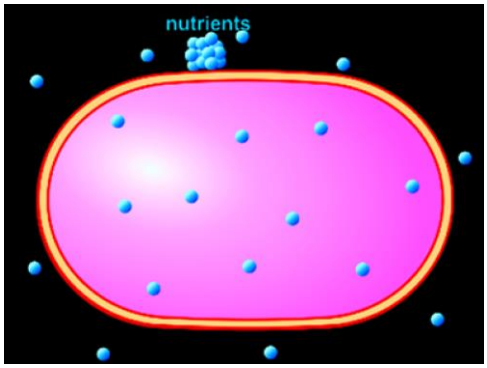
Fascinating Education Script

Fascinating Biology Lessons – Review

Biology Review - Lesson 4 – Take in Nutrients

Slide 1: Lesson 4 Review

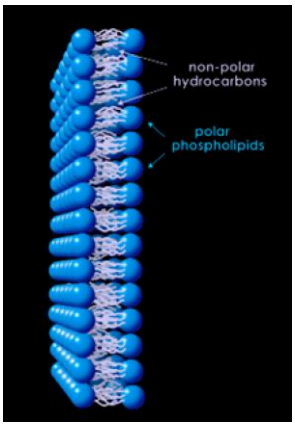
Slide 2: Lesson 4 - Question 1



Why would a nutrient outside a cell move into a cell simply because its concentration is higher outside the cell?

Because dissolved nutrients are in constant random motion which, according to the law of entropy, causes nutrients to spread out in all directions.

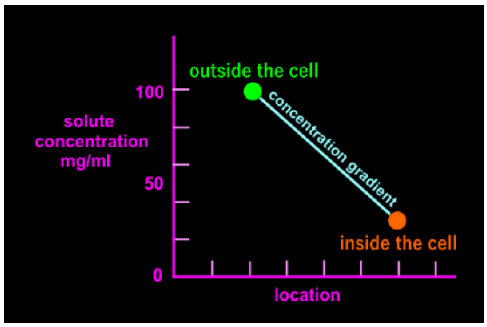
Slide 3: Lesson 4 - Question 2



What is a semipermeable membrane?

A semipermeable membrane is a membrane that allows some molecules to pass through easier than others, and some not at all. A cell membrane is semipermeable because its inner and outer layers are polar, and its middle layer is non-polar. Each layer limits the flow of certain types of molecules through the cell membrane.

Slide 4: Lesson 4 - Question 3



What is a concentration gradient?

A concentration gradient is the difference in concentration of a solute in two separate places.

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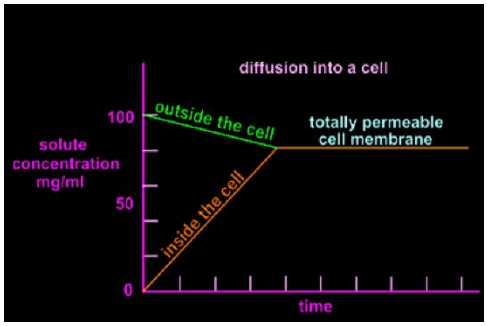
Slide 5: Lesson 4 - Question 4

Could nutrients outside a cell ever diffuse into a cell and end up with a higher concentration inside the cell than outside the cell?

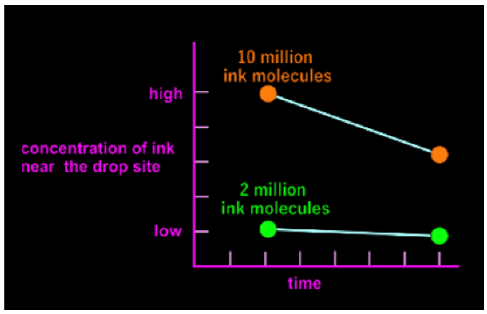


No. While a higher concentration of nutrients outside a cell will diffuse into a cell, its concentration inside the cell will never end up higher than that outside the cell.

Even if the cell membrane were totally permeable, the highest concentration inside the cell could only be equal to the concentration outside the cell, but not higher, because a solute will not diffuse up a concentration gradient, only down a concentration gradient.

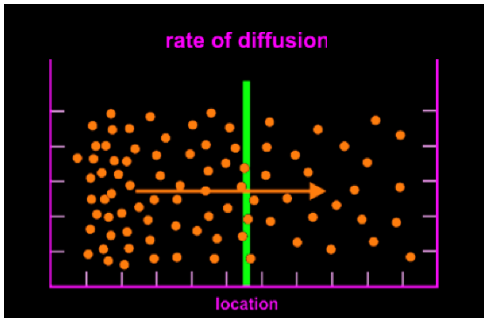
Slide 6: Lesson 4 - Question 5

An ink droplet is dropped into a plain glass of water. Will an ink droplet containing two million molecules of ink reach equilibrium throughout the water faster, slower, or the same time as the same-size droplet containing ten million molecules of ink? In other words, does the concentration gradient affect the time to reach equilibrium?



The two droplets of ink will reach equilibrium at the same time, because the concentration gradient, which is obviously higher for the ten million ink molecules, has no effect on the time to reach equilibrium. More ink molecules will reach equilibrium in the more concentrated droplet, but they won't reach equilibrium sooner.

Slide 7: Lesson 4 - Question 6



What is meant by the "rate of diffusion"?

The rate of diffusion is the number of solute particles crossing a point per second. The rate of diffusion is different from the time to reach equilibrium.

Slide 8: Lesson 4 - Question 7

In a plain glass of water with no semipermeable membrane, what are some factors that increase the rate of diffusion and what are some factors that increase the time to reach equilibrium?

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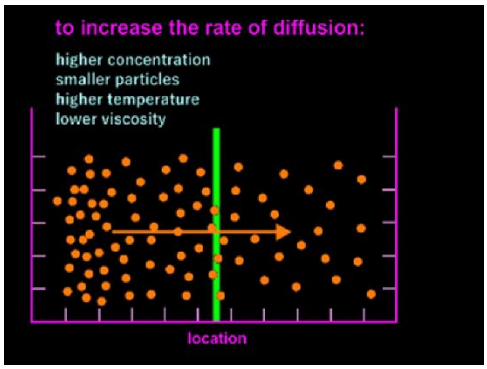
The concentration gradient, solute particle size, temperature, and viscosity, or "thickness," of the solvent all affect the rate of diffusion. The concentration gradient affects the rate of diffusion because a solute with a higher concentration allows more solute molecules to diffuse past a certain point per second, which is the definition of rate of diffusion.



Likewise, more molecules pass by a certain point when the molecules are small, have more heat energy, and are passing through a low viscous solvent.

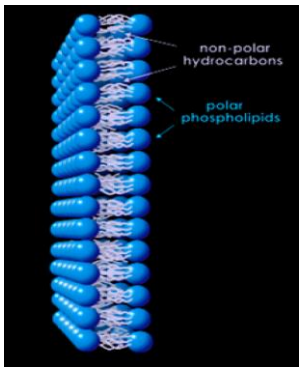
Since molecular size, temperature, and viscosity of the solvent affect the rate of molecular movement through the solvent, these three factors will lengthen the time it takes to reach equilibrium. A higher concentration of solute, though, will not affect the time it takes for the solution to reach equilibrium because it doesn't change the speed of molecular movement though the solvent.

If there were a semipermeable membrane in the water, I suspect that a concentration gradient across the semipermeable membrane could affect the time to reach equilibrium. It seems to me that, first off, you would you have to consider the higher number of solute collisions in the higher concentration, especially if the molecules are polar or ionic and might be attracted to or repelled by each other.

Also, a semipermeable membrane means that solute molecules will be moving across the semipermeable membrane in both directions. Accordingly, you would need to know whether the higher concentration gradient was due to a higher concentration of solute on the left side of the semipermeable membrane, a higher concentration on the right side, or some combination of changes in concentration on both sides of the semipermeable membrane.

Let me just add that molecular size is important when speaking about molecular movement though a liquid solvent, but in gases the molecules are so far apart that molecular size is much less important than molecular weight. Heavier gas molecules move slower.

Slide 9: Lesson 4 - Question 8



Why do solute molecules have difficulty diffusing through cell membranes?

Solutes have difficulty diffusing through a cell membrane because the molecules in the cell membrane are packed tightly together, the middle layer of the cell membrane is nonpolar, and either side of the nonpolar middle layer is coated with a layer of polar molecules capable of repelling polar solutes trying to gain entry to the cell.

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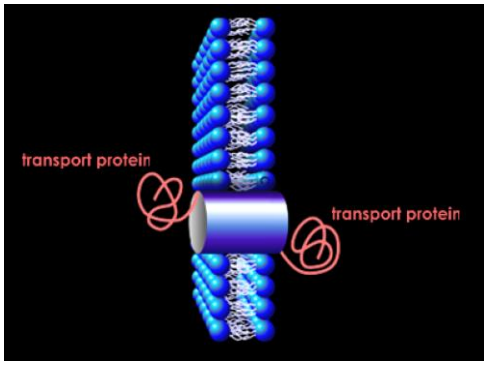
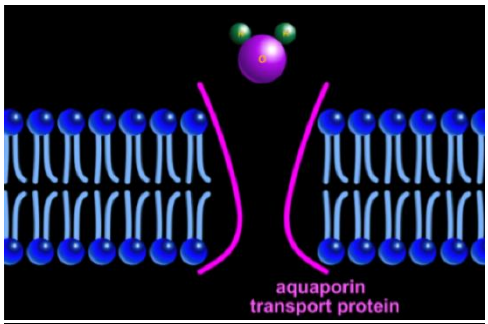
Slide 10: Lesson 4 - Question 9



How, then, are solutes able to get through a cell membrane?

Solutes can only enter a cell by passing through a pore in the cell membrane, which is guarded by a transport protein that only allows one particular solute through the pore.

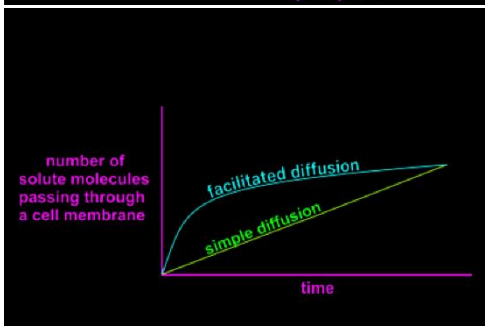
Slide 11: Lesson 4 - Question 10



What is aquaporin?

Aquaporin is the transport protein for water molecules. The movement through an aquaporin-guarded pore is called "osmosis."

Slide 12: Lesson 4 - Question 11

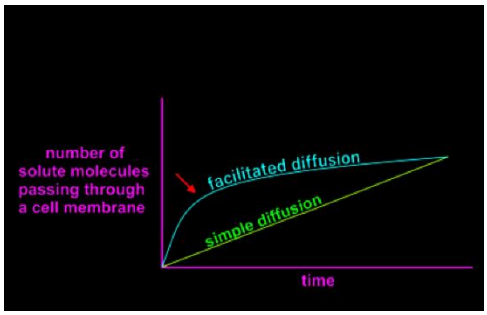


What is facilitated diffusion across a cell membrane?

Facilitated diffusion is an increase in the rate of diffusion brought about by transport proteins escorting solutes through the cell membrane faster than simple diffusion.

Slide 13: Lesson 4 - Question 12

Why does facilitated diffusion taper off when the concentration of the solute trying to pass through the membrane is high?



When the concentration of the solute is high, the number of solute molecules passing through the cell membrane overwhelms the transport protein. When the transport protein becomes saturated with solute molecules trying to enter the cell, the remaining solutes outside the cell have to rely on slower simple diffusion to enter the cell, so the rate of diffusion across the cell membrane slows down and the graph line flattens out.

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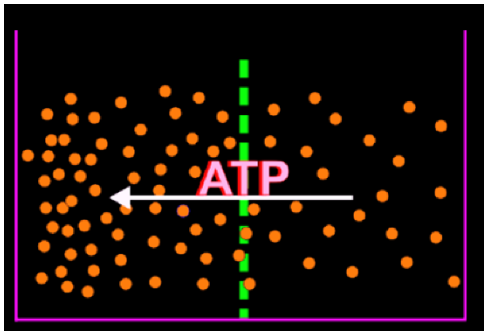
Slide 14: Lesson 4 - Question 13

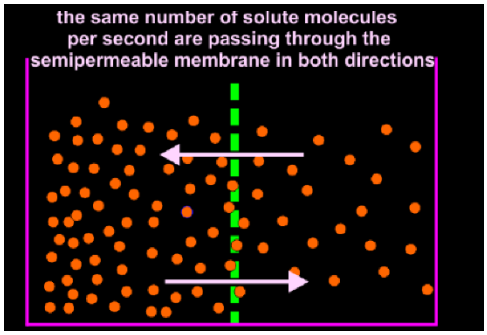


What is active transport across a cell membrane?

Active transport is movement of a solute across a cell membrane into a higher concentration of solute. Moving solutes against a concentration gradient like this requires the transport protein to use ATP to accomplish this.

Slide 15: Lesson 4 - Question 14

What does it mean when we say that a solute on either side of a membrane is at equilibrium?



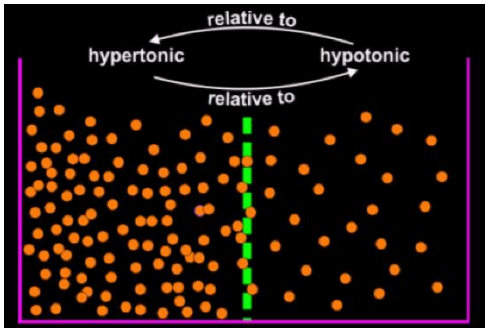
To be at equilibrium means that the same number of solute molecules are moving across the membrane in both directions with no energy being exerted to accomplish this. To be at equilibrium does not mean that the concentration of solutes is the same on both sides of the membrane.

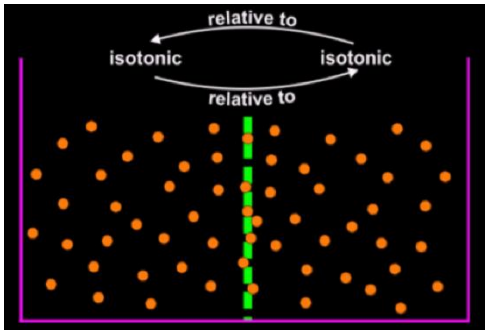
One additional point about terminology: when the same number of solute molecules are moving across the membrane in both directions because energy is being exerted, we say the solution is at a "steady-state," not that it is at equilibrium.

Slide 16: Lesson 4 - Question 15

What do the terms hypertonic, hypotonic, and isotonic mean?

These terms refer to the concentration of two solutions relative to each other. A solution alone is none of these terms. A solution can only be hypertonic -- more concentrated, hypotonic – less concentrated, or isotonic – the same concentration, relative to another solution.





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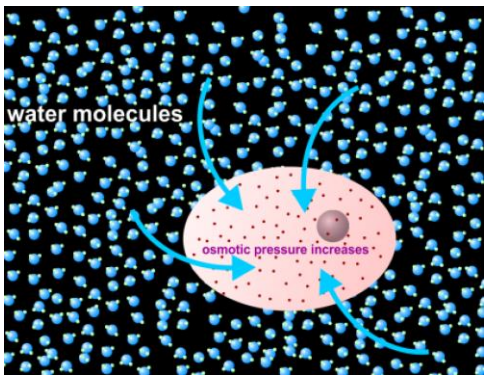
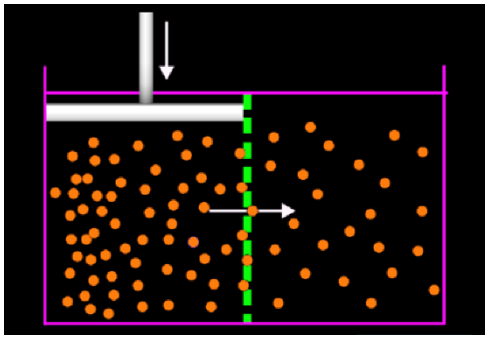
Slide 17: Lesson 4 - Question 16



What happens to a cell's internal pressure when placed in a solution hypotonic to the cell?

Water will flow into the cell, in accordance with the adage that "water chases salt." The incoming water raises the "osmotic" pressure inside the cell.

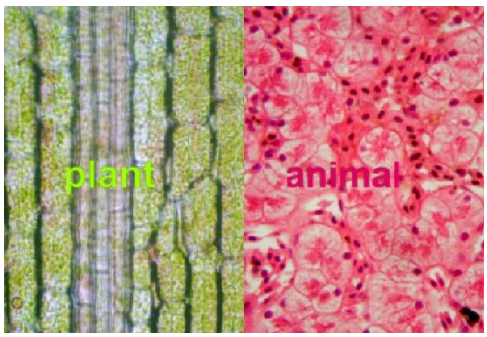
Slide 18: Lesson 4 - Question 17



How do you make water flow from a hypertonic solution into a hypotonic solution?

Raise the osmotic pressure in the hypertonic solution with, in this case, a piston pushing down on the hypertonic solution. Raising the osmotic pressure forces water to flow from the hypertonic solution to the hypotonic solution.

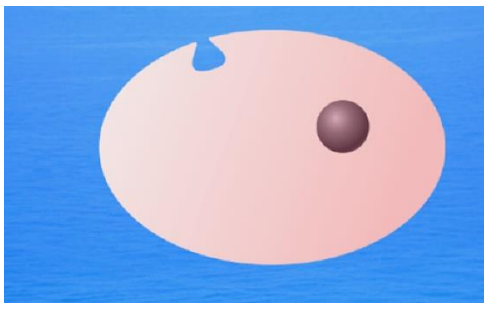
Slide 19: Lesson 4- Question 18



Plant cells remain upright because of high intracellular osmotic pressure. How are plant cells able to maintain such high osmotic pressure without bursting?

Plant cells withstand high osmotic pressure by being surrounded by a rigid cell wall made of cellulose, seen here as dark green.

Slide 20: Lesson 4 - Question 19



What is pinocytosis?

Pinocytosis is the trapping of a droplet of water with an infolding of the cell membrane.

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