

SECTION 3

Animals and Agriculture

We have seen that the total energy needed to grow plants for food is much less than the energy needed to raise animals as food. However, most animal proteins contain more essential amino acids than proteins found in plants do, and most humans include some animal products in their diet. Food from animals has been the basis of life for some human populations for centuries. For example, many human populations have traditionally obtained most of their protein from fish and seafood.

Our ancestors obtained animal protein by hunting and fishing, but today most people get animal protein from domesticated species. About 50 animal species have been **domesticated**, which means that they are bred and managed for human use. Domesticated animals include chicken, sheep, cattle, honey bees, silkworms, fish, and shellfish. In many parts of the world, goats, pigs, and water buffalo are also important domesticated animals.

Food from Water

Because fish are an important food source for humans, the harvesting of fish has become an important industry worldwide. However, as shown in **Figure 19**, when too many fish are harvested over a long period of time, ecological systems can be damaged.

Overharvesting Catching or removing from a population more organisms than the population can replace is called **overharvesting**. Many governments are now trying to stop overharvesting. They have created no-fishing zones, so that fish populations can recover. Research shows that fishing in areas surrounding no-fishing zones improves after no-fishing zones have existed for a few years. In some areas of the world, such restrictions are necessary if fish markets, such as the one shown in **Figure 20**, are to prosper.



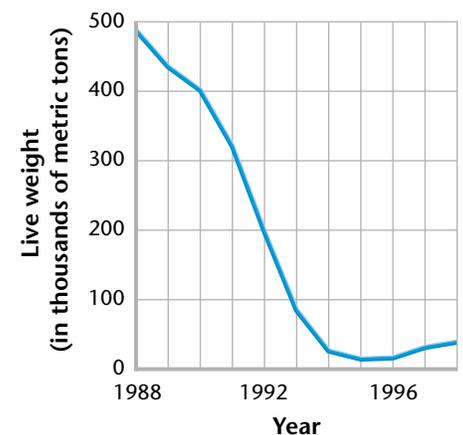
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Objectives

- ▶ Explain how overharvesting affects the supply of aquatic organisms used for food.
- ▶ Describe the current role of aquaculture in providing seafood.
- ▶ Describe the importance of live-stock in providing food and other products.

Key Terms

domesticated
overharvesting
aquaculture
livestock
ruminant



Source: Department of Fisheries and Oceans, Canada.

Figure 19 ▶ The North Atlantic cod fishery has collapsed because of overharvesting.

Figure 20 ▶ Whole, fresh tuna are one of the many types of seafood for sale at the Tokyo fish market, the largest fish market in the world.



Figure 21 ▶ This oyster farm in Washington State shows how aquaculture concentrates seafood production.

Aquaculture

Fish and other aquatic organisms provide up to 20 percent of the animal protein consumed worldwide. But overharvesting is reducing the amount of fish and other organisms in the world's oceans. One solution to this problem may be a rapid increase in **aquaculture** (AK wuh KUHL chuhr), the raising of aquatic organisms for human use or consumption.

Aquaculture is not a new idea. This practice probably began in China about 4,000 years ago. Today, China leads the world in using aquaculture to produce freshwater fish.

There are a number of different methods of aquaculture. The oyster farm shown in **Figure 21** represents one such method. The most common method is known as a fish farm. Fish farms generally consist of many individual ponds that each contain fish at a specific stage of development. Clean water is circulated through the ponds and brings in oxygen while sweeping away carbon dioxide and fecal wastes. The fish grow to maturity in the ponds and then are harvested.

Another type of aquaculture operation is known as a ranch. In this method, fish such as salmon are raised until they reach a

CASE STUDY

Menhaden: The Fish Behind the Farm

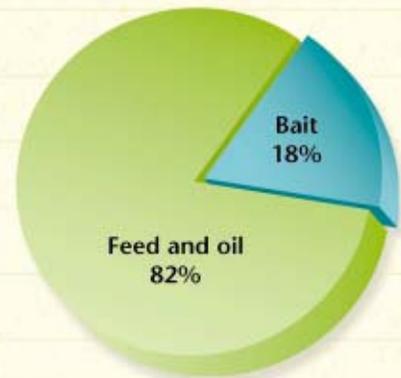
One of the largest commercial catches in the United States each year is of a fish that most people have never heard of—the menhaden (men HAYD 'n). Menhaden are small, silver, oily fish in the herring family and are found in the Atlantic Ocean from Maine to Florida. More than one-third of the weight of commercial fish caught on the East Coast each year is menhaden. But menhaden are so full of bones that they are inedible. So why are they so important?

When the first colonists arrived in the area we now call New England, local Indians showed them how to fertilize their crops with menhaden. This is where the legend that the best corn is grown by planting a fish with each seed came from. Later, menhaden oil was used

in oil lamps, and ground menhaden were added to cattle feed.

The menhaden catch is processed to produce fishmeal and fish oil. The oil is used in cooking oils and margarine. The fishmeal has a high protein content, and it is added to the feed of pets, chickens, turkey, hogs, cattle, and farm fish. Menhaden is also used by recreational fishermen as bait for fish such as bluefin, striped bass, shark, and tuna.

Menhaden spawn in the ocean. The eggs hatch into larvae, which are carried into estuaries where they spend their first year. After the menhaden mature, they return to the ocean and usually live within 50 km of the coast. The Chesapeake Bay is one of the most important nurseries for menhaden.



Source: Menhaden Resource Council.

▶ The enormous menhaden catch is used entirely to produce feed and oil and as bait for catching other fish.

Menhaden live in large schools near the surface, so they are easily caught with *purse seine* nets, nets that hang down from the surface. Boats towing the nets encircle the

certain age and then are released. The salmon, for example, migrate downstream to the ocean, where they live until adulthood. When they are mature, the fish return to their birthplace to reproduce. When they return, they are captured and harvested.

Today, most of the catfish, oysters, salmon, crayfish, and rainbow trout eaten in the United States are the products of aquaculture. In the 1980s, domestic production of these species quadrupled, and imports of these species increased even faster. Worldwide, about 23 percent of seafood now comes from aquaculture.

However, as with other methods of food production, aquaculture can cause environmental damage if not managed properly. For example, the aquatic organisms can create a large amount of waste, which can be a source of pollution. Also, because aquaculture requires so much water, the process can deplete local water supplies. In a few cases, sensitive wetlands have been damaged when large aquaculture operations were located within the wetland. Despite these problems, aquaculture will continue to be an important source of protein for the human diet.



► A menhaden catch is unloaded from purse seine nets in Chesapeake Bay, Virginia.

fish, which are pumped out of the ocean into refrigerated containers.

An adult menhaden is an important member of the marine ecosystem. The fish are filter feeders that scoop up large mouthfuls of water and filter out the plankton for food. An adult menhaden can filter a million gallons of water in six months.

The Chesapeake Bay Ecological Foundation estimates that the menhaden population removes up to one-fourth of the nitrogen pollutants dumped into the Chesapeake Bay each year. Because nitrogen runoff from lawns and farms is a major pollutant of the Chesapeake Bay, this function of the fish is important. Sport fishermen also value menhaden as bait because they are the natural food of many sportfish.

Both environmentalists and the sport fishing industry were worried when the menhaden catch declined during the 1990s. The catch in 2000 was the second-lowest catch

on record. Both groups believe that overharvesting by commercial fishing boats was the reason for the reduced catch. As a result, the Atlantic Menhaden Management Board, which manages the menhaden fishery, has been restructured to have fewer members who represent the commercial fisheries.

CRITICAL THINKING

1. Applying Ideas Many different groups have potentially conflicting interests in the future of the menhaden fishery. Write a paragraph that explains the opposing points of view of two of these groups.

WRITING SKILLS

2. Expressing Viewpoints If you were on the Atlantic Menhaden Management Board, what changes would you suggest to prevent the fishery from declining? Write a paragraph that explains these changes.

WRITING SKILLS



Figure 22 ▶ Modern livestock operations, such as this pig farm in North Carolina, are large and efficient.

Table 3 ▼

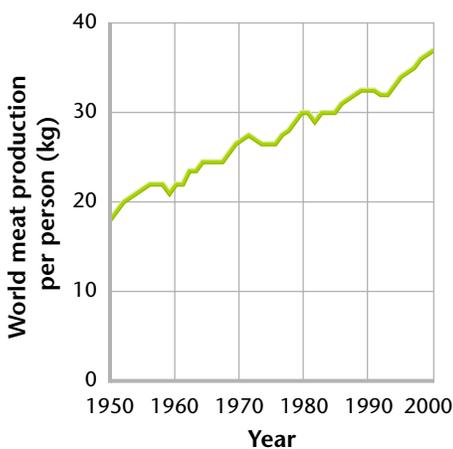
| UN FAO Estimates of Animal Populations | | | |
|--|------------------------------|--------------|----------|
| Species | Global Livestock Populations | | Increase |
| | 1961 | 2001 | |
| Chickens | 3.9 billion | 14.8 billion | 280% |
| Sheep | 1 billion | 1 billion | 0% |
| Cattle | 942 million | 1.4 billion | 53% |
| Pigs | 406 million | 928 million | 129% |
| Goats | 349 million | 702 million | 101% |
| Horses, donkeys, and mules | 110 million | 114 million | 4% |

Livestock

Domesticated animals that are raised to be used on a farm or ranch or to be sold for profit are called **livestock**. As shown in **Table 3**, populations of livestock have changed dramatically in the last 40 years. Large livestock operations, such as the pig farm shown in **Figure 22**, produce most of the meat that is consumed in developed countries. Meat production per person has increased worldwide since 1950, as shown in **Figure 23**. Livestock are also important in developing countries. In these countries, livestock not only provide leather, wool, eggs, and meat, but also serve many other functions. Some livestock are used as draft animals to pull carts and plows. Other livestock provide manure as the main source of plant fertilizer or as a fuel for cooking.

Ruminants Cattle, sheep, and goats are **ruminants** (ROO muh nuhnts), cud-chewing mammals that have three- or four-chambered stomachs. *Cud* is the food that these animals regurgitate from the first chamber of their stomachs and chew again to aid digestion. Ruminants also have microorganisms in their intestines that allow the animals to digest plant materials that humans cannot digest. When we eat the meat of ruminants, we are using them to convert plant material, such as grass stems and woody shrubs, into food that we can digest—such as beef.

Humans have created hundreds of breeds of cattle that are suited to life in different climates. Cattle are most common in North America, India, and Africa. But the cattle are not always slaughtered for meat. In Africa for example, traditional Masai herders drink milk and blood from their cattle, but the herders rarely kill them for meat. India has almost one-fifth of the world's cattle. However, many of these cattle are not killed or eaten because cows are sacred to Hindus, who make up a large part of India's population. These cattle instead produce milk and dung, and the cattle are used as draft animals.



Source: Worldwatch Institute.

Figure 23 ▶ Worldwide meat production per person has increased significantly since 1950.

Poultry Since 1961, the population of chickens worldwide has increased by a greater percentage than the population of any other livestock, as shown in Table 3. Chickens are a type of *poultry*, domesticated birds raised for meat and eggs, which are good sources of essential amino acids. In more-developed countries, chickens and turkeys are usually raised in factory farms, as shown in Figure 24. Some people have criticized this industry because the animals live in cramped, artificial environments.

Fewer ducks and geese are raised worldwide than chickens, but in some areas ducks and geese are economically important. For example, the Chinese use ducks not only for meat, but also as part of an integrated system that produces several types of food at one time. The ducks' droppings are used to fertilize fields of rice called *rice paddies*. The rice paddies are flooded several times per year with water from nearby ponds. Mulberry trees, which feed silkworms, are also irrigated by the ponds. Plant materials and filtered sewage are dumped in the ponds and serve as food for carp and other fish. The integrated system uses little fresh water, recycles waste, and produces ducks, silk, rice, and fish.

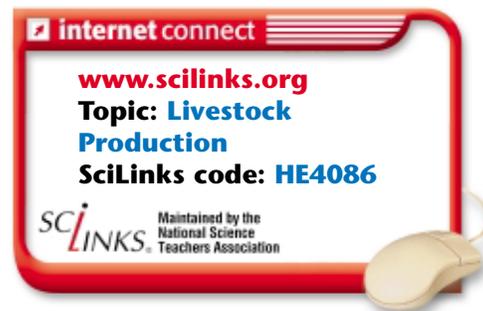


Figure 24 ▶ Modern chicken farms, such as this one, are often huge, industrial-scale operations.

SECTION 3 Review

1. **Explain** why the percentage of seafood produced by aquaculture is increasing so rapidly.
2. **Explain** how overharvesting affects the supply of fish such as salmon.
3. **Describe** the importance of livestock to cultures that consume no meat.

CRITICAL THINKING

4. **Inferring Relationships** Read the description of poultry above and explain why chickens are such an important source of food for humans. **READING SKILLS**
5. **Applying Ideas** Look at the graph in Figure 23. Write a short paragraph explaining why meat production has increased so rapidly. **WRITING SKILLS**

1 Feeding the World



Key Terms

famine, 379
malnutrition, 379
diet, 380
yield, 381

Main Ideas

- ▶ The foods produced in the greatest amounts worldwide are grains, the seeds of grass plants.
- ▶ Malnutrition is a condition that occurs when people do not consume enough Calories or do not eat a sufficient variety of foods to fulfill all of the body's needs.
- ▶ More food is needed each year to feed the world's growing population. Distribution problems and drought can lead to food shortages.
- ▶ The green revolution introduced new crop varieties with increased yields through the application of modern agricultural techniques.

2 Crops and Soils



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topsoil, 385
erosion, 386
desertification, 386
compost, 388
salinization, 388
pesticide, 389
biological pest control, 391
genetic engineering, 393

- ▶ The basic processes of farming are plowing, fertilization, irrigation, and pest control. Modern agricultural methods have replaced traditional methods in much of the world.
- ▶ Fertile soil is soil that can support the growth of healthy plants. Soil conservation methods are important for protecting and managing topsoil and reducing erosion.
- ▶ Pests cause considerable crop damage. The use of pesticides has both positive and negative effects on the environment. Integrated pest management can minimize the use of chemical pesticides.
- ▶ Genetic engineering is the process of transferring genes from one organism to another. Plants that result from genetic engineering are called genetically modified plants.

3 Animals and Agriculture



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ruminant, 398

- ▶ Overharvesting has reduced the populations of many aquatic organisms worldwide.
- ▶ Aquaculture, the raising of aquatic animals, may be a solution to the problem of overharvesting.
- ▶ Livestock are important for the production of food and other products. Worldwide meat production per person has increased greatly over the past several decades.

Using Key Terms

Use each of the following terms in a separate sentence.

1. *overharvesting*
2. *erosion*
3. *livestock*
4. *yield*
5. *genetic engineering*

For each pair of terms, explain how the meanings of the terms differ.

6. *pesticide* and *biological pest control*
7. *arable land* and *topsoil*
8. *livestock* and *ruminant*
9. *malnutrition* and *famine*
10. *salinization* and *desertification*



STUDY TIP

Making It a Habit Many people find that developing a routine helps them to study more effectively. Decide which time of day you feel most alert, and set it aside for studying. Make sure that any distractions around you will be minimal. When you regularly follow through with your study plan, you may find that you begin to learn more in less time.

Understanding Key Ideas

11. Malnutrition can be caused by
 - a. a lack of enough Calories.
 - b. a lack of carbohydrates.
 - c. a lack of essential amino acids.
 - d. All of the above
12. Humans need which of the following nutrients?
 - a. carbohydrates and minerals
 - b. lipids and vitamins
 - c. proteins
 - d. all of the above
13. Which of the following is *not* one of the six most produced foods worldwide each year?
 - a. potatoes
 - b. beef
 - c. rice
 - d. wheat
14. Which of the following statements about human diets in all parts of the world is true?
 - a. Most people eat pork.
 - b. An adequate diet includes carbohydrates, proteins, and fats.
 - c. Most people do not have protein in their diets.
 - d. Most people are obese.
15. Malnutrition is largely a result of
 - a. war.
 - b. soil erosion.
 - c. poverty.
 - d. salinization.
16. Which of the following is *not* found in fertile soil?
 - a. rock particles
 - b. worms
 - c. high concentrations of salts
 - d. high concentrations of organic matter
17. Which of the following is *not* a soil conservation method?
 - a. contour plowing
 - b. salinization
 - c. no-till farming
 - d. terracing
18. Which of the following statements is a disadvantage of using chemical pesticides?
 - a. Pesticides can pollute waterways.
 - b. Pests evolve resistance to pesticides.
 - c. Pesticides kill beneficial insects.
 - d. all of the above
19. How do pesticides that are growth regulators work?
 - a. They kill fleas.
 - b. They disrupt the pest's life cycle.
 - c. They attract predators of the pest.
 - d. They prevent the pest from attacking the plant by poisoning its nervous system.

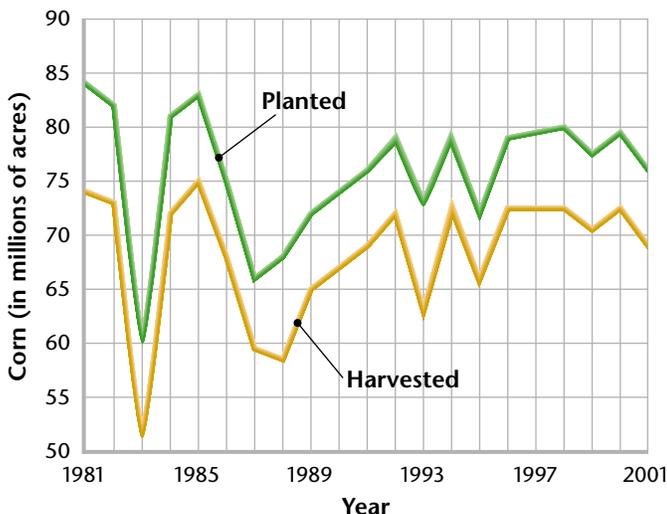
Short Answer

20. Why does it cost more to produce a kilogram of meat than to produce a kilogram of plants?
21. How does plowing soil increase soil erosion?
22. Why are biological controls for killing pests sometimes more effective than chemical pesticides are?
23. Why are ruminants valuable livestock?
24. Explain how soil degradation leads to loss of arable land.

Interpreting Graphics

Use the graph below to answer questions 25–27.

25. In which year was the most corn planted? In which year was the least corn harvested?
26. How many acres were planted with corn in 1991?
27. According to the graph, more acres of corn are planted than are harvested each year. Why?



Source: U.S. Department of Agriculture.

Concept Mapping

28. Use the following terms to create a concept map: *contour plowing*, *no-till farming*, *organic farming*, *careful irrigation*, *soil erosion*, *nutrient depletion*, and *salinization*.

Critical Thinking

29. **Making Comparisons** Both wars and drought can lead to famine. In what ways do they have similar effects, and in what ways are their effects different? Write a short paragraph that explains your answer. **WRITING SKILLS**
30. **Analyzing Ideas** What incentives to conserve soil do farmers in developed nations have?
31. **Inferring Relationships** Read the text in this chapter under the heading, “Disrupting Insect Breeding.” Are pheromones a type of pesticide? Explain your reasoning. **READING SKILLS**

Cross-Disciplinary Connection

32. **Social Studies** Thousands of tons of dead fish are shoveled back into the ocean each year from fishing vessels because the fish are species that consumers do not want to buy. Identify some ways that humans might be able to reuse this protein.
33. **Economics** Hundreds of thousands of people starve to death every year. How is this problem related to the problems of poverty? Explain your answer.

Portfolio Project

34. **Prepare a Report** Environmental degradation caused by farming is not a new problem. The Dust Bowl of the 1930s is an example of an environmental disaster caused by farming practices that we would now consider to be damaging. Investigate the Dust Bowl, and write a report about it. Include information about the farming practices, laws, and regulations that were introduced in the United States as a result of the lessons learned during the 1930s.

WRITING SKILLS



MATH SKILLS

Use the table below to answer questions 35–38.

| Worldwide Production of Food in Metric Tons | | | |
|---|-------|-------|-------|
| Food | 1990 | 1995 | 1999 |
| Total grains | 1,700 | 1,800 | 1,900 |
| Wheat | 590 | 540 | 590 |
| Rice | 350 | 370 | 400 |
| Legumes | 58 | 55 | 59 |
| Poultry | 37 | 51 | 58 |
| Milk | 441 | 381 | 387 |

- 35. Analyzing Data** Which foods had increased production in 1995 and 1999?
- 36. Analyzing Data** Which foods had lower production in 1995 than in 1990?
- 37. Analyzing Data** Taking into account the 1999 data, can you think of any possible reasons for the answer to question 36?
- 38. Analyzing Data** The human population of the world grew by 15 percent between 1990 and 1999. By what percentage did total grain production increase during this time?



WRITING SKILLS

- 39. Communicating Ideas** Explain how the way in which insects reproduce allows them to evolve pesticide resistance very rapidly.
- 40. Analyzing Ideas** Explain why the pesticide DDT can still be detected in the environment even though its use was banned decades ago.



READING FOLLOW-UP

Now that you have read the chapter, take a moment to review your answers to the **Reading Warm-Up** questions in your **EcoLog**. If necessary, revise your answers.



Read the passage below, and then answer the questions that follow.

A large amount of energy is needed to produce food. In all parts of the world, the energy used to process, distribute, and cook food is greater than the energy used to grow it. In the United States, it is estimated that every Calorie of food on our dinner tables has required 9 Calories of energy to get there. Half a Calorie accounts for the energy used on the farm. The other 8.5 Calories account for energy for processing, packaging, distribution, and cooking. In rural India, twice as much energy goes into cooking a kilogram of rice as was invested in producing it. Energy shortages, such as a shortage of wood for cooking, have caused environmental problems such as deforestation. In poor countries, cooking may require more energy than is used by transportation, heating, and all other uses for energy combined.

- According to the passage, which of the following statements about food is true?
 - Most of the energy invested in food production goes into distributing the food.
 - More energy is used to grow food on the farm than is used to cook the food.
 - Most energy used to produce food goes into processing, distributing, and cooking the food.
 - In developing countries only, cooking food requires more energy than growing food does.
- Which of the following points is not discussed in this passage?
 - Packaging is the least costly part of preparing food for sale to the customer.
 - It takes more energy to cook a kilogram of rice than to grow a kilogram of rice.
 - In some countries, cooking requires more energy than all other processes that use energy combined.
 - Gathering sufficient wood to cook food has led to deforestation.

Objectives

▶ USING SCIENTIFIC METHODS

- ▶ **Hypothesize** how to reduce the amount of water a garden needs.
- ▶ **Compare** the amount of water different soil samples can hold.
- ▶ **Explain** how adding materials to a soil sample can help increase the sample's ability to hold water.

Materials

beaker, 250 mL
 compost, 5 g
 crucible (or other heat-safe container)
 dry chopped grass clippings, 5 g
 eyedropper
 filter paper
 funnel
 heat source (hot plate or oven)
 metric balance
 sawdust, 5 g
 soil sample, 50 g
 stirring rod
 tongs
 watch (or clock)
 water



- ▶ **Step 4** Fold the moist filter paper into quarters, and then open it to form a cup that fits in a funnel.

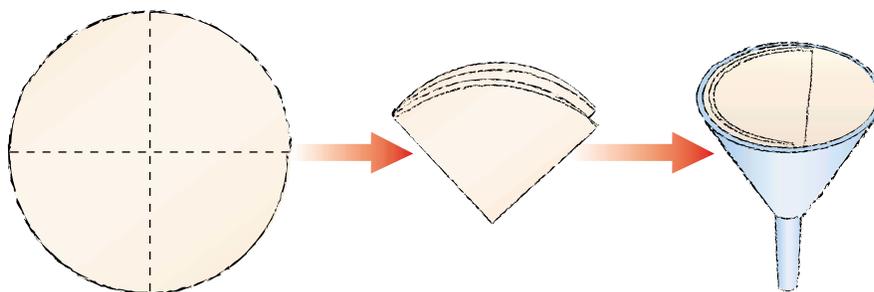
Managing the Moisture in Garden Soil

You work as a soil specialist with the Smith County Soil Conservation District. You are trying to help Mrs. Latisha Norton, a local resident, solve an agricultural problem. Mrs. Norton has found that she must water her vegetable garden very often to keep it healthy. As a result, her family's water bills have skyrocketed! Mrs. Norton and her family may have to give up their garden project because of the added expense.

You realize that the water is probably draining out of the garden soil too quickly. To solve this problem, you need to find out how much water the soil can hold. You visit her garden and collect several soil samples. (Your teacher will provide you with soil.)

Procedure

1. Dry your soil sample without burning any of the organic matter. To do this, place about 50 g of soil in a crucible or other heat-safe container. Using tongs, gently heat the sample over a hot plate or put the sample in an oven. Stir the sample occasionally with a stirring rod to ensure that the sample becomes completely dry.
2. After the sample is completely dry, weigh about 10 g of dry soil. Record the mass in a data table.
3. Dampen a circle of filter paper until it is thoroughly moist, but not dripping. Weigh the moist filter paper, and record its mass in a data table.
4. As shown below, fold the moist filter paper into quarters. Next, open the filter paper to form a cup that fits in a funnel. Place the cup-shaped filter paper in the funnel.
5. Place the dry soil sample on the filter paper in the funnel. Place the funnel in the beaker.
6. Add water to the soil sample one drop at a time until all of the soil is moist and water begins to drip out of the funnel. Stop adding water, and let the funnel sit for 5 min.



7. After 5 min, remove the filter paper and moist soil from the funnel, and weigh the paper and soil together. Record their mass in a data table.
8. Calculate the mass of the moistened soil sample by subtracting the mass of the damp filter paper from the mass of the completely moistened sample and the filter paper. Record the mass in a data table.
9. Calculate the amount of water that your soil sample can hold by subtracting the mass of the dry soil sample from the mass of the moistened soil sample. Record the result in a data table.
10. Calculate the percentage of water that your sample held. Divide the mass of water the soil held by the mass of the moistened soil sample, and multiply by 100. The higher the percentage is, the more water the soil can hold. Record the percentage in a data table.
11. Divide the remaining dry soil sample into three 5 g portions. To the first soil sample, add 5 g of dry compost. To the second soil sample, add 5 g of dry chopped grass clippings. To the third soil sample, add 5 g of dry sawdust. Weigh each mixed soil sample, and record the masses of the three samples in a data table.
12. Perform steps 3–10 for each of your mixed soil samples. Record your results in a data table.

Analysis

1. **Organizing Data** Compare your results with the results of your classmates. Which soil samples held water the best? Why?
2. **Analyzing Data** Which of the additional materials improved the soil's ability to hold water?

Conclusions

3. **Evaluating Methods** Based on your results as well as your research, what could you recommend to Mrs. Norton to reduce the amount of water her garden needs?

Extension

1. **Designing Experiments** With the help of your teacher, choose one more material in addition to the three materials you used in step 11. Combine two of these materials, and mix them with a soil sample. Combine the remaining two materials with another soil sample. Perform steps 3–10 for these two mixed soil samples. Compare your results with the results you gathered earlier in the lab. Which combination of materials in the soil samples held water the best?



► **Step 6** When adding water to the soil sample, add one drop at a time until all of the soil is moist and water begins to drip out of the funnel.

POINTS of view

GENETICALLY ENGINEERED FOODS

Genetically engineered foods are now on sale in the world's supermarkets, and we do not recognize them because they are not labeled as such.

As the world's population continues to increase, food production must try to keep pace with the increase. Genetic engineering provides one way to develop new foods. Biotechnologists develop desirable characteristics in an organism by altering its genes or by inserting new genes into the organism's cells. For example, a gene that makes one plant species resistant to pests might be transferred to another plant species. The second plant species would then have the same resistance to pests.

In 1994, the first genetically modified food was offered for sale. It is a tomato called the Flavr Savr™ which softens slowly, so it can remain on grocery shelves

► The corn plants in this field have been genetically engineered to resist the effects of herbicides.



longer before becoming soft and overripe. Biotechnologists developed the tomato by altering the gene that causes ripe tomatoes to soften. The Food and Drug Administration (FDA) said it was as safe as other tomatoes and cleared it for sale. Here are two points of view on genetically engineered foods.

The Benefits Outweigh the Risks

Scientists who support the development of genetically engineered foods view the process as simply an extension of previous plant-breeding techniques. Traditionally, farmers altered the genetic makeup of plants by crossbreeding different strains to combine the best traits of both plants. However, the direct manipulation of genes makes it possible to control genetic changes more precisely and efficiently.



► A scientist examines experimental samples of genetically modified fruit trees.

Biotechnologists say that their new products are as safe for consumers as plants developed through crossbreeding. Why shouldn't genetically engineered foods sit beside other foods on grocery store shelves?

The benefits of creating genetically engineered fruits and vegetables include keeping produce fresh longer, adding nutrients, and creating more-successful crops. For example, by inserting a gene that gives virus resistance to squash plants, scientists could boost the plants' resistance to viral infection. These resistant squash could produce five times the amount of squash per harvest as other squash does. Or scientists could increase the amino acids in a food product to give it more nutritional value.

Crops could be developed to grow faster and have higher yields. To combat world hunger, scientists may be able to develop seeds that can grow well in areas that have poor soil or poor water conditions. For more immediate relief, genetically engineered foods that would not spoil as quickly could be shipped to needy nations.

The Risks Outweigh the Benefits

Critics of genetically engineered foods believe that these products are significantly different from foods developed through traditional methods. Genetic engineering allows genes from any living organism, including genes from animals or bacteria, to be placed into crops. Opponents are concerned about the safety of foods that contain these “foreign” genes.

Another safety concern is the possibility of allergic reactions. Some foods, such as peanuts and shellfish, cause allergic reactions in many people. If genes from these foods are placed in an entirely different product, people who eat these new products and do not know the products contain the foreign genes may have allergic reactions.

Other critics object because of religious or ethical reasons. Certain



► This farmer from Oaxaca, Mexico, holds up ears of traditional corn varieties. Some people fear that genes from genetically engineered varieties could accidentally be introduced to native varieties.

religions prohibit eating pork and other foods. People may object to the insertion of genes from pigs or other prohibited foods into foods they normally eat. Similarly, vegetarians might object to eating foods containing animal genes.

Some scientists are concerned that genetically engineered plant species may be accidentally introduced into the wild. Genetic engineering may give a new species an advantage over an existing wild species. If the new species thrives at the expense of the wild species, the wild species could become extinct.

► These people in Montreal, Quebec, are protesting the importation of genetically modified organisms (GMOs). Many countries have not accepted genetically engineered crops as much as the United States has.



What Do You Think?

Some people propose that genetically engineered foods should have labels that identify them as such. Could such a measure decrease criticism about the safety of genetically engineered foods? Based on what you have read, decide whether you would buy genetically engineered foods at the grocery store. Explain your reasoning.