A SCIENCE CURRICULUM FOR MEETING THE INSTRUCTIONAL NEEDS OF STUDENTS FROM GRADES 5-9

by Ernest Raymond Cicierski

A Practicum

Submitted to the Faculty of Education

Department of Mathematics and Natural Sciences

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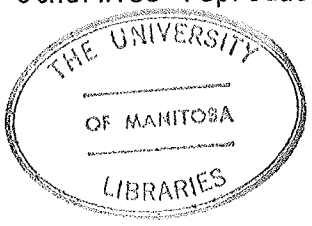

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CHAPTER I

INTRODUCTION

The present Manitoba Schools science curriculum guides make a definite division between grades K-6 and 7-9 by providing all encompassing guides for each of the two areas. Each guide treats its own area as a separate entity with a total absence of transition from grade six to grade seven. The guides seem to assume that students leave one realm of science at the end of grade six and enter something completely new at the beginning of grade seven. This division has created a curriculum gap from grade six to grade seven.

Basic differences

The curriculum guides make use of conceptual themes for the purpose of providing direction in the development of a science unit. The K-6 guide spells out three such themes at each grade level. These same three themes, Interdependency and interaction among organisms, Changes in matter and energy, and Earth, space and time, are used throughout each

grade.

In 7-9 the curriculum, repeats six subject areas each year. The six topics are Environmental Science, Life Science, Earth Science, Space Science, Chemistry, and Physics. Three conceptual schemes are included but only one theme is used in any given year. Identifying and measuring is the theme in grade seven, Looking for patterns is included in grade eight, and in grade nine it is Searching out interactions.

An examination of both guides reveals that the K-6 is done in a more organized fashion -- that is, it is developed in such a way as to make it easy for the teacher to function as a facilitator in the classroom. For example, in grade six, one objective in the physical and chemical changes section is to observe that a gas can be introduced into a liquid, and infer that the introduction of the gas produces a reversible chemical change. The suggested activities list the steps, describe what is seen and why, and tell what to do as a follow up. In grade seven earth science, one objective is to collect and identify some of the organisms in soil (other than micro-organisms) and examine them in the laboratory. No indication is given of how the student would go about this and what he should be looking for during the examiniation. In grade six there is a recipe to follow, whereas in grade seven the teacher has to scramble for ideas.

The need for updating

The assumption appears to be that K-6 teachers have very little science teaching background and everything is spelled out more clearly. Based upon the author's experience in working with student teachers,

there is good evidence to suggest that this assumption is correct and needs to be carried on through grade seven and eight level as well.

At present, the majority of teachers are not teaching in both K-6 and 7-9 areas, and they are either not aware of the scope and sequence that exists within each area or they use the information from both guides and upset the natural sequencing that should occur.

Some of the schools are presently being incorporated into K-9 complexes and the possibility exists that teachers will be required to teach multi-levels of science. The K-6 and 7-9 guides represent the curriculum for their respective areas, but very few teachers have either the opportunity or the motivation to read both guides. Junior high teachers will experience difficulties in finding the time to peruse the K-6 program in any detail, and the converse is also true for the K-6 teachers. A single guide for grades 5-9 would be of benefit to them.

The 7-9 section on student evaluation suggests continuous evaluation and numerous techniques are given. The K-6 guide states rules for constructing various test items and gives suggestions on keeping anecdotal records. Both guides have good points on student evaluation and these should be combined. They contain suggestions that are used or should be used at all levels.

Problems in Grades

There are a few problems with the present guides, in that there is redundancy in some areas. For example, the weather unit in grade six requires that students study fronts and weather instruments, and in grade nine they have to repeat this experience. The astronomy units repeat

various activities throughout grades 5-9, and by the time students reach grade nine they appear to have lost their motivation for basic space science.

Another problem occurs in the area of use of laboratory equipment. The K-6 guide states, on page 13, that the program will help students use self-constructed or standard laboratory equipment appropriately. Yet, experience has shown that this is not happening. Students entering into grade seven do not have the necessary skills in the proper and safe use of laboratory equipment. For example, students are unable to use microscopes properly and unnecessary damage occurs.

The Manitoba Schools science curriculum is broken into two levels, K-6 and 7-9. It is a fairly recent development and the Department of Education is unlikely to change it for some time. This sequencing of the present curriculum is not generally suitable for the middle years, i.e. grades five to nine. Consequently, the identified concepts are not as teachable as they might be.

Coupled with the problem of inadequate sequencing of the curriculum there are a number of other deficiences. For example, the suggested activities in grade seven earth science are not practical for most schools since they require on-site examination. This is a physical impossibility for most classrooms. Similarly, the grade eight space science unit suggests activities which can only be done in the evening. These are frustrating assignments for students living in the city. The "hints" for teaching space science are not appropriate for our schools as they exist today and many other suggestions are required.

The middle years child

In the development of children there is a period of transition, extending from ages ten to sixteen. This period has often been equated with pre- and early adolescence, and is now referred to as the middle years.

At the beginning of the middle years the children are very comfortable with concrete operations such as ordering and classifying, and they gradually move into the realm of the abstract where they are able to deal with many combinations in a given situation. As they progress in this manner they undergo a period of self-doubt and become more conscious of the outside world.

For these children, the middle years are a time for physical change. They grow rapidly, become awkward and are extremely conscious of their awkwardness. More demands are made on their energies resulting in periods of lethargy and hyperactivity. Shoving, punching, and jostling are part of this age.

Relations with their peers become extremely important. Rejection by one's peers can be devastating, especially, if an awareness of their sexual identity intensifies during this period. They must learn to come to terms with their emotions and avoid being stifled or overwhelmed by them.

As the middle years progress students begin to think about moral issues and values in a more sophisticated way. They examine what they have learned, make personal evaluations and become less inclined to accept adult values.

The role of the teacher

The teacher must be aware that not all students develop at the same rate and this is most important when dealing with the curriculum. One student may be dealing in abstract terms while another is still comfortable with the concrete. One student may be extremely clumsy while another may be well coordinated. One may appear to be day dreaming while another can not sit still. One tends to do what the peer group dictates while another is capable of going his own way. One may be extremely ecstatic while another might be almost overwhelmed with despair. One might accept parental values while another might not.

It is these differences in students that the science teacher must recognize. The teacher must develop learning situations which permit each child to work to capacity in that area. The learning itself must be valuable enough to the student to bring about student action. In the present curriculum guides there are numerous examples of activities which are extrinsic in terms of motivation. For example, in grade seven earth science, one activity suggests that the student explain the action of a migratory dune. The student sees little value in the learning itself but works at it for what it will get him -- better grades.

Certain science modules lend themselves to stimulating learning activities. One such unit is the study of insects which has been deleted from the present curriculum. In this unit, observation and classification of insects was a challenge to the students and maintained their interest and attention. The prescribed unit on classification of rocks and the rock cycle in grade eight does not fascinate and intrinsically

motivate the students in the same way.

Plan of action

There is a need for a grade 5-9 curriculum guide that will meet the instructional demands of the present day student and at the same time, remove the extra burden that has been placed on the shoulders of science teachers, especially those who are teaching science for the first time.

A revised-combined guide will eliminate redundancy, fill in existing gaps, and streamline existing information so as to be more informative to all teachers.

Presently, there is a trend toward stressing the study of technology in society. This concept is present in both curriculum guides but has not been clearly defined. Consequently, the revised guide will address itself to this problem. This will add a new and challenging dimension to the science program.

The major purpose of this study is to develop a curriculum guide which will overcome the present curriculum gap that exists between grades (K-6) and (7-9) and correct errors, deficiencies and redundancies in the guides. To achieve this goal it will be necessary to critically appraise the present guides. This appraisal will also include clearing up redundancies between the present two guides, correcting omissions, and revision of the present guides in grades 5-9 into a single document. The new guide will be more sequential and better articulated.

The six subject areas presently in use in grades 7-9 will be retained throughout with a number of extensions built into the modules, rather than being separate entities.

A scope and sequence section will be developed to maintain a smooth

transition of program throughout the various levels from grades 5-9.

The text-book section will be updated and streamlined for quick and easy reference.

An opinion survey of the grade 4-9 science teachers in the St. Vital School Division has been undertaken to examine the extent of the use of the present guides. The results of this survey will be included in this study.

Statement of the Problem

The problem for this study is to design a science curriculum guide for the middle years to meet the instructional needs of present day students.

The design of the guide will:

a) Assist teachers in presenting the required concepts in an interesting fashion;

b) Reduce redundancy and overlap to a minimum;

c) Assist teachers in providing effective evaluation of the students' progress;

d) Allow teachers to be cognisant of the articulation of the programs from grade 5-9;

e) Allow teachers to better meet the unique needs of the grade 5-9 science student.

Limitations

There are a number of factors which limit this developmental study. They are:

a) The revisions will be limited to the present K-6 and 7-9 approved guides;

b) The revisions will consider only presently approved texts and supplementary material;

c) The revision will make recommendations within the present funding programs for science.

Definition of Terms

Middle years

This is the period of time often referred to as the period of transescence. It is the period in human development which begins in late childhood prior to the onset of puberty and extends through the early stages of adolescence. It extends approximately from the ages of ten to fourteen.

Scope

Scope refers to the breadth or actual coverage of the curriculum.

Sequence

Sequence refers to the ordering of the content of the curriculum.

Strategy

Strategy refers to planning for instruction at the curricular level. It is a planned design for achieving particular goals.

Articulation

Articulation refers to the way that the school curriculum should reflect a continuous unity, in the same manner as human development reflects continuous progress.

CHAPTER II

REVIEW OF LITERATURE

The literature was examined to determine the growth pattern of children, their learning and intellectual development, the relationships of these patterns to the curriculum, and, at the same time, develop an understanding of the emerging adolescent learner.

The literature review makes it apparent that there was a high degree of agreement by the majority of writers as to the changes that occur in children during the middle years and that the curriculum should be developed to reflect these changes.

Growth Patterns

Wiles and Bondi (1981) suggested that curriculum change is a natural outcome of the study of growth patterns. More biological changes occur in the body of youngsters between the ages of ten and fourteen that any other period of life, with the exception of the first three years. Wiles and Bondi (1981) observed that since these changes occur at different rates teachers have to understand each child individually.

Students approaching adolescence become more aware of themselves and this awareness causes conflicts in their thinking and emotions (Kindred et al, 1981). Preadolescence is a restless age; a steady grind at the school desk is undesirable, and activity related learning would be more appropriate (Wiles and Bondi, 1981).

Most boys enter adolescence at the age of fourteen whereas girls reach that point at about age twelve or twelve and a half. Kindred, et al (1981) indicated that this disparity causes the physical development of girls to be ahead of that of boys.

Kindred et al (1981) observed that rapid physical growth results in poor motor coordination and the awkwardness that results can become embarassing and disconcerting. Their study confirmed that both boys and girls develop anxieties about their personal grooming, accompanied by feelings of restlessness and irritability.

Wiles and Bondi (1981) observed that in the latter stages of their development boys and girls become pre-occupied with their appearance and behavior. They believe they are the center of everyone's attention and sometimes contrive to create an audience by loud and prevocative behavior.

Intellectual Development

The research indicates that among children, between the ages of ten and fourteen, a wide range of mental abilities can be found because of the irregularities of physical, social, and psychological growth. Kindred et al (1981) concluded that rapid physiological growth at an early age will be accompanied by a correspondingly rapid rate of mental growth, and that if physiological development occurs later, mental development will develop at a slower rate.

Watson and Lindgren (1979) examined the various stages in the intellectual development of children as identified by Jean Piaget. They were in agreement that of the four stages, sensorimotor, preoperational, concrete operations, and formal operations, only the latter two are relevant to the middle years.

Wiles and Bondi (1981) suggested that in the concrete operations stage students have the ability to think out problems which had previously been worked out; that they possess logical thought and are able to organize objects into a series and also reverse operations.

Kindred et al (1981) concluded that students can manipulate ideas only in the presence of actual things or immediate experiences.

Concerning the formal operations stage, Wiles and Bondi (1981) indicated that students have the ability to form ideas and develop hypotheses as well as testing them out. Kindred et al (1981) suggested that the individual can develop ideas about ideas and handle relationships in the absence of the concrete. Wiles and Bondi (1981) observed further that in the new adolescent the normal operations are not yet in full control and the capacity to think of many alternatives is not immediately coupled with the ability to assign priorities and to decide which choice is best.

Needs

Wiles and Bondi (1981) indicated that there are certain needs that are characteristic of children of the middle years. These needs are:

a) The need to be safe and free of threat;

b) The need to be loved;

c) The need to be part of a group;

d) The need to have identification and acceptance;

e) The need to be recognized;

f) The need to be independent.

Moss (1969) indicated however, that society also has needs and the purpose of schools is to provide children with the skills necessary to function effectively in the social order.

Wiles and Bondi (1981) indicated that the early adolescents are in the early stages of the conflict between their desires to be independent and the necessity to depend on others, and, as a result, they need guidance in the middle years to help them grow and develop into fully functioning individuals.

Children and Society

Wiles and Bondi (1981) concluded that the middle years children are the least understood, the least cared for, and the most fragile group in our society.

They supported their conclusions with these observations:

a) Adult misunderstanding:

Adults misread signals from the children and become impatient and short tempered with them. This has resulted in the belief that it is best to just leave them alone and they will gradually mature into adolescents.

b) Need for parental guidance:

Middle years students do not want their parents to abdicate their responsibilities as parents.

c) Lack of parental understanding:

Parents feel that students should be concentrating on basic skills during the middle years, especially if they have fallen behind in the earlier grades. The parents do not understand

that there has to be a balance in the curriculum of personal development activities, basic skills programs, and content study.

d) The strength of statisitics:

Statistics show that the typical family nucleus is changing. There are more broken homes, more single parent families, and more situations where both parents are working. Television is affecting life styles, and juvenile deliquency and alcoholism are on the increase.

Based upon the aforementioned research, it is logical to assume that the ten to fourteen year old group is the most impressionable and that it has become the victim of a changing society.

Early Sophistication

A review of growth studies indicated that our youth are maturing physically approximately one year earlier than students of the early 1900's. Moss (1969) concluded that this early sophistication could be attributed to the fact that today's youth have better educated parents, travel more extensively, have more money to spend, and they are exposed by mass media to sex and violence.

Curriculum Change and the Role of the Teacher

The earlier maturation and sophistication has resulted in enrichment of the courses of study at each grade level. Usually this enrichment is developed from material taken from the next higher grade. This was confirmed by McCarthy (1972) who, upon examining programs offered at the

grades five to eight level, found that most middle years programs were little more than junior high programs moved down one or two grades.

McCarthy (1972) suggested that as well as enrichment, the school must develop new educational goals, explore new curriculum offerings, re-examine old methods of instruction and initiate new ones. He observed that the curriculum should encourage teachers to be flexible and adjust the program to suit the student's needs. McCarthy (1972) concluded that the teacher must no longer be required to fill the pupil's head with many so-called vital, but unrelated, facts. The teacher's role is to help the student understand the process of how to acquire knowledge and thus become an independent learner.

Lounsbury and Vars (1978) indicated that the curriculum guides must make it possible for teachers to develop interesting and cohesive lessons, and above all, they must allow for freedom to adapt to a variety of classroom situations. They suggested that quite often our best plans and exciting new curriculum guides, though sincerely and conscientiously developed by groups, have little or no effect on the learning experiences that students engage in during school.

Lounsbury and Vars (1978) indicated further that we must recognize and take into account the enduring significance of the classroom teacher as the agent of curriculum change. The interaction of students and teachers in the classroom is one of the major factors governing the effectiveness of learning experiences.

Curriculum Design

Overly (1972) stated that in bringing about curriculum change close attention must be paid to selecting worthwhile objectives. He suggested that this should be done by considering two factors. Firstly, the objective should state what it is that a learner will be able to do upon completion of the objective. Secondly, the objective should reflect the three domains; namely, cognitive, affective, and psychomotor, which are described in Bloom's Taxonomy of Educational Objectives. Overly concluded that if the student is to be challenged, higher level domains must be stressed, with the affective domain emphasizing the need for the curriculum to focus on relevancy.

It is important that the design of the curriculum permits the development of different instructional systems. Therefore, the design must be concerned with objectives, content, and strategy. It is universally agreed that these three components are inter-related. This is borne out by Kindred et al (1981) who concluded that statements of curricular objectives define intent, provide criteria for the selection of content, allow for the determination of basic instructional strategies, and delimit that which is to be evaluated.

The majority of writers were in agreement that the broad scope of the curriculum must be delimited and that this could best be achieved by examining the rationale for a middle years school. The rationale was best summarized by Kindred et al (1981) who indicated that the school:

a) serves young people in the age range of ten to fifteen,

b) facilitates self-development and self-actualization,

c) provides for general education, including opportunities for the development of a sense of inquiry, curiosity and commitment to learning,

d) provides opportunity for exploration,

e) provides for the individualization of instruction,

f) improves articulation with elementary and high school programs.

Further research showed that the rationale for the program along with objectives will determine the scope, and that, as objectives are refined, scope is narrowed.

Kindred et al (1961) concluded that is is the responsbility of the school to make curriculum provisions for the development of concepts and skills introduced at the elementary level, to introduce new content, and to ensure the interlocking and blending of the curriculum for the middle years with that of the high school.

By and large, the objectives to be reached will determine which strategies will be used. The strategies that are commonly used are those of critical thinking, discovery, the method of inquiry, and problem solving. Guilford (1968) indicated that in practice there is not a great deal of difference between them, it seems likely that the basic cognitive abilities in their performances are not substantially different, no matter what the strategy is called.

Evaluation is not really part of curriculum design but still must be included, simply because it is a process of finding out how well objectives have been met.

Wiles and Bondi (1981) concluded that student evaluation plays three specific roles in the instructional process:

a) It is a diagnostic device which allows the instructional staff to determine current student growth patterns;

b) It is a descriptive device that allows teachers, students, and parents to communicate about the growth and development of the individual student;

c) Evaluation of the student allows the teacher to give future direction to further learning activities by pinpointing needs.

A further study by Overly (1972) concluded that the greatest value of evaluation would be to the teacher because the results would lead to better instruction.

In Summation

Kindred (1981) indicated that the middle years pupils usually range in age from ten to fourteen years, but their actual growth stages range from late childhood to early adolescence. This diversity in physical maturation and in emotional, social, and intellectual characteristics makes these years exciting. Each student becomes a challenge for the teacher.

To assist the teacher in meeting this challenge a stimulating and relevant curriculum must be developed. The curriculum must address itself to the fact that children mature physically and mentally at differenct ages, pupils come from different socio-economic backgrounds, and a changing society is resulting in more sophisticated young people.

Greater stress must be placed on evaluation of programs to ensure

that the individual needs of the student are being satisfied.

The courses will have to be made more challenging, but the enrichment should result from a broadening of available programs rather than drawing from material in the next higher grade.

The teacher's role as a facilitator will become increasingly more important as time progresses and the emphasis will gradually shift from developing better teacher skills to that of concentrating on developing individuals who can function in today's society.

CHAPTER III

METHODOLOGY

The first stage of this study included obtaining teacher reaction to the present curriculum guides by administering an opinion survey and tabulating the results.

A careful examination of both guides was carried out to determine the extent of proper sequencing, areas of deficiencies and examples of errors and redundancies.

The final task required organizing the material from both guides into a sequencial pattern, re-arranging the information, re-writing and developing new units where deficiencies had been created.

Teacher Survey

The grade four to nine science teachers in the St. Vital School Division were given a survey questionnaire to complete. The questionnaire consisted of:

Part A:

The teachers indicated the level at which they were presently teaching, their total years of teaching experience, and the grades at which they taught previously.

Part B:

The teachers were surveyed on:

a) How familiar they were with the guides at the K-6 and 7-9 levels.

b) How often they consulted the guide.

c) Whether or not it was easy to find information quickly.

d) Whether or not the guide was too bulky.

e) Whether or not the suggested activities were helpful to them.

f) Whether or not the guide provided enough information on student evaluation.

g) Whether or not the guide should include information on topics covered from grades 1-9.

h) Whether or not the guide covered a broad enough range of topics.

i) Whether or not the guide allowed for a proper sequential pattern from one grade to the next.

j) Whether or not there were any gaps in sequence from one grade to the next.

k) Whether or not there were redundancies.

l) Whether or not there were errors or omissions.

m) What changes, if any, they would like to see in the present curriculum.

Part C:

The teachers were asked to elaborate on any points covered by the survey and to make further comment regarding the guides in general.

Twenty-five teachers responded to the survey. Seven of the teachers reported that they did not use the guides very often and were unable to comment on the items in question. One person reported that the guide made his year of science teaching very frus-

trating and that he would no longer be teaching science. The responses of the remaining seventeen teachers are summarized on the pages following.

TEACHER REACTION TO THE SCIENCE CURRICULUM GUIDES PRESENTLY IN USE IN MANITOBA SCHOOLS - Summary of Information Provided in Teacher Survey

Teacher	Grade Taught	Years of Experience	Grades previously taught in Science	Familiarity with the Science Program at K-6	7-9	How often is the guide used	Is information found quickly	Is the guide too bulky	Are suggested activities helpful	Are the extensions useful
A	4	7	4,5	comfortable	not at all	once in a while	yes	no	yes	no
B	4	5	4	"	somewhat	every 2 months	yes	somewhat	yes	not really
C	4,5	12	4,5,6	"	"	regularly	yes	yes,too much information	adequate	sometimes
D	4,5	8	1-6	totally	totally	only for developing new units	yes	not if you are totally familiar	they are bland but they fit in	yes
E	5	14	6-10	"	"	three or four times a year	yes	no	yes	yes
F	6	17	2,3,4	somewhat	no at all	sometimes	"	"	"	"
G	6	16	1-5	"	"	once at month	"	"	some are	yes
H	6	13	3,5,6	totally	"	seldom	fair	"	yes	never tried them
I	6	14	4,5	comfortable	"	once or twice each term	yes	not really	yes, at times	yes
J	5,6	19	none	somewhat	"	once a week	yes	no	only if equipment is available	no
K	5,6	23	1-4,7-9	comfortably	totally	often	no problem	yes and no preambles are	somewhat	sometimes

TEACHER REACTION TO THE SCIENCE CURRICULUM GUIDES PRESENTLY IN USE IN MANITOBA SCHOOLS - Summary of Information Provided in Teacher Survey

Teacher	Grade Taught	Years of Experience	Grades previously taught in Science	Familiarity with the Science Program at K-6	7-9	How often is the guide used	Is information found quickly	Is the guide too bulky	Are suggested activities helpful	Are the extensions useful
L	7,8	7	9-12	somewhat	"	regularly	yes	no	some	some
M	7,8	4	none	"	comfortably	at beginning of unit	"	"	yes	yes
N	7,8,9	14	7,8,9	"	totally	rarely now	once you become familiar with it	"	none whatsoever	no
O	7,8,9	13	none	"	comfortably	once a week	yes	"	some only	some are
P	7,8,9	8.5	2,4	comfortably	totally	often	"	"	yes	yes
Q	8,9	8	5,6,7	"	comfortable	"	"	"	no there are plenty of poor suggestions	yes

	Are the text suggestions useful	Is there enough information on evaluation	Should guide include information on topics covered from 1-9	Is there a broad enough range of topics	Is there a proper sequential pattern from one grade to the next	Are there any gaps from grade 6-7	Are there redundancies	Are there errors or omissions	If it was being revised what would you change
A)	yes	yes	yes	not really	okay	not familiar with 7-9	not familiar with all units	--	nothing
B)	"	"	"	yes	adequate	not knowledgeable about content	need more information	--	nothing - I develop my own
C)	"	"	"	"	I don't like it	not sure about grade 7-9	would have to study other units	--	less long-winded preambles
D)	Some good texts are not included	no	"	"	yes	yes	yes, if the teacher has not taught the other grades	levels of thought	set it out in terms of comprehension and application
E)	yes	"	"	"	"	no	none noticed	no	can't comment
F)	"	"	no	don't know	can't comment	"	--	--	--
G)	"	yes	yes	yes, general topics	fairly good	"	--	--	--
H)	"	"	"	yes	yes	"	--	--	--
I)	"	"	"	"	"	"	am not conversant with the other grades	none	much more emphasis on processes of science - more sequencing
J)	"	"	"	no	"	teachers ignore fundamentals. Rob activities from other grades.	repetition from 4-9 leads to problems in 7 & 8	not enough nature study	more nature study. Improve evaluation. Lessen teachers fears in 1-6.

	Are the text suggestions useful	Is there enough information on evaluation	Should guide include information on topics covered from 1-9	Is there a broad enough range of topics	Is there a proper sequential pattern from one grade to the next	Are there any gaps from grade 6-7	Are there redundancies	Are there errors or omissions	If it was being revised what would you change
K)	"	"	no	yes	"	no	--	--	--
L)	Some are good others are poor	no	no	too much astronomy other topics should be included	satisfactory in some instances astronomy is poor	not sure	too many topics are done in grds 1-6 & repeated in grds 7-9. Brighter students find the work tedious.	--	Reduce astronomy to one unit in grade 7-9. Bring in other units for a broader over-view. Fifteen topics over three years with an optional sixth unit, teachers would have a choice of topics requiring to cover 5 out of 6. No spiral approach. Each unit would be complete within itself.
M)	yes	yes	no, just an over-view	yes	yes	no	--	--	--
N)	"	no	yes	"	usually	I don't know K-6 that well	some, such as astronomy	A good guide should not have errors	Absolutely one textbook per grade
O)	Usually, but texts are unavailable	"	"	"	no	no	--	--	more description of activities
P)	yes	yes	no	yes	yes	"	some topics repeat themselves	--	more physical science with experiments
Q)	yes	not a necessary feature	yes	yes	yes	?	--	--	A better selection of activities - some are a joke.

ADDITIONAL COMMENTS:

I) Department of Education should be putting emphasis on on-going inservices for teachers who are not familiar with the teaching techniques of science. The Department should be taking a more active role in initiating alternate programs as well as putting a regular two-year provincial assessment in place.

J) If we could have the equipment and text-books to go with the guide we would be able to carry on. As it is, everyone is going his own way.

K) Fancy worded preambles scare people. Keep them to a minimum or get rid of them altogether. Forget about garbage introductions. Teachers know that the people who drew up the curriculum are knowledgeable in science, so why lengthen the guide unnecessarily? In K-6: Pg 1-20 could be omitted and would not be missed. Omit pages 27-34. Leave in pages 41-62. It should be clearly emphasized to teachers that the suggested activities are just that -- suggested activities. Some teachers only do two units a year as a result of these activities.

ANALYSIS OF INFORMATION

1. Number of teachers sampled 17

2. Grades taught 4 5 6 7 8 9

3. Number of teachers at each level 4 4 6 5 6 4

4. Only 3 had no previous science teaching experience, however the years of experience ranged from 4 to 23 years.

5. In terms of distribution 11 are in the K-6 area
   6 are in the 7-9 area

6. Familiarity with the guides

K-6	7-9
7 - comfortable with the K-6 guide	3 - comfortable with 7-9 guide
1 - somewhat	3 - totally knowledgeable
3 - totally familiar	
---	---
2 - somewhat familiar with 7-9 guide	4 - somewhat knowledgeable with the K-6 guide
6 - not at all	2 - comfortable
3 - totally	

7. How often is the guide consulted?

	K-6	7-9
once in a while	2	-
every two months	2	-
regularly	1	1
sometimes	1	-
seldom	1	1
once or twice each term	1	-
often	1	2
at beginning of new unit	1	1
once a week	1	1

8. Is information found quickly?

Most teachers found very little difficulty in obtaining information from the guides.

ANALYSIS OF INFORMATION

9. Is the guide too bulky?

Only 3 found it so. The others have learned to over-look the supplementary information.

10. Are the suggested activities helpful?

yes 6	only if equipment is available..... 1
adequate..... 2	none whatsoever..... 1
some are..... 5	very poor..... 1
at times..... 1	

11. Are the extension activities useful?

no..... 3	yes..... 8
not really..... 1	never tried them..... 1
sometimes..... 4	

12. Are the text-book suggestions useful?

14 said yes
3 agreed that only certain books were adequate.

13. Is there enough information on student evaluation?

yes..... 12 no..... 5 didn't know 1

14. Should the guide contain information on topics covered from 1-9?

yes..... 13 no..... 4

15. Is there a broad enough range of topics?

yes..... 13 no..... 3

16. Is there a proper sequential pattern?

yes..... 10	don't like it..... 1
usually..... 2	can't comment..... 1
adequate..... 1	poor in some areas.... 2

17. Are there gaps?

not familiar with K-6... 1	no..... 9
not familiar with 7-9... 2	yes..... 2
not knowledgeable about content... 1	no comment... 1

ANALYSIS OF INFORMATION

18. Are there redundancies?

not familiar with units in all grades..... 4
yes -- repetition in 7-9 of units covered in K-6.... 5
none..... 1
did not comment..... 7

19. Are there errors or omisssions?

no comments..... 12
none..... 2
not enough nature study..... 1
expects the guide to be flawless..... 1
levels of thinking are not included..... 1

20. Summary of general comments

- preambles too long
- more emphasis on process needed
- improve evaluation section
- reduce text-book choice
- more physical science
- I develop my own program
- include more nature study
- reduce the astronomy
- more description of activity
- lack of equipment and suitable text-books makes the guide useless

Outcome of survey

1. The majority of teachers are not familiar with the total science program from K-9. They were not able to answer questions dealing with redundancy because of this lack of familiarity.

2. The 4-6 teachers are not as aware of what is occurring in the other area as are the 7-9 teachers. Since these teachers will be sending students to grade 7, a combined guide is definitely needed.

Outcome of survey cont'd-

3. Even though the teachers indicated that the guides are not too bulky, there was a general consensus that there was much unnecessary information included and they simply ignored it.

4. The general feeling is that many of the suggested activities are no longer suitable due to the sophistication of today's youngsters.

5. Many of the teachers have their own pet units and concentrate on them, causing the other units to be ignored or to be superficially covered.

6. A common complaint was that teachers in Grades 5 and 6 are using suggested activities from the grade 7 and 8 section. This is causing a problem in the upper grades.

7. About one half of the teachers found the extension activities of any use. This would indicate that these activites should be included in the main framework of the unit.

8. The general consensus was that the guide should be revamped because much has changed since the guides were issued. For example, changes have occurred in technology, students are more sophisticated, and some text-books are becoming out-dated.

Examination of Guides

The K-6 and 7-9 guides were examined to determine:

a) The unit contents at each grade level from 4-9;

b) The sequential arrangment of material from grade 5-9;

c) The presence of redundancy of content;

d) The existence of omissions;

e) The extent of overlap of content;

f) The extent of textual material required.

Procedure

The guides were carefully examined, changed and amended according to certain criteria which had been established.

a) Broad ideas of science or general conceptual themes were identified for grades 5-9. The three themes used were: Interdependency and Interaction among Organisms, Changes in Matter and Energy, and Earth, Space and Time.

b) Each unit was assigned a main conceptual theme in order that students could relate facts and experiences to a major idea.

c) Each unit was developed to ensure that the material became more difficult as the student progressed through the different grade levels.

d) The activities were developed so as to match the physical and mental development levels of the students.

e) The unit extensions were incorporated, where possible, into the main body of each unit.

f) The unit material was organized in a sequential pattern and this manner of sequencing was extended into each succeeding unit which appeared within the same general topic.

g) The units were designed to provide a balance between an understanding of the concepts of science and the development of skills or processes such as observation, classification, communication, measuring, using space-time relationships, inferring, predicting, defining operationally, experimenting, controlling variables, formulating hypotheses, interpreting data, modelling and theorizing.

h) An effort was made to keep redundancies to a minimum.

i) New units were developed where deficiencies became apparent.

j) The sections on student evaluation were combined and enlarged to provide further examples of evaluation techniques.

k) The textual and supplementary materials were listed and special note was made of these materials which are no longer available at the Manitoba Textbook Bureau.

CHAPTER IV

RESULTS

A Science Curriculum Guide

For

Grades 5-9

Table of Contents

INTRODUCTION

Today's student is being confronted with rapidly changing scientific and technological developments. As a result, the science program must enable the student to develop skills of science such as simple observation and classification and more complex processes such as inferring and hypothesizing rather than concentrating solely on content learning. The development of specific science skills is the primary goal of this science program.

The science content is specified for each of the levels from grades 5-9 and is based on themes or ideas of science.

The three conceptual themes are:

a. Interdependency and interaction among organisms

b. Changes in matter and energy

c. Earth, space and time

The themes are developed from generalizations which in turn are developed from grouping of related concepts. They can provide direction for the development of a science unit as well as useful main ideas.

Student should become active participants in the learning process. They should be able to make choices and learn to work independently. The inquiry approach to learning should be emphasized in order to develop the self-activated individual, so that by thinking objectively and reasonably they can seek new and better solutions to personal and social problems. The task of the teachers becomes more difficult as they arrange situations that are challenging to the students and will facilitate the development and skills that will enable them to

further their own learning.

The 5-9 science program attempts to integrate information known about the intellectual and social development of students with the nature of science education. Most students in the 5-9 level are in a transition from a concrete to a formal stage of intellectual development. Almost all students will demonstrate both stages of thinking at different times throughout this period.

The concrete operational student can solve problems where actual objects can be observed and manipulated and can discover relationships but not hypothesize possibilities. This student has difficulty in separating relevant from irrelevant information and tends to consider one factor at a time, ignoring all others.

The formal operational student can solve theoretical problems by manipulating words or symbols. He is able to isolate and control variables, test problems systematically and is able to establish relationships between variables.[1]

In the 5-9 science program topics and activities are oriented towards a concrete approach, with a gradual increase in sophistication of the topics as the student porgresses from one level to the next. There is flexibility within the units for teachers to provide depth or variety according to the needs of this students i.e. different levels of intellectual development.

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1. Kindred, L.W., et al. The Middle School Curriculum: A Practitioners handbook. Toronto: Allyn and Bacon, Inc., 1981.

GOALS AND OBJECTIVES OF THE 5-9 SCIENCE PROGRAM

GOALS

1. To encourage self-awareness in and to help the student understand the environment and the interrelationships that exist within it.

2. To help the student develop the skills and attitudes necessary to inquire systematically into questions concerning the natural world.

3. To help the student understand the impact of science and technology upon the human and natural environment.

4. To help the student describe and help maintain a healthy environment, experience success in science activities, and exhibit attitudes of appreciation of other viewpoints.

OBJECTIVES

1. To enable the student, as a learner and investigator, to develop and use the skills of science. These skills should include:
   a. science process skills
   b. interpretive and computational skills
   c. communication skills related to the gathering and interpretation of information, the presentation of data, and the presentation of tentative conclusions.
   d. those psychomotor skills which are required for first-hand investigations.

2. To increase the students' knowledge of basic concepts of life, earth, and physical sciences so that they are able to:
   a. interpret and evaluate fundamental ideas;
   b. relate scientific concepts to everyday life;
   c. make informed choices in future studies or careers.

3. To help the student develop a critical awareness of the interaction between science, technology, and the individual or society.

4. To develop the student's interest in and appreciation of scientific values and problem-solving; to promote attitudes of curiosity and open-mindedness; to promote respect for accuracy, precision, and opinions based on adequate evidence; to promote belief in cause-effect relationships.

5. To train the student in safe laboratory practices entailing proper care of equipment, correct experimental procedures; and appropriate work habits.

The Metric System

Canada's conversion to the metric system has made it necessary for:

1) Teachers to implement the S1 (Systeme Inernationale) throughout the science program;
2) Teachers to make certain that students are familiar with the base units and prefixes such as centre, deci, and kilo.

The metric system is an internationally accepted system of measurement. Scientists in all countries know and use metric units in their work.

Advantages of converting the science program to S1 lie in the internal coherence of S1 and in the ease of conversion of one unit of measurement into another. Conversion from one unit to another is very easy since metric units are based on ten or multiples of ten.

Important points to note

1. Temperature is measure in degrees Celsius °C
2. Cycles per second are hertz
   $1\ Hz = 1s^{-1}$
3. Forces are expressed in newtons
   $N = kg \cdot m/s^2$
4. The unit of energy is the joule. The calorie is replaced by the joule.
5. The symbol cc is written as cm^3.
6. The term weight is better expressed as mass or related to the force of gravity.
7. Pressure is expressed in pascals (Pa) $Pa = N/M^2$
   Atmospheric pressure is about 100 kilopascals k Pa

Further information may be obtained from the Metric Style Guide or Science Teacher's Guide to Metrification.

Science 5-9 and the Special Student

Identification of the Educationally Disadvantaged Students: One or more of the following characteristics may be observed:

a) Have repeated one or more grades
b) Read below their age level
c) Have difficulty with basic Mathematical processes
d) Are in need of time and support to gain confidence to work successfully
e) Generally have difficulty functioning in the regular class environment.

Identification of Gifted Students

One or more of the following characteristics may be observed:

a) Perform outstandingly in all academic subjects
b) Are in excellent physical health and have good attendance

c) Have an unusually advanced vocabulary for their age and grade level
d) Read a great deal
e) Work independently
f) Are often self-assertive
g) Are uninhibited in expression of opinion.

Teaching the Special Student

The Disadvantaged:

a) Set up remedial classes
b) Involve resource and guidance personnel
c) Keep size of classes small
d) Enlist help of older students
e) Use individualized instruction
f) Allow for periodic work in groups with brighter students.

The Gifted

a) Make use of a variety of materials
b) Use techniques such as panel discussion, group presentations, opinion polls
c) Allow for independent reasearch
d) Arrange process of self-evaluation
e) Allow students to develop test items
f) Make use of enrichment in the program
g) Seek out advice and assistance from resource personnel
h) Make use of community resources and facilities.

DESIGN OF THE PROGRAM

In designing the program, the following basic premises are adhered to:

1. A general science structure is maintained and strengthened by specifying the topics that will be studied each year from the six areas of science: Environment, life, earth, space, physics, and chemistry.

2. The science curriculum for grades 5-9 has been summarized and streamlined in this guide but does not deviate too far from the K-6 and 7-9 guides presently in use.

3. It is the intent that this guide not be a replacement for the guides presently in use but a study to help teachers in developing the science program within their own schools. For a more detailed description of certain areas of content teachers are to refer directly to the authorized guides.

4. In addition to science content, the processes of science are stressed. To encourage the student to become an increasingly active investigator of science is an important objective of science instruction. This objective will be satisfied through a conscious, systematic development of the processes of science. Through process develop-

ment, the student will become better equipped for more complex learning in science as well as in other areas of investigation. These processes are: observing, classifying, communicating, measuring, hypothesizing, defining operationally, controlling variable, collecting and interpreting data, inferring, modelling and theorizing.

5. Materials which vary in their emphasis on content or laboratory activities have been recommended in order to provide teachers with a number of alternative organizational patterns. Teachers must select the material according to the conceptual needs of their students.

6. A large measure of flexibility is built into the program. Flexibility is achieved through the use of different recommended materials, the use of different teaching approaches, activities and classroom organizations.

THE PROCESSES OF SCIENCE

The course in a given year consists of a number of units that have been selected from the component areas of science, namely environmental, earth, life, space, chemistry and physics. Each unit appears to stand alone, however, the entire course is unified and coordinated. Within each grade there is a common unifying theme which runs through each of the units. The concepts and processes stressed in a particular year provide a developmental and sequential treatment of the subject area studied.

Processes are intellectual skills which are developed and used both in 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. Children should begin to develop basic processes from their early experiences. Experimenting and controlling variables are termed integrated processes and can usually be more effectively learned by children at the late concrete and formal operational stages. Each process, in turn, consists of a series of levels of difficulty or sub-processes. For example, the process of observation varies from the skill of describing an object in terms of a single physical property to identify the object in terms of its many properties. The basic processes are gradually developed from Kindergarten through Grade 6. The integrated processes are stressed at the higher grade levels as the children begin to develop formal reasoning. It should be noted that many of the main processes often include other activities that reflect various aspects of that process. For example: observing includes identifying; classifying includes comparing and ordering.

The processes of observing, classifying, communicating, measuring, hypothesizing, defining operationally, controlling variables, collecting the interpreting data,

inferring, modelling, and theorizing are to be emphasized throughout grades 5-9 and should be practised whenever the opportunity arises.

Selection of Materials

Recommended curriculum materials are described in both of the K-6 and 7-9 guides presently in use. Not all of the recommended curriculum materials will be found in a given school, therefore teachers are advised to acquire those materials which are compatable with their teaching style. As new technology in the science field is being developed very rapidly no single text-book can provide all of the information required for any given core unit. The resources of the libraries should be utilized as much as possible throughout the entire science program.

The reference column in the objectives and activities section have been left blank so that teachers may list their own choices of reference material.

TEXTUAL MATERIALS - Grades 5-9

References Abbreviated:

MAPS - Modular Activity Program

ESS - Elementary Science Study

EYE - Examining Your Environment

EDS - Elementary Discovery Series

ESSP - Elementary School Sciences Program

ASEP - Australian Science Education Project

STEM - Elementary School Science

SPIES - Self-paced Investigations for Elementary Science

IIS - Ideas and Investigations in Science

GRADE FIVE

Unit	References
Adaptation to the Environment	1. MAPS 5 2. Science 5 3. Sc 5/13 4. ESS Supplementary 5. EYE 6. Science In Action
Physical and Chemical Change	1. STEM 5 2. MAPS 6 3. Science 5 4. SC 5/13 5. ESS Supplementary 6. EDS 7. EYE 8. SPIES 9. Exploring Sc. 6
Forces and Resulting Motion	1. STEM 5 2. MAPS 5 3. Science 5 4. Sc 5/13 5. ESS Supplementary 6. SPIES 7. Understanding Your Environment-5
Shape, Dimensions, and Movement of the Earth	1. STEM 3,5,6 2. MAPS 5 3. Sc 5/13 4. ESS Supplementary 5. SPIES 6. Exploring Science - 6 7. Science: Understanding your Environment - 5
The Changing Earth	1. STEM 5 2. MAPS 5 3. Sc 5/13 4. ESS Supplementary 5. SPIES 6. Exploring Sc. 5 7. Science: Understanding Your Environment - 5
Body Movement	1. STEM 4 2. MAPS 5 3. Science 5 4. ESS Supplementary 5. EYE 6. ESSP 7. SPIES 8. Exploring Sc. 5 9. Science: Understanding Your Environment - 6

GRADE SIX

Unit	References
Interaction of Population with the Environment	1. STEM 6 2. MAPS 6 3. Science 6 Supplementary 4. EDS 5. ESSP 6. SPIES 7. Exploring Science - 6
Body Covering	1. STEM 6 2. MAPS 6 3. Science 6 4. Sc 5/13 5. ESS Supplementary 6. EDS 7. EYE 8. ESSP 9. SPIES 10. Exploring Science - 6 11. Science: Understanding Your Environment - 6
The Earth in Space	1. STEM 3,5,6 2. MAPS 5,6 3. Science 5/13 Supplementary 4. Science: Understanding Your Environment - 5
The Earth in Space cont'd	5. SPIES 6. Exploring Science - 6
Interaction between Earth and the Atmosphere	1. STEM 5,6 2. MAPS 5,6 3. Science 6 4. Science 5/13 Supplementary 5. EDS 6. EYE 7. SPIES 8. Science: Understanding Your Environment - 6
Electric Charges, Forces, and Machines	1. STEM 5,6 2. MAPS 4,5 3. Science 5,6 4. Sc 5/13 5. ESS Supplementary 6. ESSP 7. Exploring Sc. 5
Studying Chemical Change	1. STEM 5,6 2. MAPS 6 3. Science 5 4. Sc 5/13 5. ESS Supplementary 6. EYE 7. SPIES 8. Exploring Sc. 6

GRADE SEVEN

Unit	References
Plants and Photosynthesis	1. Focus on Life Science: Activity centered program; teacher's guide 2. Life Science: Learning Strategy for the Lab. (labs 14,24,25) 3. Focus on Science: Animals and Plants 4. Searching for Structure: Plants 5. Field Guide to the Native Trees of Manitoba 6. Focus on Life Science: Reproduction & Heredity
The Earth	1. Exploring Earth Science 2. MAPS: Soil, Sea and Sky 3. Focus on Earth Science
Introduction to Physics	1. Cambridge Lab Inquiry text: Methods of Science
Introduction to Physics - cont'd	2. MAPS
Biological Levels of Organization	1. Focus on Life Science: Acitivity Centered Program; Teacher's Guide 2. Life Science: Learning Strategy for the laboratory (lab 15) 3. Focus on Life Science Animals and Plants
Introduction to Space Science	1. EYE: Astronomy 2. Earth Science (Lab Inquiry text) 3. Exploring Earth Science
Investigating States of Matter	1. Searching for Structure: Solids, Liquids and Gases 2. ASEP: Water 3. Exploring Physical Science 4. Exploring Science - Stage One 5. Life and Environment Series: Water world

GRADE EIGHT

Unit	References
Microbiology	1. Focus on Life Science: Activity Centered Program; Teacher's Guide 2. Focus on Life Science 3. Life Science: A Learning Strategy for the Lab 4. Exploring Life Science 5. A Source Book for the Biological Sciences (Brandwein)
Patterns in the Earth's Crust	1. Exploring Earth Science: The Earth's Surface 2. MAPS: Soil, Sea and Sky 3. Exploring Earth Science: Geology 4. Searching for Structure: Rocks, Minerals and Fossils 5. Focus on Earth Science 6. MAPS: Earth in Time and Space 7. Our Planet in Space
Investigating Energy	1. Searching for Structure: Heat and Electric Energy Light and Sound 2. ASEP: Place for People 3. 100 Ways to Save Energy and Money in the Home 4. Keeping in the Heat in (Gov't Public) 5. ASEP: Solar Energy 6. Examining Your Environment: Mini Climates
Human Organ Systems	1. Focus on Life Science 2. Focus on Life Science: Activity Centered Program; Teacher's Guide 3. Life Science: A Learning Strategy for the Laboratory 4. ASEP 5. EYE: Your Senses
Earth, Moon, and Sun	1. Exploring Earth Science 2. Exploring Science - 2 3. EYE: Astronomy
Matter and Change	1. Searching for Structure: Solids, Liquids and Gases The Structure of Matter 2. ASEP: Water/Energy and Change/ Pigments and Acidity 3. Exploring Science - 1 4. Science 5/13, Stages 1,2,3

GRADE NINE

Unit	References
Land Ecology	1. Exploring Life Science (The Environment) 2. Terrestial Ecology (Teacher Reference) 3. Focus on Life Science: Activity Centered Program Teacher's Guide 4. Life Science: A Learning Strategy for the Lab
Weather	1. Exploring Earth Science 2. MAPS: Soil, Sea and Sky 3. Lab Inquiry Text: Earth Science (Meteorology and Weather Prediction)
Investigating Force, Work, Motion and Simple Machines	1. Cambridge Lab Inquiry Text: Force and Motion 2. Science 5/13
Reproduction and Heredity	1. Focus on Life Science 2. Life Science (second edition) 3. ASEP: Genetics
The Universe	1. Exploring Earth Science 2. Lab Inquiry Text: Earth Science 3. Searching for Structure: A Universe to Explore
Chemical Interaction	1. ASEP: Atoms 2. Searching for Structure: the Structure of Matter

APPROVED TEXTBOOKS AND SUPPLEMENTARY MATERIAL
(Available through the Manitoba Textbook Bureau - 1983-84)

Textbooks

1. Houghton Mifflin SCIENCE: (1979)
   Levels 4,5,6

2. STEM SCIENCE (Rockcastle et al - 1977)
   Box 4,5,6

3. Addison-Wesley SCIENCE (1980 edition of Stem Science) Book 4,5,6

4. Physical Science: A Problem Solving Approach (Carter et al)

5. Life Science: A Problem Solving Approach (Carter et al)

6. Earth Science: A Search for Understanding (Brown & Anderson)

7. Exploring Physical Science (Thurber et al)

8. Focus on Earth Science (1976) - Mer.

9. Focus on Life Science (1977) - Mer.

10. Focus on Physical Science (1977) - Mer.

11. MAPS (Berger et al) Levels 4,5,6
    Available in both text and pupil activity book.

Modular Materials

1. Science 5/13 (Ennever)
   (Teacher Material Only)
   a. With Objectives in Mind
   b. Minibeasts
   c. Tackling Problems
   d. Early Experiences
   e. Science from Toys
   f. Metals
      Background
      Stages 1,2
   g. Early Explorations
   h. Working with Wood
      Background
      Stage 1,2
   i. Structures and Forces, Stage 1,2
   j. Holes, Gaps and Cavities
   k. Investigations (Part II)
   l. Coloured Things
   m. Ourselves
   n. Time
   o. Change
   p. Like and Unlike
   q. Children and Plastics
   r. Tackling Problems (Part II)

APPROVED TEXTBOOKS AND SUPPLEMENTARY MATERIAL
(Available through the Manitoba Textbook Bureau - 1983-84)

Modular Materials - cont'd

s. Science, Models and Toys (Stage 3)
t. Structures and Froces (Stage 3)

2. ASEP
   a. Life Science: (Choice of student book and/or record book)
      Genetics (Stages 2&3)
      Skin and Clothes (Stage 2)
   b. Physical Science
      Water (Stage 1)
      Energy and Change (Stage 1)
      Pigments and Acidity (Stage 1)
      Atoms (Stage 2)

3. Exploring Science Series: Thruber et al
   a. Exploring Life Science
      The Environment
      The Human Body
   b. Exploring Earth Science
      The Earth's Surface
      The Atmosphere
      Astronomy
   c. Exploring Physical Science
      Balanced and Unbalanced forces
      Heat, Sound and Light
      Electricity
      Energy

4. Focus on Science Modules
   Life Science

Modular Materials - cont'd

      Animals and Plants
      Microbes and Disease
      Human Biology
      Reproduction and Heredity
   Physical Science
      Properties of matter
      Changes in matter
      Measurement and Motion
      Heat, Light and Sound
   Earth Science
      Erosion
      Earth's Matter and Origin
      The Atmosphere and the Hydrosphere

5. MAPS: Cunningham et al
   a. Soil, Sea and Sky
   b. Continuity of Life
   c. Matter, Force and Motion
   d. The Physical World

6. Searching for Structure Series: Pike (ed.)
   Life Science
      a. Microbiology
      b. Ecology
      c. Environmental Science

APPROVED TEXTBOOKS AND SUPPLEMENTARY MATERIAL
(Available through the Manitoba Textbook Bureau - 1983-84)

Modular Materials - cont'd

Physical Science
- a. Solids, Liquids and Gases
- b. Structure of Matter
- c. Heat and Electric Energy

Earth Science
- a. Rocks, Materials and Fossils
- b. Weather and Climate

Materials that are no longer in print

1. Examining Your Environment (MacBean et al)
   Astronomy

2. Exploring Science Series (Thurber et al)
   - a. Exploring Earth Science
     Geology
   - b. Exploring Physical Science
     Chemistry

3. Lab-Inquiry Texts: Physical Science
   (Eisler et al)
   - a. Behavior or light and sound
   - b. Force and Motion
   - c. Measurement
   - d. Methods of Science
   - e. The Physical World

4. Cambridge Science
   - a. Earth Science Work-A-Text
     Pupil's Ed.
   - b. Physical Science Work-A-Text
     Pupil's Ed.

5. Elementary Science Study, Teacher's
   Guide
   Peas and Particles

6. Environmental Discovery Series,
   Teacher's Guide
   - a. Contour Mapping
   - b. Soil
   - c. Stream Profiles
   - d. Transect Studies

7. Investigations in Science - A Modular
   Approach (7-9)
   Matter and Energy
   - a. Bubbles to Batteries
     (Magnetism and Electricity)
   - b. Wings, Weights and Wheels
     (mechanics)

SCIENCE: Occupational Program

GRADE SEVEN

1. Cambridge Science (Hession et al)
   a. Science is Predicting
   b. Science is Experimenting

2. Concepts and Challenges in Science: Book 1 (Bernstein et al)

3. Pathways in Science - metric (Oxenhorn et al)
   a. Biology 1
   b. Biology 2
   c. Biology 2 Workbook
   d. Chemistry 1
   e. Earth Science 1
   f. Earth Science 1 Workbook
   g. Earth Science 3
   h. Earth Science 3 Workbook
   i. Physics 3

GRADE EIGHT

1. Cambridge Science (Hession et al)
   a. Science is Predicting
   b. Science is Experimenting

2. Concepts and Challenges in Science: (Bernstein)
   a. Book 1
   b. Book 2
   c. Book 3

3. Pathways in Science - Metric (Oxenhorn et al)
   a. Biology 2 and Workbook
   b. Chemistry 1
   c. Earth Science 1 and Workbook
   d. Earth Science 3 and Workbook
   e. Physics 2 and Workbook

4. Searching for Structure Series (Pike)
   Ecology

GRADE NINE

1. Action Biology (Weinberg and Stoltze)
   a. Food
   b. Reproduction

2. Cambridge Science (Hession et al)
   a. Science is Predicting
   b. Science is Experimenting

3. Concepts and Challenges in Science (Bernstein)
   Books 1,2 and 3

4. Discovering Science (Barratt - 1969 Ed.)
   a. Book 7 - Sound (limited quantity)
   b. Book 8 - Final Listing

5. Pathways in Science - Metric (Oxenhorn et al)
   a. Biology 3
   b. Chemistry 1

SCIENCE: Occupational Program

GRADE NINE cont'd

c. Earth Science 3 and Workbook
d. Physics 2 and Workbook

6. You and Your Environment (An investigative Approach) 1976 Ed. - Educational Research Council of America

7. Laboratory Supplement (for You and Your Environment)

Material No Longer Available

1. 1.1.S Life Science: Part One: Wong et al

2. 1.1.S Life Science: Part Two: Wong et al

3. Life and Environment Series (Olson)
Asphalt Jungle (Ecosystems)

GRADE 7 - MATERIALS FOR DISADVANTAGED STUDENTS - Correlation Chart (Core Objectives)

Core Topic	ENVIRONMENTAL SCIENCE	Core Topic	LIFE SCIENCE	Core Topic	EARTH SCIENCE
Plants and Photosynthesis	Pathways in Science 1: Biology Unit III, Chapters 1-7 Pathways in Science 2: Biology Unit I, Chapter 1-3 Unit III, Chapter IV Unit V, Chapters 2-3 Concepts and Challenges in Science: Book 1, Biology Unit I, Section 1-7 Unit II, Section 14-21 Cambridge Work-A-Text Science is Experimenting Unit I, Chapter 1 Unit II, Chapter 2 Cambridge Work-A-Text Science is Experimenting Unit I, Chapter 1 Unit II, Chapter 2-7	Biological Organization	Pathways in Science 1: Biology Unit III, Chapter 3-5 (see Life Science 7) Unit IV, Chapter 1-2 Concepts and Challenges in Science: Book 1: Biology Unit II, Sections 16-17 Unit III, Section 27 Cambridge Work-A-Text: Science is Experimenting Biology Unit I, Chapter III	The Earth	Pathways in Science 1: Earth Science Unit I, 6-7 Concepts and Challenges in Science, Book I: Earth Science Unit I, Sections 4-8 Unit II, Sections 7-19 Laboratory Program Concepts and Challenges in Science, Book I: Earth Science Section 1-2 Cambridge Work-A-Text Science is Experimenting Unit IV, Chapters 4-5

GRADE 7 - MATERIALS FOR DISADVANTAGED STUDENTS - Correlation Chart (Core Objectives)

Core Topic	SPACE SCIENCE	Core Topic	PHYSICS	Core Topic	CHEMISTRY
Introduction to Space Science	Pathways in Science 3: Earth Science Unit I, Unit II, Chapters 5-7, 9 Concepts and Challenges in Science, Book 3: Earth Science Unit II, Section 11 Unit III, Sections 16, 21, Unit IV, Sections 25-29 Cambridge Work-A-Text: Science is Predicting Unit IV, Chapter 5	Introduction to Physics	Pathways in Science 3: Physics Unit III, Chapters 11-16 Concepts and Challenges in Science, Book 2 The Metric System Sections 1-2 Concepts and Challenges in Science, Book 3 Unit 11, Sections 16-23 Cambridge Work-A-Text Science is Experimenting Methods of Science Sections VII - X Unit V, Chapter 5 Cambridge Work-A-Text Science is Predicting Unit III, Chapter 3	Investigating States of Matter	Pathways in Science 1: Chemistry Unit I, Chapters 1-5 Pathways in Science 2: Chemistry Unit I, Chapters 1-2 Unit II, Chapters 1 -6 Concepts and Challenges in Science, Book 1: Chemistry Unit 1, Sections 1-7 Laboratory Program Concepts and Challenges in Science: Chemistry, Book 1 Section 1 Cambridge Work-A-Text Science is Experimenting Unit III, Chapter 3 Unit V, Chapter 1

GRADE 8 - MATERIALS FOR DISADVANTAGED STUDENTS - Correlation Chart (Core Objectives)

Core Topic	ENVIRONMENTAL SCIENCE	Core Topic	LIFE SCIENCE	Core Topic	EARTH SCIENCE
Microbiology	Pathways in Science 2: Biology, Unit III Chapters 1-7 Concepts and Challenges in Science: Book 2; Biology Unit II, Sections 11-20 Cambridge Work-A-Text: Science is Experimenting Unit II, Chapter 2 Cambridge Work-A-Text: Science is Predicting Unit II, Chapter 6 Exploring Living Things Unit V, Chapters 20-22	Human Organ Systems	Pathways in Science 2: Biology, Unit IV, Chpaters 1-5 Exploring Living Things Unit III, Chapters 10-11 Life Science: A Problem Solving Approach (Teacher Reference only) Unit III, Chapters 8-10	Patterns in the Earth's Crust	Pathways in Science 1; Earth Science Unit I, Chapters 1-5, 8-11 Unit II, Chapters 4-9 Unit III, Chapters 1-6 Concepts and Challenges in Science: Book 1 Unit I, Sections 9-16 Unit II, Sections 17-23 Cambridge Work-A-Text Science is Experimenting Unit IV, Chapters 2,4 Cambridge Work-A-Text Science in Predicting Unit IV, Chapter 2
Core Topic	SPACE SCIENCE	Core Topic	PHYSICS	Core Topic	CHEMISTRY
Earth, Moon, and Sun	Pathways in Science 3: Earth Science;Unit II,Chapter 7-9; Unit III,Chapter 10-14;Unit IV,Chapters 19-22 Concepts and Challenges in Science: Book 3; Earth Science;Unit II,Section 8-9, 12-14;Unit III, Sections 10-11, 19-20, 25-27;Unit IV, Sections 28-29 Cambridge Work-A-Text: Science is Experimenting Unit IV, Chapter 6; Science is Predicting, Unit IV, Chapter 6	Energy and its Relationship	Pathways in Science 2: Physics Units II, Chapters 1-3, Unit IV, Chapter I Concepts and Challenges in Science: Book 1; Physics Unit I, Sections 1-5 Unit III, Sections 25-28	Matter and Change	Pathways in Science 1; Chemistry Unit II, Chapter 6-11 Unit III Chapters 13-18 Concepts and Challenges in Science: Book 1; Chemistry Unit I, Sections 8-10 Unit II, Sections 13-19

GRADE 9 - MATERIALS FOR DISADVANTAGED STUDENTS - Correlation Chart (Core Objectives)

Core Topic	ENVIRONMENTAL SCIENCE	Core Topic	LIFE SCIENCE	Core Topic	EARTH SCIENCE
Land Ecology	Exploring Living Things Unit II, Chapters 5-8	Reproduction and Heredity	Pathways in Science 3: Biology, Unit I Unit II, Chapters 3-4 Unit III, Chapter 9-12 Unit IV, Chapters 18-20 Concepts and Challenges in Science: Book 3; Biology Units I - III Cambridge Work-A-Text: Science is Experimenting Unit I, Chapter 3 Cambridge Work-A-Text: Science is Predicting Unit I, Chapter 3 Exploring Living things: Unit V, Chapter 24, Unit VI, Chapter 26	Weather	Pathways in Science 2; Earth Science Unit I, Chapters 1-2 Unit II, Chapters 3-9, 11-12 Unit III, Chapters 13-15 Concepts and Challenges in Science: Book 2 Units I & II
Core Topic	SPACE SCIENCE	Core Topic	PHYSICS	Core Topic	CHEMISTRY
The Universe	Pathways in Science 3; Earth Science Unit IV, Chapters 19-22 Concepts and Challenges in Science: Book 3; Earth Science; Unit I, Sections 3-5 Laboratory Program, Concepts and Challenges in Science: Book 2, Earth Science Sections 1 and 2	Force, Work and Motion	Pathways in Science 2: Physics Unit II, Chapters 4-8 Unit III, Chapters 1-8 Concepts and Challenges in Science: Book 2; Physics Unit III, Sections 14-20 Unit IV, Sections 21-23	Chemical Interaction	Pathways in Science 1: Chemistry Unit IV Chapters 23-31 Concepts and Challenges in Science: Book 1; Chemistry Unit II, Sections 19-2 Unit III, Sections 23-24 Laboratory Program Concepts and Challenges in Science: Book 1; Chemistry Section 5

STUDENT EVALUATION

Teachers should encourage their students to assess their own competencies and direct the students' efforts towards self-improvement whenever a weakness is identified. Emphasis should be placed on individual acheivement rather than that of the group.

This emphasis on self-evaluation will provide a feeling of satisfaction for the student and this will lead to a healthy self image.

The type of feedback a student receives as a result of evaluation is important in terms of future learning.

The key to evaluation, be it evaluation of the program, the teaching, or the students' performance, is to have a clear understanding of the basic goals and objectives. Once this has been achieved the appropriate evaluation technique can then be applied.

Although many of the science text-books have built-in techniques for evaluation, the teacher must not rely entirely upon paper and pencil tests. The evaluation process should indicate how well the related knowledge, skills, attitudes, and values have been learned by the students. This process should indicate how a student best learn, specify student growth and achievement, and constantly recognize the goals and objectives of the program.

The following techniques for evaluation are suggested:

1. Anecdotal records:

The anecdotal record presents the teacher with a method of recording his observations of spontaneous behaviors that may be significant in evaluating achievement. The record should not be used without a purpose and should be written immediately as it occurs. It gives and objective report of an event. A simple form or Anecdotal record:

Name _____ Date _____
Place _____ Time _____
Incident _____
Comments _____
Signature _____

Specific Forms of Anecdotal Records:

a) Skills of inquiry

Name of Students	Is curious, asks questions on variety of topics	Predicts Hypothesizes Speculates	Plans investigations Observes closely Keeps records	Repeats experiments Gathers information from different sources	Bases answers on evidence or on reliable data

b) Evaluating performance with manipulating materials:

Names of Students	Manipulates Material with Ease	Observes closely while working	Reveals stick-to-it-iveness	Finds relationships	Avoids hasty inferences	Describes discoveries clearly	Asks new questions	In independent in clean-up	Uses safety precautions

c) Checking the growth of inquiry processes:

Names of Students	Suggested a prediction	Offered ways of of testing predictions	Changed opinion for better idea	Selected materials with purpose	Used "I think" "I don't know"	Criticized his/her own work	Observed carefully	Stated relationships while observing	Repeated work and/or changed for better procedures

d) Checking the growth of scientific attitudes

Names of Children	Shows willingness to have ideas questioned	Modifies views in face of new evidence	Shows a disposition not to jump to conclusions	Looks upon guesses and hypotheses as idea to be tested	Shows respect for ideas of others	Seeks data and information to validate observations or explanations	Exhibits a healthy skepticism for generalizations not based on verifiable observations	Questions conclusions based on incomplete data

e) Evaluating an investigation (as a group)

Problem	Response
1. What did we do that helped you most to find an answer to our question?	
2. What could we have done better?	
3. What new words did we learn from this study?	
4. What new ideas did we discover?	
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?	

2. Multiple-choice items:

Almost all levels of learning from recognition to application can be tested using multiple-choice items and scoring is very simple. The writing is reduced to a minimum and there is little encouragement for guessing.

Rules for constructing multiple-choice items

1. Each item should deal with one and only once central idea or theme.
2. Use direct questions rather than incomplete statements.
3. Each item should hve one and only one correct answer.
4. Items should be written in clear, direct style.
5. Correct grammatical construction should be used.
6. Avoid clues that reveal correct answers.

7. Make each item independent of the others in the test.
8. Avoid copied text-book statements.
9. Make certain that the items make sense.

3. True-False items:
This type of test should be used in extensive sampling, such as that of testing knowledge of facts covering an entire unit.

Rules for constructing true-false items

1. There should be a fairly large number of true-false items.
2. Each item should contain only one idea.
3. Statements should not be copied directly from the text.
4. Statements should be clear and direct.
5. Do not emphasize trivial items.
6. Make certain that the statement is definitely true or false and not open to challenge.
7. Make the number of true statements and false statements approximately equal.

4. Short-answer items:
This test can be used for testing simple recall.

Rules for constructing short-answer items

1. Construct the items so that only a
2. Do not omit trivial or incidental parts from the sentence and avoid mutilation. For example: _____, _____, and _____, are important agents of the _____.
3. Have the answers recorded in a column on the right for ease of scoring.
4. Make certain that there is only one possible answer for each blank.

5. Matching items:

Rule for constructing matching items

1. Make certain that instructions are clearly given.
2. Entries should be homogenious; i.e. relating men with events. Do not include relating dates with events on the same test.
3. Do not make the matching part too long. An average of ten is sufficient.
4. Make certan that the entire matching part is on the same page.
5. There should be about 2 or 3 more responses than premises.

6. Interpretive exercises:
This type of test is based upon a chart, or diagram, or description of a phenomenon accompanied by statements for student evalution. e.g. Which of the following graphs support the hypothesis that the world's climate is changing?

7. Essay test items:

The teacher's expectations should match the child's writing ability.

Rules for constructing essay test items:

1. Pose only well-defined problems. Do not ask broad, general questions.
2. Be explicit. Indicate exactly what the student is to do.
3. Indicate how long the answer is to be, as this will help in controlling the time factor.
4. Bear in mind the elements of the desired response.
5. Have all students take the same test.

8. Problem-solving items:

This test should involve the utilization of knowledge or skills which the student has been previously taught. The problem itself must not be one that the student has previously worked through. The student must be confronted with a situation in which he is called upon to apply his acquired knowledge.

9. Projects:

These can be in the form of written papers, working models or a combination of both. Make certain that the students are aware of the criteria that will be used in evaluating the project.

10. Notebooks:

The teacher's expectations as to the nature of notes and reports must be made clear to the students. The notebook should be well organized with distinct and sequential headings, inlcuding important lists, diagrams, graphs and summaries. Grammatical errors and spelling errors should be noted and corrections neatly made.

11. Qualitative experiments:

These can be used to evaluate manipulative and behavioral performance, such as safety precautions taken, efficient use of equipment and experimental design.

12. Quantitative experiments:

These add the dimensions of measurement and counting to the qualitative experiment.

13. Critical thinking:

This attempts to evaluate reasoning skills. Questions should promote student's attempts to relate cause and effect, to draw inferences, to distinguish fact from fiction, and to develop tentative conclusions, e.g., Answer the following questions basing your replies on the statement, "The use of penicillin produces bacteria that are resistant to penicillin."

i) What does this statement mean?
ii) What are the main consequences of this fact?
iii) What is the logical conclusion?
iv) How does this fact affect you?
v) How does it or will it affect your community?

Sources of information concerning methods and items of evaluation in science education are:

1. Ronald D. Anderson et al, Developing children's thinking trough science (Englewood Cliffs: Prentice-Hall, Inc., 1970).

2. Fred M. Smith et al, Educational measurement for the classroom teacher (New York: Harper and Row, 1972).

3. William D. Hedges, Testing and evaluating for the sciences in secondary school (Wadswroth Publishing Company, Belmont, California, 1966).

4. International Reading Association, Improving reading in science (International Reading Association, Newark, Delaware, 1976).

5. William K. Esler, Teaching elementary science (Belmont: Wadsworth Publishing Co. Inc. 1968) p. 85-86.

6. Paul E. Blackwood and T.R. Porter, How to evaluate science learning in the elementary school (Washington: National Science Teachers' Association, 1968).

OVERVIEW OF THE GRADE 5-9 SCIENCE PROGRAM

	GRADES 5	6	7	8	9
CORE TOPICS	CONCEPTUAL THEMES: Interdependency and Interaction among Organisms; Changes in Matter and Energy; and Earth, Space and Time				
ENVIRONMENTAL SCIENCE	Adaptation to Environment	Interaction of population with environment	Plants and Photosynthesis	Microbiology	Land Ecology
LIFE SCIENCE	Body Movement	Body Covering	Biological levels of Organization	Human Organ Systems	Reproduction and Heredity
EARTH SCIENCE	The Changing Earth	Interaction between Earth and Atmostphere	The Earth	Patterns in the Earth's Crust	Weather
SPACE SCIENCE	Shape, Dimensions, and Movement of the Earth	The Earth and Space	Introduction to Space Science	The Earth, Moon and Sun	The Universe
PHYSICS	Forces and Resulting Motion	Electric Charges, Forces, and Machines	Introduction to Physics	Investigating Energy	Investigating Force, Motion, and Simple Machines
CHEMISTRY	Physical and Chemical Change	Studying Chemical Change	Investigating States of Matter	Matter and Change	Chemical Interaction

GRADE FIVE

Grade Five

ENVIRONMENTAL SCIENCE - Adaptations to the Environment

MAIN CONCEPT: ORGANISMS ARE ABLE TO SURVIVE IN THEIR ENVIRONMENTS BECAUSE OF SPECIFIC ADAPTATIONS.

Objectives	Activities	Materials
Students should be able to:		
1. (a) Observe adaptations of some organisms.	Students observe a characteristic in an organism, e.g., cats' claws, birds' flight, root of a plant, the height of a tree, and discuss it in terms of the organisms natural environment. Students should note that the survival of the organisms is dependent on its adaptations to its environment. Note: Living organisms are best for this activity. Have a "pet day". Take a walk in the school yard to observe animal or plants organisms found there.	
(b) Identify specific adaptations of an organism.		
(c) Infer that adaptations may be structural.	Students working in small groups choose an organism for study. Needs of the organism are listed along with characteristics of its natural environment. Students try to discover which adaptations help the organism survive.	
(d) Infer that adaptations may be behavioural.	Students examine a specific structural adaptation of an organism such as dog's hair or flower petals and discuss how this particular physical characteristic is advantageous to the organism.	
	Students examine a specific behavioural adaptation of an organism such as a cat's stealth or a bird's song and discuss how this particular behavioural characteristic is advantageous to the organism.	
(e) Operationally define an adaptation as any characteristic of an organism which provides it with an advantage for survival in a specific environment.	Students observe a specific organism and list as many adaptations as possible. Each adaptation should then be defined in terms of its function. Through discussion of the function of each adaptation, students should infer how adaptations to an environment give the organism an advantage for survival in that environment.	

Objectives	Activities	Materials
(f) Predict the most useful structural and behavioural adaptations an animal should exhibit in any given environment.	Students are assigned a specific environment, e.g., pond, desert, tundra, and are asked to design and draw a picture of an imaginary animal that could survive in that particular environment. Students should be prepared to discuss the features of their animal and explain reasons for their choice of features.	
2. (a) Observe feet in different animals and compare their function.	Students collect pictures of different animals which show clearly the type of foot the animal has. These pictures are then glued to a large wall mural broken up into several sections to show the functions of various types of foot. Some functional groupings are: - grasping, - silent movement, - movement in water, - tearing flesh, - digging, - balancing. Note: Some animals have feet which will fit in more than one category.	
(b) Observe different types of body covering of animals and compare their functions. Infer the advantages and disadvantages of several.	Students using pictures or drawings compare the body coverings of a fish, birds, and mammals. Detailed drawings can be done to show scales, feathers, and hair. Discussion of these body coverings should lead to a listing of the advantage of each type of body covering and how it helps the organism to survive in its environment. Students make up questions for each other such as: "Why are frogs not covered with scales?" "Why don't squirrels need shells?" Games can be made up with these questions and their answers.	
(c) Observe different types of roots in plants and compare their structure. Infer the advantages and disadvantages of each type.	Students examine the two basic types of plant roots: a tap root (dandelion), and a filamentous root (grass). Comparisons should be made in terms of how each type of root helps the plant gather moisture. It should be pointed out that both plants may exist in the same environment while each acquires water from a different layer.	

Objectives	Activities	Materials
(d) Observe different types of plant stems and compare their function.	Students observe the stem of a tree and a dandelion and compare them in terms of length, thickness, and flexibility. Integrate with mathematics: Find the height of a tree. Examine height to thickness ratio. This may relate to the flexibility of the tree.	
(e) Infer reasons for specific adaptations of plants or animals and communicate these reasons.	Pairs of students go outdoors and select a plant or animal living in the local environment. Each pair of students formulates a question about the structure of their chosen plant or animal. One student in each pair remains with the organism as his partner goes in turn to each plant or animal chosen by his classmates. As each student comes to a new organism the "question" is posed and his answer recorded. All students should have a turn at each location. Answers may be used for further discussion and for evaluation of students' progress.	
3. (a) Observe different types of movement in animals and compare their function.	Students observe live animals or animals on films (e.g., horse, turtle, snake), and classify them as slow moving or fast moving. Discuss how the animal is able to survive in its environment. Animals which do not move faster than their enemies must have other adaptations for self protection. Animals which are slower moving than their food must have other adaptations which give them an advantage over animals which the eat. Note: Students may point out that the behavioural adaptations of locomotion are dependent upon structural adaptations of form. This is a valid argument which leads to the question "which came first?" Investigations of animals which have evolved from the land back to the sea (e.g., dolphin, seal, killer whale) provide a good basis for pursuit of this question.	

Objectives	Activities	Materials
(b) Observe coniferous and deciduous trees and compare the benefits of each type of adaptation.	Students observe coniferous and deciduous trees and their distribution in terms of both latitude and altitude. Benefits of each of these adaptations should be listed with particular emphasis on moisture availability and climate.	
(c) Infer that plants have adaptations which help them survive changes in their environment.	Students examine a broadleaf and a pine needle under a magnifier and with a microscope. Similar structures should be identified and compared. Discuss adaptations which help grass survive constant mowing. Locate a lawn with a dandelion population. Select one plant and cut it down completely. Mark the spot with a marker with the date on it. Observe over several days. When observation period is completed, dig up the whole plant and examine its root. list adaptations of the dandelion.	
(d) Observe and classify adaptations that help in seed dispersal for plants.	Individually or in groups, students make a seed collection and classify each type of seed in terms of the way it is dispersed in nature. Students should record where the seeds were found and if possible identify the plant from which each seed came. Students should observe each seed carefully to identify those structures which help in its dispersal. Students should try to find relationships between where the plant grows and how it disperses its seed. This activity should be done in the autumn. Seeds are dispersed by being carried by wind, water or animals.	

Objectives	Activities	Materials
(e) Observe adaptations that help in the survival of a chicken egg.	Students examine a chicken egg and then crack it into a bowl. Students examine the shell and the membrane under the shell with a microscope. Then examine the yolk and discuss where the chick embryo obtains its food for growth and development.	
(f) Infer that animals have adaptations which help them survive changes in their environment.	Discuss colouration changes in animals which have evolved as adaptations to their changed environments (i.e., fawns and penguins).	
(g) Observe patterns of behaviour in animals and relate them to survival in a changing environment.	Students observe live or on film migration of birds, salmon, monarch butterflies or caribou. Discuss environmental changes which cause migration to occur. Construct a map showing the major migration routes of a particular animal. Students observe animals which hibernate in the winter months, e.g., insects, bears, squirrels. Discuss environmental changes which cause hibernation to occur.	
(h) Infer which adaptations allow animals to hibernate, migrate or remain active during the winter months.	Students construct a chart listing characteristics of animals which hibernate, migrate, remain active. Students are presented with information about a little known animal and are asked to predict its seasonal behaviour based on its adaptations.	

Grade Five

LIFE SCIENCE - Body Movement

MAIN CONCEPT: THE STRUCTURE OF THE BODY IS IMPORTANT IN THE ROLE OF LOCOMOTION.

Objectives	Activities	Materials
Students should be able to:		
1. (a) Observe that an animal's frame is composed of bones.	Review concept of Endoskeleton and Exoskeleton. Examine the internal structure of a bone.	
(b) Infer that the skeleton is important for protection and support.	Collect examples of assorted bones, e.g., chicken, ham, hallowe'en costume of a skeleton, etc. Examine each to see how the bones are connected to each other. Where might muscles be attached? Examine for size and shape. Discuss the purpose of bones in a body. Music: "Them Bone's Connected to the Thigh Bone..." etc. Word Book: 2 Human Skeleton Transparency.	
	Examine the bones of a small animal and how they are put together. Compare the bone structure to the actual outline of the animal. Discuss the purpose of the structure.	
	Examine pictures of dinosaur bones and scientists' interpretations of what the animals actually looked like. Why did some have heavy legs or small legs?	
2. Infer that muscles are necessary for movement.	Look at assorted bones. Discuss what would make them move. Could they move by themselves. Imagine a body without bones.	
3. Observe two places in the body where there is a hinge joint and two where there is a ball and socket joint.	Have a student sit on table and swing one leg from the knee. Discuss which muscles move. Experiment to see how far the leg can be bent in either direction. Compare knee joint to a door hinge.	

Objectives	Activities	Materials
	Bend elbow in either direction. Discuss. Compare to leg joint. Standing, rotate one leg in a circle. Find the joint from which it moves. Discuss term ball and socket. Rotate straight arm in circle. Find the joint that moves. Discuss type of joint. Make a model with plasticine. Lubricate with water.	
4. Infer the importance of cartilage to movement.	Loosely string together several spools with sponge "washers" between. Flex and bend column to illustrate the cushioning effect of cartilage discs. Hold the bottom spool and bend the others on an angle, touching the bottom one at one point. Staple string onto the side not touching. Secure at the top spool. Pull the string so that the spools are straight or one on top of the other. Observe what happens. Compare to the spinal column. Discuss how the cartilage protects the bones.	
5. (a) Observe that muscles are made of fibers and are attached to the bone by tendons.	Examine pieces of wool and string under a magnifying glass. Discuss the composition of their fibers and compare it to that of a muscle. Examine the muscle of a chicken leg. Note the tendons which connect the muscles to the bone. Place one hand on the opposite upper arm. Flex the arm. Observe what happens to the muscle. Discuss.	
(b) Observe muscle movement and infer muscles work.	Tape a ruler vertically to a desk. Tie a string around the top with the ends on each side of the ruler. Pull both ends simultaneously and equally. Observe. Pull only one end. Observe. Compare to pairs of muscles in the arms and legs.	

MAIN CONCEPT: SEDIMENTARY ROCKS CAN BE FORMED IN MANY WAYS AND THEIR STRUCTURE PROVIDES CLUES TO HOW THE EARTH HAS CHANGED.

Objectives	Activities	Materials
Students should be able to: 1. (a) Classify minerals according to structure and the properties of colour, hardness, layering and grain size.	Divide the class into groups and obtain enough mineral samples of many different kinds so that there are at least 12 specimens for each group of students. Ask students to sort rocks according to the properties they see. Give them hand magnifiers to use. List on a chart the groups and the common properties. Have them give the reasons for their classifications. Encourage them to order within the properties, e.g., hardness, colour, grain, size. Mines, Resources and Environmental Management (Mineral Sets). Conservation Comment, July, 1976, Mineral Resources Division, "Common Rocks in Manitoba".	
(b) Observe the process of crystallization and discuss how this relates to mineral growth in nature.	Have students grow their own crystals: Fill jar with hot water, add Borax a little at a time and stir until no more will dissolve; let settle and pour clear liquid into new jars; tie a weighted thread (use thumb tack) to a pencil and suspend in liquid; place jar where it will not be disturbed and observe every day; measure daily. Discuss the formation of stalactites and stalagmites.	
2. (a) Infer order of deposition from layered structures.	Collect layers of lint from the clothes dryer and have students infer the origin and order of the layers.	
(b) Measure the speed of settling particles. Communicate, using graphs, the speed at which particles settle.	Conduct a sinking sand race: Get a tall empty bottle and fill it to the top with clean water; tape a strip of black paper along one side of bottle from top to bottom to help see the particles. Use a strong light and a magnifying glass; drop a pinch of clean sand in the water and watch grains as they sink. Do they all fall at the same speed? Then use different kinds of particles. Time the speed of each size. Graph results. Discuss the variables which may affect the results (size to mass ratio, height of drop).	

Objectives	Activities	Materials
(c) Hypothesize on the basis of the previous activity, the order in which rock particles will settle.	Mix sand, pebbles, water, and garden soil in a large jar. Seal and then shake it. Predict settling of particles and subsequent layers. Observe. Note relative sizes of particles in layers. Discuss.	
(d) Infer the process of sedimentation for some layered rocks.	Obtain samples of coarse and fine grained bedded sandstone or use pictures of layered rocks and have students infer their origin. Add layers of different kinds of mud to a jar of water daily to form a model of how layering takes place in sedimentary rock.	
3. (a) Observe the role of cements in forming some sedimentary rocks.	Make conglomerate with pebbles and glue. (Conglomerate is a naturally formed cement). Have students examine some samples of conglomerates both natural and man-made.	
(b) Predict the formation of crystals by evaporation.	Let saturated salt solution evaporate to form rock salt. Examine with magnifiers.	
(c) Observe natural and man-made sedimentary rock.	Observe rock samples, sand grains in shale, and fossil fragments in limestone using a microscope. Collect samples of man-made bricks and stone for housing facades. Examine and compare. Discuss how they may have been made.	
(d) Srate and identify the two main types of sedimentary rock.	The main fragmental kinds are shale, sandstone, and conglomerate. The main precipitate kinds are limestone, salt, and gypsum.	

Objectives	Activities	Materials
4. (a) Infer some of the conditions under which rocks might have been formed. (b) Simulate fossil formation and infer change on the basis of fossil evidence, how plants and animals have changed over the years, and what ancient climates were like and how they have changed.	Have students make impressions of leaves, shells, water prints in mud, or modelling clay. Take a walk to look for rain prints, foot prints, bird tracks, etc. Examine examples of actual rocks with structures such as layers, rain prints, mud cracks, ripple marks or fossils. Have students suggest how they were formed. Examine pictures if rocks are not available. Mix plaster of paris and water and have the students simulate "fossil" impressions of objects they wish to preserve for the future, e.g., pennies, toys, leaves, bones, nuts, etc. Coat the outside of an object with vaseline and then press into the plaster. Let it stand and then remove the original article to leave the imprint. Make a prehistoric diorama with dinosaurs and vegetation. Go on a fossil collecting trip or visit the museum. Compare fossils with modern specimens. Compare past climates (from diorama) with present-day climates.	

SPACE SCIENCE - Shape, Dimensions and Movement of the Earth

MAIN CONCEPT: THE EARTH'S SHAPE AND MOVEMENT CAN BE USED TO EXPLAIN EVERYDAY PHENOMENON.

Objectives	Activities	Materials
The students should be able to:		
1. Infer that the earth is round.	Study photographs of ships sailing off into the distance, use various objects to produce shadows on a screen. Determine which objects always give a circular shadow.	
2. Infer that the earth is not a perfect sphere.	Research and discuss. Use satellite photographs as visual evidence. Obtain the dimensions of the earth from valid sources.	
3. Infer that the earth or sun must move.	Observe the passage of the sun across the sky during one day. Suggest different explanations for this motion.	
4. Hypothesize that, as the earth turns, the sun's rays strike a different part of the earth.	Shine a light beam on a globe in a darkened room and slowly rotate the globe. Discuss observations and suggest how this would affect time on the earth.	
5. Infer that rotation of the earth makes time zones necessary.	Shine a light beam directly on Winnipeg and discuss the time at that location as compared to Regina or Toronto. Research time zones as to how many there are, where they begin and how they appear on a map and discuss the purpose of time zones.	
6. Operationally define time zones.	Have students write a definition of a time zone based on their observations. Discuss the meaning of daylight saving time.	
7. Observe that time is the same at different latitudes.	Have the students discuss time in different cities around the world and make suggestions for similar or different times at various latitudes and longitudes and why watches are adjusted when travelling.	

Grade Five

PHYSICS - Forces and Resulting Motion

MAIN CONCEPT: CHANGE OF MOTION IS A RESULT OF UNBALANCED FORCES.

Objectives	Activities	Materials
Students should be able to:		
1. Observe forces acting on objects and operationally define "force".	Look at pictures that indicate forces. Note what is causing the force and on what object the force is acting, e.g., vehicles, sports equipment. Operationally define a force as a push or a pull on an object.	
2. Observe forces causing an object to be put in motion and to change its motion (direction or speed).	Students place a rubber ball on a table. Blow on it to start it moving. Blow on it to make it move the opposite way and in a circle. Alter the force of your breath to speed up and slow down the ball.	
3. Predict the effects of forces upon objects and identify the variables Infer that varying the height of the drop will vary the force exerted by an object. Infer that different masses exert different forces when falling.	Give the students a bar magnet and steel ball. Start the ball moving by using the bar magnet. Make it move in the opposite direction. Make it move in a crooked path and in a circle. Holding the magnet different distances from the ball, alter the speed with which the ball moves. Have pairs of students engage in push of war contests. Students face each other and place their right feet side by side, touching. The right hand of each pushes on the palm of the right hand of the other. A third student says "go". When either of the pair moves his foot or lets his hand touch the floor, that person is the loser. Students should note that even though the loser was originally applying pressure in one direction, the winner made the loser change the direction of his original force.	

Objectives	Activities	Materials
4. (a) Construct a device for measuring the mass of everyday objects.	Students should work in groups to make at least one of each of the following four spring scales. The scales should be calibrated according to a standard measure and the distance the standard measure moves the spring. 1. Fasten a rubber band to a piece of cardboard. Bend a paper clip into the shape of a hook and hang it on the rubber band. Use small metal washers to establish calibrations. 2. Fill a large juice can with sand or another heavy material. Secure one end of a hacksaw blade to the top of the can so that it runs across the diameter of the can. Hang a paper cup from the other end of the hacksaw blade by means of three 10 cm strings. Place a piece of cardboard beside and slightly behind the paper cup. Make a mark on the cardboard to coincide with the top of the paper cup; this will be the zero mark. Use washers or other standard weights to calibrate the cardboard. Each time a weight is added, a line is made to coincide with the top of the cup. Record the standard weights on the cardboard. 3. Nail a long piece of wood vertically to a wooden block base. Use a metal bracket or a small piece of wood from which to suspend a spring of medium strength. Attach a cup to the bottom of the spring. The top of the cup will coincide with the zero point which will be calibrated on the piece of wood. Use a washer or any other standard weight to calibrate the spring scale on the strip of wood.	

Objectives	Activities	Materials
(b) Measure weights with a spring scale constructed by the students. (c) Graph force and distance relationships. (d) Infer that the distance an object moves a spring in a scale is a method of measuring the weight of the object.	4. Fold a file card in half and insert an equal sized piece of cardboard or other heavy material to reinforce it. Fasten the open edges with tape, glue, or staples. Punch a hole in the top of the card and insert a rubber band through it. Attach a paper clip to the rubber band. Use a washer or other standard weights to calibrate your spring scale. A modification of this spring scale can be made: If the rubber band is cut so that it is only a single strand rather than the complete double strand, it can measure smaller weights. In both cases the spring scale can be calibrated by having zero correspond to the bottom of the rubber band. Students now use the spring balances to measure the weight of everyday objects with reference to the calibration scale. Students now make graphs of force in washers vs. distance the spring stretched. The home-made spring scales may be standardized by weighing the washers on a gram scale and transferring the weight in grams to the home-made spring scale. Note: Converting the number of washers moved or the distance moved in cm to the weight in grams could be a good exercise in the teaching of fractions.	

Objectives	Activities	Materials
5. Master the same skills as for the investigations with the spring balance.	Construct a balance beam. Do the same activities for the balance beam as for the spring balance. Physical Education: Work with the balance beam.	
6. (a) Observe and record the direction of force applied upon an object.	Place a piece of cardboard under the wheel of a bicycle. Turn the pedal and note which way the cardboard moves. Stand on a piece of cardboard. Take a very big step. Note which way the cardboard moves.	
(b) Observe the effect of a force on a series of several objects.	Show students pictures of forces acting on objects. Have the students draw arrows to show which way the forces are moving. Music: Make a musical instrument using elastic bands. Attach a link of five identical elastic bands to a hook. Note that each stretches the same amount when a strong pulling force is applied.	
7. Observe and record the strength of materials with reference to forces that they can withstand.	Wrap a length of various threads and strings around a desk. Tie a plastic pail to the strings one at a time. Fill the pail with calibrated weights until the thread or string breaks. Do this with each string or thread. Record the maximum amount of force each can exert or withstand before it breaks. Make a bar graph to show your results. Film: Energy and Work. Energy and Matter.	

Objectives	Activities	Materials
8. Infer that balanced forces act equally in opposite directions.	Have pairs of students of approximately the same weight hook up a pair of heavy duty spring scales. Have the students pull in opposite directions. Have two other students take the reading of each scale. Note that each scale reads the same if the students are not moving.	

Grade Five CHEMISTRY - An Introduction to Physical and Chemical Change

MAIN CONCEPT: CHANGES IN MATTER CAN BE CLASSIFIED AS PHYSICAL OR CHEMICAL.

Objectives	Activities	Materials
Students should be able to: 1. (a) Observe the physical properties of some everyday objects by the use of the senses.	Seeing: Observe the characteristics of colour, shape, size, rough/smooth, dull/shiny, transparent/opaque, bouncy, liquid/-solid/gas. Art: Make a collage of the dominant area of one of the senses, e.g., sight - flowers, birds, etc.; sound - records, radio. Feeling, touching or lifting: Observe an object as to hard/soft, smooth/rough, cold/warm, stretchy, heavy for its size/light for its size.	

Objectives	Activities	Materials
	Hearing: Observe whether the object ticks, rings, rattles, hisses or makes no sound. Smelling: Smells/does not smell, sweet/sour, clean/dusty, pleasant/pungent. Caution: Instruct children when observing through the sense of smell, never to put the nose directly near the source, but to waft the odour toward the nose with the hand. Tasting: Observe tastes. Sweet/sour, smooth/bitter, cold/hot. Caution: One should never taste an unknown substance. Beware of allergies to certain foods and diabetes.	
2. (a) Observe and compare the properties of different kinds of matter.	Observe equal amounts of white sand, sugar, and salt to see if you can identify them. Use sense of sight, touch and small. Look at the materials listed above under a microscope or magnifying lens and rub samples of each between your thumb and forefinger. Health: Locate origin of taste sensation, e.g., different area for different taste (sour, sweet).	
(b) Infer that each object has one or more properties which identify it.	See how much of each will dissolve in a glass of warm water. Weight equal samples of each. Observe the odours of the samples.	

Objectives	Activities	Materials
	Look for differences in whiteness. Note whether they are shiny or dull. Students should note that even though all three objects have similar properties, each has unique properties.	
3. (a) Observe, measure, and classify objects according to common properties.	Use the following criteria to compare and classify tool steel, cast iron, a glass tumbler, bricks and cotton. - strength or the resistance of the object to breakage; - stiffness: the resistance to bending; - brittleness: the liability to crack when bent.	
(b) Observe, measure and classify objects according to their hardness.	Try to scratch different metals using a fingernail, a brass or copper pin, a file and an iron nail. Make a scale of hardness according to the ease with which the objects can be scratched.	
4. (a) Observe that a powdered or granulated solid will mix more rapidly with a liquid than would a large piece of the same solid.	Place a large piece of hard candy in a container of water. Crush the same amount of the same candy and place it into a second container of water. Note that the solution containing the small particles will become clouded more rapidly. It can be shown that this is a physical change by allowing the solution to evaporate slowly. The candy will remain in the container when all of the water has evaporated.	
(b) Infer that surface area (or size or particles) affects the rate of dissolving.		
5. (a) Observe that a gas can be introduced	Pour water into two small containers. Put enough bromothymol blue into each container to get a strong blue colour. Blow through a straw into one of the containers. Note that the colour changes to yellow or green. This is due to the fact that	

Objectives	Activities	Materials
5. (a) (cont.) into a liquid and infer that the introduction of the gas produces a reversible chemical change.	carbon dioxide has been introduced into one of the containers. Leave containers overnight and compare the colours. (This is a reversible chemical change because the carbon dioxide gas leaves the solution). Pour clear soda water into a container. Pour an equal amount of water into another container. Put several drops of bromothymol blue into each container. Note that the soda water turns yellow or green while the plain water turns blue.	
(b) Observe materials undergoing irreversible chemical change.	Make a balance scale or use a gram scale. Weigh a sheet of paper. Place the paper in a pie plate. Burn the paper. Weigh what remains. Note the colour, odour, texture, thickness and weight. Place an ordinary iron nail and a painted iron nail in a clear container of water. The pain must be waterproof, e.g., acrylic spray paint or artist's oil paint. This experiment will take several days so allow for other activities during this time. This activity could also be done with steel wool. Language Arts: Write a paragraph predicting what will happen to nail (1) and nail (2). Will it be different?	
6. (a) Infer that oxygen is consumed in the process of rusting.	Place a ball or wet steel wool in a test tube. Invert the test tube in a tray of water. The water should only be a few cm deep. Note that water rises up the tube as the rusting occurs. Students may infer that water has taken the place of something (oxygen) which has combined with the steel wool to form rust. Definition: Rust is the oxidation of a metal. Oxygen combines with iron to form iron oxide.	

Objectives	Activities	Materials
	Test for Oxygen: Burning splinters will be extinguished if no oxygen is present when they are inserted into the tube.	
6. (b) Infer on the basis of evidence that the changes are physical.	Stretch a rubber band; melt wax in a pot and let it cool. Discuss other examples.	
7. Liquids being mixed can be observed and it can be inferred that heat and force affect the rate of mixing.	Place a drop of food coloring into a clear container of water. Repeat this procedure but this time drop the food coloring into the clear water from a distance of 100 cm. Repeat using a drop of heated food coloring.	
	Repeat with hot water and cool food coloring. How can the food colouring be obtained easily from the mixture of water and food coloring? (heat)	
8. Observe the effect of various materials on litmus paper or other chemical indicators and classify as to acids, bases or neutral.	Test a number of substances with litmus paper to determine whether the materials are acidic, basic, or neutral.	
	Discuss the properties of different elements, e.g. copper, carbon, hydrogen and oxygen.	
	Compare the properties of carbon, hydrogen and oxygen to the properties of sugar.	

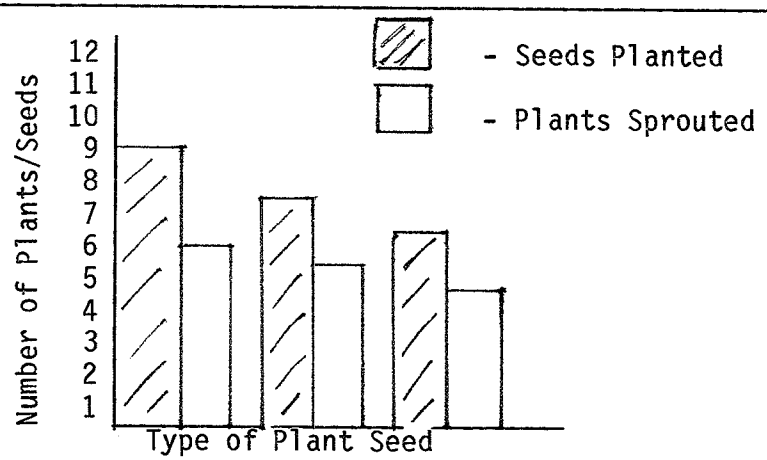
GRADE SIX

MAIN CONCEPT: ORGANISMS INTERACT WITH OTHERS AND THEIR ENVIRONMENT IN ORDER TO SURVIVE.

Objectives	Activities	Materials
Students should be able to:		
1. (a) Classify various kinds of seed, calculate the amount of each type in a box, and estimate the number of potential plants of each kind. (b) Observe producers during growth.	Measure 30 ml of hamster or gerbil seed. Classify each type of see and try to match it to its name on the package. Count the number of seeds of each type and record. Calculate or measure the number of seeds in the package. Estimate the number of each type of seed in a package. Plant 30 ml of birdseed in damp soil. Observe (six weeks to grow). Discuss plant requirements and their production of food. Note: Count number of each type of seed and record. Retain for later use.	
2. Classify organisms as first, second, and third-order consumers.	Present pictures of a plant (e.g., corn), a plant-eating insect, a herbivore, an insect-eating bird, and a carnivore. Ask the students to decide which organisms eat which, i.e., plant, herbivore, carnivore, sequence. Introduce terms first, second, and third-order consumers. Have students suggest other procedures and consumers and classify them. Discuss conclusions that can be drawn from this exercise regarding the interaction of populations with their environments.	
3. (a) Measure the total weight gained by a person since birth.	Determine student's age in years, months, and days. How many days has the student interacted with the environment? Record weight at birth in metric units. Record present weight in metric units. Calculate weight gain. How does the student account for weight gain?	

Objectives	Activities	Materials
3. (b) Measure the daily average weight of food consumed in a twenty-four hour period for one student.	Using a gram table counter, have students estimate the amount of food consumed in a twenty-four hour day. Keep a record of food consumed in a twenty-four hour period. Calculate the total. Compare the total to the estimate. Keep a daily record for five days. Calculate the daily average.	
(c) Predict the weight of food consumed in a ten-day period for one student.	Students predict the weight of food they will consume in a ten-day period by estimating and then by checking their predictions from actual records. Math: Calculate lifetime food intake for class. What conclusions can students draw from this data? See Encyclopaedia. Nutrition: Using UNESCO statistics, compare the food intake of populations in underdeveloped countries with that of populations in better-developed countries. Does this suggest any implications? See Encyclopaedia.	
(d) Measure the weight of the lifetime food intake for one student.	Multiply student's age in days by his or her average food intake per day:	
4. Value: Discuss the implications of an increased population on the environment and on individuals.	Discuss the following topics: - attitudes towards crowds; - impact of increased populations on the environment and individuals, e.g., animal life in relation to built-up cities; - changing plant populations in relation to man. Media resources such as crowd pictures, films, etc. may be used to introduce session.	
5. (a) Infer that abundant seed production increases the possibility of the survival of the species.	Count the number of seeds on a dandelion or sunflower head. Calculate population after three generations if 100% survive. Mathematics: Multiplication.	

Objectives	Activities	Materials
5. (b) Infer that plant populations compete for factors such as food, water, and sunlight, all of which influence their growth.	Dig up some dandelions and then plant them to see if roots and blades will reproduce. What factors determine their growth? Suggest experiments to support the theories put forward. Determine the enemies of dandelions. Determine those plants with which dandelions must compete for their requirements. Other competing plant populations include trees and grass, crops and weeds. Discuss factors for the success of plants such as thistle, tulips, and clover, and for the failure of such plants as the tomatoes, begonias and geraniums. Emphasize competition in the environment. Manitoba Nature: Manitoba Naturalists' Society.	
6. (a) Observe and record on a graph, the number of plants sprouted in relation to the number of seed planted.	Examine bird seed planted earlier. For identification purposes, provide pictures of plants that were expected to sprout. Count the number of each type of plant that sprouted. Record both the number of seeds planted and the number of seeds sprouted. Mathematics: Calculate the ratios of seeds planted to seeds sprouted.	
(b) Interpret data collected and infer possible reasons for the success of a plant.	From the previous activity select the plant which was most successful. This may be done either by considering the seeds planted in proportion to the plants sprouted or simply by observing which type of plants had the most sprouts. Examine all the plants in terms of leaf width, root type, and height. Determine which of these factors may have aided the most successful plant.	

Objectives	Activities	Materials
		
7. Describe the actions of a neighbourhood animal in defending its territory.	Observe the behavior of a cat or a dog in its territory when it is approached by another of its species. Report to the class. If possible, observe birds that are nesting and their reactions to other birds in their territory. Discuss why some birds are allowed in but birds of the same species are not.	
8. Infer that movement to a new territory is sometimes necessary for the survival of an animal.	Discuss animals which move to new territories, e.g., beaver, bees, deer. List factors necessary for their survival and how these in turn are related to their possible movement. Discuss how animals indicate their territories to other animals of the same species. How do people indicate their territories? Review briefly a predator-prey relationship. Discuss the implications of a decrease or increase of the prey and predator in terms of territorial movement.	

Objectives	Activities	Materials
	Present pictures of our crowded world, e.g., beaches, streets, shelters. Discuss the implications of overcrowding with regard to living conditions, e.g., noise, crime, dirt, traffic, pollution, food, shelter, etc., and what action students may take to improve living conditions.	
9. (a) Operationally define an ecosystem as being several different populations interacting with each other and their environment.	Present a number of pictures displaying ecosystems, e.g., birds, deer and trees in a forest ecosystem or a freshwater pond ecosystem. Have students identify the ecosystem and its component parts. Art: Create a bulletin board display or paint a mural illustrating an ecosystem.	
(b) Observe and record changes in a small ecosystem over a period of time and make inferences from the data.	Field trip: Identify ecosystems. Record the populations and the environments observed for each ecosystem. Construct an aquarium and/or terrarium or collect organisms suitable for each environment, e.g., insects, small animal. Cover the container with a rubber glove or balloon to allow for gas expansion. Do not uncover. A terrarium can be made in a clear plastic bag or box. Observe. On a weekly basis, record changes in the population of the above ecosystems. Students can examine and identify variables in the environment which may cause change.	
10.(a) Control variables in an artificial ecosystem.	Prepare brine shrimp water: Place tape water in a container and let stand for one day. Add about 30 ml rock salt to 1 litre of water.	

Objectives	Activities	Materials
	Put 50 to 100 brine shrimp eggs into a vial of brine. Cap and observe for a few days. After 3 days, count hatched brine shrimp by using a sampling technique. Record data. Compare number of hatched shrimp to number of unhatched to determine a ratio for hatching. Sampling Technique: Place a clear plastic container over graph paper. Pour contents of vial into plastic container. Count shrimp in one square of the graph paper and multiply by number of squares covered.	
(b) Predict the change in the population of an organism when the environmental conditions are changed.	To construct an apparatus to measure the effects of heat, cut a circle (37 cm in diameter) out of stiff cardboard. Draw concentric circles at regular intervals from the centre of the circle. Glue aluminum foil to the bottom side of the circle. Trim the edges. Cut the top off a small cardboard box. Place a lamp with a 25 watt bulb in box. Cover with a coffee can which has had both top and bottom removed and holes punched along the ridges of the top and bottom. Place the circle on top of the box. Place brine shrimp vials in various concentric circles. Record the number of shrimp hatched every day and from which circle they came. Thermometers could be used to measure heat. (Note: Keep tops on vials). Discuss conclusions.	
11.(a) Measure population density in a given unit area.	Count the number of plants or animals in your classroom. Count the number of plants or animals in several other classes. Compare plant or animal populations per classroom.	
(b) Infer factors which affect population density.	Examine photos of various land terrains. Have groups determine whether the areas would be densely populated or not and list the reasons for their conclusions.	

Objectives	Activities	Materials
(c) Interpret data and develop inferences about the reasons for variations in the population of major cities in the world.	Examine a map of Manitoba. Observe where the greatest number of cities are located. Compare this map to a topographical map for some indication of land condition. Using this information, formulate hypotheses for the location and growth of the cities. Note: Group projects could be done showing the historical growth of a city such as Flin Flon or Brandon, in relation to its environment. Using an almanac, compare the population densities of major world cities. If possible, compare their growth rate over a period of a decade. Can any conclusions be drawn from this data? World Book: Yearbook.	
12.(a) Infer that man has influenced the survival of some living things.	Discuss organisms (birds, insects, animals) that have adapted to man-made environments, e.g., spiders, mice, gulls. Discuss organisms that have been endangered as a result of man's influence on the environment (loss of habitats), e.g., passenger pigeon. Collect information regarding endangered and extinct species. (Bald eagle, prairie chicken, whooping crane).	
(b) Infer that natural or man-made factors can cause the population density in a given unit area to change.	Build a bird house and put it in an accessible location. Observe the various animals which make use of it. Discuss observations. Bring in a week's supply of various newspapers. Have students check through them to see if they can locate any items regarding natural or man-made disasaters or dangers. Clip out the articles, share them and have groups discuss the implications	

Objectives	Activities	Materials
	of the disasters to population density and to future living conditions.	
(c) Identify ways in which science has improved food production.	Discuss cross breading of plants and animals, crop rotation, fertilizer use, intensive farming and other methods scientists have developed to improve world food production. World Health Organization Pamphlets are available from United Nations.	
13. Infer the effects of man's actions on influencing an ecosystem. Interpret data and infer that detergent has a negative influence on a population of algae.	Discuss the ways in which man's actions have caused changes in populations, e.g., dredging of lakes and what effects this has on the ecosystem. Collect algae from a pond. Fill a clean jar with distilled or rain water. Add 5 ml of laundry detergent. Place some algae in the jar with the detergent and some in a control jar. Record observations. Formulate conclusions.	
EXTENSION TO UNIT:	THE MICROSCOPE	
14.(a) Name and identify the parts of the compound microscope. (b) Explain the functions of the parts of the compound microscope. (c) Prepare wet mounts. (d) Focus the microscope.	Demonstrate and discuss the function of microscope parts. Have students observe a plastic metric ruler under various powers and have students estimate the size of human hair. Have students prepare wet mounts and focus a microscope correctly. Brine shrimp at various stages of development could be observed.	

LIFE SCIENCE - Body Covering

MAIN CONCEPT: THE BODY TEMPERATURE OF AN ORGANISM IS INFLUENCED BY THE BODY COVERING.

Objectives	Activities	Materials
Students should be able to:		
1. Describe the basic structure of human skin: a) epidermis & dermis b) oil & sweat glands c) hair, muscle and pores	Scrape the inside of the cheek and examine cheek cells. Examine cross-section diagrams of the skin including epidermis, dermis, and fatty layer. Test for oil on the skin by touching the forehead with the paper. Place drops of water on the oiled part to test its effect. Test for oil on the finger by pressing the finger on a glass slide and dusting with powder. Discuss the role of the mapighian layer as protection against sunlight.	
2. Relate the basic structure of the skin to its functions: a) as a protective layer b) as a sensory surface map. c) as a temperature regulating organ.	Make a sensitivity instrument - use two toothpicks and keep moving them together until you can only feel one. Use the wrist, palm, tip of thumb, calf of leg, side of face. (Try blind folding your partner for the tests). Determine the position of the pores on the finger by placing a 10% iodine solution on the tip of the finger, allowing to dry, and pressing the finger on a clean paper. Test the top of the hand for change in the temperature by placing one or two drops of methyl alcohol on it. Check the effect or rate of evaporation by blowing on the top of the hand. Discuss heat control by the skin.	
3. Hypothesize that other animals with backbones also have a skin covering on their bodies.	Research and discuss fish, amphibians, reptiles, birds and mammals. Determine how the body covering is different or similar among the animals of the above five groups.	

Objectives	Activities	Materials
4. Infer that the body covering of an organism is directly related to its body temperature.	Discuss cold-blooded and warm blooded animals and observe that the skin of cold blooded animals will not keep heat in the body whereas the skin of warm blooded animals will. Discuss how the type of body covering is related to the environment in which an organism chooses to live.	

Grade Six EARTH SCIENCE - Interaction Between Earth and Atmosphere

MAIN CONCEPT: WEATHER, AN INDICATOR OF THE CONDITIONS WITHIN THE EARTH'S ATMOSPHERE, IS THE RESULT OF AN INTERACTION BETWEEN MATTER AND ENERGY.

Objectives	Activities	Materials
Students should be able to:		
1. Keep records of weather data and relate the data to the type of weather.	Obtaining and recording of temperature (highs and lows), precipitation, winds, humidity, and type of weather should be continuous throughout this unit after students have developed instruments and decided on the position of the weather station. Data may be recorded and inferences concerning the relationship between weather and various factors be made during the development of the unit and/or this data may be used to conclude the unit in terms of relating weather to the data collected. Predictions concerning future weather may be carried beyond the time allotted for the unit or at a time when the students have sufficient background to begin to make predictions. Obtain daily weather charts from the newspaper or the Department of Transport, Meteorological Branch. Instructions for building instruments are also available from the Department of Transport - Meteorological Branch.	

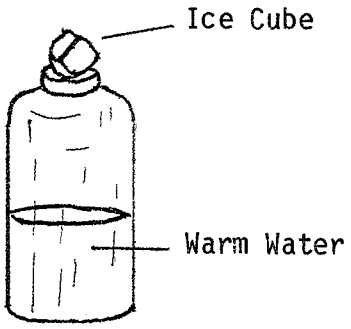
Objectives	Activities	Materials
	J.A. Konan, Watching the Weather, The Macmillan Company, is a good teacher reference.	
2. (a) Observe that warm fluids tend to rise and cooled fluids tend to sink.	Fill a wide-mouth jar with cold water. Fill a small jar with warm, coloured water and cover the jar with aluminum foil. Bind the foil to the jar with rubber bands. Lower the small jar into the large jar and puncture the foil. Observe. Place your hand above a bulb and then the same distance below the bulb. Compare degree of hotness. Compare the action of chalk dust (clouds) in projector beam with a hot plate below the dust and without a hot plate.	
(b) Predict the behavior of cold air overlying warm air and vice versa.	Using two identical jars, fill one with cold water and the other with coloured, warm water. Place the cold water container into a pan. Wet a cardboard card on both sides; place it on top of the warm water container and invert and place the container (with care) over the top of the cold water container. Carefully remove the card and observe. Repeat using a cold water container over a hot water container. Apply to air masses.	
(c) Operationally define convection as the movement of a fluid that accompanies heat transfer. Describe heat transfer in a room by means of convection.	Build a convection box and examine convection currents. Demonstration may be adequate. OR gently drop crystals of potassium permanganate or drops of food colouring along one side of a warm clear jar and observe, diagram, and explain the flow of colour.	
d) Measure, record and compare the effects of the position of a thermometer, the colour of soil, and other factors on air temperature.	Record air temperatures at different levels above the ground surface, e.g., grass. Sheild the thermometers from the sun.	

Objectives	Activities	Materials
	Test and record temperatures above other surfaces and compare. What factors should we keep constant, e.g., exposure to sunlight? Determine maximum and minimum day-time temperatures. Examine the temperature of soils at different depths and record. Compare south, north, east, and west walled areas. Compare temperatures within (same depth) and above soils of different colours, e.g., cover one plot equally with coal dust, another with white powder (e.g., chalk dust), another with sand, and compare their temperatures to that of the control (regular) soil available. Apply to the effects upon the motion of air masses. If this unit is attempted in the winter, teachers may consider using the wind and temperature activities from EYE: Snow and Ice or EDS: Snow and Ice.	
(e) Measure the speed and direction of wind using student-made apparatus. Infer the direction of air currents Predict likely directions of air currents within a closed system and the effect on wind of different land and water masses. Infer that winds blow in different directions around the world.	Use a feather, straight pins, gelatin capsules and cardboard. Assemble as in the diagram. Make a tiny hole in a gelatin capsule with a pin heated in a candle flame. Push the pin through the cardboard and into the hole in the gelatin capsule. The feather is taped to the gelatin capsule. Test the direction of air currents in various parts of the room. Suggest reasons for air movement. Make a simple wind gauge from 8.5" x 11" cardboard and thread. Cut cardboard as in diagram and hang thread from the eye. Mark 1 cm marks along the opening. To use, point, the device directly into the wind and note where the thread hangs. Make a cup anemometer using a cork for the centre and paper cups on three rods. Use an eye dropper to support the cork. Nail in the base so it will pivot easily. Measure wind speeds. Time revolutions for known wind speeds (may be used to measure larger differences in wind speeds). Measure wind speed at various locations around the school and record measurements on a map or chart.	

Objectives	Activities	Materials
3. Describe the effect wind direction on local weather.	Using weather reports or charts, make comparisons in terms of temperature and precipitation relative to air masses moving into the area.	
4. (a) Observe that evaporating water cools an object.	Place a drop of water on one of your hands. Spread the drop out and blow on it. Which hand feels warmer. Place two equal lengths of cut shoelaces around the bulbs of two similar thermometers. Tie just above the bulb. Wet one shoelace with water at room temperature. Keep the other dry. Fan the thermometers for two minutes. Record temperature at thirty second intervals.	
(b) Observe differences between temperatures within systems where condensation occurs and where no condensation is occurring.	Place a crumpled, wet paper towel and a thermometer inside a closed glass jar. Place the container in sunlight (inside thermometer should be shaded from direct sunlight). Place a thermometer (shaded from the sunlight) next to the jar. Observe condensation inside jar and temperatures of different thermometers. Discuss. Note: Heat energy is trapped inside the jar, both by air and water vapour. Condensation is caused by water vapour contacting the glass jar, which is in contact with cooler air. It is difficult to illustrate heat loss by condensation. Note: A closed system is one which odes not allow additional materials to enter the system.	

Objectives	Activities	Materials
5. (a) Formulate a hypothesis that explains an increase in forces within a sealed jar in which water has been placed.	Tape a thermometer inside each of two glass jars (equal size and shape). Use thermometers which show exactly the same temperature for room temperature (some may vary slightly). Place a cupful of water (room temperature) into one jar. Cover both jars with a tight rubber membrane (balloon with neck removed) and fasten with rubber bands. Compare the tops of containers after a short period of time.	
(b) Infer that a volume of air will hold a limited amount of water vapour.	At the same time, use three additional jars with rubber membranes and thermometers. Place one-half cupful of water in one, one-quarter cupful in another, and an eye-dropper full in the third. Label the jars. Observe and compare differences among the tops of the jars. What conclusions can be drawn about the ability of air to hold water? What would happen to the water (not evaporated) in a jar, if the top were removed and why? Note: Since saturation depends on the volume and the temperature of the air, the teacher should test the system initially in order to determine the quantities and conditions.	
6. Measure and record relative humidity over a period of time.	Keep a record of the daily relative humidity in a moist bathroom, the classroom, and outside using the wet and dry thermometers developed in 4(a) and a relative humidity table. (Relative humidity tables are available in most reference books). Suggest reasons for variations in temperature and in the relative humidity. Keep a record of relative humidity over a period of time. Discuss the ability of warm, summer air to hold moisture in comparison to cold, winter air.	

Objectives	Activities	Materials
	Note: Relative humidity refers to the amount of water vapour actually in the air compared to what it could hold at a particular temperature. Air is saturated at 100 percent humidity and contains no water vapour at zero percent. Air is seldom at 100 or 0 percent relative humidity. Teachers may wish to demonstrate the formation of dew by placing a pitcher with ice cubes in the room. The condensed water can be exained to determine whether dissolved materials are present. It can be compared to evaporated tap water (i.e., the pureness of condensed water vapour). Students can determine the dewpoint by half filling a shiny, metal juice can with water. Add ice, a piece at a time, and stir with a thermometer. Keep adding ice until condensation first appears. Record this temperature as dewpoint. Compare dewpoints inside and outside the classroom. Discuss why dew forms at night on objects that radiate heat and cool below the dewpoint. Discuss the formation of frost (water vapour condensing on objects below freezing point).	
7. Demonstrate (model) cloud formation and ways in which clouds and fog can be formed.	Take a one gallon jar and pour about 50 ml of water into it. Cover the jar with a rubber sheet and fasten lightly with elastic bands. In a few minutes strike a match, blow it out, and with a classmate's help, quickly place the smoking match (match is not burning) into the jar and replace the lid. In a minute, press down the cover, for about five seconds, and then quickly pull up. Repeat if unsuccessful. Discuss possible reasons for cloud formation, e.g., saturation of air, role of smoke particles, decrease of pressure (cooling effect). Discuss the formation of rain. Fog (clouds near ground) can be formed by using the device illustrated below. Note: Darkening the room and shining a beam of light through the jar may help to identify small "cloud droplets".	

Objectives	Activities	Materials
		
8. Infer the movement of air as it rises over mountains.	Study a diagram of wind movements as it blows from sea to dry land over a high mountain range. Discuss the changes that occur as the air is forced to rise and then move down the mountain side.	

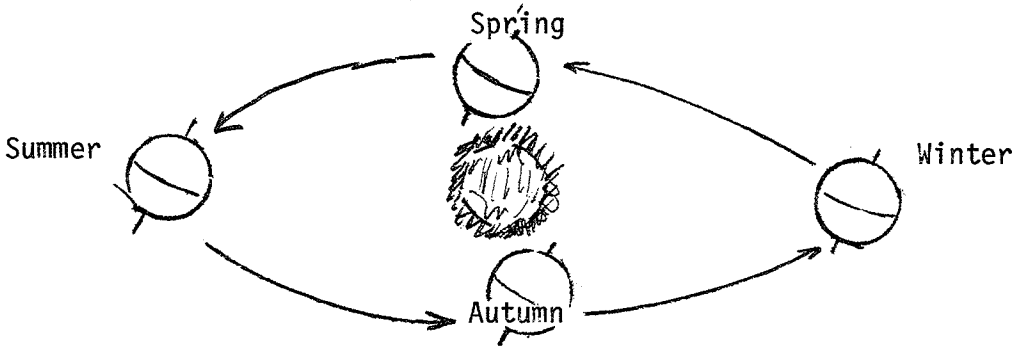
Grade Six SPACE SCIENCE - The Earth In Space

MAIN CONCEPT: EVERYDAY OCCURRENCES CAN BE EXPLAINED BY MEANS OF PATTERNS THAT EXIST IN THE EARTH-SUN-MOON RELATIONSHIP

Objectives	Activities	Materials
Students should be able to:		
1. (a) Infer that the rotation of the earth causes day and night.	Shine the light from a projector on a globe in a darkened room. Rotate the globe slowly counter clockwise looking down on the north pole. Find specific locations on the globe and note when they turn into the light (sunrise) and out of the light (sunset). Discuss this activity in terms of day and night.	

Objectives	Activities	Materials
(b) Infer the direction of the rotation of the earth.	Note the approximate locations on the horizon where the sun rises and sets. Discuss observations and confirm inferences by relating to globe and light activity above. Using the globe and light, students identify locations which are in daylight while they are in darkness.	
(c) Operationally define one day.	Locate the shadows of a permanent object which may be conveniently observed daily. The position of this shadow is noted as exactly the same time each day for a few days. Discuss observations and have students write a definition of one day in terms of what they have discovered. Note: Often a cardboard shape placed on a sunlit window will provide a good shadow for this activity.	
2. (a) Infer that the motion of an object may be detected by comparing its position with other objects.	Observe a small circle on an otherwise blank blackboard. Students cover their eyes while the teacher erases the circle and draws another in a different position. Observe the second circle and discuss whether or not its position has changed. Teacher should guide discussion toward comparison of the positions relative to other objects. Observe a distant moving object, e.g., traffic, birds in flight, airplanes, and discuss how students know the object is moving.	
(b) Infer that an object which appears to have moved may not have moved at all.	Observe a small circle inside a large square on blackboard. Students close their eyes while the teacher erases and redraws the square with the circle still inside. Students discuss what has moved.	
(c) Infer that a changing point of view may cause the illustration of motion.	Close the left eye. With the right eye sight a distant object over the point of a pencil held at arms length. Open the left eye and close the right eye. Discuss observations. What has moved?	

Objectives	Activities	Materials
	Tape a square outline on a classroom window. Observe the outdoors through the taped square and have student note how their view changes as they move around inside the classroom.	
(d) Infer how shapes may change when viewed from the opposite direction.	Each student prints his/her name in block letters the way it would look from the other side of the paper, e.g., "BOBBY" would be "Y O ".	
	Look into a mirror and wink with the right eye; observe the image winking with its left eye.	
(e) Infer that when one object is moving faster than another object, the slower object may appear to be moving backward.	Answers to this problem may be checked by printing on clear acetate and viewing from the other side. Discuss the effect of passing a car on the highway. Passengers in the slower car appear to move backwards when compared with the observer. This effect may be demonstrated by a student running past another student who is running slowly.	
(f) Hypothesize that the earth or the sun must move.	Observe the passage of the sun across the sky during one day. Suggest different explanations for this motion. Caution: Students should be warned never to look directly at the sun.	
3. (a) Compare rotational motion to revolutionary motion.	Spin objects such as balls, pennies, or tops. This type of motion is defined as rotation. Students then tie objects such as pencils or small weights to a string about one metre long. These objects are then swung around the students heads. This type of motion is defined as revolution. Stand on one spot, then rotate. Then walk (revolve) around the classroom.	
(b) Infer that the axis of the earth is tilted.	Collect sunrise and sunset times from newspapers from various times of the year. From this information, the hours of day-	

Objectives	Activities	Materials
	light throughout the year can be graphed. From the graph, students should conclude that in Manitoba, we receive less sunlight in the winter than in the summer. Try to explain why this occurs using the globe and light model. Discuss the summer "midnight sun" and "noon darkness" in the polar regions and relate this to the tilt of the earth's axis. Students should be able to demonstrate how the titled axis determines the amount of sunlight.	
(c) Observe the area lighted by direct rays and slanted rays. Compare the areas lighted.	Shine a projector light on a vertical paper about one metre away. Repeat this procedure with the paper tilted at about 45° away from the projector. Students should note that the slanted paper is lit over a larger area.	
(d) Infer that slanted rays of sunlight produce less heat on the earth than direct rays.	Discuss the fact that the sun is never as high in the sky during the winter months as it is during the summer. Since the heat must be spread over a larger area (because of slanting rays) the winter months are colder. Should repeat above activity using the globe instead of paper.	
(e) Infer that the days of longest daylight relate to the position of earth in its orbit where the axis leans toward the sun.	Draw the diagram below and demonstrate each of the four seasonal positions with the globe and light.  	

Objectives	Activities	Materials
	Note: Seasonal characteristics would be reversed in the southern hemisphere.	
(f) Infer the revolution of the earth around the sun causes seasonal change.	Discuss seasonal change and hypothesize what type of movement of the earth could account for it. Note: This concept is difficult to demonstrate in the classroom and must be confirmed over time by other activities in the unit.	
(g) Operationally define one year.	Discuss where in the earth's orbit the solstices and equinoxes occur. Write a definition of one year in terms of what has been discovered.	
4. (a) Observe through pictures, films, filmstrips, and other media the objects and events of near and distant space.	Teacher guides student research of the sun, the moon, the planets, comets, meteors, stars, constellations. Students may wish to build models of the earth-moon system, the solar system, the galaxy. Students may wish to read or write stories about spaceships, space travel, the origin of the Universe. Students may wish to observe, with or without telescopes, the moon, a comet, meteor shower, the constellations.	

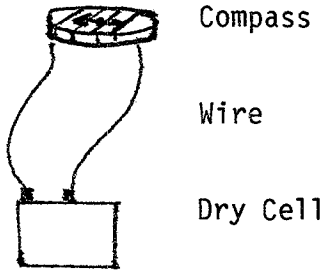
PHYSICS - Electric Charges, Forces and Machines

MAIN CONCEPT: ELECTRIC ENERGY CAN BE CONVERTED INTO OR PRODUCED FROM OTHER FORMS OF ENERGY. THE AMOUNT OF ENERGY DERIVED FROM A MACHINE IS APPROXIMATELY EQUAL TO THE AMOUNT PUT INTO THE MACHINE.

Objectives	Activities	Materials
Students should be able to:		
1. (a) Observe that a material may become electrically charged if it is rubbed against a material.	Hold a neon glow light and shuffle across the room on nylon or wool carpet. Notice that the glow light lights up. This can also be done with a small fluorescent light. It is very effective in a darkened classroom.	
(b) Hypothesize that the amount of electrical charge can be increased by rubbing two materials against each other an increased number of times.	Shuffle your feet across a rug of nylon or wool. Then touch a metal object. Note the shock. Touch the tip of a partner's finger. Touch objects such as wood and plastic. Rub a comb or a plastic brush through your hair. See how many pieces of paper you can pick up with it. Try twice as many strokes to see if you can pick up twice as many pieces of paper. Note that freshly washed or clean hair will give the comb a greater charge.	
(c) Design an experiment to stick a balloon to a wall.	Rub a balloon on your hair. Stick it to a wall. Then rub it on your clothes and stick it to a wall. Note by which method the balloon will stick the longest. Repeat using various fabrics.	
2. (a) Observe the attraction of an uncharged object by a charged object.	Rub two items such as a sweater and a balloon or a ping pong ball and a plastic bag together. Note that these objects which now have an electrical charge will attract small objects which are suspended on pieces of thread, e.g., puffed wheat, small ball of foil, toothpick broomstraw.	
(b) Observe the repulsion and the attraction of two electrically charged objects.	Charge an object such as a comb or a plastic spoon. Hold it near a slow-running water tap. Note that the charged object will deflect the flowing water.	

Objectives	Activities	Materials
	Have the students vigorously rub a strand of wool with a plastic bag. Suspend the wool over the desk. Hold it in place with a wooden block. Place uncharged objects such as wood, a rubber band, and a feather near the wool. Note that the strand of wool is attracted. Rub the uncharged objects with the same plastic bag. Note that the wool is repelled. Hold five pieces of wool together at one end and let them hang. Then, rub the five pieces and let them hang again. Note that the ends of the wool now repel each other.	
3. Infer that there are two different kinds of electrical charges.	Hold two charged strands of wool close to each other. Note that they repel. Hold two charged strands of plastic bag together. Note that they also repel each other. Hold a charged strand of wool and a charged strand of plastic bag near each other. Note that they attract each other.	
4. Infer that an electrical charge can be carried from one object to another.	Suspend two ballons from the threads about ten centimeters apart. Comb hair with a plastic comb and touch one balloon. Touch the other balloon at the same time with a glass test tube which has been rubbed with plastic wrap. Observe. Remove the labels from two large juice cans. Place one on a block of paraffin. Place a block of wood on the other. The can on the paraffin is the insulated can. It should not be touched nor should anyone stand too close to it. The can with the block on it is the uninsulated can. The uninsulated can should be hooked up to a water tap by means of a long insulated wire which is bare at each end. Hang a tack on a string from the top of the uninsulated can. Rub a plastic bag with wool and touch the insulated can with the plastic bag. Repeat five or six times.	

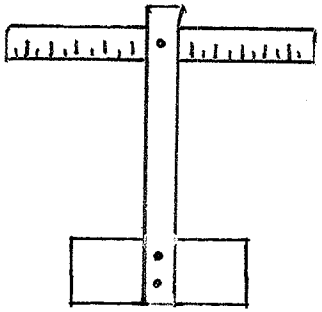
Objectives	Activities	Materials
	The tack will be attracted to the insulated can. When it touches it, it will gain an electrical charge and move back to the uninsulated can. The charge will be drained off and the tack will again be attracted to the insulated can. As long as the insulated can is charged with electricity the tack will move back and forth.	
5. (a) Observe the effects on an electrical charge of joining two insulated objects of different charges. (b) Predict and verify the kinds of material which can carry an electrical charge.	Place another insulated can a metre away from the original insulated can. Join them with a thin wire. Touch the third can with a plastic bag as above. Observe that the tack will move back and forth. Test this system with aluminum foil, wet string, and string that has been soaked in a salt solution. In another experiment, students can join a bulb to insulated and uninsulated cans. The insulated can is repeatedly touched with a charged plastic bag.	
6. Observe that two different metals can produce an electrical current when they are placed into an acid or a salt solution.	Place a thin sheet of zinc and a thin sheet of copper in a weak acid solution of vinegar or lemon juice. Attach the bare ends of copper wire to the two metals and run these wires to a flashlight bulb to make a circuit. The electrical current produced by the metals and solution should light the bulb. Try this again using water and salt, and water and sugar. Try different metals. A current too weak to light the bulb may be formed. It can be detected with earphones or a speaker from a	

Objectives	Activities	Materials
	radio. If the jack of the earphones is touching the wires a click will be heard when the circuit is completed or broken if electricity is flowing through the circuit.	
	Lay a sheet of clean copper metal on thick newspaper. Place a few paper towels on the copper so that it is almost completely covered. Carefully pour a solution of salt and vinegar on the towels until they are soaked. Place a clean sheet of zinc metal on top of the vinegar and flat soaked towels. The zinc must not touch the copper at any point. Use a mini socket to hold a flashlight bulb. Connect one wire from the socket to the copper. Connect the other wire from the socket to the zinc. The bulb will light up. If no zinc is available use a piece of galvanized metal. The apparatus should be taken apart and washed thoroughly.	
7. Infer the present of electrical currents by testing with a magnet.	Wrap a magnetic compass with about twenty turns of insulated wire and connect to a cell as in the diagram.  Compass Wire Dry Cell	

Objectives	Activities	Materials
	Note: Maximum deflection occurs when the compass is wrapped with coils parallel to needle. When an electrical current flows through the wires the needle of the compass will move. Test for the presence of an electrical current in the following cells: - a vinegar soaked blotter placed between a penny and a paper clip; - a wet cloth sprinkled with baking soda placed between an aluminum pan and bunched up copper wire; - a piece of paper towel soaked with lemon juice and placed between a strip of zinc and a strip of copper; - a galvanized pail lined with cloth, and copper screening placed against the cloth. Fill the pail with a salt solution.	
8. (a) Infer that many small forces may act together to form one large force.	Have one student at a time try to lift a large table with one finger. Next have groups of two students, then three, then four and so on, try until the table is lifted. If the number of students needed to lift the table by using one finger each is twelve, the students should note that their combined force may be about twelve times as great as one student trying to lift the table with one finger. Note: The force will not be exactly twelve times as great, as some students will exert a greater force with one finger than others. This experiment may be modified by having one student try to push a heavy object. Keep adding students until the object can be moved.	
(b) Observe that several threads can exert more force on an object than one thread.	Wrap one piece of thread around a heavy object. The object must be heavy enough to cause the thread to break. Add more pieces of thread, one at a time, until the object can be lifted without	

Objectives	Activities	Materials
	the threads breaking. The students should infer that the force transmitted by the threads against the object is greater than the force applied by one thread against the object.	
9. (a) Observe that an object with a smaller surface area will fall more quickly than the same object with a large surface area.	Take two identical sheets of paper. Crumple one up and leave the other flat. Drop them from the same height. Note that the crumpled paper falls directly to the floor while the flat piece flutters down lazily. Smooth out the crumpled paper and crumple the flat paper. Repeat the drop. Graph the results.	
(b) Graph the relation of surface area to rate of fall.	Have students trace their shoeprints on a piece of graph paper. Have them trace their heel print. Have the students calculate from the graph paper how much surface area both feet, one foot, and their heel covers. Then take the students outside and have them stand in a sand pit or in loosely packed snow. Have the students stand on two feet, then one foot, then one heel. Measure the depth each sinks.	
(c) Infer that a force exerted over a small area exerts a greater pressure than an equivalent force exerted over a large area.	Have students stand on a snow bank first with snowshoes, then without them. How far do they sink each time? Discuss. Note: This will not work in a snow bank or deep snow.	
	Have the students hold pencils vertically with the eraser resting on a piece of cardboard. Have the students apply downward force to the pencil. Repeat with the lead end of the pencil. Try to apply the same force. Note which goes further into the paper.	
	Hold a flatened nail with a head resting on a block of wood. Hit the point of the nail squarely just once. Repeat with the tip of the nail resting on the wood. Try to use the same force and hit the nail once.	

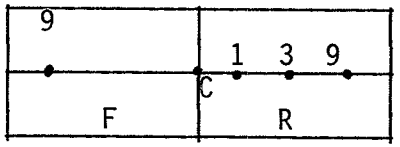
Objectives	Activities	Materials
	Caution: Students should not hit the nail too hard as it may fly off the block and strike someone.	
10. Observe that a wedge changes the direction of a force. Operationally define a wedge.	Push a wedge under a book and note that the book moves up. Define a wedge as a simple machine which changes the effect and direction of the force. All simple machines will fit this generalized definition.	
11. Construct a lever.	Levers can be made in the following ways: Drill a hole through two boards and the centre of a metre stick; run a bolt through the three holes; attach the two boards to the base and place cup hooks on the underside of the metre stick at the 0, 60, 67.5, 75 and 100 cm marks.	



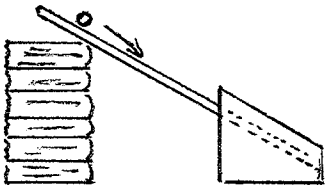
Metre Stick

OR

Use heavy, rectangular cardboard 20 cm long and 4 cm wide; punch holes at 1, 10, 11, 13 and 19 cm from one end and label the holes.



Objectives	Activities	Materials
12.(a) Observe and record effect that the location of the fulcrum of a lever has on the distance each end of a lever moves. (b) Infer that the relationship between balanced input and load forces on a lever is dependent on their location relative to the fulcrum. (c) Predict the forces that will balance a lever with an off-centre fulcrum. 13.(a) Infer that an inclined plane decreases the force required to lift an object. Identify the control and experiment with variables that affect the forces needed to move an object up an inclined plane.	Use a pencil or thin dowelling as a fulcrum. Place the fulcrum at the 0, R1, R3, and R9 positions. Record and compare the distances each end moves. Using the metre stick lever, students can balance the forces by using a constant 10 g force at the 0 marking in conjunction with masses at other points on the lever, i.e., balance a 10 g force with 10 g at the 100 cm mark, then balance 10 g with 20 g at the 75 cm mark. Vary the force at the 0 marking and balance. Record the results. OR Use the cardboard lever made for the previous activity, and washers and paper clips to hold them. Balance one washer placed at the F9 position by adding washers at the R9 position. Repeat for other positions, e.g., R3. Increase the number of washers at F9 and repeat the activity. Record results and compare the relationship between balanced sets of forces and the locations of forces relative to the fulcrum. Note: "F" could refer to input force and "R" could refer to load or resistance. Punch an additional hole in the cardboard lever at 14.5 cm with the fulcrum at R 14.5. Students are to predict the number of washers required to balance one or more washers placed at the F9 position and to balance the system. Stack several textbooks on top of one another. Run a board or a textbook to the top of the stack. Pull an object up an inclined plane at various angles. One of the angles should be 45°. Record the results and compare the forces needed with the force needed for the straight lift.	

Objectives	Activities	Materials
	Cover the inclined plane with very coarse sand paper. Pull the object up at the same angles as before. Compare the forces needed to pull the object over the rough surface with the forces needed to pull the object over the smooth surface. Fold an index card and cut it at an angle. Use a ruler with a groove running down the centre to make an inclined plane. Place the open side of the index card at the base of the incline plane.	
(b) Control the variables of release point and angle of an inclined plane. Observe and compare the forces a marble exerts on an index card. Record and interpret the data.	Release a marble from various points on the ruler into the index card. Record each release point and how far the index card moved. 	
(c) Predict the height of an inclined plane required to move an index card a specific distance along a desk.	Alter the angle of the inclined plane and release the marble. The students may either measure the angles in degrees or may increase the height of the inclined plane 5 cm at a time. They should record the results. By referring to their data the students should now be able to move the index card a specified distance in one try.	
14.(a) Construct a model a screw.	Wind a right angled triangle of paper around a pencil to demonstrate the concept of a screw.	

Objectives	Activities	Materials
(b) Compare the holding power of a screw with the holding power of a nail.	Have students bind two pieces of wood together with a nail, then with a screw. Compare the holding power of each.	
15. Observe that the force needed to lift an object with a single fixed pulley is equal to the mass of the object, and that the direction of the force is changed.	Set up a single fixed pulley. Lift a 1 kg mass on the pulley using a spring scale. The students will note that their readings are not equal to the mass being lifted. Students may suggest variables affecting the system. Discuss direction of forces.	
16. Observe an infer that less force than the mass of an object is needed to lift it when a moveable rather than a fixed pulley is used.	Set up a moveable pulley. Use a spring scale to lift an object with the pulley. Note directional changes and relationship between the input force and the load.	

Grade Six

PHYSICS - Continued

Objectives	Activities	Materials
17.(a) Observe wheels and axles.	Observe the different directions of the pedals and the wheels as a bicycle is ridden. Examine common wheels and axles, e.g., door knob, car steering wheel, bicycle. Go on a trip around the school and have students label simple machines that they see.	
(b) Construct a model of a wheel and axle.	Use tinkertoys to construct a model wheel and axle which can lift a weight.	

Grade Six

CHEMISTRY

MAIN CONCEPT: MATTER IS NEITHER GAINED NOR LOST DURING A CHEMICAL CHANGE.

Objectives	Activities	Materials
Student should be able to:		
1. Observe that matter can be changed from one form to another.	Place an aluminum pan over two bricks. Pour 250 grams of water into the pan and take its temperature. Place a nutmeat on a wire stand below the pan and burn it. Take the temperature of the water again. Note the appearance of the remains of the nutmeat. Discuss why the temperature of the water changed.	

Objectives	Activities	Materials
2. Observe that matter is only changed in form.	Hypothesize what would happen if your try to make some iron oxide by explosing a certain amount of pure iron to the oxygen in the air. If 40 grams of iron oxide is produced do we need a total of 40 grams of oxygen and iron?	
3. Observe that as matter changes one or more entirely new substances with different properties are produced.	Burn a match. Discuss what has happened to the match and what new substances are given off. Mix equal parts of powdered sulfur and iron filings on a piece of paper. Wrap a magnet in a plastic bag. Pass it through the mixture several times and observe what happens (use adequate ventilation and wear safety glasses). Mix the sulfur and iron filings again. Fill a pyrex test tube one-third full of the mixture. Heat with a bunsen burder until the mixture gets red hot. Allow the tube to cool and wrap it in a towel. Carefully break the glass with a hammer. Pass a magnet over it. Discuss what has happened.	
4. Infer that as chemical changes occur no matter is lost.	Discuss the situation of two matches sealed in a pyrex flask (by using a rubber stopper). When the matches are ignited using a bunsen burner. Have the students study the cooled flask and discuss whether the mass of the flask has changed.	

GRADE SEVEN

Grade Seven

ENVIRONMENTAL SCIENCE - Plants and Photosynthesis

MAIN CONCEPT: THE PROCESS OF PHOTOSYNTHESIS IS THE KEY TO PLANT SURVIVAL IN THE ENVIRONMENT.

Objectives	Activities	Materials
Students should be able to: 1. (a) List the major parts of a plant cell: cell membrane, vacoule nucleus, nuclear membrane, chloroplast, cytoplasm and cell wall. (b) Describe the function of each structure mentioned above. 2. (a) Describe the process of photosynthesis. (b) Explain the roles of chlorophyll, carbon dioxide and water in the photosynthesis reaction. (c) Describe the importance of light in food production by plants. 3. (a) Identify the upper and lower epidermis, palisade layers, chloroplasts, spongy layers, vein, stomata and guard cells.	Review microscope. Research assignment on cell structure. Set up a lab to observe microscopic sections of onion skin cells, algae cells, and elodea. Class demonstrations or labs: Photosynthesis and starch production Photosynthesis and carbon dioxide Rate of photosynthesis Student labs: Grow plants in enriched carbon dioxide atmosphere. Grow elodea in light and dark areas. Set up an activity to determine the structures and functions of parts of a leaf.	

Objectives	Activities	Materials
(b) Relate leaf structure to function.		
(c) Define transpiration.		
4. Classify a plant as an algae, fungus moss, or vascular plant.	Set up labs on transpiration - loss of water by plants. Conduct a research project on plant classification.	
5. Define the function of the following vascular plant organs: i) roots ii) stems	Have students identify root parts from prepared cross-section slides.	
Define and identify root structures in terms of: i) epidermis ii) phloem iii) xylem	Do a lab on kinds of root systems.	
Define the types of roots and their functions.		

	Objectives	Activities	Materials
6.	Determine the effect of different parts of the light spectrum upon food production.	Have students grow beans in containers covered with different coloured cellophane. Stem length, diameter, leaf dimensions are recorded over a period of time and the results can be graphed.	
7.	Examine the behaviour of root growth in response to gravity: geotropism.	Conduct a lab on: the effect of gravity upon seedlings grown in different directions.	
8.	Examine the behaviour of root growth in response to water: hydrotropism.	Moisten a ball of sphagnum moss and place seeds around the ball. Hang and keep moist.	
9.	Identify a plant using a simple botanical key.	Have students bring in sections of common woody plants. Use "Field Guide to the Native Trees of Manitoba".	

Grade Seven

LIFE SCIENCE - Biological Levels of Organization

MAIN CONCEPT: THE CELL IS THE BASIC UNIT OF STRUCTURE AND FUNCTION IN LIVING ORGANISMS.

Objectives	Activities	Materials
Students should be able to:		
1. Identify the cell structures found in human chook cells: Cell membrane, cytoplasm, nucleus.	Study the basic structure of a cell. Have students identify cell parts using a microscope.	
2. Discuss the function of: cell membrane, cytoplasm, nucleus.	Use diagrams.	
3. State the differences between a plant cell and an animal cell.	Research. Chloroplast, cell wall and water vacuole are structures found in plant cells.	
4. Distinguish between cells and tissues.	Discuss and use microscope demonstration.	
5. Distinguish between structure and function of various animal tissues: muscle, skin, blood, and bone.	Prepare slides.	
6. Distinguish between organs and systems.	Student research or discussion.	

Objectives	Activities	Materials
7. State examples of organs and their functions. (Also organ systems).	Discussion. (in terms of function only.) Deal with systems briefly.	
8. Compare and contrast the structure and function of the digestive system in an earthworm and a frog.	Research and lab activity. Emphasize the similarities of frog systems to those of humans.	
9. Relate the chemistry of foods to the general well-being of cells, tissues and organs.		
(a) Analyze a given food for the presence of sugar, starch, fat, and vitamin C.	Demonstrate the simple tests for these nutrients: Sugar - Benedict's test Starch - iodine test, Fat - brown paper test, Vitamin C. - indophenal test. Have students bring food samples from home.	
(b) Measure the amount of water in a food.	Weigh a sample of string beans or any similar food. Cut into small pieces and allow to air dry (low heat in an oven for 24 hours). Reweigh the sample and calculate the water loss. Determine the percentage of water in the food.	
(c) Compare the percentage of water in different foods.	Repeat above, using different foods.	

Objectives	Activities	Materials
(d) Describe the function of each nutrient in the body. Include: water, minerals, carbohydrates, sugars, starch, glycogen, fats and oils, proteins and vitamins.	Reports, written or oral. Charts may be used.	
(e) Predict the effect of heat on vitamin content in food with the use of a graph.	Have students heat sample of fresh orange juice to different temperatures. Test each sample for vitamin C using indophenol. Then plot results on graph.	
(f) Describe the following diseases that result from diets lacking specific nutrients: Scurvey, rickets, beriberi, goiter, kwasiorkor.	Have students research the nutrient deficiency and the symptoms.	

MAIN CONCEPT: THE SOIL MAKING PROCESS IS CONTINUOUS.

Objectives	Activities	Materials
Students should be able to:		
1. Describe such characteristics of soil as particle size, hardness, absorption of water, percolation, and capillarity.	Collect soil samples and examine them in terms of stickiness, particle size, and percentage of organic matter. Conduct an experiment to determine the properties in soil necessary for the effective growth of plants.	
2. Describe and use a method for identifying different kinds of soil.	Classify and test soil samples to determine the characteristics of each. If possible, compare the soil profile from more than one location.	
3. Collect and identify some of the organisms found in topsoil.	Collect soil organisms and examine them.	
4. Distinguish between weathering and erosion.	Students can provide examples for discussion and analysis.	
5. Give examples of physical and chemical weathering.	Relate to area in which students live and cite examples.	
6. Cite examples of erosion by water and wind.	Examine photographs.	

Objectives	Activities	Materials
7. Describe the role of the wind in building up the earth's surface.	Investigate the effects of wind on various types of soil. Describe the formation of sand dunes and loess deposits. Explain the action of migrating dunes. Compare the surface soil across Manitoba and relate this to the types of land use. Be certain to include Manitoba's desert in the discussions.	
8. Explain how rivers develop new land formations.	Investigate the carrying power of water, sorting action and the formation of sediments. A study of deltas may be included.	
9. Define a mineral.		
10. Describe and use some tests for identifying minerals.	Examine a variety of minerals for hardness, streak, cleavage, fracture, colour, feel and lustre. Determine how these characteristics can be used to identify minerals.	
11. Acknowledge the economic and aesthetic values associated with soil, weathering and erosion.	Have students describe the characteristics of the contents of an ordinary bag of soil. Discuss the aesthetic and economic values of soil to man and how they can be altered by erosion and weathering.	

MAIN CONCEPT: SPACE SCIENTISTS GATHER KNOWLEDGE ABOUT SPACE BY OBSERVATION.

Objectives	Activities	Materials
Students should be able to:		
1. Use an astrolabe or other instrument to determine the position of selected celestial objects, and plot the movement of these objects at different times.	Have students construct their own astrolabe. Use the clock-angle method of locating objects. (12 o'clock is north, 3 o'clock is east. The angle is the estimated angle above the horizon. Practice with selected spots on the ceiling first. Determine the azimuth and altitude of the objects. Have the students take the astrolabe home and measure one object at intervals throughout one evening. They would report their findings.	
2. Use a star finder chart or other sky map.	Use a star chart to identify common stars, planets and constellations. Prominent stars can be singled out.	
3. Determine the sun's position throughout one day and/or determine the sun's position at the same time each day for a month.	Set up an observation post and keep records of direction and length of sun's shadow at given times, over a period of time. Discuss and draw conclusions. Construct a large diagram to illustrate the relative motions.	
4. Illustrate the motions of the moon and earth around the sun during a period of several months.		
5. Describe the phenomenon that occurs when sun, moon and earth appear in a straight line.	Diagram and report on eclipses.	
6. Identify and describe the members of the solar system.	Collect necessary data. Diagram. Include Sun, planets, moon, asteroids and comets.	

Grade Seven — SPACE SCIENCE - Continued

Objectives	Activities	Materials
7. Determine the numbers of visible stars in the sky.		
8. Find out about meteor showers.	Determine the occurence of meteor showers and observe and report. If possible, note constellation of origin.	
9. Develop a project dealing with space science.	Have students develop a project of their own choice. Use diagrams, write ups, models and charts.	
10. Be aware of the unique position of space science among the sciences.	Discuss the difficulty of observations in space science compared to other sciences. Compare the observational approach of space science with the experimental approach that is possible with the other sciences. Discuss the major accomplishments in Space science inspite of these difficulties.	

Grade Seven — PHYSICS - Introduction to Physics

MAIN CONCEPT: MEASUREMENT SKILLS ARE AN ESSENTIAL TOOL IN THE STUDY OF SCIENCE.

Objectives	Activities	Materials
Students should be able to:		
1. Collect, classify and interpret data in accordance with the scientific method.	Discuss the process of observation as it applies to the scientific method; have students perform a number of skill building activities. An experiment such as the action of the pendulum is one example.	
2. Perform measurement in length, area, volume, mass, and time using SI terminology.	Laboratory problems requiring measurements of length, volume and mass. By performing numerous measurement tasks, the students will develop their ability to achieve accurate results. Through repetition, the skill is reinforced.	

	Objectives	Activities	Materials
3.	Calibrate a balance to measure its precision.	Lab activity involving simple pan balance.	
4.	Measure the temperature of water.	Lab activity involving measurement of water temperatures.	
5.	Measure the magnifying power of a convex lens.	Lab activity using an optical instrument for magnification.	
6.	Explain and cite practical examples of reflection and refraction of light from plane surfaces.	Trace the path of light through a smoke filled box. Use a plane mirror for determining the principles of reflection. Use a glass plate to determine how light refracts.	
7.	Explain how light refracts through the lens of the human eye.	Make drawings of the eye with the light rays refracting to the retina. Do the same for lenses which correct eye defects.	
8.	Discuss the history of measurement.	Discuss development of measurement from early times to today. Emphasize changing technology of measurement techniques and instruments.	

Grade Seven

CHEMISTRY - Investigating States of Matter

MAIN CONCEPT: THE NATURE OF PHYSICAL CHANGE MAY BE LEARNED BY OBSERVING THE FUNDAMENTAL PROPERTIES OF THE DIFFERENT STATES OF MATTER.

Objectives	Activities	Materials
Students should be able to:		
1. Classify given materials in terms of the three states of matter.	Observe examples of the different states of matter and describe similarities and differences between them. Classify substances in terms of states of matter, using actual substances and/or pictures.	
2. Name and define the processes, in terms of heat requirements, by which matter changes from one state to another: Evaporation, condensation, melting, freezing, sublimation, distillation.		
3. Compare the rate of evaporation of water at different temperatures.	Use beakers filled with equivalent volumes of water and place in areas where temperature differences occur. Use a heat source if necessary. Check temperatures and water levels regularly. Chart results and compare.	
4. Compare the rates of evaporation of different liquids.	Use liquids such as cooking oil, methyl alcohol, water and glycerine. Place drops on hands.	
5. Describe a test for water.	Use anhydrous copper sulfate or cobalt 11 chloride paper.	

Objectives	Activities	Materials
6. Describe the effect of cooling on water vapour (condensation).	Use beakers, ice cubes and water. Test the condensation on the side of the beaker.	
7. Graph the temperature change that occurs and the time required when melting ice and freezing water.	Break ice cubes into small pieces, place into a beaker of water, and record temperature changes at regular intervals until no temperature change occurs. Predict the temperature change after the ice melts. Repeat for freezing water.	
8. Describe the volume changes of water and other liquids upon freezing.	Freeze samples of water and wax and determine the volume changes; Discuss the importance of the changes for water. Fill half a test tube with water; freeze. Measure the original and final amounts (volumes or lengths) of water in the two states. Compare masses of equal volumes of ice and water. What are the implications for the flotation of ice? Compare the masses of equal sized cubes of wood, aluminum, polystyrene foam, and brass and similar materials to an equal volume of water. Use a bucket kit. Students can estimate and then measure the flotation qualities of the cubes.	
9. Graph the temperature change and measure the time requirements when heating water to boiling and boiling the water for a period of time.	Heat cold water until it has boiled for five minutes. Record temperature changes at regular intervals and graph. A graph of the results of this experiment can be provided to students for interpretation.	
10. Describe how low and high air pressures affect the boiling point of water.	Use the technique of "low pressure by condensation" to boil water at less than its boiling point.	

Objectives	Activities	Materials
11. Demonstrate experimentally the effect of the addition of substances on the freezing and boiling points of water.	Use a common solute such as sugar or salt to determine its effect upon the freezing point and boiling point of water.	
12. Relate changes of state to the water cycle and develop an awareness of the importance of the water cycle. 13. Be aware of the importance of water in our daily lives. 14. Research and write a report explaining the causes and possible remedies for water pollution problems.	Design a poster which illustrates the water cycle in nature. Discuss the changes of state involved. Discuss the importance of water to life. Discuss the movement of underground water, waste disposal, and make a model well using fine gravel, a beaker and water. Discuss methods of obtaining water in desert conditions. Make a solar still using a frame, clear plastic and a funnel. Examine plants for transpiration by covering the leaves with a plastic bag and testing the liquid which is caught with anhydrous copper sulfate or cobalt 11 chloride paper. Determine the quantities of water required for different activities and compare the quantities within individual and class surveys. Examine methods of recycling and conserving water. Use library resources, local community personnel, newspaper clippings, information from water supply authorities.	

GRADE EIGHT

Grade Eight

ENVIRONMENTAL SCIENCE - Microbiology

MAIN CONCEPT: MICROORGANISMS ARE AN ESSENTIAL PART OF OUR ENVIRONMENT.

Objectives	Activities	Materials
Students should be able to:		
1. Describe the ways in which bacteria influence or modify our environment and/or lives.	Discuss both the desirable and undesirable influence of bacteria. Assign above as an individual research project.	
2. (a) Prepare a stained slide of bacterial culture. (b) Identify bacteria as coccus, spirillus, or bacillus.	Conduct lab on microscopic observation of bacteria and compare shapes of bacteria.	
3. Describe the nutrition requirements of bacteria.	Discuss different nutritional requirements among bacteria. Develop colonies of bacterial growth in a medium such as agar.	
4. (a) Define and site examples of protozoans.	Observe cultures of protozoans from hay infusion. Record the numbers and kinds of organisms in a hay infusion over a period of time.	
(b) Differentiate between a ciliate and a flagellate.	Use texts and photos of protozoans to arrive at a list of differences and similarities.	
(c) Identify a protozoan under the microscope.	Using a microscope, examine fresh pond water and pond water to which lettuce has been added.	

Objectives	Activities	Materials
5. Describe the process of fermentation.	Compare the growth of yeast cells in two mediums; water, and water and syrup. Compare the production of carbon dioxide in and the temperature of both mediums.	
6. Explain how fermentation differs from decay.		
7. Identify the characteristics of a mold, yeast, mushroom.	Assign research on types of fungi and their characteristics.	
8. Compare and contrast the following pairs of organisms: i. a mold and a yeast ii. a mushroom and a yeast. iii. a mushroom and a mold.	Run a sequence of labs on each types of fungus. Compare mold growth under different conditions. Grow mold cultures on various materials.	
9. Determine the role of fungi and bacteria as decomposers.	Discuss with class.	
10. Identify lichens as to shape.	Collect on many lichens as possible. Air dry and mount them. Use a handbook to identify them. Classify according to crustose, fruticose, foliose.	

	Objectives	Activities	Materials
11.	Discuss the importance of lichens for man and the environment.	Assign as a verbal or written report.	
12.	Observe and describe the changes that take place over time (succession) to organic material.	Place slices of moist bread in a container and make qualitative observations over a period of several weeks.	
13.	Describe the ways in which the animal body adapts itself to fight disease organisms.	Research and report on the body's defense mechanism against pathogens.	
14.	Design a series of experiments which would prevent food from decomposing.	Have students design, perform, and criticize an experiment that would illustrate an effective way of microbial growth prevention. Possibilities: Dehydration pH (citric acid, vinegar) Salt concentration Temperature Spices	
15.	Observe that man has had to deal with micro-organisms since the dawn of history.	Research the various problems that micro-organisms have created for man and how man has overcome them (i.e. diseases). Include a discussion on the positive effects of micro-organisms on mankind.	

Grade Eight

LIFE SCIENCE - Human Organ Systems

MAIN OBJECTIVE: THERE ARE FUNDAMENTAL PROCESSES WHICH ARE ESSENTIAL TO MAINTAINING LIFE.

Objectives	Activities	Materials
Students should be able to:		
1. Define cells, tissues, organs, and organ systems.	Review terms with emphasis being on human organ systems.	
2. Define "diffusion" and explain its role in keeping a cell alive.	Demonstrate diffusion by dropping a crystal of potassium permanganate in water in a petri dish. Use an overhead projector to project on a screen. The molecules will move from area of high concentration to areas of low concentration. Emphasize that the diffusion process occurs only when a substance is dissolved in water.	
3. Discuss the structure and function of the heart, veins, arteries, capillaries and blood.	Fill a plastic sandwich bag with a weak solution of ammonia. Insert the bag into a beaker containing a solution of water and phenolphthalein. The phenolphthalein turns pink because NH_3 passes through the plastic bag. Phenolphthalein being a large molecule does not enter the plastic bag which is semipermeable.	
4. Discuss blood circulation with reference to heart, veins, and capillaries.	Use charts and diagrams. Refer to the cellular components of these parts, and point out that these components make up the circulatory system. Obtain beef heart for study.	
5. State the function of red blood cells, white corpuscles, platelets lymph and blood clotting.	Use Charts. Discussion.	

Objectives	Activities	Materials
6. Define respiration.	Compare oxidation with breathing (sugar + O_2 --> CO_2 + H_2O + energy.	
7. Discuss the role of the diaphragm and ribs in breathing.	Discussion and construct demonstration model.	
8. Discuss carbon dioxide and oxygen pathways and exchange of gases in alveoli.	Along with charts and diagrams use discussion method, emphasizing the relationship of the blood circulatory system to that of respiratory system. Blood carries wastes such as CO_2, H_2O, and urea from the cells. These wastes are removed by the lungs, kidneys and skin.	
9. Define excretion.		
10. Discuss the role of the kidneys and of the skin in excretion.	Emphasize the role of circulation with respect to excretion. All body systems are interdependent.	
11. Explain high blood pressure, heat attack, stroke, brain hemorrhage.	Discuss with aid of diagrams. Test for the presence of starch and sugar.	
12. Discuss the digestive system in humans. (a) Define digestion.	Observe the effect of equal volumes of the following on equal sized cubes of boiled egg white: water only; 5% pepsin solution 0.2% hydrochloric acid solution; 5% pepsin and 2-3 drops of 0.2% hydrochloric acid solution. Discuss results.	

Objectives	Activities	Materials
(b) Role of mouth, stomach, small intestine, pancreas, liver, and large intestine.		
(c) Related diseases or illness such as ulcers, gall stones, appendicitis, diarrhea, and indigestion.		
13. Explain the general function of the central nervous system and the specific functions of the brain, nerves and spinal cord.	Discuss with aid of diagrams.	
14. Discuss animal behaviours: Inborn vs acquired Reflex arc Training Instinctive behaviour Biological clocks	Discussion, activities and research.	

Objectives	Activities	Materials
15. Discuss the effect of tobacco, alcohol, and narcotics on the human body.	These last two topics lend themselves to research activity.	
16. Discuss diseases of the respiratory system.		

Grade Eight EARTH SCIENCE - Patterns in the Earth's Crust

MAIN CONCEPT: THE EARTH'S CRUST IS CONSTANTLY UNDERGOING CHANGE.

Objectives	Activities	Materials
Students should be able to:		
1. Explain the general structure of the earth.	Examine a cross-section of the earth to determine the locations of core, mantle and crust.	
2. Explain the forces that are at work, from within and without, that are causing changes.	Discuss earthquakes and volcanoes, their causes and effects. Mountain formation could be touched upon at this point. Discussion on weathering and erosion.	
3. Define and use the vocabulary associated with the terms weathering and erosion (talus, bedding, angle of rest, sediments, suspensions,	Examine weathering and erosion to determine how one leads to the other causing breakdown, sorting, deposition and build up.	

	Objectives	Activities	Materials
	oxbows, delta, alluvial fan, meandering stream).		
4.	Describe some of the physical and chemical processes by which rocks weather.	Use direct observation, photo study, films and experimentation to examine the causes and effects of diferent weathering and erosion processes.	
5.	Explain how water and wind influence erosion.	Construct a model of a stream to examine and experiment with variables such as the rate and volume of flow and the effect of slope upon water erosion.	
6.	Describe local examples of the effects and consequences of water and wind erosion.	Discuss the sorting action of wind and water and the resulting deposition. Observe and explain the occurences of deltas oxbows, alluvial fans, braided streams, and meandering streams.	
7.	Describe the formation and the characteristics of igneous, sedimentary and metamorphic rocks.	Discuss, experiment, study and report on methods of rock formation. Determine the order in which the three groups (igneous, sedimentary, metamorphic) develop.	
8.	Describe how living organisms contribute to new land formations.	Examine types of coral and discuss how reefs may develop.	

Grade Eight

EARTH SCIENCE - Continued

Objectives	Activities	Materials
9. Describe the formation of fossils. 10. Identify and classify examples of the three main rock types. 11. Explain the rock cycle. 12. Be aware of the changing patterns on the earth's crust.	Study fossils and develop a geologic time scale. Examine and classify rock samples as igneous, sedimentary and metamorphic. Sub-classify igneous into plutonic (Instrusive) and volcanic (extrusive). Produce a diagram illustrating the cyclic nature of wearing down and building up of rocks. Have students relate experiences of going back to a location after an absence of one or two years and cite the changes that have occurred. Hypothesize what the earth's surface will be like in 20 years time.	

Grade Eight

SPACE SCIENCE - Earth, Moon and Sun

MAIN CONCEPT: RESEARCH SKILLS WHICH PLAY A FUNDAMENTAL PART IN GATHERING EVIDENCE ABOUT SPACE.

Objectives	Activities	Materials
Students should be able to:		
1. Describe the apparent motion of sky objects.	Review, Plot, Research.	
2. Describe and cite evidence of the motions of the earth.	Discuss, research, use models.	

Objectives	Activities	Materials
3. Describe the apparent movement of a Foucault pendulum and explain how it shows evidence of earth's rotation.	Construct a model, demonstrate and explain.	
4. Explain sky observations as they might be explained by early people (sky motion) and as they are now explained (earth motion).	Discuss the extent of knowledge of early people. Ask for reasons for today's explanation. Stress the need for additional evidence.	
5. Account for phases of the moon.	Use models and diagrams.	
6. Describe some of the basic characteristics of the sun.	References and film.	
7. Describe and account for some of the following earth-moon-sun interactions: Seasons, auroras, tides, solar radiation received on earth, effects on earth of solar disturbances.	Research and use models.	

Grade Eight

SPACE SCIENCE - Continued

Objectives	Activities	Materials
8. Describe some of the moon flights and the information they produced.	Library research and reports.	
9. Discuss the merits of space flights.	Research, discuss, debate.	
10. Describe the shape, motions and other characteristics of the moon.	Research and discussion.	
11. Be aware of the contributions of space scientists.	Research and describe the life, times and contributions of two or more astronomers and space scientists.	

Grade Eight

PHYSICS - Investigating Energy

MAIN CONCEPT: THE BASIC CONCEPT OF ENERGY IS IMPORTANT IN THE STUDY OF HEAT, ELECTRICITY AND SOUND.

Objectives	Activities	Materials
Students should be able to:	Class discussion using current literature on energy. Use a model steam engine to convert heat to mechanical energy.	
1. Define energy by answering such questions as:		
(a) what is energy?	Produce heat by: friction, percussion, compressing a gas, dissolving substances, and electric current.	
(b) what forms does it exist in?		

Objectives	Activities	Materials
(c) what is heat?	Analyze the effects of heat upon the size of matter.	
(d) what is electricity?	Study change of state due to heat. Produce electrical energy with heat. Determine the effects of heat on conductors (thermocouple).	
2. Explain how mechanical, chemical and electrical energy may be converted into heat.	Look for evidence of how heat breaks particles apart (i.e. decompose sugar, cooper sulfate).	
	Convert chemical energy to electrical energy. (wet cell, dry cell)	
3. Determine the effects of heat energy on matter.	Convert mechanical energy to electrical energy. (generator)	
	Convert light to electrical energy. (photo-cell)	
4. Demonstrate the different ways of producing electricity.	Convert heat to electricity. (thermocouple)	
	Pass electricity through various materials. (salt solutions, metals)	
5. Explain the effects of electric current on various solids and liquids (conductors, non-conductors).	Determine the origin of sounds. Determine the effects of length of string and amplitude of vibration on the frequency and period of the pendulum.	
	Determine the effect of amplitude upon the frequency and period of the spring.	
6. Describe how sound is generated, transmitted, and reflected in terms of its wave form and speed.	Examine the material needed for the transmission of sound.	

	Objectives	Activities	Materials
7.	Compare the rate of heat transfer through different building materials.	Examine the properties of transverse and logitudinal waves. Build a material tester by using a light bulb in a socket set at a fixed distance from a slot into which materials can be placed. Use equal area and thickness squares of different materials such as fiberglass, wood, ceiling tile. Build a thermometer holder so that it can be placed against the tile at the same spot for each test. Test the temperature change when the light bulb is on for one or two minutes at a time. Test the effect of thickness and air space. Test the effect of colour by using the same material painted a different colour.	
8.	Compare the sound conductivity of different building materials.	Use the materials tester with a watch or other noise source on one side of the materials and determine the distances at which sound fades (measures fading distance by placing your head near a ruler and moving it until the sound disappears.)	
9.	Be aware of the problems associated with energy consumption in today's technological society.	Review current literature on the subjects of thermal pollution, transmission of electricity, insultation of buildings; alternative energy-conscious styles. Also noise pollution - Earphone radios and rock bands.	

MAIN CONCEPT: THE CAUSES, CHARACTERISTICS, AND RESULTS OF PHYSICAL AND CHEMICAL CHANGES MUST BE OBSERVED IN ORDER TO IDENTIFY PATTERNS AND DEVELOP A CLASSIFICATION SYSTEM FOR SOME TYPES OF MATTER.

Objectives	Activities	Materials
Students should be able to:	Test the effectiveness of water as a solvent for various solids, liquids and gases.	
1. Define the terms: soluble, isoluble, suspension, dissolve, solute, and solution.	Compare the solubility of solids such as sand, salt, copper sulfate, calcium carbonate, and sulfur. Students may wish to test the effects of fineness of powder upon dissolving rate.	
2. Compare the solubilities of some substances in water.	Separate the components of mixtures of sand and water, copper sulfate and water, or salt and water using filtration, heating or other techniques. Students should be able to suggest other techniques.	
3. Describe methods of separating dissolved and undissolved particles from a mixture or solution.	Produce physical and chemical changes in the laboratory and discover the characteristics of each. Review changes of state of water (liquid, solid, vapor) and test for water using anhydrous copper sulfate or cobalt chloride paper. Review solid-liquid solutions e.g. salt and water, and separation by evaporation (examine NaCl crystals before dissolving and after separation by evaporation.)	
4. Distinguish between a physical and chemical change, and describe the identifying characteristics of each.		
5. Test for oxygen and carbon dioxide.	Use bromythymol blue or methylene blue (blue in presence of oxygen) to test for carbon dioxide and oxygen. Lime water can also be used to test for carbon dioxide.	

Objectives	Activities	Materials
6. Describe and identify physical changes. In a physical change, one or more properties are changed but not the composition of the substance; Energy may be released. 7. Observe and record some chemical changes on the basis of colour changes, weight changes and presence of new materials (products) Chemical change: change in properties and composition; some are reversible, some are difficult to reverse; most require more energy than a physical change.	Discuss other physical changes than those mentioned above, other changes of state, (wax, metals) production of small pieces (wood and rock chips), separation of suspensions, pounding of metals, growing of crystals. Observe and record properties of a burning candle. Trap water vapour on the bottom of a beaker of cold water and test. Trap carbon-dioxide and test with limewater. Produce carbon dioxide using sodium bicarbonate and vinegar or alka seltzer and test gases produced. Chart the effects (colour changes) of heat upon basic copper carbonate, peanuts, wood, washing soda crystals, shiny copper sheet, copper sulfate crystals. Use proper safety precautions when heating materials. Burn magnesium ribbon and record changes. Do not look directly at the flame. You may wish to check for changes in mass. Demonstration: Production of oxygen from potassium chlorate and manganese dioxide. Test for oxygen. Electrolysis of water; recombine hydrogen and oxygen and test for water. Investigate complete and incomplete burning using a bunsen burner by adjusting the air control, trapping soot on a beaker of cold water and the gases (water vapour and carbon dioxide) produced. Test for changes in exhaled air. Bubble ordinary air through bromythymal blue and blow into bromythymal blue through a straw.	

Objectives	Activities	Materials
8. Distinguish between endothermic and exothermic reactions. 9. Identify physical and chemical changes that occur in the environment. 10. Observe and state the general identifying characteristics of acids and bases. 11. Classify acids and bases according to properties which have been determined through student investigation. 12. Investigate and record the effects of heat upon mass and colour of certain substances. Classify the nature of the change as physical or chemical.	Compare any of the above reactions. Compare the combustion of a match to heating zinc and powdered sulfur. Observe the changes that take place in the laboratory and the outside environment and classify them as physical and chemical change. Warn students not to taste solutions and to use care in handling chemicals. Test for acids and bases using an indicator such as litmus or phenol red. Test some natural indicators such as purple cabbage, juice or dyes made from deep red or deep blue flowers. Test the effects of acids on metals (Zn, Mg) and (polished Cu and Fe). Test the effect of dilute hydrochloric acid on marble and limestone, egg shells, sea shells and concrete chips. Use dilute solutions of hydrochloric acid, sodium hydroxide and phenolphthalein. Add phenolphthalein to a small quantity of base in a vial and alternately make the solution acidic and basic. Make inferences relative to the solutions. Predict pH values for the result of acid-base tests. e.g. greater or less than 7. Classify common household items (vinegar, shampoo, baking soda, ammonia water, salt solution, lemon rind, apply juice) as acids or bases according to the results of independent student investigation. Heat substances such as salt, wax, washing soda crystals, iron filings, copper carbonate, copper coin, and tin or lead.	

	Objectives	Activities	Materials
13.	Be aware of the problems created by chemical changes and man's constant battle to overcome these changes.	Discuss such problems as the deterioration of metal bridges, automobiles. Make a list of other such changes and describe how man attempts to develop new technology to overcome them.	

GRADE NINE

MAIN CONCEPT: MAN HAS A STRONG INFLUENCE ON THE RELATIONSHIPS THAT EXIST IN THE ENVIRONMENT.

Objectives	Activities	Materials
Students should be able to:		
1. Differentiate between abiotic and biotic factors and discuss their relationship.	Define terms and give examples. For a given list of ecosystems, have students outline the biotic and abiotic factors. Examine a rotton log and analyze its biotic and abiotic components. Perform activities on measuring abiotic factors, e.g. light intensity, soil organic matter, relative humidity.	
2. Define competition, parasitism, mutualism, commensalison and predation.	Set up growth competition experiments with plants and discuss results with class. Dissect an insect gall - willow or goldenrod. Study adaptations of leeches or tapeworms. Study ant-aphid relationships. Review lichen symbiosis. Study bacteria-termite relationship. Cite examples of commensalism.	
3. Differentiate between habitat and niche.	Have students in small groups study predation in a community and its implications.	
4. Define and use the terms producers, consumers, reducers /saprophytes, and scavengers, in the terrestial ecosystem.	Define habitat and niche. Cite examples. Select animals and plants from a particular ecosystem and have students qualify their niche and habitat. Define and cite examples in different habitats.	
5. (a) Define energy. (b) Discuss ways in which organisms use energy.	Review definition of energy. With small group or as a class determine: i) why organisms need energy ii) why all energy is not available to a consumer. Define biomass and develop concept of pyramid of biomass (energy).	

Objectives	Activities	Materials
(c) Discuss ways in which energy is lost.		
(d) Define the term biomass.		
6. Define succession and explain how it controls the development of a natural community.	Observe the changes that take place within an aquarium over time. Students can make qualitative observations as to biotic factors.	
7. Conduct a population study within a natural land community and examine and estimate the interaction that occurs within the population.	Relate succession to an abandoned field community and determine the make-up of that community from year to year. Quadrant sampling and transect sampling.	
8. Investigate the interactions of the major cycles that sustain a land ecosystem (oxygen, carbon, and nitrogen cycles).	Research and report on the major components of each cycle.	

Objectives	Activities	Materials
9. Describe ways in which man's activities have altered or destroyed ecosystems.	Class debates on selected topics. Individual reports to the class. Possible topics are: effects of pesticides on the environment clear cutting, forest mismanagement effect of forest fire control in national parks mercury pollution in our environment effect of highway systems on wildlife nuclear waste disposal.	
10. Determine the effect of pollutants on primary products.	Test the effect of sulfur dioxide on plants by placing a plant into a plastic bag with a sulfur dioxide atmosphere.	
11. Measure the effect of detergents on the germination of primary products.	Test the germination rate of seeds in water and detergent.	
12. Discuss the effects of pollutants on man and the environment.	Several essays could be assigned on: i. effects of water pollution on man ii. effects of water pollution on the biosphere iii. effects of air pollution on man iv. effects of air pollution on the biosphere.	
13. Perform a study on the impact of a manufactured item upon the enivonment.	Have students select a common item and outline all of the natural resources required for its manufacture. Specify the possible effects on the environment in the manufacture and disposal of this item.	

MAIN CONCEPT: REPRODUCTION PLAYS AN IMPORTANT ROLE IN THE STUDY OF HEREDITY.

Objectives	Activities	Materials
Students should be able to:		
1. Gain an understanding of the purpose of reproduction.	Review six life processes and conclude that a species would not survive if it did not reproduce itself (absorption, digestion, respiration, assimilation, excretion, and reproduction).	
2. Define both asexual and sexual reproduction.	In asexual reproduction, an organism makes an identical copy of itself.	
3. Name and describe briefly four kinds of asexual reproduction.	In sexual reproduction two parents are involved. The gamete from a male joins with a gamete from a female to form a new cell from which an offspring develops. The offspring has characteristics of both parents.	
4. Explain why two parents are involved in sexual reproduction.	Four types of asexual reproduction are: budding, binary fission, mitosis and regeneration. Demonstrate, using slides or overhead, using specific examples.	
5. (a) Define sperm, egg, testis, ovary, gametes, fertilization, zygote.	The gamete contains only one have of the number of chromosomes that is found in a normal body cell. Two gametes must join to complete the chromosome number.	
(b) Discuss sexual reproduction in single organisms such as paramecium or spirogyra and in complex organisms such as cat, fish, dog and man.	Discuss terms and processes and have students answer questions from reference material.	

Objectives	Activities	Materials
6. Describe reproduction in a mammal. 7. Describe the events in the estrus cycle. 8. Describe the menstrual cycle in humans. 9. Define: placenta, umbilical cord, gestation and fetus. 10. Describe how mammals feed their new born.	Use charts and transparencies, if available, to illustrate the topics discussed in objectives 6-10.	
11. Define the terms heredity and genetics. 12. Identify variations in common characteristics of peas.	Discuss Have students examine a package of peas which includes peas with variations in colour, size and shape.	
13. Identify variations in humans.	Have students make a list of variations.	

Objectives	Activities	Materials
14. Identify chromosomes and genes and their role in inheritance. (a) Distinguish between a dominant and recessive trait. (b) State the Law of Dominance. 15. Identify dominant and recessive traits by means or symbols. 16. Describe the procedure for solving genetic problems.	Students must relate traits to genes that are located on the chromosomes. A lab may be done using an onion root tip in which chromosomes are clearly visible. Have students determine which traits are dominant or recessive. Data can be gathered from other students. The ratio between the number of dominant and recessive characteristics within each trait can be compared. Dominant: tongue roller, hooked nose, brown hair, non-blue eyes, freckles, fat figure, prominant teeth, long eyelashes, round face, curly hair, protruding ears, thick lips. Recessive: non-roller, straight nose, blonde hair, blue eyes, no freckles, lean figure, normal teeth, short eyelashes, long face, wavy or straight hair, ears lie flat, thin lips. The dominant gene is represented by a capital letter and recessive gene by a lower case letter. a. Determine the letters to be used i.e. T - tall, t - short b. Determine parental genotype i.e. Mother TT (Purebred or homozygous tall) Father tt (Purebred or homozygous short)	

Objectives	Activities	Materials
17. Solve genetic problems involving single dominant recessive traits. 18. State and discuss the Gene theory and relate meiosis and fertilization to the theory.	c. Set up Pennett square t t T Tt Tt First generation T Tt Tt d. Interpret the Punnett square All offspring are Tt or heterozygous tall. The genotype is 100% hybrid tall (carries a gene for that trait from each parent). The phenotype is 100% tall. (to the observer the offspring is tall). Have students solve problems such as: 1. Cross a pure black guinea pig with a pure white guinea pig. Describe the genotype and phenotype of the first generation. 2. Cross pure tall peas with pure dwarf peas. Determine the phenotype and genotype of the first and second generations. Have students make a list of statements regarding gene theory. Briefly discuss how fertilization and meiosis make these statements possible.	

MAIN CONCEPT: WEATHER PREDICTIONS HAVE EVOLVED THE STUDY OF THE CAUSES AND NATURE OF AIR MASS INTERACTIONs.

Objectives	Activities	Materials
Students should be able to:		
1. (a) Maintain an accurate weather record on a daily basis.	Construct or obtain weather instruments. (for temperature, wind direction and speed, air pressure and relative humidity)	
(b) Define in operational terms, barometer, thermometer, anemometer, and hygrometer.	Study each instrument to determine its operation, how readings are taken and what they mean. Obtain weather maps from the weather office and set them aside until needed at the end of the unit.	
2. Describe the process of cloud formation and identify three major types of clouds.	Maintain a daily weather record, utilizing graphs and charts. Use S1 units. Study, observe, and demonstrate cloud formation. Note the relationship of cloud types to weather forecasting.	
3. (a) Define and use the terms: conduction, convection, radiation, saturation, land-breeze, sea-breeze, dew point, relative humidity, warm front, cold front and air mass.	Prepare a model and do experiments to demonstrate heat transfer by conduction, convection and radiation. Discuss land and sea breezes in relation to movements of the atmosphere.	
(b) Describe what happens when a warm front meets a cold air mass, and when a cold front meets a warm air mass.		

Objectives	Activities	Materials
4. Describe how radiant energy from the sun is transformed into heat energy.	Water movements and primary atmospheric circulation may be researched and discussed. Note the effect of evaporation on cooling. Develop the concept of humidity. Relate the direct relationship of humidity to temperature by constructing a dry and wet bulb thermometer. Ensure that the concept of saturation is developed.	
5. Investigate the factors which affect the absorption by the earth of radiant energy.	Research and report on the nature of radiant energy and how it is transformed to various forms of energy. Study the effects of sunlight on a radiometer. Use two thermometers and paint the bulb of one thermometer black. Test the effect of placing the thermometers in shade and in direct sunlight. Keep other factors constant. Record temperatures over a period of 5-10 minutes. A thermometer may be placed into a vial of dark soil and placed a certain distance from a light source for a period of time. Test different types of soil. Use vial with a cap or one-hole stopper and a thermometer. The temperature changes of this thermometer can be compared to the temperature changes of an exposed thermometer when both are placed equi-distant from a light source. Compare the greenhouse analogy to the atmosphere.	
6. Describe the role of satellites in weather prediction.	Library research on weather satellites.	
7. Describe the effect of volcanic eruptions on weather patterns and climate.	Investigate weather changes resulting as an after-affect of volcanic eruption.	
8. Practice reading weather maps and develop one as a class project.	Study the class weather records to determine patterns. Study weather maps. Observe the trend of weather systems from day to day and develop a weather map as a class project.	
9. Describe the effect of weather on lifestyle.	Investigate through discussion or projects how weather affects our choice of clothing, transportation and recreation.	

Grade Nine

SPACE SCIENCE - The Universe

MAIN CONCEPT: GAINING AN UNDERSTANDING OF THE VAST REGION OF SPACE REQUIRES CONTINUAL OBSERVATION AND RESEARCH.

Objectives	Activities	Materials
Students should be able to:		
1. Compare Ptolemy's and Copernicus' models of the universe.	Discuss the development, refinement, and use of scientific theories of the formation of the universe. Consider the evidence that led to the proposal of each theory. Discuss the explanations each could give to observations.	
2. Discuss the degree of acceptance of new discoveries in astromony throughout history.	Discuss the difficulties of applying each model to observations. State reasons for acceptance of the Copernicus model. Research the life, work and times of both scientists.	
3. Debate the theories of the origin of the universe. (big bang, steady state, condensation theory)	Research and discussion. Research and debate.	
4. Describe the solar system as it would be seen from some location other than earth.	Use a model	
5. Use or describe the use of the telescope, camera and spectroscope in investigating objects in space and	Use instruments if possible. Compare the usefulness and limitations of each.	

Objectives	Activities	Materials
5. cont'd. describe the types of information each instrument gives.		
6. Explain the method of using parallax to measure distances in space.	Discuss use and limitations.	
7. Describe some of the characteristics of galaxies, variable stars, novas, supernovas, binary stars, star clusters nebulae, quasars, neutron stars, black holes.	Research and presentations.	
8. Be aware of the fact that some of the problems encountered in studying the universe are due to the vast distances involved and/or to the movements of the earth and other space objects.	Refer to the speed of light when discussing the distances in space. Also consider the fact that all objects are moving. Hypothesize the effects if the earth and/or other space objects did not move. The elements of which both ourselves and the earth are made, were generated in supernova explosions which occured millions of years before the formation of our own sun. These explosions blew off gas clouds containing elements that condensed and solidified to form the solar system. From this information the students should be able to explain how these materials became part of our bodies.	
9. Explain the statement: "We are the stuff of stars."	Thus, we are made of the stuff of stars.	

PHYSICS - Investigating, Force, Motion, Work and Simple Machines

MAIN CONCEPT: MAN HAS LEARNED TO MAKE WORK EASIER BY DEVELOPING AN UNDERSTANDING OF THE CONCEPTS OF FORCE AND MOTION.

Objectives	Activities	Materials
Students should be able to: 1. Explain the relationship between force and motion, expressing force in newtons and distance in metres. 2. Demonstrate the effects of the force of gravity. 3. Calculate the work done in moving and lifting objects. 4. Illustrate the various types and classes of simple machines, and determine the mechanical advantage of each. Note: Students should use charts and graphs whenever possible.	Convert any measurements on the spring scales in grams to newtons and kilogram masses; Mask over the original measurements with tape. Investigate using spring scales. Experimentally determine the amount of work done in moving and lifting objects. a. Describe the ways in which levers, wedges, inclined planes, screws and pulleys are used as machines. b. Determine why there are three classes of levers by locating the positions of the fulcrum, effort and resistance; and graphing the relationship between the three points in a lab activity. c. Describe the way in which levers multiply force. d. Describe the "Law of the Lever". e. Describe the way in which the slope of an inclined plane affects the amount of effort required to overcome resistance. f. Determine the relationship that exists between the inclined plane, wedge and screw. g. Determine the mechanical advantage of simple machines. h. Determine how each machine can be modified so that less or more effort would be required.	

Objectives	Activities	Materials
5. Explain the law of inertia.	Demonstrate Newton's first law of Motion.	
6. Discover the amount of frictional force between moving objects.	Carry out activities.	
7. Explain the action-reaction principle.	Demonstrate.	
8. Illustrate the effect of centripetal force.	Demonstrate examples.	
9. Explain the historical use of simple machines in: (a) building pyramids (b) weapons (c) application of machines in day-to-day activity.	Library research, projects and/or model construction demonstration.	

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Grade Nine

CHEMISTRY - Chemical Interaction

MAIN CONCEPT: THE ATOMIC MODEL OF MATTER CAN BE USED TO EXPLAIN THE STRUCTURE OF MATTER AND THE NATURE OF CHEMICAL INTERACTIONS WHICH OCCUR IN OUR DAILY LIVES.

Objectives	Activities	Materials
Students should be able to: 1. Observe and state the general identifying characteristics of the following major classes of matter: (a) Mixtures (liquid-solid) and solutions (solid-liquid). (b) elements (c) Compounds (compare elements and compounds to mixtures). 2. Compare methods of separating mixtures. 3. Distinguish between synthesis and decomposition and classify some chemical reactions accordingly.	Review the nature of chemical and physical changes, tests for oxygen, carbon dioxide and solutions. Compare salt and iron filings, sand and iron filings, and a solution of water and copper sulfate or salt. Comparisons may be made by examining under a microscope. Separate mixtures into pure substances using filtration, distillation, or other means. Compare the products of distillation by testing for water. Compare the effectiveness of separation methods. Heat sugar in a beaker. Suspend a cold object within the beaker. Trap gases produced. Test the liquid (water) and examine the substance remaining in the beaker (carbon). Char the paper, sawdust, starch, bread in test tubes or by holding in a flame. Compare remains. Decompose water by the method of electrolysis. Test for oxygen. Recombine the hydrogen and test for water. Compare reactants and the products and the ratios of the gases produced. Produce copper from copper oxide and fire charcoal. Burn magnesium in air (do not view the flame directly). Examine the residue.	

Objectives	Activities	Materials
4. Read about and discuss the statements of atomic theory and the model of the atom. Relate to some of the decomposition reactions such as the production of copper or carbon.	Identify the main statements of the modern atomic theory, and define basic terms associated with the atomic model of matter. Compare atoms and molecules. Relate combinations to electrolysis of water (volumes of hydrogen to oxygen to produce model of water. Models of carbon monoxide and carbon dioxide (twice as much oxygen is needed to produce carbon dioxide as carbon monoxide).	
5. Compare models of simple molecules using nuts and bolts or styrofoam balls.	Carry out basic chemical reactions, describing them with word equations or symbolic equations and molecular models e.g. preparation of hydrogen with zinc and sulphuric acid; preparation of oxygen from a weak solution of hydrogen peroxide; burning of magnesium, sulfur, copper, charcoal or iron; decomposition of sugar. Hydrogen and oxygen experiments should be demonstrations only.	
6. Produce chemical reactions and describe them using simple chemical word equations.	Combine solutions of silver nitrate and sodium chloride, or observe oxidation, or acid/base reactions.	
7. Test for and state the Law of Conservation of matter.	Compare reactions where all materials are trapped, to reactions where gases are produced and released. Explain the differences.	
8. Describe the terms "solution" and "precipitate" and explain dissolving in terms of separation of ions.	Combine lead nitrate and potassium iodide, separate out the precipitate, and examine the possible combinations of ions which produced the precipitate.	

Objectives	Activities	Materials
9. Explain the conductivity of solutions on the basis of ions.	Test the conductivity of solutions. Discuss and read about ions.	
10. Investigate methods of controlling fires and factors affecting combustion kindling temperature (spontaneous combustion).	Construct a simple carbon dioxide extinguisher. Use caution concerning the quantities of the reactants and the pressure produced to avoid explosions. Have the local fire department give a lesson on this topic as well as a demonstration of fire fighting techniques using chemicals.	

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The purpose of this study was to develop a grade 5-9 science curriculum guide which would combine the K-6 and 7-9 guides presently in use in Manitoba schools, and ultimately provide a supplementary reference for science teachers.

The study required a survey to be undertaken to determine teacher reaction to the guides presently in use. Approximately 50% of the science teachers, teaching at the grade 4-9 levels in the St. Vital School Division responded to the survey and the results indicated that an effort such as this study would be welcomed by the teachers.

A critical analysis of both curriculum guides was undertaken. The process of analysis involved developing a breakdown of unit content, identification of the conceptual themes that existed at each level, determining the extent of overlap from one grade to another, identifying the textual and supplementary materials which were authorized for each grade level, and examining the sequential patterns that occurred through-

out the five grade levels. This latter step necessitated examining the science content in grade four so as to avoid redundancy and overlap from grade four to five in the new combined 5-9 guide.

The K-6 guide contained a multi theme approach at each grade level, while the grade 7-9 guide incorporated a single conceptual theme approach at each grade level. This sequencing made it difficult to combine both guides and solve the problem of the curriculum gap that existed.

The new guide has succeeded to overcome this inadequacy by incorporating the six major science topics of environmental science, life science, earth science, space science, physics, and chemistry throughout grades 5-9, and rearranging the material to meet this topical arrangement.

The guide should assist science teachers in organizing their work at each grade level, providing intresting and challenging activities for their students, evaluating their students' performance, and in selection of textual materials.

Conclusion

Within the limitations and purpose of this study it can be concluded that:

a) The present guides for K-6 and 7-9 are generally satisfactory at the levels for which they were intended.

b) There are errors, redundancy and other deficiencies in both guides.

c) Adequate sequencing does not occur from grade six to seven.

d) Certain recommended textbooks are no longer available to the

teachers.

e) The majority of teachers in grade 5-9 are not totally familiar with the contents of both guides.

f) The majority of teachers are not aware that both guides have been developed with a different approach to the development of conceptual themes.

h) The suggested activities do not explore the historical, economic, sociological, industrial, and scientific basis of technology in modern society to any extent.

i) Rapid changes in science and technology cause curriculum guides to become outdated.

j) The new combined 5-9 guide should overcome many of the shortcomings of the present guides and it will provide the teachers with a useful supplement to the present curriculum.

Recommendations

The following recommendations are made based on the findings derived from this study:

a) Teachers should utilize this new guide as suplementary material to the science curriculum guides presently in use.

b) A continuation of this study should be undertaken, with teachers contributing feedback on the feasibility of the units suggested.

c) If this follow-up proves positive, a third level document, based on this study, should be developed by the Department of Education.

d) Teachers should be aware that text books can not keep up with the rapid changes in science and technology, and careful consideration should be given to updating of reference material on a regular basis.

e) Teachers should be aware of the science content at each grade level, and insure that activities are not taken from the higher grades in order to supplement their own programs.

f) Teachers should attend inservices on the topic of changes in science curriculum.

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