Dialysis

PURPOSE

The kidneys use selective permeability in the formation of urine and in maintaining homeostasis. The student will determine the permeability of different types of membranes to various substances.

TEKS	121.15 1A, 1B, 2A, 2B, 2C, 2D, 4B Algebra I B1B, B1D	TAKS	ELA 1, 5 Mathematics 4, 8, 9 Science 1, 4

National Science Education Standards A9-12; C9-12; F9-12; G9-12
National Health Care Skills Standards .01, .02, .03, .04, .05, .06, .07
National Curriculum Standards for School Mathematics S1; S3

KEY POINTS

**Teacher Note*
Students should have an understanding of passive transport prior to lab.

I. Dialysis - smaller (diffusible) particles can be separated from larger particles (nondiffusible) by selective permeability through a specific membrane.
II. The plasma membrane of a cell selectively permits the passage of certain substances, such as nutrients, while excluding others.
III. The artificial kidney is a mechanical device that utilizes the principle of dialysis to separate large particles (such as blood cells) from small ones (such as urea and other wastes.
    a. diffusion
    b. osmosis
    c. filtration
IV. Review A & P of kidney
V. Parameters that affect kidney function
    a. blood pressure
    b. blood volume
    c. hormones
        1. ADH
        2. aldosterone
    d. caffeine
    e. trauma
    f. nutritional status
    g. disease
VI. Diseases of the kidney

ACTIVITIES

I. Complete the **Dialysis Laboratory Investigation**

MATERIALS

Deionized water
Sodium chloride
Glucose
Raw eggs
0.1 M silver nitrate solution
Benedict's solution
1 M nitric acid solution
Bunsen burner
Small test tubes
Droppers
10 ml and 1000 ml graduated cylinders
1000 ml beaker
500 ml beaker
Glass rods
String
Various materials to serve as dialysis membranes (dialysis membrane, cellophane, plastic wrap, wax paper, plastic bag, etc.)
Gloves
Goggles
Biohazard containers
Surface disinfectant
Paper towels

http://www.dekalb.dc.peachnet.edu/~vmichel/biol107/107osmosprob.html

ASSESSMENT

Laboratory Investigation Rubric

ACCOMMODATIONS

For reinforcement, the student will draw a kidney and identify the parts where osmosis and filtration occur.

For enrichment, the student will research and report on why severe kidney disease may cause generalized edema.

REFLECTIONS

Dialysis Laboratory Investigation

Purpose:
The purpose of this lab is to determine the permeability of different types of membranes to chloride ions, glucose molecules, and egg albumin. This can be used as a comparison to how the body attempts to maintain homeostasis when changes occur.

Background Information:

Materials:
Deionized water
Sodium chloride
Glucose
Raw eggs
0.2 M silver nitrate solution
Benedict's solution
1 M nitric acid solution
Bunsen burner
Small test tubes
Droppers
10 ml and 1000 ml graduated cylinders
1000 ml beaker
500 ml beaker
Glass rods
String
Various materials to serve as dialysis membranes (dialysis membrane, cellophane, plastic wrap, wax paper, plastic bag, etc.)
Gloves
Goggles
Biohazard containers
Surface disinfectant
Paper towels

Procedure:
I. Preparation
    1. Wash hands and put on gloves and goggles.

2. Assemble equipment and materials.
3. Prepare work area.
4. Test solution - add 10 g of sodium chloride, 10 g of glucose, and 10 g of raw egg white to every 500 ml of deionized water needed for the test.

II. Lab procedure

A. Create a dialysis bag by placing at least 20 ml of the test solution in each membrane to be tested and secure the solution in the membrane by tying the end with a string. Leave the ends of the string long enough to tie a glass rod to the bag of fluid.
B. Suspend the glass rod across the mouth of a 500 ml beaker ¾ full of deionized water, allowing the bag to be submersed in the water.
C. Let stand for at least one hour.
D. Run the following test on the water in the beaker and on the solution in the dialysis bag. *All tests must be made on all the membrane types. There will be six tests for each membrane-beaker fluid combination.*
    1. Test for sodium chloride- Pour 5 ml of liquid from the beaker into a test tube and add a drop of 0.1 M silver nitrate. A cloudy formation in the test tube indicates the presence of NaCl.
    2. Test for glucose- Add 5 ml of Benedict's solution into a test tube and add 5 drops of liquid from the beaker. Gently boil for two minutes over a Bunsen burner or in a water bath. Allow to cool at room temperature. A green, yellow, or red precipitate indicates the presence of glucose.
    3. Test for albumin- Pour about 5 ml of the liquid from the beaker into a small test tube and add 2-3 drops of 1 M nitric acid. The presence of albumin will be detected by the formation of a white, coagulated precipitate.
    4. Repeat the above tests using 5 mL amounts of solution from the dialysis bags tested.
    5. Clean work area with surface disinfectant. Remove goggles and gloves and wash hands.

Data:
Record observations

1. Type of membrane: _____

	Sodium Chloride	Glucose	Albumin
Contents of dialysis bag			
Water			

2. Type of membrane: _____

	Sodium Chloride	Glucose	Albumin
Contents of dialysis bag			
Water			

3. Type of membrane: _____

	Sodium Chloride	Glucose	Albumin
Contents of dialysis bag			
Water			

Conclusion:

1. Which of the membranes prevented any movement of solute particles?

2. Which membranes allowed the *most* solutes to pass?

3. Which solute particles tested positive most often in the beaker fluid?

4. Can any inference be made about the relative size of the solute particles based upon the results of the tests? If so, what is this inference?

5. Predict the consequences of a change in permeability within the kidney?

6. Compare and contrast acute and chronic renal failure with respect to urinary output, prognosis, and treatment.