

ENDOTHERMIC AND EXOTHERMIC REACTIONS

Adapted from Endothermic and Exothermic Reactions by Melissa Imler, East High and Gannon University Science in Motion

PA State Standards Addressed:

- 3.7.10.B Apply appropriate instruments and apparatus to examine a variety of objects.
- 3.4.12.B Apply and analyze energy sources & conversions & their relationship to heat & temperature.
- 3.4.10.A Explain concepts about the structure and properties of matter.
- 3.2.10.B Apply process knowledge & organize scientific & technological phenomena in varied ways.
- 2.6.5.A Organize and display data using pictures, tallies, tables, charts, bar graphs and circle graphs.
- 1.2.11.A Read and understand the central content of informational texts and documents in all academic areas.

INTRODUCTION:

In any chemical reaction, heat is either given off or absorbed causing a change in temperature. When heat is absorbed during a chemical reaction, there is a decrease in temperature. This reaction is classified as “**endothermic**”. Because heat is absorbed, the temperature of the reactants will be greater than the temperature of the products.

When heat is given off during a chemical reaction, the reaction is classified as “**exothermic**”. Such reactions release stored chemical energy resulting in an increase in temperature. The temperature of the reactants is less than the temperature of the products.

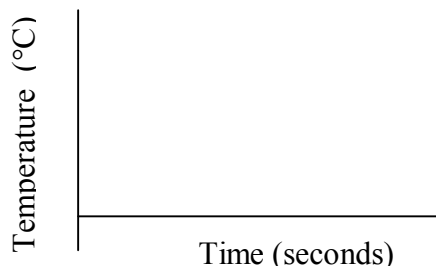
In this laboratory exercise two different chemical reactions will be observed twice. Both data that is qualitative in nature and that is quantitative in nature will be collected.

Qualitative data is data that is descriptive in nature, whereas **quantitative data** is numerical in nature.

GUIDING QUESTIONS:

Please answer the following questions before beginning the lab:

1. Predict what a graph will look like that represents the data from an endothermic reaction.



2. Read through procedure A and procedure B. Explain which procedure will produce data that is **qualitative** in nature and which will produce data that is **quantitative** in nature.

EQUIPMENT/MATERIALS:

baking soda	LabQuest
vinegar	temperature probe
peroxide	spatulas (2)
yeast	weigh boat (2)
ring stand & clamp	DI wash bottle
10 & 50 mL graduated cylinders	Kimwipes
pink reaction chamber	top-loading balance

Safety:

- **Always** wear safety goggles in the chemistry lab.
- **Never** eat or drink in the chemistry lab. **Wash** hands with soap and water after lab is complete.

PROCEDURE A: QUALITATIVE INVESTIGATION

Reaction 1: Baking Soda and Vinegar

1. Place a weigh boat on a top loading balance. Push the Tare button to set the balance to zero with the weigh boat on balance.
 2. Using a spatula, transfer 0.90-1.10 g of baking soda into the tared weigh boat.
 3. Transfer the baking soda from the weigh boat into a baggie.
 4. Measure 20 mL of vinegar in a 50 mL graduated cylinder. Slowly pour the vinegar into the baggie.
- **Caution: This reaction will cause the contents in the baggie to fizz.**
5. Seal the baggie.
 6. Carefully mix the contents of the bag by squeezing the outside of the baggie.
 7. Observe how the mixture feels. Record observation on data table.
 8. When finished observing the temperature of the baggie, empty the contents into the sink and dispose of the baggie. Rinse out graduated cylinder with wash bottle.

Reaction 2: Hydrogen Peroxide and Yeast

1. Place a weigh boat on a top loading balance. Push the Tare button to set the balance to zero with the weigh boat on balance.
2. Using a spatula, transfer approximately 0.5 g of yeast into the tared weigh boat.
3. Transfer the yeast into a plastic baggie.
4. Measure 15 mL of hydrogen peroxide in a 50 mL graduated cylinder. Slowly pour peroxide into the baggie.
5. Seal the baggie.
6. Carefully mix the contents of the bag by squeezing the outside of the baggie.
7. Observe how the mixture feels. Record observation on the Data table.
9. When finished, empty the liquid contents of the baggie into the sink and dispose of the baggie. Rinse out graduated cylinder with wash bottle.

PROCEDURE B: QUANTITATIVE INVESTIGATION

Reaction 1: Baking Soda and Vinegar

1. Turn on the LabQuest and plug the temperature probe into channel 1.
2. Tap the length box and wait for the new screen to appear. When the mode screen appears, tap the **Length: box**, backspace through 180, and type in 60. Then tap the **Interval: box**, backspace through 0.5, and type in 2. Finally tap the **OK button** in the lower right corner of the screen.
3. Place the pink reaction chamber on the ring stand base. Measure 5 mL of vinegar into a 10 mL graduated cylinder. Pour the measured vinegar into the pink reaction chamber.
4. Attach the temperature probe to the clamp. Position the clamp on the ring stand pole so that the tip of the temperature probe is in the vinegar.
5. Place a weigh boat on the balance. Tare(set to zero) the weigh boat. Mass 0.2 g of baking soda in the weigh boat.
6. Tap the **green collect arrow** on the LabQuest screen. (Hit the discard box and continue button if previous data is present). Wait about 5 seconds and add the baking soda to the vinegar in the reaction chamber. The baking soda may need to be pushed into the chamber with a spatula.
7. The LabQuest will collect data for 60 seconds. When data collection is complete, tap the **table icon** in the upper right corner of the LabQuest screen and transfer the temperature readings to Table 1. Raise the temperature probe from the reaction chamber.
8. Rinse the temperature probe off with DI water from the water bottle and dry it with a Kimwipe.
9. Empty the contents of the reaction chamber into the sink. Rinse the chamber and pat it dry with a paper towel. Rinse out the graduated cylinder.
10. Your graph may be printed by connecting your LabQuest to the provided printer using the USB cable. Tap **File** then tap **Print** followed by **Graph**. The printing process will take about one minute.

Reaction 2: Hydrogen Peroxide and Yeast

1. Tap **File** followed by tapping **New**. When the unsaved data screen appears tap **discard**.
2. To set the LabQuest to collect data every five seconds by tapping the **Rate Box**. When the **Interval: box** appears tap it and back space through 0.5 and type in 5 then tap the **OK button** in the lower right corner of the screen.
3. Place the pink reaction chamber on the ring stand base. Measure 10 mL of hydrogen peroxide and pour it into the reaction chamber. Lower the temperature probe so that the tip is in the chamber, off to one side.
4. Place a weigh boat on the balance. Tare(set to zero) the weigh boat. Mass 0.1 g of yeast in the weigh boat.

5. Tap the **green collect arrow** on the LabQuest screen. (Hit the discard box and continue button if previous data is present). Wait about 5 seconds and add the yeast to the hydrogen peroxide in the reaction chamber.
6. The LabQuest will collect data for 180 seconds. When data collection is complete, tap the table button in the upper right corner of the LabQuest screen and transfer the temperature readings to Table 2.
7. Rinse the temperature probe off with DI water from the water bottle and dry it with a Kimwipe.
8. Empty the contents of the reaction chamber into the sink. Rinse the chamber and dry it with a paper towel. Rinse out the graduated cylinder.
9. Your graph may be printed by connecting your LabQuest to the provided printer using the USB cable. Tap **File** then tap **Print** followed by **Graph**. The printing process will take about one minute.

DATA ANALYSIS:

Create a line graph using the data in Table 1 and 2 on two separate graphs. Remember to include a title for each graph and a label for each axis that includes units.

Name _____

Period _____

Date _____

EXOTHERMIC AND ENDOTHERMIC REACTIONS DATA

Procedure A:

Reaction 1: Baking Soda and Vinegar : observation of temperature _____

Reaction 2: Hydrogen Peroxide and Yeast: observation of temperature _____

Procedure B: Table 1 _Baking Soda and Vinegar

Time	Temperature
0	
2	
4	
6	
8	
10	
12	
14	
16	
18	
20	
22	
24	
26	
28	
30	
32	
34	
36	
38	
40	
42	
44	
46	
48	
50	
52	
54	
56	
58	
60	

Procedure B: Table 2: Hydrogen Peroxide and Yeast

Time	Temperature
0	
5	
10	
15	
20	
25	
30	
35	
40	
45	
50	
55	
60	
65	
70	
75	
80	
85	
90	
95	
100	
105	
110	
115	
120	
125	
130	
135	
140	
145	
150	
155	
160	
165	
170	
175	
180	

