01. Bones – note & archive

- **Gene Expression, Codons, Transcription, and Translation:**

✓ Gene expression is the process by which information from a gene is used to synthesize a functional gene product, typically a protein.

✓ It involves two major steps: transcription and translation.

1. **Transcription:**

- During transcription, the DNA sequence of a gene is copied into messenger RNA (mRNA).
- This occurs in the nucleus in eukaryotic cells.
- This mRNA then exits the nucleus and enters the cytoplasm for the next step, translation.

2. **Codons and Translation:**

- Codons are sequences of three nucleotides in the mRNA that encode specific amino acids. During translation, the mRNA is read by ribosomes in the cytoplasm.
- The ribosome facilitates the assembly of amino acids into a polypeptide chain, which then folds into a functional protein.

- **Protein Structure and Folding:**

✓ Proteins are composed of linear chains of amino acids, and their structure is organized into four levels:

i. **Primary Structure:**

- The linear sequence of amino acids in a polypeptide chain, determined by the DNA sequence of the gene.
- Peptide bonds

ii. **Secondary Structure:**

- The local folding of the polypeptide chain into structures like alpha-helices and beta-pleated sheets.
- Stabilized by hydrogen bonds between the backbone atoms of the polypeptide.
- a-helix → left-handed with 3.6 AA each turn.

iii. **Tertiary Structure:**

- The overall three-dimensional shape of the protein, formed by interactions between side chains (R groups) of amino acids.
- This structure is stabilized by a variety of bonds, including hydrophobic interactions, disulfide bridges, and ionic bonds.

iv. **Quaternary Structure:**

v. Some proteins consist of multiple polypeptide chains, or subunits, that associate to form a functional protein complex.

vi. Non-covalent bonds

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- Protein Folding and Denaturation:

✓ Protein Folding:

- Is the process by which a polypeptide chain achieves its functional three-dimensional shape
- Proper folding is essential for a protein's activity, as the structure determines the protein's function.

✓ Denaturation:

- Occurs when a protein loses its native structure due to external factors like heat, pH changes, or chemical exposure.
- This loss of structure typically leads to the loss of function, as the active site of the protein may no longer be correctly shaped to bind substrates or catalyze reactions.

- Archive:

1. Vitamin D deficiency can lead to which of the following physiological changes?

A. Hyperparathyroidism
B. Increased calcium retention in bones
C. Decreased parathyroid hormone secretion
D. Hypothyroidism
E. Enhanced muscle mass

- Correct Answer: A) Hyperparathyroidism

One of the following is true about 1,25-dihydroxycholecalciferol (active vitamin D):

A. It is lipophobic and works as a vitamin
B. It has an extracellular receptor
C. It's activated in the liver
D. It decreases PTH transcription
E. None of the above

- Correct Answer: D) It decreases PTH transcription

3. **What is the indirect action of PTH (Parathyroid Hormone) among these?**

A. It lowers the circulating calcium and phosphate levels

B. It inhibits bone resorption

C. It indirectly causes phosphate absorption from the GI along with calcium

D. It decreases the osteoclast/osteoblast activity ratio

E. It decreases renal tubular reabsorption of calcium.

- Correct Answer: C) It indirectly causes phosphate absorption from the GI along with calcium

4. **One of the following stimulates the release of calcitonin:**

A. Hypercalcemia

B. Hypocalcemia

C. Hyperphosphatemia

D. Low magnesium levels

E. Increased parathyroid hormone secretion

- Correct Answer: A) Hypercalcemia

5. **For hypocalcemia, all of the following are correct except?**

A. It manifests as a symptom of unusually low magnesium levels

B. Hypocalcemia may be associated with high levels of inactive PTH

C. It is the presence of low serum calcium levels in the blood

D. It manifests as a symptom Of a (PTH) deficiency/malfunction

E. It manifests as a symptom of a high Vitamin D levels

- Correct Answer: E) It manifests as a symptom of a high Vitamin D levels

6. **The hardness of bone results from the presence of inorganic mineral salts, mainly?**

A. Lacunae

B. Hydroxyapatite

C. Endosteum

D. Canaliculi

E. Organic matrix

- Correct Answer: B) Hydroxyapatite

7. **Bone building cells that synthesize and secrete collagen fibers and other organic components needed to build the extracellular matrix of bone tissue, and initiate calcification are?**

A. Osteogenic cells
B. Osteoblasts
C. Osteocytes
D. Osteoclasts
E. Fibroblasts

- Correct Answer: B) Osteoblasts

8. **Vitamin D is activated in the kidney by?**

A. Parathyroid hormone
B. Calcitonin
C. 7-Dehydrocholesterol
D. 25-Hydroxyylase
E. 1α-Hydroxylase

- Correct Answer: E) 1α-Hydroxylase

9. **PTH, all are true except:**

A. Prevents liberation of Ca^{2+} into the blood
B. Stimulates calcium reabsorption in kidneys
C. Increases calcium release from bones
D. Stimulates the conversion of vitamin D to its active form
E. Increases calcium absorption in the intestines

- Correct Answer: A) Prevents liberation of Ca^{2+} into the blood

10. **Vitamin D3, all are true except:**

A. Increases calcium absorption in the intestines
B. Stimulates bone resorption
C. Promotes the production of osteocalcin
D. Inhibition of osteoclast activity
E. Enhances calcium and phosphate balance in the blood

- Correct Answer: C) Inhibition of osteoclast activity

11. **Osteoclast function, all are true except:**

A. Increases bone resorption by breaking down bone tissue
B. Activates acid secretion to dissolve minerals in bone
C. Increases pH to 7 to make hydroxyapatite more soluble
D. Releases calcium and phosphate into the bloodstream
E. Stimulated by parathyroid hormone

- Correct Answer: C) Increases pH to 7 to make hydroxyapatite more soluble

12. Estrogen hormone:

A. Main circulatory steroid in males

B. Provides bone strength in males

C. Plays a role in reproductive health in females

D. Regulates secondary sexual characteristics in females

E. Increases bone density in females post-menopause

- Correct Answer: C) Plays a role in reproductive health in females