Study Guide for
THE SCIENCE OF MAGIC

Welcome to the Magical world of Science! In this show we show YOU how to make magic out of scientific concepts. Feel free to use these ideas, then, make up your own! Take the science and create amazing things of your own to amaze and amuse your family and friends.

THE PERFORMERS

(NOTE: the performance can be performed by either Mr. Fish or Lisa Lou solo, or can be presented by both of them together.)

Lisa Lou (AKA Lisa B. Lewis) is a graduate of the Ringling Bothers Barnum and Bailey Clown College, Brandeis University, and has an MA in Clown/Circus History from NYU. Ms. Lewis worked as the advance clown performing a R.I.F. program for the Ringling Brothers Barnum and Bailey Circus. She also performs in New York City hospitals with the Big Apple Circus's Clown Care Unit. She has traveled from Japan to Utah entertaining kids of all ages with her unique combination of circus skills and magic. Lisa is also the beaming mother of one amazing daughter :0)

Mr. Fish (AKA John James Lepiarz) is a long-time circus performer. He toured for 7 years with The Big Apple Circus. He has appeared on national television on HBO and on ABC's *Great Circus Performances of the World.* He has toured his own 2-man show, "The Funny Stuff Circus," around the world, including Hong Kong and Taiwan. A graduate of Oberlin College, Mr. Fish is the proud father of 4 children.

DEFINITIONS:

Magnetic Field: A field of force around the Sun and the planets, generated by electrical currents, in which a magnetic influence is felt by other currents. The Earth's magnetic field is aligned with the north and south poles, and has reversed many times during geologic history.

Magnets: A magnet is an object that has a magnetic field. The word magnet comes from the Greek "magnítis líthos" which means "magnesian stone." Magnesia is an area in Greece where deposits of magnetite have been discovered since antiquity. There are only 3 metals that are naturally magnetic: Nickel, Cobalt, and Iron. Many other metals are attracted by magnets.

Air Pressure: An invisible force always pulling in all directions at the same time at a rate of 14.7 pounds per square inch on the planet earth.

Scientific Theory: Science does not assume it knows the absolute truth about the world. Science assumes it must discover its knowledge. Science presupposes a regular order to nature and assumes there are underlying principles according to which natural phenomena work. It assumes that these principles or laws are relatively constant. But it does not assume that it can know for certain what these principles are or what the actual order of any set of empirical phenomena is. The "theory" is our best guess at the time with the observations and information generally accepted by most scientists.

Light: Light is energy in waves. A wave contains both electric and magnetic energy fields. Sometimes scientists look inside of a wave at the tiny particles that make it. They are called photons. Light radiates out and bounces off of surfaces into our eyes. That is called illumination. It is how we are able to see.

Important facts about light:

1. **Light travels at 186,000 miles per second in a vacuum.**
2. **Light travels in a straight line until it hits an object**
3. **When light hits a surface in can only do one of four things: reflect, refract, absorb or pass right through.**

Reflection: (mirrors) light hits a surface such as a mirror and bounces back at the same angle.

Refraction: (prisms and bubbles) light hits more than one surface at a time. The wave gets out of sync with itself allowing you to see rainbows.

Absorption: The atoms of the light and the atoms of the surface collide. The energy is converted to heat and we can't see it anymore.

Laser: A laser is a beam of light in which all of the frequencies are the same and going in the same direction. The *frequency* is the number of waves that pass a point in space during any time

interval, usually one second.

Mirrors: A mirror is a reflective surface that is smooth enough to form an image

Optical illusions: Something that appears to have an effect that it does not really have, such as when a flat painting seems to have three-dimensional depth.

ACTIVITIES:

MAGNETS: With a magnet, go around your house or your school and find all the things that are attracted to magnets.

MAGNETIC MAGIC:

Need: cardboard box
Bar magnet
Small magnet
Plastic cup

Put the small magnet inside the cup. Place the box on its side with the opening facing you. This makes a "stage" (the bottom of the box faces your "audience") Put the cup on top of the box and hide your arm holding the bar magnet inside the box. You can make the cup move without touching it!!! Make up your own story and enjoy.

LIGHT: To show how light travels in a straight line, turn the lights off and shine a flash light across the room. To see it better, slap two erasers together and get some chalk dust in the air, and look at the beam of light.

REFRACTION: To show how light can bounce and bend, have one of your class mates hold up a mirror and shine a flash light at it. Watch how the light bounces off the mirror and onto the wall.

MIRRORS: Have students hold up small mirrors as they stand around the class room or Gym. Shine a flash light at the first mirror, angle that mirror so the beam of light hits the second mirror, angle that to hit the third mirror, etc. See how many mirrors you can bounce light off of.

MIRRORS: Using two mirrors, place them in different relationship to each other and see what happens. For example if you place a mirror on your right and left, you will create a countless number of YOU IN THE MIRRORS. Put the mirrors at 90 degree angles and see what happens to your right and left side.

MATHOMAGIC: YOUR NUMBER IS 5

1 Choose any number between 1 and 100
2 MULTIPLY that number by 2
3 ADD 10 to that number
4 DIVIDE that number by 2
5 SUBTRACT the original number
6 Your number will always be 5.

Do this trick on the black board for the whole class. See if you can discover how to change the formula so that your number is always 2,3 or 4.

OPTICAL ILLUSION: Discuss the phrase, "I can't believe my eyes" Ask the students if they ever saw something that they could not believe they saw. If possible, seek out a book or pictures by I.M. Escher or Salvador Dali. Many of their drawings and paintings are based on optical Illusion or optical confusion.

CREATE YOUR OWN MAGIC TRICKS: Be creative, have a contest and see if you can use science to create a magic trick to fool your friends.

READING LIST:

***EVERYDAY SCIENCE EXPLAINED*, Published by The National Geographic Society, this hard bound book is the BEST and MOST COMPLETE science book ever published. It contains not only in-depth explanations of scientific principals, but also has an extensive vocabulary listing. Even more interesting, it explains the history of scientific discoveries.**

JANICE VAN CLEAVE is the author of over 25 books dealing with: physics, earth science, biology, chemistry, etc. All of her books are designed to use a "hands on" approach to understanding basic scientific principles.

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