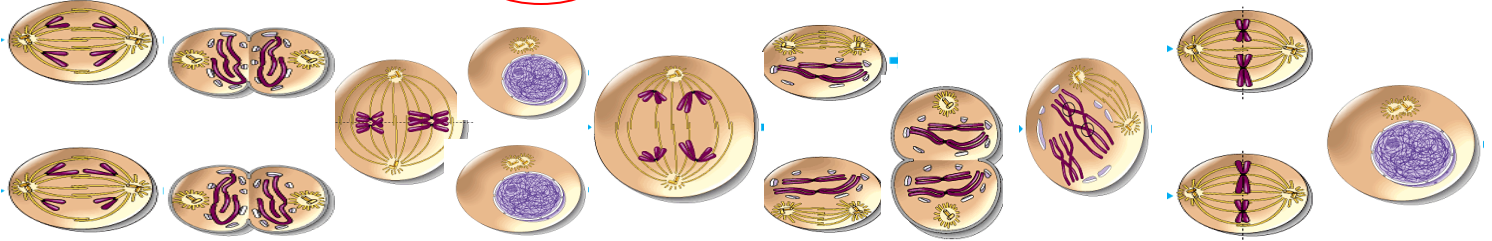


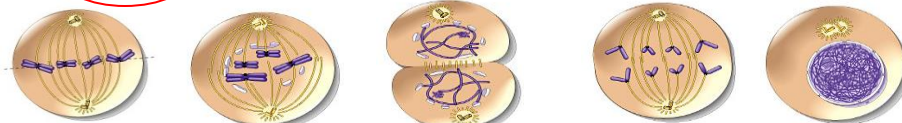
DNA & Cell Division Study Guide

1) Is this cell division process Mitosis or Meiosis (**circle**)? Number the phases 1-10 in the order that they occur.



9 10 3 6 4 7 5 2 8 1

2) Is this cell division process Mitosis or Meiosis (**circle**)? Number the phases 1-5 in the order that they occur.

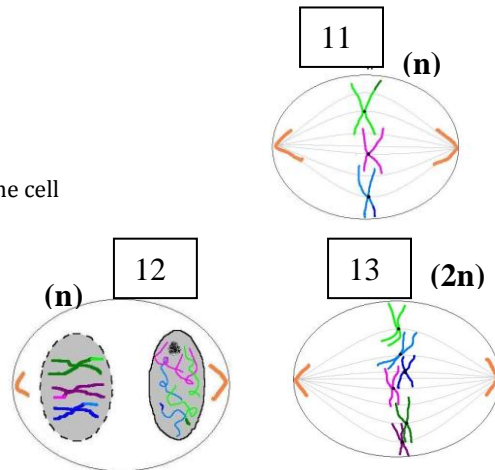


3 2 5 4 1

MM Review: Tell whether the description or cell diagram best applies to **Mitosis** or **Meiosis**, **BOTH** or **Neither**

A= Meiosis **B=** Mitosis **C=** BOTH Mitosis & Meiosis **D=** Neither Mitosis nor Meiosis

- C 3. involves ripping “double” chromosomes into “single” chromosomes
- A 4. Creates new gene combinations through “crossing over”
- C 5. produces daughter cells with “single” chromosomes at the end
- D 6. produces daughter cells with “double” chromosomes at the end
- C 7. involves “double” chromosomes lining up single file on the equator of the cell
- B 8. functions in growth, replacing lost cells, and repairing injuries
- D 9. begins with a Haploid cell
- B 10. Produces diploid daughter cells
- A 11. see diagram #11
- A 12. see diagram #12
- B 13. see diagram #13



14. Meiosis is often described (by Mr. R) as the “Mix-E, Mix-E, cut your DNA in half” story. Explain two different ways that Meiosis creates genetic variety ensuring that no 2 gametes are ever identical.

Mix-E #1 = **Crossing-over during Prophase 1**

Mix-E #2 = **Random alignment of each homologous chromosome pair during Metaphase 1 = Law of Independent Assortment**

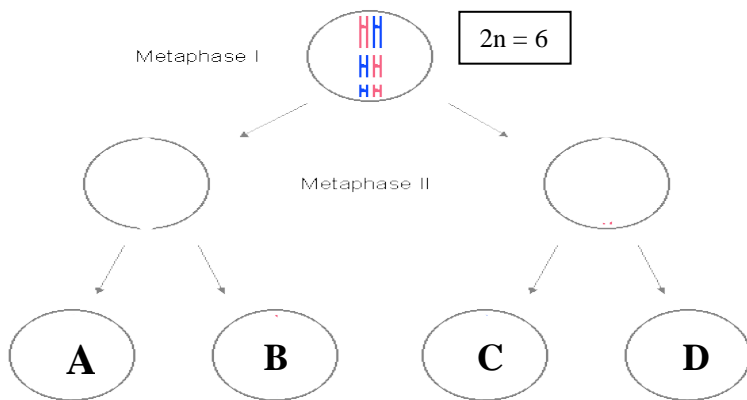
15. At the end of HUMAN Mitosis cell division, four daughter cells are produced: 2 cells each contain **44** “single” chromosomes, one cell has **2** “double” chromosomes, and the last cell has **NO** chromosomes. **CIRCLE** which of the following things most likely went **WRONG** during Mitosis cell division?

- a. 1 spindle fiber was broken
- b. 2 spindle fibers were broken**
- c. the centrioles were broke
- d. The chromatin replicated twice
- e. The chromatin failed to replicate
- f. cytokinesis failed to happen
- g. cytokinesis happened twice**

16. Number the following steps of **Mitosis** Cell Division in the correct order:

- 5 cytokinesis happens
- 2 the chromosomes line up single file on the equator line of the cell
- 4 the nucleolus and nuclear membrane reappear
- 1 the nucleolus and nuclear membrane disappear
- 3 the sister chromatids are ripped apart and pulled to opposite poles of the cell

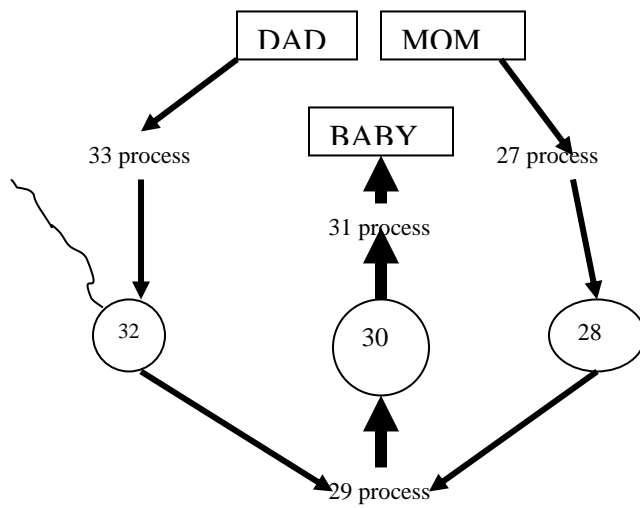
17. How many total eggs are produced by ONE ovary cell during Meiosis (oogenesis)? **1**
18. How many total sperm are produced by ONE testis cell during Meiosis (spermatogenesis)? **4**
19. How many total chromosomes are usually found in a human body cell like skin, heart, liver, etc. ? **46**
20. How many total chromosomes are usually found in a human sperm or egg cell ? **23**
21. Which of the following is a haploid cell?
- a. liver cell b. testis cell c. skin cell
d. egg e. blood cell f. both b and d
22. CIRCLE any of the following cell cycle phases when sister chromatids are visible?
- a. interphase
b. prophase
c. metaphase
d. anaphase
e. telophase
23. Two gametes each containing 4 chromosomes join during fertilization.
How many chromosomes will the zygote cell contain? **8**
24. A cell with **14** chromosomes undergoes mitosis twice. How many chromosomes will each daughter cell have? **14**



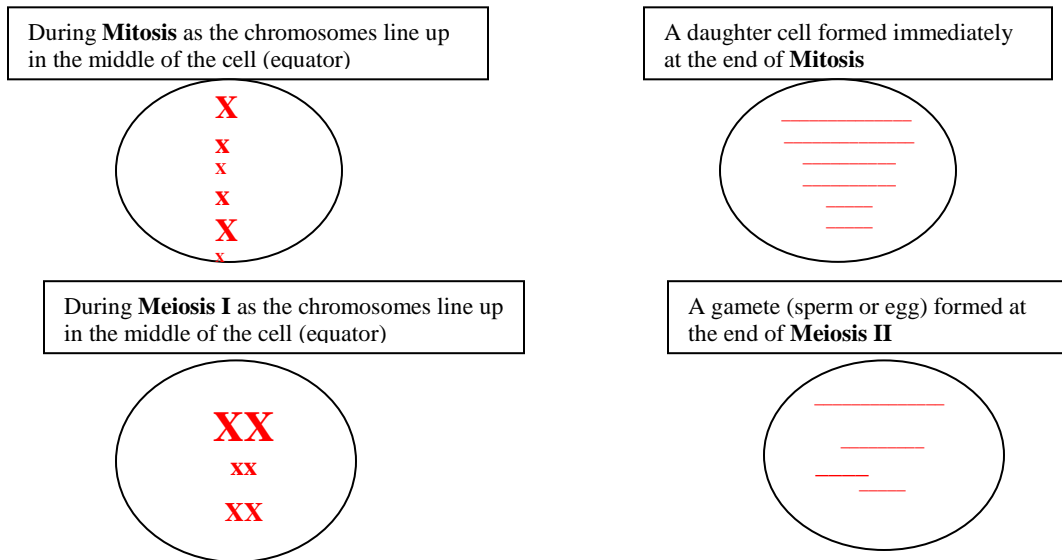
25. If the process of **meiosis** shown here proceeds normally, how many chromosomes will cells A, B, C, and D have? **3**
26. Complete the matrix table below to compare spermatogenesis vs. oogenesis

characteristics	Spermatogenesis	Oogenesis	S = same D = different
1. WHO does this type of cell division?	males	females	D
2. WHAT does this type of cell division produce?	sperm	eggs	D
3. WHERE does this type of cell division happen.....location?	testes	ovary	D
4. WHEN does this type of cell division happen?	Puberty to death	Start before birth, continue at puberty, finish at fertilization	D
5. HOW does the cytoplasm divide?	equally	unequally	D
6. # times the cell divides?	2	2	S
7. # of gametes produced?	4	1	D

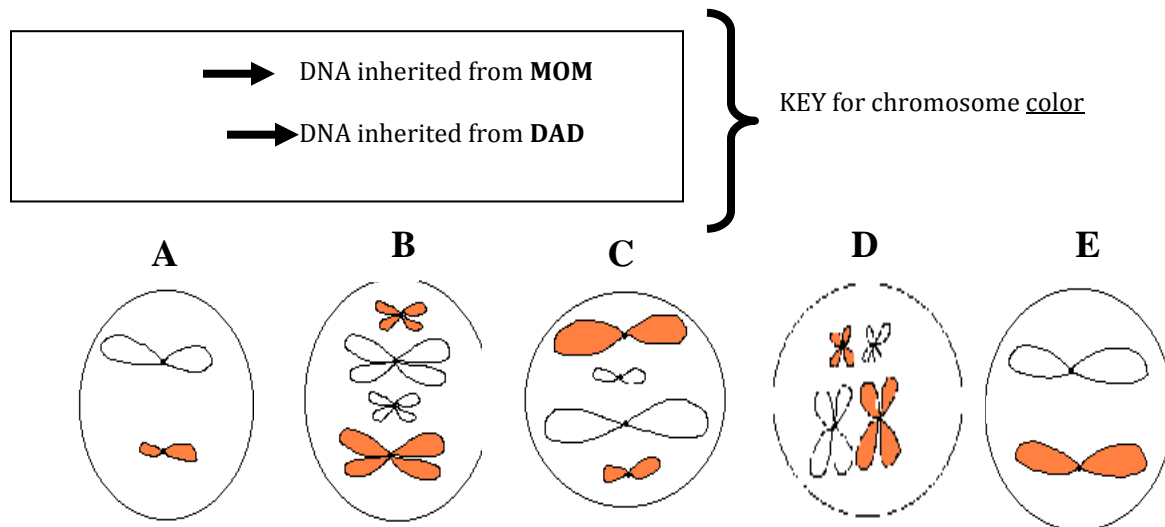
27. Name the process happening at #27 ? Meiosis
28. How many chromosomes are in the **egg** ? 23
29. Name the process happening at #29 ? Fertilization
30. How many chromosomes are in the **zygote** ? 46
31. Name the process happening at #31 ? Mitosis
32. How many chromosomes in the **sperm** ? 23
33. Name the process happening at #33 ? Meiosis
34. Is the sperm cell Haploid or Diploid ? Haploid
35. Is the zygote Haploid or Diploid ? Diploid



36. Draw a diagram of a cell with a diploid number of 6 ($2n = 6$) during the following stages of cell division:



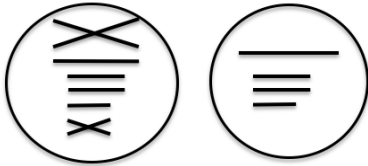
Carefully study the 5 diagrams of **Mosquito** cells below and then answer questions 37-42; each diagram shows a specific stage from either Mitosis or Meiosis cellular division.



37. Which cell above has chromosomes LINED UP on the equator during a middle stage (**metaphase**) of **Mitosis**? B
38. Which cell above was formed at the end of **Mitosis**? C
39. Which cell above has chromosomes LINED UP on the equator during the middle of **Meiosis I** (**Metaphase I**)? D
40. Which cell above was formed at the end of **Meiosis II**? A
41. How many total chromosomes are in the nucleus of a mosquito body cell like a blood cell or wing cell? 4
42. Explain which cell above is visually NOT accurate? B...chromosomes are not aligned "long-skinny" along the equator

What Went Wrong During Meiosis? First study your Meiosis diagrams ($2n=6$) and then identify what went wrong during meiosis (to create each gamete diagram below at the end of meiosis) by matching the appropriate choices from the list below:

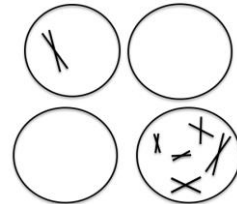
- | | |
|---|--|
| A) 1 spindle fiber pair was broken during Anaphase 1 | H) Cytokinesis failed to happen after Telophase 1 |
| B) 1 spindle fiber pair was broken during Anaphase 2 in 1 cell | I) Cytokinesis failed to happen after Telophase 2 in 1 cell |
| C) 1 spindle fiber pair was broken during Anaphase 2 in each cell | J) Cytokinesis failed to happen after Telophase 2 in each cell |
| D) 2 spindle fiber pairs were broken during Anaphase 1 | K) The centrioles never formed during Prophase 1 |
| E) 2 spindle fiber pairs were broken during Anaphase 2 in 1 cell | L) Centrioles never formed during Prophase 2 in 1 cell |
| F) 2 spindle fiber pairs were broken in Anaphase 2 in each cell | M) Centrioles never formed during Prophase 2 in each cell |
| G) The chromatin NEVER replicated | N) The chromatin replicated twice |



43. **H or J or I and E**



44. **H and J or I and E**



45. **K M**

46. Only DNA mutations in which cells below could be inherited by the next generation?

- a. egg b. skin c. pollen
d. testes e. heart f. sperm

47. Given the original strand, Identify and label the different mutations. There may be more than one for one of the strands.

Original Strand:	CTC	GGA	CTA	TTA	CGC
Mutated Strand 1:	CCG	GAC	TAT	TAC	GC
Mutated Strand 2:	CTC	GCA	CTA	TTA	CGC
Mutated Strand 3:	CTC	GTG	ACT	ATT	ACG C

Substitution, deletion
substitutio
addition

Codons in mRNA								
First base	Second base						Third base	
	U	C	A	G	U	C		A
U	UUU	UCU	UAU	UGU	U			
	UUC	UCC	UAC	UGC	C			
	UUA	UCA	UAA	UGA	A			
	UUG	UCG	UAG	UGG	G			
	Phenylalanine	Serine	Tyrosine	Cysteine				
	Leucine		Stop	Stop				
C	CUU	CCU	CAU	CGU	U			
	CUC	CCC	CAC	CGC	C			
	CUA	CCA	CAA	CGA	A			
	CUG	CCG	CAG	CGG	G			
	Leucine	Proline	Histidine	Arginine				
			Glutamine					
A	AUU	ACU	AAU	AGU	U			
	AUC	ACC	AAC	AGC	C			
	AUA	ACA	AAA	AGA	A			
	AUG	ACG	AAG	AGG	G			
	Isoleucine	Threonine	Asparagine	Serine				
			Lysine	Arginine				
G	GUU	GCU	GAU	GGU	U			
	GUC	GCC	GAC	GGC	C			
	GUA	GCA	GAA	GGA	A			
	GUG	GCG	GAG	GGG	G			
	Valine	Alanine	Aspartic Acid	Glycine				
			Glutamic Acid					

48. Some substitution mutations can be called **silent** mutations because they result in the same protein being produced. Look at the codon-amino acid chart above and explain why this can happen.

Mutations that change the 3rd letter of a CODON may result in delivery of the same amino acid and not change the protein

49. Explain how one small substitution mutation in a gene containing 300 nucleotides can still result in a protein that doesn't function and may cause a disease?

One letter added or deleted can cause a long series of mRNA letters to shift over to make new codons (frameshift) which then causes delivery of a long series of incorrect amino acids

50. A DNA mutation causes a change in which part of the DNA structure?

Mutations change the order of the nitrogen base letters in the DNA

51. List 3 general categories of things that can CAUSE a DNA molecule to mutate?

Mutations can be caused by replication of the DNA, exposure to strong chemicals or radiation, viruses, free radical damage

52. What is the root cause of ALL types of Cancer?

A bad combination of DNA mutations in the same cell that cause it to divide out-of-control

53. Explain the difference between a Malignant cancer and a cancer that begins to Metastasize?

A Malignant cancer is very dangerous because it grows rapidly, invades neighboring cells, and may spread to other parts of the body. When it does start to spread, we say that it has metastasized