How Salty Does the Sea Have to Be for an Egg to Float?

Areas of Science	Ocean Sciences (http://www.sciencebuddies.org/science-fair-projects/project-ideas/ocean-sciences)
Difficulty	
Time Required	Very Short (≤ 1 day)
Prerequisites	None
Material Availability	Readily available
Cost	Very Low (under $20)
Safety	Always wash your hands after handling uncooked eggs because they may carry *Salmonella*.

Abstract

Some objects float on top of the ocean, and other objects sink to the bottom. Why? Try this *egg*speriment to find out!

Objective

Determine what salt concentration will float an egg.

Credits

Andrew Olson, PhD, Science Buddies

Sandra Slutz, PhD, Science Buddies

Cite This Page

General citation information is provided here. Be sure to check the formatting, including capitalization, for the method you are using and upd

MLA Style

Science Buddies Staff. "How Salty Does the Sea Have to Be for an Egg to Float?" *Science Buddies*, 12 Jan. 2020, https://www.sc
projects/project-ideas/OceanSci_p003/ocean-sciences/how-salty-does-the-sea-have-to-be-for-an-egg-to-float. Accessed 6 Mar. 2

APA Style

Science Buddies Staff. (2020, January 12). *How Salty Does the Sea Have to Be for an Egg to Float?* Retrieved from https://www.
projects/project-ideas/OceanSci_p003/ocean-sciences/how-salty-does-the-sea-have-to-be-for-an-egg-to-float

Last edit date: 2020-01-12

Introduction

Did you know that if you put an egg in a cup of tap water, it will sink to the bottom? But, if you add enough salt, the egg will float b density of the egg is higher than the density of tap water, so it sinks. **Density (ρ),** as shown in Equation 1, is the **mass (m)** of a m the density of freshwater under standard conditions is approximately 1 gram (g) per cubic centimeter (cm^3). In other words, if you freshwater, the water inside the box would have a mass of 1 g. Adding salt to the water increases the density of the water, becaus changing the volume very much. With enough added salt, the saltwater solution density is higher than the egg's, and the egg will ability of something, like the egg, to float in water or some other liquid is known as **buoyancy**.

Equation 1:

$$\rho = \frac{m}{v}$$

ρ = Density in whatever units are used for mass and volume.
m = Mass in grams (g), kilograms (kg), or any other unit of weight.
v = Volume in centimeters cubed (cm^3), meters cubed (m^3), or any other unit of volume

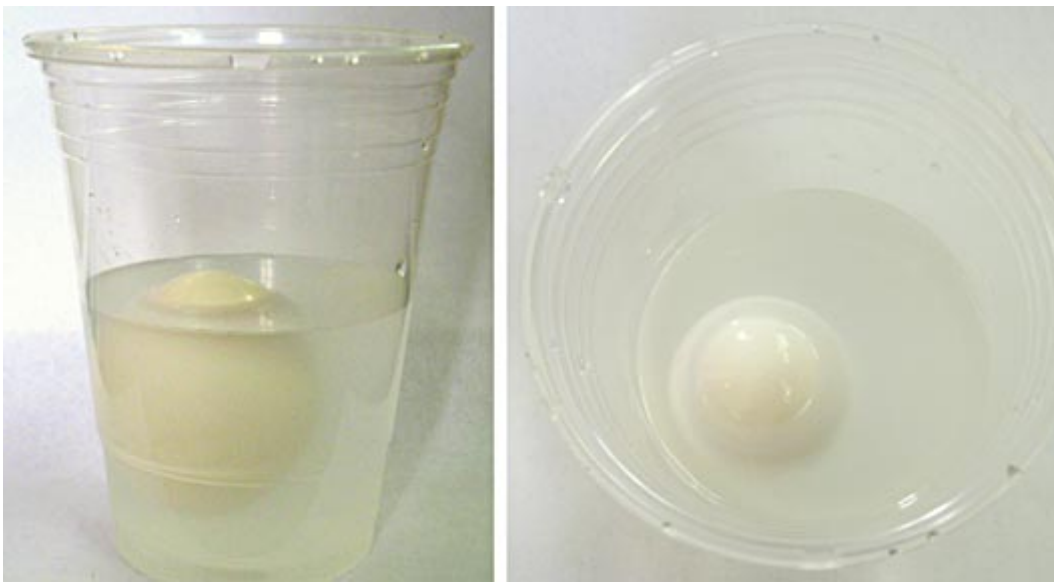

Figure 1. When an egg is placed in saltwater, if the water is salty enough then the egg will float because the egg's density is les picture shows an egg floating in very salty saltwater from two different points of view.

But just how much salt is needed to make an egg float? In this science fair project, you will figure that out by using the technique **dilution** is a method for accurately diluting a solution in regular steps. You add a known amount of your starting, or **stock,** solutio them. The new **concentration** will be determined by the ratio of the volume of stock solution to the total volume, as shown in Equ

Equation 2:

$$\text{concentration} = \frac{\text{volume of stock solution}}{\text{total volume}}$$

If the volume of stock solution and the volume of water are equal, you will be diluting the solution by half. This is called a *two-fold* should use relatively more water; if you want smaller steps, you should use relatively less water. By repeating the process, you ca is how the method got its name. In this ocean science project, you will start out using two-fold dilutions to find out how much salt

Terms and Concepts

- Density
- Mass
- Volume
- Buoyancy
- Serial dilution
- Stock
- Concentration
- Relative concentration
- Absolute concentration

Questions

- Why would an egg float in water with a lot of salt in it, but not in plain tap water?
- What happens to salt (sodium chloride or NaCl) molecules when dissolved in water?
- Why does adding salt to water increase its density?

Bibliography

- Ophardt, C. E. (2003). *Density - a Physical Property.* Virtual Chembook, Elmhurst College. Retrieved June 19, 2009, from *http://www.elmhurst.edu/~chm/vchembook/120Adensity.html* *(http://www.elmhurst.edu/~chm/vchembook/120Adensity.html)*
- Kenyon College. (n.d.). *Serial Dilutions.* Retrieved June 19, 2009, from *http://biology.kenyon.edu/courses/biol09/tetrahyme* *(http://biology.kenyon.edu/courses/biol09/tetrahymena/serialdilution1.htm)*
- Swenson, H. (n.d.). *Why Is the Ocean Salty?* U.S. Geological Survey Publication. Retrieved May 4, 2006, from *https://pubs.usgs.gov/unnumbered/70159082/report.pdf* *(https://pubs.usgs.gov/unnumbered/70159082/report.pdf)*

Materials and Equipment

- Eggs (5)
- Permanent marker
- Table salt (1 cup)
- Water
- Measuring cup, liquid
- Large container, such as a large bowl or cooking pot. Must be able to hold at least five cups.
- Spoon for stirring
- Bag of clear 16-oz. plastic cups
- Soup spoon for egg transfer
- Lab notebook

.

How Salty Does the Sea Have to Be for an Egg to Float?

https://www.sciencebuddies.org/science-fair-projects/project-ideas/OceanSci_p003/ocean-sciences/how-salty-does-the-

(http://www.sciencebuddies.org/science-fair-projects/project-ideas/OceanSci_p003/ocean-sciences/how-salty-does-the-sea-have-to-be-for-an-egg-to-float)

PDF date: 2020-03-06

Experimental Procedure

1. *Note:* For convenience of doing this science project using household measuring tools, volumes are given in terms of Unite
   However, science is done in metric units and students may need to convert when writing up their procedure. To convert un

a. Science Made Simple, Inc. (n.d.). *Metric conversions & US customary unit conversion calculator.* Retrieved April 15 http://www.sciencemadesimple.com/conversions.html (http://www.sciencemadesimple.com/conversions.html)

2. Take five eggs out of the refrigerator, use a permanent marker to label them 1-5, and allow them to warm to room tempera
3. Make a stock solution of 1 cup of salt dissolved in 5 cups of water, as follows:
    a. Pour 3 cups of water into your large container.
    b. Add 1 cup of salt.
    c. Stir to dissolve some of the salt. It will not all dissolve yet.
    d. Add 2 more cups of water.
    e. Stir to dissolve the rest of the salt. The salt should be completely dissolved before you go on to the next step.
        i. This may take several (5 to 10) minutes of stirring, so you may need to be patient.
4. Make a two-fold serial dilution of the stock solution, as follows:
    a. Label five of the plastic cups 1-5. Cup 1 will be for the stock solution, cups 2-4 will be for the dilutions, and cup 5 wi
    b. Add 3/4 cup of your stock salt solution to cup 1.
    c. Add 3/4 cup plain tap water to cups 2-5.
    d. Measure out 3/4 cup stock solution, and add it to cup 2. Mix.
    e. Measure out 3/4 cup of the solution from cup 2 and add it to cup 3. Mix.
    f. Measure out 3/4 cup of the solution from cup 3 and add it to cup 4. Mix.
    g. What are the **relative salt concentrations** of cups 1-4? *Example*: Cup 2 is made up of half stock solution and half salt concentration.
    h. What are the **absolute salt concentrations** of cups 1-4? (If you want to convert to metric units, 1 cup of salt is abo 237 milliliters [mL].) Write these concentrations down in your lab notebook.
5. Now, starting with cup 5 and working your way up, test an egg in each solution to see if it will float. Use a soup spoon to lif
6. In which cup did the egg first float? (Save this solution for step 7.) If the egg floated in more than one cup, did you notice a
    a. Be sure to record your results and observations in your lab notebook, including the egg's number.
7. Repeat steps 5-6 with four other eggs.
8. Now you know, within a factor of 2, how much salt it takes to float an egg. How can you narrow down the range further to g another serial dilution, of course.
9. This time you will start your dilution with the salt concentration in which the egg first floated, the one you selected in step 6
    a. Figure out a new serial dilution with smaller steps. For example, you could try diluting the solution by 25 percent wit the new concentration should be 75 percent of the original concentration.
    b. What amounts of stock solution and water do you need to use?
        i. Remember that you will need enough solution to more than cover the egg, which will probably be around 3/4 than 2 cups of solution in each 16-oz. cup.
        ii. *Hint:* You may only be able to test the first few cups in a dilution series at a time unless you use larger cups.
        iii. *Tip:* If you need additional help for making serial dilutions, check out the serial dilutions resource in the Biblic (http://www.sciencebuddies.org/science-fair-projects/project-ideas/OceanSci_p003/ocean-sciences/how-salty-does-the-sea-have-to-be-for-an-egg-to-float) S
    c. Write up your new dilution procedure in your lab notebook, including the calculated relative and absolute salt conce
    d. Make the new dilution series. Remember to start with salt concentration where the egg first floated. (If you do not ha serial dilution, make some more by starting from the stock solution.)
10. As before, test an egg in each cup, starting with the lowest salt concentration. In which cup did the egg float first?
    a. Be sure to record your results and observations in your lab notebook, including the egg's number.
    b. Repeat this step with the four other eggs.
11. If you want, make another dilution series, with even smaller steps, to improve the precision of your estimate.
    a. Be sure to record your results and observations in your lab notebook, including the egg's number.
    b. Repeat this step with the four other eggs.
12. When you are done handling the eggs, wash your hands with soap and warm water. It is important to wash your hands aft may carry *Salmonella*.
13. Determine the densities for all five eggs and record this in your lab notebook.
    a. *Hint:* If the density of the saltwater is less than the egg's density, the egg will sink, and if the density of the saltwater will float. So the density of the egg would be between these two absolute salt densities.

14. Plot the densities for all five eggs on a chart, putting the egg's number on the x-axis and its density on the y-axis. What is t variation in density is there from egg to egg?

.

If you like this project, you might enjoy exploring these related careers:

(http://www.sciencebuddies.org/science-engineering-careers/earth-physical-sciences/chemist)

Chemist (http://www.sciencebuddies.org/science-engineering-careers/earth-physical-sciences/chemist)

Everything in the environment, whether naturally occurring or of human design, is composed of new knowledge about chemicals to develop new processes or products. Read more (http://www.scie physical-sciences/chemist)

(http://www.sciencebuddies.org/science-engineering-careers/engineering/marine-architect)

Marine Architect (http://www.sciencebuddies.org/science-engineering-careers/engineering/marine-architect)

Water covers more than 70 percent of Earth's surface, and marine architects design vessels tha through or under those waters safely and efficiently. Some of their watercraft designs are enorn huge loads of oil, cars, food, clothing, toys, and other goods, across thousands of miles of oper trade between countries. Other vessels are smaller and more specialized, like luxury yachts or military purposes. Read more (http://www.sciencebuddies.org/science-engineering-careers/engineering/marine-architect)

Variations

- Does a hard-boiled egg float at the same salt concentration as an uncooked one? Hint: You will need to measure the same very precise about your serial dilutions.
- Find out how much salt there is in sea water. From the results of your experiment, predict whether an egg would float or si to the ocean, you can get collect some sea water and test your prediction!)
- Figure out another method of determining the density of an egg. Compare the density measurements for the same eggs u test.
- For another way of looking at salt water density, see the Science Buddies project Can Water Float on Water? (http://www.scienc ideas/OceanSci_p002/ocean-sciences/can-water-float-on-water).

Ask an Expert

The Ask an Expert Forum is intended to be a place where students can go to find answers to science questions that they have be If you have specific questions about your science fair project or science fair, our team of volunteer scientists can help. Our Expert make suggestions, offer guidance, and help you troubleshoot.

Ask an Expert (http://www.sciencebuddies.org/science-fair-projects/ask_an_expert_intro.shtml)