ACTIVITY 2

How Does Your Garden Grow?

Study Question:

What is the optimum level of plant nutrient application?

Activity:

In this lesson students will conduct an experiment that will examine different rates of applying plant nutrients and how this affects the growth of plants.

Curriculum Fit:

Science - Division Two and Three
- Division 2 - Living Things and Environment
- Grade 7 - Characteristics of Living Things
- Grade 8 - Growing Plants
- Grade 8 - Interactions and Environments
- Grade 9 - Environmental Quality

Language Arts - Division Two and Three
- Division 2 - Concepts B-3, C-2, K-6
- Division 3 - Concepts 3, 4, 5, 15-19, 23-25

Major Concepts:

There is an optimum level of soil nutrients for plant growth.

Levels of Taxonomy:

Application and Analysis

Major Agricultural Concepts:

- Technology & Capital Intense Nature of Agriculture.
- Importance of Soil and Water.
- Production, Processing and Marketing Systems in Agriculture.

Purpose:

To gain awareness that growth of plants is affected by human interventions & environmental modifications.
To control variables and describe the response of plants to these changes.
To show practical application of knowledge of plant growth and how plants respond to change in their environment through scientific processes.
To predict outcomes.
To practice writing and communication skills.

Materials Required:

- five small plants for each group of 4-5 students
- purchased plant fertilizer - rulers
- five labelled 750 ml jars for each group to hold pre-mixed fertilizer solutions

Student Resource sheets
natural fertilizer (optional)

Time Required:

2 full periods and parts of several others to record plant growth and apply fertilizer.

Background — for the Teacher

Plant nutrients are often an unknown quantity in the life of a plant. When we plant our gardens, flowers or crops we know they need light, water and other conditions. We know that plants need "food" to grow, but sometimes we are not sure what amount of "food" plants require.

Farmers are aware that it is important to have strong, healthy and abundant crops. By adding plant nutrients to the soil, farmers are able to produce good crops. The farmer must also be concerned with protecting the environment and sustaining the productivity of the soil. The concept of sustainable agriculture is to economically produce optimum yields while protecting the environment. Good farmers want to produce the best crop while protecting the environment for future use.

In this lesson students will investigate how the amount of fertilizer added to the soil will affect plant growth. The students will predict the growth of plants and then compare predictions with actual outcomes by following scientific methods. The students will analyze how the farmer must understand the amount of nutrients required by plants.

Procedure:

Preparation

1. Obtain copies of Alberta Agriculture's pamphlet House Plants —Fertilizer Agdex 285/541-1 from: Print Media Branch, Alberta Agriculture, 7000 - 113 Street, Edmonton, T6H 5T6.
2. Make a copy of the Student Resources for each student and also a group task sheet.
3. Purchase some **small** plants or ask your students' parents to donate small plants.
4. Purchase liquid plant fertilizer. (Recommend using "Schultz Instant" Plant Food)

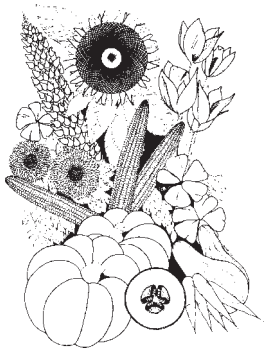
Introduction

5. With the class as a whole, do a brainstorming session on what environmental factors they believe affect plant growth. This will be an excellent review of the life-cycle of a plant.
6. Hand out Student Resource Sheet #1.

Activity

7. Divide the class into groups of 4 or 5 students. Give each group 5 plants, and fertilizer.
8. Have students mix fertilizer solutions according to the fertilizer application rate. Students must label each plant with rate of fertilizer application.
9. Have each group predict how they believe their plants will grow according to the rate of fertilizer application. Collect the group prediction sheets and keep until the end of the experiment.
10. Have each group decide how tasks for this experiment are to be divided.
11. Have each group design a recording system for the experiment.

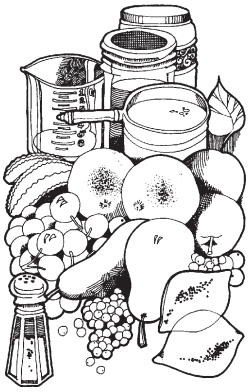
> ***NOTE:*** *This experiment may take a few weeks to see any measurable results, so encourage them to keep their experiments going.*



Conclusion

12. At the conclusion of the experiments, have students compare their predictions to the actual outcomes of the experiment. Have each group present to the class their predictions, the actual outcomes and their conclusions.
13. Students should understand that the measured height or growth of the plant is similar to the yield of a crop.
14. Have each group prepare a presentation on what the best rate of fertilizer application was and why. Remind the students to consider the cost of fertilizer and the growth of the plants in their final decisions.

NOTE: *If students have access to organic fertilizer sources, one group may wish to use it in the experiment*



Discussion Questions:

1. What other variables, besides fertilizer, affect plant growth?
2. What other forms of plant nutrients could the farmer apply besides chemical fertilizer?
3. Why would a farmer choose chemical fertilizer over other types of fertilizer?
4. Why is the growth of healthy plants so important to our food supply?
5. Which plants showed the best results? What amount of fertilizer was used? What conclusions can we make about the use of fertilizers, plant nutrients and the growth of plants?
6. What happens to the nutrients not used by the plants?

Related Activities:

1. Research how and why chemical fertilizer use has increased since WWII.
2. Ask a local horticulturist in to talk about the use of fertilizer in the urban setting.
3. Explore the option of organic fertilizers.

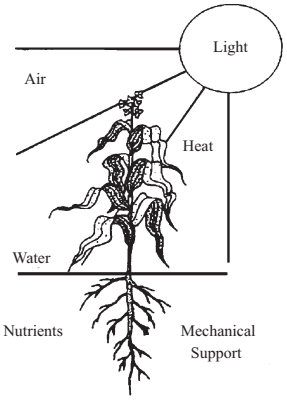
Resources:

Alberta Soils Course, Alberta Agriculture, Home Study Section

Fertilizers and The Environment, Alberta Agriculture, Agri-fax, Agdex 090-1

House Plants -- Fertilizer, Alberta Agriculture Garden Fax, Agdex 285/541-1

The Growth Cycle of a Plant



These are the essential plant growth factors:

- LIGHT
- HEAT
- AIR
- WATER
- NUTRIENTS
- MECHANICAL SUPPORTS (FOOTING IN THE SOIL)

Reprinted from Alberta Soils Course

Maintaining Soil Nutrients

Plants use nutrients to grow. The three main nutrients needed by plants are **nitrogen**, **phosphorus** and **potassium**. When farmers plant crops and harvest them, some of these nutrients go with the crops. Fertilizers contain varying amounts of these nutrients. The percentage of each nutrient contained in a fertilizer is given on the package in the form of three numbers, such as 5-10-5, 20-20-20, or 10-20-15. The first number represents the percentage of nitrogen (N), the second phosphorus (P), and the third potash (K). These three nutrients are called the **macronutrients**. In addition, to the macronutrients, small amounts of trace elements are included in the fertilizer formula, but these are not expressed in the ratio numbers. The trace elements or **micronutrients** include boron, calcium, copper, iron, manganese, molybdenum, sulphur, and zinc.

The question that faces the farmer is:

How to restore the nutrients the crops take away?

There are three ways to maintain nutrients in the soil:

Chemical Fertilizers

These are man-made products from elements found in the natural environment. Applied properly, these products can increase the plant-available nutrients exactly to the soil needs. Chemical fertilizers do not contribute to the organic matter in the soil, and are expensive to purchase.

Animal Manure

This is a natural waste product from animals that is an excellent source of organic matter. If used in sufficient amounts, animal manure will raise the plant-available nutrients in the soil. The nutrients in animal manure are released slowly over a number of years. Using this product requires more tillage than the application of chemical fertilizer. This can lead to soil erosion. Animal manure is bulky and hard to transport, so it is usually applied close to the source of supply.

Green Manure

This organic fertilizer is produced by crops high in nutrients. These crops are worked into the soil while they are still green and actively growing. This results in raising plant-available nutrients and organic matter in the soil. When green manure is used as a fertilizer the land is taken out of economic production for one year.

Group Task Sheet

Day One

Your group will receive 5 plants. Number each according to the Fertilizer Solution Chart below.

1. Place plants in sunny location.
2. Design a record sheet.
3. Measure height of plants on Day One and record on record sheet.
4. Mix liquid fertilizer in jars according to fertilizer chart.
5. Label the jar with the amount of fertilizer added.
6. Label plants with the amount of fertilizer each plant will receive according to the jars.
7. Water each plant with 25ml of fertilizer solution.
   (NOTE: This step should be done every second day for duration of experiment.)
8. Predict which plants will:
   a. grow the tallest. Why?
   b. be the shortest. Why?
   c. have the most leaves. Why?
   d. have the fewest leaves. Why?
   e. might die. Why?
9. Hand in your production sheets.

Week One

1. Continue watering plant with 25ml fertilizer solution every second day.
2. Measure height of each plant and record on record sheet.
3. Record any noticeable changes in plant health. (For example growth of leaves or signs of yellow or dead leaves.)
4. Mix up more fertilizer solution in the jars according to chart as needed.

Week Two

Continue as directed in Week One.

Week Three

Continue as directed in Week One.

Week Four

1. Record height of each plant on record sheet.
2. Record any changes in each plant on record sheet.
3. Record amount of liquid fertilizer used for this experiment on record sheet.
4. Compare outcome of experiment to the predictions you made on the first day. Are the outcomes different or the same? Why?

Fertilizer Solution Chart

Solution 1 for Plant 1	***Solution 2 for Plant 2***	***Solution 3 for Plant 3***	***Solution 4 for Plant 4***	***Solution 5 for Plant 5***
Mix solution according to recommended amount on label	Double the recommended amount of fertilizer.	Add four times the recommended amount of fertilizer.	Add ten times the recommended amount of fertilizer.	Add no fertilizer.

Rate of fertilizer and water mix is for a 750ml container.

taken from
Garden Fax - Agdex 285/541-1 (June, 1976)

HOUSE PLANTS - FERTILIZER

Plants need not only water, light and air, but also certain elements known as plant nutrients. These are absorbed from the soil through the plant's root system. Most house plants require regular feeding to replenish the soil's nutrients supply which may be depleted as a result of the limited soil and rooting volume of potted plants. Fertilizers replenish soils exhausted of nutrient reserves and correct specific nutrient deficiencies. An important objective of sound fertilizer practice is to maintain a balance of nutrients for plant growth.

Plant Nutrients

The three major elements, nitrogen (N), potassium (K) and phosphorous (P), are used by the plant in relatively large quantities. Consequently they may need replacing through regular fertilizing.

Nitrogen promotes the development of healthy green foliage, and contributes to overall plant health. Too much nitrogen retards flower development and causes excessive leaf growth. A nitrogen deficiency causes stunted growth, small leaves, and yellowing of the lower leaves followed by drying to a light brown color. Leaf drop is not a common symptom.

Phosphorous is essential for the growth of strong healthy roots and the development of flowers, fruit and seeds. Fertilizers high in posphorous are particularly beneficial to flowering plants. Deficiencies cause dark green foliage, retarded growth, and leaf drop; lower leaves may turn yellow between the veins, but more often the whole plant takes on a purplish blue color.

Potassium has a balancing effect on plant growth, promoting strong root and stem development. It is necessary for development of good color and disease resistance. A potassium deficiency is indicated by: lower leaves mottled, usually with brown, deadened areas near tip and margins; yellowing beginning at the margin and continuing toward the center, with margins later becoming brown and curving under; lower leaves dropping.

The **minor elements**, or trace elements, are so-called because they are needed in very small quantities. Magnesium, sulphur, calcium, boron, zinc, copper, iron, manganese, sodium, molybdenum and cobalt are in this category. At an additional cost, fertilizers containing the trace elements can be purchased. However, trace deficiencies are very seldom a problem with house plants, since their individual requirements are minute. Trace elements are usually provided by the soil alone. Supplementary feeding of minor elements can easily create excesses which cause incurable damage to the plant.

Most fertilizers provide three major elements; the N-P-K formula found on their labels is a series of numbers indicating the percentage of nitrogen, phosphorous and potassium in the fertilizers. For example, a 15-30-15 solution, high in phosphorous, is exactly triple the strength of a 5-10-5 solution.

taken from
Garden Fax - Agdex 285/541-1 (June, 1976)

HOUSE PLANTS - FERTILIZER (continued)

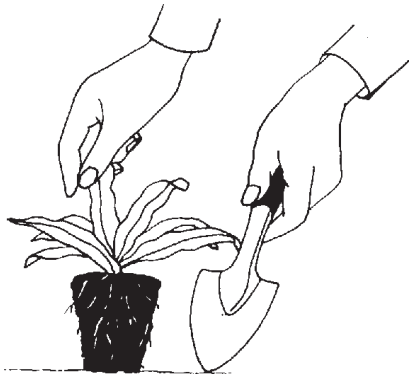
Types of Fertilizers

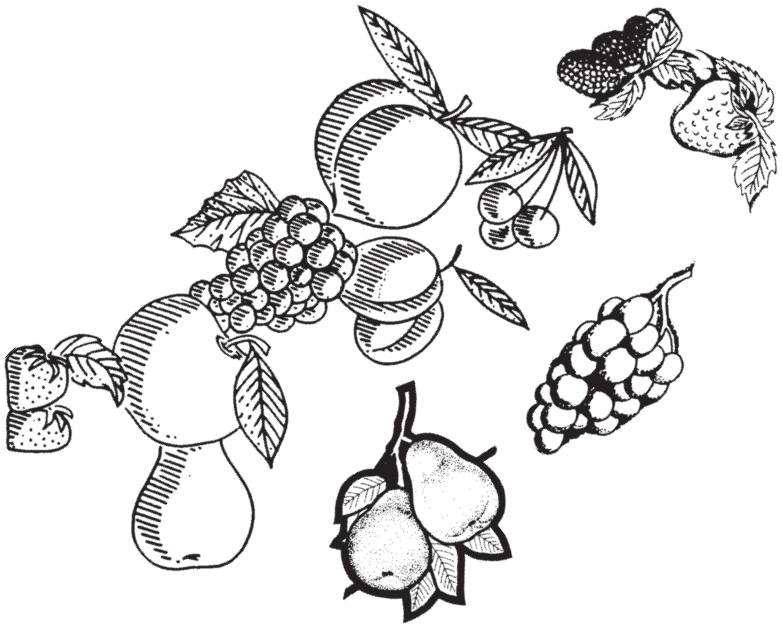
Organic or natural fertilizers such as bone meal, dried blood and manure contain highly complex chemicals which must be broken down by soil bacteria before the plant can utilize them: they are slow-acting but long lasting. They are therefore used to better advantage in the garden rather than the home, where a faster-acting fertilizer is desirable. Organic fertilizers are low in nutrient content, and this, with their slow-acting quality, makes them relatively safe to use. Some kinds, such as bone meal, wood-ash, or well-rotted manure, are often added in making potting soils, reducing the need for later fertilizer applications.

Although unnecessary, this practice may prove beneficial to many plants, and will certainly do them no harm. Other types, including fish tankage or cotton seed meal, are sprinkled on the soil and lightly mixed in as needed. Dried blood contains 9 to 14% nitrogen; bone meal and fish meal supply phosphate and small amounts of potash and nitrogen; wood-ash supplies potassium; seaweed is rich in trace elements; manure provides small amounts of several essential nutrients.

Copies of this and related publications may be obtained from

the Print Media Branch, Alberta Agriculture, 7000 - 113 Street, Edmonton, T6H 5T6 or Alberta Agriculture's District Offices.





CHOICES