Background Information for Flu Unit

This is divided by background topics and the topics outlined in black font are geared for a biotechnology class. Also included are more detailed topics outlined in red that could be geared toward AP biology. Using the flu scenario as a theme, you could teach all the red topics below in a thematic approach to meet college board AP standards.

Student Background: DNA

- DNA structure, base pairing, replication
    - Enzymes (DNA polymerase, Ligase, restriction enzymes, etc)
    - 5'-3', Okasaki fragments, chemical bonds
- DNA → RNA → amino acid → protein folding
    - mRNA splicing (introns/exons)
    - Transcription factors, inhibitors, competitive inhibitors, promoters
    - Amino acid properties and protein folding tendencies
    - Secondary, tertiary, quaternary structures
        - Protein structure/shape and relationship between bonding to substrates

Teacher Background: DNA

- Understand all of the above
- Activities and lab experiences that support the concepts above

Student Background: Bacteria as a pathogen (optional)

- Basic structure
- Genome info, plasmids

Teacher Background: Bacteria

- Understand all of the above
- Examples of bacteria, how they cause disease, gram positive vs. gram negative
- Structure of cell wall
    - How antibiotics target bacteria
- Reproduction (sexual and asexual)

Student Background: Viruses as pathogens

- Basic structure
- Reproduction
    - How viruses enter/exit cells
    - Specificity with viruses bonding to molecules on cell membrane

Teacher Background: Viruses as pathogens

- Understand all of the above
- How flu viruses specifically enter and exit cells
- How therapeutics target flu viruses
- How flu viruses are named
    - Surface proteins (Hemagglutinin, Neauraminidase, M2 protein channels)
- Flu virus genome- 8 RNA segments and how retroviruses work in the cell
- Facts and figures about why we study the flu
- Pathogenesis of the flu
- Antigenic Drift vs. Antigenic shift

- Zoonotic disease- animal to human transfer
    - How does this create new strains of flu
- Pandemic vs. Epidemic

Student Background: Cell Membranes

- Basic structure
    - Phospholipid bilayer, transmembrane proteins, surface molecules
- Cell signaling
    - **Protein confirmation changes, receptor molecules**
    - **Transduction pathways**

Teacher Background: Cell Membranes

- **All of the above**

Student Background: Immune System

- **Major cell types and function**
    - **Phagocytes, B-cell, Memory T-cells, Killer T-cells, Helper T-cells**
    - **Basic immune response**
        - **Antigens, immune cell signaling, eliminating the pathogen, immune memory**
- **Vaccines**
    - **What is being injected**
    - **How it helps build immune memory**

Teacher Background: Immune system

- Understand all of the above
- Time frame for immune system to respond to viral infections
- Immune memory: 1^{st} and 2^{nd} exposure to antigen vs. vaccine and 1^{st} exposure to antigen
- How antibodies bind to viruses
    - Epitopes
    - Ability to block viruses from entering cells
- Specificity of antibody and binding to specific antigens
- Structure/Function of antibodies
    - Non-variable regions
    - Heavy chains
    - Light chains
    - Variable regions
    - Antigen binding sites
        - VDJ recombination and how it creates the variety of antigen binding
- Immune system organs
    - Primary and secondary organs
        - Immune cells production, maturation, and adaptive immune response

Student Background: Lab equipment and experience

This could be taught prior to unit or within the unit…

- Micropipettes
- Centrifuges
- Serial dilutions

- Gel electrophoresis
- PCR
- ELISA

Teacher Background: Lab experiences

- Serial Dilutions
- Gel electrophoresis
    - Purpose
    - How the box works
    - How to make gels
- PCR
    - Purpose
    - How it works
        - Reagents and equipment needed
    - Primers
    - How it is used clinically
- ELISA
    - Purpose
    - How it works
        - Difference between direct, indirect, and sandwich ELISA
        - How the antigens, washes, antibodies, and enzymes work together to show viral load
        - Data analysis with the serial dilution, known and unknown samples
    - How it is used clinically
    - ELISA in the classroom lab vs. ELISA in a doctor's office
- BLAST
    - Blast scores
        - Max score/Total score, Query coverage, percent identity, Expect value
        - Comparing DNA sequences vs. amino acid sequences
        - Using phylogenetic trees within program to show sequence relatedness