**Lesson Plan Template**

**Grade/Subject: Biology (Life Science)**  **Date:** **CT’s Initials: \_\_\_\_\_\_**

**Number of Students:** **School:**

**Check One**: **Day “Before”** \_\_\_\_\_ **Day “Of”** \_\_\_\_\_ **Day “After”** \_\_\_\_\_

|  |
| --- |
| **Title: PBL Lesson: the Immortal Cells of Henrietta Lacks** |
| **Lesson Goals** |
| **Central Focus:** High School Biology I  Life Science: Structure and Function/Growth and Development  **Standards:** BIO1.LS1.1, BIO1.LS1.3, BIO1.LS1.1.UC, BIO1.LS1.6, BIO1.LS1.6: UC  **Objectives (**From TN lesson plan-See other lesson plans included below for lower-level instruction in Middle school**)**  The content module supports educators’ planning and implementation of instructional units in science by:   Developing an understanding of the concepts and vocabulary that interconnect with information in the module units.   Learning instructional strategies that support teaching students the concepts, knowledge, and skills related to the module units.   Discovering ways to transfer and generalize the content, knowledge, and skills to future school, community, and work environments.  The module provides an overview of the science concepts, content, and vocabulary related to High School Biology I  Life Science: Structure and Function/Growth and Development and provides suggested teaching strategies and ways to support transference and generalization of the concepts, knowledge, and skills. The module does not include lesson plans and is not a comprehensive instructional unit. Rather, the module provides information for educators to use when developing instructional units and lesson plans.  The module organizes the information using the following sections:  I. Tennessee Academic Standards for Science and Related Knowledge and Skills Statements and Underlying Concepts;  II. Scientific Inquiry and Engineering Design;  III. Crosscutting Concepts;  IV. Vocabulary and Background Knowledge information, including ideas to teach vocabulary;  V. Overview of Units’ Content;  VI. Universal Design for Learning (UDL) Suggestions;  VII. Transference and Generalization of Concepts, Knowledge, and Skills; and  VIII. Tactile Maps and Graphics. |
| **Knowledge of Students** |
| **Prior Academic Learning and Prerequisite Skills:** See TN lesson plan Section 1-Page 4.  **Personal/Cultural/Community Assets:**  **Key ideas in The Immortal Life Of Henrietta Lacks**  **Introduction**   1. **Henrietta Lacks was a poor black American woman who died of an extremely aggressive form of cancer.** 2. **Although Henrietta Lacks succumbed to her illness, her cells – named “HeLa” – survived and thrived.** 3. **To help combat diseases like polio and cancer, scientists created a factory for producing HeLa cells.** 4. **Although her cells spread across the globe, Henrietta and her family were largely forgotten.** 5. **After Henrietta’s death, her family struggled to survive.** 6. **Black Americans have a long history of being wary of the medical profession.** 7. **Although HeLa cells helped many scientific discoveries, their prevalence threatened much research.** 8. **The search to learn more about HeLa brought scientists to the Lacks family.** 9. **The HeLa case is not the only one that involved concerns about privacy in cell donation.** 10. **To whom do my cells belong: The right to cells vs. the right to medical research.** |
| **Supporting Students’ Learning** |
| **Planned Supports:**  **Preconceptions, Common Errors, and Misconceptions:**  Race issues  Ethical issues  Safety issues |
| **Lesson Considerations** |
| **Grouping Strategies:**  See lessons on Cells and Cytology and HIIM Lessons on Health Literacy  **Differentiation:**   * **Modifications:**   See the lessons and links attached below. Students in lower levels may only need discussion topics as this is not a science standard required at their level.   * **Accommodations:**   See the lessons and links attached below |
| **Lesson Plan Details:** |
| **Materials:**   * **Needed by Teacher:** (see specific lesson for teacher needs) * Select a YouTube Video overview of Henrietta Lacks history. * Select a YouTube Video overview of Henrietta Lacks’ family winning cases. * Slides/YouTube of cells, preferably cancer cells * **Needed by Students:**   Pens, Paper, Notebooks  **Lesson Introduction “Before”:** Scenario I: “Who do cells belong to”?  **Learning Activities “During”: (1)** Cells and Cell make-up (2) AMA Code Of Ethics (see link below)  **Closure “After”:**  **Extension Activity:** History of scientific contributions by minorities (see links below) |
| **Evidence of Student Learning:** |
| **Formative Assessment:** See the lessons and links attached below. Determine your lesson and add an assessment. Consider using Rubric to create an assessment.(see PBL works <https://www.pblworks.org/download-project-based-learning-rubrics> )   * **Objective(s) Being Assessed:** * **Feedback:** * **Modifications/Accommodations:** * **Evidence of Student Understanding:**   **Summative Assessment:**   * **Objective(s) Being Assessed:** * **Feedback:** * **Modifications/Accommodations:** * **Evidence of Student Understanding** |
| **Supporting Literacy Development:** |
| **Language Function:**  **Learning Task:**  **Language Demands:**   * **Vocabulary/Key Phrases:** * **Syntax** * **Discourse**   **Language Supports:** |
| **Sources:**  **Research/Theory Addressed:** |
| **NOTE: Attach any Relevant handouts, activities, templates, PPT slides, etc. that are referenced and utilized in this lesson.** |

Scenario I: “Who do cells belong to”?

You are a Researcher at Johns Hopkins University. Your department just received some samples, and you checked them into the lab. Later that night you were listening to some people talk and heard the following story:

A person smiling in front of a brick wall

Description automatically generated

In January of 1951, Henrietta went to The Johns Hopkins Hospital after finding a lump in her cervix. A sample of the mass was taken and a few days later, she was diagnosed with stage 1 cervical cancer. The following month, Henrietta had her first radiation therapy treatment. The Hopkins Cancer Lab Scientist took samples of the cervical tissue without obtaining her consent (the U.S. health system did not yet have established practices for doing so). Hopkins Scientist Dr. George Gey sent them to a lab to see if they could be grown in culture, as was routine for women with cervical cancer being treated at the hospital. After a brief stay at Johns Hopkins, Henrietta was discharged and she returned home to continue to care for her family. During the next six months, she received radiation treatment.

However, her health eventually deteriorated. Henrietta Lacks was admitted to The Johns Hopkins Hospital in August of 1951. Her tumor had spread, as the cancer was unresponsive to radiation treatment. Treatment ended and her health continued to decline. Henrietta was given medication to ease her pain, and tragically, at the age of only 31, she passed away on Oct. 4, 1951.

(available at <https://ictr.johnshopkins.edu/community-engagement/programs/henrietta-lacks-memorial-lecture/mrs-henrietta-lacks/> )

Scenario II: What are “Ethics”?

A person smiling in front of a brick wall

Description automatically generated

You are a long-retired since retired scientist. One day you hear the news story on your television.

The family of Henrietta Lacks settled a lawsuit against the biotech company Thermo Fisher Scientific in August of 2023. The settlement reached after daylong negotiations at federal court in Baltimore stems from the family's allegations about the use of Lacks' cells following her death without her permission, which were used -- and still are used -- for medical research.

But not all of Henrietta Lacks died on October 4, 1951. She unknowingly left behind a piece of her that still lives today and will outlive us all. Henrietta is the human behind the HeLa cells, the first immortal cell line. HeLa cells have been mass produced, they traveled into space, they were used to help develop the polio vaccine, mapping and even COVID-19 vaccines They made possible many other landmark scientific discoveries in genetics and the treatment of disease. Henrietta Lacks has been described many ways: as a heroine of modern medicine, a medical miracle and a wonder woman, to name a few. But to her family, she was a daughter, wife and mother, and friend to the world.

The family claimed unjust enrichment by Thermo Fisher Scientific Inc., a company that used Lacks' cell line to make products and profits. The terms of the agreement are confidential but are expected to open the door to more lawsuits.

# [Blinkest 10 facts](https://www.blinkist.com/en/books/the-immortal-life-of-henrietta-lacks-en?utm_source=gsn&utm_medium=paid&utm_campaign=15405570131&utm_content=150207638862&utm_term=__678851231954_c_dsa-2156381857642_EAIaIQobChMIvNKLj9KkhgMVOaNaBR1AOAIdEAEYAiAAEgIWKvD_BwE&gad_source=2&gclid=EAIaIQobChMIvNKLj9KkhgMVOaNaBR1AOAIdEAEYAiAAEgIWKvD_BwE)

**Key ideas in The Immortal Life Of Henrietta Lacks**

**Introduction**

1. **Henrietta Lacks was a poor black American woman who died of an extremely aggressive form of cancer.**
2. **Although Henrietta Lacks succumbed to her illness, her cells – named “HeLa” – survived and thrived.**
3. **To help combat diseases like polio and cancer, scientists created a factory for producing HeLa cells.**
4. **Although her cells spread across the globe, Henrietta and her family were largely forgotten.**
5. **After Henrietta’s death, her family struggled to survive.**
6. **Black Americans have a long history of being wary of the medical profession.**
7. **Although HeLa cells helped many scientific discoveries, their prevalence threatened much research.**
8. **The search to learn more about HeLa brought scientists to the Lacks family.**
9. **The HeLa case is not the only one that involved concerns about privacy in cell donation.**
10. **To whom do my cells belong: The right to cells vs. the right to medical research.**

AMA Code Of Medical Ethics

<https://code-medical-ethics.ama-assn.org/ethics-opinions/commercial-use-human-biological-materials>

**Lessons (Small Sample)**

Immortal Cells (Lesson Plan) | Sanford PROMISE (Use as your guide to set-up your PBL)

<https://ket.pbslearningmedia.org/resource/immortal-cells-lesson-plan/sanford-promise/>

Teaching Notes for Alternative Narratives for Henrietta Lacks and HeLa HeLa Cells & HPV Genes: Immortality & Cancer Module

<http://www.stemcellcurriculum.org/assets/modules/module_1/activities/HeLa-Learning-Activity-1-Alt-Narratives-Teaching-Notes-8_8_17.pdf>

Cancer and HeLAa cells

<https://www.teachengineering.org/content/cub_/lessons/cub_cells/cub_cells_lesson03_hela_extension_handout.pdf>

Activity 3.3.3 The Immortal Cells

<https://www.claytonschools.net/site/handlers/filedownload.ashx?moduleinstanceid=20606&dataid=39067&FileName=3.3.3.A%20ImmortalCellsF.pdf>

Genome Unlocking

<https://www.unlockinglifescode.org/resource/henrietta-lacks-lesson-plans>

Teacher Institute of Philadelphia

<https://theteachersinstitute.org/curriculum_unit/henrietta-lacks-hela-cells-and-health-inequities-making-student-research-relevant-and-authentic/>

ELA Curriculum Example--The Immortal Life of Henrietta Lacks:

<https://www.sabes.org/content/ela-curriculum-example-immortal-life-henrietta-lacks-introduction-jim-crow-and-great>

**Articles (Small Samples)**

HeLa Cells: A Lasting Contribution to Biomedical Research

<https://osp.od.nih.gov/hela-cells/>

What are the differences between HeLa cells and cancer cells?

<https://www.aatbio.com/resources/faq-frequently-asked-questions/what-are-the-differences-between-hela-cells-and-cancer-cells?adwords=1&gad_source=2&gclid=EAIaIQobChMIvNKLj9KkhgMVOaNaBR1AOAIdEAAYASABEgJHIfD_BwE>

HELA100: The Henrietta Lacks Initiative

<https://hela100.org/herstory>

The Johns Hopkins Institute for Clinical and Translational Research

<https://ictr.johnshopkins.edu/community-engagement/programs/henrietta-lacks-memorial-lecture/mrs-henrietta-lacks/>

Expedia: Hopkins Cancer Lab Head, Dr. George Gey

<https://en.wikipedia.org/wiki/George_Otto_Gey>

The Henrietta Lacks case-Legal aspects

<https://www.science.org/content/article/what-does-historic-settlement-won-henrietta-lacks-s-family-mean-others#:~:text=Last%20week%2C%20the%20family%20of,its%20use%20of%20her%20cells>.

***The Immortal Life of Henrietta Lacks*** (2010) is a [non-fiction](https://en.wikipedia.org/wiki/Non-fiction) book by American author [Rebecca Skloot](https://en.wikipedia.org/wiki/Rebecca_Skloot). It was the 2011 winner of the [National Academies Communication Award](https://en.wikipedia.org/wiki/National_Academies_Communication_Award) for best creative work that helps the public understanding of topics in science, engineering or medicine.

**YouTube links (Small Sample)**

BBC: Immortal Cells of Henrietta Lacks

<https://www.youtube.com/watch?v=pgB1IqGp8BE>

Scripps News: Thermo Fischer Settlement

<https://www.youtube.com/watch?v=WLkqDOWeZWE>

NIH SETTLEMENT-HeLA cells

<https://www.youtube.com/watch?v=y38pgPY6Zq0>

**Henrietta Lacks (1920-1951)**  
*MSA SC 3520-16887*

**Sources:**

**Newspaper articles (in chronological order):**

"Hopkins Cancer Lab Head, Dr. George Gey, Dies At 71," *Baltimore Sun*, November 9, 1970.

Randal, Judith. "Baltimore tumor creeps up on cancer research." *Baltimore Sun*, September 9, 1980.

Gold, Michael. "The cells that would not die." *Baltimore Sun*, March 29, 1981.

Jacques, Kelly. "Her cells made her immortal; Research: A Turners Station woman donated cells that revolutionized medicial science; nearly 46 years later, her family is seeking recognition." *Baltimore Sun*, March 18, 1997.

Ewell, Christian. "Cancer victim's contribution 'immortal': Family receives plaque honoring her for cells that aided research." *Baltimore Sun*, September 14, 1997.

Rosten, Eric. "She changed medicine, but her family can't afford care." *Washington Post*, January 31, 2010.

Brewington, Kelly. "RIGHTS TO TISSUE A MATTER OF DEBATE: CELLS FROM WOMAN IN '50S MADE ADVANCES POSSIBLE." *Baltimore Sun*, February 18, 2010.

Moorhead, Joanna. "Henrietta Lacks: the mother of modern medicine." *The Guardian*, June 23, 2010. Accessed June 24, 2014. <http://www.theguardian.com/science/2010/jun/23/henrietta-lacks-cells-medical-advances>.

Fears, Darryl. "'Unsung hero of modern medicine' hailed." *Washington Post*, September 26, 2010.

Wenger, Yvonne. "A day honoring Henrietta Lacks: Turners Station pays tribute to woman whose cells were used for medical discoveries." *Baltimore Sun*, August 5, 2012.

"German lab apologizes for publishing the genome of 'immortal' woman's cell line." *Washington Post*, April 2, 2013.

Caplan, Arthur, Ph.D. "NIH finally makes good with Henrietta Lacks' family--and it's about time, ethicist says." *NBC News*, August 7, 2013. Accessed June 24, 2014. <http://www.nbcnews.com/health/health-news/nih-finally-makes-good-henrietta-lacks-family-its-about-time-f6C10867941>.

Curtis, Mary C. "Family of Henrietta Lacks gains some control over her cells and perhaps some peace." *Washington Post*, August 8, 2013.

Walker, Andrea K. "Lacks' kin finally get say in use of her cells: After decades, NIH accord requires permission to use her genome in research." *Baltimore Sun*, August 8, 2013.

"An immortal contribution: Our view: Henrietta Lacks and her family have received some overdue recognition for the Baltimore County woman's role in advancing medical science." *Baltimore Sun*, August 9, 2013.

"The legacy of Henrietta Lacks." *Washington Post*, August 19, 2013.

**Other Sources:**

Curtis, Adam. "The Way of All Flesh." Available on YouTube: <https://www.youtube.com/watch?v=C0lMrp_ySg8>.  
  
Ehrlich, Jr., Robert L. "In Memory of Henrietta Lacks" (June 4, 1997). Congressional Record Volume 143, Number 75. <https://beta.congress.gov/congressional-record/1997/06/04/extensions-of-remarks-section/article/E1109-1>.  
  
Jha, Alok and Rebecca Skloot. "*The 'immortal' Henrietta Lacks--Science Weekly*." Podcast audio, The Guardian: Science Weekly. Accessed June 25, 2014. <http://www.theguardian.com/science/blog/audio/2010/jun/21/science-weekly-podcast-henrietta-lacks-rebecca-skloot?commentpage=1>.  
  
Warner, Margaret. Interview with Dr. Francis Collins. *PBS Newshour*, PBS, August 8, 2013. <http://video.pbs.org/video/2365060560/>.

[Return to Henrietta Lacks' Introductory Page](https://msa.maryland.gov/msa/speccol/sc3500/sc3520/016800/016887/html/msa16887.html)

**HISTORY OF CONTRIBUTIONS BY MINORITIES:** Google search will provide numerous articles and YouTube videos on contributions by minorities. Below is a starting point:

# Hispanic scientists throughout history (Careful this link has pop-ups)

<https://www.biotechniques.com/opinion/hispanic-scientists-throughout-history/>

# **List of Mexican inventions and discoveries**

<https://en.wikipedia.org/wiki/List_of_Mexican_inventions_and_discoveries>

# **8 Groundbreaking Contributions by Asian Americans Through History**

<https://www.history.com/news/asian-american-inventions-contributions>

# **Promotion of Asian American Pioneers & History**

# <https://www.aasforum.org/promotion-of-asian-american-pioneers-history/>

# **The Contributions of Asian Americans in U.S. Science and Engineering (not student-friendly, but provides teachers a lesson on technology theft)**

<https://www.youtube.com/watch?v=xbFrHo0K8aU>

# **Highlighting Black Scientists from Past to Present**

<https://gladstone.org/news/highlighting-black-scientists-past-present>

# **Learn More About these 38 Scientists for Black History Month**

<https://www.sciencebuddies.org/blog/black-history-month-scientists>

**LESSON PLANS:**

**State of Tennessee**

Tennessee Science Module 10

High School Biology I  Life Science: Structure and Function/Growth and Development

## Module Goal

The goal of this module is to provide information that will help educators increase their knowledge of grade-appropriate science concepts, knowledge, and skills to support effective planning or modification of their existing science instructional units for students with significant cognitive disabilities. The module includes important concepts, knowledge, and skills for the following instruction:

* Structure and Function (High school)—All living organisms are made of cells and can be characterized by common aspects of their structure and functioning. Living things have characteristics (e.g., maintain internal environment through homeostasis, respond to changes in the environment, reproduce and pass genetic information to their offspring). Viruses appear to share some of these characteristics. However, viruses are considered to be nonliving because viruses are not cells, do not respond to the environment, and do not use energy to grow and develop. The cells of all living organisms contain genetic information in the form of DNA. DNA molecules contain the genetic information that controls inherited traits. Genes are sections of DNA that contain instructions to code for the formation of proteins that control inherited traits. When new cells are formed, DNA replicates, forming two identical daughter cells.
* Growth and Development (High school)—In multicellular organisms, cell division is an essential component of growth, development, and repair. Cell division occurs via a process called mitosis. When a cell divides in two, it passes identical genetic material to two daughter cells. Successive divisions produce many cells. The process is repeated as new cells are needed to replace old cells or to support growth of the organism.

### Module Objectives

The content module supports educators’ planning and implementation of instructional units in science by:

* Developing an understanding of the concepts and vocabulary that interconnect with information in the module units.
* Learning instructional strategies that support teaching students the concepts, knowledge, and skills related to the module units.
* Discovering ways to transfer and generalize the content, knowledge, and skills to future school, community, and work environments.

The module provides an overview of the science concepts, content, and vocabulary related to High School Biology I  Life Science: Structure and Function/Growth and Development and provides suggested teaching strategies and ways to support transference and generalization of the concepts, knowledge, and skills. The module does not include lesson plans and is not a comprehensive instructional unit. Rather, the module provides information for educators to use when developing instructional units and lesson plans.

The module organizes the information using the following sections:

1. Tennessee Academic Standards for Science and Related Knowledge and Skills Statements and Underlying Concepts;
2. Scientific Inquiry and Engineering Design;
3. Crosscutting Concepts;
4. Vocabulary and Background Knowledge information, including ideas to teach vocabulary;
5. Overview of Units’ Content;
6. Universal Design for Learning (UDL) Suggestions;
7. Transference and Generalization of Concepts, Knowledge, and Skills; and
8. Tactile Maps and Graphics.

# Section I

## Tennessee Academic Standards for Science and Related Knowledge and Skills Statements and Underlying Concepts

It is important to know the expectations for each unit when planning for instruction. The first step in the planning process is to become familiar with the identified academic standards and the Knowledge and Skills Statements (KSSs) and Underlying Concepts (UCs) covered in the module. The KSSs are specific statements of knowledge and skills linked to the grade-specific science academic standards. The UCs are entry-level knowledge and skills that build toward a more complex understanding of the knowledge and skills represented in the KSSs and should not be taught in isolation. It is important to provide instruction on the KSSs along with the UCs to move toward acquisition of the same knowledge and skills.

[Table 1](#_bookmark0) includes the academic standards and related KSSs and UCs for High School Biology I  Life Science: Structure and Function/Growth and Development. While only the academic standards targeted for the Tennessee Comprehensive Assessment Program/Alternate (TCAP/Alt) are included, instruction on additional standards will aid in student understanding. Standards that are not included still represent important content for students to master. Therefore, the KSSs and UCs included in the table do not cover all the concepts that can be taught to support progress and understanding aligned to the standards.

#### Table 1. Tennessee Academic Standards for Science and Related KSSs and UCs 1

|  |  |  |
| --- | --- | --- |
| **Academic Standard** | **Knowledge and Skill Statement (KSS)** | **Underlying Concept (UC) of the Academic Standard** |
| **Structure and Function (High School)** | | |
| **BIO1.LS1.1:** Compare and contrast existing models, identify patterns, and use structural and functional evidence to analyze the characteristics of life. Engage in argument about the designation of viruses as non- living based on these characteristics. | **BIO1.LS1.1.a:** Ability to identify characteristics of living things (i.e., respond to environmental stimuli, actively maintain internal environment through homeostasis, and transfer genetic information to their offspring)  **BIO1.LS1.1.b:** Ability to identify characteristics of a virus which cause it to be considered a nonliving particle (e.g., does not use energy to grow; does not respond to the environment; cannot make food, take in food, or produce wastes; and cannot replicate its own DNA) | **BIO1.LS1.1.UC:** Recognize that organisms that grow and reproduce are living things. |
| **BIO1.LS1.3:** Integrate evidence to develop a structural model of a DNA molecule. Using the model, develop and communicate an explanation for how DNA serves as a template for self-replication | **BIO1.LS1.3.a:** Ability to recognize that genetic information in chromosomes is contained in molecules of DNA  **BIO1.LS1.3.b:** Ability to use a model to demonstrate that when DNA replicates, it results in two identical strands of DNA that are exact copies of the original | **BIO1.LS1.3.UC:**  Understand that inherited traits of individuals are controlled by genes (i.e., sections of DNA). |

|  |  |  |
| --- | --- | --- |
| and encodes biological information. | **BIO1.LS1.3.c:** Ability to recognize that sections of DNA code for the production of proteins that control inherited traits |  |
| **Growth and Development (High School)** | | |
| **BIO1.LS1.6:** Create a model for the major events of the eukaryotic cell cycle, including mitosis. Compare and contrast the rates of cell division in various eukaryotic cell types in multi-cellular organisms. | **BIO1.LS1.6.a:** Ability to identify mitosis as the type of cell division where one cell divides to produce two new identical cells  **BIO1.LS1.6.b:** Ability to identify the cell cycle as a regular sequence of growth and division which cells undergo  **BIO1.LS1.6.c:** Ability to recognize that the time it takes different cells to complete one cell cycle is different depending on the cell type | **BIO1.LS1.6.UC:**  Understand that the human body is constantly replacing old cells with new ones. |

1 Instruction is not intended to be limited to the concepts, knowledge, and skills represented by the KSSs and UCs listed in [Table 1.](#_bookmark0)

# Section II

## Scientific Inquiry and Engineering Design

It is important for students with significant cognitive disabilities to have the opportunity to explore the world around them and learn to problem solve during science instruction. This approach to science instruction does not involve rote memorization of facts; instead it involves scientific inquiry. A Framework for K-12 Science Education (2012) unpacks scientific inquiry, providing eight practices for learning science and engineering in grades K–12. These practices provide students an opportunity to learn science in a meaningful manner. Students should combine the science and engineering practices as appropriate to conduct scientific investigations instead of using a practice in isolation or sequentially moving through each practice. Support should be provided as necessary for students with significant cognitive disabilities to actively use the practices. A link to *Safety in the Elementary Science Classroom* is in the resources of this section. See [Section VI.](#_bookmark6) Universal Design for Learning Suggestions for support ideas. Following are the eight science and engineering practices (National Research Council, 2012) with added examples.

* Asking questions (for science) and defining problems (for engineering).

*Examples: How are characteristics from one generation related to the previous generation? How do the structures of organisms enable life’s functions? Why aren’t all elephants the same size? Farmers want to spray an herbicide on their crops to kill weeds, but not the crops. Can the DNA of the plant be altered to make it herbicide-resistant? How is society influenced by science and technology (e.g., the bioethics and economics of genetically modified foods)?*

* Developing and using models.

*Examples: Use a model based on evidence to illustrate the role of cellular division (mitosis). Evaluate the merits and limitations of two different models of the process of mitosis. Use a model based on evidence to illustrate the relationships between DNA, genes, and proteins in controlling inherited traits. Students might demonstrate that all cells in an organism have the same genetic content by using paper models, manipulatives, or computer simulations to simulate DNA replication.*

* Planning and carrying out investigations.

*Examples: Collaboratively plan and conduct an investigation to produce data to serve as the basis for evidence that a plant is living. Conduct an investigation to observe the process of cell multiplication (i.e., mitosis) using garlic or onion roots. Investigate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.*

* Analyzing and interpreting data.

*Examples: Interpret data collected on viruses to determine if they are living or nonliving. Use data to illustrate the multiplication of cells.* Analyze data in m*odels that show the number of cells at different stages of development.*

* Using mathematics and computational thinking.

*Example: Data could be collected from observing the different stages of mitosis using a microscope or virtual or computer simulations. Graphs and functions could be used to show growth rate in terms of cell division. Interpret data related to homeostasis (e.g., the concentration of sugar in an animal’s blood three hours after being fed a strong sugar solution).*

* Constructing explanations (for science) and designing solutions (for engineering).

*Examples: Make a qualitative claim about the relationship between a person’s internal processes and external environmental factors. Construct and revise an explanation of how the human body continually replaces old cells with new ones. Support explanations about the relationship between*

*the role of DNA and chromosomes in coding instructions for characteristic traits passed from parents to offspring. Create a situation in which a character is under a stressful situation. Develop solutions or activities to reduce the character’s stress and a plan to monitor successes and setbacks.*

* Engaging in argument from evidence.

*Examples: Make and defend a claim based on evidence of how feedback mechanisms allow an animal to remain alive even as external conditions change within some range. Use reasoning to explain why the ability of organisms to reproduce offspring is the best characteristic to distinguish living things from nonliving matter on a cellular basis. Evaluate the evidence behind currently accepted explanations that genes are regions in DNA that contain instructions that code for the formation of proteins.*

* Obtaining, evaluating, and communicating information.

*Examples: Critically read scientific text adapted for classroom use to determine central ideas of homeostasis and summarize the process in simpler, but accurate terms. Compare information from different sources regarding the status of viruses as living or nonliving and present the evidence for both. Communicate scientific information about the effectiveness of modifying the DNA of organisms in order to prevent a problem such as cystic fibrosis.*

### Science Practices Resources2

* Safety in the Elementary Science Classroom provides safety information for teachers and students. [https://www.acs.org/content/dam/acsorg/about/governance/committees/chemicalsafety/safetypr](https://www.acs.org/content/dam/acsorg/about/governance/committees/chemicalsafety/safetypractices/safety-in-the-elementary-school-science-classroom.pdf) [actices/safety-in-the-elementary-school-science-classroom.pdf](https://www.acs.org/content/dam/acsorg/about/governance/committees/chemicalsafety/safetypractices/safety-in-the-elementary-school-science-classroom.pdf)
* This site categorizes inquiry into three types: structured inquiry, guided inquiry, and open inquiry. <http://www.justsciencenow.com/inquiry/>
* Education.com provides a variety of life science activities and experiments. <http://www.education.com/activity/life-science/>

# Section III

## Crosscutting Concepts

Grade-level science content includes Crosscutting Concepts, which are concepts that connect information between different science strands and grade levels. The Crosscutting Concepts are intended to work together with the science inquiry and engineering practices, in addition to core content, to enable students to reason with evidence, make sense of phenomena, and design solutions to problems. Helping students make connections between these types of concepts and new content information supports comprehension of the concepts, knowledge, and skills as well as transference and generalization (see [Section VII](#_bookmark10) for more information). Crosscutting Concepts that are specific to this module connect to content across the units within the module as well as across modules.

Crosscutting Concepts are a common link between multiple standards and units of study. The Crosscutting Concepts, by being revisited and linked to multiple units of study, become a strong foundation of understanding and support the students in learning new concepts. Life sciences focus on patterns, processes, and relationships of living organisms. For example, understanding patterns of change is a Crosscutting Concept that applies to similarities in the traits of a parent and the traits of an offspring, the relationships between DNA and inherited traits, and the patterns of interactions that occur between organisms and their environments. Some Crosscutting Concepts may apply across multiple content areas and instructional emphases (e.g., cause and effect in reading science texts). The Crosscutting Concepts of stability and change provide a framework for understanding how our bodies maintain an internal environment when the external environment changes.

This content module, High School Biology I  Life Science: Structure and Function/Growth and Development, addresses characteristics of living things, how genetic information is controlled and passed to offspring, and the process of cell division.

### Teaching Crosscutting Concepts

The following strategies pulled from the principles of UDL (CAST, 2011) are ways in which to teach Crosscutting Concepts to help students understand the concepts and make connections between different curricular content. During instruction, highlight:

* patterns (e.g., point out patterns in the shape of a graph or repeating pattern on a chart),
* critical features (e.g., provide explicit cues or prompts, such as highlighting, that help students to attend to important features),
* big ideas (e.g., present and reinforce the “big ideas” that students should take and apply to the students’ lives.), and
* relationships (e.g., make the connection between the unit concepts and how they apply to the students’ lives).

Following are **Crosscutting Concepts** for this Content Module— High School Biology I  Life Science: Structure and Function/Growth and Development. According to *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas* (2012), these concepts help provide students with an organizational framework for connecting knowledge from the various disciplines into a coherent and scientifically based view of the world.

#### Patterns

##### Patterns

* Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena (e.g., base pair of DNA).
* Classifications or explanations used at one scale may fail or need revision when information from smaller or larger scales is introduced, thus requiring improved investigations and experiments (e.g., classification based on DNA comparisons versus those based on visible characteristics).
* Patterns of interactions of organisms with their environments, both living and nonliving, may be observed.

### Causality

##### Cause and Effect

* Empirical evidence is required to differentiate between cause and correlation and to make claims about specific causes and effects (e.g., Genes correlate with diseases such as diabetes but do not cause them.).
* Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system (e.g., understand how feedback mechanisms maintain a living system’s internal conditions).

##### Structure and Function

* Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal the systems’ or structures’ function and/or solve a problem. (e.g., Identifying the characteristics of living things helps in determining life in other organisms or materials. Studying DNA is vital to understanding its function and finding ways to prevent diseases.).

#### Systems

##### Systems and System Models

* Models (e.g., physical, mathematical, computer) can be used to simulate systems and—including energy, matter, and information flows—within and between systems at different scales (e.g., computer models showing the sequence of cell division).

##### Stability and Change

* Feedback (negative or positive) can stabilize or destabilize a system (e.g., maintaining internal environment through homeostasis. Genetic programs modified over generations result in a different trait that helps an animal survive better in its environment).

### Crosscutting Concept Resources

* Grant Wiggins talks about “big ideas” in this article. <http://www.authenticeducation.org/ae_bigideas/article.lasso?artid=99>
* A Framework for K-12 Science Education, Appendix G explains the crosscutting concepts and how the concepts help students deepen their understanding of the information. [http://www.nextgenscience.org/sites/default/files/Appendix%20G%20-](http://www.nextgenscience.org/sites/default/files/Appendix%20G%20-%20Crosscutting%20Concepts%20FINAL%20edited%204.10.13.pdf)

[%20Crosscutting%20Concepts%20FINAL%20edited%204.10.13.pdf](http://www.nextgenscience.org/sites/default/files/Appendix%20G%20-%20Crosscutting%20Concepts%20FINAL%20edited%204.10.13.pdf)

* Teacher Vision provides ten science graphic organizers that are free and printable. <https://www.teachervision.com/graphic-organizers/science/52539.html>
* Utah Education Network provides a variety of student interactives for grades seven through twelve. <http://www.uen.org/7-12interactives/science.shtml>

# Section IV

## Vocabulary and Background Knowledge

Vocabulary is critical to building an understanding of science concepts, knowledge, and skills. The vocabulary words that students gain through experiences provide ways for students to comprehend new information (Sprenger, 2013). Students can better understand new vocabulary when they have some background knowledge to which they can make connections. In addition, learning new vocabulary increases students’ background knowledge. Therefore, it is important to teach vocabulary purposely when introducing new concepts, knowledge, or skills (e.g., living things) and in the context of the specific content (e.g., Teach the terms “grow,” “reproduce,” and “homeostasis” while students determine if something is living or nonliving.).

This module includes two types of vocabulary words, both equally important to teach. The first type, **general vocabulary words**, labels groups of words that generalize to a variety of animals, plants, organisms, and activities. For example, understanding the meaning of the word “model” helps students to connect to models in life science, physical science, and Earth and space science. The second type, **specific content words**, represents groups of words that are associated with an organism, system, process, or phenomena. For example, the specific word “DNA” connects to the general words “characteristics,” “traits,” and “division” when learning about how living things grow and reproduce.

Providing exposure and instruction on general words provides background knowledge when introducing corresponding or related specific words.

### Key Vocabulary for Instructional Units

[Table 2](#_bookmark1) and [Table 3](#_bookmark2) contain lists of key general vocabulary words and specific content words that are important to the units in this module. Teach general vocabulary words to the student using a student- friendly description of the word meaning (e.g., Organisms inherit alleles from their parents. That is why most organisms look a little like both parents.) and an example of the word (e.g., One human trait that is controlled by a gene with multiple alleles is blood type.). Teach the specific content vocabulary using a student-friendly description of the word meaning (e.g., Mitosis is a type of cell division where the cell divides into two identical cells.) and a possible connection to a general vocabulary word (e.g., Mitosis helps organisms grow.).

Do not teach memorization of vocabulary words; instead, place emphasis on understanding the word as a result of observation, investigation, viewing a model, etc. For example, a student should learn to identify characteristics of inherited traits instead of giving a formal definition.

**Table 2. General Vocabulary Words**

|  |  |  |
| --- | --- | --- |
| **General Vocabulary**—words that generalize to different animals, plants, organisms, and activities.  Describe the word and provide examples (e.g., Stimuli cause something to happen. *Example: Exercise and heat are stimuli that makes you sweat.).* | | |
| * cell | * food | * organism |
| * characteristics | * grow/growth | * reproduce |
| * copies | * identical | * response |
| * develop/development | * inherited | * stimuli |
| * divide | * internal | * strand |
| * division | * living | * traits |
| * energy | * model | * virus |
| * environment/environmental | * nonliving | * waste |
| * external | * offspring |  |

**Table 3. Specific Content Words**

|  |  |  |
| --- | --- | --- |
| **Specific Content Words**—words that specify a particular thing (e.g., sedimentary rock) or phenomena (e.g., biodiversity).  Describe the word and when possible make the connection to a Crosscutting Concept (e.g., A cell cycle is when a cell divides to make two new cells. The cell cycle is a cause and effect relationship showing how mechanisms within a system affect the more complex system.). | | |
| * abiotic | * daughter cell | * mitosis |
| * allele | * DNA | * natural selection |
| * biotic | * gene | * proteins |
| * cell cycle | * genetic information | * replication |
| * chromosome | * genetic variation/mutation | * sex cells |
| * cytoplasm | * homeostasis |  |

### Ideas to Support Vocabulary Learning

[Table 4](#_bookmark3) includes ideas and examples for teaching vocabulary in ways to build conceptual understanding of the words. The examples include ideas on how to provide individualization, indicated in brackets, for unique student needs. These individualization ideas are provided to guide educators in ways to create access to vocabulary instruction for individual students.

#### Table 4. Ideas to Teach Vocabulary Effectively (Marzano, 2004)1

|  |  |
| --- | --- |
| **Ideas** | **Examples** |
| Explain, describe, and/or give examples of the vocabulary word rather than formal definitions. | * Provide a description and an example of a characteristic, “A characteristic is a distinctive feature of a person or thing. Red hair is one characteristic she has that is different from her brother.” |
| Have students restate the vocabulary word in their own words. Take this opportunity to help students connect new vocabulary, especially general vocabulary, to prior knowledge. | * Have students state in their own words or give an example of “offspring.” Help students make connections that they are offspring of their parents. |
| Have students represent vocabulary words in a variety of ways (e.g., pictures, symbols, graphic organizers, or models). | Have students create a “fake” social media post which describes a vocabulary term using an online site (e.g., <https://www.classtools.net/>) or create a paper version (see [Figure 1](#_bookmark5)   * [Figure 1](#_bookmark4)). [Individualization idea: Provide students with phrases and short sentences to choose from to create their post.] * Have students sort pictures of organisms or objects into categories: living or nonliving, reproduce or do not reproduce, grow or do not grow, etc. |
| Provide multiple exposure to vocabulary words in a variety of ways. This does not suggest mass trials, but rather distributed trials in different ways or contexts. Reference [http://projectlearnet.org/tutorials/learning\_trial](http://projectlearnet.org/tutorials/learning_trials.html) [s.html](http://projectlearnet.org/tutorials/learning_trials.html) for information on learning trials. | * Read books or watch videos related to the vocabulary and concepts. (e.g., mitosis: [https://www.youtube.com/watch?v=f-](https://www.youtube.com/watch?v=f-ldPgEfAHI).%20) [ldPgEfAHI).](https://www.youtube.com/watch?v=f-ldPgEfAHI).%20) * Have students access online texts about mitosis (e.g., [http://www.biology4kids.com/files/cell2\_mit](http://www.biology4kids.com/files/cell2_mitosis.html) [osis.html](http://www.biology4kids.com/files/cell2_mitosis.html)). [Individualization idea: Have students use a screen reader to access the text.] * Create a word wall with vocabulary terms and pair with images. |
| Ask students to discuss the vocabulary words with each other. | * Have students share a favorite word and explain why. [Individualization idea: Place a description of a few vocabulary words on a voice output device and have the student choose which one to share with a classmate using an adapted switch.] * Have students share their representations (e.g., drawings or pictures) of a vocabulary word with each other. |

|  |  |
| --- | --- |
| **Ideas** | **Examples** |
| Play vocabulary word games with students. | * Present groups of four words. In each group include three words that relate to each other and one that does not (e.g., offspring, trait, characteristic, rotate). Have students pick the one that does not belong. |
| Have students watch a dramatization or have them act out the vocabulary term. | * Have students solve a mystery by using clues to determine if something is living or nonliving (e.g., [https://www.uen.org](https://www.uen.org/lessonplan/view/28279)   [/lessonplan/view/28279](https://www.uen.org/lessonplan/view/28279)).   * Have students use or observe hand movements to show the mitosis (e.g., [https://www.youtube.com/watch?v=5Xlg\_A](https://www.youtube.com/watch?v=5Xlg_AMyHWo) [MyHWo](https://www.youtube.com/watch?v=5Xlg_AMyHWo) or [https://www.youtube.com/](https://www.youtube.com/watch?v=khoYx5BgT18) [watch?v=khoYx5BgT18](https://www.youtube.com/watch?v=khoYx5BgT18)). |

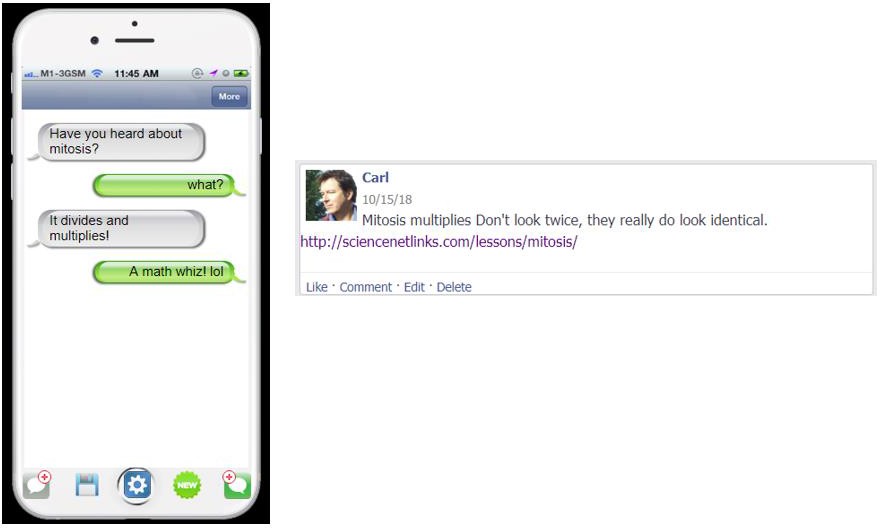
1 Refer to [Section VI, Universal Design for Learning (UDL) Suggestions](#_bookmark6) for additional instructional strategies.

### Vocabulary Example

Have students create a social media post which describes a vocabulary term using an online site (e.g., <https://www.classtools.net/>) or create a paper version (see [Figure 1](#_bookmark5)). [Individualization idea: Provide students with phrases and short sentences to choose from for the post.] Two National Center and State Collaborative (NCSC) resources are available and may prove helpful:

* Use systematic instruction as described in the NCSC Instructional Guide. [https://wiki.ncscpartners.org](https://wiki.ncscpartners.org/)
* Reference ideas in the NCSC Vocabulary and Acquisition Content Module. [https://wiki.ncscpartners.org](https://wiki.ncscpartners.org/)

**Figure 1. Example Social Media Vocabulary Activities**



### Vocabulary Resources

* Vocabulary.com provides explanations of words using real-world examples. Once signed in, an educator can create word lists for students. <http://www.vocabulary.com/>
* TextProject provides Word Pictures that are free for educators to use. The site includes word pictures for core vocabulary and various content areas including science and social studies. This link will take you to the Word Pictures page where you can select the category of words you want to use. <http://textproject.org/classroom-materials/textproject-word-pictures/>
* The Science Penguin site provides ideas to teach science vocabulary. The vocabulary demonstration activity uses real objects to teach vocabulary terms. <http://thesciencepenguin.com/2013/12/science-solutions-vocabulary.html>

# Section V

## Overview of Units’ Content

This section of the module contains additional content and references to support educators’ understanding and instruction of the instructional units. The information reflects important content to address the KSSs and to build students’ knowledge, skills, and abilities; however, it is not exhaustive and should be expanded upon as appropriate.

### Structure and Function

#### Content

* Characteristics of living things include:
  + made of one or many cells,
  + maintain internal environment through homeostasis,
  + use energy (metabolism),
  + grow and develop,
  + respond to changes in the environment,
  + feedback mechanisms maintain internal conditions within certain limits,
  + eliminate waste, and
  + reproduce and pass genetic information to their offspring.
* Viruses are nonliving particles and cannot:
  + use energy to grow,
  + respond to the environment,
  + make food,
  + take in food,
  + produce waste, or
  + replicate their own DNA.
* All cells contain genetic information in the form of DNA molecules.
* Traits are distinguishing features or characteristics each person has.
* Inherited traits of individuals are controlled by genes.
* Genes are specific segments of DNA.
* The gene segment of DNA contains instructions that tell the cell how to make a particular protein.
* Proteins specify inherited traits.
* Proteins carry out most of the work of cells.
* Changes (mutations) to genes can result in changes to proteins, which can affect the structures and functions of the organism and thereby change traits.
* DNA replication occurs when a double-stranded DNA molecule is copied to make two identical DNA molecules.
* The two identical DNA molecules are exact copies of the original.
* Models can demonstrate DNA replication.

### Growth and Development

#### Content

* Cells make up all living organisms.
* All cells in an organism have the same genetic content.
* The human body is constantly replacing old cells with new ones.
* The regular sequence of growth and division that cells undergo is known as the cell cycle.
* The cell cycle is a regular sequence of growth and division the cells undergo:
  + The cell grows to its mature size, makes a copy of its DNA, and prepares to divide into two cells.
  + One copy of the DNA is distributed into each of the two daughter cells.
  + The cytoplasm divides, distributing the organelles into each of the two new cells.
* Each daughter cell repeats the process, creating more cells.
* Cells pass identical genetic material in the form of homologous chromosome pairs to both daughter cells.
* Mitosis is a type of cell division in which one cell’s nucleus divides to produce two new identical cells.
* Mitosis is mostly used for growth and to replace old cells.
* In multicellular organisms, individual cells grow and then divide via a process called mitosis, thereby allowing the organism to grow.
* The cell type determines how long it takes for a cell to complete one cell cycle.
* Models can be used to illustrate cell division and multiplication (e.g., pipe cleaners to represent the position of chromosomes at different stages of mitosis).

### Unit Content Resources

* Interactive Sites for Education provides a wide variety of topics that include interactive animations. <http://interactivesites.weebly.com/science.html>

#### Characteristics of Living Things

* This site has information on the characteristics of life. <http://spot.pcc.edu/~jvolpe/b/bi112/lec/examples/112examplesCh1_Ch3.htm>
* This site includes a lesson plan on characteristics of living things. [http://annex.exploratorium.edu/imaging\_station/activities/classroom/characteristics/ca\_characteri](http://annex.exploratorium.edu/imaging_station/activities/classroom/characteristics/ca_characteristics.php) [stics.php](http://annex.exploratorium.edu/imaging_station/activities/classroom/characteristics/ca_characteristics.php)
* This site has information on characteristics of living things including pictures and videos. <https://kidsbiology.com/biology-basics/living-things/>
* Science Learning Hub has information and an activity on characteristics of living and nonliving thing. <https://www.sciencelearn.org.nz/resources/14-characteristics-of-living-things>
* Khan Academy provides information on signs of life and viruses. <https://www.khanacademy.org/test-prep/mcat/cells/viruses/a/are-viruses-dead-or-alive>

#### DNA

* Scientific American has an article on how traits are passed on through DNA. <https://www.scientificamerican.com/article/how-are-traits-passed-on/>
* Scitable has information on DNA replicating. [https://www.nature.com/scitable/topicpage/cells-can-](https://www.nature.com/scitable/topicpage/cells-can-replicate-their-dna-precisely-6524830) [replicate-their-dna-precisely-6524830](https://www.nature.com/scitable/topicpage/cells-can-replicate-their-dna-precisely-6524830)
* This site has animations and other materials about DNA and genes. <https://geneed.nlm.nih.gov/topic_subtopic.php?tid=15>
* Ducksters has information on DNA and genes. <https://www.ducksters.com/science/biology/dna.php>
* Science NetLinks has a lesson plan on DNA and genetics. [http://sciencenetlinks.com/lessons/cell-](http://sciencenetlinks.com/lessons/cell-dna/) [dna/](http://sciencenetlinks.com/lessons/cell-dna/)
* Owlcation has information on DNA for kids. [https://owlcation.com/academia/explaining-dna-to-a-](https://owlcation.com/academia/explaining-dna-to-a-six-year-old) [six-year-old](https://owlcation.com/academia/explaining-dna-to-a-six-year-old)
* This site has multiple links related to basic genetics. <https://learn.genetics.utah.edu/content/basics/>

#### Cell Cycle (Mitosis)

* This site provides information on cell growth and division, including images, a time-lapse video, and models. <https://askabiologist.asu.edu/content/cell-division>
* This site provides the big idea of mitosis. [https://www.reference.com/science/mitosis-occur-](https://www.reference.com/science/mitosis-occur-4d6fe937748de4ca?qo=contentSimilarQuestions) [4d6fe937748de4ca?qo=contentSimilarQuestions](https://www.reference.com/science/mitosis-occur-4d6fe937748de4ca?qo=contentSimilarQuestions)
* This site provides information on mitosis. <http://www.yourgenome.org/facts/what-is-mitosis>
* Science-Class has a variety of resources for teaching cell division. [http://science-](http://science-class.net/archive/science-class/Biology/Cell_Division.htm) [class.net/archive/science-class/Biology/Cell\_Division.htm](http://science-class.net/archive/science-class/Biology/Cell_Division.htm)
* Khan Academy provides information on cell cycles and mitosis. [https://www.khanacademy.org/science/biology/cellular-molecular-biology/mitosis/a/cell-cycle-](https://www.khanacademy.org/science/biology/cellular-molecular-biology/mitosis/a/cell-cycle-phases) [phases](https://www.khanacademy.org/science/biology/cellular-molecular-biology/mitosis/a/cell-cycle-phases)
* This site has a lesson plan on teaching mitosis. <https://www.biologycorner.com/2009/09/27/teaching-mitosis/>
* This site has a mini lesson on mitosis. <http://www.indiana.edu/~ensiweb/lessons/gen.mm.html>
* CPALMS has a lesson plan on mitosis. <http://www.cpalms.org/Public/PreviewResourceLesson/Preview/75954>
* This site has a lesson plan on cell division. <https://www.ngsslifescience.com/science.php?/biology/lessonplans/C396/>

# Section VI

## Universal Design for Learning (UDL) Suggestions

Three principles of the UDL—multiple means of representation, multiple means of action and expression, and multiple means of engagement—guide development of instruction, instructional materials, and assessments to provide access to learning to the widest range of students. A well- designed lesson using the principles of UDL reduces the need to make accommodations and modifications. However, some students with significant cognitive disabilities, especially students with visual and/or hearing impairments, physical disabilities, and students with complex communication needs, may require additional scaffolds, adaptations, and modifications to access content and support learning. UDL’s three guiding principles guide educators in creating instructional materials and activities in a flexible manner to address the needs of different types of learners. Utilizing the three principles of UDL as a framework when designing instruction allows for individualization when needed. [Table 5](#_bookmark7) provides strategies and examples for the UDL Principle I, **Multiple Means of Representation**: presenting information in a variety of ways to address the needs of different types of learners. [Table 6](#_bookmark8) provides strategies and examples for the UDL Principle II, **Multiple Means of Action and Expression**: providing a variety of ways for students to interact with the instructional materials and to demonstrate understanding. [Table 7](#_bookmark9) provides strategies and examples for the UDL Principle III, **Multiple Means of Engagement**: providing a variety of ways to engage and motivate students to learn.

The strategies and examples provided in Tables 5 through 7 are based on UDL principles and can assist all students in understanding the basic concepts. The strategies and examples, as well as individualization ideas, should serve as a catalyst for ideas that can be individualized to meet the needs of each student. Some of the examples include activities that work exceptionally well for students with vision, hearing, and/or physical limitations as well as for all students. Each example has a code to indicate when it includes specific ideas or activities that meet these needs:

**V** = visually impaired (low vision, blind, or deaf-blind)

**H** = hearing impaired (deaf, hard of hearing, or deaf-blind)

**P** = physical disability (limited use of hands)

**Table 5. Instructional strategy ideas using the UDL Principle: Multiple Means of Representation**

|  |  |
| --- | --- |
| **Multiple Means of Representation** | |
| **Strategies** | **Examples** |
| Introduce information through a multi-sensory approach (e.g., auditory, visual, tactile). | Involve the students in extracting DNA from food (e.g., <https://learn.genetics.utah.edu/content/labs/extraction/howto/>). [Individualization idea: Provide students with a model of measurements (e.g., line drawing of a measuring cup with an arrow pointing to ½-cup mark). Have students use an adapted switch to operate the blender.] **P**  Listen to a podcast on viruses being nonliving things (e.g., [https://medium.com/the-philipendium/is-a-virus-a-living-creature-](https://medium.com/the-philipendium/is-a-virus-a-living-creature-8664a9496ece) [8664a9496ece](https://medium.com/the-philipendium/is-a-virus-a-living-creature-8664a9496ece)). [Individualization idea: Preview the podcast and give students key words, phrases, or concepts to listen for during the podcast. Ask students questions after listening to the podcast and share key ideas (e.g., viruses are nonliving because . . .).]  Share a video on proteins (e.g., <https://learn.genetics.utah.edu/content/basics/proteins/>). Share an animation of mitosis (e.g., [http://www.johnkyrk.com](http://www.johnkyrk.com/mitosis.html)  [/mitosis.html](http://www.johnkyrk.com/mitosis.html)).  Involve students in creating and exploring a tactile model of mitosis (e.g., [http://www.perkinselearning.org/accessible-](http://www.perkinselearning.org/accessible-science/activities/mitosis-student-built-model) [science/activities/mitosis-student-built-model](http://www.perkinselearning.org/accessible-science/activities/mitosis-student-built-model)). |
| Model content through pictures, dramatization, videos, etc. | Show videos on:   * characteristics of living things (e.g., <https://www.youtube.com/watch?v=30qOijVBS7o> or <https://www.youtube.com/watch?v=cQPVXrV0GNA>), * DNA (e.g., <https://www.youtube.com/watch?v=IN8pKyQz2RQ>) and * DNA replication (e.g., <https://www.youtube.com/watch/?v=5qSrmeiWsuc>). [Individualization idea: Sign a summary of the video before watching, sign the narration while watching, and sign the key concepts after watching the video.] **H**   Create a DNA model (e.g., [https://www.wikihow.com/Make-a-Model-](https://www.wikihow.com/Make-a-Model-of-DNA-Using-Common-Materials) [of-DNA-Using-Common-Materials](https://www.wikihow.com/Make-a-Model-of-DNA-Using-Common-Materials)). [Individualization idea: Use jumbo pipe cleaners and larger beads. **P** Use four different textured beads to differentiate the nitrogen bases found in DNA. **V**] |
| Present information using graphic organizers and models. | Use a KWHL to help students make connections between what they already **K**now, **W**hat they want to know, **H**ow they can find out, and finally, what they **L**earn. (Here’s a slide show explaining the use of the KWHL chart and how it was made accessible for students with significant cognitive disabilities: [https://nceo.umn.edu/docs/Tele](https://nceo.umn.edu/docs/Teleconferences/tele14/CourtadeFlowers.pdf) [conferences/tele14/CourtadeFlowers.pdf](https://nceo.umn.edu/docs/Teleconferences/tele14/CourtadeFlowers.pdf)). **V/H/P**  Use an extended version of the KWHL: What do I **K**now? What do I **W**ant to know about or wonder about (e.g., a phenomena)? **H**ow will I find out (e.g., determine how to organize investigations)? What have I |

|  |  |
| --- | --- |
| **Multiple Means of Representation** | |
| **Strategies** | **Examples** |
|  | **L**earned? What **A**ction will I take (e.g., share with others, apply to daily life, etc.)? What new **Q**uestions do I have? More information can be found at [http://langwitches.org/blog/2015/06/12/an-update-to-the-](http://langwitches.org/blog/2015/06/12/an-update-to-the-upgraded-kwl-for-the-21st-century/) [upgraded-kwl-for-the-21st-century/](http://langwitches.org/blog/2015/06/12/an-update-to-the-upgraded-kwl-for-the-21st-century/). [Individualization idea: Use strategies for the KWHL chart for accessibility ideas: [https://nceo.umn.edu/docs/Teleconferences/tele14/CourtadeFlowers.](https://nceo.umn.edu/docs/Teleconferences/tele14/CourtadeFlowers.pdf) [pdf.](https://nceo.umn.edu/docs/Teleconferences/tele14/CourtadeFlowers.pdf)]  Create and share a flowchart model of mitosis (e.g., [http://dailyrevshare.com/mitosis-and-meiosis-flow-chart/mitosis-and-](http://dailyrevshare.com/mitosis-and-meiosis-flow-chart/mitosis-and-meiosis-flow-chart-awesome-mitosis-and-meiosis/) [meiosis-flow-chart-awesome-mitosis-and-meiosis/](http://dailyrevshare.com/mitosis-and-meiosis-flow-chart/mitosis-and-meiosis-flow-chart-awesome-mitosis-and-meiosis/)).  Create a wall chart to display evidence that something is living or nonliving (e.g., [https://www.biologycorner.com/worksheets/martian](https://www.biologycorner.com/worksheets/martian.html)  [.html](https://www.biologycorner.com/worksheets/martian.html)). [Individualization idea: Provide students with prewritten evidence that they can attach to the wall chart.] **P** |
| Provide appropriate and accessible text on the content for students to listen to or read. | Provide an article or textbook pages on characteristics of living things, DNA replication, or mitosis. [Individualization idea: Paraphrase the information from the article on a large sticky note and place over the original text. Keep any graphics visible.]  Provide online books that have an embedded text reader (e.g., <http://bookbuilder.cast.org/view.php?op=view&book=8880&page=1> *(requires free account)*) or create book(s) on the unit topics (e.g., <http://bookbuilder.cast.org/>). [Individualization idea: Have students use an adapted mouse to turn the pages of the online book.] **P**  Provide an online article about genes, DNA, and proteins that has a screen reader and text size options (e.g., <https://kidshealth.org/en/kids/what-is-gene.html>). |
| Teach information using songs, poems, or rhymes. | Use an acronym to learn the characteristics of living things (e.g., <https://www.sciencealert.com/are-viruses-alive>).  Play songs about mitosis (e.g., [https://www.youtube.com/watch?v=](https://www.youtube.com/watch?v=f7Dmhfo7XXA) [f7Dmhfo7XXA](https://www.youtube.com/watch?v=f7Dmhfo7XXA) or <https://www.youtube.com/watch?v=pOsAbTi9tHw> ). [Individualization idea: Only sing the chorus (or key words) and add motions to the words.] |

**Table 6. Instructional strategy ideas using the UDL Principle: Multiple Means of Action and Expression**

|  |  |
| --- | --- |
| **Multiple Means of Action and Expression** | |
| **Strategies** | **Examples** |
| Use technology/assistive technology to optimize student access and interaction with the instructional materials and content. | Have students complete an online interactive activity demonstrating mitosis (e.g., [https://biomanbio.com/HTML5GamesandLabs/Genegames/](https://biomanbio.com/HTML5GamesandLabs/Genegames/mitosismoverpage.html) [mitosismoverpage.html](https://biomanbio.com/HTML5GamesandLabs/Genegames/mitosismoverpage.html) or [http://www.mhhe.com/biosci/genbio/](http://www.mhhe.com/biosci/genbio/virtual_labs_2K8/labs/BL_03/index.html) [virtual\_labs\_2K8/labs/BL\_03/index.html](http://www.mhhe.com/biosci/genbio/virtual_labs_2K8/labs/BL_03/index.html)). [Individualization idea: Read text to students and provide any support needed to answer questions.  Have students perform the tasks using an adapted mouse. **P**]  Have students read an online article about viruses (e.g., [https://www.](https://www.sciencedaily.com/terms/virus.htm) [sciencedaily.com/terms/virus.htm](https://www.sciencedaily.com/terms/virus.htm)). [Individualization idea: Have students use a screen reader. **V** Summarize the text using an online program (e.g., <http://textsummarization.net/text-summarizer> or [https://www.](https://www.splitbrain.org/services/ots) [splitbrain.org/services/ots](https://www.splitbrain.org/services/ots)).]  Have students read online text about mitosis with a built-in screen reader (e.g., [http://bookbuilder.cast.org/view.php?op=view&book=29902](http://bookbuilder.cast.org/view.php?op=view&book=29902&page=1) [&page=1](http://bookbuilder.cast.org/view.php?op=view&book=29902&page=1)). |
| Allow for instructional materials that can be modified to provide access. | Place printed text and pictures on a slant board. **V/P**  Research characteristics of living things and complete a checklist to determine if things are living or nonliving. [Individualization idea: Provide links to key information on a visual bookmarking board (e.g., [https://www.educatorstechnology.com/2017/05/10-good-bookmarking-](https://www.educatorstechnology.com/2017/05/10-good-bookmarking-tools-for-teachers.html) [tools-for-teachers.html](https://www.educatorstechnology.com/2017/05/10-good-bookmarking-tools-for-teachers.html)). Provide a checklist with images for each characteristic for students to use in determining if something is living or nonliving. Allow students to use a stamp to select living or nonliving. **P**]  Provide students with multiple ways to demonstrate understanding of DNA replication (e.g., pointing to stages on a model and explaining, putting a model together, answering yes/no questions, etc.). [Individualization idea: Have students sign answers. **H** Provide a tactile model. **V**] |
| Provide multiple means for students to make choices and select answers. | Have student dictate answers. [Individualization idea: Place answer options in the student’s AAC device or on multi-select voice output switch.] **P**  Provide answer choices. [Individualization idea: Have students use three switches with generic labels (e.g., a, b, c; red, blue, green; or three different textures) to which they listen, and then choose their answer.] **V/P**  Allow multiple ways to indicate an answer when working with paper materials. [Individualization idea: Allow student to select answer using touch, large pencil grip, paper stabilizer, eye gaze board, etc.] **P** |
| Provide simulation activities. | Help students create a simulation of a cell cycle by creating a flip book (e.g., [http://www.hannasd.org/cms/lib2/PA01001586/Centricity/](http://www.hannasd.org/cms/lib2/PA01001586/Centricity/Domain/662/Mitosis-Simulation-Activitystudent.pdf) [Domain/662/Mitosis-Simulation-Activitystudent.pdf](http://www.hannasd.org/cms/lib2/PA01001586/Centricity/Domain/662/Mitosis-Simulation-Activitystudent.pdf)). [Individualization  idea: Print the templates on card stock paper to make cutting easier. Take |

|  |  |
| --- | --- |
| **Multiple Means of Action and Expression** | |
| **Strategies** | **Examples** |
|  | a picture of each completed page of the flip book and insert each on a separate slide in a slide presentation (e.g., Microsoft PowerPoint, Google slides, etc.). Allow a student to use an adapted switch to move through the presentation.] **P** |
| Provide graphic organizers and templates. | Help students create a classroom graphic showing characteristics of living things (e.g., slide 4 in [https://www.slideshare.net/kyle\_kauffman](https://www.slideshare.net/kyle_kauffman/characteristics-of-life-66274211)  [/characteristics-of-life-66274211](https://www.slideshare.net/kyle_kauffman/characteristics-of-life-66274211)). [Individualization idea: Provide preprinted names, descriptions, and pictures for students to use to complete the graphic organizer. Provide a model for students to use as they complete the graphic organizer.]  Have students create a DNA replication foldable (e.g., [https://](https://www.youtube.com/watch?v=AEYUQ2sCCRI) [www.youtube.com/watch?v=AEYUQ2sCCRI](https://www.youtube.com/watch?v=AEYUQ2sCCRI)). |

**Table 7. Instructional strategy ideas using the UDL Principle: Multiple Means of Engagement**

|  |  |
| --- | --- |
| **Multiple Means of Engagement** | |
| **Strategies** | **Examples** |
| Provide a schedule. | Provide personal schedules with tangible symbols. Have students select the next activity on the schedule and set the visual timer to indicate how long the student has before a break.  Use a first-then schedule (e.g., [https://www.autismclassroom](https://www.autismclassroomresources.com/visual-schedule-series-first-then/) [resources.com/visual-schedule-series-first-then/](https://www.autismclassroomresources.com/visual-schedule-series-first-then/)).  Provide a checklist of tasks to complete in a particular order. [Individualization idea: Place words paired with pictures on a sheet with a “To Do” column and a “Finished” column using hook and loop tape.] |
| Vary the challenge and amount of information presented at a time. | Chunk the information provided to the student in five-minute intervals or less. Address the big ideas first (e.g., people grow and reproduce, and they are living). Then, expand on the characteristics of people as living. Next, apply the characteristics to animals and plants. Continue to stress the big idea throughout. [Individualization idea: Have students sort living and nonliving things as you introduce the information.] |
| Make connections to topics or activities that are motivating. | Watch a video that relates DNA enzymes to video game characters (e.g.,<https://www.youtube.com/watch/?v=5qSrmeiWsuc>).  Make the connection between living things or cell division and a student’s favorite animal. |
| Allow choices as possible. | Allow students to choose where to sit and options of types of seats (e.g., stool, exercise ball, etc.). |
| Provide opportunities to work collaboratively with peers. | Provide opportunities for students to work in a general education classroom with peers when learning about unit topics or have peer tutors come into the special education classroom to work on a project about DNA.  Have students work in cooperative groups with mixed abilities. [Individualization ideas: Present instructions and group expectations using a task checklist and group rules. Develop and read a social story (e.g., <http://www.pbisworld.com/tier-2/social-stories/>) about working in a group to the student. Provide the student with the necessary communication tools to participate in the group activity. Assign specific pieces of the task to each student.] |
| Teach student self- regulation skills. | Provide communication symbols to request a break or express feelings and model how to use them appropriately. Provide students with stress balls, finger fidgets, etc.  Teach students how to self-reflect on their performance using scaffolding. |

### UDL Resources

* The National Center on Universal Design for Learning has a plethora of information on UDL along with examples and resources. [www.udlcenter.org](http://www.udlcenter.org/)
* The UDL Curriculum Toolkit provides two applications for science. [http://udl-toolkit.cast.org/p/](http://udl-toolkit.cast.org/p/applications/l1) [applications/l1](http://udl-toolkit.cast.org/p/applications/l1)
* Perkins School for the Blind provides life science activities for students who are blind or have low vision. <http://www.perkinselearning.org/accessible-science/activities/life-science>
* This Perkins School for the Blind 20-minute video describes the techniques used to make science accessible for students who are blind and deaf-blind. [https://www.youtube.com/watch?v=tpAejot1-](https://www.youtube.com/watch?v=tpAejot1-Ec) [Ec](https://www.youtube.com/watch?v=tpAejot1-Ec)
* Symbaloo is a free online tool that allows an educator to create bookmarks using icons. It is easy to create and allows an educator to provide students links to sources of information that can be used for specific instructional units. [www.symbaloo.com](http://www.symbaloo.com/)
* This site provides a brief description of Symbaloo and multiple ways to use the online tool. <https://www.theedublogger.com/2014/04/09/11-ways-to-use-symbaloo-in-the-classroom/>
* Perkins School for the Blind provides information on using tangible symbols to increase communication, create personal schedules, and provide choices. <http://www.perkinselearning.org/videos/webcast/tangible-symbols>

# Section VII

## Transference and Generalization of Concepts, Knowledge, and Skills

For learning to be meaningful for all students, including students with significant cognitive disabilities, it is important to intentionally make connections to future content, real-world application, and college and career readiness skills. For example, students can learn that the way they discover information through observation and investigation can also be used to problem solve daily living tasks. Additionally, the instruction of science concepts, knowledge, and skills may be the catalyst to developing other areas such as needed communication skills, reading/listening comprehension, mathematics skills, age-appropriate social skills, independent work behaviors, and skills in accessing support systems. [Table 8](#_bookmark11) provides instructional ideas to help transfer and generalize concepts, knowledge, and skills and suggested opportunities to embed other skills into instruction.

**Table 8. Transfer and Generalization Ideas**

|  |  |  |
| --- | --- | --- |
| **Area** | **Instruction** | **Opportunity to Embed Skills** |
| **Communication** | When students are engaging in Scientific Inquiry and Engineering Design practices (see Section II), help students make the connections between analyzing and interpreting data and understanding data in real-world situations (e.g., favorite sports team data). | Work on communication skills (e.g., speaking in complete sentences, using AAC system, asking questions) during science instruction. |
| **Reading and Listening Comprehension** | Expose students to a variety of information sources on unit topics (e.g., online information, text books, magazines) and provide students access (e.g., screen reader). | While reading or accessing online information, have students work on fine motor skills (e.g., turning pages of the book, pointing to pictures in the text, operating the computer mouse). |
| **Mathematics** | Teach coding patterns during DNA instruction.  Make sense of quantities and relationships to describe and predict the variation and distribution of expressed traits in a population.  Use data to calculate the percent of offspring that have a given trait. | Provide practice on number identification and general number sense. |
| **Age-Appropriate Social Skills** | Make connections between the Crosscutting Concepts (e.g., cause and effect) and real-life experiences (e.g., student sweats during exercise). | Practice social skills (e.g., taking turns, listening to others, actively participating in discussion or conversation) while working with peers in a small group. |
| **Independent Work Behaviors** | Encourage and reinforce independent completion of tasks to build independent work skills. | Use this time to have the student work on following task completion checklists independently. |
| **Skills in Accessing Support Systems** | Encourage students to ask appropriately for assistance from peers and adults when researching information on the characteristics of living things. | Use this time to have the student work on behavior and communication skills. |

# Section VIII

## Tactile Maps and Graphics

The maps and graphics guidelines will help create tactile versions of instructional maps, diagrams, models, and timelines to use with students who are blind or deaf-blind. The tactile maps and graphics may be beneficial to other students as well. A tactile graphic is a representation of a graphic (e.g., picture, drawing, diagram, map, etc.) in a form that provides access through touch. It is not an exact copy of the graphic. The section provides basic guidance and links to more comprehensive resources.

### Importance of Tactile Maps and Graphics

It is important to provide tactile graphics for young readers (BANA, 2010). It helps students understand and gain information when presented with science concepts, knowledge, and skills. Science instruction often presents diagrams (e.g., water cycle) and two-dimensional models of living and nonliving things (e.g., model of cell) to teach the related concepts. The following guidance includes information to build upon when creating tactile graphics.

### Tactile Graphic Guidance

1. **Determine need for graphic:** When encountering graphics in instructional materials, determine if the graphic is essential to understanding the concept. The Braille Authority of North America (2010) provides a decision tree to help in this determination. It can be accessed online at <http://www.brailleauthority.org/tg/web-manual/index.html> by selecting “Unit 1 Criteria for Including a Tactile Graphic.”

#### Consult with the local educator trained to work with students with visual impairments.

1. **Determine the essential information in the graphic.** Read the surrounding information and the caption to determine which information in the graphic to exclude. For example, a model to illustrate the cell wall, nucleus, chloroplast, and vacuole would not need to include the nuclear membrane, Golgi body, and ribosomes.
2. **Reduce unnecessary detail in the graphic.** Identify details that are not necessary for interpreting the information in the graphic. For example, a model of the water cycle may show crevices on the mountains, leaves on a tree, and waves in an ocean. Eliminate unnecessary details, as they are difficult to interpret tactilely.
3. **Remove frames or image outlines if they serve no purpose.** Ensure that all lines are necessary (e.g., the lines showing the river), and remove any that are not (e.g., ripples in the water).
4. **Modify the size of the graphic.** Modify the graphic as needed to reduce clutter and allow a blank space between adjacent textures. Additionally, consider the size of the student’s hand.
5. **Use solid shapes as feasible.** When solid shapes do not clearly represent the information, use clear solid lines.
6. **Systematically teach exploration and interpretation of tactile graphics.** Systematic instruction and repetition are important when teaching a student to understand a tactile graphic. Pairing the tactile graphic with a 3-dimensional object may help (e.g., pair a raised line drawing of a plant, an example of plants and their parts, with a real plant).

##### Specific Graphic Type Guidance

Following is information for specific types of graphics that may support instruction in science.

#### Graphic Organizers/Concept Maps

* It is best to present information to compare or make connections using a tactile graphic. A tactile graphic presents the information in a spatial display and aids in comparison better than a list.

#### Diagrams/Models

* Limit the number of areas, lines, and labels. Having more than five makes interpretation difficult.
* Consider pairing a tactile graphic with a 3-dimensional model.

#### Timelines

* Present timelines in the same direction every time (i.e., horizontal or vertical).

#### Maps

* Distinguish water from land using a consistent background texture for the water.
* Align the direction of the compass rose arrows with the lines of longitude and latitude on the map.

### Creating Tactile Graphics

Following are some ways to create tactile graphics. Additional information can be found at [www.tactilegraphics.org.](http://www.tactilegraphics.org/)

#### Commercial products:

* Capsule paper or swell paper for printing, and
* Thermoform.

#### Textured shapes can be made from:

* Sticky back textured papers found at craft stores,
* Corrugated cardboard,
* Fabric with texture (e.g., corduroy, denim),
* Silk leaves,
* Cork,
* Felt,
* Vinyl,
* Mesh tape (used for drywall), and
* Sandpaper.

#### Raised lines can be made from:

* Glue (best not to use water-based glue), and
* Wax pipe cleaners.

### Resources

* The American Foundation for the Blind provides basic principles for preparing tactile graphics. [http://www.afb.org/info/solutions-forum/electronic-files-and-research-work-group/tactile-](http://www.afb.org/info/solutions-forum/electronic-files-and-research-work-group/tactile-graphics/345) [graphics/345](http://www.afb.org/info/solutions-forum/electronic-files-and-research-work-group/tactile-graphics/345)
* The Texas School for the Blind and Visually Impaired provides basic principles for preparing tactile graphics, element arrangement on a tactile graphic, resources for preparing quality graphics, etc. <http://www.tsbvi.edu/graphics-items/1465-basic-principles-for-preparing-tactile-graphics>
* Perkins School for the Blind has tips for reading tactile graphics in science with a focus on state assessment. [http://www.perkinselearning.org/accessible-science/blog/tips-reading-tactile-graphics-](http://www.perkinselearning.org/accessible-science/blog/tips-reading-tactile-graphics-science-focus-state-assessment) [science-focus-state-assessment](http://www.perkinselearning.org/accessible-science/blog/tips-reading-tactile-graphics-science-focus-state-assessment)

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## Picture Citations

Fakebook post created using <https://www.classtools.net/FB/home-page> SMS created using <https://www.classtools.net/SMS/>

2 All resources provided for this module only. Mention does not imply endorsement, recommendation, or approval by the Tennessee Department of Education.

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**LESSON PLANS:**

**Middle School Level**

Note: SWBAT stands for “students will be able to”.

# Henrietta Lacks, HeLa Cells, and Health Inequities: Making Student Research Relevant and Authentic

Charlette Walker Tilden Middle School

## Abstract

This curriculum unit will explore Hela cells, cancer, and medical ethics. It will be divided into four mini-lessons. The first lesson will teach basic cancer cell biology and address the following questions: How do cancer cells behave? How are cancer cells different from normal cells? How are HeLa cells different from other cancer cells? The second lesson will explore the positive developments and discoveries made from the use of HeLa cells, such as the polio vaccine, the human papillomavirus (HPV) vaccine, advances in cancer research, and the study of genetics. The third lesson will explore the ethical

implications of how those cells were obtained and distributed without the family’s knowledge, consent, or compensation in any way, while others profited tremendously. Finally, the last lesson will look at how the obtaining and using these HeLa cells has contributed to systemic medical racism and health inequities in this country.

# Keywords: Henrietta Lacks, HeLa cells, cancer biology, systemic medical racism, science, social studies, English Language Arts, research, writing, digital literacy

**Content Objectives**

The American Cancer Society estimates that there will be 1.9 million new cases of cancer and 608,570 cancer deaths in the United States in 2021.1 Because these statistics are staggering, they present the perfect backdrop to introduce a topic that nearly every student will have heard of, but very few really understand. Cancer is a very broad topic and there are more than 100 different types of cancers that are generally named for the organ or tissue from which they come. This unit will focus on cervical cancer and a very specific cervical cancer cell line called HeLa cells. HeLa cells are the first immortalized human cell line and the most commonly used cells in biomedical research today. They were taken from 31-year Henrietta Lacks, an African American woman who had cervical cancer, and was treated at Johns Hopkins Hospital in Baltimore, MD. A surgeon removed a tumor from her in 1951. Cell biologist, George Otto Gey took a small piece of the cervical cancer from Henrietta Lacks and tried to grow it in the laboratory. It was discovered that these cells would replicate indefinitely in a petri dish if given the right nutrients and growth conditions. The cells from Henrietta Lacks grew so quickly and so easily that they were ideal for all kinds of research. The cell line was named HeLa cells,

1 American Cancer Society, [www.cancer.org](http://www.cancer.org/)

which was an abbreviation for the patient’s name, Henrietta Lacks.2,3 Prior to the discovery of immortal HeLa cells, human cells did not survive long enough outside of the body to be used in research. Although many scientific discoveries were made because of HeLa cells, the way these cells were obtained without permission or knowledge and kept secret from Henrietta Lacks’ family as well as the subsequent expansion and marketing of these cells raises a number of moral and ethical questions.

Although 8th graders will be targeted with this unit, it is also appropriate for high school students as well, especially students who are studying Rebecca Skloot’s book, “The Immortal Life of Henrietta Lacks”.4 This curriculum unit can be used in many subject areas, including English Language Arts (ELA), social studies/history, science/biology, and digital literacy.

# Cancer Cell Biology and HeLa Cells

## *What is Cancer?*

“Cancer is a genetic disease—that is, it is caused by changes (mutations) to genes that control the way our cells function, especially how they grow and divide.” 5 In all types of cancer, regardless of the specific cancer type, cells begin to grow and divide without stopping and enter the bloodstream, spreading into surrounding tissues or distant tissues (see Graphic 1). These cancer cells can be inherited (germline mutations) or they can be formed by cell mutations, or errors in the DNA that occur when the cell divides (somatic mutation). Germline mutations can be inherited from either parent, while somatic mutations occur after birth. Somatic mutations cannot be inherited from a parent or passed to child.6 Somatic mutations can be caused by a number of factors. These factors include ultraviolet exposure, smoking, obesity (caused by diet and lack of exercise), and exposure to carcinogens, such as lead and asbestos.

***How Do Cancer Cells Behave? How Do Cancer Cells Differ from Normal Cells?*** Cancer cells differ from normal cells in that they have developed a way to overcome the checks and balances of normal cells. Normal cells are made up of two basic drivers-- proto-oncogenes and tumor suppressor genes. Proto-oncogenes instruct the cell to divide (gas pedal) and tumor suppressor genes instruct the gene to stop dividing (brakes). In normal cell division, cells divide up to a certain point and then they stop dividing. Their growth is regulated by proto-oncogenes and tumor suppressor genes.

Cancer cells have devised a way to hijack the proto-oncogenes so that they divide uncontrollably and bypass or deactivate the tumor suppressor genes so there are no

2 Sarah Zielinski, “Cracking the Code of the Human Genome,” *Smithsonian Magazine,* 2010

3 John R. Masters, "HeLa cells 50 years on: The good, the bad and the ugly". *Nature Reviews Cancer*. **2** (4): 315–319.

4 Rebecca Skloot, “The Immortal Life of Henrietta Lacks,” (New York: Crown Publishing Group, 2010)

5 National Cancer Institute, “What is Cancer,” www cancer.gov

6 Robert A. Weinberg, “How Cancer Arises,” *Scientific American*, 1996, 62-70

brakes, and they also avoid apoptosis, or cell death even though they are damaged or mutated. In addition to dividing uncontrollably, cancer cells are less specialized than normal cells. They can evade the immune system or use the immune system to serve their needs. They can influence their microenvironment to supply blood vessels to provide nutrients and remove waste. Finally, they can metastasize and travel to other parts of the body by way of the bloodstream, entering normal organs and colonizing and forming tumors in distant sites (metastases).7

**Graphic 1: Tumor Development Occurs in Stages (Source: Weinberg, 1996)** [https://docs.google.com/document/d/1Roai3nrWVdvrxViH1jDsfJbLjw7qLjtzkR7EK5s2e](https://docs.google.com/document/d/1Roai3nrWVdvrxViH1jDsfJbLjw7qLjtzkR7EK5s2eKs/edit) [Ks/edit](https://docs.google.com/document/d/1Roai3nrWVdvrxViH1jDsfJbLjw7qLjtzkR7EK5s2eKs/edit)

In the first two stages, the mutations are basically undetectable because the cells still appear normal. In stage three, the cells no longer appear normal in shape and orientation, but this would still not be cancer, although the cells would possibly raise suspicions. By stage four, a tumor is now observable, but as long as it remains confined to a single location and does not invade any boundaries between tissues, it is not considered to be malignant. Once these cells begin to invade surrounding tissues and/or travel to other parts of the body via the bloodstream or lymph nodes, the cancer is said to be malignant. It can become lethal when it forms new tumors that impair the operation of vital organs.8

## *What are HeLa cells? Why Were These Cells Special?*

HeLa cells were the first human cell lines that were able to grow continuously in a petri dish in a lab. HeLa cells came from a cervical cancer patient named Henrietta Lacks, and this particular cancer that killed Henrietta Lacks formed a very aggressive tumor that had many mutations. When an autopsy was performed on Henrietta Lacks after she died, doctors found that the cancer had spread all over her body, indicating its aggressive behavior. HeLa cells divide very rapidly, doubling every 20-24 hours, and they divide indefinitely. That is why they are called immortal. HeLa cells have been sold to laboratories around the world and because they are immortal, they provide an unlimited supply of cells and income for the companies that sell them for research. Their ability to grow indefinitely makes them well-suited for use in research. They can be produced in large quantities, in a short amount of time, and they live indefinitely, so they can be studied over the course of years. There are many different strains of HeLa cells because these cells continue to mutate, but they all originate from one source—Henrietta Lacks.

Why were these cells special? Dr. George Otto Gey had been trying for years to grow human cells outside the body in a petri dish. It was a tremendous breakthrough for him to have finally discovered human cells that would allow him to study how cancer behaves so that he could work towards finding a cure. 9

7 Weinberg, 62-70

8 Weinberg, 62-70

9 The Way of All Flesh, (documentary, BBC 1997) <https://watchdocumentaries.com/the-way-of-all-flesh/>

**Graphic # 2 HeLa Cells Images** [https://docs.google.com/document/d/1d9koHT61yyIZVBfXsmgr8k2AjqeO7QsED3enUE](https://docs.google.com/document/d/1d9koHT61yyIZVBfXsmgr8k2AjqeO7QsED3enUELBA5g/edit) [LBA5g/edit](https://docs.google.com/document/d/1d9koHT61yyIZVBfXsmgr8k2AjqeO7QsED3enUELBA5g/edit)

# Graohic #3 Henrietta Lacks Timeline

[https://unlockinglifescode.org/education-resource-profile/henrietta-lacks-timeline-her-](https://unlockinglifescode.org/education-resource-profile/henrietta-lacks-timeline-her-life-and-immortal-hela-cells) [life-and-immortal-hela-cells](https://unlockinglifescode.org/education-resource-profile/henrietta-lacks-timeline-her-life-and-immortal-hela-cells)

# Developments That Stemmed from the Use of HeLa Cells

The world owes a tremendous debt to Henrietta Lacks (but this is a debt that is unlikely to ever be paid). Ironically, for many years, scientists who used these cells for research were unaware that they came from Henrietta Lacks. The very cancer cells that eventually took her life also opened the door to myriads of other discoveries and developments that have helped to save and enrich countless other lives. (See Table 1)

# Ethical Implications of How HeLa Cells Were Obtained

Despite the tremendous accomplishments that have stemmed from the use of HeLa cells, the acquisition of cells from the body of Henrietta Lacks without her consent and the subsequent replication and marketing of trillions upon trillions those cells has raised a number of ethical and moral questions. At the time that these cells were extracted, there was no law that made it illegal to do so without obtaining consent. In fact, very little information was given to Blacks who were treated medically during that time.

Nevertheless, these questions remain-- “*Should* it have been legal? Should human beings (or any portion of their bodies) be used in experimentation without their consent? Should others profit from the sale and distribution of any part of a person’s body without their knowledge and with no form of compensation to the family whatsoever?”

It would have been a different story if countless others had not profited from the sale of Henrietta Lacks’ cells with no compensation to her family. One cannot help but think about the fact that for centuries, others have profited from the buying and selling of Black bodies in this country through the system of slavery. But these transactions for profit did not exist only during the *life* of Black people—profits continued to be made in their *death.* The University of Pennsylvania was the first medical school of the British colonies that boasted of the substantial use of the bodies of Black people for dissection and research.10

10 Craig Steven Wilder, “Ebony and Ivy: Race, Slavery, and the Troubled History of America’s Universities” (New York: Bloomsbury Press, 2013), 203

**Table 1- Research Advances Enabled by HeLa Cells**

|  |  |  |  |
| --- | --- | --- | --- |
| **ADVANCEMENT** | **DESCRIPTION** | **YEAR** | **SOURCE** |
| Chromosome Counting | An accident mixing of HeLa cells with the wrong liquid led to the ability to stain and count chromosomes for the first time. | 1953 | [https://www.technologynetworks.com/cell-](https://www.technologynetworks.com/cell-science/lists/5-contributions-hela-cells-have-made-to-science-305036) [science/lists/5-contributions-hela-cells-have-](https://www.technologynetworks.com/cell-science/lists/5-contributions-hela-cells-have-made-to-science-305036) [made-to-science-305036](https://www.technologynetworks.com/cell-science/lists/5-contributions-hela-cells-have-made-to-science-305036) |
| Polio Vaccine | Jonas Salk used HeLa cells to test the first polio vaccine because he discovered that they could be easily infected with  poliomyelitis. | 1954 | [https://www.technologynetworks.com/cell-](https://www.technologynetworks.com/cell-science/lists/5-contributions-hela-cells-have-made-to-science-305036) [science/lists/5-contributions-hela-cells-have-](https://www.technologynetworks.com/cell-science/lists/5-contributions-hela-cells-have-made-to-science-305036) [made-to-science-305036](https://www.technologynetworks.com/cell-science/lists/5-contributions-hela-cells-have-made-to-science-305036) |
| Cloning | HeLa cells were the first to be successfully  cloned by Theodore Puck and Phillip I. Marcus. | 1955 | [https://www.smithsonianmag.com/science-](https://www.smithsonianmag.com/science-nature/henrietta-lacks-immortal-cells-6421299/) [nature/henrietta-lacks-immortal-cells-6421299/](https://www.smithsonianmag.com/science-nature/henrietta-lacks-immortal-cells-6421299/) |
| Effect of X-rays | HeLa cells were used to study the effect of X-rays on human cells. | 1956 | [https://osp.od.nih.gov/scientific-sharing/hela-](https://osp.od.nih.gov/scientific-sharing/hela-cells-timeline/) [cells-timeline/](https://osp.od.nih.gov/scientific-sharing/hela-cells-timeline/) |
| Cancer Research | HeLa cells were used to create a method of testing cell lines to determine if they are cancerous. | 1956 | [https://osp.od.nih.gov/scientific-sharing/hela-](https://osp.od.nih.gov/scientific-sharing/hela-cells-timeline/) [cells-timeline/](https://osp.od.nih.gov/scientific-sharing/hela-cells-timeline/) |
| Stem Cell Isolation | Scientists were able to take HeLa cells and change them genetically, so they can form into cells that could behave like heart or  tissue cells. |  | [https://watchdocumentaries.com/the-way-of-all-](https://watchdocumentaries.com/the-way-of-all-flesh/) [flesh/](https://watchdocumentaries.com/the-way-of-all-flesh/) |
| Treatment of Blood Disorders | HeLa cells were used to shed light on the treatment of blood disorders such as sickle  cell anemia and blood cancers. | 1964 | [https://osp.od.nih.gov/scientific-sharing/hela-](https://osp.od.nih.gov/scientific-sharing/hela-cells-timeline/) [cells-timeline/](https://osp.od.nih.gov/scientific-sharing/hela-cells-timeline/) |
| Taken into Space | HeLa cells were taken into space on the  first satellite to test the effect of zero gravity on human cells. | 1964 | [https://osp.od.nih.gov/scientific-sharing/hela-](https://osp.od.nih.gov/scientific-sharing/hela-cells-timeline/) [cells-timeline/](https://osp.od.nih.gov/scientific-sharing/hela-cells-timeline/) |
| Hybrid Mouse Developed | HeLa cells combined with mouse cells to produce first hybridized mouse. This  technology paved the way for gene mapping. | 1965 | [https://www.technologynetworks.com/cell-](https://www.technologynetworks.com/cell-science/lists/5-contributions-hela-cells-have-made-to-science-305036) [science/lists/5-contributions-hela-cells-have-](https://www.technologynetworks.com/cell-science/lists/5-contributions-hela-cells-have-made-to-science-305036) [made-to-science-305036](https://www.technologynetworks.com/cell-science/lists/5-contributions-hela-cells-have-made-to-science-305036) |
| Salmonella Research | HeLa cells were used to study the behavior of salmonella and how it causes infection. | 1973 | [https://osp.od.nih.gov/scientific-sharing/hela-](https://osp.od.nih.gov/scientific-sharing/hela-cells-timeline/) [cells-timeline/](https://osp.od.nih.gov/scientific-sharing/hela-cells-timeline/) |
| Tuberculosis | HeLa cells were used to study how tuberculosis makes people sick. | 1993 | [https://osp.od.nih.gov/scientific-sharing/hela-](https://osp.od.nih.gov/scientific-sharing/hela-cells-timeline/) [cells-timeline/](https://osp.od.nih.gov/scientific-sharing/hela-cells-timeline/) |
| HPV Vaccine | Harald zur Hausen discovered that the HeLa cells biopsied from Henrietta Lacks contained HPV-18, the virus that caused her cervical cancer. This discovery led to the development of the HPV vaccine and  the 70% reduction of cervical cancers. | 1980 | [https://www.technologynetworks.com/cell-](https://www.technologynetworks.com/cell-science/lists/5-contributions-hela-cells-have-made-to-science-305036) [science/lists/5-contributions-hela-cells-have-](https://www.technologynetworks.com/cell-science/lists/5-contributions-hela-cells-have-made-to-science-305036) [made-to-science-305036](https://www.technologynetworks.com/cell-science/lists/5-contributions-hela-cells-have-made-to-science-305036) |
| In Vitro Fertilization | Howard Jones’ work led to the first baby born in the U.S. via in vitro fertilization. He was also the doctor who treated Henrietta Lacks’ cancer. | 1981 | [https://www.smithsonianmag.com/science-](https://www.smithsonianmag.com/science-nature/henrietta-lacks-immortal-cells-6421299/) [nature/henrietta-lacks-immortal-cells-6421299/](https://www.smithsonianmag.com/science-nature/henrietta-lacks-immortal-cells-6421299/) |
| HIV Research | It was discovered that HeLa cells are not easily infected with HIV, but they can be  used to study it. | 1988 | [https://osp.od.nih.gov/scientific-sharing/hela-](https://osp.od.nih.gov/scientific-sharing/hela-cells-timeline/) [cells-timeline/](https://osp.od.nih.gov/scientific-sharing/hela-cells-timeline/) |
| How Cells Age (Telomerase) | Scientists studying HeLa cells discover telomerase in DNA that protects chromosomes from damage due to aging | 1989 | [https://osp.od.nih.gov/scientific-sharing/hela-](https://osp.od.nih.gov/scientific-sharing/hela-cells-timeline/) [cells-timeline/](https://osp.od.nih.gov/scientific-sharing/hela-cells-timeline/) |
| Gene Mapping and the Human Genome Project | Gene mapping and the Human Genome Project made possible because of the study of HeLa cells. | 2003 | [https://www.technologynetworks.com/cell-](https://www.technologynetworks.com/cell-science/lists/5-contributions-hela-cells-have-made-to-science-305036) [science/lists/5-contributions-hela-cells-have-](https://www.technologynetworks.com/cell-science/lists/5-contributions-hela-cells-have-made-to-science-305036) [made-to-science-305036](https://www.technologynetworks.com/cell-science/lists/5-contributions-hela-cells-have-made-to-science-305036) |
| Synthetic Nanomotor Implants | Synthetic nanomotors implanted into HeLa cells. Chemists and engineers believe this could pave the way for cancer to be destroyed from the inside. | 2014 | [https://www.oprah.com/inspiration/uses-](https://www.oprah.com/inspiration/uses-of-hela-cells-immortal-life-of-henrietta-lacks) [of-hela-cells-immortal-life-of-henrietta-](https://www.oprah.com/inspiration/uses-of-hela-cells-immortal-life-of-henrietta-lacks) [lacks](https://www.oprah.com/inspiration/uses-of-hela-cells-immortal-life-of-henrietta-lacks) |

Body snatchers trespassed upon the spiritual dignity of their most vulnerable neighbors in their most vulnerable state and disturbed the psychic comforts of the living. Doctors and students reached into the graves of those who could not protect themselves in death and practiced upon their bodies, rendering their corpses little more than “meat”. Those most vulnerable to exhumation and dissection were from the lowest social orders: African American, Irish, and Indians.11

Do the ends justify the means? I do not believe they do. When people consent to be participants in research and/or experimentation, are informed of all known risks, are compensated for their time and sacrifice, and are given medical treatment for any complications that may arise as a result, then medical research can and should be conducted using willing human participants. Anything less than that is criminal and unethical.

# Systemic Medical Racism and Health Inequities

The treatment of Henrietta Lacks was not an isolated occurrence. The events surrounding her medical treatment and the obtaining of her cells is a symptom of a much larger issue—systemic medical racism. In systemic medical racism, “…institutionalized white socioeconomic resources, discrimination, and racialized framing from centuries of slavery, segregation, and contemporary white oppression severely limit and restrict access of many Americans of color to adequate socioeconomic resources, and to adequate health care and health outcomes.”12

In the United States, there is a long history of oppression and mistreatment of African American men and women, beginning during the period of slavery.

There are countless examples in subsequent years of treatment that has been perpetuated through the use of African Americans in medical research without their knowledge.

Racism has been perpetuated under the guise of science going back centuries, notably by 18th century Swedish botanist Carl Linnaeus, the godfather of taxonomy, and Samuel George Morton, a 19th century American doctor and anatomy professor who documented the supposed differences between indigenous people and Europeans by looking at their skulls…These perceived differences have helped drive centuries of

11 Wilder, p. 207

12 Joe Feagin and Zinobia Bennefield, “Systemic Racism and U.S. Healthcare,” *Social Science and Medicine*, 2014

oppression. Concepts like these, which appeared to be rooted in science, were used to rationalize slavery. Painful experimentation was conducted. Segregation was justified…The University of Pennsylvania Museum of Archaeology and Anthropology—which housed a Morton exhibit until July 2020—said in an 1851 obituary of Morton published by the Charleston Medical Journal of South Carolina that his research had ‘given to the negro his true position as an inferior race’. 13

# More Historical Evidence of Medical Racism

|  |
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| ***Use of Blacks as Guinea Pigs*** |
| In the 1700’s, enslaved men and women were used as guinea pigs to test smallpox vaccines. One scandal involving medical research since the 1940s is the heavy use of people of color as “guinea pigs.” Their health is often negatively affected, yet they are frequently abandoned once research is completed. In 1945, white doctors, working with the Atomic Energy Commission, injected [plutonium](https://www-sciencedirect-com.proxy.library.upenn.edu/topics/social-sciences/plutonium) into patients of color without consent to observe effects of radiation, without follow-up care. 14,15 Recently, prisoners of color have been used for drug trials, including for drugs too toxic for use on the general population.” 16,17,18 |

|  |
| --- |
| ***Experimentation on Black Women*** |
| “Between 1845 and 1849, J. Marion Sims, considered the father of gynecology, experimented and operated on Black women with no anesthesia, as it was widely believed that Black people didn’t experience pain the same as white people did.”19 “Sims’ vaginal speculum was developed through horrific surgeries performed on enslaved Black women without anesthesia.”20  “Collaborative actions of abusive experimentation and malpractice by early medical scientists and physicians often set a white model for later discriminatory experimentation and treatment. Throughout the first half of the 20th century, black |

13 Nicole Mortillaro, "How historical racism in science continues to shape the Black experience." The Canadian Broadcasting Corporation, February 25, 2021

14 Harriet A. Washington, “Medical Apartheid: The Dark History of Medical Experimentation on Black Americans from Colonial Times to the Present” (New York, New York: Harlem Moon, 2006),

15 Eileen Welsome, “The Plutonium Files” (New York: The Dial Press, 1999)

16 Jessica Mitford, “Kind and Unusual Punishment: The Prison Business” (New York: Alfred A. Knopf, 1973)

17 Washington, “Medical Apartheid”

18 Feagin and Bennefield, “Systemic Racism and U.S. Healthcare”

19 Mortillaro, "How historical racism in science continues to shape the Black experience."

20 "Ending Systemic Racism in Medicine." 2020.*Nature Medicine* 26 (7): 985-985.

women were recurring victims of [involuntary sterilization](https://www-sciencedirect-com.proxy.library.upenn.edu/topics/medicine-and-dentistry/compulsory-sterilization) and [hysterectomies](https://www-sciencedirect-com.proxy.library.upenn.edu/topics/medicine-and-dentistry/hysterectomy). 21 One was Fannie Lou Hamer, later a civil rights leader. In 1961 she was hospitalized to have a [uterine tumor](https://www-sciencedirect-com.proxy.library.upenn.edu/topics/medicine-and-dentistry/uterus-tumor) removed; the white doctor performed a hysterectomy instead. “I went to the doctor who did that to me and I asked him, ‘Why? Why had he done that to me?’ He didn't have to say nothing – and he didn't.”22). “Hamer was silenced by powerful white agents of a systemically racist system. Hundreds of black women have reported a similar story; thousands more probably remain undocumented” 23

In “Reconstructing the Patient, Starting with Women of Color,” Dorothy Roberts argues that contemporary dehumanizing medical treatments of black women are grounded in a racist history of medical experimentation. In the 19th century, profit- driven growth of the scientific medical system pressed white physicians and scientists to discover technologies and treatments to serve whites. In the South medical experiments were carried out on black women that no white physician would try on whites. This resulted in death for many enslaved women and set the model for continued use of African Americans as guinea pigs for medical progress, as well as for white physicians' provision of inadequate care for them. Black women were often denied treatment for real ailments, resulting in excruciatingly painful deaths for many.24,25

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| ***Tuskegee Syphilis Study on Black Men*** |
| “One of the most notable was the Tuskegee syphilis study, which began in 1932, where almost 400 Black men were left untreated for their disease in a government experiment that went on for 40 years. (They were also not informed that they even had the disease.) By the time it was exposed in a 1972 New York Times story, 128 men had died of the disease or complications from it, 40 of their wives had been infected, and 19 children had also been infected.” 26,27,28 |

***Margaret Sanger’s “Negro Project***

21 Betsy Hartmann, “Reproductive Rights and Wrongs: The Global Politics of Population Control” (Boston: South End Press, 1995)

22 Jerry DeMuth, “Sick and Tired of Being Sick and Tired” The Nation 1964 538, 549

23Feagin and Bennefield,

24 Dorothy Roberts, “Reconstructing the Patient, Starting with Women of Color,” 124

25 Feagin and Bennefield

26 Mortillaro, "How Historical Racism in Science Continues to Shape the Black Experience."

27 James H. Jones and Tuskegee Institute, “Bad Blood: The Tuskegee Institute Syphilis Experiment” (New York and London: Free Press. 1981)

28 Feagin and Bennefield, 2014

“Margaret Sanger, birth control pioneer, helped to devise a 1939 “Negro Project,” which sought to reduce the black population through negative [eugenics](https://www-sciencedirect-com.proxy.library.upenn.edu/topics/social-sciences/eugenics). 29 Partly due to Sanger's lobbying, numerous forms of birth control were tested in black communities. Because of high levels of hormones in early pills, black women were placed at high risk of hypertension and stroke; early IUDs were silent killers in African American communities because of the high rate of infection associated with them.30.White women were mostly sheltered from these effects. White government officials supported birth-control-eugenics and forced sterilization by funding experimentation.

Thousands suffered and died in this highly racist medical system.”31,32,33

|  |
| --- |
| ***Breast Cancer Disparities between Black and White Women*** |
| “Black women are less likely to contract breast cancer than whites, yet, if they contract it, they are much more likely to die. Black women with white physicians are often not educated as well about preventive care, are not screened as effectively, or are not as often referred to state-of-the-art treatments as white women with white physicians.”34,35 As a result, morbidity rates associated with breast cancer are affected by patient–physician interaction, as well as by unjust distribution of health care resources from generations of systemic racism.”36 |

|  |
| --- |
| ***COVID-19 Disparities*** |
| “Almost a year into the COVID-19 pandemic, there has been increased awareness of the disparities between the care delivered to white people versus people of color, and in particular Black and indigenous people. According to the Centers for Disease Control and prevention (CDC), people in the black community are almost three times more likely to die of COVID-19 than those who identify as being white.”37 |

29 Margaret Sanger, “The Pivot of Civilization” (New York: Brentano’s Publisher, 1922)

30 Washington, “Medical Apartheid”

31 William A. Darity and Castellano B. Turner, “Family Planning, Race Consciousness and the Fear of Race Genocide” *American Journal of Public Health*, 62 (1972), pp. 1454-1459

32 William A. Darity, Castellano .B. Turner, “Fears of Genocide Among Black Americans as Related to Age, Sex, and Region**,** *American Journal of Public Health*, 63 (1973), pp. 1029-1034

33 Feagin and Bennefield, 2014

34 Molly M. Ginty, “Black Women at Higher Risk for Major Diseases,” We News (2005) Available at <http://womensenews.org/story/health/050225/black-women-at-higher-risk-major-diseases>

35Dorothy Roberts, “Fatal invention,” (New York: The New Press, 2011) loc. 2540–48

36 Feagin and Bennefield, 2014

37 Mortillaro

# Health Inequities

These examples of historical medical racism have led to current health inequities for people of color and other marginalized people. It is important to recognize that what happened with Henrietta Lacks was a symptom of a much larger issue in America. Fortunately, these health inequities are finally beginning to be addressed.

# Teaching Strategies

In this curriculum unit, students will gain a deeper understanding of cancer, HeLa cells, Henrietta Lacks, and systemic medical racism while practicing research skills and creating digital projects to creatively communicate their findings.

1. SWBAT complete a K-W-L chart IOT articulate their current understanding of cancer.
2. SWBAT define cancer biology terminology IOT lay the groundwork for understanding cancer.
3. SWBAT create a Google slides presentation IOT explain basic cancer biology and how cancer operates in the human body.
4. SWBAT create a scientific diagram IOT explain how cancer cells differ from ordinary cells using Google Drawings.
5. SWBAT cite textual evidence IOT support an analysis of what the texts says explicitly.
6. SWBAT explain who Henrietta Lacks is and what HeLa cells are IOT recognize contributions made to society because of her cells.
7. SWBAT research a topic from a choice board IOT learn about medical developments made as a result of research conducted with HeLa cells.
8. SWBAT review information from a variety of resources IOT create written work related to those resources that answers a specific research question.
9. SWBAT utilize paraphrasing skills IOT relay researched information.
10. SWBAT create a Google Doc that compiles research into an online platform IOT communicate their findings.
11. SWBAT cite the sources used in their research IOT give credit the original authors.
12. SWBAT explain the concept of medical racism and give examples of historical evidence IOT form opinions about the subsequent consequences.
13. SWBAT articulate current examples of health inequities IOT explore possible ways to resolve the issues.
14. SWBAT participate in philosophical chairs IOT articulate and defend their thoughts about the use of humans in medical research without their consent.
15. SWBAT engage in active listening and present themselves verbally in large and small group situations with both peers and adults IOT meet grade appropriate outcomes/expectations as identified in the standards.
16. SWBAT create a Google website IOT showcase all of the projects created during this unit.

**Classroom Activities**

**Lesson 1: Introduction to Cancer: What is Cancer? How Do Cancer Cells Differ from Normal Cells? (5 days)**

**Objectives:**

1. SWBAT complete a K-W-L chart IOT articulate their current understanding of cancer.
2. SWBAT define cancer biology terminology IOT lay the groundwork for understanding cancer.
3. SWBAT create a Google slides presentation that includes text, images, and animations IOT explain basic cancer biology and how cancer operates in the human body.
4. SWBAT create a scientific diagram IOT explain how cancer cells differ from ordinary cells.

# Standards:

**15.4.8.K:** Create a multimedia project using student-created digital media. CC.1.4.8.U Use technology, including the Internet, to produce and publish writing and present the relationships between information and ideas efficiently CC.1.4.8.V Conduct short research projects to answer a question (including a self- generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.

**ISTE Standard 3: Knowledge Constructor**: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.

# Materials Needed:

Teacher Slides Presentation [https://docs.google.com/presentation/d/1C9BySAlQorbSGoFjpI6Byzi0pxaIfoYw2TqGH](https://docs.google.com/presentation/d/1C9BySAlQorbSGoFjpI6Byzi0pxaIfoYw2TqGHhLsDjM/edit#slide%3Did.ge131e11421_0_205) [hLsDjM/edit#slide=id.ge131e11421\_0\_205](https://docs.google.com/presentation/d/1C9BySAlQorbSGoFjpI6Byzi0pxaIfoYw2TqGHhLsDjM/edit#slide%3Did.ge131e11421_0_205)

Graphic Organizer (K-W-L chart) [https://www.readwritethink.org/sites/default/files/resources/lesson\_images/lesson924/kwl](https://www.readwritethink.org/sites/default/files/resources/lesson_images/lesson924/kwl.pdf)

[.pdf](https://www.readwritethink.org/sites/default/files/resources/lesson_images/lesson924/kwl.pdf)

Vocabulary Handout

[https://docs.google.com/document/d/1JSUeRV-xVc2IG9JzEpUVH46joFitgNpOr2Ubv-](https://docs.google.com/document/d/1JSUeRV-xVc2IG9JzEpUVH46joFitgNpOr2Ubv-PAa-0/edit) [PAa-0/edit](https://docs.google.com/document/d/1JSUeRV-xVc2IG9JzEpUVH46joFitgNpOr2Ubv-PAa-0/edit)

What is Cancer? What Causes Cancer (4 min.) https:/[/www.youtube.com/watch?v=WPgJafGz4fg](http://www.youtube.com/watch?v=WPgJafGz4fg)

What is Cancer? (7 min.) https:/[/www.youtube.com/watch?v=UopUxkeC4Ls](http://www.youtube.com/watch?v=UopUxkeC4Ls)

3D Animation: What is Cancer? (1 min) https:/[/www.youtube.com/watch?v=LEpTTolebqo](http://www.youtube.com/watch?v=LEpTTolebqo)

How Cancer Starts (2 min) <https://www.youtube.com/watch?v=3wHYOEeAsD8>

Cancer Cells are Like Vampires (1.5 min) <https://www.youtube.com/watch?v=5o4sj4TsBiI>

Applied Digital Skills: All About a Topic (Google Slides) [https://applieddigitalskills.withgoogle.com/c/middle-and-high-school/en/create-a-](https://applieddigitalskills.withgoogle.com/c/middle-and-high-school/en/create-a-presentation-all-about-a-topic/overview.html) [presentation-all-about-a-topic/overview.html](https://applieddigitalskills.withgoogle.com/c/middle-and-high-school/en/create-a-presentation-all-about-a-topic/overview.html)

Applied Digital Skills: Draw a Scientific Diagram (Google Drawings) [https://applieddigitalskills.withgoogle.com/c/middle-and-high-school/en/draw-a-](https://applieddigitalskills.withgoogle.com/c/middle-and-high-school/en/draw-a-scientific-diagram/overview.html) [scientific-diagram/overview.html](https://applieddigitalskills.withgoogle.com/c/middle-and-high-school/en/draw-a-scientific-diagram/overview.html)

Student Chromebooks/Desktops

# Day 1

**Materials Needed:**

K-W-L Chart [https://www.readwritethink.org/sites/default/files/resources/lesson\_images/lesson924/kwl](https://www.readwritethink.org/sites/default/files/resources/lesson_images/lesson924/kwl.pdf)

[.pdf](https://www.readwritethink.org/sites/default/files/resources/lesson_images/lesson924/kwl.pdf)

Teacher Slides Presentation [https://docs.google.com/presentation/d/1C9BySAlQorbSGoFjpI6Byzi0pxaIfoYw2TqGH](https://docs.google.com/presentation/d/1C9BySAlQorbSGoFjpI6Byzi0pxaIfoYw2TqGHhLsDjM/edit#slide%3Did.ge131e11421_0_205) [hLsDjM/edit#slide=id.ge131e11421\_0\_205](https://docs.google.com/presentation/d/1C9BySAlQorbSGoFjpI6Byzi0pxaIfoYw2TqGHhLsDjM/edit#slide%3Did.ge131e11421_0_205)

Vocabulary Handout

[https://docs.google.com/document/d/1JSUeRV-xVc2IG9JzEpUVH46joFitgNpOr2Ubv-](https://docs.google.com/document/d/1JSUeRV-xVc2IG9JzEpUVH46joFitgNpOr2Ubv-PAa-0/edit) [PAa-0/edit](https://docs.google.com/document/d/1JSUeRV-xVc2IG9JzEpUVH46joFitgNpOr2Ubv-PAa-0/edit)

**Video**: Introduction to Cancer: 3D Animation: What is Cancer? (1 min) <https://www.youtube.com/watch?v=LEpTTolebqo>

**Video**: How Cancer Starts (2 min) <https://www.youtube.com/watch?v=3wHYOEeAsD8>

**Video**: What is Cancer? What Causes Cancer (4 min.) <https://www.youtube.com/watch?v=WPgJafGz4fg>

**Opening Questions**: Do you know that currently has cancer? Do you know anyone who has had cancer? Do you know anyone who has died from cancer?

**Opening Activity—**Have students complete a K-W-L Chart responding to the following questions, “What do you know about cancer? What do you want to know about cancer? What would you like to learn about cancer?”

# Slides Presentation:

1. **Video**: Introduction to Cancer: 3D Animation: What is Cancer? (1 min) <https://www.youtube.com/watch?v=LEpTTolebqo>

Students will take notes during/after each video and be given the opportunity to ask questions and record their responses about what they just saw.

1. **Video**: How Cancer Starts (2 min) <https://www.youtube.com/watch?v=3wHYOEeAsD8>

Students will take notes during/after each video and be given the opportunity to ask questions and record their responses about what they just saw.

1. **Cancer Vocabulary**: Students will fill-in vocabulary words on their handouts. Definitions will be provided in the Slides presentation for the following terms:

**cancer**: a group of many related diseases that all have to do with cells. Cancer happens when abnormal cells grow and spread very fast.

**cells**: the basic components or "building blocks" of the human body.

**cancer cells**: cells that grow and divide uncontrollably, which may spread quickly throughout the body, making someone sick.

**tumor**: abnormal body cells grouped together in a mass or lump. Tumors are classified as benign (not cancerous) and malignant (cancerous).

**benign**: a term used to describe tumors that are slow-growing, noncancerous, and do not spread to surrounding tissue.

**malignant**: another word for cancerous.

**metastasis**: the spread of disease (in this case, cancer) from the original site to other parts of the body.

**gene**: sections or segments of DNA that are carried on the chromosomes and determine specific human characteristics, such as height or hair color. Because each parent provides one chromosome in each pair, people have two of every gene (except for some genes on the X and Y chromosomes in boys because boys have only one of each).

**genetics**: the study of the way physical traits and characteristics get passed down from one generation to the next. This is also called **heredity**. Genetics includes the study of genes, which have a special code called DNA that determines what you will look like and whether you are likely to have certain illnesses.

**proto-oncogene**: proto-oncogenes are genes that normally help cells grow. Proto- oncogenes function like the gas pedal in a car.

**DNA:** DNA, or deoxyribonucleic acid, is the hereditary material in humans and almost all other organisms.

**mutation**: any change in a gene.

**oncogenes**: proto-oncogenes that have mutated and cause cells to grow and duplicate out of control. Oncogenes function like a gas pedal that is stuck.

**tumor suppressor gene:** Tumor suppressor genes are normal genes that slow down cell division, repair DNA mistakes, or tell cells when to die (a process known

as *apoptosis* or *programmed cell death*).

**apoptosis**: programmed cell death

1. **Video**: What is Cancer? What Causes Cancer (4 min.) <https://www.youtube.com/watch?v=WPgJafGz4fg>
2. Students will take notes during/after each video and be given the opportunity to ask questions and record their responses about what they just saw.
3. **Think-Pair-Share:** Question- “What have you learned about cancer today?” Students will think about this question independently before sharing their thoughts with a partner. Then the pair will work together to complete their K-W-L charts.
4. **Homework**: Review what you have learned in class today and start learning the vocabulary words.

# Days 2-3

**Opening Question: “**What is cancer? What did you learn during our last lesson? What questions do you have?”

**Vocabulary Review:** Use the slides from the previous lesson to review the vocabulary words. Give students the opportunity to fill-in the missing vocabulary words by playing a Jeopardy style game where students earn points, Dojo points etc., for correctly answering each question. Students must respond by saying, “What is cancer?”, “What is a cell?”, etc.

**Slides Presentation Continued:** [https://docs.google.com/presentation/d/1C9BySAlQorbSGoFjpI6Byzi0pxaIfoYw2TqGH](https://docs.google.com/presentation/d/1C9BySAlQorbSGoFjpI6Byzi0pxaIfoYw2TqGHhLsDjM/edit#slide%3Did.ge131e11421_0_205) [hLsDjM/edit#slide=id.ge131e11421\_0\_205](https://docs.google.com/presentation/d/1C9BySAlQorbSGoFjpI6Byzi0pxaIfoYw2TqGHhLsDjM/edit#slide%3Did.ge131e11421_0_205)

1. Video: What is Cancer? (7 min.) <https://www.youtube.com/watch?v=UopUxkeC4Ls>

Students will take notes during/after each video and be given the opportunity to ask questions and record their responses about what they just saw.

1. Video: Cancer Cells are Like Vampires (1.5 min) <https://www.youtube.com/watch?v=5o4sj4TsBiI>

Students will take notes during/after each video and be given the opportunity to ask questions and record their responses about what they just saw.

1. Project #1--Applied Digital Skills: All About a Topic (Google Slides) [https://applieddigitalskills.withgoogle.com/c/middle-and-high-school/en/create-a-](https://applieddigitalskills.withgoogle.com/c/middle-and-high-school/en/create-a-presentation-all-about-a-topic/overview.html)

[presentation-all-about-a-topic/overview.html](https://applieddigitalskills.withgoogle.com/c/middle-and-high-school/en/create-a-presentation-all-about-a-topic/overview.html)

Applied Digital Skills is a free online program that teaches students how to use the Google Suite by way of video instruction. It includes its own lesson plans for how to use the program if you chose to do so. “All About a Topic” teaches students how to create a Google Slides presentation that includes text, images, transitions, and animations. Most of my students will be familiar with how to do this without watching the videos, but new students may need to watch the videos. The topic for this assignment will be “What is Cancer?” The students will create a slides presentation that explains cancer to someone who knows nothing or very little about cancer. They will use the vocabulary they have learned, include images or illustrations to help explain the concepts with source citations, and include animations and transitions in their presentation. The presentations may also include short videos, but must include citations as well. Extra credit points will be awarded if information is included that was not shared in class.

Students may work independently on this assignment or with a partner. Students may watch the videos independently or as a class. They may also work in small groups with the teacher if they are struggling with this project. Students will work on this assignment over the course of 2 days. This assignment may require an extra day if students have never created a slides presentation before.

To get started using Applied Digital Skills, teachers will sign in “as a teacher” using their teacher Gmail address. Students will sign-in “as a student” using their school district Gmail account. The teacher will then create a class to assign this activity and all other subsequent lessons so that students may access them easily in their Dashboard. If a teacher is also using Google classroom, they may import their entire class into this Applied Digital Skills classroom or they may give their students the code generated by the class they created to allow their students to join that class. Teachers will then be able to use their Dashboard to monitor whether individual students have watched the video lessons, and which students have completed their activities. The completed assignments may also be uploaded to Google classroom so that teachers may be able to see at a glance, which students have turned in their assignments and be able to assess them or give feedback easily.

# Days 4-5

**Opening Question:** “What questions do you still have about cancer?”

1. Vocabulary Review Game- Teacher will review slides and give students an opportunity to fill in the blanks.
2. Project #2-- Applied Digital Skills: Draw a Scientific Diagram (Google Drawings) [https://applieddigitalskills.withgoogle.com/c/middle-and-high-](https://applieddigitalskills.withgoogle.com/c/middle-and-high-school/en/draw-a-scientific-diagram/overview.html) [school/en/draw-a-scientific-diagram/overview.html](https://applieddigitalskills.withgoogle.com/c/middle-and-high-school/en/draw-a-scientific-diagram/overview.html)

In this project, students will create their own drawing or infographic using Google Drawings to visually represent how cancer cells operate. This activity will follow the same format as the previous one. Students will watch the videos independently or as a class and create their scientific diagram on Google Drawings. There are lesson plans that can be used with teaching this portion, but the video instruction in very thorough, and students can watch and re-watch at their own pace. The plans also include a rubric for grading the drawing as well. This assignment can be completed in one day, depending on the length of the class period, but again, depending on the comfort level of the students using Google Drawings, an extra day may be needed.

# Lesson 2: What are HeLa Cells? Why are they Important? What Significant Medical Contributions Have Been Made Using HeLa Cells? (7-8 days)

**Objectives:**

1. SWBAT explain who Henrietta Lacks is and what HeLa cells are IOT recognize contributions made to society because of her cells.
2. SWBAT research a topic from a choice board IOT learn about medical developments made as a result of research conducted with HeLa cells.
3. SWBAT create a Google Doc that compiles research into an online platform IOT communicate their findings.
4. SWBAT cite the sources used in their research IOT give credit the original authors.

# Standards:

ISTE Standard 3: Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.

15.4.8.K: Create a multimedia project using student-created digital media.

15.4.8.L**:** Evaluate the accuracy and bias of online sources of information; appropriately cite online resources.

CC.1.2.8.B Cite the textual evidence that most strongly supports an analysis of what the text says explicitly as well as inferences, conclusions, and/or generalizations drawn from the text.

CC.1.4.8.V Conduct short research projects to answer a question (including a self- generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.

CC.1.4.8.W Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation

# Materials Needed:

“The Way of All Flesh” (video, BBC 1997) [https://watchdocumentaries.com/the-way-of-](https://watchdocumentaries.com/the-way-of-all-flesh/) [all-flesh/](https://watchdocumentaries.com/the-way-of-all-flesh/)

Article ["How One Woman's Cells Changed Medicine"](https://abcnews.go.com/WN/womans-cells-changed-medicine/story?id=9712579). [ABC World News](https://en.wikipedia.org/wiki/ABC_World_News).

Article ["5 Contributions HeLa Cells Have Made to Science"](https://www.technologynetworks.com/cell-science/lists/5-contributions-hela-cells-have-made-to-science-305036). *Cell Science from Technology Networks*.

Article “Wealthy funder pays reparations for the use of HeLa cells” (Witze, 2020) <https://www.nature.com/articles/d41586-020-03042-5>

Article ["Cracking the code of the human genome – Henrietta Lacks' 'immortal' cells"](https://www.smithsonianmag.com/science-nature/henrietta-lacks-immortal-cells-6421299/). Smithsonian.

Main Idea Graphic Organizer [https://docs.google.com/document/d/1gzTdz5Dz2ohQCWajxMwyn6Xt2hXvv2brqC6zLP](https://docs.google.com/document/d/1gzTdz5Dz2ohQCWajxMwyn6Xt2hXvv2brqC6zLPqivE/edit) [qivE/edit](https://docs.google.com/document/d/1gzTdz5Dz2ohQCWajxMwyn6Xt2hXvv2brqC6zLPqivE/edit)

HeLa Cells Timeline

[***https://osp.od.nih.gov/scientific-sharing/hela-cells-timeline/***](https://osp.od.nih.gov/scientific-sharing/hela-cells-timeline/)

Research and Develop a Topic (Document) [https://applieddigitalskills.withgoogle.com/c/middle-and-high-school/en/research-and-](https://applieddigitalskills.withgoogle.com/c/middle-and-high-school/en/research-and-develop-a-topic/overview.html) [develop-a-topic/overview.html](https://applieddigitalskills.withgoogle.com/c/middle-and-high-school/en/research-and-develop-a-topic/overview.html)

Table 1- Research Advances Enabled by HeLa Cells [https://docs.google.com/document/d/1WiUrNX025f7S2NsA0KxXL50aV5Be-](https://docs.google.com/document/d/1WiUrNX025f7S2NsA0KxXL50aV5Be-kk3IDqqegdlX9U/edit#heading%3Dh.rf3dtx31o3x8) [kk3IDqqegdlX9U/edit#heading=h.rf3dtx31o3x8](https://docs.google.com/document/d/1WiUrNX025f7S2NsA0KxXL50aV5Be-kk3IDqqegdlX9U/edit#heading%3Dh.rf3dtx31o3x8)

Student Chromebooks/Desktops

# Day 1 **Materials Needed**:

1. Article ["How One Woman's Cells Changed Medicine"](https://abcnews.go.com/WN/womans-cells-changed-medicine/story?id=9712579). [ABC World News](https://en.wikipedia.org/wiki/ABC_World_News).
2. Article ["5 Contributions HeLa Cells Have Made to Science"](https://www.technologynetworks.com/cell-science/lists/5-contributions-hela-cells-have-made-to-science-305036). *Cell Science from Technology Networks*.
3. Article “Wealthy funder pays reparations for the use of HeLa cells” (Witze, 2020) <https://www.nature.com/articles/d41586-020-03042-5>
4. Article ["Cracking the code of the human genome – Henrietta Lacks' 'immortal'](https://www.smithsonianmag.com/science-nature/henrietta-lacks-immortal-cells-6421299/) [cells".](https://www.smithsonianmag.com/science-nature/henrietta-lacks-immortal-cells-6421299/) Smithsonian.

Main Idea Graphic Organizer [https://docs.google.com/document/d/1gzTdz5Dz2ohQCWajxMwyn6Xt2hXvv2brqC6zLP](https://docs.google.com/document/d/1gzTdz5Dz2ohQCWajxMwyn6Xt2hXvv2brqC6zLPqivE/edit) [qivE/edit](https://docs.google.com/document/d/1gzTdz5Dz2ohQCWajxMwyn6Xt2hXvv2brqC6zLPqivE/edit)

# Reading Activity: Teacher will divide students into 4 heterogenous groups, each with varying degrees of reading proficiencies. Each group will be given a graphic organizer and asked to read one of the four articles and will then share the main ideas with the other groups in this fashion:

* + Students will take turns reading a paragraph in the article assigned to their group. Then the group will assign one main idea to each member of the group to share with the entire class when it is time to share out. The group will make sure that that student understands their concept and will be prepared to share with the class. That student will become the “expert” on that portion of the article. Each student will write down the name of their article and their one main idea. Then they will add the main ideas from each member of their group.
  + Each of the other groups will do the same with their article. When all groups have finished reading and been given their individual assignments, the groups will begin to share their information with the whole class, one student at a time.
  + As each group shares their main ideas, all students will add this information to their graphic organizer. Any information that is shared again or repeated by another group will have a “check mark” placed next to it. Any information that is new or different will receive a “star”.
  + In this way, every student will end up with all the notes. The “checked” material will be reinforced because it is repeated often. The “starred” material will need special attention when studying. Every student will have something that they understand very well.

**Homework**: Review the notes taken in class today. Tomorrow we will watch a documentary about HeLa cells and you will add to your notes.

# Days 2-3 Materials Needed:

Documentary “The Way of All Flesh” (documentary, BBC 1997) <https://watchdocumentaries.com/the-way-of-all-flesh/>

Students will continue the activity from the previous day, but will watch the documentary “The Way of All Flesh” (video, BBC 1997) <https://watchdocumentaries.com/the-way-of-all-flesh/> . They will need their graphic organizer and will check off information that is repeated and add information that is new. The documentary will require an entire 60-minute class period, but may be broken up into two separate classes to allow time for discussion after each segment. The teacher may also choose to edit out portions of the video in the interest of time. The discussion period should be student-led and driven by questions and comments they would like to make about the documentary.

# Days 4-8 Materials Needed:

HeLa Cells Timeline

[***https://osp.od.nih.gov/scientific-sharing/hela-cells-timeline/***](https://osp.od.nih.gov/scientific-sharing/hela-cells-timeline/)

Table 1- Research Advances Enabled by HeLa Cells, [https://docs.google.com/document/d/1WiUrNX025f7S2NsA0KxXL50aV5Be-](https://docs.google.com/document/d/1WiUrNX025f7S2NsA0KxXL50aV5Be-kk3IDqqegdlX9U/edit#heading%3Dh.rf3dtx31o3x8) [kk3IDqqegdlX9U/edit#heading=h.rf3dtx31o3x8](https://docs.google.com/document/d/1WiUrNX025f7S2NsA0KxXL50aV5Be-kk3IDqqegdlX9U/edit#heading%3Dh.rf3dtx31o3x8)

Research Choice Board (More Historical Evidence of Medical Racism) [https://docs.google.com/document/d/1yD0KzeKVgfYZArEJQYLtM5gj3MGxaPSLToU](https://docs.google.com/document/d/1yD0KzeKVgfYZArEJQYLtM5gj3MGxaPSLToUX2vnhimY/edit) [X2vnhimY/edit](https://docs.google.com/document/d/1yD0KzeKVgfYZArEJQYLtM5gj3MGxaPSLToUX2vnhimY/edit)

Applied Digital Skills: Research and Develop a Topic (Google Docs) (3-4 hours) [https://applieddigitalskills.withgoogle.com/c/middle-and-high-school/en/research-and-](https://applieddigitalskills.withgoogle.com/c/middle-and-high-school/en/research-and-develop-a-topic/overview.html) [develop-a-topic/overview.html](https://applieddigitalskills.withgoogle.com/c/middle-and-high-school/en/research-and-develop-a-topic/overview.html)

Student Chromebooks/Laptops

In these activities, students will look at the HeLa Cells Timeline created by the National Institute of Health (NIH), Table 1- Research Advances Enabled by HeLa Cells, and the Research Choice Board to determine which topic they would like to explore for their research paper which will be completed on Google Docs. This activity will take approximately 5 days to complete.

# Activities:

1. As a class, students will read through the HeLa Cells Timeline and Table 1to learn about some of the many breakthroughs in medical science that came about as a result of research using HeLa cells.
2. Then, using the Research Choice Board, students will choose one topic on which to conduct further research and write about their findings using Google Docs.
3. Finally, students will use the “Applied Digital Skills: Research and Develop a Topic” lesson to learn how to recognize credible sources when conducting research, research and develop a topic, and use code to code a pop-up window for their research. This activity is actually three separate lessons and the teacher may choose to use some or all of them in this activity. The teacher may also choose to use a portion as a lesson extension or for extra credit. This will determine, to a large extent, how long it takes to cover this lesson. As with all Applied Digital Skills lessons, this lesson comes with prepared lesson plans and rubrics, so no additional materials are needed. Students may be assigned to complete these activities independently at their own pace, or the teacher may work with the entire class or small groups to walk through the video instruction.
4. The students will use the topic they selected from the Research Choice Board when completing this activity and will disregard the examples used in the videos. In this way, teachers may use the same Applied Digital Skills lessons on a multitude of different topics. Teachers may use the rubric provided to assess the final project or may modify or create their own, depending on the subject area in which this lesson is being used.

# Lesson 3—Historical Medical Racism and Current Health Inequities

**Objectives:**

1. SWBAT explain the concept of medical racism and give examples of historical evidence IOT form opinions about the subsequent consequences.
2. SWBAT articulate current examples of health inequities IOT explore possible ways to resolve the issues.
3. SWBAT participate in philosophical chairs IOT articulate and defend their thoughts about the use of humans in medical research without their consent.
4. SWBAT engage in active listening and present themselves verbally in large and small group situations with both peers and adults IOT meet grade appropriate outcomes/expectations as identified in the standards.
5. SWBAT create a Google website IOT showcase all of the projects created during this unit.

# Standards:

**ISTE Standard 3: Knowledge Constructor**: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.

**15.4.8.K:** Create a multimedia project using student-created digital media.

**15.4.8.L:** Evaluate the accuracy and bias of online sources of information; appropriately cite online resources.

CC.1.4.8.U Use technology, including the Internet, to produce and publish writing and present the relationships between information and ideas efficiently

CC.1.4.8.W Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation

S8.A.1.2.1 Describe the positive and negative, intended and unintended, effects of specific scientific results or technological developments (e.g., air/space travel, genetic engineering, nuclear fission/fusion, artificial intelligence, lasers, organ transplants).

CC.1.5.8.A Collaborative Discussion Engage effectively in a range of collaborative discussions, on grade level topics, texts, and issues, building on others’ ideas and expressing their own clearly.

CC.1.5.8.B Critical Listening Delineate a speaker’s argument and specific claims, evaluating the soundness of the reasoning and the relevance and sufficiency of the evidence.

CC.1.5.8.F Multimedia Integrate multimedia and visual displays into presentations to add interest, clarify information, and strengthen claims and evidence

# Materials Needed:

Article**:** Racism in healthcare: What you need to know <https://www.medicalnewstoday.com/articles/racism-in-healthcare>

Article: “Henrietta Lacks: Science Must Right a Historical Wrong.” <https://www.nature.com/articles/d41586-020-02494-z>

Handout: Historical Examples of Medical Racism [https://docs.google.com/document/d/1yD0KzeKVgfYZArEJQYLtM5gj3MGxaPSLToU](https://docs.google.com/document/d/1yD0KzeKVgfYZArEJQYLtM5gj3MGxaPSLToUX2vnhimY/edit) [X2vnhimY/edit](https://docs.google.com/document/d/1yD0KzeKVgfYZArEJQYLtM5gj3MGxaPSLToUX2vnhimY/edit)

**Series of Very Short YouTube Videos Produced by Center for Prevention MN**

1. Health Equity Animated: Equity vs. Equality <https://www.youtube.com/watch?v=tZd4no4gZnc>
2. The Cost of Health Inequity <https://www.youtube.com/watch?v=HJeUnHGE4IE>
3. Health Equity Animated: Race <https://www.youtube.com/watch?v=PTaLFmnS_jo>
4. Heath Equity Animated: Zip Code <https://www.youtube.com/watch?v=v_GfpuavbIU>
5. Health Equity Animated: Income <https://www.youtube.com/watch?v=p9BZHz-duMw>
6. Health Equity Animated: Gender <https://www.youtube.com/watch?v=lKboL0tgWdk>

Applied Digital Skills- Build a Portfolio with Google Sites (Sites) [https://applieddigitalskills.withgoogle.com/c/middle-and-high-school/en/build-a-](https://applieddigitalskills.withgoogle.com/c/middle-and-high-school/en/build-a-portfolio-with-google-sites/overview.html) [portfolio-with-google-sites/overview.html](https://applieddigitalskills.withgoogle.com/c/middle-and-high-school/en/build-a-portfolio-with-google-sites/overview.html)

Student Chromebooks/Laptops

# Days 1-2 Objectives:

* 1. SWBAT explain the concept of medical racism and give examples of historical evidence IOT form opinions about the subsequent consequences.
  2. SWBAT articulate current examples of health inequities IOT explore possible ways to resolve the issues.

# Standards:

CC.1.2.8.B Cite the textual evidence that most strongly supports an analysis of what the text says explicitly as well as inferences, conclusions, and/or generalizations drawn from the text.

# Materials Needed:

Article**:** Racism in healthcare: What you need to know <https://www.medicalnewstoday.com/articles/racism-in-healthcare>

Handout: Historical Examples of Medical Racism [https://docs.google.com/document/d/1yD0KzeKVgfYZArEJQYLtM5gj3MGxaPSLToU](https://docs.google.com/document/d/1yD0KzeKVgfYZArEJQYLtM5gj3MGxaPSLToUX2vnhimY/edit) [X2vnhimY/edit](https://docs.google.com/document/d/1yD0KzeKVgfYZArEJQYLtM5gj3MGxaPSLToUX2vnhimY/edit)

1. Health Equity Animated: Equity vs. Equality <https://www.youtube.com/watch?v=tZd4no4gZnc>
2. The Cost of Health Inequity <https://www.youtube.com/watch?v=HJeUnHGE4IE>
3. Health Equity Animated: Race <https://www.youtube.com/watch?v=PTaLFmnS_jo>
4. Heath Equity Animated: Zip Code <https://www.youtube.com/watch?v=v_GfpuavbIU>
5. Health Equity Animated: Income <https://www.youtube.com/watch?v=p9BZHz-duMw>
6. Health Equity Animated: Gender <https://www.youtube.com/watch?v=lKboL0tgWdk>

# Activity:

1. Each video is 1-2 minutes long, so it should take about 15 minutes to watch them all. Teacher should prepare to answer questions, if students should have them.
2. Students will read the article, “Racism in Healthcare: What You Need to Know” together as a class or teacher can read aloud.
3. Class will review the handout on “Historical Examples of Medical Racism” and students will discuss how they feel about hearing each of these examples. Then students will develop their own “policies” about how each of these examples “should” have been handled.

# Days 3-4—Philosophical Chairs Activity Objectives:

1. SWBAT participate in philosophical chairs IOT articulate and defend their

thoughts about the use of humans in medical research without their consent.

1. SWBAT engage in active listening and present themselves verbally in large and small group situations with both peers and adults IOT meet grade appropriate outcomes/expectations as identified in the standards.

# Standards:

S8.A.1.2.1 Describe the positive and negative, intended and unintended, effects of specific scientific results or technological developments (e.g., air/space travel, genetic engineering, nuclear fission/fusion, artificial intelligence, lasers, organ transplants).

CC.1.5.8.A Collaborative Discussion Engage effectively in a range of collaborative discussions, on grade level topics, texts, and issues, building on others’ ideas and expressing their own clearly.

CC.1.5.8.B Critical Listening Delineate a speaker’s argument and specific claims, evaluating the soundness of the reasoning and the relevance and sufficiency of the evidence.

# Materials Needed:

1. Framework for Philosophical Chairs <https://www.edutopia.org/article/framework-whole-class-discussions>
2. Classroom set up for Philosophical Chairs

[www.socialstudiestoolbox.pbworks.com](http://www.socialstudiestoolbox.pbworks.com/)

Possible Topics for Discussion/Debate:

1. Should doctors be allowed to take tissue samples from patients for research without their consent?
2. Part 1: If doctors discovered that there was something in your body (i.e. cells, blood, tissue) that could help to cure others, would you want to know about it?

Part 2: Would you be willing to allow doctors to use your (cells, blood, tissue, etc. to help others?

1. If a patient does not have medical insurance, should doctors offer their patients expensive treatments or cures?
2. Teacher may allow students to formulate their own topics for discussion.

# Activity:

Teachers will familiarize themselves with the framework for philosophical chairs using the link above and then teach it to their students. They should conduct some practice rounds before moving into the actual discussion to make sure everyone is comfortable with the format.

# Days 5-6—Culminating Activity-Create a Google Site Objective:

SWBAT create a Google website IOT showcase all of the projects created during this unit.

# Standards:

CC.1.4.8.U Use technology, including the Internet, to produce and publish writing and present the relationships between information and ideas efficiently

CC.1.4.8.W Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation

CC.1.5.8.F Multimedia Integrate multimedia and visual displays into presentations to add interest, clarify information, and strengthen claims and evidence

# Materials Needed:

Applied Digital Skills- Build a Portfolio with Google Sites (Sites) [https://applieddigitalskills.withgoogle.com/c/middle-and-high-school/en/build-a-](https://applieddigitalskills.withgoogle.com/c/middle-and-high-school/en/build-a-portfolio-with-google-sites/overview.html) [portfolio-with-google-sites/overview.html](https://applieddigitalskills.withgoogle.com/c/middle-and-high-school/en/build-a-portfolio-with-google-sites/overview.html)

# Activity:

This is the culminating activity for this curriculum unit. Students will create a Google Site and upload all the projects completed in this unit. This will include the Google Drawing (Scientific Diagram), the Google Slides presentation (Cancer Biology),

the Google Doc (Research), and reflections from Philosophical Chairs. They may also include links to any of the videos shared in class, vocabulary (students may generate their own quiz using Google Forms), a summary of their comments about what they have learned in this unit, and anything else they choose to add that is relevant to this unit.

Students will watch the videos for the “Build a Portfolio with Google Sites” to learn how to build a Google website. Then they will build a website showcasing the work they have completed in this curriculum unit.

# Resources

**Bibliography for Teachers:** [https://docs.google.com/document/d/15YLXm\_1STSPBeVJPDf8CvDpv-](https://docs.google.com/document/d/15YLXm_1STSPBeVJPDf8CvDpv-jVNytC45BsVoGaFq_g/edit) [jVNytC45BsVoGaFq\_g/edit](https://docs.google.com/document/d/15YLXm_1STSPBeVJPDf8CvDpv-jVNytC45BsVoGaFq_g/edit)

**Optional Resources**: [https://docs.google.com/document/d/12F7y\_lQRI40Nuz4wQ\_wp0bEjFYgHHC2ofBqTs5](https://docs.google.com/document/d/12F7y_lQRI40Nuz4wQ_wp0bEjFYgHHC2ofBqTs5on8RM/edit) [on8RM/edit](https://docs.google.com/document/d/12F7y_lQRI40Nuz4wQ_wp0bEjFYgHHC2ofBqTs5on8RM/edit)

**Student Reading List:** [https://docs.google.com/document/d/1BQB\_LD1ottXa-](https://docs.google.com/document/d/1BQB_LD1ottXa-wwbjdoBhE2ii5qJHOC8W81XZDukv2g/edit) [wwbjdoBhE2ii5qJHOC8W81XZDukv2g/edit](https://docs.google.com/document/d/1BQB_LD1ottXa-wwbjdoBhE2ii5qJHOC8W81XZDukv2g/edit)

**Classroom Resources:** [https://docs.google.com/document/d/1enCUI8psHgO3q8uX25F\_RkZm9Eqpngg9Gaamt](https://docs.google.com/document/d/1enCUI8psHgO3q8uX25F_RkZm9Eqpngg9GaamtRd3rqY/edit) [Rd3rqY/edit](https://docs.google.com/document/d/1enCUI8psHgO3q8uX25F_RkZm9Eqpngg9GaamtRd3rqY/edit)

**Standards:** [https://docs.google.com/document/d/1T\_mQyjuTQxXjOZvBL3S8bRrB1S9HGhJsxDUz](https://docs.google.com/document/d/1T_mQyjuTQxXjOZvBL3S8bRrB1S9HGhJsxDUz8ZOP7bU/edit) [8ZOP7bU/edit](https://docs.google.com/document/d/1T_mQyjuTQxXjOZvBL3S8bRrB1S9HGhJsxDUz8ZOP7bU/edit)

# Appendix: Additional Handouts for Classroom Use

Graphic Organizer (K-W-L chart) <https://www.readwritethink.org/sites/default/files/resources/lesson_images/lesson924/kwl>

[.pdf](https://www.readwritethink.org/sites/default/files/resources/lesson_images/lesson924/kwl.pdf)

Teacher Slides Presentation (Lesson 1)

[https://docs.google.com/presentation/d/1C9BySAlQorbSGoFjpI6Byzi0pxaIfoYw2TqGH](https://docs.google.com/presentation/d/1C9BySAlQorbSGoFjpI6Byzi0pxaIfoYw2TqGHhLsDjM/edit#slide%3Did.ge131e11421_0_205) [hLsDjM/edit#slide=id.ge131e11421\_0\_205](https://docs.google.com/presentation/d/1C9BySAlQorbSGoFjpI6Byzi0pxaIfoYw2TqGHhLsDjM/edit#slide%3Did.ge131e11421_0_205)

Main Idea Graphic Organizer [https://docs.google.com/document/d/1gzTdz5Dz2ohQCWajxMwyn6Xt2hXvv2brqC6zLP](https://docs.google.com/document/d/1gzTdz5Dz2ohQCWajxMwyn6Xt2hXvv2brqC6zLPqivE/edit) [qivE/edit](https://docs.google.com/document/d/1gzTdz5Dz2ohQCWajxMwyn6Xt2hXvv2brqC6zLPqivE/edit)

Cancer Vocabulary Worksheet

[https://docs.google.com/document/d/1JSUeRV-xVc2IG9JzEpUVH46joFitgNpOr2Ubv-](https://docs.google.com/document/d/1JSUeRV-xVc2IG9JzEpUVH46joFitgNpOr2Ubv-PAa-0/edit) [PAa-0/edit](https://docs.google.com/document/d/1JSUeRV-xVc2IG9JzEpUVH46joFitgNpOr2Ubv-PAa-0/edit)

HeLa Cells Images [https://docs.google.com/document/d/1d9koHT61yyIZVBfXsmgr8k2AjqeO7QsED3enUE](https://docs.google.com/document/d/1d9koHT61yyIZVBfXsmgr8k2AjqeO7QsED3enUELBA5g/edit) [LBA5g/edit](https://docs.google.com/document/d/1d9koHT61yyIZVBfXsmgr8k2AjqeO7QsED3enUELBA5g/edit)

Henrietta Lacks Timeline

[https://unlockinglifescode.org/education-resource-profile/henrietta-lacks-timeline-her-](https://unlockinglifescode.org/education-resource-profile/henrietta-lacks-timeline-her-life-and-immortal-hela-cells) [life-and-immortal-hela-cells](https://unlockinglifescode.org/education-resource-profile/henrietta-lacks-timeline-her-life-and-immortal-hela-cells)

More Historical Evidence of Medical Racism [https://docs.google.com/document/d/1yD0KzeKVgfYZArEJQYLtM5gj3MGxaPSLToU](https://docs.google.com/document/d/1yD0KzeKVgfYZArEJQYLtM5gj3MGxaPSLToUX2vnhimY/edit) [X2vnhimY/edit](https://docs.google.com/document/d/1yD0KzeKVgfYZArEJQYLtM5gj3MGxaPSLToUX2vnhimY/edit)

Table 1- Research Advances Enabled by HeLa Cells [https://docs.google.com/document/d/1WiUrNX025f7S2NsA0KxXL50aV5Be-](https://docs.google.com/document/d/1WiUrNX025f7S2NsA0KxXL50aV5Be-kk3IDqqegdlX9U/edit#heading%3Dh.rf3dtx31o3x8) [kk3IDqqegdlX9U/edit#heading=h.rf3dtx31o3x8](https://docs.google.com/document/d/1WiUrNX025f7S2NsA0KxXL50aV5Be-kk3IDqqegdlX9U/edit#heading%3Dh.rf3dtx31o3x8)