

Appendices

The appendices of *Nelson Physics 11* are an important feature of the text, enabling students to learn how to learn. The four appendices cover:

- Scientific Inquiry Skills
- Technological Problem Solving
- Decision-Making Skills
- Lab Reports
- Math Skills
- Safety Skills
- Reference Tables
- Answers to selected Questions

Appendix A1

Observational Studies

The purpose of inquiry is simply to study a natural phenomenon with the intention of gaining scientifically significant information in answer to a question. Observational studies involve observing a subject or phenomenon in its natural or uncontrolled environment, usually with no hypothesis. A hypothesis may, however, be generated from repeated observations, and modified as new information is collected over time.

The flow chart (Figure 3) summarizes the stages and processes of scientific inquiry through observational studies.

Appendix A1

Correlational Studies

When the purpose of scientific inquiry is to test a suspected relationship (hypothesis) between two different variables, but a controlled experiment is not possible, a correlational study is conducted. The investigator cannot purposefully change or control the variables but instead must allow them to change naturally. It is often difficult to isolate cause and effect in correlational studies. A correlational inquiry requires large sample numbers and many replications to increase the certainty of the results.

The flow chart (Figure 2) outlines the components that are important in designing a correlational study. An investigator must be prepared to follow researchers in that

Appendix A2

Decision-Making Skills

Modern life is filled with environmental and social issues that have scientific and technological dimensions. An issue is defined as a problem that has at least two possible solutions rather than a single answer. There can be many positions, generally determined by the values that an individual or society holds, on a single issue. Which solution is "best" is a matter of opinion; ideally, the solution that is implemented is the one that is most appropriate for society as a whole. The common components involved in the decision-making process are outlined in the graphic below.

In this stage, you will analyze the issue and clarify what you need to find. First, you should establish criteria for evaluating your information to determine the relevance and significance of the data. You can evaluate your sources of information, determine what assumptions may have been made, and assess whether enough information was provided for you to make a decision. Once the issue has been analyzed, you may decide to evaluate the alternative solutions. You may decide to carry out a risk benefit analysis—i.e., that enables you to look at each possible result of a proposed action and helps you make a decision.

Appendix A3

Technological Problem Solving Skills

There is a difference between science and technology. The goal of science is to understand the natural world. The goal of technological problem solving is to develop or improve a product or a process in response to a human need. The product or process must fulfill its function best, in contrast to which leads to a clear definition of the problem, and ends with an appropriate solution that addresses the need. It is important to be kept in mind that the process itself is a temporary determination of effective problem solving. Figure 2 outlines the process of technological problem solving in the

Appendix A4

Scientific Inquiry Skills

Planning an Investigation

In our attempts to further our understanding of the natural world, we encounter questions, mysteries, or events that are not readily explainable. We can use controlled experiments, correlational studies, or observational studies to help us look for answers or explanations. The methods used in scientific inquiry depend, to a large degree, on the purpose of the inquiry.

Controlled Experiments

Controlled experiments are performed when the purpose of the inquiry is to create or test a scientific concept. In a controlled experiment, an independent variable is purposefully and steadily changed to determine its effect on a second, dependent variable. All other variables are controlled or kept constant. The common components for controlled experiments are outlined in the flow chart (Figure 1). Even though the sequence is presented linearly, there are normally many cycles through the steps during the actual experiment.

Appendix A5

Reference Tables

Table 1: Inventory of Trees in Sample Areas of Local Region

Species name (scientific and common)	Sample area										Total
	1	2	3	4	5	6	7	8	9	10	
...

Table 2: Individual Coloured and Normal by Sex

Participant	Colour	Identified	
		Coloured	Normal
1	1	1	1
2	1	1	1
3	1	1	1

Table 3: Percentage of Coloured and Normal by Sex

Sex	Coloured		Normal
	Coloured	Normal	
Male
Female

Appendix A6

Scientific Inquiry Skills (continued)

Observations of Model Cells

Model cell	Initial mass (g)	Mass after 10 min (g)	Mass after 20 min (g)	Other observations
Cell 1—Synthetic tube with distilled water in beaker of distilled water
Cell 2—Synthetic tube with starch suspension in beaker of distilled water
Cell 3—Synthetic tube with distilled water in beaker of starch suspension

Appendix A7

Technological Problem Solving Skills (continued)

Rating for Reopromizer Designs

Design criterion	Design 1	Design 2
Stability	3	2
Accuracy	4	3
Reproducibility	5	3
Cost of process	4	2
Logistical safety	5	4
Total score	21	12

Lab Reports

SKILLS

When carrying out investigations, it is important that scientists keep records of their plans and results, and share their findings. In order to have their investigations repeated and tested, scientists generally share their work by publishing papers in which details of their design, procedure, evidence, analysis, and evaluation are given.

Lab reports are generally prepared after an investigation is completed. To ensure that you can accurately describe the investigation, it is important to keep thorough and accurate records of your activities as you carry out the investigation. All investigations use a similar format in their lab books or final reports, although the headings and order may vary. Your lab book or report should reflect the type of scientific inquiry that you used in the investigation and should be based on the following headings as appropriate. (See Figure 1 for a sample lab report.)

Title: At the beginning of your report, write the number and title of your investigation. This is usually given but if you are designing your own investigation, create a title that suggests what the investigation is about. Include the date of the investigation and the names of your lab partners (if you worked as a team).

Purpose: State the purpose of the investigation. Why are you doing this investigation?

Question: This is the specific question that you attempted to answer in the investigation. If it is appropriate to do so, state the question in terms of independent and dependent variables.

Hypothesis/Prediction: Based on your reasoning on a concept that you have studied, formulate an explanation of what should happen (a hypothesis). From your hypothesis make a prediction, a statement of what you expect to observe, before carrying out the investigation. Depending on the nature of your investigation, you may or may not have a hypothesis or prediction.

Design: This is a brief general overview (one to three sentences) of what was done. If your investigation involved independent, dependent, and controlled variables, list them. Identify any control or control group that was used in the investigation.

Materials: Give a detailed list of all materials used, including lists and quantities where appropriate. Be sure to include safety equipment as goggles, lab apron, latex gloves, and tongs, where needed. Draw a diagram to show any complicated setup of apparatus.

Procedure: Describe, in detailed step-by-step format, the procedure you followed in carrying out your investigations. Observe this while you investigate.

Observation: This includes all qualitative and quantitative observations that you make. Be as precise as possible when describing quantitative observations, include any unexpected observations, and present your information in a form that is easily understood. If you have only a few observations, this could be a list; for controlled experiments or for many observations, present them in a table.

Analysis: Interpret your observations and present the evidence in the form of tables, graphs, or illustrations, each with a title. Include any calculations, the results of which can be used in a table. Make statements about any patterns or trends you observed. Conclude the analysis with a statement answering the question that initiated the investigation.

Evaluation: The evaluation is your judgement about the quality of information obtained and about the validity of the prediction and hypothesis (if present). This section can be divided into two parts:

- Did your observations provide sufficient and appropriate evidence to enable you to answer the question?
- Were the prediction and hypothesis supported or rejected by the results?

Investigation 2.5 - Acceleration of Different Masses

February 2, 2015

By: Amy Wilson and Sarah Khan

Purpose

The purpose of this investigation is to determine if the mass of a falling object determines its acceleration while falling.

Question

What effect does the mass of a free-falling object have on the value of its acceleration?

Hypothesis/Prediction

It seems logical that an object with a greater mass will fall faster because it is pulled down to Earth at a greater rate. Our prediction is that the greater the mass the greater will be the acceleration of the object when it falls.

Design

A ticker tape timer of known frequency and a mounting tape will be used to measure the time and distance of falling balls of similar size but different masses. The size of ball is the controlled variable, the ball's mass is the independent variable, and the acceleration of the ball is the dependent variable.

Materials

- 3 balls of similar size with different masses
- ticker tape timer
- mounting tape

Procedure

- Select a safe area to set up your apparatus.
- Prepare an observation table similar to the one below.
- Clamp the ticker tape timer to a stand place near the edge of a table or lab bench. Set the timer to 60 dots per second.
- Obtain a piece of ticker tape slightly shorter than the distance the ball will fall so that the tape passes completely through the timer before the ball hits the floor.
- Insert the ticker tape through the timer and attach the end of the ticker tape to the first ball with a small piece of mounting tape.
- Keep the ball steady, just below the timer, by holding the upper end of the piece of ticker tape. Hold the tape directly above the timer so the tape will move freely through the timer.
- Start the timer and immediately release the ball.
- Turn off the timer when the tape has passed completely through the timer.

Figure 1

Sample Lab Report

Lab Report 17

SKILLS

Safety Skills

SAFETY SKILLS

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Symbol	Description
	CORROSIVE This material can burn your skin and eyes, or if you swallow it, it will damage your throat and stomach.
	FLAMMABLE This product or the gas (if vapour) from it can catch fire easily when kept away from heat, flames, and sparks.
	EXPLOSIVE Contains with vapour (if it is heated or if a bulb is punctured) or if mixed or heated carefully and heated your eyes and other parts of your body.
	POISON If you swallow or get this product, you could become very sick or die. Some products with this symbol are so toxic that you can't see your eyes if you breathe or touch them.



Figure 1 Hazardous Product Symbols

Table 1. WHMIS Symbols

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Class 3. Oxidizing materials (materials that can cause other materials to burn or support combustion)		• can oxidize, ignite and/or burn • increase fire and explosion hazard • may cause corrosion by vapour or mist velocity	• store away from combustibles • wear body, face, and eye protection • store in proper container that will not react with contents
Class 4. Toxic materials (toxic materials and potentially fatal materials that cause irritation and severe harm)		• may be fatal if inhaled or absorbed • may be absorbed through the skin • small amounts have a toxic effect	• avoid breathing dust or vapour • avoid contact with skin and eyes • wear protective clothing and face and eye protection • work in well-ventilated areas and use breathing apparatus
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