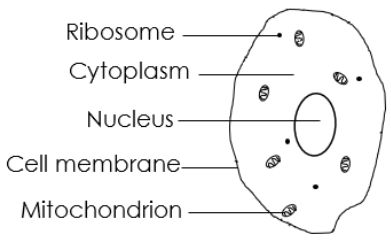
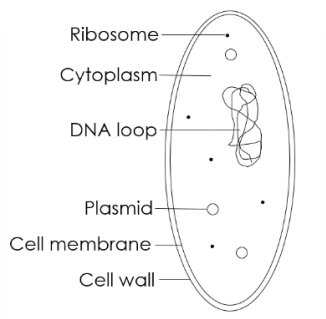
Eukaryotes and prokaryotes

1. **Eukaryotic cells** have membrane-bound organelles and have genetic material contained in the nucleus
2. An **organelle** is a part of a cell that carries out a specific function
3. Plant and animal cells are examples of **eukaryotic cells**
4. Eukaryotic cells are typically between **10-100 µm** in size
5. All eukaryotic cells have a nucleus, mitochondria, ribosomes, cytoplasm and a cell membrane. Plant cells also have a cell wall, vacuole and chloroplasts
6. **Mitochondria** are the site of aerobic respiration which releases energy for cellular processes
7. **Ribosomes** are the site of protein synthesis

8. **Prokaryotic cells** do not contain membrane-bound organelles
9. Prokaryotic cells are approximately 10 orders of magnitude smaller than eukaryotic cells
10. Prokaryotic cells contain genetic material in small rings called **plasmids**, or in larger loops
11. Prokaryotic ribosomes are smaller than eukaryotic ribosomes





Growing microorganisms

12. Petri dishes are used to produce **cultures** of bacteria and other micro-organisms
13. Cultured bacteria are grown on a **nutrient medium** in controlled conditions
14. **Aseptic techniques** must be used to prepare cultures to prevent contamination of the culture and the growth of harmful bacteria
15. Petri dishes, inoculating loops and culture media must be sterilised before use. A flame can be used to sterilise equipment
16. An **inoculating loop** is a piece of equipment used to transfer bacteria to the petri dish
17. The lid of a Petri dish should be partially secured with tape to ensure bacteria cannot escape but conditions remain aerobic
18. The Petri dish must be stored upside down to prevent condensation affecting bacterial growth
19. In school laboratories, cultures should generally be incubated at **25 °C** to prevent the growth of harmful bacteria
20. A cotton wool swab can be used to transfer a sample to a Petri dish to investigate bacterial growth
21. Bacteria on a Petri dish divide rapidly whilst the nutrient supply is rich. Every time the bacteria reproduce, the number doubles. The total number of bacteria can be calculated using the following formula:
    Final number of bacteria = Initial number of bacteria x 2 $^{\text{number of divisions}}$

Microscopy

22. **Microscopy** is the field of using microscopes to view samples that cannot be seen with the naked eye
23. **Light microscopes** allow us to see the largest organelles, including the nucleus, cell membrane, cell wall

and cytoplasm. A **stain** is often used to make the organelles clearer

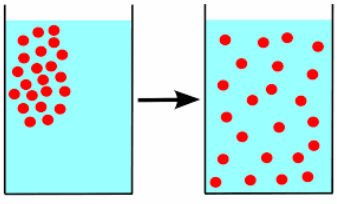
24. The parts of a light microscope include the eyepiece lens, objective lenses, stage, coarse focusing wheel, fine focusing wheel, light/mirror
25. A sample used with a light microscope must be very thin to allow light to pass through
26. The total magnification of a microscope can be calculated using the following equation: **Total magnification = Objective lens x eyepiece lens**
27. **Electron microscopes** have a greater magnification and resolution than light microscopes. They are much more expensive than light microscopes
28. **Magnification** is the number of times larger an image is than the object
29. **Resolution** is the ability to distinguish between two points
30. Electron microscopes allow are to see more organelles and study cells in greater detail
31. **Magnification** can be calculated using the following equation:

$$\text{Magnification} = \frac{\text{Size of image}}{\text{Actual size of object}}$$

32. A **scale bar** can be used to calculate the magnification of an irregular object
33. Magnification does not have a unit because it is a ratio

Transport of substances

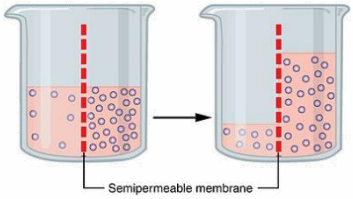
34. **Diffusion** is the spreading out of particles, of a gas or liquid, resulting in net movement from an area of high concentration to low concentration



35. In gas exchange, oxygen and carbon dioxide diffuse between the alveoli and the blood
36. The **rate of diffusion** is increased by:
- an increase in temperature
- an increase in the difference in concentrations (**concentration gradient**)
- a greater surface area

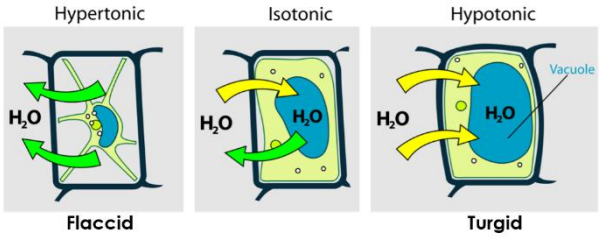
37. **Unicellular organisms** have a relatively high **surface area to volume ratio** allowing for sufficient transport of all required substances
38. Large, **multicellular organisms** have adaptations to increases the surface area to volume ratio to allow for efficient exchange of substances

39. **Osmosis** is the diffusion of water from a **dilute solution** to a **concentrated solution** through a **partially permeable membrane**



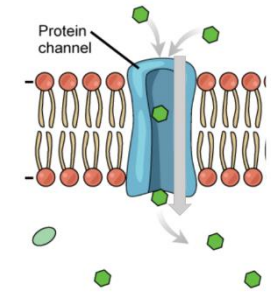
40. A **partially permeable membrane** is a membrane that lets particular substances pass through it, either into or out of the cell
41. A **hypertonic solution** is one in which the external solution has a higher concentration of solute than the cell. Water always moves out of a cell that is placed in a hypertonic solution, causing the cell to shrivel or become **flaccid**
42. Tissue placed in hypertonic solutions decreases in mass
43. A **hypotonic solution** is one in which the external solution has a lower concentration of solute than the cell. Water always moves into a cell that is placed in a hypotonic solution, causing the cell to swell or become **turgid**
44. Tissue placed in hypotonic solutions increases in mass

45. An **isotonic solution** is one in which the external solution has the same concentration of solute as the cell. Water will not move in or out of cells placed in an isotonic solution so their size will stay constant



46. **Guard cells** open and close due to the movement of water by osmosis
47. The mass of plant tissue can be measured before and after being placed in a solution of known concentration to calculate the **percentage change** in mass due to osmosis

48. **Active transport** moves substances from a more dilute solution to a more concentrated solution, requiring energy from respiration
49. Active transport works **against the concentration gradient**
50. Active transport is used in root hair cells to absorb mineral ions from the soil that are essential for plant growth



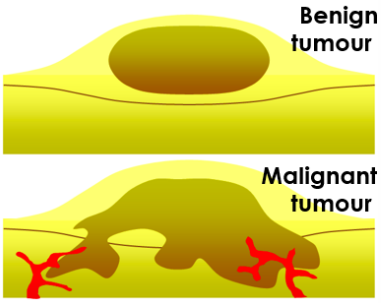
Cell division and differentiation

51. Both eukaryotic and prokaryotic cells undergo **cell division**
52. Cells increase in number by dividing into two
53. The **eukaryotic cell cycle** contains a **growth phase** where the cell grows to double sub-cellular structures (such ribosomes and cell membrane) and DNA, then the cell splits into two during **mitosis**
54. The length of time in a certain stage of the cell cycle can be calculated using the following formula:

$$\frac{\text{observed number of cells initial stage}}{\text{total number of cells observed}} \times \text{total length of time of cell cycle}$$

55. The mass of **DNA** in a cell doubles during the growth phase of the cell cycle
56. During **mitosis** DNA (arranged into chromosomes) is pulled to separate ends of the cell ready for division
57. The final part of the cell cycle is when the cell membrane splits to produce two identical **daughter cells**
58. Mitosis is used by eukaryotic organisms for growth and repair and by those that reproduce asexually
59. Mitosis does not occur in prokaryotic cells because they do not possess a nucleus

60. **Checkpoints** in the cell cycle control the rate of cell division
61. **Cancer** is caused by uncontrolled cell division
62. A **tumour** is a mass of cells caused by **uncontrolled cell division**
63. **Benign tumours** are a mass of cells contained in one area
64. **Malignant tumours** are formed of cancer cells that invade other tissues and spread around the body where they form secondary tumours



65. A **risk factor** is a gene or lifestyle choice that can increase the likelihood of a person developing a disease
66. **Lifestyle risk factors** for cancer include poor diet, lack of exercise, smoking, UV exposure
67. **Genetic risk factors** for cancer include gene mutations

68. Specialised cells arise from **stem cells**
69. Stem cells are cells that are capable of **differentiating** into other types of cell
70. When a cell differentiates, it acquires specific structures needed for that cell type
71. Most animal cells differentiate at an early stage of development
72. **Embryonic stem cells** can differentiate into all human cell types
73. **Adult bone marrow** contains stem cells that can differentiate into different types of blood cell
74. Embryonic stem cells can be used to study and treat diseases. There are **religious and ethical objections** to using embryonic stem cells in scientific research
75. Plants contain **meristem tissue** at the tips of shoots and roots that retains the ability to differentiate throughout a plant's life