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ABSTRACT

The Integrated Occupational Program (IOP) was designed for students who may function a year or more behind their peers. It consists of both core and complimentary courses designed to provide for the development of essential concepts, skills and attitudes in science that will enable the student to function successfully at home, in the classroom, the workplace, and the community. This document contains a list of the goals for the IOP Science Grade 8 and Grade 9 program and discusses the model; social skills; nature of science; science, society and technology; required and elective components; planning; learning resources; methodology; evaluation and scope; and sequence. Statements of the content of the Science Grade 8 and Grade 9 include the program, presentation, and suggested options. (CW)

INTEGRATED OCCUPATIONAL PROGRAM

Program of Studies/Curriculum Guide
Grades 8 and 9

SCIENCE

INTERIM 1989

Curriculum

Alberta EDUCATION

Science

Program of Studies/Curriculum Guide

Grades 8 and 9

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NOTE

CURRICULAR DOCUMENT FORMAT

To provide educators with a comprehensive overview of the Integrated Occupational Program, all I O P. curricular documents have adopted the format of combining the Program of Studies and Curriculum Guide into one document The shaded statements or segments within this document indicate the prescriptive contents of the Program of Studies All other advice and direction provided are suggested only

The terminology and format used in this document reflect policy in effect when I O P curriculum development began in 1987

METRICATION POLICY

It is the policy of Alberta Education that "SI units become the principal system of measurement in the curriculum of the schools in the province" In preparing students for transition to the workplace where imperial/U S measurements may still be in use, both SI metric and other units of measurement are addressed in the practical arts/occupational component of the Integrated Occupational Program

The comparison/teaching of metric units with other units of measurement should be restricted to those that are relevant to student needs as reflected by common usage in course-related workplaces

ACKNOWLEDGEMENTS

The Integrated Occupational Science 8 and 9 Program of Studies/Curriculum Guide has been developed through the cooperative efforts of many individuals Each person's contribution is sincerely appreciated The program has also benefited from the validation of a number of educators across the province Their comments provided valuable assistance and direction

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RATIONALE

The Integrated Occupational Program (I O P), developed as an outcome of the *Secondary Education in Alberta* (June 1985) policy statement, is a program for students who may function a year or more behind their age peers The program consists of both core and complementary courses designed to develop skills necessary for everyday living

I.O P Science 8 and 9 is designed to provide for the development of essential concepts, skills and attitudes in science that will enable the student to function successfully at home, in the classroom, in the workplace and in the community Determining the essential concepts, skills and attitudes relative to environmental demands and providing opportunities for students to negotiate their needs and wants for functioning in these environments are vital to ensure that students will become motivated to participate in the learning process Traversing the span between the concepts, skills and attitudes required and the needs and wants of students is integral to a successful science program

The science program has been developed to teach skills within contexts that are meaningful and relevant to students Many opportunities are provided for instruction through "thematic study", through the integration of skills "across the curriculum", and through application of skills to "real life" situations These experiences add a motivational dimension to the program, and provide students with the direct assistance they need to transfer specific skills to more generalized situations

Students within the program are typically unaware of the strategies they may generate and employ to become more efficient in their cognitive functioning Evidence supports, however, that students with learning difficulties can perform strategically if instructed to do so The strategies and skills for scientific inquiry, problem solving and decision making that are developed and applied throughout the program will provide students with a systematic and logical approach for dealing with a variety of phenomena encountered in their environment As students learn that they can understand and control the outcome of tasks demanded of them, restored confidence in taking risks, accepting challenges, solving problems and making responsible everyday decisions will reverse the "learned helplessness" syndrome and passive acceptance of failure so typical in many of their lives

PHILOSOPHY

The Integrated Occupational Science 8 and 9 program focuses first and foremost on the needs of the learner. As attitude and self-esteem have powerful influences over learning, the program must foster within each student a positive self-concept and a positive attitude toward learning The concepts, skills and strategies delivered by the program must:

- provide meaningful and relevant experiences
- be appropriate to student ability
- provide for student success
- enable students to understand better their personal environment

Students vary in the way they receive, process, recall, apply and communicate information. Each student has a preferred learning style. Instructional planning and delivery must include careful assessment of each student's developmental characteristics, knowledge, skills and learning style. Adjustments to instructional delivery may often be necessary to ensure that individual student needs are being met.

An integrated approach presupposes the linking together of various scientific skills and strategies into meaningful investigations and activities Organization of content into "themes" is intended to advance the notion of holistic instruction relative to both the student and the discipline of science Learning activities will help students deal with practical problems in coping with their lives and their environment. Relevancy to daily living and future employment should be emphasized throughout the program

Although students are at various stages of cognitive development, most students will continue to use concrete operational thinking Students will depend upon personal experience and personalized content in order to link ideas As the process of analysis must be based on tangible experience, learning activities should begin at the concrete level High emphasis should be placed on experiential learning involving first-hand investigation An experiential approach will enable students to relate what they are learning to past experience and knowledge While concepts and skills cannot be developed in the absence of supporting facts, the knowledge component of science should not be over-emphasized Strategies that will assist the learner in moving from the concrete level of thinking to transitional stages have been provided throughout this Program of Studies/Curriculum Guide

Today's technological society makes it increasingly important for students to possess the thinking skills necessary to gather, process and apply information to a variety of life situations The science program must take responsibility for developing within each student the skills used in scientific inquiry, problem solving and decision making These process skills, as described in the curriculum, are best learned through practice Models that give student and teacher a systematic and local structure in which to apply the process skills when investigating, solving problems and making decisions have been provided throughout the curriculum Frequent use of appropriate thought processes will enable students to gain confidence in their ability to control certain aspects of their personal environment and to make responsible everyday decisions

As science and technology affect our lives in so many ways, it is necessary for students to appreciate and understand the dynamic relationships that exist among science, technology and society Learner activities must illustrate how science is used in technology, and how technology affects the quality of our life and the health of our planet Students must recognize the value of technology as well as the problems that result from its uncontrolled use Societal issues involving science and technology have been integrated throughout the curriculum Students should be given opportunity to investigate these issues and to make responsible decisions based on the information they gather Community partnerships will provide opportunity for students to become involved in the community by way of meaningful activity linked to the science program

It is intended that the content and process of I O P Science 8 and 9 provide a student-centred, personal and practical approach to science A program with these emphases will ensure students' success in developing concepts, skills and processes that are requisite to responsible participation in the home, community and workplace

GOALS OF I.O.P. SCIENCE 8 AND 9

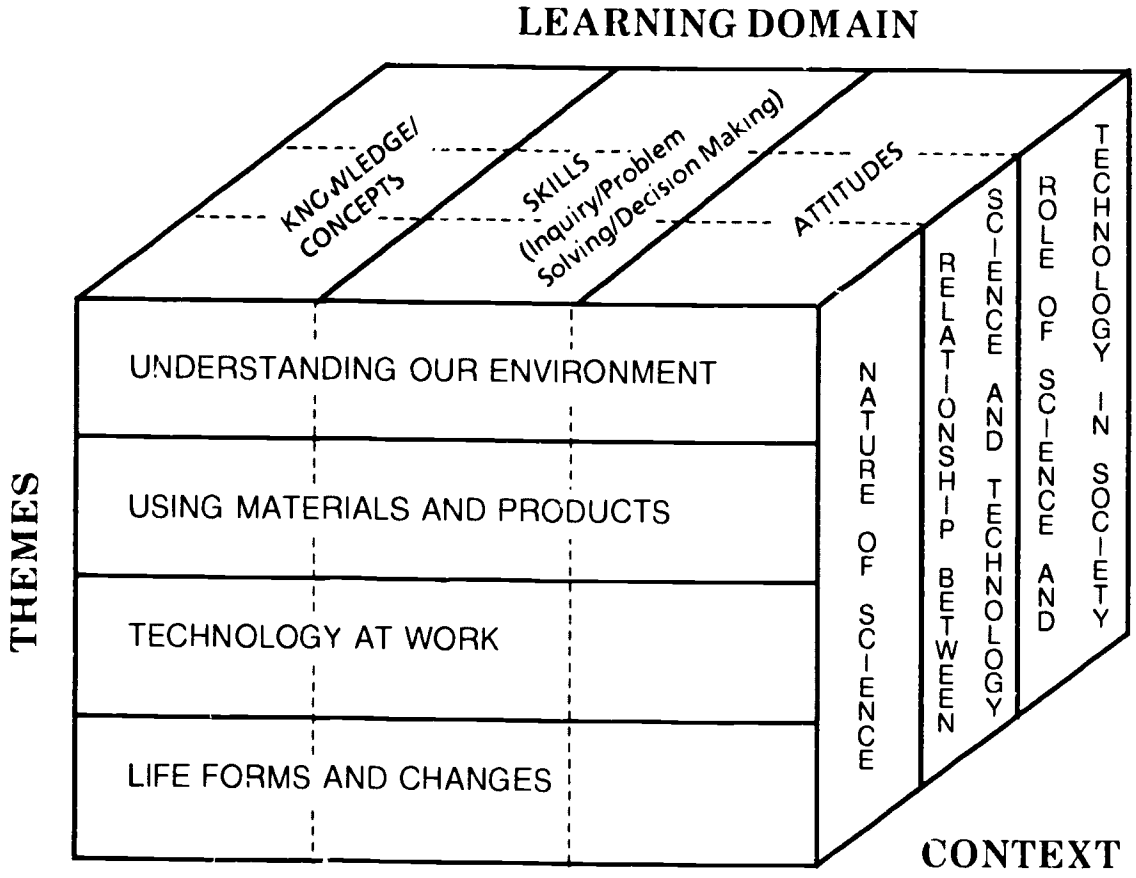
Within the Integrated Occupational Science 8 and 9 program, students will be expected to

- develop a positive self-concept and attitude toward science and lifelong learning
- develop essential concepts, skills and attitudes of science that are requisite to responsible participation in the home, the community and the workplace
- apply scientific concepts, skills and attitudes to daily life and occupational situations that are experienced both within and outside the classroom
- develop critical and creative thinking skills, and apply these skills to a variety of life situations through processes of scientific inquiry, problem solving and decision making
- develop appropriate attitudes, skills and knowledge in the responsible use of science and technology by demonstrating how science and technology influence society and how society influences science and technology
- develop the ability to use effective forms of communication in gathering, interpreting and applying scientific knowledge

MODEL FOR I.O.P. SCIENCE 8 AND 9

The model for the Integrated Occupational Science 8 and 9 program illustrates an integration of program dimensions, thus emphasizing a "holistic" approach to instruction and learning Three dimensions that provide a basis for program planning are represented on the cube

- Learning Domain
- Context for Instruction
- Themes



he themes have been deliberately placed on the "face" of the cube to highlight their importance in planning for relevant and meaningful learning experiences

LEARNING DOMAIN

This dimension of the model represents the knowledge, concepts, skills and attitudes that the program is intended to deliver. The knowledge/concepts component refers to those key ideas and understandings in science that are transferable to many real life situations and are considered essential to investigations undertaken within the science program. The skills component highlights discrete thinking or process skills that are used within the broader context of inquiry, problem solving and decision making. Attitudes that reflect an understanding of the nature and appropriate use of science and technology have been identified, and must be fostered throughout the program.

Instructional planning should provide for a balance among components of the learning domain. Activities must foster a synthesis of knowledge, skills and attitudes. Caution should be exercised to avoid over-emphasis on memorization and recall of facts that are of little practical use in real life.

Although it is essential that students develop the knowledge, concepts, skills and attitudes identified for I.O.P. Science 8 and 9, it must be remembered they are not, in themselves, the ends of the program. They are, rather, a type of "road map" that can be used in planning thematic activities that provide students with the practical experiences and processing strategies that foster responsible participation in everyday life.

The "Knowledge/Concepts, Skills and Attitudes" dimension reflects the content of the science program, and is dealt with in further detail in the "Statement of Content" section of this guide.

CONTEXT FOR INSTRUCTION

The dimension of the model highlighting context provides for an element in learning that transcends and permeates all that is done within the science program. The context for instruction is intended to foster positive attitudes, build appropriate mindsets, and develop strategies that will enable students to interpret and process information in their environment relative to the demands of everyday life.

The context of the program will enable students to

- develop an understanding of the nature of science. Students will study particular bodies of knowledge, with an emphasis on how that knowledge was developed and how the study of that particular area illustrates the nature of science. Students will also develop appropriate strategies and skills for scientific inquiry, and use these processes to interpret information in their environment.

- recognize the relationship between science and technology. Learner activities suggested throughout the program will develop an awareness of how science and technology are used in solving practical everyday problems. Students will develop appropriate strategies and skills for solving technological problems, and use these processes in solving problems related to the use of simple technologies.

- develop an understanding of how science and technology influence and are influenced by societal issues Learner activities will enable students to understand the interactive nature of science/technology/society, how science and technology affect our life styles, occupational choices and environment, and how personal and societal attitudes influence science and technology. Students will develop strategies and skills for decision making, and use these processes in making responsible decisions about the use of science and technology in society.

It is intended that all themes foster the development of strategic behaviours as they relate to scientific inquiry, technological problem solving and decision making in society Further detail on this dimension of the program is provided in ensuing sections of this guide (see "The Nature of Science" and "Science, Technology and Society")

THEMES

Themes provide the setting in which knowledge, skill and process are linked together into meaningful activities. Such activities direct attention and inquiry to a particular topic or concern, and provide students with the experiences necessary for successful functioning at home, at school, in the workplace, and in the community

The thematic approach provides for the natural integration of knowledge and skills, and allows the student to solve problems and make decisions that relate to real issues affecting their lives A well-constructed theme allows for activities in all levels of thinking (e.g , recall, application, analysis, synthesis and evaluation) Other advantages of thematic planning and organization include

- provision for cumulative development of background knowledge and skill, enabling students to relate and transfer understandings from one day to the next

- flexibility in responding to student interests and needs Teacher can address local interests and needs within each theme, as well as individual differences in cognitive development and ability Learning will be facilitated when students see activities as worthwhile and meaningful

- opportunity for concrete and experiential learning in relevant and meaningful settings

- opportunity to use a wide variety of activities, media and resources

- opportunity to develop strategies and skills in problem solving and decision making through investigations that reflect real issues and problems present in the local community

Four themes at each grade level have been developed that assure coverage of the knowledge, skills and processes identified for I O P Science 8 and 9 At the local level, teachers are encouraged to develop additional themes that will address the needs of students who require or have interest in other areas of study

INTERPERSONAL SKILLS AND THE SOCIAL SPHERE

Junior high school students are in a transitional stage of life Adolescence, which is characterized by rapid growth and the onset of puberty, is often a time of uncertainty and excessive concern about peer relationships Responses in early adolescence may appear to be volatile and inconsistent as students are developing the ability to reflect upon and analyze their emotions Students at this age are practising to be adults

Although schools are not the sole influences on the student's emotional, social and moral development, the instructional program does affect interpersonal learning

The Goals of Secondary Education directly state the importance of affective, interpersonal and moral goals when they indicate that students should.

- learn about themselves and develop positive, realistic self-images
- develop constructive relationships with others based on respect, trust, cooperation, consideration and caring as one aspect of moral and ethical behaviour

Students will vary in their emotional/social development and their ability to cope with personal problems Behaviours viewed as "problematic" are often simply an indication of the adolescent's lack of sophistication in using adult skills Classroom instruction must provide a variety of approaches that will encourage students to reflect upon their responses in social situations and to develop productive interpersonal skills The guidelines that follow have been adapted from Alberta Education's monograph *Students' Interactions: The Social Sphere* (1988), and are intended to foster affective, interpersonal and moral learning within the classroom.

- Model appropriate behaviour for students When teachers are polite and respectful of students' dignity, students will respond positively Students imitate and thereby implicitly learn to deal with emotions, other people and moral issues by observing the consistency of adult behaviour
- Encourage students to express their opinions and feelings, to ask questions and to accept emotions as they occur in day-to-day life Through mediated learning, encourage students to examine emotional responses from different frames of reference, and to organize and interpret their own responses as well as the responses of others
- Provide students with supportive comments, guidance and genuine expressions of concern Set expectations that are firm and fair, and then believe in the students' ability to meet these expectations and do well. Develop "working agreements" to help tasks flow smoothly, and to ensure that students understand the nature of the instructional tasks they are asked to perform
- Ensure that classroom management practices and rules are known, upheld, moderate in nature, negotiable, and consistently applied Responding to the harmful or unjust effects/consequences of a moral transgression is more effective than reference to broken rules or unfulfilled social conventions
- Recognize that experiential learning is a particularly effective vehicle for teaching interpersonal skills. Although some learning may occur through listening and reading, one best learns to live with other people by living with other people Cooperative learning techniques are especially useful where students are actively involved in lessons linked to their own needs, interests or experiences

- Be aware that although adolescents deal with a number of issues, they usually cope by managing one problem/issue in their lives at a time Help students to integrate various aspects of their lives by encouraging them to recognize how various problems/issues/solutions are often interrelated

- Assist students to learn skills that are more appropriate in differing contexts Although some students are described as "lacking in social skills", socially maladapted students do not necessarily lack "either skills" or social involvement; rather, they use inappropriate skills in particular contexts When directly teaching interpersonal skills, be as concrete as possible, and "build bridges" by linking situations with appropriate actions and behaviours

- Assist students to focus on the need for a system of shared conventions As students affirm the social system of conventions, they will view conventions more positively and will become less disruptive in their behaviour.

- Encourage students to interpret and evaluate the competing moral issues presented to them. Provide opportunities for open discussion and debate, wherein students interact with their peers. Discuss issues that are "real" to the student

- Provide students with practical strategies for resolving interpersonal conflict A framework for social problem solving is provided in the *Teacher Resource Manual* This framework uses a problem-solving approach in helping students to identify:
  - reasons for the difficulty
  - strategies to avoid the conflict another time

Student development in the affective, interpersonal and moral domains has been addressed in this curriculum through attitudinal learning objectives that accompany each cluster of concepts and skills in the program of studies. Instruction must include a balance of approaches appropriate to student development in each domain, as delivery of isolated content will not ensure the formation of desired attitudes. The *Teacher Resource Manual* provides additional strategies that facilitate attitudinal development within the context of themes suggested in the program.

THE NATURE OF SCIENCE

Learning to understand natural objects and events and to apply knowledge gained to a variety of real life situations is emphasized throughout the science program Today's ever-changing society requires that students are active investigators, possessing the critical and creative thinking skills that will enable them to interpret and evaluate information gathered through the senses. A focus on the nature of science and the inquiry process will enable students to understand the way in which scientific knowledge is gathered, as well as use this knowledge in conducting investigations of their own

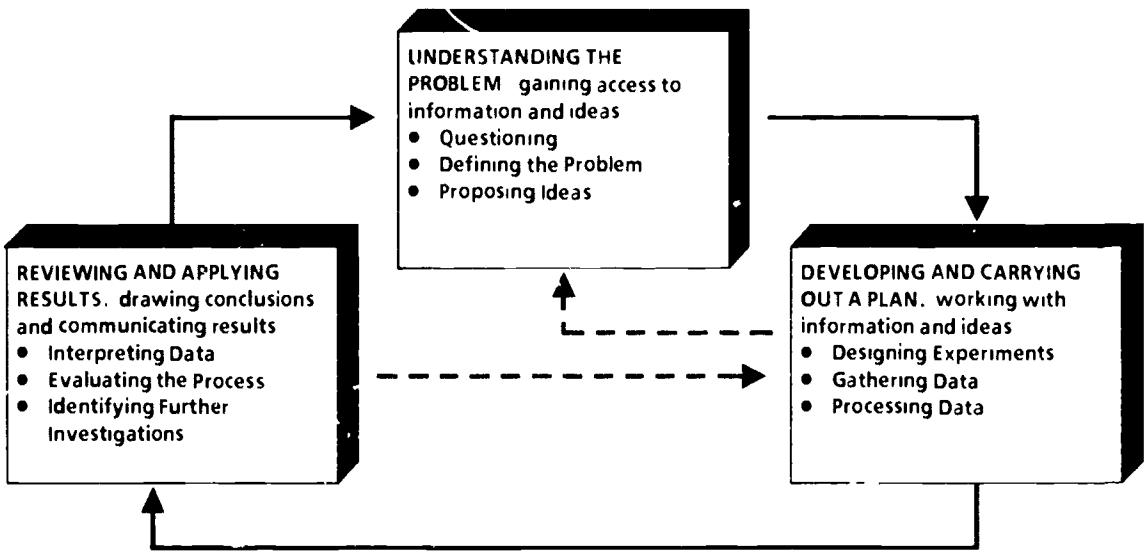
Learning activities used throughout the science program will enable the student to recognize that:

- science is a disciplined way to develop explanations for the events and objects of the natural world
- science is comprised not only of an accumulated body of knowledge, but also of the processes by which that knowledge is developed
- scientific knowledge is gathered by observation and experiment
- scientific knowledge is not fixed, but, rather, is based on theory which may change as additional evidence accumulates.

A MODEL FOR SCIENTIFIC INQUIRY

Critical to the development of the inquiry process is the attitude with which students approach an investigation. Students are often uneasy and hesitant to involve themselves in situations in which procedures are not easily determined and outcomes are not evident Appropriate attitudes must be nurtured through an atmosphere that provides encouragement, flexibility and acceptance Discussion and activity should foster student curiosity about natural events and an interest in trying to understand them Students must be persuaded to take risks in planning investigative procedures and to develop a concern for accuracy, honesty and evidence in the investigations they perform Students will be supported in their understanding of the inquiry process when investigations are selected that relate to their personal experience, interest and need

This model for scientific inquiry suggests an overall process for attacking investigation It provides a starting point for ways of organizing efforts



Specific actions identified at each stage of the inquiry process represent possible strategies that might be used in conducting an investigation Students may not always use each stage of the process, and will select only those actions that are appropriate to purpose and ability Students should, however, recognize inquiry as a series of interrelated actions that lead to an outcome

The model for inquiry should be explicitly presented to students as an overall process, and then constantly used as a teaching and learning model

THE INQUIRY SKILLS

The inquiry skills are individual mental skills that enable the student to participate actively in the inquiry process Students will develop an awareness of, and receive instruction in the use of the inquiry skills identified below Learner ability will determine the degree to which each skill is independently applied in the inquiry process

UNDERSTANDING THE PROBLEM	DEVELOPING AND CARRYING OUT A PLAN	REVIEWING AND APPLYING RESULTS
• Questioning – recognizes patterns/ discrepant events – formulates questions	• Designing Experiments – plans appropriate procedures for testing predictions/hypotheses – identifies and controls variables – selects appropriate materials/apparatus	• Interpreting Data – infers relationships – identifies cause and effect – creates models/analogies to explain ideas – applies discovered knowledge
• Defining the Problem – identifies factors relevant to a problem – defines the problem	• Gathering Data – makes observations through direct use of the senses – uses specialized tools of observation – uses appropriate measuring tools/units/ procedures – makes estimates – accurately records data that is gathered	• Evaluating the Process – assesses procedures/ thought processes used – considers adequacy of data in supporting inferences made
• Proposing Ideas – generates ideas about possible relationships – makes predictions – formulates hypotheses	• Processing Data – organizes data by comparing/ordering/ classifying/calculating – summarizes/displays data using simple charts and graphs – identifies patterns/trends	• Identifying Further Investigations – seeks further evidence – formulates additional questions defines new problems

The inquiry skills are described in further detail within the "Scope and Sequence" section of this document The *Teacher Resource Manual* provides strategies/activities for developing inquiry skills. as well as techniques for evaluating student ability to use these skills in the inquiry process

USING THE INQUIRY MODEL

The inquiry process has been integrated throughout the curriculum Themes developed in the *Teacher Resource Manual* provide opportunity for students to use the skills of inquiry within meaningful contexts Through discussion and activity, students should recognize that the processes and skills of inquiry are "lifetime tools" and, w' en chosen according to purpose and need, are useful in a variety of real life situations

By bringing thought processes to the metacognitive level (i.e , making students aware of the thinking skills and thought processes that they and others use), students will be able consciously to select and use those strategies and skills that are appropriate to the situations they encounter. Research strongly supports the teaching practice of:

- modelling (talking through) the processes and skills that are appropriate to an investigation
- discussing the processes and skills that the student is presently in the habit of using (i.e , raising the level of metacognitive awareness)
- encouraging students to develop additional strategies that will structure and support the thought process

Teaching strategies that are useful in developing metacognitive awareness are provided in the "Instructional Mediation" section of this document.

The following guidelines may be useful in helping students to plan and perform investigations of their own:

- Share the model for inquiry with all students. The model provides structure to the overall process, as well as specific strategies/skills that might be used at each stage of the process Familiarity with the model will increase the students' repertoire of strategies that can be used when performing an investigation
- Encourage students to be creative and experimental in their approach to investigations. While useful in the structure it provides, the model for inquiry should not be interpreted as consisting of fixed stages and strategies. Its use will depend on individual problems and individual students
- Ensure that investigations do not become tedious or unrealistically complex Data related to the phenomena investigated must be readily available, and should be relevant to student interest and experience
- Foster the development of attitudes and behaviours that promote student thinking and ability to monitor progress through the inquiry process:
  - open-mindedness in considering alternative ideas and interpretations
  - concern for accuracy and evidence
  - honesty and completeness in reporting and evaluating evidence
  - critical mindedness in evaluating inferences and conclusions
  - sub-vocal rehearsal/self-talk (e.g., "Where was I?", "Am I done with this?", "What comes next?").
- Relate the inquiry process to other thought processes used by students. Models for problem solving and decision making are provided in the "Science, Technology and Society" section of this document. Encourage students to recognize how the models for inquiry, problem solving and decision making parallel each other in the structure they provide for thinking.

SCIENCE, TECHNOLOGY AND SOCIETY

Science and technology affect every aspect of our lives Their influences on the foods we eat, the products we use, our lifestyles and our environment are evident While individual technologies may be of benefit to man and society, the long-term consequences of the use of technology are not always immediately recognizable Our lives are affected not only by the benefits that result from the growth of science and technology, but also by the problems associated with their development Students must be aware of how science and technology shape our present and future society and must use this knowledge to make responsible decisions about their use

The goal of science education during the 1980's, as stated by the National Science Teachers' Association, is to develop scientifically literate individuals who understand how science, technology and society influence one another and who are able to use this knowledge in their everyday decision making Furthermore, the 1984 Science Council of Canada report, *Science for Every Student*, offers these recommendations

- science education must provide a more accurate view of the practice, uses and limitations of science
- science education must include study of how science, technology and society interact
- students must be taught how Canadians have contributed to science and how science has affected Canadian society
- teachers and curriculum planners must evaluate students' progress in all the goals of science education, not just their learning of scientific content

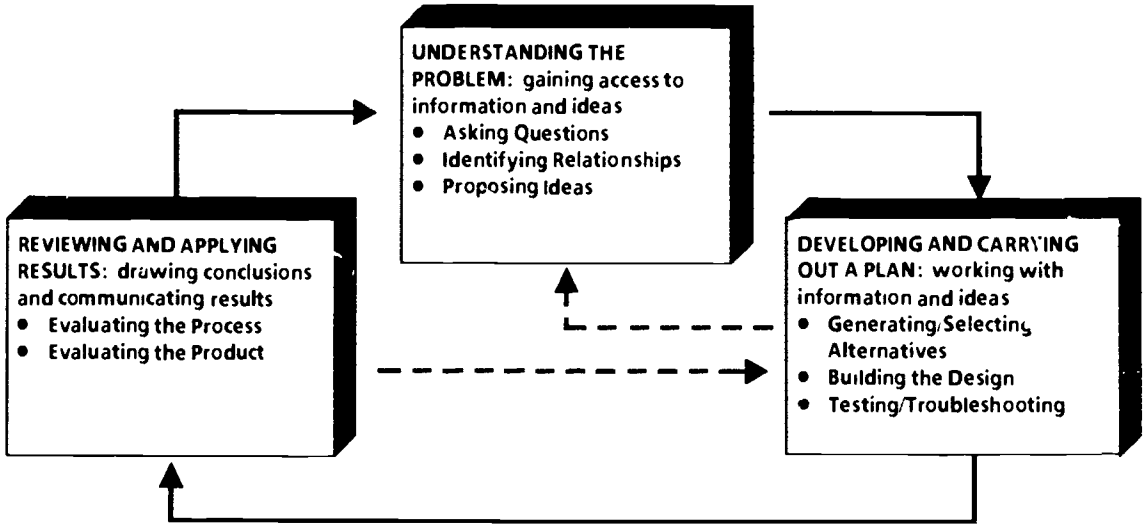
These recommendations have formed the foundation for the "Goals of I O P Science 8 and 9" provided in the introduction to this document

THE RELATIONSHIP BETWEEN SCIENCE AND TECHNOLOGY

Science and technology combine to affect the student's life in a multitude of ways Program content provides for an understanding of the relationship between science and technology, and will enable students to recognize:

- that technology is concerned with the solution of practical problems
- basic scientific principles associated with the operation of familiar technologies
- that science can be used to advance technology and that technology can be used to advance science
- various technologies as they are used in practical situations

Students should be given opportunity throughout the program to solve practical problems of a technological nature through the application of scientific concepts and principles Particular emphasis should be given to problems that incorporate hands-on activities in their solution The model that follows provides a structure for organizing thought and action, and identifies particular skills that might be used at each stage of the problem-solving process



Problem-solving activities should be selected on the basis of the opportunity they provide for students to.

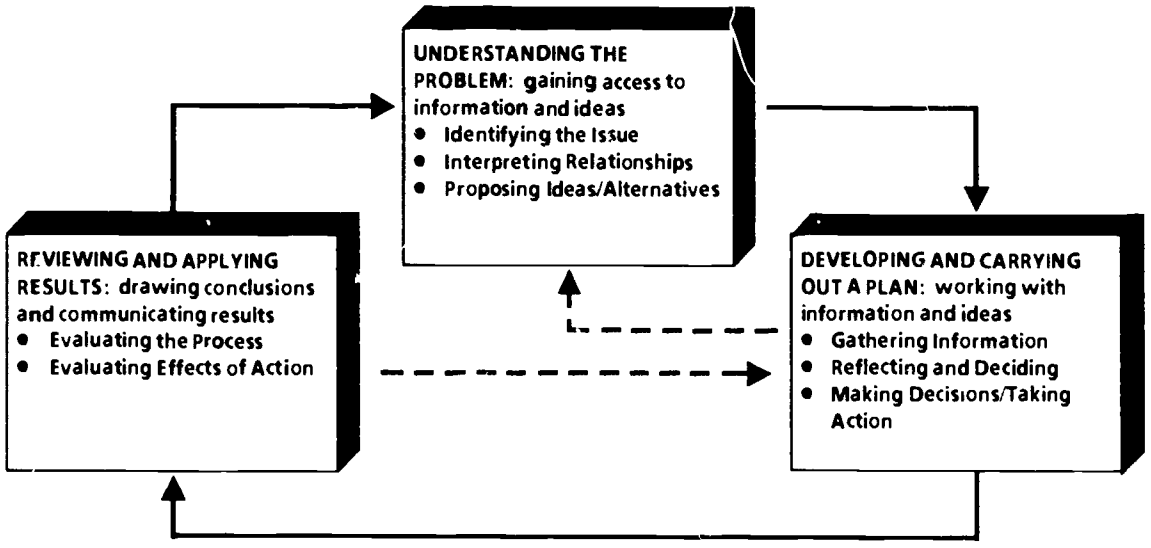
- develop confidence in personal ability to solve practical problems
- recognize alternative strategies for solving problems
- use psychomotor skills
- use critical and creative thinking skills
- appreciate efficiency and design in technological systems

THE ROLE OF SCIENCE AND TECHNOLOGY IN SOCIETY

Science and technology influence and are influenced by societal issues. The science program will provide an understanding of how science, technology and society interact, and will enable students to recognize:

- the impact of science and technology on lifestyle, occupational choice, environment and welfare
- that personal and societal needs/attitudes influence science and technology
- that often the products of science and technology are accepted and used by society before the full extent of benefits/problems resulting from their use can be fully known
- the need for "trade-offs" in order to arrive at workable solutions to problems involving science and technology in society
- appropriate strategies for making responsible decisions about the use of science and technology in society.

Students will investigate the impact of science and technology on their personal lives and in their local community. Particular emphasis should be placed on developing a process for making responsible decisions about the use of science and technology. The model that follows provides a structure for organizing thought and action, and identifies particular skills that might be used at each stage of the decision-making process



Issues selected for investigation should enable students to.

- appreciate the beauty and complexity of living things
- recognize the interdependence of life forms
- recognize the need for resource conservation
- respect the perspectives and viewpoints of others
- realize that the solution to one problem may result in the creation of another problem

USING THE PROBLEM-SOLVING/DECISION-MAKING MODELS

Scientific concepts and skills have been developed within the context of technology and society throughout the curriculum The strategies that follow may be useful in planning thematic activities that foster an understanding of the interactions among science, technology and society.

- Gather data related to **local ideas** and problems through a variety of methods
  - direct observation
  - reading/viewing
  - interview/discussion/debate

- Consider **current perspectives** on issues/problems that are provided through the local media (e g , newspaper, periodicals, television, radio)

- Make students aware of the thinking skills and thought processes that are useful in solving problems and making decisions Ask questions that encourage students to discover their own answers, and model (talk through) complete thought processes that are used in problem solving and decision making

- Provide frequent opportunity for students to apply the models for problem solving and decision making to **significant issues** in their lives Encourage students to deal with problems in a constructive way

REQUIRED AND ELECTIVE COMPONENTS

The required component of the Integrated Occupational Science 8 and 9 program reflects the concepts, skills and attitudes that all students must acquire. Content for the required component has been selected on the basis of its broad application and frequent use in real life situations. The Program of Studies outlines the required component of the program

The elective component of I.O.P. Science 8 and 9 permits the teacher to:

- **remediate** or **reinforce** concepts/skills from the required component that appear to be weak. Student needs may suggest that the elective component be used to enhance the learning process within particular content areas of the required component
- **extend** or **enrich** the program by way of introducing additional concepts, skills and attitudes considered appropriate to student interest and need.

Student interests and needs will determine how the elective time will be addressed Opportunities exist for experimenting with varying organizational and instructional strategies that facilitate learning and are appropriate to students' developmental stages and learning styles

The instruction time for I O P Science 8 and 9 should be apportioned

- 80% Required
- 20% Elective

OVERVIEW OF THEMES COVERING THE REQUIRED COMPONENT

In keeping with the philosophy that concepts, skills and attitudes are best taught in context, they have been embedded into four themes at each grade level.

	GRADE 8	GRADE 9
Theme A UNDERSTANDING OUR ENVIRONMENT	INTERACTING WITH OUR ENVIRONMENT	MONITORING THE LOCAL ENVIRONMENT
Theme B USING MATERIALS AND PRODUCTS	WORKING WITH SOLUTIONS	USING CHEMICAL PRODUCTS
Theme C TECHNOLOGY AT WORK	USING ENERGY AND MACHINES	ELECTRICAL SYSTEMS IN THE HOME
Theme D LIFE FORMS AND CHANGES	GROWING PLANTS	DIVERSITY IN LIVING THINGS

Study of the topics outlined in these themes at each grade level will ensure coverage of the required component

SUGGESTIONS FOR THE ELECTIVE COMPONENT

Several factors must be considered in planning content and activities for the elective component.

- curriculum goals and philosophy
- student ability/interest/need
- availability of learning resources/support materials.

For most students and classes, the elective component will be used in providing additional instructional time (extension and remediation) for study of the four themes that support the required portion of the program In situations where the science program is offered through more than 100 hours of instruction, teachers may wish to enrich their program through the study of optional content

Optional content may involve the student in the study of:

- specific science competencies required in the practical arts
- specific science competencies required in the home
- a student-interest topic
- a topic of significance to the local community

"Suggested Options" for Grade 8 and Grade 9 have been included in the "Statement of Content" as a service to teachers Teachers may choose to develop one or more of the options suggested or develop other topics considered appropriate to student interest and need

SUGGESTED OPTIONS (GRADE 8)

PERSONAL INTEREST:

- Selecting a Consumer Product

LOCAL COMMUNITY:

- Local Landforms and Resources

SUGGESTED OPTIONS (GRADE 9)

SCIENCE IN THE HOME:

- Heat Energy in the Home

SCIENCE IN THE PRACTICAL ARTS:

- Using Fluids

There is no requirement that optional content be included in the science program. Teachers may decide to use the elective component to address special needs within the required component of their program. Local circumstances will determine how the elective component is used within each school offering the program.

PLANNING

GENERAL COURSE PLANNING

Themes and their subsequent concepts, skills and attitudes may be sequenced at the teacher's discretion Program planning should take into consideration the developmental nature of concepts and skills in science, as well as student interest, ability, and learning style Four themes that cover the required components of the course have been provided in the *Teacher Resource Manual* However, teachers may choose to replace these with other locally developed material in addressing individual student needs

Through cooperative conferencing, teachers may find that students are required to use certain science-related competencies in other courses before they are learned in science class Joint planning and negotiation with teachers of other courses will be required in establishing an integrated program that places consistent expectations upon the student

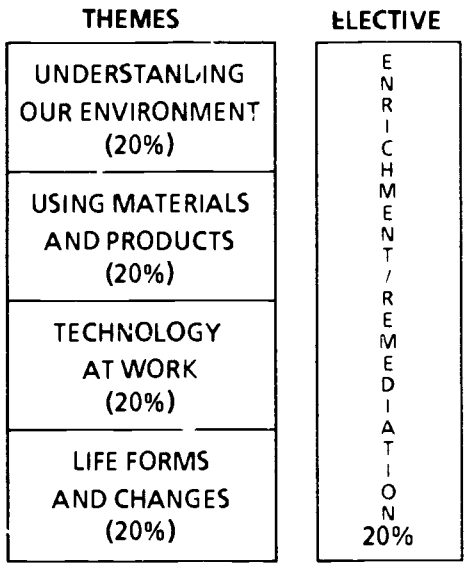
Program planning should emphasize the nature of science, as well as an understanding of the role of science and technology in society Activities must support the development of thinking skills, and provide all students with the opportunity to use appropriate strategies for inquiry, problem solving and decision making The strategies and activities suggested throughout both the curriculum guide and *Teacher Resource Manual* are numerous, but by no means exhaustive Teacher use of these ideas will depend upon their appropriateness in meeting individual student needs Be prepared to add, delete, and modify activities in adapting a theme to the particular circumstances of the classroom and student.

TIME ALLOCATION

The Integrated Occupational Science 8 and 9 program must be offered through a minimum of 100 hours of instruction at each grade level. In meeting student needs, however, schools may find it desirable to offer the course through a time structure that exceeds the 100-hour minimum requirement

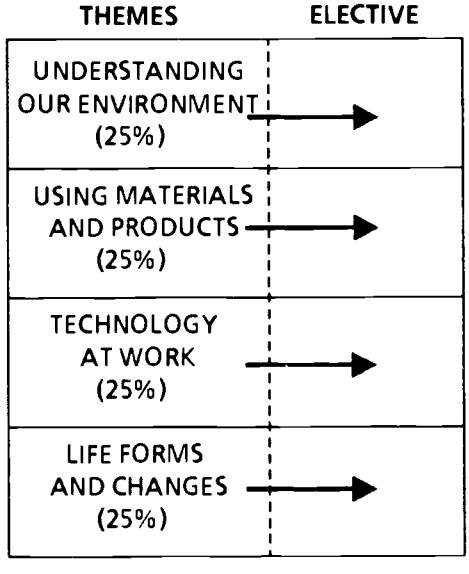
Minimum time allocations are recommended for the delivery of themes outlined in the *Teacher Resource Manual* These recommendations are intended to ensure that key concepts, skills and processes outlined in the Program of Studies are adequately addressed within each theme

Understanding Our Environment	20%
Using Materials and Products	20%
Technology at Work	20%
Life Forms and Changes	20%
Required Time	80%
Elective Time	20%
Total	100%



The elective component enables the teacher to spend 20% of the available instructional time on remediation and reinforcement (e g., allowing students more time to meet learning expectations within the required component of the program), or on extension and enrichment (e g , study of additional concepts/skills). If student needs suggest that the elective component be used to enhance the learning process within the required component, time allocations for each theme might be increased to those indicated below

Understanding Our Environment	25%
Using Materials and Products	25%
Technology at Work	25%
Life Forms and Changes	25%
Total	100%



Teachers may find it desirable to plan programs using time allocations that fall between those described in the two alternatives

COMMUNITY PARTNERSHIPS

The concept of community partnerships is integral to all courses within the Integrated Occupational Program. Guest speakers, field trips, job "shadowing" and mentorship are but a few examples of inviting members of your community into the class, or having students involved in the community by way of meaningful activities linked to science.

Partnerships of this nature strengthen the science program by relating concepts and skills studied to personal experience and everyday life within the community. Concepts taught in the classroom can be reinforced through this component of the program, and students can be provided with additional opportunities to raise questions, collect data or investigate related problems.

Suggestions for the use of community partnerships in science include:

- inviting guest speakers from government, business, the professions and the trades to discuss topics that relate to each theme of investigation
- visiting local business and industry for first-hand observation of a variety of technologies and skills in use
- investigating career and employment opportunities in areas related to each theme studied in the science program (e.g., job shadowing, analysis of skills required, mock employment interviews)

Community groups or facilities that lend themselves particularly well to partnerships with the science program include:

- service groups that promote personal and environmental health (e.g., doctor, nurse, nutritionist, pharmacist, social worker, police officer, agriculturalist, wildlife officer)
- government officials (e.g., aldermen, councillors, MLA's)
- local businesses and industries that apply and use the technologies/skills studied in science (e.g., hair care, dry-cleaning, automotives, agriculture, food preparation, construction, electrical repair)
- local utility plants (e.g., power generating plant, sewage treatment plant, water purification plant, waste disposal site)
- natural phenomena (e.g., local river valley, meadow, or wooded area)

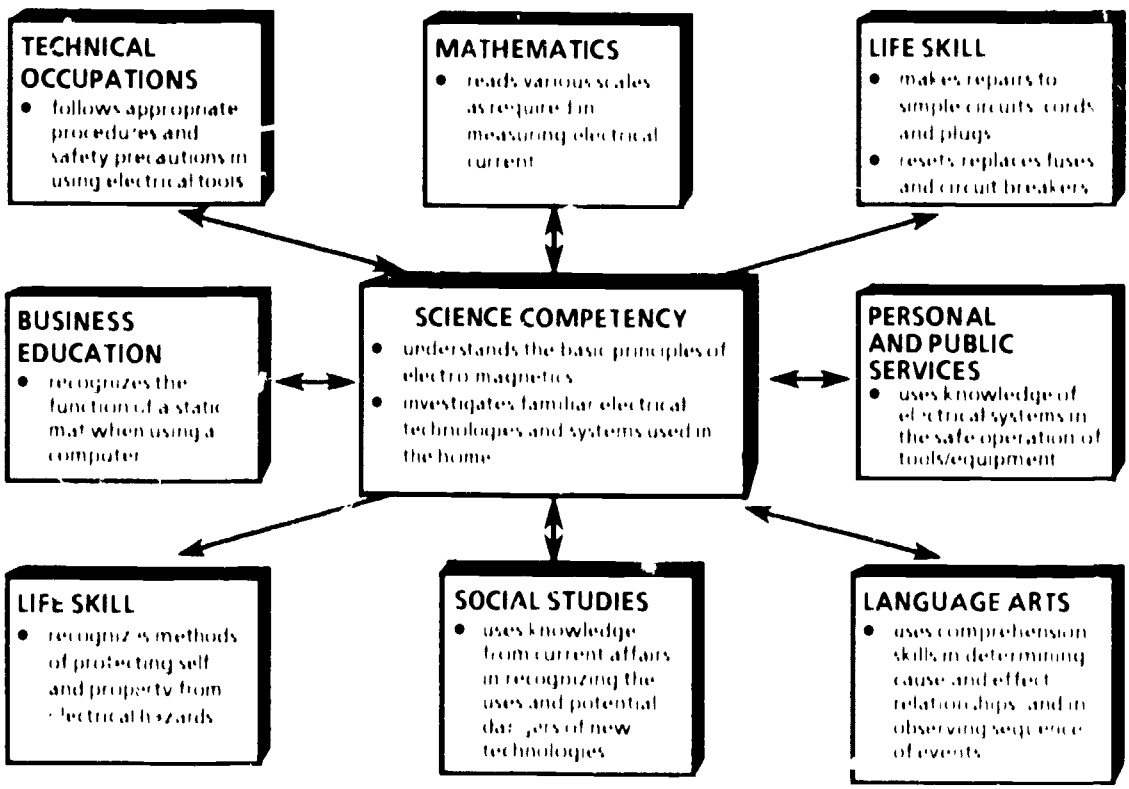
Additional suggestions as to how these community groups and facilities can be meaningfully linked to the science program are provided within each theme of the curriculum.

CURRICULAR INTEGRATION

Emphasis has been placed on relating science skills and concepts to life skills and other applications across the curriculum. Curricular integration will become a motivating factor as students see the relevance of skills and concepts studied to real life situations. Student ability to transfer knowledge, skill and process to new and unfamiliar problem situations will improve as a result of multiple exposures to their application

Instructional strategies should provide for the development of skills within the context of their application to real life, the practical arts and other academic disciplines Teachers must be familiar with the science ompetencies required of students in these areas Experience indicates that cooperative conf encing and planning among teachers will foster this familiarity and ensure coi sistency in expectations and learning outcomes Heightened sensitivity to the content of other subject areas will facilitate identification of generic skills and concepts required by students The identification of generic skills will provide direction for program emphases Curricular integration of this nature increases opportunity for the provision of concrete and experiential learning activities

The diagram below describes one instance of curricular integration It illustrates possible outcomes of cooperative planning with respect to the study of magnetism and electricity While in this instance application is shown in many subject areas, some skills may have a more limited base for application



Basic principles of magnetism and electricity are developed in science and related to areas of application in other subjects Subject areas across the curriculum will maintain and reinforce specific concepts and skills related to electro magnetics as they are used within each discipline

PLANNING AN INTEGRATED UNIT OF INSTRUCTION

1 Identify a possible theme, based on.
- curriculum goals and objectives
- student needs/interests/abilities
- availability of suitable learning resources.

2 Develop a purpose for the theme. Include:
- thematic objectives
- a checklist of concepts, skills and attitudes that lend themselves to the theme Identify those skills that may need some focused/direct teaching
- a checklist of process objectives to be emphasized in the theme

3. Consider suitable resources:
- books, pamphlets, monographs
- appropriate laboratory equipment
- computer software, films, videos
- resources from the occupational program
- community resources
- newspapers and periodicals

4. Design activities:
- allocate activities to the purposes developed in STEP 2
- break activities into lessons with general objectives
- sequence the lessons

5 Develop ongoing strategies to build community partnerships into your theme
- field trips
- guest speakers.

6 Plan for evaluation:
- students' evaluation
- teacher ongoing and summative evaluation

7 Share the unit:
- other teachers need access to good work!
- expand, keep current, e-work the unit, every time it is used by any teacher
- as others experiment and your unit enlarges, develop a mechanism for evaluating all the activities, with different classes of students

LEARNING RESOURCES FOR I.O.P. SCIENCE 8 AND 9

STUDENT RESOURCES

BASIC LEARNING RESOURCES

The textbooks listed below meet the majority of the goals and objectives identified in this curriculum (authorization pending).

McFadden, Charles, et al. *Science Plus Technology and Society 8*. Toronto, Ontario. Harcourt Brace Jovanovich, Canada, publication anticipated in 1990

McFadden, Charles, et al. *Science Plus Technology and Society 9* Toronto, Ontario. Harcourt Brace Jovanovich, Canada, publication anticipated in 1990.

Science Plus Technology and Society 8/9 will provide for the development of concepts, skills and attitudes identified in the Grade 8 and Grade 9 Program of Studies. These learning resources will be available in manuscript form throughout the 1989/90 school year A final print of each textbook is scheduled for the summer of 1990

TEACHER RESOURCES

RECOMMENDED LEARNING RESOURCES

Teacher manuals designed to support instructional use of the student learning resources include

McFadden, Charles, et al. *Science Plus Technology and Society 8 Teacher's Resource Book*. Toronto, Ontario: Harcourt Brace Jovanovich, Canada, publication anticipated in 1990

McFadden, Charles, et al. *Science Plus Technology and Society 9 Teacher's Resource Book*. Toronto, Ontario: Harcourt Brace Jovanovich, Canada, publication anticipated in 1990

The teacher manuals for *Science Plus Technology and Society 8/9* include lesson objectives, instructional methods and evaluation strategies that relate to each theme identified in the Grade 8 and Grade 9 programs. These manuals are useful to anyone using the textbooks

The *Teacher Resource Manual* (1989) for I.O.P. Science 8 and 9 developed by Alberta Education contains strategies and sample student activities intended to structure and support:

- development of the concepts, skills and attitudes as outlined in the Program of Studies
- development of the processing strategies used in scientific inquiry, problem solving and decision making
- delivery of thematic instruction in the four theme areas described as covering the required components of the program

TECHNOLOGY AND THE MEDIA

An annotated list of computer software that may be useful in supporting curriculum objectives is provided in Alberta Education's catalogue of *Computer Courseware Evaluations* (Curriculum Support Branch, Student Programs and Evaluation Division, Alberta Education, 1986) and yearly supplements

Course delivery may be enhanced through the use of various kits, films, videotapes and brochures that support specific goals and objectives of the science program. Teachers may wish to use local media services, libraries and government agencies in obtaining audio and visual materials appropriate to the science program

METHODOLOGY

WORKING WITH THE RELUCTANT LEARNER

All students are capable of successful learning experiences in science. Students differ, however, in their rate and style of learning, as well as in the degree of support and encouragement required Previous experiences, perceptions of the value of science, and the fear of being wrong or making a mistake are all factors that may cause the students to look upon science as a place where personal inabilities are exposed **A supportive learning environment will assist students in dealing with these attitudes. In order to meet the interests and abilities of individual students, the program must be varied in materials, content, pace and instructional methods.**

A supportive classroom environment that decreases anxiety levels and builds appropriate attitudes may be fostered through program planning that incorporates the following strategies.

- Become familiar with the learning characteristics (e g., reading level, interests, preferred learning style) of individual students through background information, interviews and direct observation.

- Choose topics for investigation that are relevant to everyday life Be aware that students are concerned with the immediate and practical effects of science. Relate concepts and skills studied to personal experience Make an effort to ensure that terminology commonly used is part of the students' working vocabulary. Focus attention on what students consider interesting or important Familiar problems/issues will "make sense" more readily than unfamiliar ones

- Provide much opportunity for learning at the concrete level Plan activities that emphasize a "hands-on" and multi-sensory approach to the learning of science Encourage students to verbalize and discuss the relationships that are discovered. Assist students to transfer and apply relationships discovered to a variety of related life situations

- Avoid unnecessary tension in the classroom by being patient, receptive and understanding. Ensure that students recognize that making a mistake is acceptable, and that such occurrences provide valuable learning experiences Urge students to ask questions, and to accept that "there is no such thing as a stupid question" Remember that an offhand remark about a question being "easy" may be interpreted by a student as "If it's easy and I'm confused, then I must be stupid" Recognize and accept alternative interpretations/explanations that students may formulate

- Match the reading level of resources and materials used to that of the students Provide assistance and support in developing necessary science vocabulary Steps should be taken to ensure that reading deficiencies do not prevent students from learning science Additional strategies are provided in the section entitled "Using Language Skills in Science"

- Group for instruction through a variety of organizational patterns that will facilitate meeting the needs of individual students Ensure that grouping patterns remain flexible, allowing student movement from group to group Include learning activities that require whole group, small group, and one-to-one (teacher to student and/or student to student) involvement Use such resources as the buddy system, peer tutoring and aides

- Ensure that investigative activities are well structured, recognizing the organizational problems and language deficiencies that some students may have Provide students with direction when gathering data for investigation After the data has been gathered, leading questions may be used to guide students in making a reasonable interpretation and evaluation of the results Encourage students to discuss their results with other members of the class Students should be led to suggest ways of resolving differences in data collected or in the interpretation of results.

- Use a variety of assessment and evaluation strategies While paper-and-pencil tests are an effective way of evaluating some learning outcomes, their use does not always enable students to demonstrate gains made Provide opportunities for students to demonstrate acquired knowledge and skills in a variety of ways Effective evaluation should draw upon information gathered through teacher observation, student demonstration and project work Additional strategies for student evaluation are provided in the section entitled "Evaluation"

- Recognize that while most attitudinal problems of the reluctant learner are brought about through past experiences, which may foster natural apprehension of new or challenging situations, there are other emotional symptoms and displays that may well be related to deeper personal or social problems Personal interviews with students may assist in identifying such instances, and may establish a need for consultation (or referral) with counsellors who have expertise in dealing with such problems

INSTRUCTIONAL MEDIATION

A great deal of recent research has focused on instructional mediation and "teacher talk" in the classroom Instructional mediation is an interactive process whereby teachers refine their interpretation of tasks to students, as students construct their own interpretations of the tasks and processes being learned This back and forth exchange stimulates the development of thinking skills by allowing both sides to contribute to a meaningful learning situation Lectures, or one-sided explanations, rely on students to be "self-mediating" and to supply their own meaning to processes Unfortunately, most students are not yet able to do this

Instructional mediation regulates the students' behaviour in terms of the use of strategies and heuristics on tasks Emphasis on a strategic view of tasks will encourage students to become independent in the tasks they perform and the processes they use For example, a strategy for conducting scientific inquiry will enable more students to perform investigations on their own In addition, such a strategy enables the student to identify for the teacher at what point they need assistance, if they are unable to completely solve the problem.

A further use of mediation is in developing the students' feeling of competency Students need to see themselves as competent and able to do things Students who feel competent, and who recognize their effort as being effective in learning, are more likely to be persistent in attempting new tasks that are difficult On the other hand, students who require frequent praise for their effort come to have limited performance goals and are hesitant to engage in any task at which they cannot quickly become successful Teachers can encourage students to extend their learning goals by focusing mediation on the role of effort and strategy in achieving success, rather than solely on praising positive performance

In creating a classroom environment that will stimulate strategic behaviour and thinking skill, the teacher should.

- point out, but not correct errors
- encourage students to correct their own errors
- pause and clarify, but not interrupt
- demand constant vocalization of student thought processes that are used, and model these for students
- encourage persistence

The mediation process can also be enhanced through the use of appropriate "questioning techniques" and the "modelling" of complete processes and thought patterns These instructional methods are described in the paragraphs that follow

QUESTIONING TECHNIQUES

Questioning techniques should include the use of chains of questions that lead students to discover their own answers Question chains should begin with focus questions such as

- What are we looking for?
- What do we want to explain/investigate?
- What do you think might happen if ?
- Why did . . . ?
- What should we do first?
- What is stopping us?

Once students have focused on the significant pieces of information, questioning is expanded to include:

- What is my next step?
- How will I do that?
- What is the relationship between . and . . ?
- How are . . . and . . . related?
- Why did . . happen after . . ?
- What is the likelihood that . . ?
- What do you notice about . ?

Students should be encouraged to evaluate the thought processes used in completing individual tasks and the problem-solving process Questions asked may include:

- How did you know that . ?
- What does the data indicate?
- What caused . to happen?
- How does . . . apply to . ?
- How could you explain . . in another way?
- How might you use these results?
- How could we make our work easier another time?
- What should we tell others?

Questions that probe and prompt students to process information, rather than fixate at the simple recall level, will make students aware that they are expected to be actively involved in thinking processes. When students experience success with investigation through use of the teacher's questioning chain, they will discover the importance of the thought processes used, and be encouraged to develop personal strategies that direct their efforts in related tasks.

MODELLING

Modelling, as opposed to demonstrating, involves "talking through" a complete process in order to expose thinking processes to the student While in a demonstration everything turns out as it should, modelling should include false starts, trouble spots, and errors Modelling requires teachers to express their thinking processes out loud so that students can see not only how the process is done, but also how difficulties and ambiguities are addressed

While teachers often model when explaining processes and problems, knowledge and awareness of the value of modelling can serve to sharpen this process. Asking students where they might begin to solve a problem makes a good starting point. If the reply is "I don't know", an area of difficulty is determined The mini-processes of "identifying the problem" and "proposing ideas" might then be modelled for students

SAFETY IN SCIENCE

The development of positive student attitudes toward safety is critical in the science program. An awareness of safety should be developed through a common sense approach. Students should recognize that accidents can be avoided through advance planning and an awareness of hazardous situations.

When conducting experiments and investigations, students should be expected to:

- follow directions exactly as given
- understand the import of what they are doing
- maintain order and neatness in arranging equipment
- use prior knowledge in making judgments
- ask for advice when in doubt.

No laboratory work should be expected of students if they are not fully aware of possible hazards and preventative measures.

Students should also be encouraged to transfer the safety knowledge and attitudes developed in school to potentially dangerous situations they may encounter at home, at work and in the community.

RESPONSIBILITIES OF THE TEACHER

The most effective method of teaching safety is by example The procedures and attitudes consistently displayed by the teacher influence students more than actually teaching a unit on safety. The teacher should be conscious of the example being set, and encourage development of the following habits and attitudes:

- careful observation and alertness at all times
- constant application of safety techniques
- constructive criticism of experimental procedures
- planning of procedures and advance identification of the safety responsibilities associated with these procedures.

Teachers must provide adequate supervision of students at all times, and emphasize accident prevention Students must be alerted to situations they may create that are unsafe or hazardous

RESPONSIBILITIES OF THE STUDENT

At the beginning of the course, students should be alerted to general safety precautions and safety procedures Specific hazards and precautions related to the use of equipment and chemicals should be discussed as the materials are used Students must plan their laboratory investigations and procedures in ways that will minimize the possibility of accidents All accidents and unexpected events that occur should be reported and discussed with the teacher.

It is advised that a Student Safety Contract be issued early in the school year, after students have been alerted to general safety precautions and procedures Use of a safety contract will increase the students' awareness of personal responsibilities in the safety of self and others A sample student safety contract is provided in the *Teacher Resource Manual.*

SAFETY GUIDELINES

While no set of safety rules can be complete, the statements provided here will give direction in establishing a set of appropriate safety procedures for the science program. Teachers must be familiar with the policies and statements adopted by their employing board. In the absence of such statements, teachers should be aware of specific hazards that students face in the science program and take suitable precautions to avoid such hazards.

- Never leave students unsupervised.
- Insist upon the use of correct laboratory techniques.
- Strictly enforce rules with regard to behaviour.
- Avoid any laboratory procedure if there is any doubt as to its safety.
- Locate and teach the use of appropriate safety equipment (e.g., eyewash, first aid kit, fire blanket, fire extinguisher).
- Provide medical attention immediately if there is any question as to its need.
- Insist that students carry out a procedure only after they understand how it is to be done.
- Ensure that students are properly dressed (e.g., wearing protective glasses or aprons if required; no loose clothing or hair that will interfere with equipment and materials).
- Provide instruction in appropriate procedures for using possibly hazardous equipment and supplies such as bunsen burners, alcohol lamps, candles, acids/bases or solvents.
- Provide adequate ventilation, working space and suitable equipment for each investigation.
- Label all chemicals clearly.
- Store potentially dangerous chemicals and apparatus in a locked and well-organized storeroom.
- Insist on well-planned and organized procedures, and on cleanliness of hands, benches, tables and equipment.
- Do not allow students to use concentrated acids or bases, volatile solvents, sodium, potassium, phosphorus or hydrogen.
- Do not heat anything in glass other than pyrex.
- Do not heat test tubes over an open flame.
- Use 110 volt electricity only in CSA approved apparatus
- Do not force glass tubing through rubber stoppers.
- Do not allow activities that involve the extraction or analysis of human tissue or fluid (e g., cell scrapings, blood samples).

Teachers should be familiar with policy and information provided in Alberta Education's monograph *Clarification of Statements Prohibiting the Use of Human Body Substances in the Alberta Science Curriculum*, 1988 Due to the potential risk of infection from hepatitis and AIDS, all activities involving the extraction and analysis of samples of human fluid or tissue are prohibited in Alberta schools

THE USE OF TECHNOLOGY AND THE MEDIA IN SCIENCE CLASS

USING COMPUTER TECHNOLOGY

Due to the present development of microtechnology and the availability of low cost and effective microcomputers, computer technology is affecting everyone's life The traditional meaning of the word "literacy" has taken on a new dimension. To be literate in our changing society, students need not only the ability to communicate through the written word, but also the skill of interacting with machine technology (i.e., the hand-held calculator and the microcomputer)

The knowledge, skills and attitudes required to be computer literate will vary according to student maturation and ability Nevertheless, the science program should provide opportunity for students to:

- describe the basic operation of a computer
  - identify major parts of a computer
  - distinguish between hardware and software
  - recognize that computers get their instructions from a program written by a person

- use a computer
  - use a prepared program on a computer
  - show respect and responsibility for hardware/software.

Students can apply their computer skills in science by working independently with computer programs that provide for drill and practice, simulation, problem-solving experience and computer-assisted instruction. Selection of such programs should be determined by their value in contributing to the knowledge, skill and process objectives of the course. Experiences of this kind will enable students to gain first-hand knowledge of how one interacts with a computer, while at the same time develop an understanding of the versatility and limitations of computers

USING THE MEDIA

Media materials should be selected after considering student needs and program objectives Materials that might be used to supplement instruction include:

- newspapers and periodicals
- television and video recordings
- films and filmstrips

Media materials must be carefully previewed for accuracy, validity and level of maturity. Only those materials relevant to student experience and need should be selected for use

The following strategies are useful in planning effective learning activities that involve the use of audio-visual material.

- The material need not be shown in its entirety Selected portions may more effectively meet student needs
- Consider viewing the material without audio accompaniment, or with only teacher accompaniment
- Provide students with a prepared question sheet for use while the material is being viewed This will focus attention on relevant aspects of the topic/issue being investigated
- Materials may be viewed more than once. They might be initially viewed in an uninterrupted manner, and then a second time for note-taking or answering questions
- Plan specific follow-up activities to ensure that students have understood key concepts and ideas related to the investigation

Suggestions on how the media might be used in facilitating specific learning outcomes within each theme of the science program are provided in the *Teacher Resource Manual*

EVALUATION

Evaluation should be an ongoing part of the teaching and learning process, providing feedback to the student, the teacher, and the parent Major functions served by the process of evaluation include:

- provision of feedback to the student relative to success in the learning process Students often have difficulty in monitoring and regulating their learning behaviours, and require a great deal of external feedback as to their progress Feedback and encouragement must be provided on a regular basis
- provision of information to the teacher concerning the appropriateness of learning goals and objectives, and the effectiveness of learning strategies and materials used. Such information enables the teacher to modify the program as required with respect to pacing, learning resources, teaching methods or objectives
- provision of information to the parent regarding the student's progress. Where possible, reports to parents should be interpreted through an interview or letter so that the implications of the evaluation are understood.

Evaluation should serve diagnostic purposes in identifying student strengths and weaknesses, as well as summative needs in measuring overall growth Because evaluation is an integral part of all aspects of the instructional process, information used in evaluation of the student should be gathered from a variety of sources by using a variety of methods The evaluation process in science must consist of more than paper-and-pencil tests. While such tests may be an effective way of evaluating some learning outcomes, the evaluation program should include, to some degree, the use of all of the following sources of information:

- both formal and informal observation of student attitudes and performance
- oral and written presentations describing the outcomes of investigation
- personal interviews with students
- project work
- feedback from parents
- teacher rating scales/checklists/anecdotal records
- self-rating/self-marking
- peer marking
- written achievement tests on specific learning objectives or on topics investigated
- practical tests on laboratory procedures
- records of previous achievement
- suitable standardized exams.

STRATEGIES FOR EFFECTIVE EVALUATION

Evaluation has been the process by which some students have in the past been identified as "failures" These students will go to extreme measures to avoid being "tested" again Absence from exams, feigning an "I don't care" attitude, or not giving their best effort so that anticipated failure can be explained with "I didn't try", are all common behaviours Although evaluation is a fact of daily life and necessary to the program, effort must be made to provide variation in the procedures used so as to draw upon students' strengths and provide for their success in the evaluation process

The strategies that follow are intended to serve as guidelines to the teacher in developing a system of evaluation that will improve both student learning and the quality of the science program offered to students.

- Provide frequent opportunities for students to "demonstrate" their understanding of concepts and skills through discussion, project work and group activities

- "Observation" of the student in small group situations often provides insights as to the student's:

  - level of independence with the work
  - ability to use the strategies of inquiry/problem solving/decision making
  - understanding and ability to apply concepts and skills to new situations

- Evaluation should emphasize the "synthesis" of a variety of knowledge and process objectives rather than recall or recognition of isolated facts Provide students with informal situations in which they can demonstrate their application of knowledge, process skills and problem-solving strategies in simple investigations.

- Personal interviews can be structured to provide feedback to both student and teacher relative to various aspects of the science program In addition to providing feedback and encouragement to the student, such interviews may also provide direction to the teacher in the selection/modification of teaching strategies.

- Overdependence on paper-and-pencil techniques for evaluation often does not permit the student with learning difficulties to do well. When planning formal evaluation procedures, caution should be exercised with regard to the overuse of:

  - multiple choice exams
  - difficult wording and vocabulary
  - simple recall of information without understanding and application.

- Provision of taped versions of tests for the weak reader is often a useful strategy Some students may also benefit if allowed to explain answers on tape, or to another trustworthy individual

- Provide encouragement by asking questions and making statements that will prompt students to evaluate their own work and learning Some examples might include:

  - "You did a good job of (be specific) "
  - "What steps did you find most difficult?"
  - "What made it difficult?"
  - "How could you improve your work in this question?"

  Such techniques will encourage students to be less "reward dependent" and more responsible for their own learning

- Provide opportunity for the use of self and peer evaluation techniques

- When planning formal evaluation, students should be given plenty of advance notice and a study guide to highlight the areas that need to be reviewed Students rarely do their best when caught off guard by a "surprise quiz"

- Students with learning difficulties often do not do their best under time pressure Provide plenty of time for students to complete their work

The *Teacher Resource Manual* contains additional guides and checklists for evaluating student performance and growth in science

SCOPE AND SEQUENCE

The scope and sequence chart provided on the following pages identifies the concepts, processes, skills and attitudes of science that are developmentally addressed throughout Grade 8 and Grade 9. In recognizing that students differ in the rate at which they learn, the chart is intended to assist teachers in:

- assessing present levels of student performance
- diagnosing particular areas of deficiency
- sequencing instruction in a manner that will suit individual needs and growth patterns

In using the scope and sequence, it should be noted that:

- process, skill and attitude are developmental through Grades 8 and 9 (i.e., the spiral approach) Students will reinforce and extend the processes, skills and attitudes developed in Grade 8 through more sophisticated and complex applications at the Grade 9 level (The *Teacher Resource Manual* provides for the development of processes, skills and attitudes in Grades 8 and 9 through themes of increasing maturity and complexity.)

- concepts developed at the Grade 8 level are in most cases discrete from concepts developed at the Grade 9 level. Effort has been made to apportion concepts throughout Grade 8 and Grade 9 on the basis of their cognitive demand.

- the concepts, processes, skills and attitudes are interdependent and are not meant to be developed in isolation. Although some content may be mastered more effectively through discrete instruction, this approach is not advocated as a primary focus of instruction. The thematic structure permits a holistic view of instruction through the linking of strategies and skills.

Teachers may also wish to examine a scope and sequence chart for the high school science program (Science 16 and 26). An understanding of the developmental progression of concepts, process and skill occurring beyond Grade 9 will facilitate articulation between the junior high and high school science programs.

THE NATURE OF SCIENCE

GRADE 8	GRADE 9
Demonstrates an understanding of the nature of science. Recognizes that: • science is a disciplined way to develop explanations for the events and objects of the natural world • science is comprised not only of an accumulated body of knowledge, but also of the processes by which that knowledge is developed • scientific knowledge is based on observation and experimentation • scientific knowledge is not certain, but, rather, it is based on theory which is subject to revision as additional evidence accumulates.	Demonstrates an understanding of the nature of science in increasingly abstract settings 
Displays attitudes appropriate to the process of scientific inquiry: • concern for accuracy and supporting evidence • honesty and completeness in reporting/evaluating evidence • open-mindedness in considering alternative ideas/interpretations • critical mindedness in evaluating inferences/conclusions.	Displays attitudes appropriate to the process of scientific inquiry in an increasingly consistent manner. 
Uses appropriate strategies and skills to conduct scientific inquiry: • formulates questions – recognizes patterns/discrepant events – formulates relevant questions about relationships • defines problems – identifies factors relevant to a problem – defines the problem in a form suitable for investigation • proposes ideas – generates ideas about possible relationships – makes predictions based on observations/existing data – formulates hypotheses to explain existing data	Uses appropriate strategies and skills to conduct scientific inquiry in increasingly complex situations 

THE NATURE OF SCIENCE (cont'd)

GRADE 8	GRADE 9
• designs experiments – plans appropriate procedures for testing predictions/hypotheses – identifies kinds of observations/ measurements that might be used – identifies and controls variables – selects appropriate materials/ apparatus • gathers data – makes observations through direct use of the senses – uses specialized observation tools – uses appropriate measuring tools/units/ procedures – makes estimates – records data that has been gathered accurately – prepares drawings of objects/ materials investigated • processes data – organizes data by comparing/ ordering/classifying/calculating – identifies qualitative as well as quantitative differences – summarizes/displays data using simple charts and graphs – identifies patterns/trends • interprets data – infers relationships – identifies cause and effect – generates appropriate explanations based on data that has been gathered – creates models/analogies to explain ideas – evaluates hypotheses in light of data gathered – applies discovered knowledge • evaluates the process – assesses procedures/thought processes used – considers adequacy of data in supporting inferences made • identifies further investigation – seeks further evidence – formulates additional questions – defines new problems	Uses appropriate strategies and skills to conduct scientific inquiry in increasingly complex situations

SCIENCE AND TECHNOLOGY

GRADE 8	GRADE 9
Demonstrates an understanding of the relationship between science and technology. Recognizes: • that technology is concerned with the solution of practical problems • basic scientific principles associated with the operation of familiar technologies • that science can be used to advance technology and that technology can be used to advance science • various technologies as they are used in practical situations.	Demonstrates an understanding of the relationship between science and technology in increasingly abstract settings. 
Displays attitudes appropriate to the process of solving technological problems: • confidence in personal ability to solve practical problems • initiative and perseverance • respect for alternative strategies that might be used in solving problems • appreciates efficiency and design in technological systems	Displays attitudes appropriate to the process of solving technological problems in an increasingly consistent manner 
Uses appropriate strategies and skills to solve technological problems: • understands the problem – asks questions – identifies relationships – proposes ideas • develops and carries out a plan – generates/selects alternatives – builds the product/design – tests and troubleshoots the product/design • reviews and applies the results of problem solving – evaluates the process used to solve the problem – evaluates the product in terms of effectiveness and efficiency	Uses appropriate strategies and skills to solve technological problems in increasingly complex situations 

SCIENCE AND TECHNOLOGY IN SOCIETY

GRADE 8	GRADE 9
Demonstrates an understanding of the role of science and technology in society. Recognizes: • the impact of science and technology on lifestyle, occupational choice, environment and welfare • how personal and societal needs/attitudes influence science and technology • that often the products of science and technology are accepted and used by society before the full extent of benefits and problems resulting from their use can be fully known • the need for "trade-offs" in order to find workable solutions to problems involving science and technology in society • appropriate strategies for making responsible decisions about the use of science and technology in society	Demonstrates an understanding of the role of science and technology in increasingly abstract settings →
Displays attitudes appropriate to the process of making responsible decisions in society: • appreciation of the beauty and complexity of living things • awareness of the interdependence of life forms • awareness of the need for resource conservation • respect for the perspectives and viewpoints of others	Displays attitudes appropriate to the process of making responsible decisions in an increasingly consistent manner →
Uses appropriate strategies and skills to make responsible decisions about the use of science and technology in society: • understands the problem – identifies the problem – interprets relationships – proposes ideas and alternatives • develops and carries out a plan – researches factual information – researches different perspectives – reflects and decides – makes decisions and takes action • reviews and applies results – evaluates the decision-making process – evaluates the long-term/short-term effects of decisions made and actions taken.	Uses appropriate strategies and skills to make responsible decisions in increasingly complex situations. →

UNDERSTANDING OUR ENVIRONMENT

GRADE 8	GRADE 9
INTERACTING WITH OUR ENVIRONMENT Recognizes that living things interact with other living and non-living parts of the environment. Identifies interactions that occur among living organisms in the local environment: • plant and plant • plant and animal • animal and animal. Describes the effect of non-living parts of the local environment on living organisms: • light • soil • water • temperature. Recognizes the sun as the original source of all energy in the environment. Describes the flow of energy in living things: • food chains • food webs. Recognizes the delicate balance that exists among living and non-living factors present in the environment Recognizes the ways in which human practices have affected: • inhabitants of the local environment • balance among living and non-living factors in the environment. Recognizes that individuals and society have the ability to protect and improve balance among living and non-living factors in their environment	**MONITORING THE LOCAL ENVIRONMENT** Identifies major forms of pollution in the local environment • air pollution • water pollution • soil pollution • noise pollution Describes local situations where human activity has altered living and non-living elements of the environment: • development of a local resource • disposal of solid wastes/sewage • land-use practices • use of biocides • population growth. Describes ways in which local use of natural resources has upset ecological balance and threatens environmental quality Recognizes how the use of certain technologies has created/intensified local environmental problems. Recognizes the value of biodegradable materials in reducing the impact of the products we use on the environment. Recognizes that individuals and society have the ability to monitor and manage their use of resources and environment.

USING MATERIALS AND PRODUCTS

GRADE 8	GRADE 9
WORKING WITH SOLUTIONS Recognizes the properties of familiar household solutions and mixtures. Distinguishes between solutions and non-solutions. Gives familiar examples of solutions that are composed of: • solid and gas • gas and liquid • liquid and liquid • solid and solid • gas and gas. Demonstrates an understanding of techniques used to: • separate mixtures • recover solutes from a solution. Distinguishes between the properties/uses of household solutions that: • are water-based • contain solvents other than water Identifies factors/conditions that affect the solubility of materials: • temperature • choice of solvent. Identifies factors/conditions that affect speed of dissolving: • temperature • particle size • mechanical movement. Distinguishes between diluted, concentrated and saturated solutions Describes the effect of the strength of a solution on its freezing/boiling point Demonstrates crystal formation through the use of super-saturated solutions	**USING CHEMICAL PRODUCTS** Recognizes chemical and physical properties of familiar household substances Identifies/distinguishes between chemical and physical change in household substances Recognizes that chemical substances react according to predictable patterns. Demonstrates an understanding of acid and base substances used in the home: • natural properties of acids/bases • reactions of acids/bases with other household substances • their usefulness and potential dangers. Identifies factors that affect the reaction rates of chemical products used in the home: • temperature • concentration • surface area Describes the nature of chemical changes that occur through oxidation: • burning • corrosion Recognizes the usefulness, as well as the potential dangers of chemical substances/reactions used in the home. Demonstrates an understanding of safe procedures for handling and storing potentially dangerous chemical products

TECHNOLOGY AT WORK

GRADE 8	GRADE 9
USING ENERGY AND MACHINES Explains the relationship between force, motion, work and energy in real life situations. Recognizes how the forces of gravity and friction affect work that is accomplished Demonstrates, through the use of simple labour saving devices, how simple machines help us to do work: • transfer of energy • increase/decrease in speed • change in direction of force • increase/decrease in force. Recognizes how combinations of simple machines are used in familiar mechanical systems and technologies to change direction/speed/magnitude of force Identifies major sources/forms of energy used to power mechanical systems: • chemical • mechanical • heat • electrical Recognizes that machines transfer energy from one form to another in doing work, and that useful energy is often lost in the form of heat. Describes energy: • flow/transformation/efficiency in familiar mechanical systems Distinguishes between renewable and non-renewable sources of energy Recognizes the rapid rate at which non-renewable sources of energy are being used by society, and the need to conserve these sources of energy	**ELECTRICAL SYSTEMS IN THE HOME** Demonstrates an understanding of the basic principles of static electricity and magnetism Describes the interrelationship between magnetism and an electric current Gives examples of electrical circuits, identifying: • the source of electricity • the conducting path • energy users along the path. Recognizes methods of producing electrical energy for home consumption. • generators • chemical action Describes basic principles of electrical resistance, and applies knowledge in: • selecting appropriate conductors • recognizing how electrical technologies produce light and heat Demonstrates, through sketches/assembly/construction, an understanding of basic household circuitry. • series and parallel circuits • conductors and insulators • switches • short circuits • safety features. Relates principles of magnetism and electricity to the operation of familiar electrical technologies used in the home Illustrates energy flow/transformation in familiar electrical technologies Recognizes hazards inherent in the use of electricity: • identifies potentially dangerous situations • predicts possible consequences of unsafe habits/routines Monitors personal consumption of electrical energy in the home, recognizing strategies that will ensure its efficient use

LIFE FORMS AND CHANGES

GRADE 8	GRADE 9
GROWING PLANTS Recognizes the importance of plants as basic producers of food. Describes how energy for all living things is provided through the process of photosynthesis. Identifies general characteristics and specializations in the structure of vascular plants: • leaf • stem • root • flower. Recognizes that living plants function as the sum total of their structural systems and the life processes they perform. Demonstrates an understanding of the ways in which plants reproduce in natural and specialized environments: • propagation by vegetative reproduction • flowering and seeds. Describes how specialized varieties of plants are developed through programs of controlled breeding. Identifies essential natural requirements for germination and plant growth. Recognizes how technology may be used to maximize plant growth: • fertilization/growth supplements • aeration/liming • hydroponics • pesticides/herbicides. Identifies symptoms of plant stress that may be caused by an imbalance in essential growth requirements, or by plant diseases and pests. Recognizes biological and chemical methods of controlling plant diseases and pests	**DIVERSITY IN LIVING THINGS** Illustrates, through example, diversity in the size, shape and physical structure of living things present in the immediate environment. Identifies adaptive structures/behaviours of local organisms that enable them to survive in their environments Recognizes that diversity in living things has been caused by the adaptive response of organisms to their environment. Recognizes that organisms may become extinct if there is lack of diversity/adaptation/specialization. Explains why features of particular species change over generations through the process of natural selection. Affirms the need to organize living things by classifying them into groups and sub-groups according to structural characteristics. Displays an understanding of systems used to classify living organisms: • Linnaean system of classification • recent developments in classification. Describes the diverse stages/forms of life in the life cycles of organisms common to the local environment: • complete metamorphosis • incomplete metamorphosis Recognizes how certain species perform diverse functions through the use of specialized structures and appendages: • social insects • human body

STATEMENT OF CONTENT

An I.O.P. "Science Profile" has been included for Grade 8 and Grade 9. These profiles provide an overview of the concepts and skills being addressed throughout each year of the program, and will assist teachers in:

- diagnosing individual student needs
- planning for the evaluation of both program delivery and student development

The "Program of Studies/Presentation of Content" follows each profile. This section describes the essential concepts, skills and attitudes identified for Grade 8 and Grade 9:

GRADE 8
- **Interacting with Our Environment**
- **Working with Solutions**
- **Using Energy and Machines**
- **Growing Plants**

GRADE 9
- **Monitoring the Local Environment**
- **Using Chemical Products**
- **Electrical Systems in the Home**
- **Diversity in Living Things**

Prescriptive statements in this section (i.e., the Program of Studies, Column One) have been shaded.

Learning objectives stated in the Program of Studies/Curriculum Guide (Column One) have been supported with:

- Related Life Skills (Column Two)
- Related Applications Across the Curriculum (Column Three)
- Suggested Strategies/Activities (Column Four)

The advice and direction offered throughout Columns Two, Three and Four are not prescriptive, and are offered only as a service to teachers. Column Two, Related Life Skills, establishes an immediate need or use for each concept/skill being studied, and suggests ways of planning relevant learning experiences Column Three, Related Applications Across the Curriculum, provides further suggestions for relating learning in science to the practical arts program and other academic disciplines. The references provided in this column will facilitate curricular integration by establishing a base for cooperative planning among other subject areas/teachers in the program Column Four, Suggested Strategies/Activities, provides a variety of strategies useful in addressing developmental characteristics and learning styles of the student.

While the Statement of Content represents the provincial curriculum for the majority of students within the program, it may be necessary to make local adjustments to the design and development of this curriculum in order to meet individual needs, abilities and learning styles.

SCIENCE PROFILE, I.O.P. GRADE 8

		1	2	3	4
01	**THE NATURE OF SCIENCE**	Demonstrates an understanding of the nature of science	Displays attitudes appropriate to the process of scientific inquiry	Demonstrates ability to use scientific inquiry skills	Conducts scientific inquiry, using appropriate strategies and skills
		1	2	3	4
02	**SCIENCE AND TECHNOLOGY**	Recognizes the relationship between science and technology	Displays attitudes appropriate to the process of solving technological problems	Demonstrates ability to use problem-solving skills	Solves technological problems, using appropriate strategies and skills
		1	2	3	4
03	**SCIENCE AND TECHNOLOGY IN SOCIETY**	Recognizes the role of science and technology in society	Displays attitudes appropriate to the process of making responsible decisions	Demonstrates ability to use decision-making skills	Makes decisions about the use of science/ technology, using appropriate strategies and skills
		1	2	3	4
04	**INTERACTING WITH OUR ENVIRONMENT**	Recognizes that living things interact with living/non-living parts of the environment	Identifies interactions that occur among living organisms in the local environment	Describes the effect of non-living factors in the local environment on living organisms	Recognizes the sun as the original source of all energy in the environment
		5	6	7	8
		Describes the flow of energy in living things	Recognizes the delicate balance that exists among living/non-living factors in the environment	Recognizes how human practices have affected balance within the local environment	Recognizes that individuals and society have the ability to improve the environment
		1	2	3	4
05	**WORKING WITH SOLUTIONS**	Recognizes the properties of familiar household solutions/ mixtures	Distinguishes between solutions and non-solutions	Gives familiar examples of different types of solutions	Uses appropriate techniques to separate mixtures/recover solutes from a solution
		5	6	7	8
		Distinguishes between water-based solutions and those containing solvents other than water	Identifies factors/ conditions that affect solubility of materials	Identifies factors/ conditions that affect speed of dissolving	Distinguishes between diluted, concentrated and saturated solutions
		9	10		
		Describes the effect of solution strength on freezing/boiling point	Demonstrates crystal formation through the use of super-saturated solutions		

SCIENCE PROFILE, I.O.P. GRADE 8 (cont'd)

		1	2	3	4
06	**USING ENERGY AND MACHINES**	Explains the relationship between force/motion/work/energy in real life situations	Recognizes how the forces of gravity and friction affect work that is accomplished	Demonstrates, through the use of simple labour saving devices, how simple machines help us to do work	Recognizes how combinations of simple machines are used in familiar mechanical systems
		5	6	7	8
		Identifies major sources/forms of energy used to power mechanical systems	Recognizes that machines transfer energy in doing work, and that useful energy is often lost	Describes energy flow/transformation/efficiency in familiar mechanical systems	Distinguishes between renewable and non-renewable sources of energy
		9			
		Recognizes the need for energy conservation			

		1	2	3	4
07	**GROWING PLANTS**	Recognizes the importance of plants as basic producers of food	Describes how energy for all living things is provided through photosynthesis	Identifies general characteristics/specializations of vascular plants	Recognizes that living plants function as the sum total of their structural systems and life processes
		5	6	7	8
		Recognizes how plants reproduce in both natural and specialized environments	Describes how specialized varieties of plants are developed through programs of controlled breeding	Identifies essential natural requirements for germination and plant growth	Recognizes how technology may be used to maximize plant growth
		9	10		
		Identifies symptoms of plant stress caused by imbalance in growth requirements/disease/pests	Recognizes biological and chemical methods of controlling plant diseases and pests		

PROGRAM OF STUDIES/PRESENTATION OF CONTENT

SCIENCE (I.O.P. GRADE 8)

INTERACTING WITH OUR ENVIRONMENT

OVERVIEW:

Students will investigate the interactions that occur among living and non-living elements in their environment. Activities will include first-hand observation of living things in the immediate environment, and should emphasize those relationships and interactions having the greatest impact on life in the local community. Investigations will enable students to recognize:

- the ways in which people affect the environment
- the ways in which the environment affects our lives
- the need to monitor and manage the local environment

ATTITUDES:

- Displays a positive attitude toward self and the study of science
  - assumes responsibility for personal conduct
  - performs investigations and completes assignments both independently and in cooperation with others
  - practises strategies for resolving interpersonal conflict
  - shows interest and curiosity through willingness to ask questions/share observations and ideas/seek answers
- Appreciates the extent to which people are dependent upon and influenced by their environment
- Shows concern for the changes made to the natural environment by technology and society
- Demonstrates commitment, through discussion and personal action, to protecting and improving the environment
- Accepts responsibility for the care of living organisms in both natural and artificial environments.
- Values the use of scientific knowledge in making decisions that affect the health of our environment.

LEARNING OBJECTIVES

Related Life Skills

CONCEPTS:

- Recognizes that living things interact with other living and non-living parts of the environment.

- Identifies interactions that occur among living organisms in the local environment:
  - plant and plant
  - plant and animal
  - animal and animal.

- Describes the effect of non-living parts of the local environment on living organisms:
  - light
  - soil
  - water
  - temperature.

- Recognizes the sun as the original source of all energy in the environment.

- Describes the flow of energy in living things:
  - food chains
  - food webs.

- Recognizes the delicate balance that exists among living and non-living factors present in the environment.

- Recognizes the ways in which human practices have affected:
  - inhabitants of the local environment
  - balance among living and non-living factors in the environment.

- Recognizes that individuals and society have the ability to protect and improve balance among living and non-living factors in their environment.

Recognizes factors that have caused changes in local populations of living things:

- factors that have caused some species to decrease in number to the degree that the species has become "endangered" or "extinct"
- other factors that have caused populations of certain species to increase to the degree that the species has become over-abundant and is a "pest".

Recognizes the effect of seasonal and other sudden changes on plants and animals in the local area:

- fires
- floods
- drought.

Recognizes food chains/food webs that exist among wild and domestic organisms in the local area.

- plant → mouse → hawk
- plant → cow → human.

Recognizes the effect of predator extermination programs (e.g., control of coyotes/wolves) on other wildlife populations

Identifies local activities/practices that affect interaction and balance among living and non-living parts of the environment:

- use of pesticides
- hunting
- pollution and waste disposal
- urban development

Identifies problems associated with parasitic relationships present in the local environment.

- the tapeworm and humans
- the trichina worm and pigs
- rust disease and wheat
- the spruce budworm and spruce tree

Related Applications Across the Curriculum

Social Studies

Uses knowledge and awareness gained from current affairs in identifying ecological problems and environmental issues of immediate and current concern.

Uses a decision-making process to identify personal and societal actions that can be taken to manage resources/environment in a responsible way

Recognizes the effects of climate and physical features on.

- resources
- populations
- culture

Realizes the dependency of humans on their environment.

Compares the living and non-living components of the local environment to a community in Mexico/Brazil

Practical Arts

Practises appropriate sanitation procedures for personal and public hygiene

Appreciates the short-term and long-term effects of improper sanitation procedures on others and the environment.

Recognizes the effect of seasons and climate on:

- availability of fruits, vegetables and other foods
- clothing selection and customs of dress
- heating and cooling systems used in the home, school and workplace
- types of technology used (e g , lawn mowers, snowblowers, in-car warmers)
- the condition of natural and man-made building materials (e g , wood, metal, stone, plastic)

Manages work area, following procedures that ensure waste materials are properly contained, stored and appropriately recycled

Suggested Strategies/Activities

In developing thematic content, emphasis should be placed on ecological relationships in the local environment that relate most directly to the student. Assist students to develop the required knowledge base by providing a variety of "input" activities:

- films/videos/computer software
- field trips into the local environment
- guest speakers from local "environmentalist" groups
- research (newspapers, magazines, booklets/ pamphlets available from various environmental agencies).

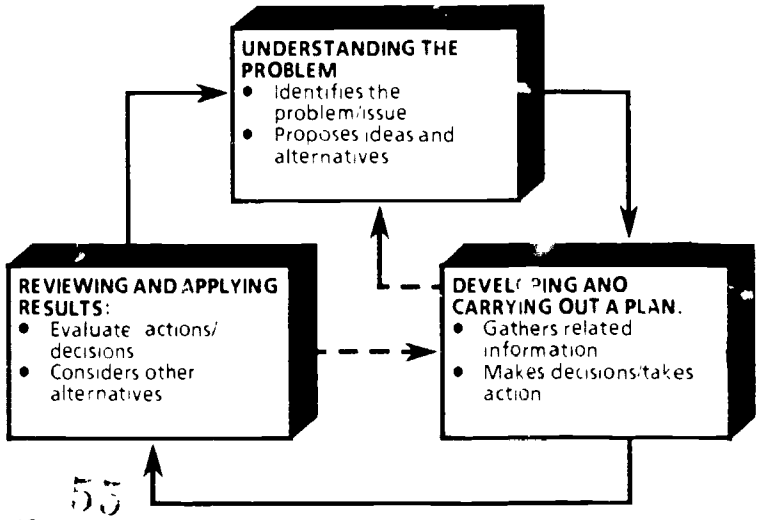
Encourage students to assimilate, organize and summarize information they gather by drawing "idea diagrams" and "semantic webs" (see *Teacher Resource Manual*) Prompt students to recall ideas through brainstorming activities and by asking appropriate chains of questions.

- What might happen if . ?
- How does . apply to . ?

Many activities will require the student to make accurate observations The attribute guides provided in the *Teacher Resource Manual* are intended to enhance student skills in making and describing observations Students should gain experience in recording their observations through a variety of methods.

- by collecting
- through counts/tallies
- through lists/tables/charts
- through the written word
- through sketches/diagrams
- by taking photographs/tape recordings

Encourage students to identify issues and problems associated with their personal use of environment and resources, and to use the decision-making model in considering related factors and alternative courses of action



LEARNING OBJECTIVES	Related Life Skills

SKILLS:

- Identifies common plants and animals found in the local environment.

- Uses appropriate inquiry skills in monitoring the effect of abiotic (non-living) factors on local plants/animals (e.g., light, soil, water, temperature):
  - designs experiments
  - gathers and processes data
  - interprets data
  - applies findings to local situation.

- Gathers, processes and interprets information related to the interdependence and relatedness of living organisms in the local environment:
  - observes the distribution patterns of plants and animals
  - observes and infers animal activities that indicate dependencies for food or protection
  - observes and infers examples of commensalism/mutualism/parasitism.

- Gathers, processes and interprets information related to energy flow in the local environment:
  - observes and infers food chain relationships
  - classifies familiar animals as producers/consumers/decomposers
  - constructs diagrams/models of food chains/food webs.

- Performs a plant and animal census within a given plot in the local community, observing and inferring:
  - distribution of plants/animals in relation to abiotic factors
  - interrelationships that exist among plant and animal inhabitants.

- Uses decision-making skills in analyzing a local environmental issue:
  - identifies a problem/issue related to use of the environment
  - gathers information related to the issue through observation/interview/research
  - evaluates information gathered (i.e., identifies cause and effect, predicts the effects of alternative responses to the issue)
  - chooses actions/makes decisions that minimize environmental impact
  - anticipates long-term consequences of actions taken.

Recognizes the wide range of waste materials produced in the local community, and the detrimental effect that these wastes have on living and non-living segments of the environment:

- pollutants of local waters
- air pollutants
- soil pollutants

Recognizes the value of biodegradable products in protecting the environment.

Accepts personal responsibilities in:

- controlling the production of waste materials
- using appropriate methods for disposing of waste materials

Recognizes that there are often long-term burdens associated with the use of modern technologies:

- use of herbicides and pesticides on crops
- use of fossil fuels for energy

Recognizes global factors that are threatening the health of our environment.

- acid rain
- radioactive fallout
- destruction of the ozone layer
- greenhouse effect

Follows local policies and controls designed to protect the environment

- fishing and hunting regulations
- waste controls
- noise controls

Recognizes ways in which the individual can initiate/support social action intended to improve the quality of the environment

Related Applications Across the Curriculum

Suggested Strategies/Activities

Language Arts

Uses skills of "reporting/making notes" when gathering, recording and organizing information related to environmental investigations:

- selects suitable sources for gathering information
- makes lists
- outlines
- summarizes
- synthesizes notes
- reports

Uses skills of "discussing" when evaluating and applying the findings of investigation to personal situation:

- differentiates between fact and fiction
- forms personal opinion
- permits/respects opinions of others
- recognizes that an issue can have two sides
- asserts personal opinion
- shares information

Uses the "mechanics of language" in recording information gathered and in communicating results

Applies "semantic web configurations" and/or "mind mapping strategies" in organizing concepts, understanding relationships, and recording main ideas and supporting detail

Mathematics

Uses skills of "data interpretation and display" when gathering, recording and organizing information related to the environment:

- gathers and records data using tally sheets and frequency tables
- reads and interprets information provided in list/table/chart/graph form
- organizes and displays data gathered in table/chart form

Emphasize the use of critical thinking skills Students need to be encouraged to consider all factors and viewpoints related to a given issue, and to justify the conclusions drawn and the personal action plans adopted A variety of strategies that will guide students through the process of analysis and critical thought have been provided in the *Teacher Resource Manual*:

- PMI (Plus-Minus-Interesting)
- CAF (Consider All Factors)
- OPV (Other People's Views)
- C and S (Consequences and Sequels)

Many opportunities exist for the integration of thematic activities with social studies (current affairs), language arts (skills in research, reporting and discussing) and mathematics (data interpretation and display, measurement) Teachers are encouraged to pursue such an approach in their instructional planning

Community Partnership(s).

Student investigation and research should include extensive contact with the local community and environment The following activities offer opportunity for students to learn through direct observation and interview within the local community:

- Invite a wildlife officer, agriculturalist or forestry official to speak to students about cyclic phenomena in wildlife, the effects of a forest fire, or some similar topic
- Interview a long-time local resident who can describe ways in which the local environment has changed during the last 20-50 years
- Observe land erosion by taking a field trip to an eroded area or an erosion prevention project
- Interview local officials responsible for water quality/disposal of wastes
- Visit local facilities used for water chlorination/ sewage treatment/waste disposal
- Invite local aldermen, councillors or MLA's to discuss current policy and debate relating to pollution and environmental quality

SCIENCE (I.O.P. GRADE 8)

WORKING WITH SOLUTIONS

OVERVIEW:

By carrying out a series of controlled experiments, students will investigate the properties and uses of solutions and substances found in their homes Activities must emphasize the study of those household and personal care substances already familiar to students through frequent use in real life situations. Students will develop a strategy and respect for the safe handling of laboratory equipment and supplies, and should become aware of appropriate procedures for handling potentially dangerous materials that they may encounter in real life situations

ATTITUDES:

- Displays a positive attitude toward self and the study of science
  - assumes responsibility for personal conduct
  - performs investigations and completes assignments independently and in cooperation with others
  - practises strategies for resolving interpersonal conflict
  - shows interest and curiosity through willingness to ask questions/share observations and ideas/seek answers.

- Appreciates the extent to which solutions are a part of both natural and manufactured products, and how science and technology have contributed to the development of a variety of household products that we use each day

- Realizes the usefulness of scientific inquiry skills in gathering information and explaining natural phenomena

- Displays an attitude of personal safety, and concern for the safety of fellow students when handling hazardous equipment and supplies in the laboratory.

- Appreciates the potential dangers of hazardous chemical substances found at home and elsewhere in the community

LEARNING OBJECTIVES

Related Life Skills

CONCEPTS:

- Recognizes the properties of familiar household solutions and mixtures.
- Distinguishes between solutions and non-solutions.
- Gives familiar examples of solutions that are composed of:
  - solid and gas
  - gas and liquid
  - liquid and liquid
  - solid and solid
  - gas and gas.
- Demonstrates an understanding of techniques used to:
  - separate mixtures
  - recover solutes from a solution
- Distinguishes between the properties/uses of household solutions that:
  - are water-based
  - contain solvents other than water.
- Identifies factors/conditions that affect the solubility of materials:
  - temperature
  - choice of solvent.
- Identifies factors/conditions that affect speed of dissolving:
  - temperature
  - particle size
  - mechanical movement
- Distinguishes between diluted, concentrated and saturated solutions.
- Describes the effect of the strength of a solution on its freezing/boiling point.
- Demonstrates crystal formation through the use of super-saturated solutions.

Recognizes solutions frequently encountered each day in the home:

- vinegar (acetic acid and water)
- antifreeze (ethylene glycol and water)
- fruit juice (water and fruit concentrate)
- carbonated soft drinks (carbon dioxide and water)
- tincture of iodine (iodine and alcohol)
- perfume in the air

Recognizes real life situations in which solutions are used to accomplish a particular task:

- using baking soda and water to settle an upset stomach
- using varsol to remove paint from the hands
- using alcohol to de-ice a lock
- using cleaning fluid to remove grease from clothing

Applies knowledge of the properties of mixtures/solutions in performing routine activities around the home

- preparing juices
- mixing cooking and baking ingredients
- mixing paints
- mixing herbicides/insecticides
- using household cleaning products
- using personal hygiene products

Recognizes and uses techniques that increase/hasten solubility in practical situations:

- dissolving sugar
- preparing refreshments sold in crystal form

Recognizes the effect of a solution's concentration on its freezing and boiling points. Applies this knowledge in understanding the:

- use of antifreeze
- use of salt on sidewalks and highways in the winter
- use of salt in raising cooking temperatures
- use of oils in cooking.

Related Applications Across the Curriculum

Social Studies

Investigates how concepts related to solutions and mixtures are used in the processing of primary resources (e.g , processing of crude oil and sour gas).

Uses knowledge and awareness gained from current affai- in identifying current health or safety concerns related to the use of particular solutions or mixtures sold in the marketplace

Practical Arts

Recognizes mixtures and solutions frequently found in the home, the school and the workplace:

- cleaning fluids
- lubricating fluids
- recipe ingredients
- beverages
- child care products.

Uses a variety of mixtures and solutions:

- sanitizes tools, equipment and the work area
- lubricates moving parts of tools and equipment
- cooks, bakes and prepares beverages
- maintains personal hygiene through the use of soaps and shampoos
- develops negatives and prints
- cleans minor injuries by gently wiping with a germicide, disinfectant or antiseptic

Uses knowledge of safe handling and storage procedures when using hazardous solutions and mixtures in the workplace. (Cooperative conferencing will facilitate identification of mixtures and solutions frequently used by students in the practical arts program. The properties and appropriate uses of these solutions/mixtures might then be investigated in science class)

Recognizes "hazardous product" symbols and "safety" symbols appropriate to the work area

Suggested Strategies/Activities

Emphasize active inquiry and involvement in the learning process by encouraging students to.

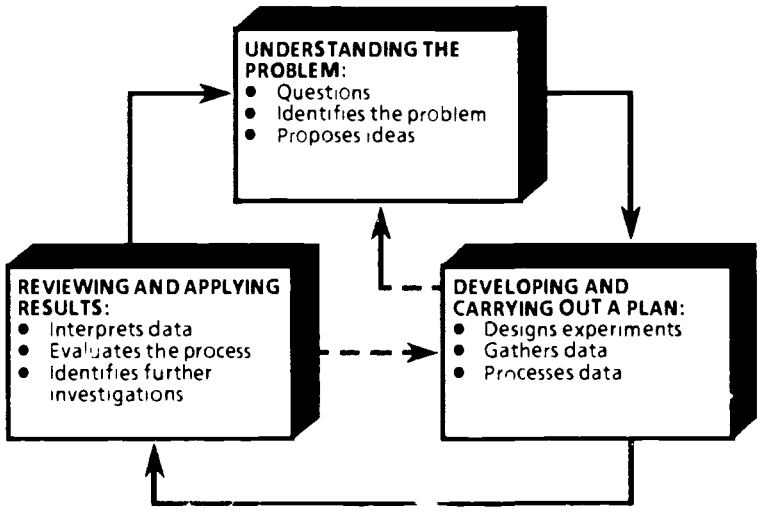
- observe, think about and discuss the solutions/mixtures encountered each day in real life activities
- obse,ve and attempt to explain unusual reactions/discrepant events in which the materials used behave in unexpected ways
- engage in dialogue and debate so they may become aware of other explanations and ways of thinking about phenomena observed

Assist students to prepare for what they will learn, and to organize and integrate new concepts/ relationships by using advance organizers and conceptual overviews that are provided in the *Teacher Resource Manual*:

- semantic webs
- skeletal outlines
- concept circles.

Develop inquiry skills and learning strategies appropriate to each stage of the inquiry process through direct instruction and modelling. By making students aware of the model being used, they will be better able to:

- relate specific skills to an overall strategy
- discuss the process being used with their peers and the teacher
- monitor and evaluate their own progress



"Talk through" an investigation to illustrate how discrete inquiry skills are used at various points throughout the model Ask probing questions that will focus attention on elements of the situation that might otherwise be overlooked

COURSE: SCIENCE (I.O.P. Grade 8)
WORKING WITH SOLUTIONS

LEARNING OBJECTIVES	Related Life Skills

SKILLS:

- Measures mass/capacity/temperature/time, using units, tools and procedures that are appropriate to the task being performed.

- Practises safe procedures for handling and storing laboratory/household materials that are potentially dangerous.

- Uses inquiry skills to investigate familiar household solutions, demonstrating ability to:
  - manipulate materials
  - observe/measure accurately
  - identify and control variables
  - hypothesize and infer relationships between variables
  - interpret graphs
  - make predictions.

- Classifies familiar mixtures as solutions or non-solutions.

- Performs experiments in order to determine:
  - factors affecting solubility
  - factors affecting speed of dissolution
  - effect of solution strength on freezing/boiling point.

- Prepares solutions in a manner that demonstrates an understanding of:
  - laboratory procedure
  - solubility concepts.

- Identifies appropriate methods of separating parts of a solution.

- Demonstrates manipulative skill and an understanding of laboratory procedure in:
  - using filter paper
  - recovering a solute by evaporation
  - using the distillation process
  - growing crystals.

- Uses problem-solving skills in determining effective techniques for removing undissolved material/impurities from solutions in practical situations:
  - gathers information/proposes alternatives
  - selects an alternative/builds a design
  - tests/evaluates/applies the design

Recognizes the usefulness of water as a solvent for many substances. Identifies other solvents that are useful for dissolving substances that water cannot dissolve:
- turpentine (paint thinner and remover)
- acetone (nail polish remover)
- gasoline (dissolves engine oil for two-cycle engine)
- alcohol (de-icer for keyholes)
- cleaning fluid (dissolves grease)

Recognizes differences in the properties of "hard water" and "soft water":
- understands why water may become hard
- identifies problems caused by hard water
- explains how hard water may be softened

Identifies special kinds of mixtures and solutions in the environment that are often the cause of the pollution.
- contaminated ground water
- acid rain
- oil spills
- dust
- smog.

Selects/uses appropriate thinners and cleaners when working with "oil-base" and "water-base" paints

Follows safe procedures for using and storing household products that contain hazardous solvents:
- interprets ingredient/direction labels
- identifies hazardous chemical symbols
- recognizes dangers associated with the use of hazardous solvents.

Appreciates that water from many natural sources may be unsuitable for drinking because of suspended pollutants and other dissolved materials. Recognizes the use of "filtration" and "distillation" in removing impurities present in water

Recognizes that "distilled water" is pure water that does not contain dissolved mineral matter and bacteria, and understands its use in familiar situations
- automobile batteries
- steam irons
- contact lens cleaning

Related Applications Across the Curriculum

Language Arts

Recognizes the transferability of inquiry strategies developed in language arts to scientific investigations:

- identifying cause and effect
- distinguishing between fact/fiction/opinion
- drawing conclusions/making inferences
- making predictions
- summarizing

Uses skills of "giving and following directions" when planning and performing experiments:

- recognizes need for sequence
- discerns when instructions must be followed exactly
- interprets verbal and written instructions
- interprets tables, diagrams, signs and symbols in order to follow instructions

Uses skills of "asking and answering" when identifying problems and formulating questions for investigation:

- probes for further information
- formulates increasingly higher levels of questions

Mathematics

Writes ratios that describe the composition of mixtures and solutions Uses ratio and proportion to determine appropriate ingredients for mixtures and solutions.

Uses appropriate units/tools/procedures for estimating and measuring

- mass
- capacity
- time
- temperature.

Uses skills of "data interpretation and display" when collecting and processing data obtained from experimentation:

- tally sheets and frequency tables
- tables/charts/graphs

Suggested Strategies/Activities

Activities in this concept area provide much opportunity for enhancing interpersonal skills among students within the classroom Experiments can be performed in group settings through the use of group problem solving As interactive/communicative problems become evident, use a problem-solving approach to generate

- reasons for the difficulty
- strategies to avoid the problem next time

A framework for social problem solving is provided in the *Teacher Resource Manual*

Emphasize the safe handling of laboratory equipment and potentially dangerous substances Develop appropriate safety attitudes and procedures by

- viewing slide sets/videos/cartoons that demonstrate safe laboratory procedures
- collecting and interpreting the warning labels on familiar household products
- discussing the recovery techniques for errors in handling potentially dangerous household substances
- assembling bulletin board displays that include safety posters/hazardous chemical symbols/labels from potentially dangerous chemicals used by the student

Community Partnership(s):

- Invite a paramedic or fire chief to discuss the hazards/safe handling and storage techniques for potentially dangerous products found in the home
- Invite a local pharmacist to discuss the properties of mixtures and solutions used in personal care products
- Invite a representative from the hair care, dry cleaning, automotive, agricultural or paint industries to discuss the properties of mixtures and solutions used in their respective service areas
- Visit local stores in an attempt to gather information provided on the labels of familiar household products (e g , hazardous chemical symbols, product ingredients, directions for use, recovery techniques for errors in handling)
- Visit a local water purification facility and observe solutions/filtration techniques being used

SCIENCE (I.O.P. GRADE 8)

USING ENERGY AND MACHINES

OVERVIEW:

Technology makes use of our energy sources in mechanical systems that are frequently used by students in the home and the community. Investigations undertaken will focus attention on the scientific principles that govern the operation of simple machines and more sophisticated mechanical systems. Students will gain experience in the actual construction and repair of simple mechanical technologies. Activities that demonstrate our dependence on energy systems and the need to manage our energy resources will enable students to become increasingly "energy wise"

ATTITUDES:

- Displays a positive attitude toward self and the study of science.
  - assumes responsibility for personal conduct
  - performs investigations and completes assignments independently and in cooperation with others
  - practises strategies for resolving interpersonal conflict
  - shows interest and curiosity through willingness to ask questions/share observations and ideas/seek answers
- Appreciates the usefulness of technological problem-solving skills in finding solutions to practical problems
- Demonstrates confidence in personal ability to solve practical problems.
- Realizes the relationship between science and familiar machine technologies
- Appreciates the extent to which science and machine technology have influenced and changed our society
- Displays responsible attitudes toward energy consumption as it relates to personal and global needs

LEARNING OBJECTIVES	Related Life Skills

CONCEPTS:

- Explains the relationship between force, motion, work and energy in real life situations.
- Recognizes how the forces of gravity and friction affect work that is accomplished.
- Demonstrates, through the use of simple labour saving devices, how simple machines help us to do work:
  - transfer of energy
  - increasing/decreasing speed
  - changing direction of force
  - increasing/decreasing force.
- Recognizes how combinations of simple machines are used in familiar mechanical systems and technologies to change direction/speed/magnitude of force.
- Identifies major sources/forms of energy used to power mechanical systems:
  - chemical
  - mechanical
  - heat
  - electrical
- Recognizes that, in doing work, machines transfer energy from one form to another, and that useful energy is often lost in the form of heat.
- Describes energy flow/transformation/efficiency in familiar mechanical systems.
- Distinguishes between renewable and non-renewable sources of energy.
- Recognizes the rapid rate at which non-renewable sources of energy are being used by society, and the need to conserve these sources of energy.

Applies knowledge of force, motion, work, friction and gravity in recognizing efficient methods of accomplishing everyday tasks:

- moving an object across the floor
- raising/lowering heavy objects

Recognizes useful effects of friction in everyday life

- brakes on a car
- traction of tires and shoes
- sanding and grinding

Recognizes the detrimental effects of friction in machine technologies, and the importance of regular machine maintenance and repair

Recognizes how simple machines contribute to the operation of tools and labour saving devices used around the home.

- shovel/broom
- hammer/pliers/screwdriver
- tweezers/nutcracker/scissors
- doorknob/can opener
- ramp/stairs

Recognizes how simple machines contribute to the operation of more sophisticated mechanical systems and technologies used around the home

- bicycle/motorcycle
- moving toys
- lawn mower/typewriter/sewing machine

Demonstrates an ability to use simple machines in performing routine tasks around the home

- pulley
- lever
- inclined plane

Improvises and builds simple labour saving devices that incorporate the use of these machines

Recognizes the effects of machine technology on personal lifestyle

- occupational choices
- leisure time activities
- levels of health/fitness
- pollution and environmental health

Related Applications Across the Curriculum

Suggested Strategies/Activities

Social Studies

Examines the variety of machines used in local industry, and the effect that technology has on career opportunity

Uses knowledge and awareness gained from current affairs in recognizing technologies that have been recently developed, their uses, and the dangers they may impose on human health and the environment.

Relates local forms of energy to:

- natural resource base
- employment opportunities

Compares/contrasts energy sources and machines used in Alberta communities with communities in Mexico/Brazil.

Practical Arts

Begins to identify the basic technologies used in the eight occupational clusters:

- Agribusiness
- Business and Office Operations
- Construction and Fabrication
- Creative Arts
- Natural Resources
- Personal and Public Services
- Tourism and Hospitality
- Transportation

Uses a variety of technologies/tools to:

- bake/cook
- build/construct
- communicate
- count/measure
- cultivate
- design/draw
- repair/service

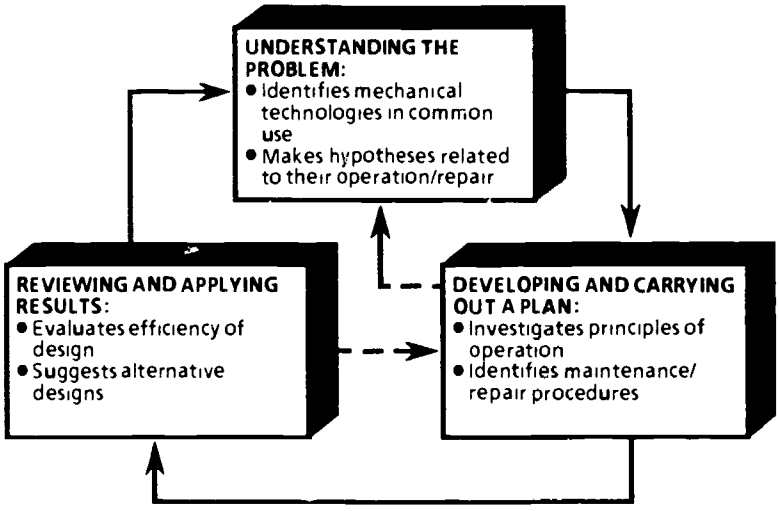
Begins to appreciate the potential effect of technology on:

- job and career opportunities
- the need for worker/entrepreneurial adaptability
- lifestyle/leisure time activities

Uses technology to design, construct and produce a product. Applies decision-making/problem-solving skills in selecting the correct tools/equipment for each task performed

Activities should enable students to "experience" energy and machines through first-hand investigation and manipulation of familiar mechanical devices. Model the problem-solving process, and encourage students to pose/answer questions about the technologies investigated:

- How does it work?
- How do I use it?
- How might I repair it?



Initial investigations should relate to simple machines and mechanical devices with relatively few components. Following these activities, encourage students to trace the energy flow through more complex mechanical "systems" that involve the use of several simple machines (e.g., bicycle, building crane). Ask students to bring to class old or non-functional appliances, tools, machines and toys, for analysis. Determine how these mechanical systems work, what is wrong with them, and make repairs where possible.

Students learn by reflecting on what they have done and will gain understanding by discussing and talking about their work. Provide opportunity for students to:

- work independently as well as in small groups
- engage in group discussion where observations/procedures are shared
- summarize and explain outcomes to others.

Provide frequent opportunity for students to report, summarize and communicate the outcomes of investigation and discussion through informal writing activities. The process of writing enables students to sort and relate ideas, and helps the learner to internalize observations and outcomes. Strategies that will support students in their use of writing skills are provided in the *Teacher Resource Manual*.

LEARNING OBJECTIVES	Related Life Skills

SKILLS:

- Measures force/mass/distance, using units, tools and procedures that are appropriate to the task being performed.

- Calculates work done in accomplishing simple tasks (e.g., lifting or moving an object).

- Performs experiments with the lever, inclined plane, pulley and pulley system, demonstrating ability to:
  - manipulate materials
  - measure
  - collect and report data
  - interpret data
  - draw conclusions.

- Performs simple calculations required in developing an understanding of concepts related to:
  - mechanical advantage
  - work input/output
  - efficiency

- Analyzes familiar tools/labour saving devices/ mechanical systems, identifying:
  - sub-systems
  - component parts
  - energy flow

- Identifies ways to improve the efficiency of simple mechanical systems by:
  - lessening frictional losses
  - improving the design.

- Applies problem-solving skills in troubleshooting mechanical systems containing relatively few components:
  - identifies the source of the problem
  - considers alternative approaches to a solution
  - evaluates alternatives and makes necessary repairs.

- Constructs/invents a simple mechanical device intended to perform a given function

- Constructs energy chains that trace forms of energy used in machines back to their original source

Troubleshoots and repairs simple mechanical systems used in the home:

- identifies energy sources used to power mechanical devices
- detects energy transformations that occur in mechanical devices
- isolates component parts and infers how each part contributes to the functioning of the "system"

Recognizes that some energy sources are renewable, while others are not Appreciates the importance of conserving our non-renewable energy resources

Identifies ways in which the environment is affected by the use of fossil fuels in powering machines.

- thermal pollution
- greenhouse effect
- temperature inversions

Considers alternative sources of energy that will reduce environmental pollution

Identifies energy sources that may play a vital role in powering future technologies

- solar energy
- nuclear energy
- wind energy

Appreciates the contributions of science and technology in.

- the design of familiar labour saving devices
- providing large amounts of energy for everyday use
- developing new technologies and energy sources that meet changing needs of society

Relates knowledge of energy issues to personal energy consumption in the home:

- classifies mechanical systems/ appliances in the home as high, medium and low energy users
- recognizes energy costs associated with the use of these devices
- identifies strategies that might be used in reducing energy consumption in the home

Related Applications Across the Curriculum

Language Arts

Uses skills of "comprehension" when interpreting data obtained through experimentation:

- develops technical vocabulary
- identifies cause and effect relationships
- observes sequence of events
- draws conclusions/makes inferences
- makes predictions
- summarizes
- uses visual/graphic information

Uses skills of "giving and following directions" when planning and performing investigation

- recognizes need for sequence
- interprets verbal and written instructions
- interprets tables, diagrams, signs and symbols in order to follow instructions

Uses skills of "reporting/making notes" in obtaining information, processing data, and communicating results of investigation.

- selects relevant details
- outlines
- reports
- uses symbols and abbreviations

Mathematics

Uses appropriate units/tools/procedures for estimating and measuring

- mass
- force
- distance

Writes ratios that describe:

- mechanical advantage o machines
- efficiency of machines

Uses computational skills in determining

- mechanical advantage
- work input/output
- efficiency.

Distinguishes between variables and constants Uses algebraic skills in.

- understanding simple formulas
- performing substitution.

Suggested Strategies/Activities

Energy concepts/attitudes should be developed through the use of learning resources that give a current perspective on related issues and problems (e g , periodicals, films, videos) Activities should enable students to recognize

- their dependence on energy systems
- non-renewable energy resources for which supply is a matter of current concern
- the need to find alternative forms of energy.

Brainstorm and debate current problems/issues related to energy supply and use Structure discussion through semantic webs, idea diagrams and critical thinking strategies (see *Teacher Resource Manual*)

Community Partnership(s):

- Visit local business for first-hand observation of mechanical technologies in use (e g , service station, construction site)
- Visit a local power generating plant and note energy transformation/application of mechanical systems
- Visit a solar efficient building and note energy transformation/conservation
- Invite a representative from the local electrical/ natural gas utility company to discuss energy consumption/conservation practices in the home
- Invite a local mechanic, carpenter or other tradesperson to discuss the applications made of energy and machines in their work
- Invite a doctor/nurse to discuss the muscular and skeletal systems of the human body and how they work to lift a load
- Invite an engineer/environmentalist to discuss issues that relate to local energy supply and use

SCIENCE (I.O.P. GRADE 8)

GROWING PLANTS

OVERVIEW:

This topic will develop a strategy for monitoring and managing plant growth By conducting a series of controlled experiments, students will gain first-hand knowledge of factors that contribute to the nourishment and care of familiar home and garden plants Opportunity will be provided for students to investigate and use various technologies designed to enhance plant growth and yield Activities should focus attention on the extent to which human actions and interventions have affected the variety, distribution and growth of plants found in the local environment

ATTITUDES:

- Displays a positive attitude toward self and the study of science
  - assumes responsibility for personal conduct
  - performs investigations and completes assignments independently and in cooperation with others
  - practises strategies for resolving interpersonal conflict
  - shows interest and curiosity through willingness to ask questions/share observations and ideas/seek answers.
- Appreciates the role of plants in sustaining human life
- Realizes that the distribution and growth of plants is very much affected by technology and society through environmental modifications and human interventions
- Realizes that agricultural and domestic varieties of plants are usually the products of intensive breeding programs
- Demonstrates, through discussion and personal action, a respect for living things and a commitment to protecting the environment.
- Displays confidence in personal ability to nurture plants

LEARNING OBJECTIVES	Related Life Skills

CONCEPTS:

- Recognizes the importance of plants as basic producers of food.
- Describes how energy for all living things is provided through the process of photosynthesis
- Identifies general characteristics and specializations in the structure of vascular plants:
  - leaf
  - stem
  - root
  - flower.
- Recognizes that living plants function as the sum total of their structural systems and the life processes they perform:
  - osmosis
  - conduction
  - transpiration
  - photosynthesis
  - reproduction.
- Demonstrates an understanding of the ways in which plants reproduce in natural and specialized environments:
  - propagation by vegetative reproduction
  - flowering and seeds.
- Describes how specialized varieties of plants are developed through programs of controlled breeding
- Identifies essential natural requirements for germination and plant growth.
- Recognizes how technology may be used to create specialized environments that maximize plant growth:
  - fertilization/growth supplements
  - aeration
  - liming
  - hydroponics
  - pesticides/herbicides.
- Identifies symptoms of plant stress that may be caused by an imbalance in essential growth requirements, or by plant diseases and pests
- Recognizes biological and chemical methods of controlling plant diseases and pests

Recognizes the importance of plants as a basic source of food supply
- grains (bread, macaroni, cereals, pastry)
- fruit and vegetables

Recognizes how technology has influenced the nature of the food products available to us.
- specialized varieties of grains, fruits and vegetables
- fresh produce that is available "out of season"

Uses appropriate methods of propagating plants both indoors and outdoors.
- leaf/stem cuttings, runners, bulbs, tubers, corms, rhizomes
- seeds

Appreciates the economic importance of propagating some plants by vegetative methods

Identifies different types of soil in the local environment. Recognizes the advantages/disadvantages of each type of soil relative to the growth of particular plant varieties

Identifies common house and garden plants suited to the local environment Distinguishes between those considered useful and those considered harmful

Develops a "care strategy" for house and garden plants.
- monitors supply of essential growth requirements
- recognizes symptoms of plant stress/illness
- diagnoses and corrects health/growth problems

Develops a strategy for selecting and using appropriate fertilizers/growth supplements
- identifies the components of different fertilizers
- recognizes how each component contributes to plant growth
- selects a fertilizer according to soil conditions/growth needs
- mixes/applies fertilizer according to the directions provided

Recognizes the use of "slow release" fertilizers

Compares the use of chemical fertilizers with that of organic manure Recognizes the advantages of "organic gardening"

Related Applications Across the Curriculum

Social Studies

Recognizes the effect of agriculture and plant husbandry on employment opportunities in the local community:

- fertilizer companies
  - chemists
  - skilled/unskilled labour
- machine manufacturers
  - managers
  - office staff
  - skilled/unskilled labour
- retail machine outlets
  - managers
  - mechanics
  - office staff
  - sales personnel.

Relates vegetation to climate and human population in Alberta communities.

- effect of differing amounts of rainfall on agricultural production
- effect of agriculture/forestry on density of population

Uses knowledge and awareness gained from current affairs to identify current technologies/issues related to plant husbandry:

- new plant varieties developed through controlled breeding
- use of hydroponics in food production
- biological versus chemical methods of controlling plant disease
- soil pollution

Practical Arts

Recognizes the importance of plants as

- basic sources of food
- important components of a balanced diet

Recognizes and uses various methods to control the growth and reproduction of harmful bacteria.

- chemicals
- heat
- refrigeration/freezing

Recognizes occupational opportunities that are related to:

- agriculture
- horticulture

Suggested Strategies/Activities

Ensure that investigations are relevant to students Select activities that focus attention on:

- the structure/adaptations of plants in the local environment familiar to the student
- strategies for monitoring and managing the growth of plants found in the home and garden

Organize classroom activities in ways that encourage students to be active participants in thinking and investigating Provide opportunities for:

- total group involvement in listening/viewing and interacting
- cooperative group work in pairs or small groups
- individual student work.

An instructional model useful in fostering active involvement in thematic investigation includes the sequence of activities outlined below:

- involve students in a situation that stimulates them to ask questions and identify problems
- record questions/problems on the blackboard/ overhead
- encourage students, either individually or in groups, to suggest ideas related to the questions asked
- ask students to design a research proposal, describing.
  - questions/answers they are going to check on
  - how and where they will find their information
  - how long it will take them
  - what equipment they will need
- permit students to conduct an inquiry on their problem using their suggested activities This may include:
  - observation/experiment
  - consulting books
  - interviewing knowledgeable people
- provide opportunity for students to report their finding to the class Encourage students to comment on:
  - whether or not they really found out what they were trying to find out
  - possible alternative explanations
  - further investigations that might follow

Ask questions and pose statements that promote and challenge higher-level reasoning and cause students to explore ideas they may not have considered:

- "What do you mean when you say ?"
- "Tell me more about ..."
- "How did you think of that idea?"
- "What made you ask that question?"
- "How did you come to that conclusion?"
- "What would you do in that situation?"

LEARNING OBJECTIVES	Related Life Skills

SKILLS:

- Observes/identifies local vascular plants.
- Gathers information related to the structure of vascular plants:
  - observes and infers the function of major plant structures (e.g., leaf, stem, root, flower)
  - uses a microscope to observe the cellular structure of plants
  - dissects flowers, identifying individual parts and their function.
- Observes and infers the life processes of plants (e.g., osmosis, conduction, transpiration, gas exchange, photosynthesis, reproduction).
- Constructs/interprets charts that indicate the results of selective breeding and cross-breeding.
- Uses appropriate inquiry skills, demonstrating ability to:
  - manipulate materials
  - follow safe procedures for handling laboratory equipment and materials
  - accurately observe and measure
  - identify and control variables
  - infer relationships between variables
  - hypothesize and make predictions.
- Performs experiments that monitor the effect of variations in growth conditions on plant development and growth:
  - manipulates light/soil/moisture conditions
  - tests soils used for pH
  - compares the use of different fertilizers/ growth supplements
  - uses hydroponic solutions
- Propagates plants through methods of vegetative reproduction and from seeds.
- Demonstrates a knowledge of plant-care procedures by growing a healthy plant:
  - monitors supply of essential requirements for growth
  - diagnoses health/growth problems
  - corrects problems that are diagnosed
  - maintains a growth record from germination to flowering, noting care procedures followed.
- Uses decision-making skills in order to evaluate the effects of familiar technologies in plant science on the local environment.

Uses appropriate technologies in order to maximize the growth of plants both indoors and outdoors:
- fertilization
- aeration
- liming
- irrigation
- herbicides/pesticides

Recognizes disadvantages and problems inherent in the use of certain technologies designed to enhance the growth of plants
- overuse of fertilizers
- long-term effects of using herbicides/ pesticides

Recognizes the "brand names" of commercial products suited to particular applications in home gardening:
- fertilizers suitable for lawns, vegetable gardens, houseplants
- lime products for the garden
- insecticides suited to the control of particular insect pests

Follows appropriate safety procedures in storing and handling herbicides/pesticides

Avoids practices that may contribute to a loss of soil nutrients in the garden.
- over-watering
- removal of plant debris
- overuse of soil

Recognizes the effect of "pruning" on plant growth

Recognizes government regulations intended to control the spread of plant diseases/pests
- regular inspection of fresh produce, nursery stock, etc
- restrictions on the movement of plant material between countries

Recognizes different ways in which plant diseases/pests are transmitted from one host to another Follows appropriate procedures in disposing of dead or diseased plants

Recognizes biological methods of controlling pests in the house and garden Understands the pros and cons of biological versus chemical methods of controlling plant pests

Identifies alternatives for disease and pest control Considers the relative merits of each alternative in a particular situation before choosing a course of action

Related Applications Across the Curriculum

Language Arts

Uses skills of "comprehension" in gathering and evaluating information related to plant growth.

- identifies cause and effect relationships
- makes inferences and predictions
- draws conclusions
- summarizes

Uses skills of "following directions" when performing plant investigations:

- discerns when instructions must be followed exactly
- interprets verbal instructions
- interprets written text that provides directions
- interprets tables in order to follow directions

Uses skills learned in "discussing" when evaluating and applying the results of investigation:

- distinguishes between fact/fiction/opinion
- recognizes that an issue can have two sides
- expresses personal opinion
- permits/respects opinions of others

Mathematics

Uses appropriate units/tools/procedures in estimating and measuring:

- mass
- capacity
- temperature

Uses skills in ratio and proportion when

- identifying the components of various fertilizers/growth supplements
- mixing/applying various fertilizers and growth supplements according to the directions provided

Uses skills of "data interpretation and display" when gathering, recording and organizing information on plant growth:

- gathers and records data using tally sheets and frequency tables
- reads and interprets information provided in list/table/chart/graph form
- organizes and displays data that has been gathered in table/chart form

Suggested Strategies/Activities

Provide opportunity for students to debate the advantages/disadvantages of various technologies used in plant husbandry:

- organic versus chemical methods of fertilization
- biological versus chemical methods of controlling plant diseases and pests

When considering these issues, guide students through the process of analysis and critical thought by using strategies provided in the *Teacher Resource Manual*

- PMI (Plus-Minus-Interesting)
- CAF (Consider All Factors)

Research recent developments in plant science:

- the use of hydroponics in food production
- new plant varieties developed through programs of controlled breeding

Gather information through the use of periodicals/ resource people/films/videos Assist students to organize the information they gather by using "idea diagrams" and "semantic webs" (see *Teacher Resource Manual*).

Community Partnership(s):

- Observe and identify plants found in the local environment Compare the root/stem/leaf/ flower structure of the plants observed
- Investigate different soil types found in the local environment, noting the micro environment surrounding each
- Visit a local greenhouse/nursery, noting technologies that are used to maximize plant growth and yield
- Invite an agriculturalist or other informed person to discuss local practices with respect to soil analysis/fertilizer use/control of plant disease
- Interview a local resident who can describe changes that have occurred in the distribution/growth of plants found in the surrounding area over the last decade
- Invite an agriculturalist/horticulturalist to explain how breeding programs have developed specialized plant varieties (e.g., grains, trees, garden plants) that are suited to the local environment

SUGGESTED OPTIONS, I.O.P. GRADE 8

In situations where I O P Science 8 is offered through more than 100 hours of instruction, teachers may wish to enrich their program with the study of optional content. While there is no requirement that optional content be included in the science program, two optional topics have been provided as a service to teachers:

- Selecting a Consumer Product
- Local Landforms and Resources

The outlines that follow will assist teachers who wish to develop these topics as optional content

SELECTING A CONSUMER PRODUCT

OVERVIEW:

This topic will provide students with a strategy for selecting consumer products Students will gather information about the characteristics and quality of various products they may wish to purchase, and learn to avoid the powerful influences of advertising in making purchase decisions Students should be encouraged to consider factors such as product standards, product testing and safety when evaluating competing consumer products

ATTITUDES:

- Develops confidence in personal ability to evaluate a product and make appropriate consumer decisions
- Appreciates the influence of advertising on our opinions of a product
- Appreciates the possible impacts of certain consumer products on our environment

CONCEPTS:

- Recognizes sources of consumer information about different types of products (e g , characteristics, quality).
- Uses product labels to compare composition/ingredients of competing consumer products
- Recognizes accepted standards for product composition, packaging, labelling and advertising
- Distinguishes between useful and biased information presented through advertising
- Recognizes errors frequently made by manufacturers/advertisers when conducting tests on products
- Recognizes the use of language, music and visuals in creating opinions about a product
- Identifies safety factors related to product design and conditions of use

SKILLS:

- Identifies/asks questions about consumer products that can be answered through inquiry and investigation
- Gathers and compiles relevant information about a product
- Identifies and controls variables for product testing
- Designs and performs product-testing experiments
- Identifies components within a system that have the potential to fail
- Evaluates products according to one or more criteria

LOCAL LANDFORMS AND RESOURCES

OVERVIEW:

Students will investigate the constructive and destructive forces that act upon and change landforms Activities should develop an understanding of how local landforms have been created, and how they have changed over time through folding, faulting, weathering and erosion Students might also investigate the formation and deposition of soil and mineral resources present in the local environment.

ATTITUDES:

- Develop confidence in personal ability to interpret geological materials and changes.
- Appreciate the value of scientific theory in interpreting earth changes.
- Realize that local soil and mineral resources have been formed over long periods of time, and must be used responsibly

CONCEPTS:

- Describes how movements within the earth create and change landforms:
  - crustal movements
  - earthquakes/volcanoes
  - mountain building
- Recognizes the use of technology in predicting the occurrence of major changes in landforms
- Describes the formation and major characteristics of igneous, sedimentary and metamorphic rock groups
- Recognizes the value of rock and mineral resources present in the local environment
- Describes the process of fossil formation and local history as portrayed through fossil records
- Identifies the effects of weathering and erosion on local landforms
- Describes the process of soil formation and deposition
- Distinguishes between topsoil and subsoil, and recognizes the characteristics of local soil types

SKILLS:

- Observes the characteristics of local landforms, rocks and minerals
- Classifies local rocks and minerals according to physical and chemical properties.
- Identifies patterns and trends of crustal movements/changes
- Uses a model to describe how changes occur in the earth's crust

SCIENCE PROFILE, I.O.P. GRADE 9

		1	2	3	4
01	THE NATURE OF SCIENCE	Demonstrates an understanding of the nature of science	Displays attitudes appropriate to the process of scientific inquiry	Demonstrates ability to use scientific inquiry skills	Conducts scientific inquiry, using appropriate strategies and skills
02	SCIENCE AND TECHNOLOGY	Recognizes the relationship between science and technology	Displays attitudes appropriate to the process of solving technological problems	Demonstrates ability to use problem-solving skills	Solves technological problems, using appropriate strategies and skills
03	SCIENCE AND TECHNOLOGY IN SOCIETY	Recognizes the role of science and technology in society	Displays attitudes appropriate to the process of making responsible decisions	Demonstrates ability to use decision-making skills	Makes decisions about the use of science/technology, using appropriate strategies and skills
04	MONITORING THE LOCAL ENVIRONMENT	Recognizes interaction among living/non-living parts of the environment (Grade 8 review)	Describes the effect of non-living factors on living organisms (Grade 8 review)	Recognizes balance among living/non-living factors in the environment (Grade 8 review)	Identifies major forms of pollution in the local environment
		5	6	7	8
		Describes how humans have altered living/non-living elements of the environment	Describes how our use of natural resources has upset ecological balance	Recognizes how certain technologies have created/intensified ecological problems	Recognizes the value of biodegradable materials to the environment
		9			
		Recognizes that individuals and society can monitor/manage the environment			
05	USING CHEMICAL PRODUCTS	Recognizes the properties of mixtures and solutions (Grade 8 review)	Identifies factors that affect solubility/speed of dissolving (Grade 8 review)	Distinguishes between diluted/concentrated/saturated solutions (Grade 8 review)	Recognizes chemical and physical properties of familiar household substances
		5	6	7	8
		Identifies/distinguishes between chemical and physical changes in household substances	Recognizes that chemical substances react according to predictable patterns	Demonstrates an understanding of acid and base substances used in the home	Identifies factors that affect the reaction rates of chemical products
		9	10	11	
		Describes the nature of chemical changes that occur through oxidation	Recognizes the usefulness/potential dangers of chemical substances and reactions	Recognizes safe procedures for handling/storing chemical products	

SCIENCE PROFILE, I.O.P. GRADE 9 (cont'd)

06 ELECTRICAL SYSTEMS IN THE HOME

1	2	3	4
Demonstrates the basic principles of static electricity and magnetism	Describes the inter-relationship between magnetism and an electric current	Describes an electrical circuit (electrical source, conducting path, energy users)	Recognizes methods of producing electrical energy for home consumption
5	**6**	**7**	**8**
Describes/applies the basic principles of electrical resistance	Demonstrates, through sketches/assembly/ construction, an understanding of basic household circuitry	Relates principles of magnetism/electricity to the operation of familiar technologies	Illustrates energy flow/transformation in familiar electrical technologies
9	**10**		
Recognizes hazards inherent in the use of electricity	Monitors personal consumption of electrical energy		

07 DIVERSITY IN LIVING THINGS

1	2	3	4
Illustrates diversity in the size, shape and physical structure of living things	Illustrates adaptive structures/behaviours of local organisms	Recognizes that diversity has been caused by the adaptive response of organisms	Recognizes why organisms may become extinct (i.e., lack of diversity/adaptation/ specialization)
5	**6**	**7**	**8**
Explains how species change over generations through natural selection	Affirms the need to organize living things by classifying them according to structural characteristics	Displays an understanding of systems used to classify living organisms	Describes the diverse stages/forms of life in the life cycles of familiar organism
9			
Recognizes how species use specialized structures to perform diverse functions			

PROGRAM OF STUDIES/PRESENTATION OF CONTENT

SCIENCE (I.O.P. GRADE 9)

MONITORING THE LOCAL ENVIRONMENT

OVERVIEW:

Environmental care is becoming increasingly important in our technological society We often experience adverse environmental conditions that can be associated with liquid, gas, material and noise pollutants The media frequently provides us with additional information on environmental issues of both local and global significance Activities undertaken will enable students to

- recognize the sources and effects of different types of pollution in the local environment
- perform pollution related experiments
- develop and evaluate action plans for dealing with local environmental issues

ATTITUDES:

- Displays a positive attitude toward self and the study of science
  - assumes responsibility for personal conduct
  - performs investigations and completes assignments independently and in cooperation with others
  - practises strategies for resolving interpersonal conflict
  - shows interest and curiosity through willingness to ask questions/share observations and ideas/seek answers
- Develops a sensitivity for the delicate balance among living things and their environment
- Shows concern for the changes in the natural environment made by technology and society
- Demonstrates a commitment, through discussion and personal action, to protecting and improving the environment
- Recognizes that environmental issues involve relationships among science, technology and society
- Values the use of scientific knowledge in understanding environmental issues, and in making personal and community decisions that relate to care of the environment

LEARNING OBJECTIVES	Related Life Skills

CONCEPTS:

- Demonstrates an understanding of concepts previously developed in Grade 8:
  - recognizes that living things interact with other living and non-living parts of the environment
  - describes the effects of non-living parts of the local environment on living organisms
  - recognizes the delicate balance that exists among living and non-living factors present in the environment.

- Identifies major forms of pollution in the local environment:
  - air pollution
  - water pollution
  - soil pollution
  - noise pollution

- Describes local situations where human activity has altered living and non-living elements of the local environment:
  - development of a local resource
  - disposal of local waste/sewage
  - land-use practices
  - use of biocides
  - population growth.

- Describes ways in which local use of natural resources has upset ecological balance and threatens environmental quality

- Recognizes how the use of certain technologies has created/intensified local environmental problems.

- Recognizes the value of biodegradable materials in reducing the impact of the products we use in the environment.

- Recognizes that individuals and society have the ability to monitor and manage their use of resources and environment

Recognizes the wide range of waste materials produced in the local community, and the detrimental effect these wastes have on personal health and lifestyle

- pollutants of local waters
- air pollutants
- soil pollutants
- noise

Accepts personal responsibility for:

- controlling the production of waste materials
- using appropriate methods for disposing of waste materials

Recognizes the value of biodegradable products in protecting the environment
Uses biodegradable products when appropriate

- paper products rather than plastic products
- natural fibres rather than synthetic fibres
- organic cleaning agents rather than chemical cleaners
- peat moss/manure rather than chemical fertilizers

Recognizes that there are often long-term burdens associated with the use of modern technologies:

- use of herbicides and pesticides on crops
- use of fossil fuels for energy

Identifies local practices/activities that have a disruptive influence on natural food chains
Predicts the long-term effects of these practices on the local environment

- hunting/extermination programs
- pollution/waste disposal
- urban development
- use of biocides

Understands global factors that are threatening the health of our environment

- acid rain
- radioactive fallout
- destruction of the ozone layer
- greenhouse effect

Recognizes ways in which the individual can initiate/support social action intended to improve the quality of the environment

Related Applications Across the Curriculum

Social Studies

Uses knowledge and awareness gained from current affairs in identifying ecological problems and environmental issues of immediate and current concern

Examines the effects of environmental use on the local community.

- monitors personal use/misuse of environmental elements
- develops a strategy to increase community awareness of environmental use/misuse
- uses a decision-making process in identifying personal and societal actions that can be taken to manage resources/environment in a responsible way

Recognizes the effects of climate and physical features on the local community:

- natural resources
- human geography
- economic base

Practical Arts

Practises appropriate sanitation procedures for personal and public hygiene

Appreciates the short-term and long-term effects of improper sanitation procedures on others and the environment

Recognizes conditions that affect health and productivity in the home, school and workplace

- temperature
- moisture/humidity
- light

Uses scientific inquiry skills and technology to monitor and adjust temperature, moisture and light conditions

Appreciates the need for environmental controls in the workplace.

Manages work area, following procedures that ensure waste materials are properly contained, stored and appropriately recycled.

Suggested Strategies/Activities

Thematic content should place emphasis on environmental factors and pollutants that directly affect life in the local community Assist students to develop the required knowledge base by providing a variety of "input" activities:

- films/videos
- field trips into the local environment
- guest speakers from local "environmentalist" groups
- interviews with local residents
- research (newspapers, magazines, booklets/ pamphlets available from various environmental agencies)

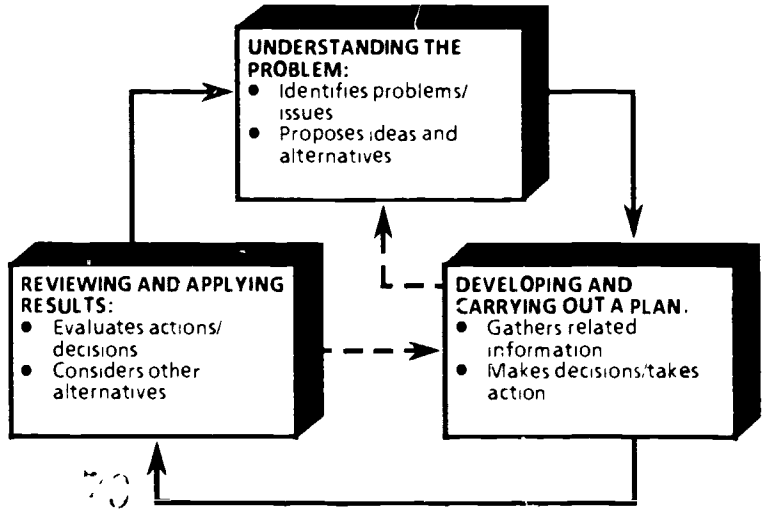
Encourage students to assimilate, organize and summarize information they gather by drawing "idea diagrams" and "semantic webs" (see *Teacher Resource Manual*) Prompt students to recall ideas through brainstorming activities and by asking appropriate chains of questions:

- Why did happen?
- What might happen if ?
- How does . cause ..?

Activities often require students to make accurate observations The attribute guides provided in the *Teacher Resource Manual* are intended to enhance student skills in making and describing observations Students should gain experience in recording their observations through a variety of methods.

- through counts/tallies
- through lists/tables/charts
- through the written word
- through sketches/diagrams
- by taking photographs/tape recordings

Identify issues and problems related to local use of environments and resources Use the decision-making model in considering factors related to the issues identified, in proposing alternatives, and in developing personal action plans



LEARNING OBJECTIVES	Related Life Skills

SKILLS:

- Selects and uses measuring instruments as required in monitoring environmental quality

- Observes and measures non-living parts of the environment that are modified as a result of human activity:
  - temperature
  - moisture
  - light
  - pH level.

- Uses appropriate strategies to gather data related to materials that are added to the environment as a result of human activity:
  - particles carried in the air
  - solid particles carried in water
  - solid wastes generated in the home

- Predicts/hypothesizes the effects that changes in non-living parts of the environment have on living parts of the environment.

- Uses inquiry skills to monitor local pollution factors (e.g., water quality, air quality, sound/noise pollution):
  - designs a plan
  - gathers and processes data
  - interprets data
  - applies data to acceptable standards

- Uses decision-making skills to analyze a local environmental issue:
  - identifies a problem/issue related to use of the environment
  - gathers and organizes information related to the environmental issue
  - considers the perspectives and points of view of different groups within the community
  - evaluates information gathered (i.e., identifies cause and effect, predicts the effects of alternative responses to the issue)
  - chooses actions/makes decisions that minimize environmental impact
  - communicates findings and decisions verbally and through written expression

Recognizes how our natural resources contribute to environmental quality. Identifies measures that can be taken to avoid waste and abuse of local natural resources

- soil
- water
- atmosphere
- minerals and fossil fuels
- forests and wildlife

Uses recycling centres

- bottle depot
- newspaper collection centres
- scrap metal dealer

Identifies household practices that will:

- reduce the production of solid wastes
- ensure safe disposal of toxic wastes
- avoid waste/maintain quality of community water supplies

Recognizes local instances of soil erosion Identifies preventative measures that can be taken against loss of local soil resources.

Recognizes methods used to dispose of garbage in the local community Considers the advantages/disadvantages of the methods being used

Identifies major sources of noise pollution in the local community Recognizes the effects of noise pollution on personal health Identifies local noise bylaws and regulations

Recognizes local regulations designed to control air pollution

- smoking restrictions
- pollution standards for automobiles
- regulations on smoke stacks

Follows local policies and controls designed to protect the environment

- fishing and hunting regulations
- accepted practices for disposing of wastes
- noise controls

Related Applications Across the Curriculum

Language Arts

Uses skills of "reporting/making notes" when gathering, recording and organizing information related to environmental investigations:

- selects suitable sources for gathering information
- makes lists
- outlines
- summarizes
- synthesizes notes
- reports

Uses skills of "discussing" when evaluating and applying the findings of investigation to personal situation

- differentiates between fact and fiction
- forms personal opinion
- permits/respects opinions of others
- recognizes that an issue can have two sides
- asserts personal opinion
- shares information

Uses the "mechanics of language" in recording information gathered and in communicating results

Applies "semantic web configurations" and/or "mind mapping strategies" in organizing concepts, understanding relationships, and recording main ideas and supporting detail

Mathematics

Uses skills of "data interpretation and display" when gathering, recording and organizing information related to the environment

- gathers and records data using tally sheets and frequency tables
- reads and interprets information provided in list/table/chart/graph form
- organizes and displays data that has been gathered in table/chart form

Uses appropriate units/tools/procedures for measuring:

- length
- mass
- capacity
- temperature

Suggested Strategies/Activities

Emphasize the use of critical thinking skills Students need to be encouraged to consider all factors and viewpoints related to a given issue, and to justify the conclusions drawn and personal action plans adopted A variety of strategies that will guide students through the process of analysis and critical thought have been provided in the *Teacher Resource Manual*

- PMI (Plus-Minus-Interesting)
- CAF (Consider All Factors)
- OPV (Other People's Views)
- C and S (Consequences and Sequels)

Many opportunities exist for the integration of thematic activities with social studies (current affairs), language arts (skills in research, reporting and discussing) and mathematics (data interpretation and display, measurement) Teachers are encouraged to conference with their colleagues in planning for instruction

Community Partnership(s)

Student investigation and research should include extensive contact with the local community and environment A variety of activities will offer opportunity for students to learn through direct observation and interview within the local community

- Invite a wildlife officer, agriculturalist or forestry official to discuss concerns related to local use of the environment
- Interview a long-time local resident who can describe ways in which pollution has changed the local environment during the last 20-50 years
- Observe land erosion by taking a field trip to an eroded area or an erosion prevention project
- Interview local officials responsible for water quality/disposal of wastes/noise control
- Visit local facilities used for water purification/sewage treatment/waste disposal
- Visit a recycling plant
- Invite local aldermen, councillors or MLA's to discuss current policy and debate relating to pollution and environmental quality

SCIENCE (I.O.P. GRADE 9)

USING CHEMICAL PRODUCTS

OVERVIEW:

Activities will focus attention on chemical substances and products that are frequently encountered by students in their everyday lives By carrying out a series of controlled experiments, students will investigate the properties and reaction patterns of familiar chemical products used in their homes Students will develop a strategy and respect for the safe handling of laboratory equipment and supplies, and should become aware of appropriate procedures for handling potentially dangerous materials that they may encounter in real life situations

ATTITUDES:

- Displays a positive attitude toward self and the study of science:
  - assumes responsibility for personal conduct
  - performs investigations and completes assignments independently and in cooperation with others
  - practises strategies for resolving interpersonal conflict
  - shows interest and curiosity through willingness to ask questions/share observations and ideas/seek answers
- Appreciates that all materials have a chemical composition of some kind
- Realizes that science and technology have contributed to the development of a variety of chemical products that we depend upon and use each day
- Realizes the usefulness of scientific inquiry skills in gathering information and explaining natural phenomena
- Displays an attitude of personal safety, and concern for the safety of fellow students when handling hazardous equipment and supplies in the laboratory
- Appreciates the potential dangers of hazardous chemical substances found at home and elsewhere in the community

LEARNING OBJECTIVES	Related Life Skills

CONCEPTS:

- Demonstrates an understanding of concepts previously developed in Grade 8:
  - recognizes properties of mixtures and solutions
  - identifies factors that affect solubility/speed of dissolving
  - distinguishes between diluted/concentrated/saturated solutions.
- Recognizes chemical and physical properties of familiar household substances.
- Identifies/distinguishes between chemical and physical change in household substances
- Recognizes that chemical substances react according to predictable patterns
- Demonstrates an understanding of acid and base substances used in the home:
  - natural properties of acids/bases
  - reactions of acids/bases with other household substances
  - their usefulness and potential dangers
- Identifies factors that affect the reaction rates of chemical products used in the home:
  - temperature
  - concentration
  - surface area
- Describes the nature of chemical changes that occur through oxidation:
  - burning
  - corrosion
- Recognizes the usefulness, as well as the potential dangers, of chemical substances/reactions used in the home.
- Demonstrates understanding of safe procedures for handling and storing potentially dangerous chemical products.

Recognizes that chemical substances are an essential part of our everyday lives
Develops an awareness of both the useful and harmful effects of reactions that occur among chemical substances present in the home.

Applies knowledge of the properties of chemical substances/mixtures/solutions in performing routine activities around the home:

- mixing cooking and baking ingredients
- using household cleaning products
- using personal hygiene products

Recognizes and uses techniques that increase/hasten solubility in practical situations

- dissolving sugar or other substances in crystal form
- removing stains

Recognizes familiar uses of acids and bases in cooking and baking/household cleaning/personal hygiene.

- sour milk and its effect on baking soda in the production of baked goods
- the use of lemon juice to dispel fish odours
- removal of stains with vinegar
- hair shampoo and rinse
- antacids for the stomach
- oven and drain cleaners
- soaps/detergents

Develops techniques for identifying acid and base substances used in the household

- acids taste sour, bases taste bitter
- acids wear away metals and cause corrosion changes
- bases feel slippery/soapy and dissolve fats and oils
- bases destroy the properties of an acid

Identifies familiar acids and bases:

- familiar acids may include citric acid, boric acid, milk, vinegar, aspirin, battery acid
- familiar bases may include milk of magnesia, lye, ammonia, baking soda, fertilizer

Related Applications Across the Curriculum

Social Studies

Identifies businesses/industries within the local community that utilize chemical products

Uses knowledge and awareness gained from current affairs in identifying current health or safety concerns related to the use of chemical solutions or mixtures in the local community

- safety in relation to the use of particular personal care/household products
- the effect of various forms of chemical pollution on environment and health

Practical Arts

Practises safe procedures for handling and storing potentially dangerous chemical substances

Interprets "hazardous product" symbols and "safety" symbols used on products found in different workplaces

Uses a variety of chemical mixtures and solutions:

- sanitizes tools, equipment and the work area
- lubricates moving parts of tools and equipment
- cooks, bakes and prepares beverages
- maintains personal hygiene through the use of soaps and shampoos
- develops negatives and prints

Appreciates that chemical reactions occur in a variety of occupations and occupational tasks when preparing and/or producing a product

Recognizes the advantages/disadvantages of using alkaline and neutral chemical substances.

- shampoos/conditioners
- soaps
- cooking ingredients
- cleaning products

Suggested Strategies/Activities

Emphasize active inquiry and involvement in the learning process by encouraging students to

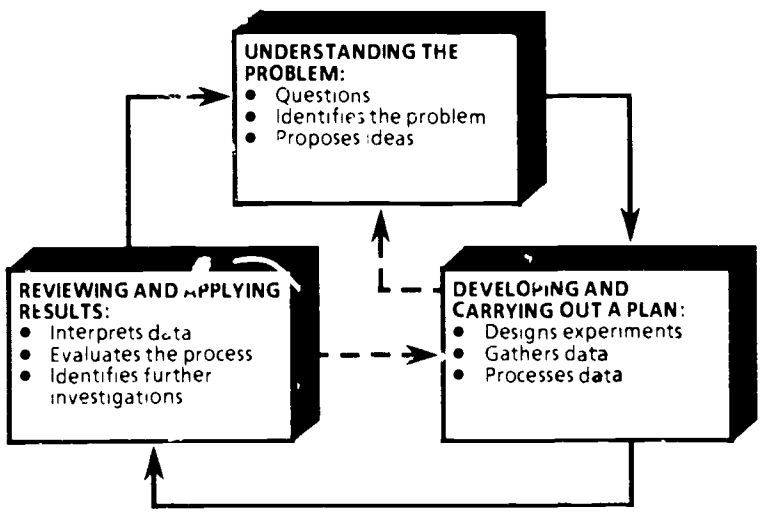
- observe, think about and discuss the chemical products and reactions encountered in real life activities each day
- observe and attempt to explain unusual reactions/discrepant events where the substances used behave in unexpected ways
- engage in dialogue and debate so they may become aware of other explanations and ways of thinking about the phenomena observed

Assist students to prepare for what they will learn, and to organize and integrate new concepts/relationships by using advance organizers and conceptual overviews that are provided in the *Teacher Resource Manual*:

- semantic webs
- skeletal outlines
- concept circles.

Develop skills and strategies appropriate to each stage of the inquiry process through direct instruction and modelling. By making students aware of the model for scientific inquiry, they will be better able to:

- relate specific skills to an overall strategy
- discuss the process being used with their peers and the teacher
- monitor and evaluate their own progress



"Talk through" an investigation to illustrate how discrete inquiry skills are used at various points throughout the model. Ask probing questions that will focus attention on elements of the situation that might otherwise be overlooked

LEARNING OBJECTIVES	Related Life Skills

SKILLS:

- Measures mass/capacity/temperature/time using units, tools and procedures that are appropriate to the task performed.

- Uses inquiry skills to investigate chemical and physical properties/changes in household substances, demonstrating ability to:
  - manipulate materials
  - accurately observe/measure
  - identify and control variables
  - hypothesize and infer relationships
  - predict reactions.

- Identifies/classifies common household substances according to chemical composition.

- Follows appropriate procedures in monitoring:
  - acid/base reactions
  - oxidation reactions
  - factors that influence the reaction rate of chemical substances.

- Demonstrates an understanding of laboratory procedure in:
  - performing simple identification tests on household substances
  - working with acids and bases
  - comparing the solubility of given substances

- Uses problem-solving skills in determining practical methods for inhibiting the corrosion of household materials:
  - identifies a problem related to corrosion
  - gathers related information/proposes possible alternatives
  - selects an alternative/builds a design
  - tests/evaluates/applies the design.

- Practises safe procedures for handling and storing laboratory/household materials that are potentially dangerous:
  - interprets hazardous product symbols
  - reads product ingredient labels
  - follows instructions for safe handling/storing
  - predicts the results/potential dangers of mixing certain products
  - identifies recovery techniques for errors in handling chemical substances.

Identifies the useful properties and active ingredients of familiar personal care products:
- toothpaste/soap
- deodorant/antiperspirant
- shampoo/hair rinse
- aspirin/milk of magnesia/antacids

Follows appropriate procedures when using chemical products
- identifies hazardous chemical symbols
- reads product ingredient labels
- follows directions for use
- recognizes antidotes/recovery techniques for errors in handling
- follows safe storage practices

Realizes the potential danger of mixing certain household products.
- bleach and drain cleaners
- ammonia and bleach
- ammonia and aluminum

Recognizes instances of slow oxidation in the environment:
- respiration
- rusting and corrosion
- spontaneous combustion
- food decay

Identifies procedures that can be used to control the rusting/corrosion of household materials:
- coating materials with paint or a lubricant
- keeping materials dry

Recognizes elements of the fire triangle, and applies knowledge of these elements in determining appropriate methods of fire control:
- fuel
- oxygen
- heat

Describes the dangers of spontaneous combustion Follows procedures that will prevent its occurrence

Identifies mixtures/solutions of chemical substances in the environment that are often the cause of pollution:
- contaminated ground water
- acid rain
- dust/smog

Related Applications Across the Curriculum

Language Arts

Recognizes the transferability of inquiry strategies developed in language arts to scientific investigations

- identifies cause and effect
- distinguishes between fact/fiction/opinion
- draws conclusions/makes inferences
- makes predictions
- summarizes

Uses skills of "giving and following directions" when planning and performing experiments

- recognizes need for sequence
- discerns when instructions must be followed exactly
- interprets verbal and written instructions
- interprets tables, diagrams, signs and symbols in order to follow instructions

Uses skills of "asking and answering" when identifying problems and formulating questions for investigation:

- probes for further information
- formulates increasingly higher levels of questions

Mathematics

Writes ratios that describe the composition of chemical mixtures and solutions. Uses ratio and proportion to determine appropriate ingredients for mixtures and solutions.

Uses appropriate units/tools/procedures for estimating and measuring:

- mass
- capacity
- time
- temperature

Uses skills of "data interpretation and display" when collecting and processing data obtained from experimentation:

- tally sheets and frequency tables
- tables/charts/graphs

Suggested Strategies/Activities

Activities in this theme provide much opportunity for enhancing interpersonal skills among students within the classroom. Experiments can be performed in group settings through the use of group problem solving. As interactive/communicative problems become evident, use a problem-solving approach to generate:

- reasons for the difficulty
- strategies to avoid the problem next time

A framework for social problem solving is provided in the *Teacher Resource Manual*.

Emphasize the safe handling of laboratory equipment and potentially dangerous chemical substances. Develop appropriate safety attitudes and procedures by

- viewing slide sets/videos/cartoons that demonstrate safe laboratory procedures
- collecting and interpreting the warning labels on familiar household products
- discussing the recovery techniques for errors in handling potentially dangerous household substances
- assembling bulletin board displays that include safety posters/hazardous chemical symbols/labels from potentially dangerous chemicals used by the student

Community Partnership(s):

- Invite a paramedic/fire chief to discuss
  - the hazards and safe handling/storage techniques for potentially dangerous products found in the home
  - methods of minimizing the occurrence of fires in the home
  - appropriate methods of extinguishing different types of fires
- Invite a local pharmacist to discuss the chemical properties/active ingredients of mixtures and solutions used in personal care products
- Invite a representative from the hair care, dry cleaning or automotives industry to discuss the chemical properties/active ingredients of mixtures and solutions used in their respective service areas
- Visit local industries and observe the use of chemical products and processes/safety precautions taken by workers
- Invite a local agriculturalist/soil expert to discuss the effects of soil acidity on plant growth, and methods of adjusting acid level in soil

SCIENCE (I.O.P. GRADE 9)

ELECTRICAL SYSTEMS IN THE HOME

OVERVIEW:

Interrelated forms of magnetism, electricity and energy are used each day in a variety of household technologies. Investigation will focus attention on the basic principles of magnetic energy, how it is related to electrical energy, and the many technological applications made of electromagnetism. Students will become aware of the inherent hazards of electricity, as well as gain experience in the actual construction and repair of simple electrical systems. Activities that demonstrate our dependence on energy systems and the need to manage our use of electrical energy will enable students to become increasingly "energy wise".

ATTITUDES:

- Displays a positive attitude toward self and the study of science:
  - assumes responsibility for personal conduct
  - performs investigations and completes assignments independently and in cooperation with others
  - practises strategies for resolving interpersonal conflict
  - shows interest and curiosity through willingness to ask questions/share observations and ideas/seek answers
- Appreciates the usefulness of technological problem-solving skills in finding solutions to practical problems.
- Demonstrates confidence in personal ability to solve practical problems
- Realizes the relationship between science and the development of familiar electrical technologies
- Appreciates the extent to which science and electrical technology have influenced and changed society.
- Develops an attitude of safety toward the use of electrical devices.
- Displays responsible attitudes toward energy consumption as it relates to personal and global needs

LEARNING OBJECTIVES	Related Life Skills

CONCEPTS:

- Demonstrates an understanding of the basic principles of:
  - static electricity
  - magnetism.
- Describes the interrelationship between magnetism and an electric current.
- Gives examples of electrical circuits, identifying:
  - the source of electricity
  - the conducting path
  - energy users along the path.
- Recognizes methods of producing electrical energy for home consumption:
  - chemical action
  - generators.
- Describes basic principles of electrical resistance, and gives examples of their application in:
  - selecting appropriate conductors
  - electrical technologies designed to produce light and heat.
- Demonstrates, through sketches/assembly construction, an understanding of basic household circuitry:
  - series and parallel circuits
  - conductors and insulators
  - switches
  - short circuits
  - safety features (e.g., grounding devices, fuses/circuit breakers).
- Relates principles of magnetism and electricity to the operation of familiar electrical technologies (e.g., doorbell, electric motor, electric toys/games, kitchen appliances, hair dryer).
- Illustrates energy flow and transformation in familiar electrical technologies.
- Recognizes hazards inherent in the use of electricity:
  - identifies potentially dangerous situations
  - predicts possible consequences of unsafe habits/routines.
- Monitors personal consumption of electrical energy in the home, recognizing strategies that will ensure its efficient use

Recognizes the effects of static electricity around the home Identifies methods of:

- controlling the production of static electricity
- protecting self and property from lightning

Recognizes everyday uses of magnets:

- compass
- magnetic screwdriver
- weather stripping.

Identifies factors that will increase/destroy magnetism in these devices

Recognizes the effect of magnetism on recording tapes and computer diskettes

Recognizes common applications of the electromagnet:

- electric motors
- automatic door openers
- buzzers and chimes
- transformers
- induction coils
- tape recorders

Follows appropriate safety precautions when using electricity:

- applies knowledge of conductors, insulators and circuits in developing safe habits and routines
- recognizes conditions that increase the danger of electrical shock
- recognizes the need for electrical grounding devices
- identifies steps to follow in the event of an electrical accident

Makes simple and safe electrical repairs to

- extension cords/appliance plugs
- battery operated toys/games

Understands the function of switches, fuses and circuit breakers in the home Replaces fuses and resets circuit breakers

Related Applications Across the Curriculum

Social Studies

Investigates the sources/uses of electrical energy in the home, community and workplace

Compares/contrasts the cost of electrical energy with the cost of alternative forms of energy

Uses knowledge and awareness gained from current affairs in recognizing electrical technologies that have been recently developed, their uses, and the dangers they may impose on human health and the environment.

Relates local sources of electrical energy to:

- natural resource base
- employment opportunities

Practical Arts

Recognizes the use of electricity as a source of energy in the home, the school, and the workplace

Appreciates the value of using electrical energy to operate

- keyboards, computers, cash registers
- power tools and equipment
- ovens, ranges, stoves
- refrigerators, freezers
- cars, motorcycles

Understands the basic principles of electrical circuits:

- constructs different types of circuits
- uses electrical meters
- records and calculates electrical measurements

Identifies safe procedures related to the operation of electrical technologies in the workplace. Interprets related safety symbols and signs

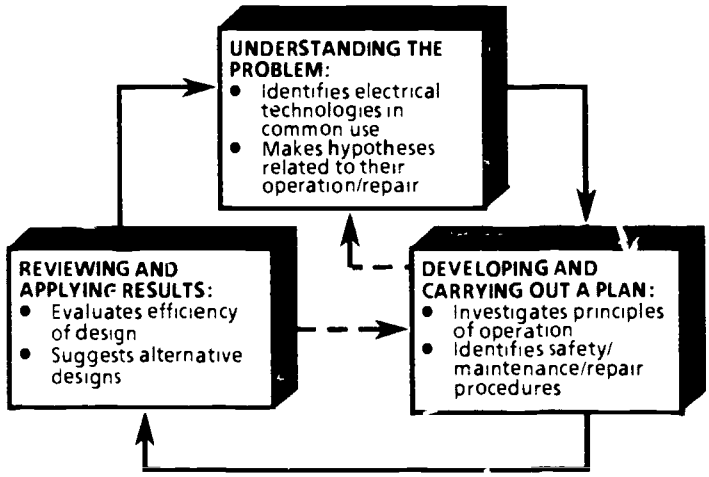
Applies knowledge of simple electrical systems in troubleshooting and repairing tools and equipment:

- constructs an electrical extension cord
- performs basic maintenance procedures on small electrical engines

Suggested Strategies/Activities

Activities should enable students to observe the nature of magnetic and electrical forces, and to relate concepts learned to electrical technologies used in the home. Model the problem-solving process, and encourage students to pose/answer questions about electrical technologies they use at home.

- How does it work?
- How do I use it?
- How might I repair it?



Initial investigations should enable students to understand the relationship between magnetism and electricity, and to recognize the components of an electrical circuit. Provide ample opportunity for students to develop concepts through manipulation and construction. Following these activities, investigate the principles governing the operation of familiar electrical technologies (e.g., doorbell, toaster). Ask students to bring old or non-functional appliances, tools, and battery operated toys/games that might be analyzed. Determine how these electrical systems work, what is wrong with them, and make repairs where possible.

Students learn by reflecting on what they have done, and will gain understanding by discussing and talking about their work. Provide opportunity for students to:

- work independently, as well as in small groups
- engage in group discussion where observations/ procedures are shared
- summarize and explain outcomes to others

Provide frequent opportunity for students to report, summarize and communicate the outcomes of investigations and discussion through informal writing activities. The process of writing enables students to sort and relate ideas, and helps the learner to internalize observations and outcomes. Strategies that will support students in their use of writing skills are provided in the *Teacher Resource Manual*.

LEARNING OBJECTIVES	Related Life Skills

SKILLS:

- Measures electrical current, using appropriate units/tools/procedures.

- Performs experiments with static electricity/ magnetism/simple electrical circuits, demonstrating ability to:
  - manipulate materials
  - follow appropriate safety precautions
  - make accurate observations
  - collect and record data
  - interpret data/draw conclusions

- Demonstrates an understanding of appropriate laboratory procedures in:
  - assembling series and parallel circuits
  - constructing a simple electromagnetic system
  - repairing a short circuit.

- Interprets/draws simple diagrams of electrical circuits.

- Analyzes familiar electromagnetic devices, identifying:
  - subsystems
  - component parts
  - energy flow/transformation.

- Applies problem-solving skills in troubleshooting electrical devices/systems containing relatively few components:
  - identifies the source of the problem
  - considers alternative approaches to a solution
  - evaluates alternatives and makes necessary repairs.

- Constructs/invents a simple electrical device intended to perform a given function.

- Performs simple calculations related to personal consumption of electrical energy, determining:
  - energy used in performing specific household tasks
  - energy costs related to the tasks performed.

Recognizes appropriate procedures for handling and storing wet cells/dry cells Installs dry cells, considering

- voltage requirements
- terminal positions.

Recognizes the beneficial and harmful effects of electrical resistance Uses this knowledge in:

- understanding the operation of electrical-thermal technologies (e g , toaster, hair dryer)
- selecting appropriate wire size/lamp size when repairing or constructing simple devices.

Distinguishes between applications of series and parallel circuits Applies this knowledge in troubleshooting simple electrical problems (e.g , Christmas lights)

Understands the household electrical system in terms of

- energy source
- method of distribution through home circuits
- energy users in the home
- safety procedures and devices (e g , grounding, fuses, circuit breakers)

Conducts an inventory of electrical energy consumption in the home

- determines which appliances use the most energy
- identifies strategies that might be effective in reducing the energy consumed by these appliances

Appreciates the variety of ways in which our daily activities depend on the use of electrical technologies

- light
- heat
- transportation
- food preparation
- personal hygiene.

Related Applications Across the Curriculum

Suggested Strategies/Activities

Language Arts

Uses skills of "comprehension" when interpreting data obtained through experimentation:

- develops technical vocabulary
- identifies cause and effect relationships
- observes sequence of events
- draws conclusions/makes inferences
- makes predictions
- summarizes
- uses visual/graphic information.

Uses skills of "giving and following directions" when planning and performing investigations:

- recognizes need for sequence
- interprets verbal and written instructions
- interprets tables, diagrams, signs and symbols in order to follow instructions.

Uses skills of "reporting/making notes" in obtaining information, processing data, and communicating results of investigation:

- selects relevant details
- outlines
- reports
- uses symbols and abbreviations

Mathematics

Uses appropriate units/tools/procedures in measuring electrical current.

Uses computational skills in determining

- personal energy consumption
- energy costs.

Develops simple formulas for determining energy consumption and costs Performs substitution into formulas in order to determine energy consumed in performing specific tasks

Uses skills of "data interpretation and display" when collecting and processing information:

- tally sheets and frequency tables
- tables/charts/graphs.

Brainstorm and debate current problems/issues related to the supply and use of electrical energy Gather information through the use of learning resources that give a current perspective on the issues/problems identified (e g , periodicals, films, videos, guest speakers). Structure discussion through semantic webs, idea diagrams and critical thinking strategies (see *Teacher Resource Manual*)

Investigate the process by which local electrical energy is produced Select activities that will enable the student to recognize:

- the use of renewable/non-renewable resources
- scientific principles/technologies that are used
- energy transformation
- environmental impact/possible alternatives.

Community Partnership(s):

- Visit local business for first-hand observation of electrical technologies in use (e.g , service station, restaurant, appliance repair shop).
- Invite an electrician/electronics repair person to discuss basic principles and applications of electrical circuitry
- Visit a construction site and note electrical circuits that have been installed prior to the drywall stage
- Visit a local power generating plant and note energy transformation/technologies in use
- Invite a representative from the local electrical utility company to discuss energy consumption/ costs/conservation in the home
- Invite a doctor/nurse to discuss hazards inherent in the use of electricity, and to identify related safety practices/emergency treatments for electrical shock.
- Invite an engineer/environmentalist to discuss issues that relate to the supply and use of electrical energy in the local area

SCIENCE (I.O.P. GRADE 9)

DIVERSITY IN LIVING THINGS

OVERVIEW:

This topic will enable students to recognize the diversity that exists among living things present in the immediate environment. Investigations will emphasize interrelationships among living things and their environment, and will develop an understanding of how organisms interact, adapt, compete and change. Activities will provide opportunity for students to design and conduct their own scientific investigations of plant and animal adaptations. Students will also acquire a knowledge of how scientific classification is used to organize and structure the diversity present in living things.

ATTITUDES:

- Displays a positive attitude toward self and the study of science:
  - assumes responsibility for personal conduct
  - performs investigations and completes assignments independently and in cooperation with others
  - practises strategies for resolving interpersonal conflict
  - shows interest and curiosity through willingness to ask questions/share observations and ideas/seek answers.
- Develops an awareness and appreciation of the diversity and interrelatedness of life forms
- Develops a sensitivity for the delicate balance among living things and their environment
- Appreciates the usefulness of scientific systems of classification
- Values the use of scientific inquiry in acquiring knowledge of natural phenomena
- Develops confidence in personal ability to conduct scientific investigations of living things.

LEARNING OBJECTIVES	Related Life Skills

CONCEPTS:

- Illustrates, through example, diversity in living things present in the immediate environment:
  - diversity in size/shape
  - diversity in physical structure.
- Identifies adaptive structures and behaviours of local organisms that enable them to survive in their environments.
- Recognizes that diversity in living things has been caused by the adaptive response of organisms to their environment.
- Recognizes that organisms may become extinct when there is lack of diversity/adaptation/ specialization.
- Explains why the features of particular species of living things change over generations through the process of natural selection.
- Affirms the need to organize living things by classifying them into groups and sub-groups according to structural characteristics.
- Displays an understanding of systems used to classify living organisms:
  - Linnaean system of classification
  - recent developments in classification.
- Describes the diverse stages/forms of life in the life cycles of organisms common to the local environment:
  - complete metamorphosis
  - incomplete metamorphosis.
- Recognizes how certain species perform diverse tasks/functions through the use of specialized structures and appendages:
  - social insects
  - human body.

Realizes that all living things interact and are dependent upon each other and their environment

Identifies plants and animals in the local community, and recognizes how they
- affect each other
- change over time.

Identifies special adaptations of plants and animals that are used for
- obtaining food
- protection
- movement

Recognizes local plants and animals that protect themselves through.
- camouflage
- mimicry

Recognizes that plant and animal species must produce offspring in order to survive
Appreciates the diverse ways in which the offspring of different plants and animals develop and reach maturity

Relates knowledge of the life cycle of insects to biological and chemical methods of control.
- mosquito
- grasshopper

Applies knowledge of the life cycle of various garden plants in determining appropriate propagation methods

Recognizes everyday uses of classification systems
- telephone book
- library organization

Recognizes natural factors that have caused changes in local populations of living things
- factors that have caused some species to decrease in number to the degree that the species has become "endangered" or "extinct"
- other factors that have caused populations of certain species to increase to the degree that the species has become overabundant and is a "pest"

Related Applications Across the Curriculum

Social Studies

Recognizes the need for tolerance and understanding in accepting human diversity

Examines human diversity within the local community

- diversity in ethnic origin
- diversity in education/training
- diversity in lifestyle/interests
- diversity in employment

Compares/contrasts human diversity between Canada and the United States

Uses knowledge and awareness gained from current affairs to identify current issues/problems related to diversity in life forms:

- natural changes in local wildlife
- new species of plants/animals developed through controlled breeding
- the effects of fires/floods/drought
- the effects of predator/pest extermination programs
- the effects of pollution and urban development

Practical Arts

Appreciates diversity among

- children and adults
- child and adolescent behaviours
- behaviours in the workplace

Recognizes and responds appropriately to the needs of others

- parents
- peers
- teachers
- community members
- employers
- infants and young children

Classifies the behaviour of children according to age and stage of development

Suggested Strategies/Activities

Ensure that investigations are relevant to students. Select activities that focus attention on

- diversity of living things in the local environment
- the structures/behaviours of familiar plants and animals

Organize classroom activity in ways that encourage students to be active participants in thinking and investigating. Provide opportunity for

- total group involvement in listening/viewing and interacting
- cooperative group work in pairs or small groups
- individual student work

An instructional model useful in fostering active involvement in thematic investigation includes the sequence of activities outlined below:

- involve students in a situation that stimulates them to ask questions and identify problems
- record questions/problems on the blackboard/ overhead
- encourage students, either individually or in groups, to suggest ideas related to the questions asked
- ask students to design a research proposal describing
  - questions/answers they are going to check on
  - how and where they will find their information
  - how long it will take them
  - what equipment they will need
- permit students to conduct an inquiry on their problem using their suggested activities. This may include
  - observation/experiment
  - consulting books
  - interviewing knowledgeable people
- provide opportunity for students to report their finding to the class. Encourage students to comment on
  - whether or not they really found out what they were trying to find out
  - possible alternative explanations
  - further investigations that might follow

Ask questions and pose statements that promote and challenge higher-level reasoning, and cause students to explore ideas they may not have considered

- "What do you mean when you say ?"
- "Tell me more about "
- "How did you think of that idea?"
- "What made you ask that question?"
- "How did you come to that conclusion?"
- "What would you do in that situation?"

LEARNING OBJECTIVES

Related Life Skills

SKILLS:

- Uses appropriate inquiry skills to gather, process and interpret information related to the adaptations/relatedness of local plants and animals:
  - observes/counts/measures
  - identifies variables
  - infers relationships
  - uses charts/tables/diagrams
  - makes predictions

- Performs a plant and animal census within a given plot in the local community, observing and inferring:
  - structural features of plants and animals
  - the adaptive value of particular structures/behaviours
  - similarities/differences in the overall structure of particular groups of plants and animals
  - environmental conditions that affect the survival and distribution of particular species

- Uses classification skills:
  - classifies materials/objects by dichotomous grouping
  - constructs/applies a dichotomous key
  - uses a classification key in identifying local plants and animals
  - classifies familiar organisms by major scientific groups (e g., kingdom, phylum).

- Follows appropriate procedures in caring for plants and animals

- Uses appropriate strategies in gathering data related to:
  - diversity in the developmental stages/life cycles of major plant and animal groups
  - diversity in the tasks performed by similar species through use of specialized structures.

- Uses decision-making skills in evaluating the effects of human action/intervention on the diversity and distribution of local plants and animals.

Recognizes local practices/activities that may affect interaction and balance among living and non-living parts of the environment.

- use of pesticides
- hunting
- pollution and waste disposal
- urban development

Recognizes why some animals have been able to survive in urban areas while others have not

Understands how new species of plants/animals have been developed through programs of controlled breeding Recognizes some of the effects of these breeding programs on plant and animal species:

- resistance to disease/adverse weather conditions
- improved quality/yield (e g , seedless grapes, dairy cows)
- aesthetic qualities (e g , ornamental shrubs, domestic pets).

Recognizes how environmental factors may influence our own personal characteristics·

- height
- weight
- intelligence

Recognizes the effect of seasonal or other sudden change on plants and animals in the local area.

- fires
- floods
- drought

Recognizes food chains/food webs that exist among wild and domestic organisms in the local area.

- plant → mouse → hawk
- plant → cow → human

Recognizes the effect of predator/pest extermination programs (e g , control of wolves/grasshoppers) on other wildlife populations

Related Applications Across the Curriculum

Language Arts

Applies "outline" and/or "semantic web" configurations to assist in organizing scientific information.

Uses skills of "comprehension" in gathering and evaluating information related to diversity in life forms:

- identifies key concepts
- discards irrelevant information
- identifies cause and effect relationships
- makes inferences and predictions
- draws conclusions
- summarizes.

Uses skills of "following directions" when performing investigations:

- discerns when instructions must be followed exactly
- interprets verbal instructions
- interprets written text that provides directions
- interprets tables in order to follow directions

Uses skills learned in "discussing" when evaluating and applying the results of investigation

- distinguishes between fact/fiction/opinion
- recognizes that an issue can have two sides
- expresses personal opinion
- permits/respects opinions of others

Mathematics

Uses appropriate units/tools/procedures in estimating and measuring:

- length
- mass
- capacity
- temperature.

Uses skills of "data interpretation and display" when gathering, recording and organizing scientific information:

- gathers and records data using tally sheets and frequency tables
- reads and interprets information provided in list/table/chart/graph form
- organizes and displays data that has been gathered in table/chart/graph form

Suggested Strategies/Activities

Many activities will require the student to gather information through observation In making observations, encourage students to.

- determine which senses can be most appropriately used
- determine which observations can be quantified (measured)
- identify similarities or differences in objects/events
- notice changes in objects/events

The attribute guides provided in the *Teacher Resource Manual* will assist students in making accurate observations Students should record their observations through a variety of methods (e g , collections, tables and charts, sketches and diagrams, photographs)

Provide opportunity for students to consider the effects of human action/intervention on the diversity and distribution of plants and animals found in the local area Guide students through the process of analysis and critical thought by using strategies provided in the *Teacher Resource Manual*:

- C and S (Consequences and Sequels)
- CAF (Consider All Factors).

Community Partnership(s):

- Visit local fields and woodlots, noting diversity and characteristics of plants and animals that are present.
- Visit a local greenhouse/nursery/pet store/zoo, noting:
  - diversity and characteristics of plants/animals
  - procedures followed in caring for plants and animals.
- Interview a local resident who can describe changes that have occurred in the diversity/ distribution of plants and animals found in the surrounding area over the last decade
- Invite a horticulturalist/veterinarian to explain how controlled breeding programs have changed the characteristics/adaptations of certain plant and animal species

SUGGESTED OPTIONS, I.O.P. GRADE 9

In situations where I O P Science 9 is offered through more than 100 hours of instruction, teachers may wish to enrich their program with the study of optional content While there is no requirement that optional content be included in the science program, two optional topics have been provided as a service to teachers

- Heat Energy in the Home
- Using Fluids

The outlines that follow will assist teachers who wish to develop these topics as optional content

HEAT ENERGY IN THE HOME

OVERVIEW:

Students will study the effects of heat energy on the behaviour of familiar objects and materials Through investigation, students will develop an understanding of the relationship between heat and temperature, observe the effects of heat and temperature on matter, and recognize different methods of heat transfer and insulation Students should recognize their dependence on heat energy, and become familiar with strategies that will ensure its efficient use in the home

ATTITUDES:

- Realizes the usefulness of scientific inquiry skills in explaining natural phenomena
- Appreciates how efficiency in design contributes to the conservation of heat energy
- Demonstrates a commitment, through discussion and personal action, to conserving heat energy in the home

CONCEPTS:

- Distinguishes between heat and temperature
- Recognizes the effects of heat and temperature on matter (i e , expansion, contraction)
- Describes methods of heat transfer (i e , conduction, convection, radiation)
- Describes the use of different types of insulating materials
- Recognizes methods of heat distribution used in the home
- Identifies major sources of heat loss in the home, and recognizes ways of minimizing heat loss according to source
- Recognizes solar energy as an important source of heat energy

SKILLS:

- Observes/measures the effects of heat and temperature on matter
- Uses models to explain heat flow by conduction, convection and radiation
- Designs and performs experiments to compare heat conduction and insulation properties of familiar materials
- Uses problem-solving skills in determining effective methods of reducing heat loss in the home
  - identifies the source of heat loss
  - considers alternative approaches to a solution
  - evaluates alternatives and makes necessary home repairs
- Designs/constructs a solar heating device

USING FLUIDS

OVERVIEW:

This topic is intended to develop an understanding of the basic principles of buoyancy and pressure, and will enable students to recognize how these principles are applied in familiar technologies. Abundant opportunity should be provided for students to observe fluid behaviour through first-hand investigation. Students might investigate familiar applications of buoyancy and floatation, as well as the principles governing the operation of simple hydraulic and pneumatic systems used around the home.

ATTITUDES:

- Appreciates the relationships between science and technology
- Appreciates the usefulness of technological problem-solving skills in finding solutions to practical problems
- Develops confidence in personal ability to understand and solve problems related to the operation of simple fluid systems

CONCEPTS:

- Demonstrates an understanding of basic concepts related to mass, volume and density
- Demonstrates an understanding of basic concepts related to force, area and pressure
- Describes the nature of forces exerted by fluids
- Demonstrates an understanding of the principles of buoyancy and floatation
- Illustrates, by relating to real life experiences, the effects of water pressure and air pressure on our everyday activities
- Recognizes technological applications of fluid pressure and buoyancy
  - ship design
  - hydraulic systems
  - pneumatic systems

SKILLS:

- Uses appropriate units/tools/procedures for measuring
  - mass, volume and density
  - force, area and pressure
- Compares the densities of familiar fluids
- Identifies and controls variables affecting pressure in fluids
- Uses problem-solving skills in troubleshooting familiar fluid technologies containing relatively few components
  - identifies the source of the problem
  - considers alternative approaches to a solution
  - evaluates alternatives and makes necessary repairs
- Designs/constructs simple fluid technologies intended to perform a given function