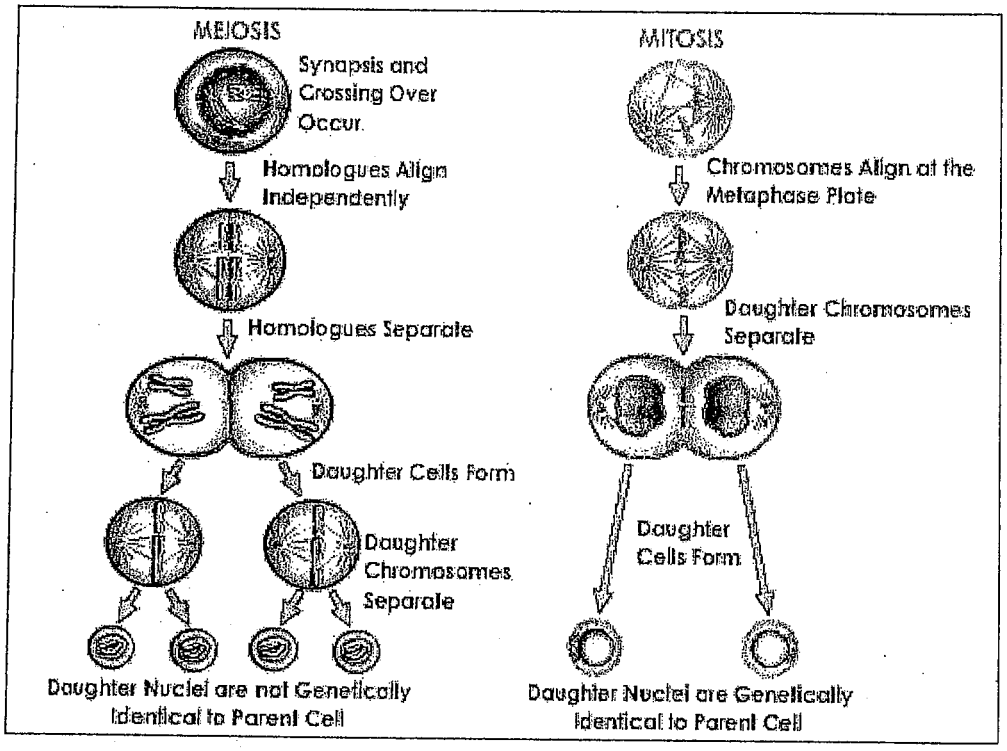
Unit 6:

Mitosis and Meiosis



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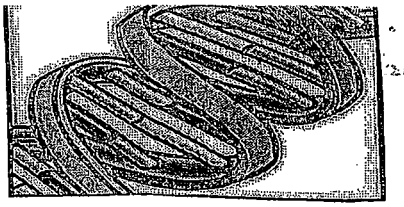


By the end of this unit, you should be able to…

Chapter 6

1) Identify a chromosome and label its parts (chromatids and centromere).

2) Differentiate between homologous chromosomes, autosomes and sex chromosomes.

3) Compare haploid and diploid cells

4) Identify and describe the cell cycle and its roles in controlling cell division and cancer.

5) Identify and describe what happens in each of the 6 steps of mitosis.

6) Use specific examples to describe how some organisms carry out asexual reproduction using mitosis.

Chapter 7

1) Identify and describe the stages of meiosis.

2) Relate crossing-over to genetic variation.

3) Compare and contrast the formation of gametes in male and female animals.

4) Predict how changes in chromosome number or structure can affect development of an organism.

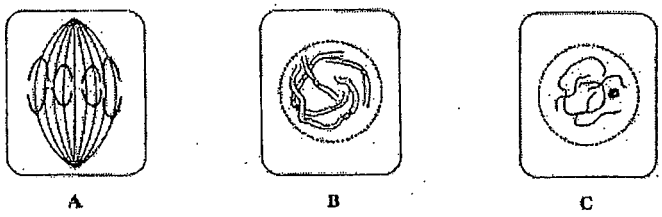
5) Define karyotype and identify its use in genetic testing.

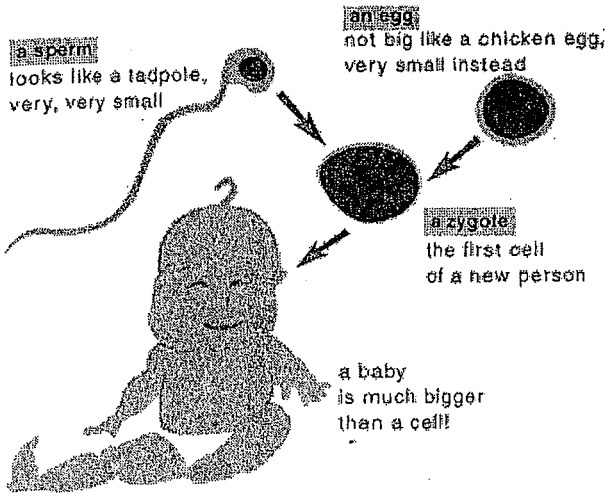
6) Identify non-disjunction given a human karyotype.

Both

Compare and contrast mitosis and meiosis.

Compare and contrast asexual and sexual reproduction.





VOCAB

Anaphase

Asexual Reproduction

Autosome

Binary Fission

Budding

Cancer

Cell Cycle

Centromere

Chromatid

Chromosome

Crossing Over

Cytokinesis

Diploid

Down's Syndrome

Fertilization

G1

G2

Gamete

Haploid

Homologous Chromosome

Interphase

Karyotype

Meiosis

Metaphase

Mitosis

Oogenesis

Ovum

Polar Body

Prophase

S

Sex Chromosome

Sexual Reproduction

Spermatogenesis

Spermatogenesis

Spindle Fiber

Telophase

Vegetative Propagation

Zygote

A) The Cell Cycle:

Why do cells divide?

a)

b)

1) G_1, or _____

*

*

*

2) S, or _____

*

3) G_2, or _____

*

*

4) Mitosis, or _____

*

*

*

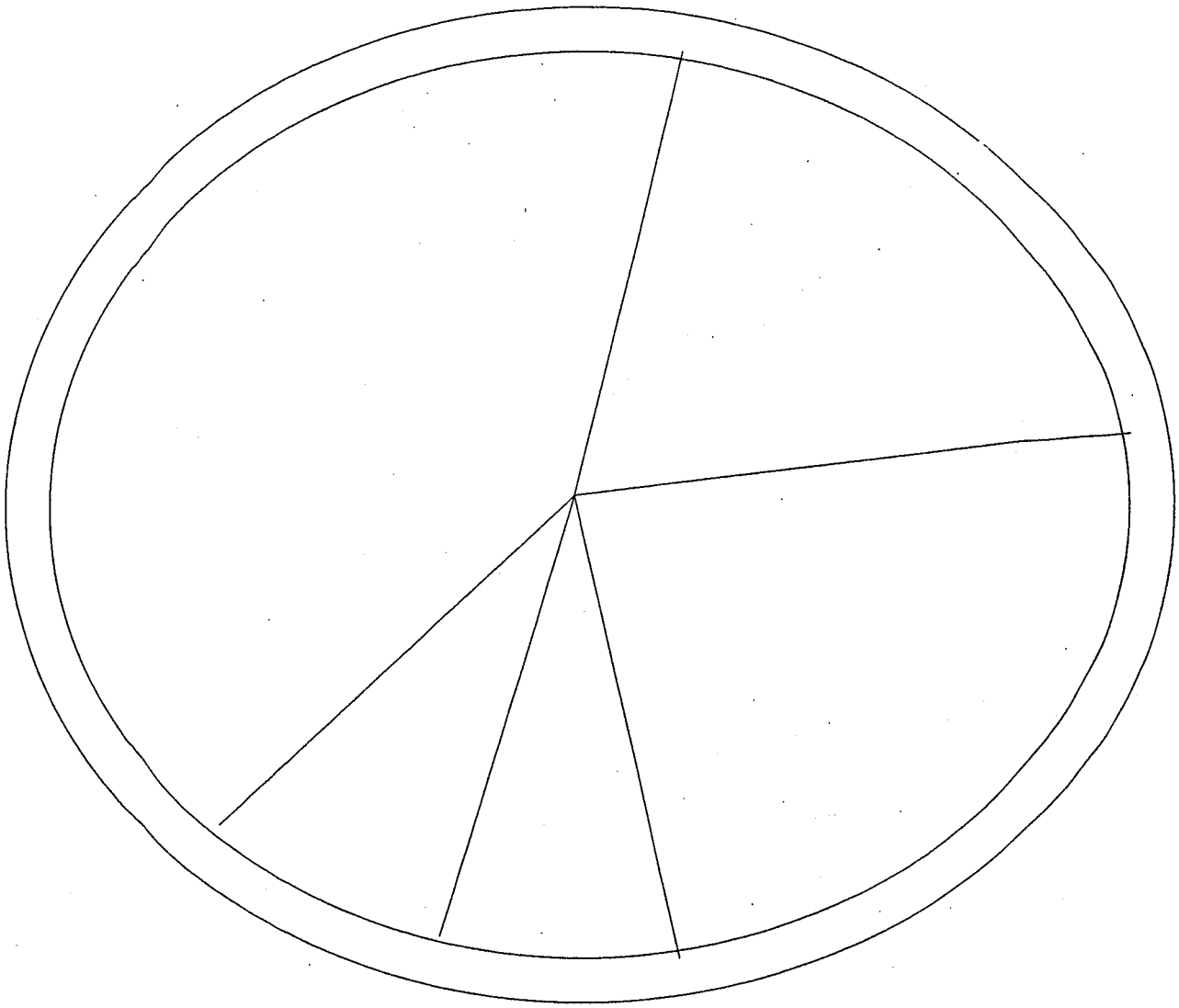
*

*

5) Cytokinesis, or _____

*

The Cell Cycle



The cell spends most of its time in _____ (%).

There are _____ "checkpoints", or _____ that control the cell cycle.

What do you think would happen if the "stoplights" were broken??

his condition is called _____.

Before we really "dig in" to Mitosis…

The _____ in a cell holds information on how to be a human.

This information is called _____ (___ ___ ___)

Most of the time, the ___ ___ ___ is _____ so that the cell can "read" its instructions and know what to do

BUT…

Before a cell _____, the ___ ___ ___ must _____ so that

Each cell gets a _____ of the cell's "_____"

To make life easier, the ___ ___ ___ _____ to make a _____

Chromosome: "_____"

*Found in the cell's _____

* Made of ___ ___ ___, which contains _____

DRAW!!

Humans have _____ pairs, or _____, chromosomes

We each get _____ chromosomes from our mom and _____ chromosomes from our dad

The first 22 pairs (pairs #1 – 22) are known as _____

The last set (pair #23) are known as the _____, because they determine whether or not a new human will be a girl or a boy.

If the 23rd pair of chromosomes are BOTH ____, then the human is a _____

If the 23rd pair of chromosomes are one _____ & one _____ then the human is a _____

B1. Mitosis:

Stages of _____

Animal Cell Plant Cell

1) I_____

*

*

2) P_____

*

*

3) M_____

*

*

4) A_____

*

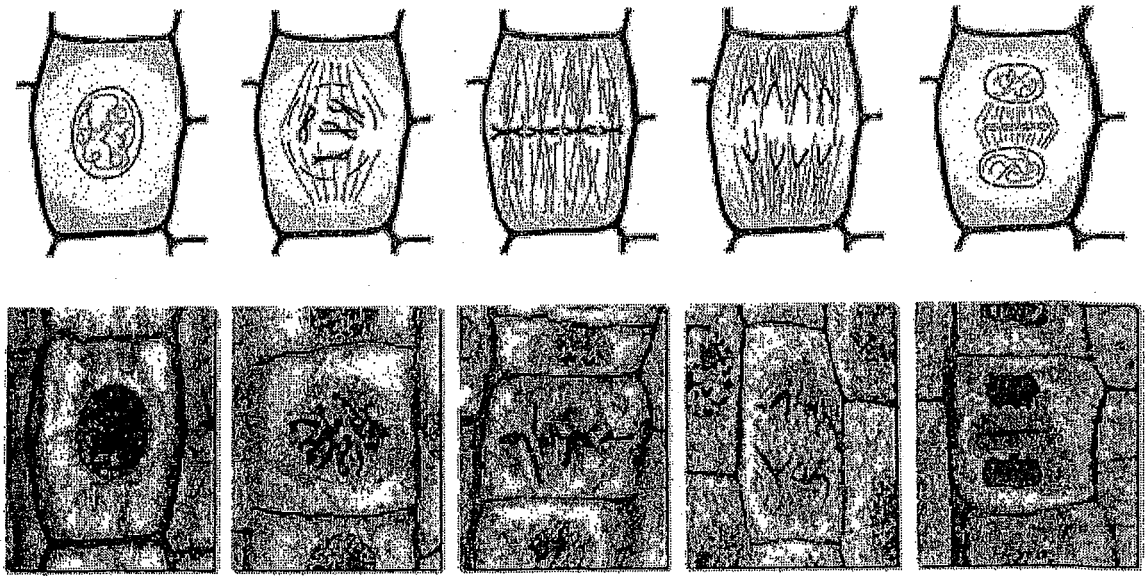
5) T_____

*

6) Cytokinesis:

RESULT of Mitosis: _____

Label the following



Summarize what is happening at each of the above stages of cell division.

Interphase: _____

_____

_____

Prophase: _____

_____

_____

Metaphase: _____

_____

Anaphase: _____

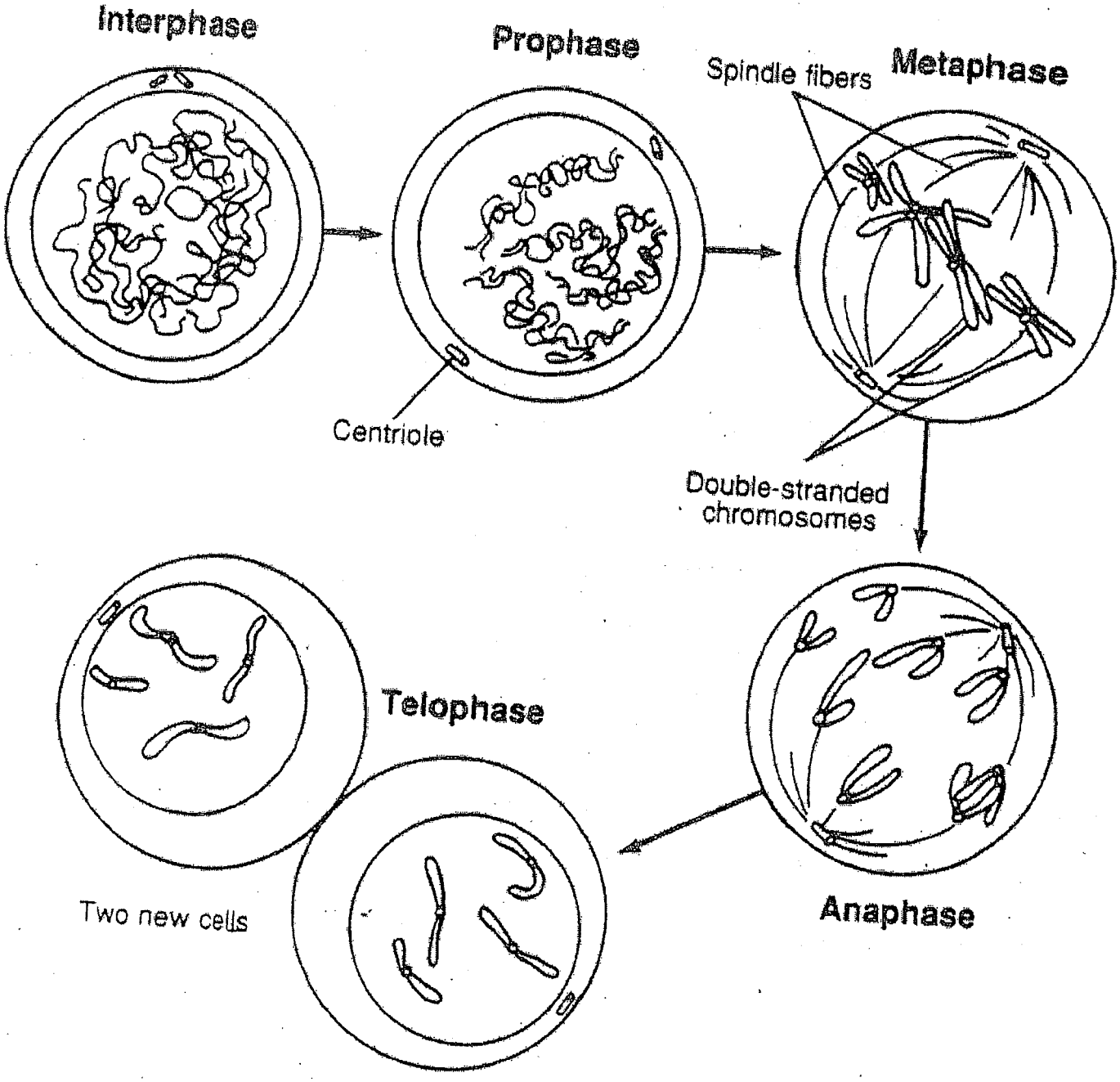
_____

Telophase: _____

_____

Cytokinesis: _____
(not shown)

MITOSIS


Interphase
Prophase
Spindle fibers
Metaphase
Centriole
Double-stranded chromosomes
Telophase
Two new cells
Anaphase

Cell Reproduction

MITOSIS

1. When does the nuclear membrane disappear during mitosis?

2. Human cells contain 46 chromosomes before mitosis. How many do they have after mitosis?

3. During prophase, what structures are held together by the centromeres?

4. What do you think is the function of centrioles in animal cells?

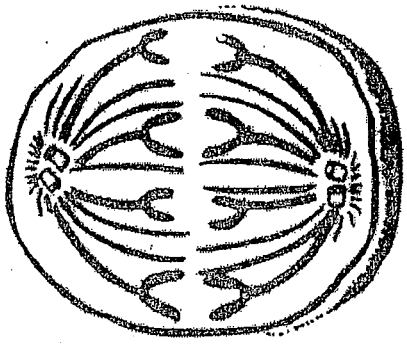
5. When do chromosomes become visible during mitosis?

6. How can you tell whether cells in mitosis are animal cells or plant cells?

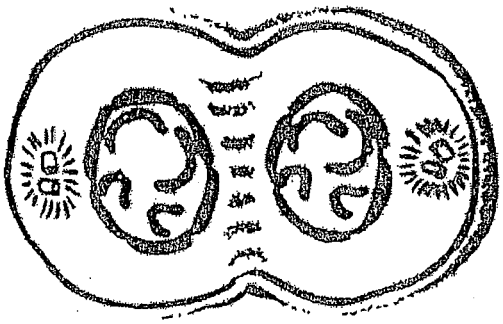
7. What happens during interphase?

Each animal cell in the figure below shows a different stage of mitosis. Use the figure below to complete items 9–16.

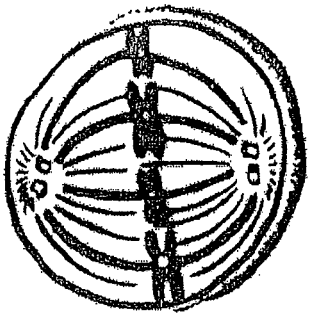
In the space provided below each cell in the figure, write the name of the stage of mitosis that is represented.



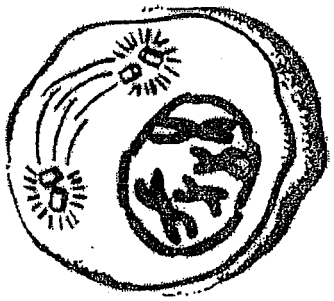
9. _____



10. _____



11. _____



12. _____

Determine the order in which the following four stages of mitosis take place. Write the number of each step (1–4) in the space provided.

_____ 13. anaphase

_____ 14. metaphase

_____ 15. telophase

_____ 16. prophase

B2. _____

Some organisms use _____ to reproduce (_____).

Why would this be a good thing? _____

Why would this be a not so good thing? _____

Here are some different ways organisms reproduce via _____...

1) Binary Fission

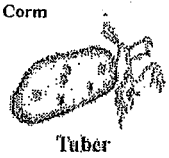
2) Budding

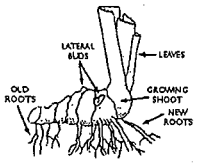
3) Spore formation

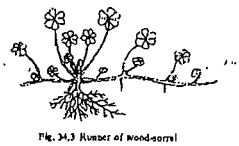
4) Vegetative Propagation

a) Bulb 

b) Corm 

c) Tuber 

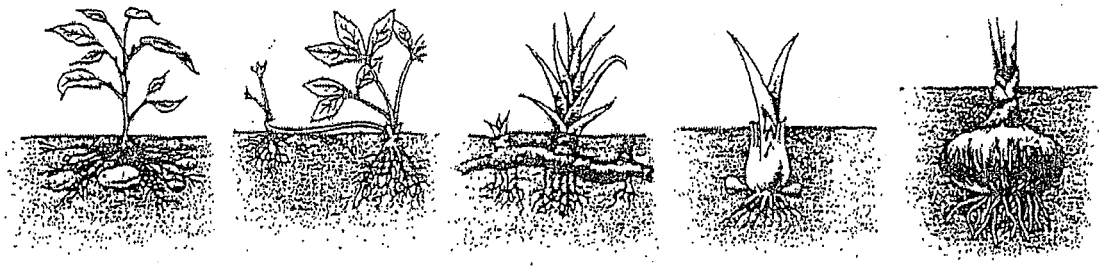
d) Rhizome 

e) Stolon (runner) 

Can humans create vegetative propagation artificially in a lab or factory? YES / NO

Why would we want to do this?

1. Using the following terms, label each type of vegetative propagation shown in the following diagrams: bulb, rhizome, corm, stolon, and tuber.



_____ _____ _____ _____ _____

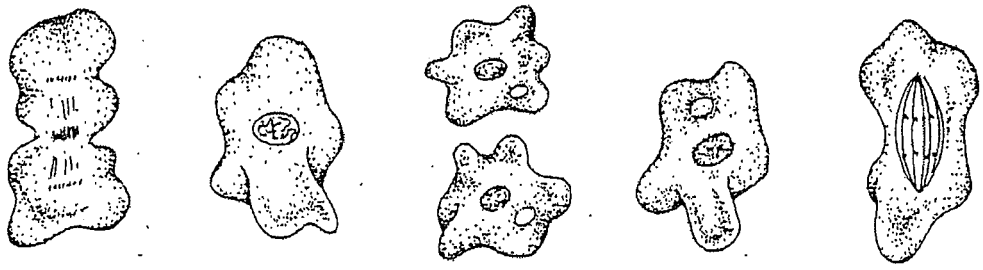
2. Name a plant that reproduces asexually by means of each of the following vegetative structures.

Bulb _____ Rhizome _____

Corm _____ Stolon (Runner) _____

Tuber _____

3. Using the numbers 1–5 indicate the proper sequence of binary fission in the diagrams of the ameba.



_____ _____ _____ _____ _____

SPORE FORMATION

Spores are single, specialized cells that are produced by certain organisms. Spores can be formed sexually or asexually. When released, spores germinate and grow to form new individuals. Many spores are surrounded by thick protective walls that allow them to withstand extreme drying, heat, and cold.

Bread molds produce spores in *spore cases* on specialized stalks that grow upward from the surface. Each spore case produces thousands of spores. Eventually, the spore cases burst, releasing the spores. Those that land in favorable environments germinate, producing new bread mold organisms.

1. In bread molds, spores are produced in specialized structures called _____ _____.
2. List two types of organisms that produce asexually-formed spores.

_____

3. Under what types of conditions might the capacity to form spores be advantageous to an organism?

_____

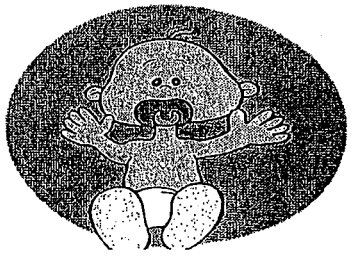
_____

C. Meiosis:

a.k.a.: Gametogenesis: "gamete" = "genesis" =

Two types of gametes are _____ and _____

Fertilization = _____ + _____ =



Why would we bother to do this???

Diploid (____):

i.e. humans =

fruit flies =

What would happen if two **diploid** human cells combined? _____

Is this correct number of chromosomes for a human? YES / NO

o avoid this from happening, we use _____ to _____ the normal chromosome number (_____) by _____.

Haploid (____):

i.e. humans =

fruit flies =

What would happen if two **haploid** human cells combined? _____

Is this correct number of chromosomes for a human? YES / NO

How do you think we could cut the number of chromosomes in half???

We first have to _____ the number of chromosomes in _____.

hen, we _____ the chromosomes like normal mitosis.

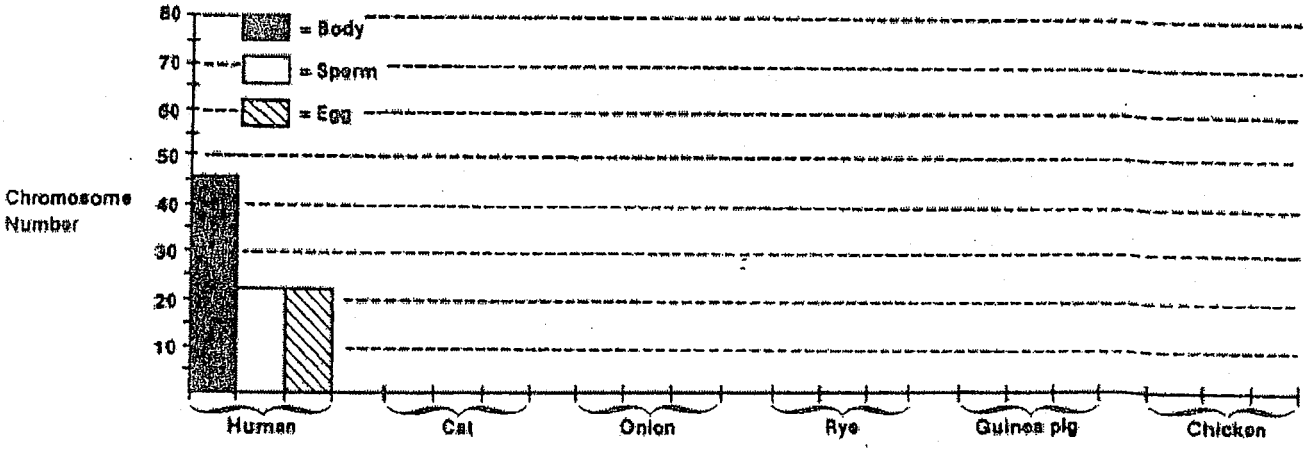
Meiosis is also known as a "_____" for this reason.

20–2 Chromosome Number in Sex Cells and Fertilized Eggs

1. Examine the chart below. Fill in the missing information based on the numbers that are given. The first one is done for you.

Organism	Body cell chromosome number	Chromosome number in sperm	Chromosome number in egg
Human	46	23	23
Cat	38		
Onion		8	
Rye	14		
Guinea pig			32
Chicken		39	

2. Graph the data in the table above on the graph below. Follow the example that is done for you on the graph.



3. Using the information from above, complete the following chart. The first one is done for you.

Organism	Sperm chromosome number	Egg chromosome number	Fertilized egg chromosome number	Chromosome number in each body cell of offspring
Human	23	23	46	46
Cat				
Onion				
Rye				
Guinea pig				
Chicken				

Stages of _____

Interphase:

Animal Cell

1a) Prophase I

*

*

*

2a) Metaphase I

*

*

3a) Anaphase I

*

4a) Telophase I

*

*

This is the _____ phase of meiosis

In Humans, there would now be _____ chromosomes in each cell.

Animal Cell

1b) Prophase II

*

2b) Metaphase II

*

3b) Anaphase II

*

4b) Telophase II & cytokinesis

*

*

This is the _____ phase of meiosis

In Humans, there would now be _____ chromosomes in each cell.

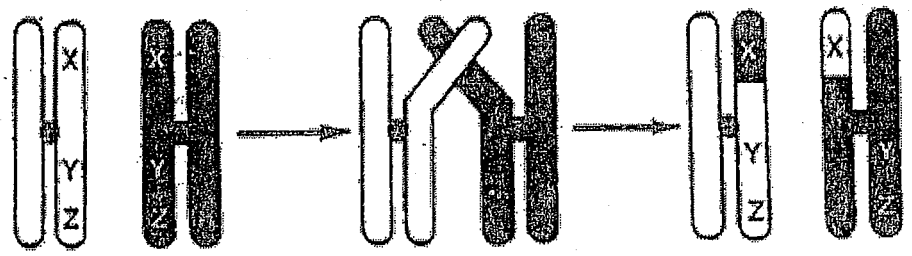
CROSSING-OVER

During meiosis, homologous pairs of chromosomes undergo synapsis (form tetrads). Sometimes there is an exchange of segments between the chromatids of a tetrad. In such an exchange of parts some linked genes become separated. This exchange of parts between homologous chromosomes is called *crossing-over*. The greater the distance between two genes on a chromosome, the more likely they are to be separated by crossing-over.

1. What is crossing-over? At what stage in meiosis does it occur?

2. If two genes are at opposite ends of a chromatid, are their chances of being separated by crossing-over greater or less than if they were close together?

3. Answer the following questions based on the diagrams below.

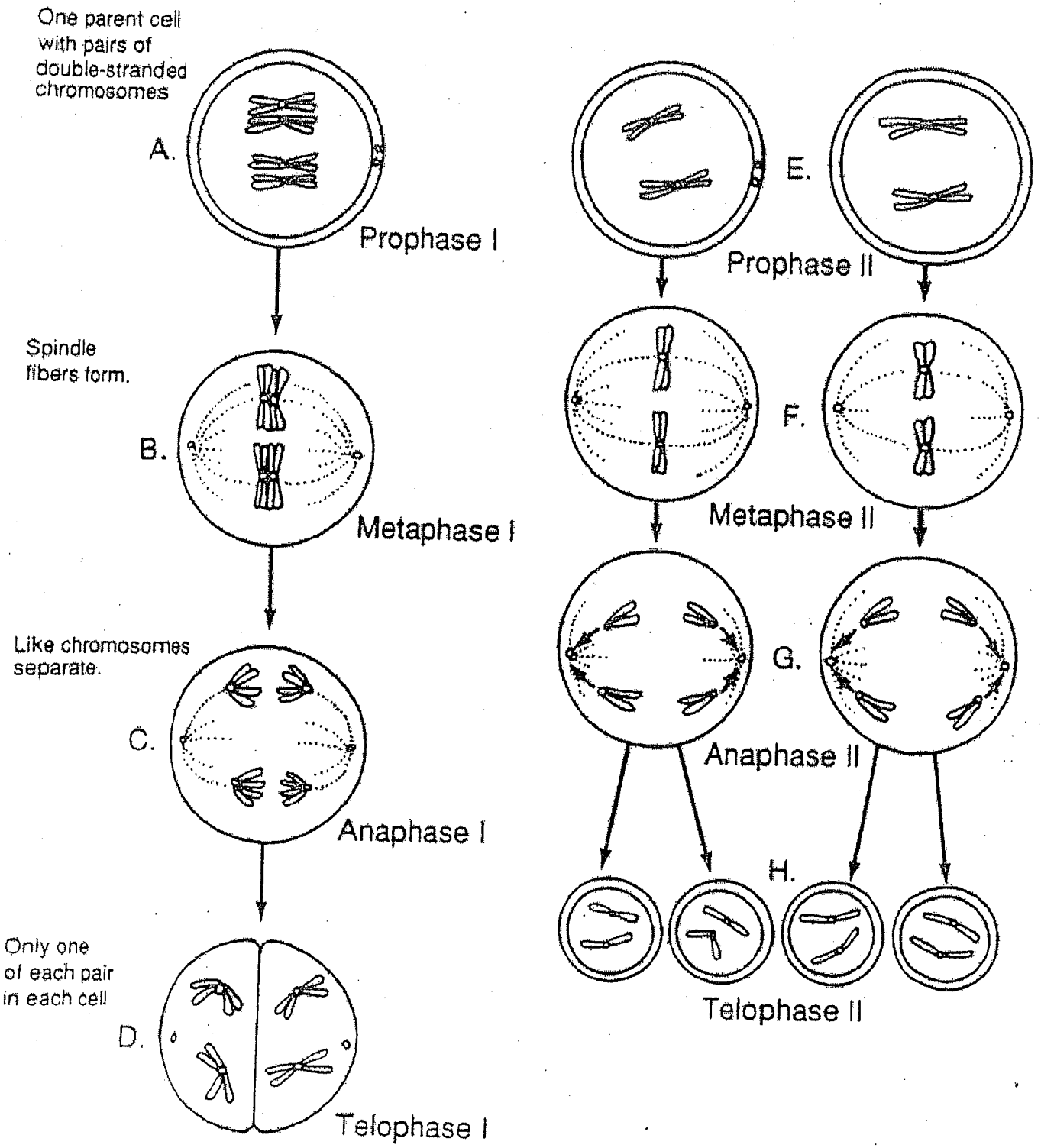


a. What is the relationship between genes X and x?

b. Which genes are exchanged by crossing over?

c. What new linkage groups are formed by the crossing over?

MEIOSIS


One parent cell with pairs of double-stranded chromosomes
A.
Prophase I
Spindle fibers form.
B.
Metaphase I
Like chromosomes separate.
C.
Anaphase I
Only one of each pair in each cell
D.
Telophase I
E.
Prophase II
F.
Metaphase II
G.
Anaphase II
H.
Telophase II

Cell Reproduction

MEIOSIS

1. When does the first cell division in meiosis occur?

2. What part of the cell divides during meiosis?

3. Human body cells have 46 chromosomes. How many chromosomes does a human cell that has been produced by the process of meiosis have?

4. How is anaphase II in meiosis similar to anaphase in mitosis?

5. In which phases of meiosis do the centromeres attach to spindle fibers?

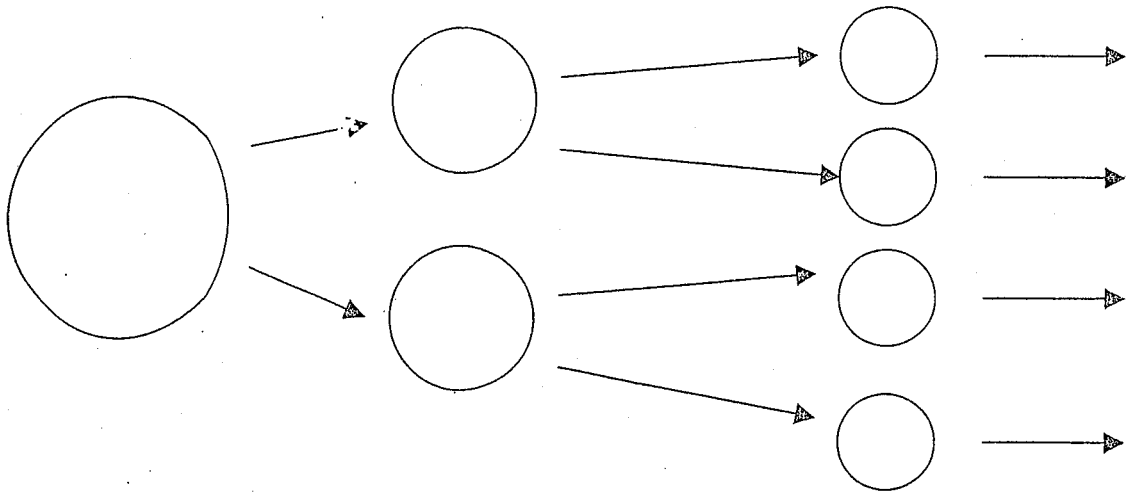
6. How many gametes are possible from a single diploid cell that undergoes meiosis?

7. List the sequence of stages of meiosis.

8. Why is meiosis called reduction division?

If meiosis happens in males, _____ are produced.

"to make" _____ = _____

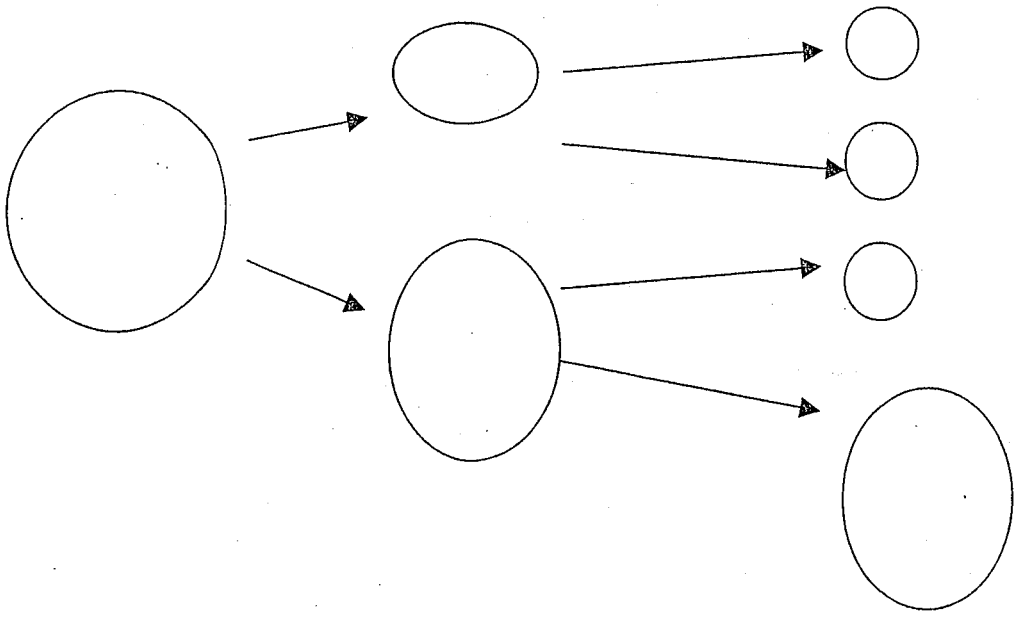


_____ sperm are produced for each cycle of meiosis.

Males make _____ of sperm and continue to make sperm until_____!

If meiosis happens in females, _____ are produced.

"to make" _____ = _____



_____ ovum (egg) is produced for each cycle of meiosis.

Females make are born with all of the _____ they will ever have.

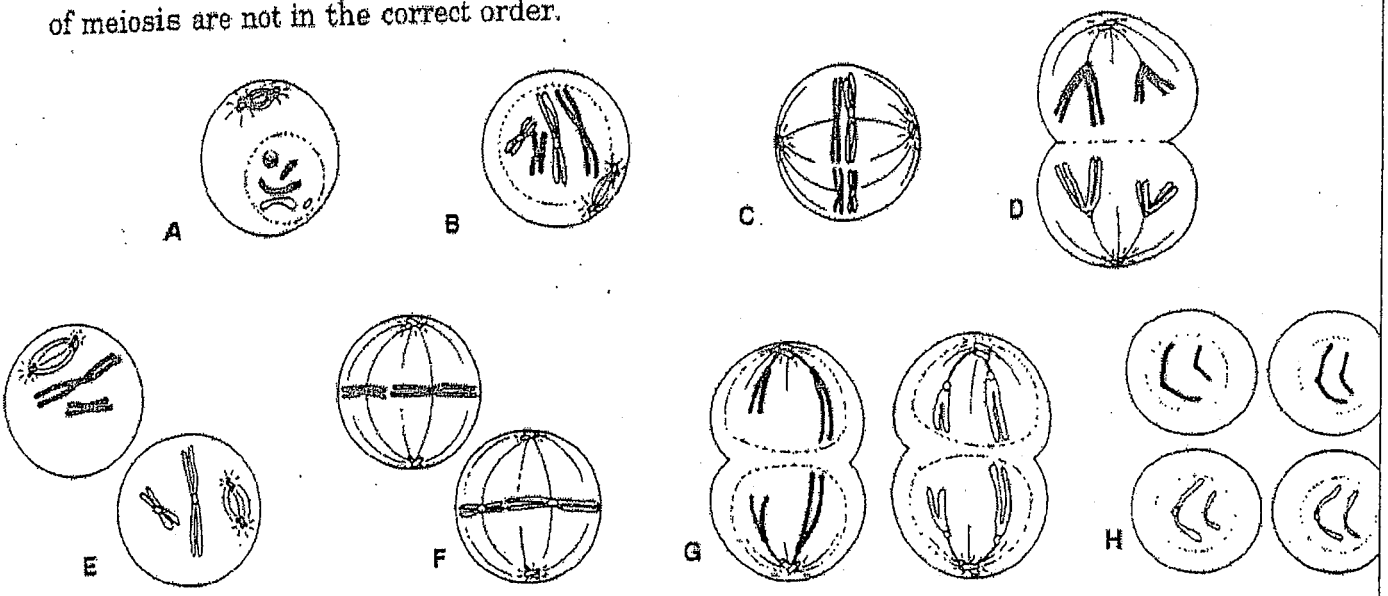
ecause of this, sometimes older eggs (and sometimes sperm, too) will have problems when they undergo meiosis II.

Name _____ Date _____ Class _____

MEIOSIS

In your textbook, read about the steps of meiosis in Section 22:2.

5. Match each of the following steps of meiosis with the statements below. Letters may be used more than once. Write the correct letter on each blank. Note: The statements describing the step of meiosis are not in the correct order.



a. Matching chromosomes come together to form pairs. ____

b. Each chromosome has two strands of sister chromatids. Pairs of sister chromatids are lined up near cell's center; original and copy still together. ____

c. One cell division completed and two new cells formed. ____

d. Each chromosome becomes doubled, forming sister chromatids. ____

e. Original and copy chromosome move to opposite ends of cell. ____

f. Centrioles move again to opposite ends of cells. ____

g. Pairs of sister chromatids move to center of cell. ____

h. Four new cells have formed from original. ____

i. Nuclear membrane begins to fade away. ____

j. Sister chromatid pairs move to opposite ends of cell. ____

k. Four single chromosomes are present in cell. ____

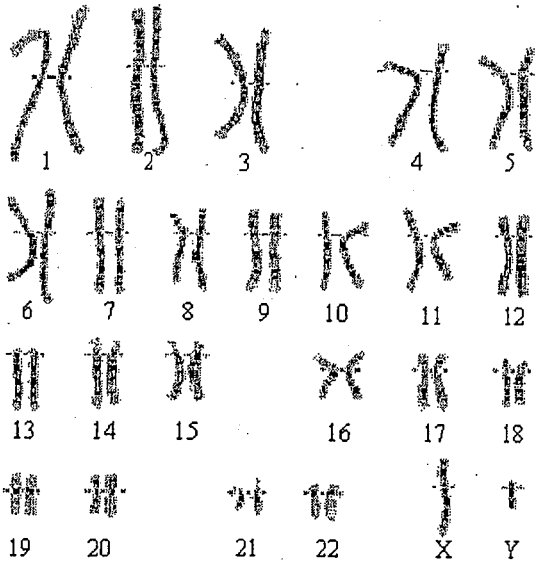
l. Each cell is now a sex cell. ____

m. Nuclear membrane is reappearing. ____

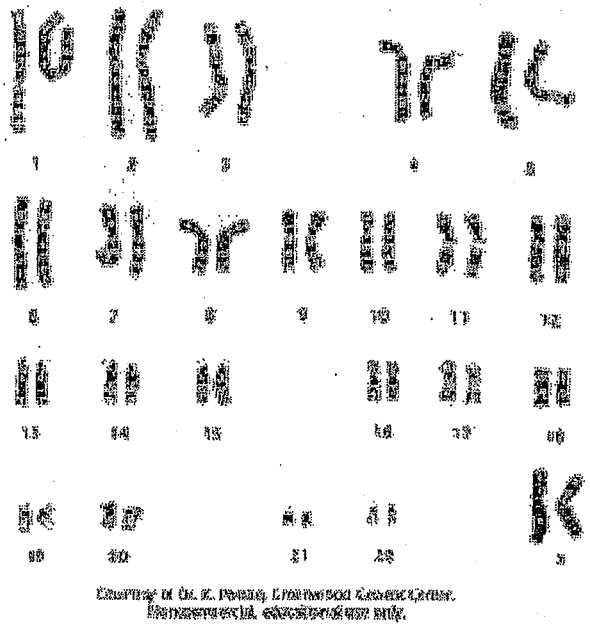
D. Abnormalities in Chromosome Number

Karyotype:

Why do we need to use white blood cells and not red blood cells when performing a karyotype?



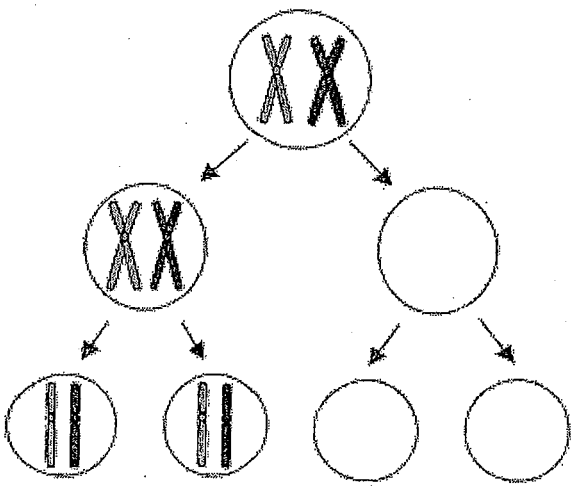
MALE / FEMALE

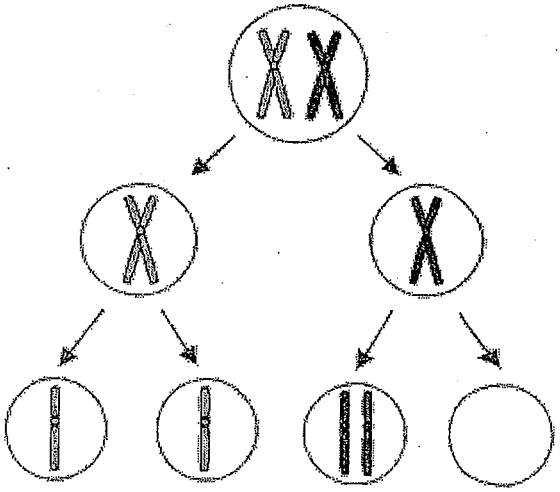


MALE / FEMALE

Non-Disjunction:

Can result in _____ copies OR _____ copies of a given chromosome.





Non-disjunction of the 21st Chromosome =

Non-disjunction of the X or Y chromosome =

NONDISJUNCTION

Look carefully at the following picture.

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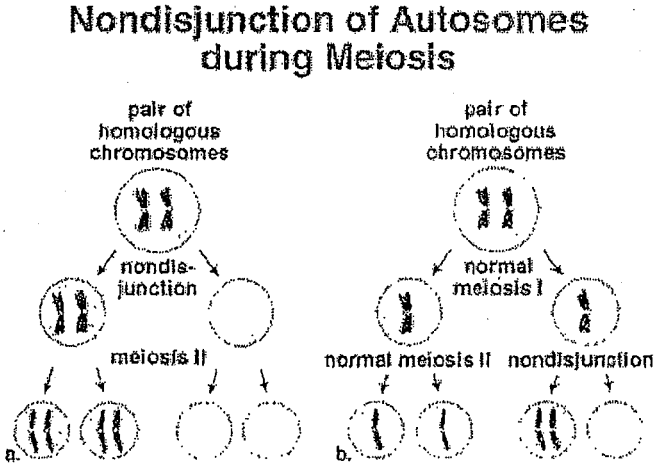


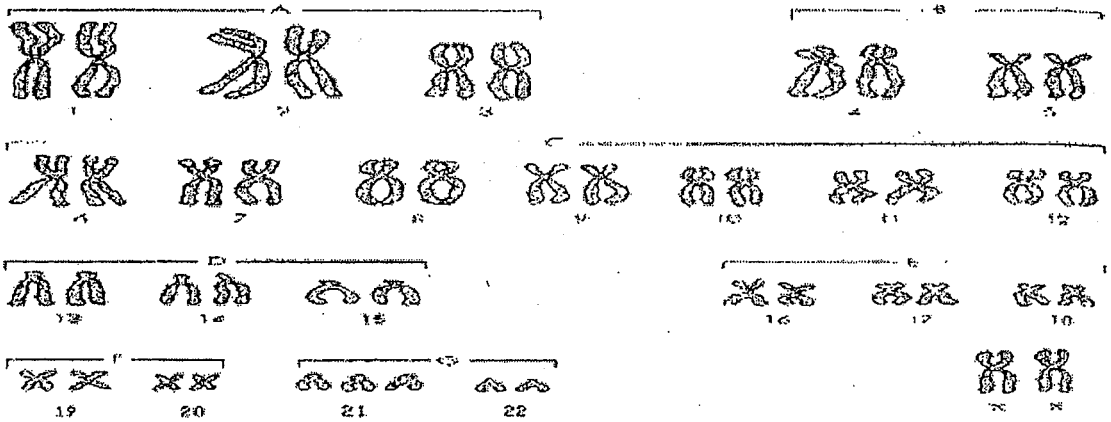
What is wrong with the processes illustrated above? Be specific.

Define "nondisjunction" as illustrated in the pictures above.

Write the definition of "nondisjunction" from a text.

What might happen as a result of nondisjunction?

Observe the *karyotype* below.



Down's Syndrome

	MITOSIS	MEIOSIS
# of chromosomes in A parent cell		
# of chromosomes in the daughter cells		
# of Daughter cells made		
Produces diploid (2n) or haploid (n) cells?		
Chromosomes Identical OR Different to parent cell		
Why do this type of cell division?		
Where does it happen in humans?		
Examples from notes:		

Name _____ Date _____ Class _____

CHAPTER 6 DIRECTED READING

Chromosomes and Cell Reproduction

▶ Section 6-1: Chromosomes

New Cells Are Formed by Cell Division

In the space provided, explain how the terms in each pair differ in meaning.

1. cell division, gamete

2. gene, DNA

3. chromosomes, chromatids

Study the following steps of binary fission in a bacterium. Determine the order in which the steps take place. Write the number of each step in the space provided.

_____ 4. New cell wall forms around the new membrane.

_____ 5. New cell membrane is added to a point on the membrane between the two DNA copies.

_____ 6. The bacterium is pinched into two independent cells.

_____ 7. The growing cell membrane pushes inward and the cell is constricted in two.

_____ 8. DNA is copied.

Chromosome Number and Structure Affect Development

Complete each statement by writing the correct term or phrase in the space provided.

9. Chromosomes that are similar in size, shape, and genetic content are called

_____ .

10. A cell, such as a somatic cell, that contains two sets of chromosomes is said to be

_____ .

11. Biologists use the symbol _____ to represent one set of chromosomes.

12. A fertilized egg cell, the first cell of a new individual, is called

a(n) _____ .

Read each question, and write your answer in the space provided.

13. What is the difference between an autosome and a sex chromosome?

_____

_____

_____

14. What is a karyotype?

_____

_____

_____

15. Describe the features of a person with Down syndrome.

_____

_____

_____

16. Describe four types of mutations resulting from the breakage of chromosomes.

_____

_____

_____

_____

▻ Section 6-2: The Cell Cycle

The Cell Cycle Describes the Life of a Eukaryotic Cell

Complete each statement by writing the correct term or phrase in the space provided.

1. The cell cycle is a repeating sequence of growth and _____ during the life of a cell.

2. The first three phases of the cell cycle are collectively called _____.

In the space provided, write the letter of the description that best matches the term or phrase.

_____ 3. first growth (G_1) phase

_____ 4. synthesis (S) phase

_____ 5. second growth (G_2) phase

_____ 6. mitosis

_____ 7. cytokinesis

a. nucleus divides into two nuclei
b. cytoplasm divides
c. preparations are made for the nucleus to divide
d. DNA is copied
e. cell carries out its routine functions

The Cell Cycle Is Carefully Controlled

Complete each statement by writing the correct term or phrase in the space provided.

8. Many _____ control the cell cycle.

9. The checkpoint that makes the key decision of whether the cell will divide is the _____ _____ checkpoint.

10. _____ contain the information necessary to make the proteins that regulate cell growth and division.

Read the question, and write your answer in the space provided.

11. Describe the role of checkpoints in the onset of cancer.

_____

_____

_____

12. What types of environmental influences can induce mutations?

_____

_____

_____

▶ Section 6-3: Mitosis and Cytokinesis

In Mitosis, Chromatids Are Pulled by Microtubules

Read each question, and write your answer in the space provided.

1. What function do spindles perform during mitosis?

_____

_____

_____

_____

2. What function do centrioles perform in animal cell mitosis?

_____

_____

_____

Mitosis and Cytokinesis Divide Cells

In the space provided, write the letter of the description that best matches the term or phrase.

_____ 3. prophase

_____ 4. telophase

_____ 5. metaphase

_____ 6. anaphase

a. chromosomes move to the center of the cell and line up along the equator

b. a nuclear envelope forms around the chromatids at each pole

c. chromosomes coil up and become visible

d. the two chromatids move toward opposite poles as the spindle fibers attached to them shorten

Study the following steps of mitosis. Determine the order in which the steps take place. Write the number of each step in the space provided.

_____ 7. prophase

_____ 8. telophase

_____ 9. metaphase

_____ 10. anaphase

Complete each statement by underlining the correct term or phrase in the brackets.

11. Cytokinesis begins [before / after] mitosis.

12. During cytokinesis in animal cells, the cell is pinched in half by [the cell wall / a belt of proteins].