

# Animal Sciences

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## Egg Experiments: A Fun and Informative Way to Teach the Fundamentals of Science

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### Introduction

Students enjoy “hands-on” assignments, and teachers enjoy using them to convey specific points about science. And because of that, the focus of this publication is to bridge science with agriculture and show how common agriculture products, namely eggs, can be used to teach some science concepts.

*Egg Density Experiment:* Density can be expressed as grams per cubic centimeter ( $\text{g}/\text{cm}^3$ ) or pounds per cubic foot ( $\text{lb}/\text{ft}^3$ ). The general standard to measure density is usually compared directly to water. A 1 cubic centimeter of water at  $4^\circ\text{C}$  ( $39^\circ\text{F}$  refrigerator temperature) weighs 1 gram; therefore, water’s density at that temperature is  $1 \text{ g}/\text{cm}^3$ , which is equal to 1 cc of water.

### Materials:

- Chicken eggs: purchase one dozen and allow to sit in the refrigerator for three weeks, and on the day of an experiment purchase a brand new dozen.
- Two quart jars per pair of students
- A box of table salt
- Water
- Disposable syringe (measure 1 cc of water)
- Gram scale

### Procedure:

- a) With each egg (old vs. new) in the two separate jars have students begin the following:
  - b) Weigh the eggs and syringe and record it.
  - c) Put 400 ml of water into the jars.
  - d) Remove 1 cc of water using the syringe and weigh it. The weight should be at or near 1 gram.
  - e) Place the egg(s) into each separate jar, and have the students observe the eggs.

- f) Have the students add three tablespoon of salt into the jar and stir-in (warm water works well), and have them try to float the eggs again.
- g) Next, get one 1 cc of water containing the mixture and weigh it, record all data.
- h) Place egg in jar and observe if it floats. If the egg floats, you have the density of the solution that floats that particular egg, because the solution was weighed in Step “f” above.
- i) Repeat steps “g-h” until the egg floats.

### Fundamental Questions:

1. Did the students notice one floating sooner than the other?
2. If so, the students could try to determine the relative density of each egg. They could explain why one would float sooner than the other.

### Relative Density Calculations

1. The student initially weighed each egg and for illustration purposes, assume one weighed 50 grams.
2. Students should do this for each egg.
3. Have the students carefully crack open the eggs and weigh the internal contents (yolk and albumen). A very good way to separate the internal components is to use an egg separator, shown below.



4. After each component is weighed, have the student determine the relative density.
5. For illustration purposes, let's assume the yolk weighed 15 grams, shell 5 grams and albumen was 30 grams, and total egg weight was 50 grams.
  - a) Protein is more dense than fat, so  $(30/50 * 100 = 60\%)$  is the contribution of protein directly. The yolk is approximately 50% protein, so determining the protein component would be  $(15/50 * 100 = 30\%)$  times 0.5 [account for the protein], so 15% for yolk, so total is  $(60\% + 15\% = 75\%)$ . The shell was  $5/50 * 100 = 10\%$ . Now, have the students add all the numbers up  $60\% + 15\% + 10\% = 85\%$  and compare it between the eggs.

### Chemical Challenge(s):

- In these experiments, students will realize the importance of chemical challenge to egg shells. Students can work in pairs or individually.

### Materials:

- Fresh chicken eggs (get enough so each student will have one egg)
- Vinegar and crayons
- Tooth paste (a couple varieties would be ideal, i.e., kids, adult, etc.,)

### Procedure:

- a) In separate quart jars fill to approximately 2/3 for each solvent.
- b) Have students put one egg in the jar.
- c) Have students take other eggs and coat 1/2 of the egg with toothpaste (the amount applied will affect results so a thin layer will protect differently than if a student applies a thick amount). This should be replicated for each type of toothpaste available. The amount of toothpaste put on each egg should be consistent in weight, so equal amounts are being compared on a weigh basis.
- e) Have students put 1/2 coated eggs in solvent jars.
- f) In separate jars, have students write their names (make the names essentially bold/wide and well defined) on the eggs using crayons and place them in vinegar jars.
- g) Be sure students label jars by toothpaste treatment.
- h) Let eggs sit for 24 hours.
- i) After the 24 hour period, have students remove eggs from jars.

- j) Have students record their observations as well as making comparisons between the various egg treatments.
- k) Students should notice the complete removal of eggshell from all uncoated surfaces. If this does not happen, have the students return the eggs back to jars, and have them check again the following day.

### TEACHER NOTES:

In the above experiment, students should discover shell removal under the harsh conditions of acid, as well as protection from toothpaste and even crayons. By using a variety of toothpastes, students should gain some appreciation as to which kind of toothpaste may be best for them by examining loss of calcium due to acid.

### Egg in a Bottle

#### Materials:

1. Need medium size boiled egg.
2. Boil eggs by placing eggs in a pot with enough to cover completely by 1-2 inches above eggs. Bring to a boil. Once the water is boiling, turn the heat to medium and allow to cook for 10-minutes.
3. Remove from heat and place under cool water to chill them quickly.
4. Crack and peel.
5. Bottle with a neck just small enough that the egg won't fall in (Erlenmeyer Flask, 1000 ml is perfect, see below). You may want to put a little water around the rim to guard against tearing of the egg.



**Procedures:**

There are a number of ways to get the egg into the bottle:

1. If you are going to use paper, wad it up, drop it in the bottle, and light it and allow it to burn out and immediately (be sure the egg shell is removed and the egg is moist). Put the egg in the neck of the bottle. The egg will be sucked into the bottle. This happens because as the air inside the bottle cools and takes up less space. Now, the external pressure outside the bottle will force the egg into the bottle in order to balance the pressure. To get the egg out of the bottle, turn the bottle upside down with the egg resting on the inside of the mouth of the bottle. Place your mouth over the mouth of the bottle and blow hard. When you stop blowing, the egg will pop out.
2. Another way to do this is to use hot water. If you take the flask and hold it under hot water from the tap for 30-40 seconds and then place the egg on top (the neck) and then turn the water to cold, it will suck in the egg inside. Conversely, you can remove the egg by tilting the bottle and then allowing hot water to run on the flask bottom.

**Diffusion and Osmosis in Animal Cells**

*Diffusion* — the process by which molecules spread from areas of high concentration to an area of lower concentration. When the molecules are evenly distributed, it is called EQUILIBRIUM. In the experiment below, the yolks will try to achieve equilibrium given the two different solvents.

*Concentration gradient* — a difference between concentrations in a space.

*Osmosis* — the diffusion of water (across a membrane)

Procedures to test different levels of diffusion and osmosis.

**Materials Available:**

- Fresh eggs (separate the from previous investigation)
- Clean jars
- Have students break open eggs and weigh the yolks.
- Vinegar and Syrup (any flavor will work, more sugar the better)

**Procedures:**

1. In separate jars, put vinegar and syrup.
2. Break open two eggs, separate the yolk from albumen and weigh the yolk. Chances are the students will have to repeat this a few times.

3. After the weight is determined, have students place them into the jars.
4. After 3-4 hours, have the students get the yolks out and reweigh them.
5. Have students determine if they yolk gained or lost weight as the calculations suggest.
  - a) Yolk weight after 3-4 hours minus original weight = a positive number means the yolk took on weight in the form of water. A negative number means the yolk lost water weight.

*Egg strength* — Try to see how much weight an egg will support.

**Materials:**

- Eggs (suggest three populations of eggs (some very old eggs, 3-months in the refrigerator; some fresh; all hard boiled).
- Soft drink bottle tops or similar
- Bucket to add water
- Plastic tablecloth for the table
- Piece of wood 12" by 12"
- The base would be set up similar to the picture below.



- The second picture below shows the board on top, bucket and pouring in water.

**Procedures**

1. Weigh the eggs (the eggs should not be mixed between the three proposed groups, old, fresh, and hardboiled). Repeat this three times, and start with fresh eggs.
2. Have students place the eggs, small end down into the bottle caps, then place boards over the top.
3. Before stacking weight, weigh the board on top of eggs and bucket. With the bucket on top have students, carefully add water in known amounts. Students should weigh the water in contains before adding so they can carefully track the weight being applied.
4. Calculations:
  - a) Total weight it took to crack the eggs divided by four puts this on a per egg basis.
  - b) Have students compare the strength between fresh, old and hard boiled.

**NOTES:**

It will take approximately 25 lbs to break the four fresh eggs.