Cell Division Unit Objectives

In this second unit of biology, you will be learning how cells divide. Did you know that your body contains over a trillion cells? Where did all of these cells come from? How did we get so many if all we started with was just the one cell? How do cells know when to divide? What happens if they make a mistake? Also, not all cells are the same. Do all cells divide the same? To investigate cell division, you will use your microscope skills to identify the different stages of cell division as well as how long each of the stages takes to complete. Many of the concepts and skills that you learned in the cell unit will be used to investigate cell division. This is a short unit – only 2 weeks! If you work at learning the stages of cell division and the differences between the two types of cell division, you will have a very successful cell division unit.

Upon conclusion of this unit the learner will:

1. Relate the process of mitosis by sequencing the stages of mitosis as body cells are formed.

2. Relate the process of meiosis as sex cells are formed.

3. Compare and contrast the chromosome number in mitosis and meiosis.

Vocabulary you should be familiar with:

Mitosis	Meiosis	Cell cycle
Interphase	Haploid	Apoptosis
Prophase	Diploid	
Metaphase	Crossing over	
Anaphase	Non-disjunction	
Telophase	Chromosome	
Homologous	Chromatid	
Karyotype	Centromere	
Random Assortment	Checkpoints	

INSERT CALENDAR HERE

Cell Reproduction - Mitosis

"All cells come from pre-existing cells." True, but how does this happen?

Mitosis –

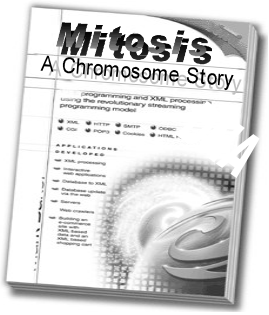
In higher organisms, mitosis only occurs in _____ cells such as _____, _____, and _____.

Mitosis does **NOT** occur in _____ (_____ and _____)

Why must cells go through mitosis?

1.
2.

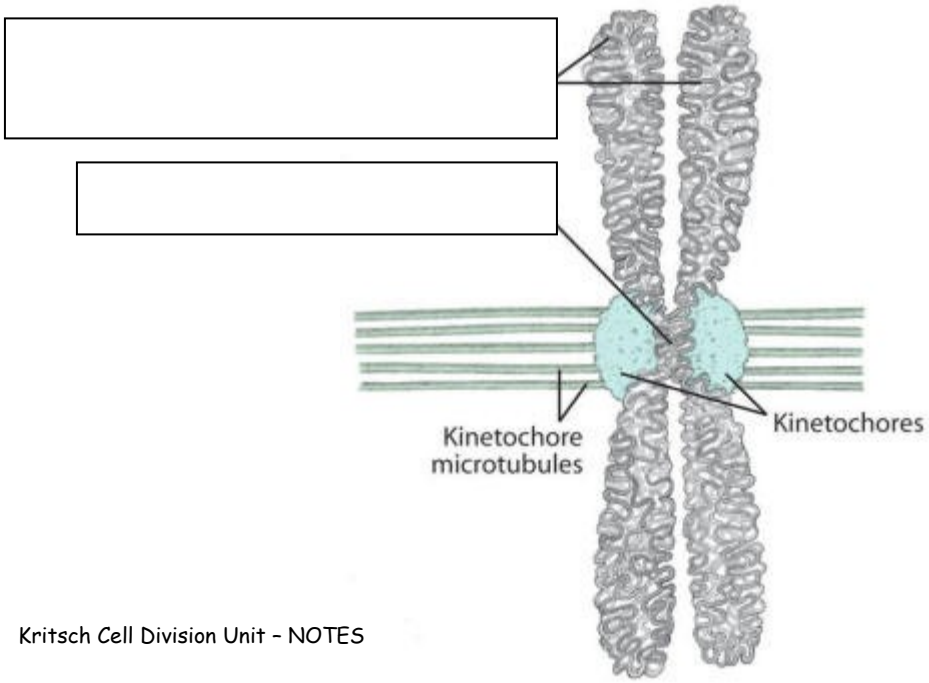
Mitosis is really a story about **chromosomes** – packages of DNA.



What do chromosomes look like?

Chromosomes come in _____ called _____.

These are held together at a _____.

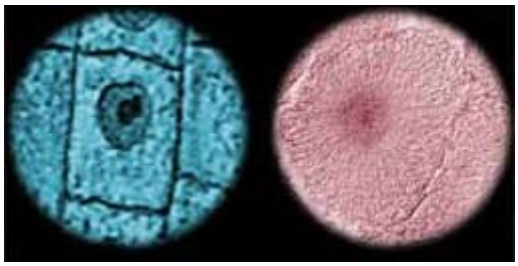


What are the steps of mitosis?

1. Interphase

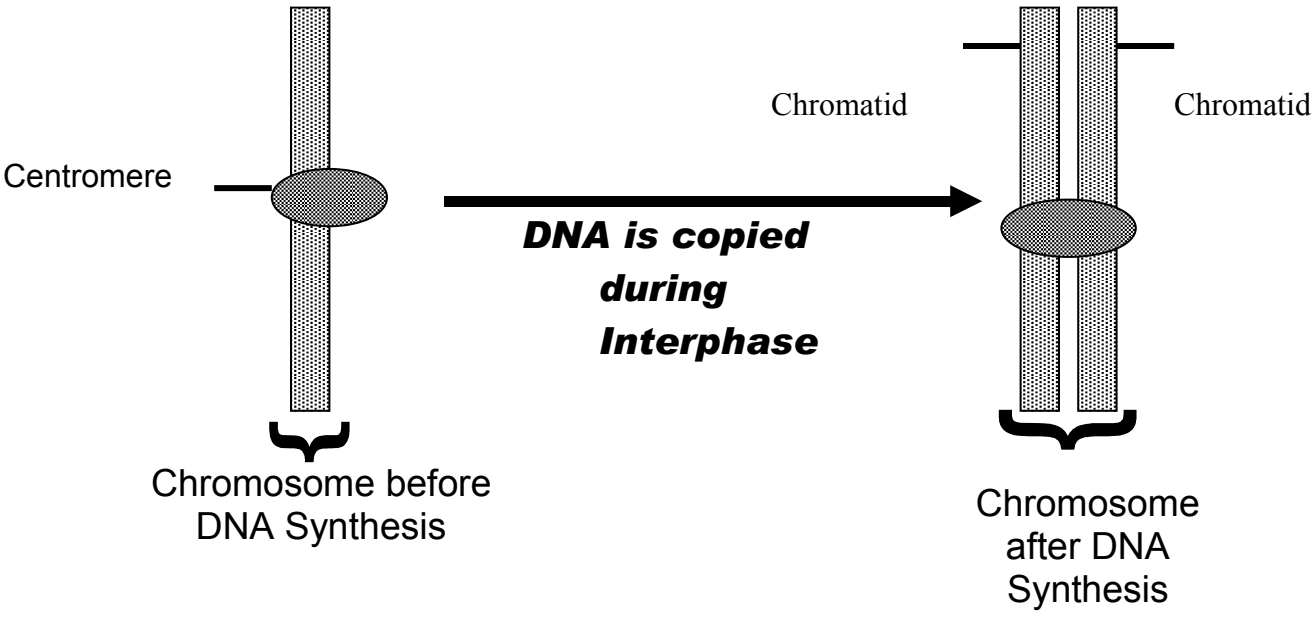
   A.

   B.



Plant and animal cells in **interphase**.

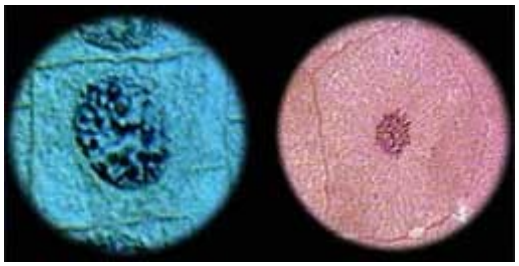
During **Interphase**, DNA copies itself so it can be divided equally between the two "daughter" cells.



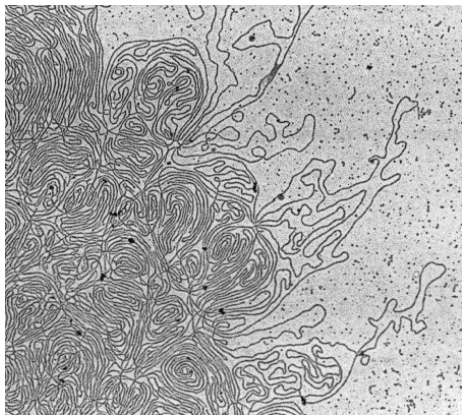
2. Prophase is the next step in mitosis.

A.

B.



Plant and animal cells in **prophase.**



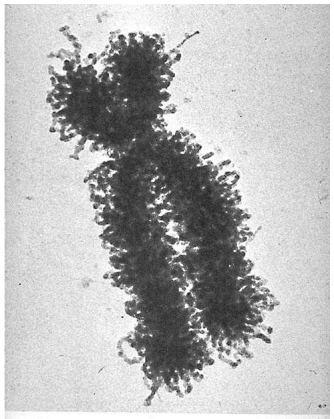
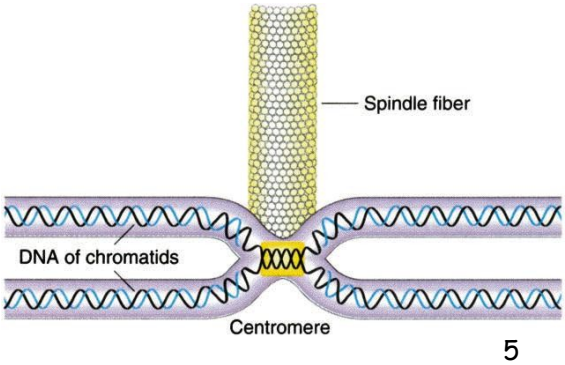


FIGURE 1-14
An electron micrograph of a human chromosome. Chromosome XII from a HeLa cell culture. (Courtesy of Dr. E. Du Praw.)

_____ condenses into _____

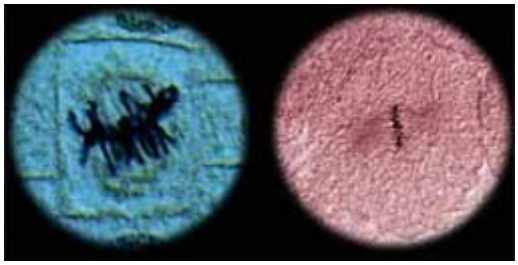
Since chromosomes are packages, they easier to move around than messy chromatin!

C. _____ send out _____(made of microtubules) which attach to the _____ of each chromosome.



3. Metaphase

A.



Plant and animal cells in **metaphase.**

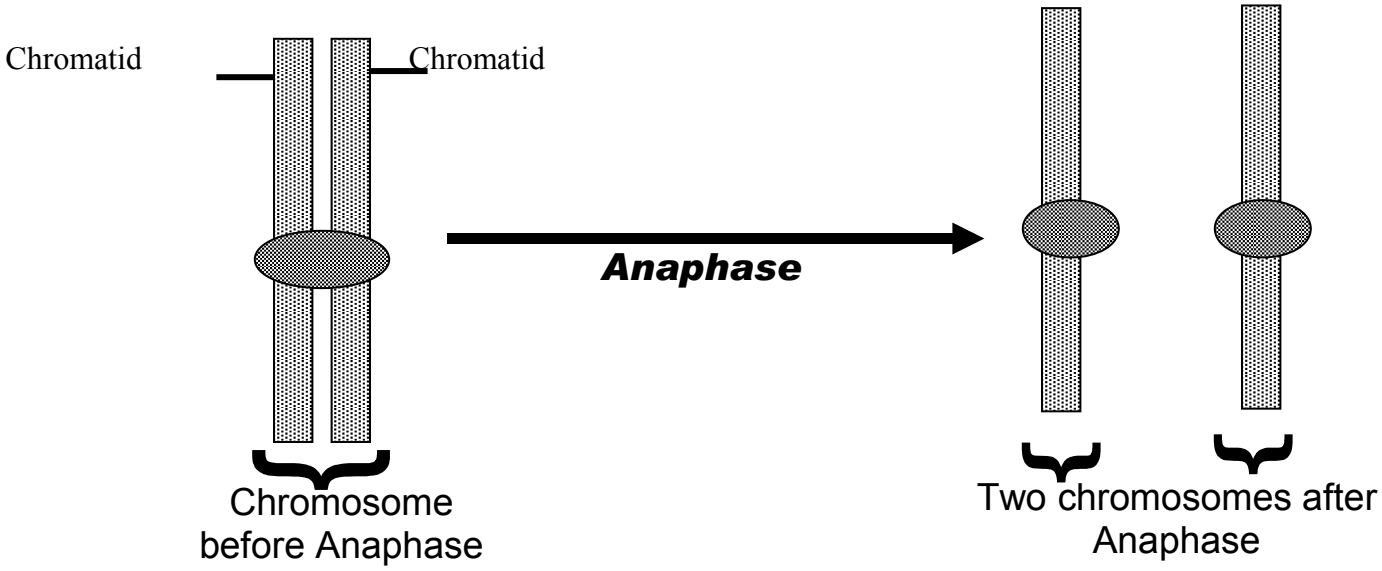
4. Anaphase

A.

B.

anaphase.

During **Anaphase**, spindle fibers pull chromosome apart. This creates two separate chromosomes.

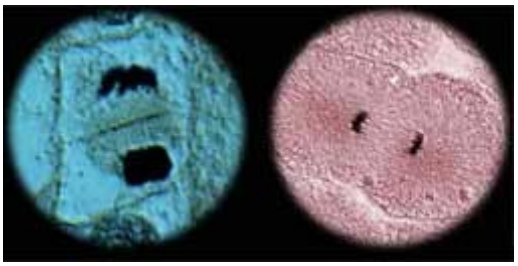


5. Telophase and Cytokinesis

A.

B.

C.



telophase.

A good way of remembering the stages of mitosis is:

I

Prefer

Mangoes

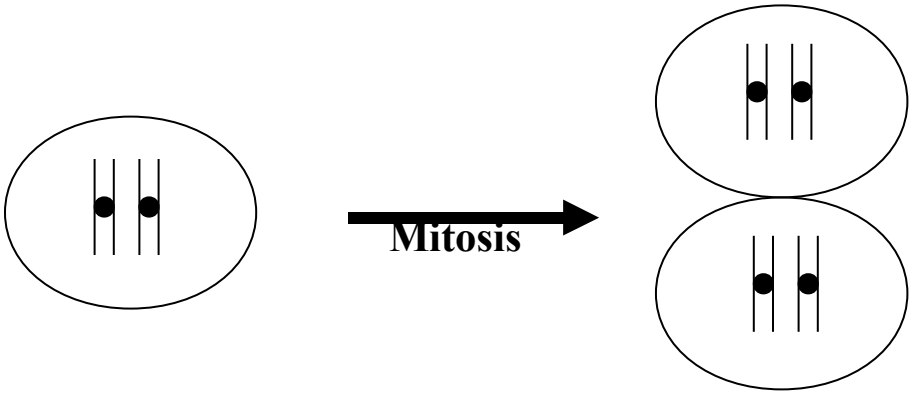
After

Tea

Overall goal of Mitosis:

1.

2.



For a good computer animation, go to www.cellsalive.com. Click on “Cell Biology and then on “Mitosis”.
OR
http://www.iknow.net/CDROMs/cell_cdrom/cellmovies.shtml and click on “Plant Mitosis Movie”
OR
http://cellimages.ascb.org/cdm4/item_viewer.php?CISOROOT=/p4041coll2&CISOPTR=55&REC=1
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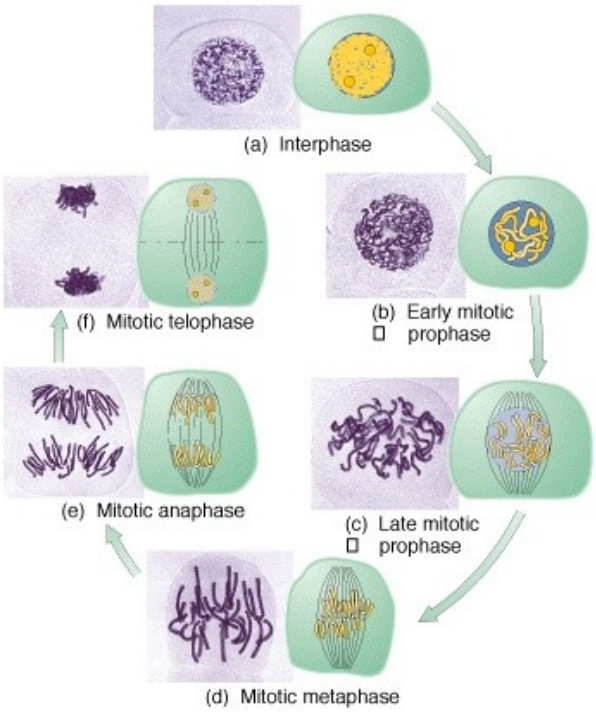
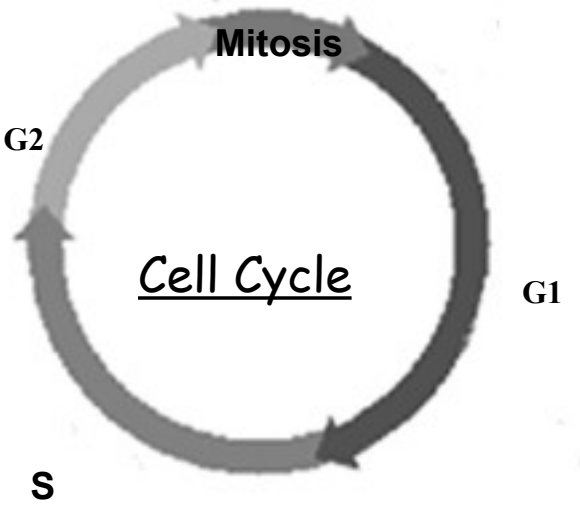


When does mitosis occur?



G1 – cell carries out normal functions

S – DNA is copied

G2 – cell carries out normal functions

http://iknow.net/CDROMs/cell_cdrom/index.shtml and click on The Cell Cycle Movie

In otherwords: Cells do a lot more than just reproduce!

How long does mitosis take?

Bacteria –

Human kidney cell –

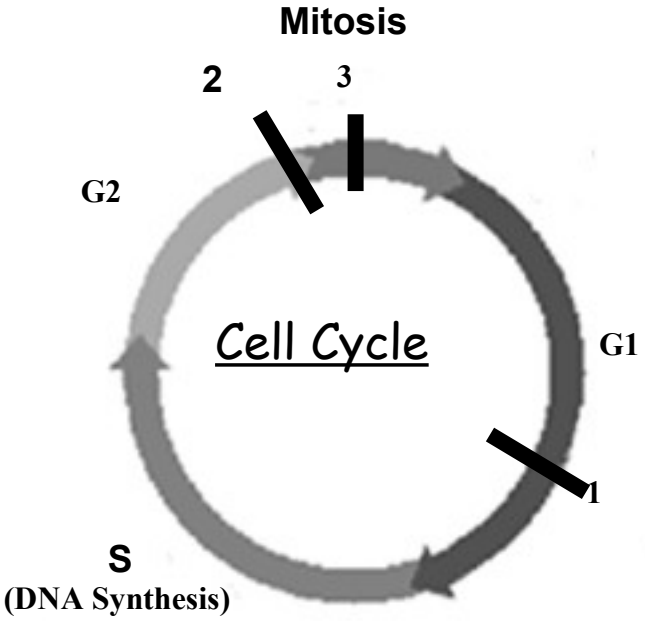
Human nerve cell –

When does mitosis occur?

When during life does mitosis occur the fastest?

Cancer – when the cell cycle doesn't stop

The cell cycle doesn't always keep going – there are three **"checkpoints"** to make sure that the cell is doing the cell cycle correctly.



Checkpoint 1 – occurs during G1, a protein called **Cdk** checks:

1. the cell is big enough
2. surrounding environment is good for DNA Synthesis.

Checkpoint 2 – occurs at the end of G2 right before mitosis. A protein called **p27** checks:

1. DNA has been replicated.
2. the cell is big enough
3. surrounding environment is good for DNA Synthesis.

Low levels of **p27** in patients who have breast cancer is not a good sign (cells have lost the ability to regulate themselves and cancer will continue).

Checkpoint 3 – occurs at metaphase. A protein called **p53** checks:

1. DNA lined up in middle of cell.
2. DNA is not damaged

- A mutation to **p53** is the most frequent mutation leading to cancer.

If the cell is too damaged, _____ or “programmed cell death” occurs.

What organelle might be involved in this process?

When else during life does “programmed cell death” occur?

For a good cell cycle computer animation, go to www.cellsalive.com, click on “Cell Biology”, and then click on “Cell Cycle”.

http://www.copernicusproject.ucr.edu/ssi/HighSchoolBioResources/CellDivision/Mitosis/Cancer_Cells.asf

Cancer Video

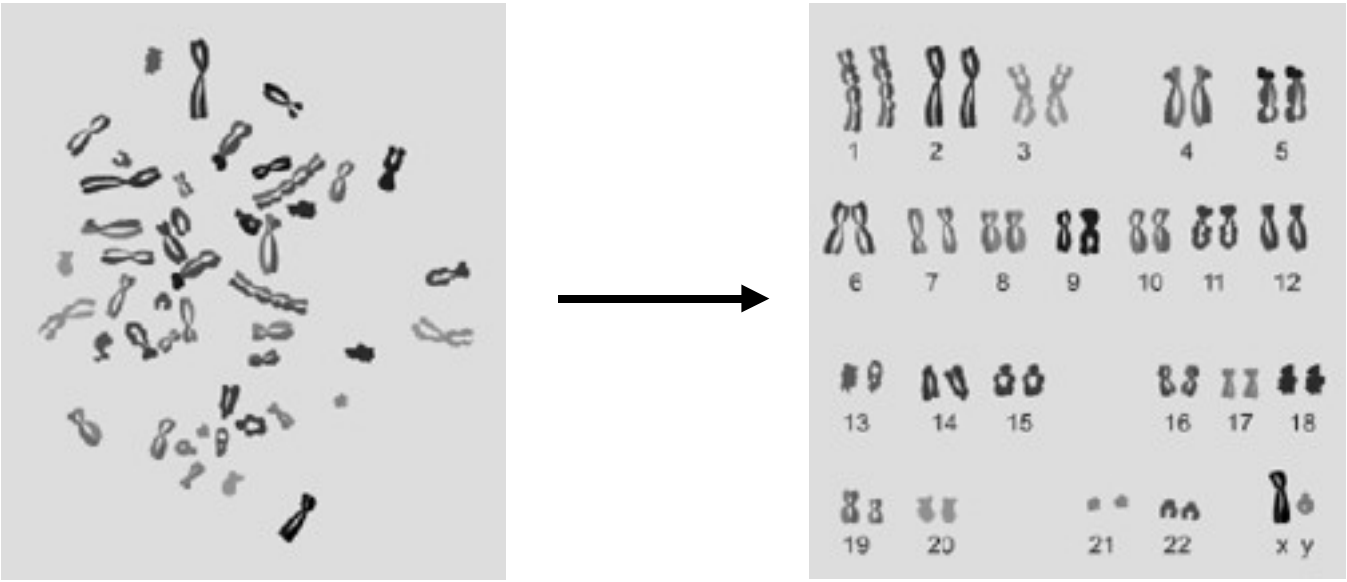
Meiosis – You mean there's another form of cell division?

Meiosis –

http://www.copernicusproject.ucr.edu/ssi/HSBiologyResources.htm

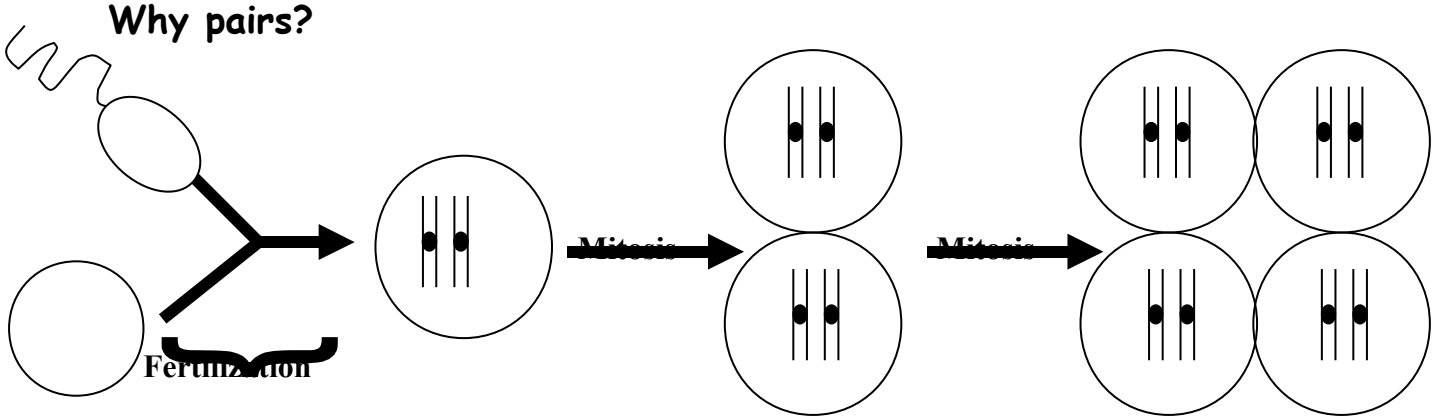
Meiosis Video

How many chromosomes do human somatic cells have? – In order to answer this question, we look at a **karyotype** – a picture of all the chromosomes in one cell.



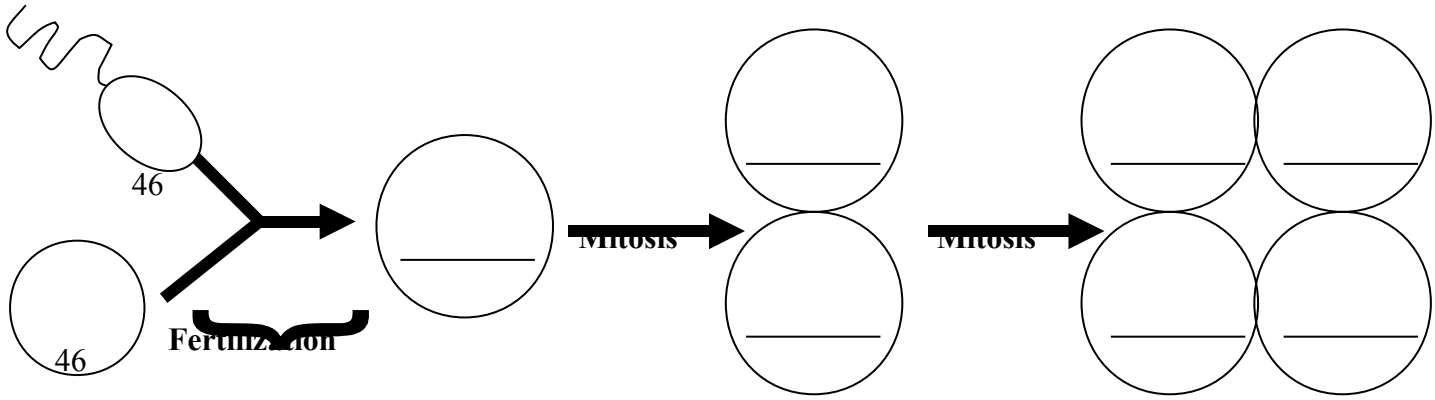
Karyotypes show that human somatic cells have _____ chromosomes and these chromosomes come in _____ .

Why pairs?



So if humans have 46 chromsomes in every cell how many chromosomes do human sperm and human eggs have?

Why sperm and egg <u>don't</u> have 46 chromosomes . . .



This means that the chromosome number has to be _____ to produce gametes (sperm and egg only).

How is the chromosome number reduced?

_____

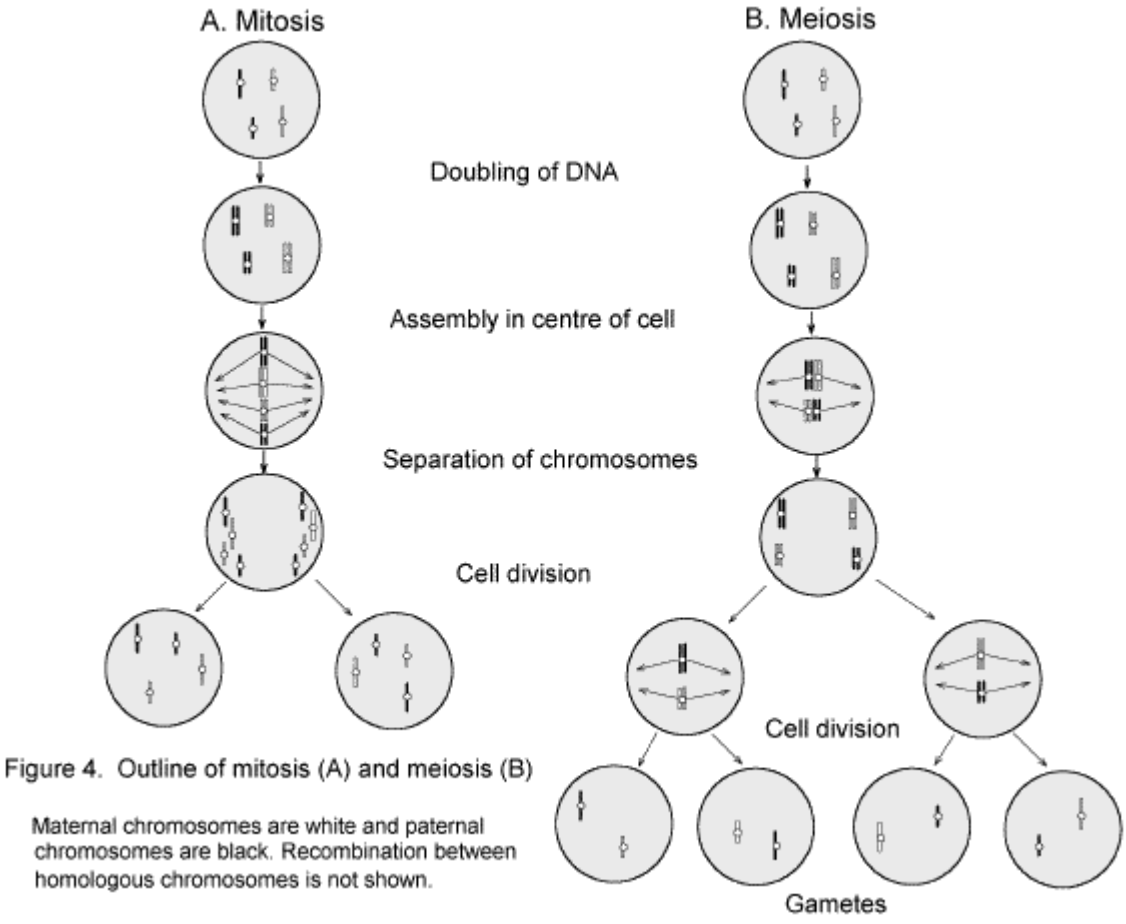


Figure 4. Outline of mitosis (A) and meiosis (B)

Maternal chromosomes are white and paternal chromosomes are black. Recombination between homologous chromosomes is not shown.

Differences between Mitosis and Meiosis:

Difference #1 – Meiosis makes

Difference #2 – Meiosis cuts chromosome number (no more)

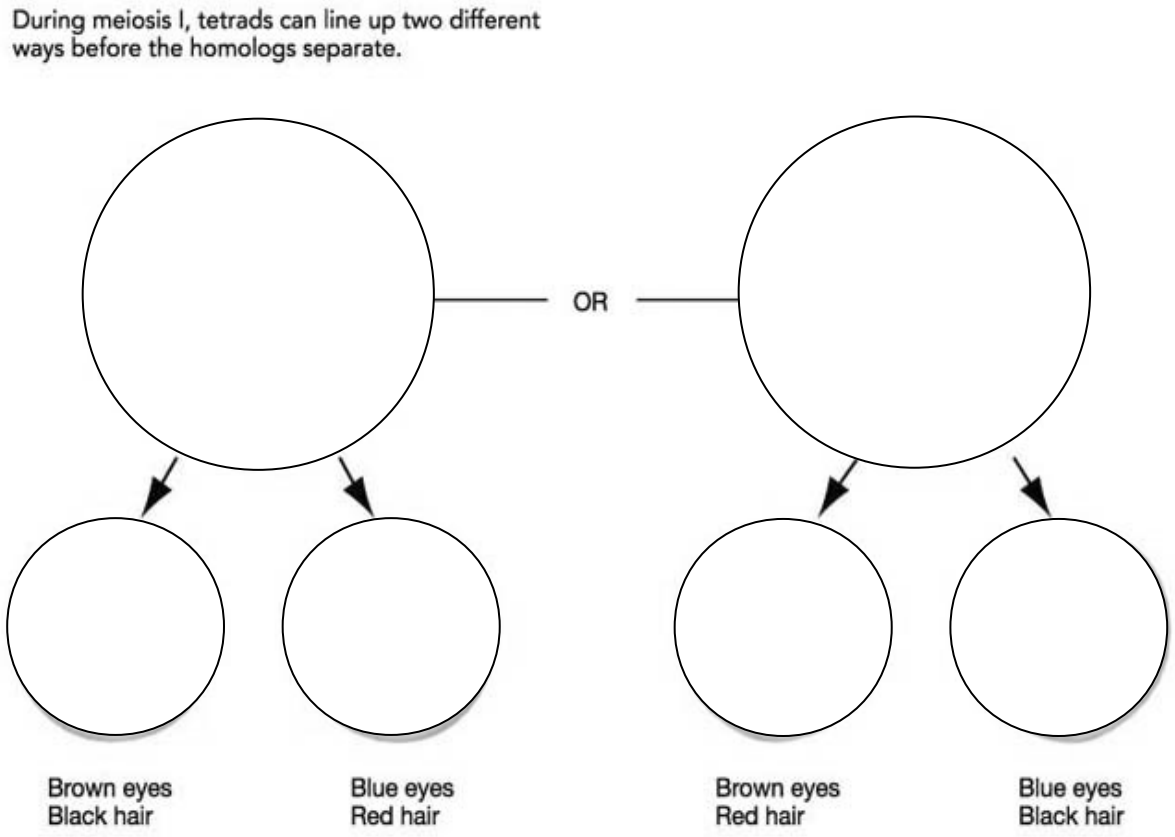
Difference #3 – Meiosis has rounds of cell division (mitosis only has)

Difference #4 – Chromosome pairs

http://www.biologyinmotion.com/cell_division/

1st Round of Meiosis

- homologous (similar) chromosomes pair up and meet in middle
- They can meet in any order as long as they are paired (RANDOM ASSORTMENT)
- When homologous chromosomes separate . . . NO MORE PAIRS!!!



2nd Round of Meiosis

- Chromosomes meet in middle (just like mitosis)
- *Chromatids* separate

In what type of cells does meiosis occur?

(Hint: a good way of remembering this is

"My toeses don't have sex" . . .Get it? **Mitosis don't have sex**.)

When does meiosis begin in humans?

Males –

Females –

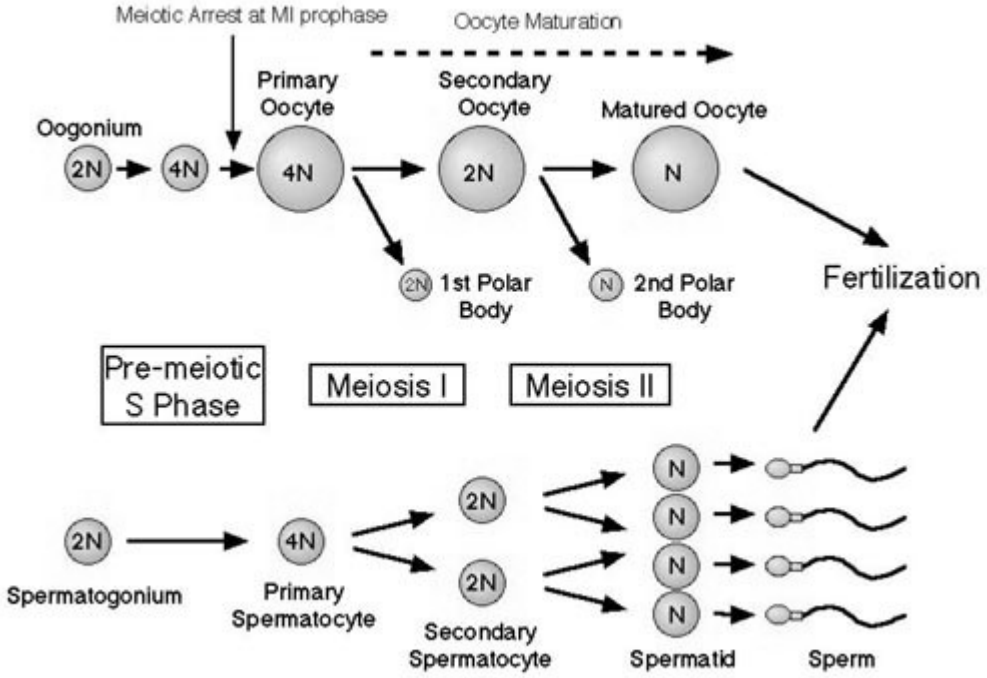
When does meiosis stop in humans?

Males –

Females –

How many sperm are produced from one cell in meiosis?

How many eggs are produced from one cell in meiosis?



Other terms to be familiar with:

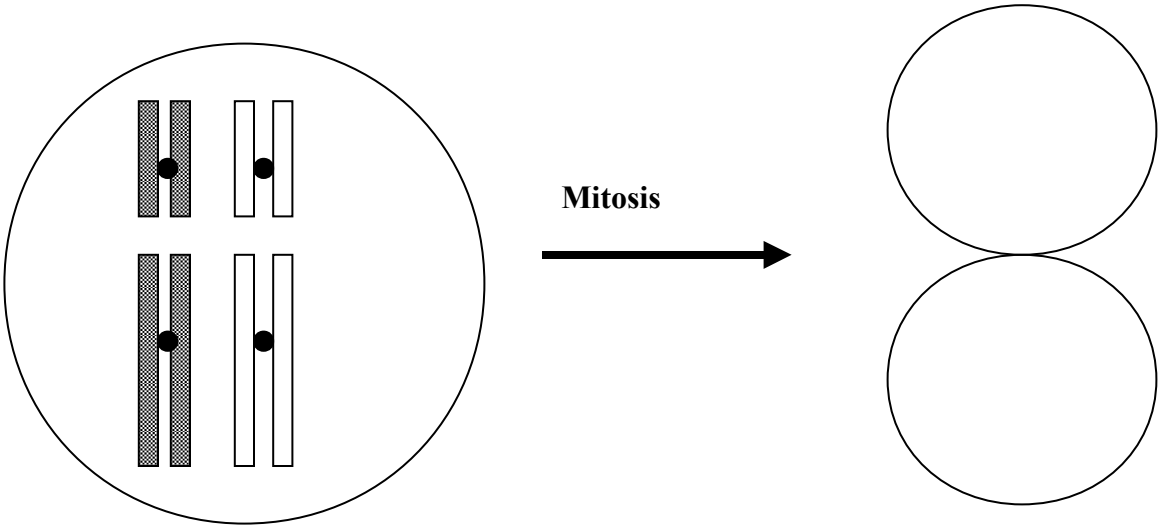
Diploid

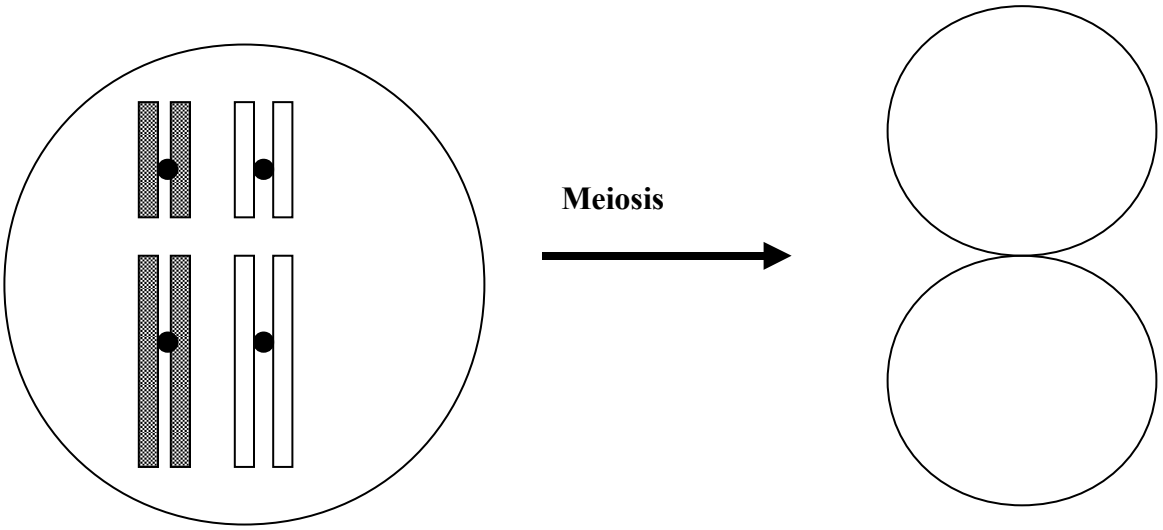
Haploid

Homologous

Non-Disjunction – What happens when Meiosis is not performed correctly?

Remember: In **Mitosis**, the goal is to get a copy of one of each chromosome into each daughter cell (Mom and Dad's). In **Meiosis**, the goal is to get one of each type of chromosome into each daughter cell (Mom or Dad's).



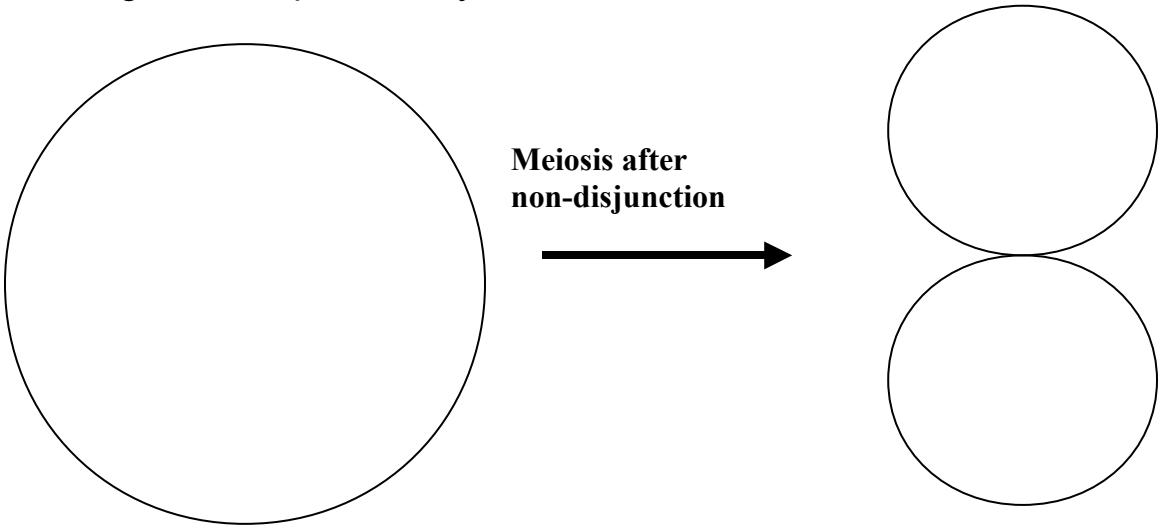


In **meiosis**, _____ chromosomes meet in the middle during _____ . Pairs of chromosomes go in _____ directions.

However, this isn't always the case.

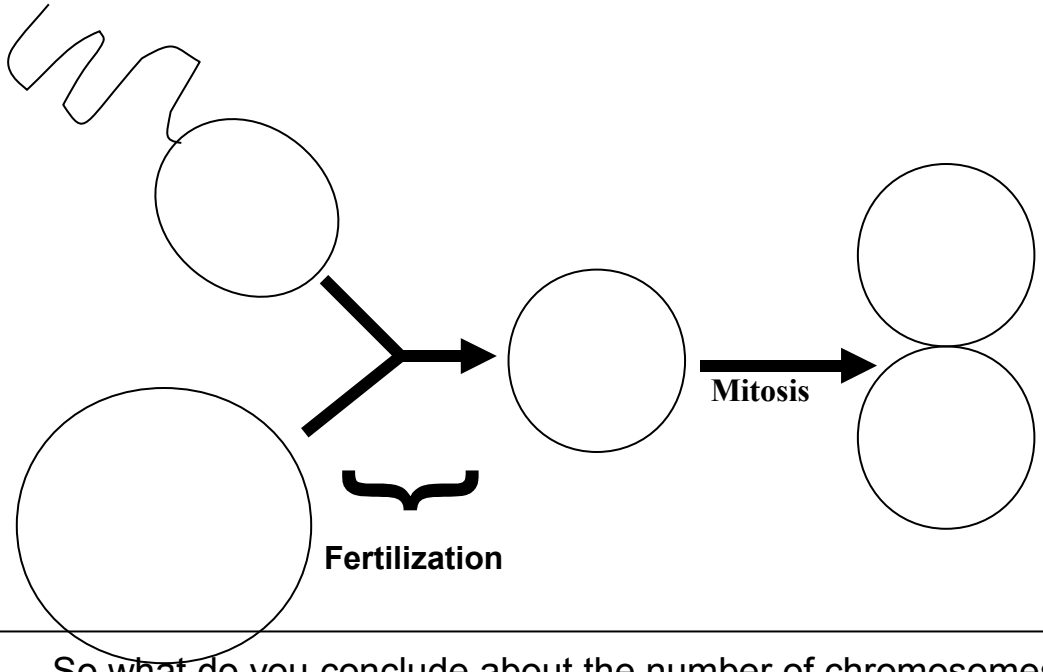
Non-disjunction –

When non-disjunction occurs, some pairs of chromosomes stay together and do not go their separate ways.



Non-disjunction of chromosomes during meiosis can result in major complications after fertilization.

Let's fertilize a "normal" egg with an "abnormal" sperm. Draw the results.



So what do you conclude about the number of chromosomes an individual has after fertilization with an egg or sperm that was produced by non-disjunction?

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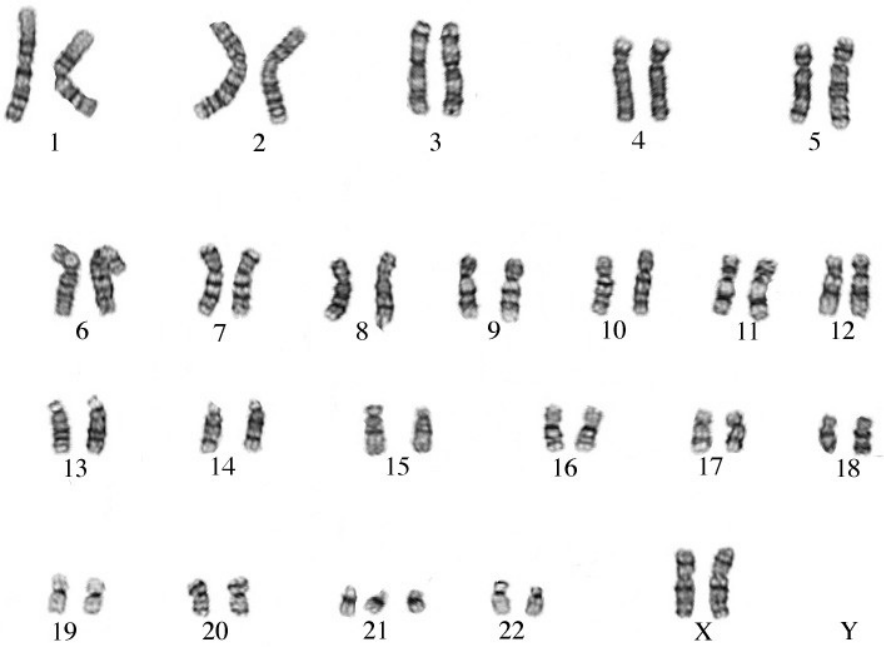

Count the total number of chromsomes. _____ Any problems?

Down's Syndrome occurs when –

Trisomy 21 –

Typical characteristics –

Other non-disjunction chromosome disorders –

Can all types non-disjunction result in the birth of a child?