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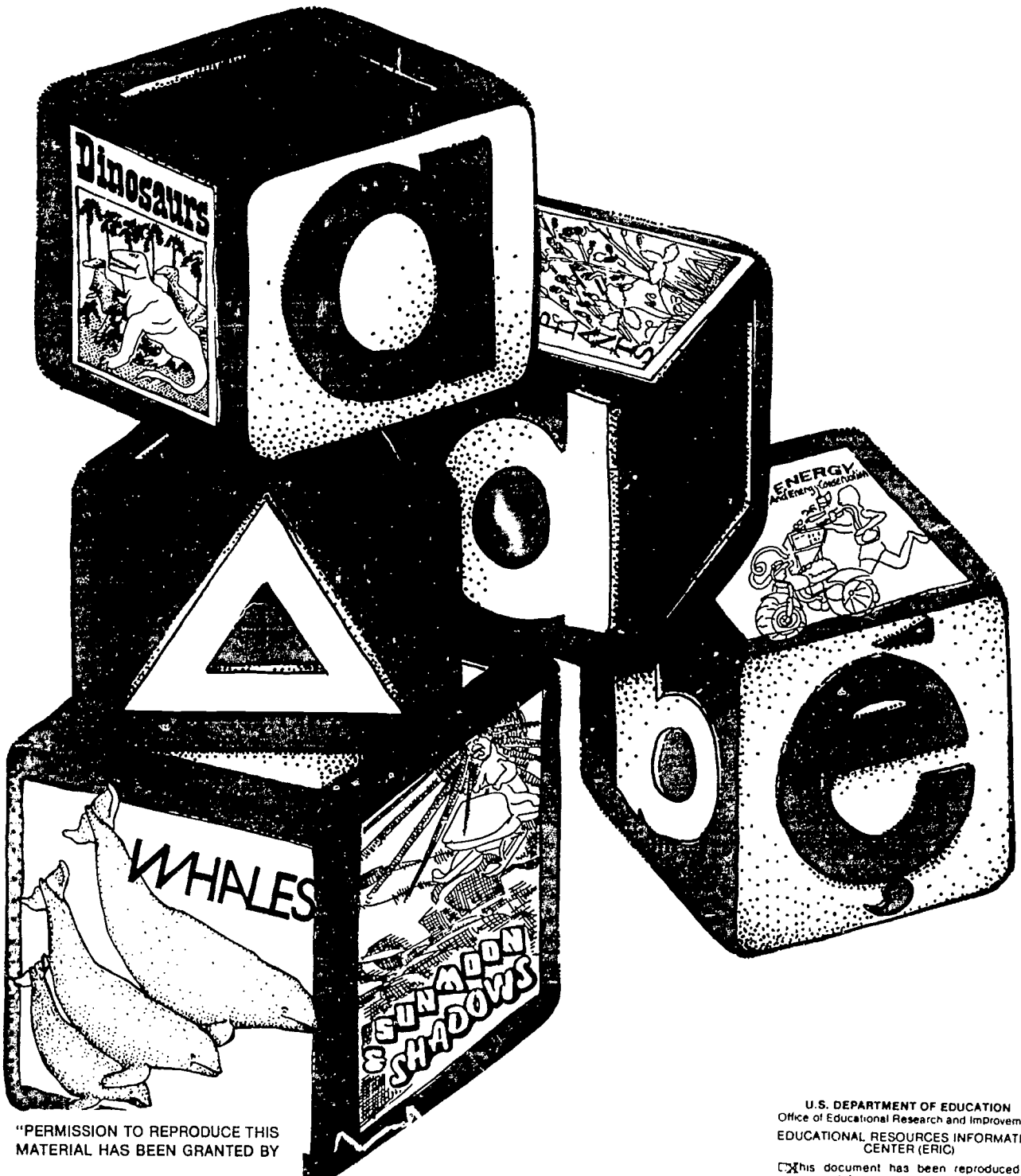
ABSTRACT

As the world becomes more complex and the rate of change increases, Canadian students need more and better science education increases, Canadian students need more and better science education to prepare them for the future. This book provides a framework for building scientific concepts and developing the learning of process skills for grades 1 to 3 in the Northwest Territories. The major sections include: (1) Science--A Verb, Not a Noun; (2) Goals of the Elementary Science Program; (3) Elementary Science Program Elements (process skills, psychomotor skills, attitudes, and science concepts); (4) Program Structure (format, time allotments, grade specific objectives, and learning resources); (5) Approaches to the Teaching of Science (language development (LD) approach to teaching science, how to develop a LD unit, LD framework, how to plan LD lessons, possible sequences using this approach, and inquiry approach); (6) evaluation (concepts related to grades one, two, and three, evaluating the process skills, attitudes and behaviors, and performance with manipulative materials, checking the growth of inquiry process); (7) scope and sequence (correlation of grades one, two, and three units to various resource materials, suggested sequence using LD approach; (8) Primary Science Program Details; and (9) Appendix (classroom organization and management, safety in science, reporting and research skills, effective questioning technique, plant and animal care, use of Systeme Internationale (SI)--the metric system, Systeme Internationale equipment list, a list publishers/distributor, and a list of suppliers). (PR/CW)

ELEMENTARY SCIENCE
Primary Program Guide



Foreword

Tomorrow's citizens and decision makers are in school today. They are receiving the education they will need for the 1990's and beyond. As the rate of change increases and the world becomes ever more complex, Canadian students need more and better science education to prepare them for the future.

In learning about the environment, one must consider the influence of man; in learning about the altering of nature's plan, one must consider the effect of this action on society and on the individual; in learning about advanced technology, one must consider lifestyle.

We must come to understand the connection between **science and culture** (the contribution that science makes to society and to the world of ideas); **science and citizenship** (the utilization of scientific developments and their technological applications); **science and the world of work** (the use to which science and technology are put in specific industrial, commercial and social situations); **science and leisure** (science and technology provide a basis for a wide range of leisure activities and pursuits as well as freeing up our time to enjoy leisure activities); **science and survival** (as related to self sufficiency, the careful use of our resources and the implications of alternative technologies).

The **Elementary Science Program** provides a framework for building scientific concepts and developing the learning of process skills. The goal of scientific literacy can be achieved through the delivery of a balanced curriculum which extends the learning to the humanistic sphere in a manner relevant to the students.

Acknowledgements

The N.W.T. Department of Education acknowledges the contribution of the people who assisted so ably in the revision process and in the preparation and development of the Elementary Science Program.

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Don Kindt, Program Specialist for Sciences, was responsible for the development of this publication.

Table Of Contents

Science — A Verb, Not A Noun

Science is curiosity, wonderment and appreciation. It is exploration and discovery, comparison and classification, making and recording observations so that facts can be assimilated and placed in the proper framework of understanding.

Science is examining, questioning, speculating, testing, experimenting.

Science is continual searching for meaning and significance. It is ceaseless effort to discover interrelationships and interdependencies, causes and effects, and the patterns that bind all things and experiences together.

Science is checking and rechecking previous explanations and solutions, either to establish and strengthen their validity or to discover their weaknesses so that newer and better insights and solutions may be developed.

Science is persistent thoughtful effort to analyze one's knowledge, to recognize the components of things observed, to learn how these may be separated and reconstituted for use in new situations.

Science is making interpretations, applying ideas, and using theories, principles, and natural laws to answer questions and to solve problems.

Science is the utilizing of acquired knowledge in areas of human need to improve present conditions and to plan for the future.

We are constantly being reminded of the role of science in our daily lives. Cosmos 954 flashed across the Northern Sky spreading radioactive particles in its wake. Issues such as Cruise missiles, recombinant DNA, and in vitro fertilization are constantly making headlines in the news. Dr. David Suzuki seeks to unravel the mysteries of science to the layman. People share a strange fascination with astrologers, numerologists, psychics and magicians.

The pace of development in the scientific and technological fields overwhelms the individual and results in a "leave it to the experts" attitude. As educators, we are obliged to ensure that children acquire the fundamental scientific concepts and processes with which they can interpret the world around them.

Final steps are underway to clear the last known bits of debris from the downed Russian satellite, Cosmos 954, from Canadian territory.

However, Canadian Forces Hercules are still covering the survey area and metering for radioactive materials. Cpt. Greg Hogan says they will continue to do so until it is confirmed there are no more pieces of the satellite in the Northwest Territories.

But the main activity area now is near Warden's Grove in the Thelon Game Sanctuary, where the largest section of the satellite came down on the doorstep of six men involved in "co-habitating with Canada's wilderness".

On Sunday, Feb. 5, the Canadian Forces dropped a bulldozer near the impact area to clear a land strip capable of handling military aircraft. Up until now helicopters have been used to get in and out of the site.

The aircraft will be taking in the equipment necessary to set up a tent city about eight miles from the impact area. The city will be the home for 25 to 30 men until clean-up operations have been completed.

Monday, Feb. 6, a Twin Otter was sent with a nuclear response team to do the final cleanup work at a site near Fort Reliance, referred to by the military as "hit one". The surface snow in the area was also scraped off and brought to Yellowknife for shipment to Edmonton.

These trends advocate a science curriculum which:

1. progresses in scope and sequence from grade one to grade twelve.
2. uses the resources of the community and outside materials to understand the environment.
3. emphasizes scientific principles, rather than just factual subject matter.
4. encourages scientific literacy and understanding of the concepts of science at the level of comprehension of the learner.
5. teaches the strategy of inquiry and the processes of science to enable students to investigate their environment.
6. develops independent learning skills which will help young people to adapt to a rapidly changing world.

Historically, science may be viewed as the process by which man attempts to interpret, to live effectively within, and to manage his environment. The young child is, in his own way, engaged in the same process; his activities are naturally, though crudely, scientific. It is the genesis of this scientific attitude with which we are concerned in the elementary program.

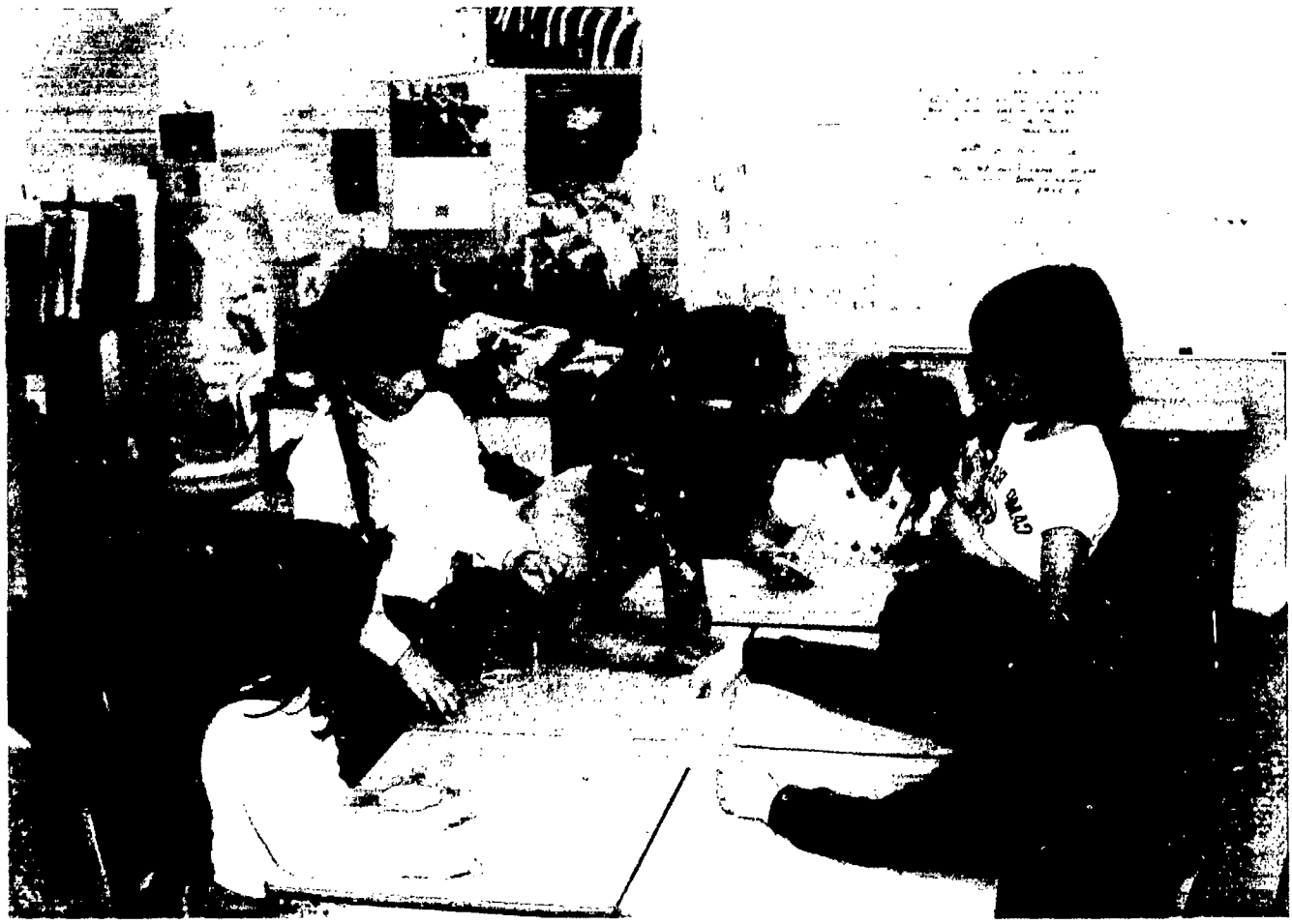
At present, our children's environment is rapidly changing. Survival skills must be developed. A "conserver" society must be promoted.

Goals of the Elementary Science Program

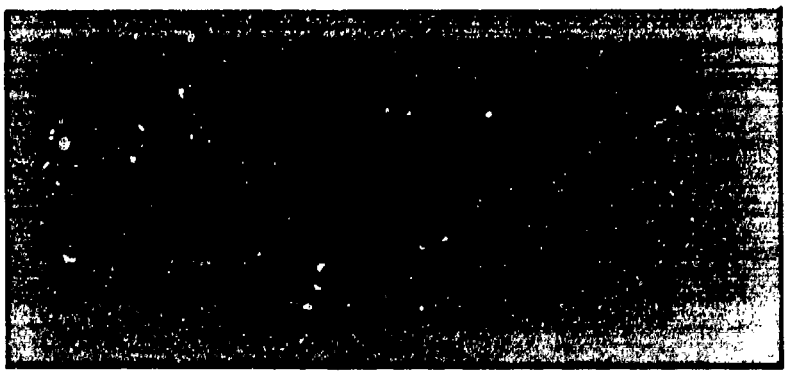
The Elementary Science Program reflects these needs by encouraging each student to develop a scientific attitude and process skills, to practise the scientific method, and to acquire and integrate functional information. It is the responsibility of the teacher to emphasize neatness, accuracy and safety in the quest to achieve the stated goals.

The Program Advocates

1. The development of appropriate science attitudes: curiosity, objectivity and a willingness to suspend judgement.
2. The development of process skills appropriate to the level of the learner.
3. A sequential development of content (scientific knowledge) within the following conceptual framework.
   a. Life and Environment
   b. Matter and Energy
   c. Earth, Space, and Time
4. The development of effective communication skills — questioning, discussing, reading, writing and researching through science activities.
5. The acquisition of manipulative skills necessary for the safe handling of organisms, materials, and apparatus used in the development of process skills.
6. The promotion of a continuing interest in science and a continuing awareness of and understanding for one's environment with positive user attitudes.
7. The development of an appreciation for the interdependence of the scientific and humanistic streams of learning.
8. The development of skills necessary for social interaction.
9. The development of an understanding of the interplay between (1) science and technology and (2) vocational knowledge and skill.



Elementary Science Program Elements



Process Skills

Process skills are intellectual skills which are developed and used in both science and other areas of study. When children experiment with materials and examine ideas, both processes and concepts are being used. Observation and classification skills are important to the development of more complex processes such as interpreting data, and are therefore classified as basic processes. Experimenting and controlling variables are termed integrated processes and are learned by children at the later concrete and formal operational stages.

The basic processes are gradually developed from Kindergarten through Grade six. The integrated processes are stressed once the children begin to develop formal reasoning. In many cases, the processes are interdependent. For example:

observing includes identifying
classifying includes comparing and ordering
communicating includes describing and graphing
controlling variables includes the preliminary stage of identifying variables

The following process skills are dealt with in detail in the section on Inquiry.

Observing	Classifying
Communicating	Inferring
Predicting	Measuring
Defining Operationally	Interpreting Data
Controlling Variables	Formulating Models
Formulating Hypotheses	Experimenting

The Grade 1-3 level should deal primarily with the process skills of observing, classifying, communicating, inferring, predicting and measuring.

At the Grade 4-6 level we add to the above, the skills of defining operationally, interpreting data, controlling variables, formulating models, formulating hypotheses and experimenting.

Correlation of Units to Process Skills Being Developed at the Grade 1, 2, 3 Level.

Contents	Observing	Classifying	Communicating	Inferring	Measuring	Predicting	Defining Operationally	Controlling Variables	Interpreting Data	Formulating Hypotheses	Formulating Models	Experimenting
Living and Non-Living Objects	●	●	●	●	●							
Ourselves	●	●	●	●	●							
Properties of Materials and Change	●	●	●	●	●	●						●
Energy and Energy Conservation	●	●	●	●	●	●						●
Comparing and Measuring	●	●	●	●	●	●						
Properties of Living Objects	●	●	●	●	●	●		●				●
Properties of Matter	●	●	●	●	●	●		●				●
Energy and Energy Conservation	●	●	●	●	●	●		●				●
Measuring Time	●	●	●	●	●	●		●				●
Measuring Objects	●	●	●	●	●	●						
Populations	●	●	●	●	●	●						
Energy, Heat and Temperature	●	●	●	●	●	●		●	●			●
Changes in Matter	●	●	●	●	●	●		●	●			●
Energy and Energy Conservation	●	●	●	●	●	●						
Air and Air Pressure	●	●	●	●	●	●			●			●
Sun, Moon and Shadows	●	●	●	●	●	●		●	●			●

Psychomotor Skills

Psychomotor skills are skills which involve a co-ordination between the intellect and muscular movement. In the science program, students develop psychomotor skills through:

a. handling and manipulating a variety of materials such as water, magnets, minerals, rocks, living things, etc.
b. specific movements requiring careful hand and eye co-ordination (eg. measuring activities using balances, metre sticks, graduated cylinders and thermometers).
c. movement of large muscles eg. feeling object for texture, picking up large objects for examination, judging the mass of an object by holding it in one's hand.

It is important that the psychomotor activity be geared to the level of development of the student.

Attitudes and Behaviour

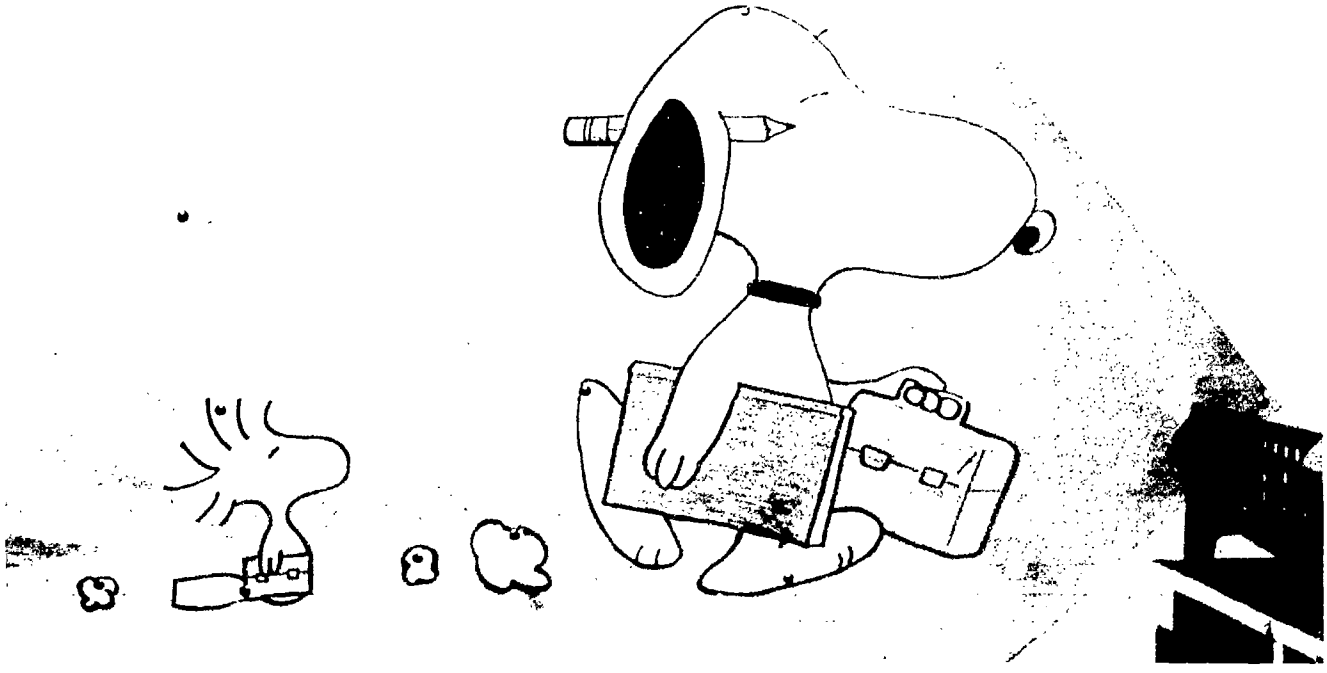
An attitude can be defined as a state of mind, behaviour or conduct regarding some matter, as indicating opinion or purpose.

One of the goals of the Elementary Science Program is to foster within the student appropriate science attitudes. Informal evaluation methods which can be used to determine the presence or absence of particular behaviours are essential. They are however, the most difficult to devise. The most practical approach is for the teacher to be conscious of the expected behaviour and to make a subjective evaluation.

The following attitudes are ones which may be fostered through the science program.

- curiosity
- openness
- reality orientation
- risk-taking
- objectivity
- precision
- confidence
- perseverance
- satisfaction
- respect
- responsibility
- consensus & collaboration

A more detailed evaluation of attitudes and their attendant behaviour indicators can be found in the evaluation section of this guide.



The following checklist is to familiarize the teacher with behaviours which reflect growth in the cognitive domain.

Checking the Growth of Scientific Attitudes

1. Shows willingness to have ideas questioned.
2. Modifies views in the face of new evidence.
3. Shows a disposition not to form hasty conclusions.
4. Looks upon guesses and hypotheses as ideas to be tested.
5. Shows respect for the ideas of others.
6. Seeks data and information to validate observations or explanations.
7. Exhibits a healthy skepticism for generalizations not based on verifiable (repeatable) observations.
8. Questions conclusions based on incomplete data.

Science Concepts

The Elementary Science Program is divided into two divisions — the Primary Science Program and the Intermediate Science Program.

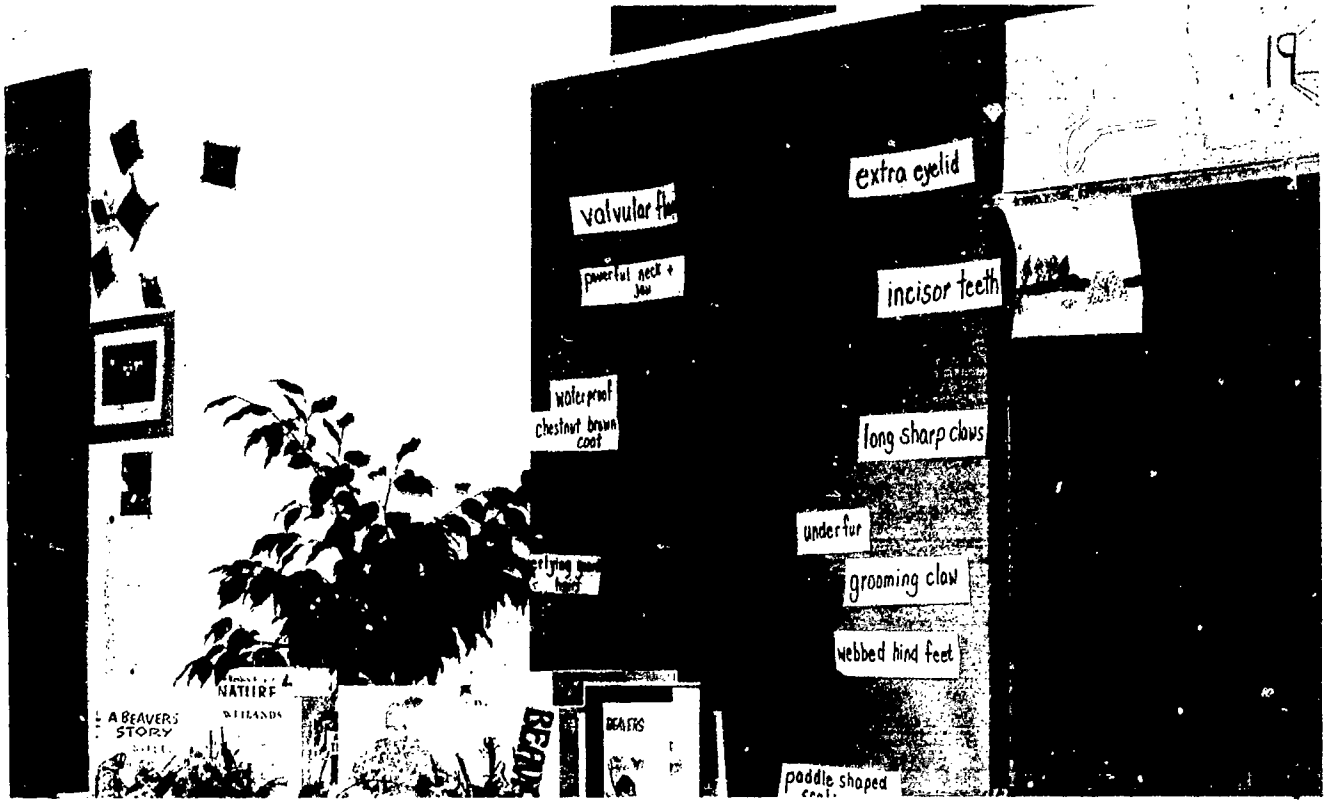
Both the Primary and the Intermediate Science Programs of Study focus upon three major concept areas:

a. Matter and Energy
b. Life and the Environment
c. Earth, Space and Time

The students will have an opportunity to develop an understanding of the concepts in life sciences, physical sciences and earth-space sciences.

The developmental level of the student must be a prime consideration when presenting concepts that are of an abstract nature.

Many of the concepts introduced in the elementary science program are further developed in the junior high (Middle Years) program. It is at this level where concepts can be dealt with in a more abstract or complex manner.



Format
Recommended Minimum Time
Allotments
Grade Specific Objectives
Learning Resources

Format

Both the Primary and Intermediate Science Programs follow an 80%-20% core to elective format. Approximately 80% of the allotted time should be spent on the core topics. At the Primary level, the teacher may spend the entire time allocation on the core portion of the course if he/she feels the situation warrants it, or he/she may spend 20% of the time on locally designed units. At the Intermediate level, the 20% may be spent on either the designated elective units or locally developed and approved units.

A correlation of topics to various resources and to the process skills has been included at each grade level. As well, a detailed program outline with concepts to be taught, objectives covered and possible teaching strategies to be employed has been provided.

Recommended Minimum Time Allotment

The chart below shows the suggested time allotments for the elementary science program by grade:

Grades 1, 2, 3	150 minutes per week
Grades 4, 5, 6	150 minutes per week

Grade Specific Objectives

The program of studies for Elementary Science defines the skills, content and objectives to be developed at the end of each grade level.

Learning Resources

Recommended Resources

1) Language Development Units for Grades 1-3 (1985) Department of Education

2) Addision-Wesley Science, Rockcastle, et al., Addison-Wesley Ltd. 1984

Additional Resources

MacDonald 5/13 Science,
Richards et al., GLC Publishers Ltd. 1973-76

Examining Your Environment,
Wentworth et al., Holt, Rinehart and Winston. 1976-77

Elementary Science Study (ESS),
Education Development Center, McGraw Hill Ryerson. 1967-1975

Energy Literacy Series Grades 1-6,
S.R.A. Publishers, SEEDS Foundation.

Science On A Shoestring,
Addison-Wesley Publishers, Box 580, Don Mills, Ontario.

Invitations To Science Inquiry,
Dr. Tik Liem, St. Francis Xavier University, Antigonish, Nova Scotia.

Animal Care From Protozoa To Small Mammals,
Addison-Wesley Publishers.

Winter Investigations,
Enviro-Concerns Publisher, Box 131, St. James Postal Stn., Winnipeg, Manitoba.

Unesco Source Book For Science Teaching,
Renouf Publishing Co. Ltd., 2182 St. Catherine St. West Montreal, Quebec.

Approaches To The Teaching of Science

Introduction
Language Development Approach
Inquiry Approach

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Introduction

The Elementary Science Program identifies three major components (levels of responsibility) for a successful science program.

1. The student should
   a. develop a science attitude.
   b. develop the process skills.
   c. practise the scientific method.
   d. acquire functional knowledge.
   e. develop language skills.

2. The teacher should
   a. encourage students to meet these responsibilities.
   b. emphasize neatness, accuracy and safety.
   c. stress the interdependence of the streams of learning.

3. The program should
   a. provide scope and sequence.
   b. provide suggested activities.
   c. provide for two teaching approaches.

These are not isolated components — a successful blending of the identified responsibilities can be achieved through a variety of means. Two approaches to teaching science are described — the Language Development Approach and the Inquiry Approach. The Language Development Approach is recommended at both the Grade 1-3 level and the Grade 4-6 level. Units have been developed for use in the implementation of this approach.

In a situation where the language of instruction is not the first language of the student, it is recommended that the teacher employ the Language Development Approach.

In a situation where the language of instruction is the first language of the student, the Language Development Approach is also recommended, however, the teacher may also choose to use a more traditional approach in this situation, (inquiry/experiential). The recommended resource for this alternative approach is the Addison-Wesley Science Series. It should be noted that the Language Development Approach includes some inquiry process, but due to its nature, the emphasis is on vocabulary and sentence patterns associated with the science concepts. A number of other materials are listed as supplementary resource references. They should be used for "ideas" rather than as prescriptive courses in themselves. The following suggestions should be considered.

Motivation

Motivation is not the same as external stimulation but something generated within the child himself. Children have a basic urge to explore and find answers to their own questions and they carry on the activities with great persistence. They are challenged by ideas that are different from the information that they already have.

The young experimenter needs fuel for motivation through leading, thought provoking questions, by seeing a variety of the interesting realities in his environment that invite his exploration, and by experiencing/feeling a warm and encouraging climate developed by effective adult guidance. Children who have not experienced this need patience and help from the teacher.

Any child may show some reluctance in pursuing his own "exploration" if he has been conditioned to passive learning approaches. Moreover, for some children, their reluctance "to try things on their own" can be compounded by a hesitancy to ask questions — their cultural background may suggest to them that to ask a lot of questions of an adult is unacceptable.

Community

The local environment should not be overlooked as a potential "science laboratory". The relative closeness of science problems (erosion, pollution, conservation, etc.) can be useful stimulators, and more importantly, can demonstrate the relevance of science to the community and its development.

In most communities there are many excellent resource people who should be invited to participate in the program: game management officer, nursing staff, seismic crews, hunters, trappers, research workers, parents or other adults.

The program must also be sensitive to and attempt to address the various cultural attitudes, values and beliefs as they relate to science.

N.W.T. Schools Need a Language Development Approach to the Teaching of Science

Language of Instruction

Students in the Northwest Territories come to school understanding and speaking a number of different languages.

Where appropriate, where possible and where it is mandated by parents and/or LEA's, students should be instructed in Science classes in the language in which they are most proficient.

In some communities, students are not proficient in their first language, the parents do not want instruction in the first language, or staff, programs and materials are not available in the first language. In those situations, schools instruct Science classes in English. Because students in those communities may not be proficient in the standard English used to teach the curriculum, Science teachers must take the time and make the effort to teach students the language required to talk, read and write about Science concepts. Success in the Science program is not possible otherwise.

Language Development Approach To Teaching Science

What is the Purpose of the Language Development Approach?

The purpose of the Language Development Approach is to provide students with the vocabulary and sentence patterns necessary to talk about school curriculum. A related aim is to help students develop their thinking skills and to use the language of instruction for a variety of purposes: to imagine, to investigate, to explain, to describe, to question, etc.

A second purpose of the approach is to help students learn the vocabulary and sentence patterns required to communicate in various social situations. It provides them with opportunities to learn to use language to satisfy material needs, to regulate behaviour, and to establish and define social behaviour.

What Are The Expectations Regarding The Use Of This Approach and Accompanying Units?

The Department of Education has determined that this approach is suitable in meeting the needs of students in the N.W.T. who speak the language of instruction as a second language or dialect. If adequate mastery of the language of instruction is absent, it is the responsibility of teachers of all subjects at all levels to teach it. Language Development Units have been developed at the Grade 1-3 level. Both the Primary and Intermediate Science Guides address the manner in which units and lessons are prepared using this approach. It is intended that the Language Development Approach be stressed at both the Primary and Intermediate levels. The Inquiry Approach can be integrated within both levels with greater emphasis during the Intermediate grades.

Principles of the Language Development Approach

The Language Development Approach has been chosen as the recommended teaching approach to science education in the N.W.T. Elementary Science Program due to the diverse language needs of the school population in the N.W.T. The Language Development Approach to teaching science draws on elements of many of the approaches to second language teaching. The choice of useful teaching ideas and practises has not been haphazard or indiscriminate, rather, it has drawn extensively on traditional and contemporary practice in second language teaching and general Language Arts to form a broad set of principles on which the suggested classroom practices are based. In brief, the principles include the following:

1. Students need to have their experiences, skills, knowledge, and particularly, the language they bring to school identified and used as the basis for the school language program.

   This means the Science Program should relate new concepts to the students' past experiences, previous knowledge, and immediate environment. In other words, teachers must take into consideration where the students are coming from (cultural attitudes) and their understandings of various concepts.

2. Students need to learn to articulate for themselves and to communicate their thoughts, feelings, needs, opinions, and intentions for a variety of purposes in many different communication contexts. They need to be able to understand, learn from and respond to the communication of others. This involves being able to:
   - express/inquire about personal needs, desires, feelings, attitudes, etc.
   - socialize.
   - direct the actions of the self and the actions of others.
   - impart and seek factual information on past and present experiences.
   - reason logically.
   - make and express predictions.
   - project into the experiences, feelings, and reactions of others.

   The Science program should involve students in a variety of activities which require them to use language in all these ways. Traditional paper and pencil exercises must be extended to include graphing, interviewing, reporting, discussing, etc.

3. Students need to learn language to communicate, but they also use language to learn. Therefore, language should be taught across the curriculum.

   Science programs should teach second language students the language they require to learn about new concepts. Success in Science is not possible otherwise. This may mean teachers cannot cover all concepts for all topics. It is preferable to cover some concepts for all topics rather than omitting some topics altogether.

4. Second language students need to spend more time learning to communicate in the language of instruction than they do learning about the language of instruction.

   The time spent in Science teaching students language should be devoted to introducing, practicing, and applying the vocabulary and sentence patterns students require to talk, read, and write about a concept.

5. Students need to learn language that is meaningful. It is easiest to accomplish this when teaching language in a context. Without adequate concept development, the language students learn is either vague or devoid of meaning.

   Science programs should take the time to ensure that students learning new concepts have enough first hand or indirect experiences with the concepts to understand them clearly. There is no point in students' studying material they don't understand.

6. Students need to learn to develop their thinking skills and to engage in more abstract levels of thought as they mature. They must learn the language that allows them to express their thinking about concepts. Initially, they need to learn the concrete vocabulary and functional sentence patterns which enable them to recall, match, sequence, classify, etc. Eventually they need to learn more complex sentence patterns so that they can generalize, analyze, hypothesize, imagine, predict and evaluate.

   Science programs for primary students should concentrate on teaching and using concrete thinking skills. Science programs for older students should introduce more abstract thinking skills as students can handle them.

7. Students need to participate in language activities that integrate the language strands of listening, speaking, reading and writing. Specific skills taught vary with the proficiency level of the student. Reading and writing activities should use language which students have internalized. Strong oral proficiency is a prerequisite to reading. The successful reader relies on three cue systems:
   - a storehouse of vocabulary (semantic associational cue system)
   - a sense of how the linguistic system works (syntactic cue system)
   - a sense of how the words sound and interact (grapho-phonemic cue system).

   The language activities included in Science programs should focus on the first two cue systems. Students who cannot talk about a concept will have difficulty reading and writing about it.

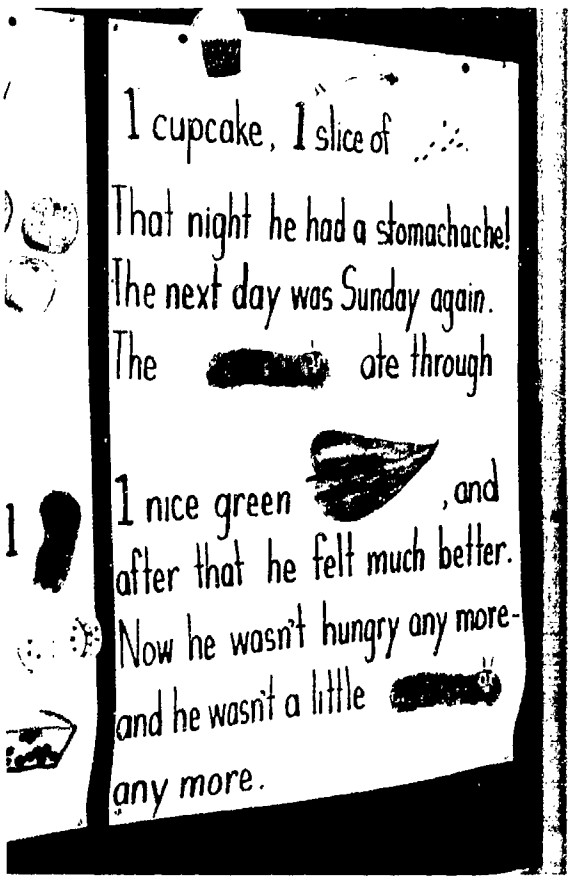
8. Students need to learn "real" language and how to use it in the natural situations in which it is required.

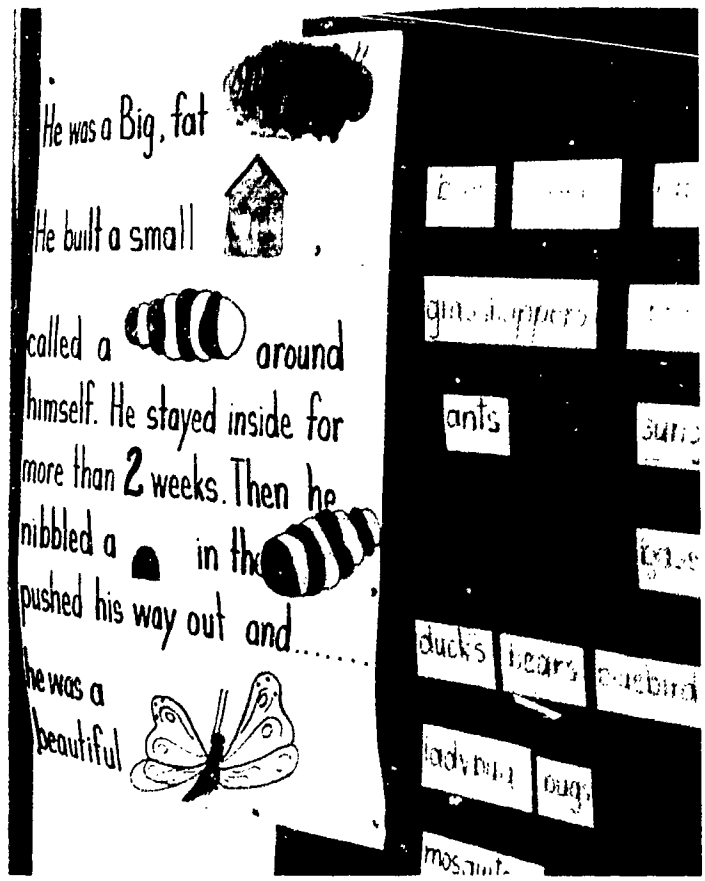
   The language included in Science programs should be as close as possible to the everyday vocabulary and sentence patterns people actually use to talk or write about a concept. Students need to get into the community to use the language they are learning with people outside the classroom.

Program content, classroom organization and teaching techniques used to develop concepts and skills should:

- reflect all of the above principles
- vary according to:
- the language proficiency of the students in the first and second language
- cultural background (experiences, interests and cognitive abilities)
- age/grade levels
- type of topic
- learning style of students
- materials and equipment available
- teaching style of teacher

These principles hold whether English is the first or second language of the students. The difference lies in the method and techniques used. The Language Development Approach allows flexibility in choosing specific classroom practices and techniques to meet the varied language needs of the students.



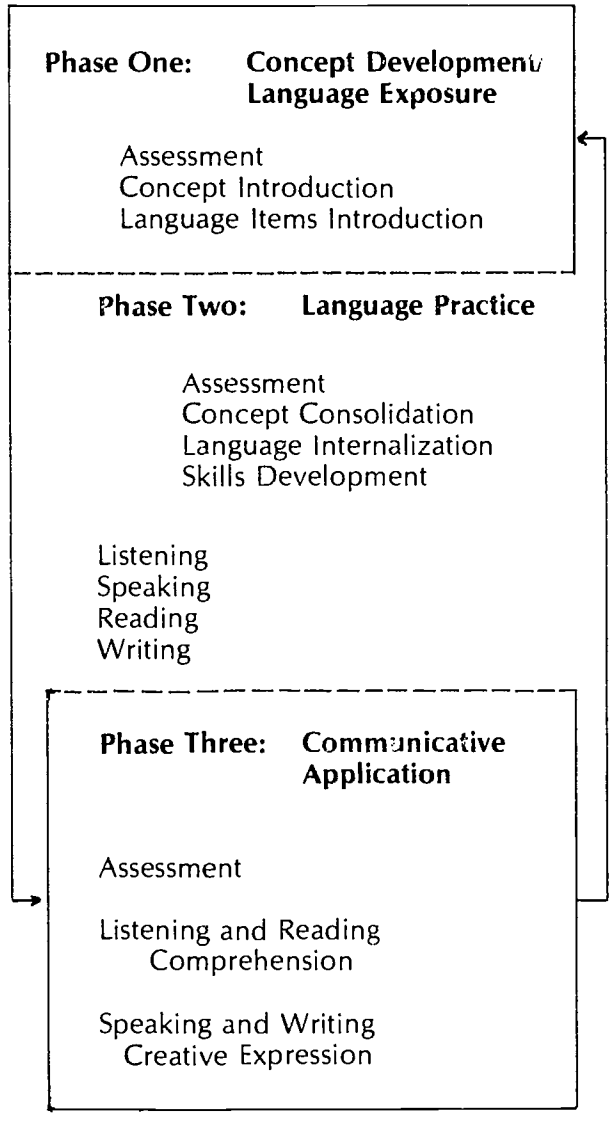


How to Develop A Language Development Unit

1. **Identify** the topic of study from the Science Curriculum.
   Optional: Identify other situations that may be related to the topic of study (local culture, areas of interest, social situations).
2. **Determine** the key concepts and subconcepts for the topic. Use brainstorming, semantic mapping, or content diagramming to outline knowledge for your own reference. For more details on these three techniques, see the Language Development E.S.L./E.S.D. Guide published by the Dept. of Education.
3. **Predict** what background experiences students already possess that you can relate to the concept and subconcepts of the topic
   — through observing the activities in the community in which students engage.
   — through determining previous school experiences students have had with respect to the topic.
4. **Determine** what materials and resources are available in the school and community to teach the key concepts and subconcepts.
5. **Brainstorm** techniques and activities that you can use to teach the concepts and subconcepts of the unit. Keep in mind the cognitive maturity, proficiency level, and background experiences of the students in the class.
6. **Brainstorm** the language items (vocabulary, sentence patterns and discourse patterns) that students need to know in order to understand and discuss the concepts and subconcepts of the topic.
7. **Determine** other language items students may need to know in order to carry out the activities.
   For example, if students are using a microscope for a science activity, they should learn the word "microscope" as well as the labels for other key parts of the microscope so that they can follow directions with ease, or ask questions about its operation.
8. **Predict** which of brainstormed list of language items students already know. Predict language items students have in their linguistic storehouses that you can use to introduce the concept-specific language.
9. **Plan** an initial assessment activity that identifies which concepts and what language items students already have for the topic.
10. **Plan** specific lessons to teach key concepts, subconcepts and associated language.
11. **Plan** culminating activities which provide students with opportunities to use knowledge and language learned throughout the unit. These can be sharing sessions with other classes, parents or community members.
12. **Plan** activities that evaluate student progress; these should determine what they have learned from the unit in terms of concepts and language items.

Intellectual Skills

Perceiving
Recalling
Matching
Sequencing
Classifying
Comparing/
Contrasting
Generalizing
Inferring
Predicting
Interpreting
Hypothesizing
Imagining
Applying
Analyzing
Synthesizing
Evaluating



How To Plan Language Development Lessons

Plan specific lessons to teach key concepts and subconcepts using the Language Development Framework.

Concept Development/Language Exposure Activities

Choose concept development activities that help students relate previous knowlege to the topic of study or fill gaps in that knowledge. These activities should involve direct, first-hand, active learning with concrete materials as much as possible. Where necessary, indirect experiences (films, filmstrips, pictures, etc.) allow students to move beyond the confines of the immediate classroom to explore concepts associated with other times and places.

While students learn about the concepts, activities should also introduce them to new language items that express the concepts. They should learn to associate new vocabulary with relevant objects or actions and to express the relationships among concepts with appropriate sentence patterns.

Language Practice Activities

In this part of the lesson, students use the new language items introduced in concept development activities in a variety of activities that develop listening, speaking, reading, and writing skills. Through intensive practice of items in a variety of ways, students come to "own" the new language, i.e., commit it to memory so that it becomes part of their permanent storehouse of language items. These activities should also strengthen the bond developed between the new concepts and the language items that represent those concepts. While the whole class may participate in most of the concept development activities, it is important to group students for language practice according to their language skills and needs. During these group activities you can assess how well students are mastering new language items.

Communicative Application

The final phase of the lesson sequence includes opportunities for students to use their acquired knowledge and language to communicate in a variety of situations. Students show they have understood the new concepts and can use the new language items by interacting with others. Activities involve students in listening, speaking, reading, and writing to solve problems, bridge an information gap, share information, complete a task, develop an arts and crafts project, or share a finished product. These activities provide students with an opportunity to explore related concepts and language, eventually coming full circle to new concept development and language exposure. While carrying out these activities, the teacher can work individually with students to assess the extent to which they have mastered the concepts and language from the lesson.

Intellectual Skills

An essential component of the framework is the development of intellectual skills. Learning new concepts and language involves thinking skills. On the other hand, the ability to think abstractly involves conceptual and linguistic knowledge.

In the Concept Development/Language Exposure phase, plan assessment activities that establish whether or not students have basic building block concepts and language to engage in more abstract thinking about a topic. Subsequent activities can fill gaps and or extend the students' background. The structured nature of Language Practice activities demands less high level intellectual activity. Answers are more convergent in nature; the information readily provided or available. However, Communicative Application activities should involve more divergent thinking. Students can draw on what they already have learned during the previous two phases to bridge an information gap or solve a problem.

Possible Sequence Using Language Development Approach

If the language of instruction is not the first language of the students, then the Language Development Approach is the recommended teaching strategy.

Language Development Units have been developed. A suggested sequence for those units is provided below. These units have been correlated to the core curricula at each level and can be found in the section of this guide entitled program details. As well, each language development unit lists the curriculum concepts covered at the outset.

Language Development/Science Units

SCIENCE THEME	GRADE/YEAR		
	1	2	3
Life and the Environment*	Living/Non-Living Things		
	Land Animals Arctic/Sub-Arctic	Birds	Marine Mammals
	Plants		
	Populations		
	Bears/Polar Bears	Dinosaurs	Fish
Matter and Energy	Popcorn (Solids)	Magnets	Water
	Energy and Energy Conservation		
Earth, Space and Time**	Sun, Moon and Shadows		
	Air and Air Pressure		

* Other animals are covered under Social Studies topic: Fall, Winter and Spring.

Moose/Caribou
Beaver/Muskrat
Rabbits
Seals
Other fur-bearing animals

** Weather will be covered in an integrated Science/Social Studies/Math unit.

Inquiry Approach

Sometimes children are introduced to new learning either too soon or too late. Readiness is determined by both the child's cultural environment and the child's stage of intellectual development. Each determinant influences the selection of materials, experiments, activities and ideas to which the child should and may be exposed. The Elementary Science Program's conceptual framework suggests the **Optimum Time** for learning. The framework provides a continuum based on content. It is the teacher's responsibility to ensure that **Inquiry Skills** are emphasized in the pursuit of this content.

Teaching content item by item will not achieve the goals of the Elementary Science Program. Inherent in that approach is the fragmentation of learning. The science program emphasizes the acquisition of skills for collecting and processing information. These skills are generally referred to as the **Process Skills**; the avenue to their attainment is **Inquiry**. Discovery is the product of successful **Inquiry**.

The first avenue to the **Inquiry** process is the introduction of an inconsistency. The **Process Skills** are employed to unravel the observed inconsistency and the resultant assimilation of this information into the student's conceptual framework is **Discovery**.

Consider the Following Situations:

1. Drop an ice cube in a glass container that is filled with alcohol. Drop another into a glass that is filled with water.
2. Float a piece of aluminum foil on water; crumple it up. Now try!
3. Drop an egg into a container of water; now try it with salt water.
4. Briskly comb your hair. Hold the comb next to a stream of water coming from a faucet.
5. Fill a bucket with water and whirl it over your head, (you'd get a good reaction if on the second try you only went half way).
6. Construct a lever so that a small mass is balanced by a larger mass.
7. Put a metre stick on a table with about 10 cm sticking over the end of the table. Strike the protruding end sharply. Repeat, but this time lay a newspaper over the portion which is on the table and press it flat against the table top. Strike the protruding end of the metre stick sharply.
8. Blow up a balloon. Rub it briskly on a wool sweater. Stick it on the wall.
9. Fill a can with water. Attach a long rubber tube using a stopper. Invert and let the water flow out.
10. Using a similar can, put in approximately 20 mL of water. Heat the water to boiling, screw on the lid tightly and set back.

The Process Skills

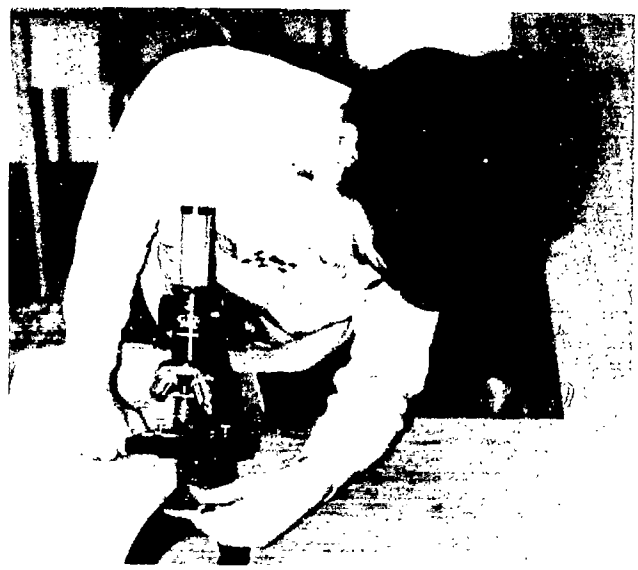
An awareness of the **Process Skills** is essential. Each is not a separate entity. Often several skills are involved in a single **Inquiry**.

The first six process skills are employed at the Primary level while the remaining six are added during grades four to six.

Observing

The perception of an object or event using any of the senses. Beginning with identifying objects and properties of objects, this sequence proceeds to the identification of changes in various physical systems, the making of controlled observations, and the ordering of a series of observations.

*observe plants and animals that live in soil
*observe physical properties of salt, sugar and sand using all of your senses.



Classifying

Grouping objects according to directly observable properties. Development begins with classification of various physical and biological systems and progresses through multi-stage classifications, their coding and tabulation.

*given a tray of materials gathered in the classroom, sort them into two groups on the basis of whether or not the objects are attracted by a magnet
*classify objects as solids, liquids, or gases or some combination of these.

Communicating

Describe objects, events or findings (data) so that others can know the results of observations. Development in this category begins with bar graph descriptions of simple phenomena, and proceeds through describing a variety of physical objects and systems and the changes in them, to the construction of graphs and diagrams for observed results of experiments.

*describe orally, observations of food coloring spreading through cold water
*construct histograms or bar graphs with strips of colored paper to compare the number of seeds found in certain fruits.

Inferring

Make a judgement based on evidence which may not be directly observable. Initially the idea is developed that inferences differ from observations. As development proceeds, inferences are constructed from observations of physical and biological phenomena, and situations are constructed to test inferences drawn from hypotheses.

*infer what has caused a plant to die from what has been learned about the necessity of soil
*infer eroding effects of running water by observing a "mudpile" mountain.

Measuring

Describing or comparing objects or events to a conventional standard. Beginning with the identification and ordering of lengths, development in this process proceeds with the demonstration of rules for measurement of length, area, volume, mass, temperature, force, speed and a number of derived measures applicable to specific physical and biological systems.

*measure the growth of a plant at weekly intervals over a period of time
*measure time without using a clock or a watch.

Predicting

Forecasting future events on the basis of observed regularities in past events. For this process, the developmental sequence progresses from interpolation to extrapolation, in graphically presented data, to the formulation of methods for testing predictions.

*predict the effect of wet and dry paper on nails sealed in a jar
*predict the way(s) a flashlight bulb, a wire and a dry cell can be connected so that the bulb will light.

Defining Operationally

Objects and events are defined in such a way that they can be tested or observed. The developmental sequence begins with the distinction between definitions which are operational and those which are not. Finally, the student constructs operational definitions in problems that are new to him.

*an operational definition for a completed circuit would be, "When I join the copper wires, a bulb, and a dry cell in this way, the bulb will light up".

Controlling Variables

Discriminating among factors that will or will not affect the outcome of an experiment, and holding all such factors constant except the one to be tested or manipulated. The developmental sequence for this "integrated" process begins with identification of manipulated and responding (dependent and independent) variables in a description or demonstration of an experiment. Development proceeds to the level at which the student (being given a problem, inference, or hypothesis) actually conducts an experiment, identifying the variables and describing how variables are controlled.

*isolate and control variables affecting the conductivity of two samples of wire.
*isolate and control the variables in an experiment to test the effect of water velocity on stream erosion.

Interpreting Data

Using collected results to pose possible answers to a problem. A critical analysis of the data should accompany this, before hasty conclusions are drawn. This sequence begins with descriptions of graphic data and inferences based upon them, and progresses to constructing equations to represent data, relating data to statements of hypotheses, and making generalizations supported by experimental findings.

*make a generalization based on tabulated results of an animal census.
*make a generalization based on the results of measuring relative humidity.

Formulating Hypotheses

Proposing a tentative explanation, based on a previous observation, for the occurrence of a set of events. It can be a guess to guide an investigation or accepted as highly probable in light of established facts.

*hypothesize a cause for inconsistent results among classmates concerning the observed properties of two flashlight bulbs.
*hypothesize the variables that would affect the strength of an electromagnet.

Formulating Models

Devising models to describe the behaviour of something that is unfamiliar in terms of something whose behaviour is familiar. Three types of models are common in Science: Three dimensional (iconic), Mathematical (analogue), and Hypothetical (symbolic). Elementary school children would experience the iconic and analogue models.

*make a model of a constellation such as the Big Dipper.
*make a model illustrating the distance from the Earth to the Moon.

Experimenting

The process of recognizing and formulating a problem, planning and conducting a test of an hypothesis, and using the collected results to pose possible answers to the problem. Experimenting is developed through a continuation of the sequence for controlling variables, and includes the interpretation of accounts of scientific experiments, as well as the activities of stated problems, constructing hypotheses, and carrying out experimental procedures.

*plan and conduct experiments to test the hypotheses concerning the variables that affect the rate of motion of a pendulum
*plan and conduct experiment to find out if an electromagnet will stay magnetized after it has been disconnected.

Evaluation

Introduction

The activity-oriented elementary science programs require a fresh look at evaluation. Some of these programs have built-in evaluation techniques or tests whereas others rely on teachers constructing their own evaluation measures. No longer will paper and pencil tests tell the complete picture of each child's progress. The evaluation report should indicate how well the related knowledge, skills, attitudes, and values have been learned by the children. This information will assist the teacher in gauging the effectiveness of the teaching strategies and techniques as well as the overall success of the program itself.

To evaluate the program, the teaching, and the children's performance, one must have a clear statement of the basic goals and objectives, and then use the appropriate evaluation techniques. Evaluation of the child's learning should be based on the individual needs and abilities of each pupil. Many formal and informal evaluation techniques have been developed over the past few years which are suited to this purpose.

'Out of a little seed grows a big tree' aptly describes record keeping systems. The suggestions for science checklists represent the pruning of that tree to meet individual requirements.

The following is a suggested teacher checklist. It provides detailed information at a glance and should be used by everyone.

Concepts Related to Grade One

Life and Environment

Unit 1.1 Living and Non-Living Objects

Main Concept: Objects can be classified into living and non-living objects according to certain properties.

Concepts	Taught	Tested
1. Objects are living or non-living on the basis of the following characteristics: a. Living — need food and water. — grow. — reproduce. — die. b. Non-Living — do not need food. — do not grow. — do not reproduce. — do not die.		

Unit 1.2 Ourselves

Main Concept: There are variations and similarities among human beings.

Concepts	Taught	Tested
1. Bodies vary in: a. height. b. mass. c. shape. 2. Heads and faces vary in size and shape. 3. Eyes vary in color and ability to see. 4. Ears vary in size and shape. 5. Hair varies in form and color. 6. Legs and feet vary in size, shape and strength. 7. Arms and hands vary in size, shape and strength.		

Matter and Energy

Unit 1.3

Properties of Materials and Change

Main Concept: Change occurs when the properties of objects (matter) are modified. Changes occur in observable patterns of order and time, and occur constantly throughout the environment.

Concepts	Taught	Tested
1. Review properties of objects (kindergarten). Properties of objects are examined further to develop classification skills and the ability to compare objects on the basis of one or more properties. 2. Objects (solids) can be distinguished by physical properties such as color, size, mass, and shape (solids retain their shape...). 3. Objects (solids) differ in their texture, hardness and relative mass. 4. Change occurs where the properties of objects (matter) are modified. 5. Changes in properties of objects (solids) can occur when water is added to some objects. 6. Changes in properties of objects (solids) can occur when the objects are heated or cooled. 7. Some changes occur in a regular pattern and can be ordered. 8. Some changes are more easily reversed than others. 9. Some changes occur slowly and others rapidly. 10. Weather can exhibit different kinds of change.		

Unit 1.4 Energy and Energy Conservation

Main Concept: Energy is found in many forms. Plants and animals use food energy. Machines use a different kind of energy. Energies that are commonly used such as light, heat, oil, gas and electricity can be saved if used wisely.

Concepts	Taught	Tested
1. Energy is found in many forms. Everything that we do requires energy. 2. Machines use a different kind of energy. 3. The sun's energy can be seen as light or felt as heat. 4. If we are careful (wise), some energies can be saved.		

Earth, Space and Time

Unit 1.5 Comparing and Measuring Objects and Events.

Main Concept: Objects can be compared, described, ordered and measured on the basis of arbitrarily chosen reference points and non-standard units. Events occur in a particular order or sequence, having varying durations of time. Events may be regular or irregular in frequency.

Concepts	Taught	Tested
1. Objects can be compared and ordered by size by using non-standard units. 2. The position of an object is determined relative to arbitrarily chosen reference points. 3. Events may be of short or long duration. 4. Changes may occur over different time periods and in varying degrees (space). 5. Events may be regular or irregular. 6. Events occur in a regular time sequence (days, weeks, months, seasons).		

Concepts Related to Grade Two

Life and Environment

Unit 2.1 Properties of Living Objects.

Main Concepts: Living organisms exhibit unique properties.

Concepts	Taught	Tested
1. Objects can be classified as living or non-living. (Review of Grade One) 2. Living things can be classified according to properties. 3. Plants differ from animals in specific ways relative to how they obtain food, how they react to stimuli, how they move and how they reproduce. 4. Plants live in many different habitats within the environment. 5. Animals live in many different habitats within the environment. 6. Young plants resemble their parents. Some animals reproduce young which resemble their parents. Other animals do not resemble their parents until mature. 7. Plants move in response to stimuli whereas animals have locomotion. 8. Plants require nutrients which they obtain from the water, air and soil. Green plants require light to make food.		

Matter and Energy

Unit 2.2 Properties of Matter (Solids, Liquids and Gases).

Main Concept: Objects (matter) commonly exist in three distinct forms: solids, liquids and gases. Each form has characteristic properties.

Concepts	Taught	Tested
Review properties of objects (solids) from Grade One. 1. All objects are made of materials which have unique properties. 2. All objects are made of material called matter. 3. Solids have distinct properties: a. tend to retain their shape, can be stacked. b. can be poured only if in small pieces. 4. Some solids can be classified as metals on the basis of specific properties, such as: a. shininess. b. flexibility (bends). c. can often be beaten flat by hammering (malleable). 5. Liquids have distinct properties: a. take the shape of the container. b. can be poured. c. splash. d. form drops. 6. Liquids vary in degree of specific properties such as: a. color. b. transparency to light. c. ability to dissolve sugar. 7. Gases have distinctive properties: a. take up space. b. can move and cause objects to move.		

Unit 2.3 Energy and Energy Conservation

Main Concept: Energy is the ability to do work. Energies are converted by man to do work. All Energies are present in nature. Wind, water and wood can provide energy for our wise use.

Concepts	Taught	Tested
Review Grade One concepts. Plants, animals and machines use energy. Gasoline and electricity are two forms of energy which we can use. We get heat and light energy from the sun. 1. Energy is the ability to do work. 2. There are natural (wind, water and wood) and man-made forms of energy. 3. Some energy sources are renewable while others are not.		

Earth, Space and Time

Unit 2.4 Measuring Objects and Positions

Main Concept: An object's size and position can be measured by non-standard and standard units. SI is an international system of measurement.

Concepts	Taught	Tested
1. One object can be used to measure another. It is more satisfactory to use a standard acceptable to all. 2. Objects can be located and measured with respect to a reference object. 3. SI is an international system and is used in Canada for most measurements.		

Unit 2.5 Measuring Time

Main Concept: Events occurring with regularity can be measured in non-standard and standard units.

Concepts	Taught	Tested
1. Certain events occur at regular intervals, others are irregular. 2. The passage of time can be measured in non-standard units — sand clock, shadow clock. 3. The passage of time can be measured in standard units — hours, minutes, and seconds...		

Concepts Related to Grade Three

Grade Three: Life and the Environment

Unit 3.1 Populations:

Main Concept: Populations vary, grow and develop in different environments.

Concepts	Taught	Tested
1. The term "population" describes a group of organisms of the same kind in a particular environment. 2. The place of a population is its habitat. 3. Populations in a particular habitat form a community. These populations are usually interdependent. 4. The existence and behaviour of living organisms affects the well-being of mankind and/or the overall life of the community and vice versa. 5. Living things compete for the things they need to survive and reproduce. 6. It is important to find out all we can before we try to control or change a community.		

Matter and Energy

Unit 3.2 Energy, Heat and Temperature

Main Concept: Heat is a form of energy. Heat can produce changes in the properties of matter.

Concepts	Taught	Tested
1. Work is done when a force acts to move an object. 2. There are different forms of energy. Heat is one form of energy. 3. Temperature is a measure of the degree of hotness or coldness of an object. 4. Matter tends to expand when heat is added (warmed) and contract when heat is removed (cooled). a. gases expand and contract when heat is added or removed b. liquids expand or contract. Gases expand more than liquids c. different liquids expand differently d. temperature can be measured by a thermometer which has a liquid that expands or contracts e. solids expand or contract f. different solids expand differently g. for a given substance, large masses change temperature more slowly than small masses (other factors being equal) h. heat passes easily through some materials (conductors) and not so easily through other materials (insulators) i. metals are better conductors than non-metals		

Unit 3.3 Changes in Matter

Main Concept: Matter is made of particles which are too small to be seen. Changes in matter can be classified as physical or chemical.

Concepts	Taught	Tested
1. Review properties of matter from Grade 1 and 2. 2. Matter occupies space. 3. Matter is made of smaller parts. 4. Small objects (particles) can be used to build larger objects. 5. Particles can distribute themselves throughout a liquid or a gas (smoke). 6. Water can exist as particles in air. 7. In a physical change, an object (matter) may be changed in form, but no new matter is produced. 8. Some physical changes can be easily reversed while others cannot. 9. In a chemical change, new materials are produced whose properties differ from the original materials. 10. Mixtures of materials can be separated on the basis of unique properties: a. Solids: — some solid materials float in water. — some solids are attracted by magnets. — different mixtures of solids may be separated by different methods on the basis of unique properties. b. Solid-Liquid Solutions: — some solids dissolve readily in water to form a solution (soluble); others do not (insoluble). — dissolving a solid in a liquid is a physical change. — filtration can separate solids from mixtures, but not from solutions.		

Unit 3.4 Energy and Energy Conservation

Main Concept: Coal, oil, and gas are fossil fuels. We must use them wisely for they are non-renewable resources.

Concepts	Taught	Tested
Review of previously taught concepts. Sources of energy studied in Grade 1 and 2 were oil, gas, electricity, wind, water and wood. Some resources are renewable, some are not. 1. Fossil fuels are a source of energy. 2. Once we use fossil fuels, they are gone forever. 3. Energy can be saved at home, at school and in my community.		

Earth, Space and Time

Unit 3.5 Air and Air Pressure:

Main Concept: Air is a gas which has certain properties.

Concepts	Taught	Tested
1. Air occupies space. 2. Air exerts pressure. The larger the surface air presses on, the greater the total force. 3. Air contracts when cooled and expands when warmed. 4. Warm air rises and cold air sinks.		

Unit 3.6 Sun, Moon and Shadows:

Main Concept: The physical structure of matter affects the passage of light. The rotation of the earth causes day and night. It also causes the sun and moon to appear to move across the sky. The moon appears to change shape during the month.

Concepts	Taught	Tested
1. A shadow results when an object blocks the passage of light. 2. A light source which allows a shadow to be cast is always located in the direction opposite that of the shadow. 3. The size and shape of the shadow is dependent upon the relative positions of the object, light source and receiving surface. 4. Shadows can be made both by light sources and by reflected light. 5. The size of the light source determines the type of shadow. 6. Multiple light sources produce multiple shadows. 7. Sunlight can be blocked by clouds and objects which form shadows on the earth. 8. The rotation of the earth causes day and night. Day and night are regular events. 9. The turning of the earth explains why the sun appears to move across the sky. 10. The rotation of the earth causes the moon to appear to move across the sky. 11. The moon appears to change shape during the month.		

Evaluating The Process Skills

The Science program emphasizes a balance between content and the process skills. Science is not an unchangeable list of facts, concepts, and principles to be learned by memorizing. Teachers are urged to try these suggestions for evaluation to provide feedback for their improvement.

Inquiry

Skills are directly involved in content learning. When constructing evaluation tasks to identify students who have specific inquiry skills, first have in mind what a student can do with that skill. Secondly, obtain some understanding of the science content that is being evaluated. With this understanding, the next steps will be to (1) write the objectives of the science lesson; (2) determine the tasks from which inferences can be made about the student's learning; (3) design a test that gives the student the opportunity to demonstrate specified behaviors; (4) establish standards by which to judge whether the student has attained the objectives; and (5) give the test, correct it, match the student's test performance with the pre-determined expectations, and determine whether the student has attained the objective.

Observing

Following these steps, construct a test that will help evaluate the inquiry skill of observation. To evaluate this skill, know the characteristics of an observation. A student who has acquired this skill can "collect data through the use of the five senses and construct statements of observations in qualitative and quantitative terms". These characteristics should help to identify an observant student. These indicators might (1) identify and name the physical properties of an object; (2) construct statements of observations in qualitative terms; and (3) construct statements of observations in quantitative terms.

In selecting the objects for a test to evaluate the observation skills ensure that any one of the five senses is not favored more than any other. For example, if a student is to observe a small piece of plastic and has previously been cautioned about putting objects into his mouth, do not expect him to respond to that evaluation with observations using all five senses.

The dimensions of objects are important when choosing the materials to be used in this type of evaluation. If the student has been working with three-dimensional objects and is given a two-dimensional picture of the object to observe, it is likely to affect the number and kind of responses he gives. There is much evidence to show that test directions also affect responses. One set of objects used with different directions give different responses. For example: *"Make observations using all five senses,"* and, *"List those things that you can see about the objects, hear about the objects, feel about the objects..."* The second will receive a longer and more complete list of observations. These considerations should be kept in mind when evaluating.

The following is a sample test that may help to evaluate a student's ability to observe. Since these skills cannot be evaluated without content, content is included in each sample.

Objective

The student should be able to observe and record what happens to iron filings sprinkled on a piece of paper placed on top of a magnet.

Tasks

1. *The student sketches the iron filings' patterns from the ends of the magnet outward at least twenty centimetres.*
2. *The student sketches the iron filings' patterns around the center of the magnet.*

Test

Have the students place a bar magnet under a piece of plain white paper and sprinkle some iron filings as evenly as possible on top of the paper. Instruct the students to sketch their observations of the iron filings.

Performance

Each student who has successfully completed the tasks must reproduce both patterns. Some performances may indicate inferences.

Comparing

Comparing is the ability to recognize and state similarities and differences among objects, events, and places. Suitable tasks would be:

1. The student selects and records characteristics common to a set of objects.
2. The student selects and records characteristics not common among a set of objects.

The two or more objects, events, or places used in the evaluation must have definite similarities and differences if the student is expected to indicate these similarities and differences in his responses. Often a student can identify differences, but has difficulty with listing the similarities among the materials. The complexity of the objects, events, or places and the age and development of the student must be taken into consideration.

Be as specific as necessary when writing the directions for the test. Consider: *"Compare this set of objects with that set,"* and *"Describe the things you can see that make the objects in this set different from the objects in that set"*. It is not just a matter of being clear or specific, but also of deciding how many clues are given in the directions. The following sample may help prepare tests to evaluate the skill of comparing.

Objective

The student should be able to compare lima beans, raisins, and prunes soaked in water with those not soaked in water.

Tasks

1. *The student selects and records five characteristics the edibles have in common.*
2. *The student selects and records three characteristics the edibles DO NOT have in common.*
3. *The student measures and records the volume and mass of each edible, in metric units.*
4. *Using the five common characteristics, the three unlike characteristics, and the volume and the mass, the student compares each edible with every other.*

Test

The teacher should soak enough lima beans, raisins, and prunes in water before the test so that each student will have one sample of each item. Give the soaked and unsoaked samples to the students and ask them to record their comparisons.

Performance

Each student who has succesfully completed each of the four tasks has attained the objective.

Identifying

Consider one possible descriptive definition of the skill of *identifying*. It can be considered the ability to (1) name objects, events, and places; (2) select from several alternatives the designated object, event, place, or sequence; (3) devise a method to measure the properties of an object.

Parts (1) and (2) of this definition suggest the following tasks.

1. Name the object by using its conventional name, where a name exists.
2. Name the object by creating a reasonable name where no name exists.
3. Select from a set of similar objects the object to be identified.
4. Collect sufficient data to substantiate your identification.

Part (3) may involve other tasks directly related to the student's past experience. He would probably have to know several methods of measuring the properties of objects before he could do this task. The following is a sample of a test to evaluate a student's ability to identify an unknown solution.

Tasks

1. *The student records the conventional name of the solution; or*
2. *He records a descriptive name of the solution.*
3. *The student selects a sample of the solution to be identified from among several unlabeled solutions.*
4. *The student writes a description of the technique used to identify the solution.*

Test

Give the students a small vial containing a sample of a solution. This solution can be made by combining two solutions that were used in the lesson. Thus, the students should recognize enough properties of the new solution to identify it, employing techniques previously used.

Performance

The student must record accurately!

1. *The conventional or a descriptive name for the solution.*
2. *The one vial out of three that contains a sample of the solution.*
3. *All the steps of the technique used to identify the solution.*

Classifying

One possible definition of classifying is the ability to formulate groups based upon one or more observed common properties and to construct a graph from a table of data. Possible tasks are:

1. The student identifies and names the observable properties of objects in a set.
2. He divides all the objects in the set into two subsets: a subset of these objects with an observable property and a subset of objects without this same observable property.
3. Using other observable properties, S/he continues to divide the objects into subsets, until each object from the original set is the only element in a subset.

As these inquiry skills become more complex, it becomes more important that test directions are clear and concise. Ensure for example, that young children understand directions for classifying. The tasks listed above can be accomplished by young children.

Objective

The student should be able to classify by physical characteristics all the students in the classroom who can taste a solution as being sweet.

Tasks

1. *The student divides a list of students who can taste the solution as being sweet into two groups: those who have some physical characteristics in common, for example, eye color — and those who do not.*
2. *The student divides each of the above groups of "tasters" into two smaller groups, using another common physical characteristic. He continues this subdividing until the name of each "taster" is the only name in each subgroup.*

Test

The names of students who can taste the solution are supplied to the students taking the test. The students are then asked to group, or classify, the tasters with respect to their physical characteristics.

Performance

The student must show ability to distinguish differences of each group identified. This is the basis of classifying.

Measuring

The skill of measuring is the ability to quantify observations, using a frame of reference. Possible tasks are:

1. Select and describe clearly the frame of reference in your method of measuring.
2. State all steps to be followed in the method.
3. Record the measurement of several objects, using your method.

The frame of reference used in measuring a quantity may be a standard one, such as a metric rule, or it may be devised, such as a system of units invented by the child. For instance, such an invented system could be "paper clips". The length of the table, in this system, is the number of paper clips that can be placed end to end down the length of the table.

Upper elementary-grade students should be encouraged to use more complex frames of reference. They should have the opportunity to use several kinds of balances, microscopes, graduated cylinders, various time clocks, and other measuring devices that help record, in very accurate units, the particular characteristics of an object or event.

Objective

The student should be able to measure, in metric units, the volume of an irregularly shaped object.

Tasks

1. *The student states clearly all steps he used to find the volume of the object.*
2. *The student states the volume of water, in millilitres, found in the cylinder before and after the object was placed into the cylinder.*
3. *The student states in writing the relationship between millilitres and cubic centimetres.*

Test

(To use this as a test question, the teacher must be certain the students understand how to measure volumes of regularly shaped objects and of liquids). Tell the students to devise a method, using their previous knowledge, to measure the volume of an irregularly shaped object. Volume must be determined in metric units.

Performance

The student must perform each task successfully.

Inferring

Inferring is the ability to form a judgement from a set of observations and comparisons and to interpret a table of data. The following tasks could be considered:

1. The student makes several inferences from a set of observations.
2. The student makes several inferences from a set of comparisons.
3. The student indentifies observations that support an inference.
4. The student describes and demonstrates additional observations needed to test alternative inferences.
5. The student identifies inferences that should be accepted, rejected, or modified on the basis of additional observations.

Interpreting a table of data is one possible way of making inferences: numbers in a table are a set of observations. These data, however, are more understandable to an upper elementary-grade student than to a primary-grade student. The younger student may be able to make inferences about things he can see, hear, feel and compare, but not about abstract numbers.

Objective

The student should be able to infer an explanation of his observations of iron filings sprinkled on a piece of paper placed on top of a magnet.

Tasks

1. *The student writes an inference based on the position of the iron filings and one inference based on the motion of the iron filings.*
2. *The student describes the observations that support each inference.*
3. *The student records alternative inferences for each inference in item 1.*
4. *The student describes additional observations that would be needed to accept these alternative inferences.*

Test

Repeat the magnet-iron filings test for observation and have students infer an explanation of the position(s) of the iron filings.

Performance

The student must record accurately:

1. *One inference based on the position of the iron filings.*
2. *One inference based on the motion of the iron filings.*
3. *All observations supporting each inference.*
4. *Alternative inferences and supporting observations.*

Predicting

The definition of predicting used here is the ability to state a future occurrence from previous observations. Some tasks include the following:

1. The student is able to distinguish between a prediction and a guess.
2. The student can make predictions by extrapolating beyond the range of observed events.

The Jellybean Jar

Provide a jar and a large bag of jellybeans. The students will experience guessing, inferring, predicting and verifing.

The Guess

How many jellybeans can this jar take?

The Inference

Tommy put 387 jellybeans in the jar.
Susie put 394 jellybeans in the jar.
Michael put 392 jellybeans in the jar.

No one could put 500 jellybeans in the jar.

The Prediction

If the following numbers of jellybeans were put in the jar,

Tommy — 387
Susie — 394
Michael — 392

How many do you think you could put in the jar?

The Verification

Count how many jellybeans you put in the jar.

In order to write tasks to evaluate predicting skills, be clear about the difference between a guess and a prediction. *A guess is a statement based upon no data or very limited data; a prediction is a statement based upon several data, and these data are observations or science principles that have been verified.*

The test should include materials to manipulate and specific directions that caution the student to write down his previous observations and any other information upon which he bases his predictions. Then there will be some evidence as to whether the student was guessing or predicting. To collect more evidence, require the student to rank his predictions from the one in which he

places the most confidence to the one in which he places the least confidence. For example, a student may predict the time of sunrise three months from now to be either 6:03 or 6:00, depending on which of two methods he uses to arrive at these different preditions. The 6:03 prediction was made after consulting the current almanac for times of sunrise over the months before and after the particular date he is investigating. The 6:00 prediction was made by finding that in weather bureau records the time of sunrise on the particular date was 6:00, 5:50, or 6:01 for ten consecutive years, and 6:00 for seven of these ten years. He may, therefore, be more confident in the 6:00 prediction than the 6:03 prediction.

Predictions are closely related to inferences; both are based on observations.

Predictions are based on *measured* data and are made before an event occurs.

Inferences are based on *implied* data and are made after an event has occurred.

Objective

The student should be able to predict the location(s) of growth on the stem of a plant.

Tasks

1. *The student marks all the places on the stem that will show growth.*
2. *The student explains the evidence supporting his prediction(s).*
3. *The student describes a test of his predictions as to where growth will occur in a stem.*

Test

Give each student a small green plant. Have the student mark with India ink which sections of the stem will show growth. Students should also state the reasons why they marked particular sections.

Performance

The student must record accurately his predictions, the evidence supporting each prediction, and one way to test each prediction of the place(s) on a stem that will show growth.

Attitudes and Behaviors

Informal evaluation methods which can be used to determine the presence or absence of particular behaviors are essential. They are, however, the most difficult to devise. The most practical approach is for the teacher to be conscious of the expected behavior and to make a subjective evaluation.

Informal evaluation is most suited to attitudes, interests and appreciations.

A more specific evaluation of attitudes is possible by considering the following attitudes and their attendant behavior indicators.

Observable Behaviors of Certain Attitudes

Attitude	Behavior
1. Curiosity	1. Expresses a desire to investigate new things or ideas. 2. Expresses a desire for additional information. 3. Asks for evidence to support conclusions made from scientific materials. 4. Expresses interest in scientific issues in the public domain. 5. Expresses a desire for explanations.
2. Openness	1. Demonstrates willingness to subject data and/or opinions to criticism and evaluation by others. 2. Seeks and considers new evidence. 3. Expresses the realization that knowledge is incomplete. 4. Expresses understanding of the tentative nature of conclusions as products of science.
3. Reality orientation	1. Demonstrates understanding and acceptance of his limitations. 2. Expresses awareness that change is the rule rather than the exception. 3. Expresses awareness of several sources of knowledge. 4. Expresses awareness of the fallibility of human effort. 5. Expresses belief in science as a means of influencing the environment 6. Does not alter his data. 7. Demonstrates the realization that research in science requires hard work. 8. Demonstrates awareness of the limitations of present knowledge. 9. Expresses awareness of the historic development of patterns of inquiry and of the processes and characteristics of science.

Attitude	Behavior
	10. Demonstrates belief that the search for desirable novelty should be tempered by awareness and understanding of traditional concepts.
4. Risk-taking	1. Willingly subjects himself to possible criticism and/or failure. 2. Expresses his opinions, feelings, or criticisms in spite of the presence of authority. 3. Participates freely in class discussions. 4. Indicates a willingness to try new approaches.
5. Objectivity	1. Indicates a preference for statements supported by evidence over mere opinion. 2. Indicates a preference for scientific generalizations that have withstood the test of critical review.
6. Precision	1. Indicates a demand for coherent statements. 2. Seeks definition of important words. 3. Demonstrates sensitivity to the appropriateness of general and/or specific statements in a given context. 4. Expresses the need to examine a problem from more than one point of view.
7. Confidence	1. Expresses confidence that success can be achieved through inquiry. 2. Demonstrates willingness to take "intuitive leaps".
8. Perserverance	1. Pursues a problem to its solution or to a practical point of termination.
9. Satisfaction	1. Expresses satisfaction with the process of inquiry. 2. Expresses confidence that the inquiry experience will enable future goals to be attained

Attitude	Behavior
10. Respect for Theoretical Structures	1. Demonstrates awareness of the importance of models, theories, and concepts as means of relating and organizing new knowledge. 2. Demonstrates awareness of the importance of currently accepted theories and concepts as a framework or basis for the emergence of new knowledge. 3. Demonstrates awareness of the importance of scientific procedures for the generation of new knowledge, theories and concepts.
11. Responsibility	1. Is active in helping to identify and establish learning goals. 2. Demonstrates willingness to work beyond the assignment. 3. Insists upon adequate evidence on which to base conclusions. 4. Suggests changes to improve procedure. 5. Shows respect for the contributions of others. 6. Demonstrates willingness to share knowledge with others. 7. Offers rationale for criticism. 8. Initiates action for the benefit of the group.
12. Consensus and Collaboration	1. Demonstrates willingness to change from one idiom, style, or frame of reference when working with others. 2. Calls upon other talent from within the group when opinions and help are needed. 3. Seeks clarification of another person's point of view or frame of reference.

SOURCE: Richard M. Bingman, ed., **Inquiry Objective in the Teaching of Biology** (Kansas City: Mid-Continent Regional Eductional Laboratory and Biological Science Curriculum Study, 1969), pp. 34-47.

Also pertinent to Informal Evaluation would be the science related activities including:

1. Performance with Manipulative Materials.
2. Growth of Inquiry Process.
3. Evaluation of an Investigation.

Some suggestions are included for reference.

Evaluating Performance With Manipulative Materials

1. Manipulates materials with ease.
2. Observes closely while working.
3. Reveals perserverance.
4. Suggests new uses of materials.
5. Finds relationships.
6. Avoids hasty inferences.
7. Describes discoveries clearly.
8. Asks new questions.
9. Independent in clean-up.
10. Uses safety precautions.

Checking The Growth Of Inquiry Processes

1. Suggests a prediction.
2. Offers ways of testing prediction.
3. Changes opinion for better idea.
4. Selects materials with purpose.
5. Uses "I think", "I don't know".
6. Criticizes his/her own work.
7. Observes carefully.
8. States relationships while observing.
9. Repeats work and/or changes for better procedures.
10. Uses data to draw inferences.

Evaluating an Investigation:

Teacher and Student Evaluating An Investigation (Group) Problem

1. What did we do that helped you most to find an answer to our question?
2. What could have been better done?
3. What new ideas did we discover?
4. What new words did we learn from this study?
5. If you tried the experiments at home, were the results the same as in school?
6. What predictions were we able to test with the materials we had?
7. What different ways could we have used to keep records of our observations?
8. What materials and equipment helped us most?
9. What equipment did we have to construct?
10. How did we use numbers and measurement to help find answers?

Guidelines For Construction of Test Questions

Multiple Choice Items

1. Each item should reflect an important learning outcome.
2. Present a single problem in the core of the item.
3. Use simple clear language.
4. State the problem in positive form wherever possible.
5. Underline negative wording wherever it is used.
6. Make certain that the intended answer is clearly best.
7. All alternative answers should be parallel in form to the intended answer
8. Vary the length of the intended answers to eliminate length as a possible clue.
9. Vary the position of the intended response.
10. Each item should be independent of other test items.

True-False Items

1. Only one central idea should be in each statement.
2. Wording of the statement should be very precise.
3. Statements should be short and use simple language.
4. Avoid use of double negatives and excessive use of negatives or words such as always, never, sometimes and usually.
5. Avoid extraneous information.

Matching Items

1. Keep the lists of items short.
2. Brief responses should be kept on the right.
3. Use more or fewer responses then premises.
4. Permit some responses to be used more than once.
5. Specify clearly in the directions the basis for matching.
6. Indicate that each response may be used once, more than once, or not at all.

Short-Answer Items

1. The question should be stated so that only a single, brief answer is possible.
2. Avoid giving extraneous information.
3. Use incomplete statements only when the meaning is perfectly clear.
4. Place the blanks at the end of the statement.

Essay Test Items

1. A third-grade student's essay responses may be only one or two sentences while a sixth-grader's may run to a paragraph.
2. The teacher's expectations should match the child's writing ability.
3. Ask well defined questions, not broad, general questions.
4. Indicate exactly what the child is to do.
5. Indicate how long the response should be.
6. Know beforehand what comprises an acceptable response to a question.

	1	2	3
Life and the Environment	1.1 **Living and Non-Living Objects** Objects can be classified into living and non-living according to certain properties. 1.2 **Ourselves** There are variations among human beings.	2.1 **Properties of Living Objects** a) Living objects have certain properties. b) Cycles of animals. c) Living things depend upon energy and water to respond to their environment.	3.1 **Populations** Populations grow and develop in different environments. a) Population describes a group of organisms. b) Populations exist in a habitat. c) Populations are in a state of change.
Matter and Energy	1.3 **Properties of Materials and Change** a) Physical properties of solids can be used to classify objects into groups. b) Change occurs when properties of objects are modified. 1.4 **Energy and Energy Conservation** a) Everything that we do requires energy. Plants, animals and machines use energy.	2.2 **Properties of Matter** a) Matter commonly exists in three distinct forms: solids, liquids, and gases. b) Each form has its characteristic properties. 2.3 **Energy and Energy Conservation** a) Energy is the ability to do work. b) There are natural and man-made forms of energy. c) Some energy sources are renewable while others are not.	3.2 **Energy, Heat and Temperature** Heat is a form of energy. 3.3 **Changes in Matter** a) Matter is made up of particles which are too small to be seen. b) Changes occurring on a regular basis can be predicted. c) Changes in matter can be physical or chemical. 3.4 **Energy and Energy Conservation** a) Fossil fuels are a source of energy. b) Once we use fossil fuels, they are gone forever. c) Energy can be saved at home, school and in my community.
Earth, Space and Time	1.5 **Comparing and Measuring** a) Objects can be compared, described, ordered and measured on the basis of arbitrarily chosen reference points. b) Events occur in a particular order or sequence, having varying durations of time and space. c) Events can be regular or irregular.	2.4 **Measuring Time** Regularly occurring events can be measured in non-standard and standard units. 2.5 **Measuring Objects and Positions** a) An object's position can be measured by non-standard units. b) Objects can be measured with or without respect to a reference point.	3.5 **Air and Air Pressure** a) Air has special properties. b) Air exerts pressure, occupies space, expands and contracts. 3.6 **Sun, Moon, and Shadows** a) A shadow is caused by the blockage of light. The physical structure of matter affects the passage of light. b) The moon appears to move across the sky and to change shape during the month.

Correlation of Grade One Units To Various Resource Materials

Theme	Units	Language Development Units	Addison-Wesley Science Series	Examining Your Environment	Sc. 5/13	Other
Life and the Environment	1.1 Living and Non-Living Objects	Plants Populations Living/Non-Living (Land Animals)	Level One	Ecology in Your Community		ESS Growing Seeds Animals in the Classroom Eggs and Tadpoles Life of Beans and Peas
	1.2 Ourselves	Social Studies Topic "Me"	Level K		Ourselves (page 5-41) Coloured Things (pages 8-10)	
Matter and Energy	1.3 Properties of Materials and Change	Popcorn (solids)	Level 1		Changes (pg.4-6, 28, 29, 56, 57,) Working with Wood (page 43)	ESS Primary Behavior Changes (pg. 4-6, 53) Mobiles
	1.4 Energy and Energy Conservation	Energy and Energy Conservation	Level 1, 2			Seeds Literacy Series, Level One
Earth, Space and Time	1.5 Comparing and Measuring	Math Topic, "Time"	Level 1		Time	

Correlation of Grade Two Units To Various Resource Materials

Theme	Units	Language Development Units	Addison-Wesley Science Series	Examining Your Environment	Sc. 5/13	Other
Life and the Environment	2.1 Properties of Living Things	Plants Populations Living/Non-Living (Birds)	Level 2	Ecology in Your Community	Minibeasts	ESS Plants in Your Classroom Animals in Your Classroom Frogs and Tadpoles
Matter and Energy	2.2 Properties of Matter	Solids (Popcorn) Water (Liquids) Air and Air Pressure	Level 2		Metals Working with Wood	Invitations to Science Inquiry
	2.3 Energy and Energy Conservation	Energy and Energy Conservation				Seeds Literacy Series Level Two
Earth, Space and Time	2.4 Measuring Time	Math Topic, "Time"	Level 2		Time Early Experiences	
	2.5 Measuring Objects and Position		Level 2		Ourselves	ESS Match and Measure

Correlation of Grade Three Units To Various Resource Materials

Theme	Units	Language Development Units	Addison-Wesley Science Series	Examining Your Environment	Sc. 5/13	Other
Life and the Environment	3.1 Populations	Plants Populations Living/Non-Living (Marine Mammals)	Level 3	Ecology in Your Community Pollution Dandelions	Colored Things	ESS Earthworms Brine Shrimp Starting from Seeds Peas and Particles
Matter and Energy	3.2 Energy, Heat and Temperature	Popcorn, Energy & Energy Conservation, Water, Air and Air Pressure	Level 2,3	Snow and Ice	Science from Toys Metals Change	ESS Ice cubes
	3.3 Changes in Matter	Popcorn, Water Air and Air Pressure	Level 3		Colored Things Change Working with Wind/ Holes, Gaps and Cavities	ESS Mystery Powders
	3.4 Energy and Energy Conservation	Energy and Energy Conservation				Seeds Literacy Series Level Three
Earth, Space Time	3.5 Air and Air Pressure	Air and Air Pressure	Level 3			
	3.6 Sun, Moon and Shadows	Sun, Moon and Shadows	Level 3		Early Experiences	ESS Light and Shadows Where is the Moon? Where was the Moon?

Suggested Sequence Using Language Development Approach

If the language of instruction is not the first language of the students, then the Language Development Approach is the recommended teaching strategy.

Language Development Units have been developed for use. A suggested sequence for those units is provided below. These units have been correlated to the core curricula at each level and can be found in the section of this guide entitled program details. As well, each language development unit lists at the outset the curriculum concepts covered.

Language Development/Science Units

SCIENCE THEME	GRADE/YEAR		
	1	2	3
Life and the Environment*	Living/Non-Living Things		
	Land Animals Arctic/Sub-Arctic	Birds	Marine Mammals
	Plants		
	Populations		
	Bears/Polar Bears	Dinosaurs	Fish
Matter and Energy	Popcorn (solids)	Magnets	Water
	Energy and Energy Conservation		
Earth, Space and Time**	Sun, Moon and Shadows		
	Air and Air Pressure		

* Other animals are covered under Social Studies topic: Fall, Winter and Spring.

Moose/Caribou
Beaver/Muskrat
Rabbits
Seals
Other fur-bearing animals

** Weather will be covered in an integrated Science/Social Studies/Math unit.

Grade One

1.1 Living and Non-Living Objects

Main Concept: Objects can be classified into living and non-living objects according to certain properties.

Concepts	Processes and Skills	Suggested Activities	References
1. Objects have certain properties.			Language Development Units: Living/Non-Living Populations Plants
	a) To **observe**, **describe**, and **classify** objects according to their properties.	a) Place a number of objects on a tray. Child describes what is seen and felt. Classify the results either orally or in chart form. b) Sort groups of objects into similar kinds on the basis of their shape, size, color, etc. c) Game: Think of an object, describe it's properties; have children try to guess what it is based upon it's description.	
2. Objects are living or non-living based on the following characteristics:			Language Development Unit: Living/Non-Living Populations Plants Guidelines for plant and animal care can be found in Appendix
a) Living: — need food and water — grow — reproduce — die	a) To **observe** live objects, their characteristics and their needs.	a) Make and/or take care of an aquarium, a terraruim or small animal. Special considerations concerning type of animal, when to order, feeding, etc. must be considered in more remote communities.	Protozoa to small Mammals. Also Ecology and your Community (EYE) Page 12-15
b) non-living — do not need food — do not grow — do not — reproduce — do not die		b) Discuss the needs which animals have through an indepth look at specific animals. — types of needs. — how animals meet these needs. — discuss how animals move, feed, find homes, help each other, etc.	Addison-Wesley Science Level One. Page 1-14 (T.E.) 150-151 (T.E.)
		c) Discuss basic needs of plants — water, light, and good places to grow. Look at relevant examples — where do they get their water, light, etc.	Level One Page 14-28 (T.E.) 152 (T.E.)
		d) Compare and contrast how plants and animals differ as they grow and change over time. Extend to how we change over time.	Addison-Wesley Science Level One Page 109-122 (T.E.)
	b) **Compare** living object to a non-living object on the basis of growth, need for food and water and reproduction.	a) Compare a living object to a non-living object. List their various properties and discuss — animal and non-living object. — plant and non-living object.	

c) To **observe** how seeds grow. (germinate)	a) Place seeds between damp, rolled blotting paper (or paper towel) and a clear glass. Put a small amount of water into the bottom of the glass to keep the paper moist. Observe the growth within three to six days.
d) To **observe** that fruits produce seeds.	a) Cut up a variety of fruit. Examine the seeds and discuss findings. Determine what is needed for seeds to grow.
e) To **compare** and **classify** seeds on the basis of large and small. To **observe** and **compare** the growth of different seeds and **make a simple bar graph showing** their growth.	a) Give children a number of seeds on a plate. Bird seed works well. Sort the seeds into like groups. Examine with magnifying glass. Each group plants two small seeds and two large seeds. Observe the growth over several weeks and make measurements. Make a simple bar graph of the growth. b) Use seeds from pumpkin (possible Halloween activity) to count, sort, cook, plant, eat, etc.
f) To **classify** objects into living and non-living groups.	a) Field trip: In the school yard, examine the area, chart observations and explain why the objects discovered are living or non-living.

Grade One

1.2 Ourselves

Concepts	Processes and Skills	Suggested Activities	References
1. Bodies vary in a) height b) mass c) shape NOTE: Teachers should take care that children do not become concerned about personal comparisons.			Language Development Unit... Social Studies Topic "Me".
	a) To **observe** differences in height, mass and shape of people.	a) Use partners. Measure height of children in the class using colored strips of ribbon or paper. Make comparisons by graphing heights: — as a class; — boys and girls separately. Discuss findings.	
NOTE: Children should be encouraged to devise ways of recording data.		b) Make a book about yourself. Put pictures in it. Measure your height and mass each month. Find out how you are growing.	Addison-Wesley Science Level One Page 115 (T.E.)
	b) To **indentify** and name various body parts.	a) Have students discuss various body parts, (fingers, hand, head, nose, eyes, chest, leg, toes, etc.) and when you use them. b) Game — "Simon Says". Have students point to various body parts.	Addison-Wesley Science Level One Page 122A to 131 (T.E.) Your Body.
	c) To **measure** and **compare** the height and weight of people.	a) Measure and record child's mass. Compare with heights. Any relationship?	Sc. 5/13 **Ourselves**
	d) To **graph** and **record** information (use **one-to-one** relationship eg. ribbon length equals student.	a) Trace body outline on graph paper or paper which has grids on it. Count the squares.	Sc. 5/13 **Ourselves** Page 6,7, 10 **Integration** **Math** — differences **Art** — make life-sized stuffed "people".
2. Head and faces vary in size and shape.	a) To **observe** and **classify** head shapes.	a) Draw face profiles and full face views. Classify.	Sc. 5/13 **Ourselves** Page 11
	b) To **measure** and **compare** head sizes.	b) Measure heads with tape measure or paper strips. Take random sample of head sizes of children of differing sizes. Compare size of head to age of child.	Sc. 5/13 **Ourselves** Page 11

3. Eyes vary in color and ability to see.	a) To **observe** differences in eye color.	a) Count number of students with blue eyes, brown eyes, etc. Make a graph to show distribution. Note: There may be few differences in some communities.	Sc. 5/13 **Ourselves** Page 12
	b) To **classify** and graph eye colors.	b) Make a chart of parent's eye color in relationship to eye color of child. Discuss findings. Note: Be careful of reactions of adopted children.	Sc. 5/13 **Ourselves** Page 13-14
		c) Test children's eyesight with an E type chart. Discuss results and eye care. You may want to invite the school nurse to visit at this time.	Sc. 5/13 **Ourselves** Page 15 Integrate with White Cane Week. (February)
		d) Have one child look out a window and another at his pupils. Then have one child close his eyes for ten seconds and another one examine the pupil for change.	Sc. 5/13 **Ourselves** Page 18
4. Ears vary in shape and size	a) To **observe, classify** and graph variations in ear lobes.	a) Have children examine each other's ear lobes to determine types. Graph your findings.	Sc. 5/13 **Ourselves** Page 22
	b) To **identify** sounds.	a) Tape household sounds and children guess what they are. Tape school sounds.	Music — hit similar shaped bottles filled with various amounts of water. Note results.
5. Hair varies in form and color.	a) To **classify** types of hair as to: —color —straight or curly and graph.	a) Survey hair color of class members. Graph results. Then have each child decide if his/her hair is curly or straight. Devise simple experiments to test strength of each. If available, look at hair using a microscope.	Sc. 5/13 **Ourselves** Page 25
	b) To **classify** on the basis of hair and eye color and to infer the relationships between hair color and eye color.	b) Have each child list his/her hair color and eye color on a card. Put like cards in one pile. Chart results and discuss any relationships discovered. If everyone's hair and eye color is the same, discuss reason. Are there greater differences in hair and eye color in other communities?	Sc. 5/13 **Ourselves** Page 25
	c) To **observe** the use of the tongue, teeth and mouth in speaking and eating.	c) Using a mirror, have child speak and observe what he does with his mouth and tongue. Discuss. — Count child's teeth. Compare number with other children. Note their ages. Discuss. — With a blindfold on, identify foods by taste only. Then hold the nose and identify foods. Discuss results.	Sc.5/13 **Ourselves** Page 27 **Health** — How to Clean Teeth.

6. Legs and feet vary in size, shape and strength. NOTE: A lesson in personal hygiene may be in order under certain circumstances.	a) To **measure** the length and width of feet.	a) Measure feet of children by: -- using a ruler — tracing onto graph paper.	Sc. 5/13 **Ourselves** Page 29 **Mathematics** — Integration. **Art** — Feet picture portraying people from different "walks" of life.
	b) To **observe** differences in foot shape.	a) Sprinkle bare foot with powder and print on black paper. Observe differences in children's prints. b) Put several barefoot children behind a screen with only their feet showing. Do boy's feet differ from girl's feet? What is a fair test? c) Put a large sheet of white paper on well. Each child inks fingers, then jumps as high as possible and puts fingerprints on the paper. Record names on prints. Is there any general difference in height of boys' and girls' jumps?	Sc. 5/13 **Ourselves** Page 30 **Health** — Foot Care Sc. 5/13 **Ourselves** Page 32
7. Arms and hands vary in size, shape and strength	a) To **measure** finger length.	a) Trace finger outlines on paper. Measure length. Discuss differences in their length.	Sc. 5/13 **Ourselves** Page 35
	b) To **measure** how large the hand is.	a) Place water in a clear container and mark level with tape. Place hand in container. Note differences in water level.	Sc. 5/13 **Ourselves** Page 36
	c) To **measure** the strength of the arm.	a) See how long a child can hold up a heavy object in each hand. In which hand can he hold it longer? Discuss.	Sc. 5/13 **Ourselves** Page 38
	d) To **observe** and **compare** differences in fingerprints.	a) Using an ink pad, ink finger and print on the paper. See if prints are the same for both hands. Compare with a friend's print.	Sc. 5/13 **Ourselves** Page 41

1.3 Properties of Materials and Change

Main Concept: Change occurs when the properties of objects (matter) are modified. Changes occur in observable patterns of order and time, and occur constantly throughout the environment.

Concepts	Processes and Skills	Suggested Activities	References
NOTE: Properties of objects are examined further in order to continue to develop classification skills and the ability to compare objects on the basis of one or more properties.			Language Development Unit... Popcorn
1. Objects (Solids) can be distinguished by physical properties such as color, size, mass and shape (solids retain their shape...)	a) To **describe** objects in terms of properties.	a) Use common objects found in pupils' pockets, and describe their properties.	
	b) To **identify** objects on the basis of description of their properties.	a) Name specific properties of objects and ask children to identify objects. eg. Can you find an object which is blue? light? heavy? round? soft? hard?	
	c) To **compare** masses of objects.	a) Set up balances and have children compare masses of balanced objects. Make mobiles.	Sc. 5/13 Changes — Stages 1 and 2 and Background, Pages 28, 29 Making Mobiles.
	d) To **classify** a group of objects on the basis of single properties and graph.	a) Put objects (such as buttons, cut out shapes of cardboard, pictures of plants, animals. non-living objects) into their sets or categories on the basis of the following criteria: color, living, non-living, number of corners, etc.	
	e) To **identify** and **classify** objects on the basis of two properties.	a) Put objects into sets on the basis of two properties: round and yellow; round and red; square and red, etc. Choose an object. Try to list as many combinations of two properties as possible that are related to size, shape, color, mass, texture, eg. soft and yellow, round and heavy, small and square.	
2. Objects (solids) differ in their texture, hardness and relative weight.	a) To **compare** a specific property in pairs of objects.	a) Look at pairs of things and compare them as to soft (when looking at a sponge and a stone), smooth (a cactus and a leaf), etc. A sponge is **softer** than a stone. A leaf is **smoother** than a cactus. A feather is **lighter** than a rock.	

	b) To **compare** three objects to determine the degree of a specific property.	a) Look at three objects and order them on the basis of texture, weight, and hardness (eg. hardness would include a penny, pencil, modelling clay). hard, harder, hardest light, lighter, lightest soft, softer, softest	
3. Change occurs where the properties of objects (matter) are modified.	a) To **observe** and **identify** objects that have had properties changed.	a) Introduce the concept of change through various observations over a period of time, eg. moistened bread in an open jar, dry bread and an apple in an open jar, concentrated sugar solution. Present something like moldy bread, cheese, yogurt, etc. and ask if it was always like this. Use (or have students draw) pictures of before and after.	Sc. 5/13 **Change** Page 57
	b) To **observe** and **identify** changes in properties such as shape, size and color on the basis of evidence.	a) Give groups of children plastic bags, aluminum plates or other containers holding such things as: — crushed potato chips — grated carrots — confetti (or paper from a paper punch) — white chalk dust — crushed hard candy — minced colored and white chalk dust — pencil shavings Show examples of the original objects, eg. whole potato chips or whole carrots. Ask children to identify the objects in the bags by matching them with the whole objects. Ask children to identify those objects which changed in such properties as color, size, shape. b) Provide rubber bands, cardboard squares, paper clips, and similar materials and ask children to identify possible changes in size and shape.	
	c) To **distinguish** between a solid and a liquid.	a) Through use of various examples, students should formulate an operational definition for solids and liquids.	Addison-Wesley Science Level One Page 43-47 (T.E.)
4. Changes in properties of objects (solids) can occur when water is added to some objects.	a) To **observe**, **identify** and **describe** change in the properties of solids and and water.	a) Select objects which change readily on contact with water (eg. sugar, soil, soft-drink powder, tissue, crackers) and objects which do not (buttons, wood, spaghetti, celery). Add water and observe changes. Provide samples of the dry materials for comparison. b) Make gelatin dessert and have students observe various stages of solidifying. (Use one cup of water with package). Make peppermint creams. You will need: 1 white of egg 1 tsp. water icing sugar oil of peppermint (essence)	Science 5/13: Change Stage 1 and 2, Pages 53, 56

		After beating the egg white, add sugar until mixture is stiff. Add water and a few drops of essence and beat again. Then add more sugar until the mixture will knead. Turn out onto a piece of greaseproof (waxed) paper. Roll out and cut into shapes. Allow to set in a warm place. List the changes which you have caused starting with the egg, sugar and water.	
5. Changes in properties of objects (solids) can occur when the objects are heated or cooled.	a) To **observe** changes in properties of objects (solids) when objects are heated or cooled.	a) **Demonstrate:** — a candle burning — melting ice in a spoon over a candle — melting and cooling of hard candy — burning of a wooden splint — melting snowballs Ask children to observe, describe and compare changes in the heated and cooled objects, eg. the candle has changed from being cold to giving off heat, it has changed in mass and length over time.	Addison-Wesley Science Level One Pages 48-50 (T.E.) Science 5/13 Change Stage 1 and 2 Pages 49-52.
	b) To **infer** the presence of change by comparing changed objects to the originals.	a) Provide pictures or samples of unpopped and popped corn, bread and toast, cake and cake dough, burned splint and unburned splint, and other materials. Students match changed and unchanged materials and describe the properties changed.	
		b) Have children draw before and after pictures. Let other children discuss the properties of each of the objects (before and after). Discuss what properties have changed and how the change was effected.	Art
6. Some changes occur in a regular pattern and can be ordered.	a) To **compare** and **order** in sequence, steps which illustrate changes.	a) Have children order groups of three pictures which are out of sequence. Examples could be ice cubes melting, food being prepared, pictures of growth, clothes washed and dried and other examples that are available. Have children draw examples to share with class.	Art
7. Some changes are more easily reversed than others.	a) To **discriminate** between changes in terms of ease of reversal.	a) Present easily reversed changes (eg. move a chair back and forth, open and close a door, inflate and deflate a balloon) and less easily reversed changes (eg. break chalk, tear paper, sharpen a pencil). Ask children to identify the changes in properties which can easily be undone or not easily undone. b) Present pictures of change and ask children to indicate those changes which can be easily reversed or not easily reversed.	
8. Some changes occur slowly and others rapidly.	a) To **observe** and **describe** changes of different duration.	a) Have children look at a big and a small candle and decide which will take longer to burn. Observe a big and small ice cube, and observe which takes longer to melt. Draw a large picture of a flower and a small picture. Which takes longer to draw?	

	b) To **compare** the time needed to produce a change where changes begin simultaneously.	a) Observe a young plant and an adult plant. Note which takes longer to grow. Look at a popsicle and a snowman. Note which takes longer to melt if melting starts at the same time. b) Record and graph the time required for snowballs of different diameters to melt.	
9. Weather can exhibit different kinds of change.	a) To **observe** changes in the weather and **infer** whether they are rapid or gradual.	a) Have the students make a weather record from Monday to Friday. Use the following criteria to record the weather: sunny-cloudy, windy-not windy, dry-rainy and cold-warm-hot. At the end of the first week have them predict Saturday's weather according to what they observed during the week. Do this until the end of the third week at which time they predict the weather for the whole weekend. Some students may want to predict the weather for the entire week after predicting three weeks. Emphasize that the important thing is the basis for the prediction and not whether the prediction was correct.	Science 5/13 Changes Stage 1 and 2 Page 23-25

Grade One

1.4 Energy and Energy Conservation

Main Concept: Energy is found in many forms. Plants and animals use food energy. Machines use a different kind of energy. Energies that are common such as light, heat, oil, gas and electricity can be saved if used wisely.

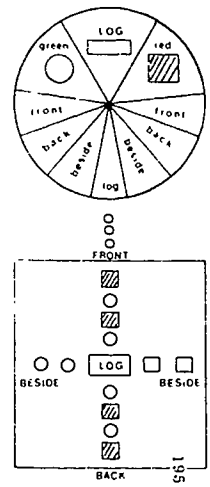
Concepts	Processes and Skills	Suggested Activities	References
1. Energy is found in many forms. Everything that we do requires energy.			Language Development Unit... Energy and Energy Conservation.
	a) To **describe** several human functions (walk, talk, run, play, etc.) as examples of human energy.	a) Have students list all the things they have done in in the last half hour. How many of them required energy? b) Discuss how one feels after not sleeping for a long time or not eating all day. Where do we get our energy from?	Seeds and Literacy Series Level One Activities 1, 2 (T.E.) Filmstrip: Energy Everywhere Seeds Literacy Series.
	b) To **compare** activities of living/non-living objects.	a) Show pictures of plants, animals, non-living objects. Ask students to list any type of movement or action by that object. Move the discussion towards the statement "Living things move and use energy to do so". b) Read a short story from your reader. List the different ways that a person/animal/etc. used energy in the story.	Seeds Literacy Series Level One Activities 3, 7, 8 ,9, 12 (T.E.)
2. Machines use a different kind of energy.	a) To **identify** the different types of machines that are all around us.	a) Make a list of various machines that we need everyday (ski-doo, furnace, can opener, etc). What type of fuel do they use? (Save the list for later use). b) Is the community generator a machine? What kind of energy does it use? (Diesel fuel) Produce? (Electricity). How many ways do we use electricity? Make a big list on chart paper. (Save this for later use).	
	b) To **identify** gasoline or electricity as the major source of energy for most machines.	c) Name a machine that: — produces heat — produces light — produces electricity to run other machines — heats water — runs on gas — runs on wood — ...etc. d) Have students pretend that they are a machine. By either acting out or by making the sound that the machine makes, have other children try to guess what machine they are and also indicate the type of energy the machine uses.	Drama

3. The sun's energy can be seen as light or felt as heat.	a) To **predict** the effect of energy from the sun.	a) Place one glass of water on a window ledge in the sunshine and another identical glass away from the sun's rays. After a short wait, feel the water in each glass. Do they feel the same? Why?	Addison-Wesley Science Level Two Page 170-181 (T.E.)
		b) Repeat using two snowballs placed in different areas.	In some communities, winter sunlight is of very short duration. You may substitute a light bulb to represent the sun. The light bulb should be placed very close to the glass and perhaps a piece of cardboard could separate the second glass of water from our "substitute" sun.
		c) Students have already established in section 1.1 that light is essential for plant growth. Two identical plants could be grown, one in a light free environment to demonstrate the need for light energy from the sun.	
		d) Teacher could discuss how we use light: — to see — for plants — solar cell to run calculators — to cook (solar collector — box lined with tin foil).	Addison-Wesley Science Pages 69-73 (T.E.) Level One
4. If we are careful (wise) some energies can be saved.	a) To **identify** ways that we can save energies.	a) Refer back to your list of how we use electricity. Is there any way that we could use less energy to do/use these things?	Seeds Literacy Series Level One Activities 16, 17, 18 (T.E.)

Grade One

1.5 Comparing and Measuring

Main Concept: Objects can be compared, described, ordered and measured on the basis of arbitrarily chosen reference points and non-standard units. Events occur in a particular order or sequence, having varying durations of time. Events may be regular or irregular in frequency.

Concepts	Processes and Skills	Suggested Activities	References
1. Objects can be compared and ordered by size by using non-standard units.	a) To **compare** sizes large/small.	a) Use terms (large, small) to compare sizes of objects in pictures. For example, the chair is larger than the waste basket but smaller than the desk.	
	b) To **compare** sizes relative to arbitrary standards.	b) Use any object with range of sizes, eg. beans, buttons, and compare. Place them in order from smallest to largest; from very narrow to very wide, etc. Choose 3 to show patterns such as big, bigger, biggest; wide, wider, widest.	**Mathematics:** Integrate vocabulary and measurement skills.
	c) To **measure** objects with arbitrary units.	c) Ask children to compare sizes of two similiar objects. Then try measuring using a stick or a string. Try more methods of measuring using toothpicks, popsicle sticks, etc. Discuss reasons for standard units. Why would a pencil or crayon not be a good choice to use?	
2. The position of an object is determined relative to arbitrarily chosen reference points.	a) To **describe** the position of objects — relative to reference point or object. Use the terms **above/below, front/back, up/down,** etc. in terms of **far/near.**	a) Use a toy animal and other objects which you move in relation to the toy. For example. A toy on a table top may be above the floor but below the ceiling while it is on top of a table.	
		Game "Frog on the Log". Use a spinner and colored square. (See diagrams at right). Place paper as in diagram. One child is appointed the frog and sits on the log that spins the spinner. S/he tells the first child in line to take the position the spinner indicates. If it spins to the log, children change places. Continue until all spaces are filled then repeat.	
	b) To **measure** distance in arbitrary units.	b) Hold objects far and near from reference points. Describe the position using the suggested terms.	

3. Events may be of short or long duration.			Language Development Unit...Time
	a) To **observe** length of events.	a) Burn short candles and long candles of same thickness. Graph results. Record the time burned and the length of the candle at regular intervals. Graph the results using a picture of the candle drawn to the exact length that it was at the times measured.	An alternate reference to cover these concepts is Sc. 5/13 Time
	b) To **predict** the comparative durations of events.	a) Melt snowballs/ice cubes of different sizes and observe duration of each race.	
		b) Predict and verify difference in time between opening zipper and buttons of coat.	
4. Changes may occur over different time periods and in varying degrees (space).	a) To **compare** changes in objects over time.	a) Have students observe and compare changes in cut fruit, mixed cement, pudding mix, beans in water and dry, nails in water and dry, over a period of time.	
	b) To **infer** periods of time from pictures.	Observe that growth and change occur in humans and animals.	Addison-Wesley Science Level One Page 116-119 (T.E.)
		b) Have children describe length of time between changes (eg. pictures of summer and fall, plants growing, balloons breaking).	Addsion-Wesley Science Level One Page 92-93. (T.E.)
5. Events may be regular or irregular.	a) To **test** events for regularity or irregularity.	Perform a variety of activities to test for regular or irregular repetition, eg. tap out a regular beat and observe a clock second hand as regular events. Test events for regularity — pendulum, see-saw, popcorn in a pan (irregular), traffic on a street (irregular).	
6. Events occur in a regular time sequence (days, weeks, months, seasons).	a) To **sequence** events.	a) Use sequenced pictures, comic strip sequences, Let's Pretend game, to illustrate concept of sequence.	Addison-Wesley Science Level One Pages 85-96.
	b) To **record** data relative to time spent at tasks.	b) Make a chart of each day's activities.	
		c) Name and record recurring events, eg. weekends, T.V. programs (repeat daily or weekly), day-night sequence.	
		d) Study seasonal changes.	
	c) To **estimate** and **compare** different regular time sequences.		The months for each season will change from community to to community.

Grade Two

2.1 Properties of Living Objects

Main Concept: Living Organisms exhibit unique properties.

Concepts	Processes and Skills	Suggested Activities	References
1. Objects can be classified as living or non-living. (Review of Grade One).			Language Development Units ... Plants ... Populations ... Living/Non-Living
	a) To **identify** and **classify** objects as living and non-living.	a) Visit (or imagine yourself in) the local Co-op or Bay Store. Discuss the reasons for the organization of objects. What "areas" of goods are grouped together? What do they have in common?	Field trip to Co-op or Bay Store. Integrate Mathematics "Like and Unlike Sets".
		b) Make a large chart divided into columns labelled "living" and "non-living". Have children choose objects from school, the home and the community and put under the correct heading. Discuss reasons for their choices.	
		c) If you have an aquarium or a terrarium in the classroom, list all of its components and classify them as to "living" or "non-living".	EYE — Ecology in your community. Pages 12-15.
2. Living things can be classified according to properties.	b) To **identify** some properties of living things.	a) Measure a growing object over a period of time. Keep a record. b) Keep track of all the food that you have eaten for several days. What would happened if you stopped eating? c) Have children bring an article of clothing they wore last year. What has happened? Why do they not fit any more? d) If you have a plant such as the Pitcher Plant, Venus Fly Trap, or Touch-me-not (Mimosa), allow the children to touch them. Note what happens. (react to stimili). e) If you have a dog whistle, blow it and see what happens. Can students hear it? Why not? Can anyone hear it? Why? f) Ask students if they have ever observed insects around a light or lamp. Explain!	

3. Plants differ from animals in specific ways relative to how they obtain food, how they react to stimuli, how they move and how they reproduce.	a) To **identify** some of the differences between plants and animals, eg. — most animals have locomotion, plants do not. — plants produce own food, animals do not. — most plants are green, most animals are not.	a) Depending on the time of year, make a trip to a small pond, stream, ditch or seashore. Collect specimens, using jars and dip nets. Look at various aspects such as means of locomotion, feeding habits, color, etc.	
	b) To **infer** that seeds are important for the continuation of most plants and to **identify** ways in which seeds are transported.	a) Through the use of pictures and/or actual samples, examine the difference in size, shape, color, etc. among seeds. b) Discuss where seeds can be found and how they get there (wings, fluff, hooks, floats, etc). Children really enjoy the chance to examine and eat various seeds such as sunflowers, coconut, pumpkin, poppy, caraway and celery seed.	Addison-Wesley Science Level Two Page 1-5 (T.E.) Addison-Wesley Science Level Two Page 6-9 (T.E.)
4. Plants live in many different habitats within an environment	a) To **identify** habitats in which plants live, eg. — soil, air — trees — water — water lily — air — spanish moss	a) Examine several plants (actual and in picture). Identify substance in which each is growing. Transplant some plants into another environment and observe what happens. Compile scrapbooks — place plants under appropriate heading (soil, water, air).	
	a) To **identify** changes that plants undergo on a seasonal basis.	a) Discuss the changes that must occur in plants as the weather changes due to the seasons. When do plants grow best? When do they die? How do some plants survive the winter? What happens in the spring?	Addison-Wesley Science Level Two Pages 20-23 (T.E.) Pages 158-161 (T.E.)
5. Animals live in many different habitats within an environment.	a) To **identify** the habitats where animals live.	a) Have children name various animals. Chart. Show pictures of different animals, eg. birds, fish, insects, land animals. Discuss where these live. Develop a chart on where the animals live, eg. tundra, bush, desert, ocean.	
	b) To **identify** changes that animals undergo on a seasonal basis.	a) Discuss how animals prepare for the onset of winter: — grow more fur — gather food — migrate — hibernate — change eating habits — some lay eggs which will hatch in spring?	Addison-Wesley Science Level Two Pages 24-31 (T.E.)

		b) What sort of changes occur in animals in spring? — become more active — seek mates — lay eggs/give birth to young.	Pages 162-168 (T.E.)
6. Young plants resemble their parents. Some animals reproduce young which resemble their parents. Other animals do not resemble their parents until mature.	a) To **compare** the appearance of young plants with their parents.	a) Examine seeds for evidence of a tiny embryo and stored food. Soak seeds in water before slicing open and examining with a hand lens or magnifying glass. b) Grow several seeds and compare young plants with pictures of or actual parent plants. Note that young plants resemble their parents.	Addison-Wesley Science Level Two Pages 10-13 (T.E.)
	b) To **predict** which pictures of young animals correspond to pictures of their parents.	a) Have sets of pictures of both young and adult animals. Try to match them up.	Various magazines containing numerous photos of young and adult animals — PIK — Owl — Chickadee — Ranger Rick
	c) To **identify** similarities and differences between young and adult animals.	a) Collect egg specimens (if available) and raise in classroom. Illustrate stages of life cycle. Check with library or resource centre for a film-strip on life cycles of various animals. b) Draw a series of pictures showing life cycle sequences for some animals, eg. egg - young - adult - egg.	Addison-Wesley Science Level Two Page 164 (T.E.)
7. Plants move in response to stimuli whereas animals have locomotion.	a) To **observe** and **identify** ways in which animals can move. b) **To predict** plant movement in response to light.	a) Observe organisms in a terrarium or aquarium. Discuss what parts help the organisms to move. Record. b) Place one plant in a closed box with a hole and place another plant beside the box. After watering, leave plants for one week. Predict what will happen.	S.S. — Transportation L.A. — Communications.

8. Plants require nutrients which they obtain from the water, air and soil. Green plants require light to make food.	a) **Describe** what happens to plants: — when deprived of water or light. — when placed in cold temperatures.	a) Place two like plants in sunlight. Water only one. Observe what happens over a period of time. Take two like plants. Put one in sunlight and one in a dark room or box. Water. Observe what happens. Place one plant in a freezer, one in the fridge, one in the closet. Observe.
	b) To **observe** and **describe** the effects of different soils upon seed growth.	b) Plant seeds — several in soil, several in sand, and several in pebbles. Water and observe.

Grade Two

2.2 Properties of Matter

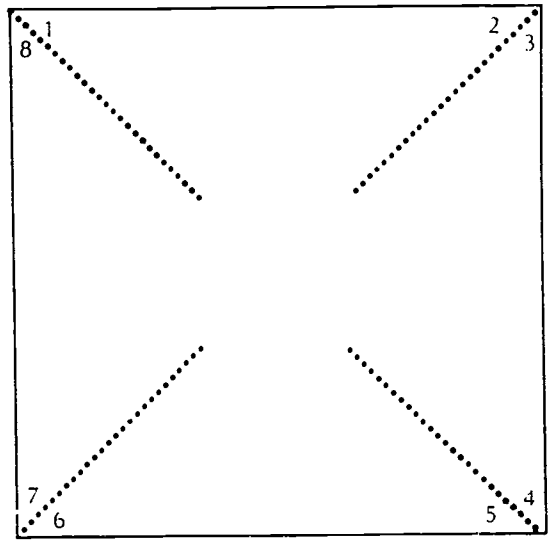
Main Concept: Objects (matter) commonly exist in three distinct forms: solids, liquids and gases. Each form has characteristic properties.

Concepts	Processes and Skills	Suggested Activities	References
Review properties of objects (solids) and change from Grade 1.			Language Development Units ... Solids (Popcorn) ... Water (Liquid) ... Air and Air Pressure
1. Objects are made of materials which have unique properties.	a) To **identify** objects on the basis of their properties (material).	a) Have a child who is "it" pick up an object and give a clue about the material from which it is made; eg. bends or is shiny. Children are asked to name the object.	
	b) To **discriminate** between objects made of one material and those made of more than one material.	a) Use pictures or sets of objects which contain objects made of one or more materials. The number of materials in the objects in the set are identified and the objects can be classified according to the number of materials in the objects.	
	c) To **classify** objects in terms of the kind of material.	a) Use pictures or sets of objects which are made of metal, wood, fabric, paper, plastic, or similar materials. Objects are classified on the basis of their materials. Identify the material of which the object is made before grouping sets of objects together. Use the classroom furniture, fixtures, equipment, etc. and group objects composed of identical materials.	
2. All objects are made of material called matter.	a) To **identify** as matter all things that have weight and take up space.	a) Before proceeding be sure that the children know the pronunciation and meaning of weight and matter. b) Have children look at pictures, or their classroom surroundings. Identify living things that are matter and non-living things that are matter. c) Look in some magazines for pictures of matter. Cut them out and paste them on construction paper.	Addison-Wesley Science Level Two Page 77-79 (T.E.) Art
3. Solids have distinct properties: a) ability to retain their shape, can be stacked.	a) To **identify** solids in a group of solids and liquids.	a) Use pictures of a mixed group of solids and liquids or a single demonstration set of objects. A cup of sand and a cup of water can be poured into other containers. Sugar cubes can be crushed and poured. Children sort the objects into liquids and solids.	Addison-Wesley Science Level Two Page 80-83 (T.E.)

b) can be poured only if in small pieces.	b) To **identify** different forms of the same solid as containing the same material.	a) Modelling clay, sugar cubes, aluminum foil, candy, paper clips, or similar materials are provided along with plastic bags and wooden block. Children change form of the material. Emphasize that there is no change in material. b) Provide students with pictures or samples of different forms of solids, eg. cloth and thread from the cloth, wood and wood shavings, peanuts and crushed peanuts, pencil and pencil shavings, aluminum foil and aluminum cubes, sugar cubes and sugar grains, etc. Similar solids are matched.	
4. Some solids can be classified as metals on the basis of specific properties, eg. — shininess — flexibility (bends) — can be beaten flat by hammering (malleability).	a) To **observe** and **record** some properties of metals.	a) Provide students with samples of copper wire or nails, aluminum wire or nails, paper clips, brass nails or similar material. Small toy hammers, and wooden blocks should be available. Other tests such as the scratch test can be applied to examine hardness.	
	b) To **compare** a property in samples of the same material.	a) Samples of three or four different woods, eg. balsa, pine, spruce, oak (available from the shop or DPW) can be tested in terms of hardness by a scratch test. A common testing instrument such as the fingernail or a nail can be used. Compare strengths of different strings (of same thickness).	
5. Liquids have distinct properties: — take the shape of the container — can be poured — splash — form drops	a) To **observe** and **describe** the behavior of liquids.	a) Demonstrate: Pour water into bottles of different shapes. Tilt a jar of water to observe the shape of the liquid. Place single drops (by eyedropper) on some pieces of wax paper or a number of drops into a shallow dish.	
	b) To **compare** liquids to solids.	a) Pour liquids, eg. vinegar, cooking oil, into bottles of different shapes. Children can describe the different shapes taken by the liquids. Place a few pebbles into a shallow container. Pour sand into a shallow container. Children should compare the effect of containers upon materials.	Sand can be very confusing for students. Careful discussions will be required.
	c) To **observe** and **compare** some properties of different liquids.	a) Provide groups of children with a vial of clear liquid, several different colored liquids and cooking oil, paper towelling, waxed paper and a short soda straw. Have students place a drop of the liquid first on the paper towel, then on waxed paper. Note the color, whether the liquids are transparent or opaque, and whether they are absorbed.	

6. Liquids vary in the degree of specific properties such as: — color — transparency to light — ability to dissolve sugar.	a) To **test** and **compare** different liquids on the basis of properties of color, light transparency, and ability to dissolve sugar.	a) Assemble six vials (labelled A-F) of liquid such as vinegar, milk, water, cooking oil, syrup or motor oil; short straws, paper towelling and sugar cubes. Test viscosity by stirring with the straw and by dipping a straw into a liquid and allowing the liquid to drip on the towel. b) Discuss what is fair trial for testing absorbency (a drop of two liquids on squares of paper towelling at the same time, repeat for other pairs of liquids). c) Place sugar cubes into the vials and observe rate of dissolving. Order from fastest to slowest. Results should be recorded on the board.	
	b) To **identify** sample liquids on the basis of evidence	a) Mystery Liquids — provide children with pairs of liquids, eg. water and vinegar, cooking oil and syrup. Children can test and compare properties and identify the samples by slowly pouring each of the pairs from a teaspoon at the same time.	
	b) To **order** liquids on the basis of properties.	a) Use sets of three vials of different liquids. Order them from 1-3 on the basis of color of liquids, clarity, ability to dissolve sugar.	
7. Gases have distinctive properties: — take up space. — can move and cause objects to move.	a) To **infer** the presence of gases on the basis of evidence.	a) Take a shoe box and cut a hole in it. Students should note that their box looks empty. Have them push on the sides of the box and feel the air escape. b) Have students place solid objects such as an eraser in a bag. Force all of the air out of the bag so that the eraser pushes against it. Put water in another bag and tie it. Blow up a third bag. Students should note that the air pushes on the bag just as the eraser and the water do. c) Blow up a balloon. Students should note that the gas blown into the balloon gives it shape. Thus the gas takes up space.	
	b) To **infer** the presence of air by observing that it can make objects move.	a) Fold a small piece of paper and set it on the table. Observe that it doesn't move. Using a straw, the students should then blow on the paper and observe that the air they blew out moved the paper.	Art — blow paint pictures using a straw.

b) Have students make a pinwheel. Make a diagonal cut from each of the four corners of a piece of plastic, art paper or construction paper. Fold corners 2, 4, 6 and 8 into the centre. Stick a pin through the centre and then pin to the eraser on the end of the pencil.



The students may blow on their pinwheel, hold them near open windows or vents and take them outside. They should infer what causes the pinwheel to move.

The students could look at pictures to observe and point out motion caused by the air, eg. trees swaying, snow falling, flag waving.

c) Place anywhere from 5 to 8 garbage bags on a desk or table top so that they cover most of the surface and the open ends are over the outside edges. Place an inverted desk or tabletop over the garbage bags. Have one student sit on top of the inverted desk or tabletop while the other students blow into the garbage bags. The more the students blow into the garbage bags, the higher the person on top of the desk or the tabletop will rise as the air is forced to do work.

Invitations to Science Inquiry, Page 48. Excellent ideas and motivators can be found in the text "Invitations to Science Inquiries".

Grade Two

2.3 Energy and Energy Conservation

Main Concept: Energy is the ability to do work. Some energies are converted by people to do work. All energies are present in nature. Wind, water, and wood can provide energy for our wise use.

Concepts	Processes and Skills	Suggested Activities	References
Review of grade one concepts. Plants, animals and machines use energy. Gasoline and electricity are two forms of energy which we can use. We get heat and light energy from the sun.			Language Development Unit... Energy and Energy Conservation.
1. Energy is the ability to do work.		a) Review the different ways in which people and animals use energy everyday. In what ways do plants and machines use energy?	Seeds Literacy Series Level Two Activities 1 Filmstrip — Energy Everywhere, Seeds Literacy Series.
2. There are natural and man-made forms of energy.	a) To **identify** objects as being man-made or made by nature.	a) From a grouping of objects, eg. book, pencil, paper clip, apple, bean seed, stone, etc. ask the children which are man-made and which are natural.	Seeds Literacy Series Level Two Activities 2
	b) To **infer** that electricity is an example of a man-made form of energy.	a) Discuss how your community gets its major energy. Is it from a generator which produces electricity? What does the generator use as fuel? How do you use this electricity? Is the electricity man-made or natural? Once you use this electricity, can you use it again? b) Keep an electricity diary for several days. List all your uses of electricity: — hot water for washing — toasting bread — cooking porridge — listening to radio — lights — listen to radio — etc.	Seeds Literacy Series Level Two Activities 6, 7, 8
	c) To **infer** that wind, water and wood are natural forms of energy.	a) Discuss ways in which wind may be used as an energy source: — windmills — sailing (small boats in a pail of water) — pinwheels, etc. — gliders — fly flags — wind generators — pump water — etc.	Seeds Literacy Series Level Two Activities 4, 5 Filmstrip: Energy from Wind, Water and Wood Seeds Literacy Series.

		b) In what ways can we use energy produced by moving water? Make drawings showing several ways. — moving boats down river — washing cars — sawmills — water wheels	
		c) Using an eavestrough and corks, show how water can do work. Change the speed of water moving down the trough. Have children make paper boats and record the time to pass through your man-made stream.	
		d) Discuss the different ways in which we use wood — to keep warm, to build things, papers, newspapers, books, toothpicks, etc. If you are below the treeline, you might include campfires, to keep warm, fireplaces, etc.	Seeds Literacy Series Level Two Activities 10, 11
3. Some energy sources are renewable while others are not.	a) To **infer** that both wind and water energy are renewable energy sources.	a) Keep a log (morning and afternoon) of whether or not it is windy. After one week, establish the fact that the wind keeps coming back — it is a renewable energy source.	Seeds Literacy Series Level Two Activity 3
		b) Where do you get your water from? Where does it go once you use it? Establish a simplified version of a water cycle. Since water is never really lost from the system, it must be renewable.	
		c) Once a tree is chopped down, can another grow in it's place? What must occur for this to take place? Since trees can be replaced, wood is a renewable resource.	
		d) What does it mean to "recycle" in terms of paper? How can we save or recycle so that there is more for everyone and so that it does not cost a lot?	

Grade Two

2.4 Measuring Time

Main Concept: Events occurring with regularity can be measured in non-standard and standard units.

Concepts	Processes and Skills	Suggested Activities	References
1. Certain events occur at regular intervals, others are irregular.	a) To **distinguish** between regular and irregular events.	a) Listen to a tape of regularly occurring events and some which are irregular. Have children simulate both. — clock ticking — tapping of fingers, slow, fast, irregular — snapping of fingers — phone ringing — tapping of pen on counter — leaky faucet — dropping a handful of coins b) Make a drip system and use it to measure time spans. For instance, how many drips fall while you walk from one end of the room to the other? To put on your parka and zip it up? To do five jumping jacks? etc. Could these events be measured using: — rings of a phone? — tickings of a clock — snapping of your fingers?	Language Development Unit...Time
2. The passage of time can be measured in non-standard units.	a) To **recognize** regular events and use them to tell the passage of time. b) To **predict** time intervals.	a) Shadow Clock. Stick a pole in the ground and mark its shadow at fixed intervals of time. Then use this shadow clock to predict time intervals. Check out predictions. b) Sand clock. Use an egg timer or make a sand clock from a funnel set in a baby bottle with a marked scale. Candle clock. Mark a candle with centimetre markings. Predict time intervals and burn to check predictions (teacher demonstration).	Sc. 5/13 **Time** Page 9-12, 19 Math. Integrate Sc. 5/13 **Time** Page 5, 19-20.
3. The passage of time can be measured in standard units hours, minutes and seconds.	a) To **recognize** duration of seconds, minutes, hours.	a) Ask children to suggest ways of telling a second, eg. water dripping, blinking an eye. Have them practice "one hundred and one". b) Have children suggest events lasting one minute. Example, how many times does a record go around a turntable in one minute?	

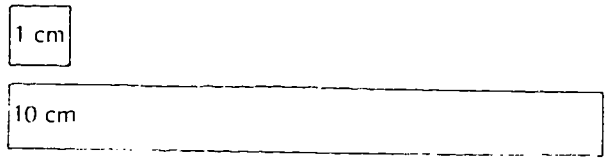
Have students close their eyes and put their hand up when one minute has passed.

c) Give each student a string of different length. Attach a washer or similar object to the string. Practice holding and releasing your pendulum. Count the number of times your pendulum swings back and forth in 10 sec. Each person records the number of swings in 10 seconds. What happens if you change the length of string, the object attached to string or the position of release for the pendulum? Discuss and explore possible experiments that you could perform. How could data be recorded? Extension: Go with your partner and find an activity that takes 10 seconds to do. Use your pendulum to measure the time. In 10 seconds (one student uses the pendulum to measure the time interval), how many times can you tap your feet, snap your fingers, etc. or how far can you count by 2's, 5's, 10's, etc.?

Grade Two

2.5 Measuring Objects

Main Concept: An object's size and position can be measured by non-standard and standard units. SI is an international system of measurement.

Concepts	Processes and Skills	Suggested Activities	References
1. One object can be used to measure another. It is more satisfactory to use a standard acceptable to all.	a) To **measure** a variety of objects, using a basic reference unit.	a) Have students make paper strips of two pencil lengths and then measure several articles with strips. Compare results. Recognize the need for standard size of unit. b) Trace and cut out your shoeprint. Measure distances such as hall length, room length, etc. and compare answers. Recognize the need for standard size of unit.	Addison-Wesley Science Level Two Pages 33-37 (T.E.)
	b) To **select** appropriate size of unit to measure both small and large objects.	a) Measure books, desk tops, etc. with paper clips and then thumb tacks. Compare answers. Recognize the advantage of using a standard unit.	
	c) To **select** and make a standard unit.	a) Children select an appropriate standard for the task and then all duplicate it and use it for measuring. Invent a name for your new standard unit. Practise using your new standard unit.	
2. Objects can be located and measured with respect to a reference object.	a) To **demonstrate** the six principal directions in space relative to an object (front, back, above, below, right, left).	a) Have children act out directions with respect to an object. Play "Guess the Mystery Object" game. One child is chosen to begin the game. He secretly picks an object which he can see and describes the position of this mystery object with respect to a previously designated reference object. The children of the class try to guess the object. The winner is then "it".	
	b) To **describe** the position of an object relative to a reference point.	a) Show the children the picture of a lost boat, bicycle or any other object and ask them how they would help find it and tell where it was.	
	c) To **measure** the position of an object with respect to a reference point.	a) Hand out a piece of paper with one centimetre square and a rectangle measuring 1 cm x 10 cm.  Have students determine how many of the smaller shapes (rectangles) can fit into the larger (10). Explain that the distances across the smaller rectangle is 1 cm and 10 cm for the larger one.	

		Measure the desk, your book, floor tiles, etc. using the smaller standard unit first and a combination of the two for larger distances.	
3. SI is an international system and is now used for measurements in Canada.	a) To **estimate** using SI units. Practise using metres and centimetres appropriately to **graph** data.	a) Present the class with a metre stick. How many of the larger units from the previous exercise will fit onto the length of the metre stick (10)? How many of the smaller ones (100)? a) Have children measure their heights and graph class growth. c) Grow beans. Measure height daily and graph daily growth. (Do not repeat if already done in section on living and non-living). d) Get some small objects. Measure them with a ruler. Tape the objects to a chart. Write down how may centimetres long each object is.	Addison-Wesley Science Level Two Pages 40-41 (T.E.)

Grade Three

3.1 Populations

Main Concepts: Populations vary, grow, and develop in different environments.

Concepts	Processes and Skills	Suggested Activities	References
1. The term "population" describes a group of organisms of the same kind in a particular environment.			Language Development Unit ...Populations Plants Living and Non-Living
	a) To **explain** in their own words the definition of a population.	a) Initial Activity — Examine a picture with a variety of living things in their natural environment and have the children give the population count of each, eg. caribou population, fish population.	
	b) To **observe** and **identify** various populations, and classify them as plant or animal populations.	a) Have children identify populations in different environments familiar to them, eg. — classroom populations Use terrariums, aquariums, small animals, pets, plants, people. Classify. Distinguish between land and water populations.	
		b) Choosing headings such as tundra, forest, beach, meadow, street, have children apply their understanding of populations by listing organisms to be found in each area.	
		c) School Yard Populations: Explore the school yard to find as many different organisms as possible. Record the type found and where it was found, eg. name of population, place where seen.	
		and/or	
	NOTE: Some N.W.T. communities have park/playground areas which could be explored	Park Populations: On a short field trip observe and identify various populations in the park. Record findings.	EYE **Ecology in the Community.** Page 26-34
		d) Raise a population of fruit flies. Leave a ripened banana or fruit in a jar for a week or until fruit flies appear. Place cheese-cloth over the opening. **Observe** the daily changes in the jar and record the findings. As flies increase in number, have children speculate about reasons for the increase.	
		Mix one part water with three parts oatmeal and place in a vial. Add a few grains of active dry yeast. Place the vial over an opening in the jar until four or five flies fall in. Put on cover. Put small holes in lid. Close up hole in cheesecloth. Put name on vial.	
		Observe the vial daily for changes in population, food color, and fly behavior. Record findings.	

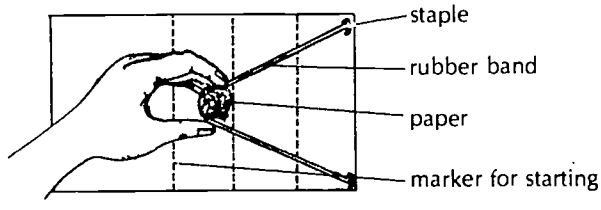
		Alternatives: Study the lifecycle of the earthworm or brine shrimp. Brine shrimp eggs are available commercially in packages and are easily raised in the classroom.	Alternate Resources: ESS Earthworms ESS Brine Shrimp
		e) Plant Populations — Plant a variety of seeds in small containers. Place on a drip tray. Keep a record of each plant population, eg. date planted, type, number, first seedling, seeds that grew, pictures of young plant, mature plant, leaf tracing. Discuss life cycle.	
2. The place of a population is its habitat.	a) To **describe** in their own words the definition of a habitat.	a) Discuss the habitat of the fruit fly, earthworm, or brine shrimp (eg. the life cycles studied). Have children identify the habitat of pets at home or school. Check for understanding.	
	b) To **identify** organisms with their habitat.	a) Prepare cards with animals in one set and their habitats in the other set. Match. Discuss other animals and ellicit their habitats from the children.	
		b) Take a closer look at the habitat of a selected organism such as bears, certain fish or perhaps even dinosaurs.	Language Development Units...Populations.
		c) Leave raw meat (caribou) etc. and obtain maggots.	
3. Populations in a particular habitat form a community. These populations are usually inter-dependent.	a) To **observe** a community and to identify its various populations	a) Have a small group of students stake off a 1 metre square (may need to be bigger) in a selected site such as a playground, any area with medium to dense vegetation. Observe its plant and animal populations.	Addision-Wesley Science Level Three Pages 12-17 (T.E.)
NOTE: Due to diverse geography of N.W.T. settlements, some students may be able to study sea-shore communities while others may study lawn, pond or wooded area communities. Expose the students to as many types of community as you can.	b) To **predict** the effect upon a community when one of the populations is removed.	a) Discuss the actions of the lawn community (eg. grass produces food; earthworms eat grass) and chart a simple interdependence chain, eg. earthworms loosen soil to help the grass grow and the grass provides them with food.	
		b) **Pond Community** — visit a pond and draw or describe the pond and its plant life. Children collect a litre jar of about six organisms. Study and record descriptions of organisms. Examine small, microscopic organisms. Return organisms to pond in a week or two. Supplement studies with filmstrips, books, recordings, etc. Discuss interdependence of pond life.	Addison-Wesley Science Level Three Pages 20-26 (T.E.)
	c) To **infer** that seashore communities are affected by day, night, tides and temperature.	a) **Seashore Community** — study first hand if possible, otherwise study by means of films, filmstrips, book. Note: The Barnacle — at high tide has a slit through which it reaches for food. At low tide slit closes to protect it from wind and temperature	Addison-Wesley Science Level Three Pages 32-33 (T.E.)

	d) To **apply** their knowledge of the interdependence of populations by communicating	a) Review this section by posing problems for the children to discuss, eg. how are populations interdependent? What would happen if one or two of the populations were removed from a community? Children in a group could be given a picture of a scene with an environmental problem and asked to discuss it.	Addison-Wesley Science Level Three Pages 34-37 (T.E.)
4. The existence and behavior of living organisms affects the well-being of mankind and/or of the overall community life and vice-versa.	a) To **infer** that organisms are labelled helpful or harmful depending upon one's viewpoint or values.	a) Activity: **What Do You Think?** Locate pictures which show such organisms as a dragon fly and a mosquito, a bird eating corn, a dandelion and a slug, a deer eating tree bark or others. Discuss if the organism is being helpful or harmful to man. Bring out the idea that an organism can be both helpful and harmful, eg. bird eating corn — harmful; bird eating insect — helpful. b) Take a walk in your area to see where man has been helpful or harmful to a community, eg. man-made structures discouraging animal and plant populations, areas where pipeline has been set up, etc. Chart ideas. Expand the discussion by providing other examples such as cutting down trees or filling in water holes. Group projects could be planned to improve a particular area for plants and animals.	Addison-Wesley Science Level Three Pages 206-211 (T.E.)
5. Living things compete for the things they need to survive and reproduce.	a) To **determine** how organisms compete for the things they need and to explain why all offspring do not survive to become adults.	a) Begin a discussion using pictures of plants and/or animals. What do each of the organisms need to survive? Where do they get these things needed for survival? Could other organisms be using these things? etc. Talk about plants that produce many seeds such as sunflowers, maple seeds, or animals that produce many offspring such as insects, snakes, etc. What would happen if all the offspring survived? What happens to the offspring? Do they just die? Are they eaten by other organisms? Do they move to new areas? etc.	Addison-Wesley Science Level Three Pages 212-215 (T.E.)
6. It is important to find out all we can before we try to control or change a community.	a) To **describe** the effect of a given change made in a community.	a) Discuss various examples of where man has made a change in a community. eg. Man sprays apples for insects and reduces the effect of competition for the apples. As a result, more and better apples are picked for our use. Has the spraying of the apples caused any other effects — kills insects that feed on spiders; — kills insects on which birds feed; — spray may kill other desirable insects such as ladybird beetles, etc. b) Think of more relevant examples of situations in your community such as spraying for mosquitos, examples of how man-made pollution has changed the organisms in your community or has affected the water quality.	Addison-Wesley Level Three Pages 216-219 (T.E.)

Grade Three

3.2 Energy, Heat And Temperature

Main Concept: Heat is a form of energy. Heat can produce changes in the properties of matter.

Concepts	Processes and Skills	Suggested Activities	References
1. Work is done when a force acts to move an object.	a) To **observe** and **describe** that two objects have interacted to produce motion and to describe the object that is doing the work.	a) Use before and after pictures which indicate motion — eg. nail hammered into wood; a bicycle moving; or a review of children's actions in moving desks, pencils, and other objects in order to identify work situations. Evidence of situations where work is not being done. eg. book on a table can be identified. b) Make a pinwheel from a 12-15 cm paper square. Cut diagonal lines to about 2 cm from the centre, curve the corners into the centre, push a pin into an eraser. The energy of air or water (if the wheel is of heavy cardboard) can be used to develop the concept of interaction and work.	
	b) To **observe** variables which will change the motion of an object. Examples are: — height affects a bouncing ball; — pulling on a rubber band affects the motion of a paper object.	a) Using one kind of ball (rubber, tennis, golf) children can drop a ball from different heights and measure and record the heights to which a ball bounces. Heights can be graphed by using a histogram. Investigate and compare the effects of other variables. For example, drop the balls (above) from the same height on the same surface and observe the differences. b) Staple a rubber band to cardboard and shoot a ball made of crumpled paper from the band. Record and compare the distances the ball is moved to the distance the band is pulled. Three or four trials for each distance the rubber band is pulled back should be recorded.  Other variables such as different sized bands or pulling the band back from the centre of left can be compared.	
2. There are different forms of energy. Heat is one form of energy.			Language Development Units... Popcorn, Energy and Energy Conservation
	a) To **observe** different kinds of energy and the interactions which have produced motion.	a) Different examples of motion and the object producing or supplying the motion can be discussed, eg. car moving, electric motor, water wheels. The middle of a pencil can be twisted four to six times in the loop of a rubber band and released.	

	b) To **identify** heat as a source of energy.	b) Make spirals out of thin pieces of paper. The spiral is balanced on a pencil point. Find a place in the room where the spiral moves, eg. near hot water register. A heavy spiral can be made out of aluminum foil and placed over an incandescent lamp or radiator. **Caution: Supervise carefully if using a hotplate or similar device.** Other examples can be discussed, eg. kettle.	
3. Temperature is the degree of hotness or coldness of an object.			Language Development Unit...T.B.A.
	a) To **observe** that differences in temperature (hot and cold) can be determined by the use of the skin. To **infer** that the skin is not a reliable temperature — measuring instrument.	a) Three cups can be filled with water at different temperatures (warm, room temperature, and cold). Students place one finger into the cold water and a finger from the other hand into the warm water. Then reverse the position of the hands. The hot and cold water should be identified in each case. After holding a finger from each hand in the hot, the student alternatively dips his fingers into the container with water at room temperature. Fingers should indicate different degrees of warmness for the water at room temperature	Addison-Wesley Science Level Three pg. 178-179 (T.E.)
4. Matter tends to expand when heat is added (warmed) and contract when heat is removed (cooled).			Language Development Unit...Air and Air Pressure
a) Gases expand and contract when heat is added and removed.	a) To **infer** the cause of expansion and contraction in a gas.	a) Assemble a narrow-necked bottle, colored water in a pie plate and a wooden piece or other heavy object. Warm the bottle in direct sunlight and insert upside down into the colored water in the pie plate, which has been placed in a cool spot. Attach the heavy object to the bottle with masking tape. Note that when the warm bottle becomes cool the colored liquid rises up the neck of the bottle.	Addison-Wesley Science Level Three Page 181 (T.E.)
		b) Make an air thermometer. Place a strip of tape on the neck of the bottle used in the previous activity. Place apparatus in a sunny area and then in a cold area (eg. refrigerator) for about a half hour. Mark level of liquid when it stops moving in both the hot and cold areas. Make a scale between the hot and cold markings. Use air thermometer to check temperatures in the morning, noon, etc.	Addison-Wesley Science Level Three Page 182 (T.E.)
b) Liquids expand or contract. Gases expand more than liquids.			Language Development Unit..... Water Air and Air Pressure

	a) To **observe, measure** and **compare** expansion and contraction of liquids and gases.	a) An air thermometer and a second bottle (same shape and size) are used. Fill second bottle with water to the same level in the neck as the air thermometer, and place in the refrigerator for a half hour. Measure and compare heights of liquids in the two bottles.	
c) Different liquids expand differently.	a) To **observe** the expansion of two liquids and to **infer** that different liquids expand different amounts.	a) Fill two identical bottles to the level in their necks, one with water and the other with rubbing alcohol. Place in refrigerator for a half hour. Measure and compare the heights of the liquid in the two bottles. Then place in the sunlight and repeat the measurements.	Addison-Wesley Science Level Three Page 183 (T.E.)
d) Temperature can be measured by a thermometer which has a liquid that expands or contracts.			Language Development Unit T.B.A.
	a) To **investigate** the variables that affect a thermometer and temperature. To **predict** and graph the temperatures obtained.	a) Uncalibrated thermometers or regular thermometers should have the scales covered with masking tape. Investigate the most sensitive parts of the thermometer by touching different areas of the thermometer. b) Test the temperature outside the building during different times of the day in the same spot, in the shade and sun, and at different heights.	
e) Solids expand or contract.	a) To **observe** and **infer** that solids expand or contract when heat is applied/removed.	a) Using a ball and ring apparatus, demonstrate how a solid can expand and/or contract. b) Fasten a bare copper wire between two chairs. Attach a weight at the centre of the wire, close to but not touching the floor. Swing the weight and heat the sire. Observe the distance of the weight from the floor.	Addison-Wesley Science Level Three Page 184 (T.E.)
f) Different solids expand differently.	a) To **compare** the expansion of two solids and to **infer** that solids expand different amounts. To **predict** the effect of heat upon objects.	a) Repeat the above experiment using different wires such as picture and aluminum wire of the same thickness. b) Use pictures or examples of heat effects and ask students to predict the change, eg. placing a stuck jam jar lid (metal) under hot water, the effect of temperature upon the space at the end of bridges and steel rails in the summer and winter. A bicycle tire is filled in the morning and changes in the afternoon. Why?	
g) For a given substance, large masses change temperature more slowly than small masses (other factors being equal).			Language Development Unit Water

	a) To **measure**, **record** and **graph** temperature changes of two masses of water during the same period of time. To **infer** that a large mass of water cools more slowly than a small mass. To control variables which affect rate of cooling: total area exposed, kind of cup (plastic, styrofoam, etc.)	a) Leave hot water in different size containers for a few hours in the same place. Temperatures of the liquid to be compared. b) Children can dip one or two small cans into a pail of cold water and place the filled cans on pie plates. Measure temperature every ten minutes for a hour, and compare the temperature of the water in the can with the water in the pail. c) Use equal masses of water at equal temperatures. One variable at a time can be investigated. For example, use glass, metal, plastic and styrofoam containers, several containers with openings of different sizes.	Sc. 5/13 Change (Page 49) Addison-Wesley Science Level Three Page 193 (T.E.) Sc. 5/13 Change (Page 49)
h) Heat passes easily through some materials (conductors) and not so easily through other materials (insulators).	a) To **compare** the insulating qualities of materials. To **infer** that materials vary in their ability to conduct heat.	a) Wrap ice cubes of the same size in tin foil, paper towelling, newspaper or other materials, in order to try to prevent the cubes from melting. Keep a control cube in a cup. Record starting time. Observe every hour and compare to control cube left in air.	Addison-Wesley Science Level Three Pages 194-199 (T.E.) Sc. 5/13 Change (Pages 49-51 T.E.)
i) Metals are better conductors than non-metals.	a) To **observe** conductors and to **Classify** conductors according to their ability to carry heat.	a) Container of hot water and different materials of about the same thickness and length (iron and copper nails or wires, plastic straws, rubber lengths). Place materials into a container at the same time. Place a spot of wax on each object. Note the order in which the wax melts from each object.	Addison-Wesley Science Level Three Page 196 (T.E.) Sc. 5/13 Change Page 45

Grade Three

3.3 Changes In Matter

Main Concept: Matter is made of particles which are too small to be seen. Changes in matter can be classified as physical or chemical.

Concepts	Processes and Skills	Suggested Activities	References
1. Review properties of matter from Grades One and Two			Language Development Units Popcorn Water Air and Air Pressure
2. Matter occupies space.	a) To **infer** that two objects cannot occupy the same space at the same time.	a) Place a book on a desk and ask students whether they can place another book in the same spot without moving the first book. What happens when we try to place two solid objects in the same place, eg. two cars. Other examples can be discussed.	
	b) To **observe** that solids occupy space in liquids.	b) Provide narrow jars, water and stones (marbles). The jars are partially filled with water. Ask the children to predict the effect of adding marbles to the water. The effect of adding three marbles to the level of the water can be measured.	
	c) To **record** data in graphical form.	c) Stones or marbles can be added in groups of three and the levels of the water compared to the number of marbles. Compare on a graph.	
	d) To **predict** the effect of adding insoluble solids to liquids.	d) Ask children to predict the effect of adding more marbles to the water. The effect of other solids on liquids can also be examined.	
	e) To **observe** that a liquid takes up space and takes the shape of the container into which it is placed.	e) Provide three or four labelled jars, two of which are of about equal volume but of different heights, and a container of water for each group of children. The groups are to discover which container holds the greatest volume of water. One method is to use one of the jars as a standard unit. Records should be kept.	
3. Matter is made of smaller parts.	a) To **observe** the similarities between the properties of large and small parts of an object.	a) Chalk and sugar cubes can be broken into pieces as small as possible using a spoon and paper towelling. Pieces can be examined with a hand lens and observations recorded. Other objects which can be examined are newspaper photographs, crushed spaghetti, and sand. Blackboard erasers can be clapped together in a beam of sunlight as an alternative activity.	Addison-Wesley Science Level Two Pg. 94-97 (T.E.)
4. Small objects (particles) can be used to build larger objects.	a) To **observe** how a small object can build larger objects.	a) Have students observe filter paper, Epson salts or ordinary salt under a hand lens. Stir a spoonful of Epson salts or ordinary salt into a saucer of water until dissolved. Let the solution evaporate overnight or until crystals are formed. Children can use a hand lens to examine the crystals. **Caution: Children should be warned not to taste any substance at any time unless they have been told that it is safe to do so.**	

		b) Try making other crystals using sugar, alum, copper sulphate, etc. Once again, caution children against tasting any substance.	
5. Particles can distribute themselves throughout a liquid or a gas.			Language Development Units Water Popcorn
	a) To **identify** and **infer** the presence of a substance by a smell (ability to pass through pore or openings).	a) A drop of perfume or artificial flavoring can be placed into jars with paper towelling held over the jar with a rubber band. Students identify the odor. Ask student to go outside the room, then place a perfumed jar in a corner. Ask him to locate the odor. How did he do it?	Addison-Wesley Science Level Two pg. 98-101 (T.E.)
		b) Ask students how they know what's for supper when they walk into the house near suppertime? How is it that you can smell food from a distance?	
6. Water can exist as particles in air.	a) To **observe** the formation of condensation and to **infer** the presence of water vapour in air.	a) Ice cubes can be placed into a metal lid over the top of a container of warm water. The activity can be repeated in different parts of the room or outside.	
	b) To test the effect of different temperatures upon rate of evaporation. To **identify** variables that affect the rate of evaporation. To **measure** and **graph** the water levels.	b) Different jars of the same size are filled with water and placed in different places in the room (eg. over the radiator, on a shelf, refrigerator) at the same heights. Mark the level of water. Measure, graph and compare the water level each day. Students can be asked to suggest other variables that they could test (eg. narrow and wide-mouthed jars with equal amounts of water, paper strips in water and no paper strips).	
7. In a physical change, an object (matter) may be changed in form, but no new matter is produced.	a) To **identify** a property which is common to different forms of of solid materials.	a) Modelling clay can be used by children to produce many shapes. Children are asked to identify the change. How do they know? Can the original shape of modelling clay be made? Pieces of paper and the original paper or small or large pieces of wood and wood shavings can be compared for similar properties.	
8. Some physical changes can be easily reversed while others cannot.	a) To **classify** the same material, different forms of several solids.	a) Samples or pictures of peanuts and peanut butter, bread crumbs, wood and wood shavings, aluminum foil and shred, hard and crushed candy or other examples can be provided. Materials are identified and classified on the basis of similar properties.	
	b) To **identify** some changes as easily reversed and others as not easily reversed.	a) Discuss changes of state of water from ice to liquid and liquid to ice. How are changes made? Can we make the change easily?	Addison-Wesley Science Level Two pg. 80-83 (T.E.)

9. In a chemical change, new materials are produced whose properties differ from the original materials.	a) To **observe** changes in the the properties of materials and to **infer** that new substances are produced.	a) Heat shavings from different woods on a tin lid. Use pliers to hold the lid over the candle. Use only a few shavings and begin by holding the lid at a distance from the flame so that the shavings char slowly. b) Heat sugar in a pie plate over a heat source. c) Place steel nails into two jars. One jar contains a wet paper towel and the other a dry paper towel, and the containers are closed. Child can predict possible changes. d) Make ice cream in a test tube. Place ice in a tin can, add 10 mL salt and mix. Continue adding salt until the temperature reaches -8°C to -10°C. Put 12 mL milk, a pinch of sugar and a drop of vanilla in a test tube. Place in ice and stir using a swizzle stick or straw every few minutes. In 15 minutes the mixture should become ice cream. Have students keep a log recording the temperature of the ice and a description of the contents of the test tube every few minutes.	
	b) To **identify** changes as physical or chemical.	a) Provide examples such as the cooking of egg, melting of ice, building structures out of blocks, baking a cake, cutting cloth, burning wood, etc. Ask children to identify the change and indicate reasons for their choice, eg. ease of changing back, new materials formed.	
10. Mixtures of materials can be separated on the basis of unique properties:			Language Development Unit:... Magnets Water
a) **Solids:**	a) To **identify** materials that float or sink in water.	a) Children can be provided with a rubber band, pencil, paper clip, plastic button, popsicle stick or similar materials. Experiment to see which float in water.	
— Some solid materials float in water.			
— Some solids are attracted by magnets.	b) To **classify** objects according to their attraction to magnets.	a) Chalk, tacks, pencils, toothpicks, washers, erasers or other materials can be tested and recorded according to their attraction to magnets.	
	c) To **predict and test** materials on the basis of their attraction to magnets.	a) Use different shapes of the metals used in the above activity and other metals (penny, steel nail, aluminum nail, large paper clip, copper tack). A chart can be provided to make prediction.	

OBJECT	ATTRACTED	NOT ATTRACTED

	d) To **infer** that the magnetic field of a bar magnet is greatest at its poles.	a) Lightly sprinkle iron filings on a sheet of paper held over a magnet. Note the accumulation of iron filings at the poles. b) A magnet and 10-15 paper clips are provided. Children can test and record the number of paper clips which are picked up by the magnet at different points on the magnet. Results of all the children can be recorded on the board.	
	e) To **infer** that like poles repel and unlike poles attract each other.	a) Two magnets can be used to demonstrate the differences between the two poles of a magnet.	
	To **infer** that a magnetic field can pass through some materials.	b) Children can test the ability of magnets to attract a nail or paper clips through file cards or cardboard, plywood, plastic, glass or other materials.	
— Different mixtures of solids may be separated by different methods on the basis of unique properties	a) To separate mixtures of solids on the basis of known properties.	a) Mixtures of wood chips and sand, sand and iron filings, sugar and rice, gravel and sand can be placed at different work stations with a magnet. Have ready a container of water and a wire strainer. Groups of children attempt to solve the problem of separating a mixture. Methods of separation other than the straining, floating, or using a magnet may be suggested by the groups.	
b) Solid-Liquid Solutions: —**Some solids dissolve readily in water to form a solution (soluble); others do not (insoluble** —**form a suspension).**			Language Development Units Water Popcorn
	a) To **observe, compare,** and **record** the properties of **different solids.** To **identify** solids on the basis of texture, color, and taste.	a) Samples of powders (sugar, starch, baking soda, salt, plaster of paris) can be examined on the basis of texture, color and taste. A magnifying glass may be used. **Warn children not to taste any of the materials unless given permission.** Predictions about the identity of the material can be made and results compared.	

	b) To **classify** mixtures of water and solids as solutions, suspensions, or do not mix, and to **record** changes over time.	a) Make a chart to show if certain materials dissolve readily in water. Can be extended to dissolve after 5 minutes, 15 minutes and the next day.	

Substance	Dissolves Readily	Dissolves after five minutes	after 15 minutes	Dissolves the next day
Starch				
Baking Soda				
Plaster of Paris				
Powdered Milk				
Powdered Drink Mix				
Instant Tea				
Cocoa				
Flour				

— **Dissolving a solid in a liquid is a physical change.**	a) To **infer** that dissolving is a physical change.	a) Students record the amount of a teaspoonful of salt by volume or weighing. Dissolve the salt in water. Let the solution evaporate and record the amount of solid remaining.	Mathematics -- Integration.
— Filtration can separate solids from mixtures but not from solutions	a) To **compare** the properties of a solution after filtration with the original solution.	a) Solution is poured through a paper towel into a container. How will the filtered liquid taste.	
	b) To **infer** that solids, when dissolved, have the ability to pass through small openings in a towel.	a) The filtered liquid can be allowed to evaporate and the remaining crystals examined with a magnifying glass. Use a taste test on safe crystals.	
	c) To **observe** and **compare** filtered mixtures of solids and liquids.	a) Mixtures of solids whch dissolve in water (salt, baking soda, or water-color paints) and solids which do not dissolve easily (cocoa, starch, or flour) are filtered through paper towel. Record and discuss observations of the filtered liquids and any residues.	
	d) To **test** different filters	a) Make predictions about the best filters for the above materials, eg. paper towel, tissue paper, various kinds of cloth, nylon stocking. Perform the operations using samples of coarse and fine filters. Record and compare results. This can be related to filtering systems for water purification.	

Grade Three

3.4 Energy and Energy Conservation

Main Concept: Coal, oil and natural gas are fossil fuels. We must use them wisely for they are non-renewable resources.

Concepts	Processes and Skills	Suggested Activities	References
Review of previous concepts. Sources of energy studied in grade 1 and 2 were oil, gas, electricity, wind, water and wood. Some resources are renewable, some are not.			Language Development Unit ... Energy and Energy Conservation
a) Fossil fuels are a source of energy.	a) To **identify** uses for coal, oil and gas in my home community.	a) List different ways in which we use coal, oil, or natural gas at home, school or in your community.	Filmstrip — Energy Everywhere Seeds Literacy Series
		b) Discuss formation of coal through a gradual evolution of questions and establish coal as a fossil fuel: — What happens to plants when they die? — What happens to plants that died millions of years ago? Where are they now? What is a fossil? — Where did the energy from these plants originally come from? (Sun) — How do we get coal from the ground? Where is it found?	Seeds Literacy Series Level Three Activities 2, 3, 4
	b) To **distinguish** between the three states of fossil fuel.	Students have already learned that matter exists in three states (solid, liquid, gas). Fossil fuels can also exist as solid (coal), liquid (oil), and a gas (natural gas). a) Compare different types of oil products (motor oil, diesel fuel, furnace oil, crude oil, (if available), etc.) Discuss how they are alike. How are they different? Elicit from children that oil that has not been processed (or cleaned) is called crude oil.	Seeds Literacy Series Level Three Activities 5, 6
		b) Have children produce a series of drawings, one for each statement below. The first drawing could be a title page "The Story of Oil and Natural Gas". — Millions of years ago, much of the Earth was covered in water. — Many tiny plants and animals lived in the oceans. — When they died, they sank to the bottom of the ocean. — Over the years, layers of plants and animals were covered by mud and sand. — The mud and sand turned to rock and the sea plants and animal bodies changed to crude oil and gas.	Art

2. Once we use fossil fuels they are gone forever.	a) To **identify** fossil fuel as the major energy source in most communities.	a) Look at filmstrip and identify ways in which your community uses fossil fuels. b) Establish that fossil fuels are non-renewable. Compare the time needed to wait for a tree to grow versus waiting for oil or natural gas to form. If we use wind, water or wood energy, can we use it again? When? If we use coal, oil or gas energy can we use it again? When?	Filmstrip – Energy from Fossil Fuels Seeds Literacy Series. Seeds Literacy Series Level Three Activities 7-11
3. Energy can be saved at home, at school, in my community.	a) To **distinguish** between needs and wants as related to energy use.	a) List all the devices that we use that are not essential: – machines – appliances (clothes dryer, dishwasher, etc.) – oil by-products -- plastics, plates, cups, containers, package wrapping, plastic toys, etc.	
	b) To **identify** ways to reuse, recycle reduce.	a) Focus on the three ways to save – recycle – reuse – reduce What items can we recycle (jars, tins, containers, newspapers); reuse: (jars, containers, things that can be fixed); or reduce (buy only what you need – no frills, buy in bulk, buy few disposable items). b) Make a display with the class on items that can be recycled, reused or reduced. c) Look at individual situations such as home, school, community in general and identify areas where one could save energy by wise use of what one already has or will purchase.	

Grade Three

3.5 Air and Air Pressure

Main Concept: Air is a gas which has special properties

Concepts	Processes and Skills	Suggested Activities	References
1. Air occupies space			Language Development Unit ... Air and Air Pressure
	a) To **infer** the presence of air by its feel and the resistence it offers. (Some of these activities reinforce concepts and processes taught in the section Properties of Matter, within Grade 2.)	a) Fill a plastic bag with air, tie it and then squeeze	Invitations to Science Inquiry Page 10
		b) Invert a small plastic bag over the mouth of a jar. Blow a little air in the bag such that it stays inflated over the jar. Tape the bag into the jar (without tearing it). It is the air occupying the space in the jar which keeps the bag from going inside the jar after it has been taped against the jar.	
		c) Pour a glass of air (under water) into an inverted glass of water (under water). The air will fill up the inverted glass and take up the space of the water that was in the glass.	Invitations to Science Inquiry Page 12 Addison-Wesley Science Level Three Page 93 (T.E.)
		d) Fill an inverted glass of water with air by blowing air into it using a plastic tube.	
		e) Ask students to find a way to put a paper towel under water and not get it wet. Crumple paper towel in bottom of glass. Hold upside down and push down in basin of water. Do the same with a floating ball.	Invitations to Science Inquiry Page 13
2. Air exerts pressure. The larger the surface air presses on, the greater the total force.	a) To **demonstrate** the effects of air pressure conter-acting other forces, eg. gravity.	a) Drop a piece of cardboard from shoulder height to the floor. First hold horizontally and second vertically. Note difference in resistance. Try dropping various objects and observe any differences, eg. crumpled piece of paper and sheet of paper.	Addison-Wesley Science Level Three Page 90-93 (T.E.)
		b) Do teacher demonstration of crushed can experiment. Put small amount of water in empty can (eg. duplicating fluid can). Heat until steam comes out. Remove from heat. Seal tightly. Observe.	
		c) Fill large plastic garbage bag with air. Seal. Allow children to sit on it. Note that the air pushes in all directions.	
		d) By blowing into garbage bags placed between a table top and an inverted table, try to lift a person who is sitting on top of the inverted table.	Invitation to Science Inquiry, Page 48 Addison-Wesley Level Three Page 97

e) Make a parachute using a piece cut from a plastic food bag, tape, some string and a ball of clay (weight or toy model).

Addison-Wesley Science Page 91 (T.E.)

f) Stand plumber's plunger on a table. Put scraps of paper around edge. Push down hard on plunger and observe movement of paper. Try to lift plunger. Make a small hole in a second plunger and repeat experiment. Observe. Seal hole and repeat.

g) Fill a glass with water. Place an index card over opening. Invert over sink. What happens? Why?

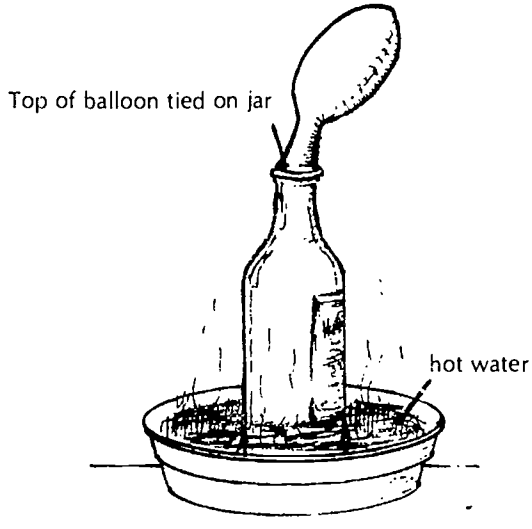
h) Discuss real-life applications, eg. car lifts in garage, air mattresses, bubble dome buildings, compressed air.

Addison-Wesley Science Page 96, 98, 99 (T.E.)

3. **Air contracts when cooled and expands when warmed.**

a) To **observe** the results of expansion and contraction of air.

a) Place jar or pop bottle in pan of hot water (as in diagram) and observe results. Repeat with ice cubes.

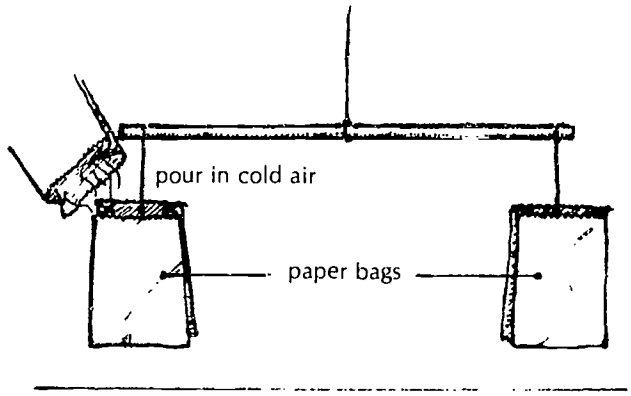


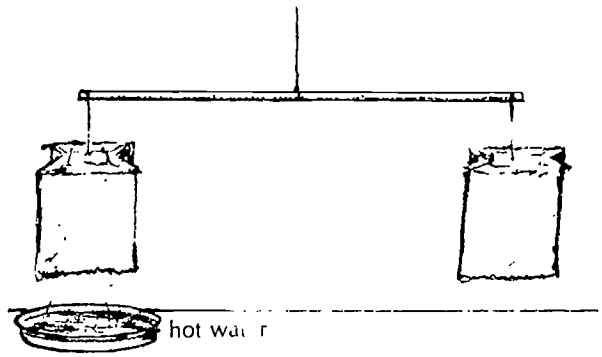
b) Blow balloon up and then place in a refrigerator. Remove and place into a warm area. Note expansion and contraction.

4. Warm air rises and cold air sinks.

a) To **infer** that warm air rises because it expands and cold air sinks because it contracts on cooling.

a) Make a bag balance for weighing warm and cold air.





b) Discuss examples from nature where warm air rises and cold air sinks, eg. heat from your furnace or wood stove.

c) Construct a merry-go-around. Draw a spiral on a paper card of about 1 cm width and cut out the spiral with scissors. Tape a needle or pin to a pencil or straw. Balance the paper spiral on the needle point and hold it about 10 cm above lit candle. Observe.

Invitation to Science Inquiry
Page 39

Grade Three

3.6 Sun, Moon, and Shadows

Main Concept: The physical structure of matter affects the passage of light. The rotation of the earth causes day and night. It also causes the sun and moon to appear to move across the sky. The moon appears to change shape during the month.

Concepts	Processes and Skills	Suggested Activities	References
1. A shadow results when an object blocks the passage of light.			Language Development Unit... Sun, Moon, and Shadows
	a) To **record** the elements necessary to produce a shadow.	a) Using a strong light (200 watt bulb or filmstrip projector), place objects in front of the beam to produce clear shadows on the wall. Try making shadows with hands.	
		b) Make silhouettes of each student.	
	b) To **infer** the shape of an object by looking at its shadow.	a) Try to guess the type of object on the basis of the shadows produced.	Addison-Wesley Science Level Three Page 124-127 (T.E.)
	c) To **distinguish** between opaque, translucent and transparent, and observe the resulting type of shadow.	a) Hold various materials (some opaque, some translucent) before a light and observe the effect.	Addison-Wesley Science Level Three Page 140-141 (T.E.)
2. A light source which allows a shadow to be cast is always located in the direction opposite that of the shadow.	a) To **predict** the direction a shadow will fall when a light source is placed in various position.	a) Hold the light source in various places with respect to the objects and note the different places of the shadow.	Addison-Wesley Science Level Three Page 126, 132-133 (T.E.)
3. The size and shape of the shadow is dependent upon the relative positions of the object, light source and receiving surface.	a) To **predict** size, shape and sharpness of shadow from the relative positions of the light, object and screen.	a) Manipulate several objects and cast shadows with them — ruler, ball, paper towel roll, cube, scotch tape roll.	Addison-Wesley Science Level Three Page 126-129 (T.E.)
4. Shadows can be made both by light sources and by reflected light.	a) To **distinguish** between light sources and source of reflected light.	a) Discuss light sources around you such as ceiling light, sunlight, lamps, flashlights, candles, simple battery run light, etc. b) A mirror is a source of light but it is reflected light. Suggest other possibilities such as tin foil, shiny polished surfaces, etc.	Addison-Wesley Science Level Three Page 130-131 (T.E.)

		c) In a darkened room, hold a mirror facing a flashlight beam. Let this light reflect on a wall. Then let the flashlight shine directly on the wall. Observe. Repeat this investigation using crinkled aluminum foil instead of the mirror.	
5. The size of the light source determines the shadow.	a) To **infer** the size of the light source from the type of shadow.	a) Compare the shadow produced from a table lamp with its shade off and a flashlight.	Addison-Welsey Science Level Three Page 136-139 (T.E.)
6. Multiple light sources produce multiple shadows.	a) To **infer** the number of light sources by observing the number of shadows.	a) Set up a pencil vertically on a wad of plasticine. Cast a shadow with a flashlight. Then with several flashlights.	Addison-Wesley Science Level Three Page 134 (T.E.)
7. Sunlight can be blocked by clouds and objects which form shadows on the earth.	a) To **observe** the shadows caused by clouds.	a) Go outside on a day when there are fluffy cumulus clouds and observe the shadows made by them. Simulate this in the classroom with a lamp and paper or cotton. Move cloud.	Addison-Wesley Science Level Three Page 148-152 (T.E.)
	b) To **infer** the location of the sun by observing shadows.	a) Make a sun fan. Find a pole or place a stick in the ground and observe the movement of the shadows. Mark place at regular times.	
8. The rotation of the earth causes day and night. Day and night are regular events.	a) To **simulate** the sun, earth relationships.	a) Darken a room and set up an electric light for sun and ball for earth. Observe shadow on earth ball. Rotate earth and observe how shadow changes. Discuss day and night with respect to sunlight and shadows as regular events. Make a sundial.	Addison-Wesley Science Level Three Page 153-155 (T.E.)
9. The turning of the earth explains why the sun appears to move across the sky.	a) To **predict** the time of day at various locations and to **simulate** the sun/earth relationship.	a) Because we are not directly aware of the earth's motion, we think the sun is moving. Review and have students perform exercise from previous day using sun and ball for earth and electric light. You might substitute a globe for the ball. As you are turning the globe, ask what time of the day it is (morning, afternoon, evening) at various locations on the globe. Imagine you were a spot on the globe and you were looking up at the sun. If you were not aware of the fact that you were moving, what would the sun appear to be doing as the day passed on.	Addison-Wesley Science Level Three Page 156, 158-162 (T.E.)
10. The rotation of the earth causes the moon to appear to move across the sky.	a) To **measure** and **chart** the path of the moon.	a) Set up a moon watch. Mark at regular times approximate positions of the moon on a chart, using the fist measuring method. Keep a daily and monthly record. eg. It takes nine fists to go from the horizon straight up.	Addison Wesley Science Level Three Page 156-157 (T.E.)
11. The moon appears to change shape during the month.	a) To **observe** and **record** the phases of the moon.	a) Keep a record of the phases of the moon.	Addison-Wesley Science Level Three Page 166-171 (T.E.)

Appendix

Classroom Organization and Management
Safety
Research and Reporting Skills
Questioning Techniques
Plant and Animal Care
Use of SI Metrics
Equipment Lists
Publishers/Distributors
Suppliers

Classroom Management

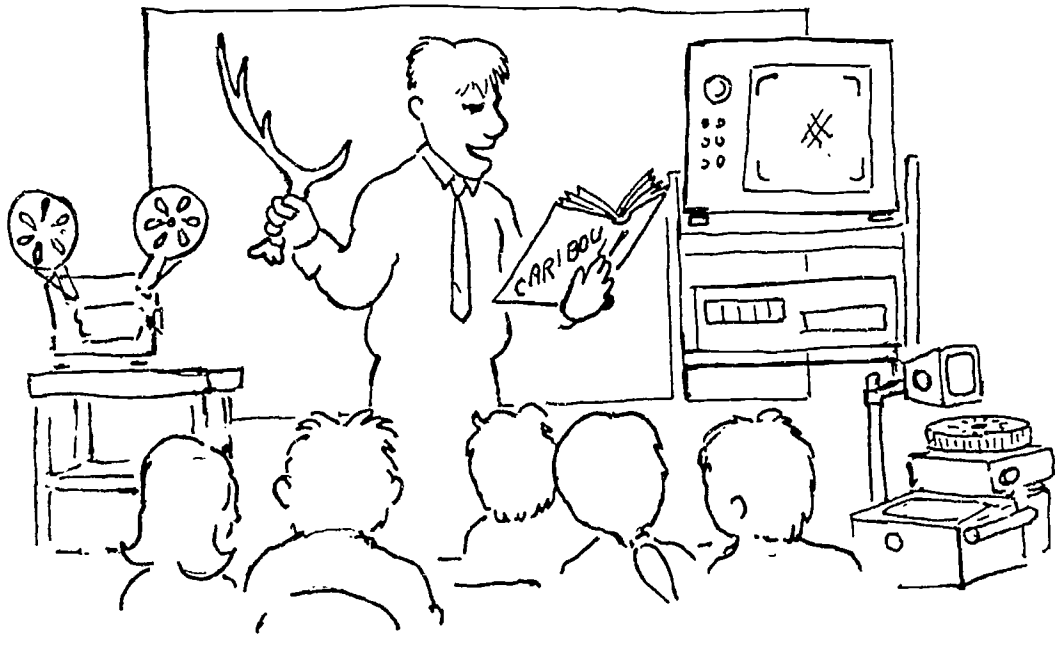
In this science program, the student learns by becoming an active participant in the learning process. This learning process takes a variety of forms including viewing, listening, reading, writing and discussing as well as direct hands-on learning experiences.

The teacher's role is mainly to guide and manage the total learning process rather than to be primarily a source of information. Effective management of the science classroom is critically important to the program's success. Following are some suggestions for effective management that have been found to be helpful.

1. **Be well prepared**
   - check that all needed materials are available for each activity
   - become familiar with each activity by trying it out in advance
   - prepare and assemble materials in advance.

2. **Use a variety of materials and approaches**
   - combine investigative problem solving activities with the special related language skills of listening, reading, writing and speaking
   - use a variety of manipulative materials and equipment
   - use reading materials for supporting and reinforcing learning
   - use audio-visual materials for introduction, reinforcement and extension of learning activities.

3. **Establish routines**
   - establish routines to handle events that come up regularly rather than deal with every event separately. Routines should be established for:
   - where materials are stored
   - how materials are to be gathered and used
   - how groups are to be formed
   - how groups should work
   - clean-up procedures
   - format of written work, etc.
   - safe practices and procedures
   - student conduct.



Safety in Science

The "just in time" attitude can lead to poor and sometimes unfortunate results in science education. Often the common sense reactions are overridden by the desire for expedience. The electrical octopus, the sharp pointed scissors, the wet hands switching off the lights, the matches left behind, and the desks pushed in front of the door are but a few of the "mistakes" that one can make when in a hurry. Young children, however, do not distinguish between the exception and the rule.

It is the responsibility of the teacher and the school to provide a safe working environment. It is imperative that the teacher instills in the student a respect for the inherent dangers of science activities. It would be remiss to assume that safety procedures are limited to the discipline of science: the shop, the gym, the cooking area, the hallway and the playground are all potential disaster areas when disorganization, loose procedures, poor supervision and disregard for accepted procedures abound.

The guidelines represent one small step . . . in assuring that our science rooms are a place wherein the student:

- learns
- accepts responsibility for himself
- accepts responsibility for others, and
- inculcates safety habits which will carry over into daily lifestyles.

Did You Know

1. Some students are allergic to guinea pigs, hamsters and other fur bearing animals.
2. Poinsettia, Dieffenbachia, Azalea, Juniper and Snowberry plants are toxic.
3. No experiment should be undertaken which involves anesthetic drugs, surgical procedures, pathogenic organisms, toxicological products, carcinogens, or radiation unless a trained biological scientist, physician, dentist or veterinarian directly supervises the experiment.
4. Formalin should only be used in a well ventilated classroom. Formaldehyde should not be used.
5. Pressure cookers should never exceed 150 kPa.
6. Eyes can be shielded from ultraviolet radiation by a piece of ordinary glass.

The National Science Teachers Association has identified the following safety considerations which teachers should check and/or establish prior to teaching science.

Accident: Notify the principal, nurse, parents, family and physician.

Animals in the Classroom: Establish proper selection, cages, care and handling.

Plants in the Classroom: Establish proper selection of non-toxic plants and handling procedures.

First Aid: Have a first aid kit readily available.

Field Trips: Establish parental permission, supervision, and equipment needs.

Fire: Establish or locate extinguishers, alarm box, other fire fighting aids, and evacuation procedures.

Use of Non-Restricted Chemicals: Avoid using concentrated acids and bases, volatile liquids, active metals and restricted chemicals, eg., mercury and/or known carcinogens.

Health Hazards: Establish procedures to avoid hazards related to bacterial and other biological specimens.

Storage and Labelling of Materials: Establish a storage space, labels for stock, and procedures for discarding chemicals.

Safe Use and Care of Equipment: Select approved equipment, establish maintenance procedures, and develop safe techniques regarding use.

Research and Reporting Skills

One of the goals of the Elementary Science Program is that students should be able to independently find and use information for themselves. They should understand and demonstrate the skills of locating, organizing, evaluating and reporting information.

In order to achieve these objectives, library research skills need to be developed as part of your program. Many small schools lack library facilities. A good library/book centre at the back of the room can be established. Students should receive instructions which enable them to make use of as many resources as are available to them.

If you do have a library, success will depend upon the co-operative efforts of the librarian and the teaching staff.

In either case, gather together a collection of Science related books which coincide with the

topics being taught. Having these in your classroom will provide motivation, enrichment and interest. The teaching of research skills may be part of your science instruction or, if you are lucky, it may be part of your scheduled library instructional program. The nature of the program could be one of individualized instruction where each student advances to the next step once the previous skill has been mastered or it might be a group task-oriented program.

Look For Print and Non-Print Materials

Encyclopedias	Card Catalogue
Almanacs	Yearbooks
Handbooks	Dictionaries
Tapes (Audio-video)	Slide/Film/Filmstrips
Micro-Computer	

Find Supporting Materials

Pamphlets	Atlases
Clippings	Globes
Magazines	Newspapers
Picture Sets	Models
Displays	

Skills Needed In Producing A Good Report

There are many special skills that the student needs as he/she learns to deal with report projects. The most basic one is how to locate information — eg. what are the possible sources of information that are available to me? The student also needs to be able to sort through the available information and decide which information is relevant and which is irrelevant. The determination of extraneous informaton is a highly valued skill required in many subject areas.

The student must also learn to rewrite the newly found information in his/her own words. Once all the data has been collected, the next step is to arrange the data in a logical fashion.

Finally, the student must choose a suitable format for indicating which references books were used eg. bibliography.

Effective Questioning Technique

The essence of good questioning is to relate your questions directly to the skill or concept being developed. The skill or concept which is being taught should be broken down into the fundamental concepts needed to accomplish your task and, for each of these, a determination must be made at each step of the task as to what the student needs to know.

Clear statements or questions require careful thought on the teacher's part. Writing questions in advance is a good strategy for keeping them clear and concise. Your lesson plans should include sample questions. By being clear and concise, the student knows where to begin and where to end. If the student is not answering, or is misunderstanding the question, re-examine your question. Demonstrate flexibility in being able to edit your own questions.

Both concrete and abstract levels should be considered when preparing questions. Your overall goal is to develop critical thinking. Vary the level of difficulty to challenge the students appropriately. Having overcome a challenge, they feel good about the experience and their self concept grows. By asking questions that cause students to relate the major points of a lesson in their own words, you promote readiness in applying the concept being taught.

Most studies indicate that a wait time of three or more seconds will improve and strengthen student response to a question. Allow adequate wait time. Studies also indicate that failures to respond decrease and the number of unsolicited but appropriate responses by students increases when a proper wait interval is exercised. The time spent in waiting is easily outweighed by the improved responses that occur. Wait time can be an important element in your questioning technique.

Quite often we direct our questions to a few individuals only when we could and perhaps should be directing them to the total group. When this is done, all class members focus on the problem. When a question is directed specifically at one individual, other students tend to wander in their attentions. For example, saying, "I want all of you to think about this question" or "Each of you should be ready to describe your next move. In just one minute, I will ask one of you to describe yours", are examples of covert strategies for questioning. While covert strategies enable more students to participate mentally, the overall strategy is equally important — for it is an essential means of observing responses.

Often times, even our carefully worded questions fail to produce the desired result. When this occurs, try to supply more information or restate the question. Asking the student what information is needed to answer the question is one technique to overcome obstacles. A second student may need to be involved to keep the lesson moving. By soliciting a response from a second student, you are assisting the first student in solving the problem at hand.

Your questioning techniques serve as a model for the students. Students should be encouraged to participate in questioning and thereby develop questioning skills of their own. Thinking skills will develop as student solve and make decisions on their own. As well, their ability to interact with each other increases.

Good questioning techniques can be an invaluable tool for today's teacher. It promotes total class involvement as well as individual success.

References:

Rowe, Mary Budd. "Give Students Time To Respond"
Education Digest (May 1978)

Hunter, M. And D.R. "How Can I Plan More Effective Lessons?" Instructor (Sept. 1977)

McCullough, D. and Findley, E. "How To Ask More Effective Questions" Arithmetic Teacher (March 1983)

Plant and Animal Care

The presence of plants and animals in the classroom for study and handling can be a valuable asset to any science program. However, certain precautions must be observed to ensure the health and safety of both the students and study organisms.

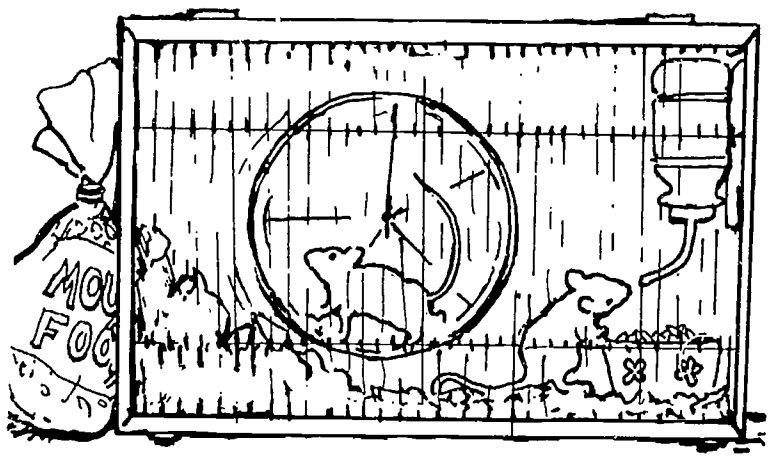
1. Determine if any of the students have allergies by checking medical records or by sending a note home advising the parents of the animals to be kept. In an extreme case, the keeping of animals may have to be ruled out whereas a mild allergy may require that the student simply not handle the animal.
2. Animals should be well fed and cared for. The enclosure that the organism lives in should be of suitable size, easily maintained, and cleaned on a regular basis.
3. All animals which are purchased should be from a reputable supplier. Wherever possible, animals which have been donated should be examined by the veterinarian.
4. Any animal that appears in poor health should be removed from human contact until the situation has remedied itself or until the animal has been examined. The danger to avoid is that the animal may have an infectious ailment.
5. Animals which repeatedly bite should not be kept in the classroom. However, quite often the underlying reason for the animal's behaviour is that students have not been advised regarding safe handling of animals. Most animals will bite if just awakened, handled roughly, or when food is taken away. Caution students that too much handling may be stressful for the animal. As a normal procedure, a student who has been bitten should receive a tetanus shot if he/she has not recently had one.
6. Hands should be washed after handling all animals.
7. An animal should be kept in the classroom only so long as it is a meaningful part of the program. A negative learning experience can be created when an animal is left neglected. As well, a potential health hazard could occur.

Suitable Classroom Study Animals

Mammals	**Birds**	**Insects**	**Fish**
rabbit	chicks	aphids	goldfish
guinea pig	canaries	beetles	guppies
hamster	pigeons	caterpillar	tropical fish
gerbil	doves	fruit fly	
mouse		ants	
Worms	**Reptiles**	**Crustaceans**	**Amphibians**
earthworms	chameleons	crayfish	frogs
	small snakes		tadpoles
			newts

Animals That Should Not Be Kept

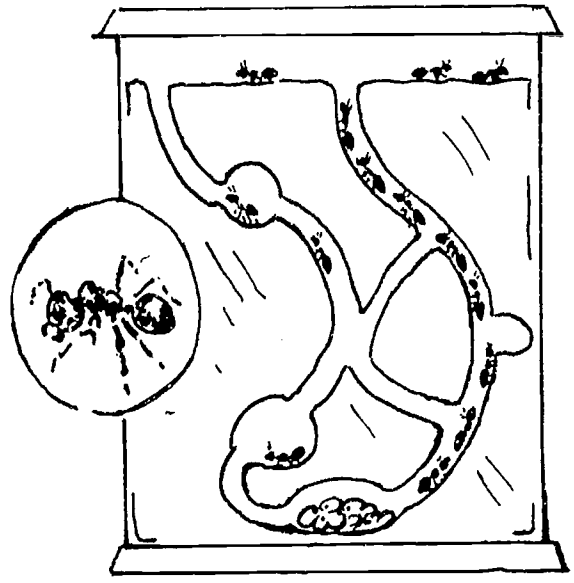
No native species of wildlife (wild animals and birds) should be kept in the classroom. To do so can create an unwarranted source of possible infection. In most cases, the keeping of these mammals and birds is also unlawful. Check with your local wildlife officer for more information.



Suggestions For Materials

A Woodland Terrarium

Materials — an aquarium or tank or wide-mouthed four litre jar set on its side in sand, clay or plaster to keep it from rolling. Gravel on the bottom. Several centimetres of good soil with pieces of charcoal buried in it to keep it from going sour. Rocks, small woodland plants, mosses, and ferns. Water daily, but not heavily.



A Desert Terrarium

Materials — the same container as above, but with 5 cm of sand. Cacti from the florist, or grown from seed.

An Ant Farm

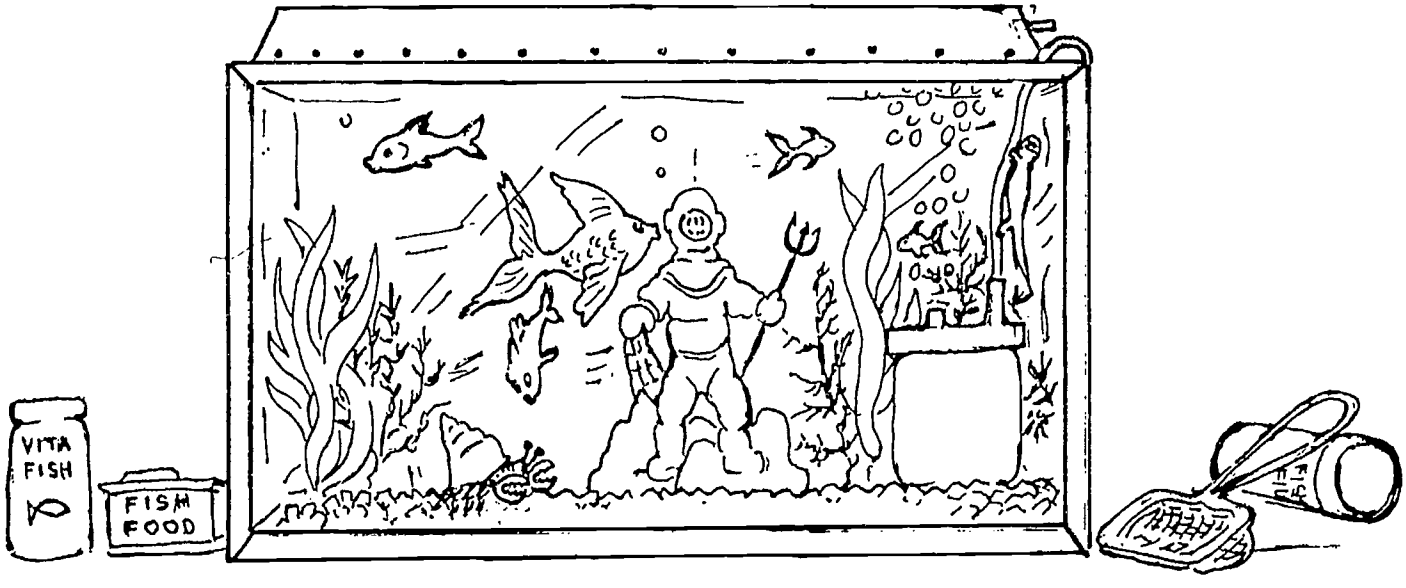
An ant farm may be purchased commercially, or fill a four litre jar with loose soil dug from an ant hill. Tie gauze or a piece of stocking over the top. Feed apple, sugar, peanuts or lettuce in very small pieces. Wrap in dark paper and set aside for a week or two to look at later.

A Mealworm Culture

Put a thin layer of oatmeal or other cereal in large shallow cake pan. Add mealworms purchased from a pet store or other supplier. Alternate layers of worms and layers of cereal. Put thin apple slices across the top of the food, and add moisture. Cover with plastic wrap and put in a warm dark place. Check often to see what is happening and keep it slightly damp. If you have reptiles or amphibians for pets, a mealworm farm is necessary to raise food for them.

Guppies

Guppies are interesting as the male is easily distinguished from the female and they reproduce often. They require a small aquarium or large bowl filled with washed sand and tap water which has had the chlorine removed by a liquid or tablet developed for that purpose. Water plants are needed for food and oxygen and fish will thrive if an inexpensive aerator or "bubbler" is added. Commercial fish food may be used.

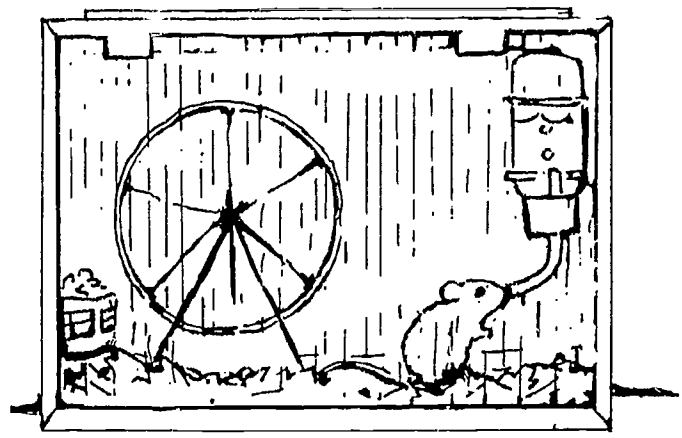


Tadpoles

Collect frogs or toad eggs and carry them home in a container of pond water. Put into an aquarium with 2 cm of sand and fill with pond water or boiled, cooled tap water. Add water plants. Feed the tadpoles lettuce or raw liver bits. Aquatic insects may live in the same environment with the addition of sticks slanting up to the sides of the jar above water level. (Keep the lid on).

Birds

Keeping a live bird in the classroom provides a good opportunity for the students to learn how to care for it and to learn much about its physical characteristics and behaviour. If it is difficult to keep a bird for even a short time, children should observe and feed birds outside, but not to the point where the bird places dependence on human feeding.



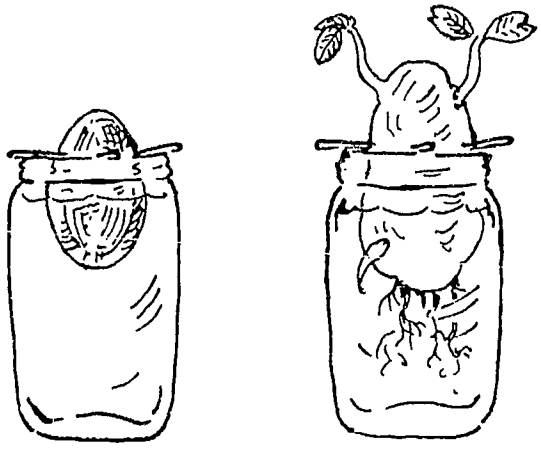
Mammals

Most mammals need a cage or pen, straw, shredded paper or sawdust and a diet of grains and greens. The smalier mammals need a drip type bottle and holder. This will assure the cage remains clean and dry.

Plants In The Classroom

Again, some students may have alle ies and you will have to do some investigating in order to identify potential problems. Some leaves of plants such as the Dieffenbachia are poisonous and teachers should eliminate them from the classroom environment.

Growing plants is a varied and interesting task which students enjoy. Plants can be progagated from roots, stems leaves, bulbs and seeds.



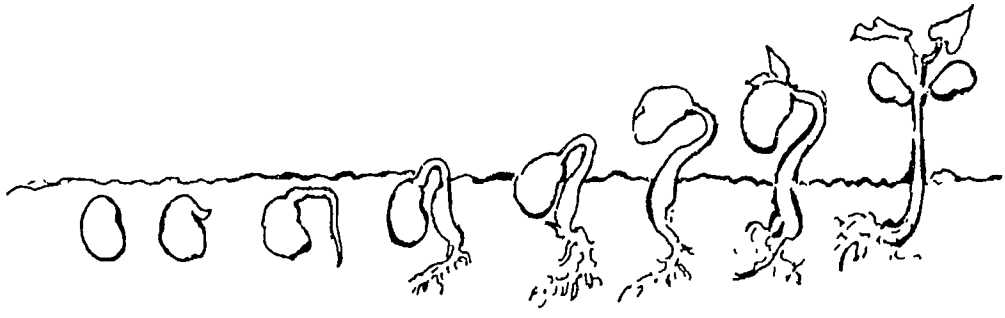
From roots — sweet potato, beet, carrot, turnip, parsnip. Put a sweet potato in a jar of water (a large instant coffee jar is good) so that the narrow end sits in water. If the fit is not perfect, anchor the potato with toothpicks for supports. Put in a warm dry place, adding water as needed. When the plant takes root, move it to a sunny place. Carrots, beets, parsnips and turnips grow best on stones, marbles or aquarium gravel in a saucer of water.

From stems — pussy willow, geranium, ivy and philodendrons. Many plants will root when placed in water. An ordinary potato and an onion are actually stems. A piece of potato with two or three eyes may be planted in soil in a pot. An onion may be set in a glass with a little water in the bottom.

From leaves — african violets and snake plants These plants will grow from leaves. Prepare leaves from the snake plant by cutting the leaf into little finger lengths and planting in damp sand, covering with glass. This is the rooting box.

From bulbs — anemone, narcissus, hyacinth, tulip and venus flytrap. Bulbs are usually accompanied by planting instructions. As a rule they are planted in a pot which has a few stones or broken pottery in the bottom for drainage, followed by rich potting soil and a layer of sphagnum moss. They may be well watered, sealed into a plastic bag and refrigerated for six to eight weeks, following which they are brought out to bloom. The venus flytrap obtainable as a bulb or plant from florists is interesting to most children as it is carnivorous. The mouth may be opened gently and the plant may be fed live flies or tiny pieces of meat.

From seeds — beans, corn, peas, peanuts, citrus fruits, pumpkin, watermelon, canary seed and avocado. To plant an avocado pit, remove the brown papery coat from the seed and set in a jar of water as you did the sweet potato. Put in the dark and be very patient, for it will take weeks to get started. After about two months, add soil gradually or replant it in a large pot. Plant grain and grasses in a large shallow tray or in a sponge. Line a glass container with blotter or paper towel and plant seeds between the glass and the towel.



Use Of SI

The metric system (Systeme Internationale or SI) is to be used in N.W.T. schools. The following chart indicates the extent of metric usage in the recommended and supplementary texts for the Elementary Science Program.

Primary Language Development Units (Dept. of Education) uses metric units only

Addison-Wesley Science Series (grades 1-6) uses metric units only

Science 5/13 (teachers guide) Imperial units in brackets

*Examining Your Environment (EYE) uses imperial units

Elementary Science Study (ESS) uses both Imperial and metric units

Energy Literary Series (SEEDS) uses metric units

*You could use a senior class to help you write in the appropriate metric measurements, under your direction.

Equipment Lists for Elementary Science Program (Unit by Unit)

Unit 1.1 — Living and Non-Living Objects

Basic Equipment List
- Assorted seeds such as bean, pea, corn, birdseed, etc.
- Pumpkin, or other large fruit with seeds.
- Tall glasses or jars (for sprouting seeds).
- Paper towels.
- Pictures of plants, animals, from old calendars and magazines, (such as Pik, Owl, and Chickadee).

NOTE TO ELEMENTARY TEACHERS:
Create a file of pictures. Bring old magazines, calendars, and scissors to class. Have students locate pictures of animals, plants, landforms, etc. Put pictures against colored background and laminate. These pictures can be used later at any time for any subject area.

Teacher Supplied Materials:
1 — Aquarium and/or terrarium
— Living small animal (optiona!).

Unit 1.2 — Ourselves

Basic Equipment List

1 roll	— Ribbon
class set	— Large sheets, (for tracing body outlines)
1 pkg.	— Graph paper
1 dozen	— Metric tape measures
1	— E type chart for testing vision
several	— Mirrors
1	— Ink pad
class set	— Metric ruler
1 pkg.	— Baby powder

Teacher Supplied Materials:

1	cassette tape of household sounds
1	blindfold
class set	scissors
1 roll	masking tape

Basic Equipment List

Items to be sorted
- buttons
- marbles
- geometric shapes
- pictures of plants
- pictures of animals

Items to compare
- sponge
- feather
- cactus
- penny
- pencil
- modelling clay

Items needed to show chemical changes
- candle
- wood splint
- oil of peppermint
- spaghetti
- celery
- gelatin
- icing sugar

General
- equal arm balances (to compare masses)
- plastic bags
- aluminum plates
- rubber bands
- paper clips

Teacher Supplied Materials

- Pictures of before and after situations (or actual items)

eg. unpopped corn, and popped corn
bread and toast
cake and cake batter
burnt splint and unburned splint

Basic Equipment List

several	— Pictures of plants, animals and non-living objects.
several	— Pictures of various machines (ski-doo, furnace, can opener, car, etc.)
several	— Glass tumbler or jar
1	— Solar collector, (box lined with tin foil).

Teacher Supplied Materials

several	— Snowballs
two	— Green plants
	— Solar calculator
	— SEEDS, Literacy Series — Level One (includes filmstrip — Energy Everywhere)

Unit 1.5

Comparing and Measuring

Basic Equipment List

several	— beans, buttons, and/or marbles.
1 box	— toothpicks.
1 box	— popsicle sticks.
assorted	— candles.
	— cement mix.
	— nails.

Teacher Supplied Materials

- fruit.
- pudding mix.
- water.
- pictures of seasons.
- tape recording of sounds that may/may not indicate a regular interval, (for measuring time).

Unit 2.1 — Properties of Living Objects

Basic Equipment List

1	— dog whistle.
several	— jars and/or dip nets (to obtain specimens from lake, pond, stream, ditch or seashore).
assorted	— seeds (sunflower, coconut, pumpkin, poppy, radish, caraway, celery, bean, pea, corn, birdseed).
several bags	— soil
several	— pictures of various animals (birds, fish, insects, land animals, etc.)
	— pictures of both young and adult animals (use Owl, Pik, Chickadee, Ranger Rick, National Geographic, etc. as your source).

Teacher Supplied Materials

	— visit to the Bay, or Co-op store.
optional	— aquarium and/or terrarium.
	— plants.

Basic Equipment List

Solids	Liquids	Woods	Metals
— sand	— vinegar	— balsa	— copper wire
— sugar	— cooking oil	— pine	— aluminum wire
— modelling clay	— water	— spruce	— nails — copper
— aluminum foil	— milk	— oak	— brass
— paper clips	— syrup	— other	— aluminum
— cloth & thread	— motor oil		

— pictures of sets of objects which are made of metal, wood, fabric, paper, plastic, etc.

1 roll	— wax paper
1 box	— straws
1	— empty shoe box
1 pkg.	— balloons
1 pkg.	— garbage bags

Teacher Supplied Materials

class set	— scissors
several	— old magazines
1 roll	— paper towels

Basic Equipment List

— objects for sorting such as book, pencil, paper clip, fruit, seeds, stone, etc.
1 — eavestrough (or roof gutter) approximately 3.5 metres long.

Teacher Supplied Materials

pictures of wind as energy source:
- — windmill
- — sailboats
- — gliders
- — flag waving in the wind, etc.

SEEDS Literacy series, Level two, includes filmstrip:
- — Energy Everywhere
- — Energy from Wind, Water, and Wood.

Unit 2.4

Measuring Time

Basic Equipment List

1	— egg timer
1	— sand clock
1 pkg.	— washers (for making a pendulum)
1 roll	— string
several	— candles
several	— sticks or poles (for making a shadow clock)
1	— coffee can with small hole near bottom (to make a drip system for telling time)

Teacher Supplied Materials

tape of regularly occurring events (clock ticking, snapping of fingers, etc.)

Unit 2.5 Measuring Objects and Positions

Basic Equipment List

1 box	— paper clips
1 box	— thumbtacks
clss set	— metre sticks
1 roll	— string and/or ribbon for measuring lengths
1-2 pkg.	— seeds
class set	— metric rulers

Teacher Supplied Materials

class set	— papers with centimetre squares drawn on it
class set	— papers with a 10 x 1 cm rectangle drawn on it

Basic Equipment List

1-2 pkg.	— brine shrimp
1 pkg.	— rock salt
several	— pictures of various plants and animals
several	— pictures showing large animal populations
class set	— scissors
	— aquarium and/or terrarium
	— old copies of magazines such as Owl, Chickadee, Ranger Rick, National Geographic, etc.

Teacher Supplied Materials

fruit flies (can be raised in mixture of water and oatmeal.
Cards with animals in one set, and their habitat in another set.
film — filmstrip — videos on different types of communities (seashore, desert, pond, etc.)

Basic Equipment List

dozen	— assorted balls (golf, ping pong, tennis, rubber, volleyball, soccer, etc.)
1 box	— rubber bands
3	— cups and/or beakers
1 pkg.	— liquid soap
2-3	— narrow necked bottles
1 pkg.	— food colouring
1 pkg.	— pie plates (large)
6	— thermometers (Celsius)
several strands	— wire (copper, aluminum)
1	— ball and ring apparatus
several	— equal volume containers made of different materials, (glass, metal, plastic, styrofoam, etc.)
1 roll	— Tin foil
	— paper towelling
	— newspaper

Teacher Supplied Materials

— before and after pictures of work being done eg.
- — nail and harnmer
- — bicycle moving
- — other work situations

Basic Equipment List

several	— narrow jars
1 pkg.	— marbles (or stones)
several	— jars of equal volume, but different heights
class set	— hand lens
1 pkg.	— filter paper
1 pkg.	— epsom salts
1 pkg.	— salt
several pkg.	— modelling clay
	— wood shavings
couple	— steel nails
1 pkg.	— pie tins
1 pkg.	— baking soda
1 pkg.	— plaster of paris
1 pkg.	— file cards
class set	— magnets
1 jar	— iron filings
1 pkg.	— paper clips
1 pkg.	— rubber bands
1 small	— bottle of vanilla
several	— rolls of paper towels

Teacher Supplied Materials

To make crystals, solutions of salt, sugar, alum, or copper sulfate may be used
perfume or artificial flavouring
To make ice cream, (ice, salt, milk, vanilla)
heat source (alcohol lamp, or bunsen burner)
various household/classroom objects such as: water colour paints, chalk, pencils, erasers, newspaper, photographs, milk, pennies, washers, rice, starch, ice, tea, cocoa, flour, powdered drink mixes.

Basic Equipment List

— motor oil — furnace — crude oil
— collection of materials that can be recycled: jars, tins, containers, newspapers, re-used (jars, containers, things that can be fixed) or reduced (non-disposable)
— pictures of things that use coal, oil, or natural gas.

Teacher Supplied Materials

— SEEDS Literacy Series — Level Three, includes filmstrip:
  — Energy Everywhere
  — Energy from Fossil Fuels.

Unit 3.5

Air and Air Pressure

Basic Equipment List

1 pkg.	— plastic bags, clear
several	— wide mouth jars and narrow mouth jars
1	— plumber's plunger
several	— pans or trays
1 pkg.	— balloons
1 pkg.	— small paper bags
1 box	— straws
1 box	— pins
1 pkg.	— index cards
1 pkg.	— large green garbage bags
1 roll	— paper towels

Teacher Supplied Materials

1 roll	— masking tape

Unit 3.6 — Sun, Moon, and Shadows

Basic Equipment List

	— collection of objects: some opaque, some transparent, some translucent
1-2	— mirrors (large)
2 pieces	— tin foil
1 pkg.	— plasticine
1 pkg.	— cotton balls (to make fluffy cumulus clouds)
1-2	— candles
1	— flashlight
1	— electric light bulb (in a socket)
1	— rubber ball or round object, to represent Earth in an Earth-Sun model
1	— large globe.

Teacher Supplied Materials

- projector (200 watt bulb) for use in making shadows
- overhead projector
- cut out shapes/figures that are solid (cast opaque shadows), clear (transparent), and translucent (wax paper, rice paper, etc.)

Publishers/Distributors

The following Publishers and their Distributors are listed to assist teachers in the ordering of resource materials. The list deals with those directly related with the Elementary Science Program. Some of the most common publishers/ distributors have been indicated by an asterisk.

Addison-Wesley	Addison-Wesley Canada P.O. Box 580 Don Mills, Ontario M3C 2T8
Enviro-Concerns	Enviro-Concerns Box 131 St. James Postal Stn. Winnipeg, Manitoba R3J 0H4
*Ginn	Ginn and Company 3771 Victoria Park Ave. Scarborough, Ontario M1W 2P9
GLC	GLC Publishers Ltd. 115 Nugget Avenue Agincourt, Ontario M1S 3B1
Heath	D.C. Heath Canada Ltd. 100 Adelaide St. West Suite 1600 Toronto, Ontario M5H 1S9
Holt	Holt, Rinehart and Winston of Canada Ltd. 55 Horner Avenue Toronto, Ontario M8Z 4X5
*Houghton Mifflin	Houghton Mifflin Canada 150 Steelcase Road West Markham, Ontario L3R 1B2
Liem, Dr. Tik	Dr. Tik Liem St. Francis Xavier University Antigonish, Nova Scotia B2G 1C0
MacDonald	See GLC
*McGraw	McGraw Hill Ryerson Ltd 330 Progress Avenue Scarborough, Ontario M1P 2Z5
Merrill (Bell & Howell)	Charles E. Merrill Publishing Division 3665 Kingsway, Suite 203 Vancouver, B.C V5R 5W2
Renouf	Renouf Publishing Ltd, 2182 St. Catherine Street West, Montreal, Quebec
*Scholar's Choice	Scholar's Choice 777 Douro Street Stratford, Ontario N5A 6T9
*Silver Burdett	see GLC
*Spectrum	Spectrum Educational Supplies Ltd. 8 Denison Street Markham, Ontario L3R 2P2
S.R.A.	S.R.A. 707 Gordon Barker Road Willowdale, Ontario M2H 2S6
*J. Weston Walch	J. Weston Walch P.O. Box 158 St. Stephen, N.B E3L 2X1

Suppliers

There are many supply companies to choose from. A few are listed below:

Boreal	Boreal 1820 Mattawa Avenue, Mississauga, Ontario L4X 1K6
Fisher	Fisher Scientific Co. 10720-178th Street Edmonton, Alberta T5S 1J3
Northwest	Northwest Laboratories 61 Malcolm Road P.O. Box 1356 Guelph, Ontario N1H 6N8 or 3581 Shelbourne Street P.O. Box 6100, Station C Victoria, B.C.
Sargent-Welch	Sargent-Welch Scientific of Canada 4220-23rd St. N.E. Bay No. 12 Calgary, Alberta T2E 6X7
Scholar's Choice	Scholar's Choice 777 Douro Street Stratford, Ontario N5A 6T9
Spectrum	Spectrum Educational Supplies Limited 8 Denison Street Markham, Ontario. L3R 2P2

Northwest
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