DOKTOR KABOOM!
"THE SCIENCE OF SANTA"

Educator's Resource Guide

Science and Magic are the same thing. Therefore, Santa Claus must be the greatest scientist alive. This realization does not sit well with the towering ego of science comedian, Doktor Kaboom. Join us as Kaboom struggles valiantly to solve the magical mysteries of the man in red. In this new holiday show, Doktor K attempts to learn the secrets behind making reindeer fly, getting down those tight chimneys, and knowing who's been bad or good. Will he succeed? We doubt it, but we're sure going to have fun watching him try!

(K-5. No holiday icons will be harmed during the making of this show)

Introduction

Welcome, this study guide is intended to assist educators as a supplement to live performances of "*Doktor Kaboom! The Science of Santa".* The resources on the following pages are designed to help your students fully grasp the scientific and theatrical concepts they have experienced, and to nourish the seeds of discovery and adventure that we hope to have planted.

Mission

Doktor Kaboom! strives to remind audiences of all ages that the foundations of scientific discovery can be joyful tools for a lifetime. Through highly interactive comic performances we encourage students to express their awe of scientific demonstrations, to creatively explore the world around them, and to realize that science and mathematics are meant for everyone.

Artist Bio

Doktor Kaboom is the creation of Actor/Comedian David Epley.

David has been fortunate enough to discover two passions in his life. Science, his first, took him to studies at the North Carolina School of Science and Mathematics. His second, performing, became his career, and for 20 years David has made his living writing, performing, and directing original interactive comedy across the US and Canada.

Since creating the character of Doktor Kaboom, science education has become David's life, taking him to theatres, festivals, and schools all over the world. Recent performances of note include the John F. Kennedy Center, the Singapore Science Festival, and the Word Science Festival.

Vocabulary

Chemical: A substance with a distinct molecular composition that is produced by or used in a chemical process

Chemical Reaction: occurs when two different elements or compounds come together and at least one of them changes its composition or identity.

Exothermic: chemical reactions that produce (or give off) heat.

Clock Reaction: Reaction of chemical compounds in which the concentration of one or more components exhibits periodic changes.

Bernoulli's Principle: the principle in hydrodynamics that an increase in the velocity of a stream of fluid results in a decrease in pressure

Friction: resistance (rubbing) encountered by moving object relative to another object with which it is in contact

Air Pressure: the force exerted by air on any surface in contact with it.

Gravity: force that attracts a body toward the center of the earth, or toward any other physical body having mass.

STEM: Acronym for Science Technology Engineering Mathematics

Trajectory: the path described by a projectile flying or an object moving under the action of given forces.

Thrust: the propulsive force of a jet or rocket engine.

Topics for Discussion

These topics are great conversation starters for classroom discussions following the performance:

Science vs. Magic

What does Doktor Kaboom mean when he says science and magic are the same thing?

Did he succeed?

Do you think Doktor Kaboom got anything right about how Santa does what he does? Which ones? Why/Why not?

Science History

In his opening song, Doktor Kaboom mentions many famous men and women of science. Here are a few and a little bit about them:

Albert Einstein, Physicist

1879-1955. German born, became US citizen. (Like Doktor Kaboom!)
Won the Nobel Prize for Physics in 1921
Most famous for developing his Theory of Relativity, a foundation of modern physics
Also famous for the equation $E=mc^2$

Daniel Bernoulli, Physicist and Mathematician

1700-1782. Swiss
Known for Bernoulli's principal, governing conservation of energy in fluid mechanics.
Also for the underlying mathematics of the principle.

Michael Faraday, Chemist and Physicist

1791-1867. Made great contributions to the study of electricity. Best known for discoveries of electromagnetic induction, diamagnetism, and the laws of electrolysis. Had very little formal education, and poor math skills, but still one of the greates scientists of history. Albert Einstein kept a picture of Faraday on his wall, for inspiration.

Marie Curie, Physicist and Chemist

1876-1934. Polish. Won the Nobel Prize in Physics in 1903, and again for Chemistry in 1911. Best known for her studies of radioactivity. (She's even the one who made up the word!) Discovered two of the elements on the periodic chart, Polonium and Radium.

Here are the other scientists mentioned in the song. What can you find out about them?

Stephen Hawking Jane Goodall Nikola Tesla Alan Turing

Classroom Demo, CD Hovercraft

Materials:

* Old CDs or DVDs (Note: They will no longer be playable after this demo)
* Balloons, medium sized
* Pull spout bottle caps
* superglue

Procedure:

1. Glue the bottle lid over the hole of the CD. Make sure it is centered over the hole.
2. Make sure you can still open and close the lid.
3. Let it dry completely.
4. Attach the balloon to the opening of the lid. Push the stem of the balloon as far as you can down the bottle lid.
5. Open the bottle lid.
6. Blow air into the balloon through the hole in the CD.
7. Close the lid so the air cannot escape.
8. Release the hovercraft and watch it glide across the table.

Explanation:

When the cap is pulled up, it will let the air flow through and under the CD, lifting it up and causing it to hover. The balloon is the lift engine that supplies a steady stream of pressurized air underneath the CD. You don't need a skirt as the CD is light enough to lift by itself.

Compare the hovercraft to a disc without a balloon sliding across the same surface.

Experiment by moving it over different surfaces and see how it responds.

Can it work over water?

How might you build this bigger?

Classroom Demo, Air Pressure

Materials:

* Boiled eggs
* Narrow necked bottle or flask
* Matches, paper

Procedure:

1. Place the peeled, boiled egg on top of the bottle.
2. Question students to see if they can think of a way of getting the egg into the bottle without causing it to break.
3. Remove the egg from the top of the bottle, momentarily.
4. Light the match and start burning a small piece of paper.
5. Drop the burning paper into the bottle and place the egg on top of the bottle, narrow end down.
6. Observe the flame go out shortly thereafter, the egg beginning to be "sucked" into the bottle, and the entire egg, with minimal damage, in the bottle.

Discussion:

1. How are the burning piece of paper and the fact that the egg gets "sucked" into the bottle related?
2. Does the egg really get "sucked" into the bottle? Explain the procedure in a more scientific fashion.
3. Propose a method for getting the egg out of the bottle, without causing damage to the egg.

Explanation:

The egg is not sucked into the bottle. In reality it is pushed. The flame has heated the air inside the bottle, causing the air to expand. It escapes the bottle, creating a pressure differential between the inside and the outside of the bottle, resulting in the air molecules outside the bottle hitting the egg with more force per area than the air molecules on the inside, resulting in the egg being literally pushed into the bottle.

Classroom Demo, Iodine Clock Reaction

A simple, but extremely memorable, clock reaction for the classroom.

Materials:

1. 3 clear plastic cups 4 ounces or larger
2. A 1000 mg Vitamin C tablet (or two 500mg)
3. Tincture of iodine (2%) (pharmacy)
4. Hydrogen peroxide (3%) (pharmacy)
5. Liquid laundry starch (you can use corn starch, but it will be cloudy and slower)
6. Safety goggles
7. Measuring spoons
8. Measuring cup

SAFETY NOTE: Iodine stains just about anything it touches. Hydrogen peroxide can cause eye and skin irritation - safety goggles and gloves are needed throughout the experiment. Lab coats or other protective garments are recommended.

Procedure:

1. Put on those safety goggles and gloves. Mash the Vitamin C by placing it into a plastic bag and crushing it with a rolling pin or the back of a large spoon. Get it into as much of a fine powder as possible., and put all the powder in the first cup. Add 2 ounces (60 ml) of warm water. Stir for 30 seconds. (The water may be a little cloudy) This is now “LIQUID A”.
2. Place 1 teaspoon (5 ml) of LIQUID A into a new cup and add 2 oz (60 ml) of warm water and 1 teaspoon (5 ml) of the iodine. This is “LIQUID B.”
3. In the last cup, mix 2 oz of warm water, 1 Tablespoon (15 ml) of the hydrogen peroxide and 1/2 teaspoon (2.5 ml) of the liquid starch to make “LIQUID C”
4. Now it’s time for the clock reaction. Pour all of LIQUID B into LIQUID C. Then pour them back and fourth between the 2 cups a few times. Place the cups down and observe.

This is called a clock reaction because you can change the amount of time it takes for the liquids to turn blue.* Basically, we have a battle of chemistry between the starch which is trying to turn the iodine blue, and the Vitamin C which is keeping it from turning blue. Eventually the Vitamin C loses and, voila, Blue!

*Change it up to make a real experiment, not just a demo. How does the outcome change if you change the variables? Try changing the water temperature, the amount of Vitamin C, or the amount of mixing time to see how it affects the outcome.

An Invitation

Join me online for fun videos, links and daily discussion at

www.facebook.com/doktorkaboom

See you there!

Ja? Ja!