Syllabus

Chemistry, Semester B

Course Overview

Chemistry is the study of matter and how it changes. The course looks at matter's composition, properties, and transformations. In this semester, you will calculate the theoretical quantities of substances involved in a chemical reaction through the study of stoichiometry. You'll analyze chemical reactions that involve aqueous solutions, acids and bases, and gases. You'll see how gases respond to changes in pressure, volume, temperature, and quantity through the ideal gas law. You'll also calculate changes in temperature caused by physical and chemical processes and analyze reactions in terms of bond energies. Finally, you will understand how atoms are changed by the unique processes of radioactive decay, nuclear fusion, and nuclear fission.

Course Goals

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

- Perform scientific calculations using dimensional analysis, and communicate answers to the correct number of significant figures.
- Calculate the theoretical quantity of product made by a reaction or of reactant required for a reaction.
- Analyze substances and determine their composition based on empirical data.
- Describe how gases respond to changes in pressure, volume, temperature, and quantity, and relate these factors for any sample of a gas.
- Apply the ideal gas law.
- Describe aqueous solutions (those with water) both qualitatively and quantitatively.
- Identify acids and bases in aqueous solutions.
- Relate the theoretical and actual quantities of reactant and product in a chemical reaction that involves gases or solutions.
- Calculate changes in temperature caused by physical and chemical processes.
- Analyze endothermic and exothermic reactions in terms of the bond energies of the reactants and the products.
- Explain how atoms are changed by the processes of radioactive decay, nuclear fission, and nuclear fusion.

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 B, 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 teacher may modify the schedule to meet the specific needs of your class.

Course Components and Grading Rubric

The table gives a breakdown of the weight for each component in the course. Weight represents the percentage of the total score coming from each activity.

Course Components	Count	Weight
Pretest. *Pretests are optional assessments, typically designed for credit recovery use. If a student shows mastery of a lesson's objective (80% proficiency), the student may be automatically exempted from that lesson in the upcoming unit. Typically, teachers do not choose to employ exemptive pretests for first-time credit courses. Pretests are not included as a component of the student's final grade.*	3	0%
Module. *Each module in this course contains an interactive tutorial and an associated mastery test. Tutorials may include one or more Lesson Activities that constitute tasks associated with the tutorial. The module score comes from a student's score on the mastery test.*	14	20%
Discussion. *Online discussions allow for higher-order thinking about terminal objectives. An online threaded discussion mirrors the educational experience of a classroom discussion. Teachers can initiate a discussion by asking a complex, open-ended question. Students can engage in the discussion by responding both to the question and to the thoughts of others. Each unit in a course has one predefined discussion topic; teachers may add more discussion topics.*	3	20%
Unit Activity. *Unit Activities are at the end a unit and constitute one or more small tasks. Their purpose is to deepen understanding of key unit concepts and tie them together. Each Unit Activity includes a simple rubric. The teacher versions include both a rubric and modeled sample answers. Unit Activities are teacher graded.*	3	10%
Posttest. *The posttest appears at the end of the unit and mirrors the pretest in structure, content, and complexity.*	3	20%
Course Activity. *Course Activities are similar to Unit Activities in scope but may be found at any point in the course, either to prepare the student for new learning or to act as a performance-based activity required for a learning objective. Like Unit Activities, Course Activities include simple rubrics, and sample answers are available for teachers. Course Activities are teacher graded.*	7	10%
End of Semester Test. *The end of semester test (EOS) appears at the end of the course. Students are delivered a few items from every tutorial in the course in order to assess the major course objectives.*	1	20%
Total	**34**	**100%**

**Teachers may manually adjust these weights if desired, per district grading requirements.*

Unit 1: Chemical Quantities

Summary
You'll begin this unit by practicing math skills important to both chemistry and physics—significant figures and dimensional analysis. Next, you'll see how the products in a chemical reaction might be limited by the reactants involved. Afterward, you'll calculate the theoretical quantity of a reactant or a product. Using these skills, you'll analyze substances and determine their composition based on empirical data. Finally, you'll investigate the unique behavior of gases and describe how gases respond to changes in pressure, volume, temperature, and quantity.

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
4 days: 2–5	**Mathematical Skills for Physical Sciences** *Perform scientific calculations with the appropriate units and proper notation, using rounding to communicate the precision of the calculated quantities.*	Lesson
3 days: 6–8	**Limiting a Chemical Reaction** *Relate the amount of a product generated in a chemical reaction to the amounts of the two reactants.*	Course Activity
4 days: 9–12	**Stoichiometry** *Calculate the theoretical quantity of product made by a reaction or of reactant required for a reaction.*	Lesson
4 days: 13–16	**Quantitative Analysis of Compounds** *Analyze substances and determine their composition based on empirical data.*	Lesson
3 days: 17–19	**Relating the Temperature and Volume of a Gas** *Determine the mathematical relationship between the temperature of a trapped sample of gas and its volume at constant pressure.*	Course Activity
3 days: 20–22	**The Behavior of Gases** *Describe how gases respond to changes in pressure, volume, temperature, and quantity.*	Lesson
3 days: 23–25	**The Ideal Gas Law** *Mathematically relate the pressure, volume, temperature, and quantity for any sample of a gas.*	Lesson

Day	Activity/*Objective*	Type
4 days: 26–29	**Unit Activity and Discussion—Unit 1**	Unit Activity/ Discussion
1 day: 30	**Posttest—Unit 1**	Assessment

Unit 2: Molecular-Level Forces and Solutions

Summary

You'll begin the unit by investigating the strengths of the forces between particles of different substances based on macroscopic properties. Next, you'll relate the properties of a compound to its molecular structure. You'll also describe aqueous solutions, which are solutions containing water. You'll analyze the circumstances in which unsaturated, saturated, and supersaturated solutions are produced. Next, you will identify acids and bases and describe their behavior at the molecular level. Finally, you'll apply what you've learned about stoichiometry to more advanced problems.

Day	Activity/*Objective*	Type
3 days: 31–33	**Comparing Forces Between Particles** *Compare the strengths of the forces between particles of different substances based on macroscopic properties.*	Course Activity
4 days: 34–37	**Molecular Shapes and Intermolecular Forces** *Relate the macroscopic properties of a compound to its molecular structure.*	Lesson
3 days: 38–40	**Purifying Water** *Evaluate a problem relating to Earth's water supply in terms of solutions and the properties of water.*	Course Activity
4 days: 41–44	**Water and Solutions** *Describe aqueous solutions both qualitatively and quantitatively.*	Lesson
3 days: 45–47	**Creating a Supersaturated Solution** *Analyze the circumstances in which unsaturated, saturated, and supersaturated solutions are produced.*	Course Activity

Day	Activity/*Objective*	Type
4 days: 48–51	**Acids and Bases** *Identify acids and bases in aqueous solutions and explain the interactions of acids and bases on the molecular level.*	Lesson
4 days: 52–55	**Advanced Stoichiometry** *Relate the theoretical and actual quantities of reactant and product in a chemical reaction that involves gases or solutions.*	Lesson
4 days: 56–59	**Unit Activity and Discussion—Unit 2**	Unit Activity/ Discussion
1 day: 60	**Posttest—Unit 2**	Assessment

Unit 3: Energy and Changes in Matter

Summary

In this unit, you'll calculate changes in temperature that result from combining substances at different temperatures. You'll see how changes in temperature relate to physical and chemical processes. You will also analyze endothermic and exothermic reactions in terms of the bond energies of the reactants and the products. You'll compare the theoretical and experimental amounts of energy released by an exothermic reaction. Finally, you'll explain how atoms are changed by the processes of radioactive decay, nuclear fission, and nuclear fusion.

Day	Activity/*Objective*	Type
3 days: 61–63	**Heat and Temperature** *Calculate changes in temperature that result from combining substances at different temperatures.*	Lesson
3 days: 64–66	**Combining Objects at Different Temperatures** *Compare the heat lost by one substance with the heat gained by another substance when the substances are combined and explain any discrepancy.*	Course Activity
4 days: 67–70	**Heat and Changes in Matter** *Analyze changes in temperature caused by physical and chemical processes.*	Lesson

Day	**Activity**/*Objective*	Type
4 days: 71–74	**Energy in Bonding** *Analyze endothermic and exothermic reactions in terms of the bond energies of the reactants and the products.*	Lesson
3 days: 75–77	**Measuring Energy in Chemical Reactions** *Compare the theoretical and experimental amounts of energy released by an exothermic reaction.*	Course Activity
3 days: 78–80	**Radioactive Decay** *Explain how atoms are changed by the processes of radioactive decay.*	Lesson
3 days: 81–83	**Nuclear Fission and Fusion** *Explain how atoms are changed by the processes of nuclear fission and nuclear fusion.*	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

Course Map

You will achieve course level objectives by completing each lesson's instruction, assignments, and assessments. For a detailed look at how the materials meet these objectives, review the course map for Semester B.

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 B)

Unit	Activity Name	Task	Equipment List
1	Course Activity: Limiting a Chemical Reaction	Task 1: Changing the Amount of Ammonia	Italicized items may be found in the Edmentum Chemistry Kit. • *safety goggles* • *protective gloves* • *apron* • 3 identical empty disposable water bottles (about 16.9 fluid ounces each) • permanent marker • water • Epsom salt (3 tablespoons) • tablespoon measure • 1/3-cup measure • ammonia (1 to 2 cups)
		Task 2: Changing the Amount of Epsom Salt	Italicized items may be found in the Edmentum Chemistry Kit. • *safety goggles* • *protective gloves* • *apron* • 3 identical empty disposable water bottles (about 16.9 fluid ounces each) • permanent marker • Epsom salt (8.5 tablespoons) • tablespoon measure • 1/2-tablespoon measure (or a 1/2-teaspoon measure) • 1/3-cup measure • water • ammonia (1 cup)

Unit	Activity Name	Task	Equipment List
1	Course Activity: Relating the Temperature and Volume of a Gas	Task: Comparing Temperature and Volume	Italicized items may be found in the Edmentum Chemistry Kit. • *thermometer, readable from 0°C to 100°C (32°F to 212°F)* • *25-milliliter graduated cylinder* (may also use kitchen measures: cup, tablespoon, teaspoon, ½ teaspoon) • disposable plastic water bottle with cap (10-ounce capacity preferred) • 2 large bowls or pots • hot and cold tap water • ice • stopwatch (may also use a timer or a clock)
2	Course Activity: Comparing Forces Between Particles	Task 1: Water and Oil: Drop Shapes	• water • cooking oil • waxed paper • a flat glass surface (for example, a mirror, glass baking dish, or glass coffee table) • pipette (may also use an eyedropper)
		Task 2: Sugar, Salt, and Oil: Melting Points	• sugar (1 tablespoon) • salt (1 tablespoon) • cooking oil • tablespoon measure • cooking pan • stove • oven mitts or hot pads

Unit	Activity Name	Task	Equipment List
2	Course Activity: Purifying Water	Task 1: Distilling Water	• cooking pot or saucepan with lid (a transparent lid works best) • stove or hot plate • microwave-safe plastic bowl that fits in the pot, large enough to cover more than half the width of the pot • salt • food coloring • oven mitts
2	Course Activity: Creating a Supersaturated Solution ***Special lab materials required (Edmentum Chemistry Kit or school-provided lab materials).***	Task 1: Preparing and Observing a Solution	Italicized items may be found in the Edmentum Chemistry Kit. • *electronic balance, precise to at least 0.1 gram* • *scoop* • *weighing boat* • *25-milliliter graduated cylinder* • *50-milliliter Erlenmeyer flask* • *sodium acetate (20 grams)* • *goggles* • water • microwave oven (may also use a hot plate) • oven mitt or hot pad (may also use tongs if working with a hot plate)

Unit	Activity Name	Task	Equipment List
3	Course Activity: Combining Objects at Different Temperatures	Task: Determining Heat Gain and Loss	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) • *thermometer, readable from 0°C to 100°C (32°F to 212°F), precise to at least the nearest degree*—readings to the nearest tenth degree will produce better results • foam cups (quantity: 2) • lids to fit the cups (may use squares of cardboard as lids) • solid object or group of objects of a known material (such as dominoes) • tongs • pen or fine-tip marker • stove, hot plate, or microwave oven • container for heating water (depends on the selected heat source)

Unit	Activity Name	Task	Equipment List
3	Course Activity: Measuring Energy in Chemical Reactions ***Special lab materials required (Edmentum Chemistry Kit or school-provided lab materials).***	Task 1: Hydration of Copper(II) Sulfate	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: 2) • test tube rack • test tube labels (quantity: 2) • electronic balance, precise to at least 0.1 gram • 25-milliliter graduated cylinder • weighing boats (quantity: 2) • wash bottle with distilled water • thermometer, readable from 0°C to 100°C (32°F to 212°F) • scoop • goggles • apron • gloves • pen or fine-tip marker • chemical ○ copper(II) sulfate, anhydrous (3.00 grams)

Unit	Activity Name	Task	Equipment List

		Task 2: Copper(II) Sulfate and Zinc	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: 2)
			• test tube rack
			• test tube labels (quantity: 2)
			• electronic balance, precise to at least 0.1 gram
			• 25-milliliter graduated cylinder
			• 25-milliliter volumetric flask
			• weighing boats (quantity: 3)
			• wash the bottle with distilled water
			• thermometer, readable from 0°C to 100°C (32°F to 212°F)
			• pipettes (quantity: 2)
			• scoop
			• goggles
			• apron
			• gloves
			• pen or fine-tip marker
			• chemicals
			  ○ copper(II) sulfate pentahydrate (3.12 grams)
			  ○ zinc powder (0.75 grams)

Unit	Activity Name	Task	Equipment List

		Task 3: Citric Acid and Sodium Bicarbonate	All of these items may be found in the Edmentum Chemistry Kit, except for the pen and the distilled water.
			• electronic balance, precise to at least 0.1 gram
			• 50-milliliter Erlenmeyer flask
			• 25-milliiter graduated cylinder
			• weighing boats (quantity: 2)
			• wash bottle with distilled water
			• thermometer, readable from 0°C to 100°C (32°F to 212°F)
			• scoop
			• goggles
			• apron
			• gloves
			• chemicals
			  ○ citric acid (1.92 grams)
			  ○ sodium bicarbonate (2.52 grams)