

The Cell Cycle and Cancer

Lesson Topic The cell cycle and cancer

RIEL Biology Element

Attention to Language

Time Required

Two class periods

Standards Addressed

 SC.912.L.16.8 Explain the relationship between mutation, cell cycle and uncontrolled cell growth potentially resulting in cancer.

Science and Engineering Practice

- Constructing scientific explanations
- Obtaining, evaluating, & communicating information

Content Learning Objectives

 Students will assess how uncontrolled cell growth may result from mutations that affect the proteins that regulate the cell cycle and potentially cause cancer.

Lesson Summary

In this lesson, students will listen to a Ted Talk and complete a worksheet to be introduced to a case involving cancer and medical ethics. Students will then draw conclusions from various news alerts that identify potential causes of cancer and complete a table of claims using evidence. Collaboratively in small groups, students will read and annotate five resources and form summary sentences to demonstrate what they have learned.

Throughout this lesson, attention to language will support student learning. Students are given multiple opportunities to access scientific language, use scientific language, and use their home language to assess how uncontrolled cell growth resulting from mutations can potentially cause cancer. Students are engaging with this scientific language at the word, sentence and discourse level.

Students will watch the Ted Talk covering information about Henrietta Lacks and form an opinion based on this scenario regarding medical ethics. This activity will act as the anchoring phenomena to introduce cancer. the following activity, students will identify potential causes of cancer while providing evidence from various news alerts. Utilization of pictures and a word bank will help students access the scientific language needed throughout this lesson. They then will read, annotate and discuss the information from different resources in small groups in order to summarize the details about the cell cycle. Students will use the sentence stems and vocabulary definitions provided to communicate their learning.





Materials

- <u>The Immortal Cells of Henrietta Lacks Ted Talk</u>
- The Immortal Cells of Henrietta Lacks Ted Talk Worksheets
- The Cell Cycle and Cancer Packets
- Laminated Resource Cards 1-5 (1 set for each group)
- Dry Erase Markers (1 per student)
- <u>Teacher and Student Moves Grades 5-12-English</u> (wceruw.org)

Before the Activity

Students should have received instruction on mitosis and the cell cycle before instruction of this lesson which focuses on cancer. The teacher should also create a set of the laminated resource cards at the end of this document for each small group. Each group should receive 5 cards.

Lesson Activities

- 1. Engage: Ted Talk The Immortal Cells of Henrietta Lacks. As a starter or bellwork, the teacher should instruct students to complete the pre-viewing question on the Ted Talk worksheet. After students have a chance to write down their responses, answers should be shared aloud to generate conversation, and an actual example of a HIPPA form can be displayed for reference. To then introduce the concept of cancer and medical ethics, the teacher should play the Ted Talk(with subtitles and/or a live translator) and instruct students to complete the viewing questions as they watch. The video can be played twice. Important words are bolded on the worksheet. After the answers are reviewed in small groups or as a class, students should then complete the post viewing section where responses in their home language are accepted.
- 2. Explore: Cell Cycle and Cancer News Alerts. Individually, students should read the news alerts identifying potential causes of cancer seen in history. The teacher should circulate the room while providing focus to bolded words that students may not know. Using the pictures and information provided in the news alerts, students should then use the word bank to match the images to the factor that causes cancer.







Lesson Activities

- 3. Explain: Evidence Column of News Alert Table. Sentence stems are provided to guide students in the next table of the column where they must use evidence from the news alerts to support the claims associated with the factor that can cause cancer. An example is provided in the chart already. The teacher should circulate and assist students by providing feedback to their responses helping them to emphasize and clarify their writing.
- 4. Elaborate: Resource Annotation in Small Groups. Intentional grouping is now needed to have students work in groups with dry erase markers to read and annotate the five laminated resources provided to them. The teacher should go over a preferential annotation key or how to mark the text to help students understand the scientific language used regarding the cell cycle. An example is provided in the few first sentences of resource #1. As students are reading aloud each resource (their home language may be used), discussing as a group and annotating, the teacher should be circulating while listening in on small group discussion and discourse. Each group member should be responsible for reading aloud at least 1 resource so everyone's voice is heard. A recorder can be assigned to help gather the thoughts of the group when creating each summary sentence.
- 5. Evaluate. Student learning will be assessed through the creation of summary sentences that will be formed in the assigned small groups. Vocabulary definitions and sentence stems are provided to help students. Student discourse should occur to create the summary sentences and all voices should be heard. Again, students' home language can be used if necessary and translation should be provided. A recorder can be assigned each round that a resource is read.









Ted Talk: The Immortal Cells of Henrietta Lacks Worksheet

Date:

Pre-Viewing:

When you visit a Doctor you or your guardian (if you are a minor) must complete a form called the Health Insurance Portability and Accountability Act (HIPAA) Release Form which indicates who the Doctor is allowed to share medical information with. Why do you think this is necessary?

Viewing:

- 1. How do HeLa cells keep dividing while other cells die off?
 - a. HeLa ignore signals to stop dividing
 - b. HeLa ignore mutations that accumulate over generations
 - c. HeLa avoids apoptosis
 - d. All of these

2. Research with HeLa cells led to a vaccine for ______, which likely caused Henrietta's cancer.

a. Polio b. HPV c. Mumps d. HIV

- 3. A disadvantage of working with HeLa cells in a laboratory is
 - a. HeLa cells die off after a few generations.
 - b. HeLa cells do not survive well on different surfaces.
 - c. HeLa cells spread easily and can infect other cell lines.
 - d. HeLa cells are difficult to obtain.
- 4. What are some of the characteristics of cancer cells that help them avoid death? List at least three.

| a | |
|-----------------|--|
| b. | |
| с. _. | |





5. Why is it important for scientists to have a tool like HeLa cells in order to study human diseases?

Post-Viewing:

Dr. Gey took a sample of the tumor cells from Henrietta Lacks without her or her family's permission. He gave the samples of HeLa cells to labs all over the world. While Dr. Gey did not profit from HeLa cells, the Lacks family was completely unaware of Henrietta's contributions to science for decades. Do you think that what Dr. Gey did was ethical? Do you think this type of situation would happen today? Why or why not? Your answer should be at least 1 paragraph (5-7 sentences) long.

For more information or further reading, check out the book The Immortal Life of Henrietta Lacks by Rebecca Skloot.











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Packet

Directions: Read the news alerts below and use the information provided along with the word bank to complete the table. Sentence stems and an example are given to assist you.

Date:

#1 Dr. Percivall Pott London, 1775

plog

I've been studying the various forms of cancer that plague our society. It has come to my attention that people who have certain occupations have higher frequencies of certain types of cancer than the general public. In particular, chimney sweeps have a high rate of cancer of the scrotum. Young boys entered this profession because they were able to squeeze down narrow chimneys. Once inside the chimneys, they spent hours scraping them clean of the accumulated tars that otherwise would cause disastrous chimney fires. Sweeps are continually covered with flu tar and dust, and because the young men likely do not bathe regularly, this dust remains trapped in the folds of the skin. I believe that some agent in the coal tar, when exposed to the scrotum across many years, actually causes this disease.



#2 Dr. Hilario de Gouvea Brazil, 1886

Today I would like to present a most curious case. It may shed light on an aspect of cancer about which we know little. Fourteen years ago, a man brought his two year old son in for treatment of retinoblastoma, a very rare form of cancer that develops within the eye, often of young children. If untreated, the cancer travels up the optic nerve until it reaches the brain and spreads throughout the body. I removed the tumor, and the boy was completely cured. He got married and had seven children. Curiously two of his girls developed retinoblastoma in both eyes. The parents refused treatment, and both girls died within several months. Here a form of cancer that normally occurs once in every 20,000 children has occurred three times in one family. I believe this represents evidence that susceptibility to cancer can be transmitted from parents to children, just like hair or eye color.





#3 X-Ray Technician New York, 1902

X-rays are the marvel of modern science. These powerful yet invisible rays permit us to see the inner workings of the body and provide treatments that we are just beginning to understand. Let technicians be warned however, these rays, while capable of doing great good, can also do great harm. We have noticed a high rate of skin cancer among technicians who use their hands to focus the energized machine. Patients are exposed only briefly to these rays. Technicians, on the other hand, work on these machines all day long and have many hours of exposure. Our advice is to keep the machine off while adjusting it and even go to the next room when it is time to energize it.



#4 News Reporter

Miami, 1945

Now that the war is over, Americans are ready to relax and enjoy their freedom. What better place to recuperate than at the beach? Women have cast aside the Victorian fashions of yesteryear and have adopted the new, sleet, trimmed down swimsuit. Some bathers say the more skin, the better. Be warned, however, that all this skin and sun can lead to painful burns. In fact, now doctors are warning of a possible connection between the sun's rays and skin cancer. Perhaps the unseen ultraviolet rays that fade our clothes can also damage skin and lead to deadly disease. Maybe a healthy tan is not so healthy after all.











Word Bank:

X-Ray, Radiation Exposure, Your Family History, UV Light, Chimney, Chemical Poisons, Tanning, Family Tree

| Image | Factor that Causes Cancer | Evidence from the News Alert |
|------------|------------------------------|---|
| | | (Observations or examples from the news alerts that support your claim) |
| 1. Chimney | 2. Chemical Poisons | I can conclude that |
| | | because |
| 3. | 4. | Based on |
| | | I think that |
| 5. | 6. | I know that |
| 7. | 8. | I believe |







Directions: In your small groups, read and annotate each of the five resource cards with your dry erase markers. Discuss the information each resource presents and form a one-sentence statement that summarizes what you have learned.

Resource #1

Cancer involves...

Resource #2

Cell division normally is...

Resource #3

Cell cycle regulation is accomplished by...

Resource #4

Cancer-causing agents often...

Resource #5

When damage occurs to genes that regulate the cell cycle...

Vocabulary Words:

- Mutation- an alteration (permanent change) in the genetic material of a cell
- Proto-Oncogene- a type of gene that codes for proteins that are responsible for regulating (speeding up) cell division. Mutations (mistakes) in the DNA code of these genes can impair their ability to regulate cell division, leading to uncontrolled cell growth and cancer. When protooncogenes are mutated, they are called oncogenes.
 - Prefixes: Proto= first or earliest form Onco=cancer
- Tumor suppressor gene- A type of gene that codes for proteins that are responsible for controlling (slowing down) the speed of cell division. Mutations (mistakes) in the DNA code of these genes can impair their ability to control cell division, leading to uncontrolled cell growth and cancer.







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Annotation Key

Date:

CIRCLE vocabulary words you do not know.
SQUARE science vocabulary words you do know.
<u>UNDERLINE</u> key points that support the main idea.
STAR* anything that is important.
QUESTION MARK? information you are confused about.
WRITE comments in the margins.

Resource #1

The rate and timing of **cell division** in your body normally are very precisely regulated. Cells are formed, mature, and eventually die. As this happens, new cells divide, creating replacement cells. Chemical messengers that pass between neighboring cells help keep the rate of cell division equal to the rate of cell death. Sometimes, a cell breaks free from its normal restraints and begins to follow its own pattern of cell division. This pre-cancerous cell divides more often than normal, eventually producing a mass of cells that also divide more often. Further changes in these cells can increase the frequency of cell division even more, until eventually a cancerous **tumor** develops. At this point, the tumor grows large but is confined to the tissue where it originated. Late in the development of cancer, some cells may gain the ability to move into blood vessels and travel to other parts of the body.





For many years, it was a mystery to scientists how cells controlled their cell division. Scientists now know that the chemical messages that cells receive from neighboring cells affect a complicated group of molecules in the cell. These molecules are called the cell cycle clock. The cell cycle clock integrates the mixture of signals the cell receives from its neighbors and determines whether the cell should move through each stage of growth and division. If the answer is yes, the cell grows and divides. The cell cycle is composed of four phases. In the G1 phase, the cell increases in size and prepares to copy its DNA. Once all the necessary molecules are made, the clock moves the cell to the S phase called S for "synthesis." This is when the cell copies its DNA. After the DNA is copied, a second gap phase called G2 occurs, and then the cell divides. The phase in which the cell divides is called M, for **mitosis**. The new daughter cells immediately enter G1. Depending on the signals they receive from neighboring cells and the decisions their cell cycle clocks make, they may go through the cell cycle again or stop cycling temporarily or permanently. Thus, in normal tissues, cell growth and division is precisely controlled by internal clocks.







Two types of genes play a major role in regulating the cell cycle. Genes called proto-oncogenes encourage cell division. Proteins produced by genes act like accelerators, stimulating the cell to grow and divide. In contrast, genes called tumor suppressor genes inhibit cell division. Proteins produced by these genes act like brakes to slow down or stop cell division. The balance between the activities of proto-oncogenes and tumor suppressor genes keeps normal cells dividing at a rate that is appropriate for their position and role in the body.







An important milestone in scientists' efforts to understand cancer came in the 1970s when it was shown that many cancer-causing agents also are able to cause changes in DNA that we call **mutations.** In fact, research showed that in many cases, chemicals that are powerful cancer-causing agents also are powerful mutagens. Mutagens are agents that produce mutations. It was found in a study that chemicals that had only a weak ability to stimulate the development of cancer, were also considered weak mutagens. We now know that some cancer-causing agents do not fit this simple pattern but the fact that many cancer-causing agents also cause mutations gave scientists an important clue about what might cause cells to become cancerous.







Normal cell division in the body depends on a precisely regulated set of events that determine when a cell will divide and when it will not divide. Two types of genes, called proto-oncogenes and tumor suppressor genes, are responsible for this regulation.

When mutated, however, proto-oncogenes can become what scientists call "oncogenes", genes that stimulate excessive division. This situation is similar to getting a car's accelerator stuck in the downward position. A cell that experiences such mutations tends to divide more frequently than it normally would. In contrast, mutated tumor suppressor genes can become inactive. A cell that experiences a mutation in a tumor suppressor gene loses some of its crucial breaking power. Again, the result is a tendency for the cell to divide more frequently than it normally would. For a cancerous tumor to develop, mutations must occur in several of the cells division controlling genes. These mutations disturb the balance that normally exist between signals that stimulate cell division and signals that inhibit cell division. The result is uncontrolled division.





