# MovieMotion™ Zoetrope

By Ruth Hayes

The zoetrope is one of several animation toys which were invented in the 19th century, a time when people developed many ways to make still pictures move. The zoetrope appeared first in England in 1834, then France in 1860 and finally the United States in 1867.

The zoetrope was named by its French inventor, Pierre Desvignes. In "zoetrope" you might recognize the root word "zoo." That is from a Greek word meaning animal or life. "Trope" is also from Greek and refers to things that turn.

The zoetrope is the wheel of life. When you place a strip of drawings inside the zoetrope's drum, spin it and look through the



slots, you will see the images come to life. Of course, they are not really alive. They only appear to move. This illusion of motion depends on two things; persistence of vision and the Phi phenomenon.

Persistence of vision, first noted in 1820 by Peter Mark Roget, refers to the length of time the retina (the "screen" at the back of our eyes which is sensitive to light) retains an image. You may have heard that "the hand is quicker than the eye." Our vision is slow. Many things happen too fast for us to see them. If we see a light flash every tenth of a second or less, we perceive it as continuous. We cannot see that the light is interrupted. The impression of each flash of light remains, or persists, in the

retina for at least one-tenth of a second. Because of this persistence, the flashes appear to overlap. We can't tell where one ends and the next begins. We perceive one constant light.

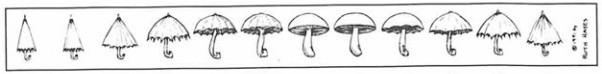
Try spinning your zoetrope but instead of looking through the slots, look over the top of the drum at the drawings. Notice that the illusion of motion is gone. All you see is blur. The slots of the zoetrope simulate flashes of light. They create a strobe. Persistence of vision is a stroboscopic effect. The images you see must be interrupted by moments of darkness in order for the illusion to work.



The Phi phenomenon is a result of human instinct. When we see two different images close to each other we automatically create a relationship between them. We interpret the arrows below as one jumping arrow instead of two separate ones.

If these arrows were separated by a short amount of time instead of a small space, you would be even more inclined to see them as one moving arrow. Your instinct to connect these two images gives them movement and meaning. When you look at a zoetrope strip, you perceive one single event but you actually

see a succession of images which follow one another rapidly. An umbrella becomes a mushroom without interruption even though this is not something you would ever see in the real world.



12 11 10 9 8 7 6 5 4 3 2 1

On a larger scale, movies are composed of different scenes. The scenes contain shots of characters taken from different angles, at a variety of distances. All are edited together. You may not notice the edits. A skilled editor can work the Phi phenomenon to his or her advantage. The film can be edited to maximize



an illusion of continuity. But you, as the viewer, are most responsible for continuity. You see the shots together, and your mind creates a world from them which seems to have its own space and time.

The zoetrope and other nineteenth century animation devices such as the flipbook, thaumatrope, praxinoscope and mutoscope were steps in the development of film and television. On the surface, modern media technologies look different from the optical toys of the 1800s, but they share common properties.

Your zoetrope has slots which create a stroboscopic effect. Movie projectors have a

shutter which interrupts the light from the projector bulb as the film advances through the gate. The strobe of the projector shutter keeps the film from blurring. Video images are scanned onto your television by a beam which zig-zags across the screen from top to bottom twice for each frame. In between each frame is a little black, which you may see as a roll-bar when your televison's vertical hold needs adjustment.

You can vary the speed of your zoetrope. The faster it turns, the smoother the motion in the strips appear. When the zoetrope slows down so that each image is seen for a tenth of a second or more, the illusion of movement begins to break down. You can see the strobe



more easily. Film projectors usually run at a rate of 24 frames, or pictures, per second. But old silent movie projectors run at 18 frames per second. This is why silent movies may seem to flicker. They are slow enough that we can detect the strobe. Video cassette recorders play and record tape at a rate of 30 frames per second. Both film and television are designed to take advantage of persistence of vision and the Phi phenomenon.

Your zoetrope is also designed to take the best advantage of persistence of vision. For best viewing results, you should follow a few simple steps.

Place one strip of animation into the zoetrope. Make sure it is the right side up with images facing the center of the drum. Slide the bottom edge of the strip into the narrow trough inside the drum.

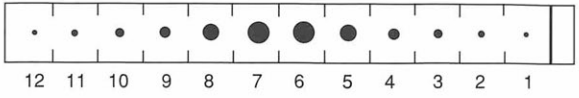
View the zoetrope in good light. Shine a lamp into the center of it, or stand by a window. You will see the images more clearly if you have your back to the light source.

To make the strips move forward, spin the zoetrope clockwise. All the strips provided with your zoetrope have been animated to work in this direction. If you would like to see the animation go backwards, you can spin the zoetrope counter clock-wise.



After you have looked at the strips that come with this zoetrope, you might want to try to make your own. Blank strips with pre-measured frames have been provided. You can draw directly on them or use them as guides to

make your own strips. Here are some tips to help you get started:




1. Think of simple shapes to draw. A dot could get bigger and bigger with each frame. A line could rotate like the hands of a clock or wag back and forth like a dog's tail. A smile on a face could turn into a frown.

2. Draw in pencil first, then go back over your lines with a dark pen. Pencil lines are too light to show up in the strobe of the zoetrope.



3. Draw the extremes of the motion first and separate them with five empty frames. Go back and draw gradual changes in the frames between your key drawings.

4. To animate a metamorphosis, or one thing transforming into something else, draw your first image in frame one and the image you will transform it into in frame seven. Use the frames in between one and seven to draw the gradual changes of the metamorphosis. You can copy these "in-betweens" in reverse order in frames eight through eleven to complete the cycle.

5. Keep in mind that your animated sequence repeats itself in the zoetrope. It's a cycle. The drawing in the first frame follows the one in the twelfth frame directly. The difference between these frames should be small.

After you have made some simple strips, you might want to try more complicated ones. Instead of twelve frames, make a strip with ten, eleven or fourteen frames of equal size. Draw the same simple shape in each frame. Notice that in the zoetrope, the shape seems to move in one direction or the other even though you have not animated it. If you animate a ten frame cycle of someone walking, they will appear to walk from right to left in a clockwise



spin, and left to right in a counter-clockwise spin.


You may want to make your drawings more detailed. You can draw them larger, then reduce them to the right size on a copy machine. Make sure that your lines are bold and black or they won't reduce well.

You can color your strips. Because of the strobe, pale colors don't show up very well. Use bright, bold ones. Experiment with alternative blocks of color from frame to frame.