

A Student-Led Hearing on the Use of HeLa Cells in Research

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Abstract

In this role-playing case study, students will learn about the HeLa cell line and its origins while examining multiple perspectives surrounding the cell line and its uses. The goal of this case study is for students to use guided questions to analyze different points of view such as researchers, family members, center directors, and contemporary scientists. Students will assume pre-designated roles and prepare short presentations for a panel of their peers to arrive at a decision regarding the further use of HeLa cells. This case may be completed in one 75-minute lesson or over a two-hour lab period. To accomplish this, the case study is divided into three parts including: 1) individual pre-class research and homework; 2) in-class group work and sharing of information among the class; and 3) an individual written post-class reflection. Ultimately, students are expected to consider and formulate an informed perspective to address the question: Should the *continued use of HeLa cells be permitted in scientific research at our university?*

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Supporting Materials: Supporting Files S1. HeLa Hearing - Perspective Profiles (includes eight perspective profiles of personnel involved in the acquisition or use of HeLa cells); S2. HeLa Hearing - Hearing Script; S3. HeLa Hearing - IRB conduct & considerations; S4. HeLa Hearing - Pre-class homework; S5. HeLa Hearing - Post-class reflection; S6. HeLa Hearing - Lesson facilitation slides; and S7. HeLa Hearing - Grading rubric.

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Learning Goals

Students will:

- demonstrate an understanding of the generation of the HeLa cell line and its importance in modern day biological research.
- discuss bioethical questions surrounding the HeLa cell line and the life of Mrs. Henrietta Lacks.
- articulate relevant bioethical concepts as they formulate perspectives on historical and future use of HeLa cells in scientific research.

From the Science Process Skills Framework:

- Communicating results: Communicate perspectives of investigators, patients, and family members for the use of patient-derived materials.
- Analyzing data: Foster an open discussion to develop skills to evaluate the bioethics of informed consent and usage of patient-derived materials in research.

From the Introductory Biology Framework:

- Ability to understand the relationship between science and society: Describe how various perspectives have contributed to the informed consent process.

Learning Objectives

Students will:

- communicate perspectives of a clinician, researcher, administrator, or family member as it relates to the generation or use of HeLa cells.
- familiarize themselves with the actions of select personnel involved with the medical care of Mrs. Henrietta Lacks and discuss the bioethical repercussions of their actions.
- synthesize the various perspectives of the key players presented during the hearing and formulate individual perspectives to address whether HeLa cells should continue to be used for scientific research.

INTRODUCTION

The HeLa cell line is vitally important in biological research, but its contribution to science has been marked by violations to the responsible conduct of human research. Mrs. Henrietta Lacks was unaware that her cells were harvested in 1951, yet the extent to which they have influenced modern medicine has been unprecedented (1). Her cells are the world's first "immortal" human cells to be studied, and as a result, their significance to research and medicine is unparalleled (2). However, the process of studying HeLa cells has been interwoven with injustice and ethical questions. Mrs. Lacks was an African American woman living in mid-twentieth century Maryland, so her experience is irrevocably tied to the social upheaval of the time (1). Much of Mrs. Lacks' experiences are skillfully relayed in Rebecca Skloot's 2010 book *The Immortal Life of Henrietta Lacks* (1) and the later film of the same name released in April 2017 (3).

Mrs. Lacks' experiences remain relevant to several issues that continue to impact our society such as racism, sexism, and poverty. When Mrs. Lacks first sought treatment for a tumor in her cervix, she travelled nearly 20 miles to the Johns Hopkins Hospital in Baltimore, Maryland. Johns Hopkins was the nearest hospital that provided care for African American patients (1). Through stipulations by its founder, Mr. Johns Hopkins, the hospital would serve the African American community, albeit under segregated conditions (4). For most impoverished African Americans in Mrs. Lacks' community, seeking medical attention at a hospital was a last resort (1). At the time, physicians rarely explained diagnoses or terminology to their patients (5). Segregation in the American south also permeated into medicine, meaning that the quality of medical care one received was often dependent upon their race (5). Regardless of whether this racism was intentional on an individual basis or a deeply ingrained societal norm, when combined with a lack of communication between doctors and patients, it resulted in a substandard level of care for people of color, posing a very real threat to their health (1).

History of the HeLa Cell Line and Its Importance in Modern Biology

The chronicle of Mrs. Lacks' treatment began when she sought treatment for a cervical carcinoma at Johns Hopkins Hospital. Upon arrival at the hospital, she signed a vague consent form, certifying that she would allow the staff at Johns Hopkins to perform any procedures they deemed necessary during her treatment for cervical cancer (1). Unbeknownst to Mrs. Lacks, a biopsy was taken without her knowledge during her first cancer treatment, and these cells were cultured in the hospital's lab by Dr. George Gey, a Johns Hopkins Hospital staff physician (1). Until Mrs. Lacks' cells were harvested, scientists had not been able to successfully keep human cells alive in culture for a significant amount of time (2). However, within a few days of the biopsy, it became clear to the staff at the Johns Hopkins lab that the cells not only survived, but doubled in volume daily (1). Dr. Gey believed the cells could be used to treat cancer and began freely dispensing them to his colleagues and biological researchers (1). This was the initial distribution of the HeLa cell line and soon the cells were passed between colleagues around the world (1). Mrs. Lacks' cells continue to be bought and sold by the trillions today (1).

The ability of HeLa cells to continuously multiply and survive multiple cell divisions in culture made the cell line extremely valuable for biological research. As noted in the perspective profiles, their impact on modern science has led to a deeper understanding of the nature of cancer as well as the effects of certain cancer treatments on human cells. HeLa cells contributed to the mapping of the human genome and advancements in cloning. They were used to develop the polio vaccine as well as the process of *in vitro* fertilization.

It is important for students to understand the unique and important nature of HeLa cells. Though cell lines have since been discovered with similar properties to the HeLa line, it is not unreasonable to assume that today's medicine would be significantly different if HeLa cells had not been cultured. This basic understanding of the biological importance of HeLa cells will prove vital to the successful debate of ethical questions surrounding the continued use of the HeLa cell line.

Bioethical Debate

The use of the HeLa cell strain shines a light on many bioethical debates within the medical community. In the emerging era of personalized medicine, it is important to consider cases like those of Mrs. Lacks to establish appropriate guidelines (6). The HeLa case raises questions about patient consent, privacy, and the inherent ambiguity that results from collecting living (in this case, possibly "immortal") cells from a human being. At a time when discrimination was widespread in segregated hospitals, it was the cells of an African American woman that changed the course of biomedical research (1). Mrs. Lacks' cells are responsible for many developments that have contributed greatly to modern medicine, yet her family could not afford access to a physician (1). Mrs. Lacks' cells have been sold and purchased countless times, yet her family has not been given any of the profits. In the United States alone, there are roughly 17,000 patents that involve HeLa cells (7). It was more than 25 years after Mrs. Lacks' death before her family learned that her immortalized cell lines existed (2). Informing patients or families about how samples were to be used was not required in 1951. Further, the 1990 Supreme Court of California *Moore v. Regents of the University of California* ruling (8) maintained that material can be commercialized without compensation to the patient (9). However, this does not address privacy concerns with patient derived material. Mrs. Lacks' family was not consulted regarding the release of her health records, and with the cell line widely available, it is possible for the genome to be sequenced and released to the public, such as was posted by a European lab in 2013 (10). While the genomic data was later removed from genomic databases by an investigator, there continues to be data repositories where the HeLa genomes can be assembled (11). Although the cell line has experienced genetic drift over countless passages, a publicly available genome associated with a specific person has the potential to compromise the confidentiality of the remaining family members' genetic information, an egregious violation of privacy. As such, the National Institute of Health (NIH) requires requests to be submitted and reviewed prior to release of the HeLa genome to investigators who are receiving NIH funds (12). Researchers are also expected to add their data to a database for future use and acknowledge their gratitude to the Lacks family for their contributions (12). However, no such provisions extend to other researchers. Students will consider the family's perspective, and this will likely be the center of class discussions.

The issue of consent is also connected to the use of HeLa cells in the development of treatments for syphilis and polio. As students consider the perspectives of Mr. Peter Buxtun and Dr. Russell Brown, they explore other instances of racial discrimination that were prevalent in society, science, and medicine in the 1950s. Peter Buxtun, while working for the Public Health Service, filed several protests in 1966 and 1968 against the Tuskegee treatment of venereal disease patients. He later provided information to the media in 1972 leading to the termination of the experiment (13, 14). While the treatment of the Tuskegee study participants (15) is outside the scope of the HeLa case, we briefly include it to focus on key scientists who used the cells to advance medicine as well as to enrich bioethical discussions. Researchers Dr. Russell Brown and Dr. James H.M. Henderson, both African Americans, led a team of federally funded scientists at Tuskegee University to develop the critical protocols to mass produce HeLa cells. Moreover, this batch-production capability was vital to the later development and testing of the polio vaccine (16). Prior to this, studies required labor and time intensive animal models for vaccine development. The HeLa cells, received from Johns Hopkins in April 1953 (17), were chosen as an alternative experimental model increasing the speed of scientific understanding and treatment. The story of Dr. Brown and his colleagues at a historically Black university is a particularly notable juxtaposition of how HeLa cells were both a product of what we now know to be unethical clinical practices but also part of a larger narrative for the articulation of health policy in the United States (16).

The concept of “benevolent deception” refers to physicians withholding information from their patients about their diagnoses, supposedly to protect their patients from the potential negative effects of receiving the diagnosis, like additional stress or anxiety (18). In Mrs. Lacks’ case, they believed the compassionate option was to not fully disclose the extent of her illness and further thought that she would be unable to comprehend the diagnosis (19). This was prevalent during a time in which healthcare was relatively inaccessible for African Americans in the South. This leads to questions about whether Mrs. Lacks would have been treated differently or offered the opportunity to consent to a biopsy, or even a second opinion, if she were a different race or gender. Students may discuss how race, gender, and socioeconomic status influenced Mrs. Lacks’ or the Tuskegee experiences.

There are multiple aspects of bioethical debate surrounding the use of HeLa cells; a few of these topics will be examined during this case study, which takes the form of a student-led public hearing. This lesson is designed to provide students an opportunity to consider the historical use of Mrs. Lacks’ cells in biological research as well as the perspectives of contemporary researchers who authorize or continue to use cells derived from her treatment at Johns Hopkins. Ultimately, the goal of this case study is for students to understand the history and importance of the HeLa cell line and make an informed decision as to whether the cells should be used in future research.

Student-Led Hearing on the Future of HeLa Cell Line Use

While the acquisition, distribution, and use of HeLa cells are widely debated in the literature, there are few, if any, opportunities for undergraduate students to examine this history and make an informed decision within a consolidated lesson. We

present a method for students to assume the roles of scientists, clinicians, and family members as the class collectively hears arguments to vote on the continued use of HeLa cells in research. To begin this assignment, students are pre-designated to specific roles as either a key player who will present testimony or part of the hearing panel. Students receive their assigned roles prior to class. Their pre-class homework is to examine the questions, conduct independent research, and use the provided Perspective Profiles (Supporting File S1. HeLa Hearing – Perspective profiles) as a guide to develop a position statement to be presented to the class. The pre-designation of roles is vital for students to arrive at class ready to engage with their peers in a debate or public hearing style dialogue. Student assignments include seven primary perspectives: Dr. George Gey, researcher who established the original HeLa cell culture; a member of the Lacks family; Dr. Francis Collins, the director of the NIH; Mr. Peter Buxtun, a Tuskegee Syphilis Study Whistleblower; Dr. Russell Brown, a polio vaccine researcher; a member of the Institutional Review Board (IRB); and a modern-day scientist using HeLa cells for their research. An additional subset of students is designated to form the hearing panel. The panel will consider testimony from all perspectives, ask questions of those presenting evidence, and vote on a decision. One individual of the hearing panel will be the head of the panel and a second will be responsible for ensuring that individual testimony and hearing is within the established time limits.

The in-class portion initially begins with a few minutes for the groups to assemble and discuss their plan to present their position to the rest of the class while the hearing panel members finalize the mechanics and timing for the class. The groups will then have designated times to present their position to the predesignated student hearing panel. Once all positions are heard, the hearing panel will vote to determine consensus regarding the question, should the continued use of HeLa cells be permitted in scientific research? After the hearing, students complete a reflective exercise to consider the information presented as well as independently discuss and support their own position on the further use of HeLa cells. Together, this debate style case study, held in the forum of a public hearing, allows students to relate science to society.

Our approach to mimic a public hearing offers a unique mechanism to examine the HeLa cell line and historic contributions. Others have used role-playing to understand the cell line in the context of how Human Papillomavirus (HPV) genes transform cells into cancer (20) using a fictional story. Moreover, our case focuses on the actual events and people involved rather than the research methodology. Additionally, we introduce considerations for the use of human specimens in research with an introduction to an IRB.

Others have synthesized various bioethical considerations in research methods (21). That resource explores the experience of Mrs. Lacks, the Havasupai Indians’ genetic analysis, the Tuskegee Syphilis Study, and the Willowbrook hepatitis study. However, it does not provide a role-playing opportunity. It provides information about these important events in biomedical research but does not allow students to build the same quality of understanding that is gained in a role-playing exercise. Our case synthesizes the highlights of these prior efforts and provides a framework for students to actively engage with history and make a collectively informed decision.

Intended Audience

The intended audience is upper-level life science majors or courses who desire additional dialogue on bioethics and informed consent. Our students were all life science majors predominantly in their third year of study who had completed one semester of advanced biology and one semester of genetics. They were concurrently enrolled in a one-semester cell biology course. The additional understanding of cell lines, including their derivation and maintenance, is helpful to understand the unique challenges facing researchers at the time in which cell immortality was not well understood.

Required Learning Time

This case can be completed in one 75-minute lesson or a two-hour lab session. To accomplish within the time frame, students must be pre-assigned their roles and arrive to class prepared to present facts and perspectives on their designated role. The hearing panel can consider information presented by each role player, ask questions, and vote on the continued use of HeLa cells in research within the 75-minute time frame. The subsequent individual reflection is completed for post-class homework and is due at the beginning of the next lesson.

Prerequisite Student Knowledge

It is helpful for students to have a basic understanding of cell biology and the maintenance of cell lines within the laboratory to understand the unique challenges of the time with regards to maintaining or studying cell lines from patient-derived material. The term informed consent may be new to students and thus one role player will discuss this with the class during their presentation. Otherwise, students are provided quick facts and recommended sources to query for each role player in the student-led discussion (Supporting File S1: HeLa Hearing – Perspective profiles).

Prerequisite Teacher Knowledge

Like the prerequisite student knowledge, a solid understanding of the unique challenges of cell line maintenance and immortalization is helpful to assist the discussion. A brief CBS News story (22) shows an overview of Mrs. Henrietta Lacks and her cells, which could be useful to instructors who may be unfamiliar with the story. Teachers can review the basic facts to quickly learn of the various perspectives that will be presented as well as review the resources prior to convening the class designated as the hearing panel.

The intent is for the hearing to be student-led with minimal teacher intervention. However, allowing groups to have the first few initial minutes to gather their thoughts as a group is helpful, particularly with students who are very nervous when presenting to their peers. It does provide a unique opportunity for student voices to emerge and teachers should be prepared to intervene and moderate, if needed.

SCIENTIFIC TEACHING THEMES

The goal of this case study is for students to use guided questions to analyze different points of view such as researchers, family members, center directors, and contemporary scientists. This is an active strategy employing diverse perspectives. The inclusion of perspectives from the students and hearing panel offers a unique opportunity to encourage dialogue, which links the science to society in both a historical and contemporary context.

Active Learning

The format of the case study encourages an active, student-led, dialogue where the end state is a vote on whether (or not) HeLa cells should continue to be used in scientific research. The power of this activity is achieved when students complete their pre-class research homework (Supporting File S4: HeLa Hearing – Pre-class homework) and can articulate their ‘quick facts’ from the provided materials (Supporting File S1: HeLa Hearing – Perspective Profiles) in a brief position summary. The panel members conduct the hearing using the provided script as a guide (Supporting File S2: HeLa Hearing – Hearing Script). Debates are shown to foster communication skills, teamwork, and are effective mechanisms to educate moral sensitivity (23). These group discussions, responding to questions, and student-led interactions encourage the exchange of ideas from a variety of perspectives. Further, students can achieve a greater understanding of content through the instructional strategy of role-playing, such as that used within an analytical chemistry setting (24), through the integration of biological and social information (25), or when making history come alive (26). As previously described, role-playing in the sciences begins with an individual research assignment leading into a seminar where students assume various roles as they become scientists (27).

Assessment

As Fennessey illustrates, it is important to establish assessment expectations for a role-playing exercise (28). These expectations require the integration of tools such as scripts, debates, and storytelling to effectively communicate ideas. This is most effective when students are accountable for individual preparation and research. In larger enrollment courses, a prescriptive worksheet can be used to make notes on the presentations for later individual reflections or to assign participation points. Reflective experiences are necessary to provide closure to the role-playing experience, particularly when attempting to understand the history or sociology of science as part of an interdisciplinary curriculum (28). In our case, we have modeled a similar experience. Each student has a specific role to research prior to class. They are expected to examine the person as well as query the suggested reference and summary facts provided in Supporting File 1 (Supporting File S1: HeLa Hearing – Perspective profiles). From here, students are directed to prepare summary files for submission at the beginning of the class period in which the hearing is conducted (Supporting File S4: HeLa Hearing – Pre-class homework). Instructors have the option of scoring this pre-class assignment for a grade (Supporting File S7: HeLa Hearing – Grading rubric). Importantly, students who do not complete their pre-class homework will be unable to provide meaningful contributions to the discussion. To encourage homework compliance, instructors may choose to score students on their oral presentation and teamwork skills (Supporting File S7: HeLa Hearing – Grading rubric). However, the more insightful assessment is the post-class reflection. This written assignment allows students to consider what was presented at the hearing and arrive at their own informed position. Teachers may grade this submission for both stylistic (grammar, syntax, etc.) as well as the logic or rationale of their position. A grading rubric is provided (Supporting File S5: HeLa Hearing—Post-class assignment; Supporting File S7: HeLa Hearing – Grading rubric).

Inclusive Teaching

The field of bioethics and the subsequent development of informed consent have lagged behind the science of the past

decade. As students assume roles as a family member, clinician, or researcher, they can envision the situation and questions that these historical or contemporary figures face(d) and how their decisions impacted both scientific advances and the advent of bioethics. This requires students to assume perspectives which they may not have otherwise considered and weigh evidence that shapes or informs their own perspectives during the post-class reflection. Moreover, role-playing activities help students as they explore the diversity of science through not only the foundational knowledge, but also the people involved in making the science; this helps students connect to the learning experience (27). An inclusive experience incorporates race, ethnicity, and gender (29), which are all nested components of this case. Together, this collaborative effort seeks to acknowledge diverse perspectives and, through collaboration with peers, have students examine scientists and participants from a variety of backgrounds to enrich learning through inclusive practice.

LESSON PLAN

Preparing for Class

Lesson facilitation slides

Lesson facilitation slides are included (Supporting File S6: HeLa Hearing—Lesson facilitation slides) to provide an overview of the objectives and design of the case, in the form of a hearing. There is a brief introduction to cervical cancer and HPV, which can be used, as needed. These slides are designed as an orientation to the case and are to be used in the lesson immediately preceding the in-class hearing.

Assigning Character Roles to Students

Each individual student will be assigned one of eight roles. Each of these roles are provided to understand the actions surrounding the generation of the HeLa cell line, the use of the cells in research, or protections associated with patient-derived materials. Likewise, a subsection of students will be designated to be members of a hearing panel, which will consider testimony to determine whether they will continue to use HeLa cells in scientific research. Multiple students may be assigned to the same role, depending on class size. Table 1 illustrates how student names can be pre-designated to each role and directed to the relevant information provided to each student as they perform their preparatory research. These perspective profiles (Supporting File S1: HeLa Hearing – Perspective Profiles #1-8) provide suggested links for students to obtain additional information on their character as well as a summary of quick facts regarding their perspective. This is useful as they prepare their individual pre-class homework (Supporting File S4: HeLa Hearing – Pre-class homework) and their principal contributions summaries for the hearing.

While we conducted the hearing in small class sizes of twenty students or less, it is possible to adapt to larger classes. The pre-designated roles are the same, but the additional students can be managed by having students within the same roles briefly meet at the beginning of class to compare the salient points and designate a spokesperson to present their perspective. Alternatively, instructors can randomly generate the name of the spokesperson to encourage everyone with the group to participate in the preparatory discussions. Non-presenting students can be explicitly instructed to prepare questions to pose to the panel and take notes for later use in the post-class homework. The freedom within this role-playing exercise allows

instructors to focus on whichever aspect(s) are best suited for their course (cell culture, bioethics, history, etc.) and emphasize these during the student discussions.

In-Class Activities

Students, having prepared their pre-class homework, have the tools to discuss these perspectives in the form of a hearing, with the estimated timeline shown in Table 2. Students who are designated as part of the panel should be familiar with the supporting file S2 (Supporting File S2: HeLa Hearing – Hearing Script) to conduct the hearing. At the beginning of class, faculty will provide a brief welcome and small amount of time, less than five minutes, for groups to assemble and coordinate any final comments or perspectives that they will present. From here through the end of the class, the activity is student-led and student-driven. Using the script, testimony and perspective is presented by each character role followed by a brief question and answer by the hearing panel. Students should present a 3-5 minute statement including a brief summary of their perspective, their position on whether HeLa cells should be used for further scientific research, and evidence to support their argument. In total, each role should present no more than five minutes, allowing no more than seven minutes total, including questions. This will allow all seven roles to present their information within the class period. One of the panel members is pre-designated as the timekeeper to ensure that all testimony and questions or answers are completed within this time frame.

After the panel has received all testimony from the seven perspectives, they will briefly confer to summarize the points and address the question, “Should HeLa cells be continued for use in scientific research?” It is beneficial for the entire class to hear this discussion, taking approximately five minutes. This will allow those who presented to hear how their position was received and interpreted by the panel. At the end of the panel dialogue, the panel chair will call for students on the panel to vote on the question. Each panel member will orally vote yes, no, or choose to abstain. Once the votes are tallied, the panel chair will announce the decision to the class.

Following the vote, the remaining eight to ten minutes of class are available to the instructor. This is an opportunity to reflect on the presentations, their content, as well as remind students of the post-class reflection assignment.

Post-Class Activities

Following the hearing, students will individually complete the post-class reflection (Supporting File S5: HeLa Hearing – Post-class reflection). This provides an opportunity for each student to consider key facts or position(s) of the character(s) and summarize their own thoughts on the continued use of HeLa cells in scientific research. This reflection is then submitted at the beginning of the following lesson.

Assessment

The assignment is graded based on the pre-class homework and the post-class reflection. The requirements for each are listed in Table 3. These items are further clarified in the lesson facilitation slides, which may be provided to students (Supporting File S6: HeLa Hearing – Lesson facilitation slides). Grading rubrics are provided (Supporting File S5: HeLa Hearing—Post-class reflection; Supporting File S7: HeLa Hearing—Grading rubric). Optionally, the in-class presentations and the hearing itself can be graded using the provided rubrics. This is most

effective when a teaching assistant is available allowing the instructor to focus on the content presented and student-led discussion.

TEACHING DISCUSSION

There are several opportunities to pair topics within this lesson to support integration into several upper-level biology courses. For instance, bioethics is an underlying theme across biology programs. This lesson could introduce the ideas of informed consent and IRBs to students preparing to enter research, technical, or clinical aspects of science. Additional emphasis on the cellular biology components of tissue culture and cell immortalization naturally lends itself to a cell biology course, for which we implemented this lesson. Interestingly, medical history or public policy courses could be interested in this lesson to illustrate the intersection of science and society. The breadth of possibilities for the application of this lesson are as vast as the uses that HeLa cells have encountered in modern science. When students actively discuss and present this information, it fosters a dialogue and stimulates analysis of the thought process and decision of providers and administrators, all of whom are necessary components of a personalized medicine team. Beyond the actual grade for the activities, we find that the introduction of students to informed consent, familiarization with bioethical consideration, and qualitative discussions were the most beneficial aspects of this lesson, tenets that could be further refined in later courses.

One of the most beneficial aspects of this exercise is for students to complete the pre-class homework. We associated a grade with the homework to encourage completion. Otherwise, students will arrive at the hearing and have minimal contributions to the discussion. Suggested grading rubrics for the pre-class homework and post-class reflection are provided (Supporting File S7: HeLa Hearing – Grading rubric). The richest discussion was when students prepared and reflected on their role and took an active part in the hearing. Remind students that they will be submitting their pre-class homework at the beginning of class. They should have additional notes that they maintain to coherently present their ideas. Students who rely upon information recall quickly become discouraged or anxious when presenting if they are not prepared. Potential challenges are when students have limited ability to internet or print resources. While suggested references are designed to minimize proprietary sources, it is possible that students may find their own references, which requires coordination with local library resources to minimize cost.

As the panel prepares for the hearing, it is also helpful for students to prepare a general list of questions to ask their classmates regarding their character's role or actions. This may contribute new information in some instances and will stimulate dialogue between students. The effectiveness of this lesson is largely based on qualitative discussions. While the grading rubrics for the pre- and post-class assignments provide intrinsic quantitative measurements, the student-led dialogue allows for a discussion of history, society, and bioethics within the same lesson. Some students will passionately present information and assume the role of their character. Others may experience more of a factual debate style tone. Thus, each iteration or classroom experience may differ based on the individual students. The result accomplishes the objectives to familiarize students with

the historical context and consider bioethics. Moreover, this may be the first time that students are introduced to the IRB. This early, informal, exposure to the IRB will plant the seed for their future careers in science or administration.

Instructors should plan to introduce the activity in the preceding lesson. Using the provided slides (Supporting File S6: HeLa Hearing – Lesson facilitation slides) presents an overview and common understanding of student expectations. With clearly defined outcomes of the case, students can perform independent research and engage in the hearing to address the main question. Similarly, this provides exposure to the IRB process with some of the considerations when researchers want to include patient-derived materials. Importantly, the bioethics discussion is particularly relevant as the panel considers each perspective on the acquisition and use of HeLa cells in the past and today. Instructors may encourage the panel and students to reflect on the bioethics of patient-derived materials using questions such as:

- Is patient consent always necessary for the use of human tissue in research?
- Should benevolent deception ever be permitted between physicians and patients?
- Should family members be permitted to decide whether tissue is collected from a patient?
- Should individual human genomes be made public?
- Should patients (or their family) receive compensation for providing tissue samples that are used for research?

Together, this lesson provides a framework for students to engage with history and see how the past informs the present research and bioethical considerations for the acquisition and use of patient-derived materials.

SUPPORTING MATERIALS

- S1. HeLa Hearing - Perspective Profiles. Each perspective profile contains the name and information regarding personnel involved in the acquisition or use of HeLa cells. The perspectives contain quick facts along with links to suggested resources for students to use as they research their roles in preparation for class.
 - S1. #1 – Perspective Dr. George Gey, Cell culture scientist
 - S1. #2 – Perspective Lacks family member
 - S1. #3 – Perspective Dr. Francis Collins, NIH Director
 - S1. #4 – Perspective Mr. Peter Buxtun, Tuskegee Syphilis Study whistleblower
 - S1. #5 – Perspective Dr. Russell Brown, Polio vaccine researcher
 - S1. #6 – Perspective Modern-day scientist using HeLa cells in research
 - S1. #7 – Perspective IRB member
 - S1. #8 – Perspective Hearing panel member
- S2. HeLa Hearing - Hearing Script. Hearing panel members are encouraged to review the hearing script provided to shape the format of the discussion. The designated panel chair can use this to guide the proceedings as students present the perspective of each individual. The panel members can ask questions of each person as they present their respective testimony.

- S3. HeLa Hearing - IRB conduct & considerations. The conduct of an Institutional Review Board or Human Research Protection panel can be new to students. Although this will not provide extensive insight into the IRB process, which may differ among organizations, this supplement will provide context as to how and why IRBs are generally conducted and the types of questions of interest to panel members.
- S4. HeLa Hearing - Pre-class homework. Each student will complete pre-class homework on their respective role and submit responses to these questions at the beginning of the class in which the hearing is conducted.
- S5. HeLa Hearing - Post-class reflection. Each student will individually reflect on the hearing and prepare a response to the post-class reflection regarding whether HeLa cells will continue to be used for scientific research.
- S6. HeLa Hearing - Lesson facilitation slides. Lesson facilitation slides are available for faculty to prepare and discuss the lesson design with students. These slides may be provided or made available to students, at the instructor's discretion.
- S7. HeLa Hearing – Grading rubric. Suggested grading rubrics for both the pre-class homework and post-class reflection are provided.

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REFERENCES

1. Skloot R. 2010. *The immortal life of Henrietta Lacks*, Broadway Books, New York, NY.
2. Khan FA. 2011. The immortal life of Henrietta Lacks. *The Journal of IMA* 43(2):93-94.
3. Wolfe, GC. 2017. *The immortal life of Henrietta Lacks* (film).
4. Johns Hopkins Hospital. 2016. *The legacy of Henrietta Lacks* (hopkinsmedicine.org).
5. National Public Radio. 2010. 'Immortal' cells of Henrietta Lacks live on in labs.
6. Ahluwalia M. 2020. Genetic privacy: We must learn from the story of Henrietta Lacks. *NewScientist*.
7. Brown DL. 2018. Can the 'immortal cells' of Henrietta Lacks sue for their own rights? *The Washington Post*.
8. California Court of Appeal, SD Division. 1988. *Moore v. Regents of the University of California*. *West's Calif Report* 249:494-540.
9. Helmenstine AM. 2018. What HeLa cells are and why they are important. *ThoughtCo*.
10. Parry W. 2013. Controversial 'HeLa' cells: Use restricted under new plan. *Live Science*.
11. Callaway E. 2013. Deal done over HeLa cell line. *Nature* 500(7461):132-133.
12. National Institutes of Health. 2013. NIH, Lacks' family reach understanding to share genomic data of HeLa cells.
13. Buxtun P. 2018. Peter Buxtun to share historic tale. (<https://bioethics.jhu.edu>).
14. Thomas SB, Quinn SC. 1991. The Tuskegee Syphilis Study, 1932 to 1972: Implications for HIV education and AIDS risk education programs in the black community. *Am J Public Health* 81(11):1498-1505.
15. Curran WJ. 1973. The Tuskegee syphilis study. *N Engl J Med* 289(14):730-731.
16. Turner T. 2012. Development of the polio vaccine: A historical perspective of Tuskegee University's role in mass production and distribution of HeLa cells. *J Health Care Poor Underserved* 23(4):5-10.
17. Brown RW, Henderson JH. 1983. The mass production and distribution of HeLa cells at Tuskegee Institute, 1953-55. *J. Hist Med Allied Sci* 38(4):415-431.
18. Beauchamp TL, Childress JF. 2009. *Principles of biomedical ethics*, Oxford University Press, USA.
19. Sisk B, Frankel R, Kodish E, Isaacson J. 2016. The truth about truth-telling in American medicine: A brief history. *Perm J* 20(3):15-219.
20. Chamany, K. 2017. Stem cells across the curriculum—Learning activity 3: Teaching notes for case study role-play HeLa cells & HPV Genes: Immortality & cancer module.
21. Agatsuma R, Arnone M, Brown D, Ting Chowning J, Cooksley E, Fraser P, Griswold J, Ryong Lee RE, Spitze J, Thompson D. 2013. Science and ethics of humans in research. *Northwest Association for Biomedical Research* 23-28.
22. CBS News. 2010. CBS Sunday Morning segment on The Immortal Life of Henrietta Lacks.
23. Kim WJ, Park JH. 2019. The effects of debate-based ethics education on the moral sensitivity and judgment of nursing students: A quasi-experimental study. *Nurse Educ Today* 83:104200.
24. Jackson PT, Walters JP. 2000. Role-playing in analytical chemistry: The alumni speak. *J Chem Edu* 77(8):1019-1025.
25. Fox AM, Loope LL. 2007. Globalization and invasive species issues in Hawaii: Role-playing some local perspectives. *J Nat Res Life Sci Ed* 36:147-157.
26. McDaniel KN. 2000. Four elements of successful historical role-playing in the classroom. *The History Teacher* 33(3):357-362.
27. Howes EV, Cruz BC. 2009. Role-playing in science education: An effective strategy for developing multiple perspectives. *J Elem Sci Ed* 21(3):33-46.
28. Fennessey SM. 2000. History in the spotlight: Creative drama and theatre practices for the social studies classroom, Heinemann, West Port, CT.
29. Dewsbury B, Brame CJ. 2019. Inclusive teaching. *CBE—Life Sci Educ* 18(2):fe2.

Table 1. Key roles and supporting information for student assignments.

Student name(s)	Role	Description	Notes
	Dr. George Gey	Scientist attempting to establish cell cultures in the lab	S1. HeLa Hearing - Perspective Profile #1
	Member of the Lacks family	Select one of the family members to present their perspective on the acquisition and/or use of Henrietta's cells	S1. HeLa Hearing - Perspective Profile #2
	Dr. Francis Collins	Director of the NIH	S1. HeLa Hearing - Perspective Profile #3
	Mr. Peter Buxtun	Tuskegee Syphilis Study whistleblower	S1. HeLa Hearing - Perspective Profile #4
	Dr. Russell Brown	Polio vaccine researcher	S1. HeLa Hearing - Perspective Profile #5
	Modern day Scientist	A contemporary scientist using HeLa cells in research	S1. HeLa Hearing - Perspective Profile #6
	IRB/HRP Manager	Institutional Review Board/Human Research Protections representative	S1. HeLa Hearing - Perspective Profile #7
	Hearing Panel Member	Voting panel member considering whether to allow use of HeLa cells in research	S1. HeLa Hearing - Perspective Profile #8

Table 2. Timing and specifics on the preparation and execution of the in-class public hearing and supporting events.

Activity	Description	Estimated Time	Notes
Preparation for Class			
Prepare assignments with roles to hand out prior to class	1. Identify each student to assume a specific perspective in class. 2. Prepare instructions for students on how to research and prepare for student-led discussion. 3. Review script for hearing panel members. 4. Identify one student as timekeeper for testimony. 5. Identify one student to lead the hearing panel, monitor testimony, and coordinate questions from panel members to role players. 6. Distribute the roles and specific instructions to students prior to the next lesson.	About 15 minutes to prepare.	• Supporting File S1 (Supporting File S1: HeLa Hearing – Perspective Profiles #1-8) contains the profiles and supporting quick facts for each role to assist student research and preparation. • Supporting File S2 (Supporting File S2: HeLa Hearing – Hearing Script) contains recommended script for the hearing panel as they receive, question, and evaluate testimony. • Multiple students may be assigned to the same role. In the initial few minutes of class, students can finalize how testimony will be presented at the hearing. • One student on the hearing panel should be designated as the timekeeper to ensure that all testimony is received during the class time. • One student on the hearing panel should be designated to lead the hearing panel and coordinate questions and voting by the panel. • Distribute the roles and specific instructions to students. This can be accomplished during the last few minutes of a previous lesson or via email or designated learning management platform (i.e., Blackboard announcement). • Supporting File S6 (Supporting File S6: HeLa Hearing – Lesson facilitation slides) are facilitation slides containing an overview of the process, which is useful to review prior to instructing students.
Student Pre-Class Homework			
Students research their designated roles to prepare for class	1. Locate the role that they are to fulfill in class. 2. Use the Perspective Profiles to facilitate independent research. 3. Complete pre-class assignment.	About 60 minutes	• Supporting File S1 (Supporting File S1: HeLa Hearing –Perspective Profiles #1-8) contains recommended links and quick facts regarding each designated role. Students can use this to facilitate their independent research and preparation. • Supporting File S2 (Supporting File S2: HeLa Hearing – Hearing Script) contains a recommended format for the student panel to use when receiving testimony. Students on the panel will familiarize themselves with this document. • Supporting File S3 (Supporting File S3: HeLa Hearing—IRB conduct & considerations) contains recommended links to familiarize students with review boards and human research protections. • Supporting File S4 (Supporting File S4: HeLa Hearing—Pre-class homework) contains the questions that each role player will consider from the perspective of their designated character. • Students will submit their pre-class homework on their designated role at the beginning of class. • Students will bring their notes and be ready to begin the hearing at the beginning of class. • Lecture slides with notes are in Supporting File S6 (Supporting File S6: HeLa Hearing—Lesson facilitation slides). This may be provided to students, if desired, to help frame the activity and upcoming lesson expectations.

Activity	Description	Estimated Time	Notes
In-Class Activities			
Students conduct hearing to consider testimony whether to use HeLa cell in research	1. Students submit their pre-class homework at the beginning of class. 2. Students assigned to the same role will briefly meet to finalize ideas and organize (panel members) or structure testimony (character roles). 3. Timekeeper and hearing chair will monitor and keep students on time. <i>Note: Time is assuming a 75-minute class</i>	~75 minutes	• Students submit (either in hard copy or digital format through the designated course platform) their pre-class homework on their pre-designated role (Supporting File S4: HeLa Hearing—Pre-class homework) not later than the beginning of class in which the hearing is held. (<5 minutes) • Instructor initially allows not more than five minutes for groups to convene and prepare to present testimony. • Designated timekeeper provides one-minute warning and ensures that hearing begins on time. • Hearing panel uses script as guideline to receive testimony from peers (Supporting File S2: HeLa Hearing—Hearing Script). Initial comments are made, and testimony begins. (~2 minutes) • Character roles will present 3-5 minutes testimony on their position, using their completed homework as a guide. • After a character role presents testimony, panel members have 2-3 minutes to ask questions of those presenting testimony. This allocates 5-7 total minutes per character (seven roles x seven minutes = ~49 minutes) • Once questions are completed, the panel will call the next person for testimony until all are complete. • Panel members will then have five minutes to convene to discuss the merits of testimony and consider whether to continue to allow HeLa cells to be used for research. • The panel chair will collect oral votes and tally those in favor, opposed, or abstaining for the vote. (~1 minute) • The decision is made by the panel and the class is notified of the decision. (~1 minute) • The final few minutes of class are for instructors to reflect on the process, students' presentations, and provide further instructions to students on the post-class reflection assignment. (8-10 minutes)
Post-Class Reflection			
Students reflect on the results of the hearing.	1. Students complete the post-class reflection. 2. Students consider all testimony and arrive at their own decision, supported by the facts presented. 3. Reflections are submitted to the instructor.	~30 minutes	• While the panel reached a decision, this could vary greatly at the individual level. The post-class reflection is an opportunity for students to consider all perspectives presented and arrive at their own position on the question. • Supporting File S5 (Supporting File S5: HeLa Hearing—Post-class reflection) contains the student assignment. All students are placed in the role of a voting panel member and must describe at least one key fact or perspective for each character role testimony and synthesize their own opinion or conclusion on the further use of HeLa cells at their organization. • Students complete individual post-class reflections and submit via the designated learning management platform prior to the next class.

Table 3: Assessment and lesson facilitation information.

Assignment	Description	Notes
Pre-class homework	Students will individually complete the pre-class assignment as homework in preparation for the hearing. Using the resources in S1, they will complete the questions found in S4 and submit at the beginning of class in which the hearing is conducted.	Supporting File S1: HeLa Hearing – Perspective Profile #1-8 Supporting File S4: HeLa Hearing – Pre-class homework
Post-class reflection	Students will individually reflect on the information presented during the in-class hearing. From here they will complete the post-class reflection found in S5. The reflection will be submitted at the beginning of the following class.	Supporting File S5: HeLa Hearing – Post-class reflection
Lesson facilitation slides	Slides are available with information describing the sequence of events for hearing. Information is provided that facilitates how instructors may convey how students will prepare and conduct the hearing. Information is also provided on how student performance will be assessed and what material(s) are required for submission	Supporting File S6: HeLa Hearing – Lesson facilitation slides