# Reaction Rates: The Kinetics of Chemical Reactions

Several different factors affect how quickly chemical reactions occur. One of the basic concepts is that in order for a reaction to occur, reactant particles (atoms, molecules, etc.) must **collide**. <u>Collisions between particles can produce a reaction</u>. The rate of a reaction refers to how quickly or slowly the reactants turn into products. In life there are some reactions that we want to speed up and some that we want to slow down. There are many ways that we can affect the rate of a reaction; these include temperature, concentration, and surface area.

(a)

(b)

The collision of two particles (reactants)
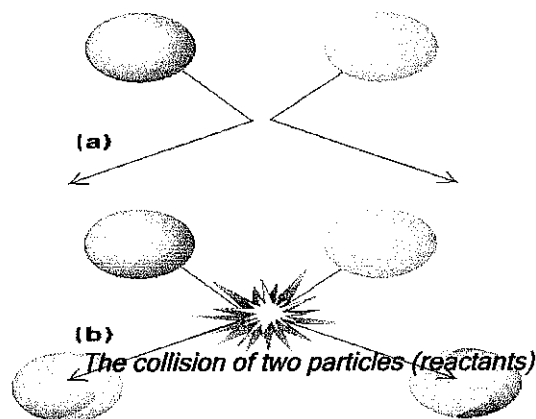
Effects Of Temperature On Molecular Motion

SOLID
COLD   HOT

LIQUID
COLD   HOT
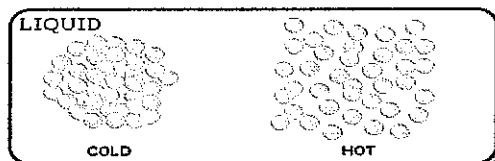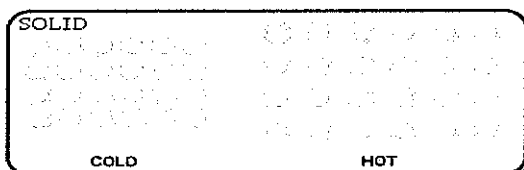
<u>Temperature</u> affects reaction rate by increasing the speed of the particles, which means there will be a greater number of collisions. This increases the chances of a reaction occurring. <u>Increasing the temperature increases both the speed and number of the collisions.</u> A reaction will occur faster at a temperature of 100 degrees Celsius than 0 degrees Celsius because particles have higher energy and move much more quickly, increasing the number of collisions.

The <u>concentration</u> (number of particles per unit of volume) affects reaction rate. <u>By increasing the number of particles in a given volume, the number of collisions increases and the reaction goes faster.</u> A reaction will happen much more quickly between 300 particles than between 3 particles.
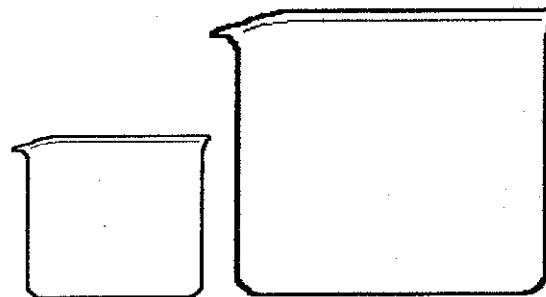
The <u>surface area</u>, the amount of material that comes in contact with other objects, affects the rate of a reaction. <u>Decreasing the surface area increases the rate of the reaction because there is less space for collisions to take place.</u> Crushing a substance into a fine powder will increase surface area and increase the number of collisions; a crushed alka seltzer will react more quickly than a solid alka seltzer because it has less surface area.
A crushed pill vs. a whole pill

Name: _____   Date: _____

Reaction Rate Reading – Practice

Paragraph	Main Idea	Picture	Supporting Details
1			1.
			2.
2			1.
			2.
3			1.
			2.
4			1.
			2.

Physical change	Chemical Change
	Signs: 1. 2. 3. 4. _____ A _____ forms from a chemical reaction that takes place in a _____ (Liquid)
Ex:	Ex:

Physical or Chemical Change Lab

Directions:
1. Identify name of Chemical formula
2.Record your observation (what happened?)
3. Was it PHYSICAL or CHEMICAL?

NaHCO₃ = Baking Soda   *CaCl₂ = Calcium Chloride*

Reactants	Observations	Physical or Chemical? (sign)
1. $NaHCO_3 + H_2O$ _____ + _____		
2. $CaCl_2 + H_2O$ _____ + _____		
3. $NaHCO_3 + CaCl_2$ _____ + _____		
4. 1. Pour 20 mL of water into cup #1. 2. Add 2 drops of food coloring to the water 3. Add one drop of bleach to the solution 4. Add bleach one drop at a time until you notice a change, when you notice a change, stop adding bleach		

Name: _____Independent Practice: Reaction Rate Questions

Knowledge:

1. Increased Temperature = _____ Reaction

    1)   Which will have a greater reaction rate?   **2)**   Which will have a greater reaction rate?

         (a) 28 °C   (b) 40 °C   (a) 298 °C   (b) 272 °C

2. _____ Concentration = Increases Reaction Rate

    1)   Which will have a greater reaction rate?   **2)**   Which will have a greater reaction rate?

         (a) 300 particles/liter   (b) 3.5 particles/liter   (a) 2000 particles/liter (b) 200 particles/liter

3. Increasing Surface Area = _____ Reaction Rate

    1)   Which will have a greater reaction rate?   **2)**   Which will have a greater reaction rate?

         (a) Salt Cubes   (b) Table Salt   (a) Cubed Ice   (b) Crushed Ice

Comprehension:

1. If two reactants collide, what will be the result?
     a. product   c. volume
     b. mixture   d. a new element

2. As the number of collisions between reacting particles increases, the rate of the reaction
     a. decreases   c. remains the same
     b. increases   d. depends on the reactants

3. In the reaction $2Mg + O_2 \rightarrow 2MgO$, as the surface area of Mg increases, the rate of the reaction
     a. decreases   c. remains the same
     b. increases   d. depends on the amount of oxygen present

4. Consider the following equation.
     $Mg + 2H_2O \rightarrow Mg(OH)_2 + H_2$
For the reaction to occur at the fastest rate, 1 g of Mg should be added in the form of
     (1) large chunks   (2) small chunks   (3) a ribbon   (4) a powder

Analysis: (Complete on the loose leaf paper and attach at the end of class)

1. Why would little pieces of iron rust faster than an iron nail?

2. We put foods such as meats, cheese and fruits it in the fridge. Explain, using your knowledge of factors affecting the rate of reaction, why food doesn't spoil as fast when it is refrigerated as it would at room temperature?

3. Why would a mixture of gases react faster when the volume (space) they occupy is decreased?

4. When Diet Coke and Mentos combine, a chemical reaction occurs. If I have 7 Mentos and a Diet Coke, how many of the Mentos would you use to have the biggest chemical reaction? Using your new knowledge on the three factors that affect chemical reactions, explain why.

Synthesis: What could you do to increase the reaction of baking soda and vinegar? Hint: Think about the ways you can increase reaction rate.