THE JOURNEY TO END CANCER

FROM CAUSE TO CURE

PRESENTED BY

THE UNIVERSITY OF TEXAS
MD Anderson
~~Cancer~~ Center

CLASSROOM TEACHER'S GUIDE — GRADES 6-8

TABLE OF CONTENTS

The Journey to End Cancer: From Cause to Cure is presented by The University of Texas MD Anderson Cancer Center.

This Teacher's Guide is created by TurnKey Education, Inc. for Evergreen Exhibitions. The National Cancer Institute (NCI) is an education advisor.

WELCOME TO THE JOURNEY TO END CANCER: FROM CAUSE TO CURE

Partnering with leading researchers and clinicians, The Journey to End Cancer: From Cause to Cure guides your students through the most up-to-date scientific investigations into cancer – one of the biggest health challenges of all time. Cancers, and there are many, affect millions of people around the world every year. Most likely, they impact the lives of many of your students, your colleagues, and maybe even yourself.

The Journey to End Cancer is an innovative, interactive science exhibition that examines the complex nature of cancer. Your students will experience firsthand how groundbreaking research and cutting-edge technologies unlock the mysteries of cancer and reveal solutions to end it once and for all.

How? By asking the right questions. Ones that unveil advances in cancer science, detection, treatment, prevention, and collective action.

- What is cancer?
- How do we detect cancers?
- How do we treat cancers?
- How can you reduce your risk?
- Can we end cancer together?

To answer these questions, the exhibition **The Journey to End Cancer** offers your students a unique glimpse into the world of scientific research and its direct effect on their personal health decisions. They will meet heroes on the front lines of ending cancer, from researchers to cancer care specialists, to survivors and caregivers, all who will inspire them to act in their own communities.

You will find something to engage students of all skill levels and interests on a field trip to **The Journey to End Cancer**. There are opportunities to connect the educational themes of the exhibition to the mandated national and local STEAM content requirements. Teachers of Science, Math, Language Arts, Social Studies, and Health will find this experience relevant to their classroom lessons and activities.

This Teacher's Guide features a curriculum that is interdisciplinary across several grade levels and areas of study. It is important to note that it is not intended to be used in addition to what you already must teach, but rather as a multidisciplinary, standards-compliant way to meet your daily instructional requirements.

The Journey to End Cancer is an opportunity for your students to see the real-world impact of their STEAM learning. On this interactive journey, they will discover how the ever-evolving world of science and research connects them to the discoveries of the past and prepares them for breakthroughs in the future. Ask your students: Are you ready to join the movement to end cancer?

WHAT TO EXPECT ON YOUR FIELD TRIP

The accessible messages and welcoming tone of The Journey to End Cancer break things down for your students in ways they will understand and remember.

The Journey to End Cancer invites your class to join the movement to end cancer. Five questions. Five galleries. Each unlocks new powers to eliminate cancer.

1. **KNOW IT.** What is cancer? Unlock the power of scientific understanding.
2. **FIND IT.** How do we detect cancers? Unlock the power of earlier and better detection.
3. **TREAT IT.** How do we treat cancers? Unlock the power of more effective and precise treatments.
4. **PREVENT IT.** How can you reduce your risk? Unlock the power of healthy actions.
5. **DEFEAT IT.** Can we end cancer together? Unlock the power of collective impact.

To help your students along their journey, each gallery will feature inviting displays:

- **Guideposts** to spark curiosity about the topic explored in that gallery.
- **Multimedia experiences** to involve students with story-based moments of wonder and discovery.
- **Unique science interactives** to explore cancer science in surprising and empowering ways.
- **Animations and graphics** to deliver cancer science and data in engaging, bite-sized moments.
- **Print Infographics** to break down science content to its essence so it is easier for students to grasp.
- **Story Pods** to feel connected and ready to act through inspiring video stories from diverse cancer survivors, caregivers, scientists, and others.

LOVE YOUR CELLS

Your field trip begins with a dynamic experience in the first gallery, showcasing the science of cells. Stunning visuals, dynamic lighting, and dramatic zoom-ins and zoom-outs draw students into the latest advances. These discoveries are leading to new ways of detecting cancers earlier and better, treating cancers more effectively, and preventing cancers before they start.

KNOW IT

To end cancer, we must first understand it. Cancer always starts with errors — gene variants — in the DNA of cells. But we do not always know what causes these errors. "MISTAKES HAPPEN" is a quick-fire activity where students try to beat the clock to match rapidly changing visual patterns and colors. In real life, replication in cells happens much, much faster and with way more information. When your cells replicate, they copy billions of nucleotides — little, tiny bits of information in your cellular instructions — in a flash. During this game, students come to realize how easy it is for mistakes to happen during cell division.

A visual introduction to how cancer starts identifies some of the recognized sources of the gene mutations that lead to cancer, some by chance and others with known causes. Understanding both origins can help your students make choices to lower their cancer risk.

Cancer happens when a healthy, hardworking cell in the body changes, enabling it to "go rogue" and multiply and spread uncontrollably. An animated "ROGUES GALLERY" follows a healthy cell through a series of mutations that transforms it from vital to cancerous, making a complex idea engaging and memorable for your class.

Science is constantly unveiling discoveries about cancer. "WAIT, WHAT?" is a wall with interactive circles that reveal some surprising facts about cancer.

So, who gets cancer? Studying clues about cancer in humans and animals helps us understand what cancer is and how we can better detect, treat, and prevent it. Students will find information about cancer in humans, animals, and back in time (even dinosaurs got cancer!).

FIND IT

For many cancers, early detection dramatically improves five-year survival rates. This is particularly true for cancers of the lung, breast, prostate, colon, and cervix, all of which can be effectively screened for at appropriate times in life.

In this gallery, students take on the role of a "CANCER DETECTIVE" and investigate a variety of methods to uncover cancers in various parts of the body. They will use simulated tools and technologies like MRI, *Q. Which body part rarely gets cancer?*

A. The Heart. Because heart muscle cells do not multiply often.

PET scan, molecular test, tissue biopsy, and more, to look for cancer. They can even add the power of AI to boost their detective skills through enhanced imaging. Students will come away reassured that if cancer is lurking somewhere in the body, science will find it.

"FUTURE DETECTION" is a large visual highlighting the exciting — and unusual — advances that are transforming cancer detection and diagnosis. Imagine cancer-sniffing dogs and cancer-smelling bees! Wild ideas today could become life-saving tools tomorrow.

For some cancers, a powerful way to detect early signs is to "go inside" the body and look. This is particularly true for cancer of the colon, or large intestine, currently the third most common cancer worldwide. In "POLYP PURSUIT," students perform a virtual colonoscopy, searching for growths that can potentially develop into cancer. They will navigate a virtual camera through a simulated colon and use computer-generated tools to remove polyps until the colon is clear.

"THE POWER OF EARLY DETECTION" shows what happens when diverse types of cancer are found early versus those that are discovered at later stages. Understanding the stages of cancers helps doctors, cancer survivors, and their families determine the best treatment strategy. The typical stages of cancer are illustrated to show students that the addition of more variants in the DNA of cancer cells allows them to grow and spread more aggressively.

Every cancer diagnosis experience is unique. "I HAVE CANCER?" features interviews with survivors and others as they share their personal stories.

TREAT IT

How do we treat cancers? And how do today's breakthroughs build on the past? Cancer treatments are advancing faster than ever, revolutionizing the effort against cancer, saving lives, and sparking new optimism.

"BREAKTHROUGH!" takes students on a video journey through time, celebrating the bold ideas and pioneering science that mark monumental breakthroughs in cancer treatment. From ancient practices to tomorrow's technologies, they will witness how progress is speeding up and bringing us closer to ending cancer as we know it.

Navigating an interactive timeline, students discover the advances behind today's "Five Pillars" of cancer treatment. They are encouraged to think about what could come next among the future of cancer care.

"SUPER CELLS" is a game-based experience where students supercharge immune cells to better defend against cancer. They will learn the basics of how T cells work as they track down, identify, and eliminate as many rogue cancer cells as possible. This high-energy, hands-on introduction to the science of immunotherapy makes it easier for your students to understand it. Discovering how science can power up our immune systems to outmaneuver cancer is an exciting frontier in cancer treatment.

Fiber in your diet keeps your gut healthy and may help reduce your risk of certain cancers. It may even help improve the effectiveness of some cancer treatments. With "GUT CHECK," an eye-catching infographic spotlights the power of fiber in your diet. Fiber works to keep your colon running smoothly and supports a healthy gut microbiome, which is crucial for a strong immune system.

Undergoing treatment for cancer can be very tense and demanding. Stress weakens the immune system and complicates the healing process. In "CALM," students learn about the power of stress-busting techniques for cancer patients, caregivers, or anyone who might benefit from them. They will explore calming techniques that, used regularly, can improve emotional wellness and keep you healthier.

Considering the entirety of the individual is so important in cancer treatment. "THE WHOLE PERSON" emphasizes the significance of integrative therapies in enhancing cancer outcomes. Practices like yoga, acupuncture, healthy eating, and art and music therapy are backed by science and can improve cancer treatment. Students discover that caring for mind-and-body is a secret superpower in the effort to end cancer. And for everyone to live happier and healthier lives!

Just as everyone's cancer is unique, every treatment journey is too. In "HEROES," students will hear personal stories from diverse cancer survivors, caregivers, treatment team members, and behind-the-scenes staff who contribute valiantly to the cancer care effort. These stories are reminders that heroes come in many forms, and it takes a whole team to support the effort to treat an individual cancer patient.

Every cancer treatment in the U.S. needs approval from the Food and Drug Administration (FDA) to make sure it is safe and effective. As part of this process, treatments are tested in clinical trials involving real people. "TRIALBLAZERS" celebrates these brave participants and emphasizes the need for greater diversity and inclusion in clinical trials. These research studies conducted throughout the U.S. test how well new medical approaches work in people.

PREVENT IT

What is the best way to end cancer? Prevent it from starting in the first place. You can take steps to lower your risks through healthy habits that protect your cells.

"RISKY BUSINESS" reimagines the topic of cancer prevention as a digital game, involving strategy along with some elements of chance. At each stop in the game, students get to make a choice: a healthy choice or a not so healthy choice. A personal risk meter measures the impact of their selections. Students learn that even small daily choices—eat a donut or walk the dog—will lower their risk of getting cancer.

The "POWER OF PREVENTION" highlights compelling statistics that students can analyze, compare, and contrast to see the effectiveness of cancer prevention. Research shows that 40% to 50% of cancers are associated with modifiable risk factors. Lifestyle choices linked to meaningful reductions in cancer risk include avoiding smoking, and alcohol, maintaining a healthy weight, getting routine cancer screenings, eating a cancer-wise diet, scheduling regular exercise, protecting your skin from ultraviolet (UV) radiation, and getting vaccinated against HPV and hepatitis.

Video stories in "A PATH FORWARD" capture the range of emotions and experiences that come with surviving cancer or having cared for someone through treatment. It is another opportunity for your students to make an emotional connection to the science of cancer prevention.

DEFEAT IT

Can we end cancer? That depends on all of us doing our part, both individually and together, to ensure that everyone has fair access to the best cancer prevention, detection, and treatment.

"THE POWER OF US" is a collaborative interactive where students physically move and play to reveal a celebratory image on a reactive wall. The more students work together, the more the image comes into focus — driving home the power of collective action.

"WORLDWIDE EFFORT" reveals initiatives that people all over the world are working on to end cancer. Students can spin a globe to see major centers of action on each continent and tap on hotspots to learn about different international efforts. The fight against cancer even extends into space with cancer research aboard the International Space Station!

"IN IT TOGETHER" uses simple graphics and easy-to-understand facts to show how important it is for everyone to have the resources they need to stay healthy and safe from cancer. Every student in your class can make a difference in the movement to end cancer. Each step adds up to change. Band together at your school to create a world without cancer!

CANCER STRIKETHROUGH

As they exit **The Journey to End Cancer**, students are welcomed to leave a personalized message on the MD Anderson's interactive "Cancer Strikethrough" wall. Here, they can express their own thoughts, feelings, experiences, and hope. A nearby QR code links to trusted online resources.

Teachers, a field trip to the exhibition **The Journey to End Cancer** is a memorable way to help your students see the real-world impact of their STEAM learning. Let your voices be heard. Join the chorus of people committed to ending cancer once and for all.

USING THIS TEACHER'S GUIDE

As a companion to your field trip experience, this Teacher's Guide has been developed to complement your classroom instruction and make the most of your school field trip to The Journey to End Cancer. It contains original, assessable, STEAM-related classroom lesson plans featuring dynamic activities and assignments for students in grades six through eight. There is also a Teacher's Guide for Elementary School, grades three through five. Both resources have been created to be flexible. Use them to best meet the needs and capabilities of your class. You know your students better than anyone else.

Following this introduction, you will find **Ignite:** four interdisciplinary classroom lesson plans and project-based inquiries addressing national and local curriculum standards. The lesson plans begin with instruction pages for teachers that include answer keys and a list of the content areas and skills addressed by the activities. You will see how concepts and content used to create cures for cancer in the future have their foundations in the curriculum you must teach your students today.

Rounding out the lessons are ready-to-copy Student Activity pages that center on key STEAM topics featured on your visit to **The Journey to End Cancer** and include "Terms to Know" for vocabulary development. Using a scaffolding approach, the parts of each lesson consider a variety of instructional techniques. Use these to move your students progressively toward a stronger understanding of the content, with both objective and subjective assignments for assessment.

The first lesson, **"Cell" Phone Messages**, reviews the parts of a cell so students will better understand what causes cancer and the latest ways scientists and doctors work together to defeat it. In Part 2, your class will play a game that demonstrates how easily a mistranslation can happen, how quickly it can spread, and how disastrous the results can be, which is exactly what happens when DNA mutates during cell division.

In the second lesson plan, "**The Chemistry of Cancer**," students will explore the connection between biology and chemistry. They will examine the properties of 20 of the elements on the periodic table that play key roles in detecting cancer. Then, students will learn how these elements are leveraged in advanced technologies to identify, diagnose, and even treat cancer effectively.

Thirdly, **Cancer Treatment Family Tree** focuses on the ways immunotherapy boosts our own immune system to destroy cancer cells. Students will learn about Dr. James P. Allison, a Nobel Prize-winning researcher whose childhood influenced him to make discoveries in cancer treatment. They will also investigate different kinds of cancer therapies on a Cancer Treatment Family Tree and track down some of the latest developments in this ever-changing field.

The fourth lesson, **Think Globally, Act Locally**, shows students how Social Determinants of Health (SDOH) affect cancer in the community, and how their interests and abilities can help their friends and neighbors survive and thrive — today. Math skills cross paths with human geography as your students see how poverty often underpins other SDOH related to childhood cancer survival rates worldwide and at home.

The next section, **Evolve**, has themed games and puzzles you can assign for extra credit or earmark for your bus ride to and from the exhibition. **Inspire** includes additional classroom resources for your own background knowledge and context and to use with your students as you see fit. These include a timeline of developments in cancer treatments, glossary of scientific cancer terms, data on cancer treatments, and information on careers in health care.

We know how important it is to be able to justify field trips and document how instructional time is spent outside of your classroom. In **Understand**, this Teacher's Guide is directly correlated to the Next Generation Science Standards, Common Core State Standards for Mathematics and English Language Arts, C3 Framework for Social Studies State Standards and National Health Education Standards.

You can readily see how the lesson plans and your field trip fit into your required curriculum making it easier than ever to connect a field trip to **The Journey to End Cancer** with your classroom teaching. These educational resources can be used before your group visit to help prepare students for the teachable moments found throughout exhibit as well as when you return to school to further explore connections between these educational themes and your daily STEAM instruction.

Ending cancer is not just a job for scientists and doctors. By asking the right questions and working together, you and your students can make even more progress. Take action to KNOW IT, FIND IT, TREAT IT, PREVENT IT, and DEFEAT IT!

LESSON PLAN 1 — “CELL” PHONE MESSAGES

Teacher Instructions

Science, Mathematics, Life Science, Patterns

At their age, your students’ bodies are made up of at least 17 trillion cells, and probably more. It is hard to picture just how many 17 trillion of anything is but let’s try! If we counted 17 trillion seconds, it would be over 538,000 years. Going back in time, this would put your class in an ice age with mammoths, saber-toothed cats, and giant ground sloths. If we lined up 17 trillion pennies, they would stretch 269 billion miles, which is far beyond our own solar system. At an adult size, an average female human has around 28 trillion cells and a male has 36 trillion.

As the body grows, it continues to produce cells through mitosis. The “parent” cell copies its own DNA and shares it with two “daughter” cells as it splits. That DNA tells each new cell what it will become and what its job in the body will be. Your students need to know about DNA, some of the parts of a cell, and how they work together to understand how cancer begins and spreads.

Cancer can start with mistakes inside the DNA of just one cell. These mistakes are called gene mutations. DNA inside the nucleus of the cell delivers its genetic instructions to the rest of the cell by sending out messengers as a code, the mRNA. The cell’s ribosomes read the instructions from the mRNA to find out which proteins it needs to make to get things started. Now, the rest of the cell is ready for its working orders!

Cancer means that a cell can’t do the work it was made to do, according to the directions in the DNA. Something happens to the DNA, and the wrong message gets sent out on the mRNA. So, the ribosomes start making the wrong proteins for the cell. Cancer changes the cell from doing its original job to now doing just one thing—making more cancer cells.

In Part 1 of this lesson, your students will review the parts of a cell to understand what they’ll see in **The Journey to End Cancer** about cancer causes and how scientists and doctors are fighting it. They will play a game in Part 2 with their classmates to see how easily mistakes can happen and spread, just like when DNA mutates during cell division.

PART 2 — TEACHER'S INSTRUCTIONS

The game "Pass the DNA!" is based on the old "Telephone" party game. As a metaphor for imperfect data transmission over multiple iterations, it shows how small changes in copying DNA for new cells can lead to big differences in the final "message." You will give the first person in each student group a written code using abbreviations from the nucleotides, the four chemical building blocks of DNA: adenine (A), thymine (T), guanine (G), and cytosine (C). Students will whisper the code to each member of their group and compare the final version to the original.

MATERIALS:

- 1 slip of paper with a coded message
- Pens or pencils for each group
- Student groups with at least 6 members

INSTRUCTIONS:

1. Prepare as many coded messages as you have groups of students. Write the codes as two codons (groups of three) using combinations of A, T, G, and C. For example: ATC AAG, TAC ACA, GTC CCT, TGG CGA, TTT GAA, TGA TAA, CCT TGA, etc. These samples use actual codon examples but feel free to come up with your own.
2. Explain to your students that nucleotides are in groups of three, called codons, during the process of translation for protein synthesis. That is how they are grouped here. They are in codons when the mRNA delivers the message from the DNA to the ribosomes.
3. Instruct each student group to sit side-by-side in a straight line (or in a circle if it fits your room better). The group members need to be close enough to each other to whisper a message from one student to the next but far enough away so that they cannot be overheard by the others.
4. Give the first person in each group the written code (two codons such as ATC GTC, CGA TGA, etc.). Only that first person in the group should see it.
5. The first person in the group whispers the code to the next person, and so on down the line until the last student hears it. Each student only hears it once. They cannot ask for it to be repeated. They are to whisper what they heard, or what they think they heard.
6. The final student in the group will write down the code they heard.
7. As a group, the students will compare and discuss that final version of the nucleotide code to the original and complete their activity page.

Wrap up: During the class discussion with your students at the end of the activity, questions to ask and points to make include:

- What are the differences between the beginning and ending codes?
- How, where, and why did they change?
- Explain how this process is like the mutations in DNA caused by cancer.
- Common types of mutations are substitutions, insertions, and deletions. A "C" might be misheard as a "G," for example. A letter could be dropped, and the code became 5 letters instead of 6 total. Were any letters added?
- What external factors affected the message's translation? Were there environmental factors like loud noises or other things they couldn't control?
- In real-life biology, such changes can lead to different proteins or functions, which may or may not be beneficial. Highlight how these small changes can have big effects on the traits or functions of organisms.
- Cells have some mechanisms to correct errors, much like how players need to listen carefully in the game. Corrections might even end up happening during the game.

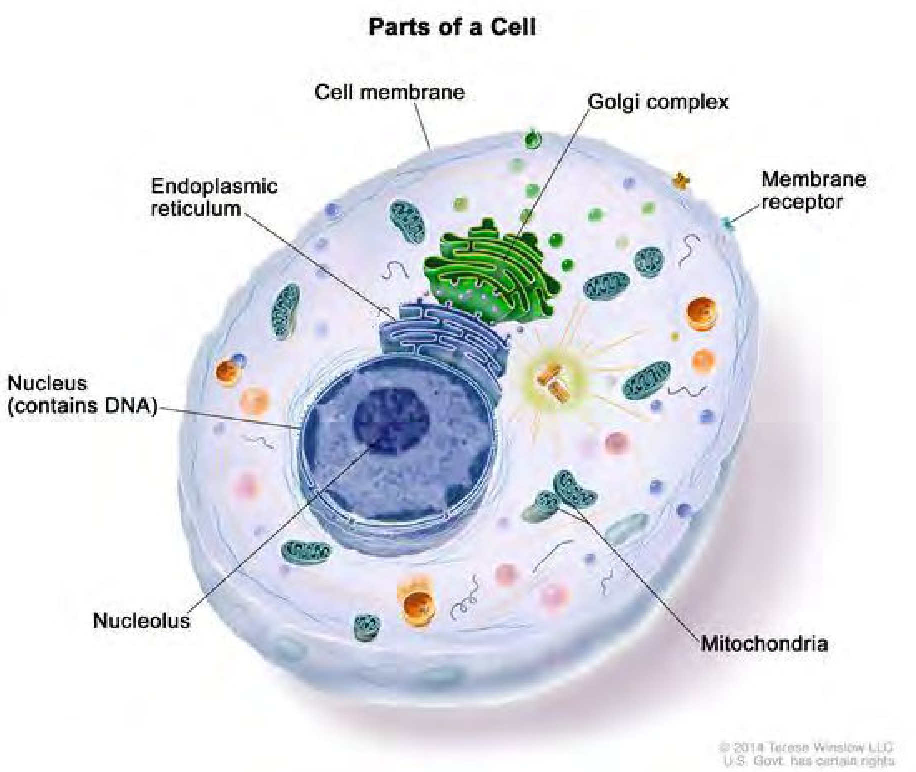
Alternate version: Play the game as a "Rhythm Relay" with a series of taps and pauses in a specific sequence passed from student to student. Students should sit facing the same direction and tap the pattern on the next person's shoulder or back. For example: tap-tap-pause-tap-pause-tap. This tactile version can be better suited to some classes, or might be an interesting comparison to the original, lettered game.

ANSWER KEY: *Part 1:* 1b, 2e, 3j, 4i, 5c, 6h, 7l, 8k, 9m, 10a, 11f, 12d, 13g, 14n. *Part 2:* Check students' "Reflection" section for completion.

NAME CLASS DATE

"CELL" PHONE MESSAGES

Student Activity



Parts of a Cell. *National Cancer Institute, Terese Winslow (Illustrator)*

Terms to Know: codon, insertion, mutation, nucleotides, omission

Your body is made up of at least 17 trillion cells, and probably more. It is hard to picture just how many 17 trillion of anything is but let's try! If we counted 17 trillion seconds, it would be over 538,000 years. Going back in time, this would put you in an ice age with mammoths, saber-toothed cats, and giant ground sloths. If we lined up 17 trillion pennies, they would stretch 269 billion miles, which is far beyond our own solar system. At an adult size, an average female human has around 28 trillion cells and a male has 36 trillion.

As the body grows, it continues to produce cells through mitosis. The "parent" cell copies its own DNA and shares it with two "daughter" cells as it splits. That DNA tells each new cell what it will become and what its job in the body will be. You need to know about DNA, some of the parts of a cell, and how they work together to understand how cancer begins and spreads.

Cancer can start with mistakes inside the DNA of just one cell. These mistakes are called gene mutations. DNA, inside the nucleus of the cell, delivers its genetic instructions to the rest of the cell by sending out messengers as a code, the mRNA. The cell's ribosomes read the instructions from the mRNA to find out which proteins it needs to make to get things started. Now, the rest of the cell is ready for its working orders!

Cancer means that a cell can't do the work it was made to do, according to the directions in the DNA. Something happens to the DNA, and the wrong message gets sent out on the mRNA. So, the ribosomes start making the wrong proteins for the cell. Cancer changes the cell from doing its original job to now doing just one thing—making more cancer cells.

In Part 1 of this lesson, you will review the parts of a cell to understand what you'll see in **The Journey to End Cancer** about cancer causes and how scientists and doctors are fighting it. You will play a game in Part 2 with your classmates to see how easily mistakes can happen and spread, just like when DNA mutates during cell division.

NAME ______ CLASS ______ DATE ______

PART 1: Review these key parts of the cell. Match the words to their meanings below. Use your science class resources or search online.

a. cell
b. cell membrane
c. chromosomes
d. cytoplasm
e. DNA
f. endoplasmic reticulum (ER)
g. Golgi apparatus
h. mitochondria
i. mRNA
j. nucleus
k. organelles
l. ribosomes
m. vacuoles
n. mitosis

1. ______ a thin covering that goes around a cell and holds all its parts together inside

2. ______ instructions for the cell's job stored in the nucleus, written as a code and formed as a double helix

3. ______ largest organelle, it directs all a cell's activities, like its brain or control center

4. ______ little thread-like pieces of a messenger-chain molecule; they copy instructions from the DNA, take the copy out of the nucleus, and deliver it to the ribosomes

5. ______ molecules inside the nucleus that hold and organize the cell's DNA

6. ______ organelle that uses nutrients from food to produce the energy the cell needs to make the proteins for its job

7. ______ organelles that make special proteins for the one job that cell has, after they get the instructions delivered by the mRNA

8. ______ parts of a cell floating around in cytoplasm working together to carry out the cell's job

9. ______ storage spaces in cells that can hold nutrients, waste, and water

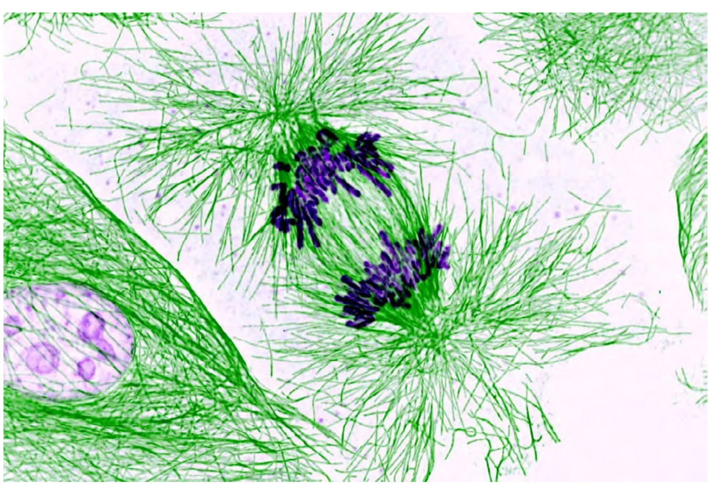
10. ______ the basic unit or "building block" of everything that is alive, like animals, plants, bacteria, fungi, etc.

11. ______ the bumpy part of this organelle shapes and packages the cell's instructional proteins from the ribosomes, getting them ready to send out to the rest of the cell

12. ______ the clear, jelly-like substance inside the cell in which all the organelles float

13. ______ this organelle receives the proteins from the ER and repackages them for delivery based on their destination, inside or outside of the cell

14. ______ the way a cell makes a copy of the DNA in its nucleus and then splits apart into two new, identical cells



This parent cell is dividing. The chromosomes (dark colored part) duplicated, and it is about to split into two daughter cells. If mistakes are made in the DNA on the chromosomes when they duplicate, cancer starts in the daughter cells—and in every cell after that. *National Heart, Lung, and Blood Institute, National Institutes of Health*

NAME ______________________ CLASS ______________ DATE ______________

PART 2

What starts with one small error, like a spelling mistake or omission, can quickly turn into a very big problem. In 2023, a woman in Atlanta, GA, came home from vacation to find her family's house destroyed. It was knocked down by a demolition company whose truck driver had the wrong address in the right neighborhood. In 1962, NASA purposefully destroyed an unmanned spacecraft soon after takeoff. It was supposed to fly past Venus but had veered wildly off course and was crashing toward Earth. Why? One hyphen had been left out of thousands of lines of coded instructions and doomed the project.

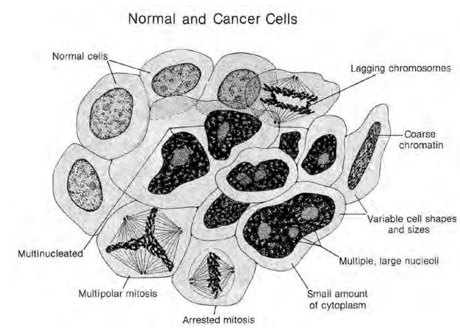


Diagram of normal and cancer cells side-by-side with the normal and cancerous characteristics are identified. *National Cancer Institute, Pat Kenny*

Small mistakes also have big consequences in DNA. We know cancer starts with mutations in the DNA, but we don't always know why or how. Sometimes, they are just "copy and paste" mistakes that occur naturally and randomly when cells divide. When your cells replicate, they copy billions of nucleotides, the codes that write that cell's instructions. It's no surprise that there are mistakes. Other times, a cell's DNA is already damaged before mitosis even starts. The changed version gets copied, passed on, and makes cancer cells. This activity demonstrates how quickly and easily such mutations in DNA happen.

PASS THE DNA!

This game shows how small changes in copying DNA for new cells can lead to big differences in the final "message."

Your group will sit in a line or circle, close enough to each other to whisper a message from one student to the next yet far enough away so that message cannot be heard by the others. Your teacher will give the first person in your group a small piece of paper with a written code using nucleotide abbreviations. Nucleotides are the four chemical building blocks of DNA: adenine (A), thymine (T), guanine (G), and cytosine (C). The unique order of nucleotides creates the instructions for each individual cell. The code you will get is how they might appear as two codons. A codon is three of the nucleotides from the mRNA grouped together during protein synthesis in the ribosomes. For this game, two codons such as ATC GTC, CGA TGA, etc. will be used together as a secret message code.

Steps

- Your teacher gives your line leader the group's secret code, written on a piece of paper. Only that first person in your group can see it.
- That first person whispers the code to the next person, who turns and whispers what they heard to their neighbor, and so on down the line until the last student hears it.
- Each student can only hear it once. You cannot ask for it to be repeated. Repeat what you heard, or what you think you heard, when it's your turn to pass the code.
- Do not purposefully change the code in any way.
- The final student in the group will write down the code they heard.
- Compare that final version of the nucleotide code to the written version that started with the first student.

Original Code: ______ ______ ______ ______ ______ ______

Final Code: ______ ______ ______ ______ ______ ______

NAME CLASS DATE

REFLECT AND DISCUSS WITH YOUR GROUP

- What are the differences between the two codes?
- How and when did they change?
- What caused the changes?
- Explain how this process is like the mutations in DNA caused by cancer.
- Common mutations are substitutions, insertions, and deletions. Which happened with your group's code?

REFLECTION

Write your results and conclusions here. Be prepared to share them with the rest of the class.

FUN FACT! In 2012, a global game of Telephone was played with 237 people speaking seven different languages. Beginning in a library in Melbourne, Australia, the starting phrase "Life must be lived as play" became "He bites snails" by the time the game reached its end in Alaska 26 hours later.

LESSON PLAN 2 — THE CHEMISTRY OF CANCER

Teacher Instructions

Science, English Language Arts, Health

Physical Science, Life Science; Literacy in Science & Technical Subjects

To defeat cancer, we have to find it first. At The Journey to End Cancer your class will learn about new tools that can uncover and pinpoint cancers and how these inventions are improving all the time. Detecting cancers early and knowing exactly where they are makes treatment much more effective. So, what does any of this have to do with the elements on the periodic table?

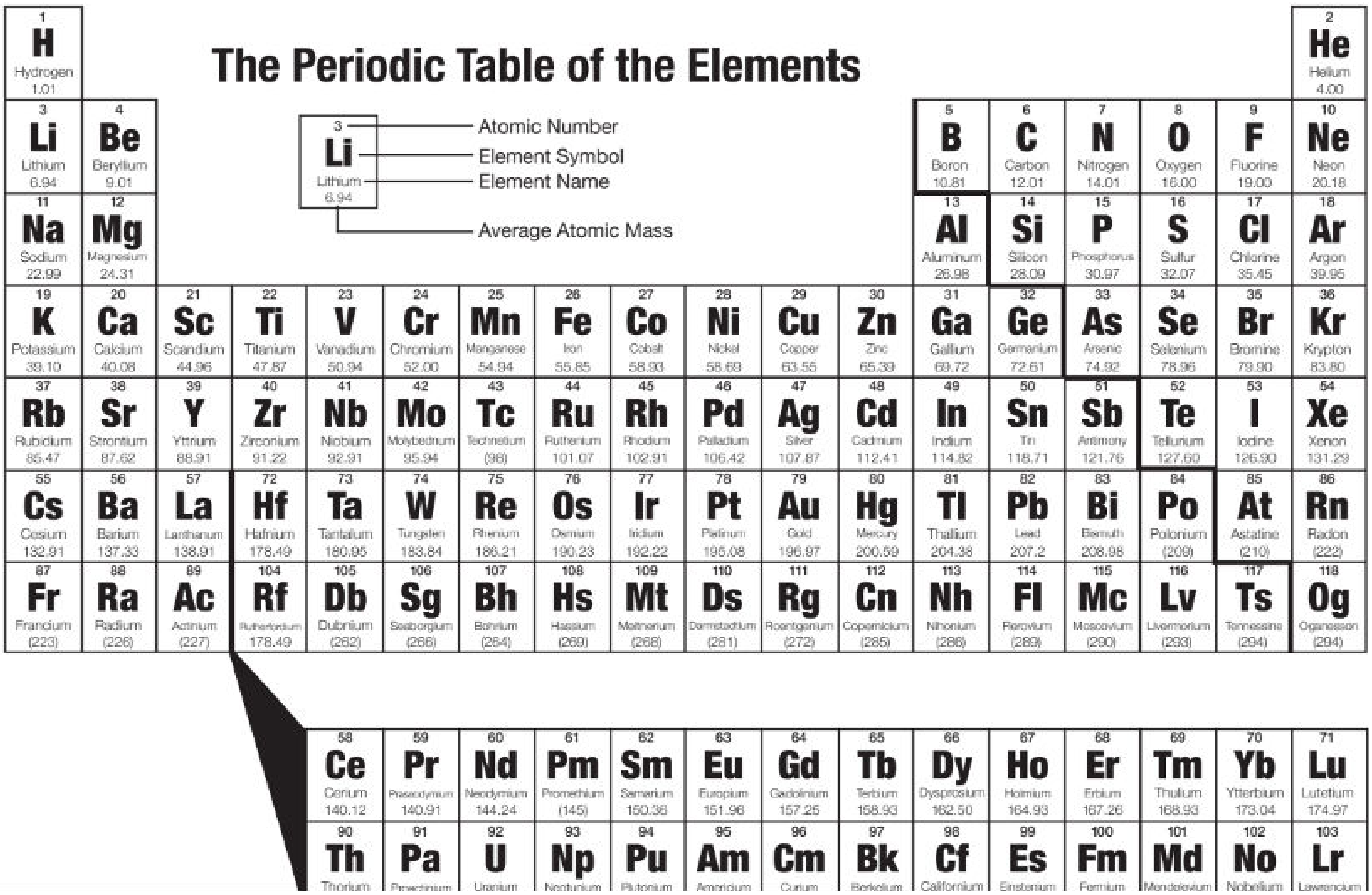
The periodic table is like a big chart or map that organizes all the chemical elements we know. Elements are the basic building blocks of everything around us. One element is made from (a lot of!) one type of atom, like hydrogen, oxygen, or gold. When elements join, they form compounds. For example, water is H2O, a compound made from hydrogen (H) and oxygen (O) elements.

Cancer is all over the periodic table. Well, not really! But too much of one element might cause it, a little less in a different form of the same element might treat it. Chemistry is everywhere in the quest to defeat cancer. Causes, detections, treatments…it's all there. Even the word "chemotherapy"— using drugs to target and destroy cancer cells — literally means "chemical treatment."

As of right now, the periodic table has 118 elements, and your students probably already know some of them. What they might not know is which ones are major players in hunting down cancer. In Part 1 of this lesson plan your students will explore 20 elements with important roles in cancer detection. This activity is an excellent way to introduce or review the periodic table. A copy from the American Chemical Society is provided on the next page in case your class does not have easy access to one.

Students, working in groups, can divide the 20 elements in the chart among their members, then come together to share results. If your students need a hint, the elements in the chart are listed in order of atomic number. Classes with more experience using the periodic table can include more data on the chart such as periods, isotopes, oxidation states, electron shell configurations, or classifications as metals, nonmetals, or metalloids.

In Part 2, students will learn where these elements are found in cancer detection and how their properties use the latest technologies to get the job done. After learning about the elements' roles in biomarkers, biosensing, nanotechnology, and imaging, students will return to their original groups to develop a one-pager highlighting one specific element in more detail, explaining how it helps find cancers earlier and locate them more precisely.


The Periodic Table of the Elements
Atomic Number
Element Symbol
Element Name
Average Atomic Mass

PART 2 — TEACHER'S INSTRUCTIONS (cont.)

ANSWER KEY: *Part 1:*

SYMBOL	NAME	ATOMIC #	ATOMIC MASS	GROUP #
1. H	Hydrogen	1	1.01 u	1
2. C	Carbon	6	12.01 u	14
3. N	Nitrogen	7	14.01 u	15
4. O	Oxygen	8	16.00 u	16
5. F	Fluorine	9	19.00 u	17
6. Si	Silicon	14	28.09 u	14
7. P	Phosphorus	15	30.97 u	15
8. S	Sulphur	16	32.06 u	16
9. Fe	Iron	26	55.85 u	8
10. Cu	Copper	29	63.50 u	11
11. Zn	Zinc	30	65.38 u	12
12. Ga	Gallium	31	69.72 u	13
13. As	Arsenic	33	74.92 u	15
14. Tc	Technetium	43	98.91 u but no stable isotopes	7
15. Ag	Silver	47	107.87 u	11
16. In	Indium	49	144.82 u	13
17. I	Iodine	53	126.90 u	17
18. Ba	Barium	56	137.33 u	2
19. Gd	Gadolinium	64	157.25 u	3
20. Au	Gold	79	196.97 u	11

1. Answers will vary based on the elements students already know
2. Any 2 of hydrogen (H), nitrogen (N), oxygen (O), or fluorine (F)
3. Hydrogen (low), gold (high)
4. Atomic number is the number of protons in the nucleus of an atom, and it identifies the element; atomic mass is the protons (atomic number) plus the number of neutrons in the nucleus
5. Hydrogen or barium
6. Any 3: gadolinium, copper, technetium, iron, silver, gold, zinc
7. 11
8. Answers will vary based on elements selected

PART 2 — TEACHER'S INSTRUCTIONS (cont.)

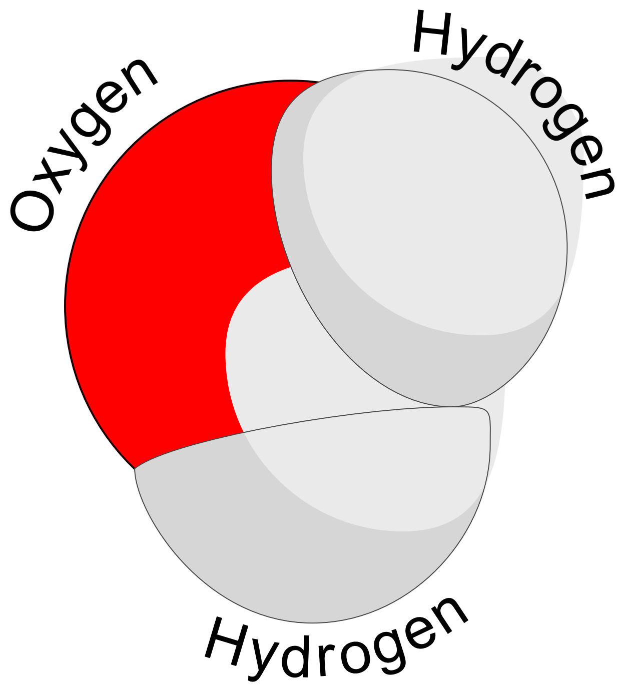
ANSWER KEY: *Part 2:*

ONE-PAGER RUBRIC				
	4 POINTS	**3 POINTS**	**2 POINTS**	**1 POINT**
Content	Includes 5 sections from instructions	Missing 1 section	Missing 2-3 sections	Missing 4 or more sections
Organization of Information	Clear, logical, and visually appealing; all items are well-spaced on the page.	Mostly clear, logical, appealing, and well-spaced. One item seems out of place.	Most is organized, but some things are missing or don't fit.	No clear plan for organizing the information.
Graphics & Text	Both neat and easy to read. Colorful pictures match content. The page has a good balance of text and graphics, about 50/50 or 60/40.	Most graphics/images support the content. Text is legible, does not distract from the information. Balance of text to graphics is 70/30.	Some graphics are missing or irrelevant. Text is hard to read. Balance of text to graphics is closer to 80/20 either way.	Most graphics are unrelated to the content or missing. Or the text is too difficult to read. Almost all text or all graphics.
Spelling & Grammar	No misspellings or grammatical errors.	A few minor errors but they don't detract from the information.	Frequent errors distract from the page.	Many mistakes, making it hard to read.
Sources cited	3 sources	2 sources	1 source	No sources

NAME CLASS DATE

THE CHEMISTRY OF CANCER

Student Activity



Water is a compound made from two elements, hydrogen and oxygen.

Terms to Know: atomic mass, atomic number, biomarker, biosensor, enzyme, isotope, metalloid, nanotechnology

To defeat cancer, we must find it first. **At The Journey to End Cancer** you will learn about new tools that can uncover and pinpoint cancers and how these inventions are improving all the time. Detecting cancers early and knowing exactly where they are makes treatment much more effective. So, what does any of this have to do with the elements on the periodic table?

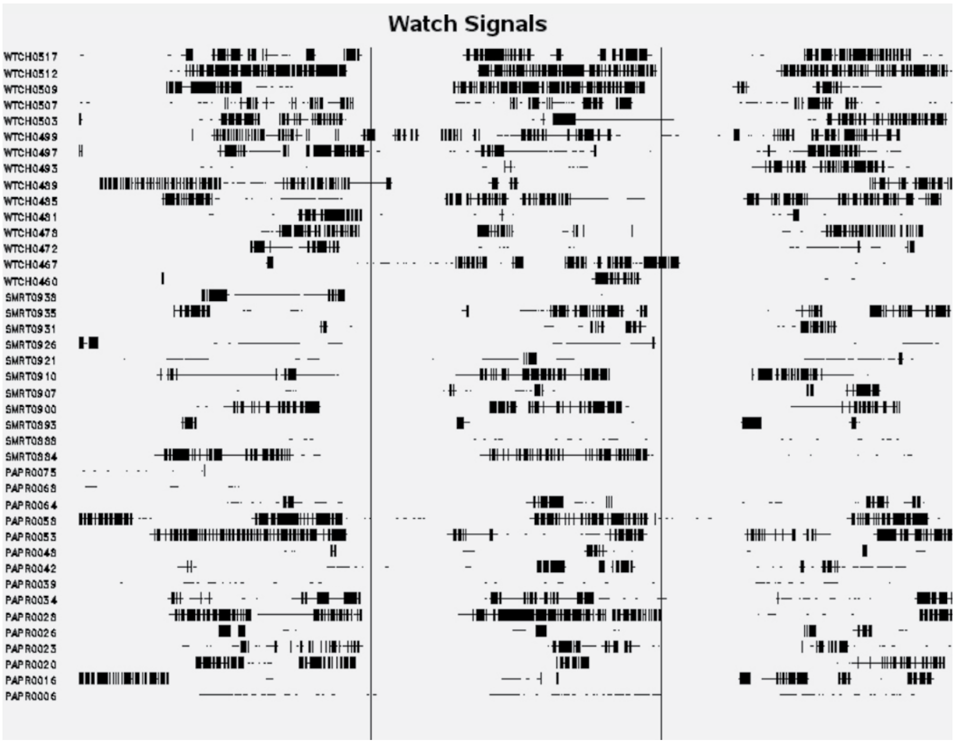
The periodic table is like a big chart or map that organizes all the chemical elements we know. Elements are the basic building blocks of everything around us. One element is made from (a lot of!) one type of atom, like hydrogen, oxygen, or gold. When elements join, they form compounds. For example, water is H2O, a compound made from hydrogen (H) and oxygen (O) elements.

Cancer is all over the periodic table. Well, not really! But too much of one element might cause it, a little less in a different form of the same element might treat it. Chemistry is everywhere in the quest to defeat cancer. Causes, detections, treatments...it's all there. Even the word "chemotherapy" — using drugs to target and destroy cancer cells — literally means "chemical treatment."

As of right now, the periodic table has 118 elements, and you probably already know some of them. What you might not know is which ones are major players in hunting down cancer. In Part 1 of this lesson plan you will explore 20 elements with important roles in cancer detection. In Part 2 you will learn where they are found and how their properties use the latest technologies to get the job done.

NAME	CLASS	DATE

Did You Know? Chemistry is essential for engineering high-tech, wearable devices that will someday detect cancer early, before people even feel sick. These tools will need to be small enough to fit inside everyday items like jewelry or watches and be able to sense chemical changes within the body.



Output of heart rate monitoring in a study of patients utilizing Apple Watches, with gaps in data and variable times of heart rate data collection. The increasing availability and sophistication of mobile health technology continues to generate promise for oncology care and research. Am Soc Clin Oncol Educ Book. 2021 Jul 31. National Library of Medicine, NCBI, NIH.

NAME ____________________ CLASS ____________ DATE ____________

PART 1: Form a group with some classmates and split the 20 elements in this chart among you. Use the periodic table to identify these elements commonly used to detect cancer. Share your results with your groupmates, complete the chart, and answer the questions that follow.

SYMBOL	NAME	ATOMIC NUMBER	ATOMIC MASS	GROUP NUMBER
1. H				
2. C				
3. N				
4. O				
5. F				
6. SI				
7. P				
8. S				
9. FE				
10. CU				
11. ZN				
12. GA				
13. AS				
14. TC				
15. AG				
16. IN				
17. I				
18. BA				
19. GD				
20. AU				

1. Which elements did you know already? Were there any you didn't know? Which ones?

2. Name two of these 20 elements that are in gas form at room temperature.

3. Which element has the lowest atomic mass? Which has the highest atomic mass?

4. What is the connection between atomic number and atomic mass?

NAME ______ CLASS ______ DATE ______

5. Elements in groups 1 and 2 are very reactive. Name an element from one of these groups.

______

6. Groups 3 through 12 are called "transition metals." Name three elements from this group.

______

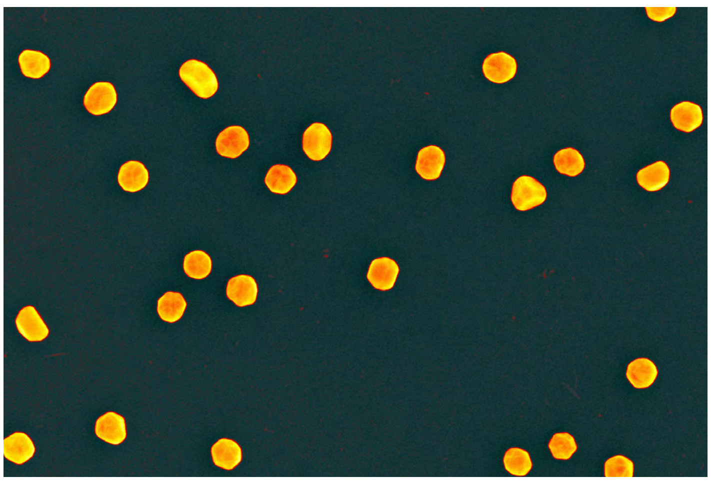
7. Groups 13 to 18 include a mix of metals, metalloids, post-transition metals, and nonmetals. How many elements on the chart are in these groups?

______

8. Choose 2 elements from the chart and describe other ways they are used. For example, gold (Au) is found in jewelry.

______

______



Gold nanoparticles magnified 250,000 times, created by the National Cancer Institute and National Institute of Standards and Technology. NIST

What do these metal blocks have to do with detecting cancer? This is indium. Its isotope, In-111, makes cancer visible on nuclear imaging scans. CC Nerdtalker

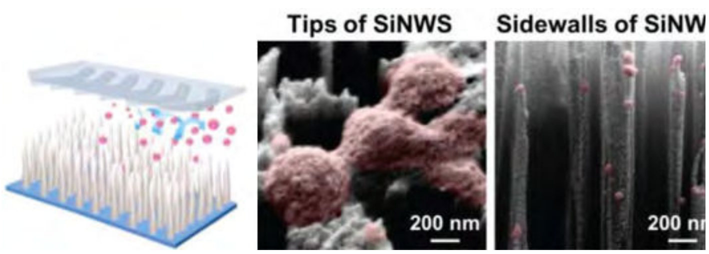
NAME ______________________ CLASS ______________ DATE ______________

PART 2: The 20 elements you explored in Part 1 are found in biomarkers, biosensors and nanotechnology, plus special imaging methods. Used alone or combined into compounds, these elements have key roles in early cancer detection. Finding cancer as soon as possible is one of the best ways to defeat it!

Biomarkers are like little clues floating around in your body that will reveal you have cancer. They are signals from cancer cells and can be found in your blood, urine, sweat, saliva, or other fluids. Biomarkers include pieces of DNA and RNA, proteins, and enzymes that are linked to cancer. They are made of elements like carbon (C), copper (Cu), hydrogen (H), nitrogen (N), oxygen (O), phosphorus (P), and sulfur (S).

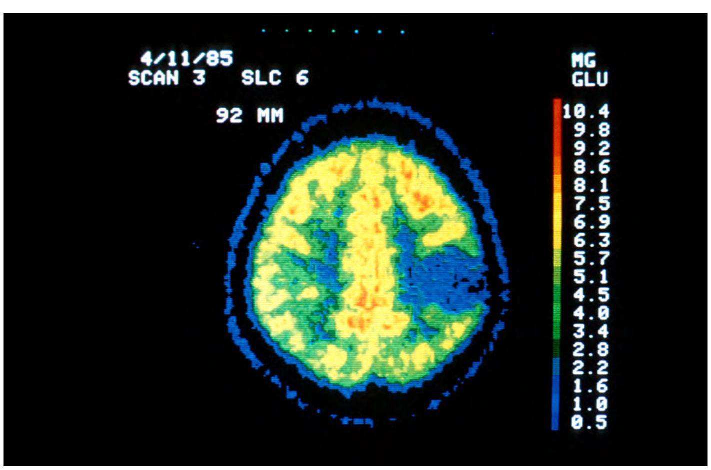
Biosensors detect cancer biomarkers. They are made to identify different types of cancer cells and let doctors know where they are located. The sensors need to be able to find even the smallest hints of cancer inside the body for early detection. Various elements are used based on the kind of cancer suspected and what the sensor is supposed to do when it finds the biomarker.

Nanotechnology is the science of making very tiny things. "Nano" means one-billionth of a meter. Biosensors use this tiny technology to find biomarkers inside the human body. Biosensors are made with nanoparticles, which are tiny bits of elements like zinc (Zn), silver (Ag), gold (Au), carbon (C), iron (Fe), or silicon (Si). These elements are often good conductors, which lets the biosensor send a signal out if it finds a sign of cancer.



Silicon nanowire chips (SiNWs) can capture rare cells from blood samples to diagnose diseases early. The images in the center and on the right show samples from Ewing sarcoma, a bone cancer in children, being studied as biomarkers for new biosensors. National Cancer Institute

Imaging lets doctors look inside you without having to open you up! They use special cameras combined with elements and compounds to detect cancer. Many elements on the periodic table have radioactive isotopes like fluorine (F), technetium(Tc), Arsenic (As), iodine (I), indium (In) and gallium (Ga). Attaching radioactive isotopes to molecules that bind to cancer cells makes tumors visible with high-tech imaging machines. Other types of imaging technologies use barium (Ba), iodine (I), iron (Fe) and Gadolinium (Gd).



Silicon nanowire chips (SiNWs) can capture rare cells from blood samples to diagnose diseases early. The images in the center and on the right show samples from Ewing sarcoma, a bone cancer in children, being studied as biomarkers for new biosensors. National Cancer Institute

NAME ______ CLASS ______ DATE ______

Think about how these amazing tools help doctors find cancer cells earlier and see them more clearly. Pick one element from the chart your group completed in Part 1. Your original group will research and make a one-pager about this element, exploring its properties, how it detects cancers, its other uses, and how it might also create stronger treatments if cancer is detected.

Begin with what you have learned so far in this lesson. Continue your investigation online and with your science class resources. Below are the five content sections and the specific information you will track down to include on your infographic. Record and save the research and results in a document that everyone in your group can access.

One-pager Sections

Element

- Name & symbol
- Atomic number
- Atomic mass
- Group number
- Classification (metal, nonmetal, metalloid)
- Properties

Find cancer

- Ways it is used in cancer detection (biomarkers, biosensors, nanotechnology, imaging)
- Describe the technologies
- What kinds of cancer it detects
- What about the element makes it good for this task
- Whether it is used alone as an element or in a compound for this

Defeat cancer

- How this element can also be used in treatment, prevention, therapy, etc.
- Kinds of cancers involved
- Technology or methods of treatment that use this in element
- Whether it is used alone as an element or in a compound for this

Availability

- Where is this element usually found?
- Are its supplies of it easy to access?
- What must be done to it before it can be used?
- What happens if the natural source runs out?

Describe 3 ways this element is found or used elsewhere

NAME | CLASS | DATE

NAME ______________________ CLASS ______________ DATE ______________

Create a well-organized one-pager to showcase your findings. Divide the page into the five sections that summarize your research. Balance the graphics (pictures) and text (words) neatly. Check spelling and grammar. List three sources (websites, books, articles) on the back or separate paper. If you're new to citing sources, try the MLA (Modern Language Association) format:

- Website: Author's Last Name, First Name (if available). "Title of Web Page." Title of Website, Publisher (if different from website title), Date of Publication, website address. Date you used the website.
- Article: Author's Last Name, First Name. "Title of Article." Title of Journal/Magazine, volume number, issue number, year, pages.
- Books: Author's Last Name, First Name. Title of Book. Publisher, year of Publication.

Below is the rubric your teacher will use to assess your group's one-pager.

ONE-PAGER RUBRIC				
	4 POINTS	**3 POINTS**	**2 POINTS**	**1 POINT**
Content	Includes 5 sections from instructions	Missing 1 section	Missing 2-3 sections	Missing 4 or more sections
Organization of Information	Clear, logical, and visually appealing; all items are well-spaced on the page.	Mostly clear, logical, appealing, and well-spaced. One item seems out of place.	Most is organized, but some things are missing or don't fit.	No clear plan for organizing the information.
Graphics & Text	Both neat and easy to read. Colorful pictures match content. The page has a good balance of text and graphics, about 50/50 or 60/40.	Most graphics/images support the content. Text is legible, does not distract from the information. Balance of text to graphics is 70/30.	Some graphics are missing or irrelevant. Text is hard to read. Balance of text to graphics is closer to 80/20 either way.	Most graphics are unrelated to the content or missing. Or the text is too difficult to read. Almost all text or all graphics.
Spelling & Grammar	No misspellings or grammatical errors.	A few minor errors but they don't detract from the information.	Frequent errors distract from the page.	Many mistakes, making it hard to read.
Sources cited	3 sources	2 sources	1 source	No sources

Total points: ______________/ 20 points possible

BONUS! Create an expanded periodic table with the rest of your class to include your element one-pagers. Display them in the room, hallway, or school media center. The more we KNOW it, the more we FIND it, the more we TREAT it, the more we PREVENT it, the more we can DEFEAT cancer – together.

LESSON PLAN 3 — CANCER TREATMENT FAMILY TREE

Teacher Instructions

Science, English Language Arts

Life Science; Writing, Reading Informational, Literacy in Science & Technical Subjects

Cancer treatments have come a long way, saving more lives today than ever before. Some treatments, like surgery, date back to ancient Egypt, while others are recent discoveries. Scientists and doctors are continuously seeking ways to help more people survive various types of cancer.

The Journey to End Cancer illustrates the five main methods of modern cancer treatments to your students. They are:

1. Surgery: removes cancer by cutting it out
2. Radiation Therapy: uses high-energy rays to kill cancer cells
3. Chemotherapy: prescribes medicine to kill cancer cells
4. Targeted Therapy: focuses on specific cancer cells
5. Immunotherapy: boosts the immune system to destroy cancer cells

Let's focus on #5, immunotherapy. During your field trip, your students can play a game that shows how immunotherapy defeats cancer. They will turn immune cells, which usually fight off viruses, bacteria, and toxins, into superheroes that seek out and destroy cancer cells. Scientists and doctors are helping our bodies do what they already know how to do, but even better. This can feel like a miracle for patients and families when other treatments haven't worked.

Dr. James P. Allison is a well-known scientist in cancer treatment. He became interested in science as a child because of his teachers and his father. Instead of becoming a doctor like his dad, however, he became a science professor and researcher because he loved asking questions and finding answers. He is now part of The University of Texas MD Anderson Cancer Center in Houston, Texas, and studies how to make T cells fight and destroy cancer until it's gone.

In 2018, Dr. Allison and Dr. Tasuku Honjo, a scientist from Japan, won the Nobel Prize in Physiology or Medicine for their amazing work on cancer treatments. When Dr. Allison won, he remembered moments from his childhood that inspired him to make these discoveries. Your students will read some of his memories in Part 1.

For Part 2, your class will investigate different kinds of cancer therapies on a Cancer Treatment Family Tree and identify some of the latest developments in this ever-changing field. The diagram includes the names of seven common immunotherapy treatments as well as examples for each one. Your students will use these terms to practice key word searches and track down current research online.

PART 2 — TEACHER'S INSTRUCTIONS

ANSWER KEY: *Part 1:*

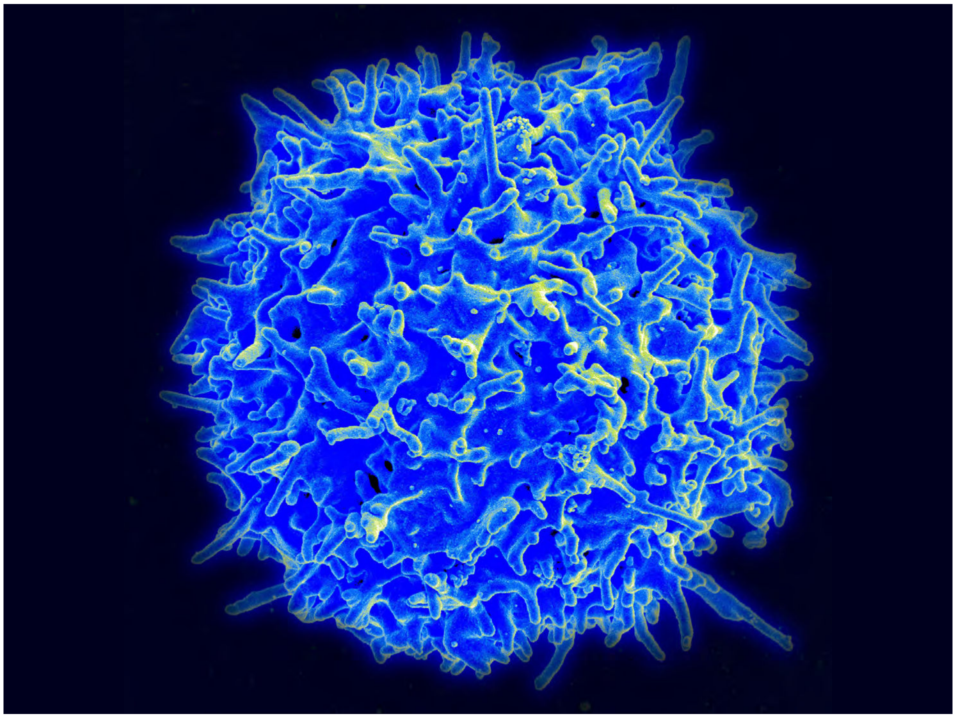
1. Farming and oil
2. He didn't like it; says it was "not his idea of fun" and describes it as "being crushed under a pile of big sweaty boys on a hot Texas afternoon"
3. Reading, dissecting frogs, making homemade bombs
4. Doctor
5. Exposed him to other children who had diseases to develop immunity
6. Measles or mumps
7. 11
8. She was getting sicker, spending time in bed, going to the hospital, coming back with burns on her neck
9. Two uncles
10. Encouraged him to do his best, and to take advantage of available resources and programs outside of the school
11. In special programs at University High School in Austin, Texas
12. Summer after junior year

ANSWER KEY: *Part 2:* Assess each student for completion of their column in the chart

NAME _______________ CLASS _______________ DATE _______________

CANCER TREATMENT FAMILY TREE

Student Activity



A healthy T cell is crucial for your immune system. Immunotherapy uses them to fight difficult-to-treat cancers more effectively than some other treatments. NIAID, NIH

Terms to Know: immunologist, immunotherapy, lymphoma, melanoma, Nobel Prize, physician, physiology, T cell

Cancer treatments have come a long way, saving more lives today than ever before. Some treatments, like surgery, date back to ancient Egypt, while others are recent discoveries. Scientists are continuously seeking ways to help more people survive various types of cancer. **The Journey to End Cancer** illustrates the five main methods of modern cancer treatments to you. They are:

1. Surgery: removes cancer by cutting it out
2. Radiation Therapy: uses high-energy rays to kill cancer cells
3. Chemotherapy: prescribes medicine to kill cancer cells
4. Targeted Therapy: focuses on specific cancer cells
5. Immunotherapy: boosts the immune system to destroy cancer cells

Let's focus on #5, Immunotherapy. During your field trip, you can play a game that shows how immunotherapy defeats cancer. You will turn immune cells, which usually fight off viruses, bacteria, and toxins, into superheroes that seek out and destroy cancer cells. Scientists and doctors are helping our bodies do what they already know how to do, but even better. This can feel like a miracle for patients and families when other treatments haven't worked.

James P. Allison, Ph.D. is a well-known scientist in cancer treatment. He became interested in science as a child because of his teachers and his father. Instead of becoming a doctor like his dad, however, he became a science professor and researcher because he loved asking questions and finding answers. He is now part of The University of Texas MD Anderson Cancer Center in Houston, Texas, and studies how to make T cells fight and destroy cancer until it's gone.

In 2018, Dr. Allison and another scientist, Dr. Tasuku Honjo, won the Nobel Prize in Physiology or Medicine for their amazing work on cancer treatments. When Dr. Allison won, he remembered moments from his childhood that inspired him to make these discoveries. You will read some of his memories in Part 1. For Part 2, you will investigate different kinds of cancer therapies on a Cancer Treatment Family Tree and track down some of the latest developments in this ever-changing field.

NAME ______________________ CLASS ______________ DATE ______________

PART 1: What kind of childhood does the inventor of a possible cure for cancer have? Read about the early years of a real-life hero, Dr. James P. Allison, who would grow up to find some of the most effective new ways to treat cancer. The text below comes from an autobiography he wrote when he won the Nobel Prize. Enjoy his memories of growing up during the 1950s and 1960s in South Texas, then answer the questions that follow.

James P. Allison, Ph.D., Department of Immunology, Division of Discovery Science, The University of Texas MD Anderson Cancer Center. Image: MD Anderson Cancer Center

"Cancer treatment has always been in the back of my mind. Still, I can't really say that the impact of cancer on my family motivated all that I would later do, but years later I knew that should the opportunity ever arise I would do all that I could to apply my work to curing cancer."

I was born in 1948 in Alice, a small farming and oil town in the brush country of the Rio Grande Valley in South Texas. Those early years in Alice shaped who I would later become. Being in Texas, the whole town, including my two older brothers, was obsessed with football. But, I learned from a young age that being crushed under a pile of big sweaty boys on a hot Texas afternoon was not my idea of fun. My interests lay more in knowledge and playing at chemical and biological experimentation. If you couldn't find me curled up with a book, I was probably in the garage dissecting frogs.

1. What were the main industries in Alice, Texas?

2. How did he feel about playing football as a kid? How do you know?

3. What examples did he give of the things he liked to do?

My Dad was the old-fashioned kind of doctor that made house calls, and I would sometimes accompany him on his rounds around town. I think he was the first immunologist I met because, in the days before vaccines for measles, mumps, and other childhood diseases, he would take me with him so that I could be exposed to the other children who had these illnesses. It was his way of exposing me...while I was young so that I could develop immunity against these infections....

4. What was his father's job?

5. How did his father protect him against childhood diseases, before scientists invented vaccines?

6. Name one of the childhood diseases he listed.

NAME ______ CLASS ______ DATE ______

My Mom died when I was 11 years old. This was my first loss to cancer. At the time I didn't know it was cancer because people simply did not speak of such things during those days. All I knew was that my mom was getting sicker and spending increasing amounts of time in bed. She would go to the hospital for treatment and come back with burns on her neck. I later learned that she was suffering from lymphoma and was receiving radiation therapy, the standard-of-care treatment at the time. One morning in summer of 1960, as I was leaving with family friends to go swimming, I was told to go back inside and see my mom. I sat at her bedside and held her hand as she died. That was a defining moment in my early life. And then, not long after my mom died, my uncle died from melanoma and another uncle later died from lung cancer…

7. How old was James Allison when his mom died of cancer?

______

8. What did he know about her illness?

______

______

9. Who else in his family died of cancer when he was young?

______

______

In high school in Alice, I was fortunate to have a few great teachers who went the extra mile to encourage me to do my best and to take advantage of available resources, some outside the reach of the standard curriculum. A counselor arranged for me to participate in special summer programs for talented students at University High School in Austin after the 8th, 9th, and 10th grades. … The summer after my junior year, I participated in a biology course sponsored by the National Science Foundation at UT [University of Texas] Austin.… I enrolled at UT Austin in the summer session immediately after high school graduation. Due to my summers in Austin, I never thought of going anywhere else.

10. How did his schoolteachers and counselor in Alice help him?

______

______

11. Where did he spend his summer breaks?

______

12. When did he try out his first college science course, at UT Austin?

______

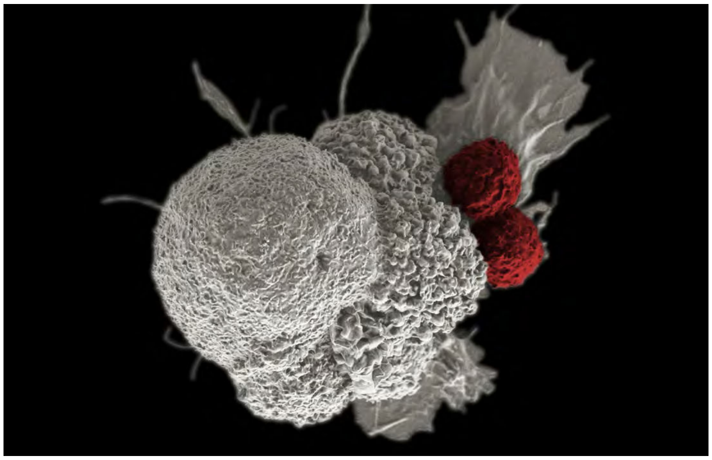
Passages excerpted from Allison's autobiography available at James P. Allison – Biographical. NobelPrize.org. Nobel Prize Outreach 2025, www.nobelprize.org/prizes/medicine/2018/allison/biographical/ and published in The Nobel Prizes 2018, on behalf of The Nobel Foundation by Science History Publications/USA, division Watson Publishing International LLC, Sagamore Beach, 2019.

NAME CLASS DATE

PART 2: When we think of our immune system and vaccines, we often think about childhood diseases like those Dr. Allison's father treated. Or we think of germs and viruses that cause COVID-19 or the flu. These sicknesses are contagious; we catch them from someone else. Cancer is not contagious; it starts inside our own cells. Scientists like Dr. Allison have learned how to make our immune system work extra hard to fight cancer just like it fights other things that don't belong in our bodies.

Look at the Cancer Treatment Family Tree on the next page. It shows how cancer is treated with the "five pillars." One of these ways is immunotherapy. For a quick introduction to cancer immunotherapy, watch the video available on www.MDanderson.org/treatment-options/immunotherapy.html. The treatment family tree lists the names of seven common ways to defeat cancer within immunotherapy.

Dr. Allison and his team made important discoveries and inventions with checkpoint inhibitors; the first category of immunotherapy listed in the chart. Each of the seven ways also has examples given, like Dr. Allison's discovery "CTLAl-4.". Don't worry about the details of all the specific names and examples. You will use these terms for key word searches to track down the latest research online.

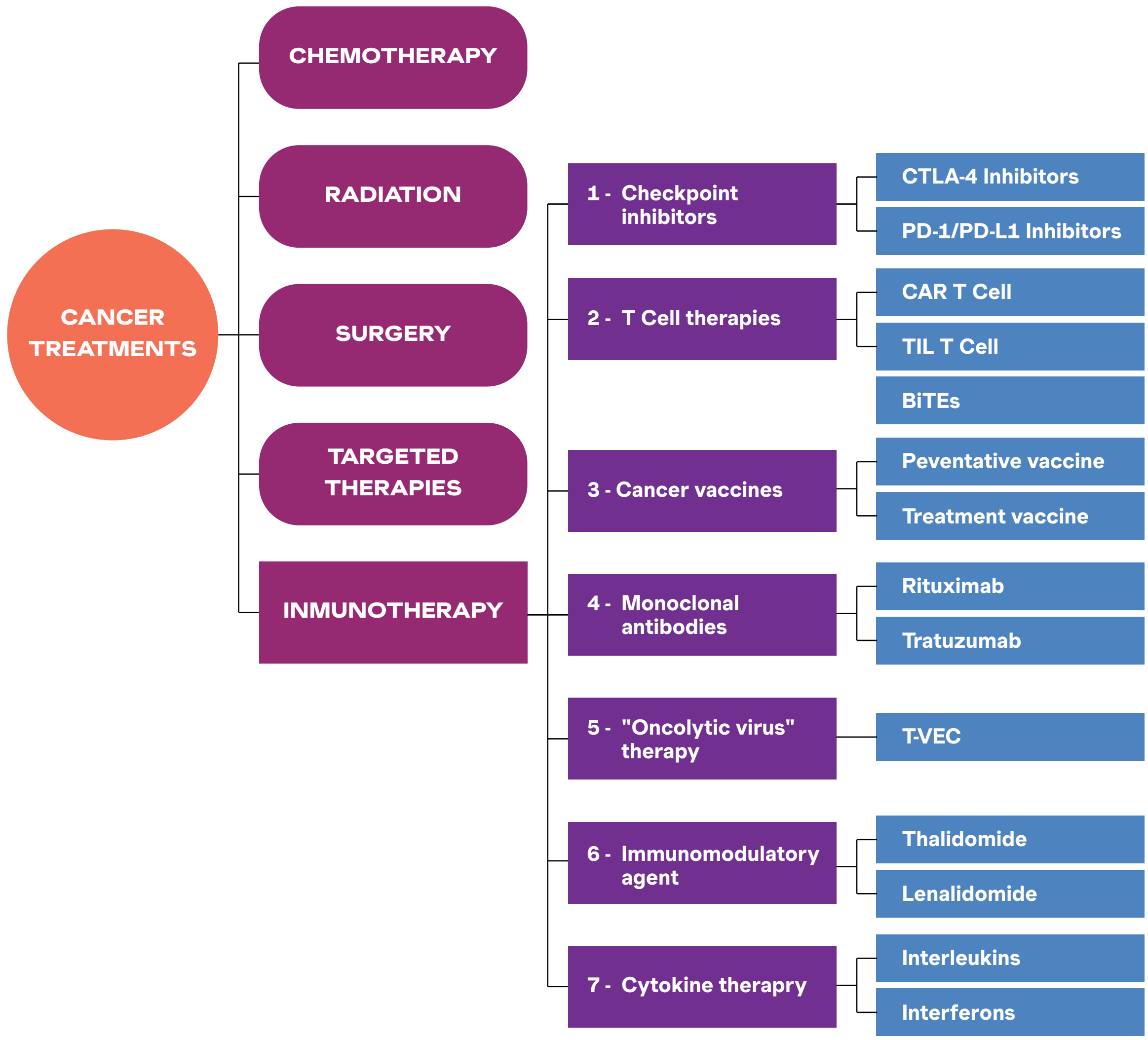


This magnified image shows two small T cells attacking a large mouth cancer cell. Immunotherapy boosts these T cells with special treatments. The boosted T cells inject the cancer cell, making it shrink and die. This is called TIL T cell therapy.. Duncan Comprehensive Cancer Center at Baylor College of Medicine, NCI

Did You Know? Chemistry is essential for engineering high-tech, wearable devices that will someday detect cancer early, before people even feel sick. These tools will need to be small enough to fit inside everyday items like jewelry or watches and be able to sense chemical changes within the body.

NAME ______________________ CLASS ______________ DATE ______________

CANCER TREATMENT FAMILY TREE



What's New?

Work with a partner and choose two of the seven immunotherapy treatments from the family tree diagram above—one for each of you. Decide which of you will investigate which method, "Treatment A" or "Treatment B" for the table on the next page.

- Online, go to MD Anderson's Cancerwise blog.
- Enter the immunotherapy treatment type you chose in the search bar.
- Select one of the results from the search. Read the article or post.
- Record information from your article or post it in the table on the next page based on what you read.
- Search tips:
    - Use quotation marks around the name of the treatment for accurate searches, like "cancer vaccines" or "cytokine therapy."
    - If you have trouble finding an article or want to narrow down your results, use an example next to the category as your search term. For instance, try "interleukins" if you are doing cytokine therapy.
- Complete the table by sharing the information in your column with your partner.

NAME ______________________ CLASS ______________ DATE ______________

	TREATMENT A	TREATMENT B
Kind of immunotherapy		
Title of article or post		
Author		
Date		
Type or types of cancers discussed		
Doctors or scientists mentioned, and their job titles		
Successes with this treatment		
Other kinds of treatment it is sometimes combined with		
If there is a quote featured on the page, what is it and who is it by?		
Something you found interesting in the article or post		

With your partner, be prepared to reveal your research with the class:

- Similarities and differences in the two types of immunotherapies
- How they are used in combination with other treatments for the best outcomes
- What was difficult about searching for the information you needed
- What helped you search for the information you needed
- Your top take-away from the value of immunotherapy treatments in defeating cancer

LESSON PLAN 4 — THINK GLOBALLY, ACT LOCALLY

Teacher Instructions

Mathematics, Social Studies, Health

Mathematical Practice, Expressions & Equations, Statistics & Probability; Human Geography; Collective Responsibility

Pediatric cancer is not very common, but it is one of the main reasons why kids get seriously sick. The most common types of pediatric cancer include leukemias (blood cancers), brain tumors, and lymphomas (lymph node cancers). Thanks to new treatments, 80% of kids with cancer survive at least five years after being diagnosed. Globally, however, the five-year survival rate is estimated to only be about 37%.

Going through cancer treatment is very hard for kids and their families all over the world. Things like how much money they have, where they live, their race or ethnicity, or how educated the parents are affect how a child does when they have cancer. If a family is poor, they might not be able to get the best care, it might take longer to go to the doctor, or they skip expensive medicines and treatments.

Even the distance to the nearest grocery store can be a factor in who survives cancer. All these circumstances together are called "social determinants of health," or SDOH. Researchers and scientists discovered that SDOH lead to poorer health and lower survival rates for children with cancer. The good news is that now that we know, we can do something about it.

At **The Journey to End Cancer** your students will find examples of worldwide partnerships that make a difference in treatments for children and adults. In the DEFEAT IT gallery, look for the touchscreen globe that shows successful international efforts improving cancer rates across the continents. They may be surprised to see how the fight against cancer extends to the most remote place on Earth, Antarctica, and even into space with cancer research aboard the International Space Station!

Your students don't have to wait until they are adults and can travel the world to make a difference! This lesson shows them how their interests and abilities can help their friends and neighbors survive and thrive today. Think globally, act locally!

In Part 1, your students will complete a logic puzzle to match three hypothetical middle school students, their current interests, and their future careers in pediatric oncology and SDOH. In Part 2, math skills including expressions and equations along with statistics and probability cross paths with human geography as your students see how poverty often underpins other SDOH related to childhood cancer survival rates worldwide.

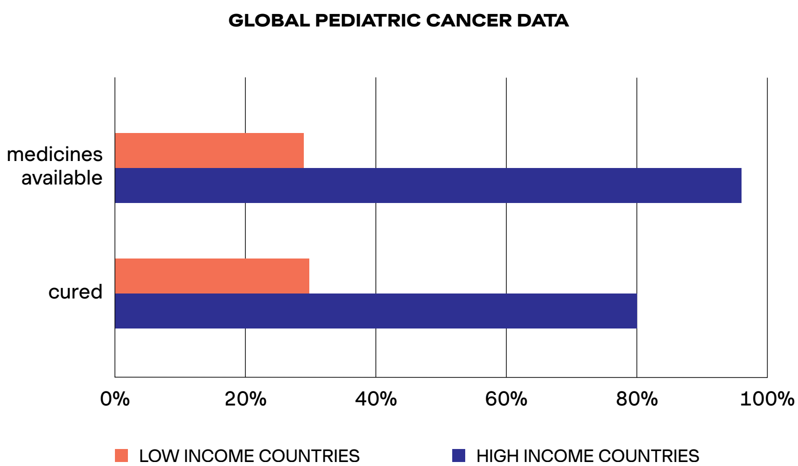
PART 2 — TEACHER'S INSTRUCTIONS

ANSWER KEY: *Part 1:*

Cora—Math—Epidemiologist

Sam—Education—School Counselor

Ruby—Geography—Urban Planner



ANSWER KEY: *Part 2:*

a., b., c. labeled here

d. high income countries have better healthcare: they have more medicine available, and more children are cured

e. successful cancer treatments, like being cured, depend on access to good healthcare, like medicine being available

2. a. NH American Indian/Alaska Native, b. NH White girls but almost tied with NH American Indian/Alaska Native boys, c. NH American Indian/Alaska Native, d. NH Black, e. answers will vary, f. answers will vary

3. a. 30%, b. 62.5%, c. 18.75%, d. 80 more

4. a. $15, b. 600 miles, c. $1800, d. yes, e. $180, f. $3,480, g. answers will vary

NAME CLASS DATE

THINK GLOBALLY, ACT LOCALLY

Student Activity

Project ECHO® is a program where doctors from MD Anderson help train and support healthcare providers in rural and underserved areas through video calls. This helps doctors in areas like Latin America, Africa, and rural Texas provide better care for their patients.

Terms to Know: determinant, diagnose, epidemiologist, income, lymph node, pediatric, rural, survival rate

Pediatric cancer is a kind of cancer that happens to kids and teenagers. Although it's not very common, it is one of the main reasons why kids get seriously sick. The most common types of pediatric cancer include leukemias (blood cancers), brain tumors, and lymphomas (lymph node cancers). Thanks to new treatments, 80% of kids with cancer survive at least five years after being diagnosed. Globally, however, the five-year survival rate is estimated to only be about 37%.

Going through cancer treatment is very hard for kids and their families all over the world. Things like how much money they have, where they live, their race or ethnicity or how educated the parents are affect how a child does when they have cancer. If a family is poor, they might not be able to get the best care, it might take longer to go to the doctor, or they might skip expensive medicines and treatments.

Even the distance to the nearest grocery store can be a factor in who survives cancer. All these circumstances together are called "social determinants of health," or SDOH. Researchers and scientists discovered that SDOH lead to poorer health and lower survival rates for children with cancer. The good news is that now that we know, we can do something about it.

At **The Journey to End Cancer** you will find examples of worldwide partnerships that make a difference in treatments for children and adults. In the DEFEAT IT gallery, look for the touchscreen globe that shows successful international efforts improving cancer rates across the continents. You may be surprised to see how the fight against cancer extends to the most remote place on Earth, Antarctica, and even into space with cancer research aboard the International Space Station!

You don't have to wait until you're an adult and can travel the world to make a difference! This lesson shows you how your interests and abilities can help your friends and neighbors survive and thrive NOW. Think globally, act locally!

NAME ______ CLASS ______ DATE ______

PART 1: Read the short story below then solve a logic puzzle that matches three fictitious students to the cancer-related careers they hope to have some day. Logic puzzles are a fun way to practice mathematical skills without using any numbers! You will be making deductions and establishing equalities like those used in algebra: if A = B and B = C, then A = C.

The Story

In Middle School Science this year, cancer was a topic in units on cells, genetics, human body systems, and atoms and molecules. Three students, Sam, Ruby, and Cora, got really interested in pediatric cancer, even though science isn't usually their favorite subject. They want to help improve survival rates for kids, but without careers in biology or chemistry. Their teachers introduced the idea of social determinants of health (SDOH) and how community programs can help. In the logic puzzle below, match the three students to possible careers that will contribute to fighting cancer locally and the subjects they can study in school now to get involved.

To solve this logic puzzle, carefully read each clue and use the chart to track what you know. Place an X in the box if a clue tells you someone does NOT like something. Put a checkmark when you can match a student with a subject or career.

For example, the first clue says Cora does not want to work face-to-face with children, so she certainly won't want to be a school counselor. This clue is already marked on the grid. Continue reading the clues, marking X for false/no and ● for true/yes until the three students match their careers and subjects. Everyone can help fight cancer!

Student

- Cora
- Sam
- Ruby

Subject

- Geography
- Education
- Math

Career

- Epidemiologist
- School Counselor
- Urban Planner

Use the clues on the next page to match each student to her or his subject of interest and potential career.

NAME ______________________ CLASS ______________ DATE ______________

The Clues

1. Cora does not want to work face-to-face with children.
2. Ruby wonders how far families must travel for their children's cancer treatments and how they get there, especially if they don't have a car.
3. The student who likes math wants to know why children whose parents have higher-paying jobs have better cancer survival rates than those with lower paying jobs.
4. The student who wants to work in education will help sick kids stay on track with their schoolwork either by becoming a teacher in a hospital or a counselor in a school.

		CAREER			SUBJECT		
		Counselor	Epidemiologist	Urban Planner	Education	Math	Geography
STUDENT	Ruby						
	Sam						
	Cora	X					
SUBJECT	Education						
	Math						
	Geography						

Write the solution to the puzzle here.

STUDENTS	SUBJECTS	CAREERS

Did You Know? Although Black women are diagnosed with breast cancer at similar rates as White women, they are about 40% more likely to die from it. This difference is not because of DNA or different types of breast cancer. It is caused by SDOH—things like socioeconomic inequality, delayed diagnosis, and systemic racism.

NAME CLASS DATE

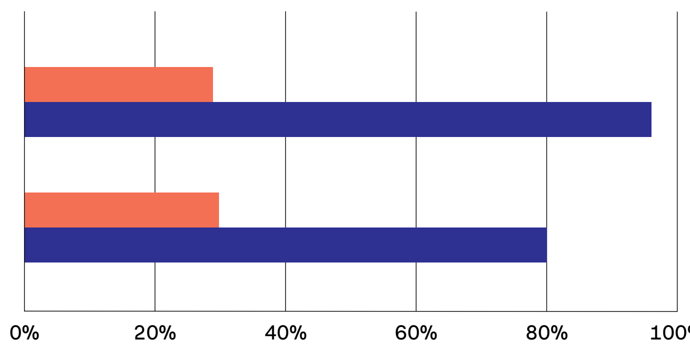
PART 2: In the US, one in five children who receive a new diagnosis of childhood cancer are already living in poverty. Families with low income might...

- not be able to afford regular doctor visits or treatments. Without regular check-ups, cancer might not be detected early, making it harder to treat.
- not have access to good schools or educational resources. Less education can lead to less knowledge about healthy habits and cancer prevention.
- be unable to afford healthy foods. Poor nutrition increases the risk of developing cancer.
- live in unsafe or unhealthy environments. Exposure to pollutants and unsafe living conditions increase cancer risk.

Practice your math skills as you review the correlation between pediatric cancer and social determinants of health. Think about cause and effect, and the role poverty plays in many other SDOH.

1. **Global Pediatric Cancer Date:** The World Health Organization (WHO) reports that only 29% of low-income countries have pediatric cancer medicines available to most people, while 96% of high-income countries do. They also report that in high-income countries, where medical services are generally easy to get, more than 80% of children with cancer are cured. But in lower-income countries, less than 30% of the children are considered cured.

Identify the missing information for this clustered bar chart below based on global pediatric cancer data, then answer the questions that follow.



a. Identify which bar color represents high-income countries, and which is for lower-income countries in the two clusters. Add a key.

b. Determine and label, on the graph, which cluster of bars shows medications available and which cluster shows cancer cured rates.

c. Add a title to the top of the chart.

NAME ______________________ CLASS ______________ DATE ______________

d. What conclusion can you make about healthcare in the two categories of countries based on income?

____

____

____

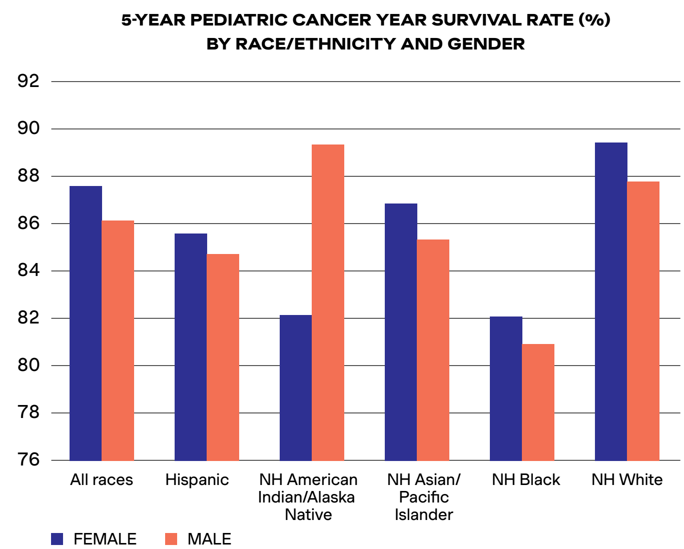
e. What conclusion can you make about access to good healthcare and the outcomes of cancer treatment?

____

____

____

2. **US Pediatric Cancer Survival Rate by Race/Ethnicity and Gender:** This bar graph shows the percentage of children under 20 who survive at least five years after being diagnosed with cancer. It breaks down the data by race/ethnicity (like African American, Hispanic, Asian, and White) and gender (boys and girls). "NH" stands for non-Hispanic. For example, 86% of boys from all race/ethnicity groups combined survived at least five years after being diagnosed with pediatric cancer.



a. What is the only category in which boys have a better childhood cancer survival rate than girls?

____

b. Which category has the highest childhood cancer survival rate?

____

c. Which race/ethnicity category has the biggest difference between girls and boys?

____

d. Which race/ethnicity category has the lowest survival rates for both girls and boys?

____

NAME CLASS DATE

e. Why do you think different racial groups experience cancer differently in terms of diagnosis, treatment, and survival rates? How do cultural factors affect the health of children with cancer from different racial backgrounds?

f. Make one conclusion about SDOH and pediatric cancer survival rates supported by the data in the graph.

3. Cora, Sam, and Ruby, the students from Part 1, want to organize a fundraiser at their middle school. They plan to raise money for the cancer center at their local children's hospital. The donations will be part of a fund that helps those children and families who battle social determinants of health along with their fight against cancer.

Before they begin planning their event, the students want to know if their community is already contributing to the cancer center at the children's hospital. They designed a flyer with a survey to distribute in the community, and their math teacher just taught them how to calculate probabilities.

- There are 1,000 households in the community.
- Volunteers distribute flyers to 400 randomly selected households.
- Out of these 400 households, 120 households responded to the survey.
- In the survey, 75 households reported that they have donated to the pediatric cancer center in the past year.
- The remaining households did not donate to the pediatric cancer center.

Questions:

a. What is the probability that a randomly selected household from the 400 surveyed households responded to the survey?

b. What is the probability that a household that responded to the survey donated to pediatric cancer center?

c. Based on the survey results, what is the estimated probability that any randomly selected household from the entire community donated to the pediatric cancer center?

d. If the students want to increase the survey response rate to at least 50%, how many additional households need to respond to the survey?

NAME ______________________ CLASS ______________ DATE ______________

4. The middle school students decide there will still be enough potential donors for their fundraiser. Cora, Sam, Ruby, their classmates, and their teachers want to raise money to help families who are dealing with pediatric cancer and the extra challenges from SDOH, like rides to the doctors' appointments, medications, babysitters for younger children during appointments and hospital stays, or medical equipment needed at home.

The middle school is planning a walkathon for their "SDOH Fund" and participants will get sponsors who pledge money for each mile they walk. Here are the details:

- Each participant walks an average of 5 miles.
- There are 120 students participating in the walkathon for this first year.
- Each participant gets sponsors who pledge $3 per mile walked.
- Additionally, there are some bonus donations:
    - The school receives a $1,500 flat donation from a local grocery store if the total miles walked by all participants exceed 500 miles.
    - For every $100 raised, an additional $10 is donated by the school's Parent-Teacher Association (PTA).

Questions:

a. How much money does each walking student raise on average from their sponsors?

____

b. What is the total number of miles walked by all participants?

____

c. How much total money is raised by all participants before bonus donations?

____

d. Does the school qualify for the $1,500 donation from the local grocery store?

____

e. Calculate the additional amount donated by the PTA.

____

f. What is the grand total amount of money raised, including the bonuses?

____

g. As a member of the research team at the local pediatric cancer center, write a thank you note to Cora, Ruby, Sam and their classmates for their "SDOH Fund" donation. In your note, explain the connection between pediatric cancer survival rates and social determinants of health. Use what you learned in these activities as evidence that more can be done to help children with cancer who are also challenged by SDOH.

____

____

____

____

____

NAME ______________________ CLASS ______________ DATE ______________

HOPEFUL WORDS: CRYPTOGRAM

Games and Puzzles

Hopeful words can greatly impact mental health, especially for those battling cancer. Encouragement and resilience can bring optimism during tough times. Solve this cryptogram to reveal an inspirational quote from Jimmy Carter, the 39th President of the United States, offering support to fight against childhood cancer

Use the key to match the numbers to their letters. Two letters have been filled in to get you started (G= 25 and D = 18).

KEY

A	B	C	D	E	F	G	H	I	J	K	L	M
12	7	24	18	3	9	25	2	16	20	14	8	19

N	O	P	Q	R	S	T	U	V	W	X	Y	Z
6	22	13	10	11	26	4	17	1	15	21	5	23

“ 4 2 3   7 11 12 1 3 11 5   22 9   12   24 2 16 8 18 (D)

15 16 4 2   24 12 6 24 3 11   16 6 26 13 16 11 3 26

17 26   4 22   12 18 (D) 1 22 24 12 4 3

9 22 11   24 2 12 6 25 (G) 3 ”

ANSWER KEY

Cryptogram: “The bravery of a child with cancer inspires us to advocate for change.”

MILESTONES — DECADES OF CANCER HISTORY

A long time ago, people didn't know much about cancer. Over the years, doctors and scientists have made amazing discoveries to help treat and understand this disease. Take your students on a journey through time to learn about some important moments in cancer history. Your class will discover more about these important moments in cancer research and treatment in this Teacher's Guide and within the galleries at The Journey to End Cancer.

Ancient Times

- Over 3,000 years ago in Ancient Egypt, people wrote about cancer for the first time. They tried to treat breast cancer by using a hot tool to burn the tumor.
- Around 460 BCE a Greek doctor named Hippocrates called cancer "carcinos," which means "crab" in Greek because the shape of tumors reminded him of a crab.

1600s-1700s

- In the 1600s a German surgeon named Wilhelm Fabricius made surgeries better by carefully studying how to remove tumors.
- In 1775 an English doctor named Percivall Pott found that chimney sweeps (people who cleaned chimneys) often got cancer from being around soot and smoke.

1800s

- In 1846 doctors began using a special medicine called anesthesia to help patients sleep during surgery so they wouldn't feel pain.
- In 1895 Wilhelm Roentgen discovered X-rays, which allowed doctors to see inside the body to find tumors.

1900s

- In 1937 the National Cancer Institute was formed.
- In 1943 scientists discovered that certain chemicals could shrink cancer, leading to the first chemotherapy treatments.
- In 1956 E. Donnall Thomas, MD, performed the first successful bone marrow transplant, which helps treat blood cancers like leukemia.
- In 1971 the U.S. government started a "War on Cancer" to give more money to cancer research and find better treatments.

2000s to Today

- In 2006 the first vaccine to prevent HPV, a virus that can cause cancer, was approved.
- In 2017 a new treatment called CAR T cell therapy was approved to help children with a serious type of leukemia.
- In 2023 a 14-year-old student named Heman Bekele created a special soap to help treat skin cancer.

Why This Matters: Thanks to these discoveries, doctors can find and treat cancer more easily. With each new breakthrough, we get closer to ending cancer for good. Who knows? Maybe one day, one of your students will become a scientist who helps find the next big cure!

GLOSSARY

Key Terms Related to Cancer

Teachers: This glossary contains important words related to cancer. Keep this list handy for you and your class. It can help with learning new vocabulary and checking your understanding. Students can also add new words and definitions they find during their visit to The Journey to End Cancer and while doing lessons and activities in this Teacher's Guide.

A

Adenocarcinoma: A type of cancer that starts in glands that make mucus.
Adjuvant Therapy: Extra treatment given after the main treatment to help improve the chances of getting better, often used after surgery.
Anemia: A condition where there are not enough red blood cells, which are important for carrying oxygen in the body.

B

Benign Tumor: This means that a growth or change to a body tissue is not cancer. A benign tumor can grow but doesn't spread to other parts of the body.
Biopsy: A small sample of tissue taken from the body to check for cancer cells.
Blood Cancer: A cancer that starts in blood cells. Leukemia and lymphoma are blood cancers.
Bone Marrow Transplant: A treatment where unhealthy stem cells (cells that develop into blood cells) are destroyed and then replaced with healthy ones. The healthy cells usually come from the bone marrow of a donor.
BRCA1 and BRCA2: Two genes that help fix damaged DNA. If there's a change (mutation) in one of these genes, it can raise your risk of certain cancers, like breast, ovarian or pancreatic cancer.

C

Cancer Survivor: Anyone who has had cancer, starting from the time they're diagnosed through the rest of their life. This includes people still living with cancer and those who are now cancer-free. Some people may choose a different word to describe themselves.
Carcinogen: Something that can damage DNA in our cells and lead to cancer. Carcinogens can be in the air, in what we eat or drink, or in materials we use. Some examples are chemicals in tobacco, ultraviolet (UV) rays from the sun or tanning beds, and harmful substances like asbestos, radon, and air pollution.
Carcinoma: A type of cancer that starts in the cell's lining organs. Most cancers are carcinomas.
CAR T Cell Therapy: A cancer treatment where doctors take out some of a person's T cells, "reprogram" them in a lab to better fight cancer cells, and then put them back into the body. It's mostly used for blood cancers, but scientists are testing it for other types of cancer too.
Catheters: Thin tubes placed in veins to give medicine or drain fluids.
Chemotherapy: A strong medicine that attacks cancer cells or stops them from multiplying. "Chemo" works best on cells that multiply quickly, like cancer cells do. But it can also affect healthy cells that multiply fast, like hair cells. That's why people sometimes lose their hair during treatment.
Chronic Myeloid Leukemia (CML): A type of cancer where too many myeloid cells grow in the bone marrow and blood.
Clinical Trials: Research studies that test how well new medical approaches work in people.
Colonoscopy: A procedure where a doctor looks inside the colon to check for polyps or cancer.
Computerized Tomography (CT): A method that takes detailed pictures of the inside of the body using X-rays.

D

Diagnosis: Figuring out what kind of cancer someone has and whether it has spread in the body. Doctors develop a diagnosis using scans, biopsies, or other tests.
Distant Metastasis: Cancer that has spread from where it started to other parts of the body.
Dysplasia: Abnormal cells that may lead to cancer if not removed.

GLOSSARY (cont.)

E

Early Detection: Finding cancer early, which can help with treatment.
Endometrial Cancer: Cancer that starts in the lining of the uterus.
Epithelial Cells: Cells that line the surfaces of organs; many cancers start in these cells.

F

Fecal Occult Blood Test (FOBT): A test used to check for blood in poop, which can be a sign of bowel cancer.
Follicular Lymphoma: A slow-growing type of non-Hodgkin lymphoma.

G

Grading: When doctors check how abnormal cancer cells look under a microscope, to see how fast the cancer might grow.
Gleason Score: A score that helps describe how aggressive prostate cancer is to help plan treatment.

H

Hematologic Cancer: Cancers affecting blood and bone marrow, like leukemia and lymphoma.
Hormone Replacement Therapy: Hormones given to women after menopause that can increase the risk of some cancers.
Hepatitis B and C Viruses (HBV and HCV): A sickness that causes swelling in the liver. Hepatitis B and C can raise the risk of liver cancer. Hepatitis B can be prevented with a vaccine.
Hepatocellular Carcinoma: The most common type of liver cancer.

I

Immune Checkpoint Inhibitor: A medicine that helps the immune system spot and destroy cancer cells better. It works by blocking checkpoints that normally tell immune cells not to attack.
Immunotherapy: A cancer treatment that gives the superheroes of the immune system a power-up! It helps the body's defense team find and destroy cancer cells more easily.
Invasive Cancer: Cancer that has spread into nearby tissues.

K

Kaposi Sarcoma: A cancer that causes abnormal growth of blood vessels, leading to spots on the skin and other areas.
Keratinocyte Skin Cancer: A type of nonmelanoma skin cancer that starts in cells on the skin's surface.

L

Leukemia: A type of cancer that starts in the blood or bone marrow where new blood cells are made.
Leukopenia: Having low white blood cell counts.
Lumpectomy: Surgery to remove a breast lump and some surrounding tissue.
Lymph Nodes: Tiny, bean-shaped organs found throughout your body that help keep you healthy by filtering a fluid called lymph. Immune cells in the lymph nodes identify harmful cells, including cancer cells and dangerous bacteria, and destroy them or mark them for destruction by other immune cells. Also known as lymph glands.
Lymphoma: A type of cancer that starts in the lymph nodes or other part of the lymph system.
Cancer-Related Lymphedema: Swelling that happens when the lymphatic system is blocked or damaged by cancer or treatments.

M

Malignant: Another word for cancerous.
Mammography: A screening tool that uses X-rays to take pictures of the inside of the breast. It helps doctors look for early signs of breast cancer.
Margin: The normal tissue around a tumor that is removed during surgery to make sure all cancer is gone.
Mastectomy: A surgery to remove breast tissue, usually to treat or prevent breast cancer. It can help stop cancer from spreading in the body.
Medical Oncologist: A doctor who specializes in treating cancer.

GLOSSARY (cont.)

Melanoma: A serious type of skin cancer that starts in the melanocytes, cells that give the skin its color.
Menopause: The time in a woman's life when she stops having periods.
Mesothelioma: A cancer that affects the lining of the chest or abdomen, often due to asbestos exposure.
Metastasis: When cancer cells break away from where they started, travel to other parts of the body, and start causing trouble there too.
Mutation: A change in the DNA of a cell that can lead to cancer.

N
Neuroblastoma: Cancer that starts in young nerve cells, mostly affects infants and children.
Neutropenia: A low number of neutrophils, a type of white blood cell that fights infections.

P
Palliative Care: A special type of medical care that aims to improve the quality of life for people with serious diseases like cancer. It focuses on easing pain and other symptoms caused by the illness, and on relieving side effects from treatment.
Pathology Report: A report from a doctor that explains what a tissue sample shows, including the type of cancer and how severe it is.
Ports: Devices placed in the body to give medicine or take blood samples.
Prognosis: A doctor's best estimate for what may happen with a person's cancer. The doctor may mention how likely the person is to be cured, how long they may live, or the chances the cancer could come back after treatment.
PSA (Prostate Specific Antigen): A protein made by the prostate; high levels can suggest cancer.

R
Radiation Therapy: A cancer treatment that uses powerful invisible beams of radiation to destroy cancer cells. The patient doesn't feel the radiation during treatment, but side effects such as vomiting, skin changes, or feeling very tired can happen afterward.
Retinoblastoma: A rare eye cancer that affects the retina, mainly in young children.

S
Sarcoma: A type of cancer that occurs in the bones, muscles, and other connective tissues.
Stage (of a cancer): Describes how advanced the cancer is and whether it has spread from where it started.
Surgery: When a doctor makes a cut into the body to remove or fix a problem. This is a common way to remove cancers.
Systemic Therapy: Treatment that affects the whole body, usually through the bloodstream.
Targeted Therapy: A cancer medicine that zooms in on a specific characteristic of cancer cells. Targeted therapies are designed to precisely focus on cancer cells while leaving healthy cells alone.
Tumor: A group of cells that multiply and form a lump or bump in the body. Some tumors are cancer and some are not.

U
Uncontrolled Cell Growth: A sign of cancer, where cells divide and grow without control.
Ultraviolet (UV) Radiation: Rays from the sun that can damage skin and cause skin cancer.

W
Wilms Tumor: A type of kidney cancer that mostly affects children.

FACTS & FIGURES — CANCER BY THE NUMBERS

Let statistics (and maybe a little math!) help your students better understand the impact of groundbreaking cancer treatments and pioneering research on the successful movement to end cancer.

This information can be used in a variety of ways in your classroom. For example, it can serve as a **Reference Tool** for student research; as a focal point for relevant **Data Analysis** in a statistical investigation; or as the basis for student-created **Infographics** to display in your classroom or school media center.

KNOW IT: What is Cancer?

Cancer happens when some cells in the body grow too much and don't stop. These extra cells can form lumps called tumors or travel to other parts of the body.

What Are The Most Common Types Of Cancers?

These are the most common types of cancer (diagnoses per year):

- Breast cancer: About 298,000 women will get it.
- Lung cancer: About 236,000 people will get it.
- Prostate cancer: About 200,000 men will get it.
- Colorectal (colon) cancer: About 150,000 people will get it.
- Skin cancer (melanoma): About 100,000 people will get it.

Who Gets Cancer?

- Most people who get cancer are over 50 years old.
- About 1 in 2 men and 1 in 3 women in the U.S. will get cancer sometime in their lives.
- More than 17,000 children in the U.S. are diagnosed with cancer each year.

FIND IT: How do we detect cancer?

Doctors use special tests to find cancer early, including:

- **Mammograms:** A screening tool that uses X-rays to take pictures of the inside of the breast. It helps doctors look for early signs of breast cancer.
- **Colonoscopy:** A procedure where a doctor looks inside the colon to check for polyps or cancer.
- **Blood Tests:** Some cancers can be found by looking for signs of cancer in the blood.

New Ways to Find Cancer

- **Liquid Biopsies:** A blood test that looks for tiny bits of cancer cells floating in the blood. It can sometimes help detect cancer early, though it can't pinpoint exactly where it is in the body.
- **AI Imaging:** Smart computers help doctors find cancer on X-rays and other images.

TREAT IT: How do we cure cancers?

- **Immunotherapy:** A cancer treatment that gives the superheroes of the immune system a power-up! It helps the body's defense team find and destroy cancer cells more easily.
- **CAR T cell Therapy:** A cancer treatment where doctors take out some of a person's T cells, "reprogram" them in a lab to better fight cancer cells and then put them back into the body. It's mostly used for blood cancers, but scientists are testing it for other types of cancer too.
- **Clinical Trials:** Research studies that test how well new medical approaches work in people.

PREVENT IT: How can you reduce your risk?

You can make healthy choices to lower your risk. Nine ways to lower your cancer risks:

- Avoid tobacco
- Keep a healthy weight
- Skip alcohol
- Be sun safe
- Eat healthy foods
- Move your body
- Know your family history
- Get recommended screenings
- Get protective vaccines

DEFEAT IT: How can we end cancer together?

- More people are surviving cancer than ever before!
- Today, about 68 out of 100 people with cancer live at least five years. In the 1970s, 49 out of 100 people survived five years.
- Some cancers, like breast and prostate cancer, have survival rates over 90% when found early.

By learning about cancer, staying healthy, and supporting research, we can all be part of the fight to end cancer. Together.

NAME ______________________ CLASS ______________ DATE ______________

HEALTH CAREERS MATCH UP

The healthcare field offers many diverse career opportunities. Some of these might be familiar, while others could be surprising and interesting. Match each career with its main responsibilities. For further research, or for hints, check out the links to career profiles after the activity. Each profile provides a detailed job description, recommended high school courses, a "Day in the Life" schedule, and information about earning potential.

1 ____ Manages projects in the medical field, studies health data to spot future health trends, and finds ways for people to stay healthy.	A. Social Worker
2 ____ Diagnoses and treats patients, performs physical exams, and uses imaging tools to choose the best treatment.	B. Genetic Counselor
3 ____ Cares for patients directly, gives medications, and watches their recovery. Also teaches patients and their families about health.	C. Dietician/Nutritionist
4 ____ Specializes in taking blood from patients for tests, transfusions, or research.	D. Physician
5 ____ Studies disease patterns to find ways to lower risks and shares findings with local leaders and the public.	E. Physical Therapist
6 ____ Combines research and technology to organize and analyze complex medical data.	F. Pharmacist
7 ____ Works with patients on nutrition, promotes healthy eating, and helps manage diet-related health issues.	G. Nurse
8 ____ Aims to make healthcare easier to access and guides patients through the healthcare system.	H. Technician
9 ____ Tests patient samples and analyzes the results, as ordered by physicians, and communicates results to physicians to make their diagnoses.	I. Phlebotomist
10 ___ Supports individuals in dealing with and solving their personal challenges.	J. Researchers
11 ___ Evaluates the risk of inherited conditions and helps patients manage their diagnoses.	K. Epidemiologist
12 ___ Prepares and dispenses medicines correctly.	L. Bioinformatics Scientist
13 ___ Assists people with physical injuries or disabilities in healing and recovering.	M. Medical Writer
14 ___ Writes scientific documents like regulatory applications and research papers for scientists.	N. Patient Navigator

Adapted from resources available at https://www.decodingcancer.org/career-spotlight

NAME CLASS DATE

CAREER PROFILES

Pick two career paths that interest you and explain what you like about them.

- **Genetic Counselor** www.decodingcancer.org/career/genetic-counselor
- **Dietician/Nutritionist** www.decodingcancer.org/career/dietitian-nutritionist
- **Physician** www.decodingcancer.org/career/physician
- **Therapist** www.decodingcancer.org/career/therapist
- **Pharmacist** www.decodingcancer.org/career/pharmacist
- **Nurse** www.decodingcancer.org/career/nurse
- **Lab Technician or Phlebotomist** www.decodingcancer.org/career/technician
- **Researcher** www.decodingcancer.org/career/researcher
- **Epidemiologist** www.decodingcancer.org/career/epidemiologist
- **Bioinformatics Scientist** www.decodingcancer.org/career/bioinformatics-scientist
- **Medical Writer** www.decodingcancer.org/career/medical-writer

ANSWER KEY: 1.J, 2.D, 3.G, 4.I, 5.K 6.L, 7.C, 8.N, 9.H, 10.A, 11.B, 12.F, 13.E, 14.M

UNDERSTAND — CURRICULUM CORRELATIONS

We know how important it is for you to justify field trips and document how instructional time is spent outside of your classroom. Both the activities in this Teacher's Guide and the experiences your students have during their field trip to The Journey to End Cancer are correlated to the Next Generation Science Standards, Common Core State Standards for Mathematics and English Language Arts, the C3 Framework for State Social Studies Standards, the National Health Education Standards, and the National Core Arts Standards for Visual Arts.

The connections to national standards are arranged by content area and grade level to assist with your planning needs. For teachers in the Texas region, the Texas Essential Knowledge and Skills are also outlined below by grade.

NATIONAL CONTENT STANDARDS

Next Generation Science Standards

- Life Science: MS-LS1-1, MS-LS1-2, MS-LS1-3, MS-LS1-5, MS-LS3-1, MS-LS4-5
- Physical Science: MS-PS1-1, MS-PS1-3, MS-PS2-5, MS-PS4-2
- Engineering Design: MS-ETS1-1

Common Core State Standards for Mathematics

- Grade 6: CCSS.Math.Content.6.NS.B.3, CCSS.Math.Content.6.EE.A.2, CCSS.Math.Content.6.EE.B.6, CCSS.Math.Content.6.SP.A.1, CCSS.Math.Content.6.SP.B.5
- Grade 7: CCSS.Math.Content.7.NS.A.3, CCSS.Math.Content.7.EE.A.2, CCSS.Math.Content.7.EE.B.3, CCSS.Math.Content.7.SP.A.1, CCSS.Math.Content.7.SP.A.2, CCSS.Math.Content.7.SP.C.5, CCSS.Math.Content.7.SP.C.7
- Standards for Mathematical Practice: 1, 3, 4, 5, 6, 7

Common Core State Standards for English Language Arts

- Grade 6: CCSS.ELA-Literacy.RI.6.1, CCSS.ELA-Literacy.RI.6.3, CCSS.ELA-Literacy.RI.6.4, CCSS.ELA-Literacy.RI.6.7; CCSS.ELA-Literacy.SL.6.1, CCSS.ELA-Literacy.SL.6.2
- Grade 7: CCSS.ELA-Literacy.RI.7.1, CCSS.ELA-Literacy.RI.7.3, CCSS.ELA-Literacy.RI.7.4, CCSS.ELA-Literacy.RI.7.7; CCSS.ELA-Literacy.SL.7.1, CCSS.ELA-Literacy.SL.7.2
- Grade 8: CCSS.ELA-Literacy.RI.8.1, CCSS.ELA-Literacy.RI.8.3, CCSS.ELA-Literacy.RI.8.4, CCSS.ELA-Literacy.RI.8.7; CCSS.ELA-Literacy.SL.8.1, CCSS.ELA-Literacy.SL.8.2
- Grades 6-8 Literacy in History/Social Studies: CCSS.ELA-Literacy.RH.6-8.1, CCSS.ELA-Literacy.RH.6-8.4, CCSS.ELA-Literacy.RH.6-8.6, CCSS.ELA-Literacy.RH.6-8.7
- Grades 6-8 Literacy in Science & Technical Subjects: CCSS.ELA-Literacy.RST.6-8.1, CCSS.ELA-Literacy.RST.6-8.2, CCSS.ELA-Literacy.RST.6-8.3, CCSS.ELA-Literacy.RST.6-8.4, CCSS.ELA-Literacy.RST.6-8.7, CCSS.ELA-Literacy.RST.6-8.9

UNDERSTAND — CURRICULUM CORRELATIONS (cont.)

- Grades 6-8 Writing: CCSS.ELA-Literacy.WHST.6-8.2, CCSS.ELA-Literacy.WHST.6-8.4, CCSS.ELA-Literacy.WHST.6-8.6, CCSS.ELA-Literacy.WHST.6-8.7, CCSS.ELA-Literacy.WHST.6-8.8, CCSS.ELA-Literacy.WHST.6-8.9

C3 Framework for Social Studies State Standards

- Economics: D2.Eco.13.6-8
- Geography: D2.Geo.3.6-8, D2.Geo.4.6-8, D2.Geo.7.6-8, D2.Geo.10.6-8
- History: D2.His.1.6-8, D2.His.3.6-8
- National Health Education Standards: 1, 2, 5, 7

TEXAS ESSENTIAL KNOWLEDGE AND SKILLS

Grade 6

- Science: 6.2, 6.3, 6.4, 6.6, 6.13A
- Math: 6.3D, 6.3E, 6.7B, 6.7C, 6.12A, 6.12B
- ELA: 6.1, 6.2, 6.5, 6.6, 6.11, 6.12
- Social Studies: 6.4A, 6.8B, 6.13D, 6.18, 6.19, 6.20, 6.21
- Health: 6.1, 6.2

Grade 7

- Science: 7.2, 7.3, 7.4, 7.5, 7.6, 7.13
- Math: 7.3A, 7.3B, 7.6A, 7.6.B, 7.11A, 7.12A, 7.12B
- ELA: 7.1, 7.2, 7.5, 7.6, 7.11, 7.12
- Social Studies: 7.12C, 7.19C, 7.19E, 7.20, 7.21, 7.22
- Health: 7-8.1, 7-8.2, 7-8.23C, 7-8.23M

Grade 8

- Science: 8.2, 8.3, 8.4, 8.5, 8.6, 8.13A
- Math: 8.11C
- ELA: 8.1, 8.2, 8.5, 8.6, 8.11, 8.12
- Social Studies: 8.28, 8.29, 8.30
- Health: 7-8.1, 7-8.2, 7-8.23C, 7-8.23M

*TEKS for mathematics were updated in April 2012 and K-8 were implemented in the 2014-2015 school year. The TX SBOE initiated a revision process for math in the 2022-2023 school year. Adoption was scheduled for that year with implementation in the 2026-2027 school year. The adoption schedule was revised and intended to begin in the 2024-2025 school year.