



THE IMMORTAL WOMAN

Cancer killed Henrietta Lacks more than 60 years ago, but her cells live on

Henrietta Lacks, a 30-year-old African-American woman, went to Johns Hopkins Hospital in Baltimore, Maryland, in 1951. For months, she had felt pain in her *cervix*, the lower part of the uterus. A doctor examined her and found an abnormal lump of tissue, called a *tumor*, growing there. Lab tests showed that the tumor was cancerous.

Cancer develops when cells divide and grow uncontrollably. Doctors at the hospital gave Lacks the standard treatment of the day: They sewed small packets of radium, a *radioactive* element, onto the tumor. Radiation can damage *DNA*—the genetic material in cells—so that the cells can't divide anymore.

But the doctors did something else too: They took tissue from Lacks's cervix without telling her, which was typical back then. The tissue was placed in test tubes and kept warm in an incubator. Doctors hoped the cells would survive outside of Lacks's body so they could be used for medical research.

Scientists had been trying to *culture* human cells, or grow them in a lab, for a long time. But no matter what they did, the cells died. Lacks's cells thrived. (Scientists now think it's partly because a molecule called *telomerase*, which protects DNA from damage, is unusually active in her cells.)

Lacks's cells have fueled nearly 75,000 studies in genetics, cloning, vaccines, and other areas of biology. Last year, for the first time, her descendants were given a say in research conducted on her cells.

DEATH AND EVERLASTING LIFE

The radiation treatment Lacks received didn't stop her cancer and she died later that year. Remarkably, though, her cultured cancer cells survived and reproduced in test tubes. They grew just as aggressively as they had in her body. Every day, they doubled in number. The cells were immortal.

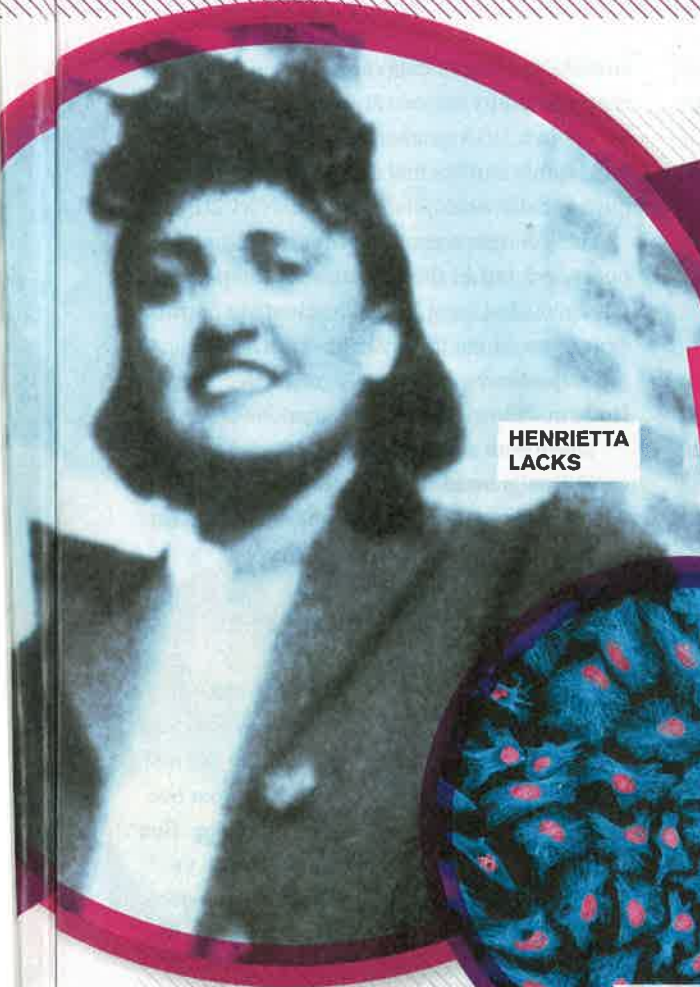
Scientists who heard about them asked for samples, and soon Lacks's cells arrived in

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4 BONUS SKILLS SHEETS

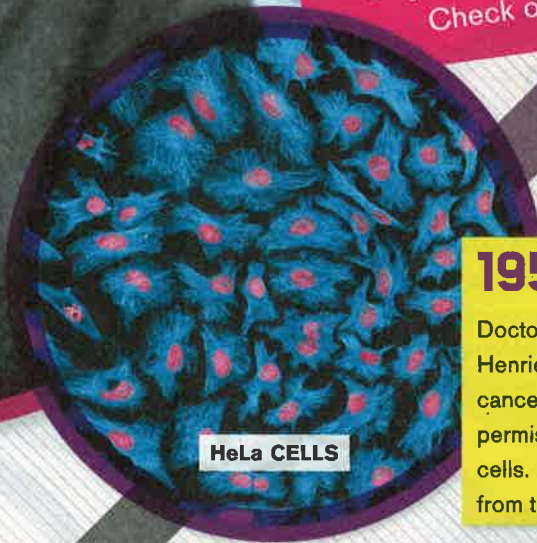
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HENRIETTA LACKS

THE IMMORTAL CELLS OF HENRIETTA LACKS

A woman's cells are still going strong more than 60 years after doctors first collected them. Check out some of their major milestones.



HeLa CELLS

1951

Doctors take cancer cells from Henrietta Lacks, who has cervical cancer, without her knowledge or permission. They name them "HeLa" cells. Despite treatment, Lacks dies from the disease later that year.



POLIO VACCINE

1952

HeLa cells survive shipment by mail—the first successful transport of live cells. Scientists use them to study viruses and to test the polio vaccine.



HeLa CELLS CLONED

1955

HeLa cells are the first to be successfully cloned, or copied exactly.

Turn the page for more of HeLa's historic journey

labs around the world. They were given the name "HeLa," combining letters from her first and last names.

HeLa cells allowed researchers to run experiments on human cells that they couldn't ethically do on people—such as

infecting them with diseases or administering high doses of drugs. Such experiments helped scientists understand how human cells work and led to the development of vaccines and treatments for diseases (*see time line above*).

Continued on the next page

In the past 63 years, several scientists have won Nobel prizes for research on HeLa cells. Winners of national student research competitions have used them too. "It's hard to find a biology lab that doesn't have HeLa cells sitting in the freezer or incubator," says Kathy Hudson, deputy director at the National Institutes of Health (NIH), the agency in charge of U.S. medical research.

smaller molecules called *bases*, which are represented by letters. A genome is the list of letters in a DNA sequence. Lacks's genome will help scientists learn more about how human cells work.

Her genome wasn't the first to be published, but in the other cases, the people who provided samples gave scientists permission to use them. "They said, 'I'm OK with my sequence being publicly available,'" says Hudson. "Henrietta wasn't asked."

There was another problem. A genome can reveal personal information, such as which diseases someone might develop. And

A FAMILY'S LEGACY

Last year, scientists in Europe published the *genome* of HeLa cells on the Internet. DNA molecules are made of a string of

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SPACE FLIGHT

1960

HeLa cells travel into space aboard a Russian satellite. Later, NASA sends more HeLa cells into space, discovering that they reproduce faster in low gravity.

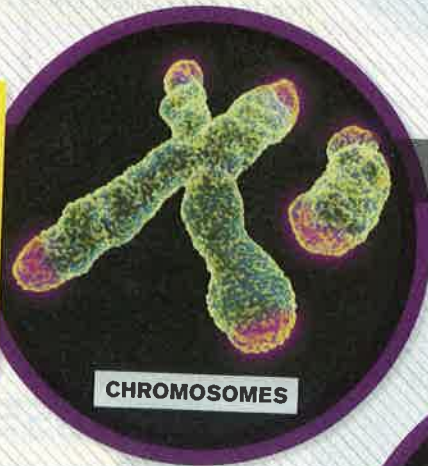


1965

HeLa cells are combined with mouse cells to make the first hybrid cells from two different species. Such cells were used in research on genetics and cell division.

1989

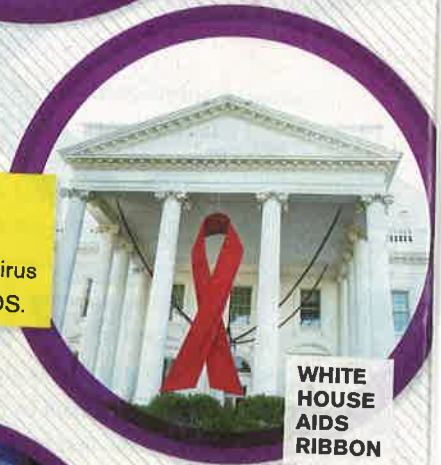
Researchers working with HeLa cells discover that a molecule called *telomerase* protects the DNA in human chromosomes from damage due to aging.



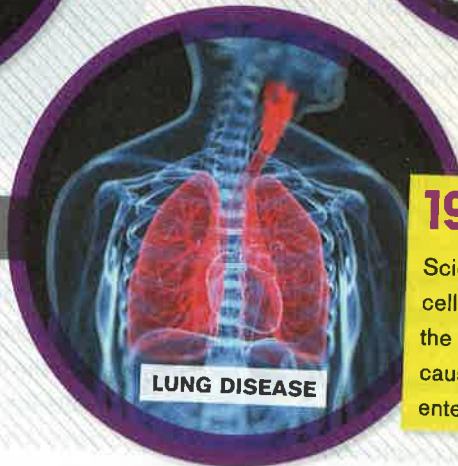
CHROMOSOMES

1986

Scientists use HeLa cells to study HIV, the virus that causes AIDS.



WHITE HOUSE AIDS RIBBON



LUNG DISEASE

1993

Scientists use HeLa cells to learn how the bacteria that cause tuberculosis enter human cells.

since family members share similar DNA, a person's genome holds clues about diseases their relatives might be susceptible to.

Henrietta Lacks left behind five children, ages 16, 12, 4, 2, and 1, when she died. She has many living descendants today. When researchers published the HeLa genome in 2013, they hadn't informed the Lacks family or asked their permission, since they weren't required to. When the family expressed concerns about privacy, the scientists removed the sequence from the Internet.

Hudson and other NIH leaders then met with the Lacks family. Her relatives wanted to

find a way to keep Henrietta's DNA sequence somewhat private without cutting off scientific progress. "They are really proud of the contribution Henrietta Lacks's cells have made to biology," says Hudson.

Together, the family and the NIH came to an agreement. Researchers can use the HeLa genome by applying to the NIH for access. A group of scientists and Lacks family members reviews the applications. And from now on, when scientists publish research conducted using HeLa cells, it'll include a note thanking Lacks and her family for their everlasting gifts to science. ❀ —Jennifer Barone

CORE QUESTION

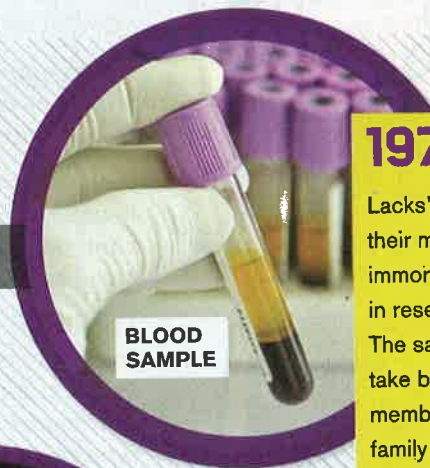
How have HeLa cells contributed to biology and medicine? Give three examples.



GEORGE GEY

1971

Henrietta Lacks is identified by name for the first time in an article honoring George Gey, the scientist who cultured HeLa cells, following his death in 1970.



BLOOD SAMPLE

1973

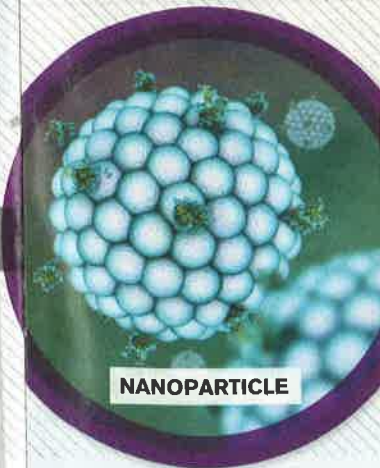
Lacks's children learn that their mother's cells are immortal and are used in research worldwide. The same year, scientists take blood samples from members of the Lacks family for genetic analysis without proper permission.

1984

Research on HeLa cells proves that a virus known as human papillomavirus, or HPV, can cause cervical cancer (which killed Lacks). A vaccine that protects against some strains of the virus became available in 2006.



CANCER CELL



NANOPARTICLE

2005

Researchers test how quickly HeLa cells absorb nanoparticles. The results suggest new methods for delivering drugs to cancer cells.



LACKS FAMILY

2013

The HeLa cell genome is published online without permission from the Lacks family. The family and the NIH reach an agreement for future use of the genome in research.

DEBENUTZER/PH/CC BY-SA 3.0 (1980); ISTOCKPHOTO.COM (1980 BACKGROUND); 1981; THE ALAN MASON CHERNEY MEDICAL ARCHIVES/JOHN HOPKINS MEDICAL INSTITUTIONS (1971); ISTOCKPHOTO.COM (1973); STEVE GOSCHMIDT/SCIENCE SOURCE (1984); PASIJEVA/SCIENCE SOURCE (1989); BRENDAN SMIALOWSKI/AF/GETTY IMAGES (1990); SHUTTERSTOCK (1990); MEDICATION LTD/SCIENCE SOURCE (2005); COURTESY OF REBECCA SKLOOT (2013)

Name: _____

JUST THE FACTS?

Read the following sentences related to "The Immortal Woman" (p. 14). Write an "F" on the line if the statement is a fact and an "O" if the statement is an opinion.

FACT	OPINION
<ul style="list-style-type: none"> • True statement • Can be tested or proved • May have numbers, dates, locations, or other details that can easily be checked through other sources 	<ul style="list-style-type: none"> • Shows what someone thinks • May include emotions • May use words like <i>believe</i> or <i>think</i> • May contain bias, an attitude for or against something

STATEMENTS

- | | |
|---|--|
| <p>_____ 1. The first cells to be successfully cloned were HeLa cells.</p> <p>_____ 2. HeLa cells are the most important cultured cells in the world.</p> <p>_____ 3. Scientists would never have been able to develop vaccines for diseases without HeLa cells.</p> <p>_____ 4. When scientists grew HeLa cells in test tubes, the cells doubled in number each day.</p> <p>_____ 5. A virus called human papillomavirus causes cervical cancer.</p> | <p>_____ 6. Scientists should not publish the HeLa cell genome, because it contains private information about the Lacks family.</p> <p>_____ 7. Today's doctors are better than the ones who treated Henrietta Lacks.</p> <p>_____ 8. Scientists discovered that HeLa cells reproduce faster in space than on Earth.</p> <p>_____ 9. A person's genome contains clues about diseases his or her relatives might be susceptible to.</p> <p>_____ 10. Doctors should have told Henrietta Lacks that they were collecting her cells for research.</p> |
|---|--|

Name: _____

CANCER FIGHTER

In "The Immortal Woman" (p. 14), you learned that Henrietta Lacks died of cervical cancer more than 60 years ago. Treatments for cancer have improved greatly since then. Read the following passage to learn how doctors kill cancer cells using chemicals. Then answer the questions that follow.

CHEMICAL TREATMENT

In the 1940s, scientists began experimenting to see if chemicals could slow the growth of cancer cells—abnormal cells that grow out of control. The first studies looked at compounds in mustard gas, a chemical weapon used in World War I. These medicines became the first types of chemotherapy—chemicals that kill cancer cells.

Scientists now have many different chemotherapy drugs to treat cancer. Each chemical works in a different way to slow cell reproduction. For instance, medicines called *alkylating agents*, which are derived from mustard gas, enter the cell and attach to the cell's DNA. That damages the DNA and prevents the cell from reproducing. Other drugs interfere with cells' *enzymes*, which speed up the reactions that control reproduction. Today, there are more than 90 different chemotherapy drugs are commonly in use.

The downside to chemotherapy drugs is that they also affect the reproduction of healthy cells—and that causes side effects like nausea and hair loss. Doctors who prescribe chemotherapy treatment must find a balance between destroying cancer cells and preventing damage to normal ones.

QUESTIONS

1. What are cancer cells?
2. How do chemical weapons relate to cancer treatment?
3. How do alkylating agents affect cell reproduction?
4. Why do chemotherapy drugs cause side effects?
5. Why must doctors use care in prescribing chemotherapy?