

SNC2D/2P Tissues, Organs, and Systems of Living Things/Tissues, Organs, and Systems

Teacher Demo: Eggmosis

| Topics | Timing |
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| osmosis hypertonic, hypotonic, and isotonic solutions | preparation: 10 min (36 and 12 hours in advance) demonstration: 10 min |

Specific Expectations

SNC2D

- A.1.1** formulate scientific question about observed relationships, ideas, problems, and/or issues, make predictions, and/or formulate hypotheses to focus inquiries or research
- A1.5** conduct inquiries, controlling some variables, adapting or extending procedures as required, and using standard equipment and materials safely, accurately and effectively, to collect observations and data
- A1.10** draw conclusions based on inquiry results and research findings, and justify their conclusions
- B3.3** explain the links between specialized cells, tissues, organs, and systems in plants and animals (e.g., muscle cells and nerve cells form the tissue found in the heart, which is a component of the circulatory system; granum and thylakoid structures act as solar collectors in the chloroplast to produce carbohydrates for plant growth)

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- B3.4** explain the general function of some of the systems in the human body (e.g., the function of the circulatory system is to transport materials through the body; the function of the digestive system is to absorb nutrients; the function of the respiratory system is to bring oxygen into and remove carbon dioxide from the body)

Introduction

Osmosis is the process by which the concentrations of two solutions equalize across a selectively permeable membrane. Osmosis is necessary for the digestive and excretory systems to function. This demonstration models the behaviour of cells in hypertonic and hypotonic solutions. The terms *hypertonic* and *hypotonic* are used in the context of a solution surrounding living cells. If a solution has a higher concentration of a solute than occurs within the cells, the solution is *hypertonic*. This causes water to move from the cells through the membrane into the

hypertonic solution. A *hypotonic* solution is a solution with a lower concentration of solute than occurs within the cells. This causes water to move from the hypotonic solution through the membrane into the cells. An *isotonic* solution is a solution with the same concentration of solute as the cells. In an isotonic solution, therefore, the cells will neither gain nor lose water.

Materials

| | |
|--------------------------|--|
| safety goggles | 400 mL vinegar (5% acetic acid, $\text{HC}_2\text{H}_3\text{O}_2(\text{aq})$, by volume) |
| lab coat or apron | 200 mL distilled water |
| plastic or rubber gloves | 200 mL corn syrup |
| 3 eggs | 3 Mason jars or beakers |

Safety Considerations

- There is a small chance that raw eggs may be contaminated with *Salmonella*. After handling the eggs, wash hands thoroughly with warm water and soap.

Procedure

Wear appropriate PPE: safety goggles, lab coat or apron, and plastic or rubber gloves.

Prepare the following before class:

1. 24–36 hours before the demonstration place the eggs in the one of the Mason jars and cover them with about 200 mL of vinegar. The egg shells will dissolve over the next 12–24 h.
2. Prepare two more Mason jars as follows: to one jar add 200 mL of distilled water; to the other add 200 mL of corn syrup.
3. Once the egg shells have completely dissolved, put on the plastic gloves. With your hands, carefully remove two of the eggs from the Mason jar and place one into the jar containing distilled water and one into the jar containing corn syrup.
4. Replace the vinegar in the first jar (which now contains only one egg), with fresh vinegar.
5. Allow the eggs to sit undisturbed for another 12 h (approximately). Store all three jars out of view of the students.

During class:

6. Show the students the egg that has been kept in vinegar first.
7. Have the students think about what substances are present in vinegar.
8. Explain that the shell of the egg has been removed so that only a selectively permeable membrane now surrounds the white and yolk of the egg.
9. Show the students the original containers of corn syrup (an aqueous solution) and distilled water. Ask them to name the main solute in corn syrup. Encourage them to rank the relative concentrations of this solute in corn syrup and in water.
10. **Predict/Explain**
Invite students to predict what would happen to the de-shelled egg if it were placed in water or corn syrup. Have them use a series of diagrams (with arrows to indicate motion) to illustrate and explain the process that would occur in each case.
11. **Observe**
Show the students the eggs in distilled water and corn syrup. Set all three jars side by side to make the size comparison between the eggs easier.
12. **Explain**

Have the students revise their explanations and diagrams based upon the observed results and their knowledge of osmosis and selectively permeable membranes.

Disposal

The eggs can be disposed of in the trash, or in an organic/compost recycling container. The water, vinegar, and corn syrup can be poured down the sink. Follow disposal procedures that are consistent with school board protocol and appropriate for your municipality.

What happens?

The egg in the distilled water increases in size as the water flows through the membrane toward the solutes within the egg (Fig.1). Conversely, the egg placed in the corn syrup shrinks and shrivels as water flows out of the egg and into the surrounding solution.

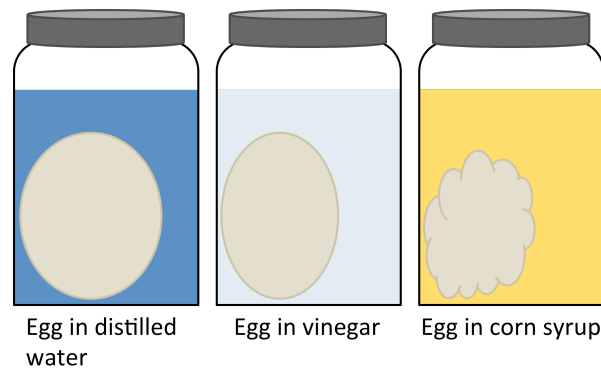


Fig.1 Comparison of size and appearance of the three eggs

How does it work?

Osmosis tends to equalize the concentration of solutes across a selectively permeable membrane. The solutes are unable to move through the membrane, so instead water flows towards the solution with the higher concentration of solutes until the concentrations are equalized. To achieve this, the volume of the more concentrated solution must increase.

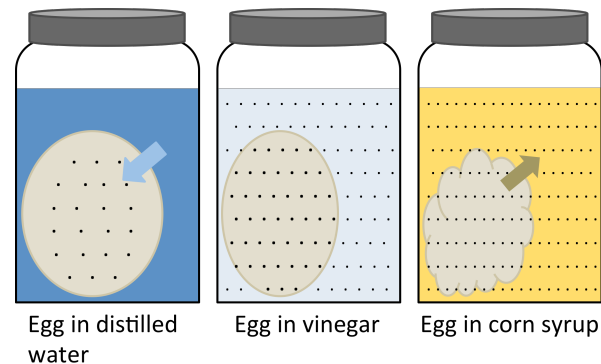


Fig.2 Comparison of solute concentrations of the three solutions

Teaching Suggestions/Hints

1. Once the shells have been removed the eggs are very fragile and can easily be burst, and so should be handled with the utmost care to prevent making a mess. Always keep a tray beneath the eggs to catch any spills that occur. You could place a fourth egg in vinegar, to have a spare on hand in case of accidents.
2. Review the concept of diffusion with students before this demonstration. Students might use a compare-and-contrast chart or Venn diagram to summarize the processes of diffusion and osmosis.

Next Steps

Once the students have an understanding of osmosis, this principle can be related to absorption of water in the large intestine and/or filtering of the blood by the kidneys. The terms isotonic, hypotonic, and hypertonic should be introduced.

Additional Resources

1. An explanation of osmosis and the terms hypertonic, hypotonic, and isotonic, as they apply to this demonstration - <http://ilovebacteria.com/eggosmosis.htm>
2. A description of an “Eggsperiment” to understand osmosis and how this works through the cell membrane of the egg - <http://c-lab.co.uk/default.aspx?id=9&projectid=56>
3. Compare and contrast chart - http://www.readwritethink.org/files/resources/lesson_images/lesson275/comcon_chart.pdf
4. Venn diagrams template - <http://www.eduplace.com/graphicorganizer/pdf/venn.pdf>
5. Editable graphic organizers - <http://www.worksheetworks.com/miscellanea/graphic-organizers.html>