

OVERVIEW

Animation: Illusion of Motion

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INTRODUCTION

This kit is designed to acquaint students with principles associated with the illusion of motion. All types of movie devices— from simple flipbooks to motion picture film— operate on a basic set of principles. These principles are described and defined in the kit. By studying the definitions and looking at the kit's images, an instructor can help students understand how their eyes perceive motion where there is only a series of still images. Then students can make their own devices to produce motion pictures.

While learning about moving picture devices, the students will also be learning some basic things about the whole process of seeing: how the eye receives light and translates the image on the retina into an understandable pattern in the brain. It is important students understand something about how the eye works to comprehend the illusion of motion.

The kit contains instructions for the class to make several projects- the Zoetrope (or Praxinoscope), Flipbook, Thaumatrope, and Phenakistoscope. The projects all illustrate some aspect of the principle of persistence of vision and all the projects are easy to reproduce. Additional information may be obtained by using the bibliography included. Some of the other devices illustrated- the Mutoscope, Kinora and Filoscope- should be discussed as adaptations of the phenomena and to further illustrate the principles. To place the devices in a sociological context, it may be helpful to point out that these devices became popular with the general public in the 19th century and began as an entertainment industry, which has had a major impact on society up to the present.

The Muybridge motion study series can be used to discuss the parts of an episode of motion. By conveying the idea of animation, the studies will help students understand how they should draw their motion picture strips/discs for the devices. The panels in the Muybridge study can be used as a model for making action sequences by showing how individual segments of motion are actually related.

The persistence of vision devices- the thaumatrope, for example- demonstrate the difference between that phenomenon and illusion of motion. It can be confusing for students to separate the two. Although persistence of vision is necessary to produce the illusion of motion, they are not the same thing.

The timeline included in the section of Important Dates in the History of Early Motion Pictures provides an easy reference for the historical flow of events leading to its development. The instructor might use this chronology to give students a perspective on the evolution of animation technology by pointing out parallel historical events with which they should be familiar- the Civil War, a particular president, or perhaps another significant invention.

IMPORTANT DATES IN THE HISTORY OF EARLY MOTION PICTURES

Note: We have started our chronology roughly at the beginning of the nineteenth century, when scientific progress had made possible a serious pursuit of the subject of motion. Concern with the phenomenon, however, goes back several centuries. Leonardo Da Vinci described the Camera Obscura ("dark room") in 1500 and knowledge of principles such as Persistence of Vision go back much further still. The dates conclude at the end of the nineteenth century.

1798

Using a **Magic Lantern** on wheels with a screen of smoke, Etienne Gaspard Robertson creates the "**Phantasmagoria**"- depicting the ghosts of heroes of the French Revolution.

1822

Louis-Jacques Mandé Daguerre, an artist and pioneer in photography, invents the **Diorama** in Paris. The illusion of motion is created by changing lights on transparent paintings.

1825

Michael Faraday, a British scientist, invents a way to demonstrate persistence of vision using a disc with a slot cut in one side. It became known as the **Faraday Disc**.

1826

Although the device was probably known much earlier, the **Thaumatrope**, a spinning disc that demonstrates persistence of vision, is patented by Dr. John Ayrton Paris.

1832

The **Phenakistoscope** is patented by Prof. J.A.F. Plateau of Brussels. It is probably the oldest device to show motion using a sequence of still pictures.

Prof. S. Stampfer of Vienna invents the **Stroboscope**, which was another version of the **Phenakistoscope**.

1834

In England, William Homer invents a motion picture device that he calls the **Daedelum**, although he fails to patent it.

1853

Franz von Uchatius, an Austrian army officer, develops a motion picture projector based on the **Phenakistoscope** and the **Magic Lantern**.

1860

Homer's idea for the **Daedelum** is patented by the Frenchman Pierre Hubert Desvignes. The popularity of the device increases rapidly.

1861

William Thomas Shaw exhibits his mechanism, the **Stereoscope**, which synthesizes motion from still stereoscopic photographs.

1867

William Lincoln introduces the **Daedelum** to the United States, changing its name to that by which we know it – the **Zoetrope**.

1868

The **Kineograph**, or **Flipbook** as it is more commonly known, is patented by Linnett and marketed commercially.

1872

Eadweard Muybridge (Edward James Muggeridge) begins his experimentation of taking pictures of animals in motion, presenting these still pictures as a series.

1874

Pierre Jules César Janssen, a French astronomer, makes a fixed motion picture camera, the “photographic revolver,” to aid in his work.

1877

In France, Charles Emile Reynaud invents the **Praxinoscope**, an improvement on the **Zoetrope**. The device uses an arrangement of mirrors in the center of the cylinder instead of slots around the edge, as is done with the **Zoetrope**. This arrangement gives an improved image to the viewer.

1878

Muybridge, with engineer John B. Isaacs, uses a “battery” of still cameras arranged to take a series of pictures of a moving object.

1879

Reynaud works out a way to make his **Praxinoscope** project its images.

1882

Muybridge develops the **Zoopraxiscope**, which uses a magic lantern system to project his pictures onto a screen.

French physiologist Étienne Jules Marey makes the first portable motion picture camera, a rifle-shaped device that takes twelve exposures in one second. Marey is also instrumental in the development of Muybridge's **Zoopraxiscope**.

1884

In Rochester, New York, George Eastman begins to manufacture paper roll film for use in the Kodak camera (later introduced to the public in 1888). This development opens the way for a flexible roll film to be adapted to use in motion picture photography.

1887

Marey uses strips of coated paper film in his motion picture system- the "chronophotographic" system.

Thomas Alva Edison begins experiments aimed at producing a motion picture system.

1889

Eastman's celluloid film makes modern cinematography possible.

1890s

Mutoscope parlors are set up throughout the United States as a popular form of entertainment.

1891

Edison applies for patents on two motion picture devices- the **Kinetograph**, for photographing moving objects and the **Kinetoscope**, for viewing the results.

1892

Reynaud opens the first movie theater in Paris, the "Theatre Optique", using the basic principle of the **Praxinoscope**.

1895

The Lumière brothers, Louis and Auguste, develop the **Cinematographe**, an apparatus that combines camera and projector into one unit. They use film similar to that used by Edison, but adapt an intermittent gear drive that improves the projection process. On December 28, at the Grand Café in Paris, they become the first to charge admission for a public exhibition of moving pictures.

1896

Projection of motion pictures on a screen for a large audience becomes commercially feasible and opens the way for the subsequent development of the industry to its important position in the twentieth century.

1898

H.W. Short patents the **Filoscope**, a mechanism based on the flipbook.

IMPORTANT NAMES IN THE HISTORY OF EARLY MOTION PICTURES

Louis-Jacques Mandé Daguerre (1789-1851) French Artist and pioneer in photography. Developed the method of using copper plates as backing for photographic images- the famous daguerreotypes- and had a successful photograph by 1837.

His contribution to the illusion of motion came earlier, in 1822, when he invented the Diorama. The Diorama involved a public exhibition staged inside a special building, where the illusion was achieved by the use of transparent paintings illuminated by changing lights. The paintings were done on a flat, two-dimensional gauze-like material. For example, by "dissolving" from one transparency to another with the changing lights it could appear that a wave was moving across the set. Although the Diorama was not a 'moving picture' display as we think of one, Daguerre and his associates were instrumental in both initiating public exhibitions for entertainment and using multiple images and light to create motion.

George Eastman (1854-1932) Lived most of his life in Rochester, New York, where he established the Eastman Kodak Company. In 1888 the first Kodak camera, using paper roll film on a spool, was introduced. The Kodak revolutionized photography, replacing cumbersome glass plates and allowing a number of pictures to be made without removing the film from the camera. This development was a major step on the road to film that could be made in long strips- essential to the evolution of motion pictures.

In 1889, his flexible cellulose nitrate film helped solve the problem of extended continuous motion. He supplied some of this film for Thomas Edison's experiments. Although Eastman's primary interest was not in producing motion pictures, the manufacture of motion picture film became an important part of the company's operation. The Eastman Kodak Company went on to receive several Oscars from the Motion Picture Academy of Arts and Sciences for its contributions to the technical advancement of the industry.

Thomas Alva Edison (1847-1931) A prolific American inventor with 1,093 patents in his lifetime, Edison's experiments included the development of motion picture machines. In 1887 he began work on what later became the kinetograph and kinoscope. By 1894, the kinoscope was ready for display in New York City. Using flexible 35mm film with perforations for projector sprockets, this device set standards that are still in use today.

Auguste Marie Louis Nicolas Lumière (1862-1954) and **Louis Jean** (1864-1948) French brothers who were experienced photographers when they became interested in motion pictures. The Lumieres patented the Cinematographe in 1895. Like Edison's devices, the Cinematographe used perforated film to aid in guiding it through the projector- but with only one perforation per frame (rather than Edison's four). The Lumieres' major contribution was the use of an eclectic claw drive to move the film rather than the less satisfactory methods previously developed. They are also credited with giving the first public exhibition of moving pictures where admission was charged: on December 28, 1895, some 35 people paid one franc each for the show.

Étienne-Jules Marey (1830- 1904) French scientist who invented chronophotography which recorded multiple phases of a movement on one surface. He was interested in how humans and animals moved and he used chronophotography in his research. Unlike Muybridge who used multiple cameras to record movement, Marey used one camera that could record multiple phases of movement on one piece of film or glass plate. He is considered to be a pioneer in the development of early motion pictures.

Eadweard Muybridge (1830-1904) Born Edward James Muggeridge in England, Muybridge became interested in photography about 1860 after an earlier career that included representing a printing company and managing his own bookstore. By 1872, he was experimenting with photography in motion, initiated largely by Leland Stanford, onetime governor of California. Stanford wanted to settle a bet that all four feet of a horse are off the ground at the same time when it is running. Muybridge solved the problem by using a series of cameras set up along the track, with strings from the shutters stretched across the track. The running horse tripped the shutters, taking its own pictures. From the series of pictures taken, Muybridge was able to prove that all four feet were indeed in the air simultaneously.

Muybridge's experiments with human and animal locomotion, while not initially directly involved with efforts to produce moving pictures, had a lot to do with the understanding of motion- breaking down the parts of movement into a series of still photographs which could be used to analyze motion. This understanding was invaluable in learning how to depict movement. Muybridge's photographs could be used in motion picture devices and as a basis to develop other series. By 1880 he had perfected a device to project moving pictures based on his motion studies (the Zoopraxiscope- a revolving disc arrangement with a magic lantern), although he is still best known for his work with the motion studies themselves.

Charles Emile Reynaud (1844-1918) In 1877, this French inventor developed the Praxinoscope, which basically functioned like its predecessor, the Zoetrope. Although similar, the Praxinoscope used a central polygonal column of mirrors inside a larger cylinder so that instead of looking through slots on the side of the device, as you do with a Zoetrope, one or several people could look directly at the mirrors to see the illusion of motion. With this arrangement, the picture was clearer and brighter; the apparent motion being smoother than looking through slots. By 1881, Reynaud had produced a projector to use in conjunction with the Praxinoscope and in 1892 opened a motion picture theater, the Theatre Optique, in Paris. The pictures used in the theater were hand-drawn, not photographed.

GLOSSARY

Animation- the process by which inanimate (not moving) objects are made to appear to move- to be animated. This can be seen in movie film, by isolating two or three frames of an image. Animation here is accomplished by exposing one or two frames, moving the

image/ objects slightly, exposing one or two frames again, moving the image/ objects again, and so on. The finished product, when projected on a screen with all the frames running continuously, gives the illusion of motion.

Cartoon- a drawing or sequence of drawings showing an action or telling a story, often humorous. Cartoons may be animated by drawing the sequence so that each picture forms part of a continuous action, i.e. each new drawing is a copy of the last with a small change to indicate action. When used in a motion picture device, they appear to move.

Filoscope- a much simpler example of a home entertainment version of the **flipbook**.

Flipbook- a series of pictures drawn on a stack of cards (i.e. plain 3"x5"index cards) and held together by a rubber band so that each card is equivalent to one frame of movie film or one panel of a zoetrope strip. Each picture represents a part of an action sequence. When the cards are held in one hand and the edges are flipped past the thumb in rapid sequence, there is an illusion of motion.

Kinora- an adaptation of the **flipbook**. These were used primarily in the home as entertainment, working very much like the **mutoscope**.

Movies- After flexible, nitro-cellulose film made modern motion pictures commercially feasible, a major industry developed dealing primarily in entertainment. After the turn of the century, "going to the movies" became a favorite pastime for millions of people across both America and Europe. Although highly sophisticated today, "movies" are fundamentally elaborations of the same basic principles found in the earlier, simpler devices.

A strip of movie film is basically the same as a zoetrope/ praxinoscope strip or the pages of a flipbook, showing one step (or drawing) at a time a series of images covering an episode of movement. Each frame of movie film is like a panel of a zoetrope strip or each individual page of a flipbook.

The standard rate of movement for a modern motion picture film is 24 frames per second for 16mm and 35mm film, and 18 frames per second for 28mm film.

Mutoscope- an early motion picture machine using the **flipbook** technique. Public arcades featured this device where, for a nickel, you could see a show.

Phenakistoscope - invented simultaneously by Dr. Joseph Plateau and Simon von Stampfer in 1831, the device has slots both in the body of the wooden turning mechanism and the paper that is held in place on it. The panels created by the slots on the paper are where each picture in the action sequence is drawn. The viewer would place the paper disc on the body of the device and fasten it on, matching the slots evenly. The viewer would then hold the device up to a mirror, bringing the slots up to eye-level (with the drawing facing out) and turns its "wheel" while holding the handle steady. From Greek roots meaning "deceiving viewer."

Praxinoscope- an early motion picture device that gives the illusion of motion by using a series of pictures that revolve inside a cylinder. A center post inside the cylinder is made of mirrors which reflect the pictures as they rotate. By watching the spinning mirrors, one can experience the sensation that movement is taking place. For example, a series of pictures of a running horse, each with its legs in different consecutive positions would give the impression when watching the mirrors that the horse is in motion.

Thaumatrope- from the Greek *thauma* (wonder) and *tropos* (turn). The "wonder-turner", a device using a small disc with a picture on each side, illustrates one of the major principles of animation. The two pictures together make up one single coherent image. When the thaumatrope is rapidly turned by the strings attached to opposite sides of the device and wound up tightly, the two images come together for the viewer appearing as one. The device demonstrates persistence of vision.

Zoetrope- introduced in the United States in 1867 by William Lincoln of Providence, it was also known as the "wheel of life" from the Greek *zoe* (life) and *tropos* (turn). The rotating drum or cylinder with slots at equal distances around the wall uses a strip of panels equal in number to that of the slots to show some sequence of action. When the viewer looks through the slots, the pictures seen sequentially in the rotating device give the illusion of motion. The zoetrope is the basic rotating illusion of motion machine from which several others are derived.

Zoopraxiscope- an device created by Eadweard Muybridge in 1879 that projected a sequence of images that were printed on a rotating, circular glass disc to give the illusion of motion. The zoopraxiscope was closely related to the **phenakistoscope**.

WEB RESOURCES

<http://www.geh.org/precin.html>
<http://courses.ncssm.edu/gallery/collections/toys/opticaltoys.htm>
<http://www.precinemahistory.net/index.html>

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