SN IN HIGH SCHOOLS March 4, 2017

Built for Speed

Student Guide for From Lactose to Glucose

Enzymes are catalysts that do certain jobs inside you. Your body can easily use simple sugars like glucose as energy sources. However, milk mainly contains lactose, two simple sugars (glucose and galactose) bonded together. Therefore, your body (especially when you are young) makes the enzyme lactase, which breaks lactose into its two parts. If people don't have enough lactase, milk can upset their stomachs. But there's a solution: Lactase tablets provide the enzyme, and Lactaid milk comes with all the lactose already broken down.

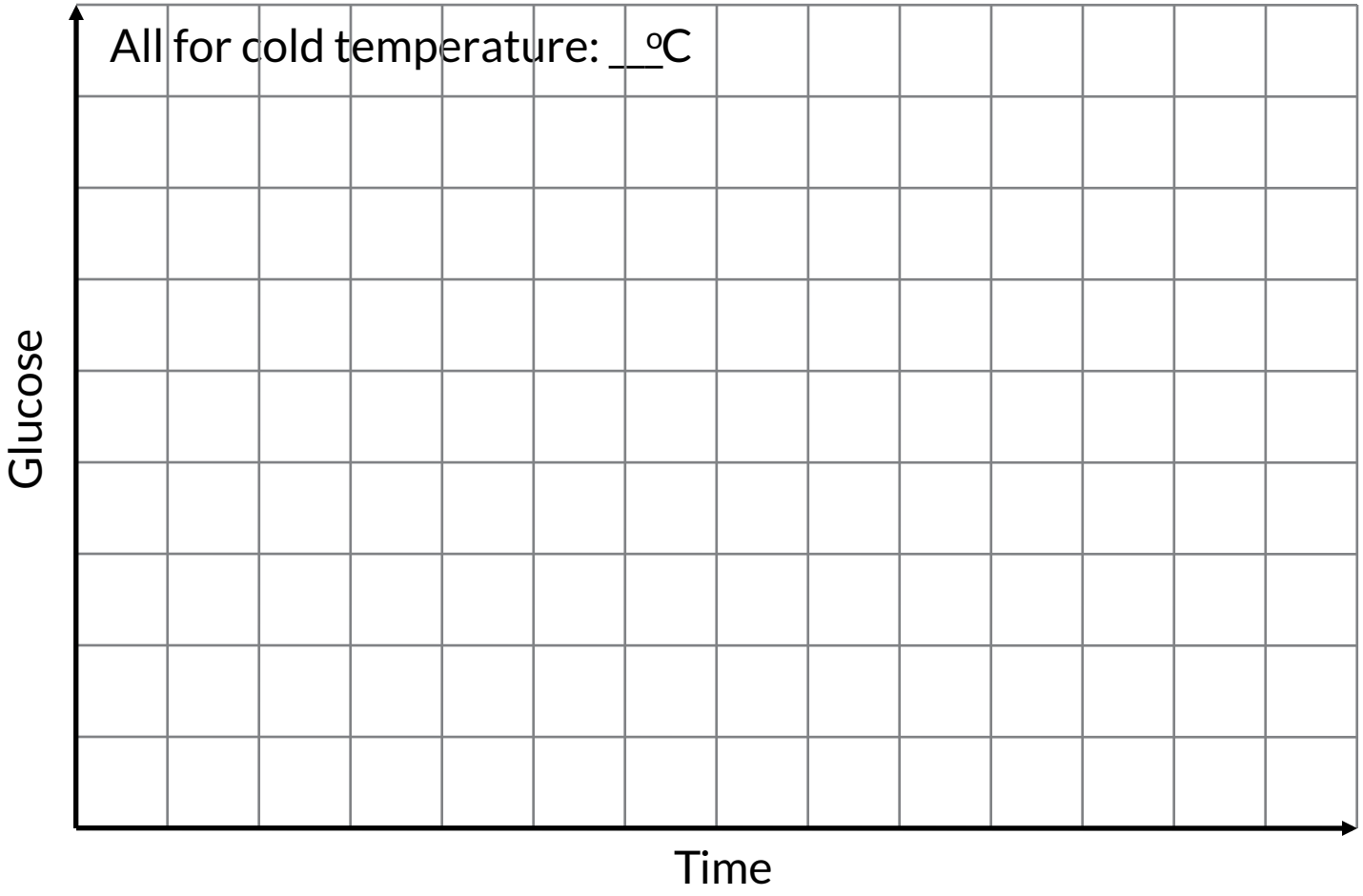
1. Cut the glucose test strips in half lengthwise so you can do two tests with one strip.
2. Fill three test tubes approximately half full with milk.
3. Briefly dip a glucose test strip into each tube of milk, then let the strip dry on the table for a minute or two. Compare the color of the strip with the color code on the side of the bottle of test strips. How much glucose is in the milk? Record your data on the accompanying sheets.
4. According to the thermometer, what is room temperature?
5. Fill a beaker most of the way with hot water. Record the water temperature.
6. Fill a beaker most of the way with cold water. Record the water temperature.
7. Use pliers or a mortar and pestle to crunch a Lactaid (lactase enzyme) tablet into powder. Put the powder on weigh paper on the scale. Record the mass of the powder.
8. Add the lactase powder to the test tubes of milk (1/3 tablet of powder per tube). Mix each tube by putting your gloved thumb over the top and shaking gently (or use a stopper if provided).
9. Set or hold one milk tube in the beaker of hot water, one in the beaker of cold water and one at room temperature (in no water).
10. After 1 minute, test the milk in each tube with new glucose test strips. How much glucose is in the milk? Record your data on the accompanying data table.
11. After 2 minutes, test the milk in each tube with new glucose test strips. Record your data.
12. Repeat the testing and recording procedure on each minute until you test and record the amount at 7 minutes.
13. Graph your data for the cold temperature on the accompanying sheets (add appropriate units to the axes).
14. Graph your data for room temaperature on the accompanying sheets (add appropriate units to the axes).

15. Graph your data for the hot temperature on the accompanying sheets (add appropriate units to the axes).
16. Pick one length of time (for example, 4 minutes) and graph the results for temperature versus glucose (add appropriate units to the axes). Mix hot and cold water to create two water baths with new, unique temperatures. For the length of time previously chosen (for example, 4 minutes), repeat steps 7 through 9 for the two new water baths. Make sure you use the same mass of lactase as you did in the first three test tubes, and make sure that the lactase is crushed to the same degree. Plot your results on the same temperature versus glucose graph.
17. Test and graph the results for different amounts of milk per tube (measure and record the amount of milk in each tube with a graduated cylinder or ask your teacher for specific instructions), with the same length of time, same temperature and same lactase mass for all tubes. Add appropriate units to the axes.
18. Test and graph the results for different masses of lactase per tube, with the same amount of time, same temperature and same milk amount for all tubes.
19. Once you have collected all of your data, answer the following questions. Explain your answers by using specific evidence from your graphs.
    - How does time affect the amount of glucose produced at a specific temperature? Explain.
    - How does temperature affect the amount of glucose produced after a specific amount of time? Explain.
    - What temperature gives the most glucose? What might happen to the lactase enzyme at high temperatures? Explain.
    - How does the amount of milk affect the amount of glucose produced by the reaction in a specific amount of time? Because glucose is a product, what does this tell you about how the amount of milk affects the rate of the chemical reaction? Is there a maximum or minimum amount of milk above which or below which this relationship no longer exists? If so, why might this "amount of milk limit" exist?
    - What is the relationship between the amount of lactase used and the amount of glucose produced for a given amount of time and a specific temperature? What does this tell you about how the amount of lactase affects the rate of the chemical reaction? Based on your knowledge of catalysts, explain why this might be the case.

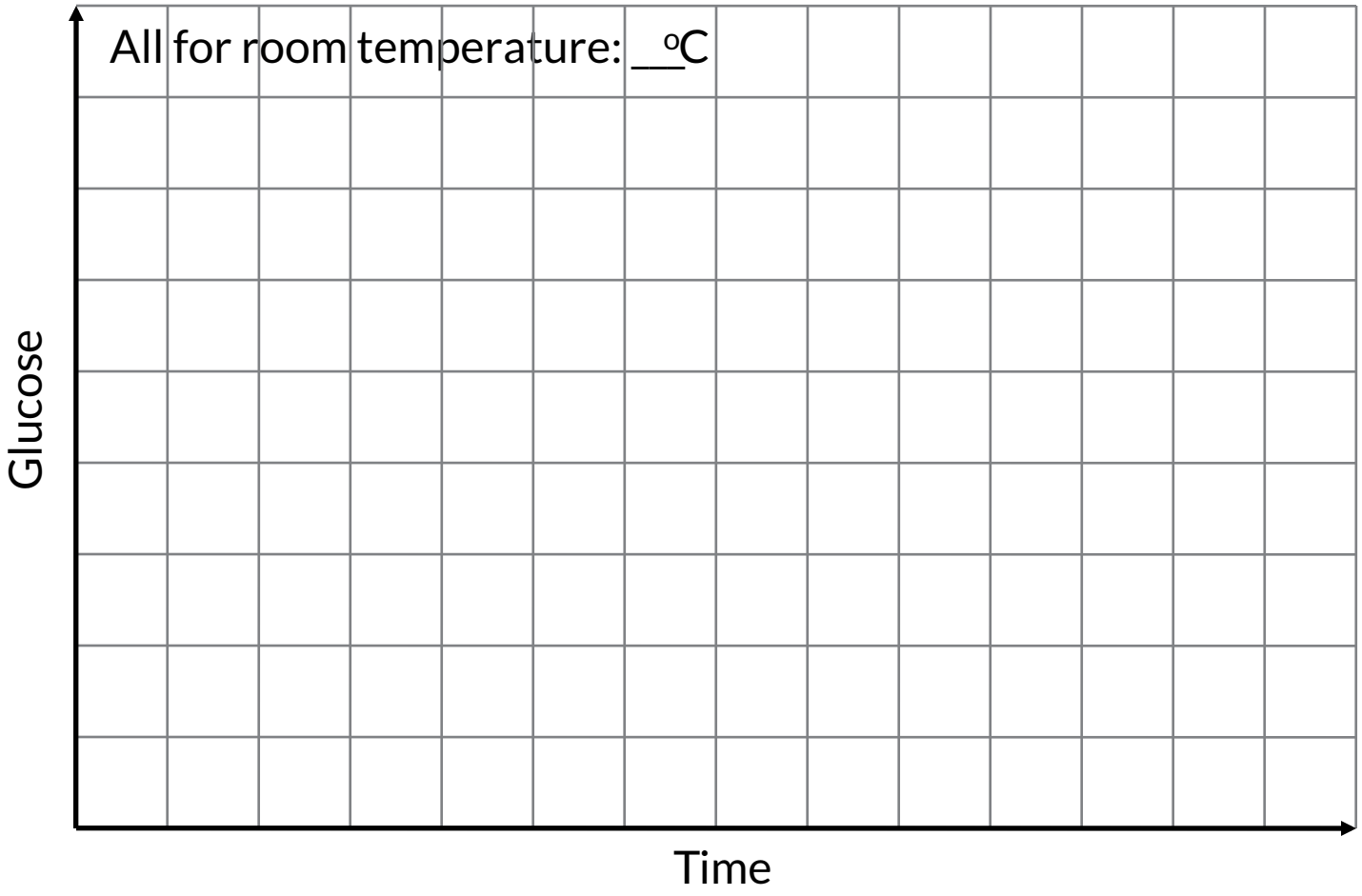
Lab: Lactase Enzyme Activity Name: _______________

Cold water bath temperature:	**Room temperature:**	**Hot water bath temperature:**
Time: 0 Glucose:	Time: 0 Glucose:	Time: 0 Glucose:
Time: Glucose:	Time: Glucose:	Time: Glucose:
Time: Glucose:	Time: Glucose:	Time: Glucose:
Time: Glucose:	Time: Glucose:	Time: Glucose:
Time: Glucose:	Time: Glucose:	Time: Glucose:
Time: Glucose:	Time: Glucose:	Time: Glucose:
Time: Glucose:	Time: Glucose:	Time: Glucose:
Time: Glucose:	Time: Glucose:	Time: Glucose:

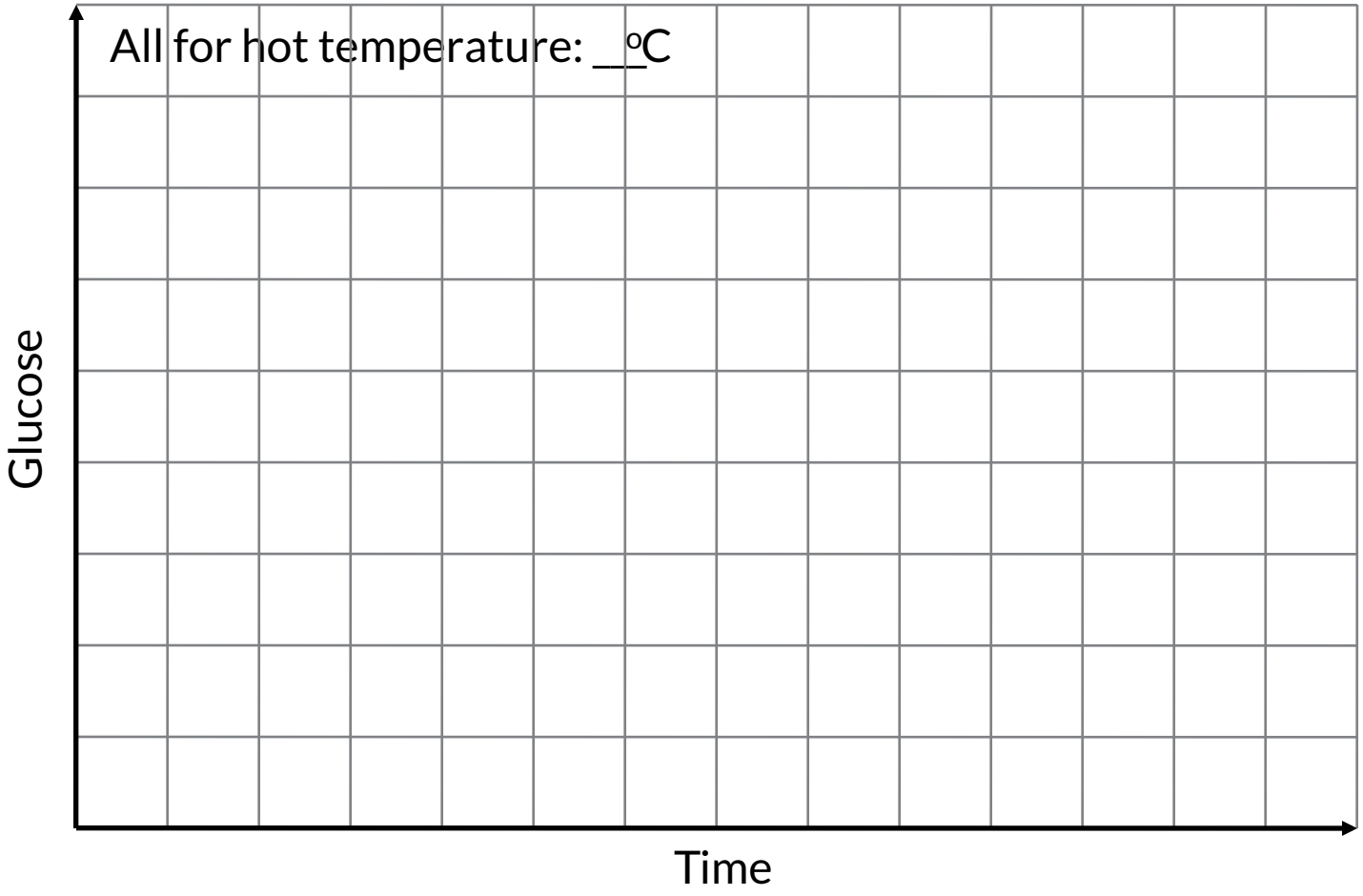
All for cold temperature: __°C



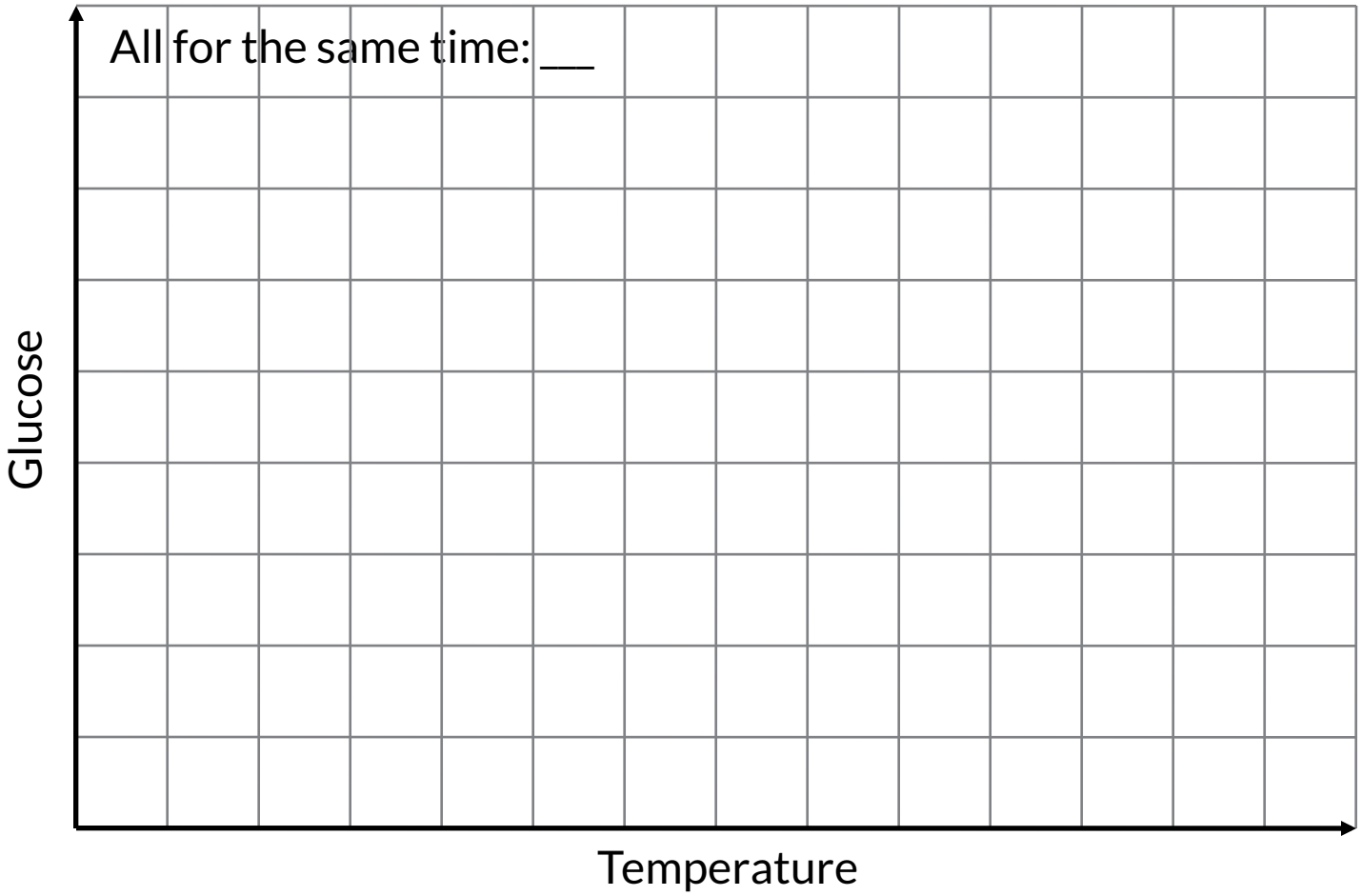
All for room temperature: __°C



All for hot temperature: ___°C



All for the same time: ___



All for the same time and temperature: _____

Glucose

Milk per tube (ml)

All for the same time and temperature: _____

Glucose

Lactase per tube (grams)