Questions

1. This fill-in-the-blank question reviews the information from the previous page and provides some additional explanations about 6 steps needed for mitosis to occur.

1. DNA is copied; this is called _____.

2. DNA is wound tightly into compact chromosomes (each with two sister _____). These compact chromosomes are easier to move than the long thin chromosomes in a cell which is not undergoing cell division. **Spindle fibers** which will move the chromosomes begin to form.

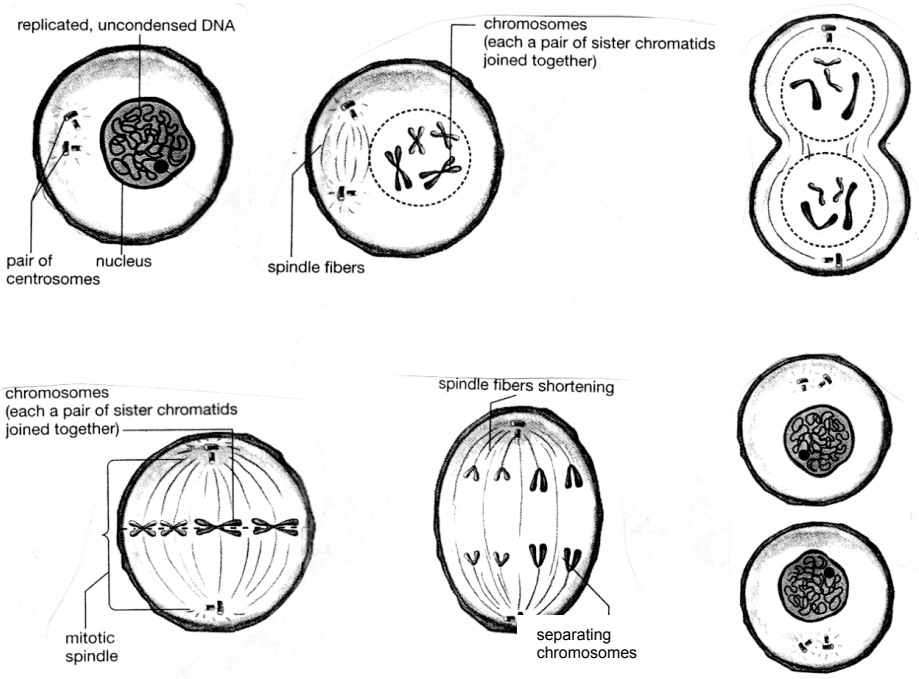
3. Spindle fibers attach to the chromosomes and line the chromosomes up in the middle of the cell.

4. Spindle fibers pull the sister _____ apart to form separate chromosomes which are moved toward opposite ends of the cell.

5. In a process called cytokinesis, the cell begins to pinch in half, with one set of chromosomes in each half.

6. Two _____ cells are formed. Each _____ cell has received a complete set of chromosomes. Each chromosome unwinds into a long thin thread so that genes can become active and give the instructions for making proteins.

2. For each of the figures below, give the number of the corresponding step described above. Draw arrows to indicate the sequence of events during cell division. (For simplicity, the figures show cells that have only 4 chromosomes (2 pairs of homologous chromosomes), but the basic process is the same as in human cells which have 46 chromosomes.)



3. Use an * to mark the arrow you drew which shows when sister chromatids separate to form individual chromosomes.

4. Each of the daughter cells shown in step 6 can divide to produce two new cells. What needs to happen before these cells will be ready for mitosis? (Hint: Compare the daughter cells with the cell that is ready for mitosis in step 1.

New Information: Complete the notes below each title for the corresponding slide from the overhead.

Meiosis

Meiosis -- How Your Body Makes Sperm or Eggs

Almost all the cells in your body were produced by mitosis. The only exception is sperm or eggs which are produced by a different type of cell division called **meiosis**.

During **fertilization** the sperm and egg unite to form a single cell called the **zygote** which contains chromosomes from both the sperm and egg. The zygote undergoes mitosis to begin development of the embryo which eventually becomes a baby.

Why your body can not use mitosis to make sperm or eggs

1. Remember that a typical cell in your body has 46 chromosomes (23 pairs of homologous chromosomes). Suppose that human sperm and eggs were produced by mitosis. How many chromosomes would each sperm or egg have? ____

2. If a sperm of this type fertilized an egg of this type, and both the sperm and egg contributed all of their chromosomes to a zygote, how many chromosomes would the resulting zygote have? _____

3. In humans, how many chromosomes should a zygote have, so the baby's body cells will each have a normal set of chromosomes? _____

4. Obviously, if the body used mitosis to make sperm and eggs, the resultant zygote would have too many chromosomes to produce a normal baby. To produce a normal zygote, how many chromosomes should each sperm and egg have? _____

To produce the needed number of chromosomes in sperm and eggs, meiosis reduces the number of chromosomes by half. For example, in humans each sperm and each egg produced by meiosis has only 23 chromosomes, including one chromosome from each pair of homologous chromosomes.

When an egg and sperm are united during fertilization, the resulting zygote has 23 pairs of homologous chromosomes, one in each pair from the egg and one from the sperm. Thus, the zygote has 46 chromosomes, and when the zygote undergoes mitosis to begin to form an embryo, each cell will have the normal number of 46 chromosomes.

Cells that have two copies of each chromosome (i.e. cells that have pairs of homologous chromosomes) are called **diploid** cells. Most of the cells in our bodies are diploid cells.

5. Cells that only have one copy of each chromosome are called **haploid** cells. Which types of cells in our bodies are haploid?

Steps of Meiosis 1

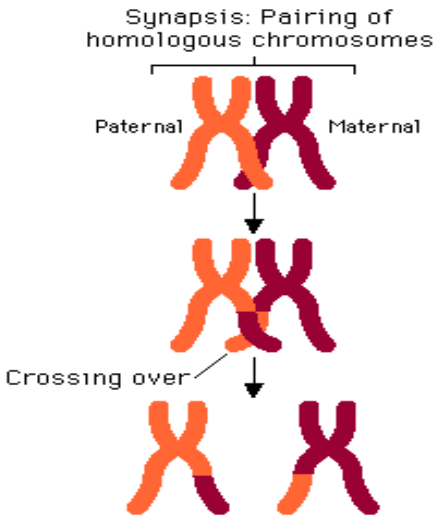
Interphase 1

Cell undergoes a round of DNA _____ forming _____ chromosomes.

Prophase 1

Each chromosome pairs with its corresponding _____ _____ to form a _____.

_____ occurs (the pairing of homologous chromosomes/tetrads- does not occur in mitosis); _____-OVER occurs (does not occur in mitosis).



Metaphase 1

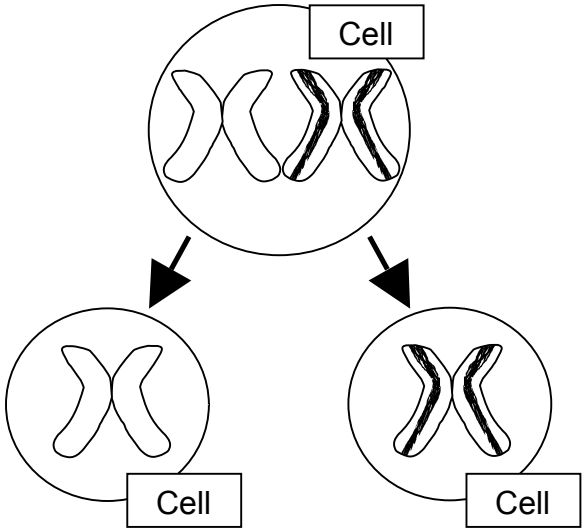
_____ line up randomly along the _____ of the cell.

Anaphase 1

Each _____ moves to opposite pole of cell

Telophase 1

Chromosomes reach opposite sides of cell, _____ begin. Result is <u>two</u> new cells that contain _____ _____ of chromosomes (46).



Meiosis I
Meiosis I is different from mitosis because homologous chromosomes line up next to each other and then the two homologous chromosomes separate, as shown above. This produces daughter cells with half as many chromosomes as the parent cell, i.e. haploid cells. Notice that each daughter cell has a different chromosome from the homologous pair of chromosomes.

1. Compare the chromosomes in the two daughter cells produced by Meiosis I. Do these chromosomes have the same alleles? How do you know?

2. Label the sister chromatids of the chromosome in the first daughter cell shown above.

<u>Steps of Meiosis 2</u>

Prophase 2

Spindle fibers form in each cell from Meiosis I.

Metaphase 2

_____ move to the equator of the daughter cells.

Anaphase 2

_____ separate and move towards the <u>poles</u> of the cell.

Telophase 2/Cytokinesis

¨_____ reappears in each of _____ new cells; each cell contains _____ of the original cell's number of chromosomes (23).

Gamete Formation (Male)

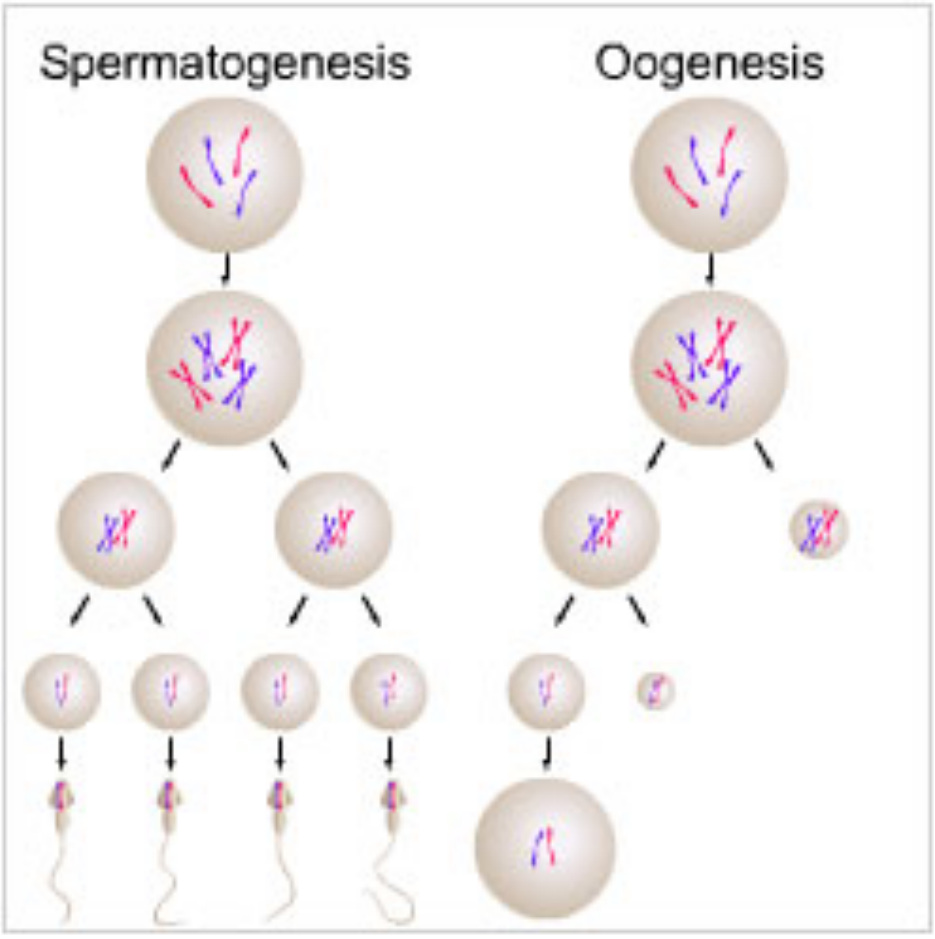
¨In _____animals (including humans), the haploid gametes produced by meiosis are called _____
¨_____ are produced from one meiotic division

Gamete Formation (Female)

¨In _____ animals (including humans), the _____gametes produced by meiosis are called _____ (ova – plural; ovum-singular)

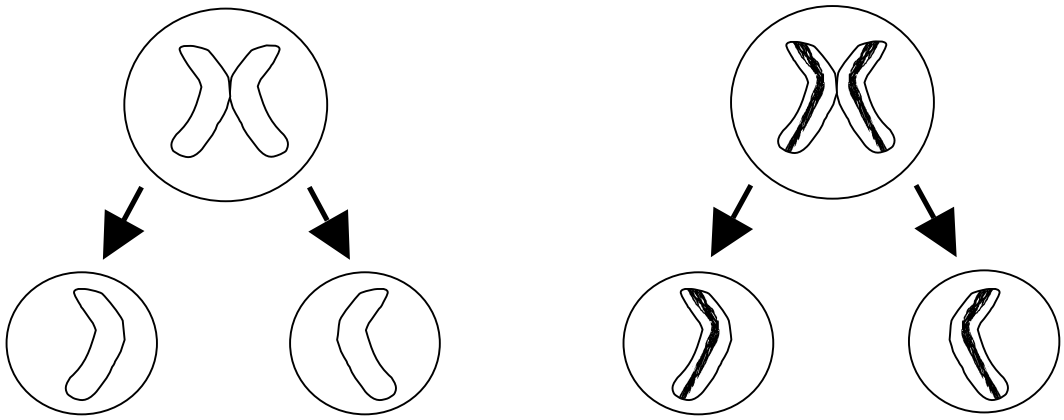
¨The cell divisions at the end of meiosis I & II are _____, so that _____ _____ egg is produced and other _____ cells produced, called polar bodies, are not involved in reproduction.

¤_____: formation of 4 haploid sperm
¤_____: formation of 1 haploid egg and three polar bodies



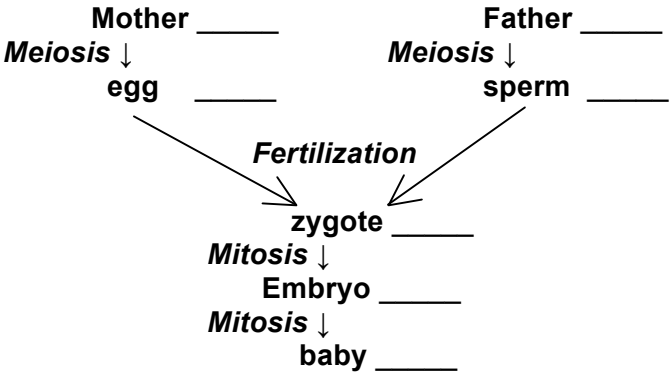
Meiosis II

Meiosis II is like mitosis, since the sister chromatids of each chromosome are separated, so each daughter cell gets one copy of each chromosome in the mother cell.



3. In the diagram above, label the cells which represent the sperm or eggs produced by meiosis.

4. The following diagram provides an overview of the information covered thus far. Review the diagram, and fill in the correct number of chromosomes per human cell in each blank.



Activity: Complete the following questions using information from your notes and from pg. 153-156 in the Modern Biology textbook.

Matching: Mark the correct letter in for each numbered term in the blank.

1) _____ Sexual Reproduction

2) _____ Asexual Reproduction

3) _____ Chromatid

a) fusion of two gametes

b) one of two identical halves in a chromosome.

c) reproduction involving two parents

4) _____ Tetrad

d) reproduction involving only one parent

5) _____ Fertilization

e) a group of two homologous chromosomes.

TRUE-FALSE: Read each statement. If the statement is true, mark "A" in the space provided. If the statement is false, mark "B" in the space provided.

6) _____ Each cell produced by "meiosis" has <u>half as many</u> chromosomes as its parent cell.

7) _____ Egg and sperm cells are <u>diploid</u> in nature.

8) _____ A female human has an <u>X and Y</u> pair of sex chromosomes.

9) _____ The primary form of reproduction for bacteria is <u>sexual reproduction</u>.

10)_____ <u>Meiosis</u> is a "reduction division."

Multiple Choice: Mark the letter of the most correct answer in the blanks.

11)_____ If an organism has 12 chromosomes in each body cell, how many chromosomes would you expect to find in the organism's gametes (sex cells)?

a) 4 b) 6 c) 10 d) 12

12)_____ During which phase of meiosis does crossing-over occur?

a) prophase I b) telophase I c) metaphase II d) anaphase II

13)_____ During mitosis and meiosis, spindle fibers are thought to

a) control cytokinesis.

b) make centromeres.

c) move chromosomes.

d) join chromatids.

14)_____ Spermatogenesis results in

a) four haploid sperm cells.
b) one haploid cell and three polar bodies.
c) four diploid sperm cells.
d) two sperm cells and two polar bodies.

15)_____ The sex cells (sperm and egg cells) of an animal are also called

a) zygotes. b) gametes. c) spores. d) bud cells.

16)_____ In anaphase I of meiosis, pairs of chromosomes

a) uncoil and spread throughout the nucleus.
b) line up at the cell's equator.
c) develop centromeres between DNA strands.
d) separate and move to opposite sides of the cell.

17)_____ How many chromosomes do the human sex cells contain?

a) 12 b) 23 c) 36 d) 46

18)_____ In what part of meiosis would you observe a tetrad splitting apart?

a) prophase II b) metaphase I c) anaphase I d) anaphase II

19)_____ Which stage of meiosis occurs after telophase I?

a) anaphase I b) prophase II c) anaphase II d) metaphase II

20)_____ In what part of meiosis would you observe the chromosomes lined up at the cell's equator?

a) metaphase I b) metaphase II c) anaphase I d) both a. and b.

21. List two ways meiosis differs from mitosis?

22. During which stage of meiosis is the diploid number of chromosomes reduced to the haploid number of chromosomes?

23. How many chromosomes do human gametes normally contain?

24. Explain the role of crossing over in ensuring genetic variation?

25. Describe the primary differences between spermatopgenesis and oogenesis?

26. _____Crossing over occurs during

a. mitosis b. meiosis II c. interphase d. meiosis I

27. _____During synapsis, the

a. DNA in each chromosome is copied
b. Spindle fibers disappear
c. Cytoplasm divides
d. Chromosomes line up next to their homologues

28. _____During crossing over, portions of chromatids

a. Double the amount of DNA in each chromosome
b. Move from autosomes to sex chromosomes
c. Break off and attach to adjacent chromatids on the homologous chromosome
d. Separate from each other and move to opposite poles of the cell

29. _____In which phase of meiosis do tetrads form?

a. prophase I b. telophase I c. metaphase II d. anaphase II

30. _____Meiosis II

a. Is followed by the copying of DNA
b. Separates chromatids into opposite poles of the cell
c. Separates homologous chromosomes into opposite poles of the cell
d. Produces diploid offspring cells.

31. _____In oogenesis, a diploid reproductive cell divides by meiosis to produce

a. One diploid cell
b. Four diploid cells
c. One haploid gamete
d. Four haploid gametes

32. How do the products of meiosis I differ from those of meiosis II?