

# Semester Exam Study Guide

*This study guide should be used as a supplement to your studying for the Midterm exam. It should not replace going over old notes, quizzes and activities.*

1. What is the difference between a scientific theory and a scientific law? (Hint: what do both explain?)

Theory – explains why a scientific event is happening.

Law – describes what is happening in a scientific event.

2. Describe a dependent variable, independent variable, experimental group, and control group. (You may want to use an example like those we covered in class, such as an experiment testing the effects of amount of light on the rate of photosynthesis.)

3. Dependent Variable – the part of the experiment that will be measured (ex. Growth of a plant)

Independent Variable – the part of the experiment that is being changed. This is what you are assuming will affect your dependent variable. (Ex. Amount of plant food)

Experimental Group – The group that you are changing the independent variable with. (Ex. Plants that receive more food grow taller)

Control Group – The group that mimics normal conditions. This group is what you compare your results to so you can see if a change has occurred. (Ex. Plants that receive a normal amount of food.)

4. What is a hypothesis? How do we develop hypotheses?

A hypothesis is an answer to a scientific question. It is developed using research and observations. It is never a guess.

5. What are the 8 characteristics of life?

1. Evolve	2. Composed of Cells	3. Homeostasis	4. Reproduction
5. Heredity	6. Metabolism	7. Responsiveness	8. Growth/Development

6. What characteristics of life do viruses possess? Which ones do they not possess? Are they considered alive?

Possess: Evolve and Heredity

Do Not Possess: All other characteristics (remember they use the host for reproduction and metabolism).

Not considered alive.

7. What type of questions can science answer?

Questions where data can be collected (not opinion/moral questions like is it wrong to steal)

8. Betty Sue had a new pair of shoes. Betty Sue always seemed to ruin her shoes within two months. Betty Sue had heard of a new product called Scuff-B-Gone which was supposed to keep your shoes looking brand new for up to 6 months. Betty Sue decided to apply the Scuff-B-Gone to only the left shoe of her new shoes. She wore her new pair of shoes for two months. At the end of the two months, she compared the two shoes to see if the left shoe with Scuff-B-Gone looked any better than the right shoe without Scuff-B-Gone.

A. Independent variable

The use of Scuff-B-Gone

B. Dependent variable

How the shoe looks

C. Constants

Same brand of shoes, same person walking in them, time period (2 months)

D. Control Group

Shoe without Scuff-B-Gone

E. Experimental Group

Shoe with Scuff-B-Gone

9. Scientists observed that white mice that were fed seeds appeared to grow more than mice fed the regular diet of leafy green and yellow vegetables. The scientists hypothesized that the protein in the seed was responsible for the growth. They designed an experiment to test this hypothesis. They divided 200 mice of the same age, size, health, and sex into two groups of 100 mice each. The mice were kept under identical conditions for 90 days. One group was given the normal low protein diet. The other group was given new high protein diet. The mass of each mouse was recorded weekly for 90 days.

A. Independent variable

Type of diet – High protein diet

B. Dependent variable

Mass of each mouse

C. Constants

Age, size, health, sex of mice, and time period they are fed the diet

D. Control Group

100 mice fed leafy green and yellow vegetables

E. Experimental Group

100 mice fed high protein diet

9. Design an experiment for testing the effectiveness of Advil on treating headaches.

Describe what your control group is and will be doing:

Take 10 people who experience headaches. Have each person use 100mg placebo (fake medicine) for 15 days and record whether or not their headaches go away.

Describe what your experimental group is and will be doing:

Take the same 10 people who experience headaches. Have each person use 100mg of Advil for 15 days and record whether or not their headaches go away.

Independent Variable:

Type of Medicine - Advil

Dependent Variable:

If the headaches go away

10. How does spontaneous generation differ from biogenesis?

Spontaneous generation states that life appears from nothing. (Such as flies appearing from nothing around a carcass)

Biogenesis – All life comes from other life forms

11. What were the experiments Pasteur, Redi, and Spallanzani do to help disprove abiogenesis?

Redi – Showed that flies come from maggots laying eggs in rotten meat.

Spallanzani – Showed that microorganisms appeared in gravy left out exposed

Pasteur – Used the swan-necked flask to prove that if no microorganisms were present no new microorganisms appear, thus disproving spontaneous generation.

## The Atom and the Cell

Describe the charge and location of the following atomic particles:

Atomic Particle	Electrical Charge	Atomic Location
Electron	Negative	Around the Nucleus
Proton	Positive	In the Nucleus
Neutron	Neutral	In the Nucleus

7. Describe the differences between a covalent, ionic, and metallic bond.

Ionic Bond – Electrons are transferred (given/taken)

Covalent – Electrons are shared

Metallic – “Free flowing” electrons travel around the metal ions.

8. The following is an element from the periodic table. Identify the following:

Atomic Number: 28

Number of Protons: 28

Number of Electron: 28

Atomic Mass: 59 (or 58.6934)

Number of Neutrons:  $59 - 28 = 31$

28
Ni
Nickel
58.6934

9. What element is in every macromolecule?

Carbon

10. List the four macromolecules. For each polymer list its monomer (if applicable), at least 2 functions, and at least 2 examples.

Macromolecule	Monomer	At least 2 Functions	At least 2 Examples
Protein	Amino Acids	<p>1) Regulate cellular processes (enzymes)</p> <p>2) Form bone and muscle</p> <p>3) Help fight disease</p> <p>4) Transport substances in and out of the cell.</p>	<p>Meat</p> <p>Eggs</p> <p>Cheese</p>
Carbohydrates	Sugars	<p>1) Main source of Energy</p> <p>2) Used as identifiers on cells (carbohydrate chains)</p>	<p>Bread</p> <p>Pasta</p>
Lipids (Fats)	Glycerol and Fatty Acids	<p>1) Forms biological membranes</p> <p>2) Storage of energy</p>	<p>Oil</p> <p>Butter</p> <p>Grease</p>

Nucleic Acids	Nucleotides	1) Transmit genetic information 2) Store genetic information	DNA RNA
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11. What macromolecule are enzymes? What is an enzymes function?

Protein. The function is to speed up biological reactions (processes) in the body, such as the break down of food or the production of ATP.

12. What is a prokaryote? What is a eukaryote? (What are the differences/similarities?)

- A prokaryote and a eukaryote are types of cells.
- Similarities – Both contain cytoplasm, DNA, cell membrane, and ribosomes. (Remember “Can’t Do Cells Right”)
- Differences – Prokaryotes do not have a nucleus and Eukaryotes do. Also, Prokaryotes do not have membrane bound organelles such as mitochondria and golgi, and Eukaryotes do have these.

13. What are the three statements of cell theory?

1. All living things are composed of cells.
2. Cells are the basic unit of structure and function. (The smallest part of an organism that still acts as a living thing is the cell like the brick in a cement wall possess all the characteristics of the wall and is the smallest piece)
3. All cells come from other cells. (Mitosis/Meiosis)

13. Fill in the following table.

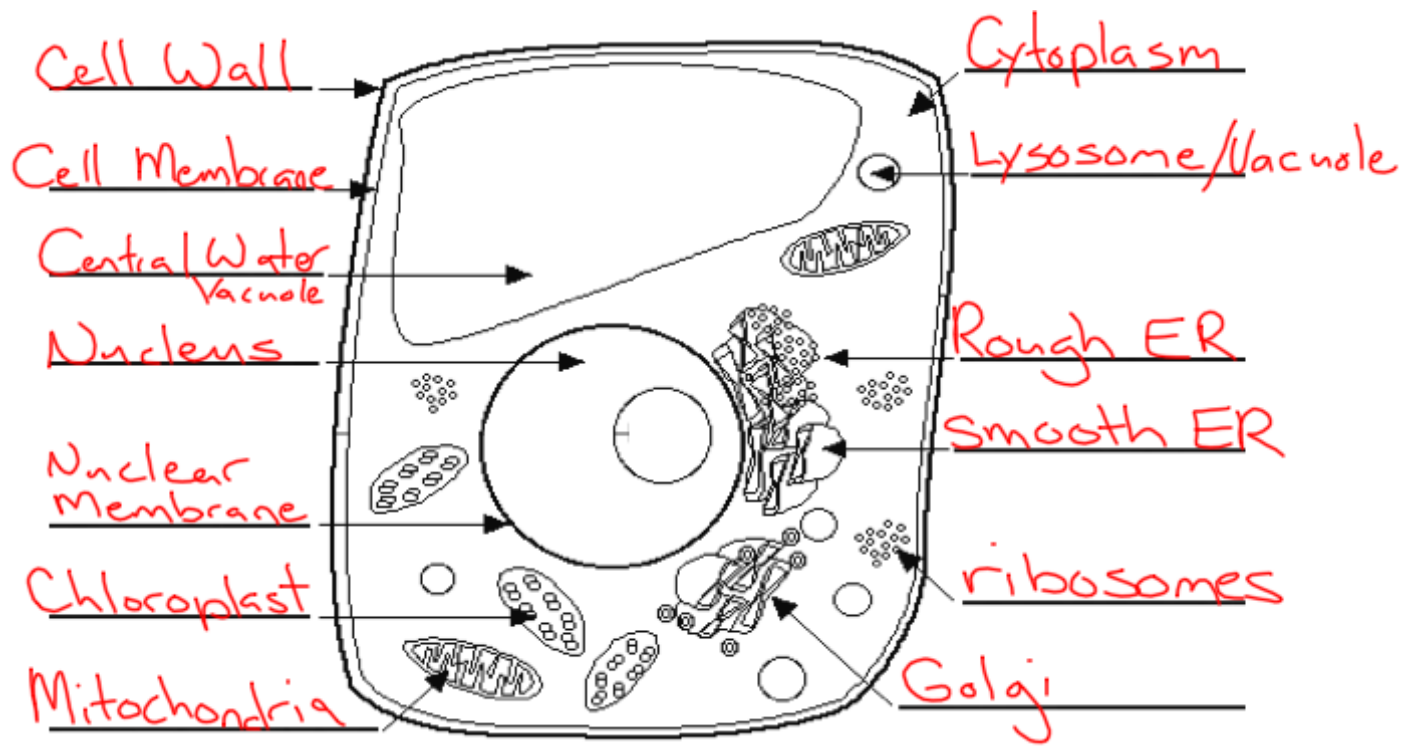
Organelle	Function (what it does)
Nucleus	Protects the DNA
Endoplasmic Reticulum	Stores and modifies proteins
Golgi apparatus	Modifies, packages, and ships protein
Chloroplast	Performs photosynthesis for plants
Ribosome	Makes proteins

Cell Wall	Supports a plant cell
Mitochondria	Provides energy for cell through respiration
Cell Membrane	Controls what goes in and out of the cell
Lysosome	Digests materials for the cell
Cytoplasm	Holds the organelles in place
Central Water Vacuole	Stores water for the plant cell

14. What three organelles are specific to plants?

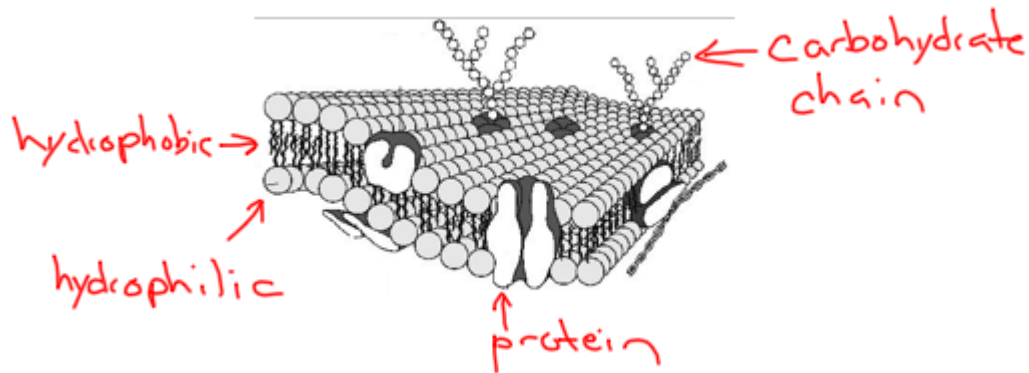
Cell Wall, Chloroplast, and Central Water Vacuole

Label the following plant cell diagram



# Cell Membrane and Transport

15. Label the carbohydrate chain, lipid bilayer – hydrophobic, lipid bilayer – hydrophilic, and the protein channel in the cell membrane illustration.



16. How does the lipid bilayer stop large molecules from passing through the cell membrane? How does it stop charged molecules?

Large – Can't fit through the spaces between the phospholipids.  
Charge – Repelled by the hydrophobic region of the lipid bilayer.

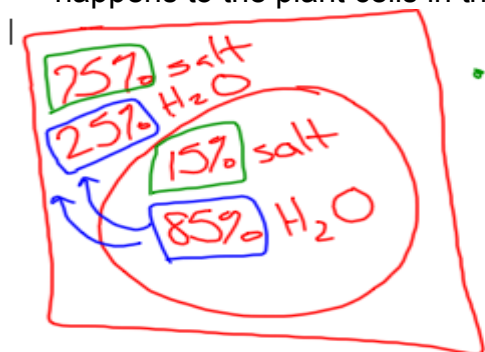
17. Give an example of a large molecule. Give an example of a charged molecule. Give an example of a small, uncharged molecule.

- a. Large: Sugar, Carbohydrate
- b. Charged:  $\text{Na}^+$ ,  $\text{Cl}^-$ , salt
- c. Small, Uncharged: oxygen ( $\text{O}_2$ ), carbon dioxide ( $\text{CO}_2$ )

18. What is diffusion? What is it called when diffusion has reached a point where there is an equal concentration everywhere?

Diffusion is the movement of particles from an area of high concentration to an area of low concentration.  
It is called equilibrium.

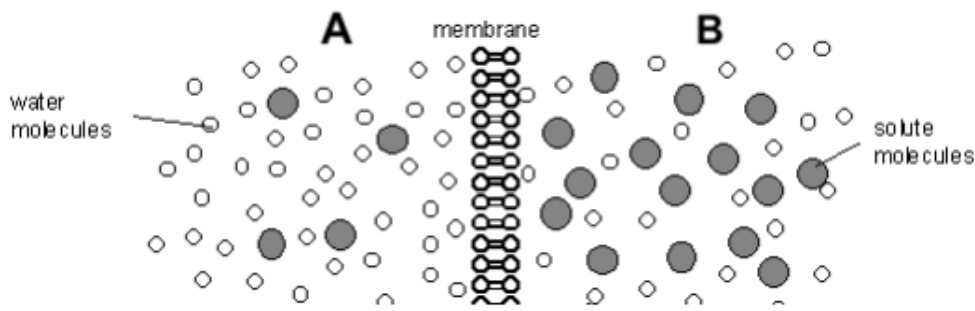
19. You place a leaf in a 75% salt solution. The leaf is 15% salt and 85% water. Explain what happens to the plant cells in this solution. What type of solution is the salt solution?



• Salt solution has MORE solute than leaf.  
→ hypertonic

Water leaves the cells and causes the cell to shrivel up.

20. Using the picture below answer the following questions.



a. What type of solution is side A (hypertonic, hypotonic, or isotonic)?

Hypotonic

b. The solutes are charged and cannot diffuse. Which way will the water diffuse?

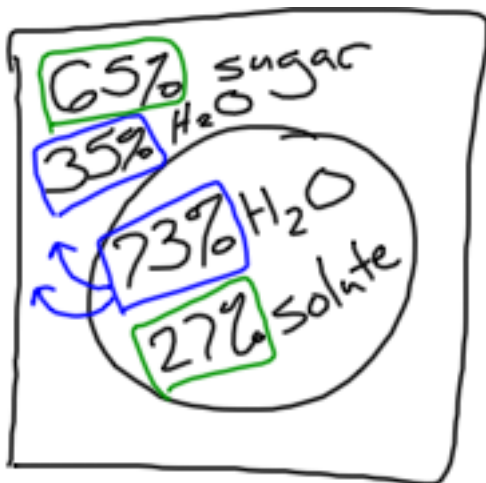
From A to B

c. After 24 hours what will happen to the concentration of solutes on each side? (Go up or down)

Concentration on A will go up since we are losing water (think about when a glass of koolaid starts to evaporate and the koolaid gets more concentrated).

Concentration on B will go down since we are adding water (this is going to dilute the solution).

21. You place your egg into the corn syrup solution that was 65% sugar. An egg is 73% water and 27% solute. Is the egg hypotonic, hypertonic, or isotonic? Is the solution hypotonic, hypertonic, or isotonic? What happens to the egg?



The egg is Hypotonic – less solute than solution  
The solution is Hypertonic – more solute than egg

Water leaves the egg and the egg shrivels.

22. What is osmosis?

Osmosis is the diffusion of water from a high concentration of water to a low concentration of water.



23. What are two differences between active and passive transport, and what is one similarity?

Differences:

- 1) Active transport requires energy and passive does not
- 2) Active transport goes from a low concentration to a high concentration and passive goes from a high concentration to a low concentration.

Similarity:

- 1) Both involve transporting materials across the cell membrane.

24. Give three types of active transport

- 1) Endocytosis
- 2) Exocytosis
- 3) Protein Pump

25. What is the difference between Endocytosis and Exocytosis?

Endocytosis brings material into the cell, and exocytosis brings material out of the cell.

26. How do protein pumps work?

ATP is used to change the shape of the protein channel and it pushes the material into the cell or out of the cell.

27. Describe the pH range of an acid and a base. What is the pH of a neutral substance?

Substance	pH (range)
Acid	0 - 6
Neutral	7
Base	8 - 14

## Energy, Photosynthesis and Respiration

28. What molecule is used directly for energy in living organisms?

ATP

29. The energy from our **FOOD** is converted into **ATP** (the molecule used for energy directly) and used in the body for cellular processes.

30. What source of energy does photosynthesis use? To what type of energy is this converted into?

Light energy.

It is converted into chemical energy (in the bonds of glucose)

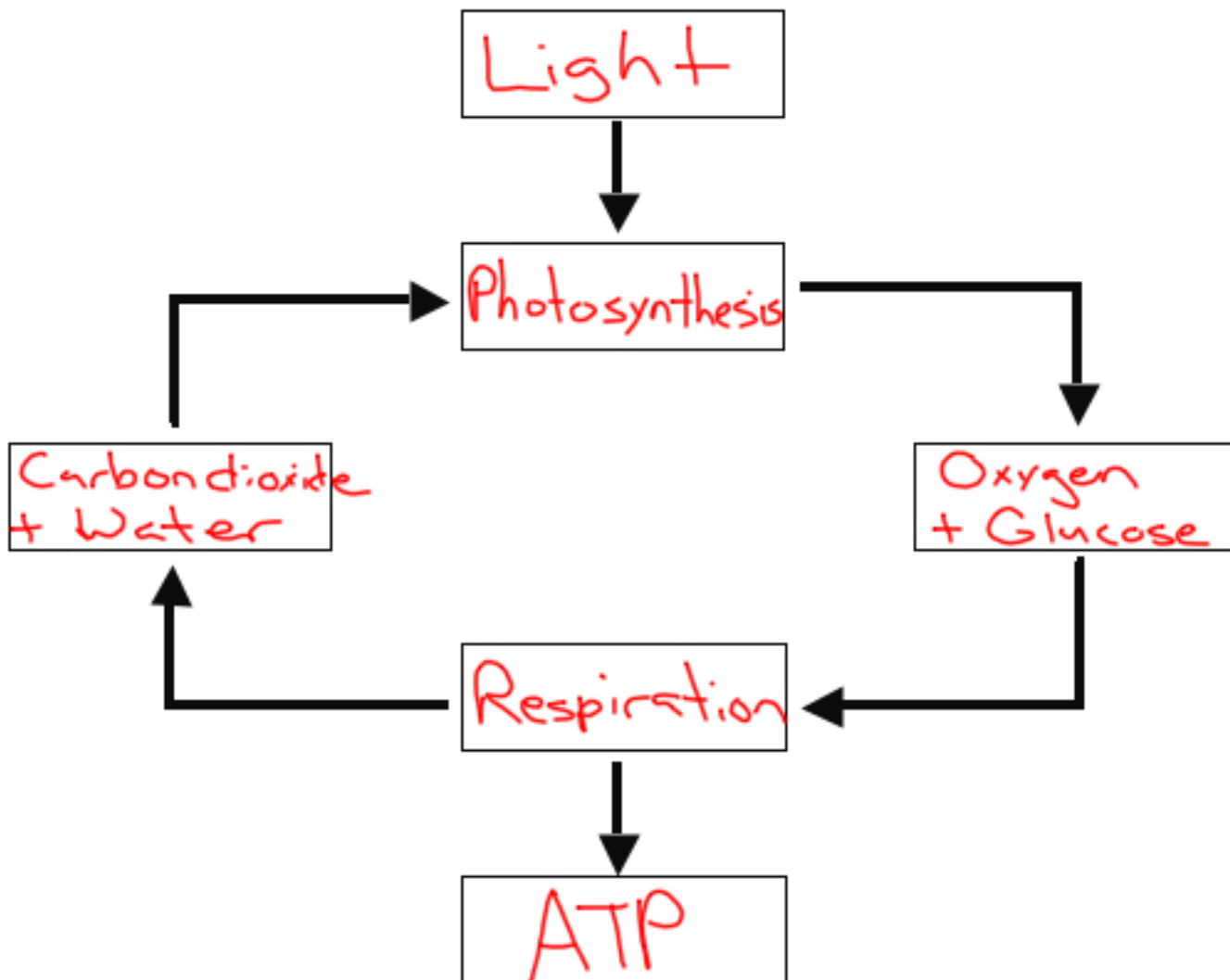
31. What is the overall equation for photosynthesis?

Carbon dioxide + Water ----light----> oxygen and glucose

32. Fill in the below diagram showing the relationship between Photosynthesis and Respiration using the following terms:

Photosynthesis  
ATP  
CO<sub>2</sub> and H<sub>2</sub>O

Sugars and O<sub>2</sub>  
Cellular Respiration  
Light Energy



33. Describe how energy is A) stored in ATP, and B) released from ATP.

A) Bonding a phosphate to ADP

B) Removing a phosphate from ATP (breaking the bond)

34. In what organelle does aerobic respiration occur? Mitochondria

35. What is the overall reaction for cellular respiration?

Oxygen + glucose ----ATP--> carbon dioxide + water

36. What type of fermentation (anaerobic respiration) do humans undergo?

Lactic acid fermentation

37. What is it called when a process (any process, but especially referring to respiration) occurs WITHOUT oxygen? How about WITH oxygen?

WITHOUT: anaerobic

WITH: aerobic

38. T or F: ATP is a product of respiration? TRUE

39. How is photosynthesis and cellular respiration related?

The oxygen and glucose produced through photosynthesis are used in respiration. The carbon dioxide and water produced through respiration are used in photosynthesis.

40. What is photosynthesis' role in the carbon cycle? What is respiration's role in the carbon cycle?

Photosynthesis – take carbon out of the atmosphere

Respiration – Put carbon into the atmosphere

## Cell Size and Division

43. Explain why cells are small instead of large. (Reference surface area and volume).

Cells are small because it makes for a large surface area to volume ratio. Meaning it has a large surface area and small volume. The large surface area allows more materials to move in and out of the cell at a time. The small volume allows materials to move through the cell faster.

44. What are the two main phases of the cell cycle?

Interphase and M Phase

45. In which stage/phase of the cell cycle does the cell spend most of its time? Why would it spend most of its time in that stage/phase?

Interphase.

This is where the cell performs its normal functions, so it is important that it spend most of its time there if the cell is to function correctly.

46. What are the three stages of interphase? What happens in each of those stages?

G1 – Growth and normal functions

S – Replication of DNA

G2 – Preparing for mitosis (making proteins and organelles for division)

47. In M-phase there are two divisions that occur. Describe both.

Nuclear – The DNA is splitting

Cytokinesis – The cytoplasm is dividing.

48. What is the function of mitosis?

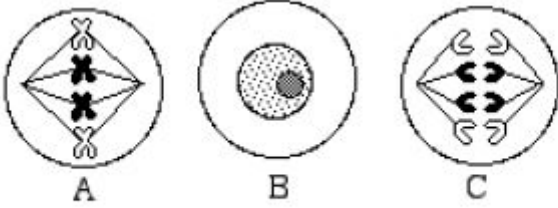
To repair damaged cells and growth of the organism.

49. Which would a liver cell perform: mitosis or meiosis? Mitosis (it is a body cell)

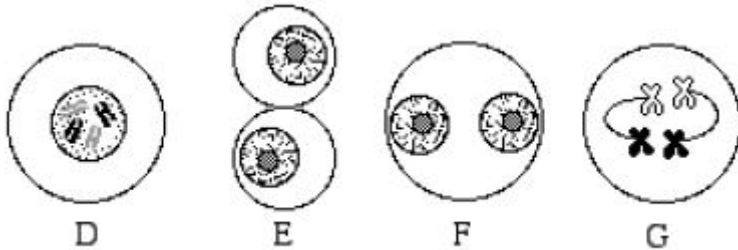
50. What happens to the chromosomes during anaphase of mitosis? Why is an important step in producing the daughter cells?

Sister chromatids are pulled apart. It is important, because it makes sure that each daughter cell receives a complete set of DNA.

List the following pictures in the correct order.



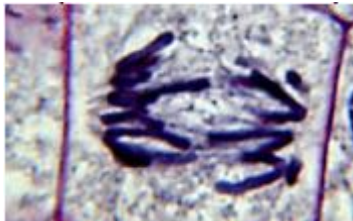
B, D, G (Prometaphase – will not be tested on this), A, C, F, E



51. What is it called when a cell divides uncontrollably? Give an example of something that can cause this.

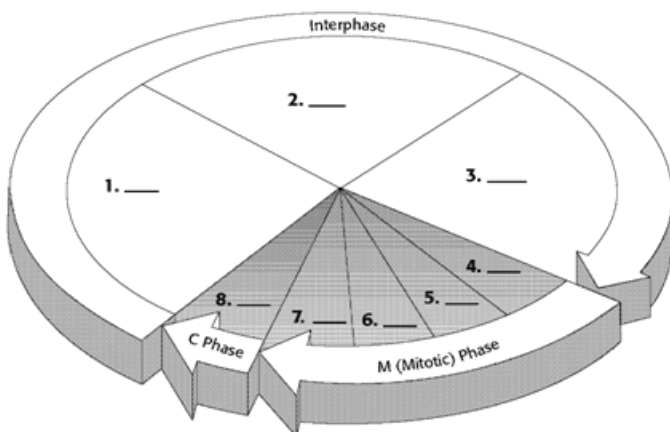
Cancer. UV Radiation from the sun, Smoking, nuclear radiation, genetics.

52. What phase is the cell picture below in?



Anaphase

53. Fill in the diagram.



1. G1
2. S Phase
3. G2
4. Prophase
5. Metaphase
6. Anaphase
7. Telophase
8. Cytokinesis

54. Define **homologous chromosome**.

A pair of chromosomes that have the same genes.

55. What is it called when there are two copies (2n) of each chromosomes in a cell? **Diploid**

56. What is a gamete?

**A cell created from meiosis that is used for reproduction (sperm or egg).**

57. What is it called when there is one copy of each chromosome in a cell? **haploid**

58. What is the purpose of meiosis?

**To create cells to perform sexual reproduction.**

59. What happens during Interphase in regards to the DNA that is important to cell division?

**The DNA replicates. It is important, because I want the cells I create to have the correct amount of DNA.**

60. How do the offspring of asexual reproduction and sexual reproduction differ in regards to their genetic makeup?

**Asexual – are exact copies**

**Sexual – unique genetic make up**

61. What two things happen during Prophase I?

1. **Tetrads form**

2. **Crossing over occurs**

62. What is crossing-over? How does this affect genetic variability (Increase or decrease)?

**Where homologous chromosomes swap parts. This increases genetic variability, because it shuffles up the genes.**

63. What are two processes that happen during meiosis to increase the combinations of genes (genetic variability)?

**Crossing over**

**Independent assortment**

64. How are the cells produced by meiosis I different from the cells produced from mitosis? Why are they different?

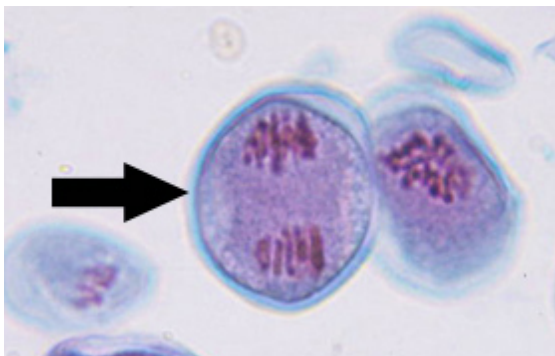
**The cells produced by meiosis I are haploid (even though sister chromosomes are duplicated they only have ONE set of the DNA). In mitosis they diploid. They differ because in meiosis I homologous chromosomes are pulled apart instead of sister chromatids.**

65. How many cells (in total) result from meiosis II? **4 cells**

66. Below, describe six differences between mitosis and meiosis.

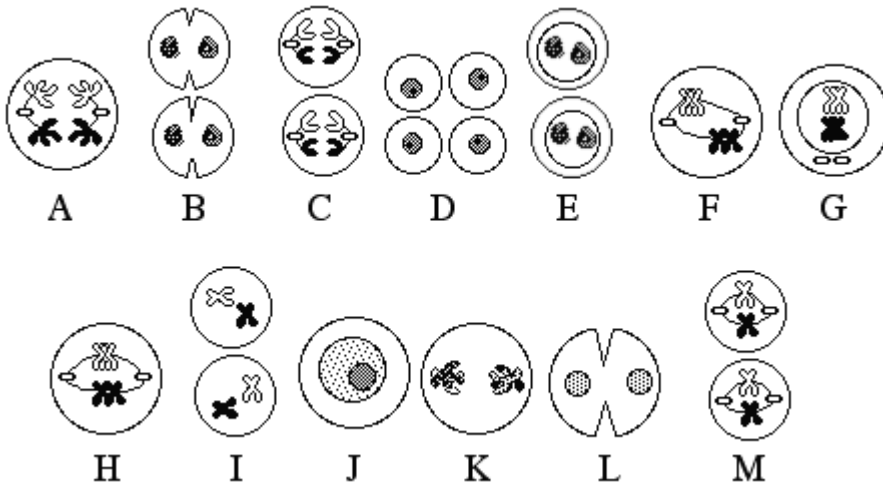
Mitosis		Meiosis	
1.	Performed by body cells	1.	Performed by sex cells
2.	Used for asexual reproduction	2.	Used for sexual reproduction
3.	Two daughter cells produce	3.	Four daughter cells produced
4.	Daughter cells are diploid	4.	Daughter cells are haploid
5.	Genetic variability from mutation	5.	Genetic variability from crossing over and independent assortment
6.	Function is for growth and repair	6.	Function is for reproduction

67. What phase is the cell pictured below in?



Anaphase (you are actually just looking at the one cell)

68. List the correct sequence for the following cells undergoing meiosis.



J, G, F, H, A, K, L, E, I, M, C, B, D

\*\*There are pictures of cells between phases in this diagram. That will not be the case on the test.

69. DNA that is spread out (non-condensed) in a non-dividing cell is called \_\_\_\_\_.

- A. chromosomes
- B. chromatin**

19. The two copies of each chromosome that are the same size, same shape, and carry genes for the same traits are called \_\_\_\_\_ chromosomes.

- A. maternal
- B. paternal
- C. heterozygous
- D. homologous**

20. As a cell grows in size, which increases more rapidly?

- A. its volume
- B. its surface area**

21. Cells spend most of their lifetime in \_\_\_\_\_ phase of interphase.

- A. Mitosis
- B. S
- C. G<sub>1</sub>**
- D. G<sub>2</sub>

22. \_\_\_\_\_ is a kind of cell division that produces haploid cells with 1/2 the number of chromosomes of the parent cell.

- A, mitosis
- B. meiosis**

23. Cells undergo meiosis to \_\_\_\_\_.

- A. grow bigger
- B. repair injuries
- C. replace worn out cells
- D. make gametes**



25. The group of 4 chromatids (two homologous chromosomes) that forms during prophase I is called a \_\_\_\_\_.
- A. biad
  - B. triad
  - C. tetrad**
  - D. quadrad
26. The exchange of genetic material between homologous chromosomes is called
- A. synapsis
  - B. independent assortment
  - C. asexual reproduction
  - D. crossing over**
27. The pairing up of maternal and paternal homologous chromosomes during meiosis happens in \_\_\_\_\_.
- A. prophase I**
  - B. metaphase I
  - C. prophase II
  - D. interphase II
28. During meiosis, crossing over happens in \_\_\_\_\_.
- A. prophase I**
  - B. metaphase I
  - C. prophase II
  - D. interphase II
29. In MEIOSIS a parent cell divides to produce \_\_\_\_\_.
- A. four genetically identical cells
  - B. two genetically identical cells
  - C. two genetically different cells
  - D. four genetically different cells**
31. The production of offspring from one parent without joining gametes is called \_\_\_\_\_ reproduction.
- A. sexual
  - B. asexual**

### TRUE or FALSE

Circle T if the statement is TRUE.  
 Circle F if the statement is FALSE.

*If it is FALSE, MAKE CORRECTIONS to the underlined word(s) to make the statement true.*

- |   |   |  |
|---|---|--|
| T | F | Offspring from <u>asexual</u> reproduction are genetically identical to the parent.<br><b>TRUE</b>   |
| T | F | The <u>2<sup>nd</sup></u> division in meiosis is similar to mitosis division <u>without</u> first copying the DNA.<br><b>TRUE</b>  |
| T | F | Gametes produced in meiosis are <u>identical</u> to each other, but <u>different</u> from the parent cell.<br><b>FALSE – Gametes produced in meiosis are different to each other, and different from the parent. (This is due to crossing over.)</b> |