



Correlation of

BIOLOGY: A Community Context

© 1998

(053865208X)

by

Leonard & Penick

to

National Science Standards

CORRELATION TO NATIONAL SCIENCE STANDARDS FOR SCIENCE AS INQUIRY (PART 1)

SUBMISSION TITLE: *BIOLOGY: A COMMUNITY CONTEXT*, BY LEONARD AND PENICK, © 1998 (053865208X)

OBJECTIVES	PAGE REFERENCES
<p style="text-align: center;">ABILITIES OF SCIENTIFIC INQUIRY</p> <p>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.</p> <p>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.</p> <p>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.</p>	<p>Unit 1: 29-31, 46-55 Unit 2: 78-79, 100-102, 108-111, 124-127 Unit 3: 141, 148-150, 162-165 Unit 4: 202-205, 212-214, 226-228, 232-235, 253-255, 255-257, 257-259, 260-261, 262-265, 267-268, 269 Unit 5: 331-335, 343-344 Unit 6: 369-371, 378-380, 386-389, 393-396, 399-400, 405-407, 408-412, 413-414 Unit 7: 443-445, 453-455 Unit 8: 492-496, 499-500, 502-503</p> <p>Unit 1: 29-31, 46-55, 54-55 Unit 2: 124-127 Unit 3: 148-150, 162-165 Unit 4: 232-235, 269-270 Unit 5: 331-335, 343-344 Unit 6: 413-414 Unit 7: 480 Unit 8: 510-513</p> <p>Unit 1: 24-25, 41-42, 49-55 Unit 2: 78-79, 91-92, 94-96, 107-111, 113-116, 121-123, 128 Unit 3: 143-145, 147-150, 154-155, 176-178, 189, 191-193, (All Congress and Forum Sections should use the Internet) Unit 4: 212-216, 222-224, 229-231, 232-235, 255-256 Unit 5: 347, 348 Unit 7: 444-445 Unit 8: 511-513</p>

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<p>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 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.</p>	<p>Unit 1: 14-15, 35-37, 64-67 Unit 2: 78-80, 82-84, 91-92, 94-96, 100-101, 112-114, 124-128, 132-134 Unit 3: 143-145, 147-150, 151, 182-189, 154-155, 159-160, 162-165 (All Extended Inquiries.) Unit 4: 202-205, 211-216, 232-235, 243-265, 269-270 Unit 5: 318-320, 343-344, 348 Unit 6: 369-371, 378-380, 386-389, 393-396, 413-444 Unit 7: 428-430, 466-467 Unit 8: 517-518</p>
<p>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.</p>	<p>Unit 1: 48-51, 55, 64-67 Unit 2: 132-134 Unit 3: 182-188, 191-193 Unit 4: 267-268, 269-270, 272-276 Unit 5: 354-355, 356, 358-361 Unit 6: 413-414 Unit 7: 436-442, 457-458 Unit 8: 511-516, 516-517, 522-525</p>
<p>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.</p>	<p>Unit 1: 56-58, 64-67 Unit 2: 124-125, 127-128, 132-134 Unit 3: 185-188, 191-193 (All Congress and Forum Sections.) Unit 4: 272-276 Unit 5: 358-361 Unit 6: 416-420 Unit 7: 468, 472-473, 473-479, 482-485 Unit 8: 496-497, 522-525</p>

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OBJECTIVES	PAGE REFERENCES
UNDERSTANDING ABOUT SCIENTIFIC INQUIRY	
<p>1. Scientists usually base their investigations on existence questions or causal-functional questions. Causal-functional questions lead to investigations of <i>how</i> physical, living, or designed systems function. Conceptual principles and knowledge guide scientific inquiries. Historical and current scientific knowledge influence the design and interpretation of investigations and the evaluation of proposed explanations made by other scientists.</p>	<p>Unit 1: 4, 5, 6, 9, 11-16, 17-24, 24-25, 26-28, 28-31, 31-43, 49-62 Unit 2: 72-74, 76-77, 82-88, 91-93, 99-102, 102-107, 112, 120-121 Unit 3: 141, 145-146, 157-160, 165-167, 169-170 Unit 4: 200-201, 206-211, 216-220, 224-225, 231-323, 235-241, 244-249 Unit 5: 284, 288-292, 294-297, 301-311, 315-317, 320-323, 326, 329-331, 335-338, 348-353 Unit 6: 378-380, 386-389, 408-412 Unit 7: 460-461, 456-459, 473-479 Unit 8: 492-496, 502-506, 508, 513-515</p>
<p>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.</p>	<p>Unit 1: All extended inquiries, 47-61 Unit 2: All investigations, 78-79, 82-84, 91-92, 94-96, 100-102, 107-111, 113-116, 121-123, 124-125, 128 Unit 3: 162-165, 182-189 Unit 4: All investigations (Guided & Extended Inquiry), 267-268, 269-270 Unit 6: 372-373 Unit 7: 451, 456-459, 460-461 Unit 8: 498</p>
<p>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.</p>	<p>Unit 1: 16, 22, 56 Unit 2: 78-79, 91-92, 94-96, 107-111, 113-116, 121-123, 128 Unit 3: 151-153, 161 Unit 4: 212-216, 222-224, 229-231, 232-235, 255-256 Unit 5: 348, 349-350, 350-352 Unit 6: 372-373 Unit 7: 443-445 Unit 8: 511-513</p>

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<p>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.</p>	<p>Unit 1: 24-25, 29-31, 54-55 Unit 2: 84-88, 92, 102-106, 129-130 Unit 3: 189, 191-193 Unit 4: 200-201, 206-211, 216-220, 223-225, 228-231, 235-243, 244-249, 263 (Fig. 4.60), 265 Unit 5: 350-353 Unit 6: 380-384, 389-392, 396-397 Unit 7: 456-459 Unit 8: 497-500</p>
<p>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.</p>	<p>Unit 1: All “Congress” & “Forum” sections, 64-67 Unit 2: 132-134 Unit 3: All “Congress” & “Forum” sections, 191-193 Unit 4: 269, 273-276 Unit 5: 358-361 Unit 6: 416-420 Unit 7: 482-483 Unit 8: 496-497, 522-523</p>

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OBJECTIVES	PAGE REFERENCES

CORRELATION TO NATIONAL SCIENCE STANDARDS FOR SCIENCE AND TECHNOLOGY (PART 2)

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OBJECTIVES	PAGE REFERENCES
<p style="text-align: center;">ABILITIES OF TECHNOLOGICAL DESIGN</p> <p>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.</p> <p>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.</p> <p>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.</p> <p>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.</p>	<p>Unit 1: All "Extended Inquiries," 47-63 Unit 2: 73-75, 91-92, 106-111, 124-125, 127 Unit 3: 147-150, 176-178, 187-188 Unit 4: All "Applications" sections in each lab, 269 Unit 5: 358-359 Unit 6: 413-414 Unit 7: 452, 453-455 Unit 8: 511-513</p> <p>Unit 1: 29-31, 35-38, 54-55 Unit 2: All "Extended Inquiries," 94-96, 124, 125, 127, 132-134 Unit 3: 147-150, 176-178, 187-188 Unit 4: 269 Unit 5: 348-352 Unit 6: 405-407, 413-414 Unit 7: 453-455 Unit 8: 511-513, 517-518</p> <p>Unit 1: 13-16, 64-67 Unit 2: 124-125, 132-134 Unit 3: Congress and Forum, 191-193 Unit 4: 269, 272-276 Unit 6: 413-414 Unit 7: 482-483 Unit 8: 522-525</p> <p>Unit 1: 64-67 Unit 2: All "Congress and Forum" sections, 132-134 Unit 3: Congress and Forum, 191-193 Unit 4: All "Interpretations" sections in all labs, 255-257, 257-259, 269 Unit 5: 359-359 Unit 6: 416-419</p>

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OBJECTIVES	PAGE REFERENCES
<p>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. <i>continued</i></p> <p>5. Communicate the problem, process, and solution. Students should present 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.</p>	<p>Unit 7: 482-483 Unit 8: 522-525</p> <p>Unit 1: 22-23, 64-67 Unit 2: All "Congress" and "Forum" sections, 132-134 Unit 3: Congress and Forum, 191-193 Unit 4: "Individual Research Projects," 269, 272-276 Unit 5: 358-359, 360-361 Unit 6: 413-414, 416-419 Unit 7: 482-483 Unit 8: 492-496, 522-525</p>
<p>UNDERSTANDING ABOUT SCIENCE AND TECHNOLOGY</p>	
<p>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.</p> <p>2. Scientists and engineers can only conduct research on human subjects if they have the consent of the subjects.</p> <p>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.</p>	<p>Unit 1: 9-10, 16-17 Unit 2: 82-87, 94-96 Unit 3: 151-153, 161 Unit 4: 217-219, 221, 242 Unit 5: 298, 321, 324 Unit 6: 372-373 Unit 7: 451, 465 Unit 8: 496-497</p> <p>Unit 2: 106-112 Unit 3: 151-153 Unit 4: 232-235, 255-257 Unit 5: 321, 324 Unit 6: 378-380, 386-389, 407-412, 413-414</p> <p>Unit 1: 16 Unit 2: 75 Unit 3: 151-153 (Census taking.) Unit 4: 219-220, 239 Unit 5: 324, 348-353 Unit 6: 372-373</p>

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<p>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. <i>continued</i></p>	<p>Unit 7: 437, 443 Unit 8: 513-515</p>
<p>4. Creativity, imagination, and a good knowledge base are all required in the work of science and engineering.</p>	<p>Unit 1: 9-10, 16 Unit 2: 90, 98, 119-120, 132-135 Unit 3: 161 Unit 4: "Individual Research Projects," 269 Unit 5: 321 Unit 6: 372-373, 413-414 Unit 7: 451, 465 Unit 8: 513-515</p>
<p>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.</p>	<p>Unit 1: 9-10, 16, 18-19 Unit 2: 72-74, 76-75, 132-135 Unit 3: 165-167 Unit 4: 239, 248, 272-275 Unit 5: 348-353 Unit 6: 372-373 Unit 8: 504-506, 513-515</p>
<p>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.</p>	<p>Unit 1: 64-67 Unit 2: "Public Hearing & Congress & Forum," 132-135 Unit 3: 191-193 Unit 4: 272-275 Unit 5: 358-359, 360-361 Unit 6: 416-420 Unit 7: 482-485 Unit 8: 496-497, 522-525</p>

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PERSONAL AND COMMUNITY HEALTH	
<p>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.</p>	<p>Unit 1: 2-6, 27-28, 58-61, 64-67 Unit 2: 72-74, 76-77, 89 (Bio Issues), 127 Unit 3: 156 (Emotional hazard) Unit 4: 200-201, 238, 246-249 Unit 6: 368, 369-371, 386-389, 407-414</p>
<p>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.</p>	<p>Unit 1: 58-59 Unit 4: 243-250, 253-255, 248, 267-268</p>
<p>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.</p>	<p>Unit 1: 2-6, 58-59, 64-67 Unit 2: 106-112 Unit 3: 156 Unit 4: 231-238, 240-241, 243-249, 250, 253, 255-257, 267-268, 272-276 Unit 6: 376-378</p>
<p>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 result in physical dependence and can increase the risk of injury, accidents, and death.</p>	<p>Unit 4: 240-241 Unit 6: 366-367, 368, 376-378</p>
<p>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.</p>	<p>Unit 2: 106-112 Unit 4: 222-228 Unit 8: 501, 502-504, 505-506</p>
<p>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.</p>	<p>Unit 3: 156 Unit 4: 250, 272-276 Unit 8: 501</p>

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<p>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 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.</p>	<p>Unit 3: 156 Unit 5: 304-307</p>
<p>POPULATION GROWTH</p>	
<p>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.</p>	<p>Unit 1: 2-6, 7-9, 11-13, 17-23 Unit 2: 94-112 Unit 3: All of Unit 3, 157-160, 165-167, 185 Unit 8: 490-491, 496, 504-506</p>
<p>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.</p>	<p>Unit 3: 157-160, 165-167, 169-175, 182-185, 191-193 Unit 5: 304-307 Unit 8: 490-491, 496</p>
<p>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.</p>	<p>Unit 1: 2-6, 7-9, 11-13, 17-23, 56-61 Unit 2: 94-97, 99-112, 119 Unit 3: All of Unit 3, 157-160, 165-167, 185 Unit 7: 466-467, 468, 482-483 Unit 8: 490-491, 496, 511-515, 516, 520-521, 522-525</p>
<p>NATURAL RESOURCES</p>	
<p>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.</p>	<p>Unit 1: 2-6, 7-9, 11-13, 17-23, 56-61 Unit 2: All of Unit 2, 72-77, 119, 126-127 Unit 3: All of Unit 3, 165-167, 174-175 Unit 7: 468 Unit 8: 496-497, 501, 502-506, 511-515, 517-518, 520-521, 522-525</p>

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<p>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.</p> <p>3. Humans use many natural systems as resources. Natural systems do have the capacity to reuse waste, but that capacity is limited. Changing natural systems can exceed the limits of organisms to adapt naturally or humans to adapt technologically.</p>	<p>Unit 1: 2-6, 7-9, 11-13, 17-23, 56-61 Unit 2: 72-77, 94-97, 99-112, 112-116, 119, 122, 126-127, 132-134 Unit 3: All of Unit 3, 165-167, 174-175 Unit 7: 468 Unit 8: 496-497, 501, 502-506, 511-515, 517-518, 520-521, 522-525</p> <p>Unit 1: 2-6, 7-9, 11-13, 17-23, 56-61 Unit 2: All of Unit 2, 99-112, 112-116, 119, 122, 126-127, 132-134 Unit 3: Inferred in Unit 3, 191-193 Unit 8: 496-497, 501, 502-506, 511-515, 517-518, 520-521, 522-525</p>
<p>ENVIRONMENTAL QUALITY</p>	
<p>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.</p> <p>2. Materials from human societies disturb both physical and chemical cycles of the Earth.</p>	<p>Unit 1: All of Unit 1, 2-6, 7-9, 11-13, 17-23, 56-61 Unit 2: All of Unit 2, 99-112, 112-116, 119, 122, 126-127, 132-134 Unit 3: Inferred in Unit 3, 165-167 Unit 6: 372-373, 401 Unit 7: 468 Unit 8: 501, 511-515, 517-518, 522-525</p> <p>Unit 1: All of Unit 1, 2-6, 7-9, 11-13, 17-23, 56-61 Unit 2: All of Unit 2, 72-74, 76-77, 89 Unit 3: Inferred in Unit 3 Unit 6: 372-373, 401 Unit 8: 490-497, 497-500, 509, 522-525</p>

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<p>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.</p>	<p>Unit 1: All of Unit 1, 2-6, 7-9, 11-13, 17-23, 56-61 Unit 2: All of Unit 2, 72-74, 76-77, 132-134 Unit 3: Population study 191-193 Unit 4: 248 Unit 7: 468 Unit 8: 490-497, 497-500, 509, 522-525</p>
<p>NATURAL AND HUMAN-INDUCED HAZARDS</p>	
<p>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.</p>	<p>Unit 2: All of Unit 2, 72-77, 89 Unit 7: 460-461</p>
<p>2. Human activities can enhance potential for hazards. Acquisition of resources, urban growth, and waste disposal can accelerate rates of natural change.</p>	<p>Unit 1: All of Unit 1, 2-6, 7-9, 11-13, 17-23, 56-61 Unit 2: 72-77, 89 Unit 3: Inferred in Unit 3, 165-167 Unit 6: 372-373, 401 Unit 8: 490-496, 497-500</p>
<p>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.</p>	<p>Unit 2: 72-77, 89 Unit 7: 457</p>
<p>4. Natural hazards present the 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.</p>	<p>Unit 1: 64-67 Unit 2: 72-77, 132-134 (Congress and Forum)</p>

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OBJECTIVES	PAGE REFERENCES
<p style="text-align: center;">SCIENCE AND TECHNOLOGY IN LOCAL, NATIONAL, AND GLOBAL CHALLENGES</p> <p>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.</p> <p>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.</p> <p>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.</p>	<p>Unit 1: 64-67 Unit 2: 132-134 (Congress and Forum) Unit 3: 191-193 Unit 4: 248 Unit 5: 348-361 Unit 6: 404-407, 416-420 Unit 7: 482-485 Unit 8: 511-515</p> <p>Unit 1: 5-6, 10, Fig. 1.6 (p. 13,) 18-22, 24-27, 28-43, 49-57, 59-61, 64-67 Unit 2: All of Unit 2 (All activities are designed to build science background for Congress and Forum) 78-80, 82-84, 91-93, 120-121, 124-125 Unit 3: All of Unit 3 (All activities are designed to build science background for Congress & Forum) 191-193 Unit 4: 239, 240-241, 248, 250, 272-276 Unit 5: 358-361 Unit 6: 416-420 Unit 7: 482-485 Unit 8: 496-497</p> <p>Unit 1: 2-6, 7-9, 23, 58-59, 64-67 Unit 2: 132-134 (Congress and Forum) Unit 3: 191-193 Unit 4: 239, 248, 250, 272-276 Unit 5: 358-361 Unit 6: 416-420 Unit 8: 496-497</p>

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OBJECTIVES	PAGE REFERENCES
<p>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?"</p>	<p>Unit 1: "Congress" and "Forum" all units, 64-67 Unit 2: 132-134 Unit 3: 191-193 Unit 4: 239, 246-247, 248 Unit 5: 358-361 Unit 6: 416-420 Unit 8: 496-497, 513-516, 522-525</p>
<p>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.</p>	<p>Unit 1: All of Unit 1, 17-23, 40-43, 53, 64-67 Unit 2: All of Unit 2, 72-77, 132-134 Unit 3: All of Unit 3, 140-142, 165-167 Unit 4: 239 Unit 6: 372-373 Unit 7: 460-461, 473-480 Unit 8: 496-497, 513-516, 522-525</p>

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OBJECTIVES	PAGE REFERENCES
<p style="text-align: center;">SCIENCE AS A HUMAN ENDEAVOR</p> <p>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.</p> <p>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.</p>	<p>Unit 1: 9, 10, 16, 18, 23, 64-67 Unit 2: All Bio Occupations, 90, 98 Unit 3: All Bio Occupations, 151-153, 161 Unit 4: All Bio Occupations, 221, 242, 248 Unit 5: 298, 321, 324, 358-359 Unit 6: 372-373, 413-414 Unit 7: 451, 456-458 Unit 8: 492-496, 496-497, 498</p> <p>Unit 1: 64-67 Unit 3: 191-193 Unit 4: 221, 239, 272-276 Unit 5: 358-361 Unit 6: 413-414 Unit 7: 452, 465 Unit 8: 522-525</p>
<p style="text-align: center;">NATURE OF SCIENTIFIC KNOWLEDGE</p> <p>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.</p>	<p>Unit 1: 27-28, 28-31, 64-67 Unit 2: Forum, 132-134 Unit 3: 191-193 Unit 4: 198-199, 226-228, 243-244, 252-261, 262-265, 267-268 Unit 5: 358-361 Unit 6: 405-407, 407-412, 413-414 Unit 7: 456-458 Unit 8: 506-507</p>

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OBJECTIVES	PAGE REFERENCES
<p>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 myths, personal beliefs, religious values, mystical inspiration, superstition, or authority, may be personally useful and socially relevant, but they are not scientific.</p> <p>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.</p>	<p>Unit 1: 27-28, 47-55 Unit 2: 89, 122-123 Unit 3: 147-150, 176-178, 187-188 Unit 4: 198-199, 226-228, 243-244, 252-261, 262-265, 267-268 Unit 5: 321, 324 Unit 6: 372-375, 378-380, 380-381, 389-392, 396-398 Unit 7: 430-434, 456-458 Unit 8: 506-507</p> <p>Unit 3: 157-160, 165-170, 174-175 Unit 4: 239, 248 Unit 5: 284-285, 288-292, 315-317, 321, 322-323, 324, 326, 329-331, 338, 347-353, 354-355 Unit 6: 380-381, 396-398 Unit 7: 456-458 Unit 8: 497-500</p>
<p>HISTORICAL PERSPECTIVES</p>	
<p>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.</p> <p>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 study.</p>	<p>Unit 1: 4 Unit 3: 165-167, 188 Unit 4: 217-218 Unit 5: 324 Unit 7: 456-458 Unit 8: 496-497</p> <p>Unit 1: 10, 16 Unit 2: Bio Occupations, 90, 98 Unit 3: 161 Unit 4: 221, 242 Unit 5: 298, 321, 324 Unit 6: 396-397 Unit 7: 451, 465 Unit 8: 498</p>

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OBJECTIVES	PAGE REFERENCES																
<p>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:</p> <table border="0"><tr><td>Copernican revolution</td><td>Industrial revolution</td></tr><tr><td>Newtonian mechanics</td><td>Molecular biology</td></tr><tr><td>Relativity</td><td>Information and communication</td></tr><tr><td>Geologic time scale</td><td>Quantum theory</td></tr><tr><td>Plate tectonics</td><td>Technology</td></tr><tr><td>Atomic theory</td><td>Galactic universe</td></tr><tr><td>Nuclear physics</td><td>Medical and health technology</td></tr><tr><td>Biological evolution</td><td>Germ theory</td></tr></table> <p>The historical perspective of scientific explanations demonstrates how scientific knowledge changes by evolving over time, almost always building on earlier knowledge.</p>	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	<p>Unit 2: 87, 88 Unit 3: 165-167 (Malthus), 186-187 (Darwin) Unit 4: 217-218, 228-230 Unit 5: 316-317, 352 Unit 6: 380-381 Unit 7: 428-434, 456-458 Unit 8: 502-503</p>
Copernican revolution	Industrial revolution																
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CORRELATION TO NATIONAL SCIENCE STANDARDS FOR UNIFYING CONCEPTS AND PROCESSES (PART 5)
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OBJECTIVES	PAGE REFERENCES
<p style="text-align: center;">ORDER AND ORGANIZATION</p> <p>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.</p> <p>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.</p> <p>3. The behavior of units of matter, objects, organisms, or events in the universe 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.</p> <p>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.</p>	<p>Unit 1: 32-38, 38-40 Unit 2: 84-87, 88 Unit 3: 165-167 Unit 4: 217-218, 248 Unit 6: 380-381 Unit 7: 441-442, 456-459</p> <p>Unit 1: All "Bio Predictions," 12, 23, 26, 29-31, 42, 54-55 Unit 2: 81 Unit 3: 182-185, 187-188 Unit 4: All Inquiries, 202-205, 212-216, 225-228, 232-235, 243-244, 253-265, 267-269 Unit 5: 301-303, 316-320, 343-344 Unit 6: 378-380, 386-389, 392-396, 399-400 Unit 8: 497-500</p> <p>Unit 1: 14-15, 35-37 Unit 2: 94-96 Unit 3: 151-153, 154-160, 162-165, 165-167 Unit 4: 201, 206, 211, 219-220, 231-232, 235-243, 244-247, 249, 265-267 Unit 5: 301-303, 316-320, 343-344 Unit 6: 378-380, 386-389, 392-396, 399-400</p> <p>Unit 1: 14-15, 40-43, 58-61 Unit 2: All of Unit 2, 79-80, 94-96, 99-104, 112-114, 122-123 Unit 3: 147-150, 176-178, 187-188 (Same investigation) Unit 4: 206-211, 218-220, 224-225, 228, 231-232, 235-241, 244-247 Unit 6: 373-375, 388-392, 396-398 Unit 7: 430-442, 456-459 Unit 8: 508</p>

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OBJECTIVES	PAGE REFERENCES
<p>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.</p>	<p>Unit 1: 40-43, Fig. 1.3 Unit 2: 99-103 Unit 3: 171-175 Unit 4: 206-211, 218-220, 224-225, 228, 231-232, 235-241, 244-247 Unit 5: 329-337 Unit 6: 373-375, 389-392 Unit 7: 436-442 Unit 8: 502-503</p>
<p>EVIDENCE, MODELS AND EXPLANATION</p>	
<p>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.</p>	<p>Unit 1: 7-9, 14-16, 24-25, 29-31 Unit 2: All "Inquiries" in Unit 2, 78-80, 82-84, 107-111, 112-116, 122, 128 Unit 3: 147-150, 176-178, 187-188 (Same investigation) Unit 4: 203-205, 211-216, 226-227, 232-235, 243-244, 252-265, 267-268 Unit 5: 321 Unit 6: 386-389, 393-396, 399-400, 405-412 Unit 7: 456-459 Unit 8: 492-496, 506-507</p>
<p>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.</p>	<p>Unit 1: 14-16, 24-25, 29-31 Unit 2: 94-97 Unit 3: 157-160, 162-164 Unit 4: 203-205, 211-216, 243-244, 267-268 Unit 5: 292-294, 299-301, 331-335, 349-350 Unit 6: 393-396 Unit 7: 428-434, 453-455, 462-464 Unit 8: 511, 517-518</p>

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OBJECTIVES	PAGE REFERENCES
<p>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.</p>	<p>Unit 1: 29-31, 49-55 Unit 2: 89, 132-134 Unit 3: 157-160, 165-167 Unit 4: Individual Research--269, all Inquiries leading to "Individual Research" Unit 5: 348 Unit 6: 373-375, 380-381, 396-398 Unit 7: 430-434, 436-442, 452, 456-459, 468</p>
<p>CONSTANCY, CHANGE, AND MEASUREMENT</p>	
<p>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. Changes vary in rate, scale, and pattern. Many changes occur in patterns that include trends and cycles.</p>	<p>Unit 1: 11-16, Fig. 1.11, 24-25, 32 Unit 2: 76-77, 88, 105, 122 Unit 3: 157-160, 165-167, 169-178 Unit 4: 244-247, 248 Unit 8: 490-495, 497-500</p>
<p>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.</p>	<p>Unit 1: 29-32, 38-40 Unit 2: 88, 107 Unit 8: 502-506</p>
<p>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.</p>	<p>Unit 1: 49-53 Unit 2: 112-115, 120-121 Unit 3: 165-167, 169-178 Unit 4: 202-205, 226-228, 228-231, 232-238 Unit 7: 428-430, 430-436, 460, 462-464, 466-467, 468, 473-480 Unit 8: 502-503</p>
<p>4. Scale includes understanding that different characteristics, properties, or relationships within a system may change as its dimensions are increased or decreased.</p>	<p>Unit 1: 54-55 Unit 2: 106-112 Unit 3: 149-153 Unit 4: 202-205 Unit 7: 428-430 Unit 8: 490-495</p>

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OBJECTIVES	PAGE REFERENCES
<p>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.</p>	<p>Unit 1: 13, Fig. 1.6, 17-23, Fig. 1.11 Unit 2: 78-80 Unit 3: 157-160 Unit 4: 202-205, 226-228, 228-231, 232-238 Unit 6: 386-389 Unit 7: 462-464, 466-467</p>
<p>EVOLUTION AND EQUILIBRIUM</p>	
<p>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.</p>	<p>Unit 3: 165-167 Unit 6: 380-384 Unit 7: 456-459, 460-461</p>
<p>2. Equilibrium is a physical state in which forces and changes occur in opposite 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.</p>	<p>Unit 3: 165-167, 169-170 Unit 4: All of Unit 4, 198-201, 211-216, 218 Unit 7: 452, 468 Unit 8: 496-497, 501, 504-506, 513-516, 522-525</p>
<p>FORM AND FUNCTION</p>	
<p>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.</p>	<p>Unit 1: 32-38 Unit 2: 82-88, 91-92, 120-121 Unit 4: 224-226, 228, 231-232, 237-238, 244-247, 266-267 Unit 5: 326, 329-331, 335-337, 338 Unit 6: 373-375, 389-392, 397-398 Unit 7: 430-432</p>

CORRELATION TO NATIONAL SCIENCE STANDARDS FOR LIFE SCIENCE (PART 6)

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OBJECTIVES	PAGE REFERENCES
<p style="text-align: center;">THE CELL</p> <ol style="list-style-type: none"> 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. 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. 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. 4. Cell functions are regulated. Regulation of cells occurs both through changes 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. 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. 	<p>Unit 1: 24-25, 28-31 Unit 2: 85-87, 91-93 Unit 3: 147 Unit 4: 206-211, 211-216, 222-224, 244-247 Unit 5: 287, 290-292, 294-297, 301-309, 310-311, 338 Unit 7: 430-432</p> <p>Unit 1: 38-40 Unit 2: 88 Unit 4: 222-224, 225-228, 262-268</p> <p>Unit 3: 186-187 Unit 5: 286-287, 290-292, 329-337, 344-346, 352</p> <p>Unit 4: 262-268 Unit 5: 294-309, 322-326</p> <p>Unit 4: 208-211, 214-216 Unit 7: 430-432 Unit 8: 502-503, 504-506, 508</p> <p>Unit 5: 288-289, 307-309, 347-348</p>

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OBJECTIVES	PAGE REFERENCES
THE MOLECULAR BASIS OF HEREDITY	
<p>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.</p> <p>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 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.</p> <p>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.</p>	<p>Unit 5: 326-337, 347-353, 358-361 Unit 7: 441</p> <p>Unit 5: 286-292, 310-326, 338-339, 343-344 Unit 7: 453-455</p> <p>Unit 5: 344-346, 352, 354, 355, 358-361 Unit 7: 453-455</p>
BIOLOGICAL EVOLUTION	
<p>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.</p> <p>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.</p> <p>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.</p>	<p>Unit 3: 165-167 Unit 6: 380-381 Unit 7: 453-455, 456-459, 465, 466-467</p> <p>Unit 1: 41-43 Unit 4: 208-211 Unit 6: 380-381 Unit 7: All Unit 7, 426-427, 427-434, 434-436, 465, 466-467</p> <p>Unit 6: 380-381 Unit 7: 428-434, 456-459, 465, 466-467</p>

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OBJECTIVES	PAGE REFERENCES
<p>4. The millions of different species of plants, animals, and micro-organisms that live on Earth today are related by descent from common ancestors.</p> <p>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.</p>	<p>Unit 1: 28-31 Unit 7: 436-442, 456-459, 460-461, 465, 466-467</p> <p>Unit 1: 41-43 Unit 4: 208-210 Unit 6: 380-381 Unit 7: 436-442, 456-459, 460-461, 465, 466-467</p>
<p>THE INTERDEPENDENCE OF ORGANISMS</p>	
<p>1. The atoms and molecules on the Earth cycle among the living and nonliving components of the biosphere.</p> <p>2. Energy flows through ecosystems in one direction, from photosynthetic organisms to herbivores to carnivores and decomposers.</p> <p>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.</p> <p>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.</p>	<p>Unit 1: 31-37 Unit 2: 82-88, 91-93 Unit 8: 506-507</p> <p>Unit 1: 38-43 Unit 2: 82-88, 99-103 Unit 4: 225-228 Unit 8: 502-503</p> <p>Unit 1: 24-26, 41-43 Unit 2: 99-107, 119 Unit 3: Inferred in Unit 3, 140-142, 162-165, 165-167 Unit 6: 380-381 Unit 7: 443-450 Unit 8: 504-506</p> <p>Unit 1: 2-6, 9, 11-13, 18-21, 64-67 Unit 2: 94-96 Unit 3: All of Unit 3, 140-142, 147-150, 162-165, 165-167, 176-178, 187-188 Unit 7: 443-450, 452, 468, 473-480 Unit 8: 490-497, 501, 502-506, 513-518</p>

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OBJECTIVES	PAGE REFERENCES
<p>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.</p>	<p>Unit 1: 2-6, 9, 11-13, 18-21, 64-67 Unit 2: All of Unit 2, 72-77, 89, 119, 126-127, 132-134 Unit 3: All of Unit 3, 165-167, 182-185, 186, 188 Unit 6: 372-373, 401 Unit 7: 473-480 Unit 8: 490-497, 501, 502-506, 513-518</p>
<p style="text-align: center;">MATTER, ENERGY, AND ORGANIZATION IN LIVING SYSTEMS</p>	
<p>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.</p>	<p>Unit 1: 13-15, 24-25, 38-40, 53 Unit 2: 82-88, 99-104 Unit 3: 165-167 Unit 4: 225-228, 260-261 Unit 8: 502-506, 508</p>
<p>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 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.</p>	<p>Unit 2: 82-88 Unit 4: 208-211, 214-216, 262-265 Unit 8: 501, 502-506</p>
<p>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.</p>	<p>Unit 1: 29-32, 34-40, 43, Fig. 1.30 Unit 2: 106-112 Unit 4: 226-228, 262-265</p>
<p>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.</p>	<p>Unit 4: 201, 211-216, 222-224, 228-231</p>
<p>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.</p>	<p>Unit 2: 106-112, 112-116 Unit 3: All of Unit 3, 165-167 Unit 7: 473-480 Unit 8: 504-506, 506-508</p>

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OBJECTIVES	PAGE REFERENCES
<p>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.</p>	<p>Unit 1: 38-40, Fig. 1.30 Unit 2: 82-88, 94-104, 106-112, 122-123 Unit 4: 201, 211-216, 222-224, 226-228, 228-231, 262-265 Unit 8: 502-503, 506-508</p>
<p>THE NERVOUS SYSTEM AND THE BEHAVIOR OF ORGANISMS</p>	
<p>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.</p>	<p>Unit 6: 367, 368, 373-375, 389-392, 396-398</p>
<p>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.</p>	<p>Unit 4: 244-247 Unit 6: 367, 368, 386-389, 389-392, 392-396, 399-400</p>
<p>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.</p>	<p>Unit 6: 380-381</p>
<p>4. Behavioral biology has implications for humans, providing links to psychology, sociology, and anthropology.</p>	<p>Unit 3: 169-175 Unit 4: 239 Unit 6: 380-381, 396-398, 399-400, 405-407 Unit 8: 497-500</p>



Correlation of
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OBJECTIVES	PAGE REFERENCES
<p style="text-align: center;">THE NATURE OF SCIENCE The Scientific World View</p> <ol style="list-style-type: none"> 1. Scientists assume that the universe is a vast single system in which the basic rules are the same everywhere. The rules may change from very simple to extremely complex, but scientists operate on the belief that the rules can be discovered by careful systematic study. 2. From time to time, major shifts occur in the scientific view of how the world works. More often, however, the changes that take place in the body of scientific knowledge are small modifications of prior knowledge. Change and continuity are persistent features of science. 3. No matter how well one theory fits observations, a new theory might fit them just as well or better, or might fit a wider range of observations. In science, the testing revising, and occasional discarding of theories, new and old, never ends. This ongoing process leads to an increasingly better understanding of how things work in the world but not to absolute truth. Evidence for the value of this approach is given by the improving ability of scientists to offer reliable explanations and make accurate predictions. <p style="text-align: center;">Scientific Inquiry</p> <ol style="list-style-type: none"> 1. Investigations are conducted for different reasons, including to explore new phenomena, to check on previous results, to test how well a theory predicts, and to compare different theories. 2. Hypotheses are widely used in science for choosing what data to pay attention to and what additional data to seek and for guiding the interpretation of the data (both new and previously available). 3. Sometimes, scientists can control conditions in order to obtain evidence. When that is not possible for practical or ethical reasons, they try to observe as wide a range of natural occurrences as possible to be able to discern patterns. 4. There are different traditions in science about what is investigated and how, but they all have in common certain basic beliefs about the value of evidence, logic and good arguments. And there is agreement that progress in all fields of science depends on intelligence, hard work, imagination, and even chance. 	<p>teacher extension of first and second laws of thermodynamics on p. 88</p> <p>456</p> <p>456-459</p> <p>Guided and Extended Inquiries throughout the text, e.g., pp. 7-9. 54-55</p> <p>47-48, 78, 100, 227, 255, 264, 386, 389, 392, 399, 408, 436</p> <p>27-31, 78, 226, 261</p> <p>teacher implemented</p>

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OBJECTIVES	PAGE REFERENCES
<p>5. Scientists in any one research group tend to see things alike, so even groups of scientists may have trouble being entirely objective about their methods and findings. For that reason, scientific teams are expected to seek out the possible sources of bias in the design of their investigations and in their data analysis. Checking each other's results and explanations help, but that is no guarantee against bias.</p> <p>6. In the short run, new ideas that do not mesh well with the mainstream ideas in science often encounter vigorous criticism. In the long run, theories are judged by how they fit with other theories, the range of observations they explain, how well they explain observations, and how effective they are in predicting new findings.</p> <p>7. New ideas in science are limited by the context in which they are conceived; are often rejected by the scientific establishment; sometimes spring from unexpected finding; and usually grow slowly, through contributions from many investigators.</p>	<p>peer critiques of abstracts for Conferences, e.g., p. 46 and p. 181</p> <p>442, 456</p> <p>teacher extension about the controversy surrounding the work of Charles Darwin described on pp. 456-459</p>
<p style="text-align: center;">The Scientific Enterprise</p> <p>1. The early Egyptians, Greek, Chinese, Hindu, and Arabic cultures are responsible for many scientific and mathematical ideas and technological inventions.</p> <p>2. Modern science is based on traditions of thought that came together in Europe about 500 years ago. People from all cultures now contribute to that tradition.</p> <p>3. Progress in science and invention depends heavily on what else is happening in society, and history often depends on scientific and technological developments.</p> <p>4. Science disciplines differ from one another in what is studied, techniques used, and outcomes sought, but they share a common purpose and philosophy, and all are part of the same scientific enterprise. Although each discipline provides a conceptual structure for organizing and pursuing knowledge, many problems are studied by scientists using information and skills from many disciplines. Disciplines do not have fixed boundaries, and it happens that new scientific disciplines are being formed where existing ones meet and that some subdisciplines spin off to become new disciplines in their own right.</p>	<p>teacher extension of Biooccupation on p. 324</p> <p>teacher extension of Figure 3.38 on p. 187; teacher extension of Extended Inquiry 4.7 on p. 269, #1; 426</p> <p>teacher implemented</p>

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OBJECTIVES	PAGE REFERENCES
<p>5. Current ethics in science hold that research involving human subjects may be conducted only with the informed consent of the subjects, even if this constraint limits some kinds of potentially important research or influences the results. When it comes to participation in research that could pose risks to society, most scientists believe that a decision to participate or not is a matter of personal ethics rather than professional ethics.</p> <p>6. Scientists can bring information, insights, and analytical skills to bear on matters of public concern. Acting in their areas of expertise, scientist can help people understand the likely causes of events and estimate their possible effects. Outside their area of expertise, however, scientists should enjoy no special credibility. And where their own personal, institutional, or community interests are at stake, scientists as a group can be expected to be no less biased than other groups are about their perceived interests.</p> <p>7. The strongly held traditions of science, including its commitment to peer review and publication, serve to keep the vast majority of scientists well within the bounds of ethical professional behavior. Deliberate deceit is rare and likely to be exposed sooner or later by the scientific enterprise itself. When violations of these scientific ethical traditions are discovered, they are strongly condemned by the scientific community, and the violators then have difficulty regaining the respect of other scientists.</p> <p>8. Funding influences the direction of science by virtue of the decisions that are made on which research to support. Research funding comes from various federal government agencies, industry, and private foundations.</p>	<p>teacher extension of Bioissue on p. 239</p> <p>64-67 Biooccupation on p. 161, Bioissue on p. 239</p> <p>peer critiques of abstracts for Conferences, eg., pp. 45-46 and p. 118</p> <p>teacher extension of Bioissue on p. 239</p>
<p>THE NATURE OF MATHEMATICS</p>	
<p>Patterns and Relationships</p>	
<p>1. Mathematics is the study of any patterns or relationships, whereas natural science is concerned only with those patterns that are relevant to the observable world. Although mathematics began long ago in practical problems, it soon focused on abstractions from the material world, and then on even more abstract relationships among those abstractions.</p> <p>2. As in other sciences, simplicity is one of the highest values in mathematics. Some mathematicians try to identify the smallest set of rules from which many other propositions can be logically derived.</p> <p>3. Theories and applications in mathematical work influence each other. Sometimes a practical problem leads to the development of new mathematical theories; often mathematics developed for its own sake turns out to have practical applications.</p>	<p>176-178 teacher extension of Figure 3.24 on p. 167</p> <p>teacher extension of first and second laws of thermodynamics on p. 88</p> <p>teacher implemented</p>

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OBJECTIVES	PAGE REFERENCES
<p>4. New mathematics continues to be invented, and connections between different parts of mathematics continue to be found.</p>	<p>teacher extension/implementation</p>
<p>Mathematics, Science, and Technology</p>	
<p>1. Mathematical modeling aids in technological design by simulating how a proposed system would theoretically behave.</p>	<p>22-23, Figure 2.25 on p. 103, Figure 3.24 on p. 167</p>
<p>2. Mathematics and science as enterprises share many values and features: belief in order, ideals of honesty and openness, the importance of criticism by colleagues, and the essential role played by imagination.</p>	<p>teacher implemented</p>
<p>3. Mathematics provides a precise language for science and technology-to describe objects and events, to characterize relationships between variables, and to argue logically.</p>	<p>157-159, 177-178</p>
<p>4. Developments in science or technology often stimulate innovations in mathematics by presenting new kinds of problems to be solved. In particular, the development of computer technology (which itself relies on mathematics) has generated new kinds of problems and methods of work in mathematics.</p>	<p>185</p>
<p>5. Developments in mathematics often stimulate innovations in science and technology.</p>	<p>teacher implemented</p>
<p>Mathematical Inquiry</p>	
<p>1. Some work in mathematics is much like a game-mathematicians chose an interesting set of rules and then play according to those rules to see what can happen. The more interesting the results, the better. The only limit on the set of rules is that they should not contradict one another.</p>	<p>201-206</p>
<p>2. Much of the work of mathematicians involves a modeling cycle, which consists of three steps: (1) using abstractions to represent things or ideas, (2) manipulating the abstractions according to some logical rules, and (3) checking how well the results match the original things or ideas. If the match is not considered good enough, a new round of abstraction and manipulation may begin. The actual thinking need not go through these processes in logical order but may shift from one to another in any order.</p>	<p>162-165</p>

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OBJECTIVES	PAGE REFERENCES
<p style="text-align: center;">THE NATURE OF TECHNOLOGY</p> <p style="text-align: center;">Technology and Science</p> <ol style="list-style-type: none"> 1. Technological problems often create demand for new scientific knowledge, and new technologies make it possible for scientists to extend their research in new ways or to undertake entirely new lines of research. The very availability of new technology itself often sparks scientific advances. 2. Mathematics, creativity, logic, and originality are all needed to improve technology. 3. Technology usually affects society more directly than science because it solves practical problems and serves human needs (and may create new problems and needs). In contrast, science affects society mainly by stimulating and satisfying people’s curiosity and occasionally by enlarging or challenging their views of what the world is like. <p style="text-align: center;">Design and Systems</p> <ol style="list-style-type: none"> 1. In designing a device or process, thought should be given to how it will be manufactured, operated, maintained, replaced, and disposed of and who will sell, operate, and take care of it. The costs associated with these functions may introduce yet more constraints on the design. 2. The value of any given technology may be different for different groups of people and at different points in time. 3. Complex systems have layers of controls. Some controls operate particular parts of the system and control other controls. Even fully automatic systems require human control at some point. 4. Risk analysis is used to minimize the likelihood of unwanted side effects of a new technology. The public perception of risk may depend, however, on psychological factors as well as scientific ones. 	<p>2-3, 504, 504-505, 513-515 teacher extension of Figure 4.24 and information about dialysis on p. 220 teacher extension of Biooccupation on p. 498 Biooccupation on p. 501</p> <p>505-506, 514-515, 522-523 teacher extension of Figure 4.24 and information about dialysis on p. 220 Biooccupation on p. 501</p> <p>514-515 Biooccupation of p. 501 Bioissue on p. 156 teacher extension of Figure 4.24 and information about dialysis on p. 220</p> <p>18-19 Biooccupation on p. 10 Figure 8.12 on p. 513</p> <p>9, 11, 64-67 Bioissue on p. 156, Figure 4.23 on p. 219 Biooccupation on p. 501</p> <p>teacher extension of Figure 4.2 on p. 200</p> <p>17-18, 552-524</p>

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OBJECTIVES	PAGE REFERENCES
<p>5. The more parts and connections a system has, the more ways it can go wrong. Complex systems usually have components to detect, back up, bypass, or compensate for failures.</p> <p>6. To reduce the chance of system failure, performance testing is often conducted using small-scale models, computer simulations, analogous systems, or just the parts of a system thought to be least reliable.</p>	<p>teacher extension of Figure 4.24 on p. 220 teacher extension of 520-521</p> <p>506-507 teacher extension of Figure 1.7 on p. 14</p>
<p>Issues in Technology</p>	
<p>1. Social and economic forces strongly influence which technologies will be developed and used. Which will prevail is affected by many factors, such as personal values, consumer acceptance, patent laws, the availability of risk capital, the federal budget, local and national regulations, media attention, economic competition, and tax incentives.</p>	<p>64-67 Bioissue on p. 239</p>
<p>2. Technological knowledge is not always as freely shared as scientific knowledge unrelated to technology. Some scientists and engineers are comfortable working in situations in which some secrecy is required, but others prefer not to do so. It is generally regarded as a matter of individual choice and ethics, not one of professional ethics.</p>	<p>teacher implemented</p>
<p>3. In deciding on proposals to introduce new technologies or to curtail existing ones, some key questions arise concerning alternatives, risks, costs, and benefits. What alternative ways are there to achieve the same ends, and how do the alternatives compare to the plan being put forward? Who benefits and who suffers? What are the financial and social costs, do they change over time, and who bears them? What are the risks associated with using (or not using) the new technology, how serious are they, and who is in jeopardy? What human, material, and energy resources will be needed to build, install, operate, maintain, and replace the new technology, and where will they come from? How will the new technology and its waste products be disposed of and at what costs?</p>	<p>17-21 teacher extension of Bioissue on p. 239</p>
<p>4. The human species has a major impact on other species in many ways: reducing the amount of the earth's surface available to those other species, interfering with their food sources, changing the temperature and chemical composition of their habitats, introducing foreign species into their ecosystems, and altering organisms directly through selective breeding and genetic engineering.</p>	<p>All of Unit One, 132-134 Bioissue on p. 239</p>
<p>5. Human inventiveness has brought new risks as well as improvements to human existence.</p>	<p>126-127 Teacher extension of world population video (see p. 140)</p>

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OBJECTIVES	PAGE REFERENCES
<p style="text-align: center;">THE PHYSICAL SETTING</p> <p style="text-align: center;">The Universe</p> <ol style="list-style-type: none"> 1. The stars differ from each other in size, temperature, and age, but they appear to be made up of the same elements that are found on the earth and to behave according to the same physical principles. Unlike the sun, most stars are in systems of two or more stars orbiting around one another. 2. On the basis of scientific evidence, the universe is estimated to be over ten billion years old. The current theory is that its entire contents expanded explosively from a hot, dense, chaotic mass. Stars condensed by gravity out of the clouds of molecules of the lightest elements until nuclear fusion of the light elements into the heavier ones began to occur. Fusion released great amounts of energy over millions of years. Eventually, some of the stars exploded, producing clouds of heavy elements from which other stars and planets could later condense. The process of star formation and destruction continues. 3. Increasingly sophisticated technology is used to learn more about the universe. Visual, radio, and x-ray telescopes collect information from across the entire spectrum of electromagnetic waves; computers handle the avalanche of data and increasingly complicated computations to interpret them; space probes send back data and materials from the remote parts of the solar system; and accelerators give subatomic particles energies that simulate conditions in the stars and in the early history of the universe before stars formed. 4. Mathematical models and computer simulations are used in studying evidence from many sources in order to form a scientific account of the universe. <p style="text-align: center;">The Earth</p> <ol style="list-style-type: none"> 1. Life is adapted to conditions on the earth, including the force of gravity that enables the planet to retain an adequate atmosphere, and an intensity of radiation from the sun that allows water to cycle between liquid and vapor. <p style="text-align: center;">Processes That Shape The Earth</p> <ol style="list-style-type: none"> 1. Plants alter the earth's atmosphere by removing carbon dioxide from it, using the carbon to make sugars and releasing oxygen. This process is responsible for the oxygen content of the air. 2. The formation, weathering, sedimentation, and reformation of rock constitute a continuing "rock cycle" in which the total amount of material stays the same as its form changes. 	<p style="text-align: center;">teacher extension of 430-431</p> <p style="text-align: center;">456-458</p> <p style="text-align: center;">38, 87-88, 120 Figure 1.29 on p. 40</p> <p style="text-align: center;">teacher extension of Figure 7.39 on p. 457</p>

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OBJECTIVES	PAGE REFERENCES
<p>3. The slow movement of material within the earth results from heat flowing out from the deep interior and the action of gravitational forces on regions of different density.</p> <p>4. The solid crust of the earth-including both the continents and the ocean basins-consist of separate plates that ride on a denser, hot, gradually deformable layer of the earth. The crust sections move very slowly, pressing against one another in some places, pulling apart in other places. Ocean-floor plates may slide under continental plates, sinking deep into the earth. The surface layers of these plates may fold, forming mountain ranges.</p> <p>5. Earthquakes often occur along the boundaries between colliding plates, and molten rock from below creates pressure that is released by volcanic eruptions, helping to build up mountains. Under the ocean basins, molten rock may well up between separating plates to create new ocean floor. Volcanic activity along the ocean floor may form undersea mountains, which can thrust above the ocean's surface to become islands.</p>	<p>teacher extension of volcanic activity shown in Figure 7.3 on p. 431</p> <p>teacher implemented</p> <p>teacher implemented</p>
<p style="text-align: center;">Structure of Matter</p> <p>1. Atoms are made of a positive nucleus surrounded by negative electrons. An atom's electron configuration, particularly the outermost electrons, determine how the atom can interact with other atoms. Atoms form bonds to other atoms by transferring or sharing electrons.</p> <p>2. The nucleus, a tiny fraction of the volume of an atom, is composed of protons and neutrons, each almost two thousand times heavier than an electron. The number of positive protons in the nucleus determines what an atom's electron configuration can be and so defines the element. In a neutral atom, the number of electrons equals the number of protons. But an atom may acquire an unbalanced charge by gaining or losing electrons.</p> <p>3. Neutrons have a mass that is nearly identical to that of protons, but neutrons have no electric charge. Although neutrons have little effect on how an atom interacts with others, they do affect the mass and stability of the nucleus. Isotopes of the same element have the same number of protons (and therefore electrons) but differ in the number of neutrons.</p> <p>4. The nucleus of radioactive isotopes is unstable and spontaneously decays, emitting particles and/or wavelike radiation. It cannot be predicted exactly when, if ever, an unstable nucleus will decay, but a large group of identical nuclei decay at a predictable rate. This predictability of decay rate allows radioactivity to be used for estimating the age of materials that contain radioactive substances.</p>	<p>33</p> <p>teacher extension of 32-38</p> <p>teacher extension of 32-38</p> <p>teacher extension of 32-38</p>

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OBJECTIVES	PAGE REFERENCES
5. Scientists continue to investigate atoms and have discovered even smaller constituents of which electrons, neutrons, and protons are made.	teacher extension of 32-38
6. When elements are listed in order by the masses of their atoms, the same sequence of properties appears over and over again in the list.	teacher extension of 32-38
7. Atoms often join with one another in various combinations in distinct molecules or in repeating three-dimensional crystal patterns. An enormous variety of biological, chemical, and physical phenomena can be explained by changes in the arrangement and motion of atoms and molecules.	32-38
8. The configuration of atoms in a molecule determines the molecule's properties. Shapes are particularly important in how large molecules interact with others.	Figure 4.5 on p. 247, 266-267 teacher extension of 32-38
9. The rate of reactions among atoms and molecules depends on how often they encounter one another, which is affected by the concentration, pressure, and temperature of the reacting materials. Some atoms and molecules are highly effective in encouraging the interaction of others.	262-267
Energy Transformation	
1. Whenever the amount of energy in one place or form diminishes, the amount in other places or forms increases by the same amount.	88
2. Heat energy in a material consists of the disordered motions of its atoms or molecules. In any interactions of atoms or molecules, that statistical odds are that they will end up with less order than they began-that is, with the heat energy spread out more evenly. With huge numbers of atoms and molecules, the greater disorder is almost certain.	88
3. Transformations of energy usually produce some energy in the form of heat, which spreads around by radiation or conduction into cooler places. Although just as much total energy remains, its being spread out more evenly means less can be done with it.	49-50, 106-111 Figure 2.25 on p. 103
4. Different energy levels are associated with different configurations of atoms and molecules. Some changes of configuration require an input of energy whereas others release energy.	teacher extension of 32-38

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<p>5. When energy of an isolated atom or molecule changes, it does so in a definite jump from one value to another, with no possible values in between. The change in energy occurs when radiation is absorbed or emitted, so the radiation also has distinct energy values. As a result, the light emitted or absorbed by separate atoms or molecules (as in gas) can be used to identify what the substance is.</p> <p>6. Energy is released whenever the nuclei of very heavy atoms, such as uranium or plutonium, split into middleweight ones, or when very light nuclei, such as those of hydrogen, and helium, combine into heavier ones. The energy released in each nuclear reaction is very much greater than the energy given off in each chemical reaction.</p>	<p>teacher extension of 32-38</p> <p>teacher extension of 32-38</p>
<p>Motion</p>	
<p>1. The change in motion of an object is proportional to the applied force and inversely proportional to the mass.</p> <p>2. All motion is relative to whatever frame of reference is chosen, for there is no motionless frame from which to judge all motion.</p> <p>3. Accelerating electric charges produce electromagnetic waves around them. A great variety of radiations are electromagnetic waves: radio waves, microwaves, radiant heat, visible light, ultraviolet radiation, x-rays, and gamma rays. These wavelengths vary from radio waves, the longest, to gamma waves, the shortest. In empty space, all electromagnetic waves move at the same speed—the “speed of light”.</p> <p>4. Whenever one thing exerts a force on another, an equal amount of force is exerted back on it.</p> <p>5. The observed wavelength of a wave depends upon the relative motion of the source and the observer. If either is moving toward the other, the observed wavelength is shorter; if either is moving away, the wavelength is longer. Because the light seen from almost all distant galaxies has longer wavelengths than comparable light here on earth, astronomers believe that the whole universe is expanding.</p> <p>6. Waves can superpose on one another, bend around corners, reflect off surfaces, be absorbed by materials they enter, and change direction when entering new material. All these effects vary with wavelength. The energy of waves (like any form of energy) can be changed into other forms of energy.</p>	<p>84-86</p> <p>Figure 2.10 on p. 86</p>

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<p style="text-align: center;">Forces of Nature</p> <ol style="list-style-type: none">1. Gravitational force is an attraction between two masses. The strength of the force is proportional to the masses and weakens rapidly with increasing distance between them.2. Electromagnetic forces acting within and between atoms are vastly stronger than the gravitational forces acting between the atoms. At the atomic level, electric forces between oppositely charged electrons and protons hold atoms and molecules together and thus are involved in all chemical reactions. On a larger scale, these forces hold solid and liquid materials together and act between objects when they are in contact-as in sticking or sliding friction.3. There are two kinds of charges-positive and negative. Like charges repel one another, opposite charges attract. In materials, there are almost exactly equal proportions of positive and negative charges, making materials as a whole electrically neutral. Negative charges, being associated with electrons, are far more mobile in materials than positive charges are. <p>A very small excess or deficit of negative charges in a material produces noticeable electric forces.</p> <ol style="list-style-type: none">4. Different kinds of materials respond differently to electric forces. In conducting materials such as metals, electric charges flow easily, whereas in insulating materials such as glass, they can move hardly at all. At very low temperatures, some materials become superconductors and offer no resistance to the flow of current. In between these extremes, semiconducting materials differ greatly in how well they conduct, depending on their exact composition.5. Magnetic forces are very closely related to electric forces and can be thought of as different aspects of a single electromagnetic force. Moving electric charges produce magnetic forces and moving magnets produce electric forces. The interplay of electric and magnetic forces is the basis for electric motors, generators, and many other modern technologies, including the production of electromagnetic waves.6. The forces that hold the nucleus of an atom together are much stronger than the electromagnetic force. That is why such great amounts of energy are released from the nuclear reactions in the sun and other stars.	<p>teacher extension of 32-38</p> <p>teacher extension of 32-38</p> <p>teacher extension of 32-38</p> <p>teacher extension of 32-38</p> <p>teacher extension of 32-38</p> <p>teacher extension of 32-38</p>
<p style="text-align: center;">THE LIVING ENVIRONMENT</p> <p style="text-align: center;">Diversity of Life</p> <ol style="list-style-type: none">1. The variation of organisms within a species increases the likelihood that at least some members of the species will survive under changed environmental conditions, and a great diversity of species increases the chance that at least some living things will survive in the face of large changes in the environment.	<p>53, 187-188, 456-459</p>

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OBJECTIVES	PAGE REFERENCES
<p>2. The degree of kinship between organisms or species can be estimated from the similarity of their DNA sequences, which often closely matches their classification based on anatomical similarities.</p>	436-439
<p>Heredity</p>	
<p>1. Some new gene combinations make little difference, some can produce organisms with new and perhaps enhanced capabilities, and some can be deleterious.</p>	310-315
<p>2. The sorting and recombination of genes in sexual reproduction results in a great variety of possible gene combinations from the offspring of any two parents.</p>	299-303
<p>3. The information passed from parents to offspring is coded in DNA molecules.</p>	284, 330
<p>4. Genes are segments of DNA molecules. Inserting, deleting, or substituting DNA segments can alter genes. An altered gene may be passed on to every cell that develops from it. The resulting features may help, harm, or have little or no effect on the offspring's success in its environment.</p>	284, 344-346
<p>5. Gene mutations can be caused by such things as radiation and chemicals. When they occur in sex cells, the mutations can be passed on to the offspring; if they occur in other cells, they can be passed on to descendant cells only. The experiences an organism has during its lifetime can affect its offspring only if the genes in its own sex cells are changed by the experience.</p>	344-346
<p>6. 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. Different parts of the instructions are used in different types of cells, influenced by the cell's environment and past history.</p>	307, 309
<p>Cells</p>	
<p>1. Every cell is covered by a membrane that controls what can enter and leave the cell. In all but quite primitive cells, a complex network of proteins provides organization and shape and, for animal cells, movement.</p>	206-208
<p>2. Within each cell are specialized parts for the transport of materials, energy capture and release, protein building, waste disposal, information feedback, and even movement. In addition to these basic cellular functions common to all cells, most cells in multicellular organisms perform some special function that others do not.</p>	208-210

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<p>3. 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-acid molecules. The function of each protein molecule depends on its specific sequence of amino acids and the shape the chain takes is a consequence of the attractions between the chain's parts.</p>	<p>teacher extension of 209</p>
<p>4. The genetic information in DNA molecules provides instructions for assembling protein molecules. The code used is virtually the same for all life forms.</p>	<p>teacher extension of 208-209, 229-337</p>
<p>5. Complex interactions among the different kinds of molecules in the cell cause distinct cycles of activities, such as growth and division. Cell behavior can also be affected by molecules from other parts of the organism or even other organisms.</p>	<p>240-241, 294</p>
<p>6. Gene mutation in a cell can result in uncontrolled cell division, called cancer. Exposure of cell to certain chemicals and radiation increases mutations and thus increases the chance of cancer.</p>	<p>teacher extension of 344-346</p>
<p>7. Most cells function best within a narrow range of temperature and acidity. At very low temperatures, reaction rates are too slow. High temperatures and/or extremes of acidity can irreversibly change the structure of most protein molecules. Even small changes in acidity can alter the molecules and how they interact. Both single cells and multicellular organisms have molecules that help to keep the cell's acidity within a narrow range.</p>	<p>262-266</p>
<p>8. A living cell is composed of a small number of chemical elements-mainly carbon, hydrogen, nitrogen, oxygen, phosphorous, and sulfur. Carbon, because of its small size and four available bonding electrons, can join to other carbon atoms in chains and rings to form large and complex molecules.</p>	<p>35-38, teacher extension of 206</p>
<p>Interdependence of Life</p>	
<p>1. Ecosystems can be reasonably stable over hundreds or thousands of years. As any population of organisms grows, it is held in check by one or more environmental factors: depletion of food or nesting sites, increased loss to increased number of predators, or parasites. If a disaster such as flood or fire occurs, the damaged ecosystem is likely to recover in stages that eventually result in a system similar to the original one.</p>	<p>75-77, 162-169</p>
<p>2. Like many complex systems, ecosystems tend to have cyclic fluctuations around a state of rough equilibrium. In the long run, however, ecosystems always change when climate changes or when one or more new species appear as a result of migration or local evolution.</p>	<p>104-105</p>

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<p>3. Human beings are part of the earth’s ecosystem. Human activities can, deliberately or inadvertently, alter the equilibrium in ecosystems.</p>	<p>All of Unit One, 105 Biooccupation on p. 90</p>
<p style="text-align: center;">Flow of Matter and Energy</p> <p>1. At times, environmental conditions are such that plants and marine organisms grow faster than decomposers can recycle them back to the environment. Layers of energy-rich organic material have been gradually turned into great coal beds and oil pools by the pressure of the overlying earth. By burning these fossil fuels, people are passing most of the stored energy back into the environment as heat and releasing large amounts of carbon dioxide.</p> <p>2. The amount of life any environment can support is limited by the available energy, water, oxygen, and minerals, and by the ability of the ecosystems to recycle the residue of dead organic materials. Human activities and technology can change the flow and reduce the fertility of the land.</p> <p>3. The chemical elements 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. Continual input of energy from sunlight keeps the process going.</p>	<p>105 teacher extension of Figure 7.5 on p. 432</p> <p>72-77</p> <p>Figure 1.30 on p. 43, Figure 2.30 on p. 107</p>
<p style="text-align: center;">Evolution of Life</p> <p>1. The basic idea of biological evolution is that the earth’s present-day species developed from earlier, distinctly different species.</p> <p>2. Molecular evidence substantiates the anatomical evidence for evolution and provides additional detail about the sequence in which various lines of descent branched off from one another.</p> <p>3. Natural selection provides the following mechanism for evolution: some variation in heritable characteristics exists within every species, some of these 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.</p> <p>4. Heritable characteristics can be observed at the molecular and whole-organism-in structure, chemistry, or behavior. These characteristics strongly influence what capabilities an organism will have and how it will react, and therefore influence how likely it is to survive and reproduce.</p>	<p>456</p> <p>436-437</p> <p>456-459</p> <p>440, 453-455</p>

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OBJECTIVES	PAGE REFERENCES
<p>5. New heritable characteristics can result from new combinations of existing genes or from mutations of genes in reproductive cells. Changes in other cells of an organism cannot be passed on to the next generation.</p>	432, 478
<p>6. Natural selection leads to organisms that are well suited for survival in particular environments. Chance alone can result in the persistence of some heritable characteristics having no survival or reproductive advantage or disadvantage for the organism. When an environment changes, the survival value of some inherited characteristics may change.</p>	458-459
<p>7. The theory of natural selection provides a scientific explanation for the history of life on earth as depicted in the fossil record and in the similarities evident within the diversity of existing organisms.</p>	456-459
<p>8. Life on earth is thought to have begun as simple one-celled organisms about 4 billion years ago. During the first 2 billion years, only single-cell microorganisms existed, but once cells with nuclei developed about a billion years ago, increasingly complex multicellular organisms evolved.</p>	430-432
<p>9. Evolution builds on what already exists, so the more variety there is, the more there can be in the future. But 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 other branches repeatedly, sometimes giving rise to more complex organisms.</p>	462-464 Figure 7.12 on p. 438
THE HUMAN ORGANISM	
Human Identity	
<p>1. The similarity of human DNA sequences and the resulting similarity in cell chemistry and anatomy identify human beings as a single species.</p>	142, 292, 352-353
<p>2. Written records and photographic and electronic devices enable human beings to share, compile, use, and misuse great amounts of information and misinformation. No other species uses such technologies.</p>	377, 413
Human Development	
<p>1. As successive generations of an embryo's cells form by division, small differences in their immediate environments cause them to develop slightly differently, by activating or inactivating different parts of the DNA information.</p>	307, 309

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<p>2. Using artificial means to prevent or facilitate pregnancy raises questions of social norms, ethics, religious beliefs, and even politics.</p> <p>3. The very long period of human development (compared to that of other species) is associated with the prominent role of the brain in human evolution. The ability to learn persists throughout life and may improve as people build a base of ideas and come to understand how to learn well. Human mental abilities that apparently evolved for survival are used for newly invented cultural purposes such as art, literature, ritual, and games.</p> <p>4. The development and use of technologies to maintain, prolong, sustain, or terminate life raise social, moral, ethical, and legal issues.</p>	<p>Bioissue on p. 156 teacher extension of 307</p> <p>teacher extension of 347, 378-381</p> <p>347-353, 358-359, 376-378 Bioissue on p. 156, Bioissue on p. 239, Bioissue on p. 356</p>
<p>Basic Functions</p>	
<p>1. The immune system is designed to protect against microscopic organisms and foreign substances that enter from outside the body and against some cancer cells that arise within.</p> <p>2. The nervous system works by electrochemical signals in the nerves and from one nerve to the next. The hormonal system exerts its influence by chemicals that circulate in the blood. These two systems also affect each other in coordinating body systems.</p> <p>3. Communication between cells is required to coordinate their diverse activities. Some cells secrete substances that spread only to nearby cells. Others secrete hormones, molecules that are carried in the bloodstream to widely distributed cells that have special receptor sites to which they attach. Along nerve cells, electrical impulses carry information much more rapidly than is possible by diffusion or blood flow. Some drugs mimic or block the molecules involved in transmitting nerve or hormone signals and therefore disturb normal operations of the brain and body.</p> <p>4. Reproduction is necessary for the survival of any species. Sexual behavior depends strongly on cultural, personal, and biological factors.</p>	<p>243-250, 267-268</p> <p>240-241, 373-374, 389-390</p> <p>240-241, 366-367, 373-374, 376-378</p> <p>teacher extension of 206-207, teacher extension of 380-381 Bioissue on p. 156</p>
<p>Learning</p>	
<p>1. Differences in the behavior of individuals arise from the interaction of heredity and experience-the effect of each depends on what the other is. Even instinctive behavior may not develop well if the individual is exposed to abnormal conditions.</p>	<p>378-381</p>

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OBJECTIVES	PAGE REFERENCES
<p>2. The expectations, moods, and prior experiences of human beings can affect how they interpret new perceptions or ideas. People tend to ignore evidence that challenges their beliefs and to accept evidence that supports them. The context in which something is learned may limit the contexts in which the learning can be used.</p>	<p>165-166, 272-276, 382-384</p>
<p>3. Human thinking involves the interaction of ideas, and ideas about ideas. People can produce many associations internally without receiving information from their senses.</p>	<p>165-166, 272-276, 378-379, 382-384</p>
<p>Physical Health</p>	
<p>1. 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.</p>	<p>247, 267-268</p>
<p>2. Faulty genes can cause the body parts or systems to work poorly. Some genetic diseases appear only when an individual has inherited a certain faulty gene from both parents.</p>	<p>286-288, 309-316, 321, 338</p>
<p>3. New medical techniques, efficient health care delivery systems, improved sanitation, and a fuller understanding of the nature of disease give today's human beings a better chance of staying healthy than their forebears had. Conditions now are very different from which the species evolved. But some of the differences may not be good for human health.</p>	<p>219-220 Bioissue on p. 239 Biooccupation on p. 221</p>
<p>4. Some viral diseases, such as AIDS destroy critical cells of the immune system, leaving the body unable to deal with multiple infection agents and cancerous cells.</p>	<p>246-247</p>
<p>Mental Health</p>	
<p>1. Stresses are especially difficult for children to deal with and may have long-lasting effects.</p>	<p>teacher extension of 182-184</p>
<p>2. Biological abnormalities, such as brain injuries or chemical imbalances, can cause or increase susceptibility to psychological disturbances.</p>	<p>366 Bioissue on p. 368</p>
<p>3. Reactions of other people to an individual's emotional disturbance may increase its effects.</p>	<p>Bioissue on p. 368</p>
<p>4. Human beings differ greatly in how they cope with emotions and may therefore puzzle one another.</p>	<p>Bioissue on p. 89</p>
<p>5. Ideas about what constitutes good mental health and proper treatment for abnormal mental states vary from one culture to another and from one time period to another.</p>	<p>367</p>

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OBJECTIVES	PAGE REFERENCES
<p style="text-align: center;">HUMAN SOCIETY</p> <p style="text-align: center;">Cultural Effect on Behavior</p> <ol style="list-style-type: none"> 1. Cultural beliefs strongly influence the values and behaviors of the people who grow up in the culture, often without their being fully aware of it. Response to these influences varies among individuals. 2. The ways that unacceptable social behavior is punished depend partly on beliefs about the purposes of punishment and about its effectiveness. Effectiveness is difficult to test scientifically because circumstances vary greatly and because legal and ethical barriers interfere. 3. Social distinctions are a part of every culture, but take many different forms, ranging from rigid classes based solely on parentage to gradations based on the acquisition of skill, wealth, or education. Differences in speech, dress, behavior, or physical features are often taken by people to be signs of social class. The difficulty in moving from one social class to another varies greatly with time, place, and economic circumstances. 4. Heredity, culture, and personal experience interact in shaping human behavior. Their relative importance in most circumstances is not clear. <p style="text-align: center;">Group Behavior</p> <ol style="list-style-type: none"> 1. The behavior of a group may not be predictable from an understanding of each of its members. 2. Social organizations may serve business, political, or social purposes beyond those for which they officially exist, including unstated ones such as excluding certain categories of people from activities. <p style="text-align: center;">Social Change</p> <ol style="list-style-type: none"> 1. The size and rate of growth of the human population in any location is affected by economic, political, religious, technical, and environmental factors. Some of these factors, in turn, are influenced by the size and rate of growth of the population. 2. The decisions of one generation both provide and limit the range of possibilities open to the next generation. 3. Mass media, migrations, and conquest affect social change by exposing one culture to another. Extensive borrowing among cultures has led to the virtual disappearance of some cultures but only modest change in others. 	<p>405-407, 416-417, 418-420</p> <p>366-367, 418-420</p> <p>413 (suggested research topic #2)</p> <p>380-381, 418-420 Bioissue on p.89</p> <p>272-276 Bioissue on p. 89</p> <p>272-276</p> <p>106, 182-185</p> <p>193 Bioissue on p. 239</p> <p>Figure 3.16 on p. 159</p>

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OBJECTIVES	PAGE REFERENCES
<p>4. To various degrees, governments try to bring about social change or to impede it through policies, laws, incentives, or direct coercion. Sometimes such efforts achieve their intended results and sometimes they do not.</p>	<p>272-276 Bioissue on p. 156</p>
<p style="text-align: center;">Social Trade-Offs</p> <p>1. Benefits and costs of proposed choices include consequences that are long-term as well as short-term, and indirect as well as direct. The more remote the consequences of a personal or social decision, the harder it usually is to take them into account in considering alternatives. But benefits and costs may be difficult to estimate.</p> <p>2. In deciding among alternatives, a major question is who will receive the benefits and who (not necessarily the same people) will bear the costs.</p> <p>3. Social trade-offs are often generational. The cost of benefits received by one generation may fall on the subsequent generations. Also, the cost of a social trade-off is sometimes borne by one generation although the benefits are enjoyed by their descendants.</p>	<p>513-515 Bioissue on p. 156</p> <p>64-67, 272-276, 522-525 Bioissue on p. 156</p> <p>522-525 Bioissue on p. 156</p>
<p style="text-align: center;">Political and Economic Systems</p> <p>1. In the free market model, the control of production and consumption is mainly in private hands. The best allocation of resources is believed to be achieved by individuals and the organizations competing in the marketplace. Individual initiative, talent, and hard work are expected to be rewarded with success and wealth. Government's role is primarily to protect political and economic freedoms for society as a whole-even at the cost of some individual or group material benefits.</p> <p>2. In the central-planning model, production and consumption are controlled by the government. The best allocation of resources is thought to be achieved through government planning by experts. Dedication to the good of society as a whole is expected to motivate initiative, talent, and hard work. The main purpose of government is to promote comparable welfare for all individuals and groups-even at the cost of some individual or group freedoms.</p> <p>3. In practice, countries make compromises with regard to economic models. Central planning has to allow for some individual initiative, and markets have to provide some protection for unsuccessful competitors. The countries of the world use elements of both systems and are neither purely free-market nor entirely centrally controlled. Countries change, some adopting more free market policies and practices, others more central planning ones, and still others doing some of each.</p>	<p>teacher implemented</p> <p>Bioissue on p. 156</p> <p>teacher implemented</p>

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OBJECTIVES	PAGE REFERENCES
<p style="text-align: center;">Social Conflict</p> <ol style="list-style-type: none"> 1. Conflict between people or groups arises from competition over ideas, resources, power, and status. Social change, or the prospect of it, promotes conflict because social, economic, and political changes usually benefit some groups more than others. That, of course, is also true of the status quo. 2. Conflicts are especially difficult to resolve in situations in which there are few choices and little room for compromise. Some informal ways of responding to conflict-use of pamphlets, demonstrations, cartoons, etc.-may sometimes reduce tensions and lead to compromise but at other times they may be inflammatory and make agreement more difficult to reach. 3. Conflict within a group may be reduced by conflict between it and other groups. 4. Intergroup conflict does not necessarily end when one segment of society gets a decision in its favor, for the “losers” may then work all the harder to reverse, modify, or circumvent the change. Even when the majority of the people in a society agree on a social decision, the minority who disagree must be protected from oppression, just as the majority may need protection against unfair retaliation from the minority. 	<p>64-67, 165, 272-276</p> <p>182-184, 272-276</p> <p>64-67, 191-192, 272-276</p> <p>teacher extension of 272-276</p>
<p style="text-align: center;">Global Interdependence</p> <ol style="list-style-type: none"> 1. The wealth of a country depends partly on the effort and skill of its workers, its natural resources, and the capital and technology available to it. It also depends on the balance between how much its products are sought by other nations and how much of other nations’ products it seeks. Even if a country could produce everything it needs for itself, it would still benefit from trade with other countries. 2. Because of increasing international trade, the domestic products of any country may be made up in part by parts made in other countries. The international trade picture is often complicated by political motivations taking priority over economic ones. 3. Migration across borders, temporary and permanent, legal and illegal, plays a major role in the availability and distribution of labor in many nations. It can bring both economic benefits and political problems. 4. The growing interdependence of world social, economic, and ecological systems does not always bring greater worldwide stability and often increases the cost of conflict. 	<p>106 (see applications), 182-184, self-check questions 4 and 5 on p. 519</p> <p>106 (see applications), self-check question 5 on p. 519</p> <p>Figure 3.16 on p. 159</p> <p>182-185, 496-497, 520-521 teacher extension of 524</p>

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<p style="text-align: center;">THE DESIGNED WORLD</p> <p style="text-align: center;">Agriculture</p> <ol style="list-style-type: none"> 1. New varieties of farm plants and animals have been engineered by manipulating their genetic instructions to produce new characteristics. 2. Government sometimes intervenes in matching agricultural supply to demand in an attempt to ensure a stable, high quality, and inexpensive food supply. Regulations are often also designed to protect farmers from abrupt changes in farming conditions and from competition by farmers in other countries. 3. Agricultural technology requires trade-offs between increased production and environmental harm and between efficient production and social values. In the past century, agricultural technology led to a huge shift of population from farms to cities and a great change in how people live and work. <p style="text-align: center;">Materials and Manufacturing</p> <ol style="list-style-type: none"> 1. Manufacturing processes have been changed by improved tools and techniques based on more thorough scientific understanding, increases in the forces that can be applied and the temperatures that can be reached, and the availability of electronic controls that make operations occur more rapidly and consistently. 2. Waste management includes considerations of quantity, safety, degradability, and cost. It requires social and technological innovations, because waste-disposal problems are political and economic as well as technical. 3. Scientific research identifies new materials and new uses of known materials. 4. Increased knowledge of the molecular structure of materials helps in the design and synthesis of new materials for special purposes. <p style="text-align: center;">Energy Sources and Use</p> <ol style="list-style-type: none"> 1. A central factor in technological change has been how hot a fire could be made. The discovery of new fuels, the design of better ovens and furnaces, and the forced delivery of air or pure oxygen have progressively increased the available temperature. Lasers are a new tool for focusing radiation energy with great intensity and control. 	<p>teacher extension of 350-352, 504</p> <p>126-127</p> <p>teacher implemented</p> <p>17-21</p> <p>Bioissue on p. 239 Biooccupation on p. 16</p> <p>Biooccupation on p. 16</p> <p>17</p>

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OBJECTIVES	PAGE REFERENCES
<ol style="list-style-type: none"> 2. At present, all fuels have advantages and disadvantages so that society must consider the trade-offs among them. 3. Nuclear reactions release energy without the combustion products of burning fuels, but the radioactivity of fuels and by-products poses other risks. 4. Industrialization brings an increased demand for the use of energy. Such usage contributes to the high standard of living in the industrially developing nations but also leads to more rapid depletion of the earth's energy resources and the environmental risks associated with the use of fossil and nuclear fuels. 5. Decisions to slow the depletion of energy sources through efficient technology can be made at many levels, from personal to national, and they always involve trade offs of economic costs and social values. 	<p>teacher extension of Figure 7.5 on p. 432</p> <p>teacher extension of 32-33</p> <p>teacher extension of Figure 2.40 on p. 126</p> <p>teacher implemented</p>
<p style="text-align: center;">Communication</p> <ol style="list-style-type: none"> 1. Almost any information can be transformed into electrical signals. A weak electrical signal can be used to shape a stronger one, which can control other signals of light, sound, mechanical devices, or radio waves. 2. The quality of communication is determined by the strength of the signal in relation to the noise that tends to obscure it. Communication errors can be reduced by boosting and focusing signals, shielding the signal from internal and external noise, and repeating information, but all of these increase costs. Digital coding of information (using only 1's and 0's) makes possible more reliable transmission of information. 3. As technologies that provide privacy in communication improve, so do those for invading privacy. 	
<p style="text-align: center;">Information Processing</p> <ol style="list-style-type: none"> 1. Computer modeling explores the logical consequences of a set of instructions and a set of data. The instructions and the data input of a computer model try to represent the real world so the computer can show what would actually happen. In this way, computers assist people in making decisions by simulating the consequences of different possible decisions. 2. Redundancy can reduce errors in storing or processing information but increases costs. 	

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OBJECTIVES	PAGE REFERENCES
<p>3. Miniaturization of information-processing hardware can increase processing speed and portability, reduce energy use, and lower cost. Miniaturization is made possible through higher purity materials and more precise fabrication technology.</p>	<p>Figure 4.41 on p. 234</p>
<p>Health Technology</p>	
<p>1. Owing to the large amount of information that computers can process, they are playing an increasingly larger role in medicine. They are used to analyze data and to keep track of diagnostic information about individuals and the statistical information on the distribution and spread of various maladies in populations.</p>	<p>Figure 4.41 on p. 234</p>
<p>2. Almost all body substances and functions have daily or longer cycles. These cycles often need to be taken into account in interpreting normal ranges for body measurement, detecting disease, and planning treatment of illness. Computers aid in detecting, analyzing, and monitoring these cycles.</p>	<p>Figure 3.14 on p. 155</p>
<p>3. Knowledge of genetics is opening whole new fields of health care. In diagnosis, mapping of genetic instructions in cells makes it possible to detect defective genes that may lead to poor health. In treatment, substances from genetically engineered organisms may reduce the cost and side effects of replacing missing body chemicals.</p>	<p>220</p>
<p>4. Inoculations use weakened germs (or parts of them) to stimulate the body's immune system to react. This reaction prepares the body to fight subsequent invasions by actual germs of that type. Some inoculations last for life.</p>	<p>246</p>
<p>5. Knowledge of molecular structure and interactions aids in synthesizing new drugs and predicting their effect.</p>	<p>teacher extension of pp. 246-247 and p. 249</p>
<p>6. The diagnosis and treatment of mental disorders are improving but not as rapidly as for physical health. Techniques for detecting and diagnosing these disorders include observation of the behavior, in-depth interviews, and measurements of body chemistry. Treatments range from conversation to affecting the brain physically with chemicals, electric shock or surgery.</p>	<p>teacher implemented</p>
<p>7. Biotechnology has contributed to health improvement in many ways, but its cost and application have led to a variety of controversial social and ethical issues.</p>	<p>teacher extension of 350-352</p>

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OBJECTIVES	PAGE REFERENCES
THE MATHEMATICAL WORLD	
Numbers	
1. Comparison of numbers of very different size can be made approximately by expressing them as nearest powers of 10.	201, 352
2. Numbers can be written with bases different from ten (which people probably use because of their 10 fingers). The simplest base, 2, uses just two symbols (1, and 0, or on and off).	teacher extension of 201
3. When calculations are made with measurements, a small error in the measurement may lead to a large error in results.	227
4. The effects of uncertainties in measurements on a computed result can be estimated.	teacher extension of 227
Symbolic Relationships	
1. In some cases, the more of something there is, the more rapidly it may change (as the number of births is proportional to the size of the population). In other cases, the rate of change of something depends on how much there is of something else (as the rate of change of speed is proportional to the amount of force acting).	154-165, 338
2. Symbolic statements can be manipulated by rules of mathematical logic to produce other statements of the same relationship, which may show some interesting aspect more clearly. Symbolic statements can be combined to look for values of variables that will satisfy all of them at the same time.	157-159
3. Any mathematical model, graphic or algebraic, is limited in how well it represents how the world works. The usefulness of a mathematical model for predicting may be limited by uncertainties in measurements, by neglect of some important influences, or by requiring too much computation.	teacher extension of Figure 3.24 on p. 167

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OBJECTIVES	PAGE REFERENCES
<p>4. Tables, graphs, and symbols are alternative ways of representing data and relationships that can be translated from one to another.</p> <p>5. When a relationship is represented in symbols, numbers can be substituted for all but one of the symbols and the possible value of the remaining symbol computed. Sometimes the relationship may be satisfied by one value, sometimes more than one, and sometimes maybe not at all.</p> <p>6. The reasonableness of the result of a computation can be estimated from what the inputs and operations are.</p>	<p>49-53, 144, 157-159, 176, 379, 396, 434, 511 Figure 2.5 on p. 70, Figure 2.6 on p. 80, Figure 2.12 on p. 87, Figure 2.23 on p. 100, Figure 2.31 on p. 109, Figure 2.32 on p. 110, Figure 2.33 on p. 112, Figures 2.35 and 2.36 on p. 116, Figure 3.14 on p. 155, Figures 3.17 and 3.18 on p. 160, Figure 3.22 on p. 166, Figures 3.23 and 3.24 on p. 167, Figure 3.27 on p. 170. Figure 3.28 on p. 171, Figure 3.29 on p. 172, Figure 3.30 on p. 173, Figure 3.33 on p. 177, Figure 3.36 on p. 185, Figure 3.38 on p. 187, Figure 4.6 on p. 203, Figure 4.7 on p. 204, Figure 4.15 on p. 211, Figure 4.30 on p. 226, Fig. 5.2 on p. 283, Figure 5.24 on p. 308, Figure 5.37 on p. 319, Facts About Sickle-cell Anemia on p. 325, Figure 5.56 on p. 344, Figure 6.9 on p. 376, Figure 6.13 on p. 386, Figure 6.16 on p. 388, Figure 7.2 on p. 429, Figure 7.5 on p. 432, Figure 7.9 on p. 434, Figure 7.18 on p. 444, Figure 7.33 on p. 454, Figure 7.35 on p. 455, Figure 7.36 on p. 455, Figure 7.41 on p. 462, Guided Inquiry 7.6 on p. 466, Figure 8.9 on p. 503, Figure 8.11 on p. 506</p> <p>50-52, 158, 227, 389</p> <p>157-159, 227</p>
<p style="text-align: center;">Shapes</p> <p>1. Distances and angles that are inconvenient to measure directly can be found from measurable distances and angles using scale drawings or formulas.</p> <p>2. There are formulas for calculating the surface areas and volumes of regular shapes. When the linear size of a shape changes by some factor, its area and volume change disproportionately: area in proportion to the square of the factor, and volume in proportion to its cube. Properties of an object that depend on its area or volume also change disproportionately.</p>	<p>204</p> <p>7, 204</p>

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<p>3. Geometric shapes and relationships can be described in terms of symbols and numbers-and vice versa. For example, the position of any point on a surface can be specified by two numbers; a graph represents all the values that satisfy an equation; and if two equations have to be satisfied at the same time, the values that satisfy them both will be found where their graphs intersect.</p>	204, 227
<p>4. Different ways to map a curved surface (like the earth's) onto a flat surface have different advantages.</p>	95
Uncertainty	
<p>1. Even when there are plentiful data, it may not be obvious what mathematical model to use to make predictions from them or there may be insufficient computing power to use some models.</p>	152
<p>2. When people estimate a statistic, they may also be able to say how far off the estimate might be.</p>	147-149
<p>3. The middle of a data distribution may be misleading-when the data are not distributed symmetrically, or when there are extreme high or low values, or when the distribution is not reasonably smooth.</p>	teacher extension of Figure 7.36 on p. 455, teacher extension of 546
<p>4. The way data are displayed can make a big difference in how they are interpreted.</p>	555-557
<p>5. Both percentages and actual numbers have to be taken into account in comparing different groups; using either category by itself could be misleading.</p>	Figure 3.30 on p. 173, 243-244
<p>6. Considering whether two variables are correlated requires inspecting their distributions, such as in two-way tables or scatter plots. A believable correlation between two variables doesn't mean that either one causes the other; perhaps some other variable causes them both or the correlation might be attributable to chance alone. A true correlation means that differences in one variable imply differences in the other when all other things are equal.</p>	Figure 3.28 on p. 171 and Figure 3.29 on p. 172
<p>7. The larger a well-chosen sample of a population is, the better it estimates population summary statistics. For a well-chosen sample, the size of the sample is much more important than the size of the population. To avoid intentional or unintentional bias, samples are usually selected by some random system.</p>	115, 151-153
<p>8. A physical or mathematical model can be used to estimate the probability of real-world events.</p>	Figure 3.18 on p. 160, Figure Figure 3.22 on p. 166, Figure 3.24 on p. 167

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OBJECTIVES	PAGE REFERENCES
<p style="text-align: center;">Reasoning</p> <ol style="list-style-type: none"> 1. To be convincing, an argument needs to have both true statements and valid connections among them. Formal logic is mostly about connections among statements, not about whether they are true. People sometimes use poor logic even if they begin with true statements, and sometimes they use logic that begins with untrue statements. 2. Logic requires a clear distinction among reasons: A reason may be sufficient to get a result, but perhaps is not the only way to get there; or, a reason may be necessary to get the result, but it may not be enough by itself; some reasons may be both sufficient and necessary. 3. Wherever a general rule comes from, logic can be used in testing how well it works. Providing a generalization to be false (just one exception will do) is easier than proving it to be true (for all possible cases). Logic may be of limited help in finding solutions to problems if one isn't sure that general rules always hold or that particular information is correct; most often, one has to deal with probabilities rather than certainties. 4. Once a person believes in a general rule, he or she may be more likely to notice cases agree with it and ignore cases that don't. To avoid biased observations, scientific studies sometimes use observers who don't know what the results are "supposed" to be. 5. Very complex logical arguments can be made from a lot of small logical steps. Computers are particularly good at working with complex logic but not all logical problems can be solved by computers. High-speed computers can examine the validity of some logical propositions for a very large number of cases, although that may not be a perfect proof. 	<p>Congresses and Forums, e.g. pp. 132-134, 191-193</p> <p>Congresses and Forums, e.g. pp. 132-134, 191-193</p> <p>Congresses and Forums, e.g. pp. 132-134, 191-193</p> <p>Congresses and Forums, e.g. pp. 132-134, 191-193</p> <p>Congresses and Forums, e.g. pp. 132-134, 191-193</p>
<p style="text-align: center;">HISTORICAL PERSPECTIVES</p> <p style="text-align: center;">Displacing the Earth from The Center of the Universe</p> <ol style="list-style-type: none"> 1. People perceive that the earth is large and stationary and that all other objects in the sky orbit around it. That perception was the basis for theories of how the universe is organized that prevailed for over 2,000 years. 2. Ptolemy, an Egyptian astronomer living in the second century A.D., devised a powerful mathematical model of the universe based on constant motion in perfect circles, and circles on circles. With the model, he was able to predict the motions of the sun, moon, and stars, and even of the irregular "wandering stars" now called planets. 	<p>teacher extension of Figure 2.20 on p. 96</p>

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<ol style="list-style-type: none">3. In the 16th century, a Polish astronomer named Copernicus suggested that all those same motions could be explained by imagining that the earth was turning around once a day and orbiting around the sun once a year. This explanation was rejected by nearly everyone because it violated common sense and required the universe to be unbelievably large. Worse, it flew in the face of the belief, universally held at that time, that the earth was the center of the universe.4. Johannes Kepler, a German astronomer who lived at about the same time as Galileo, showed mathematically that Copernicus' idea of a sun-centered system worked well if uniform circular motion was replaced with uneven (but predictable) motion along off center ellipses.5. Using the newly invented telescope to study the sky, Galileo made many discoveries that supported the ideas of Copernicus. It was Galileo who found the moons of Jupiter, sunspots, craters and mountains on the moon, and many more stars than were visible to the unaided eye.6. Writing in Italian rather than Latin (the language of scholars at the time), Galileo presented arguments for and against the two main views of the universe in a way that favored the newer view. That brought the issue to the educated people of the time and created political, religious, and scientific controversy.	
Uniting the Heavens and the Earth	
<ol style="list-style-type: none">1. Issac Newton created a unified view of force and motion in which motion everywhere in the universe can be explained by the same few rules. His mathematical analysis of gravitational force and motion showed that planetary orbits had to be the very ellipses that Kepler had proposed two generations earlier.2. Newton's system was based on the concepts of mass, force, and acceleration, his three laws of motion relating them, and a physical law stating that the force of gravity between two objects in the universe depends only upon their masses and the distance between them.3. The Newtonian model made it possible to account for such diverse phenomena as tides, the orbits of planets and moons, the motion of falling objects, and the earth's equatorial bulge.4. For several centuries, Newton's science was accepted without major changes because it explained so many different phenomena, could be used to predict many physical events (such as the appearance of Halley's comet), was mathematically sound, and had many practical applications.	

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OBJECTIVES	PAGE REFERENCES
<p>5. Although overtaken in the 20th century by Einstein’s relativity theory, Newton’s ideas persist and are widely used. Moreover, his influence has extended far beyond physics and astronomy, serving as a model for other sciences and even raising philosophical questions about free will and the organization of social systems.</p> <p style="text-align: center;">Relating Matter & Energy and Time & Space</p> <p>1. As a young man, Albert Einstein, a German scientist, formulated the special theory of relativity, which brought about revolutionary changes in human understanding of nature. A decade later, he proposed the general theory of relativity, which, along with Newton’s work ranks as one of the greatest human accomplishments in all of history.</p> <p>2. Among the surprising ideas of special relativity is that nothing can travel faster than the speed of light, which is the same for all observers no matter how they or the light source happen to be moving.</p> <p>3. The special theory of relativity is best known for stating that any form of energy has mass, and that matter itself is a form of energy. The famous relativity equation, $E=mc^2$, holds that the transformation of even a tiny amount of matter will release an enormous amount of other forms of energy, in that the c in the equation stands for the immense speed of light.</p> <p>4. General relativity theory pictures Newton’s gravitational force as a distortion of space and time.</p> <p>5. Many predictions from Einstein’s theory of relativity have been confirmed on both atomic and astronomical scales. Still, the search continues for an even more powerful theory of the architecture of the universe.</p> <p style="text-align: center;">Extending Time</p> <p>1. Scientific evidence implies that some rock near the earth’s surface is several billion years old. But until the 19th century, most people believed that the earth was created just a few thousand years ago.</p> <p>2. The idea that the earth might be vastly older than most people believed made little headway in science until the publication of Principles of Geology by an English scientist, Charles Lyell, early in the 19th century. The impact of Lyell’s book was the result of both the wealth of observations it contained on the patterns of rock layers in mountains and the locations of various kinds of fossils, and of the careful logic he used in drawing inferences from his own data.</p> <p>3. In formulating and presenting his theory of biological evolution, Charles Darwin adopted Lyell’s belief about the age of the earth and his style of buttressing his argument with vast amounts of evidence.</p>	<p>430, 457</p> <p>teacher extension of 457</p> <p>teacher extension of 457</p>

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OBJECTIVES	PAGE REFERENCES
<p style="text-align: center;">Moving the Continents</p> <ol style="list-style-type: none">1. Early in the 20th century, Alfred Wegener, a German scientist, reintroduced the idea of moving continents, adding such evidence as the underwater shapes of the continents, the similarity of plants and animals in corresponding parts of Africa and South America, and the increasing separation of Greenland and Europe. Still, very few contemporary scientists adopted his theory.2. The theory of plate tectonics was finally accepted by the scientific community in the 1960's, when further evidence had accumulated in support of it. The theory was seen to provide an explanation for a diverse array of seemingly unrelated phenomena, and there was a scientifically sound physical explanation of how such movement could occur.	<p>teacher extension of Figure 7.5 on p. 432</p> <p>teacher extension of Figure 7.5 on p. 432</p>
<p style="text-align: center;">Understanding Fire</p> <ol style="list-style-type: none">1. Lavoisier invented a whole new field of science based on a theory of materials, physical laws, and quantitative methods, with the conservation of matter at its core. He persuaded a generation of scientists that his approach accounted for the experimental results better than other chemical systems.2. Lavoisier's system for naming substances and describing their reactions contributed to the rapid growth of chemistry by enabling scientists everywhere to share their findings about chemical reactions with one another without ambiguity.3. John Dalton's modernization of the ancient Greek ideas of elements, atom, compound, and molecule strengthened the new chemistry by providing a physical explanation for reactions that could be expressed in quantitative terms.4. While the basic ideas of Lavoisier and Dalton have survived, the advancement of chemistry since their time now makes possible an explanation of the bonding that takes place between atoms during chemical reactions in terms of the inner working of atoms.	<p>teacher extension of 32-34</p> <p>teacher extension of 32-34</p> <p>teacher extension of 32-34</p> <p>teacher extension of 32-34</p>
<p style="text-align: center;">Splitting the Atom</p> <ol style="list-style-type: none">1. The Curies made radium available to researchers all over the world, increasing the study of radioactivity and leading to the realization that one kind of atom may change into another kind, and so it must be made up of smaller parts. These parts were demonstrated by other scientists to be a small, dense nucleus that contains protons and neutrons and is surrounded by a cloud of electrons.2. Ernest Rutherford of New Zealand and his colleagues discovered that the heavy radioactive element uranium spontaneously splits itself into a slightly lighter nucleus and a very light helium nucleus.	<p>teacher extension of 33</p>

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<p>3. Later, Austrian and German scientists showed that when uranium is struck by neutrons, it splits into two nearly equal parts plus one or two extra neutrons. Lisa Meitner, an Austrian physicist, was the first to point out that if these fragments added up to less mass than the original uranium nucleus, then Einstein’s special relativity theory predicted that a large amount of energy would be released. Enrico Fermi, an Italian working with colleagues in the United States, showed that the extra neutrons trigger more fusions and so to create a sustained chain reaction in which a prodigious amount of energy is given off.</p> <p>4. A massive effort went into developing the technology and building the first nuclear fission bombs used in Japan in World War II, the nuclear fusion weapons that followed, and the reactors for the controlled release of nuclear energy to produce electric power. Nuclear weapons and energy remain matters of public concern and controversy.</p> <p>5. Radioactivity has many uses other than generating energy, including in medicine, industry, and scientific research in many different fields.</p>	<p>teacher implemented</p> <p>teacher extension of 457</p>
<p>Explaining the Diversity of Life</p>	
<p>1. The scientific problem that led to the theory of natural selection was how to explain similarities within the great diversity of existing and fossil organisms.</p> <p>2. Prior to Charles Darwin, the most widespread belief was that all known species were created at the same time and remained unchanged throughout history. Some scientists at the time believed that features an individual acquired during its lifetime could be passed on to its offspring, and the species could thereby gradually change to fit its environment better.</p> <p>3. Darwin argued that only biologically inherited characteristics could be passed on to offspring. Some of these characteristics were advantageous in surviving and reproducing. The offspring would also inherit and pass on those advantages, and over the generations the aggregation of these inherited advantages would lead to a new species.</p> <p>4. The quick success of Darwin’s book <i>Origin of the Species</i>, published in the mid-1800s, came from the clear and understandable argument it made, including the comparison of natural selection to the selective breeding of animals in wide use at that time, and from the massive array of biological and fossil evidence it assembled to support the argument.</p>	<p>456</p> <p>456, 457-458</p> <p>439-440, 456-459</p> <p>teacher extension of 166 and 456</p>

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<p>5. After publication of Origin of the Species, biological evolution was supported by the rediscovery of the genetic experiments of an Austrian monk, Gregor Mendel, by the identification of genes and how they are sorted in reproduction, and by the discovery that the genetic code found in DNA is the same for almost all organisms.</p> <p>6. By the 20th century, most scientists had accepted Darwin’s basic idea. Today that still holds true, although differences exist concerning the details of the process and how rapidly evolution of the species takes place. People usually do not reject evolution for scientific reasons but because they dislike its implications, such as the relation of the human beings to other animals, or because they prefer a biblical account of creation.</p>	<p>437, 456</p> <p>teacher extension of 456-459</p>
<p>Harnessing Power</p>	
<p>1. The Industrial Revolution happened first in Great Britain because that country made practical use of science, had access by sea to world resources and markets, and had an excess of farm workers willing to become factory workers.</p> <p>2. The Industrial Revolution increased the productivity of each worker but it also increased child labor and unhealthy working conditions, and it gradually destroyed the craft tradition. The economic imbalance of the Industrial Revolution led to a growing conflict between factory owners and workers and contributed to the main political ideologies of the 20th century.</p> <p>3. The Industrial Revolution is still underway as electric, electronic, and computer technologies change patterns of work and bring them economic and social consequences.</p>	<p>teacher extension of video on world population (see p. 140)</p> <p>teacher implemented</p>
<p>COMMON THEMES</p> <p>Systems</p>	
<p>1. A system usually has some properties that are different from those of its parts, but appear because of the interaction of those parts.</p> <p>2. Understanding how things work and designing solutions to problems of almost any kind can be facilitated by systems analysis. In defining a system, it is important to specify its boundaries and subsystems, indicate its relation to other systems, and identify what its input and its output are expected to be.</p>	<p>218-247</p> <p>201-205</p>

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<p>3. The successful operation of a designed system usually involves feedback. The feedback of output from some parts of a system to input of other parts can be used to encourage what is going on in the system, discourage it, or reduce its discrepancy from some desired value. The stability of a system can be greater when it includes appropriate feedback mechanisms.</p>	200-201, 305
<p>4. Even in some very simple systems, it may not always be possible to predict accurately the result of changing some part or connection.</p>	teacher implemented
Models	
<p>1. The basic idea of mathematical modeling is to find a mathematical relationship that behaves in the same ways as the objects or processes under investigation. A mathematical model may give insight about how something really works or may fit observations very well without any intuitive meaning.</p>	166-167
<p>2. Computers have greatly improved the power and use of mathematical models by performing computations that are very long, very complicated, or repetitive. Therefore computers can show the consequences of applying complex rules or changing the rules. The graphic capabilities of computers make them useful in the design and testing of devices and structures and in the simulation of complicated processes.</p>	185
<p>3. The usefulness of a model can be tested by comparing its predictions to actual observations in the real world. But a close match does not necessarily mean that the model is the only “true” model or the only one that would work.</p>	22, 187-188, 202-205, 331-335
Constancy and Change	
<p>1. A system in equilibrium may return to the same state of equilibrium if the disturbances it experiences are small. But large disturbances may cause it to escape that equilibrium and eventually settle into some other state of equilibrium.</p>	187-188, 198-201, 211-216
<p>2. Along with the theory of atoms, the concept of the conservation of matter led to revolutionary advances in chemical science. The concept of conservation of energy is at the heart of advances in fields as diverse as the study of nuclear particles and the study of the origin of the universe.</p>	34, 88
<p>3. Things can change in detail but remain the same in general (the players change but the team remains; cells are replaced, but the organism remains). Sometimes counterbalancing changes are necessary for a thing to retain its essential constancy in the presence of changing conditions.</p>	Figure 1.29 on p. 40, Figure 3.24 on p. 167

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<p>4. Graphs and equations are useful (and often equivalent) ways for depicting and analyzing patterns of change.</p> <p>5. In many physical, biological, and social systems, changes in one direction tend to produce opposing (but somewhat delayed) influences, leading to repetitive cycles of behavior.</p> <p>6. In evolutionary change, the present arises from the materials and forms of the past, more or less gradually, and in ways that can be explained.</p> <p>7. Most systems above the molecular level involve so many parts and forces and are so sensitive to tiny differences in conditions that their precise behavior is unpredictable, even if all the rules for change are known. Predictable or not, the precise future of a system is not completely determined by its present state and circumstances but also depends on the fundamentally uncertain outcomes of events on the atomic scale.</p>	<p>49-52, 157-160, 166-167, 170, 176-178, 202-205, 308, 379, 388-389, 396, 511</p> <p>92-93, 305 Figure 3.24 on p. 167, Figure 4.2 on p. 200</p> <p>456</p> <p>teacher implemented</p>
<p style="text-align: center;">Scale</p> <p>1. Representing large numbers in terms of powers of ten makes it easier to think about them and to compare things that are greatly different.</p> <p>2. Because different properties are not affected to the same degree by changes in scale, large changes in scale typically change the way that things work in physical, biological, or social systems.</p> <p>3. As the number of parts of a system grow in size, the number of possible internal interactions increases much more rapidly, roughly with the square of the number of parts.</p>	<p>teacher extension of Figure 3.30 on p. 173</p> <p>14-16</p> <p>114</p>
<p style="text-align: center;">HABITS OF MIND Values and Attitudes</p> <p>1. Know why curiosity, honesty, openness, and skepticism are so highly regarded in science and how they are incorporated into the way science is carried out; exhibit those traits in their own lives and value them in others.</p> <p>2. View science and technology thoughtfully, being neither categorically antagonistic nor uncritically positive.</p>	<p>teacher directed</p> <p>teacher directed</p>

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Computation and Estimation	
1. Use ratios and proportions, including constant rates, in appropriate problems.	158, 230, 319, 343, 445, 454, 503
2. Find answers to problems by substituting numerical values in simple algebraic formulas and judge whether the answer is reasonable by reviewing the process and checking against typical values.	7, 158, 227, 389
3. Make up and write out simple algorithms for solving problems that take several steps.	176-178, 256
4. Use computer spreadsheet, graphing, and database programs to assist in quantitative analysis.	185, 444
5. Compare data for two groups by representing their averages and spread graphically.	115, 225-228
6. Express and compare very small and very large numbers using powers-of-ten notation.	265, 329
7. Trace the source of any large disparity between an estimate and the calculated answer.	151-152
8. Recall immediately the relations among 10, 100, 1000, 1 million, and 1 billion (knowing, for example, that 1 million is a thousand thousands).	Figure 3.30 on p. 173
9. Consider the possible effects of measurement errors on calculations.	151-152, 259
Manipulation and Observation	
1. Learn quickly the proper use of new instruments by following instructions in manuals or by taking instructions from an experienced user.	234
2. Use computers for producing tables and graphs and for making spreadsheet calculations.	185, 444
3. Troubleshoot common mechanical and electrical systems, checking for possible causes of malfunction, and decide on that basis whether to make a change or get advice from an expert before proceeding.	234
4. Use power tools safely to shape, smooth, and join wood, plastic, and soft metal.	
Communication Skills	
1. Make and interpret scale drawings.	121, 214-216

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2. Write clear, step-by-step instructions for conducting investigations, operating something, or following a procedure.	62
3. Choose appropriate summary statistics to describe group differences, always indicating the spread of the data as well as the data's central tendencies.	abstract preparations for Conferences, e.g., pp. 45-46, p. 118
4. Describe spatial relationships in geometric terms such as perpendicular, parallel, tangent, similar, congruent, and symmetrical.	teacher implemented
5. Use and correctly interpret relational terms such as if...then, and, or, sufficient, necessary, some, every, not, correlates with, and causes.	80
6. Participate in group discussions on scientific topics by restating or summarizing accurately what others have said, asking for clarification or elaboration, and expressing alternative positions.	191-193 Conferences, e.g., pp. 45-46, p. 118
7. Use tables, charts, and graphs in making arguments and claims in oral and written presentations.	132-134 Conferences, e.g., pp. 45-46, p. 118
Critical Response Skills	
1. Notice and criticize arguments based on the faulty, incomplete, or misleading use of numbers, such as in instances when (1) average results are reported, but not the amount of variation around the average, (2) a percentage or a fraction is given, but not the total sample size (as in "9 out of 10 dentists recommend..."), (3) absolute and proportional quantities are mixed (as in "3,400 more robberies in our city last year, whereas other cities had an increase of less than 1%"), or (4) results are reported with overstated precision (as in representing 13 out of 19 students as 68.42%).	Congresses and Forums, e.g. pp. 132-134, 191-193 abstract presentations for Conferences, e.g., pp. 45-46, p. 118
2. Check graphs to see that they do not misrepresent results by using inappropriate scales or by failing to specify the axes clearly.	abstract presentations for Conferences, e.g., pp. 45-46, p. 118
3. Wonder how likely it is that some event of interest might have occurred just by chance.	abstract presentations for Conferences, e.g., pp. 45-46, p. 118
4. Insist that the critical assumptions behind any line of reasoning be made explicit so that the validity of the position being taken-whether one's own or that of others-can be judged.	Congresses and Forums, e.g. pp. 132-134, 191-193 abstract presentations for Conferences, e.g., pp. 45-46, p. 118

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<p>5. Be aware when considering claims, that when people try to prove a point, they may select only the data that support it and ignore any that would contradict it.</p> <p>6. Suggest alternative ways of explaining data and criticize arguments in which data, explanations, or conclusions are represented as the only ones worth consideration, with no mention of other possibilities. Similarly, suggest alternative trade-offs in decisions and designs and criticize those in which major trade-offs are not acknowledged.</p>	<p>Congresses and Forums, e.g. pp. 132-134, 191-193 abstract presentations for Conferences, e.g., pp. 45-46, p. 118</p> <p>Congresses and Forums, e.g. pp. 132-134, 191-193 abstract presentations for Conferences, e.g., pp. 45-46, p. 118</p>