

Name: _____ Period: _____ Date: _____

Open peebedu.com and navigate to **Glycogen Hydrolysis Lab**. Click the **Start Experimenting** button to begin. Read the tutorial popup, which describes how to use six tools to break bonds, form bonds, harvest molecules, and add monosaccharides to the workspace.

Part 1 – Model Evaluation (MAPP Framework)

Scientific models are simplified representations of complex biological phenomena. Use the MAPP framework below to evaluate the Glycogen Hydrolysis Lab as a scientific model.

M – Mode

What type of model is the Glycogen Hydrolysis Lab? Describe how this computational simulation represents the chemical reactions that build and break carbohydrates. In your answer, identify at least three specific simulation elements and explain what each one is designed to show about macromolecule chemistry.

A – Accuracy

(a) Identify two things this simulation represents **accurately** about how polymers are built and broken down. For each, name the specific simulation feature and explain what concept of macromolecule chemistry it demonstrates.

(b) Identify two things this simulation **oversimplifies or leaves out** about the chemical reactions that build and break macromolecules. Consider what you cannot observe in the simulation that would be important for a complete molecular-level understanding of hydrolysis and dehydration synthesis.

P – Purpose

What is the learning goal of this simulation? Explain how the Glycogen Hydrolysis Lab is designed to help you understand how covalent bonds between monomers are broken by hydrolysis and formed by dehydration synthesis. In your answer, connect at least one specific simulation feature to why these reactions are biologically important for living organisms.

P – Permanency

Could this model change with new scientific evidence? Describe one way that new discoveries might change or improve a simulation like the Glycogen Hydrolysis Lab. Explain why scientific models, including computational simulations, are revised as new evidence becomes available.

Small-Group Discussion

With your group, discuss the following:

- How does the water inventory system help you understand the role of water in hydrolysis and dehydration synthesis?
- What information about the bonds between monomers is missing from the simplified hexagon representations?
- How does breaking down glycogen into individual glucose molecules connect to how cells obtain energy?
- If you could add one feature to this simulation to better represent carbohydrate chemistry, what would it be and why?

Part 2 – Free Response Questions

Conceptual Analysis

Question 1 – Hydrolysis of Glycogen

*Simulation Task: Select the **Hydrolyze** tool and click on three different bonds in the glycogen polymer. After each bond break, observe how the water count in the Environmental Inventory changes and note what happens to the molecules on either side of the broken bond.*

(A) (1 pt) **Describe** the chemical process of hydrolysis.

(B) (1 pt) **Explain** the mechanism by which a water molecule participates in breaking a covalent bond during hydrolysis.

(C) (1 pt) **Predict** what would happen to an organism's ability to break down stored glycogen if the cells had a severely limited supply of water molecules available for chemical reactions.

(D) (1 pt) **Justify** your prediction by explaining why water is a necessary reactant in hydrolysis and how its absence would affect the breakdown of polymers into monomers.

Analyze Model / Visual Representation

Question 2 – Carbohydrate Structure

*Simulation Task: Use the **Reset Glycogen** button to restore the branched glycogen polymer. Then select the **Dehydrate** tool and bond two free glucose molecules together. Next, select **Add Fructose**, place a fructose molecule on the canvas, and bond it to a free glucose molecule. Compare the branched glycogen structure with the two disaccharides you created.*

(A) (1 pt) **Describe** how monosaccharides serve as monomers that are connected by covalent bonds to form polysaccharides.

(B) (1 pt) **Explain** the relationship between the arrangement of glucose monomers in the glycogen polymer shown in the simulation and the branched structure that results from how those monomers are bonded together.

(C) (1 pt) **Represent** the structural difference between a linear polysaccharide and a branched polysaccharide.

Draw your diagrams here.

(D) (1 pt) **Explain** how the regulation of glycogen breakdown in an organism's cells connects to gene expression.

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