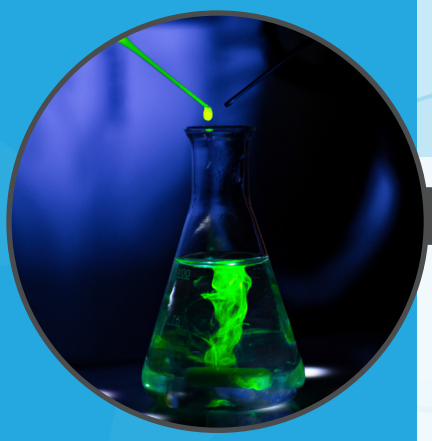


Chemical Reactions

Scope Planning and Overview

Scope Overview

In this instructional unit, students deepen their understanding of chemical reactions by exploring reaction types, balancing equations, and predicting products. They utilize models and solubility tables to engage with various reaction mechanisms, particularly focusing on predicting precipitates in double-replacement reactions. Supported by resources like periodic tables and solubility charts, students develop explanations and test designs that help them identify reaction types and outcomes. This comprehensive approach enhances their grasp of chemical stability and changes, fostering a robust understanding of how chemical systems interact and transform.

Student Wondering of Phenomenon

How can chemical reactions be classified?

Student Expectations

The student will–

- develop an explanation using the reactants in a chemical reaction to identify reaction type (i.e., synthesis, decomposition, combustion, single replacement, double replacement) and predict products.

Scope Vocabulary

The terms below and their definitions can be found in Picture Vocabulary and are embedded in context throughout the scope.

Acid-base reaction
A type of double-replacement reaction; occurs when equal amounts of an acid are added to a base so that the acid and the base neutralize each other, forming water and salt. The general equation is HX (acid) + MOH (base) → H2O (l) + MX (salt).

Chemical equation
A representation of a chemical reaction using numbers and symbols of the elements to represent atoms and molecules

Chemical reaction
The process by which one or more substances change to produce one or more different substances

Combustion reaction
A reaction that is an oxidation process in which a compound containing carbon, hydrogen, and sometimes oxygen reacts with oxygen gas to produce carbon dioxide gas and water; the general equations are CxHyOz + O2 → CO2 + H2O or CxHy + O2 → CO2 + H2O.

Decomposition reaction
A reaction in which a single compound on the reactant side breaks down into two or more products during a chemical change; the general equation is AX → A + X.

Double-replacement reaction
A chemical reaction where two compounds exchange chemical bonds to form two products with bonding properties similar to those of the reactants; the general equation is AX + BY → AY + BX.

Oxidation-reduction reaction
A chemical reaction that involves the transfer of electrons between atoms or molecules, changing the oxidation state of the reactants; the atom or molecule that loses electrons is oxidized, and the atom or molecule that gains electrons is reduced.

Precipitation reaction
A reaction that results in the precipitation of a solid from a solution; the general equation is AX (aq) + BY (aq) → AY (aq) + BX (s).

Product(s)
The ending substance(s), written on the right side of the chemical reaction arrow, that are created during a chemical change

Reactant(s)
The starting substance(s), written on the left side of the chemical reaction arrow, which will be destroyed during a chemical change

Redox reactions
All chemical reactions in which atoms have their oxidation state changed

Single-replacement reaction
A redox reaction where one element or ion in a compound is replaced by another element or ion; the general equation is A + BX → AX + B.

Synthesis reaction
Also known as a combination reaction; a reaction in which two or more reactants combine during a chemical change to create one product; the general equation is A + X → AX.

Engage Activity Summaries

APK

Accessing Prior Knowledge: : Always, Sometimes, Never

In this activity, students evaluate statements about chemical reactions using “Always, Sometimes, Never” cards to classify them as always true, sometimes true, or never true. This exercise is designed to reveal student misconceptions regarding the nature of chemical reactions, such as the composition and rearrangement of atoms and the structure of chemical equations. Students must justify their choices, discussing and defending their reasoning with peers, which enhances their understanding and identifies areas needing clarification as they progress in their study of chemistry.

SP

Scope Phenomenon

In this activity, students watch a video demonstrating a metal reacting with water and a subsequent interaction with a lit match, to learn about classifying chemical reactions. They use a handout to guide their understanding and answer related questions. Following the video, students engage in a class discussion, and conclude by writing their queries on note cards, which helps generate further interest and guide future lessons on classifying chemical reactions. This method encourages active learning and curiosity about chemical processes.

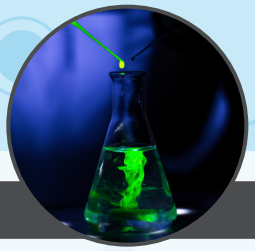
Explore Activity Summaries

Explore 1

Activity - Types of Reactions

In this activity, students explore different types of chemical reactions, learning how to accurately write and balance them, and predict reaction products. They use models to understand reaction mechanisms, predict precipitates in double-replacement reactions using a solubility table, and practice predicting products. The activity incorporates model development for explaining phenomena and testing designs, while also discussing the stability and changes within chemical systems. This process is supported by various materials, including periodic tables and solubility charts, facilitating a deep understanding of chemical reactions and their classifications.

Notes



Chemical Reactions

Accessing Prior Knowledge: Always, Sometimes, Never

Activity Preparation

Students will play Always, Sometimes, Never to determine whether statements or claims about chemical reactions are sometimes true, always true, or never true. This element is designed to uncover student misconceptions. It should not be taken for a grade.

Materials

Activity Files

- 1 Always, Sometimes, Never Cards (per student)

Reusable

- None

Consumable

- None

Preparation

- If not assigning the Accessing Prior Knowledge digitally, print one class set of Always, Sometimes, Never Cards. (The print document includes a color version and a black-and-white version. Select the version that works best for your classroom.)
- Cut out one set of cards for each student.
- Consider laminating the cards for repeated use.

Procedure and Facilitation

CLASSROOM MANAGEMENT TIP

To save time, use hand signals rather that distributing cards to students: Sign language for A, S, and N, thumbs up/ down/sideways, or any other familiar tool may be more efficient.

CLASSROOM MANAGEMENT TIP

Provide clear success criteria for student justifications. Encourage them to use complete sentences and incorporate scientific vocabulary effectively.

Activity

1. Distribute Always, Sometimes, Never Cards to students.
2. Tell students you are going to read a series of statements to them, and that they will determine whether each statement is sometimes true, always true, or never true.
3. Students will hold up cards with their responses, and they must be able to justify their responses.
4. Ask students to justify their responses to their elbow partners. Choose volunteers to explain their reasoning to the whole group.
5. Scenario statements and whether or not they are always, sometimes, or never true are provided below:
    1. Chemical reactions involve reactants and products. Always
    2. Different types of atoms are found in the reactant and product sides of a chemical equation. Never
    3. During a chemical reaction, two or more reactants combine to form one product. Sometimes
    4. One element can switch places with another element during a chemical reaction. Sometimes
    5. Unbalanced chemical equations can be found in nature. Never

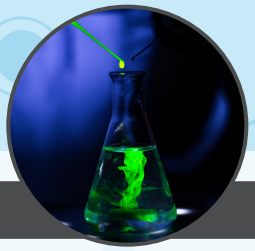
Notes

Identifying Misconceptions

Accessing Prior Knowledge activities help you identify possible student misconceptions. The following misconceptions may be revealed during this APK. These misconceptions will be addressed as students move through the scope and do not need to be clarified at this point.

- Students may not realize that products include the same atoms as the reactants and that they are just rearranged.
- Students may think unbalanced chemical equations exist in nature. No chemical equation is unbalanced; however, there are chemical statements that are incorrect or have not yet been balanced.
- Students may think that during chemical reactions, the reactants only combine to form a single product. They may not realize that reactants can separate to form two or more products or that elements can replace each other.

Notes



Chemical Reactions

Scope Phenomenon

Activity Preparation

Students will watch a video of metal reacting in water and a lit match brought near the reaction to learn about how to classify chemical reactions based on the reactants. Students should build on their knowledge and understanding of the phenomenon as they move through the different activities in this scope.

Materials

Printed Material

- 1 Student Handout: Chemical Reactions (per student)

Reusable

- None

Consumable

- None

Preparation

- If not assigning the activity digitally, print one Student Handout per student.
- Prepare to project the Student Handout.
- Brainstorm additional questions you may want to discuss beyond the Student Handout during the activity.

Procedure and Facilitation

ACTIVITY TIP

Prior to having students read the Student Handout, show the video three times and provide different prompts each time. "What do you notice (see)?" or "One hypothesis is..."

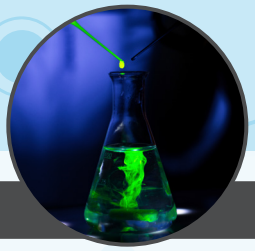
ACTIVITY TIP

Post or project the Student Wondering of Phenomenon question and add the student wonderings from Step 6 to it.

Activity

1. Distribute the Student Handouts.
2. Show students the video.
3. Instruct students to read each question on the Student Handout and independently answer the questions.
4. After all students have answered the questions, discuss as a class.
5. To wrap up the activity, give each student a note card or sticky note.
6. Have students use the note cards or sticky notes to finish this sentence stem:
    a. I wonder...
7. Collect the sentence stems to identify class questions.
8. Use the questions to spur interest throughout the scope.
9. Introduce students to the Student Wondering of Phenomenon question below:
    a. How can chemical reactions be classified?
10. Let students know that, as they move through the scope, they will be doing a number of activities to help them answer the Student Wondering of Phenomenon question and to learn the information that is needed to describe the events in the Scope Phenomenon.
11. When the scope is completed, have students review the Scope Phenomenon. As you lead them in answering the question, encourage them to use the information that they learned throughout the scope.

Notes



Chemical Reactions

Explore 1: Activity - Types of Reactions

Activity Preparation

Timestamp *1–2 hours*

In this Explore activity, students will learn about the different types of chemical reactions and how to correctly write and balance them. In Part II, students will work with the solubility table and determine precipitates in double-replacement reactions. In Part III, students will practice predicting products of reactions.

Materials

Printed Material

- 1 Student Handout: Types of Reactions (per student)
- 1 Periodic Table of the Elements (per student)
- 1 Solubility of Common Ionic Compounds (per group)
- 1 Activity Series of Metals (per group)
- 1 Summary Chart of Naming Compounds (per group)

Consumable

- None

Reusable

- None

Preparation

- Print out the Student Handout and Periodic Table of the Elements for each student.
- Print out a copy of Solubility of Common Ionic Compounds, Activity Series of Metals, and Summary Chart of Naming Compounds for each group.
- Divide the class into groups of two to three.

Connections

SEP Connection

SEP Connection: Developing and Using Models

During this activity, students will develop and use models to develop explanations for phenomena, to go beyond the observable and make predictions or to test designs.

While students work through this activity, they should do the following:

- Use models to develop explanations for phenomena
- Use models to make predictions
- Use models to test designs

Once students have completed this activity, ask these questions:

- How did the model help to explain the phenomenon?
- What were some limitations of the model?
- How could the model be improved so that it is a better representation of the phenomenon?

CCC Connection

CCC Connection: Stability and Change

During this activity, students will explore a system's stability and change.

Ask students the following questions:

- Where do you see a system's stability and change in this activity?
- Where have you seen a system's stability and change before this activity?
- Where do you see a system's stability and change outside the classroom?
- Where do you think you will see a system's stability and change in other science lessons?

Notes

Procedure and Facilitation

Procedure and Facilitation Points

1. Before proceeding, make sure the students understand the symbols used for each general equation. The *A*, *B*, *X*, and *Y* stand for elements or polyatomic ions. In the combustion reaction, the *x*, *y*, and *z* subscripts refer to the subscripts that could be present in the carbon compounds. The carbon compounds may or may not contain oxygen.
2. You may also want to go over each specific example, as well as highlight others with which students may be familiar from other work they have done.
3. As an option, ask students to create their own reference of chemical equation types as an ongoing support sheet.

DIFFERENTIATION TIP

Consider that some students may need some front loading for the different types of reactions noted on the Student Handout before reading the handout independently.

ACTIVITY TIP

On Part II, take time to read the solubility rules together as a class and clarify details for students.

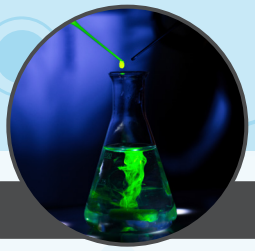
Phenomenon Connection

Once students have completed this learning activity, revisit the Student Wondering of Phenomenon and use the following questions to guide a class discussion.

How can chemical reactions be classified?

- How does this activity connect to or answer the question above?
- How does this activity change your thinking about the phenomenon?
- Do you have any additional questions or observations about the connection between the phenomenon and the activity?

Notes



Chemical Reactions

Scope Resources and Assessment Planner

Scope Resources

Explain

- ☐ **Picture Vocabulary**
  A slide presentation of important vocabulary terms along with a picture and definition.
- ☐ **STEMscopedia**
  Reference materials that includes parent connections, career connections, technology, and science news.
- ☐ **Linking Literacy**
  Strategies to help students comprehend difficult informational text.

Elaborate

- ☐ **Math Connections**
  A practice that uses grade-level appropriate math activities to address the concept.
- ☐ **Reading Science - The Haber-Bosch Process**
  A reading passage about the concept, which includes five to eight comprehension questions.
- ☐ **Engineering Connections**
  A creative, kinesthetic extension into engineering and design that uses concepts addressed in the scope.

Evaluate

- ☐ **Claim-Evidence-Reasoning**
  An assessment in which students write a scientific explanation to show their understanding of the concept in a way that uses evidence.
- ☐ **Open-Ended Response Assessment**
  A short-answer and essay assessment to evaluate student mastery of the concept.
- ☐ **Multiple Choice Assessment**
  A standards-based assessment designed to gauge students' understanding of the science concept using their selections of the best possible answers from a list of choices

Intervention

- ☐ **Guided Practice**
  A guide that shows the teacher how to administer a small-group lesson to students who need intervention on the topic.

Acceleration

- ☐ **Science Art**
  An activity where students use a form of visual art expression such as sculpture, painting, or drawing to express mastery of the topic.

Notes

Assessment Planner

Use this template to decide how to assess your students for concept mastery. Depending on the format of the assessment, you can identify prompts and intended responses that would measure student mastery of the expectation. See the beginning of this scope to identify standards and grade-level expectations.

Student Learning Objectives	What Prompts Will Be Used?	What Does Student Mastery Look Like?
develop an explanation using the reactants in a chemical reaction to identify reaction type (i.e., synthesis, decomposition, combustion, single replacement, double replacement) and predict products.		