



PHARMACOLEARN

It's Important to Know!

BP203T — Biochemistry

B.Pharm Semester 2 · Unit 5 — Amino Acid Metabolism and Genetic Information

Unit V: Amino Acid Metabolism and Genetic Information

This unit connects amino acid breakdown with nitrogen disposal and explains how genetic information is expressed. Learn the difference between transamination, deamination and the urea cycle, then relate DNA, RNA and protein synthesis.

Transamination and deamination

Examples include alanine aminotransferase transferring an amino group between alanine and alpha-ketoglutarate, and aspartate aminotransferase transferring an amino group between aspartate and alpha-ketoglutarate. Oxidative deamination of glutamate by glutamate dehydrogenase releases ammonia and regenerates alpha-ketoglutarate.

Transamination transfers an amino group from an amino acid to a keto acid. Aminotransferases commonly use pyridoxal phosphate as a coenzyme. Deamination removes an amino group and releases ammonia. These reactions help channel nitrogen toward safe disposal and carbon skeletons toward energy or biosynthetic pathways.

Urea cycle

Urea cycle: 5 steps and locations

1. In the mitochondrial matrix, carbamoyl phosphate synthetase I forms carbamoyl phosphate from ammonia, carbon dioxide and ATP.
2. In the mitochondrial matrix, ornithine transcarbamylase combines carbamoyl phosphate with ornithine to form citrulline.
3. In the cytosol, argininosuccinate synthetase combines citrulline with aspartate and ATP to form argininosuccinate.
4. In the cytosol, argininosuccinate lyase splits argininosuccinate into arginine and fumarate.
5. In the cytosol, arginase hydrolyses arginine to urea and ornithine. Ornithine returns to the mitochondrion.

The urea cycle converts toxic ammonia nitrogen into urea, which can be excreted in urine. The cycle occurs partly in mitochondria and partly in the cytosol of liver cells. Its carbon and nitrogen sources include carbon dioxide, ammonia and aspartate.

Inborn errors of metabolism

An inborn error of metabolism results from a genetic defect affecting an enzyme, transporter or related protein. The defect can cause accumulation of a substrate, deficiency of a product or formation of an abnormal metabolite. Examples in the standard textbook list used for this draft are phenylketonuria, alkaptonuria, albinism, maple syrup urine disease, homocystinuria and galactosaemia. List source: Harper's Illustrated Biochemistry, sections on inborn errors of metabolism.

DNA replication and transcription

DNA replication copies genetic information before cell division. Each parental strand serves as a template for a new complementary strand. Transcription uses DNA information to produce RNA. Messenger RNA carries coding information, transfer RNA helps deliver amino acids and ribosomal RNA forms part of the ribosome.

Translation

DNA replication uses helicase to separate strands, primase to make RNA primers, DNA polymerase to extend new DNA and DNA ligase to join fragments. Transcription uses RNA polymerase to make RNA from a DNA template. Translation uses ribosomes, messenger RNA, transfer RNA and aminoacyl-tRNA synthetases. In eukaryotic cells, RNA processing includes capping, polyadenylation and splicing before mature messenger RNA is translated.

Translation is the synthesis of a polypeptide using the codon sequence of messenger RNA. Ribosomes read codons in order. Transfer RNA molecules bring amino acids whose anticodons pair with messenger RNA codons. Translation begins at a start codon and ends when a stop codon is reached.

Mutations

A mutation is a change in genetic material. Substitution, insertion and deletion are common categories. The effect can be silent, change an amino acid, introduce a stop codon or alter the reading frame. The biological effect depends on the location and nature of the change.

Unit V: Frequently asked questions

Q: What is transamination?

A: Transamination is transfer of an amino group from an amino acid to a keto acid, forming a new amino acid and keto acid. Pyridoxal phosphate commonly participates in the reaction.

Q: What is the purpose of the urea cycle?

A: The urea cycle converts ammonia nitrogen into urea, a less toxic compound that can be excreted by the kidneys.

Q: What is the difference between transcription and translation?

A: Transcription uses DNA as a template to make RNA. Translation uses messenger RNA as a template to make a polypeptide.

Q: What are the five enzymes of the urea cycle?

A: They are carbamoyl phosphate synthetase I, ornithine transcarbamylase, argininosuccinate synthetase, argininosuccinate lyase and arginase.

Unit V: Key takeaways

- Transamination transfers amino groups, while deamination releases ammonia.
- The liver converts ammonia nitrogen to urea through the urea cycle.
- DNA replication copies genetic information.
- Transcription makes RNA and translation makes a polypeptide.
- Mutations can alter genetic information and protein function.
- The urea cycle has two mitochondrial steps and three cytosolic steps.

Unit V: Clinical correlation

Clinical correlation: jaundice and bilirubin handling. Heme catabolism produces bilirubin, and the liver conjugates bilirubin before biliary excretion. Impaired production, conjugation, hepatic handling or bile flow can produce different jaundice patterns.