

# 3 DAY PROJECT OVERVIEW

<b>Name of Project:</b>	Bionic Eye	<b>Teach Dates:</b> March 22, 23, 25, 2013
<b>Subject:</b>	Biomedical Engineering	<b>Teachers:</b> Christine Rittenhouse and Tanja Smith
<b>Driving Question:</b>	How can we design a functional bionic human eye with one other animal adaptation that would be useful to a pirate?	
<b>Scenario:</b> Summary of the project, include the entry event.	A trillionaire pirate requests a proposal of a dynamic and creative design team to come up with a functional bionic human eye with an added adaptation from the animal kingdom that would enhance her abilities as a seafaring pirate captain. Presentations of each design teams bionic eye would be given in order to “sell” the pirate a new bionic eye.	
<b>Student Products/Assessment:</b>	Five minute oral presentation demonstrating content knowledge, preparation, collaboration, and explanation of a schematic/cutaway of a bionic replacement for a human eye.	
<b>Objectives:</b> SWBAT	Examine the relationship between light, lenses, images, and focal lengths. Research eye evolution and adaptations. Identify critical features of the human eye and possible man-made analogues.	
<b>Content Standards to be taught and assessed:</b>	<p>§112.34. Biology.</p> <p>(c) Knowledge and skills.</p> <p>(2) Scientific processes. The student uses scientific methods and equipment during laboratory and field investigations. The student is expected to:</p> <p>(E) plan and implement descriptive, comparative, and experimental investigations, including asking questions, formulating testable hypotheses, and selecting equipment and technology;</p> <p>(H) communicate valid conclusions supported by the data through methods such as lab reports, labeled drawings, graphic organizers, journals, summaries, oral reports, and technology-based reports.</p> <p>3) Scientific processes. The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions within and outside the classroom. The student is expected to:</p> <p>(B) communicate and apply scientific information extracted from various sources such as current events, news reports, published journal articles, and marketing materials;</p> <p>(E) evaluate models according to their limitations in representing biological objects or events;</p> <p>(8) Science concepts. The student knows that taxonomy is a branching classification based on the shared characteristics of organisms and can change as new discoveries are made. The student is expected to:</p> <p>(C) compare characteristics of taxonomic groups, including archaea, bacteria, protists, fungi, plants, and animals.</p> <p>§112.39. Physics,</p> <p>(c) Knowledge and skills.</p> <p>(7) Science concepts. The student knows the characteristics and behavior of waves. The student is expected to:</p> <p>(D) investigate behaviors of waves, including reflection, refraction, diffraction, interference, resonance, and the Doppler effect;</p> <p>(E) describe and predict image formation as a consequence of reflection from a plane mirror and refraction through a thin convex lens</p>	
<b>Safety:</b> Include any safety issues and <i>how</i> they will be addressed.	There are no safety hazards associated with this lesson. Standard classroom procedures apply.	

# 3 DAY PROJECT CALENDAR

**Project: Bionic Eye**

**Teach Dates: March 22, 23, 25<sup>th</sup> 2013**

DAY 1	DAY 2	DAY 3
<p>Entry Document (Request for Proposal)                      Assign a signal to get attention of the class.                      Generate Know &amp; Need to Know list (<i>on the white board</i>)                      Provide list of helpful websites                      Provide rubric</p> <p>Conduct initial research                      Allow students to self-assign topic choices</p> <p>Students may use a program they already know or may have the option of drawing on graph paper.</p> <p>Assist students by answering and posing questions, keeping students on task, and providing support where necessary.</p> <p>Distribute copies of video link to CPO Science lab demo to be watched outside of class. (<i>Flipped classroom</i>)</p> <p>Students will provide an initial design for their product as an exit ticket.</p> <p>After class get together with partner to address questions raised during class.</p>	<p>5 minutes:                      Address any questions that may have come up during the students' research.</p> <p>Review initial designs and say what we like about them to each group.</p> <p>10 - 15 minutes:                      Conduct biology of the human eye workshop on one end of room and physics of vision and optics on the other end of the room. Open CPO lab setup for students to explore.</p> <p>Remainder of the class time will be spent actually designing and drawing each team's bionic eye. Individual feedback advice given throughout class-time.</p> <p>Facilitators will check teams for developing the correct type of end product as well as assist in conceptual understanding and development.</p> <p>(Video tape of each workshop to put online for students to refer to while finishing up their presentations outside of class.)</p>	<p>Presentation day!</p> <p>Each group is allotted five minutes to present design to the pirate captain.</p>
<p>Create group assignments list</p> <p>Supplies needed:                      Folders containing:                          Name badges                          Copies of Entry doc                          Copies of Websites                          Copies of rubric                          8.5" x 11" graphing paper                      Copies of video link to CPO Science lab demo</p>	<p>Supplies needed:                      CPO Science Optics lab setups                      Drafting vellum</p>	<p>Supplies needed:                      Timer                      Copies of rubric to assess projects</p>

## R E F L E C T I O N   Q U E S T I O N S

**What scaffolds, workshops, or learning support will you provide for students?**

**Prior to arrival of Day 1, we will film ourselves performing the CPO Optics lab and our mentor teacher will provide the link on her class website. This way, we can have an element of flipped class experience to prepare students for Day 2.**

**We have designed short informational workshops on the physics and biology of the human eye and plan to have the CPO Optics lab available to the students to use as a hands-on/minds-on experience.**

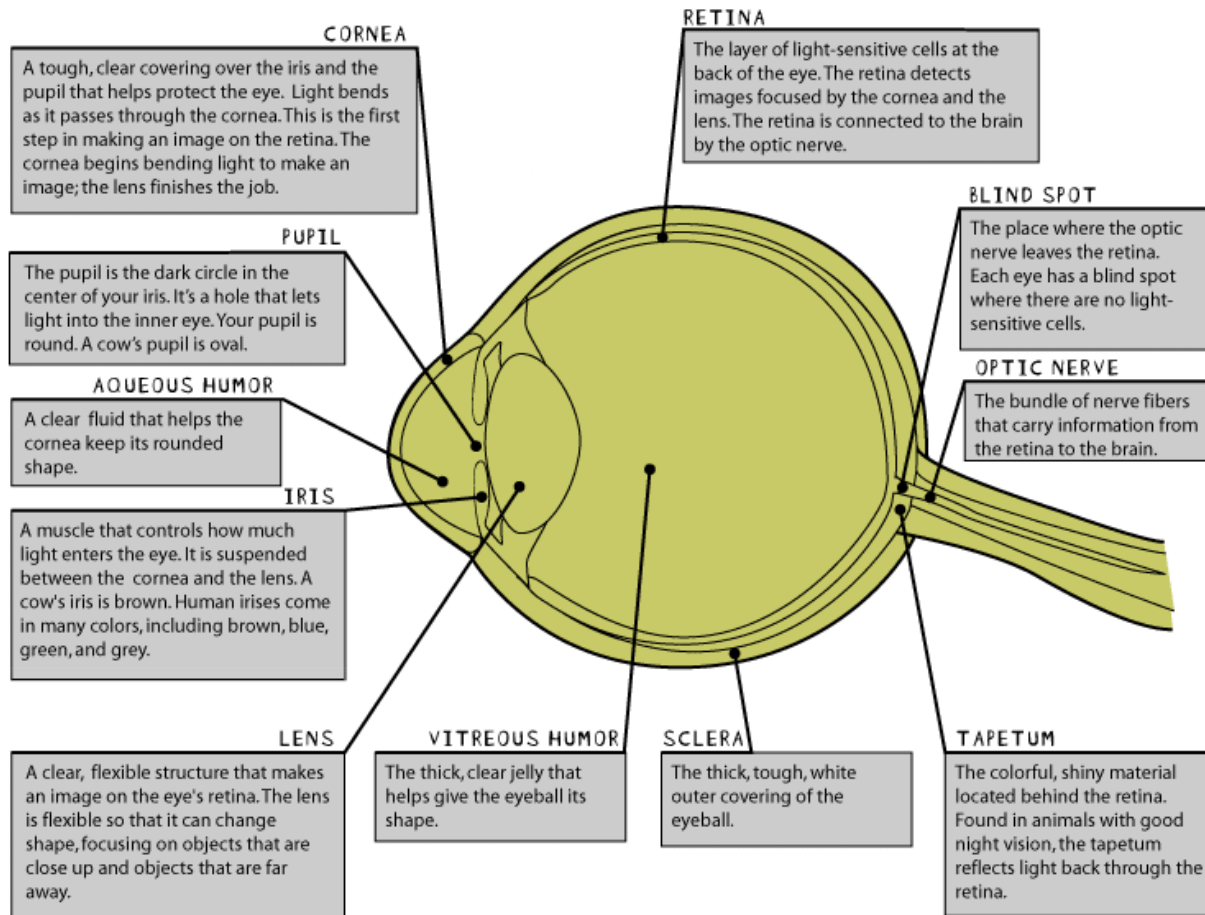
**How will you get to know your students and foster a sense of community?**

**We will be stopping at each group to get know how the groups will work together, what roles they will play, how they plan to execute the project, and how they will remain accountable for each other's part. Each group will form a team to compete against each other for the best planned and presented project.**

**What do you see as the biggest challenge in implementing this lesson and how do you plan to address that challenge?**

**The biggest challenge will be to get students to buy into the idea of creating a bionic eye. We have developed the lesson plan to include a pirate theme that incorporates current topics from movies, adding interest in the subject and hopefully encourage creativity.**

Team Name						100%
Trait	3	2	1	Points Earned	Weighted Value	Comments
<b>Content - Organization</b> 5%	Presentation was well organized. Content flowed very clearly and demonstrated depth of understanding of the content.	Presentation was somewhat organized. Content flowed somewhat clearly and demonstrated some understanding of the content.	Presentation was not organized. Content did not flow clearly nor demonstrate understanding of the content.	3		
<b>Content - Clear Concepts</b> 35%	Provides complete, accurate, and relevant information; based firmly on extensive and careful research.	Provides partially complete, accurate, and relevant information; based on adequate research.	Provides basic information, some of which may be incorrect and/or irrelevant; based on minimal research.	3		
<b>Presentation - Appeal</b> 10%	Message was clear and memorable; effectively sold product. Performance was well rehearsed, engaging, creative and entertaining.	Message was clear and memorable; did not effectively sell product. Performance was somewhat rehearsed and creative. Message delivered with conviction.	Message was unclear or inaccurate; did not sell product. Performance was unrehearsed or lacked creativity. Message presented without conviction.	3		
<b>Presentation - Creativity</b> 10%	Final product design was unique and creative, with much attention to detail.	Final product design and appearance were neat and readable.	Final product does not appear neat or carefully planned.	3		
<b>Presentation - Illustration</b> 10%	Final product is clearly linked to the material, well executed, and informative to the audience. Elegantly delivers the content and efficiently describes structure and function.	Final product is appropriate to the topic but are not well integrated into the overall presentation. Delivers some content and somewhat describes structure and function.	Final product does not adequately demonstrate content, is incomplete, or in some other way does not meet criteria.	3		
<b>Presentation - Timing</b> 5%	Used time allotted without going over.	Used slightly less or slightly more time than was allotted (up to 59 seconds).	Used significantly less or more time than was allotted (+/- 60 seconds).	3		
<b>Collaboration - Leadership / Facilitation</b> 5%	Leadership was shared equally by all group members.	One or more group members did not actively lead in any way.	One or more group members tried to take over entire project.	3		
<b>Collaboration - Contribution</b> 20%	Group members worked well together and balanced each others strengths, supported each others learning, demonstrated willingness to spend significant time outside of class to complete project.	Some group members were prepared to work each day, met due dates by completing assignment and duties, and worked hard on the project most of the time, and contribution was significant and appropriate to the project.	Some group member were often off-task, did not complete assignment or duties, or impeded progress on project. Contribution was irrelevant or inappropriate.	3		
<b>Comments</b>				<b>Total Points</b>	24	
				<b>Possible Points</b>	24	
				<b>Grade</b>	<b>100%</b>	





The spookfish is a deep water, ghostly-looking fish that has some of the most bizarre eye structures known to science; each eye has a lateral swelling called a diverticulum, separated from the main eye by a septum. While the main part of the eye has a lens and functions in a similar way to other animal eyes, the diverticulum has a curved, composite mirror composed of many layers of what seem to be guanine crystals. This “mirror” is superior at gathering light than the normal eye; the diverticulum reflects light and focuses it onto the retina allowing the fish to see both up and down at the same time.

The spookfish is the only vertebrate known to use a mirror eye structure to see, as well as the usual lens. Spookfish are found worldwide but are rare to see, since they spend most of their lives at a depth of 1000-2000 meters. They feed on small crustaceans and plankton, and measure about 18 cm in length.

# Dragonfly



The dragonfly, possibly the most formidable aerial hunter among insects, also has some of the most amazing eyes in the animal world. They are so big that they cover almost the entire head, giving it a helmeted appearance, and a full 360 degree field of vision. These eyes are made up of 30,000 visual units called ommatidia, each one containing a lens and a series of light sensitive cells. Their eyesight is superb; they can detect colors and polarized light, and are particularly sensitive to movement, allowing them to quickly discover any potential prey or enemy.

Some dragonfly species that hunt at dusk can see perfectly in low light conditions, when we humans can barely see anything. Not only that; dragonflies also have three smaller eyes named ocelli which can detect movement faster than the huge compound eyes can; these ocelli quickly send visual information to the dragonflies' motor centers, allowing it to react in a fraction of a second and perhaps explaining the insect's formidable acrobatic skills. Although dragonflies are not the only insects with ocelli (some wasps and flies have them too), they do have the most developed ones.



## 9. Geckos

*Macro of my gecko's eye*

Nocturnal geckos have to be able to block out the bright sun during the day while still retaining excellent night vision, which is why they have long zig-zagged pupils that can tightly constrict to let in only pinpoints of light. Interestingly, while humans cannot see colors in dim moonlight, these animals can discriminate between colors and their eyes are calculated to be almost 350 times stronger when it comes to seeing color.





## 8. Gharials

Gharials are ancient creatures that are practically living fossils. Despite this, they have extremely well-evolved eyes that are located in such a way that they can keep almost their entire head underwater and leave their eyes out to look out for prey. Their eyes are also primed for night vision, as a thin, mirror-like structure at the back of their eye helps reflect light that was not already absorbed by the eye back into the eye a second time. When lights are shown on the creatures at night, their eyes will reflect the light so brightly that it looks like they are glowing.



## **Goats**

**The square pupils of goats attract a lot of attention, but they aren't just there to look pretty. The width of the pupils allows the animals to see at a 330 degree angle, as opposed to humans who generally see at around a 185 degree angle.**



## Cuttlefish

Some of the most evolved eyes in the entire animal kingdom belong to cuttlefish. Their strange, w-shaped pupils are unable to register color, but can see the polarization of light, which allows them to see contrasts, even in dim light. While humans reshape their eye lenses to see things in better focus, the cuttlefish reshapes its whole eye. Additionally, internal sensors in the eye allow the creatures to observe things in front of them and behind them at the same time.



## Snails

Snails have one or two sets of tentacles that are on top of the head. The number of pairs will depend on the species you are describing. Most of the time you will find that the eyes are present on the longer set of them if they have two. You may not always see these tentacles though as all land snails have the ability to retract them.

## References

<http://www.snail-world.com/Snail-Anatomy.html>

<http://www.environmentalgraffiti.com/news-eyes-have-it-coolest-eyes-animal-kingdom?image=0>

<http://listverse.com/2010/12/12/10-animals-with-incredible-eyes/>