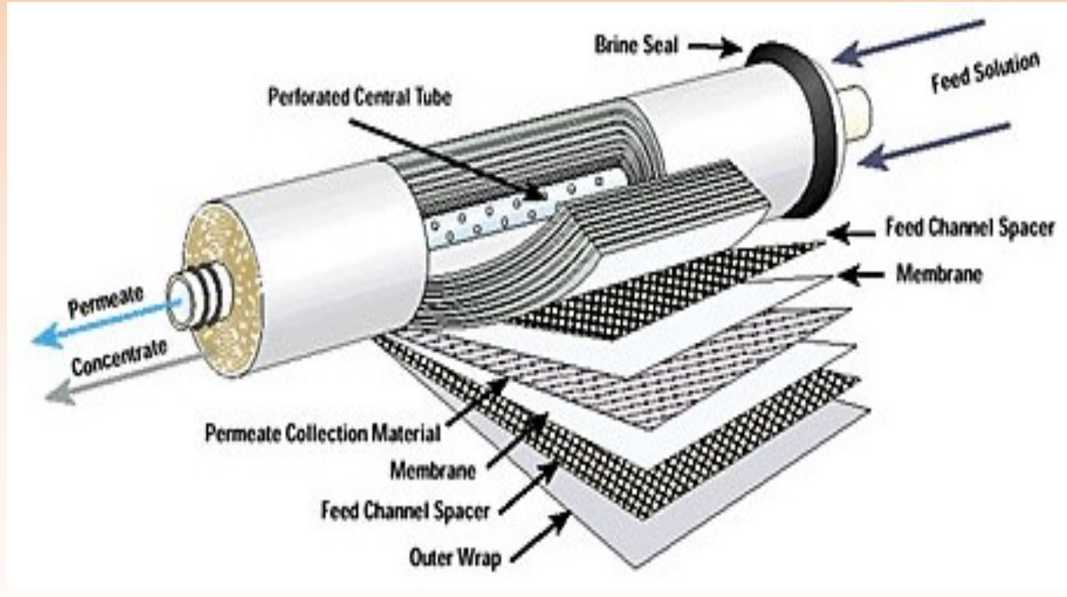
# PUTTING THE SQUEEZE TO MAPLE SAP

**Osmotic Pressure -** ***the minimum pressure applied to a solution that prevents the INWARD flow of water across a semi permeable membrane.***

**Osmotic Pressure is exothermic. Reverse Osmosis is endothermic. Reverse Osmosis requires a pressure greater than the osmotic pressure of the solute.**
**Exo = outer  Endo = inner  thermic = heat**

| *Substance* | *Molar Mass* | *Osmotic Pressure* |
|---|---|---|
| Water | 18 g/mol | |
| Sodium | 158 g/mol | 329 psi |
| Fructose | 180 g/mol | |
| Glucose | 180 g/mol | |
| Sucrose | 342 g/mol | 58 psi |




**The semi permeable RO membrane allows the small (18 g/mol) water molecule, under pressure, to pass through but not the larger fructose and glucose (180 g/mol) molecules, nor the giant sucrose (342 g/mol) molecules. From raw sap, the RO produces pure $H_20$, (Permeate), and concentrated sap (Concentrate). Maple tree sap with a 2% sugar content has about 1,000 molecules of $H_2O$ for each molecule of sucrose $C_{12}H_{22}O_{12}$. Finished Maple Syrup has about 10 molecules of $H_2O$ for each molecule of sucrose.**

| Maple Sap Sugar Concentration | Gallons of Sap Needed to Produce 1 Gallon of Syrup |
|---|---|
| 2% | 43 |
| 6% | 14.3 |
| 12% | 7.2 |
| 18% | 4.8 |
| 24% | 3.6 |

**Different maple producers *squeeze* their raw sap to different concentrations depending on many factors: equipment, seasonal quality of the sap, cost and personal preference. Producers then boil the resulting concentrate in an evaporator until it reaches the density of syrup. Reverse osmosis units, depending on their size, run at 200 psi to 600 psi to counter osmotic pressure of maple sap.**

**What is the minimum pressure needed to run a maple reverse osmosis unit?**

**How does the producer use the byproduct permeate?  Why?  Hint: It is a pure solute!**

**New Hampshire Maple Producers Association, Inc.**
**www. nhmapleproducers.com**