Science:
Biology
Unit 3: Matter, Energy, and Organization in Living Systems

Essential Understandings	▪ Living systems require a continuous input of energy. ▪ The energy for life is derived primarily from the sun. ▪ Chemical bonds in molecules contain energy. ▪ Organisms are designed to obtain, transform, transport, release, and eliminate the matter and energy used to sustain life. ▪ Availability of energy limits the distribution of organisms in an ecosystem. ▪ 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 recombined in different ways.
Essential Questions	▪ How do living organisms acquire energy? ▪ Where does most energy come from in living systems? ▪ Where is energy stored? ▪ How is energy and matter cycled through living systems? ▪ How does the availability of energy and matter limit an ecosystem's productivity and diversity?
Essential Knowledge	▪ All activities require energy. ▪ Energy comes primarily from the sun. ▪ Photosynthesis converts sunlight energy in chemical energy. ▪ Chemical energy stored in chemical bonds is released by respiration. ▪ Chemical energy is obtained and transported in various ways in an ecosystem. ▪ Matter and energy are recycled and recombined in the ecosystem.
Vocabulary	▪ <u>Terms</u>: ○ chemical bonds, molecule, macromolecules, enzymes, chemical reactions, photosynthesis, cellular respiration, ATP, autotroph, heterotroph, trophic levels, water, carbon, nitrogen cycles
Essential Skills	▪ Trace the energy flow through biological pyramids. ▪ Compare how organisms satisfy their nutritional needs. ▪ Trace the path of energy in a model of photosynthesis. ▪ Identify how cellular respiration releases energy from food molecules. ▪ Explain the relationship between photosynthesis and respiration.

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Related Maine Learning Results	Science B. The Skills and Traits of Scientific Inquiry and Technological Design B1. Skills and Traits of Scientific Inquiry Students methodically plan, conduct, analyze data from, and communicate results of in-depth scientific investigations, including experiments guided by a testable hypothesis. a. Identify questions, concepts, and testable hypotheses that guide scientific investigations. b. Design and safely conduct methodical scientific investigations, including experiments with controls. c. Use statistics to summarize, describe, analyze, and interpret results. d. Formulate and revise scientific investigations and models using logic and evidence. e. Use a variety of tools and technologies to improve investigations and communications. f. Recognize and analyze alternative explanations and models using scientific criteria. g. Communicate and defend scientific ideas. C. The Scientific and Technological Enterprise C1. Understandings of Inquiry Students describe key aspects of scientific investigations: that they are guided by scientific principles and knowledge, that they are performed to test ideas, and that they are communicated and defended publicly. a. Describe how hypotheses and past and present knowledge guide and influence scientific investigations. b. Describe how scientists defend their evidence and explanations using logical argument and verifiable results. D. The Physical Setting D2. Earth Students describe and analyze the biological, physical, energy, and human influences that shape and alter Earth Systems. a. Describe and analyze the effect of solar radiation, ocean currents, and atmospheric conditions on the Earth's surface and the habitability of Earth. c. Describe and analyze the effects of biological and geophysical influences on the origin and changing nature of Earth Systems. d. Describe and analyze the effects of human influences on Earth Systems.

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Related Maine Learning Results	D3.Matter and Energy Students describe the structure, behavior, and interactions of matter at the atomic level and the relationship between matter and energy. a. Describe the structure of atoms in terms of neutrons, protons, and electrons and the role of the atomic structure in determining chemical properties. b. Describe how the number and arrangement of atoms in a molecule determine a molecule's properties, including the types of bonds it makes with other molecules and its mass, and apply this to predictions about chemical reactions. c. Explain the essential roles of carbon and water in life processes. e. Describe factors that affect the rate of chemical reactions (including concentration, pressure, temperature, and the presence of molecules that encourage interaction with other molecules). f. Apply an understanding of the factors that affect the rate of chemical reaction to predictions about the rate of chemical reactions. h. Describe radioactive decay and half-life. E. The Living Environment E2.Ecosystems Students describe and analyze the interactions, cycles, and factors that affect short-term and long-term ecosystem stability and change. a. Explain why ecosystems can be reasonably stable over hundreds or thousands of years, even though populations may fluctuate. b. Describe dynamic equilibrium in ecosystems and factors that can, in the long run, lead to change in the normal pattern of cyclic fluctuations and apply that knowledge to actual situations. c. Explain the concept of carrying capacity and list factors that determine the amount of life that any environment can support. d. Describe the critical role of photosynthesis and how energy and the chemical elements that make up molecules are transformed in ecosystems and obey basic conservation laws.

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Related Maine Learning Results	E3.Cells Students describe structure and function of cells at the intracellular and molecular level including differentiation to form systems, interactions between cells and their environment, and the impact of cellular processes and changes on individuals. a. Describe the similarities and differences in the basic functions of cell membranes and of the specialized parts within cells that allow them to transport materials, capture and release energy, build proteins, dispose of waste, communicate, and move. b. Describe the relationship among DNA, protein molecules, and amino acids in carrying out the work of cells and how this is similar among all organisms. c. Describe the interactions that lead to cell growth and division (mitosis) and allow new cells to carry the same information as the original cell (meiosis). d. Describe ways in which cells can malfunction and put an organism at risk. e. Describe the role of regulation and the processes that maintain an internal environment amidst changes in the external environment. f. Describe the process of metabolism that allows a few key biomolecules to provide cells with necessary materials to perform their functions. E5.Evolution Students describe the interactions between and among species, populations, and environments that lead to natural selection and evolution. a. Describe the premise of biological evolution, citing evidence from the fossil record and evidence based on the observation of similarities within the diversity of existing organisms. b. Describe the origins of life and how the concept of natural selection provides a mechanism for evolution that can be advantageous or disadvantageous to the next generation. d. Relate structural and behavioral adaptations of an organism to its survival in the environment.
Sample Lessons and Activities	▪ Analyze photosynthetic pigments using paper chromatography ▪ Observe chloroplasts in plant cells ▪ Record the respiration rate using bromothymol blue ▪ Analyze food webs ▪ Compare and contrast the four macromolecules

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Sample Classroom Assessment Methods	▪ Quiz ▪ Chapter Test ▪ Worksheets ▪ Labs
Sample Resources	▪ Publications: o Biology - Kenneth Miller and Joseph Levine o Biology: The Dynamics of Life - Glencoe ▪ Videos: o Cycles of Life ▪ Other Materials: o Lab Supplies