



# Standards Statements for the Topic “Conservation of Matter” California

## Grades 9-12 Chemistry

*The conservation of atoms in chemical reactions leads to the principle of conservation of matter and the ability to calculate the mass of products and reactants.*

As a basis for understanding this concept, students know:

- how to describe chemical reactions by writing balanced equations.
- the quantity one mole is defined so that one mole of carbon 12 atoms has a mass of exactly 12 grams.
- one mole equals  $6.02 \times 10^{23}$  particles (atoms or molecules).
- how to determine molar mass of a molecule from its chemical formula and a table of atomic masses, and how to convert the mass of a molecular substance to moles, number of particles or volume of gas at standard temperature and pressure.
- how to calculate the masses of reactants and products in a chemical reaction from the mass of one of the reactants or products, and the relevant atomic masses.
- how to calculate percent yield in a chemical reaction.
- how to identify reactions that involve oxidation and reduction and how to balance oxidation-reduction reactions.

### Benchmarks

#### 4D 6-8 #7

No matter how substances within a closed system interact with one another, or how they combine or break apart, the total mass of the system remains the same. The idea of atoms explains the conservation of matter: If the number of atoms stays the same no matter how they are rearranged, then their total mass stays the same.

### National Science Education Standards

#### Content Standard B

#### Physical Science: Properties and changes of properties in matter Grades 5-8

Substances react chemically in characteristic ways with other substances to form new substances (compounds) with different characteristic properties. In chemical reactions, the total mass is conserved...



# Standards Statements for the Topic “Conservation of Matter”

## Colorado

### GRADES 5-8

- Observing and gathering data to support the concept of conservation of mass within a closed system (*for example, precipitation reaction, forming mixtures, gas production*);
- Describing, measuring (*for example, temperature, mass, volume, melting point of a substance*) and calculating quantities before and after a chemical or physical change within a system (*for example, temperature change, mass change, specific heat*).

### GRADES 9-12

- Identifying, describing, and explaining physical and chemical changes involving the conservation of matter and energy (*for example, oscillating pendulum/spring, chemical reactions, nuclear reactions*).
- Observing, measuring, and calculating quantities to demonstrate conservation of matter and energy in chemical changes (*for example, acid-base, precipitation, oxidation-reduction reactions*), and physical interactions of matter (*for example, velocity, force, work, power*), using word or symbolic equations.

### Benchmarks

#### 4D 6-8 #7

No matter how substances within a closed system interact with one another, or how they combine or break apart, the total mass of the system remains the same. The idea of atoms explains the conservation of matter: If the number of atoms stays the same no matter how they are rearranged, then their total mass stays the same.

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# Standards Statements for the Topic “Conservation of Matter”

## District of Columbia

### Grade 8

Weighs and experiments with materials to know that no matter how substances within a closed system interact with one another, or how they combine or break apart, the total weight of the system remains the same. Recognized that the idea of atoms explains the conservation of matter: If the number of atoms stays the same no matter how they are rearranged, then their total mass stays the same.

### Benchmarks

#### 4D 6-8 #7

No matter how substances within a closed system interact with one another, or how they combine or break apart, the total mass of the system remains the same. The idea of atoms explains the conservation of matter: If the number of atoms stays the same no matter how they are rearranged, then their total mass stays the same.

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## Delaware

### GRADES 6-8

•Substances react chemically in characteristic ways with other substances to form new substances. In all chemical reactions the total mass is conserved. Substances can be categorized and grouped based on similarity in reactivity, for example metals. (National Science Education Standards, November 1994.)

### GRADES 9-12

•Regardless of how atoms and molecules in a closed system interact with one another, or how they combine or break apart, the total weight of the system remains the same. (Benchmark for Scientific Literacy, 1993.)

Benchmarks	National Science Education Standards
<b>4D 6-8 #7</b> No matter how substances within a closed system interact with one another, or how they combine or break apart, the total mass of the system remains the same. The idea of atoms explains the conservation of matter: If the number of atoms stays the same no matter how they are rearranged, then their total mass stays the same.	<b>Content Standard B</b> <b>Physical Science: Properties and changes of properties in matter</b> <b>Grades 5-8</b> Substances react chemically in characteristic ways with other substances to form new substances (compounds) with different characteristic properties. In chemical reactions, the total mass is conserved...



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## Florida

### **Strand A: The Nature of Matter**

#### **Grades 6-8**

#### **Benchmark SC.A.1.3.2**

The student understands the difference between weight and mass.

#### **Grade Level Expectations**

The student:

Eighth

1. Understands that weight will vary with the location of the mass in the universe, but the mass will remain constant.

#### **Grades 9-12**

#### **Benchmark SC.B.1.4.2**

Understand that there is conservation of mass and energy when matter is transformed.

### **Benchmarks**

#### **4D 6-8 #7**

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#### **Content Standard B**

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## Illinois

### **Middle/Junior High School**

**12.C.3a** Explain interactions of energy with matter including changes of state and conservation of mass and energy.

**12.C.3b Model and describe the chemical and physical characteristics of matter (e.g., atoms, molecules, elements, compounds, mixtures)**

### **Benchmarks**

#### **4D 6-8 #7**

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### **National Science Education Standards**

#### **Content Standard B**

#### **Physical Science: Properties and changes of properties in matter Grades 5-8**

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## Indiana

### Grade 8

#### **Standard 3: The Physical Setting**

Students collect and organized data to identify relationships between physical objects, events, and processes. They use logical reasoning to question their own ideas as new information challenges their conceptions of the natural world.

*Matter\* and Energy*

#### **8.3.12**

Explain that no matter how substances within a closed system interact with one another, or how they combine or break apart, the total mass of the system remains the same. Understand that the atomic theory explains the conservation of matter: if the number of atoms stays the same no matter how they are rearranged, then their total mass stays the same.

\***matter:** anything that has mass\* and takes up space

\***mass:** a measure of the matter in the object

### **Benchmarks**

#### **4D 6-8 #7**

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## Kentucky

SC-M-1.1.1

**Grade 7**

The chemical properties of a substance cause it to react in predictable ways with other substances to form compounds with different characteristic properties. In chemical reactions, the total mass is conserved. Substances are often classified into groups if they react in similar ways.

Benchmarks	National Science Education Standards
<p><b>4D 6-8 #7</b> No matter how substances within a closed system interact with one another, or how they combine or break apart, the total mass of the system remains the same. The idea of atoms explains the conservation of matter: If the number of atoms stays the same no matter how they are rearranged, then their total mass stays the same.</p>	<p><b>Content Standard B</b> <b>Physical Science: Properties and changes of properties in matter</b> <b>Grades 5-8</b> Substances react chemically in characteristic ways with other substances to form new substances (compounds) with different characteristic properties. In chemical reactions, the total mass is conserved...</p>



# Standards Statements for the Topic “Conservation of Matter”

## Louisiana

As students in **Grades 5-8** extend their knowledge, what they know and are able to do includes:

### **Properties and Changes of Properties in Matter**

#### **PS-M-A7**

Understanding that during a chemical reaction in a closed system, the mass of the products is equal to that of the reactants.

As students in **Grades 9-12** extend their knowledge, what they know and are able to do includes:

### **Chemical Reactions**

#### **PS-H-D5**

Applying the law of conservation of matter to chemical reactions.

### **Energy**

#### **PS-H-F2**

Applying the universal law of conservation of matter, energy, and momentum and recognizing their implications.

### **Benchmarks**

#### **4D 6-8 #7**

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### **National Science Education Standards**

#### **Content Standard B**

#### **Physical Science: Properties and changes of properties in matter Grades 5-8**

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## Massachusetts

### Strand 3: Physical Sciences (Physics and Chemistry)

#### Grades 6-8

#### Topic: Properties of Matter

4. Explain and give examples of how mass is conserved in a closed system.

#### Benchmarks

##### 4D 6-8 #7

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##### Content Standard B

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## Maryland

By the end of **grade 8**, students know and are able to do everything required at earlier grades and:

**4.8.6** Explain that matter and energy cannot be created or destroyed but instead can be changed from one form into another.  
(MLO 4.4)

By the end of **grade 12**, students know and are able to do everything required at earlier grades and:

The student will conclude that the conservation of mass and energy holds true for all systems, and that the total amount of energy in any closed system remains constant (total amount of energy in any closed system remains constant).  
(CLG 4.3.3)

### Benchmarks

#### **4D 6-8 #7**

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#### **Content Standard B**

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# Standards Statements for the Topic “Conservation of Matter” Michigan

**All students will investigate, describe, and analyze ways in which matter changes.**

**MIDDLE SCHOOL (5-7)**

1. Describe common physical changes in matter: evaporation, condensation, sublimation thermal expansion and contraction.  
*Key concepts:* States of matter-solid, liquid, gas. Processes that cause changes of state or thermal effects: heating, cooling, boiling. Mass/weight remains constant during physical changes in closed systems.
2. Describe common chemical changes in terms of properties of reactants and products.  
*Key concepts:* Common chemical changes – burning, rusting iron, formation of sugars during photosynthesis, acid reacting with metal and other substances. Mass/weight remains constant in closed systems.
3. Explain physical changes in terms of the arrangement and motion of atoms and molecules.  
*Key concepts:* Molecular descriptions of states of matter. Changes in state of matter – melting, freezing, evaporation, condensation; thermal expansion and contraction. Speed of molecular motion-moving faster, slower, vibrate, rotate, unrestricted motion; change in speed of molecular motion with change in temperature.

**HIGH SCHOOL (8-12)**

2. Explain why mass is conserved in physical and chemical changes.  
*Key Concepts:* atom, molecule, mass.

**Benchmarks**

**4D 6-8 #7**

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**National Science Education Standards**

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# Standards Statements for the Topic “Conservation of Matter”

## Minnesota

### **Middle Level**

Understand the fundamental laws and concepts of the physical world including:

- a. properties of matter
- b. physical and chemical changes

### **Grades 9-12**

Understand the laws of conservation (e.g. mass)

### **Benchmarks**

#### **4D 6-8 #7**

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# Standards Statements for the Topic “Conservation of Matter” North Carolina

## Competency Goal 4

**7<sup>th</sup> Grade** - The learner will build an understanding of the general properties and interactions of matter.

### Objectives

**4.01** Classify substances based on their properties:

- Elements.
- Compounds.
- Mixtures.

**4.05** Describe and measure quantities related to chemical/physical changes within a system:

- Temperature.
- Volume.
- Mass.
- Precipitate.
- Gas production.

**4.06** Evaluate evidence to support the law of **conservation of matter.**

### Benchmarks

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## North Dakota

### GRADES 5-8

#### 8.3.1

- Law of Conservation of Matter

#### Benchmarks

##### 4D 6-8 #7

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# Standards Statements for the Topic “Conservation of Matter”

## Nebraska

### **GRADE 5-8**

**8.3.1 By the end of eighth grade, students will develop an understanding of properties and changes of properties in matter.**

- Investigate and relate that in chemical reactions, total mass is conserved.

### **Benchmarks**

#### **4D 6-8 #7**

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# Standards Statements for the Topic “Conservation of Matter”

## New York

### Standard 4 - Science

#### Commencement [grades 9-12]

3. Matter is made up of particles whose properties determine the observable characteristics of matter and its reactivity.

Students:

- explain the properties of materials in terms of the arrangement and properties of the atoms that compose them.
- use atomic and molecular models to explain common chemical reactions.
- apply the principle of conservation of mass to chemical reactions.
- use kinetic molecular theory to explain rates of reactions and the relationships among temperature, pressure, and volume of space.

*This is evident for example, when students:*

- ▲ use the atomic theory of elements to justify their choice of an element for use as a lighter than air gas for a launch vehicle.
- ▲ represent common chemical reactions using three-dimensional models of the molecules involved.
- ▲ discuss and explain a variety of everyday phenomena involving rates of chemical reactions, in terms of the kinetic molecular theory (e.g., use of refrigeration to keep food from spoiling, ripening of fruit in a bowl, use of kindling wood to start a fire, different types of flames that come from a Bunsen burner.)

### Benchmarks

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# Standards Statements for the Topic “Conservation of Matter”

## Ohio

### Grade 9

8. Demonstrate understanding that atoms may be bonded together by losing, gaining, or sharing electrons and that in a **chemical reaction**, the number, type of atoms and total **mass** must be the same before and after.

Benchmarks	National Science Education Standards
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# Standards Statements for the Topic “Conservation of Matter”

## Pennsylvania

### PA 3.4.4

A. Recognize basic concepts about the structure and properties of matter.

- Know that combining two or more substances can make new materials with different properties. (#2)

### PA 3.4.10

A. Explain concepts about the structure and properties of matter.

- Describe various types of chemical reactions by applying the laws of conservation of mass and energy

### Benchmarks

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# Standards Statements for the Topic “Conservation of Matter”

## South Carolina

### Grade 7

#### Physical Science

#### **2. In chemical reactions, the total mass is conserved.**

- e. Use balanced chemical equations such as photosynthesis and respiration to support the law of conservation of matter.
- f. Explain how the total mass of matter involved in the chemical reaction does not change even when a gas is released.

### Grade 9-12

#### Life Science

#### **E. Matter, Energy and Organization in Living Systems**

4. As matter and energy flow through different levels of organization of living systems (cells, organs, organisms, communities) and between living systems and the physical environment, chemical elements are recombined in different ways. Each recombination results in storage and dissipation of energy into the environment as heat. Matter and energy are conserved in each change.

**Analyze energy in biological systems in terms of transformation, conservation, and efficiency.**

#### Benchmarks

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# Standards Statements for the Topic “Conservation of Matter” Tennessee

<p><b>Fifth Grade Accomplishments</b> <b>Physical Science</b> <b>Structure and Properties of Matter</b> 5.2.2 Recognized that matter is composed of basic units, some too small to be seen with the naked eye, and has predictable properties.     a. Explain The Law of Conservation of Matter</p> <p><b>Eighth Grade Accomplishments</b> <b>Physical Science</b> <b>Interactions of Matter</b> 8.3.5 Understand the meaning of chemical equations.     b. Explain why the mass of the reactants is the same as the mass of the products during a chemical change.</p>	<p><b>CHEMISTRY 1 (Grades 9-12)</b> <b>2.0 Matter and Energy</b> The student will investigate the characteristics of matter and the interaction of matter and energy. <b><u>Performance Indicators State:</u></b> <i>As documented through state assessment, at Level 2, the student is able to:</i> •Demonstrate an understanding of the law of conservation of matter, given experimental data.</p>	<p><b>PHYSICAL SCIENCE (Grades 9-12)</b> <b>3.0 Interactions of Matter</b> The student will investigate the interactions of matter. <b><u>Learning Expectations</u></b> The student will: 3.4 explore the laws of conservation of matter <b><u>Performance Indicators State:</u></b> <i>As documented through state assessment, at Level 2, the student is able to:</i> demonstrate the law of conservation of matter in a chemical reaction by selecting the balanced equation.</p>
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<b>Benchmarks</b>
<p><b>4D 6-8 #7</b> No matter how substances within a closed system interact with one another, or how they combine or break apart, the total mass of the system remains the same. The idea of atoms explains the conservation of matter: If the number of atoms stays the same no matter how they are rearranged, then their total mass stays the same.</p>

<b>National Science Education Standards</b>
<p><b>Content Standard B</b> <b>Physical Science: Properties and changes of properties in matter</b> <b>Grades 5-8</b> Substances react chemically in characteristic ways with other substances to form new substances (compounds) with different characteristic properties. In chemical reactions, the total mass is conserved...</p>



# Standards Statements for the Topic “Conservation of Matter”

## Texas

### Integrated Physics and Chemistry

#### Grades 9 or 10

(8) *Science concepts.* The student knows that changes in matter affect everyday life. The student is expected to: (C) investigate and identify the law of conservation of mass.

#### Benchmarks

##### 4D 6-8 #7

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# Standards Statements for the Topic “Conservation of Matter”

## Virginia

### PS.5 (Physical Science)

The student will investigate and understand changes in matter and the relationship of these changes to the Law of Conservation of Matter and Energy. Key concepts include:

- physical changes (effect of temperature on state, particle size on solubility, and temperature on solubility);
- chemical changes (types of reactions, reactants and products, and balanced equations).

### CH.3 (Chemistry –High School)

The student will investigate and understand how conservation of energy and matter is expressed in chemical formulas and balanced equations. Key concepts include: \* nomenclature; \* balancing chemical equations; \* writing chemical formulas -- molecular, structural, empirical, and Lewis diagrams; \* bonding types -- ionic, covalent; \* reaction types -- synthesis, decomposition, single and double replacement, oxidation-reduction, neutralization, nuclear, exothermic and endothermic, spontaneous/non- spontaneous, dissociation ionization; \* physical and chemical equilibrium; and \* reaction rates and kinetics: activation energy, catalysis, degree of randomness.

### Benchmarks

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# Standards Statements for the Topic “Conservation of Matter”

## Vermont

**From Science, Mathematics, and Technology Standards:**

**Space, Time, and Matter**

**Matter, Motion, Forces, and Energy**

**7.12** Students understand forces and motion, the properties and composition of matter, and energy sources and transformations. This is evident when students:

**Grades 5-8**

**bb.** Provide examples of substances reacting chemically to form new substances with different characteristics, and describe and model the phenomenon with reference to elements and compounds.

**Grades 9-12**

**bbb.** Demonstrate an understanding of the atomic structure of matter in relationship to the periodic table, bonding, elements, and compounds; demonstrate an understanding of the conservation of matter, understand how radioactive elements decay (e.g. half life, alpha and beta emissions).

**Benchmarks**

**4D 6-8 #7**

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# Standards Statements for the Topic “Conservation of Matter”

## Wisconsin

### Physical Science

#### Content Standards

Students in Wisconsin will demonstrate an understanding of the physical and chemical properties of matter, the forms and properties of energy, and the ways in which matter and energy interact.

Note: *For more details of the content of physical sciences, see National Science Education Standards (1996, p.115-201).*

#### Performance Standards

By the end of **eighth grade**, students will:

**D.8.3** Understand how chemical interactions and behaviors lead to new substances with different properties.

### Benchmarks

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