Lab-wide Learning Outcomes for Transcription and Translation Explored

Knowledge-Based Outcomes

Upon completion of *Transcription and Translation Explored*, students should be able to:

1. Explain how DNA and RNA encode information for building polypeptides in the sequences of nucleotides.
2. Define DNA, RNA, tRNA, mRNA, amino acid, polypeptide, and protein, and describe the role of each in gene expression.
3. Distinguish between:
    - DNA and RNA
    - coding and template DNA strands
    - pre-mRNA and mRNA
    - amino acids, polypeptides, and proteins
4. Define a gene and explain which parts of a gene are transcribed and translated and which are not.
5. Identify key regulatory sequences/locations and their function in transcription and translation (promoter, terminator, start codon, etc.).
6. Recount the roles and cellular locations of RNA polymerase and ribosomes.
7. Explain qualitative differences in gene expression between prokaryotic and eukaryotic cells.

Skills-Based Outcomes

Upon completion of *Transcription and Translation Explored*, students should be able to:

1. Guide prokaryotic and eukaryotic cells through the processes of transcription, RNA processing, and translation, noting the differences among them.
2. Predict qualitative effects of drugs or perturbations that alter transcription, RNA processing, or translation.
3. Predict what would happen if a eukaryotic gene were transplanted into a prokaryotic cell.
4. Generate a DNA or RNA sequence that produces a given amino acid sequence, and then use this process to identify mutations that could cause observed differences between two amino acid sequences.

Transcription and Translation Explored, Part 1: How Cells Make Proteins

Knowledge-Based Outcomes

Upon completion of *Part 1: How Cells Make Proteins*, students should be able to:

1. Define gene expression, transcription, and translation, and explain why they are essential for all cells.
2. Describe the cellular locations where transcription and translation occur, and what molecule is produced by each process.

Skills-Based Outcomes

Upon completion of *Part 1: How Cells Make Proteins*, students should be able to:

1. Create and label a diagram that illustrates the basic steps of genetic information flow in cells, from gene to protein.

Transcription and Translation Explored, Part 2: Transcription and RNA Processing

Knowledge-Based Outcomes

Upon completion of *Part 2: Transcription and RNA Processing*, students should be able to:

1. Describe the key molecules and events involved in the initiation, elongation, and termination of transcription.
2. Summarize the key changes to RNA during RNA processing and what effect these changes have on RNA and resulting polypeptide.

Skills-Based Outcomes

Upon completion of *Part 2: Transcription and RNA Processing*, students should be able to:

1. Given a DNA sequence with promoter and terminator, indicate which strand is transcribed and determine the RNA sequence produced.
2. Predict the qualitative effect of skipping intron splicing or performing alternative splicing on a molecule of pre-mRNA in a eukaryotic cell.

Transcription and Translation Explored, Part 3: Translation

Knowledge-Based Outcomes

Upon completion of *Part 3: Translation*, students should be able to:

1. Describe the key molecules and events involved in the initiation, elongation, and termination of translation.
2. Explain how three DNA/RNA bases are used to specify each amino acid in the polypeptide, and explain why 2-base codons would be insufficient.
3. Explain the relationship between codons and anticodons, as well as the functional importance of their interaction for translation.

Skills-Based Outcomes

Upon completion of *Part 3: Translation*, students should be able to:

1. Use a codon table to determine the amino acid sequence specified by the open reading frame of an mRNA molecule.

Transcription and Translation Explored, Part 4: Mutations

Knowledge-Based Outcomes

Upon completion of *Part 4: Mutations*, students should be able to:

1. List the different types of mutation (point, frameshift, sense, missense, etc.) and explain their effect (or lack of effect) on amino acid sequence.

Skills-based Learning Outcomes

Upon completion of *Part 4: Mutations*, students should be able to:

1. Predict possible effects of point mutations and insertion/deletion mutations on amino acid sequence and overall function of protein.