PT CODE: S-7-1 ***SALINE AND CELLS***

Overview: Investigating the chemistry of living cells

There are three parts of this performance task: 1) classroom instruction, 2) partner work, and 3) independent work.

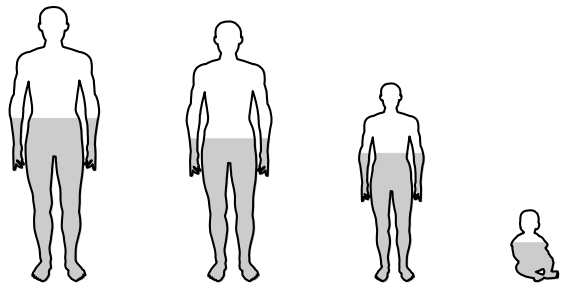
Water covers three-quarters (75%) of Earth's surface. This essential fluid is required by all organisms on Earth to perform life functions. Because of its chemical properties, this water easily dissolves a wide range of substances and carries materials easily into and out of cells. The average human body is about 60% water, and human organs contain varying amounts of water. Average water content also changes as humans move through stages of life, from infancy to adulthood.

When a person does not drink enough water, he or she can become tired, get a headache, or feel dizzy. When exercising or staying outside in the Sun on a hot day, a person should consume more water than usual to avoid dehydration.

Water Content of Organs in the Human Body

Organ	Percent Water
brain	73
heart	73
lungs	83
skin	64
bones	31

Percentage of Water in the Human Body by Body Type



Water in the body is not pure water. It is actually a mixture of substances that form a salt solution known as saline. **Saline** contains sodium chloride (NaCl) and water (H_2O). Often, small amounts of other substances are dissolved into saline solutions. The human body contains 0.9% saline, or 9 grams of salt for every 1 liter (or 1,000 mL) of fluid in the body. This concentration of sodium chloride allows water to move freely into and out of cells, keeping the fluids inside and outside the cells balanced. Too little or too much salt in the body can cause the fluids to become unbalanced. This disrupts normal body functions. Returning the body to its normal state (homeostasis) helps regain those functions.

Sometimes people get sinus infections. Doctors may recommend that patients keep their sinus tissues moist by using saline nasal sprays. Saline eye drops can help to soothe dry, irritated eyes. If you are in the hospital and the doctor notices that you are dehydrated, a solution of saline with added sugar may be pumped into your veins to rehydrate the body.

Water is a **covalent** substance (two nonmetals bonded) that dissolves most ionic substances (a metal and a nonmetal bonded). When sodium chloride is added to water, the **ionic bond** holding the molecule together breaks, leaving a positive **ion** (Na^+) and a negative ion (Cl^-). Sodium and chlorine ions are essential to keep the electrical system of the body functioning properly. By acting like stepping stones across a brook, these charged particles allow the electrical signals of the nervous system to pass through the water in the body.

In this activity, you will develop models that represent the components of normal saline, identify properties of the two compounds that make up saline, and investigate saline within living cells.

✓ **Checkpoint 1:** Continue with parts I and II on page 2 of the student document.

Student Name _____

I. The Chemistry of Saline Solutions

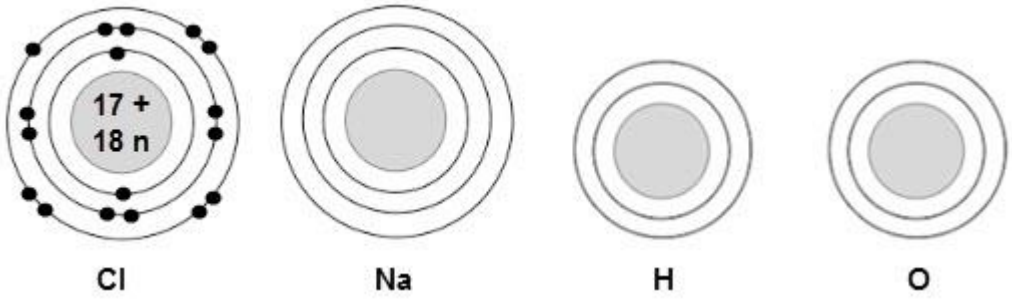
The chart lists the elements that make up saline. Complete the chart by using the periodic table of the elements.

Elements in a Saline Solution

	Chlorine	Sodium	Hydrogen	Oxygen
Symbol				
Atomic number				
Atomic mass				
Number of protons (+)				
Number of electrons (-)				
Number of neutrons (n)				
Metal or nonmetal?				

II. Modeling the Elements in Saline Solutions

Make Bohr models of the elements in saline by writing the proton and neutron numbers for each element in its model. Position the electrons in their rings. Chlorine has been completed.



✓ **Checkpoint 2:** *As directed by your teacher*, discuss answers with a partner or as a class.

III. Properties of Salt and Water

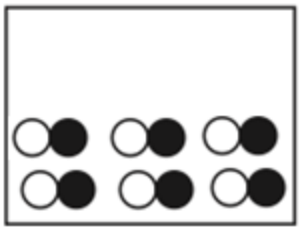
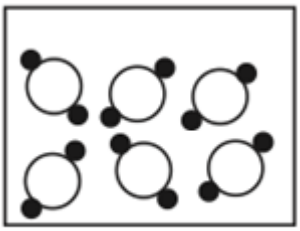
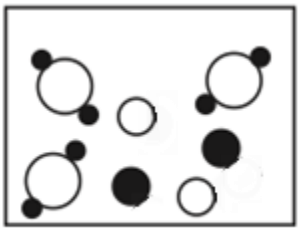
Identify the type of bond in NaCl, the type of bond in H_2O, and the listed properties of salt and water as either physical or chemical. One gram per cubic centimeter is equal to one gram per milliliter.

Property	Salt (NaCl)	Water (H_2O)	Chemical or Physical Property?
boiling point	1413°C	100°C	
density	2.15 g/mL	1.00 g/mL	
flammable	no	no	
type of bond			determines physical properties
state of matter (room temp. 27°C)	solid	liquid	

✓ **Checkpoint 3:** *As directed by your teacher*, discuss answers with a partner or as a class.

IV. Classifications

One of the diagrams below represents pure salt, one represents pure water, and one represents a saltwater solution. **Name each diagram, and explain your reasoning for that label.**

 A	 B	 C
Name:	**Name:**	**Name:**
Explanation: _____	**Explanation:** _____	**Explanation:** _____

✓ **Checkpoint 4:** *As directed by your teacher*, discuss answers with a partner or as a class.

V. Bonding

Use the periodic table of elements to identify the type of bond in the following compounds that are commonly found in the human body.

KCl = potassium chloride = _____

O_2 = oxygen (gas) = _____

CO_2 = carbon dioxide = _____

$C_6H_{12}O_6$ = glucose (sugar) = _____

$MgCl_2$ = magnesium chloride = _____

$Mg(OH)_2$ = magnesium hydroxide = _____

✓ **Checkpoint 5:** *As directed by your teacher*, discuss answers with a partner or as a class.

VI. Making Salt Solutions

Use the relationship of normal saline (grams of salt per 1,000 mL of water) to determine the amount of salt needed to form these salt solutions. The prefix "hyper" refers to a solution that has a greater concentration of salt than a solution that is hypotonic.

1 g H_2O = 1 mL H_2O

(Normal saline: 0.9% = 9 grams NaCl/1,000 mL of water)

Hypertonic* saline: 15% = _____ grams NaCl/1,000 mL of water

Hypotonic* saline: 0.2% = _____ grams NaCl/1,000 mL of water

✓ **Checkpoint 6:** *As directed by your teacher*, discuss answers with a partner or as a class.

ACTIVITY: Microscope Investigation

One of the most important organelles within a cell is the cell membrane. The cell membrane is described as being selectively **permeable**, meaning that some materials can move easily into or out of the cell. When a substance passes through the membrane without any help from the cell, it's most likely caused by the process called **diffusion**. Ions, sugar molecules, and cell waste are some substances that do this. These substances move from areas of high concentration to areas of low concentration. When *water* diffuses into or out of a cell, it is called **osmosis**. Since cells have water in them and live in a water-based environment, osmosis is always possible.

When does water enter a cell? When does water leave a cell? This laboratory investigation will help answer these questions.

✓ **Checkpoint 7:** *When directed by your teacher*, move to your lab station.

Observe the materials at your lab station. You should have the following:

Materials List (per student lab group)

- 1 recently prepared red onion cell slide with cover slip
- 1 microscope
- dropper bottle of solution A
- dropper bottle of solution B
- dropper bottle of solution C
- calculators
- periodic table of the elements

Procedure

1. Place the onion cell microscope slide on the stage. Scan the entire onion tissue on *low power* to find the darkest purple area, and focus the microscope on this area. Set the microscope to *medium power* and focus the view. Draw one of the cells in the center of your view in the space provided. Use colors to match those seen in the magnified onion cell.

Initial Onion Cell Drawing

2. Without moving the slide from the microscope stage, add one drop of solution A near each edge of the cover slip. Allow the slide to sit for one minute. Observe the onion cells through the microscope. Draw one of the cells in the center of your view in the space provided. Use colors to match those seen in the magnified onion cell.

Solution A Onion Cell Drawing

3. Contrast the appearance of the initial onion cell to the appearance of the onion cell in solution A.

_____

_____

_____

_____

4. Which features of these cells identify them as plant cells rather than animal cells?

_____

_____

5. Without moving the slide from the microscope stage, place a small piece of paper towel at the edge of the slide and cover slip to absorb any extra fluid on the slide. Then, place one drop of solution B near each edge of the cover slip. Allow the slide to sit for one minute. Observe the onion cells through the microscope. Draw one of the cells in the center of your view in the space provided on the next page. Label the cell wall and cell membrane. Use colors to match those seen in the magnified onion cell.

Solution B Onion Cell Drawing

6. Contrast the appearance of the initial onion cell to the appearance of the onion cell in solution B.

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_____

7. Finally, without moving the slide from the microscope stage, place a small piece of paper towel at the edge of the slide and cover slip to absorb any extra fluid on the slide. Then, place one drop of Solution C near each edge of the cover slip. Allow the slide to sit for one minute. Observe the onion cells through the microscope. Draw one of the cells in the center of your view in the space provided. Label the cell wall and cell membrane. Use colors to match those seen in the magnified onion cell.

Solution C Onion Cell Drawing

8. Contrast the appearance of the initial onion cell to the appearance of the onion cell in solution C.

_____

_____

_____

✓ **Checkpoint 8:** *As directed by your teacher*, discuss answers with your group or as a class.

Clean up your lab station and return to your seat to work independently on the application questions on pages 7 and 8.

Application Questions (to be done on your own) **Student Name** _____

9. Based on your observations, which dropper bottle contained a **normal** saline solution so that the salt solution inside the cell was the same as that outside the cell (normal condition of onion cells)? **(inside = outside)**

□ Solution A □ Solution B □ Solution C (check one)

10. Based on your observations, which dropper bottle contained a **hypertonic** saline so that the salt solution inside the cell is less than that on the outside, causing water to move out of the cell? **(inside < outside)**

□ Solution A □ Solution B □ Solution C (check one)

11. Based on your observations, which dropper bottle contained a **hypotonic** saline so that the salt solution inside the cell is greater than that on the outside, causing water to move into the cell? **(inside > outside)**

□ Solution A □ Solution B □ Solution C (check one)

12. During the winter, many highway departments apply salt to roads to lower the freezing point of water on the roads. This reduces the ice that accumulates on roadways and prevents car accidents caused by sliding on surface ice. The grasses that border these roadways often turn yellow and may die. Based on what you've learned in this activity, explain why this occurs. z

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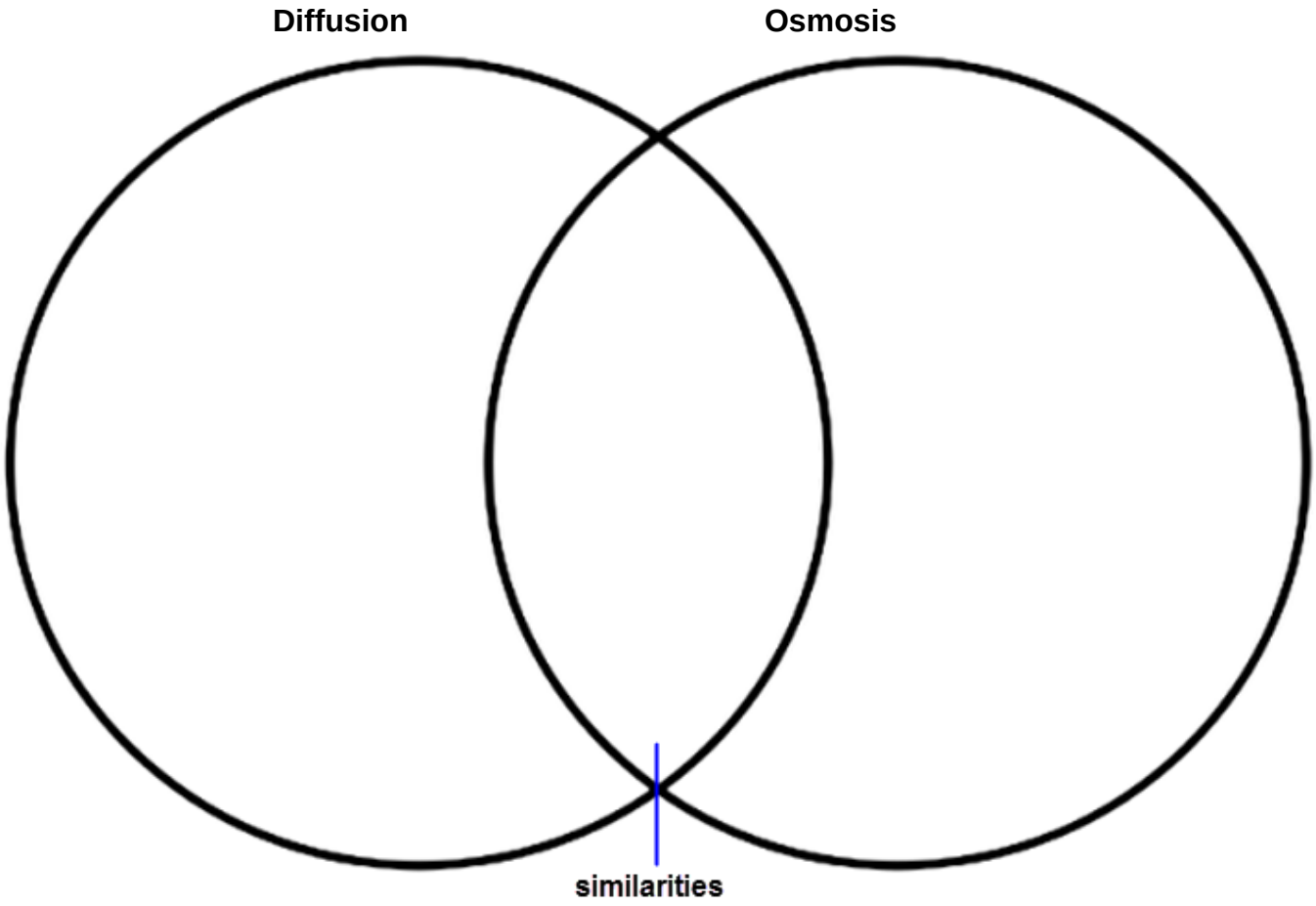
_____

_____

_____

13. A person eats food containing high levels of salt. Draw an arrow to represent the movement of water in the cells lining the digestive system.

14. Complete the Venn diagram to explain how the processes of diffusion and osmosis are similar and different. Be sure to include a reference to concentration in your answer.



15. Circle **two** statements that explain how the rate of diffusion and the concentration gradient are related.

A. The greater the difference in the concentration of a substance inside the cell compared to outside the cell, the greater the rate of diffusion.

B. The lesser the difference in the concentration of a substance inside the cell compared to outside the cell, the greater the rate of diffusion.

C. The greater the difference in the concentration of a substance inside the cell compared to outside the cell, the lesser the rate of diffusion.

D. The lesser the difference in the concentration of a substance inside the cell compared to outside the cell, the lesser the rate of diffusion.