Solute and Solvent

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This giant Buddha statue, which is a national treasure in Japan, is made of bronze. Bronze consists mainly of copper but also contains some tin. Bronze is an example of a solution. A solution is a type of mixture that has the same composition throughout.

How a Solution Forms

A solution forms when one substance is dissolved by another. The substance that dissolves is called the solute. The substance that dissolves it is called the solvent. The solute is present in a lesser amount that the solvent. When the solute dissolves, it separates into individual particles, which spread throughout the solvent.

Q: In bronze, what are the solute and solvent?
A: Because bronze consists mainly of copper, copper is the solvent and tin is the solute. The two metals are combined in a hot, molten state, but they form a solid solution at room temperature.

What’s Your State?

In the example of bronze, a solid (tin) is dissolved in another solid (copper). However, matter in any state can be the solute or solvent in a solution. For example, in a saltwater solution, a solid (salt) is dissolved in a liquid (water). The Table 1.1 describes examples of solutions consisting of solutes and solvents in various states of matter.
### Table 1.1: Solutes, Solvents, and States of Matter

<table>
<thead>
<tr>
<th>Type of Solution: Example</th>
<th>Solute</th>
<th>Solvent</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Gas dissolved in gas</em>: dry air</td>
<td>oxygen</td>
<td>nitrogen</td>
</tr>
<tr>
<td><em>Gas dissolved in liquid</em>: carbonated</td>
<td>carbon dioxide</td>
<td>water</td>
</tr>
<tr>
<td>water</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Liquid dissolved in gas</em>: moist air</td>
<td>water</td>
<td>air</td>
</tr>
<tr>
<td><em>Liquid dissolved in liquid</em>: vinegar</td>
<td>acetic acid</td>
<td>water</td>
</tr>
<tr>
<td><em>Solid dissolved in liquid</em>: sweet tea</td>
<td>sugar</td>
<td>tea</td>
</tr>
</tbody>
</table>

### Water as a Solvent

Salt isn’t the only solute that dissolves in water. In fact, so many things dissolve in water that water is sometimes called the universal solvent. Water is such a good solvent because it is a very polar compound. A polar compound has positively and negatively charged ends. Solutes that are also charged are attracted to the oppositely charged ends of water molecules. This allows the water molecules to pull the solute particles apart.

On the other hand, there are some substances that don’t dissolve in water. Did you ever try to clean a paintbrush with water after painting with an oil-based paint? It doesn’t work. Oil-based paint is nonpolar, so its particles aren’t charged. As a result, oil-based paint doesn’t dissolve in water. (You can see how to dissolve oil-based paint in the Figure 1.1.)

![Paint Thinner](paint_thinner.png)

**FIGURE 1.1**
To dissolve a nonpolar solute such as oil-based paint, a nonpolar solvent such as paint thinner must be used.

### Like Dissolves Like

These examples illustrate a general rule about solutes and solvents: like dissolves like. In other words, polar solvents dissolve polar solutes, and nonpolar solvents dissolve nonpolar solutes. You can see below a student’s video demonstrating solutes that do and solutes that don’t dissolve in water.

![Like Dissolves Like](like_dissolves_like.png)

**MEDIA**
Click image to the left or use the URL below.
URL: [http://www.ck12.org/flx/render/embeddedobject/5007](http://www.ck12.org/flx/render/embeddedobject/5007)
Ionic and Covalent Solutes

All solutes separate into individual particles when they dissolve, but the particles are different for ionic and covalent compounds. Ionic solutes separate into individual ions. Covalent solutes separate into individual molecules.

Salt, or sodium chloride (NaCl), is an ionic compound. When it dissolves in water, it separates into positive sodium ions (Na\(^+\)) and negative chloride ions (Cl\(^-\)). You can see how this happens in the Figure 1.2. The negative oxygen ends of water molecules attract the positive sodium ions, and the positive hydrogen ends of water molecules attract the negative chloride ions. These forces of attraction pull the ions apart.

![How Salt Dissolves in Water](http://www.ck12.org/flx/render/embeddedobject/647)

The sugar glucose is a covalent compound. When sugar dissolves in water, it forms individual glucose molecules (C\(_6\)H\(_{12}\)O\(_6\)). You can see how this happens in the Figure 1.3. Sugar is polar like water, so sugar molecules also have positive and negative ends. Forces of attraction between oppositely charged ends of water and sugar molecules pull individual sugar molecules away from the sugar crystal. Little by little, the sugar molecules are separated from the crystal and surrounded by water.

![Media](http://www.ck12.org/flx/render/embeddedobject/647)

Summary

- A solution forms when one substance dissolves in another. The substance that dissolves is called the solute. The substance that dissolves it is called the solvent.
- Solutes and solvents may be any state of matter.
- Many solutes dissolve in water because water is a very polar compound.
- A general rule: like dissolves like. For example, polar solvents dissolve polar solutes, and nonpolar solvents dissolve nonpolar solutes.
- Ionic solutes separate into individual ions when they dissolve. Covalent solutes separate into individual molecules.
Review

1. Compare and contrast the solute and solvent of a solution.
2. Describe an example of a gaseous solute dissolved in a liquid solvent.
3. Explain the expression “like dissolves like,” and give an example.
4. Outline how sodium chloride dissolves in water.

Explore More

Watch the video about solutes and solvents and then answer the questions below.

1. The majority component of a solution is the __________.
2. The minority component of a solution is the __________.
3. Decide whether the following statement is true or false, and then explain why: There is no such thing as a universal solvent.
4. An aqueous solution is a solution in which the solvent is __________.
5. A solution in which there is a lot of solute relative to the solvent is __________.
6. A solution in which there is little solute relative to the solvent is __________.
7. How is the concentration of solute in a solution measured?
References

1. Zachary Wilson. Non-polar paint thinner is used to dissolve non-polar oil based paints . CC BY-NC 3.0
2. Christopher Auyeung. Diagram showing how salt dissolves in water . CC BY-NC 3.0
3. Christopher Auyeung. Diagram showing how sugar dissolves in water . CC BY-NC 3.0