Plant Growth and Changes

A sequence of lessons
for Grade Four students

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This dialogue involved the following participants representing expertise and views from the agricultural community:

Simone Demers Collins	Promotions Coordinator, Alberta Canola Producers Commission
Ross Gould	Head, Animal Management Section; Alberta Agriculture
Lois Hole	Co-Owner, Hole"s Greenhouses and Gardens
Kathy Playdon	Sheep Farmer

Participants representing school expertise and views were:

Joan Alexander	Supervisor of Education, St. Albert Protestant Schools
Wayne Flaska	Teacher, St. Albert Protestant Schools
Isabelle Neumann	Teacher, St. Albert Protestant Schools
Terry Nipp	Teacher, St. Albert Protestant Schools

These participants met six times over a seven month period to discuss issues related to teaching and learning science in elementary classrooms, to set the direction for the development of this plant unit, and to discuss and propose changes to the unit after the field testing was completed.

The field testing of the lessons took place in Isabelle Neumann"s grade four classroom.

Simone Demers Collins also contributed a set of craft project ideas which have been included to connect art instruction to the plant theme.

We are grateful to all the above individuals and to the students in Isabelle"s classroom who contributed to this Alberta plant unit.

TABLE OF CONTENTS
Plant Growth and Changes

LEARNING AND TEACHING
ABOUT
PLANT GROWTH AND CHANGES

The Plant Growth and Changes unit is an eight week study of plants containing four weekly lessons, each approximately 45 minutes in length.

There is some flexibility in the order in which you may choose to arrange these lessons. The following charge shows a logical progression, but changes in sequence are possible to accommodate classroom scheduling and resource availability. As you may note, it is also possible to complete this unit in seven weeks by including Share and Tell activities in other lessons and by deleting Outdoor Investigations-2 and the lesson of your choice.

This science unit also readily lends itself to integrated learning across the curriculum. The agricultural theme of several of the lessons relates closely to topics in the grade four social studies program of studies. There are numerous opportunities for measuring and graphing, as well as basic computation. In addition, writing is an integral part of these lessons and numerous suggestions are given for additional writing and research activities. Art instruction, too, is easily integrated into the theme of plants.

Children's learning
The lessons in this unit have been prepared as a sequence of activities to support students" learning. These activities provide opportunities for students to:

- recognize their existing ideas about the topic,
- build connections between existing ideas and new observations and information, and
- revise and/or extend their ideas.

Learning is viewed as the revision and/or extension of existing ideas by the individual learner, and does not include memorization of teacher-transmitted information. The revision of ideas is usually not a one-step process, nor is it a linear progression. The re-structuring of an idea may require numerous encounters from different starting points, and almost certainly takes more time than a single lesson.

It is essential that students be encouraged to express their ideas by talking or writing. Talking and writing enhance the recognition of ideas which already exist or which are generated in small group discussion, whole class brainstorming or hands-on investigations. The hands-on activities in these lessons provide a means for introducing ideas and experiences necessary to build conceptual understanding.

Hands-on activities alone, however, unaccompanied by student attempts to express their own ideas and interpretations, will not necessarily lead to the revision or extension of these ideas. As it is growth in understanding, not simple exposure to enjoyable hands-on activities, that is the goal, students need ample time to personally make sense of these experiences and to share and contrast their understandings.
Collaborative group work is a common feature of these lessons. Through small group discussions while engaged in the activities, students have the opportunity to define their own ideas, to listen to the ideas and experiences of their peers and to construct a group understanding that is broader than that available to any one of the students.

Learning in science
Often science is regarded as a body of facts, dissociated from people‟s everyday lives. If children are to recognize key ideas which build understanding about the world, they need to do this in the context of their everyday world and the world of people. Opportunities for meeting people whose work is dependent on a knowledge of scientific ideas and of scientific inquiry help to make science more immediate to the students.

Teaching
Teaching this sequence of activities requires a recognition of the key ideas (concepts) to which the lessons are oriented. This will enable you to focus each lesson towards the development of a specific idea or ideas. To this end, a concept statement (or statements) is included with each lesson.

As well, it is important to find out what beginning ideas the students have brought to class, so that you can build on these or introduce interventions to encourage revision or their ideas when this is necessary.

Teaching about plants
In this sequence of lessons, time is required for the following activities:

- Discussion – whole class and small group
- Writing and drawing
- Observing and investigating

In this sequence of lessons, time is required to develop continuity through the extended observations of and sharing of information about the growth in plants.

In this sequence of lessons, the focus is on the development of keys ideas about plants in the everyday world of people. (See the following “map” for a representation of these key ideas.) While the role of plants as producers is included, the examples which children are able to associate with their personal experiences lie within the areas of growing and observing plants and the uses of plants by people. Thus, these areas are the focus of the following lessons.

CONCEPTS
Developed during this plant study

Plants grow and thrive when their needs are met.

- Plants have essential requirements that need to be satisfied in order for them to grow and thrive.
- Requirements for growth vary from one plant species to another.

The parts of plants have functions that help the plant to grow and thrive.

- Plant parts (roots, stems, leaves & flowers for flowering plants) have features that enable the plant to grow and thrive.
- Each plant has parts developed to assist the plant in satisfying its essential requirements.

Plants continue to exist because they are capable of reproducing themselves.

- Plants can be grown from seeds.
- Plants can reproduce by means other than seeds.
- A complete sequence of growth stages from seed to new seed is called a life cycle.

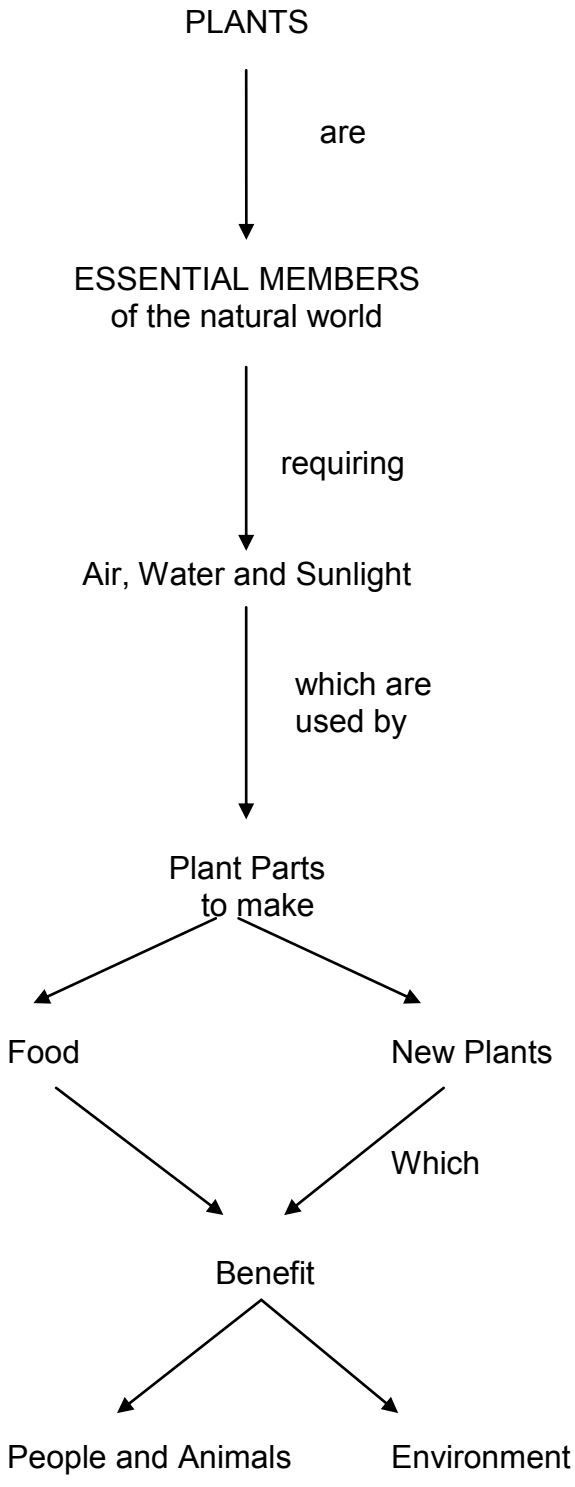
Plants are of importance to humans (and humans to plants).

- Plants are an important food source for humans.
- Plants provide many useful products for humans.

Plants are essential members of the environment.

- Plants are affected by and affect the environment.
- Plants play a valuable role in erosion prevention.

PLANT CONCEPT MAP



STUDENT ASSESSMENT

Individual student growth in understanding about plants may be documented by having students answer a similar set of questions before and after their plant growth and changes study. Questions and time are provided in the unit plan for this assessment. Criteria for judging concept development are found on the following pages.

On-going assessment is also important. This provides information useful for documenting student understanding as well as providing feed back on the lesson, allowing you to make corrections, present and future, you perceive to be necessary to successfully develop each lesson concept.

At the end of each lesson is a list of suggestions for evaluating student performance during that lesson. This includes routinely reading student journal entries during the course of the unit and making observations while students are talking and working together. You may wish to use statements and a format similar to those on the following pages for your observations.

STUDENT ASSESSMENT
CONCEPT DEVELOPMENT

To assess concept development, you may wish to use criteria similar to the following. Using these statements, it is possible to assess the student‟s pre-unit and post-unit knowledge about plants and document each student‟s growth in understanding.

Plants grow and thrive when their needs are met.

Level 1: The student does not recognize that plants have specific requirements for growth, nor does he/she relate growth and survival to these needs being met.

Level 2: The student recognizes that plants have specific requirements for growth, but is not able to describe in detail how these relate to the growth and survival of the plant.

Level 3: The student recognizes that plants have specific requirements for growth and is able to relate these to the growth and survival of the plant. [For **example**: The student is able to identify basic requirements for most plants to grow and thrive and is able to describe how each is necessary for plant growth and survival.]

The parts of plants have functions that help the plant to grow and thrive.

Level 1: The student cannot identify the major parts of a plant, nor can he/she describe the specific functions of each plant part.

Level 2: The student identifies the major parts of the plant, but is unable to describe in any detail the functions served by each part.

Level 3: The student identifies the parts of the plant and describes the major functions of each, relating these to the growth and survival of the plant.

Plants continue to exist because they are capable of reproducing themselves.

Level 1: The student does not recognize that plants have ways of producing more plants like themselves.

Level 2: The student recognizes that most plants are capable of producing seeds which grow into new plants, but cannot fully describe a plant‟s life cycle.

Level 3: The student recognizes that new plants may be produced from seeds or from a variety of propagation methods and can describe a complete life cycle of a plant.

Plants are of importance to humans.

Level 1: The student is unable to give examples of how plants are used by humans.

Level 2: The student is able to describe the importance of plants as a food source for humans and to give examples.

Level 3: The student is able to describe a variety of uses of plants by humans. [For **example**: The student is able to describe and give examples of plants being used for food, as well as describe and give examples of at least three of the following uses: for shelter, medicine, clothing, dyes or any other plausible use.]

Plants are essential members of the environment.

Level 1: The student is unaware of the importance of plants in the environment.

Level 2: The student is aware that plants are important, but is not able to provide any examples.

Level 3: The student describes examples of why plants are essential to our environment, such as making food, preventing erosion, and providing shelter.

OBSERVATIONAL CRITERIA

Ongoing, written observations of student activity provide invaluable assessment information about student skills, attitudes and knowledge. In making observational notes, you may wish to consider using statements similar to the following:

Contributions to classroom discussions

- Asks questions about plants
- Shares personal experiences and knowledge about plants
- Offers reasonable interpretations

Group/Individual work

- Is able to work independently
- Is able to work with others
- Plans purposively
- With guidance, is able to design a “fair test”
- With guidance, is able to identify and access sources of information
- Keeps accurate records
- Makes reasonable inferences
- Is able to communicate results by different means (words, diagrams, charts, etc.)
- Perseveres at tasks
- Shows interest in plants
- Pursues questions about plants beyond the classroom
- Shows growth in understanding plant-related concepts (give example/s)

You may wish to enter these comments on a sheet similar to the one on the following page, use self-adhesive notes, or design your own observational sheet.

Student Observation Sheet – Plant Growth and Changes

Name	**Name**
Name	**Name**

OVERVIEW OF PLANT GROWTH AND CHANGES UNIT

Introductory Activities and Discussions

Students write their beginning ideas about plants in their logbooks.
Students are involved in activities and discussions introducing them to plants and their uses.

Seeds

Students cut open, examine and sketch what they see inside a bean seed. They discuss the parts they have observed and their possible functions.

Planting Seeds and Germination

Students discuss the necessary conditions for seed germination and plant seeds of their choice. They design and start an experiment to test one germination condition.

Uses for Plants

Students discuss how people use plants and identify plant products found in their daily lives.

Plant Propagation

Students discuss ways that plants can be propagated other than by seed. A number of different plants are started using stem cuttings, runners, bulbs and tubers.

People and Plants

Students discuss the work that people do who can are in plant-related occupations. The teacher tells the students about a “plant visitor” who will be coming to talk to them and the students develop a set of questions to ask the visitor.

Plant Visitor

A person who works with plants visits the classroom to tell the students about his/her job. The students ask the visitor the questions they prepared in their previous science lesson.

Growing Conditions for Healthy Plants

Students discuss their ideas about conditions necessary for plants to grow and thrive. In groups, they design and set up a fair test to test one of the conditions designated as necessary.

Share and Tell

Students individually and in their groups share information about their plant experiments, at school and at home; their plant observations; and information, written or experiential, they have learned about plants.

Requirements for Growth – Agricultural Context

Students learn that requirements for growth vary from one plant species to another. Through role playing, students will get an idea of how farmers living in different regions of Alberta make decisions about which crop they will plant on each field on their land.

Outdoor Investigation – Conditions for Growth

Students go outdoors to observe plants in their local area. They will note the conditions under which these plants grow and thrive – or merely survive.

Roots

Students examine plant roots and infer the functions of the root.

Stems

Students examine plant stems and infer the functions of the stems.

Share and Tell

Update of above lesson.

Leaves and Photosynthesis

Students discuss the function of leaves. An experiment is set up to provide information about the role leaves play in plant survival.

Contemporary Problem – Agricultural Chemicals

Students compare a sample of “perfect” apples with one of organically grown apples and discuss the role of chemicals in agriculture.

Flowers and Pollination

Students examine a flower and observe its internal structure. They discuss pollination and the production of seeds.

Outdoor Investigation – Looking at Plant Structures

Students go outdoors to observe stems, leaves and flowers in their natural setting.

Plant Life Cycles

Students discuss the growth stages of their plants and are introduced to the concept of plant life cycles.

Share and Tell

Update of above lesson

Special Needs – Design a Plant

Student groups invent a plant capable of surviving under specified environmental conditions.

Review and Post-Assessment

Students review what they have learned and answer questions in their log books similar to those they answered in the Introductory Activities

Preparing for the Grand Finale Plant Share and Tell

Students draw on and use their review of what they have learned about plants to plan how they will share this knowledge at a Grand Finale Plant Share and Tell for the students‟ families and other invited guests.

Grand Finale Plant Share and Tell

Students share their learning about plants with their families and other guests.

Lesson Sequence Chart

Week 1 – Activity and Discussion Students answer questions in their log books	**Activity and Discussion**	**Activity and Discussion**	**Activity and Discussion**
Week 2 – Seeds	**Planting Seeds and Germination** Students plan and start an experiment. After seeds are planted, plants will need to be cared for daily.	**Plant Uses** Set up a Plant Use Centre	**Propagation** Daily plant care may be required
Week 3 – Propagation Daily plant care may be required	**People and Plants**	**Plant Visitor**	**Growing Conditions** Students plan an experiment
Week 4 – Growing Conditions Students start an experiment Daily observation and care will be necessary	**Share and Tell**	**Crops in Alberta**	**Outdoor Investigation** May need to shift this lesson with one of the following, depending on the weather
Week 5 – Roots	**Stems** Prepare for Plant Share and Tell	**Share and Tell/Stems** If students are regularly sharing plant information this separate lesson may not be necessary	**Leaves and Photosynthesis** A shorter lesson; Interpret follows in a week or more
Week 6 – Contemporary Problem Agriculture Chemicals	**Flowers and Pollination**	**Outdoor Investigation – 2** May need to shift this, depending on weather	**Life Cycles**
Week 7 – Share and Tell (Finish Leaves and Photosynthesis discussion) (See comments for Share and Tell, Week 5)	**Special Needs – Design a Plant**	**Your Choice**	Review and Post-Assessment
Week 8 – Preparing for the Grand Finale Plant Share and Tell	**Preparation**	**Preparation**	**Grand Finale Plant Share and Tell**

GUIDE TO THE LESSON FORMAT

Each lesson plan is divided into three sections:

1. **Background and planning statements for the teacher**

   Overview A short summary of the major activities to be undertaken by the students in the lesson

   Concept A statement of the concept being developed through the activities. The concept statement is meant as a guide to the teacher, **not** as a statement to be directly taught to the students

   Skills A list of the process skills which will be used and developed through the activities

   Background Information for the teacher; this section provides information in more depth than would be appropriate for most students

   Materials A list of the materials necessary in this lesson

   Preparation A list of tasks the teacher needs to complete before the lesson is introduced to the students

2. **The lesson sequence**

   Focus The question guiding the activities the students will undertake in this lesson

   Explore/Investigate
   A sequence of questions and activities structured to help the students explore the subject of the focus question

   Interpret A list of questions and other means for helping students make sense of the activities and for sharing their understandings

3. **Further activities and assessment strategies**

   Extensions Suggestions of further activities related to the topic of the lesson which will help broaden student understanding about this topic

   Connections
   Suggestions for integrating activities related to other curricular subjects with the topic in this science lesson

   Assessment
   Suggestions for evaluating student performance during this lesson

ADDITIONAL RESOURCES FOR PLANT GROWTH AND CHANGES

Printed resources
There are a number of very good plant books and reference materials available on the market.

In writing these lessons, the Elementary Science Syllabus from the New York State Education Department was of particular value, both for its clear conceptual framework and concept statements and for the unit plans which develop concepts included in the Alberta Program of Studies, Elementary Schools, Science 1995.

Trade books found useful in the classroom:

Bjork, Christina and Anderson, Lena (1988). Linnea"s Windowsill Garden.
Stockholm: R&S Books. (Distributed by General Publishing, Toronto in Canada)
Especially appealing to girls. Activities and information (including the water cycle, bulbs and insect pests)

Burnie, David (1989). Eyewitness Books – Plant. Toronto: Stoddart.
An Eyewitness Book – Pictures and information for the teacher and more capable student.

Hickman, Pamela M. (1991). Plantwise (The Federation of Ontario Naturalists).
Toronto: Kids Can Press Ltd.
Information and suggestions for activities for the teacher and student.

Ontario Science Center (1994). Plants. Toronto: Kids Can Press Ltd.
A Starting with Science book – Colorful format, activities for students to do, and simple explanations of "What's Happening"

Oppenheim, Joanne (1994). Floratorium. Toronto: Bantam Books.
An illustrated tour through a botanical museum introducing many different plants and the conditions under which they grow, and different plant uses.

Suzuki, David (1985). Looking at Plants. Toronto: Stoddart.
Information and suggestions for activities for the teacher and students

The authorized teaching resource Explorations in Science (Level Four, Teacher"s Resource Book) and support resource Explore! A Book of Science (Level Four, Teacher"s Resource Book) were found useful for this plant study.

Visual resources

As the visual resources available to schools vary across the province, no recommendations will be made. If you find your students are having difficulties understanding one of the concepts being developed through these lessons, you may want to order a film or video on this subject. This was not found to be necessary during the field testing of the unit.

THE

LESSONS

INTRODUCTORY ACTIVITIES AND DISCUSSIONS

Overview In these lessons, students write their beginning ideas about plants in their logbooks and are then engaged in activities and discussions introducing them to plants and their uses.

Concepts Plants can be grown from seeds.
Requirements for growth vary from one plant species to another.
Plants are an important food source for humans.

Skills Observing, comparing, inferring, communicating

Background

These Centre Activities are designed to introduce the students to some of the ideas that will be developed during the plant unit. They may not know answers to many of the questions; close observation and reasonable predictions are what count.

It is suggested that one Centre be set up each day. [The exception is the Book Centre which will remain for the duration of the unit.] Arrange to have pairs or trios of students visit the Centre during the day, do the prescribed task together and then write their answers in their science log books. After all the students have completed the task, assemble the class and discuss the students‟ answers, predictions and questions.

You may wish to include all of the following activities, or you may prefer to delete one or two.

Materials Science log book for each student
Other required materials are listed with each activity

Preparation

1. Divide the class into pairs or trios of students.

2. Each day, assemble the materials for that day‟s activities.
These are listed with each activity

3. Prepare an Activity Card for each Centre. (You may want to laminate these onto cards. Blackline Masters are provided.)

Assessing what the students already know:

To assess the students‟ background knowledge about plants, ask the students to respond to the following questions in their log books before they start the introductory activities.

- **What do you think plants might need in order to grow and be healthy?**
- **Name all the parts of a plant that you know. How do you think each of these parts help the plant grow and be healthy?**
- **How do you think plants make new plants?**
- **How are plants important to people?**
- **How are plants important to the environment?**

The answers to these questions will help you to adjust the lessons to meet your students‟ needs, to identify students with special knowledge about plants, and to document student concept development about plants over the course of the plant unit.

* * * * *

Further assessing what the students already know:

During your classroom discussions, you may also wish to ask questions similar to the following to further assess student background knowledge:

- **Have you ever visited a farm? Tell us about it.**
- **Do you have (or are you planning) a garden at home? What do (will) you grow?**
- **What plants have you eaten today?**
- **Are plants used for anything other than food? What ideas do you have?**
- **What plant projects have you done at home or at school?**

ACTIVITY CENTRE

SEEDS AND PLANTS

Background

This activity is designed to encourage the students to closely observe and compare samples of different seeds and plants. (It is unlikely they will be able to identify many of the samples.)

Material

Seeds – 4 to 6 different kinds of seeds in clear plastic bags.
Label A, B, C… Include those to be planted in class: *nasturtium, marigold, bean, pea, cucumber, canola, a grain.*

Plants – 2 to 4, corresponding to the kinds of seeds chosen

Activity Card (see below and Blackline Masters)

ACTIVITY CARD

Seeds and Plants

1. Describe two ways these plants are all alike.
2. Describe two ways these plants are different from each other.
3. Which plant do you think grew from which type of seed?

   I think Plant A grew from seed _____ because _____

   I think Plant B grew from seed _____ because _____

   I think Plant C grew from seed _____ because _____
4. How are the seeds alike? How are they different?

ACTIVITY CENTRE

GROWING CONDITIONS

Background

This activity is designed to introduce the students to the concept that plants require specific conditions to grow and thrive and that these conditions may be different for different plants.

You may wish to show the students how to access information in the garden catalogues.

Materials Seed packages – approximately 4 (The best ones for this activity give information about how to grow the plant.)

Gardening and seed catalogues

Activity Card (see below and Blackline Masters)

ACTIVITY CARD

Growing Conditions

1. Choose a seed package for a plant you would like to grow.
2. Using the information on the package and in the gardening catalogues, write a description of <u>where</u> in a garden you would plant the seeds and what you need to do to help them grow.
3. Why did you choose this plant?

ACTIVITY CENTRE

PLANT BOOKS

Background

This activity is designed to introduce the students to books they may want to read or refer to during the plant unit.

You may wish to review skimming and reviewing skills with the students

Materials 3 to 4 attractive, informative books on plants

Activity Card (see below and Blackline Masters)

ACTIVITY CARD

Books

You have been chosen to participate in the "Young Science Book Choice" awards. You are to review two of these books and nominate on as **Best Book** in the Plant category

Which one would you nominate? Think about –

1. Which book is the most interesting to read?
2. Which book has the most interesting activities?
3. Which book would you recommend to others and why?

Write the title of your nominee in your log book and give the reasons why you chose it.

ACTIVITY CENTRE

BREAKFAST CEREALS

Background

This lesson is designed to increase student awareness of the different grains to be found in breakfast cereals.

In the discussion following this activity, you may want to mention that these grains are all seeds from plants and that all cereal crops are members of the grass family.

Materials 3 to 4 boxes of breakfast cereals
(President‟s Choice Ancient Grain Cereal O‟s contains a number of unusual grains)

Samples of some of the grains found in the cereals (if possible)

Activity Card (See below and Blackline Masters)

ACTIVITY CARD

Breakfast Cereals

Make a list of the grains found in these breakfast cereals.

(Suggestion – read the small print.)

ACTIVITY CENTRE

GRANOLA

Background

This lesson is designed to encourage the students to consider the origin of some of the ingredients found in their food.

Materials Activity Card (see below and Blackline Masters)

ACTIVITY CARD

Granola

3 cups	rolled oats
1/3 cup	firmly packed brown sugar
1/2 cup	canola oil
1 cup	dried apples, chopped
1 cup	raisins
1/2 cup	walnuts
1/3 cup	sunflower seeds
2 tbsp.	sesame seeds

Make a list of each ingredient and tell where it comes from.
[An example is: rolled oats – oat plant]

(For the teacher: If you want to make this granola…)

Preheat oven to 350 degrees F. (180 C)
Combine rolled oats, brown sugar and oil in a large bowl. Add remaining ingredients and stir thoroughly.
Spread in a rimmed cookie sheet. Bake for 30 minutes or until golden, stirring twice. Cool and store in a tightly covered container.

[From Canola Council of Canada, Cooking with Canola Oil)

ACTIVITY CENTRE

SALAD SPROUTS

Background

This activity is designed to allow the students to grow seeds that rapidly germinate and grow into edible sprouts.

Materials

Alfalfa seeds (can be bought in bulk at health food stores)
Small dishes (aluminum tart plates work well)
Cotton balls
Small plastic sandwich bags
Small spoon
Marking pens
Water
Activity Card (see below and Blackline Masters)

ACTIVITY CARD

Salad Sprouts

GROW YOUR OWN SALAD SPROUTS

WHAT YOU NEED:

1 small spoonful of alfalfa seeds
1 dish
1 cotton ball
Water
1 small plastic bag

WHAT TO DO:

1. Label your dish with your group name.
2. Place the cotton ball in the dish.
3. Drip water on the cotton ball until it is damp, but not too wet.
4. Sprinkle the seeds evenly over the cotton ball.
5. Put the dish into the plastic bag and store in a safe location.
6. Check the dish every day. Keep the cotton ball damp.
7. Watch what happens!

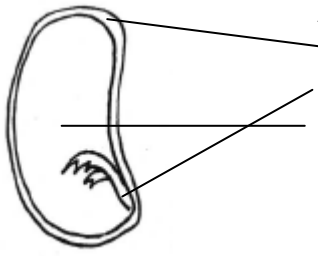
SEEDS

Overview In this lesson the students will cut open, examine and sketch what they see inside a bean seed. They will discuss the parts they have observed and their possible functions.

Concept The parts of the plants have functions that help the plant to grow and thrive

Skills Observing, manipulating, inferring, communicating

Background



All seeds have three parts:
- A seed coat (to protect the seed)
- A tiny plant (the embryo)
- Stored food (used by the embryo as it grows into a seedling.)

Misconceptions

Children frequently believe one or more of the following ideas:

Seeds are not alive. [The concept of dormancy is complex and should **not** be introduced as a major focus.]

Seeds need to be planted in a specific orientation if their roots are to grow down. [Gravity affects plant cells, causing roots to grow downward.]

Materials Seeds from the introductory activities
Bean seeds – soaked overnight
Magnifying lenses
Toothpicks

Preparation
1. Soak the beans overnight. [The seed takes in water and swells.]
2. Place the student materials in a central location.
3. Practice opening a bean seed in order to anticipate any problems the students may have.

Focus **What does the inside of a seed look like?**

Explore/Investigate

1. Look at samples of seeds from the initial seed activity.
   Ask students to describe their observations about the seeds.
   Are all the seeds alike?
   How are they different?
   Are there any other comments they would like to make about seeds?

2. Focus question: **What do you think the inside of a seed looks like?** Explain that a bean seed was chosen because it is large enough to easily examine.

3. Distribute the soaked beans, toothpicks and magnifying lenses.

4. Working in small groups, ask students to carefully open their bean seed with the toothpick, trying to keep each side intact. (The embryo is fragile and may break off.) They should examine the inside of the seed with the magnifying lens and discuss their observations with their group members.

Interpret

1. The teacher leads a classroom discussion about the students‟ observations.
   What does the inside of a bean seek look like?

2. **What part of the seed do you think will grow into a plant?**

3. The teacher draws and labels a diagram of a bean seed, explaining the function of each part. The students draw their own diagrams, labeling the seed coat, the tiny plant (the embryo) and the food supply.

4. The teacher may ask questions such as:
   Which parts of a seed do you think are needed for the seed to grow into a plant?
   How can we find out?
   [Interested students should be encouraged to experiment with planting seed parts and observing the results – See Extension 1.]

Extensions

1. Students experiment with growing parts of seeds, or cooked or frozen seeds.

Questions may include:

What parts of a seed are needed for the seed to grow into a plant?
Will a seed that was frozen grow?
Will a seed that was cooked grow?
Will a seed grow if the seed cover is taken off?
Will half a seed grow?

2. Place soaked beans between 2 layers of paper towels and keep damp. When the seed coat starts to split (generally in 3 to 4 days), students observe the tiny plant at this stage in its germination (the root and leaves will be much more apparent). You may want the students to include a diagram of the growing seed in their log books.

Connections

to language arts

Read stories such as:

Cooney, Barbara. *Miss Rumphius*
Waterton, Betty *Pettranella*
Jack and the Beanstalk
Johnny Appleseed

Ask the students to create and write a story about a person who plants seeds. What kinds of seeds would be planted? What would happen?

Assessment

Note the following:

1. The student‟s skill in cutting open and examining the seed.

2. The student‟s ability to draw an accurate representation of the inside of the bean.

3. The student‟s contributions to the group and class discussion on seeds.

4. Any activity the student undertakes to learn more about seeds.

PLANTING SEEDS
and
GERMINATION

Overview In this lesson the students will discuss the necessary conditions for germination and will plant seeds of their choice. They will also design and start a „fair test" to test a germination condition.

Concept Plants have basic requirements that need to be satisfied in order for them to grow.

Skills Predicting, manipulating materials, designing a „fair test"

Background

Requirements for germination:
- Seeds need **water** to grow. The water softens the seed coat and swells the root and shoot cells.
- Seeds need **air** to grow. Seeds planted in tightly packed soil, planted far below the surface of the soil or kept covered by a liquid will suffer from a lack of oxygen.
- Seeds need the right **temperature** to grow. Although some seeds need to go through a cold phase, most seeds need a warm temperature (between 15 C. and 25 C.) for germination to take place.
- Seeds (most) do **not** need light to germinate. The seedling initially lives off the food stored in each seed. When the true leaves appear, the plant needs sunlight in order to produce its own food.

Seed planting instructions

Students should
- Fill their containers nearly full of potting soil and level off the top of the soil. (A level top aids in successful watering.)
- Plant the seeds not much deeper than the thickness of the see. Thus, the small seeds will be planted nearer to the top of the soil than the larger seeds.
- Gently water the soil so it is wet, but not soaking.

As the plants grow, students will need to increase the amount of water they give their plants.

Misconceptions Children often believe one or more of the following ideas:
- Seeds need light to start growing. [Most seeds do not.]
- Seeds need soil to start growing. [Soil is not required for germination]

Materials Containers in which to plant the seeds
(Include clear plastic glasses which will allow students to observe root growth)
Potting soil
Waterproof trays in which to place the pots
Newspapers to cover the work areas
Seeds: nasturtium, marigold, pea, bean, cucumber – for students
beans, grain – for the teacher **[Note: If you are planting the Brassica, Wisconsin Fast Plant, you will want to start now.]**

Preparation **1.** Set out containers, soil, water and seeds in a central location.
2. Prepare a place in the classroom where the students can put their planted pots in the waterproof trays
3. Divide the students into groups – two to four students in a group. (They will work in this group for many of the following lessons.)

Focus **What do seeds need in order to start growing?**

Explore/Investigate

1. The class brainstorms answers to the focus question,
What do seeds need in order to start growing?
2. Choose a limited number of "ideal" germination conditions that the students feel are the most essential ones, the ones they will supply when they plant their own seeds.
3. Let the students plant seeds under these conditions.

- In order for each student to have his/her own plant to grow, care for and take home, it is recommended that each student plants **2 seeds** of his/her choice in **one container**.

- Each group will plant **2 pea seeds** in **one container** under the designated "ideal" germination conditions.

Note: Two seeds are planted as not all the seeds will germinate.

4. Challenge groups to plan a fair test to see how necessary these "ideal" conditions really are for successful germination to occur. Each group will plan an experiment to test one of the germination conditions.

If the students are not well acquainted with experimental procedures, they will need to discuss how to set up a fair test; that is, the need to keep all conditions but the one being tested the same.

They may also need help setting up a care and observation schedule to help in the reporting and discussion of their tests.

Students may ask (or be encouraged to ask) such questions as:

What happens if we put the seed at the bottom, half way down or on top of the soil?
What happens if we don't water the soil? What happens if we keep the soil very wet?
What happens if we put the pot where it is cold?

What happens if we put the pot in a dark place?
What happens if we plant the seed in a container and then put a lid on it?
What happens if we plant the seed in sand? In gravel? In regular dirt? (etc.)

You may want to guide the groups so that a variety of questions are asked.

5. To describe their fair tests in their log books, you may want the students to use a form similar to the following:

Our question is_____
We will do this_____
We will change this one condition_____
We will keep these conditions the same_____
We will measure_____
We think this will happen_____

6. Each group will plant **2 pea seeds** in **one container** under their chosen test condition.

The students may have to plant these seed son another day if they need supplies (for example, regular soil, sand, a container with a lid) not already available in the classroom.

Following this exercise, the students will need time EACH DAY to care for and observe their plants and to write their observations in their log books.

Teachers, too, plant seeds:
For use in the Roots and the Stems lessons, teachers plant:

- **Bean seeds in 10 containers (or enough for one container per group)**
- **Grain seeds in 10 clear plastic containers (or as above)**

Interpret **Log books:** Each student will describe his/her group prediction and test in the log book. Do they think all the seeds will germinate at the same rate?

Extensions Read Eric Carle"s The Tiny Seed to the class. Discuss the conditions under which the little seed grew to be a big plant.

Connections

to mathematics Students record the number of seeds planted in their group. This figure will be used later to calculate the fraction of seeds that germinate.

to mathematics Measure and graph the growth of the plants.

to art Students draw a plant using Carle"s style from The Tiny Seed.

Assessment

Note the following:

1. The student"s contribution to the discussion on germinating conditions.
2. The student"s skill in working with the soil and planting the seed.
3. The group"s ability to set up an experiment to test on variable for germinating seeds.
4. The student"s understanding of the group experiment as demonstrated by the write-up in the log book.

As soon as the seeds sprout, the little plants will need to be placed in a naturally lighted (or its equivalent) area. A sunny, south facing window works well. If this is not available, you need to consider buying or making a light table. Plans for a simple light table are included in Appendix B.

Lighting with a Light Table

1. The light table in Appendix B has a single bulb fluorescent **fixture**. More light (and possibly better results) can be obtained by hanging two fixtures. This is, however, more expensive and involves more cords.
2. Two cool white fluorescent **tubes** – the tubes generally used in schools - may be installed in the fixture but one cool and one warm tube is preferable as this provides a broader spectrum of light for the plants. "Grow light" tubes are more expensive and may not be appreciably better.
3. **Light height**. The light fixture should be adjusted so the lights are kept three to six inches above the plants.
4. **Light duration**. Most plants need both a light and a dark period each day. The plants grown in the classroom will need about 14 hours of light a day. A timer can be used to maintain these light levels.

The Wisconsin Fast Plant, Brassica rapa

The Brassica rapa Wisconsin Fast Plant referred to in the Science Program of Studies is a variety of canola bred to go through its life cycle rapidly.

Although the instructions for successfully growing the Wisconsin Fast Plant are rather elaborate, the plant was successfully grown in ordinary containers in a large, sunny, south facing window. The plants were not as robust as those pictured in *Plant Growth and Development* in the Science and Technology for Children series, nor did they mature as quickly. However, they did bloom and gave the children experience in cross-pollinating flowers. Soon thereafter they formed seed pods. After harvesting the mature seeds, these seeds were immediately planted and within four days new plants had sprouted.

A second set of seeds were lit 24 hours a day (as recommended), but with a small "grow light" bulb. These did not grow as well. There were but two blossoms on the six plants and, as these were not blooming at the same time, cross-pollination was impossible. Thus, no fertile seeds were produced capable of producing new plants.

While this plant is a valuable supplement to the Plant Growth and Changes unit, we would recommend using it as only one of the plant species you grow in your classroom.

USES FOR PLANTS

Overview In this lesson, the students will discuss how people use plants and identify plant products found in their daily lives.

Concept Plants are of importance to humans.

Skills Communicating

Background

Major uses for plants include the following:

Food
- Plant roots, leaves, stems and seeds

Shelter
- Roofing thatch
- Bamboo for building
- Lumber for house frames
- Palm leaves for roofing
- Reeds for mats used as walls of shelters

Medicine
- Bark of South American cinchona trees – quinine to treat malaria
- Fox glove plants – digitalis to treat heart disease
- Poppy seeds – morphine to ease pain
- Bark of the Pacific yew – compound promising as a cancer treatment

Fuel
- Wood
- Charcoal
- Oil, oil-based products and natural gas – from ancient plant life

Clothing
- Cotton
- Linen – from flax

Dye
- Dandelion roots – purple dye
- Onion skins – dark yellow dye
- Lily of the valley stems and leaves – green dye

Others
- Rubber – originally made from latex from a rubber plant [Today most rubber is synthetic.]
- Burlap – from jute plants
- Rope – from hemp plants
- Paper – from plant fibers, wood pulp, and recently, straw
- Musical instruments – gourds, wooden instruments

Materials You may want to bring a few plant products to class to start the discussion.

Preparation Choose an area in the classroom and make the necessary preparations for a Plant Use Centre.

Focus **How are plants important to us?**

Explore/Investigate

1. (Lead-in question relates to the preceding seed activities)
   Have you eaten a seed today? List the responses.

2. **What other plants do we eat?** List the responses.

3. **How do we use plants other than for food?**
   The students will brainstorm ideas in their groups and then contribute their ideas to a class list.

4. Explain the Plant Use Centre
   Students are encouraged to bring in plant products, pictures of plant products or an explanation of how a plant is used and place these in the Plant Use Centre.

Interpret Ask the students to keep a list of all the plant products – food and otherwise – they use or encounter the day after this lesson.

This information can be compiled and put in graph form to determine the most important plant for these students

Connections

to art Dyeing cloth

See a.) Suzuki, D., Looking at Plants, pages 24 to 25.

and/or

b.) Hickman, P.M., Plantwise, pages 84 to 85.

to health Review (or introduce) the basic food groups and the role of fruits, vegetables and grains in nutrition

Assessment

Note the following:

1. Student contributions to the discussion on plant uses.

2. The completeness of the student‟s list of plant products encountered in one day.

3. Student contributions to the Plant Use Centre.

PLANT PROPAGATION

Overview In this lesson the students will discuss ways that plants can be propagated other than by seed. A number of different plants will be started using stem cuttings, runners, tubers and bulbs.

Concept Plants continue to exist because they are capable of reproducing themselves.

Skills Observing, manipulating materials, communicating.

Background

Plant cells, unlike animal cells, are *totipotent*. This means that any single cell has the potential to develop into a whole plant; that is, it is "totally potent." Every cell, both in the animal and plant worlds, carries the DNA for the entire organism. Only in plants, however, can you entice a single cell to reproduce more cells and to grow into a new organism.

Plant propagators use this ability of plants to clone; that is, to produce genetically identical plants from a single cell, tissue or organ of a parent plant. The larger the starting piece, the easier the growth of new progeny.

In many species of plants, new roots will form *adventitiously* from a node. This means that the roots will develop in an "adventurous" way from a node on the stem. To improve the success of rooting, **stem cuttings** for propagating should be cut between nodes, leaving a short stub of internode only. (See Plant Diagram – Appendix A) Starting at the plant tip, count down the stem at least four nodes. Cut the stem between the fourth and fifth nodes. Remove the leaves from the bottom two nodes and place the cutting in water or in a rooting medium. It is best to use a good grade soil-less mix containing peat moss, vermiculite or perlite and some sand, if available. For the very early stages, you can use straight perlite or vermiculite.

Spider plants and other plants like strawberries send out small "plantlets" on **runners**. These runners are actually modified stems and the plantlets come fully equipped with roots already. This type of plant is very easy to start. You can just cup off the small plants, repot them in their own pot and stand back. To give them a head start, you can leave them attached to the parent plant for awhile until the baby is well established in its new home. You can also put the babies in a glass of water until they grow more roots before planting in soil.

A **bulb** is composed of a basal plate to which is attached an embryo plant surrounded by thickened leaves that act as a food source until the plant is able to grow new roots and top growth. Tulips, lilies and onions are examples of bulbs.

Potatoes are an example of a **tuber**, the food storage tip of an underground stem called a rhizome. Potato plants can produce seeds, but „seed" potatoes (not seeds, but potatoes used to grow the next generation of potato plants) are preferred by potato producers because the new potato plants will be clones of the parents. That is, potato growers know just what they will get and will not be surprised by a natural product that may be the wrong shape or colour for their market. The sprouts and the roots of the new potato plants develop from the indentations called „eyes".

Many plants grow multiple shoots up from the same root. It is very easy to split this plant into many small ones, each with a root and a shoot, and repot the small plants separately in their own pots. This is called *division* and is a common method for plant propagation. Try this on anything that has a bushy bunch of shoots coming out of the crown (examples, rhubarb, peonies).

More information on plant propagation can be found in Appendix A.

Materials

2 to 3 plants for stem cuttings. Choose from:
- Impatiens
- Geranium
- Mint
- Coleus

Seed Potatoes [If small, one potato per group. If large, cut in pieces to fit the planting containers.]

Plant with runners. Choose from:
- Strawberry plants
- Spider plants

Onion bulbs

Containers for planting in
- [Root growth is visible when planted in clear plastic glasses.]

Rooting soil – see description in Background information

Plant Diagrams for students

For extension:

1 or 2 carrots from grocery store

Preparation

1. Collect materials.
   A local garden centre may be willing to donate plants to the project.
   Parents may have a spider plant they would be willing to loan the class.

2. Assemble the plants and other materials in a central location.

3. Copy the Plant Diagram for the students.

Focus **How can we grow a new plant without planting a seed?**

Explore/Investigate

1. Pose the question. List the students‟ ideas.

2. Add any information the students will need to know in order to understand the simple plant propagation the class will be undertaking.

3. Distribute the Plant Diagrams to the students. Using one of the plants, identify the nodes and internodal sections.

4. Demonstration #1
   Following the instructions in the Background section, propagate a new plant from a stem cutting. (**Note:** This is not always successful. This just means that plant propagation sometimes requires skill which must be learned.)
   Place the potted stem cutting in the growing area.

5. Demonstration #2
   Plant a runner from a strawberry or spider plant. See the instructions given in the Background section.
   Place the plant in the growing area.

   [You may wish to end the lesson here and continue another day.]

6. Next, draw the student‟s attention to a seed potato, an example of a tuber. Explain how potatoes are grown and give each group a whole or a piece of a seed potato. Each group should decide how to plant its potato, plant the potato in potting soil and place this in the growing area. They should describe how they planted their potato in their log books.

7. Students cut open and examine an onion bulb and talk about its structure and how it grows into a plant. As onion bulbs are easy to grow, you may wish the students to start an onion.
   Or, you could try forcing a bulb to bloom indoors. (Instructions for this process can be found in many gardening books.)

Interpret **Log books:**

Present the following scenario:

Mrs. Root went to a friend's house. Seeing a geranium in the garden, she exclaimed, "Oh, what a beautiful geranium. I love the colour of the flower."
Her friend replied, "Why don't you take a stem cutting?"
Mrs. Root asked, "What do you mean?"

Explain to Mrs. Root what a stem cutting is and why her friend suggested she might want to have one.

Extensions

1. Cut the top off a carrot about 5 cm below the stem end. Remove any leaves. Stand the carrot piece in a shallow dish of water. Keep the cut end of the carrot wet. Watch as new leaves grow!

2. Place a stem cutting in water in a clear glass and watch to see if roots form. (Follow the instructions in Plant Propagation – Appendix A. **Note:** This does not always happen.)

Connections

to art Potato prints

Assessment

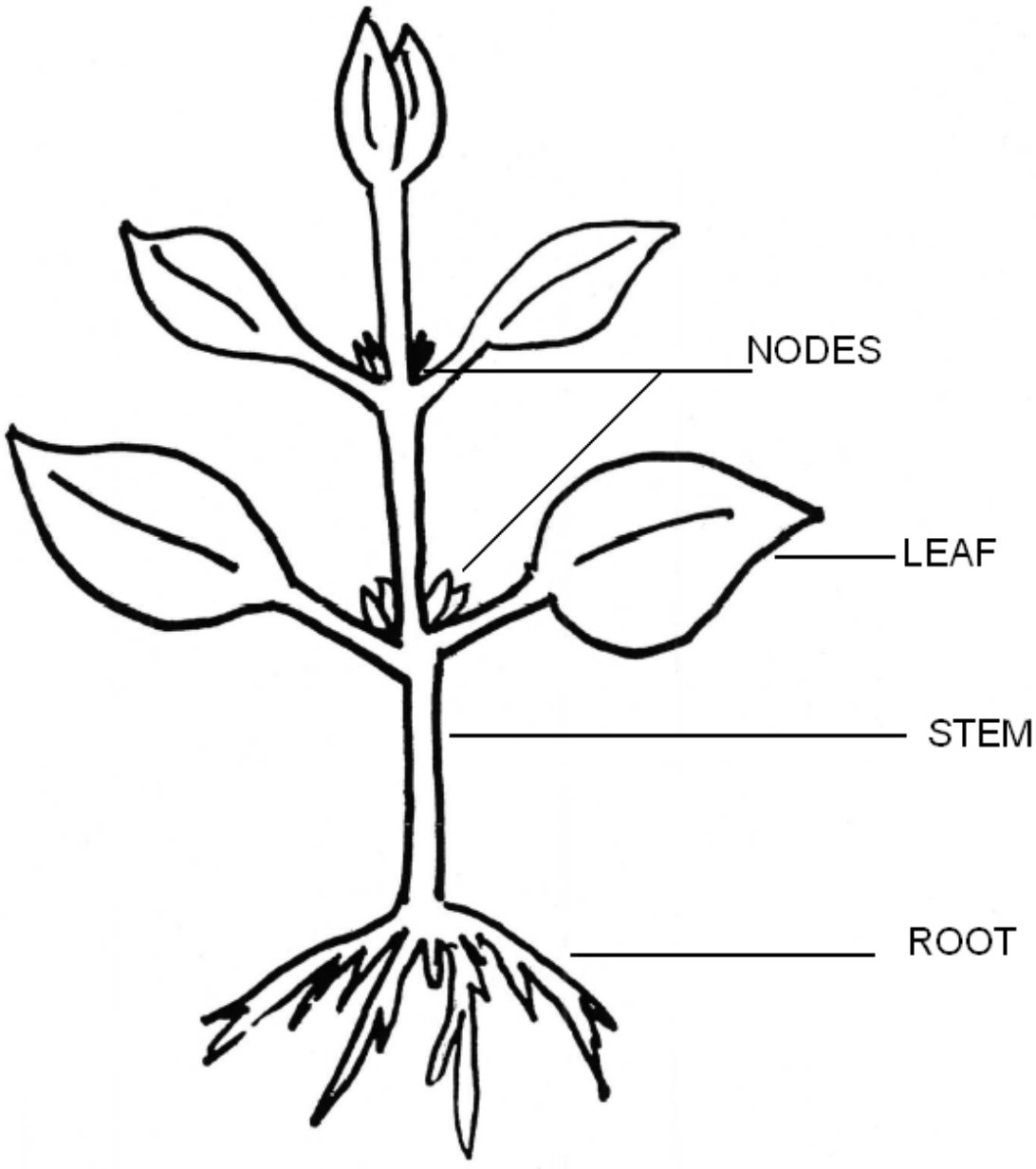
Note the following:

1. The student‟s contributions to the group discussions.

2. The student‟s ability to plan for and plant the seed potato and onion.

3. The understanding of plant propagation demonstrated in the student‟s response to Mrs. Root.

PLANT DIAGRAM



PEOPLE AND PLANTS

Overview In this lesson, the students will discuss the work that people do who are in plant-related occupations. The teacher will also tell the students about the "plant visitor" who will be coming to talk to them and the students in their groups will develop a set of questions to ask the visitor.

Concept Plants are of importance to humans (and humans to plants).

Skills Communicating

Background

There is a widespread idea that the people who "do" science are those working in laboratories (often men, and invariably wearing white coats!) It is important for children to begin to realize that there are many different kinds of occupations dependent on using ideas in science. Moreover, everyone is dependent on the jobs which these people do to provide us with food from plants.

Also, because many children live in cities and seldom visit farms and other agricultural site, there is little awareness of many of the activities carried out by those in the agricultural community.

There are numerous occupations which deal with plants. Some of these include:

Farmers such as grain and forage (grasses and legumes for animal food) producers, market gardeners, fruit growers

Research scientists and educators in

- botany
- genetics
- agriculture
- molecular biology
- soil science
- entomology
- chemistry

Business people who buy and sell plant products

Processors of

- Human food (examples: potato chips, canned and frozen fruits and vegetables)
- Animal food (examples: beef, dairy, pork, lamb, poultry feed industries)
- Oils for beauty products

Horticulturists

Landscape designers

Greenhouse growers

Nutritionists

Seed producers

Conservationists
Florists
Fertilizer, herbicide and pesticide producers
Consultants
    publicists
    government agents
(There are others who work with trees, but this is discussed more extensively at the Grade 6 level.)

Materials Student sheets: Bread – Brought to you by…

Preparation

1. Arrange to have a person who works in a plant-related occupation visit the class. Possible contacts are listed at the end of this lesson.

2. Give the visitor a short explanation of what the students have been and will be studying and any information you may wish the visitor to talk about. A list of the specific learner expectations from the science curriculum may help your visitor to understand the context for his/her visit.
    The guest should be invited to focus on his or her job activities and relate these to children‟s usual experiences with plants. (You may need to provide some information here.)

3. Prepare one set of Bread – Brought to you by…for each group.

Focus **Who works with plants?**
What do they do?

Explore/Investigate

1. In their log books, have the students answer the question: **Who do you think is involved in producing a loaf of bread?** They should list all the people or steps they can think of.

2. As a whole group, discuss the students‟ bread production ideas, tracing the production of a loaf of bread through all the steps from pre-sowing to the supermarket. (For background information, see attached, “Bread – Brought to you by…”)

3. Distribute the “Bread – Brought to you by…” sheets to the groups (there are six major groups in the scenario) and assign each group a section to read aloud in a readers theatre-like production. Ask the students to practice reading their assigned section prior to the class reading. They may wish to choral read the introductory statement and

then individually read each “bread producers” statement. In larger classes, several students can represent the farmers and consumers.

4. After the reading, the students may have questions or comments to add.

5. Ask if students can give examples of other people who work with plants. What do they do?

6. Tell the students about their “plant visitor” and talk about the kind of job this person does.

7. In their groups, the students will write a set of questions to ask their visitor. These questions should focus on learning more about this person‟s occupation and how s/he works with plants.

Interpret

1. Read “Cutting Edge (pg. 31, Explore!, Student Resource Book 4), to the students. Have them write in their **log books** about a plant they would like to develop if they were a plant geneticist.

or

2. **Log books:** Students answer, **Who do you think is involved in producing a box of cereal?**

Extensions

1. Bake a loaf of bread. (You may wish to briefly mention the chemical reactions involved if you bake a yeast bread.)

2. Several selections in Explore! (Student Resource Book 4) refer to people involved with plants. See especially, “Flashbacks”, pages 12 and 32 and “Designing Green,” pages 13 to 15.

Assessment

Note the following:

1. The student‟s contributions to the class discussion on plant related occupations.

2. The quality of the group questions. Do they focus on the person‟s job and his/her work with plants?

3. The student‟s entry in the log book. [If responding to (1), Is the response thoughtful? Imaginative? Relevant?]

BREAD – Brought to you by…

THE FARMER

I am the **farmer**. I plant wheat to make money for my family and to feed people all around the world.

or

We are the **farmers**. We plant wheat to make money for our families and to feed people all around the world.

WE ARE THE SCIENTISTS AT WORK IN OUR LABS

I am a **plant geneticist.** I study how characteristics are passed from one generation of plants to the next one and how to change particular characteristics to produce better crops.

I am a **chemist.** I study substances and how they combine with other substances. We can use this information to make better fertilizers, herbicides and pesticides.

I am an **entomologist.** I study insects so we can learn how to control insects harmful to crops.

I am a **soil scientist.** I study soil and how to use it to produce good crops.

I am an **agricultural engineer.** I design better machines for cultivating fields and seeding, harvesting and storing crops.

WE ARE THE FARM TOWN BUSINESS PEOPLE
HERE TO HELP THE FARMER SUCCEED WITH HIS CROP

I am a **banker**. I loan the farmers money so they can buy their seeds, fertilizer and farm equipment.

I am an **equipment dealer**. I sell and fix the farmers‟ tractors, seeders, cultivators, harvesters and other equipment.

I am a **gas and oil dealer**. I sell the gas and oil the farmers need to run their farm equipment.

I am a **seed and fertilizer dealer**. I sell the seed, fertilizer, herbicides and pesticides necessary to the farmer to produce a good crop.

WE ARE THE GRAIN ELEVATOR OPERATORS
AFTER THE CROP IS HARVESTED
WE HELP THE FARMERS TO STORE AND SELL THEIR CROPS

I am the **grain elevator manager**. I keep track of the grain the farmers bring to the elevator and take orders for the grain from the customers.

I am the **grain elevator employee**. I weight the grain and put it in the elevator when the farmer brings it to us and then load it on the trains when we ship it to the customers.

I am the **train engineer**. I deliver the grain to Canadian customers or to ships when the grain is being sent to customers across the ocean.

WE ARE THE OPERATORS AT THE MILL
CHANGING THE WHEAT KERNALS
INTO FLOUR AND WHAT PRODUCTS

I am the person who operates the machines that **clean the grain**.
I separate out the sticks and stones, metal bits and all other unwanted materials.

I am the person who operates the machines that **grind and sift** the wheat. I separate the bran from the rest of the wheat kernel and then grind and grind the wheat again.

I am the person who operates the machines that **bleach the flour** pure white and then **enrich it** with vitamins.

I am the person who **sacks the flour**.

I am the person in charge of **delivering the flour** to the bakers and the grocery store.

WE ARE THE BAKERS
WHO CHANGE THE FLOUR
INTO LOAVES OF BREAD

I am the **baker** who prepares the dough.

I am the **baker** who forms the dough into loaves of bread.

I am the **baker** who bakes the loaves of bread in the large, hot ovens.

I am the person who **wraps** the warm loaves of bread to keep them fresh for you.

I am the **truck driver** who delivers the fresh bread to the grocery store.

WE ARE THE GROCERS
BRINGING THE BREAD
FRESH TO YOU

I am the **grocery store manager**. I order the bread that I know my customers want.

I am the **grocery store employee**. I carefully place the bread on the shelves for the customers to choose.

I am the **checkout clerk**. I take your money and put your bread in a bag.

AND WE ARE THE CONSUMERS
EATING BREAD AND HONEY

Suggestions for Plant Visitors

Listed below are possible sources for finding classroom visitors who work with plants

- Local farmers

- Local garden centres/greenhouses

- Alberta Agriculture branches

- Landscape architects/designers

- Food processors

- Seed and bulb dealers

- Science Hotlines
  Calgary Science Hotline: 403-263-6226

  Edmonton Science & Technology Hotline: 780-448-0055

  Grande Prairie – Peace Country Science & Technology Hotline: 780-539-9847

  Medicine Hat Praxix Science Hotline: 403-527-5365

- Educational Organizations
  If you live near an educational organization offering agriculture, food and/or plant programs, it may be a source for a classroom visitor.

- If a particular crop is grown in your area, look for a local organization
  (Examples – Flax Growers, Western Barley Growers, Forage Councils, Fruit Growers, Oat Producers)

PLANT VISITOR

Overview In this lesson, a person who works with plants will visit the classroom to tell the students about his/her job. The students will ask the visitor the questions they prepared in their previous science lesson.

Concept Plants are of importance to humans (and humans to plants).

Skills Communicating

Preparation Prior arrangement for a person who works in a plant-related occupation to visit the class. (See Preparation, People and Plants lesson.)

Focus **What job does M. X do? How does he/she work with plants?**

Explore/Investigate

1. Introduce the visitor to the students

2. The visitor will tell the students about his/her job and the work done with plants.

3. Students ask the visitor the questions they have prepared.

Interpret **Log books**: Students explain what they have learned about their visitor"s job and anything new they may have learned about plants.

Connections

to art Children prepare thank you cards for the visitor featuring pictures of the plant/s the visitor works with.

Assessment

Note the comments expressed by the students in their log books. (You may want to individually ask students to expand on their comments if you think their written work does not reflect their actual knowledge.)

GROWING CONDITIONS FOR HEALTHY PLANTS

Overview In this lesson, the students will discuss their ideas about the conditions necessary for plants to grow and thrive. In groups, the students will design and set up a fair test to test one of the conditions they have designated as necessary.

Concept Plants grow and thrive when their needs are met.

Skills Communicating, controlling variable, experimenting

Background

Plants grow and thrive when provided with the following:

Air. Plants use carbon dioxide from the air to manufacture food in the process called photosynthesis ("putting together with light").

Water.
Water is needed for photosynthesis to occur. As well, water contains dissolved minerals necessary for plant growth and contributes to structural support. Plant species also require differing degrees of humidity for survival.

Sunlight (or its approximation).
Sunlight provides the energy necessary for photosynthesis to occur.

Proper **Temperature.**
Each plant has a temperature range in which it grows best. Beyond its temperature limitations, the plant will die.

Nutrients.
Plants require varying amounts of nitrogen, phosphorus, potassium, calcium, magnesium and iron. These may be found naturally in the soil or provided in compost or fertilizers.

Adequate **Space.**
Most plants do not thrive when grown under crowded conditions.

You may want to review how these conditions contrast with those required for germination.

Materials Two plants of similar size and health for each group.
These may be from seeds planted earlier by the students and the teacher, or may be purchased for this experiment.

Those materials required by the students to carry out their experiments (from lists to be prepared during the lesson)

Preparation Place the plants to be used in the experiments in a central location.

Focus **What do plants need to grow well?**

Explore/Investigate

1. Ask students to describe what they have been doing to help their plants grow.

2. List the conditions described by the students. Ask, **What conditions do you think are the most important ones for growing healthy plants?** Refine the list until about a half dozen important conditions for plant growth are agreed upon by the students.
   Have the students list their designated “Most Important Growing Conditions” in their log books.

3. Explain that each group is to select one of these conditions and plan a fair test to test the importance of that condition for their plant. Review the importance of changing just one of the conditions.

4. Review the importance of having a control, a plant provided with all the requirements for healthy plant growth. **Why is this important?**

5. You may need to help students ask a variety of questions similar to the following:
   How does fertilizer affect plant growth?
   How does sunlight affect plant growth?
   Do plants grow better if they are always in the light?
   How does the colour of light affect plant growth?
   Can plants live without water?
   Can plants live without air?
   Can plants live without light?
   Can you water a plant too much?

Note: If each group explores a different condition (or no more than two groups explore the same condition), the students will gain a broader understanding of the conditions necessary for plant growth when they share their observations and conclusions.

6. To describe their fair tests in their log books, you may want the students to use a form similar to the following:

   Our question is_____

   We will do this_____

   We will change this one condition_____

   We will keep these conditions the same_____

   We will measure_____

   We think this will happen_____

7. Students should list all the material they will need to carry out their experiment. They should designate those they will provide and those the teacher needs to provide. (**Note:** You may want to have some extra materials on hand for any forgetful students.)

8. **NEXT DAY** – (after the materials have been gathered)
   The groups will set up their fair tests.

> **The students will need time EACH DAY to care for and observe their plants and to write their observations in their log books.**

Interpret **Log books:** Pose a hypothetical experiment similar to the one the students are engaged in. Ask them if this is a fair test and to explain why or why not.

Extensions If experiments have not been set up to test all the conditions necessary for successful plant growth, you may wish to plan a demonstration experiment or suggest one or more experiments that the students could pursue at school or at home.

Connections

to language arts

To help students accurately report their observations, explore descriptive and objective language related to plants.

The students could then use this language to write a description, in prose or poetry, of a plant. From this description, can other students successfully identify the plant?

to art Similarly, students could draw a picture of a plant. Can other students successfully identify the plant in the drawing?

Assessment

Note the following:

1. Student responses to questions about the conditions they think are necessary for continued plant growth.

2. Student purposefulness in planning and setting up their fair tests.

3. Student responses to their fair test question.

PLANT SHARE AND TELL

Overview In these lessons, groups and individuals will share information about their plant experiments, at school and at home; their observations; and information, written or experiential, they have learned about plants.

Concepts Varied

Skills Observing, recording data, interpreting data, generalizing, inferring, communicating

Background

A number of opportunities are offered in this unit for groups of students to design their own experiments. Reporting, sharing and comparing their observations and results with their classmates is an important component of learning. As well, students are encouraged to read about, observe and experiment with plants outside of the classroom. These experiences can be shared with benefit to both the reporter and to the listeners.

In this lesson, groups present their work and discuss its implications with their classmates. Individuals are encouraged to share information they have learned about plants. Or, during Plant Share and Tell; each student could be asked to share on thing s/he has recently learned about plants. Additional information about plant uses may also be shared.

Preparation

1. Announce the Plant Share and Tell lesson a day or two in advance to give students time to think about what they will share.

2. Arrange a time for the groups to meet and prepare a short presentation for their classmates about one or two of their experiments. This may be a class period prior to Plant Share and Tell or at the beginning of the sharing class.

One possible format for presentation:

a. What we wanted to know (stated as a question)_____
b. We did (procedures)_____
c. We found out_____
d. Why we think that happened_____
e. Now we want to know_____

Focus **What have we observed and learned about plants?**

Communicate

1. Announce the Plant Share and Tell. You may wish to help the students choose effective and diverse means (for example, charts, graphs, drawings) to present their observations and results. You may also want to establish time guidelines.

2. Groups report on their experiments. Comparisons between similar experiments and questions about what was done and what was learned should be encouraged.

3. Students individually share what they have learned (observed, done). Again, questions should be encouraged. Asking for ideas about why something happened or is as reported may encourage a productive discussion.

Interpret **Log books:**

Ask students to discuss in their log books one new thing they learned during Plant Share and Tell and to tell how it related to what they already know about plants.

Possible format:

a) Today I learned_____
b) I think it is true because_____
   or
   I'm not sure if that is true because_____

Extensions Questions raised during the discussions may prompt students to ask new experimental questions to think about ways to vary their experiments. If materials are available, you may wish to encourage students to start or change an experiment.

Connections

to language arts

Following a discussion on the different ways to communicate scientific date (including notes, charts, tables, graphs, diagrams), the students write up, in good copy, one of their experiments. A standard reporting format may help them organize their data and ideas. These reports can be collected in a prominently-displayed Plant Activities binder so that students and parents are able to read about the scientific work being pursued in the classroom.

Assessment

Note the following:

1. The student‟s contributions to the group presentation.

2. Extra information the student presents.

3. The student‟s log book entry. Is there an attempt to relate the new information to what s/he already know (or thinks s/he knows) about plants?

REQUIREMENTS FOR GROWTH
AGRICULTURAL CONTEXT

Overview In this lesson, the students will learn that requirements for growth vary from one plant species to another. Through role playing, students will get an idea of how farmers living in different regions of Alberta make decisions on which crop they will plant on each field of their farms.

Concepts Plants grow and thrive when their needs are met.
Plants are affected by and affect the environment.

Skills Identifying variable, interpreting data, making decisions, communicating.

Background

Plants grow and thrive when their needs are met. This concept is central to a farmer"s decision about which crops to grow on his/her land. In Alberta the average annual precipitation and the length of the growing season are the major limiting factors in crop viability. Other important factors for farmers include: the availability and cost of land; fertility and type of soil; the expected income from a crop; the availability and cost of irrigation; the susceptibility of the crop to disease and pests; the prevalence of disease or pests in an area; and the rotation necessary to avoid problems with previous crops, pests or disease.

New possibilities and opportunities are constantly arising as researchers develop:

a) plant varieties which produce successful crops under a variety of conditions;
b) better means to control disease and pests; and
c) technology and management techniques for maximizing soil fertility and working the land.

An example of the complexities facing farmers can be illustrated by outlining some of the factors farmers must consider if they are thinking of growing canola. The following information can be found in extended form in Canola Production in Alberta, an Alberta Agriculture publication (AGDEX 149/20-1).

As would be expected, canola production varies depending on a number of major considerations such as climatic factors, soil, rotations, and disease prevalence. Varieties of two major canola species, *Brassica napus* (Argentine) and *Brassica rapa* (Polish) are grown in Alberta.

Table 1 indicates the principle differences between these two species and why a farmer might choose one over the other. Sixty-five to seventy per cent of the canola grown in Alberta is Rapa. Farmers usually choose the higher-yielding Napus varieties where they have a longer growing season.

Table 1. Characteristics of B. napus and B. rapa

Characteristic	Brassica napus	Brassica campestris
Seed yield	Yields high under good moisture and frost-free conditions	Under good growing conditions, 15 to 20% less than B. napus; under frost or Drought about equal to B. napus
Days to mature	Same as wheat	10 days to 3 weeks earlier than wheat
Height	Depends on growing conditions; ranges from 75 to 175 cm (30-69in.)	Depends on growing conditions; ranges from 50 to 125 cm (20-49in.)
Disease tolerance	Varieties similar but more resistant than B. campestris	Very susceptible to disease; Tobin has white rust resistance, while Candle is susceptible.
Frost damage	Slightly more susceptible to late spring frosts than cereals; susceptible to early fall frosts	More resistant to late spring frosts and usually mature before fall frosts
Drought tolerance	Similar to cereals; may suffer loss in yield and quality from late summer drought	Similar to cereals; often mature early enough to escape late summer drought
Shattering	Shatters readily when ripe	More resistant to shattering; may be straight combined
Flowering	May flower during high temperature Periods in July with reduced pod set	Usually finishes flowering before higher temperatures occur

(Table 1 taken from Canola Production in Alberta, p.2)

Inadequate average rainfall during the growing season can be partially compensated for if the stored soil moisture is high. This, in turn, is influenced by conservation of snow moisture, the texture of the soil and its organic matter content, and any weeds which may compete for the available moisture. “Adequate soil moisture promotes root growth and a large abundant leaf area. This helps plants retain their leaves longer, lengthens the flowers period, and increases the number of branches per plant, number of flowers forming pods, seeds per pod, seed weight and seed yield,” (Canola Production in AB, page 7).

Most canola varieties now being seeded need good protection against weeds which compete for light, moisture and nutrients. This means a well-prepared field is very important for success in growing canola.

As well, canola requires a three year wait period between canola crops in the same field. This is done to avoid a build-up of disease, insects and hard-to-control weeds.

In addition, there are the common agricultural decisions regarding fertilizer application (fertilizing will not increase yields if the added nutrients are not required); date of seeding (warmer soils hasten germination and plant growth, but if seeds are sown too late, the plants risk fall frost damage); insect, weed, and disease control; and timing the canola harvest (swathing and combing) to coincide with the optimum stage of ripening when the seeds are most likely to dry properly and not shatter.

This level of complexity is inappropriate for students, but does indicate some of the factors farmers must annually take into account in choosing the best crops to sow on their land.

Materials Student sheets – Crops Grown in Alberta and letters to the farmers
Alberta geography books

Preparation

1. Read background and student materials.
2. Prepare student materials: Crops Grown in Alberta and the letters to the farmers.

Focus **What conditions are necessary for different crops to grow and thrive in Alberta?**

Explore/Investigate

1. Set the farming scenario with the students.
   They have just bought a farm in Alberta. To help them make a decision about the best crops to grow on their farm, they wrote to Alberta Agriculture to ask for any crop information the department could send them. They have just received an answer and they are ready to make some plans for their farm.

2. Assign one region to each group. If the class is divided into eight groups, two groups will then consider each region. This will allow comparisons to be made when the “farmers” decisions are discussed.

3. The groups will first locate their regions on a map of Alberta and then decide on and list the crops that could grow on their farms. After this is completed, they will star the ones that they would like to grow. (You may wish to first review how to read and choose the most important information in a passage.)

Interpret

1. Each group will show the class their region on a map and describe the major conditions which affect crop productivity in this region.

2. Each group then reads its list of the crops that would grow in this region and the one/s the students would choose to grow. The lists of the two groups considering the same region can be compared at this time.

3. To further the discussion, students might be asked:
   Why did you choose that crop?
   What conditions in your region would allow you to grow that crop?
   (List the conditions important in their choices.)
   Are some areas better for growing a variety of crops?

4. **Logbooks:** In their logbooks, the students will answer: **If you were a farmer in Alberta, what would be the most important conditions to consider when choosing crops to grow on your farm?**

Extensions

If you have copies of Explore!, Student Resource Book 4, the students could play "The Wheat Game" on pages 9 to 11.

Students research the recommended growing conditions for cucumbers. They will then decide where they would plant a cucumber in their own yards and tell why they chose that location.

Connections

To language arts

Assuming the role of the farmer, students write a letter to a friend describing his/her farm – the landscape, weather conditions, what is exciting about their new venture, what may be a worry, etc.

Assessment

Note the following:

1. The student"s ability to read the information and make logical decisions based on this.

2. The learning stated by the student in his/her logbook.

CROPS GROWN IN ALBERTA

WHEAT

- Wheat can grow quite well in dry weather. (It is fairly drought resistant.)
- It grows on a wide range of soil types.
- Wheat needs a longer growing period and higher temperatures than most other small grains. However, the very long summer days of northern Alberta help wheat to mature in less than the 110 frost-free days usually necessary.
- It is most suitable to southern areas, although different kinds of wheat can be grown in other regions of Alberta
- Hard red spring wheat for bread is grown in the south-central regions.
- Durum wheat for pasta is grown only in southern Alberta.

BARLEY

- Barley has a short growing period. It can be grown in areas with at least 90 frost-free days.
- It is also an efficient user of moisture, so it can be grown where it is dry.
- Varieties of barley have been developed which allow it to grow in both hot and cool regions.

RYE

- Rye grows well on light poor soil.
- Rye grows quite well in dry weather. (It has good drought resistance.)
- Rye is the most productive of the cereal grain crops grown under conditions of low temperature, low fertility and drought.
- It‟s root system helps prevent erosion.
- Most of the rye planted in Alberta is fall rye. It is planted in the fall and can be used as pasture or harvested the following summer.
- There is a limited market for rye and the price the farmer receives is often low.
- Rye is also attacked by ergot, a disease that is poisonous to humans and animals.

OATS

- Oats can be grown on many kinds of soil.
- Oats require more moisture than other small grains.
- Heat can damage oats. Thus, oats grow best in the cooler, moister areas of west-central, north-central and parts of the Peace River region.

CANOLA

- Canola grows on most soil types in Alberta.
- It requires good moisture in the soil.
- Two types of Canola are grown in Alberta. One produces bigger crops, but has a longer growing period (about the same as wheat).
- Canola is attacked by many diseases and pests. To help control these, it should not be grown in the same field more than one year out of every four years.
- Canola is grown throughout Alberta.

SPECIAL CROPS AND VEGETABLES

- Southern Alberta receives more heat than the rest of the province. This allows crops to be grown which require higher temperatures. These crops include sugar beets, sunflowers and corn.
- North central Alberta and the Peace River region are good for crops which require cooler, wetter growing conditions. Potatoes grow well in the cooler, black soil areas of central Alberta. Carrots and cabbages are grown in both regions.

CROPS GROWN ONLY FOR ANIMAL FOOD
(FORAGE CROPS)

- Forage crops include grasses and plants known as legumes. Legumes have a thick root which can grow deep into the soil to reach moisture. Legumes also help make the soil more fertile by adding nitrogen to the soil.
  Nitrogen is a nutrient important to plants.
- Grasses have roots which spread out and help hold the soil in place. This helps decrease soil erosion by wind and water.
- Many grasses can live where it is cold.
- These forage crops can be grown on less fertile soil. This allows these crops to be grown in the foothills where growing conditions make it difficult to raise many crops.

Dear Farmer Central,

Congratulations on your purchase of a farm near St. Albert! To be a successful farmer there is some information about your area that you should know.

- There is a yearly average of 450 mm. of precipitation (rain and snow) near St. Albert.

- There is an average of 100 to 120 frost-free days a year in your area.

- Summer days are mild to warm.

- The soil is black and fertile.

We have also enclosed information about the major crops grown in Alberta.

If you have any more questions, please write to us.

Sincerely,

Al Agri

Dear Farmer West,

Congratulations on your purchase of a farm near Rocky Mountain House! To be a successful farmer there is some information about your area that you should know.

- There is a yearly average of 600mm. of precipitation (rain and snow) near Rocky Mountain House.

- There is an average of 80 or fewer frost-free days a year in your area.

- Summer days are cool.

- The soil is of rather low fertility.

We have also enclosed information about the major crops grown in Alberta.

If you have any more questions, please write to us.

Sincerely,

Al Agri

Dear Farmer North,

Congratulations on your purchase of a farm near Peace River! To be a successful farmer there is some information about your area that you should know.

- There is a yearly average of 350mm. of precipitation (rain and snow) near Peace River.

- There is an average of 80 to 100 frost-free days a year in your area.

- Summer days are long and temperature is mild.

- The soil is of medium fertility.

We have also enclosed information about the major crops grown in Alberta.

If you have any more questions, please write to us.

Sincerely,

Dear Farmer South,

Congratulations on your purchase of a farm near Medicine Hat! To be a successful farmer there is some information about your area that you should know.

- There is a yearly average of 300mm. of precipitation (rain and snow) near Medicine Hat.

- There is an average of 120 or more frost-free days a year in your area.

- Summer days are warm to hot.

- The soil is of medium fertility.

We have also enclosed information about the major crops grown in Alberta.

If you have any more questions, please write to us.

Sincerely,

OUTDOOR INVESTIGATION
CONDITIONS FOR GROWTH

Overview In this lesson, students will go outdoors to observe plants in their local area. They will also note the conditions under which these plants grow and thrive – or merely survive.

Concept Plants grow and thrive when their needs are met.
Specific learner expectation: Students will be able to recognize that a variety of plant communities can be found within the local area, and that differences in plant communities are related to variations in the amount of light, water, and other conditions.

Skills Observing, classifying, communicating.

Background

You may wish to pursue the focus questions of what plants live locally and under what conditions on more than one occasion. A field trip which includes the possibility of investigating a natural area provides the chance to observe plants under specific conditions which may vary from the sites surrounding the school

You may also wish to investigate just one site at a time near the school and chart your observations over a period of time, encouraging the students to add their own personal observations.

However scheduled, the emphasis is on student recognition of the conditions under which a plant is growing and that different plants have different requirements for growth and survival.

Materials Plant identification book(s)

Preparation 1. Choose the outdoor areas the children will investigate.
2. Inform parents, if necessary.

Focus **What plants grow in our area?**
Under what conditions do these plants thrive?

Explore/Investigate:

1. Investigate 2 to 3 different sites. These may include area that are:
   - sunny - hilly - other local conditions
   - shady - dry
   - trampled - sheltered
   - damp - forested

2. The students will describe or draw three (or more) of the most common plants to be found in each of these sites.

3. They will also describe the growing conditions observed in each site.

Interpret

1. In the classroom, place the observations into a table similar to the following:
   [As described in the Background section, this may occur over a period of time.]

Different areas (habitats)	Plants:	Daisy	Dandelion	Chamomile	Violet	Chickweed	Buttercup
Open field		✓	✓	✓			✓
Shady area					✓		
Marshy area					✓	✓	
Trampled Playground			✓	✓			

2. Using the chart, identify plants found in more than one habitat and those with more specific needs. Discuss any variations that students have observed.

3. **Log books:** The students write about their outdoor observations.
   What did they learn?
   What would they like to know more about?

Extensions

1. While they are studying plants, ask the students to keep a record of the plants that appear on the sunny side and the shady side of their homes.

2. Encourage the students to report to the class any observations they may make about plants growing under different conditions. Stress the importance of noting both the plant life and the growing conditions (amount of light, of moisture, shelter, etc.)

Connections

to language arts

Read a selection from *The Secret Garden* by Frances H. Burnett describing spring‟s arrival in the garden. [There are numerous possibilities in Chapter 15, “Nest Building,” and in Chapter 19, “It has come!”] Ask the students to make observations of spring‟s arrival in an area of their choice and then write about these spring observations. (You may wish to have them write either prose or poetry).

to art

1. In preparation for a Natural Form Treasure Hunt (see the “Outdoor Investigation – Looking at Plant Structures” lesson, art Extension), collect 6 to 10 different types of easily found leaves.

2. Another way for students to study form, shape, as well as light and shadow is with solargraphics (sun sensitive paper that develops in water). Solargraphic paper is available at nature stores and a variety of student/educational stores.

Assessment

Note the following:

1. The meaningfulness of the student‟s search for plants.

2. The depth/superficiality of the observations.

3. The learning communicated in the student‟s log book, as well as the quality of the questions the students express.

ROOTS

Overview In this lesson, the students will examine plant roots and infer their functions.

Concept The parts of plants have functions that help the plant to grow and thrive.

Skills Observing, inferring, communicating.

Background

Roots

- anchor the plant in the ground.
- absorb water and minerals from the soil.
- in some plants, store food for the plant.

There are two main types of root systems.

1. *Taproots* are primary roots which are much larger than the smaller secondary roots which grow out of them. Carrots and dandelions have taproots.
2. *Diffuse (or fibrous) root systems* contain many roots of approximately the same length and diameter. Examples include the roots of grasses, beans and marigolds.

Root hairs, very find hairs growing along the root, absorb water and dissolved minerals from the soil. Root hairs give off an acid that helps dissolve the minerals in the soil.

Amazing Facts

- The taproots of the mesquite plant can grow as long as 12m. in order to reach water in its desert environment.
- A rye plant may have as many as 14 billion root hairs and its entire root system, laid end to end, may extend more than 20,000 km. All of this, however is contained in an area no bigger than half a cubic meter.

Misconceptions

Children frequently believe one or more of the following ideas:
Roots absorb soil. [Roots penetrate the spaces between soil particles.] Roots take in „food for the plant. [Roots take in water and mineral salts dissolved in the water, which are used by the plant in building new cells.]

Materials Dandelion plants with roots intact (or other plants with taproots) – one per group
Beans planted by the teacher in Lesson Four or other plants with diffuse root systems – one per group
Grain plants (optional)
Magnifying lenses
Styrofoam trays (or newspapers) on which to place the dirty plants

Preparation

1. Dig dandelion plants, being careful to keep the plants intact.
2. Place dandelions, beans or other plants, and other supplies in a central location.

Focus **How do roots help the plant to grow and be healthy?**

Explore/Investigate

1. Each group receives an example of a plant with a taproot and one with a diffuse root system.

2. Students are asked to consider the following questions while examining the roots.
   How are the roots alike? How are they different?
   What do you think roots do for the plant? What reasons can you give for this answer?

Interpret

1. Reassemble the class and discuss the groups‟ answers. If the students have not suggested the major functions of roots, explain these to them.

2. **Log books:** The students will answer the focus question:
   How do roots help the plant grow and be healthy?

Extensions

1. Bean seeds planted in a clear jar – viewing of root growth and direction.
   Place 2 thicknesses of paper towel, folded to fit the height of the jar, around the inside diameter of a clear jar. Stuff more paper towels inside and dampen the towels. These should be quite wet. Halfway down the jar, between the jar and the folded towels, “plant” about five bean seeds at even intervals in different orientations. Ask the students, **Which direction do you think the roots will grow?** When roots are obviously growing down, lay the jar on its side and watch what happens next to the roots. [The roots will grow down, affected by the earth‟s gravity.]

2. Groups plant 4 kernels of grain in a container. As soon as the seedlings appear, students gently dig. Pull up one plant per day, measure the root and the stem, and chart this growth.
   Which grows faster, the roots or the stem?

3. To observe root hairs, evenly space approximately 10 radish seeds on a damp cotton ball. (See Introductory Lessons, Activity Centre – Salad Sprouts for more detail.) In four to five days, roots with obvious root hairs should be visible.

Connections

to mathematics

Measuring and graphing – See above, Extensions, Number 2.

to language arts

1. Ask students to help their parents or friends pull weeds. Using their observations, write a story from the weed‟s point of view about the difficulty of surviving in a world where they are considered undesirable.

2. Students research how roots are used by humans and report their findings to the class.

Assessment

Note the following:

1. The student‟s contributions to the group and the class discussion.

2. The quality of understanding displayed in the log book entries.

STEMS

Overview In this lesson, the students will examine plant stems and infer the functions of the stems.

Concept The parts of plants have functions that help the plant to grow and thrive.

Skills Observing, comparing, inferring, communicating.

Background

Stems

- are the transport system between the roots and the leaves.
  - Some cells are specialized to transport water and dissolved minerals from the roots to the other parts of the plant.
  - Other cells transport food produced in the leaves to other parts of the plant.
- support and position leaves so they can receive the light necessary for photosynthesis.

Kinds of stems

1. **Erect** - stand above the ground by themselves.
2. **Shortened** - may seem to be missing. (Examples: carrot, dandelions)
3. **Creeping** - long, thin and growing along the surface of the ground. These are also called runners or stolons. (Examples: strawberries, Creeping Jenny or Charlie)
4. **Climbing** - thin and long; grow vertically by wrapping themselves around a taller object. (Examples: morning glory, sweet pea)
5. **Underground** - grow horizontally not far below the surface of the ground. These are also called rhizomes. The *potato* is a *tuber*, the enlarged tip of a rhizome which is used for food storage by the plant.

Misconceptions

Children frequently believe one or more of the following:
Cutting a stem will lead to death of the plant. [This would depend on the position of the cut.]
Stems are all the same.
Tree trunks are not stems. [They <u>are</u> stems with outer layers which have become woody.]

Materials 1 pea and 1 bean plant/group (started by the students and the teacher in the Planting Seeds and Germination lesson) or two student grown plants/group
1 celery stalk/group
Magnifying lenses
Knife(s)
Jars of water containing red and blue food colouring

Preparation Place the materials in a central location.

Focus **How does the stem help the plant to grow and be healthy?**

Explore/Investigate

1. Each group collects a pea and a bean plant or two of its own plants.

2. The groups examine the two plants and discuss among themselves:
   What do the stems look like?
   What do the stems feel like?
   What is attached to the stem?
   How are the stems of plants alike and how are they different?
   What do you think the stem does for the plant?

3. A group member collects a stalk of celery and a jar of coloured water. Each group cuts off the bottom end of the stalk of celery and stand the stalk in a jar of coloured water. Let it sit for several hours – from morning to later afternoon or late afternoon to the following morning.

LATER

4. The students in their groups will observe what has happened to the celery since it was placed in the coloured water.

5. Cutting the celery crosswise, have the students observe the coloured fibers. If the students carefully scrape the outer layer of tissue off the back of the celery stalk, they can more easily see the coloured tubes.

Interpret

1. Students discuss their observations about stems (both their comparisons of stems and their celery stalk observations). **How do they think the stem helps the plant to grow and be healthy?**

2. **Log books:** The students answer the focus question, **How does the stem help the plant to grow and be healthy?**

Extension Cut the lower part of the stem of a white carnation lengthwise and insert each half in a jar of different coloured water. Have the students write in their log books their predictions for what they think will happen and why they think this. Later, check to see if they were right and if their explanations were reasonable.

Connections

to language arts

Students research how stems are used by humans and report their findings to the class.

Assessment

Note the following:

1. The student"s observations in his/her group.

2. The student"s contributions to the group discussion.

3. The student"s understanding of the function of stems as demonstrated in his/her log book entry.

LEAVES AND PHOTOSYNTHESIS

Overview In this lesson, the students will discuss the function of leaves. The teacher will set up an experiment to provide information about the role leaves play in plant survival. In seven to ten days, conclusions can be drawn from the experiment and the process of photosynthesis briefly discussed.

Concept The parts of plants have functions that help the plant to grow and thrive.

Skills Observing, experimenting, communicating, inferring

Background

1. The main function of the leaf is to produce food for the plant. Chlorophyll, a green-pigmented chemical located in the leaves of plants, is able to convert water and carbon dioxide, using the energy received from sunlight, into a simple sugar. This process is known as **photosynthesis**. The sugar is then used for plant growth or converted into starch which can be store din the plant. **Photosynthesis is the basic process of which the earth's entire food supply is based.**

2. Leaves allow gases (carbon dioxide and oxygen) to enter and leave the plant.

3. Leave also allow water to leave the plant.

As photosynthesis requires sunlight (or its approximation), leaves position themselves to maximize their exposure to this light. Without the food produced through the process of photosynthesis, the plant weakens and will eventually die.

The students study photosynthesis in more detail in Grade Eight, but they are introduced to the idea of plants as food producers at this grade level.

Misconceptions

Children frequently believe one or more the following ideas:
Leaves capture rain for the plant.
Leaves capture the sun‟s warmth.
Leaves change colour because they can‟t breathe.
Plants get their food form the roots and then store it in their leaves.
Leaves use energy from the sun and change it directly into plant parts.

Materials 4 plants of the same type and similar in size and health
3 brown bags large enough to fit over the plants
3 fasteners to close the bags

Preparation

1. Assemble the materials
2. Read through the lesson to acquaint yourself with the sequence of questions.

Focus **How do leaves help the plant grow and be healthy?**

Explore/Investigate

1. Pose the question to the students for a brainstorming activity.

2. Discuss their ideas. During the discussion, ask such questions as:
   Which direction do you think leaves face? (If students cannot answer this, do Extension Activity 1.)
   How might light be important for plants?
   What do you think happens to plants that don't get enough light?
   How can we find out?

3. Plan a fair test to see what happens to plants that receive varying amounts of light.

You may wish to set up an experiment similar to the following:
Start with four plants of similar size and health.

a. Place the plants in a sunny window.
b. Put a brown paper bag over one plant.
c. Cut a 5 centimeter hole in the center of one bag and place this over the plant so that the hole faces away from the window.
d. Cut a 5 centimeter hole in the center of another bag and place this so the hold faces the window.
e. Leave the fourth plant uncovered.

Do not turn the plants or the bags during the experiment. Check the plants briefly each day and water when necessary.

When an appreciable difference is apparent, (usually 7 to 10 days), continue onto the following section – Interpret.

4. If time is available, you may want to do Extension Activity 2.

Interpret

1. During the follow-up discussion, ask such questions as:
   Which plant is greenest?
   Which is healthiest?
   What might cause this difference?
      Could it have been a difference of air?
      Could it have been a difference of water?
      Could it have been a difference of soil?
   How does light affect the health and growth of plants?
   Which part of the plant seems to take in light?

2. Explain briefly that plants are Marvelous Machines; they can make food. They do this by a process called *photosynthesis*. **In the leaf**, using energy from the sun, plants chemically combine water and carbon dioxide to form a simple sugar. This sugar is used for growth and the excess is changed to starch and stored in the plant.

   Many students think that nutrients supply the plant‟s food. You may want to compare nutrients to vitamins – necessary, but not nutritionally adequate to sustain life.

3. **Log books**: After the discussion following the experiment, the students will answer the focus question, **How do leaves help the plant grow and be healthy?**

Extensions

1. To watch how many leaves position themselves relative to the sun, in the morning place a plant near a window so it‟s leaves are facing away from the sun. At intervals during the day, observe and record the changing position of the leaves.

2. Students observe and compare the different types of leaves found on the plants they have grown. How are they alike and different? Why might there be so many types of leaves?

Connections

to language arts

Students research the different uses for plant leaves and report their findings to the class.

Assessment

Note the following:

1. The student‟s contribution to the classroom discussion.

2. Any observations the student may make while the plants are covered.

3. The quality of understanding show in the log book response.

If the student responses indicate confusion about the function leaves play in plant growth and survival and/or about plants as food producers, you may want to review these concepts.

CONTEMPORARY PROBLEM
AGRICULTURAL CHEMICALS

Overview In this lesson, the students will compare a sample of “perfect” apples with one of organically grown apples and discuss the role of chemicals in agriculture. **Or** (if organic produce is not available), students will discuss how they choose fruit to eat and how this affects the use of chemicals in agriculture.

Concept Crops need to be protected from weeds and pests that can harm them, but the chemicals used may harm the environment. (from AAAS – Benchmarks)

Skills Comparing, decision making, communicating.

Background

A farmer is in business to

- produce a profitable crop
- protect his crop
- protect his land

However, these goals are sometimes in conflict with a number of environmental and health concerns.

Farmers are driven by market pressures to produce an attractive crop at a price acceptable to consumers. These pressures, and the farmers‟ need to make a profit, lead to the use of fertilizers to enhance the productivity of the land and of other chemicals (for example, herbicides, pesticides and fungicides) to protect the crops. These measures are costly to the farmer, but increased production of a quality product is felt to offset the cost.

There is concern about the use of agricultural chemicals being voiced by environmentalists, consumers and by farmers themselves. Governments are concerned about the costs involved in health care and farmers need to very carefully follow chemical application instructions (as the length of time that these chemicals are effective is reduced, the immediate toxicity has increased, posing a greater health risk to the applicator). Environmentalists fear the consequences if chemicals are used as an exclusive solution for pest management and petroleum-based fertilizers for increasing land productivity. And while danger to health from food stuffs grown in Canada is almost non-existent, the government does need to monitor food stuffs entering Canada from countries with less stringent controls on the use of agricultural chemicals.

There is a growing interest in the agriculture community in using a better balanced approach to pest management and land productivity; that is, one that does not primarily rely on chemicals. As usual, this is complicated. For example, organic farming (defined as farming on land that is certified to have been chemical free for at least three years) requires more tilling – and tilling increases the chance of soil erosion, another major agricultural problem.

The use of agricultural chemicals is a subject that introduces students to the relationship between consumer demands and food production methods. Alternative and their costs and benefits can be considered. Most importantly, students should start to realize that this is a complex issue and there is no easy answer.

This lesson is written with two alternatives to accommodate teachers who are able and those who are not able to find organic produce.

Materials Two "picture perfect" apples
Two organically grown apples, not so "picture perfect"

OR

Fruit brought by students

Focus **Why are chemicals used by farmers?**

Explore/investigate

1. Present the samples of apples to the students. Pass them around and ask which apple(s) the students would choose if they went shopping.
2. Ask why they would choose that apple. Write down their criteria for apple selection.
3. Do they think adults use these same criteria?
4. Introduce the cost factor – how much did each of these apples cost? Does this make a difference in their selection?

OR

If organic produce is not available in your area

1. Ask students to bring to school a piece of fruit they have chosen to buy and eat. (A letter home explaining the request may result in a larger sample for classroom discussion.)

2. Discuss the samples of fruit brought to class. Ask why they chose that piece of fruit. Write down the student‟s criteria for fruit selection.

3. Do they think adults use these same criteria?

4. Introduce an alternative – organically grown produce.
   - Perhaps not as attractive
   - Certainly more expensive (may cost twice as much)

5. Solicit student comments.

Interpret
(for both of above)

1. Discuss the reasons agricultural chemicals are used by farmers.

2. Do the students think consumers would be willing to make changes in their fruit and vegetable purchases? What changes would they be willing to make?

3. **Log books:** Pretend you are going shopping for fruit. What fruit would you like to buy? How would you select the pieces of fruit?

Extensions

1. Students who are acquainted with farmers could interview them about their use of agricultural chemicals. How do the chemicals help them? Do they take any precautions when using chemicals? Has their use of chemicals changed over time? (Students could brainstorm their own list of questions they would like to have answered.)

2. Students can question their parents and neighbours about their use of chemicals in their yards. Why do they use these chemicals? Are there any alternatives? (For example, digging up dandelions, instead of spraying them.)

Assessment

Note the following:

1. The student‟s contributions to the discussion on produce desirability and the use of agricultural chemicals.

2. The relevance of the log book response to the preceding discussion.

3. Any additional information the student brings to class about this issue.

FLOWERS AND POLLINATION

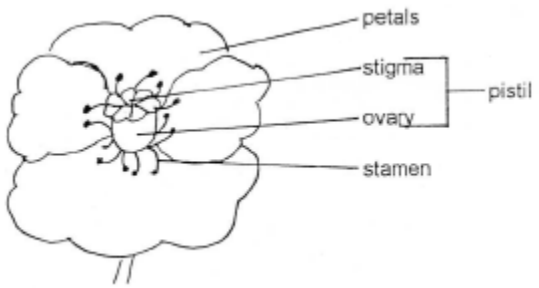
Overview In this lesson, the student will examine a flower and observe its internal structure. They will discuss pollination and the production of seeds.

Concept The parts of plants have functions that help the plant to grow and thrive. (The flower is the part of the plant that produces seeds.)

Skills Observing, inferring, communicating

Background

The flower is the reproductive part of flowering plants. Stated simply a flower has the following parts:



Petals function to attract insects to the flower and protect the reproductive parts.
The **pistil** is the female part of the flower.
The **stigma** is the sticky top of the pistil.
The **ovary** is at the base of the pistil; it contains ovules which will develop into seeds if they are fertilized.
The **stamen** is the male part of the flower where pollen is produced.

When a grain of pollen lands on the stigma, (a process called **pollination**), a pollen tube forms. This tube leads to the ovary and allows a sperm cell from the pollen to reach and fertilize an ovule.

For fertilization to occur, plants may require pollen from a different plant of the same species (cross-pollination), or may accept pollen from the same plant (self-pollination).

After fertilization, the ovules start to develop into seeds. The ovary of the flower develops into a fruit which protects the seeds. The flower also functions to aid in pollination. Its colour or scent may attract insects or hummingbirds which can carry pollen from flower to flower. These insects and birds are seeking nectar, a sweet liquid located at the base of the petals. As well, the location and shape of the stamen and stigma may aid in self-pollination or allow wind (or water, for plants that live in water) to easily carry the pollen to adjoining flowers.

It is not necessary, or even desirable, to introduce much of this detail to the students. They will study this in more detail in Grade Eight.

If students want to label their flower diagrams, the following designations should suffice:

Petals
Pollen producer (stamen)
Pollen receiver (stigma)
Pre-seeds (ovules)

Single flowers such as poppies, tulips and lilies are easiest for the students to examine. Flowers like daisies and sunflowers are composites; the centers are a composite of many tiny flowers which are not easily observed by the students.

Materials One poppy, tulip or lily for each group (florists may be able to contribute not-so-fresh flowers)
Magnifying lenses

Preparation

1. Read Background information
2. Gather materials and place in a central location.

Focus **What do flowers do for the plant?**

Explore/Investigate

1) Ask the students to name some of the flowers they know.

2) Do you grow flowers in your yard at home?
Do you like flowers? Why?

3) Explain that each group will receive a flower to observe **carefully**.

a. They are to look at the entire flower. What do they observe?
b. They will then *carefully* remove petals from one half of the flower. What do they observe now?
c. Have the students draw a diagram of their observations in their log books showing all of the different parts of the flower that they now observe.
d. Next, carefully remove the rest of the petals. What do they observe?

Interpret

1. As a class, discuss their observations.
   How many flower parts did you find?
   What were the petals like?
   Did you notice the part with the powdery substance at the tip?
   Do you know the name for this powder? (pollen)

2. Introduce the term **pollination** – the transfer of pollen. (**Note:** If you are growing Brassica rapa, the student "pollinators" will learn that these flowers must be cross pollinated as no seeds will form if pollen from the same plant reaches the stigma.)

The discussion of pollination may include such questions as:
How can pollen be transferred from one flower to another?
Have you ever observed insects near flowers?
How could these insects be useful to the plants?
How are insects attracted to flowers?

3. Explain that pollination is important because **a flower must be pollinated in order to produce seeds.**

Discuss, **How are seeds important to plants?**

4. Log books: Students will answer the focus question, **What do flowers do for the plant?**

Connections

to art Tissue Paper and Water-base Marker **FLOWERS**

1. Using masking tape, tape pieces of tissue paper to a flat, dry surface. Make sure that tape and water will not harm the surface.
2. Use a light pencil (light blue lead works well) to draw flower and leaf shapes on the tissue paper.
3. Use water-base markers to trace over the pencil lines.
4. Use a soft paint brush dipped in water to brush over the flowers and leaves. Be sure to follow the shape of the flowers and leaves. The water causes the colours to bleed, making the flowers look soft.
5. Let the paper dry, then cut the flowers and leaves.
6. Pinch in the centre of each flower, and twist a small bit of the tissue tightly. Carefully open each flower, petal by petal.
7. Glue the flowers and leaves onto a springtime basket to create a decoration; to the top of a Mothers‟ Day card; or to a green plastic straw if a field of flowers is the plan of the day.

to language arts

There are numerous possibilities for having children listen to, read, and write poetry on the topic of flowers. Check your school library for examples and use these in structuring your lesson.

Assessment

Note the following:

1. The student‟s ability to carefully examine, make observations, and draw the flower.

2. The student‟s contributions to the discussion on pollination.

3. The quality of understanding expressed in the log book. (If you think necessary, individually ask students to expand on their explanations.)

If students seem confused about pollination, you may want to review this process with the class.

OUTDOOR INVESTIGATION
LOOKING AT PLANT STRUCTURES

Overview In this lesson, the students will go outdoors to observe stems, leaves and flowers in their natural setting.

Concept The parts of plants have functions that help the plant to grow and thrive.

Skills Observing, comparing, inferring, communicating

Background

This lesson is designed to enhance the learning of the students as they take the knowledge developed in the classroom out of doors to find examples of plant form and function in their everyday lives.

Preparation Locate an area near the school where the students can explore a variety of stems, leaves and flowers.

Focus **What kinds of stems, leaves and flowers can you find? How are they alike? How are they different?**

Explore/Investigate

1. Challenge the students in their groups to find examples of plants with (for example):

   - short stems
   - long stems
   - thick stems
   - hollow stems
   - thin stems
   - different shapes of leaves (See connections – to art)
   - flowers
     - of different colours
     - with different scents
     - with observable pollen

   You may wish the students to collect actual samples or to make observations and note the position of the plant, so they can later share these observed plants with their fellow students

2. When the students have collected a number of observations or samples, call them together to share what they have observed. If they have noted plant positions, the class can travel from observed plant to observed plant with the "discovery group" explaining what it has observed with this particular plant.

Interpret

1. When the groups are sharing their observations, ask questions which will encourage the students to compare and contrast their plants.

2. Asking questions which require students to recall and/or infer the function of the parts of plants will reinforce past lessons. You may want to ask such questions as:
   Why might that stem be long (short, thin, thick, etc.)?
   How might that flower attract bees?
   Why would the plant want to attract bees?

3. **Log books:** Describe the most interesting plant you observed. Why did you find it interesting?

Connections

to language arts

Have the students read "Sidewalk Survivors" in Explore! (Student Resource Book 4), pages 6 to 8.

Ask the students to look for an example of a sidewalk survivor growing in their neighbourhood and to write about it in prose or poetry

to art

Natural Form Treasure Hunt

1. Collect 6 to 10 different types of leaves that are easily found in an area near your school. (You may have done this in the first Outdoor Investigation lesson.)
2. Glue a set of leaves onto a white sheet of paper.
3. Photocopy sheets so each student or group of students has a copy.
4. While looking for examples of plant stems, leaves and flowers, ask students to watch for leaves to match those on their leaf-form sheets and to discover art forms in their natural forms.

Assessment

Note the following:

1. The student"s ability to conduct a meaningful search for plants with the prescribed characteristics.

2. The student"s ability to carefully observe and compare plants.

3. The student"s ability to discuss the functions of the parts of the plant.

4. The student"s description of an interesting plant and reason for choosing it.
   How much detail has been included? Does it communicate an understanding and appreciation of plants?

PLANT LIFE CYCLES

Overview In this lesson, the students will discuss the growth stages of their plants and will be introduced to the concept of plant life cycles.

Concepts Plants continue to exist because they are capable of reproducing themselves.
A complete sequence of growth stages from seed to new seed is called a life cycle.

Skills Observing, inferring, communicating

Background

Plants go through a series of changes from seed to mature plant. The mature plant produces seeds that enable the plant to produce the new generation of plants of like characteristics. (The ability to reproduce is, of course, also true for plants which reproduce by means other than seeds.)

The complete sequence of changing includes these stages (those listed are for seed-producing plants):

- seed
- seedling
- growth and development
- flowering
- pollination
- seed and fruit development
- seed

A complete sequence of growth stages from seed to new seed is referred to as the **life cycle** of the plant.

Materials Student Life Cycle sheets

Preparation Prepare Life Cycle sheets for the students

Focus **What happens to the seeds that plants produce?**

Explore/Investigate

1. To introduce the concept of the life cycle, you may wish to ask such questions as:
   When we wanted to grow a plant, what did we start with?
   What happened next?
   And then?
   And then?

   Draw simple pictures on the board of the children‟s descriptions of their growing plants.

   If their plants have not yet flowered, ask them to predict what will happen next and add pictures to these predictions. (You may need to help them.)

   (**Note:** If you have been growing the Wisconsin Fast Plant Brassica rapa, you may want to concentrate on this plant in this lesson as it should have gone through most, if not all, of the plant life stages by this time.)

2. Draw the students‟ attention to the cycle they have described and explain that this is called a plant life cycle. Discuss any other life cycles they are acquainted with.

Interpret Give the students the Life Cycle sheets. Have them cut out the squares and arrange them in the correct order in their log books. [If students arrange the pictures incorrectly, ask them individually to explain why they put them in that order.]

Extensions Groups of students draw posters for the classroom showing the life cycle of one of their plants.

Connections

to language arts

Students write, in prose or poetry, about the plant “cycle of life”.

to art

Tear Tissue Art

1. Have students rip tissue paper into various sizes of four-petal flowers. Have various sized leaves also ripped up.

2. Arrange the tissue paper shapes on a sheet of white paper. Paint over the pieces of tissue with a thinned white glue. Brush lightly so as not to tear the tissue.

3. Take care not to have the various colours of tissue run together.

4. Keep adding tissue pieces until a colourful bouquet or field of flowers scene is created.

5. The students may want to collect seeds and add them to their picture.

Assessment

Note the following:

1. The student‟s contribution to the class discussion.

2. The student‟s arrangement of the life cycle pictures and/or the explanation given for the chosen arrangement.

PLANT LIFE CYCLE

SPECIAL NEEDS
DESIGN A PLANT

Overview In this lesson, the student groups will design a plant capable of surviving under specified environmental conditions.

Concepts Plant parts have features that enable the plant to grow and thrive. Plants are affected by and affect the environment.

Skills Inferring, communicating

Background

Plants live in locations that allow them to reproduce and their offspring to germinate and grow.

In the **desert**, plants have evolved that can live for extended lengths of time with very little water. Some desert plants have very long tap roots (the root of the mesquite tree may grow as deep as 12 meters). Others have long diffuse root systems growing near the surface of the ground that are capable of quickly collecting rain when it does fall.

Many cacti have stems which are able to expand to store water and to fold in when the amount of stored water is low. Also, many cacti have lost their leaves and others have adapted their stomata (the tiny leaf pores through which a leaf breathes) to minimize water loss. Other cacti have modified their leaves into spines which reduce water loss and protect the plant from animal attack; some “hairy” spines also help protect the plant from heat and cold. (In plants where the leaves have been severely modified or are nonexistent, the green stems are capable of producing food for the plant.)

Desert plants also produce seeds which are able to lie dormant for years, awaiting a rainfall adequate to allow them to germinate and grow.

Alpine plants which grow at **high altitudes** must be able to withstand low temperatures, heavy snow packs, thin soil and punishing winds. Plants which live under these conditions are generally short and compact, often living in spreading colonies. As the number of days between snow melt and snowfall is limited, life cycles are short. Mountain meadows seem to burst into bloom soon after the snow melts! The brightly coloured flowers then invite pollination.

The leaves (and even stems) of some alpine plants are covered with fine hairs with act as insulation. As well, leaves are often small, reducing the loss of heat and water.

Materials Geography books of Alberta

Focus **How do plants survive under different growing conditions?**

Explore/Investigate

1. Review the major ecological regions of Alberta and the type of climate found in each.

2. Ask questions similar to:
   Can we find plants in each of these regions? Students may share experiences they have had with plants in any of these locations.
   Would the same types of plants grow in each of these regions?

3. Explain that each group will design a plant capable of surviving in either the desert or on a high mountain. They will draw and describe the roots, stem, leaves and flowers of their plant and tell why they have chosen each of these. [You may need to stress that their designed plants are to resemble real plants. Imagination is fine – **if** limited to what is possible in the plant kingdom.]

4. You may wish to give them an example.
   Challenge: Invent a plant that can live in a boggy area where the soil contains very few of the nutrients required by plants.

   Solution: Carnivorous plants supplement their diet with insects. Their leaves have evolved to trap insects which are then dissolved in the plants‟ digestive juices.

Interpret

1. The students will share their plant designs with the class. Comparing their solutions, discuss which plants might be more successful at surviving in the designated environment.

2. The drawing can be added to the classroom Plant Activities notebook if this activity has been undertaken.

3. **Logbook:** Have the students describe and draw a plant that can compete with other plants for sunlight.

Connections

to language arts

The students write a story about the life, or a day in the life, of their invented plant.

Assessment

Note the following:

1. The student‟s contributions to the group while they are designing their plant.

2. The student‟s ability to explain and rationalize the plant form and function invented by the group.

3. The student‟s ability to design a plant which can compete for light. Imagination is to encouraged, but within the demands of the task.

REVIEW AND POST-ASSESSMENT

Overview In this lesson, the students will review what they have learned about plants and answer questions similar to those they attempted to answer in the pre-assessment exercise.

Concepts The parts of plants have functions that help the plant to grow and thrive.

Plants have essential requirements that need to be satisfied in order for them to grow and thrive.

A complete sequence of growth stages from seed to new seed is called a life cycle.

Skills Communicating

Background

This lesson has been designed to fulfill Specific Learner Expectation 10: "Students will be able to describe the care and growth of a plant that students have nurtured, in particular:
- Identify the light, temperature, water and growing medium requirements of the plant.
- Identify the life stages of the plant.
- Identify the reproductive structures of the plant."

It also functions to assess the student"s ability to take the information they have learned during the plant unit and apply it to a specific plant with which they are acquainted.

Materials Log books
Plants (optional)

Focus **How do the parts of a plant help it to grow and be healthy?**
What conditions did one of your plants need to grow well?
What stages did it go through in its growth?

Explore/Investigate

Completed in previous lessons.

Interpret

1. Explain to the students that the plant study will finish with a Grand Finale Plant Share and Tell when they will be able to share what they have learned about plants with their families and other guests they may wish to invite.

2. Ask the students for their ideas to the question, **What have we learned about plants?**
   (Record these on chart paper and save for next lesson.)

3. In their **log books**, ask them to answer the following questions in as much detail as possible.
   This will show them, their parents and you how much they have learned since trying to answer the same questions at the start of the plant study.

- **Name, draw and label the parts of one of the plants that has been grown in the class during the plant study.**
  (They may wish to have an example of this plant in front of them. Emphasize that they should also draw those parts that cannot be seen, but that they know about.)

- **How does each of these parts help the plant to grow and be healthy?**
  (Urge students to describe the functions in as much detail as possible.)

- **What conditions were necessary for your plant to grow and be healthy?**
- **Describe how you know these conditions are necessary.**

- **Draw pictures showing the life stages of a plant we have talked about.** (They may need to infer the final stages if their own plants are not fully grown.)

- **How are plants important to humans?**

- **How are plants important to the environment?**

Assessment

Note the following:

1. The student‟s contributions to the discussion on what they have learned about plants.

2. The student‟s ability to successfully answer the questions.

3. The student‟s ability to make reasonable inferences or predictions if he or she is unsure of an answer.

PREPARING FOR THE GRAND FINALE
PLANT SHARE AND TELL

Overview

In this lesson the students will draw on their review of what they have learned about plants to plan how they will share this knowledge at the Grand Finale Plant Share and Tell for the students‟ families and other invited guests.

Concepts Those investigated during the plant study

Skills Communicating

Background

A Grande Finale Plant Share and Tell to which the students‟ families and other guests are invited is the culminating activity in this unit. The preparation for this sharing provides an opportunity for the students to review and reflect on their learning about plants and to plan how they can share their knowledge, experiences and insights with others.

Materials Student log books
Students may have requests for materials after they have decided how they wish to share their learning.

Focus **What have we learned about plants?**
How can we share this learning?

Explore/Investigate

Completed

Interpret

1. Referring to the review chart from the previous lesson, discuss how this plant information can be shared at the Grand Finale Plant Share and Tell. Will groups present? And/or individuals?

2. This decided, select the topics to be shared and designate who is responsible for sharing that topic.
   (It is preferable to have a variety of topics presented.)

3. Students may choose to share their information in a variety of ways. They may wish to draw and present a poster, do a skit, prepare a report, demonstrate a technique, etc. Variety should be encouraged. If students have written narrative or poems about plants during the unit, examples of these could also be shared. You may wish to suggest a **time limitation** for each presentation.

4. Students prepare their presentations.
   (**Note:** Misconceptions still help by students can be discussed and challenged at this time.)

5. **Log books:** Final entry – What is the most interesting idea you learned during the plant study?

REFRESHMENTS?	You may wish to discuss the possibility of serving refreshments. Oatmeal cookies could be baked. A fruit salad might be prepared or raw vegetables and dip.

Connections

to art Write and illustrate invitations to the Grand Finale Plant Share and Tell.

Assessment

Note the following:

1. The student"s contributions to planning the Grand Finale presentations.

2. The student"s preparation for an individual or group presentation.

3. The student"s log book answer. Is it thoughtful? Does it demonstrate an interest in plants? Does it illustrate a growth in understanding plant-related concepts?

GRAND FINALE
PLANT SHARE AND TELL

Overview In this lesson, the students will share their learning about plants with their families and other guests.

Concepts Those decided on during the previous lesson

Skills Communicating

Materials Any designated during the previous lesson

Preparation

1. Prepare or have the refreshments prepared.

2. Organize the order of presentations.

3. Have the students place their log books on their desks for parents to read. Display other plant-related materials, as well.

Share and celebrate student learning about plants!

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APPENDIX A
Plant Propagation

By Katie Benschop, owner
Blooming Prairie
Edmonton

A. INTRODUCTION

Plant cells, unlike animal cells, are **totipotent.** This means that any single cell has the potential to develop into a whole plant, "totally potent". Every cell, both in the animal and plant worlds, carries the DNA for the entire organism. Only in plants, however, can you entice a single cell to reproduce more cells, and to grow into a new plant.

Plant propagators use this ability of plants to **clone** or produce genetically identical plants from a single cell, tissue, or organ of a parent plant. The larger the starting piece, the easier the growth of new progeny. For instance, to grow a new plant from a single cell requires specialized media and growing conditions, lots of skill, patience, and luck. To grow a plant from a completely formed cutting with stem, leaves, and tissues, missing only the roots, is as easy as putting it in a glass of water.

We will discuss the methods involved in cell culture and rooted cuttings, for the novice and the experienced grower.

To understand the terminology and the theories to be discussed, you will need to understand basic plant anatomy. Following is a diagram illustrating the important structures in whole plants.

B. THE SIMPLEST METHOD – A GLASS OF WATER

Many plants can be started from cuttings placed just in a glass of water. Starting at the tip, count down the stem at least four **nodes**. Cut the stem between the fourth and fifth nodes. Remove leaves from the bottom two nodes and place the cutting in water.

Use clean water in a clean container. Clear glass is best so you can see what"s happening inside. You can add a teaspoon of aquarium charcoal to the jar if you want. This will absorb some of the toxins and impurities in the water. Change the water regularly if it becomes cloudy or discolored.

The cloudiness is caused by bacteria and fungi growing in the water, living on the decaying plant cells. To help control this problem you can wash the glass, and the whole cutting with soapy water (dish detergent works best), removing any squashy bits, and replace the cutting in clean water.

The discoloration of the water is caused by secretions of the plant itself. These are produced to help the plant fight off attacks from bacteria and fungi, but the compounds can build up in the water and harm the plant eventually.

Place the cuttings to be rooted in a sunny window. You do not need to worry about stress caused by a lack of water, since the cutting can take up all the water it wants. You need to encourage the healthy growth and development of the top shoots and leaves.

The cells and tissues in this top region, will produce a plant growth regulator, **Indole Acetic Acid (IAA**) which travels down the stem until it gets to the cut end where it accumulates. When it reaches a certain concentration, it will induce the formation of roots. On a normal, rooted plant, the IAA acts to promote the healthy growth of new roots. Commercial rooting powder from the garden center, contains IAA in low concentration. You dip the cutting into the rooting powder, and the IAA in the powder is absorbed into the plant and begins the process of root development. This is just a way to accelerate the process, or to get roots on difficult to handle plants.

Try just stem cuttings in water for the following plants: pothos, coleus, mint, anything with a square stem, vines, geraniums, impatiens, tropical plants, spider plants, grape ivy, pussy willows.

Once the plant has rooted you can plant it in soil in a pot. Some plants will survive indefinitely in water. This is a simple form of **hydroponics**. Be sure to give the plant a weak solution of fertilizer once in a while, as there are no nutrients in the water.

C. STEM CUTTINGS

Most people are familiar with the methods for taking stem cuttings from plants like geraniums to produce many new plants from one „mother plant". These new plants are genetically identical to the parent, they are clones.

On many species of plants, the new roots will form **adventitiously** from the node. This means that the roots will develop in an adventurous way, out from a node on a stem. Some plants are so good at producing roots, that new roots will also grow in the **internode** section of the stem, not at a node at all.

Make the Cut. To improve the success of rooting, stems for propagating should be cut between the nodes, leaving a short stub of internode only. The roots will usually form at the node, and the bottom piece of internode tissue may be attacked by **pathogenic** fungi and bacteria. If the internodal section below the node is long enough, the root formation will be unaffected by the deterioration of the cut end of the stem.

If the internodal section is too short, if the cut is made too close to the node, the root development can be hindered by the damage to the internodal stem section. Do not cut the sections at the nodes.

Remove the leaves from the bottom two nodes, so they won't be buried in the rooting medium. Cut these off cleanly without damaging the stem. The cutting should have at least 2-4 nodes with leaves intact, two more at the bottom, with no leaves, and a short piece of internode below the lowest node. It is not necessary for all the cuttings to have **terminal** buds. You can cut a long stem into several sections, from top to bottom, as long as each section has enough buds and nodes to produce leaves, shoots and roots.

Some plants will produce adventitious roots along the internodal section. This is common when growth regulators are applied and absorbed into this section of the stem. Some plant species are quick to root, and unspecialized as to which part of the stem will produce roots, although more roots are usually produced at the nodes.

Growth Regulators. The production of roots is controlled by the movement of plant growth regulators within the plant. The leafy shoots and leaves at the top of the plant produce indole acetic acid and other similarly active compounds which travel to the base of the stem. They act on cells at the bottom of the plant to stimulate root growth in whole plants, and in cuttings. Therefore, it is important to have cuttings with healthy leaves and shoots at the top end as well.

Environment. Rooting can be stimulated by providing a moist environment for the plant, reducing stress on the water **transpiration** and absorption system in the plant, and by providing an hospitable soil environment for the growth and development of roots. The soil moisture should be fine and soft, moist, and easy for new, young roots and root hairs to penetrate. Keep the cuttings in slightly moist soil, and cover with a plastic bag to help to provide the correct environment. This will reduce the rate of transpiration of water from the leaves, and thus reduce the water stress on the unrooted cutting.

Soil. Use a good grade soilless mix containing peat moss, vermiculite or perlite and some sand if available. For the very early stages, you can use straight perlite or vermiculite to root cuttings. Do not incorporate any garden or black soil into your rooting media as this will introduce soil pathogens and weed seeds. Once the cutting has rooted and has re-established its defense mechanisms, it can go into a soil mix which includes black soil. The potting mix you buy at the hardware store is usually to heavy and

contains too much black soil to use for propagating. Usually, these mixes are even too heavy for normal use. Try mixing it with half peat moss to make it lighter for potting up your full grown, rooted plants.
Pathogens – Bacteria and Fungi. If the environment is too moist, however, you will increase the growth of pathogenic bacteria and fungi, so the soil should be allowed to dry out between waterings, and cuttings should be monitored regularly for signs of fungal damage. As the plant develops roots, you can cut small holes in the plastic bag, or leave it open slightly at the bottom, and gradually remove the plastic altogether.

You can use ***Equisetum***, horsetails, as natural fungicides. Just mix dried, or fresh horsetails in water, allow to sit overnight, and pour this „tea" on the plants as a soil drench at weekly intervals, when watering. You can also mix dried, broken horsetail stem pieces into your soil mix when potting the cuttings.

D. SPECIAL PLANTS
There are some plants that will produce new plants in unusual ways. Many members of the cactus and succulent families of plants, desert plants, are very easy to propagate from stem cuttings, petioles, leaf sections, even small stem sections. These plants are from a harsh, dry environment, so they are programmed to take every advantage to develop a new plant.

Try taking any piece of a **jade plant**, a whole stem section, a leaf with a petiole, a whole leaf without a petiole, even a half of a leaf. Let the cut pieces dry out overnight; this will allow a callus layer to form over the cut ends. This reduces the possibility of infection and also gives a good start to root formation. Lay the pieces on a pot filled with a mix of peat moss and sand (desert plants like sand). You could cover the pot in a plastic bag, but this is not necessary if the pieces are buried a bit in the soil. Water well and put in a sunny window. Allow the soil to dry out before watering again so you don't have fungus problems. New roots should form in about two weeks.

This method will work with many succulent and cactus plants.

Begonias will grow roots from the veins in the leaves. Cut a large healthy leaf and make small cuts or breaks in the major leaf veins, one cut for each main vein. Lay the leaf right side up on a peat moss and sand mix. Make sure there is good contact between the leaf and the soil. You can put small pebbles on top of the leaf to weight it down, or pin it in place with toothpicks or wires. Cover the whole thing well in a plastic bag and put in a sunny window (not too sunny, or the plant will get steamed in the bag). Roots will form at the break sites on the veins. Then the roots will send up small new shoots. When these are large enough, you can cut them away from the main leaf and repot them in their own pots.

Spider plants and other plants like strawberries send out small plantlets on runners. These runners are actually modified stems, and the plantlets come fully equipped with roots already. This type of plant is very easy to start. You can just cut off the small plants, repot them in their own pot and stand back, To give them a head start, you can leave them attached to the parent plant for a while until the baby is well established in its new home. You can also put the babies in a glass of water until they get more roots before planting in soil.

Lots of plants grow multiple shoots up from the same root. It is very easy to split the plant into many small ones, each with a root and a shoot and repot the small plants separately in their own pots. This is called **division** and is a common method for plant propagation. Try this on anything that has a bushy bunch of shoots coming out of the crown.

E. FROM A SINGLE CELL

In a clean laboratory, you can take small pieces of the plant, wash them, and reduce them down to just a few **cells**. If you put these cells in a good growing environment, they will divide from one cell into 2 and 2 into 4 until there is a large mass of cells. With further manipulations, you can get a whole plant to grow from a few starting cells.

The **culture** conditions have to be just right to get the original cells to begin to divide. You must feed them appropriate nutrients, including nitrogen, phosphorus and potassium, minor or trace elements and some **growth regulators**. You also have to include some **antibiotics** to keep bacteria and fungi from growing. You can use the same nutrients to make a liquid or a solid **media** for the cells to grow in.

The first single cell culture media is often a liquid, so it needs to be shaken regularly to keep the culture aerated and the cells from all falling to the bottom. The growing cells need light and heat too, just like a normal plant.

Over several weeks the clumps of growing cells get larger and larger. You can move two or three small clumps, smaller than a pea, into a **petri plate** filled with solid media, made with a gelling agent. This media will contain a carefully controlled amount of a specific plant growth regulator, designed to induce the cells to form shoots and leaves, and not just more cells. Once the little plants have a few leaves, they will begin to produce their own IAA (Indole Acetic Acid) which will travel to the base of the plantlet, and accumulate there to induce root formation.

During this stage of development, the small plants are increasing in height, and may be getting too big for the petri plate. They are transplanted into large jars containing the same growing media and allowed to develop into larger plants. Once they are strong enough, they can be transplanted out into pots with regular soil and put in the window or outside.

The original cells that you started with are meanwhile still swirling away in the light and they are still dividing and making even more new cells. You can continue to take new pieces out of this culture, place them on solid media, and induce them to produce new plants. You can get thousands of plants from the single cell you started with, and they will all be genetically the same; they will be clones.

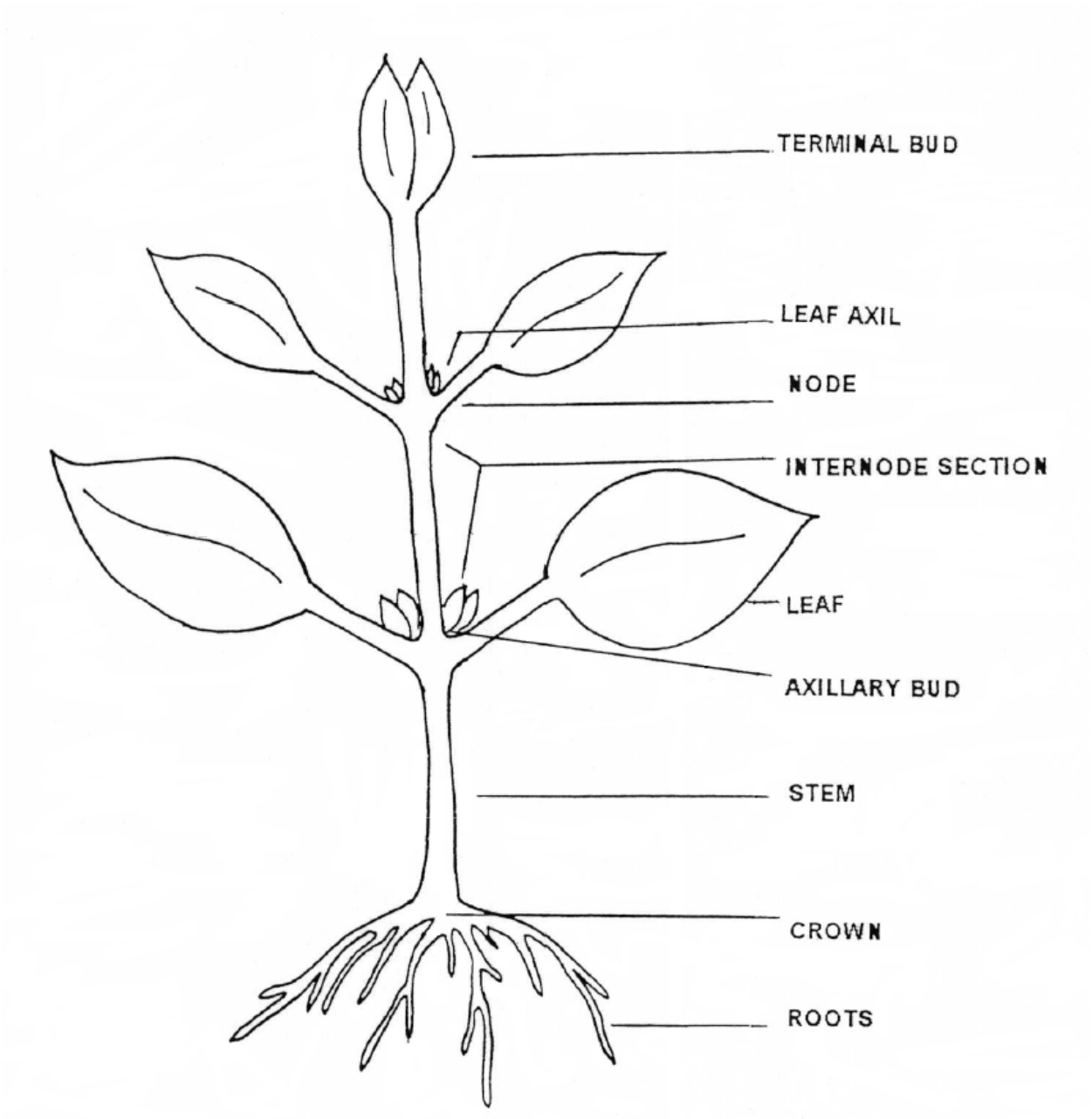
F. THE MAGIC TRICK

The key to all these types of plant propagation is the „decision" by the plant cells to organize themselves into shoots and roots, or to stay as **undifferentiated cells**. These undifferentiated cells can continue to multiply indefinitely, and can form large cell masses in culture, and on the living plants. They are known as **callus cells**, the same as when you have a callus on your heel, from shoes that rub. These are also undifferentiated cells, laid down to protect your heel from the chafing shoe. On a plant, callus cells will form at a wound site.

In plants the callus cells and callus tissue (a group of cells) form at the base of the stem cutting, in the wound in the begonia leaf, on the cut edges of the jade plant cuttings and leaves, and in the cell cultures. The change from undifferentiated callus cells to organized shoot and root tissues is mediated by the levels of various growth regulators in the plant. In cell culture we had to add these growth regulators externally in the media. In plants with leaves or roots, the growth regulators are produced by the plant and transported to the site of action.

The roots produce **cytokinins** which travel to the top of the cell mass, or stem, and induce the development of shoots and leaves. The leaves produce **auxins** like IAA which travel down the stem to collect at the base and induce root formation. The balance of these two and other growth regulators control the even growth and development of the plant.

PLANT DIAGRAM



APPENDIX B
PLANS FOR A LIGHT TABLE

MATERIALS:

1. Plywood, minimum thickness 15mm (5/8 inch).
   1-4 ft x 4 ft piece (one half of an 8x4 ft sheet) **or 2**-4 ft x 2 ft pieces

2. **5** fir or pine 2 x 4s – 2" x 4" x 8' (2 inches by 4 inches by 8 feet)

3. Any chain-hanging fluorescent light fixture for two 4 foot fluorescent bulbs. The prototype was built with a Liteway, cat # 91-2418RLE purchased at Revy.

4. **24 –** Three inch drywall screws
   24 – Three inch deck screws
   12 – Two inch drywall screws
   2 – One inch brass screws for hanging light

5. Carpenter's glue, sand paper for belt sander (optional).

EPQUIPMENT:

Circular saw, tape measure, screw driver (power drill driver is handy), drill and bits, belt sander (optional), clamps.

CONSTRUCTION STEPS:

A. ***Sawing***

1. Cut the plywood into two 24" x 48" pieces (You can probably buy them this way.)
   Trim one piece to 43 inches.

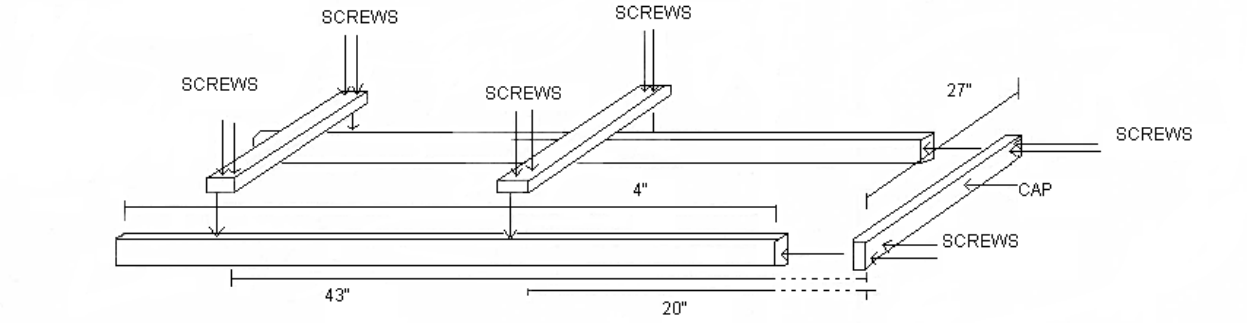
2. Cut two of the 8ft 2x4s in two. (We need four 4 ft boards).

3. Cut six 27" pieces from two of the 8ft 2x4's.

4. Cut four 24" pieces from an 8ft 2x4.

B. ***Building the ends***

Diagram #1

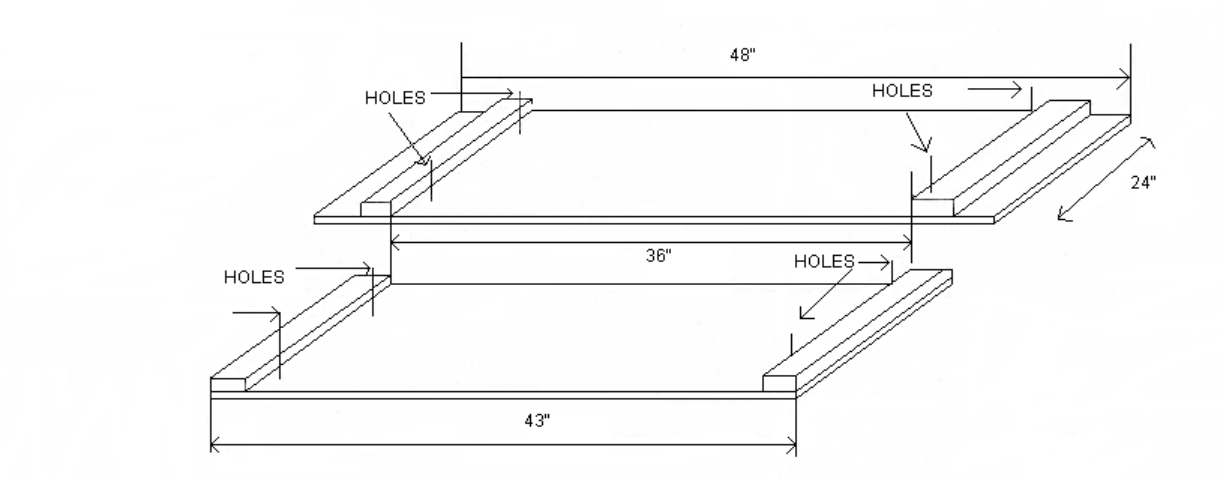


1. Lay two 4' 2x4s on their narrow side on the floor parallel to each other and 24" apart (see diagram #1).
2. Pre-drill two holes at each end of the 27" 2x4s through the narrow thickness of the boards about ¾" from the ends. The holes are for the screws that will hold the end pieces together (see diagram #1). Match drill bit size to the diameter of the screw being used.

3. Smear carpenter‟s glue onto the upper end of two of the four 2x4s, fit one of the pre-drilled 27” 2x4s (narrow side down, just like the 4 foot pieces) flush onto the glue covered ends, clamp so that everything is at right angles and screw the boards together with 3” drywall screws (see diagram #1).
   You should now have two parallel 4‟ 2x4s tied together on their ends with a 27” cap 2x4.
4. Attach the second 27” 2x4 on the up-facing side of the capped end pieces as shown in diagram #1 so that the top of the 27” board is 20” down from the top of the cap. Attach the third 27” 2x4 in the same way, only 43” from the top of the cap. The boards are attached by smearing glue on the ends that will face each other, aligning them to the exact dimensions, making sure they are at right angles, clamping them and screwing them tight with 3” drywall screws.

   You now should have a finished end piece made up of two 4ft and three 27” 2x4s. Repeat above steps to make up the second end piece.

Building the shelves
Diagram #2



1. Attach two 24” 2x4s to the same side of the 43” piece of plywood so that they exactly fit to the ends (flush at sides and ends, see diagram #2). The insides of the 2x4s should be exactly 36” apart. The boards are attached by smearing glue onto the surfaces facing each other, aligning them to the exact dimensions, clamping them and screwing them tight with 2” drywall screws (three per board).

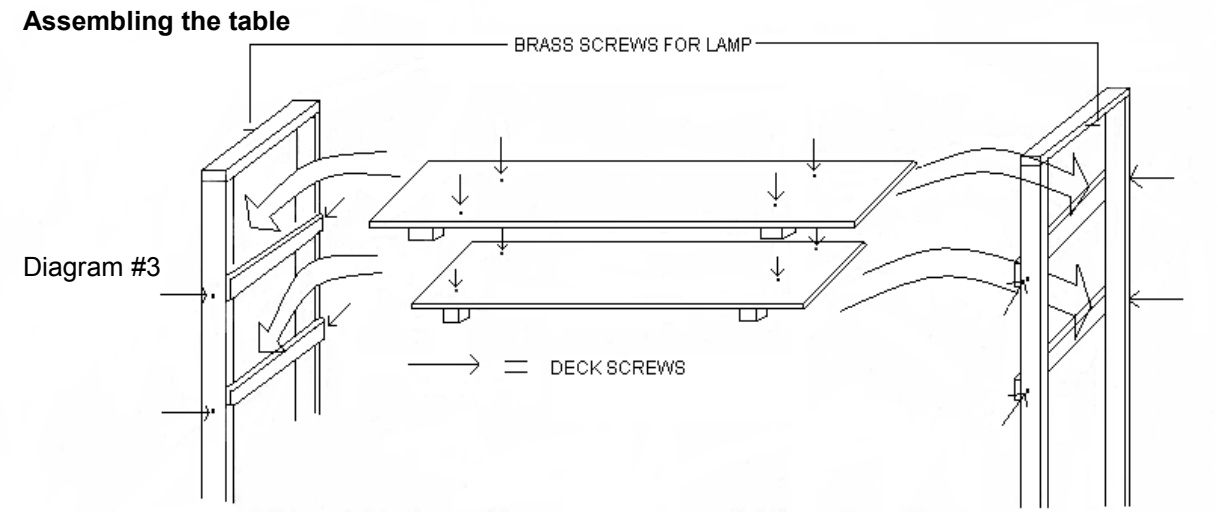
2. Attach two 24” 2x4s to the same side of the 48” piece of plywood so that they are flush at the sides and the *inside* of each 2x4 is about 6 1/8” from the end of the plywood (see diagram #2). The *important dimension* is that the insides of the 2x4s should be *exactly 36” apart*. The boards are attached in the same way as described above.

   You now should have two shelves that have two 2x4s attached near or at their ends. It is important that the 2x4s should be exactly the same distance (36”) apart on both shelves.

3. Drill two holes through each end of the plywood shelves ¾” inside the attached 2x4s and about 6” from the sides (4 holes per shelf, see diagram #2). These holes are for the deck screws to be used for assembling the table.

Assembling the table

Diagram #3



1. It is useful at this point to have either a small swarm of children for assistance or four hands. Also make sure that the shelves (which should be about 24" wide) easily fit between the upright 2x4s of the end pieces (which should be 24" apart). If not, trim a bit to fit.

2. Stand the end pieces upright on an even floor so that the attached side pieces face each other (see diagram #3). Have the children hold the end pieces up while you fit the 43" shelf to the bottom cross pieces. The 2x4s on the bottom of the shelf should fit on the outside of the cross pieces (see diagram). Make sure that the shelf is at right angles to the end pieces and drill guide holes through the 4 pre-drilled holes into the supporting cross pieces. Before the children get tired of holding things together, screw the shelf on with 3" deck screws.

3. Repeat the above procedure (children and all) with the top shelf. Make sure everything is at right angles.

4. Keeping everything straight, drill guide holes through the side of the end pieces into the 2x4s attached to the bottom of the shelves (see diagram #3). There will be 4 of these for each shelf and they help keep the table braced. Screw in the 3" deck screws.

5. (Optional) Use a belt sander to smooth down the splinters and round the edges.
   You now have the table put together. If it is wiggly, go around and tighten a few screws. Don't tighten so much that you strip the wood.

Hanging the lamp fixture

1. The fluorescent light fixture hangs from chains that loop onto small screws set into the center of the outer side of the cross piece cap (see diagram #3). The screw head should be small enough to allow the chain loops to be easily taken on and off for adjusting lamp height, but large enough to keep them from falling off when children bump into the lamp. If two lamps are hung, space the hanging screws accordingly.

2. Put in the lamp bulbs, adjust the height, plug in the lamp and start growing plants (see note on page 16 for instructions on types of bulbs and the height of the fixture above the plants).

3. The table can be easily broken down into two end pieces, two shelves and the lamp fixture for storage by:
   a. Detaching the lamp chains (be careful not to drop the lamp).
   b. Removing the deck screws holding the shelves on (4 on the top of each shelf and 4 on the side – see steps 2, 3 and 4 in table assembly).

APPENDIX C

BLACKLINE MASTERS

ACTIVITY CARD

Seeds and Plants

1. Describe two ways these plants are all alike.

2. Describe two ways these plants are different from each other.

3. Which plant do you think grew from which type of seed?

   I think Plant A grew from seed _____ because _____

   I think Plant B grew from seed _____ because _____

   I think Plant C grew from seed _____ because _____

4. How are the seeds alike? How are they different?

ACTIVITY CARD

Books

You have been chosen to participate in the "Young Scientist Book Choice" awards. You are to review two of these books and nominate one as **Best Book** in the Plant category.

Which one would you nominate? Think about –

a) Which book is the most interesting to read?

b) Which book has the most interesting activities?

c) Which book would you recommend to others and why?

Write the title of your nominee in your log book and give the reasons why you chose it.

ACTIVITY CARD

Salad Sprouts

GROW YOUR OWN SALAD SPROUTS

WHAT YOU NEED:

1 small spoonful of alfalfa seeds
1 dish
1 cotton ball
Water
1 small plastic bag

WHAT TO DO:

1. Label your dish with your group name.
2. Place the cotton ball in the dish.
3. Drip water on the cotton ball until it is damp, but not wet.
4. Sprinkle the seeds evenly over the cotton ball.
5. Put the dish into the plastic bag and store in a safe location.
6. Check the dish every day. Keep the cotton ball damp.
7. Watch what happens!

ACTIVITY CARD

Growing Conditions

1. Choose a seed package for a plant you would like to grow.

2. Using the information on the package and in the gardening catalogues, write a description of where in a garden you would plan the seeds and what you need to do to help them grow.

3. Why did you choose this plant?

ACTIVITY CARD

Breakfast Cereals

Make a list of the grains found in these breakfast cereals.

(Suggestion – read the small print.)

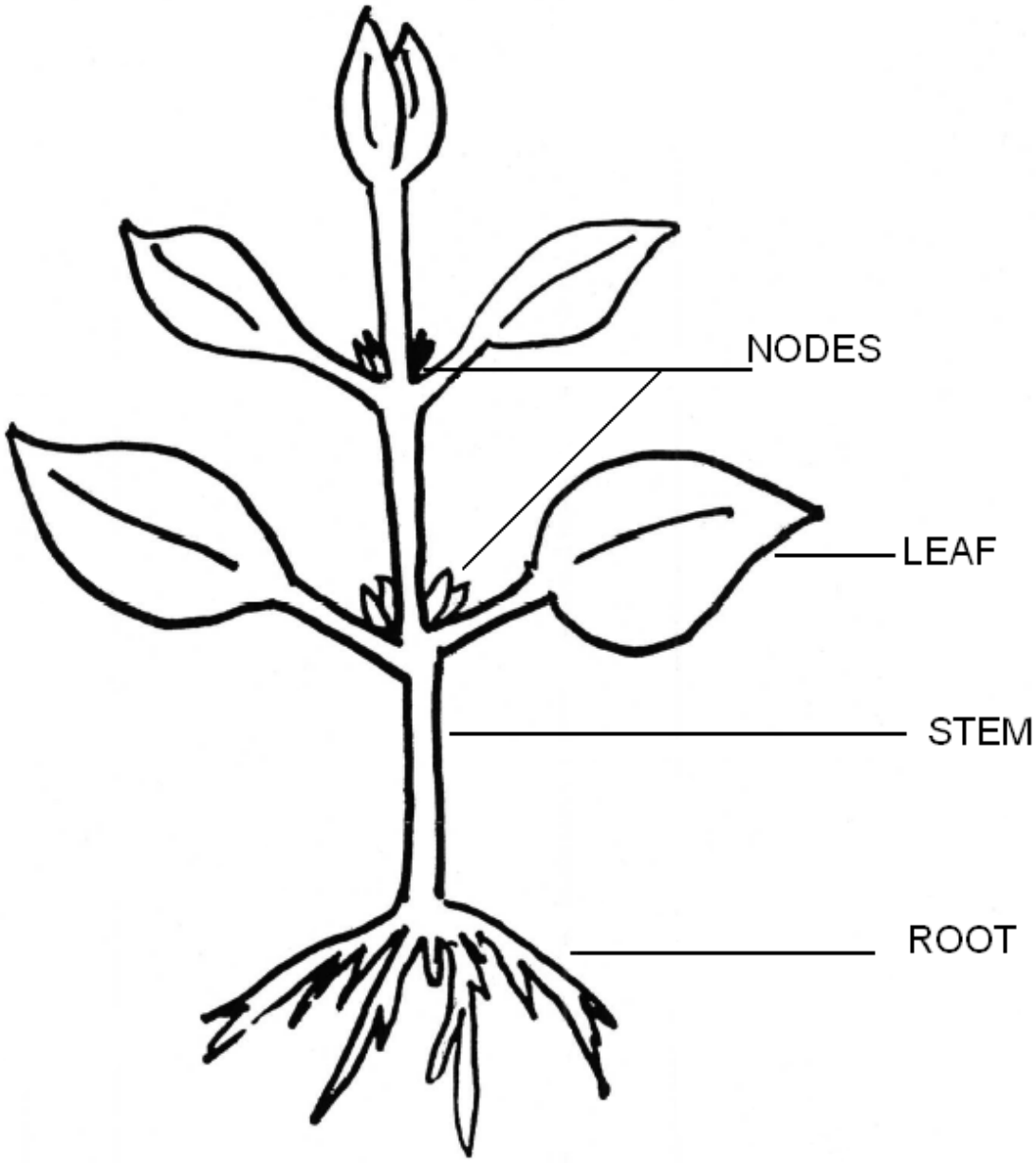
ACTIVITY CARD

Granola

3 cups	rolled oats
1/3 cup	firmly packed brown sugar
1/2 cup	canola oil
1 cup	dried apples, chopped
1 cup	raisins
1/2 cup	walnuts
1/3 cup	sunflower seeds
2 tbsp.	sesame seeds

Make a list of each ingredient and tell where it comes from.
[An examples is: rolled oats – oat plant]

PLANT DIAGRAM



BREAD – Brought to you by…

THE FARMER

I am the **farmer**. I plant wheat to make money for my family and to feed people all around the world.

or

We are the **farmers**. We plant wheat to make money for our families and to feed people all around the world.

WE ARE THE SCIENTISTS
AT WORK IN OUR LABS

I am a **plant geneticist.** I study how characteristics are passed from one generation of plants to the next one and how to change particular characteristics to produce better crops.

I am a **chemist.** I study substances and how they combine with other substances. We can use this information to make better fertilizers, herbicides and pesticides.

I am an **entomologist.** I study insects so we can learn how to control insects harmful to crops.

I am a **soil scientist.** I study soil and how to use it to produce good crops.

I am an **agricultural engineer.** I design better machines for cultivating fields and seeding, harvesting and storing crops.

WE ARE THE FARM TOWN BUSINESS PEOPLE
HERE TO HELP THE FARMER SUCCEED WITH HIS CROP

I am a **banker**. I loan the farmers money so they can buy their seeds, fertilizer and farm equipment.

I am an **equipment dealer**. I sell and fix the farmers‟ tractors, seeders, cultivators, harvesters and other equipment.

I am a **gas and oil dealer**. I sell the gas and oil the farmers need to run their farm equipment.

I am a **seed and fertilizer dealer**. I sell the seed, fertilizer, herbicides and pesticides necessary to the farmer to produce a good crop.

WE ARE THE GRAIN ELEVATOR OPERATORS
AFTER THE CROP IS HARVESTED
WE HELP THE FARMERS TO STORE AND SELL THEIR CROPS

I am the **grain elevator manager**. I keep track of the grain the farmers bring to the elevator and take orders for the grain from the customers.

I am the **grain elevator employee**. I weight the grain and put it in the elevator when the farmer brings it to us and then load it on the trains when we ship it to the customers.

I am the **train engineer**. I deliver the grain to Canadian customers or to ships when the grain is being sent to customers across the ocean.

WE ARE THE OPERATORS AT THE MILL
CHANGING THE WHEAT KERNALS
INTO FLOUR AND WHAT PRODUCTS

I am the person who operates the machines that **clean the grain**.
I separate out the sticks and stones, metal bits and all other unwanted materials.

I am the person who operates the machines that **grind and sift** the wheat. I separate the bran from the rest of the wheat kernel and then grind and grind the wheat again.

I am the person who operates the machines that **bleach the flour** pure white and then enrich it with vitamins.

I am the person who **sacks the flour**.

I am the person in charge of **delivering the flour** to the bakers and the grocery store.

WE ARE THE BAKERS
WHO CHANGE THE FLOUR
INTO LOAVES OF BREAD

I am the **baker** who prepares the dough.

I am the **baker** who forms the dough into loaves of bread.

I am the **baker** who bakes the loaves of bread in the large, hot ovens.

I am the person who **wraps** the warm loaves of bread to keep them fresh for you.

I am the **truck driver** who delivers the fresh bread to the grocery store.

WE ARE THE GROCERS
BRINGING THE BREAD
FRESH TO YOU

I am the **grocery store manager**. I order the bread that I know my Customers want.

I am the **grocery store employee**. I carefully place the bread on the shelves for the customers to choose.

I am the **checkout clerk**. I take your money and put your bread in a bag.

AND WE ARE THE CONSUMERS
EATING BREAD AND HONEY

CROPS GROWN IN ALBERTA

WHEAT

- Wheat can grow quite well in dry weather. (It is fairly drought resistant.)
- It grows on a wide range of soil types.
- Wheat needs a longer growing period and higher temperatures than most other small grains. However, the very long summer days of northern Alberta help wheat to mature in less than the 110 frost-free days usually necessary.
- It is most suitable to southern areas, although different kinds of wheat can be grown in other regions of Alberta.
- Hard red spring wheat for bread is grown in the south-central regions.
- Durum wheat for pasta is grown only in southern Alberta.

BARLEY

- Barley has a short growing period. It can be grown in areas with at least 90 frost-free days.
- It is also an efficient user of moisture, so it can be grown where it is dry.
- Varieties of barley have been developed which allow it to grow in both hot and cool regions.

RYE

- Rye grows well on light poor soil.
- Rye grows quite well in dry weather. (It has a good drought resistance.)
- Rye is the most productive of the cereal grain crops grown under conditions of low temperature, low fertility and drought.
- It‟s root system helps prevent erosion.
- Most of the rye planted in Alberta is fall rye. It is planted in the fall and can be used as pasture or harvested the following summer.
- There is a limited market for rye and the price the farmer receives is often low.
- Rye is also attacked by *ergot*, a disease that is poisonous to humans and animals.

OATS

- Oats can be grown on many kinds of soil
- Oats require more moisture than other small grains.
- Heat can damage oats. Thus, oats grow best in the cooler, moister areas of west-central, north-central and parts of the Peace River region.

CANOLA

- Canola grows on most soil types in Alberta.
- It requires good moisture in the soil.
- Two types of canola are grown in Alberta. One produces bigger crops, but has a longer growing period (about the same as wheat).
- Canola is attacked by many diseases and pests. To help control these, it should not be grown in the same field more than one year out of every four years.
- Canola is grown throughout Alberta.

SPECIAL CROPS AND VEGETABLES

- Southern Alberta receives more heat than the rest of the province. This allows crops to be grown which require higher temperatures. These crops include sugar beets, sunflowers and corn.
- North central Alberta and the Peace River region are good for crops which require cooler, wetter growing conditions. Potatoes grow well in the cooler, black soil are of central Alberta. Carrots and cabbages are grown in both regions.

CROPS GROWN ONLY FOR ANIMAL FOOD
(FORAGE CROPS)

- Forage crops include grasses and plants known as legumes. Legumes have a thick root which can grow deep into the soil to reach moisture. Legumes also help make the soil more fertile by adding nitrogen to the soil. Nitrogen is a nutrient important to plants.
- Grasses have roots which spread out and help hold the soil in place. This helps decrease soil erosion by wind and water.
- Many grasses can live where it is cold.
- These forage crops can be grown on less fertile soil. This allows these crops to be grown in the foothills where growing conditions make it difficult to raise many crops.

Dear Farmer Central,

Congratulations on your purchase of a farm near St. Albert! To be a successful farmer there is some information about your area that you should know.

- There is a yearly average of 450 mm. of precipitation (rain and snow) near St. Albert.

- There is an average of 100 to 120 frost-free days a year in your area.

- Summer days are mild to warm.

- The soil is black and fertile.

We have also enclosed information about the major crops grown in Alberta.

If you have any more questions, please write to us.

Sincerely,

Al Agri

Dear Farmer West,

Congratulations on your purchase of a farm near Rocky Mountain House! To be a successful farmer there is some information about your area that you should know.

- There is a yearly average of 600mm. of precipitation (rain and snow) near Rocky Mountain House.

- There is an average of 80 or fewer frost-free days a year in your area.

- Summer days are cool.

- The soil is of rather low fertility.

We have also enclosed information about the major crops grown in Alberta.

If you have any more questions, please write to us.

Sincerely,

Dear Farmer North,

Congratulations on your purchase of a farm near Peace River! To be a successful farmer there is some information about your area that you should know.

- There is a yearly average of 350mm. of precipitation (rain and snow) near Peace River.

- There is an average of 80 to 100 frost-free days a year in your area.

- Summer days are long and temperature is mild.

- The soil is of medium fertility.

We have also enclosed information about the major crops grown in Alberta.

If you have any more questions, please write to us.

Sincerely,

Dear Farmer South,

Congratulations on your purchase of a farm near Medicine Hat! To be a successful farmer there is some information about your area that you should know.

- There is a yearly average of 300mm. of precipitation (rain and snow) near Medicine Hat.

- There is an average of 120 or more frost-free days a year in your area.

- Summer days are warm to hot.

- The soil is of medium fertility.

We have also enclosed information about the major crops grown in Alberta.

If you have any more questions, please write to us.

Sincerely,

Al Agri

PLANT LIFE CYCLE