It's a Bird! It's a Plane! It's a. . . Stereogram!

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***** Note: Figures may be missing from this format of the document**

Article:

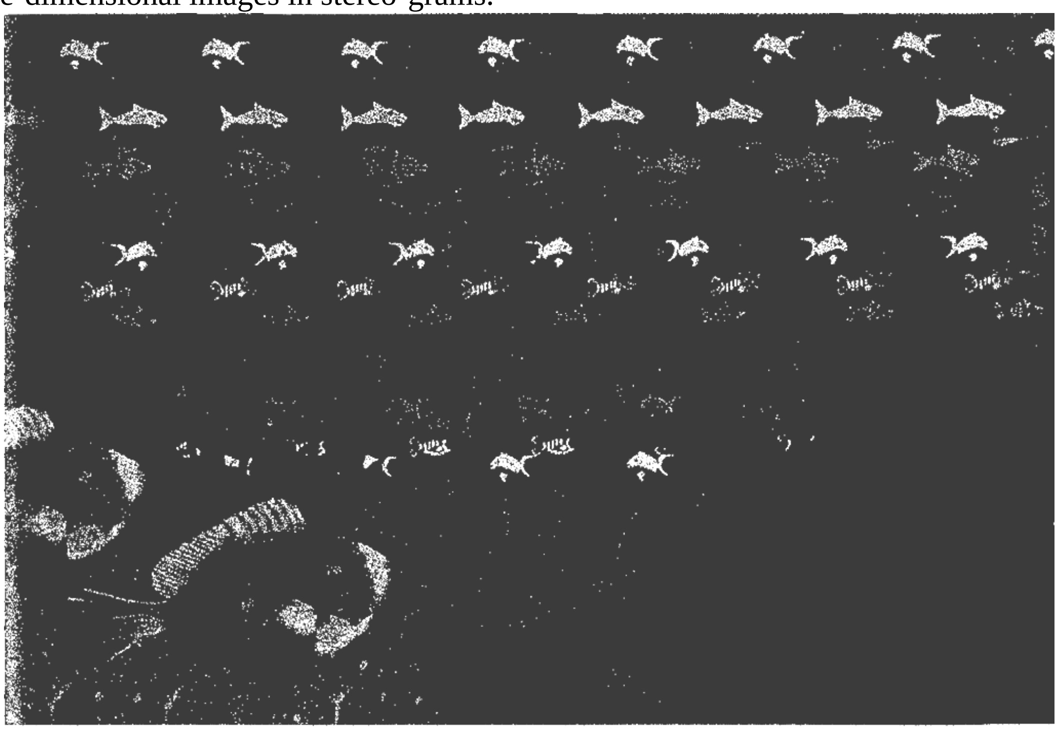
They are popping up everywhere—in books, in the newspaper, on greeting cards, and as poster-size prints—colorful pieces of artwork that contain hidden three-dimensional images. These pictures, commonly known as hidden-image stereograms, are certainly all the rage at the local mall. Kiosks selling prints are constantly surrounded by people staring at the images, trying to discover the three-dimensional secret.

"Can't you see it? It's a fighter plane coming right at us! Look, there's the wing!"

"No, I don't see anything but a bunch of different colors."

Reactions to the pictures range from fascination to dismay. In general, those who are able to see the three-dimensional images are fascinated. However, not everyone can see them. Many people stare and stare, seeing nothing, and become frustrated. People who can see the images try to help those who cannot. Their tips vary from person to person, and everyone is an expert.

Students may think of stereo-grams as merely entertainment, but the science of seeing the images can bring stereograms out of the shopping mall and into the classroom. Using these hidden images, students can learn more about their sense of sight and how it learns. In middle school science classes, students can discover that "seeing is believing," or perhaps not. Many real-world concepts of sight can be introduced. For example, we all see differently; some of us are nearsighted, others are far-sighted. Some of us are colorblind, most are not. All of us are "fooled" by optical illusions, and with a lot of patience, all of us who have sight in both eyes can see the hidden three-dimensional images in stereo-grams.



What you see

Stereograms are two-dimensional patterns of repeating shapes and colors that when viewed "just so" create a three-dimensional image. Each of our eyes sees slightly different images, which the brain then interprets as one three-dimensional image. Prior to the development of the first stereograms in the 1950s, stereo pair pictures—two slightly dissimilar pictures viewed side by side—also produced three-dimensional images (remember those old ViewMasters?). Now, several decades later, artists and scientists use what we know about how the brain takes two slightly different two-dimensional images and converts diem into a three-dimensional image to make stereograms.

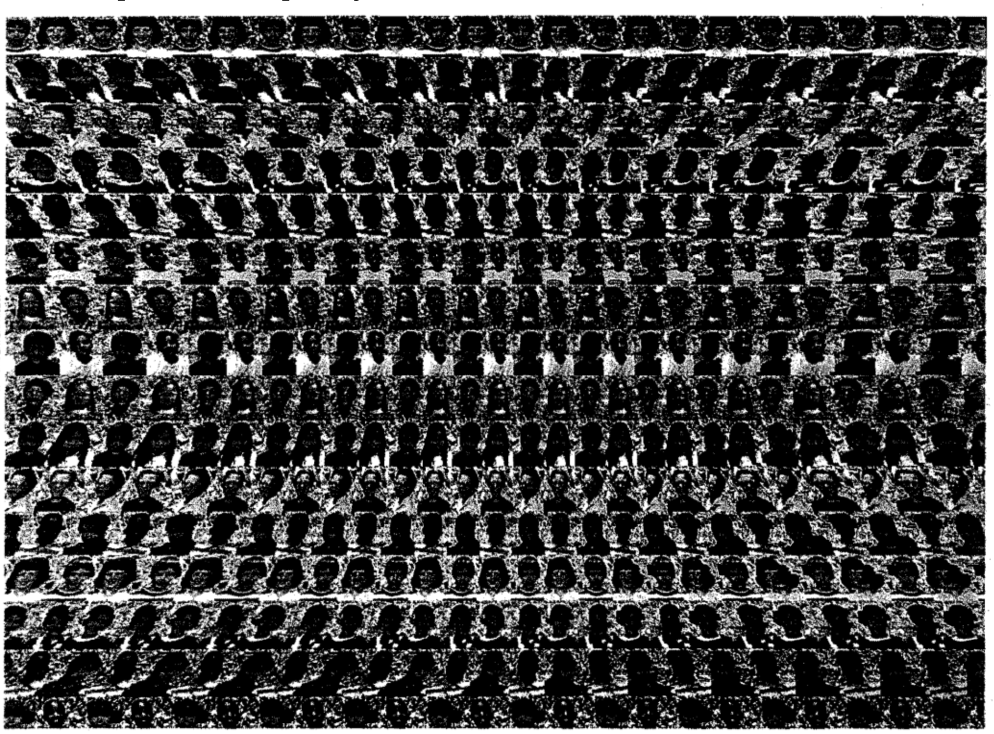
Stereograms come in varying degrees of difficulty. Some are easier to see than others, not he- cause of the three-dimensional image itself, but rather the pattern that overlays the image. Some stereograms have very complicated and intricate patterns, which give the brain more information to process. The more intricate the pattern, the more the viewer must focus and concentrate in order to see the hidden image.

The simplest stereograms depict a two-dimensional image in the forefront that becomes three-dimensional as you stare at it For example, at first glance, the above picture (from The *Magic Eye)* shows a picture of a school of fish, but as you stare at it, the fish begin to float off the page. Some stereogram fans do not consider these types of images actual stereograms because the challenge in seeing the three-dimensional image is not as great.

The most popular stereograms are colorful, regardless of the hidden image. The more colorful the stereogram, the more people are drawn to it. One popular stereo- gram is an abstract mixture of blues and greens at first glance, with a hidden image of the Statue of Liberty and the New York City skyline. A red, orange, yellow, and pink stereogram that reveals Bugs Bunny and his pals is another favorite. One stereogram in The *Magic* Eye (see page 24) depicts many rows of children. Behind the children is an image of the Earth, complete with continents and the words "All the children of the world."

What's behind what you see?

For many years, researchers have been studying how the brain processes visual information. To process and convert what we see into a complete picture, the brain must (1) sense motion, (2) detect color, and (3) interpret the size and distance of objects. This is an awful lot for the brain to do in a short amount of time, so the brain often takes shortcuts to help us see completely.



One of the shortcuts our brains take involves interpreting our blind spot. Everyone has a region of the retina that is not sensitive to light, and as a result, a blind spot exists in the visual field. However, the brain compensates for our blind spot in one of two ways, so we are not aware of this "hole" in our vision. First, because we have two eyes, the blind spot in each eye is canceled out when both eyes are open. Second, the constant motion of the eyes prevents the blind spot from staying in one place for a long period of time. So the brain is able to synthesize a complete picture of the outside world in spite of our blind spot.

A simple activity can help students understand the concept of a blind spot. Using a dark marker, draw an X and a circle on an index card, as shown in Figure 1. Holding the card at arm's length, close your right eye and focus on the X with your left eye. Slowly bring the card toward your face. At some point, the circle will disappear, and as you continue moving the card toward you, it will reappear. At what point does the circle disappear from sight? Repeat the procedure, closing your left eye and focusing on the circle with your right eye. At what point does the X disappear?

This simple activity illustrates that a blind spot exists in our vision, yet the brain is able to fabricate all of the information the eye cannot see. If students still do not believe the brain fills in information the eye does not see, take the index card and draw a horizontal line across it, through the circle and the X. Again close one eye and focus on the opposite symbol. When you move the card toward you and the symbol disappears, the line will still appear continuous, without gaps, where the symbol used to be. The symbol disappears when the light traveling from it strikes the blind spot, but the line appears continuous because the brain has filled in the gaps.

Another simple activity, The Third Finger, can illustrate the concept of optical illusions—another nuance of visual perception. While focusing on a distant object, slowly bring your hands together with pointer fingers extended. As you move your hands, suddenly a third finger appears suspended between your real fingertips (Figure 2). This third finger is fabricated by the brain as it attempts to interpret unfocused messages from each eye. This procedure is very similar to what happens when you view a stereogram.

Visual perception is the brain's role in interpreting light—turning what we see into what we understand. As in these activities, visual perception is not always "correct." We know that the third finger does not really exist; we know that there cannot really be a three-dimensional object hidden in a two-dimensional picture, but the brain perceives it. Is seeing believing or is believing seeing?

FIGURE 1.

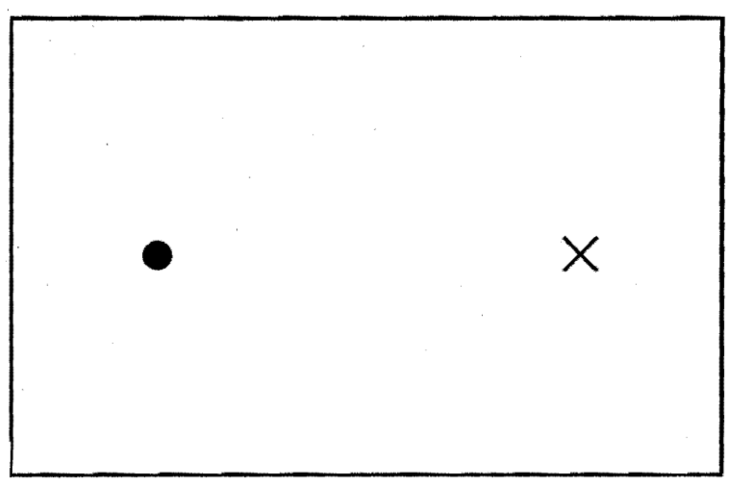
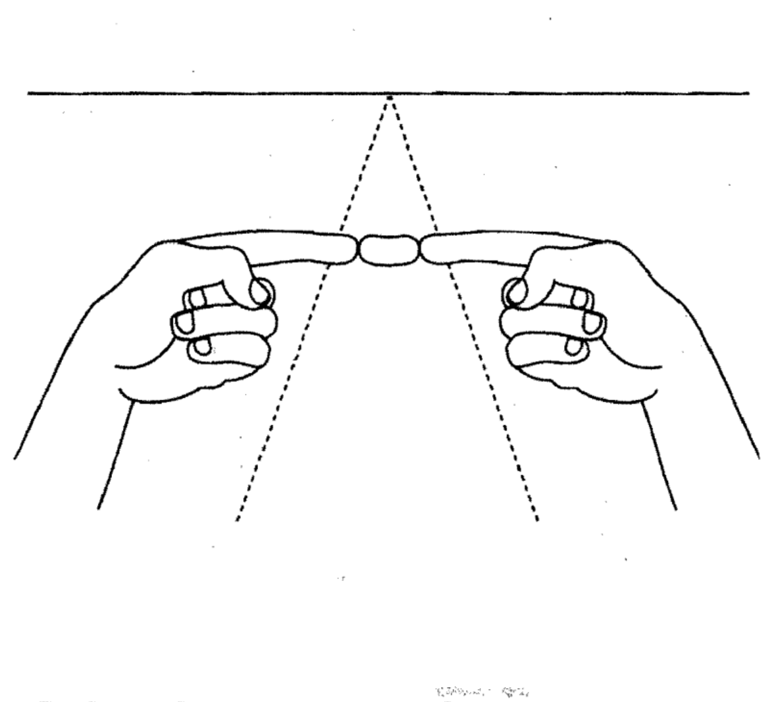


FIGURE 2.



How to see the image

Techniques for viewing stereograms vary from person to person and manufacturer to manufacturer. The three most popular are the reflection method, the arm's length method, and the object in the distance method.
The reflection method uses the reflection in a piece of glass or a transparency sheet that is laid over the picture. Standing two to six feet from the image, focus your eyes on your reflection in the glass. Do not concentrate on your likeness, but instead relax your eyes and try to gaze off into the distance. While your gaze is relaxed, focus on your reflection and the image should come into view.

For the arm's length method, bring the stereogram to the end of your nose. Stare at the image, but be careful not to cross your eyes. lowly move the image away from your face without focusing on the image, hut rather looking through it. When the image is at arm's length, hold it steady and continue staring through the image. The image should appear in three dimensions. Be careful to avoid the natural instinct to stare directly at the picture. If this happens, bring the stereogram back to your nose and start over. Try not to become frustrated if you cannot see the image right away. Take a break, let your eyes rest, and try again in a few minutes.

For the object in the distance method, focus your gaze on an object in the distance, such as a doorknob or a lamp. Then, slowly move the image into your field of vision. Your gaze will then be centered on the stereogram, and the three-dimensional image should come into view.

The three-dimensional image is concealed behind a repeating abstract pattern. In order to see the image, the brain must first focus on one part of the repeating pattern and then focus on the same point in the pattern at another place in the stereogram. By seeing the pattern at two different points, the brain can focus beyond the pattern to see the image underneath. Second, the brain must decode the three-dimensional image from the repeating pattern. When the brain completes these two tasks, the hidden three-dimensional image comes into view.

Using stereograms in the classroom

To introduce the science of stereograms in your class, first provide appropriate background information about how the brain "sees." Use the index-card activity to illustrate the concept of the blind spot. Then, divide the class into groups of four and give each group a stereogram and a sheet of transparency film.

Allow students to spend some time trying to see the images. Many will already have experience with stereograms, and they can assist those who are less experienced. Some students may not be able to see the images at first, but after a little help from classmates, most should be successful.

After all (or most) students have seen the images, encourage them to experiment with different techniques. Many will already know different ways to see the hidden images, and some may come up with a few of their own. Ask students to determine which techniques work best. Can you see the image upside clown? What happens if you turn the print 90 degrees while staring at it? How far away can you stand and still see the image? How close can you stand? Can you see the image with one eye closed?

Students can use their measurement skills by calculating and recording the distances from which they can see the image. By rotating the images 90 or 180 degrees, students can draw on their knowledge of angles.

In one class of sixth graders, it took about 20 minutes until everyone could see the image. As they experimented with different viewing techniques, students quickly discovered that they could see the image upside down, but not sideways. It is difficult to see the image sideways because the eyes cannot focus on two similar points in the horizontally repeating pattern. However, in some stereograms, the artist has designed a horizontal pattern that is easy to interpret. Students also discovered that it is not possible to see the three-dimensional image with one eye closed, because information from both eyes is needed to process the three-dimensional image.

The longer students played with the images, the more they wanted to experiment. Could they see the image without using the transparency? Could they see the image while lying on the floor? Was it easier to see if someone else held the picture? They were fascinated with new viewing methods and had a chance to use their measuring skills at the same time.

Stereograms are sure to be a classroom hit. Most students are familiar with using their five senses to make observations and collect data, but probably few of them know how our senses are affected by perception. Using stereograms, optical illusions, and other activities regarding light and sight can help to introduce this fascinating aspect of science.

Stereogram resources

N.E. Thing Enterprises publishes the very popular series of stereo-gram books entitled The *Magic Eye.* The images in the books range in difficulty from easy to extremely hard. And for those who need a little help in seeing the images, the books also have the "answers" in the back. The stereograms in this article are from The Magic Eye.

For computer-equipped classrooms, special software can allow students to generate their own stereograms. Stare-EO Workshop software (N.E. Thing Enterprises, 540) can be used on most PC-compatible computers. Graphics or text that you and your students create can be turned into hidden three-dimensional images. The software requires 512K of memory, and a mouse and a hard disk are recommended for easier use. The graphics can be printed on most printers.

The hottest wave of novelty items, stereograms, can be starting point for a range of science teaming. Students can study light and vision in a hands-on, eyes-on, minds-on manner. What is the image lurking in the horizon? Why it's middle school students shedding new light on new material.