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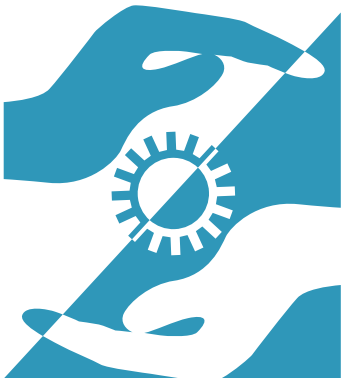

TECHNOLOGY EDUCATION 8 TO 10

Integrated Resource Package 1995

Province of
British Columbia
Ministry of
Education

IRP 014

PREFACE: USING THIS INTEGRATED RESOURCE PACKAGE

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Implementation of Technology Education 8 to 10 will commence in September 1996 with full implementation in September 1997. This Integrated Resource Package (IRP) provides some of the basic information that teachers will require to implement the curriculum. The information contained in this IRP is also available through the Internet. Contact the Ministry of Education's home page: http://www.educ.gov.bc.ca/

THE INTRODUCTION

The Introduction provides general information about Technical Education 8 to 10, including special features and requirements. It also provides a rationale for the subject—why technical education is taught in B.C. schools—and an explanation of the curriculum organizers.

THE TECHNOLOGY EDUCATION 8 TO 10 CURRICULUM

The provincially prescribed curriculum for Technology Education 8 to 10 is structured in terms of *curriculum organizers*. The main body of this IRP consists of four columns of information for each organizer. These columns describe:

- provincially prescribed learning outcome statements for Technology Education 8 to 10
- suggested instructional strategies for achieving the outcomes
- suggested assessment strategies for determining how well students are achieving the outcomes
- provincially recommended learning resources

Prescribed Learning Outcomes

Learning outcome statements are content standards for the provincial education system. Learning outcomes set out the knowledge, enduring ideas, issues, concepts, skills, and attitudes for each subject. They are statements of what students are expected to know and do in each grade. Learning outcomes are clearly stated and expressed in measurable terms. All learning outcomes complete this stem: "It is expected that students will. . . ." Outcome statements have been written to enable teachers to use their experience and professional judgment when planning and evaluating. The outcomes are benchmarks that will permit the use of criterion-referenced performance standards. It is expected that actual student performance will vary. Evaluation, reporting, and student placement with respect to these outcomes depend on the professional judgment of teachers, guided by provincial policy.

Suggested Instructional Strategies

Instruction involves the selection of techniques, activities, and methods that can be used to meet diverse student needs and to deliver the prescribed curriculum. Teachers are free to adapt the suggested instructional strategies or substitute others that they think will enable their students to achieve the prescribed outcomes. These strategies have been developed by specialist and generalist teachers to assist their colleagues; they are suggestions only.

Suggested Assessment Strategies

The assessment strategies suggest a variety of ways to gather information about student performance. Some assessment strategies relate to specific activities; others are general. These strategies have been developed by

specialist and generalist teachers to assist their colleagues; they are suggestions only.

PROVINCIALLY RECOMMENDED LEARNING RESOURCES

Provincially recommended learning resources are materials that have been reviewed and evaluated by British Columbia teachers in collaboration with the Ministry of Education using a stringent set of criteria. They are typically materials suitable for student use, but they may also include information primarily intended for teachers. Teachers and school districts are encouraged to select those resources that they find most relevant and useful for their students, and to supplement these with locally approved materials and resources (such as locally available guest speakers or exhibits). The *recommended* resources listed in the main body of this IRP are those that have a comprehensive coverage of significant portions of the curriculum, or those that provide a unique support to a specific segment of the curriculum. Appendix B contains a complete listing of provincially recommended learning resources to support this curriculum.

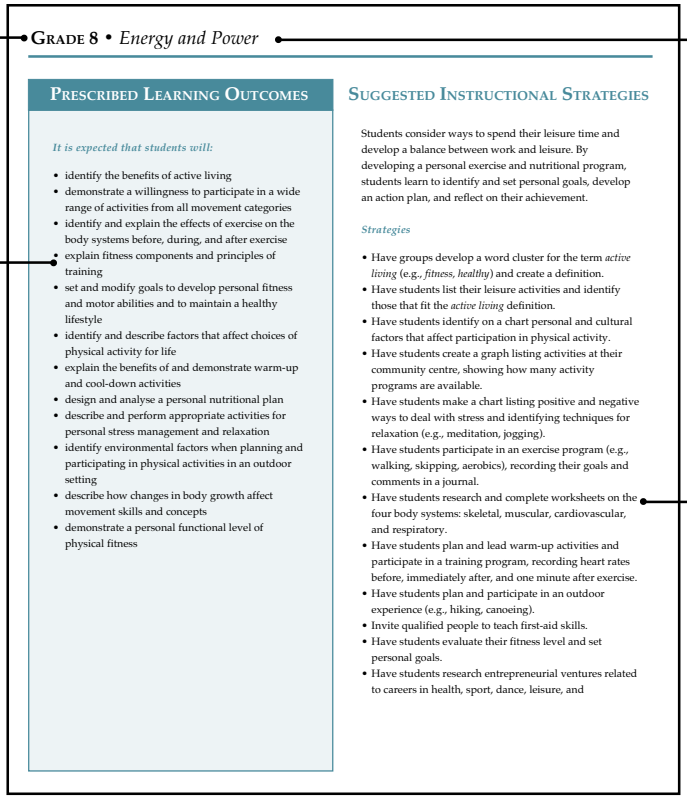
THE APPENDICES

A series of appendices provides additional information about the curriculum, and further support for the teacher:

- ***Appendix A*** contains a listing of the prescribed learning outcomes for the curriculum arranged by curriculum organizer and by grade.
- ***Appendix B*** contains a comprehensive listing of the provincially recommended learning resources for this curriculum. As new resources are evaluated, this appendix will be updated.
- ***Appendix C*** outlines the cross-curricular screens used to ensure that concerns such as equity, access, and the inclusion of specific topics are addressed by all components of the IRP.
- ***Appendix D*** contains assistance for teachers related to provincial evaluation and reporting policy. Curriculum outcomes have been used as the source for examples of criterion-referenced evaluations.
- ***Appendix E*** acknowledges the many people and organizations that have been involved in the development of this IRP.
- ***Appendix F*** contains a glossary of terms specific to the Technology Education 8 to 10 curriculum.

Grade

Curriculum Organizer



Prescribed Learning Outcomes

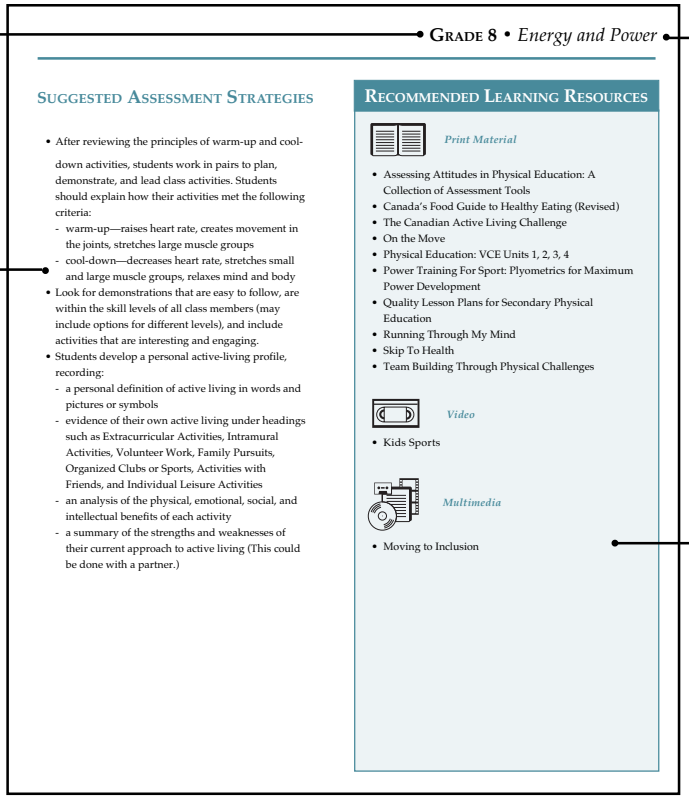
The Prescribed Learning Outcomes column of this IRP lists the specific learning outcomes for each curriculum organizer or sub-organizer. These aid the teacher in day-to-day planning.

Suggested Instructional Strategies

The Suggested Instructional Strategies column of this IRP suggests a variety of instructional approaches that include group work, problem solving, and the use of technology. Teachers should consider these as examples that they might modify to suit the developmental levels of their students.

Grade

Curriculum Organizer



Suggested Assessment Strategies

The Suggested Assessment Strategies offer a wide range of different assessment approaches useful in evaluating the Prescribed Learning Outcomes. Teachers should consider these as examples they might modify to suit their own needs and the instructional goals.

Recommended Learning Resources

The Recommended Learning Resources component of this IRP is a compilation of provincially recommended resources that support the Prescribed Learning Outcomes. A complete list including a short description of the resource, its media type, and distributor are included in Appendix B of this IRP.

This Integrated Resource Package (IRP) contains prescribed learning outcomes and support materials for the Grades 8 to10 Technology Education curriculum. It has been designed to help teachers identify possible ways to link learning outcomes, instructional strategies, and assessment strategies.

Principles of Learning

Technology education should be guided by the principles of learning. These are:

- Learning requires the active participation of the student.
- People learn in a variety of ways and at different rates.
- Learning is both an individual and a group process.

Rationale

Technology is embodied in devices that extend human capabilities. It provides the tools to extend our vision, to send and receive sounds and images from around the world, and to improve health, personal relationships, lifestyle, economies, and ecosystems.

Technology is a dominant force in today's society. Technological literacy is as essential to participation in modern society as is numeracy and the ability to read and write. A technologically literate person uses tools, materials, systems, and processes in an informed, ethical, and responsible way. Technology education helps young people prepare to live and work in a technological world.

The Aim and Approach of The Curriculum

The aim of the Grades K to 12 Technology Education curriculum is to help students develop the technological literacy and lifelong learning patterns that they need to live and work effectively in a changing technological society. To achieve this, the curriculum provides a framework for students to learn how to design and make solutions to real-world problems.

Preparing for the Workplace

To meet career challenges, students must be able to make independent decisions, solve problems, work independently and co-operatively with others, and become technically competent. Technology education helps students develop the types of learning patterns that are required in today's changing workplace.

Preparing the Citizen

To be responsible members of society, students must be aware of the ever-growing impacts of technology. They need to reflect critically on technology's role in society and consider its positive and negative effects. Technology education fosters the development of skills and attitudes that increase students' abilities to address the social and ethical issues of technological advancements.

Relevant to Everyone

The Grades K to 12 Technology Education curriculum is designed to provide learning opportunities for male and female students with a wide range of abilities. The instructional and assessment strategies described in this Integrated Resource Package encourage students to apply skills and knowledge gained in and out of the classroom to the design and making of solutions to real-life problems. As students study technology related to the materials, tools, and processes used in their design and practical work, they develop research skills and learn how to evaluate their work. Because of the changing

nature of society and the workplace, the skills, knowledge, and attitudes developed in technology education are relevant to many other areas of life.

Preparing for Further Education

The technology education curriculum spans Kindergarten to Grade 12. It provides a framework for students to solve problems using a design process and make what they have designed. The aim of the curriculum is to develop technological literacy and lifelong learning patterns that will enable students to live and work effectively in a changing technological society. The following provides an overview of technology education, Kindergarten to Grade 12.

OVERVIEW

Grades K to 3	
Students begin to appreciate that technology is everywhere. They become aware of the role of technology in their lives by exploring familiar devices. Through problem-solving activities, they develop group interaction and communication skills, and self-confidence in handling simple processes and products. Student activities are based on classroom themes and their own experiences and personal interests.	***In grades K to 3, students:*** • construct devices that are useful and relevant to them • explore materials, tools, and processes, independently and in groups • realize that there are several solutions to a single problem • learn the importance of using tools and materials safely
Grades 4 to 7	
Students consider the personal, community, and global consequences in the use of technology now and in the future, and develop a concern for its responsible application. They investigate the historical development of technology and begin to appreciate its impact on society and individuals. By investigating a product from its inception to its completion, students learn to research, create, and communicate solutions to design problems.	***In grades 4 to 7, students:*** • gain experience using a variety of communication tools (e.g., modem, CD-ROM, video, overhead projector) • identify problems involving design and investigate possible solutions • use an expanding variety of tools, materials, and production processes • use objective tests and feedback to refine and modify designs • become increasingly responsible for managing their time and resources, and for planning and organizing their activities within a specific task • begin to recognize that a system is made up of parts and devices that interact to achieve a purpose

Grades 8 to 10	
Students work in specialized environments to develop and use technological solutions to problems that they identify or that are identified for them. They continue to learn about the technical requirements of various careers. They consider the personal, local, and global consequences, and the cultural, ethical, and aesthetic implications of technology. They investigate the future applications of technology to improve the human condition.	***In grades 8 to 10, students:*** • set goals, develop plans, and assess their own ability to design products (individually and in groups) • use graphic designs and oral and written language to convey technical ideas • learn about the safe use of specialized tools and machinery • consider how they will use technology in daily life and in the workplace • study the characteristics and uses of materials and information while solving problems involving design that occur in daily life and in the workplace • learn to create and manage systems that energize and control products
Grades 11 to 12	
Students work in a sophisticated technological learning environment designed to promote their skills, knowledge, and abilities to solve complex and varied problems. Students take advantage of opportunities to prepare for postsecondary training opportunities.	***In grades 11 to 12, students:*** • develop skills appropriate to the workplace • produce products and systems that meet community standards • work in co-operative groups to develop solutions to real-life problems • develop detailed understanding of materials, processes, systems, and information gathering • select appropriate technologies to solve problems • evaluate possible solutions using models, simulations, and prototypes

Curriculum Organizers

The prescribed learning outcomes for technology education are grouped into the following five curriculum organizers:

- Self and Society
- Communications
- Production
- Control
- Energy and Power

These five curriculum organizers are the key elements of technology education. They were developed to provide a framework for the learning outcomes—a way of organizing knowledge, skills and attitudes. Because of the dynamic nature of classroom learning, no one organizer should be used in isolation or as a basis for a lesson or unit of instruction.

Although all organizers work together in various ways, learning outcomes in Self and Society focus on career development and personal and social responsibility, making these learning outcomes central to all activities in technology education.

Self and Society

Technology touches our lives every day. Students need to understand how humans shape technology and the impact that current and future technologies will have on our society, culture, and environment. The prescribed learning outcomes emphasize:

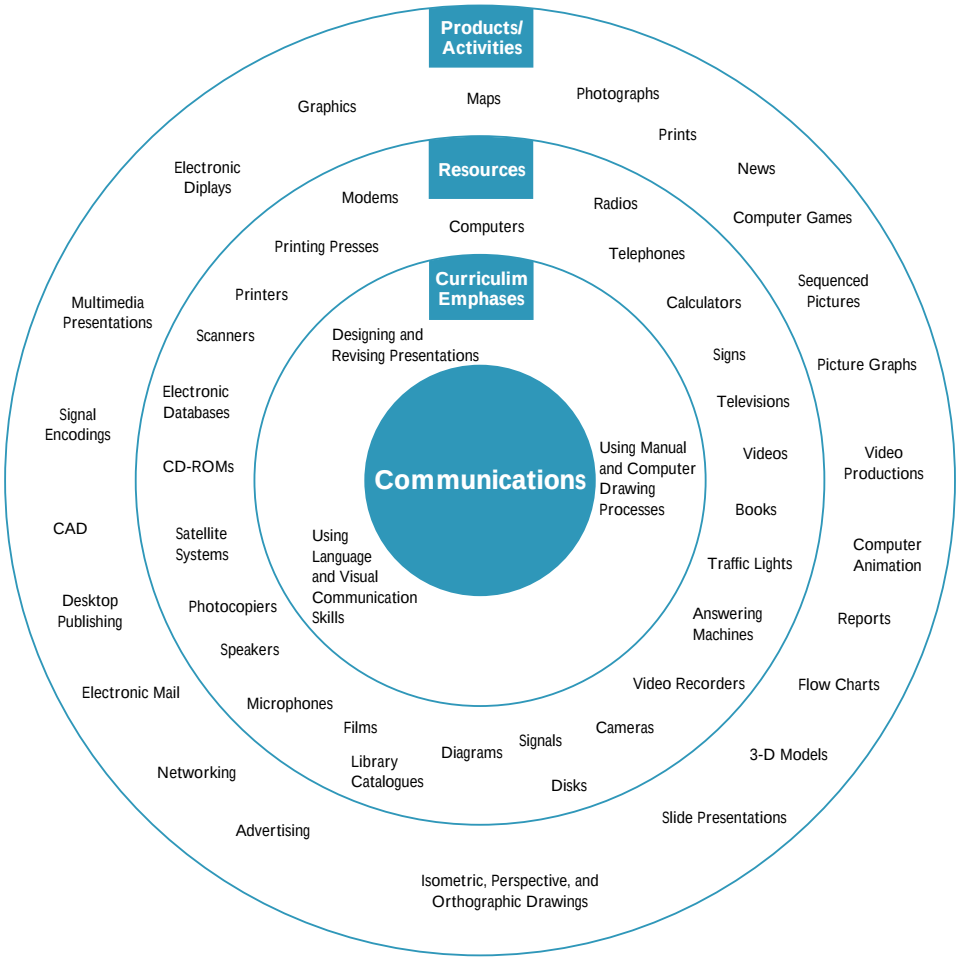
- learning to solve design problems involving technology
- the personal relevance of problems involving technology and the discovery that there may be several solutions to a problem
- developing positive attitudes toward lifelong learning and the integration and application of skills across areas of learning and technologies
- developing appropriate interpersonal skills and attitudes for working both independently and co-operatively within a group
- exploring careers and lifestyles associated with technology
- discovering how technology has changed society and the workplace

Together, the five curriculum organizers manage the content of technology education and are intended to provide direction for development of integrated units of study and the planning of instructional materials.

Communications

Images and messages can be sent instantly almost anywhere in the world, adding a global perspective to our lives. At home and in the workplace, students will need to use technology to process and share information and to communicate ideas using language and graphic forms. The prescribed learning outcomes emphasize:

- using technology to access, store, and retrieve information (although information technology is a separate curriculum, it is a major part of technology education)
- developing knowledge and skills related to accessing, storing, retrieving, and using information
- using manual and computer-assisted processes to present models and simulations in 2-D and 3-D forms to explain design ideas
- developing and using criteria to create and revise design presentations
- making use of skills, knowledge, and technologies from various curriculum areas to solve problems
- making responsible choices about the use of technology

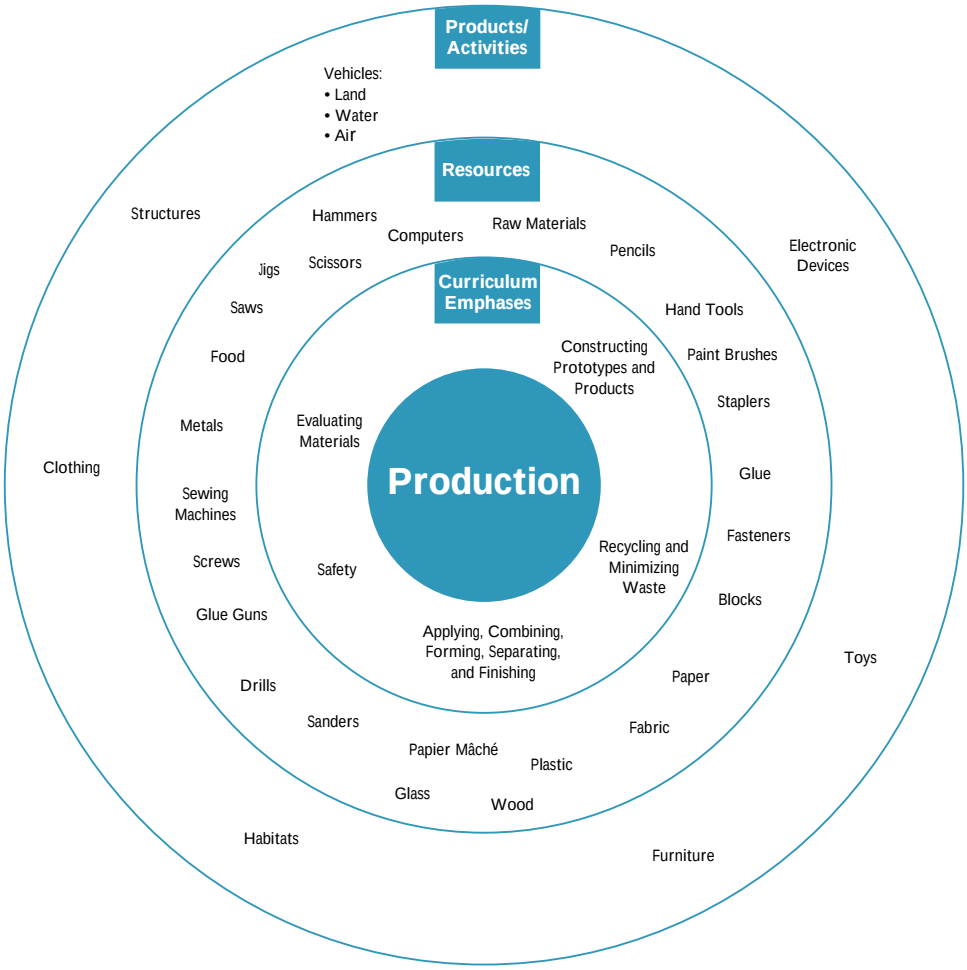


Together, the five curriculum organizers manage the content of technology education and are intended to provide direction for development of integrated units of study and the planning of instructional materials.

Production

The introduction of new technologies has influenced the way we create and make things. Students need to know about the safe use of tools and materials. They acquire skills by designing and developing products and systems that satisfy human needs and wants. The prescribed learning outcomes emphasize:

- applying the processes of combining, forming, separating, and finishing to the development and improvement of products at home and in the industrial world
- evaluating and selecting materials to meet specific design requirements
- constructing models, prototypes, and products to detailed specifications
- investigating the effects of technological changes on the production and use of materials
- examining processes and procedures used to minimize waste and to reuse products
- developing appropriate attitudes and practices about working safely, whether in the workplace, at home, or in the school laboratory

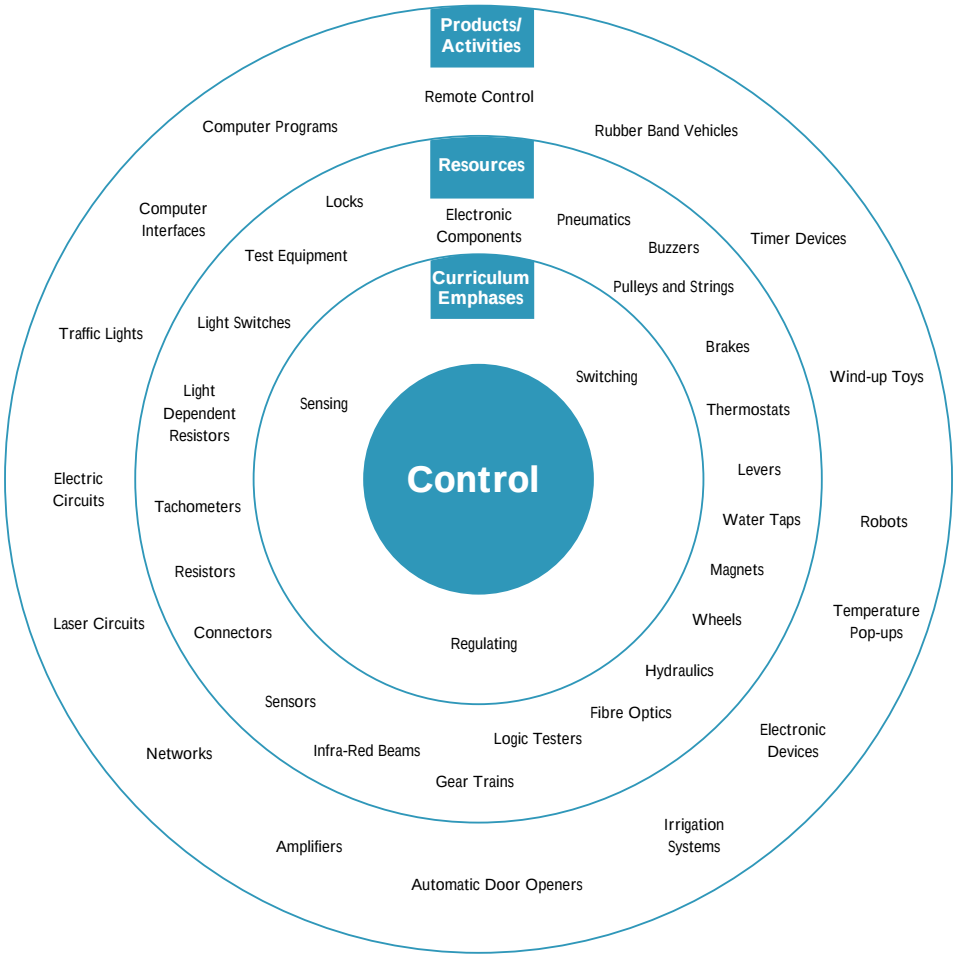


Together, the five curriculum organizers manage the content of technology education and are intended to provide direction for development of integrated units of study and the planning of instructional materials.

Control

Control addresses the application of devices and processes to manage, sort, control, and organize systems. The prescribed learning outcomes emphasize identifying and designing devices and processes in systems that integrate the following:

- *Sensing:* detecting, interpreting, and monitoring energy in a system using electric, electronic, fluid, or mechanical devices. Information is processed, and a decision is made that results in a specific outcome (e.g., the auto-stop function on a cassette player; an infra-red beam on a conveyor belt counts boxes as they pass).
- *Switching:* any method (e.g., mechanical, electronic) used to turn the flow of energy in a system off and on (e.g., a motion detector activates an alarm when an intruder is present; triggering the start of a model car on a ramp).
- *Regulating:* varying the flow, amount, and direction of all forms of energy (e.g., human, fluid, mechanical, electrical, heat).

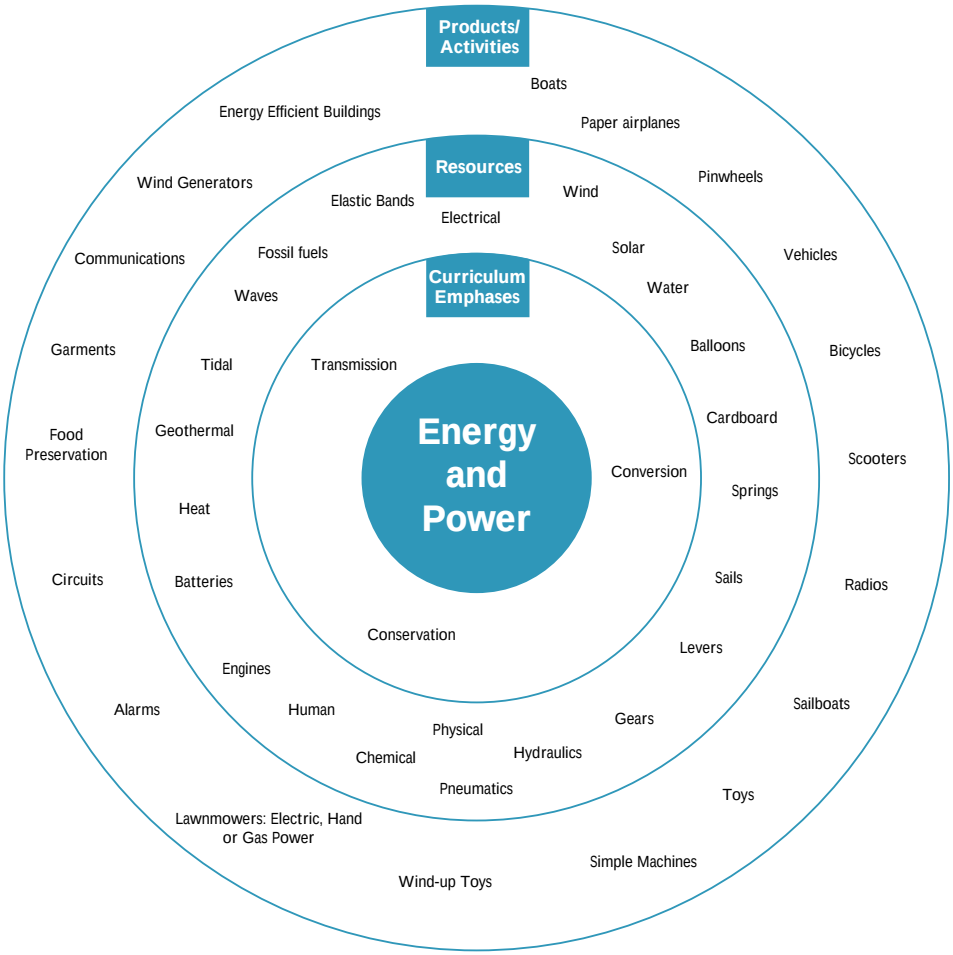


Together, the five curriculum organizers manage the content of technology education and are intended to provide direction for development of integrated units of study and the planning of instructional materials.

Energy and Power

Energy and Power refers to devices and processes that convert, transmit, and conserve forms of energy. The prescribed learning outcomes emphasize the analysis, design, and construction of systems that apply the following principles:

- *Conversion:* when energy is changed from one form to another (e.g., energy stored in a battery is converted into mechanical energy by an electric motor).
- *Transmission:* using devices and systems to transfer energy from one location to another (e.g., energy is transmitted from an electric motor through gears that turn the wheels of a model car, causing it to move).
- *Conservation:* using existing energy efficiently and finding alternative energy forms (e.g., aerodynamically designed vehicles; using solar energy to toast bread).



Together, the five curriculum organizers manage the content of technology education and are intended to provide direction for development of integrated units of study and the planning of instructional materials.

Instructional Strategies

The instructional strategies suggested in this IRP include techniques, ideas, and methods that illustrate a variety of approaches to the prescribed curriculum for a diverse population of students. Teachers determine the best instruction methods for their students, the best way to group students for particular studies, and the best way to present material to make it relevant and interesting.

Context Statements

Each set of instructional strategies in this IRP starts with a context statement, followed by several examples of instructional activities. The context statement links the prescribed learning outcomes with instruction. It states why these learning outcomes are important for the student's development and suggests some ways to integrate the learning outcomes into various subject areas.

Strategies

The suggested instructional strategies may be undertaken by individual students, partners, or small groups. Technology education emphasizes the skills needed in a continually changing workplace. Emphasis is given to the following:

- **Strategies that foster the development of individual and group skills**. The workplace requires that people work effectively, individually and with others, to solve problems and to complete tasks. Students need to experience the dynamics of group work to enhance their understanding of the problem-solving process. Group work focusses on such skills as collaboration, communication, leadership, and cooperation.
- **Strategies that develop applied skills**. In order to see technology education as relevant and useful, students must learn how it can be applied to a variety of real-world situations. Technology education helps students to understand and interpret their world, and to identify and solve problems that occur in their daily lives.

  As students access, synthesize, and present information, they apply their skills in various subject areas. They listen, read, write, and present ideas for various purposes, find specific information and summarize it graphically and in writing, and apply their knowledge of mathematics and science to the projects they develop.
- **Strategies that foster research and critical-thinking skills**. In order to make informed and responsible choices about the appropriate use of technology, students need to listen, view, and read critically.
- **Strategies that use technology**. The ability to use technology to solve problems is becoming a mandatory skill in the workplace and is an important "new basic" in postsecondary education. Students use technology to access information, to calculate, and to enhance the presentation of ideas.
- **Strategies that require the solving of problems involving design**. Students identify needs, pose real or invented problems of their own, and respond to problems presented by the teacher.

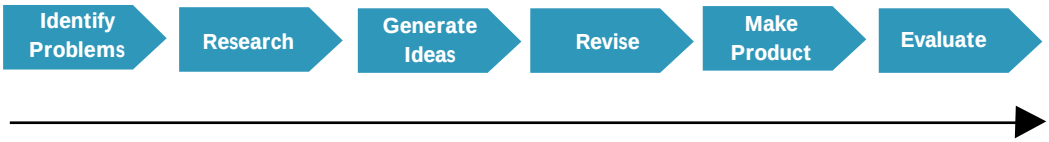
  To develop decision-making and problem-solving skills, students need to be challenged to identify problems and present appropriate design solutions. The problems students identify or are assigned in technology education involve the development of new or improved products and systems.

Problem-Solving Models

Models that describe problem-solving processes should be developed with students so they understand the recurring nature of solving real-world problems (as part of a problem is solved, new problems arise and some steps in the processes recur). The following diagrams present a variety of approaches to describe problem-solving in technology education. They are intended to provide teachers with ideas. They are not intended as prescribed models.

A Simple Linear Model

Some models suggest that problem solving is a set of clearly defined and prescribed steps. This is rarely the case.



Designing, Troubleshooting and Social Impact Models

Some specialized problems are approached in unique ways

Troubleshooting

Troubleshooting is a method of solving problems used to isolate and diagnose a malfunction.

- Identify purpose of system (inputs and outputs)
- Identify purpose of subsystems (inputs and outputs)
- Test subsystems
- Identify cause and implement solution
- Test solution

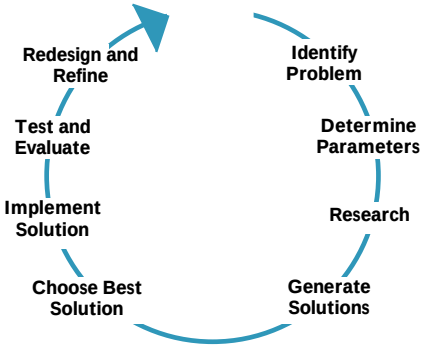
Social Impact

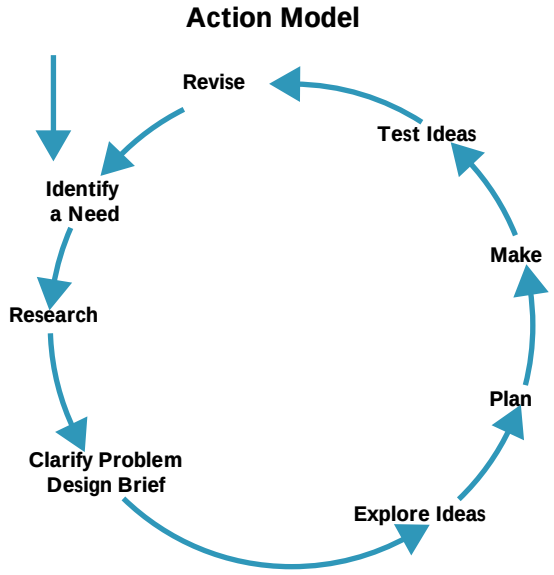
This is a method of solving problems used to appraise the social, environmental, and ethical implications of technological decisions.

- Identify consequences and effects
- Develop a value system through critical thinking
- Judge benefits and disadvantages of technological applications
- Make ethical decisions

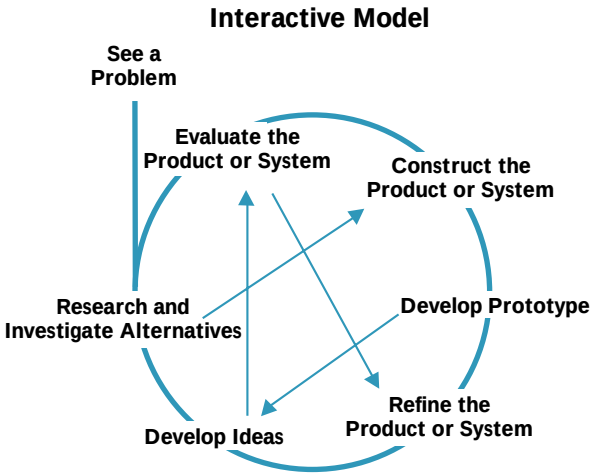
Designing

Designing is a problem-solving method used to develop solutions leading to the creation of articles, systems, or environments.





Some models suggest a continuous flow of activity, from problem identification to the development of a refined product.



Interactive models illustrate the complexity of a process, where at any time you might move to any point in the process in order to figure something out.

Considerations for Instruction in Technology Education

When selecting and developing learning activities, consideration must be given to safety, gender equity, and diverse student needs.

Safety

The nature of technology education requires that correct safety practices be established as soon as students begin their studies. It is the responsibility of the teacher to ensure that students are aware of the hazards in facilities and that established safety procedures are followed. Safety education is a continuing experience. Teachers must use good judgment when instructing students in safety practices, remembering that the main objective is education.

It is essential that teachers address the following questions before, during, and after an activity:

- Has the instruction been sequenced progressively to ensure safety?
- Have students been given specific instruction about how to use and handle equipment and tools correctly?
- Are the tools and equipment in good repair and suitably arranged?
- Are students being properly supervised?
- Do the facilities provide adequate lighting and ventilation for the activity?
- Have students been made aware of hazards in the facility area?
- Have students been made aware of appropriate school-based and industrial safety standards?

Teachers should select safe activities, techniques, and projects, and ensure that the following safety practices are implemented. This is not an all-inclusive list but a guide to

help teachers establish a safe learning environment.

Students should:

- wear appropriate clothing and footwear
- follow established rules and routines
- select tasks that are within their ability
- demonstrate self control and show respect for the safety of others
- recognize hazards in work areas

Teachers should select activities, techniques, and projects that reflect safe practices.

Facilities

The technology education curriculum reflects a significant shift in focus from industrial education. The learning outcomes in the technology education IRP represent different expectations for student learning than were described in the industrial education curriculum guide.

Schools may already have the facilities and equipment needed to meet the needs of the technology education curriculum. However, for some schools, to accommodate changes in the curriculum, it may be necessary to modify their use of existing industrial education facilities.

Teachers can assist in this transition by rearranging existing instructional space to better meet the needs of students. For example, dividing existing space into separate areas for "clean" work (such as planning and design) and "dirty" work (such as material preparation) may be required. If there is no available clean (design or computer) space in the existing production area, it may be possible to share other space in the school for these purposes.

The suggested instructional and assessment strategies in this IRP provide teachers with many examples of ways to meet the intents of the technology education curriculum. The prescribed learning outcomes have been written in a way that allows teachers to use a variety of processes, in a variety of settings, to ensure their students can meet required expectations.

Gender Equity

The education system is committed to helping all students succeed. This is particularly important in this area because female participation is low in technology education courses and women tend not to choose careers that require technical skills. Teaching, assessment materials, learning activities, and classroom environments should place value on the experiences and contributions of all people from all cultures.

Teachers should consider the diversity of learning styles, gender bias in learning resources, and unintentional gender bias when teaching. The following instructional strategies are suggested to help teachers deliver a gender-sensitive technology education curriculum.

- Think about ways to feature female technologists or women who make extensive use of technology in their careers as guest speakers or subjects of study in the classroom.
- Design instruction to acknowledge differences in experiences and interests between girls and boys.
- Demonstrate the relevance of technology education to careers and to daily life in ways that may appeal to particular students in the class or school. Successful links include biology, environmental issues, architecture and design, computers, and current affairs.
- Explore not only the practical applications of technology education but also the human elements, such as the ways ideas

have changed throughout history, and the social and moral implications of technology.
- Explore ways of teaching the uses of design and technology that will appeal to all students.
- Provide practical learning opportunities designed specifically to help girls develop confidence and interest in technology education and non-traditional roles.
- Emphasize that technology is used by people with various interests and responsibilities.
- Provide opportunities for visual and hands-on activities. Experiments, demonstrations, field trips, and exercises that provide opportunities to explore the relevance of technology education are important for both girls and boys.

Diverse Student Needs

Instruction and assessment methods should be adapted to meet the needs of all students. When students with special needs are expected to achieve or surpass the learning outcomes set out in the technology education curriculum, regular grading practices and reporting procedures are followed. However, when students are not expected to achieve the learning outcomes, modifications must be noted in their Individual Education Plans (IEPs).

The following strategies may help students with special needs succeed in technology education:

Adapt the environment:

- Change the student's classroom seat.
- Make use of co-operative grouping.

Adapt presentations:

- Provide students with advance organizers of key technology education concepts.
- Demonstrate or model new concepts.
- Adjust the pace of activities as required.
- Use bilingual peers or volunteers to help ESL students (e.g., to clarify safety rules).

Adapt materials:

- Use techniques to make the organization of activities more explicit (e.g., colour code the steps used to solve a problem).
- Use manipulatives or large-print charts.
- Use large print on activity sheets.
- Use opaque overlays on text pages to reduce the quantity of visible print.
- Highlight key points on activity sheets.
- Use translated material for information such as safety rules.

Adapt methods of assistance:

- Have peers or volunteers help students with special needs.
- Have students with special needs help younger students.
- Have teacher assistants work with individuals and small groups of students with special needs.
- Work with consultants and support teachers to develop appropriate problem-solving activities and strategies for students with special needs.

Adapt methods of assessment:

- Allow students to demonstrate their understanding of technology education concepts in a variety of ways (e.g., murals, displays, models, puzzles, game boards).
- Modify assessment tools to match student needs. For example, oral tests, open-book tests, and tests with no time limit may allow students to better demonstrate their learning than traditional tests.
- Set achievable goals.
- Use computer programs that allow students to practise word processing and to record and track their results.

Provide opportunities for extension and practice:

- Require the completion of only a small amount of work at any given time.
- Simplify the way questions are worded to match the students' levels of understanding.
- Provide functional, practical opportunities for students to practice skills.

Assessment and Evaluation

Assessment is the systematic process of gathering information about students' learning in order to describe what they know, are able to do, and are working toward. From the evidence and information collected in assessments, teachers describe each student's learning and performance. They use this information to provide students with ongoing feedback, plan further instructional and learning activities, set subsequent learning goals, and determine areas requiring diagnostic teaching and intervention.

Teachers determine the purpose, aspects, or attributes of learning on which to focus the assessment. They also decide when to collect the evidence and the assessment methods, tools, or techniques most appropriate to use. Assessment focusses on the critical or significant aspects of the learning students will be asked to demonstrate. Students benefit when they clearly understand the learning goals and learning expectations.

Assessment in Technology Education

The activities suggested in this IRP illustrate a variety of strategies for observing and interacting with students and for collecting their work. Each set of assessment strategies begins with a context statement that suggests an overall approach for the assessment of content, processes, and procedures. Teachers may want to adapt some of the suggested activities to suit particular students or situations. While students perform activities, teachers use a variety of strategies to assess their levels of understanding in relation to outcomes. Possible strategies include performance assessment, oral and written reports, and student self-assessment. For further support, Appendix D of this IRP includes a more detailed discussion of assessment and evaluation.

The provincial reference sets are an additional resource that can be used to help teachers assess skills across curricular areas. The reference sets can help teachers establish criteria that focus assessments and provide a more complete picture of student development.

The reference sets include:

- *Evaluating Reading Across Curriculum* (RB 0034)
- *Evaluating Writing Across Curriculum* (RB 0020 & RB 0021)
- *Evaluating Problem Solving Across Curriculum* (RB 0053)
- *Evaluating Group Communication Skills Across Curriculum* (RB 0051)
- *Evaluating Mathematical Development Across Curriculum* (RB 0052)

A series of assessment handbooks have also been developed to provide guidance for teachers as they explore and expand their assessment repertoires.

- *Performance Assessment* (XX0246)
- *Portfolio Assessment* (XX0247)
- *Student-Centred Conferencing* (XX0248)
- *Student Self-Assessment* (XX0249)

Learning Resources

The ministry promotes the establishment of a resource-rich learning environment through the evaluation of educationally appropriate materials in a variety of media and formats. This includes, but is not limited to, materials in print, video, and software formats, as well as a combination of these formats intended for use by teachers and students. Resources that support provincial curricula are identified through an evaluation process in which practising teachers act as evaluators. Resources not on the provincially recommended list must be evaluated through a local board-approved process. It is expected that teachers will select resources from those that meet the provincial criteria and that suit their particular pedagogical needs and audiences.

The use of the learning resources involves the teacher as a facilitator of learning. However, students may be expected to have some choice in materials for specific purposes such as independent reading or research. Teachers are expected to use a variety of resources to support learning outcomes at any particular level. A multimedia approach is encouraged.

Some selected resources have been identified to support cross-curricular integration. The ministry also considers students with special needs in the evaluation and annotation of learning resources. Special format versions of some selected resources (Braille and taped-book formats) are also available.

Learning resources for use in British Columbia schools fall into one of three categories:

- provincially recommended materials
- provincially authorized materials
- locally evaluated materials

All learning resources used in schools must have either *recommended or authorized* designation or be approved through district evaluation and approval policies.

Provincially Recommended Materials

Materials evaluated through the provincial evaluation process, approved through minister's order, and purchased using targeted learning resource funds are categorized as *recommended* materials. These resources are listed in the print and CD-ROM versions of the *Catalogue of Learning Resources*.

Appendix B of this IRP includes a list of *recommended* resources for technology education.

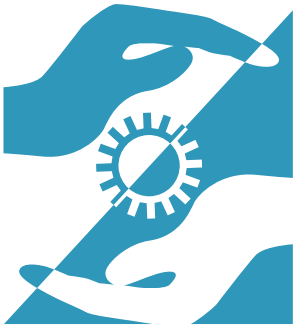
Provincially Authorized Materials

Materials selected prior to 989 by curriculum committees and purchased through the Credit Allocation Plan are categorized as *authorized* materials. These resources are listed in the print and CD-ROM versions of the *Catalogue of Learning Resources*.

Locally Evaluated Materials

These are the materials evaluated through local (district and school) evaluation processes and approved for use according to district policy.

The Technology Education 8 to 10 Curriculum



PRESCRIBED LEARNING OUTCOMES

It is expected that students will:

- demonstrate confidence and positive attitudes when solving problems that arise during the design process
- identify practical problems involving technology in a variety of contexts
- work with others to solve problems that come up during the design process
- list career paths in technological fields, and examine potential career opportunities
- demonstrate a willingness to express thoughts and feelings about the effects of technology on their personal lives, society, and the environment

SUGGESTED INSTRUCTIONAL STRATEGIES

Students work together to refine their group and problem-solving skills. They consider how changing technology influences their lives today and in the future.

- Have students work in pairs or small groups to develop a product.
- Ask students to consider how technology influences their lives. Have them create a poster, cartoon strip, animation, or video to illustrate developments in a particular technology.
- Brainstorm reasons to work co-operatively in groups.

- Engage students in planning a space colony. Tell them they are a development team hired to design a model geodesic dome in which the inhabitants of a colony will live. Have them work together to develop sketches and technical drawings of the structures inside the dome and produce a report discussing the human and social issues that need to be addressed. Students could keep journals to record their thoughts as they work through the design process. Prompt their reflective thinking by having them respond to the following frames:
  - Things I liked____.
  - Things I disliked____.
  - Problems I met today and how I dealt with them____.

SUGGESTED ASSESSMENT STRATEGIES

As students solve problems that come up during the design process, they identify needs, set goals, develop plans, and assess their own abilities to work together and to design products that meet stated criteria.

Observe

- Students examine a device (e.g., computer, washing machine, electric wheelchair) and write about the effects of that technology on society and the environment. Notice the extent to which they are able to:
  - identify both positive and negative effects on individuals, society, and the environment
  - relate the implications of the device in their own lives

Question

- Students list careers in technological fields. After investigating several occupations, hold a conference with students to determine their levels of awareness of possible career directions. Pose questions such as:
  - Which career or field interests you the most?
  - What captured your interest?
  - How could you use this information to make decisions about your future career options?
  - Has that career been the subject of cultural, gender, or ability stereotyping? What barriers, if any, can you anticipate? How might they be overcome?
  - What education or training is required for this career?

Self-Assessment

- Conference with students individually about how they contributed to their design teams. Pose questions such as:
  - What were your specific contributions to the group?
  - What strategies did you use to help your group as you encountered problems?
  - What will you do differently next time?

RECOMMENDED LEARNING RESOURCES

Print Material

- Exploring Transportation
- GCSE Technology
- Living with Technology, Second Edition
- Q Science Series

Video

- Alternative Energies: Fuels for the Future
- How to Make Great Videos - With Just a Camcorder
- Making the Most of Things
- Manufacturing Processes
- Manufacturing Resources
- Manufacturing Systems
- Parking Places
- The Secret Life of Machines Series

Multimedia

- Experience Technology: Communication, Production, Transportation, Biotechnology
- Technology Today and Tomorrow, Second Edition
- Technology Wheel

Software

- The Way Things Work - CD-ROM

Manipulatives

- Artstraws

PRESCRIBED LEARNING OUTCOMES

It is expected that students will:

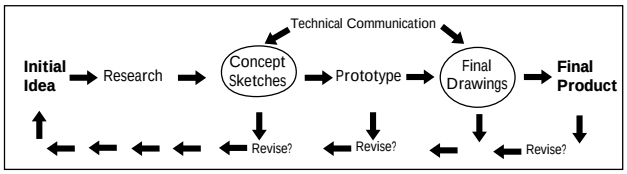
- produce initial concept sketches and final drawings using a design process
- solve problems that come up during the design process by using various information sources
- develop two- and three-dimensional graphics using manual and computer-assisted processes
- revise presentations based on suggestions and comments from others
- identify how information and concepts from other fields of knowledge are used in the design process

SUGGESTED INSTRUCTIONAL STRATEGIES

Students work as product designers, using graphics and oral and written language to convey their thoughts and technical ideas. They learn manual techniques and technological skills to compose design ideas and communicate them to others.

- Ask students to tell about objects or products they designed and made at home or at school (e.g., jewellery, clothing, model cars). Help them develop drawings and graphics to illustrate the steps of the design processes they used.

Design Process



- Use questions to prompt discussion of what the world might be like without graphic and electronic communications.
- Help students revise their presentations by giving them opportunities to present their ideas at various stages of their work. Allow each group to update others on the progress of their work, and give the rest of the class time to suggest ways to make improvements.
- Have students develop design portfolios. Ask them to develop logos that reflect the activity for their portfolios. (See Appendix D for suggestions about the development and use of design portfolios.)

SUGGESTED ASSESSMENT STRATEGIES

Interactions between teacher and students as they work on problems that come up during the design process help students develop a variety of communication skills.

Observe

- After explaining the purpose of concept sketches and final drawings, work with students to develop a two-column chart of criteria. For example:

Initial Concept Sketches	Final Drawings
• Labels with arrows used to identify design process	• Labels used to enhance clarity
• Drawings easy to see	• Drawings useful as a blueprint for production
• Rough measurements included	• Precise measurements included
• Possible materials list provided	• Materials list provided including exact quantities

- Use these criteria to assess the abilities of students to communicate design solutions effectively through drawings.

Question

- After students complete a design project, have them brainstorm ideas they used. Record the responses, and have them categorize the list by discipline (e.g., physics, art, English, mathematics). Discuss their classifications, and assess their understandings with questions such as:
  - How did you decide on the category for the items?
  - How will you use this classification in future problems that come up during the design process?

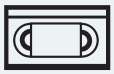
Self-Assessment

- Students present their ideas frequently during the design process and receive peer feedback on a checklist or rating scale. Keep a continuous record, and notice the extent to which presentation skills improve over time. Criteria might include:
  - effective use of voice
  - variety of presentation tools
  - clarity of explanations

RECOMMENDED LEARNING RESOURCES

Print Material

- Basic Technical Drawing, 6th Edition
- Communication Systems
- GCSE Technology
- Living with Technology, Second Edition
- Q Science Series
- The Sky's the Limit with Math and Science
- Technology Craft Topics
- Technology I.D.E.A.S.: A Teaching Resource Book



Video

- Alternative Energies: Fuels for the Future
- How to Make Great Videos - With Just a Camcorder
- In the Kitchen
- Manufacturing Processes
- Manufacturing Systems
- Parking Places
- The Secret Life of Machines Series
- Storage and Retrieval

Multimedia

- Experience Technology: Communication, Production, Transportation, Biotechnology
- Technology Today and Tomorrow, Second Edition
- Technology Wheel

Software

- The Way Things Work - CD-ROM

Manipulatives

- Artstraws

PRESCRIBED LEARNING OUTCOMES

It is expected that students will:

- describe and use the process of product design
- identify and classify the properties of materials used to manufacture products
- select materials based on a set of design specifications
- describe combining, forming, separating, and finishing processes as they relate to materials used in product manufacturing
- apply finishes and details to manufactured products to enhance their appearance and durability
- evaluate the efficiency of a production process
- identify ways to minimize waste and reuse products
- demonstrate safe work habits when using tools, equipment, and technical processes

SUGGESTED INSTRUCTIONAL STRATEGIES

Students learn about the safe use of tools and machinery. As students solve problems that occur in the design process, they study the diversity and characteristics of materials and processes used in daily life and in industry. Students apply this knowledge to build a product or system.

- Have students work in teams to design and produce cardboard foundations capable of supporting a vertical downward load. Ask them what they need to find out before they begin production. Review or help them develop a design process. Have students sketch ideas, build paper prototypes, and construct their foundations. A design portfolio should be submitted as part of the evaluation. (See Appendix D for information about design portfolios.)
- Lead a discussion about the properties of materials. Have students classify the materials used in a design activity and describe appropriate combining, forming, separating, and finishing processes. This could be done using a chart that includes the materials, equipment, processes, and safety measures required. Ask questions that lead students to consider minimizing waste and recycling material.
- Select a mass-production project that uses a variety of materials. Guide students through the production steps. Challenge each student to complete a higher-quality product more efficiently using mass-production than can be done one at a time. Enhance their understandings of the design process with prompts such as:
  - How does the step you are doing now relate to the previous one?
  - How does it relate to the next one?
  - What are the consequences of a breakdown in a specific part of the process?

SUGGESTED ASSESSMENT STRATEGIES

By observing students as they work to develop products, teachers can assess their knowledge of material properties, manufacturing processes, safety measures, and waste reduction techniques.

Observe

- Develop a checklist to record the safe procedures students use as they work on design projects.
- As a post-production activity, ask design teams to investigate waste management. Look for evidence that students are able to:
  - identify areas of waste
  - generate ways to reduce waste
  - suggest methods to recycle or reuse materials

Question

- Students are presented with examples of manufactured items composed of a variety of materials (e.g., paper, plastic, fabric). Assess their understandings of the properties of each material with prompts such as:
  - What was this item designed to do?
  - What materials were used?
  - Why were they chosen?
  - What other materials could have been used?

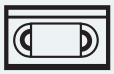
Self-Assessment

- Work with students to develop an assessment tool (e.g., rating scale) for a product or prototype. Criteria might include:
  - Does it perform its function?
  - Does it satisfy specific design parameters?
  - Is it durable? Stable? Safe?
  - Is it easy and cost-effective to manufacture?
  - Is it aesthetically pleasing?

RECOMMENDED LEARNING RESOURCES

Print Material

- GCSE Technology
- Living with Technology, Second Edition
- Q Science Series
- The Random House Book of How Things Were Built
- Technology Craft Topics
- Tracktronics: Opportunities for Design Using Electronics



Video

- Fluid Power Technology at Work
- In the Kitchen
- Making the Most of Things
- Manufacturing Processes
- Manufacturing Systems
- Parking Places
- Robots at Work
- The Secret Life of Machines Series

Multimedia

- Experience Technology: Communication, Production, Transportation, Biotechnology
- Lego/Dacta Control Lab Starter Pack
- Technology Wheel

Software

- The Way Things Work - CD-ROM

Manipulatives

- Artstraws
- Capsela
- Lego/Dacta Manufacturing Systems

PRESCRIBED LEARNING OUTCOMES

It is expected that students will:

- design and construct a control device that senses, switches, or regulates
- compare ways that various control devices work, and explain their applications
- integrate electric, electronic, pneumatic, and mechanical control devices within a system
- demonstrate an understanding of the concept of control by dismantling devices

SUGGESTED INSTRUCTIONAL STRATEGIES

All managed systems (e.g., communications, production, mechanical, pneumatic, electric, electronic) use control devices. Students are introduced to sensing, switching, and regulating devices by dismantling them. They demonstrate an understanding of control devices by building a product or system that incorporates one or more control methods.

- Have students work in small groups to dismantle common devices (e.g., switches, valves, motion sensors) to learn how they operate. Provide students with formats that help them to focus on the function of devices.

Investigation of Control Devices

Description of the system: *household light*

Input: *electricity*
Output: *light*
Control Device: *wall-mounted toggle switch*
Operating Principles: *electrical contacts are separate or connected by movement of the toggle...*

- Ask students to use print and electronic resources to research various control devices—their effectiveness and related problems. Have students present the research to their peers orally and using visual aids. Have students use the information gathered to design and construct a system that incorporates electronic, pneumatic, or mechanical control devices (e.g., burglar alarm, water-level controller, winker-blinker). Help students list design considerations (e.g., function, form, aesthetics, ergonomics) to include in their design briefs. (See Appendices D and F for a description of design briefs.)

SUGGESTED ASSESSMENT STRATEGIES

As students build and operate a variety of control devices, they demonstrate their abilities to identify the type of control used in a device, differentiate between input and output, and describe the roles of operating devices and feedback loops.

Observe

- Students investigate a variety of discarded control devices from home, school, or industry and work in small groups to prepare a display for the classroom. Look for evidence that students are able to:
  - categorize control devices (switches, sensors, regulators)
  - identify inputs, outputs, processes, and feedback components
  - identify components of control devices and their functions
  - identify practical applications for these devices

Collect

- Examine student-constructed systems that use a variety of control devices for:
  - appropriate selection of control devices
  - efficiency (i.e., do what they were intended to do)
  - quality of construction and attention to detail

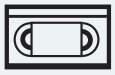
Self-Assessment

- After students design and construct a control device, give them an opportunity to reflect on their learning. To focus their assessment, use prompts such as:
  - How does your work reflect what you know about control devices?
  - What was the most difficult challenge as you worked on this task?
  - How did you deal with that challenge?

RECOMMENDED LEARNING RESOURCES

Print Material

- Exploring Transportation
- GCSE Technology
- Living with Technology, Second Edition
- Q Science Series
- Techniques For Technology
- Technology Craft Topics
- Technology I.D.E.A.S.: A Teaching Resource Book
- Tracktronics: Opportunities for Design Using Electronics



Video

- Fluid Power Technology at Work
- Manufacturing Processes
- Manufacturing Systems
- Robots at Work

Multimedia

- Experience Technology: Communication, Production, Transportation, Biotechnology
- Technology Today and Tomorrow, Second Edition
- Technology Wheel

Software

- The Way Things Work - CD-ROM

Manipulatives

- Capsela
- Discovery Kits: Pumping it up with Pneumatics
- Lego/Dacta Manufacturing Systems

PRESCRIBED LEARNING OUTCOMES

It is expected that students will:

- incorporate selected devices in the design of energy transmission and conversion systems
- explain how systems transmit and convert energy
- identify how simple machines are combined into energy and power systems
- construct devices that are powered in various ways

SUGGESTED INSTRUCTIONAL STRATEGIES

Learning about energy conversion, transmission, and conservation helps students understand the impact of energy use on individuals, society, and the environment. To enhance their understandings of the relationship between energy and power, students design and build devices that use energy in various ways, and present their findings using various media.

- Have students discuss and list power sources used in Canada in the 1800s. Have them compare the list to power sources used today.
- Ask students to predict future sources of energy and power and their possible costs to the environment and society.
- Lead a class discussion on the discrepancy between energy use per capita in Canada and in France, Mexico, or Nepal.
- Have students in small groups use a variety of mechanical, electric, and solar devices (e.g., solar cells) to create products that demonstrate the conversion of energy (e.g., a mock car using mechanical energy from a mousetrap).
- Ask students to use a suitable medium (e.g., Hypercard stacks, video) to explain and demonstrate how the systems they construct transmit and convert energy.
- Have students dismantle discarded items and identify simple machines or tools (e.g., wheels, pulleys, levers). The parts could be used in other student projects.
- Encourage students to work co-operatively to construct devices that combine simple machines (e.g., a time-delay mechanism). Discuss applications for the devices in the community.

SUGGESTED ASSESSMENT STRATEGIES

As students work on the design and construction of mechanical devices, they demonstrate their understandings of how energy is transmitted and converted, how simple machines are combined to create complex movements, and how energy can be conserved within a mechanical system.

Question

- Conference with individual students to assess their understandings of how simple machines are used in the design of complex devices. Use prompts such as:
  - What simple machines have you used in your design?
  - How would a change in this simple machine affect the system as a whole?
  - What other simple machine could you use in your design? What function would it serve?
  - How would it change the system?

Collect

- Examine design portfolios for evidence that students are able to:
  - incorporate a variety of simple machines into their designs
  - identify ways to conserve energy in their products
  - modify a design to solve an energy transmission or conversion problem

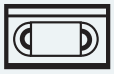
Self-Assessment

- Engage students in a design challenge that requires incorporating at least four simple machines in a device that converts energy and puts this energy to useful work (e.g., lifting, propelling, pulling). Have students brainstorm and refine a list of criteria to assess their designs. Criteria may include efficiency, usefulness, and innovation in design.

RECOMMENDED LEARNING RESOURCES

Print Material

- Exploring Transportation
- Living with Technology, Second Edition
- Q Science Series
- The Sky's the Limit with Math and Science
- Techniques For Technology
- Technology Craft Topics
- Technology I.D.E.A.S.: A Teaching Resource Book
- Tracktronics: Opportunities for Design Using Electronics



Video

- Alternative Energies: Fuels for the Future
- Fluid Power Technology at Work
- Manufacturing Processes
- The Secret Life of Machines Series

Multimedia

- Experience Technology: Communication, Production, Transportation, Biotechnology
- Lego/Dacta Control Lab Starter Pack
- Technology Today and Tomorrow, Second Edition
- Technology Wheel

Software

- The Way Things Work - CD-ROM

Manipulatives

- Capsela
- Discovery Kits: Pumping it up with Pneumatics
- Lego/Dacta Manufacturing Systems

PRESCRIBED LEARNING OUTCOMES

It is expected that students will:

- contribute to group success by encouraging others to fulfil their responsibilities
- identify role models in technological occupations, including those that are sensitive to culture, gender, and physical ability
- explain relationships between technological advancements and changes in the workplace, including the changing roles of workers
- evaluate design ideas based on assessments by others
- demonstrate a willingness to look for and develop improved solutions to problems that arise during the design process
- express personal thoughts and feelings about how societal pressures may influence technological advancements and, conversely, how technological changes influence society and the environment
- demonstrate confidence and positive attitudes when solving problems that arise during the design process

SUGGESTED INSTRUCTIONAL STRATEGIES

Students examine the issues and impacts of technology on themselves and society. They continue to learn about the technical requirements of various careers. They learn that ethics, regard for others and the environment, respect for diversity, and technical skills are valued in school, in the workplace, and by society in general.

- Lead a class discussion on ways people use technology to overcome physical disabilities. Have students research existing devices and design models of new products that help people with special needs. Help them develop questions to interview someone with a disability.
- Lead a class discussion about career opportunities in various technological occupations. Help students develop interview questions that address such issues as the ethical and environmental implications of technology, workers' roles, and how workers use technology to perform their jobs. Have students interview people in various occupations, then in small groups discuss their findings and compile a report using charts or visual materials.
- Ask students to investigate an aspect of technology that has evolved significantly. Give them worksheets such as the following to compare and contrast the past, present, and future applications of this technology.

Technological Change

Write a brief description of a technology that has evolved significantly:

	THEN	NOW	FUTURE
Efficiency			
Working Conditions			
Worker Skills			
Effect on Society			

What factors have allowed this technology to progress?

SUGGESTED ASSESSMENT STRATEGIES

As students investigate technologies and the related careers related to those technologies, they demonstrate their understandings of the effect of technology on their lives, on society, and on the environment.

Question

- After completing a design project, hold a conference with students to assess their abilities to critically analyse their designs. Ask questions such as:
  - What are the strengths and limitations of your design solution?
  - What potential societal and environmental effects—both positive and negative—does your solution contain?
  - What new problems have you identified?
  - How could you address these issues in a subsequent design?
- To assess their understandings of the effect of a recently evolved technology, ask questions such as:
  - In what ways has this technology made human activities more or less effective?
  - How have the skills needed to use this technology changed?
  - How has this technology affected the number or kinds of jobs available?
  - How might this technology evolve over the next ten years?
  - How might the changes you predict affect society, the environment, and the work force?

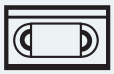
Collect

- Examine design portfolios for evidence that students are able to:
  - generate a variety of ideas in response to a problem during the design process
  - work through different ideas to improve solutions
  - evaluate solutions to refine the design
  - evaluate solutions from ethical and environmental perspectives

RECOMMENDED LEARNING RESOURCES

Print Material

- Communication Systems
- Design and Problem Solving in Technology
- Design and Technology
- Exploring Transportation
- GCSE Technology
- Living with Technology, Second Edition
- Small Gas Engines



Video

- Alternative Energies: Fuels for the Future
- A Design Project - Case Study: Four Responses to a Design Brief
- Fluid Power Technology at Work
- How to Make Great Videos - With Just a Camcorder
- In the Kitchen
- Making the Most of Things
- Manufacturing Processes
- Manufacturing Resources
- Manufacturing Systems
- Robots at Work
- The Secret Life of Machines Series

Multimedia

- Technology Today and Tomorrow, Second Edition
- Technology Wheel

Software

- The Way Things Work - CD-ROM

Manipulatives

- Artstraws

PRESCRIBED LEARNING OUTCOMES

It is expected that students will:

- communicate ideas for designing products and systems using various drawing projection methods, spreadsheets, graphics, or other media
- use information-gathering and communication methods to solve problems during the design process and to create effective presentations
- revise presentations based on personal review and feedback from others
- describe the advantages and disadvantages of various information-gathering and communication processes
- develop two- and three-dimensional graphics using manual and computer-assisted processes
- identify how information and concepts from other fields of knowledge are used in the design process

SUGGESTED INSTRUCTIONAL STRATEGIES

Students expand their skills to effectively communicate ideas and solutions orally, graphically, and in written form and using a variety of technologies. They become increasingly independent in researching, developing project plans, refining recording skills related to technological activities, and completing projects.

- Have students work in groups to chart the advantages and disadvantages of electronic-based information-gathering and communication processes, and to present their findings to the class. Remind them that you will assess their presentations on the depth of information and thoughtfulness of issues raised (e.g., privacy, effects on workers). For example, a group could focus on communication technologies for people with special needs (e.g., audio-crosswalk signals, telephones for hearing impaired, closed-captioning on TV).
- Encourage students to communicate their plans using drawings, procedure sheets, flow charts, storyboards, or scripts, and to include them in their design portfolios. Have students create their own clip art or record original sights and sounds to enhance their presentation.
- Some groups may wish to design a marketing campaign for an existing product or for one they design themselves.
- Help students to develop criteria for effective presentations and to use them to assess their own work and the work of others.

SUGGESTED ASSESSMENT STRATEGIES

Students extend their communication skills by analysing and selecting the most appropriate methods and media to represent their ideas. Both technical skills and the effectiveness of presentations can be assessed.

Question

- Help students evaluate various methods of representing ideas by asking questions such as:
  - In designing a three-dimensional puzzle, what limitations do drawing methods have that physical or electronic modelling techniques do not?
  - What are the advantages and disadvantages of using only electronic-based methods to communicate ideas?

Collect

- Assess design portfolios for evidence of effective communication of ideas such as:
  - Do their sketches and drawings clearly communicate their ideas?
  - Have they used a variety of methods to communicate their ideas?
  - Have they integrated information from a variety of sources into their work?

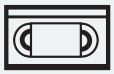
Self-Assessment

- Work with students to develop a rating scale to assess presentations. Criteria could include: factual content (relevant research information, correct terminology); communication techniques (a variety of presentation tools, logical sequence of ideas). Encourage students to reflect on their assessments and use them as a basis for improvement.

RECOMMENDED LEARNING RESOURCES

Print Material

- Basic Technical Drawing, 6th Edition
- Communication Systems
- Design and Problem Solving in Technology
- Design and Technology
- GCSE Technology
- Living with Technology, Second Edition
- The Sky's the Limit with Math and Science
- Technology I.D.E.A.S.: A Teaching Resource Book



Video

- Alternative Energies: Fuels for the Future
- Coding and Transmission
- A Design Project - Case Study: Four Responses to a Design Brief
- How to Make Great Videos - With Just a Camcorder
- In the Kitchen
- Manufacturing Processes
- Manufacturing Systems
- The Secret Life of Machines Series
- Storage and Retrieval

Multimedia

- Technology Today and Tomorrow, Second Edition
- Technology Wheel

Software

- The Way Things Work - CD-ROM

Manipulatives

- Artstraws

PRESCRIBED LEARNING OUTCOMES

It is expected that students will:

- use a design process to modify products to improve their appearance, usefulness, and function
- classify and describe the characteristics of industrial materials
- investigate and select materials to meet design specifications
- devise and use assembly-sequence diagrams and flow charts to explain a process or system
- devise a manufacturing process
- identify new trends in manufacturing processes
- describe ways to reduce waste
- select and use a variety of finishes on products to improve their appearance and durability
- select and safely use hand and power tools in the manufacture of products
- demonstrate safe work habits when using tools, equipment, and technical processes, and encourage the same in others

SUGGESTED INSTRUCTIONAL STRATEGIES

Practical skills are best developed through hands-on experience while addressing real-world issues. Students have such opportunities as they design and produce both assigned and self-selected products and systems. As their production skills become increasingly sophisticated and precise, they extend their knowledge of the safe use of various tools and equipment.

- Have students investigate the differences between handcrafted and mass production processes and techniques by:
  - fabricating simple objects using a multiple-step method (e.g., paper pinwheels)
  - finding out in a measured time how many objects can be fabricated by individuals and by co-operative teams
  - describing the advantages and disadvantages of both methods.
- Work with students to illustrate a design process to update an existing product. Discuss the need to redesign a product when it does not market well or becomes obsolete, and show students an example (e.g., a toy). Have them identify weaknesses in its design, and have each team redesign it and develop a prototype.
- Have students investigate trends in manufacturing by examining the function and construction of tools and machines from various time periods. Ask them how modern processes have replaced older methods of manufacturing.
- Encourage students to work in teams to design and construct products or systems made of recycled materials. Have students list ways that cardboard, scrap wood, metal, and paper are used in their designs.

SUGGESTED ASSESSMENT STRATEGIES

Encourage students to discuss their ideas and strategies as they devise, modify, and improve existing processes and products. To assess their understandings, focus on their abilities to explain and justify their choices in materials and processes.

Observe

- While students work with hand and portable power tools, look for evidence that safety procedures are being followed. For example:
  - blade guards replaced
  - electric tools unplugged when not in use
  - gloves and glasses worn when necessary
  - extension cords stored safely

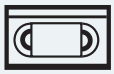
Question

- As students work on a design project, assess their planning abilities by asking questions such as:
  - What steps do you plan to work on today?
  - How does this fit in with your plan for competing the whole project?
- After students complete and evaluate a prototype, assess their design processes by asking questions such as:
  - What new problems have you identified?
  - What further improvements could be made to your prototype?
  - How could you address these issues in a subsequent design?
- While students work in design teams to manufacture a product, ask them to:
  - justify their choices of materials
  - explain how the materials relate to the design specifications (e.g., scratch resistant, lightweight, non-toxic)
  - justify the finishing processes they have chosen

RECOMMENDED LEARNING RESOURCES

Print Material

- Design and Problem Solving in Technology
- Design and Technology
- GCSE Technology
- Living with Technology, Second Edition
- The Random House Book of How Things Were Built
- The Sky's the Limit with Math and Science



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- Making the Most of Things
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- Manufacturing Resources
- Manufacturing Systems
- Robots at Work
- Safe and Effective Grinding
- The Secret Life of Machines Series

Multimedia

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- Technology Today and Tomorrow, Second Edition
- Technology Wheel

Software

- The Way Things Work - CD-ROM

Manipulatives

- Artstraws
- Lego/Dacta Manufacturing Systems

PRESCRIBED LEARNING OUTCOMES

It is expected that students will:

- demonstrate an understanding of the operating principles used in various control devices
- design and construct a system that uses a control device
- use troubleshooting strategies to locate the source of malfunctions in a system
- modify electric, electronic, pneumatic, and mechanical control devices for particular applications

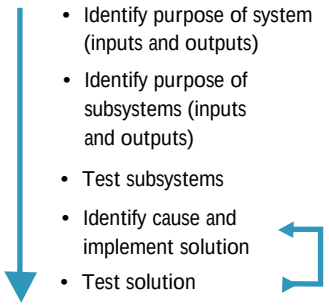
SUGGESTED INSTRUCTIONAL STRATEGIES

Students learn more about how control systems in their immediate environment operate, and they practise troubleshooting techniques when they don't work. They develop an understanding of the component parts of various systems, and design and build control devices for them.

- Ask students to identify control systems in the classroom, in the school, and at home. To extend their understandings of control devices in a variety of technologies (e.g., transportation), students examine the control components of a vehicle (e.g., steering, braking), and explain how they work and contribute to the entire operation of the system.
- Have students work together to record appropriate strategies to diagnose problems and establish solutions. For example, they could identify why a small engine does not run after being reassembled, or why an electronic circuit does not perform as intended.

Systems Analysis

Systems analysis or troubleshooting is a problem-solving method used to isolate and diagnose a malfunction.



- Devise ways for students to adjust control devices to improve the operation of a system (e.g., adjust the idle mixture on a carburetor, correctly set the gain of a microphone).
- Encourage students to apply their understandings of control mechanisms by designing and building systems for specific clients (e.g., modify household control mechanisms for a person in a wheelchair with little hand strength).

SUGGESTED ASSESSMENT STRATEGIES

As students design, build, or modify electronic and mechanical devices to suit particular applications, they demonstrate an understanding of design, construction, and troubleshooting procedures.

Observe

- While students are troubleshooting, observe the extent to which they are able to:
  - approach the problem systematically
  - identify interrelationships between various parts
  - identify the effect of a failed component on the system
  - explore alternative solutions
  - use tools and testing equipment in the trouble-shooting process

Question

- To assess the thinking of students as they modify electronic or mechanical devices to suit particular clients, conference with individuals or design teams. Ask questions such as:
  - What design parameters did you define based on the user's needs?
  - How did you modify the device?
  - How else could you have solved this problem?

Collect

- As students construct systems that include control devices, notice the extent to which they are able to:
  - choose task-appropriate control devices
  - modify control device to suit the tasks
  - efficiently incorporate appropriate control devices into their design plans
  - construct devices that are controlled effectively

RECOMMENDED LEARNING RESOURCES

Print Material

- Communication Systems
- Design and Problem Solving in Technology
- Exploring Transportation
- GCSE Technology
- Living with Technology, Second Edition
- Small Gas Engines
- Techniques For Technology
- Technology I.D.E.A.S.: A Teaching Resource Book

Video

- Fluid Power Technology at Work
- Manufacturing Processes
- Manufacturing Systems
- Robots at Work
- The Secret Life of Machines Series

Multimedia

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- Technology Wheel

Software

- The Way Things Work - CD-ROM

Manipulatives

- Discovery Kits: Pumping it up with Pneumatics
- Lego/Dacta Manufacturing Systems

PRESCRIBED LEARNING OUTCOMES

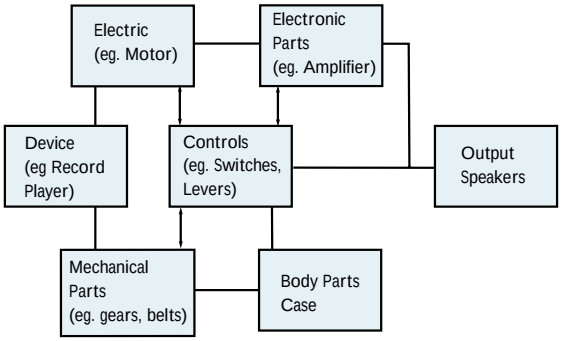
It is expected that students will:

- explain how systems convert potential energy to kinetic energy, and assess their environmental and social implications
- construct devices that convert and transmit various forms of energy
- disassemble devices and explain the transfer and conversion of energy within mechanical systems
- describe alternative sources of energy
- incorporate selected devices in the design of energy transmission and conversion systems

SUGGESTED INSTRUCTIONAL STRATEGIES

Modern society needs efficient transportation and reliable and affordable sources of energy. Students investigate methods of energy conversion and conservation, sources of energy, and power transmission to develop an understanding of global energy issues.

- Have students list sources of energy and applications that convert energy from one form to another (e.g., electric to heat, electric to mechanical, wind to mechanical). To focus their thinking, use prompts such as:
  - What systems in your home, school, or community convert electric energy to heat energy? Electric energy to mechanical energy?
  - What do you know about energy conversion systems used in other countries?
- Ask students to list the strengths and weaknesses of each system.
- Extend the activity by having groups research different countries to discover relationships between their sources of energy and economic conditions.
- Encourage students to bring discarded devices from home or workplace (e.g., gas station, computer service store, junk yard). Have students take each device apart systematically, noting on a flow chart the function of each component and how it works.



- Challenge students to design and make a device that either transmits or converts energy (e.g., solar-powered cooker; wind-powered generator).
- Where appropriate, incorporate energy transmission and conversion devices (e.g., electromagnets, heating elements, solar panels, gears, pulleys, wheels) in the design and construction of student projects.

SUGGESTED ASSESSMENT STRATEGIES

Students demonstrate an understanding of the principles of energy and power when they construct devices and explain how they work.

Observe

- As students research alternative sources of energy and present their findings to the class (e.g., oral presentation, chart, poster, computer presentation), look for evidence that students are able to:
  - identify practical applications for the energy source
  - describe how that form of energy is converted to other forms
  - predict future applications for the energy source

Question

- As students work, individually or in groups, determine the extent to which they have developed an understanding of the principles of the transfer and conversion of energy within mechanical systems with prompts such as:
  - What have you designed that converts potential energy to kinetic energy?
  - How is energy transferred within your system?
  - What practical applications might your system have?

Self-Assessment

- Students assess their own abilities to plan design projects by completing the following sentence stems in their design portfolios:
  - Three alternatives I considered when I started planning my project were____.
  - One part of the project I had to plan ahead for was____.
  - One design issue I had to find background information on was____.
  - One part of the project I would change if I made this product again is____.
  - One piece of advice I would give someone else designing this product is____.

RECOMMENDED LEARNING RESOURCES

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Manipulatives

- Discovery Kits: Pumping it up with Pneumatics
- Lego/Dacta Manufacturing Systems

PRESCRIBED LEARNING OUTCOMES

It is expected that students will:

- demonstrate a willingness to find unique solutions to problems that arise during the design process
- identify methods to improve their abilities to work with others during problem-solving activities
- demonstrate the ability to use community resources to help solve problems that come up during the design process
- describe new careers and occupations in technological fields and determine their educational prerequisites
- identify gender and ethnic bias in technological fields
- demonstrate confidence and positive attitudes when solving problems that occur during the design process
- describe how societal pressures influence technological advancements and, conversely, how technological changes influence society

SUGGESTED INSTRUCTIONAL STRATEGIES

Students develop critical- and creative-thinking skills as they generate solutions to problems that occur during the design process. They become more responsible users of technology and are increasingly aware of the implications of technology at home and in the workplace.

- Generate a set of problems relevant to students (e.g., devise ways of increasing student awareness of school-related environmental issues). Have them suggest solutions and act on them. As students generate needs and solve problems, encourage them to:
  - devise plans, goals, and timelines
  - complete daily progress reports that reflect their personal accomplishments and provide criteria for future improvement
  - make decisions and find ways to overcome setbacks
  - hold regular group discussions to monitor progress and improve group performance
- Engage students in a class discussion on issues related to accessing and policing the Internet, or the effect of the automobile on society. Alternatively, have them present lists of new consumer technologies that add a level of luxury to our lives, but are not needed to serve our basic needs.
- Have students interview resource people who can help them generate the best solutions to problem they found during the design process.
- Ask students to design and make a product that will help humanity.

SUGGESTED ASSESSMENT STRATEGIES

As students explore and discuss ideas and work toward solving problems, they demonstrate their design skills, their group interaction skills, and their abilities to understand complex relationships. To help students clarify and communicate their understandings, ask questions about the processes and strategies they are using.

Observe

- While students are working in design teams, look for evidence that they are able to:
  - assume different group roles
  - manage time and resources effectively
  - work to ensure the success of the group

Question

- Discuss the role of mentors, and how students could find mentors in technological fields that interests them. Ask questions such as:
  - How could a mentor help you pursue this career?
  - Who do you know in this field who could serve as a mentor for you?
  - How could you find mentors in the community? What community businesses and organizations might employ people in this field?
  - What is the first thing you could do to find a mentor?

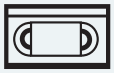
Collect

- Students each interview someone who works in a technological field, write a report summarizing theresearch, and develop an educational plan for that occupation. Collect the reports, and look for evidence that students are able to:
  - identify all facets of the jobs
  - identify relevant personal attributes and skills
  - generate sequential lists of educational requirements (e.g., high school courses, postsecondary education, on-the-job training)

RECOMMENDED LEARNING RESOURCES

Print Material

- Communication Systems
- Design and Problem Solving in Technology
- Design and Technology
- Exploring Transportation
- GCSE Technology
- Living with Technology, Second Edition
- Small Gas Engines



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- Manufacturing Resources
- Manufacturing Systems
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- The Secret Life of Machines Series

Multimedia

- Technology Today and Tomorrow, Second Edition
- Technology Wheel

Software

- The Way Things Work - CD-ROM

Manipulatives

- Artstraws

PRESCRIBED LEARNING OUTCOMES

It is expected that students will:

- develop a plan to clearly communicate ideas for creating products and systems
- use a variety of drawing projection methods
- evaluate information-gathering tools and processes used to access, store, organize, and present data
- apply knowledge and concepts from other disciplines in solving problems that arise during the design process
- revise presentations based on personally set objectives
- demonstrate skill in managing time and resources
- use information-gathering and communication methods to solve problems involving technology and to create effective presentations

SUGGESTED INSTRUCTIONAL STRATEGIES

Activities involving communications are woven throughout all steps of a design process. Project work helps students explore traditional methods to communicate ideas and concepts and extend their understandings of applications for emerging technologies. Students connect their learning with other subjects and consider how to use their understandings of technical communications in everyday life and in the workplace.

- Have student teams form companies to each design, develop, and market a product. In the process, encourage students to:
  - use group interaction skills as they discuss market needs and create plans for developing products
  - use electronic media to help develop product criteria and discuss the effectiveness of various information sources (e.g., Internet, World Wide Web, CD-ROM)
  - create flow charts and graphics to communicate the construction process
  - use applied mathematics to calculate the costs of materials required to create the products based on their designs, and summarize in reports for the CEOs of their companies
  - develop prototypes, learn ways to try out new products, and develop presentations to summarize their findings
  - produce three-dimensional and orthographic drawings as promotional materials for marketing their products in the school and in the community

SUGGESTED ASSESSMENT STRATEGIES

As students document their thinking in design portfolios, they demonstrate their abilities to communicate using drawings, sketches, and plans, and to integrate concepts from other disciplines into the design process.

Observe

- Students develop and present flow charts to create a product or system. Note the extent to which the diagrams:
  - reflect a logical progression of steps
  - highlight key points in the manufacturing process
  - show necessary detail
  - make complex ideas easily understood
  - reflect a professional finish

Collect

- Students each develop a design brief (see appendices D and F) for a product that solves a problem for a particular client group (e.g., help the elderly retrieve items from the floor). Collect the design briefs and look for evidence students are able to:
  - identify potential problems their client group may encounter
  - focus on one problem, describe it in detail, and generate possible solutions
  - articulate what they still need to find out (e.g., client information, specific design parameters)
  - identify appropriate sources of information (e.g., interviews, print resources)

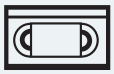
Self-Assessment

- As students develop presentations (e.g., design brief, manufacturing plan), have them list the objectives of their presentations and the extent to which they feel those objectives were met. Conference with students to assess the extent to which they recognize the strengths and limitations of their presentations. Help them develop a plan to improve future presentations and look for evidence that subsequent presentations are based on this plan.

RECOMMENDED LEARNING RESOURCES

Print Material

- Basic Technical Drawing, 6th Edition
- Communication Systems
- Design and Problem Solving in Technology
- Design and Technology
- GCSE Technology
- Living with Technology, Second Edition
- Technology I.D.E.A.S.: A Teaching Resource Book



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Multimedia

- Technology Today and Tomorrow, Second Edition
- Technology Wheel

Software

- The Way Things Work - CD-ROM

Manipulatives

- Artstraws

PRESCRIBED LEARNING OUTCOMES

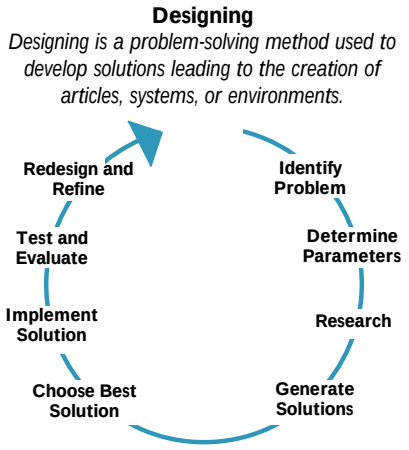
It is expected that students will:

- use a design process in production activities
- match materials to specific product requirements
- use orderly assembly and disassembly techniques
- explain and use WHMIS information
- devise a production process
- use hand and power tool techniques to process materials in order to improve the appearance, usefulness, and function of products
- examine new trends in manufacturing processes
- describe ways to reuse and recycle materials and products to reduce waste
- demonstrate safe work habits when using tools, equipment, and technical processes, and encourage the same in others
- classify and describe the characteristics of industrial materials

SUGGESTED INSTRUCTIONAL STRATEGIES

As students design and construct products, they apply the principles of combining, forming, separating, and finishing. By considering real-world and workplace problems, they learn that these principles and associated safety concerns are fundamental to all production, from home repair to commercial manufacturing.

- Lead class discussions about the various models people use to describe the design processes. Present visual models to help explain the process.



- Show students examples of design solutions developed to meet human wants and needs (e.g., sound). Elaborate on the technical evolution, and describe some of the unexpected spinoffs. Ask them questions to prompt their thinking about possible spinoff products from their designs.
- Have students work in teams to develop, design, and manufacture solutions to problems that involve the design process (e.g., a holder for a soft boiled egg using acrylic plastic). Their design portfolios should contain summaries of why certain materials were chosen, the relevant fabrication techniques used, and associated health and safety hazards.
- Lead class discussions about the various ways automation is used in a manufacturing processes. Students might build a conveyor belt assembly line. Have students incorporate computer-driven manufacturing processes such as CAD, CAM, and CNC to improve production efficiency and accuracy.

SUGGESTED ASSESSMENT STRATEGIES

Teachers can help students to clarify their thinking and communicate their understandings of production and safety issues by asking questions about the processes and strategies they are using, and by encouraging them to reflect on their choices.

Observe

- Divide students into small groups, and have each group study a different portion of the WHMIS handbook. Have each group role-play an accident and demonstrate safe response measures. Give classmates an opportunity to ask questions of the presenting group. Notice the extent to which students are able to identify:
  - materials that pose health risks
  - proper initial responses
  - community resources
  - proper clean-up and disposal procedures

Question

- As students investigate manufacturing processes (e.g., robotics, assembly line, surface-mount technologies), assess their abilities to relate those processes to their own manufacturing choices with questions such as:
  - What made you choose your manufacturing process?
  - What other processes might have worked?
  - What made you decide against the other choices?

Self-Assessment

- Students examine their design portfolios and prototypes. To focus their reflection, pose questions such as:
  - How did you redefine the design problem as you worked?
  - How did you choose materials to best match specific product requirements?
  - How did you address the issue of waste management in the manufacturing process?
  - What modifications could you make to improve your product?

RECOMMENDED LEARNING RESOURCES

Print Material

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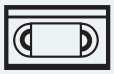

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Manipulatives

- Artstraws
- Lego/Dacta Manufacturing Systems

PRESCRIBED LEARNING OUTCOMES

It is expected that students will:

- devise ways to monitor, modify, and improve systems by incorporating control devices
- devise troubleshooting strategies for correcting malfunctions in a system
- demonstrate an understanding of the principles involved with interconnected control devices in product manufacturing
- design and construct a system that uses a control device, and assess its environmental and social implications

SUGGESTED INSTRUCTIONAL STRATEGIES

For students to design, diagnose, or repair technological systems, they need a fundamental understanding of control theory. They should understand that technological systems (e.g., transportation, communication, production) are managed by sensors, switches, and regulating devices.

- To help students understand how sensors (e.g., optical, magnetic, mechanical) are used to initiate an action in an electronic or mechanical system, have them build an electronic alarm system or investigate the mechanism used to change gears in a simple transmission (e.g., bicycle). As students work on the control device, ask questions such as:
  - What is the purpose of this control device?
  - How is information sensed by and incorporated into this system?
  - Can this device be integrated with others to form a system?
  - What other control devices can be used in a similar way?
- Work with students to brainstorm a list of strategies to diagnose or troubleshoot problems. Have them work in teams to create flow charts of the steps used to identify faults in an electronic or mechanical system. Examples include finding defective components in a simple electric circuit (e.g., flasher) or a fault in a small engine. Students annotate the completed flow charts and include them in their design portfolios.
- Have students design and construct devices to perform specific operations (e.g., pick-and-place, sort, transport). As part of the design criteria, each device should incorporate the type of power (e.g., fluid system, mechanical, electric) most appropriate to the device selected.

SUGGESTED ASSESSMENT STRATEGIES

As students design and construct control systems, they demonstrate their knowledge of a variety of sensors, switches, and regulating devices and their skill at diagnosing and repairing problems in a system.

Observe

- Students demonstrate their understandings of interconnected control devices by directing their classmates in skits that illustrate devices they have researched. Look for evidence that students are able to identify:
  - individual control devices within the system
  - the function of each device
  - how each control device affects others within the system

Question

- Have students analyse a malfunctioning system that they have constructed or been given. Note the extent to which students are able to:
  - systematically test subsystems to isolate a malfunction
  - identify the cause of the malfunction
  - explore and test alternative solutions

Collect

- Collect student-constructed systems that include sensors and their design portfolios for the project. Look for evidence of:
  - appropriate choice or modification of a sensor
  - effectiveness of the product
  - efficiency of the control device
  - reflection of initial criteria set out in the design process

RECOMMENDED LEARNING RESOURCES

Print Material

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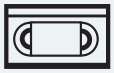

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PRESCRIBED LEARNING OUTCOMES

It is expected that students will:

- design systems that multiply, reduce, and transmit power, and assess their social and environmental implications
- analyse the function of systems used in machines and equipment
- construct devices to convert, store, and distribute energy in usable forms
- explain the transfer and conversion of energy within a mechanical system

SUGGESTED INSTRUCTIONAL STRATEGIES

Applying devices and processes to convert, transmit, and conserve power and energy sources helps students understand both traditional and innovative applications for power and energy and their technical functions. Students can investigate the application of these underlying principles through the design, construction, and analysis of systems and devices.

- Using models or diagrams, demonstrate products and systems that convert energy from one form to another (e.g., wind generators, wind-up toys, solar vehicles). After students decide on systems or products to construct, have them develop design briefs that include explanations of how their products use energy and power. (See Appendix D for a description of design briefs.)
- Present a variety of mechanisms and help students analyse them by asking questions such as:
  - What is the function of this mechanism in terms of energy storage, transmission, or conversion?
  - Suggest how two or more of these mechanisms could be combined to form a more complex system.
- Have students design and construct energy-efficient devices (e.g., aerodynamic CO_2-powered vehicles, energy-efficient housing, solar-powered wheelchairs).

SUGGESTED ASSESSMENT STRATEGIES

As students design complex, interrelated mechanical systems, they demonstrate their abilities to apply engineering principles by solving problems that occur during the design process, and recording their ideas.

Question

- To assess the extent to which students associate purpose and design, have them design mechanical devices (e.g., to scare birds away from a garden). In a conference, ask questions such as:
  - How did you decide on the system you are using to operate your device?
  - What other system could you have used?
  - What do you think the advantages and disadvantages of your system are?

Collect

- Collect student design briefs, and look for evidence that students are able to:
  - identify and describe task issues
  - focus and detail each task clearly
  - explore a variety of solutions
  - use prior knowledge to develop their designs
  - investigate relevant areas of the task

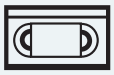
Self-Assessment

- Students develop criteria to evaluate their own products. Assess student-developed criteria for evidence they are able to:
  - identify criteria relevant to their products
  - consider possible users for their products when developing criteria
  - identify appropriate methods to evaluate their products

RECOMMENDED LEARNING RESOURCES

Print Material

- Design and Problem Solving in Technology
- Design and Technology
- Exploring Transportation
- GCSE Technology
- Living with Technology, Second Edition
- Small Gas Engines
- Technology I.D.E.A.S.: A Teaching Resource Book



Video

- Advanced Transportation and Solar Energy (Junior)
- Alternative Energies: Fuels for the Future
- A Design Project - Case Study: Four Responses to a Design Brief
- Fluid Power Technology at Work
- Manufacturing Processes
- Manufacturing Systems
- The Secret Life of Machines Series

Multimedia

- Lego/Dacta Control Lab Starter Pack
- Technology Today and Tomorrow, Second Edition
- Technology Wheel

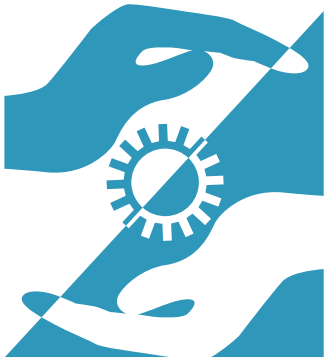
Software

- The Way Things Work - CD-ROM

Manipulatives

- Discovery Kits: Pumping it up with Pneumatics
- Lego/Dacta Manufacturing Systems

Technology Education
8 to 10 Appendices



Appendix A
Prescribed Learning Outcomes

Self and Society

Students need to understand how humans shape technology and the impact that current and future technological advances have on our society, culture, and environment.

It is expected that students will:

Grades K to 1	Grades 2 to 3	Grade 4
• solve problems that come up during the design process, independently and in groups • demonstrate confidence and a positive attitude throughout the problem-solving process • manage materials, time, and resources • identify and describe the effects of technology on their lives, at home, and in the classroom • identify occupations and role models in technological fields in their community, being sensitive to culture, gender, and physical ability	• solve problems the come up during the design process, independently and in groups • demonstrate confidence and a positive attitude throughout the problem-solving process • use a variety of classroom resources when looking for answers to problems involving design • manage materials, time, and resources • identify the effects of technology on their lives, at home, and in the classroom • identify occupations and role models in technological fields in their community, being sensitive to culture, gender, and physical ability	• demonstrate risk taking and perseverance throughout the problem-solving process • organize their work to improve the management of materials, time, and resources • express personal thoughts and feelings about the effects of technology in their lives, at home, and in the classroom • identify past and current technological occupations and role models, being sensitive to culture, gender, and physical ability

SELF AND SOCIETY

Students need to understand how humans shape technology and the impact that current and future technological advances have on our society, culture, and environment.

It is expected that students will:

Grade 5	Grade 6	Grade 7
• solve problems that come up during the design process, independently and in groups • manage their work and resources during design activities • analyse the positive and negative effects of technology in their lives. • categorize and compare various occupations in technological fields, and discuss how some have been the subject of culture, ability, and gender stereotyping.	• demonstrate, independently and in groups, confidence and a positive attitude when solving problems involving technology • compare and contrast solutions to problems involving design and technology in other cultures • describe how technological change affects their quality of life at home, in the community, and in society • identify career paths in technological fields, and examine possible career directions • investigate the traditional roles of people of different cultures and gender in technological fields	• apply innovative thought and actions when solving problems involving technology, independently and in groups • organize activities to make the best use of time, materials, and resources • investigate career paths in technological fields, and examine possible career directions • describe how societal pressures influence technological change and how technological change influences society

Self and Society

Students need to understand how humans shape technology and the impact that current and future technological advances have on our society, culture, and environment.

It is expected that students will:

Grade 8	Grade 9	Grade 10
• demonstrate confidence and positive attitudes when solving problems that arise during the design process • identify practical problems involving technology in a variety of contexts • work with others to solve problems that come up during the design process • list career paths in technological fields, and examine potential career opportunities • demonstrate a willingness to express thoughts and feelings about the effects of technology on their personal lives, society, and the environment	• contribute to group success by encouraging others to fulfil their responsibilities • identify role models in technological occupations, including those that are sensitive to culture, gender, and physical ability • explain relationships between technological advancements and changes in the workplace, including the changing roles of workers • evaluate design ideas based on assessments by others • demonstrate a willingness to look for and develop improved solutions to problems that arise during the design process • express personal thoughts and feelings about how societal pressures may influence technological advancements and, conversely, how technological changes influence society and the environment • demonstrate confidence and positive attitudes when solving problems that arise during the design process	• demonstrate a willingness to find unique solutions to problems that arise during the design process • identify methods to improve their abilities to work with others during problem-solving activities • demonstrate the ability to use community resources to help solve problems that come up during the design process • describe new careers and occupations in technological fields and determine their educational prerequisites • identify gender and ethnic bias in technological fields • demonstrate confidence and positive attitudes when solving problems that occur during the design process • describe how societal pressures influence technological advancements and, conversely, how technological changes influence society

COMMUNICATIONS

At home and in the workplace, students will need to use technology in the processing and sharing of information, and communicate ideas using language, graphics, and technology.

It is expected that students will:

Grades K to 1	Grades 2 to 3	Grade 4
• follow instructions to construct a product • communicate ideas for creating a product • make a drawing to communicate solutions to problems that come up during the design process • identify different ways to communicate using technology	• describe the purpose of technical communications used in the home • describe a problem involving design using their own words • describe a solution to a problem involving design • present ideas about products they have made, and show how they work • identify ways of enhancing technical communications	• describe a solution to a problem involving technology • use established criteria for designing presentations of ideas • develop a plan and clearly communicate ideas for creating a product or system • use appropriate tools in the presentation of ideas

COMMUNICATIONS

At home and in the workplace, students will need to use technology in the processing and sharing of information, and communicate ideas using language, graphics, and technology.

It is expected that students will:

Grade 5	Grade 6	Grade 7
• gather information from available resources to solve problems involving technology • describe a solution to a problem involving technology • determine appropriate criteria for the presentation of ideas • choose appropriate tools for the presentation of ideas • develop a plan and communicate ideas for creating products and systems	• use appropriate research strategies to solve problems involving technology • develop a plan and clearly communicate ideas for creating products or systems • choose appropriate tools to represent ideas to others • determine appropriate criteria for the presentation of ideas • select appropriate methods to convey information	• communicate ideas for designing products or systems using different kinds of drawings • choose appropriate tools to transmit ideas to others • develop a plan and clearly communicate ideas to create a product or system • use appropriate research techniques to help solve problems involving technology

COMMUNICATIONS

At home and in the workplace, students will need to use technology in the processing and sharing of information, and communicate ideas using language, graphics, and technology.

It is expected that students will:

Grade 8	Grade 9	Grade 10
• produce initial concept sketches and final drawings using a design process • solve problems that come up during the design process by using various information sources • develop two- and three-dimensional graphics using manual and computer-assisted processes • revise presentations based on suggestions and comments from others • identify how information and concepts from other fields of knowledge are used in the design process	• communicate ideas for designing products and systems using various drawing projection methods, spreadsheets, graphics, or other media • use information-gathering and communication methods to solve problems during the design process and to create effective presentations • revise presentations based on personal review and feedback from others • describe the advantages and disadvantages of various information-gathering and communication processes • develop two- and three-dimensional graphics using manual and computer-assisted processes • identify how information and concepts from other fields of knowledge are used in the design process	• develop a plan to clearly communicate ideas for creating products and systems • use a variety of drawing projection methods • evaluate information-gathering tools and processes used to access, store, organize, and present data • apply knowledge and concepts from other disciplines in solving problems that arise during the design process • revise presentations based on personally set objectives • demonstrate skill in managing time and resources • use information-gathering and communication methods to solve problems involving technology and to create effective presentations

PRODUCTION

Students build skills in designing and developing products and systems that improve the human condition.

It is expected that students will:

Grades K to 1	Grades 2 to 3	Grade 4
• solve problems involving technology using various tools, materials, and processes • modify familiar products by experimenting with ways of combining, separating, forming, and finishing materials • compare the properties and uses of familiar materials • identify common tools, and compare their characteristics and intended uses • recognize the potential safety hazards presented by tools, and identify safety equipment and procedures • recognize and suggest ways to reduce, reuse, and recycle materials and products to control waste	• solve problems involving technology using appropriate tools and materials • identify natural and manufactured materials • follow given steps in making a product • modify a variety of materials by combining, separating, forming, and finishing • identify ways to reduce, reuse, and recycle materials and products to control waste • identify the potential safety hazards presented by tools in the classroom, and use appropriate safety equipment and procedures.	• choose appropriate tools and materials for the construction of a product or system • develop a design, make a product or system, and determine the steps for its construction • determine ways to reduce, reuse, and recycle waste materials • identify natural and manufactured materials used in the manufacture of a product or system • modify a variety of materials by combining, separating, forming, and finishing to construct products or systems • identify the potential hazards of classroom tools, and use appropriate safety equipment and procedures

PRODUCTION

Students build skills in designing and developing products and systems that improve the human condition.

It is expected that students will:

Grade 5	Grade 6	Grade 7
• choose appropriate tools and materials for the design and construction of products or systems • identify the potential hazards of tools, and use appropriate safety equipment and procedures • demonstrate ways to reduce, reuse, and recycle materials and products to control waste • modify a variety of materials by combining, separating, forming, and finishing to construct products or systems • develop a design for a product or system, and determine the steps for its construction	• determine a sequence of steps before making a product or system based on a design • identify and use suitable tools, processes, and materials for combining, separating, forming, and finishing to construct products or systems • use appropriate hand and portable power tools in the safe manufacture of products or systems • describe ways to reduce, reuse, and recycle materials and products to control waste	• describe production processes involved in the development of products • identify and use suitable tools, processes, and materials for combining, separating, forming, and finishing to construct products or systems • modify designs to improve the appearance, usefulness, and function of a product or system • use hand and portable power tools for their intended function in the safe manufacture of products or systems • reuse and recycle materials and products to reduce waste

PRODUCTION

Students build skills in designing and developing products and systems that improve the human condition.

It is expected that students will:

Grade 8	Grade 9	Grade 10
• describe and use the process of product design • identify and classify the properties of materials used to manufacture products • select materials based on a set of design specifications • describe combining, forming, separating, and finishing processes as they relate to materials used in product manufacturing • apply finishes and details to manufactured products to enhance their appearance and durability • evaluate the efficiency of a production process • identify ways to minimize waste and reuse products • demonstrate safe work habits when using tools, equipment, and technical processes	• use a design process to modify products to improve their appearance, usefulness, and function • classify and describe the characteristics of industrial materials • investigate and select materials to meet design specifications • devise and use assembly-sequence diagrams and flow charts to explain a process or system • devise a manufacturing process • identify new trends in manufacturing processes • describe ways to reduce waste • select and use a variety of finishes on products to improve their appearance and durability • select and safely use hand and power tools in the manufacture of products • demonstrate safe work habits when using tools, equipment, and technical processes, and encourage the same in others	• use a design process in production activities • match materials to specific product requirements • use orderly assembly and disassembly techniques • explain and use WHMIS information • devise a production process • use hand and power tool techniques to process materials in order to improve the appearance, usefulness, and function of products • examine new trends in manufacturing processes • describe ways to reuse and recycle materials and products to reduce waste • demonstrate safe work habits when using tools, equipment, and technical processes, and encourage the same in others • classify and describe the characteristics of industrial materials

CONTROL

Control addresses the application of devices and processes used to manage, sort, control, and organize systems.

It is expected that students will:

Grades K to 1	Grades 2 to 3	Grade 4
• identify common control devices in their homes and at school • operate familiar control devices • identify methods to control a device manually • make a manual control device	• identify common control devices in their home and school environments that sense, switch, and regulate • design and make products that use control devices	• describe the function of control devices used in the community • describe a method to control a device • design and construct a control device

CONTROL

Control addresses the application of devices and processes used to manage, sort, control, and organize systems.

It is expected that students will:

Grade 5	Grade 6	Grade 7
• describe familiar control systems and the devices that control them • describe a sequence of steps to control a device • design and construct a control device that senses, switches, or regulates	• describe and use control devices that sense, switch, and regulate • design and construct a mechanical control device that senses, switches, or regulates	• explain the operation of control devices that sense, switch, or regulate • design and construct a control device that operates a system

CONTROL

Control addresses the application of devices and processes used to manage, sort, control, and organize systems.

It is expected that students will:

Grade 8	Grade 9	Grade 10
• design and construct a control device that senses, switches, or regulates • compare ways that various control devices work, and explain their applications • integrate electric, electronic, pneumatic, and mechanical control devices within a system • demonstrate understanding of the concept of control by dismantling devices	• demonstrate an understanding of the operating principles used in various control devices • design and construct a system that uses a control device • use troubleshooting strategies to locate the source of malfunctions in a system • modify electric, electronic, pneumatic, and mechanical control devices for particular applications	• devise ways to monitor, modify, and improve systems by incorporating control devices • devise troubleshooting strategies for correcting malfunctions in a system • demonstrate an understanding of the principles involved with interconnected control devices in product manufacturing • design and construct a system that uses a control device, and assess its environmental and social implications

ENERGY AND POWER

Energy and power addresses the application of devices and processes that convert, transmit, and conserve forms of energy.

It is expected that students will:

Grades K to 1	Grades 2 to 3	Grade 4
• identify products that use various forms of energy • demonstrate an understanding of the ways objects move • make products that use a mechanical power source	• identify a variety of energy sources • identify how energy can be transferred and converted to make devices function • design and make a device that is powered by an energy source	• identify simple machines • identify various forms of energy and how energy can be stored • identify devices that are used to convert, store, and transmit energy • design and construct devices that use simple machines

ENERGY AND POWER

Energy and power addresses the application of devices and processes that convert, transmit, and conserve forms of energy.

It is expected that students will:

Grade 5	Grade 6	Grade 7
• describe ways to conserve energy • identify alternative ways to make an existing product or system function • identify various forms of energy and power • design and construct devices that use simple machines	• identify systems that convert and transmit energy • design a device that converts and transmits energy • design and construct a product or system that uses simple machines	• design a system that converts energy into power • identify various forms of energy and their applications • design and construct devices that use different forms of energy to operate

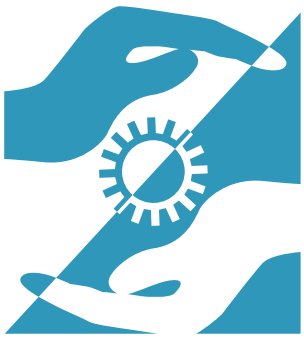
Energy and Power

Energy and power addresses the application of devices and processes that convert, transmit, and conserve forms of energy.

It is expected that students will:

Grade 8	Grade 9	Grade 10
• incorporate selected devices in the design of energy transmission and conversion systems • explain how systems transmit and convert energy • identify how simple machines are combined into energy and power systems • construct devices that are powered in various ways	• explain how systems convert potential energy to kinetic energy, and assess their environmental and social implications • construct devices that convert and transmit various forms of energy • disassemble devices and explain the transfer and conversion of energy within mechanical systems • describe alternative sources of energy • incorporate selected devices in the design of energy transmission and conversion systems	• design systems that multiply, reduce, and transmit power, and assess their social and environmental implications • analyse the function of systems used in machines and equipment • construct devices to convert, store, and distribute energy in usable forms • explain the transfer and conversion of energy within a mechanical system

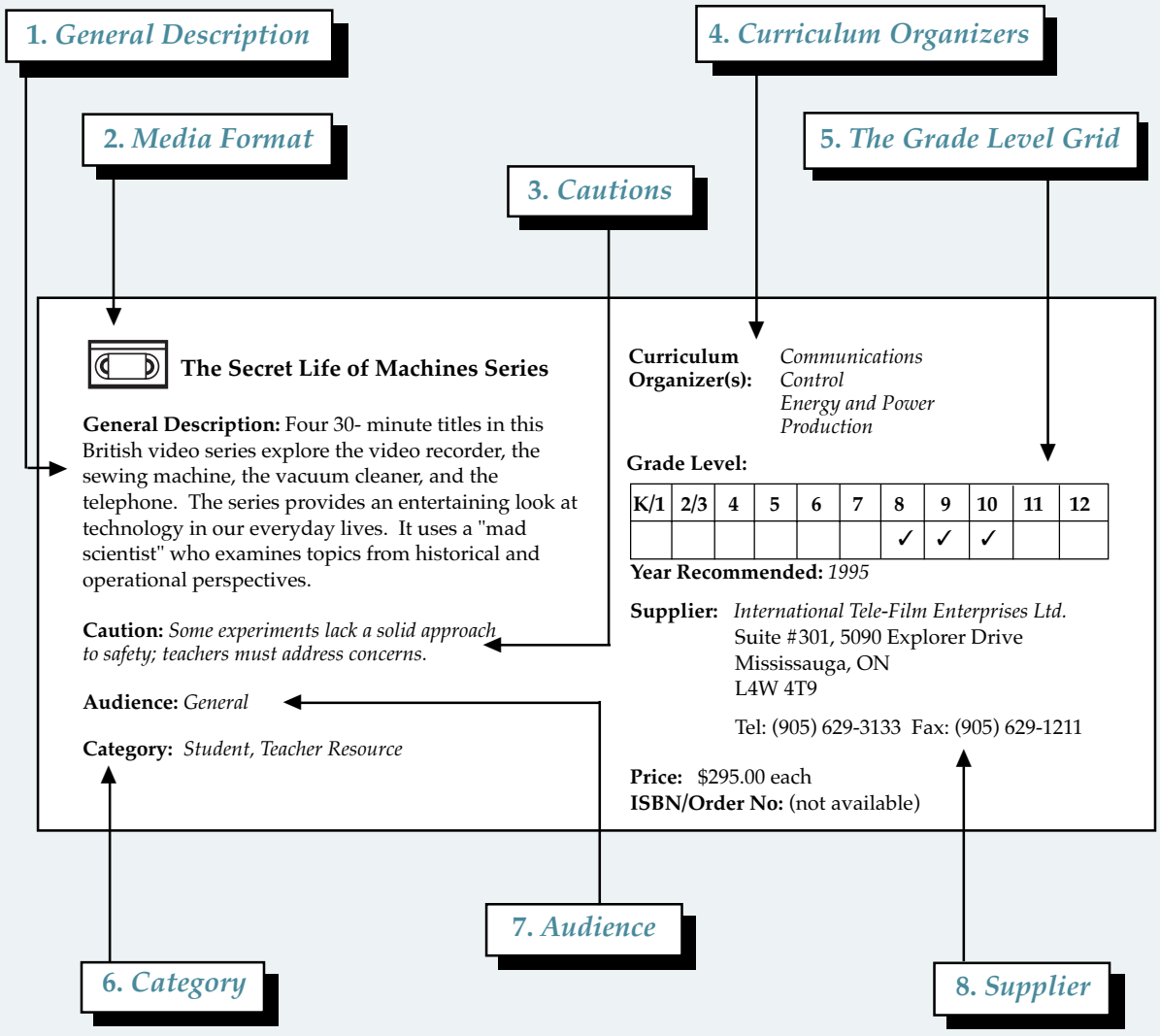
Appendix B
Learning Resources



WHAT IS APPENDIX B?

Appendix B is a comprehensive list of the *recommended* learning resources for Technology Education 8 to 10. The titles are listed alphabetically and each resource is annotated. In addition, Appendix B contains information on selecting learning resources for the classroom.

What information does an annotation provide?



1. ***General Description:*** This section provides an overview of the resource.

2. ***Media Format:*** is represented by an icon next to the title. Possible icons include:

Audio Cassette

CD-ROM

Film

Games/Manipulatives

Laserdisc, Videodisc

Multimedia

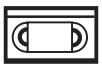
Music CD

Print Material

Record

Slides

Software


Video

3. ***Caution:*** This category is used to alert teachers about potentially sensitive issues.

4. ***Curriculum Organizers:*** This category helps teachers make links between the resource and the curriculum.

5. ***Grade Level Grid:*** This category indicates the suitable age range for the resource.

6. ***Category:*** This section indicates whether it is a student and teacher resource, teacher resource, or professional reference.

7. ***Audience:*** The audience category indicates the suitability of the resource for different types of students. Possible student audiences include the following:
   - general
   - English as a second language (ESL)
   - *Students who are:*
     - gifted
     - blind or have visual impairments
     - deaf or hard of hearing
   - *Students with:*
     - severe behavioural disorders
     - dependent handicaps
     - physical disabilities
     - autism
     - learning disabilities (LD)
     - mild intellectual disabilities (ID-mild)
     - moderate to severe/profound disabilities (ID-moderate to severe/profound)

8. ***Supplier:*** The name and address of the supplier are included in this category. Prices shown here are approximate and subject to change. Prices should be verified with the supplier.

What about the videos?

The ministry attempts to obtain rights for most *recommended* videos. Negotiations for the most recently recommended videos may not be complete. For these titles, the original distributor is listed in this document, instead of British Columbia Learning Connection Inc. Rights for new listings take effect the year implementation begins. Please check with British Columbia Learning Connection Inc. before ordering new videos.

SELECTING LEARNING RESOURCES FOR THE CLASSROOM

Selecting a learning resource means choosing locally appropriate materials from the list of recommended resources or other lists of evaluated resources. The process of selection involves many of the same considerations as the process of evaluation, though not to the same level of detail. Content, instructional design, technical design, and social considerations may be included in the decision-making process, along with a number of other criteria.

The selection of learning resources should be an ongoing process to ensure a constant flow of new materials into the classroom. It is most effective as an exercise in group decision making, co-ordinated at the school, district, and ministry levels. To function efficiently and realize the maximum benefit from finite resources, the process should operate in conjunction with an overall district and school learning resource implementation plan.

Teachers may choose to use provincially recommended resources to support provincial or locally developed curricula; or they may choose resources that are not on the ministry's list; or they may choose to develop their own resources. Resources that are not on the provincially recommended list must be evaluated through a local, board-approved process.

CRITERIA FOR SELECTION

There are a number of factors to consider when selecting learning resources.

Content

The foremost consideration for selection is the curriculum to be taught. Prospective resources must adequately support the particular learning objectives that the teacher wants to address. Resources on the ministry's *recommended* list are not matched directly to learning outcomes, but they are linked to the appropriate curriculum organizers. It is the responsibility of the teacher to determine whether a resource will effectively support any given learning outcomes within a curriculum organizer. This can only be done by examining descriptive information regarding that resource; acquiring additional information about the material from the supplier, published reviews, or colleagues; and by examining the resource first-hand.

Instructional Design

When selecting learning resources, teachers must keep in mind the individual learning styles and abilities of their students, as well as anticipate the students they may have in the future. Resources have been recommended to support a variety of special audiences, including gifted, learning disabled, mildly intellectually disabled, and ESL students. The suitability of a resource for any of these audiences has been noted in the resource annotation. The instructional design of a resource includes the organization and presentation techniques; the methods used to introduce, develop, and summarize concepts; and the vocabulary level. The

suitability of all of these should be considered for the intended audience.

Teachers should also consider their own teaching styles and select resources that will complement them. The list of *recommended* resources contains materials that range from prescriptive or self-contained resources, to open-ended resources that require considerable teacher preparation. There are *recommended* materials for teachers with varying levels and experience with a particular subject, as well as those that strongly support particular teaching styles.

Technology Considerations

Teachers are encouraged to embrace a variety of educational technologies in their classrooms. To do so, they will need to ensure the availability of the necessary equipment and familiarize themselves with its operation. If the equipment is not currently available, then the need must be incorporated into the school or district technology plan.

Social Considerations

All resources on the ministry's *recommended* list have been thoroughly screened for social concerns from a provincial perspective. However, teachers must consider the appropriateness of any resource from the perspective of the local community.

Media

When selecting resources, teachers should consider the advantages of various media. Some topics may be best taught using a specific medium. For example, video may be the most appropriate medium when teaching a particular, observable skill, since it provides a visual model that can be played over and over or viewed in slow motion for detailed analysis. Video can also bring otherwise unavailable experiences into the classroom and reveal "unseen worlds" to students. Software may be particularly useful when students are expected to develop critical-thinking skills through the manipulation of a simulation, or where safety or repetition are factors. Print resources or CD-ROM can best be used to provide extensive background information on a given topic. Once again, teachers must consider the needs of their individual students, some of whom may learn better from the use of one medium than another.

Funding

As part of the selection process, teachers should determine how much money is available to spend on learning resources. This requires an awareness of school and district policies, and procedures for learning resource funding. Teachers will need to know how funding is allocated in their district and how much is available for their needs. Learning resource selection should be viewed as an ongoing process that requires a determination of needs, as well as long-term planning to co-ordinate individual goals and local priorities.

Existing Materials

Prior to selecting and purchasing new learning resources, an inventory of those resources that are already available should be established through consultation with the school and district resource centres. In some districts, this can be facilitated through the use of district and school resource management and tracking systems. Such systems usually involve a computer database program (and possibly bar-coding) to help keep track of a multitude of titles. If such a system is put on-line, then teachers can check the availability of a particular resource via a computer.

SELECTION TOOLS

The Ministry of Education has developed a variety of tools to assist teachers with the selection of learning resources.

These include:

- Integrated Resource Packages (IRPs) which contain curriculum information, teaching and assessment strategies, and *recommended* learning resources
- learning resources information via annotation sets, resource databases on disks, the Learning Resources CD-ROM, and, in the future, on-line access
- sets of the most recently recommended learning resources (provided each year to a number of host districts throughout the province to allow teachers to examine the materials first hand at regional displays)
- sample sets of provincially recommended resources (available on loan to districts on request)

A MODEL SELECTION PROCESS

The following series of steps is one way a school resource committeee might go about selecting learning resources:

1. Identify a resource co-ordinator (for example, a teacher-librarian).
2. Establish a learning resources committee made up of department heads or lead teachers.
3. Develop a school vision and approach to resource-based learning.
4. Identify existing learning resource and library materials, personnel, and infrastructure.
5. Identify the strengths and weaknesses of the existing systems.
6. Examine the district Learning Resources Implementation Plan.
7. Identify resource priorities.
8. Apply criteria such as those found in *Selection and Challenge* to shortlist potential resources.
9. Examine shortlisted resources first-hand at a regional display or at a publishers' display, or borrow a set from the Learning Resources Branch.
10. Make recommendations for purchase.

FURTHER INFORMATION

For further information on evaluation and selection processes, catalogues, CD-ROM catalogues, annotation sets, or resource databases, please contact the Learning Resources Branch at 387-5331 or by fax at 387-1527.

Advanced Transportation and Solar Energy (Junior)

General Description: Fifteen-minute video on clean transportation technologies including solar race cars, solar-assisted commuter cars, and electric vehicles. It also addresses the use of renewable crops to produce ethanol.

Audience: *General*

Category: *Student, Teacher Resource*

Curriculum Organizer(s): *Energy and Power*

Grade Level:

K/1	2/3	4	5	6	7	8	9	10	11	12
						✓	✓	✓		

Year Recommended: *1995*

Supplier: *International Tele-Film Enterprises Ltd.*

Suite #301, 5090 Explorer Drive
Mississauga, ON
L4W 4T9

Tel: (905) 629-3133 Fax: (905) 629-1211

Price: $310.00

ISBN/Order No: ADV200

Alternative Energies: Fuels for the Future

General Description: Twenty-minute video examines a variety of renewable and non-renewable energy resources, their uses, concerns, and environmental impact. Teacher's guide with glossary, discussion topics, and follow-up activities is included.

Audience: *General*

Category: *Student, Teacher Resource*

Curriculum Organizer(s): *Communications*
Energy and Power
Self and Society

Grade Level:

K/1	2/3	4	5	6	7	8	9	10	11	12
					✓	✓	✓	✓		

Year Recommended: *1995*

Supplier: *McIntyre Media Ltd.*

30 Kelfield Street
Rexdale, ON
M9W 5A2

Tel: 1-800-565-3036 Fax: (416) 245-8660

Price: $99.00

ISBN/Order No: 849600-61

Artstraws

General Description: Carton of 1800 paper straws 43.2 cm long accompanied by two instruction pamphlets. Activities allow students to discover properties of the straws and learn how to modify a structure using scissors, tape, and plasticine. Complementary print resource is *Challenging Artstraws*.

Audience: *General*

Category: *Student, Teacher Resource*

Curriculum Organizer(s): *Communications*
Production
Self and Society

Grade Level:

K/1	2/3	4	5	6	7	8	9	10	11	12
✓	✓	✓	✓	✓	✓	✓	✓	✓		

Year Recommended: *1995*

Supplier: *Louise Kool + Galt Ltd.*

Unit 11, 1149 Bellamy Road
Scarborough, ON
M1H 1H7

Tel: (416) 439-4322 Fax: (416) 439-1861

Price: $39.95

ISBN/Order No: 009.N3519E

Basic Technical Drawing, 6th Edition

General Description: Student text and activity book teach technical drawing. Essential information is enhanced by numerous and clear illustrations. Answer key provided.

Caution: *Most measurements are imperial; few drawings are in metric.*

Audience: *General*

Category: *Student, Teacher Resource*

Curriculum Organizer(s): *Communications*

Grade Level:

K/1	2/3	4	5	6	7	8	9	10	11	12
						✓	✓	✓		

Year Recommended: *1995*

Supplier: *McGraw-Hill Ryerson Ltd. (Ontario)*

300 Water Street
Whitby, ON
L1N 9B6

Tel: (905) 430-5000 Fax: (905) 430-5020

Price: Student Text: $52.03
Problems/Answer Key: $25.02/$7.81

ISBN/Order No: Student Text: 0-02-685660-3
Problems/Answer Key

Capsela

General Description: Construction and modelling kit of moving gears and parts that are contained inside transparent capsules. The interlocking parts snap together to make a variety of motorized land and water models. The resource engages students in active learning of mechanical and electrical principles.

Audience: *General*

Category: *Student, Teacher Resource*

Curriculum Organizer(s): *Control*
Energy and Power
Production

Grade Level:

K/1	2/3	4	5	6	7	8	9	10	11	12
		✓	✓	✓	✓	✓				

Year Recommended: *1995*

Supplier: *Louise Kool + Galt Ltd.*

Unit 11, 1149 Bellamy Road
Scarborough, ON
M1H 1H7

Tel: (416) 439-4322 Fax: (416) 439-1861

Price: Class Pack: $119.95
Junior 400 Kit: $59.95

ISBN/Order No: Class Pack: 019-08848
Junior 400 Kit: 019-08845

Coding and Transmission

General Description: Twenty-two-minute video covers how human sensory organs convey information to the brain where it is decoded; what analog and digital coding means; optic fibre, wireless transmission; and the interconnection of computer faxes and modems. This video provides a good introduction to digital electronics.

Audience: *General*

Category: *Student, Teacher Resource*

Curriculum Organizer(s): *Communications*

Grade Level:

K/1	2/3	4	5	6	7	8	9	10	11	12
							✓	✓		

Year Recommended: *1995*

Supplier: *T. H. A. Media Distributors Ltd.*

#307, 1200 West Pender Street
Vancouver, BC
V6E 2S9

Tel: (604) 687-4215 Fax: (604) 688-8349

Price: $199.00

ISBN/Order No: (not available)

Communication Systems

General Description: Student text, student activity manual, and an instructor's manual introduce the variety of ways we use technology to communicate. Topics explored include design and problem solving, measurement systems, sketching, drafting, multiview drawings, and dimensioning.

Audience: *General*

Category: *Student, Teacher Resource*

Curriculum Organizer(s): *Control*
Communications
Self and Society

Grade Level:

K/1	2/3	4	5	6	7	8	9	10	11	12
						✓	✓	✓		

Year Recommended: *1995*

Supplier: *Irwin Publishing*

1800 Steeles Avenue West
Concord, ON
L4K 2P3

Tel: (905) 660-0611 Fax: (905) 660-0676

Price: Student Text/Manual: $46.40/$12.56
Instructor's Manual: $16.80

ISBN/Order No: Student Text/Manual:
0-87006-9616/0-87006-9624

Design and Problem Solving in Technology

General Description: Student text and instructor's guide focus on the design and problem-solving process and feature problem-solving activities. Material is applied to analyses of a variety of systems. The instructor's guide contains answer keys and transparency masters.

Audience: *General*

Category: *Student, Teacher Resource*

Curriculum Organizer(s): *Control*
Communications
Energy and Power
Production, Self and Society

Grade Level:

K/1	2/3	4	5	6	7	8	9	10	11	12
							✓	✓		

Year Recommended: *1995*

Supplier: *Nelson Canada*

1120 Birchmount Road
Scarborough, ON
M1K 5G4

Tel: (416) 752-9100 Fax: (416) 752-9365

Price: Text: $37.76
Instructor's Guide: $25.16

ISBN/Order No: Text: 0-8273-5244-1
Instructor's Guide: 0-8273-5246-8

Design and Technology

General Description: Canadian student text and instructor's guide emphasize design as the critical element driving the technological process. Problem-solving activities and career profiles are included. The guide provides evaluation tools, answers, and blackline masters.

Audience: *General*

Category: *Student, Teacher Resource*

Curriculum Organizer(s): *Communications*
Energy and Power
Production
Self and Society

Grade Level:

K/1	2/3	4	5	6	7	8	9	10	11	12
							✓	✓		

Year Recommended: *1995*

Supplier: *McGraw-Hill Ryerson Ltd. (Ontario)*

300 Water Street
Whitby, ON
L1N 9B6

Tel: (905) 430-5000 Fax: (905) 430-5020

Price: Student Text: $28.01
Teacher's Resource: $45.00

ISBN/Order No: Student Text: 0-07-549650-X
Teacher's Resource: 0-07-549941-X

A Design Project - Case Study: Four Responses to a Design Brief

General Description: Thirty-two-minute Australian video explores questions in contemporary design using the camper trailer, or caravan, as the example. Architects from around the world were commissioned to create innovative designs for discussion. Manufacturers in turn produced working prototypes.

Audience: *General*
Gifted - open-ended problem solving and design

Category: *Student, Teacher Resource*

Curriculum Organizer(s): *Communications*
Energy and Power
Production
Self and Society

Grade Level:

K/1	2/3	4	5	6	7	8	9	10	11	12
							✓	✓		

Year Recommended: *1995*

Supplier: *Classroom Video Inc.*

9005 Centaurus Circle, Unit C
Burnaby, BC
V3J 7N4

Tel: (604) 420-3066 Fax: (604) 420-3095

Price: $69.00

ISBN/Order No: (not available)

Discovery Kits: Pumping it up with Pneumatics

General Description: Resource kit provides an introduction to pneumatics and hydraulics through theory and practical, hands-on activities. Support structures and several circuits can be constructed.

Audience: *General*

Category: *Student, Teacher Resource*

Curriculum Organizer(s): *Control*
Energy and Power

Grade Level:

K/1	2/3	4	5	6	7	8	9	10	11	12
					✓	✓	✓	✓		

Year Recommended: *1995*

Supplier: *Spectrum Educational Supplies*

2102 Elspeth Place
Port Coquitlam, BC
V3C 1G3

Tel: (604) 942-5835 Fax: (604) 941-1066

Price: $29.95

ISBN/Order No: 70022

Experience Technology: Communication, Production, Transportation, Biotechnology

General Description: Multi-format resource introduces students to the principal fields of technology. Visually rich, it provides challenging problem-solving activities. Components include: introductory student text, student workbook, student video, annotated teacher's text, resource binder, teacher's video, computer test bank in Macintosh or MS-DOS format.

Audience: *General*
Gifted - extension in activities
LD - concept development, highly visual, appropriate vocabulary, other forms of communication such as group presentation, speaking versus writing

Category: *Student, Teacher Resource*

Curriculum Organizer(s): *Control*
Communications
Energy and Power
Production, Self and Society

Grade Level:

K/1	2/3	4	5	6	7	8	9	10	11	12
				✓	✓	✓				

Year Recommended: *1995*

Supplier: *McGraw-Hill Ryerson Ltd. (Ontario)*

300 Water Street
Whitby, ON
L1N 9B6

Tel: (905) 430-5000 Fax: (905) 430-5020

Price: $40.00 - $140.00

ISBN/Order No: (not available)

Exploring Transportation

General Description: Student text, non-reproducible student activity manual, and an instructor's manual explore the topics of transportation, energy, and power from a historical to futuristic perspective.

Audience: *General*

Category: *Student, Teacher Resource*

Curriculum Organizer(s): *Control*
Energy and Power
Self and Society

Grade Level:

K/1	2/3	4	5	6	7	8	9	10	11	12
						✓	✓	✓		

Year Recommended: *1995*

Supplier: *Irwin Publishing*

1800 Steeles Avenue West
Concord, ON
L4K 2P3

Tel: (905) 660-0611 Fax: (905) 660-0676

Price: Student Text/Manual: $36.80/$10.00
Instructor's Guide: $15.84

ISBN/Order No: Student Text/Manual:
87006-9799/87006-9802

Fluid Power Technology at Work

General Description: Twenty-three-minute video provides an introduction to hydraulic and pneumatic power systems with discussion of applications, social impact, and comparison of the two systems.

Audience: *General*

Category: *Student, Teacher Resource*

Curriculum Organizer(s): *Control*
Energy and Power
Production
Self and Society

Grade Level:

K/1	2/3	4	5	6	7	8	9	10	11	12
						✓	✓	✓		

Year Recommended: *1995*

Supplier: *McIntyre Media Ltd.*

30 Kelfield Street
Rexdale, ON
M9W 5A2

Tel: 1-800-565-3036 Fax: (416) 245-8660

Price: $145.00

ISBN/Order No: 700020-61

GCSE Technology

General Description: Four books cover mechanisms, structures, electronics, and pneumatics. Each book contains a collection of design problems, skill-building activities, and a reference or research section. Designed for the British National Curriculum.

Audience: *General*

Category: *Student, Teacher Resource*

Curriculum Organizer(s): *Control*
Communications
Energy and Power
Production, Self and Society

Grade Level:

K/1	2/3	4	5	6	7	8	9	10	11	12
						✓	✓	✓		

Year Recommended: *1995*

Supplier: *Bacon & Hughes*

13 Deerlane Avenue
Nepean, ON
K2E 6W7

Tel: (613) 226-8136 Fax: (613) 226-8121

Price: $15.95 each

ISBN/Order No: (not available)

How to Make Great Videos - With Just a Camcorder

General Description: Twenty-five-minute video examines numerous stages in planning a video, developing ideas, storyboarding, and casting. Techniques such as lighting, in-camera editing, and animation are demonstrated. Student-centred activities show how to plan and produce using just one camera.

Audience: *General*

Category: *Student, Teacher Resource*

Curriculum Organizer(s): *Communications*
Production
Self and Society

Grade Level:

K/1	2/3	4	5	6	7	8	9	10	11	12
					✓	✓	✓	✓		

Year Recommended: *1995*

Supplier: *McIntyre Media Ltd.*

30 Kelfield Street
Rexdale, ON
M9W 5A2

Tel: 1-800-565-3036 Fax: (416) 245-8660

Price: $149.00

ISBN/Order No: 352700-21

In the Kitchen

General Description: Twenty-minute British video shows students working in groups to design kitchens based on efficient use of space for two different situations. It walks the viewer through a series of steps for design and problem-solving strategies, while emphasizing scale drawing and modelling.

Audience: *General*

Category: *Student, Teacher Resource*

Curriculum Organizer(s): *Communications*
Production
Self and Society

Grade Level:

K/1	2/3	4	5	6	7	8	9	10	11	12
					✓	✓	✓	✓		

Year Recommended: *1995*

Supplier: *Marlin Motion Pictures Ltd. (Man.)*

418 Waterloo Street
Winnipeg, MB
R3N 0S8

Tel: (204) 489-6185 Fax: (204) 489-0347

Price: $750.00

ISBN/Order No: 73842

Lego/Dacta Control Lab Starter Pack

General Description: Modelling kit has more than 500 interlocking parts which snap together to make a variety of working, control-related models. Models can be interfaced with the computer in Macintosh or MS-DOS to perform control functions. Reference guides and a literature pack are included.

Audience: *General*
ESL - visuals and manipulatives
LD - hands-on activities

Category: *Student, Teacher Resource*

Curriculum Organizer(s): *Control*
Energy and Power
Production

Grade Level:

K/1	2/3	4	5	6	7	8	9	10	11	12
						✓	✓	✓		

Year Recommended: *1995*

Supplier: *LEGO Canada Inc.*

380 Markland Street
Markham, ON
L6C 1T6

Tel: (905) 887-5346 Fax: (905) 887-1274

Price: $100.00 - $350.00

ISBN/Order No: (not available)

Lego/Dacta Manufacturing Systems

General Description: *Systems Set* has 282 interlocking parts which snap together to make a variety of manufacturing related models such as conveyor, drill press, dough mixer, jewellery polisher. An activity pack comprises teacher guide and reproducible design briefs. Models can be customized. The tool promotes active learning of mechanical and electrical principles.

Audience: *General*
ESL - visuals and manipulatives
LD - hands-on activities

Category: *Student, Teacher Resource*

Curriculum Organizer(s): *Control*
Energy and Power
Production

Grade Level:

K/1	2/3	4	5	6	7	8	9	10	11	12
						✓	✓	✓		

Year Recommended: *1995*

Supplier: *LEGO Canada Inc.*

380 Markland Street
Markham, ON
L6C 1T6

Tel: (905) 887-5346 Fax: (905) 887-1274

Price: $148.00

ISBN/Order No: (not available)

Living with Technology, Second Edition

General Description: Student textbook begins with a general discussion of technology in a changing world, resources for technology, problem solving, and systems. Subsequent chapters apply this to analyses of a variety of real situations. A teacher's resource guide supports the activity-based instruction.

Audience: *General*

Category: *Student, Teacher Resource*

Curriculum Organizer(s): *Control*
Communications
Energy and Power
Production, Self and Society

Grade Level:

K/1	2/3	4	5	6	7	8	9	10	11	12
						✓	✓	✓		

Year Recommended: *1995*

Supplier: *Nelson Canada*

1120 Birchmount Road
Scarborough, ON
M1K 5G4

Tel: (416) 752-9100 Fax: (416) 752-9365

Price: Student Text: $42.26
Teacher's Resource Guide: $46.76

ISBN/Order No: Student Text: 8273-4907-6
Teacher's Resource Guide: 8273-4909-2

Making the Most of Things

General Description: Twenty-six-minute video features the life of Elizabeth Gale, an 81-year-old furniture maker from Newfoundland. Completely self-taught and using just a few tools, she developed her own style of folk art furniture.

Audience: *General*

Category: *Student, Teacher Resource*

Curriculum Organizer(s): *Production*
Self and Society

Grade Level:

K/1	2/3	4	5	6	7	8	9	10	11	12
				✓	✓	✓	✓	✓		

Year Recommended: *1995*

Supplier: *Moving Images Distribution*

402 West Pender Street, Suite 606
Vancouver, BC
V6B 1T6

Tel: (604) 684-3014 Fax: (604) 684-7165

Price: $295.00

ISBN/Order No: 662-1

Manufacturing Processes

General Description: Fifteen-minute video illustrates primary and secondary manufacturing processing including: casting and molding, forming, separating, conditioning, assembling, and finishing. Also discussed are properties of manufactured materials.

Audience: *General*

Category: *Student, Teacher Resource*

Curriculum Organizer(s): *Control*
Communications
Energy and Power
Production, Self and Society

Grade Level:

K/1	2/3	4	5	6	7	8	9	10	11	12
						✓	✓	✓		

Year Recommended: *1995*

Supplier: *McIntyre Media Ltd.*

30 Kelfield Street
Rexdale, ON
M9W 5A2

Tel: 1-800-565-3036 Fax: (416) 245-8660

Price: (not available)

ISBN/Order No: 700027-61

Manufacturing Resources

General Description: Seventeen-minute video uses dramatization to illustrate the requirements of manufacturing systems: material resources, human resources, and capital resources. It explores renewable and exhaustible raw materials, industrial materials, and engineered materials.

Audience: *General*

Category: *Student, Teacher Resource*

Curriculum Organizer(s): *Production*
Self and Society

Grade Level:

K/1	2/3	4	5	6	7	8	9	10	11	12
						✓	✓	✓		

Year Recommended: *1995*

Supplier: *McIntyre Media Ltd.*

30 Kelfield Street
Rexdale, ON
M9W 5A2

Tel: 1-800-565-3036 Fax: (416) 245-8660

Price: (not available)

ISBN/Order No: 700026 - 61

Manufacturing Systems

General Description: Seventeen-minute video uses dramatization to illustrate manufacturing systems: continuous, intermittent, and custom. Discussion includes a comparison of strengths and weaknesses, as well as requirements in terms of tools, equipment, and workers.

Audience: *General*

Category: *Student, Teacher Resource*

Curriculum Organizer(s): *Control*
Communications
Energy and Power
Production, Self and Society

Grade Level:

K/1	2/3	4	5	6	7	8	9	10	11	12
						✓	✓	✓		

Year Recommended: *1995*

Supplier: *McIntyre Media Ltd.*

30 Kelfield Street
Rexdale, ON
M9W 5A2

Tel: 1-800-565-3036 Fax: (416) 245-8660

Price: (not available)

ISBN/Order No: 700025

Parking Places

General Description: Twenty-minute British video explores the principles behind a well-designed parking lot. It shows students in groups brainstorming and working toward a conclusion and solution.

Audience: *General*

Category: *Student, Teacher Resource*

Curriculum Organizer(s): *Communications*
Production
Self and Society

Grade Level:

K/1	2/3	4	5	6	7	8	9	10	11	12
			✓	✓	✓	✓				

Year Recommended: *1995*

Supplier: *Marlin Motion Pictures Ltd. (Ont.)*

211 Watline Avenue
Mississauga, ON
L4P 1P3

Tel: (905) 890-1500 Fax: (905) 890-6550

Price: $750.00

ISBN/Order No: 73807

Q Science Series

General Description: Collection of seven books organized around three themes: "forces and energy," "material," and "communications." The books contain a large number of student activities and experiments related to each concept.

Audience: *General*

Category: *Teacher Resource*

Curriculum Organizer(s): *Control*
Communications
Energy and Power
Production, Self and Society

Grade Level:

K/1	2/3	4	5	6	7	8	9	10	11	12
				✓	✓	✓				

Year Recommended: *1995*

Supplier: *Copp Clark Longman Ltd.*

2775 Matheson Boulevard East
Mississauga, ON
L4W 4P7

Tel: (905) 238-6074 Fax: (905) 238-6075

Price: $7.60 - $8.40 each

ISBN/Order No: (not available)

The Random House Book of How Things Were Built

General Description: Book explores the history and development of structures including buildings, bridges, dams, aqueducts, and roads. Clearly detailed scene-setting diagrams are used. A comprehensive glossary is included.

Audience: *General*

Category: *Student, Teacher Resource*

Curriculum Organizer(s): *Production*

Grade Level:

K/1	2/3	4	5	6	7	8	9	10	11	12
				✓	✓	✓	✓			

Year Recommended: *1995*

Supplier: *Random House of Canada Ltd.*

1265 Aerowood Drive
Mississauga, ON
L4W 1B9

Tel: (905) 624-0672 Fax: (905) 624-6217

Price: $19.00

ISBN/Order No: 0679820442

Robots at Work

General Description: Ten-minute video provides an introduction to robotics and the principles of robotics movements using industrial applications as examples. It shows how Cartesian co-ordinates are applied to program the robots for three-dimensional movement. Questions are posed to viewers during the video and highlighted by examples.

Audience: *General*

Category: *Student, Teacher Resource*

Curriculum Organizer(s): *Control*
Production
Self and Society

Grade Level:

K/1	2/3	4	5	6	7	8	9	10	11	12
					✓	✓	✓	✓		

Year Recommended: *1995*

Supplier: *Marlin Motion Pictures Ltd. (Man.)*

418 Waterloo Street
Winnipeg, MB
R3N 0S8

Tel: (204) 489-6185 Fax: (204) 489-0347

Price: $500.00

ISBN/Order No: (not available)

Safe and Effective Grinding

General Description: Fifteen-minute video addresses the safe operation and set-up of bench and pedestal grinders. It covers installation and testing of grinding wheels, grinding wheel classification, dressing, and safe grinding procedures.

Audience: *General*

Category: *Student, Teacher Resource*

Curriculum Organizer(s): *Production*

Grade Level:

K/1	2/3	4	5	6	7	8	9	10	11	12
							✓	✓		

Year Recommended: *1995*

Supplier: *Safetycare Inc.*

3354 Tennyson Avenue
Victoria, BC
V8Z 3P6

Tel: 475-6775 Fax: 475-6705

Price: $180.00

ISBN/Order No: (not available)

The Secret Life of Machines Series

General Description: Four 30-minute titles in this British video series explore the video recorder, the sewing machine, the vacuum cleaner, and the telephone. The series provides an entertaining look at technology in our everyday lives. It uses a "mad scientist" who examines topics from historical and operational perspectives.

Caution: *Some experiments lack a solid approach to safety; teachers must address concerns.*

Audience: *General*

Category: *Student, Teacher Resource*

Curriculum Organizer(s): *Control*
Communications
Energy and Power
Production, Self and Society

Grade Level:

K/1	2/3	4	5	6	7	8	9	10	11	12
						✓	✓	✓		

Year Recommended: *1995*

Supplier: *International Tele-Film Enterprises Ltd.*

Suite #301, 5090 Explorer Drive
Mississauga, ON
L4W 4T9

Tel: (905) 629-3133 Fax: (905) 629-1211

Price: $295.00 each

ISBN/Order No: (not available)

The Sky's the Limit with Math and Science

General Description: Reproducible investigations provide a technological approach to math and science. The major focus is on an aerodynamics theme: concepts such as trigonometry and Bernoulli's Principle are explored through a Technology Education problem-solving approach.

Audience: *General*

Category: *Student, Teacher Resource*

Curriculum Organizer(s): *Communications*
Energy and Power
Production

Grade Level:

K/1	2/3	4	5	6	7	8	9	10	11	12
			✓	✓	✓	✓	✓			

Year Recommended: *1995*

Supplier: *Spectrum Educational Supplies*

2102 Elspeth Place
Port Coquitlam, BC
V3C 1G3

Tel: (604) 942-5835 Fax: (604) 941-1066

Price: $34.95

ISBN/Order No: 1-881431-44-4/20128

Small Gas Engines

General Description: Textbook covers the fundamentals of small engine construction, operation, maintenance, trouble-shooting, rebuilding, repairs, and related career opportunities. Hands-on activities are suggested. A workbook and teacher's guide are available.

Audience: *General*

Category: *Student, Teacher Resource*

Curriculum Organizer(s): *Control*
Energy and Power
Self and Society

Grade Level:

K/1	2/3	4	5	6	7	8	9	10	11	12
							✓	✓		

Year Recommended: *1995*

Supplier: *Irwin Publishing*

1800 Steeles Avenue West
Concord, ON
L4K 2P3

Tel: (905) 660-0611 Fax: (905) 660-0676

Price: Student Text/Workbook: $36.80/$11.20
Instructor's Guide: $5.00

ISBN/Order No: (not available)

Storage and Retrieval

General Description: Twenty-two-minute video explores the history and development of recording information, from book form to vinyl LPs, to laser and CD, as well as analog and digital storage systems. It explains the development of mechanical recording systems ranging from vinyl LPs to laser-etched discs.

Audience: *General*

Category: *Student, Teacher Resource*

Curriculum Organizer(s): *Communications*

Grade Level:

K/1	2/3	4	5	6	7	8	9	10	11	12
						✓	✓	✓		

Year Recommended: *1995*

Supplier: *T. H. A. Media Distributors Ltd.*

#307, 1200 West Pender Street
Vancouver, BC
V6E 2S9

Tel: (604) 687-4215 Fax: (604) 688-8349

Price: $199.00

ISBN/Order No: (not available)

Techniques For Technology

General Description: Book promotes practical ideas and concepts related to power, energy and controls, especially electrical. Black and white design sketches provide information about using a variety of materials, ranging from everyday to sophisticated, in order to encourage technological activities in the classroom.

Audience: *General*

Category: *Teacher Resource*

Curriculum Organizer(s): *Control*
Energy and Power

Grade Level:

K/1	2/3	4	5	6	7	8	9	10	11	12
					✓	✓	✓			

Year Recommended: *1995*

Supplier: *Technology Teaching Systems*

Unit 2 - 45 Basalatic Road
Concord, ON
L4K 1C5

Tel: (905) 660-3933 Fax: (905) 660-3056

Price: $19.95

ISBN/Order No: 1-8994-13-103/TTS-TFT

Technology Craft Topics

General Description: Collection of six books: *Planes and Flight*, *Land Transportation*, *Space*, *Canals and Waterways*, *Ships and Shipwrecks*, and *Bridges and Tunnels*. Each book provides a historical and international approach to its topic, and gives background information. Some activities are suggested. Large, colourful visuals enhance the text.

Audience: *General*
Gifted - opportunities for independent study

Category: *Student, Teacher Resource*

Curriculum Organizer(s): *Control*
Communications
Energy and Power
Production, Self and Society

Grade Level:

K/1	2/3	4	5	6	7	8	9	10	11	12
				✓	✓	✓				

Year Recommended: *1995*

Supplier: *Nelson Canada*

1120 Birchmount Road
Scarborough, ON
M1K 5G4

Tel: (416) 752-9100 Fax: (416) 752-9365

Price: $16.99 each

ISBN/Order No: (not available)

Technology I.D.E.A.S.: A Teaching Resource Book

General Description: Book provides some philosophy of technology education, implementation ideas, processes for evaluation, and numerous project ideas that tie technology education to other curricular areas.

Audience: *General*

Category: *Teacher Resource*

Curriculum Organizer(s): *Control*
Communications
Energy and Power

Grade Level:

K/1	2/3	4	5	6	7	8	9	10	11	12
			✓	✓	✓	✓	✓	✓		

Year Recommended: *1995*

Supplier: *Prentice Hall Ginn Canada (Ont.)*

1870 Birchmount Road
Scarborough, ON
M1P 2J7

Tel: (416) 293-3621 Fax: (416) 299-2539

2102 Elspeth Place
Port Coquitlam, BC
V3C 1G3

Tel: (604) 942-5835 Fax: (604) 941-1066

Price: $30.00

ISBN/Order No: 0-02-954154-9

Technology Today and Tomorrow, Second Edition

General Description: Resource package provides an introduction to technology through hands-on activities. Components include student textbook and workbook, teacher's annotated textbook and manual, resource binder, reproducible material, transparencies, tests, answer keys, safety handbook, and career handbook. Software in Apple, Macintosh, or MS-DOS provides test banks.

Caution: *Measurements are imperial, not metric. Teachers will have to convert these measurements for classroom activities in student text and student workbooks.*

Audience: *General*
Gifted - extension activities

Category: *Student, Teacher Resource*

Curriculum Organizer(s): *Control*
Communications
Energy and Power
Production, Self and Society

Grade Level:

K/1	2/3	4	5	6	7	8	9	10	11	12
						✓	✓	✓		

Year Recommended: *1995*

Supplier: *McGraw-Hill Ryerson Ltd. (Ontario)*

300 Water Street
Whitby, ON
L1N 9B6

Tel: (905) 430-5000 Fax: (905) 430-5020

Price: $45.00 - $140.00

ISBN/Order No: (not available)

Technology Wheel

General Description: Activities package consists of Macintosh or MS-DOS computer disks and print material organized into 12 units or "spokes": computer programming, lasers, engineering, aerospace, electronics, laser light show, aerodynamics/ propulsion, holography, aeronautics, wind energy, solar energy, and telecommunications/space links. Activities can be delivered without the computer through the use of program printouts.

Audience: *General*

Category: *Teacher Resource*

Curriculum Organizer(s): *Control*
Communications
Energy and Power
Production, Self and Society

Grade Level:

K/1	2/3	4	5	6	7	8	9	10	11	12
						✓	✓	✓		

Year Recommended: *1995*

Supplier: *Advance School Equipment*

Box 488
Ponoka, AB
T4J 1S8

Tel: 1-800-465-7737 Fax: 1-800-661-6676

Price: Single Spoke: $110.00 each
Hub and 4 Spokes: $595.00

ISBN/Order No: (not available)

Tracktronics: Opportunities for Design Using Electronics

General Description: Student workbook and teacher's guide provide a framework for a hands-on approach to electronic components. Resource focusses on recognition and understanding of electronic components, ability to read and work with simple schematic diagrams and real circuits, and developing manipulative skills.

Audience: *General*

Category: *Teacher Resource*

Curriculum Organizer(s): *Control*
Energy and Power Production

Grade Level:

K/1	2/3	4	5	6	7	8	9	10	11	12
					✓	✓				

Year Recommended: *1995*

Supplier: *Spectrum Educational Supplies*

2102 Elspeth Place
Port Coquitlam, BC
V3C 1G3

Tel: (604) 942-5835 Fax: (604) 941-1066

Price: Student Workbook: $24.95
Teacher's Guide: $39.00

ISBN/Order No: Student Workbook: 1-873101-15-5/21672
Teacher's Guide: 1-873101-16-3/21670

The Way Things Work

General Description: CD-ROM with an entertaining and interactive design features a program that provides information on a variety of technological topics using visuals and sound very effectively. Format allows the student to move easily through various levels of scope and depth. Requires Windows PC. Macintosh version under development.

Audience: *General*

Category: *Student, Teacher Resource*

Curriculum Organizer(s): *Control*
Communications
Energy and Power
Production, Self and Society

Grade Level:

K/1	2/3	4	5	6	7	8	9	10	11	12
		✓	✓	✓	✓	✓	✓	✓		

Year Recommended: *1995*

Supplier: *Irwin Publishing*

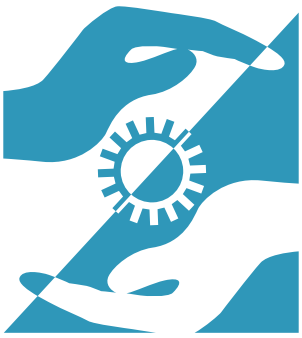
1800 Steeles Avenue West
Concord, ON
L4K 2P3

Tel: (905) 660-0611 Fax: (905) 660-0676

Price: $60.00

ISBN/Order No: 1-56458-901-3

Appendix C
Cross-Curricular Outlines



The three principles of learning stated in the introduction of this Integrated Resource Package (IRP) support the foundation of the Kindergarten to Grade 12 Education Plan. They have guided all aspects of the development of this document, including the curriculum outcomes, instructional strategies, assessment strategies, and learning resource evaluations. In addition to these three principles, it is recognized that British Columbia's schools include young people of varied backgrounds, interests, abilities, and needs. In order to meet these needs and ensure equity and access for all learners, the development of each component of this document has also been guided by a series of cross-curricular outlines. It is expected that these principles and cross-curricular outlines will guide the users of this document as they engage in school and classroom organization and instructional planning and practice.

The following cross-curricular outlines have been used to focus the development and evaluation of the components of the IRP:

- Applied Focus in Curriculum
- Career Development
- English as a Second Language (ESL)
- Environment and Sustainability
- First Nations Studies
- Gender Equity
- Information Technology
- Media Education
- Multiculturalism and Anti-Racism
- Science-Technology-Society
- Special Needs

APPLIED FOCUS IN CURRICULUM

An applied focus in all subjects and courses promotes the use of practical applications to demonstrate theoretical knowledge. Using real world and workplace problems and situations as a context for the application of theory makes school more relevant to students' needs and goals. An applied focus strengthens the link between what students need to know to function effectively in the workplace or in post-secondary education and what they learn in Kindergarten through Grade 12.

Implementation of an applied approach involves working with a wide range of partners including universities, colleges, institutes, employers, community groups, parents, and government.

The applied focus in curriculum is consistent with the following statements from the Kindergarten to Grade 12 Education Plan:

> *All levels of the program are developed around a common core of learning to ensure that students learn to read, write, and do mathematics, solve problems, and use computer-based technology.*
>
> *Employers expect graduates to be good learners, to think critically and solve problems, to communicate clearly, to be self-directed, and to work well with others. The new workplace also re quires people to be knowledgeable about technology and able to search out and apply information from many sources.*

Some examples of an applied focus in different subjects are:

English Language Arts—increasing emphasis on language used in everyday situations and in the workplace, such as for job interviews, memo and letter writing, word processing, and technical communication (including the ability to interpret technical reports, manuals, tables, charts, and graphics)

Mathematics—more emphasis on skills needed in the workplace, including knowledge of probability and statistics, logic, measurement theory, and problem solving

Science—more practical applications and hands-on experience of science, such as reducing energy waste in school or at home, caring for a plant or animal in the classroom, using computers to produce tables and graphs and for spreadsheets

Business Education—more emphasis on real world applications such as preparing résumés and personal portfolios, participating in groups to solve business communication problems, using computer software to keep records, and using technology to create and print marketing material

Visual Arts—applying visual arts skills to real world design, problem solving, and communications; exploring career applications of visual arts skills; experimenting with a variety of new technologies to create images; and a new emphasis on creating and understandng images of social significance to the community.

This summary is derived from The Kindergarten to Grade 12 Education Plan (September 1994), and curriculum documents from British Columbia and other jurisdictions.

CAREER DEVELOPMENT

Career development is an ongoing process through which learners integrate their personal, family, school, work, and community experiences to facilitate career and lifestyle choices. The main emphases of career development are career awareness, career exploration, career preparation, career planning, and career work experience.

In the process of career development students develop:

- an open attitude toward a variety of occupations and types of work
- an understanding of the relationship between work and leisure, work and the family, and work and one's interests and abilities
- an understanding of the role of technology in the workplace and in daily life
- an understanding of the relationship between work and learning
- an understanding of the changes taking place in the economy, society, and the job market
- an ability to construct learning plans and reflect on the importance of lifelong learning
- an ability to prepare for multiple roles throughout life

In the Primary Years

Career awareness promotes an open attitude toward a variety of career roles and types of work. Topics include:

- the role of work and leisure
- relationships among work, the family, one's personal interests, and one's abilities

A variety of careers can be highlighted through the use of in-class learning activities focussing on the students themselves and on a range of role models, including non-traditional role models.

In Grades 4 to 8

The emphasis on self-awareness and career awareness is continued. Topics include:

- interests, aptitudes, and possible future goals
- technology in the workplace and in our daily lives

- social, family, and economic changes
- future education options
- career clusters (careers that are related to one another)
- lifestyles
- external influences on decision making

Games, role-playing, drama, and appropriate community volunteer experience can be used to help students actively explore the world of work. Field experiences in which students observe and interview workers in their occupational environments may also be appropriate. These learning activities will facilitate the development of interpersonal communications and group problem-solving skills needed in the workplace and in other life situations.

In Grades 9 and 10

The emphasis is on providing students with opportunities to prepare for and make appropriate and realistic decisions. In developing their student learning plans, they will relate self-awareness to their goals and aspirations. They will also learn many basic skills and attitudes that are required for an effective transition into adulthood. This will assist in preparing them to be responsible and self-directed throughout their lives. Topics include:

- entrepreneurial education
- employability skills (e.g., how to find and keep a job)
- the importance of lifelong education and career planning
- involvement in the community
- the many different roles that an individual can play throughout life
- the dynamics of the working world (e.g., unions, unemployment, supply and demand, Pacific Rim, free trade)

The examination of personal interests and skills through a variety of career exploration opportunities (e.g., job shadowing) is emphasized at this level. Group discussion and individual consultation can be used to help students examine and confirm their personal values and beliefs.

In Grades 11 and 12

Career development in these grades is focussed more specifically on issues related to the world of work. These include:

- dynamics of the changing work force and changing influences on the job market (e.g., developing technology and economic trends)
- job-keeping and advancement skills (interpersonal skills needed in the workplace, employment standards)
- occupational health issues and accessing health support services
- funding for further education
- alternative learning strategies and environments for different life stages
- mandatory work experience (minimum 30 hours)

Work Experience

Work experience provides students with opportunities to participate in a variety of workplace situations to help prepare them for the transition to a work environment. Work experience also provides students with opportunities to:

- connect what they learn in school with the skills and knowledge needed in the workplace and society in general
- experience both theoretical and applied learning, which is part of a broad liberal education
- explore career directions identified in their Student Learning Plans

Descriptions of career development are drawn from the Ministry of Education's *Career Developer's Handbook, Guidelines for the Kindergarten to Grade 12 Education Plan, Implementation Resource, Part 1,* and the *Career and Personal Planning IRP,* April 1995.

ENGLISH AS A SECOND LANGUAGE (ESL)

ESL assistance is provided to students whose use of English is sufficiently different from standard English to prevent them from reaching their potential. Many students learning English speak it quite fluently and seem to be proficient. School, however, demands a more sophisticated version of English, both in reading and writing. Thus even fluent speakers might require ESL to provide them with an appropriate language experience that is unavailable outside the classroom. ESL is a transitional service rather than a subject. Students are in the process of learning the language of instruction and, in many cases, the content matter of subjects appropriate to their grade level. Thus ESL does not have a specific curriculum. The provincial curriculum is the basis of much of the instruction and is used to teach English as well as individual subject areas. It is the methodology, the focus, and the level of engagement with the curriculum that differentiates ESL services from other school activities.

Students in ESL

Nearly 10% of the British Columbia school population is designated as ESL students. These students come from a diversity of backgrounds. Most are recent immigrants to British Columbia. Some are Canadian-born but have not had the opportunity to learn English before entering the primary grades. The majority of ESL students have a well-developed language system and have had similar schooling to that of British Columbia-educated students. A small number, because of previous experiences, are in need of basic support such as literacy training, academic upgrading, and trauma counselling.

Teachers may have ESL students at any level in their classes. Many ESL students are placed in subject-area classes primarily for the purpose of contact with English-speaking peers and experience with the subject and language. Other ESL students are wholly integrated into subject areas. A successful integration takes place when the student has reached a level of English proficiency and background knowledge in a subject to be successful with a minimum of extra support.

Optimum Learning Environment

The guiding principle for ESL support is the provision of a learning environment where the language and concepts can be understood by the students.

Good practices to enhance the learning of students include:

- using real objects and simple language at the beginning level
- taking into consideration other cultural backgrounds and learning styles at any level
- providing adapted (language-reduced) learning materials
- respecting a student's "silent period" when expression does not reflect the level of comprehension
- allowing students to practise and internalize information before giving detailed answers
- differentiating between form and content in student writing
- keeping in mind the level of demand placed on students

This summary is drawn from *Supporting Learners of English: Information for School and District Administrators,* RB0032, 1993, and *ESL Policy Discussion Paper (Draft),* Social Equity Branch, December 1994.

ENVIRONMENT AND SUSTAINABILITY

Environmental education is defined as a way of understanding human relationships with the environment. It involves:

- students learning about their connections to the natural environment through all subjects
- students having direct experiences in the environment, both natural and human-built
- students making decisions about and acting for the environment

The term *sustainability* helps to describe societies that "promote diversity and do not compromise the natural world for any species in the future."

Value of Integrating Environment and Sustainability Themes

Integrating these themes into the curriculum helps students develop a responsible attitude toward caring for the earth. Studies that integrate environment and sustainability themes provide students with opportunities to identify their beliefs and opinions, reflect on a range of views, and ultimately make informed and responsible choices.

The guiding principles that should be interwoven in subjects from Kindergarten to Grade 12 are:

- Direct experience is the basis of human learning.
- Analysis of interactions helps humans make sense of their environment.
- Responsible action is both integral to and a consequence of environmental education.

Some organizing principles are:

- Human survival depends on complex natural and human-built systems.
- Human decisions and actions have environmental consequences.
- Students should be provided with opportunities to develop an aesthetic appreciation of the environment.

The theme study units might include: Consumerism, School Operating Systems, Pollution, or Endangered Species.

This summary is derived from *A Plan for Environmental Education,* Curriculum Branch, October 1995.

FIRST NATION STUDIES

First Nations studies focus on the richness and diversity of First Nations cultures and languages. These cultures and languages are examined within their own unique contexts and within historical, contemporary, and future realities. First Nations studies are based on a holistic perspective that integrates the past, present, and future. First Nations peoples are the original inhabitants of North America and live in sophisticated, organized, and self-sufficient societies. The First Nations constitute a cultural mosaic as rich and diverse as that of Western Europe, including different cultural groups (e.g., Nisga'a, KwaKwaka'Wakw, Nlaka'pamux, Secwepemc, Skomish, Tsimshian). Each is unique and has a reason to be featured in the school system. The First Nations of British Columbia constitute an important part of the historical and contemporary fabric of the province.

Value of Integrating First Nations Studies

- First Nations values and beliefs are durable and relevant today.
- There is a need to validate and substantiate First Nations identity.
- First Nations peoples have strong, dynamic, evolving cultures that have adapted to changing world events and trends.
- There is a need to understand similarities and differences among cultures to create tolerance, acceptance, and mutual respect.
- There is a need for informed, reasonable discussion and decisionmaking regarding First Nations issues, based on accurate information (for example, as modern treaties are negotiated by Canada, British Columbia, and First Nations).

In studying First Nations, it is expected that the students will:

- demonstrate an understanding and appreciation for the values, customs, and traditions of First Nations peoples
- demonstrate an understanding of and appreciation for unique First Nations communications systems
- demonstrate a recognition of the importance of the relationship between First Nations peoples and the natural world
- recognize dimensions of First Nations art as a total cultural expression
- give examples of the diversity and functioning of the social, economic, and political systems of First Nations peoples in traditional and contemporary contexts
- describe the evolution of human rights and freedoms as they pertain to First Nations peoples

Some examples of curriculum integration include:

Visual Arts—comparing the artistic styles of two or more First Nations cultures

English Language Arts—analysing portrayals and images of First Nations peoples in various works of literature

Home Economics—identifying forms of food, clothing, and shelter in past and contemporary First Nations cultures

Technology Education—describing the sophistication of traditional First Nations technologies (e.g., bentwood or kerfed boxes, weaving, fishing gear)

Physical Education—participating in and developing an appreciation for First Nations games and dances

This summary is derived from *First Nations Studies: Curriculum Assessment Framework (Primary through Graduation),* Aboriginal Education Branch, 1992, and *B.C. First Nations Studies 12 Curriculum,* Aboriginal Education Branch, 1994.

Gender Equity

Gender-equitable education involves the inclusion of the experiences, perceptions, and perspectives of girls and women, as well as boys and men, in all aspects of education. It will initially focus on girls in order to redress historical inequities. Generally, the inclusive strategies, which promote the participation of girls, also reach boys who are excluded by more traditional teaching styles and curriculum content.

Principles of Gender Equity in Education

- All students have the right to a learning environment that is gender equitable.
- All education programs and career decisions should be based on a student's interest and ability, regardless of gender.

- Gender equity incorporates a consideration of social class, culture, ethnicity, religion, sexual orientation, and age.
- Gender equity requires sensitivity, determination, commitment, and vigilance over time.
- The foundation of gender equity is co-operation and collaboration among students, educators, education organizations, families, and members of communities.

General Strategies for Gender-Equitable Teaching

- Be committed to learning about and practising equitable teaching.
- Use gender-specific terms to market opportunities—for example, if a technology fair has been designed to appeal to girls, mention girls clearly and specifically. Many girls assume that gender-neutral language in non-traditional fields means boys.
- Modify content, teaching style, and assessment practices to make non-traditional subjects more relevant and interesting for female and male students.
- Highlight the social aspects and usefulness of activities, skills, and knowledge.
- Comments received from female students suggest that they particularly enjoy integrative thinking; understanding context as well as facts; and exploring social, moral, and environmental impacts of decisions.
- When establishing relevance of material, consider the different interests and life experiences that girls and boys may have.
- Choose a variety of instructional strategies such as co-operative and collaborative work in small groups, opportunities for safe risk taking, hands-on work, and opportunities to integrate knowledge and skills (e.g., science and communication).
- Provide specific strategies, special opportunities, and resources to encourage students to excel in areas of study in which they are typically under-represented.
- Design lessons to explore many perspectives and to use different sources of information; refer to female and male experts.
- Manage competitiveness in the classroom, particularly in areas in which male students typically excel.
- Watch for biasses (e.g., in behaviour or learning resources) and teach students strategies to recognize and work to eliminate inequities they observe.
- Be aware of accepted gender-biassed practices in physical activity (e.g., in team sport, funding for athletes, and choices in physical education programs).
- Do not assume that all students are heterosexual.
- Share information and build a network of colleagues with a strong commitment to equity.
- Model non-biassed behaviour: use inclusive, parallel, or gender-sensitive language; question and coach male and female students with the same frequency, specificity, and depth; allow quiet students sufficient time to respond to questions.
- Have colleagues familiar with common gender biasses observe your teaching and discuss any potential bias they may observe.
- Be consistent over time.

This summary is derived from the preliminary *Report of the Gender Equity Advisory Committee*, received by the Ministry of Education in February 1994, and from a review of related material.

INFORMATION AND TECHNOLOGY

Information technology is the use of tools and electronic devices that allow us to create, explore, transform, and express information.

Value of Integrating Information Technology

As Canada moves from an agricultural and industrial economy to the information age, students must develop new knowledge, skills, and attitudes. The information technology curriculum has been developed to be integrated into all new curricula to ensure that students know how to use computers and gain the technological literacy demanded in the workplace.

In learning about information technology, students acquire skills in information analysis and evaluation, word processing, database analysis, information management, graphics, and multimedia applications. Students also identify ethical and social issues arising from the use of information technology.

With information technology integrated into the curriculum, students will be expected to:

- demonstrate basic skills in handling information technology tools
- demonstrate an understanding of information technology structure and concepts
- relate information technology to personal and social issues
- define a problem and develop strategies for solving it
- apply search criteria to locate or send information
- transfer information from external sources
- evaluate information for authenticity and relevance
- arrange information in different patterns to create new meaning
- modify, revise, and transform information
- apply principles of design affecting appearance of information
- deliver a message to an audience using information technology

The curriculum organizers are:

- ***Foundations***—the basic physical skills, and intellectual and personal understandings required to use information technology, as well as self-directed learning skills and socially responsible attitudes
- ***Explorations***—defining a problem to establish a clear purpose for search strategies and retrieval skills
- ***Transformations***—filtering, organizing, and processing information
- ***Expressions***—designing, integrating, and presenting a message using text, audio and visual information, and message delivery

This information is derived from the draft *Information Technology Curriculum K to 12* currently under development.

MEDIA EDUCATION

Media education is a multidisciplinary and interdisciplinary approach to the study of media. Media education deals with key media concepts and focusses on broad issues such as the history and role of media in different societies and the social, political, economic, and cultural issues related to the media. Instead of addressing the concepts in depth, as one would in media studies, media education deals with most of the central media concepts as they relate to a variety of subjects.

Value of Integrating Media Education

Popular music, television, film, radio, magazines, computer games, and information services—all supplying media messages—are pervasive in the lives of students today. Media education develops students' ability to think critically and independently about issues that affect them. Media education encourages students to identify and examine the values contained in media messages. It

also cultivates the understanding that these messages are produced by others to inform, persuade, and entertain for a variety of purposes. Media education helps students understand the distortions that may result from the use of particular media practices and techniques. All curriculum areas provide learning opportunities for media education. It is not taught as a separate curriculum.

The key themes of media education are:

- media products (purpose, values, representation, codes, conventions, characteristics, production)
- audience interpretation and influence (interpretation, influence of media on audience, influence of audience on media)
- media and society (control, scope)

Examples of curriculum integration include:

English Language Arts—critiquing advertising and examining points of view

Visual Arts—analysing the appeal of an image by age, gender, status, and other characteristics of the target audience

Personal Planning—examining the influence of the media on body concepts and healthy lifestyle choices

Drama—critically viewing professional and amateur theatre productions, dramatic films, and television programs to identify purpose

Social Studies—comparing the depiction of First Nations in the media over time

This summary is derived from *A Cross-Curricular Planning Guide for Media Education,* prepared by the Canadian Association for Media Education for the Curriculum Branch in 1994.

MULTICULTURALISM AND ANTI RACISM EDUCATION

Multiculturalism Education

Multiculturalism education stresses the promotion of understanding, respect, and acceptance of cultural diversity within our society.

Multicultural education involves:

- recognizing that everyone belongs to a cultural group
- accepting and appreciating cultural diversity as a positive feature of our society
- affirming that all ethnocultural groups are equal within our society
- understanding that multicultural education is for all students
- recognizing that similarities across cultures are much greater than differences and that cultural pluralism is a positive aspect in our society
- affirming and enhancing self-esteem through pride in heritage, and providing opportunities for individuals to appreciate the cultural heritages of others
- promoting cross-cultural understanding, citizenship, and racial harmony

Anti-Racism Education

Anti-racism education promotes the elimination of racism through identifying and changing institutional policies and practices as well as identifying individual attitudes and behaviours that contribute to racism. Anti-racism education involves:

- proposing the need to reflect about one's own attitudes on race and anti-racism
- understanding what causes racism in order to achieve equality
- identifying and addressing racism at both the personal and institutional level

- acknowledging the need to take individual responsibility for eliminating racism
- working toward removing systemic barriers that marginalize groups of people
- providing opportunities for individuals to take action to eliminate all forms of racism, including stereotypes, prejudice, and discrimination

Value of Integrating Multiculturalism and Anti-Racism Education

Multiculturalism and anti-racism education provides learning experiences that promote strength through diversity and social, economic, political, and cultural equity. Multiculturalism and anti-racism education gives students learning experiences that are intended to enhance their social, emotional, aesthetic, artistic, physical, and intellectual development. It provides learners with the tools of social literacy and skills for effective cross-cultural interaction with diverse cultures. It also recognizes the importance of collaboration between students, parents, educators, and communities working toward social justice in the education system.

The key goals of multiculturalism and anti-racism education are:

- to enhance understanding of and respect for cultural diversity
- to increase creative intercultural communication in a pluralistic society
- to provide equal opportunities for educational achievement by all learners, regardless of culture, national origin, religion, or social class
- to develop self-worth, respect for oneself and others, and social responsibility
- to combat and eliminate stereotyping, prejudice, discrimination, and other forms of racism
- to include the experiences of all students in school curricula

Examples of curriculum integration include:

Fine Arts—identifying ways in which the fine arts portray cultural experiences

Humanities—identifying similarities and differences within cultural groups' lifestyles, histories, values, and beliefs

Mathematics or Science—recognizing that individuals and cultural groups have used both diverse and common methods to compute, to record numerical facts, and to measure

Physical Education—developing an appreciation of games and dances from diverse cultural groups

This summary is derived from *Multicultural and Anti-Racism Education—Planning Guide (Draft)*, developed in the Social Equity Branch in 1994.

SCIENCE TECHNOLOGY-SOCIETY

Science-Technology-Society (STS) addresses our understanding of inventions and discoveries and how science and technology affect the well-being of individuals and our global society.

The study of STS includes:

- the contributions of technology to scientific knowledge and vice versa
- the notion that science and technology are expressions of history, culture, and a range of personal factors
- the processes of science and technology such as experimentation, innovation, and invention
- the development of a conscious awareness of ethics, choices, and participation in science and technology

Value of Integrating STS

The aim of STS is to enable learners to investigate, analyse, understand, and experi-

ence the dynamic interconnection of science, technology, and human and natural systems.

The study of STS in a variety of subjects gives students opportunities to:

- discover knowledge and develop skills to foster critical and responsive attitudes toward innovation
- apply tools, processes, and strategies for actively challenging emerging issues
- identify and consider the evolution of scientific discovery, technological change, and human understanding over time, in the context of many societal and individual factors
- develop a conscious awareness of personal values, decisions, and responsible actions about science and technology
- explore scientific processes and technological solutions
- contribute to responsible and creative solutions using science and technology

The organizing principles of STS are: Human and Natural Systems, Inventions and Discoveries, Tools and Processes, and Society and Change. Each organizer may be developed through a variety of contexts, such as the economy, environment, ethics, social structures, culture, politics, and education. Each context provides a unique perspective for exploring the critical relationships that exist and the challenges we face as individuals and as a global society.

Examples of curriculum integration include:

Visual Arts—recognizing that demands generated by visual artists have led to the development of new technologies and processes (e.g., new permanent pigments, fritted glazes, drawing instruments)

English Language Arts—analysing the recent influence of technologies on listening, speaking, and writing (e.g., CDs, voice mail, computer-generated speech)

Physical Education—studying how technology has affected our understanding of the relationship between activity and well-being

This summary is derived from *Science-Technology-Society—A Conceptual Framework,*] Curriculum Branch, 1994.

SPECIAL NEEDS

Students with special needs have disabilities of an intellectual, physical, sensory, emotional, or behavioural nature; or have learning disabilities; or have exceptional gifts or talents.

All students can benefit from an inclusive learning environment that is enriched by the diversity of the people within it. Opportunities for success are enhanced when provincial learning outcomes and resources are developed with regard for a wide range of student needs, learning styles, and modes of expression.

Educators can assist in creating more inclusive learning environments by introducing the following:

- activities that focus on development and mastery of foundational skills (basic literacy)
- a range of co-operative learning activities and experiences in the school and community, including the application of practical, hands-on skills in a variety of settings
- references to specialized learning resources, equipment, and technology
- ways to accommodate special needs (e.g., incorporating adaptations and extensions to content, process, product, pacing, and learning environment; suggesting alternate methodologies or strategies; making references to special services)
- a variety of ways, other than through paper-and-pencil tasks, for students to demonstrate learning (e.g., dramatizing events to demonstrate understanding of a

poem, recording observations in science by drawing or by composing and performing a music piece)
- promotion of the capabilities and contributions of children and adults with special needs
- participation in physical activity

All students can work toward achievement of the provincial learning outcomes. Many students with special needs learn what all students are expected to learn. In some cases the student's needs and abilities require that education programs be adapted or modified. A student's program may include regular instruction in some subjects, modified instruction in others, and adapted instruction in still others. Adaptations and modifications are specified in the student's Individual Education Plan (IEP).

Adapted Programs

An adapted program addresses the learning outcomes of the prescribed curriculum but provides adaptations so the student can participate in the program. These adaptations may include alternative formats for resources (e.g., Braille, books-on-tape), instructional strategies (e.g., use of interpreters, visual cues, learning aids), and assessment procedures (e.g., oral exams, additional time). Adaptations may also be made in areas such as skill sequence, pacing, methodology, materials, technology, equipment, services, and setting. Students on adapted programs are assessed using the curriculum standards and can receive full credit.

Modified Programs

A modified program has learning outcomes that are substantially different from the prescribed curriculum and specifically selected to meet the student's special needs. For example, a Grade 5 student in language arts may be working on recognizing common signs and using the telephone. A student on a modified program is assessed in relation to the goals and objectives established in the student's IEP.

Ministry Resources for Teachers of Students with Special Needs

The following publications are currently available from the Learning Resources Branch or are under development and will be made available soon:

The Universal Playground: A Planning Guide (Ministry of Education, 1991, FCG 129)

Hard of Hearing and Deaf Students—A Resource Guide to Support Classroom Teachers (Ministry of Education, 1994, RB0033)

Special Education Services—A Manual of Policies, Procedures and Guidelines (Ministry of Education, 1995)

I.E.P. Planning Resource (Ministry of Education, 1995)

Students with Visual Impairments—A Resource Guide to Support Classroom Teachers (Ministry of Education, 1995)

Gifted Students—A Resource Guide to Support Classroom Teachers (Ministry of Education, 1995)

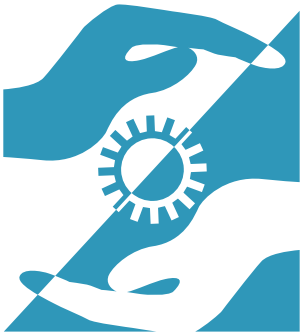
Students with Intellectual Disabilities: A Resource Guide to Support Teachers (Ministry of Education, 1995)

Teaching for Student Differences—A Resource Guide to Support Classroom Teachers (Ministry of Education, 1995)

Resource Handbook for Adapted Curriculum Software (Ministry of Education, 1995)
Awareness Series (Ministry of Education, 1995)

This summary is derived from the *Handbook for Curriculum Developers*, February 1994, and *Special Education Services—A Manual of Policies, Procedures and Guidelines*, June 1995.

Appendix D
Assessment and Evaluation



About This Appendix

Prescribed learning outcomes, expressed in measurable terms, provide the basis for the development of learning activities, and assessment and evaluation strategies. After a general discussion of assessment and evaluation, this appendix uses sample evaluation plans to show how activities, assessment, and evaluation might come together in a particular technology education program. The generic assessment and evaluation tools at the end of this appendix provide further planning support for teachers.

Assessment and Evaluation

Assessment is the systematic gathering of information about what students know, are able to do, and are working toward. Assessment methods include: student self-assessments, reviews of performance, portfolio assessments, and conferencing. Assessment tools may include observation, daily practice assignments, quizzes, samples of student work, pencil-and-paper tests, holistic rating scales, projects, and oral and written reports.

Student performance is evaluated from the information collected through assessment activities. Teachers use their insight, knowledge about learning, and experience with students, along with the specific criteria they establish, to make judgments about student performance in relation to prescribed learning outcomes.

Students benefit most when evaluation is provided on a regular, ongoing basis. When evaluation is seen as an opportunity to promote learning rather than as a final judgment, it shows learners their strengths and suggests how they can develop further. Students can use this information to redirect efforts, make plans, and establish future learning goals.

Evaluation may take different forms, depending on the purpose.

- Criterion-referenced evaluation should be used to evaluate student performance in classrooms. It is referenced to criteria based on learning outcomes described in the provincial curriculum. The criteria reflect a student's performance based on specific learning activities. When a student's program is substantially modified, evaluation may be referenced to individual goals. These modifications are recorded in an Individual Education Plan (IEP).
- Norm-referenced evaluation is used for large-scale system assessments; it is not to be used for classroom assessment. A classroom does not provide a large enough reference group for a norm-referenced evaluation system. Norm-referenced evaluation compares student achievement to that of others rather than comparing how well a student meets the criteria of a specified set of learning outcomes.

Criterion-Referenced Evaluation

In criterion-referenced evaluation, a student's performance is compared to established criteria rather than to the performance of other students. Evaluation referenced to prescribed curriculum requires that criteria are established based on the learning outcomes listed under the curriculum organizers for technology education.

Criteria are the basis of evaluating student progress; they identify the critical aspects of a performance or a product that describe in specific terms what is involved in meeting the learning outcomes. Criteria can be used to evaluate student performance in relation to learning outcomes. For example, weight-

ing criteria, using rating scales, or performance rubrics (reference sets) are three ways that student performance can be evaluated using criteria.

Samples of student performance should reflect learning outcomes and identified criteria. The samples clarify and make explicit the links between evaluation and learning outcomes, criteria, and assessment. Where a student's performance is not a product, and therefore not reproducible, a description of the performance sample should be provided.

Criterion-referenced evaluation may be based on these steps:

1. Identify the expected learning outcomes (as stated in the Integrated Resource Package).
2. Identify the key learning objectives for instruction and learning.
3. Establish and set criteria. Involve stu dents, when appropriate, in establishing criteria.
4. Plan learning activities that will help students gain the knowledge or skills outlined in the criteria.
5. Prior to the learning activity, inform students of the criteria against which their work will be evaluated.
6. Provide examples of the desired levels of performance.
7. Implement the learning activities.
8. Use various assessment methods based on the particular assignment and student.
9. Review the assessment data, and evaluate each student's level of performance or quality of work in relation to criteria.
10. Report the results of the evaluations to students and parents.

FORMAL REPORTING OF STUDENT LEARNING

Legislation requires that teachers provide parents with three formal reports each year. The following are guidelines and suggestions for assigning letter grades. Letter grades are used to indicate a student's level of performance in relation to expected learning outcomes. They may be assigned for an activity, a unit of study, a term, as a final grade at the end of the year, or at the completion of a course or subject.

The assignment of letter grades may be based on these steps:

1. Identify learning outcomes for the activity and unit to make clear what the student is expected to know and be able to do. The provincial curriculum prescribes broad learning outcomes. From these, the teacher establishes more specific outcomes for the learning activities.
2. Establish specific criteria for the unit and activity. It is helpful for students to be involved in establishing criteria. In this way, they understand what is expected of them.
3. Develop different levels of performance or models. Students are more likely to be successful when they clearly understand the criteria and the level of performance expected.
4. Students participate in learning activities to allow them to practise the skills and acquire the required knowledge. Feedback is provided to help the students continue their learning. Practice exercises help students meet the criteria and achieve the expected level of perfor-

mance. Results from practice exercises support the student's learning but should not contribute to the term evaluation or final letter grade.

5. Give students opportunities to demonstrate their learning. Teachers may have students represent their learning in a variety of ways. Assessment data may be collected from tests, teacher observations, conferences, student self-assessments, written assignments, portfolios, or performance tasks.

6. Evaluate students' levels of performance in relation to the criteria. Base the evaluation of each student's performance on the assessment data collected and compare the data to the established criteria.

7. The teacher assigns a letter grade for a set of activities. The letter grade indicates how well the criteria were met. Teachers often include written feedback to students along with the letter grade. In this way, students gain information necessary to continue their learning.

EVALUATION SAMPLES

The samples on the following pages illustrate the process a teacher might use in applying criterion-referenced evaluation in technology education. The samples represent a broad use of criterion-referenced evaluation, including individual pieces of work, units of study, and work completed over the course of a term.

There are three key stages to the process:

- planning for assessment and evaluation
- defining criteria
- assessing and evaluating student performance

Planning for Assessment and Evaluation

This section outlines:

- background information to explain the classroom context
- instructional tasks
- opportunities that students were given to practise learning
- feedback and support that was offered students by the teacher
- ways in which the teacher prepared students for the assessment

Defining Criteria

This section illustrates the specific criteria, which are based on:

- learning outcomes
- the assessment task
- various reference sets

Assessing and Evaluating Student Performance

This section includes:

- assessment tasks or activities
- support that the teacher offered students
- tools and methods used to gather the assessment information
- the way the criteria were used to evaluate student performance

GRADE 8

Topic: *Introduction to Design, Tools, and Materials*

Prescribed Learning Outcomes:

Self and Society

It is expected that students will:

- demonstrate confidence and positive attitudes when solving problems that arise during the design process
- identify practical problems involving technology in a variety of contexts
- work with others to solve problems that come up during the design process

Communications

It is expected that students will:

- produce initial concept sketches and final drawings using a design process
- develop two- and three-dimensional graphics using manual and computer-assisted processes
- revise presentations based on suggestions and comments from others

Production

It is expected that students will:

- describe and use the process of product design
- identify and classify the properties of materials used to manufacture products
- select materials based on a set of design specifications
- identify ways to minimize waste and reuse products
- demonstrate safe work habits when using tools, equipment, and technical processes

PLANNING FOR ASSESSMENT

- The classroom was divided into three areas:
  - a group meeting and planning area, with tables and chairs
  - a computer area, with a graphics and word processing software program
  - a production area, with primarily hand tools to cut, join, and form a wide range of materials
- The learning environment was designed to allow for the three facility areas to be used simultaneously, with groups rotating through them. Once students completed a rotation, groups moved freely among the three areas to complete their group project.
- Each member in the group was asked to assume an expert role. These students were given special training and information by the teacher, which they were expected to pass on to their group.
- Each group participated in the following four sets of activities, the first three in separate facility areas, and the last one in all areas of the learning environment, as needed.

1. Using a design process and design portfolio

- In the group meeting and planning area students focussed on using a design process and developing a design portfolio while creating a mobile. Students added information to their design portfolios as they worked. Each portfolio included ideas, sketches and drawings, tests of materials and processes, records of discussions, and any evaluations that had taken place during the group work.
- The teacher developed a design portfolio worksheet to help students work through

the stages of a design process. This worksheet contained all elements of design: statement of the problem, generation of initial ideas, development of possible solutions, testing of ideas and processes, development of a plan for construction, construction of the solution, and evaluation of the solution.

- The statement of the problem included:
  - the design of a mobile using a support beam (levers, cantilevers, pivot points, balance)
  - placement of component parts (balance, mass, aesthetics, presentation of ideas)
  - use of three-dimensional space (mobile structure, design and construction of component parts)
  - use of air currents to move the mobile and its component parts

2. Introduction to computer graphics

- In the computer area students used a computer graphics program to generate outlines and templates for the shapes they would construct and hang from their mobile. During the activity the students:
  - applied the computer graphics program to the task
  - used basic drawing tools
  - located clip art and symbols
  - placed clip art on a printable page
  - sized clip art
  - printed their work

3. Working characteristics of tools and materials

- In the production area, students were provided with a wide range of materials:
  - rigid materials (e.g., sheet metal, wood, plastic)
  - semi-rigid materials (e.g., styrofoam, foam board, 1/16" welding rod, card stock)
  - flexible materials (e.g., fabric, paper, foam, string)
- Students had access to the following tools:
  - pencils
  - hacksaws
  - hand drill and bits
  - sandpaper
  - tin snips
  - rulers
  - wood files
  - metal files
  - Whitney punches
  - handsaws (wood)
  - wire cutters
  - strip benders
  - pliers
  - scissors
  - spot welders
- Students were introduced to a wide variety of hand and portable power tools that could be used in the construction of their mobile.
- Students were encouraged to practise using tools safely on various materials to determine:
  - the function of various tools
  - how to choose the proper tool according to the material used and its final use or purpose
  - how to lay out, cut, bend, join, and finish materials

4. Construction of a mobile

- Students put their learning from the first three activities together to construct a mobile. Each group was responsible for the construction of one mobile, which was later hung from the ceiling in the classroom. The following task requirements had to be met before the mobile could be considered complete and submitted for evaluation:

- The design reflects a theme (i.e., festive occasions, the environment, sports, animals).
- The mobile has only one main support rod.
- The mobile has at least two secondary support rods.
- Each of the secondary supports is a different distance from the hanging point.
- Each object on the mobile is a different shape and material.
- The mobile is hung from the ceiling using string.
- At least one object looks three -dimensional.
- The finished mobile includes an object listing each group member's name, the team name, the course, and the block.

DEFINING THE CRITERIA

Co-operative Group Work

To what extent does the student:
- participate willingly and constructively in the group
- initiate, develop, and sustain interactions in the group
- contribute ideas and build on the ideas of others

Use of Tools and Materials

To what extent does the student:
- identify common tools and their proper uses
- choose materials based on their characteristics
- use materials carefully to minimize waste
- use safety equipment and follow safety procedures

Use of Computers

To what extent is the student able to:
- use correct start-up routines
- demonstrate familiarity with the operating system
- use the mouse and keyboard
- use correct computer terminology
- efficiently apply a computer graphics program to a task

Product

To what extent is the final product:
- consistent with the task requirements and design parameters
- aesthetically pleasing
- innovative in design

Problem Solving

To what extent does the student demonstrate:
- engagement in the problem
- appropriate use of background knowledge
- effective problem-solving processes
- the ability to represent solutions to the problem

ASSESSING AND EVALUATING STUDENT PERFORMANCE

Design Work in Co-operative Groups

The teacher used two sections ("Social and Ideas") from "Group Communications Skills" from the reference set *Evaluating Group Communication Skills Across Curriculum* to assess the way individual students contributed to the success of their design groups. The teacher defined a scale point of 2 as minimally acceptable. The teacher gathered information about student performance by observing students as they worked and by collecting their own evaluations of their group work.

Design Work In Co-operative Groups

Rating	Social Interaction	Ideas Development
5 • Shapes the way the group works. • Develops and extends the group's work in ideas and development.	The student is able to initiate, develop, and sustain interactions so that the group is able to work together harmoniously. The student frequently encourages the efforts of other group members, often asking them questions. The student is comfortable–but not driven–to provide leadership when needed, attempts to resolve conflicts among other group members, is able to let go of personal ideas to further group progress, and approaches the task with obvious enjoyment, often accompanied by humour.	The student participates in all phases of the activity, although contributions vary according to relevant information or experience. The student provides constructive feedback, offers predictions and hypotheses, and poses intriguing questions. The student is able to offer clarification, elaboration, or explanation as needed, and builds upon-and in some cases synthesizes-the ideas others offer. The student may use comparisons, analogies, examples, or humour to illustrate or emphasize a point.
4 • Social interactions comfortable and well developed. • Flexible and well developed ideas.	The student is comfortable working in a group and contributes to the social dynamics. The student may take a leadership role in organizing how the group will interact. The student takes responsibility for group processes by facilitating and extending discussions, and by persevering beyond initial solutions. The student is responsive to other group members and their ideas. The student tends to interact effectively with the group but may not have much effect on how the other group members work with each other.	The student contributes ideas, experience, and information that the group is able to use. The student may help to develop ideas by providing details, examples, reasons, and explanations. The student often makes suggestions, asks questions, or adjusts personal thinking after listening to others. The student may also rephrase, paraphrase, or pose questions as a way of challenging or building on ideas from other group members. The student is able to make relevant connections to other situations or ideas.
3 • Socially engaged. • Ideas are appropriate and related to the task.	The student takes part in group discussions and follows the basic rules for working with others: taking turns, listening while others are speaking, and sometimes offering recognition or support. The student may ask for or offer required information. The student is willing to accept group decisions and may share some responsibility for how the group works.	The student contributes some suggestions and ideas to the group. The student responds and sometimes adds to suggestions that others make, participates in brainstorming activities, shows interest in the ideas of others, and adds information. The student may not defend personal ideas, and tends to give in quickly when someone disagrees.

Design Work In Co-operative Groups
(Continued)

Rating	Social Interaction	Ideas Development
2 • Inconsistent social Interaction. • Ideas often disconnected.	The student may begin to show some awareness of the responsibilities of contributing to a group, may sometimes recognize and respond to the needs and ideas of others, and may show appreciation or support. At other times the student may have difficulty taking turns or accepting suggestions from other students. The student may remain uncommitted, focussing on personal needs rather than the group's task.	The student contributes ideas that address the task, but these may be unconnected to the ideas of others. The student may offer several suggestions but appears unable to elaborate, explain, or clarify ideas. The student often relates the activity to personal experiences by telling stories. The student may think out loud, judge others' ideas quickly, or drift off-task easily.
1 • Largely unaware of other's needs. • Limited contribution of ideas.	The student may not understand how personal behaviour affects others, and may be disruptive, aggressive, uninvolved, or easily frustrated.	The student may remain silent throughout the activity, contribute one idea repeatedly, or recount personal experiences unrelated to the group task. The student may not acknowledge or add to the contributions of other group members, but may respond to direct questions or other prompts from adults.

Tool and Material Use

The students' performances with respect to the safe and proper use of tools and materials was evaluated using the following performance scale:

Outstanding

The student makes exceptionally thoughtful choices of materials, uses tools with proficiency, is especially conscientious about the safety of self and others, and assists in the organization and maintenance of a safe, orderly work environment.

Competent

The student chooses appropriate materials and tools, uses tools correctly, uses the proper safety equipment and procedures, and exhibits personal preparedness with respect to clothes, shoes, hair, jewellery, sleeves, and so forth.

Unacceptable

The student may be able to identify common tools but is unsure what tools to use for particular tasks and materials. Materials choices may be inappropriate. The student may not use proper safety measures or may need excessive supervision in order to do so. The student may be unaware of how personal actions affect the safety of others.

Computer Use

Over time, the teacher expects all students to gain proficiency in using the computer to assist in designing products and communicating ideas. The teacher asks students to do a brief performance task. (e.g., "Choose a piece of clip art, draw a surrounding scene, and print your work.") Performance is evaluated using the following scale:

Product (Mobile)

Although the teacher placed more emphasis on the design team process than on the final product, the final product was evaluated by both the teacher and the class using the same scale.

Tasks	Rating
Computer Use	
• uses correct start-up routines	
• demonstrates familiarity with the operating system	
• uses the mouse and keyboard	
• uses correct computer terminology	
Product Mobile	
• consistent with the task requirements and design and design requirements	
• aesthetically pleasing	
• innovative design	

Key: **4**—met the criterion at an outstanding level
3—met the criterion at a good level
2—met the criterion at a satisfactory level
1—did not meet the criterion; needs moresupport or practice

Problem Solving

The teacher used the reference set *Evaluating Problem Solving Across Curriculum* to evaluate students' problem-solving skills and abilities.

Problem Solving

Individual Observation Sheet

Name _____ Grade/level _____

KEY:
B = Beginning
D = Developing
M = Maturing

Descriptors	Date / Problem	Date / Problem	Date / Problem	Date / Problem
Engagement				
• interested				
• involved				
• defines problem				
Background Knowledge				
• content knowledge				
• focuses				
• applies techniques (rules, methods, plans, algorithms)				
• transfers knowledge				
Process				
• recognizes what to do				
• applies strategies				
• uses alternatives				
• monitors progress				
Representation				
• restates problem				
• communicates about process				
• organizes solution				

Comments _____

_____

_____

Goal (s) _____

_____

_____

GRADE 9

Topic: *Habitat Design*

Prescribed Learning Outcomes:

Self and Society

It is expected that students will:

- contribute to group success by encouraging others to fulfil their responsibilities
- evaluate design ideas based on assessments by others
- demonstrate a willingness to look for and develop improved solutions to problems that arise during the design process
- demonstrate confidence and positive attitudes when solving problems that arise during the design process

Communications

It is expected that students will:

- communicate ideas for designing products and systems using various drawing projection methods, spreadsheets, graphics, or other media
- use information-gathering and communication methods to solve problems during the design process and to create effective presentations
- develop two- and three-dimensional graphics using manual and computer-assisted processes
- identify how information and concepts from other fields of knowledge are used in the design process

Production

It is expected that students will:

- classify and describe the characteristics of industrial materials
- investigate and select materials to meet design specifications
- devise and use assembly-sequence diagrams and flow charts to explain a process or system
- select and use a variety of finishes on products to improve their appearance and durability
- select and safely use hand and power tools in the manufacture of products

PLANNING FOR ASSESSMENT

- Students were asked to design and model a functional habitat for an identified occupant. Completed submissions were to include a floor plan, rendered exterior and interior views, and a model. This activity provided opportunities for students to engage in critical thinking, technical design, communication, and graphics and modelling techniques. The design solutions they developed included a cabin, a small house, and an animal house.
- Students initially worked in small groups to brainstorm ideas, including a list of the needs of different occupants and design ideas based on a selected occupant. This information formed the parameters for problems involving design. Each group was asked to present their three best ideas to the class.
- Students worked individually to gather necessary information and to provide preliminary sketches that they presented to their groups for feedback. Students then worked individually to:
  - revise their preliminary plans based on feedback
  - complete a final floor plan, by hand or using a computer
  - complete rendered images, by hand or using a computer
  - experiment with a variety of materials to determine their suitability for modelling
  - select tools, materials, and processes to

produce a final product
- present their model and a flow chart of their design stages to the class (e.g., oral, video, multimedia, computer).

- As students worked, they developed design portfolios in which they collected their researched design ideas, a series of developmental designs, feedback on their designs, and reflective notes. Sometimes the teacher provided a framework for the reflections. For example, these sentence stems were provided for the final reflection:
  - Three alternatives I considered when I started planning my project were____.
  - One part of the project I had to plan ahead for was____.
  - One design issue I had to find background information on was____.
  - One thing about my habitat I would change if I made it again is____.
  - One piece of advice I would give someone else designing a habitat for this user is____.

DEFINING THE CRITERIA

Design Portfolios

To what extent is the student able to:

- identify design issues and explore alternative solutions
- access a variety of information sources to solve problems involving design
- develop sketches and drawings that clearly communicate design ideas

Presentations

1. Presentation
- explanations clear and easy to understand
- relevant background information presented
- ideas sequenced in a logical way

2. Flow Chart
- reflects a logical progression of construction steps
- highlights key points in the manufacturing process
- shows details

3. Model
- satisfies user needs
- is aesthetically pleasing
- is innovative in design

ASSESSING AND EVALUATING STUDENT PERFORMANCE

Design Portfolios

The teacher placed considerable emphasis on the design portfolios, collecting them twice for evaluation—once after the student received feedback on preliminary design sketches from the group, and once at the end of the project. In both cases the design portfolios were evaluated using a performance scale. If a student was able to use the feedback from the first evaluation to get a higher grade on the second one, the teacher gave the student the higher grade. If the student received the same or a lower mark on the second evaluation, the grades from the two evaluations were averaged.

Excellent

The student's divergent approach to designing shows confidence. An exceptionally broad range of design issues have been identified, thoroughly researched, well explained, and dealt with in innovative ways. Drawings are exceptionally professional in appearance. Reflections are insightful and indicate a thorough and deep commitment to, and valuing of, design work.

Very Good

A wide range of design issues are dealt with in depth. Background information from a

variety of sources is incorporated. Drawings are detailed and easy to follow. There is evidence that a variety of design ideas were explored. Reflections indicate an ability to identify and respond to strengths and weaknesses identified by self and others.

Good

The student is able to identify some design issues and deal with them in personal plans, although complex issues may be dealt with at a superficial level. There is evidence of the use of background information from general knowledge or research. A variety of sketches and drawings are included, although some may be difficult to follow. Reflections indicate that the student can recognize the pros and cons of design solutions, and often justify reflective comments, such as "Good because____."

Satisfactory

Design ideas are presented and developed to some extent, although these may not always be realistic. User needs are identified, and some are incorporated into the design. Issues identified and dealt with may be obvious or superficial. Drawings are included but may be difficult to understand. The student is able to identify some strengths and weaknesses but may not act on them or on feedback from peers.

Minimally Acceptable

Some design ideas are presented, although these may be poorly developed or hard to follow. There has been some attempt to consider user needs, but the design solutions may be incomplete or impractical. Drawings may be incomplete. Some reflection is present, but the student may not always be realistic about strengths and weaknesses.

In Progress/Failing

Few if any design ideas are presented or developed. Drawings are absent or incomplete. There is little or no evidence that the student is able to identify user needs or access background information. Reflection may be absent or unconnected to the problem involving design.

Presentations

The students' presentations to the class were assessed using the scale on the following page. Self-assessment and scores given by the teacher and peers were combined to arrive at the student's grade. Having the same number of criteria for each aspect of the presentation ensured that they received equal weighting.

Tasks	Rating
Presentation	
• explanations clear and easy to understand	
• relevant background information presented	
• ideas sequenced in a logical way	
Flow Chart	
• reflects a logical progression of construction steps	
• highlights key points in the manufacturing process	
• shows details	
Model	
• satisfies user needs	
• is aesthetically pleasing	
• is innovative in design	

Key:

5—Excellent: criterion met to an exceptional or unusual degree

4—Very good: criterion met in a very effective way

3—Good: criterion met in a competent and effective fashion

2—Satisfactory: criterion met but with considerable room for improvement

1—Minimally acceptable: criterion met to some extent

0—Not evident: criterion not met

GRADE 9

Topic: *Electronic Communications System*

Prescribed Learning Outcomes:

Production

It is expected that students will:

- use a design process to modify products to improve their appearance, usefulness, and function
- investigate and select materials to meet design specifications

Control

It is expected that students will:

- demonstrate an understanding of the operating principles used in various control devices
- design and contruct a system that uses a control device
- use troubleshooting strategies to locate the source of malfunctions in a system
- modify electric, electronic, pneumatic, and mechanical control devices for particular applications

Energy and Power

It is expected that students will:

- construct devices that convert and transmit various forms of energy

PLANNING FOR ASSESSMENT

- Students worked in pairs to design and make an electric or electronic control system and a code to communicate between two parties. Students were required to develop and submit a design portfolio, a prototype, and a code sheet.
- Students worked with their partners to brainstorm possible methods of communicating through sight, sound, and so forth. They were then asked to design a circuit that would operate four or five signalling devices from an isolated location, assemble the unit, test it, and troubleshoot. They were required to keep a record of their design and troubleshooting in their design portfolios, as well as a list of the types of motion controls required to perform given tasks within the activity.
- Students devised a code for communicating through the system and practised using it. They designed and made an appropriate enclosure for their device. The culminating activity was a performance test in which each pair demonstrated their device, and their classmates evaluated its performance.

DEFINING THE CRITERIA

Design Portfolios

To what extent is the student able to:

- identify design issues and explore alternative solutions
- access a variety of information sources to solve problems involving design
- develop sketches and drawings that clearly communicate their design ideas
- identify strengths and weaknesses in their work, and incorporate feedback to improve their designs

Troubleshooting

To what extent is the student able to:

- approach a problem systematically
- identify interrelationships between various parts
- identify the effect of a failed component on the system
- explore alternative solutions
- use appropriate tools and testing equipment

Prototype

To what extent does the prototype demonstrate:

- quality construction and attention to detail
- efficiency
- aesthetic appeal
- innovation in design

Problem Solving

To what extent does the student demonstrate:

- engagement in the problem
- appropriate use of background knowledge
- effective problem-solving processes
- ability to represent solutions to the problem

ASSESSMENT AND EVALUATION OF STUDENT PERFORMANCE

Design Portfolios

Student design portfolios were assessed using a design portfolio performance scale. (See Grade 9: Habitat Design for a example.)

Troubleshooting Skills

The teacher observed students troubleshooting and evaluated their skills using the following observation checklist:

Troubleshooting Skills

	Always	Sometimes	Not Observed
Approaches the problem systematically			
Identifies the relationships between various parts			
Identifies the impact of a failed system component			
Explores alternative solutions			
Uses appropriate tools and testing equipment			

Prototype

The teacher worked with the class as a whole to develop criteria for a performance test of their communication devices. Each pair made copies of their code sheet for their classmates. Students evaluated their peers using the following scale:

Evaluating a Prototype

	Excellent	Good	Fair	Poor
Performance • efficiency of device				
• effectiveness of demonstration				
• efficiency of code				
Quality of construction and attention to detail				
Innovation in design				

Problem Solving

The teacher asked students to evaluate the problem-solving processes they used while working on this problem involving design using the "Student Self-Evaluation Checklist" from the reference set *Evaluating Problem Solving Across Curriculum.*

Problem Solving

Student Self-Evaluation Checklist

Student _____

Date _____

Problem _____

My interest in solving the problem:	☐ • I was not very interested in the problem. ☐ • I did not understand the problem. ☐ • The teacher had to help me many times.	☐ • I wanted to solve the problem. ☐ • I had some difficulty understanding the problem. ☐ • I asked the teacher for help sometimes.	☐ • I was very interested in the problem. ☐ • I understood the problem. ☐ • I worked independently.
My knowledge about the problem:	☐ • I didn't know very much about the problem. ☐ • I didn't know where to get the information I needed.	☐ • I knew some things about the problem. ☐ • I knew how to find some information, but I still needed more.	☐ • I was very familiar with the ideas of the problem. ☐ • I knew how to find the information I needed.
My understanding about how to solve the problem:	☐ • I wasn't sure how to solve the problem. ☐ • I had no idea which strategy to use. ☐ • I gave up.	☐ • I had some idea of how to solve the problem. ☐ • I didn't know what to do when my strategy didn't work. ☐ • I felt frustrated but kept trying.	☐ • I knew what to do to solve the problem. ☐ • I knew which strategy to use, and if it didn't work, I was able to try another. ☐ • I tried unusual ways to solve the problem.
My explanation of the problem and solution:	☐ • It was hard to explain the problem. ☐ • It was hard to explain how I solved the problem. ☐ • I don't think I solved the problem. ☐ • My solution was disorganized.	☐ • I could explain most of the problem. ☐ • I was able to explain how I solved the problem. ☐ • I solved the problem, but the solution wasn't organized.	☐ • I could explain all the details of this problem. ☐ • I was able to explain how I solved the problem and how I knew what to do. ☐ • I solved the problem, and my solution was organized.

Goal setting _____

_____

_____

GRADE 10

Topic: *Designing and Building a Box to Collect Money for a Food Bank*

Prescribed Learning Outcomes:

Self and Society

It is expected that students will:

- demonstrate a willingness to find unique solutions to problems that arise during the design process
- demonstrate the ability to use community resources to help solve problems that come up during the design process
- demonstrate confidence and positive attitudes when solving problems that occur during the design process

Communications

It is expected that students will:

- use information gathering and communication methods to solve problems involving technology and to create effective presentations

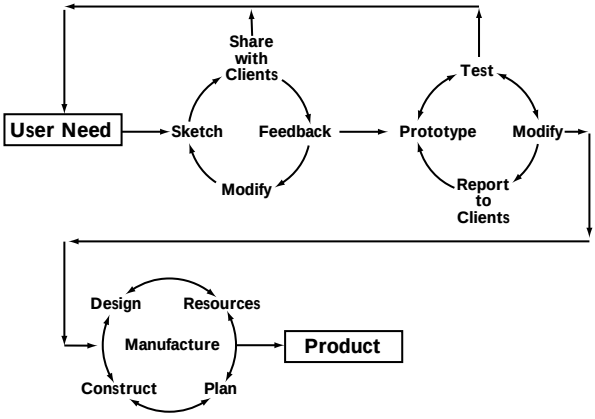
Production

It is expected that students will:

- devise a production process
- use hand and power tool techniques to process materials in order to improve the appearance, usefulness, and function of products
- demonstrate safe work habits when using tools, equipment, and technical processes, and encourage the same in others
- use a design process in production activities
- match material to specific product requirements

PLANNING FOR ASSESSMENT

- Students were asked to work individually to design and construct donation boxes for contributions to the local food bank. The completed boxes were put in local banks. Students were expected to follow a design process such as the one outlined in the diagram below, with particular emphasis on applying the process to respond to client and user needs. Students recorded their design processes in a design portfolio.



- Students developed interview questions and interviewed clients (volunteer workers at the food bank) and users (tellers at the banks) in order to develop criteria and design parameters.
- Students found that the typical client (food bank worker) listed the following design criteria:
  - attractive
  - colourful
  - eye-catching
  - name and logo of food bank accurately displayed on two sides
- They found that the typical user (bank teller) listed the following design criteria:
  - slot large enough for a loonie
  - clear window
  - can be opened and closed again easily
  - reasonably secure

  - durable
  - stable
  - well labelled
  - original in design
  - within specified maximum dimensions
- From these criteria students developed design parameters and initial concept sketches that they took back to their clients and users for feedback before completing their designs and building the boxes.
- Food bank workers and bank tellers were asked to evaluate the students' design consultations and the finished donation boxes.

DEFINING THE CRITERIA

Designing for specific clients or users

To what extent was the student able to:

- develop interview questions that elicit client and user criteria
- conduct effective interviews with clients and users to determine their needs
- base design parameters on client and user needs and wishes
- use feedback from clients and users to improve designs
- produce a product that meets or exceeds client and user expectations

Production

To what extent does the student demonstrate:

- the ability to select appropriate materials and tools
- the ability to establish a production sequence
- the use of equipment and tools in a safe and effective manner
- satisfaction in producing a well-finished product

Problem Solving

To what extent does the student demonstrate:

- engagement in the problem
- appropriate use of background knowledge
- effective problem-solving processes
- the ability to represent solutions to the problem

ASSESSING AND EVALUATING STUDENT PERFORMANCE

Design portfolios, client and user evaluations, and finished products were collected and evaluated using the following holistic scale, which emphasized the importance of consultations with clients and users in the design process.

Outstanding

Interview questions and interviews relating to the design problem are exceptionally thoughtful and thorough, resulting in a superior set of design parameters. Feedback from clients and users is especially well used to improve the design, even when the design issues raised are complex. The finished product meets all the design criteria supplied by the clients and users—often in highly innovative ways. Clients and users remark that the product exceeds their expectations, or that bank customers single it out for praise.

Good

The list of criteria developed from the interviews is complete. Feedback from clients and users has been incorporated, although some design issues may have been dealt with in more depth than others. All criteria are met in the finished product, and clients and users express satisfaction or pleasure with it.

Satisfactory

An adequate list of criteria has been developed from interviews and incorporated into the design, although some design solutions may be simplistic or superficial. Clients and users are satisfied with the finished product and use it, although they may not be very enthusiastic about it.

Unacceptable

Interview questions and interviews are brief or unfocussed and may not provide necessary information. Several problems involving design remain unsolved. The finished product did not meet client and user identified criteria to the extent that the box was not usable or its use had to be discontinued.

Problem Solving

As students worked on this problem involving design, the teacher observed and recorded their performances as problem solvers using the "Individual Observation Checklist" from the reference set *Evaluating Problem Solving Across Curriculum.* (See Grade: 8 Introduction to design, Tools, and Materials.)

Student's final products were assessed using the Design Project Assessment Checklist.

Design Project Assessment Checklist

Name: _____
Course: _____ Block: ____
Project: _____

		COMMENTS
Framing a Design Brief		
a) brief and specifications poorly developed	1	
b) help required to produce brief and identify specifications	2	
c) produces simple brief, specifications broadly stated	3	
d) produces satisfactory brief and specifications	4	
e) well-developed design brief and detailed specifications	5	
Investigation and Research		
a) minimal research and investigation conducted	1	
b) research conducted but lacking depth	2	
c) research presented from several sources	3	
d) satisfactory research conducted with minimal assistance	4	
e) research comprehensive, well organized, and well documented	5	
Generation of Ideas		
a) only one idea presented	1	
b) two ideas generated, only one seriously considered	2	
c) a variety of ideas generated	3	
d) a variety of ideas generated with distinct differences	4	
e) several ideas generated that meet design specifications	5	
Developmental Work		
a) little evidence of developmental work	1	
b) some developmental work based on one idea	2	
c) developmental work illustrates design details	3	
d) accurate sketches, drawings, and renderings presented	4	
e) high-quality drawings detailing final design	5	
Planning		
a) minimum evidence of planning	1	
a) identifies key stages of planning process	2	
b) key stages organized in logical sequence	3	
d) detailed requirements identified for each stage	4	
e) detailed planning includes flow charts	5	
Evaluation and Testing		
a) evaluation irrelevant or largely superficial	1	
b) evaluation based on aesthetic and functional qualities only	2	
c) evaluation includes self-criticism and relevant observations	3	
d) valid judgments with recommendations for improvement	4	
e) detailed evaluation that is relevant, concise, and objective	5	

TEACHER COMMENTS

MANAGING ASSESSMENT INFORMATION

Teachers keep track of changes in each student's learning in a variety of ways. The techniques they use to monitor development enable them to make informed decisions about teaching, learning, and the evaluation of learning. The following collection of ideas illustrates some of the ways that teachers keep track of change and use this information to monitor student development in technology education.

Evidence of growth in technology education can be collected in three ways:

- by observing students in the processes of doing and making products
- by listening to their comments, observations and questions they raise
- by reviewing their products

Valid judgments about individual students require repeated opportunities to observe, listen to, and review their work.

Student Journals

Assessment of student performance may be supported through the use of journals. Student journals are a useful tool for encouraging students to reflect on their experiences. Journals may be quite structured, or they may be a general review of the events of the week in the class. Entries may comment on a specific activity or topic, or provide a broad reflection on progress or on an issue.

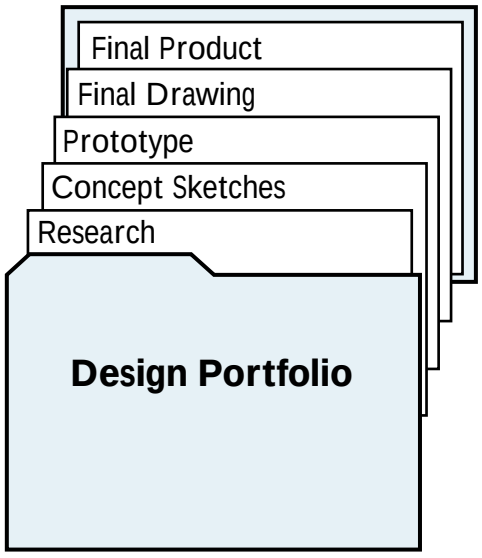
Journals are an important aspect of communication between the student and teacher. Students may ask questions, indicate successes, or identify areas where they need further assistance to develop skills.

Teachers can respond to student journals in a letter, with a short comment in the journal, or by talking to the student.

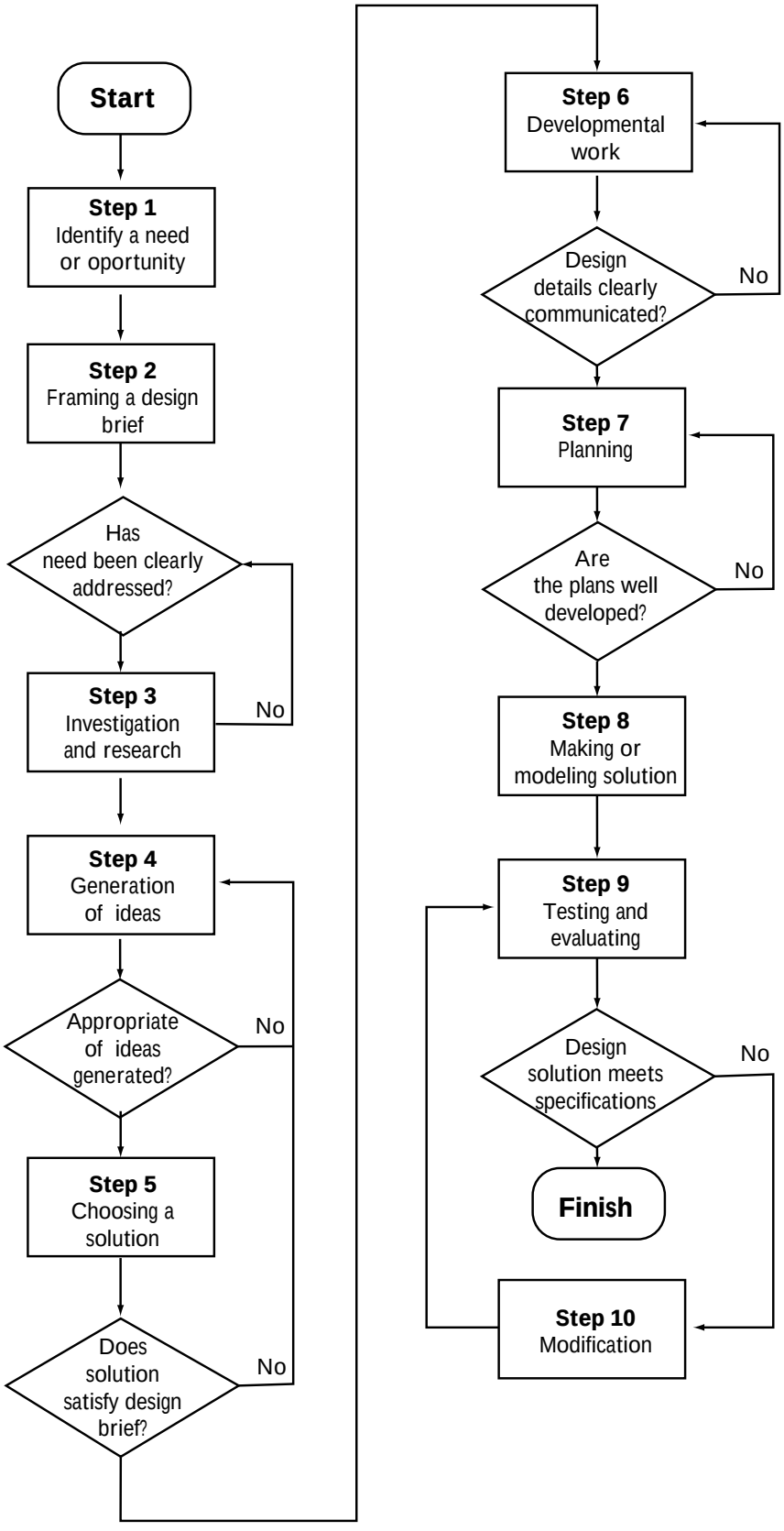
Design Portfolios

A design portfolio is a purposeful collection of a student's work that shows the student's effort, progress, and achievement over time.

Design portfolios provide teacher with one information, they need for a comprehensive assessment of students' development as they identify problems or needs and progress toward the process of designing and making their solutions. Design portfolios are an important part of career planning, particularly in engineering, graphic arts and other areas that are design oriented.



There is no one, single format for a design portfolio. Teachers and students tailor their design portfolios to the purposes for which they are used.


Start
Step 1
Identify a need or oportunity
Step 2
Framing a design brief
Has need been clearly addressed?
Step 3
Investigation and research
No
Step 4
Generation of ideas
Appropriate of ideas generated?
No
Step 5
Choosing a solution
Does solution satisfy design brief?
No
Step 6
Developmental work
Design details clearly communicated?
No
Step 7
Planning
Are the plans well developed?
No
Step 8
Making or modeling solution
Step 9
Testing and evaluating
Design solution meets specifications
No
Finish
Step 10
Modification

Developing the Design Portfolio

Developing a design portfolio is an interactive process that requires ongoing reference to the original design brief while the students are actively involved. The process results in modifications and the reviewing of previous stages as students work toward a solution.

Ideas for design portfolios:

- **Identify a need or opportunity.** A situation with a recognized need or opportunity is examined.
- **Frame a design brief.** A concise problem statement is formulated that clearly identifies: 1) what the student will do and 2) what the successful solution or product will do. As well, the design brief lists the requirements of the work, such as size, materials, cost, aesthetics, and safety issues.
- **Investigate and research.** Data or information that relates directly to the problem is collected from a wide variety of sources.
- **Generate ideas.** Students record their initial ideas for possible solutions using notes and sketches.
- **Decide on a solution.** The various design possibilities are considered and the design that best meets the requirements stated in the design brief is chosen for further development.
- **Developmental work.** Through the use of detailed, working drawings and renderings, students refine initial design ideas to produce a final design.
- **Planning.** The key stages of production are identified and organized in a logical sequence. This may require the development of flow charts.
- **Produce the solution.** Students begin to produce the final solution or product. Students document problems encountered in the production phase of the development.
- **Test and evaluate.** Students test and reflect on the results to assess the suitability of their design solutions.
- **Modify the solution or product.** Students make changes to their original design based on the results of the testing. Modifications made should be recorded in the design portfolio.
- **Summary and Evaluation.** Students review their portfolios and make judgments about the achievement of their goals.

Sample Design Portfolio

The following is an example of a design portfolio developed by students in grades 8 and 9. This example is excerpted from the reference set *Evaluating Problem Solving Across Curriculum.*

Design Brief: *Design and build a metal vehicle that fits inside a 12.5 cm track, prepare a radio or TV ad, make a poster, include an accounting of costs, write a research and discovery report, and hold a race to see how far the vehicle rolls down a ramp (gravity power).*

The project was done over several months. The teacher explained to the students what each term in a design flow chart meant, gave examples of actual problems being constructed and discussed possible ways of applying each step to design and construct a particular project.

As the students worked through their problems, they often approached the teacher with questions. He responded to their questions with a question-"I don't know, what do you think?"; "What do you see as your options

here?"; "Where might you find an answer to that problem?"; "Who in this class might best know the answer to that question?"; "Who might you call on the telephone to arrive at a possible solution to your problem?"; upon a creative solution, the teacher might say "Good idea; why did you decide to do it that way?"

Teacher Observations;

"Evan and Cory worked well together with lots of focussed discussions, and with a few friendly disagreements. All activity was productive. They stayed focussed on the problem and enjoyed the time of "not knowing," brainstorming, and figuring out things. Each time a new problem emerged, they tackled it energetically. When they were unsure of technical information, they were relentless in their search and always had specific questions to ask. When they found that something didn't work—like the wheels—they accepted it as a matter of course and looked for a new solution. All planning and drafting was detailed and complete."

"Evan is a particularly gifted artist. His ability to develop very complex prototype drawings, working drawings and poster was above anyone else in the program."
"While the problem the students dealt with were primarily technical, an important subproblem we dealt with daily was cooperative learning skills.
Both students had complimentary gifts-one in technical and artistic areas, the other in leadership skills. Their strong views and ideas ended sometimes in '"friendly disagreements." Working through these disagreements was an integral part of the overall pattern."

Samples of Student Work are not available as the scanned images do not translate to PDF format

Interviews

Interviews provide valuable information about students' understanding, thoughts, and feelings about technology education subjects. Interviews may give the student an opportunity to reflect on the unit of study and the teacher a chance to gather information about the student's knowledge and attitudes, as well as to diagnose student needs. Interviews may take the form of a planned sequence of questions that leads to an open-ended discussion or they may require independent completion of specific questions. Informal interviews between the teacher and student should take place on a regular basis throughout instruction.

Observation Sheets

Observation sheets may be used to assess students during individual or co-operative activities. Teachers should focus their assessment by selecting only a few attributes for each observation. This information is useful when reporting on individual student progress.

Checklists

Checklists allow the teacher to observe the entire class "at a glance." They provide a quick reference for keeping track of specific information about student attitudes, knowledge and skills. Checklists allow the teacher to create an individual record-keeping system organized in a variety of ways. Information might include date, skill-proficiency legends, or a simple checkmark identifying a *yes* or *no*. Checklists can be useful in developing a learning profile of a child that indicates growth over time. Checklists may be created to gather information about student co-operation, participation, attitude, leadership, or skill development.

Interviews

Questions	Teacher Notes
• How do you feel about your solution?	
• Did you have any new thoughts when _____?	
• How did you go about _____?	
• Tell me another way of doing _____?	
• What sources/resources did you use?	
• What was the most interesting thing you found out?	
• What would happen if _____?	
• Why did you _____?	
• What would you do differently next time?	
• Tell me about _____.	
• Tell me what you learned from _____.	
• Is there anything you would like to change in your product?	
• What is the best part/aspect of your product?	

Observation Sheet 1

Name(s): _____

Date	Activity	Observed behaviour	Comments for Improvement

Problem Solving

Individual Assessment Checklist

Student _____

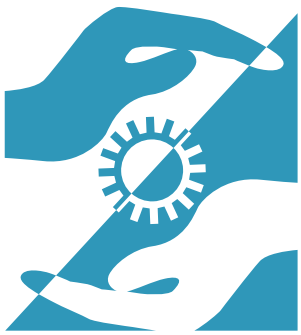
Problem ❶ _____ Date _____

Problem ❷ _____ Date _____

Problem ❸ _____ Date _____

	Beginning	Developing	Maturing	Comments
Engagement	❶❷❸ ☐☐☐ • shows little interest ☐☐☐ • has difficulty defining problem ☐☐☐ • works too quickly ☐☐☐ • gets sidetracked ☐☐☐ • needs frequent reinforcement to stay engaged	❶❷❸ ☐☐☐ • seems to want to solve problem ☐☐☐ • has some difficulty defining problem ☐☐☐ • may seek frequent reinforcement	❶❷❸ ☐☐☐ • shows interest ☐☐☐ • clarifies problem ☐☐☐ • approaches problem actively and thoughtfully ☐☐☐ • works independently	
Background Knowledge	☐☐☐ • is unsure of what to look for ☐☐☐ • has gaps in content knowledge ☐☐☐ • needs explanation ☐☐☐ • has narrow focus ☐☐☐ • seldom transfers knowledge/ strategies	☐☐☐ • can identify some required content knowledge ☐☐☐ • has some gaps in content knowledge ☐☐☐ • focus may be narrow/may seek out information ☐☐☐ • may transfer information/ strategies	☐☐☐ • relates prior knowledge ☐☐☐ • gives clear evidence of content knowledge ☐☐☐ • recognizes and finds missing information ☐☐☐ • transfers information/-strategies	
Process	☐☐☐ • may lose sight of problem ☐☐☐ • is not aware when on the wrong track ☐☐☐ • gives up/doesn't change strategies	☐☐☐ • is unsure of approach to problem ☐☐☐ • is aware when on wrong track, but not sure what to do ☐☐☐ • frustrated, but looks for help	☐☐☐ • uses appropriate strategies ☐☐☐ • is aware when on wrong track and changes strategies ☐☐☐ • uses unique or unusual strategies	
Representation	☐☐☐ • has difficulty restating problem ☐☐☐ • has difficulty communicating processes used ☐☐☐ • solution is disorganized, partial, or incorrect	☐☐☐ • restates salient features of problem ☐☐☐ • may communicate some of the processes used ☐☐☐ • solution may be complete, but not thorough and organized	☐☐☐ • communicates subtle features of problem ☐☐☐ • communicates thinking and processes used ☐☐☐ • solution is thorough, organized, appropriate, and may be original	

Appendix E
Acknowledgments



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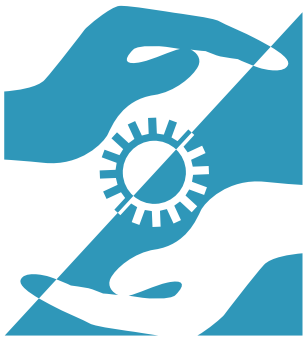
Appendix F
Glossary



aerodynamic	Designed to move through air with minimal resistance.
aesthetics	A quality dealing with the appearance of an object.
applications software	Software designed to accomplish a specific task, such as desktop publishing or word processing.
ASCII	American Standard Code for Information Interchange; allows computer equipment from different manufacturers to exchange data.
automation	Techniques of self-regulation and self-control for systems that reduce the amount of human supervision required for a machine or process.
backup	An extra copy of a program or information stored on a disk or tape.
baud rate	The speed at which data is transmitted over a communications line; used to transmit data between devices, such as computer-to-computer or computer-to-terminal.
boot	To start a computer or system; to load an operating system into a computer and begin operation.
brainstorming	A stage used in the design and problem-solving process to generate a number and variety of ideas in a noncritical atmosphere.
CAM	Computer-aided manufacturing; the operation of a machine controlled by a host computer.
CD-ROM	Compact Disk Read Only Memory; a device that uses a rigid disk to store information in a form that can be read by a computer.
CO_2 powered	Propelling a device with a cylinder of compressed carbon dioxide.
combining	A production process used to join or add materials together in a permanent or temporary fashion (e.g., glue, nails, screws, welding, soldering).

communication process	Conveying a message or idea to someone; in technology education the focus is on the use of visual and electronic media.
computer program	A set of instructions in a language understood by a computer; used to direct the operations of a computer.
CAD or CADD	Computer-Aided Design (and Drafting): a precision-drawing software program that speeds up the design process by making it easier to create and modify draft designs.
conservation	Using energy efficiently; finding alternatives to exist ing energy forms; improving energy conversion methods (e.g., reducing friction, engine tune-ups).
control	Methods used to regulate a system or device.
control device	Any device that senses, switches, or regulates an operation (e.g., switch, valve, brake).
control system	A system that senses, switches, or regulates an operation.
conversion	A technological process that changes energy from one form to another (e.g., energy is converted into heat during combustion in an engine; rotary motion is converted into reciprocal motion using a crank).
database	A collection of data that is structured and organized into a chosen format; a computer database makes it easy to create, retrieve, and resort data stored electronically.
design brief	A concise problem statement developed by a student or teacher that identifies what the student will do and what the successful solution will achieve.
design portfolio	A record of the development of a project from inception to completion.
design principles	Qualities of balance, layout, measurement, colour, scale, and projection.

design process	A planning and decision-making process that produces a solution.
electricity	A form of energy that flows along a path and can produce heat, light, magnetism, motion, or a chemical change.
electromechanical	A machine process or device that is controlled electrically.
electronics	The branch of physics that deals with the production, activity, and effects of electrons in motion; the branch of engineering that deals with the design and manufacture of devices that control the flow of electrons, such as the microprocessors used in computers; working with small electronic components (e.g., computers, stereos).
energy	The capacity for doing work; types include mechanical (e.g., motion), chemical, electric, thermal, nuclear, and radiant (e.g., light and sound); may be classified as non-renewable (e.g., fossil fuels), or renewable (e.g., biomass, human and animal muscle, wind, solar, geothermal, water).
engineering principles	The method of operation used to plan, build, and manage engines, machines, roads, and structures.
ergonomics	The field of matching technological products to human dimensions, needs, and characteristics.
finishing	A production process by which the appearance or internal structure of a product or material is changed to improve its durability, strength, usefulness, or aesthetics.
flow chart	A pictorial representation of a sequence of events.
forming	A production process by which the shape of a material is changed without adding or removing anything (e.g., reshaping plastic, bending wire).

graphics	Diagrams, pictures, and electronic images and their use to convey a message.
hydraulics	Using fluids to transmit and regulate the forces in a machine or device.
information processing	The conversion of data into information by sorting in useful ways.
information/communication systems	The use of a device or method to collect, process, store, or deliver information using electronic, graphic, photographic, or mechanical means.
input	Data, materials, resources, or instructions entered into (most often) a computer system.
Internet	A global information network linking thousands of smaller computer networks.
kinetic energy	The energy of a mass in motion (e.g., pendulum swinging, spring unwinding).
learning log	A record of activities completed during an assignment.
machine	An assembly of parts used to change the amount, speed, or direction of a force for a useful purpose.
manufactured materials	Materials that do not exist in nature (e.g., steel, fabric).
media	Various forms of communication (e.g., video, paper, film, computer imagery).
modem	A computer device that transmits and receives infor-mation over a telephone line.
monitor	The part of the feedback loop that has to do with observing the output of a system.
multimedia	The combination of text, sound, and video used to present information.
network	A connected system of software and hardware that transmits data.

operating system (OS)	Software that allows a computer to function by controlling all its application programs (e.g., DOS, OS2, Macintosh OS, UNIX).
output	The actual results of a system, desired or undesired, expected or unexpected.
parameters	Restrictions affecting the design of a product or system (e.g., size, cost, materials).
pneumatics	Using air or gas pressure to operate mechanical devices.
potential energy	The ability to do work using stored energy (e.g., compressed spring, charged capacitor, gasoline).
production	The process of converting and combining resources to construct, manufacture, or grow something.
program	A sequence of movements, steps, or instructions that a system follows to accomplish a task.
prototype	A model used to test and evaluate a design before final production.
RAM	Random Access Memory; the main working memory of a computer.
ROM	Read Only Memory; a type of computer memory in which information can be accessed, but not stored.
regulating	Varying the flow, amount, and direction of all forms of energy (e.g., human, fluid, mechanical, electrical, heat) in systems.
resources	Components necessary to design, build, and maintain technology (e.g., people, information, materials, tools and machines, energy, capital, time).
robotics	Programmable, multifunctional devices that perform physical tasks.
Rube Goldberg device	A complex device that does a simple task.

safety equipment	Devices used to protect workers (e.g., goggles, gloves, guards, ventilation).
scale	The relative size of a plan, drawing, or model.
sensing	Detecting, interpreting, and monitoring energy with electric, electronic, fluid, and mechanical devices.
sensor	A subsystem used to obtain information or data (e.g., light, temperature, number, movement).
separating	A production process in which a shape is changed by removing something (e.g., etching a printed circuit board, cutting wood).
sequential pictorials plans	A series of images representing steps used to complete a task.
simple machines	Basic devices or mechanical powers on which other machines are based (e.g., lever, wedge, pulley, wheel and axle, inclined plane, screw).
store and retrieve	Compiling information in some form of memory and recovering the data as required (e.g., storing sound and images on video tape and playing it back).
storyboard	A series of images that describe sequenced events in a visual production (e.g., video, film, animation, play); used in the the planning process of these productions.
switching	Any method (e.g., mechanical, electronic) used to turn the flow of energy on and off in a system (e.g., light switch, keyboard).
synthetic materials	Materials created through chemical synthesis (e.g., plastics, fiberglass).
system	A regularly interacting or interdependent group of items forming a unified whole.
systems and control	The application of devices and processes to manage, sort, control, and organize.

technical drawings	Drawings that contain the detailed information required to produce an object or system (e.g., measurement, scale, material, finishing information).
WHMIS	Workplace Hazardous Materials Information Systems; product safety information issued by the BC Workers' Compensation Board.