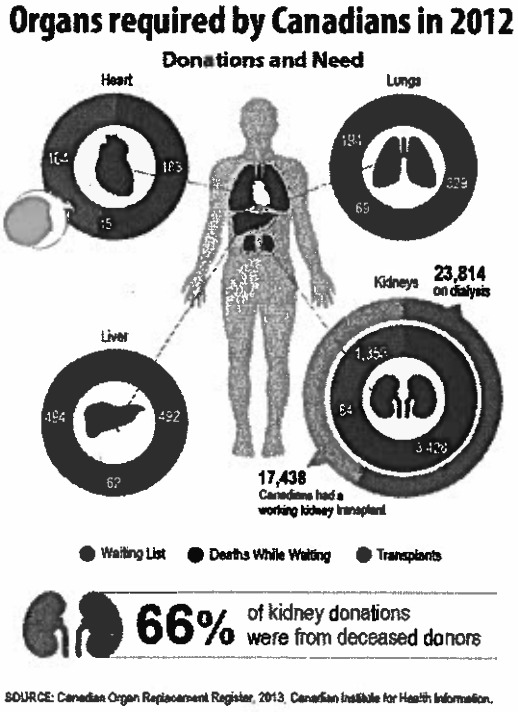
Project Background

On a stage in front of an audience of thousands, a futuristic-looking machine squirted gel from a nozzle. Layer by layer, it built up the material, shaping it into a curved, pink, kidney-shape structure based on a medical CT scan of a real organ.

It was 2011, and Anthony Atala, director of the Wake Forest Institute for Regenerative Medicine, was demonstrating his progress in using three-dimensional (3-D) printing to make a kidney during his TED Talk. Atala had printed a kidney-shape "mold" made of biocompatible materials combined with cells. The prototype, as Atala calls it, lacked the kidney's intricate inner structures and could not have functioned as a real organ and thus was not ready for transplantation.



Most Canadians waiting for an organ donor are in need of a kidney. Since kidney disease is on the rise in Canada, the need for donors is growing. In 2011, 256 people died waiting for a transplant—a third of them needed a kidney. By the end of 2012, there were more than 41,000 people living with end-stage kidney disease — 42 per cent with a kidney transplant, 58 per cent on dialysis.

Bio-printing promises to change the way the medical community deals with organ transplants. As our population ages, the need for organ and tissue donations will increase. The demand for donor organs far exceeds the supply, leaving helpless patients in a state that no one should have to be left in… waiting to live

What if you could order from a catalogue a kidney or more specifically a kind of cell that your body is in desperate need of to survive? The future of bio printing and stem cell research makes that a possibility.

After some research and investigation into the complexities of our body's cells, you will have access to technology that will provide you with the opportunity to design and print a 3-D model of a cell you would find in an organ in your body.

Part I

In this part of the assignment you will be working toward mastering the following outcomes:

- ✓ I can explain the relationship between developments in technology and the current understanding of the cell
- ✓ I can identify areas of cell research

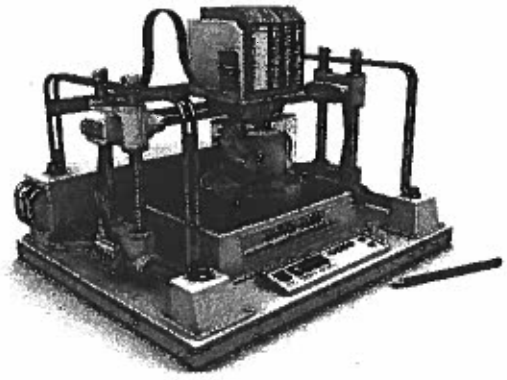
In this part of the assignment you will be required to:

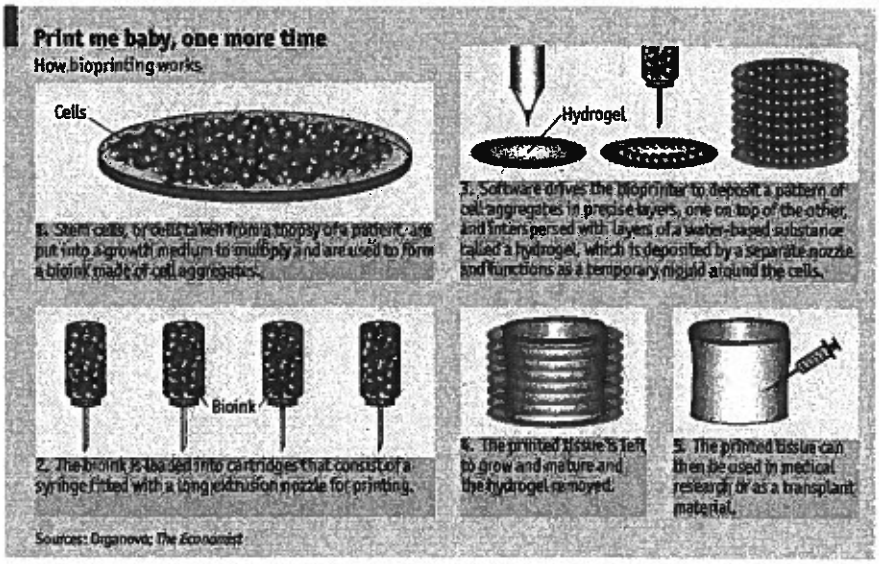
1. Investigate issues in organ transplants globally. How can someone become an organ donor in Canada? Create a web that summarizes your findings.
2. Research 3D bio printing. Be sure to answer the following questions as you explore this very exciting advancement in regenerative medicine. Use the graphic organizer provided to assist you.

3-D Bio printing

- What is it? How does it work? What is it currently used for?
- How will it change the field of medicine? Specifically how will 3-D printing change organ transplants?
- What are the benefits of printing organs with 3-D technology? What are the limitations of printing organs?
- What are stem cells? How are they used in conjunction with 3-D printing in organ transplants?

3. Watch and respond (using SOIP) to the TED Talk from Surgeon Anthony Atala demonstrating an early-stage experiment that could someday solve the organ-donor problem (https://www.ted.com/talks/anthony_atala_printing_a_human_kidney)

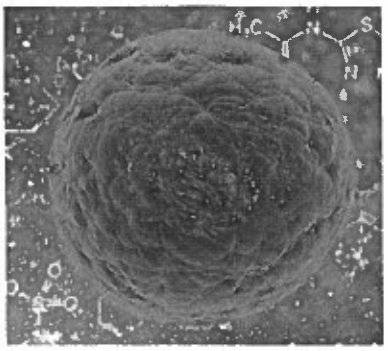




CANADIAN TRANSPLANT ASSOCIATION
L'ASSOCIATION CANADIENNE DES GREFFÉS

Stem Cell Therapy: The Future of Medicine?

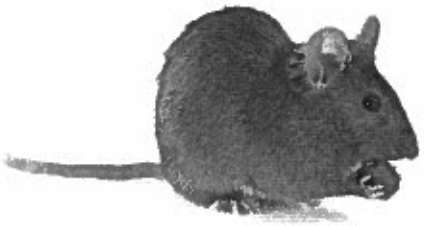
Introduction: What Is Stem Cell Therapy?



Stem-cell therapy is a method used to treat or prevent a particular type of diseases such as heart disease, diabetes, leukemia or other conditions. By definition, stem cells are cells that are able to develop into different types of cells. This is unlike your current cells that can only divide to produce cells of the same type (i.e. skin cells divide to produce more skin cells and cannot become heart cells). There are two main types of stem cells: embryonic stem cells which are taken from a 3- to 5-day-old embryo called a blastocyst and adult stem cells which are found in certain tissues (i.e. bone marrow) as well as in the umbilical cord blood.

A Brief History of Stem-Cell Therapy

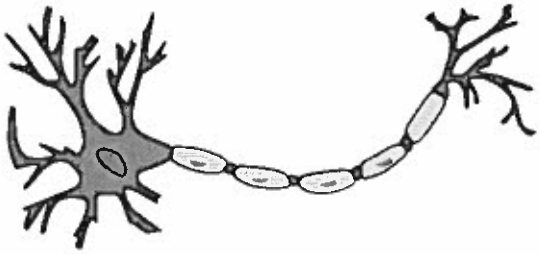
The history of adult stem cell research began in the 1950s when researchers discovered that bone marrow contained two kinds of stem cells. The first is called hematopoietic stem cells that divide to form each type of blood cells in the body. The second is called bone marrow stromal stem cells. These stem cells can repair bone, cartilage, and fat cells that support the formation of blood and fibrous connective tissue. It is a part of a small proportion of the stromal cell in the bone marrow.



In 1981, scientists discovered ways to derive embryonic stem cells from early mouse embryos. This led to a discovery in 1998 that allowed scientists to derive stem cells from human embryos and grow them in the laboratory. Cells used in early research were called human embryonic stem cell that was created for reproductive procedures such as in vitro fertilization. In 2006 a new type of stem cell called an induced Pluripotent Stem Cells (iPSCs) was made by researchers to identify conditions and genetically reprogram some specialized adult cells to create a stem cell-like structure (Steckelberg, 2014).

How Stem Cell Therapy Works?

Mature cells found either in an adult or child, are programmed to be a particular kind (i.e. skin, muscle, nerve, etc.) and when they divide, they can only become that kind of cell. This makes it difficult to replace or repair certain kinds of cells in the body. This is where stem cells come in. Stem cells serve as



an internal repair and replacement system in our body. Stem cells divide to generate replacement cells within organs such as the brain, heart, and lungs with the potential to remain a stem cell or become a new type of cell with a more specialized function (Sheen, 2015). In people where certain tissues or organs have gone awry, stem cells can be used to completely replace the organ or tissue, relieving them of their disease. A common example of this is the treatment of leukemia (a disease whereby the development of blood cells doesn't occur correctly) through bone marrow cell therapy.

Stem cell research enables scientists to learn about the cells' beneficial properties, discover and screen new drugs, study normal growth and identify causes of birth defects and disease. To treat disease, stem cells are programmed to become a specialized type of cells, such as heart muscle cells, blood cells or nerve cells. These specialized cells can then be implanted into a person to treat a certain disease such as congestive heart failure whereby the heart cells can't beat strongly enough. Stem cells can also be used to grow organs such as kidneys or livers, the potential is endless. Best of all, these are your cells so there's no chance of rejection post surgery. Note: Rejection post surgery results from the body not recognizing the cells that have been inserted into it. As a result, the immune system believes them to be invaders and kills them.

Current Applicability of Stem Cell Therapy

Today, doctors can harvest stem cells from the blood of a newborns umbilical cord, reducing the controversy as previous stem cells were taken from aborted fetuses. Note: When you are born, you are given the option of having your stem cells harvested and stored for your future use. Not only can stem cells be used to treat disease, they are also being used to screen new drugs. Newly discovered medications are tested for safety on differentiated cells generated from human stem cell lines. Other kinds of cells such as cancer cell lines have also been widely used to test anti-tumor drugs. Screening new therapies on stem cells reduces the use of animal

testing and also provides more optimal testing conditions as stem cells replicate the exact conditions of a living human treatment much more effective than do mice.

Arguments and Controversies against Stem Cell Therapy

Many opponents of stem cell research state that harvesting embryos for stem cells is immoral and should not be allowed under any circumstances. To them, an embryo is a human and destroying it is an act of murder. They believe that an embryo constitutes life has it has the potential to develop fully into a human being. They believe that is it immoral, unnatural and unethical to destroy a person's life just to save another. Furthermore, many religious groups condemn embryonic stem cell research on similar grounds. Other arguments against embryonic stem cell research cite that adult stem cells are already successfully being used and therefore, there is no need to regress back into embryonic stem cell territory.

Fears regarding unexpected outcomes and the effects of stem cell usage on the environment continue to rise. Many think that although the benefits of stem cell therapies are enormous, risks must also be considered. One concern is the passing of viruses. Recipients of stem cells may inherit viruses or other microscopic agents that can cause disease, (Murnaghan, 2015).

The Future of Stem Cell Therapy

As the famous physicist, Stephen Hawking put it, "Stem cell research is the key to developing cures for degenerative conditions like Parkinson's and motor neuron disease from which I and many others suffer." The current benefits of stem cell therapy are well documented, and continued research is expected for new treatments. Stem cell therapy offers hope for those suffering from serious diseases and we've barely scratched the surface. In the future, we could be using 3D printers to produce organs that cannot be rejected (as they are the patients cells). This would save thousands who die while waiting on the organ transplant list. These 3D printers would use stem cells for ink. We could eliminate the need for drug testing on animals or humans, simply testing them on stem cells until they were ready for the public. We could regenerate brain cells in those suffering from dementia and other degenerative diseases. The possibilities are endless and the future is bright.

"Stem cell research can revolutionize medicine, more than anything since antibiotics" – Ron Reagan.

Reading Comprehension Questions:

1. What are stem cells?

2. What are the two types of stem cells and where are they found?

3. What were the stem cells called that were used in early human research and what were they used for?

4. Can a skin cell divide to produce a muscle cell? Explain.

5. Provide an example of a stem cell treatment.

6. Why aren't stem cells rejected by your body post surgery?

7. Why are stem cells used to screen new drugs? Why is this preferred method of drug testing?

8. What are the arguments against stem cell research?

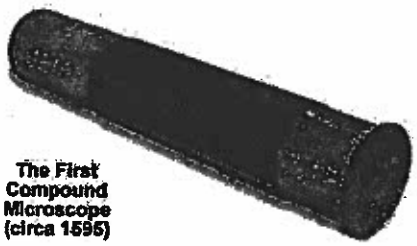
9. What is your view on stem cell research? Reference different parts of this article to support your claim. Your answer needs to be detailed and as in-depth as possible. Aim for 1-2 paragraphs.

History of the Cell Theory Article

The cell theory, or cell doctrine, states that all organisms are composed of similar units of organization, called cells. The concept was formally articulated in 1839 by Schleiden & Schwann and has remained as the foundation of modern biology. The idea predates other great paradigms of biology including Darwin's theory of evolution (1859), Mendel's laws of inheritance (1865), and the establishment of comparative biochemistry (1940).

A Complete Microscope History

Zacharias Janssen is generally believed to be the first investigator to invent the compound microscope. However, because the accomplishment is generally agreed among historians to be dated in the 1590s, most scholars believe that his father, Hans, must have played an important role in the creation of the instrument. The pair worked together as spectacle makers in Middleburg, Holland not far from Hans Lippershey, another optical scientist who is often alternatively credited with the invention of the microscope.



The First Compound Microscope (circa 1595)

The microscope illustrated above was built by Zacharias Janssen, with the help of his father Hans, in the year 1595. Janssen's probably consists of three draw tubes with lenses inserted into the ends of the flanking tubes. The eyepiece lens was bi-convex and the objective lens was plano-convex, a very advanced compound design for this time period. Focusing of this hand-held microscope was achieved by sliding the draw tube in or out while observing the sample. The Janssen microscope was capable of magnifying images approximately three times when fully closed and up to ten times when extended to the maximum. No early models of Janssen microscopes have survived, but there is a candidate housed in the Middleburg Museum in Holland that some historians attribute to Janssen.

First Cells Seen in Cork

While the invention of the telescope made the Cosmos accessible to human observation, the microsope opened up smaller worlds, showing what living forms were composed of. The cell was first discovered and named by Robert Hooke in 1665. He remarked that it looked strangely similar to cellula or small rooms which monks inhabited, thus deriving the name. However what Hooke actually saw was the dead cell walls of plant cells (cork) as it appeared under the microscope. Hooke's description of these cells was published in *Micrographia*. The cell walls observed by Hooke gave no indication of the nucleus and other organelles found in most living cells. The first man to witness a live cell under a microscope was Anton van Leeuwenhoek, who in 1674 described the algae Spirogyra. Van Leeuwenhoek probably also saw bacteria.

Formulation of the Cell Theory

In 1838, Theodor Schwann and Matthias Schleiden were enjoying after-dinner coffee and talking about their studies on cells. It has been suggested that when Schwann heard Schleiden describe plant cells with nuclei, he was struck by the similarity of these plant cells to cells he had observed in animal tissues. The two scientists went immediately to Schwann's lab to look at his slides. Schwann published his book on animal and plant cells (Schwann 1839) the next year, a treatise devoid of acknowledgments of anyone else's contribution, including that of Schleiden (1838). He summarized his observations into three conclusions about cells:

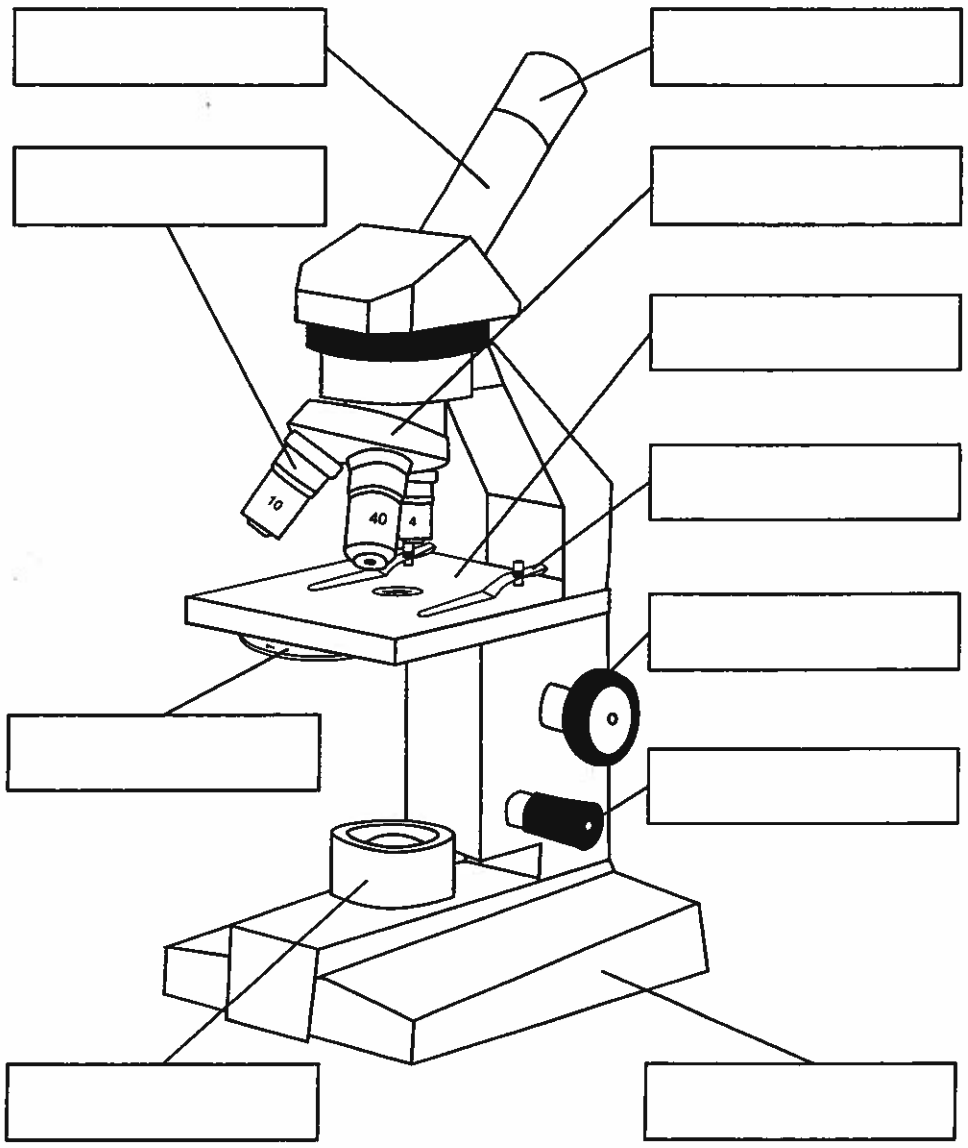
1. The cell is the unit of structure, physiology, and organization in living things.
2. The cell retains a dual existence as a distinct entity and a building block in the construction of organisms.
3. Cells form by free-cell formation, similar to the formation of crystals (spontaneous generation).

We know today that the first two tenets are correct, but the third is clearly wrong. The correct interpretation of cell formation by division was finally promoted by others and formally enunciated in Rudolph Virchow's powerful dictum in 1855, *Omnis cellula e cellula,*: "All cells only arise from pre-existing cells".

Modern Cell Theory

1. All known living things are made up of cells.
2. The cell is structural & functional unit of all living things.
3. All cells come from pre-existing cells by division. (Spontaneous Generation does not occur).
4. Cells contains hereditary information which is passed from cell to cell during cell division.
5. All cells are basically the same in chemical composition.
6. All energy flow (metabolism & biochemistry) of life occurs within cells.

BIOLOGY: The Light Microscope



Microscope Part	Microscope Part Function
Eye Piece	
Objective Lens	
Nose Piece	
Stage	
Stage Clips	
Rough Focus Wheel	
Fine Focus Wheel	
Iris Diaphragm	
Light	

CELLS: Cell Structure and Function **Date:**_____

Study Questions:

What are the three main parts of the cell theory?

Cells- the smallest unit that is capable of performing _____.
Amoeba

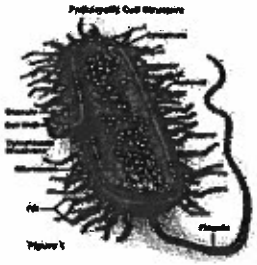
- All living things are made up of _____
- Cells are the _____ of all living things.
- All cells come from _____ through cell division.

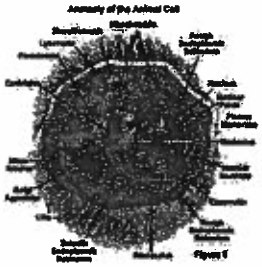
Organisms may be: _____ (composed of 1 cell) or _____ (made of many cells)

- _____:do not have a nucleus or organelles (bacteria).
- _____: have a nucleus and organelles (plants, fungi, animals, protists)

Organelles

- _____ that have a _____ and are _____ that are found in _____only.





What are the differences b/w prokaryotic and eukaryotic cells?

Prokaryotic: Believed to be the _____

- *Lack a membrane bound nucleus and organelles.*
- *Genetic material is free in the* _____
- *Ribosomes are only other cell structure.*

Eukaryotic: 2 major types: _____ *and* _____

Cell Structure and Functions

Cell Wall- Found outside of the cell membrane in plant cells & bacteria only

- Contains cellulose that provides _____

Cell or Plasma Membrane- Outer membrane of cells that controls movement of substances in and out of the cell

- _____
- In plants and bacteria, this is within the _____

Cytoplasm- _____ inside cells

- Surrounded by cell membrane
- Contains cell structure that carry out specific jobs ex. Mitochondrion, nucleus
- Provides a medium for _____

How are cell structures (organelles) related to their function?

Nucleoid- in prokaryotes.

- Region of the cytoplasm where _____ is located.
- Singular, circular chromosome.
- Smaller circles of DNA called _____ are also located in cytoplasm.

Ribosomes- Each cell contains _____

- Make_____-
- Found on endoplasmic reticulum & floating throughout the cell cytoplasm

Organelles

Nucleus- "Control center"

- Directs _____

- Contains the _____
- Separated from cytoplasm by nuclear membrane (or nuclear envelope).

Nuclear Membrane- Surrounds nucleus, separates _____

- Made of two layers
- Openings called _____ allow some materials to enter and leave nucleus

Chromatin- In nucleus

- Genetic material (DNA) of cell in its non-dividing state.
- Ie. _____
- Contain instructions for traits & characteristics

Nucleolus- Dark-staining structure in the nucleus

- Makes _____

Rough Endoplasmic Reticulum- Network of continuous sacs, studded with _____

- Internal delivery system of the cell.
- Manufactures, pro- cesses, and transports proteins for export from cell.
- Continuous with _____.

Smooth Endoplasmic Reticulum- Similar in appearance to rough ER, but _____ the ribosomes.

- Produces _____involved in carbohydrate metabolism, and detoxification of drugs and poisons.

Golgi Apparatus- Protein _____

- Modifies proteins and lipids made by the ER and prepares them for export from the cell.
- Encloses digestive enyzymes into membranes to form lysosomes (transport pods).

Lysosome- Digestive 'plant' for proteins, fats, and carbohydrates

- Digestive enzymes break down _____
- Transports undigested material to cell membrane for removal
- Cell breaks down if lysosome explodes

Mitochondria- Cell "powerhouse"

- Membrane bound organelles that are the site of _____ (use glucose to produce cell energy, ATP)

Animal Vacuole-Active cells like muscles have more mitochondria

- Membrane-bound sacs for storage, digestion, and waste removal
- Contains water solution

Plant Vacuole- Plants have _____ that store water and nutrients needed by the cell.

- Help support the _____ of the cell.

Chloroplast- Usually found in plant cells

- Contains green pigment_____
- Where photosynthesis takes place
- Produces plant food (sugars) and oxygen gas

What organelles are only found in plant cells?

Cilia and Flagella- External appendages from the cell membrane that aid in _____ (movement) of the cell.

Centrioles- Found only in _____.

- Self-replicating
- Made of bundles of _____.
- Help in organizing cell division.

Cytoskeleton- The cell's skeleton

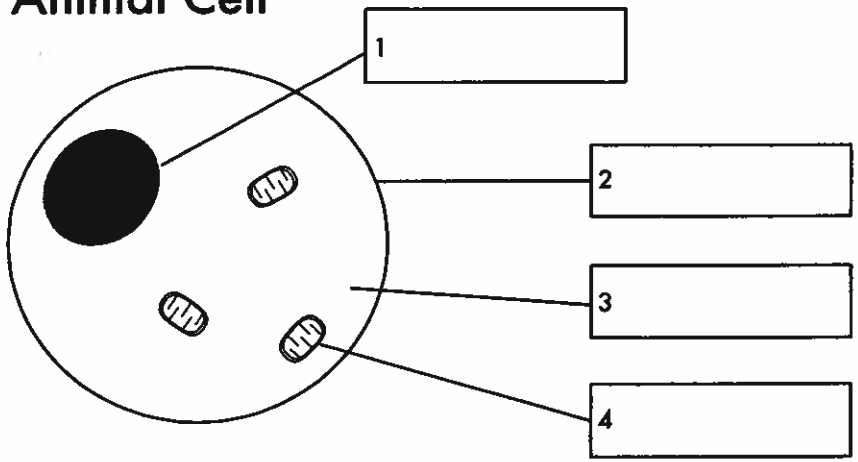
- Made of microtubules and filaments
- Give the cell _____

CELL BIOLOGY

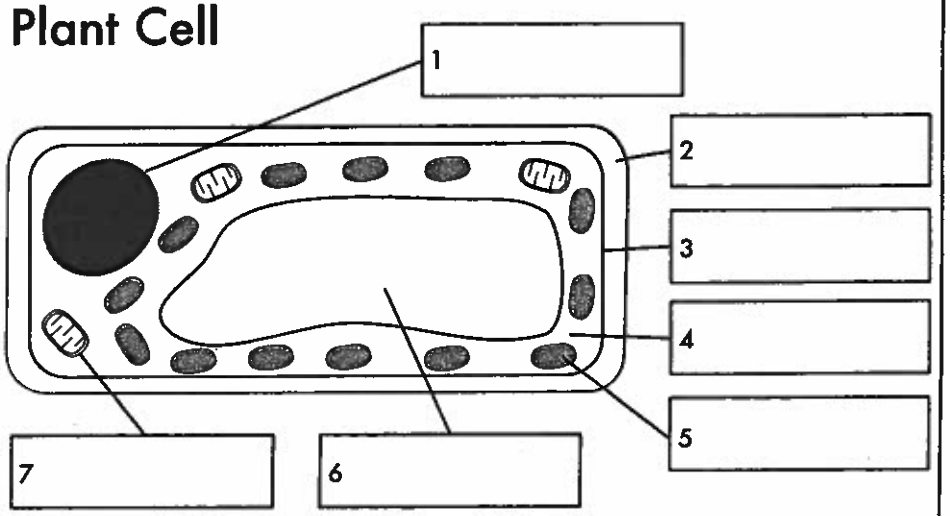
PARTS OF THE CELL

☆ Label the cell parts in the diagrams below

1. Animal Cell



2. Plant Cell



FUNCTIONS OF THE CELL PARTS

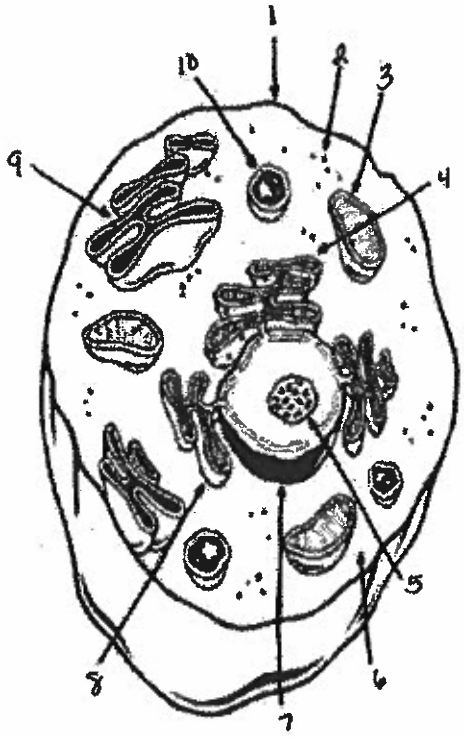
☆ Complete the table and shade in green the structures which are only found in plant cells

Cell Structure	Function (job)
Nucleus	
Cytoplasm	
Cell surface membrane	
Mitochondria	
Cell wall	
Chloroplast	
Vacuole	

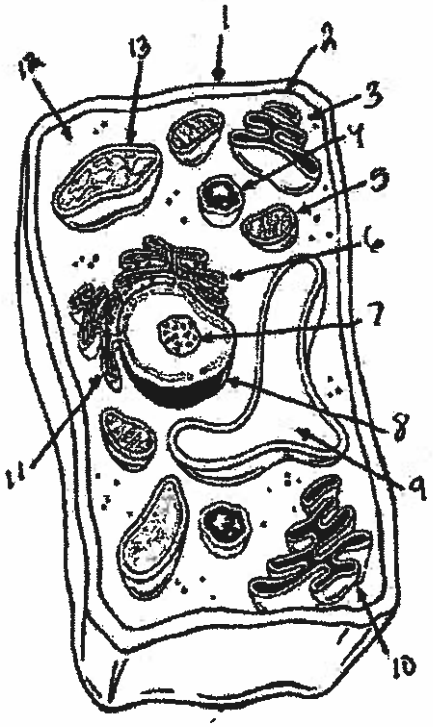
Cell Diagram WS: Plant vs. Animal Cells

1. Label the following organelles in the picture below:

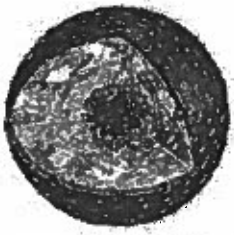
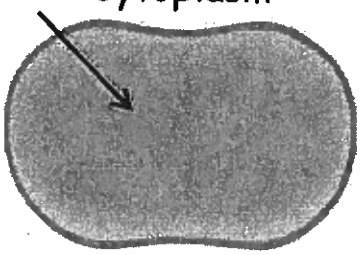
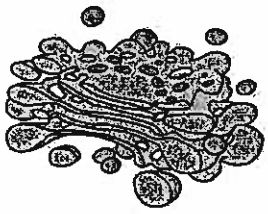
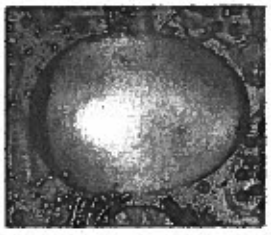
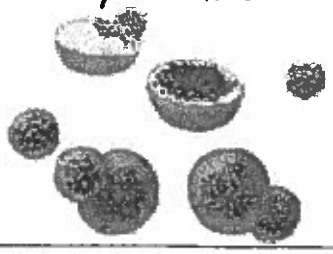
Animal Cell

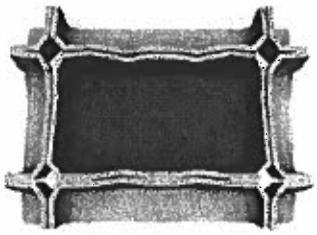
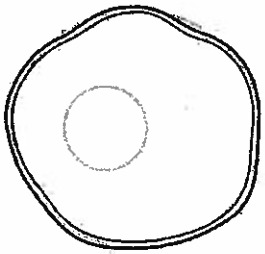
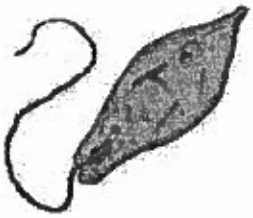
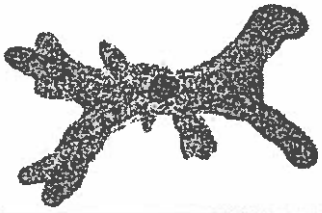
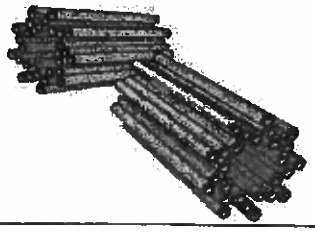
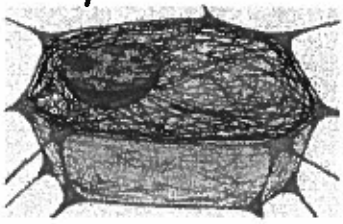
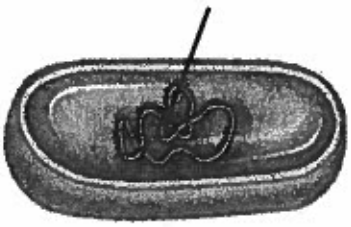
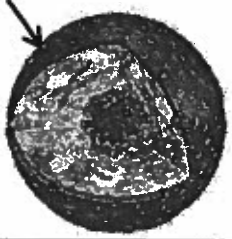


Plant Cell



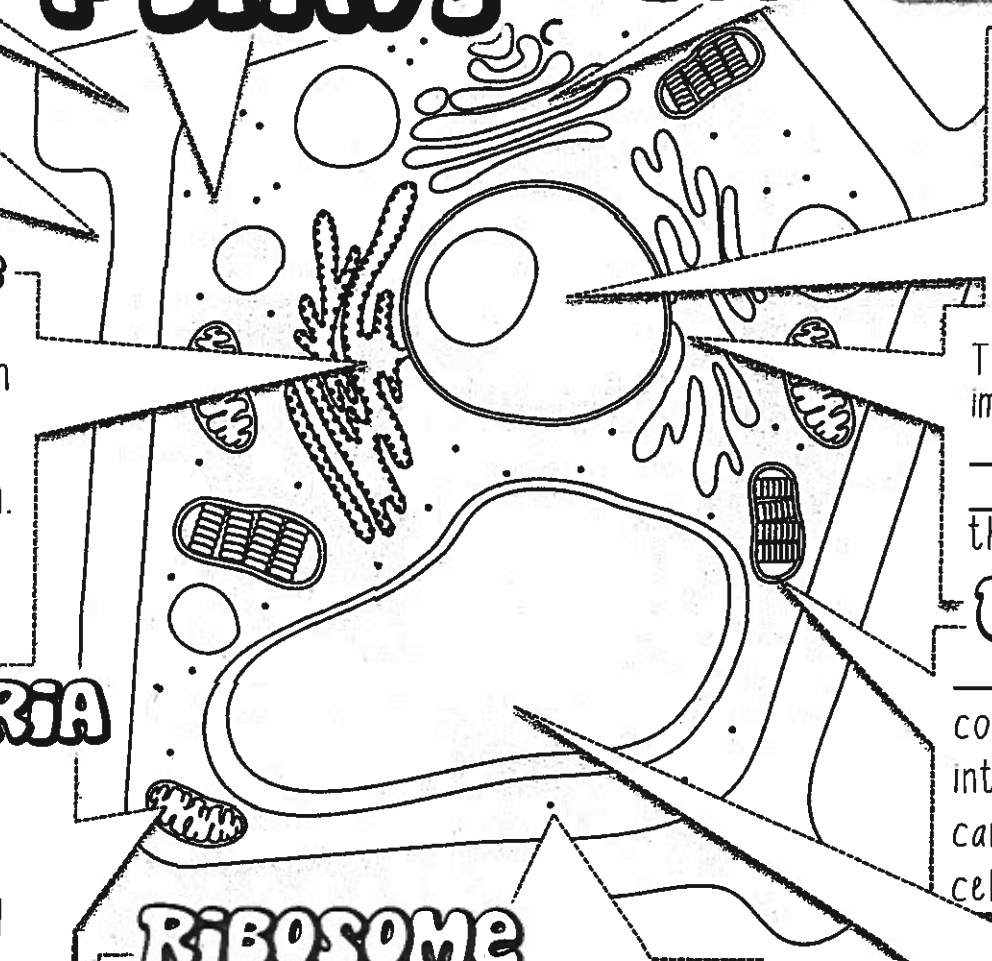
Animal Cell	Plant Cell
1.	1.
2.	2.
3.	3.
4.	4.
5.	5.
6.	6.
7.	7.
8.	8.
9.	9.
10.	10.
	11.
	12.
	13.

Nucleus 	Nucleolus 	Cytoplasm 
The control center of the cell and dictates what all of the other organelles do. Stores the DNA in eukaryotes.	Dark spherical body found in the nucleus; makes the ribosomes.	A jelly-like material that surrounds the cell organelles.
Ribosomes 	Golgi Apparatus (Bodies) 	Rough Endoplasmic Reticulum (ER) 
Tiny bodies attached to the endoplasmic reticulum and found free in the cytoplasm; help in synthesizing proteins.	Stacked membranes that receive, store, package, and secrete proteins transported in vesicles.	Transport system of the cell; tubules and sacs leading from the nuclear membrane and connecting to all the parts of the cell; contains numerous ribosomes on the surface.
Smooth Endoplasmic Reticulum (ER) 	Mitochondrion 	Chloroplast 
Similar in appearance to rough ER, but without the ribosomes. Produces lipids, involved in carbohydrate metabolism, and detoxification of drugs and poisons.	Rod-shaped structures that supply energy (ATP) for the cell; powerhouses of the cell.	Plant organelles that contain chlorophyll for photosynthesis.
Central Vacuole 	Vesicles 	Lysosomes 

Store water and nutrients needed by the cell. Help support the shape of the cell.	Small, round sacs that transport proteins from the golgi apparatus.	Small, round structures that contain enzymes used in digestion. Not to be confused with vesicles.
Cell Wall 	Plasma (Cell) Membrane 	Flagellum 
Surrounds the cell gives support and protection, made of cellulose, a non living material	Double membrane structure; allows substances to pass in and out of the cell.	Whip like tail used for movement.
Cilia 	Pseudopods 	Centrioles 
Hair like structures used for movement.	Long, arm-like extenstions "false feet" used for movement and engulfing prey.	Made of bundles of long filaments called microtubules that help in organizing cell division.
Cytoskeleton 	DNA 	Nuclear envelope (membrane) 
The cell's skeleton. Made of microtubules and filaments. Give the cell shape, strength and ability to move.	Genetic material found in the cytoplasm of prokaryotes and in the nucleus of eukaryotes.	Separates DNA from cytoplasm. Openings called pores allow some materials to enter and leave nucleus

Name:

Parts of the PLANT CELL



MEMBRANE

Flexible material that _____ the parts of the cell together.

CYTOPLASM

The _____ of dissolved molecules that fills the cell and _____ organelles.

GOLGI BODY

Gathers simple molecules and _____ and _____ them into more complex molecules.

CELL WALL

Made of _____. This is _____ and thicker than a cell membrane. (Unique to plant cells)

NUCLEUS

The _____ of the cell that controls eating _____ and reproduction.

ROUGH ENDOPLASMIC RETICULUM

Functions as a protein _____ and _____ system. _____ attach to its surface.

SMOOTH ENDOPLASMIC RETICULUM

This is important in the creation of _____ and hormones. It _____ these products throughout the cell.

CHLOROPLAST

_____ food by converting _____ energy into _____ that cells can use. (Unique to plant cells)

MITOCHONDRIA

The cell _____ _____ where nutrients are digested and energy is created for the cell. Responsible for cellular _____.

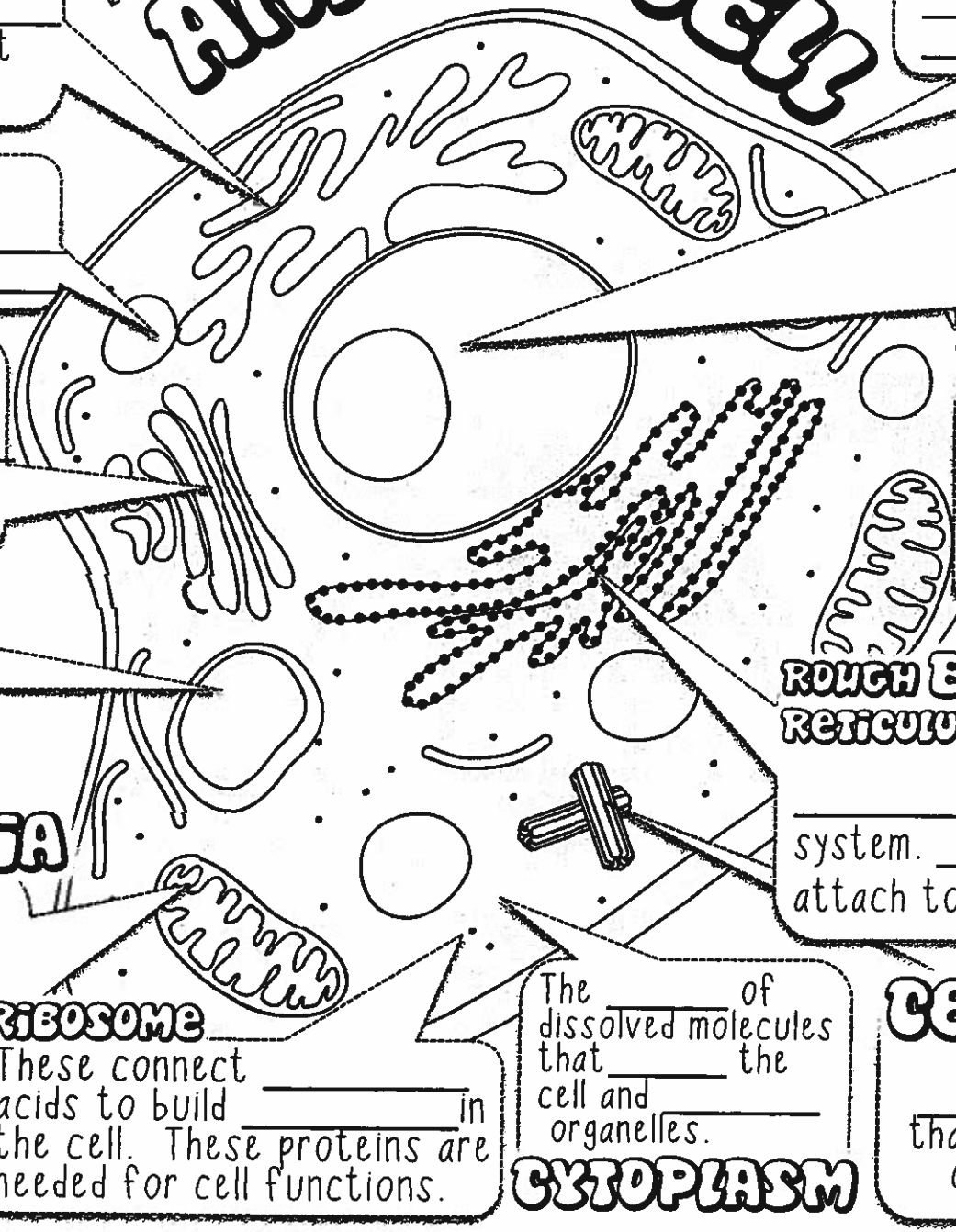
RIBOSOME

These connect amino acids to build _____ in the cell. These proteins are needed for cell functions.

VACUOLE

_____ bins where _____, nutrients or waste are kept. Much _____ in plant cells than animal cells.

Parts of the ANIMAL CELL



SMOOTH ENDOPLASMIC RETICULUM
This is important in the creation of _____ and hormones. It _____ these products throughout the cell.

LYSOSOME
_____ created by the Golgi that are used to _____ food. Removes cell _____

GOLGI BODY
Gathers simple molecules and _____ and _____ them into more complex molecules.

VACUOLE
_____ bin where food, _____ and waste are kept.

MITOCHONDRIA
The cell _____ where _____ nutrients are digested and energy is created for the cell. Responsible for cellular _____.

RIBOSOME
These connect _____ acids to build _____ in the cell. These proteins are needed for cell functions.

CYTOPLASM
The _____ of dissolved molecules that _____ the cell and _____ organelles.

CELL MEMBRANE
_____ material that _____ the parts of the cell _____.

NUCLEUS
Cell _____ or command center that _____ cell activity.

NUCLEOLUS
_____ shape in the nucleus. Makes _____ for the ER.

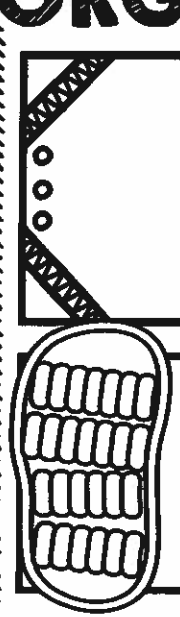
ROUGH ENDOPLASMIC RETICULUM
a protein _____ and _____ system. _____ attach to its surface.

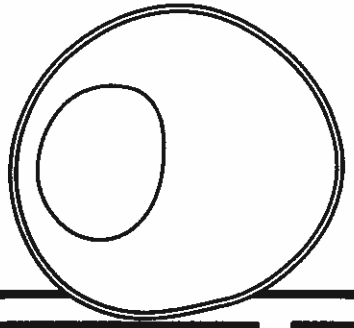
CENTRIOLES
_____ organelles that work to help the cell _____.

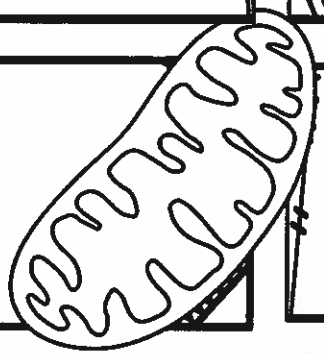
Name:

Name:

CELL ORGANELLES

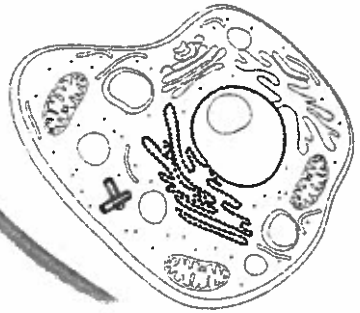




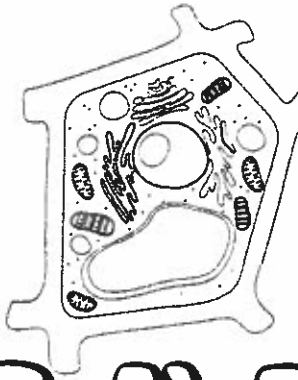


Comparing plant and animal cells

ANIMAL CELLS



BOTH



PLANT CELLS

Name:

Name(s): _____ Date: _____ Per: _____

Activity: Cell City Analogy

In a faraway city called Grant City, the main export and production product is the steel widget. Everyone in the town has something to do with steel widget making and the entire town is designed to build and export widgets. The town hall has the instructions for widget making, widgets come in all shapes and sizes and any citizen of Grant can get the instructions and begin making their own widgets. Widgets are generally produced in small shops around the city, these small shops can be built by the carpenters union (whose headquarters are in town hall).

After the widget is constructed, they are placed on special carts which can deliver the widget anywhere in the city. In order for a widget to be exported, the carts take the widget to the postal office, where the widgets are packaged and labeled for export. Sometimes widgets don't turn out right, and the "rejects" are sent to the scrap yard where they are broken down for parts or destroyed altogether. The town powers the widget shops and carts from a hydraulic dam that is in the city. The entire city is enclosed by a large wooden fence, only the postal trucks (and citizens with proper passports) are allowed outside the city.

Match the parts of the city (underlined) with the parts of the cell.

1. Mitochondria _____
2. Ribosomes _____
3. Nucleus _____
4. Endoplasmic Reticulum _____
5. Golgi Apparatus _____
6. Protein _____
7. Cell Membrane _____
8. Lysosomes _____
9. Nucleolus _____

Getting to know the Cell
Cell organelle function Matching

- ✓ I can describe the function of cell organelles and structures in a cell, in terms of life processes, and use models to explain these processes and their applications
- ✓ I can identify the structure and describe, in general terms, the function of the cell membrane, nucleus, lysosome, vacuole, mitochondrion, endoplasmic reticulum, Golgi apparatus, ribosomes, chloroplast and cell wall, where present, of plant and animal cells

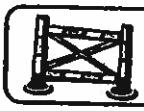
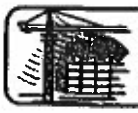
Directions: Match the function cards and memory items by gluing them into the correct locations in the chart below

Organelle	Function/Description	How can I remember it?
Cell Membrane		
Cell Wall		
Cytoplasm		
Mitochondria		
Lysosomes		
Vacuoles		
Golgi Bodies		
Chloroplasts		
Endoplasmic Reticulum		
Ribosomes		
Nucleus		
Nucleolus		

Function Cards

Captures energy from the sunlight and uses it to produce food in a plant cells	Receives proteins & materials from the ER, packages them, & distributes them
Controls what comes into and out of a cell; found in plant and animal cells	Produces the energy a cell needs to carry out its functions
Gel-like fluid where the organelles are found	Assesembles amino acids to create proteins
Control center of the cell; contains DNA	Stores food, water, wastes, and other materials
Found inside the nucleus and produces ribosomes	Has passageways that carry proteins and other materials from one part of the cell to another
Ridged outer layer of a plant cell	Tiny strands inside the nucleus that contain the instructions for directing the cell's functions
Uses chemicals to break down food and worn out cell parts	

Memory Items

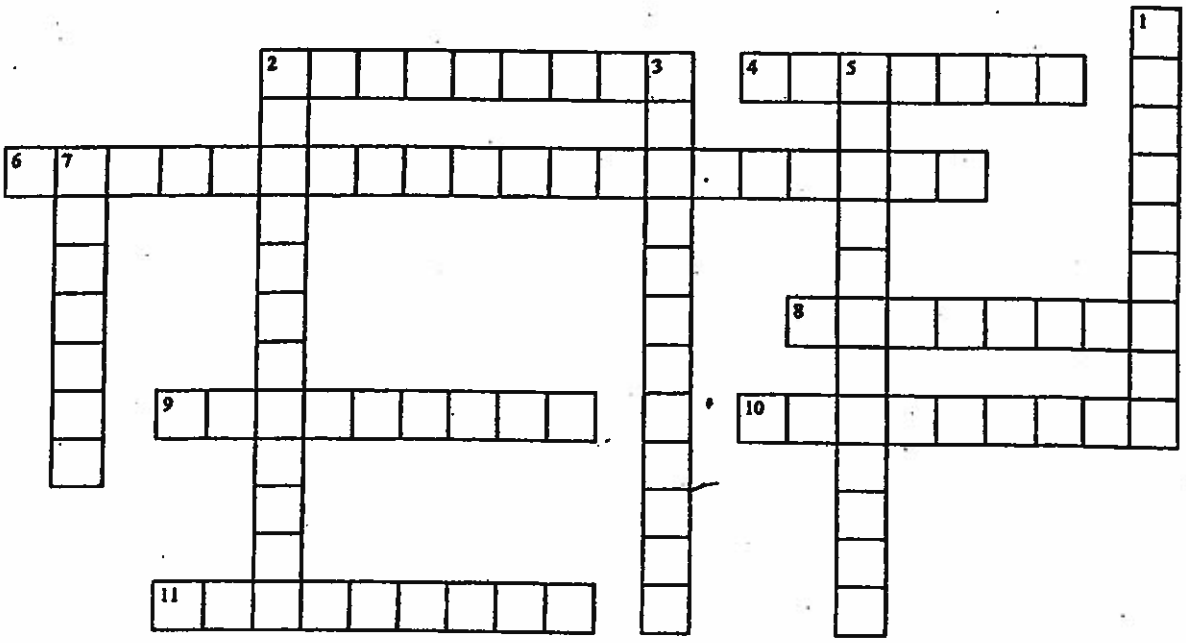
 Make me something sweet to eat	 Members only can come and go.	 I'm a "GOLden" packer.
 I'm a brick wall.	 I am the little nucleus.	 I'm a transportER.
 I am a "mighty" power house.	 I clean things up! (Hint: Lysol)	 I'll store anything, (Hint: Vacuum Bags)
 I'm the control center.	 I'm a "tin" of information.	 Sail through my plasma.
 I make "some" nice proteins.		

Getting to know the Cell

Cell Organelle Functions Crossword Puzzle

- ✓ I can describe the function of cell organelles and structures in a cell, in terms of life processes, and use models to explain these processes and their applications
- ✓ I can identify the structure and describe, in general terms, the function of the cell membrane, nucleus, lysosome, vacuole, mitochondrion, endoplasmic reticulum, Golgi apparatus, ribosomes, chloroplast and cell wall, where present, of plant and animal cells

Our bodies are made of trillions of cells working together. Inside each cell there are small structures called organelles. There are many different types of organelles, each performing specialized functions. Complete the following crossword that summarizes the functions of these specialised organelles.



ACROSS

2 The area between the cell membrane and nucleus that contains a gel-like fluid in which many different organelles are found.
4 A sac within the cytoplasm that stores water, food, waste, and other materials.
6 A network of passageways that carries materials from one part of the cell to another.
8 Provides and maintains the shape of cells and serves as a protective barrier.
9 Receives materials from the endoplasmic reticulum and send them to other parts of the cell.
10 Small structures that function as factories to produce proteins.
11 Small organelles that break down food particles and worn-out cell parts.

DOWN

1 An organelle that produces ribosomes.
2 Organelles that contain chlorophyll and capture energy from the sun and use it to produce food through photosynthesis.
3 Rod-shaped organelles that produces most of the cell's energy.
5 Protects the cell and regulates what substances enter and leave the cell.
7 The cell's control center and directs all of the cell's actives.

Cell Organelles Review Sheet

- ✓ I can describe the function of cell organelles and structures in a cell, in terms of life processes, and use models to explain these processes and their applications
- ✓ I can compare the structure, chemical composition and function of animal cells, and describe the complementary nature of the structure and function of animal cells
- ✓ I can identify the structure and describe, in general terms, the function of the cell membrane, nucleus, lysosome, vacuole, mitochondrion, endoplasmic reticulum, Golgi apparatus, ribosomes, chloroplast and cell wall, where present, of plant and animal cells

1. Complete the following table by writing the name of the cell part or organelle in the right hand column that matches the structure/function in the left hand column. A cell part may be used more than once.

Structure/Function	Cell Part
Closely stacked, flattened sacs (plants only)	
The sites of protein synthesis	
Transports materials within the cell	
Organelle that manages or controls all the cell functions in a eukaryotic cell	
Contains chlorophyll, a green pigment that traps energy from sunlight and gives plants their green color	
Digests excess or worn-out cell parts, food particles and invading viruses or bacteria	
Small bumps located on portions of the endoplasmic reticulum	
Provides temporary storage of food, enzymes and waste products	
Firm, protective structure that gives the cell its shape in plants, fungi, most bacteria and some protests	
Produces a usable form of energy for the cell	
Packages proteins for transport out of the cell	
Everything inside the cell including the nucleus	
Site where ribosomes are made	
The membrane surrounding the cell	

2. Put a check in the appropriate column(s) to indicate whether the following organelles are found in plant cells, animal cells or both.

Organelle	Plant Cells	Animal Cells
Cell Wall		
Chloroplast		
Cytoplasm		
Endoplasmic reticulum		
Golgi apparatus		
Lysosome		

Organelle	Plant Cells	Animal Cells
Mitochondria		
Nucleus		
Plasma membrane		
Central vacuole		
Ribosome		
Vacuole		

3. In what organelle does cellular respiration take place?
4. Name two storage organelles?
5. What is the list of organelles that take part in protein synthesis?
6. How is the nucleus involved in protein synthesis?
7. What organelle is considered a "factory", because it takes in raw materials and converts them to cell products that can be used by the cell?
8. How does the membrane of the cell differ from the cell wall?
9. What do ribosomes do? Are they found freely floating in the cytoplasm? OR are they found attached to another organelle? OR both. Explain why this occurs
10. What does the endoplasmic reticulum do?
11. What is the difference between rough ER and smooth ER? What is the ER doing that is different in each case?
12. What are lysosomes? What types of molecules would be found inside a lysosome?
13. Why might a lysosome fuse with or link up with a food vacuole?
14. In what organelle do molecules move from the ER to the Golgi bodies?