

Our Sense of Sight: 1. The Eye and its Connections

Out of Sight!

Student Guide

How does *PERIPHERAL VISION* work, and how does it help us to see better?

“Hey, good game!” exclaimed Heather as she and her friends left the gym. “Yeah,” agreed Erica, “thanks for the pass so I could make that last lay-up. I didn’t think you saw me signaling you.” “I just caught you out of the corner of my eye,” Heather replied. “I know what you mean,” said Erica, “but isn’t that a funny saying we have—I wonder just what it means, ‘out of the corner of my eye’?”

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. Sometimes we look directly at an object, as when we read or when we shoot a basketball toward the hoop. But we use **peripheral** vision as well—we can detect things to our sides even while we are looking straight ahead. How good is this “side vision?” Can you read something off to the side, while keeping your eyes pointed forward? Could Heather identify Erica when she first saw her “out of the corner” of her eye, or did she just see someone moving?

After your class discussion and experiment, use what you have learned to explain how Heather saw Erica during their basketball game.

Name: _____ Date: _____

Out of Sight!

CLASS EXPERIMENT

LAB QUESTION

PREDICTIONS

SUPPLIES

Vision Disk or Hat
Letter cards
Paper to record results
Recording sheet at the end of this handout

PROCEDURE

1. Write the **Lab Question** and then write your prediction in the boxes above.
2. Your teacher will **demonstrate** how to use the Vision Disk or Vision Hat.
3. Follow all **safety procedures** your teacher recommends.

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

FOR THE EYES-FOCUSED MEASUREMENTS:

5. The Subject sits at a table or desk holding the **Vision Disk** against the forehead. Brace your elbows on the table and look straight ahead at the hole in the focus marker. Or, if using a **Vision Hat**, put the hat on and center the focusing line in front of your eyes.
6. The Tester moves the arm on the Vision Disk or Hat all the way to the back on the subject's right side, selects a letter card (make sure the subject does not see it), and places one in the slit on the arm. For the Vision Hat, the Tester will put a post-it with printed letters on the end of the moveable arm.
7. The Tester slowly moves the arm forward while the Recorder sits in front of the Subject and watches to make sure the Subject's eyes stay fixed on the focus marker. Tell the Subject if you see his or her eyes move to the side.
8. The Subject tells the others **immediately** when he or she first sees the card (although reading it will not be possible at first). As the card moves into view, it will be hard for the Subject to keep from looking directly at it. If the Subject has looked directly at the card and knows the letters, change cards and continue.
9. When the Subject reports sighting the card, the Tester reads the number in the triangle on the rim of the Vision Disk or Hat for the Recorder, who writes it down and marks it on the diagram on the Eyes Focused Recording Sheet with an "S" for "sight." (Do not write on the Vision Disk or Hat.)
10. The Tester continues to slowly move the arm forward until the Subject can read the letters. (The Recorder again watches and reminds the Subject to keep eyes pointed forward.)
11. The Tester reads this number on the Vision Disk or Hat and the Recorder writes it on the sheet and also marks the Vision Disk or Hat diagram here with an "R" for "read."
12. Repeat the procedure for the left side of the subject.

FOR THE EYES-MOVING MEASUREMENTS:

13. Repeat the procedure, starting with step 5 above, but this time the Subject will be allowed to move his or her **eyes**, but **not head**. The Subject should predict what the measurements will be for both fields of vision. Proceed through step 12.
14. Switch roles and repeat the measurements for anyone else who wants to be a Subject.
15. Clean up your lab area when you finish.

DATA AND OBSERVATIONS

- On their Recording Sheets, all Subjects should now have an **S** and an **R** on the left and right sides of the diagram of the Vision Disk or Hat, corresponding to the measurements that were made. Next, Subjects should connect the center dot on the diagram of the Vision Disk or Hat with the **S** and then with the **R** marks to demonstrate the angles in which they can **sight** something in peripheral vision and in which they can **read** something **without moving eyes**. **Shade in the reading area**. Then, with dotted lines, draw lines for your fields of vision when you were allowed to move your eyes.
- Your teacher will ask someone in your group to write your results in a class chart.
- **Calculate the class average** for the two measurements done without moving eyes: Sighting and Reading. Note: the numbers on the Disk or Hat are arbitrary units, not degrees. They help compare different people's visual fields.
- 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?

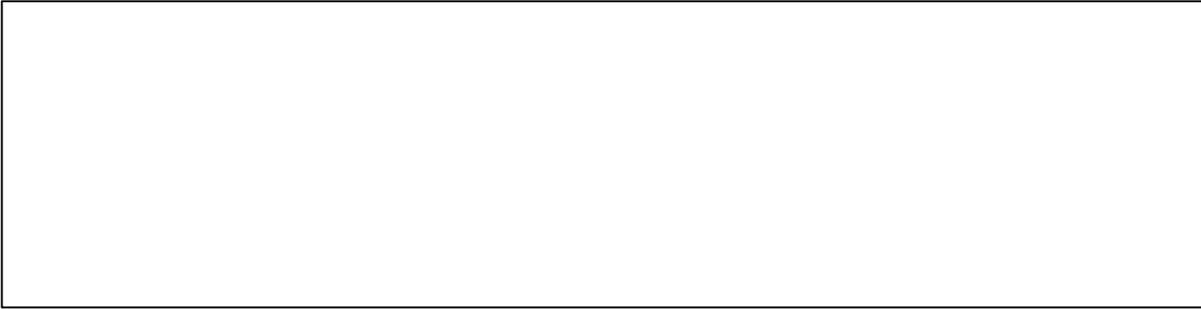
2. Were results from any Subject very different from those of everyone else? What could be some reasons for this?

3. Is peripheral vision important, even though you cannot identify an object when it first comes into your field of view? List several useful things about peripheral vision.

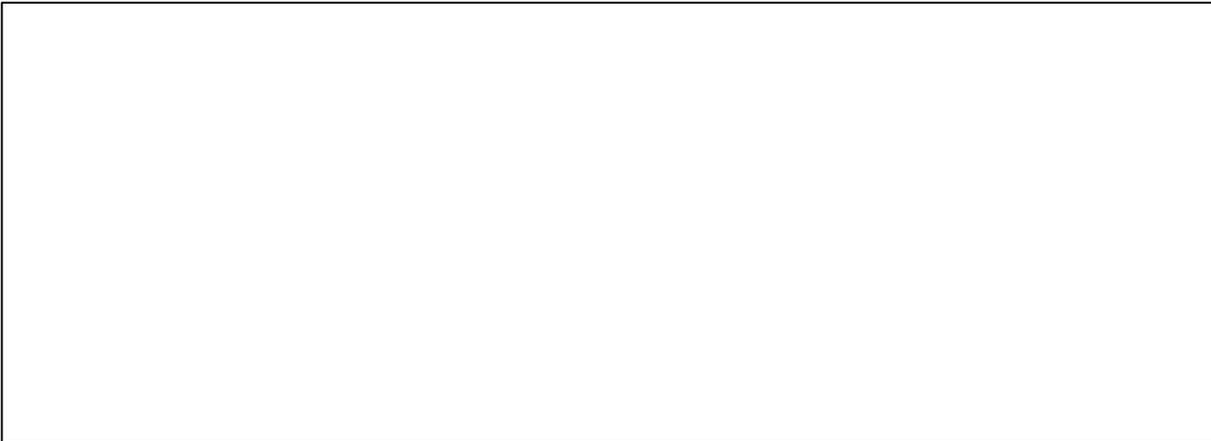
4. What part of the retina does the image of written letters fall on when you can see them but not identify the letters? What area must the image fall on in order for you to read the letters?

5. Where in the retina are cones most concentrated? In the Scenario at the beginning of this Guide, were Heather and Erica using rods or cones for peripheral vision?

6. How did your “sight” and “read” areas change when you were allowed to move your eyes?



7. How does information from the retina get to the brain? Illustrate with a simple diagram.



CONCLUSIONS

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?

The Eye and its Connections

DESIGNING AN EXPERIMENT

WHAT ELSE CAN WE FIND OUT ABOUT THE SENSE OF SIGHT?

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

- For example, to continue the experiments on peripheral vision, make some shape cards (triangle, square, etc.) and some color cards to go with the Vision Disk or Hat. How does your “shape” field compare with your reading field? At what point can you identify colors correctly?
- What would happen if your field of vision were restricted? Use masks to create “tunnel vision” and think of a way you can test this vision against normal vision.
- Do animals with eyes placed differently from ours see things differently? How could you get an idea of what vision is like for another animal?
- Do all areas of our retinas resolve things equally? Find out more about the blind spot, and learn how to demonstrate it. Ask your teacher for help.
- Do most people know how to keep their eyes safe? Make up an eye safety test and test some of your classmates.

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 people perform well if their fields of vision are restricted?”, but rather, “If a person wears a tube-shaped mask six inches long, how well can he or she catch a ball compared with not wearing it?” 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 do a “tunnel vision” test with masks, you can define performance without a mask as the control, and with a mask as the variable. To add another variable, change the length of the mask.
- 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, write them down, and think about what effects they might have.
- Some activities are not experiments but rather demonstrations. For example, you may find a way to demonstrate the blind spot, but this is not an experiment. To make your activity a real **experiment**, make a **prediction**, **test** the prediction, **analyze** the results, and write **conclusions**. For example, predict what distance a diagram must be from the eye to demonstrate the blind spot, then test your prediction. Try changing other variables, such as lighting conditions.
- If you make up an eye safety test, predict the scores you think people will get. Keep it short, perhaps ten questions. Predict whether you think people will miss the same questions, and which questions these will be.
- Keep good records of everything you do.

NAME: _____ DATE: _____

Out of Sight!

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 how subjects scored in your test or the type of mask you used, **write down** observations on what worked well and what didn't, problems with supplies, or disagreements people had in their groups.

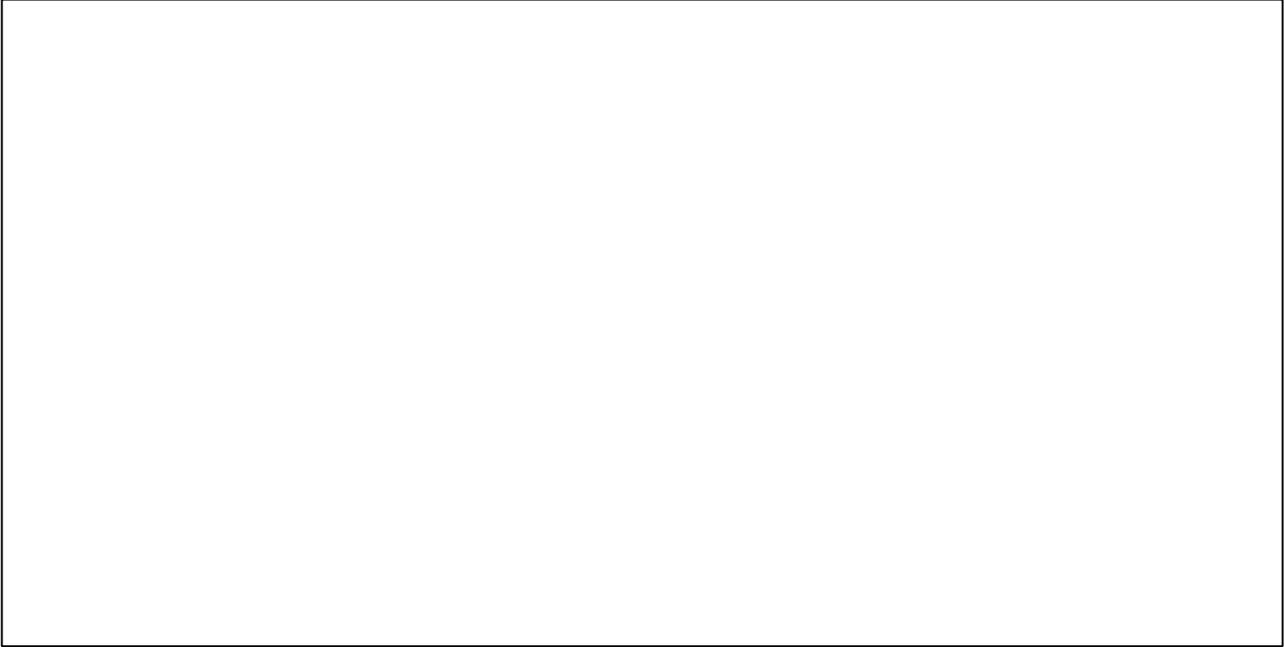
ANALYSIS: THINK ABOUT IT!

1. What is the control condition for your experiment?

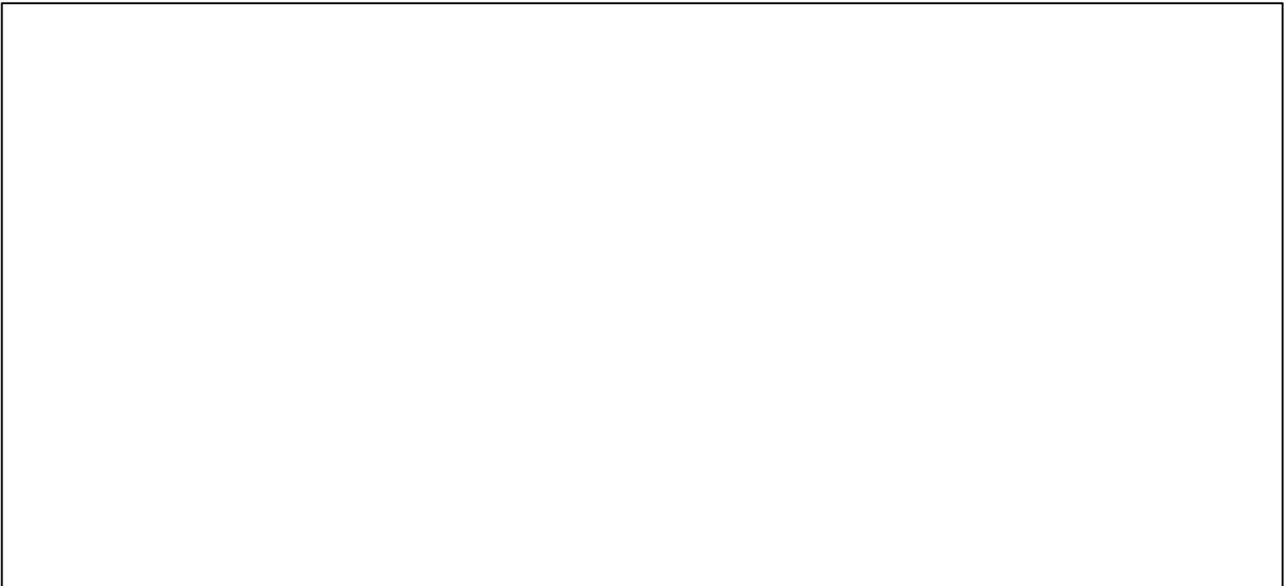
2. What did you change or add for your new experiment? Did you change only one variable?

3. If you tested people's ability to identify shape and color with their peripheral vision, what did you find?

4. If you investigated animal vision, what were your results? What must animals (or people) with restricted peripheral vision do to compensate for the restrictions?



5. Describe any other experiments you did and what you found out.



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 the sense of sight?

Record Sheet

Subject's Name _____

#1: Eyes-Focused Measurements



#2: Eyes-Moving Measurements



MORE *SENSE OF SIGHT* ACTIVITIES

What is “dark adaptation?” How does it work and why is it important?

Do some animals have higher acuity—sharper vision—than we do? What gives them sharp vision? How do they make use of it?

What are some eye problems that people have? Try looking for some of the following terms in your library or on the World Wide Web:

- Glaucoma
- Corneal transplants
- Macular degeneration
- Myopia
- Hyperopia
- Astigmatism
- Presbyopia
- Cataracts
- Eye safety
- Detached retina
- Retinitis pigmentosa
- Diabetic retinopathy
- Strabismus

Here are some good Web sites to visit for visual system information: your teacher can help you find the best one for your project.

<http://www.nei.nih.gov/pubpat.htm>

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

<http://faculty.washington.edu/chudler/bigeye.html>

<http://faculty.washington.edu/chudler/retina.html>

http://www.accessexcellence.org/AE/AEC/CC/vision_background.html

<http://www.hhmi.org/senses>

<http://www.prevent-blindness.org>

<http://www.insight.med.utah.edu/Webvision/index.html>

http://www.sfn.org/briefings/eye_repair.html