The Task

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Task 6 - EEI

1. Research an aspect of functioning organisms.
   e.g. enzymes, membrane permeability, photosynthesis, cellular respiration.
2. Identify a question about the topic that can be investigated in the laboratory.
3. Propose a suitable Hypothesis.
4. Carry out initial testing to identify your variables and suitable amounts and concentrations.
5. Design and carry out a controlled experiment to test your hypothesis.
6. Organise researched background information into an Introduction to your formal report. This must:
   – show the relevance of your investigation
   – acknowledge the prior work of scientists by rigorous in–text referencing
7. Review your testing and your hypothesis and retest any elements that are unclear.
8. Organise your data into a meaningful format. Analyse your results in relation to your hypothesis.
9. Analyse your experimenting technique and attention to safety precautions. Offer advice for future experiments.
10. Conclude your report by relating your data back to your hypothesis and relate your study to future applications.

The Inquiry Process

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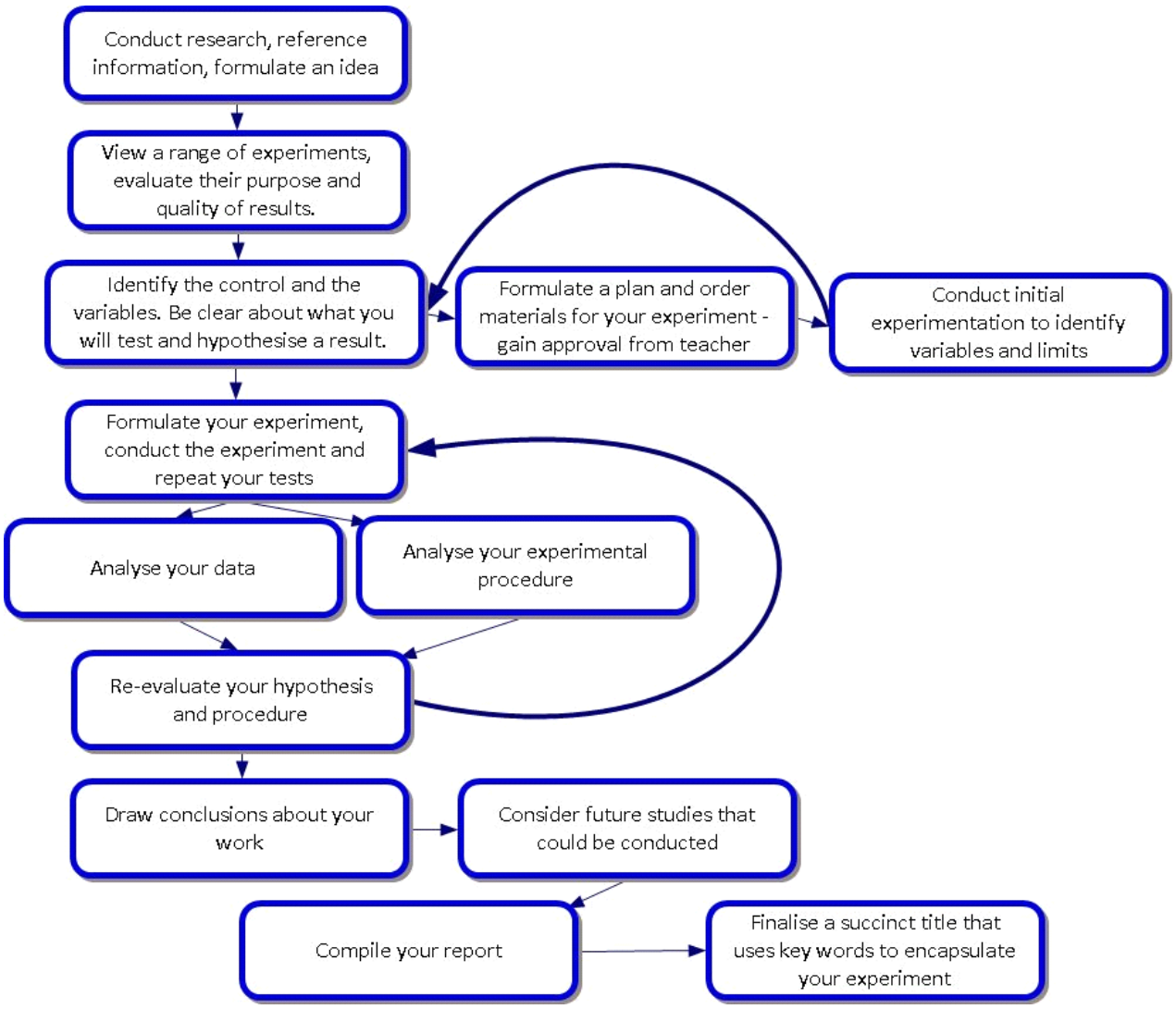

Hypothesis

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A hypothesis is a suggested explanation of a phenomenon, or alternatively a reasoned proposal suggesting a possible correlation between or among a set of phenomena.

It is a formal statement that is designed to provide a potential explanation for something that has been observed. A hypothesis is a potential answer to a question. A hypothesis is supposed to address causes that lead to effects.

Pasted from <http://scene.asu.edu/habitat/s_method.html>

Any useful hypothesis will enable predictions by reasoning. It might predict the outcome of an experiment in a laboratory setting or the observation of a phenomenon in nature.

It is essential that the outcome be currently unknown to the experimenter.

Pasted from <http://en.wikipedia.org/wiki/Scientific_method>

Locating Resources

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When conducting research, remember to select key terms with purpose. Select broad topics and then move into specific search terms. Alter your vocabulary if you cannot locate appropriate research.

You may like to use a thesaurus to assist with this.

Stages in the process

Initially, complete general research on your topic. You may use general web searches or print material. Read widely on your chosen topic.

Next, visit the Potter Library databases to locate general information and research involving potential experiments.

Finally, for more advanced studies usually published in scientific journals, search within http://scholar.google.com.au/. Use the advanced search options to narrow down your results.

Variables

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In this case, the most common variables are:

- Substrate concentration
- Enzyme concentration
- Temperature
- pH
- SA:V of substrate

A variable is a factor or characteristic that exists in different degrees or levels. For example, light is a variable because it exists in varying levels, from full light to partial, to none.

Your aim is to identify and control the variables. The independent variables are factors that are independently, deliberately set by the experimenter.

The dependent variable is a factor that is being measured by the experimenter. You alter one independent variable only to ensure it is responsible for the effect observed on the dependent variable.

Pasted from <http://scene.asu.edu/habitat/s_method.html>

Designing your experiment

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First things first… Choose your enzyme

Then...

1. Keep things as simple as possible. Test only one variable thoroughly.
2. All experiments need to have an appropriate control. You need to have a standard to test your experimental results against.
3. You will need to have several "subjects" or samples in your experiment.
4. Allow enough time for the experiment to be repeated. Also, allow enough time for complications. Begin early!
5. Complete the appropriate request form to ensure you have the correct materials.
6. Quantify your results by reporting things in numbers, not just observations.
7. Did your data support your hypothesis? If not, that's a result too.
8. Consider other possible explanations for your results.

Ask yourself questions like…

1. Where is this enzyme found in organisms?
2. Where is the enzyme made in organisms?
3. What pH and temperature will it then be suitable for?
4. How does the enzyme assist the functioning organism?
5. What happens when the functioning of the organism goes wrong?
6. How can this research be linked to the organism?

Using Word to reference

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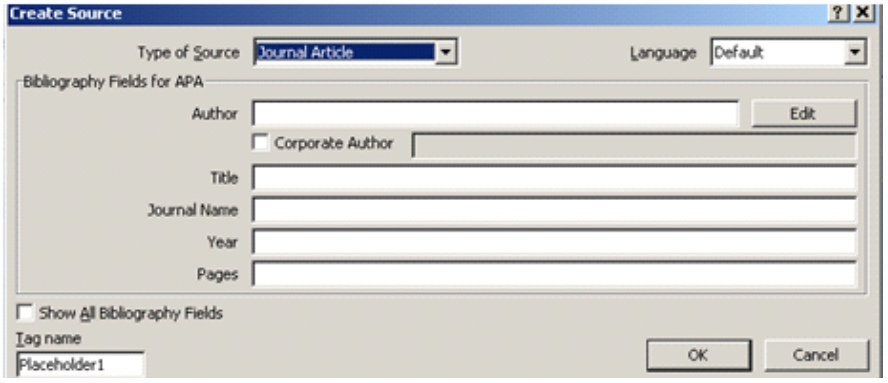
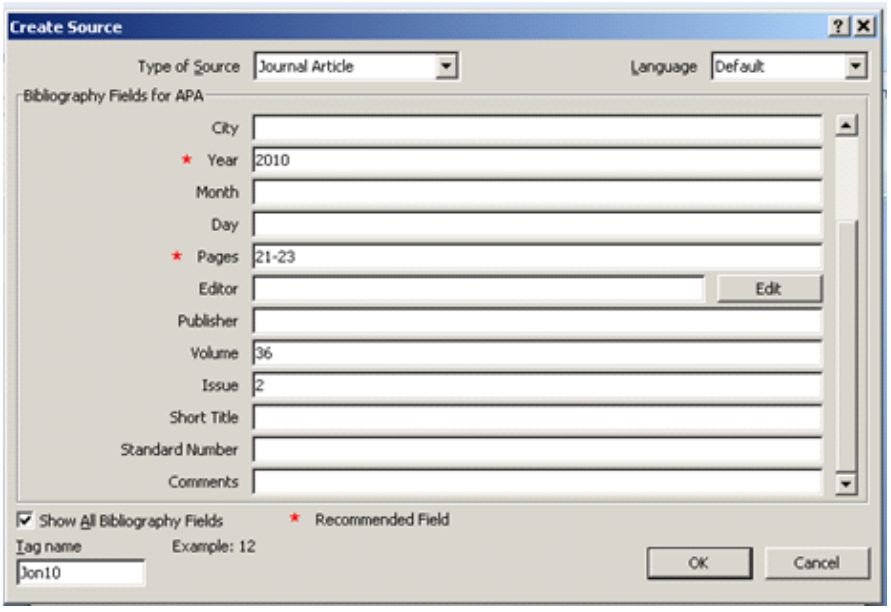
Each time you locate a source, create an entry for this source.



You may need to reveal 'All Bibliographical Fields' to record all of the necessary data.



Manage your sources to ensure only those sources referred to in the article are found in the Bibliography. Ensure you update this record before submitting your report.

Journal

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Spare journal pages

- Record every aspect of your work on this task in your individual journal, including
  - research, planning (even dead-ends!) and all raw results, observations & modifications.
  - Research notes (handwritten information, photocopies of text and/or internet printouts) are to be included in the journal with relevant sections highlighted.

  Note: All information included here must be referenced.

- Don't cross anything out, you might need to refer back to it later.
- Entries should be dated with the date and the number of days into the experiment.
- Include all observations, don't assume you'll remember points and particulars.
- Please note that the journal is expected to be a valid working record.
- The journal is very important in verifying ownership of your work.

Reporting on your experiment

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After experimenting, you will write a formal report, in standard AHS format. The introduction must not exceed 800 words. There is no specific word limit for the other sections of the report; however, your work must be concise and relevant. All of your work must be fully referenced.

Basic Structure

1. **Title**
   Make the title a succinct statement of what is in the report. Try to include significant key words that alert a reader to the content. Practical reports are often submitted without any title at all—don't forget!

2. **Introduction**
   In this section introduce your work, state why the project was worth investigating and give a brief summary of the general and background information you have gathered from books, reports and/or journals. Describe (briefly) what it was you were working on and what your aims were. As a rule of thumb it's often useful to try a three paragraph approach to your initial report writing:
   - ***Paragraph 1 - What it is you are investigating, why it is interesting.***
   - ***Paragraph 2 - What information is already known about the topic?***
   - ***Paragraph 3 - What were the aims of the study you have just done and what did you predict to find in the results (hypothesis)?***
   - ***You may like to consider the wider application of your research by relating the purpose of the experimentation to a real-life situation.***

     Make sure you connect the paragraphs together in a cohesive manner.

3. **Materials and Methods**
   In these sections – separate – you tell the reader what you used, how you did the experiment, the analysis or how you collected the data.

   In the materials section, you should list the quantities and details of all items used. What did you do it on? What did you do it with? However, do not get bogged down by listing every staple, rubber band or pencil that you used.

   When reporting on the method, you should give only sufficient detail so someone can repeat your work if they desired. List each step that you followed and outline how you collected your results. Use past tense.

   Important Point No. 1
   Make sure that you do in fact show any modifications to the method or the materials.

4. **Results**
   Describe **what** you found in your experiment. Present your numerical results (using SI units), but note that raw data are seldom reported in the Results section. Instead they should be analysed and summarised in meaningful ways (for example, by presenting means or averages and in graphs or tables showing comparisons). Do not just "spill out" the raw results that you recorded in the experiment, and leave the reader to interpret how it pertains to your objectives.

   Tables and graphs are good ways to present data. Each table or graph should:
   (1) be numbered (Figure 1, Table 4, and so on);

(2) have a title that clearly indicates the content of the figure or table;
(3) have a legend that explains all symbols and abbreviations, source of the data, and other pertinent information

Important Point No. 2
Always draw graphs or diagrams using a sharp lead pencil.

5. Discussion

This is the good bit. It is here that you get to express **yourself** the most (followed closely by the Introduction). It is here that you develop your thinking and logic. Your paragraphs should run like this:

- ***Paragraph 1 – Explain your results. What happened? Why did you get those results? Relate your answers back to the results tables or graphs to show trends – all diagrams should be referred to as you work through the results.***

  Important Point No. 3
  Never start your discussion with your final result – you should be working to prove how you came up with your results.

- ***Paragraph 2 - The results you obtained in your experiment should be compared to information you mentioned from books and other sources in the Introduction.***
- ***Paragraph 3 –What variables did you control throughout the experiment? Did you have trouble controlling them? Did you consider any safety aspects – which ones?***
- ***Paragraph 4 – Are your results expected and consistent? You get the opportunity to give suggested improvements for the experiment.***

6. Conclusion

In this section, it is appropriate to refer back to your aim and introduction. You should state whether or not you have met the initial aim and whether or not your hypothesis was correct. You may wish to lead your experiment on to future research that may be useful or some real life applications of your experiment.

7. References

The References section lists the scientific literature you cited in the main text of your report.
When should you cite a reference in your report?

- When you quote directly from the source, or closely paraphrase the source.
- Whenever ideas, facts, or data mentioned in your report are taken from another source.
- Whenever you make a statement of fact or opinion that is not common knowledge, and is not supported by your own data and arguments.

a) Citing a reference in the body of the text

If you refer directly to the source, use the surname and place the date in brackets:
Fisher (1930) was the first to propose a theory for the evolution of sex ratios.

- If you refer to the publication indirectly, both author and date go in brackets:
  Half a century after Darwin, a theory of sex ratio evolution was proposed (Fisher, 1930).
- A citation is part of the sentence it refers to. A full stop goes after the citation, not before.
  Right: DNA takes the form of a double helix (Watson and Crick, 1954).

b) Listing references in the References section.

In this section, list all the sources you have cited in the main text with full details. List in alphabetical order according to the surname of the author. Nothing should be in the reference list that is not cited in your report.

The format is: Authors. (date). Book title. Publisher: Place of publication.
Fisher, R. (1930). *The Genetic Theory of Natural Selection*. Oxford University Press: Oxford.

Your responsibilities

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- Equipment must be ordered on the requisition form.
- It will be your responsibility to organise and store your materials once provided.
- You are expected to clean up after yourself at the end of every session.
- Anything that you need to leave must be clearly labelled with your name and the date to which it is to be kept.
- Store in a place approved by your teacher.
- You may work in groups of up to three people to plan and carry out the investigation but reports and logbooks must be individual.