



## Chemistry Concepts 3-4 Syllabus

### Course Goals

#### 1 The Scientific Method

Students learn about the methods used scientists to investigate the natural world: Experimental design, controls and variables, inference and observation, and recording data.

#### 2 Concepts of Chemistry

Students learn about the core concepts of chemical science, such as states of matter and phase changes, heat, energy, acids and bases, atoms and the periodic table, and chemical reactions.

#### 3 Laboratory Science

Students learn the procedures used to conduct laboratory experiments, including safety procedures, and will get to design and conduct their own experiments in the lab.

### Course Topics

#### 1 Scientific Observation and Inference

Students differentiate between observation and inference and develop their curiosity about scientific phenomena.

#### 2 The Scientific Method

Students understand the process of developing a hypothesis, running an experiment, and interpreting results.

#### 3 Atoms and Elements

Students learn about atomic structure and its relation to elements in the periodic table.

#### 4 Heat and Energy

Students discover how heat and energy are related in chemical reactions.

#### 5 Acids and Bases

Students explore acids and bases through learning about pH and testing substances.

#### 6 States of Matter

Students understand the chemical difference between solids, liquids, and gases.

#### 7 Chemical Reactions

Students complete labs to explore different types of reactions.

#### 8 Liquids and Solutions

Students learn about solubility and the differences in how various substances dissolve.

#### 9 Experimental Design

Students learn how to plan and conduct an experiment that can determine cause and effect.

### Course Schedule

## Day 1

### Introduction and icebreaker

Students are introduced to their instructor, the class, and each other.

### Observation and Inference: Mystery Tube

Students learn the difference between observation and inference, and try to infer the contents of a mysterious object based on their observations.

### Observation and Inference Practice

Students use their understanding of observation and inference to assess a scientific sample.

### Mystery Cubes

Students use what they've learned about observation and inference to investigate a pair of mysterious objects and draw conclusions about them.

## Day 2

### Introduction to the Scientific Method

Students learn about the scientific method and how scientists structure their experiments

### Scientific Method Activity--Class

Students apply what they've learned about the scientific method to design a set of experimental questions.

### Scientific Method Activity--Groups

Students work in groups to answer the experimental questions they designed in the previous activity.

### Atomic Structure Timeline

Students learn about the structure of the atom and the history of its discovery.

### Periodic Aliens Activity

Students learn about the concept of the periodic table and how it is used to predict the properties of as-yet undiscovered elements.

### Mystery Shapes Activity

Students use what they've learned about scientific inquiry to investigate a series of mysterious hidden objects.

## Day 3

### Parts of an Atom

Students learn about the components of atoms and the significance of protons, electrons, and neutrons.

### Atomic Musical Chairs

Students model the behavior of electrons in their orbitals around atoms.

### Labeling the Periodic Table

Students learn about the periodic table, groups and periods of elements, and the difference between metals and non-metals.

### Exploring the Elements

Students explore similarities and differences between the elements of the periodic table, and search for patterns among them.

## Day 4

### States of Matter

Students learn about the characteristics and behavior of matter in its three normal states: Solid, liquid, and gas.

## **The State of Oobleck**

Students experiment with Oobleck, a material that exhibits different properties under different conditions, and learn about why it behaves the way it does.

## **Special Properties of Water**

Students learn about the unique physical properties of water that make it such an important substance on our planet.

## **Day 5**

### **Spool Racer: Kinetic vs. Potential Energy**

Students use torsion-powered racers to explore potential and kinetic energy.

### **Demonstration: Potential-Kinetic Track**

Students use marbles and tracks to explore kinetic and potential energy as it relates to gravity and elevation.

### **Creating a Roller Coaster**

Students apply what they've learned about kinetic and potential energy to create a roller coaster.

### **Endothermic and Exothermic Reactions**

Students create and observe various chemical reactions, and learn about the

### **Elephant Toothpaste Demo**

Students observe and experiment with an exothermic reaction involving yeast and hydrogen peroxide.

### **PE-KE game**

Students finish the day's class with a game that illustrates the difference between potential and kinetic energy.

## **Day 6**

### **Viscosity of Liquids**

Students learn about the concept of viscosity and conduct an experiment to observe the viscosity of different liquids.

### **Temperature and Viscosity**

Students conduct an experiment to observe how temperature affects the viscosity of a liquid.

## **Day 7**

### **Acids and Bases**

Students learn about acids, bases, and the pH scale.

### **Testing pH**

Students conduct a series of experiments to determine pH of various household substances

### **Acid Rain**

Students learn about the causes and effects of acid rain, and conduct an experiment to simulate its effect on stonework.

## **Day 8**

### **Acid-Base Neutralization**

Students will learn about how acids and bases neutralize each other, and will conduct an experiment to observe this.

### **Invisible Ink**

Students see how various chemical techniques such as acid-base interaction can be used to reveal a hidden message.

## Day 9

### **Solutions and Solubility**

Students learn about the concepts of a solution and solubility, and how solutions are formed.

### **Experiment: Dissolution**

Students conduct an experiment with salt and water to learn about solubility and solutions.

### **Salt vs. Sugar**

Students conduct an experiment to observe the difference in how salt and sugar dissolve in liquids.

### **Lab: Dissolving Life Savers**

Students apply the scientific method to design an experiment that will determine how life savers dissolve in different liquids.

### **Lab: Baking Soda and Vinegar**

Students conduct an experiment to observe the interaction between baking soda and vinegar

## Day 10

### **Final Activity: Experimental Design**

Students design their own final project, an experiment involving the reaction between Coke and Mentos in which they'll choose a variable and observe its effect on the reaction.

### **Final Activity: Running the Experiment**

Students carry out the experiments they designed in the previous activity.

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