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Measuring the Rate of an Enzyme Catalyzed Reaction: Paperase

Purpose: To determine the rate of an enzyme reaction using an imaginary enzyme and sugar, paperase and paperose.

Introduction: In this lab, your hand is the enzyme paperase. This enzyme splits the sugar paperose into subunit A and subunit B. You will split this molecule by ripping the paper model down the middle.

Each member of a group of three students will take turns ripping paperose in time trials to determine the rate of reaction of the enzyme paperase.

Materials:

- Paperose Models
- Container (large plastic cup)
- Graph Paper
- Scissors
- Clock/Timer
- Plastic Bag
- Calculator

Methods:

1. Your teacher will assign you into groups of three or four.

2. Each member will cut out molecules of paperose from the paper that the teacher gives you. Your group needs five sets of 50 molecules, kept separate in plastic baggies.

3. Place each set of 50 molecules into a container such as a large plastic cup.

4. One member will be the "timer" and will tell the "enzyme" when to start and stop.
   1st trial: 10 seconds 2nd trial: 30 seconds 3rd trial: 60 seconds
   4th trial: 120 seconds 5th trial: 180 seconds

5. The "enzyme" member of the group will do the following:
   a. When told to start, grab **one** paperose molecule and rip it down the middle. Rip **only one** molecule at a time.

   b. Place each piece **back into the container** and grab and rip another molecule.

   c. Repeat steps a and b as fast as you can for the appropriate amount of time for your trial (10 seconds, etc.).

   d. Empty your container and **count** the number of torn paperose molecules. Record the number in Table 1.

6. Other members **repeat** steps 5a – 5d for 30, 60, 120 or 180 seconds.

7. Collect class data for each time trial. Record the class averages in Table 2.

8. **Graph** the number of molecules torn vs. time in seconds. Label the x- and y-axes and give units.

   Which is the independent variable? _____

   The dependent variable? _____

Be careful when you graph the times. Note that 0, 10, 30, 60, 120 and 180 seconds are not all the same intervals.

8. Calculate the **rate of reaction** for the following time intervals:
   0-10 seconds, 10-30 seconds, 30-60 seconds, 60-120 seconds, 120-180 seconds. Record values in Table 3.

Rate = rise over run or $\frac{\Delta y}{\Delta x}$ or $\frac{(y_2 - y_1)}{(x_2 - x_1)}$.

From Teachers' Manual for an Advanced Placement Course in Biology. Duke U. TIP Manual. 1997.

Name _____ Per. _____ **Paperase Activity**

_____

Table 1 Group Time Trial Results

Time (seconds)	10	30	60	120	180

Table 2 Class Average for Time Trial Results

Time(seconds)	10	30	60	120	180

Table 3 Rate of Reaction for Class Data

Time interval	0-10	10-30	30-60	60-120	120-180

Draw graph on separate sheet of graph paper and attach to the back of this sheet.

Analysis and Conclusions:

1. At what time interval is the reaction the fastest? Explain, in terms of substrate concentration.

_____

2. At what time interval(s) is the reaction the slowest? Explain, in terms of substrate concentration.

_____

_____

3. If you were allowed to continue this lab and rip paperose molecules for 240 and 300 seconds, what reaction rate would you predict? Explain.

_____

4. If the teacher took 50 paperose molecules and dispersed them around the room:
   a. Would the molecules be more or less concentrated than they are in the container? _____
   b. How would the rate be effected? (Faster, the same, slower?) Explain your answer in terms of substrate concentration.

_____

5. Write a general statement discussing the relationship between substrate concentration and rate of reaction.

_____

7. Imagine that you are wearing very heavy work gloves. This might resemble an inhibited enzyme, or one that has been attached to an inhibitor. How would this condition affect the rate of catalysis? Explain your answer.

_____

_____

6. Write a general statement discussing the relationship between length of time and rate of reaction.

_____

A	B	A	B	A	B
A	B	A	B	A	B
A	B	A	B	A	B
A	B	A	B	A	B
A	B	A	B	A	B
A	B	A	B	A	B
A	B	A	B	A	B
A	B	A	B	A	B
A	B	A	B	A	B
A	B	A	B	A	B
A	B	A	B	A	B
A	B	A	B	A	B
A	B	A	B	A	B
A	B	A	B	A	B
A	B	A	B	A	B
A	B	A	B	A	B

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