INQUIRY & INVESTIGATION

# Life after Death: An Activity to Investigate the Scientific, Legal, & Racial Issues of the Henrietta Lacks Story

NABT BioClub RECOMMENDATION

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**Abstract**

*In this two-part activity, students examine living cervical cancer cells and chromosomes from a women named Henrietta Lacks who died over 60 years ago, but whose cancer cells continued to divide and grow even after her death. Students then debate the legal and bioethical issues surrounding the use of her cells. This laboratory activity reinforces important introductory biology concepts such as mitosis and cancer. Once the students have experimented with Henrietta Lacks's cells, they feel connected to her story and passionate about exploring the science, legal, and racial issues surrounding the use of her cells.*

**Key Words:** *Mitosis; cell division; cancer; HeLa; Henrietta Lacks; bioethics.*

Henrietta Lacks was a poor, African-American woman who died of cervical cancer in 1951 at the age of 31. Before she died, researchers at Johns Hopkins Hospital collected a sample of her cervical cancer cells and were stunned to discover that her cells had a never-before-seen ability to divide and grow outside of her body in culture. This allowed researchers to extensively study human cancer cells in the laboratory for the first time (see Gey et al., 1952). Sixty years after her death, her cells are still dividing. They've divided so many times that her cells could wrap three times around the earth. Research on her cells has led to the development of the polio vaccine, cloning, gene mapping, and in vitro fertilization (Skloot, 2010). Her cells were instrumental in the discovery of telomerase and of medicines used to treat cancer and Parkinson's disease (Moore, 2010). Despite the incredible contribution her cells have made to science, Henrietta Lacks never knew that her cells were taken for research purposes and her family wasn't informed until 25 years after her death (Skloot, 2010).

*Research on [Henrietta Lacks'] cells has led to the development of the polio vaccine, cloning, gene mapping, and in vitro fertilization.*

When researchers finally explained to the family how and why they were using Henrietta's cells, they used words like "DNA" and "clones" – technical language that the uneducated family didn't understand. Henrietta's daughter, Deborah, believed that scientists had made hundreds of clones of her mother. She lived in fear of one day bumping into a clone of her mother on the street. The family was terrified that every time researchers injected the Ebola virus into Lacks's cells, Henrietta was suffering pain. None of the researchers working on HeLa cells ever took the time to educate the family about what was really going (RadioLab, 2010).

The following laboratory activity and debate is an exciting way to bring scientific, legal, and racial issues into the classroom. It is suitable for a variety of age groups and classes and can be modified as needed to serve different student abilities and academic levels. I've used this investigation in 9th-grade Biology, AP Biology, and Research Seminar classes. My students often report learning a lot about how biology applies to the real-world through their work on this case.

> *"Observing the cancer cells was both educational and enlightening. Until recently, I was unaware of how simple cancer truly is. It is such a basic process and yet it destroys the lives of many."* – a 9th-grade biology student

## ○ Prerequisites

Before beginning the lab investigation with my students I give a brief lecture on why cancer is not contagious. I introduce the concept of major histocompatibility markers (MHC) on the surface of cells and how the immune system uses these markers to recognize self from nonself. This is so that students (and their parents) don't feel nervous about our use of living cancer cells in the lab. In addition, I cover mitosis before the lab and use the lab to reinforce the concepts students have already learned about the cell cycle.

Next, I discuss how cancer is uncontrolled cell division and how tumors are formed from a mass of rapidly diving cancerous cells. I describe the chromosomal differences between a normal diploid cell and a cancerous cell. Cancer cells are aneuploid; they have an incorrect number of chromosomes. HeLa cells have mutated so much in the past 60 years that they contain 82 chromosomes per cell (Macville et al., 1999). Because the cells are so different from normal human cervical cells and can survive and multiply outside the human body, some scientists have even proposed identifying the cells as a species, *Helacyton gartleri* (Van Valen & Maiorana, 1991).

*The American Biology Teacher,* Vol. 73, No. 6, pages 337–340. ISSN 0002-7685, electronic ISSN 1938–4211. 
DOI: 10.1525/abt.2011.73.6.6

Informing students how the HeLa cells were prepared prior to shipment will also help improve their understanding of mitosis. The cells are exposed to a colchicine, a plant-based toxin that inhibits microtubule function. Therefore, this toxin stops the cells in the middle of mitosis after the DNA has already been condensed into visible chromosomes.

## ○ Pre-lab Setup

The HeLa cell cultures can be ordered from a National Institutes of Health-sponsored company called CellServ (http://www.cellserv.org; the author has no affiliation with this company), which sells a kit for $65 called "CSK4: Preparation of Human Chromosome Spreads." Although not identified as such on the website, the kit includes HeLa cells preserved in a fixative that must be used within 2 weeks if stored at 4°C or 4–6 weeks if stored at –20°C. There are enough materials for 30 students to do the experiment individually; however, I place my students in groups of two to four. This makes it possible to do the lab with up to 120 students.

## ○ Materials Needed

Set-up is minimal and takes about 10 minutes.

CellServ Kit #4 (CSK4) includes:

- HeLa cells
- Stain 1 & 2
- Permount

Teacher will need to supply:

- Microscope slides
- Plastic pipettes
- Staining jars
- Gloves and lab coats/aprons
- Compound, light microscope (minimum 400× objective)
- Immersion oil (optional)

## ○ Safety Precautions

Students should wear aprons, goggles, and gloves during the lab. The stains used in the kit can permanently stain clothing. Although not identified as such in the kit, Stain 1 is Hema 3 (Solution 1) and Stain 2 is Hema 3 (Solution 2). These stains may cause minor irritation of the skin and digestive tract. Both are safe for use in a high school laboratory.

### Part 1: Preparation of Chromosome Spreads (45-minute class period)

The success of the lab depends on proper technique. The first step is to splatter 6–8 drops of the HeLa cell suspension onto a microscope slide from various heights and angles. The students must drop the cells from a significant height onto the microscope slides (see Figure 1). This ensures that the cells will burst open and the chromosomes spill out. It's also really important to let the slide air dry completely after dropping the cells onto the slide and before the first stain is used. To aid in the drying process as well as smear the cells over the surface of the slide, students should blow gently on the slide for a few seconds.

The next step is to dip the slide for several seconds into Stain 1 three times and then dip the slide for several seconds into Stain 2 three times. After completing the staining process, the student should rinse the slide carefully with distilled water and then let it air dry completely. Once the slide is completely dry, a drop of Permount should be added to it and a coverslip placed on top. The slide is now ready for observation.

### Part 2: Observation of the HeLa Cells (45-minute class period)

A wonderful advantage of this lab is that once the slides have been prepared with Permount, they typically last several days to weeks and do not have to be examined immediately. When students begin to examine the slides (Figure 2), I instruct them on how to properly

**Figure 1.** Students drop HeLa cells onto a microscope slide.

**Figure 2.** Students examine prepared HeLa cell slides in the microscope.

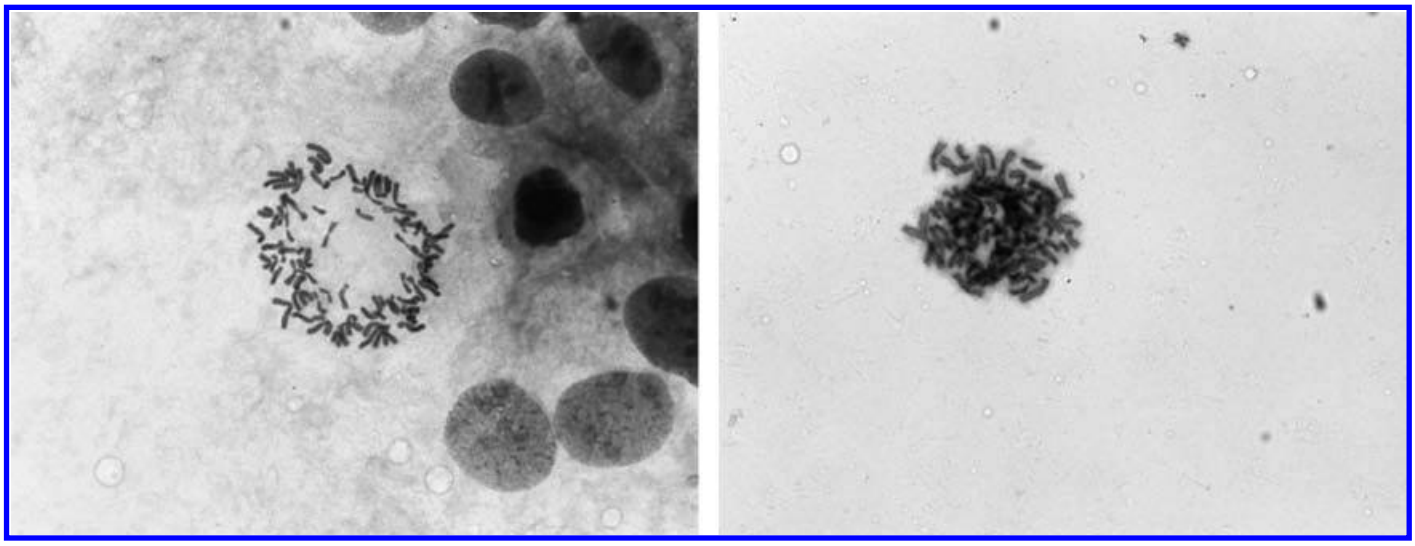

**Figure 3.** HeLa cells and chromosomes.

search the slide for HeLa cells and chromosomes. The students will be looking for purple-colored cells that appear to have tiny X's (chromosomes) bursting out of the cell. It is helpful to show students pictures of what the cells look like with the short lens objective and with the long lens objective (see Figure 3).

The students will find that some cells have remained intact and do not have any chromosomes outside them. In other cases, chromosomes are not directly near a cell and may have spread farther away from it. Whenever one student group finds an excellent sample, I have other groups look at it so that they know what to look for on their own slide. The images presented here are actual student results from one of my 9th-grade classes.

In analyzing their results, the students must draw and describe the appearance of the chromosomes and count the number of chromosomes found outside the cells. Then they submit a group paper summarizing what they learned from viewing the cells and how the HeLa cells are different from normal, diploid cells.

### Part 3: Debate

In the 6 years I've performed this activity with students, the debate has always been very exciting for students. The first 5 years were a bit difficult because so little information was readily available about Henrietta Lacks. The recent release of the New York Times bestselling book, *The Immortal Life of Henrietta Lacks* by Rebecca Skloot, has led to an explosion of media regarding her story. A simple Google search will yield an extensive amount of information for students to research. This new information has made the debate even more exciting for my students and makes it easier for teachers to reproduce this activity in their own classroom.

Before beginning this year's debate, I had the students listen to the WNYC *RadioLab* segment, "Henrietta's Tumor" (RadioLab, 2010). The segment is very powerful as it includes interviews with Henrietta's daughter, Deborah, who was deeply affected by the use of her mother's cells. As the students listen to the radio segment, I encourage them not to take a side at this point and to just write down their observations.

The class is then split into two teams. One team represents the Lacks family (the Prosecution) and the other team represents Johns Hopkins Hospital (the Defense). The Prosecution and the Defense are each made up of lawyers and witnesses. I let the students determine who their witnesses should be on the basis of the evidence they collect. The Prosecution normally uses family members as witnesses, and the Defense normally uses Dr. Gey (the researcher who first discovered the immortality of HeLa cells).

The purpose of the debate is to determine whether Johns Hopkins Hospital should be forced to compensate the Lacks family for their role in distributing Henrietta Lacks's cells without her consent. At first glance, this case may seem cut and dried. During the time the cells were taken, there were no laws regarding the use of a person's cells (and there are none today either). However, there are still many powerful arguments that each team can make to support its case (see Table 1), and each year my students are able to passionately defend both sides of the argument.

## ○ Background Research

After splitting the class into teams, I give the students two full class periods in the computer lab to conduct research. Initially, I don't give the students any assistance on where to begin their research, other than to assist them with evaluating the credibility of their sources. I do this in order to empower the students to make their own discoveries. If a team appears to be stuck and isn't sure how to collect data or what questions they should ask, I give the whole class some prompts, such as: What are patient/doctor rights? Have there been any recent legal cases regarding the use of human cells? How did the Lacks family find out about the use of Henrietta's cells?

The students' use of credible sources when collecting research is very important. During the debate, if a team doesn't know how to respond to a particular argument, they can ask the other team to state their source of the information. If the other team cites a noncredible source or can't cite a source at all, I (as the judge) will permanently erase that evidence from the record. The students really love using this tactic, and it reinforces the need for them to use credible sources.

## ○ Structure of the Debate

The debate should take between one and two class periods to complete. In order to make the debate really fun for students, I attempt to act like a typical judge in a court room. The students must "all rise" as the judge enters the room. Students who misbehave or get off-task are held in "contempt of court" and given a warning. I use a gavel to request "order in the court." However, in order to maintain

**Table 1. Arguments that students commonly use in the debate.**

| Lacks Family (Prosecution) | Johns Hopkins Hospital (Defense) |
|---|---|
| Henrietta Lacks (HL) never gave consent for the collection of her cells for research. Johns Hopkins (JH) violated the due process clause of the 14th Amendment by collecting and indefinitely storing the cells without her consent. | In 1980, the Supreme Court of California ruled in the case of John Moore vs. Regents of the University of California that patients have no rights to tissues after they leave the body. |
| JH violated the search-and-seizure clause of the Fourth Amendment by removing cells from HL's body after she died. | There are no established laws protecting a patient from the nonconsensual use of their cells. |
| The family can't even afford basic health insurance, even though their mother's cells have led to millions of dollars in profit. | The family's inability to afford health insurance is not the fault of JH. |
| JH profited from the use of HL's cells. Dr. Gey appeared on television, published papers, and became famous from the use of her cells. | JH never profited financially from the sale of HL's cells. If people were allowed to sue for the use of their cells, which is a well-established practice in research, medical research would grind to a halt. |
| HeLa cells were named after the first two letters of HL's first and last name, which acknowledges her connection to the cells. | JH did not release HL's name in order to maintain patient privacy. |
| JH acknowledged the connection of HeLa cells to the Lacks family when they asked family members for DNA samples 25 years after HL's death. | HL's cells have mutated so greatly as to be considered a separate species and they do not belong to the Lacks family. |
| The Lacks family tried contacting JH numerous times to find out what was going on with HL's cells, but they were repeatedly ignored. | JH had no legal requirement to inform the Lacks family as to how HL's cells were being used. |
| The Lacks family questions the spiritual and ethical repercussions of researchers manipulating their mother's cells (e.g., injecting HeLa cells into unwilling prisoners; infecting HeLa cells with Ebola). | The use of HeLa cells has led to development of new research methods, medicines, and tests that have benefited all members of society, which justifies their use. |

a constantly flowing debate, I do not allow "objections" to interrupt a team's statements.

Each group must prepare a 2-minute opening position statement. After the opening statements have been read, the Prosecution is given the opportunity to make a single argument in favor of their case. The Defense is then given the chance to respond. The argument continues until neither group can add any new detail to the argument or I declare the argument over (I do this when the teams begin to repeat their statements). Then, the Defense is given the opportunity to make a single argument in favor of their case and the Prosecution responds to that argument.

After both the Prosecution and Defense have had several opportunities to present arguments, each team is given 15 minutes to form a final, 2-minute closing statement. I inform the teams that the closing statements should be modified from the original statements to include new detail that was discussed during the debate.

## ○ Conclusion

I base my judge's decision on the quality and quantity of evidence presented, the team's ability to counter arguments made by the other team, and the strength of the opening and closing statements. I don't base the ruling on how I think an actual judge would rule if this were a real case. Therefore, the final ruling may change from class to class. A video, written transcript, court ruling, and grading rubric for an actual student debate is available at (http://bit.ly/HeLaNABT [case sensitive]).

*"I learned quite a bit about bioethics and how people have different standings on different issues."* – a 9th-grade biology student


## ○ Acknowledgments

My thanks to Michael Kunst for taking the images of my students' microscope slides.


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