How Proteins are made

Nucleotide order is copied to RNA molecules and decoded to specify the order (sequence) of amino acids in a polypeptide chain that will fold to make a functional protein molecule

DNA - RNA - Protein

Transfer RNA

Charged tRNA: tRNA carrying an amino acid

Small molecules carrying 70-90 nucleotides

Has a self pairing structure (clover leaf structure) - 3' end of CCA is the amino acid binding site

3 key roles: carries amino acids, associates with mRNA & interacts with ribosomes (APE)

Genetic Code

When mRNA is scanned by a ribosome, it is always read 3 nucleotides (3 bases)/a codon at a time to avoid redundancy (multiple condons can be for the same amino acids)

Start codon: AUG (code for methionine) - acts as initiation signal for translation

Stop codon: UAA, UAG, UGA - directs ribosomes to end translation

Redundancy + Wobble

Wobble rule: so long as the first 2 nucleotides pair up, the 3rd one can wobble (doesn't need to be a perfect fit)

Ex: CUC (leu) – GAG vs CUU (leu) – GAG

Pairing of tRNA anticodon and mRNA codon starts by going towards the 5' end

Membrane proteins

Transporter	Moves ions and other molecules across the membrane
Receptor	Recieves signals from the environment
Enzyme	Catalyzes elemental reactions
Anchor	Attachment and maintain cell shape and structure

Enzymes

+(delta)G: endergonic (need to put in energy for reaction, non-spontaneous reaction)

-(delta)G: exergonic (reaction releases energy, spontaneous reaction)

Metabolism: building/breaking down of carbon sources to harness or release energy – 2 types of reaction

Catabolism: breaking down larger macromolecules (proteins, lipids) into their smaller sub-units (amino acids, fatty acids)

Anabolism: building up reactions, uses atp from catabolism to use and build up larger molecules from smaller sub-units (proteins to nucleic acids_

- Enzymes decrease the amount of free energy required to turn reactants to products

- substrate + active sites: weak noncovalent interactions, transient covalent bonds (always)

Translation - Molecules needed

Messenger RNA (mRNA)

Initiation factors

Elongation factors

Aminoacyl tRNA synthetases	Binds specific amino acid to 3' end of uncharged tRNA

Transfer RNA (tRNA)

Ribosome (ribosomal RNA + ribosomal proteins)	- Arranges order of charged tRNA molecules to match mRNA order - Organizes mRNA transcript from transcription

Cell Membrane

Membranes are made up of lipids (hydrophobic with hydrocarbon tails) - majorily made from phospholipids

Phospholipids have a hydrophilic head and double hydrophobic tails that form a lipid bilayer

Membrane fluidity is determined by the types of lipid that make up the membrane.
- Saturated fatty acids have linear tails = tighter/less space means less fluidity
- Unsaturated fatty acids have a kink = more space/less packed meaning more fluidity

Cholesterol

Cholesterol can increase or decrease membrane fluidity depending on the temperature.

Cell Membrane (cont)

At normal cell temperature, the interaction of the rigid structure of cholesterol with the phospholipid fatty acid tails reduces the mobility of the phospholipids and the fluidity of the membrane.

Transport avross the membrane

Diffusion - movement of solute molecules across membranes

Osmosis - movement of solvent molecules across membranes; involves water

- Hypertonic solution: More solutes outside than inside – water moves from inside to outside the cell (Cell shrinks) -Isotonic solution: Concentration of solutes is the same inside and outside the cell = no net movement of water -Hypotonic solution: More solutes inside the cell than outside, water moves inside the cell

Facilitated Diffusion - involves net movement of solutes (ions, small molecules) down a concentration gradient until equilibrium is reached

Primary Active Transport – uses energy from ATP hydrolysis to pump ions into or out of cells against the concentration gradient

Secondary Active Transport – can drive the transport of molecules through a different transporter via the creation of an electrochemical gradient. In this example, the active transporter

Initiation

How it starts

Starts by initiation factors binding to 5' cap of mRNA

Recruits smaller subunit of ribosome

Other initiation factors bring tRNA charged with Methionine (always the starting amino acid)

Initiation complex moves along mRNA until start codon AUG is found (P site)

Large ribosomal subunit joins and binds to the complex

Initiation factors are released and next charged tRNA is ready to join

The process

New charged tRNA joins on (from A site) next to the amino acid (coupled reaction) -> connects Met to the new amino acid (first peptide bond)

Ribosome shifts onto next codon and (now uncharged) tRNA leaves the complex (from E site) to continue the process

Process stops when stop codon (UAA, UAG, UGA) is found, tRNA keeps leaving from E site until the amino acids have deattached

Elongation

Initiation process continues until required length is obtained for the polypeptide chain

-requires elongation factors (carries GTP – hydrolyses gtp and releases energy)

Termination

A protein release factor binds to the A site of the ribosome, causing the bond connected to the polypeptide of the tRNA to break

Carboxyl terminus is created at the end of the polypeptide chain following the bond breakage

Endomembrane system

Plasma membrane	Regulates the passage of materials into and out of the cell
Nuclear envelope	Organizes/maintains nuclear content - Molecules move in/out of nuclear envelop using nuclear pores
Endopl-asmic reticulum	Protein (rough) and lipid (smooth) synthesis and transport
Golgi apparatus	“Shipping and receiving center” Modify/sort proteins and lipids
Lysosomes	Digestive enzymes can help metabolize/breakdown proteins, nucleic acids, carbs

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