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HeLa Cells: Key Discoveries and the Science of Their Immortality

Listicle
Last Updated: September 16, 2024
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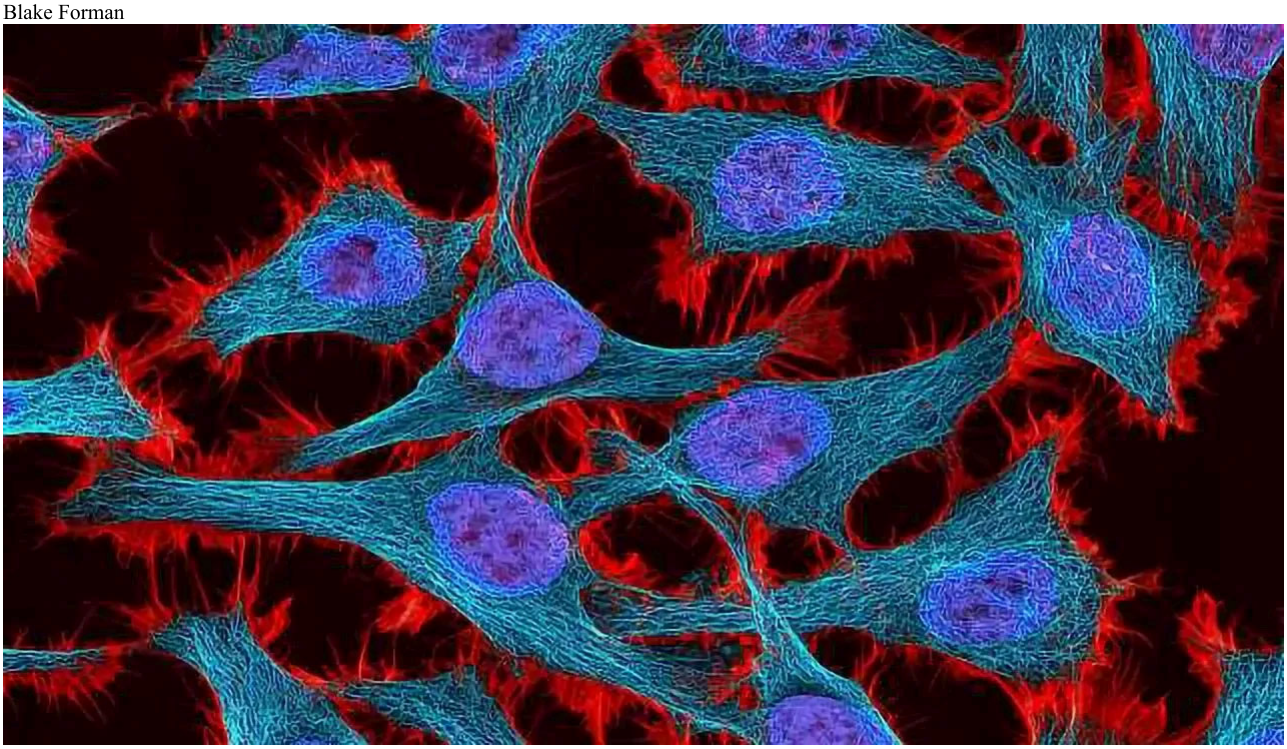

Multiphoton fluorescence image of HeLa cells stained with the actin binding toxin phalloidin (red), microtubules (cyan) and cell nuclei (blue). Credit: National Institutes of Health (Creator: Tom Deerinck, NIGMS, NIH)

What are HeLa cells? A brief overview

HeLa cells were the first human cells that researchers could grow and multiply endlessly in the lab. HeLa cells get their name from the person they belonged to: Henrietta Lacks, and remain a line of cells used commonly in biomedical research.

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What are HeLa cells? A brief overview

- Who is Henrietta Lacks?
- How were HeLa cells discovered?
- Why are HeLa cells immortal?

What are HeLa cells used for?

- Why are they important for scientific discoveries?
- What have HeLa cells been used for?
- What are HeLa cells used for today?

Key scientific contributions of HeLa cells

1. Polio eradication
2. Improved cell culture practices
3. Chromosome counting
4. Genome mapping
5. Human papilloma virus (HPV) vaccines
6. COVID-19 vaccines

Who is Henrietta Lacks?

Unlike the HeLa cell line named after her, Henrietta Lacks was little heard of until the 2010 publication of Rebecca Skloot's book, *The Immortal Life of Henrietta Lacks*. Born in 1920 in Virginia, Henrietta was an African American tobacco farmer, a wife and mother to 5 children. In 1951, aged just 31 years, Henrietta died from an aggressive form of cervical cancer, only 10 months after first seeking treatment at Johns Hopkins for a "knot" in her womb. During her treatment at the hospital, samples of cancerous tissue were taken from her cervix. These cells went on to become the immortal cell line known as HeLa.

"Henrietta Lacks (HeLa): The Mother of Modern Medicine" by Kadir Nelson, oil on linen, 2017. Collection of the Smithsonian National Portrait Gallery and National Museum of African American History and Culture, Gift from Kadir Nelson and the JKBN Group LLC. *Credit: Smithsonian National Portrait Gallery.*

How were HeLa cells discovered?

During Henrietta's first treatment for cervical cancer, the surgeon took a tissue sample from her tumor. He passed this on to the head of tissue culture at John Hopkins University, Dr. George Otto Gey. The cells the surgeon took from Henrietta's tumor were then placed in a culture medium, labeled "HeLa" to identify them. The researchers expected that the cells would multiply a few times and then die like most samples. However, in the lab, the HeLa cells remained alive and multiplied at an astonishing rate. Dr. Gey informed colleagues that his lab had grown the first immortal cell line.

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Why are HeLa cells immortal?

HeLa cells are classed as immortal as they can divide multiple times without dying. This ability comes from the cells possessing an overactive version of the enzyme telomerase, which prevents the shortening of the chromosome telomeres, and so prevents cellular aging and cell death.

What are HeLa cells used for?

HeLa cells are a vital tool in biomedical research and have led to an increased understanding of the fundamentals of human health and disease.

Why are they important for scientific discoveries?

The HeLa cell line has endured as a research model because it can be easily grown and is incredibly robust, making it an ideal tool for the laboratory. HeLa cells grow and proliferate faster than most other cancer cells. Additionally, with the volume of work done on these cells, they are well characterized. Being of human origin, HeLa cells are ideal for studying diseases that affect human cells.

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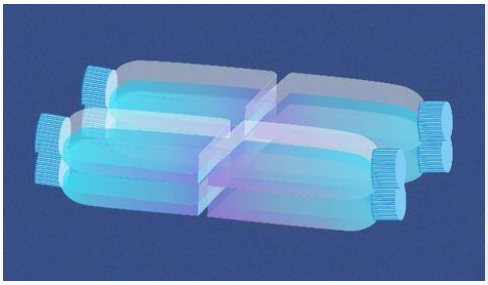

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What have HeLa cells been used for?

HeLa cells have played a role in some of the major advances in fields such as cancer biology, infectious disease and fundamental microbiology. Some of the research involving HeLa cells also served as the underpinning of several Nobel Prize-winning discoveries such as the 2014 Nobel Prize in Chemistry for the development of a microscope technique that allows for the live viewing of on-going cellular processes.

What are HeLa cells used for today?

HeLa cells continue to find use in research as an immortalized cell line. Even though these are cancer cells, they still possess many properties of healthy cells such as the production of essential proteins. HeLa cell lines continue to be used for experiments that contribute to the understanding of cell function and structure such as toxicity experiments, proliferation experiments and research into cell adhesion.

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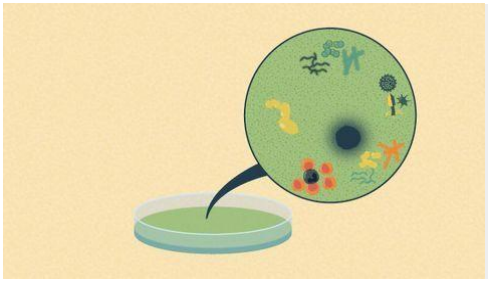

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Key scientific contributions of HeLa cells

Over the years HeLa cells have enabled scientists around the world to make great leaps in science and medicine. This list highlights six of these remarkable contributions.

1. Polio eradication

Jonas Salk had developed a polio vaccine in the early 1950's but was struggling to find a way to test it in field trials as traditionally used rhesus monkey cells were too expensive for such a large-scale study. In 1952, HeLa cells were found to be both susceptible to, but not killed by polio, making them an ideal source of host cells. A HeLa cell culture production laboratory was set up at Tuskegee University, which at its peak was shipping in the region of 20,000 tube cultures per week. Polio cases have decreased by over 99% since 1988, from an estimated 350,000 cases to just 6 reported cases in 2021.

2. Improved cell culture practices

During the mass production and distribution of HeLa cells for polio vaccine testing at Tuskegee University, lead researchers Brown and Henderson pioneered new cell culture protocols, such as the use of rubber-lined screw-capped bottles and tubes and strict quality control measures. The temperature sensitive nature of HeLa cells also led the researchers to use multiple incubators and introduce novel shipment solutions such as Equitherm and insulated shipping containers.

After Gartler's discovery that HeLa cells could travel through the air and contaminate other cultures, vast improvements were made to cell culture practices, to prevent further costly cross-contaminations. More recently, HeLa cells have been used alongside artificial intelligence and machine learning to optimize media for improved cell culture.

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3. Chromosome counting

Rebecca Skloot describes in her book, *The Immortal Life of Henrietta Lacks*, how a lab mix up in Texas in 1953 accidentally enabled researchers to see and count each chromosome clearly in the HeLa cells they were working with. Following this discovery, Tijo and Levan developed a technique for staining and counting chromosomes, demonstrating that human somatic cells have 23 pairs of chromosomes, not the previously believed 24. This has had important implications for medical diagnostics, as deviations from 23 chromosome pairs are associated with various genetic diseases, for example trisomy 21 and Down Syndrome.

4. Genome mapping

Harris and Watkins created the first human-animal hybrids in 1965, by fusing HeLa cells with mouse cells. Despite the fears and uncertainties from the general public at the time, this accomplishment enabled great advances in mapping genes to specific chromosomes and, in later years, the Human Genome Project. These initial experiments utilizing HeLa cells culminated in the publication of the first complete human genome sequence in 2022. Today, genome mapping has led to discoveries such as how non-coding DNA mutations could underlie many cases of previously unexplained neurodevelopmental disorders. Genome mapping is also being used in stem cell research to understand potential differentiation trajectories with applications in regenerative medicine.

5. Human papilloma virus (HPV) vaccines

In the 1980's, Harald zur Hausen found Henrietta's cells contained HPV-18. He later went on to win a Nobel Prize for his discovery linking HPV and cervical cancer. Subsequent work led to the development of HPV vaccines, which are now used in many countries to protect young girls from developing HPV infections associated with cervical cancer. Researchers using NHS England cancer data estimated that by mid-2020, HPV vaccination had prevented 687 cancers and 23,192 grade 3 precancerous cervical lesions (CIN3s).

More recent studies on HPV have found that the virus can lead to the development of a host of cancer types. A study published in *The Lancet Global Health* found that one in five men are infected with one or more types of HPV considered to be "high-risk" strains. Today, HPV vaccines are available for both males and females.

6. COVID-19 vaccines

HeLa cells played a vital role in characterizing SARS-CoV-2 at the outbreak of the COVID-19 pandemic. Using HeLa cells, researchers were able to confirm the receptor used by the virus to infect host cells, aiding in the initial identification of drugs and vaccines to treat and prevent infection. HeLa cells continued to play a role throughout the pandemic and were even used as part of the initial development of mRNA vaccines against SARS-CoV-2.

In addition to these six examples, HeLa cells have been involved in many other ground-breaking advances in science and medicine, ranging from being the first cells to be successfully cloned, to the first human cells to be sent into space. HeLa cells are still widely used in labs today, making it likely that their contributions will continue to grow.

Frequently asked questions *(Click to expand)* +

Meet the Author

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Blake pens and edits breaking news, articles and features on a broad range of scientific topics with a focus on drug discovery and biopharma. He earned an honors degree in chemistry from the University of Surrey. Blake also holds an MSc in chemistry from the University of Southampton. His research project focused on the synthesis of novel fluorescent dyes often used as chemical/bio-sensors and as photosensitizers in photodynamic therapy.

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