

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

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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

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/1RoaI3mWVdvrXViHljDsUJbLjw7qLjtzkR7EK5s2aKs/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/1d9koHT61vyIZVBIXsmgr8k2AjqeO7QsED3enUFLBA5g/edit>

Graphic #3 Henrietta Lacks Timeline

<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-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-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-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-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-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-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-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-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-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-cells-timeline/
Tuberculosis	HeLa cells were used to study how tuberculosis makes people sick.	1993	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-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-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-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-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-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-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

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 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](#) and [hysterectomies](#).²¹ One was Fannie Lou Hamer, later a civil rights leader. In 1961 she was hospitalized to have a [uterine 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}

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

²³ Feagin 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](#).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>

³⁵ Dorothy 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/1C9BySA1QorbSGoFjpI6Byzi0pxaIfoYw2TqGHhLsDjM/edit#slide=id.ge131e11421_0_205

Graphic Organizer (K-W-L chart)

https://www.readwritethink.org/sites/default/files/resources/lesson_images/lesson924/kwl.pdf

Vocabulary Handout

<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>

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

3D Animation: What is Cancer? (1 min)

<https://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-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-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.pdf

Teacher Slides Presentation

https://docs.google.com/presentation/d/1C9BySAIQorbSGoFjpI6Byzi0pxaIfoYw2TqGHhLsDjM/edit#slide=id.ge131e11421_0_205

Vocabulary Handout

<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.

2. **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.

3. **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

4. **Video:** What is Cancer? What Causes Cancer (4 min.)
<https://www.youtube.com/watch?v=WPgJafGz4fg>
5. 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.
6. **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.
7. **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/1C9BySA1QorbSGoFjpI6Byzi0pxaIfoYw2TqGHhLsDjM/edit#slide=id.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.
2. 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.

3. Project #1--Applied Digital Skills: All About a Topic (Google Slides)
<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-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 is 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-all-flesh/>

Article "[How One Woman's Cells Changed Medicine](#)". ABC World News.

Article "[5 Contributions HeLa Cells Have Made to Science](#)". *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](#)". Smithsonian.

Main Idea Graphic Organizer

<https://docs.google.com/document/d/1gzTdz5Dz2ohQCWajxMwyn6Xt2hXvv2brqC6zLPqivE/edit>

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-develop-a-topic/overview.html>

Table 1- Research Advances Enabled by HeLa Cells

<https://docs.google.com/document/d/1WiUrNX025f7S2NsA0KxXL50aV5Be-kk3IDqqegdlX9U/edit#heading=h.rf3dtx31o3x8>

Student Chromebooks/Desktops

Day 1

Materials Needed:

1. Article "[How One Woman's Cells Changed Medicine](#)". ABC World News.
2. Article "[5 Contributions HeLa Cells Have Made to Science](#)". *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' cells](#)". Smithsonian.

Main Idea Graphic Organizer

<https://docs.google.com/document/d/1gzTdz5Dz2ohQCWajxMwyn6Xt2hXvv2brqC6zLPqivE/edit>

Reading Activity:

Teacher will divide students into 4 heterogeneous 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/>

Table 1- Research Advances Enabled by HeLa Cells,

<https://docs.google.com/document/d/1WiUrNX025f7S2NsA0KxXL50aV5Be-kk3IDqqegdlX9U/edit#heading=h.rf3dtx31o3x8>

Research Choice Board (More Historical Evidence of Medical Racism)

<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-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 1 to 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/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. Health 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=IKboL0tgWdk>

Applied Digital Skills- Build a Portfolio with Google Sites (Sites)

<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/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=IKboL0tgWdk>

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.
2. 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.socialstudies toolbox.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?
3. If a patient does not have medical insurance, should doctors offer their patients expensive treatments or cures?
 4. 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-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-jVNytC45BsVoGaFq_g/edit

Optional Resources:

https://docs.google.com/document/d/12F7y_1QRI40Nuz4wQ_wp0bEjFYgHHC2ofBqTs5on8RM/edit

Student Reading List:

https://docs.google.com/document/d/1BQB_LD1ottXa-wwbjdoBhE2ii5qJHOC8W81XZDukv2g/edit

Classroom Resources:

https://docs.google.com/document/d/1enCUI8psHgO3q8uX25F_RkZm9Eqpngg9GaamTRd3rqY/edit

Standards:

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

Teacher Slides Presentation (Lesson 1)

https://docs.google.com/presentation/d/1C9BySAIQorbSGoFjpI6Byzi0pxaIfoYw2TqGHhLsDjM/edit#slide=id.ge131e11421_0_205

Main Idea Graphic Organizer

<https://docs.google.com/document/d/1gzTdz5Dz2ohQCWajxMwyn6Xt2hXvv2brqC6zLPqivE/edit>

Cancer Vocabulary Worksheet

<https://docs.google.com/document/d/1JSUeRV-xVc2IG9JzEpUVH46joFitgNpOr2Ubv-PAa-0/edit>

HeLa Cells Images

<https://docs.google.com/document/d/1d9koHT61yyIZVBfXsmgr8k2AjqeO7QsED3enUELBA5g/edit>

Henrietta Lacks Timeline

<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/1yD0KzeKVgfYZArEJQYLtM5gj3MGxaPSLTouX2vnhimY/edit>

Table 1- Research Advances Enabled by HeLa Cells

<https://docs.google.com/document/d/1WiUrNX025f7S2NsA0KxXL50aV5Be-kk3IDqqegdlX9U/edit#heading=h.rf3dtx31o3x8>