Teacher Notes

Do you see what I see? (Grades 5-6)

LOGISTICS
Class grade/age: 5-6th grade
Class size: 20 students
Instructional Time: 55 minutes
Location: Classroom
Safety: Students should only use materials as instructed.

BACKGROUND

In order to see, there must be light. Light reflects off of objects, enters the eye and passes through many structures in order for objects to be perceived by an animal's visual system. Light gets focused and eventually converted into electro-chemical signals that the brain can interpret. The brain must receive -- and interpret -- the eye's signals. Once this is done, vision occurs. However, what your eyes take in and report to your brain, is not necessarily exactly what you have seen. Your brain edits what your eyes see, and a lot of what you think you see is actually made-up by the brain. This can have some serious implications for the accuracy of eye-witness accounts in a court of law.

There are different aspects of vision. The use of two eyes to see one picture is known as **binocular** vision which allows for us to see in **three-dimensions (3D)**. The view from each eye is slightly different because the eyes are around two inches apart. These two views give us **depth perception**. The brain combines these views from each eye into a single 3D image, allowing us to judge distances between objects or to tell if something is near or far from us. There is a **blind spot** which is a tiny spot in the visual field of both eyes that doesn't pick up any visual cues. We don't notice our blind spot because the two different views from each eye compensate for the blind spot of each eye and your brain fills in the 'blanks' caused by your blind spots. **Peripheral** vision is what you can see off to the side, even if you are looking straight ahead. This is also referred to as the **visual field**, and it's how objects you aren't' looking directly at can 'catch your eye'. Also, most people (90%) have a **dominant eye** (80% right-eye dominant and 10% left-eye dominant); it's the eye that the brain takes most notice of when both eyes are open. There are a few simple tests that can be done to explore these and other aspects of vision.

SUMMARY OF ACTIVITIES

In this two-part lesson, students will be performing simple tests to evaluate aspects of their own vision and then dissecting a cow eye to appreciate the complexity of the eye. In part one, students will perform simple tests to identify and measure certain aspects of their own vision such as depth perception, pupil constriction/dilation patterns, blind spot location, peripheral vision, and color perception. In part two students will apply these concepts by dissecting a cow eye to identify various structures and determine their function. Part 1 and 2 can be done in any order.

INQUIRY NOTE: The goal of this lesson is NOT to lecture about the eye/vision and address relevant concepts. Instead, it is designed to progressively introduce students to mammalian visual systems. This provides students with opportunities to question, experience, and discover rather than to be told. The teacher's role is facilitator; asking the right questions will help students to develop their own ideas, thereby giving them ownership of their knowledge.

STANDARDS

MS-LS1-3. Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.

MS-LS1-8. Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memorie**s.**

OBJECTIVES

The students will …

1. define visual field, binocular, depth perception, and peripheral vision.
2. evaluate various aspects of their own vision such as pupil constriction/dilation, blind spot, peripheral vision, depth perception and dominant eye.
3. analyze qualitative data for their own peripheral vision.

Materials:

- Student Pages, 20 (1/student; print on both sides)
- Visual Explorations Instruction Cards (set of 6), 5 sets
- Visual Explorations Test cards (Blind spot & After Images)
- Paper clips
- Rulers, 10 (2/group)
- Flashlight, 5 (1/group)
- Pencils, sharpened, 20 (1/student)
- Cardboard tubes, 5 (1/group)
- Stopwatch, 5 (1/group)
- Visual Field Test Poster, 5 (1/group)
- Markers, 20 (need 4 different colors/group x 5 groups)
- Visual Field Test Cue Cards
- ONLINE STOPWATCH

Advanced Prep Materials:

Visual Explorations Instruction Cards – Part 1 Activity 1:

- Vis. Ex. Isnt. File
- Cardstock, white, 8.5 x 11, 5 sheets
- Paper cutter
- Paper clip, 5

Test Cards – Part 1 Activity 1:

- Blind spot file
- After Images file
- White card stock
- Scissors
- Paper cutter
- Double-sided tape

Visual Field Test Cue Cards – Part 1 Activity 2:

- VFT cues, PPT file
- Cardstock, 4 different colors
- Paper cutter
- Scissors
- Envelopes , 5

Visual Field Test Poster – Part 1 Activity 2:

- Poster file
- Poster printing services

ADVANCED PREPARATION INSTRUCTIONS:

1) Visual Explorations Instruction Cards: Print five copies of the file on white cardstock; there are two cards/sheet. Use a paper cutter to cut each sheet/card in half. Each group gets one set with 5 instruction cards (one set of instructions per test). Secure theses with a paper clip.

2) Visual Explorations Test Cards: Print and cut the Blind Spot Cards and After Images Cards so you have 5 of each (one/group for both types of test cards). For the Blind Spot Cards, there should be two sides (one with just a dot and a cross, and the other has a line through these same shapes). NOTE: it was hard to line these up for double-sided print; if needed, print on single sided, cut each out and fasten using double-sided tape.

3) Visual Field Test Cue Cards: Print the shapes out on differently colored cardstock (print 4 slides/page for each shape on a different color cardstock). Each shape has a different letter in it. Use a paper cutter/scissors to cut-out these shapes. Each group should get 4 different shapes, each on a different colored paper with a different letter printed on them. Place a set of 4 different shapes into the envelope (one envelope per group).

4) Visual Field Test Poster: Print 5 posters/class (or have them printed).

ACTIVITIES:

Activity 1: Visual Explorations
Activity 2: Vision Tests and Analysis

Introduction **Estimated Time:** 5 minutes

Goal: Teacher will capture student interest and gauge prior knowledge.

1) Ask students what they know about their own vision or eye biology in general? (*accept various answers*)
2) Do the "Adjusting to Light" (Pupil dilation/constriction) test as a whole class.
    a. Have everyone pick a partner (right next to them; don't make this a big production – make it quick).
    b. Tell students that you're going to ask them to close their eyes while you shut down the lights for several moments.
    c. Explain to the students that when you make an announcement and turn the lights back on, they are to look in their partner's eyes and observe what happens.
    d. When everyone understands the directions, go ahead and turn off the lights and have all students close their eyes for at least 30 seconds (preferably 1 minute).
    e. Make an announcement when it's time to turn the lights back on and have the students look immediately into the eyes of their partners and observe what happens.
3) Have a few students report-out what they observed and have them explain the relationship (what happens to the pupil in low vs. high light situations?).
4) Relate these observations to relevant eye anatomy (iris, pupil).
    a. Iris is a muscle that controls how big the pupil gets; it is the colored part of human eyes
    b. Eye needs light to see:
        i. In LOW light conditions, the pupil widens (dilates) in an attempt to obtain as much light as possible
        ii. In HIGH light conditions, the pupil gets smaller (constricts) since there is already enough light coming through.
5) Lead a brief discussion about how the eye is an important sensory organ and the brain helps the eyes to see the world.

Activity 1: Visual Explorations **Estimated Time:** 20 min

Goal: Students will perform simple tests to explore various aspects of their own vision.

Materials:

- Visual Explorations Instruction Cards (set of 5), 5 sets
- Test cards (Blind spot, After Images)
- Paper clips
- Rulers, 10 (2/group)
- Flashlight, 5 (1/group)
- Pencils, sharpened, 20 (1/student)
- Cardboard tubes, 5 (1/group)
- Stopwatch, 5 (1/group)
- Online Stopwatch

Procedures:

1) Have all materials in a tote that is accessible to each group. Pull up an online timer and set it to 2minutes.
2) Explain to students that they will have up to 2 minutes to explore each test; they need to switch to a different test at the sound of the timer.
3) The instructions for each test are printed on cards and shared among groups.
4) Have students work as pairs, but the groups will be sharing all of the materials needed to perform each test.
5) Distribute student page (lists chart/checklist of vision tests to perform with a partner) and give them 10 minutes to explore & perform the different tests.
6) Allow about 5-10 minutes to discuss results of each test and transition to the next activity.
7) Clean up materials.

Transition to next activity: Have students volunteer to share some of their observations about the various tests they performed. Ask them what surprised them, impressed them, or confused them. Address the relevant eye anatomy/structures or aspect of our visual system for each test. If doing a dissection, address the eye dissection tie-in ("As you have seen in the dissection" or "as you will see in the dissection"). Announce the next activity: collecting and analyzing some data to evaluate one particular aspect of our vision: peripheral vision.

Activity 2: Peripheral Vision **Estimated Time:** 25 min

Goal: Students will collect data to evaluate their visual field.

Materials:

- Pencils, sharpened, 20 (1/student)
- Student page, 20 (1/student)
- Visual Field Test Poster, 5 (1/group)
- Markers, 20 (need 4 different colors/group x 5 groups, marker color should match cue cards' colors)
- Marker, black, 5 (1/group x 5 groups, this is for the 'run-through' trial to help students learn their roles)
- Visual Field Test Cue Cards, 5 sets (4 different cards/set)
- Envelopes, 5 (1/group)

Procedures:

1) Have the group leaders place each poster in a designated area of the room, or go into the hallway if possible.
2) While group leaders are setting out the posters, ask students if they know what their peripheral vision is? (*what we see out of the 'corner of our eye'*).
3) Divide/Assign groups of 4 and have them report to a poster.
    a. IMPT: Each poster needs an Allies student to lead step 4
    b. The teacher leading the activity will lead step 4 for TWO groups that are close together.

4) Each teacher and group leader will go through the different roles with their group.
    a. Have the students do a quick "run-through" of the test with the cue sender (student B) using a random number of fingers.
    b. Use a BLACK marker to record the results of the finger cue.
    c. The goals of this step are as follows:
        i. Make sure each of the student jobs/roles are clear
        ii. Make sure students know there are FOUR data points per student and they need to announce when they first see each measure as follows:
            1. M for Motion – "I see movement"
            2. C for color – "I see the color _____"
            3. S for shape – "I see the shape _____"
            4. L for letter – "I see the letter _____"
        iii. Make sure the cue sender starts BEHIND the line of peripheral vision, rather than right in line with it.
        iv. Make sure student C (recorder) knows that when the test starts, they must assign a + or – next to the color, shape or letter (+ if they are correct and – if they are incorrect)
        v. Have students follow along with the instructions on the student page.
        vi. Allow them to ask any questions for clarification.
5) Once everyone knows what to do, have them proceed with the test. The assigned group leader or teacher is to help make sure the directions are followed properly.
6) Each student should get their data recorded for them by the "sheriff/data transferor"
7) Lead a discussion about the results each group obtained and how these results compare to each other?
    a. Discuss these results in terms of how this is relevant to nature and/or evolution (*it makes sense that we don't see great details unless our head is facing the particular cue; it explains why we have a natural tendency to 'turn our head' in the direction of movement or some other visual stimuli; this makes evolutionary sense because a prey animal would want to be able to run away upon detecting motion, and doesn't really need to know what color or shape the predator is, just that they need to get away*).

WRAP-UP ENTIRE LESSON **Estimated Time:** 10 minutes

Procedures:

1) Allow students an opportunity to share their opinions and experiences with today's activities.
2) Verbally quiz students on the bold-term definitions and outcome of the various visual perception tests conducted.
3) Relate the outcomes/results of their tests to "every day" life:
    - Survival
    - Communication
    - Decisions/safety
    - Others?
4) Allow students time to ask questions.

Clean-up:

1) Throw away specimen in the trash; tie-off the garbage bag and place it in the hallway before you leave the room.
2) Wash and dry ALL dissection equipment before returning it to the bin.
3) Keep all visual perception materials, instruction cards and return them to the bin.
4) Recycle any student papers left behind.

Assessment:

1) Informal/formative during class discussions and activities.

2) Relating accurate visual components/vision structures to various visual perception tests.

3) Possible survey questions:
    a. Name the structure that causes us to have a blind spot? (*optic disc on retina*)
    b. Which type of photoreceptor detects color? (*cones*)
    c. Which type of photoreceptor detects light intensity? (*rods*)
    d. What is the fancy word for having two eyes to see? (*binocular*)
    e. What happens to a pupil in low light conditions? (*it gets bigger/dilates*)

EXTENSIONS/ADAPTATIONS

1) Re: Dominant Eye. 2/3 population are right-eye dominant and 1/3 are left eye. See if your class matches the frequency observed in the general population. You can take it furtehr and do a chi-squared test!
2) Test the other eye for the visual field test (continue all the way around the semi-circle, rather than stopping at 90*) to compare peripheral vision of both eyes.
3) Do other Opitcal illusions & Visual Phenomena (search web for Michael Bach)
4) Learning to see activities; for pictures where you can't quick make out an image, once you see it you always will.
5) Cover eye diseases in greater detail.

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APPENDIX: *A more detailed description of how light passes through the structures in the eye.*

The first thing light touches when entering the eye is a thin layer of lubricating tears that coats the front of the eye. Behind these tears is the front of the eye, the **cornea**, which is a clear covering that helps to focus the light as it passes through the eye. There is more moisture on the other side of the cornea; it's a clear, watery fluid called the **aqueous humor** through which light also passes. The aqueous humor circulates throughout the front part of the eye and keeps a constant pressure within the eye. We need the right amount of pressure to maintain proper vision. Too high of an intraocular (inner eye) pressure can cause damage to the optic nerve and is a risk factor of glaucoma, an eye disease that can lead to loss of vision.

After light passes through the aqueous humor, it passes through the **iris**. This is the colored part of the eye which is actually a tiny sphincter muscle that helps control the amount of light that passes into the eye. Depending on how much light there is, the iris may contract (get smaller) or dilate (get larger), adjusting amount of light that travels deeper into the eye through the opening known as the **pupil**. The light then goes through the **lens** which focuses the light; the lens changes shape to focus on light reflecting from near or distant objects.

This focused light now beams through the center of the eye, where there is an additional jelly-like sac of clear fluid, known as the **vitreous humor**. The vitreous humor provides nourishment to the eye. The **retina**, a thin and transparent structure which covers the inner wall of the eye, is the final stop for the light as it passes through the eye. In a way, the retina is like a movie screen. The focused light is projected onto its flat, smooth surface. However, unlike a movie screen, the retina has many working parts: a) **choroid:** a layer of blood vessels behind the retina that delivers nutrients; b) **fovea:** tiny depressions near the center of the retina where sharpness of vision is greatest; c) **photoreceptors:** specialized cells that convert the received light into electro-chemical signals; cones detect bright light & are for sharp daytime vision and color perception while rods function in dim light to detect size, shape and brightness of objects. Signals sent from these photoreceptors travel along nerve fibers to a nerve bundle at the back of the eye, called the **optic nerve**. It carries all the information collected from the eye to the brain. Finally, surrounding the entire eye is the tough, fibrous, white part of the eye known as the **sclera**. It protects the delicate structures inside the eye.