You are aware of fat on a steak or other pieces of meat. Animals, including you, are made up, in part, of lipids, or fats and oils. The same holds true with plants. Some plants, called oil crops, are grown specifically for their oils. Concentrations of oils are found in seeds of most of these crops.

**Objective:**
Describe the sources and uses of vegetable oil and the production of oil crops.

**Key Terms:**
- confection sunflowers
- hydrogenation
- monounsaturated fats
- oilseed sunflowers
- peg
- polyunsaturated fats
- saturated fats
- swathing
- trans fats
- triglycerides

**Oil Crops**
Soybeans make up about 90 percent of U.S. total oilseed production. Some other sources are canola, sunflower, peanut, flax, corn, and cotton.
VEGETABLE OILS

Vegetable oils are extracted mostly from plant seeds. Vegetable oils are substances composed of triglycerides. **Triglycerides** are an important energy source in the diet. They store more than twice the energy as carbohydrates and proteins. The molecular structure of triglycerides includes three fatty acids.

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

**Types of Fat**

Vegetable oils have three major types of fat. They are saturated fats, monounsaturated fats, and polyunsaturated fats. **Saturated fats** consist of triglycerides containing only saturated fatty acids. Diets high in saturated fats increase the risk of heart disease and stroke. Foods containing **monounsaturated fats** lower LDL (bad) cholesterol and possibly raise HDL (good) cholesterol. **Polyunsaturated fats** are considered to be healthy fats. Omega-3 fatty acids found in sunflower and safflower oils are polyunsaturated fats.

**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. **Hydrogenation** is a process that adds hydrogen atoms to fat molecules to make the fat saturated. The advantages of hydrogenated saturated fats are a higher melting point and longer shelf life. Margarine is a product of hydrogenation and contains saturated fats.

**Non-Food Uses of Vegetable Oil**

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

**OIL EXTRACTION**

Seeds of soybeans, corn, sunflowers, canola, peanuts, and other crops provide rich oils and useful products from the materials left over from the extraction process.

Vegetable oils are extracted from seeds through a number of processes. The use of solvents to extract oils is quick and inexpensive. A commonly used solvent is hexane, a derivative of petroleum. The solvent draws the oil from the seed. It then evaporates, leaving the oil. This method is used with soybeans and corn. 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.

TYPES OF VEGETABLE OILS

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

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

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.

Corn oil is made up of 13 percent saturated fats, 25 percent monounsaturated fats, and 62 percent polyunsaturated fats. Corn oil is used for frying, baking, salad dressings, margarine, and shortening.

Cottonseed oil is comprised of 24 percent saturated fats, 26 percent monounsaturated fats, and 50 percent polyunsaturated fats. Uses of cotton seed oil are for margarine, shortening, salad dressings, and commercially fried products.

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.

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. Pure peanut oil has a high smoke point, making it well-suited for high heat cooking.

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.

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.

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.

FIGURE 2. Salad dressing can be made from several different types of vegetable oil.
By-Products

By-products are produced when vegetable oils are extracted from seeds. These by-products have valuable uses.

Canola by-products are used to produce a high-protein animal feed. Another by-product, called oil cake, can be used as a fertilizer.

Soybean meal is a by-product 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, fish feed, and for cattle, horses, hogs, and sheep. Another by-product is defatted soy flour, which contains less than 1 percent oil.

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

By-products of oil extraction from sunflowers are sunflower meal and pressed sunflower seed cake. These are rich in protein and used for animal feed.

Peanut by-products are used for livestock feed. By-product materials include peanut meal, raw peanuts, peanut skins, hulls, peanut hay, and silages.

SUNFLOWER PRODUCTION

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 grew it as a food crop. It is believed that Russian immigrants reintroduced sunflower production in North America in the 1800s.

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 insects pollinators.

Types of Sunflowers

Two types of sunflowers grown in the United States are oilseed and confection. Oilseed sunflowers produce small black seeds that have a very high oil content. Oilseed sunflowers are processed to extract sunflower oil. 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 and salted and sold for snacks.

**Hybrid Selection**

Hybrid selection is an important factor for profitable sunflower production. Hybrids have increased yield, pest resistance, uniformity, stalk quality, and self compatibility over open-pollinated varieties. Seed yield potential is an important trait. Good 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. Pest resistance is an important consideration. Choose hybrids with tolerance to rust, *Verticillium* wilt, and downy mildew. Good stalk quality improves harvesting and reduces field losses. Uniform stalk height contributes to ease of harvest. Oil percentage is an important trait. Genetics are the largest determining factor in oil content. Select hybrids proven to produce 38 to over 50 percent oil percentages. Pick a hybrid that matures within the average frost-free period. Select hybrids with a test weight of at least 25 pounds per bushel to meet the official USDA grade. Self compatibility is another desirable trait in hybrids.

**Production Practices**

Application of recommended production practices improves yields. A sunflower is adapted to a variety of soil conditions. It grows best on well-drained soil and has good water-holding capacity. A pH from 6.5 to 7.5 is best.

Sunflowers require 6 to 7 pounds of nitrogen for every 100 pounds of production.

As compared to other crops, the sunflower is an intermediate user of water. Its deep roots help the sunflower tolerate drought.

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.

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 at planting. Seed germination takes place when the temperature nears 50°F. Soil temperatures below 50°F delay germination.

The ideal planting depth is 1 1/2 to 2 1/2 inches. The seed should not be placed deeper than 3 inches.

Sunflower production is best with row spacing between 20 to 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.

**Harvesting**

Signs of physiologic maturity of a sunflower are when the back of the head has turned from green to yellow and the bracts are turning brown. This occurs about 30 to 45 days after flowering. Seed moisture is around 35 percent at this stage.
Harvest losses from shattering and from birds can be reduced by harvesting sunflower seeds with a moisture content as high as 25 percent.

Combines used for threshing small grains can be adapted to harvest sunflowers. Before storage, sunflowers should be dried to 9.5 percent.

**Leading Producers**

The Russian Federation leads the world in sunflower production. It is followed by Ukraine, Argentina, and India. Top producing states in order are North Dakota, South Dakota, Kansas, Colorado, and Minnesota.

**CANOLA PRODUCTION**

Canola is also called rapeseed. Canola is one of 3,000 species in the mustard family. Canola is well adapted to cool regions of the temperate zones. Minimum temperatures for growth are close to 32°F.

**Production Practices**

The optimum temperature for seed germination is 50°F. However, seeds will germinate in soil temperatures at 41°F. Medium textured, well-drained soils are best for production. Canola is tolerant of both low soil pH (pH 5.5) and saline conditions. The seedbed should be smooth and firm. The seedbed is usually tilled 4 to 5 inches deep.

Canola can be seeded in the spring or 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 produce good root reserves before a killing frost. Spring plantings should be done as early as soil is dry and the weather permits.

Canola is usually seeded with the small seed attachment of a grain drill to a depth of 1/2 to 1 inch. Rows should be spaced 7 inches or less. Canola should be seeded at a rate of 4 to 5 lbs/acre if drilled and 7 to 8 lbs/acre if broadcast, depending on seed size and soil texture.

Optimum yields can be obtained with nitrogen fertilizer rates between 80 and 100 lbs nitrogen/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 lbs/acre, followed by the remainder in the spring prior to the return of growth.

Pests and diseases need to be monitored and managed. Weeds can be controlled through tillage, establishment of a good stand, and weed control in previous crops. 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. 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.

**Harvesting**

Timing the canola harvest is essential to limit losses due to shattering. Once the pods begin to yellow, the crop needs to be checked every three to four days. Plants are ready for harvest when 30 to 40 percent of the seeds on the main stem 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 once it dries. Swathing reduces grain loss during harvest. Canola crops become brittle if allowed to dry, and seed 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.

**Leading Producers**

Canola ranks as the world’s fifth oilseed crop in terms of production. Only 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, while the United States produces less than 1 percent. North Dakota, Minnesota, and Montana are the major producing states.

**PEANUT PRODUCTION**

Peanuts are thought to have originated in South America. They thrive in tropical and subtropical climates. The peanut is an annual legume plant. The fruit develops underground. For this reason, peanuts are also known as groundpeas or groundnuts.

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.

**Peanut Varieties**

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

**FIGURE 5.** Peanuts are able to thrive best in tropical climates. (Courtesy, USDA)
Production Practices

Temperature is the major limiting factor for peanut production. Peanuts require five months of warm weather. The optimal temperature for growth is 86°F. Peanuts require a minimum of 3,000 growing degree days for proper growth and development. Growth and development ceases at temperatures below 56°F.

Seed is a major peanut production cost. The seed is difficult to handle and store. The thin skin on the seed after shelling offers little protection from damage.

The soil for peanuts should be light-colored, loose, well-drained, and moderately low in organic matter (1 to 2%). 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.

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.

Peanuts require an annual rainfall of 20 to 40 inches.

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, called a peg, elongates and grows downward and into the soil. The peg enters the soil to a depth of 1 to 2 inches.

Harvesting

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 remain in the soil.

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.

The storage of peanuts is important, as poor storage can lead to the growth of a mold fungus, *Aspergillus flavus*. *Aspergillus flavus* releases a toxic substance, aflatoxin.

Leading Producers

China is by far the largest producer of peanuts. It is followed by India. The United States, Argentina, and Vietnam trail. The vast majority of peanuts grown in China and India are for domestic consumption. The United States is the leading exporter of peanuts. Other major exporters of peanuts are Argentina, Sudan, Senegal, and Brazil. Together, these five countries account for 71 percent of total world exports.

Georgia accounts for roughly half the peanuts produced in the United States. Other states with significant production are Texas, Alabama, Florida, and North Carolina.

Summary:

Vegetable oils are substances composed of triglycerides. Three major types of fat are saturated fats, monounsaturated fats, and polyunsaturated fats. Some inedible vegetable oils are linseed oil, tung oil, and castor oil.
Vegetable oils are extracted from seeds through the use of solvents or mechanical presses.

Different crops produce different types of oils. By-products of vegetable oil extraction include flour, feeds, and fertilizer.

Two types of sunflowers are oilseed and confection. The Russian Federation leads the world in sunflower production. Top producing states are North Dakota, South Dakota, Kansas, Colorado, and Minnesota.

Canola is well adapted to cool regions of the temperate zones. Canola production ranks fifth among the world’s oilseed crops. Canada produces 15 percent of the world’s canola.

Peanuts thrive in tropical and subtropical climates. China is the largest producer of peanuts. The United States is the leading exporter of peanuts. Georgia accounts for roughly half the peanuts produced in the United States.

**Checking Your Knowledge:**

1. What types of fats are found in vegetable oils?
2. How are vegetable oils extracted?
3. What are the different oil crops?
4. How does the production of sunflower, canola, and peanuts compare?
5. What countries are the leading producers of sunflower, canola, and peanuts?

**Expanding Your Knowledge:**

Visit a supermarket and inventory the products made with vegetable oil. Determine the plant source of the vegetable oil. Compile a list of the products. Organize the list to see if certain types of oils are used for certain types of products.

**Web Links:**

- **Canola (Rapeseed)**  
  http://www.hort.purdue.edu/newcrop/afcm/canola.html

- **All About Sunflower**  
  http://www.sunfloweransa.com/all-about/

- **Peanut**  
  http://www.hort.purdue.edu/newcrop/afcm/peanut.html

- **Processing Canola Oil**  
  http://www.canolainfo.org/canola/processing.html

- **Agricultural Career Profiles**  
  http://www.mycaert.com/career-profiles