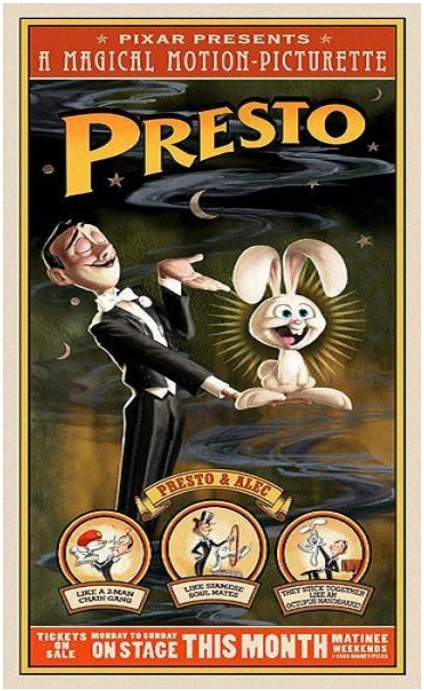
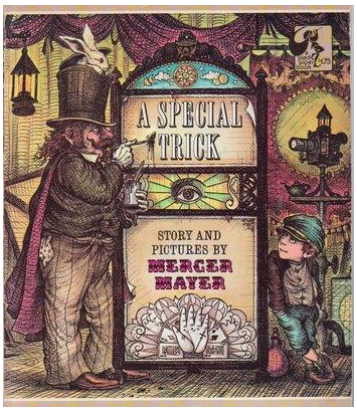
Presto!

What if? Why not? Could it be? Science is the truth…Magic is the Mystery!



Introduce the topic and access prior knowledge with a fun and funny video about magicians and magic such as Presto! http://www.youtube.com/watch?v=a0DqCxYfeT0 [*Presto is a 2008 American Pixar computer-animated short film shown in theaters before their feature length film WALL-E. The short is about a magician trying to perform a show with his uncooperative rabbit and is a gag-filled homage to classic cartoons such as Tom and Jerry and Looney Tunes. also, like the movie it was shown with, Wall-E, it has no dialogue, yet still comes off brilliantly. Presto was directed by veteran Pixar animator Doug Sweetland, in his directorial debut*.]



And/or read a picture book about magic, such as the amazing *The Magic Hat* by Mem Fox or, if you can find it, one like *A Special Trick* by the incredible Mercer Mayer wherein a little boy named Elroy met a magician and a night of adventure began, or any other appropriate magic based picture or fun short chapter book such as *The Wizard in the Tree* by wizard with words Lloyd Alexander, *The Cat Who Wished to Be a Man*, or *The Rope Trick* also by Lloyd Alexander. **As always, it is highly recommended you read any book first before reading it with your students so you can know if there is any language you wish or need to edit, sections to summarize, or if it is not appropriate for your audience.**

Humans have always been fascinated by magic. We all live by the same physical rules of the universe, and when someone breaks them we watch open-mouthed, stunned into silence.

How does a magician crush a ten ton oil tanker like it's a drinks can? Or drive a 4x4 across a swimming pool without sinking? Or make a man levitate six inches off the ground? Fusing the showmanship and mystery of street magic with the raw power of science, in our exploration of the 'Magic Of Science' we will expose and explore the marvelous mechanics behind some seemingly miraculous feats.

As well as this, the students will also test the boundaries of credulity by **performing their own magic in a final show at the conclusion of the unit**- all of which is in fact pure science. Let's uncover the secrets of these confounding performances and examine the extraordinary science that makes the impossible possible. There's nothing like the feeling of discovering a whole, new world of mystery and wonder. "Knowledge is power," they say, and nowhere is that more true than in magic.

On the surface, science and magic probably seem to have little in common. One is an art of deception while the other is an established entity based on hypothesizing, testing, repeatability and theory. But there is science phenomena that appears to be magic as well as magic that is based on science.

Option: Have fun exploring this idea by watching a few video clips from: http://dsc.discovery.com/tv-shows/breaking-magic

Magic (sometimes referred to as stage magic to distinguish it from paranormal or ritual magic) is a performing art that entertains audiences by staging tricks or creating illusions of seemingly impossible or supernatural feats using natural means. These feats are called magic tricks, effects, or illusions.

A professional who performs such illusions is called a magician or an illusionist. Some performers may also be referred to by names reflecting the type of magical effects they present, such as prestidigitators, conjurors, hypnotists, mentalists, or escape artists.

The core of a successful trick is an interesting and beautiful idea that taps into something that you would like to have happen. One of the things Pen and Teller do in their live show is squeeze handfuls of water and they turn into cascades of money. That's an interesting and beautiful idea.
The deception is really secondary, the idea is first, because the idea needs to capture your imagination."

Magic does something really that no other kind of performing art can do, and that is, it manipulates the here and now - our reality. When we're watching a movie, we don't think that what we're watching is real; we know it's not. We're staring in a dark room, at a lit screen. But in magic, we're watching someone manipulate a coin, or cards, or fire, or sawing a woman in half, right on stage, in front of our very eyes. And this is the power of magic.

But…most all magicians agree on something your students may find interesting: Performing for kids is harder than performing for adults.

But why?

Some think it has to do with the way kids concentrate, according to a report in the India Times. Adults are very good at focusing on one thing and ignoring distractions. That way, magicians can exploit avenues for misdirection much easier.

"Kids, on the other hand, tend to focus on more than one thing at a time — their attention is more diffuse [spread out or unfocused] — which may make them harder to fool. Moreover, kids are relatively free of assumptions and expectations about how the world works, and magic is all about turning your assumptions and expectations against you." What do your kids think? Will they be able to see through the mystery faster than you?

Magic Around the World

It's said that everyone stands on the shoulders of their predecessors. This is certainly the case with the art of magic. Magic existed in nearly all parts of the world during ancient times.

The term "magic" is etymologically (Etymology is the study of the history of words, their origins, and how their form and meaning have changed over time.) derived from the Greek word mageia (μαγεία). Greeks and Persians had been at war for centuries and the Persian priests, called magosh in Persian, came to be known as magoi in Greek; that which a Persian priest did come to be known as mageia and then magika, a term which eventually referred to any foreign, unorthodox or illegitimate ritual practice.

Performances we would now recognize conjuring have probably been practiced throughout history. The same level of ingenuity that was used to produce famous ancient deceptions such as the Trojan Horse would also have been used for entertainment, or at least for cheating in money games. They were also used by the practitioners of various religions and cults from ancient times onwards to frighten uneducated people into obedience or turn them into adherents. However, the profession of the illusionist gained strength only in the 18th century, and has enjoyed several popular vogues since.

Magic has been practiced for a very long time. The art of magic—producing extraordinary phenomena that seems to contradict the laws of nature dates to the dawn of time. We can easily imagine that some of the prehistoric people, scattered around the world, discovered that they had the talent of fooling their peers. Thus, they became the first magicians or sorcerers. Prehistoric implements and cave paintings suggest that, by 50,000 BCE, cavemen were performing magic as part of their religious ceremonies. People called sorcerers or shamans at that time knew certain fundamental principles about life and nature (such as what plants were helpful for healing) and were skilled at deceiving their fellows either by words, or visually.

For example, hunters would probably draw animals or hunting scenes before going on hunting trips. Scientists believe those drawings and carvings are a form of magic. They probably believed that the drawings would come to life while they were gone. They believed in its power but it didn’t actually work. By drawing the scenes they gave themselves self-confidence. That was their magic.

The First Writings

Many ancient texts allude to magic tricks or fakirism. The first historical texts that describe a magic trick come from ancient Egypt. The first magic performance is thought by some to have been in Egypt around 2000 B.C.: A shaman was proving his powers to the pharaoh. He took a duck, decapitated its head, and then restored the head to the living animal. Of course, this impressed the pharaoh very much! An image representing the famous trick, the cups and balls, dating from around 2500 BCE was discovered on the walls of Beni Hassan’s tomb. Likewise, the Westcar Papyrus provides the first written account of a magic performance. It suggests that the priests used magic to demonstrate the Pharaoh’s powers to mere mortals and to simulate supernatural powers. For instance, they used mechanisms involving sand to stop fountains from flowing on command or to open temple doors as if by magic. During the same era in

China (between 2700 and 2500 BCE), magicians were already performing the famous Chinese Linking Rings, metal circles that can be linked and unlined at will. See one performance with them here: http://www.youtube.com/watch?v=e0bVWKQHmZI

There is also a description of the cups and balls in a letter from the Greek sophist Alciphron (200AD).

Now, we're going to try it ourselves! This illusion can produce an impressive effect, but can only be done with special equipment. Learning to perform the trick requires hiding the trick's secret at all times.

Don't have the cash to splash on purchasing the Chinese Linking Rings for each student? Why not have them make some by (carefully) bending some thick (or thin) pliable wire into shape? Or, use cutters and a set of napkin rings? They do not even have to be circular. Why not squares? For each pair of rings fix one so that it is solid and leave one with a small gap. These trick ring should have a small, imperceptible break in it that allows them to link together when pressed.

Now normally in the Chinese Linking Rings you would use four or even eight rings and link them. But we're going to practice an easier variation on the effect only using two following instructions from FreeMagicTricks4U.

THE EFFECT: The magician clearly shows two solid steel rings to the audience. Yet magically and inexplicably the magician is able to link and unlink the solid rings seemingly at will. Have students watch a sample performance of this technique at: http://www.freemagictricks4u.com/chinese-linking-rings.html and the tutorial below the performance.

Begin the trick with the two rings on the table. Overlap the solid ring over the ring with the gap, so the gap is hidden. Pick up both rings in each hand making sure that when you pick up the ring with the gap, you grip it between your fingers to hide it. Show both rings to your audience.

Now the next moves are your 'convincer' moves to show the rings are solid without you having to actually spell it out. Place the solid ring over your right arm where it bends at the elbow. Hold the gimmicked ring (with gap in) up to your audience and pretend to turn it in your hands.

Spectators will think they are seeing all the ring but in fact you keep the gap hidden at all times. Just pretend to turn the ring and let it slide through your hands ***(pic 1)***.

When you have done this a couple of times (don't over do it) place the ring over your left arm where it bends at the elbow. Because your arm will be bent the gap in the ring will be hidden. You can now take the solid ring off your arm and give that a few turns to show it's solid too ***(pic 2)***.

Bring both rings together (always hiding the gap in the ring between your thumb and pointer finger). Knock them together a few times then push the solid ring through the gap in the gimmicked ring. Do this while your pointer finger hides the gap from the audience.

When you do this move you want to be as fluid as possible so it just looks like you are rubbing the rings together. Any jerking movements will look unnatural and awkward.

When you have performed the move let the solid ring drop and show it has magically linked with the other ring ***(pic 3)***.

To get the ring back off again simply reverse the moves. As you unlink you can give a little magical blow and then separate them.

Now that was maybe the simplest way to link them but I have a much more visual move to share with you. This move looks even more impressive if you get a spectator to hold the solid ring.

Grip the gimmicked ring in your fist so that the gap is touching your pinky finger (be careful not to flash the gap). ***(pic 4)***. Hold the solid ring in your hand or better still get a spectator to hold it.

Tap the two rings together a few times then when you are ready to link them, bring the ring down and bend your writs so the gap comes down over the solid ring. As soon as it goes through bend your wrist back again. Now performed quickly it will look like metal has passed through metal.

Be warned this can be a tricky move to pull off at first,

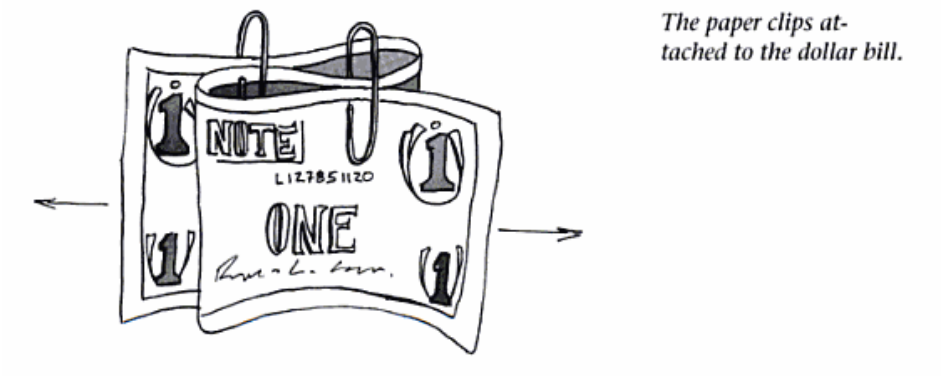
you may begin by missing the gap and hitting metal on metal. Don't worry with a bit of practice you will get it.

Finally simply perform the unlink move and you are back to normal. To finish the trick relatively clean just place the rings back on the table with the solid one overlapping the gap in the gimmick. Just make sure your spectators do not try and grab at the rings. You now know how to perform a simple version of the classic Chinese Linking Rings!

Mini Leaping Linking Rings! Okay, Paperclips...

We're going to do linking rings, in miniature! This trick is generally credited to Bill Bowman of Seattle, Washington, who published it in *The New Phoenix* around 1951.

You don't have to use money, but a dollar bill is just about the perfect size of paper. Fold the dollar bill into a Z formation. (You don't have to put hard creases in the bill; it can be curved in a backwards S-shape.) Fasten the two paperclips to the bill as shown, so that one clip holds together the first and second folds fo the bill (the outer end to the inner section). The other clip holds together the second and third folds (the center section and the inner end of the bill).

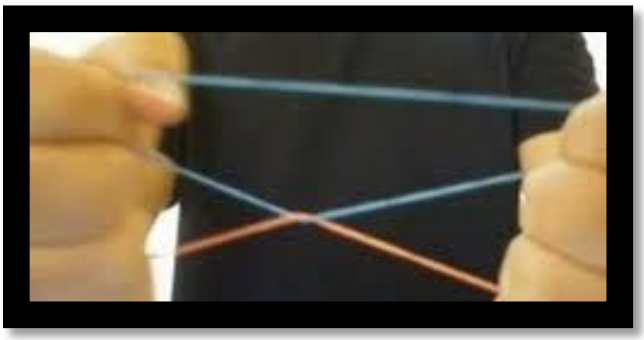


The paper clips attached to the dollar bill.

Quickly pull the two ends of the dollar bill apart, in opposite directions. The paper clips will link together and fly off the bill!

Watch how to do the linking paper clips magic trick from Magician Roger "Rogue" Quan in this office magic tricks revealed video from Howcast.http://www.howcast.com/videos/500548-How-to-Do-the-Linking-Paper-Clips-Trick-Magic-Tricks (Note: This site is also a great place to have students come back to later when they research additional magic tricks for their magic show performance. The secrets to 23 easy magic tricks are revealed by magician Roger "Rogue" Quan in these Howcast magic videos.)

Linking Rubber bands



Learn how to amaze your audience and link and unlink two rubber bands magically! Your spectators will think the ring must have a gap in it, but it does not! It's an easy but impressive trick.

http://www.howcast.com/videos/500560-How-to-Do-the-Linking-Rubber-Band-Trick-Magic-Tricks

Another tutorial: http://prop-tricks.wonderhowto.com/how-to/perform-linking-rubber-bands-magic-trick-211198/

Modern Times

Scientists: They just can´t leave well enough alone. It´s difficult for them to let certain things about life go unexplained and allow themselves to be amazed from time to time. Instead, they have to dissect, to find the truth, no matter how elusive it may be. For instance, scientists from the Barrow Neurological Institute have dug deep into neuroscience in order to explain how a certain magic trick performed by famous magicians "Penn & Teller" works.

Anyone who has ever seen Penn & Teller´s cups and balls routine (**Watch it here: http://theawesomer.com/penn-teller-cups-balls-trick/ or here** https://www.youtube.com/watch?v=oJhYySXzOq0 **(with an amazing bonus water trick following!**) already knows how the trick is done, of course. The way they do it, the trick is less of an illusion and more of an impeccably timed act, with tin foil balls of varying sizes moving seamlessly between pockets as Penn Jillette plainly yet rapidly explains the trick and Teller provides claps of distraction.

While we may "know" how the trick is done, Dr. Stephen Macknik, Director of the Laboratory of Behavioral Neurophysiology at Barrow Neurological Institute, and colleagues set out to explain why our

brains are still somehow fooled by the illusion. The resulting report has been published today in PeerJ, a new peer reviewed journal with free and open access to everyone.

“We still don´t know how (the trick) really works in the brain,” said Dr. Macknik, “because this is the first, long overdue, neuroscientific study of the trick.”

As explained by Penn & Teller, the cups and balls trick is perhaps the earliest of all illusions and can be found everywhere from China to Egypt and India. Though there are different versions of the trick (with different materials used for the cups and the balls), the basic approach is the same. A magician or illusionist places 3 balls on top of 3 overturned cups. The magician then appears to make the balls pass through the cup, end up in other cups, and even turn into different objects. As in the case of Penn & Teller´s version, one of the balls can turn into a baseball or even a potato.

Normally, cups and balls is performed with brightly colored balls and dark, opaque cups. Penn & Teller do the trick twice, breaking the first rule of magic. Then, breaking a 4th and unspoken rule of magic, Penn & Teller use clear cups to perform the trick yet again, allowing the audience to see exactly how the trick is done. Our brains are still able to make complete sense of the trick at this point, yet we´re still not able to really “see” how the trick is done.

To complete their research, Dr. Macknik and team showed clips of different variations of this trick performed by Teller to 7 subjects. They then studied the way the subject´s eyes moved during the trick, tracking where the subjects were looking and presumably expecting the next ball to emerge.

They then asked these subjects to press button “1” whenever they thought a ball had been removed and button “2” when a ball had been placed on the table or under a cup.

According to their data, even though the subjects knew how the trick was being performed, they hit button 2 more often when balls had not been placed at all.

It did not matter if the trick was being performed with clear or opaque cups; the subjects were mostly unable to accurately tell when the balls had realistically been dropped into cups. Though these subjects eventually got better at identifying the trick the more they watched it, the neuroscientists say the fact a human was performing the trick created too many subtle variations to get a real and accurate result.

With this study complete, the scientists say these results could be used to better understand how people can be misdirected by sleight of hand as well as improve the technique of magicians such as Penn & Teller, and you!

Source: Michael Harper for redOrbit.com – Your Universe Online

Which Hand Is It In?

Life is full of random events! You need to get a "feel" for them to be a smart and successful person. The toss of a coin, throwing dice and lottery draws are all examples of random events.

Probability is: *How **likely** something is to happen.*

Many events can't be predicted with total certainty. The best we can say is how **likely** they are to happen, using the idea of probability.

Probability

In general:

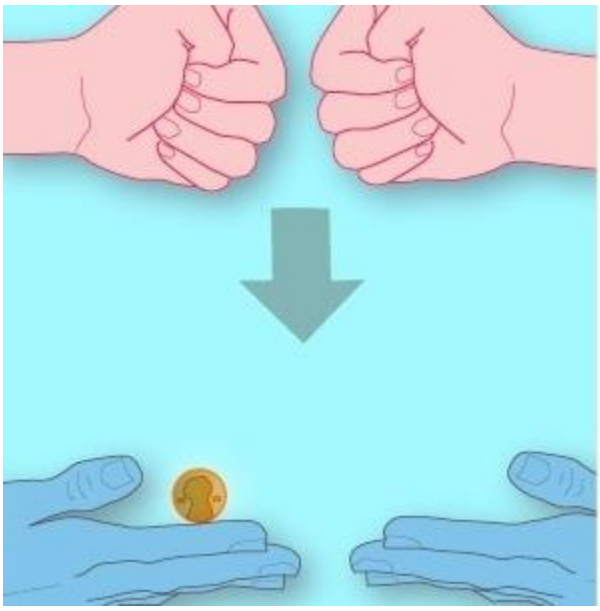
$$\text{Probability of an event happening} = \frac{\text{Number of ways it can happen}}{\text{Total number of outcomes}}$$

So if someone is hiding and object in their hand the probability of it being in their left hand might seem something like this.

Number of ways it can happen = 1 (they only have one left hand)

Total number of outcomes = 2 They have two hands.

So the probability = ½



You should have a 50/50 chance of getting it right, right? But, sometimes an event can affect the next event. For example, if someone is hiding an object they might not switch if they think you will guess, or you might have noticed that the hand with the object looks a little different than the other.

We call those Dependent Events, because what happens depends on what happened before.

We're going to see just how accurate eyes and minds are with a classic disappearing-object game and then calculate the probability of their accuracy. Have students make an estimate how many times they think they'll be able to trick their partner and how many times they'll be able to get it right when it's their turn to hide the object.

Estimate: Prediction of the future, based upon past results, or research. "In my previous rounds I've hit guessed right nearly half the time. I'm improving. I think I have a 65% chance of accuracy."

All students need is a partner, a piece of paper, a pencil and something small enough to ball up in their fist so that no one else can see that it's in there — a penny, a marble, a rolled-up piece of paper, etc.

Have one partner put their hands behind their back, concealing the object in one. Then show them both fists. Their partner will hand hides the object. Each time they guess have students record who was guessing, who was hiding, what hand it was in, and, of course, if the guesser got it right, or missed! Make sure they know they have to not cheat but try to learn the science of how to trick the other person more times than they are right by switching the item between their hands.

What is their average for getting it right? What is their partner's pattern for hiding it? Will that help them in other rounds?

Name of Person Hiding the Object	Name of Guesser	Was Hidden in Left Hand	Was Hidden in Right Hand	Did the Guesser pick the correct hand?

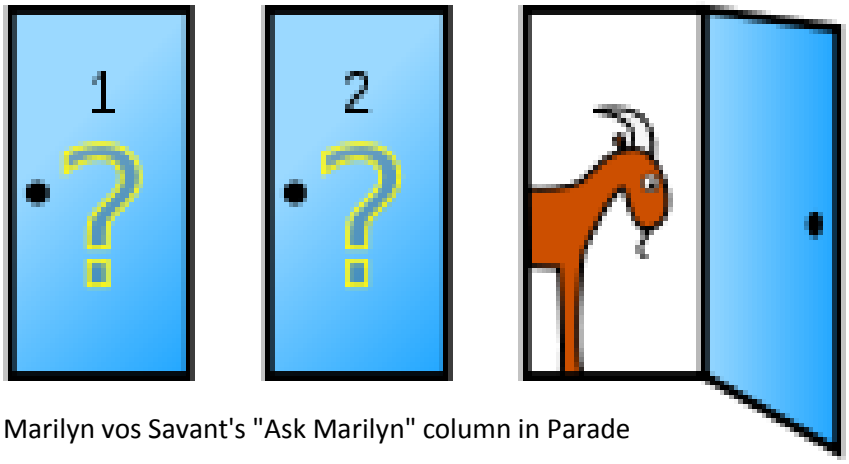
The Monty Hall Problem

Now, let's take things a bit deeper…and see how this kind of probability affects us in magic, in real life, and when we're trying to find a coin or a car instead of ending up with a goat! The following activity is a very fun way of exploring the magic of both experimental and theoretical probability with any age group.

Materials:

- Papers/PrintoutsMA
- Pencils
- Small cups
- Small hidden objects, ex. dried beans, jelly beans, pennies, or paperwads

The Monty Hall problem is a probability puzzle, loosely based on the American television game show



Let's Make a Deal (a fancy version of the classic penny under the cup game) and named after its original host, Monty Hall. The problem was originally posed in a letter by Steve Selvin to the American Statistician in 1975. It became famous as a question from a reader's letter quoted in Marilyn vos Savant's "Ask Marilyn" column in Parade magazine in 1990:

"Suppose you're on a game show, and you're given the choice of three doors: Behind one door is a car; behind both of the others, goats. You pick a door, say No. 1 (and it is left shut for now) and the host, who knows what's behind the doors, opens another door, say No. 3, which has a goat. He then says to you, "Do you want to pick door No. 2?" Is it to your advantage to switch your choice?"

What do students think? Vos Savant's response was that the contestant should switch to the other door. She said, "When you switch, you win 2/3 of the time and lose 1/3, but when you don't switch, you only win 1/3 of the time and lose 2/3. You can try it yourself and see."

The argument relies on assumptions that the host always opens a different door from the door chosen by the player and always reveals a goat by this action—because he knows where the car is hidden and doesn't want to show it. Leonard Mlodinow stated: "The Monty Hall problem is hard to grasp, because unless you think about it carefully, the role of the host goes unappreciated."

Contestants who switch have a 2/3 chance of winning the car, while contestants who stick have only a 1/3 chance. One way to see this is to notice that, 2/3 of the time, the initial choice of the player is a door hiding a goat, since there are two goats and 1 car. When that is the case, the host is forced to open the other goat door, and the remaining closed door hides the car. "Switching" only fails to give the car when

the player picked the "right" door (the door hiding the car) to begin with. But, of course, that will only happen 1/3 of the time.

Students may have a hard time understanding that the probability of winning can be other than 50/50 when there are two doors remaining. It may help them to understand if you change the problem this way: instead of picking from 3 doors, say there are 100 doors to pick from initially and only one contains a good prize. After the contestant chooses one, the host opens 98 (all but one) of the remaining doors leaving the chosen door (1% chance of containing the grand prize) and one of the others (99% chance of containing the grand prize). Then it may be clearer that the best strategy is to switch because it's so very unlikely the contestant picked the winning door the first time.

Many readers of vos Savant's column refused to believe switching is beneficial despite her explanation. After the problem appeared in Parade, approximately 10,000 readers, including nearly 1,000 with PhDs (Doctorate degrees), wrote to the magazine, most of them claiming vos Savant was wrong and many were quite insulting saying things like, "You blew it, and you blew it big!", "You're in error, but Albert Einstein earned a dearer place in the hearts of people after he admitted his errors." "May I suggest that you obtain and refer to a standard textbook on probability before you try to answer a question of this type again?" "Maybe women look at math problems differently than men." "You are the goat!" And funnily enough, "You made a mistake, but look at the positive side. If all those Ph.D.'s [who are telling you you are wrong] were wrong, the country would be in some very serious trouble."

Of the letters from the general public, 92% were against her answer, and of the letters from universities, 65% were against her answer. Overall, nine out of ten readers completely disagreed with her reply.

Even newspaper columnists joined in the fray! She read wild accusations of intellectual irresponsibility, and, as the days went by, was even more incredulous to read embarrassed retractions from some of those same people!

So let's look at it again, remembering that the original answer defines certain conditions, the most significant of which is that **the host always opens a losing door on purpose**. (There's no way he can always open a losing door by chance, he knows what's back there!) Anything else is a different question.

The original answer is still correct, and the key to it lies in the question, "Should you switch?" Suppose we pause at that point, and a UFO settles down onto the stage. A little green woman emerges, and the host asks her to point to one of the two unopened doors. The chances that she'll randomly choose the one with the prize are, what? 1/2, all right. But that's because she lacks the advantage the original contestant had—the help of the host.

When you first choose door #1 from three, there's a 1/3 chance that the prize is behind that one and a 2/3 chance that it's behind one of the others. But then the host steps in and gives you a clue. If the prize is behind #2, the host shows you #3, and if the prize is behind #3, the host shows you #2. So when you switch, you win if the prize is behind #2 or #3. You win either way! But if you don't switch, you win only if the prize is behind door #1, the door you originally picked.

And as this problem is of such intense interest, she sent out a call to math classes all across the country and asked for her thinking to be put to the test with a nationwide experiment and to test it out.

So let's try it!

The Probability of Cups and Balls

Set up a probability trial exactly as outlined below and have students keep a chart of all the games along with a description repeating just how you did it so we can make sure the methods are consistent. Have them make predictions on which strategy will work best (switching their choice of cup or not switching).

1. Divide students into pairs. One student plays the contestant, and another, the host.
2. Label three paper cups #1, #2, and #3.
3. Mark dice with stickers labeled 1, 2, 3 or use regular dice.
4. While the contestant looks away, the host randomly hides a penny under a cup by throwing a die until a 1, 2, or 3 comes up.
5. Next, the contestant randomly points to a cup by throwing a die the same way.
6. Then the host purposely lifts up a **losing** cup from the two unchosen.
7. Lastly, the contestant "stays" and lifts up his original cup to see if it covers the penny.
8. Play "not switching" two hundred times (this can be done between all students in your group, ex. 5 pairs will do it 40 times each) and keep track of how often the contestant wins.

Now, let's test the other strategy.

Play the game the exact same way **until the last instruction**, at which point the contestant instead "switches" and lifts up the cup not chosen by anyone to see if it covers the penny. Play "switching" two hundred times, also. Be sure to play the SAME number of times switching cups and without switching cups. Now, compile the data. What were the results of your class' experiments?

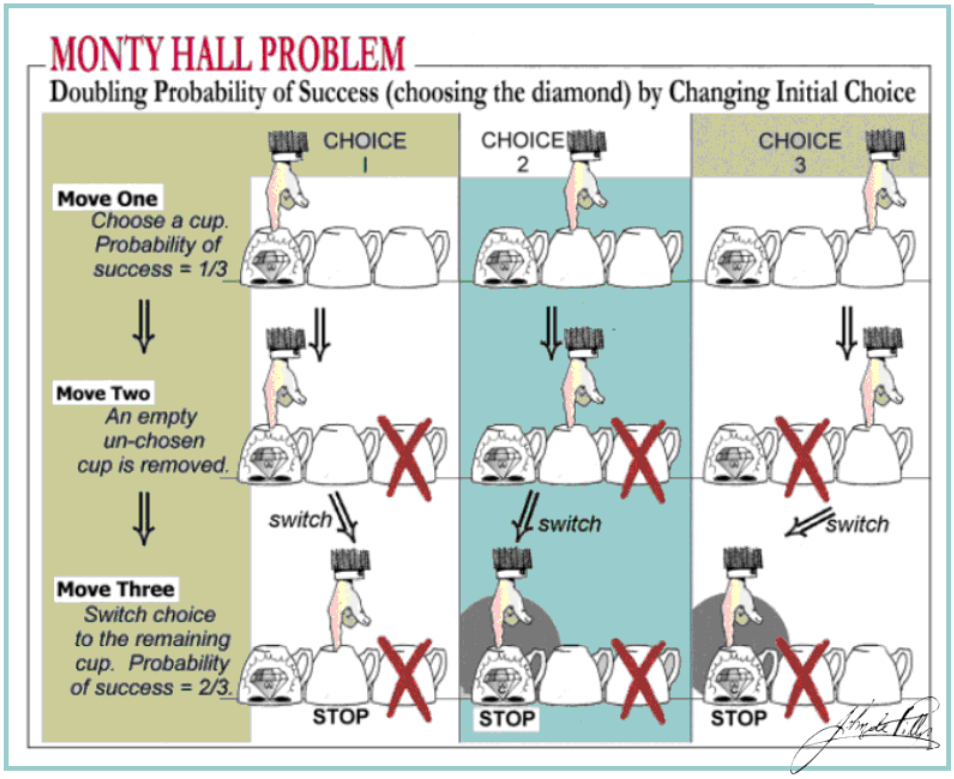
Do your results display a difference in your chance of winning based on whether or not you switched doors? Discuss this with students. Do they believe that they will have a better chance of winning if they switch doors? Why? Marilyn vos Savant's challenge resulted in her getting thousands of letters…again. But this time they often said something at least a little bit nicer.

"The teachers in my graduate-level mathematics classes, most of whom thought you were wrong, conducted your experiment as a class project. Each of the twenty-five teachers had students in their middle or high school classes play at least 400 games. In all, we had 14,800 samples of the experiment, and we're convinced that you were correct —the contestant should switch!"
Eloise Rudy, Furman University
Greenville, South Carolina

"This experiment caused so much discussion among students and parents that I'm going to have the results on display at our school open house."
Nancy Transier, Bear Branch Elementary
Kingwood, Texas

Marilyn said, "We've received thousands of letters, and of the people who performed the experiment by hand as described, the results are close to unanimous: you win twice as often when you change

doors. Nearly 100% of those readers now believe it pays to switch. (One is an eighth-grade math teacher who, despite data clearly supporting the position, simply refuses to believe it!)



But many people tried performing similar experiments on computers, fearlessly programming them in hundreds of different ways. Not surprisingly, they fared a little less well. Even so, about 97% of them now believe it pays to switch.

And plenty of people who didn't perform the experiment wrote, too. Of the general public, about 56% now believe you should switch compared with only 8% before. And from academic institutions, about 71% now believe you should switch compared with only 35% before. (Many of them wrote to express utter amazement at the whole state of affairs, commenting that it altered their thinking dramatically, especially about the state of mathematical education in this country.)"

And here's one last letter from what is arguably one of the best Science and Mathematics schools in the nation.

You are indeed correct. My colleagues at work had a ball with this problem, and I dare say that most of them, including me at first, thought you were wrong!

Seth Kalson, Ph.D.
Massachusetts Institute of Technology (MIT)

Even when given explanations, simulations, and formal mathematical proofs, many people still do not accept that switching is the best strategy. What do your students think? What will they do when playing cups and balls? Is it magic? Or is it mathematics?

Strategy	Don’t Switch	Switch
Wins		
Losses		
Winning Percentage		

Strategy	Don’t Switch	Switch
Wins		
Losses		
Winning Percentage		

Following the Rules

What constitutes a magic trick, especially on stage? It's divided into three parts. First, there's "The Pledge" wherein the magician shows the audience something ordinary he or she will use in the trick. Soon, the magician will follow this up with "The Turn" where the abovementioned ordinary object does something extraordinary in front of the audience. The pay-off of the magician's trick is "The Prestige" where the audience's astonishment occurs as they fail to deconstruct and figure out the means of the trick.

Something Old, Something New

Many of the principles of stage magic are old. There is an expression, "it's all done with smoke and mirrors", used to explain something baffling, but effects seldom use mirrors today, due to the amount of installation work and transport difficulties. For example, the famous Pepper's Ghost, a stage illusion first used in 19th-century London, required a specially built theatre. Modern performers have vanished objects as large as the Taj Mahal, the Statue of Liberty, and a space shuttle, using other kinds of optical deceptions.

Sleight of Hand is a way of moving objects around without an observer seeing or comprehending how they are moving thus making the observer believe that the movement is defying the laws of physics in 3 dimensional space. More specifically, that magic is being performed.

Sleight of hand, also known as prestidigitation (“quick fingers”) or legerdemain, is the set of techniques used by a magician (or card sharp) to manipulate objects such as cards and coins secretly.

To learn the seven basic principles of magic (and see pretty amazing illusion) have the kids watch: “Penn & Teller Explain Sleight of Hand” at http://www.youtube.com/watch?v=oXGr76CfoCs or at http://www.wimp.com/handexplained/. Or search for Penn and Teller Explain Sleight of Hand.

For centuries to follow, crowds would watch in wonder, consumed by a question that still resonates today. How does the magician get the audience member to believe? And that's where the magic takes place. How magic works - and why we keep falling under its spell - is now the subject of some serious investigation . . . not in a magician's workshop, but at a leading center for neurological (brain) research, the Barrow Neurological Institute in Phoenix, Ariz.
There, two Harvard-educated neuroscientists came to the humbling realization that magicians sometimes understand the mysterious workings of the human brain more than *they* do.
"The more we thought about it, the more we realized that magicians actually had skills that we didn't have, as scientists," said Dr. Stephen Macknik. Dr. Susana Martinez-Conde said what they are trying to get at is "why the tricks work in the mind of the spectator, and what are the brain principles behind it."

"Wanna see a trick?"

In the interest of neuroscience the two researchers have been collaborating with several magicians,

including Teller. Teller is one of five magicians who, with Macknik and Martinez-Conde, co-authored an academic article on the science of magic last year. ”That's what the art of magic is really for," said Teller. "It's the playground for perceptions."

During the test a magician will perform a trick while an audience member wears a device that tracks where their eyes are looking. A graph of the audience member’s eye movements shows how the magician manipulates his attention. No wonder he was fooled - he was looking in all the wrong places. Dr. Martinez-Conde showed him where his eyes tracked. "Here, again, you're lost," she said. "Now your eyes are following a different pattern - you are at a loss, you don't know what to do."

http://vimeo.com/4058513-Imagining the Impossible: Magic

"You think you can see everything all at once, when in fact, you can't," said Dr. Macknik. "That's an illusion that's created by your brain, and it allows us to navigate the world normally. So, the fact is that magicians are able to take advantage of that by knowing that you can only focus in one place while they do something somewhere else."

"Magicians really have this ability to distort your perceptions, to get people to perceive things that never happened, just like a visual illusion," he added.

The researchers looked into a magic trick called the "vanishing ball," in which a ball apparently disappears in midair. It's done by faking a throw while keeping the ball secretly palmed in the magician's hand.

Kuhn videotaped himself performing two versions of the illusion. In the "pro-illusion" version, on the fake throw, his gaze and head followed an imaginary ball moving upwards.(video: http://vimeo.com/3881166) In the "anti-illusion" version, Kuhn's eyes stayed on the hand concealing the ball [video http://vimeo.com/3955208]

Roughly two-thirds of volunteers watching the pro-illusion version on television had a vivid recollection of the ball leaving the top of the screen. "Often they claimed someone at the top of the screen caught the ball," Kuhn told LiveScience. In comparison, only a third of the people viewing the anti-illusion version experienced that illusion.

Kuhn and his colleagues measured the eye movements of volunteers during the experiment. Surprisingly, they found that when people believed they saw the ball vanish, most claimed they spent their entire time looking at the ball, yet most actually glanced at the magician's face prior to following the ball to help them perceive the ball's location. (video http://vimeo.com/3955750)

"Even though people claimed they were looking at the ball, what you find is that they spend a lot of time looking at the face. While their eye movements weren't fooled by where the ball was, their perception was. It reveals how important social cues are in influencing perception," Kuhn said.

"As we are looking at the world, we have this impression that what we see is the real world. What this tells us is the way we see the world is more strongly dominated by how we perceive it to be rather than what it actually is," Kuhn added. "Even though the ball never left the hand, the reason people saw it leave is because they expected the ball to leave the hand. It's the beliefs about what should happen that

override the actual visual input

Teller thinks a lot about how magicians manipulate the brain to make us *think* we see things we really don't see - like misdirecting viewers from where he's holding a ball. "What's important is that your attention is going up there, not [seeing] that, you know, the ball is secretly hidden in my hand."
He demonstrated by showing how he'd tightly hold his fist - "more tightly than I would normally . . . so that you see the strain in my fingers" - to help convince the audience the ball IS in his hand.

Magicians also sometimes manipulate our minds, simply by aiming at our funny bone. "If you want to get away with something, make somebody laugh," one said. "'Cause, I mean, when you're laughing, you can't pay attention to the secret little thing I need to do."

Drs. Martinez-Conde and Macknik, who drew some 7,000 neuroscientists to a recent conference where they discussed magic, say there's more to their work than sheer "gee whiz." For one thing, it could change the way disorders like autism are diagnosed.

"We predict that autistics will detect the method in a magic trick better than someone with a Ph.D," Macknik said. "Autistics are people with deficits in joint attention, so they not only can't pay attention very well to people and where they're *supposed* to pay attention, but they're kind of*repulsed* by it.

"Therefore, they're paying attention to the things that the magician doesn't want 'em to be paying attention to. So what we have proposed is that one can use magic tricks as a tool for early diagnosis of autism," said Martinez-Conde.

Whether their research will achieve this ambitious goal remains to be seen.
For now, what's certain is that scientific analysis of magic poses an essential question for those who make a living at it:

"Does it ruin any of that magic to boil it down to neurons and the ways connections are made between the eyes and the brain?" (What do the kids think?) "It makes it better," said Teller. "Some people believe that scientists are out to take away the mystery. And really all they're doing is going deeper into it, getting to the more real, more deep, you know, more profound mysteries.

"The deeper you go into a mystery, the deeper mystery always becomes."

http://magic.about.com/od/magichistory/a/Harry-Blackstone-And-Memoirs-Of-An-Elusive-Moth.htm

Maintaining the Mystery: The Magician's Oath & Code of Ethics

Over the centuries, honorable and serious illusionists and magicians have been, in one form or another, committed to The Magician's Oath (Promise) and The Magician's Code of Ethics, two very simple ideas connecting all respected magicians:

The Magician's Oath:

"The secret of an Illusion should never be revealed – unless to a student of magic who also takes this Oath."

It is commonly known among magicians that the outcome of sharing a secret of magic with a non-magician is usually disappointment.

Once a secret is revealed, the fire of amazement in the eyes of your audience will quickly burn out.

- Embracing The Magician's Oath empowers you to serve people as the best magician you can be, and supports the work of other magicians as well.
- Breaking The Magician's Oath weakens your own effectiveness as a magician and hurts magicians of good will everywhere.

If someone asks you, "How did you do that?" you are not permitted, by tradition, to reveal the secret.

But if a student of magic asks to be your student, then you have an obligation to accept the student as your student too.

The Magician's Code of Ethics:

"A magician should never claim to have supernatural abilities."

Both a magic trick and its audience are abused when a magician perpetuates the lie that he or she actually has supernatural abilities.

How to Perform the Cup and Balls Trick

Tip: Watching the video at http://www.videojug.com/film/how-to-perform-the-cup-and-balls-trick is very helpful. Magician Christian Lee will show you how to impress your students with this classic cup and balls trick before they get to learn it and perform it themselves.

Step 1: You will need

- 3 cups
- a napkin
- some magical know-how

Step 2: The trick

The cups and balls trick is one that has confounded audiences for hundreds of years. The cups are laid out in a row upside down. One ball is placed on top of the middle cup. The other cups are then stacked on top. When they are lifted up, there is a ball underneath the stack! It appears that it has penetrated through the base of the cup. Another ball is placed on top, the cups are stacked again and lifted to reveal two balls. This happens one more time so that all three balls end up underneath the middle cup.

Step 3: How it's done

Tear a tissue into four equal sized pieces. Roll each piece up into a ball.
Now line up 3 cups in a row. Place one ball of tissue in the middle cup but don't show anyone. The trick revolves around this hidden ball so no one can know it's there. Keep it a secret.

Line up your cups and the three remaining balls. Turn each of the cups upside down. Be careful when turning over the middle cup not to let the hidden ball fall out, or the trick will be ruined. Turn the cup quickly to avoid this.

Now that you're ready to do the trick with one ball concealed under the middle cup, place one ball on top of the middle cup. Then stack the other two cups over it. Click your fingers and lift up the stack to reveal the ball you hid underneath the middle cup. The audience will think the ball you placed on top of the cup has travelled through the base.

Separate the cups and, again being careful not to reveal the hidden ball, turn them upside down. Put the cup containing the ball in the middle. There are now two balls underneath the middle cup but the audience believes there is only one.

Place the next ball on top of the middle cup, stack the others over it, click your fingers twice and reveal that there are now two balls under the stack. With practice, you should be able to make unstacking the cups without the ball falling out look completely natural.
Place the last ball on top and stack the others once again. Click your fingers three times and show the audience all three balls under cups.

Finally, separate the cups and line them up as they were at the start.

Step 4: Done!

Hundreds of years of mystery solved.