Eggs-plosion!

Students conduct egg-mazing eggs-periments while learning about the scientific method.

Grade Level: 3rd

Objectives:

- Students will be able to make hypotheses about what will happen in an experiment.
- Students will design and conduct experiments while following the steps of the scientific method.
- Students will develop additional questions from the results of previous experiments.

Materials:

- Clear glass bottle (Starbucks frappuccino bottles work well)
- Hard-boiled eggs (medium sized)
- Raw eggs (medium sized)
- Lighter or matches, bowl, water, paper (plain or newspaper)
- A worksheet for each student

Appendixes:

- Teacher's guide to activity 2: Page 5
- Student worksheet: Page 6

Time Considerations:

Preparations: 25-30 minutes
Lesson Time: 45-50 minutes
Introduction: 10 minutes
Activity 1: 10 minutes
Activity 2: 20 minutes
Conclusion: 5-10 minutes

Related Lesson Plans:

Flubber, Yellow/Blue Switcheroo, Mentos Super Fountain, H_20lympics, Blood-Typing, Mystery Box

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Nevada Department of Education Standards

Scientific Inquiry

N.5.A Students understand that science involves asking an answering question and comparing the answers to what scientists know about the world

N.5.A.1 Students know scientific progress is made by conducting careful investigations, recording data and communicating the results in an accurate method.

N.5.A.3 Students know how to draw conclusions from scientific evidence.

Excellence in Environmental Education Guidelines

Strand 1—Questioning, Analysis and Interpretation Skills

A) Learners are able to develop questions that help them learn about the environment and do simple investigations.

G) Learners can develop simple explanations that address their questions about the environment.

This lesson has been adapted from Steve Spangler's Science's *The Egg in the Bottle Trick* lesson:

Steve Spangler Science. (2010). *The Egg in the Bottle Trick*. Retrieved Dec. 8, 2010, from http://www.stevespanglerscience.com/experiment/00000022

Background

This is the typical egg in the bottle experiment. But how does it work? The main explanation for the experiment relates to air pressure.

If you were to set an egg on the opening of the glass bottle, the egg's diameter is too large for it to slip inside. The pressure of the air inside and outside of the bottle is the same, so the only force that would cause the egg to enter the bottle is gravity. But, gravity is not sufficient to pull the egg inside the bottle.

When you change the temperature of the air inside the bottle, you are also changing the pressure of the air inside the bottle. If you have a constant volume of air and heat, the pressure of the air increases. If you cool the air, the pressure decreases. If you can lower the pressure inside the bottle enough, the air pressure outside the bottle will push the egg into the container.

It is easy to see how the pressure changes when you chill the bottle, but why is the egg pushed into the bottle when heat is applied? When

you drop burning paper into the bottle, the paper will burn until the oxygen is consumed (or the paper is consumed, whichever comes first). Combustion heats the air in the bottle, increasing the air pressure. The heated air pushes the egg out of the way, making it appear to jump on the mouth of the bottle. As the air cools, the egg settles down and seals the mouth of the bottle. Now there is less air in the bottle than when you started, so it exerts less pressure. When the temperature inside and outside the bottle is the same, there is enough positive pressure outside the bottle to push the egg inside. Positive pressure is pressure greater than that of the atmosphere.

Heating the bottle produces the same result (and may be easier to do if you can't keep the paper burning long enough to put the egg on the bottle). The bottle and the air are heated. Hot air escapes from the bottle until the pressure both inside and outside the bottle is the same. As the bottle and air inside continue to cool, a pressure gradient builds, so the egg is pushed into the bottle.

Now, if you would like to get the egg out of the bottle, you have to increase the pressure inside the bottle so that it is higher than the pressure of the air outside of the bottle. Roll the egg around so it is situated with the small end resting in the mouth of the bottle. Tilt the bottle just enough so you can blow air inside the bottle. Roll the egg over the opening before you take your mouth away. Hold the bottle upside down and watch the egg 'fall' out of the bottle.

Alternatively, you can apply negative pressure to the bottle by sucking the air out, but that might not be the best way to do it (*The Naked Scientists*). To view a video demonstration of this experiment, please visit www.stevespanglerscience.com /experiment/00000022.

Preparation

Hard boil eggs:
Place a raw egg in a saucepan. Run cold water into the saucepan until the water is 1 inch above the egg. Place the saucepan on a stove and cook over medium heat until the water begins to boil. Reduce the heat to low. Simmer for 10 to 15 minutes. Remove the egg with a spoon and let it cool slowly or run cold water over it to cool it more quickly. After cooling, carefully remove the shells and put them back in the cool water. Let the unshelled hard-boiled eggs sit in the water until you lift them out to put on the bottle top.

Doing the Activity

Egg-troduction
Ask the students if they have ever done an experiment. If so, ask them what they did, what were they trying to find out, what did they use, etc.

Whenever scientists (and we will be scientists today!) do experiments they follow certain steps to ensure they are finding quality results. Does anyone know what this group of steps or process is called?

Put the steps on the board and go over what each one entails.

1. Question: When scientists do experiments, they always begin with a question.

2. Hypothesis/Prediction: After asking the question scientists then try to guess the answer.

3. Research: Randomly combining things from around the house is dangerous so scientists have to do some research by reading, looking on the internet or asking other scientists.

4. Experiment: This is generally the fun part. Scientists do an experiment by following the directions and they have fun! But they are always safe and careful.

5. Results: Scientists keep accurate records of results of their experiment.

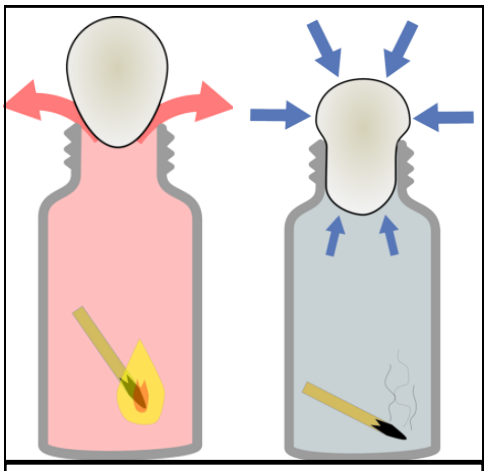
6. Conclusion: Examine the

meaning of your results; speculate why certain data resulted from your experiment.

Tell the students during today's lesson they are going to be scientists and follow the scientific method (*Science Buddies*).

Activity 2: Egg-splosion!

The goal of this experiment is to see if a hard-boiled egg can be forced inside a bottle, even when the egg is bigger than the opening of the bottle (without breaking the bottle).



Lit match = air heats up and expands
Match goes out = air shrinks reducing pressure

Pose an experimental question and have students make a hypothesis before starting the experiment

Experimental Procedure

Set a hard-boiled egg on top of the glass bottle and show how it cannot fall into the container on its own.

Remove the egg and put it back into the water.

Dip your finger in the water (or vegetable oil) and rub it on the rim of the glass to give it some lubrication.

Rip a narrow piece of paper (or newspaper). Light a small strip of paper on fire. Let the paper continue to flame and then quickly put the ignited paper into the glass bottle.

This part needs to be done very quickly to ensure the experiment works. After you put the lit paper into the glass bottle, gently place the egg on top of the bottle.

Sit back and watch the egg get sucked down into the bottle. Listen for the sucking sound.

Ask students what they observed during the experiment. Compare the results of the experiment to students' hypotheses.

What conclusions can we draw about the experiment? What additional questions do we have about why the egg was sucked into the bottle? What further experiments could we conduct to answer our questions?

Activity 3: Eggs-perimenting

The goal of this exercise is for students to use the steps of the scientific method to conduct an experiment that will help identify which of two eggs is a raw egg and which is a hard-boiled egg (suggested methods in appendix).

Have students form groups of about three or four. Give each group one hard-boiled and one raw egg.

Let the students explore the eggs for a couple of minutes. Have students record observations about what differences they can notice between the two eggs. Afterwards, regroup as a class.

Pose the experimental question to the class: How can you tell the difference between a raw and hard-boiled egg without breaking the egg open? Have student write the question on their worksheet.

Brainstorm possible hypotheses and experiments that could help answer our question with students.

Have students return to their groups and identify two hypotheses and develop two experiments that would test their hypothesis. Have students record each step of the scientific method (hypothesis, materials, procedure, results, conclusion) on their worksheet.

In order to test their results groups will crack what they think is their raw egg in front of the classroom.

Conclusion

Have students record their results and draw a conclusion from the experiment.
Have students share what conclusions they drew from their experiment.

Do you think we can draw any definite conclusions? What should we do, that all good scientists do, to ensure that we had accurate results and can draw conclusions with confidence? (*Conduct multiple trials of the same experiment.)*

Have students follow the steps of the scientific method and design an experiment to try and get the egg out of the bottle (without breaking it) in order to help test their hypothesis about why the egg was sucked into the bottle.
After conducting their experiments, have students record results and draw conclusions about their hypotheses.

What new questions do we have about why the egg was sucked into the bottle?

Vocabulary

Conclusion: a decision or answer, based on facts

Hypothesis: an educated guess

Materials: the tools and other things needed to perform a particular task

Results: the outcome(s) of a certain task or procedure

Scientific Method: the system of advancing knowledge by formulating a question, collecting data about it through observation and experimentation, and testing a hypothetical answer

Assessment

Staple student worksheets into their science journal to then be reviewed for completeness, correct spelling and grammar, and ability to follow the scientific method.

Extensions

Have students create a hypothesis about why the egg was sucked into the bottle after adding the flame to the bottle.

Sources

- Science Buddies. (2010). *Steps of the Scientific Method.* Retrieved Aug. 26, 2010, from http://www.sciencebuddies.org/science-fair-projects/project_scientific_method.shtml
- Steve Spangler Science. (2010). *The Egg in the Bottle Trick.* Retrieved Dec. 8, 2010, from http://www.stevespanglerscience.com/experiment/00000022
- The Naked Scientists. (2010). *Kitchen Science Experiments: Sucking an Egg into a Bottle.* Retrieved Dec. 8, 2010, from http://www.thenakedscientists.com/HTML/content/kitchenscience/exp/sucking-an-egg-into-a-bottle/

Images:
- Ansell, D. (2010). *What is Going On? photos*. Retrieved Aug. 31, 2011, from http://www.thenakedscientists.com/HTML/content/kitchenscience/exp/sucking-an-egg-into-a-bottle/

Teacher's Guide to Activity 2: *Eggs-perimenting*

Suggested methods for how to tell if an egg is raw or hard-boiled without cracking it.

Method 1

1. On a hard surface, spin the egg on its side with your fingers and thumb.
2. Stop its rotation with a fingertip, by placing your finger directly down on the rotating egg.
3. Lift finger immediately.
4. If the egg remains still, it is hard-boiled.
5. If the egg continues to slowly rotates, it is raw.

Method 2

1. On a hard surface, place your thumb on one end and your middle finger on the other.
2. Spin the egg
3. If the egg spins fast, then the egg has been hard boiled.
4. If, however, it spins very slowly, it is raw.

Method 3

1. Shake the egg.
2. If you feel movement or hear movement the egg is raw.
3. If you do not feel or hear any movement the egg is hard-boiled.

Method 4

1. Place an egg on a hard surface
2. Stand the egg up, so that it is standing on one of it's points.
3. Release the egg and observe the rocking motion.
4. If the egg continues to rock back and forth it is hard boiled.
5. If the egg does not rock at all it is raw.

The Scientific Method

Question: *How can you tell the difference between a raw and hard-boiled egg without breaking the eggs open?*

Prediction *Raw eggs are more green in color than hard-boiled eggs.*	**Prediction**
Materials • *Raw Egg* • *Hard Boiled Egg* • *Magnifying Glass* •	**Materials** • • • •
Steps 1. *Hard boil an egg* 2. *Use a magnifying glass to study a hard-boiled and raw egg* 3. *Compare the color of the hard-boiled egg to the raw egg*	**Steps** 1. 2. 3. 4. 5.
Results *The egg that was greener in color was the raw egg.*	**Results**
Conclusion (What did I learn?): *You may be able to tell he difference between a raw and hard-boiled egg by their color.*	**Conclusion (What did I learn?):**