Neuroscience for Kids
http://faculty.washington.edu/chudler/neurok.html

Our Sense of Sight : Part 2. Perceiving Motion, Form and Depth

Visual Puzzles

Student Guide

How does *DEPTH PERCEPTION* work, and how does it help us to see better?

"Man, I'm glad to be done with that eye patch," remarked Dan. "Yeah, it must have been weird seeing with only one eye," said Andy. "What did you do to your eye anyway?" "A guy in my Tae Kwon Do class accidently jabbed me," said Dan. "It didn't hurt much after a couple of days, but then, with the patch on, I couldn't tell how far away things were. I'd reach for a glass and practically knock it over. I did get a bit better at reaching for things after a while. Now everything looks so great, like a 3-D movie." "I wonder why seeing with two eyes does that," Andy remarked.

Of all the senses, we rely most on our **sense of sight**. With it, we recognize shape, movement, distance and perspective, and color in our environment. Seeing with two eyes rather than one is called **binocular vision**, and it gives us both a sensation of depth and the impression that objects are three-dimensional.

How do our eyes detect depth? How do our brains use visual information to give us the sensation that things are solid rather than flat? Your teacher will discuss in class the parts of the eye and brain involved in how we understand depth and how we interpret other visual information.

After your class discussion and experiment, use what you have learned to explain why Dan had trouble seeing well while wearing his eye patch.

Name:_____ Date:_____

Visual Puzzles

CLASS EXPERIMENT

LAB QUESTION

PREDICTIONS

SUPPLIES

plastic or paper cup or similar container
small items for dropping (paper clips, pennies)
tape measure or meter stick

PROCEDURE

1. Write the **Lab Question** and then write your prediction in the boxes above.

2. Follow all **safety procedures** your teacher recommends.

3. Follow your **teacher's instructions** for working in groups. Let your teacher know if you do not want to be a Subject.

4. The **Subject sits** in a chair with a cup or container about two feet away, and **covers one eye** with a hand.

5. The **Tester** stands near the cup, holding a paper clip or other small object and moving it slowly over and around the cup, about two feet above the cup.

6. The Subject says "Drop it." when the object appears to be directly over the cup. **Repeat** the procedure three times.

7. The **Recorder** writes down the number of times the object went into the cup out of the three trials.

8. **Repeat the trial** with both eyes open and record the results.

9. **Move the cup** eight to ten feet away (ask your teacher exactly how far, and measure it, so that all groups do the same thing) from the Subject and **repeat** the one and two eye

10. Repeat the procedures with **another Subject**.

11. **Clean up** your lab area when you finish.

DATA AND OBSERVATIONS

- The teacher will ask someone in your group to **write your results** in a class chart.

- When all results are written, **calculate** the class average for the number of successful drops with one eye and then with two eyes, for each of the distances tested.

- Write down any other **interesting things you noticed** while doing this experiment

ANALYSIS: THINK ABOUT IT!

1. How do your results compare with those of other groups?

2. Did anyone have very different scores from most of the class? What could be reasons for this?

3. How does having two eyes on the front of our heads give us depth perception? What is the relationship between binocular vision and depth perception?

4. Do some animals lack depth perception? If so, why?

5. Among mammals, do predators or prey animals most often have binocular vision and therefore depth perception?

6. What are some advantages that depth perception gives us?

7. People who have sight in only one eye can get along quite well. What clues from the environment do they use to help judge distances and depth?

How was the Lab Question answered in your experiment?

List three findings you think are important from today's experiment. Were you surprised by anything you found?

How could you improve this experiment?

Perceiving Motion, Form, and Depth

DESIGNING AN EXPERIMENT

WHAT ELSE CAN WE FIND OUT ABOUT VISUAL PERCEPTION?

The phrase **"visual perception"** refers to more than just depth perception: it is a broad term that refers to how we interpret the meaning of what we see. Thus, when we use our depth perception, we interpret some objects as being closer than others, and we comprehend that, for example, a globe is a solid sphere, not a flat circle.

In interpreting other visual information, we often use our **past experience**. For example, when we see a friend at some distance, we recognize the person and know that this is a human of normal size, even though the person looks much smaller than a person standing right next to us. We are using cues from the rest of the scene—we notice that the trees and buildings also appear small, and realize that this means that the person is some distance away, and is not a miniature human!

Because we use cues like this, pictures that mix up the cues can fool us. Parts of the brain that associate our memories with what we are currently seeing are responsible for visual perception, and these "higher brain centers" are frequently tricked by **visual illusions**.

You can use what you have learned about perception to develop your own experiment. Explore the materials your teacher makes available and think of some things you can investigate.

- For example, choose some of the visual illusions and **devise tests** for your classmates to see how they score.

- **Construct** your own visual illusion and test it.

- **Devise a "minimum difference test"** to see how different one or one group of objects in a set must be from the others, in order for people to notice it readily. For example, draw a page of identical smiley faces in rows. Make one smiley face a little different—make the smile a bit less curved. How long does it take someone to point to the different one? What if you make a frowning face in a sea of smiley faces? Can you think of another kind of variable to change? If all the objects are a dull color, are the results different from what you get if all are brightly colored? Do certain colors make identification harder?

- **Extend the depth perception study** to find out if there is a distance limit to the idea that two eyes are better than one, as you found in the Class Experiment. You may need to move to a large classroom or outside to finish this experiment.

HOW CAN YOU DESIGN A GOOD EXPERIMENT?

In designing experiments to answer questions like these, keep in mind what a **successful investigator** must do:

- Ask a **very specific question**: not, for example, "Can I fool someone with a visual illusion?," but rather, "With this visual illusion on relative sizes of objects, what percentage of subjects will give the wrong answer?" It's good to have the general question in mind, but ask a narrow question for each experiment.

- Be sure you understand the **control condition** for your experiment, and then **change only one thing, or variable,** in the experiment.

- For example, if you plan to test people for their ability to see if two objects are the same size in a visual illusion, for the **control** experiment show the subjects two identical circles. To change a **variable**, add a series of small circles around one of the original circles, and a series of large circles around the other original circle, and repeat the test. Do not let your Subject know you are using the same original circles! Ask your teacher for a pattern from the Teacher Guide for this experiment.

- Follow this same plan with other kinds of visual illusions: in this way you will make your activity a real **experiment**, with a **prediction** and a **test** for the prediction. Then **analyze**—think about—your results and make **conclusions**.

- Researchers try to **change only one variable** in a new experiment after they do a control experiment. Sometimes this is difficult, but at least they must be aware of other variables and think about what effects they might have.

- **Keep good records** of everything you do.

NAME:_____DATE:_____

Visual Puzzles

TRY YOUR OWN EXPERIMENT!

LAB QUESTION

PREDICTIONS

PROCEDURE (Use as many steps as needed.)

1. After you **explore** materials and **brainstorm** ideas for your experiment, each group should agree upon and write a **Lab Question** in the box above.

2. Write a **prediction** for the answer to your question in the box above.

3. **List the steps** you will take to perform your experiment. Include a list of **supplies**.

4. Figure out what the **control conditions** for your experiment will be, and whether your experiment is one that sets control conditions, or one that tests a new variable, or both.

5. Try to change only one **variable.**

6. Design a **data sheet** or table to record your results.

7. Get your **teacher's OK** before beginning your experiment.

8. **Clean up** your area when you finish.

DATA AND OBSERVATIONS

Your teacher will give you **supplies** for your new experiment.

In addition to recording your data, such as the number of correct and incorrect answers to tests, **write down** observations on what worked well and what didn't, problems with supplies, or disagreements people had in their groups.

ANALYSIS: THINK ABOUT IT!

1. What is the control condition for your experiment?

2. What did you change or add for your new experiment? Did you change only one variable?

3. If you tested people's ability to judge size or distance with illusion drawings, what did you find?

4. What are some explanations for why people are tricked by visual illusions?

5. If in your new experiment you created a "minimum difference test," explain your findings.

CONCLUSIONS

How did your results answer your Lab Question?

How certain are you of your conclusions? Would you need more evidence to convince yourself or others that your conclusions are right?

What are some other ideas for experiments on visual perception?

MORE *VISUAL PERCEPTION* ACTIVITIES

Find out more about visual perception and puzzles by searching the World Wide Web or your library. Here are some good Web sites to visit for visual system information:

http://www.vision3D.com at the Optometrists' Network, this site shows you the Magic Eye book type of illusion. Go to Magic Eye 3D.

http://www.worldofescher.com/gallery M.C. Escher's famous drawings

http://www.illusionworks.com/index.html

http://www.sandlotscience.com lots of illusions

http://faculty.washington.edu/chudler/chvision.html

http://www.hhmi.org/senses (see: The Strange Symptoms of Blindness to Motion)

http://www.visionscience.com

http://www.sciam.com/explorations/0492melzak.html#sidebar Scientific American article on "phantom seeing and hearing," similar to phantom limb experiences