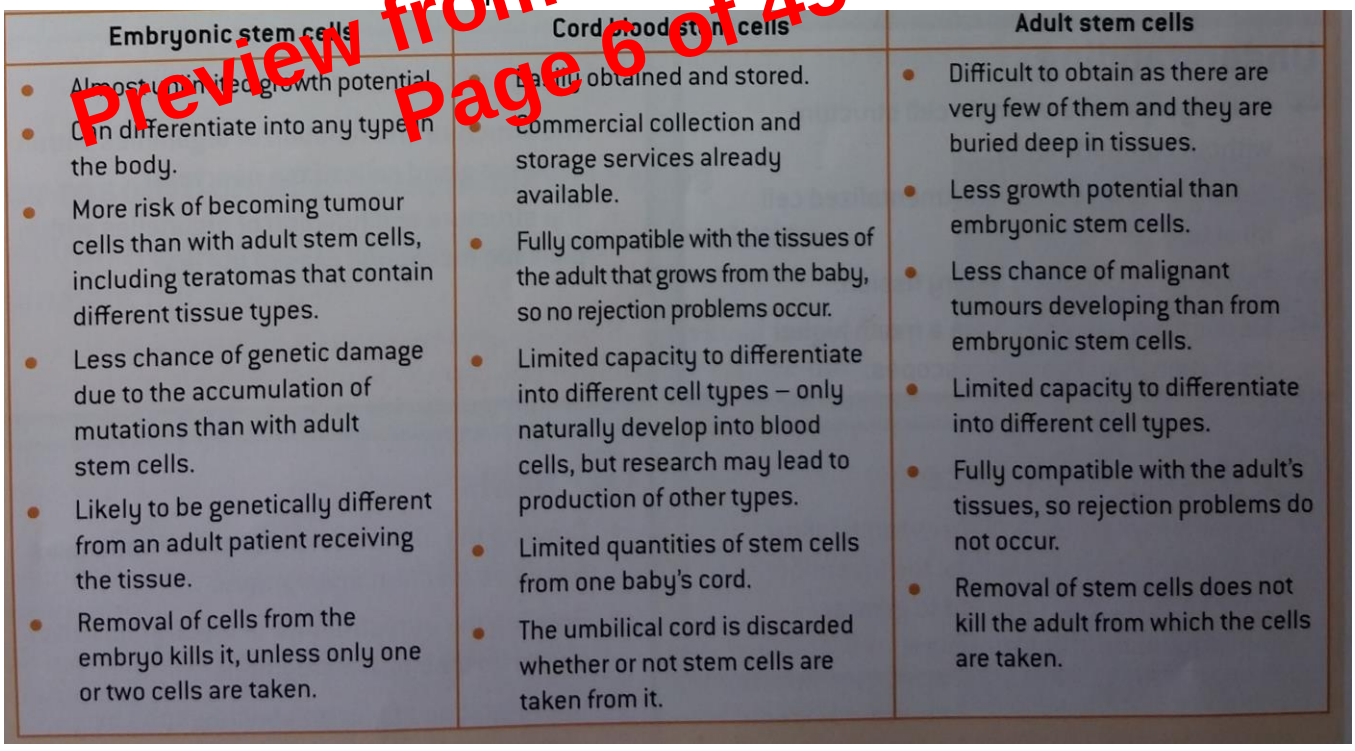
Sources of Stem Cells:

- Embryos can be deliberately created through fertilization; then allowed a little while for development so they have 14-16 cells
- Blood can be extracted and frozen from the umbilical cord; stored and use for future
- Obtained from bone marrow
- Controversial because the use of embryonic cells results in death of embryo; is an embryo is as much human as a full developed baby?
- When does life begin?
    - Some say fertilization; some say brain activities, some say outside of uterus;
- Scientists argue that if embryos are formed through **in vitro fertilization (IVF)** then they were never supposed to live; but some say that it's unethical to create life just for stem cells
- This also requires hormone treatment of women that can be risky, some women could be exploited for these purposes (college students)

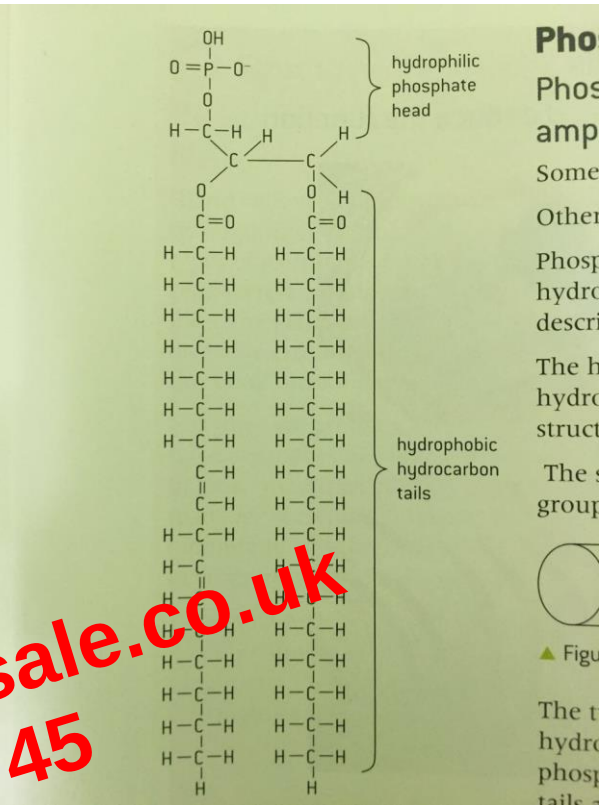
Invention of electron microscope



Embryonic stem cells	Cord blood stem cells	Adult stem cells
• Almost unlimited growth potential • Can differentiate into any type in the body. • More risk of becoming tumour cells than with adult stem cells, including teratomas that contain different tissue types. • Less chance of genetic damage due to the accumulation of mutations than with adult stem cells. • Likely to be genetically different from an adult patient receiving the tissue. • Removal of cells from the embryo kills it, unless only one or two cells are taken.	• Easily obtained and stored. • Commercial collection and storage services already available. • Fully compatible with the tissues of the adult that grows from the baby, so no rejection problems occur. • Limited capacity to differentiate into different cell types – only naturally develop into blood cells, but research may lead to production of other types. • Limited quantities of stem cells from one baby's cord. • The umbilical cord is discarded whether or not stem cells are taken from it.	• Difficult to obtain as there are very few of them and they are buried deep in tissues. • Less growth potential than embryonic stem cells. • Less chance of malignant tumours developing than from embryonic stem cells. • Limited capacity to differentiate into different cell types. • Fully compatible with the adult's tissues, so rejection problems do not occur. • Removal of stem cells does not kill the adult from which the cells are taken.

- Second half 19th century, improved light microscopes led to discovery of bacteria and other unicellular organisms

- Substances attracted to water-**hydrophilic**
- Substances not attracted to water- **hydrophobic**
- Phospholipids are unusual because part of them is hydrophilic and the other part is hydrophobic
    - The hydrophilic part is the phosphate group
    - Hydrophobic part has two hydrocarbon chains
- Simple Rep. of Structure can be done by using a circle for the phosphate group and two lines for the hydrocarbon chains
- 2 parts of the structure are called phosphate heads and 4 tails
- When mixed with water they form a double structure with the heads



Vesicle- small sac of membrane with droplet of fluid inside; spherical and present in eukaryotes

- Very dynamic; they are constructed, moved, then deconstructed
- Happens because of fluidity of membranes allowing room for shape change and movement

To form a vesicle, small region of membrane is pulled and pinced off from membrane; proteins in the membrane carry out this process using ATP

Vesicle is then formed inside the cell; contains stuff from outside of the cell; it is a method of in-taking material and is called endocytosis

These vesicles generally contains water and solutes from outside the cell but also contain larger molecules needed that can't pass through the membrane

- Eg: in the placenta, proteins including antibodies are taken in through endocytosis
- Some cells take undigested food particles through endocytosis
  - Eg: Amoebas and Paramecium use this method
- White blood cells take in pathogens through endocytosis and kill them

Vesicles move materials within cells

Sometimes it is the contents of the vesicles that need to be moved

- Eg: Secretory cells; proteins is synthesized from ribosomes and is collected in the rER
- The vesicles containing the protein bud off and take it to the GA, where they fuse to allow for the protein to be processed
- Then the vesicles take the processed proteins to the membrane for secretion

Other times it is proteins in the membrane of the vesicle that cause vesicle movement

- When a cell grows, it requires an increase in the size of the membrane
- Phospholipids are synthesized in the rER and the the proteins for the future membrane are made using the rER ribosomes

Origin of Eukaryotes

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Tissues or organs to be used in medical procedures must be bathed in a solution with the same osmolarity as the cytoplasm to prevent osmosis

- Animal cells can be damaged if osmosis occurs
- When a hypertonic solution is near a cell, then the area of the cytoplasm shrinks
- the plasma membrane's area doesn't change, it just develops indentations which are also called crenellations
- in a hypotonic solution, the cells can swell and then burst which can leave behind ghost cells (ruptured membranes)
- Both types of solutions can harm human cells, but in an isotonic solution, water molecules move in and out at the same rate, so they remain healthy
- In medical processes, organs are bathed in isotonic solutions
- Usually, isotonic sodium chloride is used aka normal saline: has an osmolarity of about 300mOsm (milliOsomles)
- Uses of normal saline
    - Can be introduced into system using IV drip
    - Can be used for cleaning wounds and skin abrasions
    - Can be used to keep area of damaged skin moist and prevent skin grafts
    - Used as a basis for eye drops
    - Can be frozen to pack donor organs

Cyanobacteria

- Type of prokaryote with a lot of in folding membrane
- Can perform photosynthesis and releases oxygen into air

Oxygen Atmosphere

- Oxygen began to accumulate 2.7 bya
- Evidence found through banded iron in rocks (rusting)
- Made aerobic respiration possible

Eukaryotes

- Depend on free oxygen to carry out metabolic processes
- Couldn't have evolved before oxygen atmosphere

The Role of Mitosis and Interphase and Chromosome Supercoiling

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The theory of endosymbiosis can be used to explain the evolution of eukaryotic cells

Says that mitochondria were once free living prokaryotic organisms that had developed aerobic cell respiration

Larger prokaryotes that could only respire anaerobically took in the mitochondria through endocytosis

Instead of killing and digesting, they let them live in the cytoplasm

As long as the smaller prokaryote could grow and divide as fast as the large one it could persist; and the theory states that they evolved into the mitochondria inside the eukaryotic cells

The two cells in the theory were in a symbiotic relationship where both benefitted, this is called a mutualistic relationship

- Small cell gets food from big cell and allow for aerobic respiration in return
- Natural selection favored cells that developed this relationship

The theory also explains chloroplasts; just substitute a smaller prokaryote developing photosynthesis in for the smaller prokaryote developing aerobic respiration

Although incapable of doing so anymore, there is proof of how they could've been independent before

- They have their own genes on a circular DNA molecule just like prokaryotes
- They have their own 70S ribosomes
- They transcribe their DNA and use the mRNA to synthesize some of their own proteins
- Can only be produced by division of preexisting mitochondria and chloroplasts

Cytokinesis

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Occurs after mitosis and is different in plant and animal cells

- Cells can divide once two identical nuclei are present
- In Animal cells
  - Membrane is pulled inwards around equator of cell to form a cleavage furrow
  - Accomplished using a ring of contractile protein (actin and myosin) inside the membrane at the equator; the proteins are very similar to the ones in muscle
  - When cleavage furrow reaches center, cell is pinced apart

- In Plant cells
  - Vesicles are moved to the equator where they fuse to form tubular structures along the equator
  - With more vesicles fusing, these structures merge to form two layers of membrane across the entire equator
    - They form the plasma membrane of the daughter cells and are still connected to the existing plasma membrane at the sides of the cells
    - Then pectins and other substances are brought in vesicles and deposited by exocytosis between the two membranes
    - The forms the middle lamella which will link new cell walls
    - Both cells then bring cellulose and deposit it (using exocytosis) adjacent to the lamella to form cell walls adjacent to the equator

cause tumors ; there is also evidence that at least 40 other chemicals are carcinogenic

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Two processes though to have led to eukaryotes

- Infolding of prokaryotic cell membrane
    - Created internal microenvironments
    - Led to efficiency
- Endosymbiosis- symbiotic relationship while one lives inside another
    - Early prokaryotes engulfed aerobic bacteria but didn't digest/ photosynthetic bacteria
    - Led to creation or evolving to mitochondria/chloroplasts; mutually beneficial relationship
    - Evidence found in both mitochondria and chloroplasts
        - Have bacterial structure
        - Have cell membranes
        - Same size as prokaryotes
        - Have 70S ribosomes
        - Have circular DNA
        - DNA shares same common sequences with modern prokaryotes
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