Water Potential
Plant Cells in Pure Water

Pure water (a hypotonic solution) will initially move into the cells.

After a period of time the cells will become turgid.

As turgor pressure increases water will diffuse out of the cell... eventually equilibrium will be reached.
Water Potential is...

...a measure of the energy available for reaction or movement.

- measures the ability of water to move.
- water always moves from areas of high potential to areas of low water potential.

-The symbol for water potential is the Greek letter $\Psi$. 

\[ \Psi \]
Water Potential

Two components:
• **Osmotic potential** (due to solutes)
• **Pressure potential** (due to turgor pressure).

These two pressures have opposite effects on water movement.

As one rises, the other decreases…
water potential is just the sum of the pressure and osmotic components.

Water Potential = Osmotic Potential + Pressure Potential

\[ \psi = \psi_p + \psi_\pi \]

Pure water has \( \psi_\pi \) of 0

\( \psi_\pi \) is **negative** for all solutions

Pure water always flows to the lower potential, so, \( \psi_\pi \) must be **negative** (lower than zero) for any water containing solutes.
Water under pressure (high P)
• few solutes (low $\pi$, - not very negative $\psi$).

Water will flow from the cell to the solution, from high (nearly zero) potential to low (very negative) potential.

Fresh water flows to salt...
The rivers flow to the sea...

Water at low pressure (low P)
• lots of solutes
• high $\pi$
• very negative $\psi$
Some Basic Principles

• Water always moves from high water potential to low water potential.
• Water potential is a measure of the tendency of water to move from high free energy to lower free energy.
• Distilled water in an open beaker has a water potential of 0(zero).
• The addition of solute decreases water potential.
• The addition of pressure increases water potential.
• In cells, water moves by osmosis to areas where water potential is lower.
  • A hypertonic solution has lower water potential.
  • A hypotonic solution has higher water potential.
Osmoconformers

- Organisms whose internal concentrations change as the salinity of water changes (narrow range)
- They usually stay where the salinity of the water matches that of their fluids

If placed in fresh water, cells will swell up and burst because of osmotic flow of water into their cells
Osmoregulators

- Control internal concentrations to adapt to different salinities by adjusting the concentrations of solutes in their body fluids. (wide range)
- Only the concentrations of solutes needs to be the same, not the exact same amounts
- Ex: Redfish
- Bull Sharks
Plasmolysis:

- The shrinkage of the cell membrane due to the loss of water pressure due to the osmotic potential gradient of a surrounding hypertonic solution.

- Can be lethal to cells due to dehydration.
Normally hydrated cells

Plasmolyzed cells
What is the effects of salt on:

• People who eat salty foods (think “blood pressure”)?

• Salting the roads for ice and snow?

• Salt intrusion into soils because of a hurricane’s storm surge?