AP BIO INSTA-REVIEW

TOPIC 2.8

Tonicity and Osmoregulation

ENE-2.H.1

External environments can be hypotonic, hypertonic or isotonic to internal environments of cells–

a. Water moves by osmosis from areas of high-water potential/low osmolarity/low solute concentration to areas of low water potential/high-osmolarity/high solute concentration.

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TOPIC 2.8

Tonicity and Osmoregulation

ENE-2.H.1

Water Potential:

$$\Psi = \Psi_p + \Psi_s$$

Ψ_p = pressure potential

Ψ_s = solute potential

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Tonicity and Osmoregulation

ENE-2.I.1

Growth and homeostasis are maintained by the constant movement of molecules across membranes.

ENE-2.I.2

Osmoregulation maintains water balance and allows organisms to control their internal solute composition/water potential.

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Tonicity and Osmoregulation

ENE-2.I.2

SOLUTE POTENTIAL OF A SOLUTION

$$\Psi_s = -iCRT$$

where:

i = ionization constant

C = molar concentration

R = pressure constant

$$\left(R = 0.0831 \frac{L \cdot bars}{mol \cdot K}\right)$$

T = temperature in Kelvin (°C + 273)

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TOPIC 2.8

Tonicity and Osmoregulation

Note:

Tonicity is one of the harder topics for students. There's something about the vocabulary that gets students confused.

Remember the terms are in respect of each other.

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TOPIC

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Solution with a higher solute concentration...

A. Hypertonic

B. Hypotonic

C. Isotonic

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TOPIC 2.8

Solution with a higher solute concentration...

A. Hypertonic

The hypertonic solution has a HIGH solute concentration and a LOW free water concentration. The solute needs to be dissolved, so there is a higher number of water molecules surrounding the solute.

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TOPIC 2.8

Solution with a lower solute concentration...

A. Hypertonic

B. Hypotonic

C. Isotonic

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TOPIC 2.8

Solution with a lower solute concentration...

B. Hypotonic

The hypotonic solution has a LOW solute concentration and a HIGH free water concentration. The solute needs to be dissolved, so there is a lower number of water molecules surrounding the solute.

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TOPIC 2.8

Solution with a higher free water concentration...

A. Hypertonic

B. Hypotonic

C. Isotonic

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TOPIC 2.8

Solution with a higher free water concentration...

B. Hypotonic

In order for solutes to dissolve, they need to be surrounded by water molecules. If there is a higher free water concentration, then there is a lower solute concentration hence the **HYPOTONIC** solution.

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TOPIC

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Solution with a lower free water concentration...

A. Hypertonic

B. Hypotonic

C. Isotonic

AP BIO INSTA-REVIEW

TOPIC 2.8

Solution with a lower free water concentration...

A. Hypertonic

In order for solutes to dissolve, they need to be surrounded by water molecules. If there is a lower free water concentration, then there is a higher solute concentration hence the **HYPERTONIC** solution.

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TOPIC

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Describe the direction of water flow.

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TOPIC 2.8

Describe the direction of water flow.

Water flows down its concentration gradient. There is a higher free water concentration in hypotonic solutions and a lower free water concentration in hypertonic solution.

So... water flows from hypotonic to hypertonic

HYPO to HYPER

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TOPIC 2.8

If the intracellular concentration is 1.0 M and extracellular concentration is 0.4 M. Which direction does water flow?

A. Both in and out (equilibrium)

B. Into the cell

C. Out of the cell

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TOPIC 2.8

If the intracellular concentration is 1.0 M and extracellular concentration is 0.4 M. Which direction does water flow?

B. Into the cell

Let's first determine the hypertonic and hypotonic solutions.

The 1.0 M solution has a HIGH solute concentration compared to the 0.4 M solution. This means than the 0.4 M is HYPOTONIC and the 1.0 M is HYPERTONIC. The water will move from the HYPOTONIC extracellular solution to the HYPERTONIC intracellular solution.

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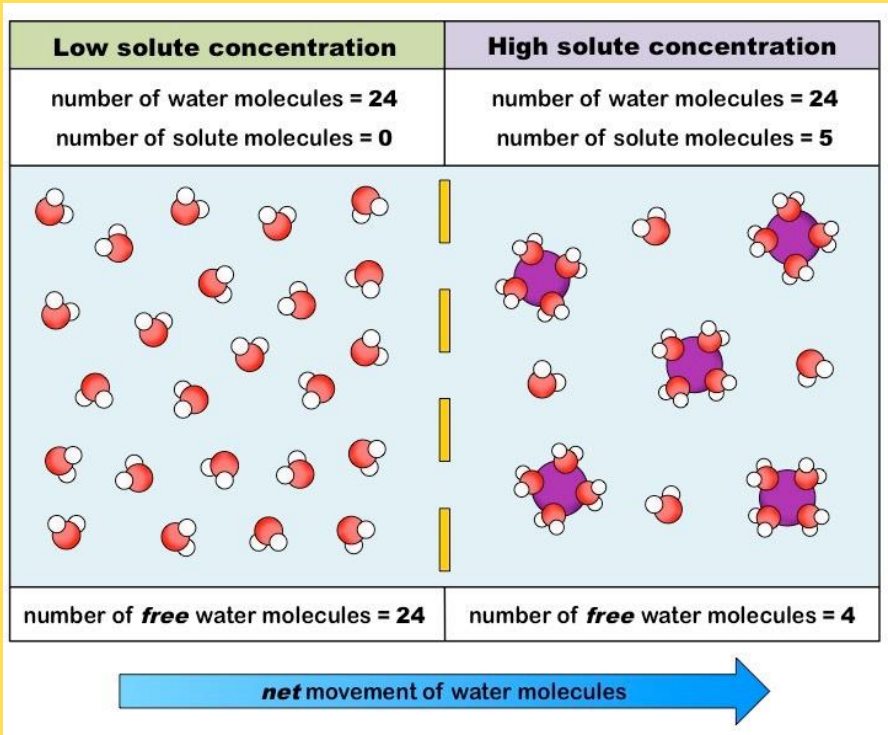
TOPIC 2.8

Note:



Nope, that wasn't an error. The concentration is telling you the concentration of the solute. The lower the solute, the higher the free water. The higher the solute, the lower the free water. The water surrounds the solute to dissolve it. So, the more items needed to be surrounded by water molecules the less are available to flow from one solution to another.

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TOPIC

2.8

Describe what happens to an animal cell in hypertonic environment.

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TOPIC 2.8

Describe what happens to an animal cell in hypertonic environment.

The cell is hypotonic if the environment is hypertonic. This means that the water is going to flow OUT of the cell. If the cells loses water from its cytosol then it will shrivel

SHRIVEL

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TOPIC 2.8

You are dehydrated and go to the ER. The doctor calls for a bag of distilled water to be given to you (instead of the saline solution that is normally given). Describe what happens to the blood cells in this situation.

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TOPIC 2.8

You are dehydrated and go to the ER. The doctor calls for a bag of distilled water to be given to you (instead of the saline solution that is normally given). Describe what happens to the blood cells in this situation.

Cell lysis

The extracellular environment is hypotonic to the intracellular environment. Water flows INTO the cell. The animal cells does not have a cell wall and the influx of water causes the plasma membrane to burst (aka cell lysis)

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TOPIC 2.8

What organelle holds the water in plant cells?

A. Central vacuole

B. Endoplasmic reticulum

C. Food vacuole

D. Golgi bodies

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TOPIC 2.8

What organelle holds the water in plant cells?

A. Central vacuole

The central vacuole is only found in PLANTS. This organelle will store water (and other materials) which provides the pressure for the plant to be turgid.

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Why doesn't a plant cell burst in a hypotonic environment?

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TOPIC 2.8

Why doesn't a plant cell burst in a hypotonic environment?

The cell wall provided a positive pressure to resist the influx of water.

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TOPIC 2.8

How does ionic compound solute potential compare to a covalent compound?

A. Higher

B. Lower

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TOPIC 2.8

How does ionic compound solute potential compare to a covalent compound?

B. Lower

The equation for the solute potential is −iCRT. The question is specifically asking the difference between the ionization constant in a ionic vs covalent compound. Covalent bonds do not ionize, so the ionic compound will have a more negative (lower) solute potential.

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TOPIC

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If solution A has -4.0 MPa and solution B has -2.0 MPa, which direction will water flow?

A. Out of solution A

B. Out of solution B

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TOPIC 2.8

If solution A has -4.0 MPa and solution B has -2.0 MPa, which direction will water flow?

B. Out of solution B

Water will move from where it has a HIGHER water potential to where there is a LOWER water potential. Think of these numbers of a number line, -2 > -4. So water flows OUT of solution B (-2.0 M)

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TOPIC 2.8

Which organelle helps protist in freshwater?

A. Central vacuole

B. Contractile vacuole

C. Golgi bodies

D. Nucleus

AP BIO INSTA-REVIEW

TOPIC 2.8

Which organelle helps protist in freshwater?

B. Contractile vacuole

Freshwater protists are surrounded by a hypotonic solution. Water will be constantly rushing into the cell, so in order to osmoregulate, the protist needs to push excess water back out of the cell. The contractile vacuole will fill with water then contract to push the water back out of the cell.

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TOPIC 2.8

In a turgid plant cell, which describes pressure potential of cell water

A. Negative

B. Positive

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TOPIC 2.8

In a turgid plant cell, which describes pressure potential of cell water

B. Positive

The pressure potential is the amount of pressure that is applied by the cell wall. The cell wall will be pushing back against the excess water, so it will have a positive pressure potential.

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TOPIC

2.8

Extracellular solution is 0.5M and the cell is 1.0M – which direction will water flow?

A. Into cell towards hypertonic solution

B. Into cell towards hypotonic solution

C. Out of cell toward hypertonic solution

D. Out of cell toward hypotonic solution

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TOPIC 2.8

Extracellular solution is 0.5M and the cell is 1.0M – which direction will water flow?

A. Into cell towards hypertonic solution

Water will move from where it has a LOWER solute concentration to HIGHER solute concentration. The water will move from the 0.5M solution to the 1.0M solution. Water will flow INTO the HYPERTONIC cell.

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TOPIC 2.8

Extracellular solution is 0.5M and the cell is 1.0M – what will happen to the animal cell?

A. Crenate

B. Lysis

C. Plasmolysis

D. Turgid

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TOPIC 2.8

Extracellular solution is 0.5M and the cell is 1.0M – what will happen to the animal cell?

B. Lysis

Due to the water rushing into the cell from the extracellular solution, the cell will burst or lyse. Water rushes in because the extracellular solution is HYPOTONIC to the cell.

AP BIO INSTA-REVIEW

TOPIC 2.8

What organelle function with plant cell in hypotonic solution?

A. Contractile vacuole

B. Central vacuole

C. Food vacuole

D. Vesicle

AP BIO INSTA-REVIEW

TOPIC 2.8

What organelle function with plant cell in hypotonic solution?

B. Central vacuole

The central vacuole is responsible for storing water. When the plant is in a hypotonic environment, water rushes into the cell. Due to the cell wall and the central vacuole, the plant cell will not burst in the hypotonic environment.

AP BIO INSTA-REVIEW

TOPIC 2.8

What organelle functions with freshwater protists?

A. Contractile vacuole

B. Central vacuole

C. Food vacuole

D. Vesicle

AP BIO INSTA-REVIEW

TOPIC 2.8

What organelle functions with freshwater protists?

A. Contractile vacuole

The contractile vacuole is found in the freshwater protsts. Due to the hypotonic environment, water rushes into the cell. In order to protect the cell, the contractile vacuole will contract to remove the excess water.

AP BIO INSTA-REVIEW

TOPIC 2.8

If extracellular solution is isotonic, which direction will water move?

A. Into cell

B. Out of cell

C. Both into and out of cell

D. No water movement

AP BIO INSTA-REVIEW

TOPIC 2.8

If extracellular solution is isotonic, which direction will water move?

C. Both into and out of cell

The isotonic solution is equal on both sides of the membrane. The water will leave the cell at the same rate as the water will enter the cell.

AP BIO INSTA-REVIEW

TOPIC 2.8

Water moves from

A. High water potential to low water potential

B. Low water potential to high water potential

AP BIO INSTA-REVIEW

TOPIC 2.8

Water moves from

A. High water potential to low water potential

Water potential is the potential for water to move. Water will move from a HIGH water potential to a LOW water potential.

AP BIO INSTA-REVIEW

TOPIC

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The higher the solute concentration...

A. the higher the water potential

B. the lower the water potential

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TOPIC 2.8

The higher the solute concentration...

B. the lower the water potential

The equation for solute potential is −iCRT. If there is a higher solute concentration, then the C value in the equation will be the difference. The more concentrated, the more negative the solute potential, and the lower the water potential.

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TOPIC 2.8

Pressure potential = 0.2 MPa and solute potential = - 0.6 MPa...

A. Water Potential = -0.8MPa
B. Water Potential = -0.4 MPa
C. Water Potential = 0.4 MPa
D. Water Potential = 0.8 MPa

AP BIO INSTA-REVIEW

TOPIC 2.8

Pressure potential = 0.2 MPa and solute potential = - 0.6 MPa...

B. Water Potential = -0.4 MPa

Water potential is pressure potential plus solute potential.

- 0.6 Mpa + 0.2 MPa = -0.4 MPa

AP BIO INSTA-REVIEW

TOPIC

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What is the ionization constant of sucrose?

A. 0

B. 1

C. 24

D. 48

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TOPIC 2.8

What is the ionization constant of sucrose?

B. 1

Sucrose is a covalently bound substance. This means that sucrose will not form ions when dissolved in the water. The ionization constant will be 1.

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TOPIC 2.8

What is the ionization constant of sodium chloride?

A. 0
B. 1
C. 2
D. 3

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TOPIC 2.8

What is the ionization constant of sodium chloride?

c. 2

When sodium chloride is added to a beaker of water, the sodium will hydrogen bond with the oxygen while the chloride will hydrogen bond with hydrogen. Since there is 1 Na^+ and 1 Cl^-, the ionization constant is 2.