SHENENDEHOWA CENTRAL SCHOOL
CLIFTON PARK, NEW YORK
OFFICE OF INSTRUCTIONAL SERVICES
ESSENTIAL CONTENT OF SCIENCE
The Living Environment

Key to understanding the document

Basic Process Skills:	Skills taught through laboratory or classroom activities that reinforce the course content.
Performance Indicators:	(1.1a, 5.1d, etc.) Refer to the middle and high school New York State Core Curriculum Guide.
Beyond Core-R:	Indicates the topic is not required in the New York State Core, but is part of Shenendehowa's Living Environment Regents Curriculum.
Beyond Core-H:	Indicates the topic is not required in the New York State Core, but is part of Shenendehowa's Living Environment Honors Curriculum.

MEASUREMENTS AND TOOLS/ GENERAL SKILLS	**7**	**8**	**9**	**10**	**11**	**12**
Follow safety procedures in the classroom and laboratory.	Basic Process Skills			Basic Process Skills		
Safely and accurately use the following measurement tools: Metric Ruler, Balance, Stopwatch, Graduated Cylinder, and Thermometer.	↓			↓		
Use indicators and interpret results.	↓			↓		
Use appropriate units for measured calculated values.	↓			↓		
Classify objects according to an established scheme and a student-generated scheme.	↓			↓		
Develop and use a dichotomous key.	↓			↓		
Determine the size of a microscopic object, using a compound microscope.	↓			↓		
Manipulate a compound microscope to view microscopic objects.	↓			↓		
MEASUREMENT AND TOOLS/ LIVING ENVIRONMENT SKILLS	**7**	**8**	**9**	**10**	**11**	**12**
Design and use a Punnett square or a pedigree chart to predict the probability of certain traits.	Basic Process Skills			Basic Process Skills		

Use appropriate staining techniques.						
Prepare a wet mount slide.						
Classify living things according to a student-generated scheme and an established scheme.						
Interpret and/or illustrate the energy flow in a food chain, energy pyramid, or food web.						
Identify pulse points and pulse rates.						
Identify structure and function relationships in organisms.						
Dissect plant and/or animal specimens to expose and identify internal structures						
Use chromatography and/or electrophoresis to separate molecules						
SCIENTIFIC METHOD/ GENERAL SKILLS	**7**	**8**	**9**	**10**	**11**	**12**
Recognize and analyze patterns and trends.	Basic Process Skills			Basic Process Skills		
Use indicators and interpret results.						
Sequence events.						
Identify cause-and-effect relationships.						
Make observations of biological processes						
States an appropriate hypothesis						
Differentiates between dependent and independent variables						
Identifies a control group and/or controlled variables						
Organizes data through the use of data tables and graphs						
Analyzes results from observations/expressed data						
Formulates an appropriate conclusion from the results of an experiment						
Recognizes assumptions and limitations of the experiment						

LIFE SCIENCES	
7 LIVING THINGS ARE BOTH SIMILAR TO AND DIFFERENT FROM EACH OTHER AND FROM NONLIVING THINGS.	**10 LIVING THINGS ARE BOTH SIMILAR TO AND DIFFERENT FROM EACH OTHER AND FROM NONLIVING THINGS.**
Key Idea 1 Living things are similar to each other yet different from nonliving things. The cell is a basic unit of structure and function of living things (cell theory). For all living things, life activities are accomplished at the cellular level. Human beings are an interactive organization of cells, tissues, organs, and systems. Viruses lack cellular organization.	Key Idea 1 Living things are similar in that they rely on many of the same processes to stay alive, yet are different in the ways that these processes are carried out. Nonliving things lack certain features of living organisms, such as the ability to maintain a cellular organization, carry out metabolic processes while maintaining internal stability (homeostasis), and pass on hereditary information through reproduction. In most biological respects, humans are like other living organisms. For instance, they are made up of cells like those of other animals, have much the same chemical composition, have organ systems and physical characteristics like many others, reproduce in a similar way, carry the same kind of genetic information system, and are part of a food web. The components of living systems, from a single cell to an ecosystem, interact to maintain balance. Different organisms have different regulatory mechanisms that function to maintain the level of organization necessary for life. Diversity is evident and important at all levels of organization from a single cell to a multicellular organism to an ecosystem.
1.1a Living things are composed of cells. Cells provide structure and carry on major functions to sustain life. Cells are usually microscopic in size.	1.2f Cells have particular structures that perform specific jobs. These structures perform the actual work of the cell. Just as systems are coordinated and work together, cell parts must also be coordinated and work together.
1.1b The way in which cells function is similar in all living things. Cells grow and divide, producing more cells. Cells take in nutrients, which they use to provide energy for the work that cells do and to make the materials that a cell or an organism needs.	1.2h Many organic and inorganic substances dissolved in cells allow necessary chemical reactions to take place in order to maintain life. Large organic food molecules such as proteins and starches must initially be broken down (digested to amino acids and simple sugars respectively), in order to enter cells. Once nutrients enter a cell, the cell will use them as building blocks in the synthesis of compounds necessary for life.

1.1c Most cells have cell membranes, genetic material, and cytoplasm. Some cells have a cell wall and/or chloroplasts. Many cells have a nucleus.	1.2g Each cell is covered by a membrane that performs a number of important functions for the cell. These include: separation from its outside environment, controlling which molecules enter and leave the cell, and recognition of chemical signals. The processes of diffusion and active transport are important in the movement of materials in and out of cells. Beyond core-H The cell membrane has a complex structure. 1.2h Many organic and inorganic substances dissolved in cells allow necessary chemical reactions to take place in order to maintain life. Large organic food molecules such as proteins and starches must initially be broken down (digested to amino acids and simple sugars respectively), in order to enter cells. Once nutrients enter a cell, the cell will use them as building blocks in the synthesis of compounds necessary for life. 1.2i Inside the cell a variety of specialized structures, formed from many different molecules, carry out the transport of materials (cytoplasm), extraction of energy from nutrients (mitochondria), protein building (ribosomes), waste disposal (cell membrane), storage (vacuole), and information storage (nucleus). 1.2j Receptor molecules play an important role in the interactions between cells. Two primary agents of cellular communication are hormones and chemicals produced by nerve cells. If nerve or hormone signals are blocked, cellular communication is disrupted and the organism's stability is affected.
1.1d Some organisms are single cells; others, including humans, are multicellular.	1.2b Humans are complex organisms. They require multiple systems for digestion, respiration, reproduction, circulation, excretion, movement, coordination, and immunity. The systems interact to perform the life functions. Beyond core-R Some organisms are prokaryotic, whiles others are eukaryotic. 1.3a The structures present in some single-celled organisms act in a manner similar to the tissues and systems found in multicellular organisms, thus enabling them to perform all of the life processes needed to maintain homeostasis.
1.1e Cells are organized for more effective functioning in multicellular organisms. Levels of organization for structure and function of a multicellular organism include cells, tissues, organs, and organ systems.	1.2e The organs and systems of the body help to provide all the cells with their basic needs. The cells of the body are of different kinds and are grouped in ways that enhance how they function together.
1.1f Many plants have roots, stems, leaves, and reproductive structures. These organized groups of tissues are responsible for a plant's life activities.	Beyond Core-R

1.1g Multicellular animals often have similar organs and specialized systems for carrying out major life activities.	1.2b Humans are complex organisms. They require multiple systems for digestion, respiration, reproduction, circulation, excretion, movement, coordination, and immunity. The systems interact to perform the life functions.
1.1h Living things are classified by shared characteristics on the cellular and organism level. In classifying organisms, biologists consider details of internal and external structures. Biological classification systems are arranged from general (kingdom) to specific (species).	Beyond core-R Beyond core-R Taxonomy and classification systems organize living things. Beyond core-H Invertebrates and vertebrates are organized into phyla within the Animal Kingdom. Beyond core-H There are three orders of mammals (monotremes, marsupials, and placental mammals). Beyond core-R Human anatomy and physiology
1.2a Each system is composed of organs and tissues, which perform specific functions and interact with each other, e.g., digestion, gas exchange, excretion, circulation, locomotion, control, coordination, reproduction, and protection from disease.	1.2e The organs and systems of the body help to provide all the cells with their basic needs. The cells of the body are of different kinds and are grouped in ways that enhance how they function together.
1.2b Tissues, organs and organ systems help to provide all cells with nutrients, oxygen, and waste removal.	1.2a Important levels of organization for structure and function include organelles, cells, tissues, organs, organ systems, and whole organisms.
1.2c The digestive system consists of organs that are responsible for the mechanical and chemical breakdown of food. The breakdown process results in molecules that can be absorbed and transported to cells.	1.2b Humans are complex organisms. They require multiple systems for digestion, respiration, reproduction, circulation, excretion, movement, coordination, and immunity. The systems interact to perform the life functions.
1.2d During respiration, cells use oxygen to release the energy stored in food. The respiratory system supplies oxygen and removes carbon dioxide (gas exchange).	5.1d In all organisms, the energy stored in organic molecules may be released during cellular respiration. This energy is temporarily stored in ATP molecules. In many organisms, the process of cellular respiration is concluded in mitochondria, in which ATP is produced more efficiently, oxygen is used, and carbon dioxide and water are released as wastes.
1.2e The excretory system functions in the disposal of dissolved waste molecules, the elimination of liquid and gaseous wastes, and the removal of excess heat energy.	1.2b Humans are complex organisms. They require multiple systems for digestion, respiration, reproduction, circulation, excretion, movement, coordination, and immunity. The systems interact to perform the life functions. Beyond core-H The kidney has specific structures which function to filter the blood and maintain water balance.
1.2f The circulatory system moves substances to and from cells, where they are needed or produced, responding to changing demands.	1.2b Humans are complex organisms. They require multiple systems for digestion, respiration, reproduction, circulation, excretion, movement, coordination, and immunity. The systems interact to perform the life functions.
1.2g Locomotion, necessary to escape danger, obtain food and shelter, and reproduce, is accomplished by the interaction of the skeletal and muscular systems, and coordinated by the nervous system.	1.2b Humans are complex organisms. They require multiple systems for digestion, respiration, reproduction, circulation, excretion, movement, coordination, and immunity. The systems interact to perform the life functions.

1.2h The nervous and endocrine systems interact to control and coordinate the body's responses to changes in the environment, and to regulate growth, development, and reproduction. Hormones are chemicals produced by the endocrine system; hormones regulate many body functions.	1.2b Humans are complex organisms. They require multiple systems for digestion, respiration, reproduction, circulation, excretion, movement, coordination, and immunity. The systems interact to perform the life functions. Beyond core-H Humans have specific endocrine glands that regulate various body functions. Beyond core-H The human brain is composed of different regions that control and coordinate various body processes and structures.
1.2j Disease breaks down the structures or functions of an organism. Some diseases are the result of failures of the system. Other diseases are the result of damage by infection from other organisms (germ theory). Specialized cells protect the body from infectious disease. The chemicals they produce identify and destroy microbes that enter the body.	5.2 Explain disease as a failure of homeostasis. 1.2d If there is a disruption in any human system, there may be a corresponding imbalance in homeostasis.
7 ORGANISMS INHERIT GENETIC INFORMATION IN A VARIETY OF WAYS THAT RESULT IN CONTINUITY OF STRUCTURE AND FUNCTION BETWEEN PARENTS AND OFFSPRING.	**10 ORGANISMS INHERIT GENETIC INFORMATION IN A VARIETY OF WAYS THAT RESULT IN CONTINUITY OF STRUCTURE AND FUNCTION BETWEEN PARENTS AND OFFSPRING.**
Key Idea 2 Every organism requires a set of instructions for specifying its traits. This information is found in the genes of cells. As organisms reproduce, these instructions are passed from one generation to the next.	Key Idea 2 Organisms from all kingdoms possess a set of instructions (genes) that determines their characteristics. These instructions are passed from parents to offspring during reproduction. Students are familiar with simple mechanisms related to the inheritance of some physical traits in offspring. They are now able to begin to understand the molecular basis of heredity and how this set of instructions can be changed through recombination, mutation, and genetic engineering. The inherited instructions that are passed from parent to offspring exist in the form of a code. This code is contained in DNA molecules. The DNA molecules must be accurately replicated before being passed on. Once the coded information is passed on, it is used by a cell to make proteins. The proteins that are made become cell parts and carry out most functions of the cell. Throughout recorded history, humans have used selective breeding and other biotechnological methods to produce products or organisms with desirable traits. Our current understanding of DNA extends this to the manipulation of genes leading to the development of new combinations of traits and new varieties of organisms. 2.1a Genes are inherited, but their expression can be modified by interactions with the environment.
2.1a Hereditary information is contained in genes. Genes are composed of DNA that makes up the chromosomes of cells.	2.1c Hereditary information is contained in genes, located in the chromosomes of each cell. An inherited trait of an individual can be determined by one or by many genes, and a single gene can influence more than one trait. A human cell contains many thousands of different genes in its nucleus. Beyond core-R The Watson and Crick model of DNA includes sugars, phosphate groups, and bases forming a ladder-like structure.

2.1b Each gene carries a single unit of information. A single inherited trait of an individual can be determined by one pair or by many pairs of genes. A human cell contains thousands of different genes.	2.1c Hereditary information is contained in genes, located in the chromosomes of each cell. An inherited trait of an individual can be determined by one or by many genes, and a single gene can influence more than one trait. A human cell contains many thousands of different genes in its nucleus.
2.1c Each human cell contains a copy of all the genes needed to produce a human being.	2.1c Hereditary information is contained in genes, located in the chromosomes of each cell. An inherited trait of an individual can be determined by one or by many genes, and a single gene can influence more than one trait. A human cell contains many thousands of different genes in its nucleus.
2.1d In asexual reproduction, all the genes come from a single parent. Asexually produced offspring are genetically identical to the parent.	2.1d In asexually reproducing organisms, all the genes come from a single parent. Asexually produced offspring are normally genetically identical to the parent.
2.1e In sexual reproduction typically half of the genes come from each parent. Sexually produced offspring are not identical to either parent.	2.1e In sexually reproducing organisms, the new individual receives half of the genetic information from its mother (via the egg) and half from its father (via the sperm). Sexually produced offspring often resemble, but are not identical to, either of their parents.

2.2a In all organisms, genetic traits are passed on from generation to generation.	2.1b Every organism requires a set of coded instructions for specifying its traits. For offspring to resemble their parents, there must be a reliable way to transfer information from one generation to the next. Heredity is the passage of these instructions from one generation to another. 2.1f In all organisms, the coded instructions for specifying the characteristics of the organism are carried in DNA, a large molecule formed from subunits arranged in a sequence with bases of four kinds (represented by A, G, C, and T). The chemical and structural properties of DNA are the basis for how the genetic information that underlies heredity is both encoded in genes (as a string of molecular bases) and replicated by means of a template. 2.1g Cells store and use coded information. The genetic information stored in DNA is used to direct the synthesis of the thousands of proteins that each cell requires. Beyond core-H Proteins are assembled through the processes of transcription and translation. 2.1j Offspring resemble their parents because they inherit similar genes that code for the production of proteins that form similar structures and perform similar functions. 2.1i The work of the cell is carried out by the many different types of molecules it assembles, mostly proteins. Protein molecules are long, usually folded chains made from 20 different kinds of amino acids in a specific sequence. This sequence influences the shape of the protein. The shape of the protein, in turn, determines its function. 2.1h Genes are segments of DNA molecules. Any alteration of the DNA sequence is a mutation. Usually, an altered gene will be passed on to every cell that develops from it. 2.1k The many body cells in an individual can be very different from one another, even though they are all descended from a single cell and thus have essentially identical genetic instructions. This is because different parts of these instructions are used in different types of cells, and are influenced by the cell's environment and past history. 2.2a For thousands of years new varieties of cultivated plants and domestic animals have resulted from selective breeding for particular traits. 2.2b In recent years new varieties of farm plants and animals have been engineered by manipulating their genetic instructions to produce new characteristics. 2.2c Different enzymes can be used to cut, copy, and move segments of DNA. Characteristics produced by the segments of DNA may be expressed when these segments are inserted into new organisms, such as bacteria. 2.2d Inserting, deleting, or substituting DNA segments can alter genes. An altered gene may be passed on to every cell that develops from it.

2.2a In all organisms, genetic traits are passed on from generation to generation. Continued from previous page.	2.2e Knowledge of genetics is making possible new fields of health care; for example, finding genes, which may have mutations that can cause disease, will aid in the development of preventive measures to fight disease. Substances, such as hormones and enzymes, from genetically engineered organisms may reduce the cost and side effects of replacing missing body chemicals. Beyond core-R Modern technology has many medical applications.
2.2b Some genes are dominant and some are recessive. Some traits are inherited by mechanisms other than dominance and recessiveness.	Beyond Core-R
2.2c The probability of traits being expressed can be determined using models of genetic inheritance. Some models of prediction are pedigree charts and Punnett squares.	Beyond Core-R
	Beyond Core-R Classical Genetics
7 INDIVIDUAL ORGANISMS AND SPECIES CHANGE OVER TIME	**10 INDIVIDUAL ORGANISMS AND SPECIES CHANGE OVER TIME**
Key Idea 3 Evolution is the change in a species over time. Millions of diverse species are alive today. Generally this diversity of species developed through gradual processes of change occurring over many generations. Species acquire many of their unique characteristics through biological adaptation, which involves the selection of naturally occurring variations in populations (natural selection). Biological adaptations are differences in structures, behaviors, or physiology that enhance survival and reproductive success in a particular environment.	Key Idea 3 Evolution is the change of species over time. This theory is the central unifying theme of biology. This change over time is well documented by extensive evidence from a wide variety of sources. Students need to know that in sexually reproducing organisms, only changes in the genes of sex cells can become the basis for evolutionary change and that these evolutionary changes may occur in structure, function, and behavior over time. Students need to be able to distinguish between evolutionary change and the changes that occur during the lifetime of an individual organism. According to many scientists, biological evolution occurs through natural selection. Natural selection is the result of overproduction of offspring, variations among offspring, the struggle for survival, the adaptive value of certain variations, and the subsequent survival and increased reproduction of those best adapted to a particular environment. Selection for individuals with a certain trait can result in changing the proportions of that trait in a population. The diversity of life on Earth today is the result of natural selection occurring over a vast amount of geologic time for most organisms, but over a short amount of time for organisms with short reproductive cycles such as pathogens in an antibiotic environment and insects in a pesticide environment.
3.1a The processes of sexual reproduction and mutation have given rise to a variety of traits within a species.	3.1b New inheritable characteristics can result from new combinations of existing genes or from mutations of genes in reproductive cells. 3.1c Mutation and the sorting and recombining of genes during meiosis and fertilization result in a great variety of possible gene combinations. 3.1d Mutations occur as random chance events. Gene mutations can also be caused by such agents as radiation and chemicals. When they occur in sex cells, the mutations can be passed on to offspring; if they occur in other cells, they can be passed on to other body cells only.

3.1a The processes of sexual reproduction and mutation have given rise to a variety of traits within a species. Continued from previous page.	3.1e Natural selection and its evolutionary consequences provide a scientific explanation for the fossil record of ancient life-forms, as well as for the molecular and structural similarities observed among the diverse species of living organisms. 3.1f Species evolve over time. Evolution is the consequence of the interactions of (1) the potential for a species to increase its numbers, (2) the genetic variability of offspring due to mutation and recombination of genes, (3) a finite supply of the resources required for life, and (4) the ensuing selection by the environment of those offspring better able to survive and leave offspring.
3.1b Changes in environmental conditions can affect the survival of individual organisms with a particular trait. Small differences between parents and offspring can accumulate in successive generations so that descendants are very different from their ancestors. Individual organisms with certain traits are more likely to survive and have offspring than individuals without those traits.	3.1g Some characteristics give individuals an advantage over others in surviving and reproducing, and the advantaged offspring, in turn, are more likely than others to survive and reproduce. The proportion of individuals that have advantageous characteristics will increase. 3.1h The variation of organisms within a species increases the likelihood that at least some members of the species will survive under changed environmental conditions. 3.1i Behaviors have evolved through natural selection. The broad patterns of behavior exhibited by organisms are those that have resulted in greater reproductive success. 3.1j Billions of years ago, life on Earth is thought by many scientists to have begun as simple, single-celled organisms. About a billion years ago, increasingly complex multicellular organisms began to evolve. 3.1k Evolution does not necessitate long-term progress in some set direction. Evolutionary changes appear to be like the growth of a bush: Some branches survive from the beginning with little or no change, many die out altogether, and others branch repeatedly, sometimes giving rise to more complex organisms.
3.1c Human activities such as selective breeding and advances in genetic engineering may affect the variations of species.	2.2 Explain how the technology of genetic engineering allows humans to alter genetic makeup of organisms.
3.2a In all environments, organisms with similar needs may compete with one another for resources.	1.1c In all environments, organisms compete for vital resources. The linked and changing interactions of populations and the environment compose the total ecosystem.
3.2b Extinction of a species occurs when the environment changes and the adaptive characteristics of a species are insufficient to permit its survival. Extinction of species is common. Fossils are evidence that a great variety of species existed in the past.	3.1l Extinction of a species occurs when the environment changes and the adaptive characteristics of a species are insufficient to allow its survival. Fossils indicate that many organisms that lived long ago are extinct. Extinction of species is common; most of the species that have lived on Earth no longer exist.
3.2c Many thousands of layers of sedimentary rock provide evidence for the long history of Earth and for the long history of changing life forms whose remains are found in the rocks. Recently deposited rock layers are more likely to contain fossils resembling existing species.	

3.2d Although the time needed for change in a species is usually great, some species of insects and bacteria have undergone significant change in just a few years.	Beyond core-R
7 THE CONTINUITY OF LIFE IS SUSTAINED THROUGH REPRODUCTION AND DEVELOPMENT	**10 THE CONTINUITY OF LIFE IS SUSTAINED THROUGH REPRODUCTION AND DEVELOPMENT**
Key Idea 4 The survival of a species depends on the ability of a living organism to produce offspring. Living things go through a life cycle involving both reproductive and developmental stages. Development follows an orderly sequence of events.	4.1a Reproduction and development are necessary for the continuation of any species.
4.1a Some organisms reproduce asexually. Other organisms reproduce sexually. Some organisms can reproduce both sexually and asexually.	4.1b Some organisms reproduce asexually with all the genetic information coming from one parent. Other organisms reproduce sexually with half the genetic information typically contributed by each parent. 4.1b Cloning is the production of identical genetic copies.
4.1b There are many methods of asexual reproduction, including division of a cell into two cells, or separation of part of an animal or plant from the parent, resulting in the growth of another individual.	4.1c The processes of meiosis and fertilization are key to sexual reproduction in a wide variety of organisms. The process of meiosis results in the production of eggs and sperm which each contain half of the genetic information. During fertilization, gametes unite to form a zygote, which contains the complete genetic information for the offspring. 4.1e Human reproduction and development are influenced by factors such as gene expression, hormones, and the environment. The reproductive cycle in both males and females is regulated by hormones such as testosterone, estrogen, and progesterone.
4.1c Methods of sexual reproduction depend upon the species. All methods involve the merging of sex cells to begin the development of a new individual. In many species, including plants and humans, eggs and sperm are produced.	4.1f The structures and functions of the human female reproductive system, as in almost all other mammals, are designed to produce gametes in ovaries, allow for internal fertilization, support the internal development of the embryo and fetus in the uterus, and provide essential materials through the placenta, and nutrition through milk for the newborn.
4.1d Fertilization and/or development in organisms may be internal or external.	Beyond core-R There are various modes and methods of reproduction and development.
4.2a The male sex cell is the sperm. The female sex cell is the egg. The fertilization of an egg by a sperm results in a fertilized egg, called a zygote.	4.1c The processes of meiosis and fertilization are key to sexual reproduction in a wide variety of organisms. The process of meiosis results in the production of eggs and sperm which each contain half of the genetic information. During fertilization, gametes unite to form a zygote, which contains the complete genetic information for the offspring.

4.2b In sexual reproduction, sperm and egg each carry one-half of the genetic information for the new individual. Therefore, the fertilized egg contains genetic information from each parent.	4.1c The processes of meiosis and fertilization are key to sexual reproduction in a wide variety of organisms. The process of meiosis results in the production of eggs and sperm which each contain half of the genetic information. During fertilization, gametes unite to form a zygote, which contains the complete genetic information for the offspring.
4.3a Multicellular organisms exhibit complex changes in development, which begin after fertilization. The fertilized egg undergoes numerous cellular divisions that will result in a multicellular organism, with each cell having identical genetic information.	4.1d The zygote may divide by mitosis and differentiate to form the specialized cells, tissues, and organs of multicellular organisms.
4.3b In humans, the fertilized egg grows into tissue, which develops into organs and organ systems before birth.	4.1d The zygote may divide by mitosis and differentiate to form the specialized cells, tissues, and organs of multicellular organisms. 4.1f The structures and functions of the human female reproductive system, as in almost all other mammals, are designed to produce gametes in ovaries, allow for internal fertilization, support the internal development of the embryo and fetus in the uterus, and provide essential materials through the placenta, and nutrition through milk for the newborn. 4.1g The structures and functions of the human male reproductive system, as in other mammals, are designed to produce gametes in testes and make possible the delivery of these gametes for fertilization. 4.1h In humans, the embryonic development of essential organs occurs in early stages of pregnancy. The embryo may encounter risks from faults in its genes and from its Mother's exposure to environmental factors such as inadequate diet, use of alcohol/drugs/tobacco, other toxins, or infections throughout her pregnancy. Beyond core-R Karyotyping and Amniocentesis are techniques for assessing the health of an embryo during pregnancy.
4.3c Various body structures and functions change as an organism goes through its life cycle.	
4.3d Patterns of development vary among animals. In some species the young resemble the adult, while in others they do not. Some insects and amphibians undergo metamorphosis as they mature.	
4.3e Patterns of development vary among plants. In seed-bearing plants, seeds contain stored food for early development. Their later development into adulthood is characterized by varying patterns of growth from species to species.	
4.3f As an individual organism ages, various body structures and functions change.	

4.4a In multicellular organisms, cell division is responsible for growth, maintenance, and repair. In some one-celled organisms, cell division is a method of asexual reproduction.	4.1b Some organisms reproduce asexually with all the genetic information coming from one parent. Other organisms reproduce sexually with half the genetic information typically contributed by each parent. Cloning is the production of identical genetic copies.
4.4b In one type of cell division (asexual), chromosomes are duplicated and then separated into two identical and complete sets to be passed to each of the two resulting cells. In this type of cell division, the hereditary information is identical in all the cells that result.	2.1d In asexually reproducing organisms, all the genes come from a single parent. Asexually produced offspring are normally genetically identical to the parent.
4.4c Another type of cell division accounts for the reproduction of egg and sperm cells in sexually reproducing organisms. The eggs and sperm resulting from this type of cell division contain one-half of the hereditary information.	2.1e In sexually reproducing organisms, the new individual receives half of the genetic information from its mother (via the egg) and half from its father (via the sperm). Sexually produced offspring often resemble, but are not identical to, either of their parents.
4.4d Cancers are a result of abnormal cell division.	Beyond core-R
7 ORGANISMS MAINTAIN A DYNAMIC EQUILIBRIUM THAT SUSTAINS LIFE	**10 ORGANISMS MAINTAIN A DYNAMIC EQUILIBRIUM THAT SUSTAINS LIFE**
5.1b An organism's overall body plan and its environment determine the way that the organism carries out the life processes.	1.2c The components of the human body, from organ systems to cell organelles, interact to maintain a balanced internal environment. To successfully accomplish this, organisms possess a diversity of control mechanisms that detect deviations and make corrective actions.
5.1c All organisms require energy to survive. The amount of energy needed and the method for obtaining this energy vary among cells. Some cells use oxygen to release the energy stored in food.	5.1d In all organisms, the energy stored in organic molecules may be released during cellular respiration. This energy is temporarily stored in ATP molecules. In many organisms, the process of cellular respiration is concluded in mitochondria, in which ATP is produced more efficiently, oxygen is used, and carbon dioxide and water are released as wastes.
	Beyond core-R Respiration performed with oxygen is called aerobic respiration; without oxygen is anaerobic respiration.
5.1g The survival of an organism depends on its ability to sense and respond to its external environment.	
5.2a Food provides molecules that serve as fuel and building material for all organisms. All living things, including plants, must release energy for their food, using it to carry on their life processes.	5.1c In all organisms, organic compounds can be used to assemble other molecules such as proteins, DNA, starch, and fats. The chemical energy stored in bonds can be used as a source of energy for life processes. 5.1e The energy from ATP is used by the organism to obtain, transform, and transport materials, and to eliminate wastes. Beyond core-H The process of cell respiration involves a complex series of reactions which include an electron transport chain. 5.1f Biochemical processes, both breakdown and synthesis, are made possible by a large set of biological catalysts called enzymes. Enzymes can affect the rates of chemical change. The rate at which enzymes work can be influenced by internal environmental factors such as pH and temperature.

	5.1g Enzymes and other molecules, such as hormones, receptor molecules, and antibodies, have specific shapes that influence both how they function and how they interact with other molecules.
	Beyond core-R Organic compounds have specific chemical structures.
5.2c Metabolism is the sum of all chemical reactions in an organism. Metabolism can be influenced by hormones, exercise, diet, and aging.	Beyond core-R
5.1f Regulation of an organism's internal environment involves sensing the internal environment and changing physiological activities to keep conditions within the range required for survival. Regulation includes a variety of nervous and hormonal feedback systems.	5.3 Relate processes at the system level to the cellular level in order to explain dynamic equilibrium in multicelled organisms. 5.3a Dynamic equilibrium results from detection of and response to stimuli. Organisms detect and respond to change in a variety of ways both at the cellular level and at the organism level. 5.3b Feedback mechanisms have evolved that maintain homeostasis. Examples include the changes in heart rate or respiratory rate in response to increased activity in muscle cells, the maintenance of blood sugar levels by insulin from the pancreas, and the changes in openings in the leaves of plants by guard cells to regulate water loss and gas exchange.
5.2d Energy in foods is measured in Calories. The total caloric value of each type of food varies and the number of Calories a person requires varies.	
5.2e In order to maintain a balanced state, all organisms have a minimum daily intake of each type of nutrient based on species, size, age, sex, activity, etc. An imbalance in any of the nutrients might result in weight gain, weight loss, or a diseased state.	
5.2f Infectious disease and personal behaviors, such as use of toxic substances and dietary habits, may interfere with one's dynamic equilibrium. During pregnancy these conditions may also affect the development of the child. Some effects of these conditions are immediate; others may not appear for many years.	4.1h In humans, the embryonic development of essential organs occurs in early stages of pregnancy. The embryo may encounter risks from faults in its genes and from its mother's exposure to environmental factors such as inadequate diet, use of alcohol/drugs/tobacco, other toxins, or infections throughout her pregnancy. 5.2h Disease may also be caused by inheritance, toxic substances, poor nutrition, organ malfunction, and some personal behavior. Some effects show up right away; others may not show up for many years.
7 PLANTS AND ANIMALS DEPEND ON EACH OTHER AND THEIR PHYSICAL ENVIRONMANT	**10 PLANTS AND ANIMALS DEPEND ON EACH OTHER AND THEIR PHYSICAL ENVIRONMANT**
6.1b Food webs identify feeding relationships among producers, consumers, and decomposers in an ecosystem.	1.1a Every population is linked, directly or indirectly, with many others in an ecosystem. Disruptions in the numbers and types of species and environmental changes can upset ecosystem stability. 1.1b An ecosystem is shaped by the nonliving environment as well as its interacting species. The world contains a wide diversity of physical conditions, which creates a variety of environments.

6.1b Food webs identify feeding relationships among producers, consumers, and decomposers in an ecosystem. Continued from previous page.	1.1c In all environments, organisms compete for vital resources. The linked and changing interactions of populations and the environment compose the total ecosystem. 1.1d The interdependence of organisms in an established ecosystem often results in approximate stability over hundreds and thousands of years. For example, as one population increases, it is held in check by one or more environmental factors or another species. 1.1e Ecosystems, like many other complex systems, tend to show cyclic changes around a state of approximate equilibrium. Beyond core-R Populations increase and decrease in ways that can be predicted. Population graphs can display these changes. 1.1f Every population is linked, directly or indirectly, with many others in an ecosystem. Disruptions in the numbers and types of species and environmental changes can upset ecosystem stability.
6.1a Energy flows through ecosystems in one direction, usually from the sun, through producer (photosynthetic) organisms, to herbivores, carnivores, and then to decomposers. This process may be visualized with food chains or energy pyramids.	6.1a Energy flows through ecosystems in one direction, typically from the Sun, through photosynthetic organisms including green plants and algae, to herbivores to carnivores and decomposers.
6.1c Matter is transferred from one organism to another and between organisms and their physical environment. Water, nitrogen, carbon dioxide, and oxygen are examples of substances cycled between the living and nonliving environment.	6.1b The atoms and molecules on the Earth cycle among the living and nonliving components of the biosphere. For example, carbon dioxide and water molecules used in photosynthesis to form energy-rich organic compounds are returned to the environment when the energy in these compounds is eventually released by cells. Continual input of energy from sunlight keeps the process going. This concept may be illustrated with an energy pyramid.
6.1c Matter is transferred from one organism to another and between organisms and their physical environment. Water, nitrogen, carbon dioxide, and oxygen are examples of substances cycled between the living and nonliving environment.	6.1c The chemical elements, such as carbon, hydrogen, nitrogen, and oxygen, that make up the molecules of living things pass through food webs and are combined and recombined in different ways. At each link in a food web, some energy is stored in newly made structures but much is dissipated into the environment as heat. 6.1c Nitrogen is also cycled between living and nonliving environment. At each link in a food web, some energy is stored in newly made structures but much is dissipated as heat into the environment. 6.1e In any particular environment, the growth and survival of organisms depend on the physical conditions including light intensity, temperature range, mineral availability, soil/rock type, and relative acidity (pH).
6.2a Photosynthesis is carried out by green plants and other organisms containing chlorophyll. In this process, the Sun's energy is converted into and stored as chemical energy in the form of a sugar. The quantity of sugar molecules increases in green plants during photosynthesis in the presence of sunlight.	5.1a The energy for life comes primarily from the Sun. Photosynthesis provides a vital connection between the Sun and the energy needs of living systems. Beyond core-H The absorbance spectrum of chlorophyll can be studied with the use of a spectrophotometer.

6.2b The major source of atmospheric oxygen is photosynthesis. Carbon dioxide is removed from the atmosphere and oxygen is released during photosynthesis.	5.1b Plant cells and some one-celled organisms contain chloroplasts, the site of photosynthesis. The process of photosynthesis uses solar energy to combine the inorganic molecules carbon dioxide and water into energy-rich organic compounds (e.g., glucose) and release oxygen to the environment.
	Beyond core-H The process of photosynthesis includes light and dark reactions.
6.2c Green plants are the producers of food, which is used directly or indirectly by consumers.	5.1b Plant cells and some one-celled organisms contain chloroplasts, the site of photosynthesis. The process of photosynthesis uses solar energy to combine the inorganic molecules carbon dioxide and water into energy-rich organic compounds (e.g., glucose) and release oxygen to the environment. 5.1c In all organisms, organic compounds can be used to assemble other molecules such as proteins, DNA, starch, and fats. The chemical energy stored in bonds can be used as a source of energy for life processes.
	Beyond core-R Plants have adapted to a particular environment.
	6.2 **EXPLAIN THE IMPORTANCE OF PRESERVING DIVERSITY OF SPECIES AND HABITATS**
	6.2a As a result of evolutionary processes, there is a diversity of organisms and roles in ecosystems. This diversity of species increases the chance that at least some will survive in the face of large environmental changes. Biodiversity increases the stability of the ecosystem.
	6.2b Biodiversity also ensures the availability of a rich variety of genetic material that may lead to future agricultural or medical discoveries with significant value to humankind. As diversity is lost, potential sources of these materials may be lost with it.
	5.2 **EXPLAIN DISEASE AS A FAILURE OF HOMEOSTASIS**
	5.2a Homeostasis in an organism is constantly threatened. Failure to respond effectively can result in disease or death.
	5.2b Viruses, bacteria, fungi, and other parasites may infect plants and animals and interfere with normal life functions.
	5.2c The immune system protects against antigens associated with pathogenic organisms or foreign substances and some cancer cells.
	5.2d Some white blood cells engulf invaders. Others produce antibodies that attack them or mark them for killing. Some specialized white blood cells will remain, able to fight off subsequent invaders of the same kind.
	5.2e Vaccinations use weakened microbes (or parts of them) to stimulate the immune system to react. This reaction prepares the body to fight subsequent invasions by the same microbes.

	5.2f Some viral diseases, such as AIDS, damage the immune system, leaving the body unable to deal with multiple infectious agents and cancerous cells.
	5.2g Some allergic reactions are caused by the body's immune responses to usually harmless environmental substances. Sometimes the immune system may attack some of the body's own cells or transplanted organs.
	5.2h Disease may also be caused by inheritance, toxic substances, poor nutrition, organ malfunction, and some personal behavior. Some effects show up right away; others may not show up for many years.
	5.2i Gene mutations in a cell can result in uncontrolled cell division, called cancer. Exposure of cells to certain chemicals and radiation increases mutations and thus increases the chance of cancer.
	5.2j Biological research generates knowledge used to design ways of diagnosing, preventing, treating, controlling, or curing diseases of plants and animals.
7 HUMAN DECISIONS AND ACTIVITIES HAVE HAD A PROFOUND IMPACT ON THE PHYSICAL AND LIVING ENVIRONMNET	**10 HUMAN DECISIONS AND ACTIVITIES HAVE HAD A PROFOUND IMPACT ON THE PHYSICAL AND LIVING ENVIRONMNET**
7.1a A population consists of all individuals of a species that are found together a given place and time. Populations living in one place form a community. The community and the physical factors compose an ecosystem.	Beyond Core-R
7.1b Given adequate resources and no disease or predators, populations (including humans) increase. Lack of resources, habitat destruction, and other factors such as predation and climate limit the growth of certain populations in the ecosystem.	6.1d The number of organisms any habitat can support (carrying capacity) is limited by the available energy, water, oxygen, and minerals, and by the ability of ecosystems to recycle the residue of dead organisms through the activities of bacteria and fungi.
	6.1d The number of organisms any habitat can support (carrying capacity) is limited by the available energy, water, oxygen, and minerals, and by the ability of ecosystems to recycle the residue of dead organisms through the activities of bacteria and fungi.
7.1c In all environments, organisms interact with one another in many ways. Relationships may be competitive, harmful, or beneficial. Some species have adapted to be dependent upon each other with the result that neither could survive without the other.	6.1g Relationships between organisms may be negative, neutral, or positive. Some organisms may interact with one another in several ways. They may be in a producer/consumer, predator/prey, or parasite/host relationship; or one organism may cause disease in, scavenge, or decompose another.
7.1d Some microorganisms are essential to the survival of other living things.	Beyond core-R
7.1e The environment may contain dangerous levels of substances (pollutants) that are harmful to organisms. The good health of environments and individuals requires the monitoring of soil, air, water, and taking steps to keep them safe.	

7.2a In ecosystems, balance is the result of interactions between community members and their environment.	6.3a The interrelationships and interdependencies of organisms affect the development of stable ecosystems.
7.2b The environment may be altered through the activities of organisms. Alterations are sometimes abrupt. Some species may replace others over time, resulting in long-term gradual changes (ecological succession).	6.3b Through ecological succession, all ecosystems progress through a sequence of changes during which one ecological community modifies the environment, making it more suitable for another community. These long-term gradual changes result in the community reaching a point of stability that can last for hundreds or thousands of years. 6.3c A stable ecosystem can be altered, either rapidly or slowly, through the activities of organisms (including humans), or through climatic changes or natural disasters. The altered ecosystem can usually recover through gradual changes back to a point of long term stability.
	7.1a The Earth has finite resources; increasing human consumption of resources places stress on the natural processes that renew some resources and deplete those resources that cannot be renewed.
7.2c Overpopulation by any species impacts the environment due to the increased use of resources. Human activities can bring about environmental degradation through resource acquisition, urban growth, land-use decisions, waste disposal, etc.	6.1f Living organisms have the capacity to produce populations of unlimited size, but environments and resources are finite. This has profound effects on the interactions among organisms. 7.2a Human activities that degrade ecosystems result in a loss of diversity of the living and nonliving environment. For example, the influence of humans on other organisms occurs through land use and pollution. Land use decreases the space and resources available to other species, and pollution changes the chemical composition of air, soil, and water. Beyond core-H Human population growth has a major impact on the Earth's ecosystems.
7.2d Since the Industrial Revolution, human activities have resulted in major pollution of air, water, and soil. Pollution has cumulative ecological effects such as acid rain, global warming, or ozone depletion. The survival of living things on our planet depends on the conservation and protection of Earth's resources.	7.1b Natural ecosystems provide an array of basic processes that affect humans. Those processes include but are not limited to: maintenance of the quality of the atmosphere, generation of soils, control of the water cycle, removal of wastes, energy flow, and recycling of nutrients. Humans are changing many of these basic processes and the changes may be detrimental. 7.1c Human beings are part of the Earth's ecosystems. Human activities can, deliberately or inadvertently, alter the equilibrium in ecosystems. Humans modify ecosystems as a result of population growth, consumption, and technology. Human destruction of habitats through direct harvesting, pollution, atmospheric changes, and other factors is threatening current global stability, and if not addressed, ecosystems may be irreversibly affected. 7.2b When humans alter ecosystems either by adding or removing specific organisms, serious consequences may result. For example, planting large expanses of one crop reduces the biodiversity of the area.

7.2d Since the Industrial Revolution, human activities have resulted in major pollution of air, water, and soil. Pollution has cumulative ecological effects such as acid rain, global warming, or ozone depletion. The survival of living things on our planet depends on the conservation and protection of Earth's resources. Continued from previous page.	7.2c Industrialization brings an increased demand for and use of energy and other resources including fossil and nuclear fuels. This usage can have positive and negative effects on humans and ecosystems. 7.3a Societies must decide on proposals, which involve the introduction of new technologies. Individuals need to make decisions which will assess risks, costs, benefits, and trade-offs.
	7.3b The decisions of one generation both provide and limit the range of possibilities open to the next generation.