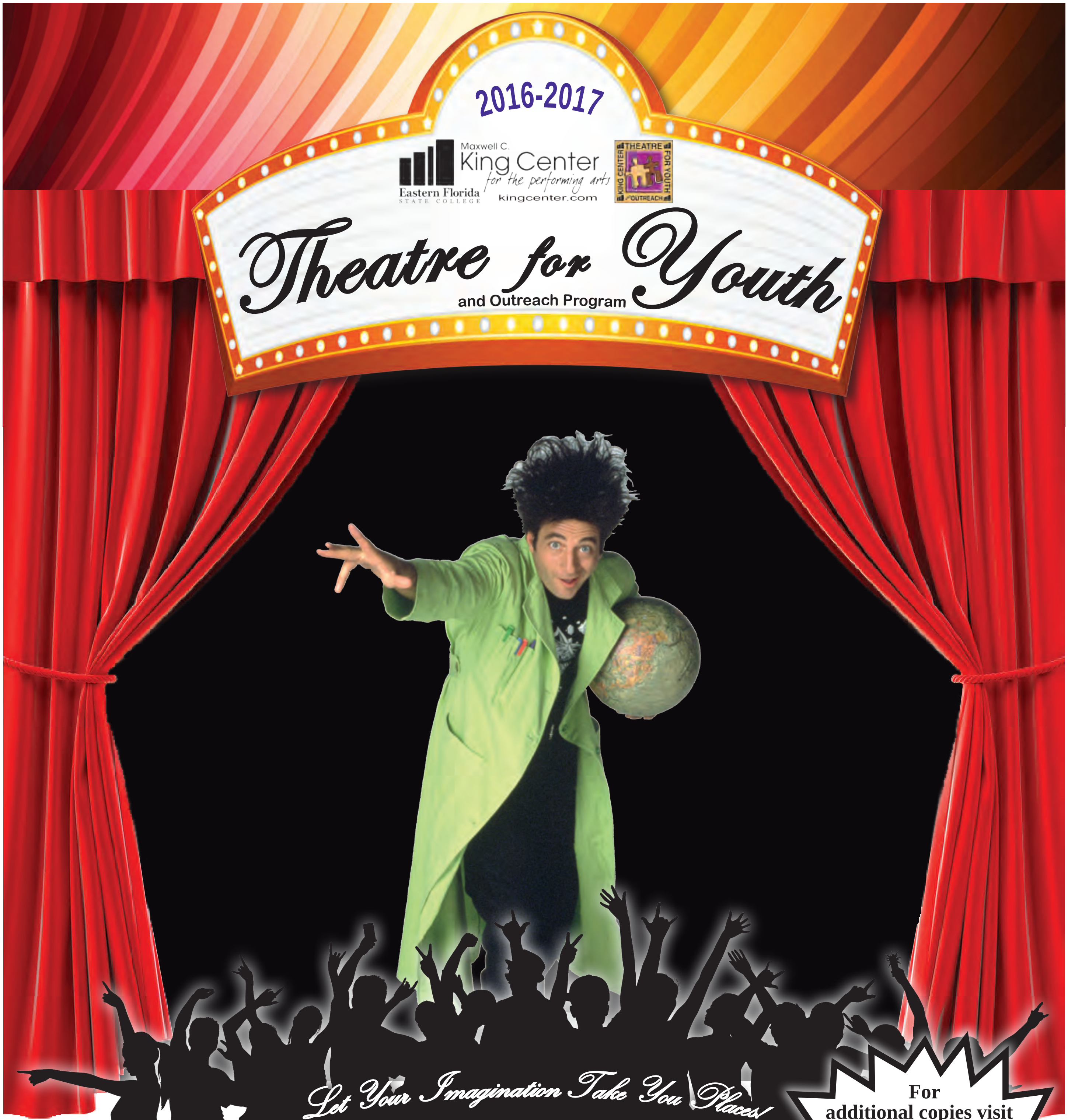

For additional copies visit **kingcenter.com** click Theatre For Youth section & proceed to Study Guides & Resources.

Beakman Live! What's Going On Here, Beakman?

Tuesday, January 31, 10:30 am

With Special Thanks

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Season 2016-2017

Dear Friends and Patrons of the Arts,

Thank you for your interest in the King Center Theatre for Youth Program. The mission of the program is to inspire, nurture and sustain a lifelong appreciation for the performing arts among our youth theatre patrons. This is accomplished by the diverse array of entertaining and educational arts offerings.

Study resource materials made possible by each artist and their management teams are being provided to augment the live theatre experience. We hope you find the materials useful.

A live theatrical experience can leave a memorable impact even after the show is over...now, *Let Your Imagination Take You Places!*

We are looking forward to your attendance at the show.

Yours in the arts,

Karen

Karen Wilson
Director,
Theatre for Youth Program

WHAT'S GOING ON HERE, BEAKMAN?

STUDY GUIDE v. 2 9-8-16

PERSISTENCE OF VISION

DEFINITION:

PERSISTENCE OF VISION is the optical illusion whereupon multiple different images blend into a single moving image in our minds. Because our eyes retain images for a short period of time, we can perceive movement between images. It's believed to be the explanation for how we see movies.

IN THE SHOW: Beakman swings a ball with flashing lights that demonstrates persistence of vision.

QUESTION: Hey Beakman, how do movies work?

ANSWER: To answer your question, first one must know that light bounces, and that's how we see things. Let's say you are looking at an orange. Light bounces off the orange and goes directly into your eyes. Your eyes and your brain make a picture of the orange, and then your brain puts together that image with past experiences of seeing oranges and perceives it as an orange.

But what about movies? How do they work? Let's say you are looking at a movie of an orange being eaten by a monkey. The light from the movie goes directly into your eyes. Your eyes hold each piece of the monkey-eating-the-orange moving pictures for 1/30th of a second, long enough for your brain to put each of those pieces together into one movie. This way that your eyes hold light for 1/30th of a second is called: Persistence of Vision.

Next time you go to the movies, remember: what you are seeing is flashing pictures. That's what movies are: flashing pictures. But because your eyes hold light for 1/30th of a second, you see movies as one moving picture.

INTERNET
Here's a Youtube video on how to build a simple Newton's disk, which demonstrates persistence of vision AND how white light is made up of many different colors.
https://www.youtube.com/watch?v=cPHOCysZS2k

Here's a link to an app for your phone that creates a Newton's Disc
https://play.google.com/store/apps/details?id=com.avoupavou.newtonsdisc&pageId=107328086152208664153

CLOUD IN A BOTTLE

DEFINITION

CLOUD

1. a mass in the sky that is made up of many very tiny drops of water and can be white or various shades of grey
2. a large amount of dust, smoke, or other tiny particles that are suspended in the air

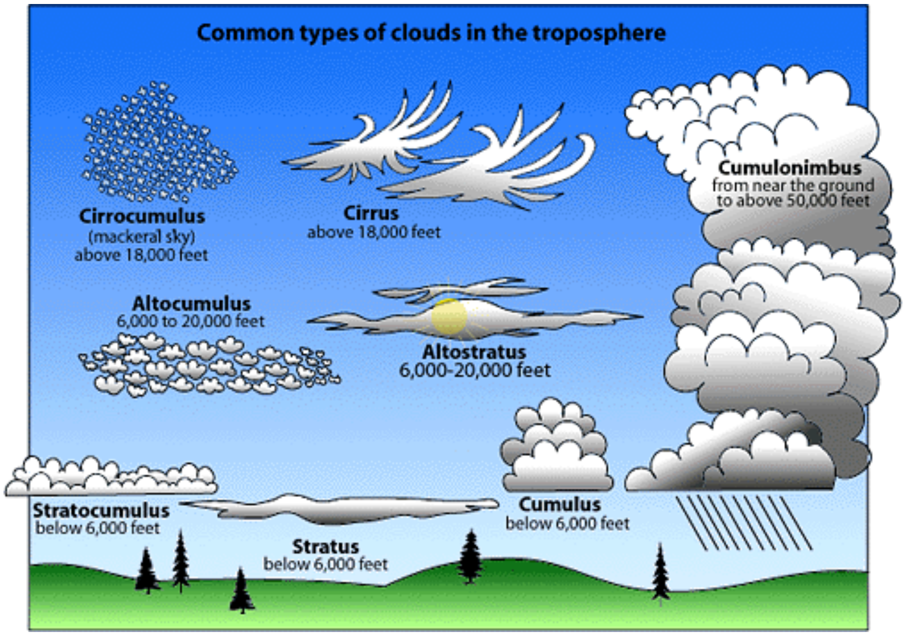
IN THE SHOW: Beakman creates an actual cloud in a bottle, showing how clouds are formed by moisture adhering to dust.

QUESTION: Hey Beakman, what is dust, and what does it have to do with clouds?

ANSWER: Dust is made up of any material that is very fine, i.e. very tiny particles. For example, bits of soil or fabric or wood or ashes or even materials from space can make up dust. You read that right! Scientists have examined dust and have found that some dust floating around or sitting on things actually contains tiny bits of meteors, stars, and other stuff from space.

A cloud we see in the sky is formed when particles of water or ice stick to dust particles that are floating in the air, usually well above the surface of the earth.

Way back in 1803, an English scientist named Luke Howard named three basic types of clouds: cirrus, cumulus, and stratus. There are many variations of these basic cloud types, but we still use these terms to describe clouds we see in the sky.



Cirrus clouds

High *cirrus* clouds are separate, delicate-appearing clouds, mostly white in color, and made up of ice crystals. They often look like tufts or bunches of feathers. There are subgroups of cirrus clouds, too: *cirrocumulus* (mackerel sky), made up of small white flakes or very small globs that are found in lines and groups and ripples; and *cirrostratus,* a thin whitish sheet cloud, which sometimes makes the entire sky look milky. These clouds can create a halo around a shining moon or sun.

Cumulus clouds

Intermediate *cumulus* clouds have subgroups, too: *altocumulus* clouds*,* are flat patches of globular masses that can be seen in groups, waves, or lines; and *altostratus* clouds*,* which look like thick cirrostratus clouds but don't make a halo with shining moon and sun. Instead they can only let an outline of the moon, if not hide it completely. Then there's a type of thick *cumulus* cloud that is seen in fair weather and often looks like a stalk of cauliflower, and the thunderstorm cloud, *cumulonimbus,* big thick masses that resemble mountains or towers and sometimes reach the stratosphere. These *cumulonimbus* clouds create rain and snow showers, hailstorms, and thunderstorms.

Cumulonimbus clouds

Stratus clouds

Stratus clouds, which are low clouds, have a number of types, too: *stratocumulus,* a cloud layer or patches composed of fairly large globular masses or flakes, soft and gray with darker parts, arranged in groups, lines, or rolls, often with the rolls so close together that their edges join; *stratus* clouds often look like fog but don't reach the ground; and *nimbostratus* clouds*,* a layer of dark grey clouds of no particular shape and often produce rain and snow.

The one thing all these clouds have in common is that they are formed by combinations of dust and tiny bits of water and ice.

RESOURCES:

Here's a great site about clouds with pictures of different types of clouds and some simple cloud related experiments you can do in the classroom.
http://www.weatherwizkids.com/weather-clouds.htm

Great photos of different types of clouds: https://scied.ucar.edu/cloud-image-gallery

EDIBLE BUGS

DEFINITION

EDIBLE: Suitable or safe to eat. BUGS: You know what bugs are! lol

IN THE SHOW: Beakman describes and illustrates some of the insects people eat in Mexico.

QUESTION: Hey Beakman, are there really people who eat bugs?

ANSWER: You bet! Some studies show that 80% of the people in the world include insects in their diets. And there are at least 1,700 species of edible insects in the world.

Cooked crickets for sale in a Thai market

Why, you wonder, oh why would people put bugs in their mouths, chew them, and then (gulp) swallow them?!?!? In the days of early humans, insects were an important part of diets because they were so much easier to catch than larger animals. People across the world eat bugs today because it takes a lot less water and feed to raise insects, and most of them are a lot healthier to eat than large animals, too, because they are low in saturated fat and filled with vitamins and minerals.

There are places in the world where insects are farmed and then sold in markets. In other cultures, the insects are gathered from the wild and then spiced, cooked, and down the hatch they go! Years ago in Japan, wasp hunters would actually catch a wasp, tying a long silk thread to its body, followed the wasp to its nest, and capture a big load for lunch.


Escamoles are ant eggs


Pancakes made from silk worms

The types of edible insects that we can find in North America include some varieties of crickets, grasshoppers, locusts, termites, June bugs, ants, centipedes, scorpions, mealworms, wasps, bees, and caterpillars. But please don't rush outside now and stuff a handful of bugs into your mouth! Some insects are not healthy for humans to eat, and many probably don't taste so good.

INTERNET
http://www.secretsofsurvival.com/survival/top-10-edible-insects.html
Girl Meets Bug: A great site with plenty of info, links, and even recipes for scarfing down insects.
https://edibug.wordpress.com/ or her Facebook page:
https://www.facebook.com/GirlMeetsBug

OPTICAL ILLUSIONS

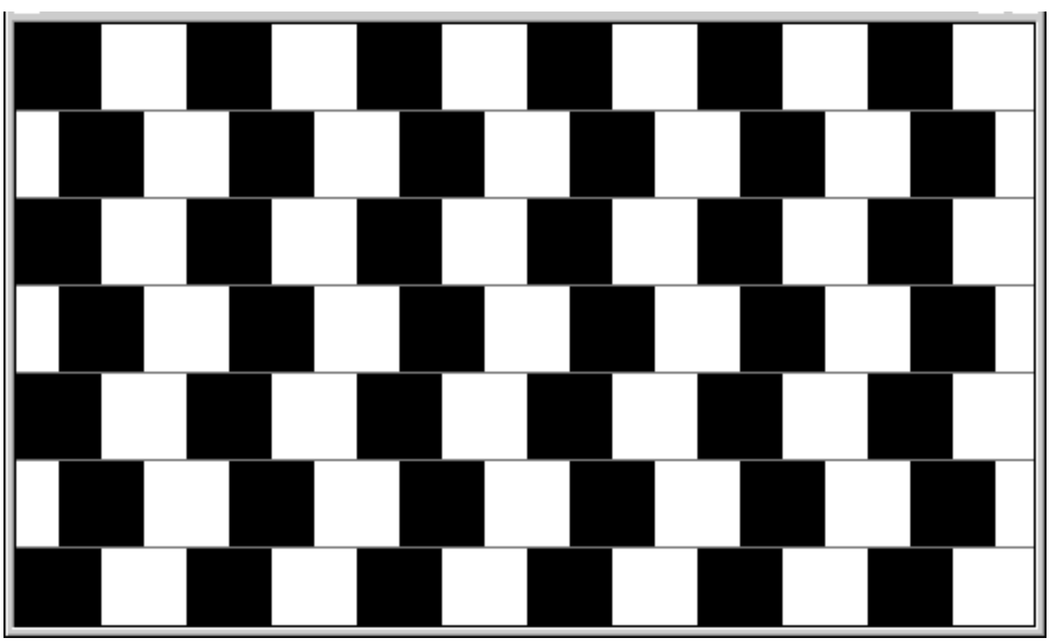
DEFINITIONS:

OPTICAL
Of or relating to sight, particularly in relation to light
ILLUSION
Something that appears to be real or true but in actual fact is not real, or it is false.
OPTICAL ILLUSION
An optical illusion appears to be different than what it really is, i.e. something that you see but is not really there, or is not what it looks like. There are a number of different kinds of optical illusions that trick our brains for different reasons. And scientists cannot explain how certain optical illusions actually work.

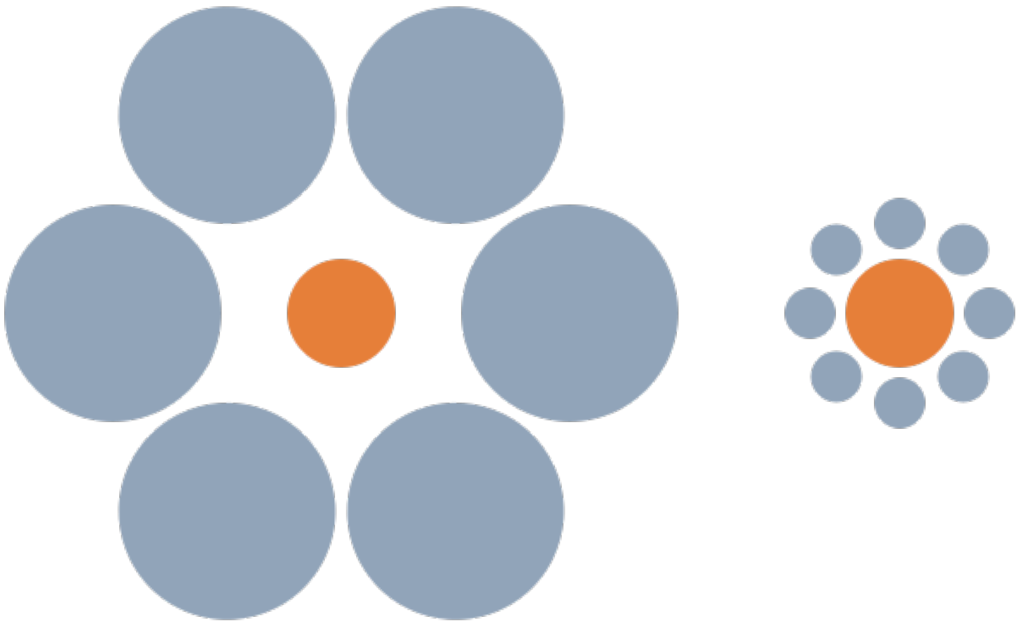
IN THE SHOW: Beakman holds up two flat models of roads that, when held in different positions, appears to be different sizes when in fact they are both the exact same size.

QUESTION: Hey, Beakman, what's an optical illusion? And what's up with these pictures?

ANSWER: Our eyes and minds have learned to identify various patterns and relationships so that we can determine what is going on around us. But our eyes and minds can be fooled by patterns that do not normally occur in our world. So our brains can get tricked, and we can see something that is not real or correct. Here are some examples:



The grey lines between the rows of boxes are actually straight and parallel to each other, even though they look wavy. Don't believe me? Place a ruler up against the horizontal lines, and you will see that they are indeed straight.



Our brain makes decisions about the size of something by looking at stuff around it. In the circles on the left, the center circle is surrounded by bigger circles. So it looks small. In the circles on the right, the center circle is surrounded by smaller circles. So it looks big. Your brain thinks: Small. Big. Small. Big. But they are actually the same. Don't believe me? Measure them.

SUBLIMATION

DEFINITION

> SUBLIMATION
> The chemical process sublimation is the transition of a substance directly from the solid phase to the gas phase without passing through the intermediate liquid phase. The reverse process – the transition of a gas into a solid, skipping the liquid phase – is also called sublimation.

IN THE SHOW: Beakman puts some dry ice into a bucket and then pours a bunch of soapy water on top of it. A mess ensues!

QUESTION: Hey Beakman, does all ice melt?

> ANSWER: Nope! Allow me to explain…

Dry ice is frozen carbon dioxide, the same stuff that's in the bubbles in soda. But dry ice carbon dioxide is frozen into a solid at 109 degrees below zero Fahrenheit and 78.5 degrees below zero Celsius…cold!

When soapy water is dumped on top of the dry ice, the dry ice does not melt into a liquid like ordinary ice would. The solid carbon dioxide goes directly from a solid mass into a gas or vapor in a process called SUBLIMATION. And that gas combines with the soap in the water to create a lot of bubbles, which make a giant mess all over the stage.

FURTHER RESOURCES

A bunch of dry ice demonstrations!
https://www.youtube.com/watch?v=QhTekm5NdiE

BEACH BALL AND LEAF BLOWER

DEFINITIONS

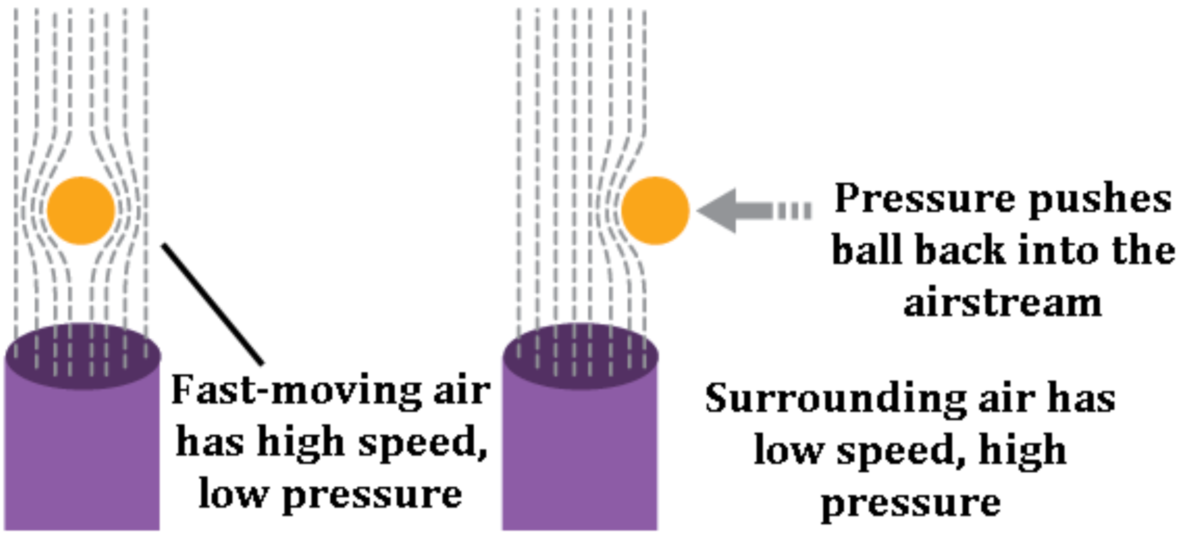
BERNOULLI'S PRINCIPLE: When the speed of a fluid increases, its pressure will fall.

PRESSURE: The force that one area of gas, liquid, or solid exerts on another.

FLUID: A liquid or a gas that flows easily and conforms to the shape of its container, like water in a glass or air in a balloon.

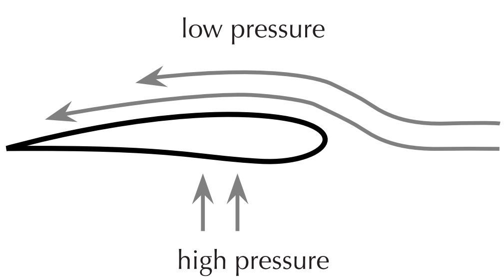
IN THE SHOW Beakman fires up a leaf blower and places a beach ball in the stream of rushing air. It stays there.

QUESTION Hey Beakman, if there's so much air pushing against it, why doesn't the ball keep going up? Or why doesn't it fly off across the room?



When we walk around on Earth, we are at the bottom of an ocean of air. That air, the Earth's atmosphere, is pressing on us and everything around us all the time, even though we aren't aware of it. Turning on a leaf blower starts a stream of fast rushing air, and fast rushing air creates lower air pressure. If you place a beach ball into that stream, it will stay in the area of lower air pressure because the higher pressure air all around the stream pushes on the ball from the sides and keeps it in place. This way that fast rushing air creates lower air pressure is called Bernoulli's Principle.

Bernoulli's principle applies to all fluids, including air and water. It is the reason that airplanes work. The curve on the upper side of an airplane wing causes the air rushing over the wing to move faster than the air rushing under the wing, so there is less pressure on top and more pressure underneath, giving the wing lift.



Air flow over an airplane wing, seen in cross section

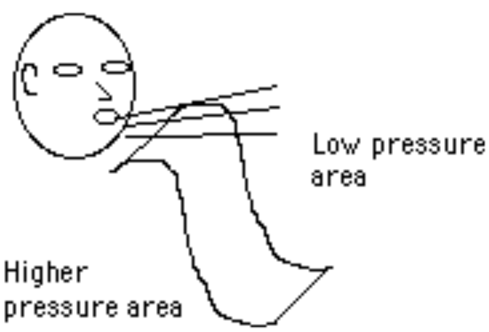
You can also blame Bernoulli's principle when this happens:

The air blowing over the top of the umbrella goes faster than the air blowing underneath the umbrella, so the pressure underneath is higher than the pressure on top, and the umbrella turns inside out.

Here are two simple experiments you can do with a piece of paper to experience Bernoulli's principle at work. You will need one sheet of 8 1/2" x 11" paper. Fold the paper in half and cut along the fold so you have two pieces that are 8 1/2" x 5 1/2".

LEVITATING PAPER

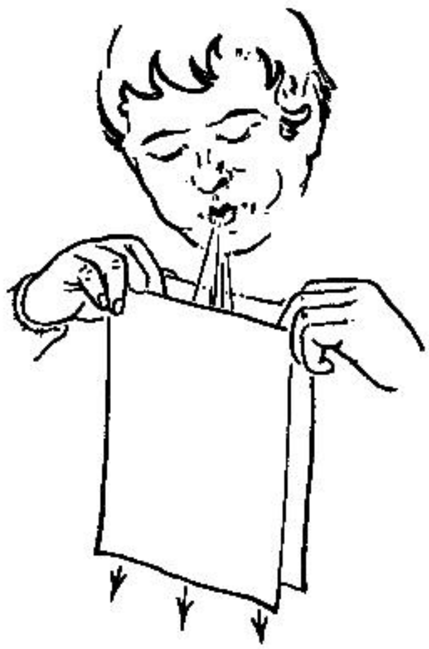
Take one of the half-piece of paper with both hands and hold it right below your mouth, like this:



Now, blow hard. What happens? Can you explain the movement of the paper using Bernoulli's principle?

TWO PAGES

Hold two half-sheets of paper in front of you like this, and blow between them.



Now, what do you expect will happen if you blow between these two pages? Will they move apart, or stick together? Try it. Can you use Bernoulli's principle to explain the movement of the two pages?

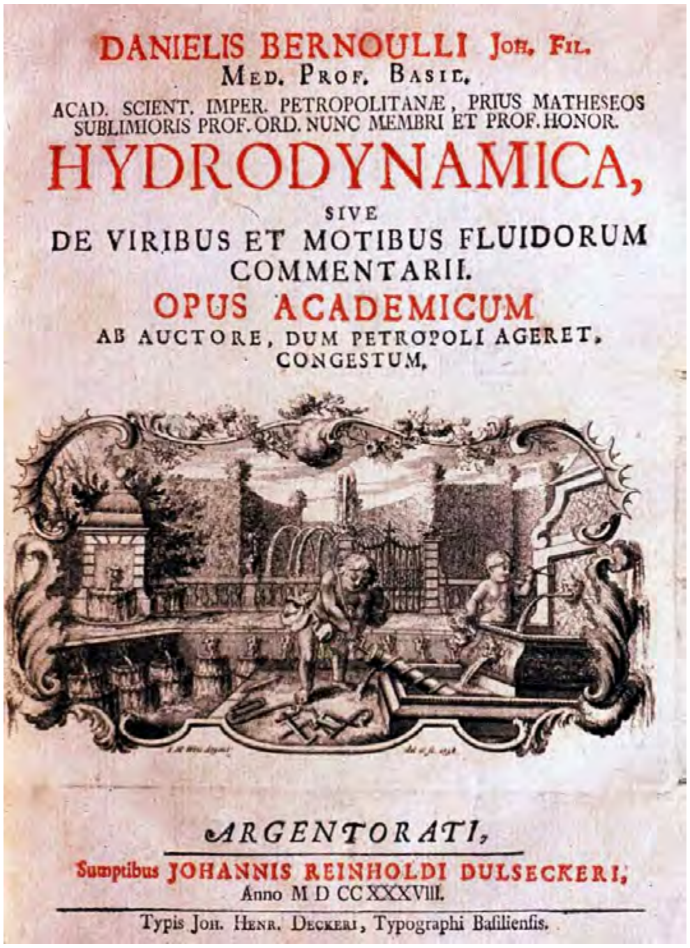
QUESTION: So, what's going on here, Beakman?

> ANSWER: When you blow across the top of the paper in the first experiment, you create an area of lower pressure, and the higher pressure air underneath the paper can push the paper up. When you blow between the two pages, you might expect them to be pushed apart, but again, the rushing air between the pages creates an area of lower pressure, and the higher pressure of the still air on either side pushes the two pieces of paper toward each other. Remember that the constant pressure of Earth's atmosphere on us and everything around us isn't just pushing down from above, but from all sides, even from below.

QUESTION So, who is Bernoulli?

Daniel Bernoulli, 1700 - 1782

ANSWER: Daniel Bernoulli wanted to be a mathematician like his father, but his dad insisted that he become a doctor instead. While studying blood pressure, Bernoulli set up an experiment. He punctured a pipe with a small open-ended straw, and watched what happened as liquid flowed through the pipe. Higher pressure in the pipe caused more liquid to rise up into the straw, so he could see that the when the water in the pipe was moving faster, the pressure was actually lower. Bernoulli did the math to show how this phenomenon was consistent with the law of conservation of energy. He invented the word "hydrodynamics" for the study of fluids in motion, and he wrote a book about it.


DANIELIS BERNOULLI JOH. FIL.
MED. PROF. BASIL.
ACAD. SCIENT. IMPER. PETROPOLITANÆ, PRIUS MATHESEOS SUBLIMIORIS PROF. ORD. NUNC MEMBRI ET PROF. HONOR.
HYDRODYNAMICA,
SIVE
DE VIRIBUS ET MOTIBUS FLUIDORUM COMMENTARII.
OPUS ACADEMICUM
AB AUCTORE, DUM PETROPOLI AGERET, CONGESTUM.

ARGENTORATI,
Sumptibus JOHANNIS REINHOLDI DULSECKERI,
Anno M D CC XXXVIII.
Typis JOH. HENR. DECKERI, Typographi Basiliensis.

Title page of Bernoulli's book

Bernoulli's father was so jealous of Daniel's work, he wrote a book plagiarizing his son's ideas and put a fake date on it so it would look like Daniel had copied from him, instead of the other way around. Fortunately, people weren't fooled, and after many years of living in places he hated and taking jobs he didn't want, Daniel Bernoulli got his dream job as a physics professor in his home town of Basel, Switzerland. He was famous for his amazing lecture demonstrations.

OTHER RESOURCES:

https://youtu.be/J4WRd7OAt0A Launchpad: Bernoulli's Principle On-Board the International Space Station

AIRZOOKA

DEFINITIONS

VORTEX: a mass of air or water that spins around very fast. The plural is vortices.

TOROIDAL VORTEX: a doughnut-shaped vortex in a fluid. Torus is the mathematical word for a doughnut shape.

IN THE SHOW: Beakman uses a vortex cannon to show the power of a vortex of air.

QUESTION Hey Beakman, what is a vortex cannon and how does it work?

Vortex cannon made from an oatmeal box and plastic wrap.

ANSWER: A vortex cannon is a kind of bucket with a round hole cut in the center of the bottom. The open end of the bucket is covered with a plastic or rubber sheet, stretched and secured all around. Beakman uses a commercially made toy called an Airzooka, but you can make your own vortex cannon using anything from a plastic cup or bottle to a bucket, a cardboard box, or even a garbage can. The bigger the cannon, the bigger and more powerful the toroidal vortex it can produce.

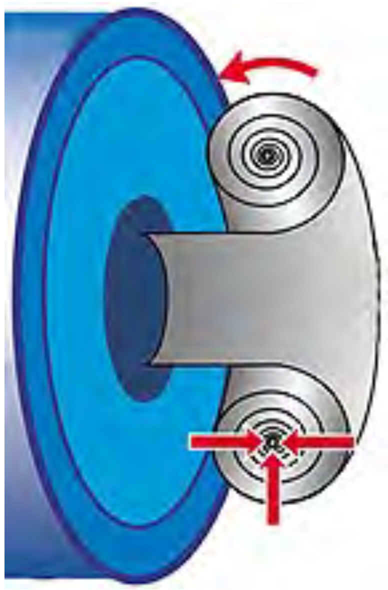
This one uses a balloon on the end. Instead of tapping the back, you can gently pull it back and snap it to release the vortex.

Here's a really simple and large one. Seal all the seams of a box with tape and cut a hole in one side. Then to operate it, you thump the side of the box opposite the hole.

This family made an extra-large cannon from a trash can.

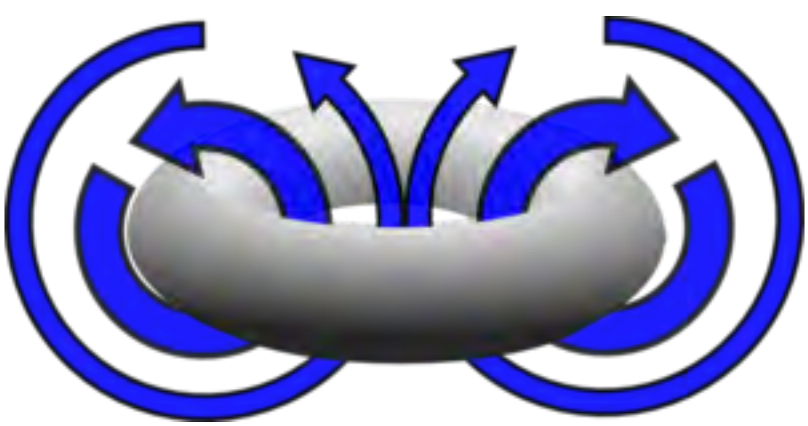
To operate your vortex cannon, simply tap the end opposite the hole to release a toroidal vortex. You won't be able to see it, but you can see its effect. Try aiming it at your friend's hair, or a stack of styrofoam cups, a house of cards, or some other lightweight target. Experiment with distance. If your cannon has a rubber sheet on the back end, you might find it's better to gently pull it out and release it to expel the air.

To make your vortices visible, you'll need to add something like dust or smoke. If you have a fog machine, you can fill the bucket with fog before firing it. Dry ice works, too. You can light a couple of incense sticks and carefully insert them into the hole of your vortex cannon to fill it with smoke. Vortex cannons work best in an enclosed room with no air currents. A breeze from an open window or from an electric fan will cause air turbulence that will affect the quality of your vortices.



How does it work? When you tap the plastic sheet, it pushes a burst of air out the hole. Most of it goes straight out, but some of the air (and whatever smoke or fog you put in the cannon) will get dragged by the edge of the hole and pushed by the surrounding air so that it curls back into a doughnut shape. It keeps on spinning as it moves away from the mouth of the cannon, and this spin is what keeps the doughnut shape together as the vortex shoots across the room.

Also, because the doughnut of air is spinning, the air inside it is moving faster than the air around it, and this is where Bernoulli's principle pops up again. The spinning air inside the ring is at a lower pressure than the still air outside, so the still air presses in on the ring from all directions, helping the ring keep its shape, and keeping the smoke in, so you continue to see that beautiful smoke ring sail on by.



QUESTION What can you do with a toroidal vortex, besides messing up someone's hair from ten feet away?

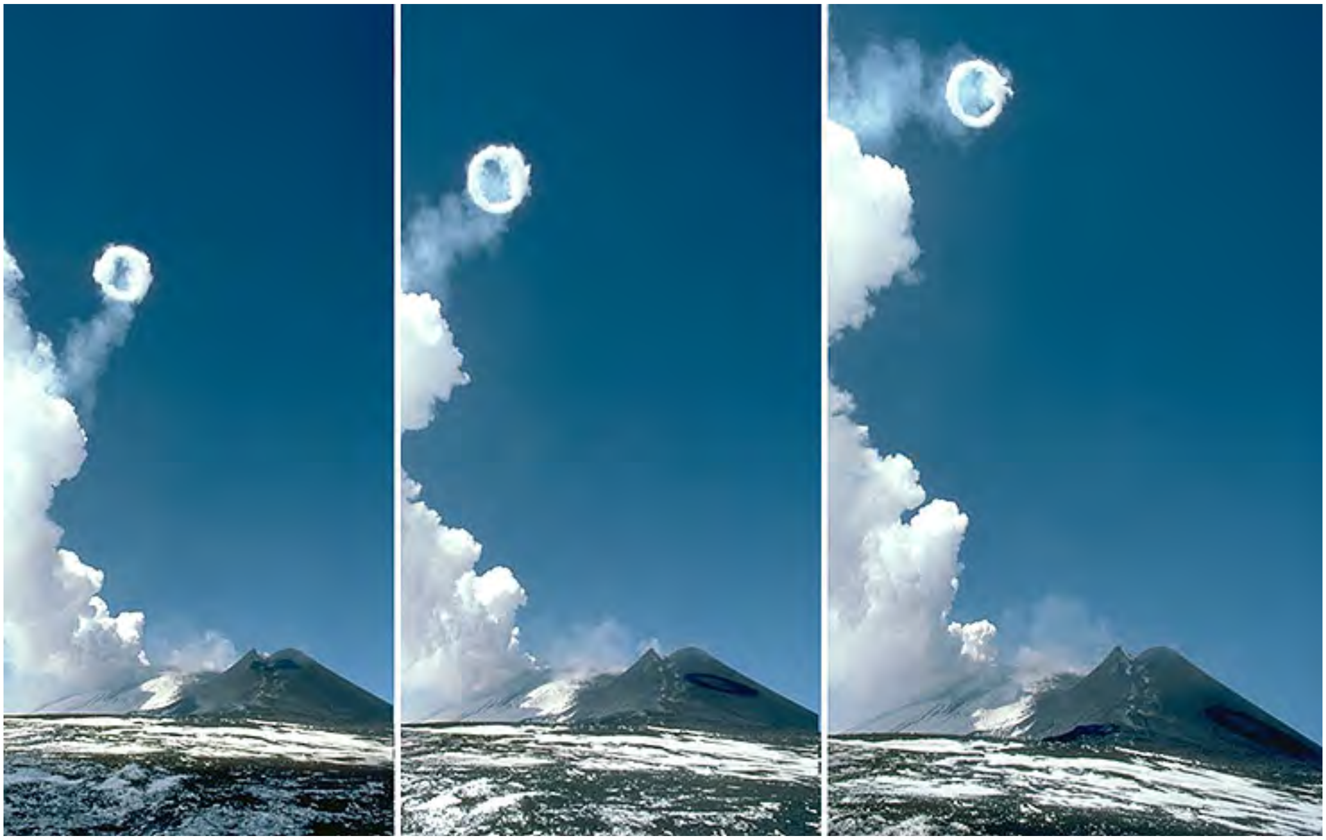
ANSWER: Not much, really, though people have tried. In 1998 the United States Army Research Laboratory experimented with converting a machine gun into a vortex cannon as a means of non-lethal crowd control. The idea was to just knock people over, or maybe to use the air vortex to carry a dye, a foul-smelling gas, or an incapacitating chemical straight to one or two people in a crowd. The experiment was not a success. The vortex was not strong enough to knock anyone down from 100 feet away, and although it could carry a gas or a dye, it was leaky, and it ended up spilling stuff on innocent bystanders between the gun and the target.

A waste management company in Denmark has found a more beautiful use for a toroidal vortex. They are building a waste to energy plant in Copenhagen that will have a special smokestack that blows a smoke ring for every ton of carbon dioxide released into the air. The company sees it as a gentle reminder of the impact of consumption on the environment. The plant itself will be built in the shape of a mountain and can be used as a year-round ski slope.


The Amager Bakke incinerator

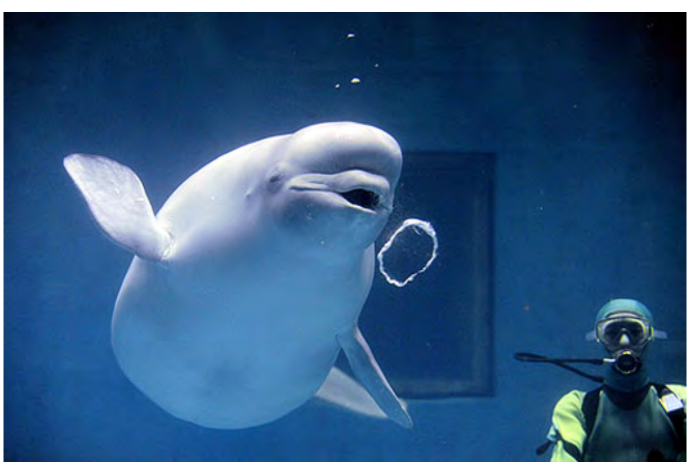
QUESTION Can you ever see a toroidal vortex in nature?

ANSWER: Several volcanoes have been seen emitting smoke rings, including Mount Etna in Italy.



Mount Etna smoke ring

Dolphins and some whales blow bubble rings, which are a kind of toroidal vortex. Dolphins enjoy playing with the bubble rings they create, sometimes splitting them into two smaller rings with their beak, sometimes biting them to break them into a cascade of normal bubbles. They can make a bubble ring in two different ways. One way works like the Airzooka vortex cannon, just a blast of air into the water that forms a ring. The second method is to swish its tail to start a toroidal vortex in the water, and then inject air into it.



A beluga whale makes a bubble ring

FURTHER RESOURCES

https://youtu.be/pnbJEg9r1o8 Crazy pool vortex. Physics girl makes a toroidal vortex in a swimming pool.

https://youtu.be/LaIzbtc8mHc Building Blows Giant Smoke Rings

https://youtu.be/VbV98Z0QP-k Spectacular, incredible, amazing.. rarely seen smoke rings at Mt Etna

https://youtu.be/wuVgXJ55G6Y Dolphin Bubbles: An Amazing Behavior | SeaWorld® Orlando Dolphin Cove®

https://youtu.be/NU6j_w5r-TY How To Make Smoke Rings -- A nice simple how-to video for making your own small vortex cannon using a plastic bottle, a balloon, and incense sticks.

http://www.physicscentral.com/experiment/physicsathome/cannon.cfm -- Instructions on making a vortex cannon from an oatmeal container

THE END!