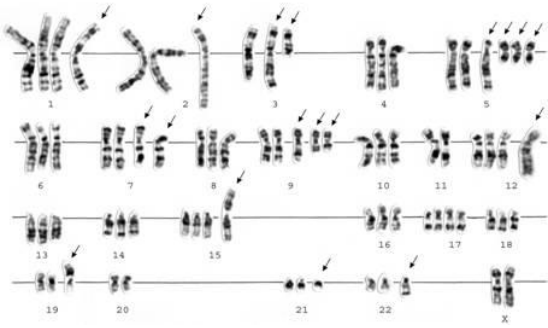


How HeLa Cells Work



Have you ever heard of HeLa cells? They've been around for more than 60 years, but unless you're a medical researcher, the name probably didn't crop up on your radar until recently, if at all. In the past decade or so, countless articles -- and one *New York Times* bestselling book -- have been written about them.

But what's a HeLa cell? It's a **line**, or population, of cells, taken from a person and used in scientific research. Cell lines are often named after the people from whom they were originally derived, and HeLa comes from the

first two letters in the name Henrietta Lacks. Cell lines are used in all kinds of ways, such as studying the effects of diseases or developing medications and vaccines, and play an invaluable role in medicine today.

But HeLa cells were the first -- the first line of human cells to survive *in vitro* (in a test tube). Named after a cancer patient, the cells were taken from Lacks' tissue samples and grown by a researcher named Dr. George Gey in 1951. Dr. Gey quickly realized that some of Lacks' cells were different from normal cells. While normal cells died, HeLa cells just kept on growing. After more than 50 years, there are now billions and billions of HeLa cells in laboratories all over the world. It's the most commonly used cell line, and it's known to be extremely resilient.

The fact that HeLa cells have been used in some very important, groundbreaking medical research is interesting enough, but there's another part of the story -- and that part is why Oprah might be making a movie about HeLa. Henrietta Lacks had no idea that her cells were taken and used in this way, and neither did her family. And while the cells became commercialized (researchers can buy a vial of them for \$250) Lacks' family has lived without **healthcare** and in poverty. Henrietta Lacks' story isn't just about her contribution to medical research; it's about the ethics of biomedical research and the practice of informed consent. But let's start at the beginning, with Henrietta herself.

The Woman Within

For a long time, researchers who were curious enough to ask were told that HeLa cells were named after "Helen Lane" or "Helen Larson." Medical journals wrote about the line and a few did mention Henrietta's real name, but few people paid attention. That part just wasn't considered important.



The real Henrietta Lacks was a young African-American mother living outside of Baltimore, Maryland. While pregnant with her fifth child, she felt what she described to cousins as a "knot." After childbirth, Lacks experienced abnormal bleeding. Her doctor discovered a lump on her cervix and sent a sample of it to a lab. The result was a diagnosis of cervical cancer. The only hospital in the area at the time that would treat African-American patients was Johns Hopkins, so that's where Lacks went for treatment.

While her husband and children often waited in the car outside, she endured radiation treatments (which were done at the time by inserting tubes of radium around her cervix and sewing

them into place) as well as X-ray treatments. The cancer spread despite these and other treatments, however, and caused Lacks horrible pain. She died in the hospital at the age of 31 on October 4, 1951. She had been diagnosed just nine months earlier.

During her radiation treatments, a doctor removed some tissue samples from Lacks' cervical tumor. She had signed the usual forms consenting to treatment for her cancer, but was not asked for her permission to remove the tissue samples, nor was she informed that it had been done, but this wasn't unusual. The tissue was sent to Dr. Gey in the Tissue Culture Laboratory at Johns Hopkins. Dr. Gey had been trying to grow human cells in the lab for decades, but they always died within a few days. Lacks' cells were unique. He isolated one of them and got it to divide -- and it just kept going. He named the line HeLa.

My Immortal Cells

All of the body's normal cells experience the effects of aging over time, known as **cellular senescence**. Repeated divisions cause the cell's DNA to become unstable, and sometimes toxins form. This means that eventually the cells are unable to replicate, or divide, and the cell dies. This is called **programmed cell death (PCD)**, **apoptosis** or even **cellular suicide**. Its part of the normal process for many cells, and it varies depending on the type of cell.

While it may sound awful, PCD can be a good thing. It's how fingers and toes are formed in utero (fetuses start out with webbed appendages) and how our **immune system** kills off cells that are infected by viruses. Too much PCD can cause tissue damage and lead to disease, but so can too little. For example, if cells grow out of control, they can become cancerous.

When grown in a laboratory setting, PCD generally occurs after about 50 cell divisions. But that's what sets HeLa apart. Under the right conditions, HeLa cells form an immortal cell line; they divide indefinitely. Remember that HeLa cells were grown from a tissue sample from Lacks' cervical tumor. Cancerous cells don't experience PCD, and Lacks' particular cells were especially hardy. Just like the cancer grew and spread quickly through Lacks' body, HeLa cells grow and spread quickly in vitro. Nobody knows quite why. Lacks had both the human papillomavirus (HPV) and syphilis, so one theory is that these helped suppress PCD in the cells.

So what makes HeLa special? As cancer cells, HeLa cells are unlike normal human cells, and there is no better proof of this than to take a look at its chromosomes, or karyotype. Normal human cells have 46 chromosomes, while HeLa has 76 to 80 heavily mutated chromosomes. The origin of this deviation from normalcy stems from the human papilloma virus (HPV), the cause of nearly all cervical cancers. HPV inserts its DNA into a host cell, causing it to begin producing a protein that binds to and inactivates the native p53 protein. p53 is known as the guardian of the genome due to its role in preventing mutations and suppressing tumors. Non-functional p53 protein can therefore have disastrous consequences.

Dr. Gey didn't seek to profit off HeLa, though. After publishing his research, he received requests from other researchers for samples of HeLa, and he was happy to provide them for free. Now HeLa cells are being used all around the world, with more than 60,000 medical journal articles published about their use and at least 11,000 patents related to their use. There are thousands of other cell lines, but HeLa remains the most popular because it is easy to grow, store and ship.

The hardiness and popularity of HeLa has actually led to a problem: contamination. Some researchers even think of the cells as a "weed" -- they are difficult to get rid of and may contaminate as many as 20 percent of other cell lines. The

presence of HeLa cells can overwhelm the others and ruin research. Gold contends that mistakes in the handling of HeLa cells have led to costly errors in the medical research community. But let's explore some of the positives of HeLa cells next.

Saving Lives After Death

Although initially HeLa was developed for use in cancer research, that was just a start. HeLa cells have even been sent to outer space, proving that cancer cells can grow there. Almost since its creation, the HeLa cell line has been used in many different ways, and it even helped found entire fields of study. For example, doctors essentially created the field of **virology** -- the study of viruses -- after infecting HeLa cells with everything from measles to mumps so they could observe how the viruses affected the cells. This led to the creation of some of the vaccines in use today. Genetic medicine might not be possible without HeLa cells, as researchers discovered that the cells' chromosomes were visible when treated with a specific stain. In the mid-1960s, HeLa cells were fused with mouse embryo cells to create the first cell hybrid, which helped researchers begin the process of mapping the human genome.

The most well-known early use of HeLa involves a disease that has been eradicated in the Western hemisphere. In the early 1950s, the United States was stricken by fear of contracting the infectious, paralytic disease called polio. Outbreaks were on the rise, with about 60,000 cases in 1952, and there was a huge push to come up with a vaccine. That year researcher Jonas Salk created the vaccine, and part of the testing process used HeLa cells. HeLa cells have also been instrumental in studying tuberculosis, HIV and human papillomavirus (or HPV, which eventually resulted in a vaccine). Researchers have used them to test medications for cancer and Parkinson's disease, and they've even been used to test products like cosmetics.

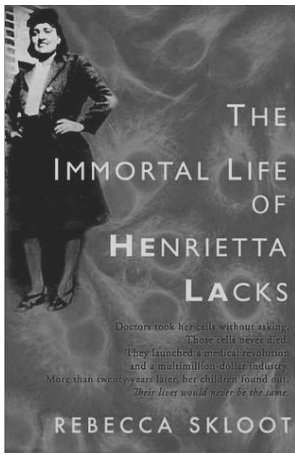
HeLa cells have also been employed to help standardize procedures and tools for culturing and growing cells. When Dr. Gey first started sharing the cells, he had to use couriers to transport them via airplane, and there was a very limited timeframe in which the cells would survive. But soon researchers found a way to keep HeLa -- and other cells -- alive in the mail.

When the story of Henrietta Lacks and her cells began to get recognition, it raised a lot of questions in yet another area -- ethics in biomedical research. Although things have changed drastically since Lacks was a patient, there's still a lot of debate. We'll end with a look at how the Lacks case has played a part.

When Your Cells Aren't Yours

At first glance, it seems unthinkable that Lacks' family didn't know about HeLa cells, but nobody ever told them. Gey and the researchers at Johns Hopkins weren't legally bound to do so -- it was routine to take samples of [blood](#), cells and tissues from patients without telling them or getting their consent. Nobody could've known then what would become of Lacks' cells.

It wasn't until the early 1970s that Lacks' family got an inkling of Henrietta's legacy. Her husband, Day, got a call from someone at Johns Hopkins hospital that confused him -- the person was telling him that his wife was still alive but as cells in a lab. He believed the researcher was telling him that they needed to test her children to find out if they also had cancer. The Lacks children submitted to testing but were never contacted about the results. Author Rebecca Skloot, who



published "The Immortal Life of Henrietta Lacks" in 2010, states that the family was misled about the research, which was not done to help them but to better understand Henrietta's genetics. Skloot befriended members of Lacks' family, including her daughter, Deborah Lacks-Pullam. Lacks-Pullam even visited a lab at Johns Hopkins, holding a vial of HeLa cells and whispering, "You're famous" [source: [New York Times](#)].

Gey and Johns Hopkins didn't profit off HeLa, but the cells and related products have been sold since 1954. The Lacks family has not received any money, and they cannot afford health insurance. Her children received very little education, and many of them have health problems. They're angry, and critics have argued that at the very least, they've been marginalized and disrespected.

Today patients sign consent forms stating that tissues can be used in research, but the argument used by the medical community is that once blood or tissues are removed from you, they're not really yours anymore. It would be far too complicated, and would ruin the field of medical research, to have to track the identities of each sample and pay if there's monetary gain. The courts have sided with researchers so far. In the 1980 case of Moore vs. Regents of the University of California, a leukemia patient discovered that his doctor had filed a patent and created a cell line worth \$3 billion using his cells. The [Supreme Court](#) ruled that Moore had no right to share in the profits.

Henrietta Lacks has finally gotten some recognition. Her contributions have been commemorated by organizations like the Morehouse College of Medicine and the Smithsonian. There's Skloot's book, which HBO has optioned for a movie. And after 60 years, a headstone was finally placed at her grave. Skloot has also created the Henrietta Lacks Foundation to educate people about Lacks and to help her family and others.

1. What differentiates HeLa cells from other human cells?
2. Henrietta's doctor removed her cancer tissue during an autopsy and didn't tell her family. Do you think he should have asked her family for permission and why?
3. How would you define informed consent?
4. If you go to the dermatologist and he or she removes a mole, what do you think is done with that tissue sample?
5. How would you define bioethics?
6. The Tuskegee Experiment is another example of people being used as research subjects without their knowledge or consent. Research the Tuskegee Experiment and write a brief summary.
7. Some feel it is the right of every person to have a say-so in how their cells are used or not used for research. Others believe it is everyone's obligation as members of society to donate (without compensation) their tissues for the good of society because that is how new drugs and treatments are discovered. What do you think?