Cell Biology

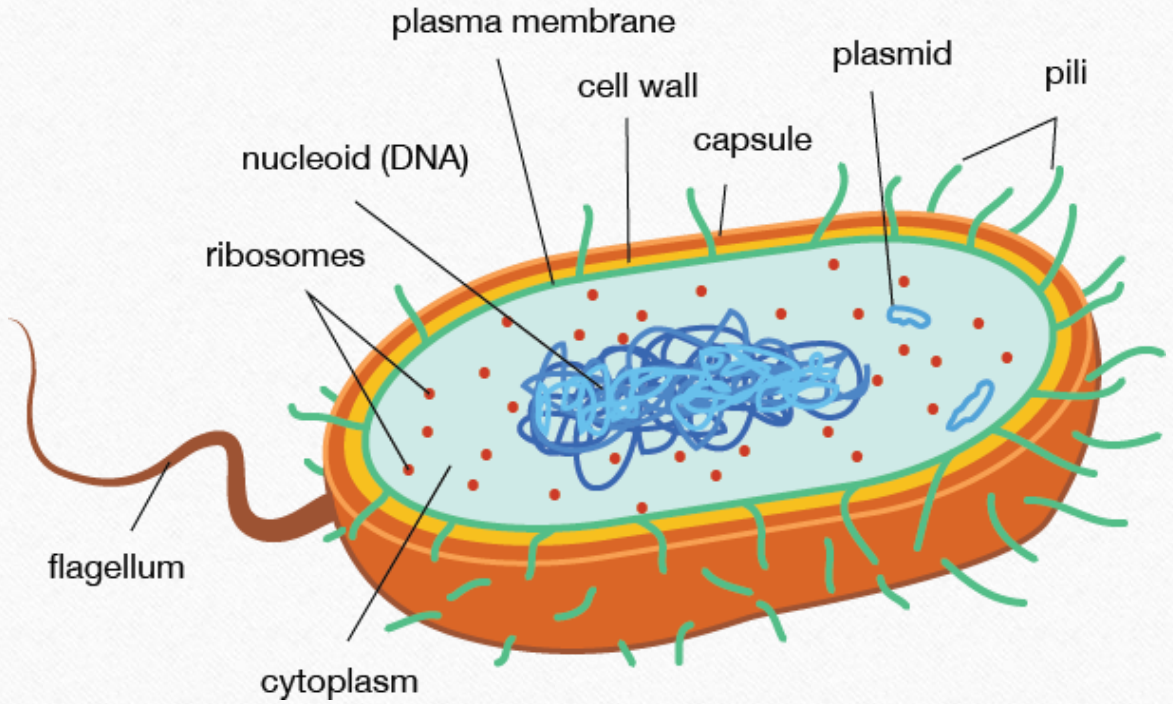
By Lauren Somers

Stem cells

- Therapeutic use of stem cells 2
- Recent stem cell research has been into the treatment of Stargardt's disease using retinal pigment epithelium (RPE). Stargardt's disease is an inherited condition which begins in childhood and leads to macular degeneration and eventually causes blindness. Retinal cells can be made from embryonic stem cells. In 2012 the first patients were given transplants of retinal cells injected into their retina. Not only did the cells survive but the number of cells increased, they began to develop important visual pigment and the patients noticed improvement in their vision.
- Scientists hope that in the future this treatment will restore sight not only to those with Stargardt's disease, but also older people suffering from macular related eye degeneration.

Ultrastructure of cells

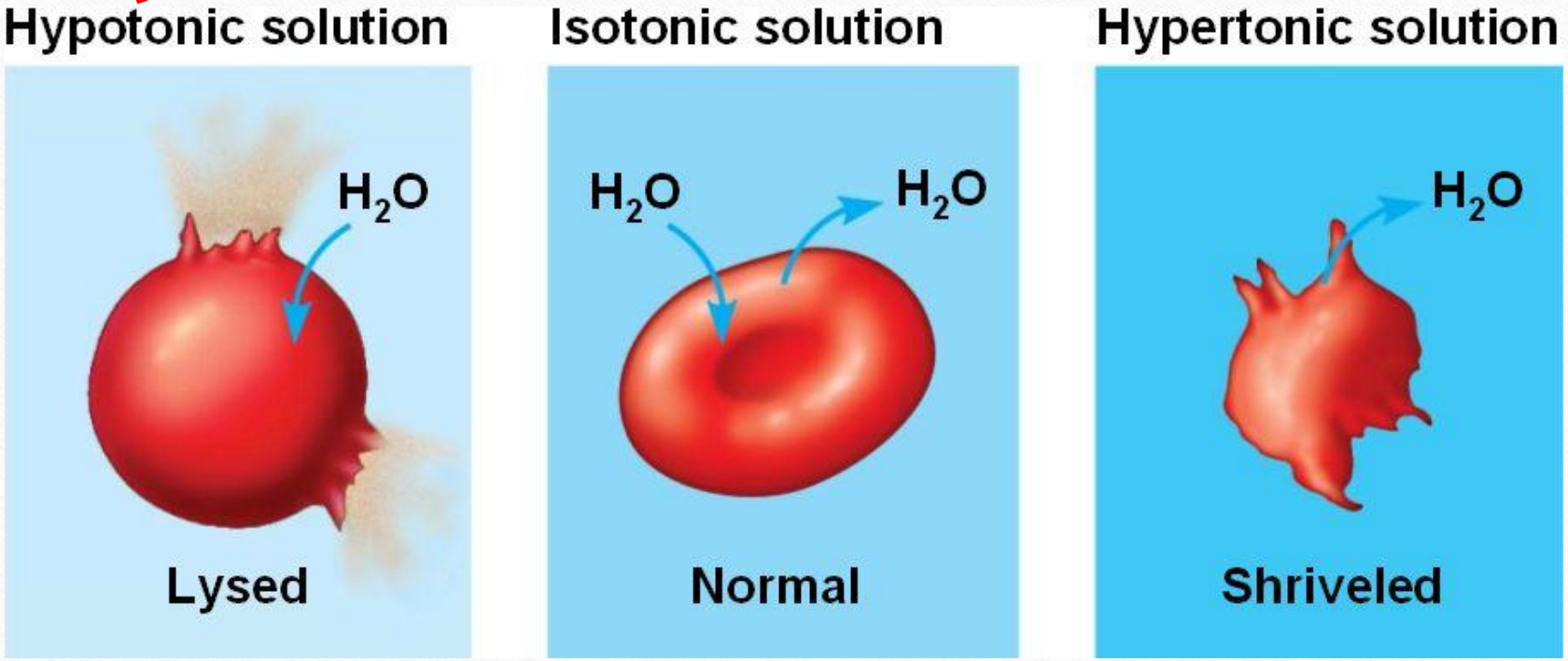
Prokaryotic cell diagram



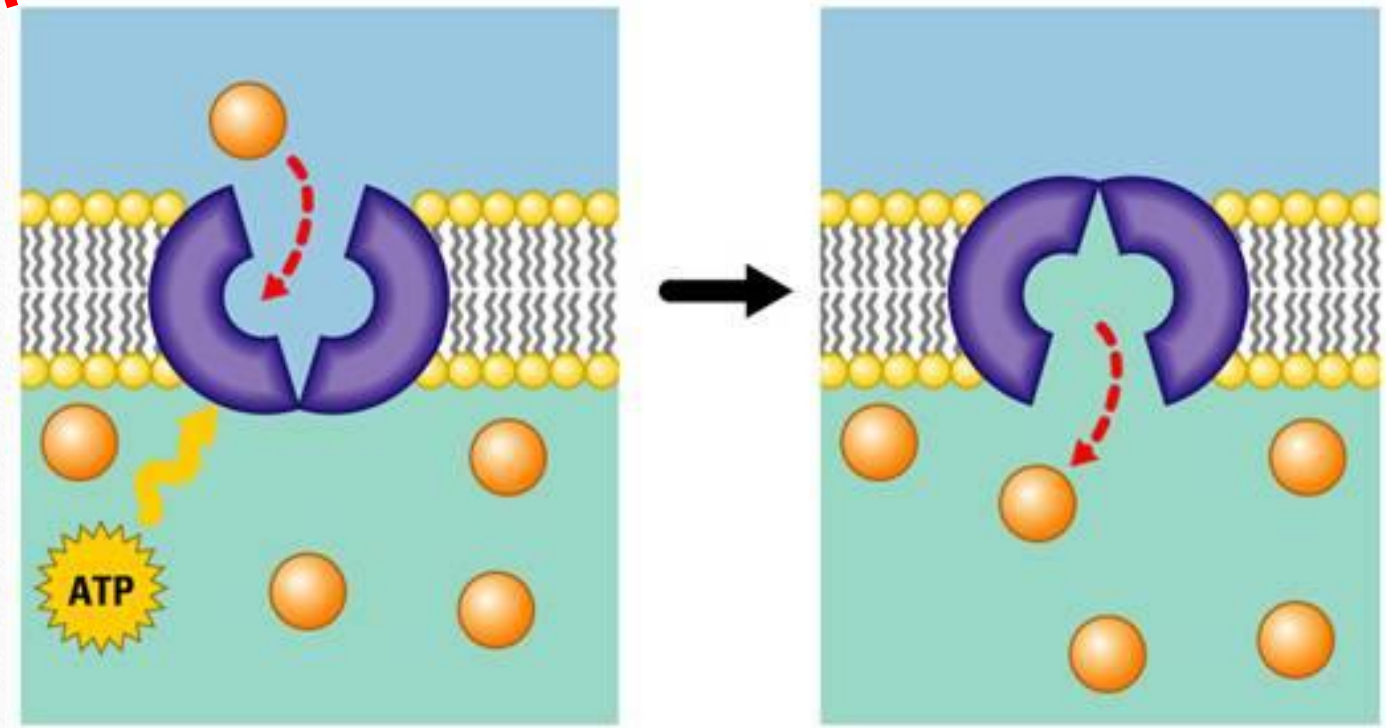
Eukaryotic cells

- Eukaryotic organisms have cells that contain a nucleus.
- The complexity of a eukaryotic cell cannot be fully appreciated with a light microscope but with electron microscopes, fine details of many different organelles and cell structures are visible.
- Eukaryotic cells contain structures called organelles each of which forms a compartment where a specific function takes place (compartmentalisation).

Osmosis on animal cells



Active transport diagram



The origin of cells

How did the first cells originate?

The endosymbiotic theory

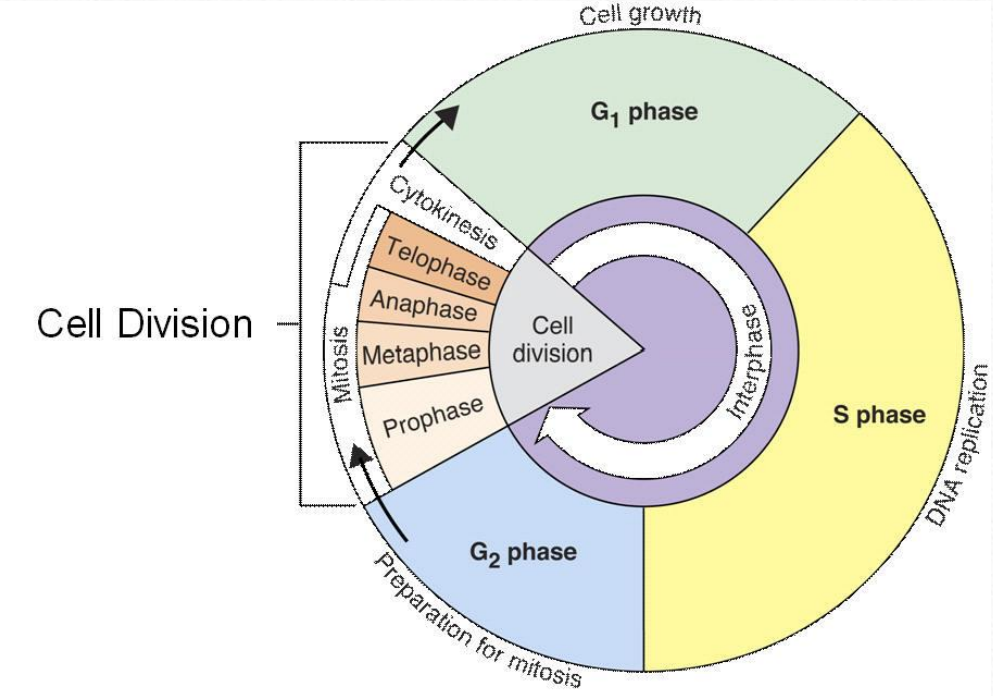
- This explains how eukaryotes could have developed from simple cells. It suggests that some organelles found inside eukaryotes were once free-living prokaryotes. There is evidence to suggest that some prokaryotes were engulfed by other cells, and remained within their membranes inside the cell where they provided some advantages.
- Evidence for this includes the fact that two very important organelles, mitochondria and chloroplasts share many characteristics with prokaryotic cells. They both:
  - Contain ribosomes smaller than those found in eukaryotes but the same size as those found in bacteria
  - Contain small, circular pieces of DNA resembling plasmids
  - Have their own envelope surrounding them on the inner membrane made of proteins synthesised by the organelle, suggesting that it may have used this ability when it was independent.
  - Can replicate themselves by binary fission

How did cells originate?

The endosymbiotic theory cont.

- This supports the theory that some organelles are modified bacteria that were engulfed by phagocytosis, early in the evolution of eukaryotic cells. They then became useful. The double outer envelope of chloroplasts and bacteria may have originated from the bacteria membrane and the membrane of an engulfing vesicle.
- Critics argue that even if they were engulfed by larger cells, there is no guarantee that they would be passed on to both daughter cells when the cell divides, but, when a cell divides, each of its daughter cells takes some of its cytoplasm, so at least one would take the chloroplast or mitochondria on and, due to binary fission, they can increase their numbers in the cell, making this more likely.
- Critics also note that mitochondria and chloroplasts cannot survive independently outside the cell, which they make be expected to do if they were once independent, but some argue that they have simply lost this ability over time.

The cell cycle diagram



Cyclins

- G1 cyclin levels gradually rise and fall throughout the cell cycle, influenced by cell growth and growth regulating signals from outside the cell. G1 cyclins coordinate cell growth and the start of a new cell cycle.
- G1/S cyclins start the initial processes of DNA replication and promote centrosome duplication in vertebrates
- S cyclins induce DNA replication. The levels of S cyclins remain high throughout S phase, G2 and the first part of mitosis to promote early events.
- M cyclin influences the formation of mitotic spindles and alignment of sister chromatids along them.