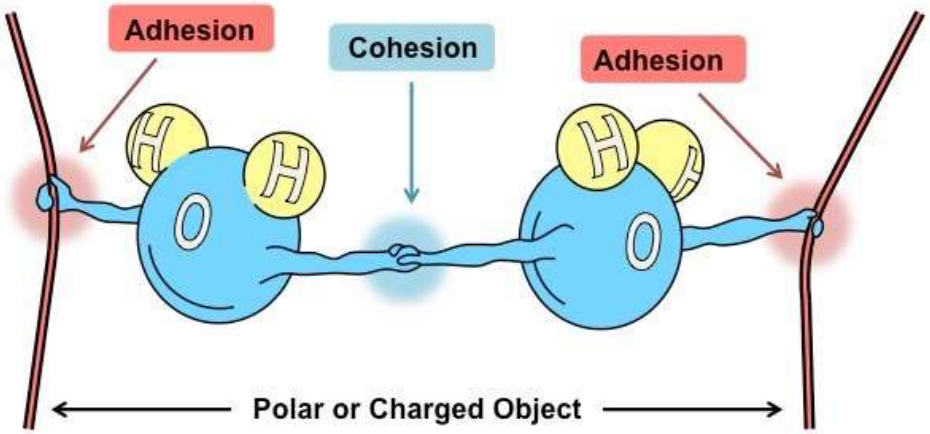
C4. Properties of Water

The Astonishing Properties of Water: Cohesion, Adhesion, Surface Tension, and Density

Water, the ubiquitous molecule that covers a significant portion of our planet's surface, possesses a set of extraordinary properties that make it a substance like no other. These properties arise from the unique arrangement of its molecules and have profound implications

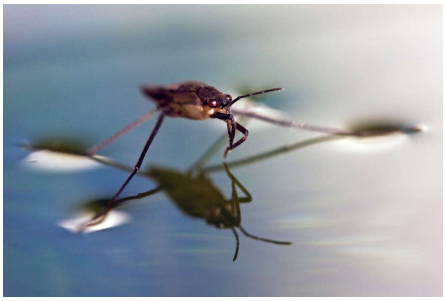


for life on Earth.

Cohesion and Adhesion: The Dance of Water Molecules

One of the most fascinating properties of water is its ability to stick to itself, a phenomenon known as cohesion. Water molecules are polar, meaning they have a positive and negative end. This polarity results in an attractive force between water molecules, allowing them to form hydrogen bonds and hold together. Cohesion is responsible for the formation of water droplets and the surface tension of water.

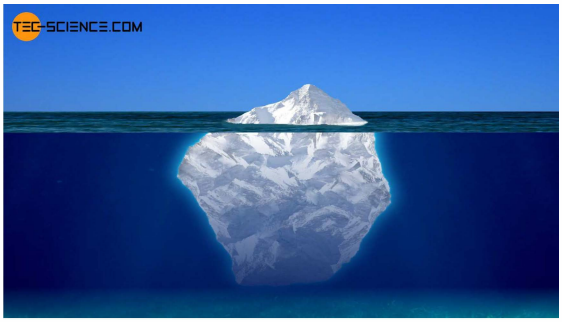
Adhesion is another remarkable property of water. It is the ability of water to adhere to other substances, such as the walls of a container or the surfaces of plant cells. Adhesion occurs because water molecules can form hydrogen bonds with other materials, allowing them to cling to various surfaces.



Surface Tension: The Elastic Skin of Water

Surface tension is the result of the cohesive forces between water molecules at the surface of a liquid. It creates a kind of "skin" on the water's surface, making it appear as if the water is stretched tightly. This property is the reason why small objects can "float" on the surface of water, seemingly defying gravity.

Surface tension is also responsible for the formation of water droplets. When water molecules come together due to cohesion, they minimize their contact with the surrounding air, creating spherical shapes. This is why raindrops, dewdrops, and even the shape of water striders' legs on the surface of ponds are all influenced by surface tension.



Solid Water: The Density Anomaly

Water's density behaves unusually compared to most other substances. Typically, when a substance transitions from a liquid to a solid state, it becomes denser because its molecules pack more closely together. However, water is an exception. When water freezes and becomes solid ice, its molecules arrange themselves in a hexagonal lattice, creating open spaces. This unique structure causes ice to be less dense than liquid water.

The density anomaly of water has significant consequences for life in aquatic ecosystems. When water cools down in the winter and approaches freezing temperatures, it becomes less dense. Consequently, ice forms on the surface of lakes and ponds, insulating the water below and allowing aquatic organisms to survive in the unfrozen water beneath the ice.

1. What is cohesion in water?
    a) The ability of water to stick to other substances.
    b) The tendency of water molecules to form hydrogen bonds with each other.
    c) The tendency of water molecules to adhere to other materials.
    d) The attractive force between water molecules that allows them to stick together.

2. Which property of water is responsible for the formation of raindrops?
    a) Cohesion
    b) Adhesion
    c) Mechanical Tension
    d) Solidification

3. What creates surface tension in water?
    a) The repulsive forces between water molecules at the surface.
    b) The cohesive forces between water molecules at the surface.
    c) The attractive forces between water and other substances.
    d) The formation of hydrogen bonds between water molecules.

4. Why does a paperclip seem to "float" on the surface of water?
    a) Because water is less dense than the paperclip.
    b) Because water is as dense as the paperclip.
    c) Because of surface tension
    d) Because the paperclip is made of a special material.

5. How does adhesion differ from cohesion in water?
    a) Cohesion is the tendency of water to stick to itself, while adhesion is the tendency of water to stick to other materials.
    b) Adhesion is the tendency of water to form hydrogen bonds with itself, while cohesion is the tendency to form hydrogen bonds with other substances.
    c) Adhesion is the attractive force between water molecules, while cohesion is the attractive force between water and other materials.
    d) Adhesion and cohesion are the same thing.

6. What is the unique structure of ice that causes it to be less dense than liquid water?
    a) Ice molecules are more tightly packed than liquid water molecules.
    b) Ice molecules are arranged in a random pattern.
    c) Ice molecules form a hexagonal lattice with open spaces.
    d) Ice molecules have stronger hydrogen bonds than liquid water molecules.

7. How does the density anomaly of water impact aquatic ecosystems in cold climates?
    a) It has no impact on aquatic ecosystems.
    b) It causes aquatic organisms to become more dense.
    c) It allows ice to form on the surface of lakes and ponds, insulating the water below.
    d) It makes water colder in the winter.

8. Which property of water is responsible for the spherical shape of water droplets?
    a) Sublimation
    b) Adhesion
    c) Surface tension
    d) Solidification

9. What is the result of the cohesive forces between water molecules at the surface of a liquid?
    a) Surface tension
    b) Adhesion
    c) Evaporation
    d) Condensation

10. Why does water have adhesive properties?
    a) Because water is less dense compared to other substances
    b) Because of water's cohesive properties
    c) Because of surface tension
    d) Because water molecules can form hydrogen bonds with other substances

ANSWERS & EXPLANATIONS

1. d) The attractive force between water molecules that allows them to stick together
    - Cohesion in water refers to the attractive force between water molecules that allows them to stick together.

2. a) Cohesion
    - Cohesion is responsible for the formation of water droplets and raindrops.

3. b) The cohesive forces between water molecules at the surface
    - Surface tension in water is created by the cohesive forces between water molecules at the surface.

4. c) Because of surface tension
    - The surface tension of water allows objects like paperclips to "float" on its surface.

5. a) Cohesion is the tendency of water to stick to itself, while adhesion is the tendency of water to stick to other materials
    - Cohesion is the tendency of water to stick to other materials, while adhesion is the tendency of water to stick to itself.

6. c) Ice molecules form a hexagonal lattice with open spaces
    - Ice is less dense than liquid water because its molecules form a hexagonal lattice with open spaces.

7. c) It allows ice to form on the surface of lakes and ponds, insulating the water below
    - The density anomaly of water allows ice to form on the surface of bodies of water, providing insulation for aquatic life beneath it.

8. c) Surface tension
    - Surface tension is responsible for the spherical shape of water droplets.

9. a) Surface tension
    - The cohesive forces at the surface of a liquid create surface tension.

10. d) Because of surface tension allowing them to stay on the surface of the water
    - Small insects like water striders can appear to "walk on water" due to the surface tension of water, which supports their weight on the water's surface.