DOKTOR KABOOM!

Look Out! Science is Coming!

Study Guide

This Study Guide was prepared by the Tennessee Performing Arts Center, Nashville, TN

Written by Teaching Artist Neil Spencer

Edited by Susan Sanders

We appreciate TPAC's willingness to share this with other presenters and the schools they serve.

Photo by Martin Albert

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Welcome to the Wacky World of Doktor Kaboom!

Doktor Kaboom offers your students a riotous romp through the varied regions of science. Actor David Epley has created a fun and engaging character, but don't be fooled by the spiky hair, goofy goggles, and extravagant German accent. Science is the real star of this show.

Rare indeed is the student that is not totally pumped up and energized about science after this hour long, one-man, scientific extravaganza. Utilizing catapult flung bananas, overflowing five-foot-high test tubes, eye-spinning optical illusions, and a smoke-ring blowing air cannon, *Dr. Kaboom* engages students with a clear message “Science is fun!”

Your students will be so caught up in the fun and jokes, they might not even realize that they are learning along the way. There is real science going on under the surface of the show. *Doktor Kaboom* introduces concepts in physics, optics, and chemistry. Epley, in the guise of the crazy character he has created, promotes science safety and self-esteem. Above all, he encourages students to dive headfirst into their scientific studies.

Photo by Martin Albert

The Pressure is On!

In one of the first demonstrations in *Look Out, Science is Coming!*, Doktor Kaboom introduces the concept of air pressure. Also known as atmospheric pressure, air pressure measures the force exerted by the weight of air molecules. Although air pressure is different at various elevations — the higher you go, the lower the pressure — or due to changes in atmospheric conditions, the air pressure on an object is generally accepted as 14.7 pounds of pressure per square inch. Air pressure is not just a downward force, but it completely surrounds us.

Here are several activities that you can do with your students to continue to explore air pressure. The final activity works best when set up as a demonstration as there is a bit of a trick involved.

Grudge Match: Air vs. Water

In this simple, but really amazing, activity, your students pit air pressure against water weight.

They will love astounding their families with this activity when they get home.

Materials:

- Small glass or cup
- Index card
- Water
- Sink or tub

Fill the glass about one third full of water. Completely cover the mouth of the glass with the index card. While holding the card over the mouth, quickly turn the glass upside down. Remove your hand from the card. You students will be thrilled to see that the card remains in place, holding the water in the glass. It is best to do this activity over a sink or tub, just in case!

The reason the activity works is that the weight of the water is less than the pressure of the air. The downward push of the water is about one pound and is greatly overwhelmed by the superior 14.7 pound upward-push of the air pressure. This is a good activity to illustrate that air pressure completely surrounds us.

Warning: It doesn't take too long for the paper card to become saturated with water and lose its structural integrity. When that happens, look out —hence the sink or tub.

Old Faithful

This is another activity that is best done in a sink or tub. Outside would be good, too.

Materials:

- Two-liter soda bottle
- Water
- Straw
- Lump of Clay

Fill the bottle about half-full of water. Insert the straw into the mouth of the bottle. While holding the straw so it sticks a short distance outside of the bottle, wrap the clay around the straw so it forms a seal at the bottle's mouth. Place the bottle in the tub or sink. Blow hard into the straw and then stand back. Thar she blows!

When you blow into the straw it increases the air pressure inside the sealed bottle. The higher pressure forces the water to shoot up and out of the straw.

Please note: This activity does not replicate the way geysers like Old Faithful work. Geo-thermal activity creates the pressure that causes geysers to erupt. "Old Faithful" is just a catchy name for the activity.

Blow Me Down

This activity is often called "The Million Dollar Bet," and can be set up as a wager with the students.

Materials:

- An empty soda or water bottle
- A piece of paper towel

Form a small ball out of the paper towel. It should be about half the size of the mouth of the bottle. Lay the empty bottle on its side and place the paper towel at the end of the mouth. Challenge a student to blow the ball into the bottle. No matter how hard they blow, they will not be able to blow the ball in. Because the bottle is already full of air, it is not possible to force more air into the bottle. There is no room for the extra air, so it flows right out, pushing away the ball.

You’re Full of Hot Air

This demonstration is a trick.
A little secret preparation is needed.

Materials:

- 2 plastic water or soda bottles of the same size
- 2+ balloons
- Push pin or tack

Out of sight, make an 1/8 inch hole in the bottom of one of the bottles. Give a balloon and a bottle to each of two volunteers. Instruct them to feed most of their balloon into the bottle. Next, they should stretch the opening of their balloon over the edge of the mouth of the bottle. Challenge them to see which student can blow-up their balloon the fastest.

The student that has the bottle with the hole in the bottom will be able to blow up their balloon with little difficulty. The student with the non-holed bottle will not be able to blow up their balloon at all, no matter how hard they try.

Invite a new challenger to try to beat the champ (replacing the balloon, of course).

As the student blows into the balloon, they are moving air into a compressed space to inflate the balloon. In the non-holed bottle, the air is trapped and has nowhere to move. The air pressure is greater in the bottle than in the balloon, preventing the balloon from inflating. In the bottle with the hole, the air in the bottle can be pushed out of the hole allowing the balloon to expand.

Doktor Kaboom 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.

Photo by Martin Albert

Doktor Kaboom Vocabulary

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

Photo by Martin Albert

I Can't Believe My Eyes

Fun With Optical Illusions

An optical illusion is a visual image that tricks our eyes and brains into thinking that we are seeing something that is different than what is really there. *Doktor Kaboom* has a little fun with optical illusions during *Look Out, Science is Coming!*

Provided below are some websites that your students can visit to continue that fun. The sites are listed from basic to most advanced.

Optics4Kids: https://www.optics4kids.org/optical-illusions

This is a good site for younger students. Although some of the images appear to be moving, all but one are static pictures. There is no user interaction with the site, you simply click from one illusion to the next.

National Institute for Environmental Health Sciences - Kids' Pages:

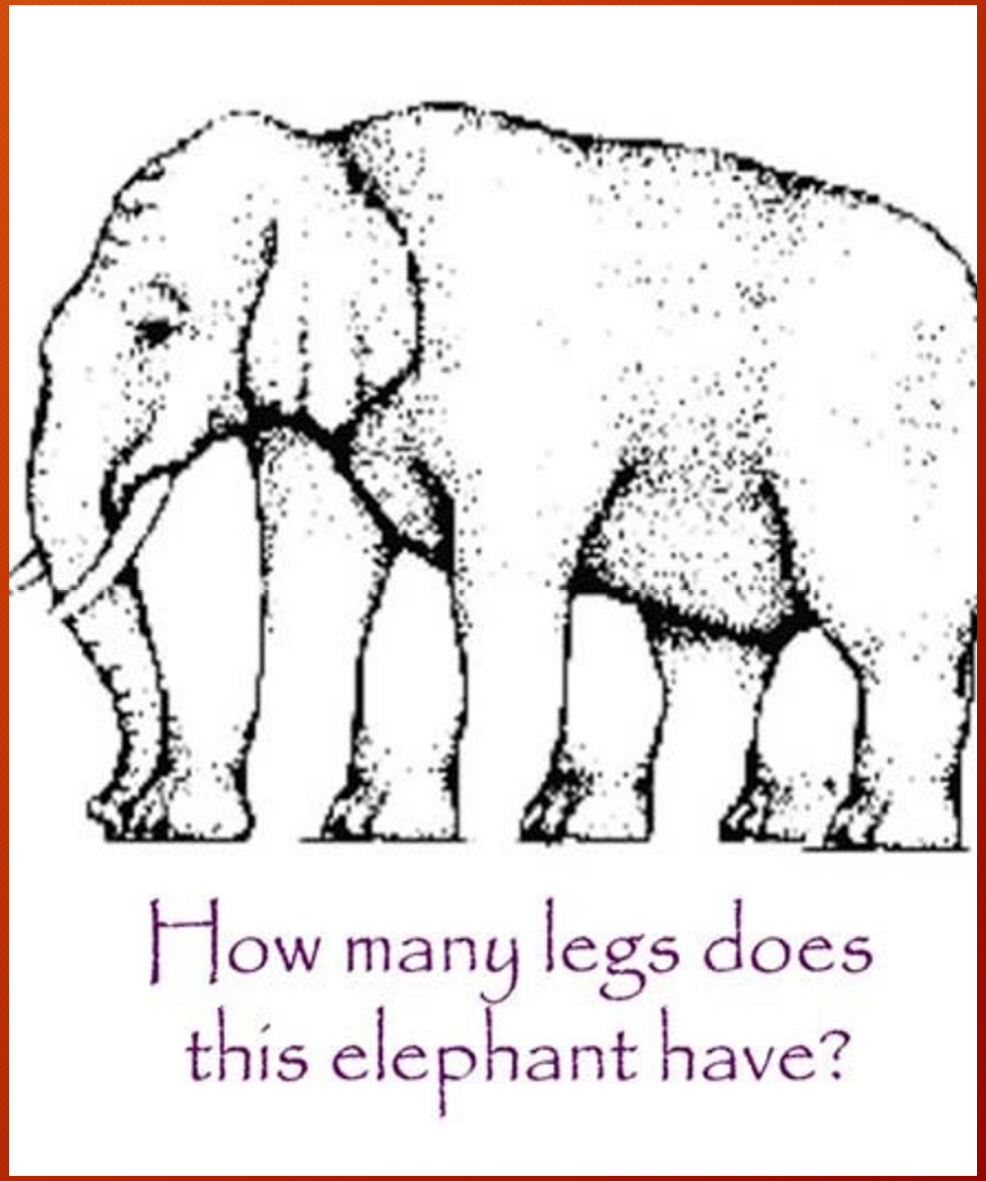
https://kids.niehs.nih.gov/games/riddles/illusions

A little more advanced than Optics4Kids. Only one illusion is animated. User interaction is limited to occasionally clicking on a box to see the correct answer.

Optical Illusions & Visual Phenomena:

https://michaelbach.de/ot/

Many of the illusions that are offered on this site are animated. Most of them are also highly interactive, allowing the user to change speeds, colors, backgrounds, etc. With the interactive component this is the most fun site to visit, but the explanations of the illusions might prove challenging for younger students.



Machine Scenes

In most plays, there is a problem that characters have to solve.

In this activity, students will work in teams to create and perform a scene in which they present a problem that can be solved using a simple machine.

Materials

- Print copies of the “Machine Scene Sheets” document in the folder. – One for each team.
- Print copies of the “Machine Scene Score Sheets and Criteria” document in the folder. – One for each student.
- Working models of the simple machines (Option: machines can be built by students before or during this lesson.)
- Timer

Time

This lesson can be divided between at least two class periods, allowing for more time as needed to build a simple machine and to refine the process of staging a scene.

Introduction

You may remember during the Doktor Kaboom show the actor used a catapult for one of his demonstrations.

A catapult is an example of a simple machine. Ask your students – what are the six types of simple machines? A simple machine has no, or only minimal, moving parts. (catapult, lever, inclined plane, wedge, screw, pulley, wheel & axel.) In today’s activity you are going to be like Doktor Kaboom and use theatre and acting to demonstrate how simple machines work.

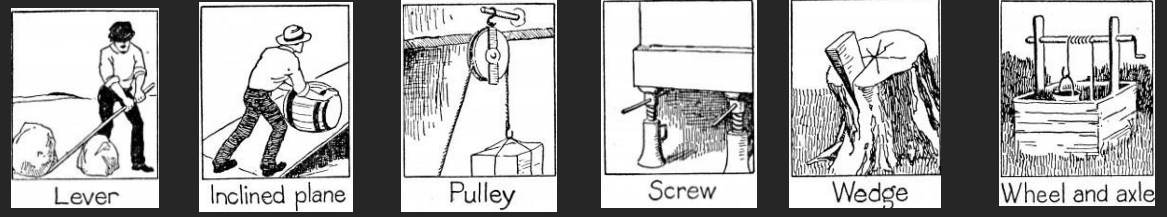
Warm Up
Practice getting into characters….teacher call out different character types: old man, young girl, muscle man, business person, cowboy, ghost, etc. Students respond by moving in ways that show: What is this character's posture? How does he/she walk? How would this character brush teeth? Toss a ball? Eat an ice cream cone? Walk on a hot beach?

Preparation
1. Divide the class into teams of 3 or 4. Give each team a **Machine Scene Information Sheet**. Each team gets a different machine. (Note: the "screw" is the most difficult machine to create a scene around.)

2. Students will work together in teams to follow the steps on their Machine Scene Information Sheet. Go over the sheets as a class and explain: the sheets assign one simple machine to your team, give basic information about that machine, and provide space for your team to write down procedures and decisions.

3. Note the "scoring" section on the Machine Sheets – explain that the goal is to make sure their team scores as many points as possible by incorporating how the machine works with Scene Elements and Acting Elements. This is a combination of scientific and theatrical process. You will use the stated Criteria to check your work as you go.

The following steps are timed. Tell students how much time they have, and give warnings as time passes.
Is everybody ready to begin?



1. Decide in one minute which kind of character to portray in a Machine Scene. For example, the sheet might say "Ninjas," "Babies," and "Other." Everyone on the team will be the same kind of character.

2. Brainstorm (three minutes): What problems can be solved by using their simple machine. The problem must relate to its characters. For example, if you are "Babies" your problem might be how to get a bottle off a tall counter. "Ninjas" would not have the same kind of problem! (See “Yes, and” procedure for a brainstorming strategy, slides 16-18)

3.Evaluate (two minutes) Which of your problems is best? Choose one based on the “Problems” criteria provided on your handout.

4. Brainstorm (five minutes) What are some possible solutions to the problem? You will need three. The first two solutions will NOT work. The 3rd, final solution will be to use the simple machine that WILL work to solve the problem.

5. Evaluate (2 minutes) Do your solutions meet the criteria? (Use your “solutions” criteria)

6. Create (15 minutes) a short scene that demonstrates their simple machine. The team should write down their script, in which the characters encounter the problem and attempt the three solutions. Students should consider what props they need to demonstrate their machine, the problem and the solutions as well as how to dramatize their scene. (See “Theatrical Elements” on slide 15 for guidance) the solution will be to use the simple machine that WILL work to solve the problem.

7. Rehearse the scenes and revise: Does your scene include the Theatrical Elements criteria?

8. Perform the scenes for each other!

Using the *Machine Scene* Score Sheet

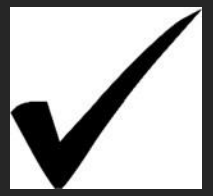
Tell students that scoring is not based on acting talent but instead is based on **how well the team met the Machine Scene criteria and effort.** Also, good audience etiquette is factored into the scores.

Students can use the score sheet to "score" the scenes for one another, for their own team, or the teacher or a guest observer can be the designated Score Keeper.

Review/Reflect

Allow time for brief questions and answers following each scene. Give each group a chance to reflect out loud or in writing about their group process, and what challenges and successes were most memorable for them.

As a final class reflection, discuss: Why do you think they decided to use the character of Doktor Kaboom to demonstrate the different scientific experiments and ideas? Did it work for you? Why? Why not? What could he have done differently? In what ways did this activity give you more insight into the performance?



Using Criteria for Your Machine Scene
Check your thinking!

Problems

1. Can the problem be solved by using your simple machine?
2. Is the problem one that is appropriate for your type of character?
3. Will the problem be a fun one for your team to work on?

Solutions

1. Do all three solutions solve the problem? They shouldn't—only one should work.
2. Are the solutions true to your type of characters?
3. Will the solutions be fun for your team to act out?

Criteria

noun, plural
(krahy-teer-ee-uh)

A standard of judgment or criticism; a rule or principle for evaluating or testing something.

Theatrical Elements

Problem: Is it clearly acted out and appropriate to your characters?

Solutions: Are all three solutions clearly acted out? Does the final one show how your simple machine solves the problem?

Scene Location: Where does this scene take place? Establish a clear location.

Characters: Are your characters clear? Can the audience tell who you are portraying?

Voices: Do you have appropriate voices for your characters?

Movements: How do your characters move? Are you showing that in your acting?

Script: Does each actor have at least one line to say?

”Yes, and…”

A Theatrical Procedure for Brainstorming

"Yes, and…” is an improvisational theatre technique developed by the famous Second City Theatre company in Chicago. A lot of great actors, including Amy Poehler, Tina Fey, Steve Carell, Mike Meyers, and Stephen Colbert, used this technique while acting at Second City.

You may use "Yes, and…" to brainstorm your ideas, for example, as you decide problems and solutions for your Machine Scene characters.

Steps For “Yes, and…”

If your group is large enough, it is recommended to have one person be a note taker and write down all the ideas as they are generated.

Standing in a circle, the first person suggests a possible problem.

Then the person to the left will say, "Yes, and…." and will suggest another possible problem.

Continue clockwise around your team, with each person starting their turn by saying, "Yes, and…" and then suggesting a problem.

(The same sequence will work to generate ideas for solutions as a later step.)

Some rules:

- You have three minutes to use "Yes, and…" to come up with as many possible problems as you can that your characters can use your simple machine to solve.
- (Give time warnings for two minutes, one minute, and 30 seconds. Monitor the teams to be sure they are using the "Yes, and…" format and are not discussing possible problems.)
- The problem must be one that can be solved by using your team's simple machine. That means the problem must be one that is physical in nature. You can't use an inclined plane to solve the problem of what to have for lunch!
- Everybody participates in the role of the character type their team has selected.
- You may not discuss any of the problems, nor can you offer an opinion about anyone's suggestions.

At this point, there are no bad ideas. If it is your turn and you don't think you have a "good" idea, just throw something out there, no matter how crazy it is. Your suggestion might give someone else a new idea. If you are absolutely stumped when it is your turn, just pass until it is your turn again. The entire purpose of this exercise is to come up with as many ideas as possible. You will keep going around the circle as many times as you can in three minutes.

Doktor Kaboom! is represented by

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