

# Card C: Making Cellulose Molecules

Recommended for expert builders

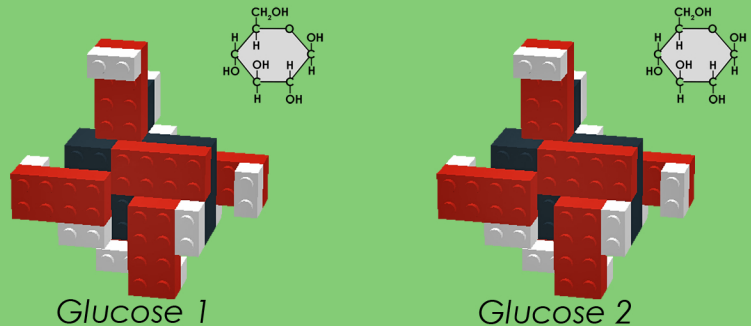
## Introduction

Plant cells build cellulose molecules by linking glucose molecules together. You can model this chemical reaction with LEGO® bricks. First, build two glucose molecules using the instructions from *Card A: Making Glucose Molecules*. Then follow the directions below to construct a short cellulose molecule.

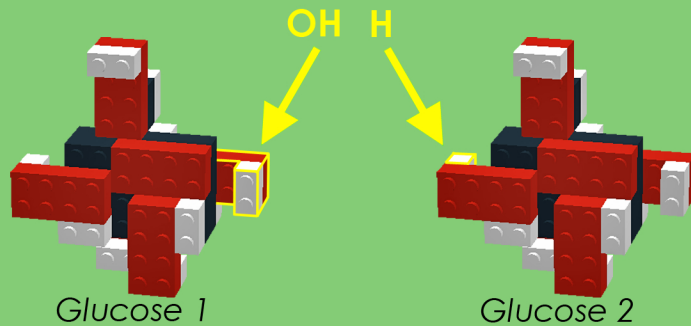
Later, your team (and any other Card C teams) will link all the short cellulose molecules together to create one longer model of cellulose. Real cellulose molecules in cells are made of hundreds of glucose molecules joined end-to-end!

## Directions:

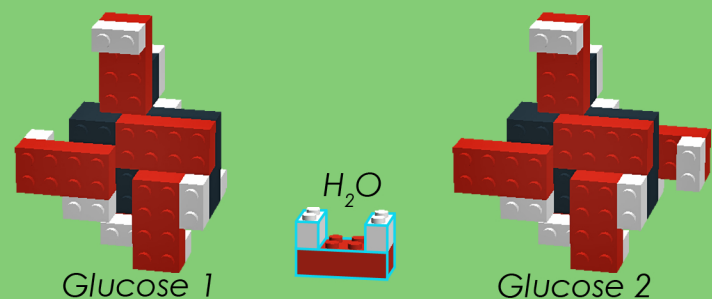
- 1 Begin with two glucose molecules. Stand them upright as shown, with the  $\text{CH}_2\text{OH}$  (head) on top.



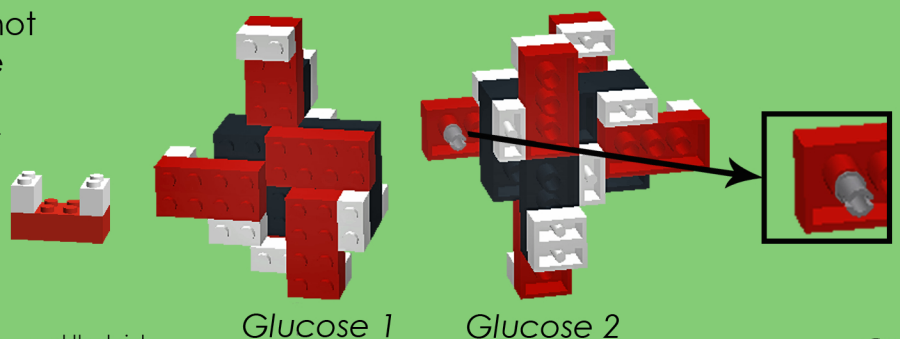
- 2 Remove an OH from the right side of glucose 1 and an H from the left side of glucose 2.



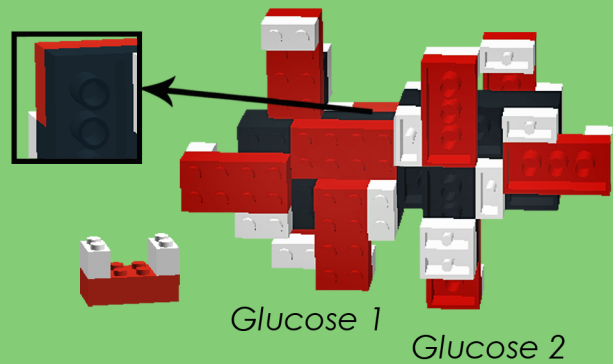
- 3 Use the free OH and H to form a molecule of water.



- 4 Flip glucose 2 on its head. (It cannot balance this way, so you will have to hold it in place.) Add a gray connector to the oxygen (without an H) as shown.



- 5 Connect the two glucose molecules together. The gray connector should fit into the top hole in back of the carbon (without an OH group). The structure cannot balance this way, so you will have to hold it up.

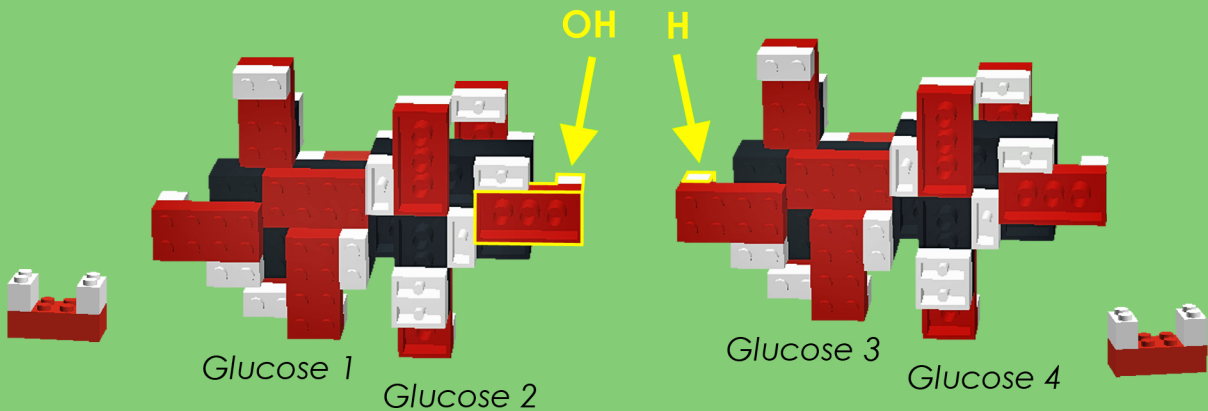


This step completes a chemical reaction. Look at this equation and your model. Do the numbers agree with your model?

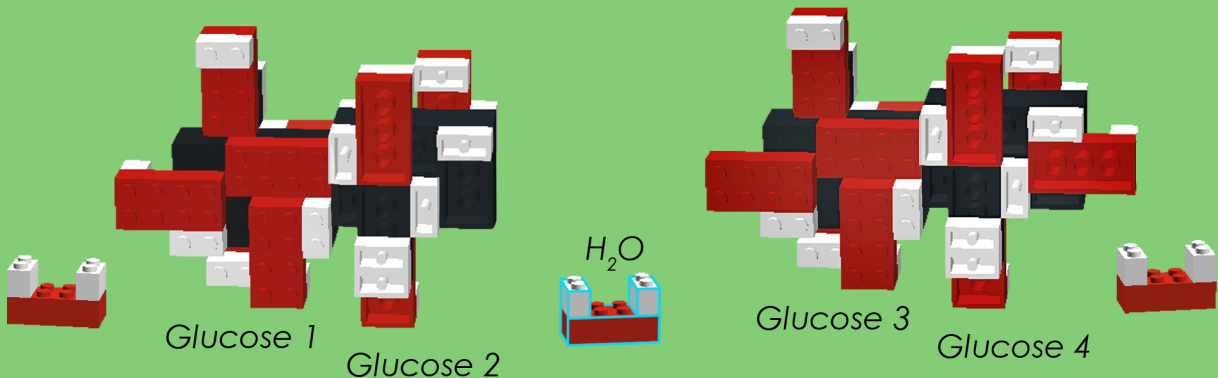


You have completed your team's short cellulose molecule! Now connect it to another team's short cellulose molecule using the steps below.

- 6 Remove an OH from the right side of the upside down glucose 2 and an H from the left side of glucose 3.



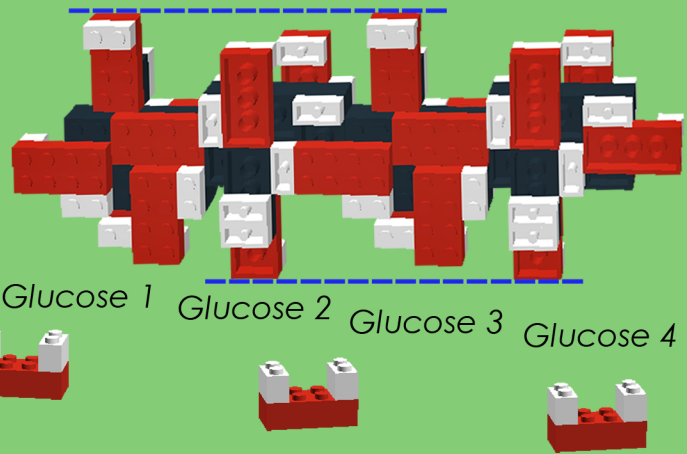
- 7 Use the free OH and H to form another molecule of water.



- 8 Add a gray connector to the bottom hole of the carbon (without an OH) as shown.



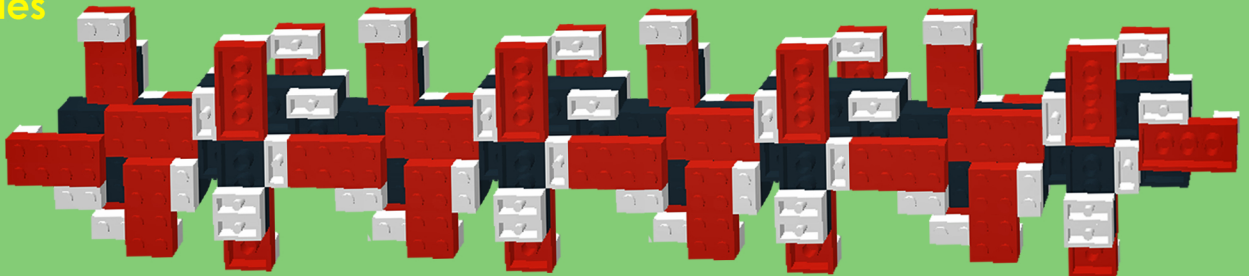
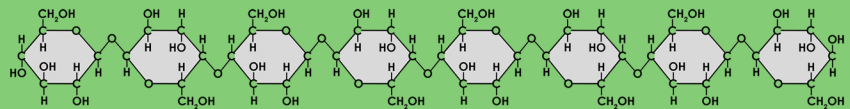
- 9 Using the gray connector, connect the carbon on glucose 2 to the oxygen (without an H) on glucose 3.



- 10 Check your chain and make sure glucose 1 and 3 are the same height, and glucose 2 and 4 are the same height. (See blue lines.)

**What is the chemical formula for the cellulose molecule your class made?**

**Here is a chain of eight glucose molecules. The chains in cellulose are actually hundreds of molecules long!**



## Conclusion

Both starch and cellulose are made from glucose molecules. So how is starch different from cellulose? One of the most important differences is how the cell connects the individual glucose molecules. In starch, the glucose molecules are all connected right side up, but in cellulose, every other glucose is connected upside down. Because of its structure, cellulose is a strong molecule. For example, wood contains a lot of cellulose.