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4-H 316 The Green Food Factory: A 4-H School Enrichment Project

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The Green Food Factory

A 4-H School Enrichment Project

Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Kenneth R. Bolen, Director of Cooperative Extension, University of Nebraska, Institute of Agriculture and Natural Resources.

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Glossary
Introduction

What is the 4-H School Enrichment Program?

The 4-H school enrichment projects are designed to supplement the regular school curriculum, particularly in the sciences. School systems and Nebraska Cooperative Extension have cooperated for years, complementing the educational goals of both organizations. Four-H bases its materials on research and current knowledge. School Enrichment resources include teacher guides, video cassettes, teaching exercises and audio visual support. Participants in 4-H School Enrichment programs “learn by doing,” which helps young people learn and apply practical living skills. As 4-H participants, your students can take part in other 4-H activities outside the classroom, such as county fairs and demonstration contests.

What is THE GREEN FOOD FACTORY school enrichment project?

The Green Food Factory school enrichment project uses soybeans and dry beans to illustrate plant physiology and anatomy. This science-based project includes hands-on experiments to reinforce learning. In addition, the project includes units on soybean and dry bean production, processing and marketing, and nutrition and consumer education.

The program is designed for upper elementary grades, preferably fifth grade. However, if the project content enhances the fourth grade curriculum in specific schools, and the fifth grade chooses not to participate, it may be offered at the fourth grade level.

How does the program work?

Upon registration, you will receive a packet at teacher training. This packet will include a step-by-step “Green Food Factory” teacher guide, developed by Extension professionals, reviewed by teachers and supported by the Nebraska Soybean Development, Utilization and Marketing Board and Nebraska Dry Bean Commission.

Cooperative Extension provides:
- Teacher training
- Teacher's manual
- Supplemental resource material
- Student workbook
- Videos: Plant physiology and anatomy
  Life cycle of beans - planting through harvest
- Enrollment and evaluation forms
- Classroom presentation (optional)

School provides:
- Teacher and students
- Teacher to attend training
- Use of audio visual equipment
- Student data on participants
- Evaluation report

Designed by the 4-H Green Food Factory School Enrichment Advisory Committee:
- Susan Williams, Saunders County Extension Agent - Home Economics
- Robert Meduna, Saunders County Extension Assistant
- Monica Schmit, Project Intern, Cooperative Extension - State 4-H Office
- Virginia Gobeli, Extension Specialist, 4-H Youth Development, Curriculum Specialist
- Judy Lewis, Teacher at Arnold School, Lincoln, NE
- Linda Boeckner, Extension Specialist - Food and Nutrition, UNL
- Lenis Nelson, Extension Specialist - Agronomy, UNL

Readers for the project:
- Keith Glewen, Saunders County Extension Agent - Agriculture
- William Caldwell, Assistant Director 4-H, University of Nebraska
Summary of Program Content
Each unit is designed to be used independently or in combination with other units. This gives teachers the flexibility to select topics and programs of interest to their individual classes.

Unit 1 - Plant Anatomy and Physiology
This unit is about plant growth and physiology. The students will experiment with seed germination and will begin to learn about nitrogen replacement in the soil. A video tape showing plant anatomy and physiology supplements this unit.

Unit 2 - Production and Processing: Soybeans and Dry Beans
In this unit, students learn about the bean production cycle and the people involved from planting seeds to making a finished product. This unit discusses growing beans, from planting through harvest, as well as processing beans into a number of food and non-food products. Two video tapes on the harvesting and processing of soybeans and dry beans complement this unit.

Unit 3 - Soybeans You Eat
This is a nutrition and consumer education unit. It highlights the importance of soybeans and soybean oil in the diet. Students learn about cholesterol and soybean oil’s role in a low cholesterol diet. This unit also introduces a variety of foods made from soy products.

Unit 4 - Dry Beans You Eat
This second nutrition and consumer education unit explains the importance of dry beans in the diet. Students learn about fiber and the role beans play in a healthy diet.

Unit 5 - Practical Math
Students apply practical math to the day-to-day operations of a business.

Unit 6 - Marketing
This unit introduces basic concepts of a market economy including: demand and supply, affect of demand and supply on price and production, and how farmers sell their products through cash and futures markets. In a game based on the Chicago Board of Trade, students buy and sell soybeans.

4-H Supplemental Green Food Factory Activities

4-H Poster Contest
Conduct a Green Food Factory poster contest in your school. Extension staff will help judge the posters and present ribbons to winners.

Exhibit at the County Fair
All posters would be eligible for 4-H county fair competition. Students also can participate in the interview judging process. Here the student meets with the judge to discuss his or her project. You may wish to collect the posters before the end of school and enter them in the county fair for the students. Each entry requires a 4-H entry tag, available from the Extension office. The Extension staff will be happy to assist your class with fair entries. Students will be awarded 4-H ribbons for their exhibits.

4-H Presentation and Speech Contests
Students can develop public presentation skills by preparing and presenting a demonstration or speech about soybeans or dry beans. Extension staff or volunteers can help students develop presentations. Students may select their own topic and demonstrate something as simple as preparing a dish using tofu, or as complex as a science experiment. A 4-H manual on how to prepare a public presentation is listed in the supplementary activity section of the Teacher’s Guide.
Organize a 4-H Project Club

If some students want to continue their study of soybeans/dry beans, they may form a 4-H project club. The club could enroll in a 4-H food, computer or agricultural project. A parent with one of these special interests may be willing to lead the club. The Extension staff will assist in organizing the club and training the leaders.

Classroom Guest Speakers

A soybean or dry bean farmer could demonstrate how the beans are planted and explain the day-to-day life of a farmer.

A food scientist could describe careers available in the food industry.

International students could talk about food in their native country.

A grain elevator operator could explain his role in marketing farm products.

Tour opportunities

A local grain elevator.
A farm machinery dealer.
The University Agronomy or Food Science Department.

Reports

Students could report on:
Current events that affect the food industry.
Historical aspects of farming.
Different uses of soybeans and dry beans including recipes from cookbooks or books on foreign cooking.
Different types of machinery, fertilizer, seeds and general farm tools used in farm production. Farm magazines could be a resource.

Bulletin Board and Other Ideas

Teachers could have children bring a product that contains soybeans from home and construct a bulletin board with the items or photos of food dishes that have beans.

Have students develop a bulletin board using variety of products. Have students develop “bean” characters using “SuperSoy” as a starting idea.

Construct bulletin board from calendar of events of production.

Construct the Chicago Board of Trade trading pits and buying stations.

Use beans or seeds in art project—glue onto molds to create texture, or paint beans and make murals.

Green Food Factory School Enrichment Resource List

Audio Visuals

Green Food Factory - Plant Anatomy and Physiology:
A 5-minute video available on 1/2” VHS describes the anatomy and physiology of green plants.

Green Food Factory - Plant Life Cycle: Soybeans
A 10-minute video available on 1/2” VHS describes the production of soybeans from planting to harvesting to processing.

Green Food Factory - Plant Life Cycle: Dry Beans
A 5-minute video available on 1/2” VHS describes the production of dry beans from planting to harvesting to processing.

The videos were funded by the Nebraska Soybean Development, Utilization and Marketing Board with the Nebraska Dry Bean Commission.

Contact your Extension office to order the videos.
Dear Parent:

Your son/daughter will be learning more about beans in the next few days. He/she will be learning about plant anatomy and physiology, how beans are grown and processed, their importance in a healthy diet and how they are marketed.

Soybeans and dry beans are important agricultural products in Nebraska. Depending on where you live, your child will learn about soybean or dry bean production. Soybeans are grown in eastern Nebraska and dry beans are grown primarily in western Nebraska.

Please help your child as they participate in this science-based school enrichment program developed cooperatively with the Nebraska Soybean Development, Utilization and Marketing Board, Nebraska Dry Bean Commission, 4-H, and UNL Cooperative Extension. Four-H is an organization working to develop life skills in today's youth while helping volunteer leaders expand their present skills. If you are interested in having your child experience the benefits of 4-H, contact your Extension office.

Introducing the Project to Your Students

This soybean project is a resource that will help you expand your science curriculum. Use what is helpful and interesting to you and your students.

If you are working on the soybeans, an interesting way to start the project is to introduce the following soybean products:
- Newspaper (soybean ink)
- Candy Bar (Reeses Peanut Buttercup - soybean oil)
- Pizza (meat extender)
- Paint (soybean oil)
- Soap (soybean oil)
- Baby Food (soybean meal)
- Plywood (soybean meal)

Have the students tell you what one ingredient is used in all of these products. Ask questions about how soybeans are turned into these products.

If you are working on dry beans, you might introduce the project by asking the students what food product comes in a variety of colors including: white, brown, red, blue, black and variegated, and can be eaten boiled, baked or fried. This product is often used as a substitute for meat protein. Then show them the variety of beans.
Purpose: To help students understand the anatomy and physiology of the bean plant.

Summary of Learning Activities: In this unit, there are four learning activities (involving individual, small group, and class participation) on seed anatomy, germination, stems, and photosynthesis.

The activities include:
- Worksheet on plant anatomy.
- Germination rate experiment (approximately 12 consecutive days). Initial time 1/2 hour, then 5 minutes daily, and 1/2 hour the final day. (Could begin 1 week before unit.)
- Water and mineral path experiment (2 days - 15 minutes per day).
- Photosynthesis experiment (1 week - 5 minutes first and last day).

Objectives:
Student will learn:
1. To identify the parts of a seed.
2. The ingredients needed for seed germination (sprouting).
3. How nutrients and water move through the plant.
4. Why plants need sunlight and carbon dioxide to grow.

Vocabulary:
- CHLOROPHYLL - Green coloring in plants. With sunlight it changes water and carbon dioxide into food for the plant.
- CHLOROPLAST - Part of the green cell that contains chlorophyll.
- COTYLEDONS - The food source for the bean while in the ground; first leaves to appear growing out of the seed.
- DICOTYLEDON OR DICOT - Plants with two cotyledons (seed leaves).
- EMBRYO - Part of the seed from which the plant develops.
- EPICOTYL - Part of the sprouting seed that develops into the stem of the plant.
- GERMINATION - The process of growing or sprouting from seed to plant.
- HYPOCOTYL - Part of the sprouting seed that forms the base of the stem.
- LEGUME - Any plant of the pea family where seeds grow in pods and are protein sources. These plants have root nodules containing bacteria that can capture nitrogen from the soil and the air to make into amino acids or protein.
MONOCOTYLEDON OR MONOCOTS - Plants with one cotyledon.

NITROGEN FIXATION - In legumes, it is the process by which rhizobia bacteria gather nitrogen and store it in nodules for use by the plant. After harvest, nodules decompose and release nitrogen into the soil.

NODE - Where the leaf petiole connects to the stem.

NODULE - A small swelling or knob on the bean root that gathers nitrogen from the air.

NUTRIENTS - Elements that are essential for plant growth.

OVARY - The part of the flower that develops into a seed.

PETIOLE - "Stem like" structure between leaf blade and stem.

PHLOEM - Food carrying tube in the stem; transports food made in the leaves to other parts of the plant.

PHOTOSYNTHESIS - Process by which sunlight converts water and carbon dioxide into sugar (food for the plant) and oxygen (air for us).

POLLEN - Powder produced by a flower that contains male genes.

RADICLE - Part of the sprouting seed that develops into the root.

ROOT HAIRS - Extension of a single cell on the root surface that extends into the soil.

SELF-POLLINATION - The pollen produced within the flower fertilizes the ovary of the same flower.

STOMATA - Openings in leaf that allow oxygen and carbon dioxide to move between the leaf and the air.

TAPROOT - The primary root of the plant.

TRIFOLIATE LEAF - Three-bladed leaf.

UNIFOLIATE LEAF - One-bladed leaf.

XYLEM - Food carrying tube in the stem; transports water and nutrients from root to the plant.

### Supplies/Preparation:

**Activity 1**
Parts of a Plant, Student Worksheet 1-1

**Activity 2**
- Paper towels
- Rubber bands
- Small container (a glass jar)
- Water
- 30 soybeans/dry beans (for each experiment)

**Activity 3**
- Glass or glass jar
- Water
- Food coloring
- Scissors
- Long-stem white flower (carnation works well) or celery stalk
- Magnifying glass

**Activity 4**
- Healthy green plant
- Aluminum foil
- Petroleum jelly (Vaseline)
Background Information

Soybeans and dry beans are members of the *legume* family. Other legume members include alfalfa, clover, peanuts and peas. Important characteristics of legumes are: 1) seeds are in pods, 2) plants use nitrogen from the air and return it to the soil, and 3) seeds are high in protein.

**Soybeans**

Can you imagine eating fish food, cattle food, soap or plywood? How about chocolate, mayonnaise, margarine or bread? Whether you eat them or not, all of these things have one thing in common — soybeans. The soybean has many uses — from food for animals and people, to industrial products.

Soybeans have a very long history dating back to China in 3000 B.C. The Chinese considered the soybean sacred. In the 13th century, Marco Polo introduced soyfoods to Europe. However, soybeans did not become a big hit until the 1700s. Benjamin Franklin was the first to introduce soybeans to the United States.

Soybeans were first used as a forage crop preserved as hay or silage. Soybeans were also plowed under as green manure to enrich the soil. Then, just as Jack (Jack and the Beanstalk) recognized the magic of beans, industry discovered the many uses of soybeans in the mid-1930s.

**Dry Beans**

There is evidence that various types of field beans, dry edible beans, evolved in Mexico and South America, where they were domesticated and cultivated between 4,000 and 6,000 years ago. Today dry beans continue to be an important source of protein in parts of Central and South America, where diets lack adequate amounts of animal protein.

In the United States, 14 states produce various kinds of dry beans. (See Diagram 2-4.) California, Idaho and Colorado are the leading bean producing states, while Michigan, New York and Nebraska also produce sizeable quantities. In addition to the United States, the leading bean-producing nations are Brazil, Mexico, Yugoslavia and Italy.

Beans require little processing for human consumption. They are eaten boiled, baked or fried, and are included in many soups. They also are used as a substitute for meat in countries where little meat is available. Because dry beans are relatively high in protein and easy to store, they are a valuable and dependable food source in many countries. Beans also can be frozen and canned, and are available in many prepackaged convenience meals.

**Seeds**

All life has a starting point. People, plants and animals must produce more of their own kind to continue to exist. Plants reproduce through seeds.

Seeds come in a variety of shapes, colors and sizes. Inside the seed is the beginning of a future plant — the *embryo*. The embryo contains the “recipe” or blueprint of the plant that produced the seed.

A legume seed has two parts: the seed coat and the embryo. (See diagram 1-1.) The seed coat, made of 8-10 layers, is a protective shell. The embryo has two leaves called *cotyledons* that store food. Because beans have two cotyledons they are also called *dicotyledons* or *dicots*. Seeds with one cotyledon are called *monocotyledons* or *monocots*.

Cotyledons are the major part of the seed and contain almost all the oil and protein. Even though cotyledons are very small, they provide enough food for germination, seedling emergence and one week of plant growth.

*Germination*, the sprouting of the seed, occurs when air, water and proper temperature combine at the correct time.

**Roots**

When a seed begins to germinate, roots appear first. Roots have three primary purposes: 1) hold the plant in the ground, 2) take in water and minerals from the soil, and 3) store food for the plant. We eat many plants that store food in their roots. These include carrots, beets and radishes.
Bean roots hold the plant in the ground and take in water and nutrients. The primary root or taproot may grow over three feet into the ground. Around the taproot is a branched root system. On the roots you will notice tiny root hairs that help the root absorb water and nutrients.

As a soybean plant grows, nodules form on the roots. These nodules trap nitrogen gas in the air and convert it to a plant nutrient. Nodules provide nitrogen for the plant and, when they decompose, replenish nitrogen in the soil. This process is called nitrogen fixation. (There is more on nitrogen fixation in Unit 2.)

Stems

The stem of a plant is like a highway. There are lanes of traffic to transport things to and from a particular place. The lanes of this plant highway are the xylem and phloem. The traffic includes water, minerals and food. Xylem carries water and minerals from the roots to the plant. Going in the opposite direction, phloem carries food made in leaves to other parts of the plant. Stems also support the leaves. (See diagram 1-2 - Cut view of stem.)

Leaves

A leaf functions much like a factory, using raw materials and energy to produce a product. Water and carbon dioxide are the raw materials. Roots absorb water and the xylem transports it to the leaves. Carbon dioxide from the air enters the leaf through the stomata. Sunlight provides energy to make the find products — sugar and oxygen. This process is called photosynthesis.

To better understand the leaf, let’s examine the parts. Green cells have chloroplasts. Chloroplasts contains chlorophyll, which makes the leaves green and helps the plant make food. Photosynthesis occurs in the chloroplast. A waxy cover on the top and bottom protects the leaf. Tiny openings called stomata allow carbon dioxide to enter and oxygen to exit the leaf. (See diagram 1-3 - Side view of leaf.)

Growth Stages

Remember Jack in Jack in the Beanstalk? Remember how his mother threw the beans out the window and the next day they had grown. How did this happen? Although our beans do not grow as tall or fast as Jack’s, they both start the same way.

Beans need four main ingredients to sprout — soil, water, air and warmth. After a seed has sprouted, there are two growth stages: vegetative and reproductive.

Vegetative Stage

Step by step, look at how beans grow (diagram 1-4 - Vegetative Stage):

The first to emerge from the seed is the radicle that forms the root. After the radicle emerges, the hypocotyl begins to grow longer forming an arch that breaks the soil.

After breaking through the soil, the hypocotyl pulls the cotyledons and epicotyl upward.

The upright cotyledons separate exposing two single-bladed leaves (unifoliates). They look like halves of a bean seed, which they are.

After this, the epicotyl grows, producing two more unifoliate leaves. Then, the first three-bladed leaf (trifoliate) grows. All the rest of the leaves will now be trifoliates.

After emergence, beans are hard to kill because buds form where each leaf is attached to the stem. This means that the plant can start new growth from each bud. These buds can produce branches or flowers. The vegetative stage will last a few weeks.

Reproductive stage or flowering stage:

Flowers form where the leaf joins the stem. The area where the leaf petiole joins the stem is called a node. Flowering starts at the bottom of the stem and continues up the stem to the top. Bean flowers are self pollinating meaning the pollen produced within the flower fertilizes the ovary of the same flower. From the flower, a pod will form. Inside the pod, new soybeans will develop and mature.
Photosynthesis

Just as you grow every day, so do plants. For you to grow, you have to eat the right foods. For a bean plant to grow, it needs 16 chemical elements or nutrients to become healthy and strong.

Beans get the 16 nutrients they need from three places: air, water and soil. Most of the nutrients come from the soil and are absorbed through the roots. So is water. Oxygen and carbon dioxide come from the air and are absorbed through the leaves. (Diagram 1-5-Nutrients for Growth)

Through the process of photosynthesis the nutrients absorbed by the roots and leaves are turned into energy (food) for the plants to grow and produce beans. Sunlight provides the energy for the chloroplasts to make sugar and oxygen. The recipe (formula) for photosynthesis is:

Carbon Dioxide + Water + Light Energy = Sugar + Oxygen

Most bean plants grow from two to three feet tall. They mature in three to five months depending on the type of bean.

Activity #1
Labeling parts of the plant, Student Worksheet 1-1

Activity #2
Germination Rate Experiment

Materials Needed:
- paper towels
- rubber bands
- small container (a glass canning jar would be fine)
- water
- 30 soybeans/dry beans (for each experiment). Should be whole with no cracks. The fresher they are the better the germination.
- magnifying glass

Procedure:
1. The life of a bean begins when the seed germinates. Break the bean in half. Look at the tiny plant or embryo.
2. Place two paper towels on top of each other and sprinkle with water.
3. Arrange 25 beans on moist towels. Do not let them touch. Do not use broken or cracked seeds.
4. Cover seeds with two paper towels and moisten them.
5. Roll the towels and seeds loosely and put a rubber band around each end. Don't make rubber band very tight.
6. Place roll of beans and paper towels in the small container.
7. Sprinkle towels daily. Keep moist but not wet.
8. Store in a warm place for five days. Unroll the towels and count the number of seeds that have germinated. (Germinated seeds will have roots at least one inch long.) Look at the root hairs through the magnifying glass.
9. How many seeds have germinated? Record result and discard germinated seeds.
10. Roll remaining seeds in the paper towels. Keep moist for seven more days.
11. Remove germinated seeds. How many more have germinated?
12. Add the number/s in step 8 and step 10.
14. Multiply by 100 to get total percentage of seed that germinated.

Note: Soybeans should have a germination rate of at least 80 percent for satisfactory performance in the field. Dry beans should have a germination rate of at least 85 percent. Additional activities: Repeat the above experiment with:
- beans in a cold environment (refrigerator)
- beans that have been damaged through shipping (cracked or split)
- beans in a hot environment

Students can graph results of each experiment and compare findings.
**ACTIVITY #3**

Stems—How do water and nutrients move through stems.

**Materials:**
- Glass
- Water
- Food coloring
- Scissors
- Long-stemmed white flower (carnation works well) or celery stalk
- Magnifying glass.

**Procedure:**

1. Fill glass 1/4 full of water. Add a few drops of food coloring.
2. Trim the end of stem of a white flower. Put in glass and leave overnight.
   - A. What does the flower look like? *Flower is the color of food coloring.*
   - B. Why? *Because tubes in stem have transported water to the flower.*
   - C. What is the name for this tube? *Xylem*
3. Use the scissors to cut the stem above the water line. Look at the cut top of the stem in the glass using a magnifying glass.
   - A. What do you see? *Round, straw-like tubes within the stem.*
   - B. What was it that transported water up through the stem? *Tubes are the same color as flower so they must have been used to transport water.*

**ACTIVITY #4**

Photosynthesis

1. Show need for sunlight in photosynthesis. Using a healthy plant, cover a leaf with aluminum foil and place in the sun. After several days uncover the leaf and notice color (due to lack of sunlight). Chlorophyll needs sunlight.
2. Show need for carbon dioxide in photosynthesis.
   - Using a healthy plant, cover a leaf with vaseline (both sides) and place in the sun. The leaf will turn yellow because the leaf's stomata are blocked by the vaseline.
   * These two experiment could be done simultaneously on a large healthy plant. In both cases, the plant will discard a leaf that is not doing photosynthesis to maintain efficiency.

**Optional Activities:**

- Discover the sacred grains of China. What do Chinese do with soybeans? What is their cultural significance?
- Grow and eat soy sprouts.
- Grow and examine dry bean sprouts.
- Examine root hairs.
- Make leaf prints — make prints using leaves like rubber stamp. Spread with light film of tempera on the leaf and press on paper. You also can make a print by putting paper over the leaf and rubbing lightly with crayon. Use a variety of leaves - oak, maple, holly, etc.
- Examine different dry beans (pinto's, northerns, etc.) grown in Nebraska.
Diagram 1-1

Seed Anatomy

- Hilum
- Radicle
- Hypocotyl
- Epicotyl
- Cotyledon
- Seedcoat
- Embryo
Diagram 1-2

Cut View of a Stem

Epidermis
Cortex
Vascular bundle
Xylem
Phloem
Pith
Diagram 1-3

Side View of Leaf

- Green cells containing Chlorophyll
- Epidermis
- Xylem
- Phloem
- Stomata
- Intercellular space
Diagram 1-4

Vegetative Stage

Step 1

Step 2

Step 3

Step 4

Step 5
From Air and Water
1. Carbon
2. Hydrogen
3. Oxygen
4. Nitrogen

92.4%

From the Soil
Major Nutrients—5.8%
- Nitrogen
- Phosphorus
- Potassium

Secondary Nutrients—1.7%
1. Calcium
2. Magnesium
3. Sulfur

Micro-Nutrients—0.2%
1. Boron
2. Zinc
3. Copper
4. Manganese
5. Iron
6. Molybdenum
7. Chlorine
Parts of a Plant

- Growing Point
- Petiole
- Node
- Unfollolate Leaves
- Trifoliate Leaves
- Axillary Buds
- Hypocotyl
- Cotyledons
- Nodules
- Branched Tap Root
Purpose: To learn how beans are grown, harvested and processed into food and non-food products. To learn how legumes, particularly soybeans and dry beans, enrich the soil and are protein rich foods.

Summary of Learning Activities: Most of the activities in this unit are worksheets that combine individual or group activity with discussion. The activities include:

a. Soybean processing — worksheet  
b. Seed to harvest — worksheet and class project  
c. Miracle crop of many uses — handout  
d. Word search — worksheet  
e. Research paper

Objectives:
Students will learn:
1. How soybeans and dry beans are grown and harvested.  
2. Where soybeans and dry beans are produced in Nebraska.  
3. About the milling process for soybeans and processing of dry beans.  
4. About the versatility of products made from soybeans for both food and non-food use.

Vocabulary:
BEAN BUGGY - A machine attached to the front of a tractor where people to ride and spray weeds competing for sunlight and nutrients of the soybean.  
BUSHELS - Unit of measure.  
COMBINE - A machine that cuts, threshes and cleans grain while moving over the field.  
CULTIVATOR - A machine that digs up the ground between the rows.  
DEHULLING - Process of removing the hulls (outer shell) of soybean.  
EXTRACTING - Using a chemical solvent to remove the soybean oil.  
FLAKING - Process of rolling the dehulled soybeans into very thin flakes.  
MINIMUM TILLAGE - A process of tilling the ground a minimum amount to help soil retain nutrients and water.  
NITROGEN - A gas in the air used by soybean plant.  
NODULES - A small swelling or knob on the bean root that gathers nitrogen from the air.  
PHOTOPERIODISM/PHOTOPERIOD - The sensitivity of a plant to changes in day length; the amount of light during the day that determines the maturing time of the plant.
RHIZOBIA - A bacterial that is important to beans to help take nitrogen from the air, and store it in the nodules.

SOYBEAN FLAKES - Product resulting from steam heating and rolling soybeans.

SOYBEAN MEAL - Product remaining after extraction of oil from flaked soybeans, "toasting" the meal and grinding it.

SOYBEAN OIL - Product resulting from solvent extraction process.

SYMBIOTIC RELATIONSHIP - The living together of two dissimilar organisms in a mutually beneficial relationship.

WINDROWS - A row of hay or grain raked up for drying.

Supplies/Preparation:

Activity 1 - How Soybean Oil and Meal are Prepared, Student Worksheet 2-1
Activity 2 - The Soybean Combine, Student Worksheet 2-2
    Farm Magazines
    Paper and Glue
Activity 3 - Miracle Crop of many Uses, Student Worksheet 2-3
Activity 4 - Soybean Products Word Search, Student Worksheet 2-4
    Dry Bean Word Search, Student Worksheet 2-5
Activity 5 - No preparation
Background Information

Production

By now you should have a basic understanding of the bean seed. In this section you will learn about the life cycle of soybean and dry beans.

Because of differences in climate, soybeans are grown mostly in eastern Nebraska and dry beans in western Nebraska. Soybeans are grown in eastern Nebraska because generally it is moister and the nights are warmer. Dry beans prefer the high altitudes in western Nebraska where the climate is drier and the nights cooler. This dry, cool climate is important for growth and disease control, especially white mold.

Farmers plant beans for many reasons; the most important is to make money. Other reasons farmers plant beans include:

Soybeans:
1) Can be planted later in the growing season than other crops. Soybeans are very sensitive to daylight so if they are planted later in the season, they will flower earlier in their life cycle.
2) Are a legume and can improve the soil by adding nitrogen to the soil through nitrogen fixation.
3) Are a good rotation crop aiding in disease, weed and insect control. They compete with different weeds for nutrients. They are rarely planted in the same field every year.

Dry Beans:
1) Can be planted late in the season and mature early and so spread the work load throughout the growing season. They are planted in the first half of June, after other crops, and harvested in the last half of September, before other crops.
2) Are a legume and can improve the soil by adding nitrogen through nitrogen fixation.
3) Are a good rotation crop aiding in disease, weed and insect control. They compete with different weeds for nutrients.

Planting

Beans are generally planted in well-prepared seedbeds. Many bean fields are prepared using minimum tillage, a process of tilling the soil as little as possible to help the soil retain nutrients and moisture. Usually, the soil is turned and loosened with a disk - a farm implement with small thin plates that turn the soil. Many farmers use a harrow or spring tooth harrow for turning the soil as well.

After the field (seedbed) is prepared, farmers seed the field with a bean planter. A bean planter digs a hole, plants the bean and covers it up. The bean planter plants seeds evenly in a row, about 1 1/2 to 2 inches deep, and packs the soil firmly over the seed.

Bean planters come in different sizes according to the distance between rows and the number of rows planted at one time.

Soybeans are generally planted the second half of May. Dry beans are generally planted between June 1-20.

Nitrogen Fixation

Both soybeans and dry beans are legumes. Legumes use nitrogen from the air and return it to the soil through a symbiotic relationship with a class of bacteria called Rhizobia. Rhizobia is a type of good bacteria important to beans. If beans have not been grown in a field recently, the Rhizobia should be added to the seed or soil when planting. If Rhizobia are not present in the soil where beans are growing, they will not produce as well nor be as effective in fixing nitrogen.

Rhizobia "catch" nitrogen from the air. Then they store it in the nodules (small knots on the roots of the plant). In the nodules, a chemical process develops food energy for the plant, helping it produce beans. After harvest the nodules break apart leaving the soil enriched with nitrogen. Nitrogen is an important chemical nutrient for other plants.

Because beans put nitrogen in the ground, they are used in crop rotation. One year a farmer may plant beans and the next corn. The corn can use the nitrogen the beans left in the
soil and so the farmer doesn’t need to use as much nitrogen fertilizer for the corn.

**Weed Control**

Just like your family garden, a farmer needs to keep a bean field weed free because weeds compete for water and nutrients or affect the quality of the bean. A farmer can control weeds mechanically, chemically and physically.

**Mechanical Weed Control**

Mechanically, the farmer uses a *cultivator* - a machine that digs up the ground between rows. The cultivator also digs up any weeds between rows. Beans usually are cultivated one or two times if weeds are present in the field.

**Chemical Weed Control**

**Soybeans:**

Chemically, the farmer uses herbicides or weed killers. Chemical herbicides are sprayed with a plane, a sprayer pulled by a tractor or with a bean buggy crew. A *bean buggy* is a machine that holds four people on the front of the tractor. As the tractor drives down the rows, the people use spray guns to spray each weed. Some of the worst soybean weeds are cockleburs, button weed and volunteer corn (corn that was lost at harvest and is growing back).

**Dry Beans:**

Herbicides for dry beans are applied and mixed into the soil before planting. The primary dry bean weed is nightshade, which affects the quality of the bean. Nightshade berries ripen at the same time as the beans. The berries go through the harvest equipment, are broken and stain the beans purple. The stained beans are then rejected.

**Physical Weed Control**

Physically, if there are only a few weeds in the field, the farmer can simply hand pull or cut them.

**Irrigation**

**Soybeans:**

Soybeans usually are irrigated only two or three times during the summer. The first irrigation is in July when the plants are beginning to fill the pods with seeds. Many farmers will irrigate a second time in August. Only about one-fourth of the soybean fields in Nebraska are irrigated.

**Dry beans:**

Dry beans are irrigated only two or three times during the summer. The last irrigation must be before the flowers start to drop, usually by mid-August. Later irrigations increase the problem of white mold disease. Most dry bean fields in Nebraska are irrigated.

**Harvesting**

**Soybeans:**

Soybean plants flower after June 21, when the days begin to shorten. The number of daylight hours in a day controls maturity of the soybean. The amount of daylight is different as one goes North and South of the equator. The closer to the equator, the shorter the days during the growing season. This is called *photoperiodism*. Because of the light sensitivity of the soybean plant, there are 10 types of varieties of soybeans with 10 different maturity rates. This allows farmers to produce soybeans in different parts of the world, depending on the daylight hours available in their area.

Soybeans are generally a bushy plant. They are harvested in September or October, when the plant is mature (all the leaves have dropped off) and the moisture content of the beans is close to 13 percent. This is similar to a washcloth that is slightly damp but not dry. The moisture content is measured with a grain moisture tester. Soybeans are mechanically harvested with a *combine*. A combine cuts, threshes and cleans the grain while moving over a field.

Soybeans are then stored in grain bins owned by the producer or the local grain elevator until they shipped to a buyer.

**Dry Beans:**

Dry beans usually are harvested in mid-September when the leaves have turned yellow...
and begun to drop off, but before they are dry. Before the beans dry further they are cut just below the soil surface and gently elevated into windrows.

This is usually done before dawn when there is dew on the plants. The dew helps prevent the pods from breaking open and spilling the beans on the ground. After the windrows have dried thoroughly, the beans are picked up with a pick-up attachment on a combine and threshed.

Farmers must be careful during threshing to not damage the seed coat. Many set their combines at a slow speed and use a wider space between the cylinder and concave. Many bean combines have been modified to prevent seed damage. Some seed damage is invisible to the human eye but will affect how the bean absorbs water when it is being cooked.

After harvest, there is little crop residue left on the field. Without a protective cover, farmers need to do something to prevent wind erosion of the soil. They can plant a cover crop such as winter wheat, triticale or rye, or deep chisel the soil to form clods and ridges.

**Processing**

**Soybeans:**

Soybeans are used in many ways to make both food and nonfood products. The first step in soybean processing is to separate the oil and the meal. These are the two basic by-products that are manufactured into other products. One bushel of soybeans (60 pounds) will yield approximately 11 pounds of oil and 47 pounds of soymeal. The last two pounds are lost as dust in the processing (diagram 2-1).

Processing soybeans includes cracking to dehull the soybean, flaking and extracting the oil with a solvent. Most of the soybeans produced in the United States are used to make industrial products and to feed livestock. However, because of their high nutritional value, soybeans also are used for human food. Most American homes contain some kind of soybean product or processed food. (See Student Worksheet 2-3).

**Soybean Oil**

A bushel of soybeans (60 pounds) yields about 11 pounds of soybean oil. About 90 percent of this oil is used in food products such as margarine, shortening and chocolate. The remaining 10 percent is used in industrial products such as linoleum, cosmetics and printing inks.

**Soybean Meal**

Of all the common seeds, soybeans are the richest in protein. They are highly valued as a protein feed for livestock. Soybean meal is made by extracting the oil from crushed soybeans, "toasting" the meal, and grinding it or making it into pellets. About 97 percent of all soybean meal returns to the farm as a protein supplement for livestock. Each bushel of processed soybeans yield about 47 pounds of soybean meal.

**Textured Foods**

Many people in the world cannot afford meat and so do not get as much protein as they need. Soybean flour and related products may help solve this nutrition problem. Until recently, though, we did not know how to make soybean foods taste and look good. New processes now spin or press soybean protein into rope-like fibers. Flavoring, coloring and binders help create textured protein foods. Textured protein can be shaped into granules, cubes, or slices and can be flavored beef, ham, bacon or chicken. Soybeans also can be made into nut-like or fruit-like products. Because these foods take little time to prepare and have a long shelf life, they undoubtedly will be widely used in the kitchens of the future.

**Other Products**

Soymilk is very popular in China and Japan. There, soymilk is produced in popular flavors such as chocolate and strawberry, and cartons are sold in machines similar to pop machines. Some baby formulas in the United States are made from soy and are used for babies who cannot drink regular milk.
Soybean ink is a new soybean product. Printing companies and newspapers across the United States are experimenting with this new ink. It is less messy than regular newsprint ink — it doesn’t get all over your hands when you read the paper.

**SOY SEAL**

The American Soybean Association has received all rights for the SOY SEAL, a trademark developed by the Monsanto Products Company to help promote non-food industrial use of soybeans, (diagram 2-2). Monsanto and DuPont herbicides use soybean oil as a carrier and the companies will print the SOY SEAL on the containers. A SOY SEAL for newspapers using soy ink also has been developed and offered to newspapers wishing to publicize their use of this new product. The SOY SEAL is printed in red, white and blue and contains the words soy___, such as soyink, soyoil, etc.

**Soy Mark**

You probably haven’t seen soybean plants unless you’ve spent some time in the countryside. So the farmers of the American Soybean Association want to be sure that you’ll see plenty of their products in the supermarket. The SOY MARK, (diagram 2-3) a green and gold logo depicting the soy plant, will be used on all food products that contain some form of soybeans.

**Dry beans:**

Nearly all dry beans are produced for human consumption. They must be kept clean and free from contamination. They dry naturally in the field before harvest. After the beans are harvested, they are taken to a processing station to be cleaned. Next, a conveyor belt takes them past an electric eye, one bean at a time. They are graded according to their class. For white beans, a bean that has a dark or off color will be rejected as it passes the electric eye.

The beans are then packaged in a variety of ways and delivered to stores, food processors (canners) and consumers.

Beans should have uniform size and color. There are many different classes of dry beans. The most common in western Nebraska are the Great Northern beans. These are large white beans used in soups and other bean dishes. Great Northern beans grow well on the High Plains of Nebraska because of the low rainfall and humidity at harvest time. Pinto beans are another kind of dry bean. Pinto beans are grown more widely because the color is not as critical as with Great Northern beans, and because more than half the beans eaten in the United States are pinto beans. They are used in many Mexican dishes and also are mixed with other kinds of beans. The Navy bean is a smaller white bean that is adapted to canning. It is found primarily in the canned “pork and beans” products found in grocery stores. Other kinds of beans such as light red kidney, pink, and black turtle soup are grown in other areas of the United States, with small amounts grown in Nebraska. See the map to find out where different beans are grown (diagram 2-4).

**ACTIVITY #1**

Processing worksheet

Have students fill in the steps in processing soybeans using Student Worksheet 2-1:

- Start
- Screening to remove hulls
- Cracking
- Heating
- Flaking
- Adding solvent to remove oil
- Separating oil
- Storing oil
- Separating flakes
- Toasting flakes and hulls
- Grinding into meal
- Storing/shipping

Have students study the sheet and select a step in the process they would like to talk about. The students can then line up around the perimeter of the room and tell about that processing step, what it does and where the soybean product goes next.
ACTIVITY #2
Seed to Harvest

1. Students prepare a calendar of events for a bean farm, from the time the beans are planted until harvest.

2. Students browse through farm magazines, select pictures and articles that are related to the production of beans, and prepare a pictorial display on the bean production cycle.

3. Students study a cut away diagram of the combine, Student Worksheet 2-2, and identify which parts do the thrashing, separating and cleaning.

ACTIVITY #3

Have students brainstorm a list of soybean products.

Study the student handout: Miracle Crop of Many Uses, Student Worksheet 2-3.

Lead a small group discussion on the edible and non-edible uses of soybean products. Have the students discuss: the different food products made from soybeans; the different non-food products; the large number of products that come from soybeans; whether this a valuable crop to raise; how might the food uses of soybeans be used to fight hunger; and other topics you might think of. Have the students report back to the large group.

ACTIVITY #5

Word Search
Soybean, Student Worksheet 2-4
Dry bean, Student worksheet 2-5

ACTIVITY #6

Individual or team research paper on topics such as:

Growth and use of soybeans/dry beans in other countries

OPTIONAL ACTIVITIES:
Visit a local elevator where soybeans are stored.
Visit a soybean/dry bean farm.
Examine root nodules on plants, discuss root vegetables.
Study possible careers related to soybean/dry bean production and processing.
Invite a farmer to be a guest speaker.
Diagram 2-1

60 lb. soybeans

11 lb. oil

47 lb. soybean meal

90% Foods
  - Margarine
  - Shortening
  - Mayonnaise
  - Salad oil
  - Chocolate

10% Industrial Products
  - Paint
  - Varnish
  - Linoleum
  - Rubber Fabrics
  - Soaps
  - Cosmetics

97% Farm Feed
  - Beef
  - Pork
  - Lamb
  - Poultry
  - Eggs
  - Butter
  - Milk

3% Industrial Products
  - Adhesive
  - Wallboard
  - Paper Coating
  - Textures Soybean Protein
  - Meat Extenders
  - Soy Flour
  - Baby Food
Dry Beans Grown in the U.S.

Diagram 2-4

Washington
Dark Red Kidney Beans
Light Red Kidney Beans
Small White Beans
Pinto beans
Pink Beans
Small Red Beans

Montana
Pinto Beans
Pink Beans

Idaho
Great Northern Beans
Pinto Beans
Red Kidney Beans
Pink Beans
Small Red Beans
Small White Beans

Minnesota
Navy Beans
Pinto Beans
Dark red Kidney Beans

North Dakota
Navy Beans
Pinto Beans
Dark Red Kidney Beans

New York
Light Red Kidney Beans
Black Turtle Soup Beans

Michigan
Navy Beans
Cranberry Beans
Dark Red Kidney Beans
Light Red Kidney Beans
Pinto Beans
Black Beans
Yellow Eye Beans

California
Small White Beans
Light Red Kidney Beans
Dark Red Kidney Beans
Pink Beans
Large Lima Beans
Baby Lima Beans
Blackeye Beans
Garbanzo Beans

Utah
Pinto Beans

Wyoming
Great Northern Beans
Pinto Beans

Kansas
Pinto Beans
Great Northern Beans
Small White Beans

Nebraska
Great Northern Beans
Pinto Beans
Red Kidney Beans
Navy Beans

Colorado
Pinto Beans
Navy Beans
Great Northern Beans
Light Red Northern Beans
Small White Beans
How Soybean Oil and Meal are Prepared

- Hulls go directly to meal processing machine.
- Flakes go to get oil removed.

Solvent: Liquid that can dissolve oil.

- Flakes and hull are toasted together.
- Then ground up into meal.
- Flakes minus oil go to toaster.

- Oil solvent mixture goes to separator.
- Soybean oil goes to storage tanks.
Soybean Combine

Basic Combine Operation

The Reel
1. holds crop against Cutterbar
2. Cutterbar cuts crop. Reel pushes crop into path of Auger
3. Auger moves crop to Feeder Conveyor
4. Feeder Conveyor delivers crop to Threshing Cylinder
5. Threshing Cylinder and Concave
6. thresh crop. Rotary Deflector
7. strips straw from cylinder and deflects grain through Finger Grate
8. Straw Walkers
9. shake grain from straw. Grain and chaff fall onto Grain Augers.
10. Grain Augers feed grain to Cleaning Shoe.
11. Grain falls through Chaffer
12. and Sieve.
13. Clearing Fan
14. blows away chaff as grain falls through cleaning shoe. Clean Grain Elevator
15. moves clean grain to Grain Tank Loading Auger.
16. Loading Auger distributes grain evenly in Grain Tank.
17. Tailing fall off end of Sieve
18. and are carried by Tailings Elevator (not shown) to Threshing Cylinder for rethreshing.
### Miracle Crop of Many Uses

#### Soybeans

**Oil Products**
- Glycerol
- Refined Soy Oil
- Soybean Lecithin

**Whole Soybean Products**
- Oil Product
- Whole Soybean Product
- Soybean Meal Product

**Soybean Meal Products**
- Baked Soybeans
- Soy Flour Concentrate & Grits

#### Edible Uses

- Emulsifying Agent
- Bakery Products
- Candy Products
- Chocolate Coatings
- Pharmaceutical
- Nutritional
- Medical Use
- Dietary Use
- Anti-Spattering Agent
- Stabilizing Agent
- Shortening
- Antifoam Agent
- Yeast Manufacture
- Alcohol Manufacture
- Ink Manufacture
- Insecticides
- Rubber Mfr.
- Lighting Agent
- Cosmetics
- Pigments (paint)
- Calf Milk Replacers

#### Fatty Acids

- Cooking Oil
- Mayonnaise
- Margarine
- Pharmaceuticals
- Salad dressings
- Salad Oil
- Sandwich Spreads
- Vegetable Shortening
- Molline
- Medicinals
- Filled Milks
- Coffee Whiteners
- Creamers
- Liquid Shortening

#### Sterols

- Technical Uses
- Caulking Compounds
- Core Oils
- Disinfectants
- Electrical Insulation
- Insecticides
- Fungicides
- Insecticides
- Pesticides
- Linseed Backing
- Oiled Fabrics
- Printing Inks
- Protective Coatings
- Plasticizers
- Putty
- Soap
- Tin & Termite Plate Oils
- Waterproof Cement
- Wallboard Mfr.

#### Soybean Derivatives

- Soybean Flour
- Soy Flour Concentrate & Grits
- Soy Coffee
- Soy Soybutter
- Soy Protein

#### Food Uses

- Bakery Ingredient
- Alimentary Pastes
- Noodles
- Meat Products
- Cereals
- Prepared Mixes
- Food Drinks
- Baby Food
- Hypoallergenic Milk
- Confections
- Candy Products
- Special Diet Foods
- Meat Analogues

#### Industrial Uses

- Adhesive
- Plywood
- Wallboard
- Insecticidal Sprays
- Particle Board
- Tape Joint Cements
- Linoleum Backing
- Texture Paints
- Nutrient
- Yeast
- Antibiotic
- Beer & Ale
Soybean Products Word Search

Find the soybean by-products (forwards, backwards, and diagonal).

SOYFLOUR
SOYBEAN FLAKES
BEEF
BABY FOOD
WALLBOARD
DOG FOOD

SOAPS
PAINT
SALAD OIL
CHOCOLATE
FISH FOOD

MEAT EXTENDERS
MILK
HULLS
VARNISH
PLYWOOD

There are 15.
Dry Bean Word Search

Words are forwards, backwards and diagonal.

There are eight.

FIBER  WINDROW
NAVY BEAN  NORTHERN
PINTO BEAN  BLACK TURTLE
KIDNEY  PINK
Soybeans
You Eat

**Purpose:** To help students understand the nutritive value of soybeans and their role in the diet.

**Summary of Learning Activities:** There are seven learning activities for students that include individual, small group or whole-class participation. They include:

- a. Know Your Nutrients Worksheet (10-15 minutes after reading materials)
- b. Magazine Advertisement (20 minutes)
- c. Supermarket Hunt (2 hour field trip or 30 minute class)
- d. Food Label Worksheet (Done during the Supermarket Hunt)
- e. Roasted Soy Treats (Soak beans overnight and boil one hour. Roast for 30 minutes in classroom.)
- f. Tofu Stir Fry or Spread (20 minutes advance preparation, 20 minutes cooking)
- g. Soy Sprouts (Sprouts take four days to reach cutting stage.)

**Objectives:**
The student will learn to:

1. Recall the nutrients found in soybeans and to explain how each nutrient is used by their bodies.
2. Explain how the body uses saturated fat to make cholesterol and how cholesterol is deposited in the arteries.
3. Use their knowledge of saturated and polyunsaturated vegetable oil to choose healthy foods by reading the labels.
4. Tell two ways the nutrients found in soybeans are like the nutrients found in ground beef.
5. Taste soybeans in one or more dishes then develop a new recipe using soy beans or tofu. They may prepare that recipe at home.
6. Develop a commercial to describe the nutritional value of soybeans.

**Vocabulary:**
CALCIUM - A mineral that helps our bodies build strong bones and teeth.
CHOLESTEROL - Found in animals, this wax-like substance is made in the liver. Excessive amounts are deposited in arteries and lead to heart disease.
FIBER - Is the part of the plant humans cannot digest. Some types of fiber have a laxative effect and are helpful in preventing and treating constipation. Other types of fiber help the body lower blood cholesterol levels.
IRON - A mineral that helps carry oxygen in the blood.
LEGUMES - Any plant of the pea family where seeds grow in pods and are protein sources. These plants have root nodules containing bacteria that can capture nitrogen from the soil and the air to make into amino acids or protein.
MEAT EXTENDER - A ground soy meal that can be mixed with ground beef to extend the protein value and lower the cost.
POLYUNSATURATED FAT - A fatty acid in which two or more points could carry a hydrogen atom (two or more points of saturation occur).
PROTEIN - A nutrient that builds and repairs cells and tissues in our bodies.
SATURATED FAT - A fatty acid carrying the highest possible number of hydrogen atoms (having no points of unsaturation).
SOY SAUCE - Seasoning used in stir-fry foods.
STIR-FRY - To cook meat or vegetables in a shallow pan by tossing in a small amount of fat over low heat.
THIAMIN & RIBOFLAVIN - B vitamins that help develop a healthy nervous system.
TOFU - Soybean curd, looks similar to cottage cheese and is a source of protein.
TROPICAL OILS - Coconut, palm and palm kernel oils that contain a high amount of saturated fat.
UMBRELLA LABELING - Similar products are put under one grouping on the ingredient label of a food item.
U.S.R.D.A. - (United States Recommended Dietary Allowances) are numbers found on food labels and are the highest nutrient intake for any age and sex group recommended by the National Academy of Sciences for the maintenance of health.

Supplies/Preparation:
Activity 1
Know Your Nutrients, Student Worksheet 3-1

Activity 2
No preparation/supplies

Activity 3
Supermarket Hunt, Student Worksheet 3-2

Activity 4
A Closer Look at Food Labels, Student Worksheet 3-3

Activity 5
Field soybeans (obtain from farmer or Extension agent - not treated with fungicide or insecticide and for food use)
Baking soda
Water
Soak soybeans overnight
Oven or drip pan for frying and heat source, or microwave
(You might prepare soynuts before class.)
Activity 6

Stir Fry
1# firm tofu
Vegetable oil
3 green peppers
1 - 20 oz can pineapple chunks
2 large onions, sliced
Cooked rice
Soy sauce
Honey
Tomato sauce or ketchup
Vinegar
Cornstarch
Ginger
Electric skillet or wok
Spoon for stirring
Plates and spoon for tasting

Tofu spread
12 oz. tofu
Peanut butter
1 1/2 bananas
Lemon juice
Honey
Blender or mixer
Large bowl
Knife
Bread
Nuts/raisins (optional)

Activity 7

6-inch clay pot with drainage (scrubbed clean)
2-inch layer of washed pebbles, marble chips, or broken flower pot shards
Plastic or non-rusting window screen
2/3 cup beans

Background Information

After covering the material on "Soybeans You Eat," students will know more about the nutrients found in soybeans. The activities in this section help the student identify soybean food products. A key concept is the difference between saturated fat and polyunsaturated fat and their effects on blood cholesterol levels.

After the label reading activity, students should be able to identify what type of fat is found in various food products.

Building Strong Bodies With Soybeans

Most people know that meat is a good source of protein. Can you think of another source of high quality protein?

Like meat, soybeans are a source of high quality protein. They are a member of the plant family called legumes. Legumes are seeds, such as kidney and other dry beans, soybeans, garden peas, lentils, black-eyed peas and lima beans. These plants have nodules on their roots that contain bacteria that can "fix" nitrogen; that is, they can capture nitrogen from the air and soil and use it to make amino acids and protein. Legumes are rich in protein, and the protein is comparable to that found in meat. To have strong healthy bodies, we must eat a variety of foods from the four basic food groups (diagram 3-1). This includes two servings from the meat and bean group. Protein supplied by the meat and bean group helps us build and repair cells and tissues in our bodies. Later we will look at foods made from soybeans.

Just like meat, soybeans also contain two B vitamins and iron. Thiamine and riboflavin are the B vitamins. They help the body build a healthy nervous system. Iron helps the blood carry oxygen to the brain.

Did you know soybeans help build strong bones? Soybeans contain calcium, which helps our bodies build strong bones and teeth. Since our bodies lose and gain tissue, it is important for adults as well as children to eat foods with calcium.

Legumes not only supply all of these nutri-
ents but they are also a rich source of fiber. Fiber is a part of the plant that humans cannot digest. Some types of fiber have a laxative effect and help in preventing and treating constipation. Other types of fiber help the body lower its level of blood cholesterol, reducing the risk of heart disease. It is not clear exactly how much and what types of fiber we need in our daily diets. However, for most Americans, a moderate increase in dietary fiber is a good idea.

**Soybeans Are Found in Many Foods**

We can eat many forms of soybeans. You’ve probably heard of soy sauce. In China, soy sauce is used as a seasoning for stir-fry foods. A stir-fry meal is made of meat and vegetables that are tossed in a shallow pan in a small amount of fat and over low heat. You may have eaten soy sauce in Chinese dishes such as beef and snow peas or chicken and cashews.

The Chinese also use another soy product in cooking— tofu or soybean curd. Tofu is found in the fresh vegetable and fruit section of your supermarket. You can cut tofu into squares and use it in stir-fry dishes and salads. Tofu tastes and looks like cottage cheese. Since it is a good protein source, it can be used as a main dish.

Soybean milk is popular in China. Many times it can be bought in several flavors from vending machines. In the United States, people who are allergies to cow’s milk can enjoy soybean milk instead. Powdered soybean milk is found in health food stores. Soybean milk also is used in infant formula. You can find this formula on the shelves of your local grocery store.

Flour is another soybean product. This flour is sold with different levels of fat. The extra fat in the soy flour makes baked products moist. Products baked with soy flour require less liquid and are baked at lower temperatures. You can find soy flour in health food stores. People allergic to wheat can use it in baking and cooking.

In some parts of the world, soybeans are eaten as green vegetables. They are picked in late summer or early fall for cooking. This green vegetable is also canned and sold in supermarkets.

Did you know pizza will have more protein when made with soybeans? Soybean meal can be used as a meat extender. The soymeal product is mixed with ground beef to extend the protein value and quality of the meat and lower the cost.

The SOY MARK (diagram 2-3) helps consumers easily identify food products made from soybeans. The American Soybean Association has invested $128,000 in market research and development to find out what consumers think of the soybean. The SOY MARK will be a great marketing opportunity for soybean products.

**Fight High Cholesterol With Soybeans**

Have you ever heard a person say, “My doctor says my cholesterol is too high?” Or they might say, “I can’t eat eggs, bacon or drink whole milk.” What they are concerned about is the risk of heart disease or a heart attack. Research tells us that one way to reduce our risk of heart disease is to lower our blood cholesterol level. For adults 20 years old or older, the blood cholesterol level should be 200 mg/dl or lower. A standard for children has not yet been set. To lower your cholesterol level, you must eat fewer foods that contain cholesterol and saturated fats.

Why all the fuss about cholesterol and fat? Are they the same thing?

Fat and cholesterol are two different things. Cholesterol is a wax-like substance found only in animals and made in the liver. Our bodies need cholesterol in small amounts; however, excessive amounts are deposited in the arteries that carry blood to the heart, (diagram 3-2). Eggs and liver are high in cholesterol and other animal foods contain smaller amounts. Your body absorbs only about half the cholesterol you eat. If you eat too much, the liver will produce less cholesterol.

You’ve seen fat trimmed from a steak, or gotten your hands greasy from eating french fries or chicken strips. Fat is important to our bodies because it is a major source of energy for many tissues. Body fat protects organs such as the...
Fat helps carry vitamins A, D and K to our bodies' cells. It is a source of the essential fatty acid, linolenic acid.

Fat is found in food in three forms: saturated, monounsaturated and polyunsaturated. When you eat saturated fat, the liver makes it into cholesterol. Excess cholesterol is deposited as plaque in the arteries. As plaque builds up in the artery walls, blood flow to the heart is restricted. Polyunsaturated fat lowers your cholesterol level. We also believe that monounsaturated fat helps lower cholesterol levels; however, this has not been proven. Three other factors that speed up the deposit of cholesterol in the arteries are cigarette smoking, stress or high blood pressure, and lack of exercise.

Since eating saturated fats produces cholesterol in our bodies, what foods should we limit in our diets? Animal fats and tropical oils, such as coconut oil, palm oil and palm kernel oil, contain high amounts of saturated fat. Most of us know we should eat lean cuts of meat, eat fewer fried foods and trim the visible fat from meat. However, many people don't know about tropical oils.

If eating polyunsaturated and monounsaturated fat lowers our cholesterol, what should we eat? The answer is simple—fruits, vegetables and whole grain breads and cereals. If we must choose a product either made with or cooked in oil, we should choose oils from soybean, corn, peanut, sunflower and cottonseed. Look at diagram 3-3. Which oil would be low in saturated fat and the best to cook with?

Reading Food Labels

Two types of labels appear on food products. Ingredient labels are required on all products and tell the consumer what is in the product. Items are listed in order by content. For example, if the label reads “beef, pork, water, sodium,” beef is the most abundant ingredient. If the label reads “water, beef, pork, sodium,” water is the most abundant ingredient. Nutrition labels are required on products that make nutritious claim such as “low fat” or “low calorie.” The labels include the U.S.R.D.A. (United States Recommended Dietary Allowances), which are the highest nutrient intakes recommended for any age and sex group. The product nutrient content is compared to the U.S.R.D.A.’s (diagram 3-4).

Why talk about food labels and soybeans? More than half of the foods made with oil, such as cookies, crackers, boxed dinners and cakes, have umbrella labeling in the ingredient label. This means the oils are listed simply as “vegetable oils” (diagram 3-4). The consumer cannot tell if the product is made with a polyunsaturated oil like soybean or corn oil or with a saturated oil like palm kernel or coconut oil. The labeling makes it easy for food manufacturers to switch oils based on availability and price. However, it makes it more difficult to try to select foods low in saturated fat.

Here is an example of a label that sends a confusing message to consumers. The product advertises “NO CHOLESTEROL” but it says nothing about not containing saturated fat which can raise your cholesterol level. The ingredient label says, “Vegetable Oil (Contains one or more of the following: Cottonseed Oil, Corn Oil, Peanut Oil, Partially Hydrogenated Cottonseed Oil, Partially Hydrogenated Soybean Oil, Partially Hydrogenated Sunflower Oil or Palm Oil).” We know that if the product is made with a saturated fat such as palm oil, it will raise our cholesterol. What do you think about this kind of advertising?

ACTIVITY #1

Know Your Nutrients is Student Worksheet 3-1. In order to complete the crossword puzzle, the students must understand the importance of each of the nutrients found in soybeans.

ACTIVITY #2

Writing Copy - Write an advertisement for a magazine that tells the readers about the benefits of soybeans. Some ideas:

a. Show how the body uses saturated fat to make cholesterol and how cholesterol can be deposited in the arteries. Explain what types of
foods people should and shouldn't eat.
b. Write a hamburger or pizza ad showing two ways in which soybeans can provide the same nutrients as hamburger.

**ACTIVITY #3**
Supermarket Hunt, Student Worksheet 3-2 is a field trip to a local supermarket. After forming teams of two or three, see which team can list the most products containing soybeans. Crackers, cookies, chips, cake mixes, box dinners, cereals and frozen dinners may contain soybeans if you look at the ingredient label under cooking oil. Conclude with a meeting in the produce section so everyone can see what tofu is. Did anyone find soy sauce or soybean infant formula?

Cupboard Hunt is an alternate activity for classes who cannot go to the supermarket. Have each student bring one or two soybean or soyoil items from home. (Label each item with the student's name so it can be returned.) The teacher might bring a special display of tofu, soy sauce and soy infant formula.

**ACTIVITY #4**
Students can complete A Closer Look at Food Labels, Student Worksheet 3-3, while in the supermarket or doing the cupboard hunt in the classroom. Each student should select one or two products that have both an ingredient label and a nutrition label and complete the worksheet. The class can discuss what types of fat and how much were found in the foods the students selected.

**ACTIVITY #5**
Roasted Soy Treats are fun and easy to eat. Obtain some field soybeans from a local farmer or your Extension agent. Be sure these seeds have not been treated with a fungicide or insecticide and are intended to be eaten. Use this simple recipe to make soy treats in the classroom.

_Oven Roasted or French Fried Soynuts_: Remove any foreign matter and cracked soybeans. Soak 1 cup soybeans and 2 teaspoons baking soda in 4 cups of water overnight in the refrigerator. Boil one hour in same water. Optional: Use 1 teaspoon of salt per quart of water in soaking.

For Oven Roasted: Drain and air dry the boiled soybeans. Spread in a shallow pan. Roast in 350-F oven for 30 minutes or until brown. Stir frequently during roasting.

For French Fried: Drain and dry the boiled soybeans. Pour oil in a french fryer and heat to 350-F. Fry until lightly browned. Season with salt.

Yield: 1 cup unsoaked beans = 2-1/2 to 3 cups soaked soybeans = 1-3/4 cups roasted soybeans.

_Microwave Oven Roasted Soybeans_: Remove any foreign matter and cracked soybeans. Soak 1 cup soybeans in 4 cups water and 3 teaspoons baking soda for 24 hours in refrigerator. Drain soybeans and rinse with tap water. Add 4 teaspoons salt to drained soybeans. Mix well and let stand 15 to 30 minutes. Spread beans evenly in microwave cake dish. Roast in microwave oven until lightly browned.

**ACTIVITY #6**
Taste Tofu by preparing this easy oriental stir-fry or this peanut butter spread right in your classroom.

**SWEET AND SOUR TOFU**
_Serves 6 to 8_

1 pound firm tofu (drained)
3 tablespoons vegetable oil
3 green peppers, in strips
1 20-ounce can pineapple chunks
2 large onions, sliced
Cooked rice

_Sauce:_
1 cup pineapple juice from recipe above
1/4 cup soy sauce
1/4 cup honey
1/4 cup tomato sauce or ketchup
1/4 cup vinegar
1/4 cup cornstarch
1 teaspoon ginger
Drain tofu. Slice into 1 inch cubes. Combine all sauce ingredients in separate bowl. Stir until cornstarch is dissolved.

Use a wok or electric skillet. In a small amount of vegetable oil, stir-fry tofu on medium heat until browned, about 10 minutes. Be careful that the fire is not too hot and tofu does not splatter. Add vegetables and stir-fry until they are tender but firm. Add drained pineapple chunks and sauce and stir until sauce thickens, about 5 minutes. Serve over rice.

**TOFU, PEANUT BUTTER AND BANANA SPREAD**

12 ounces tofu
1/2 cup peanut butter
1 1/2 bananas
2 tablespoons lemon juice
1 to 2 tablespoons honey

Combine all ingredients in a blender and puree until smooth or beat with a mixer in a large bowl. Serve as is on whole-wheat bread, or top with nuts, raisins and thinly sliced bananas. Also delicious served simply as a fruit puree or frozen until just firm, mixed well to break up ice crystals, refreeze and served as a rich ice cream.

**ACTIVITY #7**

Soy Sprouts are fun to grow and taste. Start this experiment on the first day of your study of soybeans. By the time you finish, you will have soy sprouts to serve on crackers, rice cakes or whole wheat toast. Serve them with a sharp cheese to add flavor.

To make soy sprouts, take a 6-inch clay pot with drainage and scrub it thoroughly with soapy water to sanitize it. The porous clay pot will retain some moisture and help keep humidity high. A 6-inch pot will grow enough sprouts for a family of four for a week. Place a 2-inch layer of washed pebbles, marble chips or broken flower pot shards in the bottom of the pot for drainage. Cover this layer with a piece of plastic or non-rusting window screen from a hardware store and cut to size for the lower diameter of the pot.

Soak 2/3 cup of beans overnight. In the morning, drain the beans and place them on the screen in the pot. Rinse the beans with 70°F water each morning, noon and night, allowing the water to drain through the bottom of the pot. Rinsing reduces the buildup of heat during germination, which could spoil the crop.

Between rinsing, cover the top of the pot with a loose fitting saucer or piece of cardboard. This helps maintain high humidity and, more importantly, keeps light from reaching the germinating sprouts. Remember to maintain a 70°F temperature because a higher temperature will cause stunted, mold-prone sprouts. The sprouts should be 1/2 to 3/4 inch long and ready to use in three to four days.

To remove the green seed coats that cling to the seed halves or cotyledons, drop a handful of sprouts at a time in a bowl of water and gently agitate the mass. The hulls will float to the top. The sprouts are best eaten fresh but will keep several days in the vegetable crisper of the refrigerator. Be sure these seeds have not been treated with a fungicide or insecticide and are intended to be eaten.

**OPTIONAL ACTIVITIES:**

New recipes are fun to create. Develop a new recipe using soybeans or tofu. With parents permission, prepare that recipe at home. Remember tofu is a protein and must be cooked on low heat.

Write a commercial for the radio that lasts 30 seconds or 1 minute and tells about the nutritional value of soybeans.
Diagram 3-1

The Four Food Groups

- **Fruits and Vegetables**
  - Spinach
  - Bananas
  - Tomatoes

- **Breads and Grains**
  - Cereal
  - Macaroni

- **Milk and Dairy Products**
  - Milk
  - Cottage Cheese
  - Dry Milk

- **Meat and Beans**
  - Liver
  - Beans
  - Peanut Butter
Cholesterol collects inside the artery, underneath the artery lining cells.

Platelets form a cap to isolate the cholesterol plaque.

If cap breaks, plaque can form a blood clot and lead to a heart attack or stroke.
## Fatty Acid Composition of Oils and Fat

### % of Total Fatty Acids

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<th>Saturated</th>
<th>Monounsaturated</th>
<th>Polyunsaturated</th>
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<td>58</td>
<td>36</td>
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<tr>
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<td>20</td>
<td>69</td>
</tr>
<tr>
<td>Corn Oil</td>
<td>13</td>
<td>25</td>
<td>62</td>
</tr>
<tr>
<td>Olive Oil</td>
<td>14</td>
<td>77</td>
<td>9</td>
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<tr>
<td>Soybean Oil</td>
<td>15</td>
<td>24</td>
<td>61</td>
</tr>
<tr>
<td>Peanut Oil</td>
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<td>48</td>
<td>34</td>
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<tr>
<td>Cottonseed Oil</td>
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<td>19</td>
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<tr>
<td>Lard</td>
<td>41</td>
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<tr>
<td>Palm Oil</td>
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<td>39</td>
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<tr>
<td>Beef Tallow</td>
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<td>44</td>
<td>4</td>
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<tr>
<td>Butterfat</td>
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<td>30</td>
<td>4</td>
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<tr>
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<td>86</td>
<td>12</td>
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</tr>
<tr>
<td>Coconut Oil</td>
<td>92</td>
<td>6</td>
<td>2</td>
</tr>
</tbody>
</table>

Sources: Handbook No. 8-4 and Human Nutrition Information Service, USDA, and American Soybean Association.
Diagram 3-4

Nutrition Label Information

SERVING SIZE: 1 OZ. (28.4 g, ABOUT 1 CUP)
SERVINGS PER PACKAGE: 19

<table>
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<tr>
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<th>Cereal</th>
<th>With 1/2 cup Skim Milk</th>
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<tr>
<td>CALORIES</td>
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<td>150*</td>
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<td>PROTEIN</td>
<td>2 g</td>
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<tr>
<td>CARBOHYDRATE</td>
<td>25 g</td>
<td>31 g</td>
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<tr>
<td>FAT</td>
<td>0 g</td>
<td>0 mg*</td>
</tr>
<tr>
<td>CHOLESTEROL</td>
<td>0 mg</td>
<td>0 mg*</td>
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<tr>
<td>SODIUM</td>
<td>290 mg</td>
<td>350 mg</td>
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<tr>
<td>POTASSIUM</td>
<td>35 mg</td>
<td>240 mg</td>
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</table>

Percentage of U.S. Recommended Daily Allowance (U.S. RDA)

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<tr>
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<th>Cereal</th>
<th>With 1/2 cup Skim Milk</th>
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</thead>
<tbody>
<tr>
<td>PROTEIN</td>
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<td>10</td>
</tr>
<tr>
<td>VITAMIN A</td>
<td>25</td>
<td>30</td>
</tr>
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<td>25</td>
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<tr>
<td>THIAMIN</td>
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<td>RIBOFLAVIN</td>
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<td>45</td>
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<td>NIACIN</td>
<td>**</td>
<td>35</td>
</tr>
<tr>
<td>CALCIUM</td>
<td></td>
<td>**</td>
</tr>
<tr>
<td>IRON</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>VITAMIN D</td>
<td>10</td>
<td>25</td>
</tr>
<tr>
<td>VITAMIN B6</td>
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<td>35</td>
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<tr>
<td>FOLIC ACID</td>
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<td>PHOSPHORUS</td>
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<td>15</td>
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<tr>
<td>MAGNESIUM</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>ZINC</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>COPPER</td>
<td>2</td>
<td>4</td>
</tr>
</tbody>
</table>

INGREDIENTS:
RICE, SUGAR,
SALT, CORN,
SYRUP, MALT,
FLAVORING

*Whole Milk Supplies An Additional 30 Calories, 4 g Fat, and 15 mg Cholesterol
**Contains Less Than 2% of the U.S. RDA of this nutrient.
Umbrella Labeling

Diagram 3-5

Vegetable Oil

Palm Oil
Palm Kernel Oil
Coconut Oil
Soybean Oil
Sunflower Oil
Olive Oil
Corn Oil
Peanut Oil
Know Your Nutrients
Answer Key

Across:

2. Found in animals, this wax-like substance is made in the liver.
4. A mineral that helps our bodies build strong bones and teeth.
5. A fatty acid carrying the maximum number of hydrogen atoms.
6. A soybean curd that looks like cottage cheese and is a source of protein.
7. B vitamin that helps develop a healthy nervous system.
10. Oils such as coconut, palm and palm kernel that contain a high amount of saturated fat.
12. The part of the plant that humans cannot digest.

Down:

1. A fatty acid in which two or more points could carry a hydrogen atom.
3. B vitamin that helps develop a healthy nervous system.
8. A mineral that helps carry oxygen to the brain.
9. A nutrient that builds and repairs cells and tissues in our bodies.
11. Plants that have nodules on their roots that capture nitrogen and make protein.
### Student Worksheet 3-2

#### Supermarket Hunt

Products with Soybean Oil

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<th>Product</th>
<th>Manufacturers Name</th>
<th>What Other Fat/Oils Are Listed</th>
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<tbody>
<tr>
<td></td>
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</tbody>
</table>
Looking at Food Labels

Product Name: _____________ Net Weight: ____________
Manufacturer: ____________
Address: ____________

1. Nutrition Information - Per Serving
   Serving Size: ______ Weight/or Number
   Servings Per Container:
   Calories: ______ Protein: ______ Carbohydrates: ______
   Fat: ______ Sodium: ______ Potassium: ______

2. Ingredients: (List first seven)
**Purpose:** To help students understand the nutritive value of dry beans and their role in the diet.

**Summary of Learning Activities:** There are six learning activities that help students meet the objectives of this unit. They include the following:

a. Poster or Bulletin Board
b. Dry Bean Mosaic
c. Supermarket Math Student Worksheet
d. Journalist for a Day
e. Preybranatz
f. Snappy Bean Dip and Chips

**Objectives:**
The students will be able to:

1. Recall the nutrients found in dry beans
2. Identify dry beans as a low-fat, high-fiber protein complement.
3. Identify at least four different varieties of dry beans.
4. Visit a grocery store to compare serving costs of dry beans and other protein-rich food sources.
5. Develop a media release for newspaper, television or radio that explains the nutritional, historical or international value of dry beans.
6. Describe the benefits of using dry beans in the diet for health purposes.
7. Experiment with and taste at least two dishes made with dry beans, including a recipe from another country.

**Vocabulary:**
AMINO ACIDS - Building blocks for protein.
BLOOD CHOLESTEROL - A wax-like substance in blood; high levels increase the risk for heart disease. Also referred to as serum or plasma cholesterol.
COMPLEMENTARY PROTEIN - Two or more incomplete protein-rich foods that make a complete protein when eaten together.
COMPLETE PROTEIN - Protein that contains all of the essential amino acids needed for growth, maintenance and repair, in the proper balance.
COMPLEX CARBOHYDRATE - Carbohydrates composed of several glucose units; typically called starch.
INCOMPLETE PROTEIN - Protein that lacks one or more essential amino acids so that the balance of amino acids is upset.

INSOLUBLE FIBER - A group of dietary fiber that creates bulk and roughage in the intestinal tract and prevents constipation. Found in dried beans and peas, cereal bran and some vegetables.

MICRONUTRIENTS - Vitamins and minerals needed only in small amounts for healthy bodies.

NEW WORLD - The regions of North, Central and South America that were developed as a result of the Age of Exploration in the 15th and 16th centuries.

NUTRIENT - Components of food and drink that are necessary to maintain healthy bodies.

NUTRIENT DENSITY - The proportion of vitamins, minerals and protein compared to amount of energy available in foods. High nutrient density means that proportionally more nutrients are provided than energy.

OLD WORLD - Countries, primarily of Europe and southwest Asia, that were the center of activity during the Age of Exploration in the 15th and 16th centuries.

SOLUBLE FIBER - A group of dietary fiber that attracts water and forms a gummy substance. Found in dried beans and peas, oats, fruits and some vegetables.

■ Supplies/Preparation:

**Activity #1**
- Construction paper
- Magazine pictures
- Poster board
- Scissors
- Glue
- Colors, pencils and markers
- Straight pins, tacks or stapler

**Activity #2**
- At least four varieties of dry beans
- Glue
- Heavy construction paper or poster board
- Information sheet about dry bean varieties
- Information pamphlets about dry bean varieties

**Activity #3**
- Supermarket Math, Student Worksheet 4-1

**Activity #4**
- Sample media releases and/or taped 30 second radio spots
- Paper
- Pencils or pens
- Art supplies for magazine advertisements: paper, pictures, colored markers and pens
Activity #5
2 cans (16 oz.) Great Northern beans or other white beans
Large onion
Vegetable oil
Bay leaf
Paprika
Bean pot or large casserole dish
Skillet
Spoon
Can opener
Knife and cutting board
Measuring spoons
Optional: slow cooker or electric crock pot

Activity #6
Blender
Stirring or mixing spoon
Fork
Cutting knife
Cutting board
Can opener
Set of measuring spoons
1 can pinto beans
Lemon juice
Mayonnaise
Worcestershire sauce
Jalapeno pepper
Green onions
Corn tortilla chips
Napkins
Small serving bowl
Background Information

After reading the material on “Dry Beans You Eat,” students will learn about the nutrients in dry beans and why dry beans meet some general dietary guidelines. In this section students will learn about dry beans through supermarket visits, cooking projects, international research, art projects and writing projects for media releases. After the art activity, students will be able to identify several varieties of dry beans and their growing areas.

Dry Beans: A True Health Food

Dry beans pack a powerful nutritional punch! They are known as a good energy source because they contain starch. Starch is a complex carbohydrate. These take longer to digest than simpler carbohydrates such as sugar. This is good because it is easier to meet your body’s energy needs with “slow-action” starch. In fact, it is generally a good idea to eat more starch in our daily meals. Dry beans can certainly fill that need.

In some cases, protein-rich foods lack one or more amino acids. Dry beans are like this. Protein that lacks all the essential amino acids is an incomplete protein. To make dry beans a complete protein we usually eat them with another protein source that can provide the missing amino acid. When two or more protein sources are combined to make a complete protein we call them complementary proteins. We eat complementary proteins all of the time and don’t even think about it. For example, beans and ham, bean dip and corn chips, refried beans in a burrito, cereal and milk, beans and cornbread, peanut butter on wheat bread, and red beans and rice are all complementary proteins.

Dry beans are known for the nutrients they have. They are also known for nutrients they don’t have. That spells good news for reducing heart disease risk! To help lower the risk for heart disease we are encouraged to choose foods that are lower in fat and cholesterol. Dry beans are very low in fat. Less than 6 percent of all the calories in dry beans are from fat. As for cholesterol, dry beans have none! Cholesterol comes from animal products only. Recipes that use dry beans can be low in fat and cholesterol.

Figure 1. Carbohydrate content of dry beans

In many countries around the world people depend on dry beans as a major protein source. Protein is a nutrient used for growing, muscle building and repair. The building blocks for protein are amino acids. There are 10 amino acids for children — eight for adults — that we must get from what we eat because the body cannot make them. Proteins that have all of the required amino acids in the right balance are called complete proteins. Foods that have complete proteins include eggs, meats, fish, chicken, poultry, and milk or milk products.

Figure 2. Fat content of dry beans

Dry beans also are a very good source of fiber. One cup of cooked dry beans may contain 12 to 18 grams of total fiber. This is almost half of the recommended daily amount. To get the same amount of fiber from other foods, you would have to eat 10 slices of whole wheat bread or 3 cups of broccoli.

All dietary fibers are divided into two basic groups. Insoluble fiber mostly adds bulk or roughage to your diet. It helps to keep your
Figure 3. Fiber

digestive system it in good working order. Bowel movements are easier and more regular. About 40 percent of all of the fiber in dry beans is insoluble fiber. Other foods rich in insoluble fiber are wheat bran and most vegetables.

Soluble fibers attract water and form a soft gummy substance when you eat it. Somehow soluble fibers help to reduce blood cholesterol levels by interrupting cholesterol absorption. Medical doctors and nutritionists believe lowering cholesterol helps reduce heart disease risk. Soluble fibers may also benefit people with diabetes. Over half of the total fiber in dry beans is soluble fiber. Fruit, oat bran and dry beans all contain soluble fiber.

In addition to the big or major nutrients, dry bean also contain two classes of micronutrients — vitamins and minerals. Vitamins and minerals are present in foods in very small amounts and we need only a small amount to stay healthy. There are many different kinds of vitamins and minerals and dry beans contain different amounts of each. But dry beans are considered a high nutrient dense food. Nutrient dense foods have plenty of vitamins, minerals and protein compared to the calories provided. Figure 4 shows dry beans are high in protein, many of the B vitamins and some minerals.

A Little History

There are more than 400-500 commercial varieties of the common bean — perhaps as many as 1000 varieties. The common bean is actually a seed that comes from the bean pod.

Figure 4. Great northern beans

These seeds are white, brown, red, blue to black, and variegated. Some common beans are named navy, pinto, Great Northern, kidney, pink or black.

Lima beans originally grew in Central and South America. They are sometimes known as the "aristocrats" of the bean family. In southern United States, lima beans often are called "butter" beans.

The broad bean is the original bean of the Old World — mostly the European countries, Africa and southwest Asia. Horse, Scotch or Windsor beans are other names for broad beans. They are still popular in England today.

The mung bean of India and the adzuki bean of China and Japan are not as well known. In the United States we use mung beans primarily for their bean sprouts.

These beans, like all beans, are legumes. Other members of the legume family are split peas and lentils. Bacteria in the roots of legumes take nitrogen from the air and "fix" it into the soil. This helps enrich the soil with nitrogen.

Facts and Fiction About Beans

The history of beans goes back to pre-biblical times. There is evidence that common beans including kidney, navy and pinto beans grew in Central America over 7000 years ago. Several New World explorers mention beans in their diaries and journals. Even Christopher Columbus found a bean in Cuba that was different from any that were known in Europe at that
from any that were known in Europe at that time. When some of these “new” beans were first taken back to Europe in the 16th century only the upper classes could enjoy them as a delicacy.

The fairy tale Jack and the Bean Stalk is probably about the broad bean. Broad beans grow quite rapidly and reach nearly twice the height of a child. With a clever imagination wouldn’t it be possible to grow a “super” bean that allows a small boy to climb into the clouds and find a castle?

In Native American folklore beans and corn are often found together. One legend is about the cornstalk as a young man. His green robes glistened in the sun and his golden tassels tossed in the breeze as he sang about his desire for a wife. A lovely vine, the squash maiden, answered his song but the handsome corn plant turned her down. She wandered too much and he could not follow. Along came a slender bean. Her dress of green was spotted with flowers and her soft tendrils wrapped around the cornstalk. She promised her love forever. This is the reason in Native American agriculture the bean grows closely to the corn and the corn supports the bean with its sturdy stalk!

Today, beans are so much a part of our culture that we don’t often think about it. Have you ever been “full of beans?” If so, you are energetic and spirited. If you “haven’t got a bean” you are penniless. A “bean pole” is someone who is tall and lanky but you would never want it said of you “he doesn’t amount to a hill of beans.” If you “don’t know beans” you don’t know much and if you are “beany” you are crazy.

You all know the rhyme - “Beans, beans the musical fruit?” It is true that beans do cause flatulence in some people. Food legumes such as beans, peas and soybeans cause people to have excessive amounts of gas in their digestive tract. Beans cause flatulence because they contain a carbohydrate (oligosaccharides such as stachyose and verbascose) that cannot be digested in the stomach. These carbohydrates pass into the intestinal tract where microorganisms produce gases that include carbon dioxide, hydrogen and methane.

Some traditions in other countries related beans to royalty. In the Twelfth Night celebration in England a bean is placed in a cake. Whoever discovers the bean becomes the Bean King and reigns over the festivities. Even in our country, blackeye beans eaten on New Year’s Day in Texas will bring health, wealth and happiness for the coming year.

**ACTIVITY #1**

Students can design posters that describe the nutritional qualities of dry beans. Or student teams of three or four can plan a bulletin board for the classroom, lunch room or school halls. The bulletin boards should focus on the nutritional quality of beans. A selected panel of teachers, school personnel and/or students from other classrooms can judge the posters or bulletin boards.

**ACTIVITY #2**

Using a variety of beans, students can create a mosaic picture. Before beginning, students should select at least four different kinds of beans to use in their pictures. During library time, ask students to research the beans and identify what varieties were selected and where the varieties are grown. After pictures are completed, students should explain what varieties of beans were used to create the picture.

**ACTIVITY #3**

Visit a supermarket. The worksheet, “Supermarket Math,” should be copied and used by the students during the visit. Before the visit, explain to the students that the foods will all contain approximately the same amount of protein (about 14-16 grams). The foods to be compared will be dry beans (any variety), beef roast, hamburger, chicken, pork chops, fish fillets and eggs.

**Optional:** If a grocery store visit isn’t suitable for your group, ask students to visit the grocery store with a parent to complete the
**ACTIVITY #4**

Students will become news reporters or advertising executives in this activity. To introduce the activity have students listen to or read some sample media releases. Ask students to select one of the following approaches to their news story or advertisement. Students may be permitted to work in teams of two or three for this activity.

a. Develop a feature news story about dry beans and their health benefits in diets for Americans. You may interview a registered dietitian or other health professional who knows about the health benefits of dry beans.

b. Develop a feature news story about the history of dry beans as a food or the use of dry beans in foreign countries.

c. Write a 30-second radio spot featuring the nutritional benefits of dry beans. Record the message and play it for the class to hear.

d. Develop a one-page magazine advertisement about dry beans. Art work may be used.

**ACTIVITY #5**

Preybranatz is a special recipe from Serbia. Serbia is an area of Yugoslavia in southeastern Europe. This recipe may be served with cheese, green olives and corn bread as the first course in a large meal.

This recipe is fairly easy to make.

**Preybranatz**

**Ingredients**

- 2 16-oz cans Great Northern beans or other white beans
- 1 large onion, sliced
- 2 tablespoons vegetable oil
- 1 bay leaf
- 1 teaspoon paprika

**Directions**

1. Open beans with a can opener and place in a casserole dish or bean pot.
2. Heat oil in skillet and add sliced onion. Cook onion until golden
3. Add cooked onion, bay leaf and paprika to beans. Stir.
4. Place casserole dish or bean pot in oven (250-F) for 2 hours or longer. Be sure there is enough liquid to keep the beans moist.
5. Serve with corn bread and cheese, if desired.

Alternate method: Place beans, cooked onions and seasonings in a slow cooker or electric crock pot. Cook for three to four hours on medium to high setting.

**ACTIVITY #6**

This is a quick and easy recipe students will enjoy. Serve the bean dip with tortilla chips. The bean and corn combination is common in Central and South American countries and creates a complete protein.

**Snappy Bean Dip**

Yield: 1 1/2 cups

**Ingredients:**

- 1 16-oz can pinto beans, drained
- 2 tablespoons lemon juice
- 2 tablespoons mayonnaise
- 1 teaspoon Worcestershire sauce
- 1 teaspoon chopped and seeded Jalapeno peppers
- 3 tablespoons chopped green onion

**Directions:**

1. Place drained beans and remaining ingredients, except 1 tablespoon chopped green onion, in blender. Blend until smooth.
2. Alternate method: mash beans with a fork and then mix in remaining ingredients.
3. Place in small bowl and garnish with 1 tablespoon chopped green onion.
4. Serve dip with corn tortilla chips
Visit the grocery store. Find the price per pound for each of the following food items. Divide the price per pound by the Food Factor. The answer will give you the price for equal amounts of protein from each food item. Answer the questions at the bottom of the page.

<table>
<thead>
<tr>
<th>Food</th>
<th>Price per pound</th>
<th>Food Factor</th>
<th>Price for Equal Protein Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry beans (uncooked)</td>
<td></td>
<td>+6</td>
<td></td>
</tr>
<tr>
<td>Dry beans (canned)</td>
<td></td>
<td>+2</td>
<td></td>
</tr>
<tr>
<td>Beef roast (boneless)</td>
<td></td>
<td>+5</td>
<td></td>
</tr>
<tr>
<td>Ground beef</td>
<td></td>
<td>+6</td>
<td></td>
</tr>
<tr>
<td>Chicken fryer</td>
<td></td>
<td>+3</td>
<td></td>
</tr>
<tr>
<td>Pork chops</td>
<td></td>
<td>+5</td>
<td></td>
</tr>
<tr>
<td>Fish fillets</td>
<td></td>
<td>+6</td>
<td></td>
</tr>
<tr>
<td>Eggs (use price per dozen)</td>
<td></td>
<td>+6</td>
<td></td>
</tr>
</tbody>
</table>

A. Arrange the food from most costly to least costly in terms of price per equal amount of protein.

Most Costly

Least Costly

B. How do dry beans rank among the foods you surveyed?

C. Write a statement about how you can use dry beans in your diet. Consider cost, quality of protein, nutritional value and preparation.
PURPOSE: To help students understand the practical application of math in the day-to-day operations of a business.

SUPPLIES/PREPARATION:

Copies of math problems

1. **16** bags
A farmer wants to plant 150,000 seeds per acre in his soybean field. There are 1,500 seeds in 1 pound of soybeans. How many 50 pound bags will it take to plant the 8 acre field?

2. **66** times
A farmer has a planter that will plant 8 rows, each 30 inches wide. If the farmer's field is 1/4 mile or 1,320 feet wide, how many times will he have to drive across his field to finish planting it?

3. **5** pounds
A farmer wants to check his 8 row planter to see if it is planting enough seed in his field. He wants to plant 10 seeds per foot in the field. There are 1,600 seeds per pound in the soybeans he uses. If the farmer goes 100 feet, how many pounds of seed should he use?

4. **25** acres
A farmer has 50 bags of soybean seed that weighs 50 pounds each. The farmer wants to plant 100 pounds of soybean seed per acre. How many acres can the farmer plant with the supply of seed that he has?

5. **8** rows
A farmer has a combine that is 20 feet wide. The farmer used an 8 row planter with 30 inch wide rows. How many rows will the farmer be able to harvest at one time when he goes across the field?
6. Yes or No

A farmer has a combine that is 20 feet wide. His neighbor used a planter that plants 6 rows that are 40 inches wide. Will the farmer be able to help his neighbor combine his beans? If so, how many rows will he be able to harvest?

30__ rows

7. __30__ bushels

A bushel of soybeans weighs 60 pounds. A farmer harvests 3,600 pounds of soybeans from 2 acres. How many bushels per acre is the farmer harvesting?

7. __30__ bushels

A bushel of soybeans weighs 60 pounds. A farmer harvests 3,600 pounds of soybeans from 2 acres. How many bushels per acre is the farmer harvesting?

8. __300__ bushels

A farmer has a truck that weighed 16,000 pounds when it was empty. He went to the field and filled the truck with soybeans he harvested. When he weighed the truck after it was filled, it weighed 34,000 pounds. If soybeans weigh 60 pounds per bushel, how many bushels does this truck contain?

9. __30__ bushels

A farmer harvested 144,000 pounds of soybeans from an 80 acre field. Soybeans weigh 60 pounds per bushel. How many bushels per acre did the farmer's field yield?

10. Yes or No

A farmer has a bin that will hold 3,000 bushels of soybeans. A bushel of soybeans weighs 60 pounds. If a farmer harvests 192,000 pounds of soybeans, will the crop fit into his bin? How many bushels can it still hold or how many extra bushels does he have?

11. __18__ hours

A farmer is harvesting his soybeans with a combine that burns 5 gallons of fuel per hour. The tank on the combine holds 90 gallons of fuel. How many hours can the farmer harvest before he runs out of fuel?

12. __4__ times

A farmer has a combine that holds 300 bushels of soybeans. The farmer also has a semi-trailer truck that will haul 72,000 pounds of grain to the elevator. If a bushel of soybeans weighs 60 pounds, how many times can the farmer unload the combine in the truck?

13. __3000__ bushels

A farmer has a combine that will harvest 10 acres every hour. The field is yielding 30 bushels per acre. How many bushels will the farmer harvest at the end of a 10 hour day?
Purpose: To help students understand the concepts of a market economy and how farm products are bought and sold.

Summary of Learning Activities: The activities in this unit include individual and team activities.

a. Factors of Production
b. Demand Schedule and Curve (graph)
c. Supply Schedule and Curve (graph)
d. Futures Market - using newspaper
e. Factors that affect prices
f. Trace the soybean from field to consumer
g. Marketing Practices
h. Futures Market Trading Game

Objectives:
The student will learn about:
1. Concepts of supply and demand.
2. Affect of supply and demand on price and production.
3. Factors of production.
4. Graphing a supply and demand curve.
5. Concept of the futures market.
6. Careers involved in bean production.

Supplies and Preparation:

Activity 1
Factors of production, Student Worksheet 6-1

Activity 2
Demand schedule and curve, Student Worksheet 6-2

Activity 3
Supply schedule and curve, Student Worksheet 6-3

Activity 4
Futures Price chart, Student Worksheet 6-4
Futures page from newspaper

Activity 5
No preparation necessary

Activity 6
Chalkboard or Newsprint
**Activity 7**
Marketing Practices Worksheet

**Activity 8**
Futures Trading Game
Prepare materials

**Vocabulary:**

- **CAPITAL GOODS** - The machines, buildings and equipment used to produce goods and services.
- **COMMODITY** - Product of agriculture, mining or manufacturing.
- **CONSUMER** - Individual who purchases or uses goods or services.
- **DEMAND** - The amount or quantity of goods and services that consumers are willing or able to buy at various prices.
- **DEMAND CURVE** - A graph showing the quantity of a good or service demanded at various prices.
- **DEMAND SCHEDULE** - A chart expressing the quantity of a good or service demanded at various prices both for the individual and for the total group.
- **ECONOMIC SYSTEM** - A way of producing goods and services and of providing a means for people to buy and sell them.
- **ENTREPRENEURSHIP** - The ability to put together a business to make goods or provide services.
- **EQUILIBRIUM PRICE** - The point at which supply and demand meet; the amount supplied of a product equals the amount demanded at that price.
- **EXPORTS** - Products sold outside the United States.
- **FACTORS OF PRODUCTION** - Natural resources, labor, capital goods and entrepreneurship that go into producing goods and services.
- **FUTURES CONTRACT** - A promise to deliver (sell) a commodity or to take (buy) a commodity at a future date at an agreed price.
- **GOODS** - Products or items that we buy or someone else may buy from us. They can be physically measured or weighed. Bikes or skateboards, heating oil, groceries, lumber are goods. They are things that we can see and touch.
- **HEDGE** - Buying or selling a futures contract.
- **HEDGERS** - Farmers, county elevators, feedlots, processors and exporters who use the futures contracting system.
- **LABOR** - The work done by people to produce goods and services.
- **LAW OF DEMAND** - Consumers generally will buy less of an item at a higher price than at a lower price.
- **LAW OF SUPPLY** - Producers generally will supply more of an item at a higher price than at a lower price.
- **MARKET SYSTEM** - An economic system in which the interaction between buyers and sellers determines what is bought and sold, and for how much.
- **NATURAL RESOURCES** - All the things that come from the air, water or earth.
- **PRICE** - The amount of money given or asked for when goods or services are bought and sold.
- **PRODUCER** - Individual who makes goods or provides services.
- **SERVICES** - Tasks that people or machines perform. They are things that are done for us. Skating lessons, taking orders and serving lunch and hair cuts are examples of services. Services satisfy our wants for non-material things, things we cannot see or touch.
- **SUPPLY** - The amount or quantity of goods and service that producers will provide at various prices.
- **SUPPLY CURVE** - A graph showing the quantity of a good or service that will be produced at various prices.
- **SUPPLY SCHEDULE** - A chart expressing the quantity of a good or service that will be produced at various prices both for the individual and for a total group.
- **SURPLUS** - An oversupply of a good or service.
Background Information

Marketing
Countries, like people, have to fill wants and needs. A person may want a pair of designer jeans but needs only a pair of jeans. Every country has an economic system to meet its wants and needs and those of its people. Wants and needs can be satisfied by some type of goods or services. All of us want things. In fact, our wants can be almost unlimited in number. We have to make decisions about which wants we can afford to satisfy.

To satisfy wants and needs, a country and its citizens will use the resources available to them. People make decisions about how they will use their factors of production or the resources they have to provide goods and services.

Factors of production include:
1) Natural Resources are all things that come from the air, water or earth. Plants, trees, coal, iron, oil, oxygen and hydrogen are all examples of natural resources.
2) Labor is the work people do to produce goods and services. For example, all the steps from planting cotton to weaving the cloth to stitching the seams to producing a pair of jeans require labor. A garbage man also uses labor to provide a service for his customers.
3) Capital Goods are the machines, building and equipment that produce goods and services. Examples include the planting machines, cotton gins, sewing machines, shelves on which jeans are displayed, and stores where the goods are sold. The truck the garbage man uses also would be a capital good. Capital goods are essential for producing goods and services.
4) Entrepreneurship is the ability to put together a business to make goods or provide services. An entrepreneur takes the risk of starting and managing a business. He or she uses the other factors of production (natural resources, labor and capital goods) to provide goods and services for sale. The entrepreneur takes the risk that consumers will not buy these goods and services. A farmer, for example, is an entrepreneur who may use the factors of production to produce soybeans.

The United States has a well organized way of producing goods and services so that people can get many of the things they want and need. Our country has a market system. A market system is an economic system in which buyers and sellers determine what is bought and sold, and at what price.

In a market system, questions about what goods and services will be produced, how much will be produced and how much will cost are answered in the marketplace. The market is not only a place but a way to describe all the individual buying and selling decisions together. The market system decides which goods and services people will buy and at what price.

In a market system, the consumer is very important. Every time you buy something, you are a part of the market system and your decision helps determine what will be produced. Your buying decision, with that of other consumers, creates demand for a good or service.

Demand is the amount of a good or service that you as a consumer are willing and able to purchase at a certain price. At the same time that you are demanding a product, a producer is supplying the good or service. This is called the supply of the product. Supply is the quantity of a good or service that producers are willing and able to sell at a certain price.

In market economics, price plays an important role in deciding what goods and services will be produced. Consumer demand plays an important part in deciding the price of a good or service.

Have you ever noticed that prices for goods and services may go up and down? For example, when there is an unexpected freeze in Florida or California, the price of oranges and other citrus fruits may go up because the supply was reduced. The price of calculators or Nintendo games went down after they had been sold for awhile because the demand was lower and the supply remained high. Price go up and down because in our market system the question of supply and demand is being answered constantly.

There are many kinds of markets such as
automobiles, televisions, apples and soybeans. In all the markets, price decides what is bought, sold and produced. Price can be an encouragement or discouragement to the buyers (consumers) and sellers (producers) in the market.

Consumers (buyers) provide the demand for an item. The law of demand says that consumers generally will buy more items at a lower price than at a higher price. The opposite also is true—the higher the price the fewer items the consumer will buy.

For example, you go into a stereo store with $8.00 to buy a cassette. When you get to the store, they are having a half price sale and you can buy two cassettes instead of one. This will increase the demand for the cassettes.

However, if you go into the stereo store with $8.00 and find out the cassette you want costs $12.00 you may not buy the cassette at all. This will decrease the demand for the cassette.

The price of goods and services also affects the producers. The supply of goods and services is based on the price received by the producer. Producers must get more for selling a good or service than it cost them to produce. The difference between what it cost the producer to provide the goods and services and the price they get is called a profit. A producer must make a profit if he or she wants to stay in business.

The law of supply says that producers will produce more of an item for a higher price. The opposite also is true: The lower the price, the smaller the supply of the goods and services provided.

Suppose the price of eggs is $2.00 a dozen. At this high price, producers will probably supply more eggs because the price is so much higher than the cost of production. This means they could make a large profit. At the same time, new producers will see the potential to make money and start to supply eggs, too. However, not many consumers are willing to pay $2.00 for eggs. One day the producers realize there is a huge supply of eggs on hand that they cannot sell for $2.00. This oversupply of goods and services is called a surplus.

In order to sell the eggs before they rot, producers lower the price to $.50 per dozen. Consumers start to buy more eggs. However, it costs more than $.50 a dozen to produce eggs. Some producers will lose money and go out of business. With fewer producers, the supply of eggs starts to go down. Eventually, the market will establish a price for eggs that consumers are willing to pay and that will allow producers to make a profit.

Chicago Board of Trade

Consumers and producers will follow their own supply and demand curves. The consumer will try to buy as much as possible for the lowest price. The producers will want to make as much profit as possible by selling as much as possible at the highest price. It is in the marketplace that prices for all goods and services sold are determined.

The price of soybeans produced by farmers also is determined in the marketplace. In the 1800s, farmers did not have a central market in which to sell their grain products. The largest grain trading area in the United States was in the city of Chicago. Many times the producers would bring their grain to Chicago and try to find a buyer. In the winter there were a lot of buyers but not very many sellers, and the price of grain would be very high. When farmers harvested their grain in summer and fall, there would be a lot of sellers and very few buyers. When this happened, the price of the grain was very low.

Because of these ups and downs, 82 men created the Chicago Board of Trade (CBOT) in 1848. The CBOT served as a place where buyers and sellers of grain could come to set a price for grain. The CBOT still is working today and has become the place where many kinds of products are priced for the world market.

Not very many farmers sell their grain directly at the CBOT. Instead, they sell their products to local buyers who pay the farmer the price set at the CBOT. The price the farmer gets is usually the price on the CBOT minus what it will cost to transport the grain to Chicago. The difference between what the local grain buyer offers the farmer and the CBOT price is called
the basis. In this way, a grain seller anywhere in the world will know what he or she can get for grain if he or she knows what the CBOT price is. This makes it easier for farmers (producers) and grain buyers to buy and sell grain.

There are many ways to learn what the price of grain is on the CBOT. Newspapers, radio, television and other news organizations cover prices at CBOT.

When you look at the CBOT market report in your local newspaper, you will notice that there are different prices for soybeans for different months. This allows grain buyers and farmers to set prices for grain in the future. That is why some people refer to the prices on the CBOT as futures prices. The futures market allows farmers to sell grain all year round. It also provides the buyers with a year round supply. The grain prices are set for every month of the year.

Farmers and buyers can use CBOT prices to know what grain prices will be throughout the coming year. If the farmer sees that in a particular month the price of the grain will be above his expected cost of production, and he can make a profit, he can agree to sell it to a buyer during that month. This way a farmer can anticipate when he will sell the grain and for how much. A grain buyer will look for a price at which he can buy the grain from the farmer and produce a product to sell to the consumer. The buyer will know what it is going to cost him to have a supply of soybeans. It this way, the buyers and sellers in the marketplace determine the market price for the grain.

Many things can make the price of the soybeans on the CBOT to go up and down. Most of these factors effect the demand for or supply of soybeans. Soybean supply may go down because of lack of rain, disease, or farmers going out of business or planting different crops. The supply of soybeans might increase because of the development of a new soybean variety, more farmers planting soybeans, or a good year in terms of weather and lack of disease. Some factors may increase the demand for soybeans, such as the discovery of new uses for beans, increased exports, or the discovery of the health benefits from beans.

Marketing a commodity such as soybeans includes getting the finished product to the consumer. Marketing is moving a raw commodity from the producer (the farmer) to the end consumer (yourself). This process can be called the marketing and distribution channel. A raw commodity may go through many buyers and sellers before it gets to the consumer in its final form.

For example, soybeans are bought and sold through the futures market in the raw state, as they come from the field. Then they are shipped to a processor who produces oil and meal. The oil and meal then go to manufacturers who use them in making food and non-food items. Finally, they are shipped to the stores where the consumer purchases them.

The marketing chain looks like this:
- farmer - grain elevator - (sold through the futures market) - raw processor who produces oil and meal - food manufacturer to make chocolate - the grocery store

Taking a raw commodity and turning it into a consumer product can be complicated and expensive.

- **Activity 1:**
  Factors of Production, Student Worksheet 6-1

- **Activity 2:**
  Demand Schedule and Curve, Student Worksheet 6-2

- **Activity 3:**
  Supply Schedule and Curve, Student Worksheet 6-3

- **Activity 4:**
  Charting Prices from CBOT, Student Worksheet 6-4

- **Activity 5:**
  Factors affecting prices
  List a number of factors that would cause the soybean price to rise.
1. Fewer number of acres planted.
2. Insufficient rain.
3. Increased demand from foreign buyers.
4. Increased use due to health concerns.
   (Example: soybean oil).

List factors that would cause prices to fall. 
(Opposite of those above.)

**Activity 6:**
List some of the steps soybeans go through before they get to the final consumer. (Use Student Worksheet 6-5)

Grower, truck driver (transportation), elevator, processor, grocery store.

**Activity 7:**
Marketing Practices

**Activity A:** Select two or three marketplaces offering the same product or service in your area (such as, grocery stores, beauty salons, car repair shops). Then choose a product or service and see how prices compare among stores. How does the consumer help create prices?

**Activity B:** Talk with a supermarket manager about how volume of sales affects price.

**Activity C:** Compare a futures market as a centralized market place to a market in your area. What are the similarities and what are the differences?

**Activity D:** Identify a product or commodity that currently has a surplus or shortage. Watch the product for weeks or months to see if it changes.

**Activity 8:**
Futures Trading Game

Prepare tickets needed for trading. You will need several cards per person.

Make cards 4" x 6" in two different colors, one for buying, one for selling.

The BUY tickets should look like this:

Front:

BUY OPTION

Back:

I WANT TO BUY _______ BUSHELS

<table>
<thead>
<tr>
<th>PRICE</th>
<th>AMOUNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRICE</td>
<td>AMOUNT</td>
</tr>
</tbody>
</table>

Prepare selling tickets the same way, substituting sell for buy.

Write on the tickets different numbers of bushels (100, 50, 500, etc.), different starting prices such as: $7.00 to sell or $7.00 to buy on the top part of the ticket. Students fill in the bottom when trading.

If you laminate the tickets, you can use wipe-off pens and reuse the tickets.

**Prepare NEWS FLASH cards.**

Make the news flash cards 4" x 6" and a different color. Write on the cards things that will affect the market such as:

- Grain bin burns up, your team just lost 2,000 bushels of soybeans.
- Research plant discovers new use for soybeans, buy 3,000 bushels.
- South American producers are sending a large shipment of soybeans to the states, buy an extra 2,500 bushels.
- South American producers are having a drought, sell 1,500 bushels.
- Grasshoppers are out of control in midwest, buy soybeans now.

Make up a TRADING DAY REPORT form for each team as shown.
TRADING DAY REPORT

Trading Name ______________________________________

Members ____________________________________________

Number of bushels bought or sold ________
(Total from all tickets traded.)

Total amount of money traded. ____________
(Figure by multiplying bushels x price on each ticket and then add all tickets).

Best deal of the day. ____________

"News Flashes" received. ____________

Chicago Board of Trade Game
This activity simulates the basic trading that takes place in the trading pit. Students will not only learn objectives of the commodity exchange, but also bargaining skills, decision making skills and math skills. This project runs smoother with calculators.

Set up room into 3 areas.

BUYERS SELLERS

TRADING PIT

TEACHER'S INSTRUCTIONS

1. Appoint two students as trading captains, one for buyers and one for sellers. Divide remaining students into teams of three or four and assign them to be buyers or sellers. Have teams choose a name, such as "Super Soy Sellers" and make signs. Must have equal number of buyer teams and seller teams.

2. Explain the objectives of the buyer teams and seller teams to the students.
   A. Objective of BUYERS: To buy at the lowest possible price and fill all orders. Winning team buys the most soybeans for the least amount of money.
   B. Objective of SELLERS: To sell at the highest possible price and fill all orders. Winning team sells the most soybeans for the highest amount of money.

3. Show teams the trading tickets and point out prices and number of bushels.

4. Explain the role of the trading captain and the traders.
   TRADERS - To buy or sell commodities (soybeans) listed on the ticket at a profit for the team. Must record price and number of bushels sold. Then return to the trading captain for a new ticket.
   TRADING CAPTAIN - Holds all the tickets and maintains them in order, calculates tickets, acts as consultant on prices, receives "News Flashes", and gives final report.

5. Explain that there is a time limit of 30-35 minutes for trading.

6. Explain that these same activities take place in the Chicago Board of Trade.

7. Explain that the you will be handing out "News Flash" cards to teams on a random basis, perhaps by drawing teams names out of a hat. For instance, you give the "Super Soy Sellers" a card saying "Research plant discovers new use for soybeans - Buy 3000 bushels." Thus, the simulation is closer to the Chicago Board of Trade.

8. Give students a practice demonstration to understand and ask questions. Take a student and decide who needs a buyer card and a seller card. Enter the trading pit.
   Teacher (seller): "I am selling 500 bushels."
   Student (buyer): "I am buying 300 bushels."
   Teacher: "I want to sell my soybeans at $7.50 (card says above $7.25)."
   Student: "I want to buy soybeans for $7.00 (card says under $7.20)."

   Student and teacher must then determine a price; it may not be what either really wants, but the only way to win is to buy or sell soybeans.

   The teacher then goes back to trading captain and says, "I have sold 300 bushels at $7.25 and have 200 bushels left." He or she draws another card and goes back to the trading pit.
The student also goes back to trading captain to return finished ticket, draws another, and returns to the trading pit.

10. Circulate in the pit to spot any problems, explain what is supposed to be happening, etc.
11. Give out "News Flashes".
12. End trading and have teams figure their totals and fill out the Trading Day Report

Sample of tickets during or after trading.

SELL OPTION
I want to BUY
4000 bushels

Price 7.05
Amount 1000 bushels

Price 6.90
Amount 3000 bushels
Team A - TRADED

BUY OPTION
I want to SELL
1000 bushels

Price 7.00
Amount 1000 bushels

Price 7.05
Amount 1000 bushels
Team B - TRADED

BUY OPTION
I want to sell
3000 bushels

price $7.00
Amount 3000 bushels

Price $6.90
Amount 3000 bushels
Team C - TRADED

1. Team A bargains to buy 4,000 bushels. Team B only has 1,000 bushels. So they settle at 1,000 bushels for $7.05.
2. Team A buys remaining 3,000 bushels at $6.90 from Team C.
3. If a "News Flash" was presented to Team B such as "Mismanaged inventory - Need 2,000 bushels immediately for production in meat extender plant, buy now." Traded would enter the pit read out loud and immediately fill the order.

Note: Students can sell or buy part of an order on each ticket. A student can over sell or buy if they feel the amount needed is still available at the trading desk.

Optional Activities:
The Farming Game - commercial game
Collecting futures prices from newspaper or radio and chart them on a graph.
Develop a soybean commercial or newspaper ad.
Factors of Production

List the factors of production used by a farmer to grow soybeans and dry beans. Also list the factors needed to get the product from the field to the table.

NATURAL RESOURCES

LABOR

CAPITOL GOODS

ENTREPRENEURSHIP
Demand Schedule and Curve

List how many bottles of pop you would buy each day for each price listed. Assume you would buy at least one bottle a day.

<table>
<thead>
<tr>
<th>Price</th>
<th>Number I Would Buy</th>
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<tbody>
<tr>
<td>$.80</td>
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<tr>
<td>.70</td>
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Now suppose it is summer and very hot outside. How many bottles of pop would you buy?

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Plot the demand schedule on graph paper to show the demand curves for bottles of pop.

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1 2 3 4 5 6 7
Bottles of Pop

Make up a demand schedule for a different product—jeans, Nintendo games, etc.
Supply Schedule and Curve

It costs you $.15 to produce a bottle of pop. How many bottles would you produce at each price? Plot this supply curve.

\[
\begin{array}{c|c}
\text{Price per Bottle} & \text{Number of Bottles Produced} \\
\hline
.80 & 1 \\
.70 & 2 \\
.60 & 3 \\
.50 & 4 \\
.40 & 5 \\
.30 & 6 \\
.20 & 7 \\
.10 & \\
\end{array}
\]
Charting prices from CBOT

Record and graph daily CBOT soybean prices. Choose one month and record daily price for a week.

For example:

<table>
<thead>
<tr>
<th>Day</th>
<th>Price per bushel</th>
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<tbody>
<tr>
<td>Monday</td>
<td>7.03</td>
</tr>
<tr>
<td>Tuesday</td>
<td>7.04</td>
</tr>
<tr>
<td>Wednesday</td>
<td>7.08</td>
</tr>
<tr>
<td>Thursday</td>
<td>7.06</td>
</tr>
<tr>
<td>Friday</td>
<td>7.08</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Day (dates)</th>
<th>Price per bushel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday</td>
<td></td>
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Careers in the Production and Marketing of Soybeans

A list of businesses and professions involved in the complex economic system that produces soybeans and dry beans and its many end products more efficiently and economically than anywhere in the world.

**Seed Production**
- **Research**
  - Plant Breeder, Experimental Farm Manager,
  - Experimental Milling & Banking by University
  - and USDA scientists
- **Seed Production**
  - Grower, State Crop Improvement Association,
  - Seed Cleaning, Firms, Seed Treatment and Chemicals
- **Seed Marketing**
  - Producer, Seed Companies, Seed Salesperson,
  - Transportation, Storage

**Soybean/Dry Bean Production**
- Grower
- Landlord, Land Owner
- Farm Machinery Supplier - Manufacturer, Dealer
- Irrigation Equipment Supplier
- Supplier of Fuel, Tires, Batteries, etc.
- Supplier of Fertilizer - Manufacturer, Dealer
- Custom Spreading Equipment
- Ag Chemical Supplier for Seed Control
- Custom Combine Operator
- Transportation, Truck
- Insurance Crop - Local Agent, Company, U.S. Government
- Trade Association Soybean Growers Association
  - U.S. Soybean Growers Association
  - The Soybean Quality Council

**Soybean/Dry Bean Storage**
- Grower - On Farm
- Suppliers of storage bins and handling equipment such as augers, elevators
- Suppliers of aeration and drying equipment
- Sanitation technicians, management, research
- Suppliers of chemicals for insect control and equipment for application such as sprayers, probes, etc.
- Suppliers of temperature monitoring equipment
- Commercial storage - country elevator, terminal elevator, port elevators, subterminal elevators
Soybean/Dry Bean Marketing

Grain Buyer - Country Elevator, Subterminal, Terminal and Flour Mill
Grain Broker, Grain Merchandisers, Grain Inspection - State Grain Inspection Department, FGIS, USDA, Private Agencies and Personnel
Grain Elevator Operating Personnel - Manager, Superintendent, Laborers, Office Personnel, Grain Grader
AMINO ACIDS - Building blocks for protein.

BEAN BUGGY - A machine attached to the front of a tractor where people ride and spray weeds competing for sunlight and nutrients of the soybean.

BLOOD CHOLESTEROL - A wax-like substance in blood; high levels increase the risk for heart disease; also referred to as serum or plasma cholesterol.

BUSHELS - Unit of measure.

CALCIUM - A mineral that helps our bodies build strong bones and teeth.

CAPITAL GOODS - The machines, buildings and equipment used to produce goods and services.

CHLOROPHYLL - Green coloring in plants. With sunlight it changes water and carbon dioxide into food for the plant.

CHLOROPLAST - Part of a green cell that contains chlorophyll.

CHOLESTEROL - Found in animals, this wax-like substance is made in the liver. Excessive amounts are deposited in arteries and lead to heart disease.

COMBINE - A machine that cuts, threshes and cleans grain while moving over the field.

COMMODOITY - Product of agriculture, mining or manufacturing.

COMPLEMENTARY PROTEIN - Two or more incomplete protein-rich foods that make a complete protein when eaten together.

COMPLETE PROTEIN - Protein that contains all of the essential amino acids needed for growth, maintenance and repair, in the proper balance.

COMPLEX CARBOHYDRATE - Carbohydrates that are composed of several glucose units; typically called starch.

CONSUMER - Individual who purchases or uses goods or services.

COTYLEDONS - The food source for the bean while in the ground; first leaves to appear growing out of the seed.

CULTIVATOR - A machine that digs up the ground between rows.

DEHULUNG - Process of removing the hulls (outer shell) of soybean.

DEMAND - Amount or quantity of goods or services that consumers are willing or able to buy at various prices.

DEMAND CURVE - A graph showing the quantity of a good or service demanded at various prices.

DEMAND SCHEDULE - A chart expressing the quantity of a good or service demanded at various prices both for the individual and for the total group.

DICOTYLEDON OR DICOT - Seeds with two food sources like soybeans or dry beans.

ECONOMIC SYSTEM - A way of producing goods and services and of providing a means for people to buy and sell them.

EMBRYO - Part of the seed from which the plant develops.

ENTREPRENEURSHIP - The ability to put together a business to make goods or provide services.

EPICOTYL - Part of the sprouting seed that develops into the stem of the plant.

EXPORTS - Products sold outside the United States.

EQUILIBRIUM PRICE - The point at which supply and demand meet; the amount if a product supplied equals the amount demanded at that price.

EXTRACTING - Using a chemical solvent to remove the soybean oil.

FACTORS OF PRODUCTION - Natural resources, labor, capital goods and entrepreneurship that go into producing goods and services.
FIBER - Is the part of the plant humans cannot digest. Some types of fiber have a laxative effect and are helpful in preventing and treating constipation. Other types of fiber help the body lower blood cholesterol levels.

FLAKING - Process of rolling the dehulled soybeans into very thin flakes.

FUTURES CONTRACT - A promise to deliver (sell) a commodity or to take (buy) a commodity at a future date at an agreed price.

GERMINATION - The process of growing or sprouting from seed to plant.

GOODS - Products or items that we buy or someone else may buy from us. They can be physically measured or weighed. Bikes or skateboards, heating oil, groceries, lumber are goods. They are things that we can see and touch.

HEDGE - Buying or selling a futures contract.

HEDGERS - Farmers, county elevators, feedlots, processors and exporters who use the futures contracting system.

HILUM - Scar on seed where it was attached to the pod.

HYPOCOTYL - Part of the sprouting seed that forms the base of the stem.

INCOMPLETE PROTEIN - Protein that lacks one or more essential amino acids so that the balance of amino acids is upset.

INSOLUBLE FIBER - A group of dietary fiber that creates bulk and roughage in the intestinal tract and prevents constipation. Found in dried beans and peas, cereal bran and some vegetables.

IRON - A mineral which helps carry oxygen in the blood.

LABOR - The work done by people to produce goods and services.

LAW OF DEMAND - Consumers generally will buy less of an item at a higher price than at a lower price.

LAW OF SUPPLY - Producers generally will supply more of an item at a higher price than at a lower price.

LEGUME - Any plant of the pea family where seeds grow in the pods, store nitrates, and seeds are protein sources.

LEGUMES - Seeds of plants, such as the kidney bean, soybean, garden pea, lentil, black-eyed pea and lima bean. These plants have nodules on their roots containing bacteria that can capture nitrogen from the soil and the air to make into amino acids or protein.

MARKET SYSTEM - An economic system in which the interaction between buyers and sellers determines what is bought and sold, and for how much.

MEAT EXTENDER - A ground soy meal that can be mixed with ground beef to extend the protein value and lower cost.

MICRONUTRIENTS - Vitamins and minerals needed in only small amounts for healthy bodies.

MINIMUM TILLAGE - A process of tilling the ground a minimum amount to help soil retain nutrients and water.

MONOCOTYLEDONS OR MONOCOTS - Seeds with one food source like corn.

NATURAL RESOURCES - All the things that come from the air, water or earth.

NEW WORLD - The regions of North, Central and South America that were developed as a result of the Age of Exploration in the 15th and 16th centuries.

NITROGEN - Gas in the air used by soybean plant.

NITROGEN FIXATION - Rhizobia act as catchers of nitrogen and place in nodules. After harvest, nodules break open supplying ground with nitrogen.

NODE - Where the leaf petiole connects to the stem.

NODULES - A small swelling or knob on the bean root that gathers nitrogen from the air.
NUTRIENT DENSITY - The proportion of vitamins, minerals and protein compared to amount of energy available in foods. High nutrient density means that proportionally more nutrients are provided than energy.

NUTRIENTS - Elements that are essential for healthy growth.

OLD WORLD - Countries, primarily of Europe and Southwest Asia, that were the center of activity during the Age of Explorations in the 15th and 16th centuries.

OVARY - Flower part that develops into a seed.

PETIOLE - "Stem like" structure between leaf blade and stem.

PHLOEM - Food carrying tube in the stem; transports food made in the leaves to other parts of the plant.

PHOTOPERIODISM/PHOTOPERIOD - The sensitivity of a plant to changes in day length; the amount of light during the day that determines the maturing time of the plant.

PHOTOSENSITIVITY - The sensitivity of a plant to light; the amount of light during the day which determines the maturing time of the plant.

PHOTOSYNTHESIS - Water and carbon dioxide are absorbed and sent to leaves. Sunlight provides energy to make food for the plant (sugar) and oxygen (which we breathe).

POLLEN - Powder produced by a flower that contains male genes.

POLYUNSATURATED FAT - A fatty acid in which two or more points could carry a hydrogen atom (two or more points of saturation occur).

PRICE - The amount of money given or asked for when goods or services are bought and sold.

PRODUCER - Individual who makes goods or provides services.

PROTEIN - A nutrient that builds and repairs cells and tissues in our bodies.

RADICLE - Part of the sprouting seed that develops into the root.

RHIZOBIA - A bacteria that is important to beans to help them take nitrogen from the air and store it in the root nodules.

ROOT HAIRS - Extension of a single cell on the root surface into the soil.

SATURATED FAT - A fatty acid carrying the maximum possible number of hydrogen atoms (having no points of unsaturation).

SELF-POLLINATION - The pollen produced within the flower which fertilizes the ovary of the same flower.

SERVICES - Tasks that people or machines perform. They are things that are done for us. Skating lessons, taking orders and serving lunch and hair cuts are examples of services. Services satisfy our wants for non-material things, things we cannot see or touch.

SOLUBLE FIBER - A group of dietary fiber that attracts water and forms a gummy substance. Found in dried beans and peas, oats, fruits and some vegetables.

SOYBEAN FLAKES - Product resulting from crushing and steam heating soybeans.

SOYBEAN MEAL - Product made by extracting the oil from crushed soybeans, "toasting" the meal and grinding it.

SOYBEAN OIL - Product resulting from the solvent extraction process.

SOY SAUCE - Seasoning used in stir-fry foods.

STIR-FRY - To cook meat or vegetables in a shallow pan by tossing in a small amount of fat over low heat.

STOMATA - Openings in a leaf that allow oxygen and carbon dioxide to move between the leaf and the air.

SUPPLY - Amount or quantity of goods and service that producers will provide at various prices.

SUPPLY CURVE - A graph showing the quantity of a good or service that will be produced at various prices.
SUPPLY SCHEDULE - A chart expressing the quantity of a good or service that will be produced at various prices both for the individual and for a total group.
SURPLUS - An oversupply of goods or service.
SYMBIOTIC RELATIONSHIP - The living together of two dissimilar organisms in a mutually beneficial relationship.
TAPROOT - The primary root of a plant.
THIAMIN & RIBOFLAVIN - B vitamins that help develop a healthy nervous system.
TOFU - Soybean curd, looks similar to cottage cheese, and is a source of protein.
TRIFOLIATED LEAF - Three-bladed leaf.
TROPICAL OIL - Coconut, palm and palm kernel oils that contain a high amount of saturated fat.
UMBRELLA LABELING - Similar products are put under one grouping on the ingredient label of a food item.
UNIFOLIATE LEAF - One-bladed leaf.
U.S.R.D.A. - (United States Recommended Dietary Allowances) are figures used on food labels that represent the highest recommended nutrient intake for any age and sex group that is recommended by the National Academy of Sciences for the maintenance of health.
WINDROW - A row of hay or grain raked up for drying.
XYLEM - Food carrying tube in the stem; transports materials from soil to the plant.