

PEEBEDU Protein Modification Visualizer

Unit 6: Gene Expression
and Regulation

Name: _____ Period: _____ Date: _____

Open peebedu.com and navigate to **Protein Modification Visualizer**. Read the introduction popup, which describes how proteins are synthesized at the ER, transported to the Golgi apparatus, modified through glycosylation, phosphorylation, and cleavage, and then delivered to their final destinations. Close the popup and begin the simulation by dragging the protein toward the Golgi.

Part 1 – Model Evaluation (MAPP Framework)

Scientific models are simplified representations of complex biological phenomena. Use the MAPP framework below to evaluate the Protein Modification Visualizer as a scientific model.

M – Mode

What type of model is the Protein Modification Visualizer? Describe how this computational simulation represents the post-translational processing of proteins in eukaryotic cells. In your answer, identify at least three specific simulation elements and explain what each one is designed to show about protein modification and transport.

A – Accuracy

(a) Identify two things this simulation represents **accurately** about protein processing in eukaryotic cells. For each, name the specific simulation feature and explain what aspect of post-translational modification or protein trafficking it demonstrates.

(b) Identify two things this simulation **oversimplifies or leaves out** about protein processing. Consider what you cannot observe in the simulation that would be important for a complete understanding of the endomembrane system and protein modification.

P – Purpose

What is the learning goal of this simulation? Explain how the Protein Modification Visualizer is designed to help you understand how proteins are modified after translation and how those modifications determine protein function and destination. In your answer, connect at least one specific simulation feature to a biological consequence of post-translational modification in a living cell.

P – Permanency

Could this model change with new scientific evidence? Describe one way that new discoveries about protein processing might change or improve a simulation like the Protein Modification Visualizer. Explain why scientific models, including computational simulations, are revised as new evidence becomes available.

Small-Group Discussion

With your group, discuss the following:

- What are the strengths of this simulation as a model for post-translational protein processing?
- What are its limitations?
- If you could add one feature to improve this simulation, what would it be and why?
- How does the simulation help you connect gene expression (translation) to the final functional form of a protein?

Part 2 – NGSS Questions

1.

Simulation Task: Drag the protein from the ER toward the Golgi apparatus. Watch the transport vesicle form around the protein and carry it to the Golgi. Read the information panel that appears when the protein arrives.

Describe the path a protein follows from the place where it is made to the Golgi apparatus. Explain why the protein must be enclosed in a vesicle for this journey and what this tells you about how cells organize the movement of materials internally.

HS-LS1-1

2.

*Simulation Task: Once the protein is in the Golgi, click **Glycosylate** to attach sugar chains to the protein. Observe how the protein's appearance changes in the simulation.*

Explain how adding sugar chains to a protein changes its structure. Describe why this change in structure could affect how the protein functions or where it ends up in the cell.

HS-LS1-1

3.

*Simulation Task: Reset the simulation. Drag the protein to the Golgi again. This time, click **Phosphorylate** to add a phosphate group to the protein. Compare the visual change to what you saw during glycosylation.*

Explain how adding a phosphate group to a protein can change the protein's shape and activity. Describe why cells use different types of chemical modifications to control what proteins do.

HS-LS1-1

4.

*Simulation Task: Reset the simulation. Drag the protein to the Golgi and click **Cleave Protein**. Observe how the protein is cut. Then click **Package from Golgi** and drag the vesicle to the **Lysosome**.*

Describe what happens to the protein when it is cleaved. Explain why cutting a protein into a smaller form can be necessary for it to become active and carry out its function inside a specific organelle like the lysosome.

HS-LS1-1

5.

*Simulation Task: Complete two full protein journeys. First: drag the protein to the Golgi, click **Glycosylate**, package it, and deliver it to the **Cell Membrane**. Then reset and repeat: drag the protein to the Golgi, click **Cleave Protein**, package it, and deliver it to the **Lysosome**.*

Compare the two pathways you just completed. Explain how the specific modification a protein receives determines which destination it is sent to, and describe why accurate protein sorting is important for a cell to function properly.

HS-LS1-1

6.

Simulation Task: Review all the stages of the simulation from start to finish. Note each organelle the protein passes through and the modifications available at the Golgi (glycosylation, phosphorylation, cleavage).

In the box below, draw a labeled diagram showing the complete path a protein can take from the ER to its final destination. Include the ER, a transport vesicle, the Golgi apparatus, at least two types of modifications, and two possible destinations (cell membrane and lysosome). Use arrows to show the direction of protein movement.

Draw your diagram here.

HS-LS1-1

7.

*Simulation Task: Reset the simulation and apply **Glycosylate** and **Phosphorylate** to the protein in the Golgi. Observe the final modified protein before packaging it. Think about what would happen if the original DNA instructions for this protein contained an error.*

A protein's three-dimensional shape determines its function. Explain how a change in the DNA sequence that codes for a protein could alter the protein's structure in a way that prevents it from being properly modified in the Golgi. Describe how this could affect the organism.

HS-LS3-2