Beano – Enzymes to the Rescue

Background: Beans contain complex carbohydrates called oligosaccharides. However, humans lack alpha-galactosidase, the enzyme that breaks down oligosaccharides. Due to enzyme-substrate specificity, other enzymes will not break down the oligosaccharides. Luckily, humans have microbes living in our intestines that do have alpha-galactosidase and therefore can beak oligosaccharides down into useful sugars such as glucose. Unfortunately, these microbes also produce gas that gives us an uncomfortable, bloated feeling after eating beans. Approximately one liter of gas is released from humans daily. Some people have more trouble with gas due to a disproportionate amount of the microbes in their intestines. These people may use products such as Beano when they eat "gassy" foods. Modern fermentation techniques, used by the biotechnology industry, mass-produce a mold called *Aspergillus niger*. This mold produces the desired amounts of enzyme, which is the active ingredient used in Beano. This product breaks down the complex sugars found in many foods, making them easier to digest so they do not cause gas.

Purpose / Problem: Use the enzyme alpha-galactosidase in the product Beano to examine the behavior of enzymes under various temperatures.

Hypothesis: _____

_____

_____

Experiment:

Materials:

- Bean Solution
- Beano Solution
- Glucose Test Strips
- Graduated Cylinders
- Test Tube Rack
- Test Tubes (2)
- Thermometer
- Timing Instrument
- Pipettes (2)
- Water
- Water Bath

Methods:

1. Set up a water bath to the assigned temperature the teacher gave you. Remember to continue to check it periodically during the experiment. Add cold or warm water as needed.
    a. My group's temperature is: _____

2. Obtain 2 test tubes and label them #1 and #2

3. Put 4 ml of bean solution into each test tube.

4. Take a baseline reading of the glucose concentration at time "0" by adding a drop of liquid from each tube to the glucose strip. FOLLOW THE DIRECTIONS ON HOW TO USE THE GLUCOSE STRIPS. IF IT SAYS TO WAIT TO READ IT, WAIT. Record the results.

5. Use a CLEAN graduated cylinder to add 2 ml of the Beano solution to test tube #1.
6. Pipette the solution up and down to make sure it is mixed well.
7. Use a CLEAN graduated cylinder to add 2 ml of Water to test tube #2.
8. Pipette the solution up and down to make sure it is mixed well.
9. Place both tubes in the water bath at the temperature you were assigned.
10. At the end of 5 minutes. Take a drop from each test tube and measure the glucose concentration with another glucose test strip. FOLLOW THE DIRECTIONS ON HOW TO USE THE GLUCOSE STRIPS. IF IT SAYS TO WAIT TO READ IT, WAIT. Record the data.
11. Begin timing again and repeat after 5 more minutes. Continue to monitor the test tubes and take recordings every 5 minutes for a total of 20 minutes.
12. Share results with others.

Independent Variable: _____

Dependent Variable: _____

Controls: _____

Observation:

Time in Minutes	Glucose Concentration Tube 1	Glucose Concentration Tube 2
5		
10		
15		
20		
25		

Name: _____

Time	Glucose Concentration												
	30°C	35°C	40°C	45°C	50°C	55°C	60°C	65°C	70°C	75°C	80°C	85°C	90°C
5													
10													
15													
20													
25													

Lab Questions:

1. What type of organic molecule is an oligosaccharide? _____
2. What enzyme breaks the above-mentioned polymer into its monmers? _____
3. When oligosaccharides are broken down, what monomer is produced? _____
4. Microbes in our large intestines break down the oligosaccharides. Why are these organisms necessary? _____
5. Under which conditions in this lab did the enzyme work most efficiently?

   _____
6. Under which conditions in this lab did the enzyme work least efficiently?

   _____
7. What is a possible explanation for the difference in results among the four different conditions?

   _____

   _____

Discussion:

Conclusion: