Chapter 6

Solution, Acids and Bases

Mixtures

- Two or more substances
- Heterogeneous- different from place to place
- Types of heterogeneous mixtures
- Suspensions- Large particles that eventually settle out
- River water, pulp in orange juice
- Can be separated by filtering
- 1000 nm in size

Heterogeneous Mixtures

- Colloids- smaller sized pieces 1- 100 nm
- They do not settle,
- They can’t be separated by filtering
- Blood, fog, smoke, whipped cream
- Immiscible- liquids that don’t dissolve
- Will separate into layers
- Oil and vinegar

Mixtures

- Emulsions- colloids of liquids and liquids
- Proteins in egg yolk keep immiscible oil and vinegar together- mayonnaise
- Milk and cream
- Homogeneous mixtures- the same throughout, no piece bigger than an individual ion or atom

Solutions

- homogenous mixtures mixed molecule by molecule.
- Solvent - the stuff that does the dissolving.
- Solute -the stuff that is dissolved.
- Solutions can be any states
- Aqueous solution- a solution with water as the solvent.
- Most common

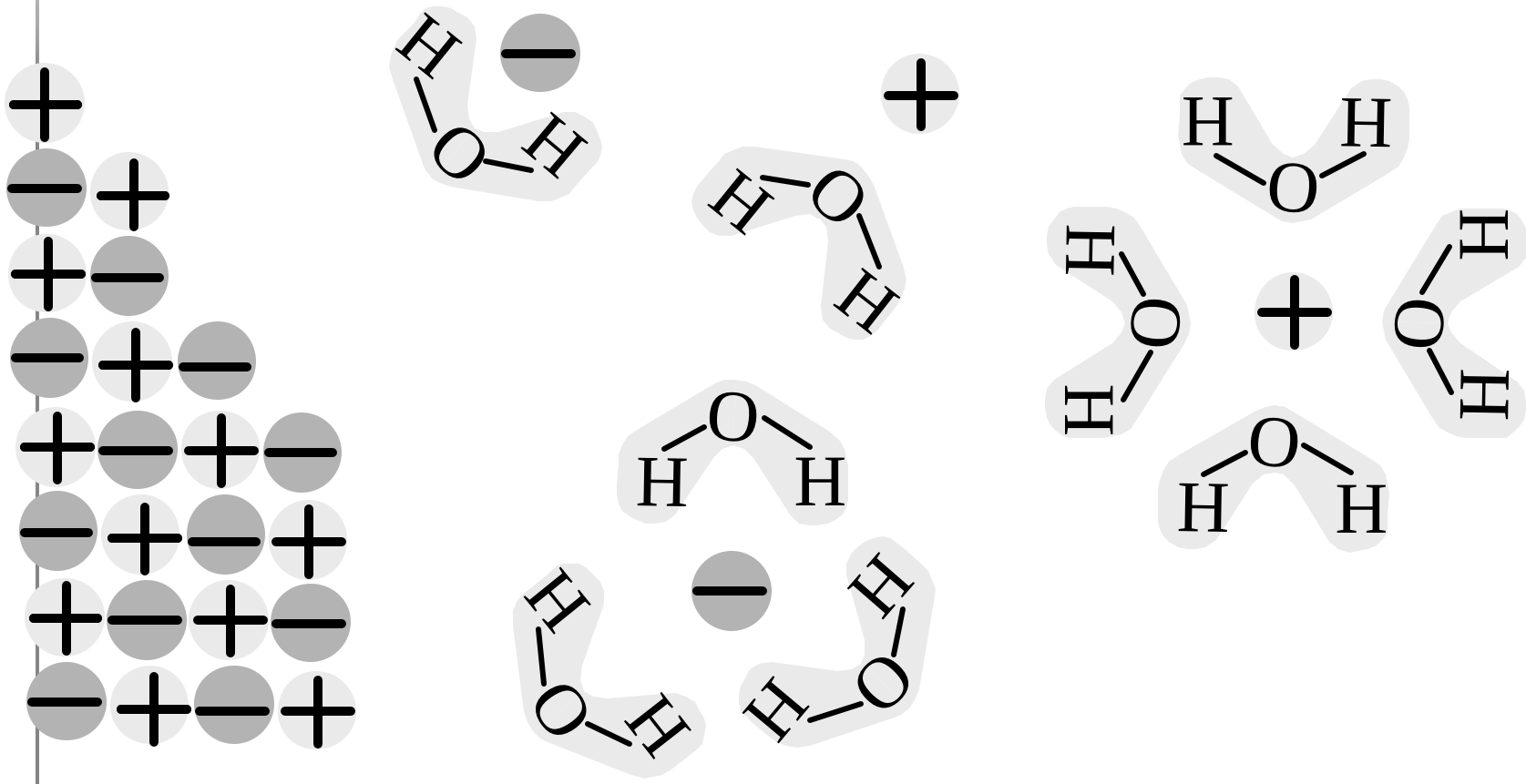
Solutions

- Miscible- Liquids that dissolve in each other
- Do not separate into layers
- Can be separated by distillation if boiling points are different enough
- Lower boiling point evaporates fastest

How Ionic solids dissolve

- Called solvation.
- Water is a polar molecule
- Oxygen pulls more on the electrons
- Gets a partial negative charge
- Hydrogens get a partial positive charge
- Ionic compounds have + and - pieces
- Water breaks the + and - charged pieces apart and surround them.

How Ionic solids dissolve



Making solutions

- What the solute and the solvent are
  - Whether a substance will dissolve.
  - How much will dissolve.
- A substance dissolves faster if-
- It is stirred or shaken.
- The particles are made smaller.
- The temperature is increased.
- Why?

Making solutions

- In order to dissolve the solvent molecules must come in contact with the solute.
- Stirring moves fresh solvent next to the solute.
- The solvent touches the surface of the solute.
- Smaller pieces increase the amount of surface of the solute.

Temperature and Solutions

- Higher temperature makes the molecules of the solvent move around faster and contact the solute harder and more often.
- Speeds up dissolving.
- Usually increases the amount that will dissolve.

How Much?

- Solubility- The maximum amount of substance that will dissolve at that temperature (usually g/L).
- Saturated solution- Contains the maximum amount of solid dissolved.
- Unsaturated solution- Can dissolve more solvent.
- Supersaturated- A solution that is temporarily holding more than it can, a seed crystal will make it come out

What affects solubility?

- For solids in liquids as the temperature goes up the solubility goes up.
- For gases in a liquid as the temperature goes up the solubility goes down.
- For gases in a liquid- as the pressure goes up the solubility goes up.

Measuring Concentration

- Amount dissolved divided by amount of solvent
- % solution= $\frac{\text{grams dissolved x100\%}}{\text{Grams of solution}}$
- Molarity = $\frac{\text{moles of solute}}{\text{Liter of solution}}$
- a 1 molar solution has 1 mole dissolved in 1 liter of solution.

Acids

- Substances that donate hydrogen ions (H^+) to water to form H_3O^+
- Called the hydronium ion
- HCl hydrochloric acid used in pools
- H_2SO_4 sulfuric acid- battery acid
- $HC_2H_3O_2$ acetic acid- vinegar
- $HC_6H_7O_7$ citric acid- lemons, limes

Properties of acids

- Taste Sour (kids, don't try this at home).
- Conduct electricity.
- Some are strong, some are weak electrolytes.
- React with metals to form hydrogen gas.
- Change indicators (litmus red).
- React with hydroxides to form water and a salt.

Acids

- The ones in food are dilute
- Concentrated acids are dangerous
- They can burn you skin and eyes
- Strong acids ionize completely
  - All the H's make hydronium
- $HCl + H_2O \rightarrow Cl^- + H_3O^+$
- Makes lots of ions
- Are dangerous

Acids

- Weak acids only partially ionize
  - Only a few H's attach to water
- $HC_2H_3O_2 + H_2O \rightleftharpoons C_2H_3O_2^- + H_3O^+$
- Can be dangerous if concentrated

Bases

- Increases the amount of OH^- in solution
- Either has OH^- in it
- Or takes an H off of water
- KOH - in drain cleaner
- NaOH - in drain cleaner
- NH_3- ammonia

Properties of bases

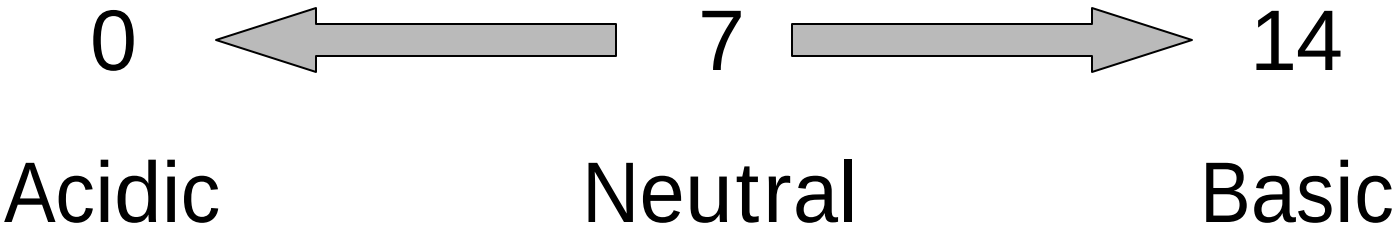
- Taste bitter.
- Feel slippery (Don’t try this either).
- Can be strong or weak electrolytes.
- Change indicators (litmus blue).
- React with acids to form water and a salt.

Bases

- $KOH \rightarrow K^+ + OH^-$
- Strong bases ionize completely
- Make lots of ions
- Are dangerous
- $NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$
- Weak acids only make a few ions
- Are dangerous if concentrated

How Acidic?

- More H_3O^+ is more acidic
- Measured with pH
- Lower pH is more acidic
- As H_3O^+ goes down, OH^- goes up
- Higher pH more basic
- pH of 7 is neutral



pH

- Measures hydronium ion concentration
- Every 1 unit less of pH is 10 times more hydronium
- A pH of 2 is 100 time more H_3O^+ ions than a pH of 4
- pH is number of places after the decimal point
- pH of 2 is 0.01 Molar H_3O^+
- pH of 4 is 0.0001 Molar H_3O^+
- pH of 9 is 0.000000001 Molar H_3O^+

pH

- Low pH is acid
  - Lots of H_3O^+
  - Little OH^-
- High pH is base
  - Little H_3O^+
  - Lots of OH^-

Neutralization Reactions

- Acids and bases react and neutralize each other
- Strong acids make lots of ions
- $HCl + H_2O \rightarrow H_3O^+ + Cl^-$
- Strong bases make lots of ions
- $NaOH \rightarrow Na^+ + OH^-$
- and
- $H_3O^+ + OH^- \rightarrow 2H_2O$

Neutralization Reactions

- Put acids and bases together
- $H_3O^+ + Cl^- + Na^+ + OH^- \rightarrow Cl^- + Na^+ + 2H_2O$
- The Na^+ and Cl^- make salt which is neutral
- Water is neutral
- All ionic compounds are salts
- Will be neutral if the right amounts of strong acids and bases are added

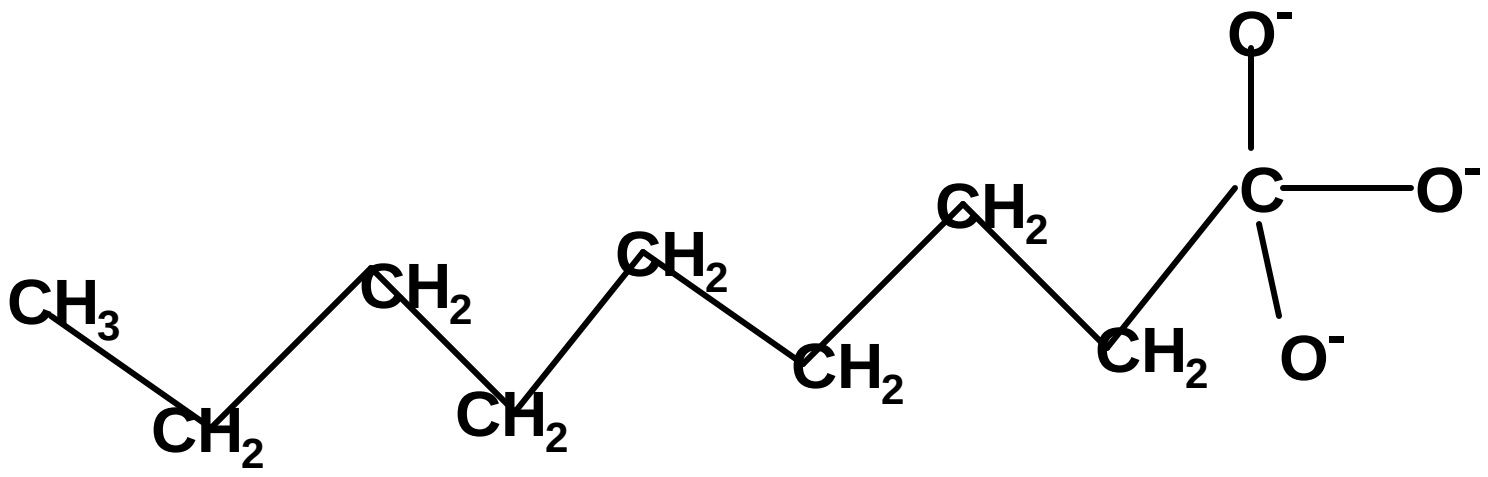
Neutralization Reactions

- Weak bases will neutralize a strong acid, but not as well.
- You need to add more of them
- If you add enough, it will make the solution basic
- Same works for weak acids and strong bases
- As you add acid to a base the pH drops
- As you add base to and acid the pH rises

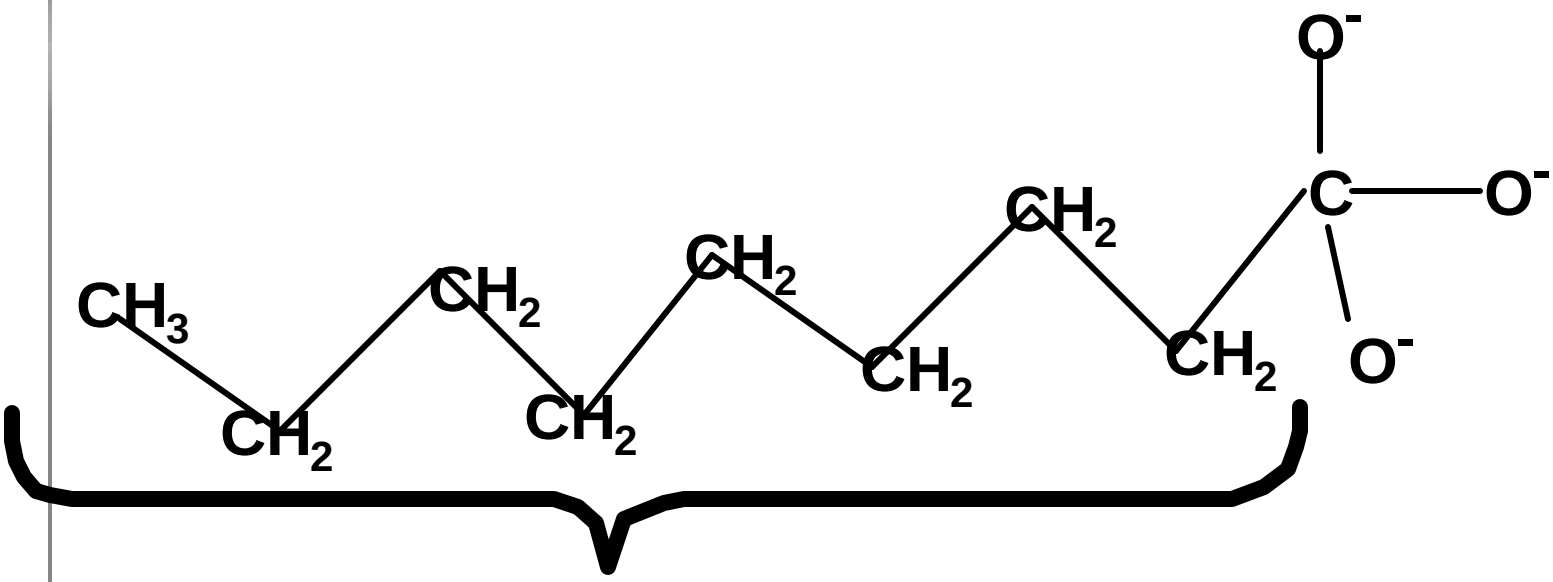
Soap

- Water and oil don’t mix
- Water is polar
- Oil is nonpolar
- Soap can dissolve in both oil and water
- Made by mixing fats with lye (NaOH)

Soap

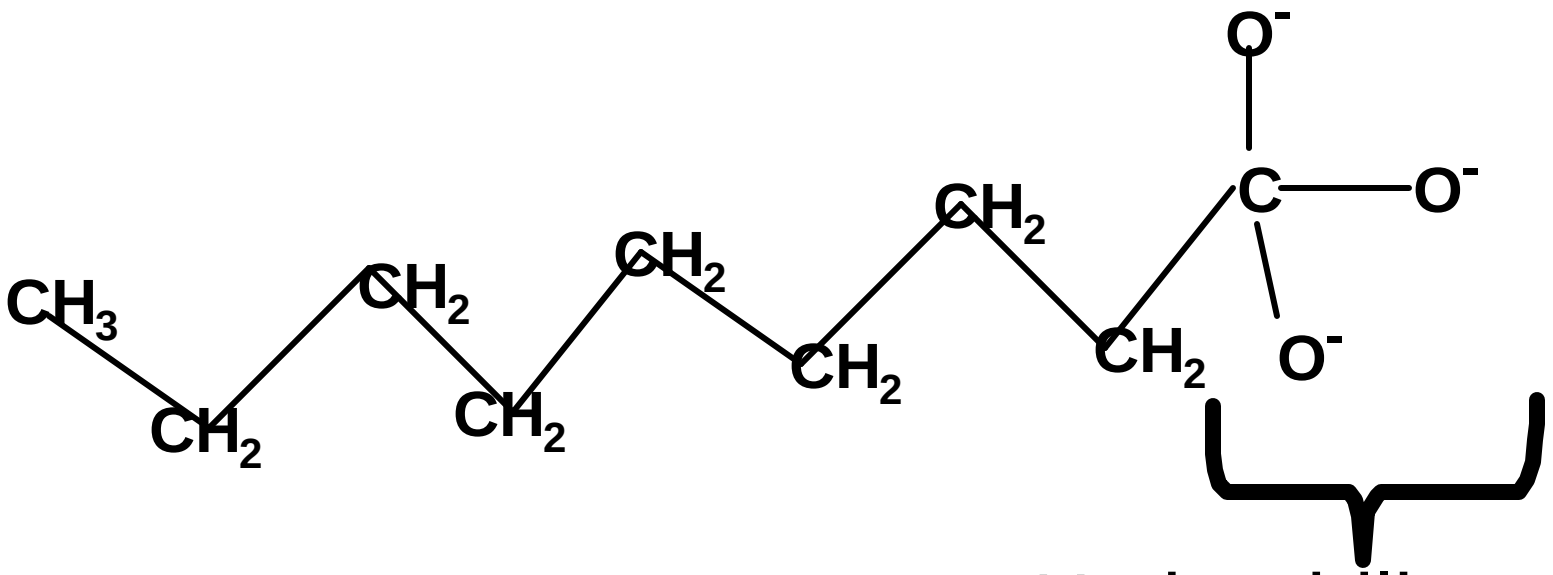


Soap

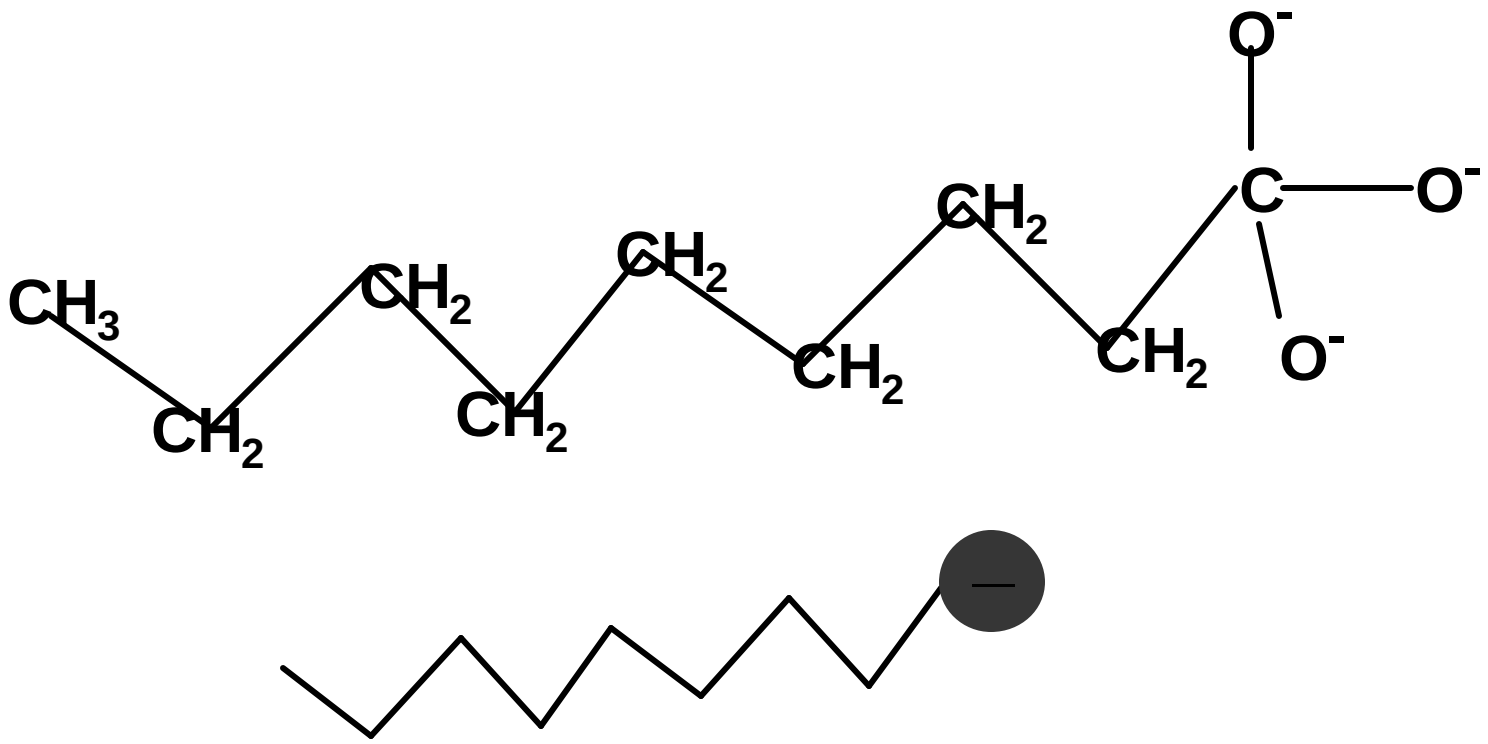


- Hydrophobic non-polar end

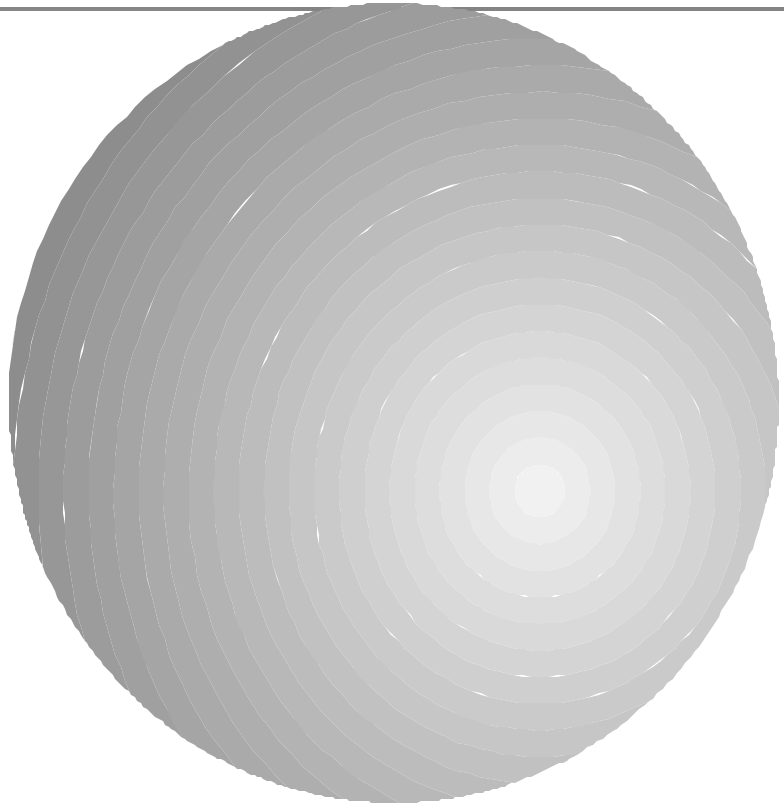
Soap

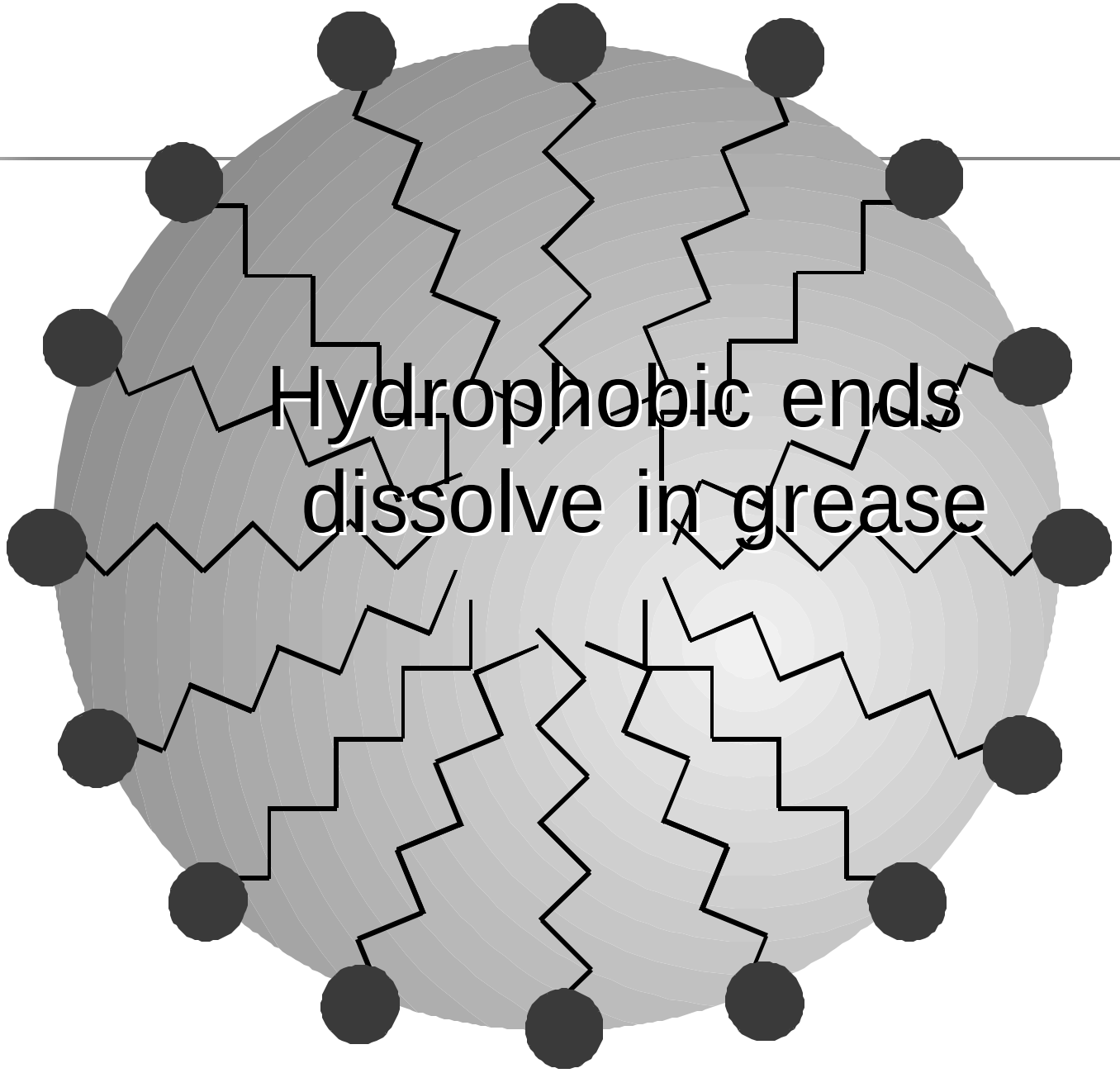


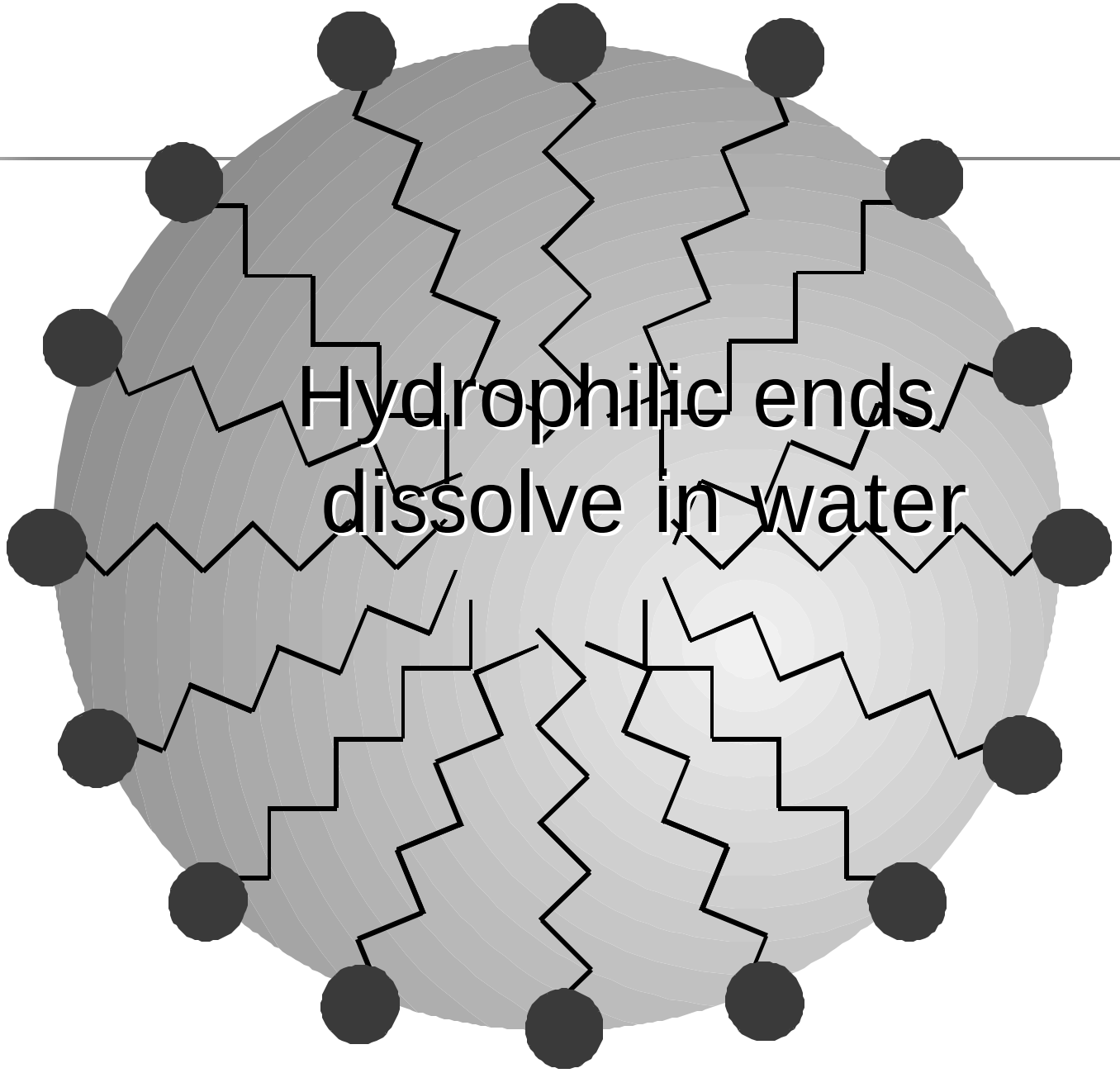
- Hydrophilic polar end

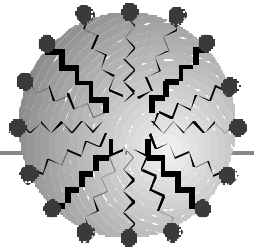

O-
C
O-
O-
CH2
CH2
CH2
CH2
CH2
CH2
CH3
CH2
CH2
—

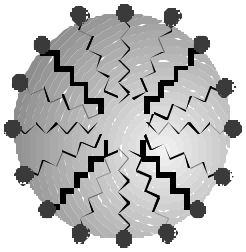
- A drop of grease in water
- Grease is non-polar
- Water is polar
- Soap lets you dissolve the non-polar in the polar.



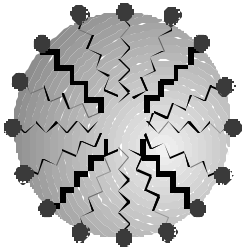

Hydrophobic ends
dissolve in grease

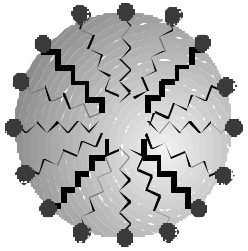

Hydrophilic ends
dissolve in water





- Water molecules can surround and dissolve grease.
- Helps get grease out of your way.





Detergents

- Soaps react with minerals in hard water and form scum that doesn’t dissolve
- Detergents have the same basic structure but have a sulfur at the end,
- And start from petroleum
- Dissolve in hard water

Ammonia

- NH_3 dissolved in water makes a weak base
- $NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$
- The OH^- ion reacts with grease and makes an emulsion which can wash away
- Slippery

Household Uses

- Antacids- Weak bases that neutralize excess stomach acid
- Shampoo- made from detergents
- Need to keep pH between 5 and 8 or it will make the hair dull
- Citric acid keeps fruit from browning
- Acidic marinades tenderize meats
- Drain cleaners are strong bases