PEEBEDU # Glycogen Hydrolysis Lab Unit 1: Chemistry of Life

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 — NGSS Questions

1.

> *Simulation Task: Select the **Hydrolyze** tool and click on three different bonds in the glycogen polymer. After each click, watch the water count in the Environmental Inventory decrease and observe the two molecules that separate on either side of the broken bond.*

Describe the role of water in the process of hydrolysis. Using your observations from the simulation, explain how a water molecule is used each time a bond between two glucose units is broken, and why this reaction is necessary for an organism to access stored energy.

HS-LS1-6

2.

> *Simulation Task: Use the **Hydrolyze** tool to break all the bonds in the glycogen polymer until every glucose molecule is free. Then select the **Remove** tool and try to harvest each free glucose molecule into your inventory. Note the final water count.*

Glycogen is a branched polymer made of glucose molecules bonded together. Explain why an organism stores energy as glycogen rather than as individual glucose molecules, and describe how breaking down glycogen through hydrolysis allows the organism to release glucose when energy is needed.

HS-LS1-7

3.

> *Simulation Task: Click **Reset Glycogen** to restore the polymer. Select the **Dehydrate** tool, then click **Add Glucose** to place two free glucose molecules on the canvas. Use the Dehydrate tool to bond the two free glucose molecules together. Note how the water count changes.*

Compare the processes of hydrolysis and dehydration synthesis as you observed them in the simulation. Explain how water is consumed in one reaction and produced in the other, and describe why both reactions are important for an organism that needs to store energy and later release it.

HS-LS1-6

4.

> *Simulation Task: Continue using the **Hydrolyze** tool until the water count in the Environmental Inventory reaches zero and the count turns red. Then try to break one more bond and read the error message that appears.*

Based on your observation, explain what happens when the cell runs out of water for hydrolysis. Describe how a limited supply of water would affect an organism's ability to break down stored glycogen and obtain the glucose it needs for energy.

HS-LS1-6

5.

> *Simulation Task: Click **Reset Glycogen**. Use **Add Fructose** and **Add Galactose** to place one of each on the canvas. Use the **Dehydrate** tool to bond a free glucose to the fructose, and then bond another free glucose to the galactose. Compare the two disaccharides you created with the glucose-glucose bonds in the glycogen polymer.*

Different combinations of monosaccharides produce different disaccharides. Using your observations, explain how the type of monosaccharides bonded together determines the identity of the resulting molecule. Describe why organisms use a variety of carbohydrates rather than relying on a single type of sugar for their energy and structural needs.

HS-LS1-7

6.

> *Simulation Task: Click **Reset Glycogen** and observe the branched structure of the glycogen polymer on the canvas. Note how some glucose units are connected in a straight chain while others branch off at different points.*

In the box below, draw a diagram showing a branched glycogen polymer with at least six glucose units. Label the bonds between monomers and indicate where water would be consumed if one bond were broken by hydrolysis and where water would be released if a new monomer were added by dehydration synthesis.

Draw your diagram here.

HS-LS1-6

7.

> *Simulation Task: Complete the **Glucose Harvester** challenge by harvesting 10 glucose molecules into your inventory. Then use the **Dehydrate** tool and **Add Glucose** to build a 6-glucose polymer chain to complete the **Polymer Pro** challenge. Observe the water and score changes throughout.*

When an organism eats food containing glycogen or starch, it breaks these polymers into glucose through hydrolysis. The glucose is then used by cells to release energy. Explain how the energy stored in the bonds of a carbohydrate polymer is transferred through an ecosystem, from a producer that builds carbohydrates to a consumer that breaks them down. Describe the role of bond-breaking and bond-forming reactions in this transfer of energy.

HS-LS2-3