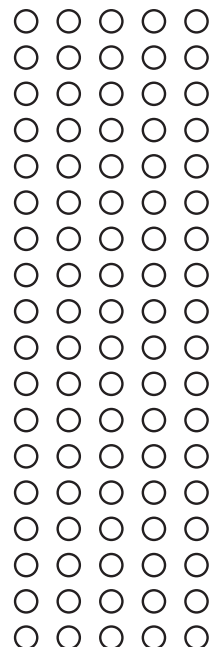


imagination
STATION

pure science. pure fun.



ANIMATION

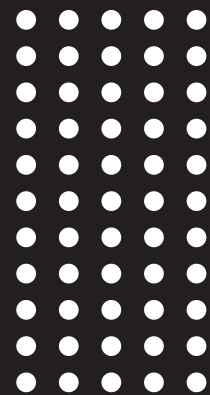
Grades K-8

Exhibit Guide

featuring



CARTOON NETWORK™



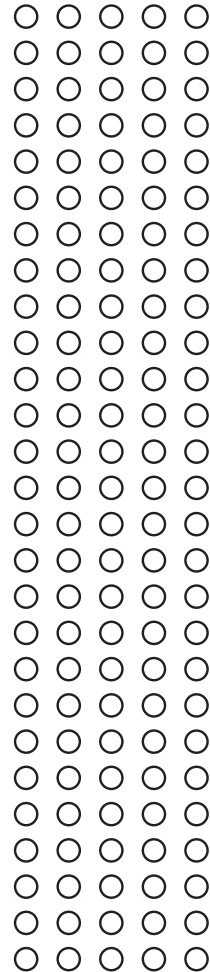
OMSI

OREGON MUSEUM OF SCIENCE AND INDUSTRY

Exhibit partially funded by:

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TEACHERS GUIDE

TABLE OF CONTENTS	PAGE
HOW TO USE THIS GUIDE	3
EXHIBIT OVERVIEW	4
CORRELATION TO EDUCATIONAL STANDARDS	9
EDUCATIONAL STANDARDS CHARTS	11
EXHIBIT EDUCATIONAL OBJECTIVES	13
BACKGROUND INFORMATION FOR TEACHERS	15
FREQUENTLY ASKED QUESTIONS	23
CLASSROOM ACTIVITIES	
• BUILD YOUR OWN ZOETROPE	26
• PLAN OF ACTION	33
• SEEING SPOTS	36
• FOOLING THE BRAIN	43
ACTIVE LEARNING LOG	
• WITH ANSWERS	51
• WITHOUT ANSWERS	55
GLOSSARY	58
BIBLIOGRAPHY	59

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HOW TO USE THIS TEACHER'S GUIDE

The *Teacher's Guide* to **Animation** has been written for teachers bringing students to see the **Animation** exhibit. These materials have been developed as a resource for the educator to use in the classroom before and after the museum visit, and to enhance the visit itself.

There is background information, several classroom activities, and the Active Learning Log – an open-ended worksheet students can fill out while exploring the exhibit.

Animation web site:

The exhibit website, www.oms.edu/visit/featured/animationsite/index.cfm, features the **Animation Teacher's Guide**, online activities, and additional resources.



EXHIBIT OVERVIEW

Animation is a 6,000 square-foot, highly interactive traveling exhibition that brings together art, math, science and technology by exploring the exciting world of animation. Through a series of hands-on exhibits, graphics and videos, visitors will explore the process of animation and create their own animated sequences. As they bring their creations to life, they will use math and science concepts and skills, just as real animators do. Visitors will have a chance to experiment with a variety of animation tools and techniques, including cartoon drawings, model animation, and computer-based animation, while gaining an appreciation of the math and science that underlie the animator's art.

Animation uses popular characters from Cartoon Network throughout the exhibition in colorful larger-than-life graphics. Families and children can experiment with storyboarding, character design, drawing techniques, model manipulation, movement, timing, filming and sound. **Animation** is ideal for both families and school groups (grades K-8). The exhibit is highly personalized for visitors, as they not only use interactive exhibits that demonstrate animation principles, but create their own animations in several areas of the exhibit. **Animation** invites the visitor to become the animator, thus creating a unique experience for visitors of all ages.

The exhibit consists of six thematic areas that touch on the various concepts important to the field of animation. In *History*, visitors will learn about early animation and persistence of vision. From there they will enter the *Animation Studio* to learn about the process of animation and the techniques and tools animators use. Next, they will enter *Art in Motion*, where they will find out why art and math are important in the creation of characters, motion and change. In *Science Laboratory*, the science and technology that make animation possible are explored. *Sound and Stage* continues the story by teaching the principles of sound and phonetics, exploring how these are used to create a finished piece. In *Cartoon Museum*, visitors will view clips of famous animations in addition to important artifacts such as cels, models and storyboard drawings from their favorite animations. The six thematic areas give the visitor not only a rounded overview of the animation process and the concepts behind that process, but an introduction to the many forms of animation and its uses in both entertainment and scientific fields. The educational messages are reinforced by the interactive components contained within the exhibition, creating an experience that will be both fun and educational for the whole family.

Following is a brief description on each thematic area and individual component in **Animation**:

HISTORY

Learn about early animation, animation principles, and how apparent motion makes animation possible—when many single images flash in front of the eye in quick succession, the brain registers these single images as a moving image.

Apparent Motion

Explore apparent motion and early animation using a praxinoscope. This modern version of an old-fashioned machine consists of a round, rotating platform divided into 12 sections, around a central column of mirrors. Slightly modify the position of



several three-dimensional objects and then spin the platform to see all the objects morph into a single animation. (5-adult)

The Early Days of Animation

Check out an updated version of another early animation machine found in the penny arcades of the late-nineteenth century, the mutoscope. While cranking a handle, watch a spool of images flip around, like a Rolodex, creating an animated sequence. (5-adult)

ANIMATION STUDIO

Explore the process of animation and story creation with a variety of Cartoon Network characters.

Animated Animals

Realistic animation must include lifelike character movement. Manipulate a two-dimensional horse and see if you can create an animation that realistically portrays a horse's natural gait. Guided by a backlit template, pose the horse at each key stage of movement and snap a quick picture of each new position. Play back your sequence and see how you did! (8-adult)

Animation Process

Find out how animation is produced in a step-by-step process. Slide a computer monitor along a track and view the different steps of cel animation from start to finish in this simple, interactive computer tutorial. (7-adult)

Cel Animation

Cel animation was developed to save time--by stacking cels, new scenes can be created and objects can be added to a cartoon in layers. Select from a variety of background, character, and effect cels and stack them in your preferred order. As you review your scene on a monitor, you'll see how the cels combine to make a full color scene. (5-adult)

A Moving Background

Panning backgrounds can fool the eye, making it appear that not only is the character moving, but sometimes even moving a long distance. Slide a moving background cel along a track, under a character cel, snapping frames as you go. As you view your finished animation, you'll see it's the stationary characters that appear to be moving. (6-adult)

Scaling Up and Down

Animators use ratios and mathematical tools, such as the pantograph, to enlarge a character while keeping the correct proportions. Trace one of three templates using an oversized pantograph. At the same time you are tracing the object, the pantograph will be drawing a larger version on a giant Magnadoodle. Switch out the template and try all three! (7-adult)

Storyboard

Stories progress in a certain sequence, which ideally should be mapped out very early in the process. Select from a series of 10 picture cards and arrange 8 of them in your preferred order to create a storyboard. Then, press a button and watch an animated sketched version of your storyboard come to life on a monitor. (7-adult)



ART IN MOTION

Discover why art and math are important in the creation of characters, motion, and change with the help of the characters from Foster's Home for Imaginary Friends.

Character Construction

Explore the basics of sketching animated figures. Did you know that all animated characters are made up of geometric shapes because that's the easiest way to draw them? View a step-by-step video of a Cartoon Network animator drawing characters from Foster's Home for Imaginary Friends. Then, give it a try yourself using the paper and colored pencils provided. Younger children can create simple figures by tracing stencils of several different Foster's characters. (3-adult)

Frames Per Second

Most animation uses about 24 frames per second because it produces the perfect apparent motion effect. Fewer frames can seem unrealistic because the animation appears to flicker between frames. Turn a dial to change the frame rate of an LED display, comparing how the same sequence looks different at 18, 24, and 30 frames per second. (6-adult)

Planning the Action

Illusions of movement (even types of movement that are impossible in real life) can be created using still images mapped out on a grid. In this fun, full-body interactive, you can animate yourself! Walk onto a large floor grid, where a camera is positioned to take 14 pictures. You are prompted by an electronic countdown to strike a pose or jump on the first square of your plan of action, where the camera will snap a picture. Move on to your next square and pose, while again an image is recorded, etc. When you're done, you can watch your animation on a large monitor and see yourself magically move around the room. If you jump as each picture is taken, you can even appear to float! (5-adult)

Stop-Motion Animation

Geometric shapes can be combined to create objects or patterns that can be given the appearance of movement through stop-motion technology. At any of these three identical stations, you can create your own stop-motion animation. Manipulate the various geometric objects a little bit at a time and snap a quick picture of each move you make. When you're done, play back your animated sequence. (5-adult)

SCIENCE LABORATORY

Explore the science and technology that make animation possible in Dexter's Laboratory.

Animation in Science

Animation is much more than cartoons; it is also a vital tool in many fields of science. At this computer station, you can explore the different applications of animation technology in fields such as genetics, space, paleontology, medicine, and archaeology. (9-adult)

Computer Animation

Find out how computers have become one of the most important tools in animation, freeing the animator from drawing the same thing repeatedly. Select an object and a background on a computer screen and manipulate the character a bit at a time, creating several "key" frames. The computer will take the "key" frames you



developed and fill in the “in-between” frames, producing a simple motion sequence that animates your object. (7-adult)

Squash and Stretch

Animators need to understand principles of physics to create a believable animation—an object elongates along its axis of acceleration (stretch) and contracts when it meets resistance (squash). In this computer activity, create a realistic animation of a bouncing ball by clicking and dragging cartoon pictures of a ball into the correct bounce sequence based on their shapes. A nearby video plays a clip of a bouncing ball from Dexter’s Laboratory, so you can see the principle in action. (6-adult)

Time-Lapse Animation

Time-lapse technology allows us to view an action that occurred over a long period of time in a matter of seconds. Explore this technology as you watch several different time-lapse videos, including flowers blooming, cookies baking, the sun setting, clouds forming, and insects hatching. You can speed up, slow down, or even stop the time-lapse action by spinning a control wheel forward or backward at any speed you choose. (4-adult)

Visual Effects

In this full-body interactive, experiment with the same type of special effects Hollywood uses in movies and television. You can jump or pose, while several digital cameras around a circular screen area take your picture simultaneously. The still images are then played back in rapid succession on a large monitor above, creating an animation in which you are viewed from several angles. (5-adult)

SOUND AND STAGE

Explore the principles of sound and phonetics with the Kids Next Door.

Foley Room

The sounds heard in animation are not always what they appear to be. In the Foley “booth”, you can become the sound technician and add audio effects to an animation clip. You’ll practice precise timing and sequencing skills as you try to synchronize your sounds with the action on screen. When you’re finished, play back the clip with the sounds you just recorded and see how you did. (6-adult)

Lip Sync

To generate realistic speech, an animator must study how people's mouths move during speech sounds. Listen to a simple phrase being spoken and see if you can match the correct mouth shapes to the right sounds in the phrase, snapping a picture of each mouth shape selected. You can use a phonetics chart and mirror to help you determine which mouth shape matches each sound in the phrase. Play back your animated sequence with the dialogue and watch the character “saying” the words. (10-adult)

Set the Mood

Explore how music can affect the psychological impact of a film. Watch a short animated clip with background music. Then, select from different soundtrack options designed to create a distinct mood (suspenseful, sad, happy, romantic) and view the scene again. Note how the mood of the scene differs based on the particular soundtrack. (5-adult)



Talking Pictures

Add your own voice to a silent animation! Choose from three animated clips, and then follow the words onscreen, adding your own voice to match the characters’ action and mouth movements. After recording, you can play back the sequence--now with your voice speaking through the animated characters. (7-adult)

CARTOON MUSEUM

Check out clips of famous animations, unique artifacts, nostalgic toys, and other fun, pop-culture objects surrounded by beloved, classic Hanna-Barbera characters.

Cartoon Museum

Explore animation’s history and see the many different tools used to create animation in this colorful museum featuring art and artifacts from popular cartoons like The Flintstones, The Jetsons, Scooby Doo, The Powerpuff Girls, The Smurfs, Yogi Bear and much more! You can examine cels, drawings, storyboards, maquettes, and backgrounds, as well as vintage toys and games that were used to market the shows. You’ll get an idea of just how much time and work has gone into these familiar animations! (8-adult)

Screening Room

Inside the Cartoon Museum, you’ll find an intimate theater setting where you can view a series of popular Cartoon Network animations and learn more about basic animation history, concepts, techniques, and the science behind animation. Each 2-3 minute cartoon clip features pop-up fact bubbles about the techniques and inspiration behind the animations, as well as other fun facts. The animations loop automatically and last a total of approximately 15 minutes and include clips from: Foster’s Home for Imaginary Friends, The Powerpuff Girls, Codename: Kids Next Door, Dexter’s Laboratory, and Hi Hi Puffy AmiYumi. The theater can also be used as a demo area or to screen films of the hosting museum’s choice. (8-adult)

Classic Hanna-Barbera Video Kiosks

Discover the behind-the-scenes techniques of animation in two Video Kiosks featuring classic Hanna-Barbera cartoons spanning over three decades. At each Video Kiosk, you can choose from a selection of six videos and watch each cartoon clip along with an introduction that presents facts about the history and techniques behind the animation. Cartoons include: Huckleberry Hound, The Flintstones, Quick Draw McGraw, Yogi Bear, The Jetsons, Top Cat, Jonny Quest, Fantastic Four, Wacky Races, Josie and the Pussy Cats, Scooby Doo, and Challenge of the Super Friends. (8-adult)

Careers in Animation

Scattered throughout the exhibition, are five Careers in Animation profiles, which feature graphic panels or digital slide shows of real animators working in the Cartoon Network studios. Each one focuses on a different artist and area of animation:

- 1). The backside of A Moving Background – a Producer and Director.
- 2). The backside of Storyboard – a Creator and Executive Producer.
- 3). The backside of Foster’s Structure – a Producer, Writer, Storyboard Artist.
- 4). The backside of Dexter’s Laboratory Structure – a Technical Director.
- 5). The backside of the Foley Room – a Voice Artist.

Numerous skills are needed in the world of animation, creating many career opportunities. (7-adult)



CORRELATION TO EDUCATIONAL STANDARDS

Animation provides rich mathematics, science, art and social studies content. The primary focus of the exhibition is learning how animators use art, math and science to create the "magic" of animation. Through exhibit activities, visitors will discover that some of the same concepts used in animation are relevant to their daily lives.

SCIENCE

Science themes explored in **Animation** include:

- Science and technology in society
- Patterns and relationships
- Properties of objects and materials and changes in properties
- Motions and forces
- Change, constancy and measurement
- Systems, order and organization
- Structure and function in living systems
- Characteristics of organisms

MATHEMATICS

Animation is designed to build the following math skills and concepts:

- Mathematics as problem solving
- Mathematical connections
- Geometry and spatial sense
- Measuring and comparing

These skills and concepts are based on the National Council of Teachers of Mathematics (NCTM) standards and strands. Additional information is available on the National Council of Teachers of Mathematics website at <http://www.nctm.org/>.

SOCIAL STUDIES

In addition to supporting science and math education, **Animation** features social studies topics, including:

- Time, continuity and change
- Individuals, groups and institutions
- Production, distribution and consumption

The National Council for the Social Studies standards is available at <http://www.socialstudies.org/>.



FINE ARTS

Animation also covers these fine arts standards:

- Understanding and applying media, techniques and processes
- Using knowledge of structures and functions
- Communicating ideas, experiences and stories
- Exploring and understanding prospective content for works of art
- Understanding the visual arts in relation to history and culture
- Making connections between visual arts and other disciplines
- Choosing and evaluating a range of subject matter, symbols and ideas

The National Standards for Arts Education outlines basic arts learning outcomes integral to the comprehensive K-12 education of every American student.

<http://www.education-world.com/standards/national/arts/index.shtml>



SCIENCE / MATH EDUCATIONAL STANDARDS CHART

Science Standards:	Society	Patterns	Properties	Motion	Change	Systems	Structure	Math Standards:	Problem Solving	Geometry	Measuring
History of Animation											
Praxinoscope	*				*						
Mutoscope	*				*						
Studio											
Scale up or down		*		*	*	*			*	*	*
Animation Process	*					*					
Animated Animals	*			*	*		*				*
Storyboard						*					
Careers	*					*					
Moving Background		*		*	*	*					
Cel Animation			*		*					*	*
Dexter's Lab											
Time Lapse	*	*			*	*					*
Animation in Science	*				*	*			*		*
Computer Animation		*			*	*			*		
Visual Effects			*	*	*						
Squash and Stretch		*			*				*	*	*
Art in Motion											
Planning the Action		*			*	*					
Character Construction		*				*	*			*	*
Frame Rates			*		*				*		*
Stop Motion		*		*	*					*	*
Cartoon Museum											
Screening Room											
Cartoon Classics											
Artifact Cases	*										
Sound and Stage											
Foley Room			*			*					
Lip Sync					*	*					*
Set the Mood						*					
Talking Pictures					*	*					*



SOCIAL STUDIES / ART EDUCATIONAL STANDARDS CHART

Social Studies Standards:	Time	Groups	Production	Art Standards:	Media	Structure	Communicating	Exploring Content	History	Connections	Ideas
History of Animation											
Praxinoscope	*		*						*		
Mutoscope	*		*						*		
Studio											
Scale Up or Down	*									*	
Animation Process	*		*		*		*				*
Animated Animals	*					*		*	*	*	*
Storyboard	*		*		*		*				*
Careers	*	*	*		*						*
Moving Background	*		*								
Cel Animation			*		*						
Dexter's Lab											
Time Lapse	*		*							*	
Animation in Science	*	*	*					*		*	*
Computer Animation	*	*	*		*					*	*
Visual Effects	*										
Squash and Stretch	*									*	
Art in Motion											
Planning the Action	*						*			*	
Character Construction			*		*	*	*	*		*	
Frame Rates	*									*	
Stop Motion	*						*				
Cartoon Museum											
Screening Room		*	*					*	*		
Cartoon Classics		*	*					*	*		
Artifact Cases		*	*					*	*		
Sound and Stage											
Foley Room			*		*		*	*			
Lip Sync	*		*		*						
Set the Mood			*		*		*	*			*
Talking Pictures	*		*		*		*				



EXHIBIT EDUCATIONAL OBJECTIVES

MAIN MESSAGE

Animators use art, math and science to create the "magic" of animation.

CONTENT THEMES

- *History*: Learn about early animation and the apparent motion effect.
- *Animation Studio*: Learn about the animation process and the tools and techniques animators use.
- *Art in Motion*: Learn to use art and math to create characters, motion and change.
- *Science Laboratory*: Learn about the science and technology that make animation work.
- *Sound and Stage*: Learn the principles of sound, phonetics and lighting, and use them to create a finished piece.
- *Cartoon Museum*: View finished works of animation and important animation artifacts.

QUESTIONS ANSWERED IN THE EXHIBIT

- What steps are involved in creating animation?
- What math and science concepts are important to animation?
- What forms of technology are used in animation?
- How can I become an animator and what types of careers exist?

EDUCATIONAL GOALS (THE CONTENT APPROACH AND PHILOSOPHY)

1. To create experiences in which visitors use math and science concepts and skills in the process of animation.
2. To introduce visitors to the art and technology of animation by involving them in the design, engineering and creation of animations.
3. To support family learning in a museum setting.
4. To support teachers in achieving science and math curriculum goals by developing a traveling exhibition and related educational resources, with specific links to national math and science standards.
5. To involve underserved audiences as participants in exhibit development and formative evaluation to enhance the relevance and accessibility of exhibit content to these groups.



WHY USE ANIMATION TO TEACH SCIENCE AND MATH?

Animation presents useful entry points for discovering concepts in science, mathematics and the arts for many types of learners. For instance, the storyline in an animation provides a *narrational* entry point, the sensory qualities of an animation provide an *aesthetic* entry point, and the hands-on process of creating an animation provides an *experiential* entry point. This topic is extremely popular and has proven to be a powerful and effective tool for engaging and teaching all ages about such math and science concepts as perception, illusion, apparent motion, geometry and measurement.

In prototype testing, animation stations attracted visitors from pre-school age to elderly, many of them in family groups. All age groups successfully used the prototypes to create their own animations, and the activity facilitated rich group interactions. Animation has been especially successful with students who typically are not motivated to study math and science or do not do well in those subjects. Meredith VandenBerg, a middle-school science teacher in Portland, Oregon, has pioneered the use of animation in her classroom. She describes “amazing results” when typically low-achieving students use animation techniques: Over 90% of her at-risk students succeeded in science units that used animation as a means to motivate.



THE SCIENCE OF ANIMATION: BACKGROUND INFORMATION FOR TEACHERS

an•i•ma•tion \ ăn-uh-'mā-shun\ n (1597) **1:** the act of animating : the state of being animate or animated **2a:** a motion picture made by photographing successive positions of inanimate objects (as puppets or mechanical parts) **b:** ANIMATED CARTOON **3:** the preparation of animated cartoons

[Merriam-Webster's Collegiate Dictionary, Tenth Edition, 2001](#)

HOW DOES ANIMATION WORK?

TV and film animations are made from a series of many pictures, each picture a little different from the previous one. If the pictures are shown fast enough, the brain connects the movement together and we see an animated picture, or moving image.

Early filmmakers experimented to find out how many frames (still pictures) per second produced the best motion effect. About a century ago, motion picture technology was new and 18 frames per second was the fastest rate possible. But at 18 frames per second or less, the dark moments between frames are visible and the picture on the screen appears to flicker. As technology improved, filmmakers found that, at 24 frames per second or greater, the moving image appeared to flow smoothly with no interruptions.

APPARENT MOTION AND PERSISTENCE OF VISION

Although scientist Peter Mark Roget is often credited with devising the first theory to explain the motion picture effect, it was actually French scientist Joseph Plateau who came up with the initial idea in 1833. His theory, called persistence of vision, suggested that the human eye blends a series of rapidly moving images with regular interruptions into a single moving image. Plateau believed that this occurred because of the eye's tendency to retain images on the retina briefly after they are viewed. This theory remained the prevalent explanation of the phenomenon for the rest of the 19th century.

Around the year 1900 the persistence of vision theory was debunked. Scientists found that although the human eye does retain images briefly after they are viewed, this effect could not create motion. If the images were retained long enough for persistence of vision to work, we would actually end up seeing images stacked one on top of the other rather than a blended moving image. Scientists realized that animation works because of the brain, rather than the eyes, and because of an illusion called **apparent motion**. The human brain is wired to see motion, sometimes even where no motion exists. This probably occurs because it was important for humans as a species to easily recognize motion in order to escape from predators or to be successful hunters. Because of this, if a series of slightly different still images is flashed in front of our eyes, our brain wants to see motion so it fills in the gaps between images. The result is that we see only a moving image. What early researchers such as Roget and Plateau did not understand is that humans perceive motion pictures not just with the eyes, but with the brain, as well.

PRECURSORS

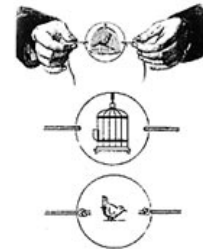
Although Webster’s defines animation as a motion picture made by photographing inanimate objects, the first forms of animation did not use cameras. Cave paintings in Europe seem to depict animals in motion. The artists achieved this effect by giving the animals eight legs instead of four. The paintings were also presented in a series from left to right, showing a visual representation of a story in a format similar to today’s comic books. Shadow puppets were also ancestors of modern animation. Shadow puppet theaters were introduced in China during the Tang Dynasty (AD 618-907). Flat figures were cut from animal hide and moved behind a screen to create a moving story. Shadow puppet theaters were introduced in Europe beginning in the 1760s and were known as Chinese shadows.



Another precursor to animation was the magic lantern, introduced by scholar Athanasius Kircher in 1645. It was a simple device, consisting of a box with a light source and a curved mirror. The lantern was used to project pictures on a wall. Although the images did not move, revolving glass discs with painted images were used to present a story in pictures. The technology was so new and unusual that early audiences were often frightened of the images, believing that magic or witchcraft was involved in their creation.

OPTICAL TOYS

The earliest forms of animation were philosophical toys, also called optical toys. The first was the **thaumatrope**, introduced in 1826. It is a very simple toy, a disc with two different images, one on the front and one on the back, and a string attached to the edges. The string is pulled and the disc flips, combining the images. For instance, a bird painted on the front might appear in the cage painted on the back.



Discussions regarding persistence of vision resulted in the invention of all manner of optical toys during the remainder of the 19th century. The **phenakistoscope**, a device made up of a disc with sequential images painted on the edges and a disc with slits that acted as shutters, created a moving image when the discs were spun. The **zoetrope** was invented in 1834 and consisted of a drum with slits in the sides and a strip of images placed inside. When the drum was spun and the viewer looked through the slits, they were able to view an animation.

Emile Reynaud, one of the early fathers of animation, created the **praxinoscope** in 1877. Like the zoetrope, the praxinoscope consisted of a drum with a strip of images, but the images were viewed in a column of mirrors rather than through a slit. Reynaud invented a projecting version of the praxinoscope in 1882, creating the first projected animation in history.

One of the most enduring animation toys, the **kineograph**, or flipbook, was invented in 1868. In 1895, Thomas Edison invented the **mutoscope**, a mechanical variation of the flipbook that resembled a Rolodex. The machine became a common sight in penny arcades and carnivals until the mid-20th century.

THE FILM AGE

With the invention of the motion picture camera and projector in the 1890s, a new animation medium was born. Vaudeville magicians J. Stuart Blackton and Albert E. Smith collaborated to form the Vitagraph Company, a studio that produced what may have been the earliest animated films. The duo used paper cutouts and drawings on an easel to create some of their earliest films. They used **stop-motion** techniques, animating three-dimensional objects by moving them slightly and taking a series of photographs to create eerie effects in their film, "The Haunted Hotel" (1907).

Winsor McCay, a talented comic strip artist, created the first drawn animation using 4,000 drawings that he made with India ink on rice paper. His first film, "Little Nemo," was hand-tinted and featured characters from his comic strips. Most studios continued to use this time-consuming method until Raoul Barre's studio created the "slash system" around 1913. This involved using one page for the background and another top page with a drawing of the character and sections cut away to reveal the background. This technique worked well with the early film technology because the poor quality of the film failed to pick up the line between the two pieces of paper. Luckily, the burgeoning field did not have long to wait for a better option, as **cel animation** was invented only two years later. This system used transparent sheets of cellulose with painted or drawn images laid over a painted background. The cel animation technique was quite a time-saver, as animators could use the same background, and even the same character, but just switch out details such as arms or legs to create movement. The cel animation technique is still one of the most popular techniques today. Most Cartoon Network shows were made using cel animation, and the technique was also used in most Disney and Warner Bros. films.

In 1917 Max Fleischer (of the Fleischer Studio that produced Koko the Clown and Betty Boop) made a contribution to the industry with his patent for the **rotoscope**. Using this device, an animator could trace live-action footage to create an animation based on real movement. Although rotoscoping was used with success in various animated productions, including the creation of the Cab Calloway dance scenes in a couple of Betty Boop features, the device never completely caught on. Disney animators realized by the 1930s that an effective animation needed exaggeration for comic effect. One important concept they developed based on this belief was **squash and stretch**. Squash and stretch is based on the idea that an object appears to lengthen as it falls, flatten as it hits the ground, and lengthen as it bounces up. The use of the squash and stretch technique results in a livelier and more convincing animation. Anticipation was also found to be important. If a character was going to make a big movement, the character should anticipate that movement by pausing or moving slightly in the opposite direction first, like when a character pauses in midair before falling off a cliff. This created a funnier comic effect and often resulted in the characters defying gravity.

Animators began experimenting with different media beginning in the mid-19th century. Stop-motion animation using three-dimensional objects became increasingly common. Puppets, beads, sand, blocks, clay, and thousands of other ordinary objects have been used throughout the years to create animation. Cutout animation, a form that uses paper cutouts that are replaced or jointed to move slightly for each frame, was perfected as early as the 1920s by German animator Lotte Reiniger in her first film (and also one of the first full-length films), *The Adventures of Prince Achmed*. Emile Courtet first used the **pixilation technique** in 1911. The technique used real people placed in slightly different positions for each frame. Virtually every kind of object available has been used to create animation.

TELEVISION ANIMATION

It made perfect sense that animation would make the jump from movie theaters to television. The first animated television show, *Crusader Rabbit*, debuted in 1949. Soon, entire studios devoted strictly to producing television animation were formed, including Hanna-Barbera, Jay Ward and Filmation, among others. Critics of television animation have felt that the quality of the animation is much lower than most previous animation shown in movie theaters. This is not surprising, however, when you consider that television shows had to be produced quickly enough to air a new episode every week. Television animators had to find ways to cut corners and produce their product with a low budget and limited time. To solve this problem, they came up with the **limited animation** technique. In limited animation, the amount of movement is minimized. A character's eyes or arms might be the only feature that moves in one scene, for instance. Sequences also are used more than once, and a single frame is sometimes photographed two, three or four times to reduce the need to produce more unique frames while still fitting within the 30 frames per second, the standard of television animation.

There are 30 frames or pictures for every second of television animation. American television signals pulse 60 times every second because the electric power pulses 60 times a second. Each television pulse contains half a frame, so 60 pulses equals 30 frames.

COMPUTERS

The first computer-generated images were made in the early 1950s at the Massachusetts Institute of Technology. Some experimental animators at that time were creating animation using oscilloscope patterns. Since then, digital animation has become increasingly sophisticated, with some movies approaching the look of real photography.

Computers can be animation time-savers. The animator can tell a computer how an object should move by drawing **key frames** that represent the extremes of action. For example, the highest and lowest points of a bouncing ball are **extremes**, while the other positions of the ball are **in-betweens**. The computer redraws the object for each in-between position, creating a smooth animation that flows from one key frame to the next. However, animation requires a great deal of knowledge in regards to physics, anatomy, story writing and special animation techniques such as squash and stretch. A computer may be able to create movement, but it cannot create an animation without the help of a knowledgeable animator.

SCIENTIFIC USES OF ANIMATION

During the late 19th century researchers found they could use the relatively new technology of animation for scientific studies. Eadweard Muybridge began to use sequential photography to study animal and human motion in the 1870s. His seminal work consisted of photographs of a running horse that he used to investigate "unsupported transit," the idea that a horse sometimes has all four feet off of the ground while running. The photographs, taken alongside a racetrack as a horse ran by, proved that all four horses' feet sometimes leave the ground at once.

Time-lapse animation also has been used to study the growth process of plants or other processes that occur too slowly for the human eye to view. By taking a photograph at regular intervals, scientists can string the photos together into an animation that presents a flower blooming, a blade of grass sprouting, or a butterfly emerging from its cocoon.

The newest form of animation used in science is **computer modeling**. Scientists can create animations of objects that are too small for the eye to see, such as electrons or DNA strands. Scientific animators can recreate prehistoric worlds, bringing life to ancient cities or extinct creatures. Animated computer simulations are used to train people in specialized jobs, like flying a jetliner or driving a freight train. Animation is also used to create future scenarios. For instance, computer modeling can be used to plan space shuttle launches or predict the effects of volcanic eruptions or river flooding.

THE ANIMATION PROCESS

Animation is created with a step-by-step process. The number and order of steps depend on the materials an animator chooses for his or her animation. Here are the steps animators might follow to make a cel animation:

Step 1: All animation starts with an idea. The animator may individually produce a film or pitch his or her idea to an animation studio. The pitch might include drawings, story lines, or even a rough animation.

Step 2: If the idea gets the green light, writers make up storylines and write scripts.

Step 3: Next, a designer sketches the characters. The designer may create several different versions of a character before the final version is chosen.

Step 4: The storyline and characters are brought together in a series of rough drawings called a storyboard. Each drawing illustrates an important scene in the animation. Using a storyboard, animators can rearrange scenes to figure out the best storyline.

Step 5: Next, the characters' voices are recorded. Voice actors often go through many takes before getting the scenes right, just like actors in a live-action film.

Step 6: A rough version of the animation called an animatic is filmed. An animatic is like a moving version of a storyboard. This is often the first chance for animators to see how the animation will flow on the screen.

Step 7: Next, the key and in-between drawings are made. The director of the animation often draws the key drawings. Key drawings represent the extreme points of action, while in-betweens are all the drawings between extremes.

Step 8: The drawings are then photographed and transferred to the computer to make a rough test animation. Once the animation is approved, cleaned-up versions of the key and in-between drawings are drawn and inked.

Step 9: Next, the backgrounds are drawn and painted. The same painted background is usually used for the entire scene. The cels are laid on top. For action scenes, longer backgrounds that slide beneath the cels are sometimes used.

Step 10: The key and in-between drawings are transferred to cels. They may be traced and painted by hand or printed from a computer. The cels are painted on the back.

Step 11: The finished cels are photographed with the backgrounds, one or two frames at a time, to create the animated film. The film is then edited down to the final version.

Step 12: A Foley artist creates sound effects for each scene. Many of the sound effects are created using household objects. Foley artists may also use pre-recorded sounds.

Step 13: Next, music is chosen or recorded. Music is an important element because it can affect the mood of an animation.

Step 14: Finally, the voice tracks, sound effects, and music are combined to make up the final soundtrack. The soundtrack is added to the film, and the animation is ready to roll!

FUN ANIMATION FACTS

- Foley sound effects are named after Jack Foley. Foley created the first sound effects using everyday objects for live-action films beginning in the 1930s.
- To make 10 minutes of filmed animation, animators have to create 14,400 still pictures or frames!
- Only about 200 of the thousands of cartoons created during the silent era (around 1913 to 1928) still exist.
- *The Newlyweds* (1913), based on a comic strip by George McManus, was the first cartoon series.
- When the United States entered World War II, many animators enlisted in the 18th Air Force Base Unit (First Motion Picture Unit). The artists created animated training films for the soldiers. Animated films were found to be more effective than live-action films because they were more entertaining. After the bombing of Pearl Harbor, the Army also commandeered the Disney Studio to store ammunition. By the end of the war, the majority of major animation studios had contributed to the war effort by producing training films and insignia.
- Felix the Cat was the first cartoon superstar. He debuted as a silent film star in 1919. At the height of Felix's fame, it was estimated that 75% of the world's population recognized him. This was quite a feat considering there were no televisions, satellites, computers or fax machines at the time!
- Speaking of Felix, the first television broadcast featured a stuffed (non-animated) Felix the Cat doll.
- A Disney short called "Flowers and Trees" won the first Academy Award for an animated short film. It was also the first color release.

SOME IMPORTANT ANIMATORS, STUDIOS, AND THEIR FILMS

Far from a comprehensive list, these are just some fun and interesting animations to complement the pieces by Hanna-Barbera and Cartoon Network.

Walt Disney – Disney created the first sound cartoon, “Steamboat Willie,” in 1928. Disney went on to create a new high standard for animated films by focusing on realistic representations of anatomy and motion, and high-quality drawings.

“Steamboat Willie” – 1928

“Snow White and the Seven Dwarfs” – 1937

Oskar Fischinger – Fischinger made films in the early to mid-twentieth century that are considered masterpieces of abstract modern art.

“Motion Painting No. 1” – 1949

Fleischer Studios – In addition to creating several popular early cartoon characters, including Koko the Clown and Betty Boop, the Fleischer brothers invented the rotoscope, a machine that enabled animators to create films by copying live motion.

“Snow-White” (featuring Cab Calloway) – 1933

Joan Gratz – Gratz’ “Mona Lisa Descending a Staircase” won an Oscar in 1993. She employed a clay-on-glass technique in her film, a survey of 20th century art.

“Mona Lisa Descending a Staircase” – 1993

Co Hoedeman – An animator who has experimented with many forms of stop-motion animation, his materials have included sand, blocks and dolls.

“The Sand Castle” – 1977

John and Faith Hubley – When John and Faith Hubley were married in 1955, they included “to make one noncommercial film a year” in their wedding vows. These committed independent animators used an abstract style in their films, including innovative uses of color, sound and texture.

“Windy Day” – 1973

Caroline Leaf—This amazing animator has perfected a painstaking form of animation using paint on glass.

“The Street” – 1976

“The Owl Who Married a Goose” – 1974

Winsor McCay – McCay created hand-drawn and painted animations on film between 1911 and 1921. These films are still unparalleled for their beauty and artistry.

“Gertie the Dinosaur” – 1914

“Little Nemo” – 1911

Norman McLaren – A Canadian animator, McLaren introduced the pixilation technique in 1952. Pixilation uses real people posed in different positions for each camera shot.

“Pas De Deux” – 1968

Otto Messmer – Messmer created the first cartoon superstar, Felix the Cat, in 1919. The Felix films were imaginative and fresh at a time when animation had become an industry, and little thought and effort often went into creating an animated story.

“Pedigree” – 1927



George Pal – Pal invented a style of puppet animation called replacement. He would switch out a puppet’s face and limbs in each frame with a slightly different version.

“John Henry and the Inki Poo” – 1946

Lotte Reiniger – Ms. Reiniger, an animator from Germany, produced one of the first full-length animated films using delicate paper cutout silhouettes.

“The Adventures of Prince Achmed” – 1926

Jiri Trnka – One of the pioneers of Eastern European puppet animation, Trnka created a masterpiece with his retelling of the Hans Christian Anderson tale, “The Emperor’s Nightingale.” Boris Karloff narrated the film.

“The Emperor’s Nightingale” – 1951

Will Vinton – Vinton coined the term “claymation.” He first used his signature technique in the 1974 film, “Closed Mondays,” a film he made with Bob Gardiner.

“Closed Mondays” – 1974

Warner Bros. – What more can you say about a studio that has inspired generations of fans with its comic films?

“What’s Opera, Doc?” – 1957

United Production Associates – UPA studios revolutionized the field of animation with their stylized animation that moved away from the realistic representations used by other studios at the time.

“Gerald McBoing Boing” –1951

“Rooty-Toot-Toot” – 1952



FREQUENTLY ASKED QUESTIONS

HISTORY

How many picture cards were traditionally used in a mutoscope?

A mutoscope reel typically held 850 cards, giving close to a minute of viewing time.

When were mutoscopes used and where were they found?

Thomas Edison invented the mutoscope in 1895. Mutoscopes typically appeared as coin-operated machines in arcades and amusement parks until the mid-20th century.

Can you still find mutoscopes today? Where?

Yes, you can still find functioning vintage mutoscopes at some old-fashioned arcades and other motion picture oriented museums. One such place is **Marvin's Marvelous Mechanical Museum** in Farmington Hills, Michigan.

More information is available at <http://www.marvin3m.com/>.

ANIMATION STUDIO

What does the "2:1 Ratio" refer to in the *Scaling Up and Down* exhibit?

The 2:1 ratio refers to the height and width of the stencil in comparison to the length of the lines in the drawn figure. The lines in the drawing are twice the height and twice the width of the stencil. This ratio is not a correlation of their respective area; that ratio would be 4:1.

What do the arrows represent on the picture cards in the *Storyboard* exhibit?

The arrows symbolize the movement of the characters in each scene, e.g., a circular arrow represents the spot where a character spins.

Why are the *Storyboard* picture cards black and white?

A storyboard is developed as a rough sketch of the animation. As a result, animators don't want to waste time adding color to a sketch of a scene that may change.

ART IN MOTION

Where is the camera in the *Planning the Action* exhibit?

The camera is located to the right of the prompt monitor in the exhibit.

Can you slow down the speed that frames are played back in *Planning the Action*?

No, the computer plays back the images at the same rate each time.

When will my animation appear on the external monitor in *Planning the Action*?

Within a minute of the completion of your 14th photo, the playback will begin on the external monitor.

Are all three of the *Stop-Motion* exhibits the same?

Yes.

How many frames do the *Stop-Motion* exhibits allow?

The programs will capture up to 400 frames. They will delete the first images captured after the 400th frame is taken.

SCIENCE LABORATORY

Where are the pictures from in the *Time-Lapse* exhibit?

A million sources, too many to name! All the animations were given to us by Technofrolics, the company that created the Spin Browser interface in the exhibit.

How many cameras are there in the *Visual Effects* exhibit? Where are they?

There are 16 cameras located inside the semicircle above the monitor.

How do the cameras work in the *Visual Effects* exhibit?

All 16 cameras take a picture at the same time. Later, each image is flashed in sequence (left to right and right to left) on the external monitors. These images capture one moment in time from 16 different positions.

When do the cameras take the pictures?

They take the pictures after the countdown.

How long does it take to process the photos before they appear on the screen?

It takes approximately two minutes to process the photos before they appear. The computer has to render the animation, which takes some time. When the button lights up, it is ready for the next set.

Which films or animations use the “Bullet-Time” effect?

“Bullet-Time” was first used in the live-action movies from *The Matrix Trilogy* and in advertisements from The Gap in the late 1990s. The technique has been used in many other movies and advertisements since then.

SOUND AND STAGE

Do they normally put voices over already existing animation or vice versa? Why?

It is easier to record the voices before the animation. However, when this is not possible, they create the characters first and then the voice artists must be able to match their voices to the characters’ mouth shapes.

Do some voice artists act out multiple characters?

Yes. In fact, Candi Milo, who is featured in *Careers in Animation*, has created the voice for over 200 characters.

Where does the word “Foley” come from?

Foley artists are named after Jack Foley. Foley established sound effect techniques in the 1930s that are still used today.

How many people are needed to create the sound effects for a cartoon?

It depends on the cartoon and the amount of sound effects required. For very active cartoons, there could be as many as 10 people creating the sound effects.

CARTOON MUSEUM

How long ago did these older cartoons go out of circulation?

They are still in circulation. They went off the air at various times.

Are Hanna-Barbera cartoons still aired?

Yes, these cartoons can be seen on the Boomerang Network, a Cartoon Network spin-off cable channel.



CAREERS IN ANIMATION

Besides animators and special-effects personnel, are there directors and producers involved in animation?

Yes, there are directors and producers involved in most films, although their roles are slightly different in animated films than in live-action films.

OTHER

Are all the cartoons affiliated with Cartoon Network?

Yes, Hanna-Barbera Studios became Cartoon Network Studios in the mid-1990s. Cartoons made by Hanna-Barbera or Cartoon Network are owned by Turner Broadcasting.

Does Cartoon Network have any anim ?

Yes, Cartoon Network airs many anim  shows. Past shows have included Pokemon, Yu-Gi-Oh, Megas XLR, Yu Yu Hakusho, Gundam Seed and Roroumi Kenshin.

Why is anim  not mentioned in the exhibit?

The exhibit focuses on American animation only. Many countries and areas of the world have fine traditions of animation, including Japan, Great Britain, Eastern Europe and Canada, but we felt the exhibit could not touch on all of these, so we decided to focus on American animation.



Build Your Own Zoetrope

Students learn about the history of animation and the science of apparent motion by creating an animation toy.

Science Topics

Animation
Apparent Motion
History
Processes

Process Skills

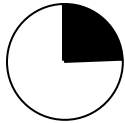
Drawing
Construction
Measuring
Following Instructions
Designing

Grade Level

3-12

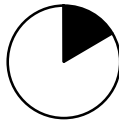
Time Required

Advance Preparation



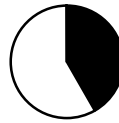
15 minutes

Set-Up



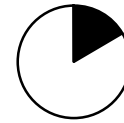
10 minutes

Activity



25 minutes

Clean-Up



10 minutes

Supplies

- Compact disc (any old CD) (1 per student)
(Optional alternative: cottage cheese container lids with center holes precut by the teacher)
- Zoetrope Template Master A (1 per student)
- Scissors (several per group)
- Tape (one per group)
- Pens and pencils (several per group)
- Highlighter markers (1 per student)

Advance Preparation

- ❑ Copy the Zoetrope Template (Master A), one per student.
- ❑ Gather one compact disc for each student.
- ❑ Gather **for each group of students:**
 - Highlighter markers
 - Pencils and pens
 - Scissors
 - Tape
- ❑ Before doing the activity with the class, practice the activity procedure below.

Set-Up

- ❑ Have all materials gathered and organized for the students.
- ❑ Make a copy of the Zoetrope Template (Master A) for each student.

Introducing the Activity

Let students speculate before offering answers to any questions. The answers at the right are provided primarily for the teacher's benefit.

Ask the students the following questions in **bold**. Possible student answers are shown in *italics*.

What are some of your favorite animated movies and TV shows?

Any animated Disney movies, Charlie Brown, Cartoon Network shows, Tom and Jerry, Scooby Doo, Shrek, A Bug's Life, Robots, Finding Nemo, or many other possible answers.

TV and film animations are made from a series of many pictures, each a little different from the previous one. If the pictures are shown fast enough, the brain connects the movement together and we see an animated picture, or moving image.

Before the invention of movies and TV, people could make animations with simple toys. Today in class, students are going to create a simple version of a zoetrope, an early animation toy from the 19th century. Zoetropes were popular toys for animating short clips of drawings or pictures, making the pictures "come to life."

Classroom Activity

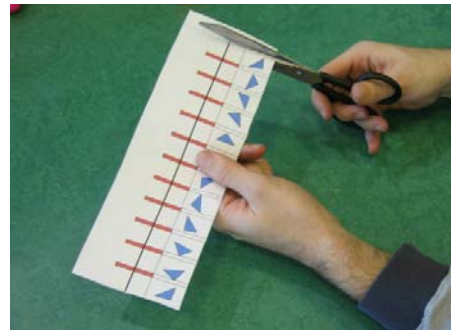
Students should work individually, sharing resources and sharing their zoetrope animations with each other.

Procedure for “Build Your Own Zoetrope”

Procedures for this activity were adapted from “howtoons.com” zoetrope activity. The complete activity can be found at:
<http://www.instructables.com/ex/i/C8F619927C861028A786001143E7E506/>

1 Distribute one Zoetrope Template (Master A) to each student.

- Have students cut out the two zoetrope strips along the dashed lines.



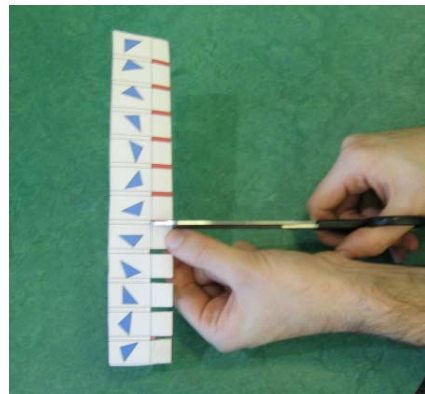
2 Fold the strip with triangles in half lengthwise.

- Crease along the thick black line, with all graphics to the outside and the blank side facing in.



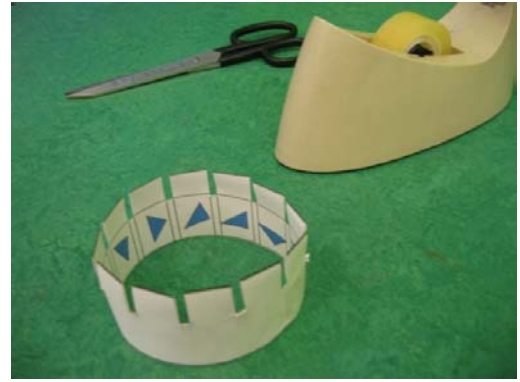
3 Cut out the red rectangles.

- Cut out each of the red rectangles.

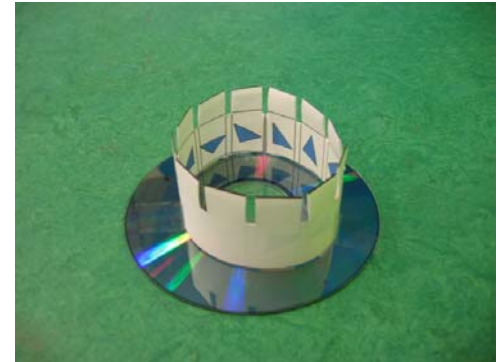


4 Tape the ends of the zoetrope strip together to make a circle.

- Have triangles facing inward, inside the circle.

**5 Tape the strip circle onto the CD.**

- Use three or four pieces of tape to attach the circle onto the CD, centered over the hole in the CD.

**6 Attach to the marker and spin the CD.**

- Take off the highlighter cap and stick the CD over the pen end. Replace the cap on the highlighter.
- Hold the zoetrope up to your eye-level and spin the CD with your fingers.
- Look through the slits of the zoetrope to the graphic on the other side of the circle.
- Adjust the speed at which the CD spins to find the best animation effect.

**7 Have students create their own graphics for a zoetrope.**

- Students can use the blank zoetrope strip to create their own animation sequence.
- Students should draw one graphic per square, simulating some motion of the graphic.
- Emphasize the concept of making small changes from one frame to the next. If the motion is too large, the animation will appear disjointed.
- Repeat steps 2 through 6 for the new zoetrope strip.

Class Discussion

Ask for student observations. There is no correct answer. Let students guide the discussion and present their hypotheses before discussing explanations.

How did changes in the spinning speed affect the animation?

Depending on the image being animated, the rate will vary somewhat. It all depends on how joined, or smooth, the animation appears, which depends on the amount of movement the character makes from one frame to the next.

Most modern movie projectors and animation clips show 24 frames per second. For the 12-frame zoetrope template, that would be 2 rotations per second.

What kinds of images work best in a zoetrope? What kinds of images would not work as well?

Tumbling triangles, walking people, horses, dogs, flying birds, or bouncing balls.

Images of a looped motion (the end frame can be connected back to the beginning frame) work best. The tumbling triangle was designed so the last triangle in the strip would be a small movement away from the orientation of the first triangle.

Explanation

George Horner invented the zoetrope in 1834. It was originally called a “daedalum” or “daedatelum,” which meant “wheel of the devil.” It became a popular animation toy around the 1860s.

The zoetrope is a cylinder that sits horizontally, with vertical slits along the top of the cylinder. As the user looks through the vertical slits, he or she briefly sees one of a series of pictures on the inside of the cylinder. The space in-between the slits acts as a shutter, separating the images. As the zoetrope spins, the user sees the series of images one after another, just like a modern movie camera shows films, one frame at a time. Small changes in the image, one frame to the next, are interpreted by the brain as movement.

The brain processes information about motion in a different fashion than other visual information, such as color, shape or depth. Certain areas in the visual cortex, a region of the brain, are responsible for processing information about motion. Cells in this region are responsible for processing different kinds of motion. For instance, certain groups of cells are active when watching an object move from right to left in front of our eyes. Scientists have discovered that the same cells are active when a person is watching a real motion, e.g., a person walking from left to right in front of them, or when a person is watching an illusory motion, e.g., a film of a person walking from left to right. This has led scientists to believe that the brain cannot distinguish between real motion and illusory motion. This is called the theory of apparent motion.

The zoetrope uses the theory of apparent motion to animate a series of images. The images flicker before the user's eye, and the brain connects the images, giving the illusion of fluid motion.

Optional Extensions

More complicated version of a zoetrope

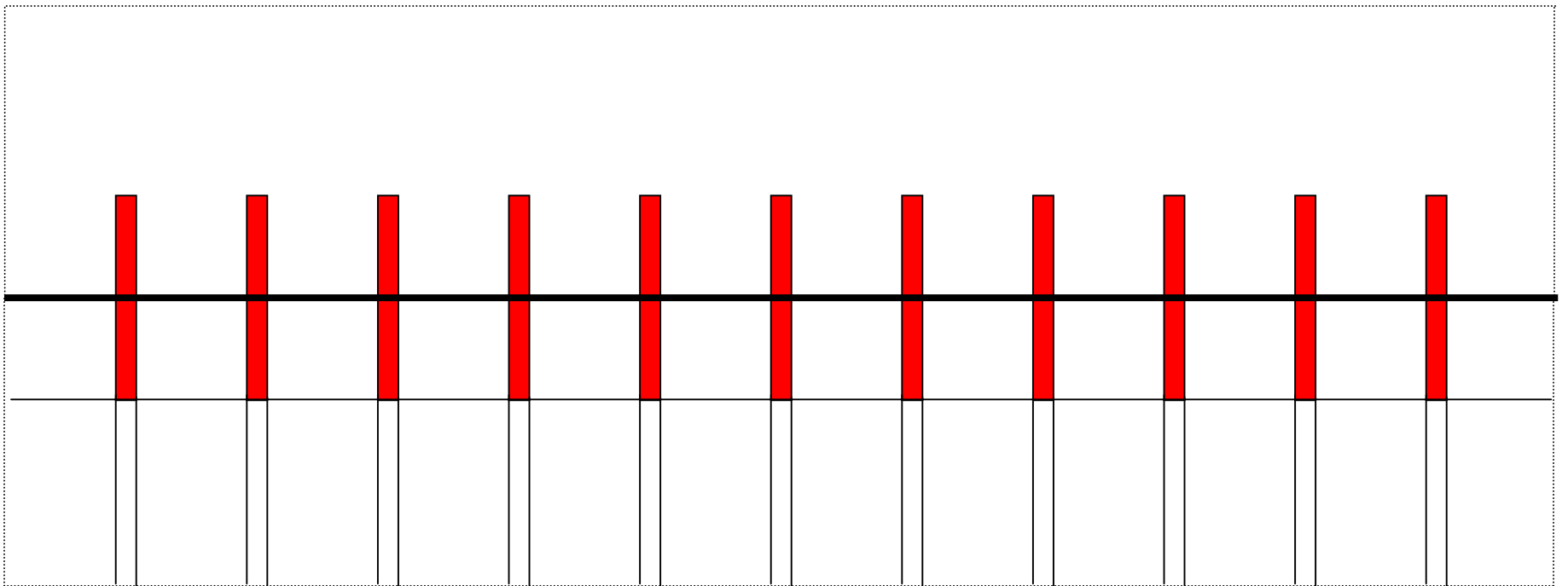
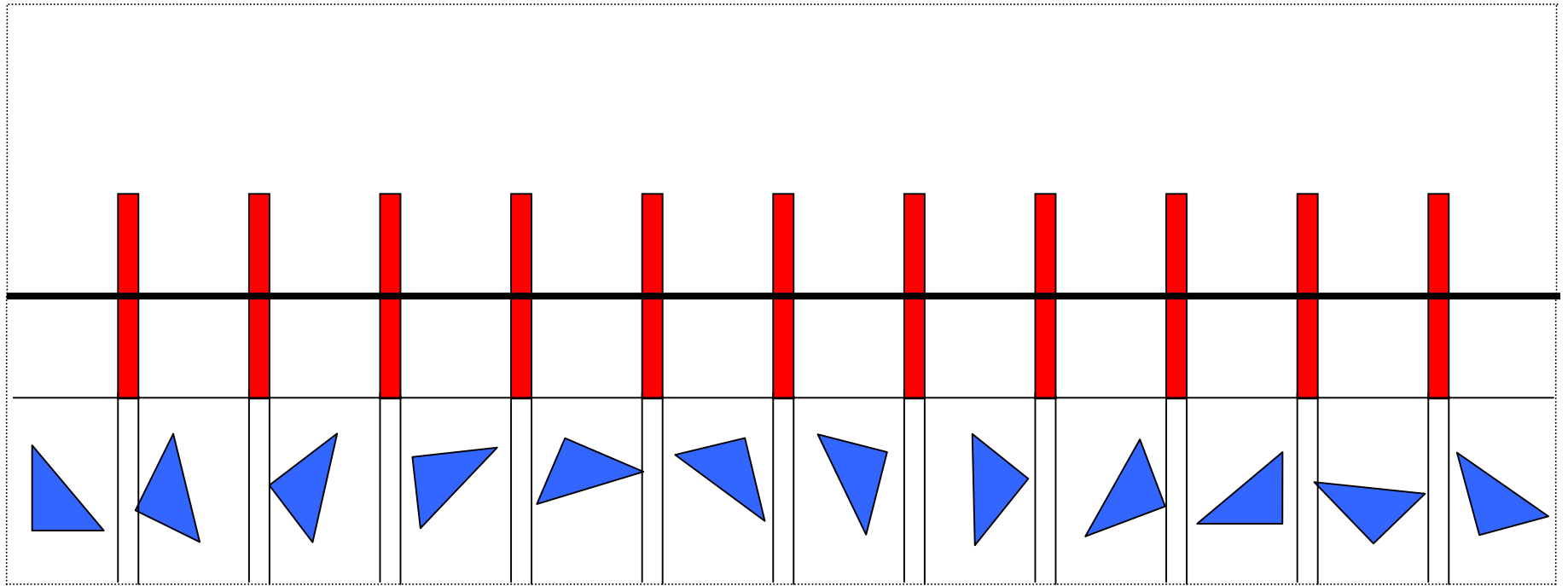
Have students go to the following website:

<http://www.groeg.de/puzzles/zoetrope.html>

This site, created by Georg Eggers, has directions and a template to build an entire zoetrope.

Cross-Curricular Connections

LANGUAGE ARTS/SOCIAL STUDIES	Read the class a story by Mark Twain, who lived around the time the zoetrope was invented. Talk about what people did for entertainment before the invention of movies.
MATH	Look at the ratios that emerge with 24 frames/second. If there are 24 frames per second, then 12 frames are $\frac{1}{2}$ second, 8 frames are $\frac{1}{3}$ second, etc. You can extend this by looking at how many pictures are needed for one minute or one hour of animation.
MUSIC	Listen to music from the 1830s.





Plan of Action

Students make a storyboard and act it out.

Science Topics

Planning

Process Skills

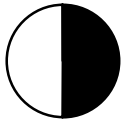
Comparing/contrasting
Investigating
Observing

Grade Level

3-12

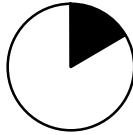
Time Required

Advance Preparation



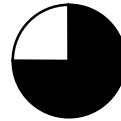
30 minutes

Set-Up



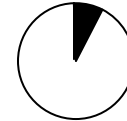
10 minutes

Activity



45 minutes

Clean-Up



5 minutes

Supplies

- Post-it notes (or blank notecards and pushpins), 10 per student
- Black markers, 1 per student
- Sheets of cardboard (or bulletin boards), 1 per group
- Easels, 1 per group

Advance Preparation

- Gather supplies.
- Make an example storyboard or enlarge a comic strip for an example.

Set-Up

- Set out the supplies.
- Put the bulletin boards on easels to display the storyboards.

Introducing the Activity

Ask students if they have a favorite animated cartoon. Explain that when animations are made, animators make a script with pictures called a storyboard. Just like a play has a script, a storyboard is the plan for animators to follow when doing all the work of creating the final story for the animation.

After a rough draft storyboard has been created, animators **pitch** the story to the director. Everyone gathers around the board and the animators act out the story, with silly voices and simple sound effects.

Classroom Activity

Students work in groups of 4 or 5

Making the storyboard

- Have students choose a legend or fairy tale they are familiar with, such as *Paul Bunyan* or the *Three Bears*. The students will use the characters from the legend or fairy tale they choose to create a storyboard that tells a new story. For example, the *Three Little Pigs* could go to the grocery store to buy milk.
- Have each group of students work together to create a new story and draw what the main characters will look like.
- Once the story is developed, students should decide what parts of the story are most important. Have each student draw at least three key moments in the new story.
- Once all the drawings are completed, each group should put their images in order on their bulletin board.
- Each group should discuss their story and make any necessary changes to the story. For example, some scenes may change order, some scenes might need to go away, and new scenes may need to be added.
- Once their storyboard is finished, each group should choose group members to voice each of the characters when presenting to the class.

Pitching the story

Each group shares their storyboard with the class:

- Set up a bulletin board where the whole class can see it.
- Students act out the story, making silly voices and sound effects.

Class Discussion

The storyboard is one of the first steps in creating animations. Once the basic story outline is written, animators sketch the key moments

of the story onto cards, then put the cards on a board in a sequence that resembles a comic strip. The animators act out the story for each other, making sounds and voices for all the characters. They then share ideas for how to make the story better, change the storyboard, and pitch the story again.

After the script is finalized, actors record the voices for all the characters. The **key frames** are illustrated next. All the pictures in between the key frames are then made by people called **in-betweeners**. All the pictures are filmed at a rate of 24 pictures per second, adding up to 14,400 pictures an hour!

Music and sound effects are recorded, the animation is edited together, and the animation is complete!

A storyboard about storyboarding is located at:
<http://pblmm.k12.ca.us/TechHelp/Storyboarding.html>

Optional Extensions

Film Scores

Most movies and TV shows use music to tell us how to feel about what we are watching. The Darth Vader theme that plays when he appears tells us he is a bad guy. We would feel differently if he entered the spaceship to the sound of "The Entry of the Gladiators." Play different pieces of music and have students describe how the music makes them feel.

Some examples of standard emotional music:

- "O Fortuna" from *Carmina Burana* by Orff, and "In the Hall of the Mountain King" from *Peer Gynt* by Grieg feel suspenseful.
- "Morning" from *Peer Gynt* by Grieg feels light and happy.
- "Entry of the Gladiators" by Julius Fucik, the "Hallelujah Chorus" from *Messiah* by Handel, and *Sabre Dance* by Khachaturian feel excited.

Show the students a clip from a popular movie with famous music, play the video again with the sound off, and then play it again with different music on a CD player.

Sound Effects

Have students make sound effects with various household objects. Use tinfoil or wax paper to make a crackling fire, coconuts to make horse hoof sounds, etc.

Cross-Curricular Connections

Read a play as a class.

Look at similarities between comic books and movies. The opening credits of *Spider-man 2* show a storyboard of the movie *Spider-man*.

Seeing Spots- The Illusion of Color

Students observe cartoons through a magnifying lens to discover that the illusion of many colors is made from tiny dots of only four colors.

Science Topics

Light and color
Color theory
Perception
Technology

Process Skills

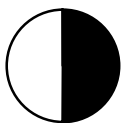
Classifying
Collecting data
Comparing/
Contrasting
Hypothesizing
Investigating
Observing

Grade Level

K-4

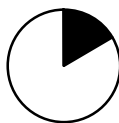
Time Required

Advance Preparation



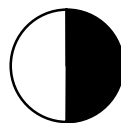
30 minutes

Set-Up



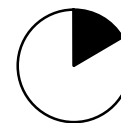
10 minutes

Activity



30 minutes

Clean-Up



10 minutes

Supplies

- 1 or 2 large coffee filters
- Several plastic eyedroppers (or straws)
- Watercolors -suggested colors are magenta, yellow and cyan (magenta is a bright pink and cyan is a light blue)
- Water
- Jar or cup for water
- Small containers for paint, e.g., lids or yogurt cups, 3 – 5 for the teacher plus 3 for each table group. Note: If you use Bingo paint daubers, you will not need paint containers for the groups.

- ❑ Marker
- ❑ Masking tape
- ❑ Hand magnifying glasses (at least 8x magnification) – 1 per student
- ❑ Cutout color newspaper cartoons (or color magazine photos) for each student
- ❑ Cotton swabs with tempera paint (suggested colors are magenta, yellow and cyan) or Bingo paint daubers with tempera paints – enough for each group of 3-4 students to have one set
- ❑ Optional: TV or computer screen
- ❑ Optional: microscopes of 10x power or more

Advance Preparation

- ❑ Week before activity: Ask students to find a color cartoon from a newspaper, cut it out, and bring it to class.
- ❑ Gather the following materials:
 - Set of 3 colors of Bingo paint daubers or cotton swabs and 3 colors of tempera paints in small containers **for each group of students**
 - Hand magnifying lens (can be shared if there are not enough for each student)
 - Large piece of white construction paper **for each student**
 - Markers (one for each group)
 - Masking tape

Set-Up

- ❑ Set out the following for color mixing demonstration:
 - Watercolor paints
 - 3 – 5 paint containers (portion cups, jar lids, etc.)
 - 3 – 5 eyedroppers or straws
 - Water in a jar or cup
 - Paint brush
 - Coffee filter
 - Marker
 - Masking tape

Introducing the Activity

Explain to students they are going to talk about colors and how animators use colors when they make a cartoon. Ask the students the following questions in **bold**. Possible student answers are in *italics*. After the discussion, begin the color-mixing demonstration below.

What are some names of different colors?
What colors do you see in cartoons or TV shows?

Let students speculate before offering answers to any questions. The answers at the right are provided primarily for the teacher's benefit.

What types of colors do you use when you draw?

Students will name many different colors.

What happens when you mix colors?

You get new colors, the colors change, the colors get darker, etc.

Are there different ways to mix colors?

This question may be hard for students. Encourage the class to think of different times that you would mix colors, such as while using crayons or paints, with different colored lights, or dyeing your hair different colors.

Color Mixing Demonstration:

Gather students where they can watch your demonstration. This activity is an exciting way to remind students of how colors mix to form new colors. Magenta, cyan and yellow are suggested because these are the colors used by most printers (including the ones that print the Sunday comic strips).

1. Explain that scientists always label their work so they don't mix things up or forget what they are doing.
2. Using a marker and masking tape, model the labeling process for your students. Label three small containers as follows: M for magenta, C for cyan, and Y for yellow (alternatively label them R, B and Y for red, blue and yellow).
3. Put a few drops of water in each of three small containers.
4. Using a paintbrush, mix magenta watercolor paint into the water in the container labeled "M" (substitute red if magenta is not available). Continue until the water is dark magenta.
5. Repeat step 4 for yellow and then for cyan (or blue).
6. Using eyedroppers or straws, put small dabs of watercolor on the coffee filter. Watch the colors mix as the different paint splotches expand and bleed into each other. Ask the students to predict which new colors will form.
7. As a class, make a color-mixing chart (see below for an example). Encourage students to be descriptive. For example, depending on the type of paints and how much was used, mixing magenta and yellow might create a "light orange," "sunset red" or a "pinkish yellow." Include room for student observations. Did it make a difference how much of each color was used? What happened when three or four colors were mixed together?

Sample Color Chart:

	Magenta	Cyan	Yellow
Magenta	<i>Really bright magenta</i>	<i>Reddish purple</i>	<i>Pinkish orange</i>
Cyan		<i>Dark cyan</i>	<i>Ocean green</i>
Yellow			<i>Bright yellow</i>

Let students know that we do not always have to mix colors to create new colors because the brain can do this for us. Printers use dots to create colors in magazines, books and newspapers. We can see these dots by looking at printed pictures with a magnifying glass or a microscope. A TV also uses tiny dots of three different colors to make all the colors that we see on the screen.

Classroom Activity

Part 1

Using magnifying glasses to look at comic strips, students can discover how color printers work.

1. Review with the class how to use their magnifying glasses.
2. Ask students to use their magnifying glasses to study their comic strips. What do they notice? Are the pictures made up of solid colors or are they composed of tiny dots? What colors are the dots?
3. Optional: While some students are examining their comic strips, other students may use their magnifying glasses to look at a TV or computer screen. If the teacher has a microscope, students can also look at their comic strips under higher magnification. **NOTE: Despite a commonly held belief, it is not dangerous to look at a TV or computer screen up close for short periods of time.**

Part 2

Students create pictures by using dots of color, just like a printer or TV.

1. Give each student a piece of white construction paper.
2. For each group, pass out a set of Bingo paint daubers or a set of cotton swabs and three containers of tempera paint (3 colors).
3. Ask students to create a picture using dots of colors. Encourage them to keep the dots separate. Can they make new colors by putting dots of different colors next to each other?
4. After the students have finished their pictures, post them on the wall. Do their pictures look different when viewed from far away?

Class Discussion

Ask for student observations. There is no correct answer. Let students guide the discussion and present their hypotheses before discussing explanations.

Part 1

Ask students what they have discovered about their comic strips.

What were some of the colors you saw in your comic strips without using the magnifying glasses?

The students will name many colors. Almost any color can be shown in a comic strip, even when the printer only uses dots of three different colors.

What did you find out about the comic strips by using the magnifying glasses? Were your comic strips made of solid colors or tiny dots?

Comic strips are printed using tiny dots of only three colors (magenta, cyan and yellow) as well as black dots.

Were any of the tiny dots the same as the colors you saw without the magnifying glasses?

Answers will vary.

Part 2

Is using dots of color different than using a paintbrush? Why?

Students may say that it was easier or harder, that they could create different textures, designs, types of pictures, etc.

What colors did you use? Did you make any new colors by combining different colored dots? What new colors did you make?

Students may name many colors. If students say they could not make any new colors, suggest they look at their pictures from far away.

Did the dots appear to blend together when you looked at your picture up close? How about when you looked at it from far away?

Although the paint dauber (or cotton swab) dots are large, students may notice they blend together only when they look at the picture from far away.

Why do you think printers and TVs use dots of only a few colors?

It would be very expensive to make a printer with many different colors of ink or to make a TV screen that could produce many colors of light. Using dots of only a few colors (and letting our brains do all the work of mixing the colors) is one way to save money.

Explanation

Printers use many dots to make color pictures. It would be very expensive to have a different color of ink for every color you wanted to print. To save money, printers use small dots of only a few colors. Most printers use magenta, yellow, cyan and black because these four colors can be combined to produce most other colors.

Our brain actually combines the small dots of colors into a single new color. There are four different kinds of cells in the retina of the eye that are sensitive to different colors. Rods are one kind of cell that is very sensitive to dim light. Cones are color-sensing cells because there are three kinds of cells, each sensitive to different colors. One kind of cone is especially sensitive to blue light, one to red light, and one is most sensitive to a greenish-yellow. Each of these cells sends information into the brain, which combines it into our experience of color.

When we watch a cartoon on television, we see thousands of different colors. Our TV screen, however, is made up of tiny dots of only three different colors — red, green and blue. Our brain combines these dots of color to make the many different colors we see. For more on how the eye works, visit:

<http://www.howstuffworks.com/eye.htm>

How does a TV screen work?

Most of the TV screens we have in our homes work because of an invention called the cathode ray tube, or CRT. A CRT contains a heated filament, similar to the filament used in most normal light bulbs, which is used to “shoot” electrons at the back of the TV screen. The back of the screen is coated with tiny dots of chemicals called phosphors, which glow when they are struck by the electrons. The stream of electrons moves across the screen, lighting up the dots in different colors. This process is repeated 30 times per second as each new picture from a movie or television show is “drawn” on the screen.

Three different types of phosphors are used. These phosphors produce red, green or blue light. When you look at a television screen, you are actually just looking at thousands of tiny blue, green and red dots. Our brain combines these dots to make all the different colors we see. For example, when we see something yellow on TV, such as a banana, we are really seeing a bunch of red and green dots that our brain combines to make yellow (if this seems confusing, remember that the red, green and blue dots are made up of colored *light*, which mixes differently than paints or dyes).

For more information about how TV works, visit:

<http://www.howstuffworks.com/tv.htm>

Optional Extensions

- Mixing different colors of light is different than mixing different colors of paint or ink. Students can study how light mixes by using several flashlights, each with a different color of plastic covering the front end. The basic colors of light used in a TV screen are blue, green and red. These colors can be mixed to form most other colors.

- On its website, the Oregon Museum of Science and Industry (OMSI) has an activity that explores color mixing, and the difference between mixing ink colors and mixing light colors at:
www.omsi.edu/visit/tech/colormix.cfm

Cross-Curricular Connections

ART	Study the use of color and dots of color in art, e.g. pointillism.
MATH	Make a chart of how colors mix and look for patterns.
BIOLOGY	Learn about how the human eye perceives color and draw a model of the human eye.

Fooling the Brain - The Illusion of Motion

This activity introduces one of the important optical illusions that make animation possible.

Science Topics

The brain
The eye
Perception
Motion
Technology

Process Skills

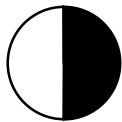
Following instructions
Observing
Analyzing

Grade Level

5-8

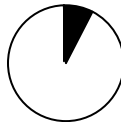
Time Required

Advance Preparation



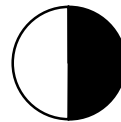
30 minutes

Set-Up



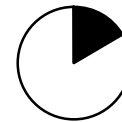
5 minutes

Activity



30 minutes

Clean-Up



10 minutes

Supplies

- Spiral disk template – 1 per student
- Compact discs (CDs) – 1 per student
- One knife or scissors
- Highlighter markers – 1 per student
- Tape – 1 roll per group
- Brightly colored ball or other noticeable object – 1 for pre-activity

Advance Preparation

- Make copies of the spiral disk template (Master A) on cardstock.
- Make a hole in the center of each spiral disk the size of the hole in the CD. It should be large enough to fit the tip of the marker through, but small enough so the whole marker does not fit. The disk will spin on the marker.

Introducing the Activity

An optical illusion is anything that tricks our eye and brain into seeing something other than what's there. TV and film animations are made from a series of many pictures, each picture a little different from the previous one. If the pictures are shown fast enough, the brain connects the movement together and we see an animated picture, or moving image. Explain to students that they are going to be studying how animation is created and why it works. Suggest to students that when we watch an animation, we are actually seeing an optical illusion. Then ask students the following questions in **bold**. Possible student answers are shown in *italics*.

Let students speculate before offering answers to any questions. The answers at the right are provided primarily for the teacher's benefit.

What types of animations have you seen before? What are your favorite cartoons?

Students will give examples.

What is an optical illusion? Are cartoons an optical illusion?

An optical illusion is something that tricks your brain or eye. Students may give examples of optical illusions. Students can discuss their initial ideas about why cartoons are or are not optical illusions.

Explain the following, or if students have demonstrated good background knowledge, summarize "what we know" with the following:

Animators draw pictures to create animation. Animators draw many pictures, each one slightly different than the one before. Animators use computers, puppets or clay characters to create different types of animation. Animators take pictures and put them on film to create animation. Scientists are just beginning to understand why our brains are tricked by optical illusions and why the illusion of motion in animation works. Scientists can use optical illusion to study how the brain and eye work.

In the activity we will experiment with an optical illusion to find out something about how the brain works.

Background information about the brain:

1. Scientists generally have background knowledge before conducting an experiment. Scientists apply “what they know” to their observations in the real world. Ask students, “What do you know about the brain?”
2. Summarize what we know:
 - The eye is a sensor that picks up light bouncing off objects around us.
 - The brain “decodes” information picked up by the eye so we can perceive our world.
 - Some parts of the brain look at color, some look at shape, some at depth, some at motion, etc.

Demonstration:

Divide the class into two groups. Each group represents a specific part of the brain:

- Brain Group #1 can only “see” objects moving up.
- Brain Group #2 can only “see” objects moving down.

Explain that these jobs are similar to the jobs performed by different sections of the brain. Students now represent specific nerve cells in the brain designed to detect either upward or downward motion information coming from the eye.

Use a brightly colored ball or other noticeable object. Explain that when the class sees the object move up, Brain Group #1 should shout “up” continuously until it stops moving up. When the class sees the object move down, the Brain Group #2 should shout “down” continuously until the object stops moving down. Move the object up and down and have the class practice. This is a simple version of how the brain sees motion!

The part of the brain that detects motion is active even when there is no motion, but the brain signals are “loudest” when motion is present. To demonstrate this, have Brain Group #1 whisper “up” whenever the object is not moving up, but shout “up” when the object is moving upward. For example, when Brain Group #1 sees the object moving up, they shout “up, up, up” continuously. When the object is not moving or is moving in a direction other than up, the group should whisper “up, up, up”. Group #2 does the same, but with the word “down” in response to downward movement. Move the object up and down and have the class practice.

This is a more realistic version of how the brain sees motion. The brain can tell the difference between the “shout” and the “whisper” and can figure out which direction an object is moving. Notice that when an object is standing still, both groups are still whispering. The double whispering is interpreted by the brain as meaning an object is standing still.

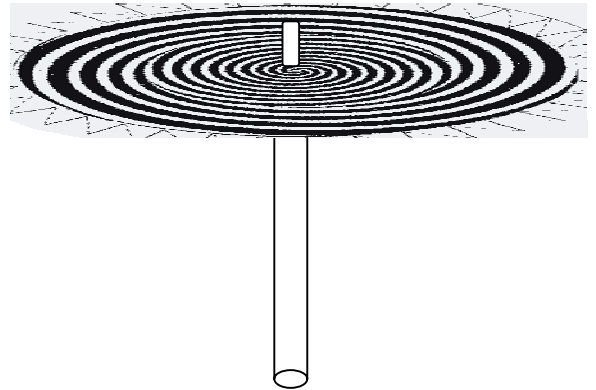
Classroom Activity

Work in groups of two

Some optical illusions trick our brains into seeing motion when nothing is actually moving. These illusions are useful because they can help scientists understand how we perceive motion. We will use the “waterfall illusion” to test how the brain sees motion.

1. Building the waterfall illusion:

- Cut out the spiral disk template.
- Use tape to attach the CD to the back of the spiral illusion disk. Make sure the CD is in the center of the spiral illusion.
- Take the cap off the highlighter.
- Put the disk on the highlighter so it can spin freely.



Waterfall Illusion

2. Using the Spiral Illusion

- Each student takes turns spinning the waterfall illusion and staring at the spiral.
- One student spins the disk with one hand while holding onto the pen with the other hand.
- Students should try to spin the spiral at a constant rate.
- The other student stares at the center of the spiral while trying not to blink or look away.
- After 30 seconds of staring at the spiral, the students should turn and look at something stationary nearby, such as a picture on their desk or their hand held up in front of them. What do the students see?
- Have the partners in each group switch roles and repeat the steps above.

Class Discussion

Review with the students the model of the brain that you introduced at the beginning of the lesson. Do they remember how the brain processed motion? Next, ask the students to talk about their observations and findings during the experiment.

Ask for student observations. There is no correct answer. Let students guide the discussion and present their hypotheses before discussing explanations.

What did you observe while staring at the spiral?

Different people will see different things when watching the spiral. Some students may see strange line patterns of color patterns. Others may only see the black and white spiral.

What happened after you stared at the disk?

For most people, after staring at the spiral objects will appear to move in the opposite direction that the spiral was moving. If the spiral appeared to be twisting outward, objects will momentarily twist inward and vice versa.

What variables affected how you saw the optical illusion, e.g., direction, speed or time?

Direction and speed can change the direction and the magnitude of the optical illusion. Time can also change the persistence of the illusion.

Does this optical illusion make sense with our model of how the brain sees motion? Can you make a hypothesis for why this optical illusion works (see post-activity below)?

Have students discuss possible explanations of their own before offering the post-activity explanation.

Optional post-activity:

Let students discuss whether their experimental findings fit the model of the brain presented earlier. Then explain that some scientists have an idea of why this illusion may work. To demonstrate this idea, lead the class through the following activity:

1. Remind class of the pre-activity and practice a few times.
2. Tell the class that the brain listens to the motion-sensitive brain cells to determine what direction objects are moving. When, for example, the left group "shouts" and the right group "whispers," the brain knows that the object is moving left. When both groups are whispering, the brain cancels both signals out and decides that the object is standing still.
3. Ask the students what they think would happen if some of the brain cells were "quiet." Would the brain be confused?
4. Explain that the class, acting as the brain, has just been staring at the waterfall illusion and that the spiral has been spinning to the right. The effect of this is that one group, the "right" group, has become very tired and no longer "whispers" or "shouts" no matter what direction objects are moving. Now move the object to the left and right and have the class practice with these new directions. Only the "left" group should be making any noise. What happens when the object is standing still? Without the right group

whispering, the brain only hears the “whispers” of the left group and perceives that the object is moving to the left. This is the optical illusion! In the case of the spiral illusion, there are actually different cells that detect motion in a spiral direction. Try the same experiment, but with the “left” group silent this time.

Discuss how this optical illusion relates to the illusion of motion seen in a movie or in an animated cartoon (see below for explanation).

How do we see?

Seeing is a complex process in which our eyes are only the first step. Our eyes are sensors that detect light and create nerve signals. The nerve signal passes to the back of the brain to an area called the primary visual cortex, which begins to make sense of what our eyes have seen.

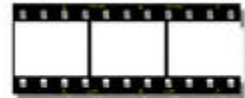


Different nerve areas specialize in recognizing lines and shapes, processing movement, discerning color, combining information from both eyes, etc. In this activity, it was the motion-sensitive nerve cells that were being activated. As the image is processed, more complex functions begin, such as recognizing objects and faces. All this activity goes on without any conscious effort!

Why Does Animation Work?

TV and film animations are made from a series of many pictures, each a little different from the previous one. If the pictures are shown fast enough, the brain connects the movement together and we see an animated picture, or moving image.

The images must be viewed fast enough for the illusion to work. Through the years, filmmakers and animators found that, at 24 frames per second or greater, the moving image appeared to flow smoothly with no interruptions. Modern motion pictures show 24 frames per second and TV shows 30 frames per second.



In 1833 French scientist Joseph Plateau came up with a theory called persistence of vision to explain why the human eye blends a series of rapidly moving images with regular interruptions into a single moving image. According to the theory, the eye retains images on the retina briefly after they are viewed, allowing for different images in a series to blend together into a single moving picture. This theory remained the prevalent explanation of the phenomenon for the rest of the 19th century.

At the beginning of the 20th century, however, scientists found that although the human eye does briefly retain images, this effect could not create motion. If the images were retained long enough for persistence of vision to work, we would actually end up seeing images stacked one on top of the other rather than a blended moving image. Scientists realized that animation works because of the brain rather than the eyes, and because of an illusion called apparent motion. The human brain is wired to see motion, sometimes even where no motion exists. When we watch a film of an object moving, the same cells that detect real motion are activated. In

other words, our brain cannot and does not distinguish between illusory motion and real motion. To the visual system, the movement in a motion picture is real motion!

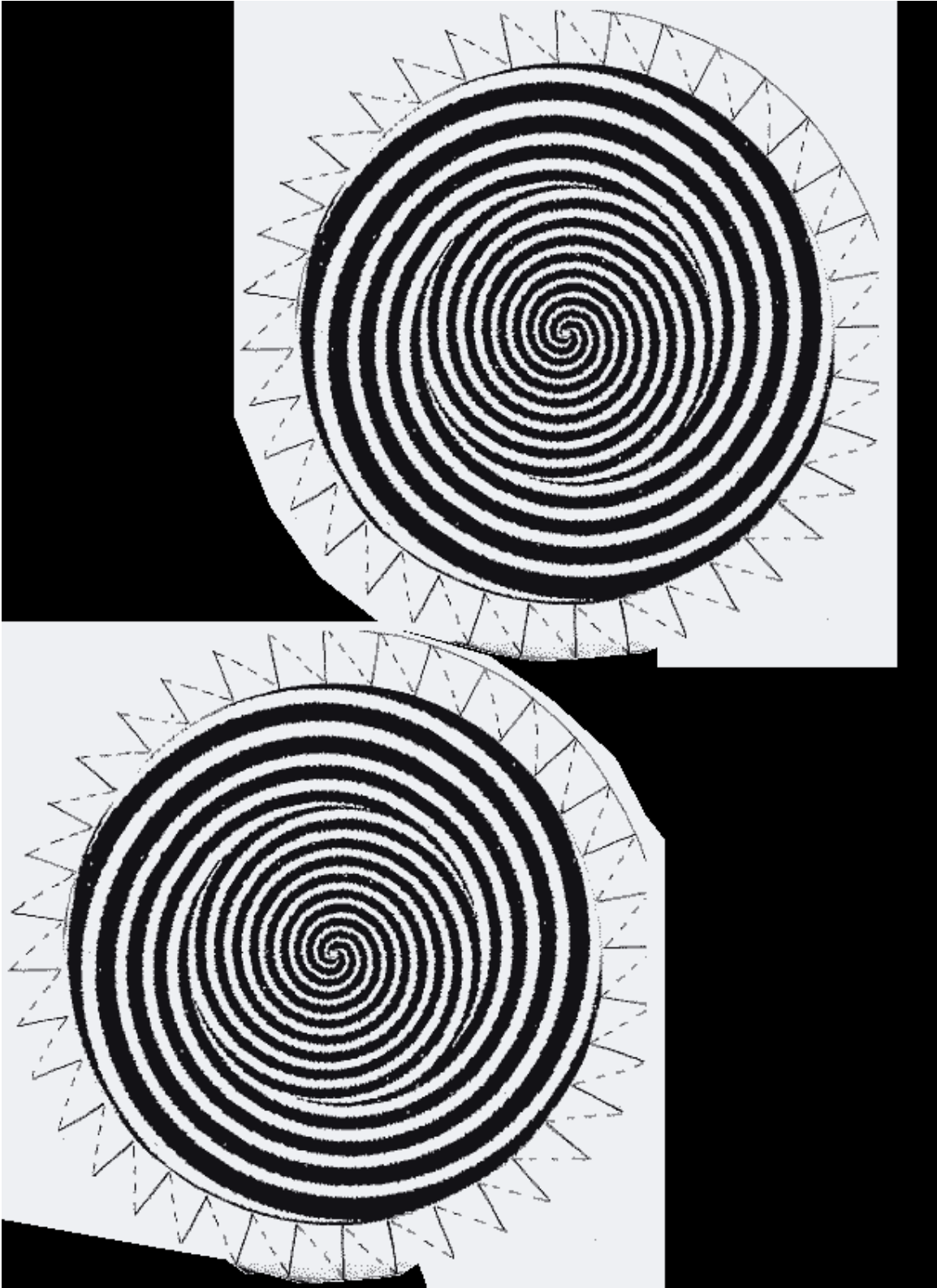
Optional Extensions

- Have students create an experiment to test a variable, e.g., disk spinning speed, distance from disk, etc. Make sure the group makes a hypothesis before they perform the experiment.
- Have students research other optical illusions and how illusions help us understand how our brain and eye perceive the world.

Cross-Curricular Connections

BIOLOGY

Have students research the biology of the eye. Look at the structure of the cornea, lens, and retina. Learn the difference between rods and cones. Use optical illusions to explore the blind spot where the optic nerve attaches to the retina.





Name: _____

My Animation Apprentice Team:

ANIMATION ACTIVE LEARNING LOG

As Animation Apprentices, you are to discover as much as you can about animation: how it developed, how different types of animation work, and what parts of the animation process interest you. At the end, you can decide what animation specialty you would enjoy.

HISTORY OF ANIMATION

Praxinoscope/Mutoscope

Which is the best explanation of how animation works? Define both terms and the best one. ★

Persistence of vision – *Your eye holds on to flashing images slightly longer than they are visible, and blends them into a moving image.*

★ Apparent Motion – *When a series of slightly different images flashes quickly in front of your eyes with a break in-between each image, your brain blends the still images together, creating the illusion of motion.*

ANIMATION STUDIO

Animation Process

Some people say, "No matter what method is used (drawing by hand, cel, stop-motion or computer), an animation team goes through the same basic steps to create an animation."

Do you agree or disagree? (Circle one.) I agree I disagree

What information supports your opinion?

[Students should support their opinions with information from the exhibit, whether or not they agree with the statement. See Answer Page for a list of steps in the animation process from the exhibit and further discussion.]

Scaling Up and Down

As you use a pantograph to draw an image on the screen, what do you notice about the size of the new image? (Hint: Use the stencil or another object to measure the height, width or a line of the image drawn.)

[The image on the screen is twice the height or width of the original.]

Why did animators use pantographs?

[Animators used pantographs to reduce, enlarge or copy images.]

Frames per Second

What's the lowest number of frames per second that lets the red square move smoothly?

24*

Now, what do you see when you decrease the frames per second to ½ of that number (or 12* frames per second)?

[Individual answers may vary]*

[The square looks bumpy as it moves and columns of red lights can be seen.]

What happens at an even slower rate? _____ frames per second

[Square seems to move left or right, one column of lights at a time.]

ART IN MOTION

Character Construction

Sketch *Mac* here:

Careers in Animation

Select one of five stations in exhibit...

Who: *[See Answer Page]*

Job:

Skills needed:

I chose this animator because

...

What shapes do you use to draw *Mac*?

[2 rounded squares, 3 circles, 2 triangles, 2 rectangles]

How would *you* use those shapes to make a character? Sketch it.

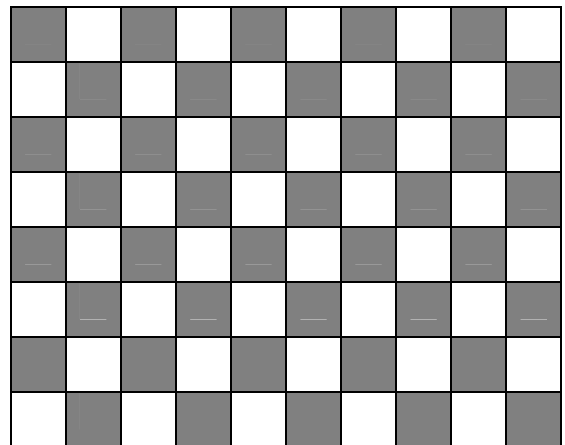
Planning the Action

What path of action would you create?

As an Animation Team, use the grid to design a path of action you and your team will do inside "*Foster's Home for Imaginary Friends*."

What will your group of "*Imaginary Friends*" do with your 14 frames? Label the sequence (order) of moves, make a code for the action (ex: standing, kneeling, jumping, waving, etc.) Be safe and have fun!

[Paths of action will vary.]



Why is planning a path of action important?

[Planning a path of action ahead of time helps the animator keep track of where the objects are and where they need to go, producing smoother, more realistic movement.]

Character Construction, Cel Animation, Stop-Motion, and Computer Animation

After discovering how all these animation methods work, create a stop-motion or computer animation.

Materials:

- camera objects: _____
 computer

Idea and Storyline:

(What is the idea of your animation? Who are the characters?)

Storyboard: *(What is the order of the action? Draw at least 3 key frames.)*

How would creating the same animation be different if you had used...

... hand-drawn pictures? *[every part of the animation is drawn by hand]*

... cels? *[painted backgrounds and figures can be reused to make different scenes, saving some time and effort]*

... stop-motion animation/computer animation?

[students should describe the method they did not use stop-motion – slight changes in the arrangement of 3-D objects are photographed

computer – backgrounds and figures are digital; in-between frames and effects can be done by the computer]

SCIENCE LABORATORY

Animation in Science

Animation is used in many fields of science. Which one surprised you the most?

How can animation be used in that field?

[See Answer Page]

SOUND AND STAGE

Foley Room

What are two objects you recognize? How are they used in the animation?

[See Answer Page]

☆ Which animation specialty would you choose? Why?

CARTOON MUSEUM

Who is your favorite character? Why?

Which characters do your teacher, chaperone or adult remember?



ANSWER PAGE

ANIMATION STUDIO

Animation Process – Steps of Animation

1. Discuss an Idea
2. Write Storylines and Scripts
3. Design Characters
4. Create a Storyboard – Illustrate/Order Important Scenes
5. Record Voices
6. Create Animatic (Moving Storyboard)
7. Create Key and In-Between Drawings – Show Extreme Action
8. Create a Test Animation – In Cel Animation, Photograph Cels
9. Create Backgrounds – In Cel Animation, Draw and Paint
10. Transfer Key and In-Between Scenes to Cels
11. Photograph Cels
12. Create Sound Effects (Foley Artist)
13. Add Music
14. Final Soundtrack – Combine Voice, Sound, Music

Note: All animators go through most of the steps listed, regardless of the method used. This question can be used for class discussion, allowing students to analyze information, form reasoned opinions and discuss alternate views.

Careers in Animation

Note: Items listed as "skills needed" are found in the "subjects to study" segments and throughout the profile.

Genndy Tartakovsky, Producer/Director

Skills: Drawing, Acting, Film, Art

Van Partible, Producer/Creator of Johnny Bravo

Skills: Writing, Timing, Animation, Psychology

Lauren Faust, Producer/Writer/Storyboard Artist

Skills: Art, Writing, Literature

Chris Staples, Technical Director

Skills: Computer, Animation, Production

Candi Milo, Voice Artist

Skills: Reading and Speaking in Front of People, Acting, Communication, Voice, Life, Making Own Characters

SCIENCE LABORATORY

Animation in Science

Field of Science

Genetics –

Space –

Paleontology –

Medicine –

Archeology –

Uses of Animation

Changes in speed or size – show how proteins are made from DNA

Plan future events – Mars Rover Launch

Visualize prehistoric creatures, their environment and behavior

Time lapse – show loss of gray matter

Visualize ancient cities – show how buildings were built

SOUND AND STAGE

The Foley Room

Object

Tarp

Metal can

Hard surface

Electric toothbrush

Plastic board

Hotel bell

Xylophone

Use in Animation

Scrunching paper

Paper hitting trash

Tapping finger

Buzzing fly

Thumping fist

Great idea

Dancing fly



Name: _____

My Animation Apprentice Team:

ANIMATION ACTIVE LEARNING LOG

As Animation Apprentices, you are to discover as much as you can about animation: how it developed, how different types of animation work, and what parts of the animation process interest you. At the end, you can decide what animation specialty you would enjoy.

HISTORY OF ANIMATION

Praxinoscope/Mutoscope

Which is the best explanation of how animation works? Define both terms and the best one. ★

Persistence of vision –

Apparent Motion –

ANIMATION STUDIO

Animation Process

Some people say, "No matter what method is used (drawing by hand, cel, stop-motion or computer), an animation team goes through the same basic steps to create an animation."

Do you agree or disagree? (Circle one.) I agree I disagree

What information supports your opinion?

Scaling Up and Down

As you use a pantograph to draw an image on the screen, what do you notice about the size of the new image? (Hint: Use the stencil or another object to measure the height, width or a line of the image drawn.)

Why did animators use pantographs?

Frames per Second

What's the lowest number of frames per second that lets the red square move smoothly?

Now, what do you see when you decrease the frames per second to 1/2 of that number (or _____ frames per second)?

What happens at an even *slower* rate? _____ frames per second

ART IN MOTION


Character Construction

Sketch *Mac* here:

Careers in Animation
Select one of five stations in exhibit...
Who:

Job:

Skills needed:

I chose this animator because
... 

What shapes do you use to draw *Mac*?

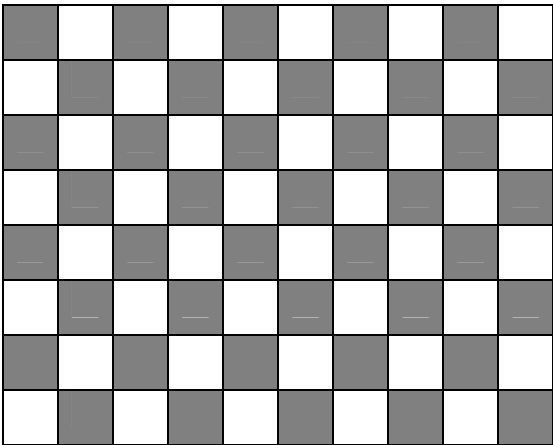
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... cels?

... stop-motion animation/computer animation?

SCIENCE LABORATORY**Animation in Science**

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SOUND AND STAGE**Foley Room**

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CARTOON MUSEUM

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Which characters do your teacher, chaperone or adult remember?

GLOSSARY

Animation

Animation can be defined as any set of technologies that creates the illusion of motion.

Atmosphere Sketch

A quick sketch used to create a specific mood for a scene. The sketch is often used in preparing the background for a scene.

Cel

A rectangular sheet of transparent acetate on which animation drawings are inked and painted.

Cel Animation

A type of animation that uses transparent plastic sheet with pictures. The sheets are layered on top of a background to create a full scene.

Frame

A frame is a static image. A series of frames filmed in sequence makes an animation.

In-Betweens

The intermediate drawings made to create a smooth flow of movement between key drawings.

Keyframe

A frame that represents a key point of change or action in an animation.

Mutoscope

A hand-cranked animation viewer invented in the late 19th century. A person turned a handle while looking in the viewer, while a light illuminated moving pictures flipping past the viewer.

Pantograph

A drawing instrument used to reduce or enlarge drawings.

Praxinoscope

An early animation device that used a strip of pictures placed around the inside of a spinning cylinder. The strip was reflected on an inner cylinder of mirrors, creating a moving image.

Replacement

A form of stop-motion animation in which a sculpture's parts are switched out to obtain different poses and movements.

Squash and Stretch

An effect in which a character or object is taken through a series of exaggerated poses, from flattened to elongated.

Stop-motion animation

An animation technique that uses physical objects instead of drawn pictures.

Storyboard

A series of sketches illustrating key points of action in a show or film.



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