Unit Plan: Chemical Equations

FOR THE TEACHER

Summary
The AACT high school classroom resource library has everything you need to put together a unit plan for your classroom: lessons, activities, labs, projects, videos, simulations, and animations. We constructed a unit plan using AACT resources that is designed to teach Chemical Equations to your students.

Grade Level
High School

Objectives
By the end of this unit, students should be able to
- Explain and apply the law of conservation of mass.
- Identify what substances are the reactants and what substances are the products in a chemical reaction.
- Count atoms in a given chemical formula.
- Understand how chemical reactions are balanced using coefficients
- Identify and differentiate between a coefficient and a subscript.
- Read and understand a balanced chemical equation.
- Write and balance chemical equations.
- Recognize when a chemical change takes place.
- Perform a composition, decomposition, single displacement, and double displacement reaction.
- Describe how elements are rearranged during each type of reaction.
- Make observations of chemical reactions and categorize them.
- Use the given reactants in a double replacement reaction to predict the possible products.
- Use data from observations to make evidence-based conclusions.
- Predict the products of a combustion reaction.
- Identify a reversible and a nonreversible reaction.
- Indicate that a precipitate can form from the reaction of two aqueous solutions.
- Write a chemical equation for a reaction that produces a precipitate.
- Understand the components described by a net ionic equation.
- Create particle diagrams for solutions containing dissociated ions.
- Apply their knowledge of solubility rules to the outcome of a chemical reaction.
- Draw accurate particle diagrams for reactions that include aqueous species and formed precipitates.
- Determine whether a single displacement reaction will occur.
- Accurately represent the activity of a single displacement reaction occurring at the molecular level.
- Determine which metals are reactive and which are not as reactive.
- Create an activity series.
- Describe each type of chemical reaction.
- Differentiate between the types of chemical reactions.
- Understand how each reaction type correlates to real-life.
- Give examples of each type of reaction.
Chemistry Topics
This unit supports students’ understanding of
- Chemical Reactions
- Stoichiometry
- Balancing Equations
- Classification of Reactions
- Law of Conservation of Matter
- Chemical Change
- Chemical Formula
- Coefficients
- Subscripts
- Predicting Products
- Combustion Reactions
- Reversible Reactions
- Nonreversible Reactions
- Indicators of Chemical Change
- Net Ionic Equations
- Solubility Rules
- Particle Diagrams
- Activity Series of Metals

Time
Teacher Preparation: See individual resources.
Lesson: 8-12 class periods, depending on class level.

Materials
- Refer to the materials list given with each individual activity.

Safety
- Refer to the safety instructions given with each individual activity.

Teacher Notes
- The activities shown below are listed in the order that they should be completed.
- The number of activities you use will depend upon the level of students you are teaching.
- The teacher notes, student handouts, and additional materials can be accessed on the page for each individual activity.
- Please note that most of these resources are AACT member benefits.

Classroom Resources:

Balancing Equations
- The Balancing Chemical Reactions simulation is a great way to introduce the topic of balancing chemical equations to your students. The introduction screen allows students to use scales or bar graphs to compare the number of reactant and product atoms of each element. They then move on to playing the game, which includes three levels of difficulty. The accompanying activity also includes a “PhET Tips for Teachers” download with suggestion for using the simulation.
- Follow up with the demonstration, Identifying Chemical Reactions which allows students to observe a series of teacher led demonstrations to learn how to identify evidence that a chemical reaction has occurred, write a word equation to explain a chemical reaction, and convert a word equation to a balanced chemical equation.
• If your students would benefit more from a tactile activity instead of a simulation, use the Balancing Legos lesson to learn about balancing equations and the law of conservation of matter.

• The Counting Atoms & Balancing Equations lesson plan includes three days full of activities focused on helping students learn how to count atoms and balance chemical equations. Activities include videos, simulations, games, and a student worksheet.

• After your students have mastered the topic of balancing chemical equations, use the Chemical Reactions & Equations lab so they can observe a series of reactions. After recording their observations, they will write balanced chemical equations to chemically describe them.

• The activity Balancing Equations with Note Cards is a great way to practice the law of conservation of matter and balancing reactions once you have introduced these two topics. Students balance equations and get immediate feedback on whether they are accurate or not while trying to solve a mystery quote. This resource includes completed notecards that you can print and use with your students.

Reaction Types and Predicting Products
• Identifying and differentiating between the types of chemical reactions is an important skill for students to master before they start predicting the products of a chemical reaction. The lab, Classifying Reaction Types will give them the opportunity to carry out a variety of different reactions, classify each reaction type, and use their observations to predict the products of the reactions. This lab also includes a PowerPoint presentation for the teacher to use that links to video examples of synthesis, double displacement, decomposition, and single displacement reactions.

• Another resource you might choose to introduce the concept of reaction types is the Geometric Equations Challenge. In this activity, students find patterns in the reactions between several geometric shapes and give names to different types of equations. They then look at chemical reactions and learn about the five main types of reactions.

• Depending on the time you have for this topic you can use one or more of these lab-based activities to help your students observe different types of chemical reactions:
  o Demonstrate two chemical reactions that produce gases inside a balloon with the Firefighter or Fireball demo. Students observe and record data as each of the balloons is ignited. This demonstration helps students better understand how to predict products, as well as familiarize them with double replacement and combustion reactions.
  
  o Students observe precipitation reactions and create particle diagrams based on their observations with the Precipitation Reaction demonstration. This demo helps students fully understand what is occurring on the atomic level during the chemical reaction. This lesson is part of the March 2018 Chemistry Solutions article Part II: Rethinking Common Practices in High School Chemistry.
  
  o Students often struggle with the concept of net ionic equations. Make this concept easier by allowing them to observe a precipitate reaction using the Net Ionic Equations animation. This animation will help them understand why a net ionic equation is used to represent what happens at the particulate level in a precipitation reaction.
Once your students have learned the basic concepts, use the simulation, *Predicting Products* to provide more practice identifying what will be produced when two substances react. While using the simulation, students reference an activity series and a solubility chart to accurately predict the products of single replacement and double replacement chemical reactions. Associated particle diagrams will be displayed to help students better comprehend the reaction at the particulate level. Students also balance the chemical equation. The simulation is designed as a five question quiz for students to use multiple times.

Students perform and analyze two single displacement reactions and prepare particle diagrams to show what is happening at the molecular level with the *Single Displacement Reactions with Test Tube Diagrams* lesson plan. In addition to a student activity sheet with answer key, this lesson includes reactant, product, and test tube cutouts.

You could also use the lab, *Investigating the Activity Series of Metals* to demonstrate the concept of single displacement reactions. In this lab, students create an activity series of metals through a series of reaction observations and then predict whether or not a single displacement reaction will occur.

Use the equation cards in the *Snowman Challenge* activity to help your students get the practice they need with this fun and interactive game. During the activity, student teams select a reaction, predict the products, and balance the final equation. Once they get the right answer, they earn a point and select another card. The group with the most points wins the game.

**Summary Activity**

Once you have covered the topics of balancing equations and reaction types, use the *It’s Time to React* lab to help your students put all of these concepts together. After carrying out four chemical reactions and identifying evidence of a reaction, students write balanced chemical equations and identify the reaction type for each. You can read more about this lab in the *Keys for Success in Teaching Chemistry* article from the *March 2016 issue of Chemistry Solutions*.

Use the *Classifying Reaction Types Mini Poster* project to give students a chance to demonstrate their knowledge of the five main types of chemical reactions. This project can be assigned to groups or individually and be used as a summative assessment for this concept. A rubric is included with this resource.