Sunflower, Canola, and Peanut Production

Unit: Plant Science
Problem Area: Producing Oil Crops
Lesson: Sunflower, Canola, and Peanut Production

Student Learning Objectives. Instruction in this lesson should result in students achieving the following objectives:

1. Determine the most common plant sources for oil, and recognize the uses for vegetable oil.

2. Describe the vegetable oil extraction process; compare and contrast vegetable oils from soybeans, corn, sunflowers, canola, and peanuts; and determine the use of valuable byproducts of the process.

3. Describe the characteristics of sunflowers, identify the types of sunflowers, examine cultural practices used in producing sunflowers, and list the leading states and nations in sunflower production.

4. Describe the characteristics of canola, examine cultural practices used in producing canola, and list the leading states and nations in canola production.

5. Describe the characteristics of peanuts, identify the types of peanuts, examine cultural practices used in producing peanuts, and list the leading states and nations in peanut production.

List of Resources. The following resources may be useful in teaching this lesson:

Corresponding E-unit(s). Danville, IL: CAERT, Inc. www.mycaert.com
List of Equipment, Tools, Supplies, and Facilities

- Copies of sample test
- Visuals from accompanying masters
- Copies of student lab sheet

Terms. The following terms are presented in this lesson (shown in bold italics):

- confection sunflowers
- hydrogenation
- monounsaturated fats
- oilseed sunflowers
- peg
- polyunsaturated fats
- saturated fat
- swathing
- trans fats
- triglycerides

Interest Approach. Use an interest approach that will prepare the students for the lesson. Teachers often develop approaches for their unique class and student situations. A possible approach is included here.

Bring a variety of vegetable oils (e.g., olive oil, Crisco, peanut oil, and canola oil) to class. Ask the students if they can tell you where and how the oils are obtained.

SUMMARY OF CONTENT AND TEACHING STRATEGIES

Objective 1: Determine the most common plant sources for oil, and recognize the uses for vegetable oil.

Anticipated Problem: What are the most common plant sources for oil? What are the uses for vegetable oil?

I. Soybeans compose about 90 percent of U.S. total oilseed production. Some other sources are canola, sunflower seed, peanuts, flax seed, corn, and cottonseed. There are multiple uses for these products.
A. Vegetable oils are extracted mostly from plant seeds and are substances composed of triglycerides, which are an important energy source in the diet. They store more than twice the energy of carbohydrates and proteins. The molecular structure of triglycerides includes three fatty acids.

B. Vegetable oils are used in food preparation. Canola, olive, soybean, corn, safflower, peanut, and sunflower are some oils used for cooking.

1. **Trans fats** are a type of unsaturated fat. They may be monounsaturated or polyunsaturated. They are not good for health. Most dietary trans fats are made through hydrogenation, which is a process that adds hydrogen atoms to fat molecules to make the fat saturated.

2. **Saturated fat** consists of triglycerides containing only saturated fatty acids. The advantage of saturated fats is they have a higher melting point and a longer shelf life. Margarine is a product of hydrogenation and contains saturated fats. Diets high in saturated fats increase the risk of heart disease and stroke.

3. Foods containing **monounsaturated fats** lower LDL (bad) cholesterol and possibly raise HDL (good) cholesterol.

4. **Polyunsaturated fats** are considered to be healthy fats. Omega-3 fatty acids found in sunflower and safflower oils are polyunsaturated fats.

C. Not all vegetable oils are edible. Some vegetable oils not meant for consumption are linseed oil, tung oil, and castor oil. These are used in lubricants, paints, cosmetics, soap, candles, pharmaceuticals, and for other industrial purposes. Vegetable oils are also used in biodiesel fuel.

Begin the lesson with an interest approach. Explain the learning objectives. Introduce new terms. Lead a discussion on the sources and uses of vegetable oils.

**Objective 2:** Describe the vegetable oil extraction process; compare and contrast vegetable oils from soybeans, corn, sunflowers, canola, and peanuts; and determine the use of valuable byproducts of the process.

**Anticipated Problem:** What is the vegetable oil manufacturing process? How do vegetable oils from soybeans, corn, sunflowers, canola, and peanuts compare? What are the uses of valuable byproducts of the process?

II. The seeds of soybeans, corn, sunflowers, canola, peanuts, and other crops result in different types of oils that have different purposes/uses. These seeds provide rich oils and useful products from the materials remaining (byproducts) from the extraction process.

A. Vegetable oils are extracted from seeds through a number of processes.

1. The use of solvents to extract oils is quick and inexpensive. A commonly used solvent is hexane, which is a derivative of petroleum. This method is used with soybeans and corn.
2. Another process involves the mechanical extraction of the vegetable oils. Mechanical extraction involves crushing the seeds and squeezing out the oil. Three different types of presses used are the expeller press, screw press, and ram press.

B. Different crops produce different types of oils. The source of the extracted oils also determines the use.

1. Canola oil consists of 6 percent saturated fats, 62 percent monounsaturated fats, and 32 percent polyunsaturated fats. It is used in frying, baking, salad dressings, and spreads.

2. Coconut oil consists of 92 percent saturated fats, 6 percent monounsaturated fats, and 2 percent polyunsaturated fats. Commercial baked goods, candy and sweets, whipped toppings, nondairy coffee creamers, and shortening are common uses of coconut oil.

3. Corn oil is composed of 13 percent saturated fats, 25 percent monounsaturated fats, and 62 percent polyunsaturated fats. Corn oil is used in frying, baking, salad dressings, margarine, and shortening.

4. Cottonseed oil contains 24 percent saturated fats, 26 percent monounsaturated fats, and 50 percent polyunsaturated fats. Uses of cottonseed oil include margarine, shortening, salad dressings, and commercially fried products.

5. Olive oil (extra virgin) consists of 14 percent saturated fats, 73 percent monounsaturated fats, and 11 percent polyunsaturated fats. Olive oil is a good choice for cooking, salad oils, and margarine.

6. Peanut oil is comprised of 18 percent saturated fats, 49 percent monounsaturated fats, and 33 percent polyunsaturated fats. Frying, cooking, salad oils, and margarine are uses for peanut oil.

7. Safflower oil contains 10 percent saturated fats, 13 percent monounsaturated fats, and 77 percent polyunsaturated fats. It is used for cooking, salad dressings, and margarine.

8. Soybean oil consists of 15 percent saturated fats, 24 percent monounsaturated fats, and 61 percent polyunsaturated fats. Soybean oil is used for cooking, salad dressings, vegetable oil, margarine, and shortening.

9. Sunflower oil consists of 11 percent saturated fats, 20 percent monounsaturated fats, and 69 percent polyunsaturated fats. Sunflower oil has a light color, a neutral taste, and withstands high cooking temperatures. Cooking, salad dressings, margarine, and shortening are common uses for sunflower seed oil.

C. Byproducts are produced when vegetable oils are extracted from seeds. These byproducts have valuable uses.

1. Canola byproducts produce a high-protein animal feed. Another byproduct called oil cake can be used as a fertilizer.

2. Soybean meal is a byproduct of the solvent extraction of oil from soybeans. The resulting flakes consist of 50 percent protein and can be used in pet foods, chicken meal, and fish feed as well as for cattle, horses, hogs, and...
sheep. Another byproduct is defatted soy flour, which contains less than 1 percent oil.

3. Cottonseed meal is a byproduct of oil extraction. It can be used as an animal feed. However, it contains a toxic compound called gossypol, which is highly toxic to monogastrics and can be toxic to calves. Therefore, it should only be fed to adult ruminants.

4. The byproduct of oil extraction from sunflowers is a pressed sunflower seed cake that is rich in protein, so it is used for feed.

5. Peanut byproducts are used for livestock feed. Byproduct materials include peanut meal, raw peanuts, peanut skins, hulls, peanut hay, and silages.

Lead a discussion on the vegetable oil manufacturing process; vegetable oils from soybeans, corn, sunflowers, canola, and peanuts; and the uses of byproducts of the process.

**Objective 3:** Describe the characteristics of sunflowers, identify the types of sunflowers, examine cultural practices used in producing sunflowers, and list the leading states and nations in sunflower production.

**Anticipated Problem:** What are the characteristics of sunflowers? What are the types of sunflowers? What are the cultural practices used in producing sunflowers? What are the leading states and nations in sunflower production?

III. The sunflower is the only crop domesticated in North America for its seed. Native Americans grew sunflowers. The Spanish brought the sunflower to Europe in the 1500s for use as an ornamental plant. Sunflowers spread across Europe to Russia. There, Russian farmers began growing sunflowers as a food crop. It is believed that Russian immigrants reintroduced sunflower production in North America in the 1800s. Sunflower characteristics vary with species. In addition, production methods are often culturally based models that differ in the leading states and nations.

A. There are 50 species and 19 subspecies of sunflowers found in the United States. Wild sunflowers have many flowers and require insect pollinators. Domesticated sunflowers have only one flower per plant and may not require insect pollinators.

B. Two types of sunflowers grown in the United States are oilseed and confection.

1. **Oilseed sunflowers** produce small black seeds that have a very high oil content. Oilseed sunflowers are processed to extract sunflower oil. A byproduct is sunflower meal, which is used for animal feed.

2. **Confection sunflowers** produce larger black-and-white-striped seeds. The hulls of these sunflower seeds may be removed by an impact dehuller. The kernels are used for a variety of food products, including snacks and breads. They are typically roasted, salted, and sold for snacks.
C. Hybrid selection is an important factor for profitable sunflower production.

1. Hybrids have increased yield, pest resistance, uniformity, stalk quality, and self compatibility over open-pollinated varieties.
   a. Seed yield potential is an important trait. Decently producing hybrids yield approximately 2,000 pounds per acre on sites with good fertility and moisture. Under optimal growing conditions, up to 3,000 pounds per acre may be produced.
   b. Pest resistance is an important consideration. Choose hybrids with tolerance to rust, Verticillium wilt, and downy mildew.
   c. Good stalk quality improves harvesting and reduces field losses. Uniform stalk height contributes to ease of harvest.
   d. Oil percentage is an important trait. Genetics are the largest determining factor in oil content. Select hybrids proven to produce 38 to more than 50 percent oil percentages.
   e. Pick a hybrid that matures within the average frost-free period.
   f. Select hybrids with a test weight of at least 25 pounds per bushel to meet the official USDA grade.
   g. Self compatibility is another desirable trait in hybrids.

2. The application of recommended production practices improves yields.
   a. Sunflowers are adapted to a variety of soil conditions. The flowers grow best on well-drained soil with good moisture and water-holding capacity. A pH between 6.5 and 7.5 is best.
   b. Sunflowers require 6 to 7 pounds of nitrogen for every 100 pounds of production.
   c. As compared to other crops, sunflowers are intermediate users of water. Deep roots help sunflowers tolerate drought.
   d. Seedbed preparation is necessary to provide moist soil for seed germination and growth. The soil surface should be left as rough to reduce wind erosion that can lead to serious damage to young seedlings.
   e. Sunflowers may be planted over a wide range of dates. Early planting dates can lead to high yields, but pest problems may be greater. The soil temperature at the 4-inch depth should be at a minimum of 45°F (7°C) at planting. Seed germination takes place when the temperature nears 50°F (10°C). Soil temperatures below 50°F (10°C) delay germination.
   f. The ideal planting depth is 1.5 to 2.5 inches. The seed should not be placed deeper than 3 inches.
   g. Sunflower production is best with row spacing between 20 and 30 inches. However, wider row spacing of 40 inches and narrower row spacing of 14 inches can produce good yields. Regardless of row spacing, the plant population per acre should be the same. Plant populations for oilseed sunflowers should be between 15,000 and 25,000 plants per acre. Confection sunflowers should be planted at populations between 14,000 and 20,000 plants per acre.
3. Signs of physiologic maturity include the back of the head turning from green to yellow and the bracts turning brown. This occurs about 30 to 45 days after flowering. Seed moisture is around 35 percent at this stage.

   a. Harvest losses from shattering and from birds can be reduced by harvesting sunflower seeds with a moisture content as high as 25 percent.
   
   b. Combines used for threshing small grains can be adapted to harvest sunflowers.
   
   c. Before storage, sunflowers should be dried to 9.5 percent.

D. The Russian Federation leads the world in sunflower production. It is followed by the Ukraine, Argentina, and India. Top producing states include the following: (1) North Dakota, (2) South Dakota, (3) Kansas, (4) Colorado, and (5) Minnesota.

Have the students read corresponding E-units. Lead a discussion regarding the characteristics of sunflowers, the types of sunflowers, the cultural practices used in producing sunflowers, and the leading states and nations in sunflower production.

Objective 4: Describe the characteristics of canola, examine cultural practices used in producing canola, and list the leading states and nations in canola production.

Anticipated Problem: What are the characteristics of canola? What are the cultural practices used in producing canola? What are the leading states and nations in canola production?

IV. Canola is also called rapeseed. Canola is one of 3,000 species in the mustard family. Although canola characteristics and production practices vary (dependent upon the species and its location), canola is in demand and is produced nationally and internationally.

A. Canola is well adapted to cool regions of the temperate zones. Minimum temperatures for growth are close to 32°F (0°C).

   1. The optimum temperature for seed germination is 50°F (10°C). However, seeds will germinate in soil temperatures at 41°F (5°C).
   
   2. Medium textured, well-drained soils are best for production. Canola is tolerant of low soil pH (pH 5.5) and low saline conditions.
   
   3. The seedbed should be smooth and firm. The seedbed is usually tilled 4 to 5 inches deep.
   
   4. Canola can be seeded in the spring or in the fall, depending on the variety selected. Fall plantings should be made early enough to allow the plant to produce about six true leaves and to produce good root reserves before a killing frost. Spring plantings should be done as soon as soil is dry and the weather permits.
5. Canola is usually seeded with the small seed attachment of a grain drill to a depth of ½ to 1 inch. Rows should be spaced 7 inches or less. Canola should be seeded at 4 to 5 pounds per acre if drilled and 7 to 8 pounds per acre if broadcast, depending on seed size and soil texture.

6. Optimum yields can be obtained with nitrogen fertilizer rates between 80 and 100 pounds of Nitrogen per acre. Phosphorus and Potassium should be applied on the basis of soil test recommendations for winter wheat. Fertilizers should be broadcast and incorporated at seeding time for spring plantings. For winter canola, apply nitrogen in two applications: a starter nitrogen application of about 10 to 20 pounds per acre, followed by the remainder in the spring prior to the return of growth.

7. Pests and diseases need to be monitored and managed.
   a. Weeds can be controlled through tillage, establishment of a good stand, and weed control in previous crops.
   b. White mold (Sclerotinia stem rot) can be a serious disease after flowering in seasons with cool, moist growing conditions. Planting canola after soybeans and dry edible beans or sunflowers can increase white mold problems.
   c. The greatest insect pest problem is caused by the flea beetle. It can be managed with a granular insecticide mixed with the seed. The diamondback moth larvae can be a problem in dry years.

8. Timing the canola harvest is essential to limit losses that result from shattering. Once the pods begin to yellow, the crop needs to be checked every three or four days. Plants are ready for harvest when 30 to 40 percent of the seeds on the main stems are brownish-red in color prior to swathing. At this stage, the seeds have 30 to 35 percent moisture. **Swathing** is a practice that involves cutting the crop while it is green and laying it on the ground. It is harvested after it dries. Swathing reduces grain loss during harvest. Canola crops become brittle if allowed to dry, and seeds can fall out of the seedpods before gathering by the harvester. Canola is susceptible to lodging. In cases of severe lodging, canola should be harvested when 40 to 50 percent of the seed in exposed pods have turned color. Harvested canola must be stored in tight bins.

B. Canola ranks as the world’s fifth oilseed crop in terms of production. Soybeans, sunflowers, peanuts, and cottonseed rank higher. Canada produces 15 percent of the world’s canola. The European Economic Community accounts for nearly 17 percent of the world’s canola, and the United States produces less than 1 percent. The major U.S. producing states include the following: (1) North Dakota, (2) Minnesota, and (3) Montana.

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**Lead a discussion on the characteristics of canola, the cultural practices used in producing canola, and the leading states and nations in canola production.**
Objective 5: Describe the characteristics of peanuts, identify the types of peanuts, examine cultural practices used in producing peanuts, and list the leading states and nations in peanut production.

Anticipated Problem: What are the characteristics of peanuts, the types of peanuts, the cultural practices used in producing peanuts, and the leading states and nations in peanut production?

V. Thought to have originated in South America, peanuts thrive in tropical and subtropical climates. The peanut is an annual legume plant with fruit that develops underground. For this reason, peanuts are also known as groundpeas or groundnuts. Characteristics vary with type. In addition, peanut type and location assist in determining the production practices in the leading states and nations.

A. George Washington Carver discovered numerous industrial uses for the peanut and plant parts. He encouraged the use of peanuts as a rotational crop for cotton production.

B. There are thousands of peanut varieties. Four major groups are Spanish, Runner, Virginia, and Valencia. Spanish peanuts have a higher oil content than other types of peanuts. Two main growth forms are bunch and runner. Bunch types grow upright, while runner types grow close to the ground.

1. Temperature is the major limiting factor for peanut production. These plants require five months of warm weather. The optimal temperature for growth is 86°F (30°C). Peanuts require a minimum of 3,000 growing degree-days for proper growth and development. Growth and development cease at temperatures below 56°F (13°C).

2. Seeds are a major peanut production cost. The seeds are difficult to handle and store. The thin skin on the seed (after shelling) offers little protection from damage.

3. The soil for peanuts should be light-colored, loose, well-drained, and moderately low in organic matter (1 to 2 percent). This type of soil allows penetration of roots and pegs, better percolation of rainfall, and easier harvesting. Light-colored soils also reduce staining of pods. Peanuts grow best in soils with a pH of 6.0 to 6.5.

4. Peanuts are best grown as part of a crop rotation plan. Soil tests should be performed prior to field preparation. Then any needed fertilizer should be broadcast before tillage.

5. Peanuts require an annual rainfall of 20 to 40 inches.

6. Peanut plants start flowering about 25 to 40 days after planting. The flowers originate in the axils of leaves. After fertilization, a thick stem at the flower base (a peg) elongates and grows downward and into the soil. The peg enters the soil to a depth of 1 to 2 inches.
7. The pods ripen 120 to 150 days after the seeds are planted. Timing of the harvest is important to obtain ripe pods that do not snap off at the stalk and will remain in the soil.
   a. Peanuts are harvested in two stages. The main root of the peanut plant is cut just below the level of the peanut pods. Then the plant is lifted from the ground, shaken, and laid upside down on the ground. Exposed in this way, the peanuts slowly dry to about a third of their original moisture level over a period of two to three weeks. They are threshed after they have dried.
   b. The storage of peanuts is important as poor storage can lead to the growth of a mold fungus, *Aspergillus flavus*, which releases the toxic substance aflatoxin.

C. China is by far the largest producer of peanuts. It is followed by India. The United States, Argentina, and Vietnam trail.
   1. The vast majority of peanuts grown in China and India are for domestic consumption.
   2. The United States is the leading exporter of peanuts. Other major exporters of peanuts are Argentina, Sudan, Senegal, and Brazil. These five countries account for 71 percent of total world peanut exports.
   3. Georgia accounts for roughly half the peanuts produced in the United States. Other states with significant production are Texas, Alabama, Florida, and North Carolina.

*Lead a discussion on the characteristics of peanuts, the types of peanuts, the cultural practices used in producing peanuts, and the leading states and nations in peanut production.*

**Review/Summary.** Use the student learning objectives to summarize the lesson. Have students explain the content associated with each objective. Student responses can be used in determining which objectives need to be reviewed or taught from a different angle. E-unit questions may also be used.

**Application.** Use the included visual masters and lab sheet to apply the information presented in the lesson.

**Evaluation.** Focus the evaluation of student achievement on mastery of the objectives stated in the lesson. Measure student performance on classroom participation, laboratory assignments, and written tests or quizzes. The sample written test can also be used.

**Answers to Sample Test:**

**Part One: Matching**

1. i
2. h
3. b
Part Two: Multiple Choice

1. c
2. a
3. d
4. a
5. c

Part Three: Short Answer

1. Some inedible vegetable oils are linseed oil, tung oil, and castor oil. These are used in lubricants, paints, cosmetics, soap, candles, pharmaceuticals, and for other industrial purposes. Vegetable oils are also used in biodiesel fuel.

2. The Russian Federation leads the world in sunflower production and is followed by the Ukraine, Argentina, and India. Canada produces 15 percent of the world’s canola, and the European Economic Community accounts for nearly 17 percent. China is by far the largest producer of peanuts and is followed by India, the United States, Argentina, and Vietnam.
Part One: Matching

Instructions: Match the term with the correct definition.

a. confection sunflowers  
b. hydrogenation  
c. monounsaturated fats  
d. oilseed sunflowers  
e. peg  
f. polyunsaturated fats  
g. saturated fats  
h. trans fats  
i. triglycerides  
j. swathing  

1. An important energy source in the diet, storing more than twice the energy of carbohydrates and proteins
2. A type of unsaturated fat that may be monounsaturated or polyunsaturated that is not good for health
3. A process that adds hydrogen atoms to fat molecules to make the fat saturated
4. Fats that lower LDL (bad) cholesterol and possibly raise HDL (good) cholesterol
5. Considered to be healthy fats, includes omega-3 fatty acids found in sunflower and safflower oils
6. Small black seeds that have a very high oil content
7. Larger black-and-white-striped seeds
8. A thick stem at the peanut flower base that elongates and grows downward and into the soil
9. These consist of triglycerides and have a high melting point and long shelf life
10. A practice that involves cutting the crop while it is green and laying it on the ground

Part Two: Multiple Choice

Instructions: Write the letter of the correct answer.

1. _____ composes about 90 percent of U.S. total oilseed production.
   a. Canola
   b. Peanuts
   c. Soybeans
   d. Sunflower
2. _____ is a method used to extract oil from seeds.
   a. Crushing the seeds and squeezing out the oil
   b. Freezing and thawing the seed in rapid succession
   c. Mixing with food-grade detergents
   d. Soaking the seeds in kerosene

3. The only crop to have been domesticated in North America for its seed is/are _____.
   a. canola
   b. peanuts
   c. soybean
   d. sunflower

4. The crop best adapted to cool regions of temperate zones is/are _____.
   a. canola
   b. peanuts
   c. soybean
   d. sunflower

5. The major limiting factor in peanut production is _____.
   a. air
   b. light
   c. temperature
   d. water

**Part Three: Short Answer**

*Instructions: Complete the following.*

1. What are some uses for inedible vegetable oils?

2. What are the major producing countries for sunflowers, canola, and peanuts?
SUNFLOWERS

(Courtesy, Agricultural Research Service, USDA)
CANOLA

(Courtesy, Agricultural Research Service, USDA)
(Courtesy, Agricultural Research Service, USDA)
PEANUT READY FOR COMBING

(Courtesy, USDA)
Lesson: Sunflower, Canola, and Peanut Production

LEADING OIL CROP PRODUCING STATES

C – Cotton
N – Canola
S – Soybean
P – Peanuts
F – Sunflower
# Comparing Oil Crops

## Instructions

Complete the following table.

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