Cell Structures: Osmosis in Red Blood Cells

Osmosis is the movement of water in response to solute concentrations. Water will always move to the region of higher solute concentration. In this activity you will examine the response of red blood cells to solutions with different tonicities.

Here are some quick bullet points relevant to this activity.

1. The red blood cells used in lab are of mammalian origin. They are animal cells and as such the cytoplasm is surrounded by a plasma membrane. These cells do not have a cell wall.
2. Mammalian red blood cells are enucleate, they lack a nucleus.
3. Under isotonic conditions water moves into and out of a cell at the same rate. There is no net movement of water.
4. Under hypertonic conditions, the solute concentration in the environment is greater than the cytoplasm of the cell, therefore water flows from the cell into the environment. The plasma membrane will collapse and the cell may shrivel. In red blood cells this leads to crenulation (bumpy appearance).
5. Under hypotonic conditions, the solute concentration in the environment is less than the cytoplasm of the cell, therefore water flows from the environment into the cell. The cell may lyse, or break open. This is called cytolysis or hemolysis in the case of red blood cells.

In this activity, you will be immersing red blood cells in three different solutions, distilled water, 0.9 % NaCl and 10 % NaCl. Write your hypothesis for this activity. What do you think will happen to the red blood cells in these solutions? _____

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Materials

Red blood cells (packed red cells)*
Toothpick
10 % NaCl solution
0.9 % NaCl
Distilled water
Microscope slides - 3
Coverslips - 3

*Use only a small amount of red blood cells. If your preparation is too thick you will not observe the desired reactions.

Procedure

1. Remove 3 clean slides and 3 coverslips from the materials box on the bench.
2. Add a small drop of distilled water to the center of one slide. Label this slide DI.
3. Add a small drop of 0.9 % NaCl to the center of the second slide. Label this slide 0.9 %.
4. Add a small drop of 10 % NaCl to the center of the third slide. Label this slide 10 %.
5. Insert a toothpick into the blood* sample. Swirl the tip of the toothpick in the water on the slide marked DI. If your instructor has diluted the blood prior to class, they will modify this protocol.
6. Insert a new toothpick into the blood sample. Swirl the tip of the toothpick in the solution on the slide marked 0.9 %.

7. Insert a fresh toothpick into the blood sample. Swirl the tip of the toothpick in the droplet on the slide marked 10 %.
8. Pick up the coverslip and slide it across the slide labeled DI at a 60 degree angle. Once the coverslip hits the drop, let the coverslip drop on to the specimen. Angling the coverslip, rather than dropping the coverslip flatly onto the smear minimizes the air bubbles that form under the coverslip.
9. Repeat step 5 for the slides labeled 0.9 % slide and the 10 %.
10. Place the 0.9% NaCl slide on the microscope. Start with the scanning objective (4X). Then proceed to the 10X objective.
11. Red blood cells are very small, only 8-10 microns in diameter. They are also unstained and so may be difficult to see. Adjusting the light levels will facilitate viewing the cells. Less light is better.
12. Continue increasing magnification until you reach 400X. Don't forget to adjust the light levels as you increase magnification. Do you see the red blood cells? Describe the shape of the cells? Is there plasma membrane smooth or rumpled? _____

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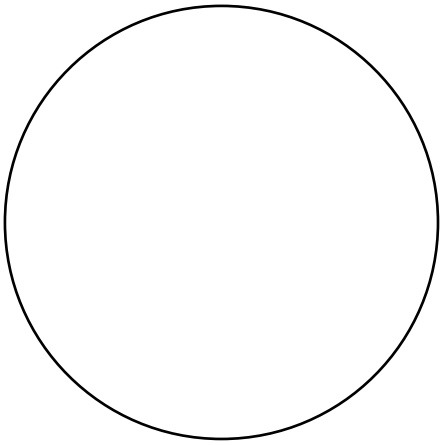
Mammalian red blood cells are normally biconcave. That is they are indented or pushed in on either side of the cell. This indented region is called the central pallor. The central pallor is lighter in color than the periphery of the cell. Do you see the central pallor? _____
13. Draw at least 10 cells in the circle below. Remember to exaggerate the size of the cells. Label the plasma membrane and cytoplasm. Make sure to include the magnification.

Specimen: _____

Magnification: _____

Description:_____

_____



14. Place the 10 % NaCl slide on the microscope. Start with the scanning objective (4X). Then proceed to the 10X objective.
15. Continue increasing magnification until you reach 400X. Don't forget to adjust the light levels as you increase magnification. Do you see the red blood cells? Describe the shape of the cells? Is there plasma membrane smooth or rumpled? _____

_____

Do you see the central pallor? _____

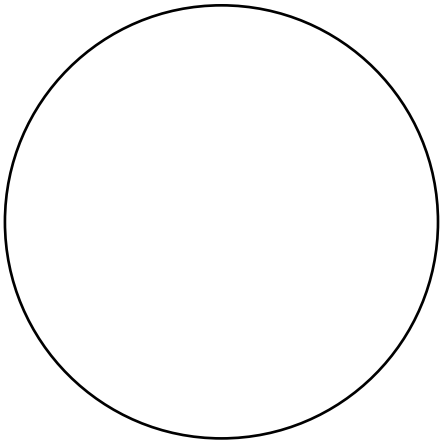
16. Draw at least 10 cells in your lab report. Remember to exaggerate the size of the cells. Label the plasma membrane and cytoplasm. Make sure to include the magnification.

Specimen: _____

Magnification: _____

Description:_____

_____



17. Place the DI slide on the microscope. Start with the scanning objective (4X). Then proceed to the 10X objective.

18. Continue increasing magnification until you reach 400X. Don't forget to adjust the light levels as you increase magnification. Do you see the red blood cells? _____Describe the shape of the cells? Is there plasma membrane smooth or rumpled? _____

_____

Do you see the central pallor? _____

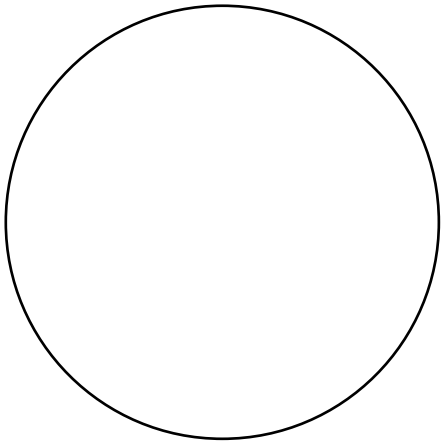
19. Draw at least 10 cells in your lab report. Remember to exaggerate the size of the cells. Label the plasma membrane and cytoplasm. Make sure to include the magnification.

Specimen: _____

Magnification: _____

Description:_____

_____



1. How would you describe the distilled water environment with respect to red blood cells? (isotonic, hypotonic, hypertonic) In which direction (in to or out of the cell) was water moving?

2. How would you describe the 10 % NaCl environment with respect to red blood cells? (isotonic, hypotonic, hypertonic) In which direction is water moving?

3. How would you describe the 0.9 % NaCl environment with respect to red blood cells? (isotonic, hypotonic, hypertonic) In which direction is water moving?

4. Under which condition did the red blood cells hemolyze?

5. People adrift at sea may drink seawater. If seawater is hypertonic to human tissues, what would be the result of drinking sea water?

6. Water intoxication is a rare phenomenon where individuals drink excessive amounts of water but cannot void (urinate) water. What physiological effects would this have on the body?