

# **Grade 10 Science**

Systems of Living Things

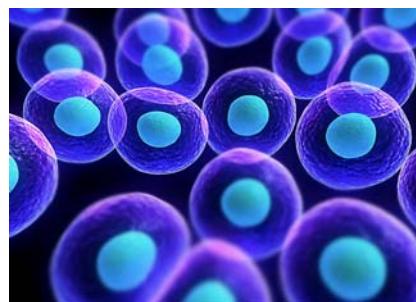
Class 4

## **Overall Expectations**

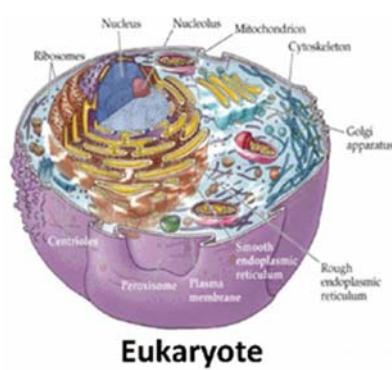
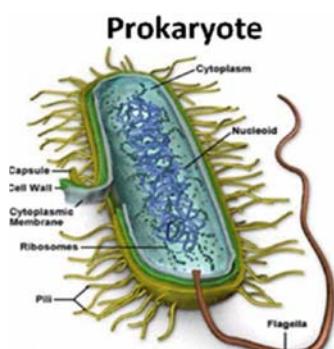
- Evaluate the importance of medical and other technological developments related to systems biology, and analyse their societal and ethical implications
- Investigate cell division, cell specialization, organs, and systems in animals and plants, using research and inquiry skills, including various laboratory techniques
- Demonstrate an understanding of the hierarchical organization of cells, from tissues, to organs, to systems in animals and plants

# The Cell Theory

1. All living things are made of one or more cells
2. The cell is the simplest unit that can carry out all life processes
3. All cells come from other cells; they do not come from non-living matter



## Prokaryotes vs. Eukaryotes

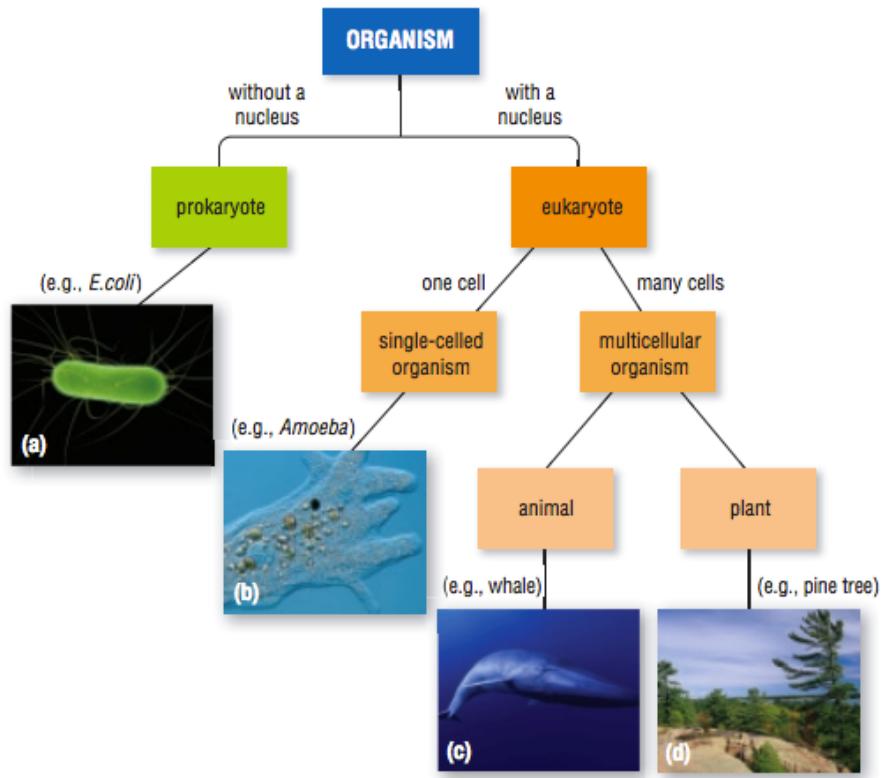


### Prokaryotes

- No nucleus
- No membrane-bound organelles
- Bacteria (*E. coli*)

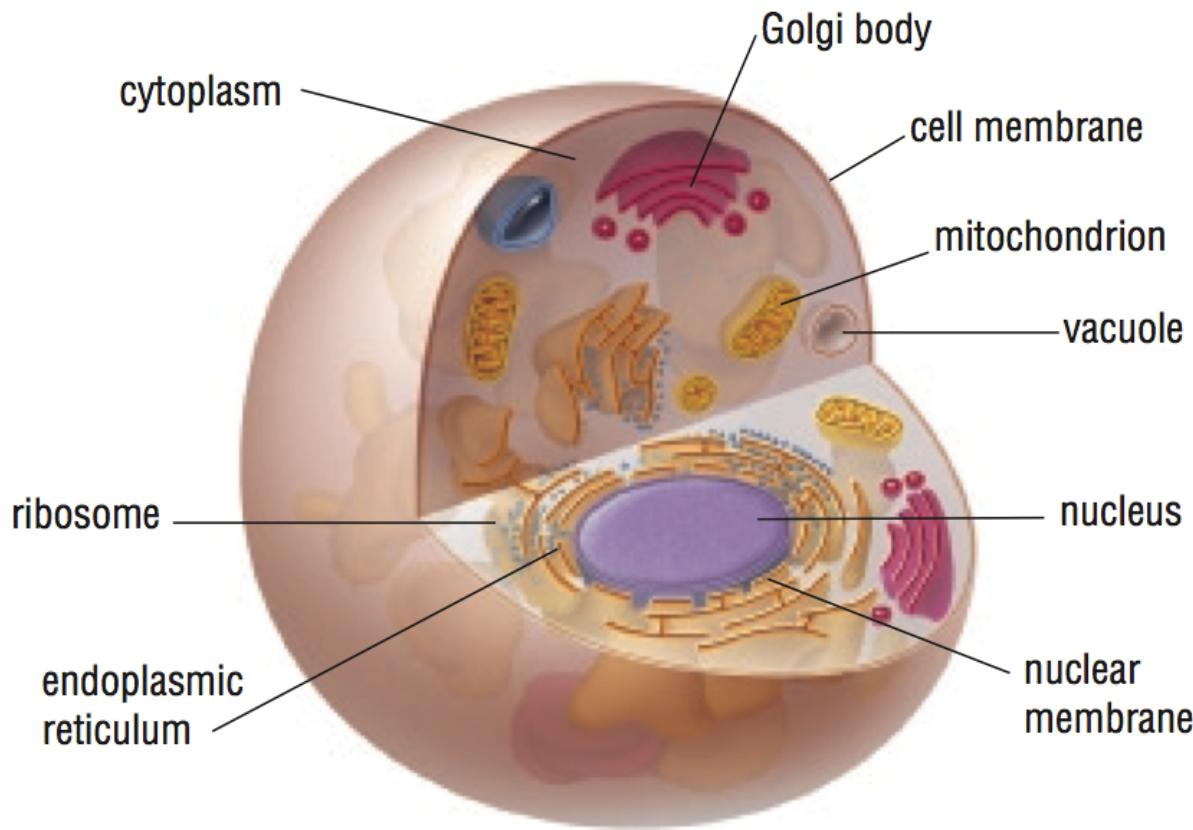
### Eukaryotes

- Nucleus
- Membrane-bound organelles
- Protists, amoeba, fungi, animal, plants



## Animal Cell

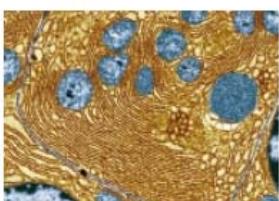
- Features:
  - **Nucleus** – stores genetic material (DNA)
  - **Nuclear membrane** – surrounds nucleus and controls what goes in and out of the nucleus
  - **Cytoplasm** – jelly-like liquid that suspends organelles; provides water and nutrients
  - **Cell membrane** – a semi-permeable double membrane to support the cell and control what goes in and out of the cell



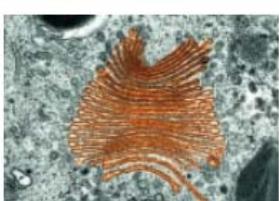
**(b) Animal cell**



**Figure 5** The mitochondrion (17 000 $\times$ ) is the large, reddish, oval structure in this TEM image.



**Figure 6** The endoplasmic reticulum (5 500 $\times$ ), coloured brown in this TEM, transports materials throughout the cell.



**Figure 7** Golgi body (30 000 $\times$ )

– **Mitochondria** – the “power house”; converts stored energy (glucose, fat) into usable energy → cellular respiration



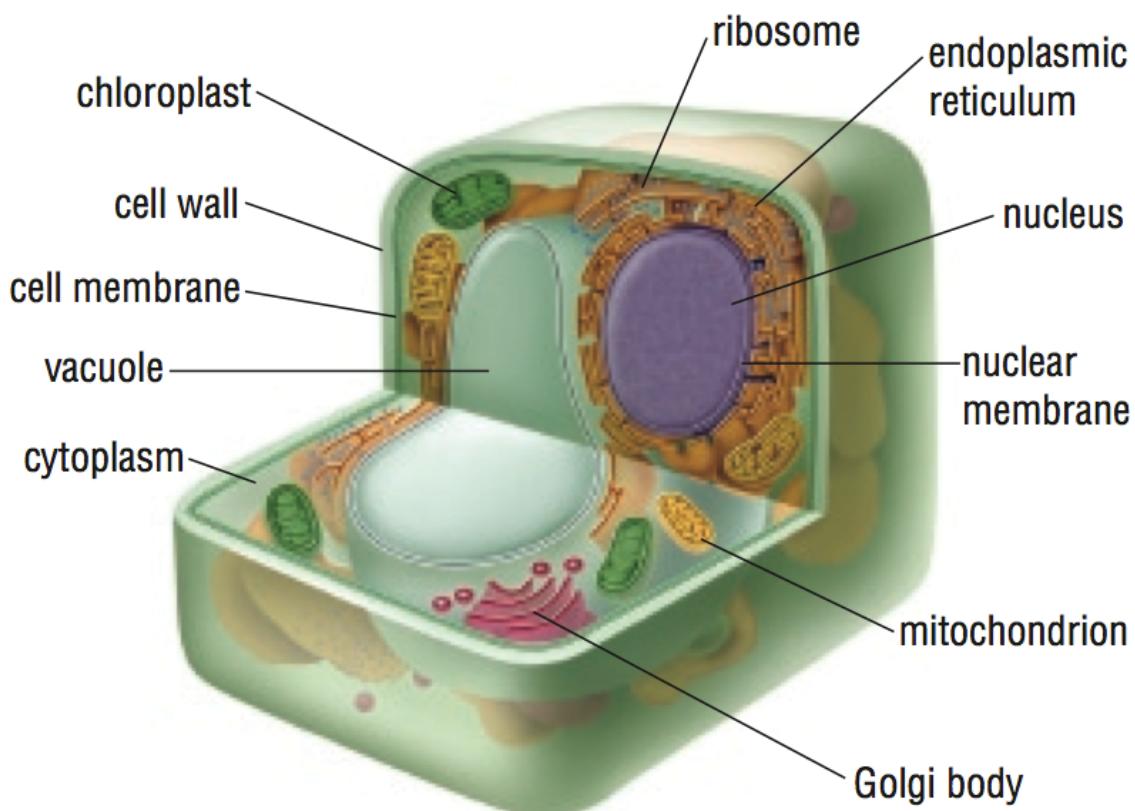
– **Endoplasmic Reticulum** – transports materials from the nucleus to the cell membrane

– **Golgi Bodies** – collect and process materials to be removed by the cell

– **Vacuoles** – bubbles that contain substances, remove substances, maintain internal pressure

# Plant Cells

- Features:
  - **Cell Wall** – found outside the cell membrane; rigid and porous structure made of cellulose
  - **Vacuole** – one large vacuole filled with water to maintain pressure inside the cell
  - **Chloroplasts** – contain chlorophyll for photosynthesis (convert CO<sub>2</sub> and water into glucose and O<sub>2</sub>)



(a) Plant cell



# Checkpoint

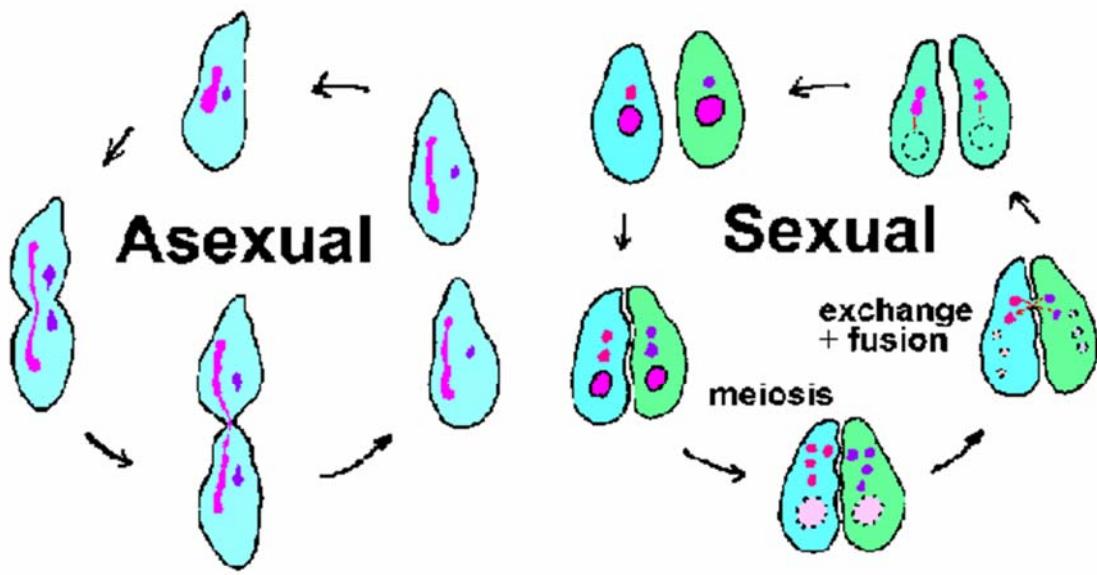


Compare the components of a cell to a factory model:

Job in the Factory	Cell Organelle
CEO	
Factory Floor	
Assembly line	
Shipping/Receiving Department	
Finishing/Packaging Department	
Support Beams (Walls, Ceilings, etc.)	
Power Plant	

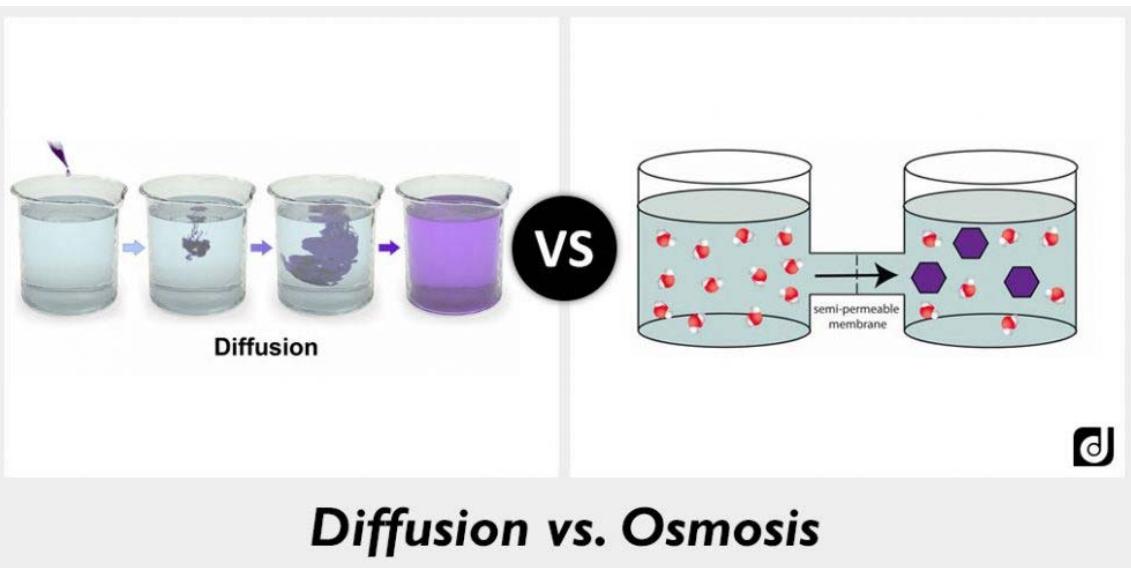
## Cell Division

- All cells must be able to reproduce:
  1. **Asexual Reproduction** – process of producing offspring from one parent; offspring are exact genetic copies (binary fission)
  2. **Sexual Reproduction** – process of producing offspring from the gametes of two parents; offspring have genetic material from both parents



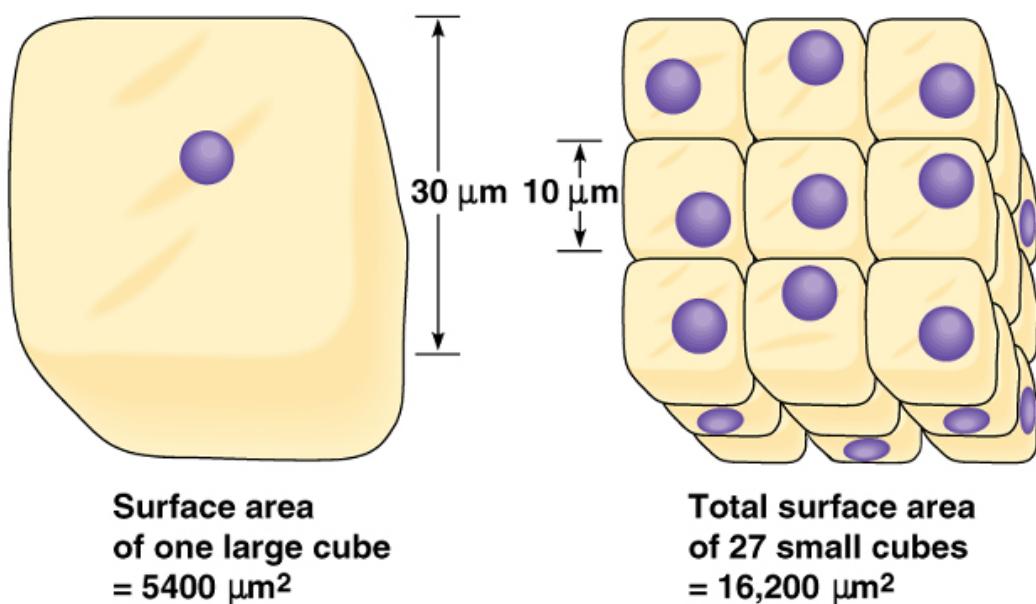
## Cell Division for Growth

- Nutrient move into the cell and waste move out of the cell by **diffusion** – movement from a high concentration to low concentration
- **Osmosis** – movement of water to an area of high solute concentration
- Cells divide to ensure enough surface area for diffusion of nutrients and wastes to occur
  - Surface area to volume ratio



## **Diffusion vs. Osmosis**

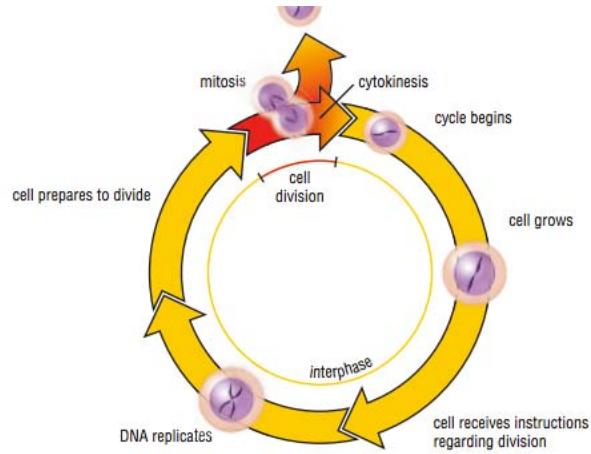
- **Diffusion** – movement of solute from high concentration solute to low solute concentration
- **Osmosis** – movement of water from high concentration of water to low concentration of water (dilute to more concentrated)



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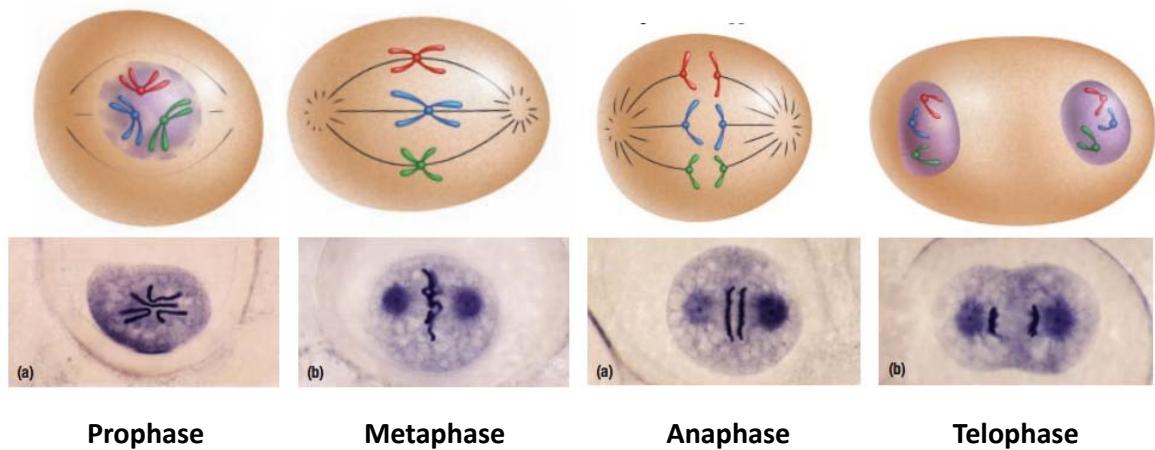
# The Cell Cycle

- Three stages:
  1. **Interphase** – cell grows and performs regular functions; genetic material is copied for cell division
  2. Mitosis
  3. Cytokinesis



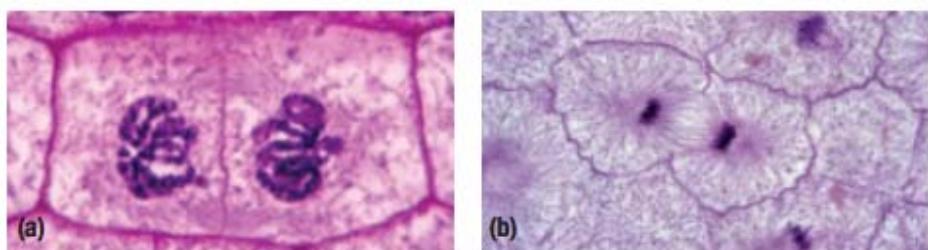
## 2. Mitosis

- Division of the contents
- Four substages: PMAT
  - **Prophase** – DNA becomes visible chromosomes; nuclear membrane dissolves
  - **Metaphase** – chromosomes line up in the middle of the cell
  - **Anaphase** – sister chromatids split at the centromere and move to opposite ends
  - **Telophase** – chromosomes unwind, nuclear membrane reforms, appearance of two nuclei



### 3. Cytokinesis

- Division of the cell
- The cytoplasm divides into two cells:
  - Plant Cells – a division plate forms a new cell wall
  - Animal Cells – cell membrane pinches off



# Cell Checkpoints

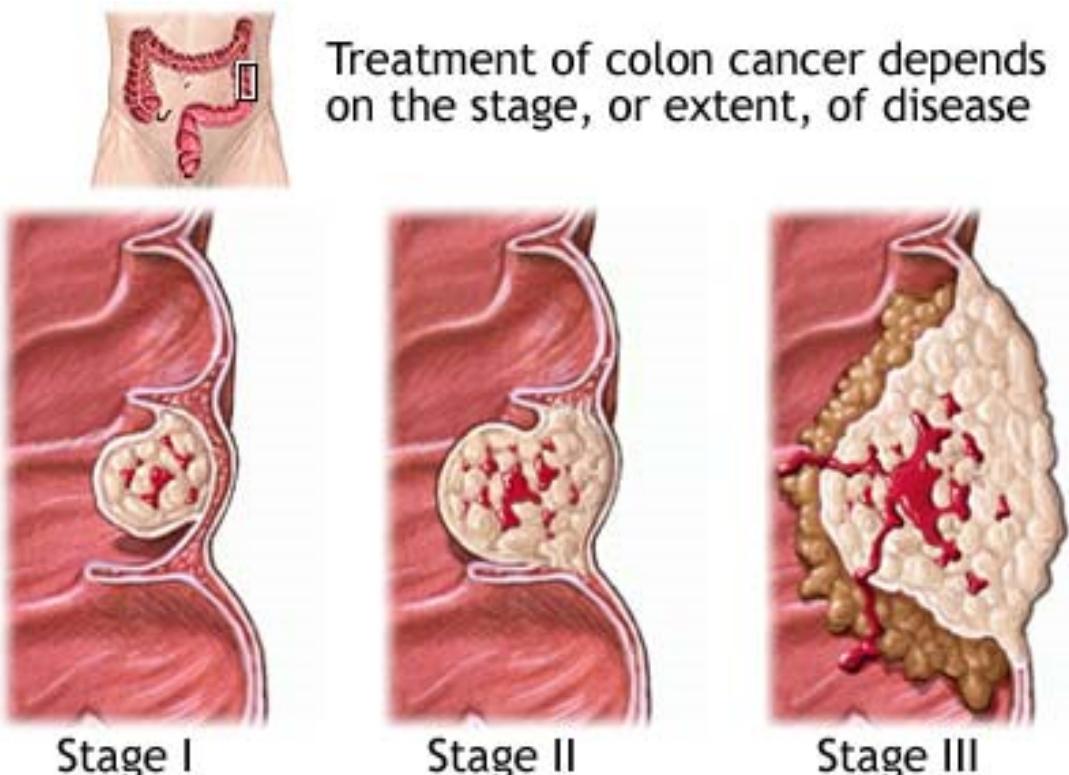
- Does it make sense to replicate a bad cell?
- A cell will not divide if:
  - Signals from surrounding cells tell the cell not to divide
  - Not enough nutrient for cell growth
  - DNA has not been replicated
  - DNA is damaged
- Too much damage to DNA, cell is destroyed

# Cancer

- Cancer cells – cells that divide and grow uncontrollably
- Causes:
  - Change in the DNA that regulates the cell cycle
  - Missing checkpoints
- Not contagious – it is hereditary or environmental
- Humans, animals and plants can have cancer

# Stages of Cancer

- **Tumour** – a growing mass of cells to form a lump
- **Benign Tumour** – a tumour that does not affect surrounding tissues except physically crowding them
- **Malignant Tumour** – a tumour that affects the functions of surrounding cells; cancerous
- **Metastasis** – malignant tumour breaks loose and spreads to other organs



# **Causes of Cancer**

- DNA mutations – random changes to the DNA that can affect cell cycle and cell division
  - Carcinogens like radiation, UV light, tobacco, smoke, viruses, and chemicals and cause mutations in the DNA
- Some cancers are hereditary (breast cancer, colon cancer)
  - You are more likely to get the cancer but it is not guaranteed

# **Treatment of Cancer**

Preventative measures:

- Early Detection
- Lifestyle changes

Treatments:

- Surgery
- Chemotherapy – using chemicals to kill the cancer cells; taken orally or injected
- Radiation – focused beam at the tumour to stop the cell from dividing