The Cell Cycle

Educator Information and Directions

The activities and resources in this PDF are designed to support student understanding of the concepts covered in our video "The Cell Cycle" in the *Life Science* course.

The following materials are included in this PDF:

- "The Cell Cycle" Vocabulary List
- "The Cell Cycle" Lesson Notes
- Drawing the Cell Cycle! Activity
- Cell Cycle Lab
- Cancer Treatment Reading Assignment

We recommend printing this packet prior to your student watching the video so that they can follow along with the guided notes, which they can then use when answering practice questions.

Please use the Student Directions on this page as a guide only and modify the pacing and instructional materials as needed.

Suggested Gold/$coops:
For guided notes, it is recommended that instructors award 50 Gold/$coops for each completed page. For most activities, 25 Gold/$coops are recommended for each correctly answered question. For larger projects, instructors may choose to reward a total of 200 to 500 Gold/$coops based on effort and creativity. Ideas for bonus Gold/$coops may also be noted.

Student Directions

Student Checklist

Day 1:
- ❑ Make sure you've downloaded or printed the notes for this lesson.
- ❑ Watch the video, taking notes and following the prompts.
- ❑ Complete Level 1 of the online practice.

Day 2:
- ❑ Complete the Drawing the Cell Cycle! Activity.
- ❑ Complete Level 2 of the online practice.

Day 3:
- ❑ Complete the Cell Cycle Lab.
- ❑ Complete Level 3 of the online practice.

Day 4:
- ❑ Complete the Cancer Treatment Reading Assignment.
- ❑ Complete Level 4 of the online practice.

Day 5:
- ❑ Complete the online assessment.

The Cell Cycle Vocabulary Review

Please review these key terms to develop a better understanding of this lesson.

1. **The cell cycle -** a process by which cells grow and divide to create new cells
2. **G1 -** the phase of the cell cycle where cells grow and prepare to divide
3. **S -** the phase of the cell cycle where cells synthesize, or create, an identical copy of their DNA
4. **DNA** - the genetic blueprint, or instructions, for our cells
5. **G2 -** the phase of the cell cycle where cells continue to grow and make final preparations to divide
6. **Mitosis -** the phase of the cell cycle where a cell actively divides into two identical cells
7. **Cytokinesis -** a process by which a cell pinches together in the middle to separate into two individual cells
8. **G0 -** a state where cells perform their normal functions without preparing to divide
9. **Cancer -** a disease characterized by uncontrolled cell growth

The Cell Cycle Guided Notes

Instructions: Download and print this PDF to complete while watching the *Cellular Metabolism* teaching video. Fill in each of the blanks with the appropriate word or phrase. It's okay to pause the video when it's time to write.

Objective:

By the end of this lesson, students will be able to define and recognize the steps of the cell cycle, explain how the cell cycle is important to living things, and describe a few of its limitations.

The Cell Cycle Overview

1. The cell cycle is a process by which cells _____ and _____ to create new cells, typically with the goal of replacing cells that are worn out or damaged.

2. Think about a time when you've bruised or scraped your skin. The injury is the result of damaged_____, and the cell cycle makes _____ of healthy cells to replace the damaged ones.

3. It is called a _____ because this process is constantly repeating itself to keep you healthy. Cells are born from the division of other cells, and then eventually, those cells _____ and create more new cells.

Pause and Reflect!

How does the cell cycle affect you?

Phases of the Cell Cycle — G, S, and G2

4. The cell cycle has _____ distinct phases, and the first we will discuss is G1. G1, or the first gap phase, is the phase of the cell cycle where cells _____ and prepare to divide.

5. If cells just divided in half without _____, we'd end up with tiny and ineffective cells.

6. Because of this, cells in G1 are essentially "_____ _____ _____" as they prepare for division, building a whole new set of organelles, or working parts, and doubling their cytoplasm.

7. This can take up to ____ hours, making G1 the most time consuming phase of the cell cycle.

8. Next, the cell enters the ____ phase. In this phase, cells synthesize, or _____, an identical copy of their DNA.

9. Remember, DNA is the genetic _____ of our cells, so S is essentially making a _____ of this blueprint so both future cells will have instructions that tell them what to do.

10. From here, we move into G2, or gap 2, which is the phase of the cell cycle where cells continue to _____ and make final preparations to _____.

Pause and Reflect!

How is each phase discussed so far important to the cell cycle?

Mitosis

11. Once the cell has decided that everything is just right for division, the cell enters the final stage, M, or _____.

12. Mitosis is the phase of the cell cycle where a cell _____ _____into two identical cells.

13. In this process, the nuclear envelope, or protective barrier surrounding the nucleus, _____, and the cell's two identical sets of DNA are lined up in the _____ of the cell by specialized organelles called centrosomes.

14. The centrosomes then _____ the two sets of _____ to opposite sides of the cell. Once there is an identical set of DNA on each side, two nuclear envelopes _____ around them, creating two identical nuclei.

15. Finally, in a process called cytokinesis, the cell _____ together in the middle to separate into two individual cells.

16. All of this typically happens in roughly _____ hours. From start to finish, most cells in your body complete the entire cell cycle in about _____ hours.

Pause and Reflect!

Why is mitosis important to the cell cycle?

_____

_____

_____

G0 and Cancer

17. Okay, so in just one day, we've made two new cells out of an existing one — now what? Well, it depends. If you still need more _____ to replace old ones, or you're just a growing teenager, these two new cells might immediately enter the _____ _____all over again to fill that need.

18. However, if division is no longer required, these new cells will _____ the cell cycle and hang out in a phase called _____ .

19. G0 is a state where cells perform their_____ _____without preparing to divide. From here, they can easily enter the cell cycle again when __._____

20. Sometimes, however, cells _____their cue to exit the cell cycle. This leads to a very serious disease called cancer, which is uncontrolled _____ _____.

21. When this occurs in solid tissue like organs or bones, tumors form, which are masses of _____ _____ cells that can impede normal function in the body.

22. Studying the cell cycle has helped scientists understand more about this disease, which has led to a broader range of _____ options for _____ patients.

Pause and Reflect!

What is G0, and why is it important to the cell cycle?

The Cell Cycle and Aging

23. Whenever our cells copy our _____, they don't always copy this information perfectly. As a result, _____ in our DNA occur over time, compounding as we get older.

24. Our skin starts to _____, our muscles lose their _____, and our organs become less effective at their respective jobs.

25. These are all unfortunate _____ _____of relying on the cell cycle for a lifetime. Of course, without it, we wouldn't live long enough to _____ much in the first place.

Pause and Reflect!

What are two major limitations of the cell cycle, and what are they caused by?

Define the cell cycle in your own words, and describe why it is important.

Drawing the Cell Cycle! Activity

Redefine It!

Write the definition of the cell cycle and its purpose in your own words below.

Draw It!

In the space below, draw what a cell looks like during G1 phase as compared to G0. Then, write the definition of each of these processes in your own words below your pictures.

Draw It!

In the space below, draw what a cell looks like during the S phase. Then, write the definition of the S phase in your own words below your picture.

In the space below, draw what a cell looks like during mitosis. For this process, you'll have to draw more than one cell! Then write the basic steps of mitosis below your pictures.

Draw It!

In the space below, draw what a cell looks like during cytokinesis. Then, write the definition of cytokinesis in your own words below your picture.

How is the cell cycle affecting you right now? How do you know that the cell cycle is taking place?

The Cell Cycle Lab

Lab Materials List:

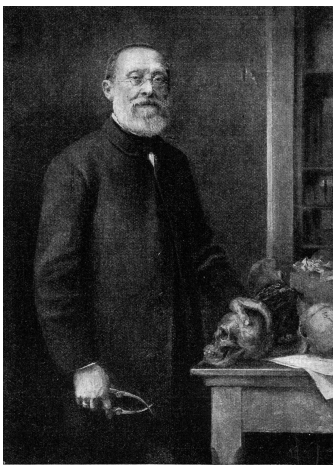
- This is a virtual lab, so all you need is yourself!

Important Note: A full list of materials needed for Unit 3 labs may be found in the compiled PDF document at the beginning of this Unit.

Overview/Observations:

When **Rudolf Virchow** first observed cells dividing under a microscope in the 1850s, it helped form the basis of **cell theory**, which is the framework for how scientists understand cells today. Over 20 years later, another scientist, **Walther Flemming**, observed and painstakingly detailed the intricate steps of cell division and mitosis.

Today, we will be following in the footsteps of these famous scientists and observing our own cells under a (virtual) microscope.



Rudolf Virchow

For each of the following **scenarios**, you will be given a brief description of where the cells came from and create a **hypothesis**, or educated guess, as to which phase of the cell cycle they will be in. You will then **observe** these cells under a microscope and form a **conclusion** based on what you find! Are you ready? Let's get started!

Sample 1 Hypothesis:

It has been about four hours since Sample 1 received a chemical signal to enter into the cell cycle. Which phase of the cell cycle do you think this cell is currently in? Write your **hypothesis** below, and explain your reasoning.

Sample 1 Observation:

Scan the QR code below to access the virtual microscope and observe the sample:

For easiest access, open this page on a computer and click the QR code at the left. You can also scan the code here.

Sample 1 Conclusion:

Was your hypothesis correct? Based on what you observed, which phase of the cell cycle was Sample 1 in, and how do you know? Write your **conclusion** below.

Sample 2 Hypothesis:

It has been about 23 hours since this Sample 2 received a chemical signal to enter into the cell cycle, but it has not split into two completely separate cells yet. Which phase of the cell cycle do you think this cell is currently in? Write your **hypothesis** below, and explain your reasoning.

Sample 2 Observation:

Observe Sample 2 under the virtual microscope.

Sample 2 Conclusion:

Was your hypothesis correct? Based on what you observed, which phase of the cell cycle was Sample 2 in, and how do you know? Write your **conclusion** below.

Sample 3 Hypothesis:

It has been about 11 hours since this cell received a chemical signal to enter into the cell cycle, and it has stopped focusing on growing at this point. Which phase of the cell cycle do you think this cell is currently in? Write your **hypothesis** below. and explain your reasoning.

Sample 3 Observation and Conclusion:

Observe Sample 3. Was your hypothesis correct? Based on what you observed, which phase of the cell cycle was Sample 3 in and why? Write your **conclusion** below.

Sample 4 Hypothesis:

It has been about 24 hours since this cell received a chemical signal to enter into the cell cycle, and it has already formed two identical nuclei on opposite sides of the cell. Which part of the cell cycle do you think this cell is currently in? Write your **hypothesis** below, and explain your reasoning.

Sample 4 Observation and Conclusion:

Observe Sample 4. Was your hypothesis correct? Based on what you observed, which part of the cell cycle was Sample 4 in, and why? Write your **conclusion** below.

Pause and Reflect!

Did the cells in various phases of the cell cycle look the way you expected? What did you learn from observing “real” cells under the microscope?

Cancer Treatment

Read It!

Read the article below, and answer the questions on the following page.

When an error happens in computer code, it can wreak havoc on a network or an individual computer. The code tells the computer what to do, and if that code is compromised, it can prevent the computer from working the way it is intended. The same is true with the DNA in our cells. This is the code that tells our cells what to do, and when it becomes compromised, the function of our cells becomes compromised as well.

Cancer occurs when cells miss their cue to exit the cell cycle. But why do they miss this cue in the first place? This breakdown in communication is typically the result of errors that occur when DNA is copied during the cell cycle. If parts of DNA that allow cells to effectively communicate and cooperate with their neighbors stop working, these cells start acting more independently — almost like they aren't a part of the rest of the body anymore. They hog up resources and don't stop dividing when they are supposed to. Essentially, cancer cells act selfishly and become an enemy of the organism they were once a cooperating part of.

Studying the cell cycle has enabled scientists to identify parts of DNA that help ensure that cells remain cooperative with other cells while dividing. By researching how to assist or strengthen our bodies' natural defenses against cancer, scientists are developing promising new preventative measures and treatment options for this disease. For this reason, cancer research is a prime example of how using the scientific method in a thoughtful and targeted way can positively impact the lives of millions of people.

Cancer Treatment Questions

Practice!

Using the article on the previous page, answer the following questions.

How is DNA similar to a computer code?

What is cancer, and how does it occur?

What helpful information have scientists been able to discover from studying the cell cycle? How can this information be used to prevent and treat cancer?

Keeping what you know about aging and the information from this article in mind, what are some similarities between aging and cancer?