Reaction Rates:
When Surface Area Matters!

Name: _____

Date: _____

Student worksheet

Directions: Answer the questions below in preparation for the experiment.

1. Pre-Experiment

a. In your own words, explain how you will monitor the Alka-Seltzer® reaction over time. How will you know when the reaction is done?

b. How does breaking the tablet into smaller pieces change the total surface area of the whole tablet?

c. What are the independent and dependent variables in your experiment? Remember, independent variables are what you change; dependent variables are what you measure.

d. Write down your hypothesis about how the surface area of the Alka-Seltzer tablet will affect the reaction rate. Write 1–3 sentences explaining why this is your hypothesis.

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Directions: Follow the steps below to conduct your experiment.

2. Experiment

Experiment 1: Whole Alka-Seltzer tablet

a. Fill the beaker or cup with water up to the top of the masking tape.

b. Take one whole Alka-Seltzer tablet. Be careful – they break easily!

c. Drop the whole tablet into the water and start the stopwatch immediately.

d. Stop the stopwatch when the solid material has completely disappeared and the bubbles have stopped forming.

e. Record the reaction time in the data table in below.

Experiment 2: Tablet broken into 16 pieces

f. Repeat steps a.-e. using an Alka-Seltzer tablet broken into 16 pieces. Take one whole effervescent tablet and start by halving it with your hands. Then halve each piece again with your fingers until you have 16 pieces of approximately the same size. Drop all pieces into the water at the same time.

Experiment 3: Powdered tablet

g. Repeat steps a.-e. using an Alka-Seltzer tablet ground into powder. To do this, fold one whole tablet inside a clean piece of paper. Use the back of a metal spoon to carefully crush the tablet into a powder once it is wrapped. Stop immediately if the paper shows signs of tearing: you do not want to lose any of the powder. Drop all of the powder into the water at the same time.

3. Record and Analyze Your Data

a. Record your results in the data table below. Calculate the average reaction times from the combined class data that you will collect together with your teacher.

Experiment	Reaction time [s]	Reaction Rate [g/s]	Average reaction time from class data [s]	Average reaction rate from class data [g/s]
Whole tablet				
16 pieces				
Powder				

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Directions: Continue following the steps below to analyze your data.

b. Convert the reaction times into average reaction rates using the equation given below. Record the results in your data table and again calculate the average from the combined class data for each experiment.

$$\text{Reaction rate} = -\frac{\Delta \text{ Mass of Alka-Seltzer tablet [g]}}{\Delta \text{ time [s]}}$$

Change in tablet mass [g] = Final tablet mass [g] – Initial tablet mass [g]

Final tablet mass [g] = 0 g

Initial tablet mass [g] = *this number will be given to you by your teacher*

Change in time [s] = Final time [s] – Initial time [s]

Final time [s] = Time at end of reaction [s]

Initial time [s] = 0 s

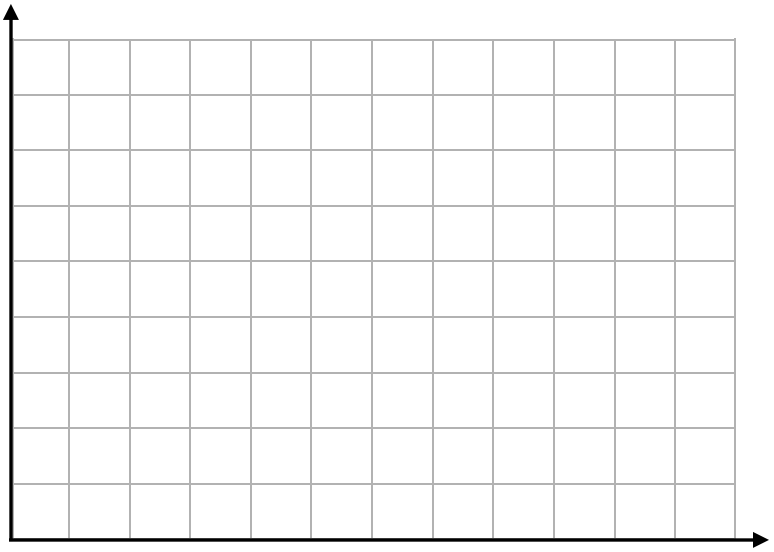
c. Which tablet size resulted in the fastest reaction rate? Which one resulted in the slowest? How do these results relate to the surface area of the tablet?

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Directions: Continue following the steps below to graph your data and reflect on the experiment.

d. Create a graph that demonstrates the correlation between surface area and reaction rate using your results from the data table above. Use "low (whole tablet)," "medium (tablet in 16 pieces)" and "high (powdered tablet)" as labels for the axis showing the surface area.



4. Reflection

a. In your own words, explain your data using the Collision Theory. What changes during the reaction on a molecular level when you change the surface area of the reactant?

b. Considering your answer in question a., explain why the reaction rate is surface area-dependent.