

Retinal Anatomy Inquiry

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Audience: About 15 undergraduate students with majors in science, technology, math, and technology prior to beginning their CfAO internship. Approximately $\frac{1}{3}$ of the students will have internships in an adaptive optics vision science laboratory and in 2005 approximately $\frac{1}{2}$ of the students were Texans.

Where: Mainland Short Course, UCSC

We usually have about 3 hours to complete the entire modified inquiry due to time constraints

Goals

- Gain a better understanding of retinal anatomy and how it applies to our vision
- Visual acuity and color vision vary by retinal location.
- Gain a better understanding of applications of adaptive optics and its use in studying the retina
- For the students to become familiar with the concept of visual angle and measuring the size and distance of retinal anatomy features.

Goals

- Be able to apply the concept of sampling that is given in the thinking tool to their observations of vision and how it applies to retinal anatomy.
- Practice the scientific process
- Become more comfortable with recording and sharing data which will be useful at their internship locations
- Become comfortable working in small teams
- Build students self esteem and increase their confidence in and familiarity with vision science research

Timeline

Total time: 3 hours

- Introduce thinking tools 10-15 min
- Break up students into two groups and show each group the starters 5 min
- Allow the students to pick the topic (starter) that most interests them. Ask the students if they have any questions verbally (try and limit 1 question per student).
- Divide the students as quickly as possible into smaller groups. 15-20 min
- Investigation by small groups 45 min
- Write up and or graph their results 15 min
- Share to all students what each student team found out 30 min
- Synthesis talk, this talk ties together what students found out during their investigation session. Also allows me to introduce interesting vision science and retinal anatomy concepts 30 min

Thinking Tools

- Since the students have little to no prior knowledge of retinal anatomy I give the students some thinking tools in the form of a short power point presentation prior to initiating the inquiry.
- I only give the critical knowledge that will allow the students to engage with the materials and carry out meaningful investigations.
- This is different from the traditional pre-lab lecture since students were not given instructions and were not walked through a lab activity.
- We also only have a limited amount of time ~3 hrs for the entire inquiry and students need to have some prior knowledge in order to figure out the interesting phenomenon they are investigating.

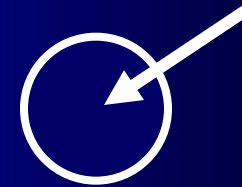
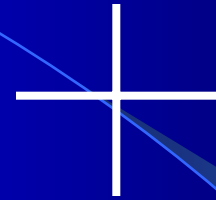
Thinking Tools

- We need photoreceptors to see light
- We have two types of photoreceptors: rods and cones
- We have an optic nerve that has no photoreceptors
- The number of cones in a set area effects how well we see color.
- Cones are responsible for color vision.
- Rods are not responsible for color vision. Rods are used for night time vision.
- Sampling theory: More sampling that is present means we have better resolution. Examples: Take a small number of samples of a semicircle locations and you get a jagged line but if you take a lot more samples then you get a better representation of the original semi circle. Another example would be a low resolution versus high resolution camera.

Starters

Whole in
the paper

- 1) Blind spot teaser



Starters

- 2) Have someone show that they cannot guess what color something is by only using their side vision if they are fixating straight ahead.
 - *You can make sure someone is looking straight ahead by asking them to look at and identify a central target at the same time as the color is being shown in their side vision.*



Synthesis

- Visual acuity varies across the retina
 - This is due to the change in photoreceptor density across the retina.
 - The nasal retina is used for our temporal visual field (in addition to being inverted)
- The optic nerve is the blind spot
- There are no photoreceptors located here thus no vision is present here
- The brain fills in the blind spot so you cannot see the whole in the paper when it matches your blind spot location
- Our color vision varies across the retina
- Relate back concepts learned during the inquiry to Adaptive Optics imaging and how we use this kind of information to determine actual size and distance between features on the retina.
- Show retinal images or fundus photos and show how you can approximately measure the size of something based on its visual angle.
- Maybe help students during the inquiry by letting them know that the average human optic nerve size $\sim 5\text{deg} = 1500\text{microns}$ for the average sized eye and that the length of the eye is 24mm or from nodal point to the back of the eye is 16.7mm. This depends on the students and the groups progress.

Major Differences Between this Inquiry and the PDW Inquiry

- Shorter time line
- The thinking tool is given prior to viewing the starters
- Less starters are used
- A gallery walk is not used and is less necessary since only two main phenomenon are available to investigate

Some of the benefits gained by the students from this inquiry

- Increased self esteem
- Science, the scientific process, and exploring interesting phenomenon is challenging, rewarding, and fun!
- Increased knowledge of vision and retinal anatomy and adaptive optics applications in studying retinal anatomy
- Students can learn a lot about the eye without having to dissect the eye

Acknowledgements

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- Thanks!

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