Standard #: SC.912.P.12.12

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Explain how various factors, such as concentration, temperature, and presence of a catalyst affect the rate of a chemical reaction.

General Information

Subject Area: Science

Grade: 912

Body of Knowledge: Physical Science

Idea: Level 3: Strategic Thinking & Complex Reasoning

Standard: Motion -
A. Motion can be measured and described qualitatively and quantitatively. Net forces create a change in motion. When objects travel at speeds comparable to the speed of light, Einstein's special theory of relativity applies.

B. Momentum is conserved under well-defined conditions. A change in momentum occurs when a net force is applied to an object over a time interval.

C. The Law of Universal Gravitation states that gravitational forces act on all objects irrespective of their size and position.

D. Gases consist of great numbers of molecules moving in all directions. The behavior of gases can be modeled by the kinetic molecular theory.

E. Chemical reaction rates change with conditions under which they occur. Chemical equilibrium is a dynamic state in which forward and reverse processes occur at the same rates.

Date Adopted or Revised: 02/08

Content Complexity Rating: Level 3: Strategic Thinking & Complex Reasoning - More Information

Date of Last Rating: 05/08

Status: State Board Approved

Related Courses

Course Number	Course Title
2000430:	Biology Technology (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
3027010:	Biotechnology 1 (Specifically in versions: 2015 and beyond (current))
3027020:	Biotechnology 2 (Specifically in versions: 2015 and beyond (current))
2000370:	Botany (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2003340:	Chemistry 1 (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2003350:	Chemistry 1 Honors (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2002480:	Forensic Science 1 (Specifically in versions: 2014 - 2015, 2015 - 2017, 2017 - 2022 (current), 2022 and beyond)
2002490:	Forensic Sciences 2 (Specifically in versions: 2014 - 2015, 2015 - 2017, 2017 - 2022 (current), 2022 and beyond)
2000440:	Genetics Honors (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2002430:	Integrated Science 2 Honors (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2002440:	Integrated Science 3 (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2002450:	Integrated Science 3 Honors (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2003310:	Physical Science (Specifically in versions: 2015 - 2022 (current), 2022 and beyond)
2003320:	Physical Science Honors (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2003800:	Florida's Preinternational Baccalaureate Chemistry 1 (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
7920011:	Access Chemistry 1 (Specifically in versions: 2014 - 2015, 2015 - 2018, 2018 and beyond (current))
2000520:	Bioscience 3 Honors (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2002445:	Integrated Science 3 for Credit Recovery (Specifically in versions: 2014 - 2015, 2015 - 2020 (course terminated))
2003345:	Chemistry 1 for Credit Recovery (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
7920022:	Access Physical Science (Specifically in versions: 2016 - 2018, 2018 and beyond (current))

Related Resources

Lesson Plans

Name	Description
	This one-day investigation begins with a teacher demonstration that introduces students to the nature of catalysts

Let's Get It Started: Chemical Reaction Rates:	and how they influence chemical reaction rates. Students then formulate hypotheses and collect data on the effects of temperature and concentration of a reactant on reaction rates. Students will be able to graph their data (both individual and group) and compile/analyze class data using GeoGebra.
Temperature, Volume, and Rate of Reaction:	This one-two day lab will allow students to collect data on temperature, volume, and rate for a reaction in a closed system. Heat speeds up the reaction, altering both volume and rate due to an increase in energy. Students will be able to graph their own lab group's data and compile class data if Google docs is available. They can then look at correlations between temperature, volume, and rate of reaction.
Chemical Reaction Rates: Inquiry on Affecting Factors:	Chemical reaction rates can differ when different factors are present. The lesson focuses on the main rate changing contributors: temperature, concentration, surface area, and catalysts. Students are intended to learn through several inquiry based lab stations with minimal teacher guidance. The labs are of thought and observational base with little complexity in construction.

Perspectives Video: Professional/Enthusiast

Name	Description
Ethanol Fuel:	Why can't you put Ethanol fuel in a boat motor? Download the CPALMS Perspectives video student note taking guide.

Project

Name	Description
Factors Affecting Chemical Reaction Rates:	This website offers a number of experiments that teachers can use to demonstrate or show to the students how chemical reaction rates can be affected by different factors.

Text Resource

Name	Description
Berkeley Scientists Discover Inexpensive Metal Catalyst for Generating Hydrogen from Water:	This informational text resource is intended to support reading in the content area. The article demonstrates the importance of hydrogen as an alternative to fossil fuels and announces the discovery of a new catalyst useful in splitting water molecules to obtain hydrogen gas. Current methods of obtaining hydrogen from natural gas, for example, release carbon and consume large amounts of energy. This new catalyst opens the possibility of making hydrogen production much less expensive and carbon neutral as compared to current technologies.

Unit/Lesson Sequence

Name	Description
Middle School Chemistry Unit | Chapter 6 | Chemical Change:	Students explore the concept that chemical reactions involve the breaking of certain bonds between atoms in the reactants, and the rearrangement and rebonding of these atoms to make the products. Students also design tests to investigate how the amount of products and the rate of the reaction can be changed. Students will also explore endothermic and exothermic reactions.

Virtual Manipulatives

Name	Description
Step Growth Polymerization:	This activity will help the students learn about the polymerization. The process of polymerization can be classified into two categories: Chain growth polymerization and step growth polymerization. In this activity students will understand the process of step growth polymerization in which bi-functional or multi-functional monomers react to form polymers.
Molarity:	This virtual manipulative will help the students understand what determines the concentration of a solution. They will learn about the relationships between moles, liters and molarity by adjusting the amount of solute, and solution volume. Students can change solutes to compare different chemical compounds in water. Some of the sample learning goals can be: • Describe the relationships between volume and amount of solute to concentration • Explain how solution color and concentration are related. • Calculate the concentration of solutions in units of molarity (mol/L) • Compare solubility limits between solutes.
Reactions Rates:	This virtual manipulative will allow you to explore what makes a reaction happen by colliding atoms and molecules. Design your own experiments with different reactions, concentrations, and temperatures. Recognize what affects the rate of a reaction. Areas to Explore: • Explain why and how a pinball shooter can be used to help understand ideas about reactions. • Describe on a microscopic level what contributes to a successful reaction. • Describe how the reaction coordinate can be used to predict whether a reaction will proceed or slow. • Use the potential energy diagram to determine : The activation energy for the forward and reverse reactions; The difference in energy between reactants and products; The relative potential energies of the molecules at different positions on a reaction coordinate. • Draw a potential energy diagram from the energies of reactants and products and activation energy. • Predict how raising or lowering the temperature will affect a system in the equilibrium.
	This activity will allow you to make colorful concentrated and dilute solutions and explore how much light they absorb and transmit using a virtual spectrophotometer.

Beer's Law Lab:	You can explore concepts in many ways including: • Describe the relationships between volume and amount of solute to solution concentration. • Explain qualitatively the relationship between solution color and concentration. • Predict and explain how solution concentration will change for adding or removing: water, solute, and/or solution. • Calculate the concentration of solutions in units of molarity (mol/L). • Design a procedure for creating a solution of a given concentration. • Identify when a solution is saturated and predict how concentration will change for adding or removing: water, solute, and/or solution. • Describe the relationship between the solution concentration and the intensity of light that is absorbed/transmitted. • Describe the relationship between absorbance, molar absorptivity, path length, and concentration in Beer's Law. • Predict how the intensity of light absorbed/transmitted will change with changes in solution type, solution concentration, container width, or light source and explain why?

Student Resources

Perspectives Video: Professional/Enthusiast

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Virtual Manipulatives

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Parent Resources

Virtual Manipulatives

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	• Compare solubility limits between solutes.
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