# 02 Cell Specialization and Homeostasis

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

## Standards

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| SCI.HS.LS1.A | Structure and Function |
| SCI.HS.LS1.B | Growth and Development of Organisms |
| SCI.HS.LS1.C | Organization for Matter and Energy Flow in Organisms |
| SCI.HS.LS2.B | Cycles of Matter and Energy Transfer in Ecosystems |
| SCI.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. |
| SCI.HS-LS1-4 | Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms. |
| SCI.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. |
| SCI.HS-LS1-2 | Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms. |
| SCI.HS-LS1-3 | Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis. |
| SCI.HS-LS1-5 | Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy. |
| SCI.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. |
| | Constructing Explanations and Designing Solutions |
| | Developing and Using Models |
| | Planning and Carrying Out Investigations |
| | Stability and Change |
| | Energy and Matter |

## 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. In multicellular organisms individual cells grow and then divide via a process called mitosis, thereby allowing the organism to grow. The organism begins as a single cell (fertilized egg) that divides successively to produce many cells, with each parent cell passing identical genetic material (two variants of each chromosome pair) to both daughter cells.

8. As successive subdivisions of an embryo's cells occur, programmed genetic instructions and small differences in their immediate environments activate or inactivate different genes, which cause the cells to develop differently—a process called differentiation.

9. In complex animals, the brain is divided into several distinct regions and circuits, each of which primarily serves dedicated functions, such as visual perception, auditory perception, interpretation of perceptual information, guidance of motor movement, and decision making about actions to take in the event of certain inputs. In addition, some circuits give rise to emotions and memories that motivate organisms to seek rewards, avoid punishments, develop fears, or form attachments to members of their own species and, in some cases, to individuals of other species (e.g., mixed herds of mammals, mixed flocks of birds). The integrated functioning of all parts of the brain is important for successful interpretation of inputs and generation of behaviors in response to them.

## Essential Questions

1. How do the structures of organisms enable life's functions?

2. How do organisms live, grow, respond to their environment, and reproduce?

3. How do organisms grow and develop?

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

5. How do organisms detect, process, and use information about the environment?

6. How and why do organisms interact with their environment and what are the effects of these interactions?

7. How do organisms interact with the living and nonliving environments to obtain matter and energy?

8. How do the processes of photosynthesis and respiration relate to biogeochemical cycling of carbon, oxygen, and water?

9. How do organisms detect, process, and use information about the environment?

10. Why are most feedback mechanisms negative?

11. How is genetic variation introduced in sexual reproduction?

## 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 in multicellular organisms individual cells grow and then divide via a process called mitosis, thereby allowing the organism to grow. The organism begins as a single cell (fertilized egg) that diodes successively to produce many cells, with each parent cell passing identical genetic material (two variants of each chromosome pair)to both daughter cells. Cellular division and differentiation produce and maintain a complex organism, composed of systems of tissues and organs that work together to meet the needs of the whole organism. (DCI LS1.B Growth and Development of Organisms).

4. 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)

5. 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)

6. 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)

7. 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)

8. 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)

9. 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)

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 the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.

4. Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.

5. 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.

6. Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.

7. Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.

## Assessments

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

## Modifications

https://docs.google.com/document/d/1ODqaPP69YkcFiyG72flT8XsUIe3K1VSG7nxuc4CpCec/edit?usp=sharing