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# *Doktor Kaboom!*

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Educator's Resource Guide

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### Introduction

Welcome, this study guide is intended to assist educators as a supplement to live performances of *Doktor Kaboom!* 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 to be fun.

### 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.

For the first time, David brings his passions together for an exciting new solo show; A Science Comedy extravaganza with an explosive style that refuses to allow audiences the time to catch a breath.

David lives in Yellow Springs, Ohio and is the proud papa of his 5-year-old daughter, Jindalee. He believes strongly in service, is a veteran of the US Army, and volunteers as an EMT and firefighter with his local Fire/Rescue department.

Vocabulary

**Amplify:** to cause to become more marked or intense

**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.

**Demonstration:** showing the existence or truth of something by giving proof or evidence

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

**Experiment:** a scientific procedure undertaken to make a discovery or to test a hypothesis

**Force:** anything that acts on a body to change its rate of acceleration or alter its momentum.

**Fulcrum:** the point on which a lever rests or is supported and on which it pivots.

**Lever:** a rigid bar resting on a pivot, used to help move a heavy or firmly fixed load with one end when pressure is applied to the other.

**Simple Machine:** a device that has only one function and a minimum of moving parts.

**Theory:** a supposition or a system of ideas intended to explain something

**Transmit:** to pass on from one place or person to another

**Vacuum:** a space where there is no matter

**Vortex:** a mass of whirling fluid or air, esp. a whirlpool or whirlwind

### Topics for Discussion

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

#### Safety

Why should we always practice Safe Science?

If you are going to do an experiment or demonstration, and you already know you won't need safety glasses, why should you wear them?

#### Vacuum

What does Doktor Kaboom mean when he says, "There is no such thing as a vacuum. There is only pressure, or the absence of pressure."?

#### *"There is no such thing as a scientific fact."*

We call gravity a scientific fact, when in reality it is no such thing. We assume gravity will work as we expect, simply because it always has. Gravity has worked, **so far**. There is always the **possibility** that some time in the future, it will behave differently. We must remember to keep an open mind. Sometimes a 'scientific fact' is falsified by newer and better science. That's how science works.

#### *"Applying science to everyday life."*

We often forget to apply what we know of science to our everyday lives. Doktor Kaboom demonstrates this with his catapult when he discusses how to win the Test of Strength at the state fair, by using our knowledge of levers and fulcrums. What other ways can we apply our knowledge of science to our daily lives?

#### Being Right

When we have an idea in science, we call it a theory. We test our theory with experiments. Does it matter in science whether we are right or wrong?

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, Elephant Toothpaste

Shows the decomposition of hydrogen peroxide catalyzed by potassium iodide. The reaction is done in a tall graduated cylinder so that the foamy product shoots out very quickly in a tall cylindrical shape; hence, the name elephant toothpaste.

#### Materials:

tall graduated cylinder (at least 500 ml)

food coloring

dish detergent

30% hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>)

**HINT:** use 6% H<sub>2</sub>O<sub>2</sub> for safer demo, available at beauty supply stores

saturated solution of potassium iodide (KI)

disposable gloves

#### Hazards:

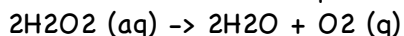
1. Wear safety goggles. Also, wear disposable gloves when pouring 30% hydrogen peroxide, as it is a very strong oxidant.
2. Do not stand over the graduated cylinder because steam and oxygen are produced quickly.

#### Procedure:

1. Place a garbage bag or other covering on the lab table and possibly on the floor.
2. Put on disposable gloves. Pour 80 ml of 30% hydrogen peroxide into a graduated cylinder.
3. Add about 20 ml of dish detergent to the hydrogen peroxide.
4. Tilt the graduated cylinder and drip red and/or blue food coloring down the sides of the graduated cylinder to make your toothpaste striped
5. Quickly add the saturated solution of KI solution and stand back. Move your hand away from the top of the graduated cylinder quickly or the hot foam will get on your hand and arm.

#### Discussion:

The rapid catalyzed decomposition of hydrogen peroxide produces O<sub>2</sub> gas, which forms foam with the liquid detergent:



The I<sup>-</sup>ion is a catalyst for the reaction. The brown color of the foam is evidence of iodine in the reaction. It will stain clothes, skin, and carpet

#### Disposal:

Leave the gloves on while cleaning up. The foam and solution left in the graduated cylinder may be rinsed down the drain with excess water.

Classroom Demo, Air Cannon  
(Vortex Generator)

Materials:

- 1 large trash can
- 1 Heavy Duty shower curtain or garbage bag
- Duct tape
- Fog Machine and fluid

Procedure:

1. Carefully measure, mark, and cut a hole in the bottom of the trash can. Be sure the hole is no more than 50% of the diameter of the can.
2. Trim and tape the shower curtain over the open end of the can. Pull fabric fairly taut, and be sure to tape it down completely around the can, you do not want air to escape this end.
3. Hold or set the can horizontally. Fill the can with fog. Slap the membrane and observe the response.

Alternatives to fog machine: Dry Ice and warm water, incense, smoke balls (outdoors only)

Discussion:

1. How are the rings being formed?
2. What would happen if the can were a box rather than a cylinder?  
(Try it!)
3. What would happen if the hole were bigger or smaller?
4. What if the hole were triangular instead of circular? (Try it!)

Explanation:

When we hit on the end of the Air Cannon, we are moving the air through the cannon at high speed. The air in the center continues to move at high speed, the air around the edges is slowed down, twisted around upon itself, making the air vortex.

Math Patterns  
(grades 5 and higher)

It is unfortunate that many people grow up deciding they hate mathematics. It is more likely that they simply dislike numbers. But, math is not about numbers. Numbers are simply the alphabet of mathematics. Math is about patterns. We use numbers to describe and explore these patterns.

For example, counting is a pattern: 1, 2, 3, 4, 5.... The next number in the pattern is, of course, 6. And on, and on, and on.

For Example, Multiples of 9:

$1 \times 9 = 09$	$10 \times 9 = 90$	09, 90
$2 \times 9 = 18$	$9 \times 9 = 81$	18, 81
$3 \times 9 = 27$	$8 \times 9 = 72$	27, 72
$4 \times 9 = 36$	$7 \times 9 = 63$	36, 63
$5 \times 9 = 45$	$6 \times 9 = 54$	45, 54

A fun pattern:

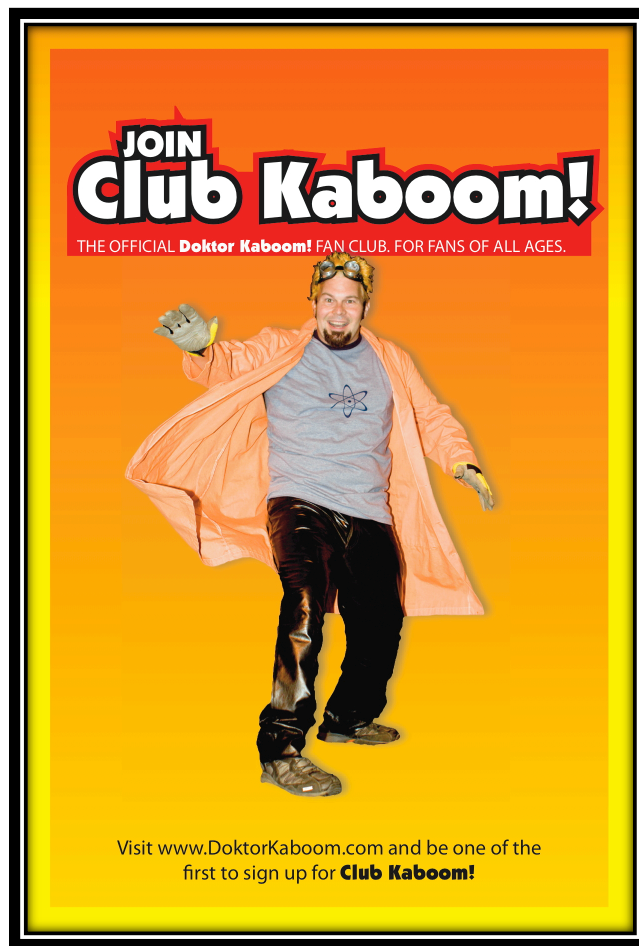
Using this pattern you can multiply 11 by any 2-digit number faster than someone else can do it with a calculator.

To multiply any two digit number by 11:

- \* For this example we will use 26.
- \* Separate the two digits in your mind (2\_\_6).
- \* Notice the hole between them!
- \* Add the 2 and the 6 together ( $2+6=8$ )
- \* Put the resulting 8 in the hole: 286. That's it!  $26 \times 11 = 286!$

The only thing tricky to remember is that if the result of the addition is greater than 9, you only put the "ones" digit in the hole and carry the "tens" digit from the addition. For example  $49 \times 11 \dots 4\_9 \dots 4 + 9 = 13 \dots$  put the 3 in the hole and add the 1 from the 13 to the 4 in order to get 5 for a result of 539 ...  $49 \times 11 = 539$ .

### An Invitation



#### **Club members receive:**

- E-subscription to The Kaboom News, with first notice of upcoming shows & special events.
- Your very own downloadable membership card.
- Special club discounts on Doktor Kaboom merchandise.
- Access to a secret, members only video page featuring monthly videos from Doktor K!

We will also automatically enroll you in a special drawing to win a free performance of Doktor Kaboom at YOUR school!