

FUTURELAB+

BIOMED

*Crowdsourcing Innovations
in Biotechnology*

Culturing Cells

Developed in partnership with:
Discovery Education and Ignited

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

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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

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Cover Image

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

BIOMED / CROWDSOURCING INNOVATIONS IN BIOTECHNOLOGY

Culturing Cells

DRIVING QUESTION

What is the role of cell culturing in the lab?

OVERVIEW

To achieve the next medical breakthrough, scientists need inexpensive and reliable specimens to conduct their studies. Working with animals and whole human subjects is limiting as it is invasive, expensive, and painful for the subjects. Because of this, medical professionals must be able to maintain and proliferate cells in the lab; it is essential for the advancement of science. Cell culture technicians are behind the scenes keeping the gears of medical research turning.

In this lesson, students will explore the role of cell culture technicians in the greater functioning of the lab. They will compare and contrast the different types of cells available for research, investigate ethical dilemmas present when working with human specimens, and ultimately create an informed interview based on their newly acquired knowledge.

ACTIVITY DURATION

Four class sessions
(45 minutes each)

ESSENTIAL QUESTIONS

Why is it necessary to perpetuate life in the lab?

What biological materials are available to research scientists?

What are the ethical considerations of taking tissue from living and non-living donors?

OBJECTIVES

Students will be able to:

Construct a comparison of primary cells and cell lines.

Distinguish between scenarios requiring primary cells and cell lines.

Examine ethical considerations when working with human tissue.

Create engaging and thoughtful interview questions for a cell culture technician or cell biologist.

BACKGROUND INFORMATION

Cell culture technicians are the unsung heroes of the lab. While clinical breakthroughs receive all the attention understandably, labs are dependent on the continued production and maintenance of cells to conduct their studies, without which research would grind to a halt. Before discovering the HeLa line of immortal cells, research was severely hampered by the inability to keep cells alive for any notable amount of time. Animals were inconsistent models, and conducting long-term research on humans was often impossible. The use of immortal cell lines has led to substantial changes in the field of medical research. However, with its advent comes numerous new ethical dilemmas about the acquisition of tissue, informed consent, and commercialization of human genetic material.

Materials**Primary Cells vs. Cell Lines
Capture Sheet****Cell Scenarios Capture Sheet****Bioethical Response****Bioethical Response Rubric****Cell Culture and Henrietta Lacks
Article and Capture Sheet****Cell Culture Technician WebQuest****Stem Cell Donation Poster Rubric****Interview with a Cell Culture
Technician****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

Within this unit, students will continue to work with their peers, which strengthens communication skills, provides leadership opportunities, and encourages social awareness. Students will examine a complex ethical question, determine their opinion, and craft an argument, which will most likely hold personal significance to them. They will practice self-management and social-management skills to complete interactive tasks as a cell culture technician.

CULTURALLY AND LINGUISTICALLY RESPONSIVE INSTRUCTION

In this lesson, students learn the origins of the HeLa cell line: cells that were extracted from Henrietta Lacks, a Black woman, without her consent. This provides opportunities to call out issues still being faced by BIPOC and the need for a Culturally and Linguistically Responsive Approach. Students employ the Campfire strategy to read about the controversies in patenting genetic materials from indigenous people, then construct their own argument in response to the problem. They employ a visual note-taking and analysis tool to examine issues around patient consent and contemplate who has the authority to approve sharing the traits unique to a particular culture. Students reflect on the historical treatment of disenfranchised communities as well as cultural or religious considerations in donating blood and tissue. Students will engage in authentic role-playing, which allows those of diverse cultural and linguistic identities to see themselves in the fields in which they may be underrepresented.

ADVANCING INCLUSIVE RESEARCH

Students examine the Henrietta Lacks case, which provides an example of how the Black community has been exploited by the medical community in the past. This has led to a mistrust of medical institutions and a reluctance to participate in medical research. Students discuss ways that the medical community might repair these relationships to further the goal of developing treatments that work for all people.

COMPUTATIONAL THINKING PRACTICES

This unit strongly features abstraction, which is a technique computer scientists use to reduce complexity and make one solution that solves many problems. Students also see the limits of abstraction when it comes to biomedical research. Humans are not all alike, and students use the computational thinking strategy of collecting data to examine how qualitative data collection tools can lead to rich data analysis that allows for variation. They use the strategy of Finding Patterns to identify how the historic mistreatment of BIPOC communities by the medical field has led to a significant dearth of research and donors from these groups.

CONNECTION TO THE PRODUCT LIFE CYCLE

This lesson connects to the **discovery** phase of the product life cycle as the mass culturing of cells is often conducted in the early phases of research and product development. This process supports cellular research and early testing of treatments. Depending on the end product, cellular cultures are also necessary in the manufacturing of certain biotech materials such as antibodies, insulin, and certain vaccines.

Have you ever wondered...

Is it possible to live forever?

While human beings cannot live forever, scientists have learned to create “immortal” cell lines that continue to proliferate perpetually.

What happens to the tissues removed during biopsies and surgeries?

The origins of many cell lines have come from excised tumors, usually taken without consent.

Where do biologists get the cells they study?

Researchers working at the cellular level get their cells from various sources, ranging from recently excised tissue to commercially available “immortal” cell lines.

MAKE CONNECTIONS!

How does this connect to the larger unit storyline?

To understand biomarkers’ function, students need to understand cell theory and how medical and research professionals use cells in the lab. By exploring the different types of cells available to researchers, students can better grasp the wide variety of work done in medical labs around the world. Additionally, it is impossible to discuss cellular research without acknowledging the ethics involved in working with human specimens, and past and present controversies surrounding their usage. At the end of this unit, students will better understand the nature of cellular research. They will demonstrate this knowledge by constructing thoughtful and informed interview questions which will be presented to a real cell culture technician or cell biologist.

How does this connect to careers?

Cell culture technicians are the backbone of laboratory research. These specialists are responsible for growing and caring for the numerous cell lines essential for the advancement of biomedical science. Cell culture technicians need to understand the differences between specimen options, steps for maintaining a healthy environment for the cells in their care, and when and how to proliferate those cells in the lab.

Biomanufacturing technicians are responsible for controlling the environment in which cells grow. They are versed in a large number of scientific and engineering disciplines and use this knowledge to form an integral link in large projects spanning multiple departments. These professionals work with a variety of other specialists to create innovations in biopharmaceuticals and biotechnologies—they are often the link that binds the research and development effort.

How does this connect to our world?

Cell research has given the world access to vaccines for deadly diseases. It has enhanced our knowledge about the nature of illness and health and has led to the discovery of new and innovative treatments. It has allowed us to explore the possibilities of cloning, growing organs and tissues in labs, and curing genetic disorders. Cellular research has been paramount as we attempt to tackle the coronavirus pandemic. To achieve these groundbreaking advancements, we need lab technicians to run the experiments and keep the research moving forward. Without their contributions, our facility for medical progress would cease to exist.



Day 1

LEARNING OUTCOMES

Students will be able to:

Determine the benefits and drawbacks of primary cells and cell lines.

Distinguish between scenarios that call for the use of primary cells and cell lines.

COMPUTATIONAL THINKING IN ACTION

Cell cultures are a representation of the computational thinking strategy of abstraction. By abstracting cells from a tissue, scientists are able to identify the impact of a drug or therapy and not run the risk of harming a subject. Students also learn that abstraction is not always the best technique for biomedical research, due to the complicated variations that exist between organisms.



Procedure

Whole Group (10 minutes)

- 1 Ask students to consider the question, “What do you think happens to tissues and organs donated to science?” Use the discussion protocol *Whip Around* to allow all students to quickly answer the question posed. Consider giving students a *Moment of Silence* prior to using the discussion protocol.
- 2 Direct the class with the following instruction: “While some experiments are still conducted using animals or the human body, most research involves studying cells. In this unit, you will learn more about how scientists use cells in the lab by exploring the cell culture technicians’ profession. You will examine the different types of cells utilized in research and the ethical implications of using human specimens. The study will conclude with preparations for an interview with an actual cell culture technician or cell biologist.”

Individual Work (20 minutes)

- 1 Have students read the following article on primary cells and cell lines: *Human Primary Cells Versus Cell Lines: Differences and Advantages*. Distribute copies to students or have them access the article online.
- 2 While reading, students will complete the *Primary Cells vs. Cell Lines Capture Sheet* outlining the benefits and drawbacks of both primary cells and cell lines.

Small Group (15 minutes)

Instruct students to move into pairs, then distribute the *Cell Scenarios Capture Sheet*. Tell students they will work together to discuss several scenarios, and determine whether they think each scenario calls for the use of primary cells or cell lines. Remind them to show textual evidence for their decisions, as per the instructions on the capture sheet.

Teacher Note > *This capture sheet can be collected as an exit ticket to inform whether further explanation, investigation, or discussion is required.*

Day 2

Procedure

LEARNING OUTCOMES

Students will be able to:

Examine the controversy of using HeLa cells.

Construct a response regarding the ethics of patenting genetic material.

CULTURALLY AND LINGUISTICALLY RESPONSIVE INSTRUCTION

Providing the graphic organizer and the rubric at the same time as the article allows support for CLD students in determining what is most important in the text. Knowing what questions need to be answered and which information will be most pertinent to the creation of their response allows for a better understanding of the material and more successful learning.

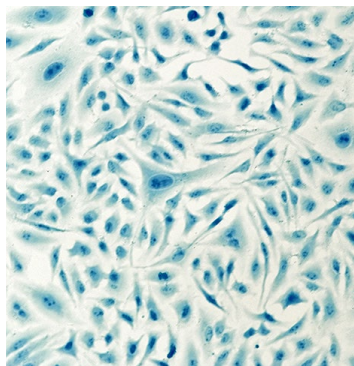
Background: Henrietta Lacks was an African American woman whose cells were taken without her consent. Those cells were used worldwide to cure diseases, develop vaccines, advance cloning, and various other applications. With these advances, researchers and biomedical companies acquired immense wealth. Meanwhile, her family knew nothing of her contributions and could not even afford health care for themselves. While there have been moves to rectify this situation with the family, Henrietta is far from the only individual whose genetic material has been used for financial gain. For students interested in learning more about Henrietta Lacks, the book *The Immortal Life of Henrietta Lacks* by Rebecca Skloot is highly recommended and grade-level appropriate.

Teacher Note > *If students do not have a copy readily available to them, there are free excerpts of the book available online.*

Individual Work (20 minutes)

- 1 Discuss this short background video on patents, *What is a Patent?* Be sure to emphasize that patent laws are different in different countries.
- 2 Give students a copy of the article on bioethics and patents of genetic material: *Bioethics and Patent Law: The Cases of Moore and the Hagahai People*. Instruct students to read the article independently, taking notes and highlighting text as they read. They will use this information to complete the capture sheet and construct their argumentative response for the next step.
- 3 Distribute the *Bioethical Response Capture Sheet* to assist students in organizing their thoughts. Once students complete the capture sheet, they will write a response on the ethics of patenting genetic and cellular material. Place these capture sheets somewhere easily accessible as students will be using them tomorrow.

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Day 2

Continued

Procedure

Whole Group (20 minutes):

- 1 Students will begin by looking at the most famous cell line in the world, HeLa, which was taken without consent from a poor African American woman suffering from terminal cancer. While a lot of good has been done with her cells, there is considerable controversy regarding their usage. Students will use the instructional strategy *Sketchnotes* to take notes in their journal, while watching the video. Remind students that, as they listen, they should visualize and synthesize what is being said to create notes that reflect their understanding.

Teacher Note > *Play the resource once without pause so students develop a general understanding of the content. Play the resource a second time, pausing frequently to allow students to process information they have heard and to make decisions about how to best represent it on their page.*

- 2 Project the following video to introduce the topic: *Henrietta Lacks: Preserving Her Legacy*. Point out to students that the speakers in this TedX talk are the actual descendents of Henrietta Lacks. This highlights that these issues are definitely still pertinent to people today and decisions made in our past affect our present.

- 3 Lead students in a discussion to respond to key words that were addressed in the video. Ask students to compare their sketchnote with a partner's. Have students share out how their sketchnotes were similar or different from their partner's.

Teacher Note > *Some key words that may arise are "cancer," "consent," "ethics," or "medical research." As a warm-up, prior to the video or in the discussion afterwards, have small groups create Frayer Models for these critical key words.*

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Day 2

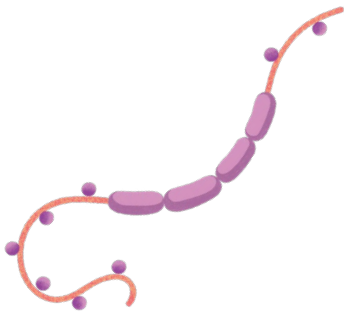
Continued

Procedure

Individual Work (10 minutes)

- 1 Allow students time to search the *U.S. Patent and Trademark Database*. Explain that there are various databases that allow you to search for patents across the world. This one is specific to our country. Have students begin by searching “cell lines” using the field “Title.”
- 2 Have students do a “Quick Write” to summarize their thoughts about patenting cell lines. What are some interesting patents that they discovered during their search? Why is it important to know what patents exist prior to beginning your research?

Teacher Note > *You may want to collect this individual “Quick Write” as an exit ticket. Patents could be a new concept for students and this will give you a better idea of where there may still be gaps or misunderstandings.*



Day 3

Procedure

LEARNING OUTCOMES

Students will be able to:

Create interview questions on the topic of Henrietta Lacks.

Craft a response on the topic of bioethics.

COMPUTATIONAL THINKING IN ACTION

Interviews are an important way to practice the computational thinking strategy of collecting data. This type of information isn't specific or quantifiable. Instead, it accommodates complexity and is useful for gathering feedback or recounting experiences.



Small Group (25 minutes):

- 1 Distribute the *Cell Culture and Henrietta Lacks* article and *Cell Culture and Henrietta Lacks Capture Sheet*. Before reading, have students review the statements on the capture sheet. Then, invite students to read the article and determine if they agree or disagree with the statements. Students should support their decision using evidence from the text.
- 2 Invite students to turn to a partner to review their responses.
- 3 Ask students to see how many letters in their first and last name match with the letters in the phrase “Cell Culture” and ask the five top matches to share out. For example, John Doe has 1 match with the letter “e”.

Application: *Cell Culture Technician WebQuest*, an activity focused on aseptic laboratory conditions for cell cultures, is provided as a capture sheet.

Small Group (15 minutes):

Redistribute to students the *Bioethical Response Capture Sheet*. Have students group with others that took the same position (i.e., those that support patenting of biological material and those that do not). Students should confer together and share key points of their argument. Each group should choose one representative to argue their position. Allow each side to express their argument, respond to their opposition, and make a concluding statement.

Day 4

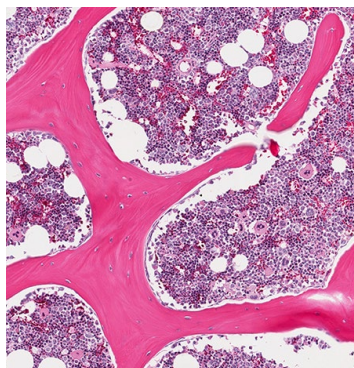
LEARNING OUTCOMES

Students will be able to:

Investigate the impact of limited minority participation in stem cell programs.

Reflect on the relationship between BIPOC communities and the medical research community.

Create a poster encouraging enhanced participation in donation programs.



Procedure

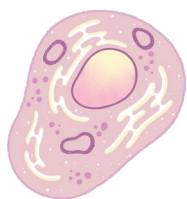
Whole Group (10 minutes):

- 1 Show the following video to the class: *Mayo Clinic Minute: Why Bone Marrow Donor Diversity is Needed*.
- 2 Distribute K-W-L charts. Students will begin completing the “K” and “W” sections of the chart with what they know and what they want to know about stem cell donations.

Small Group (15 minutes):

- 1 Direct the class to move into groups of two to three students. With their group members, students will read the article, *Racial Minorities Face a Dearth of Stem Cell Donors—Science in the News*. Groups should divide the reading into sections and choose who will be responsible for reading what section (with any infographics). As students are reading, they will record key points on a sticky note to share with their group members. Students will use the discussion protocol “Campfire” to share the key points of their reading.
- 2 After all key points and sticky notes have been read and understood, students will complete the remaining “L” section of their chart with their group members.

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Day 4

Continued

COMPUTATIONAL THINKING IN ACTION

These critical thinking questions encourage students to use the computational thinking strategy of finding patterns to examine the historical mistreatment of BIPOC by the medical community and the dearth of data and donors from BIPOC communities.



Procedure

Individual Work (10 minutes):

- 1 Students will write a brief reflection on what they learned using one of the following three prompts and post their response to *Flip*. After posting they will review their classmates' responses and comment and give feedback. This may also be completed outside of the classroom.
 - a. How do you think the historical treatment of people of color by the medical community may be impacting their current participation with blood and tissue donation? Explain.
 - b. It has been shown that having medical providers of the same ethnicity leads to better treatment for underrepresented communities. How might having larger numbers of BIPOC biomedical researchers lead to improvements within the research community? Why?
 - c. Some cultures and religious groups do not believe in tissue and organ donation. What may be some alternatives to ensuring these demographics are included in medical research? What might be some ways to increase participation in medical research?

Small Group (10 minutes):

- 1 Distribute the *Stem Cell Donation Poster Rubric* to the class. Digital posters can be created through Canva, Glogster, or Google Slides. Students will move into groups of four and work to create a physical or digital poster that either:
 - a. Explains the disparities in stem cell donations,
 - b. Advocates for people from various racial and ethnic backgrounds to donate or participate (when they are old enough).

Extension

LEARNING OUTCOMES

Students will be able to:

Review qualities of effective interview questions.

Create an engaging list of interview questions for a cell culture technician, a cell biologist, or the general public.

CULTURALLY AND LINGUISTICALLY RESPONSIVE INSTRUCTION

Quality checking with peer feedback allows for the validation and affirmation of the student work, while bridging to standard English and building consistent appropriate language for interpersonal interaction with others.

INDUSTRY & CAREER CONNECTION

In critiquing others' work and accepting criticism from others, students will demonstrate soft skills related to the cell culture technician profession. These skills include professionalism and an openness to learn.

COMPUTATIONAL THINKING IN ACTION

In this lesson, students learn how well-designed research practices are an important part of the computational thinking strategy of collecting data.

Procedure

Small Group (10 minutes)

Instruct students in small groups to review the article on crafting better interview questions, *Some Strategies for Developing Interviews*. As a group, students should annotate the text by choosing key points to highlight.

Individual Work (15 minutes)

After students complete their annotations, direct them to return to their seats. Pass out the *Interview with a Cell Culture Technician Capture Sheet*. Students will work independently to write at least 10 questions regarding the use of cells in medical research. Students should choose who to interview: a cell culture technician, cell biologist, or member of the public. These questions will later be addressed by an actual cell biologist or cell culture technician. Remind students that they can use the directions to guide them in creating appropriate questions.

Small Group (10 minutes)

Tell students to exchange their questions with a partner. Together, they will read over the questions using the “Six Ways to Ask Better Questions in Interviews” article as a quality check guide and provide constructive peer feedback.

Individual Work (10 minutes)

Direct students to consider peer feedback and make changes as they see fit.

National Standards

Next Generation Science Standards

LS1.A: Structure and Function

Feedback mechanisms maintain a living system's internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range. Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system.

Science and Engineering Practices

Constructing an Explanation

Compare and evaluate competing arguments or design solutions in light of currently accepted explanations, new evidence, limitations (e.g., trade-offs), constraints, and ethical issues.

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

Structure and Function

Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.

Career and Technical Education (CTE)

A4.2

Describe conditions that promote cell growth under aseptic conditions in the laboratory and workplace.

A7.4

Understand a patent and use online resources to search a patent database.

A7.6

Articulate issues of ethical concern, including plagiarism, copyrights, trademarks, and patents and use online data resources and searchable databases to investigate a copyright, trademark, or patent.

8.4

Understand the ways in which ethical considerations affect emerging technologies and their impact on society.

Primary Cells vs. Cell Lines Capture Sheet

ANSWER KEY

Do not share with students

Directions

As you read the article *Human Primary Cells Versus Cell Lines: Differences and Advantages*, outline the benefits and drawbacks of primary cells and cell lines.

	Benefits	Drawbacks
Primary Cells	<ul style="list-style-type: none"> Retains the same characteristics of the cells (more similar to specific tissue types) Includes cells at different stages of development No need to rely on animal models Able to test across different genetic characteristics and age groups 	<ul style="list-style-type: none"> Does not live forever Limited material May not be able to acquire more from the same donor Requires additional nutrients and growth factors
Cell Lines	<ul style="list-style-type: none"> Cost-effective Easy to work with Can live in cultures for more extended periods Good for high-output screening Good for preliminary experiments Good for studying basic biological functions or cell manipulation 	<ul style="list-style-type: none"> Physiological relevance may not be very high due to numerous mutations. May not be able to induce relevant biomarkers Results cannot be fully translated to humans Cell lines may become contaminated. Must be validated before work can begin

Cell Scenarios Capture Sheet**ANSWER KEY****Do not share with students****Directions**

Using what you have learned about primary cells and cell lines, determine which is called for based on the following scenarios. Underline the part of the scenario that led you to this determination.

1. You are conducting a study to see how cells from people of different ages respond to a particular pain medication.

Primary Cells

2. Your team is planning a 10-year-long study on how cells respond to radiation.

Cell Lines

3. The lab is doing a preliminary study on a new analgesic and has limited funding.

Cell Lines

4. You want to research how neurons behave in the presence of a new antidepressant drug.

Primary Cells

5. The lab you are working for is researching how the enzymes of people of different ethnicities may respond to a specific hypertension medicine.

Primary Cells

6. You are doing a study on biomarkers produced by the kidneys.

Primary Cells

7. The new study you have been asked to work on is performing high output screening. In other words, they are conducting large volumes of automated testing on cells.

Cell Lines

8. The team has decided to focus on how bone cells in various stages of maturation respond to trauma.

Primary Cells

Cell Culture Technician WebQuest**ANSWER KEY****Do not share with students****Directions**

Today you are going to perform the role of a cell culture technician. Follow along and complete tasks in [the lab](#) as detailed by the clipboard in the lower-left corner. The simulation will occasionally ask you quiz questions where you can earn points, and answers to all quiz questions can be found under the “theory” tab. Remember, some equipment requires you to press the “OPEN” button. Good luck!

1. Name two things you should wear when performing an aseptic technique.

Gloves and a lab coat

2. What does “in vitro” mean?

Outside a living organism

3. What is the function of phenol red?

To indicate pH and to protect the contents from light

4. If you add cold fluid to cells, what reaction can you cause?

You can cause thermal shock.

5. Before putting something under the hood, we need to first...?

Spray it with a disinfecting solution

6. When working with an air hood, the hood maintains constant _____ air flow.

Unilateral

7. What does “seeding cells” mean?

Placing cells in the proper vessel with all the required conditions for proper growth

8. What U.S. regulatory agency ensures cell lines are what they claim to be?

ATCC

9. How long did you wait for the fibroblasts to sit in incubation?

Four days

10. What is confluency?

The ratio of the area occupied by cells to the total space

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Primary Cells vs. Cell Lines Capture Sheet

Directions

As you read the article *Human Primary Cells Versus Cell Lines: Differences and Advantages*, outline the benefits and drawbacks of primary cells and cell lines.

	Benefits	Drawbacks
Primary Cells		
Cell Lines		

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Cell Scenarios Capture Sheet

Directions

Using what you've learned about primary cells and cell lines, determine which is called for based on the following scenarios. Underline the part of the scenario that led you to this determination.

1. You are conducting a study to see how cells from people of different ages respond to a particular pain medication.

2. Your team is planning a 10-year-long study on how cells respond to radiation.

3. The lab is doing a preliminary study on a new analgesic and has limited funding.

4. You want to research how neurons behave in the presence of a new antidepressant drug.

5. The lab you are working for is researching how the enzymes of people of different ethnicities may respond to a specific hypertension medicine.

6. You are doing a study on biomarkers produced by the kidneys.

7. The new study you have been asked to work on is performing high output screening. In other words, they are conducting large volumes of automated testing on cells.

8. The team has decided to focus on how bone cells in various stages of maturation respond to trauma.

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Cell Culture and Henrietta Lacks

Cell culture is the process of growing cells outside of the body or in a lab environment. This practice is often referred to as *in vitro*. *In vitro* means “in glass”. Cell culture is an important technique in both cellular and molecular biology. A cell is the basic structural, functional, and biological unit of all living things. In order to understand an organism or given tissues, it is important to understand how its cells work. Through cell culture, this becomes possible. And whatever we learn about the cells *in vitro* is representative of what is happening to the organism or tissue. Named after the first two letters of Henrietta Lacks, HeLa cells enabled the development of *in vitro* fertilization. This was because her cells could grow easily in a lab.

For cells to grow outside of the body they need to have an environment that is similar to the body. They need a way to get food, space to grow, a regulated temperature, and a way to stay safe from contaminants like bacteria or mold.

Up until 1951 nobody had yet been able to keep human cells alive for a long period of time outside the body. Henrietta Lacks went to Johns Hopkins Hospital to have a doctor look at a “knot” in her womb, which turned out to be cervical cancer. Her doctor took two biopsies without Lacks’s knowledge or consent. Her cells ended up in the lab of cell biologist Dr. George Gey. He was head of the tissue culture laboratory and found that Lacks’s cells survived and replicated. He was able to grow the cells continuously in the lab.

No one knows why but Lacks’s cells never die. They can double every 20-24 hours and are commonly known as “immortal”. An immortal cell line is an atypical cluster of cells that continuously multiply on their own outside of the organism from which they came. Today there are several immortalized cell lines but HeLa cells are still the most widely used cell line in biomedical research.

Even though immortal cell lines have made it possible to work with cells, cell culture is not easy! It takes a lot of hard work, patience, and practice to be able to grow cells. Aseptic conditions prevent contamination of cell culture and reagents from microorganisms in the environment. In order to give the cells this environment, they are provided with many things such as: use of sterilized instruments, controlled environment (i.e.: an incubator that maintains body temperature, fresh media that contains food and nutrients, and disinfected surfaces surrounding the culture). Once the right requirements have been provided, the cells will increase in numbers and may form colonies, which can then be easily seen and identified.

There are many negative outcomes if the cells are not provided with this environment. If the environment is not clean, this can lead to contamination. If there is not enough room to grow, the cells can weaken, die, or even mutate. And if there is not enough food, the cells can also weaken or die.

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Cell Culture and Henrietta Lacks Capture Sheet

Directions

Read the article “*Cell Culture and Henrietta Lacks*.” In each of the boxes below, read the statements and decide whether you agree or disagree with its contents. Then include information that supports or corrects the statement in the appropriate box.

	Support	Correction
Henrietta Lacks' cells were harvested without her knowledge or permission.	<input type="checkbox"/> Agree <input type="checkbox"/> Disagree	
HeLa cells can grow and divide endlessly.	<input type="checkbox"/> Agree <input type="checkbox"/> Disagree	
Aseptic techniques include an open, clean environment.	<input type="checkbox"/> Agree <input type="checkbox"/> Disagree	
Cell culture contributes to limited research efforts.	<input type="checkbox"/> Agree <input type="checkbox"/> Disagree	
In vitro techniques help us understand how cells work.	<input type="checkbox"/> Agree <input type="checkbox"/> Disagree	

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Bioethical Response

Question

Should companies be allowed to patent cellular material?

1. *Write down any initial thoughts, ideas, or opinions.*

2. *Respond to the following prompts to expand your ideas.*

2a. What are some of the advancements made possible by unfettered access to cell lines derived from human beings? What would be the consequence if scientists did not have access to these cells?

2b. What should informed consent entail?

2c. How has medical research exploited low-income and BIPOC communities?

2d. What was the opinion of the courts and your thoughts on their decision?

2e. If people or families were to be compensated, what would be fair compensation?

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Bioethical Response

Continued

3. *Organize your response.*

3a. I believe:

3b. Evidence supporting my claim:

3c. Evidence that supports the counterclaims:

3d. Rebuttal

3e. Closing

4. *Put it all together and write your response on a separate piece of paper.*

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Bioethical Response Rubric

Score	3	2	1
Graphic Organizer	Responses were well thought out and complete.	Organizer partially filled out; minimal effort made for prompts.	Graphic organizer was not attempted.
Belief Statement	Strong belief statement to open the response.	Belief statement is ambiguous or weak.	Student does not include a belief statement.
Supporting Evidence	Evidence is thorough and supports the student's response.	There is some evidence present but it is minimal or does not support the position.	Student does not support their response with evidence or evidence is incorrect.
Counter-argument	Counterargument is thoroughly addressed, and opposing evidence is noted.	Student addresses the opposing response, but the information is minimal or incorrect.	Student does not address the opposing response.
Rebuttal	Student creates a compelling response to counterclaims.	Rebuttal partially addresses the opposing viewpoint.	Rebuttal is not present.
Closing	Strong closing is present, which summarizes the student's response.	Closing is incomplete.	Closing is not present.
Overall	Responses are well structured and contain no spelling or grammatical errors.	Responses are structured well but contain some minor spelling or grammatical errors.	Responses are poorly structured and contain multiple spelling or grammatical errors.
Final Score			

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Cell Culture Technician WebQuest

Directions

Today you are going to perform the role of a cell culture technician. Follow along and complete tasks in *the lab* as detailed by the clipboard in the lower-left corner. The simulation will occasionally ask you quiz questions where you can earn points, and answers to all quiz questions can be found under the “theory” tab. Remember, some equipment requires you to press the “OPEN” button. Good luck!

1. Name two things you should wear when performing an aseptic technique.

2. What does “in vitro” mean?

3. What is the function of phenol red?

4. If you add cold fluid to cells, what reaction can you cause?

5. Before putting something under the hood, we need to first...?

6. When working with an air hood, the hood maintains constant _____ air flow.
7. What does “seeding cells” mean?

8. What U.S. regulatory agency ensures cell lines are what they claim to be?

9. How long did you wait for the fibroblasts to sit in incubation?

10. What is confluency?

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Interview with a Cell Culture Technician

Directions

Today, you will write 10 thoughtful, well-formed, and engaging interview questions for your future consultation with a cell culture technician or cell biologist. Utilize the provided guidelines for how to write quality interview questions.

For inspiration, consider what functions these specific jobs entail, how the profession’s work contributes to medicine as a whole, the ethics of research and its impact on minority communities, and how these jobs may relate to your larger project of creating a wearable medical device.

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<p>2.</p> <hr/> <hr/> <hr/>	<p>7.</p> <hr/> <hr/> <hr/>
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<p>4.</p> <hr/> <hr/> <hr/>	<p>9.</p> <hr/> <hr/> <hr/>
<p>5.</p> <hr/> <hr/> <hr/>	<p>10.</p> <hr/> <hr/> <hr/>

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Stem Cell Donation Poster Rubric

Score	3	2	1
General appearance of the poster	Poster is eye-catching and attractive, good use of color, pictures, and graphics.	Poster is sufficient, shows some effort, with minimal use of pictures and color.	Poster looks rushed and lacks color, pictures, or graphics.
Educates the public about stem cell donation and racial disparities	Poster educates public about racial disparities in stem cell donations and how it impacts these communities.	Poster includes some basic information about stem cell donations.	Poster does not teach the reader anything about stem cell donation or information is incorrect.
Encourages others to add themselves to a donation registry	Poster encourages others to donate and includes information on the importance of donating and how to get involved.	Poster mentions donating, but contains no information on how or why it is important.	Poster does not mention registration.
Final Score			