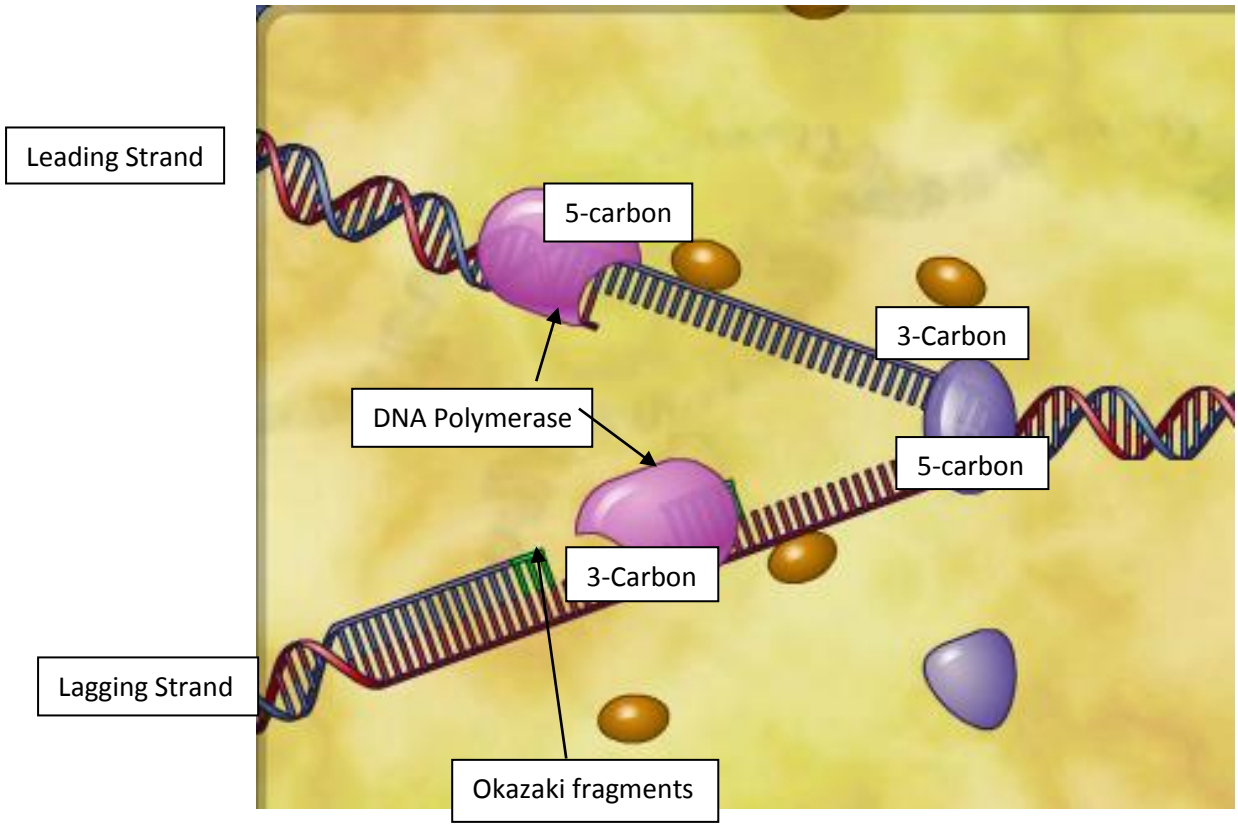
DNA Replication

- DNA strands separate and the nucleotides in the cells come in and join the nitrogenous bases
- Enzyme Helicase "unzips the DNA" ready for replication
- Enzyme Primase adds an RNA Primer which begins the replication process
- DNA polymerase then adds the DNA nucleotides **from the 5-carbon side to the 3-carbon side!**
- **CAN ONLY ADD NUCLEOTIDES FROM THE 5-CARBON SIDE TOWARDS THE 3-CARBON SIDE** therefore, there is a lagging and leading strand…

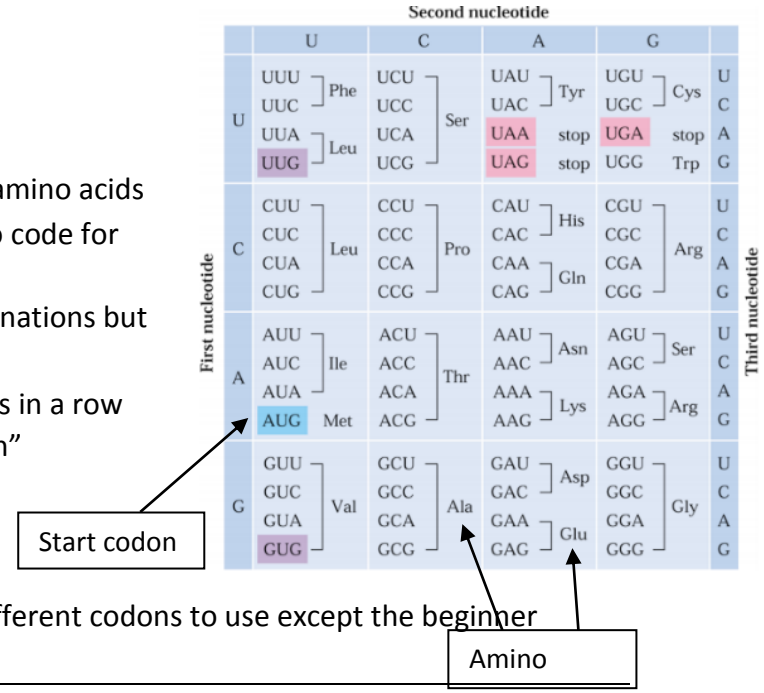
Leading and Lagging Strands



- The leading strand can code continuously from 5-carbon to 3-carbon
- The lagging strand can only code from 5-carbon to the 3-carbon so it must reset itself to allow for this
    - RNA primer is added before the DNA polymerase adds the nucleotides to form the DNA
    - This leads to Okazaki fragments which are these separately created fragments
    - Exonuclease then comes in and removes the RNA

DNA to protein

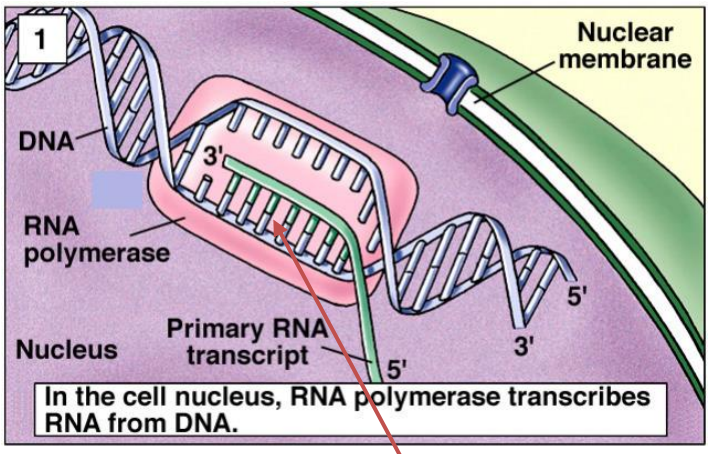
- DNA > mRNA > Protein
- DNA needs to cover for 20 different amino acids
- Only three nucleotides are needed to code for one amino acid.
    - It can actually make 64 combinations but we only need 20
- A **codon** is the name for 3 nucleotides in a row
    - AUG codon is the "start codon"
    - "stop codon" is the termination codon
- As seen to the in the above diagram, most amino acids have 2 different codons to use except the beginner codon (AUG) which has just one



Transcription

- Transcription is the formation of messenger RNA from DNA
- <u>RNA</u>
    - Exists as a **single strand**
    - RNA has a Uracil (U) instead of Thymine (T)
    - RNA has an extra hydroxyl group that DNA does not have

- <u>Steps of **Transcription**</u>:
    - First the RNA polymerase opens up the DNA double helix
    - RNA reads the DNA strand **from Carbon-5 to Carbon-3**
    - Adds nucleotides (A,G,C and **U**) to the **Carbon-3 end**
    - When RNA reaches the termination code it breaks free from the template and the RNA disassociates itself
    - Exons are then removed from the RNA and put together to form **mRNA**
        - Done through "**splicing"** where the introns are cut by spliceosomes and removed in loops from the RNA transcript leaving the valuable exons

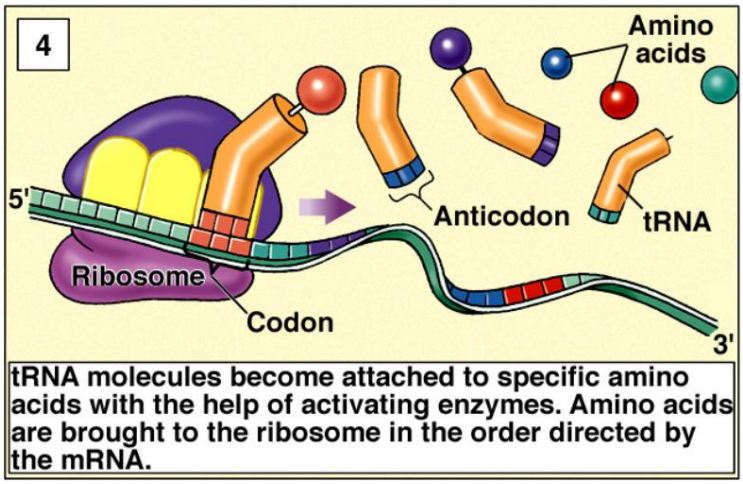


RNA codes from the 3-carbon side towards the 5-carbon

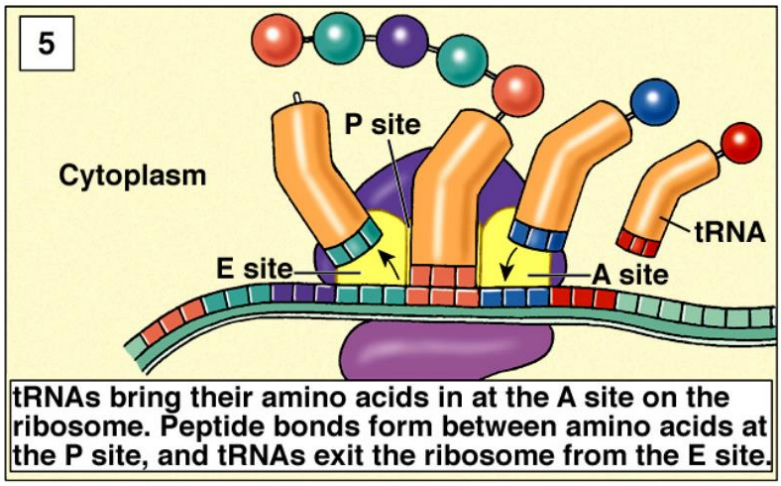
Translation

- Translation is the process in which cellular ribosomes create proteins from information provided by the mRNA
- <u>Process:</u>
  - mRNA is transported out of the nucleus
  - In the cytoplasm, ribosomal units bind to the mRNA
  - tRNA attaches to specific amino acids with the help of enzymes
  - mRNA information is used by the ribosome to correctly order the tRNA
  - Peptide bonds form between the amino acids and detach while the tRNA leaves the ribosome

- **Ribosome** has two sites
  - "A" is the entry point
  - "E" is the exit point
  - Stops when it cannot create an amino acid for a codon ("stop codon")



tRNA molecules become attached to specific amino acids with the help of activating enzymes. Amino acids are brought to the ribosome in the order directed by the mRNA.



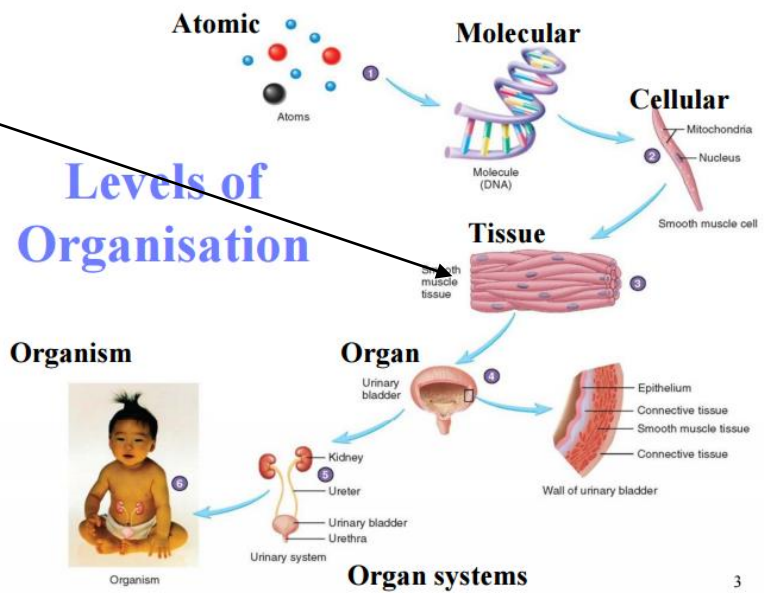
tRNAs bring their amino acids in at the A site on the ribosome. Peptide bonds form between amino acids at the P site, and tRNAs exit the ribosome from the E site.

The codon is found on the mRNA while the **anticodon is found on the tRNA**. They are **complimentary.**

Cell structure and function

Types of tissue:

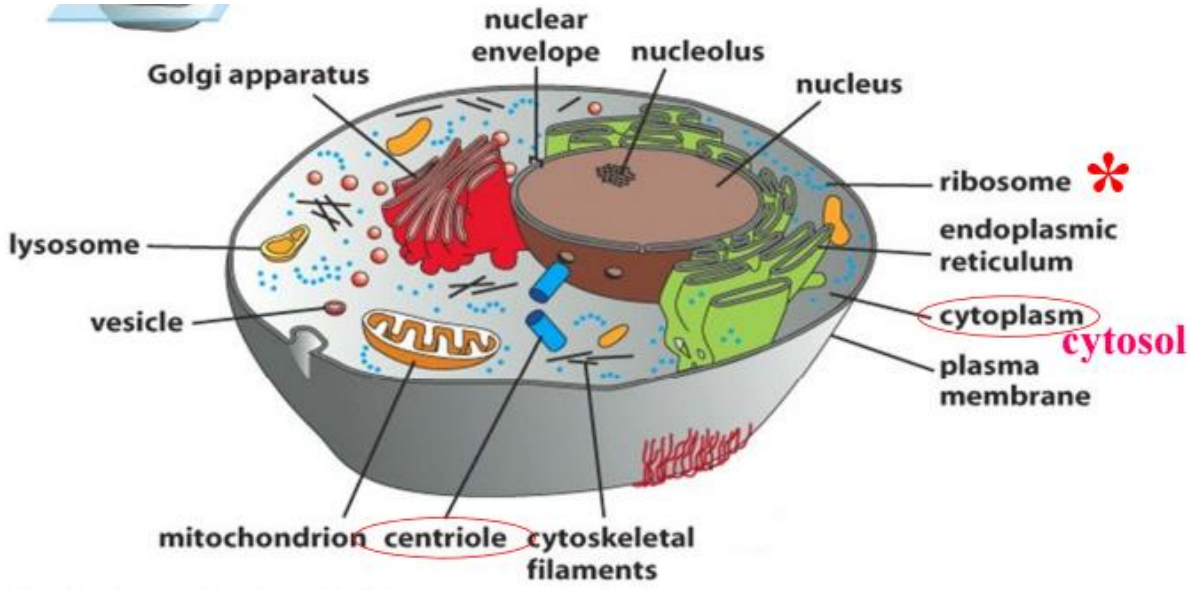
- Connective Tissue
- Muscle Tissue
- Epithelium Tissue
- Nerve Tissue (Nerve tissue is found in the cells and does not form discrete layers)



Organelles in the cells are specialized structures that perform specific functions (nucleus, mitochondria,…)

In a cell, the living tissue that surrounds the nucleus is known as cytoplasm and it contains many different organelles.

Structure of animal cells (eukaryotic cells):



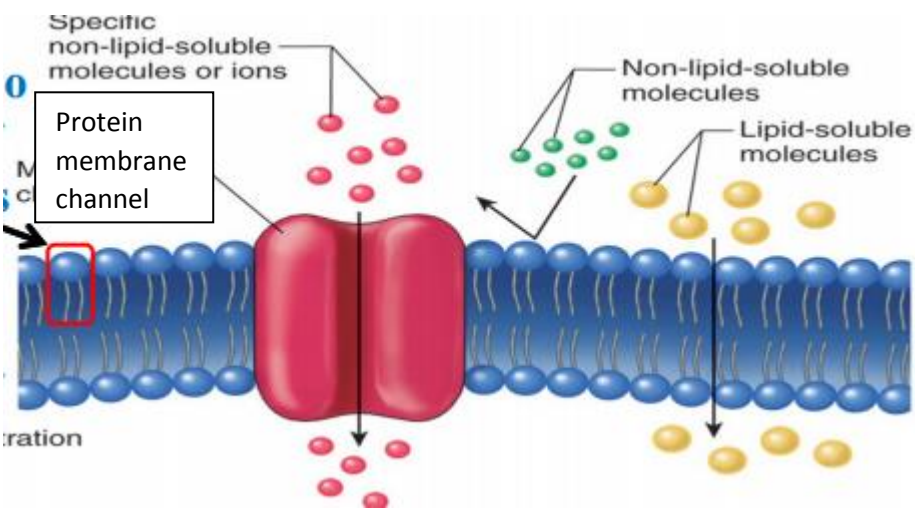
Eukaryotic cells:

- Have a nucleus with DNA
- Contain membrane-bound organelles (prokaryotic cells do not)

Cell surface membrane

Role is to enclose the cell, support the cell contents, act as a selective barrier and play a role in cell communication

This is called the fluid-mosaic model



Features:

- **Double layer of phospholipid molecules**
    - Contain a hydrophilic (water-loving) polar-phosphate (blue) head that faces outwards and inwards of the cell
    - The fatty acid ends (lipid tails) of the phospholipids are hydrophobic (water-hating) and face inwards of the double layer of phospholipids.
    - Both the phosphate heads and lipid tails are very dynamic and allow for a range of movement
- Carbohydrates are found in amongst the phospholipids for added strength and flexibility
- **Protein membrane channels (pink)**
    - Float in the phospholipids and create "channels" which allow for the movement in and out of the cell membrane
    - Allow for movements across a concentration gradient (passive) or can be active where energy is required to move ions across the membrane

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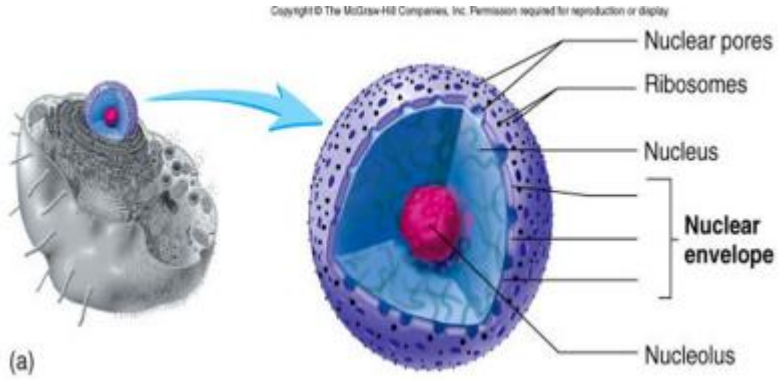
Nucleus

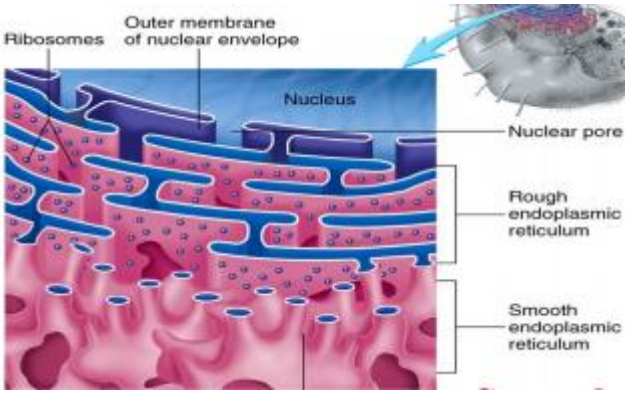
- Ribosomal RNA is formed in the nucleolus before it leaves via pores and goes onto form ribosomes
- DNA found in the nucleus
- Nucleus pores are the places which allow for materials to pass in and out of the nucleus



Ribosomes

- Ribosomal RNA leaves the nucleus and forms itself into ribosomes
- Organelle where proteins are produced
- Can be free floating in the cytoplasm or found on the endoplasmic reticulum
- Go on and perform translation (DNA reproduction)

Endoplasmic reticulum



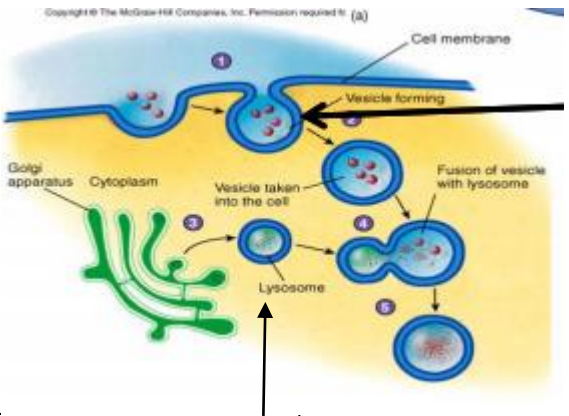
- <u>Rough</u>
  - Has ribosomes embedded onto the surface
  - Allows ribosomes to synthesise proteins for export from the cell
- <u>Smooth</u>
  - Does not have any ribosomes on the surface
  - Site for lipid synthesis and detoxification of chemicals in cells (liver cells have a lot of smooth ER in order to detoxify alcohol in the liver)

Golgi apparatus

- Closely packed stacks of membrane sacks (as they mature they move to the front)
- Collects, packages and distributes lipid and proteins manufactured by the endoplasmic reticulum (ER)
- Golgi apparatus sometimes modifies these lipids and proteins by adding carbohydrates to them (tag the protein/lipids which tell them where to go)
- Packaged into secretory vesicles which pinch of from the margins of the Golgi apparatus

Lysosomes

- Membrane bound vesicles **formed from the Golgi apparatus**
- Contain enzymes which function as a cells digestive system
- Vesicles arriving by endocytosis can fuse with lysosomes which are then broken down



Lysosomes produced from the Golgi apparatus