Unit 2: Macromolecules Enzyme/Catalase H_2O_2 Reaction

INSTRUCTOR:
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CATALASE LAB INVESTIGATION PURPOSE

To examine the functioning of the tissue enzyme catalase extracted from potato juice.

INTRODUCTION

Hydrogen Peroxide (H_2O_2) is a poisonous waste product of metabolism (oxidation) in many cells. Many tissues contain an enzyme called catalase which disposes of hydrogen peroxide by accelerating (catalyzing) this reaction:

$$2H_2O_2 \rightarrow 2\ H_2O + O_2$$

REMEMBER:
Soak discs in catalase and place in **varied** beakers of H_2O_2.

Because of its effect on bacteria, hydrogen peroxide is a strong antiseptic. Watch your clothing though; H_2O_2 is also a bleaching agent!

MATERIALS

- potato juice extract (contains catalase) / beef liver
- filter paper discs
- forceps/tweezers
- hydrogen peroxide (3% H_2O_2)
- tap water
- stopwatch
- beakers (50 mL)

METHOD

1. Soak a filter paper disc in the potato extract for a few seconds.
2. Place the saturated disc in a beaker containing H_2O_2.
3. Time how long it takes the disc to rise to the top of the H_2O_2.

PROCEDURE FOR VARYING *SUBSTRATE* CONCENTRATIONS

1. Set five beakers up according to the table. You may use the lab sheet provided as well.
2. Perform five trials for each **substrate** (H_2O_2) concentration.
3. Record data.

BEAKER	1	2	3	4	5
mL H_2O_2	0	10	20	30	40
mL H_2O	40	30	20	10	0
% H_2O_2	**0.00**	**0.75**	**1.50**	**2.25**	**3.00**

BEAKER	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Average	**Rate** (hints on next page)
1 – 0.00% H_2O_2							
2 – 0.75% H_2O_2							
3 – 1.50% H_2O_2							
4 – 2.25% H_2O_2							
5 – 3.00% H_2O_2							

REMEMBER:
Soak discs in catalase and place in **single** beaker of H_2O_2.

DETERMINING RATE

- Rate is determined by dividing 1 by the time. Please show all the work.
- Please graph your data using the determined rate.

PROCEDURE FOR VARYING *ENZYME* CONCENTRATIONS (EXTENSION)

1. Set five beakers up according to the table. You may use the lab sheet provided as well.
2. Perform three trials for each **enzyme** (catalase/potato extract) concentration. Remember to soak the discs in the extract, not the H_2O_2.
3. Record data.

4. After determining rate, please graph the data.

BEAKER	**1**	**2**	**3**	**4**	**5**
mL Potato Extract	0	2.5	5	7.5	10
mL H_2O	10	7.5	5	2.5	0
% Potato Extract	**0**	**25**	**50**	**75**	**100**

BEAKER	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Average	Rate
0% extract							
25% extract							
50% extract							
75% extract							
100% extract							

DETERMINING RATE

- Rate is determined by dividing 1 by the time. Please show all the work.
- Please graph your data using the determined rate.

QUESTIONS

1. **What was the purpose of taking 5 trials?**

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2. **Did changing the concentration of the H_2O_2 (substrate) influence the rate of the reaction? Explain.**

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3. **Did changing the concentration of the potato extract containing the catalase (enzyme) influence the rate of the reaction? Explain.**

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CONCLUSION –

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ADDITIONAL INQUIRY QUESTIONS

1. **What type of organic molecule is catalase, and all enzymes, composed?**

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_____

2. **If catalase is the enzyme, hydrogen peroxide is the _____.**
3. **What organelles are necessary for the synthesis of catalase? Explain**

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4. **What determines the structure of the catalase molecule?**

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5. **Does catalase operate the same at all pHs? Explain with data to support your answer.**

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6. **What is the active site of an enzyme?**

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7. **Why is it impossible for a paper clip to contain the enzyme catalase?**

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8. **Explain the "Lock and Key Theory" of enzyme action. Explain induced Fit Theory.**

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9. **Why can it be said that "without proper enzyme functioning, an organism will perish"?**

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10. EXPLAIN what effect low temperatures have upon enzyme activity. Use an animal's metabolism as an example.

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11. EXPLAIN what effect excessively high temperatures have upon enzyme activity.

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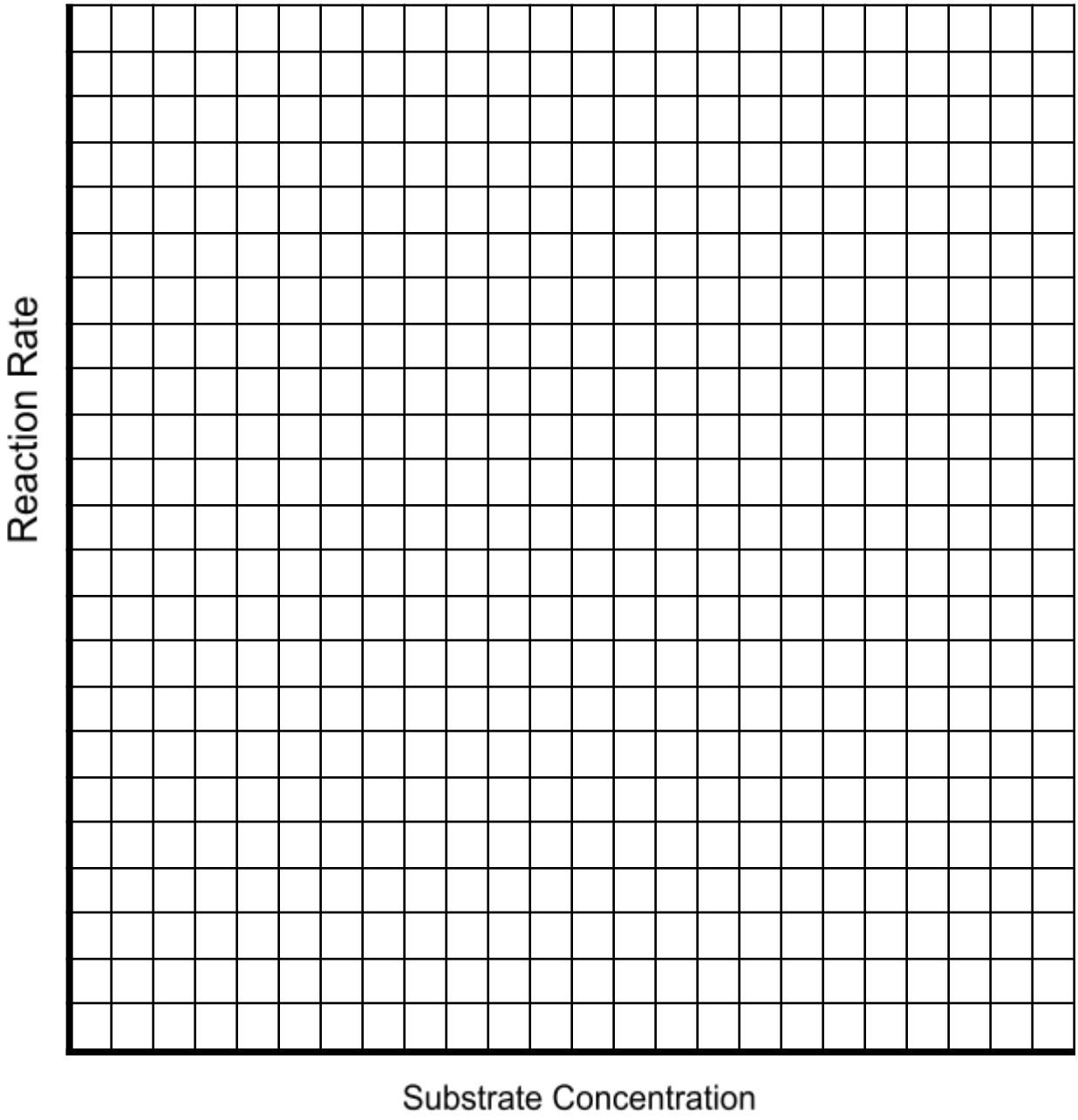
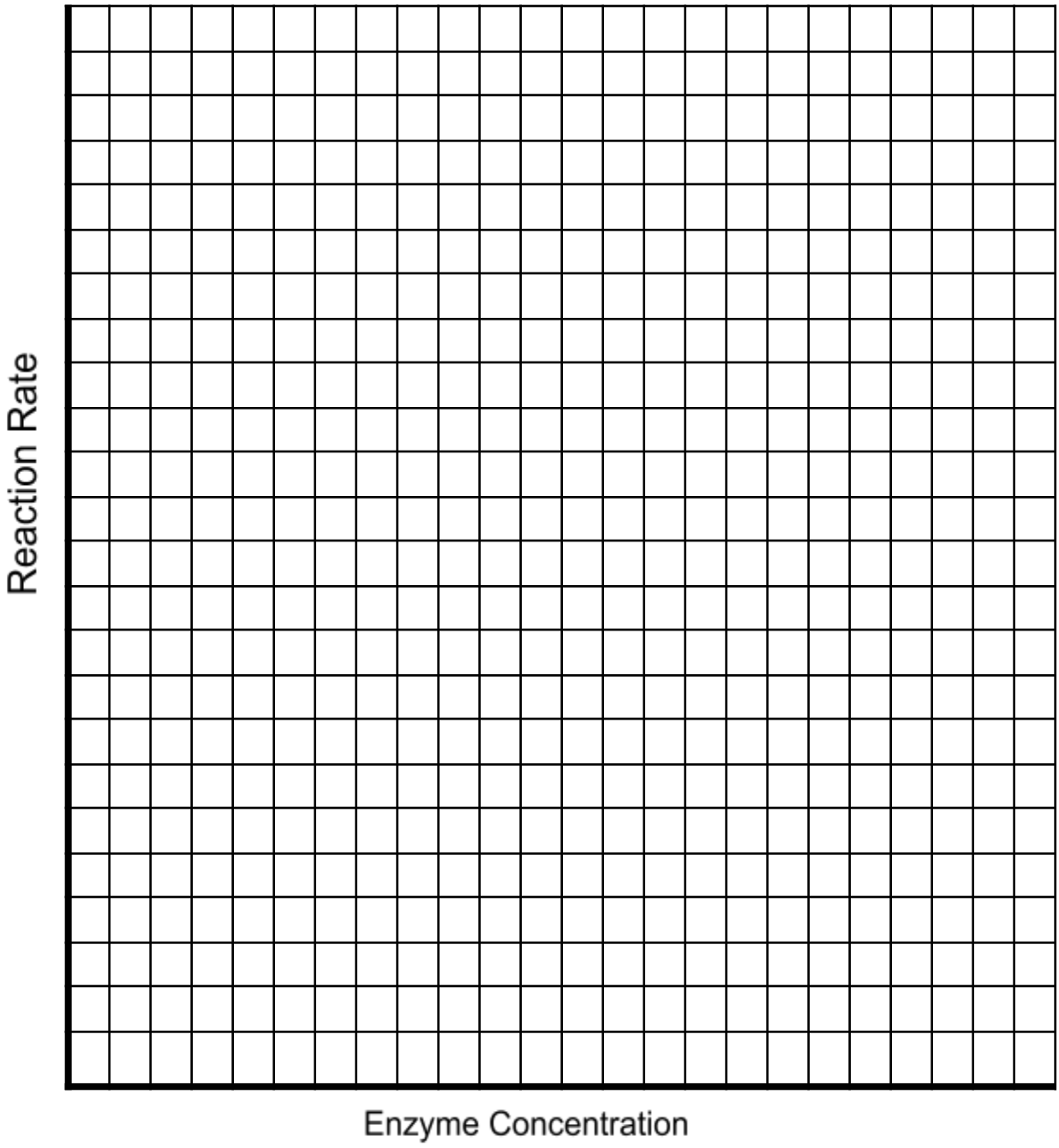
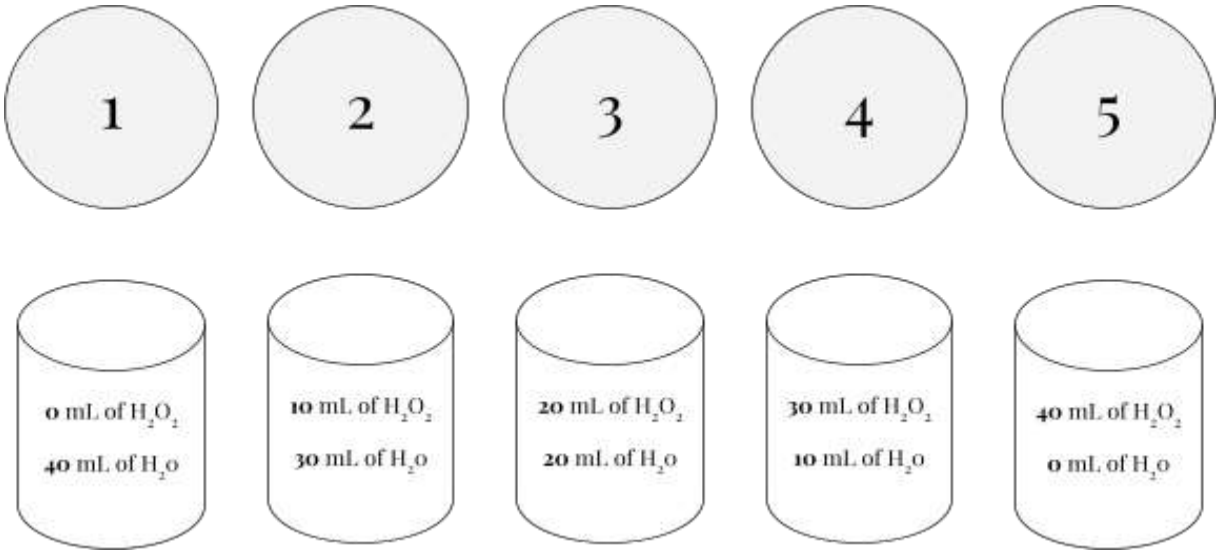
Appendices





Varying <u>H2O2</u> (Substrate) Concentrations

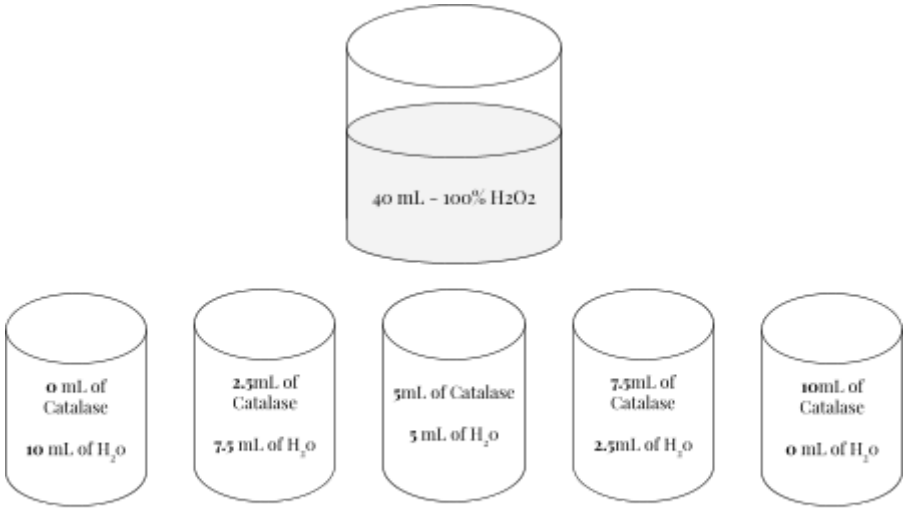


Discs are saturated with **uniform (same amount each time)** catalase and **placed in beakers with varying H_2O_2 concentrations.**

BEAKER	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Average	Rate
1 – 0.00% H_2O_2							
2 – 0.75% H_2O_2							
3 – 1.50% H_2O_2							
4 – 2.25% H_2O_2							
5 – 3.00% H_2O_2							

Varying <u>Catalase</u> (Enzyme) Concentration

Discs are saturated with **varying catalase** and **placed in beakers with uniform (40ml - 100%) H_2O_2.**



Enzyme Concentrations…you are soaking your disks in these concentrations and placing them EACH TIME in 100% H_2O_2 - 40 mL

BEAKER	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Average	Rate
0% **extract**							
25% **extract**							
50% **extract**							
75% **extract**							
100% **extract**							