Visual Fields and Visual Pathways

Objective:

To examine the field of view for each eye, and to explain in words or diagrams how changes in fields of can be associated with damage to the retina or central neural pathways, or reflect tumors in the brain, at the level of 85% proficiency for each student.

In order to achieve this objective, you will need to be able to:

1. Measure the field of view (visual field) for each eye in two axes.
2. Explain the anatomy of the visual pathways

Materials:

Group Supplies:

Colored pencils or pens
Visual field diagrams
Four colors of string to represent axons
Four colors of beads to represent cell bodies

Lab Supplies:

Disc perimetry device and target wand

Methods and Results:

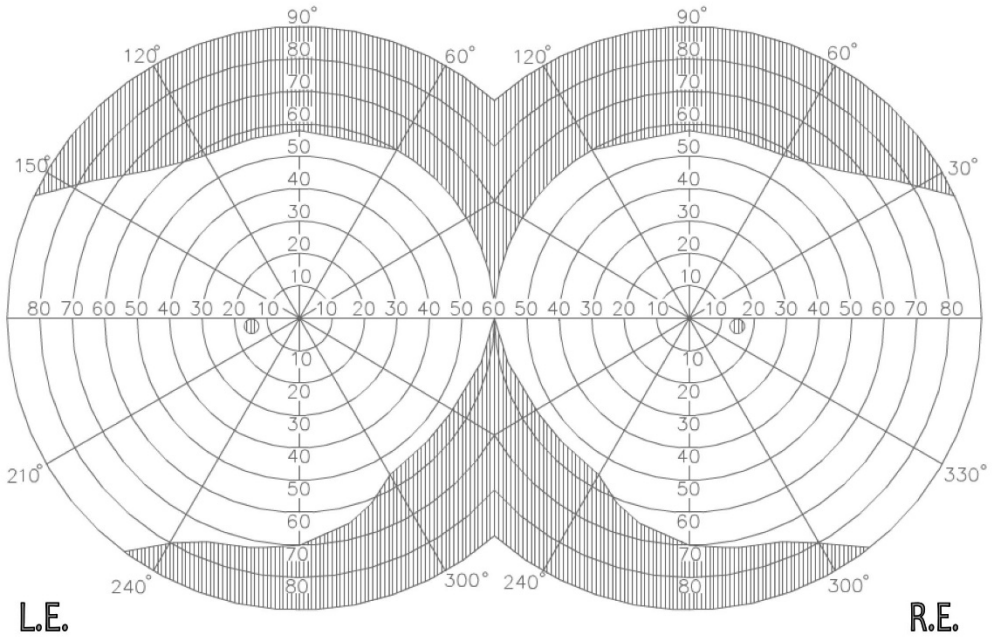
Visual Fields

When we look straight ahead and do not move our eyes, only a certain amount of the potential view can be seen. We will measure the field of view for the leftt eye and for the right eye.

1. Have the subject cover their RIGHT eye. Test the LEFT eye
2. Hold the large plastic half disc horizontally against the nose to test the temporal and nasal fields.
3. Have the subject look at the center dot of the half disc.
4. To test the temporal field, hold the wand near the center dot and move temporally until the peripheral target disappears. Repeat the test starting at temporal 90^{o} and move toward the center dot. Record the points of disappearance and appearance in degrees on the temporal side of the visual field diagram for the LEFT eye.

5. To test the nasal field, hold the wand near the center dot and move nasally until the peripheral target disappears. Repeat the test starting at nasal 90º and move toward the center dot. Record the points of disappearance and appearance in degrees on the nasal side of the visual field diagram for the LEFT eye.
6. Hold the large plastic half disc vertically against the nose to test the superior and inferior fields.
7. To test the superior field, hold the wand near the center dot and move upward until the peripheral target disappears. Repeat the test starting at 90º and move downward to the center dot. Record the points of disappearance and appearance in degrees on the superior field of the visual field diagram for the LEFT eye.
8. To test the inferior field, hold the wand near the center dot and move downward until the peripheral target disappears. Repeat the test starting at 90º and move upward to the center dot. Record the points of disappearance and appearance in degrees on the inferior field of the visual field diagram for the LEFT eye.
9. Have the subject cover their LEFT eye. Test the <u>RIGHT</u> eye. Repeat steps 2-8 and record the points of disappearance and appearance in degrees on the visual field diagram for the <u>RIGHT</u> eye

Visual Field Diagram – LEFT Eye (L.E.) and RIGHT Eye (R.E.)

	LEFT EYE		**RIGHT EYE**	
	Temporal Field	**Nasal Field**	**Nasal Field**	**Temporal Field**
Superior Field				
Inferior Field				

Visual Pathways

The retina of each eye is anatomically segregated into a nasal half and a temporal half. The left side of the retina of each eye connects to the left side of the brain. The right side of the retina of each connects to the right side of the brain.

- Axons from the retina travel through the optic nerves, optic chiasm, and optic tracts to reach the Lateral Geniculate Nucleus (LGN) of the Thalamus
- Axons from the left half of the retina of each eye pass through the left optic tract and synapse on neurons in the Left Lateral Geniculate Nucleus (LGN) of the Thalamus.
- Axons from the right half of the retina of each eye pass through the right optic tract and synapse on neurons in the Right Lateral Geniculate Nucleus (LGN) of the Thalamus
- Axons from the retina also synapse on neurons in the Superior Colliculus which contain a sensory map and coordinates orientation of the eyes, head and neck toward visual stimuli.
- Neurons in the Left Lateral Geniculate Nucleus (LGN) of the Thalamus synapse on neurons in the Left Primary Visual Cortex.
- Neurons in the Right Lateral Geniculate Nucleus (LGN) of the Thalamus synapse on neurons in the Right Primary Visual Cortex.
- Both the Lateral Geniculate Nuclei and the Primary Visual Cortex contain a sensory map of the entire visual field and process (filter) visual signals.

Organization of Visual Pathways

<table>
<tr><td colspan="2">Retina of Left Eye</td><td colspan="2">Retina of Right Eye</td></tr>
<tr><td>Left Half
(temporal)</td><td>Right Half
(nasal)</td><td>Left Half
(nasal)</td><td>Right Half
(temporal)</td></tr>
<tr><td colspan="2">Left Optic Nerve</td><td colspan="2">Right Optic Nerve</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="4">Optic Chiasm</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td>Left Optic Tract</td><td></td><td></td><td>Right Optic Tract</td></tr>
<tr><td>Left LGN

Left Superior Colliculus</td><td colspan="2" rowspan="2"></td><td>Right LGN

Right Superior Colliculus</td></tr>
<tr><td>Left Visual Cortex</td><td>Right Visual Cortex</td></tr>
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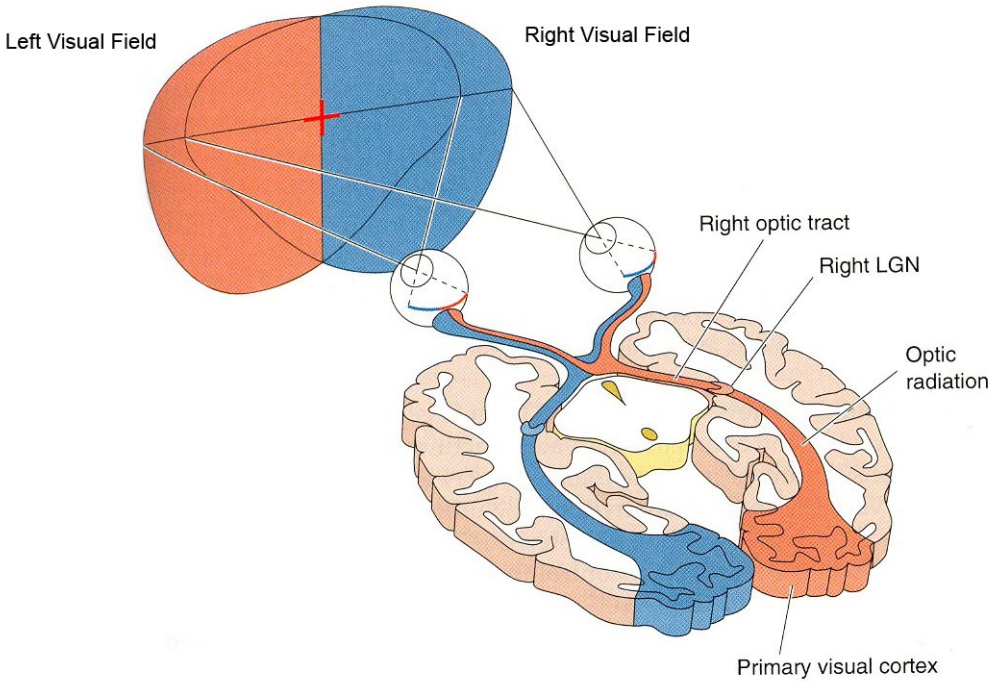
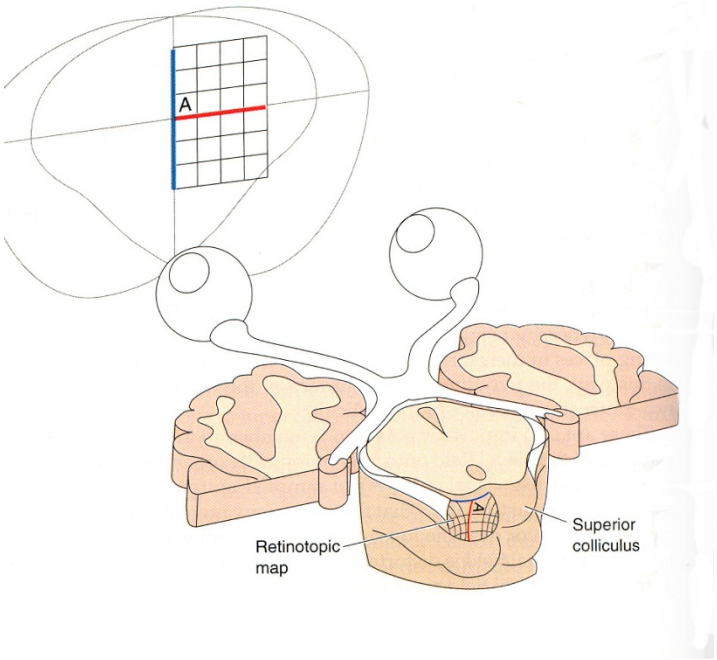
Diagram the visual pathways. Include the cell bodies, axons, and synaptic sites for each set of neurons in the pathways. Label each nucleus and tract as they are relevant.

Pathways to Primary Visual Cortex



Pathways to Superior Colliculus



Discussion:

1. Anatomically, the retina extends farther forward on the medial (inside) of the eye than the lateral (outside). Did this anatomical feature affect the findings?
2. Why is the superior field less than the inferior field?
3. Diagram the pathway of neurons involved in the connections from the retina to the visual cortex.
4. If a patient reported that he could not see at all with his left eye, how could you tell if the problem was the optic nerve or the optic tract / radiation? Explain.
5. Reduced field of vision is often a symptom of glaucoma. Offer an explanation for this occurrence.