

Scenario A: Illusions

<http://www.indiana.edu/~ensiweb/lessons/unt.illu.html>

- 1. Blind Spot:** ask your students to take a blank sheet of paper (provide some scratch paper for those in need), and place their open hand in the middle of the sheet. Using a pen or pencil, each student is to make a small dark **cross** on the paper next to the **right** side of his/her hand. Then draw a dime-sized **dot** on the paper next to the **left** side of the hand. Remove the hand, and the dot should now be about 12 cm (5 inches) from the cross.

Ask each student to hold his/her **left hand over the left eye**, hold the paper at arm's length (about 60 cm, or 2 feet) with the other hand, and **stare at the dot** on the left with the **right** eye only. Both the dot and the cross should be visible. Now ask them to slowly bring the paper **closer**, while continuing to **stare at the dot**. Ask if they notice something strange happening.

Most students will be startled that the cross seems to disappear when the paper is a little more than a foot away. If they continue to bring the paper closer to the face, the cross will reappear. Have them repeat these movements to see that there is a small distance range when they can't see the cross. They can also do this with the right eye covered, the left eye open, and staring at the cross. In this case, the dot will not be seen at about the same distance range as with the other eye. For an internet version of this "blind-spot" test, along with an explanation, **click here**. For an even better explanation, with a great diagram (along with variations), **click HERE**.

This nicely demonstrates that we all have a blind spot in each eye. These are the spots where the retinal nerves all come together and exit the eyeball through the retina to form the optic nerve. **Our eyes are not perfect**, and the sense that we normally see a complete field of view with no blind spots is an **illusion**.

2. Other illusions in nature:

- Ask where the sun was earlier this morning, and where it will be later this afternoon. Next ask how it got from the morning point to the afternoon point. Most people will say that the sun moved across the sky. You can say "are you sure...is that your final answer?" Eventually someone will point out that actually that's only an illusion; in fact, the sun stays put (in our solar system), and the earth rotates with us on it, so that the sun only **seems** to move across the sky.
- Ask what the size of a full **moon** is just above the horizon, compared to its size straight overhead. Most will say that it is larger. In fact, they are the same size...it's only an illusion. (Have anyone who doubts you just set up a device at one end of a yardstick which can hold a piece of paper on which you can mark the apparent diameter of the moon while looking at it with your eye at the opposite end of the stick. do this when the full moon rises on the horizon, then later in the evening when it is overhead. Be sure to mark the apparent diameters on the card both times. If done carefully, they will be the same.) Somehow, the bright clarity of the moon seen close to nearby objects (trees, houses, telephone poles, etc.) in a horizontal direction seems larger than when viewed higher in the sky. It's an illusion!
- A very subtle **biological illusion** is the sense that species don't change: that dogs have puppies, cats have kittens, and people have babies. It seems that species don't produce new species. However, this must be an illusion, since we have so much compelling evidence showing species arising from other species, and that even whole groups of organisms must have descended from other groups, and this over very long periods of time, i.e. **evolution**. We clearly see from the fossil record that new groups of organisms have continuously emerged over vast 100s of millions of

years. In contrast, there is absolutely NO evidence or suggestion that all life forms appeared instantly or magically, over, say, six days, six years, or even 6000 years. We also have considerable evidence of species changing, sometimes quickly, but usually over long periods of time. In addition, we are beginning to have a fairly good understanding of HOW such changes occur, and HOW such changes can accumulate to produce new species and eventually entirely new groups of life forms.

- d. Ask your students** to list as many **other illusions in nature** as they can. (They might benefit by working initially in small groups to do this for about 5 minutes, then share their suggestions with the class). There are many such illusions ...just look around, and use them as examples. The sense that the **earth is flat** is a very powerful one. **Planet motions** and the **actual star locations** in what we see as constellations are two other areas of natural illusions.

Here are some other **natural illusions**, many associated in the past (and some still) with beliefs in the supernatural:

We are in the center of the universe

Earth seems closer to sun in the summer (actually closest in our northern hemisphere winter)

Light travels instantaneously

Lightning

Rainbows

Earthquakes

Eclipses (of sun or moon)

Disease, birth defects

Floods, hurricanes, tornadoes, rain

Fire

Stars in the dome of the sky

Everyone and every solid thing is solid matter (actually, studies tell us that every atom is mostly empty space, and everything material is made of atoms)

Flying saucers

Mirages

Earth stands still (even though we now know it spins at about 1000mph at the equator, races around the sun once a year (at over 66,700 mph), travels around our galactic center, AND is coursing through space with our galaxy.)

- e. What's the point of all this?** See item #4 below.

3. Intentional illusions:

- a. Prepare some **optical illusions** on overhead transparencies. Many are available in books of optical illusions, and even on the **internet** (Illusionworks). A very clever one we offer here requires two identical transparencies, each with **two tables** drawn in perspective. Start with the two sheets in register, so that the identical table images are on top of each other. Ask which table is longer (it seems obvious), then slowly shift and turn one sheet about 90 degrees, dramatically pretending to str-r-r-etch the plastic, until the top of one table is directly aligned with the other table-top, and everyone sees that they are exactly the same size and shape! Check out a variety of other optical illusions available. Another nice collection of **optical illusions** (including the "blind spot" illusion) can be found at **Vision Education Activities**.
- b. If you can, do some simple **sleight of hand** (stage magic). There are some very easy coin tricks you can learn, or get some packaged tricks at a magic shop. Look for large, easy-to-see tricks, and those not too difficult for you to learn. See "**Some Classroom Magic Resources**" in box below.
- c. **Don't show all your illusions here**; save some for later. They are nice to sprinkle at odd moments during your course, especially if they are even remotely relevant (such as a few dice or card

tricks in your genetics unit, when you deal with probability). You will be limited only by your imagination and sense of fun.

d. Also, **NEVER reveal the secrets of your "magic"**. This is a fundamental code of magicians. If you are ever pressed by your students to "show how you did it", point out that in science, we NEVER really KNOW the secrets of nature, thereby reinforcing the fact that scientific solutions are always UNCERTAIN.

4. "**Perception is not always reality**" (with apologies to Mercedes Benz). At some point, make it clear that the natural world is full of illusions, and simple common sense doesn't always work to explain such illusions. This is where **science** is an especially reliable tool, able to cut through illusions, useful to help us dig out the real story....the most accurate explanation, the reality behind the illusions. Nevertheless, science is not perfect; science can be fooled, too. For that reason, people who practice the art of creating illusions professionally ("magicians" and "sleight of hand artists") are sometimes even better equipped to see through illusory phenomena, especially if they are intentional, as perpetrated by hoaxers and con artists. **Randi the Magician** is one such professional who has exposed such people where scientists had been fooled. Explore the world of Randi by visiting his web site. He is occasionally featured on television demonstrating his success at unmasking the tricks of those who would profit at your expense: psychic readers, magical healers, spoon benders, clock starters, and the like. If possible, tape one of his shows, and share with your classes. Great for discussion.

You might find it useful to make a large banner (or have a student do it) for your room: "**Perception is not always reality!**" (Some may recognize it as the Mercedes Benz slogan, where it has a totally (?) different meaning). In any case, it will be amazing how often during the year you can glance up at the banner, conspicuously and knowingly, when an appropriate example comes up. Even some of your students will take the initiative at times. Great! Encourage that!

5. There is a close tie between natural illusions and making false assumptions. Actually, natural illusions exist largely because we make certain false assumptions. For a most useful ongoing activity, take a look at our lesson on "**False Assumptions**".

Some Classroom Magic Resources

Courtesy of Walter Wogee (ENSI '93)

***Magic and Showmanship for Teachers* by Alan McCormack published by the Idea Factory. This is the best overall source of ideas for using magic in the classroom. I think that it is available through the NSTA Book Store.

***Mathematics* by Arthur Benjamin and Michael Shermer: a good source of magic effects based on math.

***Fun with Science Magic* and *Fun with Math Magic* is a series of books by Donald W. McCarthy published by University Classics. I am not sure if they are still available.

** *Wonder Workers* by Joe Nickell is a good source of explanations of logical explanations of magic and paranormal events for students.

** There is a *Magic for Dummies* book and a *Magic for Idiots* book out that are good introductory magic books.

** The NOVA video, *Secrets of the Psychics* with James Randi is a great video to use.

** The *Scientific American Frontiers* Video with Alan Alda on "Paranormal and Pseudoscience" is also good.

** CSICOP video, *Beyond Belief* is good if it is still available.

Two-Tables Illusion

Print this PDF file, then make two identical transparencies from it.