02 Cell Specialization, Homeostasis & Metabolism

Content Area: **Science**
Course(s): **Biology CP**
Time Period: **Semester 1**
Length: **14 weeks**
Status: **Published**

Standards

ESS3.C	Human Impacts on Earth Systems
	Constructing Explanations and Designing Solutions
LS1.A	Structure and Function
HS-LS1-2	Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
HS-LS1-3	Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.
	Planning and Carrying Out Investigations
	Stability and Change
HS-LS1-4	Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.
LS1.B	Growth and Development of Organisms
HS-LS1-5	Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.
HS-LS1-7	Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.
	Developing and Using Models
LS1.C	Organization for Matter and Energy Flow in Organisms
	Energy and Matter
HS-LS2-3	Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.
HS-LS2-5	Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.
LS2.B	Cycles of Matter and Energy Transfer in Ecosystems
HS-ESS3-6	Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity (i.e., climate change).
ESS3.D	Global Climate Change

Enduring Understandings

1. Systems of specialized cells within organisms help them perform the essential functions of life, which involve chemical reactions that take place between different types of molecules, such as water, proteins, carbohydrates, lipids, and nucleic acids

2. Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level.

3. Feedback mechanisms maintain a living system's internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range. Outside that range (e.g., at a too high or too low external temperature, with too little food or water available), the organism cannot survive. Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system.

4. The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen. The sugar molecules thus formed contain carbon, hydrogen, and oxygen; their hydrocarbon backbones are used to make amino acids and other carbon-based molecules that can be assembled into larger molecules (such as proteins or DNA), used for example to form new cells.

5. As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products. As a result of these chemical reactions, energy is transferred from one system of interacting molecules to another. For example, aerobic (in the presence of oxygen) cellular respiration is a chemical process in which the bonds of food molecules and oxygen molecules are broken and new compounds are formed that can transport energy to muscles. Anaerobic (without oxygen) cellular respiration follows a different and less efficient chemical pathway to provide energy in cells.

6. Cellular respiration also releases the energy needed to maintain body temperature despite ongoing energy loss to the surrounding environment. Matter and energy are conserved in each change. This is true of all biological systems, from individual cells to ecosystems.

7. The carbon we burn for energy (coal, oil, gas) releases stored carbon into the atmosphere much faster than plants and oceans can absorb it. This traps excess heat, raising global temperatures, increasing ocean acidification, with resulting impacts on sea organism health and marine populations

Essential Questions

1. How do the structures of organisms enable life's functions and how do structural components vary between different types of organisms?

2. How do the distinct, microscopic components of a living organism interact to sustain the macroscopic functions of the whole system?
3. How and why do organisms interact with their environment and what are the effects of these interactions?

4. How do organisms respond to changing environmental conditions such as water availability and concentration, temperature, and sunlight?

5. Why are most feedback mechanisms negative and how does this relate to the idea of homeostasis?

6. How do organisms obtain and use the matter and energy they need to live and grow?

7. How do plants capture and transform light energy into the chemical building blocks that sustain almost all life on Earth?

8. How do organisms extract and transfer energy from food molecules through aerobic and anaerobic chemical pathways?
9. How do the processes of photosynthesis and respiration relate to biogeochemical cycling of carbon, oxygen, and water?
10. How do human activities disrupt the balance of carbon in earth's spheres, and what are the consequences for Earth's climate systems and the biosphere?

Knowledge and Skills

Knowledge:

1. Students will know that multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level. (DCI LS1.A Structure and Function)

2. Students will know that feedback mechanisms maintain a living system's internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range. Feedback mechanisms can encourage (through positive feedback) what is going on inside the living system. (DCI LS1.A Structure and Function)

3. Students will know that the process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugar plus released oxygen. (DCI LS1.C Organization for Matter and Energy Flow in Organisms)

4. Students will know that as matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products. (DCI LS1.C Organization for Matter and Energy Flow in Organisms)

5. Students will know that as a result of these chemical reactions, energy is transferred from one system of interacting molecules to another. Cellular respiration is a chemical process in which the bonds of food molecules and oxygen molecules are broken and new compounds are formed that can transport energy to muscles. Cellular respiration also releases the energy needed to maintain body temperature despite ongoing energy transfer to the surrounding environment. (DCI LS1.C Organization for Matter and Energy Flow in Organism)

6. Students will know that photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes. (DCI LS2.B Cycles of Matter and Energy in Ecosystems)

7. Students will know that photosynthesis and cellular respiration are important components of the carbon cycle, in which carbon is exchanged among the biosphere, atmosphere, oceans, and geosphere through chemical, physical, geological, and biological processes. (DCI LS2.B Cycles of Matter and Energy in Ecosystems)

8. Students will know that the main way that solar energy is captured and stored on Earth is through the complex chemical process known as photosynthesis. (DCI LS3.D Energy in Chemical Processes)

9. Students will know that human activity impacts the natural cycling of carbon through biotic and abiotic systems, altering global climates and ecosystems. (DCI ESS3.C Human Impacts on Earth's Systems)

Skills :

1. Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
2. Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.
3. Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.
4. Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.
5. Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.
6. Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.
7. Compare the natural cycling of carbon among the different spheres of the earth to changes in the cycling of carbon as a result of human activity..
8. Analyze data comparing changes in atmospheric carbon dioxide over time and construct an explanation of how humans have contributed to the changes seen in atmospheric carbon dioxide concentrations.

Resources

Core Resources:

Modern Biology by Holt, Rinehart & Winston

Supplemental Resources:

Unit 2: Cell Specialization & Homeostasis

- Cell Processes investigation of structure and function
- Fluid Mosaic model
- Tylenol Cyanide murders
- Osmosis and Homeostasis in Fish

- Cells under the microscope
- dialysis tube osmosis and diffusion
- red onion cell osmosis
- Orbies red blood cell lab
- stomata lab
- leaf disk lab
- exercise lab
- anaerobic respiration lab

Assessments

https://docs.google.com/document/d/1wR7bQF-8AQoRrt0g4C3hKja0yjwDjC9_BiAmONWbTcI/edit?usp=sharing

Modifications

https://docs.google.com/document/d/1ODqaPP69YkcFiyG72fIT8XsUIe3K1VSG7nxuc4CpCec/edit?usp=sharing