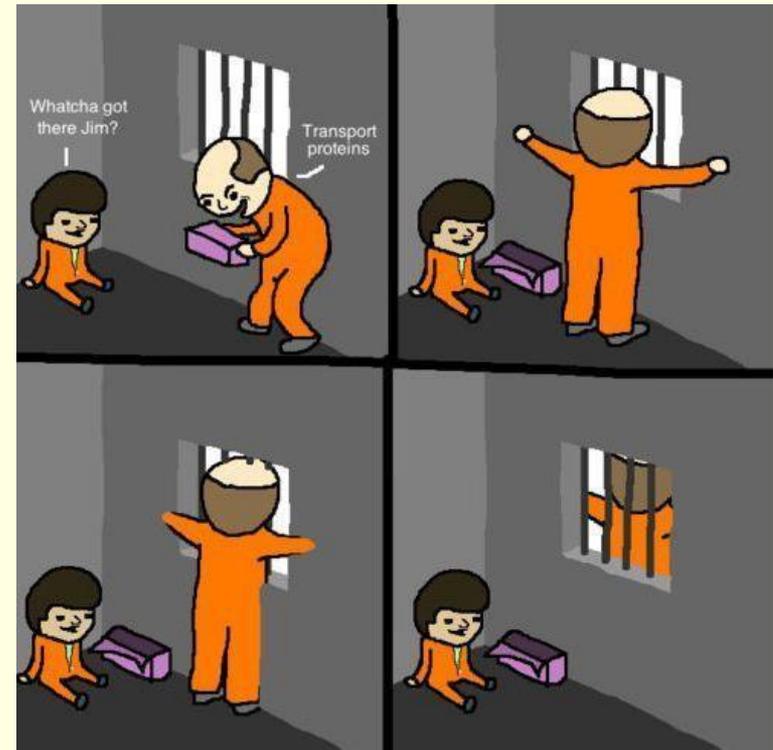


What we know...

- There are large scale occurrences that have lead to the development of coacervates that have surrounded and contained nucleic acids.
- That allowed for adaptation and reproduction of the cell, which leads to evolutionary development in complexity of the archae-bacteria, eubacteria and eukaryotes.
- In order to maintain existence, cells must have an internal homeostasis differing from the environment
- They achieve this by using cellular structure and basic chemical processes. (Passive and active transport and permeability)

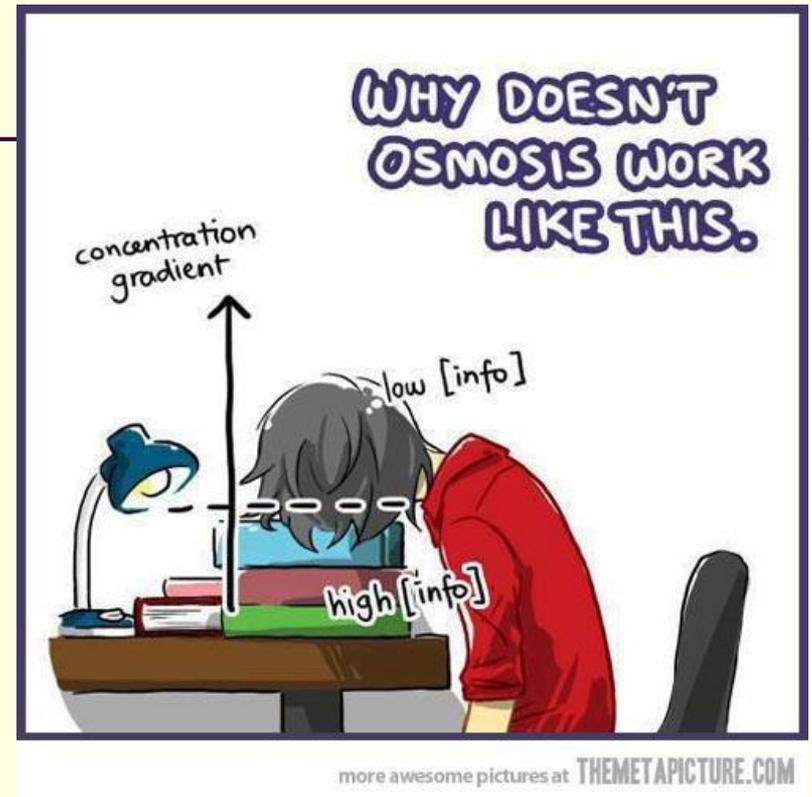
Remember now that we have a cell...

- Maintenance of homeostasis inside the cell
- There are always 2 environments. Inside the cell (intra-cellular) and outside the cell (extra-cellular)



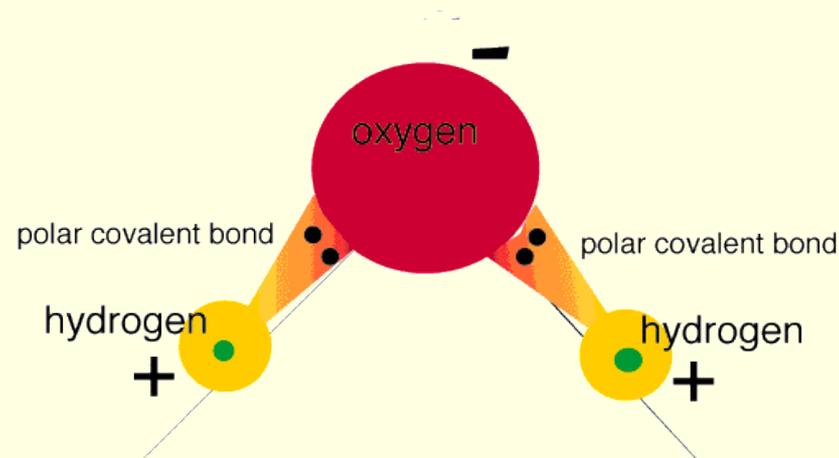
Terms to review

- Hypo
- Hyper
- Osmotic
- Tonic
- Diffusion
- Osmosis
- Concentration Gradient
- Passive and Active transport



Focus on water

- We want to now turn our attention on water
- Water IS the solvent all biology utilizes
- Water has unique properties that, in no small part, assists in maintaining homeostasis



Water...

- Water=pure, unadulterated, nothing added, just 2 hydrogen's and one oxygen hanging out together!
- In bio, we will be discussing pure water (and it's behavior) between inside (intra-cellular) and outside (extra-cellular)of cell!



THE DEADLY FACTS ABOUT WATER!

FACT!

WATER CAN BE CHEMICALLY
SYNTHESIZED BY BURNING
ROCKET FUEL!!!

FACT!

OVER CONSUMPTION CAN CAUSE
EXCESSIVE SWEATING, URINATION,
AND EVEN DEATH!!!

FACT!

100%
OF ALL SERIAL KILLERS,
RAPIST AND DRUG DEALERS HAVE
ADMITTED TO DRINKING WATER!!!



FACT!

WATER ONE OF THE PRIMARY INGREDIENTS
IN HERBICIDES AND PESTICIDES!!!

FACT!

WATER IS THE LEADING
CAUSE OF DROWNING!!!

FACT!

100 PERCENT OF ALL PEOPLE
EXPOSED TO WATER WILL DIE!

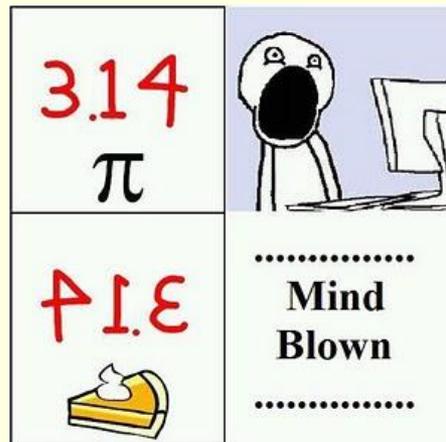
Let's stop and review some basics that the labs have re-enforced for us

- Osmosis.....
- Diffusion.....
- Passive/Active transport
- Molecular size and membrane permeability
- There is intracellular and extra cellular environments.



The predicting of water's movement is called “Water Potential”

- Water potential, represented by the Greek letter Psi (Ψ), and is the measurement/predictability of the likelihood that water will move from one area to another.
- Pure water has a water potential of zero. As if there is pure water across 2 areas, that's iso-osmotic and no water molecules move, so ZERO potential to move. (Think about that a second....mind blown....)

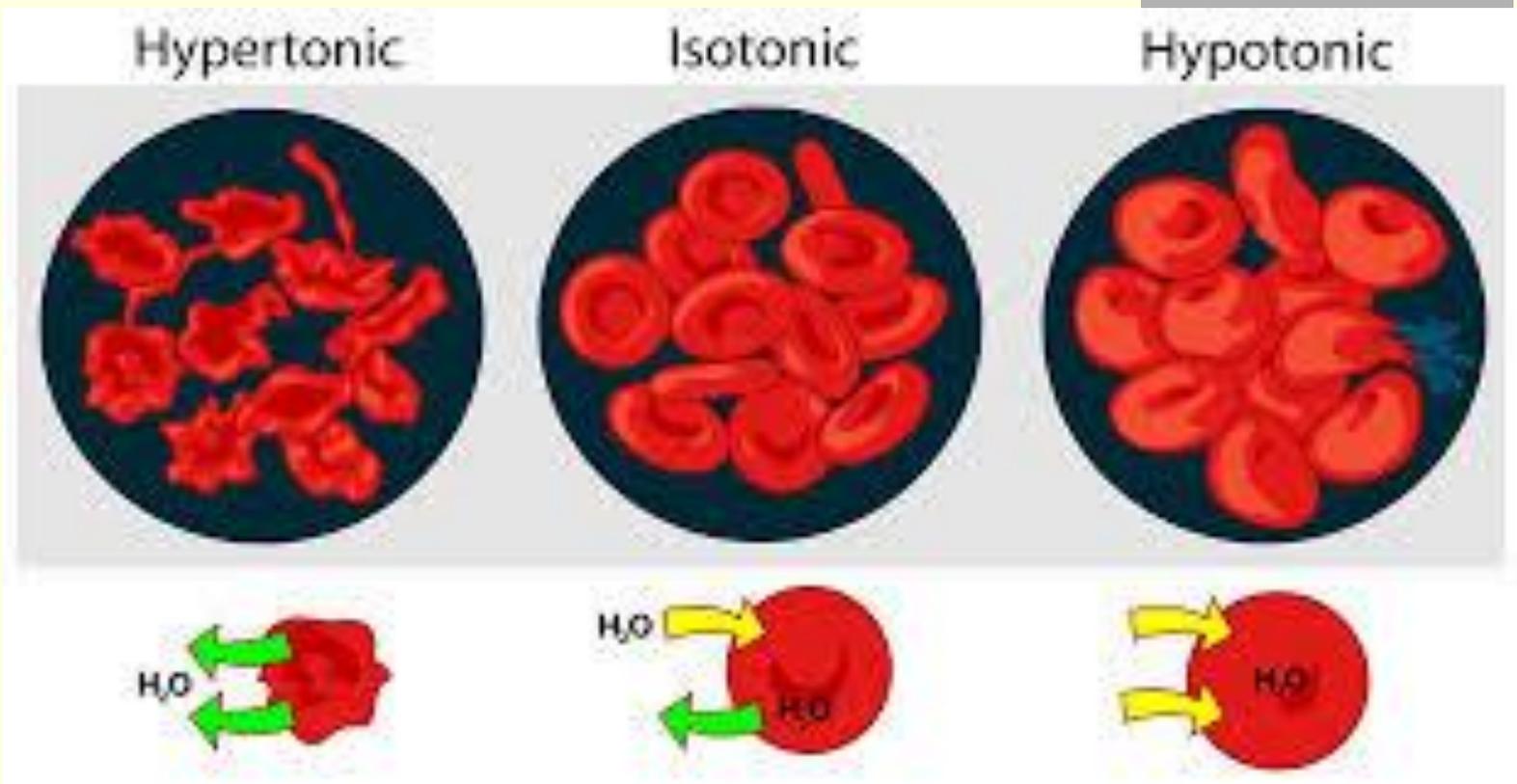


Water potential Ψ , is a plant only concept.....

- Why would we focus on plants??!!!



If doing this animal cells, we call it osmotic potential.



So again, keep this in mind:

- Water moves from areas of high water concentration to low water concentration. (Lots of water to less water) Osmosis
- Pure water is what we are comparing things to. “Where is there more or less pure water?”
- When a solute is dissolved in water, you no longer have pure water, you have a solution.
- When we talk about movement, there are always 2 areas to consider; intra-cellular and extra-cellular environments. So, things move IN and OUT of the cell depending on those 2 environments. (in comparison)

Ask yourself this:

- Which one would you drink from? Why?
- A) Pure water B) .2M NaCl C) .8M NaCl



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So that means....

- Solutes impact the amount of PURE water in the system...If we add solute to water, we have LESS free, pure water.
- Therefore we can give that value/variable:
Solute = Ψ_s
- More solute in the water, the less free, pure water!

The second way is....

- Pressure!!!
- #2) By changing pressure (Ψ_p) we can affect water's movement. THIS IS WHY Ψ ONLY APPLIES TO PLANTS!
- Therefore we can give that value/variable: Pressure = Ψ_p

-
- Higher Ψ_p = water moves away from the pressure. (Gives a + value)
 - Lower Ψ_p = water moves towards low pressure. (Gives a – value)
 - Usually don't see a – Ψ_p value in plants.
 - Think about a kinked garden hose, or a syringe.

-
- When you depress the plunger, why does the contents of the syringe easily shoot out the end of the needle?



Solutes come from cellular processes and the extra-cellular environment. (HIGH TO LOW)

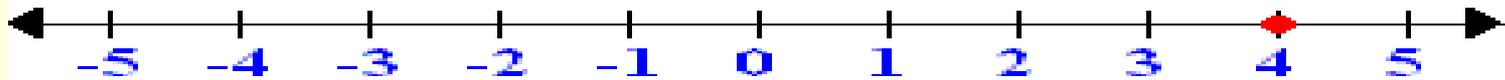
So, let's put this all together shall we....

- $\Psi = \Psi_p + \Psi_s$
- This means that you must take into account the 2 variables (pressure and solute) BEFORE you can access the way in which water will move AND the 2 environments.
- The values are in atmospheric bars (amu/Mpa or bars).
- The value of Ψ can be +, - or 0.
- Ask yourself "How?" In other words, how would we influence the set up to get these values?

REMEMBER: Number values:

More negative # = less energy to move, or less than.

A more positive # = more energy, or more than



Results of Ψ

- If the intracellular environment has a lower Ψ than the extra-cellular environment, the cell will gain water and swell. (Possibly bursting)
Bursting of a cell is called a lytic condition.
(Cytolysis)
- EX: Inside the cell: $\Psi_p = +3$, $\Psi_s = -12$ $\Psi = -9$
Extra-cellular: $\Psi_p = 0$, $\Psi_s = 0$ $\Psi = 0$

Examples:

- If the intracellular environment has a value of Ψ that is higher than the value of the extra-cellular environment, what will happen?
- The cell will lose water. (Shrink) This is called cellular plasmolysis.
- EX: Inside the cell: $\Psi_p = +3$, $\Psi_s = -12$ $\Psi = -9$
Extra-cellular: $\Psi_p = 0$, $\Psi_s = -15$ $\Psi = -15$

Other possible outcomes

- Plant cells can increase or decrease pressure in their cells. Therefore a plant cell can be **turgid or flaccid. Lack of turgid pressure= wilting.**
- Animal cells are more subject to death if solute concentrations are not regulated (Why?). If they swell to much they can burst. This is called lytic. (Cytolysis) Or as we said they can shrink plasmolyze. (Plasmolysis)

Application or why do we care? By being able to predict the direction of the flow of water, we can do lots, like:

- Increase agriculture outputs
- Weed prevention
- Emergency room fluids (hydration), surgical scenarios/faster healing process
- Disease treatments (Alzheimer's)

Calculating Ψ - take out a calculator please!

- Calculating $\Psi_s =$
- $\Psi_s = -iCRT$
- Where:
- $-i$ is the ionization constant (based on # of ions created during disassociation of a solute in water)
EX: Glucose would be -1 . What about salt?
- C = Molar concentration, “how salty is the water?” $.2$, $.4$, $.6$ molar?
- R = Pressure constant 0.0831 Lb/mole K
- T = Temperature in K ($273 + \text{Celsius temp}$)

Try this:

- A 1.0M sugar solution @ 22C. What is Ψ_s ?
- $\Psi_s = -1(1.0)(0.0831)(295) = -24.51$
- If you had this as your value for osmotic potential in a human cell, and the cell was in an environment of $\Psi_s = -24.50$, which way will water move?
- In the above scenario, what is the value of Ψ_p ? Why?

SUMMARY: (These are the free take home, parting gifts for attending lecture!)

- Ψ is used to predict the flow of water between the intra/extra cellular environments.
(Compare)
- Water moves from areas of higher water concentrations to places of less water.
- Ψ s always – value
- Ψ_p (cell walls only) usually has + value
- Number line of values, +/- will tell you which way the water will move. (- to +)

NATURE'S WAY

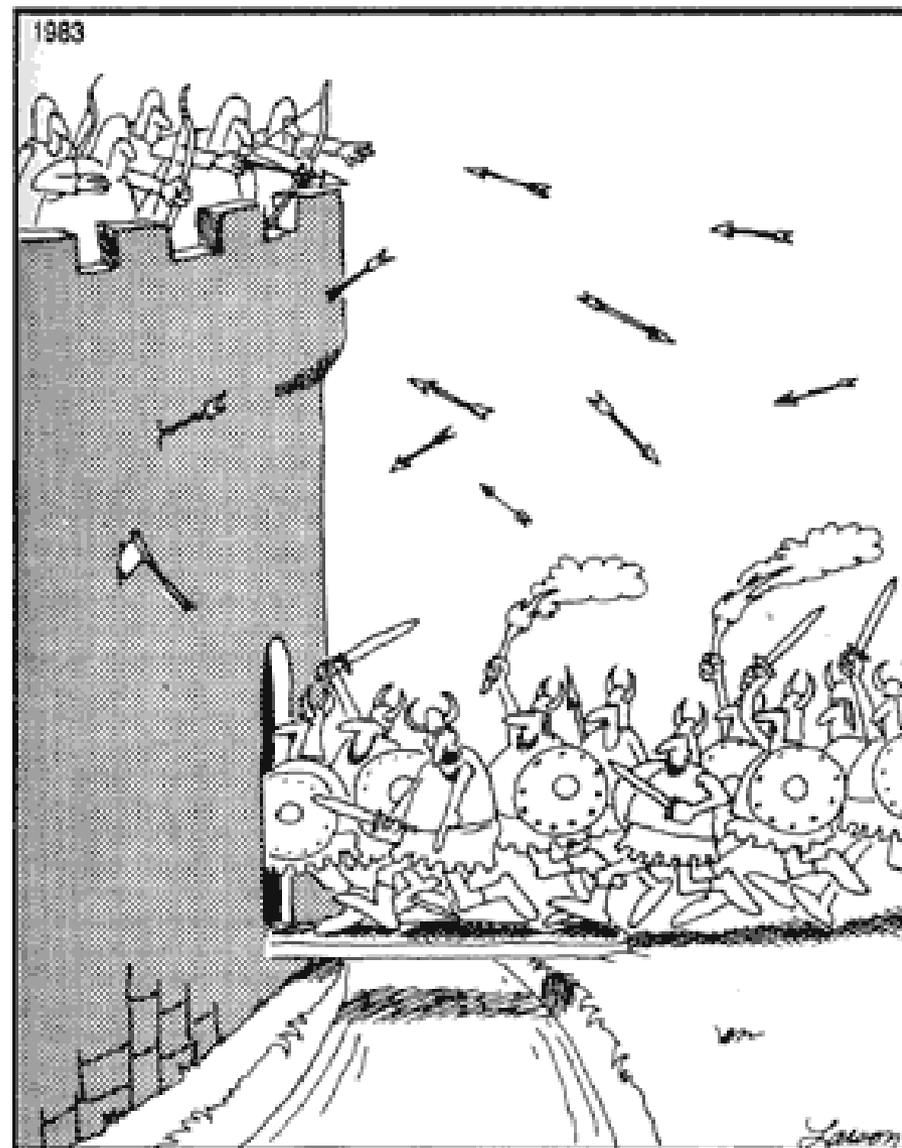


"Of course I never eat the shells."

Summary continued:

- Only plants can have a value for Ψ_p , we call this process osmotic potential in non-plant eukaryotic cells.
- Overall equation is $\Psi = \Psi_p + \Psi_s$ *
- Calculating $\Psi_s = -1CRT^*$
- Real world applications are used daily in agriculture and medicine.
- * memorize these!!

And to thank you for being such a great audience:



"Oo! Goldfish, everyone! Goldfish!"