Lesson guide: Healthy Cells, Healthy Bodies

Overview

The following presentation is intended as an introductory lesson to basic cell biology, exploring the core concept of "what is a cell" within the context of the human body. Students will additionally be introduced to the concept of cell health and how this contributes to overall human health. Links to resources for further independent student exploration are included at the end. The lesson should take no more than a single class period, or approximately 45 minutes, to complete.

Grade level

Grade 6-8

Existing student knowledge

Before starting this lesson, students should already have a basic understsanding of:

- What is a cell
- What are organelles
- What is a microscope
- What the term "protein" refers to within the context of cell biology
- A basic understanding of the central dogma of cell biology (DNA > RNA > protein) is helpful, but not required

Students do not already need an understanding of many topics covered in this lesson, including:

- What is a fluorescent protein, and how they are utilized in the context of cell imaging
- How cell health relates to human health; specifically, why the ability to visualize and observe cell structures and organelles is helpful for the study of human health and biology
- Morphological and behavioral differences between healthy and unhealthy stem cells
- That there are different types of microscopes, and that some microscopes can detect fluorescence

Learning objectives

- Students will be able to make connections between human bodies and human cells.
  - Human bodies have organs, while human cells have organelles.
    - If time or grade level permit, it could be interesting to delve more into specific organelles. This presentation includes only a general introduction to the concept of organelles and does not explore any organelles specifically.
  - Since our bodies are made up of cells, our cells need to be healthy for us to be healthy: healthy cells, healthy bodies.
    - Some cellular mutations can lead to greater human disease. Students will learn about examples of human diseases caused by cellular mutations.
- Students will be able to describe how healthy cells look and behave in the lab.
- Students will be able to describe how unhealthy cells look and behave in the lab.
- Students will know where to go to find more information about cell biology.

Equipment

- Computer and projector
- Internet access is only required to download the lesson materials, not during the presentation

Contents

Standards alignment

Next Generation Science Standards

Science and Engineering Practices	
Asking questions and defining problems	X
Developing and using models	
Planning and carrying out investigations	
Analyzing and interpreting data	
Using mathematics and computational thinking	
Constructing explanations and designing solutions	
Engaging in argument from evidence	
Obtaining, evaluating, and communicating information	X

Crosscutting concepts	
Patterns	
Cause and effect	
Scale, proportion, and quantity	X
Systems and system models	
Energy and matter	
Structure and function	X
Stability and change	

Next Generation Science Standards (continued)

Disciplinary Core Ideas - Life Science	
MS-LS1 From Molecules to Organisms: Structures and Processes	X
MS-LS1-1: Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells.	X
MS-LS1-2: Develop and use a model to describe the function of a cell as a whole and ways the parts of cells contribute to the function.	X
MS-LS1-3: Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.	X
MS-LS2: Ecosystems	
MS-LS3 Hereditary: Inheritance and Variation of Traits	X
MS-LS3-1: Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism.	X
MS-LS4: Evolution	

Teacher guide

The Allen Institute is a nonprofit biomedical research institute located in Seattle, Washington. Our four divisions – Allen Institute for Brain Science, Allen Institute for Cell Science, Allen Institute for Immunology, and The Paul G. Allen Frontiers Group – are dedicated to answering some of the biggest questions in bioscience and accelerating research worldwide.

We share all of our data and research findings with the scientific community and general public. The Allen Institute was launched in 2003 by founder Paul G. Allen as the Allen Institute for Brain Science; the Allen Institute for Cell Science launched in 2014. The Allen Institute is supported by government, foundation, and private funds to enable its projects. The Allen Institute for Cell Science creates large-scale, open datasets that address fundamental questions about the states and functions of the human cell. These datasets and advanced data analysis tools are publicly available at allencell.org.

Key cell biology concepts underlying this lesson:

- What is a cell
- What are organelles
- How are human cells related to human health
- Existence of gene editing
- Function of microscopy in cell biology

Slide deck notes:

- **A note for slide 10:** The essential message here is that your body is made of cells, your cells contain structures and organelles, and those structures and organelles are made of proteins. By attaching fluorescent tags to specific proteins, we can utilize specialized microscopes to better visualize a corresponding structure in the cell. This technique of "tagging" is used for research, not therapeutics.
- **A note for slides 19 – 28:** Slides 19 – 23 focus on healthy v. unhealthy cell morphology, while slides 24 – 28 emphasize differences in healthy v. unhealthy cell behavior.

Expected time for lesson:

45 minutes (1 class period)

Note on open research questions and applications for resources:

Additional articles about recent discoveries, the process of research, and more are available at the Allen Institute for Cell Science website (alleninstitute.org/what-we-do/cell-science) and may be of interest for students to pursue further reading.

Core to the mission of the Allen Institute is our open sharing of data worldwide, and thousands of scientists use our resources in their research every day. Notable projects where other research teams have used these resources have included:

- **Cell Shorts: A new window into heart cells (alleninstitute.org/what-we-do/cell-science/news-press/articles/cell-shorts-new-window-heart-cells)** shows research on cells from the Allen Cell Collection that have been differentiated into heart cells, and how the gene tagging technology enables new discoveries into heart function.
- **Cell Shorts: Illuminating the kidney (alleninstitute.org/what-we-do/cell-science/news-press/articles/cell-shorts-illuminating-kidney)** shows research on cells from the Allen Cell Collection that have been differentiated into kidneys, and research that may lead to regenerative therapies for kidney disorders.

Teachers who use this curriculum or other Allen Institute Educator Resources (alleninstitute.org/about/education-outreach) in their classrooms, or who have students who pursue advanced independent projects, are welcome to share their experiences with us.