Review for Biology Unit Test: The Microscope, Parts of the Cell, DNA, Mitosis and Cancer

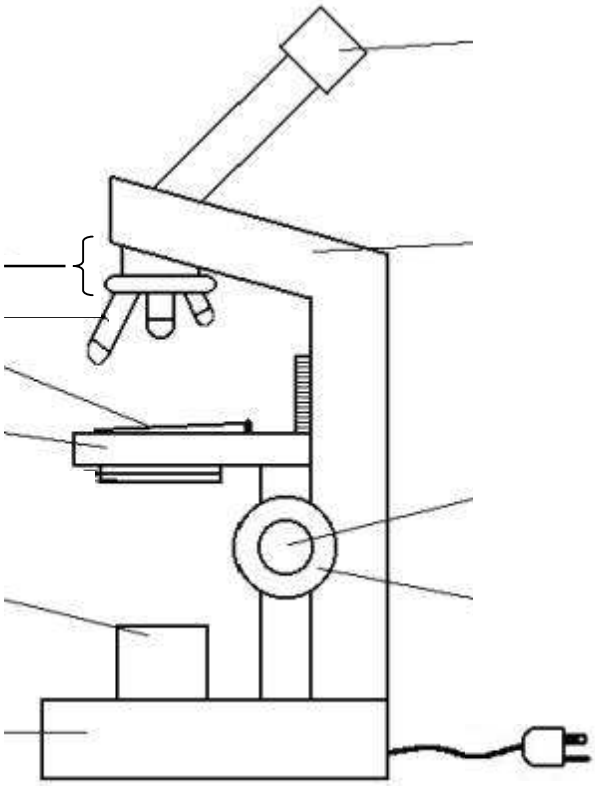
1. Define biology. Biology is the study of life and living things.
2. List 5 characteristics of living things. You can remember this using the mnemonic MRS GREN:
   - **M**ovement (is capable of changing its position eg. plants grow toward the sun)
   - **R**espiration (can obtain energy from food, usually requires O_2)
   - **S**ensitivity (can sense and respond to changes in its environment, eg. shivering when we get cold)
   - **G**rows (gets larger over time)
   - **R**eproduction (can produce offspring)
   - **E**xcretion (gets rid of waste materials eg. CO_2 & urine)
   - **N**utrition (consumes chemical material as food)

3. How is a robot like a living thing? In what three ways are robots not like living things?

How Robots are LIKE living things	How Robots are UNLIKE like living things
♦ require energy ♦ produce wastes (maybe) ♦ senses and responds to its environment ♦ has a lifespan (maybe) ♦ can move	♦ they are not made of cells ♦ they can not grow or develop ♦ they can not (usually) repair themselves ♦ they can not reproduce

4. What are the 3 main statements of the Cell Theory? The Cell Theory states that:
   - All living things are made of one or more cells.
   - Cells are the smallest living things (smallest units of life).
   - All cells come from other (pre-existing) cells.

5. Know the parts of a compound light microscope and their functions.



Write the number of the part of the light microscope beside the name of this part:

2. arm
10. base
8. coarse adjustment (focus)
7. fine adjustment (focus)
9. light source
4. objective lens (high power)
1. ocular lens
3. revolving nosepiece
6. stage
5. stage clip

6. Using the compound light microscope:
   a) describe how to focus the microscope, beginning with low power and working up to high power.

- using the **coarse adjustment** knob, lower the stage all the way
- place the prepared slide on the stage
- rotate the **low** power objective lens into place (if not already there). You will hear a "click" when the objective lens is correctly in place
- while looking into the ocular lens, use the **coarse adjustment** knob to bring the image into view. (You may have to move the slide around to find the specimen in the field of view)
- use the fine adjustment knob to bring the image into sharper focus
- while watching from the side, rotate the **medium** power objective lens into place. Use **only** the **fine adjustment** knob to bring the image into sharp focus
- while watching from the side, rotate the **high** power objective lens into place. Use **only** the **fine adjustment** knob to bring the image into sharp focus
- **NEVER** use the **coarse adjustment** knob on **HIGH POWER**.

   b) why should the coarse adjustment knob not be used with the high power objective lens?

- the coarse adjustment knob moves the stage up and down too much. If there is a slide on the stage, the bottom of the high power lens can hit the slide. This can damage the lens and break the slide.

   c) describe how to correctly prepare the microscope for storage.

- make sure the stage is empty (do not leave a slide on the stage)
- rotate the low power lens into place
- lower the stage all the way
- wrap the cord around the microscope
- cover the microscope it and return it to its proper location.

   d) the letter "F" under the microscope, is upside down and backwards. It looks like:

   e) compare the amount of detail you see under low and high magnification.

- you see much more magnification (detail) under high magnification

   f) compare the amount of the specimen you see under low and high magnification.

- you see more of the specimen under low power (it is 'zoomed" out)

   g) if the ocular lens is 8x magnification and the objective lens is 20x, what is the total magnification?

- total magnification is calculated by multiplying the power of the ocular (eye) lens by the power of the objective (object) lens
- 8 x 20 = 160X total magnification

6. Know how to prepare a wet mount:
   a) what is a "mounting medium" and why is it used (2 functions)?

- the mounting medium is a liquid in which the specimen is placed on a slide. It may be water or a biological stain. It helps to hold the specimen in place and makes it more visible by staining it.

   b) what mounting medium (stain) did we use for cheek cells? for onion cells?

- the stain for cheek cells was methylene blue
- the stain for onion cells was iodine

   c) why should you hold the coverslip by the edges?

- to prevent fingerprints on the coverslip

   d) why is the coverslip lowered slowly and at a 45° angle over the specimen?

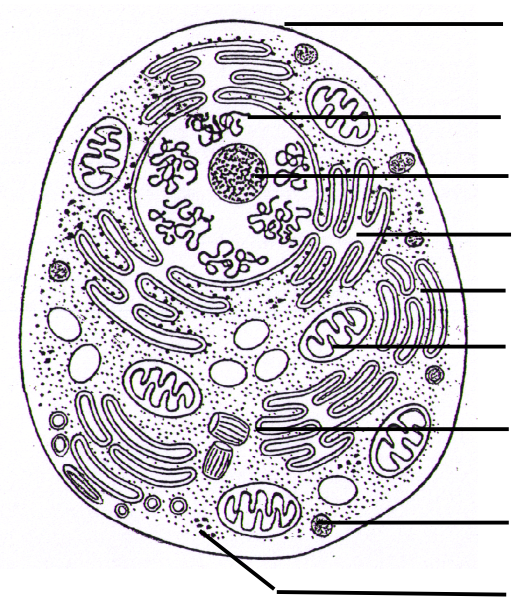
- to prevent air bubbles from getting under the coverslip

e) describe the steps to prepare a wet mount of either a human epithelial cell or an onion epithelial cell. Include the name of the mounting medium used.

- obtain a clean, dry microscope slide and coverslip
- place a drop of **mounting medium** onto the centre of the slide (methylene blue for cheek cells, iodine for onion cells)
- holding the coverslip by its edges, place the edge of the coverslip on the edge of the mounting medium at a 45° angle. Gently lower the coverslip, allowing air to escape. (If air bubbles are present, **gently** tap the slide with the eraser end of a pencil to remove them)
- the slide is ready to view under the microscope

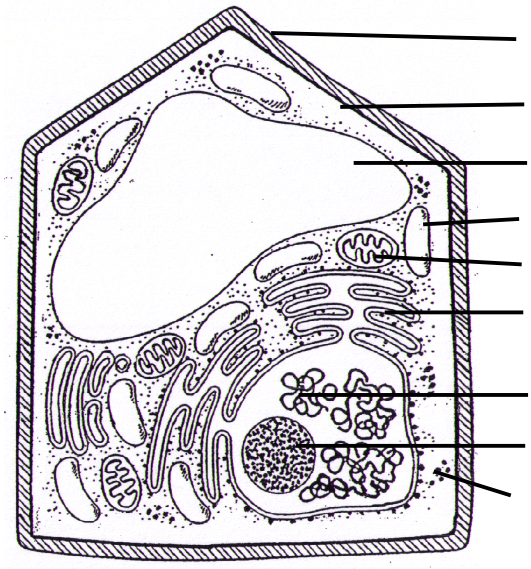
7. What parts of plant and animal cells can you see under a light microscope?
   - In an animal cell, you can usually see the cell membrane, cytoplasm and nucleus
   - In a plant cell, you can usually see the cell wall on the outside of the cell, cell membrane just inside the cell wall, the cytoplasm and nucleus. You may also see the large central vacuole.

8. Know the parts of plant and animal cells as seen through an electron microscope. Know the function of each of these parts. Practice by covering up the "Function" side of the chart on the homework page "Cell Organelles and their Functions".



Write the number of the part of the animal cell beside the name of this part:

1. cell membrane
7. centrioles
2. chromatin
4. endoplasmic reticulum
5. golgi apparatus
8. lysosome (or vesicle)
6. mitochondria
3. nucleolus
9. ribosomes



Write the number of the part of the plant cell beside the name of this part:

2. cell membrane
1. cell wall
3. central vacuole
4. chloroplast
7. chromatin
6. endoplasmic reticulum
5. mitochondria
8. nucleolus
9. ribosomes

Parts of the Cell and their Functions:

Cell Part	Function(s)
Cell membrane	• controls the movement of substances into and out of the cell • separates the cell from its environment and from other cells • surrounds the cytoplasm and holds the cell together
Cell wall	• made of cellulose; it gives plant cells rigidity • does NOT control the movement of materials into and out of the cell
Cytoplasm	• contains and supports all parts of the cell (organelles) • nutrients and wastes are dissolved in the cytoplasm for use, transportation and storage
Mitochondria	• "powerhouses" of the cell, provide the cell with energy through the process of cellular respiration • both plant and animal cells have mitochondria
Chloroplasts	• found in green plants and this is where photosynthesis takes place • photosynthesis uses chlorophyll to capture the energy from the sun which is stores in molecules of glucose
Nucleus	• the control centre of the cell, directs all of the cell's activities • contains DNA in the form of long threads of chromatin when the cell is not dividing • chromatin is made of genes, and each gene is the recipe for a single protein
Nucleolus	• found in the nucleus and makes ribosomes
Ribosomes	• found attached to the rough endoplasmic reticulum or floating free in the cytoplasm • reads the DNA recipe and makes proteins
Endoplasmic Reticulum	• a series of channels that transports materials such as proteins through the cell
Golgi Apparatus	• packages materials such as proteins into vesicles for storage or secretion
Lysosomes (in animal cells)	• breaks down old or damaged cell parts so they can be recycled • breaks down bacteria and viruses to help fight infection
Vacuoles (in plant cells)	• stores water, sugar and minerals for the plant cell • some vacuoles in plant cells can break down old cell parts
Vesicles	• stores proteins and other materials for the cell
Centrioles (in animal cells)	• centrioles form spindle fibres during cell division
Flagella and cilia	• for movement of the cell or to move material past the cell

9. Know how different organelles are related to protein production in the cell.

- the nucleus contains the DNA. The DNA contains all of the recipes that a cell needs to make its proteins. Each individual recipe for a protein is called a gene.
- ribosomes read the DNA recipe and make the proteins
- the endoplasmic reticulum transports the proteins through the cell
- the Golgi apparatus packages the proteins into vesicles for storage or secretion out of the cell

10. Know the names of two different types of proteins and where each is found in the body.

- hemoglobin is found in red blood cells to carry oxygen
- keratin is found in hair and fingernails, beaks of birds and baleen in whales
- antibodies are found in the blood to help fight infections
- collagen is found in bone and other connective tissues such as cartilage
- insulin is made by the pancreas and helps move glucose from the blood and into cells
- enzymes are found in our liver and digestive system to break down alcohol, drugs and food

11. What process takes place in chloroplasts? What green pigment allows this to happen?

- chloroplasts contain the green pigment called chlorophyll
- chlorophyll traps the energy of the sun and stores it in glucose (sugar) in the process of photosynthesis
- the reaction is: $6\ CO_2 + 6\ H_2O \rightarrow C_6H_{12}O_6 + 6\ O_2$

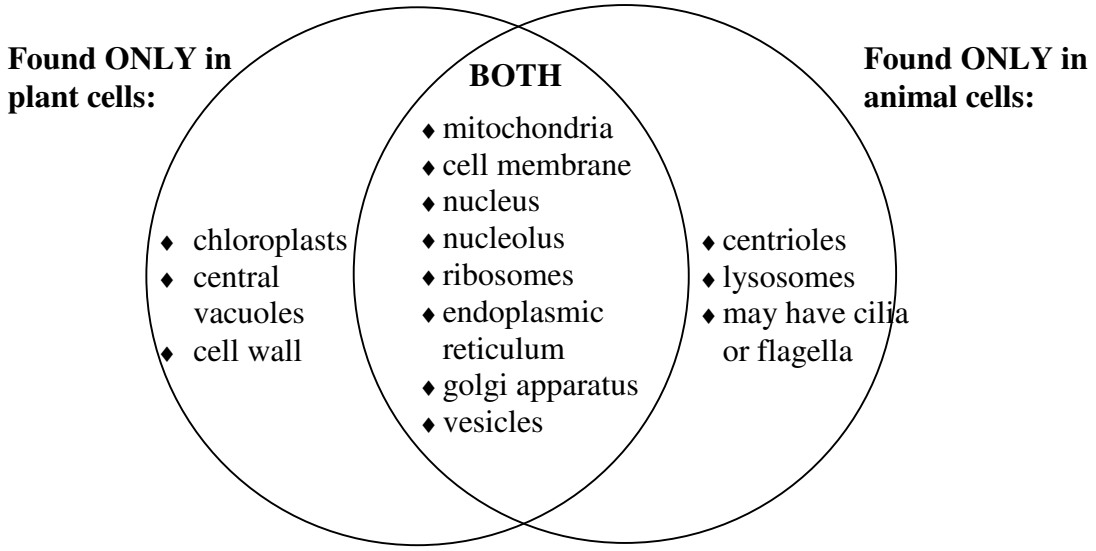
  (carbon dioxide + water → glucose + oxygen)

12. What process takes place in mitochondria? Do plants cells have mitochondria? Why or why not?

- cellular respiration takes place in mitochondria of BOTH plant and animal cells
- the sugar that is produced by photosynthesis is then "burned" to release the energy for the cell
- the reaction is: $C_6H_{12}O_6 + 6\ O_2 \rightarrow 6\ CO_2 + 6\ H_2O$

  (glucose + oxygen → carbon dioxide + water)

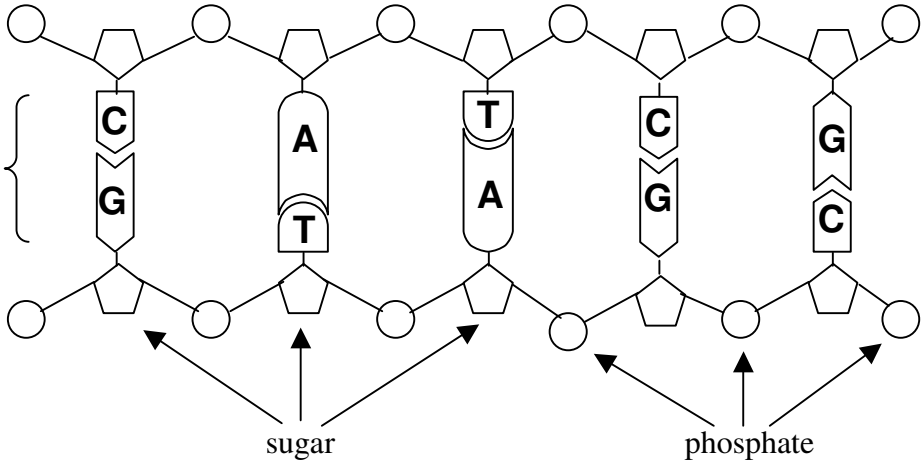
13. Complete the Venn diagram to compare plant and animal cells. The similarities go in the centre where the 2 circles overlap.



DNA

1. Label the molecule of DNA:

Nitrogen bases (adenine, guanine, cytosine, thymine)



2. "A" stands for **adenine**, it always bonds with **thymine** (T).

   "G" stands for **guanine**, it always bonds with **cytosine** (C).

3. If 22% of the nitrogen bases in a strand of DNA is guanine, calculate the percentages of the other nitrogen bases.

- if 22% of the nitrogen bases are guanine, then there must also be 22% cytosine (G and C always bond)
- that means that 100% – (2 x 22%) or 56% of the nitrogen bases are adenine and thymine
- one half of 56% is 28%, so 28% of the nitrogen bases are adenine and 28% are thymine

4. When is DNA found as chromatin? When is DNA found as chromosomes? Why is DNA found as chromosomes during this time?

- DNA is found as chromatin when the cell is in interphase (when it is not dividing)
- DNA is found as chromosomes during cell division (mitosis) because when the DNA is coiled up as chromosomes, it is much less likely to break when it is being pulled and divided between the cells

5. Using your notes from class, complete the following statements about DNA:

a) DNA is found in the **nucleus** of the cell.
b) DNA stands for **deoxyribonucleic acid**.
c) DNA contains three types of molecules: **sugar**, **phosphate** and **nitrogen bases** (A, T, C, G).
d) The shape of a DNA molecule is a called a **double helix**.
e) DNA carries the "recipes" for the cells to make its **proteins**.
f) When the genetic material is found as long thin strands of DNA it is called **chromatin**.
g) When the genetic material is coiled into shorter thicker "rods", they are called **chromosomes**.
h) The recipe for a single protein is called a **gene**.
i) Before cell division, the DNA must be **replicated** (copied exactly).

Proteins

1. Cells can be described as small factories that make **proteins**.
2. The "recipes" for **ALL** of a cell's proteins are carried in the **DNA (genetic material)**.
3. The "recipe" to make **ONE** single type of protein is called a **gene**.

4. The organelles in the cell that ***make*** the proteins are called **ribosomes**.
5. The organelle in the cell that ***transports*** the proteins is called **endoplasmic reticulum**.
6. The organelles in the cell that ***package*** the proteins are called **golgi apparatus**.
7. The organelles in the cell that ***store*** the proteins are called **vesicles**.
8. What are five examples of proteins in your body?
   - see the answer to question 10 in the Parts of the Cell section (above).

The Cell Cycle

1. How do cells obtain their nutrients?

- nutrients can diffuse through the cell membrane from the cell's environment into the cytoplasm
- nutrients can also be carried through the cell membrane by "carrier molecules" (eg. insulin is a hormone that helps glucose move into the cell)

2. Why is it important that cells not get too large?

- if cells get too large, nutrients can not diffuse into the centre of the cell fast enough to meet the cell's needs and the cell will die (remember our "jello cell"?)
- similarly, wastes such as carbon dioxide can not diffuse out of the centre of the cell fast enough and this can kill the cell

3. What are four reasons that cells divide? Cells divide to:

- keep the cell from getting too large
- to reproduce themselves
- replace dead or damaged cells
- allow an organism to grow

4. What are the two parts of the cell cycle?

- interphase and mitosis (cell division)

5. What happens during interphase?

- during interphase, the cell carries out all of its normal functions and grows
- in the middle of interphase, the DNA (as chromatin) is replicated (copied exactly) in preparation for cell division

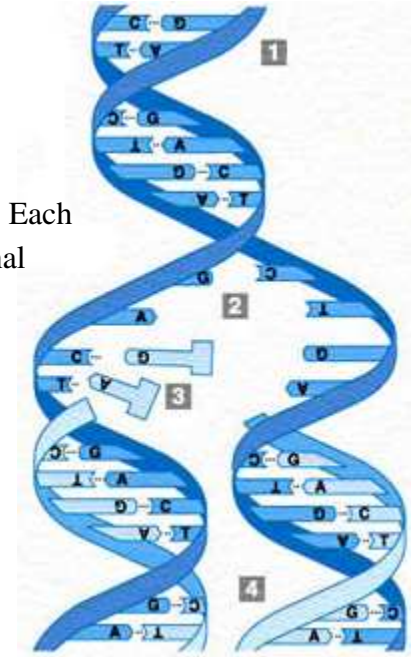
6. What are two types of cells in your body that spend the longest time in interphase?

- muscle cells (including heart cells) and nerve cells

7. What are two types of cells in your body that divide very frequently?

- skin cells
- the cells lining the stomach and intestines
- blood cells

8. Outline, in order, the four steps that take place when ***DNA*** is replicated.



- first, the double helix unwinds [1]
- second, the nitrogen bases unzip down the middle of the DNA molecule [2]
- then, nitrogen bases that are floating in the cell attach to their matching nitrogen base: adenine bonds to thymine and cytosine bonds to guanine [3]. Each side of the DNA molecule acts as a template (pattern) to replicate the original DNA double helix
- finally, once the nitrogen bases are in place, the sugar-phosphate backbone is bonded together [4]

9. Give two reasons why the structure of the DNA molecule is so well suited to its function.

- DNA uses only four nitrogen bases (A,T,C and G) to store the recipes to make all a cell's proteins. Simply by changing the order of the A, T, C and G, the cell can change the proteins that it makes. It is a simple and efficient way to store a huge amount of information
- because A always bonds to T, and C always bonds to G, when the DNA molecule unzips down the middle, it makes a pattern so that one DNA strand can be copied exactly to make two identical DNA strands

10. What happens during mitosis? (this is a Grade 10 answer….we get more specific in Grade 11 biology)

- during mitosis, one cell divides into two identical daughter cells
- the genetic information, organelles and cytoplasm are divided between the daughter cells

11. What is the function of centrioles?

- centrioles are found only in animal cells, not in plant cells
- centrioles are the organelle that forms the spindle fibers during cell division

12. What happens during cytokinesis? How is cytokinesis different in plant and animal cells?

- cytokinesis happens at the same time as telophase, at the very end of mitosis when the cytoplasm is divided between the two daughter cells
- in animal cells, the cell membrane pinches in at a cleavage furrow, and the cytoplasm is "pinched" apart
- in plant cells, a "cell plate" forms between the two daughter cells. This turns into a cell wall.

13. What happens in prophase and how can you recognize this stage in a diagram? During prophase:

- the nuclear membrane and nucleolus dissolve
- the long, threads of chromatin condense (wind up) to form short, thick chromosomes
- the centrioles duplicate and move to either end of the cell and start to form the spindle fibers
- you can recognize this stage because you can see individual short, thick chromosomes and the nuclear membrane is dissolving or dissolved

14. What happens in metaphase and how can you recognize this stage in a diagram?

- during metaphase, the spindle fibers attach to the chromosomes and push and pull until the chromosomes are lined up along the middle (equator) of the cell
- you can recognize this stage because the spindle fibers are present and the chromosomes are lined up along the middle of the cell

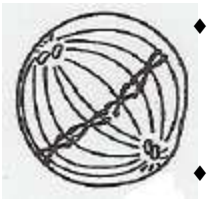
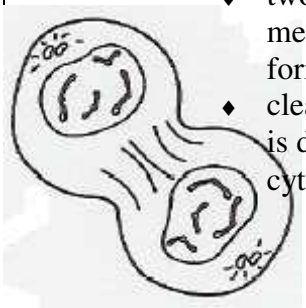
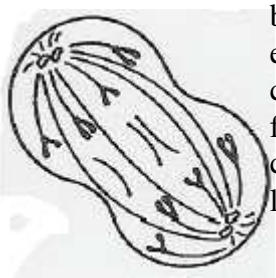
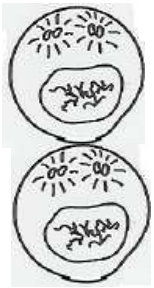
15. What happens in anaphase and how can you recognize this stage in a diagram?

- during anaphase, the spindle fibers pull the chromosomes apart and pull them to opposite ends of the cell
- you can recognize this stage because the chromosomes look like "V"s as they are being pulled apart

16. What happens in telophase and how can you recognize this stage in a diagram?

- during telophase, the nuclear membrane reforms around the chromosomes at each end of the cell to make the nucleus, then the chromosomes unwind back into chromatin
- the spindle fibers dissolve
- at the same time as telophase, cytokinesis divides the cytoplasm between the two daughter cells
- in plant cells you can recognize this stage because you can see two nuclei forming and a cell plate dividing the daughter cells
- in animal cells you can recognize this stage because you can see two nuclei forming and a cleavage furrow where the cytoplasm is being pinched in to divide the cytoplasm between the two daughter cells

17. Identify the following stages of the cell cycle. Starting with interphase (#1), write a number in the top left-hand corner of each square to indicate the order that the steps take place. Label the significant structures. How can you recognize each stage?

#3 Metaphase  • chromosomes are lined up along the equator • spindle fibers are present	#1 Interphase  • DNA is found as long thready chromatin • nuclear membrane is present	#2 Prophase (early)  • DNA is found as short, thick chromosomes • spindle fibers are forming • nuclear membrane not yet dissolving
#5 Telophase  • two nuclear membranes are forming • cleavage furrow is dividing the cytoplasm	# 4 Anaphase  • chromosomes being pulled to each end of the cell by spindle fibers and the chromosomes look like "V"s	6. Interphase  • chromosomes are dissolved back into chromatin • nuclear membranes have reformed • there are two separate cells

Cancer

1. Be able to recognize the definitions for the following terms for match-up or multiple choice questions: tumour, cancer, mutation, carcinogen, benign tumour, malignant tumour and metastasis.

2. **Are all tumours cancer? Explain why or why not.**

- No, not all tumours are cancerous
- benign tumours are often encapsulated and **do not spread** to the rest of the body, so they are not cancerous
- malignant tumours are invasive and **spread** to the rest of the body, so they are cancerous
- benign tumours can (but don't always) turn into malignant tumours

3. What is the difference between a benign and a malignant tumour?

- benign tumours are often encapsulated and do not spread to the rest of the body, so they are not cancerous. They are often smooth and spherical.
- malignant tumours are invasive and spread to the rest of the body, so they are cancerous. They are often irregularly shaped, like an ulcer or cauliflower.

4. What are three *types* of carcinogens? Give an example for each.

a) ***chemical*** carcinogens are chemicals that cause cancer, such as benzene in cigarette smoke or nitrites in processed meat (ham and other deli meats)

b) ***viral*** carcinogens are viruses that cause cancer, such as HPV (human papilloma virus that causes cervical cancer) or hepatitis C which can cause liver cancer

c) high energy ***radiation*** can also cause cancer, such as UV, X-rays and gamma rays

5. What ways can a mutation happen? Describe what happens in each.

- a mutation is any change in the order of the nitrogen bases (A, T, C and G) that takes place in a cell's DNA. Mutation can happen by:

a) deletion: when DNA is copied but a gene or part of gene is not replicated

b) insertion: when a gene or part of gene is put in the wrong place in the DNA

c) duplication: an extra copy of a gene or part of a gene is put into the DNA

d) inversion: a gene or part of a gene is put into the DNA backwards

6. Do all mutations cause cancer? Explain why or why not.

- mutations do not always cause cancer
- if a mutation is too severe, it will be lethal and kill the cell so no cancer is started
- if a mutation makes only a minor change in the DNA, it may be harmless
- if a mutation changes a gene and causes the cell to grow and divide uncontrollably, then it will cause cancer

7. What are the four stages of cancer? What happens in each stage?

Step 1: Hyperplasia

A cancer begins when a normal cell is transformed (genetically altered or mutated) into a cancer cell by a carcinogen that causes the cell to grow and divide out of control. The transformed cell grows and divides rapidly, but fairly normally (hyperplasia).

Step 2: Dysplasia (pre-cancer)

The abnormal cells divide so rapidly that they make mistakes which cause new mutations to appear. More cells divide even more abnormally (dysplasia).

Step 3: A Tumour in Situ (cancer in situ)

The abnormal cells grow and divide but stay in one place (in situ), forming a tumour

Step 4: Metastasis (Stage 4 cancer)

a) the abnormal cells start to invade the surrounding tissue and spread to other parts of the body. This is called metastasis and is full blown cancer. It is the most dangerous stage of cancer because it has spread.

8. What happens during metastasis? Why is this bad?

- during metastasis, the cancer starts to invade the surrounding tissue and spread to other parts of the body
- cancer cells can break off from the original tumour and spread to other tissues and start growing there
- at this stage, the cancer is very aggressive and secretes chemicals to make new blood vessels form so the tumour gets more than its share of blood and the nutrients it carries. People with cancer often get very skinny because the tumour is growing and depriving the rest of the body of nutrients.

9. What are six differences between healthy, normal cells and cancer cells?

Normal Cells	Cancer Cells
grow and divide under control	grow and divide uncontrollably
do not crowd too closely together	crowd very tightly together forming a dense mass of cells (a tumour)
smaller sized and have a regular, predictable shape	very large and have unusual, irregular shapes
have a single, normal sized nucleus	may have very large nuclei, or more than one nucleus that stains darkly
undergoes normal controlled mitosis with one set of spindle fibres from one pair of centrioles	undergoes very frequent and abnormal mitosis may have more than one set of chromosomes and spindle fibres
do not secrete chemicals to make new blood vessels form in the area	secrete chemicals to make new blood vessels form in the area

10. What is chemotherapy and how does it work?

- chemotherapy is the use of chemicals to treat cancer
- chemotherapy drugs act on ALL rapidly dividing cells, both cancer cells and normal body cells
- chemotherapy usually acts by interfering with some aspect of DNA replication or mitosis. It may also block the growth of new blood vessels to a tumour
- the goal of chemotherapy is kill more cancer cells than normal cells, and hopefully after treatment, the healthy cells will be able to recover

11. What is radiation therapy and how does it work?

- radiation therapy is the use of high energy radiation such as gamma rays to treat cancer
- radiation is aimed at the tumour- it is high energy and damages the DNA so it can't copy itself properly
- the radiation kills or damages all cells that are hit by it, so the goal is to try and give the cancer more radiation than the surrounding tissues to kill the cancer. Because the normal cells around the tumour get less radiation, they hopefully can recover later