Solutions

Solutions

Solvents: substances capable of dissolving other substances

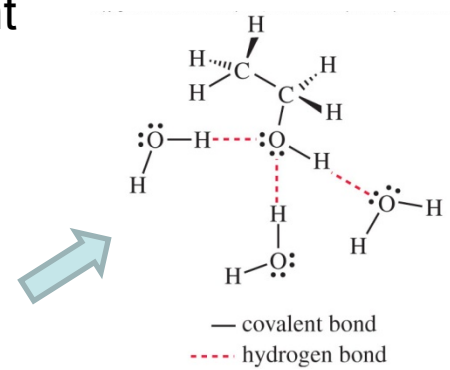
Solutes: substances that dissolve in a solvent

Solution: a homogenous mixture of uniform composition

Aqueous solutions: solutions in which water is the solvent

General rule: Like dissolves like

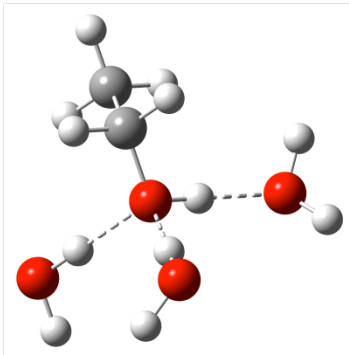
(a) Hydroxyl (OH) groups interact well with other hydroxyl groups; dissolve in water, alcohols, sugars



(b) Hydrocarbons (CH groups) mix well with other hydrocarbons; dissolve in oils, fats

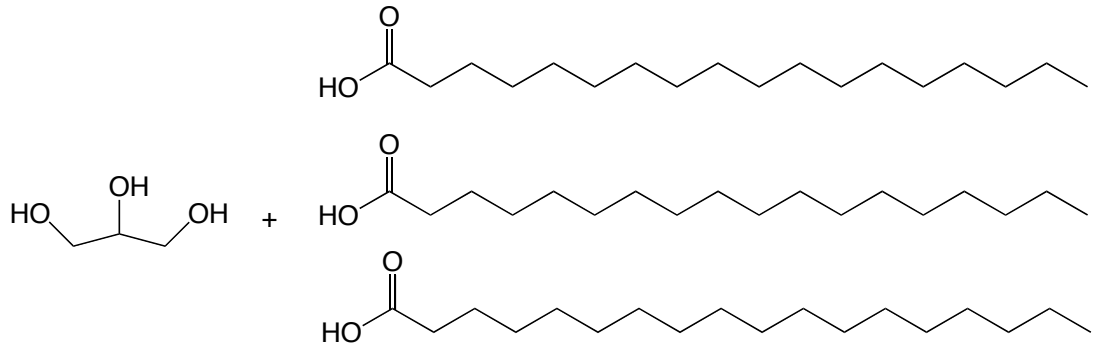
Now that we know how water/alcohol interact, then what does a fat/oil look like?

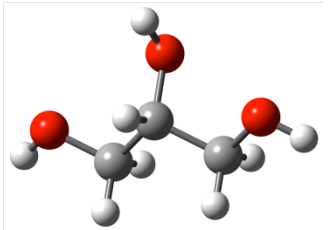
(rotatable--click on picture at least for PC)



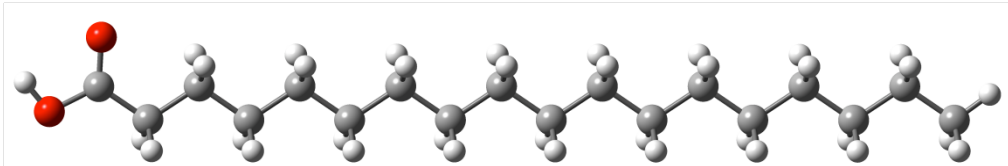
Fats, Fatty Acids, Triglycerides

Another **condensation** reaction: three **fatty acids** combine with glycerol to make a **triglyceride** and water:





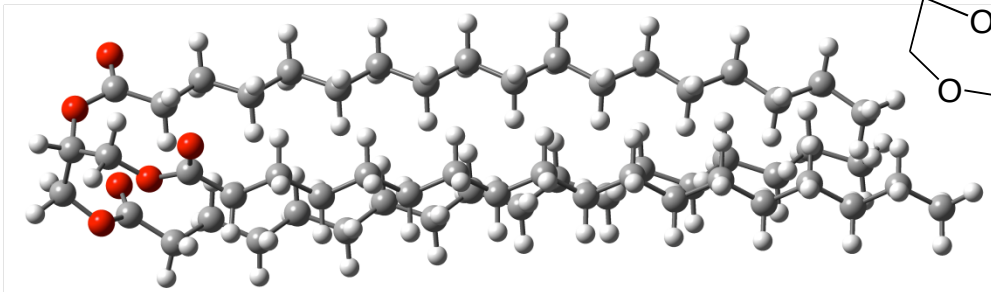
+ 3

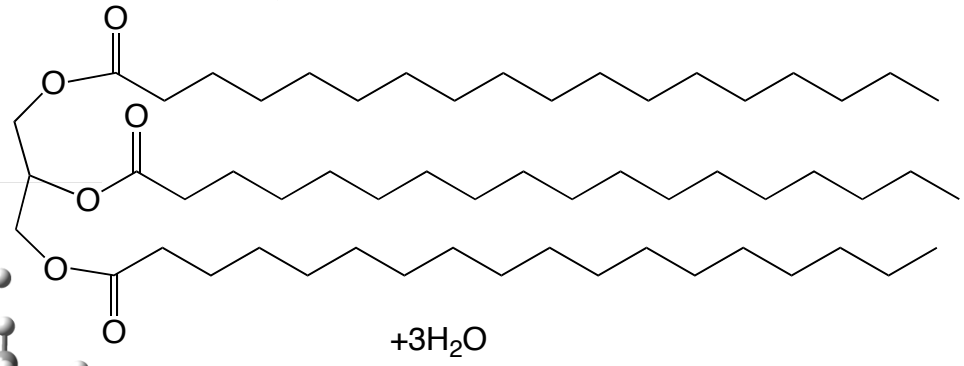


glycerol

stearic acid

a triglyceride

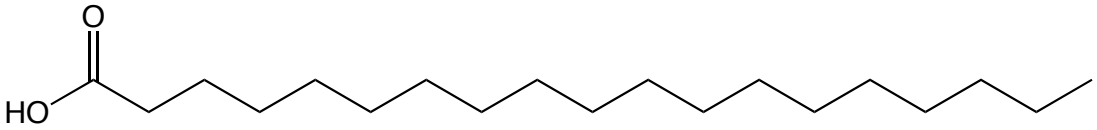


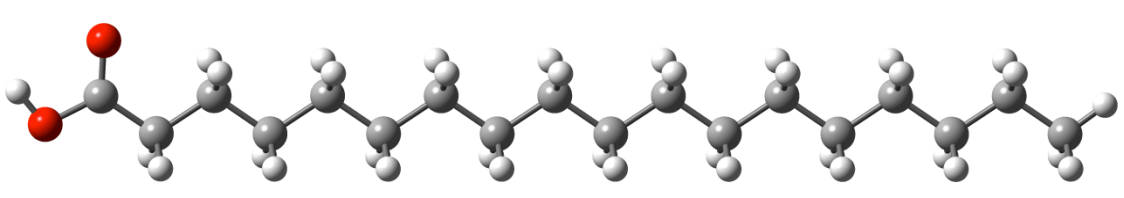


$+3H_2O$

Fats: Structure Impacts Physical Properties

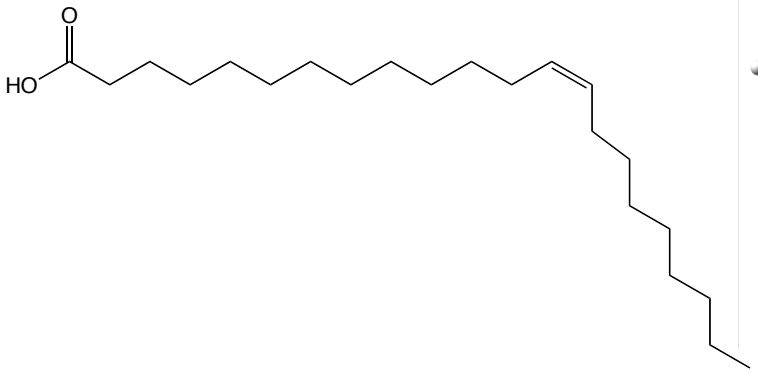
saturated fat—no double bonds in fatty acid

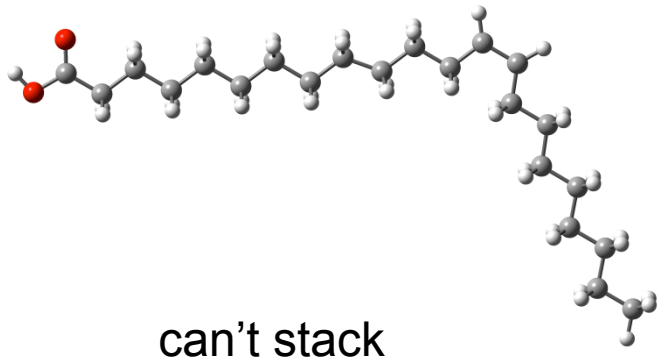




stackable

unsaturated fat, double bond (makes the chain bent)





can’t stack

Like Dissolves Like

General rule: Like dissolves like

(a) Hydroxyl (OH) groups interact well with other hydroxyl groups; dissolve in water, alcohols, sugars

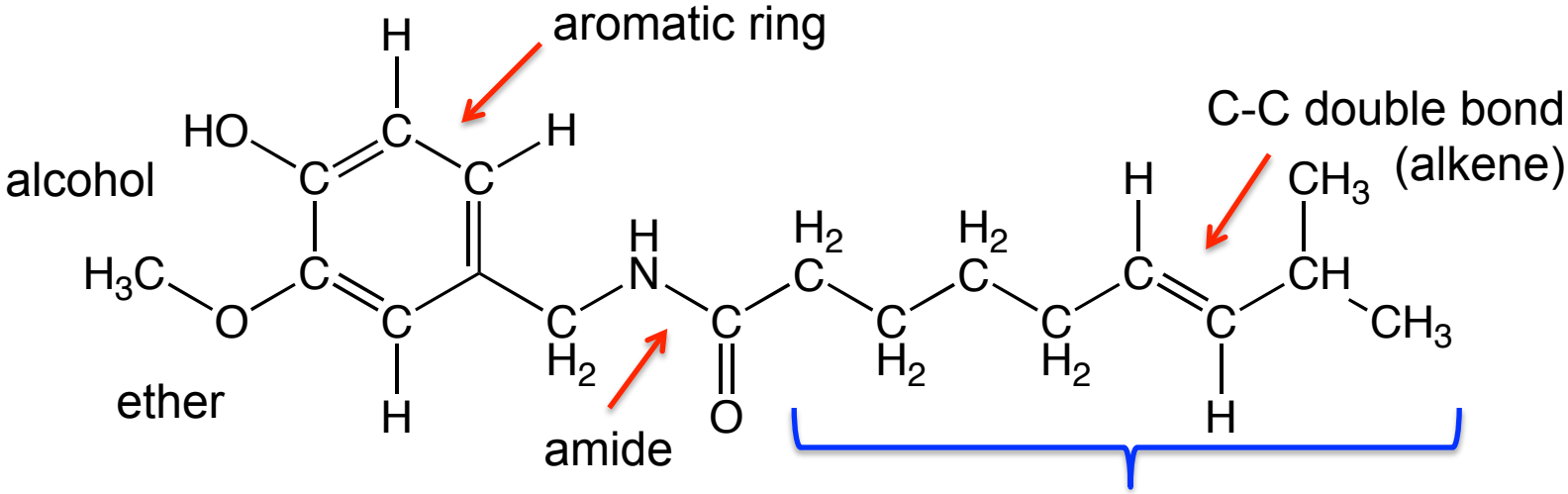
(b) Hydrocarbons (CH groups) mix well with other hydrocarbons; dissolve in oils, fats

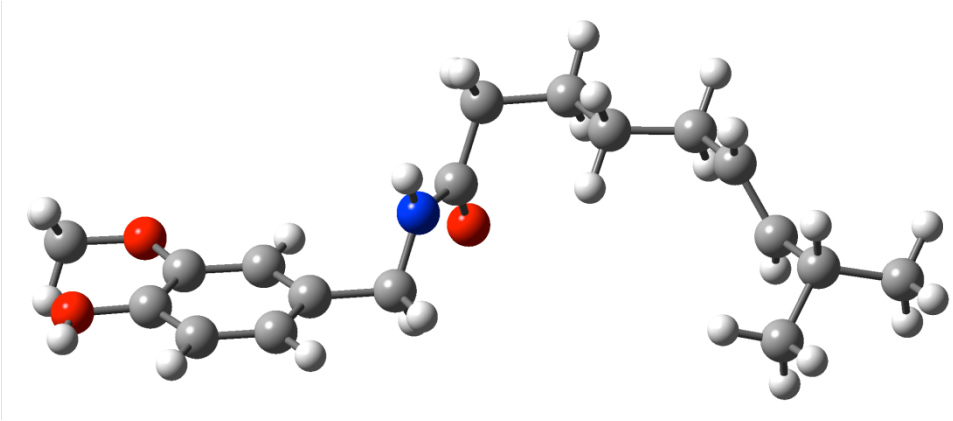
Many molecules contain both **hydrophobic** (water repelling) and **hydrophilic** (water attracting) functional groups

Your inner (cellular) environment: bodies are ~70% water, but plenty of fat in there too (and other biologically relevant molecules)

Let's look at a situation where solubility is important…

Capsaicin





Active ingredient in chiles

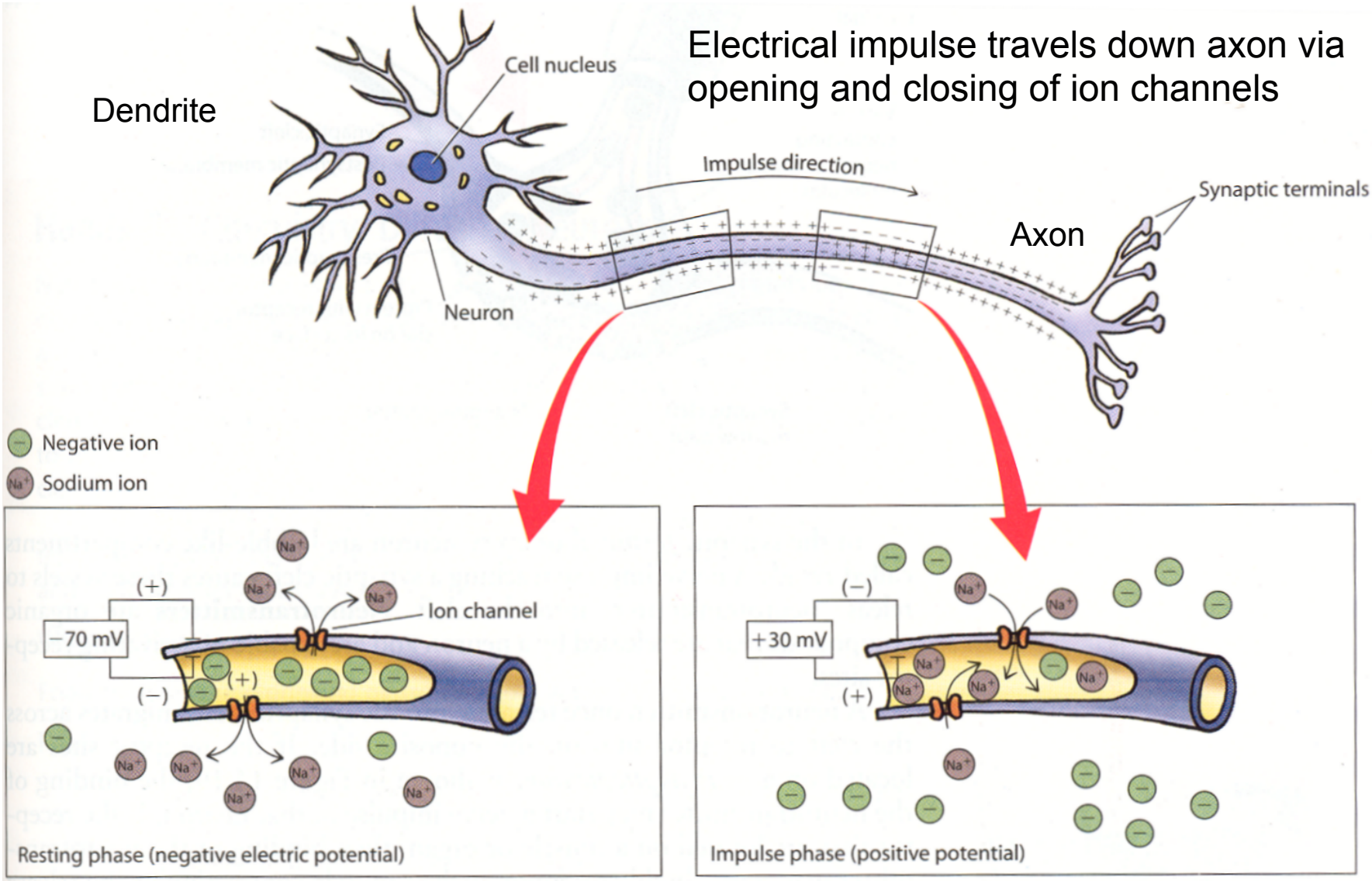
Does this look more like water or fat?

Mythbusters, Season 5 Episode 23
Hot Chili Cures

Chile Heat

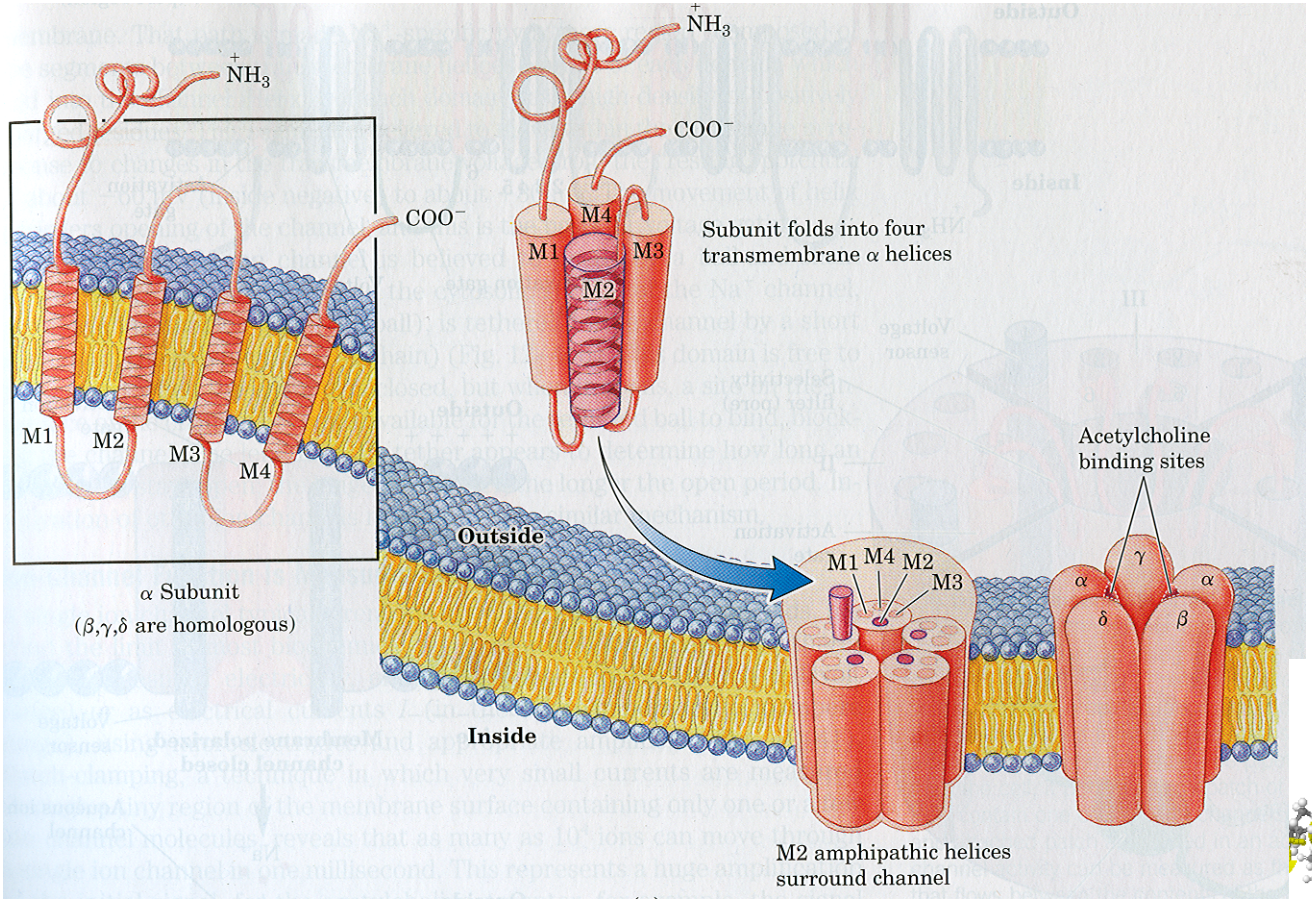
Chile Heat, Receptor Discussion

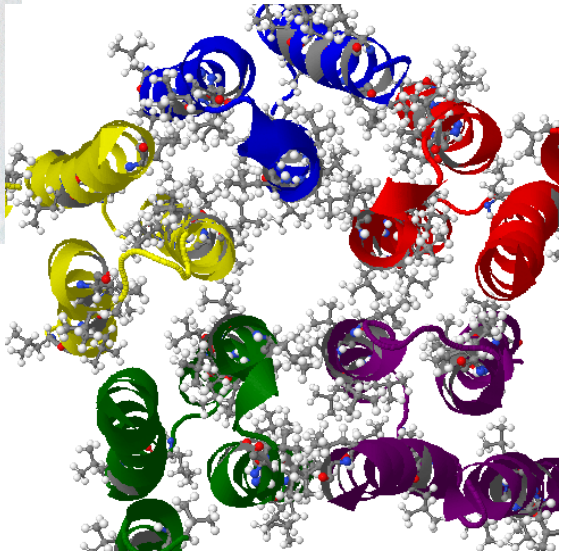
Electrochemical Transmission in Nerves

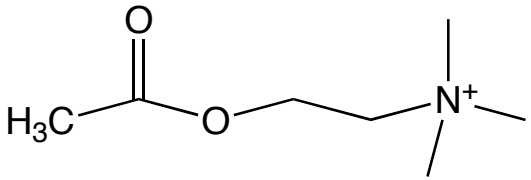


"Conceptual Chemistry" 2nd Ed. John Suchocki, 2004, Pearson Education Inc.

Acetylcholine channel

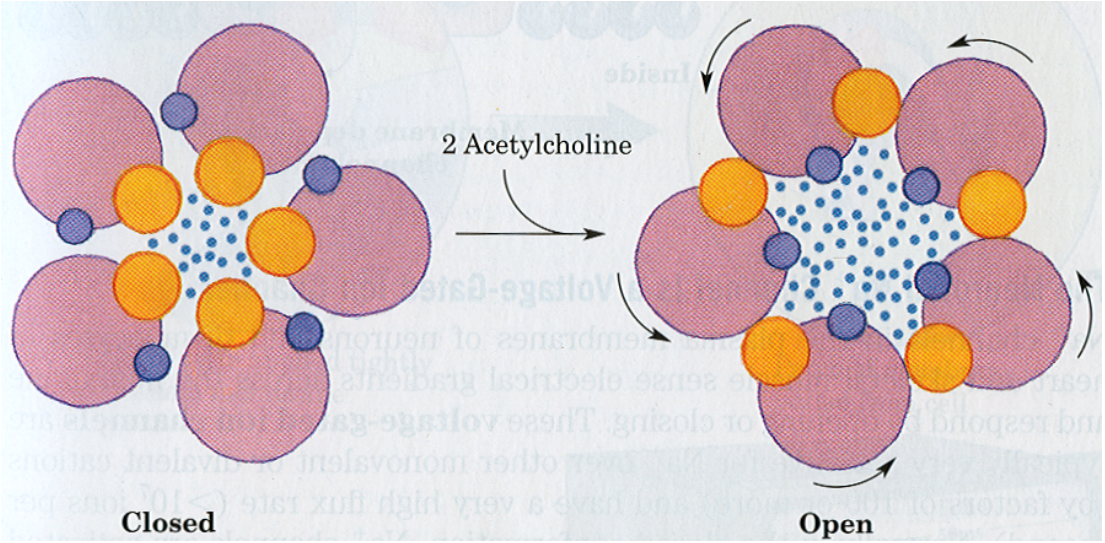


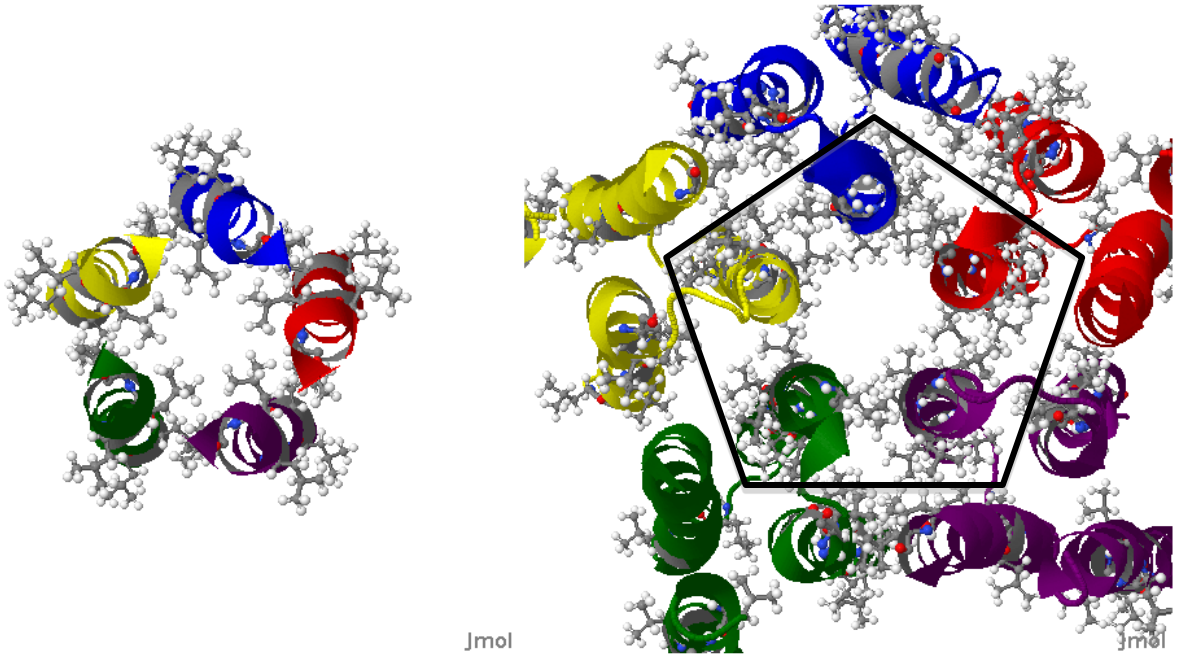




acetylcholine

Channel Rotates to Open



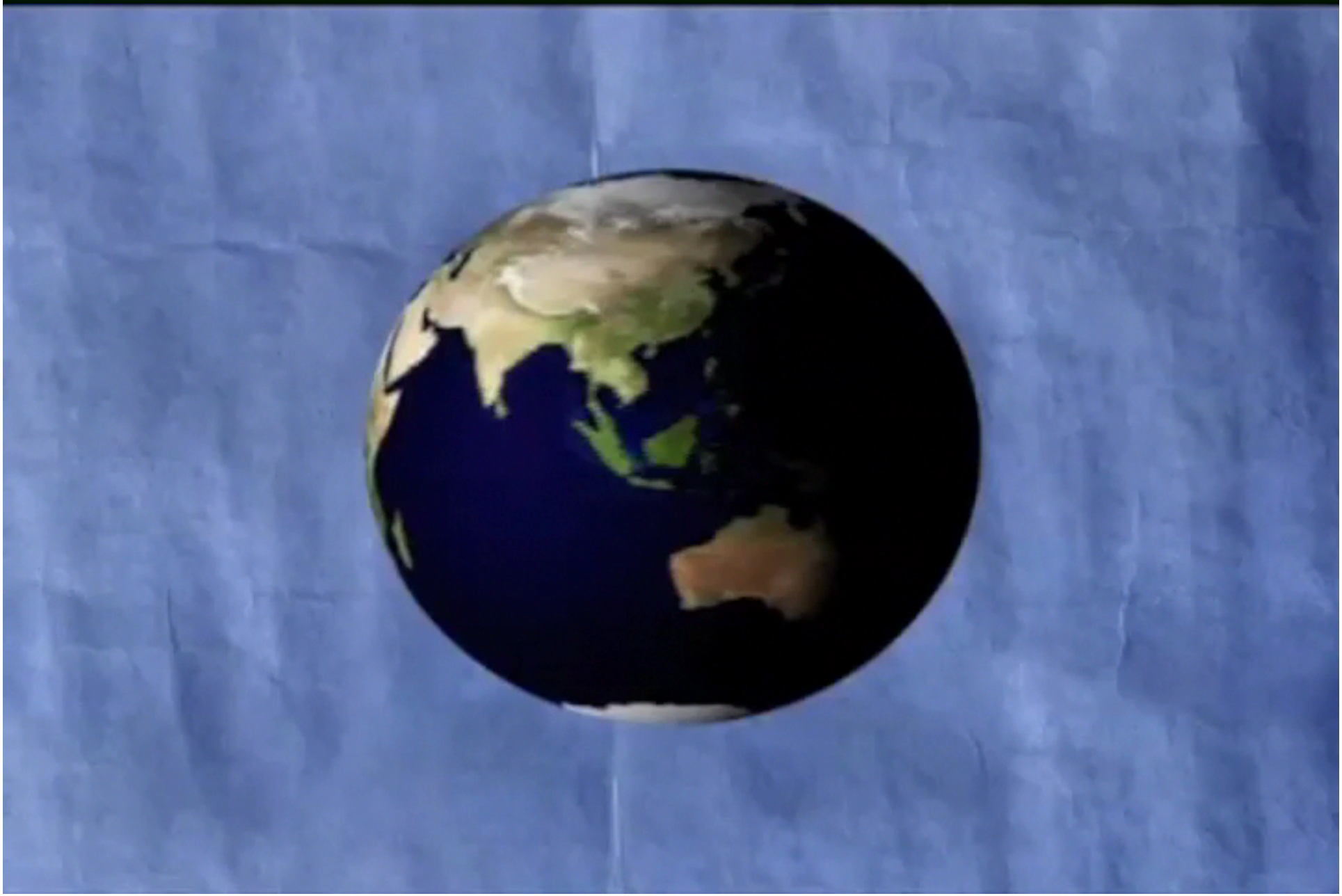


Chile Heat: Sample Preparation

Chile Heat, more prep

Chile, First Test

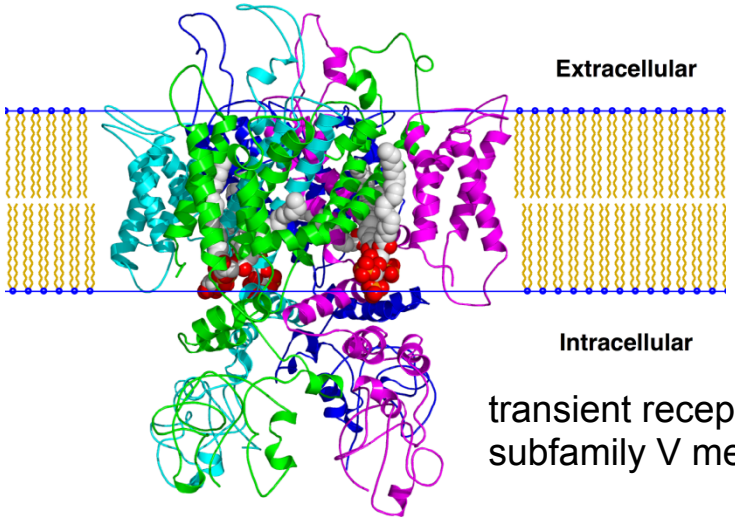
Scoville



Water

Chile, other remedies

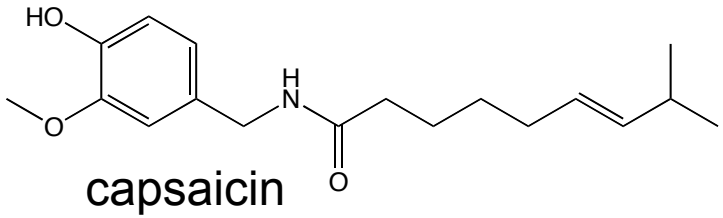
Receptor Site



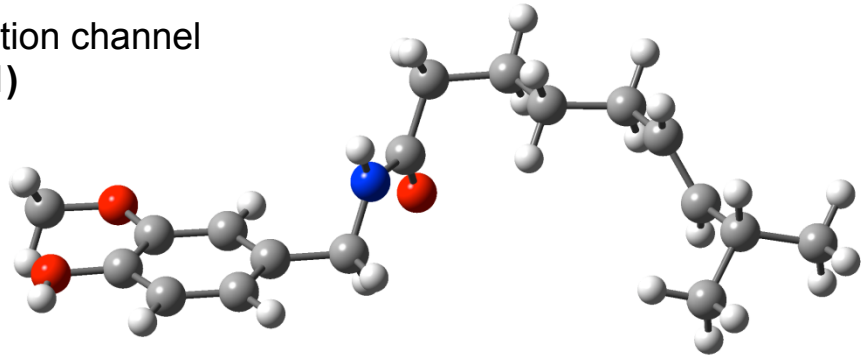
Cell membrane
(lipid bilayer)

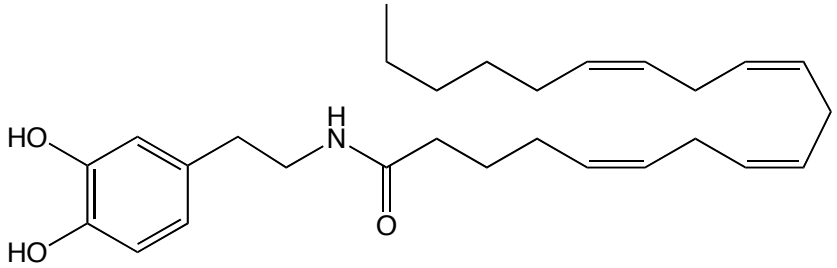
Note how the cell membrane has
structural similarity with triglycerides

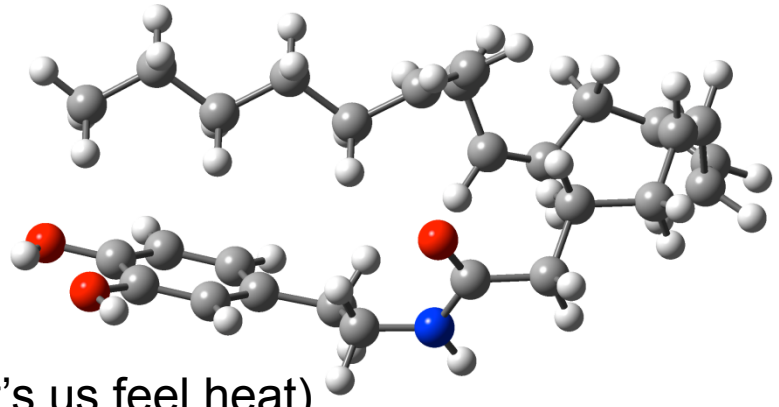
transient receptor potential cation channel
subfamily V member 1 (**TrpV1)**



capsaicin





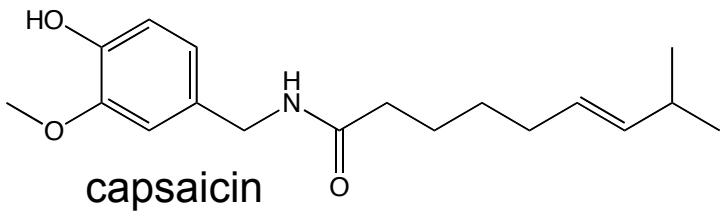


N-Arachidonoyl dopamine

Native or natural agonist (what is in us that let's us feel heat)

Recap of "Hot" Chemistry

- Capsaicin's action and our intuitive response
  - molecule binds to the same receptor as N-Arachidonoyl dopamine—the molecule released when the cell gets too hot
    - this sets off nerve (electrical) impulses to the brain that indicate "pain"
    - thus: our body is "burning" just from eating a little fruit
  - "burning" implies that water should be thrown on the fire to put it out
- Correct response to reduce capsaicin's burn
  - *match the molecular structure of the solute and solvent to improve solubility*
  - tested remedies:
    - milk
    - alcohol
    - toothpaste
    - petroleum jelly



capsaicin

  - each person has different sensitivities/responses to these small molecules, so the remedies will also be individualized

Structural Chemistry: Sweet, Fatty & Spicy

Everything is either Matter or Energy
Matter is made up of either pure substances or mixtures
Atoms have (e^-, p^+, n)
Compounds (Molecules) built from atoms
Compounds described with Chemical formulas and structural diagrams
Compounds have 3-D structures (take up space)
- Carbon forms 4 bonds (connections) Nitrogen 3, and Oxygen 2
- 3-D shapes of atoms connected to make 3-D molecules
  - Sugar
  - Capsaicin (chiles)

Reactions
- Atoms neither created nor destroyed (balanced)
- For now one important reaction: condensation

Solutions
- Like dissolves like
- What fats look like
- What sugars look like

Functional groups we've seen:
Alcohol/hydroxyl
Aromatic
Carboxylic acid
Ester