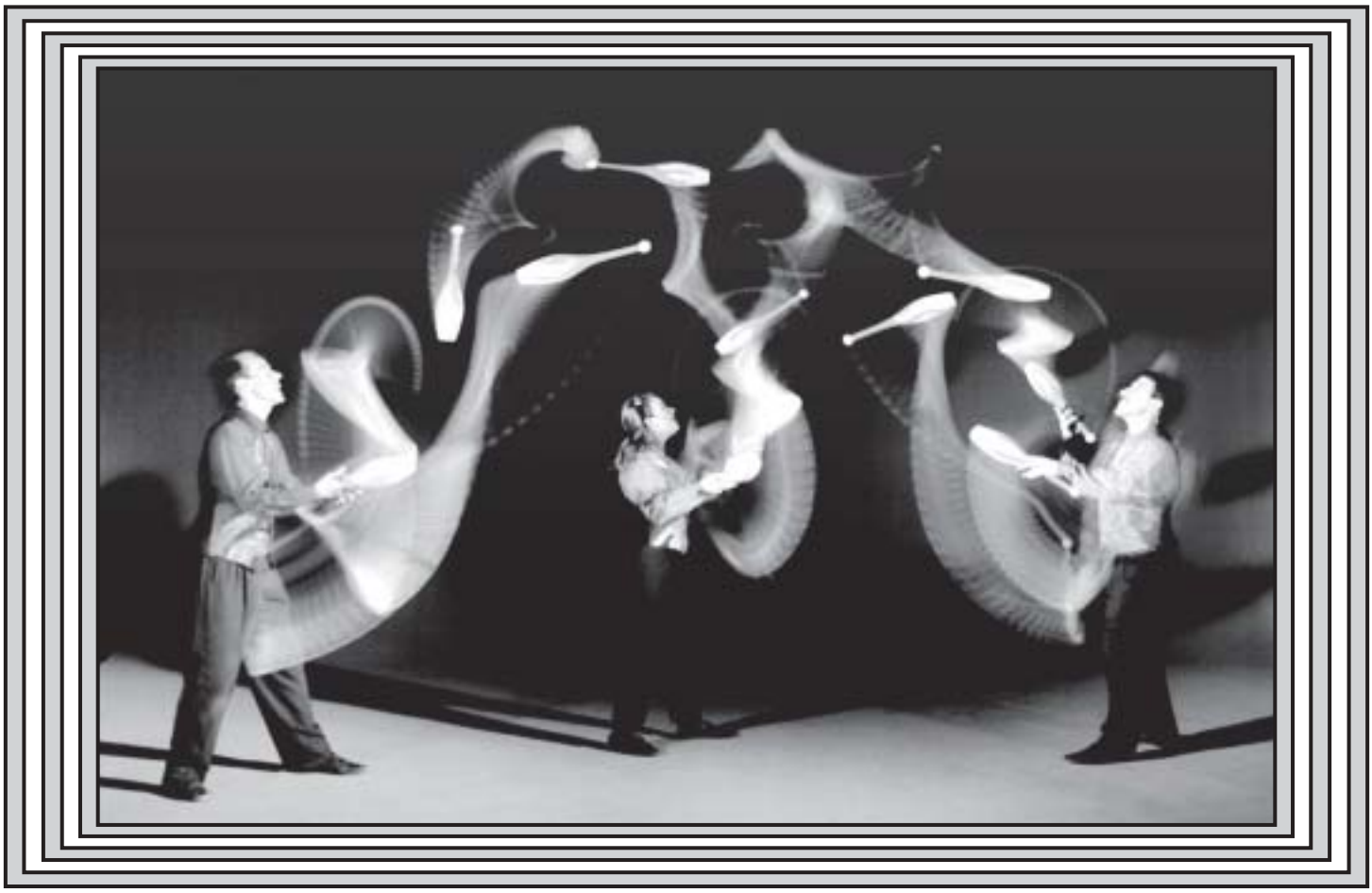
LAZER VAUDEVILLE'S CURRICULUM-BASED STUDY GUIDE & LESSON PLAN



This material is intended to assist teachers in preparing their students for a production of ***LAZER VAUDEVILLE***. It also provides topics for discussion after they have seen the performance. This study guide in conjunction with a ***LAZER VAUDEVILLE*** performance will serve as a starting point from which to connect standard curriculums such as Science, American History, Computer Class, Theater, and Physical Education to an exciting and fun filled event. This will help to arouse student's interest as well as to assist the teacher in connecting the curriculum with the everyday world. Most of the sections have been designed for ***elementary*** students. However, the level increases in the "MORE ABOUT" sections, which should be reserved for ***middle or high school***. The Quizzes provided are also divided into two levels.

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THE HISTORY OF VAUDEVILLE

INTRODUCTION

Imagine a world sometime in the future when no one knows what the word television means. Suppose something more exciting has come along and everyone has forgotten about television. Perhaps another economic depression has come along and no one can afford to pay the high priced actors in Hollywood. Maybe a holo-deck, like the one in the Star Trek series, really has been invented and all the actors in television can make more money in holo-deck programs. Maybe the owners of the holo-deck company have bought all of the television stations and studios, and shut them down, so that people have to buy holo-decks instead of televisions. Maybe all of these things have happened at the same time and that's why no one remembers television. Well, that is exactly what happened to vaudeville. Vaudeville was THE most popular form of entertainment in North America from 1875 until 1932, and now it is a word that most students have never heard, and most people know very little about. This part of our study guide is designed to give teachers and students an idea of what vaudeville was, placing it in the context of the Civil War, the Great Depression, the inventions of radio, movies, and television.

A Classic Vaudeville Poster

WHAT IS VAUDEVILLE ?

Vaudeville was THE most popular form of entertainment in America between 1875 and 1932. Before the invention of radio, movies and television, most theaters around the country presented vaudeville shows. Every place from big cities to small towns had its own vaudeville house, and performers would travel from one town to the next throughout the year. Vaudevillians were skilled in comedy, juggling, magic, clowning, acrobatics, singing, mime, music, and dancing. The performers themselves molded these skills into original acts, using music, costuming, dialogue, and their own personalities to enhance the presentation.

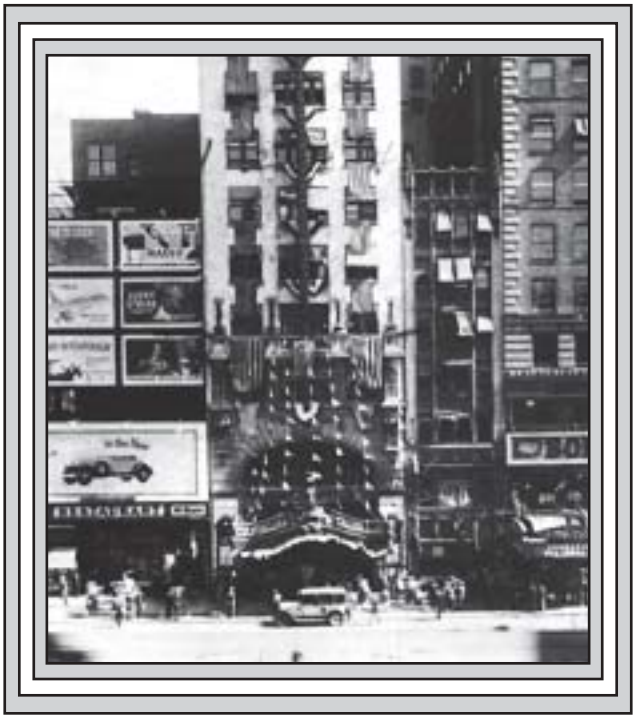
The Three Keatons - "Buster" is the little one

HOW DID THE WORD VAUDEVILLE ORIGINATE ?

Vaudeville, like many forms of theatre, dance, and music, had its origins in Europe. The word VAUDEVILLE was originally derived from two French phrases: ***Val de Vire,*** which meant "Valley of the River Vire" and ***Voix de Ville,*** which meant "Voices of the Town." The valley was a place where people would entertain each other in the evenings with ballads, folk songs, and general merry making. In the city streets, popular theatre gave rise to the Theatre de Vaudeville in Paris in 1792.

WILD AND WOOLLY BEGINNINGS !!!

Although the word is French, the form of entertainment known as vaudeville developed into a distinctly American art form. Vaudeville had its beginnings in the wild, wild west. Saloon owners would hire performers to do their acts in hopes that they would bring more customers into the saloons. Originally it was called variety, but the exotic French word "vaudeville" seemed to attract more people, and so it became vaudeville. There was one man who was a driving force to clean up vaudeville in the early days. His name was ***Tony Pastor***, and he developed the first vaudeville theatre in New York City. Despite its wild and woolly beginnings, in the mid 1800's vaudeville moved out of the saloons and into the theatres. In 1871, ***Sargent's Great Vaudeville Co.*** opened at ***Weisiger's Hall*** in Louisville, Kentucky. In 1904, ***Will Rogers*** made his vaudeville debut at the Cleveland Theatre in Chicago. Vaudeville had become a very clean, classy form ofentertainment for the entire family.



The Palace Theatre in New York City circa 1928

VAUDEVILLE FOR EVERYONE

The great appeal of vaudeville was that it was entertainment for everyone. You didn't have to be rich to buy a ticket, like the symphony. You didn't have to understand Italian to follow the story or get the jokes, as in opera. All you needed for a vaudeville show was the desire to laugh and have fun. Vaudeville performers were not picky about who their audiences were, and in turn vaudeville audiences were not picky about who their stars were. It was on the Vaudeville stage (not theatre, opera, symphony, radio, or movies) that the first African-American star was born. His name was ***Bert Williams***. It was the vaudeville stage that opened it's arms to the numerous immigrants of all nationalities at the time of North America's greatest waves of immigration. Chinese, Irish, German, French, Russian, Scottish immigrants and more all found places to perform on the vaudeville stage. The reasonably priced, fun-filled ticket attracted equally diverse audiences. Women found their highest paying jobs on the vaudeville stage, often making 100 times more than what they'd make in the sweatshop job market of the late 1800's.

Florence Mills - The first African-American woman to take vaudeville by storm in the 1920's

THE VAUDEVILLE CIRCUIT

Vaudeville was divided into circuits. A circuit was a chain of vaudeville theatres in different cities and towns that would band together and hire the same

group of acts from the same booking agents. The theatres on a circuit would usually all have the same name. Some of the best known vaudeville circuits were the ***Orpheum, Pantages, Palace, Paramount, Keith,*** and ***Hammerstein's***. There were three important groups of people in the vaudeville circuit: the ***Theatre Managers***, the ***Booking Agents***, and the ***Vaudeville Acts***. Vaudeville was definitely "Show Business" and each of these three groups helped to make it all work.

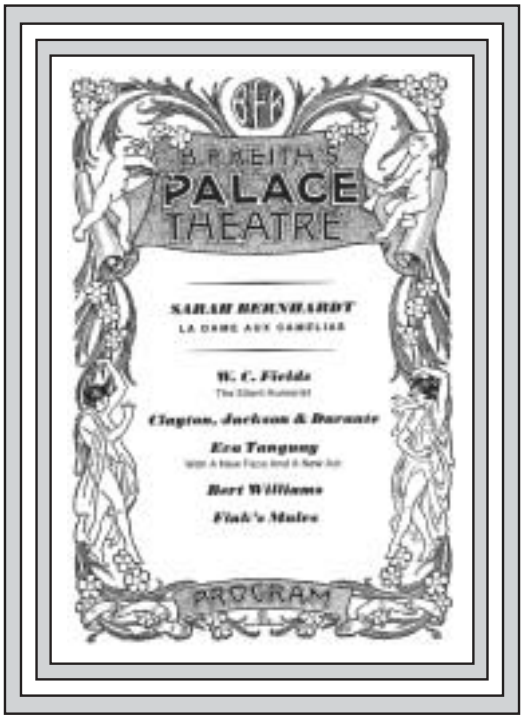
THE THEATRE MANAGERS

Each theatre would usually have it's own manager. Sometimes the managers would own the theatres themselves, and sometimes a business person or entrepreneur would own the theatre. In that case the manager would be hired by the owner to run the theatre. The theatre managers were on the business side of show business. They would run the vaudeville theatre's day to day operations such as selling tickets, making sure the shows started on time, and a thousand other details. They also made the final decisions as to which acts would play at their theatre, and in what order the acts would appear when they arrived. The theatre managers had the power to fire an act after only one performance if they did not like the act.

The running order was listed on a call board, and performers would hope for the best spots. The opening act had the difficult task of warming up the audience. The important second-to-last spot on the bill was a great honor reserved for famous headliners, legendary performers like Sophie Tucker, Nora Bayes, Sarah Bernhardt, Ethyl Barrymore, W.C. Fields, Will Rogers, or Ethel Merman. The last spot was reserved for the "dumb show," meaning a spectacle act without words, because at this point people were already starting to leave the theatre to make room for the next audience.

THE BOOKING AGENTS

This is what gave a vaudeville circuit its name. Oddly enough the theatres were not named after the theatre managers, but after the booking agent or booking agent's company. The Keith circuit was named after B.F. Keith, the booking agent. The Hammerstein circuit was named after Oscar Hammerstein, Sr., father of the lyric writer Oscar Jr. of Rogers & Hammerstein fame. Most booking agents had one theatre that they managed and called home. This theatre also housed the office where they did all of the booking for the rest of the circuit. One agent would be responsible for booking all the acts that played the theatres in their particular circuit. For instance, when the Orpheum circuit started it had only half a dozen theatres in California, but the same agent, ***Martin Beck***, did all the booking for these theatres. Therefore if you were a juggler and wanted to get booked into the San Francisco Orpheum, you had to get booked by the agent for the Orpheum circuit. The booking agent would usually hire an act to play all of the theatres on the circuit. This idea of having each set of theatres controlled by a single booking agent or company is still the way the movie industry works today. One company, for instance United Artists Cinemas, will show only movies made by that company, and not those of their competition. The booking agents were also part of the business side of Showbusiness.



A Vaudeville Bill from the Palace Theatre

THE VAUDEVILLE ACTS

This was the show part of Show Business. This was the fun part, the part the audience came to know and love. At its peak in the 1920's there were 20,000 vaudeville acts in the country, and over 2 million people saw vaudeville shows EVERY DAY!

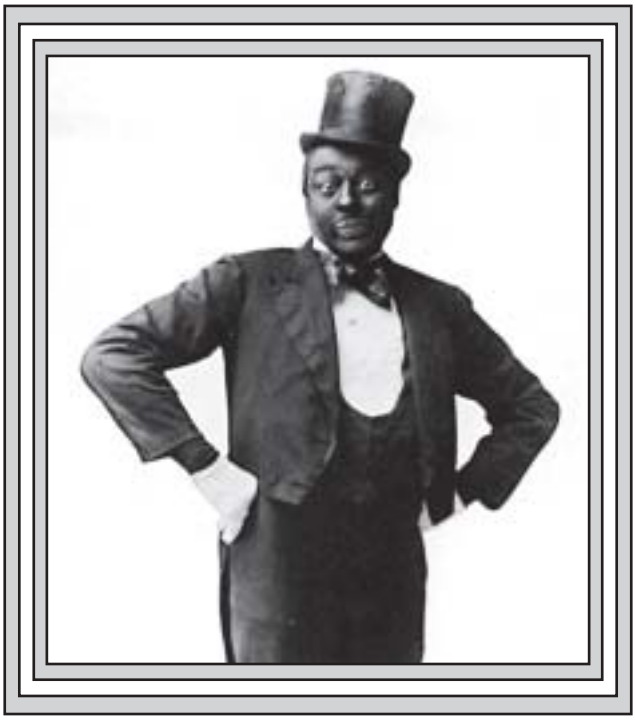
The line - up of the show, or who was playing in the show that week, was called the vaudeville bill, the vaudeville bill would change every week. There were usually nine or ten acts in a vaudeville bill, although sometimes there were as many as twenty. The acts were incredibly varied but they had one thing in common. They were all clean family fun ! The Palace in New York City, the most famous of all the vaudeville theatres, had a sign backstage to remind the performers that "This Theater caters to Ladies and Gentlemen and Children. Vulgarity will not be tolerated.".

There were an endless variety of acts: singers and dancers, jugglers and clowns, magicians and escape artists, comedians and mimes, acrobats and daredevils, animal acts and puppets, musicians and minstrels, rope spinners and horseback riders. Sometimes a well-known individual who was not a vaudeville act would appear to share their life experiences with an audience. This was true of Hellen Keller and Babe Ruth when they each played the Palace Theatre in the 1920's. There were solo acts, duets, trios, acts with 40 people, and even families who performed together like the Marx Brothers or the Dolly Sisters. Though their acts were very diverse, vaudevillians all shared a great love for traveling and performing.

VAUDEVILLE HELPED BREAK DOWN RACIAL BARRIERS

Vaudeville was the first popular entertainment in America to have an African-American celebrity, Bert Williams. He was loved and admired by all races as a comical genius. The path to acceptance wasn't easy and the following chronicle is not pretty; however, it IS part of our history. It also illustrates the openness of the vaudeville society long before the rest of show business caught on.

Before the Civil War, and before slavery was abolished, there was a form of entertainment called minstrel shows. These minstrel shows started in 1828 and were popular from 1841-1870. The white performers would cover their faces with burnt cork. This style of make-up was called black-face make-up. The performers would then go on stage and mimic the "down on the farm" lifestyle of the slaves on the southern plantations. This was done through music, song, dance, and acting. Although this type of show today would be considered racially degrading, in the mid-1800's it was popular with the white audience of the time. After the civil war these minstrel shows lost their popularity. But some of the minstrel acts moved onto the vaudeville stage, bringing their black-face make-up with them. These performances in vaudeville led to African-Americans themselves putting on black-face make-up and creating vaudeville routines. Initially African-American performers put on black-face so that they would be accepted by the audience, since the mostly white audience had never seen African-American entertainers. Bert Williams, however, did not poke fun at his own race but was a comic genius in his own right. He would use his comic talents to create universal situations that would be humorous to the low-income members of his audience who were themselves newly arrived immigrants. Ironically, when Vaudeville houses banned black-face make-up, Bert Williams felt he had lost a big part of his stage act. This was similar to a clown removing his make-up and no longer feeling like he was funny.



Bert Williams - One of the comic greats!

In 1918 singers ***Nobble Sissle*** and ***Eubie Blake*** became the first African-American entertainers NOT to use black-face make-up. Vaudeville had opened it's doors to the African-American entertainer while the rest of show business (theatre, radio, and movies) still hid behind closed doors.

HOW VAUDEVILLE DIED ☹

Everyone says that Vaudeville died. But if so, what killed it? Vaudeville did not just dry up and blow away because all of the performers became too old. There were plenty of young performers of great talent coming along then, as there still are today. Vaudeville did not die out because the public's interest in vaudeville faded. Instead the interest was taken away by other things. Vaudeville did not die a natural death, it was murdered, and in part by its own performers. There were three main things that teamed up to kill vaudeville: ***Radio***, ***The Great Depression***, and ***Talking Movies*** .

Weber & Fields - Vaudevillians on the Radio

RADIO

Although ***Guglielmo Marconi*** of Italy sent the first radio signals in 1895, experimental radio broadcasts did not begin until 1910 when ***Lee De Forest*** broadcast a program from the ***Metropolitan Opera House in New York City***. The first radio station was liscensed in 1921, when radio started putting entertainment on the air. It was the new thing that everyone was obsessed with, somewhat like the Internet is today. The first broadcast was Opera, and soon followed Music, Symphonies, Politicians, and Vaudeville. Some of the Vaudeville routines would work on radio, and some would not. Imagine trying to listen to Enrico Rastelli, the world's greatest juggler of all time and also a vaudeville act, on the radio. It would not sound like much, unless he was dropping a lot. But some vaudeville routines would play wonderfully on the radio. Bergen and McCarthy did a famous ventriloquist act. Edgar Bergen was the ventriloquist, and Charlie McCarthy was the dummy. This was all verbal comedy, and went over great on the radio. Edgar Bergen is also Candice Bergen's (Murphy Brown's) father. George Burns and Gracie Allen were another vaudeville pair that were hilarious both on the vaudeville stage, and radio.

Bergen and McCarthy with Mortimer Snerd !

ECONOMICS & DIRTY DEALS

Economic issues played a role in vaudeville's decline. Why would the audience go out and spend from one to three dollars to see the same stars they could stay at home and listen to on the radio for free? Not only could the audience hear the stars on radio for free, but very often the radio show would be broadcast right from the vaudeville theatre, and just skip the acts that didn't work well on the radio, like the jugglers. This was helped along by the new policy of the ***Palace Theatre*** which dictated that all of the performers who were able to do the radio shows broadcast from the theatre must do so.

The Palace Theatre was the biggest vaudeville theatre, and by 1920 it was the seat of power for the newly combined Keith/Albee/Orpheum circuit, 3 vaudeville circuits all rolled into one. In 1928 the business tycoon Joe Kennedy (future president John F. Kennedy's father) bought 200,000 shares of stock in the Keith/Albee/Orpheum circuit, then run by E.F. Albee (grandfather to the playwright Edward Albee). But Joe Kennedy pulled a fast one and ran Mr. Albee out of the business by taking over the controlling interest—one of the earliest economic hostile take-overs. It was Mr. Kennedy's policy that all the vaudevillians who could do their acts on radio would have to do so. Although this policy created a great many radio stars, it was the first serious sickness for the aging art of vaudeville.

THE GREAT DEPRESSION

The stock market crashed in 1929 and America went through 10 years of the worst economic crisis in history. People were jobless, homeless and without food. This was before unemployment benefits or welfare. People could no longer afford the basic necessities of life, never mind the little luxuries like going to a vaudeville show. For the theatres it became cheaper to show a movie than to hire real live vaudeville acts. The audience also wanted big stars, and big stars were expensive. It was easier to get a big star into your theatre by showing the movie they were in rather than by hiring the stars themselves. A movie in the 1930's might cost only 50 cents whereas a vaudeville show might be one, two, or even three dollars.

The Marx Brothers - A hit on stage & screen !

TALKING MOVIES

Movies became vaudeville's biggest competition. In 1925 ***Al Jolson's "The Jazz Singer"*** came out at ***The Warner Theater*** in New York City. It was the first ever moving picture synchronized to sound, and it was a hit! But movies didn't take over all at once, in fact they sort of sneaked up on vaudeville and jumped it from behind. In the middle 1600's physicists were experimenting with the beginnings of the ***Magic Lantern***, an early slide projector, but it wasn't able to project an image clearly until the 1780's. The Magic Lantern shows became quite elaborate using different slides and effects. The first form of moving pictures did not exist until May 9, 1893 when ***Thomas Edison*** gave the first public demonstration of his ***Kinetoscope*** at the ***Brooklyn Institute of Arts and Sciences***. The Kinetoscope was a box you looked into to see the very short moving pictures. Only one person could view them at a time, but soon ***Kinetoscope parlors*** where you could pay to see a short movie inside the box became popular all over the world.

The First Kinetoscope parlor, April 14, 1894

MOVIES IN VAUDEVILLE & VAUDEVILLE IN MOVIES

When the first projected movies started coming out in 1895 they were little more than a curiosity, but soon they found their way into vaudeville. Movies without sound were at first very short, two or three minutes. These would be shown in the vaudeville theatres with maybe one or two "shorts," as they were called, appearing in each vaudeville show. The movies grew in length and they would eventually replace entire vaudeville acts, so that instead of having nine vaudeville acts, a theatre

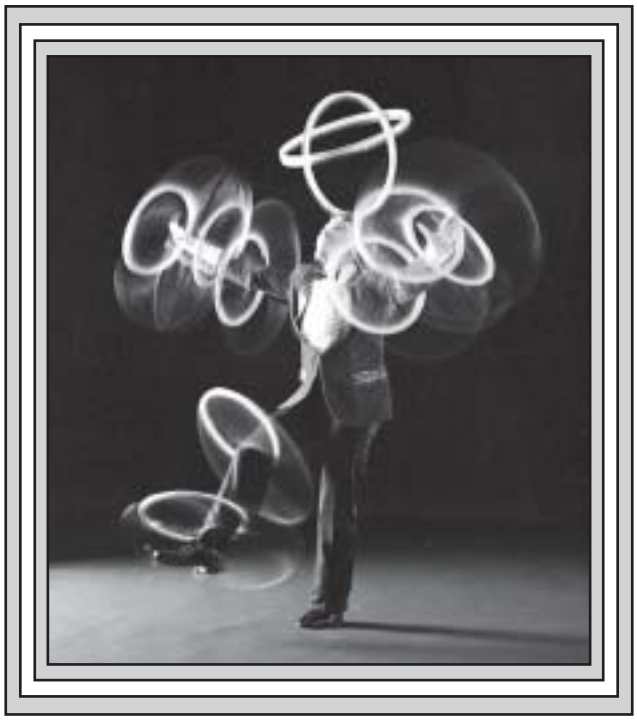
might have only seven acts and two "shorts". In 1905 Harry Davis converted a storefront in Pittsburgh, Pennsylvania to the first theatre in America devoted entirely to moving pictures. Since the price was a nickel, it was called a ***Nickelodeon***. When the Warner brothers, Paramount, and Fox all started building their own theatres in the mid 1920's they would show movies and vaudeville acts together. As with radio, many of the vaudeville stars got involved in this new technology. This time, however, it was the silent stars who got famous.

Buster Keaton started out in Vaudeville with his parents as "The 3 Keatons". Charlie Chaplin also got his start on the vaudeville stage and later directed and starred in his own silent pictures. Ginger Rogers was a singer in vaudeville before dancing in films with Fred Astaire. The vaudeville stars who would spend their entire lives learning one act, like juggling, magic, or acrobatics, could only film their act once and then everyone would have seen the movie of the act instead of the act itself. The end of the Vaudeville era is usually regarded as November 16, 1932. This is when the Palace Theatre started mixing moving pictures into their vaudeville shows. By 1935 the Palace Theatre, once the leader of a 600-theatre vaudeville circuit, had become a movie house with no live vaudeville show.

Bobby May - The Great American Juggler

JUGGLING

In ***LAZER VAUDEVILLE***, you will see some of the most difficult and unusual juggling in the world! Carter Brown performs incredible feats of dexterity with bicycle rims or "hoops" as they are called. At one point in the show he keeps ten of them simultaneously spinning around his body. This art has its roots in the great hoop acts of vaudeville in the early 1900's, when bicycles were a new and exciting invention. Some of the antique wooden hoops are still used, but Carter Brown has updated and refined the skills to create a modern version unparalleled in the world today.



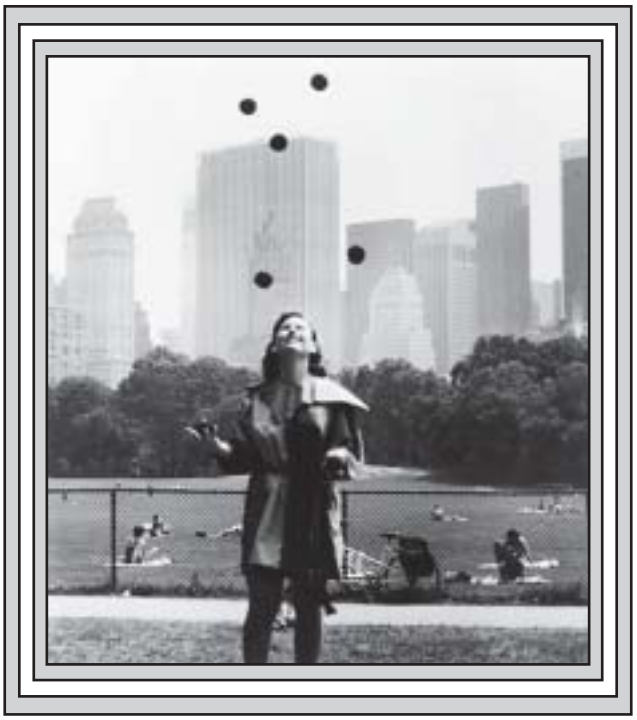
Carter Brown brings hoop rolling back to life.

Juggling has played a role in the culture and traditions of many nations around the world. Even the Egyptian hieroglyphics show images of people tossing balls in juggling patterns. In Europe and Asia, juggling has had a very long and diverse history. Chinese jugglers have generally used fewer objects at one time, adding physical skills such as acrobatics and dance to increase the difficulty and artistry of their work. They even juggle with their feet - this is called antipodism.

Russian circus jugglers have specialized in large numbers of objects, keeping up to eleven rings

airborne and passing even more between people. Jugglers from France, Germany, Switzerland, England, and other European countries combined these techniques with clowning and character work to make their performances more appealing to a larger public.

American jugglers have continued this trend, performing a wide variety of skills while striving for original forms of presentation. In ***LAZER VAUDEVILLE*** you will see phenomenal ball, club, and ring juggling, with a few surprises thrown in! Cindy Marvell, another member of the cast of ***LAZER VAUDEVILLE***, was the first woman to win the International Jugglers Association's Championship in 1989. The **IJA**, as it is called, holds a convention in a different state every year and publishes a magazine and roster of jugglers and events throughout the United States and abroad. Anyone can become a member -see the Bibliography & Sources.



Cindy Marvell - The first woman ever to win the International Juggler's Association World Championship. Shown here with 7 balls !

ROPE SPINNING

You will see the ***Neon Cowboy*** performing many of the classical western rope spinning tricks, such as the Texas skip, the wedding bell, the double rope spin, and the giant fifty-foot wedding bell. These tricks are named for the shapes created by the ropes, which stand out very clearly in the blacklight.

Rope spinning is an art similar to juggling in that it involves a lot of manual dexterity. The more hours one practices, the better one becomes. The ropes are made of cotton so that they are flexible enough to spin properly. You can order a book about roping called ***"Rope Tricks"*** by ***Frank Dean*** from ***DUBE*** in ***SOURCES***. Complete with photos of Will Rogers, the great American rope spinner, the book also teaches you how to make and manipulate your own spinning rope!

Will Rogers - Roping around the vaudevillians !

COMEDY

The performers in ***LAZER VAUDEVILLE*** combine comedy with physical skills such as clowning, slapstick, and character work. Improvisation has always been an important part of vaudeville. The performers must turn awkward situations into comedy, bringing out the humor of a fumble or a confused volunteer.

Physical comedy often revolves around an everyday situation gone wrong. When more than one person is involved, there is usually a silly or mischievous character and a "straight man", or serious person, working in opposition. Note the differences between the old film comedians such as the Marx Brothers, The Three Stooges, Buster Keaton and Charlie Chaplin, and the modern stand-up comedians performing today. Though much can be learned from observing the timing and delivery of other performers, there is no substitute for a live audience and the process of gathering material from daily life when it comes to creating your own comedy routines.

Lazer Vaudeville History Quiz

BASIC
QUIZ ON THE STUDY GUIDE

1. What was the most popular form of entertainment in the early 1900's?
2. What skills did vaudevillians have?
3. Where did vaudeville begin?
4. Who helped move vaudeville from the saloons to the theaters?
5. Who was the first African-American vaudeville star?
6. What is a vaudeville circuit?
7. What are the names of some of the circuits?
8. What do the Theater Managers do?
9. What do the Booking Managers do?
10. What is a vaudeville bill?
11. In which city was the Palace Theatre located?
12. Name three families who performed in vaudeville.
13. What three things destroyed vaudeville?
14. Who were some of the famous vaudevillians on radio?
15. What was the first moving picture that had sound? Who was the main actor?
16. What is a kinetoscope?
17. Who created the first moving picture theater?
18. What is foot juggling called?
19. Name three different types of rope spinning tricks.
20. Who was Will Rogers?

BASIC
QUIZ ON THE SHOW

1. What skills did the Lazer Vaudevillians exhibit?
2. How do you think Lazer Vaudeville travels around?
3. Where did Lazer Vaudeville perform in your town?
4. How many colors did you see in the black light?
5. What other acts did you see?
6. How many balls or clubs did the performers juggle at one time?
7. What was your favorite act? Which act would you like to try?

ADVANCED
QUIZ ON THE STUDY GUIDE

1. What was the *Val de Vire*?
2. Why was Vaudeville important for immigrants? for women?
3. If you were to create a vaudeville circuit what would you need?
4. What famous baseball player showed up in vaudeville?
5. What famous blind and deaf woman showed up in vaudeville?
6. Who were some of the prominent African-American vaudevillians?
7. How did vaudeville play a role in breaking down racial discrimination in America?
8. What types of vaudeville acts would play well on the radio? Name some that did.
9. Describe a vaudeville dirty deal.
10. How did movies develop in America?
11. What silent vaudeville performer made it into the movies?
12. Why is November 16, 1932 considered the end of the vaudeville era?
13. How does improvisation help a vaudeville performer?

ADVANCED
QUIZ ON THE SHOW

1. Which Lazer Vaudeville acts could you have seen 80 years ago? Which acts could you only see today?
2. What styles of vaudeville acts did you see?

ESSAY POSSIBILITIES:

1. Write about what your life would be like without television, VCR's, video games, computers, radios, cassette or record players.
2. What would it be like to live in the early 1900's and see radio discovered, then silent films, talking movies, then TV and computers?
3. Interview your grandparents about what it was like to live when they were your age. Do they remember seeing vaudeville when they were young? How many vaudevillians can they remember seeing or hearing about?

THE SCIENCE OF LASERS, LIGHT & ENERGY

INTRODUCTION

In this section we are going to delve into the scientific and technological parts of ***LAZER VAUDEVILLE*** which separate the show from old-fashioned vaudeville. We will provide the diving board from which students and teachers alike may plunge into a world of fascinating science projects. We'll explore how lasers work and what makes things glow in the dark. We'll experiment with regular light as well as blacklight. We'll find out why the ozone layer protects us from the sun's radiation and what that has to do with microwave cooking. We'll even show you how radio waves help us perform the ***LAZER VAUDEVILLE*** show!

LASERS

Some lasers are very tiny but some can be huge. The beams can also be incredibly small and precise. Some beams are so thin they could be used to drill 200 holes in something the size of the lead in your pencil. Lasers can cut through diamonds, the hardest substance known to humans. In 1969 astronauts placed a laser-reflecting mirror on the moon and scientists sent a laser beam to the moon and back, in order to measure the distance to the moon. It's 238,000 miles each way!

There are many different types of lasers. In everyday life we see lasers at the supermarket check-out counter. They are used to scan the bar code on groceries. Lasers also read the digital information on music and computer compact discs. Lasers are small and precise enough to do eye surgery, and big and powerful enough to cut and weld metal.

So how do lasers actually work?

The lasers you see in Lazer Vaudeville are programmed to make up a laser show. A laser show has three main elements:

1). The laser.
2). The graphic imaging system that turns the beam of laser light into all the spectacular images.
3). The surface - screen, fog, or ceiling, which the laser image shows up against.

There are three main parts to a laser:

1). An energy source - electricity.
2). A material - helium/neon gases.
3). A container - the laser tube itself.

Electricity: If you've ever used a toy train set then you've had some contact with *an* ***electrical power transformer***. On a toy train set or car set this is the small heavy box that the electricity runs in and out of. This transformer takes normal wall outlet electricity and changes it or transforms it to a lesser voltage that is safer for small children. Lasers also use a power transformer but it does the exact opposite of a train set transformer. It makes the electricity a higher voltage and therefore more dangerous. Obviously, we're very careful with the transformers we use in ***LAZER VAUDEVILLE***.

Helium/neon gases: We send the electricity into helium and neon gases for the second step. Helium and neon are both gases we see in our everyday lives. These gases are not liquid like the gas used in cars. Rather they are gases similar to the oxygen in the air we breathe. In fact, when helium inflates a balloon the helium is lighter than the air around the balloon, so the balloon floats upward. We see neon gas in action almost every day in neon signs. Neon gas is the gas inside the glass tubes of a neon sign. We combine both helium and neon gases inside our laser tube.

The laser tube: The helium and neon gases are placed in a very pure form inside the laser tube. The inside of the laser tube is a highly reflective, mirror-like surface, everywhere except for a tiny area at the end of the laser tube where the beam comes out.

When the high voltage electricity gets sent into the helium gas it makes the helium atoms bounce into each other like rush-hour traffic in Chicago. When they do this the neon atoms all get excited at the same time and go into a state of high energy. They radiate (give off) this energy as light. When they radiate this light they are influenced by each other's light, and produce more light. This is called stimulated emission. They all radiate in the same direction, down the laser tube to the tiny hole at the end.

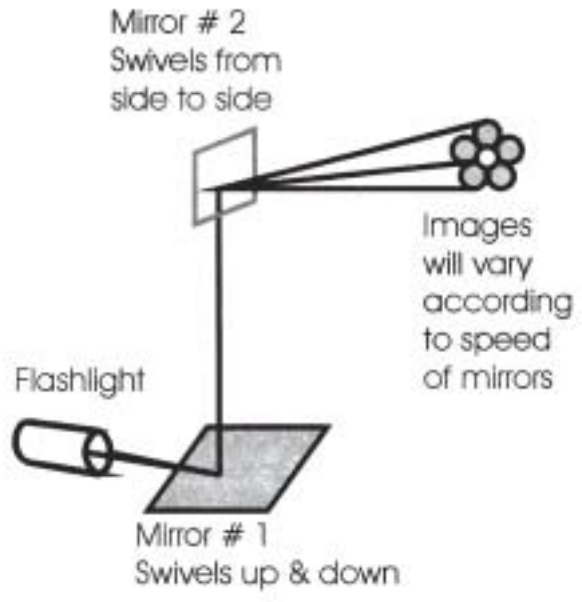
The tiny hole is covered on the inside by a mirror just like the rest of the laser. But the mirror at this point is not quite as reflective. It is more like a two-way mirror that lets some of the light through but not all of it.

Experiment: How lasers get out of the laser tube.
What you need: 1 flashlight of the "mag-lite" variety, 1 two-way mirror available from some hardware stores or ***Edmund Scientific*** listed in ***"SOURCES"*** at the back of this study guide.
What to do: Shine the light through each side of the two-way mirror. The part that is 100% reflective is like the inside of most of the laser tube, however the other side lets some of the flashlight's light through.
What it means: The side that lets some of the light through is like the hole in the laser tube that lets the laser light through.

****

Experiment: Create laser patterns.
What you need: 1 flashlight, 2 mirrors, each about 1 foot square, available in local hardware stores.
What to do: Mount the flashlight or laser pointer on the edge of a table so that it is level. Use tape. Have 1 student place the first mirror directly in front of the flashlight so that it reflects directly back to the flashlight. Now slowly tilt the mirror up so that the reflection hits the ceiling. Have a second student place mirror #2 directly over mirror #1 so that it reflects the light directly back down. Tilt mirror #2 up slowly until the reflection goes to the wall. Move mirror # 1 slowly, and then more quickly and watch the reflection on the wall do different things. Then keep mirror #1 still and move mirror #2. Then move both mirrors at different speeds and see what happens with the reflections.
What it means: This is an exact simulation of the way the lasers, the laser mirrors, and the computer work together to create the laser patterns seen in a ***LAZER VAUDEVILLE*** show.

How are the laser images made?
The laser beam hits one mirror and this mirror swivels up and down in the vertical plane known as the ***Y axis***. Next the laser hits a second mirror which swivels side to side in the horizontal plane known as the ***X axis***. When the two combine you can get diagonal lines, circles, triangles, and spectacular spiro-graphic images. These patterns change depending on which mirror is moving faster or slower and how far side to side or up and down the mirror is moving. These two mirrors are each controlled by a computer.



MORE ABOUT LASERS !

How are other types of lasers made?
The biggest difference in lasers are the amounts and power of electricity used, and the material the electricity stimulates. Some different materials lasers are made from are:

Gas lasers: Helium & neon lasers are not the only gases used in lasers. Argon, krypton and carbon dioxide are some other gases commonly used in lasers. The type of gas determines the color of the laser. Helium results in red, argon in green.

Carbon dioxide lasers produce infrared light that cannot be seen by the naked eye. These lasers are some of the most efficient lasers in the world, converting as much as 95% of their energy into laser light. If scientists are ever able to set up solar energy collection stations in outer space and then beam the energy to earth, this is the type of laser they will use.

Solid state lasers: These use a solid material usually made of crystals or glass. The most common crystals used contain small amounts of ***neodymium*** . This is how the world's largest and most powerful laser is made. It is about as long as a football field, and it lives at the Lawrence Livermore National Laboratory in Livermore, CA. Its light can go up to 100 trillion watts of power.

Semiconductor lasers: These have two solid materials and the stimulated emission occurs where they meet. These are the smallest lasers in the world. Some semiconductor lasers are in fact only visible under a microscope. Some metals used in these lasers are ***indium***, ***gallium,*** and ***arsenic***. The small size of these lasers makes them perfect for CD players, pen lasers, and other miniature devices.

Dye lasers: These lasers dissolve dye in alcohol to form the material. The best thing about this type of laser is that it can produce different colors by tuning them the way you tune a radio.

When were lasers invented and how did they get their name?

Stimulated emission was first thought of by Albert Einstein in 1916, but the first laser was not built until 1960 by the American ***Theodore H. Maiman***. Laser is a special type of word called an ***acronym***. An acronym is a word made up of the first letters of several different words. LASER stands for:

Light
Amplification through the
Stimulated
Emission of
Radiation

In the Lazer Vaudeville show, we spell laser with a "z" for that show-biz effect.

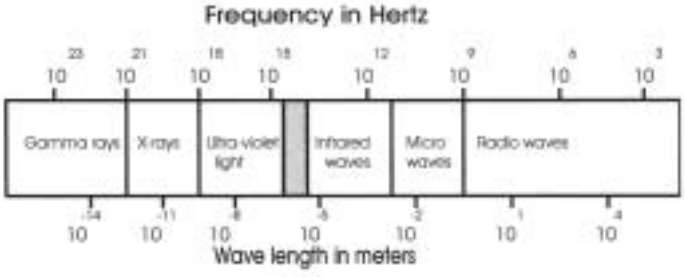
RADIATION

Lasers do have radiation, but at very safe levels, and the radiation they do have is confined inside of the laser tube where the stimulated emission occurs. The sun puts out radiation, the rocks and the soil of the earth are also putting out radiation. In fact all light is radiation and if none of the radiation from the sun reached us at all, the earth would get cold and freeze. X-rays that doctors and dentists use to see your bones and teeth also use radiation. Small amounts of radiation are natural, but large amounts can be harmful. All ***electromagnetic waves*** are radiation, but only the shorter waves of ***gamma rays*** are harmful to humans.

LIGHT

Light is energy! The sun produces heat and light energy on the earth. The energy of light is known as radiant energy. There are many kinds of radiant energy. In fact there is an entire spectrum of radiant energy. On the short wave end of the spectrum there are ***gamma-rays***, ***x-rays,*** and ***ultraviolet rays***. In the middle there is visible light, the light we as humans can actually see. On the long wave end of the spectrum there are ***infrared waves***, ***micro-waves***, and ***radio waves***.

The technical term for these rays, waves, and visible light is ***electromagnetic waves***. In 1864 the Scottish physicist ***James Clerk Maxwell*** predicted that ***electromagnetic waves*** existed but this was not proven for another 20 years. In the 1880's, the German physicist ***Heinrich R. Hertz*** proved the existence of ***electromagnetic waves***. Humans can only see visible light, we cannot see the low end of ***gamma, x,*** or ***ultraviolet rays***, nor can we see the high end of infrared, micro, or radio waves. ***Gamma rays*** have the shortest wavelengths and ***radio waves*** have the longest, sometimes as long as several miles.



Electromagnetic wave spectrum.
The shaded area in the center is the visible light spectrum.

In 1666 the English scientist ***Sir Isaac Newton*** discovered that white light is made up of all visible colors. When white light passes through a special piece of glass called a ***prism*** it is broken up into all the colors of visible light.

Experiment: Split a sunbeam.
What you need: A prism, white paper, a sunny day.
What to do: Go outside in the sun. Hold the prism up to the sun with the white paper behind it. The sun's rays will split and a rainbow of colors will shine on the white paper. Now do the same thing indoors with a regular light bulb. Now try the same thing with a fluorescent light.
What it means: Light waves from the sun are bent and broken down into their full spectrum of colors based on their vibrations and wavelengths. Light waves from an indoor or fluorescent light bulb do not have a full range of light the way the sun does. Some of the colors from the prism are not as bright. This illustrates Sir Isaac Newton's discovery.

Experiment: Bending light.
What you need: A bowl, a quarter, a pitcher full of water, a friend.
What to do: Place the bowl on a table and the quarter in the bottom of the empty bowl. Then step away from the bowl until you cannot see the coin. Have your friend pour water into the bowl. Magically the coin will appear.
What it means: This shows that light waves are bent as they pass through water.

How fast does light travel?
Light travels at ***the speed of 186,282 miles per second***. In the metric system that's 299,792 kilometers per second. Light travels fast enough to circle the Earth 7 ˚ times in one second. In 1862 the French physicist ***Foucault*** made the first semi-accurate measurement of the speed of light. He came up with 298,000 kilometers per second.

MORE ABOUT LIGHT !

Light travels in waves similar to waves in an ocean. The first scientist to mention this theory was the Dutch physicist ***Christian Huygens*** in the mid 1600's. This was later proven in the early 1800's by the English physicist ***Thomas Young***.

Early physicists thought that light waves had to travel on something, just as waves in an ocean travel on water. They called this invisible substance the ***ether***. But no one could measure the ether or even prove that it was there. In 1887 experiments by the American physicists ***Albert A. Michelson*** and ***Edward Morley*** helped prove the ether theory false. A ***theory*** is an idea that no one has yet proven true or false.

How do light waves travel?
Light waves are ***electromagnetic waves***. But light waves are just a small section of all electromagnetic waves. Light waves are just the ones we can see with the naked eye. They are actually a combination of two kinds of waves, ***electric waves*** and ***magnetic waves***. These waves are on two different planes or surfaces. Imagine the electric waves going up and down the same way a roller coaster goes up and down; this is the vertical plane. The magnetic waves move just like a snake in the grass winding from side to side; this is the horizontal plane. These two waves happen at the same time to create electromagnetic waves and light waves. The distance between the top of each wave is called the wavelength. The size of the wavelength determines the color of the light. Longer wavelengths are closer to the red end of visible light, and shorter wavelengths are closer to the purple or violet end of the visible light spectrum. ***(For a color diagram of the visible light spectrum, see a science text book.)***

How is light made?

All light comes from atoms. When an atom gains extra energy it is said to be an "excited atom". One way it can get rid of this energy is by giving off light. The wavelength of light is measured in ***nanometers***. One billion nanometers = 1 meter. Meters, centimeters, millimeters, and kilometers are part of the ***metric system.*** This is the measurement the rest of the world uses instead of inches, feet, yards, and miles. Visible light waves start at about 400 nanometers, and go up to about 700 nanometers.

Regular light from the sun or a light bulb spreads in all directions and is called ***incoherent light;*** the wave lengths of this type of light are constantly changing. Laser light goes in one direction in a very tight beam and is called ***coherent light;*** the wave lengths of this type of light are exactly the same. The main difference between regular light and laser light is that the atoms inside the laser create the light through stimulated emission.

Experiment: Make a fluorescent bulb glow without plugging it in. *Teacher/Parental Supervision Recommended*

What you need: A long fluorescent bulb, a soft wool cloth. A dark room.

What to do: Go into the dark room and rub the bulb with the wool. Watch as the bulb glows where it is touched by the wool.

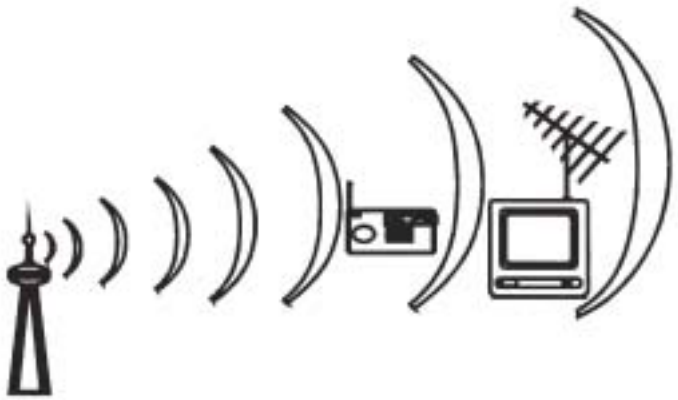
What it means: Electrons are pulled from the glass by the wool. This creates a positive charge thus drawing electrons from inside the bulb to the glass, through the mercury vapor inside the bulb. This creates the light.

RADIO WAVES

Lazer Vaudeville uses radio waves in two very important ways. When you hear a performer talking they are using a ***cordless microphone .*** This would not be possible without radio waves. This microphone is very small, about the size of the cap to a ball point pen. The performer clips the microphone onto his or her shirt, and the sound of the voice is transformed into radio waves and sent to the sound system in a fraction of a second. Having a cordless microphone allows the performer to move around the stage, juggle, and do other things without getting tangled up in cable.

Behind the scenes we also use ***cordless headsets*** to tell the lighting technician when to turn the lights on and off. We also use the headsets to tell the stage hands when to open and close a curtain or move a piece of scenery. These headsets have microphones as well as ear pieces.

Radio waves are also ***electromagnetic waves***. They are the longest of all the known electromagnetic waves. Both television and radio use the section of electromagnetic waves known as radio waves to broadcast their signals to their listeners and viewers.



The Federal Communications Commission ***(FCC)*** assigns the specific frequencies for all radio and television signals in the United States. In Canada the Canadian Radio-Television and Telecommunications Commission assigns the frequencies for all radio and TV signals.

How radio works:

Radio stations turn sound into radio waves and then broadcast them from a transmitter antenna. The radio waves go through the air in all directions and are then received by a radio. The radio then turns the radio waves into sound waves. The stronger the transmitter at the radio station, the farther the radio waves travel.

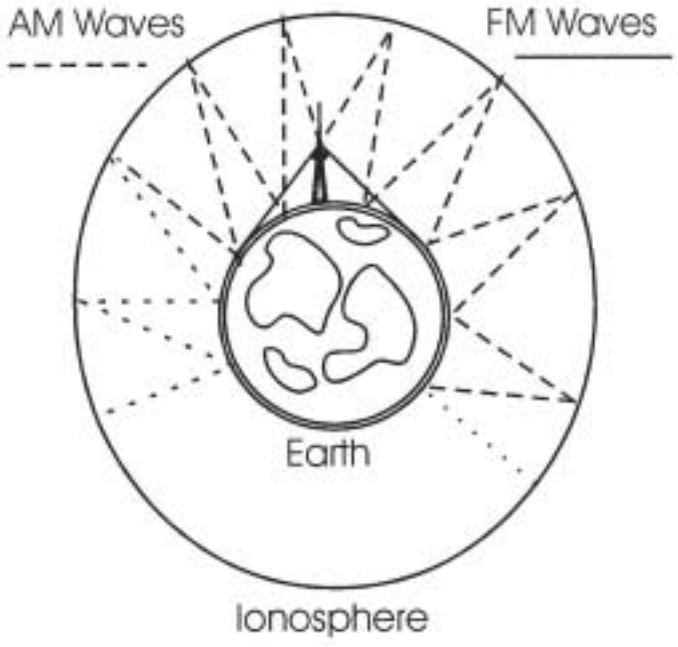
Each radio station is on a different channel or ***frequency*** which keeps them from interfering with each other's broadcasts. There are two types of radio station, ***amplitude modulation (AM)*** and ***frequency modulation (FM).***

MORE ABOUT RADIO !

Guglielmo Marconi of Italy sent the first radio signals in 1895. He was able to send telegraph code signals more than one mile. In 1901 Marconi's radio equipment sent code signals across the Atlantic Ocean from England to Newfoundland. The Canadian ***Reginald A. Fessenden*** was the first person to broadcast human speech over a radio in 1906. Experimental radio broadcasts began in 1910 with ***Lee De Forest*** broadcasting a program from the Metropolitan Opera House in New York City. Radio station WWJ in Detroit, Michigan, began the first commercial broadcasts on August 20, 1920. However KDKA in Pittsburgh, Pennsylvania grew out of an experimental station started in 1916. KDKA broadcast the election results of the Presidential elections on Nov. 2, 1920. The first license the federal government issued to a station was on Sept. 15, 1921 to WBZ in Springfield, Massachusetts.

AM and FM RADIO

Each radio station is on a different channel or ***frequency*** which keeps it from interfering with other stations broadcasts. There are two types of radio stations, ***Amplitude Modulation (AM)*** and ***Frequency Modulation (FM).*** The strongest AM stations may have 50,000 watts of power and can be heard as far as 2,000 miles away. The strongest FM stations may have 100,000 watts of power, but can only be heard 70 miles away. Why is there a difference? FM radio signals only go as far as the line of sight, in other words as far as the horizon. This is why most FM antennas are located on top of a hill, mountain or very tall building. AM radio signals follow the ground when they spread out but they also go up into the sky. When AM signals reach a layer of the atmosphere called the ***ionosphere,*** they bounce back down to earth, then they bounce back to the ionosphere, then back down to earth, and so on until the signals become too weak to be heard. These AM signals go further at night when the sky is especially clear. AM signals get more interference from static than FM signals, therefore FM stations often have a better sound quality.



Frequency is measured in units called ***hertz*** (vibrations per second). One ***kilohertz*** = 1,000 hertz. One ***megahertz*** = 1,000,000 hertz. AM stations broadcast from 535 to 1,705 kilohertz. FM stations broadcast from 88 to 108 megahertz.

BLACKLIGHT

When you come to see a Lazer Vaudeville performance, you will see some segments performed in "blacklight", or ultraviolet light. If you go to the theatre you'll see Alfonzo, the seven-foot tall, fire-breathing dragon; if we come to your school, you will see the "neon cowboy" spin ropes. To the human eye, both characters appear to glow in the dark.

In reality, neither the dragon nor the cowboy glows by himself. They are wearing clothes coated with a special ***fluorescent*** material that gives off visible light when you shine ultraviolet light on it. The ultraviolet light comes from four-foot, tube-shaped bulbs mounted on the edge of the stage like footlights. These bulbs are coated with black paint to prevent any visible light from coming out of them, and so they are called blacklight bulbs.

Experiment: Make magic markers appear differently.
What you need: Regular & "neon" style magic markers, regular light bulb, blacklight bulb, paper.
What to do: Assemble two sets of magic markers: #1 the regular colors of red, green, blue, & #2 the bright, "day-glo" highlighter markers. Write the words "normal" and "fluorescent" with each of these markers and see which is brightest. Look at the words under three types of lighting: normal round incandescent light bulbs, long white tube - fluorescent lights, and a blacklight bulb or a tube.
What it means: This illustrates the extra amount of energy the fluorescent markers absorb. You may notice that a blacklight bulb or tube, will make the highlighters glow the best. This is how we get the dragon, cowboy, and some of the juggling props to glow. The blacklight is made with very dark glass, in fact it looks black when it is turned off. That's why it is called blacklight. That very dark glass filters out all the other light so only the ultraviolet light illuminates the fluorescent highlighters.

Q. ***Who first discovered fluorescence?***
A. It was first explained in 1852 by the British scientist ***Sir George Stokes***. He was a special kind of scientist called a ***physicist***. Physicists study the physical properties of our world. They work on problems as diverse as the way an apple falls from a tree to the way stars and planets move through the sky. An important part of physics involves the study of light: how it travels through space and how it is perceived by the human eye. Sir George Stokes named this special kind of light ***fluorescence.***

Phosphorescence occurs when something glows in the dark of its own accord long after the lights have been turned off. Some stores sell toys or stick-ons that glow in the dark; these are phosphorescent. Lazer Vaudeville uses special tape that glows in the dark. We put this tape on stage in special patterns so that when the lights go out we can tell where we are and where we need to go. It's like a map that we make in each theatre we perform in, and this map is phosphorescent. You can order glow tape from Grand Stage Theatrical Lighting Co. in Chicago, IL. See ***"SOURCES"*** at the end of this study guide.

Ever wondered what makes fireflies glow? It's a process called ***bioluminescence,*** which also occurs in certain species of deep sea fish.

Q. ***Why does fluorescent material glow in the blacklight?***
A. Fluorescent material glows in the blacklight because it absorbs or soaks up ultraviolet waves and reflects it as visible light. This happens incredibly fast. Sometimes the fluorescent material only keeps (retains) the energy for one trillionth of a second; this is still fast enough to make the fabric glow to the human eye.

ULTRA VIOLET LIGHT

Ultraviolet light is put out by two sources we are all familiar with:

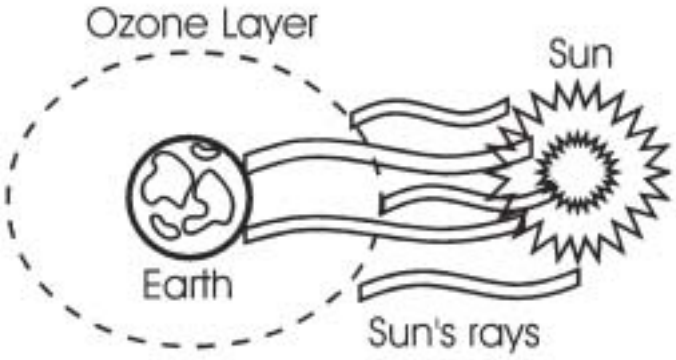
-The sun.
-The fluorescent blacklight tubes we use to perform ***LAZER VAUDEVILLE***.

Ultraviolet light can be both harmful and helpful. We need some of the sun's ultraviolet light for plants to grow. If there were no ultraviolet light from the sun, nothing would grow; it would be deep winter all the time. Great if you like skiing. Hospitals use ultraviolet light to kill bad bacteria and viruses, and to sterilize the operating rooms. Ultraviolet light can be used to treat some skin diseases. It also produces vitamin D in the human body.

Too much ultraviolet light can cause sunburn and way too much can cause skin cancer. The ultraviolet light from blacklights or from white fluorescent tubes is so low that there is no danger from exposure to the skin or eyes. The sun is actually the largest source of ultraviolet light we have in our lives. One very important thing protects us from too much of the sun's ultraviolet light: the ***ozone layer***.

THE OZONE LAYER

The ozone layer is found in the upper atmosphere between 9 and 11 miles above the earth's surface. This ozone layer shields us from 95% to 99% of the sun's ultraviolet light. In the 1970's scientists discovered that a human-made chemical compound called ***chlorofluorocarbons*** (***CFC's)*** were gradually destroying the ozone layer. People used to use these CFC's in aerosol cans and air-conditioning systems. In 1978 the United States banned CFC's in aerosol cans and by 1995 most countries had stopped making them—good news for the ozone layer and for life on earth.



Ozone in the upper atmosphere is very good since it protects us from the sun's ultraviolet rays. Down here on the earth's surface, however, it contributes to pollution. It is part of what makes up smog. Such ozone can damage rubber, plastic, plant and animal life. Ozone was discovered in 1840 by the German chemist ***Christian Frederich Schonbein***.

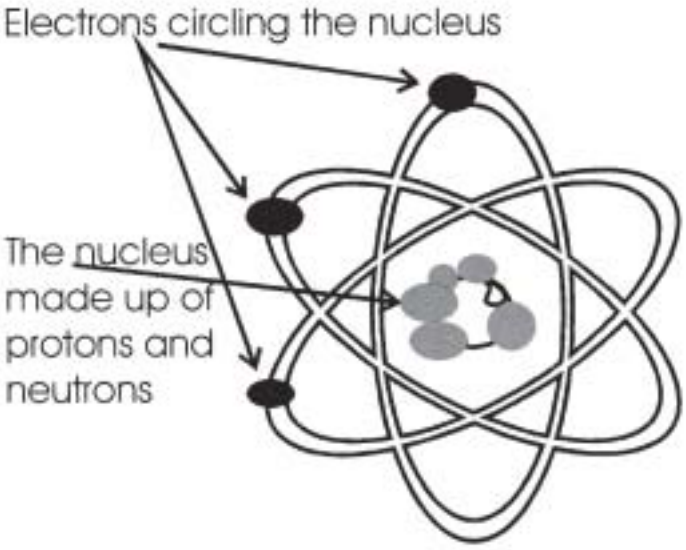
Scientists have discovered ozone holes over both Antarctica (The South Pole) and the Arctic (The North Pole). These holes are found in the winter of Antarctica (June to September), and in the winter of the Arctic (December-February). The ozone holes repair themselves during the summer. Ozone is actually a form of oxygen. ***Oxygen molecules*** have two oxygen atoms. ***Ozone molecules*** have three oxygen atoms.

THE SUBSTANCE OF THE UNIVERSE

Have you ever wondered what the smallest thing in the universe is? Have you ever wondered how small a grain of sand or a piece of dust can really get? Well, so have many scientists around the world, and here is what they have come up with.

There are actually two smallest things in the universe and they are called ***electrons*** and ***quarks***. But these are just the building blocks for bigger and better things. Quarks combine to create more complicated entities. Some quarks combine to make ***protons,*** and some quarks combine to make ***neutrons***.

To get an idea of how an atom is put together, picture an egg. Now imagine that the egg is scrambled inside its shell. The protons are the yoke, the neutrons are the egg white, and both are mixed together inside the egg. But what is the eggshell? The eggshell is make up of those other extremely tiny particles called electrons. The electrons circle around the protons and neutrons, just as the eggshell surrounds the egg yolk. The whole thing, including the protons, neutrons and electrons, is called an ***atom***. The very ***center*** of the atom, the part that is made up of protons and electrons, is called the ***nucleus***.



The makings of an Atom

Some of the atoms have more electrons and some atoms have fewer. Some atoms have more protons than neutrons and some have fewer. That's what makes some atoms ***oxygen atoms***, some ***helium atoms***, and some ***nitrogen atoms***.

When a bunch of different atoms get together they form a ***molecule***. For instance, if you put two hydrogen atoms together with one oxygen atom, you get a water molecule. If you put a bunch of water molecules together you have something awfully good to drink after climbing Mount Everest.

If you put two oxygen atoms together you have the oxygen we need to survive. If you put three oxygen atoms together, you have the ozone that protects us from the sun's ultraviolet light.

Experiment: Erupting Volcano.
What you need: 16 oz. soda bottle, large pan, 2 measuring cups, 1 tablespoon flour, 1 tablespoon baking soda, spoon, funnel, red food coloring, 1 cup white vinegar, water.
What to do: Place the soda bottle upright in the pan. Mix the flour and baking soda in one of the measuring cups. Pour the mixture of flour and baking soda through the funnel into the soda bottle. Add 20 drops of red food coloring. Pour in half the vinegar. When the volcano stops erupting pour in the rest of the vinegar.
What it means. The baking soda reacts with the vinegar creating carbon dioxide gas.
Variations: Vary the amount of vinegar, baking soda, and flour. What are the results?

MORE ABOUT ATOMS !

Electrons and quarks have something called ***electric charge***. This doesn't mean they have credit cards or bank cards, but it does mean they are slightly electrical. They have negative and positive charges similar to an electrical charge on a flash-light battery.

Electrons have only one type of charge and that's negative.

Quarks can have either a negative or a positive charge.

Protons contain two quarks with 2/3 unit of positive charge and one quark with 1/3 unit of negative charge.

Neutrons are the opposite of protons, they contain two quarks with 1/3 unit of negative charge and one quark with 2/3 unit of positive charge.

When the nucleus forms it is made up of differing numbers of protons and neutrons, but even one proton will make the nucleus of the atom positively charged. This positively charged nucleus will attract as many negatively charged electrons as it needs to balance out the positively charged protons. Thus the entire atom has a neutral charge.

Atoms will become negative if they gain an electron, and will become positive if they lose an electron. The negative and positive terminals of a battery or any electrical source will be charged negatively and positively and this is due to the electrical charge of the atoms at that terminal.
-See "Experiment: Make a fluorescent bulb glow without plugging it in" in "MORE ABOUT LIGHT"

ELECTRICITY

Imagine a water wheel at an old-fashioned water-powered mill. Now imagine that the water is the electricity and the wheel is the light bulb. If the water were to start flowing uphill then the mill and the waterwheel would not work properly.

Since electricity flows very much like water, electricity is said to have ***electric current***. The ***electric circuit*** is the path the electricity follows. For a light bulb, a toaster, a computer, or anything electrical to work, electricity must make a complete circle or ***circuit*** from its source. The source can be the batteries in a flashlight, or a giant water dam that produces electricity. These giant water dams, like the Hoover Dam in Nevada, are called ***hydro-electric power plants***. The switch on the flashlight or the switch on your wall turns the light on by completing the circuit; it turns the light off by breaking the circuit so that the electrical current cannot complete the full cycle.

Electricity flows in a current the way river water flows in a certain direction. There are two types of electrical current: ***direct current (DC)*** and ***alternating current (AC)***. Direct current is a steady flow of electricity in one direction. Things that use direct current are flashlights, small battery-powered radios, automobiles, and solar powered appliances. ***LAZER VAUDEVILLE*** uses direct current for microphones, flashlights, and headsets used backstage

for communicating with the light booth, a common practice in any theatrical production. The main sources of direct current are batteries and solar electrical panels. Batteries and solar panels use a chemical reaction to produce electricity.

Alternating current flows in both directions, in fact it changes directions 120 times every second making 60 complete cycles every second. Things that use alternating current are toasters, washers and dryers, refrigerators, and most lights in homes and schools. The main sources of alternating current are hydro-electric dams, nuclear reactor power plants, and coal or oil burning electric plants. All of these types of power plants use generators to actually make the electricity. ***LAZER VAUDEVILLE*** uses alternating current to power lasers, blacklights, sound systems, and stage lights.

Experiment: Electric lemon.
What you need: Paper clip, a lemon, copper wire.
What to do: Unbend part of the paper clip and insert in lemon. Expose both ends of the copper wire. Push one part of the copper wire into the lemon away from the paper clip. Touch your tongue to both the copper wire and the paper clip. You will feel a tingle.
What it means: You have created a mild electrical connection. Your tongue completes the electric circuit. The moistness of your tongue conducts the electricity so you can feel it.

Safety: Direct current and alternating current have advantages and disadvantages when it comes to safety. Direct current is safe in very low levels on voltages, but it is very dangerous in higher voltages. The main advantage is that it is very portable in the batteries it comes in. Alternating current is safer at higher levels or voltages, but it can still kill people. By using alternating rather than direct current in homes, we reduce the risk of injury or death from electrical accidents.

MORE ABOUT ELECTRICITY !

SOURCES OF ELECTRICITY

An electrical source must have a positive charge at one end and a negative charge at the other end. The first person to recognize this property of electricity was the French scientist ***Charles Dufay*** in the 1730's. Rather than positive and negative, he called the charges ***vitreous*** and ***resinous***, and thought of them not as a charge but as an actual fluid.

In 1752 ***Benjamin Franklin*** flew a kite while a thunderstorm was building up and recognized that the clouds also had electrical charge. Franklin was the first person to describe this charge as positive and negative. When you connect the positive and negative ends by a wire the electric charge will flow through. An electric source may be powered by heat sunlight motion or chemical reaction. Solar cells called ***photovoltaic cells*** convert the sun's energy to electricity. Solar cells are made from semi-conducting materials, usually specially treated silicone. Batteries use a chemical reaction to produce electricity. In the 1790's ***Alessandro Volta***, an Italian physicist, built the first battery using silver and zinc. It was called the ***voltaic pile*** and was the world's first source of steady electricity.

Generators produce most of the electricity the world uses. Generators take mechanical energy, a water wheel at a dam or a steam turbine at a nuclear power plant, and turn it into electrical energy. The water wheel or steam turbine turns coils of wire near a magnet to produce electricity.

COMPUTERS

Lazer Vaudeville uses many computers in our everyday world of keeping the show traveling from town to town. But one computer in particular memorizes and controls all the laser patterns you see during the laser sections of a ***LAZER VAUDEVILLE*** performance. This computer stores all of the information to make the patterns, then it stores the information for how long each pattern will appear to

the audience. We can program each pattern down to the tenth of a second. This computer controls all three of our lasers.

To make a single laser pattern the computer is programmed with a complicated formula. It has to memorize the movement for each of the two mirrors. The "X" mirror (side to side) has to be programmed to tell it how far to move, and how fast; the same with the "y" mirror (up and down). A shutter is also controlled by the computer. The computer tells the shutter whether it should be open (the audience can see the laser) or closed (the audience cannot see the laser). So when you see the lasers going on and off extremely fast, that is the shutter being controlled by the computer.

The computer talks to the lasers through an electronic language called ***M.I.D.I***. That is another acronym and it stands for:

Musical
Instrument
Digital
Interface

There are many uses for a computer within a modern vaudeville show. Backstage and behind the scenes ***LAZER VAUDEVILLE*** uses a computer to keep the show running. This Study Guide was typeset and printed using our computer. In each of the towns we visit, we use a CD-ROM map program to find the exact location of the theatres we play and any schools in which we may be performing. We use another CD-ROM atlas program to figure out exactly how many miles we have to drive to the next town. We also used a computer to build our home page on the internet. You can look it up at ***www.lazervaudeville.com.*** We even use a computer for sending e-mail all over the world when we perform in other countries like Japan. Please e-mail us at ***LazerVaudeville@msn.com*** if you have any questions or comments about this study guide or our show!

The first versions of the computer were not electronic, but mechanical. In 1642 the French scientist and mathematician ***Blaise Pascal*** invented the first automatic calculator. It could only add and subtract. In the 1670's the German mathematician ***Gottfried Wilhelm von Leibniz*** improved the calculator so that it could also do multiplication and division.

In 1888 the American *inventor* ***Herman Hollerith*** came up with a ***punch card system*** for calculating the results of the United States census. Hollerith later used this early version of the computer to found the ***Computing-Tabulating Recording Company*** which became the ***International Business Machines Corporation***, or ***I.B.M.***, in 1924.

John V. Atanasoff built the first special-purpose electronic digital computer in 1939, but it was controlled by electromechanical relays which had to be switched on and off, making it very slow. In 1946 ***J. Presper Eckert Jr.*** *and* ***John William Mauchly*** built the first electronic digital computer at the University of Pennsylvania. It contained about 18,000 vacuum tubes and occupied more than 1,500 square feet of floor space. This giant computer was called ***ENIAC***, and could perform up to 5000 additions and 1000 feats of multiplication per second. In the 1960's the integrated circuit known as a ***computer chip*** was invented. This allowed small computers to be developed, small enough to sit on a desk at home or in your school—the modern desktop computer!

Experiment: Computer use.
What you need: A computer with Internet access, a printer.
What to do: Log onto the Internet. Access ***www.lazervaudeville.com.*** **R**ead about the history of the show, the performers, the wizard and Alfonzo the dragon. Go to the performer's biographies and print them out. Send email to ***LAZER VAUDEVILLE*** after you have seen the show. Include your name, your school, your town. Write us about what you liked in the show.
What to do: Look up the ***LAZER VAUDEVILLE*** tour schedule at the ***LAZER VAUDEVILLE*** web site. Use a CD-ROM atlas to locate where ***LAZER VAUDEVILLE*** is today. Look up all the towns they play in, use a CD-ROM mileage atlas and calculate how many miles the performers drive in one year.

Lazer Vaudeville Science Quiz

BASIC
QUIZ ON THE STUDY GUIDE

1. How was the distance to the moon measured?
2. What are the elements to a laser show?
3. What are the main parts of a laser?
4. What does an electrical transformer do?
5. What is stimulated emission?
6. How are mirrors used to create laser images?
7. List the types of radiant energy.
8. What type of light "rays" are the shortest? What type are the longest?
9. What did Sir Isaac Newton discover in 1666?
10. What is phosphorescence?
11. How fast does light travel in empty space?
12. Who made the first accurate measurement of the speed of light?
13. What type of waves are radio waves?
14. Who assigns the frequencies for radio and TV in the United States? In Canada ?
15. What two types of radio stations are there?
16. What did Sir George Stokes discover?
17. What happens when fluorescent material is exposed to blacklight?
18. What creates ultraviolet light?
19. Where is the ozone layer? What does it do?
20. What are the two smallest things in the universe?
21. What is an atom made of?
22. What do you get when you combine atoms?
23. What two types of electrical current are there?

BASIC
QUIZ ON THE SHOW

1. What color were the lasers in the show?
2. What made them show up so that you could see them?
3. During what parts of the show did Laser Vaudeville turn the lights off?
4. What type of microphone do the performers use?
5. How do the performers communicate with the lighting and stage technicians?
6. What acts were the black lights used for?
7. What colors showed up in the blacklight?
8. What does Lazer Vaudeville use direct current for? Indirect current?

ADVANCED
QUIZ ON THE STUDY GUIDE

1. How does a gas laser work?
2. How are the "x" and "y" axis used to create laser images?
3. What materials besides gas are used to create a laser?
4. What does L.A.S.E.R. stand for?
5. Who invented lasers?
6. Light waves are a combinations of what kinds of waves?
7. What determines the color of light?
8. What is the difference between incoherent light and coherent light?
9. Who sent the first radio signal?
10. In radio terms what does AM stand for? FM?
11. Why are there more FM stations than AM stations?
12. Explain how blacklights work.
13. What does ultraviolet light do?
14. Diagram an ozone molecule.
15. What is happening to the ozone layer today?
16. What are the parts of an atom and what are their electrical charges?
17. What are photovoltaic cells?
18. How is electricity created ?
19. How big was the first computer? What was it called?

ADVANCED
QUIZ ON THE SHOW

1. What does Lazer Vaudeville need to think about to set up for a good laser show?
2. What generates the laser patterns?
3. In the Lazer Vaudeville show when was coherent light used? When was incoherent light used?
4. What are the many ways Lazer Vaudeville uses radio signals during a show?
5. Why does Lazer Vaudeville use blacklights?
6. What does the MIDI control in order to create a laser show?

THEATRE EXERCISES

TWIZZLE

Purpose: Fun and Focus.

What you need: A group of students and a Twizzle leader.

Instructions: Have all students stand in a circle. The Twizzle leader stands in the middle. The students walk in a circle around the leader. The leader gives all the commands. The first command is "stop". At this command the students must freeze. The next command is "go". The students must then start walking. The next command is "turn". The students must turn 180 degrees keeping both feet on the floor and then freeze. Again the command "go" starts them walking, in the direction they are now facing. The next command is "jump". The student jump into the air and rotate 180 degrees with both feet off the group. They land and freeze. The command "go" starts them walking in the direction they are facing. The final command is "twizzle". The students jump up into the air rotate 360 with both feet off the ground. They land and freeze. The command "go" starts them walking.

The commands, "stop", "turn", "jump", and "twizzle" can be used in any sequence at any time. Students are out when they do the wrong command, or do not stay frozen after they do the command. Once a student is out, he/she joins the leader in the middle and helps call other students out. The winner is the last person still in.

MIRROR IMAGE

Purpose: To increase body, space, and partner awareness.

What you need: A group of students.

Instructions: Have all students pair up. Each pair should choose who is "A" and who is "B". Have "A" and "B" face each other. "A" is the leader, "B" is the follower. "A" slowly moves a body part and "B" must mirror image that movement. "A" and "B" never touch. Do this for a while and then switch who is leader and who is follower. Then have the pairs stand back to back and do the same exercise. Can you feel another person's movement without seeing or touching them? Use the force, Luke!

GROUP NUMBER

Purpose: To help groups work well together.

What you need: A group of students.

Instructions: This game is done in complete silence. The instructor calls out a number (for example #25). The group must then create the shape of the number on the floor using everyone in the group, and doing so without talking. Once this is done successfully, the leader calls out another number.

ANIMAL TRANSFORMATIONS

Purpose: To help develop acting characters.

What you need: A group of students.

Instructions: Have the students stand in a circle around you. Tell them that they are going to change from their human form into an animal. You may choose any animal, for example a tiger. Have the students walk in a circle around you. Tell them that they are completely themselves. Then they are 10% tiger. How does that change their walk and posture? What does it feel like to have a tail? Who do they see in daily life that seems part tiger? They are 25% tiger, then 50%, then 75% then 90% then 100% tiger. Then reverse this process and build them back into humans.

This exercise is great for working on developing characters and noticing that they can use animals as a way to generate character.

BODY LEADS

Purpose: To help develop character.

What you need: A group of students.

Instructions: Have students line up in two lines, shoulder to shoulder. Pick a part of the body, for example the knees. Have the first group walk across the room leading with their knees. Their knees must be in front of the rest of their body as they walk. Once they make it across the room, have them watch as the other group moves across the room leading with their knees. Repeat with other body parts. Ask them who they see in daily life that leads with their chin, or knees, or feet, etc. The exercise is extremely fun and funny. It's great in helping to develop character, and in noticing how other people move.

THEATER TERMS

Theater has many different jobs that people do. It also has specific terms or words that help people work in a theater more effectively and consistently.

The jobs that people fill are:

The Producer: This person runs the business, hires the staff, creates the promotional material, and manages the money.

The Directors: This person hires the performers for the show, creates the material for the performers and runs the rehearsals.

The Actors: They are the performers that you see on stage.

The Choreographer: This person creates all the dances and movement that the actors perform on stage.

The Musical Director: This person is responsible for all the music in the show.

The Stage Manager: This person manages the technical aspects of the show. He schedules rehearsals, checks lighting and sound, and helps the actors and director with whatever they may need.

The Designers: They take care of costumes, build the stage props, and create scenery, lighting, sound.

The Crew: They are a group of people that work offstage to help the final show run smoothly. They operate the sound and the lights, and they help move props on and off stage.

The Lazer Vaudevillians use these roles in a very special way. They do not have separate producers, actors, or directors. They fill all these roles by themselves. They are ***Actor-Creators.*** This means that they produce, direct, act, choreograph, and design their own show.

When the Lazer Vaudevillians arrive at a theater for a show, they have several people that help them set up for the show. To be consistent in theater there are special terms for the stage and the curtains and the lights that all theater crews use. These terms are used to help ***LAZER VAUDEVILLE*** set up quickly and consistently:

Blocking: This is how actors move on stage and where they move.

Stage Directions: These directions tell the actor where to move onstage. All stage directions are from the perspective of an actor standing on stage and facing the audience.

Down stage*:* The part of the stage closest to the audience.

Upstage: The part of the stage farthest from the audience. In old theaters, the stage used to slant down toward the audience so that the audience could see the actors better. This is called a raked stage.

Stage left: The part of the stage to the actor's left.

Stage right: The part of the stage to the actor's right.

Center stage: The center of the stage.

Wings. The sides of the stage that the audience cannot see.

Legs: The short curtains that hang on the sides of the stage that the actors enter and exit from.

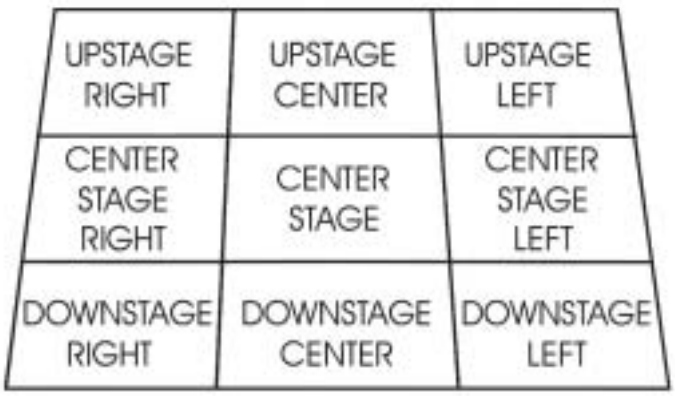
Main Drape. The curtain that closes in front of the stage.

Exercises: Upstage/Downstage

Purpose: To familiarize students with stage directions.

What you need: A group of students, a large space or a stage, Paper, Pen, Hat.

What to do: Write the following directions on nine separate pieces of paper. Downstage left, downstage center, downstage right, centerstage left, center stage, center stage right, upstage left, upstage center, upstage right. Put the pieces of paper in the hat. Choose one person to be the director. If you are in a large space choose one side to be the audience. The director should stand or sit in the audience. Everyone else plays the actors. The director picks a piece of paper out of the hat and reads the direction out loud. All the actors must move to that part of the stage. Then the director pulls out another piece of paper and reads that direction. All the actors move to that part of the stage. Continue until all directions have been read. Then switch directors.



PHYSICAL EDUCATION EXERCISES

BALANCING

There are three main types of balancing:

1. Balancing yourself.
2. Balancing an object
3. Balancing another person.

When balancing yourself, you have many options: balancing on one leg, on your head, on your hands, knees, toes, etc. This can all be done on a hard floor, or to challenge yourself, you can try to balance on a balance beam, a tightrope, a slack rope, a unicycle, stilts, the list goes on and on and is only limited by your creativity.

When balancing an object you also have many options: poles, sticks, peacock feathers, straws, ladders, pens, balls. You can choose where on your body you want to balance the object: your hand, chin, forehead, foot, shoulder, fingers, anyplace on your body that you can place an object. In addition you can balance an object while standing on two feet, on one foot, lying on your back, while riding a unicycle, etc. Again the options are endless.

BALANCING EXERCISES:

BALANCING YOURSELF

A. Stand with feet shoulder width apart. Look at a point directly in front of you (a wall is the best choice). Picture an imaginary line connecting you with this point. This point will help you balance. Hold your arms extended out at the sides. Slowly lift one foot. Keep looking at the wall. When you feel balanced, slowly close your eyes and imagine you can still see the wall. Open your eyes, bring your leg down, and find your balance on two feet. Repeat on the other side.

B. Sit on your butt with your knees pulled into your chest. Extend your arms out to the side. Slowly raise one foot off the ground and extend the leg. Feel the balance. Then raise the other foot off the ground and extend the leg. You should be balancing on your bottom.

C. Kneel on your hands and knees. Look straight ahead at a point on the wall. Lift and extend your left arm. You are now balancing on three points. Keep your arm lifted and extended. Now lift and extend your right leg. Feel the balance. You are now balancing on two points. Now lift and extend your other arm and fall over.

BALANCING AN OBJECT

The most important principle of balancing an object is being able to see the top of the object.

A. Balancing a wooden dowel, a stick or a feather. Peacock feathers are the easiest object to learn to balance but success can be made with almost any object. Top-heavy objects, such as a tennis racket or a pool cue, should be used with the heavy end on top. Small, light objects, like pencils and spoons, are most difficult. To balance the object on your hand, extend your hand. Place the object in your palm. Look at the top of the object. Let go of the object. Keep your hand centered under the top. By looking at the top of an object your body will automatically try to stay centered under the object. You may find yourself moving all over the room to keep the object balanced. Your goal is to minimize movement in other parts of your body. As you improve, a "perfect" balance is attained by making the correcting movements so fast that no one notices. Try also to balance the object on your chin, your foot, your forehead. For a very advanced trick try to balance several objects at once.

JUGGLING

Juggling can be one of the most fun and exciting activities in the known universe. It can also be a bit frustrating if approached in the wrong manner. Many people juggle as a hobby, to relieve stress, to meditate, to build strength, endurance, and coordination. Juggling stimulates both left and right brain hemispheres which can help with creativity and focused discipline. Many people also perform juggling, like the Lazer Vaudevillians.

EVERYONE CAN LEARN TO JUGGLE !

Some people learn in five minutes and some in five weeks. Juggling is also a very social activity. Once you learn to juggle you can pass balls, clubs and rings, and do all kinds of cool tricks with other friends. There many juggling clubs around the USA, groups of people that meet once a week and practice together, showing each other tricks and passing balls and clubs. Many colleges have juggling clubs open to people of all ages.

HOW TO JUGGLE

The best way to learn juggling is to start with scarves, then move on to balls, then rings or clubs. If you do not have scarves, one can easily start with balls.

What you need: 3 scarves and/or 3 balls/beanbags. Tennis balls work fine, lacrosse balls are a bit heavier and are easier to learn with. Bean bags are nice since they don't roll and bounce away when you drop. You can fill tennis balls with pennies, lima beans or rice to make your own.

STEP 1: Pick up one ball. Toss the ball from hand to hand, get used to its weight. Now throw the ball from your right hand to your left hand. The ball should peak—reach the top of its arc—at about eye level. Repeat with your left hand. Once you can do this comfortably, continue. Imagine yourself in a phone booth. When you throw the ball from your right hand it should aim at the top left corner of the phone booth. The ball will peak at eye level, above your left shoulder. Now throw from the left hand and aim the ball at the top right corner of the phone booth. The ball will peak at eye level above your right shoulder. Repeat this several times.

STEP 2: Pick up two balls. Stand centered with one ball in each hand. Keep your hands at waist level, as if carrying a tray. Throw the ball from your right hand up in the air toward your left hand. When the ball peaks throw the left hand ball under the ball in the air. Catch the ball going to your left hand first then catch the ball going to your right hand. Now start all over again, but starting with your left hand. Do this back and forth until you feel comfortable with it. Two balls is the hardest step in learning to juggle three balls, but if you can juggle two balls well, juggling three will be much easier.

STEP 3: Pick up three balls. Put two balls in your right hand and one in your left. Start with your right hand. Throw one of the balls from your right hand to your left; when the ball peaks throw the ball from your left hand; when that ball peaks throw the other ball from your right hand. HEY—YOU'RE JUGGLING!

Juggling Truths: You will drop a lot—even jugglers who have performed for 20 years still drop.

Tips on juggling:
If you find yourself walking as you juggle, stand in front of a wall.

If you are having trouble with three, go back to two, if trouble with two, go back to one. If trouble with one, just remember: practice makes perfect.

Practice every day. You will learn more quickly if you juggle in several short practices every day rather than in a long practice once a week. You will also get less frustrated. As you become more accomplished, your body will retain the skills for longer periods.

For further information **Brian Dube** (listed in **Sources** at the end of this study guide) has endless information on all aspects of juggling. ****

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Vaudeville and Film - Covering the transition from stage to film, how the vaudeville acts changed to meet the current technologies of film.
Allen, Robert, Ayers Company Publishing Inc.
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MOVIES:

Charlie Chaplin: **The Circus** , **The Gold Rush, City Lights**, or **Modern Times.**

The Marx Brothers: **A Night at the Opera** or **A Day at the Races.**

The Jazz Singer. w/Al Jolson: The first talkie (talking movie) made for movie theaters.***MOVIES OR SHORTS BY:*** **Abbott and Costello, Buster Keaton, Laurel and Hardy, Red Skelton, Rowan Atkinson a.k.a. Mr. Bean.**

SOURCES:

Brian Dube - Propmaker/Publisher: Retail Source of juggling props, books, movies, etc.
***520 Broadway, 3rd floor, NY, NY 10012.
(212)-941-0060

Celebration Barn Theater: Workshops and performances in mime, mask, juggling, voice, etc.
190 Stock Farm Rd., South Paris, Maine 04281.
Tel. 207-743-8452; Fax 207-743-3889

***D'ell Arte School of Physical Theater*:** Summer workshops and a full year training program in mime, comedy, mask performance, dance, etc.
***P.O. Box 816, Blue Lake, CA 95525-0816.
(707)-668-5663

Edmond Scientific: Laser, optical glass, science books and a free catalogue too!*** 101 East Gloucester Pike, Barrington, N.J. 08007 Tel.(609)-573-6250

Grand Stage Theatrical Supply: Glo-in-the-dark tape, fog in a can, black-light paints, and all theatrical supplies.*** 630 W. Lake St. Chicago, IL. 60661 Tel.1-800-621-2181

International Jugglers Association:
Information on jugglers, festivals, and a quarterly magazine on juggling. ***P.O. Box 122 Montague, MA 10351. Tel. (413)-367-2401

Klutz: A catalogue full of books on "how to" kids science projects, fun and educational toys, juggling books and supplies, etc.***455 Portage Ave., Palo Alto, CA 94306 Tel.1-800-737-4123

Lazer Vaudeville: You know who we are.
***Offices. 631 Spruce St. Boulder, CO. 80302 (303)-413-8116

INTERNET SITES OF INTEREST:

www.foothill.net/mda - The Magic Dealer Association. Contains a list of most magic retailers in America.

www.juggle.org - Home of the International Jugglers Association. Contains links to everything you would want to know about juggling.

www.lazervaudeville.com - Filled with pictures, biographies, tour schedules, secret Lazer Vaudeville tips and of course our e-mail address.