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Objectives	Page References
SCIENCE AS INQUIRY (PART 1)	
Abilities of Scientific Inquiry	
1. Identify questions and concepts that guide scientific investigations. Students should formulate a testable hypothesis and demonstrate the logical connections between the scientific concepts guiding a hypothesis and the design of an experiment. They should demonstrate procedures, a knowledge base, and conceptual understanding of scientific investigations.	TE-9 Unit 1: 5, TE62, 82-83, LM13-18, LM45 Unit 2: LM102-13, LM114-18 Unit 3: 425
2. Design and conduct scientific investigations. Designing and conducting a scientific investigation requires introduction to conceptual areas of investigation, proper equipment, safety precautions, assistance with methodological problems, recommendations for use of technologies, clarification of ideas that guide the inquiry, and scientific knowledge obtained from sources other than the actual investigation. The investigation may also include such abilities as identification and clarification of the question, method, controls, and variables, the organization and display of data, the revision of methods and explanations, and the public presentation of the results and the critical response from peers. Regardless of the scientific investigations and procedures, students must use evidence, apply logic, and construct an argument for their proposed explanation.	Unit 1: 5, 82-83, LM45 Unit 2: LM102-04, LM110-13, LM114-18 Unit 3: 425
3. Use technology to improve investigations and communications. Students' ability to use a variety of technologies, such as hand tools, measuring instruments, and calculators, should be an integral component of scientific investigations. The use of computers for the collection, analysis, and display of data is also a part of this standard.	Unit 1: 5, 56, 62, 66-67, 71, 107, 179, 239, LM13-83, Unit 2: 244, 249-50, LM98-13, LM114-18 Unit 3: LM135-161, LM168-75, LM187-96 Unit 4: 692, LM200-08, LM224-26 Unit 5: LM227-54
4. Formulate and revise scientific explanations and models using logic and evidence. Student inquiries should culminate in formulating an explanation or model. In the process of answering the questions, the students should	Unit 1: 62, 66-67, 82-83, 100, 107, 179, LM13-83 Unit 2: 249-50, LM102-13, LM114-18

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or model. In the process of answering the questions, the students should engage in discussions and arguments that result in the revision of their explanations. These discussions should be based on scientific knowledge, the use of logic, and evidence from their investigation.	Unit 3: LM149-52, LM187-92 Unit 4: 692, 713, LM213-18 Unit 5: 227-29, LM242-45
5. Recognize and analyze alternative explanations and models. This standard emphasizes the critical abilities of analyzing an argument by reviewing current scientific understanding, weighing the evidence, and examining the logic thus revealing which explanations and models are better and showing that although there may be several plausible explanations, they do not all have equal weight. Students should appeal to criteria for scientific explanations in order to determine which explanations are the best.	Unit 1: 22, 77, 100, 107, LM45 Unit 2: LM102-04, LM114-18 Unit 3: 348, Unit 4: 692, LM216-18 Unit 5: LM242-45
6. Communicate and defend a scientific argument. Students in school science programs should develop the abilities associated with accurate and effective communication including writing and following procedures, expressing concepts, reviewing information, summarizing data, using language appropriately, developing diagrams and charts, explaining statistical analysis, speaking clearly and logically, constructing a reasoned argument, and responding to critical comments through the use of current data, past scientific knowledge, and present reasoning.	Unit 1: 2, 20, 37, 82-83, 92-93, 100, LM13-83 Unit 2: 313, LM102-04, 110-13, LM114-18 Unit 3: 348, LM131-34, LM149-61, LM187-92 Unit 4: 692, LM213-18 Unit 5: LM227-29, LM242-45
Understanding about Scientific Inquiry	
1. Scientists usually base their investigations on existence questions or causal-functional questions. Causal-functional questions lead to investigations of *how* physical, living, or designed systems function. Conceptual principles and knowledge guide scientific inquiries. Historical and current scientific	Unit 1: 3-4, 16, 22, 24-25, 28-29, 41-52, 98, 100, 107, 120, 122-23, 133-35, 139, 159-66, 174-75, 178, 190, 196-98, 207-12, 214-18, LM13-83

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knowledge influence the design and interpretation of investigations and the evaluation of proposed explanations made by other scientists.	Unit 2: 263-64, 305, 321, 332-35 Unit 3: 379, 396-97, 404-05, 438, 504, 555-56, 618-20, LM124-38, LM176-83, LM187-92 Unit 4: 692, 703, LM209-12, LM224-26 Unit 5: 750-753, 769, LM227-54
2. Scientists conduct investigations for a variety of reasons, such as exploration of new areas, discovery of new aspects of the natural world, confirmation of prior investigations, prediction of current theories, and comparison of models and theories.	Unit 1: 3-4, 16, 22, 24-25, 28-29, 41-52, 82-83, 92-93, 98, 100, 107, 122-23, 133-35, 159-66, 174-75, 178, 190, 196-98, 207-12, 214-18 Unit 2: 263-64, 298, 305, 321, 332-35 Unit 3: 396-97, 404-05, 438, 504, 555-56, 618-20, LM128-30, LM165-183, LM187-92 Unit 4: 704, LM209-12, LM224-26 Unit 5: 745-46, 750-53, 769, LM227-54
3. Scientists rely on technology to enhance the gathering and manipulation of data. Techniques and tools used in scientific inquiry provide new evidence to guide inquiry and new methods to gather data, both of which can contribute to the eventual advances of science. The accuracy and precision of the data, and therefore the quality of the exploration, depends on the technology used.	Unit 1: 3-4, 16, 20, 40, 43-44, 56, 62, 107, 122-23, 159-66, 174-75, 178, 214-18, LM13-83 Unit 2: 244, 263-64, 298, LM105-09, 319-20, 332-33 Unit 3: 404-05, 504, LM 128-44, LM172-83, LM187-92 Unit 4: LM224-26 Unit 5: 745-46, LM227-54
4. Scientific explanations must adhere to criteria such as: a proposed explanation must have a logical structure; it must abide by the rules of evidence; it must be open to questions and possible modification; it must be based on historical and current scientific knowledge; and the methods and procedures that scientists used to obtain evidence must be adequately reported to enhance opportunities for further investigation.	Unit 1: 40-44, 45-52, 62, 98, 100, 107, 122-23, 133-35, 159-66, 174-75, 178, 187, 190, 196-98, 207-12, 214-18 Unit 2: LM 98-118 Unit 3: 379, 404-05, 555-56, 618-20, LM 124-148, LM176-79, LM187-92

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	Unit 4: 704, LM205-12 Unit 5: 745-46, 750-53, 769, LM227-54
5. Results of scientific inquiry—new knowledge and methods—emerge from different types of investigations and public communication among scientists. The nature of communicating and defending the results of scientific inquiry (proposed explanations) is guided by criteria of being logical and empirical and by connections between natural phenomena, investigations, and the historical body of scientific knowledge.	Unit 1: 28-29, 41-52, 66-67, 92-93, 98, 100, 107, 122-23, 133-35, 159-66, 174-75, 187, 207-12, 214-18 Unit 2: 263-64 Unit 3: 438, 504, 618-2o, LM119-23, LM124-27, LM176-83, LM187-92 Unit 4: 704, LM205-12, LM24-26 Unit 5: 750-53, 769, LM227-54
SCIENCE AND TECHNOLOGY (PART 2)	
Abilities of Technological Design	
1. Identify a problem or design an opportunity. Students should be able to identify new problems or needs and the ability to change and improve current technological designs.	Unit 1: LM45 Unit 2: LM102-04 Unit 5: 757-60
2. Propose designs and choose between alternative solutions. Students should demonstrate thoughtful planning for a piece of technology or technique. Students should be introduced to the roles of models and simulations in these processes.	Unit 1: LM45 Unit 2: LM102-04 Unit 5: 757-60
3. Implement a proposed solution. A variety of skills can be needed depending on the type of technology that is involved. The construction of artifacts can require the skills of cutting, shaping or forming, treating, and joining common materials, such as wood, metal, plastics, and textiles.	Unit 1: 63, 130-31, LM45 Unit 2: LM102-04
4. Evaluate the solutions and its consequences. Students should test any solution against the needs or criteria it was designed to meet. At this stage, new criteria not originally considered may be reviewed.	Unit 1: LM45 Unit 2: LM102-04
5. Communicate the problem, process, and solution. Students should present	Unit 1: 63, 130-31, LM42-45

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their results in a variety of ways, such as to other students orally, in writing, and in a variety of forms, including models, diagrams, and demonstrations.	Unit 2: LM102-04
Understanding about Science and Technology	
1. Scientists in different disciplines ask different questions, use different methods of investigation, and accept different types of evidence to support their explanations. Many scientific investigations require the contributions of individuals from different disciplines, including engineering. New disciplines of science, such as geophysics, and biochemistry often emerge at the interface of two older disciplines.	Unit 1: 17, 46, 65, 72, 74-75, 98, 112-13, 120-21, 123-24, 148-49, 158, 162-63, 182-84, 216, 229-32, LM23-28, LM33-37, LM42-49, LM53-73 Unit 2: 238, 254-57, 268-70, 284-285, 306-09, 340-42, LM93-97, LM102-04 Unit 3: 381-83, 390-91, 399-401, 405, 418-20, 435, 451-52, 455-57, 490-93, 529, 531-34, 564-67, 598-601, 631, LM172-75, LM180-83 Unit 4: 643, 654-57, 682-85, 693, 697-98, 708-10, 730-33, LM200-04, LM209-11 Unit 5: 746, 753-55, 757-60, 773, 780, 790-93, 800-02, 813-14, 819-22, LM246-54
2. Scientists and engineers can only conduct research on human subjects if they have the consent of the subjects.	Unit 1: 44, 113, 148-49 Unit 5: 755-56
3. Science often advances with the introduction of new technologies and solving technological problems often results in new scientific knowledge. New technologies often extend the current levels of scientific understanding and introduce new arenas of research.	Unit 1: 32-33, 42, 44, 46, 72, 74-75, 112-13, 120-21, 148-49, 158, 162-63, 173-74, 182-84, 229-32, LM46-49, LM53-73 Unit 2: 254-57, 268-70, 284-85, 306-09, 340-42, LM93-97 Unit 3: 356, 381-83, 399-401, 418-20, 455-57, 529, 531-34, 564-67, 598-601, 631, LM172-75, LM180-83 Unit 4: 654-57, 682-85, 693, 697-98, 708-10, 730-33, LM200-04, LM200-04 Unit 5: 746, 753-55, 757-60, 790-93, 800-02, 813-14, 819-22, LM246-54

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4. Creativity, imagination, and a good knowledge base are all required in the work of science and engineering.	Unit 1: 9, 63, 74-75, 112-13, 162-63, 182-84, 216, 229-32, LM42-45 Unit 2: 254-57,268-70, 306-09 Unit 3: 381-83, 405, 455-57, 490-93, 531-34, 564-67, 598-601 Unit 4: 654-57, 682-85, 697-98, 708-10, 730-33, LM200-04 Unit 5: 746, 757-60, 790-93, 800-02, 813-14, 819-22
5. Science and technology are pursued for different purposes. Scientific inquiry is driven by the desire to understand the natural world, and technological design is driven by the need to meet human needs and solve human problems. Technology, by its nature, has a more direct effect on society than science because its purpose is to solve human problems, help humans adapt, and fulfill human aspirations. Technological solutions may create new problems. Science, by its nature, answers questions that may or may not directly influence humans. Sometimes scientific advances challenge people's beliefs and practical explanations for various aspects of the world.	Unit 1: 32-33, 44, 72, 74-75, 98-99, 112-13, 120-21, 148-49, 158, 172-73, 182-84, 216, 229-32, LM33-37, LM46-49, LM53-73 Unit 2: 238, 254-57, 268-70, 284-85, 306-09, 340-42, LM93-97, LM102-04 Unit 3: 356, 381-83, 399-401, 418-20, 529, 531-34, 552, 564-67, 598-601, 631, LM172-75, LM180-83, LM200-04 Unit 4: 643, 654-57, 682-85, 697-98, 708-10, 730-33 Unit 5: 746, 753-55, 757-60, 773, 790-93, 813-14, 819-22, LM250-54
6. Technological knowledge is often not made public because of patents and the financial potential of the idea or invention. Scientific knowledge is made public through presentations at professional meetings and publication in scientific journals.	Unit 1: 44, 46 Unit 2: 243 Unit 3: 490
SCIENCE IN PERSONAL AND SOCIAL PERSPECTIVES (PART 3)	
Personal and Community Health	
1. Hazards and the potential for accidents exist. Regardless of the environment, the possibility of injury, illness, disability, or death may be present. Humans have a variety of mechanisms—sensory, motor, emotional, social and technological—that can reduce and modify hazards.	Unit 1: 79, 177-180, 182-184, LM1-11, LM57-61 Unit 2: 260-66, 278-79, Unit 3: 399-400, 414, 419-20, 453, 500-501, 506-07, 509-11, 512-520,

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	533-34, 544, 567 Unit 5: 755-56
2. Students should understand that some diseases are caused by micro-organisms. Severity of disease symptoms are dependent on factors, such as resistance and virulence. Many diseases can be prevented, controlled, or cured. Some diseases, such as cancer, result from specific body dysfunctions and cannot be transmitted.	Unit 1: 54, 65, 75, TE120, 121-124, 144, 220-21, 231 Unit 2: 249, 252-53, 260-66, 295-300, LM88-92, LM109, LM113 Unit 3: 451-52, 523-27, 540-44, 560-62, 601, LM139-44, LM168-71
3. Personal choice concerning fitness and health involves multiple factors. Personal goals, peer and social pressures, ethnic and religious beliefs, and understanding of biological consequences, can all influence decisions about health practices.	Unit 1: 103-06, 110-11, 113, Unit 2: 260-66 Unit 3: 396, 455-56, 474, 479-89, 529, 546-47, 563, 591-92, 600-01, LM145-48, LM158-61, LM184-86
4. An individual's mood and behavior may be modified by substances. The modification may be beneficial or detrimental depending on the motives, type of substance, duration of use, pattern of use, and level of influence, and short- and long-term effects. Students should understand that drugs can results in physical dependence and can increase the risk of injury, accidents, and death.	Unit 3: 474, 519-20, 529, 532, 601
5. Selection of foods and eating patterns determine nutritional balance. Nutritional balance has a direct effect on growth and development and personal well-being. Personal and social factors, such as habits, family income, ethnic heritage, body size, advertising, and peer pressure, influence nutritional choices.	Unit 1: 87, 103-06, LM33-37 Unit 3: 479-89, 518
6. Family systems serve basic health needs, especially for young children. Regardless of the family structure, individuals have families that involve a variety of physical, mental, and social relationships that influence the maintenance and improvement of health.	Unit 2: 269 Unit 3: 456-56, 532, 599
7. Sexuality is basic to the physical, mental, and social development of humans. Students should understand that human sexuality involves biological functions, psychological motives, and cultural ethnic, religious, and technological influences. Sex is a basic and powerful force that has	Unit 3: 591-92, 599, LM172-75, LM180-83, LM184-86 Unit 5: 755-56

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consequences to individuals' health and to society. Students should understand various methods of controlling the reproduction process and that each method has a different type of effectiveness and health and social consequences.	
Population Growth	
1. Populations grow or decline through the combined effects of births and deaths, and in countries through emigration and immigration. Populations, and other things such as resource use and environmental pollution, can increase through linear or exponential growth.	Unit 5: 738-49, 758-60, LM227-229
2. Various factors influence birth rates and fertility rates, such as average levels of affluence and education, importance of children in the labor force, education and employment of women, infant mortality rates, costs of raising children, availability and reliability of birth control methods, religious beliefs and cultural norms that influence personal decisions about family size.	Unit 5: 738-49, 751, 755-56, 758-60
3. Populations can reach the limits to growth. Carrying capacity is the maximum number of individuals that can be supported in a given environment. It is not availability of space, but the number of people in relation to resources and the capacity of Earth systems to support human beings.	Unit 5: 738-49, 750, 752-53, 758-60, LM227-29
Natural Resources	
1. Human populations use resources in the environment in order to maintain and improve their existence. Natural resources have been and will continue to be exploited to maintain human populations.	Unit 5: 737, 750, 753-56, 760, 779, 791-92, 800-06, 808-22
2. The Earth does not have infinite resources, and increasing human production and consumption places severe stress on the natural processes that renew some resources and depletes those resources that cannot be renewed.	Unit 5: 750, 753-55, 760, 779-80, 791-92, 800-06, 808-22, LM246-54
Environmental Quality	

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1. Natural ecosystems provide an array of basic processes that affect humans. Those processes include maintenance of the quality of the atmosphere, generation of soils, control of the hydrologic cycle, disposal of wastes, and recycling of nutrients. Humans are changing many of these basic processes and the changes may be detrimental to humans.	Unit 5: 776-83, 790-93, 799-822
2. Materials from human societies disturb both physical an and chemical cycles of the Earth.	Unit 5: 753-55, 776-83, 790-93, 799-822, LM246-54
3. Many factors influence environmental quality. Factors that students might investigate include population growth, resource use, population distribution, overconsumption, the capacity of technology to solve problems, poverty, the role of economic, political, and religious views, and different ways humans view the Earth.	Unit 5: 753-55, 776-83, 790-93, 799-822, LM246-54
Natural and Human-Induced Hazards	
1. Normal adjustments of Earth may be hazardous for humans. Humans live at the interface between the atmosphere driven by solar energy and the upper mantle where convection creates changes in the Earth's solid crust. As societies have grown, become stable, and valued aspects of the environment, vulnerability to natural processes of change has increased.	Unit 1: 215 Unit 5: 766-67, 770, 776-77, 785, 792
2. Human activities can enhance potential for hazards. Acquisition of resources, urban growth, and waste disposal can accelerate rates of natural change.	Unit 5: 753-55, 777-80, 785-87, LM250-54
3. Some hazards, such as earthquakes, volcanoes, and severe weather, are rapid and spectacular. Also, there are slow and progressive changes that also result in problems for individuals and societies, for example, change in stream channel position, erosion of bridge foundations, sedimentation in lakes and harbors, and continuing erosion and wasting of soil and landscapes.	Unit 5: 776-77, 809-12

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4. Natural hazards present the need for humans to assess potential danger and risk. Students should understand the costs and trade-offs of various hazards ranging from those with minor risk to a few people to major catastrophes with major risk to many people. The scale of events and the accuracy with which scientists and engineers can (and cannot) predict events are important considerations.	Unit 5: 770, 776-79, 792, 800-03, 809-12,
Science and Technology in Local, National, and Global Challenges	
1. Science and technology are essential social enterprises, but alone they can only indicate what can happen, not what should happen. The latter involves human decisions about the use of knowledge.	Unit 1: 148-49, 177, LM57-61, Unit 5: LM250-54
2. Understanding basic concepts and principles of science and technology should precede active debate about the economics, policies, politics, and ethics of various science- and technology-related challenges. But, understanding science alone will not resolve local, national, or global challenges.	Unit 1: 148-49, LM57-61 Unit2: 254-270 Unit 5: 750-560
3. Progress in science and technology can relate to social issues and challenges. Funding priorities and health problems serve as examples of ways that social issues influence science and technology.	Unit 1: 15, 17, 120-124, 182-84 Unit2: 254-270 Unit 3: LM180-186
4. Individuals and society must decide on proposals involving new research and technologies. Decisions involve assessment of alternatives, risks, costs, and benefits and consideration of who benefits and who suffers, who pays and gains, and what are the risks and who bears them? Students should understand the appropriateness and value of basic questions—"What can happen?"—"What are the odds?"—and "How do scientists and engineers know what will happen?"	Unit 1: 177, 184, LM57-61 Unit 3: 529, 591-92, 595, 599, 601 Unit 4: 730 Unit 5: 776-80, 783-93, 800-22, LM250-54
5. Humans have a major effect on other species. The influence of humans on other organisms occurs through ways, such as land use—decreasing space available to other species, and pollution—changing the chemical composition of air, soil, and water.	Unit 5: 742-43, 746-49, 750, 766-69, 777-80, 783-93, 800-22

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HISTORY AND NATURE OF SCIENCE (PART 4)	
Science as a Human Endeavor	
1. Individuals and teams have contributed and will continue to contribute to the scientific enterprise. Doing science or engineering can be as simple as an individual conducting field studies or as complex as hundreds of people working on a major scientific question or technological problem. Pursuing science as a career or as a hobby can be both fascinating and intellectually rewarding.	Unit 1: 7, 65, 133-36, 162-63, 196-98, 208-09, 215-18, Unit 2: 260-61, 263-64 Unit 3: 429, 474, 504, 552, 555-56, 574-75, 618-21 Unit 4: 703
2. Scientists have ethical traditions. Scientists abide values, such as commitment to peer review, truthfully report the methods and outcomes of investigations, and make public the results of work. Violations of rules such as these rarely occur. If violations do occur, the scientists responsible for the violations are strongly condemned.	Unit 1: 65, 133-36, 196-98, 227 Unit 2: 263-64 Unit 3: 555-56, 574-75, 618-21 Unit 4: 703 Unit 5: 769 Appendix (A-4)-(A-5)
Nature of Scientific Knowledge	
1. Science distinguishes itself from other ways of knowing and from other bodies of knowledge through the use of empirical standards, logical arguments, and skepticism, as scientists strive for certainty of their proposed explanations.	Unit 1: 65, 133-36, 162-63, 196-98, 212-13, 215-18, Unit 2: 260-61 Unit 3: 504, 618-21 Appendix (A-4)-(A-5)
2. Scientific explanations must meet certain criteria. First and foremost, they must be consistent with experimental and observational evidence about nature, and must make accurate predictions, when appropriate, about systems being studied. They must also include a logical structure, rules of evidence, openness to criticism, reporting methods and procedures, and making knowledge public. Explanations on how the natural world changes based on	Unit 1: 133-36, 196-98, 208-09, 212-13, 215-18 Unit 2: 263-64 Unit 3: 504, 574-75, 618-21 Unit 4: 703

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knowledge public. Explanations on how the natural world changes based on myths, personal beliefs, religious values, mystical inspiration, superstition, or authority, may be personally useful and socially relevant, but they are not scientific.	Unit 5: 753-56, 769 Appendix (A-4)-(A-5)
3. Because all scientific ideas depend on experimental and observational confirmation, all scientific knowledge is, in principle, subject to change as new evidence becomes available. The core ideas of science such as the conservation of energy or the laws of motion have been subjected to a wide variety of confirmations and are therefore unlikely to change in the areas in which they have been tested. In areas where data or understanding are incomplete, such as the details of human evolution or questions surrounding global warming, new data may well lead to changes current ideas or resolve current conflicts. In situations where information is still fragmentary, it is normal for scientific ideas to be incomplete, but it is also where the opportunity for making advances may be greatest.	Unit 1: 133-36, 162-63, 196-98, 208-09, Unit 2: 263-64 Unit 3: 504, 555-56 Unit 5: 753-55, 769, 810-12
Historical Perspectives	
1. In history, diverse cultures have contributed scientific knowledge and technologic inventions. The science that aided the development of modern industrialized societies began to be developed in Europe several hundred years ago. Western, as well as non-Western cultures (for example, Egyptian, Chinese, Hindu, and Arabic), have developed scientific ideas and solved human problems through technology.	Unit 1: 42, 98-99, 133-35, 162-63, 196-98, 216-17, 223-24 Unit 2: 263-64 Unit 3: 429, 438, 474, 504, 555-56, 618-21 Unit 4: 666-67, 702-03, 729 Unit 5: 755-56
2. Usually, changes in science occur as small modifications in extant knowledge. The daily work of science and engineering results in incremental advances in our understanding of the world and our ability to meet human needs and aspirations. Much can be learned about the internal workings of science and the nature of science from study of individual scientists, their daily work, and their efforts to advance scientific knowledge in their area of	Unit 1: 42, 44, 98-99, 207, 216-17 Unit 2: 263-64 Unit 3: 438, 474, 504, 555-56, 618-21 Unit 4: 666-67, 702-03, 729

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study.	Unit 5: 755-56
3. Occasionally, there are advances in science and technology that have important and long-lasting effects on science and society. Examples of such advances include the following: Copernican revolution — Industrial revolution Newtonian mechanics — Molecular biology Relativity — Information and communication Geologic time scale — Quantum theory Plate tectonics — Technology Atomic theory — Galactic universe Nuclear physics — Medical and health technology Biological evolution — Germ theory The historical perspective of scientific explanations demonstrates how scientific knowledge changes by evolving over time, almost always building on earlier knowledge.	Unit 1: 42, 98-99, 133-35, 162-63, 196-98, 207 Unit 2: 263-64 Unit 3: 438, 555-56 Unit 4: 702-03
UNIFYING CONCEPTS AND PROCESSES (PART 5)	
Order and Organization	
1. Science proceeds on the assumption that the behavior of the universe is not capricious, that nature is the same everywhere, and it is understandable, and predictable. Students can develop understandings of regularities in systems, and by extension, the universe; and they can develop understandings of basic laws, theories, and models that explain the world. Such examples as Newton's Laws of Force and Motion, Kepler's Laws of Planetary Motion, Conservation Laws, and Darwin's Laws of Natural Selection, all serve to demonstrate the idea of order and regularity. An assumption of order establishes the basis for cause-effect relationships and predictability.	Unit 1: 42, 133-35, 162-63, 196-98, 207, 216-17 Unit 2: 263-64 Unit 4: 702-03
2. Prediction is the use of knowledge to identify and explain observations, or changes, in advance. The use of probability allows for greater or lesser certainty of predictions.	Unit 1: 133-41, 201, LM50-52 Unit 2: 263-64 Unit 4: 702-03
3. The behavior of units of matter, objects, organisms, or events in the universe	Unit 1: 133-41, 201, LM50-52

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can be described on a statistical basis. Probability is the relative certainty (or uncertainty) that individuals can assign to selected events happening (or not happening) in a specified space or time. In science, reduction of uncertainty occurs through such processes as the development of knowledge of factors influencing objects, organisms, systems, or events; better and more observations; and better explanatory models.	Unit 2: 263-64 Unit 4: 702-03
4. Units of investigation and analysis can be identified as systems. Systems consist of an organized group of related objects or components that form a whole. A subsystem is a system that is entirely contained within another system. Systems consist of boundaries, components, flow of resources (input and output), and feedback. Thinking and analyzing in terms of systems will help students keep track of mass, energy, objects, organisms, and events, and will facilitate understanding other concepts such as those described in the other content standards. The idea of simple systems extends and includes subsystems and identifying the structure and function of systems, feedback and equilibrium, as well as open and closed systems.	Unit 1: 9-10, 24, 26-27, 39-79, 40-42, 45-52, 54-61, 88-91, 220-28, 240-42 Unit 2: 250-51, 329 Unit 3: 586-90 Unit 4: 693-94, 703 Unit 5: 739-49, 752-54, 767-70, 772-75, 782-84 Appendix: (A-8)-(A-11)
5. Types and levels of organization and hierarchies provide useful ways of thinking about and understanding the world. Types of organization include the periodic table and classification of organisms. Physical systems can be described at different levels of organization, such as fundamental particles, atoms, and molecules. Living systems also have different levels of organization, for example, cells, tissues, organs, organisms, populations, and communities. Within these systems, interactions between these components occur. The complexity and number of fundamental units change in extended hierarchies of organization. Further, systems at different levels of organization may manifest different properties and forms and functions.	Unit 1: 11-17, 40-42, 45-52, 54-61, 88-91, 158-63 Unit 2: 356-66, 370-80 Unit 3: 509, 519-22, LM119-123 Unit 5: 739-49, 752-54, 767-70, 772-75, 782-84
Evidence, Models and Explanation	
1. Evidence consists of observations and data on which to base scientific explanations. Using evidence to understand interactions allows individuals to predict changes in natural and designed systems.	Unit 1: 15, 18, 41-42, 46-47, 162-72, 207-13, Unit 2: 263-64 Unit 3: 552-56 Unit 4: 693-96

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2. Models are tentative schemes or structures that correspond to real structures, events, or classes of events and which have explanatory power. Models help scientists and engineers understand how things work. Models take many forms including physical objects, plans, mental constructs, equations, and computer simulations.	Unit 1: 11-15, 18, 41, 133-46, 162-72, 196-200, 215-18 Unit 2: 263-64 Unit 3: 552-56 Unit 4: 693-96, LM213-15 Unit 5: 738- 49, 772
3. Scientific explanations incorporate existing scientific knowledge and new evidence from observations, experiments, or models into internally consistent, logical statements. Different terms, such as hypothesis, model, law, theory and paradigm are used to describe various types of scientific explanations. As students develop and as they understand more science concepts and processes, their explanations should become more sophisticated. That is, they should give greater indications of a knowledge base and the use of scientific knowledge, evidence of logic, higher levels of analysis, greater skepticism, and a clearer demonstration of the relationship between logic, evidence, and current knowledge in the formulation of scientific explanations.	Unit 1: 11-15, 41, 133-46, 162-72, 191-94, Unit 2: 263-64 Unit 3: 552-56, Unit 4: 693-96, 216-18 Unit 5: 738-49, 772
Constancy, Change, and Measurement	
1. Although most things are in the process of becoming different—changing—there are properties of objects and processes that are characterized by constancy. These include the speed of light, the charge of an electron, and the total mass plus energy in the universe. Changes may occur, for example, in properties of materials, position of objects, motion, and form and function of systems. Interactions within and among systems result in change.	Unit 1: 3-7, 11-12, 16, 21-31, 66-72, Unit 3: 499-503, 521-28, 587-89, 616-18 Unit 4: 702-06 Unit 5: 738-50, 752-55, 766-70, 772-75, 803-05

Objectives	Page References
Changes vary in rate, scale, and pattern. Many changes occur in patterns that include trends and cycles.	
2. Energy and matter can be transformed—changed. Nevertheless, when measured, the sum of energy and matter in systems, and by extension in the universe, remains the same.	Unit 1: 82-91 Unit 5: 772-75, 800-07
3. Changes in systems can be quantified. Evidence for interactions and subsequent change and the formulation of scientific explanations are often clarified through quantitative distinctions—measurement.	Unit 1: 26-29, 66, 83 Unit 3: 501-503, 587-89, 617-18 Unit 5: 738-41, 744-49, 766-70, 772-75
4. Scale includes understanding that different characteristics, properties, or relationships within a system may change as its dimensions are increased or decreased.	Unit 1: 26-29, 66, 83 Unit 5: 738-41, 744-45, 772-75
5. Rate involves comparing one measured quantity to another measured quantity, for example, 60 meters per second. Rate is also a measure of change for a part relative to the whole, for example, change in birth rate as a part of population growth.	Unit 1: 16 Unit 5: 738-41, 744-45, 772-75
Evolution and Equilibrium	
1. Evolution is a series of more or less gradual changes that accounts for the present form and function of objects, organisms, and natural and designed systems. The general idea of evolution is that the present arises from materials and forms of the past. Evolution is most commonly associated with the biological theory explaining the process of descent, with modification of organisms from common ancestors.	Unit 1: 24-30, 190-235 Appendix (A-8)-(A-11)
2. Equilibrium is a physical state in which forces and changes occur in opposite	Unit 1: 24, 26-30, 46-50

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and off-setting directions, or they are of the same magnitude, or they occur at equal rates. Steady state, balance, and homeostasis also describe equilibrium states. Interacting units of matter tend toward equilibrium states in which the energy content is a minimum and distribution is random.	Unit 3: 609-15 Unit 4: 520-29 Unit 5: 738-49
Form and Function	
1. Form and function are complementary aspects of units of matter, objects, organisms, and systems in the natural and designed world. The form or shape of objects or systems is related to use, operation, and functions of the object or system. Understanding of form and function applies to different levels of organization. Students should be able to explain function by referring to form and explain form by referring to function.	Unit 1: 2-6, 29-30, 41 Unit 3: 348-66, 368-70 Unit 4: 667-70
LIFE SCIENCE (PART 6)	
The Cell	
1. Cells have particular structures that underlie their functions. Every cell is surrounded by a membrane that separates it from the outside world. Inside the cell is a concentrated mixture of thousands of different molecules which form a variety of specialized structures that carry out such cell functions as energy production, transport of molecules, waste disposal, synthesis of new molecules, and the storage of genetic material.	Unit 1: 13-17, 40-52, 53-64, 65-79, 85-87, 94-97, LM23-28 Unit 2: 239-41, 280-81, 300-01, 318 Unit 3: 355, 501
2. Most cell functions involve chemical reactions. Food molecules taken into cells are broken down to provide the chemical constituents needed to synthesize other molecules. Both breakdown and synthesis are made possible by a large set of protein catalysts, called enzymes. The breakdown of some of the food molecules enables the cell to store energy in specific chemicals that are used to power the many functions of the cell.	Unit 1: 13-16, 46-52, 58, 60—61, 84-87, 105-111 Unit 3: 474-75
3. Cells store and use information to guide their functions. The genetic information stored in DNA is used to direct the synthesis of the thousands of proteins that each cell requires.	Unit 1: 158-72, 182-87
4. Cell functions are regulated. Regulation of cells occurs both through changes	Unit 1: 67-72, 158-72, 182-87

Objectives	Page References
in the activity of the functions performed by proteins and the selective expression of individual genes, allowing cells to respond to their environment and to control and coordinate the synthesis and breakdown of specific molecules, cell growth and division.	
5. Plant cells contain chloroplasts, the site of photosynthesis. Plants, and some other organisms, use solar energy to combine molecules of carbon dioxide and water into complex, energy rich organic compounds. This process of photosynthesis provides a vital connection between the sun and the energy needs of living systems.	Unit 1: 58, 83-90, 92-100
6. Cells can differentiate, and complex organisms can develop from the generation of differentiated progeny of cell division. In the development of complex multicellular organisms, the progeny from a single cell form an embryo in which the cells differentiate to form the many specialized cells, tissues and organs that comprise the organism. This differentiation is controlled through the expression of different genes.	Unit 1: 158-59, 165-72, 179-81, 223 Unit 3: 350, 356-66, 368-70
The Molecular Basis of Heredity	
1. In all organisms, the instructions for specifying the characteristics of the organism are carried in DNA, a large polymer formed from subunits of four kinds (A,G,C, and T). The chemical and structural properties of DNA explain how the genetic information that underlies heredity is both encoded in genes (as a string of molecular "letters") and replicated (by a templating mechanism). Each DNA molecule in a cell forms a single chromosome.	Unit 1: 157-87 Unit 2: 254-59
2. Most of the cells in a human contain two copies of each of 22 chromosomes. In addition, there is a pair of chromosomes that determines sex: a female contains two X chromosomes and a male contains one X and one Y chromosome. Transmission of genetic information to offspring occurs through egg and sperm cells that contain only one representative from each	Unit 1: 120-155, LM50-52

Objectives	Page References
chromosome pair. An egg and sperm unite to form a new individual. The fact that the human body is formed from cells that contain two copies of each chromosome--and therefore two copies of each gene--explains many features of human heredity, such as how variations that are hidden in one generation can be expressed in the next.	
3. Changes in DNA (mutations) occur spontaneously at low rates. Some of these changes make no difference to the organism, whereas others can change cells and organisms. Only mutations in germ cells can create the variation that changes an organism's offspring.	Unit 1: 177-81, 190-92, LM57-61
Biological Evolution	
1. 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.	Unit 1: 189-213
2. The great diversity of organisms is the result of more than 3.5 billion years of natural selection and evolution that has filled every available niche with life forms.	Unit 1: 189-213
3. Natural selection and its evolutionary consequences provide a scientific explanation for the fossil record of ancient life forms, as well as for the striking molecular similarities observed among the diverse species of living organisms.	Unit 1: 189-213
4. The millions of different species of plants, animals, and micro-organisms that live on Earth today are related by descent from common ancestors.	Unit 1: 189-213, 220-35
5. Biological classifications indicate how organisms are related. Organisms are classified into a hierarchy of groups and subgroups based on their similarities and reflecting their evolutionary relationships. Species is the most fundamental unit of classification.	Unit 1: 220-35
The Interdependence of Organisms	

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Objectives	Page References
1. The atoms and molecules on the Earth cycle among the living and nonliving components of the biosphere.	Unit 1: 88-91 Unit 3: 334-336 Unit 5: 772-74, 803-07
2. Energy flows through ecosystems in one direction, from photosynthetic organisms to herbivores to carnivores and decomposers.	Unit 1: 88-91 Unit 5: 772-774
3. Organisms both cooperate and compete in ecosystems. The interrelationships and interdependencies of these organisms may generate ecosystems that are stable for hundreds or thousands of years.	Unit 2: 246-48 Unit 3: 625-26 Unit 5: 739-40, 753, 767-70
4. Living organisms have the capacity to produce populations of infinite size, but environments and resources are finite. This fundamental tension has profound effects on the interactions between organisms.	Unit 5: 738-63, 800-12
5. Human beings live within the world's ecosystems. Increasingly, humans modify ecosystems as a result of population growth, technology, and consumption. Human destruction of habitats through direct harvesting, pollution, atmospheric changes, and other factors is threatening global stability, and if not addressed, ecosystems will be irreversibly damaged.	Unit 1: 206 Unit 3: 449-50 Unit 5: 753-55, 776-97, 799-826
Matter, Energy, and Organization in Living Systems	
1. All matter tends toward more disorganized states. Living systems require continuous input of energy to maintain their chemical and physical organizations. With death, and the cessation of energy input, living systems rapidly disintegrate.	Unit 1: 9-10 Unit 2: 334-36 Unit 5: 772-74
2. The energy for life ultimately derives from the sun. Plants capture light energy and use it to form strong (covalent) chemical bonds between the atoms of carbon-containing (organic) molecules. These molecules can be used to	Unit 1: 9-10, 88-91, 92-101, LM38-41 Unit 5: 772-74

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carbon-containing (organic) molecules. These molecules can be used to assemble larger molecules with biological activity (including proteins, DNA, sugars and fats). In addition, the bonds between the atoms can be used as sources of energy for life processes.	
3. The chemical bonds of food molecules contain energy. Energy is released when the bonds of food molecules are broken and lower energy bonds are formed in new compounds. Cells usually store this energy temporarily in phosphate bonds of a small high-energy compound called ATP.	Unit 1: 9-10, 13-14, 82, 84-88, LM33-37
4. The complexity and organization of organisms accommodate the need for obtaining, transforming, transporting, releasing, and eliminating the matter and energy used to sustain the organism.	Unit 1: 9-10, 13-14, 84-88, 92-111, LM33-37 Unit 3: 358-62, 365-66, 393-94, 452-54, 464-78, 488, 526-27, LM119-123, LM153-57
5. The distribution and abundance of organisms and populations in ecosystems are limited by the availability of matter and energy and the ability of the ecosystem to recycle organic materials.	Unit 1: 88-90, Unit 5: 738-44, 746-49, 752—53, 772-74, 803-06, LM239-41
6. As matter and energy flow through different levels of organization of living systems--cells, organs, organisms, communities--and between living systems and the physical environment, chemical elements are transformed and recombined in different ways. Each transformation results in storage and dissipation of energy into the environment as heat. Matter and energy are conserved in each transformation.	Unit 1: 88-90, 92-97, 100, 105-110 Unit 5: 772-74, 803-06
The Nervous System and the Behavior of Organisms	
1. Multicellular animals have nervous systems to generate behavior. Nervous systems are formed from specialized cells that conduct signals rapidly through the long cell extensions that make up nerves, and the nerve cells communicate with each other by secreting specific excitatory and inhibitory molecules. In sense organs, specialized cells detect light, sound, and specific chemicals and enable animals to monitor what is going on in the world around them.	Unit 1: 6-7, 24-30 Unit 3: 356-57, 362-63, 500-18, LM162-64, LM187-92, LM193-96

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Objectives	Page References
2. Organisms have behavioral responses to internal changes and to external stimuli. Responses to external stimuli can result from interactions with the organisms' own species and others, as well as environmental changes. These responses can be either innate or learned. The broad patterns of behavior exhibited by animals have evolved to ensure reproductive success. Animals often live in unpredictable environments, and so their behavior must be flexible enough to deal with uncertainty and change.	Unit 1: 6-7, 24-30 Unit 3: 608-26, LM162-64, LM187-92, LM193-96
3. Like other aspects of an organism's biology, behaviors have evolved through natural selection. Behaviors often have an adaptive logic when viewed in terms of evolutionary principles.	Unit 1: 195-200 Unit 3: 608-26
4. Behavioral biology has implications for humans, providing links to psychology, sociology, and anthropology.	Unit 1: 195-200, 209-12 Unit 3: 608-26