Unit One
SCIENCE
READING PASSAGE
Science and fields of science
Science (Latin *scientia*, from *scire*, "to know"), is the term which is used, in its broadest meaning to denote systematized knowledge in any field, but applied usually to the organization of objectively verifiable sense experience. The pursuit of knowledge in this context is known as pure science, to distinguish it from applied science, which is the search for practical uses of scientific knowledge, and from technology, through which applications are realized.

Knowledge of nature originally was largely an undifferentiated observation and interrelation of experiences. The Pythagorean scholars distinguished only four sciences: arithmetic, geometry, music, and astronomy. By the time of Aristotle, however, other fields could also be recognized: mechanics, optics, physics, meteorology, zoology, and botany.

Chemistry remained outside the mainstream of science until the time of Robert Boyle in the 17th century, and geology achieved the status of a science only in the 18th century. By that time the study of heat, magnetism, and electricity had become part of physics. During the 19th century scientists finally recognized that pure mathematics differs from the other sciences in that it is a logic of relations and does not depend for its structure on the laws of nature. Its applicability in the elaboration of scientific theories, however, has resulted in its continued classification among the sciences.

The pure natural sciences are generally divided into two classes: the physical sciences and the biological, or life, sciences. The principal branches among the former are physics, astronomy, chemistry, and geology; the chief biological sciences are botany and zoology. The physical sciences can be subdivided to identify such fields as mechanics, cosmology, physical chemistry, and meteorology; physiology, embryology, anatomy, genetics, and ecology are subdivisions of the biological sciences.

The applied sciences include such fields as aeronautics, electronics, engineering, and metallurgy, which are applied physical sciences, and agronomy and medicine, which are applied biological sciences. In this case also, overlapping branches must be recognized. The cooperation, for example, between astrophysics (a branch of medical research based on principles of physics) and bioengineering resulted in the development of the heart-lung machine used in open-heart surgery and in the design of artificial organs such as heart chambers and valves, kidneys, blood vessels, and inner-ear bones. Advances such as these are generally the result of research by teams of specialists representing different sciences, both pure and applied. This interrelationship between theory and practice is as important to the growth of science today as it was at the time of Galileo.

(*From* **http://encarta.com**)

COMPREHENSION QUESTION
Answer the following questions by referring to the reading passage.

1. What does the term 'science' denote in its broadest meaning?

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2. What is applied science known as?

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3. In what way does pure math differ from other sciences?

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4. What sciences are pure natural sciences generally classified into?
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5. Are sciences independent of one another?
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Unit Two
PHYSICS
READING PASSAGE
Physics and scopes of Physics

Physics is the major science dealing with the fundamental constituents of the universe, the forces they exert on one another, and the results produced by these forces. Sometimes in modern physics a more sophisticated approach is taken that incorporates elements of the three areas listed above; it relates to the laws of symmetry and conservation, such as those pertaining to energy, momentum, charge, and parity.

Physics is closely related to the other natural sciences and, in a sense, encompasses them. Chemistry, for example, deals with the interaction of atoms to form molecules; much of modern geology is largely a study of the physics of the earth and is known as geophysics; and astronomy deals with the physics of the stars and outer space. Even living systems are made up of fundamental particles and, as studied in biophysics and biochemistry, they follow the same types of laws as the simpler particles traditionally studied by a physicist.

The emphasis on the interaction between particles in modern physics, known as the microscopic approach, must often be supplemented by a macroscopic approach that deals with larger elements or systems of particles. This macroscopic approach is indispensable to the application of physics to much of modern technology. Thermodynamics, for example, a branch of physics developed during the 19th century, deals with the elucidation and measurement of properties of a system as a whole and remains useful in other fields of physics; it also forms the basis of much of chemical and mechanical engineering. Such properties as the temperature, pressure, and volume of a gas have no meaning for an individual atom or molecule; these thermodynamic concepts can only be applied directly to a very large system of such particles. A bridge exists, however, between the microscopic and macroscopic approach; another branch of physics, known as statistical mechanics, indicates how pressure and temperature can be related to the motion of atoms and molecules on a statistical basis.

Physics emerged as a separate science only in the early 19th century; until that time a physicist was often also a mathematician, philosopher, chemist, biologist, engineer, or even primarily a political leader or artist. Today the field has grown to such an extent that with few exceptions modern physicists have to limit their attention to one or two branches of the science. Once the fundamental aspects of a new field are discovered and understood, they become the domain of engineers and other applied scientists. The 19th-century discoveries in electricity and magnetism, for example, are now the province of electrical and communication engineers; the properties of matter discovered at the beginning of the 20th century have been applied in electronics; and the discoveries of nuclear physics, most of them not yet 40 years old, have passed into the hands of nuclear engineers for applications to peaceful or military uses.

(*From* **http://encarta.com**)

COMPREHENSION QUESTION

Answer the following questions by referring to the reading passage.

1. What does physics study in general?

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2. What is an approach in modern physics related to?

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3. Are there any relations between physics and other sciences? Give some illustrations.

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4. What does statistical physics show?

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5. When was physics seen as a separate science?

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Unit Three

MATTER AND MEASUREMENT

READING PASSAGE

Matter and Measurement

Matter, in science, is the general term applied to anything that has the property of occupying space and the attributes of gravity and inertia. In classical physics, matter and energy were considered two separate concepts that lay at the root of all physical phenomena. Modern physicists, however, have shown that it is possible to transform matter into energy and energy into matter and have thus broken down the classical distinction between the two concepts. When dealing with a large number of phenomena, however, such as motion, the behavior of liquids and gases, and heat, scientists find it simpler and more convenient to continue treating matter and energy as separate entities.

Certain elementary particles of matter combine to form atoms; in turn, atoms combine to form molecules. The properties of individual molecules and their distribution and arrangement give to matter in all its forms various qualities such as mass, hardness, viscosity, fluidity, color, taste, electrical resistivity, and heat conductivity, among others. In philosophy, matter has been generally regarded as the raw material of the physical world, although certain philosophers of the school of idealism, such as the Irish philosopher George Berkeley, denied that matter exists independent of the mind.

Matter exists in three states: solid, liquid and gas. A solid, for example a stone, has a definite shape and a definite volume; a liquid, for example oil, has definite volume but no definite shape; a gas, for example hydrogen (H), has neither definite shape nor volume.

Water can exist in all three states; below 0^o C as a solid (ice); between 0^oC and 100^oC as a liquid (water); and above 100^oC as a gas (vapor). All matter consists of elements such as zinc (Zn) or oxygen (O), or of compounds such as nitric acid (HNO_3) or sulphur dioxide (SO_2).
When we measure quantities of matter, we may use the fundamental units of time (e.g. the second), mass (e.g. the kilogram) and length (e.g. the meter). Or we may use the units such as area (e.g. m^2) or volume (e.g. cm^3) or density (e.g. g/cm^3). These are known as derived units. The area of a rectangle is found by multiplying the length by the width. The volume of a cylinder is equal to ð x radius^2 x height ($V = ðr^2h$). The density of a substance is equal to the mass divided by the volume ($d= m/v$). We use the terms specific density or relative density to indicate density relative to the density of water. The table of densities below shows that mercury (Hg) has a density of $13.6g/cm^3$. This means that a cubic centimeter of mercury has 13.6 times the mass of a cubic centimeter of water.

Substance	Density (g/cm^3)
Gold	19.3
mercury	13.6
Aluminum	2.7
Water	1.0
Ice	0.92
Hydrogen*	0.00009
Air*	0.0013

* at standard temperature and pressure
(*Adapted from* different sources)

COMPREHENSION QUESTION

Answer the following questions by referring to the reading passage.

1. How is matter generally defined?
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2. Were the concepts on matter and energy in classical physics no longer valid? Why?
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3. What decides the qualities of matter?
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4. What do many philosophers consider matter as?
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5. How many states can matter exist in? What are they?

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Unit Four
International System of Units
READING PASSAGE
International System of Units

International system of unit is the name adopted by the Eleventh General Conference on Weights and Measures, held in Paris in 1960, for a universal, unified, self-consistent system of measurement units based on the MKS (meter-kilogram-second) system. The international system is commonly referred to throughout the world as SI, after the initials of Systome International. The Metric Conversion Act of 1975 commits the United States to the increasing use of, and voluntary conversion to, the metric system of measurement, further defining *metric system* as the International System of Units as interpreted or modified for the United States by the secretary of commerce.

At the 1960 conference, standards were defined for six base units and for two supplementary units; a seventh base unit, the mole, was added in 1971. The names of these units are exactly the same in all languages.

In the metric system, the main unit of distance is the meter. Other units of distance are always obtained by multiplying the meter by 10 or a multiply of 10. Thanks to our system of writing numbers, this means that conversion of one unit to another within the metric system can be carried out by shifts of a decimal point.

There are several standard units of length in use today such as meter, inch, foot, mile and centimeter. The meter was originally defined in terms of the distance from the North Pole to the equator; this distance is closed to 10,000 kilometers or 107 meters. The standard meter of the world is the distance between two scratches on a platinum- alloy bar which is kept at the International Bureau of Weight and Measures in France. However, there is a unit of length in Nature which is much more accurate than the distance between two scratches on a piece of metal. This is wavelength of light from any sharp spectral line. The standard meter in France has been calibrated in terms of the number of wavelengths of light of a certain spectral line. (*From* **http://encarta.com**)

COMPREHENSION QUESTION

Answer the following questions by referring to the reading passage.

1. What was the aim of the 11^{th} General Conference on Weight and Measurement, held in Paris in 1960?

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2. How many units were defined at the conference?

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3. Can you show the convenience of unit conversion within the metric system?

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4. What was the meter originally taken?

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5. How many standards to which the meter has been compared? What are they?

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Unit Five
ELEMENTARY PARTICLES
READING PASSAGE
Elementary Particles

In physics, particles that cannot be broken down into any other particles are called elementary particles. The term *elementary particles* also are used more loosely to include some subatomic particles that are composed of other particles. Particles that cannot be broken further are sometimes called fundamental particles to avoid confusion. These fundamental particles provide the basic units that make up all matter and energy in the universe.

Scientists and philosophers have sought to identify and study elementary particles since ancient times. Aristotle and other ancient Greek philosophers believed that all things were composed of four elementary materials: fire, water, air, and earth. People in other ancient cultures developed similar notions of basic substances. As early scientists began collecting and analyzing information about the world, they showed that these materials were not fundamental but were made of other substances.

In the 1800s British physicist John Dalton was so sure he had identified the most basic objects that he called them *atoms* (Greek for "indivisible"). By the early 1900s scientists were able to break apart these atoms into particles that they called the electron and the nucleus.

Electrons surround the dense nucleus of an atom. In the 1930s, researchers showed that the nucleus consists of smaller particles, called the proton and the neutron. Today, scientists have evidence that the proton and neutron are themselves made up of even smaller particles, called quarks.

Scientists now believe that quarks and three other types of particles—leptons, forcecarrying bosons, and the Higgs boson-are truly fundamental and cannot be split into anything smaller. In the 1960s American physicists Steven Weinberg and Sheldon Glashow and

Pakistani physicist Abdus Salam developed a mathematical description of the nature and behavior of elementary particles. Their theory, known as the standard model of particle physics, has greatly advanced understanding of the fundamental particles and forces in the universe. Yet some questions about particles remain unanswered by the standard model, and physicists continue to work toward a theory that would explain even more about particles.

(*From* **http://encarta.com**)

COMPREHENSION QUESTION

Answer the following questions by referring to the reading passage.

1. What are elementary particles?

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2. Have elementary particles been studied recently? How long?

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3. What did Greek philosophers believe?

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4. What was noticeable in 1800s?

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5. Do scientists now fully understand particles? What will they have to do?
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