

# Protein Modification Visualizer Activity

## AP Biology College-Level Teacher Guide (Unit 2: Cell Structure and Function)

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Interactive Biology Education

### Teacher Guide

**Learning Objectives:** - Students will apply glycosylation modifications to proteins - Students will apply phosphorylation modifications to proteins - Students will perform protein cleavage operations - Students will direct proteins to cell membrane destinations - Students will direct proteins to lysosome destinations

### Standards Alignment (AP Biology Course and Exam Description - Unit 2: Cell Structure and Function):

**Topic 2.1: Cell Structure and Function - ESSENTIAL KNOWLEDGE 2.1.A.4:** The Golgi complex receives and chemically modifies (glycosylation) proteins synthesized by the RER prior to secretion from the cell.

**Topic 2.9: Cell Compartmentalization - ESSENTIAL KNOWLEDGE 2.9.A.1:** Membranes and membrane-bound organelles in eukaryotic cells compartmentalize intracellular metabolic processes and specific enzymatic reactions.

**Prerequisites:** - Basic protein synthesis knowledge - Understanding of cell organelles

**Estimated Time:** 45 minutes

**Materials Needed:** - Computer/tablet with internet access - Student worksheet

**Key Vocabulary:** - Glycosylation - Phosphorylation - Protein cleavage - Cell membrane - Lysosome

**Teacher Preparation:** Review the five app functions: glycosylation, phosphorylation, protein cleavage, membrane delivery, lysosome delivery

**Safety Notes:** - Standard computer lab safety protocols

## Teaching Notes:

**Phase 1: ENGAGE (10 minutes)** - Students should identify all five app functions during initial exploration - Expected answers for pre-assessment: - Glycosylation: Adding sugar groups to proteins - Phosphorylation: Adding phosphate groups to proteins - Protein cleavage: Cutting proteins to activate them or remove signal sequences

**Phase 2: EXPLORE (25 minutes)** - Guide students through each of the four investigations - Encourage students to try different proteins and observe patterns - Expected observations: - Glycosylation typically occurs in ER and Golgi - Phosphorylation is reversible and affects protein activity - Cleavage can activate proteins or remove targeting sequences - Different proteins have different destination requirements

**Phase 3: EXPLAIN (10 minutes)** - Help students synthesize their observations - Connect app functions to broader cell biology concepts - Emphasize the importance of protein modifications for cellular function

**Phase 4: ELABORATE (5 minutes)** - Encourage students to think beyond the app - Connect to real-world health implications - Discuss therapeutic applications

**Phase 5: EVALUATE (5 minutes)** - Use assessment questions to gauge understanding - Look for ability to predict protein behavior based on modifications - Check understanding of the five core app functions

## Answer Key:

**Phase 1 - Initial Exploration:** 1. Glycosylation (adding sugar groups) 2. Phosphorylation (adding phosphate groups) 3. Protein cleavage (cutting proteins) 4. Delivery to cell membrane 5. Delivery to lysosome

**Phase 3 - Definitions:** - Glycosylation: Process of adding carbohydrate groups to proteins - Phosphorylation: Process of adding phosphate groups to proteins - Protein cleavage: Process of cutting peptide bonds in proteins

**Phase 5 - Assessment:** 1. b) ER and Golgi 2. c) Both reversible and irreversible 3. c) Both a and b

**Critical Thinking:** Proper protein targeting ensures proteins reach their intended locations to perform their functions. Mislocalization can lead to cellular dysfunction and disease.