



Lesson 3

WATER



It doesn't add up?!?!



Nutrition Facts

Serving Size 1/2 cup (101g)
Servings Per Container 4

Amount Per Serving

Calories 260 Calories from Fat 130

% Daily Value*

Total Fat 15g 23%

Saturated Fat 9g 44%

Trans Fat 0g

Cholesterol 60mg 20%

Sodium 80mg 3%

Total Carbohydrate 28g 9%

Dietary Fiber 1g 3%

Sugars 23g

Protein 4g

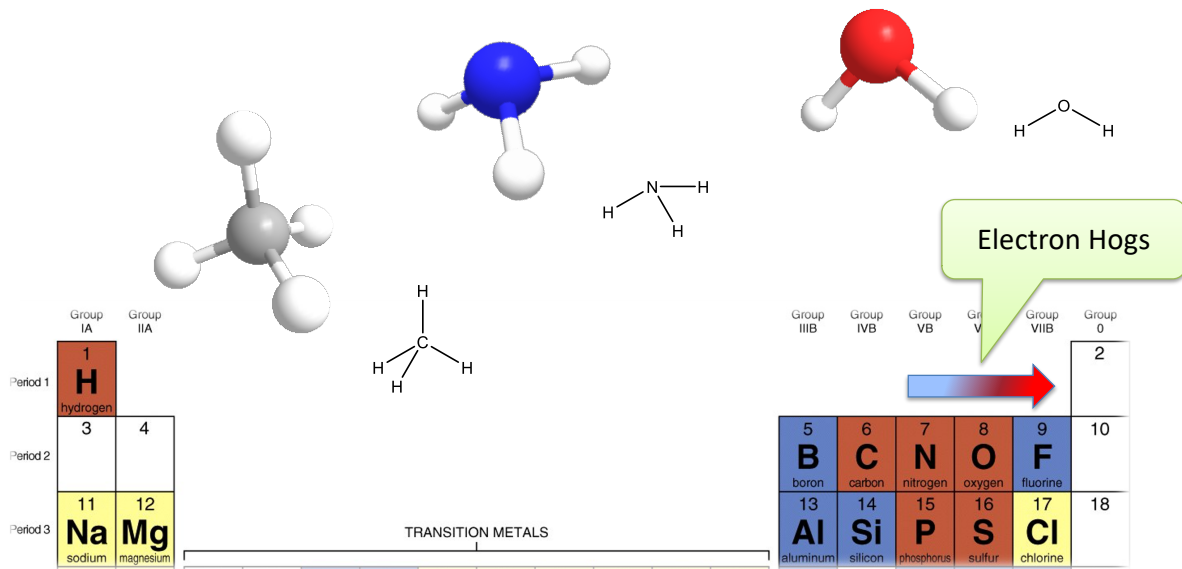
Vitamin A 10% • Vitamin C 0%

Calcium 15% • Iron 4%

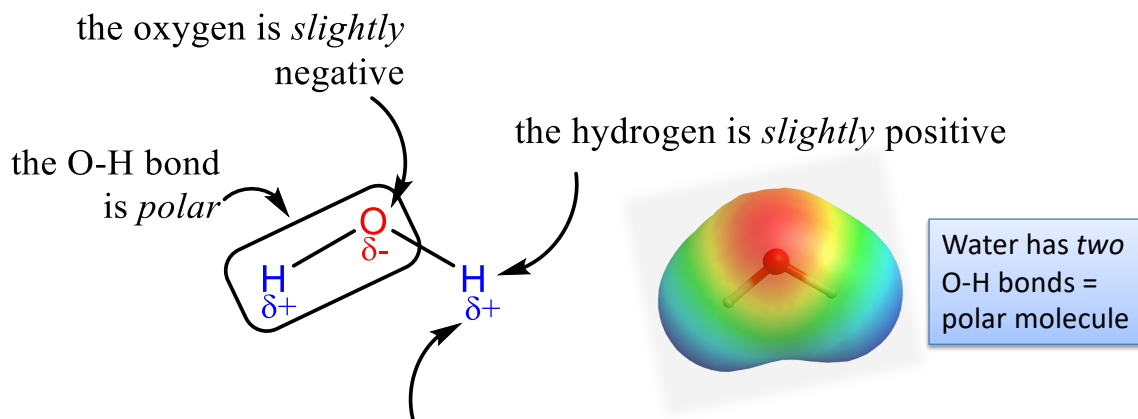
*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:



Not All Sharing is Equal



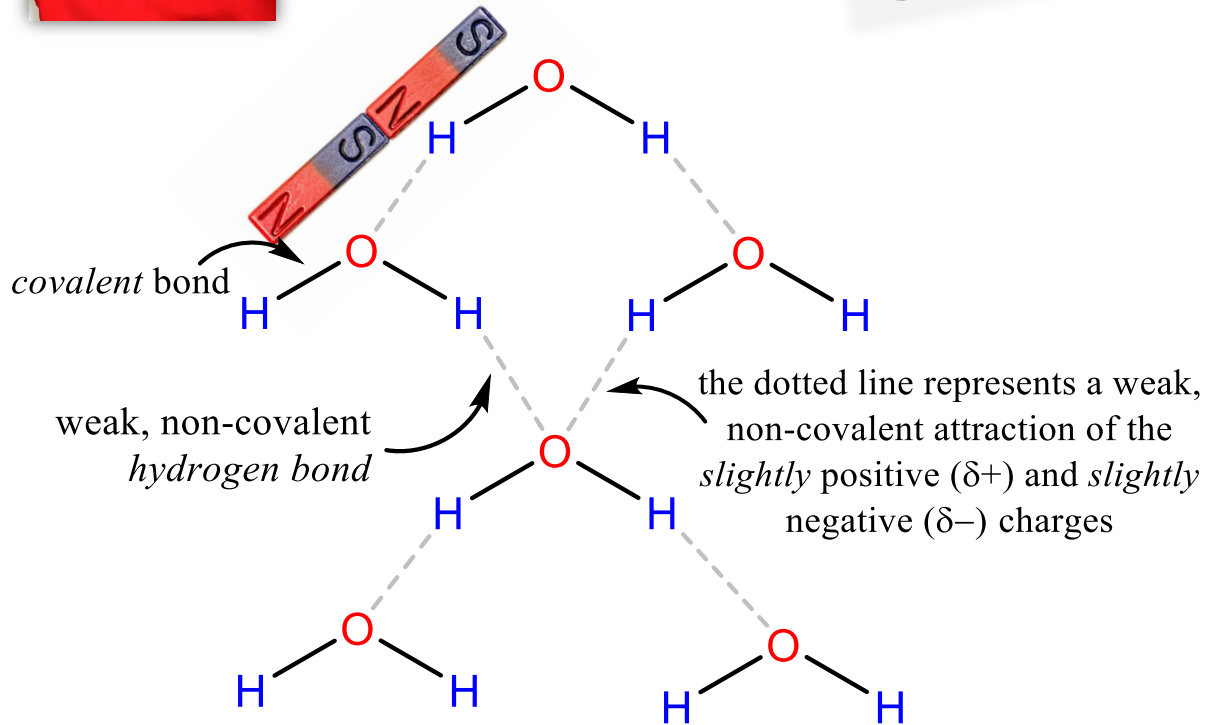
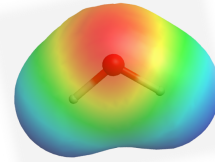
O-H is a polar bond



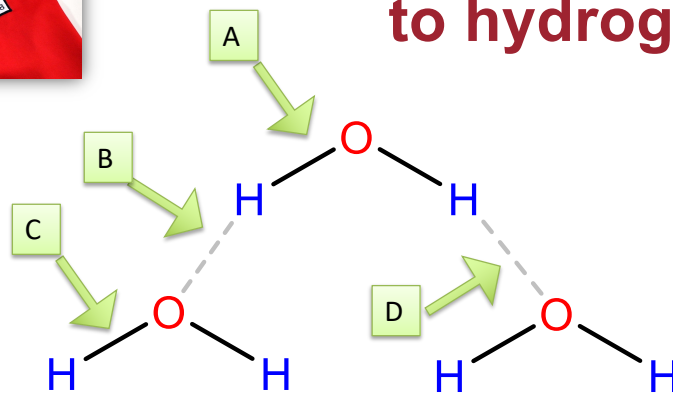
Chemists use the lowercase delta (δ) to represent "partial", so $\delta+$ means "partially" positive or *slightly* positive. This notation distinguishes these charges from the *full* charges of ions like Na^+ and Cl^-



Intermolecular attraction



Hydrogen bonds vs. bonds to hydrogen



Explain how the O-H atoms of water are different from the ions that make up a salt, like sodium chloride (NaCl).

Hydrogen bond

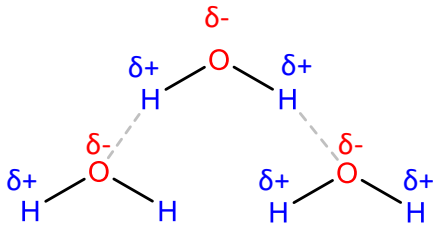
Non-covalent
Dotted line
Weak
Intermolecular

Bond to Hydrogen

Covalent
Solid line
Strong
Intramolecular

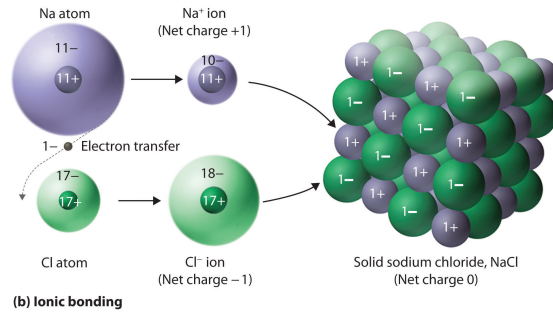


Hydrogen bonds vs. ionic bonds



Hydrogen bond

Non-covalent
Attraction of **partial** charges
Weak
Intermolecular



(b) Ionic bonding

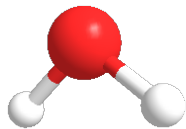
Ionic bond



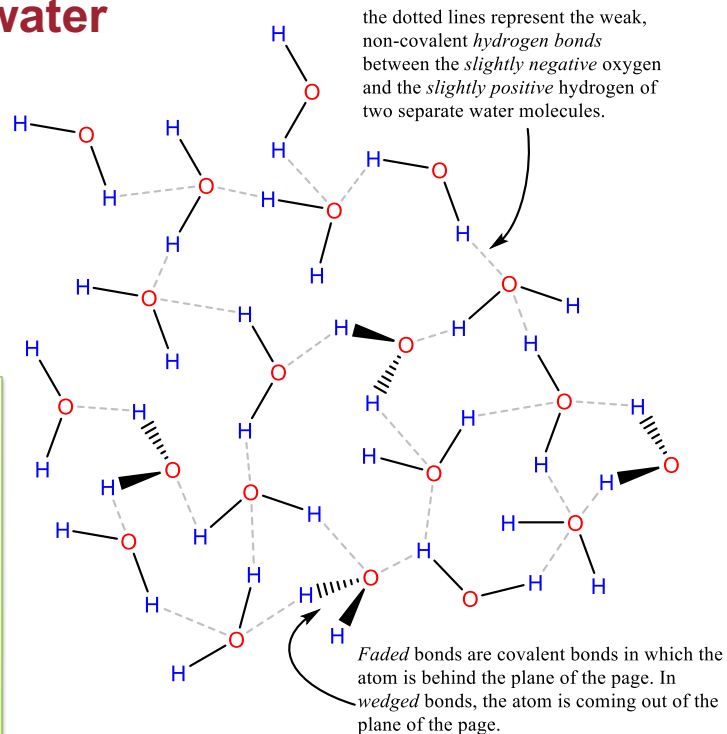
Non-covalent
Attraction of **full** charges
Stronger
Intramolecular and intermolecular



Disorganized array of many hydrogen bonds connects the molecules of liquid water

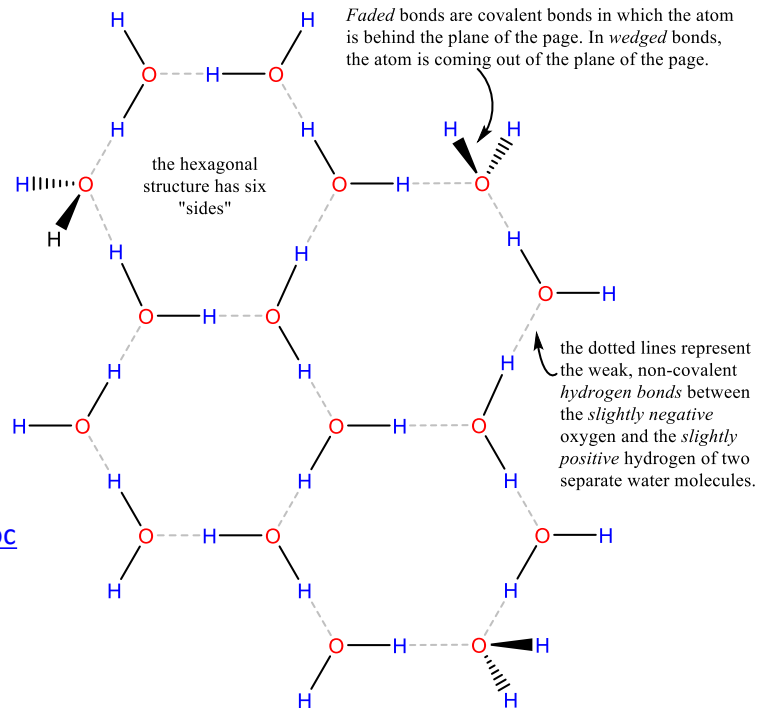
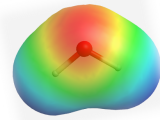


The higher temperature of liquid water (compared to ice) means that the molecules are always moving, and so *hydrogen bonds* are less stable (they break and reform often).





Organized, hexagonal array of hydrogen bonds connects the molecules of solid water



Ice melting in water

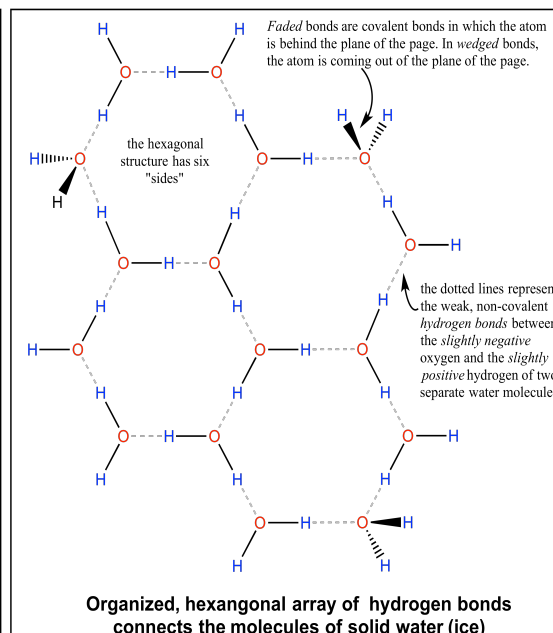
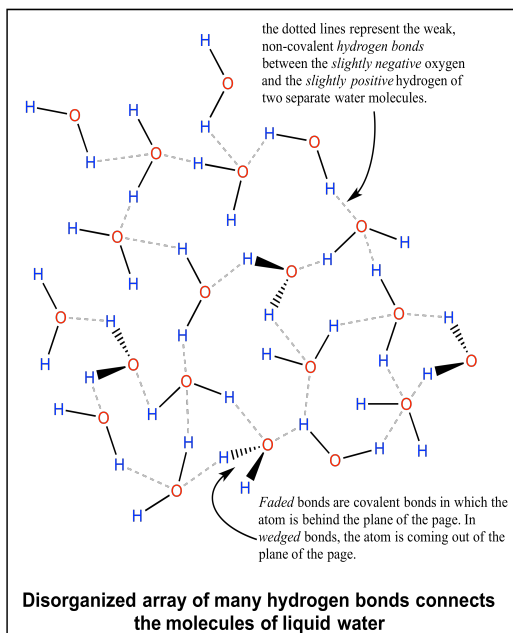
<https://youtu.be/CDTZoFGmZoc>

Water freezing into ice

<https://youtu.be/PcoiLAsUvqc>

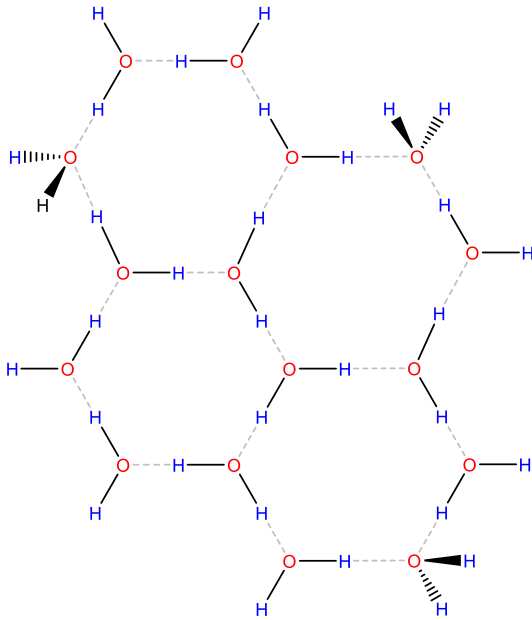


Liquid vs. Solid Water





Water is special Ice Floats

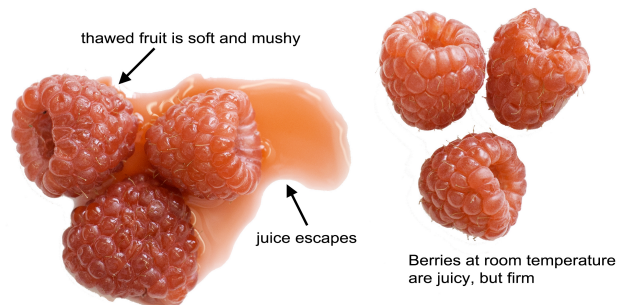


Why is liquid water *more dense* than solid water?



Freezing water

Fruits and vegetables are comprised of cells, and each cell in the plant is full of liquid water. If you place a fruit or veggie in the freezer, the plant material will freeze, but upon thawing – the plant material is mushy and drips juice. If you were to look at the thawed plant material under a microscope, you would see that the cells of the plant were punctured from the inside out.



Berries after freezing and thawing

Photo by Bill Keller, Used with Permission

Given the properties of liquid versus solid water. How did the freezing of the plant material end up rupturing the cells?

It is possible to buy “flash frozen” fruits and veggies at the grocery store. According to the food manufacturers these fruits and veggies were frozen *very quickly* to prevent the formation of large ice crystals. Consequently, the ice crystals formed in quickly frozen/flash frozen fruits and veggies are small. How might this improve the quality of the fruit or veggie upon thawing?