Combining Atoms and Molecules

Lesson 1 How Atoms Form Compounds

Grade 8 Science Content Standards—3.a: Students know the structure of the atom and know it is composed of protons, neutrons, and electrons. Also covers: 3.b, 3.f

Accept all reasonable responses.

Skim Lesson 1 of your book. Predict four topics that might be discussed.

1. how compounds differ from the elements they contain
2. how ionic compounds are formed
3. how covalent bonds are formed
4. differences between single, double, and triple covalent bonds

Review Vocabulary

Define ion using your book or a dictionary.

atom that has gained or lost electrons

New Vocabulary

Use your book to define the following terms.

compound pure substance that contains two or more elements

chemical formula ingredient list for a compound

molecule neutral particle that forms as a result of electron sharing

chemical bond force that holds atoms together in a compound

ionic bond bond between oppositely charged ions

valence number of electrons in an atom’s outermost energy level

covalent bond chemical bond formed when atoms share electrons

Academic Vocabulary

Use a dictionary to define symbol. Then use it in a sentence to show its scientific meaning.

symbol something that stands for something else; The symbol for helium is He.
Lesson 1  How Atoms Form Compounds (continued)

Main Idea

What is a compound?
I found this information on page ________.  
CA SE, pp. 218-220

Have students explain in their own words how a compound differs from an element.

Details

Contrast elements with compounds by using the phrases to complete the Venn diagram.
- made of more than one kind of atom
- about 100 kinds exist
- include water and table sugar
- include gold and carbon
- made of only one kind of atom
- can be described by a chemical formula

Element
made of only one kind of atom
about 100 kinds exist
include gold and carbon

Both
Substances

Compound
made of more than one kind of atom
can be described by a chemical formula
include water and table sugar

Identify two things a chemical formula tells you about a compound.

Chemical symbols indicate the elements that make up a compound.

Subscript numbers indicate how many atoms of the element exist in one unit of the compound.

\( \text{H}_2\text{O}_2 \)

Summarize It

Summarize two main ideas of the above sections.
Accept all reasonable responses. A compound is made up of two or more elements.
A chemical formula contains information about the type and number of atoms that make up a compound.
Lesson 1 How Atoms Form Compounds (continued)

Main Idea

What is a compound?
I found this information on page __________.
CA SE, p. 220

Ionic Bonds and Ionic Compounds
I found this information on page __________.
CA SE, pp. 220-221

Details

Distinguish between the properties of the elements sodium and chlorine and the compound that they form.

| sodium | chlorinate | = | sodium chloride |
| soft, shiny metal | greenish-yellow gas | table salt |

Sequence the steps in the formation of lithium fluoride.

A lithium atom transfers one electron to a fluorine atom.

The lithium atom becomes a positively charged ion, and the fluorine atom becomes a negatively charged ion.

The two atoms form an ionic bond.

Identify the 6 properties of ionic compounds.

Properties of Ionic Compounds

- high melting points
- high boiling point
- usually dissolve in water
- brittle and break easily
- can conduct electricity when dissolved in water
- usually solid at room temperature

Summarize It

Summarize the main ideas of the above sections.

Accept all reasonable responses. Compounds have different properties from those of the elements of which they are made. Ionic bonds form between ions. Ionic compounds share many properties.
Lesson 1 How Atoms Form Compounds (continued)

**Main Idea**

**Ionic Bonds and Ionic Compounds**

I found this information on page ____.

CA SE, p. 223

**Summarize** what can be learned about an element from its Lewis dot diagram.

A Lewis dot diagram shows an atom's valence electrons, or the number of electrons in its outer energy level.

**Model** the arrangement of the valence electrons of different elements by constructing a Lewis dot diagram for each element below.

<table>
<thead>
<tr>
<th>Lithium</th>
<th>Beryllium</th>
<th>Boron</th>
<th>Carbon</th>
<th>Nitrogen</th>
<th>Oxygen</th>
<th>Fluorine</th>
<th>Neon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Li</td>
<td>Be</td>
<td>B</td>
<td>C</td>
<td>N</td>
<td>O</td>
<td>F</td>
<td>Ne</td>
</tr>
</tbody>
</table>

**Define** noble gas, and explain why noble gases are stable.

A noble gas is ______ an element in Group 18 that has ______ electrons ______ its outer energy level is filled.

A noble gas is stable because ______ its outer energy level is filled.

**Covalent Bonds—Sharing Electrons**

I found this information on page ____.

CA SE, pp. 225–226

**Identify** five properties of covalent compounds.

1. ______ can be solids, liquids, or gases at room temperature.
2. ______ have lower melting points than ionic compounds.
3. ______ have lower boiling points than ionic compounds.
4. ______ do not separate in water.
5. ______ do not conduct electricity when in solution.

**Summarize It**

Summarize the main ideas of the above sections in three bullet points. Accept all reasonable responses.

- Lewis dot diagrams show the number of valence electrons of an atom.
- A noble gas is stable because its outer energy level is filled.
- Properties of covalent compounds differ from those of ionic compounds.
Lesson 1 How Atoms Form Compounds (continued)

Main Idea

Covalent Bonds—Sharing Electrons

I found this information on page ________.
CA SE, pp. 226–227

Organize information about the types of covalent bonds by filling in the table below.

<table>
<thead>
<tr>
<th>Type of Covalent Bond</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single</td>
<td>consists of one shared pair of electrons between two atoms</td>
<td>H₂</td>
</tr>
<tr>
<td>Double</td>
<td>consists of two shared pairs of electrons</td>
<td>CO₂</td>
</tr>
<tr>
<td>Triple</td>
<td>consists of three shared pairs of electrons</td>
<td>N₂</td>
</tr>
</tbody>
</table>

Compare and contrast ionic bonds and covalent bonds by completing the Venn diagram below with at least six facts.

<table>
<thead>
<tr>
<th>Ionic</th>
<th>Covalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>form by electrical attraction between charged ions</td>
<td>form when atoms share electrons</td>
</tr>
<tr>
<td>form between metals and nonmetals</td>
<td>can be single, double, or triple bonds</td>
</tr>
<tr>
<td>form a chemical bond</td>
<td>involve valence electrons</td>
</tr>
<tr>
<td>form compounds</td>
<td></td>
</tr>
</tbody>
</table>

Summarize two main ideas about covalent bonds with two bullet points. Accept all reasonable responses.

- Covalent bonds have properties that are different from those of ionic bonds.
- Covalent bonds can be single, double, or triple bonds.