



# She Asked, “What If...?”



Choose  
Science!

As she leaned over her dining room table, Dr. Janet Davison Rowley warned her four young sons not to sneeze. The table was covered with minuscule pieces of photos she had taken in her lab. Each piece showed a single human chromosome. Now it was time to see if Dr. Rowley could find anything unusual about the pictures.

Why was this busy scientist, wife, and mother poring over tiny photos of chromosomes? Dr. Rowley had a theory—a radical one. Could there be a connection between the chromosomes of cancer patients and inherited diseases? She was determined to find out, driven by a passion for science that had begun years ago.

## On the Fast Track

As an elementary school student, Dr. Rowley became fascinated by science. She was particularly fond of *binomial nomenclature*, the orderly system used to classify plants and animals. Dr. Rowley’s parents were both educators who shared their only child’s love of learning and encouraged her to excel in school. And excel she did. At the age of just 15, Dr. Rowley received a scholarship to study at the University of Chicago. Four years later she earned a philosophy degree. Two years after that she graduated with a second degree in science. Not finished yet, Dr. Rowley then entered medical school; she had just turned 20. She married a fellow doctor the day after she graduated and then worked part-time for the next 20 years while raising four sons.

Dr. Rowley began her medical career taking care of mentally handicapped children. Later, she worked at a lab at the University of Chicago researching the genetic changes in the chromosomes of leukemia and lymphoma patients. At the time, the accepted theory was that these diseases damaged normal chromosomes. Dr. Rowley had another thought: what if instead of the disease causing a chromosome to become abnormal, an abnormal chromosome causes the disease? She got to work testing her theory.

## A Dining-Room-Table Discovery

After using a chemical technique that made human chromosomes easier to distinguish from one another, Dr. Rowley photographed the chromosomes of leukemia patients. She cut each chromosome out of the photos. Then she laid out the tiny pieces on her table and began to study the chromosomes to see if she saw anything unusual. And she did! Dr. Rowley discovered that a piece of a chromosome called the Philadelphia chromosome had broken off and attached itself to chromosome 9. (This transfer is known as a *translocation*.) Dr. Rowley also noticed a translocation between chromosomes 8 and 21 in another type of leukemia. This discovery proved her theory that damaged chromosomes caused specific diseases.

At first, some scientists resisted Dr. Rowley’s findings. But by 1990, over 70 translocations had been identified for different cancers. Dr. Rowley’s work led to the development of new and more effective drug therapies for treating blood cancers like leukemia and lymphoma. One of these drugs, Gleevec, is one of the most successful cancer therapies ever. Because of Dr. Rowley’s persistent research, blood cancers that were once fatal could now be treated on an outpatient basis using targeted drugs.

Dr. Rowley once said, “Cancer can be cured if we work hard enough.” Her determination to test her radical theory moved the world one big step closer toward making leukemia and lymphoma a thing of the past.



## Waiting Game

When Dr. Rowley was accepted to medical school, the university had a quota of three women in a class of 65 students.

Unfortunately the female quota had been filled, so Dr. Rowley had to wait nine months before she could start. But she didn’t let this obstacle stop her. Dr. Rowley still started medical school right after she turned 20 years old.

Answer the questions in your own words. Use the back if you need more space.

1. What was Dr. Rowley's theory? \_\_\_\_\_

\_\_\_\_\_

2. What was the accepted theory about the chromosomes of leukemia and lymphoma patients? \_\_\_\_\_

\_\_\_\_\_

3. In your own words, explain what happens in a translocation. \_\_\_\_\_

\_\_\_\_\_

4. List the vocabulary word in each paragraph that matches the meaning.

A. Paragraph 1: extremely small \_\_\_\_\_

B. Paragraph 2: very different from the usual or traditional \_\_\_\_\_

C. Paragraph 4: of, involving, or relating to genes \_\_\_\_\_

D. Paragraph 6: fought against or tried to stop \_\_\_\_\_

E. Paragraph 6: not requiring an overnight stay in a hospital \_\_\_\_\_

5. Pretend you are Dr. Rowley. Write a response to the medical school explaining why you do or do not think it is fair that the school won't let you start classes yet because you are a woman. \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_



## Always Active

If you think Dr. Rowley spent all her time in a lab, you're mistaken. This multi-talented scientist knew how to work hard and enjoy life at the same time. Dr. Rowley not only loved science, but was also a devoted mother and wife who regularly spent time gardening, swimming, cycling, sailing, and skiing. In fact, she was active well into her 80s, still riding her bike every day to work—even in the snow!



Middle School: Dr. Janet Davison Rowley  
Women in Science  
PenniesforPatients.org

# Science Is Their Thing



Choose  
Science!

If you know a woman in a science career, she has probably faced a few obstacles along the way. That hasn't stopped these two physician-scientists from pursuing their passion for science.

## Biology Class Beginnings

Dr. Gwen Nichols knew she wanted to become a doctor and researcher in biology class. Her teacher helped her see how what she was learning in class connected to the world around her. Dr. Nichols particularly liked the idea of seeing a question and then finding answers for it.

Dr. Nichols worked as both a physician taking care of cancer patients and a researcher looking to develop new cancer therapies. She describes research as basically understanding how things work, whether you're talking about the human body, animals, chemicals, or anything in nature. She says that the best part of her career as a scientist has been the opportunity to help other people: "It's wonderful to know that you are able to contribute to making the world a better place. Even if your contribution seems small, it makes you want to keep working to find answers."



Today, Dr. Nichols serves as the Chief Medical Officer for The Leukemia & Lymphoma Society, where she oversees LLS's scientific research projects, services for patients, and policy and advocacy programs. She encourages students who are interested in a science career to try to see how science is everywhere—in sports, in how your TV or computer functions, in the trees outside your house, and in your own body when you get sick and when you get better. She says, "People who think science is boring don't know science! It's a really exciting field and has so many different ways to use your own personal strengths to make a difference. It's very creative—and there is no one right path to become a scientist. Follow your passion." That's definitely what Dr. Nichols did and is still doing today.

## "Why Wait?"

Dr. Irene Ghobrial has an important question: "Why wait?" She is a physician-scientist who does research at the Dana-Farber Cancer Institute. Her work centers on a condition called *multiple myeloma*. In this disease, cancer cells accumulate in the bone marrow, where they crowd out healthy blood cells. These cancer cells produce abnormal proteins that can cause a patient to develop leukemia.



A patient who has been diagnosed with multiple myeloma may not show any early signs or have symptoms of the disease. The standard practice for a patient like this has been to send him or her home and not do any treatments until leukemia actually develops. Dr. Ghobrial believes that this practice made sense years ago when treatments that were effective were also harmful to a patient's body. Today, though, much-less-toxic treatments are available. So Dr. Ghobrial has been asking, "Why wait to start treating myeloma patients?" She and her team of researchers are trying to find out if treating myeloma patients earlier, before leukemia develops, can make a difference in their survival.

Dr. Ghobrial is proud to be a woman in science today: "I can make a difference in making life better for other people." She advises other women, "Don't hold yourself back. You can achieve anything you want to do and dream big."

**Answer the questions in your own words. Use the back if you need more space.**

1. How did a biology teacher motivate Dr. Nichols to pursue a career in science? \_\_\_\_\_  
\_\_\_\_\_
2. How do you know that Dr. Nichols likes being a scientist? Use evidence from the text to support your answer.  
\_\_\_\_\_  
\_\_\_\_\_
3. Why does Dr. Ghobrial think it makes sense today to treat patients with multiple myeloma early? \_\_\_\_\_  
\_\_\_\_\_
4. List the vocabulary word in each paragraph that matches the meaning.
  - A. Paragraph 1: things that get in the way of progress or achievement \_\_\_\_\_
  - B. Paragraph 4: supervises \_\_\_\_\_
  - C. Paragraph 4: act or process of supporting a cause or proposal \_\_\_\_\_
  - D. Paragraph 5: to increase gradually in amount as time passes \_\_\_\_\_
  - E. Paragraph 6: containing poisonous substances \_\_\_\_\_
5. What personal qualities do you think scientists like Dr. Nichols and Dr. Ghobrial have that have helped them overcome obstacles in their careers? Which of the qualities is most important? Why? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

## About LLS

The Leukemia & Lymphoma Society (LLS) is the world's largest voluntary health agency dedicated to blood cancer. The LLS mission: Cure leukemia, lymphoma, Hodgkin's disease, and myeloma, and improve the quality of life of patients and their families. LLS funds lifesaving blood cancer research around the world and provides free information and support services.



**Middle School: Dr. Gwen Nichols  
and Dr. Irene Ghobrial**  
Women in Science  
PenniesforPatients.org

# From Math to the Moon



Choose  
Science!

Long before tablets and laptops, Katherine Johnson's job was to be a "computer." As a research mathematician for NASA, she turned a passion for math into a career that helped put a man on the moon. And it all began with counting.

## A Head for Numbers

As a child, Katherine Johnson loved one thing: counting. She says, "I counted everything. I counted the steps to the road, the steps up to church, the number of dishes and silverware I washed...anything that could be counted, I did." Johnson's brilliant mind and knack for numbers revealed itself at an early age. Born in 1918 in West Virginia, Johnson started high school when she was only ten and graduated from high school at 14. When she later attended West Virginia State College, a math professor named Dr. Claytor recognized Johnson's remarkable talent and told her, "You'd make a good research mathematician and I'm going to see that you're prepared." Johnson graduated from college at 18 with degrees in both mathematics and French.



After college, Johnson got a teaching job, one of the only career options open to a black woman at that time. While at a family gathering in 1952, a relative told Johnson something that changed her life.

The National Advisory Committee for Aeronautics, or NACA, was hiring African American women to work as "computers." These women analyzed data and performed mathematical calculations for NACA's engineers. Johnson decided to apply for the job. She was hired and started working in NACA's West Area Computing unit, a group composed entirely of female African American mathematicians. Johnson became known in the program for being a whiz at calculations and for asking questions. She did not just want to do her work; she wanted to know the "whys," "hows," and "why nots" of the programs she was working on. At the time, Johnson's unit did not attend any briefings or meetings with NACA's engineers. Johnson asked if she could attend the meetings. NACA's engineers began to depend on Johnson and see her as a leader and an invaluable member of the team.

## NASA Superstar

In 1958, NACA became the National Aeronautics and Space Administration (NASA). Johnson was asked by NASA to help determine how to get a human into space and back. She saw this huge feat as simply a matter of basic geometry. Johnson helped plot the path of Alan Shepard's historic 1961 journey as the first American in space. Her next challenge was to help with the difficult calculations that would send a man in orbit around Earth. By this time, NASA had started using electronic computers to do their calculations, with Johnson and others in her group verifying the calculations. Astronaut John Glenn, the astronaut for the first orbit around Earth, thought it was too risky to put his trust in a computer. He told the engineers to "get the girl"—Johnson—to check every computer calculation by hand. Glenn said, "If she says they're good, they're good; then I'm ready to go." Johnson later went on to do the calculations for the historic Apollo 11 moon landing. She also helped to develop NASA's Space Shuttle program.

Johnson retired from NASA in 1986. Since then, she has received numerous awards, including the Presidential Medal of Freedom in 2015. In 2016, NASA named a new building after her, the Katherine G. Johnson Computational Research Facility. That same year, author Margot Lee Shetterley published *Hidden Figures: The American Dream and the Untold Story of the Black Women Mathematicians Who Helped Win the Space Race*. The book became an Oscar-nominated film in 2016.

Johnson spends time today talking with students about the many opportunities that are available through math and science. She encourages them to pursue careers in STEM—science, technology, engineering, and mathematics—saying, "Some things drop out of the public eye and will go away, but there will always be science, engineering, and technology. And there will always, always be mathematics. Everything is physics and math."

## Asking Questions to Help Others

When Johnson was a student in Dr. Claytor's college class, she could sometimes see that others in her class did not understand a lesson: "I would ask questions to help them. He'd tell me that I should know the answer, and I finally had to tell him that I did know the answer, but the other students did not." Even then Johnson was working to help others understand and appreciate the math that she loves.

**Answer the questions in your own words. Use the back if you need more space.**

1. How did Johnson's college math professor impact her professional career? \_\_\_\_\_  
\_\_\_\_\_
2. What did Johnson and her coworkers in the West Area Computing unit do? \_\_\_\_\_  
\_\_\_\_\_
3. How did Johnson make an impact on space exploration as a mathematician? \_\_\_\_\_  
\_\_\_\_\_
4. List the vocabulary word in each paragraph that matches the meaning.
  - A. Paragraph 2: natural ability \_\_\_\_\_
  - B. Paragraph 3: having value too great to be estimated \_\_\_\_\_
  - C. Paragraph 4: deed \_\_\_\_\_
  - D. Paragraph 4: path taken by one body circling another body \_\_\_\_\_
  - E. Paragraph 4: proving or checking the accuracy of \_\_\_\_\_
5. Katherine Johnson had a natural curiosity that caused her to ask questions when others would not. How do you feel about asking questions? How could a willingness to ask questions help you in your education, career, and personal life? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_



### Words to Live By

Johnson says that her father was a huge influence on her life. She particularly remembers her dad saying this: "You are as good as anyone in this town, but you are no better than any of them." Johnson taught this lesson to her own children and let it guide her through her schooling, career, and every other part of her life.

# A Curious Mind Makes History



Choose  
Science!

It was uncommon for a woman in the late 1800s to become a scientist. It was even rarer for a woman to triumph in the field of science. But triumph was exactly what Marie Curie did.

## A Thirst for Knowledge

Marie Curie was born Maria Sklodowska on November 7, 1867, in Poland. Her mother died when Marie was only 10. Marie's father, a science teacher, encouraged his bright and inquisitive daughter in her studies. But he could not afford to send her to college. So Marie went to live with her sister Bronya in Paris, France. Once there, Marie worked out a unique deal with her sister: while Bronya attended university classes, Marie would get a job to support them both. After graduation, Bronya would work while Marie attended the university. During this arrangement, Marie got a job as a governess. She spent her spare time reading about physics, math, and chemistry. She eventually earned both a physics degree and a mathematics degree from Sorbonne University.



## Life in a Lab

When Marie met fellow scientist Pierre Curie in Paris, little did she know that they would become the dynamic duo of the science world. Marie and Pierre were soon married. They got jobs working in a poorly equipped lab at the School of Chemistry and Physics in Paris. The couple had to take up teaching just to make ends meet. In the lab, Marie began studying the invisible rays given off by the radioactive element uranium. She noticed that samples of pitchblende, a mineral that contains uranium, were much more radioactive than pure uranium. She hypothesized that the large readings of radioactivity proved that pitchblende contained an undiscovered element that was extremely radioactive. She and Pierre got to work testing her theory. They eventually were able to extract a black powder from the pitchblende that was more than 300 times more radioactive than uranium. They named this new element polonium after Marie's home country of Poland. Further experiments produced another discovery: there was a second new element in pitchblende that was even more radioactive than polonium! The Curies named this element radium. In 1903, the couple was awarded the Nobel Prize for Physics for their work with radioactivity, making Marie the first woman to win a Nobel Prize.

Only a few years later, Pierre was killed in Paris when he accidentally stepped in front of a horse-drawn carriage. Though grieving, Marie took over Pierre's teaching job at Sorbonne University, becoming the school's first female professor. She continued their scientific research. In 1911, Marie earned another Nobel Prize, this time in the field of chemistry. She became the first person—man or woman—to win two Nobel Prizes.

Sadly, the discoveries that Marie and her husband made led to her death in 1934. The almost daily exposure to high doses of radiation was the cause. Marie, who used to carry small vials of radium in the pocket of her lab coat, died of aplastic anemia, a condition that happens when your body stops producing enough red blood cells. Though she met many obstacles along the way—including skeptics who believed that the world of science was no place for a woman—Marie used her brilliant mind to change the world. She once said, "Life is not easy for any of us. But what of that? We must have perseverance and above all confidence in ourselves. We must believe that we are gifted for something and that this thing must be attained."

## Dangerous Artifacts

Marie Curie kept notebooks of her experiments and lab work. The notebooks and other personal items are housed in the national library of France. Even though they are over 100 years old, the notebooks are still so radioactive that they have to be kept in lead boxes! Curie's furniture and other belongings are so radioactive that visitors have to wear protective clothing.



Answer the questions in your own words. Use the back if you need more space.

1. How did Marie Curie “triumph” in the science world? \_\_\_\_\_  
\_\_\_\_\_
2. What was Marie Curie’s hypothesis about pitchblende? \_\_\_\_\_  
\_\_\_\_\_
3. How did Marie Curie respond to her husband’s tragic death? \_\_\_\_\_  
\_\_\_\_\_
4. List the vocabulary word in each paragraph that matches the meaning.
  - A. Paragraph 3: having or producing a powerful and dangerous form of energy called radiation  
\_\_\_\_\_
  - B. Paragraph 3: to withdraw something by a chemical process \_\_\_\_\_
  - C. Paragraph 5: condition of being in the presence of something \_\_\_\_\_
  - D. Paragraph 5: small, closed container especially for liquids \_\_\_\_\_
  - E. Paragraph 5: people who question or doubt something \_\_\_\_\_
5. Marie Curie made amazing scientific discoveries, yet pursuing them proved to be dangerous to her. If you were a scientist and believed you were close to making a major discovery, would you continue your work even if there were dangers in doing so? Why or why not? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_



## Images and Injuries

When World War I broke out in 1914, Marie Curie developed small, portable X-ray machines that could be used to diagnose injuries on the battlefield. These machines were nicknamed “Little Curies.” She and her teenage daughter Irene even X-rayed wounded soldiers on the front lines. The technology Curie developed is similar to what is used by the powerful X-ray machines of today.

# Nature Writer, Biologist, Inspiration



Choose  
Science!

As a child, Rachel Carson loved exploring the forests and streams on her family's Pennsylvania farm. Remarkably, this small-town girl would go on to become a renowned marine biologist, an author of best-selling books about the natural world, and the inspiration for today's environmental movement.

## A Nature Writer Is Born

Carson was born in rural Pennsylvania in 1907. As a young child, she had two passions: nature and writing. Carson's mother taught her daughter the names of plants and the sounds of animals. By the age of 10, Carson was writing for children's magazines. She said of that time, "I can remember no time, even in earliest childhood, when I didn't assume I was going to be a writer." Carson started college in 1925 as an English major, but changed to biology. While taking part in a summer research project on the Maine coast, she saw the ocean for the first time. It was love at first sight. After graduating from college and getting a graduate degree in zoology, Carson was hired by the U.S. Bureau of Fisheries, where she became a junior aquatic biologist—and one of only two women who worked at the Bureau at a professional level. For 15 years, Carson cranked out brochures and other materials for the public to read. When the Bureau became the U.S. Fish and Wildlife Service, Carson was promoted to editor-in-chief.



When she wasn't working at the Bureau, Carson focused on submitting nature and conservation articles to magazines and newspapers. She also wrote several books about aquatic life. Her first book, *Under the Sea Wind* (1941), was about the interactions between a sea bird, an eel, and a fish. *The Sea Around Us* (1951) was her next book. It has been described as "a biography of the sea." The success of this second book—which became an international bestseller—allowed Carson to quit her job, buy a small home on the coast of Maine, and write full-time. A third book, *The Edge of the Sea* (1955), focused on the marine ecosystems of the east coast. Each of these books explained the beauties of life in and near the sea using rich scientific details and poetic language. In them, Carson also expressed concerns about the impact humans had on the natural world.

## Launching a Movement

During her time at the U.S. Fish and Wildlife Service, Carson became alarmed about the danger of pesticides, especially a pesticide known as DDT. These chemicals were widely used by farmers to kill insects. In her fourth book, *Silent Spring* (1961), Carson questioned the effect of pesticides on ecosystems and humans. The book created an uproar and made pesticides a major issue in the United States. Some people, including manufacturers of pesticides, criticized Carson's views about the balance of nature. But Carson did not back down. In a rebuttal to a spokesman for the insecticide industry, she said: "Now, to these people, apparently, the balance of nature was something that was repealed as soon as man came on the scene. Well, you might just as well assume that you could repeal the law of gravity." A presidential advisory committee backed up Carson's research, and the use of DDT was soon banned. Even more importantly, the American public had been awakened to human-generated threats to the environment.

Carson died from cancer in 1964 at the age of 57. To honor her work to protect the environment, the U.S. Fish and Wildlife Service named one of its refuges near her Maine home as the Rachel Carson National Wildlife Refuge. The work of this remarkable biologist and writer also led to the creation of the Environmental Protection Agency (EPA). Most importantly, Carson called people to see their connection to the natural world and their responsibility to take care of it: "Wildlife, it is pointed out, is dwindling because its home is being destroyed, but the home of the wildlife is also our home."

## Legislation Legacy

Not only did Carson's book *Silent Spring* start the modern-day environmental movement, it also led to the passage of several new laws. These laws include the Clean Air Act (1963), the Wilderness Act (1964), the National Environmental Policy Act (1969), the Clean Water Act (1972), and the Endangered Species Act (1973).

Answer the questions in your own words. Use the back if you need more space.

1. How did Carson become interested in marine biology as a career? \_\_\_\_\_  
\_\_\_\_\_
2. What was *Silent Spring* about? \_\_\_\_\_  
\_\_\_\_\_
3. How did Carson's two careers—marine biologist and writer—combine to make the world aware of dangers to the environment? \_\_\_\_\_  
\_\_\_\_\_
4. List the vocabulary word in each paragraph that matches the meaning.
  - A. Paragraph 3: relating to water \_\_\_\_\_
  - B. Paragraph 4: argument or proof that something is wrong \_\_\_\_\_
  - C. Paragraph 4: officially made a law no longer valid \_\_\_\_\_
  - D. Paragraph 5: place that provides shelter or protection \_\_\_\_\_
  - E. Paragraph 5: gradually becoming smaller \_\_\_\_\_
5. Do you agree with Rachel Carson's belief that "the home of the wildlife is also our home"? Why or why not?  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_



### All Connected

Even though she never married, home life was important to Carson. She was the wage earner and caretaker for her elderly mother, her sister, and two young nieces. She also adopted a four-year-old grandnephew. Like family connections, Carson believed that nature and humans were connected, and that people had a responsibility to take care of the natural world.



Choose Science!

# How to Use the SCIENCE EXPLORATION PROJECTS

The six science exploration projects in this kit are designed to ignite an interest in science, encourage creative thinking, and build important research and speaking skills.

## Here's What You Get:

• 6 two-page printables that help students create science exploration projects on these topics:

- Blood Basics
- Bone Basics
- The Circulatory System Story
- Cell Science
- The Skinny on the Immune System
- Careers in Science



Each science exploration printable includes the following:

Project topic →

Information about the topic →

Variety of research questions for students to choose from →

Space to list search terms for gathering information ←

Space to describe how students will present their information ←

Due dates and teacher signature ←

Spotlight on a woman in science who is making a difference ←

• list of 30 different ways students can present their information

**Science Exploration Projects**  
**30 PROJECT OPTIONS**

- ✓ 3-panel display board
- ✓ board game
- ✓ collage
- ✓ e-book
- ✓ episode of a reality television program
- ✓ flash cards or trivia cards
- ✓ flip book
- ✓ flow chart or diagram
- ✓ foldable
- ✓ infographic
- ✓ magazine article
- ✓ mini book
- ✓ mobile
- ✓ museum exhibit
- ✓ newscast
- ✓ newspaper article
- ✓ pamphlet or brochure
- ✓ poster
- ✓ Prezi or PowerPoint presentation
- ✓ puppet show
- ✓ rap, song, or poem
- ✓ report
- ✓ scavenger hunt
- ✓ scrapbook
- ✓ skit
- ✓ social media page (replica)
- ✓ stop motion animation
- ✓ time capsule
- ✓ video/short film
- ✓ video tutorial



Middle School: LLS STEM Curriculum  
Science Exploration Project  
PenniesforPatients.org

## How to Use:

- These science exploration projects can be completed by individuals, partners, or small groups. Use the option that best fits your students' needs and interests.
- In advance, set up a schedule for the project presentations. Also gather any resources students will need for researching their topic. You may wish to give several mini-lessons on topics such as identifying search terms, how to determine which search terms to click on, and how to determine whether information is credible.
- On the day you introduce a project(s), give each student or group a copy of the appropriate printable and go over the printable as a class. Have students write in the scheduled date for their presentations.



### **Doubling the Difference She Makes**

Dr. Ann Mullally is involved in not one, but two science careers—and she loves them both. As a doctor, she takes care of patients who have blood cancers. As a medical researcher, she runs a laboratory where she and her colleagues study the cells and genes that cause blood cancers. “Really good original ideas have the potential to change the world and to improve the lives of others in the process. What could possibly be cooler than that?” she says.

**Note:** Research shows that many girls and young women have a hard time picturing themselves in STEM roles, so take time to read together the information on the female scientist featured on the printable. Encourage all students in your class to consider science as a career.

- After students have completed the printable, set aside time to meet with each student or group to review their choice of topic and presentation option. Doing this will not only give students a chance to share their ideas with you, but it will also give you a heads up about materials you may need to provide.
- Before students begin researching, discuss with them different sources they can use to find information on their topic: Web-based resources such as articles, videos, interviews, online encyclopedias, etc.; library books and reference materials; and interviews with experts in your community. List these resources on a large chart in your classroom.



**Science is all about asking questions, exploring, creating, and collaborating. Your students will do all this and more as they complete these exciting science exploration projects!**

# CELL SCIENCE

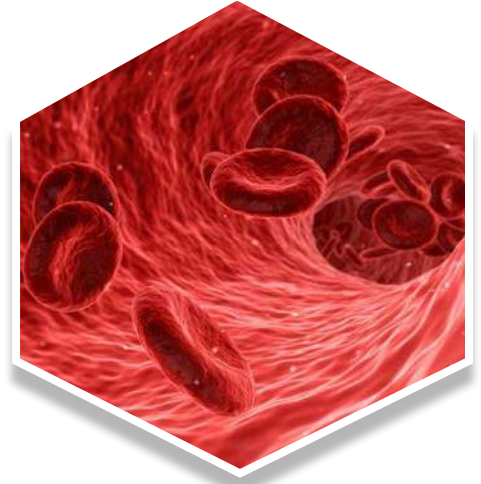
## A Science Exploration Project



### What's So Important About Our Cells?

You may have heard the saying, “Good things come in small packages.” That’s certainly true when talking about the tiny cells that make up the human body. Cells are the basic units of structure and function in all living things. There are about 200 different types of cells in your body. All of them are unique, specialized, and totally fascinating to learn about.

- According to recent research, there are about 37 trillion cells in the human body.
- Red blood cells are shaped a little like a doughnut. This helps them easily change shape so they can fit through the smallest blood vessels.
- According to one scientific estimate, about 300 million cells die every minute in our bodies. (Don’t worry: your body will replace them!)
- Cancer happens when abnormal cells grow out of control and don’t die when they’re supposed to. The tumors these cells create can kill normal cells and damage the body.
- If you like science, consider a career in cytology, a branch of biology that deals with the structure, function, reproduction, pathology, and life history of cells. With all the different cells in the body, the career options are plenty. For example, you could be a microbiologist who studies how abnormal cells cause diseases like cancer. You could also work as a pharmacologist who develops and tests new drugs.



### Be a Science Investigator

Take a closer look at your body’s cells by completing a project that answers a related question.

**Choose a topic:** Read the list of research questions below. Then circle one question to research, or come up with one of your own. If you are working with a partner or a group, discuss the questions before selecting a topic.

- **Cell Structures:** What are the parts of a human cell, and what function does each part have?
- **Diffusion Confusion:** What is diffusion, and how does it relate to cells and your health?
- **Cells, Cells, and More Cells:** How do cells reproduce, and why is this important to health and body function?
- **Blood Cell Basics:** What are the different functions of red blood cells, white blood cells, and platelets? How does their structure and shape support their functions?
- **Out of Control and Dangerous:** What happens to the blood cells of patients with blood cancers like leukemia and lymphoma? How do these cancer cells differ from normal cells?
- **An Incredible Cell Story:** Who was Henrietta Lacks, and why is she important to the study of cells today?
- **Career Options:** What careers are available for someone interested in cytology?
- **Other:** \_\_\_\_\_

List related search terms that will help you locate information on your research topic. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_



**Decide how to share your information:** In the box below, describe how you will share the information you gather to answer your research question. Use the list on the “30 Project Options” page to help you. *Note: You may want to wait to complete this step until after you have researched your question.*

Due date for the project/presentation: \_\_\_\_\_

Teacher approval of project: \_\_\_\_\_



### A True Science Rock Star

Dr. Janet Davison Rowley had a burning question: did cancer cause damage to a cell’s chromosomes or—as she hypothesized—were people with cancer actually born with damaged chromosomes that caused the disease? Her research led to new and better drugs for treating blood cancers like lymphoma and leukemia. What drove this scientist to prove her theory? She explained, “The exhilaration that one gets in making new discoveries is beyond description.”

# CAREERS IN SCIENCE

## A Science Exploration Project



Choose  
Science!

## Why Should You Consider a Science-Related Career?

What does a scientist look like? You might think it's someone wearing a lab coat, surrounded by beakers, and stuck in a noise-free lab for hours a day. But that image just isn't accurate. A scientist can look like anyone—including you. As a scientist, you can send people into space, deep-sea dive to study sharks, develop virtual reality-based video games, create a one-of-a-kind robot, or find a cure for cancer. A career in science can give you the chance to make a difference in the world—and have fun while you're doing it.



- There are literally thousands of science careers available today. Love the ocean? There's a science career for that. Is the kitchen your happy place? Then consider becoming a food scientist. If you have a passion for something, there's a science career related to it.
- The medical field is full of science career options. For example, medical researchers who are funded by The Leukemia & Lymphoma Society have learned how to use a patient's lymphoma cells to make a personalized vaccine. They hope that adding this vaccine to other treatments will keep the disease from coming back.
- Do you love the idea of teaching others about science? Today's schools need talented teachers who are passionate about science. As a science teacher, you may be the one who encourages a student who will later make an amazing scientific discovery.
- It's not too early to start considering a career in science. The more you learn about science careers, the more exciting possibilities you'll see!

## Be a Science Investigator

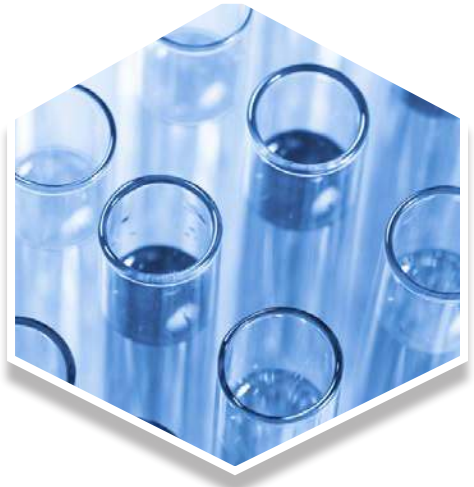
Take a closer look at careers in science by completing a project that answers a related question.

**Choose a topic:** Read the list of research questions below. Then circle one question to research, or come up with one of your own. If you are working with a partner or a group, discuss the questions before selecting a topic.

- **Why Science?** What are the benefits of pursuing a career in science? What are some of the most exciting career options out there today?
- **Hit the Books:** What are the educational requirements for three different careers in science? How can someone prepare to pursue each of these careers?
- **What Makes a Scientist?** Study three different scientists to determine the traits they have in common. From your study, what do you think are some of the characteristics of a good scientist?
- **Career Spotlight:** What science career do you think is really cool? What does a person with this career do? How could this career impact the world today and in the future?
- **In Demand:** Why are workers with skills in science, technology, engineering, and math in such high demand today? What science-related skills are today's employers looking for?
- **Girl Power:** Choose a female scientist. What impact has she made on the world? What did she do, and how did she become interested in science? Tell her story.
- **Other:** \_\_\_\_\_



List related search terms that will help you locate information on your research topic. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_



**Decide how to share your information:** In the box below, describe how you will share the information you gather to answer your research question. Use the list on the “30 Project Options” page to help you. *Note: You may want to wait to complete this step until after you have researched your question.*

Due date for the project/presentation: \_\_\_\_\_

Teacher approval of project: \_\_\_\_\_



### Combining Science with Care

When did Dr. Irene Ghobrial first know she wanted to become a scientist? It happened the moment she realized her interest in science could be used to make a difference in the lives of people with cancer. Today she treats cancer patients and also works in a lab to better understand the disease. What would she tell students to encourage them to consider a career in science? “Science is about discovering new things and having fun in understanding why certain things happen in nature or in our body.”

“People who think science is boring don’t know science!”

—Dr. Gwen Nichols

## Meet Dr. Nichols

Chief Medical Officer for The Leukemia & Lymphoma Society

Oversees LLS’s scientific research projects, services for patients, and policy and advocacy programs

Loves that science lets her take a question and find answers for it



Choose  
Science!

“Cancer can be cured if  
we work hard enough.”

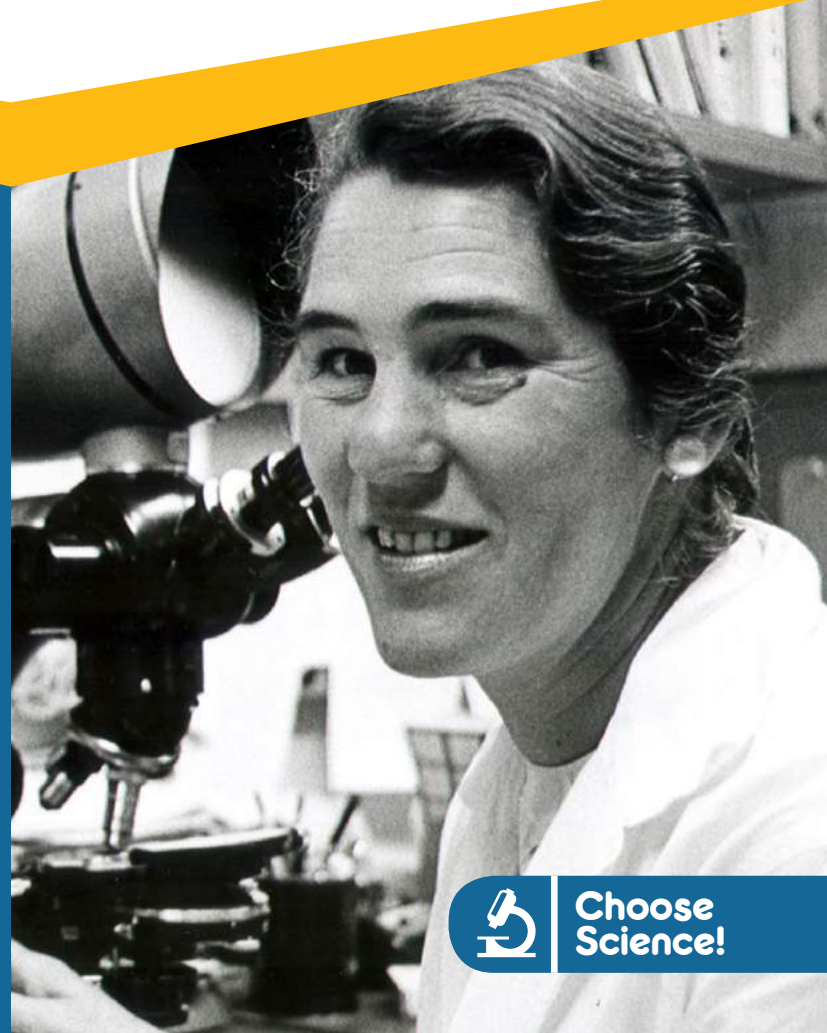
—Dr. Janet Davison Rowley

## Meet Dr. Rowley

University of Chicago

Discovered that damaged chromosomes cause specific diseases (before that many believed that specific diseases caused damage to chromosomes)

Mother of four boys, rode her bike to work



Choose  
Science!

“I always assumed  
I would go into space.”

—Dr. Mae Jemison

## Meet Dr. Jemison

Born in Decatur, Alabama, on  
October 17, 1965

Doctor, engineer, scientist, Peace Corps  
volunteer, business owner, astronaut

Earned degrees from Stanford University  
and Cornell University

First female African American astronaut;  
went into space on September 12, 1992



**Choose  
Science!**

“We must have  
perseverance and above all  
confidence in ourselves.”

—Marie Curie

## Meet Marie Curie

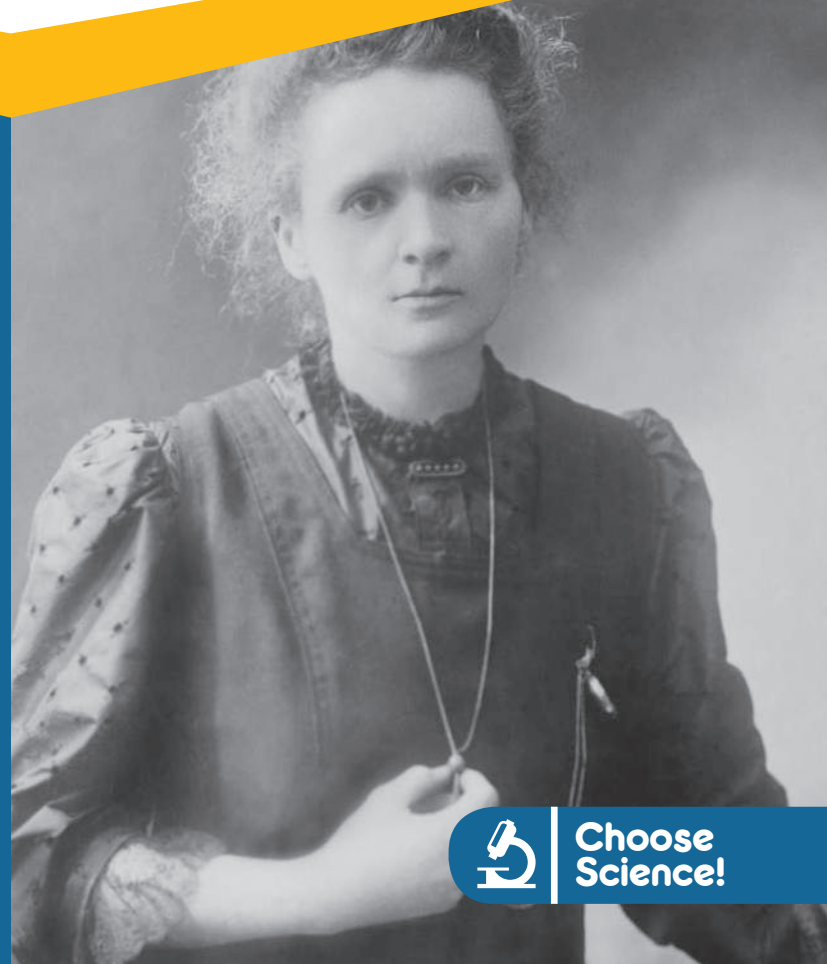
Born November 7, 1867, in Poland

Earned degrees in physics and  
mathematics from Sorbonne University

Worked at the School of Chemistry and  
Physics in Paris

Discovered the elements of polonium  
and radium

Won two Nobel Prizes



Choose  
Science!

# Fact-a-Day STEM Calendar

Hold students' interest in STEM topics by sharing one fun and fascinating fact each day.



Choose  
Science!

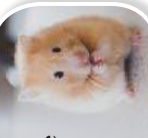
## Globetrotting Monday



The element polonium is named after Poland.

Russian chemist Dmitri Mendeleev published what most consider to be the first periodic table in 1869.

Gregor Mendel, who established genetics in the early 1900s, was an Austrian monk.



The Greek philosopher Aristotle was one of the first to classify animals according to their characteristics.



The word "scientist" was introduced by Cambridge University historian and philosopher William Whewell in 1834.

## Over-the-top Tuesday



5.88 trillion miles—a light year, the distance that light travels in a vacuum in a year.

The human body has over 37 trillion cells.



Every year about 18,000 species are discovered—and about 20,000 become extinct.

The human body has more than 60,000 miles of blood vessels—enough to wrap around the world twice.



Our brains have about 86 billion neurons.

## Wild word Wednesday

Absolute zero is the lowest temperature that can possibly be reached.

Dark matter cannot be detected but scientists know it exists because of the pull of gravity.



Substances that are immiscible are incapable of being mixed. Water and oil are an example.

Quark are believed to be one of the basic building blocks of matter.



An ectotherm is another word for a cold-blooded animal.

## Think-it-over Thursday



A chameleon can look in two different directions at once.

Water can freeze and boil at the same time.

The scientific term for brain freeze is sphenopalatine ganglioneuralgia.

A frog has an eardrum on the outside of its body.

In 2012 a fifth grader accidentally created a new molecule in science class.

## Fun-for-all Friday



How did Ben Franklin feel after he discovered electricity? Shocked!

Why did the scientist want a house without a door-bell? He wanted the no-bell prize.

Why was the book about helium on the bestseller list? Readers couldn't put it down.

Why can't you trust atoms? They make up everything.

What message would blood like to send to the world? B positive!