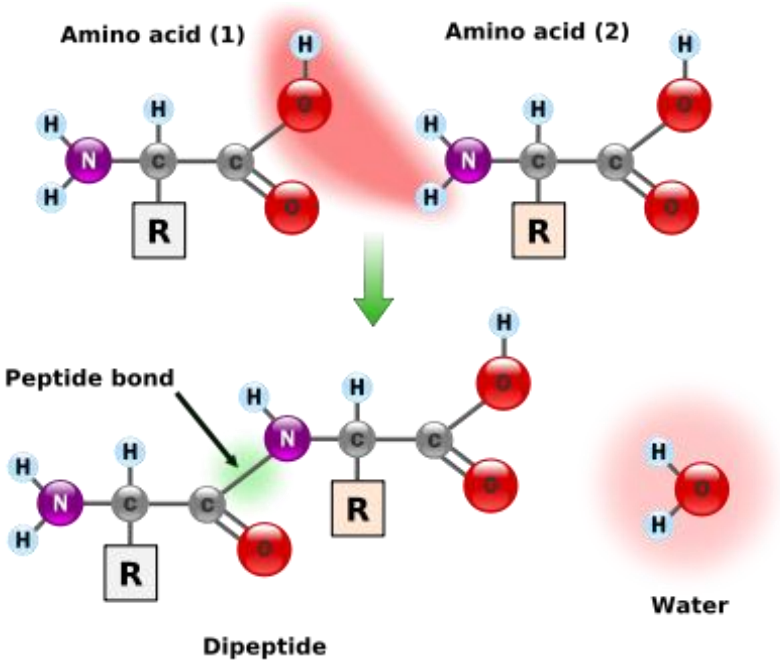
Understandings:

1. Explain how amino acids are linked, mentioning condensation and peptide bonds.
- Polypeptides are linked amino acids. They undergo condensation on the ribosomes, a process called translation (more on that in 2.7).



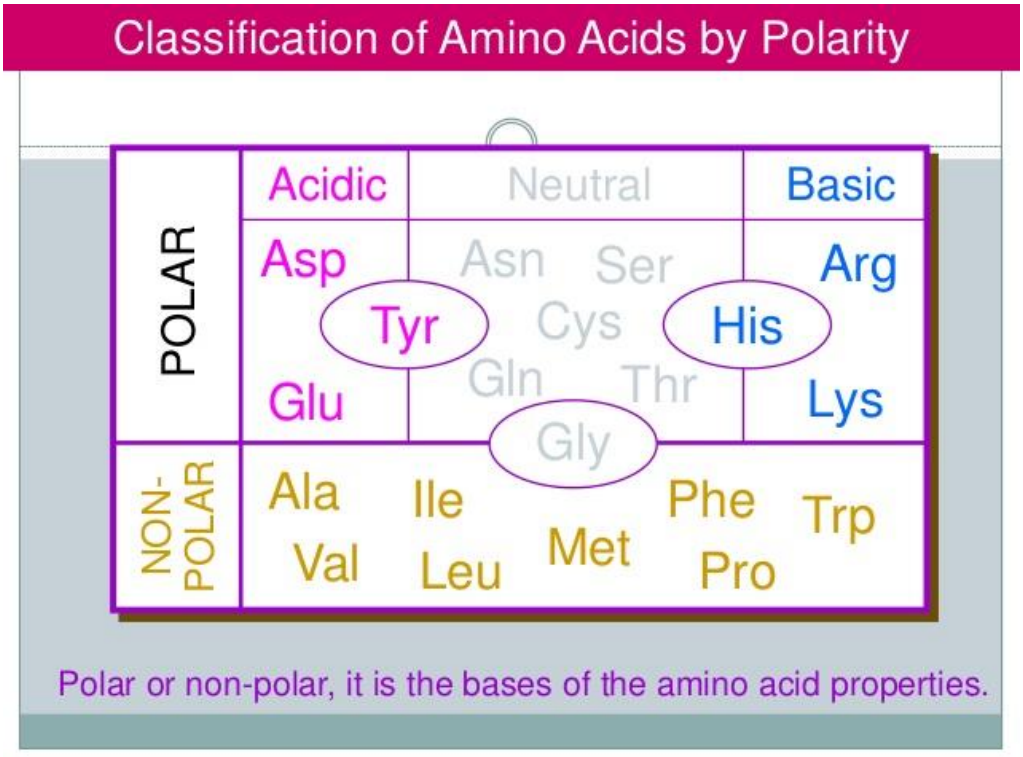
The reaction is between an amine group NH_2 and carboxyl COOH.

We have formed <u>water and a peptide bond</u> between C-N.

Two amino acids are called dipeptide.
More than two but less than 20 amino acids are called oligopeptide.
More than 20 is polypeptide.

2. State that there are 20 different amino acids synthesized on ribosomes.
- The radical "R" determines the characteristic of the amino acid.

This is how the main 20 amino acids can be classified.



3. Explain the diversity of amino acids through their bonding.
- Since peptide bonds can be formed between any pair of amino acids, we have a huge range of possible outcomes.

We will have 20x20x20x20… = 20^n where n is the number of amino acids. The number n can stretch from 2 to tens of thousands!!! Imagine 20^{2000}…No…too much!

4. Explain how the desired amino acid sequence is coded.
- Although the possibility of combinations is infinite, organisms only produce a fraction of these. Each polypeptide is coded and stored in our genes. Wow! Indeed, most of the genes are encodings of polypeptides.

5. Explain how proteins are formed by polypeptides.
- Proteins are a structure of one or more polypeptides linked together. Here are some examples:

Lysozyme: An enzyme that secretes mucous (nasal) and tears and kills bacteria.

Integrin: A protein found in membrane, composed of 2 polypeptides.

Collagen: A protein that is wound to form rope structure. It is very tensile. It is composed of 3 polypeptides.

Haemoglobin: A protein that can bind with oxygen, composed of 4 polypeptides

6. State that amino acid sequence determines the 3D structure of the protein.
- Since amino acids can be acidic, basic, hydrophobic and hydrophilic, these interactions form different structures.

Such as, lysozyme is globular and the reason for that is because the hydrophobic amino acids are folded inside and hydrophilic forms the outside, just like the membrane!

7. Outline some of the main functions of proteins living organisms synthesize.
- The other carbon compounds cannot be compared with the proteins because protein has such a wide range of functions. Here a list of function of the proteins.

Catalysts: They lower the activation energy, hence the time taken, of chemical reactions that happen all the time in our body.

Muscle contraction: Actin and myosin are protein structures that use ATP to makes us move.

Cytoskeletons: These are the skeletons in the cyto or cell. Thus it gives our cells structure and it is also used during mitosis to pull chromosomes.

Tensile strengthening: Help us to have tension to prevent bursting. Collagen is an example.

Blood clotting: Plasma proteins help us to solidify wounds.

Transport: They transfer oxygen, lipids, and all sorts of things.

Cell adhesion: The proteins in membranes help cells to stick together to communicate.

Membrane transport: Facilitated diffusion, active transport and electron transport all involve proteins embedded in membrane.

Hormones: Some hormones are made of protein, such as insulin. Not all hormones are proteins nevertheless.

Receptors: Communication as mentioned.

Packing of DNA: Histones makes small knots of DNA to make it more compressive.

Immunity: Antibodies!

8. Define proteome and state that everyone has their own proteome.
- It is the sum of all proteins that is produced in our body. It can be from cells, tissue, organ, etc. We can contrast with genome. It is the sum of all genes in our body.

So how do we find out how many proteins we have? The process is very simple.

1. Separate the different proteins by gel electrophoresis. Depending on the weight and charge, the molecule will move a different distance.

2. Then we inject known antibodies marked with fluorescent and hence see if it glows. The end!

The genome of an organism is fixed while proteome is not. Production of protein may vary from cell to cell depending on what they need at that place and that time. Thus the proteome tells us what is happening in an organism.

Thus everyone have different proteome!

Applications and skills:

1. Give example of 6 proteins, Rubisco, insulin, immunoglobulins, rhodopsin, collagen and spider silk, and explain their function.

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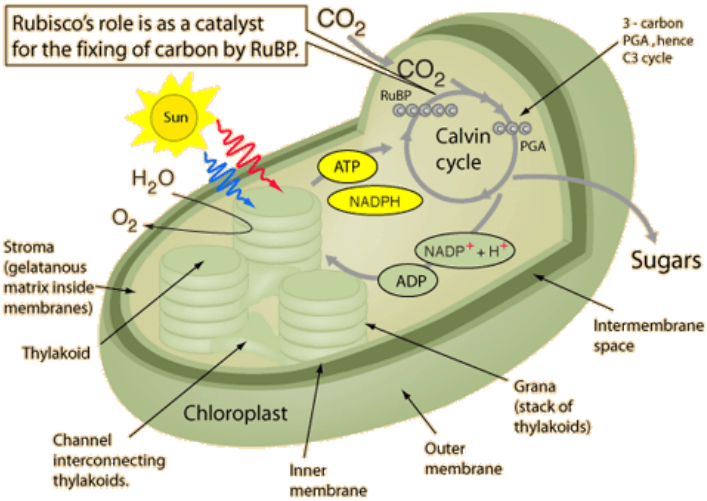

RuBisCo:

This stands for Ribulose bisphosphate carboxylase.

This protein is crucial for our carbon compounds. This enzyme enables plants to capture/fixate the CO_2 from the atmosphere to the chloroplast and hence photosynthesis.

Insulin:

We are very familiar with this protein, which is also a hormone. This hormone is secreted by Beta-cells in the pancreas to stimulate cells in our body to absorb glucose! All cells have receptors that fit exactly with this insulin. Well, except for people diagnosed with diabetes.

Immunoglobulin:

Immuno-sounds like something with our defence system! It is indeed.
These proteins are also known as antibodies. Antibodies can make phagocytosis to engulf, and the range of antibodies is enormous. This is why we have so many, various diseases.

Rhodopsin:

Rhodopsin is a light sensitive pigment. "A pigment is a material that changes the colour of reflected or transmitted light as the result of wavelength-selective absorption." So our eyes have loads of pigments that can absorb light and hence what we perceive. Rhodopsin is one of them.

When light enters the retina, rhodopsin changes shape, then causes change in opsin, which makes rod cells send impulses to brain.

Thanks rhodopsin!

Collagen:

It is a protein that is known for its tensile strength. It is structured with three interwoven polypeptides. This makes up most of our skin and it is the most abundant protein in human!

These help our vessels not to burst, our skin not to crack, and look beautiful!

Spider silk:

Thin threads like spider silk can be stronger than steel! The protein can be stretched immensely but still not break due to the parallel polypeptides.

2. Explain how proteins might get denatured by heat or pH.
- What it actually means with denaturation is that the amino acids R group gets broken. R group is relatively weakly bonded, hence a change in heat or pH will break the bond.

Denaturation is permanent! Why? Because the structures, amino structure and the R group become insoluble in water (they are hydrophobic when separated) and hence appear as solids. There is no returning back…YOU SHALL NOT PASS!

We know that heat/kinetic energy can cause bond to break, but what about pH? The pH affects in a way that change the charge. Since we know that acid and base involves the accepting and donating an electron/proton, making them charged will cause them to form new ionic bonds.
The structure will change and usually become insoluble.

3. Be able to draw amino acids and the formation of peptide bonds.
- This is a relatively simple structure. Just be sure to omit a water molecule since this is a condensation reaction.