Types of Solutions and Their Effects on Cells

A. Definition of a Solution

1. A solution consists of two parts which are the _____ and _____.

2. The _____ is the liquid which dissolves the solute which is the solid (ie. the _____ is dissolved in the _____.)

3. In organisms, the solvent is _____ while the solute can be any of a number of dissolved solids including _____ or _____.

B. The Relationship Between Solute & Solvent Concentrations

1. When the solute concentration in a solution is high, the solvent concentration will be _____, relatively. Thus in _____, the more solute that is present in a soultion, the less _____ will be present in that solution.

2. When the solute concentration in a solution is low, the solvent concentration will be _____. Thus, in organisms, the less solute that is present in a solution, the more water/solvent will be present.

3. Therefore, there is an _____ relationship between the concentrations of _____ and _____ in solutions.

C. Types of Solutions

Solutions can be described as _____, _____, or _____ based on the relative amounts of a particular _____ which they contain. By knowing the relative solute concentrations between solutions, it is also possible to determine the relative _____ concentrations between the solutions since there is an inverse relationship between the two.

1. **Isotonic Solution**
   a. 'Iso' means 'the same as' and 'tonicity' means 'the strength of solution'. The _____ concentrations of two isotonic solutions are _____.

   b. Thus, the solute concentarion of an isotonic solution outside of a cell is _____ the concentration of that _____ inside the cell.

   c. Since the solute concentrations of isotonic solutions are equal, the concentrations of the _____ will also be equal. Therefore, when a cell is immersed in an isotonic solution, the concentration of _____ will also be the same inside and outside of the cell.

2. **Hypertonic Solution**
   a. 'Hyper' means 'greater than.'

   b. Thus, the _____ concentration of a hypertonic solution outside of a cell is _____ the concentration of than _____ inside the cell.

c. Since the solute concentration of a hypertonic solution outside of a cell is _____ the concentration of that _____ inside the cell, the concentration of water outside the cell will be _____ the concentration of water inside the cell.

3. **Hypotonic Solution**
   a. 'Hypo' means 'less than.'

   b. Thus, the _____ concentration of a hypotonic solution outside of a cell is _____ the concentration of that _____ inside the cell.

   c. Since the solute concentration of a hypotonic solution outside of a cell is _____ the concentration of that _____ inside the cell, the concentration of water outside the cell will be _____ the concentration of water inside the cell.

D. Effects of Solutions on Animal and Plant Cells

Although many different types of particles can move across the cell membrane by various mechanisms, water moves across the membrane by osmosis faster than other particles can cross. Therefore, when cells are placed in various solutions, it is the movement of _____ by _____ which determine how the cell will respond.

Water always moves across a selectively _____ membrane such as the _____ membrane in both directions. However, depending on the relative concentration of water on either side of the membrane, the net movement of water by _____ could be greater in one direction than the other. It is this _____ movement of water by _____ which determines how a particular cell will respond to a given solution.

The effects of isotonic, hypertonic, and hypotonic solutions on animal and plant cells are as follows:

1. **Isotonic Solution Effects**
   a. **On Animal Cells**
      i) Since the concentration of solute inside and outside the cell is _____, the concentration of water inside and outside the cell will also be _____.

      ii) Therefore, there will be no _____ movement of _____ by osmosis.

      iii) Thus, an isotonic solution will have _____ effect on an animal cell.

   b. **On Plant Cells**
      i) Since the concentration of solute inside and outside the cell is _____, the concentration of water inside and outside the cell will also be _____.

      ii) Therefore, there will be no _____ movement of water by _____.

      iii) Thus, an isotonic solution will have _____ effect on an plant cell.

2. **Hypertonic Solution Effects**
    a. **On Animal Cells**
        i) Since the concentration of solute outside the cell is _____ than the concentration of solute inside the cell, the concentration of water outside the cell is _____ than the concentration of water inside the cell.

        ii) Therefore, the net movement of _____ by _____ will be from _____ the cell to the outside.

        iii) This will cause the animal cell to shrink or _____.

    b. **On Plant Cells**
        i) Since the concentration of solute outside the cell is _____ than the concentration of solute inside the cell, the concentration of water outside the cell is _____ than the concentration of water inside the cell.

        ii) Therefore, the net movement of _____ by osmosis will be from _____ the cell to the _____.

        iii) However, since the plant cell has a cell _____ outside the cell membrane, the plant cell will not _____ or crenate.

        iv) Instead, the large vacuole will shrink causing the cell _____ to pull away from the cell _____ in a process called _____.

3. **Hypotonic Solution Effects**
    a. **On Animal Cells**
        i) Since the concentration of solute outside the cell is _____ than the concentration of solute inside the cell, the concentration of water outside the cell is _____ than the concentration of water inside the cell.

        ii) Therefore, the _____ movement of _____ by _____ will be from _____ the cell to the _____.

        iii) This will cause the animal cell to _____ and possibly to _____ (ie. burst).

    b. **On Plant Cells**
        i) Since the concentration of solute outside the cell is _____ than the concentration of solute inside the cell, the concentration of water outside the cell is _____ than the concentration of water inside the cell.

        ii) Therefore, the _____ movement of water by _____ will be from _____ the cell to the _____.

        iii) However, since the plant cell has a cell _____ outside of the cell membrane, the plant cell will not swell much and will not _____.

iv) Instead, the large vacuole will swell, pushing the cell _____ up against the cell _____, thus creating _____ pressure.

E. Questions

1. a. If a cell is placed in hypotonic solution, where is the:
   (i) solute concentration highest? _____
   (ii) water concentration highest? _____

   b. Describe the movement of water in this solution using the appropriate terminology.
   _____
   _____
   _____

2. a. If a cell is placed in hypertonic solution, where is the:
   (i) solute concentration highest? _____
   (ii) water concentration highest? _____

   b. Describe the movement of water in this solution using the appropriate terminology.
   _____
   _____
   _____

3. Explain **why** placing a cell in an isotonic solution has no effect on the cell.
   _____
   _____
   _____
   _____

4. Explain what will happen to each of the following cells using appropriate terminology (ie. as many terms as possible.) Focus on water movement in your answer and disregard movement of solute at this time.
    a. A spinach cell containing 0.30% sucrose is place into a solution containing 0.25% sucrose.

    b. A human red blodd cell containing 5% NaCl is placed into a solution containing 7% NaCl.

    c. A nerve cell containing 0.51% glucose is placed in a solution containing 0.32% glucose.

    d. An onion cell containing 1g/L of starch is placed in a solution containing 2.7 g/L of starch.

5. Explain what would happen to the mass of a section of potato placed in a hypotonic solution. Explain your answer using appropriate terminology.

6. Explain what would happen to the mass of a section of potato placed in a hypertonic solution. Explain your answer using appropriate terminology.