



FUTU^{RE}LAB+

BIOMED

*Crowdsourcing Innovations
in Biotechnology*

Cell Damage

Developed in partnership with:
Discovery Education and Ignited

In this Lesson Plan:

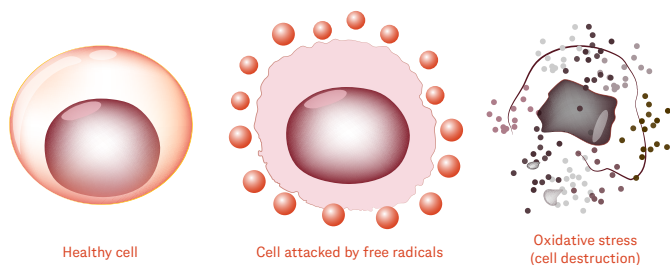
[Print the Teacher Section →](#)

[Print the Student Section →](#) 

01 For Teachers	Page
Overview	1
Pedagogical Framing	2
Questions and Connections	3
Instructional Activities	
Procedure: Day 1	4-6
Procedure: Day 2	7-8
Procedure: Day 3	9-10
Procedure: Day 4	11-12
Procedure: Day 5	13
National Standards	14

02 Student Resources	Page
Cellular Hierarchy Rubric	1
Cellular Hierarchy Capture Sheet	2-3
Sickle Cell Rubrics	4
Multiple Sclerosis Guided Research	5-6
Multiple Sclerosis Device Rubric	7
Presentation Responses	8-9
Healthy Lifestyles Capture Sheet	10
Healthy Lifestyle PSA Rubrics	11
Investigating Biomarkers Capture Sheet	12
Investigating Biomarkers Rubric	13

Cell and Free Radicals



Cell and Free Radicals

Healthy cell, cell attacked by free radicals, and oxidative stress (cell destruction).

Cover Image

The image shows a cell that has been divided by mitosis.

This document is separated into two sections, For Teachers [T] and Student Resources [S], which can be printed independently.

Select the appropriate printer icon above to print either section in its entirety.

Follow the tips below in the Range field of your Print panel to print single pages or page ranges:

Single Pages (use a comma): T3, T6

Page Range (use a hyphen): T3-T6

BIOMED / CROWDSOURCING INNOVATIONS IN BIOTECHNOLOGY

Cell Damage

DRIVING QUESTION

How do changes at the cellular level lead to systemic disease?

OVERVIEW

What does disease look like? While more extensive symptoms, like jaundice and difficulty breathing typically come to mind, those symptoms originate in changes at the cellular level. Diseases can cause cellular damage or be the result of cellular damage or alterations. Cell damage can result from changes that a cell experiences due to external or internal environmental stress. The length of exposure to a harmful stimulus and severity of damage can lead to cell death.

In this lesson, students will examine how changes at the cellular level can produce systemic disease. They will investigate lifestyle choices that lead to cellular damage and potential illness. Finally, students will create an investigation comparing biomarkers in both healthy and diseased tissue.

ACTIVITY DURATION

Five class sessions
(45 minutes each)

ESSENTIAL QUESTIONS

What does disease look like at the cellular level?

How does cellular damage relate to problems at the organ system level?

How do biomarkers differ between diseased and healthy cells?

OBJECTIVES

Students will be able to:

Explain how a disease can cause or be caused by cellular dysfunction.

Identify changes at the cellular and tissue level that are indicative of disease.

Present a report comparing biomarkers in healthy and unhealthy tissue.

Materials

Computers with Internet Access

Cellular Hierarchy Capture Sheet

Cellular Hierarchy Rubric

Prediction Exit Ticket

Sickle Cell Rubrics

Multiple Sclerosis Guided Research

Multiple Sclerosis Device Rubric

Healthy Lifestyles Capture Sheet

Healthy Lifestyle PSA Rubrics

Presentation Responses

Investigating Biomarkers
Capture Sheet

Investigating Biomarkers Rubric

Design Journal

Pedagogical Framing

Instructional materials are designed to meet national education and industry standards to focus on in-demand skills needed across the full product development life cycle—from molecule to medicine—which will also expose students and educators to the breadth of education and career pathways across biotechnology.

Through this collection, educators are equipped with strategies to engage students from diverse racial, ethnic, and cultural groups, providing them with quality, equitable, and liberating educational experiences that validate and affirm student identity.

Units are designed to be problem-based and focus on workforce skill development to empower students with the knowledge and tools to be the change in reducing health disparities in communities.

SOCIAL-EMOTIONAL LEARNING

Teamwork is a social-emotional learning strategy that aids in community building. Teamwork allows students to practice empathy and encourages them to appreciate and learn from diverse groups. This lesson encourages teamwork around the topic of securing funding for under-researched diseases and aligns with the C3 Framework of “Taking Informed Action.”

CULTURALLY AND LINGUISTICALLY RESPONSIVE INSTRUCTION

In this lesson, students investigate disparities between funding for sickle cell, a disease that disproportionately affects historically marginalized communities, and funding for cystic fibrosis, a disease that is found mostly in white children. This lesson employs the use of many culturally and linguistically responsive strategies to assist in this goal, including “Turn To Your Partner” and “Divide and Conquer,” which encourage collaborative research. Throughout the lesson there are opportunities for the teacher to call out when resources and technology have been created by culturally diverse scientists, students, and researchers.

ADVANCING INCLUSIVE RESEARCH

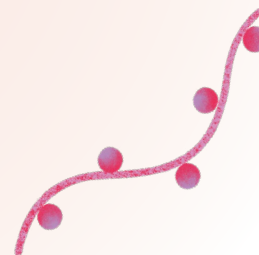
This lesson invites students to investigate funding disparities among diseases and identify platforms to encourage increased funding. This supports engaging and recruitment of diverse populations in all phases of clinical research.

COMPUTATIONAL THINKING PRACTICES

Computational thinking is the practice of using strategies from computer science to solve real-world problems. Computational thinking applies to every discipline, and in this lesson, students use the computational thinking strategies of finding patterns, decomposition, abstraction, and analyzing data to understand how disease impacts the body.

CONNECTION TO THE PRODUCT LIFE CYCLE

In this lesson, students learn about breakthroughs in histology that allow diagnosis through tissue examination. These technologies, which are relatively new but contain promise, exist between the **discovery** and **development** phases of the product life cycle.



Have you ever wondered...

How does cellular damage manifest itself as a symptom of illness?

Cellular damage can lead to numerous complaints that are dependent on the location of the degradation. Damage to lung cells can lead to difficulty breathing and susceptibility to respiratory infections. Death of heart tissue can lead to diminished pumping, resulting in decreased blood flow to essential organs that can present as lightheadedness, pale skin, and pain. Dysfunctional nerve cells lead to spasms, pain, and limited mobility. The body is a hierarchy with cells at its base and losing that base leads to damage and potential collapse of more complex structures.

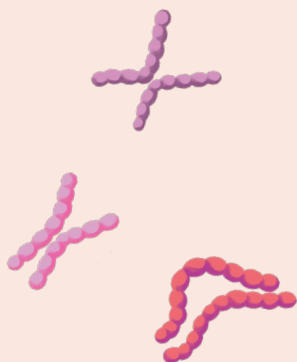
What do lab technicians look for in blood and tissue samples?

When looking at blood smears and tissue samples, lab technicians will look for everything from elevated numbers of certain types of cells, malformation of cells, lack of certain types of cells, and numerous other disease-specific markers.

MAKE CONNECTIONS!

How does this connect to the larger unit storyline?

This unit connects to the previously studied role of altered or diminished cellular function in disease. By learning about the cellular basis of a disease, students will begin to grasp how illness starts at the minuscule level to affect tissue and organ function, ultimately altering healthy biomarkers. This unit gives students a broad basis for understanding pathophysiology, which will be expanded on in the following lessons as they progress to developing their novel wearable technology device.



How does this connect to industry and careers?

Medical science liaisons are skilled in communicating scientific information. They serve as intermediaries between companies producing new drugs and technologies and specialists interested in them. This connection also ensures that the product is practical and applicable in the real world. Medical science liaisons must be professional, organized, and excel at time management and creating clearly communicated presentations.

Histology technicians are educated in the skilled art of tissue slide production. In the process of diagnosis, it is often necessary for pathologists to examine excised tumors, blood smears, and samples from dysfunctional organs. Tissues must be fixed and often stained to highlight key aspects of the material necessary for diagnosis by the pathologist. Histology technicians help to ensure timely and appropriate diagnosis of disease.

How does this connect to our world?

While students often think of disease for its whole-body symptoms, changes at the cellular level are responsible for the biomarkers we have been examining. As students move forward in creating wearable technology, it becomes essential that students can identify biomarkers that signify disease versus those that are a product of healthy cells. Biomarkers are also often our earliest signs for potential problems in our bodies and the subject of numerous medical tests. Therefore, it is crucial for students to understand the effects of cellular damage, the biomarkers produced from such, and relate it to whole organ and organ system function.

Day 1

LEARNING OUTCOMES

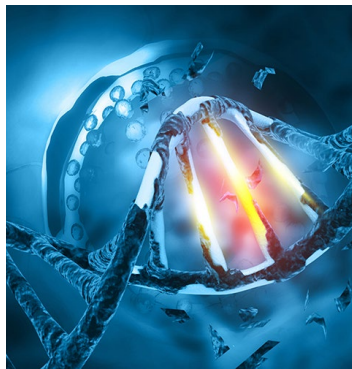
Students will be able to:

Demonstrate a specialized cell's role in the cellular hierarchy.

Identify changes in cell and tissue slides that are indicative of disease.

COMPUTATIONAL THINKING IN ACTION

Here, students are using the computational thinking strategy of finding patterns to draw connections between biomarkers and symptoms of illness and disease.



Procedure

Whole Group (10 minutes)

- 1 Lead the class in a discussion about the following questions: “How do we know when someone is sick?” and “What are signs and symptoms of illness?” Record the answers on one side of the board. Then ask, “What biomarkers did we learn about in previous lessons that would suggest disease?” Record answers on the opposite side of the board while students record this brainstorming in their notes/journals.

Teacher Note > *Students will almost always list things like fever, jaundice, changes in blood pressure or breathing, and other gross organ system dysfunctionalities as signs and symptoms of the disease. For biomarkers, students should remember things such as heart rate, X-ray results, lab work, respiratory rate, skin color and temperature, etc.*

- 2 Share with students that they will be investigating how the root of the symptoms and significant biomarkers they’ve brainstormed are signs of cellular damage. Today, students will begin by looking at how changes in their bodies’ DNA can lead to disease—most notably, cancer. Play the video [What happens when your DNA is damaged?](#) This is a link to the Ted-Ed animators page where students can see the diversity of people who work on these resources. It is always helpful for CLD students, especially BIPOC, to see others like themselves engaging in scientific studies, technology, and digital creation of resources.

- 3 [Pause](#) the video at 1:52 and ask if any of the previously brainstormed terms have been mentioned. Allow students to do a quick shout out with any answers or to record their answers in their Design Journals. (There may not be any.) Pause the video again at 3:21 and ask: How can DNA be damaged? (sun damage, high frequency radiation, etc.) Finish the video and ask: Is DNA damage or mutation always harmful? (Students may say that some mutation is beneficial to allow a species to evolve.) This quick pause and question time will allow students to activate prior learning from the previous days of instruction.

Small Group (25 minutes)

- 1 Introduce students to a potential breakthrough in histology that allows diagnosis through tissue examination, even in areas devoid of a histology laboratory, by playing this video: [2018 Innovator of the Year](#). Afterwards, ask students to note how the technology works.

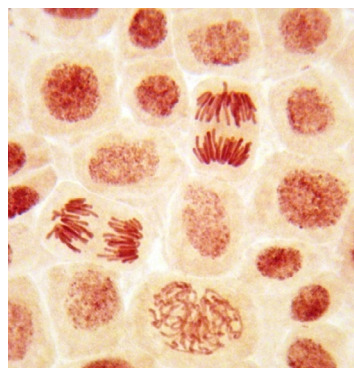
Continues next page >

Day 1

Continued

INDUSTRY AND CAREER CONNECTION

Students will learn about advances in the field of histology.



Procedure

- Students review the cellular hierarchy by examining histology slides. This helps them understand how cell changes can cause significant symptoms like heart failure and cognitive problems. Ask students to identify noticeable differences between healthy and diseased tissue. The images below can be used as an example.

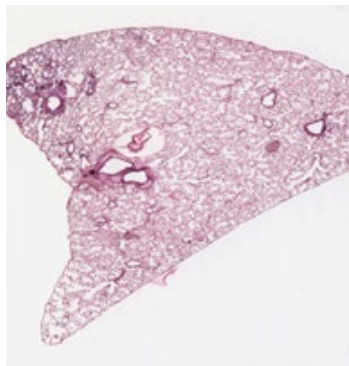


Figure 1. Healthy Lung Tissue
Lung, H&E, 20X

Source

Michigan Histology and Virtual Microscopy Learning Resources. Accessed February 10, 2021. https://histologyslides.med.umich.edu/Histology/Respiratory%20System/129_HISTO_20X.htm

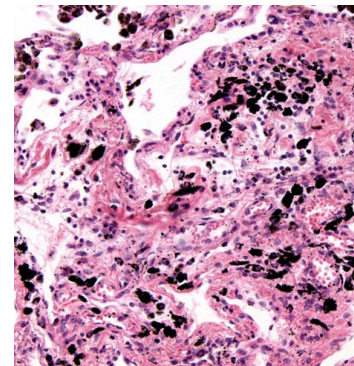


Figure 2. Black Lung Disease
Anthracosis at 10x Magnification

Source

MicroscopyU, The Source For Microscopy Education. Accessed February 10, 2021. <https://www.microscopyu.com/galleries/pathology>

- Have small groups of students examine slides of healthy tissue and corresponding slides that show the tissue while diseased.

Teacher Note > This is a good opportunity to utilize microscopes and slides in the class, if available. If not, there are many websites with virtual slides, two of which are:

[Virtual slide list](#)

[Iowa Department of Pathology](#)

- Each group should select a different specialized type of tissue. Have groups complete the [Cellular Hierarchy](#) capture sheet by doing research about the specialized cell they chose. They should observe and compare the diseased and healthy slides.

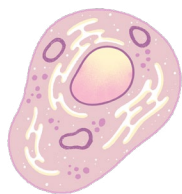
Continues next page >

Day 1

Continued

COMPUTATIONAL THINKING IN ACTION

As students complete the *Cellular Hierarchy Capture Sheet*, they are using the computational thinking strategy of decomposition to understand how organs are developed from individual components. By summarizing the cellular hierarchy they created in the previous lesson, students are utilizing the computational thinking strategy of abstraction. Abstraction allows us to reduce complexity and makes it easier to see central themes.



Procedure

Whole Group (7 minutes)

Have groups write a few sentences that summarize the cellular hierarchy they created in the previous lesson. Then, have groups take turns discussing their specialized cell, its hierarchy, and what biomarkers may be impacted by damage to the tissues associated with these cells.

Individual Work (3 minutes)

Before students leave, have them complete the *Prediction Exit Ticket* where they will predict the effect of the sickle cell mutation on the patient's health.

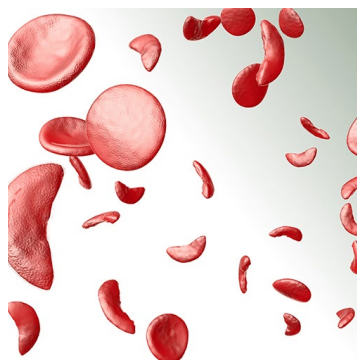
Day 2

LEARNING OUTCOMES

Students will be able to:

Examine disparities in funding for disorders that predominantly affect economically disadvantaged people.

Generate interest in increased funding for sickle cell disease.



Procedure

Whole Group (10 minutes)

- 1 Introduce the role of Medical Liaisons with the video [Beyond the Lab: Medical Science Liaison](#) (start at 2:55, end at 6:20).
- 2 Next, play the video: [Sickle Cell Patients Find a Better Way](#). Point out to students that the UC Apheresis Team physicians, a diverse set of professionals, work closely with advanced practitioners, nurses, technicians, social workers, and support staff to manage every aspect of a patient's experience as they receive treatment. Here is a [link](#) to the names and some information about this team.

Teacher Note > *It is very helpful for CLD students to see themselves represented in scientific endeavors.*

- 3 Use the discussion protocol [Turn to Your Partner](#) for two minutes. Make sure that all students understand that everyone should have a chance to speak and everyone should have a chance to listen.
- 4 Then, for the next two minutes, ask volunteers to share something they heard or said during the discussion.
- 5 Initiate a discussion with students around the following question:
How might changes to blood cells impact an individual's biomarkers?

Continues next page >

Day 2

Continued

COMPUTATIONAL THINKING IN ACTION

By identifying health disparities, students are using the computational thinking strategy of finding patterns to evaluate how systemic racism impacts medical research and erodes trust in medicine among historically marginalized populations.

COMPUTATIONAL THINKING IN ACTION

Here, students are using the computational thinking strategy of analyzing data to make connections between disease research funding and output. They use the data to draw connections between health disparities in historically marginalized populations and the chronic underfunding of diseases that disproportionately impact BIPOC communities.

Procedure

Individual Work (15 minutes)

- 1 Ask students to read one of the following articles on disparities between cystic fibrosis and sickle cell disease. Students have the option of reading:
 - a. As students read *Racism and Health Inequity: What Can We Do About It?*, have them underline anything they find important and write any questions they may have in the margins.
 - b. After reading *Comparison of US Federal and Foundation Funding of Research for Sickle Cell Disease and Cystic Fibrosis and Factors Associated With Research Productivity*, students should determine their position disparities in healthcare and write a few sentences expressing their stance. These documents also offer examples of culturally diverse researchers.

Teacher Note > *The second article is more advanced than the first. Students can select their assignment or it may be beneficial to assign the readings in accordance with their reading level.*

Small Group OR Individual Work (20 minutes)

- 1 Students will have the option of completing the first or second project a. or b.:
 - a. Students can work independently to write a letter to encourage increased funding for sickle cell disease. Students will need to conduct research to determine organizations or political leaders whom they should address. The letter should include facts about the disease and the disparities in funding.
 - b. Students can work in small groups to develop a viral Tik Tok or YouTube that would encourage donations for sickle cell disease. An example of this is the “Ice Bucket Challenge,” which led to massive donations to amyotrophic lateral sclerosis (ALS) research. The challenge should relate to the disorder or difficulties people with sickle cell disease (SCD) face. In the video, students should explain both this relationship and why SCD needs funding.

Teacher Note > *Please follow your school’s policy on social media as well as any privacy, acceptable use, or protected student data policies. Have students consider RAFT: Role, Audience, Format, Topic when creating their project.*

Day 3

Procedure

LEARNING OUTCOMES

Students will be able to:

Research how damage to nerve cells results in disease.

Generate ideas for potential products to assist someone with multiple sclerosis (MS).

Present their design ideas to the group.

Whole Group (5 minutes)

- 1 Share the following statements with students:
 - a. MS is a disease of the spinal cord.
 - b. MS causes myelin sheath to become damaged.
 - c. Scientists do not know the cause of MS.
 - d. MS is an autoimmune disease.
 - e. MS is always disabling.
 - f. Numbness, weakness, tingling, and pain are all symptoms of MS.
 - g. Slurred speech or blindness are not symptoms of MS.
 - h. There is a cure for MS.
- 2 Students focus on multiple sclerosis in [this video](#) to examine how damage to other aspects of a cell can cause disease. They respond to the statements using the instructional strategy *Myth Busting*.

Small Group (25 minutes)

- 1 Place students in small groups to conduct research on multiple sclerosis using the [Multiple Sclerosis Guided Research](#) capture sheet. Let students know that they may divide the questions among themselves to answer each section individually, then collaborate to complete the questions as a group. This will allow all participants to have informed input to share with the group and foster peer discussion as answers are shared. This should be limited to about 10 minutes, in order to provide maximum time for the next part of this activity. After eight minutes, call out a two-minute warning. After 10 minutes, instruct students to move forward with Step 2.

Teacher Note > *If Internet access is unavailable to students, supply printouts of the Mayo Clinic's Multiple Sclerosis Guide.*

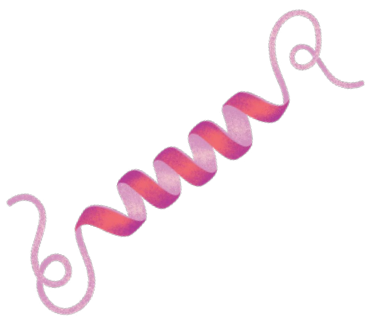
Continues next page >

Day 3

Continued

INDUSTRY AND CAREER CONNECTION

Making presentations is a technical skill necessary for medical science liaisons. Also, to complete this project on time, students will have to demonstrate time management and prioritization skills.



Procedure

- 2 After completing their research capture sheet, have groups brainstorm a new product to help people managing from multiple sclerosis. Each member of the group should participate in brainstorming. Once the group settles on their product, have students think about how they would pitch their idea in order to fund their product. Students should be prepared to present their group's pitch to the class. To do so, each group member should assume specific roles and responsibilities:
 - Project Manager—Ensures everyone is completing their task within the allotted time frame.
 - Engineers/Designers—Focuses on how the product works, create any drafts of visuals of their design.
 - Medical liaison—Explains the function of the device and its benefit to the class.

- 3 Alert students five minutes before their time is up, so that they have an opportunity to practice their delivery, as needed.

Whole Group (15 minutes):

- 1 Reserve the last 15 minutes of class for students to present their "sales pitch" to the rest of the group.
- 2 When students are not presenting, they will use the strategy "Idea Share" to gather feedback for their peers. Students will record their "ideas" in their journal and share their thoughts with classmates, after presentations are complete.

I: write about something interesting
 D: write about something different
 E: write about something exciting
 A: write about something advanced
- 3 If time permits or as optional reflection, ask students to consider how they would alter their product due to feedback from their classmates. Have them record their thoughts in their journals as an exit ticket.

Day 4

LEARNING OUTCOMES

Students will be able to:

Research how lifestyle choices can impact the integrity of our cells.

Determine connections between lifestyle choices and disease.

Present an informative commercial about the cellular implications of unhealthy lifestyle choices.



Procedure

Whole Group (10 minutes)

- 1 Use the response protocol [Give a Shout Out](#) to have students answer the question: *What are some lifestyle choices that can negatively impact cells?* Explain that this will be discussed further after viewing the video.
- 2 Show the following video to students: [Is My Heart Healthy?](#)
- 3 After students watch the video, continue the discussion using the “turn to your partner” strategy from Day 2.

Small Group (25 minutes)

- 1 Divide students into small groups. Have students choose one lifestyle choice that can negatively impact cells: smoking, tanning, high sugar consumption, heavy drinking, lack of exercise, or poor nutrition. Ask students to consider the availability and viability of choices and how they are impacted by privilege and environmental factors. Students may want to consider a lifestyle choice that is prevalent in their community. Direct students to complete the [Healthy Lifestyles Capture Sheet](#) in their groups.
- 2 Explain to students that a public service announcement (PSA) is a short commercial that attempts to educate people about issues that affect society. Let students know that they will create a PSA with their groups.

Teacher Note > Consider allowing students to create their PSA in another language. This will allow students to communicate with their community members that are not fluent in English. When students are allowed to validate and affirm their own language heritage, they continue to bridge the learning with their community and build shared connections to friends and family.

- 3 Play the following video for students: [Public Service Announcement](#).

Teacher Note > For additional scaffolding for the creation of a PSA, students can utilize this [Public Service Announcement Template](#).

Continues next page >

Day 4

Continued

Procedure

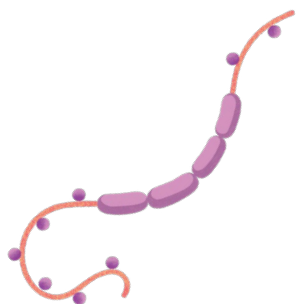
- 4 Once teams have completed their research, direct them to create a digital poster through Glogster, Canva, or Thinglink or write and film a short PSA to be uploaded to Flipgrid or Screencastify.

Teacher Note > *Flip or Screencastify will have to be prepared in advance; both allow students to post videos to a shared platform.*

Individual Work (10 minutes)

Reserve the last 10 minutes of class for students to watch other groups' presentations. As students observe, they should respond to at least three presentations with compliments, questions, and constructive criticism on the [Presentation Responses](#) capture sheet.

Teacher Note > *This practice is especially important in building SEL skills around the social awareness domain "Recognizing strengths in others" and in the relationship skills domain "seeking or offering support and help when needed."*



Day 5

Optional

LEARNING OUTCOMES

Students will be able to:

Create a report detailing the differences in biomarkers of healthy cells and mutated or damaged cells.

INDUSTRY AND CAREER CONNECTION

Medical science liaisons are often responsible for creating and presenting scientific material to educate others.

Procedure

Whole Group (5 minutes)

- 1 Lead a class discussion, using the response protocol *Raise a Righteous Hand*, to allow students to answer the following question: “During the course of the study this week, what cellular changes have you learned about that can result in disease?” Make sure you give students a brief *Moment of Silence* to allow them time to gather their thoughts prior to beginning the discussion.

Individual Work (40 minutes)

- 1 Afterward, students will work independently to complete *Investigating Biomarkers Capture Sheet*.
- 2 Using the capture sheet as a guide, students should create a report detailing their findings. Students can present their work and choose a presentation method (i.e. presentation software, poster board, or detailed written report). Encourage personal design choices, but be sure to emphasize that all research content must be completed BEFORE any design elements are added to the presentation. (Have students check for permission to begin any design features to ensure that adequate content is included.)

National Standards

**Next
Generation
Science
Standards**

LS1.A: Structure and Function

Systems of specialized cells within organisms help them perform the essential functions of life.

Science and Engineering Practices**Obtaining, Evaluating, and Communicating Information**

Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions and/or to obtain scientific and/or technical information to summarize complex evidence, concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.

Crosscutting Concepts**Stability and Change**

Feedback (negative or positive) can stabilize or destabilize a system.

Cause and Effect

Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

**Career and
Technical
Education
(CTE)**

A5.2

Use a variety of methods, including literature searches in libraries, computer databases, and online for gathering background information, making observations, and collecting and organizing data.

Cellular Hierarchy Rubric

Score	3	2	1
Accuracy	Cellular hierarchy information is accurate and complete.	Cellular hierarchy information is partially accurate.	Information on cellular hierarchy is inaccurate.
Explanation	Group gives a coherent and accurate description of the assigned hierarchy.	Group able to explain some of their hierarchy; some confusion or inaccuracy evident.	Group not able to explain their cellular hierarchy.
Final Score			

FUTU^{RE}LAB+

Cellular Hierarchy Capture Sheet

Our bodies are composed of dozens of types of specialized cells. These cells make our heart pump, exchange gases in our lungs, and tell our body when and how to move.

To begin your investigation, start by choosing one type of specialized cell:

1. Remember that cells do not work alone. They band together to form specialized tissues. What type of tissue does your specialized cell create?

2. Next, identify the organ formed by the tissue.

3. To which organ system does your organ belong?

You've just connected your single cell's existence to an entire organ system! In this unit, you will explore how changes at the cellular level can lead to problems in the whole body.

First, find an example of a healthy version of your specialized cell using in-person or virtual slides. Then, either draw to the best of your ability or copy and paste an image in the space provided. For the unhealthy section, find a slide showing your specialized cell that has been damaged or diseased and draw it to the best of your ability or insert an image in the space provided. (Note: Some of the slides may be far more specific than what you selected. It is okay to use a subtype.)

Draw or paste an image of your specialized cell.

Healthy:

Unhealthy:

4. What changes can be seen between the two cells?

5. How do you think changes to the cell may affect its function?

Continues next page >

FUTU^{RE}LAB+

Cellular Hierarchy Capture Sheet

Continued

Prediction Exit Ticket

Sickle Cell Disease is caused by a single gene mutation that causes the hemoglobin in red blood cells to stick to one another, changing the cell's shape from round disc to crescent moons.

6. Predict what symptoms a person with the disease would present.

7. Predict what important biomarkers may be abnormal due to the occurrence of Sickle Cell Disease.

FUTURELAB+

Sickle Cell Rubrics

	Score	3	2	1
Letter Writing	Addressee	Letter is addressed to the agency or official responsible for medical research funding.	Letter is addressed to someone generic in government or the medical community.	Letter is not addressed to anyone or to an inappropriate person.
	Facts and Disparities	Letter makes a clear argument for why sickle cell research requires increased funding. Letter describes traditional disparities between SCD and other genetic disorders.	Letter includes minimal facts or comments on funding disparities.	Letter does not include any facts to support an argument for increased funding.
or				
Tik Tok Challenge	Connection to Sickle Cell	The challenge has a strong connection to SCD which is clearly stated in the explanation.	The challenge makes a tenuous or forced connection to SCD.	The challenge lacks connection to SCD.
	Need for Funding	The explanation is clear and includes details and/or examples about the need for increased funding.	The explanation briefly touches on lack of funding.	The explanation does not convey why more funding is needed.
	Final Score			

FUTURELAB+

Multiple Sclerosis Guided Research

1. What type of cell damage causes multiple sclerosis (MS)?

2. How might MS change a patient's biomarkers?

3. What symptoms are associated with MS?

4. How does having this disorder impact affected individuals' daily lives? What everyday tasks do people with MS struggle with?

5. Many people with this disorder participate in physical therapy. What type of activities do they complete there?

Continues next page >

FUTURELAB+

Multiple Sclerosis Guided Research

Continued

6. What devices are already on the market to help people with MS, either in physical therapy or in their everyday lives?

7. If you made a device to help someone with MS, what might your device help with?

8. As a group, brainstorm products that may help these patients.

9. As a group, decide on your favorite product. Draw a mockup or draft design of your device, labeling components where needed.

10. Come up with a two-minute pitch to promote your new product. Focus on the symptoms or struggles it would help alleviate. Explain how it would work.

FUTURELAB+

Multiple Sclerosis Device Rubric

Score	3	2	1
Guided Research Organizer	Organizer contained factual information and creative ideas.	Organizer was partially completed, and some answers lacked detail.	Organizer was not completed.
Symptoms and Difficulties	Product demonstrates an understanding of the difficulties of living with MS.	Some effort is made to connect the product to MS, but tenuous or inaccurate symptoms addressed.	Product seems unrelated to MS.
Product Sketch	Sketch includes details and labeling where necessary.	Sketch shows general idea, no details.	No sketch is produced.
Addresses Symptoms and Difficulties	Product shows a distinct connection with a problem faced by a person with MS and shows ingenuity in an attempt to assist the population.	Product demonstrates some attempt at aiding a person with MS.	Product does not seem to assist someone with MS.
Final Score			

FUTURELAB+

Presentation Responses

Directions

*Provide reflective feedback for each group's
Public Service Announcement (PSA) presentation.*

Group 1:

What did you like about their presentation?

What could they have changed?

Group 2:

What did you like about their presentation?

What could they have changed?

Continues next page >

FUTU²RELAB+

Presentation Responses

Continued

Group 3:

What did you like about their presentation?

What could they have changed?

FUTUṚELAB+

Healthy Lifestyles Capture Sheet

Directions

Once you have completed research on your unhealthy habit, create a poster or film a short video that will serve as a Public Service Announcement (PSA) to inform others about how dangerous your selected behavior can be.

Our group has decided to research the unhealthy habit of:

1. What cells are damaged by this behavior? How are these cells damaged?

2. This habit primarily impacts which organs or organ system?

3. What types of disease processes can arise from engaging in this unhealthy behavior?

4. What biomarkers do patients suffering from the disease(s) demonstrate?

5. What would normal biomarkers look like?

6. If people are engaging in negative behaviors such as this one, what could they do to make positive changes?

FUTURELAB+

Healthy Lifestyle PSA Rubrics

Score	3	2	1
Overall Appearance	Project appears professional and polished, no obvious errors.	Some effort made toward appearance, minimal errors, some detail and color.	Project appearance is sloppy, lacks details, includes numerous mistakes.
Cells and Tissues	Project accurately addresses the affected cells and organ system.	Some information is inaccurate or missing.	Information about the affected cells and organ system is missing.
Disease Processes	Connection from a lifestyle choice to a disease process is laid out and detailed.	Minimal information on potential disease processes, little to no connection to a lifestyle choice.	Potential disease processes not addressed.
Biomarkers	Project addresses healthy and unhealthy biomarkers accurately.	Project addresses healthy biomarkers or unhealthy biomarkers, but not both or information is inaccurate.	Biomarkers not addressed.
Lifestyle Changes	Project includes encouraging information on healthy lifestyle changes with details.	Some attempt at encouraging lifestyle changes.	Lifestyle changes not addressed.
Final Score			

Investigating Biomarkers Capture Sheet

For our final assessment in this unit, you are tasked with identifying biomarkers in healthy and unhealthy cells. You will choose four different types of cells and research. Uncover what constitutes healthy biomarkers and what biomarkers may be a symptom of dysfunction and disease. Complete the chart below to help organize your thoughts.

Examples of cell types include nerve cells, bone cells, blood cells, skin cells, muscle cells, immune cells, sex cells, bronchiole cells, and cardiac cells.

Examples of biomarkers include blood pressure, heart rate, blood test results, glucose levels, respiratory rate, bone mineral density, X-ray results, and biopsy results.

Directions
Once you have completed your research, assemble your findings into a report. The type of report is up to you—create a poster, PowerPoint, Padlet, etc. Make sure your report includes all of your research and is clear and easily understood.

Cell Type	Healthy Biomarkers	Unhealthy Biomarkers

FUTURELAB+

Investigating Biomarkers Rubric

Score	3	2	1
Overall Appearance	Project is easy to navigate and attractive, no obvious errors.	Some effort is made toward neatness, minimal errors.	Project is sloppy and difficult to navigate.
Cell Type #1	Project includes well-researched information on both healthy and unhealthy biomarkers produced by this cell type.	Report includes minimal information on healthy and unhealthy biomarkers, or information is inaccurate.	Cell is missing information.
Cell Type #2	Project includes well-researched information on both healthy and unhealthy biomarkers produced by this cell type.	Report includes minimal information on healthy and unhealthy biomarkers, or information is inaccurate.	Cell is missing information.
Cell Type #3	Project includes well-researched information on both healthy and unhealthy biomarkers produced by this cell type.	Report includes minimal information on healthy and unhealthy biomarkers, or information is inaccurate.	Cell is missing information.
Cell Type #4	Project includes well-researched information on both healthy and unhealthy biomarkers produced by this cell type.	Report includes minimal information on healthy and unhealthy biomarkers, or information is inaccurate.	Cell is missing information.
Final Score			