Exploring Technology 10

Guide

NOVA SCOTIA
NOUVELLE-ÉCOSSE

2008

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Exploring Technology 10

Prepared by the Department of Education and Early Childhood Development

This is the most recent version of the current curriculum materials as used by teachers in Nova Scotia.

NOVA SCOTIA

Exploring Technology 10

Implementation Draft
June 2008

CURRICULUM

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Acknowledgments

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Contents

Introduction

Background

The Department of Education has made a commitment to provide broad-based technology education in the public school system to meet the needs of all students.

The International technology education Association states that technological literacy enables people to develop knowledge and abilities about human innovation in action. All citizens need to be technologically literate due to the need for them to be active participants in the decision-making process related to all aspects of society.

The *Standards for Technological Literacy: Content for the Study of Technology* defines what students should know and be able to do in order to be technologically literate. Exploring Technology 10 was updated using those standards along with the *Foundation for the Atlantic Canada Technology Education Curriculum*.

Technology has created a world of constant change. Students who study broad-based technology become comfortable with change and solving real-world problems. They become objective about the use of technology.

Not only do students need to learn about technology, they need to do technology by way of carrying out activities that identify technological problems and design and construct solutions to those problems. Students also need to experience technological processes to understand its breadth and depth as it relates to all career choices.

Rationale

The essential skills of employees have changed. Roles and responsibilities of occupations and professions change significantly over the progression of one's career. Problem-solving skills have become increasingly important, as are teamwork and a pragmatic approach to technology. Literacy and mathematics are essential skills that are integrated into Exploring Technology 10. Students will have the opportunity to work independently and collaboratively, and will develop skills to adapt to rapid and continuous change, not only as it relates to technology, but as it relates to society.

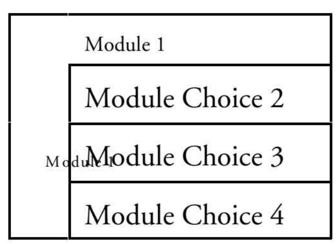
Exploring Technology 10 is an excellent introduction to technological engineering and design concepts for all grade 10 students. It provides all students with hands-on activities and introduces them to a broad spectrum of technological concepts. By the end of the course, students are able to use a range of technological tools, processes, and applications, integrate broad-based applied technology with other academic disciplines, design and create devices and systems that solve technological problems, and explain the consequences of technology and how it affects society.

This curriculum emphasizes comprehension of the basic elements of all forms of technology. The course is a foundation for all other high school-level courses, not only in technology education, but all disciplines within the public school program.

The Nature of Exploring Technology 10

The Exploring Technology 10 curriculum is designed for all students at the grade 10 level. Since the technology education facilities and resources vary throughout the province, the course is designed to offer some selection to schools as to the modules of study. There are six modules, one of which is mandatory. The school will choose three other modules to deliver to complete the full credit course. It should be noted that the term **module** is intended as a broad based approach to curriculum design and delivery as it applies to a unit of study, not as a limiting teaching method, such as **modular education**.

Each module offers several suggested activities to support teaching and learning and for assessment. Teachers may wish to choose only one of those suggestions if the students can achieve the outcomes in that module by completing the suggested activities. The Introduction outcomes are mandatory. Many outcomes within that module will thread throughout the course and may be addressed more than once. A graphic representation of this is shown below:



Modules for Exploring Technology 10
Introduction to Technology (mandatory outcomes)
Green Technology
Media Design Technology
Control Technology
Engineering Systems Technology
Exploring Trades Technology

Teachers are encouraged to create a fully integrated course where each of the four modules taught are in some way interconnected. For example, teachers may wish to choose Green Technology, Control

Technology, and Design Technology as the three modules after the Introduction. Students could complete a product that interconnects in the Green and Control modules and complete a full promotion of the product in the Design module.

Example: Create an alternative heating system, control it with sensors, pumps, and differential switches, and then promote it as the company selling it.

Course organization: Students are to complete four out of six hands-on modules of study (one of which is mandatory) at the discretion of the school, based on facilities and resources available.

Suggested learning environments: Students need access to a production/fabrication technology lab environment that is outfitted with a variety of tools and machines. Students also need access to computer technology, particularly to meet the outcomes in modules one and three. Exploring Technology 10 is not a computer course, but rather a design problem-solving course, therefore computers should be integrated into the overall program delivery and may be a major focus in one or two modules, but should not be a major focus of the entire course.

Course Designation

Exploring Technology 10 is a full-credit academic course and is an eligible technology credit to meet graduation requirements. It is a launching pad for subsequent years in high school as well as for career pathways exploration. Exploring Technology 10 is recommended for all students of all learning levels and is not a prerequisite for other technology education courses.

Essential Graduation Learnings and Exploring Technology 10

The Atlantic provinces have collaborated to identify the knowledge, skills, and attitudes that they consider to be essential for students graduating from high school. Those six essential graduation learnings (EGLs) are: aesthetic expression, citizenship, communication, personal development, problem solving, and technological competence.

Exploring Technology 10 will help students work toward attaining these essential graduation learnings through the following examples:

Aesthetic Expression

Graduates will be able to respond with critical awareness to various forms of the arts and be able to express themselves through the arts.

At the end of Exploring Technology 10, students will be expected to

- analyze inventions and innovations both past and present in a manner that is both practical and theoretical

- identify the elements of good design
- creatively express ideas though various forms of communication including writing, drawing, technical drafting, and multimedia

Citizenship

Graduates will be able to assess social, cultural, economic, and environmental interdependence in a local and global context.

At the end of Exploring Technology 10, students will be expected to

- identify and act upon consequences of technology and technological solutions to problems
- create design solutions to technological problems that consider the ecological footprint of that design
- explore the historical consequences of technological development

Communication

Graduates will be able to use the listening, viewing, speaking, reading, and writing modes of language(s) and mathematical and scientific concepts and symbols, to think, learn, and communicate effectively.

At the end of Exploring Technology 10, students will be expected to

- engage in comprehensive research and evaluation using a variety of reporting methods as part of the problem-solving process
- prepare design portfolios that include reflections and calculations throughout the process of solving problems
- manipulate tools and materials to communicate ideas effectively and accurately
- express thoughts and feelings about product design through effective teamwork

Personal Development

Graduates will be able to continue to learn and to pursue an active, healthy lifestyle.

At the end of Exploring Technology 10, students will be expected to

- engage in lifelong learning opportunities whereby students solve real-world problems using a variety of tools and processes
- demonstrate technological awareness as it relates to real-life decision making and the effects of technology on their life and community
- adapt to emerging technology and adapt technology to meet the needs of humans
- develop an understanding of technology-related trades and careers

Problem Solving

Graduates will be able to use the strategies and processes needed to solve a wide variety of problems, including those requiring language, and mathematical and scientific concepts.

At the end of Exploring Technology 10, students will be expected to

- engage in designing solutions to a variety of real-world problems using a diverse set of tools and processes
- construct and evaluate design solutions using the problem-solving model and critical-thinking skills
- adapt to a variety of situations involving operating, trouble-shooting, and managing technological systems

Technological Competence

Graduates will be able to use a variety of technologies, demonstrate an understanding of technological applications, and apply appropriate technologies for solving problems.

At the end of Exploring Technology 10, students will be expected to

- demonstrate basic technical abilities using production and communications technology tools and machines
- utilize various technological tools and processes to solve real-world problems
- demonstrate an understanding of technological systems and to delineate them into major categories
- demonstrate what technology is

General Curriculum Outcomes for Technology Education

Technological Problem Solving

- Students will be expected to design, develop, evaluate, and articulate technological solutions.

Technological Systems

- Students will be expected to operate and manage technological systems.

History and Evolution of Technology

- Students will be expected to demonstrate an understanding of the history and evolution of technology, and of its social and cultural implications.

Technology and Careers

- Students will be expected to demonstrate an understanding of current and evolving careers and of the influence of technology on the nature of work.

Technological Responsibility

- Students will be expected to demonstrate an understanding of the consequences of their technological choices.

Specific Curriculum Outcomes

Outcomes Framework

Module 1: Introduction to Technology (mandatory outcomes)

Students will be expected to

1.1 identify technology in its various forms
1.2 demonstrate an understanding of the impacts of technology and its cultural and historical influences
1.3 demonstrate an understanding of the history and evolution of a specific area of technology
1.4 investigate strengths related to technological career options
1.5 demonstrate an ability to work in a team
1.6 solve technological problems using the modified problem-solving model
1.7 create design portfolios for solutions to each design problem
1.8 implement life-cycle analysis when designing and constructing solutions to technological problems
1.9 use a variety of materials and tools as part of solving technological problems
1.10 demonstrate safety rules for tools and machines used
1.11 demonstrate safe attitudes and practices in the laboratory
1.12 safely employ appropriate tools, machines, and equipment to solve technological problems

Choose three modules of the following five:

Module 2: Green Technology

Students will be expected to

2.1 examine the consequences of technology in global manufacturing systems
2.2 examine the consequences of technology in domestic use and consumption of energy
2.3 design and construct a model renewable energy system
2.4 manipulate and test a renewable energy system

Module 3: Media Technology

Students will be expected to

3.1 demonstrate an understanding of the principles of design
3.2 demonstrate an awareness of diverse target audiences
3.3 create solutions to design problems using a variety of communication media
3.4 demonstrate effective use of communications and design tools

Module 4: Control Technology

Students will be expected to

4.1 demonstrate an understanding of technological systems (input, process, output)
4.2 design and construct solutions to problems related to control technology
4.3 manipulate a variety of materials in the construction of a control system
4.4 test and evaluate a control system

Module 5: Engineering Technology

Students will be expected to

5.1 employ appropriate technical drawing techniques
5.2 design and construct solutions to real-world engineering technology problems
5.3 evaluate solutions to problems by selecting appropriate testing methods
5.4 demonstrate an understanding of various STEM (science, technology engineering, math) connections to design problems

Module 6: Exploring Trades and Technology

Students will be expected to

6.1 explore skilled trades and technology-related careers
6.2 demonstrate skills related to technological processes in skilled trades through a series of hands-on activities
6.3 use appropriate tools of skilled trades
6.4 estimate materials and labour requirements for a skilled trades-related project

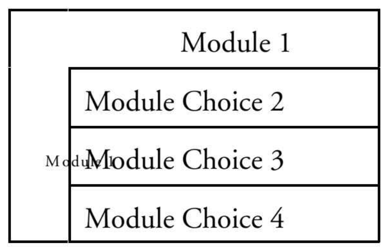
Module 1: Introduction to Technology

Overview

Integrated Outcomes

Many of the outcomes listed in Module 1 are designed to integrate into each of the three additional modules that are chosen. With the exception of outcomes 1.1–1.3, teachers are not expected to create activities specifically in the introduction module to address these outcomes, but rather should integrate them throughout the course while completing the overall planning process. Many of the activities in the subsequent modules will lend themselves to a natural threading of these outcomes.
It is the expectation that the outcomes can be achieved in diversified ways by all learners.

The Introduction to Technology module is designed to offer students a chance to explore a variety of technological concepts both at the beginning of the course as well as throughout the subsequent course modules.



Outcomes 1.1 through 1.3 are addressed by offering students an opportunity to explore the history and development of technology.

Outcome 1.4 addresses careers related to technology in its broadest forms and should be addressed throughout the entire course.

Outcomes 1.5 through 1.9 are skills-related outcomes that will be addressed throughout the course as part of solving technological problems in teams, using a variety of materials and processes to solve those problems, and preparing documentation associated with those problems.

Safety is a major concern in technology education labs. This module addresses the safety outcomes and offers tips to teachers for creating a safe environment for students to learn. Outcomes 1.10 through 1.12 should be addressed throughout the course as part of the overall safety program in exploring technology. It is expected that teachers will use the recommended materials and practices in this document as it relates to the lab safety program.

Module 1: Introduction to Technology

GCO 3: Students will be expected to demonstrate an understanding of the history and evolution of technology, and of its social and cultural implications.

Outcomes

Students will be expected to

1.1 identify technology in its various forms

1.2 demonstrate an understanding of the impacts of technology and its cultural and historical influences

1.3 demonstrate an understanding of the history and evolution of a specific area of technology

Suggestions for Learning and Teaching

Teachers can

- begin by offering students an opportunity to identify what they think technology is by creating a word wall in post-it format. Delineate the ideas into categories as a large group and reflect on the samples. Facilitate the process of having students redefine technology after this process. (1.1)
- discuss with students (or select some articles or video clips to illustrate) examples of the impacts of technology in current society, such as the environmental impact of heating and cooling technology or the cultural influences of cell phones (1.2)
- set up a debate among students to address some of the issues discussed in the brainstorm session (1.2)
- present positive and negative technological impacts, including planned and unplanned. Specify particular focus areas such as construction industry, war, car manufacturing, road building, hazardous waste removal, and nuclear power.(1.2)
- discuss ethical issues related to "can versus should" in technology such as cloning, weaponry, disease chemicals, and atmospheric dumping. (1.2)
- organize a class discussion with students on a topic such as How has the manufacturing floor changed in the past 100 years? (1.3)
- present the exponential rate of change as it relates to technology and the information age using traditional or multimedia format (1.3)

Students can

- work co-operatively throughout the brainstorming session to record and share ideas with the rest of the class (1.1)
- select a specific area of technology, and determine how it affects them personally, socially, and economically by writing, presenting, or storyboarding (1.2)

Module 1: Introduction to Technology

GCO 3: Students will be expected to demonstrate an understanding of the history and evolution of technology, and of its social and cultural implications.

Suggestions for Assessment

Students can

- complete a concept map on technology (using topic of "What is technology?") (1.1)
- *Impacts of Technology*
  divide into groups. Each group chooses an aspect of technological development related to a topic such as the automobile (the internal combustion engine, rubber, or plastic). Each group lists the positive impacts and negative impacts of that technological development. Students can also break down the topics to include planned and unplanned impacts (1.2)
- prepare a multimedia presentation about environmental impacts of technology in their communities (1.2)
- *Life without Electricity Activity*
  prepare a complete description in list format of a typical student's day as it relates to the use of electricity. Prepare a parallel list of how they might go about doing those same activities without electricity. Students discuss or write a report on the impact of electricity on their lives (1.2)
- *Time Line Activity*
  choose an area of interest and describe the evolution of a particular product, tool, or process using a time line (1.3)
- *Future History Activity*
  select a specific product as it relates to their personal interests and write a short narrative or create a presentation about what the item may be like in 50 years and trace the product back 50 years to determine how it evolved to the present day (1.3)

(For Time Line and Future History Activity: students might choose items related to areas such as communications devices, health and medical technology, agricultural technology, arts and music technology, sports technology)

Teachers can

- show students how to do a concept development using paper/pencil method or electronic method (e.g., Inspiration)
- work with students to determine presentation guidelines
- offer students tips on presentation skills and communicate expectations (See appendix for Presentation Rubric.)
- provide examples to students
- outline expectations regarding presentations, group work, and writing reports
- create scoring rubrics for activities by collaborating with students
  (Such rubrics could be block style or continuum style with checklists.)

Notes

Presentation skills for students to remember: 1) prepare notes to refer to; 2) speak clearly; 3) look up and speak out, not down; 4) stand up straight and smile at your audience.

Teachers should encourage writing opportunities for students, being clear on the expectations for content by creating scoring rubrics together.

Allow students to keep a work folder / portfolio in the classroom in a designated file drawer.

For environmental impacts of technology, search *David Suzuki Foundation: Climate Change, Impacts and Solutions.*

Reporting methods could also include creating a play or a tableau / visual presentation based on student strengths

Use rubistar as a rubric builder rubistar.4teachers.org

Technology: Engineering and Design (Brusic, S. et al.)

Technology: Design and Applications (Wright T. et al)

Technology is a way of making things better

Module 1: Introduction to Technology

GCO 4: Students will be expected to demonstrate an understanding of current and evolving careers and of the influence of technology on the nature of work.

Outcomes	Suggestions for Learning and Teaching
Students will be expected to 1.4 Investigate strengths related to technological career options	Students can • complete career navigation quizzes to better explore their strengths and growth areas • describe what they have learned about themselves in the process of searching and testing • complete a career webquest Teachers can • provide instruction to students about career exploration so that they have some strategies for continuing their search throughout the course modules • organize students into groups to develop a list of occupations related to a specific area of technology • lead students to specific sites for career navigation activities throughout the course modules • prepare webquest activities for students specific to job searching online

Module 1: Introduction to Technology

GCO 4: Students will be expected to demonstrate an understanding of current and evolving careers and of the influence of technology on the nature of work.

Suggestions for Assessment

Students can

- complete the *Hat Activity*—draw a career choice from a hat and research it (with a partner) through a careers website. Present the results to the class as a round-table discussion.
- journal their career search experiences in their lifeworks portfolio
- further develop the hat activity into an individual activity related to a career of their choice
- document their career search activities (See Appendix E: Career Search Report)

Teachers can

- prepare brief presentations to the class about job searches and career options
- explore student portfolios or presentations using the appendices (or create a scoring rubric with input from students)

Notes

Go to www.jobsetc.ca and navigate to career exploration, identify career options, and career quizzes.

The Hat Activity works well with teams of two students because students often search the screen for information. Having two students searching makes the process go more quickly.

Use 'rubistar' as a rubric builder rubistar.4teachers.org

Introduction to Technology (Pierce and Karwatka)

Students can link electronic presentations and other electronic work to their lifeworks portfolio.

When students write journal entries to document their work, teachers are encouraged to review for content more than for syntax.

Webquests are activities where students use specific websites to search for answers to a set of questions posed by the teacher.

National Construction Association of Canada

Module 1: Introduction to Technology

GCO 1: Students will be expected to design, develop, evaluate, and articulate technological solutions.

Outcomes

Students will be expected to

1.5 demonstrate an ability to work in a team

Suggestions for Learning and Teaching

Students can

- engage in collaborative review of their own and others' work
- review expectations of the team and roles within it
- develop activity plans for completing assignments as a team
- engage in technological problem-solving activities that demonstrate teamwork essential skills

Teachers can

- organize students into teams for each of the design problems in the successive modules
- work with students to outline the expectations of teamwork
- prepare examples of team activities that will take place throughout the course so students can identify various roles of team members
- when assigning teams, offer students options for choosing some team members
- change teams for each design problem
- provide students with information about "The 9 Essential Skills"

Oral Communication	Reading
Working with Others	Numeracy
Computer Use	Writing
Document Use	Thinking
Continuous Learning	

Module 1: Introduction to Technology

GCO 1: Students will be expected to design, develop, evaluate, and articulate Technological solutions.

Suggestions for Assessment

Students can

- complete self-assessments using a checklist prepared as a class
- complete peer assessments using a checklist prepared as a class
- report on teamwork within the problem-solving portfolio throughout the course
- complete an activity plan as a team, outlining the role or roles of each member of the team

Teachers can

- prepare a scoring rubric for teamwork observational assessment by collaborating with students (or Appendix B: Rubrics).
- Ask students what expectations they would have of team members, as well as what they feel would be fair for assessment. This may need to be done as a written contribution, in addition to verbal (as some valuable contributing members in a group do not speak out during class). Some checklist items might include:
  - contributes to the team in some capacity
  - demonstrates good interpersonal skills in the team
  - allows others to contribute
  - accepts constructive feedback
  - responds positively to team feedback
  - makes efficient use of time
  - demonstrates conflict resolution strategies

- work with students to create self- and peer-assessments. Some checklist items might include:
  - my contribution to the team was ...
  - I was respectful to others by ...
  - I allowed others to contribute to the team efforts by ...
  - Something I would have done differently in this project was ...

Notes

It is recommended that teams be no larger than three. Generally, there are enough tasks for three students, but a fourth student is often left out. Many teachers recommend groups of two.

Activity plans outline the roles of each team member and how those roles influence the overall completed project.

For the “nine essential skills” go to the following site and navigate to “essential skills” www.canadaprospects.ca/products/cp_nav/

srv108.services.gc.ca/english/general/home_e.shtml

Teachers can complete teamwork assessments for each studentin the team using the sample sheet provided in the Appendix and by circulating throughout the room during the activity. This method will allow teachers to list an entire class on one sheet.

Module 1: Introduction to Technology

GCO 1: Students will be expected to design, develop, evaluate, and articulate technological solutions.

Outcomes

Students will be expected to

1.6 Solve technological problems using the modified problem solving model

1.7 Create design portfolios for solutions to each design problem

Suggestions for Learning and Teaching

Students can

- use the modified problem-solving model for completing design problems throughout the course (the entire process is known as "the design process")
- test design prototypes to evaluate their effectiveness and make appropriate changes and adjustments before re-testing
- keep notes, research, and drawings throughout the design process to include in their design portfolio
- submit design portfolios after the final testing and communication process

Teachers can

- provide students with the modified problem-solving model
- provide instruction to students on appropriate methods of using the modified problem-solving model
- ensure that students have access to lab space, materials, and tools for each design problem throughout the course
- provide examples of the modified problem-solving model and how to implement it into various design activities
- develop and provide, for students, activity checklists for solving design problems throughout the course using the modified problem-solving model
- teach students how to create a design portfolio as part of the problem solving process using the steps of the modified problem-solving model
- provide details of what should be included as components of the design portfolio (See Appendix C: Problem Solving)
- require specific parts of the portfolio to be complete before allowing groups to move to the next stage of the design process
- provide specific materials and specifications to students detailing the requirements for a design problem so that students can appropriately document the design process
- provide electronic devices for students to digitize or create their work to include in the lifeworks portfolio such as scanners, CAD software, and word processing applications

Module 1: Introduction to Technology

GCO 1: Students will be expected to design, develop, evaluate, and articulate technological solutions.

Suggestions for Assessment

Students can

- maintain a design portfolio of all work related to design problems completed throughout the course
- complete and submit a design portfolio for each design problem in the course by following the steps to the modified problem-solving model
- create prototypes in the appropriate stage of design
- test prototypes
- present results of the testing process to the class

Teachers can

- develop and maintain checklists for evaluating the design portfolio (The design portfolio will be the main source of proof that students solved the technological problem, or attempted to.)
- review the design portfolio to see that all steps of the problem solving model are represented (See Appendix C: Problem Solving)
- develop a method of evaluating the object that students created as their solution to the design problem using continuum checklist items such as
  - does it solve the problem?
  - Has it been improved or modified?
  - Quality of work
  - Uses appropriate materials
  - Meets specifications
  - Uses a life cycle of cradle to cradle
- communicate the design process to students as the development of creating solutions to design problems posed by following the modified problem solving model and using those steps to create a design portfolio (See Appendix B: Rubrics)
  - Steps to the Problem Solving Model:
    - Problem Identification
    - Research
    - Ideas Development
    - Life Cycle Plan
    - Design and Build prototype
    - Evaluate/Test
      - Refine/Modify/Rebuild
      - Re-test
      - Communicate
- create a series of 3–5 questions related to the design problem so that students can include answers to those questions in the Communicate step of the modified problem-solving model.

Notes

The engineering problem-solving model differs from the traditional problem solving model in that it requires at least two testing options for the prototype, one for initial evaluation, and subsequent tests after making alterations to the design. In Nova Scotia, life cycle analysis has been added to the model as well making it a modified problem solving model (See Appendix C: Problem Solving for details on this model.)

When students present results to the class after testing a mechanism, they may wish to do so very informally, but document their findings in more detail in the Communication portion of the design process.

Technology: Engineering and Design (Brusic, et al.)

Electronic versions of portfolios should be encouraged. This may require accessing computer hardware for scanning sketches, etc. These design portfolios can be included in the lifeworks portfolio.

Encourage students to submit portfolios soon after they complete final testing and writing their communication details. A significant number of nearly complete design portfolios never get submitted if they are not submitted within three days of completing final testing.

Module 1: Introduction to Technology

GCO 5: Students will be expected to demonstrate an understanding of the consequences of their technological choices.

Outcomes

Students will be expected to

1.8 implement life-cycle analysis when designing and constructing solutions to technological problems

Suggestions for Learning and Teaching

Students can

- create design solutions that utilize life-cycle analysis
- discuss the need for life cycle analysis techniques in the design of products and services
- consider such items as wood finish and the long-term environmental effect that it may have as well as the recycling process or breakdown of the product over time

Teachers can

- provide examples of life-cycle analysis from industry and discuss the methods by which students can implement this technique throughout the design process in the course modules
- offer materials to students that are conducive to the life-cycle approach (such as nuts and bolts instead of nails, metal, or recycled plastic gussets instead of paper and glue)
- engage students in a discussion about designing for the environment

Module 1: Introduction to Technology

GCO 5: Students will be expected to demonstrate an understanding of the consequences of their technological choices.

Suggestions for Assessment

Students can

- select materials for use throughout the design and construction process and document how they can be reintroduced into the production system once the product has completed its purpose at the end of its life cycle
- prepare a life cycle plan (see appendices) that can be used for each device designed and created throughout the remainder of the course (This life-cycle plan should be included in the design portfolio.)
- research a particular product, how is it used, and the life cycle of this product (examples might be lead, batteries, steel, rubber, polyethylene, and aluminum cans).
- answer the questions, Why do we recycle aluminum cans? And what is the life cycle of an aluminum can?
- design a policy around the life cycle of a specific product that will avoid long-term degradation of the environment. This might involve dissecting a product such as a cell phone or iPod.

Teachers can

- provide students with the life-cycle plan (See Appendix C: Problem Solving) to complete as part of their design portfolios
- evaluate the life-cycle analysis of a student-developed device by its ease of assembly and disassembly and the percentage of components that can be re-entered into the manufacture of another device within the lab

Notes

Life cycle analysis involves considering all components of a product and how those components will be recycled or reused in the future.

For more on life-cycle analysis see www.gdrc.org/uem/lca/life-cycle.html

Cradle to Cradle. Remaking the Way We Make Things. (McDonough and Braungart)

Module 1: Introduction to Technology

GCO 1: Students will be expected to design, develop, evaluate, and articulate technological solutions.

Outcomes

Students will be expect to

1.9 use a variety of materials and tools as part of solving technological problems

Suggestions for Learning and Teaching

Students can

- experiment with materials to determine which ones will work best for the problem being solved
- analyse the properties of materials to determine their usefulness and how they will be recycled for life-cycle analysis
- practice using tools in the lab before working directly on a project or device

Teachers can

- provide a variety of materials and tools for students to use throughout the course
- provide instruction on how to use technological materials and tools
- make suggestions to students as to how they can use alternative materials and processes throughout the construction process

Module 1: Introduction to Technology

GCO 1: Students will be expected to design, develop, evaluate, and articulate technological solutions.

Suggestions for Assessment

Students can

- document materials and processes used throughout the construction of devices created and which members of the team completed the process or task

Teachers can

- maintain records of materials, machines, and processes used in the experiment to ensure that there is a variety
- create observational checklists for student participation in using tools and processes laid out in the experiment
- prepare and provide students with a procedural guide or production plan

Notes

Observational teamwork checklists can occur periodically (See appendix B: Rubrics) throughout the module and could include topics such as

- process used
- student completing task
- materials used
- suggestions made

Module 1: Introduction to Technology

GCO 2: Students will be expected to operate and manage technological systems.
GCO 1: Students will be expected to design, develop, evaluate, and articulate technological solutions.

Outcomes

Students will be expected to

1.10 demonstrate safety rules for tools and machines used

1.11 demonstrate safe attitudes and practices in the laboratory

1.12 safely employ appropriate tools, machines, and equipment to solve technological problems

Suggestions for Learning and Teaching

Students can

- participate in the safety lesson for each machine or tool being demonstrated
- practice using each tool or machine demonstrated under the supervision of the teacher
- always wear eye protection in the production lab area
- maintain a safe attitude at all times by showing respect to others, the machines, and tools in the lab
- stay away from safety zones when another person is using a machine or tool
- report to the teacher immediately faulty tools or machines, broken or dull blades, or any other unsafe condition in the lab
- use the right tool or machine for the right job to avoid injury
- work with a buddy when appropriate to help ensure safe and appropriate use of tools and machines

Teachers can

- establish and post a comprehensive safety program and safety rules to be enforced throughout the course (1.10)
- provide safety instruction for each tool and machine used to ensure students work safely (1.10)
- ensure the lab is outfitted with appropriate numbers of safety glasses and other safety equipment necessary to implement the safety program (1.10)
- outline safety expectations related to safe attitudes and appropriate behaviour in the lab (1.11)
- provide safety demonstrations in small groups (1.12)
- provide handout materials and/or electronic materials for students to study prior to testing (1.12)
- establish consequences when students do not meet expectations of safety (1.12)
- post signs for each machine within close proximity of that machine to remind students of specific safety rules (1.10)

Module 1: Introduction to Technology

GCO 2: Students will be expected to operate and manage technological systems.
GCO 1: Students will be expected to design, develop, evaluate, and articulate technological solutions.

Suggestions for Assessment

Students can

- complete a safety test for each machine used in the lab and receive 100% (students may re-take the test until they receive 100%) (1.10)
- demonstrate proper use and safety to the teacher for each machine used in the lab (1.10)
- ask permission before turning on any machine at any time (1.11)
- demonstrate their ability to use the right tool for the job by choosing appropriate tools (1.12)

Teachers can

- demonstrate a safety lesson for each tool and machine used in the lab (1.10)
- provide individual safety instruction for each student as needed (1.10)
- prepare and schedule safety tests pertaining to specific machines or tools (1.10)
- keep records of all safety tests for all students throughout the year (1.10)
- require students to show their knowledge of each machine by having them provide the teacher with a demonstration (1.11)
- provide student with operator's permit (after demonstration), which could be posted in the lab (1.11)
- document student demonstrations (1.11)
- use anecdotal records for student safe attitudes (1.11)
- set up a consequence system for students who require more than one warning of safe attitudes (1.11)
- demonstrate the importance of choosing the right tool for the right job by showing students safety hazards of using the wrong tools (1.12)
- document student safety habits in an observational record at least once per week in a rubric (1.12)
- keep observational records available for students to see why they may be limited within the lab (1.12)

Notes

Safe practices in the technology education lab must be established as soon as students enter the lab as well as throughout the course.

A safety zone is considered to be one arms length around the perimeter of any tool or machine.

Production machines appropriate for use in Exploring Technology 10:

- Band saw
- Drill press
- Stationary sander
- Table saw
- Jointer
- Planer
- Mitre saw
- Power drill
- Power sander
- all hand tools
- various communications equipment

When assessing safe attitudes, teachers should use an anecdotal record with dates/times for when students are presenting an uncaring attitude or inappropriate behaviour around machines and tools.

Module 2: Green Technology

Overview

The Green Technology module explores alternative energy and the role of society in domestic consumption and production. Students are expected to research, design, and construct model alternative energy systems. This module will provide students with a broader sense of energy consumption, allowing them to explore a broader view of energy systems from a solutions perspective.

Module Outcomes

Students are expected to

2.1 examine the consequences of technology in global manufacturing systems
2.2 examine the consequences of technology in domestic use and consumption
2.3 design and construct a model renewable energy system
2.4 manipulate and test a renewable energy system

Integrated Outcomes to Address in This Module

Students will be expected to

1.4 investigate strengths related to career options
1.5 demonstrate an ability to work in a team
1.6 solve technological problems using the modified problem-solving model
1.7 create design portfolios for solutions to each design problem
1.8 implement life-cycle analysis when designing and constructing solutions to technological problems
1.9 use a variety of materials and tools as part of solving technological problems
1.10 demonstrate safety rules for tools and machines used
1.11 demonstrate safe attitudes and practices in the laboratory
1.12 safely employ appropriate tools, machines, and equipment to solve technological problems

Module 2: Green Technology

GCO 5: Students will be expected to demonstrate an understanding of the consequences of their technological choices.

Outcomes

Students will be expected to

2.1 Examine the consequences of technology in global manufacturing systems

2.2 Examine the consequences of technology in domestic use and consumption of energy

Suggestions for Learning and Teaching

Students can

- complete an Ecological Footprint Assignment by determining their ecological footprint using an online carbon calculator. Do comparisons with each other and with industry. Report back using journals, portfolios, or presentations.
- calculate energy uses for solar camping kits and determine expanded uses based on upgrades of the kits (e.g., How many of those solar camping panels would be required to power their home?)
- complete a Consequences of Technology WebQuest Activity using the following topics:
    - Principles of the Natural Step System
    - Ecological Footprints
    - The Precautionary Principles
    - Eco-industrial Systems or EcoParks (and its application to Burnside Industrial Park)
    - Embodied Energy in Construction and Heating Systems
    - Life-Cycle Analysis and Cradle-to-Cradle design
    - Green Design

Teachers can

- work with the class to complete an embodied energy assessment of a product (such as a chair) to determine how much energy was consumed to produce that item
- work with students to set goals to lower their emissions by way of the ecological footprint activity
- introduce students to the concepts listed above using the Notes section
- provide examples in industry using the Notes section
- guide students throughout activities and discussion to help stimulate awareness of topics such as alternative energy
  "Any energy that is not coming from wind or solar panels is generating hydrocarbons which pollute the environment and contribute to global warming". (Leo Elshof)
- guide students to appropriate websites for research
- generate a discussion with students about a topic related to domestic use and consumption of energy such as a clothes washing machine and all components within it. Have students discuss the options of renting or leasing such a machine rather than owning it. Discuss the possible changes in manufacturing that might occur if this machine was coming back to the manufacturer at the end of its life (rather than going to a landfill).
- provide students with other examples of reducing domestic use of energy such as low flow toilets, high-efficiency dryers, and alternative energy sources for hot water systems

Module 2: Green Technology

GCO 5: Students will be expected to demonstrate an understanding of the consequences of their technological choices.

Suggestions for Assessment

Students can

- choose one of the topics from the webquest activity, and work in teams of two to research it and present it to the class
- work in teams to research energuide eco-labels for a product like a refrigerator and draw comparisons on energy consumption between products. Create an age-appropriate comparison analysis.
- create their own version of an energuide label that is more kid friendly.
- work in groups of two or three to complete a study of a systemic change in domestic use and consumption of an everyday appliance (such as the washing machine example) by recording average use and potential methods of change
- read the power meter on a house and analyse the corresponding power bill
- count Christmas lights and their wattage per hour. Calculate the change in energy consumption if the lights were switched to Light Emitting Diodes (LED). Further development of this activity could include the energy savings for an entire town, village, or city.
- determine the life cycle of traditional Christmas lights
- examine last year's power bill and compare it to the current one. Examine what changed in the house to make it go up or down (e.g., What if the family installed a hot tub?)

Teachers can

- provide students with appropriate information using the notes and resources in this guide
- prepare templates for students to use to address outcome 2.2
- assign teams for activities
- direct students to the following site for doing research in the web quest www.aresearchguide.com/energy.html
- assign weekend projects for reducing energy consumption in students' homes (e.g., Have students turn everything on in the house and go check the power meter, turn everything off and check it again.)
- have students complete a research project on Nova Scotia Power to determine where the power comes from and how the consumption of that power influences the environment in Nova Scotia
- provide examples to students of local alternative energy use such as solar heating for recreational pools or wind power on farms

Notes

Eco-industrial paper
www.cein.ca/cein/Advantage_Spring_2004.pdf

Embodied Energy refers to the quantity of energy required to manufacture, and supply to the point of use, a product, material, or service.

For a comprehensive site on embodied energy search the internet for "embodied energy"

Green Design. Design for the Environment. (Mackenzie)

See also expanded list in Appendices.

Born to Buy. (Juliet)

For an explanation of the principles of Natural Step
www.naturalstep.org/com/nyStart/

For a Canadian site for carbon calculators for kids, plus resources for teachers
www.zerofootprintkids.com
www.zerofootprint.net

For energuide information
www.uniongas.com/home/ngforhome/energysavings/energuide.asp

The Greens
www.meetthegreens.org

Module 2: Green Technology

GCO 2: Students will be expected to operate and manage technological systems.
GCO 1: Students will be expected to design, develop, evaluate, and articulate technological solutions.

Outcomes

Students will be expected to

2.3 design and construct a model renewable energy system

2.4 manipulate and test a renewable energy system

Suggestions for Learning and Teaching

Students can

- research passive and active solar power systems
- use plans and templates as samples to design and create a model solar collector
- mount the collector to the output system provided by the teacher
- take measurements of water temperature at various stages in time
- research differences in materials, tubing, looping shapes, and collector shapes for the purposes of harnessing the most heat from the sun in a solar collector
- research solar pumping system designs appropriate for pumping well water in a Third-World country

Teachers can

- collect and prepare materials for students to create a solar collector
- create an output system for solar collectors to be connected to. For instance, if students create an active collector system, have pumps, tubing, tanks, heat lamp (or alternative sun device), and thermometers ready to attach to the collector.
- teach students the basics of solar power, the differences between active and passive, and how a solar collector works
- assign teams
- teach safety lessons as appropriate for materials and processes being used in the lab
- demonstrate a passive solar collection system using tubing, valves, and a tank (See appendix F: Solar Collector Systems)
- provide students with alternative methods of design including pumps, differential switches, and sensors
- provide students with resources for researching solar collectors
- provide students with real-world examples of solar collectors
- provide instruction and demonstrations on DC motors and generators

Module 2: Green Technology

GCO 2: Students will be expected to operate and manage technological systems.
GCO 1: Students will be expected to design, develop, evaluate, and articulate technological solutions.

Suggestions for Assessment

Students can

- complete the Solar Collector Activity by working in groups to design and construct a model solar collector that can be used to heat water or air. They must use a variety of materials and processes to create the collector system to address outcome 1.9. The collector could be passive or active (using a fish tank pump).
- test the system they have created by placing the collector at a 45-degree angle due south (or by using a heat lamp source). Use thermometers to gage the change in temperature of the water in the collection tank as well as inside the collector they have designed.
- complete a design portfolio as part of the process to address outcome 1.7
- explore the local area for real-life examples of solar collectors
- cost out a solar collection system for a 1200-square foot home
- examine increasing solar gain on their existing home

Teachers can

- integrate this activity to involve the Control Technology module where students set up some electronic controls such as differential switches for monitoring the pump action in a collector, based on day or night conditions. When night conditions cause the water in the collector to cool, the differential switch that monitors the temperature in the collector causes the pump to stop. Likewise, when the temperature of the water in the tank drops, the pump would also stop. Other controls could include a computer interfaced robotic control of the light system to represent the movement of the sun.
- create a scoring system to evaluate the effectiveness of the solar collector
- provide students with detailed expectations for creating the solar collector, constructing it, the design portfolio, implementing life-cycle analysis, and teamwork
- set parameters of design such as the collector must not be larger than 15" × 18", must use specified tubing and valves, looping requirements and other materials
- provide students with materials and specifications for doing the solar activity idea (see notes) such as an old window in a frame, dense foam insulation, or thermostats

Notes

For a free book download on alternative energy, including activity ideas, see www.energyforkeeps.org/

For a complete site on solar car construction and support materials see www.sunwindsolar.com

For sample plans and ideas for creating alternative energy sources see www.homepower.com

Passive solar systems use heat transfer to create energy. Active solar systems use a pumping system to aid in creating energy.

See Appendix F: Solar Collective Systems for working sketches of active and passive solar collector systems

Solar Activity Idea

A passive solar collector system can be created using a window frame, dark screening laid inside the window frame and a layer of styrofoam insulation behind it. An air opening at the bottom will allow air in (between the screen and glass) and an air opening in the top will allow warm air out. Students can take a temperature measurement at each opening to determine the difference. Students could experiment with a variety of substances instead of the screening.

Module 2: Green Technology

GCO 2: Students will be expected to operate and manage technological systems.
GCO 1: Students will be expected to design, develop, evaluate, and articulate technological solutions.

Outcomes

Students will be expected to

2.3 design and construct a model renewable energy system

2.4 manipulate and test a renewable energy system

Suggestions for Learning and Teaching

Students can

- research wind power and wind turbine designs
- research what it means and how to get "off the power grid"
- use the modified problem solving model to design and construct a small scale house to incorporate wind and/or solar power
- research hydro power plants to determine the volume of water used
- build a "potato battery"

Teachers can

- provide a toolbox of supplies to construct a power turbine
- provide instruction on the fundamentals of basic electricity
- demonstrate how to use a multimeter
- demonstrate wire soldering techniques
- complete a Google search on "how to build a potato battery"
- explore the differences between lead alkaline batteries and lithium ion batteries with the class as it relates to the potato battery activity

Module 2: Green Technology

GCO 2: Students will be expected to operate and manage technological systems.
GCO 1: Students will be expected to design, develop, evaluate, and articulate technological solutions.

Suggestions for Assessment

Students can

- create a wind power turbine. Design and construct a model wind generator using a DC motor and light emitting diode.
- measure voltage produced and connect to other wind generators to create more voltage
- create a tidal power turbine. Students will design and construct a model tidal power turbine using 4" pvc, a DC motor, film canister, and a fan. Testing may occur using a garden hose and coupling.
- take measurements of voltage produced using a multimeter
- alter the turbine design to allow for improvements and better voltage produced
- complete a design portfolio for all work completed as part of this design problem

Teachers can

- prepare a testing/analysis system for the alternative energy system created by the students
- provide materials for students to complete the model system
- analyse the functionality of the model system created by students
- set parameters for model systems
- outline expectations for the design portfolio for all work completed as part of this design problem

Notes

Canadian Wind Energy Association www.canwea.ca

Small wind turbines www.smallwindenergy.ca/en/SmallWind.html

Research Materials for Students www.aresearchguide.com/energy.html

Distributed Generation www.distributed-generation.com

Windshare www.windshare.ca

Multimeters can be obtained at a local hardware store starting at around $15.

DC motors can be converted to a generator by reversing the polarity (switch the power on the leads).

www.howstuffworks.com

Alternative energy sources might include:

- hydro power
- atomic energy
- geothermal
- solar
- wind
- tidal
- wave

Module 3: Media Technology

Overview

The design technology module requires that students explore the concept of design by working with a variety of graphic and media tools to create visual media designs. Using the principles of design and noting the target audience are essential parts of this module.

Module Outcomes

Students will be expected to

3.1 demonstrate an understanding of the principles of design
3.2 demonstrate an awareness of diverse target audiences
3.3 create solutions to design problems using a variety of communication media
3.4 demonstrate effective use of communications and design tools

Integrated Outcomes to address in this module

Students will be expected to

1.4 investigate strengths related to career options
1.5 demonstrate an ability to work in a team
1.6 solve technological problems using the modified problem-solving model
1.7 create design portfolios for solutions to each design problem
1.8 implement life-cycle analysis when designing and constructing solutions to technological problems
1.9 use a variety of materials and tools as part of solving technological problems
1.10 demonstrate safety rules for tools and machines used
1.11 demonstrate safe attitudes and practices in the laboratory
1.12 safely employ appropriate tools, machines, and equipment to solve technological problems

Module 3: Media Technology

GCO: Students will be expected to design, develop, evaluate, and articulate technological solutions.

Outcomes

Students will be expected to

3.1 demonstrate an understanding of the principles of design

3.2 demonstrate an awareness of diverse target audiences

3.3 create solutions to design problems using a variety of communication media

3.4 demonstrate effective use of communications and design tools

Suggestions for Learning and Teaching

Students can

- identify some examples of designs that appeal to them as a target audience (using printed media and websites)
- identify other examples of print or media design that would appeal to a variety of audiences
- use the recommended texts to identify examples of work that has been altered to incorporate the principles of design for media and printed material
- practice using software and hardware available for designing print and electronic media
- practice identifying the principles of design in sample work from magazines, websites, and logo designs
- apply the principles of design to their work

Teachers can

- provide printed and electronic samples that demonstrate the Principles of Design
- teach students the elements of logo design
  The elements of a logo design are "Text, Geometric Shape, Graphic Image." Combining two or more of the elements is generally a better design. (The logo design must also follow the principles of design.)
- work with students to identify the difference between target audiences and students' personal design preferences
- prepare a series of examples of design work from industry (logos, magazine advertisements, business cards, websites) that appeal to a variety of target audiences (i.e., - pre-school age websites vs entertainment industry media vs investment portfolio websites)
- prepare tools and materials to provide students with a variety of lab experiences related to communications such as computer hardware, software, peripheral devices, and printing equipment (such as button makers, and screen printing systems)
- demonstrate the communication systems or processes in the lab that could be used or are available to solve design problems
- demonstrate the effective use of equipment
- demonstrate safety requirements as it relates to specific processes
- present examples of appropriate design solutions
- communicate specifications of the design problem and expectations of students throughout the module

Module 3: Media Technology

GCO: Students will be expected to design, develop, evaluate, and articulate technological solutions.

Suggestions for Assessment

Students can

- create a Media Awareness Campaign by working in teams to generate an advertising campaign for a topic of choice (such as another project module within this course, the school green plan, or a technology education course)
- use creative media such as video, audio, pins, posters, hats, t-shirts, banners, signs, website designs, logos, or business cards to create the promotional materials. It is recommended that the client group be school based.

Teachers can

- create an assessment tool for the project using the following topics:
  - Teamwork (through teacher observation checklists and peer assessments)
  - Quality of Product(s)
  - Impact/Effectiveness of Design
  - Follows the Principles of Design
  - Design Portfolio (to include topics listed in Module 1)
  - Appropriateness for Target Audience
  - Client/Customer Satisfaction Survey
- recommend students choose a campaign style that promotes a technical or technological skill, or a program area within the school, such as technology education.

Other activity ideas to address these outcomes:

- An electronic presentation for the awareness campaign or for another module within the course.
- Design projects completely independent of an awareness campaign, such as poster design, advertisements, and logo design.
- Architectural design using cADD—Complete a floor plan design layout for a specific purpose within the school or for a fictional client.
- Digital imaging—Use digital photography to design a digital or printed page for an advertisement, magazine cover, or other label using image manipulating software and desktop publishing software to combine images together. Assessment criteria may include principles of design, spelling/grammar, identification of target audience, and following guidelines/specifications.
- Web design
- Stop-time video (such as clay-mation)
- Screen printing
- Video production (Pod-casting—audio and/or video)
- prepare an orienteering activity or geocache for students to practice using a GPS on school grounds.
- Digital animation

Notes

One example of the principles of design includes Contrast, Rhythm, Alignment, Balance (CRAB)

Elements of Logo Design include Text, Geometric Shape, Graphic

The Non-Designer's Design Book.

The Non-Designer's Web Book.

A host of teaching and learning resources www.4teachers.org

Create customized rubrics rubistar.4teachers.org/index.php

Free blogging site for students www.21classes.com

Fantastic tutorials for learning specific software, old and new. Check with your board for licencing, most have access to it. movies.atomiclearning.com/K12/tutorials/

Maritime Geocaching www.maritimegeocaching.com/trails-maps.html

Media College (college of audio-visual resources) www.mediacollege.com

It is possible to address all four outcomes with one major project in this module, or teachers can address the outcomes separately by using small project-based learning activities.

Google SketchUp is recommended freeware for CADD applications. SoftCad.3D is also recommended.

Module 4: Control Technology

Overview

The Control Technology module explores the concepts of systems theory as it relates to electronic, remote, hydraulic, or pneumatic control. Students will use a variety of materials and tools to create and manipulate control systems. Robotics could be considered a broad approach to addressing the outcomes in modules four and five.

Module Outcomes

Students will be expected to

4.1 demonstrate an understanding of technological systems (input, process, output)
4.2 design and construct solutions to problems related to control technology
4.3 manipulate a variety of materials in the construction of a control system
4.4 test and evaluate a control system

Integrated Outcomes to Address in This Module

Students will be expected to

1.3 Demonstrate an understanding of the history and evolution of a specific area of technology
1.4 Investigate strengths related to technological career options
1.5 Demonstrate an ability to work in a team
1.6 Solve technological problems using the modified problem-solving model
1.7 Create design portfolios for solutions to each design problem
1.8 Implement life-cycle analysis when designing and constructing solutions to technological problems
1.9 Use a variety of materials and tools as part of solving technological problems
1.10 Demonstrate safety rules for tools and machines used
1.11 Demonstrate safe attitudes and practices in the laboratory
1.12 Safely employ appropriate tools, machines, and equipment to solve technological problems

Module 4: Control Technology

GCO 1: Students will be expected to design, develop, evaluate, and articulate technological solutions.

Outcomes

Students will be expected to

4.1 demonstrate an understanding of technological systems (input, process, output)

4.2 design and construct solutions to problems related to control technology

4.3 manipulate a variety of materials in the construction of a control system

4.4 test and evaluate a control system

Suggestions for Learning and Teaching

Teachers can

- provide instruction to students about the input/process/output technological concept. Use light switches or computers as examples to demonstrate the action of input and the process that is taking place to produce the output.

Input is the command given to a system. The process is the action of the system. The process of a system uses the seven technological resources to do the action (people, information, materials, tools, energy, money, and time). The output is what is produced as a result. For example, we might press the brake of a car as input to the braking system, the system process completes its tasks to create the desired output, which is to slow down the car.

- create partial samples of some systems that could be used within a robot design. Teachers are discouraged from providing full examples of completed projects to students as this can hamper creativity.
- prepare materials for students to manipulate, construct, and evaluate a robot
- work with students to create evaluation criteria
- outline the expectations for design portfolios and group work
- provide materials as options for creating a control system such as
  - gears and motors to create and control a crane device
  - syringes and tubing to create a robotic arm
  - VEX or LEGO robotics to design and construct a robot that solves a specific problem
- provide instruction about the different control systems and give some examples
- provide instruction about the parts and components of the robotics kits available to them within the lab

Students can

- manipulate partial systems to experience the materials used in that system (such as a syringe/tubing combination)
- work in teams to analyse all the systems of a vehicle or other control device
- manipulate materials involved in a robotics kit to become familiar with design options
- review support materials with robotics kits
- use classroom texts provided, such as “The Book of Mechanisms” to gain an understanding of gears, pulleys, and other mechanisms

Module 4: Control Technology

GCO 1: Students will be expected to design, develop, evaluate, and articulate technological solutions.

Suggestions for Assessment

Students can

- work in teams to design and construct a control device using a robotics kit system
- complete a design portfolio for the control device
- design and construct The Great Toy Snatcher robotic arm that will act as a competitive pick-up game. The object is to construct and manipulate a control system so that it can pick up a prize from a bin and drop it into a hopper within a specified time period. (Modelled after the amusement park / mall game where users pay a fee and have limited time to collect a stuffed toy using a robotic arm system.)

Teachers can

- provide lab space, materials, and kits to students so that they can effectively design and construct one of the recommended robots listed above
- collaborate with students to determine the specifications and expectations of the control project
- create a robotics situation using the VEX robotics system whereby the completed system must pick up something and deposit it somewhere else (e.g., The robot must collect a "bomb" and deposit it into a safe box and close the lid.)
- create an assessment and evaluation system for this project
  Assessment criteria could include:
  - *Successful Task:* The students work as groups to collaborate with the teacher to determine the best way to evaluate success with the robot and determine the criteria for design before they begin.
  - *Design Portfolio:* (To include the problem stated, evidence of research, sketches of ideas, final plan drawing of the robot, explanation of the system components, life-cycle plan, evaluation report that includes the testing experience, changes to the design as a result of the testing, and the re-testing experience)
  - *Effectiveness of robot design:* based on testing. (E.g., Perhaps the task was completed, but did the robot spin in circles on one motor the entire time?)
  - *Quality of construction:* Did the team use the appropriate materials in the appropriate manner to construct the robot?
  - *Re-construction* (after testing process)

Notes

Materials for a home made robot could include 1/4" × 1/2" pine strips for framing, nuts, bolts, washers, sheet metal gussets, electronic components, syringes, tubing, gears, pulleys, motors, LEGO

Underwater Robots (Bohm)

Living with Technology (Hacker)

Book of Mechanisms

VEX robotics systems are recommended as a resource for Exploring Technology 10. This system will allow students to use real-world materials to design a robotics system that can complete an infinite number of tasks.

When assigning roles within the groups, be certain that students rotate roles so that all members of the group have an opportunity to handle the components of the robot. This will promote teamwork, but give less assertive students an opportunity to explore the hands-on components of the activity.

Technology: Engineering and Design, Teacher Annotated Edition.

Module 4: Control Technology

GCO 1: Students will be expected to design, develop, evaluate, and articulate technological solutions.

Outcomes

Students will be expected to

4.1 demonstrate an understanding of technological systems (input, process, output)

4.2 design and construct solutions to problems related to control technology

4.3 manipulate a variety of materials in the construction of a control system

4.4 test and evaluate a control system

Suggestions for Learning and Teaching

Teachers can

- provide instruction to students on parts of a control system
- set parameters of a control system
- provide instruction on basic electronics technology
- provide examples of mechanical toys
- provide a variety of materials for students to construct control devices

Students can

- prepare a testing system for their control device
- complete a design portfolio that include total costs estimated, materials used, sketches, final working drawing, and communication questions

Module 4: Control Technology

GCO 1: Students will be expected to design, develop, evaluate, and articulate technological solutions.

Suggestions for Assessment

Other Activity Ideas

- *Disk Brake System:* Students design and construct a model disk braking system using a plastic disk (made from a container top) and a syringe system attached to a break pedal to simulate hydraulic brakes.
- *Crane Design:* Build a free-standing crane using strip pine (prepared by the teacher). The crane must pick up car bodies using magnets.
  Specs: turn 90 degrees, boom 30 mm length, max weight (20 strips of 30 mm stock). Complete a portfolio that includes total cost estimated, sketches, final on CADD, evaluation questions.
  Extensions: Use a digital interface to operate the crane base and lifting device using stepper motors.
- *Greeting Card Design Activity:* Students create a greeting card with a circuit inside for lights and/or sound (LED, copper tape, watch battery). Links to the Media Technology module.
- *Underwater Robots:* Students design tethered remote control robots for underwater operation.
- Cyborg Control Activity
- Build a Motor Activity
- Pneumatic Lift
- Design Mechanical Toys, Rube Goldberg
- EKI Digital Magic Electronics activities: Fully develop one experiment with 555 chip.

Notes

ROV competition with NSCC www.nscc.ns.ca/News_Events/Media/2006/10-27-06-00.asp

Build Your Own Underwater Robot

Robotics in Canada: Canada is a world leader in robotics, having designed the robotic arm “Canadarm” on the international space station, as well as being the first country to perform brain surgery using a robotic arm in April 2008. The Mars Pheonix exploration project of May 2008 includes a Canadian weather laser robotic station called LIDAR. Search the internet for “LIDAR” for more information.

For history on robotics in Canada see www.space.gc.ca/asc/pdf/educator-story_robot.pdf

Module 5: Engineering Technology

Overview

The Engineering Technology module explores the concept of introductory engineering problem solving. The concept of technical drawing communication is introduced. An understanding of the relationship between real-world problem solving and other subject areas is essential and is implemented using the STEM approach (science, technology, engineering, math). Robotics could be considered a broad approach to addressing the outcomes in modules four and five.

Module Outcomes

Students will be expected to

5.1 employ appropriate technical drawing techniques
5.2 design and construct solutions to real world engineering technology problems
5.3 evaluate solutions to problems by selecting appropriate testing methods
5.4 demonstrate an understanding of various STEM (science, technology engineering, math) connections to design problems

Integrated Outcomes to Address in This Module

Students will be expected to

1.4 investigate strengths related to career options
1.5 demonstrate an ability to work in a team
1.6 solve technological problems using the modified problem-solving model
1.7 create design portfolios for solutions to each design problem
1.8 implement life-cycle analysis when designing and constructing solutions to technological problems
1.9 use a variety of materials and tools as part of solving technological problems
1.10 demonstrate safety rules for tools and machines used
1.11 demonstrate safe attitudes and practices in the laboratory
1.12 safely employ appropriate tools, machines, and equipment to solve technological problems

Module 5: Engineering Technology

GCO 1: Students will be expected to design, develop, evaluate, and articulate technological solutions.

Outcomes

Students will be expected to

5.1 employ appropriate technical drawing techniques

5.2 design and construct solutions to real world engineering technology problems

5.3 evaluate solutions to problems by selecting appropriate testing methods

5.4 demonstrate an understanding of various STEM (science, technology engineering, math) connections to design problems

Suggestions for Learning and Teaching

Teachers can

- provide instruction on the basics of technical drawing in orthographic and isometric projection
- prepare design challenges to students with details of expectations
- review all aspects of instruction for students to be able to complete the design challenge (e.g., Offer students an engineering design problem with the VEX robotics system and outline the necessary engineering technology involved in constructing the body of the robot.)
- distribute materials for the engineering design problem at appropriate time periods so students can learn the applications of those materials at the appropriate time
- prepare testing mechanism or process with collaboration from students
- demonstrate methods of joinery for life cycle analysis (joining methods: gumdrops, marshmallows, screws, nuts/bolts, pins, paperclips, student developed)
- provide instruction and samples for the STEM connections to the design challenge posed to the students

Engineering problem solving involves using a modified problem-solving model which starts with the standard problem solving loop (PRIDE—problem, research, ideas, design, evaluate) with the added feature of mandatory modifications to the design when the testing process does not provide satisfactory results. Students often complete design challenges and are required to be satisfied with the results due to time constraints, etc. Using the modified problem-solving approach, time must be built in to allow for modifications to the design and for re-testing.

Students can

- practice technical drawing techniques by using paper and pencil sketching initially and then moving to a Computer-Assisted Design software application to continue the learning of the concept
- create plan drawings of all work related to design problems
- create sample parts of design solution devices to test before completing an entire design (e.g., Create a truss for a bridge, test it, and then use the results to construct an entire system of trusses for the finished bridge.)
- include STEM connections notes in their design portfolio for the challenge

Module 5: Engineering Technology

GCO 1: Students will be expected to design, develop, evaluate, and articulate technological solutions.

Suggestions for Assessment

Teachers can

- provide assessment opportunities and feedback for students to improve their technical drawing skills
- provide materials to students for creating their design solutions at appropriate time
- provide parameters for students to work within for their design solutions
- collaborate with students to create a testing system for the design problem posed
- review the expectations of the testing process to the students before they begin design and construction (e.g., If the robot system created is required to do a specific task, be sure students are involved in the selection process for testing.)
- offer feedback to students on the STEM connections that are involved with the specific design problem chosen

Students can

- create technical sketches and final working drawings of the device created to solve the engineering problem posed
- assess projects according to their ability to re-enter the production process and include a life cycle plan in the design portfolio
- write a STEM report on the connections made within the design challenge device created and include it in the design portfolio
- complete a design portfolio to include all work involved in the design process

Some Engineering Design Challenge Ideas Include:

- design and construct a trebuchet or catapult that will launch an object consistently hitting a target a 2 m distance using a counterweight of 1kg.
- use elastic bands to create a catapult that will launch an object a specified distance (STEM connection: kinetic energy, Newton's laws of motion)
- create a pneumatic lift for a specific purpose such as lifting a reclining chair for seniors
- design and construct solutions to Human Factors Engineering Problems such as:
    - a set of 'legs' for someone with broken legs
    - a model 'knee'
    - a helmet that will reduce neck injuries in hockey
    - a golfing apparatus for physically challenged persons
    - a dynamic hand splint

Notes

Technology: Engineering and Design. Teacher Annotated Edition. (Includes a STEM handbook with details on technical drawing)

STEM for catapult and trebuchet activity—math, physics (trajectory), history

Sample Trebuchet Parameters:
- size - approximately 12" × 12"
- group size 3
- challenge—best/final test
- distance

Newtons first and third laws of motion:
1) An object in motion stays in motion unless an external force is applied to it.
3) For every action, there is an equal and opposite reaction

Complete a Google search for "mechanical toys" to provide examples.

The four forces are tension, compression, shear, and torsion.

Human Factors Engineering is concerned with creating machines or work systems that they are compatible with human abilities and limitations (Virginia Tech Human Factors Engineering Dept.)

splinting.com

Module 5: Engineering Technology

GCO 1: Students will be expected to design, develop, evaluate, and articulate technological solutions.

Outcomes

Students will be expected to

5.1 employ appropriate technical drawing techniques

5.2 design and construct solutions to real-world engineering technological problems

5.3 evaluate solutions to problems by selecting appropriate testing methods

5.4 demonstrate an understanding of various STEM (science, technology engineering, math) connections to design problems

Suggestions for Learning and Teaching

Teachers can

- choose one engineering design problem suggested and develop it to address the four outcomes in this module
- provide instruction about simple machines and their application to engineering problem solving
- provide instruction about orthographic projection and basic technical drawing
- provide instruction on all basic tools and machines necessary for students to create the design solutions chosen to meet the outcomes listed
- prepare a lesson on the vertical rise for cam design using the coat hanger approach (bent on two 90° angles) for mechanical marvels
- demonstrate to students how to change direction of motion on a cam from rotary to linear using a housing for the linear

Module 5: Engineering Technology

GCO 1: Students will be expected to design, develop, evaluate, and articulate technological solutions.

Suggestions for Assessment

Other Activity Ideas

- Toy designs with "mechanical marvels"
- Rube Goldberg game activities (use syringes to create designs for toy)
- Restraint system (parachutes, egg car), research crumple zones, restraint systems, air bags, design a testing mechanism for testing the vehicle using a minimum of 2 simple machines in the design
- Hot air balloon design
- Truss design: Students research truss design and build one, then test for strength and efficiency of design. (Weigh the truss and measure the force to break it.) Test with hydraulic jack (1 ton) on bathroom scale.
- Bridges: Design and test, construct, using the engineering approach with construct/modify/reconstruct method to be more involved than junior high approach. STEM connections include dynamic and static loads.
- Freestyle vehicles: Using CO_2 power or compressed air
- Mousetrap boats
- Rocketry: One-day activity—design a paper rocket using a template as a fun hook activity.
- Towers and other structures

Notes

507 Mechanical Movements (Brown)

D & T Mechanisms Information www.dtonline.org/apps/infopage/app?3&6&1&0&1&0

Thinking Fountain www.thinkingfountain.org/f/friction/friction.html

Making Mechanical Marvels in Wood

Rube Goldberg toy design

dsc.discovery.com/fansites/mythbusters/mythbusters.html

tv.com/junkyard-wars/show/6391/summary.html

mythbusters.com

Bridges: If students have experienced bridge design previously:

- Build on the experience by trying something new in truss design.
- Have students do a spreadsheet on cost, weight to strength ratio, using Westpoint Bridge Designer.

Search "westpointbridge designer" for free software for designing and testing bridges using STEM connections

faculty.philau.edu/oakleyd/Structures_2/West_Point_Bridge_Designer/west_point_bridge_designer.htm

Module 6: Exploring Trades and Technology

Overview

The Exploring Trades and Technology module explores the concept of integrating skilled trades education into technology education curriculum. The module is designed to be an introduction to one or more of the skilled trades. Students can meet the outcomes by doing any variety of activities that explores the concepts of skilled trades and technology.

Module Outcomes

Students will be expected to

6.1 explore skilled trades and technology-related careers
6.2 demonstrate skills related to technological processes in skilled trades through a series of hands-on activities
6.3 use appropriate tools of skilled trades
6.4 estimate materials and labour requirements for a skilled trades-related project

Integrated Outcomes to address in This Module

Students will be expected to

1.4 investigate strengths related to career options
1.5 demonstrate an ability to work in a team
1.6 solve technological problems using the modified problem-solving model
1.7 create design portfolios for solutions to each design problem
1.8 implement life-cycle analysis when designing and constructing solutions to technological problems
1.9 use a variety of materials and tools as part of solving technological problems
1.10 demonstrate safety rules for tools and machines used
1.11 demonstrate safe attitudes and practices in the laboratory
1.12 safely employ appropriate tools, machines, and equipment to solve technological problems

Module 6: Exploring Trades and Technology

GCO 1: Students will be expected to design, develop, evaluate, and articulate technological solutions.

Outcomes

Students will be expected to

6.1 explore skilled trades and technology related careers

Suggestions for Learning and Teaching

Teachers can

- bring in guest speakers from industry (Contractors—plumbers, electricians, carpenters, building inspectors, and other skilled tradespeople)
- contact special associations
- take students on tour of a facility within the community (e.g., construction site or industry tour)
- arrange for the school facilities manager to take students on a tour of the school heating system
- prepare handouts for students to complete as part of the Hat Activity (expanded from Module 1) giving guidelines of what students will present
- pose the question, "Who does it take to build a house?"
- brainstorm the above question after career search activity

Students can

- correlate the systems within the heating unit for the facilities tour and research skills required and related careers
- prepare for a facility tour by outlining expectations and questions for the guide (pre-tour planning)
- complete research activities and record results outlining their expectations and actual findings

Module 6: Exploring Trades and Technology

GCO 1: Students will be expected to design, develop, evaluate, and articulate technological solutions.

Suggestions for Assessment

Teachers can

- outline the expectations for the Hat Activity and how students will be assessed throughout the activity
- prepare a list of expectations for a career journal and how it will be assessed

Students can

- complete the Hat Activity—students draw a trades career choice from a hat and research it using the specific career site below, then present the results to the class as a round table discussion (2–5 minutes)
- reflect in journals or portfolios on what they have learned about themselves and their interests related to skilled trades
- prepare questions to ask guest speakers
- prepare questions for the tour that are related to core subjects (e.g., What math skills are required to do this job?)
- do a reflection paper to journal the learning experience from the tours, guests, or career searches (specifically related to themselves)
- interview professionals/tradespeople from the community (integrate multimedia component from Media Technology module)
- journal their experiences on the trades-related search

Notes

Job Search Resources

- careeroptions.EDnet.ns.ca/home.aspx
- workopolis.com

It is important that teachers are careful to assess the content of a reflection paper in this case, rather than the writing, but do provide feedback to students on the writing so they can learn from it.

NSCC is a good source for guest speakers.

NSCC College Prep

Co-ordinators can be found at each campus and work directly with public schools.

Career Cruising: careercruising.com (Check with school board CBL consultants for username and password)

Module 6: Exploring Trades and Technology

GCO 1: Students will be expected to design, develop, evaluate, and articulate technological solutions.

Outcomes

Students will be expected to

6.2 demonstrate skills related to technological processes in skilled trades through a series of hands-on activities

6.3 use appropriate tools of skilled trades

6.4 estimate materials and labour requirements for a skilled trades-related project

Suggestions for Learning and Teaching

Teachers can

- prepare materials for a construction activity that will provide students with a broad-based introduction to construction industry practices
- set parameters for mock-up project (size, scale—e.g., ½" = 1 foot)
- demonstrate appropriate safety procedures and guidelines for tools and machines related to this activity
- prepare and implement safety tests to assess student readiness for machine use and keep tests on file
- require student hands-on, safe-use demonstration for machines used (Document this activity.)
- provide instruction about materials for dry-walling
- list costs of all materials
- create work log templates for students
- prepare an electrical activity that involves practical, hands-on experiences for students
- prepare safety lessons specific to electrical work
- demonstrate proper wire stripping procedures, wiring to terminals, where to drill holes in studs
- provide instruction on basic schematic drawings and plan reading
- provide instruction on the purpose of ground protection

Students can

- practice exercises in:
  - conductors versus insulators
  - stripping wires
  - solder and tape to connect two wires
  - mar connectors
  - underwriters knot
  - wire receptacles
  - create extension cord
  - using a voltmeter for electrical pressure
  - wire a light controlled by a switch with power going to switch first
  - add a plug to the circuit (from the switch)

Other Activities

- Installing a doorknob or deadbolt

Module 6: Exploring Trades and Technology

GCO 1: Students will be expected to design, develop, evaluate, and articulate technological solutions.

Suggestions for Assessment

Students can

- complete a construction activity that includes a wall section (e.g., A corner section using either full-size materials or scale model-size materials.)
- complete a rough opening for window and/or door
- add drywall to the wall section on interior and/or exterior sides
- tape and crack fill drywall and repair holes
- keep hourly work logs for the duration of the construction project
- prepare a quotation for the construction job using materials cost sheets and labour

Teachers can

- prepare and implement safety tests to assess student readiness for machine use
- provide materials and labour costs for the construction activity
- prepare worksheets for hourly work logs for student use
- document appropriate lab activity and tool use
- develop the construction activity to include electrical and/or plumbing additions to the wall section

Notes

Technology: Engineering & Design. Teacher Annotated Edition. (Includes a STEM handbook, See page 367 for Job Estimating.)

Nova Scotia Construction Safety Association

Ontario Council of Tech Educators

Canadian Centre of Occupational Health and Safety www.ccohs.ca/

Note: All electrical testing must be done by the teacher using a 12v power supply

Option 1: Electrical
2' × 2' sheet of plywood using mounting mock-up method.

Option 2: Electrical
Teacher prepares a mock-up wall section with electrical boxes mounted. Students wire accordingly.

Recommended Safety Program: “Heads Up for Safety” by British Columbia Ministry of Education. Includes all lab safety information, tests, etc.

Contexts for Learning and Teaching

Principles of Learning

The public school program is based on principles of learning that teachers and administrators should use as the basis of the experiences they plan for their students. These principles include the following:

1. *Learning is a process of actively constructing knowledge.*

   Therefore, teachers and administrators have a responsibility to

   - create environments and plan experiences that foster inquiry, questioning, predicting, exploring, collecting, educational play, and communicating
   - engage learners in experiences that encourage their personal construction of knowledge, for example, hands-on science and math, drama, creative movement, artistic representation, and writing and talking learning activities
   - provide learners with experiences that actively involve them and are personally meaningful

2. *Students construct knowledge and make it meaningful in terms of their prior knowledge and experiences.*

   Therefore, teachers and administrators have a responsibility to

   - find out what students already know and can do
   - create learning environments and plan experiences that build on learners' prior knowledge
   - ensure that learners are able to see themselves reflected in the learning materials used in the school
   - recognize, value, and use the great diversity of experiences and information students bring to school
   - provide learning opportunities that respect and support students' racial, cultural, and social identities
   - ensure that students are invited or challenged to build on prior knowledge, integrating new understandings with existing understandings

3. *Learning is enhanced when it takes place in a social and collaborative environment.*

   Therefore, teachers and administrators have a responsibility to

   - ensure that talk, group work, and collaborative ventures are central to class activities
   - see that learners have frequent opportunities to learn from and with others
   - structure opportunities for learners to engage in diverse social interactions with peers and adults
   - help students to see themselves as members of a community of learners

4. *Students need to continue to view learning as an integrated whole.*

   Therefore, teachers and administrators have a responsibility to

   - plan opportunities to help students make connections across the curriculum and with the world outside and structure activities that require students to reflect on those connections
   - invite students to apply strategies from across the curriculum to solve problems in real situations

5. *Learners must see themselves as capable and successful.*

   Therefore, teachers and administrators have a responsibility to

   - provide activities, resources, and challenges that are developmentally appropriate to the learner
   - communicate high expectations for achievement to all students
   - encourage risk taking in learning
   - ensure that all students experience genuine success on a regular basis
   - value experimentation and treat approximation as signs of growth
   - provide frequent opportunities for students to reflect on and describe what they know and can do
   - provide learning experiences and resources that reflect the diversity of the local and global community
   - provide learning opportunities that develop self-esteem

6. *Learners have different ways of knowing and representing knowledge.*

   Therefore, teachers and administrators have a responsibility to

   - recognize each learner's preferred ways of constructing meaning and provide opportunities for exploring alternative ways
   - plan a wide variety of open-ended experiences and assessment strategies
   - recognize, acknowledge, and build on students' diverse ways of knowing and representing their knowledge
   - structure frequent opportunities for students to use various art forms—music, drama, visual arts, dance, movement, crafts—as a means of exploring, formulating, and expressing ideas

7.Reflection is an integral part of learning.

Therefore, teachers and administrators have a responsibility to

- challenge their beliefs and practices based on continuous reflection
- reflect on their own learning processes and experiences
- encourage students to reflect on their learning processes and experiences
- encourage students to acknowledge and articulate their learning
- help students use their reflections to understand themselves as learners, make connections with other learning, and proceed with learning

Learning Styles and Needs

Learners have many ways of learning, knowing, understanding, and creating meaning. Research into links between learning styles and preferences and the physiology and function of the brain has provided educators with a number of helpful concepts of and models for learning. Howard Gardner, for example, identifies eight broad frames of mind or intelligences: linguistic, logical/ mathematical, visual/spatial, body/kinesthetic, musical, interpersonal, intrapersonal, and naturalistic. Gardner believes that each learner has a unique combination of strengths and weaknesses in these eight areas, but that the intelligence can be more fully developed through diverse learning experiences. Other researchers and education psychologists use different models to describe and organize learning preferences.

Students' ability to learn is also influenced by individual preferences and needs within a range of environmental factors, including light, temperature, sound levels, availability of food and water, proximity to others, opportunities to move around, and time of day.

How students receive and process information and the ways they interact with peers and their environment in specific contexts are both indicators and shapers of their preferred learning styles. Most learners have a preferred learning style, depending on the situation and the type and form of information the student is dealing with, just as most teachers have a preferred teaching style, depending on the context. By reflecting on their own styles and preferences as learners and as teachers in various contexts, teachers can

- build on their own teaching-style strengths
- develop awareness of and expertise in a number of learning and teaching styles and preferences
- identify and allow for differences in student learning styles and preferences

- identify and allow for the needs of students for whom the range of ways of learning is limited
- organize learning experiences to accommodate the range of ways in which students learn

Learning experiences and resources that engage students' multiple ways of understanding allow them to become aware of and reflect on their learning processes and preferences. To enhance their opportunities for success, students need

- a variety of learning experiences to accommodate their diverse learning styles and preferences
- opportunities to reflect on their preferences and the preferences of others to understand how they learn best and how others learn differently
- opportunities to explore, apply, and experiment with learning styles other than those they prefer, in learning contexts that encourage risk taking
- opportunities to return to preferred learning styles at critical stages in their learning
- opportunities to reflect on other factors that affect their learning, for example, environmental, emotional, sociological, cultural, and physical factors
- a flexible time line within which to complete their work

Meeting the Needs of All Students

Learners require inclusive classrooms, where a wide variety of learning experiences ensure that all students have equitable opportunities to reach their potential.

In designing learning experiences, teachers must accommodate the learning needs, preferences, and strengths of individuals, and consider the abilities, experiences, interests, and values that they bring to the classroom. In recognizing and valuing the diversity of students, teachers should consider ways to

- create a climate and design learning experiences to affirm the dignity and worth of all learners in the classroom community
- consider the social and economic situations of all learners
- acknowledge racial and cultural uniqueness
- model the use of inclusive language, attitudes, and actions supportive of all learners
- adapt classroom organization, teaching strategies, assessment practices, time, and learning resources to address learners' needs and build on their strengths
- provide opportunities for learners to work in a variety of contexts, including mixed-ability groupings

- identify and apply strategies and resources that respond to the range of students' learning styles and preferences
- build on students' individual levels of knowledge, skills, and attitudes
- use students' strengths and abilities to motivate and support their learning
- provide opportunities for students to make choices that will broaden their access to a range of learning experiences
- acknowledge the accomplishment of learning tasks, especially those that learners believed were too challenging for them

Teachers must adapt learning contexts, including environment, strategies for learning, and strategies for assessment, to provide support and challenge for all students, using curriculum outcomes to plan learning experiences appropriate to students' individual learning needs. When these changes are not sufficient for a student to meet designated outcomes, an individual program plan may be developed. For more detailed information, see *Special Education Policy.*

A range of learning experiences, teaching and learning strategies, motivation, resources, and environments provide expanded opportunities for all learners to experience success as they work toward the achievement of designated outcomes. Many of the learning experiences suggested in this guide provide access for a wide range of learners, simultaneously emphasizing both group support and individual activity. Similarly, the suggestions for a variety of assessment practices provide multiple ways for students to demonstrate their achievements.

The Role of Information and Communication Technology

Vision for the Integration of Information

Some of the outcomes in Exploring Technology 10 are, by nature, technology dependent; particularly those in the Design Technology module. Students also need access to the information and communication technologies available in schools to facilitate learning across the curriculum and across the modules within this course.

The Nova Scotia Department of Education has articulated five strands in the learning outcomes framework for the integration of information and communication technology within Public School Programs.

Basic Operations and Concepts: Concepts and skills associated with the safe and efficient operation of a range of information and communication technology.

Social, Ethical, and Human Issues: The understanding associated with the use of information/communication technology that encourages in students a commitment to pursue personal and social good, particularly to build and improve their learning environments and to foster strong relationships with their peers and others who support their learning.

Productivity: The efficient selection and use of information and communication technology to perform tasks such as the exploration of ideas, data collection, data manipulation, including the discovery of patterns and relationships, problem solving, and the representation of learning.

*Communication: S*pecific, interactive technology use supports student collaboration and sharing through communication.

Research, Problem Solving, and Decision Making: Students' organization, reasoning, and evaluation of their learning rationalize their use of information and communication technology.

Technological Competencies

Information and communication technology is the vehicle that students use to explore and evaluate the world of communication. While technological competency is certainly one of the Essential Graduation Learnings within Exploring Technology 10, the role of technology is to facilitate the achievement of the outcomes of this course, rather than to be an end in itself. Through the use of information and communication technology, students create design media, and learn to value, appreciate, and become critically literate participants in a technology-rich culture.

The essence of learning lies in the accessing, gathering, investigating, and managing data; problem solving; decision making; and creating and communicating new understandings in original works. If students are to understand the relationship between ideas and how they are communicated, educators need to develop high-order problem solving and decision making in their students. Students need to be able to use information and communication technology effectively for all of these purposes. Educators need to model appropriate uses of information and communication technology with their students.

Students need to develop a comfort with information and communication technology and an understanding of what medium best suits a design in order to fully utilize the power that technology offers. While information and communication technology is a tool for change, it should not become simply a tool for doing the same old thing differently. Information and communication technology enables new forms of expression.

The Exploring Technology 10 Learning Environment

The Classroom

Learning in Exploring Technology 10 should take place, for the most part, in a production laboratory and a computer laboratory. For the Media Technology module, there should be a minimum of one computer per two students and students, should have access to a printer and a scanner. Arranging the computers in a U-shape with the open end facing the front of the class allows the teacher to view all screens simultaneously and also allows all students clear access to the front of the room to view the teacher, data screen or board. Work benches, tables or counter space are necessary for students to carry out group work and to take notes.

Production lab spaces should be available when necessary to allow students to access tools, equipment, and materials to construct devices, conduct tests of those devices, and to work collaboratively with teams. Basic skills of manufacturing production tools and equipment will be a necessary part of delivering this course.

The Learning Culture

It is important to establish a culture in the Exploring Technology 10 laboratory where critical thinking, problem solving, and collaboration are valued and encouraged. Students should perceive the teacher as an instructor when necessary, but more frequently the teacher should be perceived as a facilitator, guiding and encouraging students as they acquire problem solving, collaboration, and technical skills. The continuous evolution of technology requires the teacher to be a lifelong learner, to apply prior knowledge, to be actively curious, and to model these qualities for students.

The role of the student in the Exploring Technology 10 learning environment involves investigation, interpretation, collaboration, creation, and reflection. It is important that students feel comfortable discussing their ideas with others and are willing to share their opinions of others works'. Students must be willing to take risks by presenting their ideas and design solutions in a public forum. It is important that students research a design idea first and then select a technology tool to solve the problem.

By taking an active learning approach, teachers become part of the learning community and communicate to students that problem solving is a dynamic process with multiple paths to success. It is essential that students be free to collaborate and feel comfortable to take risks in their learning. Students should be encouraged to peer teach, and teachers should be comfortable learning alongside their students.

Assessing and Evaluating Student Learning

Assessment is the systematic process of gathering information on student learning.

Evaluation is the process of analysing, reflecting upon, and summarizing assessment information, and making judgements or decisions based upon the information gathered.

The Principles of Assessment and Evaluation articulated in the document *Public School Programs* should be used as the basis of assessment and evaluation, policies, procedures, and practices.

Effective Assessment and Evaluation Practices

Effective assessment improves the quality of learning and teaching. It can help students to become more reflective and to have control of their own learning, and it can help teachers to monitor and focus their instructional programs.

Assessment and evaluation of student learning should accommodate the complexity of learning and reflect the complexity of the curriculum. Evaluation should be based on the full range of learning outcomes towards which students have been working during the reporting period, be proportionate to the learning experiences related to each outcome, and focus on patterns of achievement as well as specific achievement.

In reflecting on the effectiveness of their assessment program, teachers should consider the extent to which their practices

- are fair in terms of the student's background or circumstances
- are integrated with learning
- provide opportunities for authentic learning
- focus on what students can do rather than on what they cannot do
- provide students with relevant, supportive feedback that helps them to shape their learning
- describe students' progress toward learning outcomes
- help them to make decisions about revising, supporting, or extending learning experiences
- support learning risk taking
- provide specific information about the processes and strategies students are using
- provide students with diverse and multiple opportunities to demonstrate their achievement
- accommodate multiple responses and a range of tasks and resources
- provide evidence of achievement in which students can take pride
- acknowledge attitudes and values as significant learning outcomes
- encourage students to reflect on their learning, and to articulate personal learning plans

- help them to make decisions about teaching strategies, learning experiences and environments, student grouping, and resources
- include students in developing, interpreting, and reporting on assessment

Involving Students in the Assessment Process

When students are aware of the outcomes they are responsible for and the criteria by which their work will be assessed or evaluated, they can make informed decisions about the most effective ways to demonstrate what they know, are able to do, and value.

It is important that students participate actively in the assessment and evaluation of their learning, developing their own criteria and learning to judge a range of qualities in their work. Students should have access to models in the form of scoring criteria, rubrics, and work samples.

As lifelong learners, students assess their own progress, rather than relying on external measures (for example, marks) to tell them how well they are doing. Students who are empowered to assess their own progress are more likely to perceive their learning as its own reward. Rather than asking What does the teacher want?, students need to ask questions such as What have I learned? What can I do now that I couldn't do before? What do I need to learn next?

Effective assessment practices provide opportunities for students to
- reflect on their progress toward achievement of learning outcomes
- assess and evaluate their learning
- set goals for future learning

Diverse Learning Styles and Needs

Teachers should develop assessment practices that affirm and accommodate students' cultural and linguistic diversity. Teachers should consider patterns of social interaction, diverse learning styles, and the multiple ways oral, written, and visual language are used in different cultures for a range of purposes. Student performance takes place not only in a learning context, but in a social and cultural context as well.

Assessment practices must be fair, equitable, and without bias, providing a range of opportunities for students to demonstrate their learning. Teachers should be flexible in evaluating the learning success of students and seek diverse ways for students to demonstrate their personal best. In inclusive classrooms, students with special needs have opportunities to demonstrate their learning in their own way, using media that accommodates their needs, and at their own pace.

Using a Variety of Assessment Strategies

When teachers make decisions about what learning to assess and evaluate, how to assess and evaluate, and how to communicate the results, they send clear messages to students and others about what learning they value; for example, teachers can communicate that they value risk taking or lateral thinking by including these elements in determining marks.

Assessment involves the use of a variety of methods to gather information about a wide range of student learning and to develop a valid and reliable snapshot of what students know and are able to do that is clear, comprehensive, and balanced. The assessment process provides information about each student's progress toward achievement of learning outcomes that teachers can use to assign marks, to initiate conversations with students, or to make decisions in planning subsequent learning experiences.

Teachers align evaluation and assessment practices with student-centred learning practices when they

- design assessment and evaluation tasks that help students make judgments about their own learning and performance
- provide assessment and evaluation tasks that allow for a variety of learning styles and preferences
- individualize assessment and evaluation tasks to accommodate specific learning needs
- work with students to describe and clarify what will be assessed and evaluated and how it will be assessed and evaluated
- provide students with regular and specific feedback on their learning

Assessment activities, tasks, and strategies include, for example,

- anecdotal records
- artifacts
- audiotapes
- checklists
- conferences
- certifications
- demonstrations
- dramatizations
- exhibitions
- rating scales
- interviews (structured or informal)
- inventories
- investigations
- learning logs or journals
- media products
- observations (structured or informal)
- peer assessments
- performance tasks

- presentations
- portfolios
- reports
- presentations
- projects
- questioning
- questionnaires
- quizzes, tests, examinations
- reviews of performance
- sorting scales (rubrics)
- self-assessments
- surveys
- videotapes
- work samples
- written assignments

Design Portfolios

Exploring Technology 10 is a design problem-solving course. Design Portfolios are a necessary part of assessing students' abilities to meet outcomes related to specific design problems and to engage students in the assessment process and allow them to participate in the evaluation of their learning.

An overall course portfolio will include all design portfolios created as part of the design process. These are most effective when they provide opportunities for students to reflect on and make decisions about their learning. The students and teacher should collaborate to make decisions about the contents of the design portfolio for each design and to develop the criteria for evaluating the portfolio.

Portfolio assessment is especially helpful for the student who needs significant support. Teachers should place notes and work samples from informal assessment in the portfolio and use the portfolio to collaborate with the student in identifying strengths and needs, selecting learning experiences, and selecting work that best reflects the student's progress toward achievement of learning outcomes.

It is important that students share their portfolios with other students so that all students may see exemplars that represent a range of strategies for expression and levels of complexity in ideas and understanding.

Outlines and other evidence of planning, allow students to examine their progress and demonstrate achievement to teachers, parents, and others.

Students should be encouraged to incorporate their design portfolios into their "lifework portfolio", which demonstrates their achievements in a context beyond a particular course, including letters, certificates, and photographs, for example, as well as written documents.

Tests and Examinations

Traditional tests and examinations are not, by themselves, adequate to assess student learning. The format of tests and examinations can be revised and adapted to reflect key aspects of the curriculum. Some teachers, for example, have designed tests and examinations based on collaborative or small-group learning, projects, or portfolio learning. Creating opportunities for students to collaborate on a test or examination is an effective practice in the interactive classroom, to assess learning of a higher order than recall of information, for example, learning that requires synthesis, analysis, or evaluation.

In learning activities that involve solving a design problem, for example, students might work collaboratively to clarify and define the task, and then work either collaboratively or individually to develop a solution. Students might be given a range of questions, issues, or problems, and work collaboratively to clarify their understanding of the assignments and plan responses in preparation for the examination for which only one of the questions, issues, or problems will be assigned.

The initial list of questions, issues, or problems can be developed by the teacher, negotiated by the teacher with students, or developed by students and screened by the teacher.

Process-based tests and examinations allow students to demonstrate knowledge and skills and apply strategies at multiple stages in learning processes, for example, in identifying problems, challenges, and opportunities; gathering, evaluating, and synthesizing information; generating options; and developing and evaluating solutions.

Traditional tests and examinations may present a number of problems in scheduling and resource allocation. Process-based tests and examinations may be undertaken in steps during several class periods over a number of days. Students have opportunities to revise, reflect on, and extend their knowledge and understanding. Teachers have opportunities to develop comprehensive assessments, to monitor and evaluate learning at multiple points in a process, and to use time flexibly.

Certification Simulation

In some courses, students will need to prepare to demonstrate their learning through entrance tests and examinations, or to obtain or upgrade a certification (such as Electricians or Chartered Accountants). Replicating this type of assessment in the classroom can help students prepare for the conditions and assessment formats they may encounter in workplace and post-secondary situations.

To make this kind of assessment an effective learning experience, teachers should define a specific context and purpose, for example, the operation of a device, the identification of materials labels, or the demonstration of a technique or procedure.

Appendices

Appendix A: Life-Cycle Plan

Group Members:

Design Project: Date:

Materials Chosen for This Device	Intended Use of These Materials	Future Use of These Materials

Appendix B: Rubrics

Presentation Rubric

Student Name:										
Knowledge of content	1	2	3	4	5	6	7	8	9	10
Preparedness	1	2	3	4	5					
Body Language - eye contact	1	2	3	4	5					
Body Language - audibility	1	2	3	4	5					
Presentation content	1	2	3	4	5					
Time considerations	1	2	3	4	5					
TOTAL							/25			

Design Problem

Scoring Rubric

Portfolio		
Problem Identified	______/1	
Evidence of Research	______/3	
variety of sources (more than one), proper citations		
Ideas (rough sketches of at least 3 options)	______/3	
Life Cycle Plan completed (see sheet)	______/3	
ease of dis-assembly, percentage of parts for re-use		
Design	______/4	
3-view plan drawing of 1 option with rough dimensions		
Evaluation		
Description of modification process	______/2	
Answers to evaluation questions	______/4	
SUBTOTAL		______/20
Device		
Functionality through testing process	______/20	
Meets specifications	______/7	
Appearance	______/3	
SUBTOTAL		______/30
TOTAL		**______/50**

Note: it is important to offer students at least 3 testing opportunities and to count the last results after final modifications (rather than the average). This supports the idea of modifying the design for improvement.

Teamwork Scoring Rubric (by class list)

Class: _________

Student Name	contributes to the team in any capacity	Demonstrates good interpersonal skills	Allows others to contribute	Accepts constructive feedback	Responds positively to team feedback	Makes efficient use of time

Appendix C: Problem Solving

The Engineering Problem Solving Model and the Design Portfolio

(as part of completing The Design Process)

Problem
Research
Criteria
Develop
Life cycle
Decide
Build
Test
Modify
Re-test
Communicate

The Engineering Problem-Solving Model involves 11 steps. Those steps are listed below with notes for teachers to present them to students. This process should inform the content of the design portfolio for the problem that students are solving, whether it be in the Green Technology module or the Media Design module. The same process will apply for all design problems.

Step 1: Identify the Problem
As the teacher you will provide a design brief for students to outline the design problem. When students prepare their design portfolio as part of the package in creating their designs, this is the first and easiest step since you've provided it for them.

Step 2: Research
Students will use whatever resources you make available to them to become familiar with the topic of the design problem. They should document this research and include it in their design portfolio.

Step 3: Criteria
Each design brief should be presented to students outlining the expectations, design specifications, and criteria. Students should transfer these details into their design portfolio so that they are clear as to the expectations of the solution.

Step 4: Develop Designs
Students begin to sketch out plans for possible solutions to the design. If it is a Media Design solution, storyboards would be included here. If it is an Engineering Design solution, technical drawings would be included here. It is expected that teachers would make technical drawing tools or software available to students, in addition to technical drawing instruction at the time of teaching that particular module.

Step 5: Life Cycle Plan
Whenever students design a product, they should consider the materials they use to create that product and how those materials can be re-entered into the manufacturing process in the future. This is known as "cradle-to-cradle" manufacturing, rather than "cradle-to-grave." As part of the design process, students should consider this and choose appropriate materials for their designs and then document how they can be re-entered into the manufacturing system at the end of their life. (The manufacturing system in this case would be the classroom or laboratory and future projects.)

Step 6: Decide and Implement
Students choose a design that they will create or construct and do a full development of plans for that solution.

Step 7: Build
Students should spend most of their laboratory time in the build stage. It is expected that teachers will have covered all aspects of safety as it relates to the resources being used. The prototype created (after modification) is the object to be assessed for this stage of the process.

Step 8: Test or Evaluate
This is the point at which students will try out the design. This point in the process should not be evaluated unless the design is perfect the first time, in which case students would jump to step 10.

Step 9: Refine/Modify the Design
In the case of a web design, students will test and modify several times. In the case of an engineering design such as a trebuchet, students may not have as much time for modifications or complete rebuilds. It is important to build in lab time for this stage in the development as the real core of problem solving happens here.

Step 10: Retest
During the retest stage, students may wish to have their design evaluated for the final assessment. Students should be encouraged to repeat steps 8 and 9 as many times as time will allow.

Step 11: Communicate
Teachers should prepare evaluation questions for teams to complete after the final testing process. It might be as simple as two or three questions that relate to the modifications of the design and what the group might do differently next time. This communication process is what makes the problem-solving process hit home for students. Another option for communicating the process is to have groups give an unofficial report to the class about their design and how it worked. This helps the entire class to make the connection between the process and the final results.

Completed design portfolios should be submitted very soon after the final testing and communication. It is recommended that teachers require specific parts of the portfolio to be complete before allowing groups to move to the next stage of the design process.

Appendix D: Writing a Design Brief

Design briefs are used to present a problem or case to students for a design problem or challenge. A carefully prepared design brief provides students with the necessary information to guide them through the process of solving a particular problem. The format for solving a problem should follow a particular problem-solving model. There are many formats for design briefs. The general format described below is easily adapted to a number of different design challenges.

Situation or Background

This section of the design brief introduces students to circumstances surrounding the problem. A paragraph of background information can move from being general to being very specific, setting the stage for the problem. The information provided gives a real-world setting to the problem, providing transferability of the problem-solving process.

Assignment or Problem Statement

This section features a carefully planned, concise statement of the problem telling students what they must do. For example: "Design and construct a ____ that will ____." The problem statement also outlines boundaries and limitations, giving guidelines for the development of the problem solution.

Specifications

This part of the design brief outlines the problem-solving procedure and all of the requirements that the students must follow to complete their design. Each specification that you want the design to follow should be outlined in point form. Outline details required for following the problem solving model as well as all requirements for the device that students create.

Evaluation

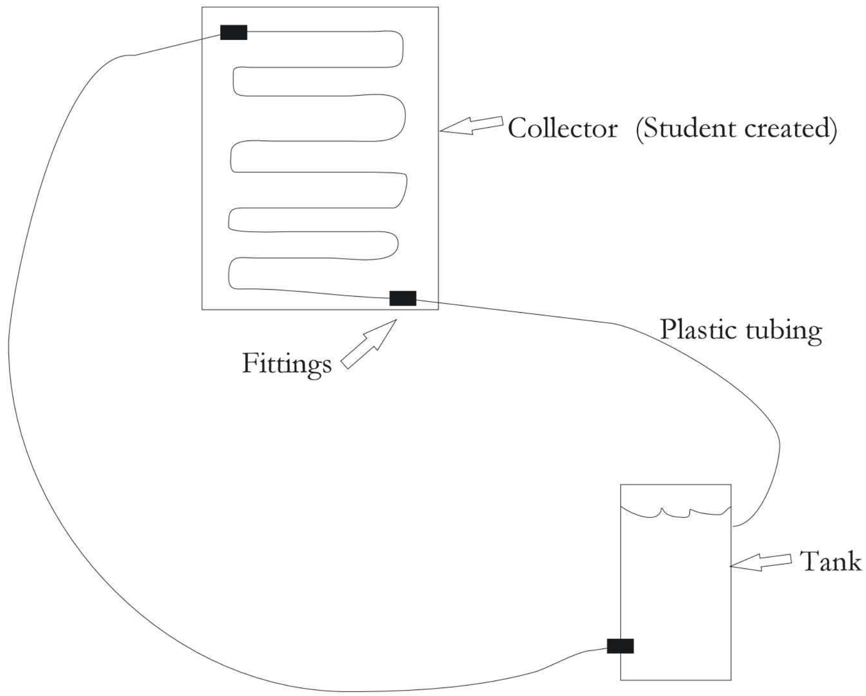
The evaluation section of the design brief identifies the exact method that will be used to assess student work related to the solution to the problem and the process by which they created the solution. Points should be awarded in accordance with the steps outlined in the problem-solving procedure. Make sure that the instructions are clear, thus allowing students to complete all of the required work and receive maximum value for their work.

Appendix E: Career Search Report

Student:	Date:
Module:	Career Search Title:
Pre-search ideas about this career:	Careers found within the search:
Post-search ideas about this career:	What did you discover about yourself after doing this search?

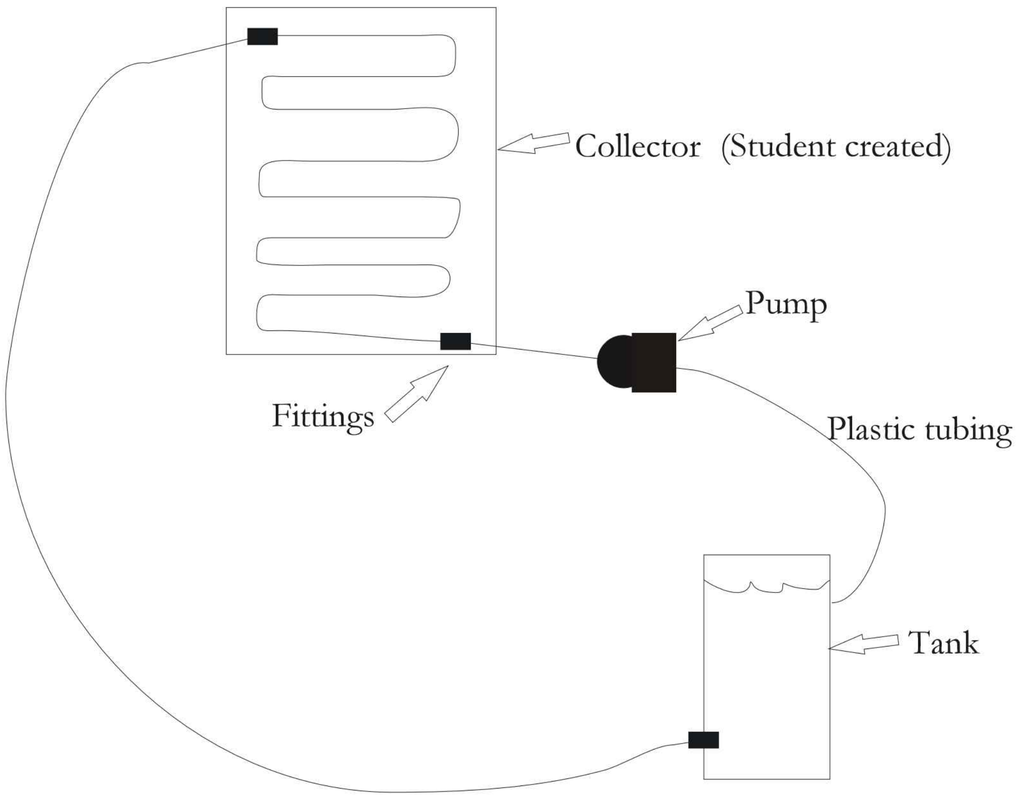
Appendix F: Solar Collector systems

Passive Solar Collector System



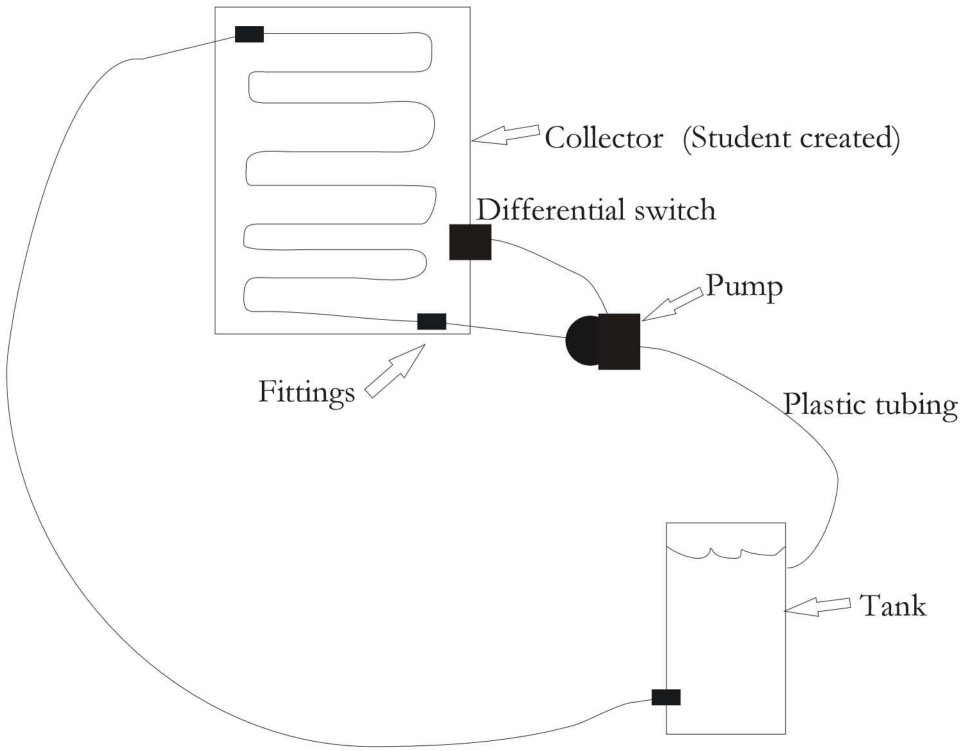
As warm water is created in the collector it will rise to the top of the collector, causing it to move to the bottom of the tank. This motion causes the cool air to move into the collector.
Note: in order for this system to work, the tank should be quite small (i.e., apple juice can) and the collector needs intense heat/light applied (such as a heat lamp)

Active Solar Collector System



In an active solar collection system, the pump draws water from the tank, moving it deliberately through the collector to be heated by the sun. When the pump is turned off, the water drops back into the tank creating a more controlled environment for the user.

Active Solar Collector System (with differential switches)



A solar collector that has a differential switch can be turned off automatically when the temperature in the collector reaches below a specified point. The sensor inside the collector will tell the switch to turn off the pump causing the water to drop down into the tank so that cool water will not be circulated in the system. The sensor will in turn switch the pump back on when the temperature inside the collector goes back up.