2L

Selected Readings

May 26 - 29

Section 1

What Is Energy?

Reading Preview

Key Concepts

- How are energy, work, and power related?
- What are the two basic kinds of energy?

Key Terms

- energy
- kinetic energy
- potential energy
- gravitational potential energy
- elastic potential energy

Target Reading Skill

Using Prior Knowledge Before you read, look at the section headings and visuals to see what this section is about. Then write what you know about energy in a graphic organizer like the one below. As you read, write what you learn.

What You Know
1. The joule is the unit of work.
2.

What You Learned
1.
2.

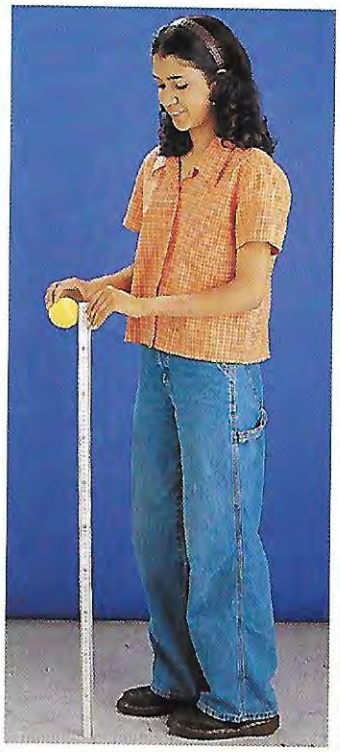
Lab zone Discover Activity

How High Does a Ball Bounce?

1. Hold a meter stick vertically, with the zero end on the ground.
2. Drop a tennis ball from the 50-cm mark and record the height to which it bounces.
3. Drop the tennis ball from the 100-cm mark and record the height to which it bounces.
4. Predict how high the ball will bounce if dropped from the 75-cm mark. Test your prediction.

Think It Over

Observing How does the height from which you drop the ball relate to the height to which the ball bounces?



Brilliant streaks of lightning flash across the night sky. The wind howls, and thunder cracks and rumbles. Then a sound like a runaway locomotive approaches, growing louder each second. Whirling winds rush through the town. Roofs are lifted off of buildings. Cars are thrown about like toys. Then, in minutes, the tornado is gone.

The next morning, a light breeze carries leaves past the debris. The wind that destroyed buildings hours before is now barely strong enough to move a leaf. Wind is just moving air, but it has energy.

When a breeze does work lifting leaves, it transfers energy to them. ▶

Energy, Work, and Power

When wind moves a house, or even a leaf, it causes a change. In this case, the change is in the position of the object. Recall that work is done when a force moves an object through a distance. The ability to do work or cause change is called **energy.** So the wind has energy.

Work and Energy When an object or living thing does work on another object, some of its energy is transferred to that object. You can think of work, then, as the transfer of energy. When energy is transferred, the object upon which the work is done gains energy. Energy is measured in joules—the same units as work.

Power and Energy You may recall that power is the rate at which work is done. **If the transfer of energy is work, then power is the rate at which energy is transferred, or the amount of energy transferred in a unit of time.**

$$\text{Power} = \frac{\text{Energy transferred}}{\text{Time}}$$

Power is involved whenever energy is being transferred. For example, a calm breeze's power is its rate of energy transfer to lift a leaf a certain distance. The tornado in Figure 1 transfers the same amount of energy when it lifts the leaf the same distance. However, the tornado has a greater power than the breeze because it transfers energy to the leaf in less time.

Reading Checkpoint What is power in terms of energy?

Kinetic Energy

Two basic kinds of energy are kinetic energy and potential energy. Whether energy is kinetic or potential depends on whether an object is moving or not.

A moving object, such as the wind, can do work when it strikes another object and moves it some distance. Because the moving object does work, it has energy. The energy an object has due to its motion is called **kinetic energy.** The word *kinetic* comes from the Greek word *kinetos*, which means "moving."

FIGURE 1
Energy and Power
A tornado and a calm breeze each do the same amount of work if they transfer the same amount of energy to a leaf. However, the tornado has a greater power than the breeze because it transfers its energy in less time.
Drawing Conclusions *Why is the same amount of work done on the leaf?*

Math Skills

Exponents

An exponent tells how many times a number is used as a factor. For example, 3×3 can be written as 3^2. You read this number as "three squared." An exponent of 2 indicates that the number 3 is used as a factor two times. To find the value of a squared number, multiply the number by itself.

$$3^2 = 3 \times 3 = 9$$

Practice Problem What is the value of the number 8^2?

Factors Affecting Kinetic Energy The kinetic energy of an object depends on both its mass and its velocity. Kinetic energy increases as mass increases. For example, think about rolling a bowling ball and a golf ball down a bowling lane at the same velocity, as shown in Figure 2. The bowling ball has more mass than the golf ball. If both balls have the same velocity, the bowling ball is more likely to knock down the pins because it has more kinetic energy than the golf ball.

Kinetic energy also increases when velocity increases. For example, suppose you have two identical bowling balls and you roll one ball so it moves at a greater velocity than the other. You must throw the ball harder to give it the greater velocity. In other words, you transfer more energy to it. Therefore, the faster ball has more kinetic energy.

Calculating Kinetic Energy There is a mathematical relationship between kinetic energy, mass, and velocity.

$$\text{Kinetic energy} = \frac{1}{2} \times \text{Mass} \times \text{Velocity}^2$$

Do changes in velocity and mass have the same effect on kinetic energy? No—changing the velocity of an object will have a greater effect on its kinetic energy than changing its mass by the same factor. This is because velocity is squared in the kinetic energy equation. For instance, doubling the mass of an object will double its kinetic energy. But doubling its velocity will quadruple its kinetic energy.

Reading Checkpoint **Which has a greater effect on an object's kinetic energy—doubling its mass or doubling its velocity?**

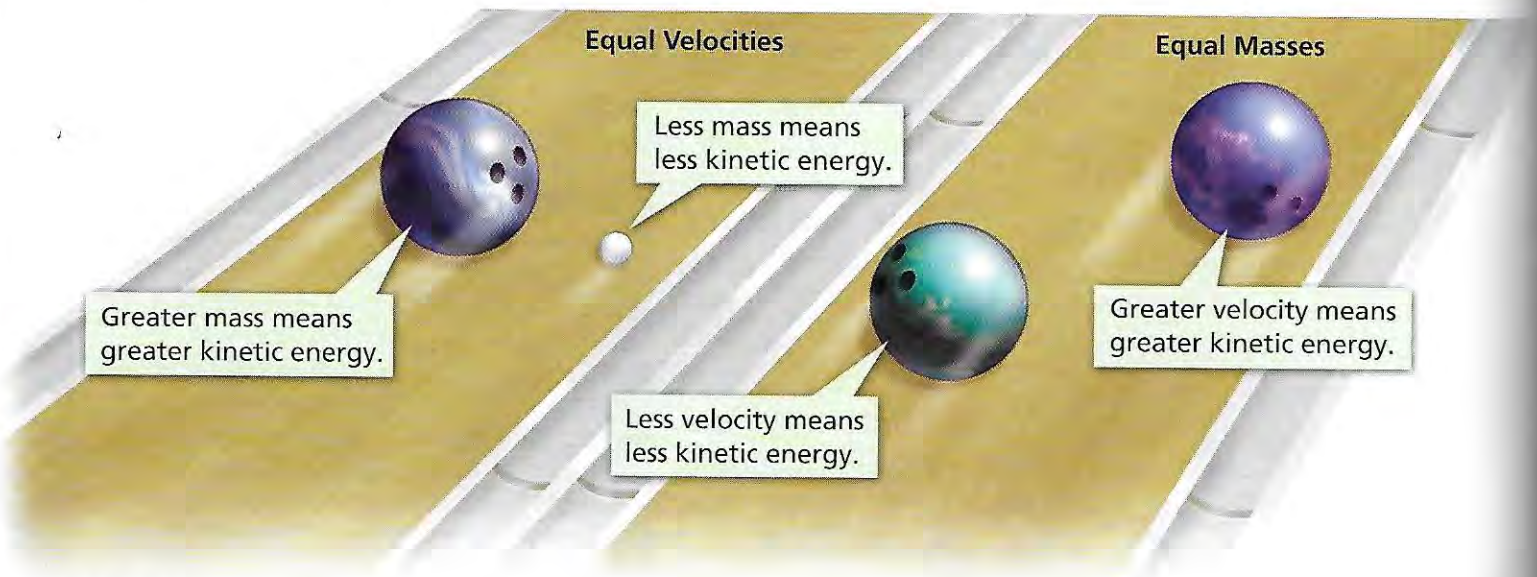


FIGURE 2
Kinetic Energy
Kinetic energy increases as mass and velocity increase.
Predicting *In each example, which object will transfer more energy to the pins? Why?*

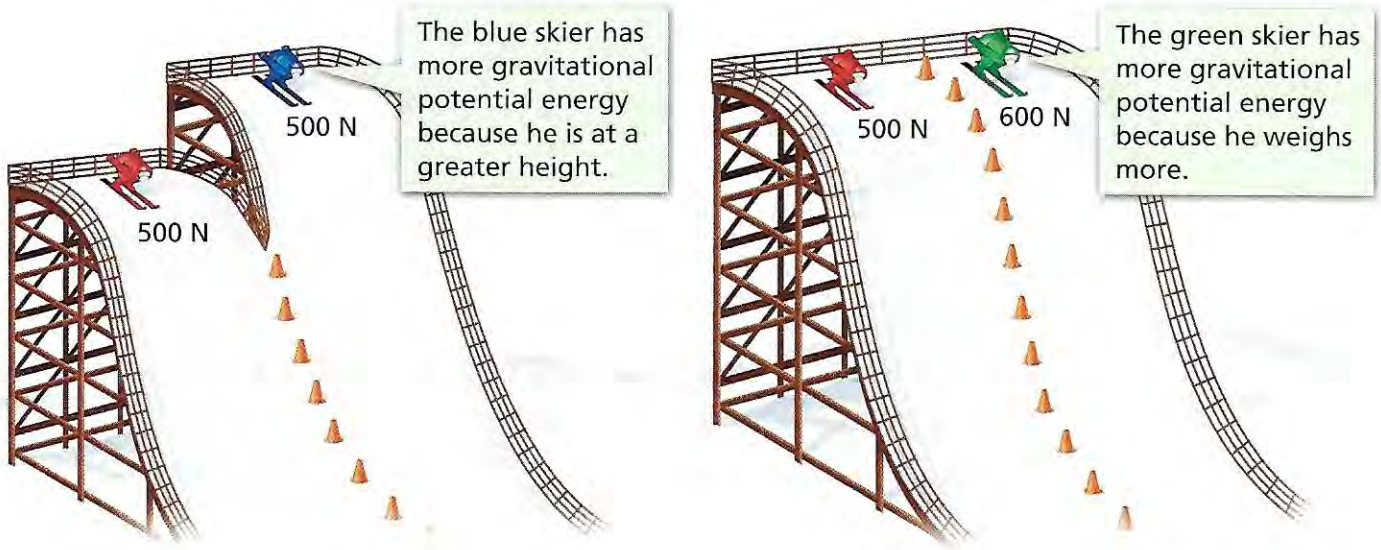


FIGURE 3
Gravitational Potential Energy
Gravitational potential energy increases as weight and height increase.
Interpreting Diagrams *Does the red skier have more gravitational potential energy on the higher ski jump or the lower one? Why?*

Potential Energy

An object does not have to be moving to have energy. Some objects have stored energy as a result of their positions or shapes. When you lift a book up to your desk from the floor or compress a spring to wind a toy, you transfer energy to it. The energy you transfer is stored, or held in readiness. It might be used later when the book falls to the floor or the spring unwinds. Stored energy that results from the position or shape of an object is called **potential energy.** This type of energy has the potential to do work.

Gravitational Potential Energy Potential energy related to an object's height is called **gravitational potential energy.** The gravitational potential energy of an object is equal to the work done to lift it. Remember that Work = Force × Distance. The force you use to lift the object is equal to its weight. The distance you move the object is its height. You can calculate an object's gravitational potential energy using this formula.

Gravitational potential energy = Weight × Height

For example, the red skier on the left in Figure 3 weighs 500 newtons. If the ski jump is 40 meters high, then the skier has 500 newtons × 40 meters, or 20,000 J, of gravitational potential energy.

The more an object weighs, or the greater the object's height, the greater its gravitational potential energy. At the same height, a 600-newton skier has more gravitational potential energy than a 500-newton skier. Similarly, a 500-newton skier has more gravitational potential energy on a high ski jump than on a low one.

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FIGURE 4
Elastic Potential Energy
The energy stored in a stretched object, such as a bow, is elastic potential energy. **Interpreting Photographs** *When the energy stored in the bow is released, how is it used?*

Elastic Potential Energy An object gains a different type of potential energy when it is stretched. The potential energy associated with objects that can be stretched or compressed is called **elastic potential energy.** For example, when an archer pulls back an arrow, the bow changes shape. The bow now has potential energy. When the archer releases the string, the stored energy sends the arrow flying to its target.

Reading Checkpoint **What type of energy does a bow have when you pull back an arrow?**

For more information watch the following youtube video https://www.youtube.com/watch?v=ZPIPUDtM1BI

Section 1 Assessment

Target Reading Skill

Using Prior Knowledge Review your graphic organizer and revise it based on what you just learned in the section.

Reviewing Key Concepts

1. a. **Defining** What is energy?
   b. **Describing** How are energy, work, and power related?
   c. **Applying Concepts** If a handsaw does the same amount of work on a log as a chainsaw does, which has a greater power? Why?
2. a. **Identifying** What is kinetic energy? What is potential energy?
   b. **Explaining** What factors affect an object's kinetic energy?
   c. **Problem Solving** At a given height above Earth, how would you determine the potential energy of a sky diver? The kinetic energy of a sky diver?

Math Practice

3. **Exponents** What is the value of the number 10^2?
4. **Exponents** What number when squared gives you the value 36?

Section 2

Forms of Energy

Reading Preview

Key Concepts

- How can you determine an object's mechanical energy?
- What are some forms of energy associated with the particles that make up objects?

Key Terms

- mechanical energy
- thermal energy
- electrical energy
- chemical energy
- nuclear energy
- electromagnetic energy

Target Reading Skill

Building Vocabulary After you read the section, reread the paragraphs that contain definitions of Key Terms. Use the information you have learned to write a definition of each Key Term in your own words.

Lab zone Discover Activity

What Makes a Flashlight Shine?

1. Remove the batteries from a flashlight and examine them. Think about what type of energy is stored in the batteries.
2. Replace the batteries and turn on the flashlight. What type of energy do you observe?
3. After a few minutes, place your hand near the bulb of the flashlight. What type of energy do you feel?

Think It Over

Inferring Describe how you think a flashlight works in terms of energy. Where does the energy come from? Where does the energy go?

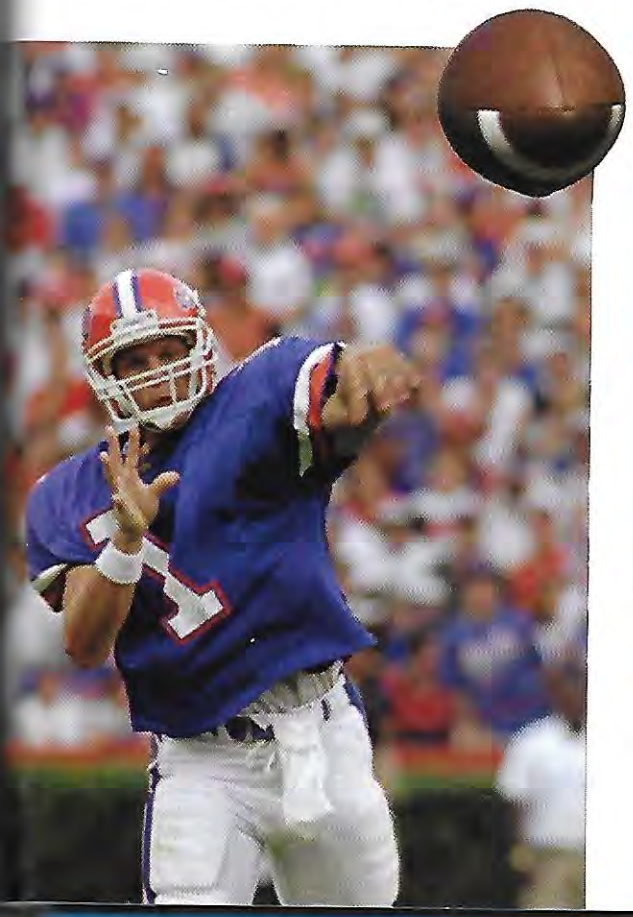
You are on the edge of your seat as the quarterback drops back, steps forward, and then launches a deep pass. The ball soars down the field and drops into the receiver's hands. The electronic scoreboard flashes TOUCHDOWN. You jump to your feet and cheer!

As the crowd settles back down, you shiver. The sun is setting, and the afternoon is growing cool. A vendor hands you a hot dog, and its heat helps warm your hands. Suddenly, the stadium lights switch on. You can see the players more clearly as they line up for the next play.

The thrown football, the scoreboard, the sun, the hot dog, and the stadium lights all have energy. You have energy, too! Energy comes in many different forms.

Mechanical Energy

Do you remember the pass thrown by the quarterback? A football thrown by a quarterback has mechanical energy. So does a moving car or a trophy on a shelf. The form of energy associated with the position and motion of an object is called **mechanical energy.**



◀ **A quarterback transfers mechanical energy to the football.**

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An object's mechanical energy is a combination of its potential energy and kinetic energy. **You can find an object's mechanical energy by adding the object's kinetic energy and potential energy.**

Mechanical Energy = Potential energy + Kinetic energy

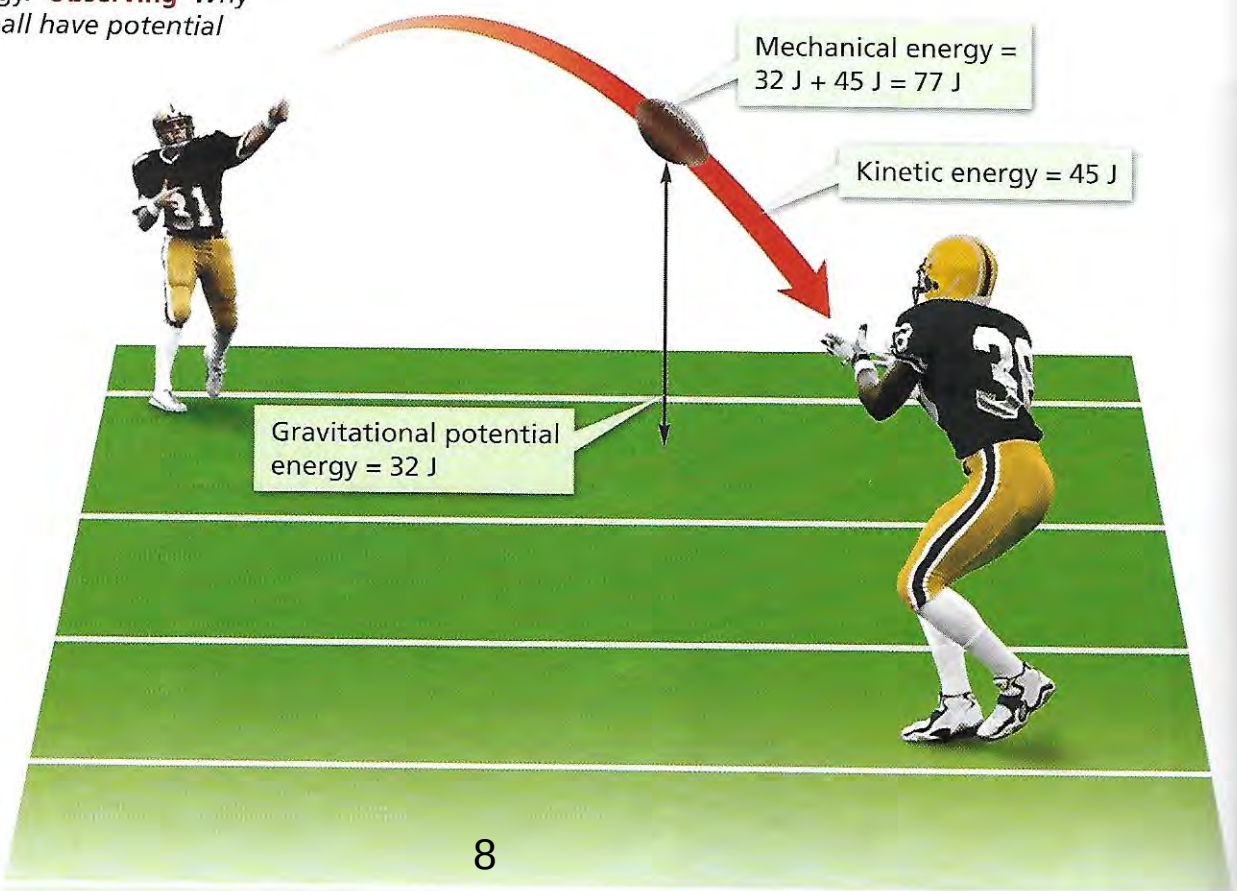
For example, a football thrown by a quarterback has both potential energy and kinetic energy. The higher the football, the greater its potential energy. The faster the football moves, the greater its kinetic energy.

You can add the potential energy and kinetic energy of the football in Figure 5 to find its mechanical energy. The football has 32 joules of potential energy due to its position above the ground. It also has 45 joules of kinetic energy due to its motion. The total mechanical energy of the football is equal to 32 joules + 45 joules, or 77 joules.

An object with mechanical energy can do work on another object. In fact, you can think of mechanical energy as the ability to do work. The more mechanical energy an object has, the more work it can do.

Reading Checkpoint **What two forms of energy combine to make mechanical energy?**

FIGURE 5
Mechanical Energy
To find the football's mechanical energy, add its kinetic energy to its potential energy. **Observing** *Why does the football have potential energy?*



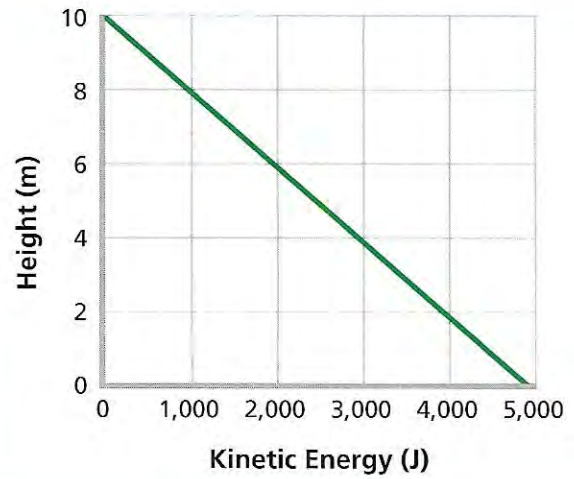
Math Analyzing Data

Calculating Mechanical Energy

The kinetic energy of a 500-N diver during a dive from a 10-m platform was measured. These data are shown in the graph.

1. **Reading Graphs** According to the graph, how much kinetic energy does the diver have at 8 m?
2. **Calculating** Using the graph, find the kinetic energy of the diver at 6 m. Then calculate the diver's potential energy at that point.
3. **Inferring** The mechanical energy of the diver is the same at every height. What is the mechanical energy of the diver?

Energy of a Diver



Other Forms of Energy

So far in this chapter, you have read about energy that involves the motion and position of an object. But an object can have other forms of kinetic and potential energy. Most of these other forms are associated with the particles that make up objects. These particles are far too small to see. **Forms of energy associated with the particles of objects include thermal energy, electrical energy, chemical energy, nuclear energy, and electromagnetic energy.**

Thermal Energy All objects are made up of particles called atoms and molecules. Because these particles are constantly in motion, they have kinetic energy. The faster the particles move, the more kinetic energy they have. These particles are arranged in specific ways in different objects. Therefore, they also have potential energy. The total potential and kinetic energy of the particles in an object is called **thermal energy.** Look at Figure 6. Even though the lava may be flowing slowly down the volcano, its particles are moving quickly. Because the particles have a large amount of kinetic energy, the lava has a large amount of thermal energy.

If you've ever eaten ice cream on a hot day, you've experienced thermal energy. Fast-moving particles in the warm air make the particles of ice cream move faster. As the kinetic energy of the particles increases, so does the thermal energy of the ice cream. Eventually, the ice cream melts.

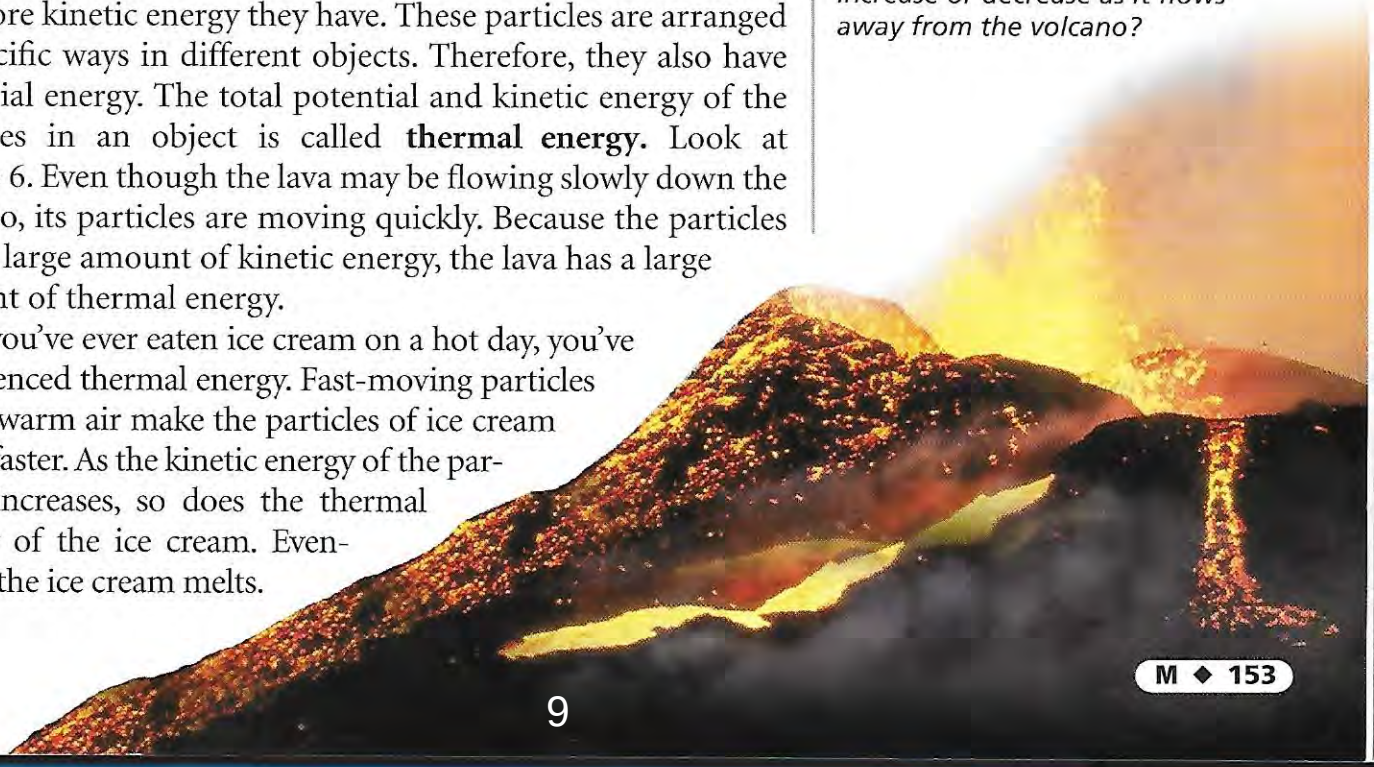


FIGURE 6
Thermal Energy
The lava flowing from this volcano has a large amount of thermal energy. **Predicting** *Will the thermal energy of the lava increase or decrease as it flows away from the volcano?*

FIGURE 7
Electrical Energy
Electric charges in lightning carry electrical energy.

Electrical Energy When you receive a shock from a metal doorknob, you are experiencing electrical energy. The energy of electric charges is **electrical energy.** Depending on whether the charges are moving or stored, electrical energy can be a form of kinetic or potential energy. The lightning in Figure 7 is a form of electrical energy. You rely on electrical energy from batteries or electrical lines to run devices such as flashlights, handheld games, and radios.

Chemical Energy Almost everything you see, touch, or taste is composed of chemical compounds. Chemical compounds are made up of atoms and molecules. Bonds between the atoms and molecules hold chemical compounds together. These bonds have chemical energy. **Chemical energy** is potential energy stored in the chemical bonds that hold chemical compounds together. Chemical energy is stored in the foods you eat, in the matches you can use to light a candle, and even in the cells of your body. When bonds in chemical compounds break, new chemical compounds may form. When this happens, chemical energy may be released.

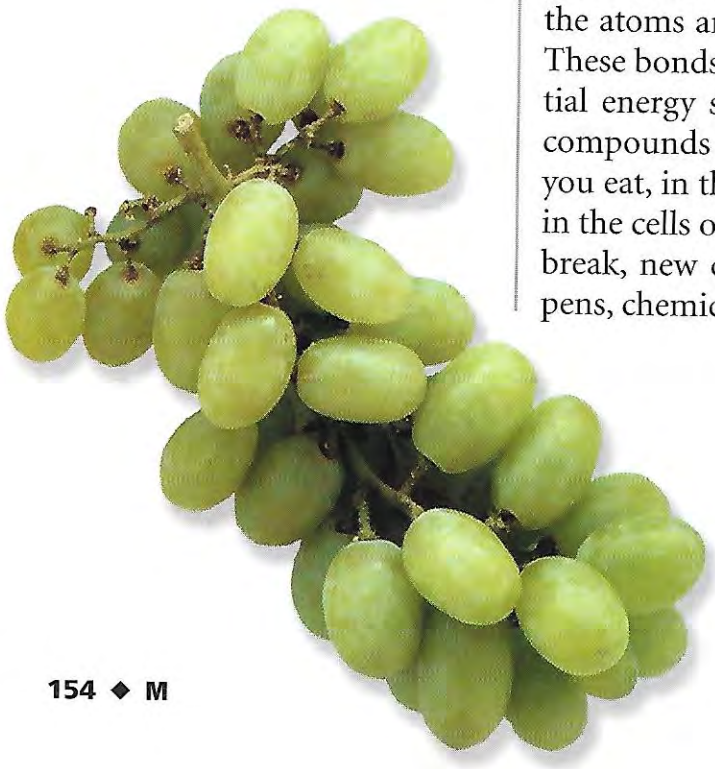


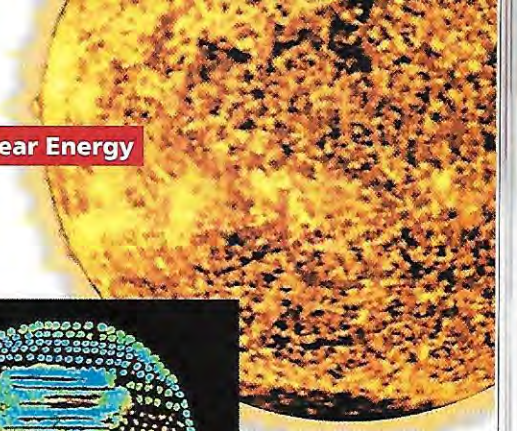
FIGURE 8
Chemical Energy
The particles in these grapes contain chemical energy. Your body can use this energy after you eat them.

Nuclear Energy A type of potential energy called **nuclear energy** is stored in the nucleus of an atom. Nuclear energy is released during a nuclear reaction. One kind of nuclear reaction, known as nuclear fission, occurs when a nucleus splits. Nuclear power plants use fission reactions to produce electricity. Another kind of reaction, known as nuclear fusion, occurs when the nuclei of atoms fuse, or join together. Nuclear fusion reactions occur continuously in the sun, releasing tremendous amounts of energy.

Electromagnetic Energy The sunlight that you see each day is a form of **electromagnetic energy.** Electromagnetic energy travels in waves. These waves have some electrical properties and some magnetic properties.

The microwaves you use to cook your food and the X-rays doctors use to examine patients are types of electromagnetic energy. Other forms of electromagnetic energy include ultraviolet radiation, infrared radiation, and radio waves.

Reading Checkpoint What form of energy are microwaves?



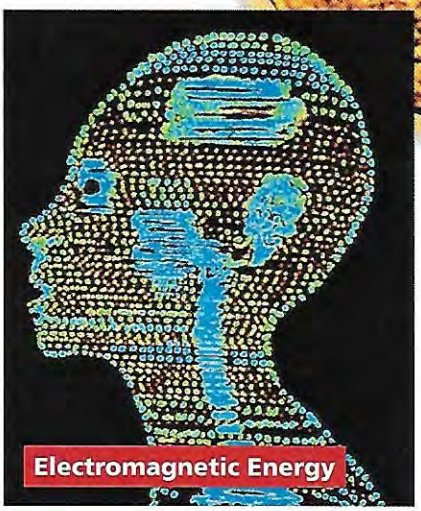


FIGURE 9
Nuclear and Electromagnetic Energy
The sun is a source of nuclear energy. Doctors use X-rays, a form of electromagnetic energy, when taking a CT scan to look for brain disorders. **Observing** *What other forms of energy from the sun can you observe?*

For more information watch youtube video https://www.youtube.com/watch?v=63t0Y2ACoh4

Section 2 Assessment

Target Reading Skill **Building Vocabulary** Use your definitions to help answer the questions.

Reviewing Key Concepts

1. a. **Defining** What is mechanical energy?
   b. **Drawing Conclusions** If an object's mechanical energy is equal to its potential energy, how much kinetic energy does the object have? How do you know?
   c. **Calculating** If the kinetic energy of a falling apple is 5.2 J and its potential energy is 3.5 J, what is its mechanical energy?
2. a. **Listing** List the five forms of energy associated with the particles that make up objects.
   b. **Explaining** Why do the particles of objects have both kinetic and potential energy?
   c. **Classifying** What kind of energy do you experience when you eat a peanut butter and jelly sandwich?

Writing in Science

Detailed Observation In terms of energy, think about what happens when you eat a hot meal. Describe all the different forms of energy that you experience. For example, if you are eating under a lamp, its electromagnetic energy helps you see the food. Explain the source of each form of energy.

Empires flourished in the Americas.

By A.D. 1500, only about 1 million Indians lived in what is now Canada and the United States. The lands farther south were much more heavily settled. Population figures vary widely, but recent scholars estimate that between 50 and 60 million Indians lived in Mexico, Central America, and South America by 1500.

The Olmecs lived in Mexico.

The first major American civilization seems to have arisen in the swampy lowlands of Mexico's Gulf Coast around 1200 B.C. The creators of this civilization were the Olmecs.

By slashing and burning the trees of the dense rain forest, the Olmecs cleared enough land for farming. Yet the forest was never far away. Late at night, the Olmecs doubtless heard the howls of the wild jaguar, a spotted cat that still lives in the area. The Olmecs carved stone figures that were half jaguar and half human, suggesting that they worshiped the jaguar's spirit. Among their many achievements, the Olmecs produced fine pottery, invented a system of writing, and developed a calendar. Ceremonial ballgames, which were important to nearly all later Indian societies in the region, began with the Olmecs.

The Olmec civilization flourished for about 800 years. It perished around 400 B.C. Our knowledge of the Olmecs is limited. However, later civilizations of Mexico and Central America clearly show the influence of the Olmecs.

The Mayas built great cities.

Around 500 B.C., the Mayas began to create their civilization in the southern Gulf Coast region and present-day Guatemala. In the insect-infested rain forest, the Mayas built a brilliant civilization. Historians call the years from 500 B.C. to A.D. 250 the Formative Period of Maya civilization. The Mayas reached their height during their Classic Period, from A.D. 250 to 900.

KEY DATES	
350 B.C.	Earliest Maya city-states appear
300 B.C.	Tiahuanaco, Peru, founded (peak A.D. 500, abandoned 1000)
200 B.C.	Teotihuacán founded (peak A.D. 500)
200 B.C.	Moche culture, coastal Ecuador (peak A.D.300, conquered 700)
100 B.C.	Hopewell culture (peak A.D. 300, ended 800)
A.D. 300	Beginning of Classical period of Maya civilization (until 800)
300	Mogollon culture, North America
400	Hohokam culture, North America (until 1450)

Slashing trees with stone tools, the Mayas cleared the rain forest to grow corn. Although they had no wheeled vehicles and no beasts of burden such as horses or oxen, they moved great pieces of stone to build their temples. They had no iron tools, yet they shaped their stone blocks so skillfully that their pyramids still stand.

The pyramids were the center of Maya religious ceremonies. Around them, cities grew up where priests, government officials, some merchants, and artisans lived. Peasant farmers probably lived outside the cities in thatched huts. The farmers came to town for religious events and to visit the market.

Like the ancient Greeks and Phoenicians, the Mayas built city-states. The ruins of at least 80 have been found. Each city-state had a hereditary ruler, nobles, and priests. Four or five of the most powerful city-states dominated their smaller neighbors.

Tikal Tikal was the largest Maya city. In its heyday, five pyramid-temples towered over its plazas and avenues. The tallest, the Temple of the Giant Jaguar, was as high as a 20-story building. A flight of stairs led up one side of each pyramid to a small temple at the top. Intricately carved panels over the temple entrances were painted bright red, blue, and orange. The priests who climbed to these temples offered sacrifices of corn, cocoa beans, and an occasional monkey to the gods.

The calendar Maya priests also measured the nightly movements of the moon and stars. Keeping track of time was crucial to the Maya priests. The calendar allowed them to predict what their heavenly gods (sun, moon, planets) would be doing from day to day. It also foretold dramatic events, such as eclipses of the sun.

The Maya calendar was both accurate and complex. The Mayas kept track of time on three different calendars. They measured the solar year to 365 days, very close to our own. They also counted a sacred year of 260 days. Third, they kept track of what was called the Long Count, in which a full cycle lasted about 400 years. After 13 such cycles, the Mayas believed, the world would be destroyed and created again.

Clearly, the Mayas were skilled mathematicians. As early as 300 B.C., they discovered the concept of zero, an idea unknown to Greeks and Romans. For numbers, the Mayas used a system of dots and bars. Five dots were equal to one bar. A shell symbol represented zero.

Source: World History: Perspectives on the Past.
Lexington, MA: D.C. Heath and Company, 1988.

THE MAYA 300 B.C.–A.D. 800

The Maya lived in what is now southern Mexico and Guatemala. They created a civilization that was at its peak while the Roman Empire was crumbling.

The engraved figures found in Mayan ruins often show richly dressed people, such as this priest with his ornate headdress. He appears to be holding a knife in his left hand.

The Maya existed as far back as 2000 B.C. Over the centuries, by draining marshy land and building irrigation systems, they became successful farmers, able to support a large population. In the early phase, from 300 B.C. to A.D. 300, they built many cities in Guatemala, Belize, and southern Yucatán, each with its own character and artistic style. Their cities had temple pyramids, a fortified palace, marketplaces, workshops, and living quarters.

MAYAN CLASS SYSTEM

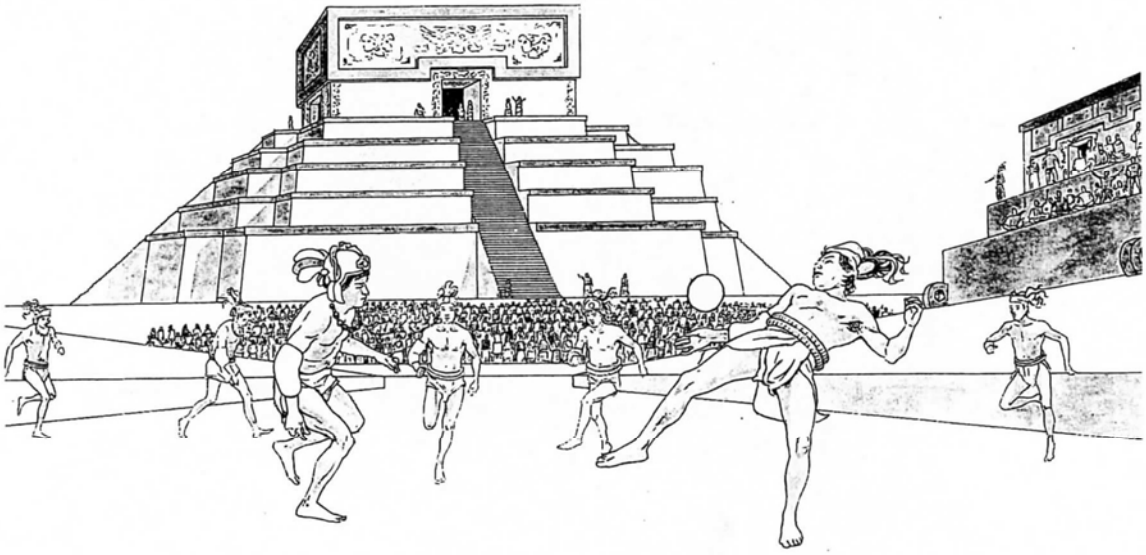
The Maya had a class system: the nobles, priests, rulers, officials, and their servants lived in the cities while ordinary people lived on the land, going into the cities for markets and religious festivals. There was an alphabet of 800 hieroglyphs, and the Maya studied advanced mathematics, astronomy, and calendar systems. As in ancient Greece, each city was an independent city-state, and there was feuding between them, usually to demand tribute and take prisoners. Around A.D. 230, a violent volcanic eruption blew apart Mount Ilopango in the south, and covered a large area with ash. The southern cities had to be abandoned, and this marked the end of the "pre-classic" period of Mayan civilization.

The Mayan heartland moved from the south in early times to the center around Tikal. After A.D. 800 the Maya lived in the north of Yucatán.

THE CLASSIC PERIOD

Between 300 and 800, Mayan civilization reached its peak. Many new cities were built in Yucatán. The dominant city was Tikal, although Palenque, Yaxchilán, Copán, and Calakmul were also important.

The Maya wrote in hieroglyphs (picture writing), which are found carved on huge stone monuments and written in books made of bark paper.



The Maya played a ball game which may have had religious importance to them as a kind of oracle. In vast courts they bounced a solid rubber ball back and forth using their hips, thighs, and elbows, aiming for a hoop in the side wall. The ball probably represented the sun.

Source: The Kingfisher History Encyclopedia. New York: Kingfisher, 2004.

2L History Reading 81 – The Maya

The Maya were skilled craftspeople, making stone sculptures, jade carvings, decorated pottery, paintings, advanced tools, and gold and copper objects. They built roads and shipping lanes to encourage trade. Their mathematical system counted in 20s, and used three symbols: a bar for "five," a dot for "one," and a shell for "zero."

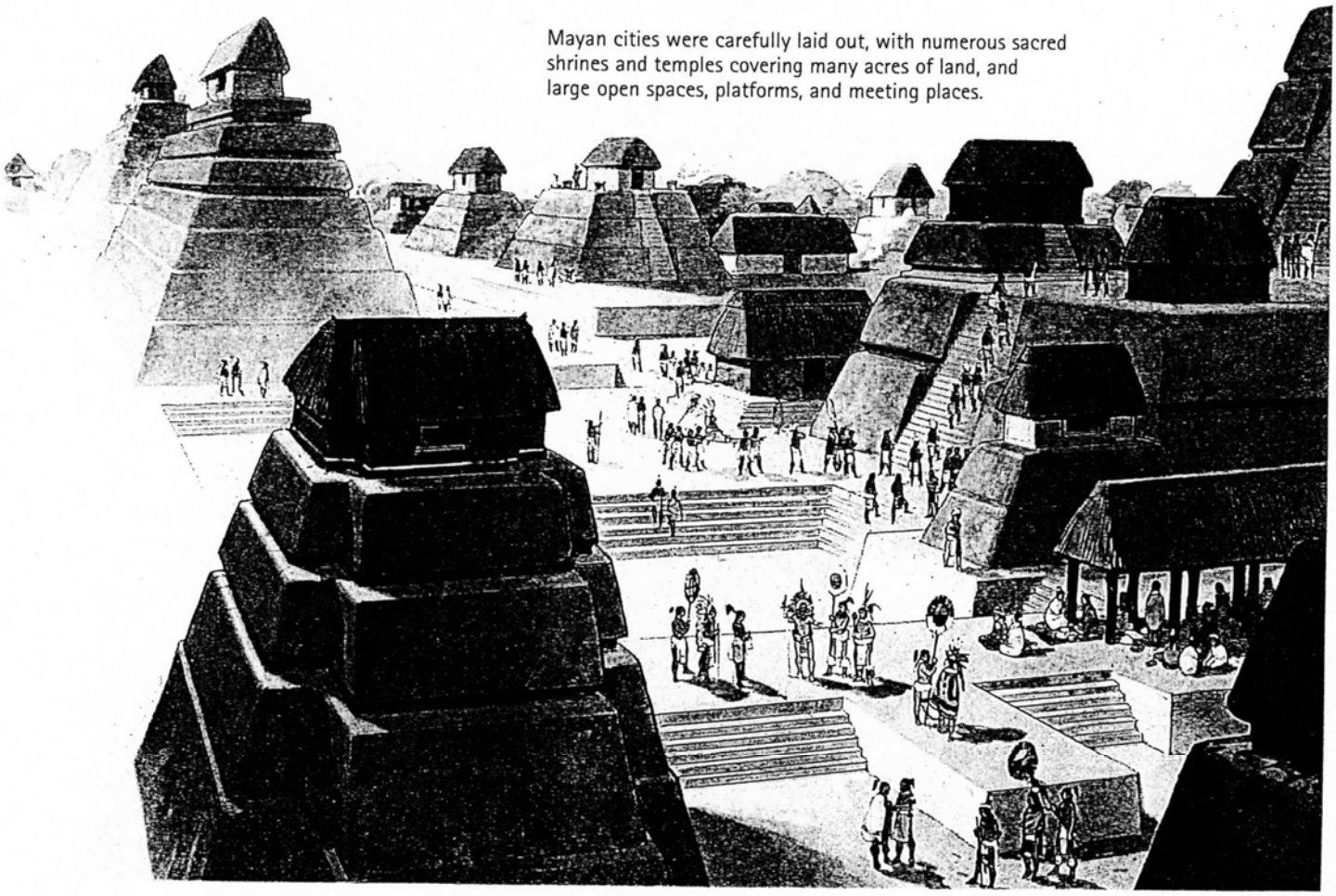
HUMAN SACRIFICE

The Maya practiced blood sacrifice. They viewed this life and the afterlife as equal worlds, and killing people for religious purposes, to please the gods and ancestors and to bring fertility and prosperity, was an acceptable thing to do. In later times, ambitious building projects meant that peasants had to supply ever more food and labor, and hostage-taking wars to capture sacrificial victims drastically cut the population. The agricultural system collapsed, and with it the cities. By 950, most central Mayan cities lay in ruins—though a later phase followed. The Maya still live in the uplands of Central America.

These were the four kinds of people at the top of the Mayan social pyramid: an official, a warrior, a noble, and a priest.

MAYAN CITIES

In the early days of Mayan city building, the largest city was El Mirador, founded in 150 B.C., and had a population of 80,000 people by A.D. 100. It was abandoned around A.D. 150. Tikal, ruled by its king Stormy Sky, later became the largest city, with some 100,000 people around 450. Most cities were impressive and planned in grids. They were built around the ceremonial centers, and often oriented to astronomical events such as the rising and setting points of the sun. The religious basis of Mayan cities and their use of pyramids resembled that of the ancient Egyptians 2,000 years earlier.



Mayan cities were carefully laid out, with numerous sacred shrines and temples covering many acres of land, and large open spaces, platforms, and meeting places.

A carved stone sculpture from Teotihuacán. Surprisingly unwarlike, this city nevertheless had a great influence on all other neighboring cultures—especially through its crafts and other goods.

TEOTIHUACÁN

As the Olmecs and Zapotecs declined, the city-state of Teotihuacán, founded around 200 B.C., grew to dominate Mexico by A.D. 100. At its height 600 years later, Teotihuacán was larger than ancient Rome. It was built in a planned grid system, with impressive temple complexes and pyramids, many craft workshops, trading markets, and foreign residents' quarters. It was the largest trading city in the Americas, linking and supplying North and South America. Teotihuacán influenced other Mexican cultures such as the Maya, and it imported materials from as far away as the Great Lakes and Colombia. It was surrounded by other cities, but it was unusually peaceful. It mysteriously declined around A.D. 600, although the Aztecs carried its heritage on into later times.

SOUTH AMERICA

In Ecuador, the state of Moche, at its peak around A.D. 300, made fine pottery, textiles, and metalwork. Farther south, the city of Tiahuanaco, 12,200 ft. (3,660m) above sea level beside Lake Titicaca in the Andes, was inhabited by 40,000 people and featured enormous stone temples and palaces. Founded around 300 B.C., the city reached its golden age around A.D. 500.

The Toltecs were very militaristic. Their temples were guarded by stone statues of warriors such as this one from Tula.

By 600, Teotihuacán was in decline, and around 750 it was burned to the ground, possibly by tribes from the north. Various peoples tried to assume control, and around 900, the Toltecs established a capital at Tula. It became the center of a military state and trading network that reached from Colorado to Colombia. In 1000, far away in Yucatán, a faction of the Toltecs invaded the Mayan Empire, expanding the northern Mayan city of Chichén Itzá. The Toltec Empire came to an end in 1168, when it was overrun, and Tula was destroyed. Soon afterward, the Aztecs moved into the area.

THE LATER MAYA

Many Mayan cities were abandoned around 800, although some still flourished in northern Yucatán from 900 onward. Around 1000, Yucatán was invaded by Toltecs, who stayed there until 1221, building a copy of Tula at Chichén Itzá. Warrior chiefs took power from the priests, and caused crafts such as pottery, art, and literature to decline in quality.

The Toltecs were beaten by the Maya from Mayapán, whose Cocom dynasty dominated Yucatán for 200 years until civil war broke out in 1480. The Spanish arrived during the 1500s, but the last Maya city-state, Tayasal, did not fall until 1697.

New cultures replaced the old.

Most Maya cities declined after the year 700. By 900, Maya civilization had collapsed. No one knows exactly why. Some scholars believe that peasants revolted against the ruling class. At the same time, invaders from the north disrupted the fragile economy of all of Mexico and Central America. Crop failure and famine may also have played a part in the Maya decline.

North of the fertile Valley of Mexico lay a dry and barren plain of scrubby grasses and cactus, a semi-desert. For centuries, this area was the homeland of warlike peoples, including the Chichimecs, the Toltecs, and the Aztecs. These groups were like the Huns and Mongols of Asia. They raided the richer, more settled civilizations whenever they could.

Between 900 and 1300, successive waves of northern warriors swept into the Valley of Mexico. One of these groups, the Toltecs, established an empire. The Toltecs learned to build pyramids and ball courts in the style of their more civilized predecessors. They dominated the Valley of Mexico for 200 years. Around 1160, their capital of Tula was destroyed by new invaders.

Footnote to History

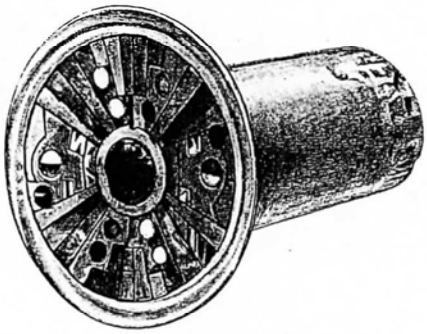
The wealthiest Mayas showed off their high status by nibbling cocoa beans. These tasty, chocolate-flavored beans served as a common medium of exchange in Tikal's marketplace. Thus, to eat them was like eating money.

TIAHUANACO AND HUARI

Civilization in South America was based in two places. One was at Tiahuanaco, a large temple-city 12,000 ft. (3660m) above sea level near Lake Titicaca in Bolivia. Between 600 and 1000, it had a population of 100,000. The people of Tiahuanaco made distinctive pottery and jewelry, massive stone dry-stack walls, and enormous temple-stones. They created a string of towns stretching to the coast and into the Brazilian rain forests. The other civilization was Huari, which included remnants of several earlier local cultures such as Nazca and Moche. This was a powerful military empire, covering over half of modern Peru. Huari and Tiahuanaco may have followed the same religion, but Huari was militaristic and Tiahuanaco was peaceful. The two empires prospered until about 1000, when they were both abandoned, possibly because of drought.

KEY DATES	
600	Teotihuacán is sacked and burned
800	Toltec migration into central Mexico
900	Toltecs establish a city-state at Tula
1000	Tiahuanaco and Huari abandoned
1168	Tula destroyed
1200	Building of the Mississippian temple-cities
1200	Rise of the Aztecs and the Incas

This pottery image of a god from Huari, decorated with corn, was probably honored by farmers to help grow their crops.



▲ This earring from Huari is made of stone inlaid with bone and shell. The Huari people also made beautiful jewelry and small objects out of gold.

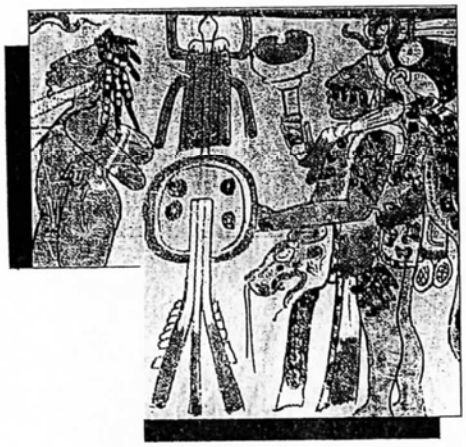
▲ This is one of the many massive carved stone figures of Tiahuanaco, erected around 700. Tiahuanaco, near the southern edge of Lake Titicaca, was ruled by a priesthood according to religious principles. The city had several large temples.

This bowl from the Mimbres people of the southwest had a hole made in it to "kill" the bowl. It was then buried with its owner.

Mayan writing was no less elaborate. The script, the only complete writing system in America, combined pictograms with phonetic signs, much the way Chinese characters do. The image of a bat, for example, might indicate a real bat, pronounced *zotz* in the Mayan tongue. But it might also stand for the similar sound *tzi*—as in *tz'ib*, meaning "to write." This double service, applied to a language replete with synonyms and homonyms, allowed Mayan scribes to indulge a taste for fancy visual wordplay. In a stone inscription at Copán the name of a local lord, Smoke-Jaguar, is written in twenty different ways. Such scribal virtuosity was not unusual.

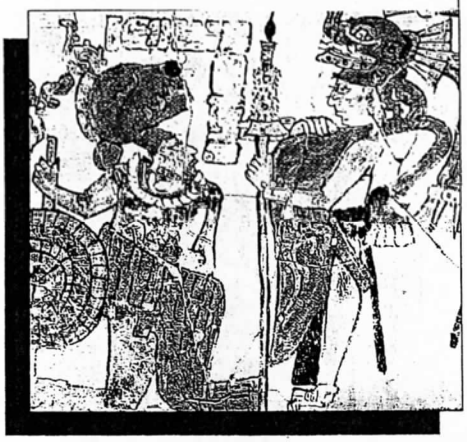
Insatiable record keepers, the Maya set down all events of dynastic or ceremonial importance. The accessions of kings, royal marriages, decisive military victories were all duly celebrated on monumental stone slabs in the city plazas. Administrative records and the astronomical tables that determined feast days and religious schedules were entered into fold-out, accordion-leaf books made of bark paper. (To make the paper, the Maya soaked pieces of a tree's inner bark to separate the fibers, and then pounded the fibers together into a smooth surface.) No works of classic Mayan literature would survive in their original form, but a compendium of myths, legends, history, religion, and astronomy known as the *Popol Vuh,* literally the "Book of the Community," was to be retranscribed by certain Mayan people not long after the Spanish conquest.

For all their intellectual sensitivity, the Maya could be savagely cruel and aggressive. Mayan men would march into battle with the passionate conviction of religious zealots—as indeed they were. Their primary purpose was not to conquer territory but to acquire captives for ritual sacrifice. And woe to the enemy who allowed himself to be taken. His death would be agonizingly slow, his bones pulled from their joints and his body tormented with knives. In the end he would be decapitated, or his heart extracted with an obsidian knife.



If the sacrifice of an enemy was sweet to the Mayan gods, so also was the blood of Mayan rulers. Ritual bloodletting was a fundamental part of Mayan religion. Just as the gods poured out their life-giving sacred liquid, rain, to nourish the people, the Mayan rulers—who were believed to be descended from gods—gave their own vital sacred liquid, blood, to sustain the gods. (An analagous belief about the blood of a deity was central to the Christian ritual of the Eucharist, a religious practice that in this same time period was spreading in the Middle East and Europe.) To fulfill their bloodletting duties, Mayan kings and queens engaged in acts of self-mutilation, usually as part of important state events. One particularly painful method was to pull a length of thorn-studded twine through the tongue, catching the blood in a bowl.

A profound sense of the supernatural permeated every aspect of Mayan life. Each phenomenon of nature had its divine counterpart. The *Popol Vuh* told the story of two popular legendary figures known as the Hero Twins, Hunahpú and Xbalanqué, who excelled as blowgun marksmen and as ball players. In one ball game, they faced off against the Lords of the Underworld, grim opponents who each bore the name of a fatal disease. By trickery, the Hero Twins triumphed and rose up to heaven to become the sun and the moon. Several deities were apparently borrowed from Central Mexico: the Plumed Serpent, which the Maya called Kukulcán, and the goggle-eyed Tlaloc, known in the Yucatán as Chaac, and here associated with blood sacrifices as well as rain.



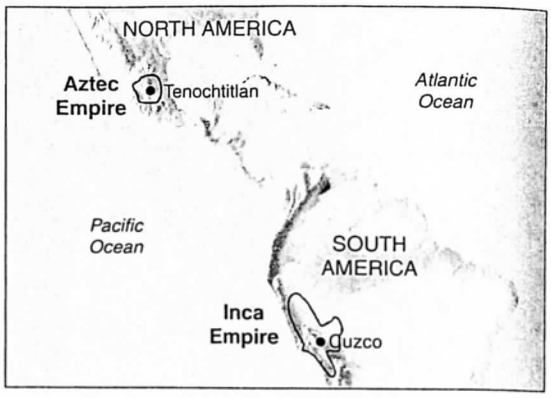
At top, a Mayan warrior wearing a pelt and carrying a mace and a staff ushers a captive off to his fate. Above, another prisoner—this one a defeated lord with a headdress, a broken staff, and a rope around his neck—kneels before his counterpart. The capture of even low-ranking men was a point of pride among the Maya, since the prisoner's lifeblood could be offered to the gods. But taking a dignitary was of greater consequence: Captive kings might be kept alive for repeated bloodlettings.

AZTECS 1100–1500

Two great civilizations were founded in the Americas within about a hundred years of each other: the Inca Empire in Peru and the Aztec Empire in Mexico.

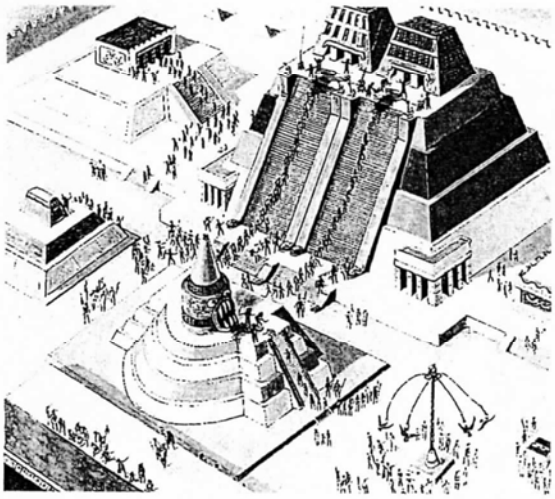
The Aztec god Huitzilopochtli was sometimes depicted as a snake. This image is made of wood, and covered with jade stones.

Legends say that the Aztec people originally came from northern Mexico. Then, in 1168, on the instructions of their god Huitzilopochtli (often depicted as a snake), they began to migrate southward. They eventually settled in the valley of Mexico, where they set up farming communities. Around 1325, during a time of warfare, they moved to a safe site on an island in Lake Texcoco. This is the site of present-day Mexico City.



The Aztec and Inca empires developed independently of each other in North and South America. By the beginning of the 1500s, they had both expanded and had great influence over their regions.

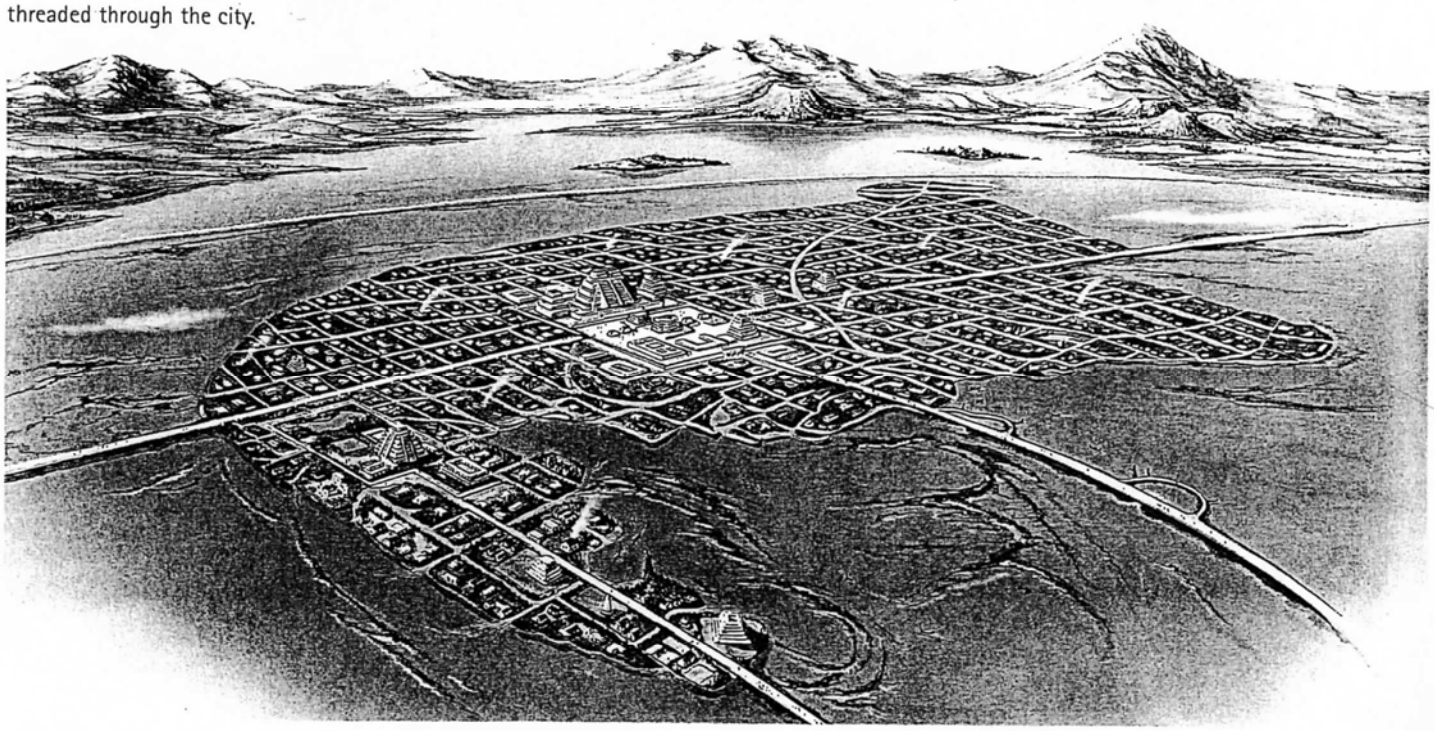
The Great Temple lay at the heart of the island city of Tenochtitlan. On top of the pyramid were shrines to the gods Tláloc and Huitzilopochtli. The monument in front of it was dedicated to Quetzalcóatl.



THE CITY OF TENOCHTITLAN

The Aztecs created garden-islands in Lake Texcoco on which to grow food. They also started to build a great city, called Tenochtitlan. It was easily defended, since it could be reached only by the causeways (raised roads) that the Aztecs had built across the lake. The Aztecs traded throughout Mexico, and their men served in the armies of other cities in return for payment. Under their great leader, Itzcóatl who ruled from 1427–40, they began to conquer these neighboring cities, eventually building up the Aztec Empire which, by 1500, stretched coast to coast.

▼ Tenochtitlan lay in the center of Lake Texcoco and was linked to the mainland by causeways. A network of canals threaded through the city.



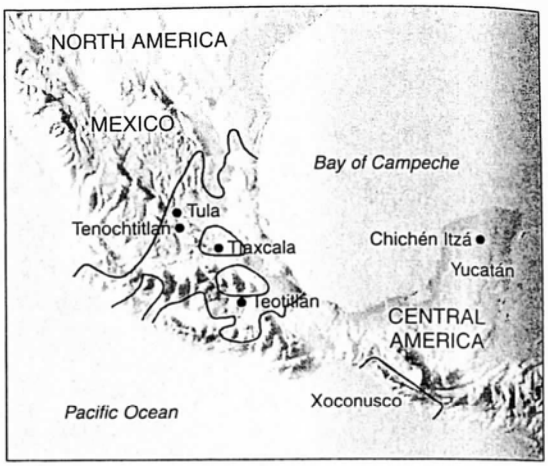
Source: The Kingfisher History Encyclopedia. New York: Kingfisher, 2004.

THE AZTECS 1430–1520

During the 1400s, the Aztecs dominated Mexico from the wondrous city of Tenochtitlan, dominated by pyramids, on an island in the middle of a lake.

▲ Priests were powerful in Aztec society. They did not marry, and they were responsible for conducting all of the many ceremonies in the Aztec 260-day calendar. They also carried out human sacrifices, using knives with blades made from very sharp stone, such as chalcedony, flint, or obsidian.

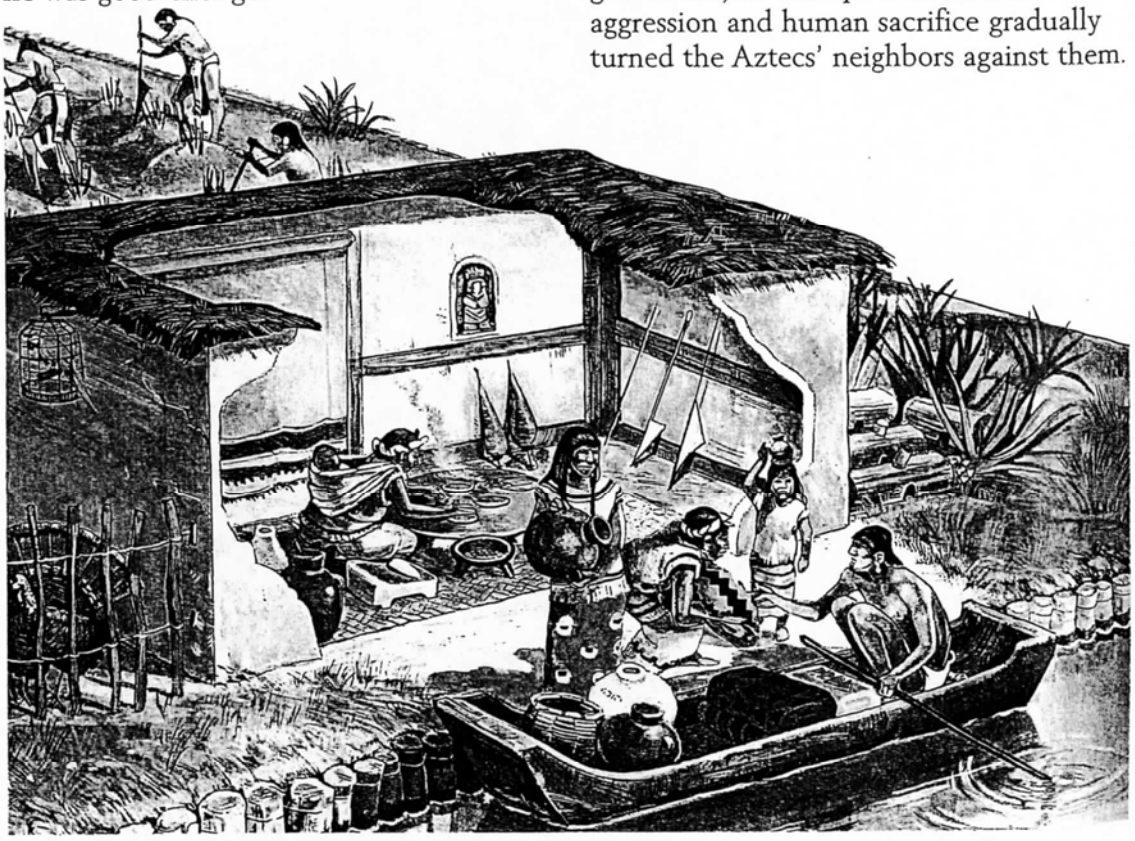
The Aztecs had started to expand in 1430, under the emperor Itzcóatl, and by 1500, they controlled a large empire in Mexico. Tenochtitlan had a population of about 300,000, and was at its most powerful, under Montezuma II (also known as Moctezuma II). In order to feed everyone, food was grown on artificial islands, or *chinampas*, built up in Lake Texcoco, in the middle of which the city stood. Conquered lands provided corn, beans, and cocoa, cotton cloth, and gold, silver, and jade for Aztec craftworkers. Traders bought turquoise from the Pueblo Indians in the north, and from the south came brightly colored feathers, which were used to make elaborately decorated capes, fans, headdresses, and shields. Aztec society was organized along military lines. All young men served in the army from the age of 17 to 22. Some stayed longer than this, because even a peasant could rise to be an army commander if he was good enough.



The Aztecs dominated the center of Mexico from coast to coast, including several cities. They also influenced much wider areas to the north and south.

HUMAN SACRIFICES

One of the main tasks of the army was to take many prisoners of war. The prisoners were sacrificed in Tenochtitlan, at the huge pyramid-temples in the middle of the city. Religious blood sacrifice was important to the Aztecs who sacrificed to many different gods. All of these gods were believed to need a great deal of human blood—especially the god of war, Huitzilopochtli. This armed aggression and human sacrifice gradually turned the Aztecs' neighbors against them.



► Ordinary Aztecs lived in huts with thatched roofs. They ate pancakes made from cornmeal, with spicy bean and vegetable fillings, very like Mexican tortillas today.

The Aztecs built an empire.

Among the invaders was a fierce and desperately poor band of barbarians. These invaders were known by two names: Mexicas and Aztecs.

According to their own legends, the Aztecs came from a northern land called Aztlan. Migrating to the Valley of Mexico, they wandered until their god of war showed them where to build a city. "Look for an eagle perched on a cactus and holding a snake," said the god.

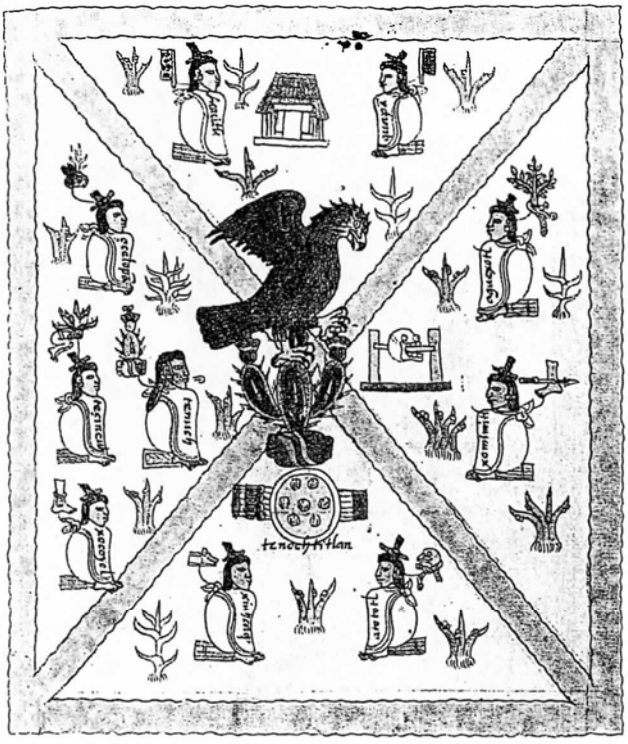
The Aztec priests stood on the shore of a great salt lake, Lake Texcoco (tehs-KOH-koh), and looked out over the water. They saw the eagle with a snake wriggling in its beak. The cactus on which the bird perched grew on one of Lake Texcoco's islands. (The eagle, snake, and cactus appear today on Mexico's flag.)

Tenochtitlán The Aztecs settled on the island, probably about 1325. Their island city was called Tenochtitlán (tay-NOCH-tee-TLAHN), which meant "Place of the Prickly-Pear Cactus." As the Aztecs gained power and wealth, Tenochtitlán became one of the most magnificent cities in the world.

Scholars guess that about 300,000 Aztecs may have lived in Tenochtitlán in 1500. (That figure would make the Aztec city five times larger than London at the same time.) People traveled to and from the lake city over three long causeways. Within the city, the quickest way to get from one's home to the Great Temple was to paddle a boat up one of the major canals that crisscrossed the island. The royal palace boasted wonderful gardens, fountains, baths, and a well-stocked zoo.

Human sacrifice The legendary god that led the Aztecs to their city was also the god of the sun. Aztec priests believed it was their sacred duty to feed human hearts to him. The Aztecs thought that the sun's life-giving light could flicker out at any time. They believed the sun could burn brightly only as long as they fed its god human blood. The Aztecs fought their wars in the Valley of Mexico in part to get victims for sacrifice.

After some 200 years of nearly constant war, the Aztecs triumphed over almost all their neighbors. By the year 1500, the Aztec king was taking tribute in gold, silver, fine cloth, feathers, cocoa beans, and furs from an immense area. Perhaps as many as 11 million Indians were subjects of the Aztec ruler. Yet within a few years, the mighty Aztec empire would come to an end,



This Aztec drawing shows Tenochtitlán beneath the legendary eagle on the cactus.

Source: World History: Perspectives on the Past. Lexington, MA: D.C. Heath and Company, 1988.

Nōmen_____ Classis (Circle) 2nd | 4th | 6th | 8th

2L Latin Distance Learning May 22 to 28 Selected Reading

Part 1: Future

Your main job is to find the person, number, and tense THEN put that together (basically do the reverse of parsing) to create the verb.

The person and number can by found by looking at the subject (the NOMINATIVE word in the sentence) which will be *puellae*. Think of your Personal Pronouns (I, You, He, She, It, We, You all, They). Is *puellae* singular or plural? Out of the options remaining, which would be the best word to take the place of *puellae*? Then, use that pronoun to find the person and number (ex. You = 2nd, Sg).

The tense is already given to you: Present.

To create the verb simply start with your stem (chop off the **-re** from the 2nd Principal Part-*docēre*) then you need to add the passive ENDING. This ending will be the combination of the Person, Number, and Tense found in Chart **India.**

After you've placed the correct verb in the blank, you are free to translate the sentence. Remember to look up your vocab words first and translate the verb in the passive tense (using a form of *to be* and the Past Participle)

Part 2: Conjugation Future

This time you will actually be using Chart **Romeo.**

Remember to find the stem by chopping off the **-re** from the 2nd Principal Part.

The imperative singular is exactly the same as the stem
The imperative plural is the stem + **te**.

The active infinitive is exactly the same as the 2nd Principal Part.
The passive infinitive is the 2nd Principal Part but with the final letter (**e**) changed to an **-ī.**

Part 3: Synopsis

A synopsis is easy if you read the directions carefully. Remember, this is **NOT** a normal conjugation. Instead of conjugation every form of one tense, you are conjugating every tense of one form.

For the Present System (Present, Imperfect, Future) find the Present Stem by chopping off the **-re** from the 2nd Principal Part and add your 2nd Person, Plural endings from Charts **D, E,** & **F.**

For the Perfect System (Perfect, Pluperfect, Future Perfect) find the Perfect Stem by chopping off the **-ī** from the 3rd Principal Part and add your 2nd Person, Plural endings from Charts **X, Y,** & **Z**.

For the Present PASSIVE System (Present Passive, Imperfect Passive, Future Passive) start with the Present Stem then add the 2nd Person, Plural endings from Charts **India, Juliet,** & **Romeo**.

Use the tips from the Part 2 notes above to complete the rest of the synopsis. Remember to translate according to the rules of each tense and voice (1) Subject (2) Magic Word (3) Verb

Nōmen_____ Classis (Circle) 2nd | 4th | 6th | 8th

Present Tense Endings (1/2): ***NONE/am, is, are***

D

Person	Singular	Plural
1st	-ō	-mus
2nd	-s	-tis
3rd	-t	-nt

Imperfect Tense Endings (1/2) ***WAS/WERE***

E

Person	Singular	Plural
1st	-bam	-bāmus
2nd	-bās	-bātis
3rd	-bat	-bant

Future Tense Endings (1/2): ***WILL***

F

Person	Singular	Plural
1st	-bō	-bimus
2nd	-bis	-bitis
3rd	-bit	-bunt

X

Perfect Tense (All Conj.)

Magic Words: have, has, + Past Participle (-ed)

Ex. I have verbed, HSI has verbed

Person	Singular	Plural
1st	-ī	-imus
2nd	-istī	-istis
3rd	-it	-ērunt

Z

Pluperfect Tense (All Conj.)

Magic Words: had + Past Participle (-ed)

Ex. I had verbed, HSI had verbed

Person	Singular	Plural
1st	-eram	-erāmus
2nd	-erās	-erātis
3rd	-erat	-erant

Future Perfect Tense (All Conj.)

Y

Magic Words: will have + Past Participle (-ed)

Ex. I will have verbed, HSI will have verbed

Person	Singular	Plural
1st	--erō	-erimus
2nd	-eris	-eritis
3rd	-erit	-erint

India

Present PASSIVE (1st/2nd Conj):

Magic Words: am, is, are + Past Participle (-ed)

Ex. I am verbed, You are verbed, HSI is verbed

Person	Singular	Plural
1st	-r	-mur
2nd	-ris	-minī
3rd	-tur	-ntur

Juliet

Imperfect PASSIVE (1st/2nd Conj):

Magic Words: was, were + Past Participle (-ed)

Ex. I was verbed, you were verbed

Person	Singular	Plural
1st	-bar	-bāmur
2nd	-bāris	-bāminī
3rd	-bātur	-bantur

Romeo

Future PASSIVE (1st/2nd Conj):

Magic Words: will be + Past Participle (-ed)

Ex. I will be verbed, you will be verbed

Person	Singular	Plural
1st	-bor	-bimur
2nd	-beris	-biminī
3rd	-bitur	-buntur

Wheelock's Latin Chapter 15

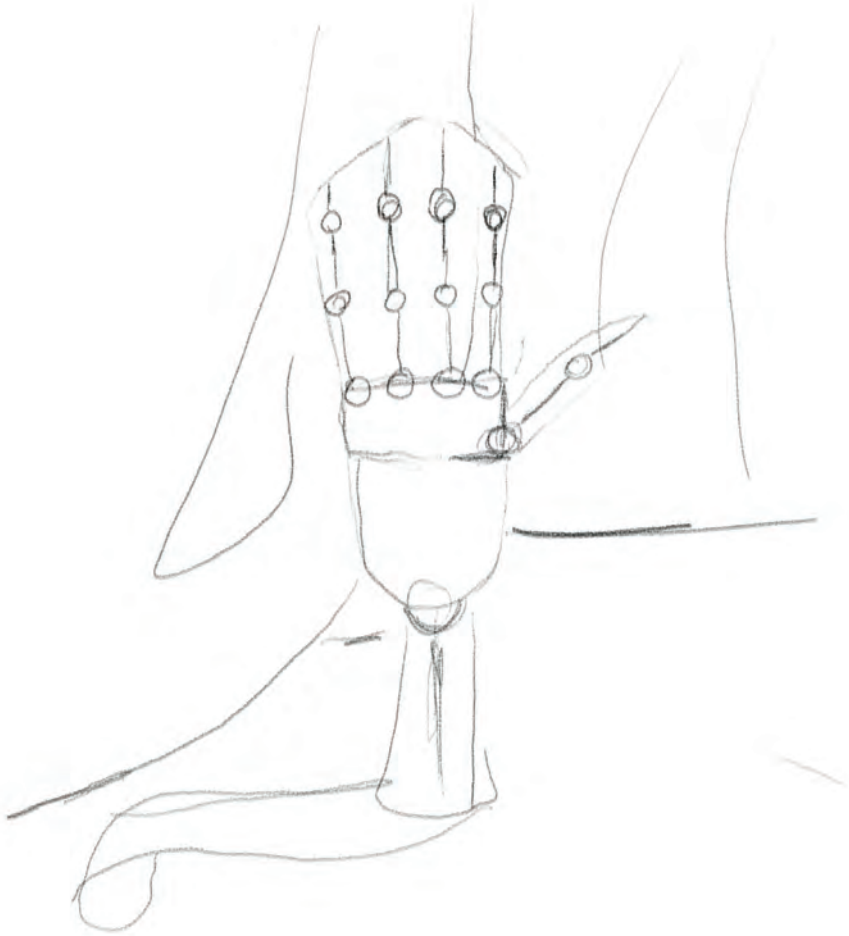
1.	**centum (indecl. adj.)**	one hundred
2.	**committō, committere, commīsī, commisum**	to entrust, commit
3.	**exspectō, exspectāre, exspectāvī, exspectātum**	to look for, expect, await
4.	**iaciō, iacere, iēcī, iactum**	to hurl, throw
5.	**inter (+acc)**	between, among
6.	**Italia, Italiae, f**	Italy
7.	**itaque**	and so, therefore
8.	**memoria, memoriae, f.**	memory, recollection
9.	**mīlle (indecl. adj. in sg.); mīlia, mīlium (n. pl.)**	thousand, thousands
10.	**miser, misera, miserum**	wretched, miserable, unfortunate
11.	**tempestās, -tātis, f.**	weather, storm, season
12.	**timeō, timēre, timuī**	to fear, be afraid of

Wheelock's Latin Chapter 14

1.	**ā/ab (+abl)**	by, from, away from
2.	**animal, animālis, n**	animal, a living creature
3.	**apellō, appellāre, appellāvī, appellātum**	to speak to, address, call, name
4.	**aqua, aquae, f**	water
5.	**ars, artis, f**	art, skill
6.	**auris, auris, f**	ear
7.	**cīvis, cīvis, m and f**	citizen
8.	**currō, currere, cucurrī, cursum**	to run, rush, move quickly
9.	**dēns, dentis, m.**	tooth
10.	**exemplar, exemplaris, n.**	model, pattern, original, example
11.	**iūs, iūris, n.**	right, justice, law
12.	**mare, maris, n**	sea
13.	**mōlēs, mōlis, f.**	mass, structure
14.	**mors, mortis, f**	death
15.	**mūtō, mūtāre, mūtāvī, mūtātum**	to change, alter; exchange
16.	**nūbēs, nūbis, f.**	cloud
17.	**ōs, ōris, n.**	mouth, face
18.	**pars, partis, f**	part, share; direction
19.	**Roma, Romae, f**	Rome
20.	**teneō, tenēre, tenuī, tentum**	to hold, keep, possess; restrain
21.	**trāns (+acc)**	across
22.	**turba, turbae, f**	uproar, disturbance; mob, crowd, multitude
23.	**urbs, urbis, f**	city
24.	**vīs, vīs, f.**	force, power, violence
25.	**vītō, vītāre, vītāvī, vītātum**	to avoid, shun (NOT vīvō=to live)

Read me: Over the last few weeks we have been working on the human form and how to draw it proportionally. First, we went over how to draw a head and lay out a face. Then, we learned how to set up a stick skeleton and draw out the body. This week, I want you to try and draw this open palm hand. Remember, if you have internet access there are videos on the school's website to help you through this sketch.

Step 1: Start by drawing in the simple shapes. To make the palm, start with a rectangle, then draw a U shape from one bottom corner to the other. To draw the fingers and thumb, make joint circles and bone lines. This should look like the example below, but also remind you of how you laid out the people you drew the last few weeks. If your sketch resembles the image below, move on to the next step.



Step 2: Start adding thickness to your fingers, thumb and wrist. For your fingers, just draw a large oval from joint to joint. For the wrist, draw a large half circle under your palm shape then a cylinder below that. If your drawing looks similar to the sketch below, you can move to the next step.

Step 3: For this step, start to add details and shading , and erase any guide lines you no longer need. If your hand sketch looks like the example below you should be good to send it back on the bus. If you want to keep your drawing you can turn it in instead by taking a photo of it and emailing it to me at Zachman@parnassusprep.com. Just make sure your full name is in the subject line of the email.