



**Reconciling Our Past, Reimagining Our Future:
Disease and Discovery in America**

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This curriculum unit is recommended for:
8th Grade Integrated Science

Keywords: antiracist pedagogy, microbiology, biotechnology, COVID-19, racial justice, social justice, health policy.

Teaching Standards: See [Appendix 1](#) for teaching standards addressed in this unit.

Synopsis: In this two-part unit, students will explore microbiology and biotechnology through an antiracist framework. This framework will allow students to critically analyze current affairs and contextualize scientific advancements with historical and present-day evidence. Part one introduces students to microbiology using COVID-19 as a case study to understand how a microbial organism such as a virus can lead to disease outbreaks in the form of a pandemic. Students will interrogate the ways in which disease outbreaks can disproportionately affect minority populations because of pre-existing societal inequities. Students will then advocate for change based on their research and brainstorm ways that public health measures can be addressed in the future. Part two introduces students to the pros and cons of biotechnology. The unit incorporates a historical lens through which to assess the way that biotechnology has advanced on account of the exploitation of people of color who do not reap the benefits of those discoveries. Students will imagine ways to invite more community-wide discussion so that all people can contribute and benefit from scientific advancement. By the conclusion of this two-part unit, students will have a deeper understanding of how they are impacted by the interconnectedness of science, and the social, political, and racial issues that pervade the US.

I plan to teach this unit during the coming year to 105 students in 8th grade Integrated Science.

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Introduction

The day before school shut down in Charlotte, North Carolina on March 13th, 2020 my students learned about the difference between an epidemic and a pandemic. They learned that, unlike an epidemic (when there is a disease outbreak that exceeds expected cases in one location) a pandemic is when a disease outbreak exceeds expected cases worldwide. So, as news coverage reporting on the derogatorily named “Wuhan Virus” announced the virus’s spread to Italy, to Spain, and finally to the United States, my class determined, based on their previous knowledge, that the coronavirus would be considered a pandemic. What they likely could not determine at that time, however, was the impact this pandemic would have on our lives.

Just eight months earlier, I had begun my first year of teaching. A recent college graduate, born and raised in England with an ambiguous hybrid accent to show for it, I had an ambitious vision for my entry into the field of public education in America. After studying American politics with a focus on the welfare state, I noticed how disconnected policymakers were from the people whom they claimed to help, and how this form of ignorance could lead to the perpetuation of systemic violence. I asked myself how I could disrupt those systems that perpetuate inequality and racism, and decided that the change I was looking for could take place in our society’s most foundational space: the classroom. However, as a white, inexperienced female teaching in a Title I school, I had a lot of work to do. In order for my students to feel empowered to advocate for change beyond the walls of the classroom, I had to put aside my good intentions and dig deeper. If I wanted my students to feel seen, I needed to put them at the center of their learning and the curriculum.

Demographics

I teach eighth grade science at a school where 52 percent of the students are African American, 36 percent are Latinx, seven percent are Asian and four percent are white. I teach English Language learners, students from immigrant families, students whose families have been victims of the criminal justice system, and students whose parents and cousins and siblings are considered essential workers during the pandemic. Since over seventy percent of the students at my school rely on the free-reduced lunch schedule, with school’s closure, hundreds of students were put at risk of going hungry. My students are living through the constant exposure to the dangerous and distressing news coverage about the ways in which the virus was ravaging communities just like their own.

Objectives

As the coronavirus swept through the country, its impact shed light on patterns in our society that, although shocking to some, are not new. The virus revealed the ugly inequities in our economy, job market, our healthcare system, and our access to basic resources. The inequities did not reveal themselves in light of a crisis, however. In fact, these patterns are ingrained in the foundations of our country, causing disproportionate harm and destruction to our communities of color. This pandemic was considered “unprecedented,” yet its effects are not unprecedented. They are expected. The [first part](#) of this curriculum unit will use microbiology to study the coronavirus as a case study. With an eye toward addressing systemic racism, my

students will interrogate the ways in which pandemics can impact populations according to pre-existing societal inequities.

As we continue to grapple with the effects of the pandemic, we also need to look forward. Therefore, the [second part](#) of the curriculum unit will focus on the future of biotechnology and how it can shape our experiences today. For example, if and when a vaccine is discovered, how will it be distributed? Who will get access to it?

By the end of this two-part unit, I want my students to come up with action steps to address the dilemmas we spent time analysing and discussing. Who is responsible for ensuring that scientific advances - be it biotechnological or related to COVID-19 vaccinations - lead to equitable outcomes? Students' knowledge about advancements in biotechnology could be used to address issues of environmental racism they had discussed in the previous semesters. How can we prevent the spread of disease among black and brown communities, both from a scientific and policy standpoint? These responses could take any form of activism the student sees fit; letters drafted to government officials, presentations, podcasts or infographics are examples. See [Appendix 1: Teaching Standards](#) for more details on how this unit accomplishes the goals set by North Carolina science standards.

The curriculum units, in their totality, will have helped students contextualize the COVID-19 trends we are seeing with the history of abuse and exploitation of people of color within the medical field. Students will be able to understand the extent to which mistrust of the medical field, paired with the historic and present barriers to accessing health care, provide the conditions necessary for a virus to lay claim to the lives of so many people in America.

Content Research

This curriculum unit is a process through which the teacher and the students uncover historic precedents in order to better understand our present world. However, the teacher must be equipped with the knowledge to adeptly align the NC standards to this antiracist approach. The following content will provide teachers with the background knowledge to inspire meaningful discussions in the classroom that allows students to see themselves and their stories reflected in the curriculum.

“The very structured way in which a disaster is experienced, forces us to -- at least at the moral and ethical level -- to really pay attention... .. to the differentiated way in which harm is experienced. And if we don't, then we end up actually becoming part of the problem.” – Eddie Glaude

Curricular Unit Part One: Impacts of COVID-19 are not “Unprecedented,” They are Expected

According to the COVID Racial Data Tracker, that traces the outcomes of COVID-19 according to race, Black people, Native people, Asian Americans, and Latinx were disproportionately dying of, or infected by COVID-19. Dr. Ibram X. Kendi discussed the revelations of this tracker in a discussion with National Low Income Housing Coalition's

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President and CEO, Diane Yentel. He stated, “we’re finding that in state after state, people of color are bearing the disproportionate burden of infection and death rates” (Racial Equity During and After the COVID-19 Pandemic, Live Conversation May 21 2020).

The reasons for these inequities are multifaceted. In the media, it has been discussed that Black people are dying at higher rates because they have pre-existing conditions. However, Dr. Kendi noted that focusing on the pre-existing conditions of Black people made it easy for the media to reduce this data to a series of bad decision making on behalf of the Black community - implying a racist and deeply uninformed understanding of this issue. Instead, Dr. Kendi notes that pre-existing conditions are compounded by “employment, access to health insurance, access to high quality medical care, poor air and water quality” (Ibid, 2020).

Employment

There exists a stark discrepancy between the way the country has treated frontline and essential workers as critical to the functioning of society during a pandemic, yet also dispensable. Kimberlé Crenshaw discussed this hypocrisy in her podcast series Intersectionality Matters: Under the Blacklight. Essential workers -- a group that is overrepresented by Black and Latinx women -- have simultaneously been the people whom we rely upon, yet are put at higher risk.

The podcast episode details the reality of a capitalist society -- one in which productivity is valued over humanity. As the country grappled with a hit to its economic prosperity while states closed businesses to slow down the spread of the virus, left out of the policy discussions were conversations on how to protect those who were deemed “essential” (Crenshaw, 2020).

“Older black women are more likely to be in jobs like domestic work where they have received low wages throughout their entire working lives; they may not be able to retire because they do not have the money to retire ...they may be continuing to work in dangerous unprotected jobs like home care. It is more likely that an elderly black woman will be working as a home care provider than receiving adequate home care. Black women are more likely to have poor health conditions in the first place before they are exposed to the virus. And why is that? Well that's structured as well...Race isn't the risk, it's racism that is the risk to people's health...We should be very alarmed by the idea of rationing health care that maybe we need to sacrifice certain people to the virus in order to get people back to work” (Roberts, Under the Blacklight: The Intersectional Vulnerabilities that COVID Lays Bare, 2020).

Pre-existing conditions are not limited to employment, or the socioeconomic obstacles that people of color experience, however. Access to information also predicts the extent to which communities are exposed or infected to the virus. A study on how knowledge about COVID-19 correlated with exposure or infection of the virus showed that African Americans reported having less information about the virus. Thus, rates of infection were higher among this demographic (Alsan et al., 2020).

What Roberts illustrated, however, is how the intersectionality of race, gender, and socioeconomic status renders women of color to be especially vulnerable to COVID. From a policy perspective, this requires policymakers to construct legislative responses with the most

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vulnerable at the center. The ways in which COVID has impacted our country is differentiated and intersectional, and should therefore be addressed in such a way that considers those intersections of identity, race, gender, economic status and employment.

Immigration

The COVID crisis reveals issues with regard to immigration, as responses to cases arising at the border went largely unacknowledged. Instead of distributing funds to supply public health resources at the borders, funds were instead steered towards converting buildings into “quarantine facilities” which simply confined large groups of people to designated buildings (“SPLC: Trump’s Racist Response to COVID-19 Endangers All Americans, Including Immigrants,” 2020). Those detained at the border are thus rendered vulnerable to the spread of the virus due to the lack of social distancing the detention centers afford them. Court hearings for those detained continue to occur, meaning that those gathered for the court hearings are put at risk of contracting the virus from being among large groups of people. Some immigrants seeking asylum are refused upon arrival, due to a proclamation prohibiting certain immigrants from entering the United States. While the administration claimed this was to preserve employment opportunities for current US citizens, the targeting of immigrants coming from the southern border suggests this decision had a more racialized and sinister objective (Jorge, Aaron, and Walter, 2020).

Criminal Justice

Jails and prisons allow for little to no social distancing. The pandemic has brought to light injustice associated specifically with jails, where people who have yet to pay bail, are forced to stay. Inability to pay bail is the most common reason jail populations are so large, putting those who either work or are incarcerated there, at risk of getting sick. Some counties or states have passed legislation that work to reduce overcrowding of these facilities by either releasing people, or cancelling jury trials (“Responses to the COVID-19 Pandemic,” 2020).

“By Sept. 22, at least 132,677 people in prison had tested positive for the illness, a 5 percent increase from the week before.” - The Marshall Project

The Marshall Project collected data from prisons around the country to expose the extent to which imprisoned people were denied the right to receive adequate health care to protect them from exposure to the virus. The project has collected data that allows viewers to assess their state’s statistics. For example, in North Carolina there have been at least 2,579 cases, and 12 deaths. This fairs better relative to Texas, where there have been 21,653 reported cases and 155 deaths (“A State-by-State Look at Coronavirus in Prisons,” 2020).

Curricular Unit Part Two: Discovery in America: Who Benefits, Who Doesn't?

“Sankofa-inspired approach to science critically engages histories of domination and subordination in order to produce knowledge that is committed to not simply biomedical consumption (as the epitome of capitalist freedom) but an ongoing process (not end point) of social liberation.”

- Ruha Benjamin



When discussing scientific development, especially that of biotechnology, we need to root our understanding of it in the context of our country's history. Where have we been, and where are we going?

Medical Exploitation

Historically, scientific innovation has grown by way of exploiting people of color. From the reports of medical abuse against enslaved women, indigenous populations, to the mass sterilization of poor populations and incarcerated people, to the Tuskegee syphilis trials, to the use of Henrietta Lacks' cells unbeknownst to her and her family.

This history reveals the way the medical institution has exploited racial minorities, constructing a system of distrust and doubt of its ability to truly care for patients. As we look into the future of stem cell research, which is a large component of biotechnology, we have to consider this history in order to contextualize what is happening today.

Stem Cell Research

“[W]hen we develop the ability to control disease and death, the benefits of this new-found ability are distributed according to resources of knowledge, money, power, prestige, and beneficial social connections” (Benjamin, 2013).

Stem cell research is one of the most prominent and controversial areas of biotechnology due to its ethical and moral concerns. The debates usually center on the idea of whether it is morally right to use stem cells from a fetus, which some people consider to be a human being. But rarely do these discussions on ethics focus on the women who donate the eggs, or the people who may benefit or be harmed by the development -- whether that is due to inequities in the

distribution of funding and resources, or due to disruptions in the environment to make room for large scientific corporations to move in.

In Ruha Benjamin's book *People's Science: Bodies and Rights on the Stem Cell Frontier*, the political agendas of advocates for increased funding for stem cell research largely overlooked important social issues. The politics that surround the topic of stem cell research is worth analysing because it allows us to critically evaluate the ways in which public participation does, or does not, affect the way that crucial resources are distributed. This begs the question of "who is at the table?"

Debates around stem cell research often neglect the controversy that involves paying the women whose eggs are used for the research. Compensation for egg donations is hotly debated among feminist groups in particular. On the one hand, compensation should be given because any involvement in research should be accounted for monetarily just as it is at any other stage in the process. On the other hand, it brings into question the ethics of coercing women (especially women who may be socioeconomically disadvantaged) into research without a complete understanding of how it works and how it may affect them. This parallels with the long history of exploitation of disadvantaged women.

In order to allow for scientific research to impact communities at large, those communities "need to be at the table, not just on the table" (Benjamin 2013, p. 10). Community members need to "actively construct and calibrate the risks of aligning their interests with scientific initiatives, forming the supple social infrastructure of stem cell research and related life science" (p. 7). The importance of educating communities on the research, and allowing them to be stakeholders in decision-making, is crucial.

Additionally, there is the question of mistrust. Benjamin writes,

"For many impoverished people, ethnoracial minorities, and people with disabilities, all of whom have been historically exploited or neglected by scientists and doctors, excitement over touted "scientific breakthroughs" may generate scepticism regarding the potential of regenerative medicine to address their well-being" (p. 18).

For example, stem cell research advocates were concerned about the low sickle cell transplant rate (due to low number of primarily African American patients contributing to the research). Benjamin posits that this was the result of a combination of processes involving uncertainty around the research itself and the institutionalized conflation of healthcare and research.

Researchers should consider that, for many, the benefits do not outweigh the risks, and that distrust in medical institutions can be seen as trust in something other than experimental methods -- spiritual methods, for example. Consider uplifting the work that caregivers do in non-medicalized contexts using experiential knowledge (which is not considered valid or legitimate in the context of westernized medical worlds).

Rejection of medication for sickle cell also relates to the rejection of being beholden to biomedical dependency and money. Medication costs money, but exercise (what many patients believe they needed to help their condition) does not. Some patients also consider the sickle cell illness to be the least of their problems, or at least not the ultimate priority.

Lastly, what about basic health care needs? When basic health care needs are neglected, why should they bother with this form of treatment? Indeed, “[w]hen families experience a disproportionate emphasis on their value to research and much less attention paid to their everyday healthcare needs, scepticism toward research solicitation appears justified” (p. 126). Benjamin argues that with a deeper understanding of these perspectives, biotechnology can be developed in a way that legitimately serves “the people.”

Instructional Implementation

Teaching strategies

Each unit can be taught in one to two weeks, depending on how frequently the class meets. The following outlines divide each unit into three parts:

- 1) Connecting to the narrative (what’s the dilemma?)
- 2) Adding intrigue (what are the details?)
- 3) Agents of change (what can we do about it?)

Each lesson follows a 5E structure: Engage, Explore, Explain, Extend and Evaluate.

Connecting to the Narrative

In order to incite change, one must be emotionally invested. In order to build up an investment in the issues we are tackling in these units, the students must first understand “What is the dilemma, and what are the details?”

Curricular Unit Part One: Using the COVID Racial Data Tracker, students will be able to understand the impact that COVID has had on their own state, and understand how they fit into the context of North Carolina as a whole. They will be asked what they notice about the data they find, and then try to find an explanation for it.

One of the explanations we will learn about is access to information. Students will thus think about their own lives and the access they had to information about the virus at the beginning of the pandemic. They will interview each other and partake in a similar survey that was conducted in the study they will read about (see [Classroom Lessons/Activities](#)).

Curricular Unit Part Two: In the biotechnology unit, students will connect to the narrative by engaging with its history first. Students will study events in history such as the Tuskegee Syphilis trials, J. Marion Sim’s experimentation on enslaved women, the mass sterilization of prison populations, indigenous populations, and the use of Henrietta Lacks’ cells to develop science without her knowledge.

With these histories in mind, students can better understand the way that “people engage with biotechnologies through a complex interplay of their past experiences (real and imagined), present circumstances, and future hopes and fears” (Benjamin, 2013). Students will thus be asked to talk to their own families about their view of doctors and the medical system at large.

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Adding Intrigue

Curricular Unit Part One: In the microbiology unit, students will next delve into the social influences that shape the way the disease impacts us, by choosing one of the topics mentioned (immigration, criminal justice, employment, etc.). This way, students can begin the process of becoming emotionally invested enough in an issue to be inspired to make a change.

Curricular Unit Part Two: In the biotechnology unit, students will look more closely at a case study to examine the interplay of politics, science, and community engagement. Using stem cell research as a point of analysis, students will engage in the debate around the ethical concerns. Usually when we talk about ethical concerns it's based around the use of embryos for research or the use of animals for cloning, but instead, students will see how the development of stem cell research produces ethical concerns beyond that debate.

Agents of change

“We need to tackle a much more fundamental question: not simply, what kinds of policies and initiatives do we wish to undertake, but also, who are the agents of change?” - Ruha Benjamin

“What we can do is make sure we don't teach just the trauma; that we teach the pain, the love, the joy, the resistance, equally, and tell our full story of our humanity. That's what makes us human -- is when we tell our full story.”

- Bettina Love

The research in both units address issues that are traumatic and difficult to face. It highlights the ways in which systemic inequality persists in our country; how some people's voices are heard over others. So how do we address this information without losing hope? How can we be agents of change with this knowledge in mind?

Curricular Unit Part One: After researching how COVID impacted the US in different ways, groups will use the topic they felt strongly about and write a letter to their local representative demanding a change. This change could be redistributing funds, it could be changing a policy, it could be providing better resources.

With a deeper understanding and investment in how diseases are impacted by policies, students will dive into the science content and learn about what caused this specific disease. The unit will thus continue with a deeper dive into microbiology - viruses, bacteria, parasites and fungi.

Curricular Unit Part Two: In biotechnology, students will cultivate a model for “participatory science” whereby scientific advancements and legislative decisions are made truly by “the people.” Students will ask who is really benefiting from biotechnological advancements. Who has a say in how it develops? How can we brainstorm ways to improve the future of biotechnology?

Students can get inspiration from groups that are doing similar work, such as Wise Young, a doctor and professor, who teamed up with hip-hop artist Richard Gaskin (otherwise known as

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[ProfessirX](#)) to demonstrate one way that “community collaboration” can generate support for, and trust in, stem cell research. Gaskin was able to be a spokesman and an educator, demystifying the research and explaining why these cures were so important to him, while Young was able to provide scientific background. This form of outreach helped to recruit “hard to reach” populations for clinical trials (John, 2010).

Finally, as we explore and analyze the impact that COVID-19 had on the United States, I want my students to refer to their own lived experiences in ways that are empowering, and not distressing. By tackling issues of race and inequality, and using their own realities as reference points, my students should know their experiences are valuable, and should be able to put those experiences into words to advocate for themselves.

I intend for my classroom to be a space of self-empowerment and change-making. It is not enough to discuss the issues - we should be deliberately teaching our students how to demand change in collaboration with others, and to understand that young voices matter.

Classroom Lessons

Curricular Unit Part One: Microbiology

Day 1: Connecting to the narrative (what’s the dilemma?)

Objective: Students will be able to identify COVID-19 as a virus that lead to a world-wide outbreak, otherwise known as a pandemic.

Engage: The teacher can open up by asking students what they already know about viruses. Students may refer to COVID-19 or the flu unprompted.

Explore: The teacher can then explain how microbiology is a science that explores microscopic organisms like viruses, but that despite their small size, has a huge impact on us because of how they can be transmitted. This impact can be in the form of an epidemic (one location) versus a pandemic (world-wide). After defining the difference between the two, the teacher can use news reports and videos to have students identify COVID-19 as a pandemic. This will establish a foundation of knowledge before moving onto a deeper analysis of how disease can impact populations differently.

Explain: Once the definitions of epidemics and pandemics have been established, students will be able to identify COVID-19 as a pandemic, and explain why.

Extend: To begin the deeper analysis, students will use [The COVID Racial Data Tracker](#) and write down some facts and figures.

What do you notice?

COVID-19 disproportionately impacted and killed people of color around the world.

Why do you think it was killing Black and brown people more than white people?

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How that links to lack of access to health care, other pre-existing conditions, environmental concerns, housing etc.

When COVID was happening, what information did you get about it? Where did you get information about it?

The teacher can refer to a study on how knowledge about COVID-19 correlated with exposure or infection of the virus. African Americans reported having less information about the virus, and were reported to have higher rates of infection.¹

Evaluate: Teacher will say, “You are all going to partake in a similar survey that was conducted in this study. You will interview each other, asking each other about the information you had about the virus. Think about where you got your information from as you go:”

1. Did you or someone you know get COVID-19?
2. If someone you knew got it, how old were they?
3. Were you or someone you know tested?
4. How is COVID-19 spread?
5. What are the symptoms of COVID-19?
6. How can you prevent transmission of COVID-19?

Day 2: Adding intrigue (what are the details?)

Objective: Students will be able to identify how diseases impact populations based on external social factors.

Engage: Teacher will say: “Yesterday we tackled questions around who gets access to information from health experts, who gets treated, who is more exposed. Today we are going to delve into the social influences that shape the way diseases impact us.”

Explore: The class will explore a variety of intersectional issues that COVID exacerbated. The teacher can either introduce each issue to the whole class through podcasts, news reports, articles, data trackers (refer to [Content Research](#) for more details on resources), or they can let the students pick a topic that piques their interest immediately and allow them to explore the resources individually or in small groups.

The following topics could be introduced to get students started:

- [Immigration](#)
- The [criminal justice system](#)
- Explicit [xenophobia](#)
- [Essential](#) workers are more likely to be people of color compared to white people, and they are less protected (thus considered both essential and [expendable](#))
- [Exposure](#) to pre-existing conditions among ethnic and racial minorities

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Explain: Students can record their findings and thoughts through a variety of methods outlined in [Appendix 2](#). These methods could include [graffiti boards](#), T-charts, or more simple notetaking on a working document.

Day 3: Agents of change (what can we do about it?)

Objective: Students will be able to explain how we can prevent the spread of disease on an individual and a community-wide level, and further, how to prevent it from disproportionately impacting vulnerable populations. Students will review their findings from the day before and complete an action document.

Extend: Groups will draft a letter to their local representative demanding a change with regard to the issue they researched the previous day. This change could be redistributing funds, changing a policy, or providing better resources.

Evaluate: Students will be provided with several “templates” they can use to write their letters, as well as a list of representatives based on where they live. The teacher can then see that these letters or emails are sent out, either by delegating the task to a student or doing it themselves.

Day 4: What is microbiology and why does it matter?

Objective: Students will be able to explain how viruses like COVID-19 reproduce and how they can be treated using vaccines. Students will be able to describe 2-3 that microbiology impacts them.

Engage: Class will begin by students choosing their “group” that represents a historical figure who has contributed to the advancement of microbiology:

- **Onesimus:** Onesimus, a previously enslaved African American who eventually gained freedom, played a pivotal role in developing a vaccine for smallpox in the 1700s.²
- **Ruth Ella Moore:** first African American woman to earn her Ph.D in natural sciences, she taught and researched at Howard University until retirement.³
- **William Augustus Hinton:** received his medical degree from Harvard University and developed a diagnosis and treatment for syphilis.
- ⁴
- **Harold Amos:** through his various faculty positions at medical institutions, he advocated for the support of minorities in the field of science.⁵
- **Jessie Isabelle Price:** conducted research that explored the relationships within ecosystems which lead to a discovery that would curb the spread of a type of cholera.⁶

Explore: We have been investigating how social factors influence the way diseases impact people. However, while we can control the spread of a disease using prevention measures, we cannot control the virus itself once it is in our bodies. The teacher will show students how viruses reproduce inside our bodies, and how vaccines work to prepare our bodies to fight off intruders such as viruses.

Explain: Students will complete a worksheet (example provided in [Appendix 2](#)) where they will get familiar with what a virus and a vaccine is.

Extend: Advancements in microbiology have allowed us to understand how the smallest of organisms can have such a great impact on us. Studying microbiology can even help us find ways of treating and preventing sickness and disease, to understand how our bodies work, and to even tackle problems such as climate change (microbes play a role in bioremediation, where organisms clean up contaminated water or land or they play a role in plant's nutrient cycles). How are *you* impacted by microbiology?

Evaluate: Students will complete a visual of 2-3 ways microbiology had impacted them. They can again use creative methods such as graffiti boards mentioned above.

Curricular Unit Part Two : Biotechnology

Day 1: What is biotechnology and how does it impact us?

Objective: Students will be able to define biotechnology and list ways we benefit from it.

Engage: Teacher will get students thinking about our genetic make-up

- Where do you find genes? You can find genes... At hardware stores In restaurants
 In garbage dumps In living things
- We can **modify** or **change** a gene so it's DNA will be different, and so the organism can become better, bigger, tastier, stronger.

Explore: When we talk about biotechnology we are talking about the way we can use living things as a tool to make something new. We can do this by using Genetically Modified Organisms.⁷ We can use biotechnology in agriculture (on farms) and in medicine (in healthcare). Teachers can modify the benefits of biotechnology based on the location they are teaching in to maintain relevancy.

Explain: Students will familiarize themselves with the vocabulary by completing a worksheet or an interactive game that allows for a check for understanding checkpoint such as Kahoot.⁸

Extend: Students will assess how they personally benefit from biotechnology by completing a chart and answering yes/no to engaging in everyday practices or using products (provided in [Appendix 2](#)).

Evaluate: Students will make their own graphic organizer of the benefits of biotechnology in medicine and agriculture.

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Day 2: Adding intrigue (what are the details?)

Objective: Students will take closer look at *who* is in the biotechnology field, and the potential the ethical concerns the industry raises.

Engage: Let's look at some of the websites of some the country's leading biotechnology companies. What do you notice? What do you wonder?

Explore: As we continue to learn about biotechnology, it's important to be critical of the information we are receiving. Who is overrepresented/underrepresented? What are the concerns that arise?

Not only should we be critical of *who* is involved but also *what* is involved. Teacher will review some ethical concerns that are often cited when discussing biotechnology including embryonic stem cell research and cloning as well as other cons including antibiotic resistance, pest-resistant crops, pesticide runoff, and high cost.

Explain: Students will be asked to look back at their graphic organizer that showed the benefits of biotechnology. Students will go into breakout rooms to answer what are some potential problems with these technologies?

Extend: In what ways has today broadened your idea of what constitutes an ethical concern? What ethical concerns do you have with North Carolina's biotechnology advancements? (refer to [Appendix 2](#) for an extended discussion using California stem cell research as an example).

Evaluate: Students will distinguish between pros and cons of biotechnology and provide evidence for what impact the consequences of biotechnology could have on people. (E.g. biotechnology is expensive; what is the consequence of it being expensive? Those who cannot afford it cannot benefit from it.)

Day 3: Connecting to the narrative (what's the dilemma?)

Objective: Students will continue to critically analyze the biotechnology industry and use historical evidence to cite reasons to be critical.

Engage: When we talk about scientific development, we need to root our understanding of it in the history of our country. Where have we been, and where are we going?

Explore: Historically, scientific innovation has grown by way of exploiting POC in our country. The teacher can introduce examples of these moments in history through a gallery walk.

- Tuskegee syphilis trials
- Reports of numerous medical abuses against women, racial and ethnic minorities
- People with disabilities
- Indigenous populations
- Prisoners
- Henrietta Lacks

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Explain: Students can use the graphic organizer outlined in [Appendix 2](#) to map out and process how history reveals the way the medical institution has exploited racial minorities, constructing a system of distrust and doubt of its ability to truly care for patients.

Extend: Teacher will say “Think about your family...what are their views of doctors? Do they trust doctors and hospitals? Do you know why/why not?” (This could also be a homework assignment from the night before that students can discuss in class)

Evaluate: Reflection: With these perspectives in mind, can you rationalize why some people may be hesitant about biotechnology? How can your life experiences contribute to the discussion on how biotechnology should continue to develop? What could you bring to the table in discussion? Let’s say you are in charge of funding stem cell research, what questions would you ask?

Day 4: Agents of change (what can we do about it?)

Objective: Students will be able to apply their deeper understanding of the historical context of scientific advancement in America to devise solutions that would reimagine the future of biotechnology.

Engage: We have been unpacking the pros and cons of biotechnology over the last few days. Now it’s time to put what we have learned into action. What does it mean to develop science in a way that accurately represents, respects and reflects all communities? How can we brainstorm ways to improve the future of biotechnology?

Explore: Examples of community outreach that spreads awareness:

- Wise Young, a doctor and professor, teamed up with hip-hop artist Richard Gaskin (otherwise known as ProfessirX) to demonstrate one way that “community collaboration” can generate support for and trust in stem cell research.⁹ Gaskin was able to be a spokesman and an educator, demystifying the research and explaining why these cures were so important to him, while Young was able to provide scientific background. This form of outreach helped to recruit “hard to reach” populations for clinical trials.

Explain: Students will refer back to their graphic organizer and identify points that this method of community organizing answers to the problems they saw with the historic examples of exploitation of and severance from communities of color within the field.

Extend: Students will engage in Participatory Science whereby they analyze the issue and provide policy based solutions. Teacher can refer to [Appendix 2](#) for the extended discussion guide.

Evaluate: Students will put together a presentation (method of their choice) to promote their ideas.

Appendix 1: Teaching Standards

Structures and Functions of Living Organisms

8L1.2 Explain the difference between epidemic and pandemic as it relates to the spread, treatment and prevention of disease.

8L1.1: Summarize the basic characteristics of viruses, bacteria, fungi and parasites relating to the spread, treatment and prevention of disease.

8L2.1 Summarize aspects of biotechnology including: specific genetic information available, careers, economic benefits to North Carolina, ethical issues, implications for agriculture

Appendix 2: Teaching Materials and Tools

Curricular Unit Part One, Day 2

Topic	What communities are impacted by this social matter?	What are the strengths of these communities?	How has COVID impacted the community?	What are your takeaways?
Immigration				
Prison				
Employment				
Other				

Curricular Unit Part One, Day 4

**Science Speak:
Microbe, Transmit, Prevent**

In order to _____ catching a dangerous _____ like a virus you should wash your hands.
Washing will also lower your chances of _____ the microbe to someone else through contact.

Guided Questions	Notes: Microbiology
<ul style="list-style-type: none">• What is a Virus?	_____ particles composed of a nucleic acid (DNA or RNA) and a _____ .
<ul style="list-style-type: none">• Viruses are NONliving!	Viruses need a _____ to _____.

<ul style="list-style-type: none"> • What does that mean? 	<p>Viruses invade the host's _____ and use their _____ to make more _____, usually _____ the _____ cells in the process.</p>
<ul style="list-style-type: none"> • How are viruses prevented? How are they treated? 	<p>_____ are medicines that help _____ a virus. Once caught some viruses can be _____ with _____ - _____ medication and stopped by our body's _____</p>
<ul style="list-style-type: none"> • What is a vaccine? How does it work 	<p>1. A vaccine places a _____ form of the _____ inside a _____ person's body</p> <p>2. The body's _____ develops antibodies to _____ the virus</p> <p>3. If the virus _____ the body _____ the body is already _____ to fight it</p>
<ul style="list-style-type: none"> • How are viruses transmitted? 	<p>Some are transmitted by _____, _____, while others are transmitted through _____ or _____ bites.</p>

Curricular Unit Part Two, Day 1

	Yes/No	Tell me more!
Do you eat fruit and vegetables?		Lots of staple items in the produce aisle of the grocery store were genetically engineered to be bigger, and tastier.
Do you know someone who is allergic to certain food?		Biotechnology scientists are working to isolate the specific proteins that trigger allergic reactions and modify the foods so as to eliminate the health risk. ¹⁰
Do you use laundry detergent?		Today, scientists have created industrial biotechnology or "white biotech," which uses enzyme cells or components of cells to generate industrially-useful enzymes for laundry detergents. ¹¹
Do you wear cotton clothes?		The cotton plant is often covered in a pesticide that kills insects who may want to eat the cotton.

Do you know someone who has diabetes?		We can genetically modify bacteria to make insulin (a hormone that helps regulate blood sugar levels for people with diabetes)
Do you or someone you know drink coffee?		When you made coffee this morning, you probably didn't realize the filter was made with a biotechnology process that uses enzymes to bleach the paper, reducing the amount of chlorine and energy used in manufacturing. ¹²
Do you like cheese?		Biotechnology has allowed scientists to create an enzyme that helps produce purer cheese at a greater rate without the use of animals who produce the enzyme naturally. ¹³

Curricular Unit Part Two, Day 2:

It's all too often that legislative decisions are made without properly including "the people" into these discussions. Who is really benefiting from these advancements? Who has a say in how it develops?

Here's what we know about stem cell research in California, one of the leading states in stem cell research:¹⁴

- Recently they received \$3 million dollars from the state (paid for by taxpayers) to develop their research.
- The California Institute for Regenerative Medicine (CIRM) has a board with 27 people on it. 93% are white, 11% are people of color (only 2 board members are African American).
- At the time that a bill was sent out to vote on whether or not to fund this research, another bill was also on the ballot, which was supposed to expand healthcare coverage for uninsured Americans.
- They built the research center in San Francisco, the country's top innovation hub, whose population is 45.4% White (40.0% Non-Hispanic White and 5.4% Hispanic White), 5.2% Black or African American, 34.3% Asian, 8.1%
- Debates over whether egg donors should be compensated - if they are compensated, stem cell research may take advantage of low-income women without disclosing the dangers of being involved, if they don't compensate, women are being used for research and not reaping any benefits (like Henrietta Lacks)

Things to consider:

- To do stem cell research, they have to use a woman’s embryonic cells (that come from her eggs) which brings up two problems:
 - Some people think that an embryo is equal to a human life, and therefore sacrificing a human life for science is unacceptable
 - Others aren’t as worried about the embryo, but are more worried about the women who are involved in this research. Are the side effects of the drugs/treatment made explicit? How are they to know that what happened to Henrietta Lacks won’t happen to them?

Discussion Question: The debate goes beyond whether to use embryos or not. It is also about *whose* embryos are we using? Usually when we talk about ethical concerns it’s based around the use of embryos for research or the use of animals for cloning. Today we are going to see how the development of stem cell research produces ethical concerns beyond that debate.

Curricular Unit Part Two, Day 3:

Exploratory Discussion Questions Example ¹⁵	Strength
What do we know about biotechnology? Where does our knowledge come from?	Allows us to reflect on our information flow, assumptions, and epistemologies.
What does our common knowledge about biotechnology reveal about our society’s values?	Allows us to shift the conversation from research subjects in need of fixing or curing and affords the opportunity to explore alternative descriptions of the problem.
How might society embrace these scientific advancements? What would be gained by doing so?	Allows us to explore multiple pathways for research and imagine the strengths of each approach that has consequences beyond the specific area of concern.

Follow-up Questions:

Dimensions	Question	Rationale. What will this question do?
Politic		
Society or Culture		

Emotions or Feelings		
Economy		
Ethics or Morals		
Spirituality or Religion		
Technology		
Environment		
Science		
Other:		

Curricular Unit Part Two, Day 4:

Cultivating “Participatory Science:”¹⁶

1. Describe the area of concern by developing questions
2. Generate policy possibilities that respond to those questions
3. Explore possible consequences in order to revise the policy options
4. Organize joint panel discussions between persons with professional experience relevant to the area of concern and citizens whose familiarity with the area of concern grows out of their general life experiences outside of work (typically called “lay” persons, their experiential knowledge is no less vital to the process)
5. Create a citizen discussion report (and items for collective action)

Appendix 3: Resources for Students

A State-by-State Look at Coronavirus in Prisons. (2020, September 23). *The Marshall Project*. <https://www.themarshallproject.org/2020/05/01/a-state-by-state-look-at-coronavirus-in-prisons>

The Marshall Project has compiled data on prison systems around the United States, revealing the numbers of cases reported among incarcerated people. This resource allows students to toggle between different locations and compare data points across states.

Biotechnology Solutions for Everyday Life. (n.d.). *Biotechnology Innovation Organization*. <https://archive.bio.org/articles/biotechnology-solutions-everyday-life>

This site provides students a chance to explore a website that promotes biotechnology. It can be used a resource that not only provides information on biotechnology and its uses, but also allows for students to be critical of who is represented across the website's pages.

Graffiti Boards. (n.d.). *Facing History and Ourselves*. <https://www.facinghistory.org/resource-library/teaching-strategies/graffiti-boards>

Use of graffiti boards in classrooms allows for students to explain an idea using a creative outlet of their choice. Graffiti boards give students space to express themselves, while teachers can assess their level of understanding of the material in a non-traditional way, without using an assessment.

Appendix 4: Resources for Teachers

Alsan, M., Stantcheva, S., Yang, D., & Cutler, D. (2020). Disparities in Coronavirus 2019 Reported Incidence, Knowledge, and Behavior Among US Adults. *JAMA Network Open*, 3(6), e2012403. <https://doi.org/10.1001/jamanetworkopen.2020.12403>

This study reveals the ways in which dissemination of information about the coronavirus was not equal. Among African American participants, knowledge about the virus and how one can prevent its spread was less than among white participants. As a result, shifts in behavior in response to the virus was different among these racial groups. Findings also revealed these differences when using age as a variable. Teachers can use the interview questions in this study for their students.

BENEFITS & RISKS OF BIOTECHNOLOGY. (n.d.). *Future of Life Institute*.
<https://futureoflife.org/background/benefits-risks-biotechnology/?cn-reloaded=1>

This site provides more examples of how biotechnology is used in our everyday lives, and details the risks associated with the field as well. This site would extend the examples of pros and cons of biotechnology that the NC standards mention and could allow for richer discussions in class.

Benjamin, R. (2013). *People's science: Bodies and rights on the stem cell frontier*. Stanford University Press.

This book provides a critical analysis of the biotechnology industry in California. It offers an in-depth chronicling of the political battle between advocates for the advancements of stem cell research, and those arguing against use of public funds to go towards the destruction of embryos. Benjamin adeptly critiques the ways in which the “stem cell frontier” is branded as the “people’s science” when in reality “people” are largely left out of the planning for such largescale redistribution of public funds to go towards science development. Benjamin thus adds nuance to an otherwise commonplace debate between pro-life advocates and science developers.

Crenshaw, K. (n.d.). *Under the Blacklight: The Intersectional Vulnerabilities that COVID Lays Bare*. Retrieved March 30, 2020, from
<https://open.spotify.com/episode/77uJBBf0L9d1CRQN1YB37d?si=UUrtbqJ2Rr2uKgV-IsxPjA>

This is an eye opening discussion about the way that COVID-19 has revealed racial disparities in employment, healthcare, education and other socio-political areas. The discussion takes place on Crenshaw’s Podcast “Intersectionality Matters” and includes other experts in the policy, economics and healthcare fields. Teachers could listen to it to lay a foundation of knowledge for themselves, or listen to it along with students in class.

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