

EXPERIMENT 2

EGG OBSERVATIONS

An Osmosis *Eggsperiment*



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ACKNOWLEDGEMENTS

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Rosemary Krygowski (Norwood School, West Chester, PA) – project leader

Penney Sconzo (Westminster High School, Smyrna, GA) – peer reviewer and adviser

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Teacher Guide

EGG OBSERVATIONS

An Osmosis Eggsperiment

AGE LEVEL

This activity in its existing format is appropriate for ages 10-18.

SUBJECT

Physical science, life science

PURPOSE(S)

1. To demonstrate the osmosis process.
2. To demonstrate changes in properties of matter.
3. To expose students to common measuring instruments used in the lab.

TIME NEEDED

Fifteen to twenty minutes per day for four consecutive days. The activity should be started at the beginning of the week and completed within four days. It is necessary to let the egg sit approximately 24 hours in a new solution each day over a four-day period.

ACTIVITY OVERVIEW (PLUS HELPFUL ADVICE)

A few minutes after the egg is placed in the vinegar, bubbles will form around the egg. This indicates a chemical reaction taking place between the vinegar and the shell of the egg. In one day the shell will be gone and water will begin moving into the egg. Osmosis is the movement of water through a semi-permeable membrane from an area of higher water concentration (the vinegar) to an area of lower water concentration (the egg).

Explain to the students that vinegar is a weak acid diluted with lots of water. Water passes from the vinegar, through the egg's semi-permeable membrane, into the egg because of osmosis. The egg will get even larger when placed in the salt water because of the solution's low salt concentration. It will shrink considerably when placed in the corn syrup. Using tap water on the final day will cause the egg to again increase in mass. Soaking the egg in the tap water helps students understand the osmosis process. They might think the egg shrank because of a hole in its membrane unless the membrane is shown to be intact.

NOTE: It is a good idea to have a few extra eggs in the room should there be breakage. Another option would be to have students share data from another group if their egg does break.

SCIENCE SKILLS AND ABILITIES

SCIENCE AS INQUIRY

- Abilities necessary to do scientific inquiry (ages 10-18)
- Understanding about scientific inquiry (ages 10-18)

PHYSICAL SCIENCE

- Understanding properties and changes of properties of matter (ages 10-18)
- Understanding chemical reactions (ages 14-18)

LIFE SCIENCE

- Understanding the cell (ages 10-18)
- Understanding the structure and function of living systems (ages 10-13)

KEY VOCABULARY

BUOYANCY: The ability or tendency to float or to rise in a liquid or in air.

CELL: The basic structural and functional unit of an organism that is capable of independent functioning. A cell consists of one or more nuclei, cytoplasm, and various organelles, all surrounded by a semi-permeable cell membrane.

CHEMICAL REACTION: The process in which substances undergo chemical changes, forming new substances with different properties.

CONCENTRATION: The strength of a solution.

GRAM: A basic measurement unit of weight or mass used in the metric system (equal to the weight of one cubic centimeter of distilled water at 4°C).

LITER: A basic measurement unit of capacity/volume used in the metric system (equal to the volume of one kilogram of distilled water at 4°C).

MASS: The quantity of a sample of matter (or more precisely, the sample's weight divided by acceleration due to gravity).

MEMBRANE: A thin, soft, pliable layer of animal or plant tissue that covers or lines a cell or an organ.

MILLILITER: A basic measurement unit of capacity/volume used in the metric system (equal to one thousandth of a liter).

MODEL: An object or process that represents another object or process in order to simplify the understanding of that other object or process.

OSMOSIS: The movement of water through a semi-permeable membrane from an area of higher concentration to an area of lower concentration.

SEMI-PERMEABLE: Capable of allowing some (smaller) substances to penetrate or pass through it.

SOLUTION: A mixture of two substances where one has dissolved into the other. Frequently (but not necessarily) a solution is a liquid.

SUBMERGE: To place into and cover completely with a solution.

TARE: To deduct out the mass or weight of a holding container in order to properly calculate the mass of the substance being held by that container.

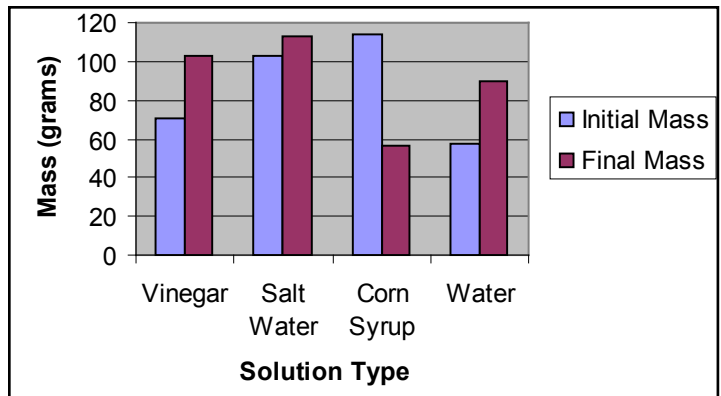
CONCLUSIONS (ANSWER KEY)

1. The formation of the bubbles signals a chemical reaction has taken place and that a gas is being released.
2. Mass changes and causes:

Solution Type	Egg's mass after 24 hrs (g)	What caused the egg's mass to change?
Vinegar	mass increases (by approx. 25 g)	A liquid entered the egg
Salt water	mass increases (by approx. 10 g)	Osmosis has taken place. The water has moved from an area of higher concentration (the beaker) to an area of lower concentration (egg).
Corn syrup	mass decreases (by approx. 50 g)	The concentration of water inside the egg was higher than the concentration of water in the corn syrup, therefore the water moved from the egg to the beaker.
Tap water	mass increases (by approx. 40 g)	The concentration of water outside the egg is now greater than the concentration of water inside the egg. Therefore, the water moved from the beaker to the egg.

3. Osmosis is the flow of water through a semi-permeable membrane from an area of higher water concentration to an area of lower water concentration. When the egg was in a solution (vinegar, salt water, tap water) that had a higher concentration of water than was inside the egg's membrane water flowed into the egg. When the egg was in a solution (corn syrup) where the concentration of water was less than inside its own membrane the water flowed out of the egg.

4. Sample results using a bar graph that shows how each solution caused a change in the egg's mass:



POSSIBLE EXTENSIONS

1. What would happen if the concentration of salt is changed? Will the mass of the egg increase or decrease? Why does this happen?

ANSWER: If the concentration of salt is increased, the concentration of water will decrease. If the concentration of salt is decreased, the concentration of water will increase. The mass of the egg will increase if the water concentration of the new salt water solution in the beaker is higher than the water concentration inside the egg. The mass of the egg will decrease if the water concentration of the new salt water solution in the beaker is less than the water concentration inside the egg. This happens because of osmosis, with the water flowing from an area of higher water concentration to an area of lower water concentration.

2. Redo the experiment by leaving the egg in the various solutions for 48 hours instead of 24 hours. Record mass and appearance changes on the observation chart. Discuss how doubling the time that the egg is in the different solutions caused changes in the egg and its mass.

ANSWER: The egg increases in size the longer you leave it in the water until the water concentration inside and outside the egg is equal.

- 3: While measuring mass changes every day, also record the egg's position in the beaker during each of the four daily observation sessions. Explain how the daily changes in the egg's size changed its buoyancy.

ANSWER: When the egg is placed in the vinegar, it sinks to the bottom with one end tilted up. As the vinegar reacts with the eggshell, bubbles surround the egg, causing it to float. When the egg is placed in the salt water, it sinks to the bottom of the beaker again, since it is more dense than the salt water solution. The egg floats in the corn syrup because the corn syrup is more dense than the egg. At the end of the experiment, the egg sinks again when it is placed in the fresh water.

4. Along with recording the mass of the egg on a daily basis, also measure the remaining volume of solution after the egg has been removed from the beaker. Create a chart to show daily egg mass changes and daily beaker solution changes. Discuss your observations and explain why these changes occurred.

ANSWER: Sample results for daily volume changes of the various solutions in the beaker:

Solution	Egg's Initial Mass	Egg's Mass After 24 Hours	Solution's Initial Volume	Solution's Final Volume
vinegar	70 grams	95 grams	200 ml	175ml
salt water	95 grams	114 grams	200 ml	179 ml
corn syrup	114 grams	62 grams	200 ml	252 ml
tap water	62 grams	102 grams	200 ml	40 ml

NOTE: Since the mass of one ml of water equals 1 gram, every gram that the egg's mass increases should equal a volume reduction of approximately 1 ml for the beaker solution.

ADDITIONAL RESOURCES

For more experiments, visit www.adamequipment.com/education regularly for new classroom experiments.

ABOUT ADAM EQUIPMENT

Adam Equipment's world headquarters is located in Milton Keynes, United Kingdom, with facilities in the United States, Australia, South Africa and China. The company's balances have been trusted by professionals worldwide for 40 years. Contact Adam Equipment at education@adamequipment.com or online at www.adamequipment.com/education.

ADAM EQUIPMENT BALANCE RECOMMENDED FOR THIS EXPERIMENT

Adam's TBB 2601T (*2610g capacity, 0.1g readability, and 225g taring capacity*): The TBB is the first triple-beam balance developed specifically for educators. The TBB offers the functions and durability that classrooms need, plus an array of useful education features. Exclusive features include an integral security bracket to prevent theft and a convenient weigh-below function with stable, built-in tripod legs that lift the TBB up for better viewing.

The balance's design makes sense for schools, as it has a wider body for more stability, strong metal housing, and an easy-to-clean stainless steel pan. Classroom extras include a built-in mass holder for handy storage of additional weights, plus a protractor, ruler, and conversion chart right on the balance's housing. The TBB delivers reliable center-point readings with well-defined notches, three graduated-tier beams, magnetic dampening, positive poise positioning and a counterbalance knob for speedy zeroing. For complete product details, visit www.adamequipment.com/education.



GETTING INVOLVED IN ADAM EQUIPMENT'S EXPERIMENT PROJECTS

FEEDBACK ON THIS EXPERIMENT

If you have feedback on the OSMOSIS *EGG*SPERIMENT activity that would be valuable to other teachers, we encourage you to share your thoughts. Please submit your comments to the company's education division by email at education@adamequipment.com.

SUBMITTING YOUR OWN EXPERIMENT

If you have an idea for a useful experiment involving weighing that you would like to share with other teachers, Adam Equipment is interested in hearing from you. Initial submissions need to include only a simple description of the activity with the activity's purpose, subject and grade level.

Please contact the company's education division by email at education@adamequipment.com to determine if your particular activity will fit into our experiment library. Adam Equipment will respond promptly to all inquiries.

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Student Section

EGG OBSERVATIONS

An Osmosis Eggsperiment

INTRODUCTION

Through your experience in the kitchen, you might know what happens to an egg when you place it into boiling water or food coloring. However, you probably never followed a recipe that instructed you to leave an egg sitting overnight in a solution. You have a good reason to do just that in this experiment. If you submerge an egg in different solutions for 24 hours, you can observe how substances enter and leave the egg. The outcome may not be as tasty as your previous activities with eggs, but the results certainly will give you food for thought.

PURPOSE

What effect does the type of solution that an egg is submerged in affect the flow of materials into and out of it? Let's take several different household solutions and see what changes occur when you leave an egg submerged in them for a day.

WHAT YOU NEED

- 400 mL beaker
- Graduated cylinder
- One raw (extra-large or jumbo) egg, shell intact
- 200 mL white vinegar
- 200 mL (light) corn syrup
- 400 mL room temperature tap water, divided
- 20g salt
- Small shallow dish (petri dish, culture dish, foil cupcake cup)
- Weighing paper (or filter paper)
- Triple Beam (TBB 2610T, 2610g x 0.1g with tare) or Balance (CQT 251, 250g x 0.1g)

MAKE A HYPOTHESIS

Predict what will happen when an egg is submerged for 24 hours in each of the four different solutions (vinegar, salt water, corn syrup, and plain tap water). Include four separate hypotheses, one for each solution type.

PROCEDURE

PRELAB: Day One

1. Place a dish on the balance and tare. Carefully place the egg in the dish. Record the egg's mass on the chart.
2. Fill the graduated cylinder with 200 mL of vinegar and pour it into a beaker. Carefully place the egg into the beaker.
3. Observe and record initial observations about the egg on the chart.

Day Two

1. Carefully remove the egg from the vinegar. Observe any changes to the egg on the chart.
2. Place the dish on the balance and tare. Then place the egg on the dish to get the new mass of the egg. Record today's new egg mass on the chart. (Also record this as the initial mass for tomorrow).
3. Empty and clean the beaker. Then add 200 mL of water to the beaker.
4. Place weighing paper on the balance and tare. Next, weigh out 20g of salt and add to the beaker and stir. Carefully place the egg into the beaker. Record your initial observations about the egg in the salt solution.

Day Three

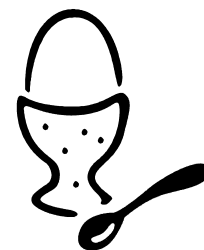
1. List changes to the egg and its new mass on the chart. (See steps 1 and 2 of Day Two).
2. Place the egg into the next solution, corn syrup (as in steps 2 and 3 of Day One).

Day Four

1. List changes to the egg and its new mass on the chart. (See steps 1 and 2 of Day Two).
2. Place the egg in the next solution, tap water (as in steps 2 and 3 of Day One).

Day Five

1. List changes to the egg and its new mass on the chart. (See steps 1 and 2 of Day Two).



STUDENT WORKSHEET

Solution Type	Egg's Initial Mass (g)	Egg's Mass After 24 Hours (g)	Observations (initial and after 24 hours)
vinegar			initial:
			after 24 hours:
salt water			initial:
			after 24 hours:
corn syrup			initial:
			after 24 hours:
tap water			initial:
			after 24 hours:

CONCLUSIONS

1. When the egg is first placed in vinegar, bubbles began appearing around it. What can be inferred about the cause of these bubbles?

2. How did the mass of the egg change after it had been sitting in each of the different solutions for 24 hours? What caused the egg's mass to change? (Include a separate two-part answer for each solution type: vinegar, corn syrup, salt water, and plain tap water).

3. Explain the changes of the egg's mass in terms of osmosis.

4. Use a bar graph to show how each solution affected a change in the egg's mass. (y-axis for mass, x-axis for solution type, and two bars for each solution: one bar for the egg's initial mass and the second bar for its mass after 24 hours).