

## 5<sup>th</sup> Grade - Lesson 3.3

### Forming a precipitate

#### Teacher Background

In Lesson 3.3, students see that when two solutions are mixed, a chemical reaction can take place resulting in the formation of a solid. The solid is called a *precipitate*. The precipitate does not dissolve into the solution. Some precipitates are intentionally produced for a specific purpose. For example, a precipitate reaction is often conducted as one step in the process of water purification so that impurities from water can be easily removed. But some precipitates, like soap scum, are by-products of everyday life and form even though they are unwanted.

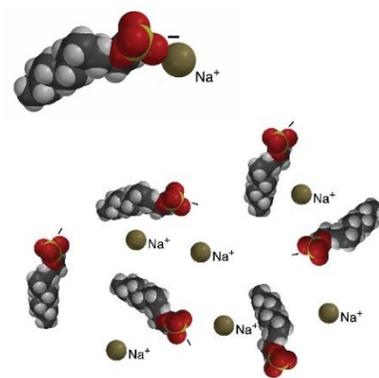


#### Soap Scum on the Molecular Level

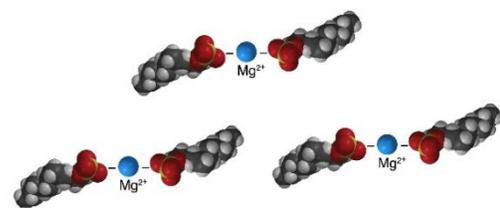
Soap molecules are made up of positive and negative ions at one end and a long chain of carbon and hydrogen atoms with no charge at the other end. When soap dissolves in water, a positive sodium ion is released into the water leaving a negatively charged end of the soap molecule.

Soap scum forms when soap is used in “hard water.” Hard water has a high concentration of ions such as magnesium ( $\text{Mg}^{2+}$ ) or calcium ( $\text{Ca}^{2+}$ ). In hard water, the ions react with soap to form the precipitate (soap scum), which does not dissolve in the water.

In the formation of soap scum from magnesium ions ( $\text{Mg}^{2+}$ ), the ion, which has two positive charges, replaces the sodium ion ( $\text{Na}^+$ ) on two soap molecules and bonds them together, making the compound insoluble in water and incapable of cleaning.



Soap Molecules



Soap Scum

#### Some Precipitates are Good

Sometimes, making a precipitate is a useful thing to do. For example, a precipitation reaction can be used to help remove the excess ions in hard water. If excess calcium ions ( $\text{Ca}^{2+}$ ) are the cause of hard water, they can be removed by adding a solution of sodium carbonate ( $\text{Na}_2\text{CO}_3$ ). Dissolving sodium carbonate releases the carbonate ion ( $\text{CO}_3^{2-}$ ), which has two negative charges, into the water. The calcium ion in the hard water and carbonate ion will bond to form the insoluble precipitate calcium carbonate ( $\text{CaCO}_3$ ), which can be filtered out of the water.

Another great use of precipitation is the removal of heavy metals, such as lead, copper, or zinc from water. These metal contaminants are in the form of positively charged ions ( $\text{Pb}^{2+}$ ,  $\text{Cu}^{2+}$ , and  $\text{Zn}^{2+}$ ). Since these metal ions are positively charged, a negatively charged ion needs to be used to make them bond together to form a precipitate. A common compound used is called sodium hydroxide ( $\text{NaOH}$ ). Sodium hydroxide dissolves to release a sodium ion ( $\text{Na}^+$ ) and a hydroxide ion ( $\text{OH}^-$ ). A metal ion with two positive charges bonds to two hydroxide ions to form a precipitate that can be filtered from the water.