EXPERIMENT 1

THATSA PASTA!

A delicious density experiment

Contents:

ACKNOWLEDGEMENTS

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Teacher Guide

THATSA PASTA!

A delicious density experiment

AGE LEVEL

This activity in its existing format is appropriate for ages 14-18. It can be adapted for ages 10-13.

SUBJECT

Physical science, chemistry

PURPOSE(S)

1. To illustrate the distinction between intensive and extensive properties.
2. To expose students to common measuring instruments used in the lab.

SCIENCE SKILLS AND ABILITIES

SKILLS NEEDED IN PHYSICAL SCIENCE - (ages 10-13)

- Students observe and measure characteristic properties, such as boiling points, melting points, solubility, and simple chemical changes of pure substances and use those properties to distinguish and separate one substance from another.
- Properties and changes of properties in matter: fundamental concepts and principles that underlie this standard include: A substance has characteristic properties, such as density, a boiling point, and solubility, all of which are independent of the amount of the sample. A mixture of substances often can be separated into the original substances using one or more of the characteristic properties.

ABILITIES NECESSARY TO DO SCIENTIFIC INQUIRY - (ages 14-18)

- Use technology and mathematics to improve investigations and communications. A variety of technologies, such as hand tools, measuring instruments and calculators, should be an integral component of scientific investigations. The use of computers for the collection, analysis and display of data is also important. Mathematics plays an essential role in all aspects of an inquiry. For example, measurement is used for posing questions, formulas are used for developing explanations, and charts and graphs are used for communicating results.

KEY VOCABULARY

DENSITY: A characteristic property of matter equal to mass per unit volume (or mass/volume.)

DISPLACEMENT: When one object/substance takes the place of another object/substance.

EXTENSIVE PROPERTY: A property of a substance that depends on sample size and varies when sample size is changed (such as mass, volume, and dimensions.)

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.)

HYDRATION: The chemical combination of water with some other substance.

INTENSIVE PROPERTY: A property that does not depend on sample size and does not vary when the sample size is changed (such as density, temperature, and color.)

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.)

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

SOLUBLE: When a substance is capable of being dissolved or passed into a solution under certain conditions.

VOLUME: The amount of space occupied in three dimensions (that is, cubic contents.)

CONCLUSIONS (ANSWER KEY)

1. Using hot water increases the rate of absorption of water, speeding up the procedure.
2. The density of the hydrated pasta remains unchanged because density is an intensive property, meaning it is fixed and therefore, the absorption of water should have no change on its value. The mass and volume are both extensive properties so they change (or increase) when the sample size changes (or increases) during the hydration. However, since both mass and volume increase, those increases are cancelled out when density is calculated.

Sample of Actual Readings:

Pasta Type	gemelli	bowtie
Initial Dry Mass (g - grams)	9.5	10.1
Initial Volume (mL - milliliters)	8.1	8.0
Wet Mass (g - grams)	17.3	15.3
Wet Volume (mL - milliliters)	15.0	13.4
Dry Density (mass / volume)	1.2	1.3
Wet Density (mass / volume)	1.15 (-1.7%)	1.14 (-9.5%)

3. The greatest source of error in this procedure will occur during volume measurement due to human errors in reading the graduated cylinder. Errors during mass measurement will be limited or nonexistent because the balance is a machine that provides accurate readings without relying on human input. (Additional sources of error seen through density values that fluctuate also originate in human error. Common human errors in this experiment include pouring or blotting off pasta residue after the pasta was submerged and errors in hand calculations of the density formula.)

POSSIBLE EXTENSIONS

1. What would happen if you increased the length of time that the pasta was in of the hot water? Why do you think so? Test your prediction by using one type of pasta and recording mass and volume displacement measurements after 4, 8, 12 and 16 minutes. Graph volume (x-axis) vs. mass (y-axis). Do you see a pattern?

   ANSWER:
   When the pasta remains in the water, the mass continues to increase as more water is absorbed. Additional mass results in an increase in the volume of water displaced. Both mass and volume are extensive properties and both properties increase as water is absorbed. Density, however, is an intensive property. The absorption of water should have no effect on the density calculations (as long as reactions are not occurring and students do not lose any of the pasta). The graph of mass vs. volume will show a pattern. Data should first appear linear and the slope of a best fit line should be close to the density of water, 1.00 g/ml. Will the pasta continue to absorb water? There would come a time where the absorption of water would taper off; there is a limit to how much water the pasta can absorb. Data would show a decrease in the slope.

2. What would happen if you increased the temperature of the hot water? Why do you think so? Test your prediction to determine if you are correct.

   ANSWER:
   Using hot water increases the rate of absorption of water, speeding up the procedure. The initial slope of the graphed data should not change but the slope will begin to taper off sooner.

ADDITIONAL RESOURCES

For more experiments, visit 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 CQT 251 compact balance offers simplicity and durability at a price that fits school budgets. A removable draft shield and an AC adapter are provided, so there is nothing extra to buy. The reliable CQT 251 features the latest in weighing technology and is easy enough for novice students. Other features include simple four-button operation, 250g capacity and 0.1g readability, nine weighing units, AC or battery operation, overload protection, integral security bracket and auto-calibration. For complete product details, visit www.adamequipment.com.

GETTING INVOLVED IN ADAM EQUIPMENT'S EXPERIMENT PROJECTS

FEEDBACK ON THIS EXPERIMENT

If you have feedback on the THATSA PASTA! experiment 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 that you would like to share with other teachers, Adam Equipment would be interested in hearing from you. Initial submissions need to include only a simple description of the activity with the activity's purpose, subject and age level.

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

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Student Section

THATSA PASTA!

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INTRODUCTION

Contrary to popular theory, Marco Polo did not bring pasta to Italy from China. In fact, ancient cookbooks note that an inventive Italian cook first created pasta by the late 13th century. Pasta is the collective name applied to any of more than 500 varieties of spaghetti, noodles, macaroni and other products made from flour, water and sometimes eggs. Capellini, cavatelli, and fettuccine are some types of pastas, not to mention lasagna and spaghetti. Spaghetti is dried pasta made from wheat and water, while fettuccine is noodles made from flour and eggs.

HYPOTHESIS

Most of us think of pasta as something out of a box. But what happens to pasta when water is added? Will the water temperature alter what happens to submerged pasta?

WHAT YOU NEED:

- 50mL graduated cylinder (Note: a 100 mL cylinder may be used)
- 250 mL beaker
- Hot tap water (approximately 70°C) and room temperature tap water
- Different types of pasta (gemelli, elbow, bowtie, etc)
- Paper towels
- Adam CQT 251 Balance (250g x 0.1g)

PROCEDURE

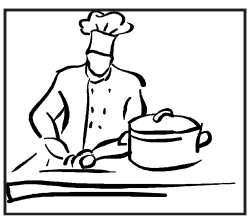
1. Place about 10.0 grams of one type of pasta on the balance and record the exact mass of the sample in the chart provided. (This is the initial dry mass.)
2. Fill the graduated cylinder with exactly 30.0 ml of room temperature water. Completely submerge the pasta sample in the water and record the change in the volume of the contents of the cylinder. (Determined by water displacement, this change is recorded as the initial volume of the dry pasta.)
3. Discard the room temperature water. Gently blot the pasta sample with a paper towel then place the pasta in a 250 ml beaker. Add hot water to completely submerge the pasta and let sit for 10 minutes.
4. Remove the pasta and gently blot with a paper towel to remove excess water. Weigh and record the new (wet) mass. Next, record the new (wet) volume of the pasta sample (see step two.)
5. Calculate the density of both the dried pasta and the slightly hydrated pasta.
6. Redo the above steps with several different types of pasta and record the results for mass, volume and density.

Pasta Type					
Initial Dry Mass (g - grams)					
Initial Volume (mL - milliliters)					
Wet Mass (g - grams)					
Wet Volume (mL - milliliters)					
Dry Density (mass / volume)					
Wet Density (mass / volume)					

ANALYSIS

Density, or mass per unit volume, is a characteristic property of matter. When mass and volume of a sample of a substance is measured, the resulting density can be calculated by:

$$\text{Density} = \frac{\text{Mass (g)}}{\text{Volume (ml)}}$$



CONCLUSIONS

1. Why use hot water instead of cold?
2. Does the density of the hydrated pasta increase? Decrease? Remain unchanged? Can you suggest possible explanations?
3. Which do you think is a greater source of error – the mass measurement or the volume measurement? Why?