Big Idea 2: Biological systems utilize free energy and molecular building blocks to grow, to reproduce and to maintain dynamic homeostasis.

LO 2.1 The student is able to explain how biological systems use free energy based on empirical data that all organisms require constant energy input to maintain organization, to grow and to reproduce. [See SP 6.2]
LO 2.2 The student is able to justify a scientific claim that free energy is required for living systems to maintain organization, to grow or to reproduce, but that multiple strategies exist in different living systems. [See SP 6.1]
LO 2.3 The student is able to predict how changes in free energy availability affect organisms, populations and ecosystems. [See SP 6.4]
LO 2.4 The student is able to use representations to pose scientific questions about what mechanisms and structural features allow organisms to capture, store and use free energy. [See SP 1.4, 3.1]
LO 2.5 The student is able to construct explanations of the mechanisms and structural features of cells that allow organisms to capture, store or use free energy. [See SP 6.2]
LO 2.6 The student is able to use calculated surface area-to-volume ratios to predict which cell(s) might eliminate wastes or procure nutrients faster by diffusion. [See SP 2.2]
LO 2.7 Students will be able to explain how cell size and shape affect the overall rate of nutrient intake and the rate of waste elimination. [See SP 6.2]
LO 2.8 The student is able to justify the selection of data regarding the types of molecules that an animal, plant or bacterium will take up as necessary building blocks and excrete as waste products. [See SP 4.1]
LO 2.9 The student is able to represent graphically or model quantitatively the exchange of molecules between an organism and its environment, and the subsequent use of these molecules to build new molecules that facilitate dynamic homeostasis, growth and reproduction. [See SP 1.1, 1.4]
LO 2.10 The student is able to use representations and models to pose scientific questions about the properties of cell membranes and selective permeability based on molecular structure. [See SP 1.4, 3.1]
LO 2.11 The student is able to construct models that connect the movement of molecules across membranes with membrane structure and function. [See SP 1.1, 7.1, 7.2]
LO 2.12 The student is able to use representations and models to analyze situations or solve problems qualitatively and quantitatively to investigate whether dynamic homeostasis is maintained by the active movement of molecules across membranes. [See SP 1.4]
LO 2.13 The student is able to explain how internal membranes and organelles contribute to cell functions. [See SP 6.2]
LO 2.14 The student is able to use representations and models to describe differences in prokaryotic and eukaryotic cells. [See SP 1.4]
LO 2.15 The student can justify a claim made about the effect(s) on a biological system at the molecular, physiological or organismal level when given a scenario in which one or more components within a negative regulatory system is altered. [See SP 6.1]
LO 2.16 The student is able to connect how organisms use negative feedback to maintain their internal environments. [See SP 7.2]
LO 2.17 The student is able to evaluate data that show the effect(s) of changes in concentrations of key molecules on negative feedback mechanisms. [See SP 5.3]
LO 2.18 The student can make predictions about how organisms use negative feedback mechanisms to maintain their internal environments. [See SP 6.4]
LO 2.19 The student is able to make predictions about how positive feedback mechanisms amplify activities and processes in organisms based on scientific theories and models. [See SP 6.4]
LO 2.20 The student is able to justify that positive feedback mechanisms amplify responses in organisms. [See SP 6.1]

LO 2.21 The student is able to justify the selection of the kind of data needed to answer scientific questions about the relevant mechanism that organisms use to respond to changes in their external environment. [See SP 4.1]
LO 2.22 The student is able to refine scientific models and questions about the effect of complex biotic and abiotic interactions on all biological systems, from cells and organisms to populations, communities and ecosystems. [See SP 1.3, 3.2]
LO 2.23 The student is able to design a plan for collecting data to show that all biological systems (cells, organisms, populations, communities and ecosystems) are affected by complex biotic and abiotic interactions. [See SP 4.2, 7.2]
LO 2.24 The student is able to analyze data to identify possible patterns and relationships between a biotic or abiotic factor and a biological system (cells, organisms, populations, communities or ecosystems). [See SP 5.1]
LO 2.25 The student can construct explanations based on scientific evidence that homeostatic mechanisms reflect continuity due to common ancestry and/or divergence due to adaptation in different environments. [See SP 6.2]
LO 2.26 The student is able to analyze data to identify phylogenetic patterns or relationships, showing that homeostatic mechanisms reflect both continuity due to common ancestry and change due to evolution in different environments. [See SP 5.1]
LO 2.27 The student is able to connect differences in the environment with the evolution of homeostatic mechanisms. [See SP 7.1]
LO 2.28 The student is able to use representations or models to analyze quantitatively and qualitatively the effects of disruptions to dynamic homeostasis in biological systems. [See SP 1.4]
LO 2.29 The student can create representations and models to describe immune responses. [See SP 1.1, 1.2]
LO 2.30 The student can create representations or models to describe nonspecific immune defenses in plants and animals.[See SP 1.1, 1.2]
LO 2.31 The student can connect concepts in and across domains to show that timing and coordination of specific events are necessary for normal development in an organism and that these events are regulated by multiple mechanisms. [See SP 7.2]
LO 2.32 The student is able to use a graph or diagram to analyze situations or solve problems (quantitatively or qualitatively) that involve timing and coordination of events necessary for normal development in an organism. [See SP 1.4]
LO 2.33 The student is able to justify scientific claims with scientific evidence to show that timing and coordination of several events are necessary for normal development in an organism and that these events are regulated by multiple mechanisms. [See SP 6.1]
LO 2.34 The student is able to describe the role of programmed cell death in development and differentiation, the reuse of molecules, and the maintenance of dynamic homeostasis. [See SP 7.1]
LO 2.35 The student is able to design a plan for collecting data to support the scientific claim that the timing and coordination of physiological events involve regulation. [See SP 4.2]
LO 2.36 The student is able to justify scientific claims with evidence to show how timing and coordination of physiological events involve regulation. [See SP 6.1]
LO 2.37 The student is able to connect concepts that describe mechanisms that regulate the timing and coordination of physiological events. [See SP 7.2]
LO 2.38 The student is able to analyze data to support the claim that responses to information and communication of information affect natural selection. [See SP 5.1]
LO 2.39 The student is able to justify scientific claims, using evidence, to describe how timing and coordination of behavioral events in organisms are regulated by several mechanisms. [See SP 6.1]
LO 2.40 The student is able to connect concepts in and across domain(s) to predict how environmental

factors affect responses to information and change behavior. [See SP 7.2]