Name Notes Filled in Hour

Unit 6: The Cell Cycle.....CH 10 & 11

earning Goals

1. I can explain why cells need to divide.
   Why Divide? Notes with demo, p. 3 – 4

2. I can name and describe what happens during the 3 phases of interphase.
   Overview of The Cell Cycle Notes, p. 5
   Replication & DNA Forms Notes, p. 6
   Mitosis Card Activity, p. 9 – 10
   DNA Replication Activity, handout

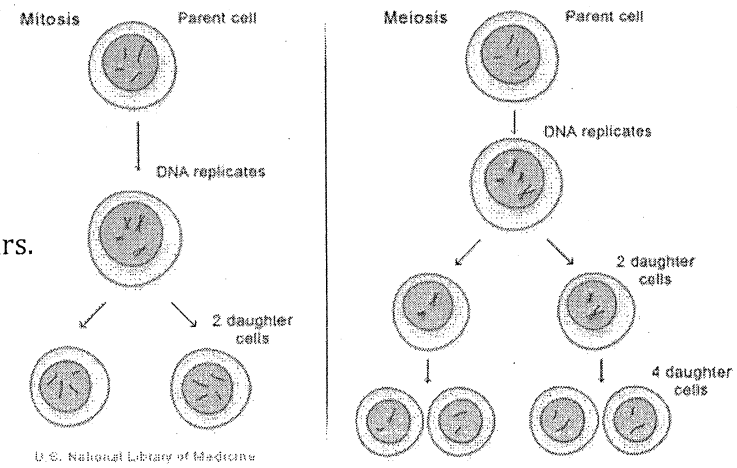
3. I can name and describe what happens during the 4 phases of mitosis.
   Mitosis Notes, p. 7 – 8
   Mitosis Card Activity, p. 9 – 10
   Ordering Pictures of Phases, activity in class

4. I can name and describe what happens during the 8 phases of meiosis.
   Meiosis Notes, p. 11 – 13
   Meiosis Card Activity, handout

5. I can compare and contrast mitosis and meiosis.
   Overview of The Cell Cycle Notes, p. 5
   Mitosis Notes, p. 7 – 8
   Meiosis Notes, p. 11 – 13

6. I can explain the effects of crossing over.
   Meiosis Notes, p. 11 – 13
   Meiosis Card Activity, handout

7. I can explain what cancer is and why it occurs.
   Cancer Notes, p. 14 – 15



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Vocabulary (*Flashcards, p. 16 – 17)*

- Anaphase
- Cancer
- Centrioles
- Centromere
- Chromatin
- Chromosome
- Crossing over
- Cytokinesis
- Daughter cells
- DNA Replication
- G_1 phase
- G_2 phase
- Gametes
- Homologous chromosomes
- Interphase
- Meiosis
- Metaphase
- Mitosis
- Prophase
- S phase
- Sister chromatids
- Somatic cells
- Spindle fibers
- Telophase
- Tetrads
- Tumor

Warm Ups

Notes: Why Divide?

asic Needs of a Cell:

1. **Bring materials into the cell across the cell membrane.**
   a. What kinds of materials?

   Amino Acids Water Vitamins
   Oxygen Glucose

   b. What processes allow them to do this?

   Facilitated Diffusion Endocytosis
   Active Transport Diffusion Osmosis

   c. Which needs to bring in more materials: big cell or little cell Big

2. **Get rid of waste out of the cell.**
   a. What kinds of materials?

   Carbon Dioxide Water Nitrates

   b. What processes allow them to do this?

   Facilitated Diffusion Osmosis Diffusion
   Active Transport Endocytosis

   c. Which needs to get rid of more waste: big cell or little cell Big

BAGGIE DEMO

	Calculate surface area.	Divide by 9cm².	Fill the bags.	Find volume.	Surface Area to Volume Ratio
Explain:	Tells the size of cell membrane.	Tells how much food the membrane can bring in (or waste-out).	To see if the cell will survive.	Tells how much cell there is to "feed" (or waste to dispose of)	For comparison.
Small Cell (Snack bag)	280 cm³	280 ÷ 9 = 31	Yes		
Large Cell (Gallon bag)	1512 cm³	1512 ÷ 9 = 168	NO		

Question: The large cell has more cell membrane than the small cell and can therefore get more food into the cell. So why can't it feed itself enough to survive?

3. **Make proteins.**
   - What materials does the cell need to make proteins & how does an organism get these materials?

     Amino Acids → eating proteins

     RNAs → Body makes these

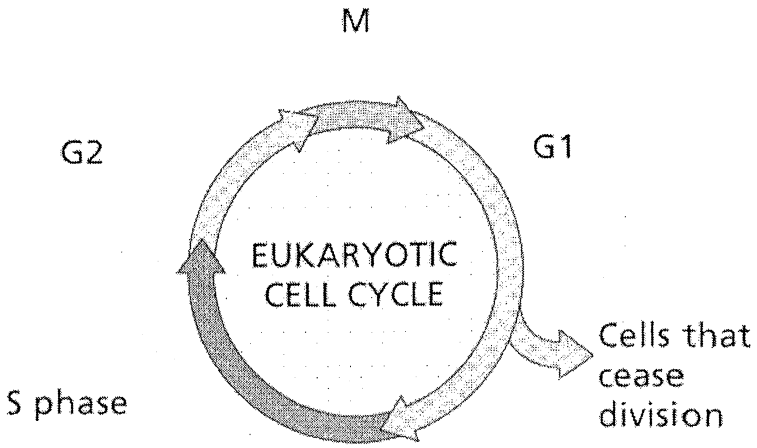
     DNA → already has a copy
   - From the list above, your cell only has one set of DNA. Therefore, protein synthesis has a maximum rate of production.
   - Which will need more protein: big cell or little cell.

Summarize:

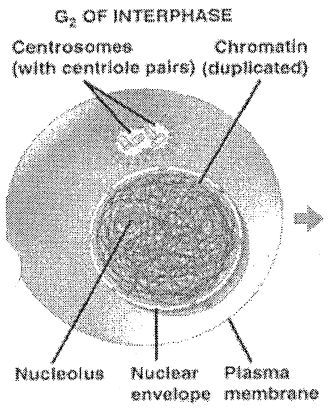
1. The larger a cell gets, the more difficulty it is has:
   - Getting materials in + out of the cell.
   - Making enough proteins for all cellular processes
2. Small cells are more efficient because they have a larger surface area to volume ratio compared to larger cells.
3. Therefore, when cell's reach a certain size, they divide instead of continuing to grow bigger and bigger.

Notes: Overview of The Cell Cycle

OVERVIEW:



INTERPHASE



Most of cell life is spent in Interphase – three parts:

- G_1 phase – growth + regular cell life processes
- S phase – cell makes a copy of DNA (DNA replication)
- G_2 phase – Prepares for mitosis (checks DNA + makes extra organelles)

CELL DIVISION:

Interphase is followed by:	Mitosis -OR-	Meiosis
For the purpose of:	growth + repair	reproduction
Occurs in which kind of cells:	Somatic Cells (non-reproductive cells)	Sex Cells (Gametes) egg + sperm
Number of divisions:	1	2
Number of daughter cells produced:	2	4
Amount of DNA in each daughter cell (compared to parent cell):	Same amount	1/2 the amount
Are daughter cells identical or different from parent cell?	identical	different

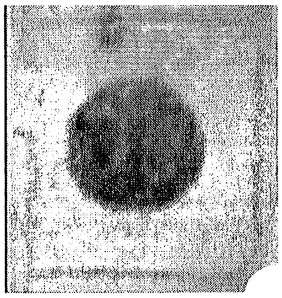
Notes: Replication & DNA Forms

Replication:

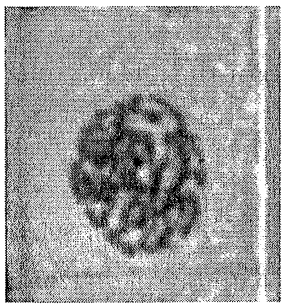
- Definition: The process in which a cell copies its DNA
- Description of Process:
  - Occurs during S-phase of interphase.
  - An enzyme called helicase unwinds DNA.
  - Another enzyme called DNA polymerase adds DNA nucleotides on the inside of both open strands.
- Results:
  - Two identical copies of DNA.
  - Half original and half new.

DNA can be found in two forms:

1. **Chromatin:**
   - **Description:**
     - DNA strand wrapped around proteins (which only allow RNA polymerase to work when the organism needs other proteins to be made).
     - Very loosely packed or uncoiled.
     - Cannot see individual pieces of DNA using a basic microscope.
   - **Reason for Form:** Gives cell access to the genes it needs to make proteins.



2. **Chromosomes:**
   - **Description:**
     - Chromatin that is coiled very tightly.
     - Can see individual pieces of DNA using a basic microscope.
   - **Reason for Form:** Prevents strands from getting tangled and, therefore, damaged during replication.



- **Double-Chromosome** (after replication)

- Two copies of the same portion of DNA are called sister chromatids
- Sister chromatids are joined by a centromere and are called a chromosome.

Single-Chromosome (after division)

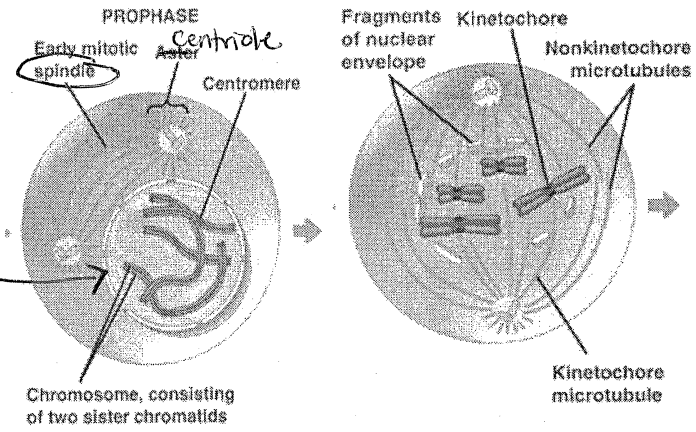
Notes: Mitosis

Overview: When a cell needs to grow/repair, Interphase is usually followed by mitosis.

- 4 phases
- 1 continuous process
- 2 identical cells produced
- Occurs in Somatic cells (non-reproductive cells)
- Generally, for the purpose of growth & repair of the organism
- Some cells divide more often than others (i.e. skin)
- Animation: http://www.johnkyrk.com/mitosis.html

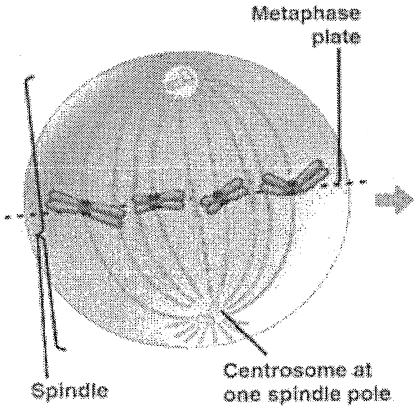
Phase 1: Prophase

1. Centrioles move towards the poles
2. Nuclear envelope disolves
3. Chromatin condenses into chromosomes
4. Spindle forms



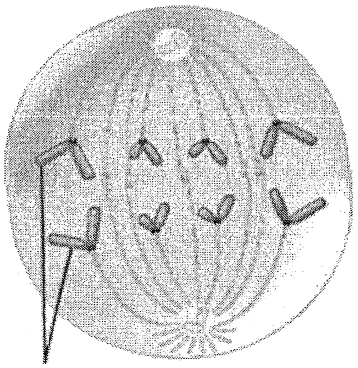
Phase 2: Metaphase

1. Chromosomes line up across the center of the cell. (Spindle fiber attaches to centromeres)



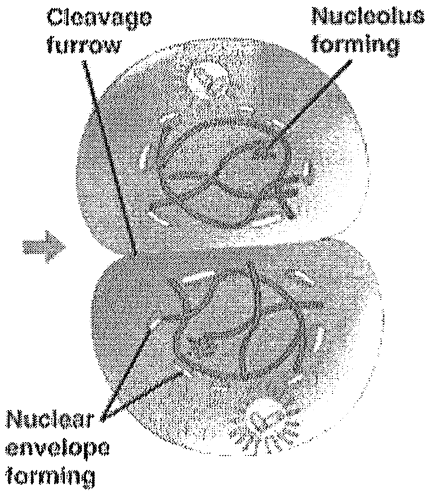
Phase 3: Anaphase

1. Spindle fibers pull sister chromatids apart. (toward poles)



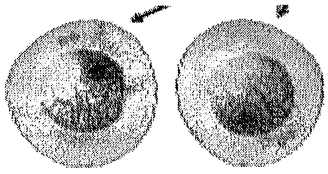
Phase 4: Telophase

1. Chromosomes unravel into chromatin
2. nuclear envelope reforms
3. Spindles dissolve
4. Cell membrane pinches

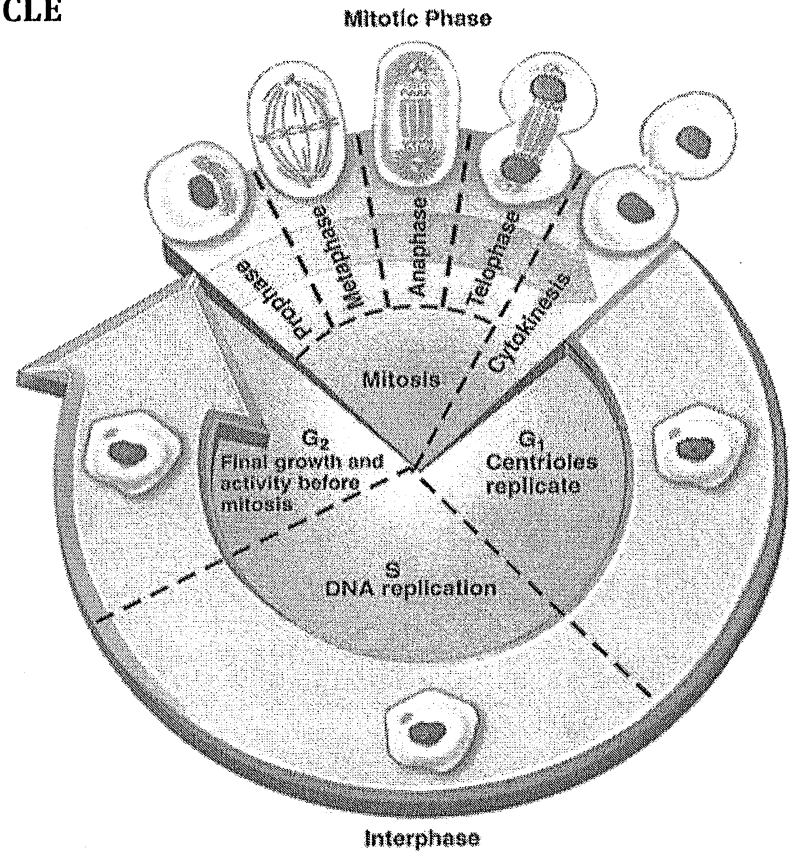


THE END: Cytokinesis

Cell membrane divides to make two separate cells that start over in G1 of interphase

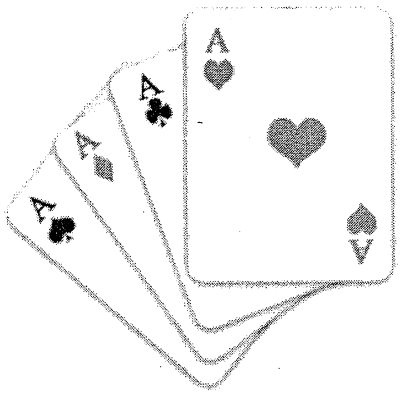

Daughter cells in interphase

THE WHOLE CYCLE



Mitosis Card Activity

Materials. What do they represent?



Puffballs:

2 pieces of long blue yarn:

2 pieces of short red yarn:

Paperclips:

A single card, face up:

A paid of identical card, face up:

A pile of cards, face down:

Your fingers:

Set up your cell in interphase. Use two of the blue pieces of yarn to make a large circle on your table. Use two pieces of red yarn to make a smaller circle inside of the blue yarn circle. Place one of each type of card face down inside the red yarn circle. Place the two puffballs together inside of the blue yarn circle, but outside of the red yarn circle.

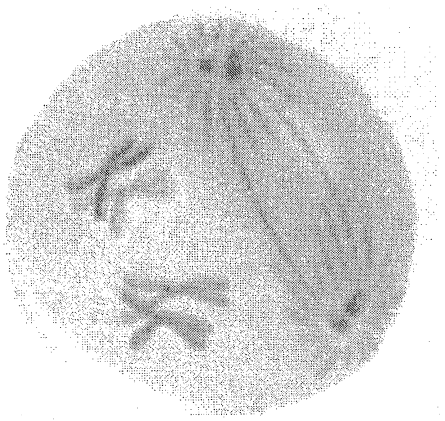
	What did I do with the materials?	A drawing of my "cell".	What did my actions represent
Interphase:	1. Your "cell" as you set it up following the directions. 2. Pair up the extra cards you have into identical sets and paperclip them together, in the end they should be face down (you should have 4 pairs). 3. Place the extra two puffballs right next to the set already inside the cell		1. G_1 phase – a cell in its normal functioning state. (Draw the cell in this phase) 2. 3.
Prophase	1. Move the puffball pairs to opposite sides of the cell. 2. Move red yarn to the side of the cell. 3. Turn card pairs face up. 4. Spread fingers out from puffballs.		1. 2. 3. 4.

Metaphase	1. Line up card pairs across the center of the cell creating an equator between your puffball sets (try to put one finger from each hand on each card pair).		1.
Anaphase	1. Use fingers to pull the card pairs apart, taking one copy of each card to each pole and creating two piles of cards.		1.
Telophase	1. Turn cards face down, keep them in two piles. 2. Put a red yarn around each of the card piles. 3. Take out fingers. 4. Pinch the blue yarn in near the middle of the cell.		1. 2. 3. 4.
Cytokinesis	1. Separate the blue yarn so that there are two cells.		1.

Notes: Meiosis

Overview: When an organism needs to reproduce, Interphase is followed by Meiosis.

- 8 phases
- 1 continuous process
- 2 different cells produced
- Occurs in gametes (reproductive cells)
- For the purpose of reproductive of the organism.
- Animation: http://www.johnkyrk.com/meiosis.html

Prophase I		**SAME as Mitosis:** • Centrioles move towards poles • Spindle fibers form. • Nuclear envelope breaks down • Chromatin → chromosomes **DIFFERENT than Mitosis:** • NEW STEP: Homologous chromosomes form TETRADS • NEW STEP: Chromosomes cross-over

Homologous Chromosomes

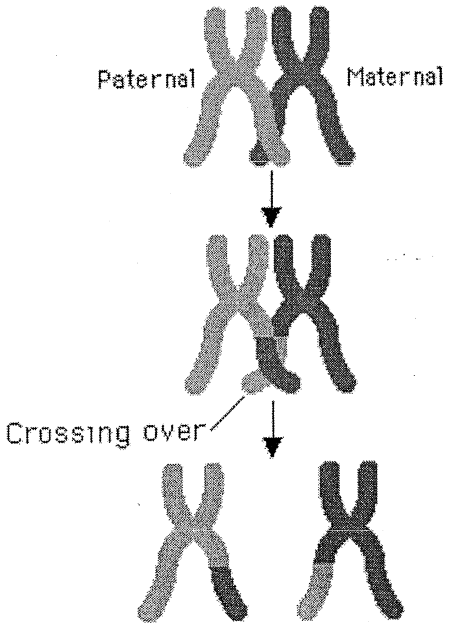
- Two chromosomes that carry the same information (i.e. the gene for hair color).
- One came from your mother and one from your father.

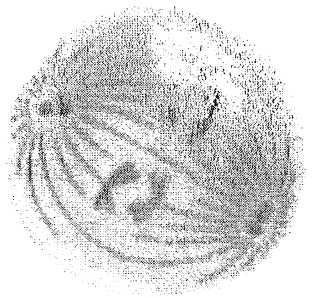
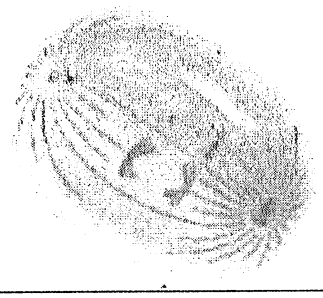
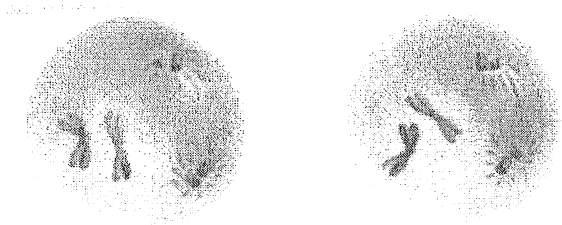
Tetrads

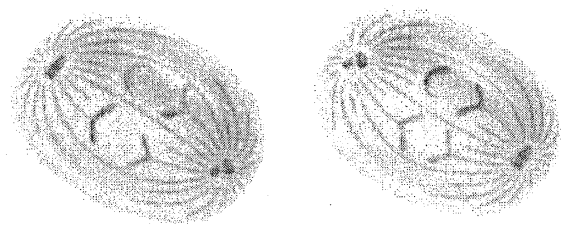
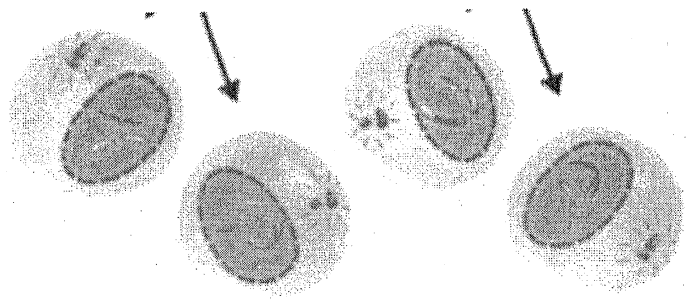
- Structure made when homologous chromosomes pair together.

Crossing Over

- When in tetrads, homologous chromosomes will trade pieces.
- This is important for genetic variability.



Metaphase I		**DIFFERENT than as Mitosis:** • Tetrads or homologous pairs line up across the middle of the cell with spindle fibers attached at centromeres.
Anaphase I		**DIFFERENT than as Mitosis:** • Spindle fibers separate tetrads or homologous pairs, pulling one chromosome toward each pole.
Telophase I & Cytokinesis		**SAME as Mitosis:** • Nuclear envelopes reform • Spindle dissolves • Chromosomes → Chromatin • Cell membrane pinches & divides
Prophase II		**SAME as Mitosis:** • Centrioles (copy &) move towards poles • Spindle fibers forms • Nuclear envelope dissolves • Chromatin → Chromosomes No tetrads formed
Metaphase II		**SAME as Mitosis:** • Chromosomes line up across the center of the cell with spindle fibers attached at centromeres.

Anaphase II		**SAME as Mitosis:** • Spindle fibers pull sister chromatids apart & toward the poles
Telophase II & Cytokinesis		**SAME as Mitosis:** • Chromosomes → chromatin • Spindle fibers dissolve • Nuclear envelopes reform • Cell membranes pinch & divide

Review

- Chromosomes that have the same type of information (one from mom and one from dad) are called:

  Homologous Chromosomes

- When homologous chromosomes pair up, the structure is called a:

  Tetrad

- During which phase do tetrads form?

  Prophase I

- During which phase does crossing-over occur?

  Prophase I

- During which phase are homologous pairs separated?

  Anaphase I

- During which phase are sister chromatids separated?

  Anaphase II.

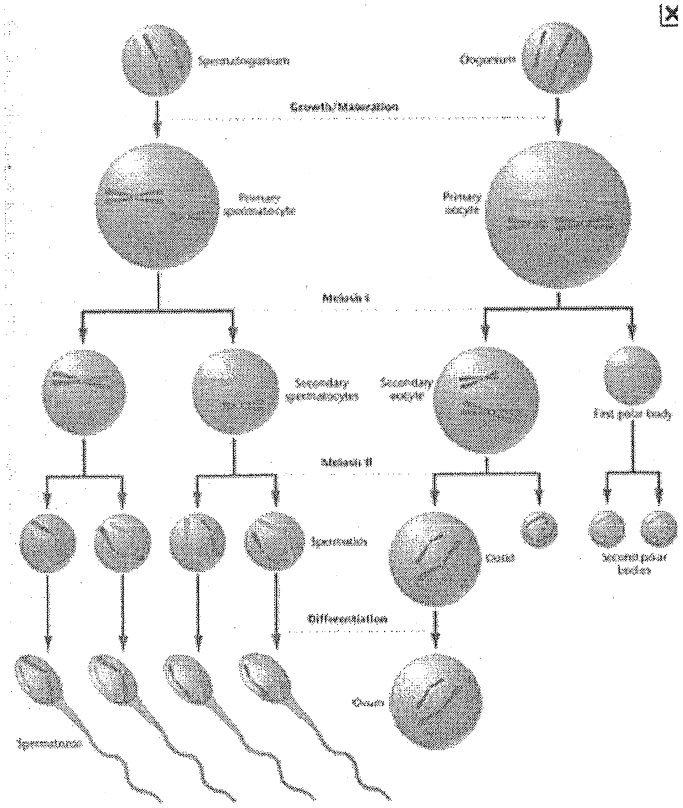
- How many times does the cell divide in meiosis?

  2 times

- How many cells are produced? 4 cells

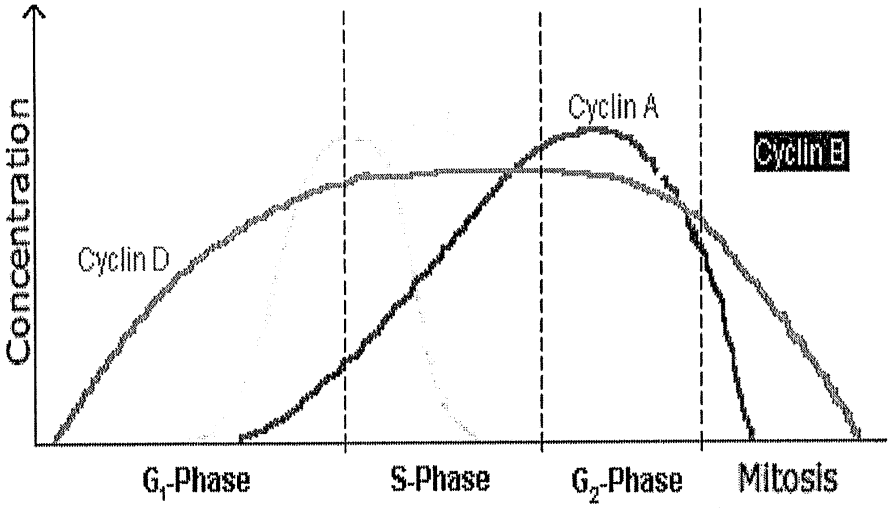
- What type of cells are produced?

  Gametes



Notes: Cell Regulation & Cancer

- The cell cycle is carefully controlled. Nerve and muscle cells don't divide once they are established, but skin, bone marrow and digestion tract cells divide continuously.
- The cell cycle has internal and external regulators.
  - One form of external regulation is contact with other cells. When you get a cut, the skin cells around the cut will begin to divide rapidly until they come into contact with other cells on all sides.
  - A group of proteins called cyclins control cell division internally.



The graph to the left shows the concentration of different cyclin proteins found throughout the cell cycle.

- Which cyclin protein signals the cell to begin mitosis?

  Cyclin B

- Which cyclin protein signals the cell to begin DNA Replication?

  Cyclin E

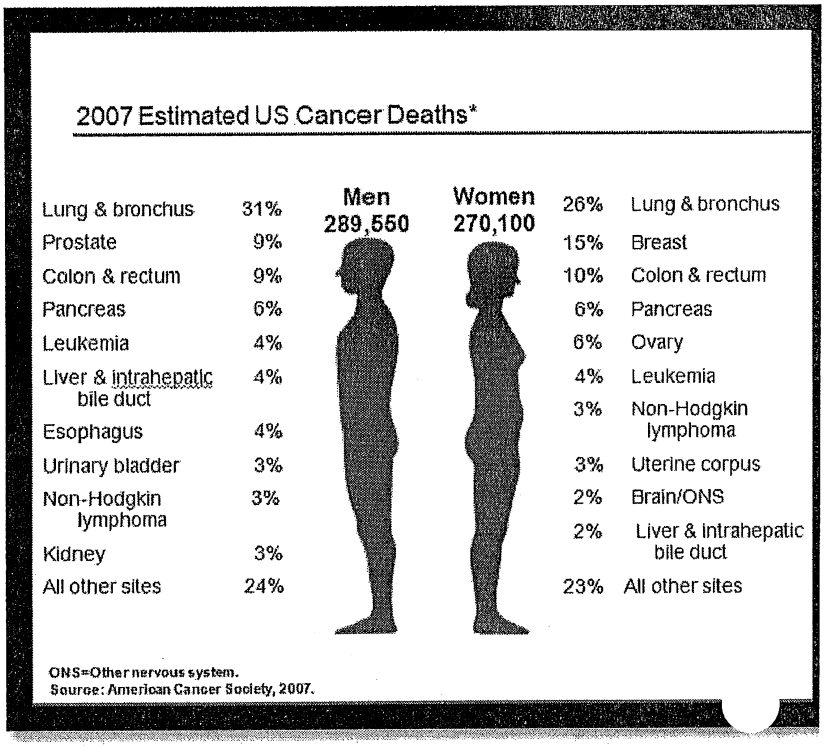
What is it called when the cell cycle is out of control?

Cancer

Cancer cells do not respond to the signals that regulate the cycle of most cells.

Some Statistics:

- More than 500,000 people will die of cancer this year.
- Half of all males and 1/3 of all females will have cancer at some point in their lives.
- Cancer can form in almost any tissue in the body



What is Cancer?

- Cancer is a malignant growth or tumor caused by abnormal and uncontrolled cell division (mitosis)

Cancer, a Cellular Disease:

- Begins when something goes wrong with controls that regulate cell growth and division. The cell doesn't recognize cyclin or doesn't respond to contact with other cells
- Tumor = a mass of uncontrollably growing cells.
- Tumors can be benign or malignant
  - Benign = non-cancerous (not bad)
  - Malignant = cancerous (bad)
- Cancerous tumors that are malignant can invade and destroy the surrounding tissue
- Malignant tumors can metastasize, which means little pieces of the tumor break free and are transported through the circulatory and lymphatic systems to other places in your body.

Causes of Cancer:

- Heredity – inheriting a gene from mom or dad that predisposes you to cancer
- Mutations – they can change the genetic code so that your cells stop responding to things that regulate the cell cycle.

Risk Factors:

- A risk factor is anything that increases a person's chance of getting a disease
  - Age
  - Gender
  - Family medical History
  - Environment – air and water quality (Erin Brockovich), chemical exposure
  - Life style: tobacco and alcohol use, diet, sun exposure, lack of physical activity (obesity).

Treatments:

- Surgery – to remove tumors
- Chemotherapy
- Radiation
- Biological therapy (using the bodies immune system to help repair damaged cells)

The final phase of cell division when the nuclear envelope reforms, spindle fibers dissolve and chromosomes turn back into chromatin.	Tightly coiled DNA. Individual pieces of DNA can be seen under a microscope when in this form.	A pair of chromosomes that contain the same type of information (one copy from mom and one copy from dad).	Organelle responsible for forming spindle fibers.
Process of cell division used for the purposed of growth or repair by the body.	Refers to the cells that are produced after mitosis or meiosis.	The process of homologous chromosomes trading pieces. This is important for genetic variability and happens during prophase I of meiosis.	Unraveled DNA. Individual pieces of DNA cannot be seen under a microscope when in this form.
Structure formed when homologous chromosomes pair up.	The first phase of cell division when the nuclear envelope dissolves, spindle fibers form and chromatin turns into chromosomes.	Phase during which the cell is performing its normal cellular functions.	Phase during which DNA (homologous chromosomes or sister chromatids) separate.
Division of the cytoplasm resulting in two daughter cells.	Process of cell division used for the purpose of sexual reproduction.	A group of cells that is growing and dividing uncontrollably.	Non-reproductive or body cells.

Phase during which DNA replication occurs	Phase during which the cell prepares for cell division by producing extra organelles and checking its DNA for errors.	The process of making a copy of all the DNA in a cell. Occurs during S phase of interphase.	Structure where sister chromatids are held together.
Phase during which DNA (homologous chromosomes or individual chromosomes) line up across the middle of the cell.	Sex cells.	Structure produced by the centriole that helps separate chromosomes during mitosis.	Phase of the cell cycle that that includes G_1, S and G_2.
When the cell cycle has gotten out of control (unregulated).	These identical copies of DNA are held together by a centromere.		