Syllabus

Chemistry, Semester A

Course Overview

Chemistry is the study of matter and how it changes. This course looks at matter's composition, properties, and transformations. In this semester, you'll explore the structure and properties of matter. You'll analyze and construct the periodic table of elements. You'll compare elements based on their atomic structures and relative positions in the periodic table. You will also discuss the chemical bonding taking place in ionic and covalent compounds and metals. Finally, you'll predict the outcome of chemical reactions based on the reactants involved.

Course Goals

By the end of this course, you will be able to do the following:

- Describe the nature of the physical sciences.
- Explain ways in which scientists collect and share information.
- Distinguish between different forms of matter, and describe their physical and chemical properties.
- Compare atoms, and describe the structure of an atom of a given element.
- Compare the properties of the elements based on their electron structures and their relative positions in the periodic table.
- Predict the structures of ionic, covalent, polyatomic, and organic compounds, and describe their typical properties.
- Predict the outcome of simple chemical reactions based on the structures and properties of the reactants.
- Describe chemical reactions in terms of precipitation, oxidation, and reduction.

General Skills

To participate in this course, you should be able to do the following:

- Complete basic operations with word processing software, such as Microsoft Word or Google Docs.
- Understand the basics of presentation software, such as Microsoft PowerPoint or Google Slides, but having prior experience is not necessary.
- Perform online research using various search engines and library databases.
- Communicate through email and participate in discussion boards.

For a complete list of general skills that are required for participation in online courses, refer to the Prerequisites section of the Student Orientation, found at the beginning of this course.

Credit Value

Chemistry, Semester A, is a 0.5-credit course.

Course Materials

- notebook
- computer with Internet connection and speakers or headphones
- Microsoft Word or equivalent
- Microsoft PowerPoint or equivalent

Course Pacing Guide

This course description and pacing guide is intended to help you keep on schedule with your work. Note that your course instructor may modify the schedule to meet the specific needs of your class.

Unit 1: Atoms and Elements

Summary

This unit begins with a foundational lesson on the nature and importance of the physical sciences (chemistry and physics). You'll explain the ways in which scientists collect and share information. By observing its physical and chemical properties, you'll identify the substance that an object is made of. You'll also distinguish between different forms and states of matter and describe the ways in which matter can change. Near the end of the unit, you'll compare atoms of different elements with respect to the subatomic particles that they contain. You'll describe the structure of an atom of a given element based on the element's position in the periodic table.

Day	**Activity/***Objective*	Type
1 day: 1	**Syllabus and Student Orientation** *Review the Student Orientation and Course Syllabus at the beginning of this course.*	Course Orientation
3 days: 2–4	**Introduction to the Physical Sciences** *Explain the nature and importance of the physical sciences.*	Lesson

Day	Activity/*Objective*	Type
3 days: 5–7	**Scientific Models and Measurement** *Explain the ways in which scientists collect and share information.*	Lesson
3 days: 8–10	**Identifying a Substance by Its Properties** *Identify the substance that an object is made of by observing its physical and chemical properties.*	Course Activity
3 days: 11–13	**Classifying Matter** *Distinguish between different forms and states of matter.*	Lesson
4 days: 14–17	**Properties and Changes of Matter** *Describe physical and chemical properties and changes of matter.*	Lesson
5 days: 18–22	**The Structure of the Atom** *Compare atoms with respect to the subatomic particles that they contain.*	Lesson
3 days: 23–25	**Constructing a Table of the Elements** *Create and analyze periodic tables based on the properties of the elements.*	Course Activity
5 days: 26–30	**The Periodic Table** *Describe the structure of an atom of a given element on the basis of element's position in the periodic table.*	Lesson
4 days: 31–34	**Unit Activity and Discussion—Unit 1**	Unit Activity/ Discussion
1 day: 35	**Posttest—Unit 1**	Assessment

Unit 2: Chemical Bonding

Summary

This unit starts with a Course Activity in which you'll compare elements in terms of their reactivity to determine what chemical reactions are likely to take place. You'll see how the properties and reactivity of the elements relate to their electron structures and relative positions in the periodic table. You'll also describe ionic compounds, covalent compounds, and metals in terms of their structure, properties, and chemical bonding. In another Course Activity, you'll investigate how a transition metal can form ions with different charges. Finally, you'll look at how an ion can contain more than one atom and study carbon's role in the formation of organic compounds.

Day	**Activity/***Objective*	Type
3 days: 36–38	**Determining an Activity Series** *Compare elements in terms of their reactivity to determine what chemical reactions are likely to take place.*	Course Activity
4 days: 39–42	**Periodic Trends of the Elements** *Compare the properties of elements based on their electron structures and their relative positions in the periodic table.*	Lesson
4 days: 43–46	**Ionic Compounds and Metals** *Predict the structures of ionic compounds and metals and describe their typical properties.*	Lesson
4 days: 47–50	**Covalent Compounds** *Predict the structures and properties of covalent compounds.*	Lesson
3 days: 51–53	**Charges on Transition Metal Ions** *Describe evidence that a transition metal can form ions with different charges.*	Course Activity
4 days: 54–57	**Complex Structures** *Predict the structures of compounds that contain polyatomic ions and transition metals.*	Lesson
4 days: 58–61	**Organic Compounds** *Describe and illustrate carbon's ability to form a variety of different compounds.*	Lesson
3 days: 62–64	**Unit Activity and Discussion—Unit 2**	Unit Activity/ Discussion
1 day: 65	**Posttest—Unit 2**	Assessment

Unit 3: Chemical Reactions

Summary

In this unit you'll predict the outcome of simple chemical reactions based on the structures and properties of the reactants. You'll also describe chemical reactions in terms of precipitation, oxidation, and reduction and then analyze how temperature and concentration affect the rate of a chemical reaction. Finally, you'll predict how altering the environment in which a chemical reaction takes place changes the rate of reaction and the amount of products.

Day	**Activity/***Objective*	Type
4 days: 66–69	**Chemical Reaction Patterns** *Predict the outcome of a simple chemical reaction based on the structures and properties of the reactants.*	Lesson
3 days: 70–72	**Oxidizing and Reducing Chemicals** *Analyze the situations in which chemicals are oxidized or reduced.*	Course Activity
4 days: 73–76	**Advanced Reaction Patterns** *Explain and predict chemical reactions in terms of precipitation, oxidation, and reduction.*	Lesson
3 days: 77–79	**Investigating Factors That Affect Reaction Rates** *Analyze how temperature and concentration affect the rate of a chemical reaction.*	Course Activity
4 days: 80–83	**Reaction Rates and Chemical Equilibrium** *Predict how altering the environment in which a chemical reaction takes place changes the rate of reaction and the amount of products.*	Lesson
4 days: 84–87	**Unit Activity and Discussion—Unit 3**	Unit Activity/ Discussion
1 day: 88	**Posttest—Unit 3**	Assessment
1 day: 89	**Semester Review**	
1 day: 90	**End-of-Semester Test**	Assessment

Appendix A: Safety Notes and Disclaimer

To get important safety information for the chemicals in the Edmentum Chemistry Kit, view the safety data sheets. Click the Product Resources tab, and then click Datasheet.

Each Course Activity and Unit Activity that includes a lab or experiment component will highlight key safety guidelines using the safety icon (⚠), which appears directly in the activity. In addition to adhering to those guidelines, follow these general safety practices:

- Work slowly and safely at all times, and abide by the safety notes and icons.
- Pay attention and be alert at all times. Limit any distractions.
- Keep your hands away from your nose, eyes, mouth, and skin. Wash your hands before and after experiments.
- When working with chemicals, do not get them in your eyes or on your skin or clothing. Do not breathe dust or vapors.
- Never ingest chemicals. Call a poison control center immediately in the event of accidental ingestion.
- If you don't understand something, ask a teacher or an adult before proceeding.
- Wear the required protective gear.
- Adult supervision is required for all activities involving an experiment or lab component.
- Do not perform experiments that have not been approved. Follow the procedures.
- Follow good housekeeping practices. Keep your work area clean.
- Abide by all disposal instructions and icons to protect yourself and our planet.
- Report any problems or complications to an adult.
- Seek medical attention if you do not feel well.

Note: *Edmentum assumes no liability for personal injury, death, property damage, equipment damage, or financial loss resulting from the instruction included in this course.*

Appendix B: Course Lab Materials (Semesters A and B)

Household Materials–Basic
• tap water • ice • table salt • sugar • cooking oil • rubbing alcohol • ammonia (2 to 3 cups) • vinegar (1.5 cups, or 360 milliliters) • baking soda (2 tablespoons, or 36 grams) • pen or fine-tip marker • tongs or oven mitts • paper towels • masking tape • waxed paper • stove, hot plate, or microwave oven • assorted teaspoon, tablespoon, and cup measures • 2 large bowls or pots • cooking pot or saucepan with transparent lid • microwave-safe plastic bowl • a narrow, transparent container for holding several pennies • 3 disposable water bottles (about 16.9 fluid ounces each) • 1 disposable plastic water bottle with cap (10-ounce preferred) • a flat glass surface (for example, a mirror, glass baking dish, or glass coffee table) • small solid object or group of objects of a known material (for example, dominoes or marbles)

Household Materials–Less Common

Italicized materials in this list are available in the Edmentum Chemistry Kit.

- kitchen scale (if an electronic balance is unavailable)
- stopwatch (could be a mobile app or on a computer)
- Epsom salt (11.5 tablespoons)
- food coloring
- distilled water
- 2 foam cups with lids
- at least 20 pennies; at least 5 of them dated before 1982, and at least 5 dated after 1982
- *thermometer, readable from 0°C to 100°C (32°F to 212°F), precise to at least the nearest degree*
- *small piece of sandpaper*
- *iron nails* (quantity: 2)
- *protective gloves*
- *safety goggles*
- *apron*

Specialized Science Materials

All materials and chemicals in this list are available in the Edmentum Chemistry Kit.

- electronic balance, precise to at least 0.1 gram
- 25-milliliter graduated cylinder
- test tubes, 16 mm × 150 mm
- test tube rack for 16 mm × 150 mm test tubes
- test tube brush for 16 mm × 150 mm test tubes
- test tube labels
- wash bottle
- pipettes
- forceps
- 50-milliliter Erlenmeyer flask
- scoop
- weighing boats
- stirring rod
- funnel
- filter paper
- copper metal strips (quantity: 3)
- copper(II) sulfate solution (10 milliliters)
- iron(III) nitrate solution, also called ferric nitrate (10 milliliters)
- magnesium sulfate solution (10 milliliters)
- hydrochloric acid (33 milliliters)
- iron(II) sulfate (16 milliliters)
- iron(III) nitrate (16 milliliters)
- potassium thiocyanate (8 milliliters)
- potassium iodide (8 milliliters)
- starch (0.25 gram)
- potassium permanganate (8 milliliters)
- sodium hydroxide (8 milliliters)
- zinc nitrate (7.43 grams)
- magnesium nitrate (6.41 grams)
- copper(II) nitrate (6.04 grams)
- zinc metal strips (quantity: 5)
- magnesium ribbon (40 centimeters)
- sodium bicarbonate (12 grams)
- sodium acetate (20 grams)
- copper(II) sulfate, anhydrous (3.00 grams)
- copper(II) sulfate pentahydrate (3.12 grams)
- zinc powder (0.75 grams)
- citric acid (1.92 grams)

Appendix C: Lab Materials by Activity (Semester A)

Unit	Activity Name	Task	Equipment List
1	Course Activity: Identifying a Substance by Its Properties	Task 1: The Composition of Pennies	Italicized items may be found in the Edmentum Chemistry Kit. • *electronic balance, precise to at least 0.1 gram* (may also use a kitchen scale) • *25-milliliter graduated cylinder* (may also use a 1-teaspoon measure) • at least 20 pennies; at least 5 of them dated before 1982, and at least 5 dated after 1982 • a narrow, transparent container that can hold water • masking tape
		Task 2: The Properties of Liquids	Italicized items may be found in the Edmentum Chemistry Kit. • *electronic balance*, *precise to at least 0.1 gram* (may also use a kitchen scale or a ¼-teaspoon measure) • *25-milliliter graduated cylinder* (may also use a 1-tablespoon measure) • *test tubes, 16 mm × 150 mm* (quantity: 3; may also use small cups) • *test tube rack* • rubbing alcohol • table salt • water • *goggles*

Unit	Activity Name	Task	Equipment List

2	Course Activity: Determining an Activity Series
	
	Special lab materials required (Edmentum Chemistry Kit or school-provided lab materials).
		Task: Comparing Reactivities of Elements	All of these items may be found in the Edmentum Chemistry Kit, except for the pen and the distilled water.
			• test tubes, 16 mm × 150 mm (quantity: 6)
			• test tube rack
			• test tube labels
			• 25-milliliter graduated cylinder
			• wash bottle with distilled water
			• pipettes (quantity: 2)
			• forceps
			• 50-milliliter Erlenmeyer flask
			• scoop
			• test tube brush
			• apron
			• goggles
			• gloves
			• pen or fine-tip marker
			• small piece of sandpaper
			• chemicals
			  ○ copper metal strip (quantity: 1)
			  ○ iron nails (quantity: 2)
			  ○ zinc metal strips (quantity: 3)
			  ○ copper(II) sulfate solution (10 milliliters)
			  ○ iron(III) nitrate solution, also called ferric nitrate (10 milliliters)
			  ○ magnesium sulfate solution (10 milliliters)
			  ○ hydrochloric acid (30 milliliters)
			  ○ sodium bicarbonate (7.5 grams)

Unit	Activity Name	Task	Equipment List

2	Course Activity: Charges on Transition Metal Ions
	
	Special lab materials required (Edmentum Chemistry Kit or school-provided lab materials).
		Task: Comparing Iron(II) and Iron(III) Ions	All of these items may be found in the Edmentum Chemistry Kit, except for the distilled water, microwave oven, and tongs.
			• test tubes, 16 mm × 150 mm (quantity: 2)
			• test tube rack
			• disposable pipettes (quantity: 4)
			• test tube brush
			• 50-milliliter Erlenmeyer flask
			• electronic balance, precise to at least 0.1 gram
			• weighing boat
			• scoop
			• stirring rod
			• funnel
			• filter paper
			• wash bottle with distilled water
			• apron
			• goggles
			• gloves
			• microwave oven or hot plate
			• tongs (or oven mitts)
			• chemicals
			  ○ iron(II) sulfate (16 milliliters)
			  ○ iron(III) nitrate (16 milliliters)
			  ○ potassium thiocyanate (8 milliliters)
			  ○ potassium iodide (8 milliliters)
			  ○ starch (0.25 gram)
			  ○ potassium permanganate (8 milliliters)
			  ○ sodium hydroxide (8 milliliters)

Unit	Activity Name	Task	Equipment List

3	Course Activity: Oxidizing and Reducing Chemicals
	
	Special lab materials required (Edmentum Chemistry Kit or school-provided lab materials).
		Task 1: Observing Oxidation-Reduction Reactions	All of these items may be found in the Edmentum Chemistry Kit, except for the pen and the distilled water.
			• 25-milliliter volumetric flask
			• electronic balance, precise to at least 0.1 gram
			• weighing boats (quantity: 3)
			• wash bottle with distilled water
			• test tubes, 16 mm × 150 mm (quantity: 6)
			• test tube rack
			• labeling tape
			• sandpaper
			• stirring rod
			• forceps
			• apron
			• goggles
			• gloves
			• pen or fine-tip marker
			• chemicals
			  ○ zinc nitrate (about 8 grams)
			  ○ magnesium nitrate (about 7 grams)
			  ○ copper(II) nitrate (about 7 grams)
			  ○ zinc strips (quantity: 2)
			  ○ copper strips (quantity: 2)
			  ○ magnesium ribbon (40 centimeters)

Unit	Activity Name	Task	Equipment List
		Task 2: Measuring Changes in Mass	All of these items may be found in the Edmentum Chemistry Kit, except for the paper towels and the distilled water. • electronic balance, precise to at least 0.1 gram • 50-milliliter Erlenmeyer flask • funnel • filter paper • wash bottle with distilled water • forceps • test tube brush • apron • goggles • gloves • paper towels

		Task 3: Measuring Production of Copper	All of these items may be found in the Edmentum Chemistry Kit, except for the paper towels and the distilled water.
			• electronic balance, precise to at least 0.1 gram
			• 50-milliliter Erlenmeyer flask
			• pipettes (quantity: 2)
			• funnel
			• filter paper
			• wash bottle with distilled water
			• apron
			• goggles
			• gloves
			• paper towels
			• chemicals
			  ○ hydrochloric acid (3 milliliters)
			  ○ sodium bicarbonate (1/4 teaspoon)

Unit	Activity Name	Task	Equipment List
3	Course Activity: Investigating Factors That Affect Reaction Rates	Task 1: Temperature and Reaction Rate	Italicized items may be found in the Edmentum Chemistry Kit. • *25-milliliter graduated cylinder* (may also use a 1-tablespoon measure) • *electronic balance, precise to at least 0.1 gram* (may also use a 1/4-teaspoon measure) • *weighing boat* • *thermometer, readable from 0°C to 100°C (32°F to 212°F)* • *safety goggles* • vinegar (3/4 cup, or 180 milliliters) • baking soda (1 tablespoon, or 18 grams) • water • stove, hot plate, or microwave oven (for heating water) • container appropriate for heating water • beaker, *flask*, or cup • spoon or *stirring rod* • stopwatch

Unit	Activity Name	Task	Equipment List
		Task 2: Concentration and Reaction Rate	Italicized items may be found in the Edmentum Chemistry Kit. • *25-milliliter graduated cylinder* (may also use a 1-tablespoon measure) • *electronic balance, precise to at least 0.1 gram* (may also use a 1/4-teaspoon measure) • *weighing boat* • *thermometer, readable from 0°C to 100°C (32°F to 212°F)* • *safety goggles* • vinegar (3/4 cup, or 180 milliliters) • baking soda (1 tablespoon, or 18 grams) • water • stove, hot plate, or microwave oven (for heating water) • container appropriate for heating water • beaker, *flask*, or cup • spoon or *stirring rod* • stopwatch