Student Name: _____

Biology STAAR Review Practice

Week of 3/23-2020-3/27/2020

Reporting Category 1:

Cell Structure and Function

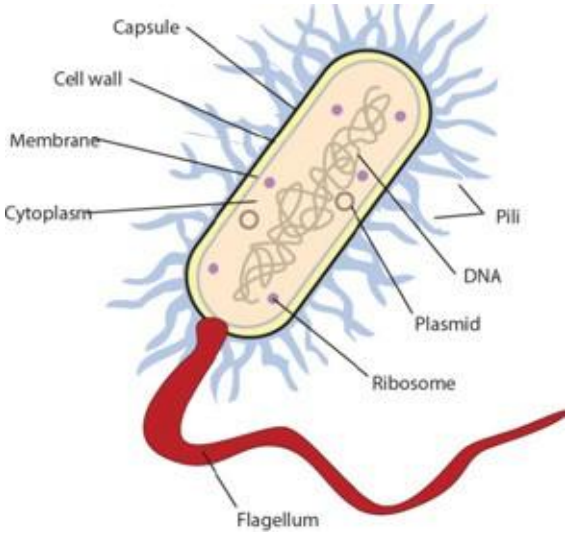
Day	Objective/TEKS	Agenda
1	TEKS 4.A (S): compare and contrast prokaryotic and eukaryotic cells, including their complexity, and compare and contrast scientific explanations for cellular complexity	1. Watch this video: Prokaryotic vs. Eukaryotic https://youtu.be/1693bWSSYiY 2. Read: Prokaryotic vs. Eukaryotic Cells. While you read, complete Linking Literacy: Categorize Cut and Paste 3. Guided Practice: Prokaryotic vs. Eukaryotic Cells 4. Writing in Science: Prokaryotic vs. Eukaryotic Cells 5. STAAR Tune-Up: Prokaryotic vs. Eukaryotic Cells 6. Assessment: Prokaryotic vs. Eukaryotic Cells

Prokaryotic and Eukaryotic Cells

Reflect

Think for a moment about all the living things on Earth. There is great diversity among organisms, from microscopic bacteria to massive blue whales, the largest animals on the planet. Despite the tremendous variety of life, all organisms have something in common—they are all made of cells. Some organisms are **unicellular**, composed of just a single cell. Other organisms are **multicellular**, composed of more than one cell. In fact, the human body is made of about 100 trillion cells!

Although different cells can perform specific functions, all cells can be divided into two large categories. What do you think these categories might be? What are the characteristics of the cells in each category?



In addition to the structures shown, prokaryotic cells contain a central area around the DNA called the nucleoid.

Structure and Function of Prokaryotic and Eukaryotic Cells

The two categories of cells are prokaryotic cells and eukaryotic cells. A **prokaryotic cell** is a simple cell that does not contain a nucleus or other membrane-bound organelles.

A prokaryotic cell is typically defined by its shape, which may be rodlike, spherical, or spiral. Prokaryotic cells are unicellular organisms, bacteria, and **archaea**. Although they lack membrane-bound organelles, prokaryotic cells have some or all of the structures referenced in the table below. Can you locate each structure in the diagram at the top right of the page?

archaea:
single-celled organisms that sometimes live in extremely harsh environments, such as hot springs and salt lakes

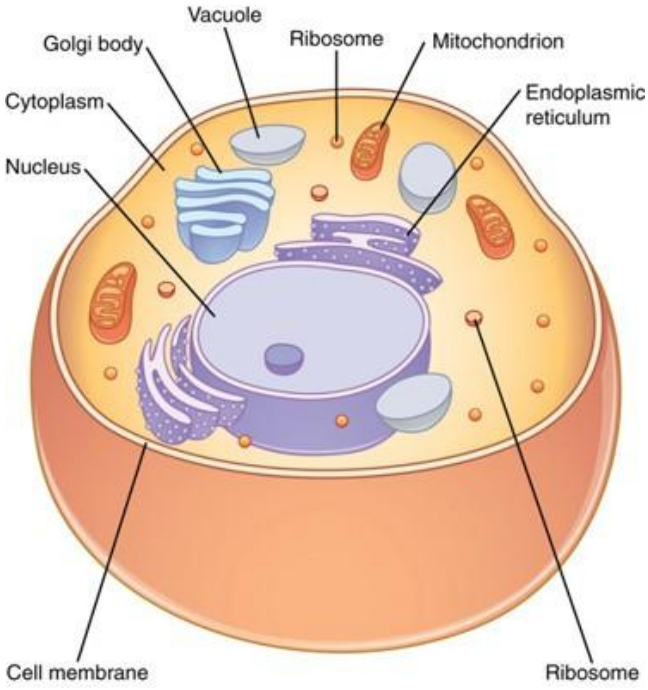
Prokaryotic Cell Structures	
Structure	**Function**
Capsule	The **capsule** is the thin, outermost layer of the cell that provides protection.
Cell Wall	The **cell wall** surrounds the cell and maintains the cell's shape.
Plasma Membrane	Individual membranes do not surround internal structures. However, a single **plasma membrane** surrounds the entire cell. The membrane helps move materials into and out of the cell.
Cytoplasm	Prokaryotic cells contain a gel-like fluid called **cytoplasm**. Cytoplasm takes up most of the space inside the cell.

Reflect

DNA	**DNA** within a prokaryotic cell is a single, circular molecule that is not enclosed in a membrane-bound compartment. DNA carries the instructions and genetic code for the cell.
Nucleoid	Although DNA is not enclosed in a nucleus, it is generally confined to a central region called the **nucleoid**.
Plasmids	**Plasmids** are circular genetic structures found inside prokaryotic cells but are not part of the main DNA strand. They are involved in cell activities such as growth and metabolism.
Ribosomes	Prokaryotic cells contain **ribosomes** that play roles in manufacturing proteins.
Pili	Hollow, hairlike structures called **pili** surround prokaryotic cells. Pili enable prokaryotic cells to attach to other cells.
Flagella	Long, whiplike structures called **flagella** (singular: **flagellum**) help prokaryotic cells move. A cell may have one flagellum, or it may have several flagella.

In contrast to prokaryotic cells, **eukaryotic cells** are more complex. They contain a nucleus and other membrane-bound organelles that perform specific functions that contribute to the overall **metabolism** and growth of the cell. Eukaryotic cells are found in multicellular organisms including plants, animals, fungi, and protists. They can also be unicellular protists. Let us take a closer look at the main structures within a eukaryotic cell. Can you locate each structure in the diagram on the right?

metabolism:
the process by which cells make, store, and transport chemicals



In addition to the structures shown in this animal cell, plant cells contain a cell wall, a central vacuole, and chloroplasts.

Reflect

Eukaryotic Cell Structure	
Structure	**Function**
Cell Wall	The **cell wall** surrounds the cell and maintains its shape. Cell walls are found in plant, fungi, and protist cells only.
Cell Membrane	A **cell membrane** surrounds the entire cell. The membrane helps move materials into and out of the cell.
Cytoplasm	As in prokaryotic cells, eukaryotic cells contain **cytoplasm** that takes up much of the space inside the cells.
Nucleus	The **nucleus** is the central organelle that holds DNA.
DNA	In eukaryotic cells**, DNA** cell is linear and organized into chromosomes. Like prokaryotic cells, DNA carries the instructions and genetic code for the cell.
Mitochondria	The **mitochondria** play major roles in transforming the energy in food into a usable form of energy called *ATP*. The cell then uses ATP to carry out activities such as reproduction and growth.
Endoplasmic Reticulum (ER)	The **endoplasmic reticulum**, called the ER, helps transport proteins and produce **lipids**.
Golgi Body	The **Golgi body** helps package and distribute proteins and lipids within the cell.
Ribosomes	Like prokaryotic cells, eukaryotic cells contain **ribosomes** that play roles in manufacturing proteins. However, the ribosomes in eukaryotic cells are larger and more complex.
Lysosomes	**Lysosomes** contain **enzymes** that help break down food or break down the cell when it dies.
Chloroplasts	Plant cells and some protists contain **chloroplasts**. These structures contain the green pigment **chlorophyll**, which captures the energy of sunlight for use in **photosynthesis**.
Central Vacuole	Many plant cells contain a large **central vacuole**, which stores water, food, and waste. Animal cells contain vacuoles, but they are much smaller than the central vacuole found in plant cells.

lipid:
an organic compound that stores energy

enzyme:
a protein in organisms that helps control a chemical reaction

photosynthesis:
the process by which certain organisms use the energy in sunlight to make food

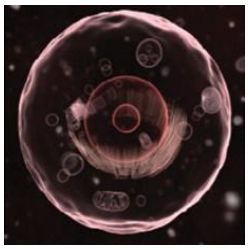
Look Out!

So far, you've learned that prokaryotic cells are much simpler than eukaryotic cells. However, prokaryotes do carry out important processes. Similar to more complex living things, prokaryotes grow, reproduce, and respond to their environments.

Cell Size
Other than a few exceptions, prokaryotic cells are much smaller than eukaryotic cells. They range in size from about 0.2 to 2.0 micrometers. In contrast, most eukaryotic cells are between 10 and 100 micrometers. An average sheet of paper is approximately 150 micrometers thick!

What Do You Think?

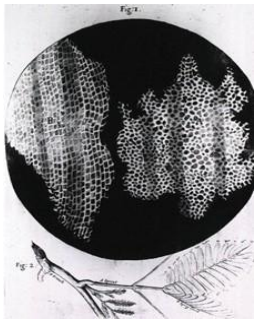
Take a look at the following images of cells. Which cell is prokaryotic, and which is eukaryotic? If the cell is prokaryotic, is it rodlike, spherical, or spiral?



Discover Science: The Cell Theory
Before the 1600s, people did not know that cells existed at all. This may be hard to believe, considering how much we now know about cells. But, until scientists were able to fully observe cells and their functions, people believed life arose spontaneously. Thanks to the work of Robert Hooke, Antonie van Leeuwenhoek, Matthias Jakob Schleiden, Theodor Schwann, Rudolf Virchow, and other scientists, the cell theory was developed.

The British scientist Robert Hooke was the first person to observe matter that made up what he called cells. In the 1660s, Hooke used a microscope to look at cork from the bark of an oak tree. He noted the cork looked like it was made of small compartments that reminded him of the rooms, or cells, in which monks lived. For this reason, Hooke named the structures he observed cells. The next major development came in the later part of the 1600s when Antonie van Leeuwenhoek observed living cells under a microscope. He examined what he called animalcules, what we now call microorganisms. Based on his notes, scientists today think that van Leeuwenhoek was observing algae and bacteria.

Matthias Jakob Schleiden, Theodor Schwann, and Rudolf Virchow are the three scientists who are typically given credit for the development of the cell theory. Schleiden studied plants and discovered they were made of cells. Around the same time, Schwann discovered animals were made of cells. In 1838, Schleiden and Schwann proposed the first two parts of the current cell theory. The theory states that all living things are made of cells and that cells are the basic units of structure and function in living things. Virchow developed the third part of the cell theory, which states that all cells arise from preexisting cells.



This magnified image of cork tissue is from Robert Hooke's book *Micrographia*.

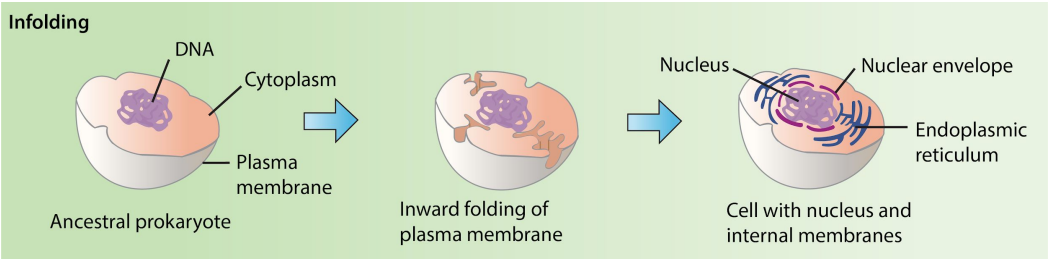
What Do You Think?

Discover Science: Scientific Explanations for Cellular Complexity

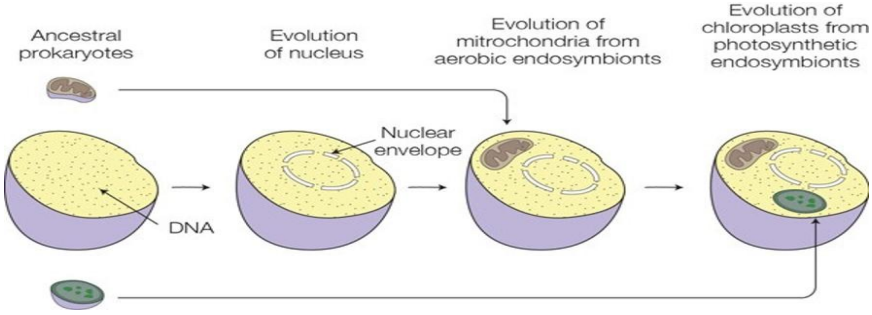
Evidence from the fossil record suggests prokaryotic cells first appeared on Earth between 3 and 3.5 billion years ago and eukaryotic cells between 1 and 1.5 billion years ago.
What do you believe are possible explanations as to how cells became more complex over time?

Two explanations for the origin of the complexity of eukaryotic cells are endosymbiosis, and the autogenous model. Both models agree eukaryotic cells evolved from prokaryotic cells, increasing in complexity over time. The models differ in explaining the order and mechanisms of the transition.

According to the autogenous theory, eukaryotes evolved from prokaryotes through the accumulation of changes over time. Gradually, the plasma membrane of prokaryotes began to fold inward, creating organelles such as the endoplasmic reticulum, the Golgi apparatus, and the nucleus. The autogenous theory is supported by membrane similarities among cell membrane and organelle membranes.



In the 1960s, biologist Lynn Margulis proposed the endosymbiotic theory. She suggested that mitochondria, which convert food into energy in cells, and chloroplasts, which convert sunlight into energy in plant cells, have more in common with prokaryotes than eukaryotes. In fact, she suggests that mitochondria and chloroplasts were once free-living bacteria that evolved a mutualistic relationship with early eukaryotic cells. Over time, the reproductive cycle of the endosymbiont became completely tied to that of the host, and the endosymbionts lost the ability to live outside of the host cell. Support for the endosymbiotic theory is found in the DNA and ribosomes of mitochondria—both of which are similar to that found in Rickettsia, a parasitic endosymbiont. Like mitochondrial DNA, chloroplast DNA is also similar to prokaryotic photosynthetic cyanobacteria.



Scientists argue that the evolution of cellular complexity occurred by a combination of the two theories. A possible explanation is complexity first developed as a prokaryote evolved into a proto-eukaryote when infolding resulting in the formation of early organelles including the nucleus, golgi, and endoplasmic reticulum. The proto-eukaryote then engulfed a prokaryote increasing the complexity of the cell, eventually leading to chloroplasts and mitochondria.

Try Now

What Do You Know?

Compare prokaryotic cells and eukaryotic cells. Read the list of cell characteristics in the box below. Write each characteristic in the correct place on the Venn diagram.

Characteristics of Cells

- Contain a nucleus
- Undergo metabolism
- Contain DNA
- Are usually smaller than 10 micrometers
- Are found in fungi
- May contain a cell wall
- Reproduce
- Are bacteria and archaea
- Contain membrane-bound organelles
- Are found in all multicellular organisms
- Contain chloroplasts

Prokaryotic Cells **Eukaryotic Cells**

Try Now

What Do You Know?

Compare scientific explanations of cellular complexity.

Theory Components	
• Eukaryotes more complex than prokaryotes • Change in prokaryotes over time • Infolding of cell membrane • Supported by mitochondrial ribosomes	• Supported by membrane-bound organelles • Supported by membrane similarities between organelles and cell • Supported by circular DNA in chloroplasts • Engulfing of small prokaryote by larger prokaryote

Autogenous Theory **Endosymbiotic Theory**

Name: _____ Date: _____

Categorize Cut and Paste

Cut out the words below and paste them in the correct category.

Prokaryotic Cells	Eukaryotic Cells

Prokaryotic and Eukaryotic Cells

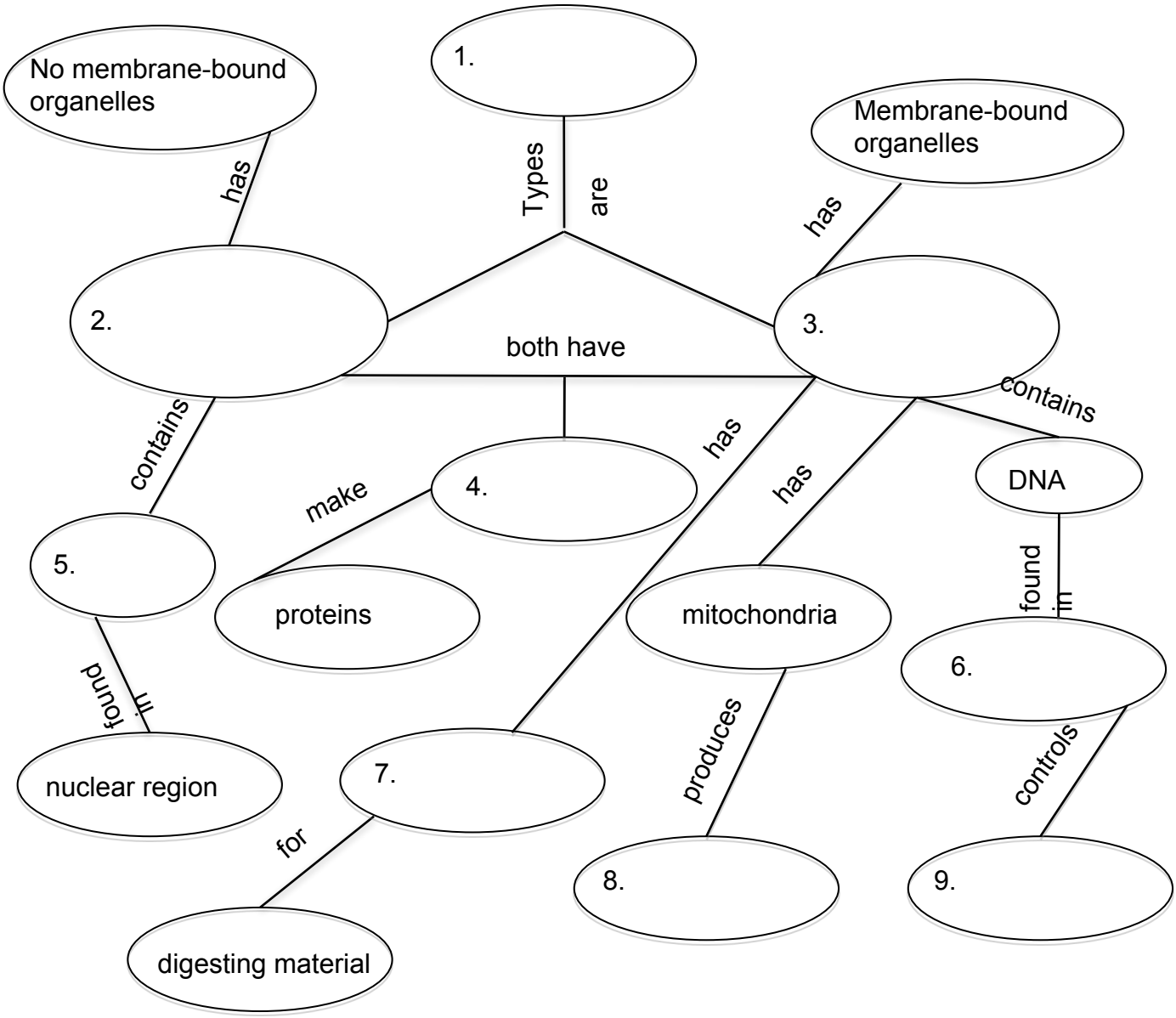
Only unicellular	**Unicellular or multicellular**	**Lack membrane-bound organelles**	**Bacteria**
Simple	**Complex**	**Membrane-bound organelles present**	**Plants, animals, fungi, protists**
0.2–2 micrometers	**10–100 micrometers**	**Contain genetic material**	**Reproduce**
Nucleus present	**No nucleus**	**Evolved from prokaryotic cell**	**Respond to environment**

Guided Practice

Using all the following terms in the word bank, complete the graphic organizer.

Word Bank

Cell	DNA	Energy	Eukaryotic	Heredity
Lysosomes	Nucleus	Prokaryotic	Ribosomes	



Guided Practice

Answer the questions below.

1. Which type of cell~~s~~ lacks a nucleus?

2. Which type of cell~~s~~ contains ribosomes?

3. Which type of cell~~s~~ contains membrane-bound organelles?

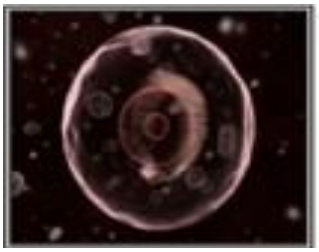
4. Why is a microscope needed to see a prokaryotic cell?

5. What is wrong with this statement: “All multicellular organisms are eukaryotic, and all single-celled organisms are prokaryotic”?

Writing Science

Name: _____ Date: _____

Look




Think

Think about the properties of cells which classify them as prokaryotic or eukaryotic cells.

Every living organism on the planet is made of cells, and those organisms could be unicellular (made of only one cell) or multicellular. It is important to understand that even though there is a large variety of organisms on the planet, the cells that they are made of share certain common characteristics. All cells are bound by a plasma membrane, all cells contain cytoplasm, all cells contain chromosomes, and all cells have ribosomes for the creation of proteins.

However, there are two main cell types that differ in obvious ways, and those two main cell types are prokaryotic cells and eukaryotic cells. Prokaryotic cells are tiny, much smaller than most eukaryotic cells. The DNA in these types of cells is contained in a region called a nucleoid, but no membrane separates this region from the rest of the cell. As a matter of fact, there are no membrane-bound organelles within the cytoplasm of prokaryotic cells at all. Eukaryotic cells are much larger than prokaryotic cells. The DNA in eukaryotic cells is contained within a true, membrane-bound nucleus. Eukaryotic cells also have membrane-bound organelles suspended within the cytosol, each with a specialized form for specialized functions.

Write

Describe the similarities and differences of prokaryotic cells and eukaryotic cells.

Be sure to –

- Address the prompt, provide support, and conclude your thoughts.
- Write legibly and concisely.

Writing Science

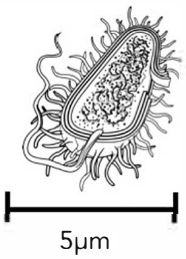
B.4 The student knows that cells are the basic structures of all living things with specialized parts that perform specific functions and that viruses are different from cells.

B.4 (A) Compare and contrast prokaryotic and eukaryotic cells, including scientific explanations for cellular complexity.

I. Comparing and contrasting prokaryotic and eukaryotic cells.

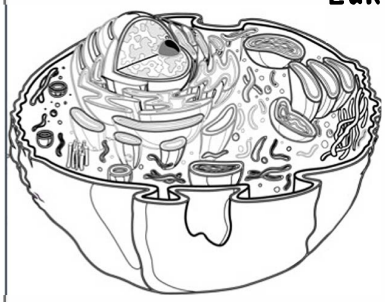
1. List examples of each type of in the space below each illustration:

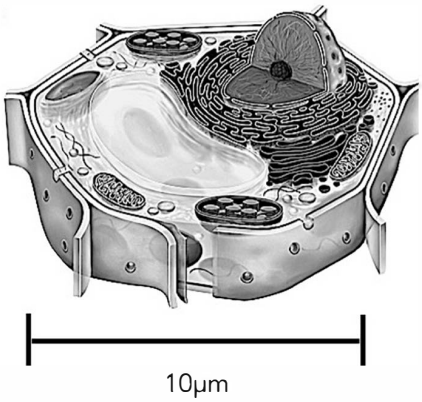
Prokaryotic Cells



Examples:

Eukaryotic Cells



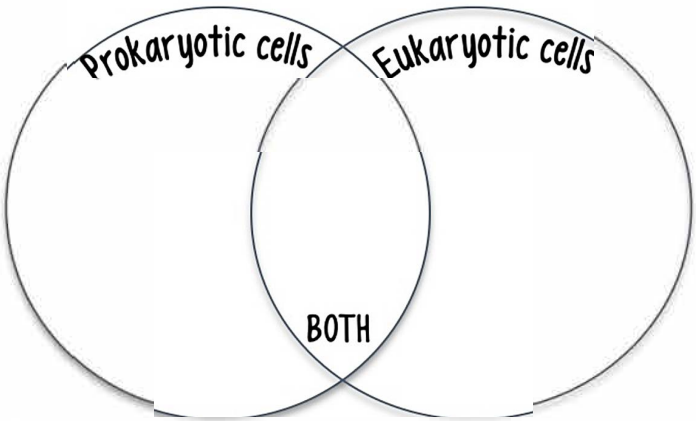


Examples:

2. In the table below, check off which type of cells has the structure or characteristics listed:

Structure	Prokaryotes	Eukaryotes
Cell Membrane		
DNA		
Nucleus		
Ribosomes		
Mitochondria		
Chloroplast		
Cytoplasm		

4. Use questions 2 and 3 to complete the Venn Diagram below:



3. Fill out the paragraph using the word bank. Some words will be used more than once.

Word bank: *smaller; organelles; nucleus; first; later; ribosomes; larger; Golgi; endoplasmic reticulum; circular*

Prokaryotic cells were the _____ types of cells to evolve. They do not have a _____; instead, their DNA forms what is called a nucleoid. Prokaryotic cells are _____ in size compared to eukaryotic cells.

Eukaryotic cells evolved much _____ than prokaryotes. Eukaryotes are _____ and contain membrane-bound organelles, such as the _____ or rough _____ _____. One major defining feature of eukaryotic cells is that they contain a _____.

Both types of cells contain DNA and _____, though prokaryotic cells have _____ DNA and eukaryotic cells have linear DNA.

Eukaryotic cells tend to be more complex due to the presence of membrane-bound _____.

B.4 the student knows that cells are the basic structures of all living things with specialized parts that perform specific functions and that viruses are different from cells.

B.4 (A) Compare and contrast prokaryotic and eukaryotic cells, including scientific explanations for cellular complexity.

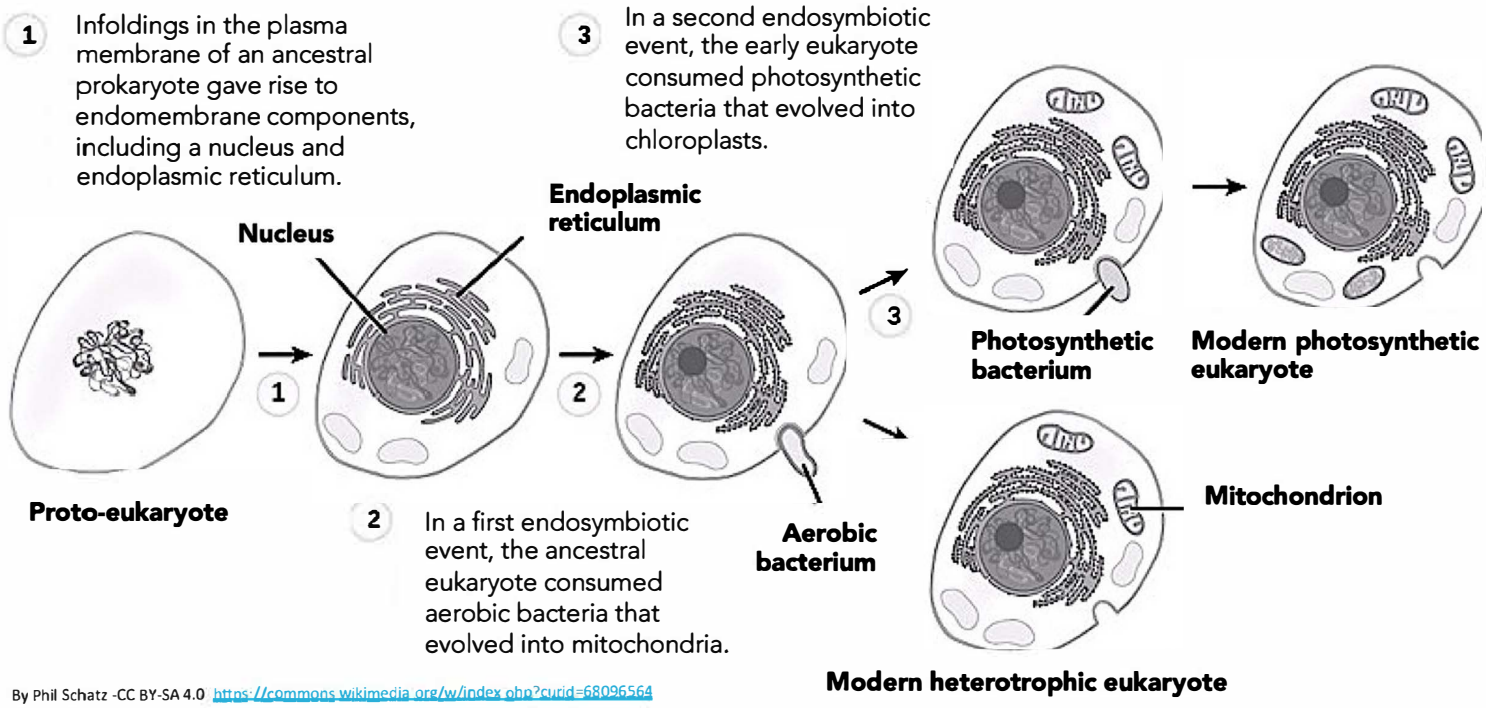
II. Scientific Explanation for Cellular Complexity- the Endosymbiotic theory

Why are eukaryotic cells more complex?

ENDOSYMBIOSIS

The endosymbiotic theory suggests that larger, more complex eukaryotic cells evolved by engulfing smaller prokaryotes and using prokaryotic mechanisms to their advantage in a symbiotic relationship.

The ENDOSYMBIOTIC THEORY



1. According to the endosymbiotic theory, how did membrane-bound organelles, such as the nucleus and endoplasmic reticulum form?

_____

_____.

2. The endosymbiotic theory suggests that mitochondria were once individual (prokaryotic) cells of aerobic _____ that were _____ by the earlier eukaryotic cells.

3. What type of bacteria were consumed to form chloroplasts? _____
What type of modern day cells would this have formed? _____

4. What is the relationship between prokaryotic cells and eukaryotic cells that lead to the development of the eukaryotic cells we see today?

_____

_____.

Assessment: Prokaryotic and Eukaryotic Cells

1 Which of the students' observations will be most helpful in classifying a cell as either prokaryotic or eukaryotic?

A Shape of the cell

B Presence of a nucleus

C Presence of organelles

D Visible DNA

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2 When compared to eukaryotic cells, prokaryotic cells are almost always–

A smaller.

B more complex.

C less rounded.

D faster.

---

3 A table comparing prokaryotic and eukaryotic cells is provided.

Type of Cell	DNA Present?	Location of DNA
Eukaryotic	Yes	Nucleus
Prokaryotic	?	?

Which set of terms below would complete the empty spaces in the table?

A No, Nucleus

B Yes, Nucleus

C No, Scattered

D Yes, Scattered

4 Which of the following organelles can be found in both prokaryotic and eukaryotic cells?

A Nucleus

B Ribosomes

C Mitochondria

D Endoplasmic reticulum

---

5 Which of the following statements regarding prokaryotic DNA is true?

A Prokaryotic DNA is found in a membrane-bound nucleus.

B Prokaryotic DNA is identical to eukaryotic DNA in structure and composition.

C Prokaryotic DNA is similar to the DNA of mitochondria and chloroplasts.

D Prokaryotic DNA contains large internal segments of non-coding DNA called introns.

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6 A table comparing features of cells is provided.

Cell	Nucleus	Cell Wall	Cell Membrane	Mode of Reproduction
Cell A	No	Yes	Yes	Sexual
Cell B	Yes	No	Yes	Sexual
Cell C	No	Yes	Yes	Asexual
Cell D	No	No	Yes	Asexual

Which of the following is most likely a eukaryotic cell?

A Cell A

B Cell B

C Cell C

D Cell D

Day	Objective/TEKS	Agenda
1	TEKS 4.B (R): investigate and explain cellular processes, including homeostasis and transport of molecules	1. Watch these videos: a. The Cell Membrane https://youtu.be/S7CJ7xZOjm0 b. Passive Transport https://youtu.be/s0p1ztrbXPY c. Active Transport https://youtu.be/STzOiRqzzL4 2. Engage Cell Processes 3. Read: Cell Processes. While 7ou read complete Linking Literacy: Cause and Effect 4. Guided Practice: Cell Processes 5. Writing in Science 6. STAAR Tune-Up- Cell Processes 7. Assessment: Cell Processes

Engage

Name: _____ Date: _____

A young woman decides to go for a hike in Yellowstone National Park on a summer day. She brings a water bottle, a protein bar, a hat, and some sunscreen with her. She also brings her bear repellant. Before her hike, she has a good breakfast, including eggs, oatmeal, fruit, and orange juice. At the beginning of her hike at 9 a.m., the day is cool, and she is wearing shorts, a T-shirt, and a light jacket. By noon, she has hiked five miles, and it is 95° F and very sunny.

Describe what cellular processes are occurring in the woman during the day.

- What occurs inside her body after she eats breakfast?
- What occurs inside her body as she starts her hike?
- What occurs inside her body as the day warms, and how might she respond to this?
- At noon, what may be occurring at a cellular and body level, and why?

Within your group, brainstorm and create a list of what may be occurring at both the cellular and body level for this woman and how her system may respond to those signals. List only those processes that occur with your group's concept. Create your list in your Engage Student Handout. Once your group has completed your list, raise your hands.

Engage

Use the spaces provided to write down the processes that occur as the woman takes her hike.

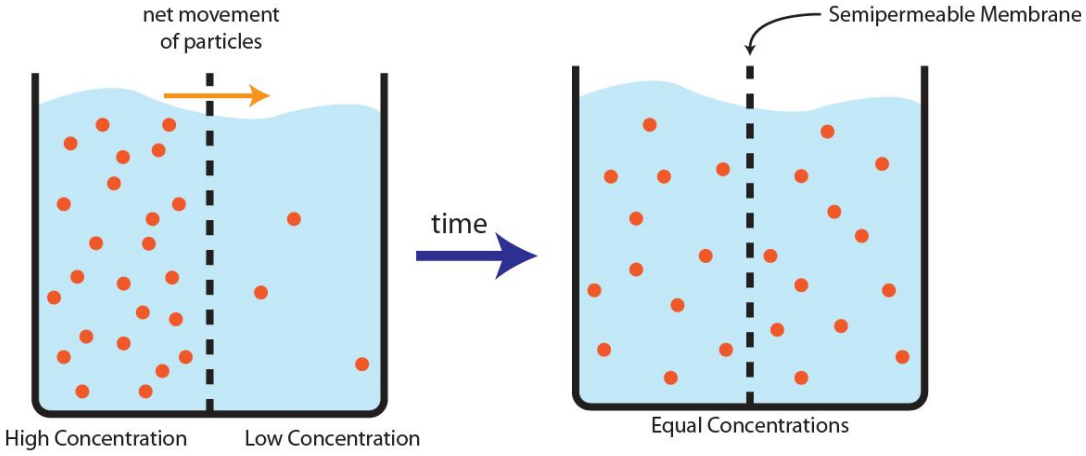
Engage

Transport of Molecules

All forms of transport occur across membranes. These may be the membranes of organelles within the cell, or across the actual cell membrane. The rate at which molecules pass into or out of the cell depends on certain factors, such as molecule size and concentration of solutes on either side of the membrane.

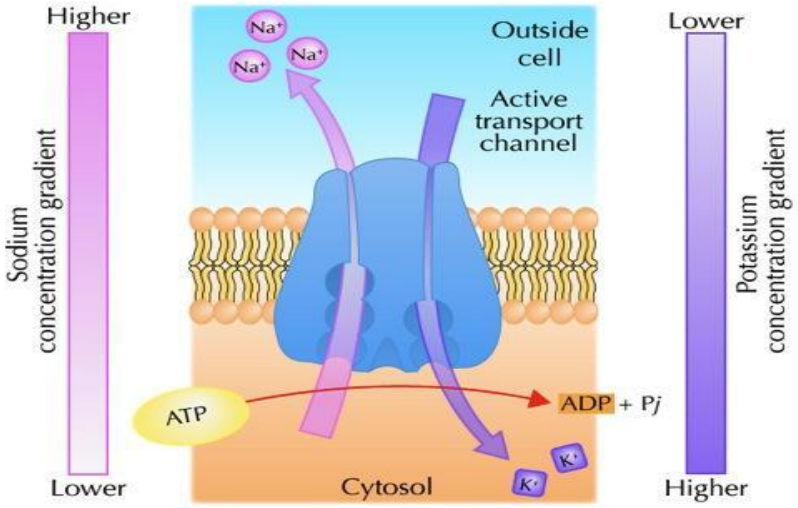
Passive Transport

Energy is not required in passive transport across cellular membranes because molecules are transported from an area of HIGH concentration to LOW concentration, and because the molecules are small enough to pass through the membrane pores. Osmosis refers to the movement of water molecules. Diffusion refers to the movement of other molecules.



Active Transport

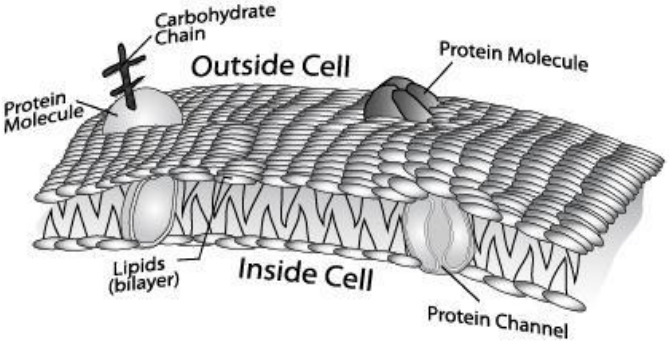
Transport across membranes may require energy for a variety of reasons. Active transport is the opposite of passive transport. Energy is required for this type of transport as molecules move from an area of LOW concentration to an area of HIGH concentration, or as the transport of larger molecules across the cellular membranes must be aided by a variety of mechanisms.



Engage

Homeostasis
Homeostasis is the process of maintaining a constant state of balance. All organisms have natural ways to regulate their internal conditions to keep a stable and healthy internal environment. Homeostasis occurs on both the cellular level and the organismal level.

Cellular Level
All cells are constantly maintaining homeostasis. They do this through their cell membrane, which keeps a balance between its internal environment and external environment. There are many ways cells can reach this equilibrium, such as changing the composition of the cellular membrane to compensate for changes in external conditions. These changes can signal your body to shiver when you are cold or sweat when you are hot. Another example is activating genes to synthesize specific molecules when they are needed. These types of changes may include your body's way to regulate blood sugar levels to maintain homeostasis.



Organismal Level
An organism uses energy to keep~~s~~ its balanced state through feedback mechanisms. These feedback mechanisms can either be negative or positive. Both mechanisms rely on a stressor (such as an increase in external temperature), a sensor/control center (cells that receive the information), and an effector (sweating to decrease body temperature) in order for the feedback loop to exist.

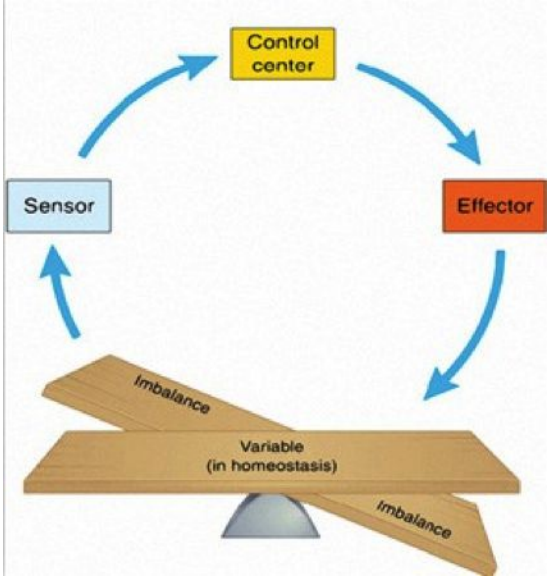
Reflect

How would your body react if you stepped outside without a jacket on a cold day? Your muscles would tighten, and you would feel very uncomfortable. If you stayed outside for more than a few moments, you would likely begin to shiver. What causes the tightening of muscles and the shivering? Why does your body react this way? Does it help you get warmer?

Homeostasis

In the example above, the body responded to cold air and reacted in a certain way in order to maintain *homeostasis*, which is the process of maintaining a constant state of balance within a normal range. The muscles tightened to conserve heat and the body shivered to help generate heat. All of this occurred in order to help maintain a fairly constant internal body temperature.

While the word itself may sound complicated, homeostasis is a fairly simple concept. Cells and organisms must exist in a state of balance. All living cells are constantly working to maintain homeostasis. Your body is even working to maintain homeostasis right now! There are three general steps in a homeostatic response. When something in the body is out of balance, it is sensed by a biological sensor. This sensor sends a message to the control center, which is usually the nervous system. The control center then sends a command to an effector, a muscle or gland, to correct the imbalance. The regulation of thirst and the regulation of body temperature are examples of homeostasis in the human body.



In order to maintain proper blood volume and fluid salinity (salt concentration), an animal must continually drink and excrete an appropriate amount of water. If body fluids are high in salinity (low in water), specific sensor cells in the brain are triggered. These cells can send commands that trigger a thirst response. They may also send commands in the form of hormones from a gland (effector) that reduces the further elimination of fluids. With respect to temperature, the human body must be maintained close to 98.6°F (37°C). Body temperature can rise, such as during physical exertion or fever. Body temperature can also decrease, such as when you step outside on a cold day. Temperature sensors detect the imbalance and the nervous system responds. On a warm day, a command could be sent to the sweat glands (effectors) to secrete sweat. This helps the body to cool and restore proper temperature. On a cold day, a signal might cause your muscles (effectors) to shiver, increasing your body temperature.

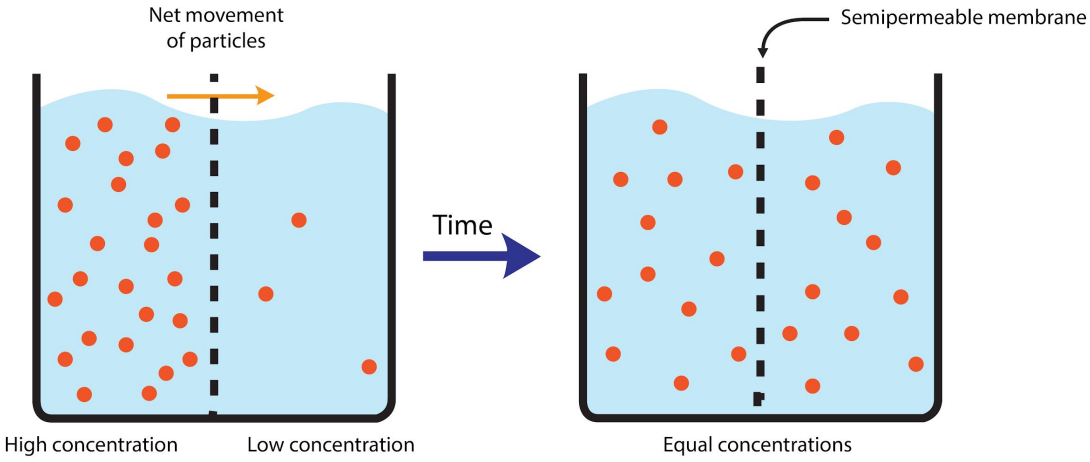
Reflect

The examples of homeostasis discussed here exist at the level of the organism. What about homeostasis at the cellular level? Individual cells must maintain their internal environment in a balanced state. This includes maintaining a constant supply of cellular energy as well as healthy cellular structures composed of biomolecules. Cells must also regulate the passage of materials across their membranes. The internal environment of a cell must maintain the proper salinity and pH. What are the cellular processes important for maintaining homeostasis?

Transport of Molecules: Crossing the Cellular Membrane

One of the primary strategies for maintaining cellular homeostasis is regulating materials that pass into and out of the cell. While some molecules can easily cross a cell membrane, the passage of many materials is tightly controlled. This variability in whether a certain substance can easily cross the membrane results from the fact that the cell membrane is selective, or *semipermeable*. Substances that are small and **nonpolar** are generally able to freely cross the cell membrane. These substances are able to squeeze through the nonpolar lipids that compose the membrane. Examples of such substances are the gases oxygen and carbon dioxide.

nonpolar: lacking chemical polarity



Look Out!

When a substance can freely cross the membrane, it moves from an area of higher concentration to one of lower concentration. This type of movement is called *diffusion*. Like a spray of perfume spreading throughout a room, any dissolved substance will naturally diffuse in this manner. The process of a molecule going freely through the lipid bilayer of the cell membrane is called *simple diffusion*. A substance that is too large or **polar,** may require the assistance of either a **carrier protein** or a **channel protein** to diffuse across the membrane. This type of movement is called *facilitated diffusion*.

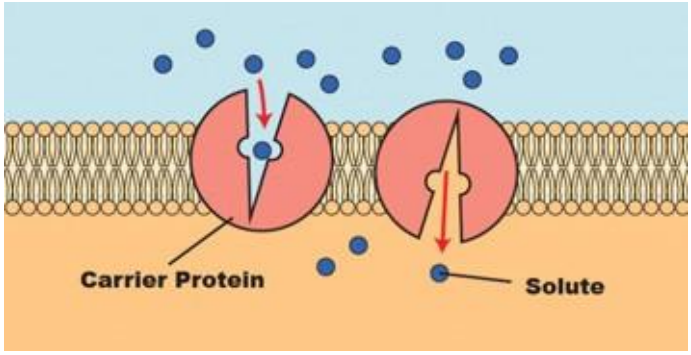
Neither simple diffusion nor facilitated diffusion requires the input of energy. They are thus considered to be forms of *passive transport* across membranes. The *active transport* of substances, on the other hand, requires the input of energy (from ATP). Why would energy be required to move substances across a membrane? Substances can move passively (diffuse) only *down* their **concentration gradient**. The movement of a substance from an area of lower concentration to one of higher concentration is in a direction against, or up, its concentration gradient. Movement in this direction requires energy.

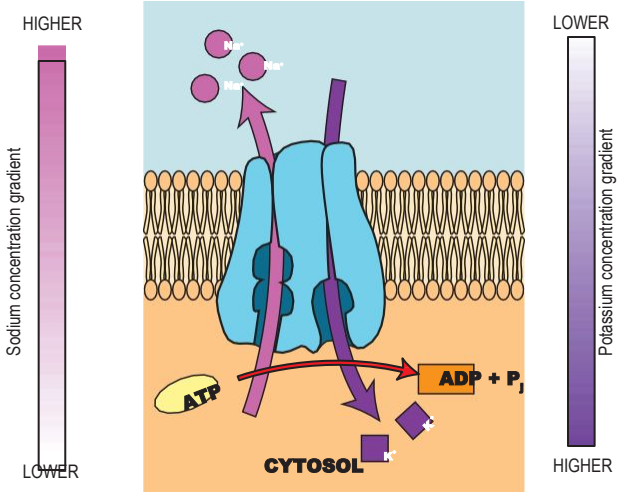
polar: having a slightly positive charge at one side of a molecule and a slightly negative charge at the other side

carrier protein: a protein in the cell membrane that changes shape to allow a substance to pass through

channel protein: a protein in the cell membrane that forms a channel through which a substance can pass through

concentration gradient: a difference in the amount of substance on two sides of a barrier





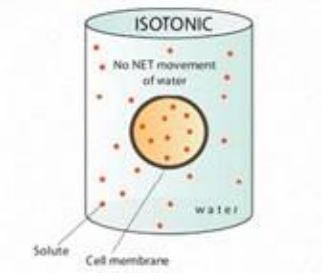
Facilitated diffusion, pictured on the left, does not require an input of energy. Active transport, pictured on the right, requires energy to move substances against their concentration gradient.

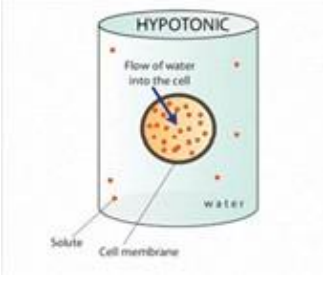
What Do You Think?

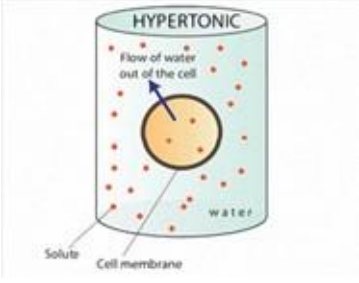
Water (H_2O) is a relatively small polar molecule. Water molecules, as with dissolved substances, must cross the plasma membrane in order to regulate the tonicity of the intracellular fluid. *Tonicity* refers to the relative concentration of water and **solutes** in a solution. A *hypertonic* **solution** is one in which there is a higher solute concentration compared to another solution. A *hypotonic* solution has a lower solute concentration compared to another solution. Two solutions that are *isotonic* have the same solute concentration. There are channel proteins within cell membranes through which water molecules can pass. *Osmosis* refers to the diffusion of water molecules. Imagine that the fluid surrounding a cell is hypertonic to the fluid inside the cell. Do you think water molecules will move into or out of the cell? What if the fluid outside the cell is hypotonic to the fluid inside? In each of these cases, is the movement of water (osmosis) passive or active?

solute: a substance that is dissolved in another substance (called the solvent)

solution: a mixture in which the molecules of one substance (solute) are dissolved in another substance (solvent)



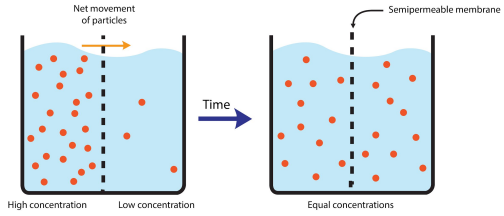




Tonicity of solution around the cell	Solution around the cell (as compared to the cell)	Solution (cytosol) in the cell
Hypertonic	High (hyper) solute concentration, low water concentration.	Low solute concentration, high water concentration.
Hypotonic	Low solute (hypo) concentration, high water concentration.	High solute concentration, low water concentration.
Isotonic	Solute and water concentrations are the same as that of the cell.	Solute and water concentrations are the same as that of the solution.

What Do You Think?

The chart below lists terms associated with cellular process in the left column. Match each term on the left with the related image or phrase on the right. Write the letter(s) of the matching image or phrase next to the term in the left column. Be sure to include all possible correct answers.

Active transport	A. 
Facilitated diffusion	B. Balance of conditions within a cell or organism
Simple diffusion	C. Requires ATP to move substances against a concentration gradient
Passive transport	D. Involves a substance moving down its concentration gradient
Homeostasis	

Name: _____ Date: _____

Cause and Effect

Complete the cause and effect boxes below. Draw a picture to illustrate each cause-and-effect relationship.

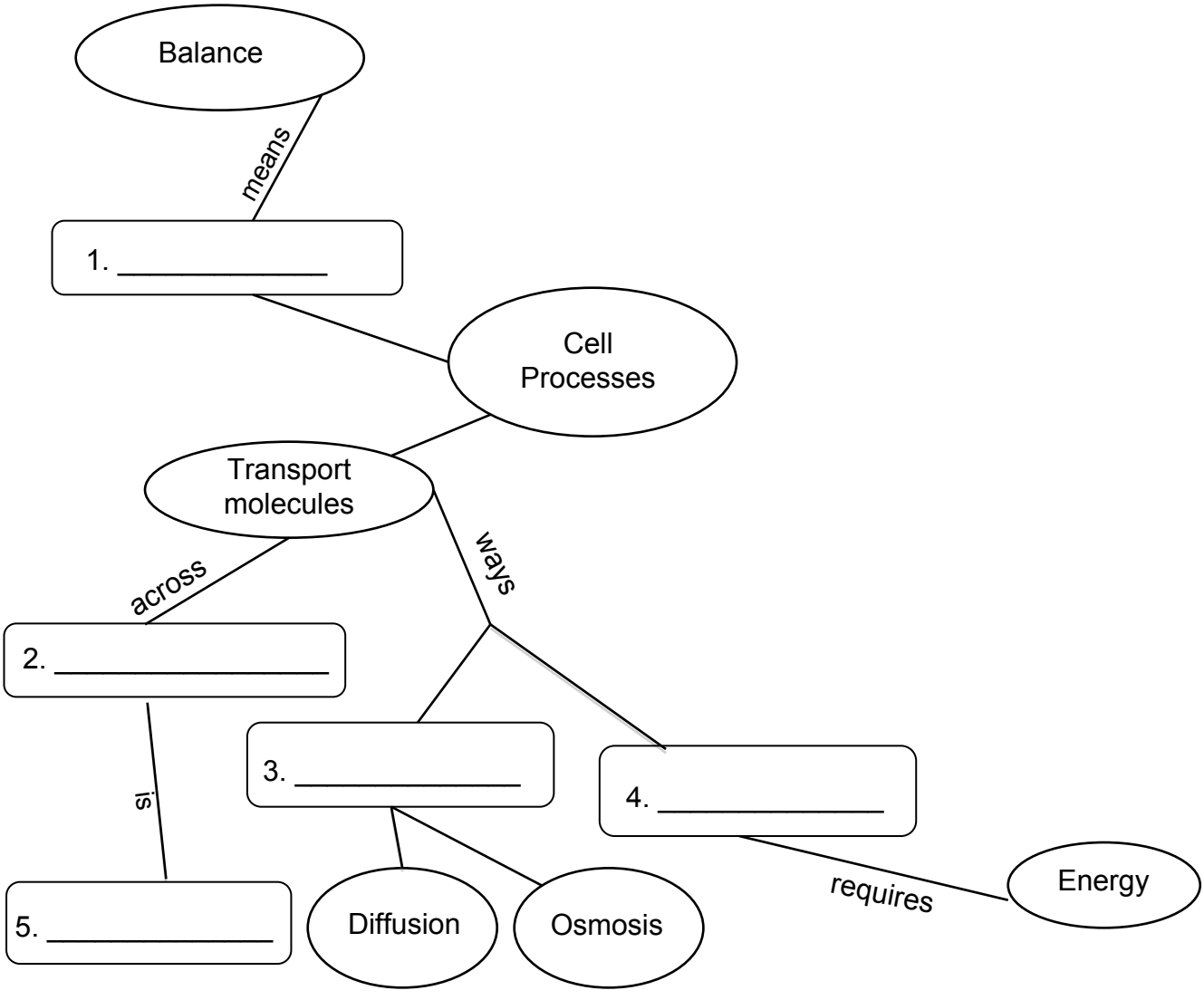
Cause	Effect	Illustration

Guided Practice

Graphic Organizer: Using all the following terms in the word bank, complete the graphic organizer below.

Word Bank

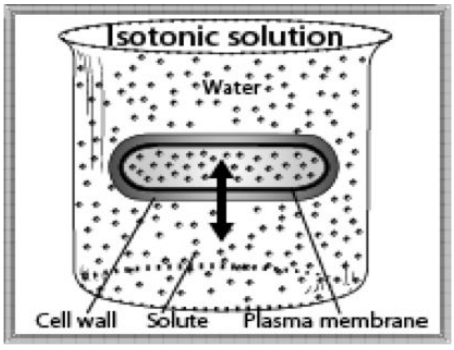
Active	Cell membrane	Homeostasis	Passive	Semi-permeable



Writing Science

Name: _____ Date: _____

Look



Think

About the process of osmosis and how that process relates to cellular function.

Life could not exist without water as most living cells exist in some type of fluid environment. The health of the cells that make up all biological organisms depends on a delicate water balance, and this balance depends on both the intake and excretion of water. For living organisms, this movement of water occurs across cell membranes. Water moves across these membranes in a process called passive diffusion, or osmosis.

Most cells live in an environment where the concentrations of solutes outside of the cell is not the same as the concentration of solutes inside the cell. If the concentration of solutes outside the cell is greater than inside the cell, the cell is said to be in a hypertonic solution. If the concentration of solutes outside the cell is less than inside the cell, the cell is said to be in a hypotonic solution. In both cases, water will be passively transported from less concentrated solutions to more concentrated solutions. This process creates a concentration gradient that can drive many different types of cellular activities.

Write

Explain the process of osmosis in biological cells and describe why this process is critical to the regulation of both cell structure and function.

Be sure to –

•Address the prompt, provide support, and conclude your thoughts.
•Write legibly and concisely.

Writing Science

RS

STAAR Tune-Up- B.4B: Cellular Processes

B.4 the student knows that cells are the basic structures of all living things with specialized parts that perform specific functions and that viruses are different from cells.

B.4 (B) Investigate and explain cellular processes, including homeostasis and transport of molecules.

I. Homeostasis

1. The negative feedback loop that causes thirst is an example of homeostasis because...

_____

_____

_____

_____

2. Give 2-3 more examples of homeostasis:

_____

_____.

3. How is homeostasis essential for survival?

_____

_____

_____.

EXAMPLE OF HOMEOSTASIS: THIRST

Hypothalamus senses that body is dehydrated → Hypothalamus stimulates pituitary to release ADH (antidiuretic hormone).

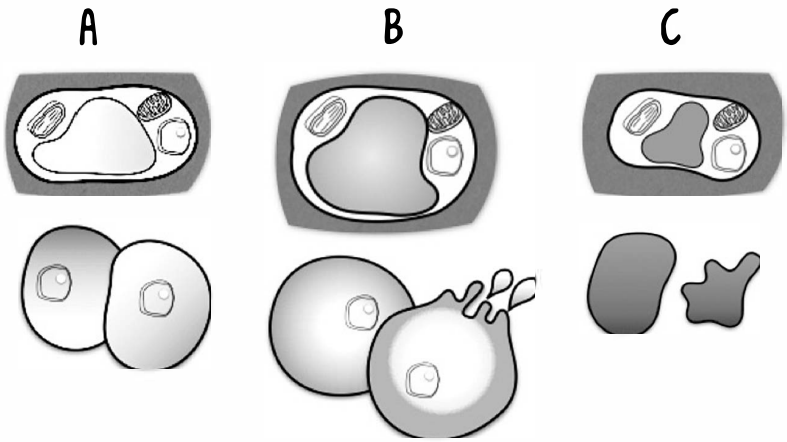
The target tissue for the ADH hormone is the kidneys. It binds to receptors on the kidneys and causes the kidneys to retain water instead of releasing it as waste (urine). This causes you to feel thirsty so that you replenish your water level.

As the water in the blood reaches a more normal state, the hypothalamus stops the pituitary from making more ADH.

II. Types of cell transport- Cell processes, including homeostasis, depend on cell transport.

Type of transport	Description	Examples
Passive Transport		
Active Transport		

III. Types of cell environments-



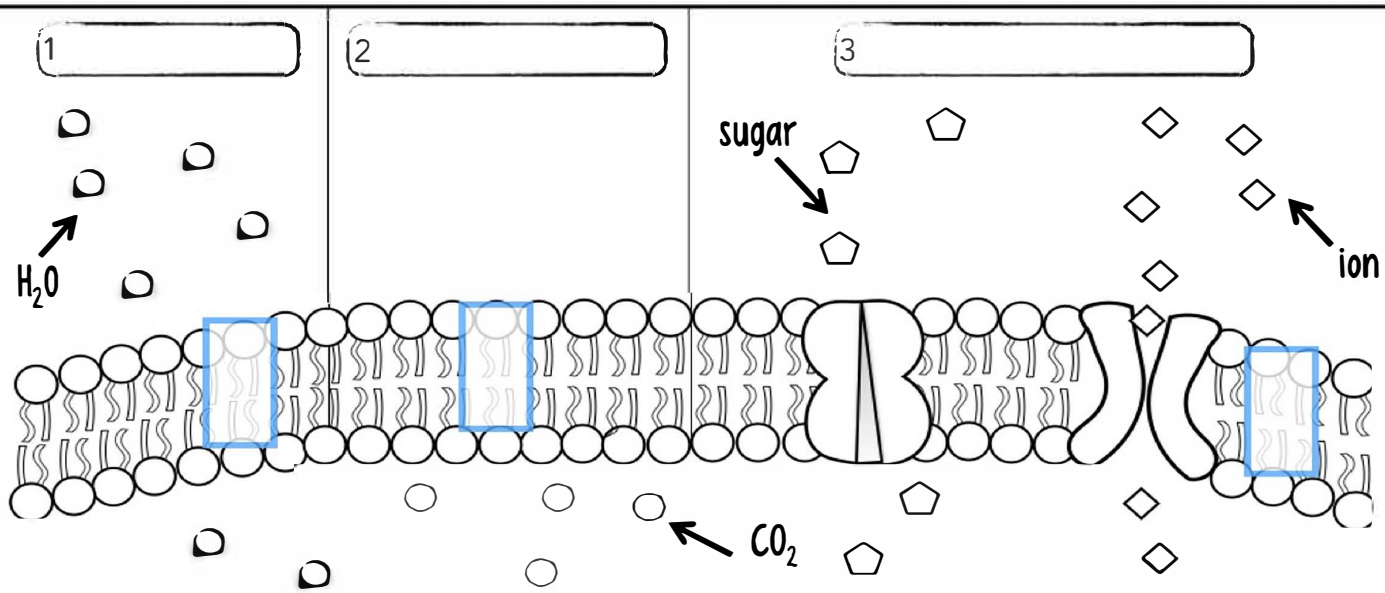
Examine the plant and animal cell diagrams A, B, and C.

1. Which diagram illustrates the ideal cell environment? _____
2. The movement of water across a semi-permeable membrane is called _____.
3. True or False. Water moves both ways across a membrane. _____
4. Which diagram at left depicts why you should not drink salt water? _____.
5. The changing in shape and pressure of cells is caused by the movement of _____ across the membrane.

B.4 the student knows that cells are the basic structures of all living things with specialized parts that perform specific functions and that viruses are different from cells.

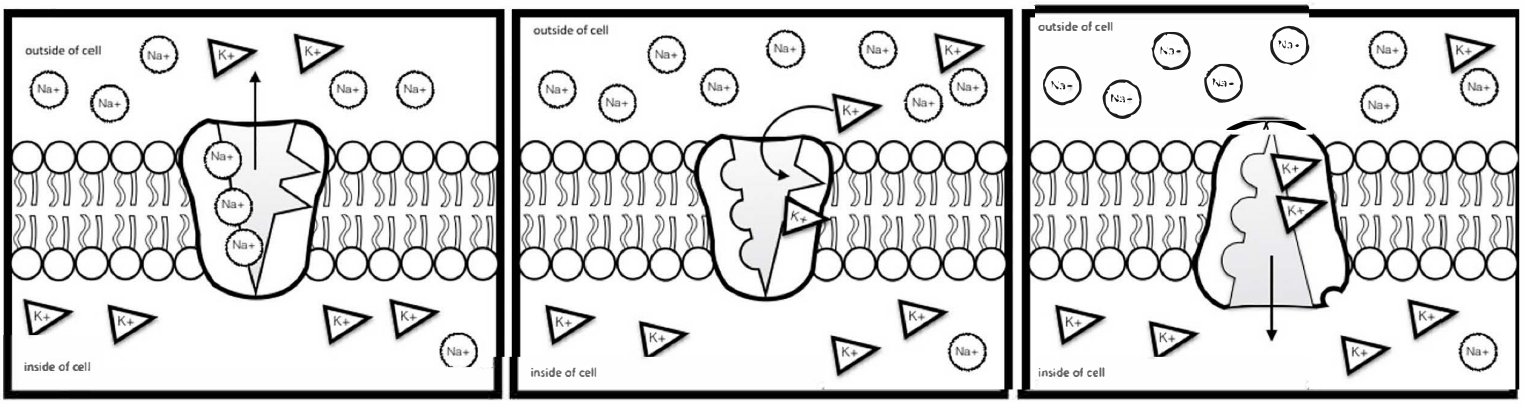
B.4 (B) Investigate and explain cellular processes, including homeostasis and transport of molecules.

IV. Passive Transport- For each type of passive transport below, determine if it's osmosis, facilitated diffusion, or simple diffusion. Write the name of the process in the box at the top of each section of the diagram. In the rectangles, draw an arrow depicting which direction the molecules will move across the membrane.



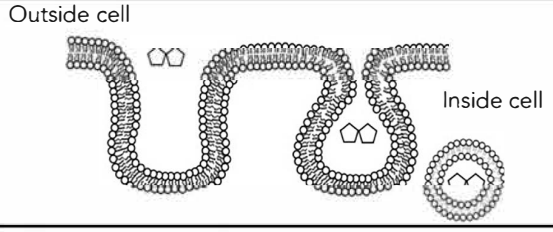
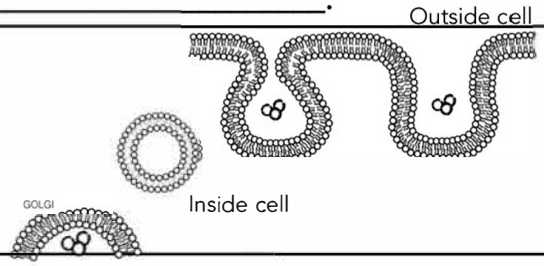
4. In passive transport, molecules move from _____ concentrations to _____ concentrations.

V. Active Transport Examine the diagram below.



1. What is the name of the transport protein above? _____
2. Why does this process require energy? _____

_____.

Diagram		
Process	**3.**	**4.**
Description	**5.**	**6.**

Assessment: Cell Processes

1 Which of the following statements correctly describes a characteristic common to both osmosis and diffusion? Both osmosis and diffusion–

A require energy to move substances.

B only move substances from high to low concentration.

C require a membrane for substances to move across.

D happen only in living cells and tissues.

---

2 The rate at which molecules, such as water and oxygen, enter a cell is determined by the–

A permeability of the cell membrane.

B mass of the nucleus.

C size of the cell.

D primary function of the cell.

---

3 The external conditions that would cause a cell to shrivel or swell in size are those in which the–

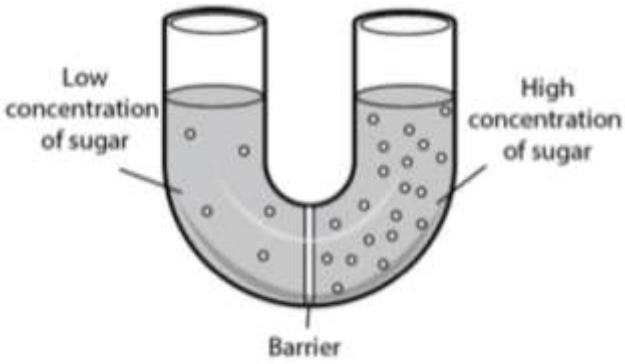
A solute to solution ratio within a cell is not in equilibrium.

B solute particles in the external environment require energy.

C internal environment of the cell has excess potential energy.

D water concentration inside and outside of the cell are equal.

4 Water with a lower concentration of sugar is placed on one side of a container, and water with a higher concentration of sugar is placed on the other side of the container. The two sides are separated by a barrier.



What will happen when the barrier is removed?

A Sugar molecules will diffuse until the concentration of sugar is uniform throughout.

B Sugar molecules will move via osmosis from high concentration to low concentration.

C The water level on one side of the tube will be higher than on the other side.

D The sugar from both sides will collect at the bottom as a solid.

---

5 Why are buffers important in a cell's ability to maintain homeostasis?

A They lower the temperature speeding up reactions.

B They allow the cell to stay within a specific pH.

C They denature proteins to be digested by the cell.

D They allow diffusion of water across the lipid bilayer.

---

6 The difference between active and passive transport is that–

A passive transport requires energy to move molecules up a concentration gradient, and active transport does not.

B passive transport can only move specific particles across a membrane, and active transport can move any particle.

C active transport requires energy to move molecules up a concentration gradient, and passive transport does not.

D active transport moves molecules in animal cells, and passive transport moves molecules in plants.

7 Which of the following scenarios represents an example of osmosis?

A Blood vessels transport glucose to cells.

B CO2 waste is eliminated during respiration.

C Limp celery becomes crisp in water.

D Sweating lowers body temperature.

---

8 Which of the following most accurately describes the difference between osmosis and diffusion within a cell?

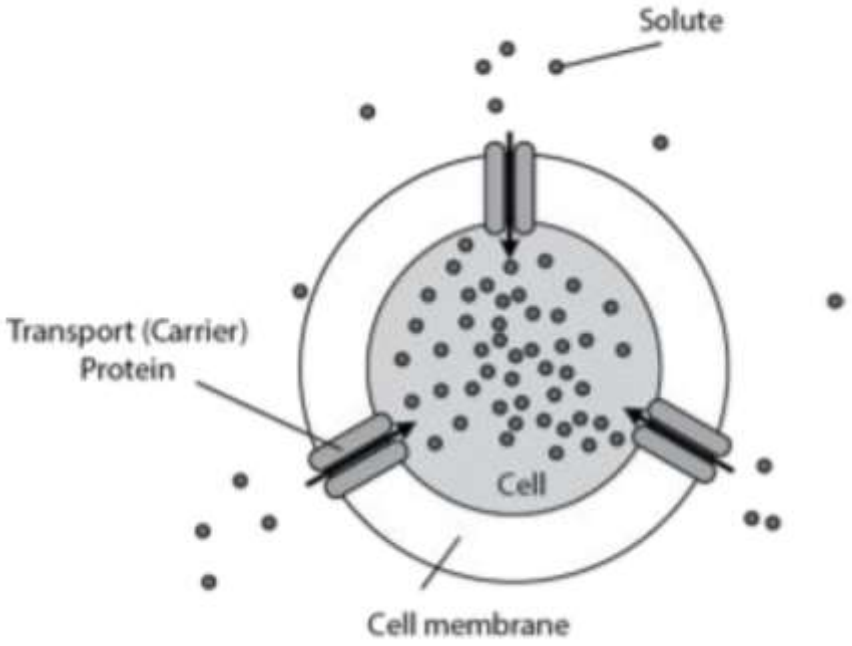
A Osmosis is the movement of water across a membrane, while diffusion is the movement of molecules from high to low concentrations.

B Osmosis is the movement of molecules from high to low concentrations, while diffusion is the movement of water across a membrane.

C Osmosis is the movement of solute across a membrane, while diffusion is movement of molecules from high to low concentrations.

D Osmosis is the movement of water across a semipermeable membrane, while diffusion is the movement of solute across a membrane.

9 An illustration of a cell interacting with its environment is provided.



The illustration best represents which of the following?

A Water moving into a cell by the process of osmosis

B Passive transport of solute into the cell by diffusion

C Active transport of solute into the cell using energy

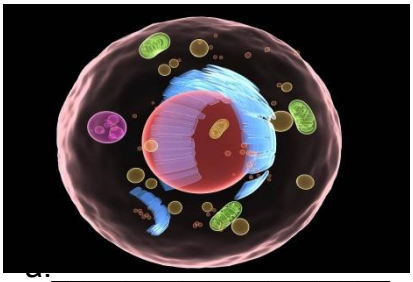
D Water leaving the cell by the process of osmosis

Day	Objective/TEKS	Agenda
3	TEKS 4.C (R): compare the structures of viruses to cells, describe viral reproduction, and describe the role of viruses in causing diseases such as human immunodeficiency virus (HIV) and influenza	1. Watch these videos: a. Introduction to Viruses and Viral Replication https://youtu.be/PEWjyx2TkM8 b. Lytic and lysogenic cycles https://youtu.be/jfqxhphr3A4 c. Flu Attack! How A Virus Invades Your Body | Krulwich Wonders | NPR https://youtu.be/Rpj0emEGShQ 2. Engage: Viruses 3. Linking Literacy: Viruses- Before you read, complete the Questions column. 4. Read Viruses. As you read, complete the Supporting Details column. 5. Writing in Science 6. Claim Evidence and Reasoning: Viruses 7. STAAR Tune-Up: Viruses 8. Assessment: Viruses

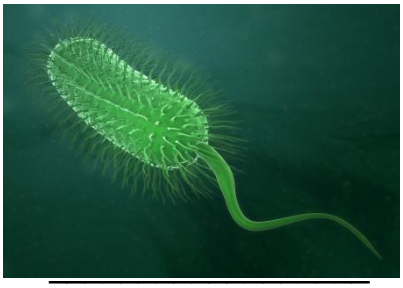
Engage

Name: _____ Date: _____

1. Label the following pictures as either a Virus, Bacteria, or Cell:



a. _____



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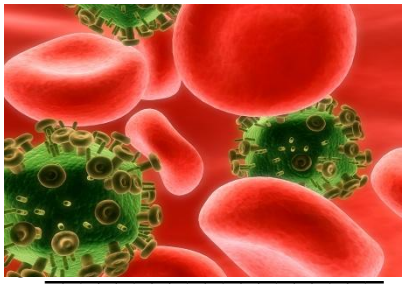


_____

2. In your own words, define a virus. Are viruses considered to be alive? Explain.

_____
_____
_____
_____

3. What ways do you think the following viruses are transmitted (air borne, blood borne, mosquito bite, animal bite, or contaminated food/water)?

West Nile Virus_____

Rabies_____

Influenza_____

Swine Flu_____

Hepatitis A_____

4. What is the difference between a vaccine and an antibiotic?

_____
_____
_____
_____

5. Circle all the diseases that are caused by viral infection.

Anthrax	Chicken pox	Influenza (flu)	Lyme disease
West Nile	Tetanus	Hepatits B	Cholera
Measles	Rabies	Mononucleosis	Whooping Cough
Hepatitis A	Bubonic Plague	Gonorrhea	Common cold

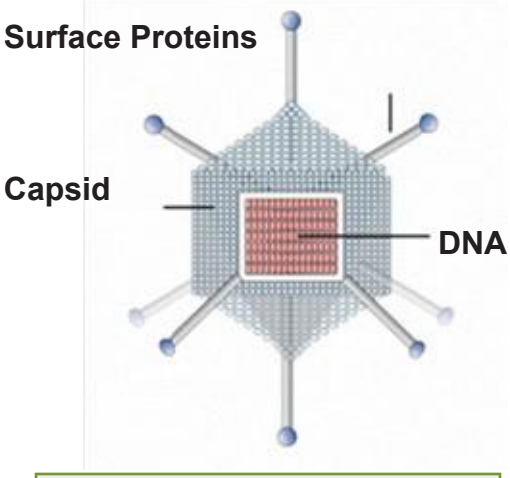
Reflect

Imagine a military base designed to keep invaders out. Soldiers patrol the fences and gates. Cameras are set up along the borders of the base to capture video of anyone who tries to get in. Sensors in the ground set off alarms if someone jumps over the fence. But, every day, the tiny invaders get past these complex security measures and take over the base. In this analogy, the military base is the human body and the tiny invaders are called *viruses*.

What are viruses? Are they alive? How do they make us sick?

Characteristics of Viruses

Viruses are nonliving particles. They do not eat, they do not have a metabolism, and they cannot move on their own. Viruses are not able to reproduce without living cells. They lack cytoplasm and membrane-bound organelles.



Viruses depend on living things to survive, and in doing so harm their cell **hosts**. This characteristic makes viruses parasites. Viruses are also very small. They are so small, in fact, that they are measured in nanometers (nm). One nanometer is 1 x 10^{-9} meters. The common cold virus is 75nm, about 100 times smaller than a red blood cell! Their tiny size is part of what makes viruses so good at invading living things. A virus is fairly basic in structure and contains only what it absolutely needs to survive.

host: organism that supports a parasite

- **Protein coat:** The outside of a virus is composed of a protective protein coat called a *capsid*. The capsid has surface proteins on it that help the virus invade cells. Protein coats come in many shapes and sizes. Some viruses are spherical in shape, while others look like rods. Some viruses also have a lipid envelope surrounding the protein coat.
- **Surface proteins:** *Surface proteins* are located on the virus's protein coat. They act as "keys" that bind with the host cell's receptor proteins, or "locks." The surface proteins allow the virus to bind to the host cell. Then, the virus can insert its genetic material into the cell or enter the cell itself. The surface proteins match up only with specific cells. This is why a virus can infect only certain cells in the body. For example, a virus with surface proteins that match up with liver cells cannot infect red blood cells.
- **Genetic material:** Like cells, viruses have genetic material. The genetic material in a virus may be single- or double-stranded RNA or DNA. As with **prokaryotic cells**, the genetic material is not contained within a nucleus. It is found inside the protein coat. Viruses vary in the size of their genome. Some viruses have as few as four genes, while others may have 1,000 genes. Viruses can copy their genetic material only while inside a host cell.

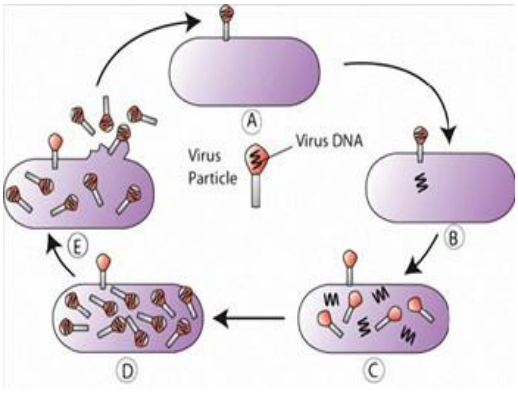
prokaryotic cell: a cell that does not contain a membrane-bound nucleus or other organelles

Look Out!

Not all viruses are bad. Scientists have found a way to use viruses to prevent disease. Most children in the United States are required to have certain vaccines before they enter school. A vaccine contains a weakened or inactive virus that is injected or sprayed into the body. The virus is not strong enough to cause the disease, but it does cause an immune response. The body learns to recognize and fight the virus. So, if the strong, active version of the virus ever attacks the body in the future, the body will be able to fight it off without getting the disease.

Viral Reproduction

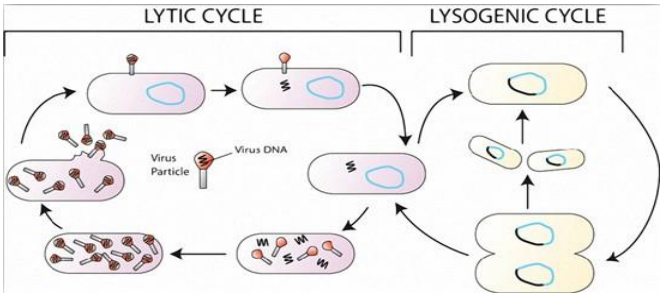
A virus can make copies of itself in two ways: lytic infection and lysogenic infection. Both of these methods involve the virus taking over a living cell in order to reproduce.



- **Lytic infection:** The *lytic* infection is so named because it causes the host cell to lyse, or be destroyed. The virus attaches to the host cell (A), where it either enters the cell or injects its genetic material into the cell (B). The virus now controls the host cell and directs the cell to make viral proteins and genetic material. The cell host cell is now filled with new virus particles (C). Think of this process as similar to breaking into a car factory and using the machinery to make your own kind of car (D). Eventually, the viral genes direct the production of enzymes that cause the release of newly produced viruses from the cell. The newly produced viruses escape the host cell either by causing it to burst or by encasing themselves within a piece of the cell membrane and then breaking away from the cell (E). Each of these new virus particles is capable of infecting another cell.
- **Lysogenic infection:** Think of the lysogenic infection as a sneaky attack compared to the lytic infection. In a *lysogenic infection*, the virus does not immediately kill its host cell. Like a lytic infection, the virus either enters the cell or injects its genetic material into the cell. The difference is that in a lysogenic infection the viral genetic material is inserted into the host cell's DNA. Whenever the host cell replicates its DNA, the viral genome is copied, too.

All of the host cell's **daughter cells** contain a copy of the virus genome. Eventually, something triggers the viral DNA to remove itself from the host's DNA. Common triggers include cellular stress or exposure to ultraviolet radiation. Once the viral DNA is triggered, the infection responds like a lytic infection. The host cell and its daughter cells replicate copies of the virus. Eventually, the cells lyse, or are destroyed, and viruses are released. Lysogenic viruses that you may be familiar with are those that cause cold sores and shingles.

daughter cells:
the cells produced during cell division



What Do You Think?

Viruses depend on living things for survival. Viruses can reproduce only if they are inside a living cell. Do you think viruses evolved before living things or after? Explain your reasoning.

Viral Diseases

Like a military base, our bodies have many defenses to prevent viruses from infecting our cells. The skin and the mucus lining the respiratory tract help prevent viruses from invading the body. But, every now and then, these tiny invaders slip past our defenses.

Viruses are the cause of a variety of diseases. Some you may have had yourself—the common cold, influenza (flu), chicken pox, and measles. Viruses can also cause more serious diseases, such as dengue fever (a disease spread by mosquitos, characterized by high fever), encephalitis (a disease characterized by swelling of the brain), small pox, and AIDS. Some viruses can even cause cancer by disrupting the normal cell cycle. Usually, a cell's DNA contains information about when the cell should stay at rest and when it should replicate. Some cancer-causing viruses are able to direct the cell to keep dividing over and over. The result is a large mass of cells called a

The symptoms of a disease are often due to the type of cell that is attacked by the virus. Remember that different viruses can infect only specific cells. Viruses that attack nerve cells, like the polio virus, can cause paralysis or loss of movement. When a nerve cell is killed by a viral infection, it is not replaced, because nerve cells do not reproduce. When enough nerve cells are killed, a person experiences paralysis. Some viruses infect white blood cells. White blood cells are part of a human body system that fights infections. When a virus kills white blood cells, the body can become more susceptible to further infection. The virus that causes the common cold infects cells in the respiratory tract. When attacked, these cells release mucus, which can result in a runny nose or cough. In this case, the symptoms are due more to the immune system response than to the actions of the virus itself!

The Immune System: Fighting Infections

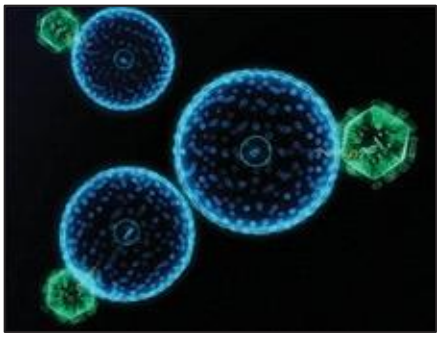
How does your body cope with a viral infection? As mentioned previously, the body's immune system fights the virus. Special cells in the immune system try to find and destroy any body cell that contains a virus. These immune cells can also direct an infected cell to self-destruct before the virus inside can make copies of itself. This process of self-destruction is called a*poptosis*. Some viruses have developed special proteins that inhibit apoptosis. This allows the virus to continue using the cell for reproduction. Sometimes the ways in which the body tries to fight the virus can end up hurting the body, too. For example, a fever is the body's way of trying to "cook" the virus to death. This attempt to control the infection can cause discomfort and even serious damage to the body, though that's rare. However, very high, prolonged fevers can cause seizures and brain damage.

What Do You Think?

Acquired Immunodeficiency Syndrome: AIDS

AIDS is caused by the human immunodeficiency virus (HIV). This virus causes a deficiency in the body's defenses by targeting and killing cells in the immune system. HIV targets helper T-cells, the very cells in the body that would be useful in fighting the viral infection. The virus is also able to hide from the immune system, allowing it to replicate without being detected.

HIV is a retrovirus. What does this mean? The prefix *retro-* means "backward." It refers to the backward way in which the virus **transcribes** DNA. In most viral infections, a virus first injects its genetic material into the cell, and the cell then makes RNA and proteins from the viral genes. In a retrovirus infection, the retrovirus injects its genetic material, RNA, along with an **enzyme** called reverse transcriptase, into the host cell. The host cell then makes double-stranded DNA from the viral RNA using the reverse transcriptase.



This model shows HIV (green) attacking white blood cells (blue).

The viral DNA is then incorporated into the genome of the host cell. Some of the medicines that are used to treat HIV and other retroviruses attempt to inhibit reverse transcriptase. This prevents the virus from incorporating its DNA into the host cell's DNA and making copies of itself.

transcribe: to convert the genetic information in DNA into RNA

Although AIDS cannot be cured, it can be delayed with treatments that inhibit virus replication. For example, a drug called AZT inhibits the function of reverse transcriptase.

enzyme: a protein that helps control a chemical reaction in the body

Career Corner: Virologists

Do you like solving medical mysteries? Do you like using laboratory equipment? If so, a career as a virologist might be in your future. A *virologist* is a scientist who studies viruses. Virologists may study the origin of a virus, its shape, its method of infection, the diseases it causes, and how to fight the diseases. Some virologists work in laboratories. Others travel to places where viral diseases are widespread within the population to learn more about the viruses. A virologist may work with other scientists to develop anti-viral medications and vaccines.

This virologist is using a micropipette to infect a culture of human cells with a virus.

Virologists work with sophisticated technology. Because viruses cannot usually be seen with a compound light microscope, virologists must use powerful electron microscopes to visualize viruses. By studying viral diseases, these scientists make a huge difference in the world. The work they do saves lives and prevents the spread of diseases.

What Do You Think?

What do you know?

Use what you know about viruses to fill out the table below. First, decide if you agree or disagree with the statement in the left column. Then, provide an explanation for your decision in the right column.

Agree/Disagree?	Explanation
Viruses are nonliving. Agree Disagree	
Viruses are larger than most living cells. Agree Disagree	
A lytic infection involves incorporating viral DNA into a host cell's DNA. Agree Disagree	

Linking Literacy

Name: _____ Date: _____

Three Column Notes

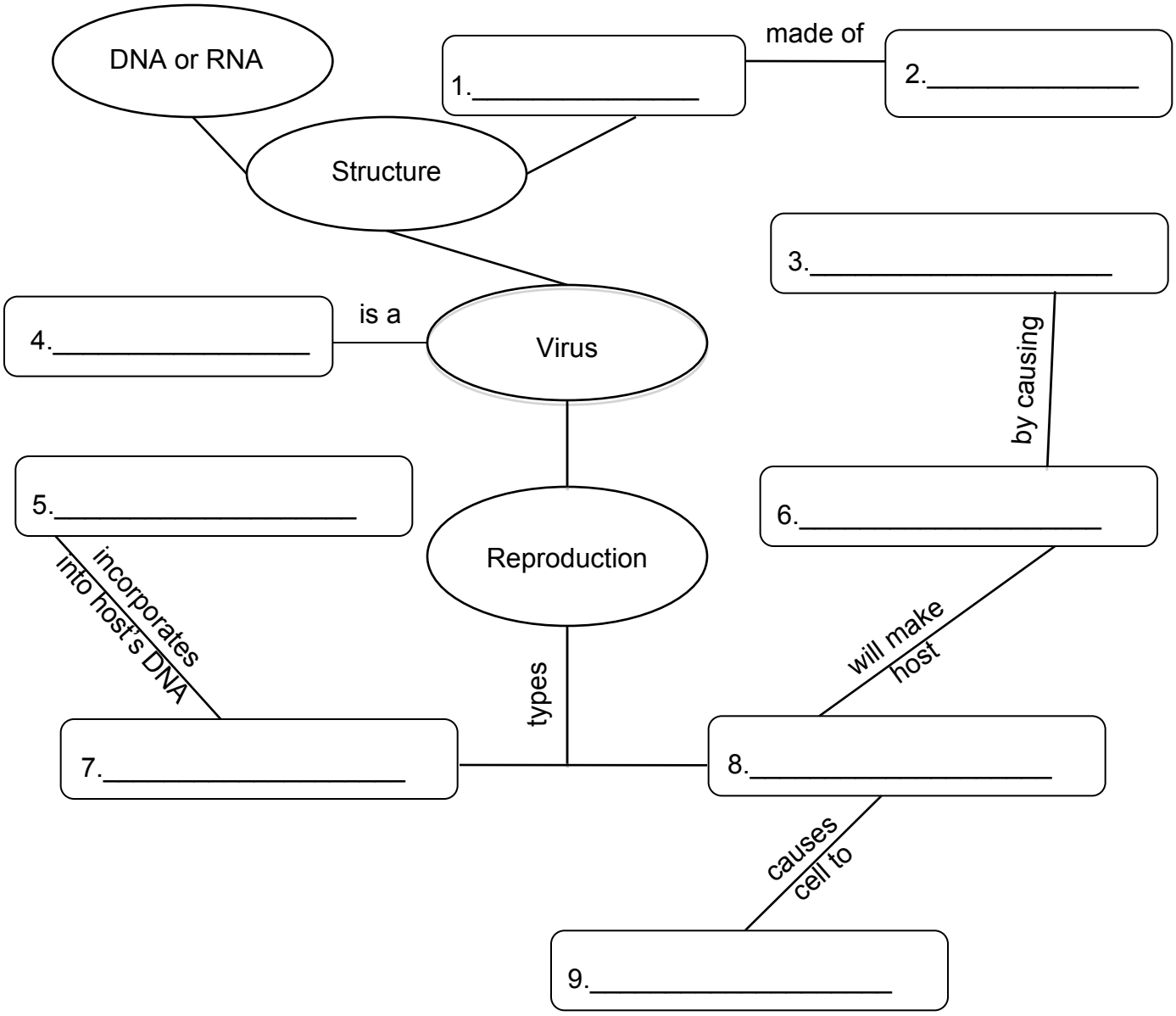
Main Idea	Questions	Supporting Details
Characteristics of Viruses		
Viral Reproduction		
Viral Diseases		
The Immune System		
AIDS		

Guided Practice

Viruses

Graphic Organizer: Using all of the following terms in the word bank, complete the graphic organizer

Word Bank
capsid burst diseases viral DNA sick
lysogenic lytic cycle pathogen protein

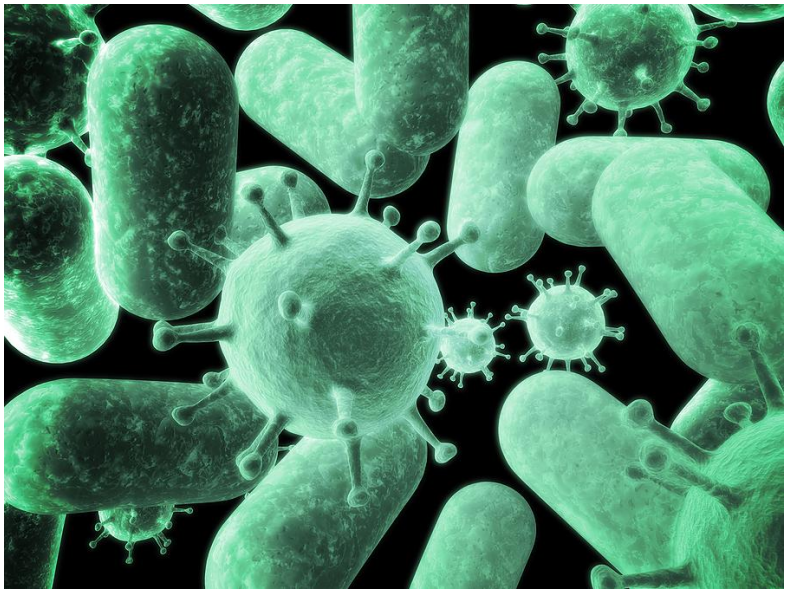


Claim-Evidence-Reasoning

Name: _____ Date: _____

Scenario

A **virus** is essentially DNA or RNA surrounded by a coat of protein. It is not made of a **cell** and cannot maintain a stable internal environment (**homeostasis**). Recall that a cell is the basic unit of living organisms.



Prompt:
Provide a scientific explanation of how viruses reproduce and how this differs from other organisms.

Claim:

Evidence:

Reasoning:

Rebuttal:

Claim-Evidence-Reasoning

Viruses CER

Rubric for Writing a Scientific Explanation

Points Awarded	2	1	0
Claim	Claim is complete and accurate.	Claim is incomplete or inaccurate.	Student does not make a claim or does not answer the question.
Evidence	Evidence cites data and patterns within the data and uses labels accurately.	Evidence cites data from the data source but not within the context of the prompt.	There is no evidence, or changes are cited but do not use data from the data source.
Reasoning	Student cites the scientifically accurate reason using correct vocabulary, connects the reason to the claim, and shows accurate understanding of the concept.	Student cites a reason, but it is inaccurate or does not support the claim. Reasoning does not use scientific terminology or uses it inaccurately.	There is no reasoning, or student relies on a restatement of the claim.
Rebuttal	Rebuttal provides reasons for different data or outliers in the data, offers relevant real-world cases, or suggests other uses for the findings.	Rebuttal is not connected to the data, or it is not accurate.	Student does not offer a rebuttal.

Writing Science

Name: _____ Date: _____

Look

Think

Think about the different types of infections and how they may be treated.

Your throat starts to hurt, your body aches, and suddenly you have a high fever. You realize that you have been infected by some sort of pathogen, or disease-causing agent. Treatment depends on the origin of the infection. If a bacterial infection occurs, an antibiotic would stop the symptoms of the illness as the antibiotic would kill the bacteria. There are no cures for viral infections. Usually once infected with a virus, only the symptoms may be treated, though some treatments for viral infections like HIV are available (AZT).

Your best defense against a viral infection is good hand washing habits. Soap and warm water will wash most viruses off of your skin before they enter your body. Vaccines are also an option for prevention. Vaccines “train” your immune system to recognize a specific virus so that if you are infected, your body is ready to defend itself. When you are vaccinated, a dead or weakened version of the virus is injected into your body. This triggers your immune system to create antibodies for that specific virus, which are then manufactured in your body. If (or when) that virus shows up again, the body is ready to attack and stop the virus from entering your cells.

Write

Describe the various types of infections, and explain why it is difficult to halt the spread of viruses.

Be sure to –

•Address the prompt, provide support, and conclude your thoughts.
•Write legibly and concisely.

Writing Science

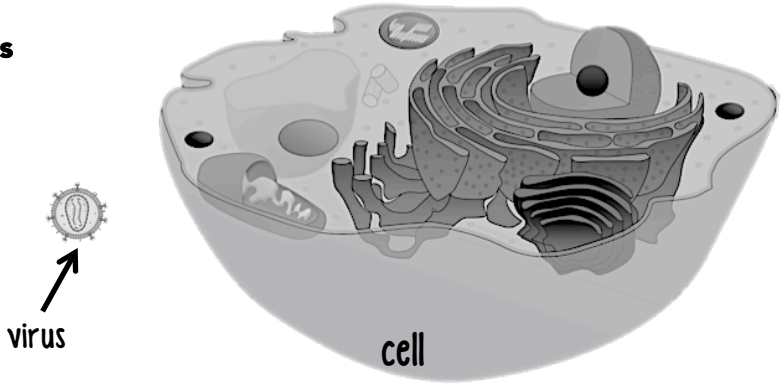
STAAR Tune-Up- B.4C: Viruses

B.4 the student knows that cells are the basic structures of all living things with specialized parts that perform specific functions and that viruses are different from cells.

B.4 (C) Compare the structure of viruses to cells, describe viral reproduction, and describe the role of viruses in causing diseases such as HIV and influenza.

I. Comparing Viruses and Cells- Characteristics

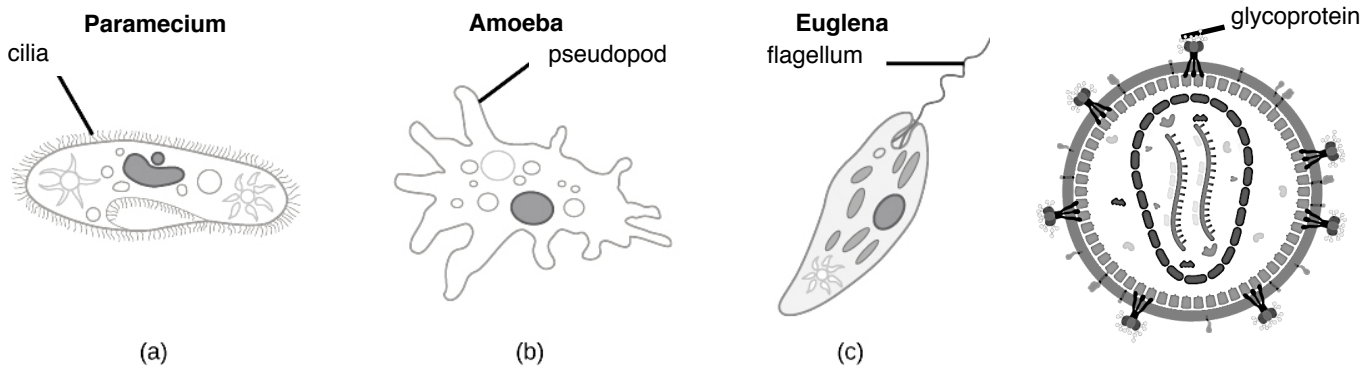
Viruses are tiny particles that are designed to infect other cells. They cannot survive without a host, and therefore are considered non-living. Viruses are very tiny in comparison to cells, and in order to make more of themselves they need to use a living cell's own DNA and replication mechanisms.



Characteristic	Virus	Cells
Structure	Proteins and RNA	Membrane, DNA, cytoplasm, nucleus, organelles
Reproduction		Independent cell division
Genetic material	_____ (or in some cases DNA)	
Growth and development		Cell cycle (_____)
Obtaining and using energy		
Response to environment		

II. Comparing Viruses and Cells- External Features

Cells have different external structures, such as cilia, pseudopods, and flagella. What function do these structures share? What do they help the cell do? _____

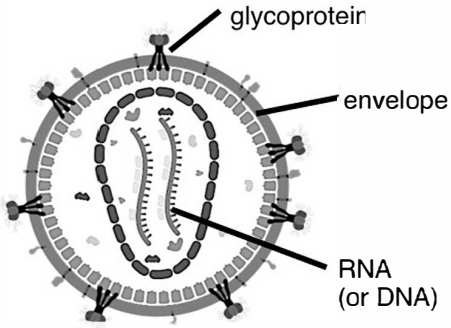


Viruses also have external structures made up of glycoproteins. But viruses are non-living particles that float around, they do not have independent movement. The glycoproteins are used for communicating with the host cell, not movement.

B.4 the student knows that cells are the basic structures of all living things with specialized parts that perform specific functions and that viruses are different from cells.

B.4 (C) Compare the structure of viruses to cells, describe viral reproduction, and describe the role of viruses in causing diseases such as HIV and influenza.

III. Viral Replication - Viruses *cannot* replicate without a host. They use the host cell's mechanisms to create more genetic material. Use the diagram below to answer the questions.



1. How does the virus use a host cell to make copies of itself?

_____

_____

_____.

2. How are virus infections like a "sneak attack"?

_____

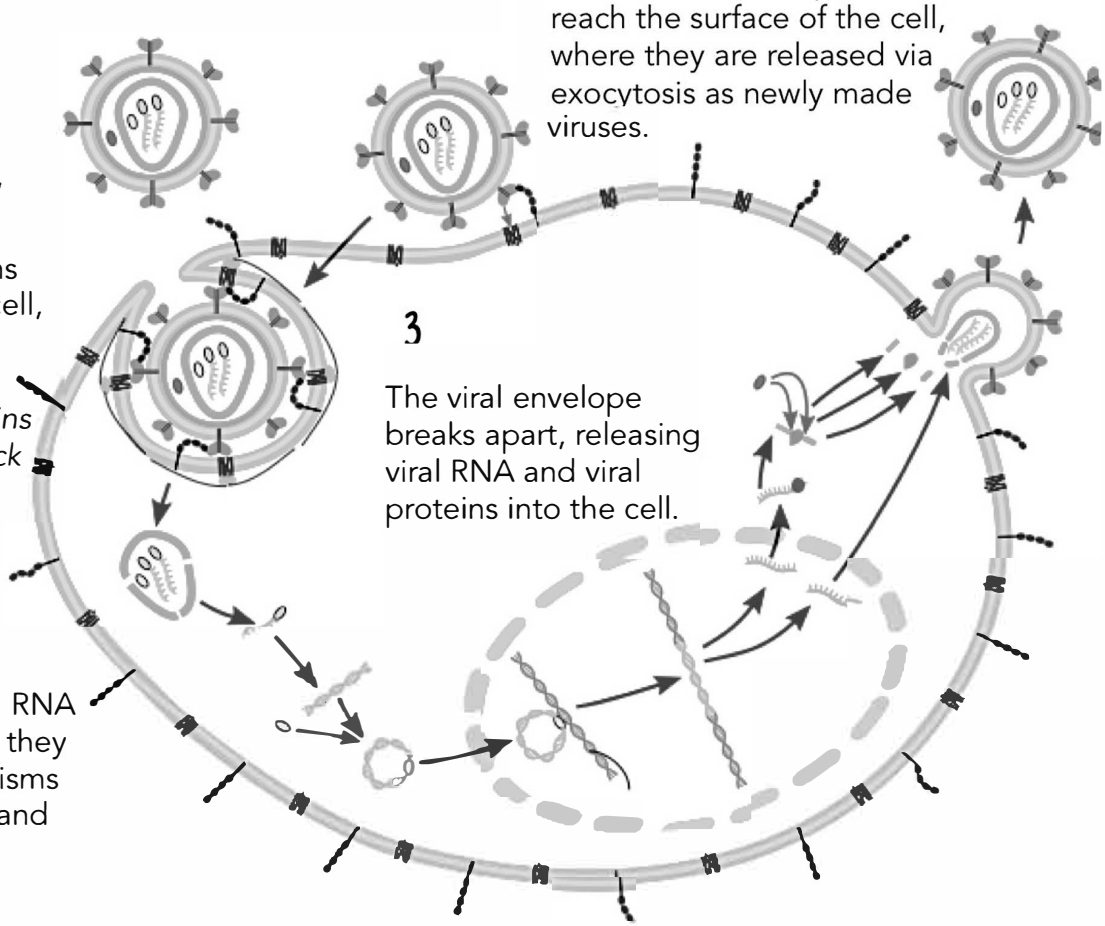
_____

_____.

3. Does the virus use any energy while replicating? (See chart on previous page). (See chart on previous page).

_____

_____.



1

Glycoproteins on the virus' surface are used to invade the cell. If the glycoproteins are accepted by the host cell, the cell will engulf it via endocytosis. *The host cell recognizes the glycoproteins as one of its own; like a lock and key.*

2

The viral proteins and viral RNA invade the nucleus, where they use the host cell's mechanisms to create more viral RNA and proteins.

3

The viral envelope breaks apart, releasing viral RNA and viral proteins into the cell.

4

The viral RNA and proteins reach the surface of the cell, where they are released via exocytosis as newly made viruses.

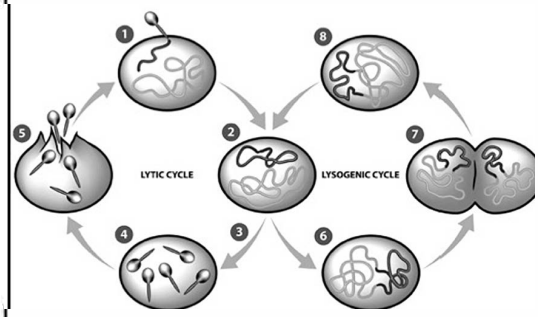
B.4 the student knows that cells are the basic structures of all living things with specialized parts that perform specific functions and that viruses are different from cells.

B.4 (C) Compare the structure of viruses to cells, describe viral reproduction, and describe the role of viruses in causing diseases such as HIV and influenza.

III. Viral Replication (continued)

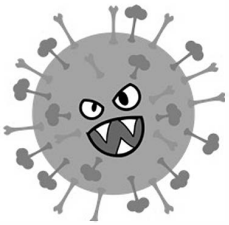
In the table below, briefly describe to the possible paths of viral replication.

Lytic Cycle	Lysogenic Cycle



IV. The role of viruses in disease

For the following scenarios, determine if the virus causing the disease is generally in a lytic cycle or a lysogenic cycle.



1. _____ The virus herpes type I, or HSV-1, causes cold sores. The virus is dormant within the nerve endings of your facial nerves, but you typically do not have any cold sores or other symptoms after your first outbreak.

2. _____ A woman was exposed to the chicken pox virus *Varicella* when she was a child. The outbreak caused itchy bumps and rashes for about one week during her childhood. The virus had been living dormant in her body, but years later caused a second outbreak in the form of shingles.

3. _____ After being exposed to the influenza virus, a teenager begins to show symptoms after 4-7 days.

Your Body's Immune Response to Viruses

4. List as many immune responses that your body produces in reaction to a viral infection (example: fever)

Examples of viruses include influenza (the flu), chicken pox (varicella), measles, Ebola, herpes, HIV (human immunodeficiency virus), SARS, and bacteriophages (viruses that infect bacteria).

Assessment: Viruses

1 Cells differ from viruses in that only cells –

A use genetic material.

B are microscopic structures.

C contain cytoplasm.

D have protective covering.

---

2 Viruses use two different cycles of replication, the lytic cycle and the lysogenic cycle. In what way is the lysogenic cycle different from the lytic cycle?

A The virus recognizes and attaches to host cell.

B The host cell is not destroyed immediately.

C Viral DNA is replicated along with host DNA.

D The virus injects its DNA into the host cell.

---

3 A bacteriophage is a type of virus that infects only a bacterial host cell. A bacteriophage can't cause disease in humans because it –

A does not have the correct surface proteins.

B can only use bacterial DNA to replicate.

C gets destroyed in the human digestive tract.

D is able to reproduce without a host cell.

4 The presence of which of the following structures could be used to distinguish a cell from a virus?

A Genetic material

B Protective covering

C Cytoplasm

D Protein coat

---

5 The viral structure responsible for recognizing specific host cells is –

A a surface protein.

B genetic material.

C a retrovirus.

D a bacteriophage.

---

6 A bacteriophage virus causes infection in bacteria by injecting which of the following?

A DNA

B Hormones

C Proteins

D Lipids

---

7 A viral infection can lead to cancer by all of the following methods EXCEPT –

A altering the host cell DNA.

B disrupting the host cell cycle.

C damaging the immune system.

D releasing viruses, infecting other cells.

8 Which of the following characteristics is shared by viruses and living cells? Both viruses and living cells –

A have a nucleus, as well as a cell wall.

B contain nucleic acids such as DNA or RNA.

C can replicate independently of a host cell.

D use organelles to perform life functions.

Day	Objective/TEKS	Agenda
4	TEKS 5.A (R): describe the stages of the cell cycle, including deoxyribonucleic acid (DNA) replication and mitosis, and the importance of the cell cycle to the growth of organisms TEKS B.5.B (S): describe the roles of DNA, ribonucleic acid (RNA), and environmental factors in cell differentiation TEKS B.5.C (S): recognize that disruptions of the cell cycle lead to diseases such as cancer	1. Watch these videos: a. Cell Cycle https://youtu.be/lf9rcqifx34 b. Cell Check Points https://youtu.be/1EB8q9aR8Hk c. DNA Replication Animation https://youtu.be/dKubyIRiN84 d. Cellular Specialization https://youtu.be/jp6L5emD8rw 2. Read Cell Differentiation 3. Linking Literacy 4. Guided Practice: Cell Differentiation 5. Reading Science: Frogs and You 6. Math Connection: Cell Differentiation 7. Claim Evidence and Reasoning: Cell Differentiation 8. STAAR Tune-Up: Cell Cycle, Cell Differentiation, Disruption to Cell Cycle 9. Assessment: Cell Differentiation

Reflect

Over the past several years, a controversial debate has been brewing over the use of *stem cells*. Stem cells can be used to treat certain diseases and conditions such as spinal cord injuries, diabetes, arthritis, and heart disease. The sources of stem cells include umbilical blood, bone marrow, specially treated peripheral blood, and **embryos**. The use of embryos as a source of stem cells has stirred controversial debate over the past several years. Stem cells are unique because they aren't special at all. They are not specialized, but they have the potential to specialize into a variety of different cell types. Because stem cells are undifferentiated, meaning they have not yet developed specific structures or functions, they can be used to replace unhealthy cells.

embryo: an early stage of development in organisms

As cells grow in an embryo, they differentiate, becoming a distinct type of cell. For example, muscle cells and nerve cells in animals and root cells and leaf cells in plants are differentiated. *Cell differentiation* allows each type of cell to perform its necessary function. To better understand what makes cells special, we will explore the answers to these questions: How do cells divide and grow? How do they become differentiated? What factors affect cell differentiation, and what happens if cell differentiation is disrupted?

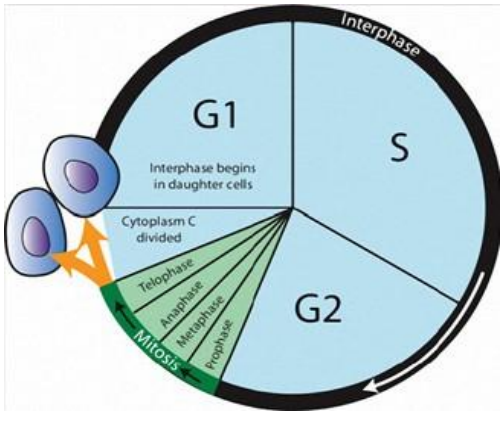
The Cell Cycle

Eukaryotic cells grow and divide through a series of events called the *cell cycle*. The cell cycle consists of two main stages: interphase and mitosis. During the cell cycle, a cell grows, prepares to divide, and then divides into two daughter cells. A cell spends 90% of its life in *interphase*, which includes G_1, synthesis, and G_2. These are growth and development stages.

eukaryotic: having a membrane-bound nucleus and other organelles

G_1: This phase is characterized by cell growth. In this phase, also known as "Gap 1," the cell grows larger, makes new proteins, and develops organelles.

Synthesis: From G_1, cells move into the S phase, or synthesis. This phase is characterized by the replication of the genetic material held within a cell, **DNA (deoxyribonucleic acid).**



DNA replication makes an exact copy of the genetic material, which will be passed onto each daughter cell during mitosis. DNA replication begins when enzymes unzip the DNA molecule, forming two strands. Then, nucleotides are added to each of the strands following the rules of base pairing. There are four nucleotides in DNA: adenine (A), thymine (T), guanine (G), and cytosine (C).

Reflect

Adenine always pairs with thymine, and guanine always pairs with cytosine. For example, a section of the template DNA strand reading TGATC would be paired with the nucleotides ACTAG. At the end of the S phase, the cell contains double its normal amount of DNA.

To start DNA replication, the molecule unzips along the base pairs, creating two single strands.

What Do You Think?

Why do you think the strict rules of base pairing are important to DNA replication?

G_2: This is the last phase before the cell enters mitosis. During G_2, the cell grows more and prepares for mitosis by producing the structures needed for the upcoming division.

Mitosis: Although it is the shortest phase of the cell cycle, mitosis is a time of great activity. *Mitosis* divides the nucleus, distributing DNA to each daughter cell. It is completed by *cytokinesis*, which divides the cytoplasm and separates the cell into two individual cells. Mitosis is subdivided into four phases.

You can see a table describing the phases of mitosis on the following page.

Look Out!

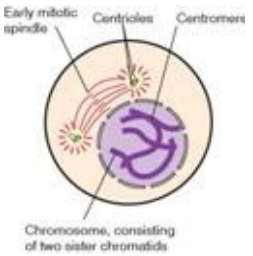
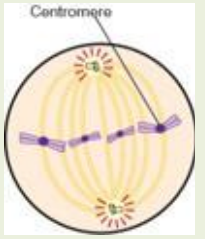
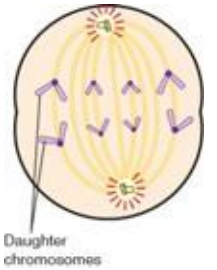
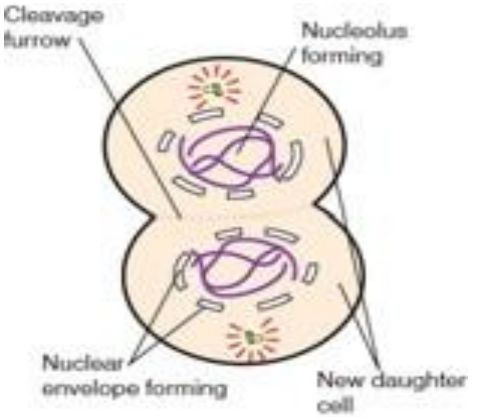
Only eukaryotic cells perform the stages of the cell cycle, including mitosis. **Prokaryotic** cells undergo a simpler form of cell division called *binary fission*. Binary fission is a form of asexual reproduction that results in two identical cells. It begins when a prokaryote replicates its DNA and attaches the copy to one part of the cell membrane and the original DNA to another. The cell pulls apart, separating the copy of DNA from the original genetic material, forming two identical cells.

prokaryotic: lacking a membrane-bound nucleus and other organelles

What Do You Think?

If you were to examine a plant or animal cell under a microscope, what phase of the cell cycle would you most likely see? Explain your reasoning.

What Do You Think?

Prophase	Metaphase →	Anaphase →	Telophase	Cytokinesis
• DNA concentrates into chromosomes made up of two sister *chromatids* connected at the *centromere*. • The spindle fiber forms, emanating from the centrioles. • The centrioles move to opposite ends of the cell.	• The nuclear envelope breaks down. • The centromeres attach to the spindle fibers. • Chromosomes are lined up at the center of the cell.	• Sister chromatids separate at the centromere and are now called chromosomes. • The chromosomes move to opposite ends of the cell along the spindle fibers. • The cell begins to elongate at the ends.	• Chromosomes uncoil. The mass of the uncoiled chromosomes is called *chromatin*. • Nuclear envelopes form around each cluster of chromosomes. • The spindle fiber breaks down and disappears.	• The cytoplasm divides in two. • In animals, the cytoplasm is drawn in until it is pinched in two, creating the two new daughter cells. • In plants, a cell plate forms between the daughter cells. It gradually forms a membrane and cell wall separating the two cells.
				

What Do You Think?

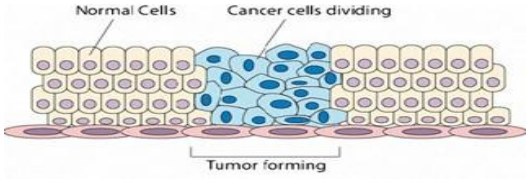
Disruptions in the Cell Cycle

The timing and organization of the cell cycle are important to the growth of an organism. Disruptions to the cycle can lead to diseases, including cancer. Organisms begin as a single cell and multiply into the billions of cells that make up living things. Cells increase in size, synthesize proteins, and develop organelles during the cell cycle. Errors, or **mutations**, that disrupt any part of the cell cycle, it can lead to disorders and disease.

mutation: change in the nucleotide sequence of DNA

Checkpoints throughout the cell cycle ensure normal operation of the various stages of the cycle. For example, a checkpoint at G_2 monitors the cell for any mutations that may disrupt normal cell function. If one is found, the cell does not enter mitosis, and disruptions may still occur, especially when checkpoints are bypassed, as the case with many cancers.

A high number of cancer cells have a defective p53 gene. This gene codes for a tumor-suppressing protein that regulates the cell cycle. When p53 is mutated, the cell cycle loses the ability to control normal growth.



Cancer develops when the cell cycle goes unchecked and cells begin to grow and divide uncontrollably. The rapid growth causes cells to amass into tumors. Not all tumors are cancerous. *Benign* tumors are masses of cells, but they do not spread and infect surrounding healthy tissue. *Malignant* tumors, on the other hand, are cancerous. The cancer cells invade healthy tissue, absorb the nutrients the normal cells need, and prevent organs from functioning properly. Cancerous cells that reach the bloodstream can travel to other parts of the body and spread cancer to many organs. This process is called *metastasis* and is very difficult to treat.

It is not always known what causes disruptions in the cell cycle. It is often the result of a random mutation. However, scientists know that certain external factors, such as viruses, extreme physical or emotional stress, and aging can cause the cell cycle to go haywire. Toxins, or poisons, that mutate cells and result in cancerous cell cycles are called *carcinogens*. Common carcinogens include tobacco smoke, asbestos, radiation from X-rays and microwaves, and smog.

Looking to the Future: Treatments for Cancer

Since cancer can spread so easily, it must be treated immediately. The most common treatments are surgery, radiation, and chemotherapy. When possible, surgeons remove tumors from the body to prevent the cancer cells from metastasizing. However, surgery is not always an option, so malignant tumors are sometimes blasted with concentrated beams of radiation that are targeted to destroy the cancer cells. A third treatment that usually accompanies surgery and radiation is *chemotherapy*, a procedure in which powerful drugs are given to the patient that target rapidly dividing cells. Radiation and chemotherapy tend to also damage healthy cells, leaving the patient with side effects including weakness, hair loss, and skin rashes.

Chemotherapy often damages healthy cells, which can result in hair loss.

What Do You Think?

Cancer researchers are constantly developing and testing new drugs and procedures to combat cancer while minimizing- damage to healthy cells. Gene therapy is one of the recent advancements in cancer treatment. Genes, often from stem cells, are injected into patients in place of damaged DNA to produce the necessary proteins for fighting infection. Also, damaged genes are completely replaced with healthy, normal-functioning genes. Other experimental procedures include injecting patients with “tumor-blasting” viruses and pinpointing diseased cells with a low-temperature “plasma blowtorch” that protects healthy cells.

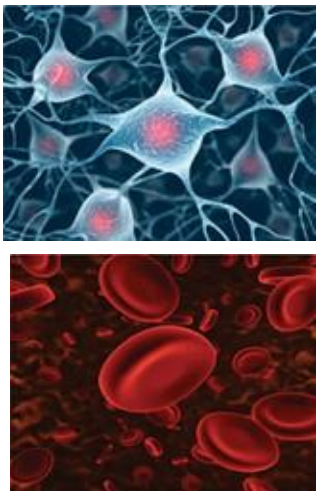
Cell Differentiation

Although every eukaryotic cell contains similar structures, including a complete set of DNA, cells are specialized to perform specific functions. In a cell, DNA is the set of instructions that controls all aspects of an organism. DNA is transcribed into another nucleic acid called *ribonucleic acid (RNA).* RNA is important because, unlike DNA, it can travel outside of the nucleus to the cytoplasm, where proteins are made. Organelles in the cell “read” the RNA and synthesize the proteins it encodes for. This is called gene expression. The proteins then build certain cell structures and perform specific cellular functions.

However, the entire strand of DNA is not read and synthesized. Only the necessary parts for each type of cell are expressed. Transcription factors determine which sequences of the DNA will be transcribed into RNA, which establishes what type of cell it will be. This process, called *cellular differentiation*, changes an unspecialized cell (stem cell) into a specialized one. As certain genes in somatic (body) cells are expressed, the cells become specialized to perform specific tasks the organism needs. For example, the cells found in the roots of plants differ from those found in the stems or leaves. This is because the different parts of a plant perform different functions.

Root cells absorb minerals and water from the soil, while cells that make up the stem need to provide structure and height for a plant to hold up its leaves to sunlight. Leaf cells must express the genes that build structures for photosynthesis.

The same is true in animals. Differentiated cells perform different functions, so they express different genes. Red blood cells, for example, express the gene for the protein hemoglobin because it is necessary for transporting oxygen. Muscle cells are differentiated to build many mitochondria, which produce energy in a cell, because muscles are responsible for movement and physical activity. Bone cells provide strength, support, and protection to the body. Nerve cells are unique in their structure. Their shape is differentiated to receive signals from stimuli and to pass them between the brain and the rest of the body. Epithelial cells are differentiated to control absorption and secretion.



Nerve cells (top) and red blood cells (bottom) differ in shape, structure, and function because of cell differentiation.

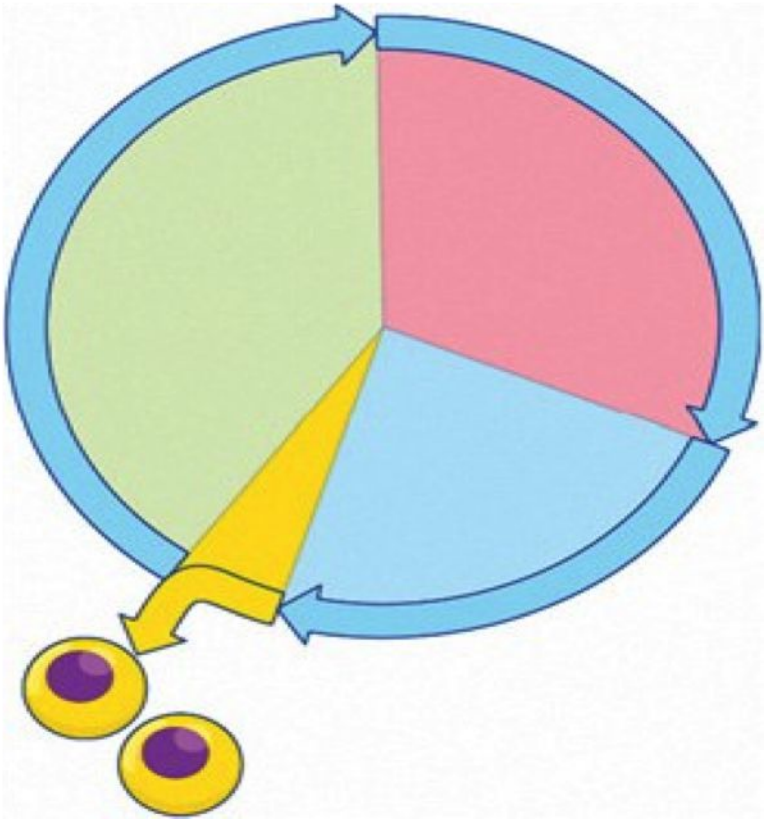
Look Out!

External factors in the environment can affect cellular differentiation by disrupting gene expression. Certain genes may become activated or inactivated in response to triggers, such as temperature changes, injury, exposure to chemicals, or lack of nutrients. For example, when the body is infected with a disease, white blood cells of the immune system will express genes that produce antibodies. Injuries, such as cuts and wounds, will initiate the expression of genes in the cells of the injured tissues for clotting factors. Temperature even determines male or female differentiation in some organisms. In certain species of alligators, eggs incubated at temperatures below 30°C will typically develop into females. Eggs incubated above 34°C will typically develop into males.

What Do You Think?

What are the advantages of cell differentiation? (Hint: Think about how an organism would be changed if all of its DNA were expressed in every cell.) What is a disadvantage of cell differentiation?

What do you know?
Use what you have learned to label the diagram of the cell cycle below. Begin by labeling the stages. Write your answers inside the sections of the circle. Then, on the outside of the circle, write the main processes that occur in each stage.



Name: _____ Date: _____

Cell Division Cycle Chart

Phase	Description	Important Terms	Drawing
Interphase			
Mitosis			

Guided Practice

Name: _____ Date: _____

Mitosis

Answer the questions below.

1. What are the stages of mitosis in order?

2. What is mitosis?

3. During which stage(s) of mitosis is the nuclear envelope visible?

4. How does mitosis contribute to your body's growth and development?

5. Not all cells in the human body undergo mitosis. Why might some cells, such as the neurons that run from your toes to the base of your spine, be unsuited to replicate via mitosis?

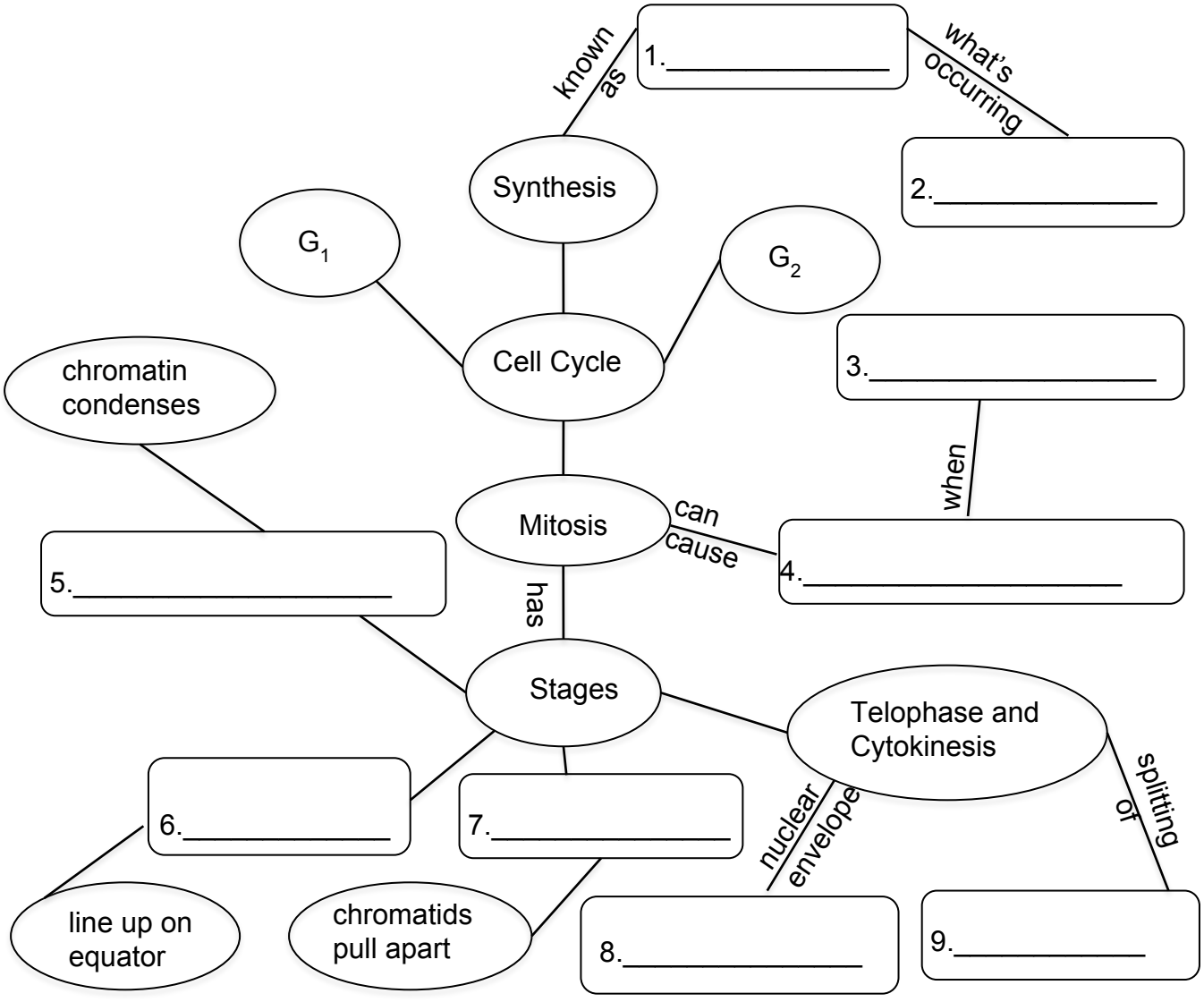
Guided Practice

Mitosis, continued

Using all of the following terms in the word bank, complete the graphic organizer.

Word Bank

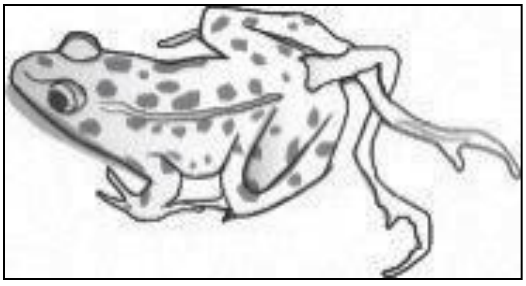
anaphase cancer cytoplasm DNA replication interphase
metaphase out of control prophase reappears



Reading Science

Name: _____ Date: _____

Frogs and You



1 Since the 1990s, there has been a sharp increase in the number of frogs found with deformities in the United States. Frogs have been found with three heads or extra sets of legs. Frogs have even been found with smaller frogs growing out of their backs!What could be causing this epidemic of deformities, and why are frogs so susceptible?

2 Frogs are amphibious. Even though many amphibians spend their adult life on land, most spend a significant portion of their life cycle in water. Amphibians go through amazing transformations from egg to tadpole to adult. At each stage, complicated cellular differentiation cycles must occur. Cells must receive messages that trigger specific responses. Specific parts of a cell determine whether that cell will start to divide to form tissues which will become a leg, an arm, or a head. Environmental factors can disrupt the signaling processes. Cells may instead be directed to create four legs, two heads, or perhaps to keep the tadpole tail. So, what could be happening in the water to "confuse" these cellular mechanisms?

3 Some scientists have hypothesized that pesticides are to blame for frog deformities. Other scientists claim that parasites are the ones causing the problem. Interestingly, it turns out that the interaction between pesticides and parasites may be what is to blame for the dramatic increase in deformities. In 2002, a study was published in the *Proceedings of the National Academy of Sciences*. It examined tadpoles infected with trematode parasites. They developed more frequent and serious deformities when exposed to pesticides in the water run-off from farms, parks, and homes than those that were not exposed to pesticides (Danielson, 2002).

4 Trematodes are the same parasites that can cause "swimmer's itch" in people. The trematode's normal host is a pond snail, but the larvae can infect other animals in the pond, such as frogs. The larvae form cysts that can disrupt cell differentiation in the growing tadpoles. The other problem is pesticides. The most common pesticides used in the U.S. are the weed-killer Atrazine and insecticides Malathion and Esfenvalerate (Danielson, 2002). Users must follow manufacturers' instructions when these pesticides are applied to fields, homes, and parks. Otherwise, these chemicals can sometimes make their way into streams, ponds, and wetlands – homes to most amphibians.

Reading Science

5 Extensive research has been done on amphibians and pesticides. According to studies by the manufacturer of Atrazine, presence of the weed-killer alone does not cause deformity in developing frogs (Kloas, et al, 2009). The EPA also says that, though Malathion breaks down quickly, it is toxic to fish and beneficial insects (EPA, 2008). The testing done with Esfenvalerate shows few harmful effects on mammals. However, the testing does show toxic effects on birds, fish, and daphnia that live in the water.

6 But, what is the link between the trematode larvae, pesticides, and frog deformities? Think of all of the developmental steps that a frog must go through from egg to adult. It is easy to see how minor disruptions in their aquatic environment could cause major deformities. Signaling triggers may be turned off, or may go into overdrive.

7 The researchers found that the pesticides in the water had reduced the amount of white blood cells found in tadpoles compared with other tadpoles that did not have exposure to pesticides. White blood cell count is a measure of an animal's immunity. Lower levels of white blood cells mean lower immunity. These white blood cells would normally detect and destroy an invasive trematode larva. But, the pesticides reduced the numbers of white blood cells, reducing the tadpole's immunity. This made it easier for trematode larvae to invade the tadpoles. Therefore, more disruptions were caused in the process of cell differentiation, leading ultimately to more frog deformities.

Reading Science

1 Why is frog development susceptible to minor environmental changes?

A They live a significant portion of their life in water.

B They go through many developmental changes.

C They are not adapted to live in aquatic environments.

D Both A and B

---

2 What are the main factors or causes in the disruption of the frog's cellular processes?

A The disruptions are unexplained.

B Larval cysts disrupt the developmental cycle and pesticides lower white blood cell count.

C Water density and temperature extremes.

D Radiation and global warming.

Reading Science

3 The pesticide manufacturers have research which shows that their products do not cause deformities in frogs. Studies by independent researchers show a link between pesticides and frog deformities. How can these two results both be true?

A Manufacturer's tests were done in the absence of parasites.

B Different types of frogs were studied and had different responses to the chemicals.

C They cannot both be true. The independent researchers have made a mistake interpreting their results.

D They cannot both be true. The manufacturers are trying to fool the public into buying their pesticides.

---

4 Why should consumers read and follow directions on pesticide labels?

A To protect their own health

B To protect the health of amphibians like frogs

C To prevent pesticides from being washed into nearby streams and other waterways

D All of the above

5 How did tadpole white blood cell counts affect the number of deformities in the frogs?

A The less white blood cells the frogs had, the more deformities the frogs had.

B The less white blood cells the frogs had, the less deformities the frogs had.

C The number of white blood cells would fluctuate, and deformities would result during these periods.

D White blood cell counts had nothing to do with frog deformities.

---

6 What impact does knowing what causes the deformities in the frogs have on the environment?

A Provides justification to eliminate trematode parasites from our bodies of water

B Provides evidence that we should not use pesticides since they are damaging the frogs

C Demonstrates that environmental systems are complex and interconnected, so we must seek complex solutions

D Does not make any difference

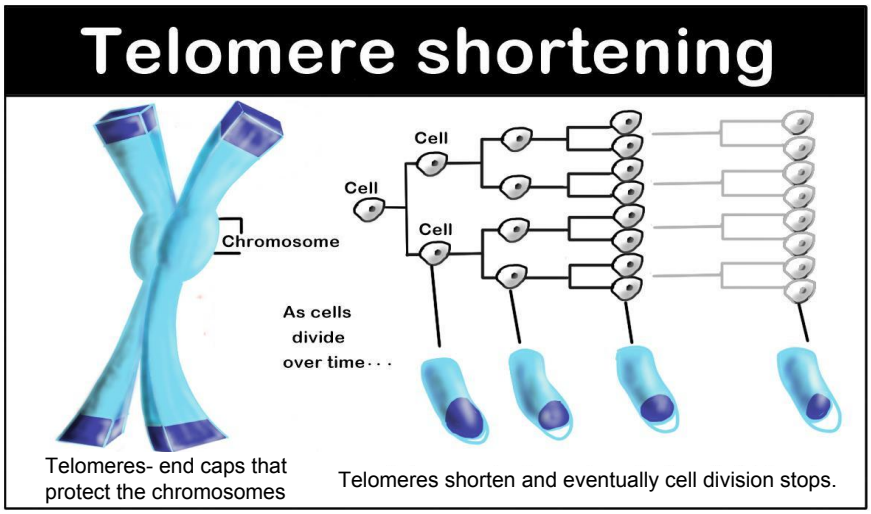
Name: _____ Date: _____

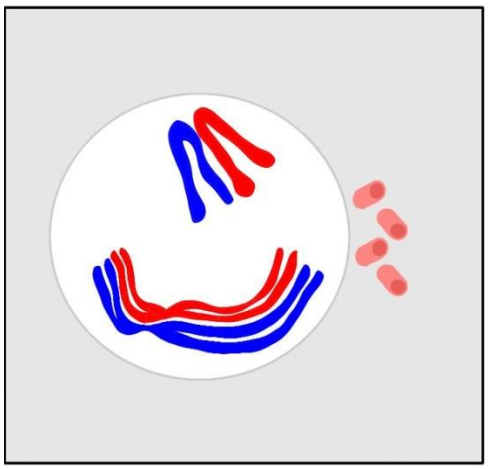
Cell Differentiation

Part I: Shortening Telomeres Responsible for Disruption of Cellular Mitosis

A team of scientists at the Salk Institute for Biological Studies in California are studying telomeres, the stretches of DNA at the end of our chromosomes that makes it possible for cells to divide. Their research shows that each time a human cell divides, its telomeres become shorter. Consequently, the cell senesces, or dies, when the telomeres become too short.

The following function, T(n) = 8000 – 100n, where *n* is the number of years and *T*(*n*) is the telomere length in base pairs, can be used to determine when a typical human blood cell no longer has the ability to divide. When a telomere has approximately 1,000 base pairs left in length, it loses its ability to divide. Using this information, complete questions 1–5.



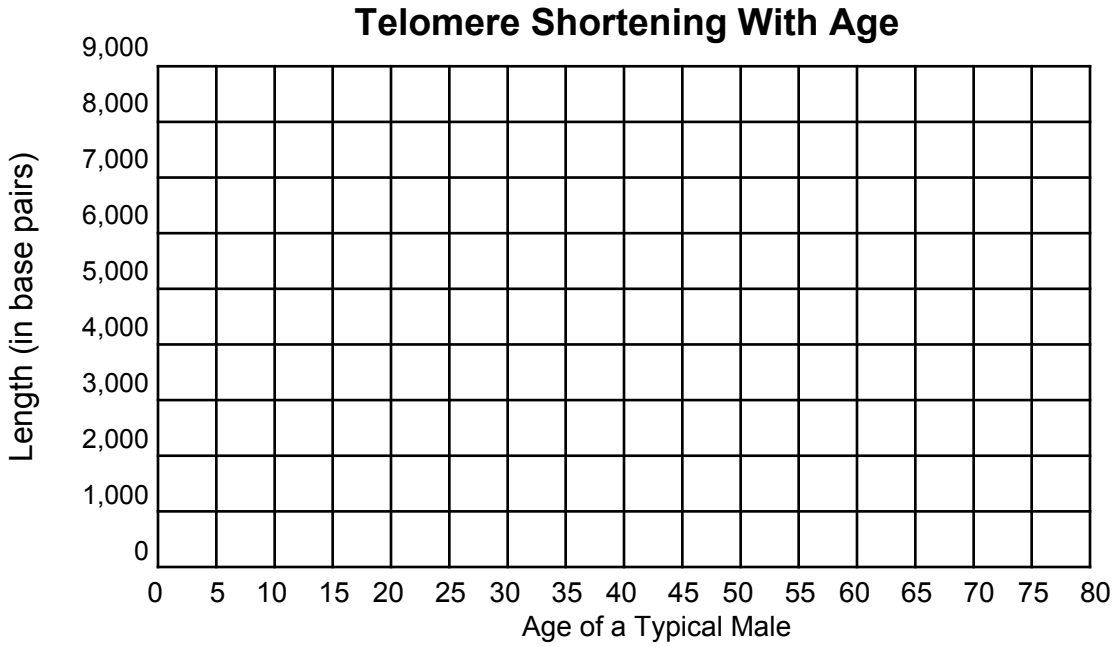


1. Complete the missing values for the table.

Age of a Typical Male	Process	Length (in base pairs)
0	8000 – 100 (0) = 8000 – 0 =	8000
1		7900
5	8000 – 100 (5) = 8000 – 500 =	7500
10		
40		4000
65	8000 – 100 (65)	
n		T(n)

Math Connections

2. Graph the function onto the graph.



3. Is the function linear (straight line), quadratic (parabola), or exponential (curve)?

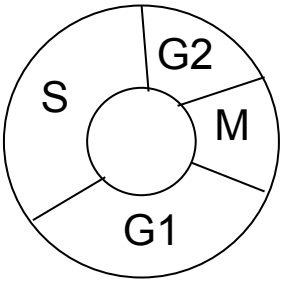
4. What does the *y*-intercept of (0, 8000) mean in this case? (Hint: use axis labels.)

5. Per the introduction, cellular mitosis stops working at 1,000 base pairs. At what age will this happen?

Part II: Background Information on Possible Causes of Cancer Development

By activating an enzyme called telomerase, some cells can prevent the telomeres from getting any shorter, thus escaping the lethal fate of most cells. However, when the DNA repair goes wrong, the inadequate telomere repair and accelerated telomere attrition can cause diseases such as cancer. Uncontrolled cellular growth is an attribute of cancer cells. These cells continue to progress through the cell cycle of Growth 1 (G1), DNA Synthesis (S), Growth 2 (G2), and Mitosis (M) phases, despite some having shortened telomeres.

Just one cancerous cell can grow into a large mass of cells called a tumor. These cells have grown without regard for the normal balance between cell growth and death; therefore, a lump of cells has formed. In the case of malignant growth, this aggressive behavior can eventually overwhelm the part of the body or particular organ where it is located.



G1- Growth
S- DNA Synthesis
G2- Growth and preparation for mitosis
M- Mitosis

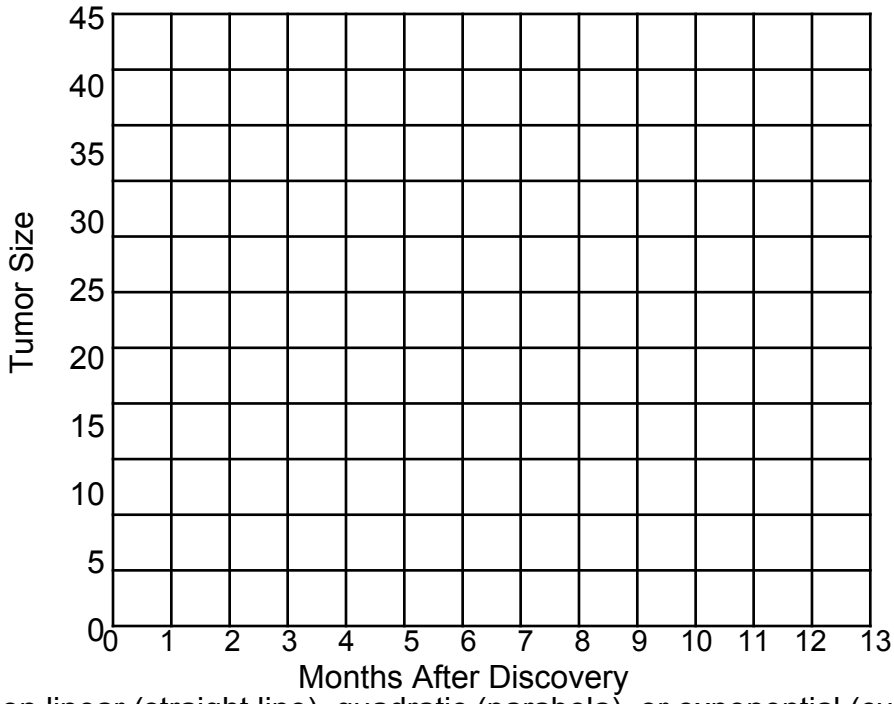
Math Connections

Lung cancer cells have a doubling rate of ~100 days. A lung cancer patient's data is shown below. Using the function, $T(m) = 3 \times 1.25^{m}$, where *m* is the number of months after the tumor was discovered and *T(m)* is the tumor volume in cubic cm, the growth of an untreated tumor can be determined. Using the information provided, complete questions 6 – 10.

6. Complete the missing values in the data table below.

Months After Discovery	Process	Tumor Size (in cm^3)
0	$3 \times 1.25^{(0)} = 3 \times 1 =$	3.00
1	$3 \times 1.25^{(1)} = 3 \times 1.5625 =$	
2		4.69
3		5.86
6	$3 \times 1.25^{(6)}$	
9		23.44
m		T(m)

7. Graph the function onto the graph. Be sure to title the graph and label the axes.



8. Is the function linear (straight line), quadratic (parabola), or exponential (curve)?

9. What does the *y*-intercept of (0, 5) mean in this case? (Hint: use axis labels.)

10. Predict the size of the tumor after only one year (12 months).

Math Connections

Part III: Cancer Can Occur in Many Specialized Cells

Cancer cells can typically occur in many parts of the body: pancreatic, bone, nerve, muscle, kidney, skin, and even in fat cells. As previously mentioned, cancer is a result of malfunctions at the molecular and DNA level. Since the process of cell differentiation is most directly regulated by DNA, specialized cells including blood, muscle, and epithelial cells are greatly affected by cancer.

There are many types of cancers. Carcinomas affect the lining tissues in the body. Sarcomas affect connective tissues and leukemia affect the body's blood cells. Myelomas and lymphomas are other types of cancers as well.

Types of Cancer in the U.S. Affecting Specialized Cells, 2013

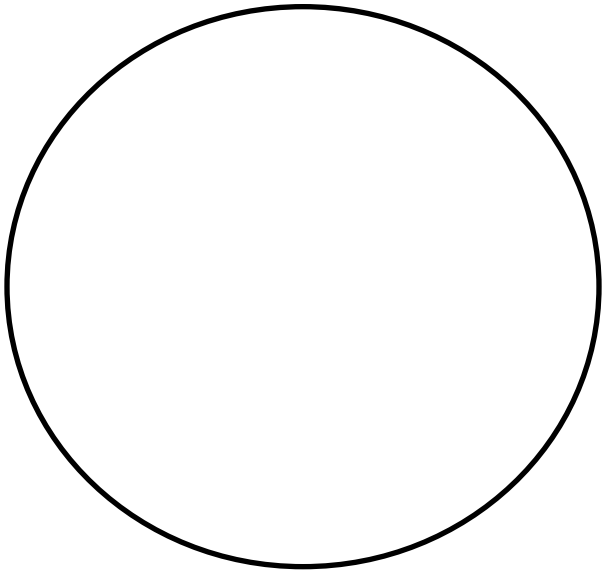
Type of Cancer	Where Cancer Affects	Number of Cases	Percentage
Carcinomas	Skin, Epithelial Cells	240,000	
Sarcomas	Bone, Fat, Muscle Cells	18,000	
Leukemia	Blood Cells	12,000	
All Others	Plasma, Immune Cells	30,000	
	Total		

11. Complete the table above by calculating the percentage of each type of cancer. Add up the number of cases for the total. Then find the percentage for each by (number of cases) / (the total number) x 100.

12. Draw a pie chart depicting the relative percentages.

Types of Cancer in the U.S.

Key
- ❑ Carcinomas
- ❑ Sarcomas
- ❑ Leukemias
- ❑ All Others

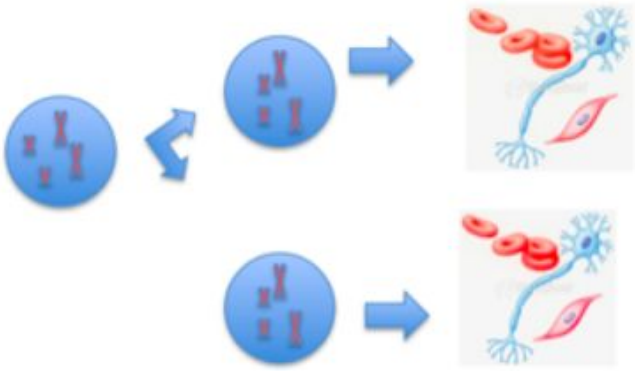


Claim-Evidence-Reasoning

Name: _____ Date: _____

Scenario

In science class, you learned about how cells reproduce.



Prompt:
Write a **scientific explanation** of how the illustrated changes occur. Make sure to include a rebuttal in your answer.

Claim:

Evidence:

Reasoning:

Rebuttal:

Claim-Evidence-Reasoning

Cellular Differentiation CER

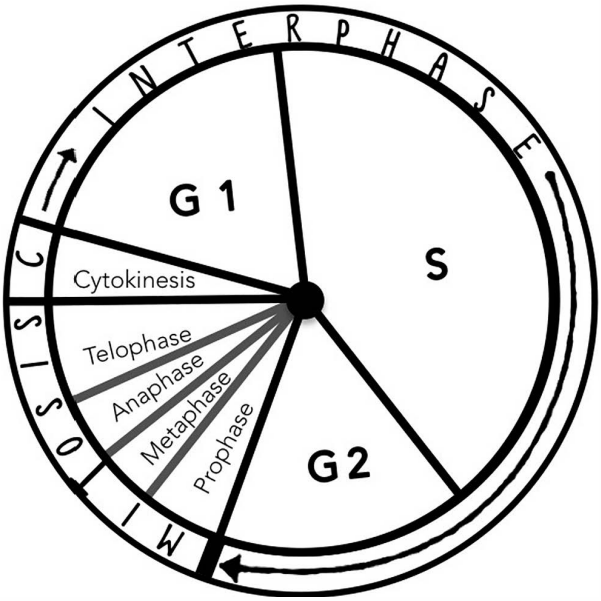
Rubric for Writing a Scientific Explanation

Points Awarded	2	1	0
Claim	Claim was complete and accurate.	Claim was incomplete or inaccurate.	Student did not make a claim or did not answer the question.
Evidence	Evidence cited data and patterns within the data and used labels accurately.	Evidence cited data from the data source but not within the context of the prompt.	There was no evidence, or changes were cited but did not use data from the data source.
Reasoning	Student cited the scientifically accurate reason using correct vocabulary, connected the reason to the claim, and showed accurate understanding of the concept.	Student cited a reason, but it was inaccurate or did not support the claim. Reasoning did not use scientific terminology, or it used it inaccurately.	There was no reasoning, or student relied on a restatement of the claim.
Rebuttal	Rebuttal provided reasons for different data or outliers in the data, offered relevant real-world cases, or suggested other uses for the findings.	Rebuttal was not connected to the data, or it was not accurate.	Student did not offer a rebuttal.

B.5 the student knows how an organism grows and the importance of cell differentiation.

B.5 (A) Describe the stages of the cell cycle including deoxyribonucleic acid (DNA) replication and mitosis, and the importance of the cell cycle to the growth of organisms.

I. The Cell Cycle- offer a brief description of each stage of the eukaryotic cell cycle in the table below:



Stage of Cell Cycle	Description/ Summary
1. G1 (gap 1)	Cell is carrying out routine functions, making new proteins and organelles.
2. S (synthesis)	
3. G2 (gap 2)	The cell prepares for division.
4. Mitotic stage	The _____ divides.
5. Cytokinesis	The _____ divides.

6. Why must the S phase occur before mitosis? _____
_____.

7. Explain why the cell cycle is important- why would we need to make more cells?

_____
_____

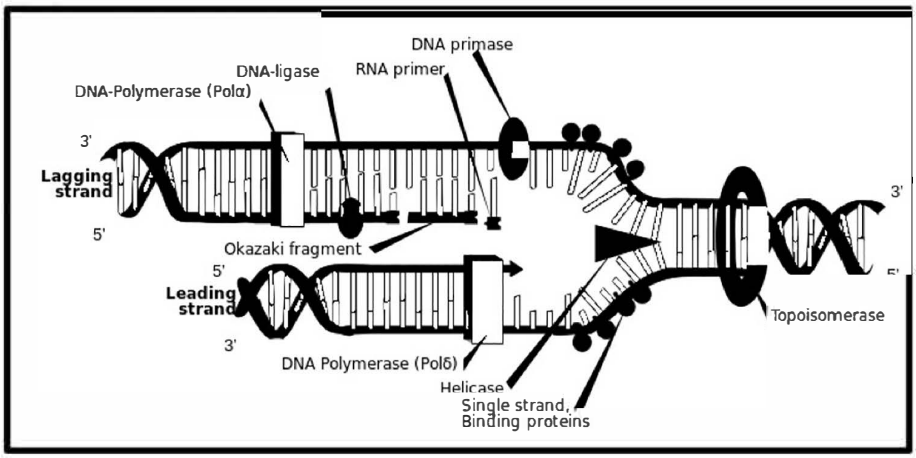
II. DNA Replication

1. DNA replication is semi-_____ because the new DNA molecule consists of one original strand and one new strand.

2. DNA helicase is an enzyme responsible for _____ the double strand of DNA.

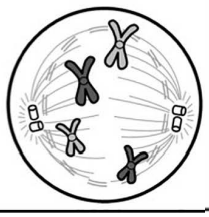
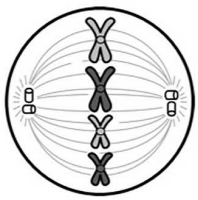
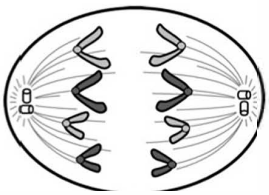
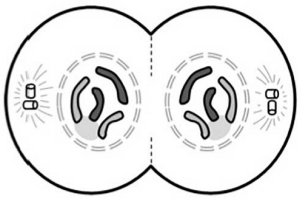
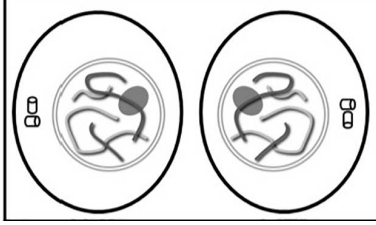
3. DNA polymerase is an enzyme responsible for adding complementary _____ to make a newly synthesized DNA strand.

3. DNA replication occurs during the ____ phase of the cell cycle.



B.5 (A) Describe the stages of the cell cycle including deoxyribonucleic acid (DNA) replication and mitosis, and the importance of the cell cycle to the growth of organisms.

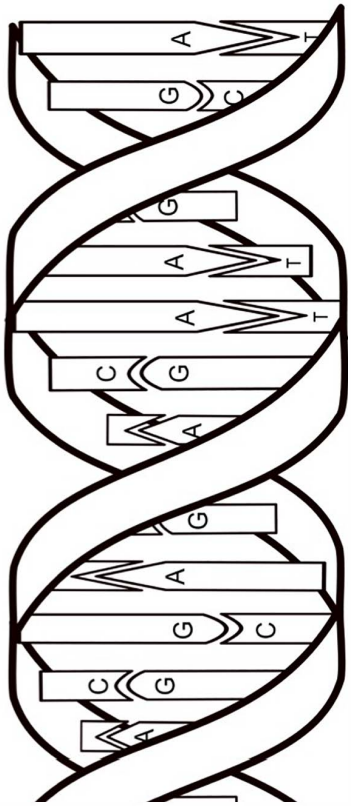
II. Stages of the eukaryotic cell cycle - In the the table below, determine which phase the cell is in during its cycle. Add a brief description of what is happening in each stage.

Diagram	Phase/Stage	Description
	Interphase	The cell is undergoing routine functions, growing, and preparing for division (G1, S, G2)
	Prophase	The chromosomes condense and the nuclear envelope begins to break down.
	Prometaphase	
		The chromosomes line up at the cell's _____.
		The chromosomes begin to move apart, to _____ poles of cell.
		The chromosomes disperse into chromatin, the _____ envelope reforms.
		

B.5 the student knows how an organism grows and the importance of cell differentiation.

B.5 (B) Describe the roles of deoxyribonucleic acid (DNA, ribonucleic acid (RNA), and environmental roles in cell differentiation.

I. The role of DNA in the cell



1. Fill out the paragraph using the word bank.

Word bank: *reproduction, thymine, stranded, nucleotides, proteins, nucleic, base, guanine, code, structure, nucleus*

DNA is a _____ acid that includes a series of _____ that make up a genetic _____. The DNA is found in the _____ of eukaryotic cells and the nucleoid of prokaryotic cells.

This genetic code serves as instructions for the development, structure, and function of living things, including survival and _____.

DNA's genetic code is decoded into messages that are used to produce _____ during a process called protein synthesis.

DNA is a double-_____ molecule that are joined at the complementary nitrogen _____ pairs: adenine, _____, cytosine, and _____.

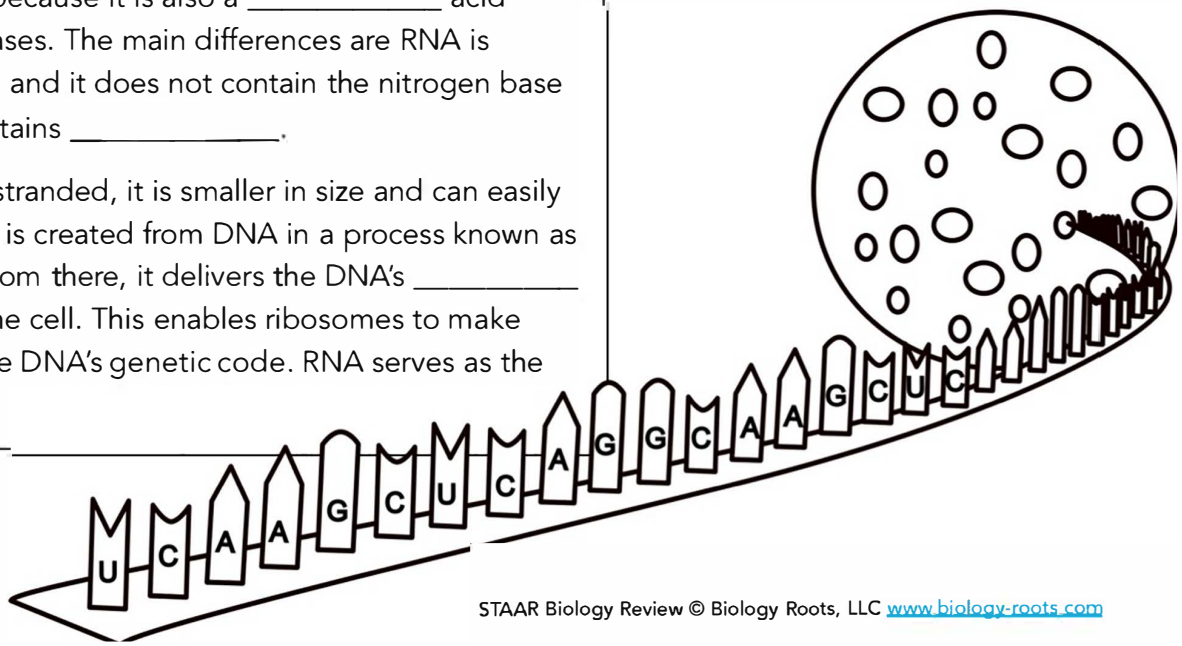
II. The role of RNA in the cell

1. Fill out the paragraph using the word bank.

Word bank: *uracil, proteins, single, messenger, code, transcription, nucleic (some words will be used more than once).*

RNA is similar to DNA because it is also a _____ acid made up of nitrogen bases. The main differences are RNA is _____ stranded, and it does not contain the nitrogen base thymine. Instead, it contains _____.

Because RNA is single stranded, it is smaller in size and can easily leave the nucleus. RNA is created from DNA in a process known as _____. From there, it delivers the DNA's _____ to ribosomes outside the cell. This enables ribosomes to make _____ using the DNA's genetic code. RNA serves as the _____.



STAAR Tune-Up- B.5B: Cell Differentiation

B.5 the student knows how an organism grows and the importance of cell differentiation.

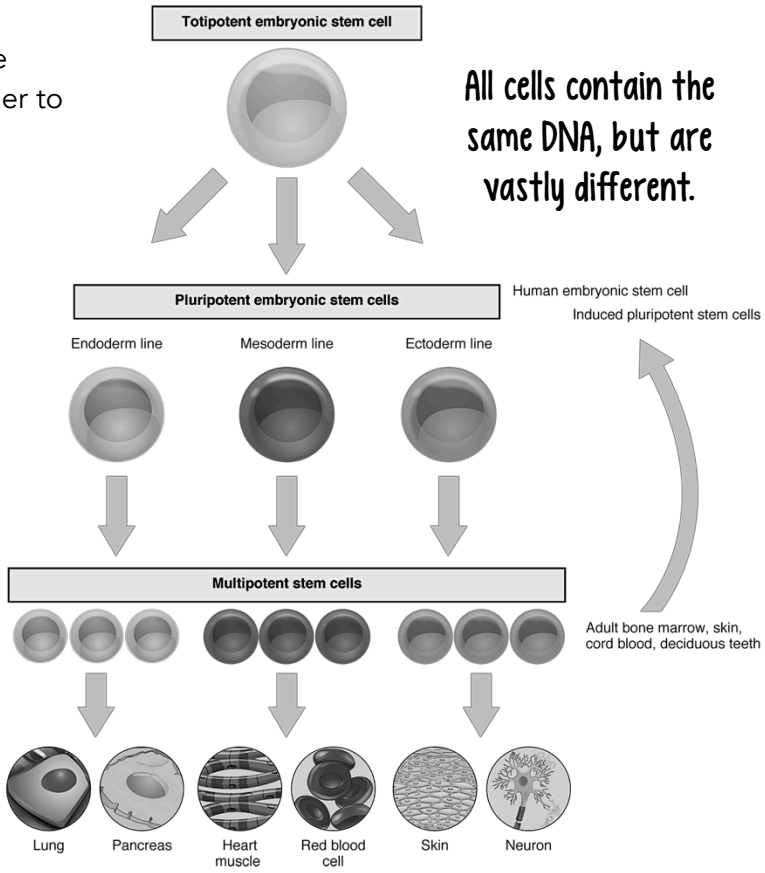
B.5 (B) Describe the roles of deoxyribonucleic acid (DNA, ribonucleic acid (RNA), and environmental roles in cell differentiation.

III. Cell Differentiation- cell differentiation is the process by which cells become specialized in order to perform different functions.

1. Name some specialized cells found in the human body:
_____
_____.

2. What are stem cells?
_____
_____
_____

3. _____ is when a stem cell differentiates into a specific type of cell. All specialized cells come from the same origin, but certain _____ are turned on or off to determine what type of cell it turns into.



All cells contain the same DNA, but are vastly different.

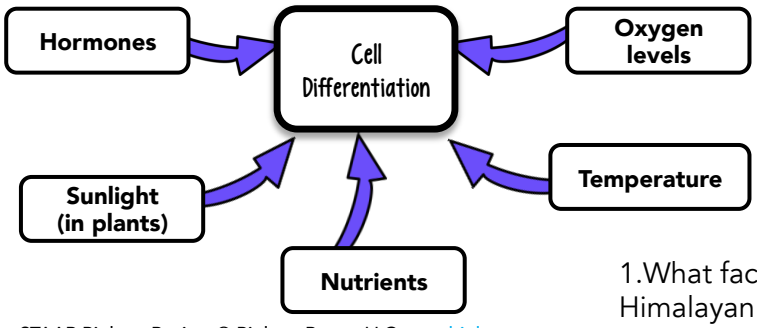
IV. DNA's role in cell differentiation- *The different types of cells that make up a living organism contain the same DNA, but they express their genes differently.*

1. What is gene expression? _____
_____.

2. How are proteins related to gene expression? Do all the proteins that DNA codes for get transcribed in a single cell? _____
_____.

3. Cell Differentiation can also be reversed. If the DNA from specialized cells is inserted into an enucleated egg, the DNA would take on the embryonic form as if it were the original DNA. This is how cloning works!

IV. Environmental Roles in Differentiation- Certain factors can have an effect in cell differentiation.



Example- In Himalayan rabbits, genes that code for fur color are turned off or on depending on temperature. Warmer temperatures cause the color gene expression to turn off, resulting in white fur. Cooler parts of the rabbits' body cause the color gene expression to turn on, resulting in dark fur.

1.What factor affects the gene color of Himalayan rabbits? _____

SS

STAAR Tune-Up- B.5C: Disruptions to Cell Cycle

B.5 the student knows how an organism grows and the importance of cell differentiation.

B.5 (C) Recognize that disruptions of the cell cycle lead to diseases such as cancer

I. What is Cancer?- Recall that eukaryotic cells divide via mitosis or meiosis. They follow a strict pattern of G1, S, G2, Mitosis, and finally cytokinesis**.**

I. Cancer is caused by mutations in a cell's DNA. But what causes these mutations to occur can vary. Examples of what can cause mutations that lead to cancer are viruses, UV radiation, and carcinogens (chemicals that can cause cancer, such as ones found in cigarettes). Things that can potentially cause a cell's DNA to mutate are called mutagens.
What are mutations? _____

2. Cancer is the result of a cell cycle that has become out of control. This leads to a rapidly dividing group of cells, which can form a _____. These tumors can prevent organs from functioning properly.

3. Two types of tumors or cancer are malignant and benign. Benign typically does not spread to other parts of the body.

4. Why does cancer occur? _____

5. What can cause mutations? _____

II. How Healthy Cells Divide- Recall that eukaryotic cells divide via mitosis or meiosis. They follow a strict pattern of G1, S, G2, Mitosis, and finally cytokinesis**. Fill in the table below using the text.**

Ways that the cell regulates its cycle to prevent cancer from occurring:

1. Genes → **Tumor Suppressor Genes** **Tumor Suppressor Genes** try to repair damaged DNA, slow down cell division, or signal cell death (apoptosis).

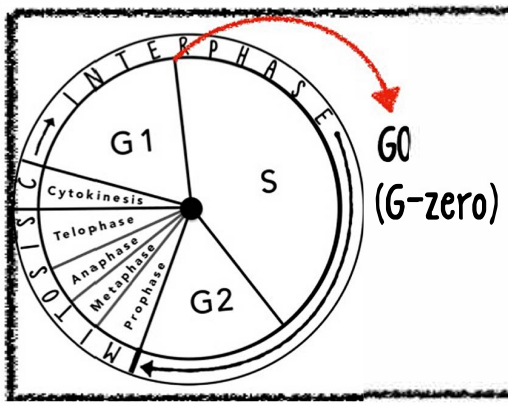
2. Proteins → **Cyclins** **Cyclins** are proteins that work with enzymes to signal cells to move on to the next phase of the cycle. If abnormalities are present, cyclins do not allow the cell to move on to the next phase until it is resolved.

Ways that the cell regulates the cell cycle to avoid cancer	
Tumor Suppressor Genes	**Cyclins**
1.	**4.**
2.	
3.	

If tumor suppressor genes or the genes that code for cyclins are damaged, the cell cycle may become out of control, causing cells to divide too quickly.

B.5 (C) Recognize that disruptions of the cell cycle lead to diseases such as cancer

II. How Healthy Cells Divide continued



G0- Some cells do not replicate once they reach maturity, such as neurons or heart cells. Red blood cells do not have nuclei, so they also do not replicate. These cells enter what is known as a G0 stage. The G0 phase is an extended resting phase of G1. Cells in the G0 phase never replicate.

5. Based on this information, do you think that cancer cells are ever in a G0 phase? Why or what not?

_____

_____.

III. Conclusion

1. _____ Cancer is caused by
A. Out of control DNA replication
B. Out of control cell cycle caused by damaged DNA
C. Out of control cell cycle caused by cyclins
D. Tumors

2. _____ Some examples of things that can cause the cell cycle to become abnormal are
A. Carcinogens
B. UV radiation
C. Viruses
D. All of the above

3. Put the following items in order to show a timetable of how cancer might occur: _____
A. Cells divide rapidly in an abnormal cycle
B. Exposure to a mutagen, such as a particular virus.
C. Tumor forms
D. DNA that regulates the cell cycle becomes mutated and damaged.

Assessment: Cell Differentiation

1 Which of the following describes anaphase of mitosis?

A Daughter chromosomes move toward opposite poles of the cell.

B Homologous chromosomes line up along the equator of the cell.

C Cytoplasm divides as the cell prepares to become two new cells.

D Chromosomes condense and the nuclear membrane breaks down.

---

2 A parent cell contains 2n chromosomes. How many chromosomes will the daughter cell contain?

A n

B 2n

C n/2

D n+2

---

3 Complex organisms develop specialized tissues as a direct result of which of the following processes?

A Cellular respiration

B Cellular differentiation

C Cellular growth

D Cellular division

---

4 Chromosomes are duplicated during which phase of the cell cycle?

A Prophase of mitosis

B S phase of interphase

C G2 phase of interphase

D Metaphase of mitosis

5 The environment has the greatest effect on the expression of genes when which of the following occurs?

A Meiosis

B Replication

C Transcription

D Mutation

---

6 One of the most important checkpoints in the cell cycle, also known as the "restriction point," is the–

A G1 checkpoint.

B Gs checkpoint.

C M checkpoint.

D interphase checkpoint.

---

7 Uncontrolled cellular division poses a serious risk to surrounding tissue because it–

A produces toxins that kill cells.

B replaces the DNA in healthy cells.

C crowds out healthy tissue.

D alters the functioning of organs.

---

8 Which of the following provides evidence for the idea that certain environmental factors can alter DNA and cause mutations?

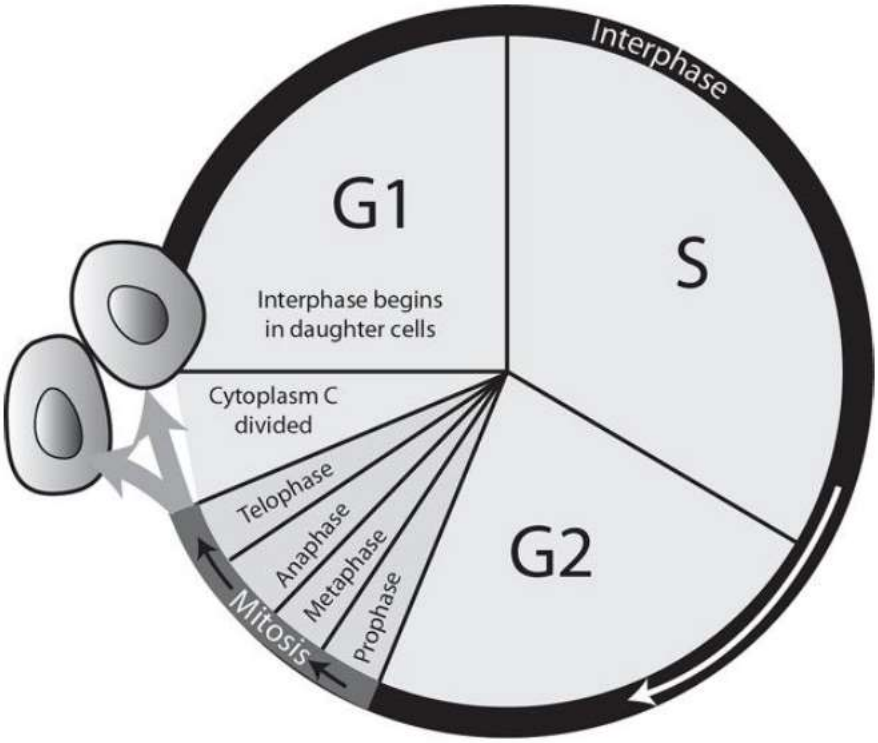
A The processes responsible for cellular growth and repair are more efficient when an individual receives adequate nutrition.

B Characteristics of certain individuals within a population make them more or less likely to survive an environmental change.

C Skin cancer is more likely to develop in individuals who experience excessive exposure to sunlight.

D Errors that occur during mitosis can sometimes provide a benefit to the individual but are more likely neutral.

9 Multicellular organisms, such as plants and animals, go through a process called the cell cycle in order to grow and repair themselves. A diagram of the cell cycle and its stages is provided.



Which part of the cell cycle is responsible for the growth of the cell?

A Mitosis

B G_1 phase

C Prophase

D S phase

---

10 What might uncontrolled cell division lead to?

A Mitosis

B Replication

C Cancer

D Cytokinesis

Day	Objective/TEKS	Agenda
5	Reporting Category 5 and Reporting Category 1	1. Check all pages from the last 2 weeks and catch up and complete missed pages as needed. 2.