

WALT DISNEY  
PICTURES PRESENTS



# FANTASIA

2000

THE TECHNOLOGY BEHIND THE FILM

## DEAR TEACHER:

The Walt Disney Company is pleased to provide you with this resource guide. Please take a few minutes and look over its contents. The teaching strategies contained in this guide will engage your students in active learning and discovery as they learn about the technologies that were involved in the making of *Fantasia/2000* and how those technologies evolved.

*Fantasia*, released in 1940, was a daring feat, combining some of the world's greatest music with stunning visual interpretations that set the standard by which all animated films have been judged ever after. *Fantasia/2000* continues this tradition by combining musical masterpieces and the vision of a new generation of animators with the technology of the new millennium. *Fantasia/2000*'s marriage of music and animation—both traditional and computer-generated—will awaken in your students an excitement and appreciation of the creative process and the scientific breakthroughs that have made this amazing film possible.

*Fantasia/2000* continues the innovative legacy of *Fantasia*. We know that you and your students will find the viewing of *Fantasia/2000* to be an unforgettable experience.

We encourage you to act now and arrange a class trip to your local theater so your students can enjoy and learn from the magic of *Fantasia/2000*. But, whether or not you are able to take advantage of a special group screening at your local theater, we hope you will use these free educational resource materials to enhance your curriculum and excite your students for many years to come.

Roberta Nusim  
Publisher  
Youth Media International

P.S. Please note that there are additional educational resource guides available for music and art classes. For more information on these resource guides and many more engaging classroom activities, check out the *Fantasia/2000* Web site at [www.fantasia2000.com](http://www.fantasia2000.com)

# ABOUT THIS TECHNOLOGY RESOURCE GUIDE

This Teacher's Guide for *Fantasia/2000* was prepared by professional educators like you and was designed to allow you and your students to enjoy an exciting educational experience tied directly to a major motion picture event. We hope that you will use these resource materials to enhance your curriculum. The inspiration for the eight segments of *Fantasia/2000* includes myth, legend, poetry and the tales of Hans Christian Andersen. The stories the segments tell are communicated through a wonderful blend of great music and a wide array of state-of-the-art animation technologies.



The activity ideas in this guide are designed to engage students in the upper elementary and middle school grades in exploring the question, "How did they make *Fantasia/2000*?" The guide is divided into three sections—**The Sound of *Fantasia/2000***, **The Art and Science of Animation**, and **The Visual Experience**. Each section looks at a different aspect of the technologies that made this remarkable motion picture possible. The activities suggested in each section are designed to engage your students in active learning experiences—experiences we hope will "inspire the innovator" in each of them.



The experiments, activities and projects in this guide have been rated according to their level of difficulty (see key below). Because the ratings are only suggestions, we recommend that you review the activities to be sure they are appropriate for your students. Please feel free to modify the activities to suit your students' needs.

**UE** = grades 4-6 **ML** = grades 7-9

### Selected Internet Resources

- <http://library.advanced.org/19537/Main.html>  
The Soundry—an interactive Web site about sound
- <http://www.gtek.co.il/distance>  
G.TEK Cyber School—an interactive lesson on the science of sound
- <http://disney.go.com/worldsofdisney/tarzan/statart.htm>  
A tutorial about the new animation techniques used to create Walt Disney's *Tarzan*
- <http://www.bergen.org/AAS/ComputerAnimation/>  
Includes information on the evolution of computer animation, the software used to create computer animation, and the different uses for computer animation
- <http://come.to/animate>  
The Animation Learner's Site—a guide to learning how to animate
- <http://tqd.advanced.org/3543>  
A resource guide for computer art and animation

## Section One

# THE SOUND OF FANTASIA/2000

## SOUND VOCABULARY

Cycles

Frequency

Orchestra

Pitch

Stereophonic sound

Vibration

### Part A: BACKGROUND/DEMONSTRATION

*Fantasia* made motion picture history in 1940 when it became the first film to be recorded and released in stereophonic sound. The process was called Fantasound, and the film traveled from city to city in special road show engagements.

Fantasound was the first significant commercial use of a truly multi-channel sound system. Each section of the **orchestra** was recorded separately, resulting in nine separate soundtracks. These were mixed into four master optical tracks that were played in synchronization. For the New York premier, 36 speakers were installed behind the screen. Fifty-four additional speakers were placed throughout the orchestra and balcony.

#### What Causes Sound

Sound is produced by **vibration**. The sound source causes vibrations, which in turn cause air molecules to move, setting up sound waves. When the waves reach the ear, the energy is transmitted to the brain where it is perceived as sound.

Here are some easy ways to allow your students to feel and see the vibrations of sound waves:

- Ask your students to put their fingers to their throats to feel the vibrations as they speak.
- Strike a tuning fork. Your students can hear the sound. Then, dip the fork in a glass of water. The vibrating fork sets up little waves in the water, just as it sets up waves of molecules in the air.

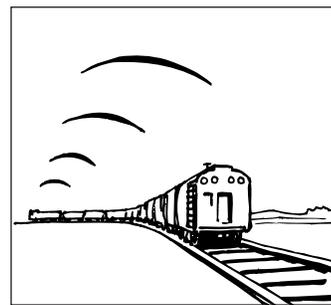
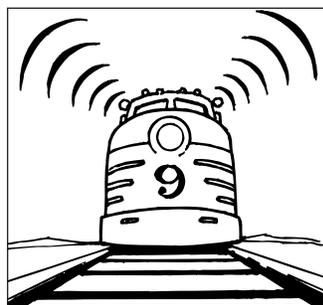
Sound waves travel at the same speed regardless of how loud or soft they are, although temperature affects the speed of sound. (Sound travels faster when the air is warm.) At room temperature (70° F), sound waves travel at a speed of 1,129 feet per second—about one-fifth of a mile. That means it takes five seconds for a sound wave to travel one mile. Light travels much faster than sound—about 186,000 miles per second. That's why, in a thunderstorm, even though the lightning and the thunder happen at the same time, you see the lightning before you hear the thunder. (To determine how many miles away the storm is, count the seconds between seeing the flash of lightning and hearing the sound of thunder, and divide



by five.) It's also why, at a baseball game where you are seated far away from the plate, you see the batter hit the ball a few seconds before you hear the crack of the bat; and why, at a concert in a large arena when you are seated far from the stage, you see the drummer hit the drum before you hear the sound.

**Frequency**, or **pitch**, is the number of **cycles** (complete vibrations) per second of a sound. Low-frequency sound waves (like those created by a low-flying airplane) can be so powerful and long that they can make distant objects vibrate. Very high-frequency sounds—like chalk screeching on the board—can be unpleasant. Most people can hear frequencies between 16 Hz (hertz, or cycles per second) and 20 kHz (kilohertz, or 1,000 Hz). To put that into perspective, the lowest note on a piano has a frequency of 27 Hz and the highest note a little more than 4 kHz.

- To demonstrate how pitch can vary, fill several jars that are the same size with different amounts of water. Have students blow across the tops of the jars and describe what they hear. The jar with the most water and the least air has the highest pitch because the vibrations are closer together. As the amount of water decreases and the amount of air in the jar increases, the vibrations spread out and the pitch becomes lower.



When a train engine is coming toward you, the sound waves from the whistle bunch together and its pitch is quite high. As the train moves away, the sound waves behind it spread out and the pitch of the whistle is lower.

## Sound Technology

The technology of sound changed dramatically between 1877, when Thomas Edison invented the phonograph, and 1940, when Walt Disney introduced multi-channel sound with *Fantasia*. And the changes have been even more dramatic in recent years. Unless you are well into your 40s, for example, you probably have never played a monophonic record, and your students may have never listened to anything other than a compact disc. Consider this: The first stereo LP records were released in 1958, and by the late '60s almost all recorded music was stereophonic. In 1969, four-channel quadrasonic sound was introduced. CD players became available in 1983. In 1998, Dolby digital audio made High Definition Television (HDTV) broadcasting possible.

The sounds we hear come from more than two directions—we are surrounded by sounds. When we listen with both ears, we can judge the direction and distance of a sound, just as we can perceive depth when we look with both eyes. Our ears can detect direction because there is a difference in the time between when each ear receives the sound, and the sound is louder in one ear than the other. The special shape of the ear also helps in determining the place and distance of sound sources. That's why speakers are placed in strategic locations around a movie theater to make the sound realistic.

**Stereophonic sound**, in its simplest form, uses two separate microphones to produce two separate recorded tracks to recreate the conditions that exist near an actual sound source. In today's multi-way digital sound systems, a digital recorder measures sound waves thousands of times per second and assigns a numerical value (digit) to each measurement. The digits are transformed into a stream of electronic pulses that are converted for playback. Unlike traditional mechanical and electronic recording technology, there is no distortion of the sound waves.

In 1941, *Fantasia* won a special Academy Award for the innovative stereophonic sound system known as Fantasound. In 1982, a new version of the soundtrack for *Fantasia* was recorded in Dolby Stereo sound. In 1990, the original soundtrack featuring conductor Leopold Stokowski was digitally remastered. That soundtrack simulates the effect of Fantasound. The soundtrack for *Fantasia/2000* was recorded on the state-of-the-art 48-track, 24-bit Sony System.

■ Before visiting a theater to view *Fantasia/2000*, have your students listen to a remastered recording of the original soundtrack for “The Sorcerer’s Apprentice” segment from *Fantasia*. (This is the soundtrack on the videocassette released in 1991. It is available in video rental stores and libraries.) After viewing *Fantasia/2000*, ask your students to compare the sound experience with that of the earlier version.



## Part B: EXPERIMENTS/ACTIVITIES

- **UE/ML** Have your students experiment with different ways of making sounds. For example: Hold a blade of grass or a piece of paper between their thumbs and blow; place a piece of tissue paper over a comb, hold it to their lips and blow; stretch a rubber band and pluck it; pluck the strings of a violin or guitar. Then, ask your students what each sound has in common. Explain that each sound is caused by a vibration, and when the vibration stops there is no more sound.
- **UE/ML** Have your students experiment with pitch using different widths and lengths of rubber bands. String the rubber bands on a shoe box with an open top.

How does the pitch vary from band to band? What happens when a band is stretched tighter? Can they see that the thinner bands vibrate faster than the thicker bands? Then, have them experiment with other materials, such as wire and string.

- **UE/ML** Have your students do some research to learn about the parts of the ear and how they work to translate sound waves into audible sound.
- **UE/ML** Have your students try this experiment to experience the directionality of sound. One student should stand at arm's length behind a blindfolded classmate and snap his/her fingers in various directions. The blindfolded student should point in the direction the sound is coming from. Next, the experiment should be repeated with the blindfolded student wearing a pair of earmuffs. Finally, with the blindfold still in place, the student should remove the earmuffs and place the cardboard tube from a roll of paper towels over one ear before the finger-snapping exercise is repeated. Students should be able to detect the direction of the sound with their ears uncovered. It will be more difficult to determine the direction when the sound is muffled by the earmuffs. Putting the cardboard tube over one ear causes the sound to travel a greater distance to reach that ear, so the student will perceive the sound as coming from the opposite direction.

## Part C: PROJECT

- **UE/ML** As a class project, have your students create a timeline that traces the evolution of sound recording technology from Edison's 1877 invention of the cylinder phonograph to today's digital recording technology. Students can visit the library, do research online and interview parents and other older adults about the changes they remember.

## Part D: WRITING WORKSHOP

- **UE/ML** Have your students make a list of all the different kinds of “nature sounds” they can hear (for example: the rustle of leaves, the lapping of waves on a beach, the singing of birds). Then, ask them to write a sentence that describes each sound and a sentence that describes how the sound makes them feel.
- **ML** Have your students write several paragraphs explaining the difference between noise and music.

## Section Two

# THE ART AND SCIENCE OF ANIMATION

## ANIMATION VOCABULARY

|                       |           |
|-----------------------|-----------|
| Cels                  | Pixel     |
| Cloning               | Remaster  |
| Illusion              | Reveal    |
| Particle animation    | Wireframe |
| Persistence of vision |           |

## Part A: BACKGROUND/ DEMONSTRATION

Animation would not be what it is today without the pioneering efforts of Walt Disney and the talented animation artists at the Disney Studios. It was Walt Disney who, in 1932, first applied a new color process, developed by Technicolor, to film animation. The process allowed the three primary colors to be combined on film, and the cartoon in which Disney introduced the technology, *Flowers and Trees*, won an Academy Award. In *Snow White*, the first feature-length animated film, the Disney artists broke the mold when they studied photos of a real dancer as a guide to ensure that their heroine moved like a real girl. An animation effects department was created to ensure that even the background scenes were true to life, and a new \$70,000 camera was designed to capture it all. For 60 years, *Fantasia* was considered by many to be Disney's greatest achievement in animation—an achievement to be eclipsed only by the release of *Fantasia/2000*.

### Where Animation Began

Some people say that animation has its roots in the figures drawn on ancient Greek vases. Others say the foundation was laid in the seventeenth century, when a primitive kind of projector known as a magic lantern was developed. (Early missionaries used the device as a teaching aid as they told stories from the Bible.) During the next two centuries, elaborate slide shows called Phantasmagoria became popular. Shadow puppets, popular for a thousand years in the Orient, were introduced to Europe in the 1770s. In shadow puppet shows, two-dimensional figures moved behind a backlit screen, telling a story with shadow images (silhouettes).

A major breakthrough happened in 1906, when J. Stuart Blackton, a British-born vaudeville performer, and his partner, Alfred E. Smith, produced what is believed to be the first animated film, *The Humorous Phases of Funny Faces*. In 1914, *Gertie the Dinosaur* was released, and the animation industry had begun for good. Also in 1914, Earl Hurd's cel process allowed animated objects drawn on sheets of celluloid to be filmed against fixed backgrounds. Walt Disney's Mickey Mouse appeared in the first film shot with a multiplane camera, which brought proper perspective to animated films. Today, with the aid of computer technology, animation artists are able to create amazing special effects and incorporate even the tiniest of details into their work.



Regardless of the incredible effects it allows animators to create, the computer is only a tool. The animator still must make sure the animation looks natural and believable. Good animators have been described as “good sponges.” They are detail-oriented and keen observers of the real world, and they often record their observations in sketchbooks.

In “The Firebird” segment of *Fantasia/2000*, the characters and the backgrounds that interpret the music were created by traditional animation

techniques. But the amazing special effects that capture our imaginations would not have been possible without special technology: A **particle animation** system allowed the animators to create the illusion of movement in the very tiniest of objects. (It took more than 1,000,000 computer-generated particles to create the final scene.)

One of the most difficult things for an animator to do is to make things move in lifelike ways. The ballerina in “The Steadfast Tin Soldier” required the design of a new computer program that would allow the hair and costumes to move in a lifelike way in response to the animator’s hand-drawn efforts. The program applies certain laws of physics to simulate how each individual strand of hair would move, for example.

- Have your students do this simple experiment to see how gravity and aerodynamics affect motion. First, have them drop a sheet of paper and watch how it falls. Then, crumple the sheet and drop it again. In both cases, gravity is pulling the paper down while the air helps to hold it up. The open sheet flutters to the ground because it must push more air aside as it falls. The crumpled sheet weighs the same as the open sheet, but the air can flow around it so it falls more quickly. Have them experiment with different ways of folding the paper so that it “flies” differently.

Computer technology also makes it possible for animators to create remarkable three-dimensional forms. The animator designs a computer model of the object that will be animated by connecting a series of points and lines. The drawing that results is called a **wireframe**, because it looks like pieces of wire have been bent and shaped in order to make it. After the wireframe is completed, the animator fills in the spaces between the points and lines with shades of gray. How the object is shaded will depend on where the light source is, just as it would in real life. The next step is to apply a surface to the object. Once the computer model is completed, it's time to think about making the object move. Unlike early animation, where the artist drew a series of individual **cels**, making each slightly different from the other, the computer animator creates key frames. These are the most significant points in an animation series—usually only 3 or 4 frames out of the 24 frames in one second of film. The computer fills in the other frames with the animation that is needed.

## The Illusion of Motion

Ask your students to think about this: Why does a film that contains nothing more than a series of still images appear to move? Explain that an animated film, like any other film (which also starts with a series of still images), creates the *illusion* of motion by tricking the eye and the brain into seeing something that isn't really there. Because each frame is only slightly different than the one before it, when the frames are projected at just the right speed (24 frames per second), the brain interprets the changing images as continuous motion. The way our eyes work causes us to see each image for a fraction of a second after it has disappeared. This is an optical illusion that is known as *persistence of vision*, and it is what causes the eye to connect the separate frames into one continuous motion.

- Help your students see how easy it is to trick the brain. Print a large letter “a” on a plain white sheet of paper. Give each student a copy of the sheet. Ask your students to stare at the “a” for one minute and then stare at a blank sheet of paper. They will see that the image is reversed—the “a” seems



to be white and the paper seems to be dark. This happens because the retina of the eye tires as it stares at the bright white part of the paper. Because the letter “a” is not bright, the part of the retina that sees it is resting. When students look at the plain white sheet of paper, the light on the part of the retina that had been resting appears brighter, and the dark part of the image appears to be white. This is called an afterimage.

## The Restoration Process

The original segment of “The Sorcerer’s Apprentice” was *remastered* (restored) before it was included in *Fantasia/2000* because today’s technology allows the restored images to be sharper and clearer, and the colors brighter. Each frame in “The Sorcerer’s Apprentice” was scanned and converted into a digital image. This allowed the restorers to work with tiny picture elements called *pixels*. Dust and dirt were removed and each frame was cleaned. Color was carefully added to each spot where a bit of dust or dirt had been removed. This process is called *cloning*—the color information from one area on the frame is copied and transferred to another, like the cut-and-paste functions on a computer.

In another restoration process known as a *reveal*, a damaged frame is overlaid on a good frame. Any part of the image that is the same on both frames can pull through and “reveal” from the good frame to the bad frame.

The experts who did the restoration were very careful not to change any of the artistic ideas in the segment from *Fantasia*. Roy Disney, Head of Disney’s Feature Animation Division, was personally involved in overseeing this whole experience.

- Before your students view *Fantasia/2000*, show your students a videotape of “The Sorcerer’s Apprentice” segment from *Fantasia*. After viewing *Fantasia/2000*, ask them to describe how the two versions differed in terms of color, clarity, etc.

## Part B: EXPERIMENTS/ACTIVITIES

- **UE/ML** Have your students experiment with their own shadow puppet shows. Suspend a white sheet above your desk in the front of your classroom. Turn off the overhead lights and hold a light (a large flashlight works well) about eight feet in front of the sheet. The student performers kneel behind the desk and hold their puppets up so the shadows can be seen by the “audience.”
- **UE/ML** Have your students do research to learn more about other early projection devices.
- **UE/ML** Have your students practice the animator’s observation skills by “soaking up the details” of the scenes they view, noticing timing, textures, structural details, lighting, colors, etc. Ask them to keep a week-long journal containing notes about or rough sketches of the things they see.
- **UE/ML** Ask your students to view the video of *Snow White* or another animated feature with their family. As they watch, they should try to spot as many of the tiny, important details as they can.
- **UE/ML** Have students follow these directions to make simple flip books that demonstrate how a series of still images can trick the eye into seeing motion. Cut unlined paper to make 30 to 40 strips, each about 1 1/2 inches wide by 3 inches long. Stack the strips neatly and staple them along the bottom. Draw a stick figure on the right side of the first sheet of paper. Then, draw the figure in a slightly different position on each following strip. Hold the bottom of the stack tightly in one hand. With the other hand, bend back the tops of the strips and let them flip forward.
- **ML** Challenge your students to find other examples of optical illusions. They can use books or the Internet. (One good Web site is Grand Illusions, <http://www.grand-illusions.com>). Many science museums also have such exhibits on display.

## Part C: PROJECT

- **UE/ML** To help students visualize how particle animation works, have them use colored art sand to create their own special effects. For example, they might create a miniature scene by gluing small objects to the bottom of a clear glass jar. When the glue is dry, they can add some sand, put the lid on the jar and then shake it so the sand “flies” through the scene.

## Part D: WRITING WORKSHOP

- **UE/ML** Have your students compare and contrast an old cartoon (“Woody Woodpecker” or “The Flintstones,” for example) with today’s “Pokemon.” Which is smoother? Clearer? Brighter? Which would you rather watch? Why?
- **ML** Ask your students to write several paragraphs that explain how the techniques used to create hand-drawn cartoons and computer-generated cartoons are alike, and how they are different.
- **UE/ML** Ask your students to imagine they are cartoonists. They have just created a new cartoon character. What is their character’s name? What does he or she look like? What makes their character special?

# THE VISUAL EXPERIENCE

## VOCABULARY

Camera obscura

Daguerreotype

### Part A: BACKGROUND/ DEMONSTRATION

Still photography, which laid the foundation for motion picture photography, had its birth in 1839, when a Frenchman named Louis Daguerre introduced a technique in which a silver-coated sheet of copper was sensitized by treatment with iodine vapor, forming a coating of light-sensitive silver iodide. This *daguerreotype* plate was then exposed to light in a camera and developed in mercury fumes. But the roots of photography go back much further in time.

The foundation for Daguerre's innovation was based on the *camera obscura* (Latin for "darkened room"), which had been used since ancient times. The camera obscura was originally a room that was sealed from light except for a small hole in one wall. An upside-down image of the outside world could be projected onto a white wall or screen placed opposite the hole. By the Renaissance, the camera obscura had been refined into a small portable box that was a popular tool for artists. They used it to trace scenes, thus making their work look more realistic.

The upside down, reversed images created by the simple camera obscura illustrate the principle behind any camera. The light is reflected from the object, travels through the hole and onto the plastic screen. Because light travels in a straight line, light from the top of the object passes through the pinhole and strikes the bottom of the screen. The light from an object on the right passes through the pinhole and strikes the left side of the screen.

Today's technology is light years beyond the simple pinhole camera.

- To help your students see how a camera works, take apart an inexpensive disposable camera **that does not have a flash (NOTE: This is important — you can be seriously injured by the shock created if you hit the wrong part of the flash with a screwdriver)** so your students can see how the different parts work. First, point out the lens, the viewfinder and the shutter release button. Then, pry off the back of the camera. Show how the film is loaded



in the camera and how it winds across the back of the camera on the advance wheel. Pry the front off the camera and push the shutter release. Your students will be able to see the shutter open and close. Explain that when the shutter release button is pushed, the shutter snaps open for a fraction of a second and lets light shine through the lens and makes an image on the film. The chemicals in the film react to the light and capture the image.



### Part B: EXPERIMENTS/ ACTIVITIES

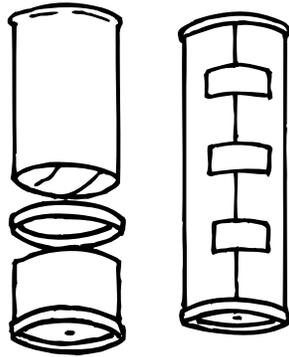
- **UE/ML** Have your students experiment with a simple lens. You will need a large (6" x 9" or larger) plastic page magnifier (Fresnel) lens. Use two large binder clips to create a base so the lens will stand in a vertical position on a desk or table. Have students stand at different distances (from very close to several feet away) from the lens and look through it at an object on the other side. Slowly move the object away

from the lens. (When the object is very close to the lens it will be magnified and right side up. When the object is moved away from the lens it will appear to be upside down.) Next, dim the lights in the classroom and place a lamp or another bright light source several feet in back of the lens. Ask a student to move a large sheet of white paper slowly away from the lens until a clear (focused) image of the light source appears on the paper. Explain to your students that light spreads out when it hits an object. The lens bends the rays together, creating a focused image. To extend the activity, ask your students to do some research to learn about Augustin Fresnel, the French physicist who was an expert on light and optics. Fresnel developed the lens that bears his name for use in lighthouses.

## Part C: PROJECT

- **UE/ML** Have your students create their own camera obscura (also known as a pinhole camera) using a cylindrical potato chip tube with a translucent plastic lid. Clean the inside of the tube.

Draw a line around the can, about two inches from the bottom, and cut along the line so the tube is in two pieces. Use a thumbtack to make a hole in the center of the metal end of the shorter section of the tube. Put the plastic lid on the opposite end of the shorter section. Tape the end with the plastic lid to one end of the



longer section of tube. Tape heavy construction paper around the sides of the entire tube to keep any light out. Go outside on a sunny day and hold the open end of the tube up to one eye. Close your other eye to help you view the images on the screen created by the translucent plastic-lid screen.

- **ML** Have your students learn more about pinhole cameras and design one they can use to take actual pictures.

## Part D: WRITING WORKSHOP

- **UE/ML** Ask your students to write several paragraphs that describe a topic they think would make a good film and to explain the reasons for their choice.

# RESOURCES

## WEB SITES

Disney's *Fantasia/2000* Web site: <http://www.fantasia2000.com>

## INFORMATION ABOUT COMPUTER GRAPHICS

<http://www.graphics.cornell.edu/online/tutorial>

<http://library.advanced.org/10015/data/info/reference/techniques/computer.animation.html>

[http://www.education.siggraph.org/materials/HyperGraph/animation/anim\\_intro.htm](http://www.education.siggraph.org/materials/HyperGraph/animation/anim_intro.htm)

## BOOKS

*Animation Tips and Tricks for Windows and Mac*, by Don and Melora Foley. Berkeley, CA: Peachpit Press, 1997.

*Computer Animation: A Whole New World*, by Rita Street. Gloucester, MA: Rockport Publishers, 1998.

*Disney's Art of Animation from Mickey Mouse to Hercules*, by Bob Thomas. New York: Hyperion, 1997.

*Food*, by Ogden Nash. New York: Stewart, Tabori & Chang, 1989.

*Parents Keep Out: Early Poems for Younger Readers*, by Ogden Nash. Boston: Little, Brown and Company, 1951.

*Versus*, by Ogden Nash. Boston: Little, Brown and Company, 1947.