Technology Education 9

Guide

NOVA SCOTIA
NOUVELLE-ÉCOSSE

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Technology Education 9

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.

Technology Education 9

Draft
April 2012

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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 & Engineering Education Association (ITEEA) states that technological literacy enables people to develop knowledge about human innovation in action. As technological needs continually change globally, all citizens need to be technologically literate due to the need for them to be active participants in the decision-making processes related to all aspects of society. Students need technology education as part of 21st-century learning.

Standards for Technological Literacy: Content for the Study of Technology (International Technology and Engineering Education Association 2007) defines what students should know and be able to do in order to be technologically literate in the 21st century. Technology Education 9 was developed using those standards along with the *Foundation for the Atlantic Canada Technology Education Curriculum* (Atlantic Provinces Education Foundation 2001).

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 also need to use technology to carry 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

Technology Education 9 involves using a hands-on approach to learning technological problem-solving concepts in the areas of Communications Technology, Energy Engineering, Inventions and Innovations, and Production Technology. Technology Education provides all students with hands-on activities and introduces them to a broad spectrum of technological concepts, both in traditional and new processes. By the end of Technology Education 9, students will be expected to use a range of technological tools, processes, and applications; integrate technology education with other academic disciplines; design and create devices and objects that solve technological problems; and explain the consequences of technology and how it affects society.

The essential skills of employees have changed. Roles and responsibilities of occupations and professions change significantly over the progression of one's career. Technological 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 technology education. 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.

The Nature of Technology Education 9

Technology education is a design problem-solving course. Technology education is designed for all students in grades 9. 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 **four** modules in the course. Each module has a set of specific learning outcomes (SCOs) that are designed to be addressed through project-based learning or problem-based learning and should comprise approximately **20–25 hours each**. Students will have an opportunity to create design solutions as a way of achieving outcomes in each of the modules. In addition, the Fundamentals of Technology Education 9 threading outcomes are those outcomes that are to be integrated throughout each module that is offered within the course and may be addressed more than once throughout the teaching and learning process. The threading outcomes must be addressed within the course.

Technology Education 9 is a project-based and problem-based learning course. Students will achieve outcomes through the design challenge approach, which requires the use of The Design Process. In doing so, students engage in solving technological problems that apply to authentic situations. Students in grade 9 will best engage in their learning when they have an opportunity to learn standing up and apply their learning to the real world.

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. This is not to be confused with a self-directed proprietary product known as Modular Learning.

Modules that comprise Technology Education 9:

1. Communications Technology
2. Energy Engineering
3. Inventions and Innovations
4. Production Technology

Teachers are encouraged to create a fully integrated course where each of the modules offered are in some way interconnected while addressing the threading outcomes.

The course design can be graphically represented as follows:

Threading Outcomes	Communications Technology
	Energy Engineering
	Inventions and Innovations
	Production Technology

How to Offer This Course

Schools are encouraged to offer as many of the modules as scheduling and resources permit. Each module requires 20–25 hours of learning time. It is acceptable to offer any or all modules. However, the outcomes for each module offered must all be addressed, along with the Fundamentals of Technology Education 9 threading outcomes. The modules of this course can be scheduled in line and integrated with other grade 9 course offerings as part of the *Time to Learn* document. Technology Education 9 is an ideal course to use as a foundation for project-based learning, which encourages the integration of other subjects to reach a common goal, project, or event.

Suggested Learning Environment

Students need access to a multi-activity technology education laboratory, or an innovations technology environment, which is a classroom that is outfitted with a variety of problem-solving tools and equipment. This should include production tools for manipulating wood or metals and computer technology and software appropriate for digitizing and editing photographs, video, completing design work, drafting, web publishing, and/or broadcasting.

Suggested Equipment

Technology education is not a computer course, nor is it a wood-working course, but rather it is a course in which computers and all other equipment play a part in solving problems related to design. It is important to note that the use of the computer for this course is not to be confused with technology integration applications or data processing, but rather it is used for design and new media engineering to support a variety of processes. The spaces in which this course is taught need to be flexible and open in order to allow for a variety of activities to take place in addition to computing, such as photography, video studio set up, sign printing, and screen printing.

Teachers have found these items to be useful in delivering Technology Education 9:

- band saw
- computers and peripherals
- design software
- drill press
- hand tools (hammers, screwdrivers, squares, hand saws, chisels, etc.)
- jointer
- photographic equipment
- power tools (drills, jigsaws, etc.)
- printing equipment
- screen-printing equipment
- scroll saw
- sheet metal equipment
- table saw
- thickness planer
- video equipment
- video, audio, and graphic editing software
- work benches with vices

Course Designation

According to the Nova Scotia Department of Education Time to Learn document, technology education is one of the elective courses that grade 9 schools are required to offer. Each grade level of technology education can be offered independent of the previous grade level. In other words, there is no prerequisite for each grade level. Technology education is a subject that is recommended for all students of all learning levels. It is recommended that technology education classes in grades 7–9 not exceed 20 students.

Essential Graduation Learnings and Technology Education 9

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.

Technology Education 9 will help students work toward attaining these essential graduation learnings through the following outcomes:

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 Technology Education 9, students will be expected to

5.8 communicate ideas using 2-D and 3-D technical drawings and sketches

1.6 apply elements and principles of design

1.7 present a solution and rationale to a target audience using a given medium

Citizenship

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

At the end of Technology Education 9, students will be expected to

5.2 demonstrate an awareness of ethics and environmental responsibility in technological decision-making and work habits

2.7 use knowledge of energy sources to make decisions about real-life energy problems

3.2 design an adaptation for an existing product that solves a new need

3.4 evaluate the impact of invention and innovation

4.10 use environmentally friendly finishing techniques to enhance the esthetics or functionality of a product

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 Technology Education 9, students will be expected to

5.1 work independently, co-operatively, and collaboratively to solve technological problems

5.9 use appropriate language and terminology as applied to technology education

1.7 present a solution and rationale to a target audience using a given medium

3.3 explain a complex system in terms of its subsystems

Personal Development

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

At the end of Technology Education 9, students will be expected to

5.4 demonstrate safe and healthy practices with regard to materials, processes, and equipment

5.3 demonstrate preparedness for technological problem solving

4.1 demonstrate an understanding of all safety features of production technology machines and equipment used to solve design problems

4.2 demonstrate safe and effective use of a variety of production technology tools and processes

5.6 independently demonstrate appropriate application of skills learned

Problem Solving

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

At the end of Technology Education 9, students will be expected to

5.5 document the design process

5.10 investigate connections between technology education, STEM (Science, Technology, Engineering, and Math), and careers

5.7 demonstrate measuring skills with accuracy and precision

2.2 design and construct solutions to energy engineering problems

3.1 design and construct a system incorporating simple machines that will initiate a series of events

4.5 construct solutions to authentic production technology problems

5.3 demonstrate preparedness for technological problem solving

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 Technology Education 9, students will be expected to

5.9 use appropriate language and terminology as applied to technology education

4.6 evaluate solutions to authentic production problems

3.8 reverse-engineer a product to explain its inner workings

2.3 evaluate solutions to energy engineering problems

5.3 demonstrate preparedness for technological problem solving

Course Design and Components

General Curriculum Outcomes

Students will be expected to

GCO 1: design, develop, evaluate, and articulate technological solutions

GCO 2: operate and manage technological systems

GCO 3: demonstrate an understanding of the history and evolution of technology, and of its social and cultural implications

GCO 4: demonstrate an understanding of the consequences of their technological choices

GCO 5: demonstrate an understanding of current and evolving careers and of the influence of technology on the nature of work

Specific Curriculum Outcomes

Fundamentals of Technology Education 9 (mandatory threading outcomes)

Students will be expected to

5.1 work independently, co-operatively, and collaboratively to solve technological problems

5.2 demonstrate an awareness of ethics and environmental responsibility in technological decision-making and work habits

5.3 demonstrate preparedness for technological problem solving

5.4 demonstrate safe and healthy practices with regard to materials, processes, and equipment

5.5 document the design process

5.6 independently demonstrate appropriate application of skills learned

5.7 demonstrate measuring skills with accuracy and precision

5.8 communicate ideas using 2-D and 3-D technical drawings and sketches

5.9 use appropriate language and terminology as applied to technology education

5.10 investigate connections between technology education, STEM (Science, Technology, Engineering, and Math), and careers

Module 1: Communications Technology

Students will be expected to

1.1 develop a plan to solve authentic communications technology problems

1.2 create solutions to authentic communications technology problems

1.3 evaluate their solutions to authentic communications technology problems

1.4 create and manipulate a variety of communications technology media to solve a design problem

1.5 determine criteria for specific target audiences
1.6 apply elements and principles of design
1.7 present a solution and rationale to a target audience using a given medium

Module 2: Energy Engineering

Students will be expected to

2.1 develop a plan to solve energy engineering problems
2.2 design and construct solutions to energy engineering problems
2.3 evaluate solutions to energy engineering problems
2.4 construct or modify a device that demonstrates the conversion of energy
2.5 create a mechanical device that demonstrates a change in motion
2.6 use mechanical advantage in the solution of a technological problem
2.7 use knowledge of energy sources to make decisions about real-life energy problems

Module 3: Inventions and Innovations

Students will be expected to

3.1 design and construct a system incorporating simple machines that will initiate a series of events
3.2 design an adaptation for an existing product that solves a new need
3.3 explain a complex system in terms of its subsystems
3.4 evaluate the impact of invention and innovation
3.5 develop improvements to an existing product
3.6 hypothesize and investigate how products are manufactured
3.7 employ control systems to regulate processes
3.8 reverse-engineer a product to explain its inner workings

Module 4: Production Technology

Students will be expected to

4.1 demonstrate an understanding of all safety features of production technology machines and equipment used to solve design problems
4.2 demonstrate safe and effective use of a variety of production technology tools and processes
4.3 demonstrate an understanding of safe management of wood dust
4.4 develop a plan to solve authentic production technology problems
4.5 construct solutions to authentic production technology problems
4.6 evaluate solutions to authentic production problems
4.7 safely use production equipment and machines to process materials
4.8 work with real-life clients or situations to solve production-related problems within school or community environments
4.9 use a variety of fasteners to combine materials or assemble a product
4.10 use environmentally friendly finishing techniques to enhance the esthetics or functionality of a product

Introduction

Before beginning any of the modules in this course, teachers will need to address safety, environmental sustainability, and The Design Process as it applies to technology education curriculum and learning spaces. The information below may be helpful in this process.

Safety

The level of safety program in the technology education laboratory will depend on which processes and equipment are being used. Provide instruction about laboratory safety with students before beginning any activity and develop safe practices together. Teachers and students can work together to

- use the document *Heads Up! for Safety* for teaching and learning as well as for laboratory inspections and assessment of student learning
- outline safety expectations related to safe attitudes and appropriate behaviour in the laboratory
- establish safe practices and follow safety rules for use and care of equipment in the laboratory
- provide safety instruction for each piece of equipment students will use
- demonstrate safe and proper use of equipment used in the laboratory
- assess and document student safety demonstrations
- maintain observational records of safety habits of students
- achieve the following four criteria before using power equipment in the laboratory:
  - 100% on a written assessment
  - provide a demonstration of their knowledge of each machine
  - operate the machine one time while being supervised one-on-one before being allowed to use it regularly
  - ask the teacher before turning on any machine
- establish consequences when safety expectations are not met

Teachers must

- not leave the lab when students are present
- ensure students always wear eye protection when anyone is operating machines or tools in the lab
- ensure all students wear hearing protection when a thickness planer or router is in operation

Life-Cycle Analysis

Teachers will need to engage students in discussions about life-cycle analysis before beginning projects that involve unpacking the life cycle of a product. Part of the learning process about the life cycle of a product will involve research and having discussions in class. Teachers and students can work together in the learning process to

- examine the life cycle of a product that is used as part of their technology education module and determine what was involved in creating that product (where it came from, the resources used to get it here, and what will happen to it when its usefulness is over)
- complete research on life-cycle analysis and consider how it applies to the equipment in the classroom or laboratory
- discuss the environmental impacts of technological equipment and processes in terms of power consumption, recycling verses down-cycling, manufacturing, society, and the economy
- use materials that are conducive to the life-cycle approach (water-based inks and finishes, recycled products, products designed to be re-entered into the manufacturing system)
- engage in a discussion about designing for the environment
- discuss the need for life-cycle analysis techniques in the design of products and services and how it affects the world

The Design Process

Technology education is a subject based on "Design Problem Solving." When students engage in learning using this approach, they must do so by following The Design Process (see Appendix C). This process, as established for technology education courses in Nova Scotia, involves several steps that include prototyping and planning, modifying and evaluating. This process should be used at all times for all design challenges in all modules of Technology Education 9. It also helps to inform exactly what will be included in the Design Portfolio created by students for each challenge. Throughout each of the steps below, students will generate a portfolio of materials, sketches, charts, and information that will eventually become the design portfolio that accompanies their device or project.

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 will be the first and easiest step since it has been provided for them.

CONDUCT RESEARCH

Students will use whatever resources are made available to them to become familiar with the topic of the design problem. They should document this research through sketches and other records, and include it in their design portfolio. Teachers should try to narrow the field during the research process (e.g., provide particular instructions for searches on the Internet or provide specific sites, books, artifacts, or parts of devices or objects).

GENERATE IDEAS

Students begin to sketch out plans for possible solutions to the design. If it is a communications design solution, storyboards could be sketched here. If it is a device, 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 appropriate time.

LIFE-CYCLE ANALYSIS

Whenever students design a product, they should consider the materials they use to create that product, where they came from, 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 will generate a Life-Cycle Plan (see Appendix B), use it to inform choices in materials for their designs, and then document how they can be re-entered into the manufacturing system at the end of their usefulness. (The manufacturing system in this case would be the classroom or laboratory and future projects.)

DESIGN AND CONSTRUCT

Students work on a number of design ideas and choose one that they will create or construct and do a full development of plans for that solution. 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, tools, and machines being used. The prototype created (after modification) is the device to be assessed for this stage of the design process.

EVALUATE

This is the point at which students will try out or test the design. There should not be an assessment at this point in the process unless the design is perfect the first time, in which case students would generate a written evaluation of their product or device (this can involve answering a few questions).

MODIFY

In the case of a communications design, students will test and modify several times. In the case of an engineering design such as a hydraulic robotic arm, students may not have as much time for modifications or complete rebuilds. It is important to build in laboratory time for this stage in the development as the real core problem-solving and learning happens during the modification stages.

The Design Process is laid out in such a way that modifications do not begin to take place until after the life-cycle plan has been generated. This allows students time to get a plan developed before making modifications to it. In addition, it is important to allow time for feedback during evaluation so that students can modify and retest before assessment of a product. The modification and feedback stages are crucial to inform learning.

Project Based Learning

LEARNING STANDING UP

More student learning styles are addressed when students stand up and move around as part of their learning. Students will learn more from doing something than they will from talking about it, reading about it, or looking at it. Technology Education 9 compels students to learn standing up. Students need more opportunities to collaborate, be creative, and define their own learning through problem solving and construction of devices and artifacts. When students have a chance to solve a real problem, they will use the tools and processes available to them to do it, but teachers have to be willing to let students get dirty, move around, and make some noise in the process.

Grade 9 students can establish connections with their communities through inquiry-based learning. Technology Education 9 allows integration of learning experiences in other subject areas through inquiry-based learning that culminates in a major project or event. The content of courses such as Child Studies 9 or Physical Education 9 may lend itself to event planning that involves designing and constructing games for a family community event. Technology education teachers should work with their colleagues to find ways to establish connections between curriculum areas to engage students in project-based learning.

Module 1: Communications Technology

Overview

Communications Technology 9 is intended to be an opportunity for students to work independently and collaboratively to design and create solutions to communications design problems related to new media.

General Curriculum Outcomes

Students will be expected to

GCO 1: design, develop, evaluate, and articulate technological solutions.

GCO 2: operate and manage technological systems.

GCO 3: demonstrate an understanding of the history and evolution of technology, and of its social and cultural implications.

GCO 4: demonstrate an understanding of the consequences of their technological choices.

GCO 5: demonstrate an understanding of current and evolving careers and of the influence of technology on the nature of work.

Fundamentals of Technology Education 9 (mandatory threading outcomes)

Students will be expected to

5.1 work independently, co-operatively, and collaboratively to solve technological problems

5.2 demonstrate an awareness of ethics and environmental responsibility in technological decision-making and work habits

5.3 demonstrate preparedness for technological problem solving

5.4 demonstrate safe and healthy practices with regard to materials, processes, and equipment

5.5 document the design process

5.6 independently demonstrate appropriate application of skills learned

5.7 demonstrate measuring skills with accuracy and precision

5.8 communicate ideas using 2-D and 3-D technical drawings and sketches

5.9 use appropriate language and terminology as applied to technology education

5.10 investigate connections between technology education, STEM (Science, Technology, Engineering, and Math), and careers

Specific Curriculum Outcomes

Students will be expected to

1.1 develop a plan to solve authentic communications technology problems
1.2 create solutions to authentic communications technology problems
1.3 evaluate their solutions to authentic communications technology problems
1.4 create and manipulate a variety of communications technology media to solve a design problem
1.5 determine criteria for specific target audiences
1.6 apply elements and principles of design
1.7 present a solution and rationale to a target audience using a given medium

Suggestions for Assessment

The Assessment Process

Before beginning any of the suggested activities, engage students in the assessment process by working together to do the following:

Co-construct criteria—Students will take ownership of the project or assignment if they are involved in deciding how it will be assessed. This can be done by showing students a large variety of sample work so that students can see there are different ways to represent their knowledge while using the same criteria.

Provide regular feedback throughout the process—When students are involved in a project or assignment, they will continue to learn as they self-assess and as the teacher provides feedback to help inform what needs to be learned next.

Suggested Activities

Students are given a communications technology problem and asked to design a solution using The Design Process. Problems can be varied, and students can work independently or in groups.

Promotions

SCREEN PRINTING

Students can design and manufacture promotional merchandise for an authentic client or situation (teachers, other school staff, community members, or not-for-profit organizations). Promotional materials may include the design of slogans, logos, graphics, signage, cards, etc. The designs could be printed on paper, fabric, wood or plastic. A specific example might include the design and creation of an “Anti-bullying Day” T-shirt for staff and students. Posters or radio advertisements could also be created to supplement the promotion of the event.

Other promotion activities may include

- Logo design and production
- Stationary design and production
- Advertising poster design
- Website creation
- Audio or video clips

Entertainment

POP-UP DIGITAL STORYTELLING

Students can use still images and music to design and produce a music pop-up video that contains text boxes of information throughout their video. Images could be drawn and scanned, shot with a digital camera, or obtained from the public domain. The pop-up text could include information that relates to the context of the music, the images, or the message. Teachers are reminded to use copyright-cleared music. For a more advanced project, a narrative track could be added to the video.

Other entertainment project ideas may include

- Photography collages
- Photo editing trading cards
- Claymation/Stop-motion animation
- Radio broadcasts
- Newscasts

Architectural Design

GREEN BUILDING DESIGN

This project can be linked with the Energy Engineering module. Students can design a building (such as a "Tiny House" that uses green energy, green roof design, cistern water collection systems for rain water collection and use, passive solar heating, and wind turbine. (http://tinyhouseblog.com)

Other architectural design ideas include

- Dream School Design (See Appendix D)
- Bedroom Design
- Classroom Design
- Cottage Design

Suggestions for Learning and Teaching

Teachers can

- work with students to identify the difference between target audiences and students' personal design preferences
- prepare a series of exemplars of good design work that appeal to a variety of target audiences (examples from industry could be used)
- prepare tools and materials to provide students with a variety of laboratory experiences related to communications, such as computer hardware, software, peripheral devices, and printing equipment

- demonstrate the communication systems or processes in the laboratory that could be used or are available to solve design problems
- provide students with real-world examples of communications technology products, jobs, companies, techniques, etc.
- establish with students realistic resource expectations for completing communications technology projects (e.g., equipment, costs, time, etc.)
- demonstrate specific production techniques as required for student projects (e.g., camera use, software, peripheral devices, drafting and design implements, screen-printing processes, lighting techniques, etc.)
- demonstrate proper principles and elements of design and provide multiple exemplars
- invite guest speakers from various related careers to visit classes to discuss and demonstrate skills and opportunities in their field
- discuss responsible and proper use of modern technologies (e.g., Internet use, cell phones and other personal communication devices, cameras, video, copyright laws)

Safety in Communications Technology

As part of the commitment to develop a culture of safety in technology education, students studying communications technology will be required to exercise safe practices while using communications tools, equipment, and supplies. The Internet and other electronic communications devices pose a series of safety concerns that will need to be addressed on a project-by-project basis. Ethics, copyright, and personal information safety will need to be discussed to help students to develop a safe personal code of conduct. A high level of safety expectations should be placed on students when completing projects in this module.

Develop a Plan

A very important part of the design process for problem-based learning and project-based learning is to perform appropriate planning exercises. This involves developing a plan drawing or a list of "required steps or tasks" to begin working on a project. After completion, the evaluation process will help to serve as a reflection on the plan, identify challenges and what may have worked well, and reveal desired changes for future design.

Variety of Tools and Processes

Students will need access to a variety of tools and processes to create and solve design problems within this module. This will require having a wide variety of tools available within the school such as various modes of print (including screen printing), scanners, digital cameras, and video and audio equipment.

Teachers can work with students to help identify a broad range of tools and processes necessary to solve Communications Technology problems. Use what is available and consider how you can broaden their access by extending into the school and the community. Use freeware and open source software where possible and consider more than just the computer as a communication tool. Students will learn best standing up.

Career Exploration

Teachers can provide instruction to students about career exploration so that they have some strategies for continuing their search throughout the various course modules. This could include bringing in guests, having students interview professionals and show interviews to the class, and could include providing specific websites, such as http://careerplanning.about.com and www.youth.gc.ca/eng/topics/career_planning/index.shtml.

Skills Canada Nova Scotia is a terrific source of information for students to connect their classroom and laboratory learning to the real world. Teachers are encouraged to find relevant competitions in Nova Scotia for students who wish to extend their learning outside the classroom. (http://skillsns.ednet.ns.ca/)

Notes and Resources

Notes

- The Design Process in Nova Scotia involves "life-cycle analysis." This process considers all aspects of society, the environment, and the economy as it relates to a product and its parts from before the beginning of its life until after it is no longer useful. Life-cycle analysis should be considered as part of the design process so as to create better designs for the environment as a whole. (See Appendix B: Life Cycle Plan)
- The principles of design are Contrast, Rhythm, Alignment, and Proximity.
- The elements of design are Line, Colour, Shape, Texture, Space, and Form.
- Teachers should encourage writing opportunities for students, being clear on the expectations for content.
- Allow students to keep a work folder in the classroom in a designated file drawer to keep ongoing project work and team design portfolios organized and intact.
- Demonstrating preparedness for technological problem solving: There is a considerable amount of instruction involved in teaching students how to achieve this outcome as compared to the "Learner Profile." Students must demonstrate preparedness by wearing personal protective equipment and related clothing (e.g., closed-toe shoes) where appropriate, choose the right tool for the job, prepare themselves for safe operation of equipment by way of tying back hair and loose clothing, and care for equipment in such a way that it can be used to solve problems for now and for next time. It is important that students research a design idea first and then select a technological tool or tools to solve the problem.

Print Resources

- For more information on assessment for learning, see *Making Classroom Assessment Work*, Third Edition, by Anne Davies. (NSSBB #: 18637)
- *Simple Screenprinting: Basic Techniques and Creative Projects* (NSSBB #: 25753)

Software Resources

- Google SketchUp is freeware for technical and mechanical drawing. (http://sketchup.google.com)
- Inkscape is an open-source free draw program ideal for vector graphics that is comparable to CorelDraw or Adobe Illustrator. (http://inkscape.org)
- Microsoft Photostory software is free digital storytelling and presentation software.
- Photoshop Elements is an inexpensive and powerful version of Photoshop. (NSSBB #: 51408, 5000020)
- Gimp is a free open source download that is comparable to Photoshop.
- Audacity is a multi-track sound-recording freeware.
- Garage Band is an Apple platform recording software.
- Windows Moviemaker is video-editing software included with all Windows computers.
- Rasterbater is freeware that converts images to poster size through multi-page printouts.
- Wordle is an online tool for creating word clouds from text that you provide. (http://www.wordle.net/)

Internet Resources

- Media College.com: A free educational and resource website for all forms of electronic media. http://mediacollege.com
- Freeplay Music: An example of a copyright-free music site. http://freeplaymusic.com
- Flickr: A large selection of royalty-free pictures [governed through Creative Common]. http://flickr.com
- Images Project: A site where teachers and students can post and download images for educational use. http://imagesproject.ednet.ns.ca/
- Printeresting: "The thinking person's favorite online resource for interesting printmaking miscellany." http://www.printeresting.org/
- Vimeo: A fully-functional video website alternative to YouTube, with a great "video school" section for teachers and students. http://vimeo.com/
- Digital Photography School: "a site dedicated to helping photographers of all levels get the most out of their cameras" http://digital-photography-school.com/
- Openclipart: A great collection of .svg graphics that "aims to create an archive of clip art that can be used for free for any use." http://openclipart.org/
- 1001 Free Fonts: Lots of great free font downloads for PCs and Macs, with custom preview bar. http://1001freefonts.com/
- 4Teachers.org, Teach with Technology (information technology). A host of teaching and learning resources. http://www.4Teachers.org
- 21Classes Cooperative Learning. Free blogging site for students. http://21classes.com
- Atomic Learning is a professional tutorial site for learning specific software, old and new. Check with your school board for licencing; most have access to it. http://atomiclearning.com

Module 2: Energy Engineering

Overview

Energy Engineering 9 offers students an opportunity to design and construct mechanical devices that use sources of energy and motion.

General Curriculum Outcomes

Students will be expected to

GCO 1: design, develop, evaluate, and articulate technological solutions

GCO 2: operate and manage technological systems

GCO 3: demonstrate an understanding of the history and evolution of technology, and of its social and cultural implications

GCO 4: demonstrate an understanding of the consequences of their technological choices

GCO 5: demonstrate an understanding of current and evolving careers and of the influence of technology on the nature of work

Fundamentals of Technology Education 9 (mandatory threading outcomes)

Students will be expected to

5.1 work independently, co-operatively, and collaboratively to solve technological problems

5.2 demonstrate an awareness of ethics and environmental responsibility in technological decision-making and work habits

5.3 demonstrate preparedness for technological problem solving

5.4 demonstrate safe and healthy practices with regard to materials, processes, and equipment

5.5 document the design process

5.6 independently demonstrate appropriate application of skills learned

5.7 demonstrate measuring skills with accuracy and precision

5.8 communicate ideas using 2-D and 3-D technical drawings and sketches

5.9 use appropriate language and terminology as applied to technology education

5.10 investigate connections between technology education, STEM (Science, Technology, Engineering, and Math), and careers

Specific Curriculum Outcomes

Students will be expected to

2.1 develop a plan to solve energy engineering problems

2.2 design and construct solutions to energy engineering problems

2.3 evaluate solutions to energy engineering problems

2.4 construct or modify a device that demonstrates the conversion of energy

2.5 create a mechanical device that demonstrates a change in motion

2.6 use mechanical advantage in the solution of a technological problem

2.7 use knowledge of energy sources to make decisions about real-life energy problems

Suggestions for Assessment

The Assessment Process

Before beginning any of the suggested activities, engage students in the assessment process by working together to do the following:

Co-construct criteria—Students will take ownership of the project or assignment if they are involved in deciding how it will be assessed. This can be done by showing students a large variety of sample work so that students can see there are different ways to represent their knowledge while using the same criteria.

Provide regular feedback throughout the process—When students are involved in a project or assignment, they will continue to learn as they self-assess and as the teacher provides feedback to help inform what needs to be learned next.

Suggested Activities

SUSTAINABLE ENERGY

Wind-Power Activity

Students can design, construct, and test a wind turbine. The blades of the turbine can be constructed out of thin gauge sheet metal and mounted to a central hub controlling a generator (DC motor with polarity reversed) to allow conversion of energy.

Air-to-Air Solar Collector

Students can design and construct a solar bird bath. The purpose is to allow a dish of water to remain liquid throughout the winter months. This requires the use of a passive solar air-to-air system. The students construct a solar panel that demonstrates the convection process for the purpose of keeping water from freezing in winter. (http://www.passivesolarbirdbath.com/)

Other Sustainable Energy Ideas

- solar-powered cat house shelter
- solar test house
- solar hot air balloon

TRANSPORTATION

Powered Magnetic Levitation

Students can use a Magnetic Levitation track system to design, construct, and test a Magnetic Levitation vehicle powered by a DC motor.

Move It Challenge

Note: This activity integrates with the Inventions and Innovations Module.

Students can design and construct a machine or device that will cause an object to initiate a series of events to accomplish a goal using simple machines and mechanical advantage. The device may include changes in motion, simple machines, mechanical advantage, and signaling devices. Materials may be limited or unlimited. For example, a router could be used to flute wood for a marble run. The sky is the limit and imagination is encouraged. Outcomes for the Inventions and Innovations and Production Technology modules can also be addressed through a move-it challenge.

Suggestions for Learning and Teaching

Teachers can

- create a scenario where students will have to solve an energy engineering problem (real or fictional)
- provide videos or other resources about how products are designed and constructed
- provide multiple exemplars of finished products that solve design problems related to Energy Engineering
- set up field trips to energy production facilities
- provide instruction about energy distribution and transfer
- provide instruction about energy conversion and mechanical advantage
- discuss energy security and how students can become more energy conscious
- teach students how to participate in energy engineering challenges
- provide opportunities to research forms of alternative energy and how it applies to the local area
- engage students in investigations about where power comes from and how it is generated in their local area

Safety

As part of the commitment to develop a culture of safety in technology education, students studying energy engineering will be required to exercise safe practices while using tools, equipment, and supplies. Technological tools and processes pose a series of safety concerns that will need to be addressed on a project-by-project basis. Review the safety information in the introduction of this document before beginning any activities with students. A high level of safety expectations should be placed on students when completing projects in this module.

Develop a Plan

A very important part of the design process for problem-based learning and project-based learning is to perform appropriate planning exercises. This involves developing a plan drawing or a list of "required steps or tasks" to begin working on a project. After completion, the evaluation process will help to serve as a reflection on the plan, identify challenges and what may have worked well, and reveal desired changes for future design.

Variety of Tools and Processes

Students will need access to a variety of tools and processes to create and solve design problems within this module. This will require having a wide variety of tools available within the school such as various modes of print, scanners, digital cameras, and video and audio equipment.

Teachers should work with students to help identify a broad range of tools and processes necessary to solve the design problem. Use what is available and consider how you can broaden their access by extending into the school and the community.

Career Exploration

Teachers can provide instruction to students about career exploration so that they have some strategies for continuing their search throughout the various course modules. This could include bringing in guests, having students interview professionals and show interviews to the class, and could include providing specific websites, such as http://careerplanning.about.com and www.youth.gc.ca/eng/topics/career_planning/index.shtml.

Notes and Resources

Print Resources

- *The Inventa Book of Mechanisms* (NSSBB #: 25361)

Notes

- Mechanical advantage can be determined using a formula of resistance divided by effort: $ma = \frac{r}{e}$.
- Simple machines are used to provide mechanical advantage.
- Energy security is defined as the physical availability of energy at an affordable price while taking the environment into consideration
- An example of energy conversion is wind energy to power by way of a generator, or solar energy to heat by way of air convection.

Internet Resources

- Make Magazine: Features a blog, projects, videos, and forums for all types of makers and innovators. http://makezine.com/
- Maya Pedal: An NGO dedicated to making bicycle "machines" for Guatemalans from repurposed Canadian and American bicycles. A great look at authentic humanitarian problem solving. http://www.mayapedal.org/index.html
- Mother Earth News Renewable Energy: Great articles and resources relating to renewable energy topics. http://www.motherearthnews.com/Renewable-Energy.aspx

- Google SketchUp is freeware for technical and mechanical drawing. sketchup.google.com
- Phun is 2D interactive software for application of online inventor and energy simulation for all ages that has been replaced by Algodoo. http://www.algodoo.com/wiki/Home
- 4Teachers.org, Teach with Technology (information technology). A host of teaching and learning resources. www.4Teachers.org
- 21Classes Cooperative Learning. Free blogging site for students. http://21classes.com
- Atomic Learning is a professional tutorial site for learning specific software, old and new. Check with your school board for licencing; most have access to it. http://atomiclearning.com

Module 3: Inventions and Innovations

Overview

Inventions and Innovations is a concept that was developed to provide students with opportunities to compare and contrast actual technological inventions and subsequent innovations. Students are encouraged to use their inventive problem-solving skills to work through design problems related to control, electronics, robotics, or other inventive or innovative devices.

General Curriculum Outcomes

Students will be expected to

GCO 1: design, develop, evaluate, and articulate technological solutions

GCO 2: operate and manage technological systems

GCO 3: demonstrate an understanding of the history and evolution of technology, and of its social and cultural implications

GCO 4: demonstrate an understanding of the consequences of their technological choices

GCO 5: demonstrate an understanding of current and evolving careers and of the influence of technology on the nature of work

Fundamentals of Technology Education 9 (mandatory threading outcomes)

Students will be expected to

5.1 work independently, co-operatively, and collaboratively to solve technological problems

5.2 demonstrate an awareness of ethics and environmental responsibility in technological decision-making and work habits

5.3 demonstrate preparedness for technological problem solving

5.4 demonstrate safe and healthy practices with regard to materials, processes, and equipment

5.5 document the design process

5.6 independently demonstrate appropriate application of skills learned

5.7 demonstrate measuring skills with accuracy and precision

5.8 communicate ideas using 2-D and 3-D technical drawings and sketches

5.9 use appropriate language and terminology as applied to technology education

5.10 investigate connections between technology education, STEM (Science, Technology, Engineering, and Math), and careers

Specific Curriculum Outcomes

Students will be expected to

3.1 design and construct a system incorporating simple machines that will initiate a series of events

3.2 design an adaptation for an existing product that solves a new need

3.3 explain a complex system in terms of its subsystems

3.4 evaluate the impact of invention and innovation

3.5 develop improvements to an existing product

3.6 hypothesize and investigate how products are manufactured

3.7 employ control systems to regulate processes

3.8 reverse-engineer a product to explain its inner workings

Suggestions for Assessment

The Assessment Process

Before beginning any of the suggested activities, engage students in the assessment process by working together to do the following:

Co-construct criteria—Students will take ownership of the project or assignment if they are involved in deciding how it will be assessed. This can be done by showing students a large variety of sample work so that students can see there are different ways to represent their knowledge while using the same criteria.

Provide regular feedback throughout the process—When students are involved in a project or assignment, they will continue to learn as they self-assess and as the teacher provides feedback to help inform what needs to be learned next.

Suggested Activities

CONTROL TECHNOLOGY

Students can design and construct a hydraulic robotic design solution that involves syringes and tubing as the hydraulic systems as the source of power. The challenge could involve designing a lift system or a robotic or mechanical arm system.

SURVIVOR GAME DESIGN

Students can design and build a series of games or challenges that incorporate a variety of simple machines, tools and materials. These challenges could include puzzle relays, obstacle courses, or the design and creation of survival shelters. Students could be given the situation such as a "lunar landing gone wrong" and design a way for survivors to cross to a specified rescue point. Scaled down versions of the challenges could be built and used within a class challenge. Tools and processes used can determine the depth and level of the challenge.

BIO-RELATED TECHNOLOGY CHALLENGE

The study of bio-related technology fits into the Inventions and Innovations unit in many different ways. Students can investigate and construct simulations of the use of fluid filtration and pumps related to dialysis machines or examine electronics related to pacemakers and defibrillators. Food management, ecological footprints, genetically modified foods, and societal and environmental implications could also be studied. Teachers must ensure that when completing these types of projects, students are immersed in the design and construction of models along with related discussions.

TOOLBOX CHALLENGE

Students can work in teams using only a limited list of supplies and tools to design a solution to a problem such as moving an object from one point to another, launching an object into a target, creating a mechanical device that will travel a certain distance using only a specified energy source.

Suggestions for Learning and Teaching

Teachers can

- create a scenario where students will have to design a solution to an invention-type problem (e.g., Design an pen shaker for pens that have gone dry; design a mechanism that will extend the mascara applicator all the way to the bottom of the tube)
- provide the students with videos on how products are designed and constructed
- provide examples of devices that can be used to change motion

Students can

- research examples of local inventions and inventors (e.g., technological development in forestry or PerfectPass)
- develop cams, cogs, pulleys, and levers as systems
- take broken or functional items apart to see how they were constructed and reverse-engineer the product
- research weathervanes and whirligigs
- investigate poorly designed products and make suggestions for improvement
- investigate how feedback can be given in devices and how that feedback can be used to control the device
- create a prototype of an invention or innovation
- build a better ... mousetrap, etc.
- show and tell a technological item (how it works; how it’s made)
- research and review the patent process

Notes and Resources

Notes

- A technological system includes input, process, and output as a means of getting a desired result. An automobile is a system that has a large number of subsystems, such as the braking system, steering system, and transmission system.
- Bio-related technology differs from biotechnology in that bio-related technology involves the design of mechanisms related to living things, whereas biotechnology involves manipulation of actual living things.
- The difference between invention and innovation: inventions are designs that have not been previously discovered or used. Innovations are variations of inventions. The tripod is a good example of an invention and innovation. The tripod was invented once, but has been innovated multiple times, and continues to experience changes in its design through innovation.
- Reverse engineering means to take things apart and see how they work.
- Rube Goldberg was an engineer who designed contraptions that were overly complicated to complete a simple task.

Print Resources

- *Inventa Book of Mechanisms* (NSSBB #: 25361)

Internet Resources

- Rube Goldberg official website. http://www.rubegoldberg.com/?page=bio
- Make Magazine: Features a blog, projects, videos, and forums for all types of makers and innovators. http://makezine.com/
- Maya Pedal: An NGO dedicated to making bicycle "machines" for Guatemalans from repurposed Canadian and American bicycles. A great look at authentic humanitarian problem solving. http://www.mayapedal.org/index.html
- How Stuff Works: Searchable resources that deconstruct machines, technology, and techniques. http://www.howstuffworks.com/
- Design Squad: Public Broadcasting Station web source for inventors and designers. Teachers can find a number of design challenges on this site. http://pbskids.org/designsquad/
- Fun Theory, The World's Deepest Bin: http://youtube.com/watch?v=cbEKAwCoCKw
- Fun Theory, Piano Stairs: http://youtube.com/watch?v=2lXh2n0aPyw
- Fun Theory, Bottle Bank Arcade: http://youtube.com/watch?v=zSiHjMU-MUo

Module 4: Production Technology

Overview

Production Technology is intended to offer grade 9 students an opportunity to design and construct something using wood, metal, or plastics. This will require access to a variety of processing machines related to the materials chosen.

General Curriculum Outcomes

Students will be expected to

GCO 1: design, develop, evaluate, and articulate technological solutions

GCO 2: operate and manage technological systems

GCO 3: demonstrate an understanding of the history and evolution of technology, and of its social and cultural implications

GCO 4: demonstrate an understanding of the consequences of their technological choices

GCO 5: demonstrate an understanding of current and evolving careers and of the influence of technology on the nature of work

Fundamentals of Technology Education 9 (mandatory threading outcomes)

Students will be expected to

5.1 work independently, co-operatively, and collaboratively to solve technological problems

5.2 demonstrate an awareness of ethics and environmental responsibility in technological decision- making and work habits

5.3 demonstrate preparedness for technological problem solving

5.4 demonstrate safe and healthy practices with regard to materials, processes, and equipment

5.5 document the design process

5.6 independently demonstrate appropriate application of skills learned

5.7 demonstrate measuring skills with accuracy and precision

5.8 communicate ideas using 2-D and 3-D technical drawings and sketches

5.9 use appropriate language and terminology as applied to technology education

5.10 investigate connections between technology education, STEM (Science, Technology, Engineering, and Math), and careers

Specific Curriculum Outcomes

Students will be expected to

4.1 demonstrate an understanding of all safety features of production technology machines and equipment used to solve design problems

4.2 demonstrate safe and effective use of a variety of production technology tools and processes

4.3 demonstrate an understanding of safe management of wood dust

4.4 develop a plan to solve authentic production technology problems

4.5 construct solutions to authentic production technology problems

4.6 evaluate solutions to authentic production problems

4.7 safely use production equipment and machines to process materials

4.8 work with real-life clients or situations to solve production related problems within school or community environments

4.9 use a variety of fasteners to combine materials or assemble a product

4.10 use environmentally friendly finishing techniques to enhance the esthetics or functionality of a product

Suggestions for Assessment

The Assessment Process

Before beginning any of the suggested activities, engage students in the assessment process by working together to do the following:

Co-construct criteria—Students will take ownership of the project or assignment if they are involved in deciding how it will be assessed. This can be done by showing students a large variety of sample work so that students can see there are different ways to represent their knowledge while using the same criteria.

Provide regular feedback throughout the process—When students are involved in a project or assignment, they will continue to learn as they self-assess and as the teacher provides feedback to help inform what needs to be learned next.

Suggested Activities

STORAGE AND DISPLAY

Students will design and construct a solution to an authentic storage or display problem. They could be designing a solution where individual projects are created or they could be given a design challenge in which the winning one would be constructed. For example, the library might need a way to display groups of books for monthly themes. Working in groups, the students could each construct a solution and the best design could receive individual recognition in the form of prizes or by having additional ones made. Other activities might include the creation of routed signage, tea-light candle holders from scrap wood, a phone docking station, hangers and racks, or display cases. Wherever possible, teachers should identify real clients or situations where solutions will be put to use.

FURNITURE DESIGN

A furniture design unit might have students designing and building indoor or outdoor furniture. Although the requirements for a particular project will be specific to resources and the design brief, consideration will likely be given to ergonomics, safety, anthropometrics, location, aesthetics, function, materials, and life cycle. In some situations, students may be presented with a design to be customized or personalized or they may be involved in meeting all the design requirements. As an example, students could be involved in designing and making rustic furniture. They might design a stool, selecting, harvesting, and drying the wood. Next, they could process the materials and finish the piece. Topics involved might include mortise and tenon and wedge joinery, levelling, bark removal, and appropriate finishing techniques. Other furniture design activities might include children's furniture, outdoor or patio furniture, driftwood pieces, benches, furniture from repurposed materials, or miniatures.

BATCH PRODUCTION

This activity involves students working in teams to build multiples in a production run. As an example, students could manufacture a set of puzzles or toys to be given to a local elementary school. After mapping out the specifics of the production process, students are given tasks and set up jigs and fixtures to help achieve a high level of consistency and quality. Students can rotate jobs, working as quality control persons and managers, and can switch jobs as the manufacturing moves along. Students could also tour a local manufacturing facility. Other project ideas might include toys and block sets, ornaments, gifts, fund-raising activities, small furniture items, wooden or wire puzzles, or other basic manufacturing processes. The quantity and type of projects produced as well as job delegation should be chosen with the group dynamics in mind.

SHORT SNAPPERS

As part of the ongoing safety and skill-building portion of the module, teachers can set up activities for students to gain practical experience using a series of production-related hand tools such as screwdrivers, hand saws, or chisels. As part of the Short Snapper activities, students can be exposed to careers in various industry-related trades. Students will have the opportunity to learn and practise skills related to these trades or technological fields. They will investigate career opportunities within Atlantic Canada. Where possible, trades people or engineers should be encouraged to visit classes to discuss and demonstrate skills and opportunities in their trade or profession.

Suggestions for Learning and Teaching

Safety

Safety is an integral part of the technology education environment. Students will demonstrate that they are aware of and can employ safe methods before they are provided with opportunities to use tools and equipment. Students will also be able to identify the reasons behind the safety rules and guidelines and be able to assess the laboratory for safety issues.

Teachers should begin the production module with instruction on the following:

- Establish safety rules and guidelines for a production environment
- Provide the four steps of instruction: provide demonstration to the full-class, provide demonstration to individuals, student provides teacher demonstration of safe use of a machine, and student asks permission each time of use).
- Demonstrate basic hand, power tool, and machine use to safely transform production materials into useful products.
- Maintain records of student safety test scores as well as anecdotal records of student safety behaviour in the laboratory.

Students can demonstrate their safety knowledge by doing the following:

- complete safety quizzes on specific machines being used until 100 per cent score is achieved
- conduct safety assessments of the production laboratory
- complete first-aid training (if possible)
- demonstrate safe working habits at all times
- design safety-related signage for the production laboratory

The Design Process

The Design Process is integrated throughout Technology Education. Teachers should refer to the process as it applies to current student projects. Teachers will need to provide instruction on the following topics to help students understand the application of The Design Process as it applies to production-related problems.

Create a scenario where students will have to solve a production-related problem (real or fictional)

- Provide students with real-world examples of production products, jobs, companies, techniques, etc. Teachers may use a real example of how a company solved a specific design or production problem or need.
- Discuss how solving production-related problems applies to The Design Process.
- Establish with students realistic expectations for production projects (e.g., size, materials, time).
- Students should document their progress in production-related problems by creating portfolios that demonstrate the application of the design process in their work.
- As students work through their solution to production-related problems, they can
  - seek out clients for opportunities for real-world production problems
  - create a portfolio to document progress as applied to The Design Process.
  - form groups and create companies to work collaboratively towards solving production-related problems
  - create their company identity (name; logo; promotional items such as signs, business cards, shirts, buttons, websites, and advertisements through the Communications Technology module)
  - work with clients, if possible, to help choose the best solution to their production-related problem
  - develop solutions to production-related problems using proper technical drawing techniques (e.g., orthographic and/or isometric projection)

Industrial Processes and Materials

Specific skills, techniques, and materials that students employ will be dependent on chosen projects. Teachers need to provide students with relevant and in-depth information and skills training as they apply to the given situation. Teachers should also provide students with a broad-based general knowledge of basic machine and tool use, safe practices, techniques, and information on the industrial materials. Teachers can do the following:

- Discuss and provide examples of different industrial materials and their applications
- Demonstrate specific production techniques as required for student projects (e.g., joining techniques, computer numeric control (CNC), routering, finishing, creation of jigs and templates)

Students will use the skills and techniques learned to build production-related products. Students can demonstrate their knowledge by completing the following:

- Produce a step-by-step plan for the production of their solution
- Create a prototype or mock-up of their solution
- Demonstrate basic hand, power tool, and machine use to safely transform production materials into their solution
- Use environmentally appropriate finishes to produce an aesthetically pleasing product
- Evaluate their solutions based on predetermined criteria
- If possible, deliver product to client and have client evaluate the product and company

Notes and Resources

Notes

- Students in grade 9 are expected to demonstrate an understanding of how wood materials are processed. This requires planing rough lumber to finished lumber. It is expected that this can be accomplished by using power equipment.
- **Dust management:** As part of learning in Production Technology, students are expected to demonstrate safe management of wood dust. This will require instruction on the dust collection system and how and when students should wear dust masks or respirators.

Internet

- Fine Woodworking: Features project plans, videos, techniques, tool guides, shop talk, and more for woodworkers http://www.finewoodworking.com/
- Popular Woodworking Magazine: "Woodworking advice, woodworking plans, woodworking projects and woodworking blogs" www.popularwoodworking.com/

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 Technology Education 9 are, by nature, technology dependent. Students 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: Specific, 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 Technology Education 9, 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 and 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 Technology Education 9 Learning Environment

The Classroom

Learning in Technology Education 9 should take place in a variety of learning environments, such as a wood production laboratory, as well as a classroom that has space for a variety activities to take place, such as computing using new media, cameras, video cameras, screen printing, and other printing or sign making devices, various types of studio sets, and space for planning. Students should have access to a variety of tools and equipment that will allow them to design and construct devices. Work benches, tables and counter spaces are necessary for students to carry out group work and to work collaboratively to solve technological problems using tools and equipment related to the module of study.

The Learning Culture

It is important to establish a culture in the Technology Education 9 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 throughout the feedback process 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 Technology Education 9 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 technological tool or tools 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.

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

Assessing and Evaluating Student Learning

Evaluation is the process of analyzing, 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
- audio clips
- certifications
- checklists
- conferences
- demonstrations
- design portfolios
- dramatizations
- exhibitions
- interviews (structured or informal)
- inventories
- investigations
- learning logs or journals
- media products
- observations (structured or informal)
- peer assessments
- performance tasks
- photographs
- presentations
- projects
- questioning
- questionnaires
- quizzes, tests, examinations
- rating scales
- reports
- reviews of performance
- self-assessments
- sorting scales (rubrics)
- surveys
- video
- work samples
- written assignments

Design Portfolios

Technology Education 9 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. The design portfolio is generated for each design challenge and can be a collaborative effort by the team.

A professional portfolio is an individual collection that includes a selection of design work created as part of the design process throughout the course. These are most effective when they provide opportunities for students to reflect on and make decisions about their own learning. The students and teacher should collaborate to make decisions about the contents of the professional 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 use the portfolio to collaborate with the student in identifying strengths and needs, select learning experiences, and select 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: Technology Education Outcomes, Grades 7–9

Fundamentals of Technology Education 7–9 Threading Outcomes

GCO 1: Students will be expected to design, develop, evaluate, and articulate technological solutions.		
GCO 3: Students will be expected to demonstrate an understanding of the history and evolution of technology, and of its social and cultural implications.		
Grade 7	Grade 8	Grade 9
Students will be expected to …		
5.1 work independently, co-operatively, and collaboratively to solve technological problems		
5.2 demonstrate an awareness of ethics and environmental responsibility in technological decision-making and work habits		
5.3 demonstrate preparedness for technological problem solving		
5.4 demonstrate safe and healthy practices with regard to materials, processes, and equipment		
5.5 document the design process		
5.6 independently demonstrate appropriate application of skills learned		
5.7 demonstrate measuring skills with accuracy and precision		
5.8 communicate ideas using 2-D and 3-D technical drawings and sketches		
5.9 use appropriate language and terminology as applied to technology education		
5.10 investigate connections amoung technology education, STEM (Science, Technology, Engineering, and Math), and careers		

Communications Technology

GCO 4: Students will be expected to demonstrate an understanding of the consequences of their technological choices.		
Grade 7	Grade 8	Grade 9
Students will be expected to …		
1.1 follow a plan to solve communications technology problems	1.1 modify a plan to solve communications technology problems	1.1 develop a plan to solve authentic communications technology problems
1.2 create solutions to communications technology problems using given media	1.2 create solutions to communications technology problems using a variety of media	1.2 create solutions to authentic communications technology problems
1.3 evaluate their design solutions, redesigning as necessary		1.3 evaluate their solutions to authentic communications technology problems
1.4 modify a variety of given communications technology media to solve a design problem	1.4 demonstrate effective use of a variety of communications technology media	1.4 create and manipulate a variety of communications technology media to solve a design problem
1.5 identify target audiences	1.5 characterize target audiences and determine effective medium	1.5 determine criteria for specific target audiences
1.6 identify elements and principles of design	1.6 apply elements and principles of design	
1.7 present a solution and rationale to a target audience using a given medium		

Energy Engineering

GCO 2: Students will be expected to operate and manage technological systems.		
Grade 7	Grade 8	Grade 9
Students will be expected to …		
2.1 read and interpret a plan to solve energy engineering problems	2.1 modify a plan to solve energy engineering problems	2.1 develop a plan to solve energy engineering problems
2.2 construct an energy engineering solution by using a given plan	2.2 construct an energy engineering solution by using or creating a modified plan	2.2 design and construct solutions to energy engineering problems
2.3 identify solutions to energy engineering problems	2.3 examine solutions to energy engineering problems	2.3 evaluate solutions to energy engineering problems
2.4 demonstrate mechanical advantage using a simple machine	2.4 demonstrate practical applications of mechanical advantage	2.4 construct or modify a device that demonstrates the conversion of energy
2.5 identify devices that change motion in real-world technological solutions	2.5 operate and analyze devices that change motion	2.5 create a mechanical device that demonstrates a change in motion
2.6 identify mechanical advantage in real-world technological solutions	2.6 create and operate devices that use mechanical advantage	2.6 use mechanical advantage in the solution of a technological problem
2.7 investigate the forces affecting structures or control systems		2.7 use knowledge of energy sources to make decisions about real-life energy problems

Innovations and Inventions

GCO 2: Students will be expected to operate and manage technological systems.		
Grade 7	**Grade 8**	**Grade 9**
Students will be expected to …		
3.1 interpret a plan to develop a system	3.1 modify a plan to develop a system	3.1 design and construct a system incorporating simple machines that will initiate a series of events
3.2 create a model or prototype of an existing invention		3.2 design an adaptation for an existing product that solves a new need
3.3 differentiate the components of simple technological systems	3.3 explain a complex system in terms of its subsystems	
3.4 examine and communicate the importance and impact of invention and innovation		3.4 evaluate the impact of invention and innovation
3.5 develop improvements to an existing product		
3.6 investigate the manufacturing process of a product	3.6 document the life cycle of a manufactured product	3.6 hypothesize and investigate how products are manufactured
3.7 engineer a prototype to solve a design challenge	3.7 employ control systems to regulate processes	
	3.8 diagnose and repair malfunctioning systems	3.8 reverse-engineer a product to explain its inner workings

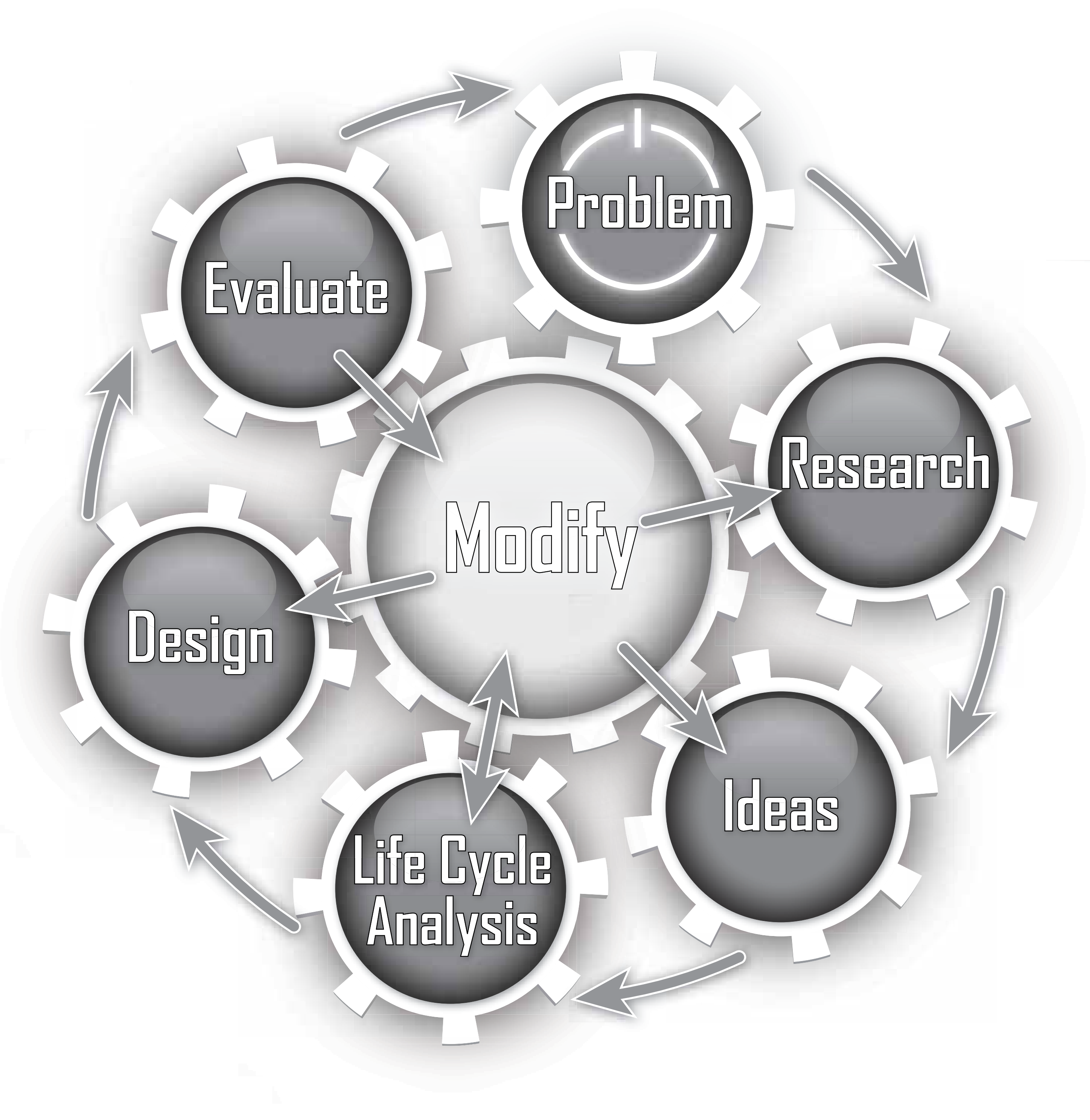
Production Technology

GCO 5: Students will be expected to demonstrate an understanding of current and evolving careers and of the influence of technology on the nature of work.		
Grade 7	**Grade 8**	**Grade 9**
Students will be expected to …		
4.1 demonstrate an understanding of all safety features of production technology machines and equipment used to solve design problems		
4.2 demonstrate safe and effective use of a variety of production technology tools and processes		
4.3 demonstrate an understanding of safe management of wood dust		
4.4 interpret a plan to solve production technology problems	4.4 modify a plan to solve production technology problems	4.4 develop a plan to solve authentic production technology problems
4.5 construct solutions to production technology problems		4.5 construct solutions to authentic production technology problems
4.6 evaluate solutions to production problems		4.6 evaluate solutions to authentic production problems
4.7 safely use basic hand tools, power tools, and equipment to create a product that solves a design problem	4.7 safely use a variety of hand tools, power tools, and equipment to prepare stock	4.7 safely use production equipment and machines to process materials
	4.8 construct an aesthetically pleasing finished product that solves a design problem	4.8 work with real-life clients or situations to solve production-related problems within school or community environments
4.9 use fasteners to combine materials	4.9 use a variety of fasteners to combine materials or assemble a product	
4.10 use environmentally friendly finishing techniques to enhance the esthetics or functionality of a product		

Appendix B: Life-Cycle Plan

Group Members:			
Design Project:		Date:	
Materials chosen (or used) for this device (or design)	Intended use of materials	Where did this material come from?	Future use of this material

Appendix C: Design Process



Appendix D: Dream School—Design Brief

Dream School! Out of the Can—Design Brief

Situation

You are finally being included in the process of designing your perfect school. One of the biggest issues that architects face is finding a balance between formal classroom space (with four walls, windows, and a door) and informal space (tables and chairs, comfortable seating arrangements, work spaces, etc.). In a perfect world, students would work on projects that integrate all of their subjects together so that the learning spaces can be open much of the time.

Problem

Using the design process, work with a team to design a floor plan of a wing in a new school that includes three classrooms that can be joined together for all students to work at the same time, but also broken apart for individual classroom learning. Be sure to include some square footage for shared spaces, or common areas where students can gather to learn in different ways. Your wing must also include an "Innovations Lab" that can be a shared space with a "Science Lab." This space must include some computers, work benches, sinks, and other interesting elements that will inspire learning in technology education and science.

Requirements

Use the problem-solving model to solve this problem, and record all work within your team design portfolio that will be submitted at the end of the challenge.

1. *Identify the Problem*—Begin by discussing the problem with your group members.
2. *Research*—Conduct research by using the research stations provided to answer the following questions:
   a) What is project-based learning?
   b) What are some important components of modern school design?
   c) How important is furniture in designing a learning space? Why?
3. *Ideas*—Generate ideas by sketching at least three different designs or parts of your design ideas on graph paper. (This can be just rough ideas.)
4. Develop a *Life-Cycle Plan.* (It may not really apply to this challenge. Explain why.)
5. *Design and Construct*—Once you have decided on a plan for your school wing, draw it up in Google Sketchup.
6. *Evaluate* the design by answering the following questions with your group:
   a) What did your group think of the design?
   b) Show your design to at least two different teachers. Explain their comments.
   c) What would you do differently next time if you had more time to modify?

Dream School! Out of the Can—Work Plan

Problem

Research

Conduct research by using the research stations provided to answer the following questions:

a) What is project-based learning?

b) What are some important components of modern school design?

c) How important is furniture in designing a learning space? Why?

Evaluation

a) What did your group think of the design?

b) Show your design to at least two different teachers. Explain their comments.

c) What would you do differently next time if you had more time to modify?

Appendix E: Two Universes Collide—Design Brief

Two Universes Collide! Out of the Can—Design Brief

Situation

What really happens when two worlds collide? Perhaps it depends upon the physical makeup of those worlds and the forces at work to cause them to collide. Suppose two worlds are like golf balls.

Problem

Using only the materials provided in the can, design and construct a device that will use kinetic energy to force two golf balls apart by a total of 45 cm or 18″. The golf balls must be touching while sitting at rest and return to their original resting position after they have been forced apart.

Requirements

Use the problem-solving model to solve this problem and record all work within your team design portfolio that will be submitted at the end of the challenge.

1. *Identify the Problem*—Begin by discussing the problem with your group members.
2. *Research*—Conduct research by using the research stations provided to answer the following questions:
   a) What are Newton's laws of motion?
   b) What is mechanical advantage?
   c) What is kinetic energy? What is gravity? How are they related in this challenge?
   d) What are golf balls made of? How does this material affect these colliding universes?
3. *Ideas*—Generate ideas by sketching at least three different designs or parts of your design ideas.
4. Develop a *Life-Cycle Plan* outlining each part of the device
5. *Design and Construct*—Once you have decided on a model for your device, construct it and draw a technical drawing of it using CAD.
6. *Evaluate* the design by answering the following questions with your group:
   a) What happened to the colliding universes?
   b) Did your design solve the problem? Explain how or why not.
   c) What would you do differently next time if you had more time to modify?

Two Universes Collide! Out of the Can—Work Plan

Problem

Using only the materials provided in the can, design and construct a device that will use kinetic energy to force two golf balls apart by a total of 45 cm or 18”. The golf balls must be touching while sitting at rest and return to their original resting position after they have been forced apart.

Research

a) What are Newton’s laws of motion?

b) What is mechanical advantage?

c) What is kinetic energy? What is gravity? How are they related in this challenge?

d) What are golf balls made of? How does this material affect these colliding universes?

Evaluation

a) What happened to the colliding universes?

b) Did your design solve the problem? Explain how or why not.

c) What would you do differently next time if you had more time to modify?

Appendix F: Resource List

Print Resources

- *The Inventa Book of Mechanisms* (NSSBB #: 25361)
- *Making Classroom Assessment Work*, Second Edition (NSSBB #: 18637)
- *Simple Screenprinting: Basic Techniques and Creative Projects* (NSSBB #: 25753)

Internet Resources

- 21Classes Cooperative Learning
  http://21classes.com
- 4Teachers.org, Teach with Technology
  www.4Teachers.org
- Atomic Learning
  http://atomiclearning.com
- Career Exploration
  http://careerplanning.about.com
  www.youth.gc.ca/eng/topics/career_planning/index.shtml
- Discover Engineering
  http://www.discoverengineering.org
- Flickr
  http://flickr.com
- Freeplay Music
  http://freeplaymusic.com
- Fun Theory, Bottle Bank Arcade
  http://youtube.com/watch?v=zSiHjMU-MUo
- Fun Theory, Piano Stairs
  http://youtube.com/watch?v=2lXh2n0aPyw
- Fun Theory, The World's Deepest Bin
  http://youtube.com/watch?v=cbEKAwCoCKw
- Google SketchUp
  http://sketchup.google.com
- Government of Canada, Skilled Trades
  http://careersintrades.ca/
- HowStuffWorks
  www.howstuffworks.com
- Information and Communication Technology Tools
  http://toolsforteachers.com/
- Make: Technology on Your Time, Make Magazine
  http://makezine.com
- Media College.com
  http://mediacollege.com

- Media College.com
  http://mediacollege.com
- Nova Scotia Career Options
  http://careeroptions.ednet.ns.ca
- Nova Scotia Department of Labour and Advanced Education, WorkIt
  http://workitns.ca/
- RubiStar
  http://rubistar.4teachers.org/index.php
- Service Canada Job Bank
  http://jobsetc.gc.ca/toolbox/quizzes/quizzes_home.do
- Society of Women Engineers
  www.swe.org
- The Honda Cog
  www.youtube.com/watch?v=_ve4M4UsJQo
- WAMC Northeast Public Radio, Women in Science, Technology, Engineering, and Technology on the Air
  http://www.womeninscience.org/

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