

# Let's Do Science

Grade Four

## Plant Growth and Changes



4

Plant Growth  
and Changes

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# Plant Growth and Changes Before You Begin

## Background Information

Plant Growth and Changes builds on two grade 1 units: Seasonal Changes and Needs of Plants and Animals. It also leads into two later topics: Wetland Ecosystem (grade 5) and Trees and Forests (grade 6). In this unit, students learn about the structure and growth of plants. By raising plants in the classroom and exploring plant growth in their community, students develop an understanding of the form and function of primary plant parts and the environmental conditions requisite to plant growth. They also learn several means of plant propagation.

### Topic E: Plant Growth and Changes

(Suggested time: 8-10 weeks)

This topic is best done in late spring to take advantage of the lengthening spring days, which support abundant plant growth both outside and on windowsills indoors.

*Botany* is the study of plant structure, plant physiology, the geographic distribution of plants and plant classification. Botanists investigate the various shapes, colours and spatial relationships of the structural components of plants: roots, stems, leaves and flowers. They explore the function (physiology) of each plant part: *roots* absorb water and nutrients, *stems* transport these nutrients to growth sites, *leaves* change the energy of sunlight into stored food reserves and *flowers* act as reproductive organs, ensuring the production of seeds and the propagation of new plants. Botanists also note where plant species will and will not grow.

Each species has evolved in response to specific environmental parameters: temperature, humidity, availability of water and sunlight, local soil nutrient make-up, room for growth. It is difficult, if not impossible, for a plant to grow successfully if even one of its specific requirements is not met. Excellent examples of plant communities that thrive under well-defined growth conditions can be found across Alberta. In the Rocky Mountains three distinct growth zones can be discerned: the Alpine zone above the timberline where rain promotes wild flower growth, but summer mean temperatures of only 10°C make it too cold for tree growth; the somewhat warmer Sub-Alpine Forest Zone populated by spruce, white bark pine and Alpine fir and larch; and the considerably warmer Montane Zone of the lower altitudes (below 1,300 m), which sustains a mixture of grassland and stands of aspen poplar, spruce, Douglas fir and lodgepole pine. East of the mountains, vast expanses of dry but fertile land are covered by “mixed prairie” growth: grasslands interspersed with the odd grove of aspen and, where there is slightly more water available, shrubs. North of Edmonton water becomes more abundant and the mixed prairie gives way to continuous forest.

There are two ways botanists classify plants. The first method classifies all plants as being either *woody* or *herbaceous*. Trees, shrubs and some vines qualify as woody tissue producers. Herbaceous, non-woody plants have an enormous range of growth. A few easily located examples include dandelions, parsley and grass.

The second classification system looks at plants from the perspective of whether or not they produce seeds. Seed-bearing plants are divided into two sub-categories: those that protect their seeds (in pods, shells and the like) and those that do not. Protected seeds, or *angiosperms*, often come from plants with broad, flat leaves that are lost on a yearly basis—deciduous plants. A few examples are grasses, vegetables and maple trees. Unprotected seeds are associated with conifers—evergreen plants that, for the most part, hold on to their needle-shaped leaves year round. Exceptions are the larch and tamarack trees. The unprotected seeds of conifers are produced in cones, like you find on pine, fir and spruce trees. Non-seed-bearing plants comprise the other major category in this system. These organisms have no functional need to develop flowers or fruit; they in fact are plants that can reproduce in many other ways than through seeds. Consider the tulip *bulbs* (short underground stems), iris *rhizomes* (long underground stems growing horizontally near the ground's surface), white potato *tubers* (enlarged rhizome tips), gladiolus *corms* (like bulbs but mostly stem), raspberry *stolons* (underground stem tips) and strawberry *runners* (above ground stems) we plant in our gardens and yards. And while gardening, it's not unusual to come across poplar or aspen *suckers* (underground lateral branches) spreading new trees into undesirable areas. If fruit trees are your passion, you might have tried *grafting* (joining a twig from one tree to a tree of the same kind) or *budding* (like grafting but using a bud instead of a twig). A favorite method of propagating house plants is rooting *cuttings* or *slips* (pieces of stem with leaves attached) or planting entire leaves, as one does to obtain new African violet plants. And who hasn't impaled a sweet potato *root* on toothpicks and grown their very own spindly, purple-leafed plant in a jar of water for a science project?

We are all familiar with the nutritive importance of plants to humans and other animals, but there are several other functions plants fulfill as well. Plants from the wood-producing category mentioned earlier give us lumber, paper, methyl alcohol, turpentine and firewood. Materials made from other plants include rubber, rope, linen and cotton. Ancient deposits of plant matter transform into fossil fuels: oil, coal and natural gas. We derive medicine from plants, such as quinine, witch hazel and cherry cough syrup. We use plants for decoration, perfumes, tobacco and dyes. Plant growth helps prevent soil erosion. Other organisms find shelter and places to make homes among plants. And undoubtedly one of the most important functions plants play is their role as major producers of oxygen. Without plants, Earth's air would be unbreathable.

# Elementary Science Program of Studies

## General and Specific Learner Expectations

The following general and specific learner expectations have been taken directly from the 1996 Elementary Science Program of Studies. The specific learner expectations (SLEs) are referred to by number in the second column of the activities table.

### General Learner Expectation

Students will be able to:

Demonstrate knowledge and skills for the study, interpretation, propagation and enhancement of plant growth.

### Specific Learner Expectations

Students will be able to:

1. Describe the importance of plants to humans and their importance to the natural environment. Students who meet this expectation should be able to give examples of plants being used as a source of food or shelter, and be aware of the role plants play in the environment for example, preventing erosion, maintaining oxygen.
2. Identify and describe the general purpose of plant roots, stems, leaves and flowers.
3. Describe common plants and classify them on the basis of their characteristics and uses.
4. Recognize that plant requirements for growth—air, light, energy, water, nutrients and space—vary from plant to plant, and that other conditions, for example, temperature and humidity, may also be important to the growth of particular plants.
5. Identify examples of plants that have special needs.
6. 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.
7. Recognize that plants of the same kind have a common life cycle, and produce new plants that are similar, but not identical, to the parent plants.
8. Describe ways that various flowering plants can be propagated, including from seed, from cuttings, from bulbs and by runners.
9. Nurture a plant through one complete life cycle: from seed to seed.
10. 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

## Cross-curricular Connections

## Children's Alternative Frameworks

- identify the life stages of the plant
- identify the reproductive structures of the plant.

11. Describe different ways that seeds are distributed, for example, by wind, by animals; and recognize seed adaptations for different methods of distribution.

### Social Studies

- Learn the usefulness of plants to different cultures.

### Mathematics

- Measure and graph plant growth.

### Language Arts

- Study poetry of various kinds, for example, haiku.

Beverly Bell (1981) suggests that children often have a restricted meaning for the word *plant*. For example, many think that a tree is not a plant; that a plant is something which is cultivated, and therefore dandelions and grass are not plants but are weeds; and that carrots and cabbages are not plants but vegetables. In Bell's sample of 8-9 year olds, only 30% thought a carrot was a plant, 50% thought an oak tree was a plant, and 60% thought grass was a plant. Bell also found that many children do not think that a seed is plant material.

Roth, Smith and Anderson (1983) and Smith and Anderson (1984) suggest that children think that both seeds (don't need light) and plants (need light) in order to grow.

Wandersee (1983) and several others suggest that children think soil is the plant's food and that soil is absorbed by plant roots. Wandersee also suggests that children think rainwater goes "into" plant leaves.

Baker and Carr (1989) suggest that children regard water as essential for plants but do not relate it directly to plant growth.

## Activities

Classroom teachers have identified the following activities that address the Specific Learner Expectations (SLEs) in the Program of Studies. The list is not prescriptive and teachers may select activities that are most appropriate for their students.

Activities have been listed under two headings: Key Activities and Extension Activities. Key activities are supported by authorized resources and identify “powerful and practical” means for achieving learner expectations. Extension activities represent alternative ways of achieving or supporting learner expectations.

### Key Activities

| Key Activity  | SLE | Print Resources   | Essential Materials   | Comments   |
|---|-----|---|---|--|
| Discovering children’s ideas about plants                         |     |   | 4 large pieces of paper   | In small groups, have students brainstorm all they know about plants. Questions to guide them might be: <ul style="list-style-type: none"> <li>• give several examples of plants;</li> <li>• what do plants need to survive; and</li> <li>• why are humans dependent on plants?</li> </ul> <p>The aim is to discover students’ prior knowledge about plants.</p> |
| Identifying plants and plant products in the home and in the yard | 1   | <i>Innovations in Science, Level 1, How Does Your Garden Grow? (From Garden to Table), p. 22</i><br><i>Explorations in Science, Level 4, Branching Out (The Productive Tree), p. 22</i><br><i>Explorations in Science, Level 4, Planting Time (The Great Outdoors), p. 10</i> | clipboards, coloured or white stickers, drawing materials, magnifying lenses  | Out-of-class activity.   |
| Investigating the functions of plant roots                        | 2   | <i>Explorations in Science, Level 4, Growing Up Green (The Root of the Matter), p. 15</i><br><i>Innovations in Science, Level 4, The Plant Project (Rooting for Roots), p. 26</i>   | several types of plants with roots still attached, magnifying lenses, fast germinating seeds, plastic cups, paper towels<br><br>food colouring, roots of various plants, plastic knives, clear containers, magnifying glasses, toothpicks |  |

| Key Activity  | SLE  | Print Resources  | Essential Materials  | Comments  |
|---|------|--|--|---|
| Investigating the stem of plants                                    | 2    | <i>Explorations in Science, Level 4, Growing Up Green (The Stem Connection), p. 17</i><br><br><i>Innovations in Science, Level 4, The Plant Project (Stalks and Stems), p. 29</i>  | long-stemmed plants, scissors, magnifying lenses<br><br>celery stalks, magnifying glasses, tweezers, strong toothpicks, scissors, elastics, thread, small cups, rulers, scales, paper clips, clothespins |   |
| Discovering the characteristics of leaves of plants                 | 2    | <i>Explorations in Science, Level 4, Growing Up Green (Leaves to Light), p. 18</i><br><br><i>Innovations in Science, Level 4, The Plant Project (Leaves at Work), p. 33</i>  | growing plants with lots of leaves, magnifying lenses<br><br>onions ready to sprout, lettuce leaves, plastic bags and ties, cooler, paper towels, variety of vegetable leaves, magnifying glasses        |   |
| Discovering the beauty, structure and function of flowers           | 2    | <i>Explorations in Science, Level 4, Growing Up Green (Flower Power), p. 20</i><br><br><i>Innovations in Science, Level 4, The Plant Project (Flower Power), p. 38</i>   | flowers of different colours, sizes and type; magnifying lenses<br><br>variety of flowers, magnifying glasses  | Florists will sometimes provide old flowers that are still in good condition and are free of charge or sold at a minimal cost. Pollen from lilies will stain. |
| Observing and classifying fruits                                    | 2, 3 | <i>Explorations in Science, Level 4, Growing Up Green (Fruit or Vegetable?), p. 22</i><br><br><i>Innovations in Science, Level 4, The Plant Project (Plant Sensation), p. 8</i><br><br><i>Innovations in Science, Level 4, The Plant Project (Fruit Toss), p. 14</i> | various fruits and vegetables<br><br>various fruits, plastic knives, magnifying glasses, towels, envelope  |   |
| Looking at plants in a given area and recording the number and type | 3, 6 | <i>Explorations in Science, Level 2, In the Field (Places for Plants), p. 12</i>   | magnifying lenses  | Discuss what factors must determine the number and type of plants in an area.   |

| Key Activity   | SLE     | Print Resources  | Essential Materials   | Comments   |
|--|---------|--|---|--|
| Observing and classifying plants                                       | 3       | <i>Innovations in Science, Level 1, How Does Your Garden Grow? (Starting with Seeds)</i> , p. 5  | coniferous and deciduous trees, herbaceous and woody plants, roots, stems, leaves, seeds, fruits, magnifying lenses, chart paper, real or pictured plants | Outdoor activity.<br>Writing: “Life without Plants.”                             |
| Investigating plant growth requirements                                | 4, 10   | <i>Innovations in Science, Level 1, How Does Your Garden Grow? (Planting Takes Time)</i> , p. 8<br><br><i>Innovations in Science, Level 1, How Does Your Garden Grow? (What Makes Your Garden Grow?)</i> , p. 19<br><br><i>Explorations in Science, Level 4, Planting Time (Shine On)</i> , p. 16<br><br><i>Explorations in Science, Level 4, Growing Up Green (Leaves to Light)</i> , p. 18 | several types of plants with lots of leaves, magnifying lenses  | Can be started at the end of class.  |
| Exploring uses and misuses of fertilizers                              | 4       | <i>Explorations in Science, Level 4, Growing Up Green (Growing Faster)</i> , p. 29   | natural liquid plant fertilizer, plants   |  |
| Determining whether plants need a certain temperature in which to grow | 4       | <i>Explorations in Science, Level 4, Planting Time (Is Warm Better?)</i> , p. 17   | corn seeds, potting soil, plastic wrap, containers  |  |
| Investigating where plants grow  | 4, 5, 6 | <i>Explorations in Science, Level 4, Growing Up Green (What Grows Where)</i> , p. 32   | plant field guides, materials   |  |
| Investigating how plants adapt to flowing water                        | 5       | <i>Explorations in Science, Level 3, Discovering Adaptation (Moving Right Along)</i> , p. 16   | magnifying lenses, sketch books, stream   |  |
| Studying seed development  | 9       | <i>Explorations in Science, Level 4, Planting Time (Sprout Some Sprouts)</i> , p. 14   |   | <b>Caution:</b> Do not eat sprouts. Wash hands after touching. Salmonella alert. |

| Key Activity   | SLE      | Print Resources  | Essential Materials  | Comments   |
|--|----------|--|--|--|
| <b>Propagation by Seeds</b>  |          |  |  |  |
| Studying seed dispersal  | 11       | <p><i>Explorations in Science, Level 3, Discovering Adaptation (Packaging and Delivery)</i>, p. 25</p> <p><i>Explorations in Science, Level 3, Discovering Adaptation (A Dynasty of Dandelions)</i>, p. 26</p> <p><i>Innovations in Science, Level 4, The Plant Project Activity Cards</i> 49-58</p> | dandelions, paper cloth, ping pong balls, glue, junk materials   |  |
| <b>Vegetative Reproduction of Plants</b>   |          |  |  |  |
| Planting stem cuttings, bulbs, runners and other plant parts to see if they grow | 8        | <i>Innovations in Science, Level 4, The Plant Project (The Eyes Have It)</i> , p. 22   | fastplant or bean plant parts, geranium, begonia or rose stems, tulip or onion bulbs, strawberry runners, etc. | Children can make their own suggestions about what plant parts to try growing.   |
| Growing plants and observing plant growth  | 7, 9, 10 | <p><i>Explorations in Science, Level 4, Growing Up Green (Seeds to Start)</i>, p. 10</p> <p><i>Explorations in Science, Level 4, Growing Up Green (A Plant in Need)</i>, p. 12</p> <p><i>Innovations in Science, Level 4, The Plant Project (Looking at Seeds)</i>, p. 18</p>                        |  | Each student will care for a least one plant throughout unit (if possible). Students can check their plants and record measurements at the beginning of the day. |

## Extension Activities

| Extension Activity   | SLE | Print Resources  | Essential Materials   | Comments       |
|--|-----|--|---|----------------|
| Growing an herb garden                                       |     | <i>Explorations in Science, Level 4, Growing Up Green (Herb Gardens), p. 13</i>  | herb seeds, growing materials   |                |
| Growing plants in water (hydroponics) and in different soils | 4   | <i>Explorations in Science, Level 4, Planting Time (Soil What?), p. 15</i><br><i>Explorations in Science, Level 4, Growing Up Green (Hydroponics), p. 34</i> | seeds, liquid plant food, soils (sand, compost, loam, clay), containers or pots |                |
| Studying dandelions  |     | <i>Explorations in Science, Level 3, Discovering Adaptation (A Dynasty of Dandelions), p. 26</i>   | dandelions  | In-depth study |
| Writing a seed catalogue                                     | 3   | <i>Innovations in Science, Level 4, The Plant Project (Putting the Parts Together), p. 41</i>  | seed catalogues, art supplies   |                |

## Assessment

For a broader discussion of science classroom assessment techniques see *Assessing Student Learning* in the introduction of this publication on p. 15. Good places to begin looking for the unit-related ideas are *Explorations in Science* assessment handbooks, *Innovations in Science* teaching notes, Unit tests and Portfolio ideas, Alberta Education sample tests at [www.education.gov.ab.ca](http://www.education.gov.ab.ca) and Alberta Assessment Consortium at [www.aac.ab.ca](http://www.aac.ab.ca)

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