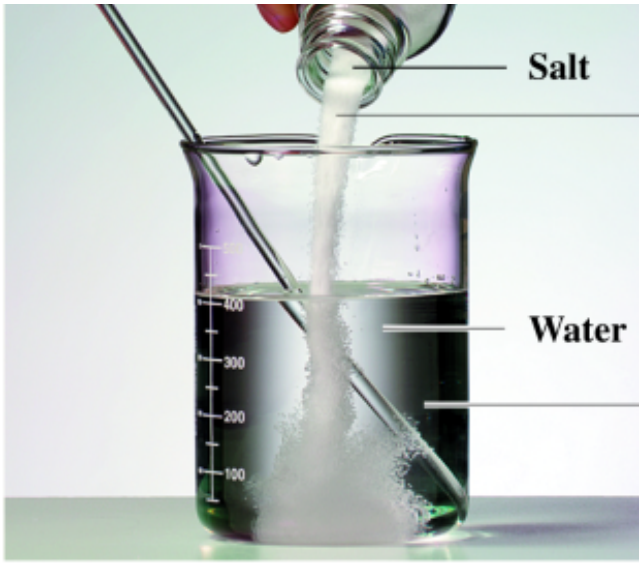
Chapter 7 Solutions and Colloids

7.7b and 7.8
Solution Properties and Colloids



Solutions

Solutions

- contain small particles (ions or molecules).
- are transparent.
- do not separate.
- cannot be filtered.
- do not scatter light.

Colloids

Colloids

- have medium size particles.
- cannot be filtered.
- can be separated by semipermeable membranes.
- scatter light (Tyndall effect – in which the path of a beam of light through the colloid is visible due to scatter light).

Examples of Colloids

Examples of colloids include

- Fog
- Whipped cream
- Milk
- Cheese
- Blood plasma
- Pearls

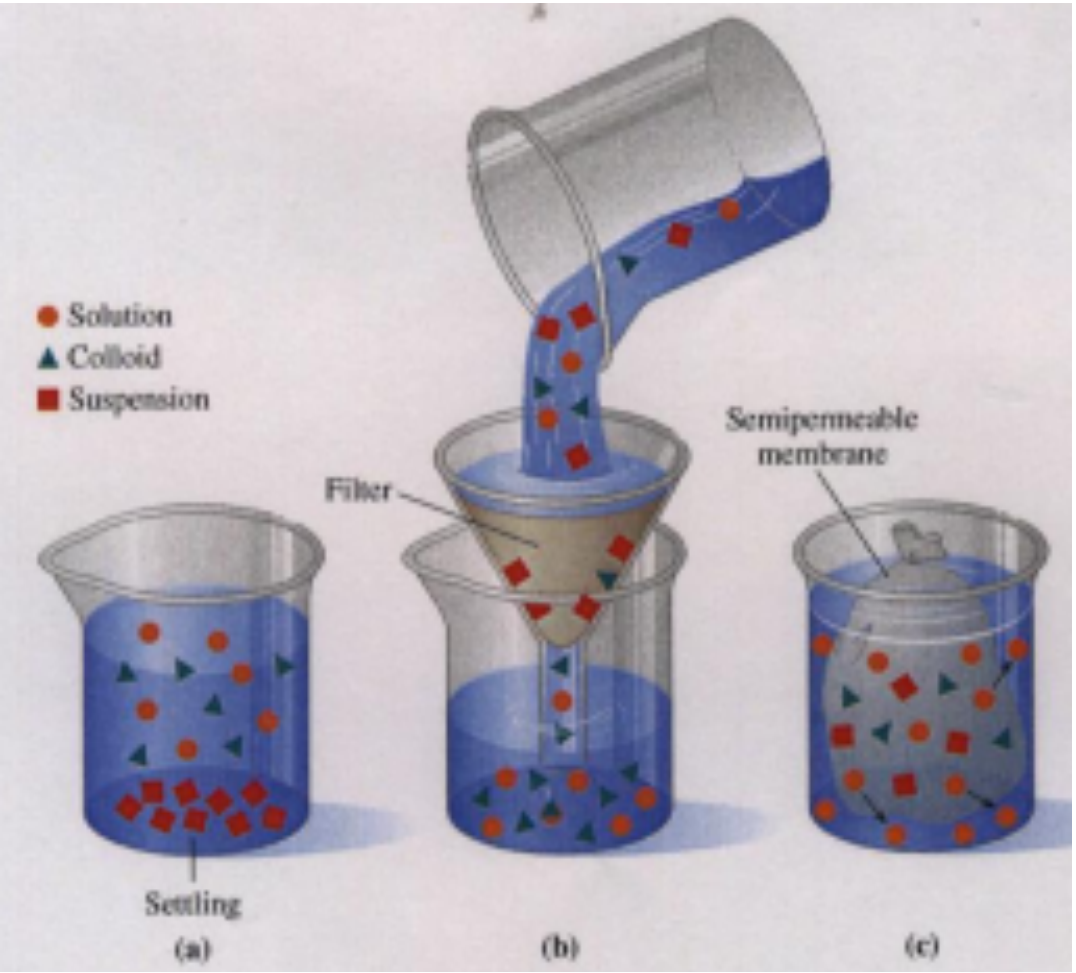
Suspensions

Suspensions

- have very large particles.
- settle out.
- can be filtered.
- must be stirred to stay suspended.

Examples include blood platelets, muddy water, and Calamine lotion.

Solutions, Colloids, and Suspensions



Learning Check

A mixture that has solute particles that do not settle out, but are too large to pass through a semipermeable membrane is called a

1) solution.
2) colloid.
3) suspension.

Solution

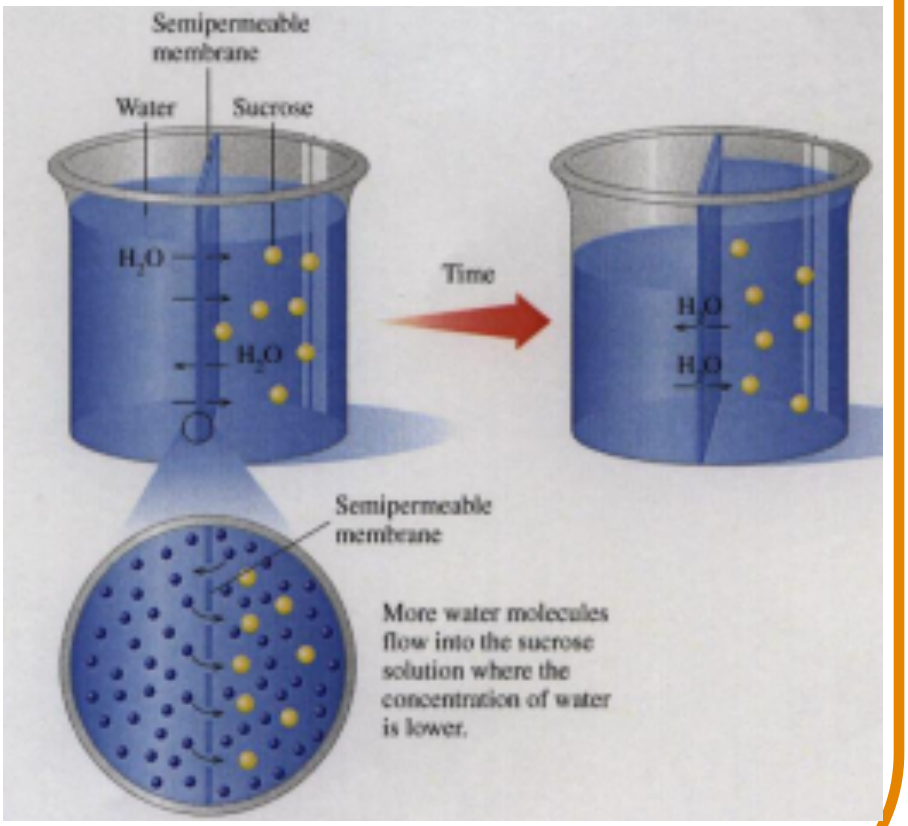
A mixture that has solute particles that do not settle out, but are too large to pass through a semipermeable membrane is called a

2) colloid.

Osmosis

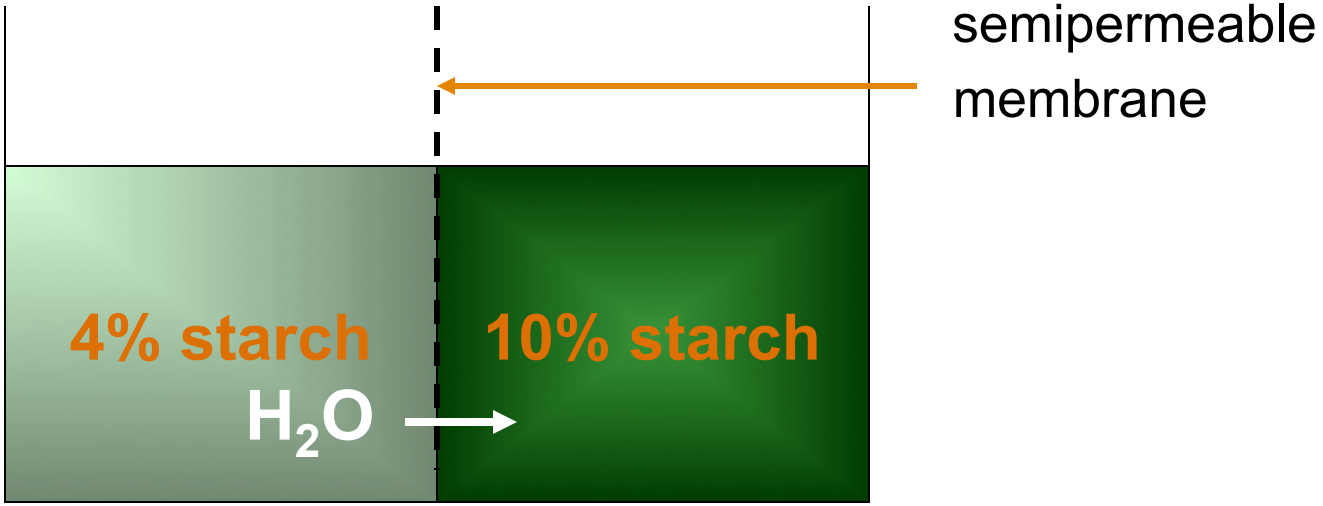
In **osmosis**,

- water (solvent) flows from the lower solute concentration into the higher solute concentration.
- the level of the solution with the higher concentration rises.
- the concentrations of the two solutions become equal with time.



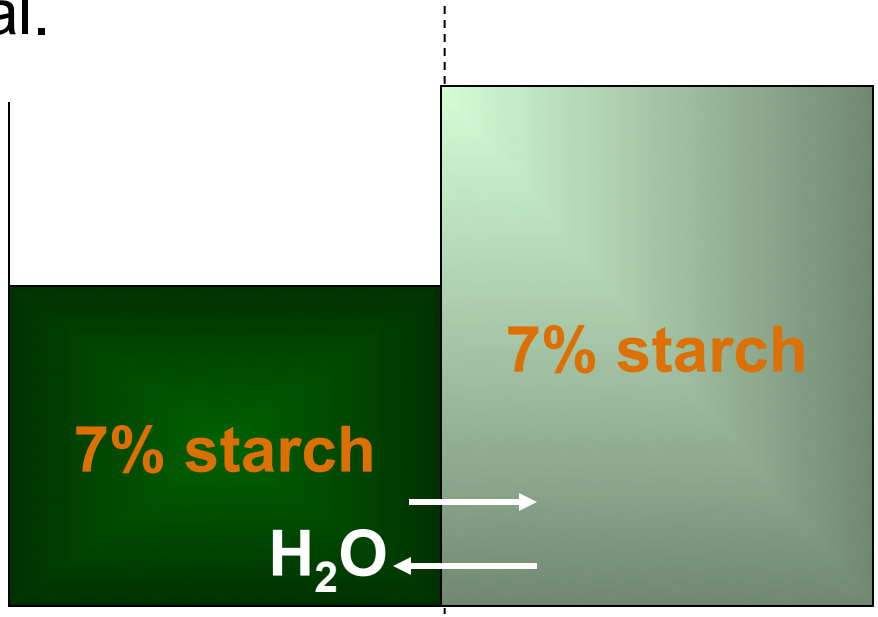
Osmosis

Suppose a semipermeable membrane separates a 4% starch solution from a 10% starch solution. Starch is a colloid and cannot pass through the membrane, but water can. What happens?



Water Flow Equalizes

- The 10% starch solution is diluted by the flow of water out of the 4% and its volume increases.
- The 4% solution loses water and its volume decreases.
- Eventually, the water flow between the two becomes equal.



Osmotic Pressure

Osmotic pressure is

- produced by the solute particles dissolved in a solution.
- equal to the pressure that would prevent the flow of additional water into the more concentrated solution.
- greater as the number of dissolved particles in the solution increases.

Learning Check

A semipermeable membrane separates a 10% sucrose solution **A** from a 5% sucrose solution **B**. If sucrose is a colloid, fill in the blanks in the statements below.

1. Solution _____ has the greater osmotic pressure.
2. Water initially flows from ___ into ___.
3. The level of solution _____will be lower.

Solution

A semipermeable membrane separates a 10% sucrose solution **A** from a 5% sucrose solution **B**. If sucrose is a colloid, fill in the blanks in the statements below.

1. Solution **A** has the greater osmotic pressure.
2. Water initially flows from **B** into **A.**
3. The level of solution **B** will be lower.

Osmotic Pressure of the Blood

Red blood cells

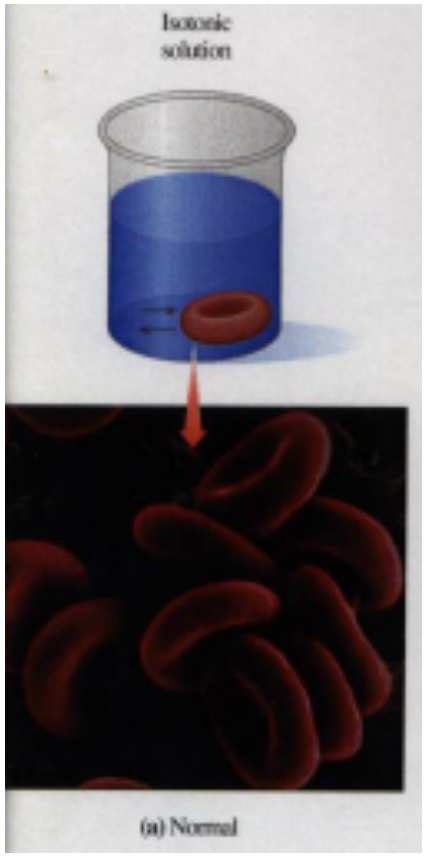
- have cell walls that are semipermeable membranes.
- maintain an osmotic pressure that cannot change or damage occurs.
- must maintain an equal flow of water between the red blood cell and its surrounding environment.

Isotonic Solutions

An **isotonic solution**

- exerts the same osmotic pressure as red blood cells.
- is known as a "physiological solution".
- of 5.0% glucose or 0.90% NaCl is used medically because each has a solute concentration equal to the osmotic pressure equal to red blood cells.

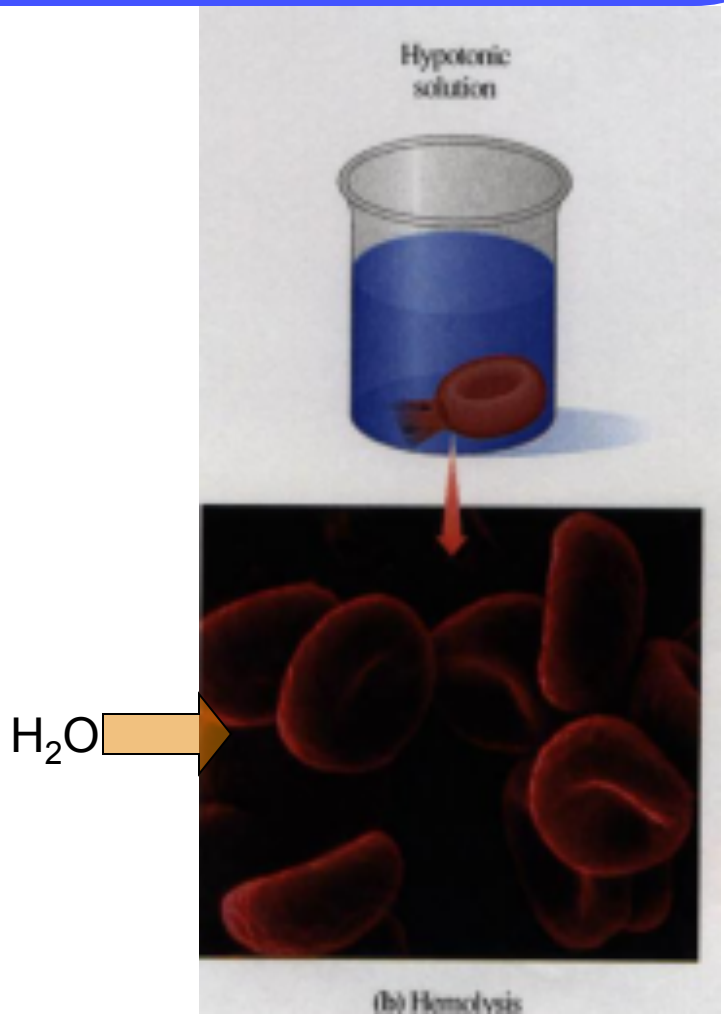
H_2O ⇌



Hypotonic Solutions

A **hypotonic solution**

- has a lower osmotic pressure than red blood cells.
- has a lower concentration than physiological solutions.
- causes water to flow into red blood cells.
- causes hemolysis: RBCs swell and may burst.

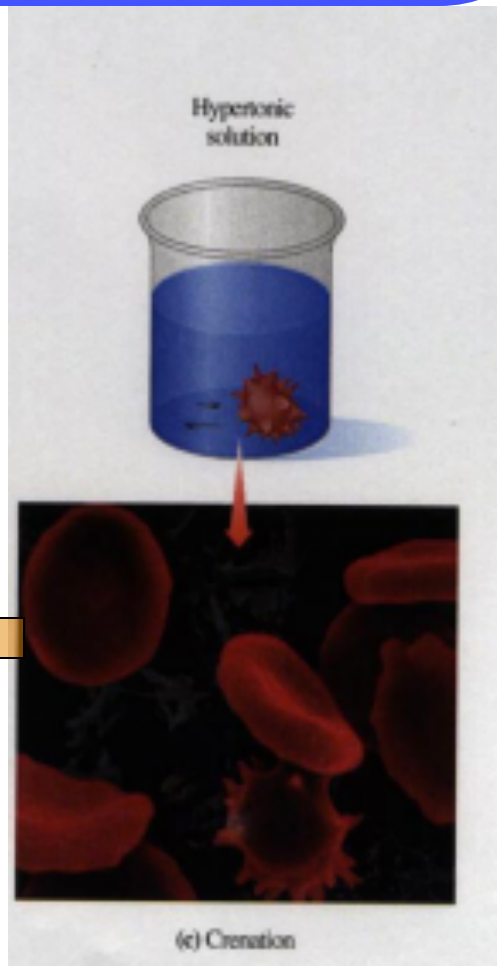


Hypertonic Solutions

A **hypertonic solution**

- has a higher osmotic pressure than RBCs.
- has a higher concentration than physiological solutions.
- causes water to flow out of RBCs.
- cause crenation: RBCs shrinks in size.

H_2O



Dialysis

In **dialysis**,

- solvent and small solute particles pass through an artificial membrane.
- large particles are retained inside.
- waste particles such as urea from blood are removed using hemodialysis (artificial kidney).

Learning Check

Indicate if each of the following solutions is
1) isotonic 2) hypotonic 3) hypertonic.

A.____ 2% NaCl solution
B.____ 1% glucose solution
C.____ 0.5% NaCl solution
D.____ 5% glucose solution

Solution

Indicate if each of the following solutions is
1) isotonic 2) hypotonic 3) hypertonic.

A. 3 2% NaCl solution
B. 2 1% glucose solution
C. 2 0.5% NaCl solution
D. 1 5% glucose solution

Learning Check

When placed in each of the following, indicate if a red blood cell will

1) not change 2) hemolyze 3) crenate.

A.____ 5% glucose solution

B.____ 1% glucose solution

C.____ 0.5% NaCl solution

D.____ 2% NaCl solution

Solution

When placed in each of the following, indicate if a red blood cell will

1) not change 2) hemolyze 3) crenate.

A. 1 5% glucose solution

B. 2 1% glucose solution

C. 2 0.5% NaCl solution

D. 3 2% NaCl solution

Learning Check

Each of the following mixtures is placed in a dialyzing bag and immersed in pure water. Which substance, if any, will be found in the water outside the bag?

A. 10% KCl solution
B. 5% starch solution
C. 5% NaCl and 5% starch solutions

Solution

Each of the following mixtures is placed in a dialyzing bag and immersed in pure water. Which substance, if any, will be found in the water outside the bag?

A. 10% KCl solution **KCl (K^+, Cl^-)**

B. 5% starch solution **None; starch is retained.**

C. 5% NaCl and 5% starch solutions

NaCl (Na^+, Cl^-), but starch is retained.