

Wound Healing and Cell Regeneration

Unit: Cells and Cellular Process	Utah SEEd Standard / NGSS Performance Expectation: Standard BIO.2.5 Construct an explanation about the role of mitosis in the production, growth, and maintenance of systems within complex organisms. Emphasize the major events of the cell cycle, including cell growth and DNA replication, separation of chromosomes, and separation of cell contents. (LS1.B)	Time: 2-3 class periods
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Access to all materials for this lesson: <https://byu.box.com/s/9w3yq0vsclhjywy6a3e0qfxvbp7ilh>






Anchor Phenomenon	Wound healing through the process of Mitosis/cell regeneration. (Relating this to animals/plants)
Driving Question(s)	How do wounds heal? Why do cells divide? When do cells divide?
Performance Task	Students will use a stop-motion model to show the phases of the cell cycle and how it is used to heal wounds (repair) or regenerate structures.



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Lesson Summary: In this lesson, students will understand the cell cycle. They will use stop-motion animation to model the cell cycle and then use their learning to explain how wounds heal or regenerate.

	Time	Guiding Question / Learning Objective	How are students answering the guiding question or meeting the learning objective?
 Engage	15 min	What is the role of the cell cycle in the production, growth, and maintenance of a system? Students will create a model to demonstrate the growth and division of cells and then explain how an organism uses the cell cycle to heal wounds or regenerate tissue.	Video Personal Experiences/Student Experiences Diagram
 Explore	20 min	Show a time-lapse video of a wound healing. Use this video to elicit discussion from the students as to the process that is taking place.	Slideshow Hand Signals Handouts
 Explain	25 min	Use Cell Cycle slides to introduce students to the cell cycle. Students will use guided notes for information on creating a model to explain the cell cycle.	Cell Cycle Storyboard
 Elaborate	Day 2 Whole class	Students will create a storyboard explaining the cell cycle steps: G1, S, G2, Prophase, Metaphase, Anaphase, Telophase, and Cytokinesis. Students have guided notes and the cell cycle article as a reference.	Stop-Motion Animation
 Evaluate	Day 3 Whole class	Students will create a stop-motion model of the cell cycle based on their storyboard.	Wound Repair Limb Regeneration Cancer

Three Dimensions Focused on in This Lesson		
<p>Disciplinary Core Idea: NGSS Appendix E LS1.B Growth and division of cells in organisms occurs by mitosis and differentiation for specific cell types.</p>	<p>Science and Engineering Practices: NGSS Appendix F <u>Developing and Using Models:</u> Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system.</p>	<p>Crosscutting Concept: NGSS Appendix G <u>Systems and System Models:</u> In grades 9-12, students can investigate or analyze a system by defining its boundaries and initial conditions, as well as its inputs and outputs. They can use models (e.g., physical, mathematical, computer models) to simulate the flow of energy, matter, and interactions within and between systems at different scales. They can also use models and simulations to predict the behavior of a system, and recognize that these predictions have limited precision and reliability due to the assumptions and approximations inherent in the models. They can also design systems to do specific tasks.</p>
<p>Learning Objectives</p> <ol style="list-style-type: none"> Using information from the cell cycle, students will create a model that demonstrates growth and division of cells. They will use this model to demonstrate understanding of cancer growth and how wounds heal/regenerate. 		
<p>Related Knowledge and Skills from Prior Grades:</p> <ul style="list-style-type: none"> <i>Prior to using this lesson, it is important to review with your students cell structure and organization.</i> 		
<p>Disciplinary Core Idea: NGSS Appendix E <ul style="list-style-type: none"> All living things are made up of cells. In organisms, cells work together to form </p>	<p>Science and Engineering Practices: NGSS Appendix F <ul style="list-style-type: none"> Develop or modify a model— based on evidence – to match what happens if a </p>	<p>Crosscutting Concept: NGSS Appendix G In grades 6-8, students can understand that systems may interact with other systems; they</p>

<p>tissues and organs specialized for particular bodily functions.</p> <ul style="list-style-type: none"> Animals engage in behaviors that increase the odds of reproduction. An organism's growth is affected by both genetic and environmental factors. 	<p>variable or component of a system is changed.</p> <ul style="list-style-type: none"> Develop and/or use a model to predict and/or describe phenomena 	<p>may have sub-systems and be a part of larger complex systems. They can use models to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. They can also learn that models are limited in that they only represent certain aspects of the system under study.</p>
Connections to Mathematics and ELA/Literacy Standards		
<p>ELA/Literacy Standards:</p> <p>SL.11-12.5: Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.</p>		<p>Mathematics Standards:</p> <p>N/A</p>

Materials		
Handouts	Lab Supplies	Other Resources
Understanding the Wound Healing Process Cell Cycle Story Board Student Animation Example	Their Story Color Pencils Clay iPad/Phone (Stop Motion app: StopMotionGIF , Google.doc, Word, PowerPoint)	Power Point Wound Healing Video Guided Notes Grading rubric



ENGAGE

What is the role of the cell cycle in the production, growth, and maintenance of a system? Students will create a model to demonstrate the growth and division of cells and then explain how an organism uses the cell cycle to heal wounds or regenerate tissue. Students will be introduced to the [cell cycle process through class discussion](#). They will develop a [model of the cell cycle using stop-motion animation](#). They will show how a [system is affected by the cell cycle by modeling how wounds heal or regenerate](#).

[Phenomenon](#) – Time lapse video of wound healing (To make this video more enriching, show at normal speed, then slow down the playback speed to 0.25 normal speed.)

****Teacher Share Personal Experience****

Teacher asks: “Have any of you ever had an injury that took time to heal?”
 “If so, what was happening at the cellular level?”
 “Draw a diagram of what you think happens. Share with your partner.”

Click on the gear at the bottom of the video to adjust the playback speed.

EXPLORE

What is the role of the cell cycle in the production, growth, and maintenance of a system? Students will create a model to demonstrate the growth and division of cells and then explain how an organism uses the cell cycle to heal wounds or regenerate tissue. Students will be introduced to the [cell cycle process through class discussion](#). They will develop a [model of the cell cycle using stop-motion animation](#). They will show how a [system is affected by the cell cycle by modeling how wounds heal or regenerate](#).

[Power Point](#)- Present the information inside of the PowerPoint. Be sure to give students enough time to write in the info needed for the PowerPoint. Watch for facial expressions and hands being raised asking for help.

Objectives- Be sure to explain the objectives to the students so that they know what the goals are for the lesson.

[Wound Healing Time Lapse](#)- Play video 2x, first time regular speed. 2nd time play video at 0.25 speed. (Share some kind of personal experience with a wound to make it more personal and get the students thinking about how they have seen this in their own lives)

Cell Cycle- Mention the 3 phases of the cell cycle. [Interphase, Mitosis, and Cytokinesis](#)

- Make sure students have access to “[Guided Notes](#)”
- The main purpose here is to give students resources to enable them to build a model of the cell cycle.

Hand Gestures to remember PMAT

You can use a pop quiz of what each section is after teaching the hand signals to make sure students know how they go together.



Interphase- The cell spends the majority of its life in interphase. G1= cell growth, S phase= DNA Synthesis, G2- Cell Growth

Mitosis- 4 stages, Prophase, Metaphase, Anaphase, Telophase (PMAT)

Prophase- Chromosomes coil, nuclear membrane dissolves, and spindle fibers appear

Metaphase- Chromosomes align down the centromere and spindle fibers attach to chromosomes

Anaphase- Spindle Fibers pull apart chromosomes and turning them into chromatid

Telophase- Nuclear Membrane reappears chromosomes uncoil, Spindle fibers break down, and cell begins to separate.

Cytokinesis- The cells completely split into 2 new cells with their own organelles and cytoplasm

Upon completion of presentation do a formative assessment while the cell cycle is fresh on their minds.

Ex. Popcorn, Kahoot, Football etc. . . .

Stop-Motion Activity- Have students start by making a storyboard; give them all of the materials needed for this assignment.



Prophase



Metaphase



Anaphase



Telophase

EXPLAIN

What is the role of the cell cycle in the production, growth, and maintenance of a system? Students will create a model to demonstrate the growth and division of cells and then explain how an organism uses the cell cycle to heal wounds or regenerate tissue. Students will be introduced to the [cell cycle process through class discussion](#). They will develop a [model of the cell cycle using stop-motion animation](#). They will show how a [system is affected by the cell cycle by modeling how wounds heal or regenerate](#).

- Have students sit in partner groups. The teacher can decide if they want to choose the partnerships or allow students to choose their partner
- At this point, students will be asked to take the information they have been given on the cell cycle and create a stop-motion model of the cell cycle.
- Give a copy of [The Cell Cycle](#) handout to each student. This handout is a reference for students to use when creating their storyboards (see next bullet).
- Give a copy of the [Storyboard](#) handout to each student. Students will use this handout to create a rough draft of their stop-motion model of the cell cycle. Remind students to use their Guided Notes as a reference for the rough draft. Emphasize that not only are they to draw a diagram of each stage of the cell cycle, but they also need to label the diagram and write a short explanation of what the diagram represents.
- A group of two students working together fits this activity the best.
- Students work together, but each student should make a storyboard.
- As a teacher, it is very important for you to roam the room to make corrections and/or suggestions to students' drawings.
- You do have the option to show the class the [Student Animation Example](#). However, it is recommended that they work on the storyboard based on the information they have before showing the example.

Formative Assessment:

This storyboard is to act as a formative assessment, and the explanations must be correct for them to move on to the next section.

ELABORATE

What is the role of the cell cycle in the production, growth, and maintenance of a system? Students will create a model to demonstrate the growth and division of cells and then explain how an organism uses the cell cycle to heal wounds or regenerate tissue. Students will be introduced to the **cell cycle process through class discussion**. They will develop a **model of the cell cycle using stop-motion animation**. They will show how a **system is affected by the cell cycle by modeling how wounds heal or regenerate**.

Plan for this portion of the lesson to take 1-2 class periods depending on the materials used.

Stop Motion:

Based on the Storyboard rough draft, students will create a stop motion document/video to model the cell cycle. Students will be expected to G1, S, and G2 of Interphase, Prophase, Metaphase, Anaphase, and Telophase of mitosis and cytokinesis. Students will need to show the interworking of the cell and how in each phase, there is a change in size, number, and shape.

The teacher has the autonomy to choose how this is accomplished

***Cell Cycle Stop Motion MUST-HAVES

You are required to have at least 10 animations of the cell cycle, as listed below.

- A cell. The cell must include cytoplasm, 4 organelles, a nucleus, and DNA.
- Cell in G1 phase.
- Cell in S phase.
- Cell in G2 phase.
- Cell in Mitosis – Prophase.
- Cell in Mitosis - Metaphase
- Cell in Mitosis - Anaphase
- Cell in Mitosis - Telophase
- Cell in Cytokinesis
- Two daughter cells, indicating the completion of the cell cycle

After going through the stages of the cell cycle, use a “Popcorn Review” to go through and review the stages of the cell cycle.

- The stop-motion activity can include drawing, clay, household objects, or anything the teacher or student feels appropriate.
- As a teacher, it is very important for you to roam the room to make corrections and/or suggestions to student work.
- Some options to create the stop motion are:
 - Students use a phone to take pictures and then transfer them to google slides
 - App called Stop motion gif

EVALUATE

What is the role of the cell cycle in the production, growth, and maintenance of a system? Students will create a model to demonstrate the growth and division of cells and then explain how an organism uses the cell cycle to heal wounds or regenerate tissue. Students will be introduced to the **cell cycle process through class discussion**. They will develop a **model of the cell cycle using stop-motion animation**. They will show how a **system is affected by the cell cycle by modeling how wounds heal or regenerate**.

Before beginning, display some student photos from stop motion animations for a formative assessment. Show students the photos and have them determine which stage of the cell cycle it represents.

Before proceeding, use the models, what they have learned about the cell cycle and the anchoring phenomenon to answer the driving questions:

- How do wounds heal?
- Why do cells divide?
- When do cells divide?

Students will use their storyboard and stop motion models to help them connect the process of the cell cycle to how injuries heal.

Cell Repair vs. Cell Regeneration – Compare and contrast the differences between how Axolotls and humans recover from injury. Watch both videos that are linked to the PowerPoint.

Go back to the power point and start on slide 19. Use the video on the Axolotl and Cell Repair to get students thinking about how the model they built has real-world applications.

Distribute the “[Making Connections](#)” handout*. Students will need to incorporate information and processes from their models to help them elaborate on the overall system. Each student will submit for evaluation an individual response to the prompts, but they will collaborate with their partner as they explore and draw conclusions from their models.

* Teachers can change the form of submission for the prompts on the handout based on need (e.g., audio, video, or oral responses).

POSSIBLE EXTENSION / ALTERNATIVE ADAPTATIONS

Extensions:

[Regeneration: What the axolotl can teach us about regrowing human limbs](#)

[Wound Healing Process handout](#)

What happens when the cell cycle goes wrong? (Use this as a research prompt for a student that needs something extra)

Adaptations:

[Mitosis/Meiosis Frayer's Vocab](#)

Teachers can change the form of submission for the prompts on the handout based on need (e.g., audio, video, or oral responses).

ASSESSMENT MATRIX

This matrix supports three-dimensional assessment across this 5E instructional sequence. For each E phase, list the artifacts/strategies that provide evidence of what students know and can do as they work towards proficiency. These formative assessment opportunities should be used to track student progress. The dimensions that are reflected in the Evaluate are the ones that can be assessed summatively at the end of this 5E plan. Make sure these Make sure to call out these connections in the lesson above so they are explicitly addressed.

	Engage	Explore/Explain	Elaborate	Evaluate
DCI	X	X	X	X
SEP		X	X	
CCC		X	X	

This lesson was developed by: Jens Andreasen, Bryan Holder, Kelly Peterson, & Thomas Wilder



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