Topic 6: Biochemistry of Life Part 1- Water

|  |  |  |
| --- | --- | --- |
| IB Assessment statements | | Unit objectives: |
| 2.1.U1  2.2.U2  2.2.U3  2.2.A1  2.2.A2  2.2.A3  2.2.NOS | Water molecules are polar and hydrogen bonds form between them.  Hydrogen bonding and dipolarity explain the cohesive, adhesive, thermal and solvent properties of water (give at least 1 example of a benefit to living organisms).  Substances can be hydrophilic or hydrophobic.  Comparison of the thermal properties of water with those of methane.  Use of water as a coolant in sweat.  Modes of transport of glucose, amino acids, cholesterol, fats, oxygen, and sodium in blood in relations to their solubility in water.  Use of theories to explain natural  phenomena- the theory that hydrogen bonds form between water molecules explain the properties of water | Basics of Biochemistry   * Describe the structure of an atom (in terms of protons, neutrons and electrons). * Contrast ion with atom. * Define anion and cation. * Contrast covalent, ionic and hydrogen bonds.   Water   * Write the molecular formula for water and draw the atomic structure of the molecule. * Describe the cause and effect of the polar nature of water. * Describe where and how water is able to form hydrogen bonds. * Contrast adhesion with cohesion. * Explain why it takes so much energy to change the temperature of water. * Describe the benefits to life of waters high heat capacity. * Explain why is water such a good solvent and explain the types of molecules will it dissolve. * Define hydrophilic and hydrophobic. * Compare the thermal properties of water and methane. * Explain why water and methane have different thermal properties based on their atomic structure. |

1

Basics of Biochemistry

Neutrons:

In the atomic nucleus, which provides…

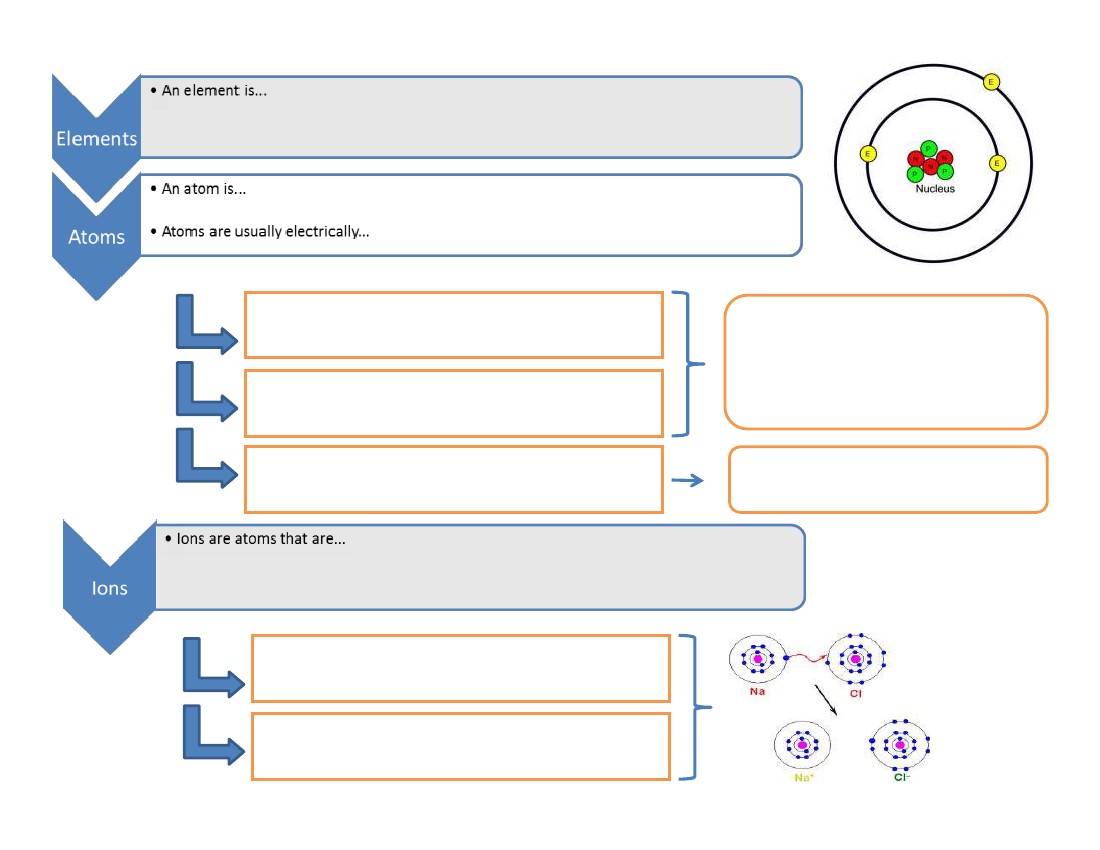
Protons:

Electrons:

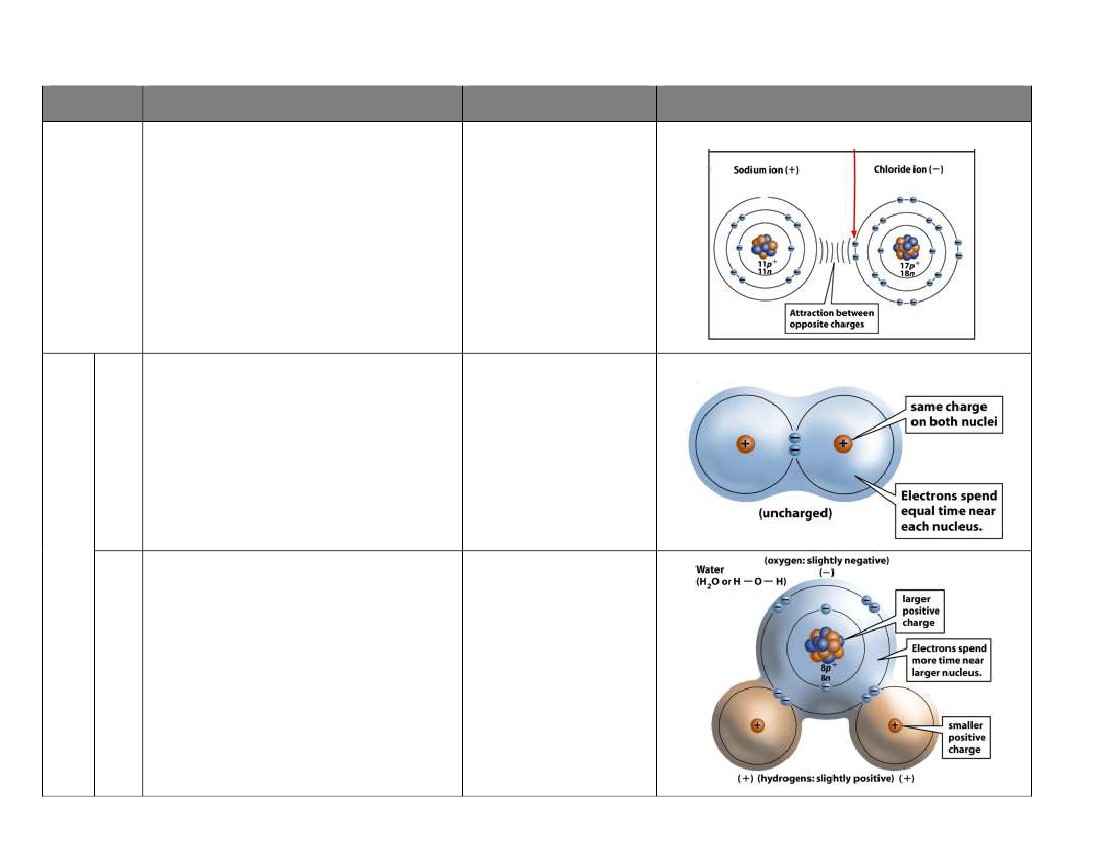
Electrons interact with…

Cations:

Anions:



2

Chemical Bonds: holding molecules together

Type

Description

Example

Diagram

Ionic bond

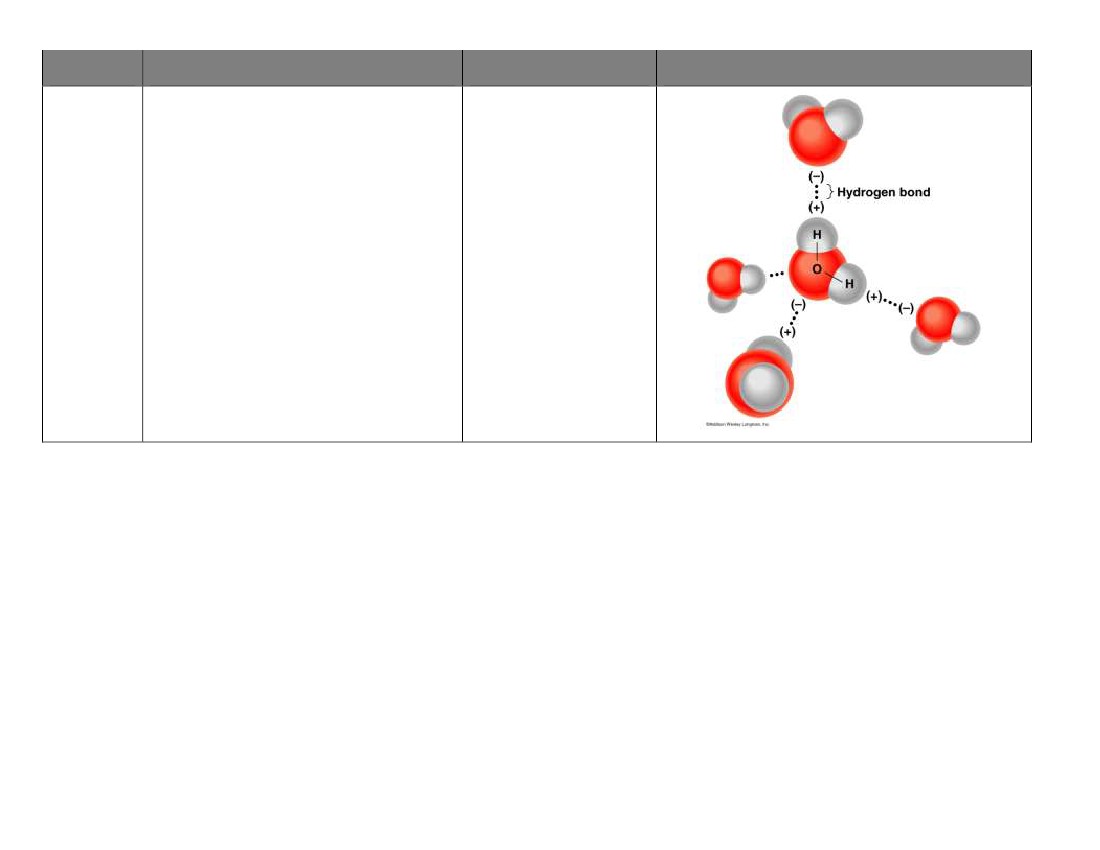
Covalent bond

Polar

Non-

polar

3

Type

Description

Example

Diagram

\*actually an intermolecular force, not a true bond. But, the name is the name.

VIDEO GUIDE FOR BOZEMAN BIOLOGY – CHEMICAL BONDS: IONIC VS. COVALENT

What are chemical bonds?

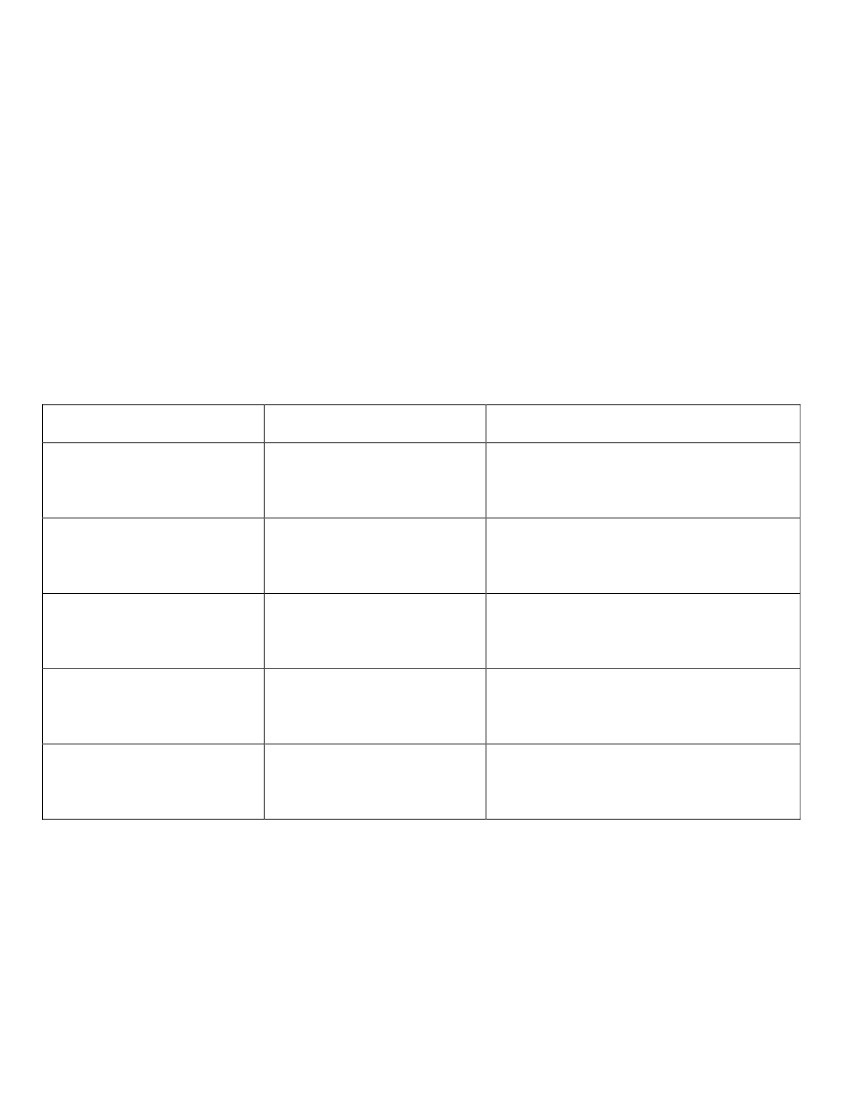
How are covalent bonds different from ionic bonds?

What are the two types of covalent bonds?

How do we know that water has polar covalent bonds?

Hydrogen “bond”\*

4

VIDEO GUIDE FOR BOZEMAN BIOLOGY – WATER AS A POLAR MOLECULE

Oxygen is unique because\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Why does water behave like a magnet?

The bond between oxygen and hydrogen within a water molecule is a \_\_\_\_\_\_\_\_\_\_\_\_\_ bond

The bond between oxygen and hydrogen on different water molecules is a \_\_\_\_\_\_\_\_\_ bond

Draw the hydrogen bonds between the five water molecules show at 3:48 (pause the video here)!

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is a polar molecule, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is a nonpolar molecule.

Describe the five properties of water that are due to its polarity

Property

High specific heat

Description

“real life” application of this property

Solvent

Cohesion

Capillary action

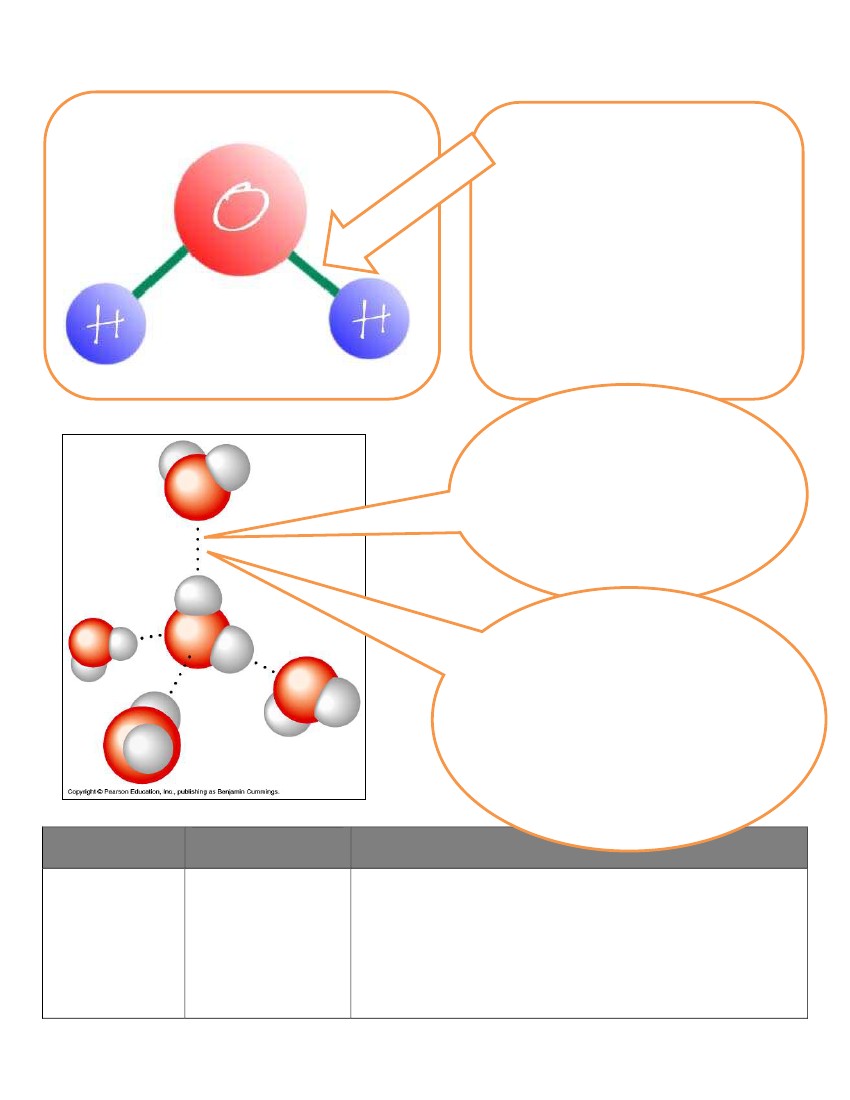
Ice floats

Why is Seattle warmer in the winter than Yellowstone, even though both locations are at similar latitudes?

How does water get to the top of a tree?

Why is it “good” for aquatic organisms that live in cold climates that ice floats?

5

Water, Water Everywhere

Structure of Water

Water molecules are polar



The e- are…



The oxygen atom…



Results in:

Water molecules can form hydrogen “bonds”

Partially \_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ atoms of one water

molecule are attracted to the partially

\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_

atom of another water molecule

.

The bonds are \_\_\_\_\_\_\_\_ and

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ quickly as the

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_,

however the \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_

of \_\_\_\_\_\_\_\_\_\_\_\_ contribute to the

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of water.

BIOLOGICALLY IMPORTANT PROPERTIES OF WATER

Significance Explanation

Property for Life

ICE FLOATS

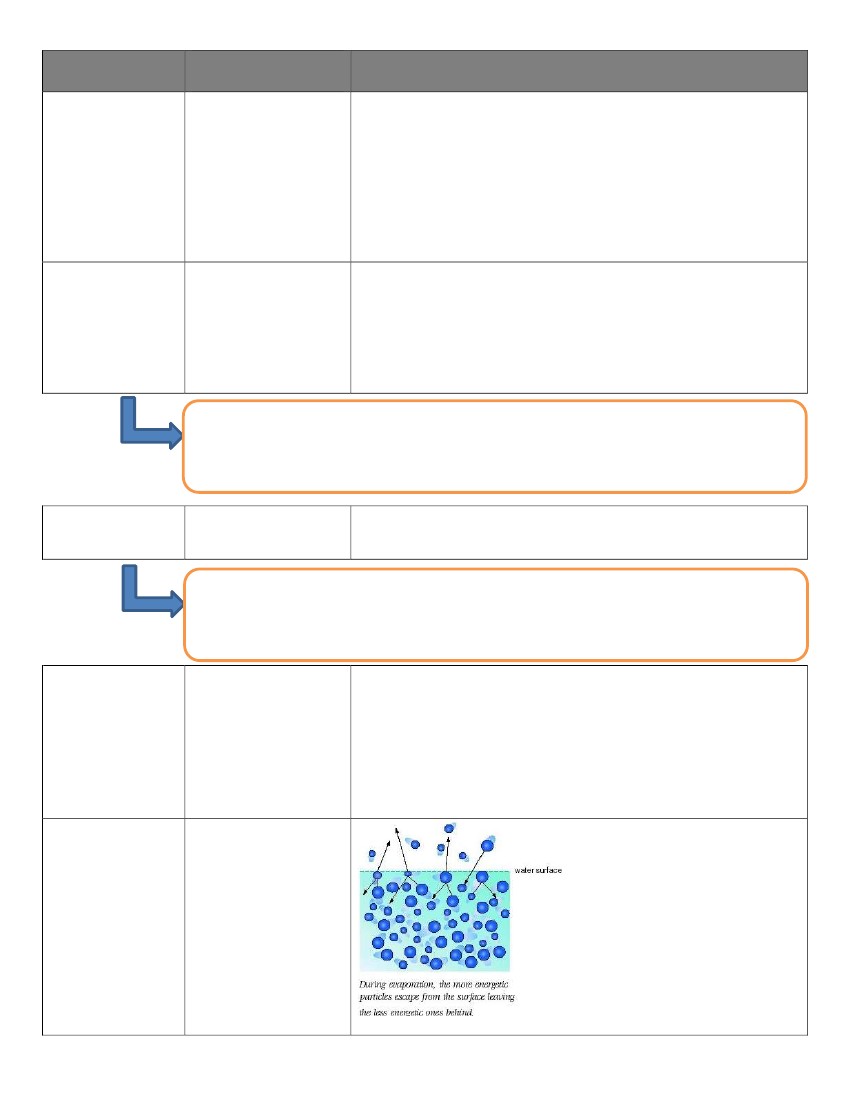
Ice floats and insulates the

underlying water so many

plants and animals are not

frozen

6

Property

Significance

for Life

Water is the main

transport medium for

dissolved nutrients. In

animals, blood (mostly

water) goes through out

all parts of the body,

carrying nutrients. In

plants, water carries

nutrients up plants and

through leaves.

Cohesion explains how

water molecules can form

a chain in delivering

moisture to the top of a

tree or through the blood

stream

Explanation

SOLVENT

COHESION

Cohesion of water molecules along a surface produces SURFACE TENSION

ADHESION

Adhesion helps water

climb up the thin tubes of

plants to the leaves

Adhesion and cohesion of water allows for CAPILLARY ACTION

HIGH SPECIFIC

HEAT

Contents of cells are

unlikely to freeze. Aquatic

environments are

thermally stable.

Organisms have stable

internal temperatures

when the external

temperature is

fluctuating.

HIGH HEAT OF

VAPORIZATION

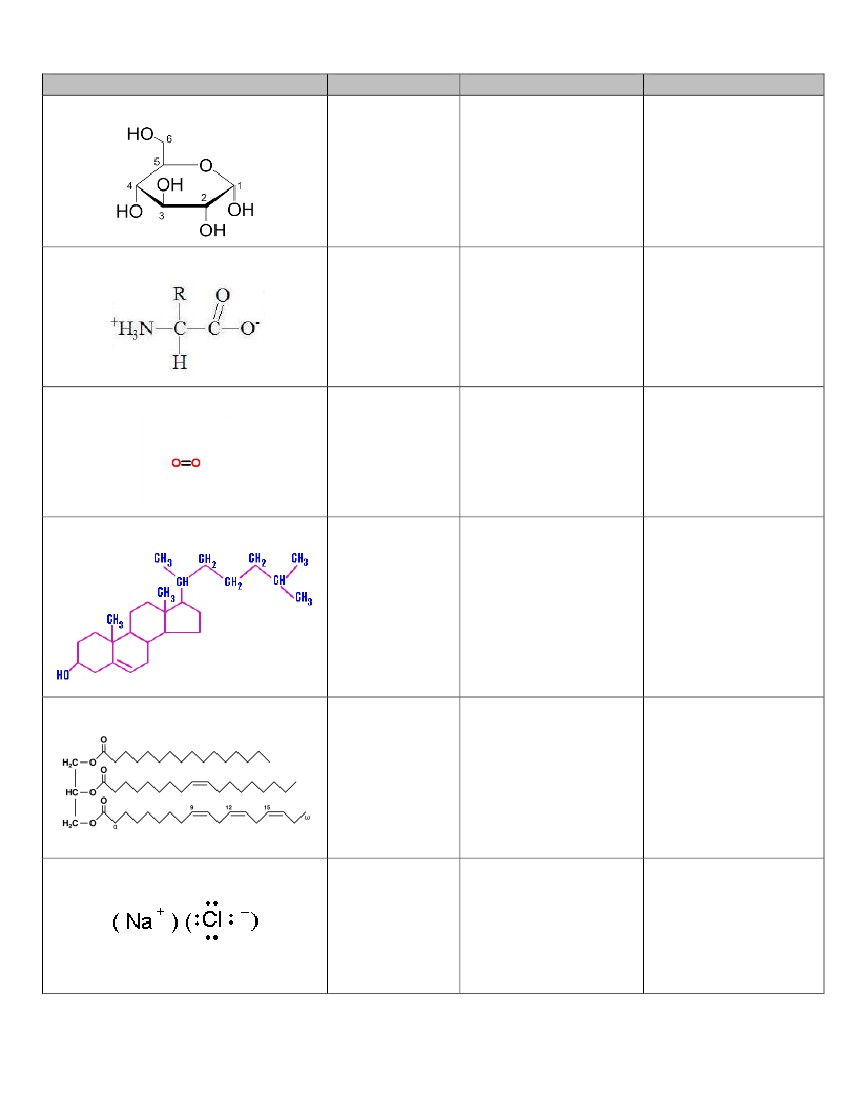
Organisms rely on hear of

vaporization to remove

body heat to remain cool.

Evaporative cooling.

7

SOLUBILITY IN WATER

MOLECULE

Glucose

-PHILIC/-PHOBIC

EXPLANATION

IMPLICATION

Amino Acid

Oxygen

Cholesterol

Fat

Sodium Chloride (salt)

8

COMPARING

WATER TO

METHANE

FORMULA

BONDING

POLARITY

DENSITY

METHANE

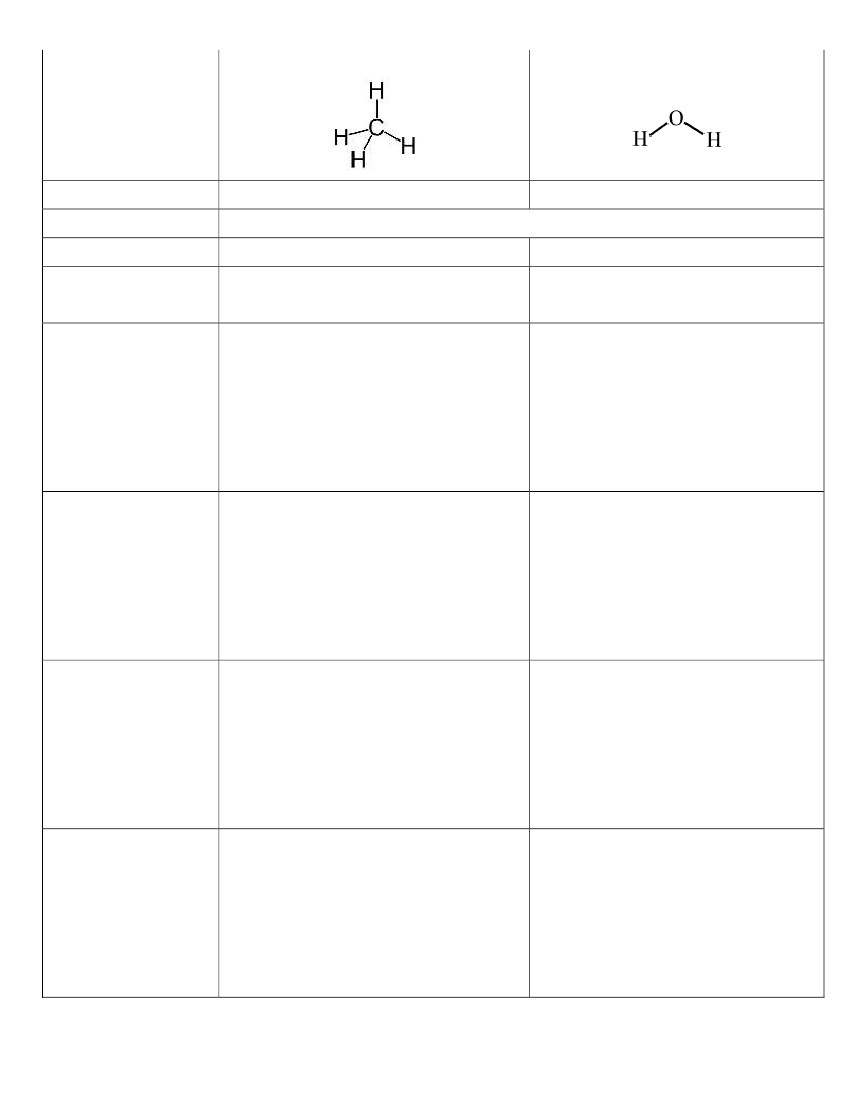
WATER

HEAT CAPACITY

HEAT OF VAPORIZATION

MELTING POINT

BOILING POINT



9