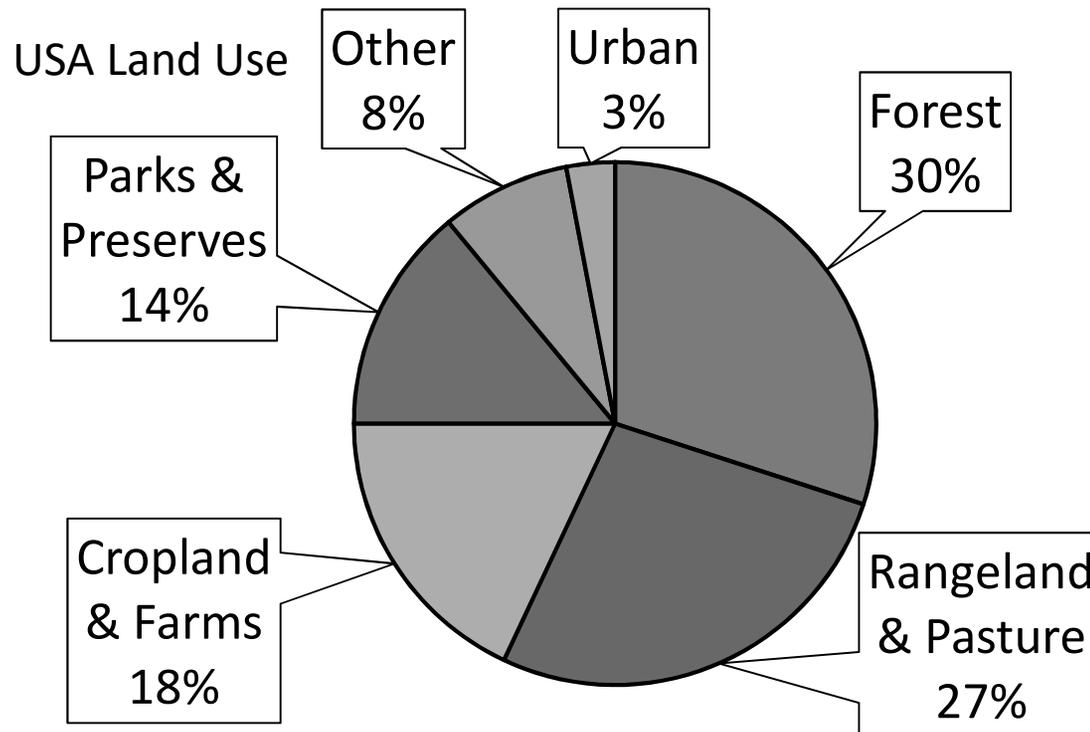


Land and Agriculture

Spring 2018

How We Use Land

- Farming, recreation, mining, buildings, roads
- **Urban** – Many people, land with mainly buildings and roads
- **Rural** – Relatively few people, open space



Urban Land Use

- Over 79% of humans lived in or near cities in 2011.
- This is called **urbanization**.
- Rapid urbanization is bad...
 - Too many people for the current infrastructure
 - Quality of life suffers
- Dense urban areas like **Atlanta** create heat islands.
- A **heat island** is a localized area of increase temperature, which can affect local weather.



Farmland Management

- The US has over 100,000,000 acres of prime farmland.
- Urbanization is threatening this land.



Rangeland Management

- **Rangeland** is land such as, grasslands, shrublands, and deserts that is not used for farming.
- Many ranchers use this land for livestock grazing, and many native wildlife species live here.
- **Overgrazing** can destroy rangeland and lead to extinctions.



Forest Management

- **Forests** remove CO₂ from the air.
- **Deforestation** can lead to soil erosion, and threatens forest plants and animals.



Review

1. How do humans use land?

2. What is a heat island?

3. How does overgrazing damage land?

4. How does deforestation damage land?

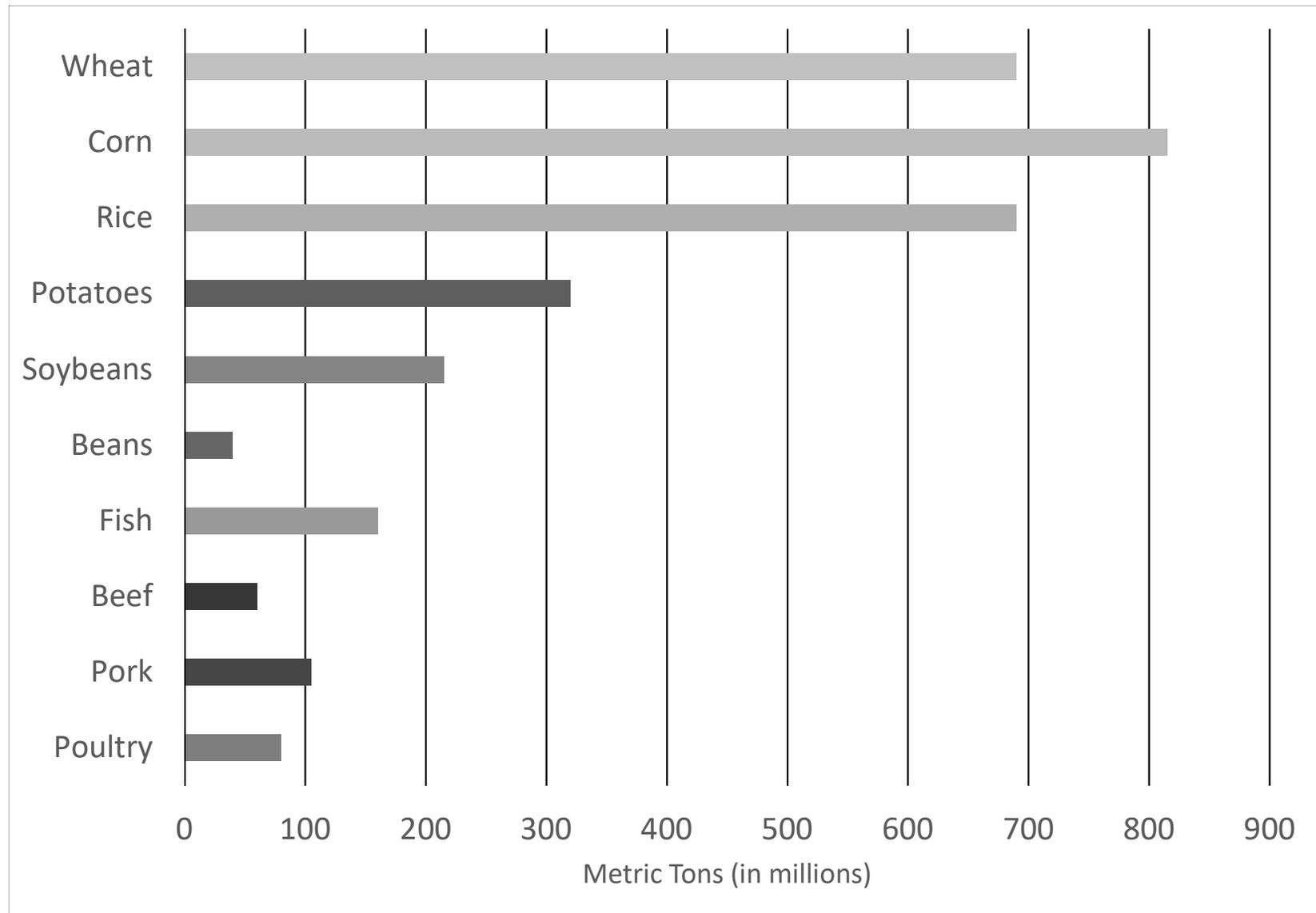
Humans and Nutrition

- **Famine** is widespread malnutrition and starvation due to a shortage of food, often caused by catastrophic events like droughts in impoverished areas.
- **Malnutrition** is a condition that occurs when a person does not consume enough calories or essential nutrients.
 - Humans need to get eight essential amino acids from a variety of protein sources.
 - Some parts of the world simply do not have access to these sources.

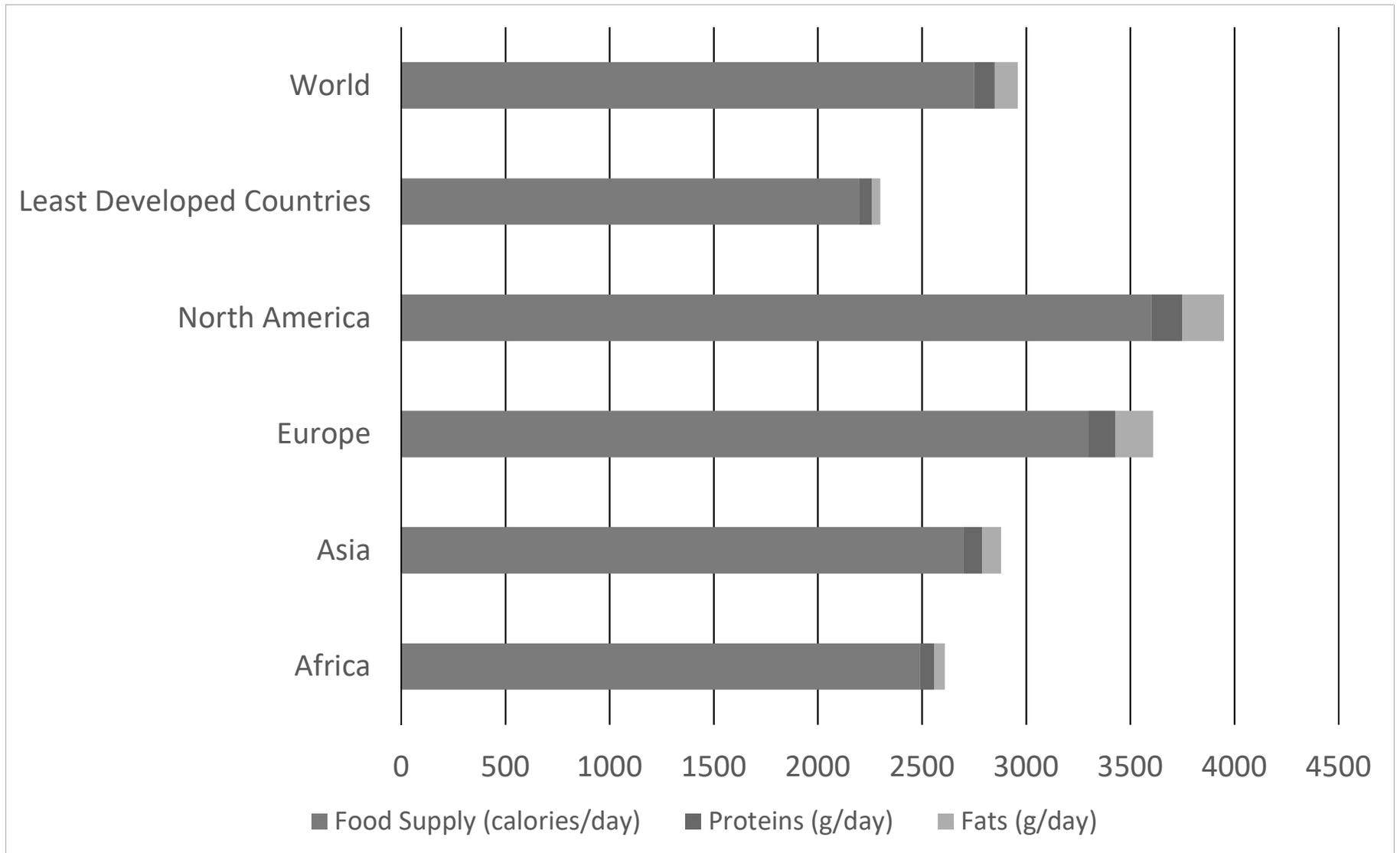
Sources of Nutrition

- **Diet** is the type and amount of food that a person eats.
- A healthy diet contains the right amounts of nutrients, minerals, and vitamins.
- The foods produced in the greatest amounts worldwide are grains.
- People in more developed countries tend to eat more food and a larger proportion of proteins and fats than people in less developed countries.

World Food Production, 2009



Total Calorie Supply, per Person, per Day



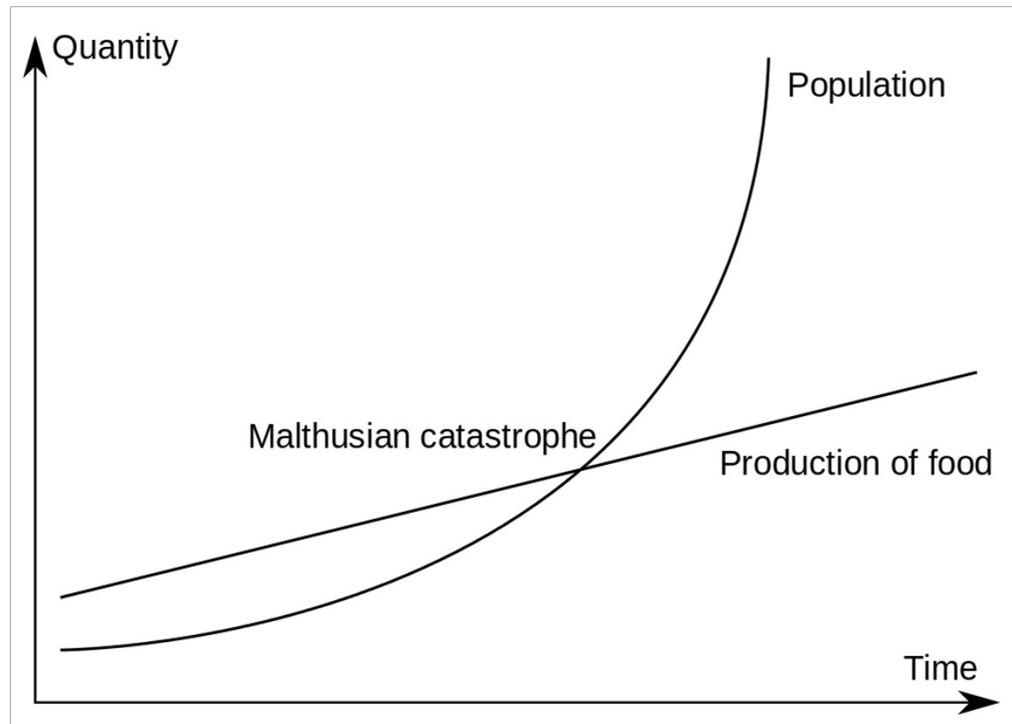
Food Efficiency

- The **efficiency** of a given type of agriculture is a measure of the quantity of food produced on a given area of land with limited inputs of energy and resources.
- An ideal food crop is one that efficiently produces a large amount of food with little negative impact on the environment.



World Food Problems

- In the late 1700's, Thomas Malthus observed that the human population was growing faster than the ability to produce food.
- Malthus called food a major limiting factor for humans.



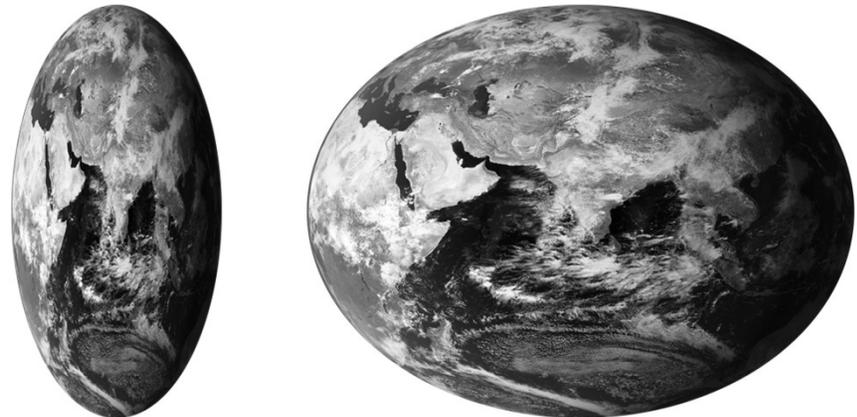
World Food Problems

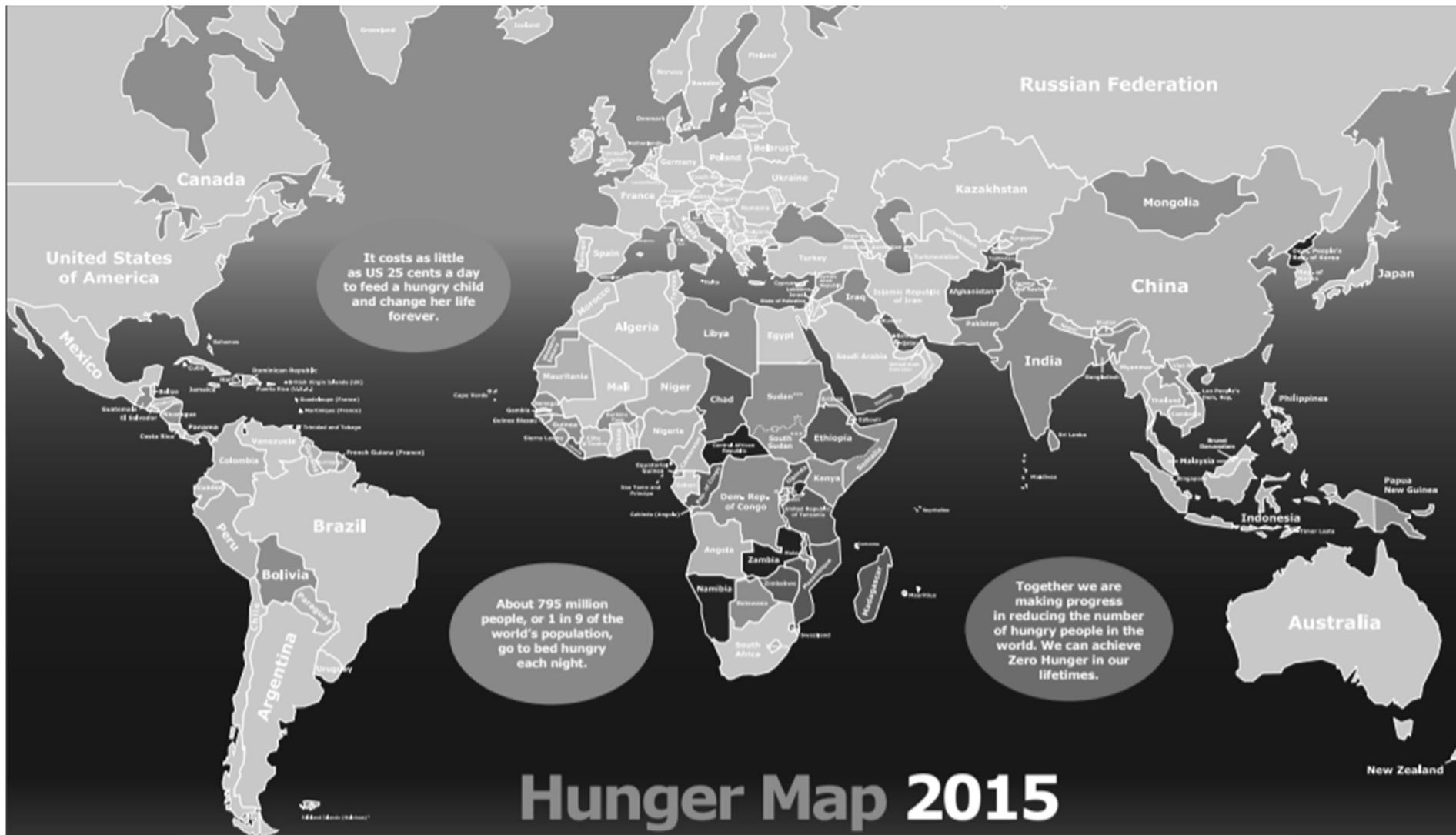
- Malnourishment is largely caused by **poverty and violence**.
- Almost **1 billion** people worldwide are undernourished.
- The world grows enough grain to feed 10 billion people an adequate vegetarian diet.
- Many people consume up to 1/3 of their calories from animals.



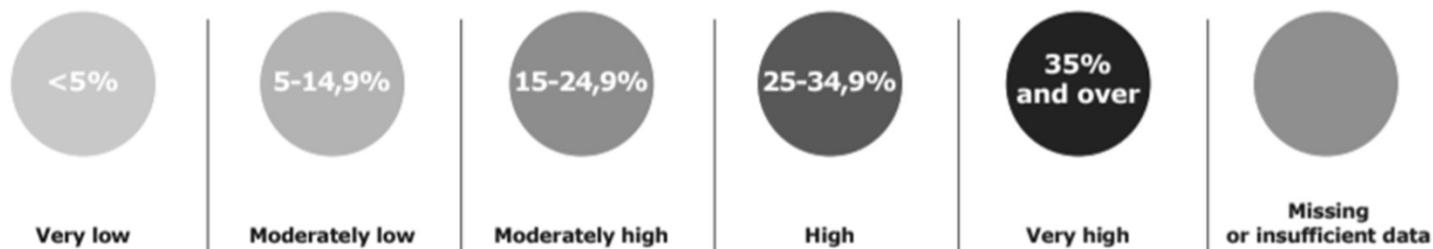
World Food Facts

- Almost **1 billion** people worldwide are undernourished.
- Around 8 million people worldwide starve to death every year.
- Over 1 billion people worldwide are over-nourished.
- About $\frac{1}{4}$ of the world's population are overweight, and 5% are obese.



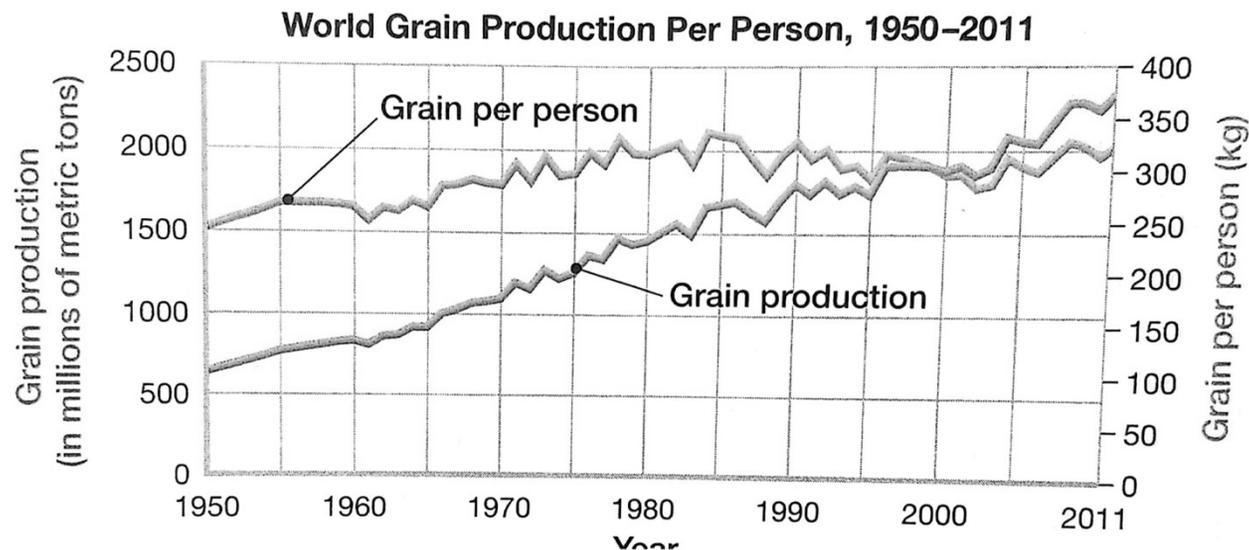


Hunger Map 2015
Prevalence of undernourishment in the population (percent) in 2014-16



The Future of the World's Food

- Grain production has **increased** over the past 50 years, but **not as fast** as the human **population** has increased.
- In order to feed all people on Earth by 2050, we need to produce more food and abolish poverty.



Review

5. What is famine? What causes famine?

6. What foods are produced in the greatest amounts?

7. What are the 2 biggest causes of malnourishment?

8. How can we feed every person on Earth by 2050?

The Green Revolution

- Worldwide, between 1950 and 1970, increases in crop yields resulted from the use of new crop varieties and the application of modern agriculture techniques.
- These changes were called the **green revolution**. Since the 1950s, the green revolution has changed the lives of millions of people.
- When provided with enough water, fertilizers, and pesticides new varieties of crops have very high yields.

The Green Revolution – Negatives

- New crops require large amounts of water, fertilizers, and pesticides.
- Subsistence farmers could not afford the water, equipment, chemicals, or seeds to grow the new crops.



Agriculture: Traditional and Modern

- The basic processes of farming are plowing, fertilization, irrigation, and pest control.
- Plowing helps crops grow by mixing soil nutrients, loosening soil particles, and uprooting weeds.
- Fertilization enriches soil and adds nutrients so that plants can grow stronger and healthier.
- Fields are considered monocultures, since usually only one crop is grown in each field.



Agriculture: Traditional

- Plows are pulled by livestock or pushed by a farmer.
- Organic fertilizers, such as manure, are added to the soil.
- Fields are irrigated by water flowing through ditches.
- Weeds are removed by the farmer.



Agriculture: Modern

- Machines powered by fossil fuels are used to plow and harvest.
- Synthetic chemicals are used as fertilizers.
- Overhead sprinklers and drip systems are used for irrigation.
- Synthetic chemicals are used for pest control.



Review

9. What was the Green Revolution?

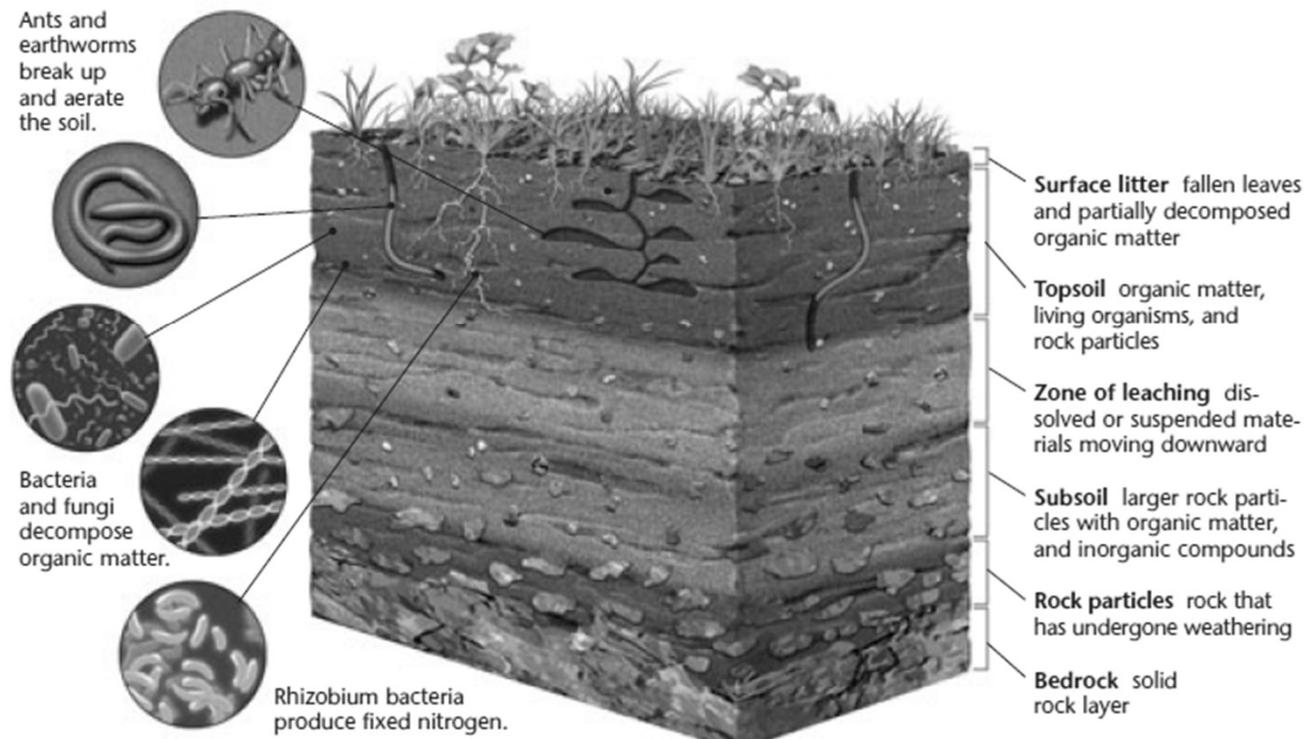
10. How did the Green Revolution harm farmers?

11. How is farming traditionally done?

12. How is farming done in modern times?

Soil

- Soil that supports plant growth is called fertile soil.
- Plant roots grow in topsoil.
- Fertile topsoil consists of living organisms, rocks, water, air, and organic material, such as dead organisms.



Soil Problems: Erosion

- Erosion causes soil to wash or blow away.
- About half of the original topsoil in the US has eroded away in the past 200 years.
- Most farming methods increase soil erosion.
 - Plowing loosens the soil and removes plants that hold soil in place.
 - Some water runs off during irrigation and carries soil with it.



Soil Problems: Desertification

- Desertification occurs when land in drier areas becomes more desertlike.
- Improper farming techniques can take nutrients out of soil, causing it to lose its fertility.
- Overgrazing leads to fewer plants to hold topsoil in place.
- Large areas of N. Africa are experiencing desertification because of infertile soil and overgrazing.

Soil Problems: Desertification



Salinization

- Salinization occurs when salts accumulate in soils.
- Salinization is a major problem in places that have low rainfall and naturally salty soil.
- When water evaporates from irrigated land, salts are left behind.
- Plants cannot grow in soils that are too salty.
- Salinization can be slowed if irrigation canals are lined to prevent water from seeping into the soil, or if the soil is watered heavily to wash out salts.

Salinization



Enriching the Soil

- A modern method of enhancing the soil is to use both organic and inorganic materials by adding compost and chemical fertilizers to the soil.
- Compost is partly decomposed organic material, such as manure or plant waste.
- Many cities and industries now compost yard and crop wastes. This compost is then sold to farmers and gardeners, saving costly landfill space.
- Composting can reduce the amount of food and plant waste that is sent to landfills.

Compost



Review

13. What does topsoil consist of?

14. How does erosion affect the land?

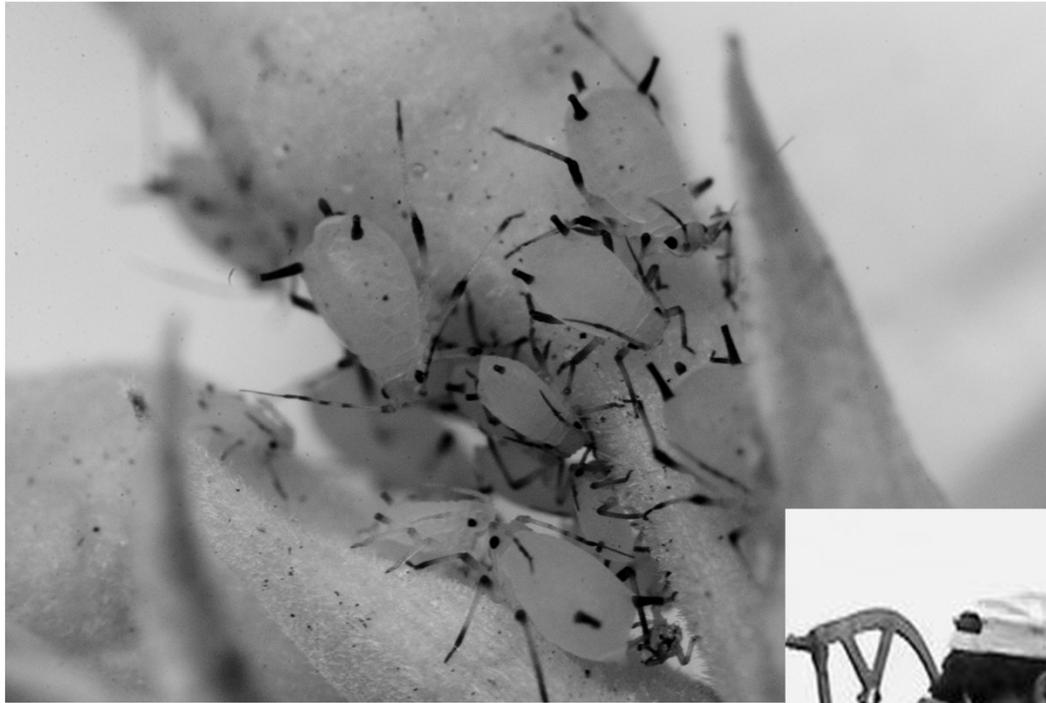
15. How does desertification affect the land?

16. What is compost? How is it beneficial?

Pest Control

- Worldwide, **pests** destroy about one-third of the world's potential food harvest.
- A *pest* is any organism that occurs where it is not wanted or that occurs in large enough numbers to cause economic damage.
- Humans try to **control populations** of many types of pests, including plants, fungi, insects, and microorganisms.
- Since crop plants are usually grown together in a field, pests have easy access to food.

Pest Control



Pesticides

- Many farmers rely on pesticides to produce their crops.
- Pesticides are chemicals used to kill insects, weeds, and other pests.
- Pesticides can also harm beneficial plants, insects, wildlife, and even people.
- Pest populations may evolve **resistance**.
- More than 500 species of insect have developed pesticide resistance, and this number grows annually.

Human Health Concerns

- **Pesticides** are designed to kill organisms, so they may also be dangerous to humans.
- Pesticides can be toxic, or have chemicals that are very similar to natural hormones.
- **Cancer** rates among children in areas of high pesticide applications are sometimes higher than the national average.
- It is important to follow safety guidelines when using pesticides.

Human Health Concerns



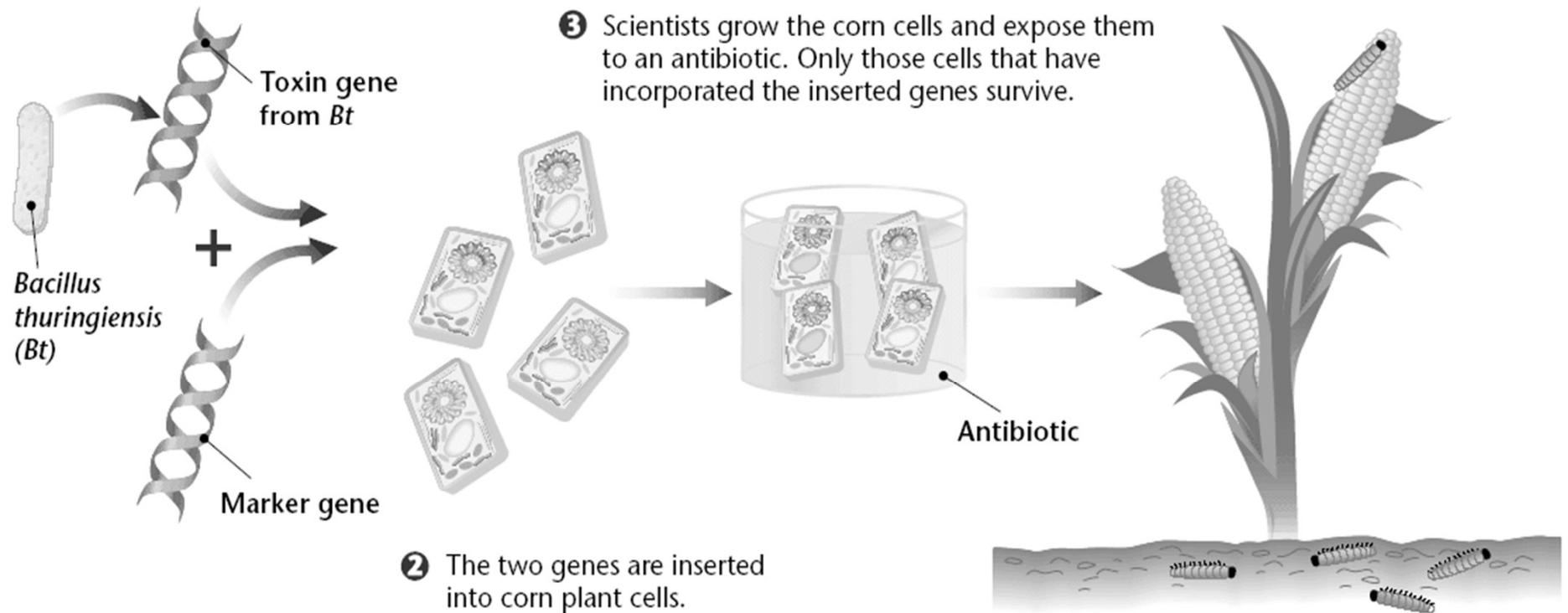
Engineering a Better Crop

- **Genetic engineering** is a technique in which genetic material in a living cell is modified for medical or industrial use.
- Scientists may use genetic engineering to transfer **desirable traits**, such as resistance to certain pests.
- Plants that result from genetic engineering are called *genetically modified organisms* (GMOs).

Engineering a Better Crop

❶ Scientists isolate the gene from *Bt* that directs a cell to produce a toxin. The *Bt* gene is then joined to a “marker gene” that enables a cell to break down an antibiotic.

❷ The surviving cells grow into corn plants. These plants produce the *Bt* toxin, which kills caterpillars.



❸ Scientists grow the corn cells and expose them to an antibiotic. Only those cells that have incorporated the inserted genes survive.

Implications of Genetic Engineering

- In the United States, we now eat and use GMOs every day.
- Many of these products have not been fully **tested** for their environmental **impacts**.
- Some scientists warn that these products will cause problems in the future.
- For example, if GMO corn that is resistant to a pesticide passes the resistance genes to a wild plant, that wild plant would no longer be killed by the pesticide.

Review

17. Why are pests harmful to crops?

18. What is pesticide resistance?

19. What are GMOs?

20. How might GMOs be harmful?

Food from Water

- The harvesting of fish is an important worldwide industry.
- **Overharvesting** is the catching or removing more organisms from a population than the population can replace.
- Many governments are now trying to **stop** overharvesting.
- For example, they have created no-fishing zones so that fish populations can recover.

Aquaculture

- **Aquaculture** is the raising of aquatic organisms for human use or consumption.
- Fish and other aquatic organisms provide up to **20 percent** of the animal protein consumed worldwide.
- Aquaculture may be one solution to the overharvesting of fish and other organisms in the world's oceans.
- Most of the catfish, oysters, salmon, crayfish, and rainbow trout eaten in the US are products of aquaculture.

Aquaculture



Livestock

- **Livestock** is the term given to **domesticated** animals that are raised to be used on a farm or ranch or to be sold for profit.
- Worldwide meat production has increased drastically since 1950.
- Large livestock operations produce **most** of the meat that is consumed in developed countries.
- Livestock are very important in developing countries, too. Uses include meat, leather, wool, eggs, manure, and labor.

Ruminants

- **Ruminants** are cud-chewing mammals that have a three- or four-chambered stomach.
- Cattle, sheep, and goats are examples of ruminants.
- **Cud** is the food that these animals regurgitate from the first chamber of their stomachs and chew again to aid digestion.
- 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.

Review

21. What is overharvesting?

22. What is aquaculture?

23. Why are livestock important worldwide?

24. How do we get energy from ruminants?
