



Osmotic Egg *Performer's Version*

Safety Hazards

- Personal Protective Equipment:
 - Safety glasses/goggles
 - Nitrile gloves
 - Chemical & flame retardant lab coat
- Physical Hazards
 - Glacial acetic acid is a flammable liquid and vapor.
- Chemical Hazards
 - Glacial acetic acid causes severe skin burns and eye damage.

Materials

- 3x Large eggs
- 1L White distilled vinegar or 5% Acetic acid solution
- 250mL Corn syrup
- 3x Mason jars

Safety Data Sheet(s)

- [Acetic acid, glacial](#)
- [Corn syrup](#)

Procedure

1. Remove the eggs from their respective jars and either hold them up for the class to observe or place them under the document camera.
 - a. The egg in tap water should swell, whereas the egg in corn syrup should shrink.

Pedagogy & Supplemental Information

The osmotic egg demonstration is a visually compelling and biologically relevant way to explore colligative properties, particularly osmotic pressure, the pressure required to prevent the net flow of solvent through a semipermeable membrane separating solutions of different concentrations. This experiment uses decalcified eggs, which retain their flexible membranes while having their rigid calcium carbonate shells removed by soaking in 5% acetic acid. The reaction between acetic acid and calcium carbonate (CaCO_3) produces carbon dioxide gas and dissolves the shell, leaving behind the selectively permeable egg membrane.

Once the shell is removed, the egg serves as a natural model of a semipermeable membrane, allowing water molecules to pass through while restricting larger solutes. When the decalcified eggs are placed in three different environments – deionized water, corn syrup, and a control (no added solution) – the changes in egg volume reveal the osmotic flow of water driven by solute concentration gradients.

In deionized water, the external solution is hypotonic relative to the egg's interior. Water flows into the egg due to the lower solute concentration outside, increasing the internal volume and causing the egg to swell. This flow is governed by osmotic pressure, which depends only on the number of solute particles, not their identity – a defining trait of colligative properties. Conversely, in corn syrup (a hypertonic solution), the solute concentration outside the egg is significantly higher than inside. Water flows out of the egg, causing it to shrink and wrinkle as it loses internal volume. The reference egg remains unchanged in its sealed jar, serving as a visual baseline.

This demonstration reinforces the idea that osmotic pressure (Π) is directly proportional to the molar concentration of solute particles in solution, described by the equation shown below, where i is the van't Hoff factor (for non-electrolytes like sugars, $i \approx 1$), M is molarity, R is the gas constant, and T is temperature in Kelvin. As the solute concentration increases, so does osmotic pressure, pulling water toward the higher solute concentration across the membrane.

$$\Pi = iMRT$$

Real-world applications of osmotic pressure are vast. Biological systems depend on osmotic regulation to maintain cell turgor and hydration, pharmaceutical formulations use osmotic gradients in drug delivery systems, and industrial processes such as reverse osmosis water purification rely on these same principles to remove solutes from water. By using a familiar biological material – the egg – this demonstration provides a tangible, memorable introduction to a fundamental thermodynamic concept with direct relevance across chemistry, biology, and engineering.