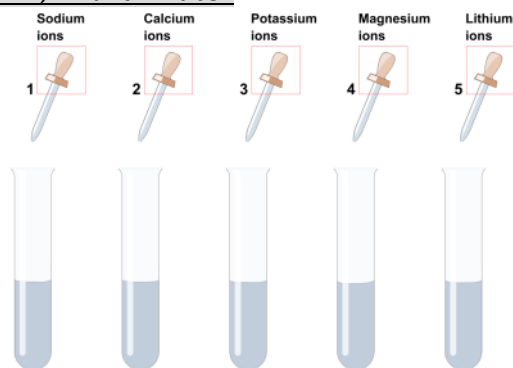


## XII) Hard Water



An interactive animation illustrating an experiment to investigate which metal ions cause water hardness. Click the highlighted areas to add the ions to water with a little soap added. Hard water does not easily lather and forms scum on the surface

<https://yenka.com/media/attachment.action?quick=v1&att=2224>

Hard water is caused by a high concentration of Ca<sup>2+</sup> and/or Mg<sup>2+</sup> ions in water. It's a problem in areas of the world rich in limestone (CaCO<sub>3</sub>) and/or magnesite (MgCO<sub>3</sub>). Water from rivers, lakes, and streams pass over limestone rock, and Ca<sup>2+</sup> ends up in water by two processes.

Hard water is not harmful to health, but can cause pipes to clog and hinders soap from creating suds: Ca<sup>2+</sup> + NaC<sub>17</sub>H<sub>35</sub>COO → Ca(C<sub>17</sub>H<sub>35</sub>COO)<sub>2</sub> + 2Na<sup>+</sup>

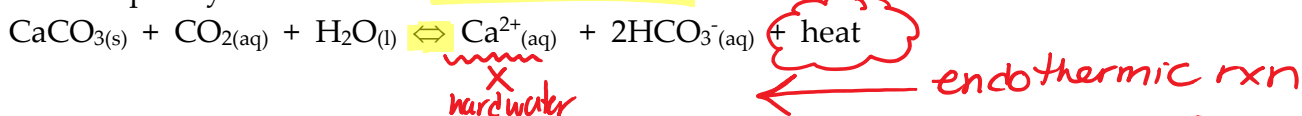
soap                      soap scum

1. **Permanent Hard Water** is formed by acidic water (water containing H<sup>+</sup>) due to acid rain. It is deemed 'permanent' because the reaction is not reversible:



How do you soften permanently hard water? *treated by adding an anion, such as CO<sub>3</sub><sup>2-</sup>; this will form a less solubility (ppt) product (CaCO<sub>3</sub> or MgCO<sub>3</sub>) which can be removed/filtered.*

2. **Temporary Hard Water** is due to the CO<sub>2</sub> dissolved in regular rainwater. It is deemed 'temporary' because it's a reversible reaction



How do you soften temporary hard water? *cause an equilibrium shift left. Increase the temp. (heat the water), the endothermic rxn is favored ← shift left, therefore the Ca<sup>2+</sup> ion will precipitate out of solution as CaCO<sub>3</sub>(s).*

**Assignment 10:** Read Hebden p. 103 & 104 and do p. 104 #76-80