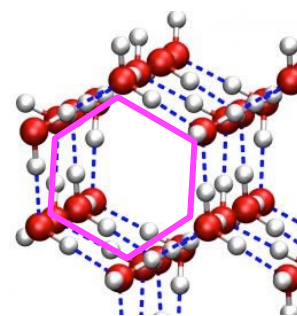


**Water is a liquid at room temperature:**

- 1) O<sub>2</sub>, N<sub>2</sub>, and CO<sub>2</sub> all have low molar masses, so it makes sense that they are all gases at room temperature. Water also has a low molar mass, **but** water is a liquid at room temperature. Answer these questions to determine why.
- a) O<sub>2</sub>, N<sub>2</sub>, and CO<sub>2</sub> are **all (nonpolar, polar)**. Intermolecular bonding? dispersion
- b) Water is **(nonpolar, polar)**. Intermolecular bonding? hydrogen bonding
- c) Explain why water normally stays as a liquid on earth instead of being a gas like the others.  
**H-bonding is much stronger than dispersion, so it takes more energy to break the intermolecular forces, which means that higher temperatures are needed to boil.**

**Density of Ice:**

- 2) Why is it so important that ice floats on water?  
**Ice floating on water insulates the water below and keeps it from freezing. Aquatic life is protected from the cold. If ice were to sink, bodies of water would freeze from the bottom up, and without the protective top layer would freeze solid, killing all life.**
- 3) a) For almost all substances, the solid state is **(more, less)** dense than the liquid state.  
b) However, for water, the solid state is **(more, less)** dense than the liquid state.
- 4) Why is solid ice less dense than liquid water? (Hint: Describe molecular structure of ice.)  
**When ice forms, the molecules spread out because the hydrogen bonds cause the molecules to arrange themselves into a hexagonal structure.**
- 5) What is similar about the molecular structure of ice and snowflakes?  
**Snowflakes are also hexagonal, with six sides/points.**
- 6) Why is a protein from bacteria added to snow making machines?  
**The bacteria provides a place for the snow crystals to form and allows the crystals to form above 0°C.**



**Solubility of water:**

- 7) Why is water able to dissolve both ionic (ex: NaCl) and polar substances (alcohol)?  
**Water is very polar, so it is similar to (and has strong attractions to) both ionic and polar substances.**
- 8) What type of substance doesn't water mix with? nonpolar
- 9) Water can dissolve a large variety of substances. (Thus, it is sometimes called the *universal solvent*.)
- a) List some benefits of this.  
**We can cook with water, a lot of chemical reactions are performed in aqueous solutions, blood can transport electrolytes and nutrients**
- b) List some dangers of this.  
**It is easily contaminated (polluted) because much waste is also soluble.**
- 10) List the three steps used in water treatment plants to clean our drinking water
- **Settling (septic tanks)**
  - **Addition of bacteria**

- Disinfection with  $\text{Cl}_2$  or  $\text{O}_3$