

Sensible Science

Real World Ecosystems
Learner Worksheet
Grade Level: 5-8



Name: _____

The purpose of this worksheet is to refresh your memory about some aspects of the scientific method of studying or dealing with a problem while introducing you to some different kinds of problems in our environment.

After reading the Sensible Science Backgrounder, answer the following questions.

1. Nine major steps to be used when carrying out the scientific process may include:

Hypothesizing

The tentative idea of what the solution to a problem may be is a hypothesis. In a way, a hypothesis says that “If these are the conditions, then this will be the outcome.” Use the preceding format to write a hypothesis for each of the following:

2. Reasons why a person may be overweight.

3. Reasons why a person may be underweight.

Predicting

Can Science Predict the Future?

Even with the most sophisticated computer models, there is still more we need to learn about the role of global warming in determining the Earth's climate. Scientists agree on some things and disagree or are uncertain about others in relation to climate change.

Agreed:

- (1) There is a natural **greenhouse effect** that keeps the Earth warmer than it would otherwise be.
- (2) The main greenhouse gas, water vapour, increases in response to the increased atmospheric concentrations of other gases such as carbon dioxide, methane, nitrous oxide, and chlorofluorocarbons (CFCs) which are released from fuels. As the concentration of all of these atmospheric gases increases, the atmospheric temperature also increases further.
- (3) Global atmospheric temperature has increased by 0.3 to 0.6 degrees Celsius over the past 100 years, This is referred to as **global warming**.

Uncertain:

- (1) Although scientists agree that there is a build-up of greenhouse gases in the atmosphere, they are uncertain about the future rates of greenhouse gas emissions
- (2) The response of the global climate to these emissions. It is difficult to predict the combined effects of technical, social, and political factors when taken together with the effects of reforestation, the increased or decreased use of fossil fuels, the increased energy efficiency of homes and appliances.
- (3) Scientists really do not understand the interrelationships between clouds, oceans, polar ice, ozone depletion, and climate.

The best that scientists can do in the situation is to make predictions that are based upon educated assumptions about populations, energy sources, energy use, economic growth, and so on. Due to the various uncertainties, climate predictions are based upon certain potential ranges of temperature increase. So, the answer to the initial question "Can science predict the future?" seems to be, "Not necessarily." But, with accurate information, we can do some predicting with reasonable certainty.

4. Looking only at the preceding list of facts which are Agreed, write a prediction about the future temperature on the surface of the Earth.

5. Look at the Agreed points on the previous page and write a properly worded hypothesis based upon that information.

Apparatus and Materials

Any investigation, whether it is a hands-on experimental procedure, or library or computer-based research, requires materials of some sort, and perhaps an apparatus or laboratory equipment.

Procedure

Depending upon the purpose of an experiment, the procedure must be designed specifically towards determining outcomes related to a particular purpose or hypothesis.

6. For example, if the purpose of your study were to determine an appropriate eating plan for a man of age 45 years who requires a minimum of 10,500 kJ per day, what steps would the procedure necessarily include?

An extremely important part of any experimental procedure is often the data analysis. It is possible that any number of inferences or conclusions might be drawn, depending upon what the purpose of the investigation is. The data on the chart below was collected at the Mill Woods Bottle Depot, 2004.

Refer to the information in the chart below in order to answer the following questions.

7. What flaw or weakness do you see in attempting to draw conclusions about the consumption of different beverages based upon the chart provided below?

8. Can you think of other types of substances besides beverages that can be bought in what appear to be recyclable containers?

9. State a reason why you think that containers other than those for beverages might not be accepted at the same depot?

Abbreviations on the table below:

- > greater than, < less than
- Alum pop cans – aluminum pop cans
- Bi-metal (two-layer lined) – pineapple, tomato juice
- HDPE (high density polyethylene) – juice, water
- PET (polyethylene terephthalate) – milk
- Paperbd (coated paperboard) – milk
- Tetra (multi-layer plastic, paper) – juice
- Glass – beer, imported
- Alum beer – aluminum beer can

Table A: Mill Woods Bottle Depot Data for June 2004

| Month/ Year | Alum pop Cans | Bi- metal > litre | HDPE > litre | PET > litre | PET < liter | Pa- perbd > litre | Tetra < litre | Glass | Alum Beer |
|----------------|---------------------|-------------------------|-----------------|----------------|----------------|-------------------------|------------------|---------|--------------|
| May-02 | 69902.5 | 117 | 774 | 12874 | 16782 | 1167 | 16082.7 | 12606 | 27000 |
| Jun | 62027.6 | 118 | 644.3 | 11107.1 | 16546 | 1042 | 14275.7 | 12236 | 28800 |
| Jul | 79435.3 | 128 | 753.7 | 13300 | 23668.3 | 1292 | 14696.3 | 15657 | 30900 |
| Aug | 63048 | 98.2 | 595 | 10762 | 19691 | 961 | 9871 | 12898 | 34800 |
| Sep | 58340.9 | 149 | 543.4 | 9960 | 18092 | 899.9 | 9901 | 11504 | 27600 |
| Oct | 55552.3 | 120 | 483.8 | 9137.1 | 16432 | 926 | 12045.9 | 11239 | 21600 |
| Nov | 45650 | 83 | 441 | 8017 | 13256 | 732 | 11050.1 | 8980.1 | 26400 |
| Dec | 50600 | 121 | 502 | 8891 | 14129 | 864 | 11558.3 | 9768.8 | 19200 |
| Jan-03 | 47334 | 133 | 458.4 | 9262 | 11878 | 814 | 9921.8 | 9276 | 26250 |
| Feb | 44857.6 | 87 | 390 | 8301.4 | 11122.7 | 808 | 9497.3 | 7803 | 20400 |
| Mar | 57148.8 | 136 | 546 | 10311 | 14541.1 | 1066 | 13632 | 10498 | 18900 |
| Apr | 69371.2 | 134 | 759 | 12889 | 18769 | 1439 | 16368 | 12510 | 33000 |
| May | 66244.2 | 157 | 723 | 12006.3 | 18728.3 | 1349.2 | 15973 | 11664 | 31800 |
| Jun | 67542.7 | 129 | 688 | 11873 | 21210 | 1198 | 15596.6 | 12534 | 27600 |
| Jul | 71688.5 | 105 | 682.7 | 11733 | 24489.4 | 1243 | 13552.7 | 13500 | 34800 |
| Aug | 67611 | 127 | 629.2 | 10288 | 23362.4 | 1176 | 10486.3 | 13038.4 | 39750 |
| Sep | 65760.1 | 131 | 595.4 | 10027.7 | 22721.7 | 1090 | 11700.6 | 12704 | 30600 |
| Oct | 56350 | 153 | 542 | 9231 | 19225 | 973 | 11828 | 11170 | 33450 |
| Nov | 41124 | 85 | 370 | 6885 | 13315 | 712 | 9247 | 7710 | 17850 |
| Dec | 49332 | 104 | 491 | 8809 | 15211 | 1089 | 11130 | 9849 | 19200 |
| Jan-04 | 48332 | 114 | 424 | 8975 | 13837 | 878 | 9360 | 8788 | 28650 |
| Feb | 52650 | 122 | 519 | 9834 | 15140 | 1150 | 12473 | 9879 | 23850 |
| Mar | 62260 | 101 | 650 | 11451 | 19333 | 1373 | 14893.3 | 11882 | 23700 |
| Apr | 72760 | 124 | 733.6 | 12435.3 | 22986.2 | 1584 | 16972 | 12922 | 34189 |

Source: Mill Woods Bottle Depot, June 2004, Edmonton, AB, data for May 2002 – April 2004

Observe and Record

The type or types of data that are to be observed and recorded depend upon the original objective of an experiment, so there are a number of ways in which data or findings may be reported. Charts or tables may be custom-designed for the data. Although you are familiar with observing and recording in individual scientific investigations, sometimes the main reason for the existence of an entire organization or company is to record observations and to make them available to researchers in the field. Use this website for the following questions:

<https://plantwatch.naturealberta.ca/index.html>

10. Looking at the website, what is the stated purpose of Plant Watch?

11. When was Plant Watch started in Alberta? Why is it important?

12. What is the common name for *Rhododendron groenlandicum*?

13. Describe two adaptations that help the leaves of this plant to retain moisture.

14. Describe in terms of light and moisture the preferred habitat of *Rhododendron groenlandicum*.

Analysis and Discussion

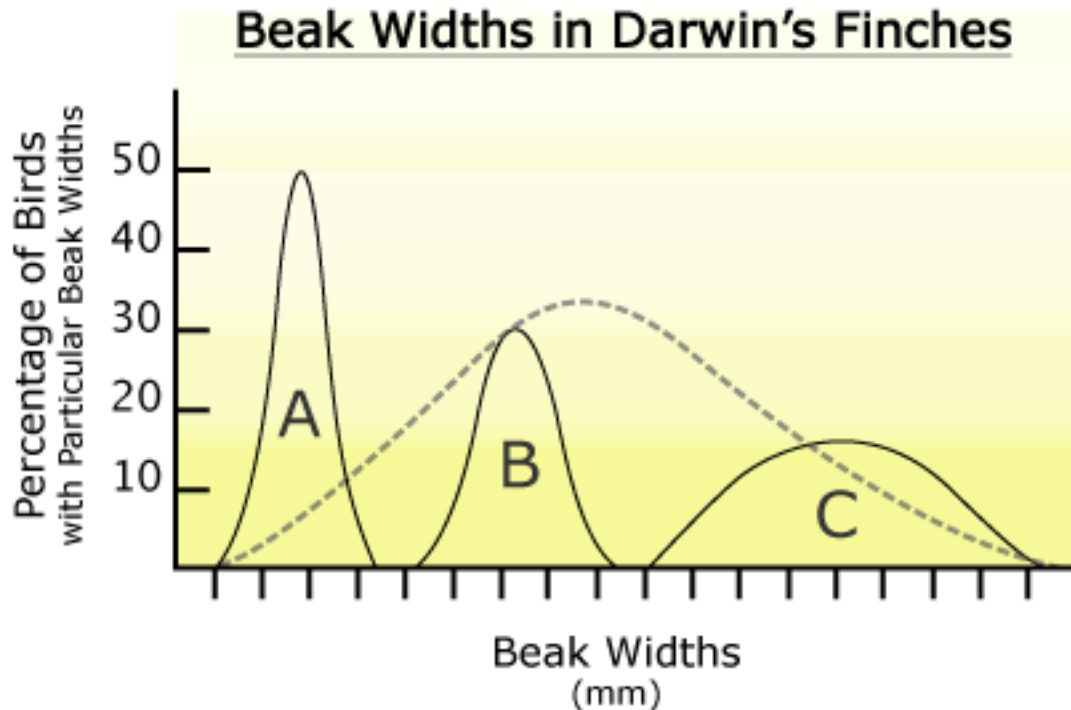
Once data has been collected, it must be analyzed and perhaps discussed. The analysis may include the construction of graphs, tables, and diagrams or the discussion and answering of specific analysis questions.

For example, after Charles Darwin visited the Galapagos Islands and reported his findings, an English biologist, David Lack, visited the islands in 1939 and collected some additional information for further study. One species he examined in detail was the ground finches of the Galapagos. The results of his research are graphed below.

Beak Widths in Darwin's Finches Legend

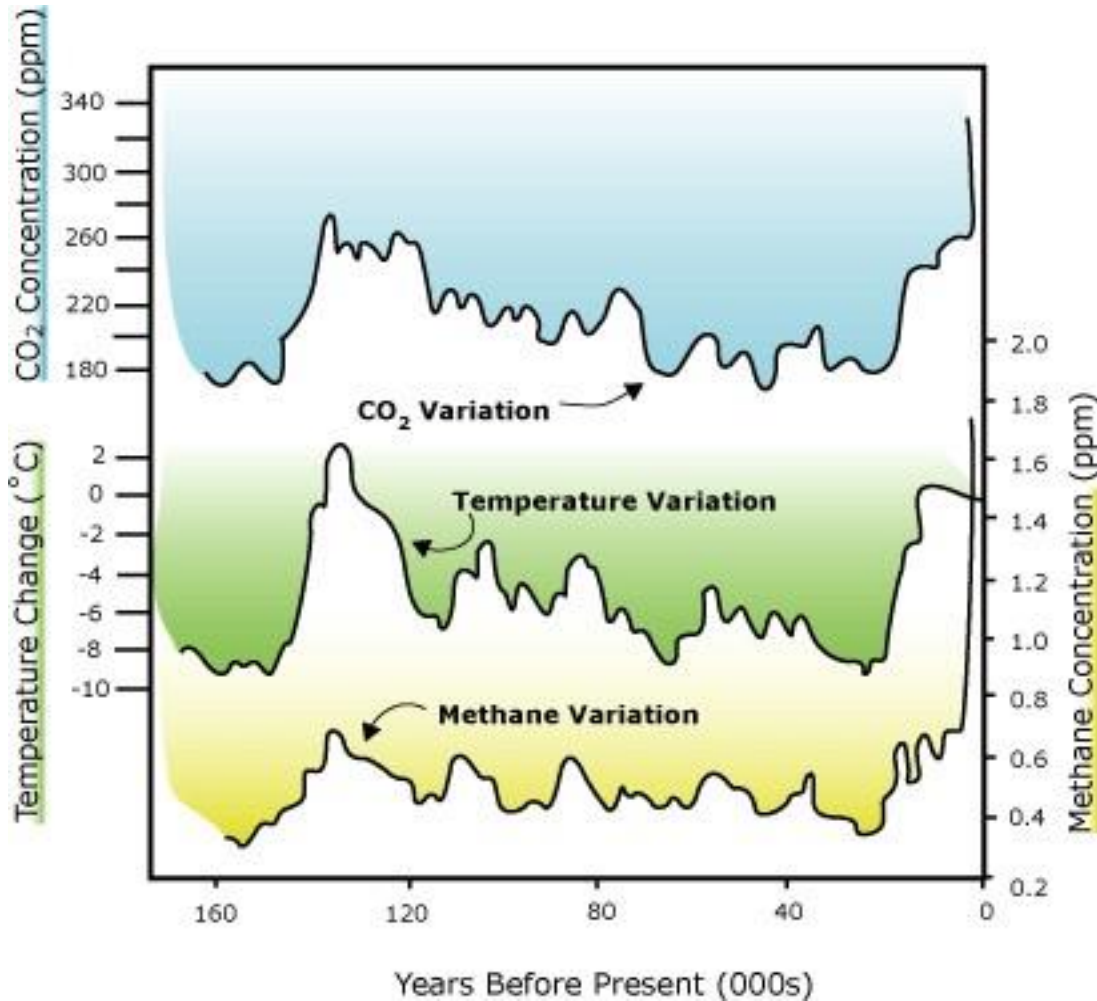
_____ A, B, C observed distribution

----- expected distribution of beak widths if all birds belong to the same species



Adapted from: J.D. Reimer and W.G. Wilson, *Understanding Living Things*, Toronto: D.C. Heath Canada, 1997, 408.

15. What is suggested by the fact that Lack's data on the preceding graph resulted in three non-overlapping bell curves?



Adapted from: A Matter of Degrees: A Primer on Climate Change, Environment Canada, 1997, 6.

16. When analyzing graphic information, it is important to be able to interpret and state in words the trends that seem to be revealed by the graphs. Look at the graph above and state in no more than two sentences your analysis of its information.

Once you have studied a particular topic such as the importance of water, the information might be analyzed in a variety of ways. One of the possibilities is through discussion. That might be followed by a presentation to other interested groups, more discussion, and so on until a conclusion is reached.

Analyze This!

The class will be divided into five groups, each of whose assignments is to analyze the information related to one of the following questions and report to the rest of the class. The amount of time allowed for research and reporting will be announced by your educator at the outset.

How Important Is Water?

Discussion Topics

Native Culture: How is water important to native people in Canada? How did some native people use water for transportation? What types of food did native people harvest from water bodies? How did different climates and precipitation affect the lifestyle of indigenous groups in northern and southern Alberta? How is water used in native spiritual rituals and native stories?

Alberta Heritage: In what ways was water important to explorers and settlers in Western Canada? How did the early explorers travel? Why are major settlements located close to water? How did settlers get drinking water? How did the amount of available water affect settlers in southern and central Alberta?

Economy: How is water important to many Alberta industries? How do farmers and ranchers rely on water? What kind of crops grown in Alberta need irrigation? How is water used in the oil and gas industry? In electricity generation? In the forest products industry? What would happen to these industries if there were not enough water? What sorts of pollutants does each industry add to the water? How do people living in towns and cities depend on water?

Environment: Why is water important to the natural environment? Name some plants and animals that make their homes in the water. Name some plants and animals that depend on water for their food. What happens to these species when there is not enough water? What happens if the water is polluted? Why are these plants and animals important to us?

Recreation: Name activities that we like to do that use water. What would happen if there was not enough clean water? How do recreational activities affect the environment? How should we use water so the environment is not affected?

Adapted from: DC Teacher's Resource Manual, Destination Conservation, 2001, p. 3 – 14.

For the following questions, please refer to Table A: Mill Woods Bottle Depot Data for June 2004 (above):

17. In what two months is the recycle count for aluminum pop cans the lowest? State two possible explanations for this.

18. In what two months is the recycle count for aluminum pop cans the highest? State two possible explanations for this.

19. February and November appear to exhibit the lowest intake of 500 mL glass bottles. Why do you think that is?

20. Why do you think there are fewer paperboard containers for milk than those made of PET?

21. Two months were showing the highest beer can recycling in 2002 and 2003. What difference has appeared already in 2004 data? Suggest a possible explanation for the change.

Conclusion

Once all the research or experimentation has been done and the data collected, it is time to put together the data and analysis to try to make a connection **back to** the original hypothesis or problem. This is the step that makes clear whether the problem has been solved or the original question answered. Unfortunately, it is also the step that is often overlooked. Sometimes, learners assume that if they have carried out an investigation and have recorded results of some sort, they are finished.

However, if one looks back at the original hypothesis or problem, there is still a conclusion to be drawn. This statement is vitally important, as it might reasonably be the second of two items that a research evaluator might review. The first to be reviewed would be the purpose of the experiment and the last would be the conclusion that was drawn after the experiment was performed.

In one experiment, a researcher selected two identical groups of rats. One group was fed 30g of cereal with 120 ml of milk, the other group was fed 30 g of shredded cereal box cardboard mixed with 120 mL of milk. Both sets of rats were kept on the same diet for the same amount of time, all the rats survived, and there was no difference in mass gained or state of health.

22. State two possible conclusions that might be drawn, based upon the description of the findings above.

23. State a possible hypothesis for the experiment above.

24. Based upon the Mill Woods Bottle Depot data chart, state two possible conclusions that you feel qualified to make.
