Basics of Softening

Presented by: Stephanie Layfield

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- Graduate of Texas State University
- Active in TWQA as well as WQA

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Ionico Technical Services

Objectives

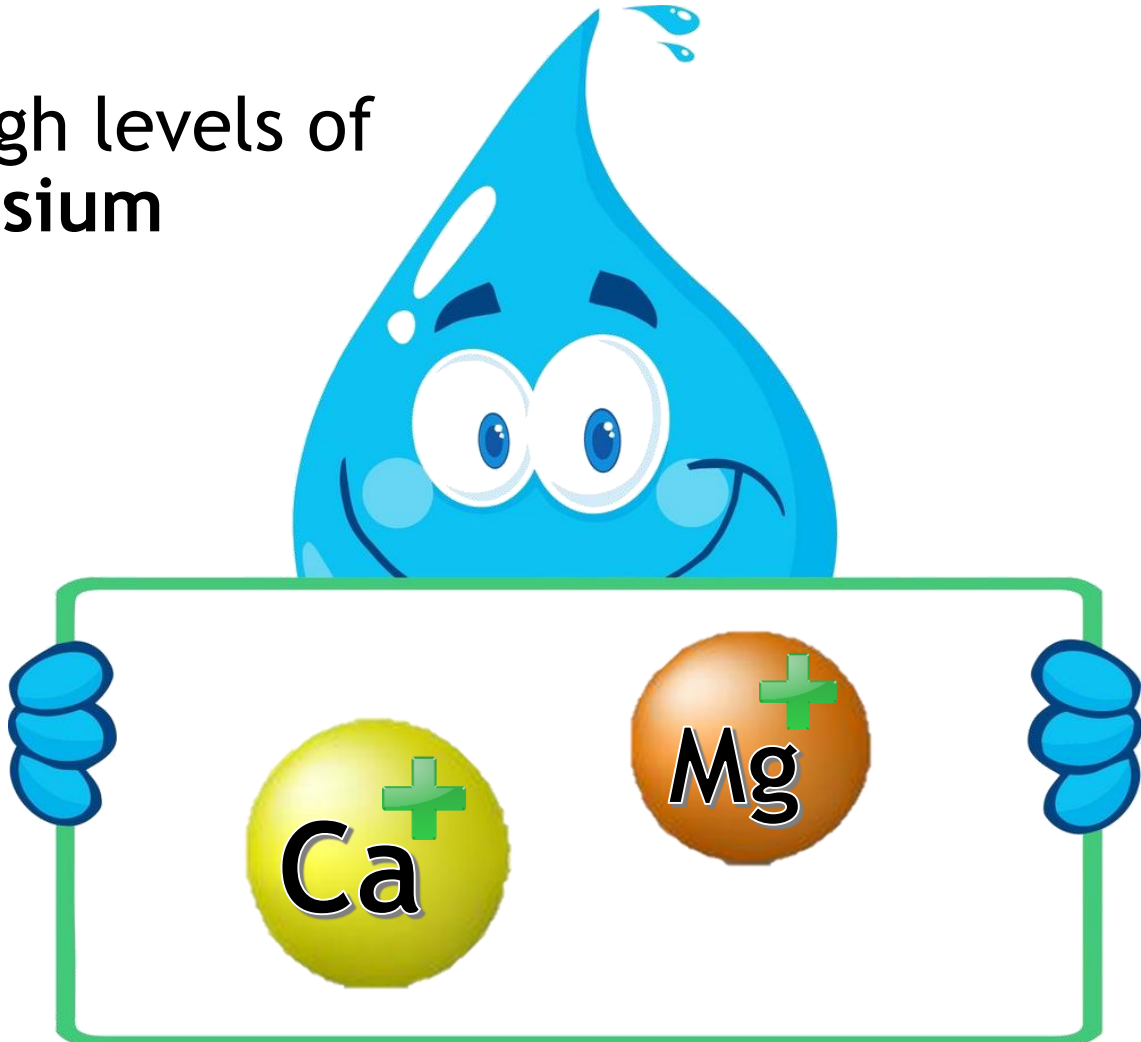
- Define Hard Water and Explain the Purpose of Water Softening
- Describe the Structure, Function, and Purpose of Ion Exchange Resin
- Explain the Ion Exchange Process and Cation Selectivity
- Outline the Steps and Purpose of Resin Regeneration
- Identify Basic Water Softener Technologies and Equipment

What is hard water?

Effects of Hardness

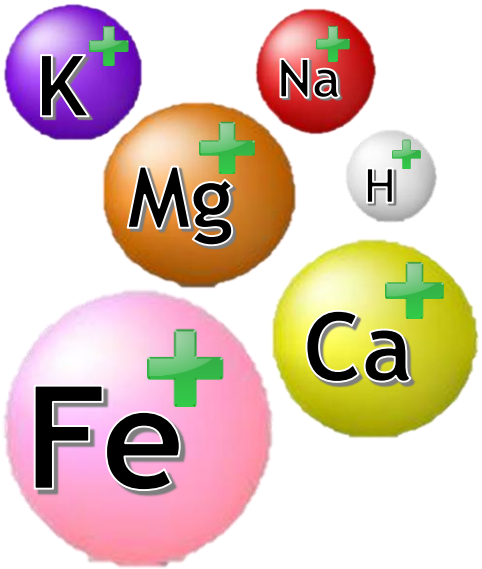
Hard Water

- Water containing high levels of **Calcium** and **Magnesium**

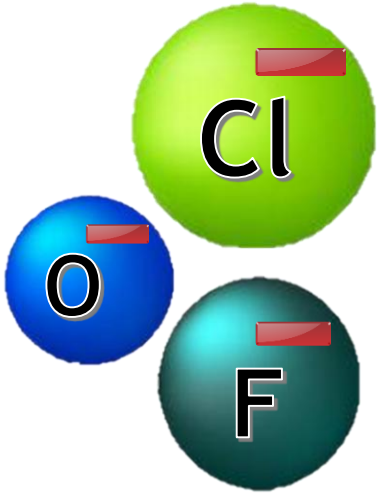


Ions

- Particles in water that contain either a **positive** or **negative charge**



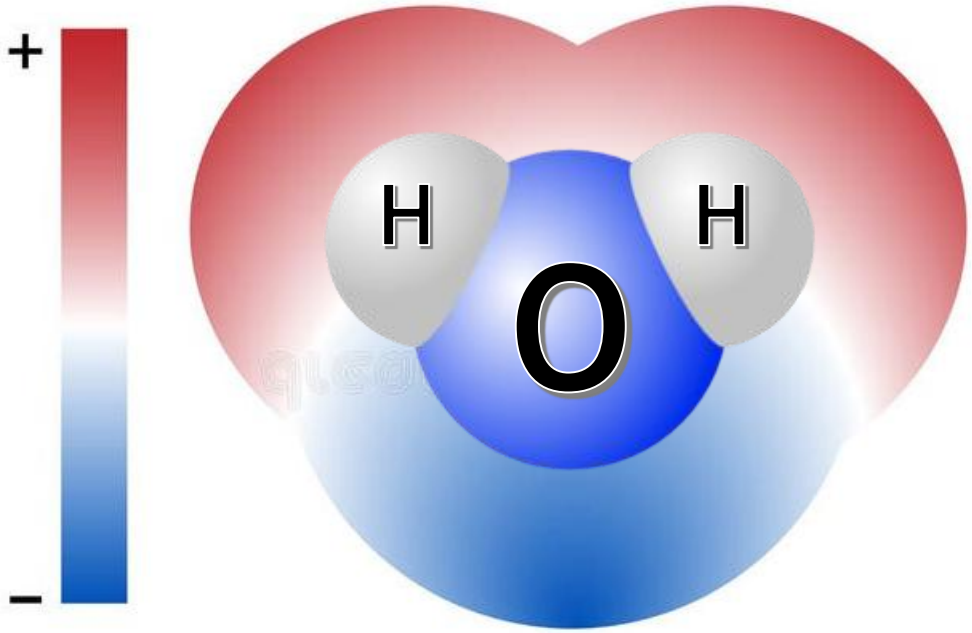
Cations



Anions

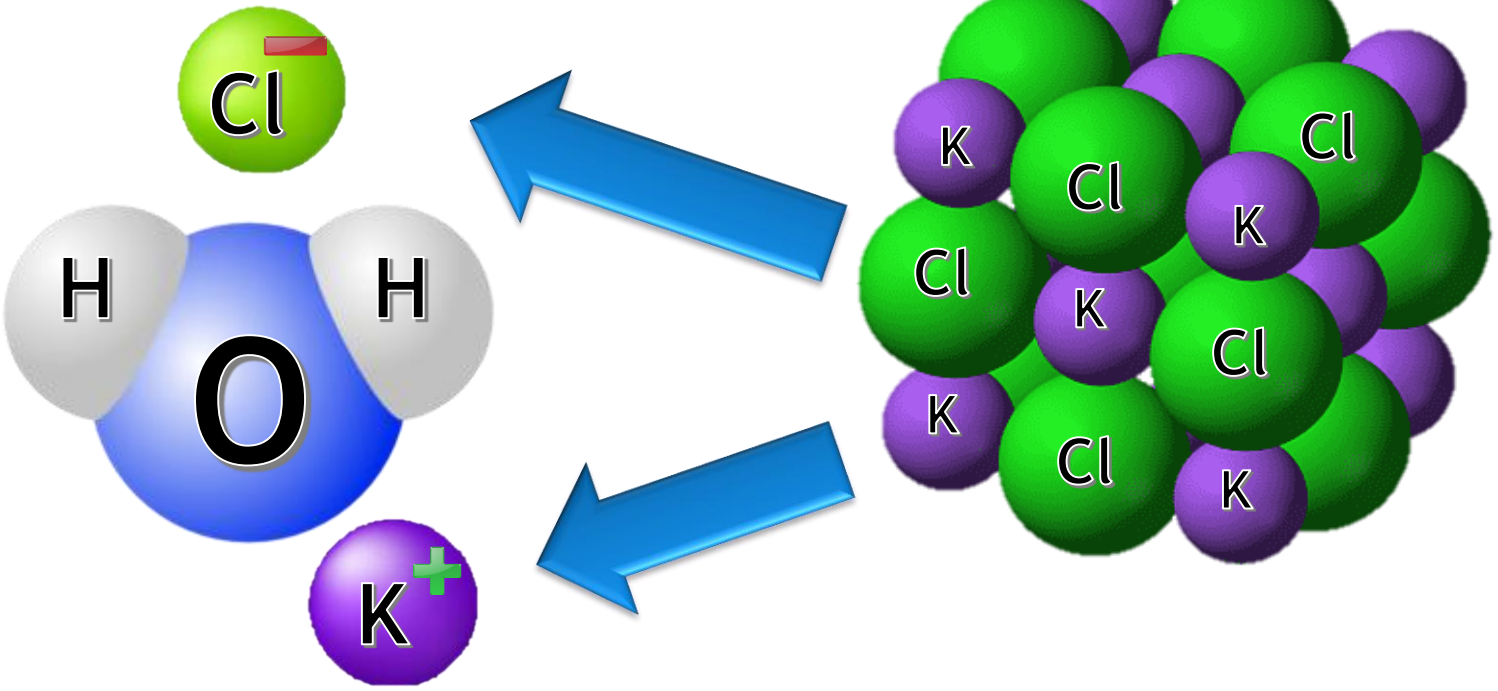
Polar

- Molecules have **one side that is more positive** and the **other side is more negative**, but it is **neutral overall**



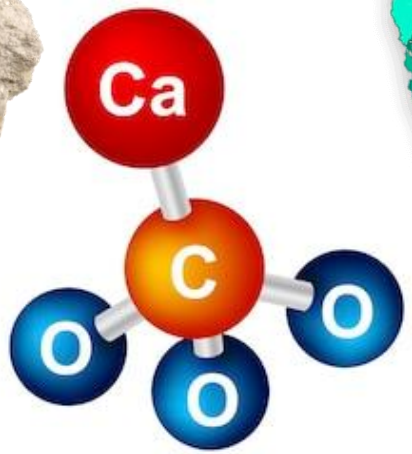
Dissolution

- **Water dissolves compounds** such as Potassium Chloride “salt” into individual Potassium and Chloride Ions

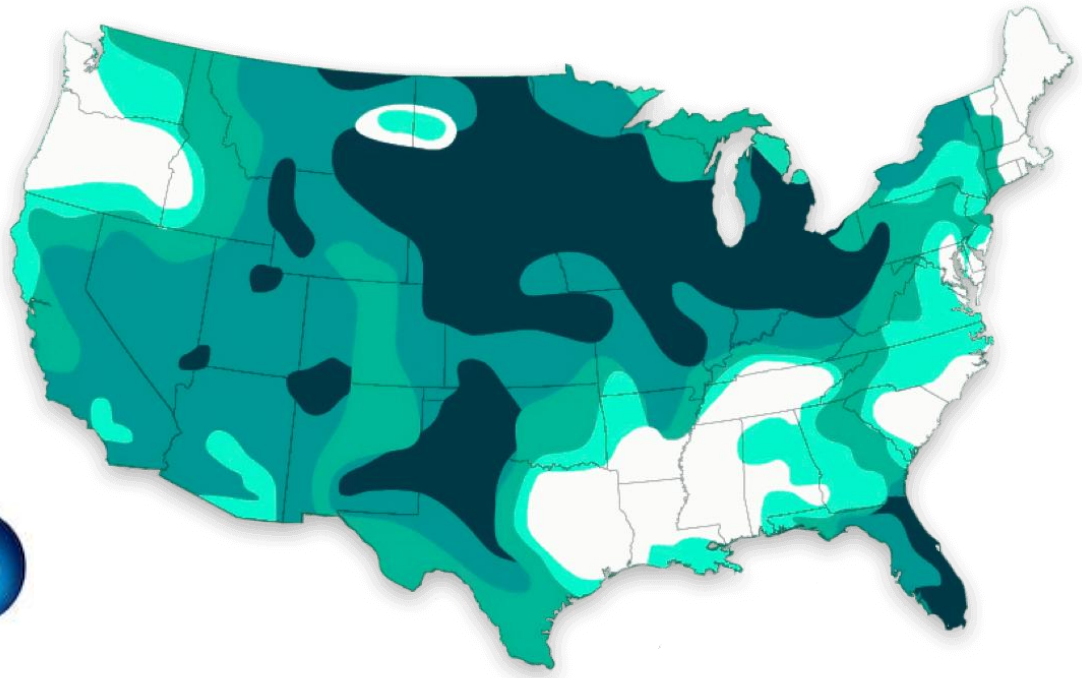


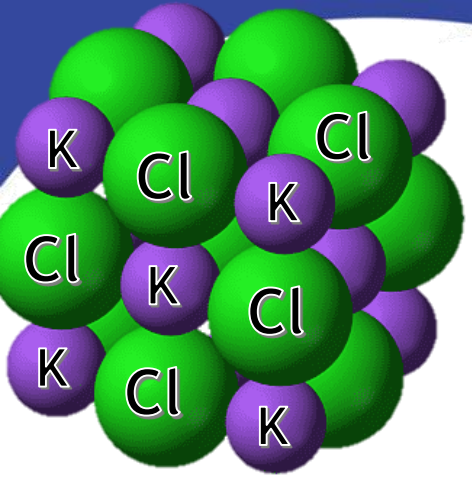
Where does hardness come from?

- **Limestone** substrate **dissolved in groundwater**

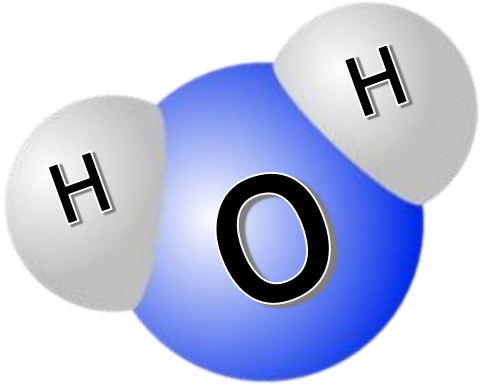


$CaCO_3$
Calcium Carbonate





Why does all this matter?

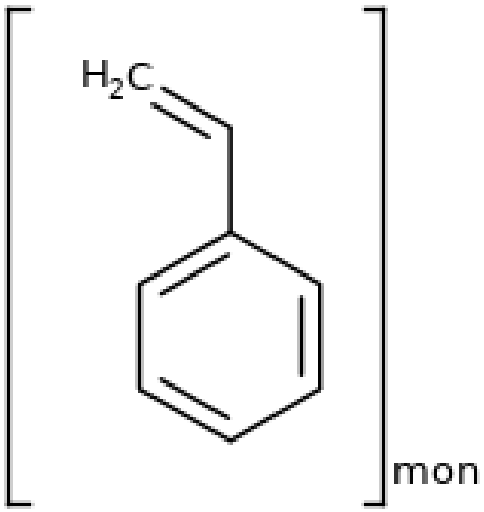


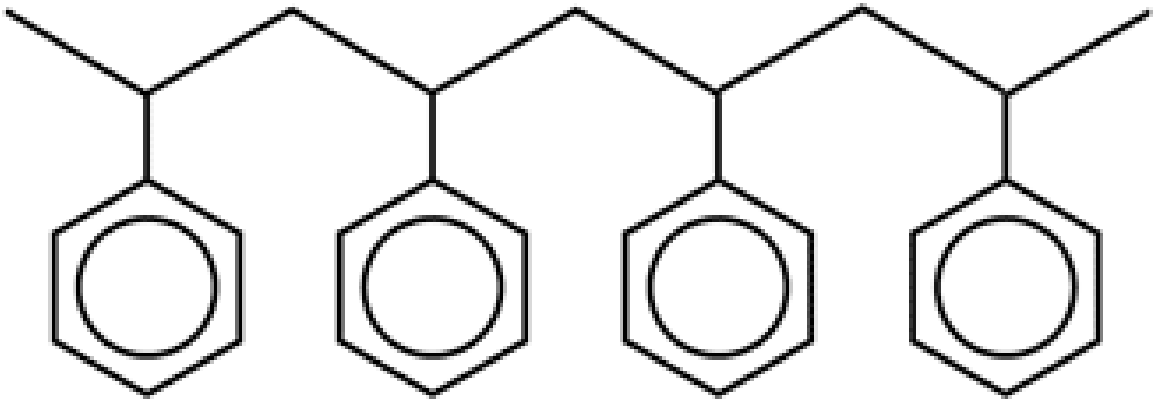
Softening Water

- Hardness is reduced in water through **Ion Exchange** using **Resin**

How is resin made?

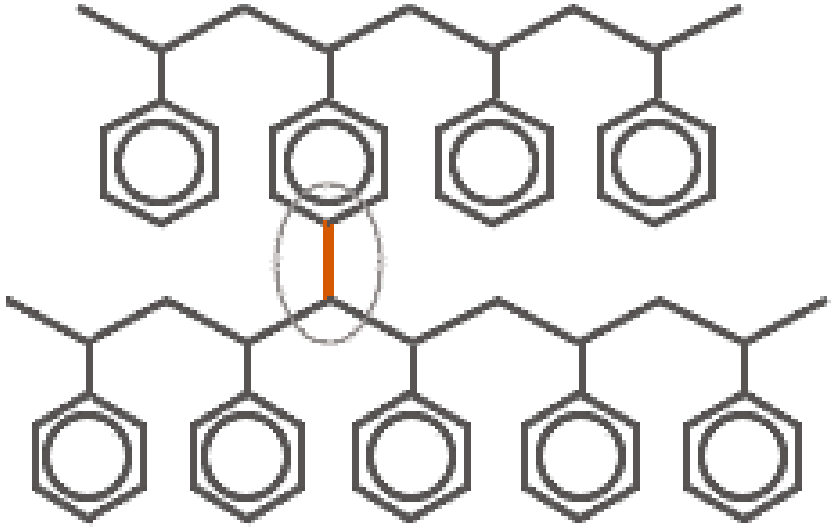
- Manufacturing process begins with styrene molecules that are polymerized into long chains
- The resulting ‘globules” are stirred and broken into small droplets





How is resin made?

- To build the resin's internal structure, divinylbenzene (DVB) is added in an exothermic reaction forming small plastic beads

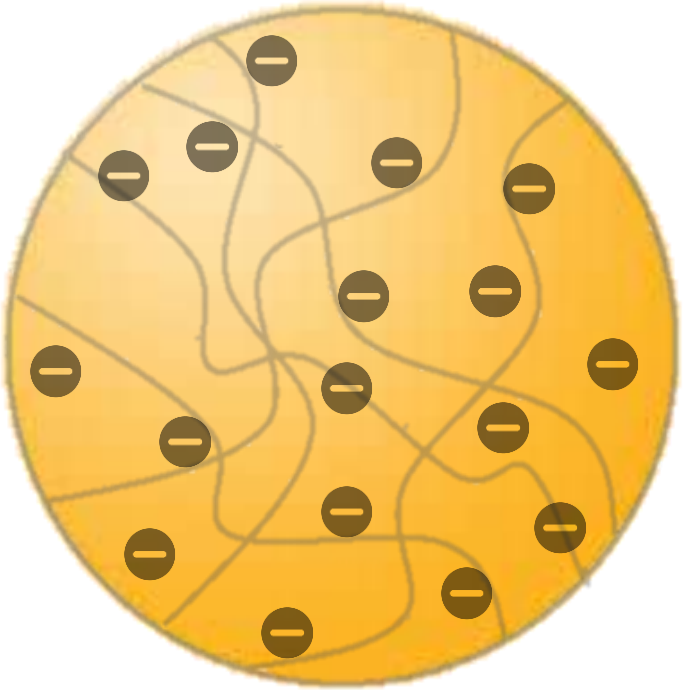


- This is the Cross-linking that gives the beads strength

How is resin made?

- In the case of softening, a cation resin must be made by attaching a negative functional group to the resin's molecular structure
- These functional groups form the "Active Exchange sites" for ions in solution

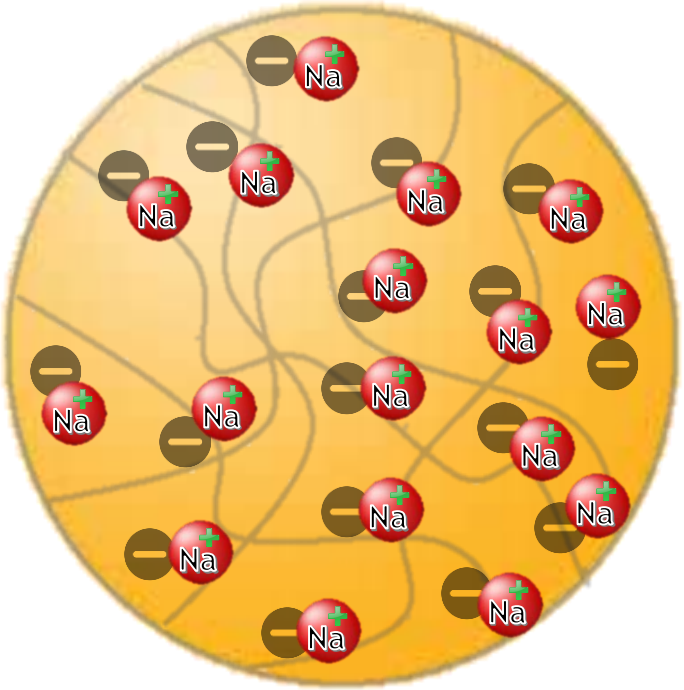
The results….



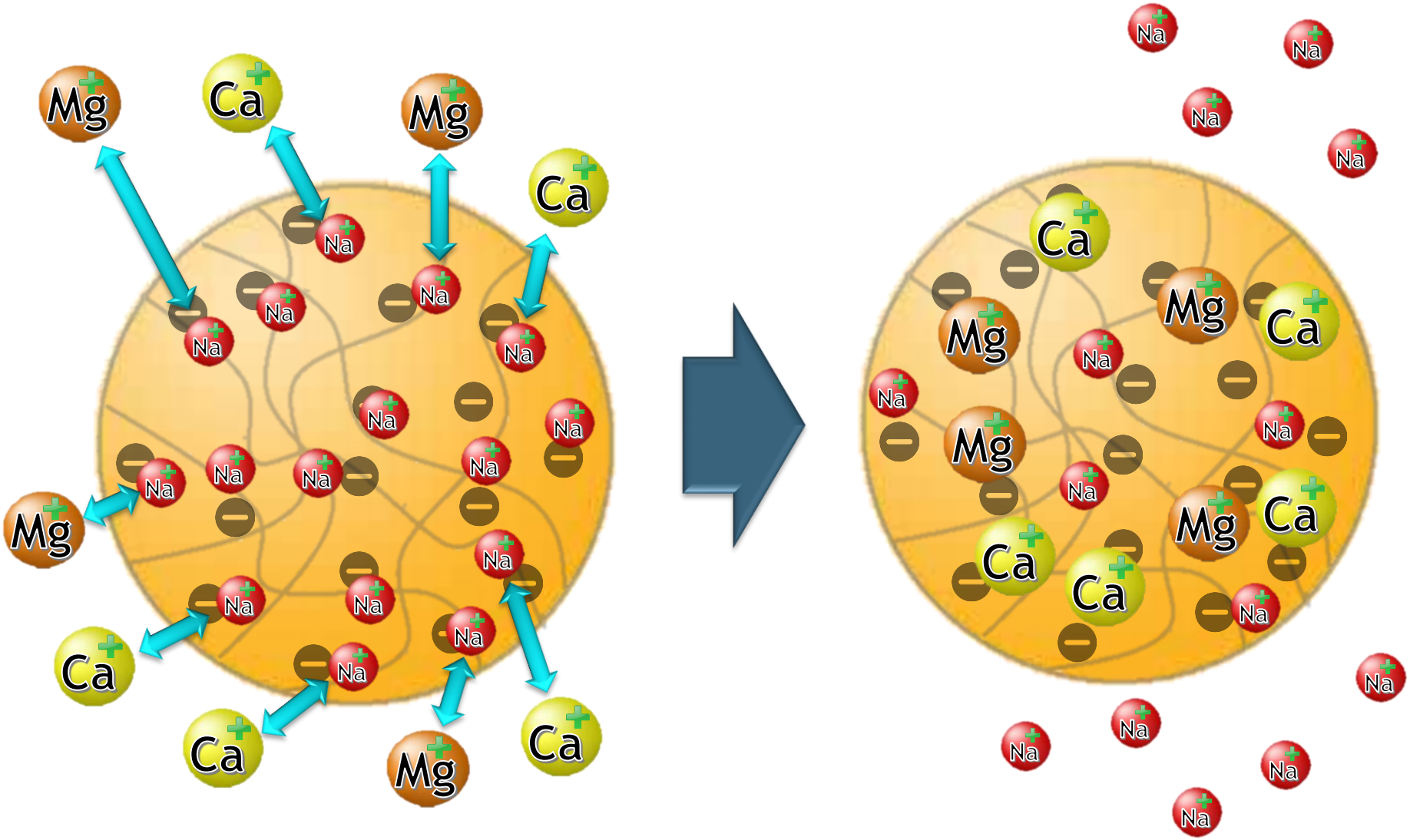
Cation Resin Bead

How does ion exchange work?

Sodium State



Softening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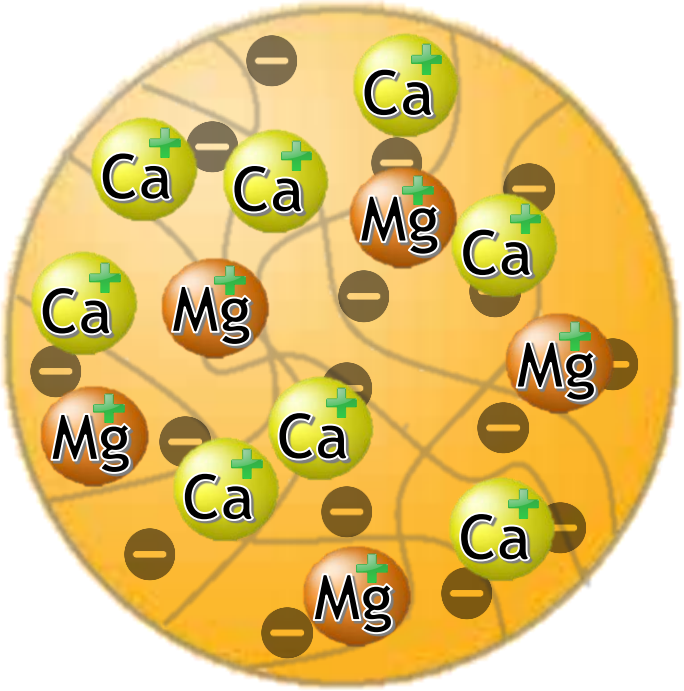
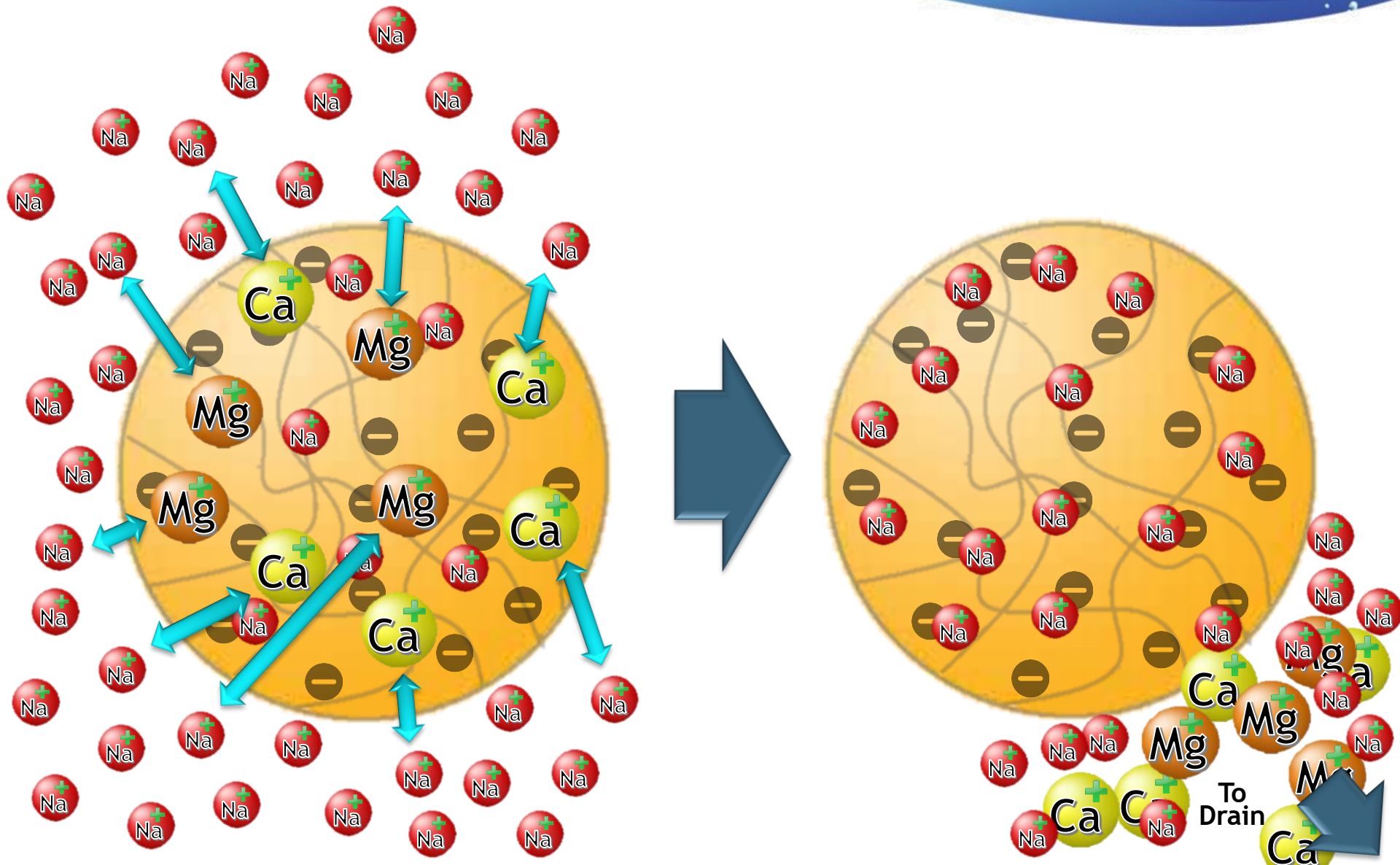
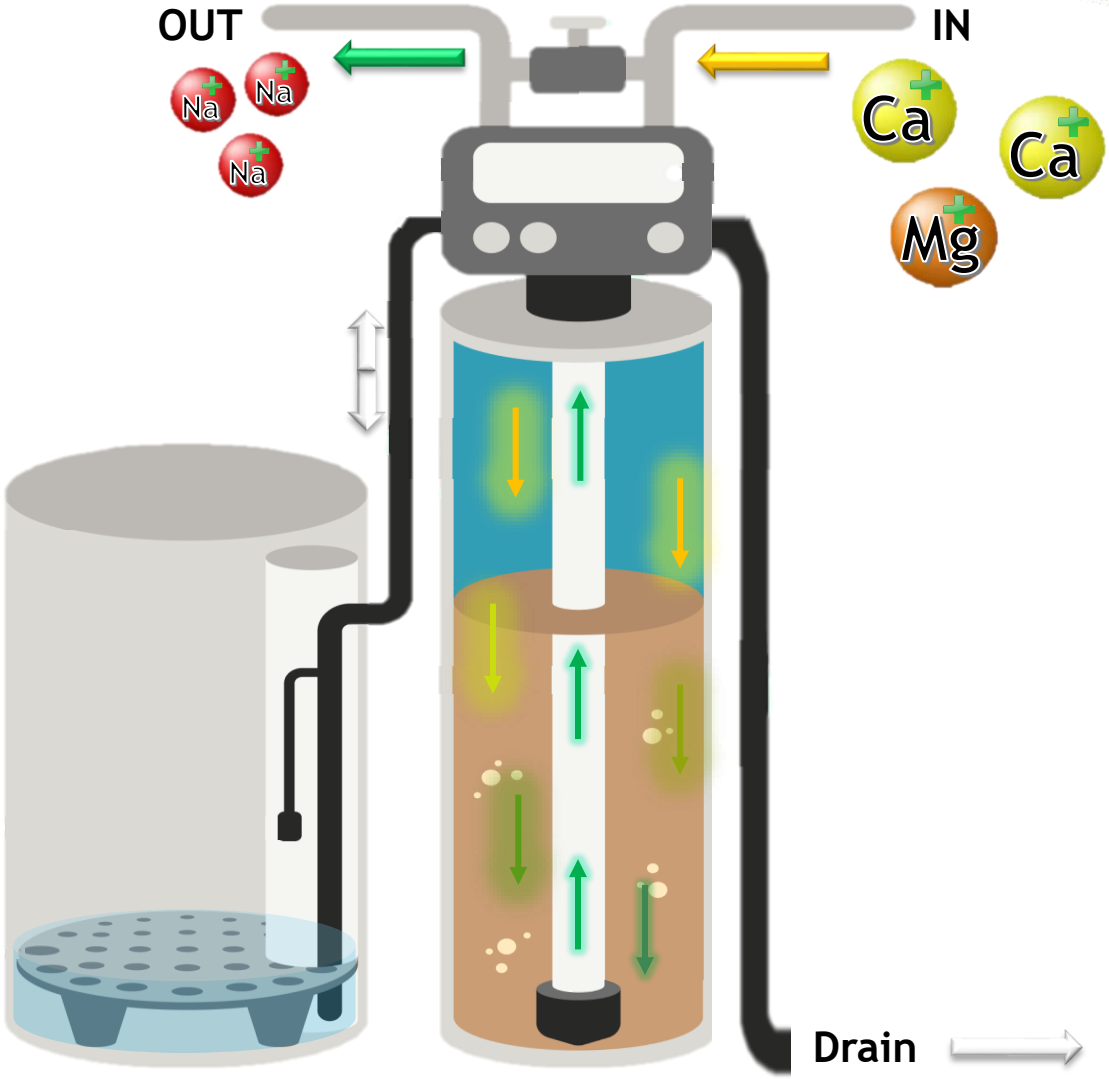
Exhausted State



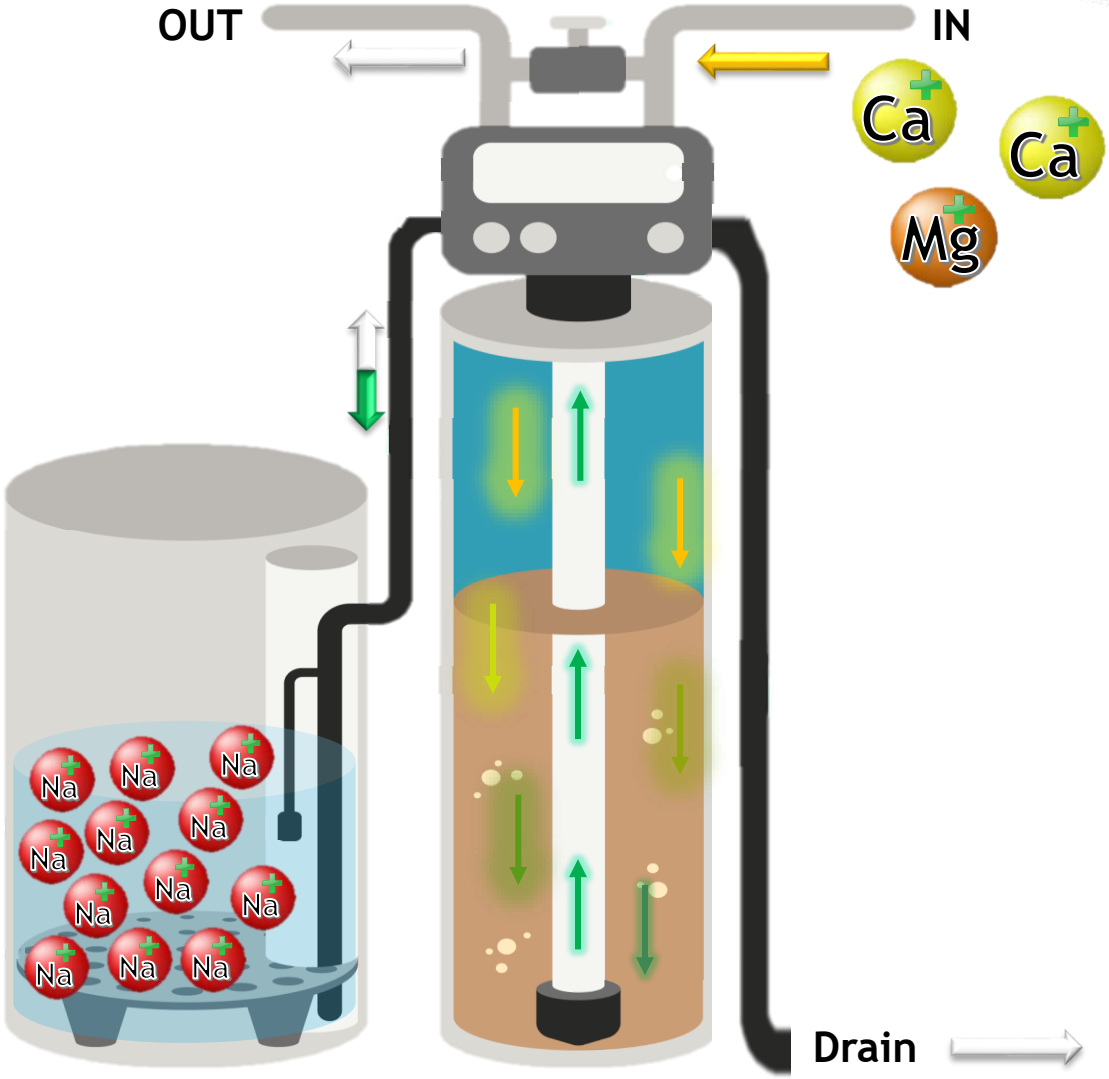
Regeneration



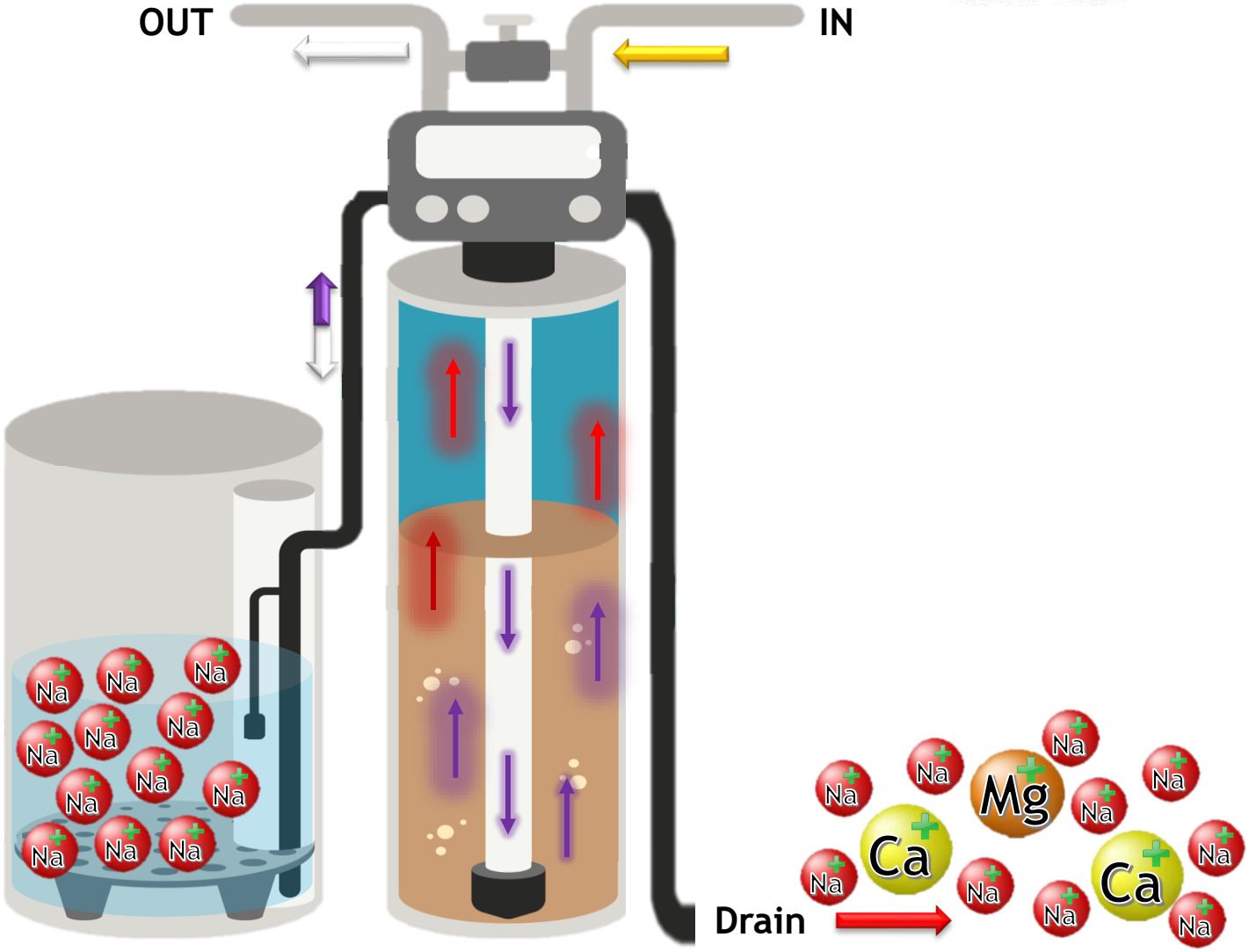
Service



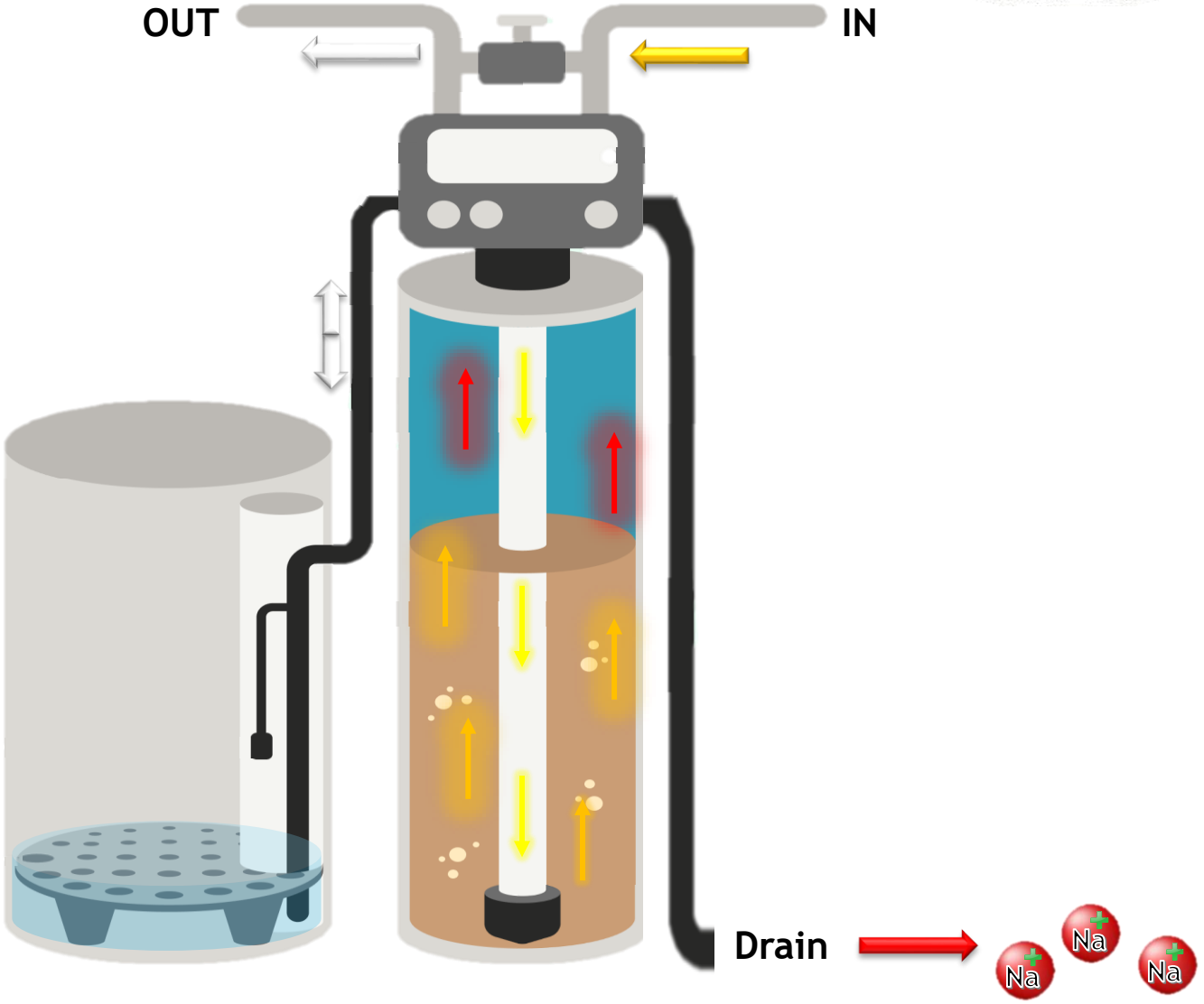
Fill



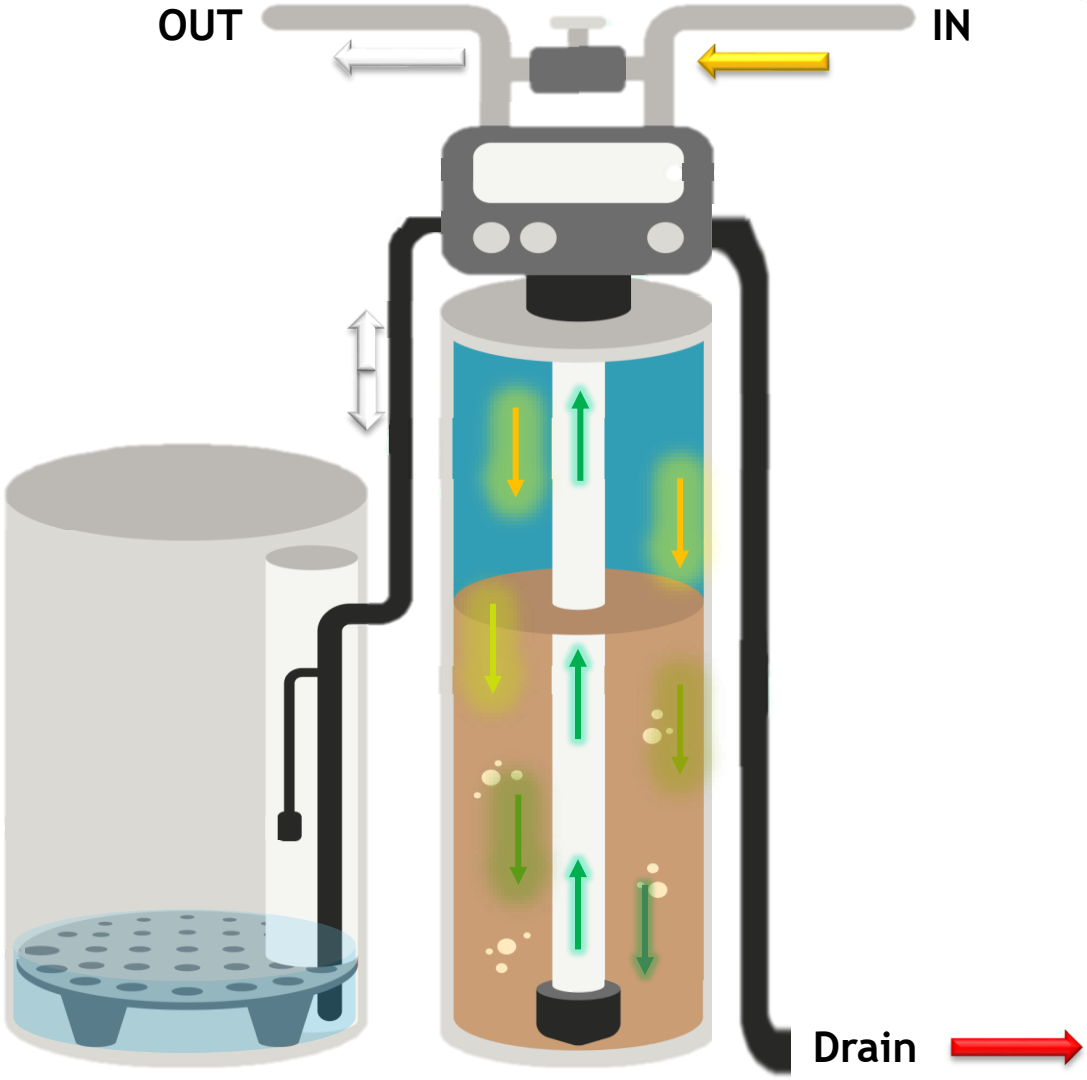
Brine



Backwash

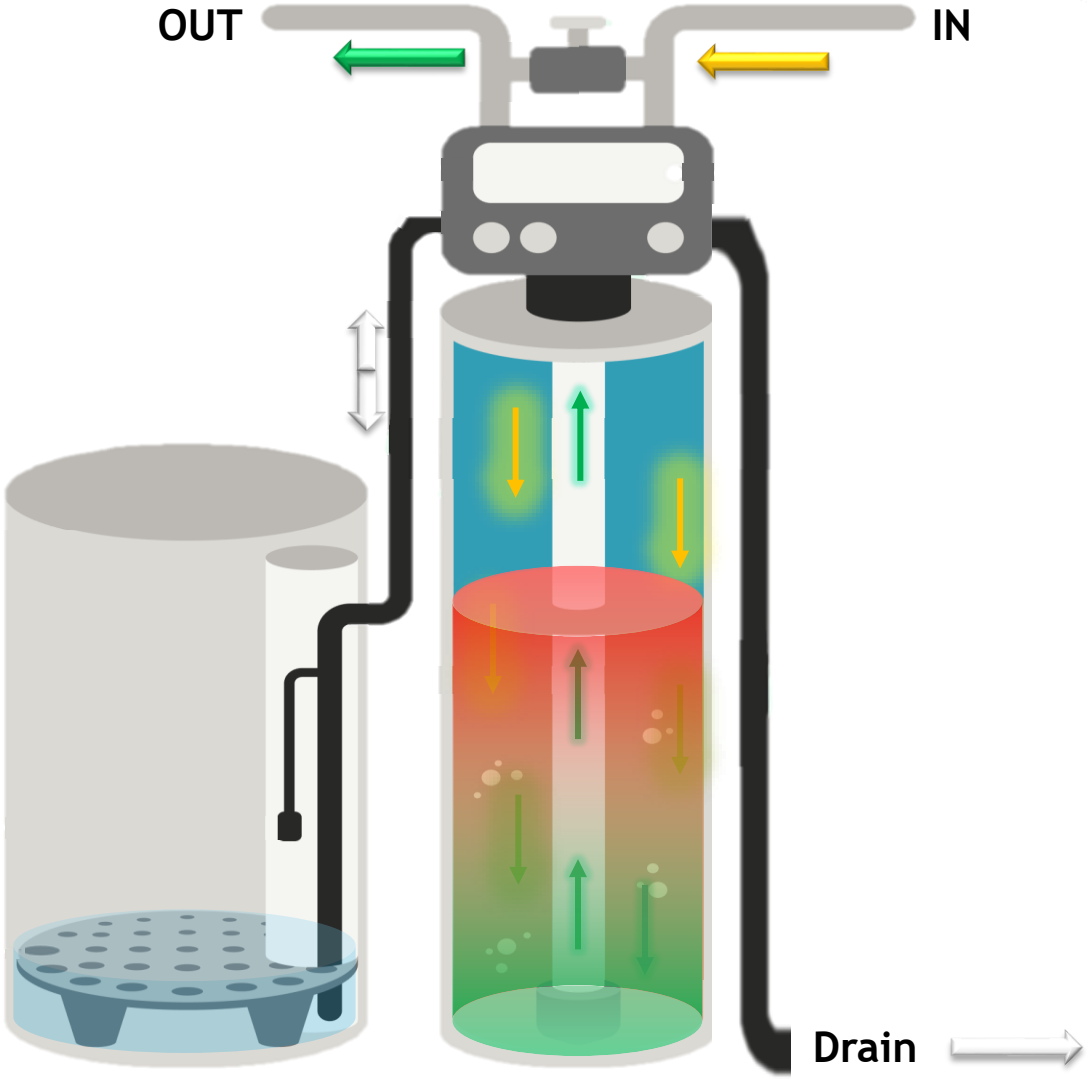


Rinse

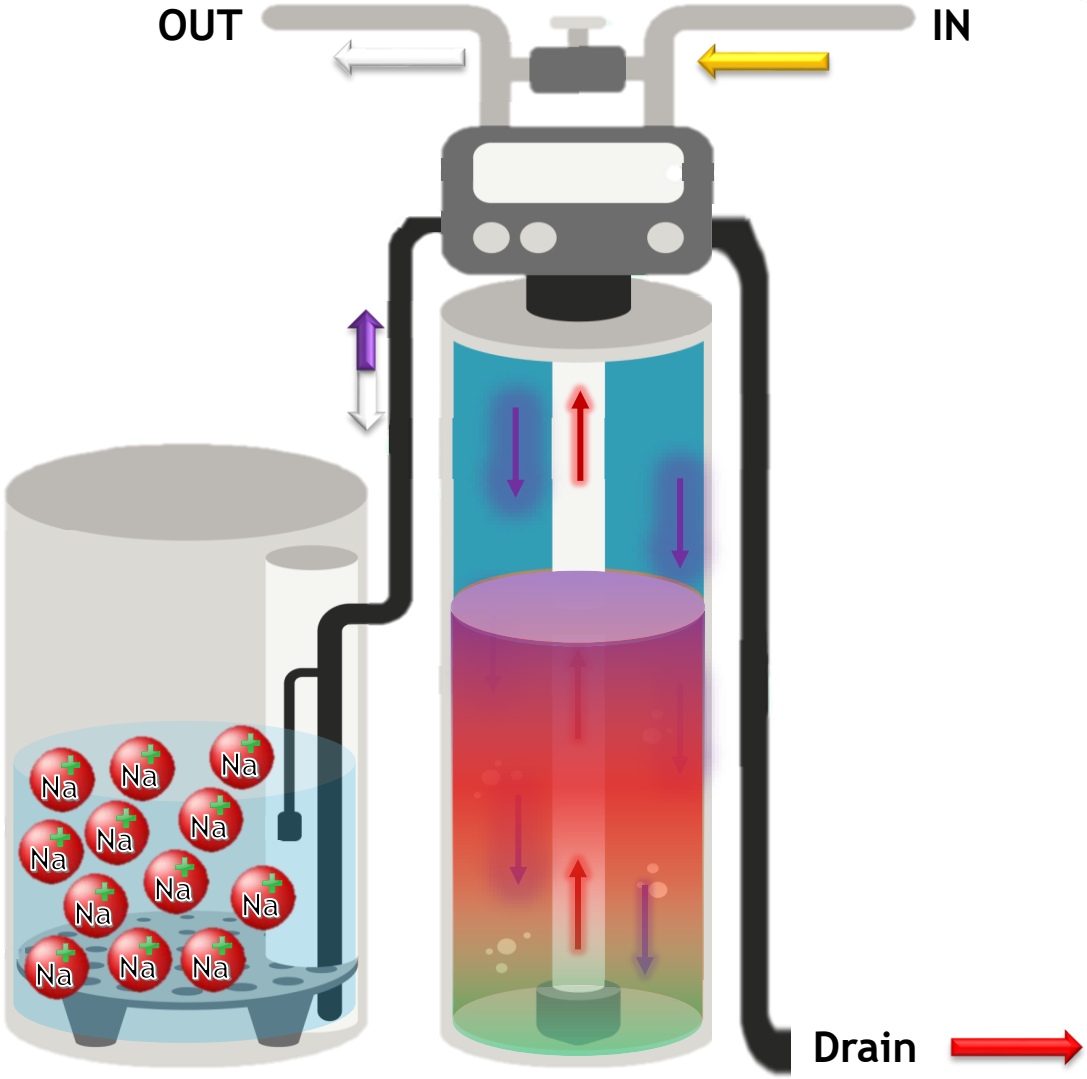


Upflow vs. Downflow Brine

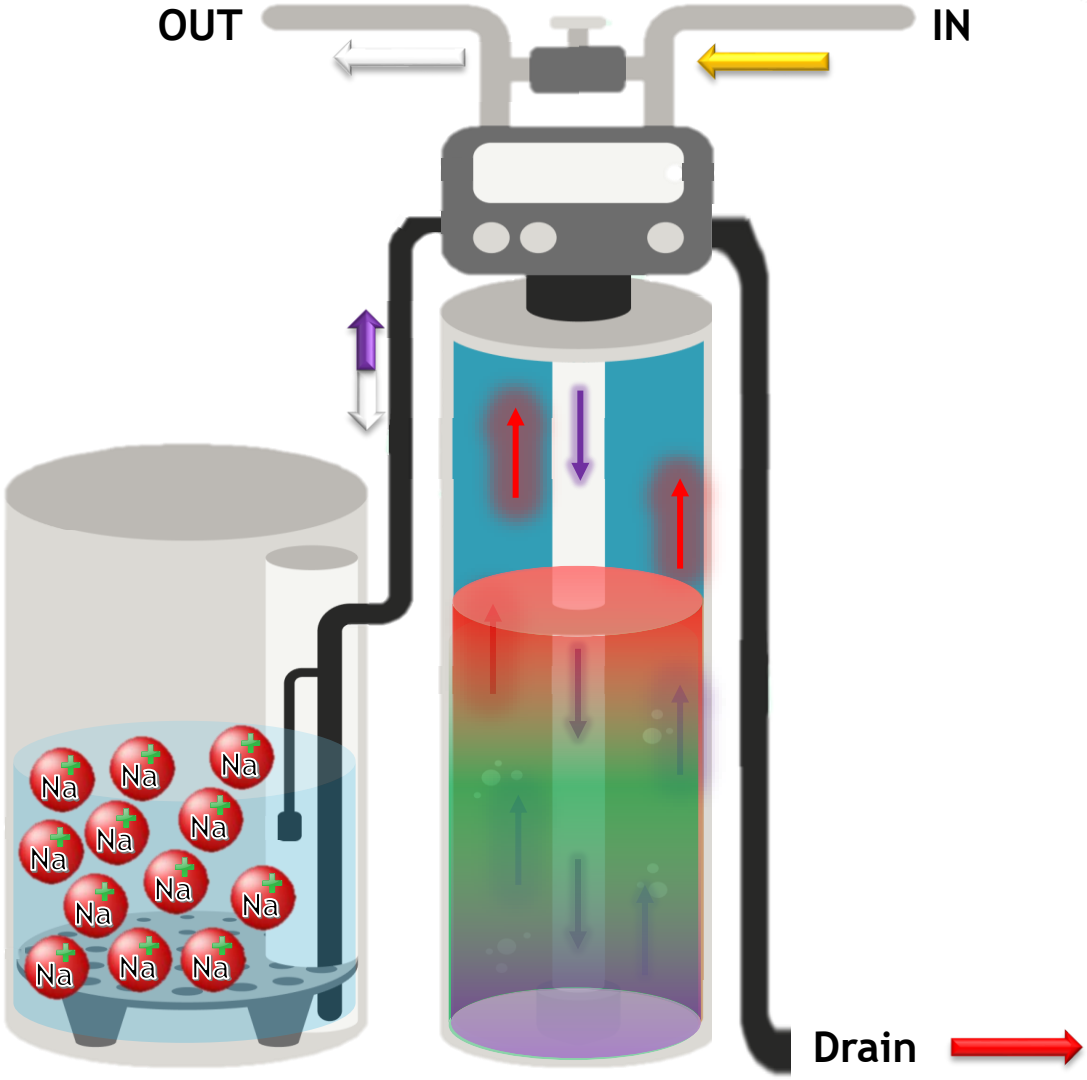
Service



Downflow Brine



Upflow Brine



Other Thoughts and Considerations

- Is TDS reduced after a softener?
- How often should a softener regenerate?
- What if they have a low sodium diet?
- What about a “salt-free” water softener?
- Can they use Potassium rather than Sodium?
- What if I want to reduce an anion?

Thank you!

Stephanie Layfield
Contact Info