Student’s Lesson at a Glance

Lesson Summary

This lesson has two activities. Students will be introduced to chemical kinetics through making connections with chemical reactions from previous lessons. Using a marathon as a metaphor for reaction rate, students will explore the terms “rate” and the “extent of a reaction”. In the final activity of the lesson, students will learn that kinetics is a combination of many of the other earlier concepts in chemistry. Students will briefly review these concepts through completion of submicroscopic sketches of the provided scenarios.

SWBAT (Student will be able to)

- Define chemical kinetics
- Define rate of the reaction
- Define extent of the reaction

Essential Vocabulary

Keep a list of all important words from this lesson. This list, in addition to the lists from other lessons, will make studying easier and improve scientific communication skills. The essential vocabulary from the unit is in bold. Additional words that will expand your scientific vocabulary are in italics.
**CCC Reminder**

- Use the vocabulary and notes sections to take good notes so studying for tests and quizzes is easier.
- Use vocabulary notes from previous sections to help refresh your understanding of concepts.
- Draw a key when you are sketching. Keys can help you and others decode your sketches at a later time.
- Create clear explanations of the sketches you create so they are usable at a later time to study.
- There is a periodic table and list of common elements used in the back of this book. You will need to refer to the periodic table often.

**Notes**

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**Homework**

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**Upcoming Quizzes / Tests**

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Activity 1: Connecting

1. What do you think: Why does milk spoil faster when it is at room temperature than when it is placed in a cold refrigerator?

2. What does the word **intermediate** mean to you?

Not all chemical reactions react at the same rate. Some reactions reach completion in less than a second, and other reactions reach completion after many years. The **extent of a reaction** refers to how far a reaction has progressed to completion. The extent of a reaction is comparable to the distance traveled by a runner in a marathon. The **reaction rate** is the change in the concentration of reactants with respect to time, or how quickly the reaction is progressing to completion. Using the same marathon analogy, the reaction rate is comparable to how fast the runner is running.

**Chemical kinetics** is the study of the reaction rate, the extent of the reaction, the factors affecting reaction rates, the rearrangement of atoms, and the formation of intermediate products. **Kinetics** is derived from the Greek word “kinesis,” which means “movement.” Chemical kinetics is an important way to study different reactions in nature. For example, all of the following observable phenomena are chemical reactions with important differences in their chemical kinetics:

- Strike a match and it burns quickly
- The Statue of Liberty’s copper metal skin turns a shade of light green after years of exposure to weather
- Vinegar and baking soda immediately form bubbles when mixed together
- Real silver jewelry tarnishes over several weeks as it reacts to substances in the environment surrounding it

Chemical kinetics differs from kinetics in that it does not focus solely on movement of molecules. Rather, chemical kinetics is focused on the change of reactant and product concentration over time during a reaction. This is related to kinetics because the motion of the molecules is related to the rate of a reaction.

3. What is the difference in the four examples of chemical reactions above?
### Activity 2: Sketching Concept Review Challenge

Chemical kinetics includes concepts from many other areas of chemistry including solutions, reactions, collision theory, and thermodynamics.

As a group, select one of the scenarios below. Fill in the scenario numbers that you select into the tables on the following pages. Create a submicroscopic drawing for each of the scenarios your group selected. Include a key and captions to explain what is happening in the drawing. Use arrows to show both direction and velocity. Make sure to include the arrows in the key.

#### Scenarios

*Select one of the following scenarios*

1. A system containing a monatomic and diatomic gas at low temperatures
2. A concentrated solution of sodium chloride (NaCl) and water
3. A monatomic gas under high pressure
4. The products of a combustion reaction between methane gas and oxygen gas
5. Water at 100 °C
6. Table salt (NaCl) added to cold water
7. A mixture with three non-reactive substances representing all three states of matter
8. The final products of a reaction that starts with the reactants: Pb(NO₃)₂ (aq) + 2 KI (aq)
9. A mixture of a polar and non-polar substance
10. Helium molecules inside a refrigerated jar that has been set out in a 25°C room

*After your group has completed the drawing in your workbooks, be prepared to explain your drawings to the class.*

<table>
<thead>
<tr>
<th>Scenario Number _____</th>
<th>Sketch</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Key</td>
<td></td>
<td></td>
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Lesson Reflection Questions


5. Use your definition of *rate* to define a rate that captures what is happening in the scenario that you chose.