in loamy soil.
2. To see if ants move away from loud noises.
3. To see if sea stars prefer purple rocks over other colours of rocks.
4. To see if cupcakes rise higher when _____
5. By using a fan it will be determined which type of tree seed _____





When designing an experiment it is important to be able to say what is being controlled and what is being allowed to change. Controlled means to keep certain things exactly the same.

1. In our strawberry experiment we need to keep the amount of light the plants get each day the same. We need to keep temperature the same, and we need to try to keep the plants equally moist.

2. In our ant experiment we need to keep the surroundings (temperature, light, container) of the ants the same.

3. In our sea star experiment we need to control water temperature, light levels, amounts and sizes of rocks, and types of sea stars.

4. In our experiment to see if cupcakes rise higher we will need to control:

_____

_____

_____

5. In our experiment with seeds blown by a fan, we will need to control:

Why is it important to keep so many things the same?

In our experiments we try to only change one thing. The "thing" that changes is called the variable.

1. In our strawberry experiment the variable is the type of soil.
2. In our ant experiment the variable is the loudness of noise. The type of noise needs to stay the same.
3. In our sea star experiment only the colour of rocks is changed.
4. In our experiment with cupcakes rising, the only variable is _____

   _____

5. In our experiment with blowing seeds, the variable is _____

   _____

STEP 4: HYPOTHESIS

After we have our purpose and we know what needs to be controlled and what will be changed, we write our prediction of what will happen. This is called a hypothesis. It is best if a hypothesis can be answered with a simple yes or simple no.

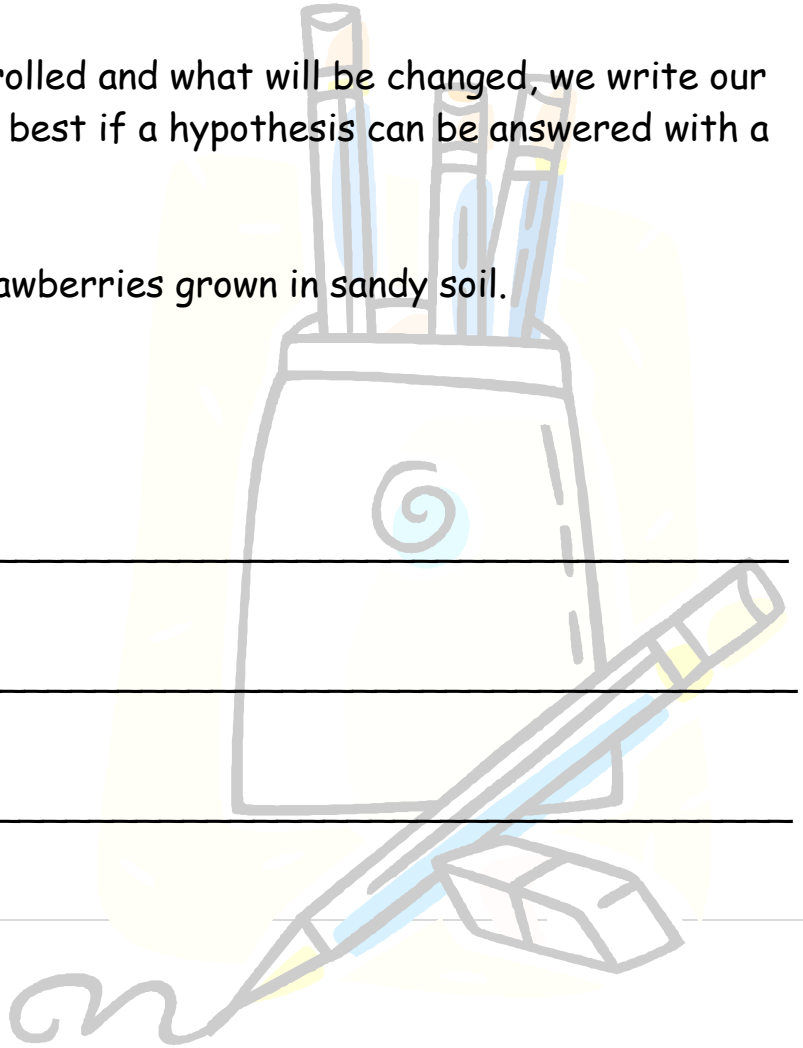
1. Strawberries grown in loamy soil will weigh more than strawberries grown in sandy soil.

2. Ants scatter larger distances as noises become louder.

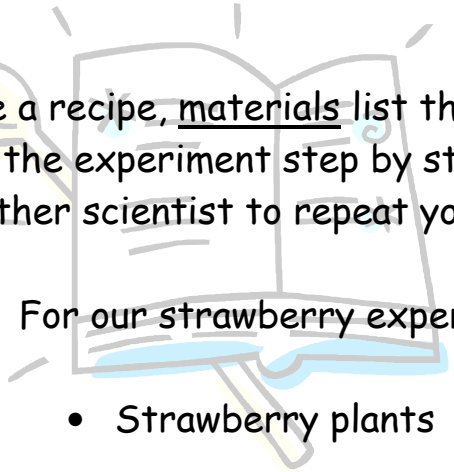
3. Sea stars will _____

4. Cupcakes will rise higher when _____

5. Tree seeds will _____



STEPS 5 AND 6: MATERIALS AND METHOD



Like a recipe, materials list the required ingredients". Also like a recipe, the method describes how to carry out the experiment step by step. These two parts of the scientific method are important: They allow another scientist to repeat your experiment exactly or to repeat it with a tiny bit of change.

For our strawberry experiment our materials include:

- Strawberry plants
- Loamy soil
- Sandy soil
- Scale
- A large window if grown inside
- Sunlight
- Water
- 2 large planters

For our strawberry experiment our method includes:

1. Place equal amounts of loamy soil and sandy soil into two planters.

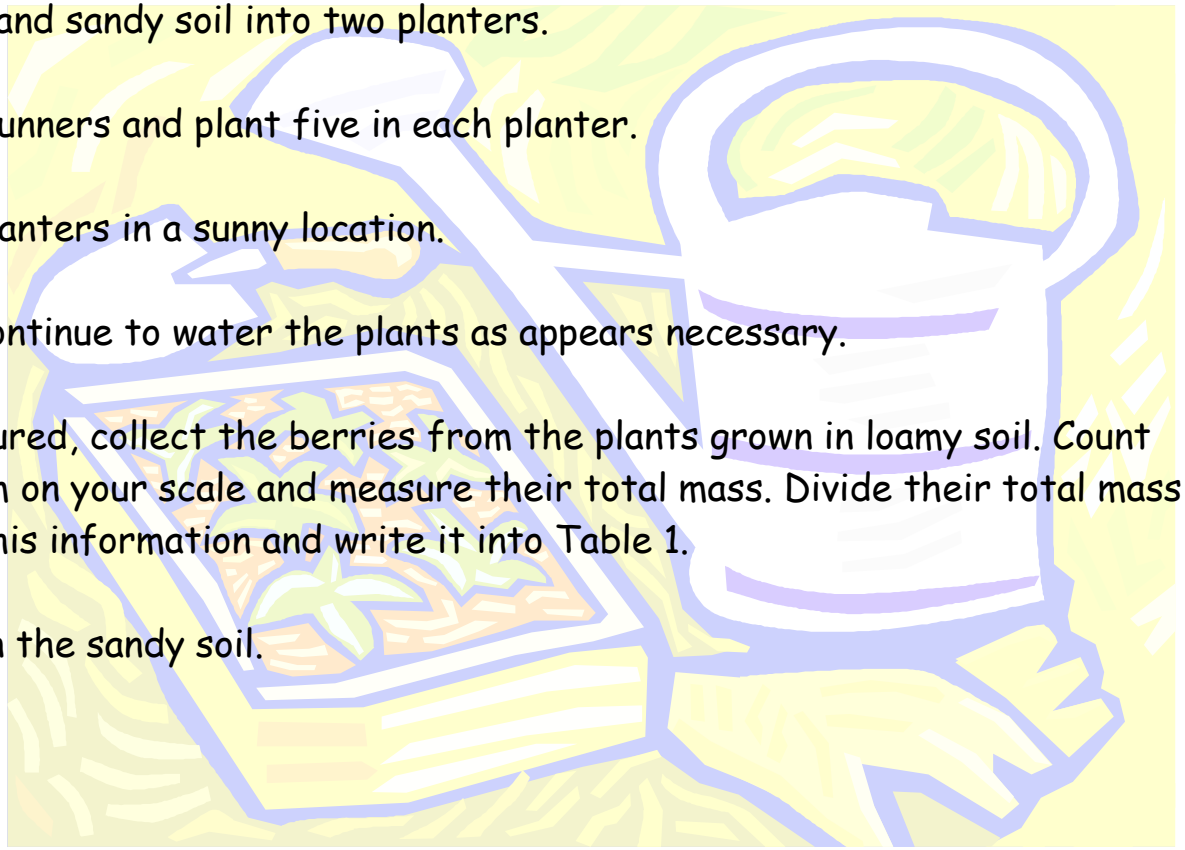
2. Select similar-sized strawberry runners and plant five in each planter.

3. Water the plants and place the planters in a sunny location.

4. Throughout the growing season continue to water the plants as appears necessary.

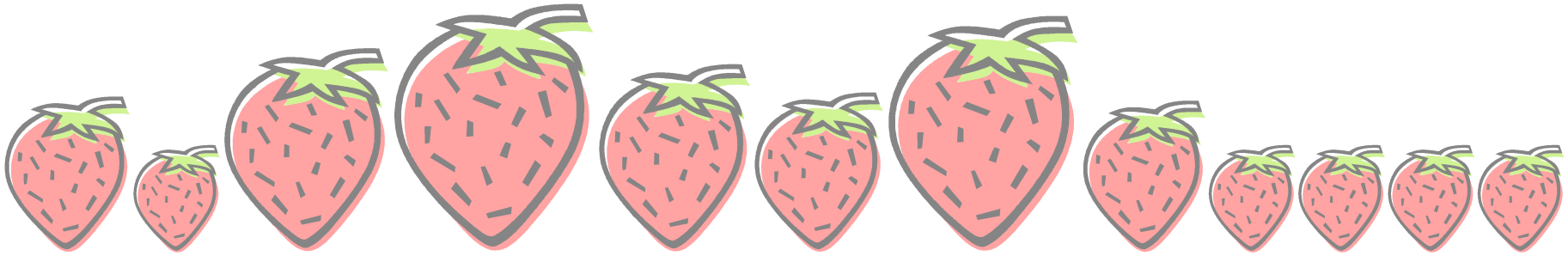
5. When the strawberries have matured, collect the berries from the plants grown in loamy soil. Count the number of berries. Place them on your scale and measure their total mass. Divide their total mass by the number of berries. Take this information and write it into Table 1.

6. Repeat step 5 using the berries in the sandy soil.



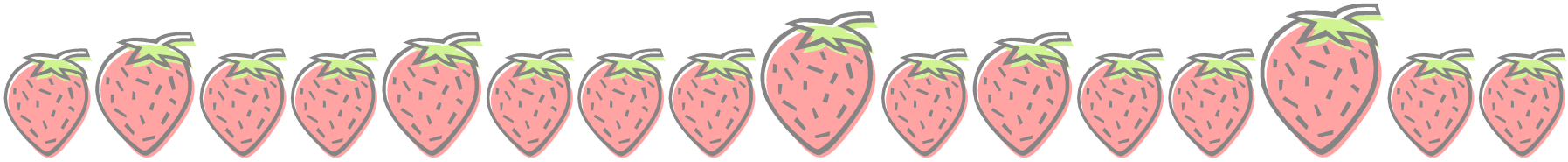
STEPS 7 AND 8: OBSERVATIONS AND ANALYSIS

When we run our experiment, we will measure things and notice things that we need to record. We write the things we measure and notice in our observations. Photographs can also be used to show your observations. Let's use some imaginary data to build Table 1 found on the next page.



Strawberries Grown in Loamy Soil. Total Mass: 240 g

Did you notice that there are some really large strawberries and some smaller strawberries?



Strawberries Grown in Sandy Soil. Total Mass: 180 g

Did you also notice most of the sandy soil strawberries are small; but, there are more of them than in the loamy soil?

You might need a calculator to help you with the fourth column.

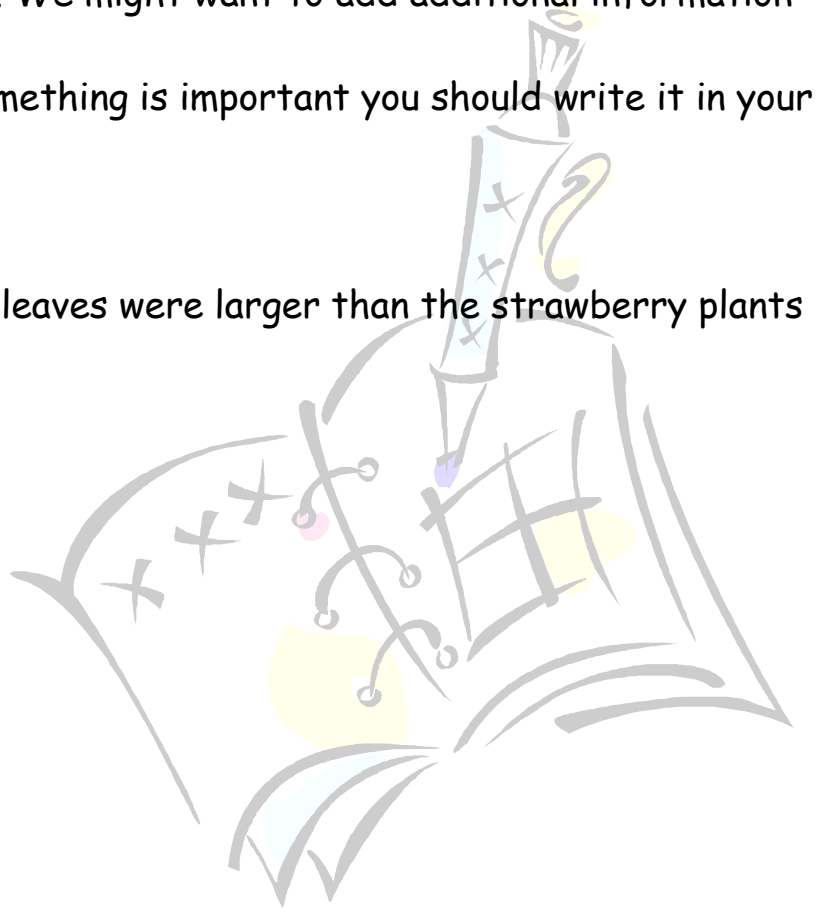
Table 1: Strawberry Yield in Loamy and Sandy Soil

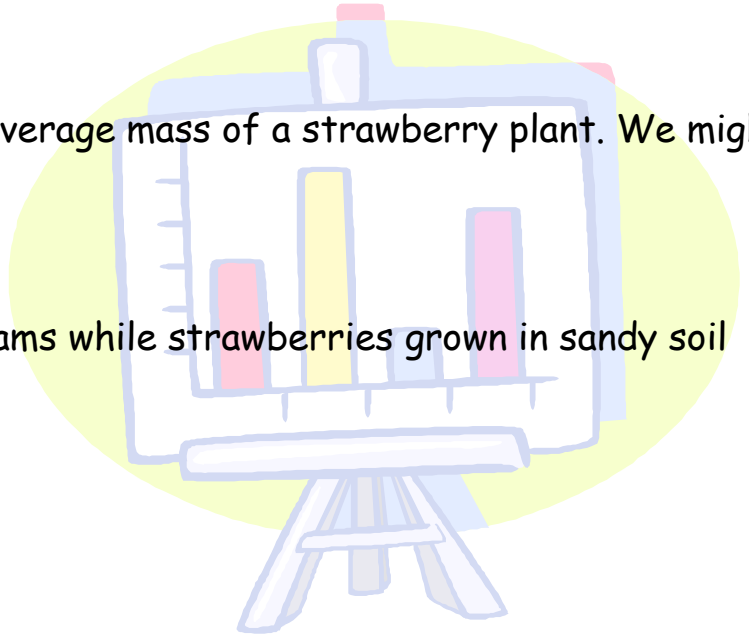
Type of Soil	Mass of all strawberries (g)	Number of Strawberries	Average Mass of Strawberry (Mass ÷ number)
Loamy			
Sandy			

As an extension to this exercise, students could calculate average lengths of the printed strawberry pictures.

Table 1 is part of our observations. It includes data that we've measured by both counting (the number of strawberries) and weighing (the mass of the strawberries). We might want to add additional information about what the plants looked like. If you are not sure if something is important you should write it in your notebook.

- The plants in the loamy soil had more leaves and their leaves were larger than the strawberry plants grown in the sandy soil.
- The plants in the sandy soil flowered first.
- The plants in the sandy soil produced more runners.
- The largest strawberries were grown in loamy soil.





When we write an analysis, we make calculations such as the average mass of a strawberry plant. We might include graphs as well. Our analysis might read as follows:

"Strawberries grown in loamy soil averaged _____ grams while strawberries grown in sandy soil averaged only _____ grams."

STEP 9: SOURCES OF ERROR

In every experiment there are always things that couldn't be perfectly controlled. These uncontrolled things might affect the outcome of an experiment and so they are listed as sources of error.

In our strawberry experiment we might have noted the following sources of error:

- There were more earthworms in the loamy soil.
- There were more ants in the sandy soil.
- The sandy soil appeared dry and so it was watered more frequently.
- During the middle of the day, the plants in the sandy soil wilted.
- There were fewer available nutrients in the sandy soil.

STEP 10: CONCLUSION

When an experiment is finished and the data has been analyzed and sources of error identified, it is time to write a conclusion. A conclusion is a one or two sentence statement that tells the reader about the results of the experiment.

For our strawberry experiment our conclusion might be:

Strawberries grown in loamy soil weighed more on average than strawberries grown in sandy soil.

Let's compare our purpose, hypothesis, and conclusion for the strawberry experiment.

Purpose: To see if strawberries grown in sandy soil weigh less than strawberries grown in loamy soil.

Hypothesis: Strawberries grown in loamy soil will weigh more than strawberries grown in sandy soil.

Conclusion: Strawberries grown in loamy soil weighed more on average than strawberries grown in sandy soil.

What do you notice about those three statements?

STEP 11: ACKNOWLEDGEMENTS

If you open the front of a book sometimes you will see a page titled acknowledgements. This is the place where an author thanks everyone who has helped with the book. We use acknowledgements in science too. Even professional scientists receive help from their peers – so we make sure to mention that help.

In your project you might receive help from your parents, your teacher, someone in the community, or even your classmates. Be sure to thank them in your acknowledgements by specifically stating how they helped.

Your acknowledgements might read:

I'd like to thank my parents for helping me get the materials for my project. I'd also like to thank them for helping me test my experiment. And I'd like to thank my mom for helping me type my project and lay it out on my project board. Thank you also to my neighbour, Bill, who used his power tools to help me build my equipment.

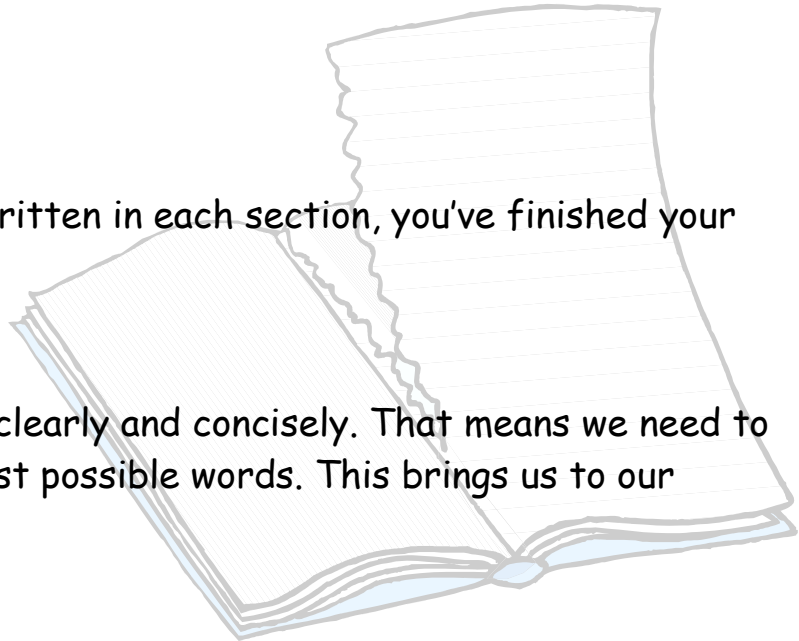
STEP 12: REFERENCES

In our references we list websites, books, magazines, and even conversations with someone if we have learned something important about our project from them.

For our strawberry experiment we might have

- A website reference from which we learned all about strawberry plants.
- We might need to list the garden centre where we bought our dirt because it is there we learned about loamy soils and sandy soils.

Sometimes, we even need to reference our own work, if our current project is an extension of a past project!



So, after all of that hard work and you know what needs to be written in each section, you've finished your rough copy of your project.

The scientific method is also about communicating experiments clearly and concisely. That means we need to write a report that is both easy to read and written in the fewest possible words. This brings us to our second last step:

STEP 12: PUTTING IT ALL TOGETHER

To participate at the VIRSF you will need to write a report and to build a display board. It is now time to break out the computer and type your report and the information needed for your display board.

In your written report and on your display board, you start with your title and your name. You then describe each of the steps of the scientific method.

- Query
- Initial Research
- Purpose
- Hypothesis
- Materials
- Method
- Observations

- Analysis
- Sources of Error
- Conclusion
- Further Research
- Acknowledgements
- References

Be sure to proof read your work. Make sure that you use headings and list each section in order of the scientific method.

IS THAT IT? …

You will need to explain your project to some judges.

When presenting, remember to speak clearly and slowly. Because we get nervous, most people talk too quickly. So practice your talk ahead of time.

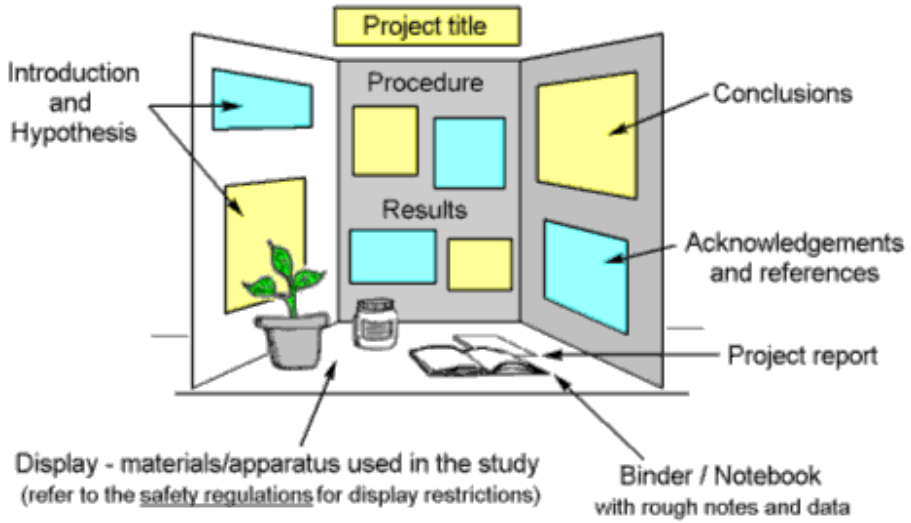
When you present, you will want to briefly review your project. The best approach is to follow the scientific method. When you are finished, your classmates, teacher, or judges might want to ask you some questions.

Be sure to thank everyone who listened to your talk.

HELPFUL HINTS ABOUT DISPLAY BOARDS

- Use a font that is large enough to easily read from one metre away.
- List your sections in a sequential order from top down left panel to top down middle panel to top down right panel. (See the diagram on the next page.)
- Use computer-generated graphs if possible. You might need an adult's help for this.
- Use a coloured display board. They are more visually appealing.
- Be as neat as possible.
- Frame your sections with borders.
- Add photographs if possible.
- Do not use fluorescent colours of ink or paper.
- Use dark colour fonts.

- Do not plagiarize someone else's work.



For further information and registration, please check out our website at:

web.uvic.ca/~virsf/

or simply Google VIRSF

Good luck and have fun exploring science.