Let's Do Science

Introduction

Waste and Our World

Wheels and Levers

Building Devices and Vehicles that Move

Light and Shadows

Plant Growth and Changes

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Nickle Family Foundation

Brad & Tanya Zumwalt

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Preface

Science Alberta Foundation is pleased to present a revised edition of *Let's Do Science*, a guide for the implementation of the 1996 Elementary Science Program of Studies (Alberta Learning). Since the first printing, elementary teachers across Alberta have found this guide to be a very useful tool in planning, implementing and evaluating hands-on science programs in their classrooms.

The *Let's Do Science* package consists of a print guide divided into grades and science units within each grade, as well as a searchable version on CD. In addition, a PDF of the implementation guide is available free of charge on the Science Alberta Foundation website, www.sciencealberta.org.

Science Alberta Foundation works shoulder-to-shoulder with teachers in the province in building a scientifically literate population. Young people who are knowledgeable and enthusiastic about science, math and technology are essential to the continued prosperity of Alberta and Canada in the global economy. So too, are our artists, economists and politicians who make informed decisions based on an understanding of scientific issues, inquiry and problem-solving.

We hope this guide will be of assistance, and that you and your students will experience the excitement and wonder of science discovery in your classroom. We welcome your remarks and suggestions on *Let's Do Science* or any of our educational programs. Please visit the Teacher Site at www.wonderville.ca for more information on integrating ICT outcomes into science instructional planning, and to share ideas with colleagues across the province.

Hyacinth Schaeffer
Director of Learning
Science Alberta Foundation

What is Science Alberta Foundation?

Science Alberta Foundation is a not-for-profit, charitable organization with the mission:

"To inspire communities, students, teachers, and families by creating and providing programs and services that promote the advancement, learning, and valuing of science and technology in every day life. Our partners and stakeholders, who are key to our success, include Alberta's rural and urban communities, educational institutions, government and the private sector."

We inspire minds in science, math and technology. Our science programs travel throughout the province providing all Albertans access to intriguing, hands-on and educational science resources. We make science relevant and fun by focusing on current issues, and by placing science in a real-life context. People learn best by doing, which is why our programs promote scientific inquiry and problem solving through hands-on, engaging and meaningful learning experiences.

Science Alberta Foundation's programs include…

• Science-In-A-Crate • www.wonderville.ca • Travelling Science Exhibitions • Community Festivals of Science

• Conference and Convention Workshops

• Catalyst For the Future: Professional Learning Program for Teachers

For a Program Guide or other information about Science Alberta Foundation, visit our website at www.sciencealberta.org, or call 403-220-0077.

Our Sponsors

Supporting Education

Our desire is to make a difference in those communities where we have a significant presence or business interest. Our emphasis is on education and youth, with over two-thirds of ExxonMobil's donations going to programs that enrich the lives of young people.

Our vision in education is to contribute to building a life-long learning system in Canada that ranks among the best in the world. Our focus is on programs that enhance math, science and technology education for Canadian school children. These skills are key to the development of the workforce of the future.

ExxonMobil

Supporting the Teacher

We highly value the important role that teachers play in elementary classrooms across the province and we recognize their valuable contributions to creating the next generation of knowledge workers. Teachers are professionals who direct the learning in the classroom and *Let's Do Science* has been created to support each teacher in that role. We are therefore delighted to help make *Let's Do Science* available to all elementary school teachers in Alberta.

Brad & Tanya Zumwalt

Supporting the Community

The Nickle Family Foundation's goal is to strengthen our community. We do this by funding non-profit organizations which excel at serving important community needs that enhance the quality of life throughout our city and province.

Nickle Family Foundation

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Brad & Tanya Zumwalt

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Overview of *Let's Do Science*

Each guide in the *Let's Do Science* series includes the following sections.

Teaching Science in the Elementary Classroom

This provides a general introduction to successful teaching in the elementary science classroom, including strategies for instruction and assessment, and some brief suggestions regarding safety and gender-fair instruction. More extensive information on these topics can be found in the teacher resource books for *Explorations in Science* (Addison-Wesley) and *Innovations in Science* (Harcourt Brace).

Year Planning

General Planning

This identifies things to be taken into account when planning science for the year.

Topic Planning

This gives suggestions regarding advance planning of the individual science topics.

Implementing the Topics

The topics for grade 4 are:

- Electricity and Magnetism
- Mechanisms Using Electricity
- Classroom Chemistry
- Weather Watch
- Wetland Ecosystems

For each topic, the following information is provided.

Before You Begin

This provides a topic overview and a listing of general and specific learner expectations. It also provides a cross-reference to other areas of the elementary school curriculum and provides suggestions for guiding concept development.

Background Information

This is a quick and easy summary of ideas and information related to the topic. The depth of treatment is intended to help teachers gain a better understanding of the topic and be able to handle student questions.

Activities

These tables identify key activities that address all of the specific learner expectations in the program of studies. For each activity, print resources and essential materials are listed and helpful comments are supplied. The print resources follow the format: *title* (author), *unit (activity)*, page(s). References to *Innovations in Science* are to the teaching notes at each level. Extension activity ideas are also provided.

Assessment

References to assessment ideas are provided.

Bibliography

This provides a bibliographic list of the resources referenced for the topic and other related resources.

Teaching Science in the Elementary Classroom

Science Inquiry and Problem Solving Through Technology

Children learn by doing. The knowledge and skills that children develop about the world are rooted in their experiences—the things they have explored and investigated for themselves. The skills of inquiry and problem solving are not only important as outcomes of the elementary science program, they are part of the process of learning as well. This section will describe some ways to support student learning through inquiry and problem-solving activities.

Models for inquiry and problem solving are shown in Figures 1 and 2. The models each show a general pattern that is often followed in science activities, but should not be regarded as a fixed instructional sequence. The particular steps that are followed, and the way those steps are linked, varies from activity to activity, and may also vary with the individual student.

The two models show a similar pattern of activity but with a few key differences. These differences reflect the fact that inquiry and problem solving have different purposes and different outcomes.

- Science inquiry is aimed at finding answers to questions. The outcome of inquiry is knowledge.
- Problem solving is aimed at finding one or more ways to achieve a desired result. The outcome of problem solving is a product or process one can use.

Opportunities for developing inquiry and problem-solving skills can be found in connection with every topic in the science program. For example, in studying magnets, students may apply their *inquiry* skills to learn what materials are magnetic and which ones are not. They may later apply *problem-solving* skills to develop a toy using their knowledge of magnetic and non-magnetic materials.

Most topics lend themselves mainly to an inquiry approach, but one topic at each level is aimed primarily at problem solving through technology.

Learning activities that support inquiry and problem solving can involve different degrees of structure. In the early stages of work on a particular topic, the activities generally tend to be exploratory in nature whereas at a later stage they may take the form of structured investigations. Opportunities for students to explore materials on their own help prepare students for more formal investigations.

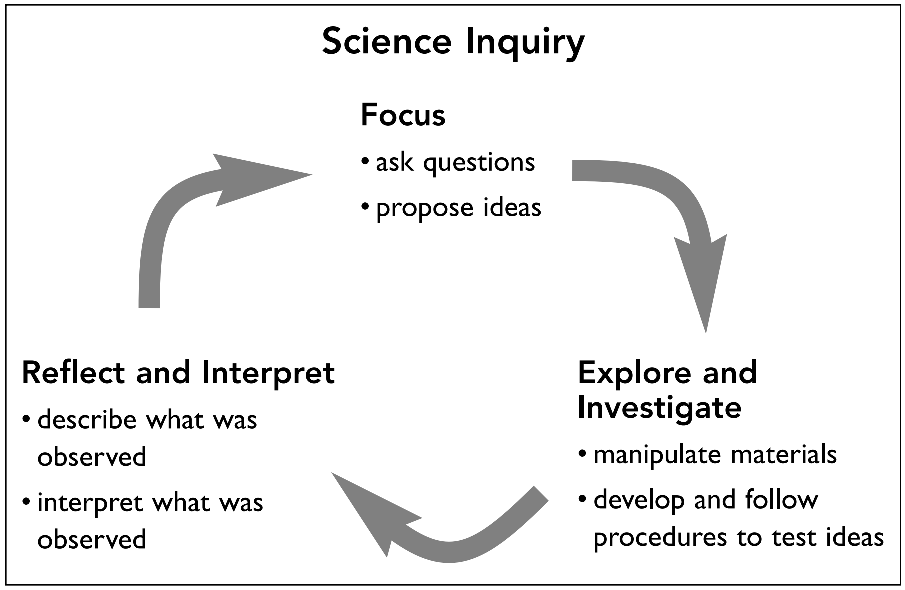

Figure 1. *Science inquiry model*

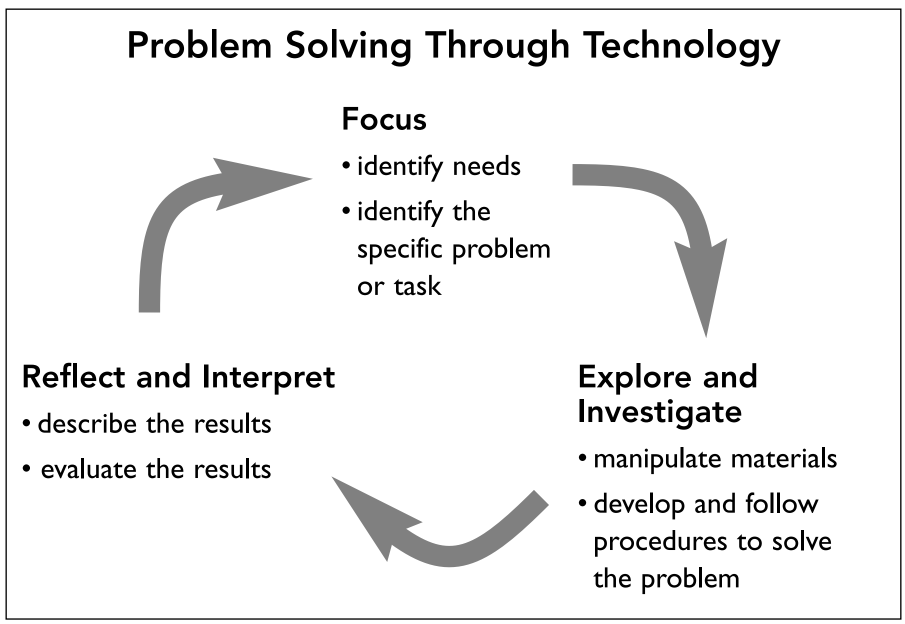

Figure 2. *Problem-solving model*

Curriculum Integration

It is important to maximize opportunities for curriculum integration to assist students to identify the links, not only between concepts within a single subject area, but also between ideas and processes in other subject areas and in the world outside of school.

Subject Integration	Approaches	Examples
Within one subject alone	Intradisciplinary • Involves arrangement of knowledge and skills within one subject area • Respects subjects' way of knowing distinct conceptual structures and methods of inquiry	• Integrating earth, life and physical sciences in the study of science • Integrating listening, speaking, reading, writing, viewing and representing in the study of Language Arts
Between two or more subjects	Multidisciplinary • Subject areas are independent of one another, teachers deliberately coordinate the timing and delivery of related topics – no attempt to synthesize subject area perspectives Interdisciplinary • Connects interdependent knowledge and skills from more than one subject area to examine a topic theme or experience	• Students study Greek Mythology in language arts, constellations in Sky Science and how Ancient Greek people's psychological needs were met in Social Studies • Graphing skills are a focus in mathematics and in science – students carry out experiments where results are presented in graph form
Beyond the subject areas	Transdisciplinary • Students engage in independent projects which aim to develop initiative, creativity, research skills, synthesis skills and autonomy • Places the characteristics, needs, interests and personal learning processes at the forefront of the learning experience	• Using environmental conservation as a theme, students work to achieve outcomes from science, social studies and mathematics to better understand a complex issue • Students work on independent research projects – teachers guide students in their inquiry

Structuring the Learning Environment

A key element of learning activities for science is the engagement of students in the direct study of materials. The particular activities may vary from class to class, but the overall pattern of science teaching and learning usually has the following elements.

- A stage where a *focus* for learning is established.
- A stage of *exploration* and *investigation*, usually involving hands-on materials.
- A stage of *reflection* and *interpretation*, in which key ideas are identified and applications of the ideas are explored.

This learning cycle can be a natural part of each lesson. It can also provide a pattern for developing each topic as a whole.

As a way of setting a *focus* for the topic, students can be given opportunities to explore new materials through one or more introductory activities. From these initial *explorations*, students develop questions and ideas, which can be listed in classroom charts. These in turn can be used as entry points and linkages to the learning activities and *investigations* that will follow.

At the end of a topic it is often helpful to have students *reflect on* and *interpret* their overall experience within the topic and apply what they have learned through activities such as constructing concept maps, developing models and writing stories illustrating the ideas learned.

There are a variety of teaching strategies and learning activities that can be used to organize science learning experiences. The choice of strategies and activities depends upon the learning outcomes to be achieved and other factors, including:

- previous learning experiences of students: the knowledge and skills they have acquired, as well as recent experiences that provide starting points for learning;
- the learning environment;
- learning styles of students;
- student interests; and
- available resources.

The following are some effective strategies and activities that promote an activity-based approach to teaching science.

Initiating Inquiry and Problem Solving

Before a student can investigate a question or problem, the student must recognize that there is a question to be answered or a problem to be solved. Questions and problems can arise from a variety of sources, examples of which follow.

Observation of Living Things

Living things are a constant source of wonder and questions for students. By providing opportunities for students to observe one or more living things and pose questions, a list can be generated. These can be kept in a student log or transferred to a class chart. Here are some examples of questions that students most often ask.

- How many legs, wings, teeth, etc. does it have?
- What is the purpose of a particular feature or characteristic?
- How does it move? Eat? Have babies?
- Where is it found?
- What does it eat?
- How can we explain certain behaviors?

Observation of Materials and Objects

Natural and human-made materials and manufactured objects can also be sources of questions.

- What is it like?
- What is it made of?
- Where do you find it?
- How is it made?
- How does it work?
- What problem or issue sparked this invention or innovation?

Unexplained Objects or Events

When things happen that are different from the usual patterns, students will often ask questions such as the following.

- What causes a piece of wood to float or not?
- The magnet didn't pick up the metal. How can that be explained?
- How can I find out why the light bulb didn't go out when the switch was turned off?

Sometimes questions about why something happens lead students to propose two or more possible answers, where only one can be correct. This creates an opportunity to look for evidence that would support or not support each idea. Try to change a "why" question into a question that can be investigated.

Guiding the Question-finding and Problem-finding Process

Almost all of the questions that students pose can lead to science investigations, but many of the students' initial questions will look more like questions to be answered by a reference book than things that students can investigate for themselves. Part of the art of guiding students involves helping them refocus their initial questions. A technique for doing this is to redirect student thinking by asking questions such as the following.

- How would we find out?
- What do you think will happen?
- Why do you think that happens? (Hypothesis)
- Does anyone have another idea?
- Is there anything that we could look for to help us decide which idea is best?
- What evidence would we look for?
- Is there something that makes it do that?
- Does it happen every time, or just some of the time?

To help students define problems one can ask questions such as:

- What do we need to make?
- What does it have to do?
- How will we know that it does the job?
- How will we know if it is good enough?

Facilitating Explorations and Investigations

When students have a question or problem to investigate they are often able to learn much through exploring the materials on their own. To carry out a more focused investigation they will often need more guidance that can be provided through questions such as the following.

- What do we need to do?
- What steps should we take?
- What materials will we use?
- What could we do to make a fair test?
- What will we do the same each time?
- What will we do differently?
- What do we need to observe?
- How could we make it work better?

Reflecting on and Interpreting the Learning Experience

There are a number of ways to encourage students to reflect on and interpret their learning experiences.

Journal Writing

Journal writing is an opportunity for students to produce pictures and written expressions of thoughts and feelings, to ask questions and to comment on their learning experiences. This strategy for gathering assessment data is often left unstructured, i.e., the student may determine the content and format. Journal writing allows a student to clarify thinking and to reflect on learning, using various modes to express their ideas.

Journals provide students a safe way of identifying strengths, weaknesses and interests. Students who keep journals often look forward to this informal, non-judgmental process, and provide insights into their thinking that would not otherwise be available.

Learning-Logs

Some teachers instruct their students to keep a science learning-log. It is similar to a writing journal, but it is used to respond to specific questions that have been planned by the teacher as an integral part of learning activities. Questions may be asked before, during or following each investigative or problem-solving activity. The learning-log is used to give students an opportunity both to record results and reflect on what those results mean. A learning-log entry also can reveal feelings and attitudes about learning.

Noteworthy journal and learning-log entries can be photocopied and added to a teacher's recording system, or placed in the student's assessment portfolio.

Involving Students in Individual and Group Hands-on Experiences

Depending on the activity and the objectives, hands-on science experiences can be presented to students individually or in groups.

Learning Centres

Learning centres provide a form of individualized instruction, where the teacher prepares a learning environment and the student engages in self-directed learning using materials at the centre. Teachers monitor student progress at centres and provide guidance and feedback where needed.

Science activities lend themselves to a learning centre approach.

The use of hands-on materials, print materials, audiovisual materials, pictures and computers can all contribute to the learning experience at a centre. Centres are especially appropriate when the supply of key materials in the classroom is limited. Methods used in organizing learning centres include the following.

- Activity Cards: An activity card identifies a question or a problem to be studied using materials that are provided at the centre. Activities may be highly structured in order to provide a common set of experiences for all students visiting the centre, or they may be open-ended to provide maximum opportunity for students to apply and extend their skills. Structured activities normally identify the materials to be used and how they are to be used, usually by providing a sequence of numbered steps accompanied by one or more illustrations. A sheet for recording observations and results is often included. Follow-up questions may be provided.

For open-ended activities, students can keep a record of what they do in a notebook or activity log-book. A picture and a summary of what was done may be all that is required, or a more detailed write-up, with headings such as "Problem," "Materials," "Steps Followed," and "Things Learned."

- **Science-In-A-Crate** resources available from Science Alberta Foundation (www.sciencealberta.org) provide the materials required to incorporate Learning Centres in your classroom (see p. 24).

Group Activities

Group activities in science involve students in common tasks. In groups, students learn to work cooperatively—sharing materials, communicating ideas and plans, evaluating accomplishments, and planning next steps. Students learn that problem solving and inquiry can involve joint effort in which different people contribute their ideas and skills.

There are various ways to divide students into groups. The size of group selected will depend on the particular activity, the kinds of materials required, and the overall maturity of students. For most activities, groups of two or three students are desirable in order to provide the maximum opportunity for students to work directly with materials.

Teachers should ensure that students have the opportunity to take on different roles within the group, and that all students have equal opportunity to work directly with hands-on materials.

Catalyst for the Future, a professional learning program for teachers, provides exemplars of effective group work in science. The program is free in Science-In-A-Crate (www.sciencealberta.org).

Assessing Student Learning

The purpose of evaluation is to determine student progress in learning. Evaluation may be diagnostic, formative or summative.

- Diagnostic evaluation is used to find out what students know. This assists the teacher with further instructional planning.
- Formative evaluation is the daily or frequent assessment of the student's progress. Progress is examined to give students feedback and to let teachers decide whether or not to modify methods or materials.
- Summative evaluation is used at the end of a lesson or a unit to determine whether goals and objectives have been achieved. It is important that this phase of assessment is balanced. It should evaluate growth in skills and changes in attitude as well as achievement of knowledge. A variety of evaluation instruments, not only paper-and-pencil tests, should be used for summative evaluation.

Evaluation of elementary science learning is based on the general and specific learner expectations identified for students at each grade level of their school program. These expectations describe the knowledge, skills and attitudes that students should develop as a result of their learning experiences.

Students demonstrate their learning through carrying out investigations, solving practical problems, communicating their understanding and showing their creativity, persistence and curiosity. A variety of assessment strategies should be used to assess what students know and are able to do in relation to the Program of Studies.

A well-rounded assessment should:

- provide a variety of means for students to demonstrate their learning, including oral, pictorial and written modes of representation, and to work with actual materials;
- use a broad range of science tasks, including new applications of what was learned;
- recognize such attitudinal outcomes as responsibility and appreciation;
- evaluate process as well as product; and
- involve students in the assessment process.

Some effective strategies to assess student progress in science include the following.

Observation and Anecdotal Records

Direct observation of student performance is probably the most frequently used form of assessment. It is used on a daily basis, and can occur naturally during science classes, or can be developed as a more formal process while students work alone or in groups. Systematic observation can provide information about the skills students have developed as well as students' attitudes toward science, their preferred learning styles and work habits.

Use of observation as a technique for evaluation can be assisted by a rating scale or rubric for the learner expectations to be assessed. A rating scale is usually a three-, four- or five-point scale, where each number is matched to one or more descriptors of student performance.

Observation can also provide the basis for developing anecdotal records. An anecdotal record is an objective description of an event or performance that is a significant example of a student accomplishment or a learning need. Dated records provide a documentary account of student progress and a useful supplement to evaluations of a student's overall performance.

Discussions and Student Conferences

Discussions and student conferences are opportunities for the teacher and the student to share ideas. They provide a means to find out how students approach questions and problems, and whether they have a grasp of key concepts and procedures. They also provide an opportunity for the teacher to clarify misunderstandings.

Self- or Peer-assessment

Self-assessment enables students to reflect on their own learning as independent learners or as part of a group. Peer-assessment allows students working in groups to examine what and how they have learned. Questionnaires, daily journal writing and student or group conferences can be used for self- and peer-assessment.

Performance Tasks and Investigations

Performance tasks place emphasis on the processes of scientific inquiry and problem solving and also provide opportunity for students to demonstrate conceptual growth. Students are presented with an authentic science task—a question to answer or a practical problem to solve—and given opportunity to investigate the question or problem on their own or in groups.

Performance-based assessment provides the means to assess student abilities to:

- learn and apply science concepts and skills;
- identify and define a problem;
- make and carry out a plan;
- create and interpret strategies;
- collect and record necessary information;
- organize data and look for patterns;
- persist in looking for more information if needed; and
- discuss, review, revise, and explain results.

As evidence of their learning, students are normally required to provide a record of the questions or problems asked, the steps followed, the observations made and the results found during the investigation. The scoring criteria used to evaluate the processes used and the work produced should be shared with students before they begin the investigation.

Paper-and-pencil Tests

Paper-and-pencil tests are another way for students to demonstrate what they know and can do. Several strategies can be used to help students feel that tests are important opportunities to learn and to demonstrate learning.

- Provide some open-ended questions with no predetermined limits on solutions, procedures or processes to be used for finding solutions. This type of problem is especially important if testing is to give students opportunities to show the breadth and depth of their thinking and learning.

- Provide opportunity to view or handle materials relevant to the question.
- Provide a picture or diagram as part of the information given in a problem. This helps students who experience difficulties with reading or interpreting print to visualize the information and to show what they have learned.
- Read or tell the context for some problems. This is especially important for students in the younger grades, and for students whose reading skills prevent them from demonstrating their science knowledge and skills.

Assessment Portfolios

Assessment portfolios provide a method of involving students in the assessment and evaluation process. Students gather samples that they (and their teacher) think demonstrate their developing knowledge and skills. This involvement becomes a powerful way of motivating self-responsibility for learning.

An assessment portfolio provides a picture of the student's performance and achievement over time. Student portfolios can provide the following:

- evidence of knowledge and skill acquisition
- evidence of appropriate use of processes
- opportunities for the student to practice evaluating and selecting "best examples" of one's own performance and learning
- a permanent record of student work

An assessment portfolio may include the following personally chosen or teacher-chosen examples of student work.

- graphic or written descriptions of problem solving, performance tasks, investigations, etc.
- photographs, video and audio tapes, flipcharts, etc. from assigned or self-designed project work and presentation
- excerpts from the student's science journal and science learning-log
- computer-generated examples of developing technology skills and knowledge
- student self-reports on what has been learned, on feelings about oneself as a learner and on attitudes towards science

Strategies for Combined Grade Classes

The following strategies are often used in programming for combined grade classes. Of these, the *cycling of topics* approach is the most commonly used strategy, and can readily be adapted to the science program.

Cycling of Topics

Cycling of topics is normally done on a Year A/Year B basis. In Year A, three topics are presented from one grade level and two from the other level. In year B the remaining units are taught.

To ensure coordination between levels, a school plan is developed in which all Year A topics and all Year B topics are identified. The plan is then used for all combined grade classes.

Combined classes that involve three grade levels may develop a Year A/Year B/Year C plan.

Combined Topics

Some topics in consecutive grade levels provide opportunities for common learning experience, in particular:

- technology topics at grades 1 to 5
- the topic Seasonal Changes at grade 1 and Hot and Cold Temperature at grade 2
- life science topics at grades 1 to 3
- life science topics at grades 5 and 6

Independent Tasks

For some topics, resources can be selected that will enable students to work independently for much of their activities. The student components of the National Science Resource Centre materials are particularly useful for this purpose. Wonderville.ca provides on-line interactive activities that can be used for independent or small group tasks (see p. 24).

Regrouping for Instruction

Team teaching can be used to regroup students into grade level groups for the purpose of science instruction. For example, the grade 5 students from a 5/6 class may work with a grade 5 class (or the grade 6 students with a grade 6 class) when this can be arranged. The regular class teacher can then work with the remaining smaller group of students.

Safety

Safety is a concern for everyone in the science classroom, and teachers should work with students to develop a shared plan for ensuring safety. Before beginning an activity, teachers should identify potential risks and take precautions that will eliminate or minimize those risks. In preparing students for science activities, teachers should ensure that the students also recognize potential risks, and can identify ways to avoid them, as well as appropriate responses if difficulties should arise. Students should understand that even safe practices can become unsafe if thoughtless actions are taken, and that everyone must be conscious of safety at all times.

Let's Do Science does not provide a comprehensive listing of all safety procedures.

For specific information regarding safety in science activities, teachers are referred to the teacher guides and teacher resource books authorized for use with the elementary science program. **All teachers should have a copy of Alberta Education's elementary science safety manual, *Safety in the Science Classroom* (2005). It is available for viewing and downloading from the science section of the Alberta Education website: www.lrc.learning.gov.ab.ca. All teachers should be aware of, and follow, all safety procedures outlined by their school jurisdiction.**

Workplace Hazardous Materials Information System (WHMIS)

When potentially hazardous chemicals are used or stored in a workplace, including schools, the provisions of the Workplace Hazardous Materials Information System apply. WHMIS promotes safe working conditions by ensuring that complete and accurate information is available regarding hazardous products. Compliance with WHMIS is mandatory throughout Canada.

WHMIS guidelines and procedures are outlined in the book *Guidelines for Management of Chemicals and Hazardous Waste in Schools*, Alberta Special Waste Management Corporation, May 1991. Further information on WHMIS can be obtained by contacting the Alberta Government's Workplace Health and Safety toll free line, 1-866-415-8690, or the Canadian Centre for Occupational Health and Safety (1-800-263-8466).

Teachers should be aware of, and follow, WHMIS regulations as outlined by their school jurisdiction.

Care of Living Things in Live Animal Studies

In elementary and secondary science classes, the opportunity to study live animal species provides a compelling and enriching learning experience. It is incumbent on the teacher to ensure that the principles of science inquiry and problem-solving are taught and modelled without causing pain, injury, stress or suffering to the animal—regardless of species.

If you choose to introduce live animals into your study, *follow the strictest regulations set by your school jurisdiction.* The following information is provided to assist you in explaining and modelling to your students, parents, classroom volunteers and administrators the proper care and handling of living things.

Why Study Live Animals?	Respect and Care of Live Animals
• Observation and investigation provides unique and meaningful experiences not provided by other means • Students develop important skills of observation and interpretation, an understanding of the diversity, interrelationships and complexity of life, and a sense of stewardship • Students have the opportunity to observe and investigate in a "real-world" context, thus developing their interest in science and science careers	• Appropriate acquisition and care of the animal is required. For example, threatened species, such as certain species of frogs in Alberta, should not be removed from their environment • Teachers must instruct and model safety and care in handling live animals • Plans must be in place for maintaining the organism in the classroom under appropriate and safe conditions, or for the release of the animal into its **native** habitat if that is allowed. • *Note: if purchasing butterfly kits from a science supply company, ensure ahead of time that the insects are native to your area and can be released upon completion of the classroom study* • *Note: never release domesticated animals into the wild* • No study of animals should be undertaken that has the potential of introducing ethical costs

It is advised that the Background Information provided in this publication be used carefully in explaining what scientists know about the animals under investigation, but not necessarily as opportunities for testing on live specimens.