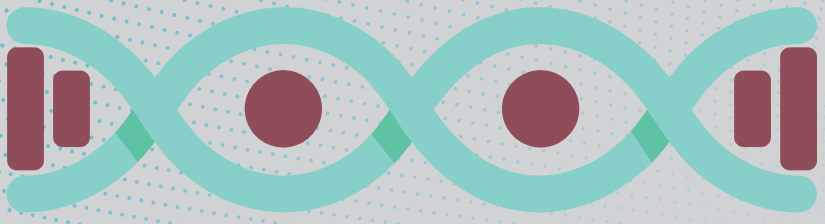
Realeyes

TEACHER'S GUIDE

BIOLOGY & GENETICS *OF THE EYE*



High School Curriculum

""This work is funded either in whole or in part by a grant awarded by the Ohio Department of Health Bureau of Child and Family Health, Save our Sight Program."

This script will help you use the Realeyes videos and activities to teach your students about the eyes. The program uses trivia questions to engage your students. Feel free to have the students split into groups or keep score of their answers to make it more fun.

In the script, each question will have the answer and some will include a video segment or activity to further explain and teach about the answer.

Instructions for each activity are found at the back of the document in the "Activities" section. If you have any questions about any of the activities, please reach out to your Realeyes coordinator or email: **realeyes@ooa.org**.

When playing video segments, make sure to PAUSE when it goes to images of the Realeyes and Ohio Optometric Association logo.

Also, if any of the students have questions about the eyes, please email **questions@ooa.org**, and we will have an optometrist answer them.

Suggested opening discussion

Have you thought much about what type of work you would like to do later in life? Is anyone interested in being a doctor? Today we are going to learn a little about an **optometrist**. Does anyone know what an optometrist does? They are eye doctors. They went to college for 4 years, then to optometry school for 4 years to be able to treat vision disorders, prescribe glasses and contacts, do vision therapy, and even treat eye diseases and injuries. There is also another type of eye doctor called an **ophthalmologist**. They can perform eye surgery. There are **opticians**, which either study on the job or do 2 years of schooling. They help do some of the vision tests and fit people's glasses.

We know there are a lot of questions and myths about the eyes and today we will look at some of those.

QUESTION 1

How old should you be when you receive your first eye exam?
A. 6-12 months old
B. 3 years old
C. 9 years old
D. When you first notice any problems seeing
Answer: A.

More Information:
Eye doctors can often catch many vision disorders and diseases at an early age and begin treating them. Infant eye exams are offered for free by some optometrists. Find participating optometrists at infantsee.org. This is DIFFERENT than a vision screening. Vision screenings are not exams, even when done by a pediatrician or school nurse. Screenings only detect about 25% of possible vision disorders. Many parents wait until there is a problem before taking a child to an eye doctor, but that is often too late.

QUESTION 2

Is your eye shaped round like a basketball, or more like a football?
A. Basketball
B. Football
Answer: A.

More Information:
Although the eyes look like a football, they are actually a sphere. It's your eyelids that make you think they are football-shaped, but those are shaped that way to protect your eyes when the lids close.

ACTIVITY 1 – EYE SIZE (page 9)
Student Handout – Eye Size
Then pass around the small eyeball replica so students can feel the actual size of the eye.

More Information about Activity 1:
A common myth about eyes is that they are fully grown at birth, but that is not true. An infant's eye is about 18mm long at birth, but fully grown the human eye is about 25mm. The growth that takes place from a baby to full grown is significant because it can change our vision from being farsighted, to normal vision, to nearsighted dependent on the size.

QUESTION 3

Truth or Myth - It is possible to receive an eye transplant that sees.

PLAY SCENE 1 – How the Eye Works (00:00 - 6:44)
Answer: Myth

More Information:
The optic nerve on the back of the eye is only about 1 millimeter across and contains over a million nerve fibers transmitting information from the eye to the brain. No one has figured out how to attach a new eye because it is impossible to attach a million microscopic nerve fibers.

QUESTION 4

Truth or Myth – You have a blind spot in front of you.

PLAY SCENE 2– Blind Spot (06:45 - 7:52)
Answer: Truth

ACTIVITY 2 – BLIND SPOT (page 10)
Student Handout – Find Your Blind Spot

QUESTION 5

Which of the following do you think can affect how you see?
A. E-cigarettes, including Juuls
B. Staring at a flashlight
C. Sitting too close to the TV
D. Crossing your eyes too much
E. All of the above

PLAY SCENE 3– Eye Disease Information & Smoking (07:53 - 09:44)
Answer: A. E-cigarettes including Juuls

More Information:
Decisions you're making now can affect your eyes later in life. What do you think causes eye diseases? Here are the main causes: exposure to the sun, family history, high blood pressure, and smoking including e-cigarettes. The health of your body is closely linked to the health of your eyes. The nicotine from cigarettes, including Juuls, blocks oxygen from reaching the retina and can lead to eye diseases.

Answers B, C and D are common myths. Looking at a flashlight may cause a headache, but it will not damage the eye. Sitting too close to the TV does not hurt the eyes, despite what all our parents told us. Crossing your eyes can be rude, but it will not damage the eyes.

ACTIVITY 3 – SEE LIKE ME APP (page 11)
If you have the See Like Me App, have the students take turns looking through it now as the next scene about eye diseases plays.

PLAY SCENE 4– Eye Disease (09:45 - 13:05)

QUESTION 6

Truth or Myth - Eating carrots can help you see better.
Answer: Myth

More Information:
The myth that carrots improve your eyesight began in World War II. During the war, the British Royal Air Force developed the first radar detectors used in planes and it helped them shoot down German enemy planes at night. In order to keep the new technology a secret the government said that feeding their pilots lots of carrots was the reason they could see better at night. This lie is still believed today. No foods will make you see better, but the best foods you can eat to help prevent eye diseases are spinach (or any dark green leafy vegetable), salmon, almonds, and oranges.

QUESTION 7
Truth or Myth - All tears are the same.

PLAY SCENE 5 – Tears (13:06 - 14:57)
Answer: Myth

QUESTION 8
Truth or Myth - Bleach in your eye could make you go blind.

PLAY SCENE 6– Eye Safety in the Lab (14:58 - 17:29)
Answer: Truth.

QUESTION 9
Truth or Myth - You can only see in black & white in your peripheral vision.
Answer: Truth

ACTIVITY 4 – PERIPHERAL VISION TEST (page 12)

QUESTION 10
What % of kids your age have a vision disorder?
A. 10%
B. 15%
C. 25%
D. 35%
Answer: C

More Information:
About 1 out of 4 students has a vision disorder. What is the percentage in your class?
Did you know the percentage of students on an IEP that also have a vision disorder is significantly higher, at 70%? Why do you think that is? Difficulties with your vision can make schoolwork so much harder.

QUESTION 11
Truth or Myth – There's a delay from what you're seeing to your brain processing it.

PLAY SCENE 7– Delay in Processing (17:30 - 18:22)
Answer: Truth

More Information:
It takes 15 hundredths of a second from the time light hits the retina, to when your brain recognizes it.

ACTIVITY 5 – VISUAL REACTION TIME (page 13)

QUESTION 12

Truth or Myth - 20/20 means you have perfect vision.
Answer: Myth

More Information:
20/20 is only a measure of your distance vision. The first number stands for how many feet away from an eye chart you need to stand to read it. The second number is for the distance that a person with normal vision is able to read that same line on the eye chart. Having 20/20 vision is good but does not mean perfect vision. If you are 20/100, you need to be at 20 feet away to see what a typical person can see from 100 feet away. You can also be better than 20/20. There is so much more to seeing well than just distance vision. Your near vision, muscle teaming, convergence, how your brain is processing information, and more, all need to be tested through an eye exam by an eye doctor.

Much of how we see is actually related to the brain, not just the eyes. You have a bundle of over a million nerve fibers sending visual images to the brain, and it controls what you see by deciding how to combine those together. Optical illusions show us how our eyes and brain work together to see. We live in a 3-dimensional world, so our brain gets clues about depth, shading, and lighting to help us interpret what we see. When we look at a 2-dimensional image, our brain can be fooled because it doesn't get the same clues. In other illusions, our brain is trying to make shortcuts or predictions to save time in order to compensate for the small lag time between when an event happens and our ability to perceive it. Sometimes the prediction doesn't match reality. Optical illusions are designed to take advantage of that and sort of confuse and trick your brain by having it make assumptions about how the world should be… instead of how the world actually is. Here are a few to try:

ACTIVITY 6 – ILLUSIONS (page 14)
Student Handout – Illusions. There are 3 "illusions" to choose from. 1. Gray Box Illusion. 2. Hole in the hand activity. 3. A bird in the bush illusion.

QUESTION 13

Truth or Myth - A cat's eye inspired road reflectors.

PLAY SCENE 8 – Road Reflectors (18:23 - 19:23)
Answer: Truth

QUESTION 14

Truth or Myth - Reading too much will hurt your eyes.

PLAY SCENE 9 - Reading Too Much (19:24 - 20:23)
Answer: Myth

QUESTION 15

Truth or Myth - Using your phone too much can damage your eyes.
Answer: Myth

More Information:
There is no research that shows that using your phone too much can damage the eyes. However, eye doctors do recommend students spend 2 hours per day or a total of 14 hours per week outside. Why do you think that is? Because looking at things farther away relaxes the muscles of the eye. There is currently a worldwide epidemic of nearsighted (having trouble seeing farther away), but not from cell phones themselves. It's believed to be from a lot of attention being put on near work combined with people not spending time outside. Spending all day using a computer at school, then all night on your phone or playing video games exhausts your eyes. Has anyone heard of blue light? Blue light is all around us, it comes from the sun, TVs, computers, and yes, your cell phone. Blue light can actually help keep you alert during the day. However, it can mess with your natural body rhythms if you use your phone too much at night because it can block your body from releases the melatonin that it needs to help you fall asleep. Cell phone usage can also cause dry eye if you use them for more than 3 hours per day because you blink less often when using them, from about 15-20 blinks per minute, to only 5-6 per minute (the same happens during video games). Try to practice the 20/20/20 rule. Every 20 minutes, look at something 20 feet away, for 20 seconds to help rest the eyes.

QUESTION 16

Truth or Myth - You can pop a blood vessel in your eye by going to the bathroom.

PLAY SCENE 10 – Pop a Blood Vessel (20:24 - 21:10)
Answer: Truth

QUESTION 17

Truth or Myth - It can take half an hour for your eyes to adjust to darkness.

PLAY SCENE 11 – Eyes in Darkness (21:11 - 22:30)
Answer: Truth

QUESTION 18

Truth or Myth - Reading in dim light will damage your eyes.

PLAY SCENE 12 – Dim Light (22:31 - END)
Answer: Myth

BIOLOGY & GENETICS OF THE EYE

ACTIVITIES

This sheet can also be used during the peripheral vision test.

Activity 1 - EYE SIZE

Refer students to handout in their packets called **"Eye Size"**

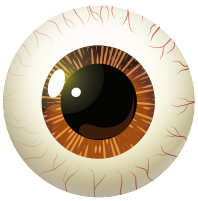
Have them choose the actual size of the (adult) human eye. Answer: B.

Then pass out the model of the eye for students to feel the actual size.

A

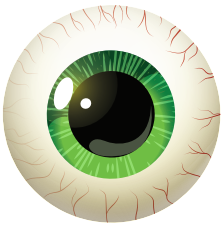
3/4 inch

B



1 inch

C

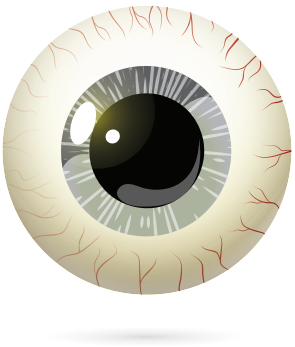


$1^{1/8}$ inch

D

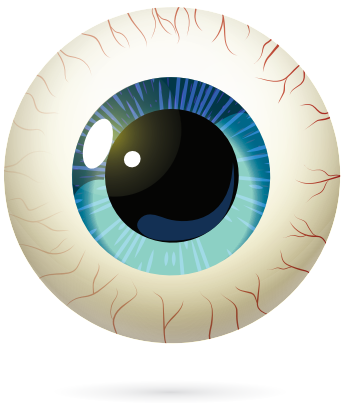
$1^{1/4}$ inch

E



$1^{1/2}$ inch

F



$1\ ^{3/4}$ inch

BIOLOGY & GENETICS OF THE EYE

Activity 2 - BLIND SPOT

The back of the eye is made up of light-sensitive cells called photoreceptors. There are two types of photoreceptors – rods and cones. However, there is one spot in the eye where there are none of these cells; that is where the optic nerve attaches to the eye. The optic nerve connects the eye to the brain and carries all the images we see to the brain. The optic nerve connecting to the back of the eye causes us to have a blind spot in our vision.

Why don't we notice the blind spot? There are two reasons. The first is the opposite eye compensates for the missing information and fills it in. This is because when we have both eyes open, the visual fields from each eye overlap and fill in the info for the opposite eye. The other reason is that the brain will guess and fill in the missing information, even if you have one eye closed. It does this by using whatever colors are near the blind spot to fill in that space.

Refer students to this handout in their packets called **"Find Your Blind Spot"**

INSTRUCTIONS:

1) Cover their right eye with their right hand.
2) Hold the sheet of paper in their left hand straight out in front of them.
3) Stare at the "X" on their paper.
4) **VERY SLOWLY** move the paper closer to their face until the circle dissappears.
5) Explain that the point where the dot disappears is their blind spot. The blind spot is small, about 6" in front of the nose.

* If they don't see it, it is possible they moved the paper towards their face too quickly.

Realeyes

Find Your Blind Spot!

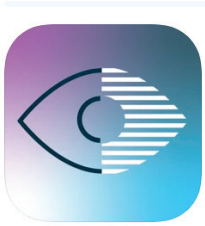
● X

BIOLOGY & GENETICS OF THE EYE

Activity 3 - SEE LIKE ME

Currently available for iPhones or iPads only.
Download and Open the "See Like Me" app (VR Goggles optional)

- Tap to START
- On the SCREEN MODE of the app, Select SCREEN to use the app with a phone or tablet when you are NOT wearing the goggles. Choose "AR" if you are using the goggles. Then hit START.
- In the next screen you can simply hit START to begin or you also have the option of turning off any disorders, or toggling on or off its mild or severe views.
- Simply tap right to progress through the mild and severe form of each disorder and left to return to previous screen.



SEE LIKE ME

If you're using the VR mode:

- Follow cardboard goggle instructions for assembly.
- Insert the phone into the goggles. Depending on which VR Google you have, make sure the camera on the back is on the side that has the opening but always face the camera away from you.
- To get started you may have to hold down both buttons on the top of the goggles for a second or two.

Here are some tips you could share about the diseases:

These are the four most common vision diseases that can lead to blindness. Most eye diseases can cause vision damage and eventual blindness without the individual experiencing pain or discomfort.

Macular Degeneration

- Smoking, UV exposure, and high blood pressure increase the risk of developing macular degeneration.
- It is very important to detect early, since there is no cure. There are treatments to lessen the severity of the disease.

Diabetic Retinopathy

- It is important for anyone with diabetes to have regular eye exams by an eye doctor because they are at risk for developing diabetic retinopathy.
- Diabetic retinopathy occurs because of poor control of blood glucose levels that over time damages the tiny blood vessels in the retina.
- It is very important to detect early, since there is no cure. There are treatments to lessen the severity of the disease.
- Diabetic Retinopathy does not have to get to this point if the individual controls their blood sugar.

Glaucoma

- Caused by an increase of fluid pressure within the eye and when left untreated, can result in blindness.
- Individuals at higher risk for glaucoma are African Americans and Hispanics over the age of 40 and everyone over the age of 60.
- It is very important to detect early, since there is no cure. There are treatments to lessen the severity of the disease.
- Despite popular thought, marijuana is not an effective cure for glaucoma.

Cataract

- More than half of all Americans age 65 and older have a cataract. They are also common in cats and dogs.
- A cataract is the clouding of the eye's lens related to natural aging. They occur when the proteins in the lens clump together to cloud areas of the lens.
- Smoking and UV exposure increase the risk of developing a cataract.
- The common treatment is cataract removal surgery in which the clouded lens is replaced by a plastic one. It's one of the most performed surgeries in the USA.

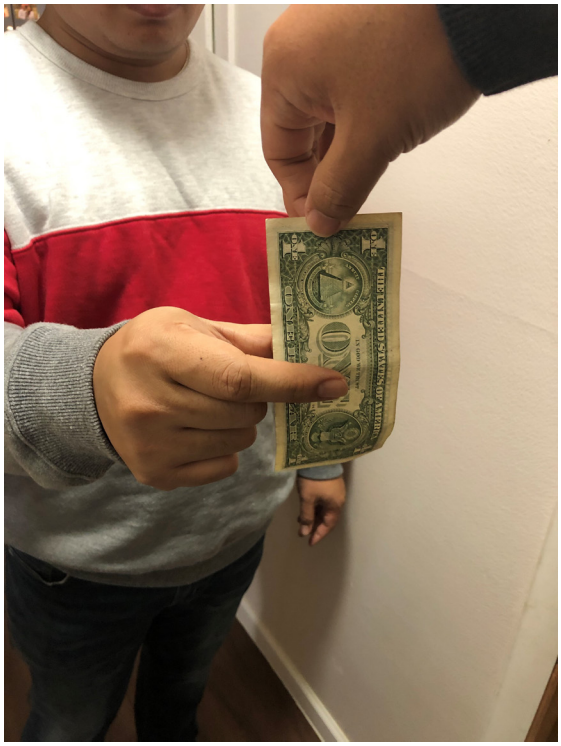
Activity 4 - PERIPHERAL VISION TEST

- Using a brightly colored index size (3” x 4”) piece of paper (included), or the color packing sheet.
- Ask a volunteer to stand directly in front of you facing the class and stare at an object in front of them -- do not look away from that object and do not look from side to side. They can blink, but no moving of the eyes. Have the students directly in front of the volunteer help by making the sure they don’t move their eyes. (Make sure the volunteer is not wearing glasses as they will see the reflection of the color in them.)
- Explain that you will wave an object in their peripheral vision and that they should say “stop” as soon as they sense something moving, but DO NOT LOOK AT THE MOVEMENT.
- Standing behind the volunteer, slowly move one of the sheets of colored paper up and down at the student’s ear level. While waving the sheet, slowly move it closer to the front of the student’s face.
- When the student says, “stop,” ask them what color they see.
- Explain that the reason the sheet of paper appeared to have no color (or was black, white, or gray) was because they saw it using their peripheral vision, which is only through the rods, and those see only in black and white.

Activity 5 - VISUAL REACTION TIME

Would you accept a challenge to catch a freely falling dollar? More precisely, the person who has offered a challenge holds the bill vertically. The center of the bill is between another person's index finger and thumb, spread apart. He or she has to catch the dollar (without moving hands down) when challenger releases the bill. Make sure their fingers are halfway up the bill when you begin. Which person do you think has the advantage in this challenge?

TRY IT WITH YOUR STUDENTS.

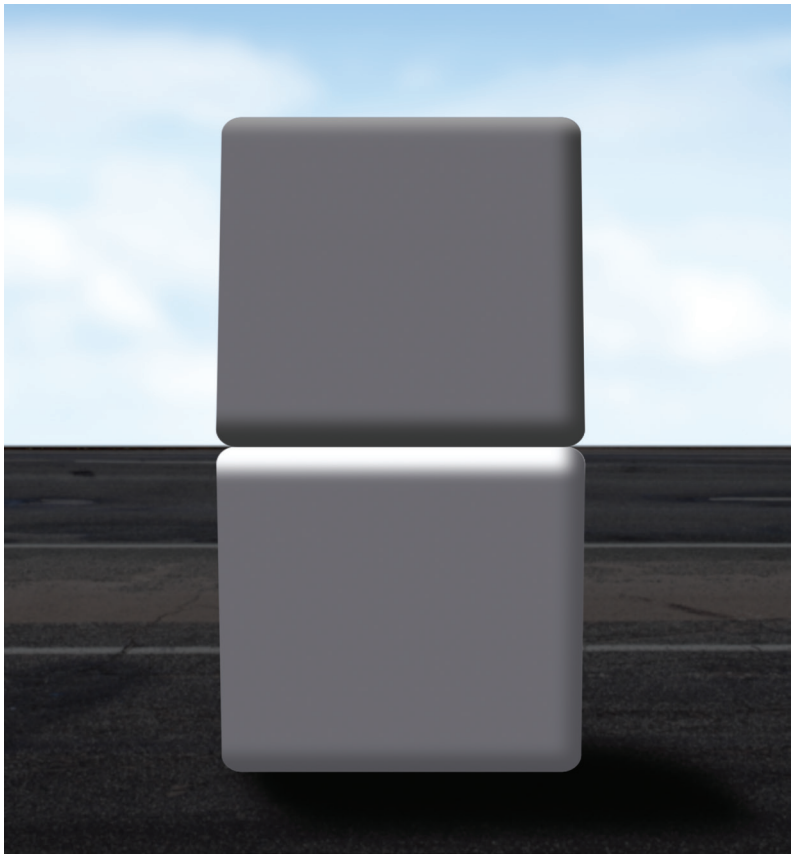


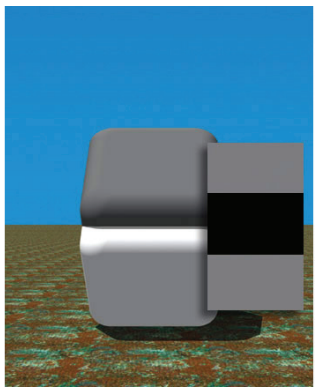
Your reaction time is the time it takes from seeing a stimulus to responding to it. The better your reaction time, the better your chance of catching the bill. Light has to reflect off the dollar bill and enter the eye. From there it travels through fluid to the back of the eye, the retina. The retina then turns the light into nerve signals to be sent to the brain. It takes about 0.15 seconds from the moment light hits the retina to when the earliest recognition of basic object identity can occur in the brain. Then the brain has to tell your fingers to respond. The total time? For most people, about 0.2 seconds. The distance from the top of bill to the center is at about 10 centimeters. A freely falling object will fall about 20 centimeters in the first 0.2 seconds. Thus, there is a little chance to catch the dollar.
Obviously there are a lot of variables, like how far apart the fingers are and how far down the bill they begin.

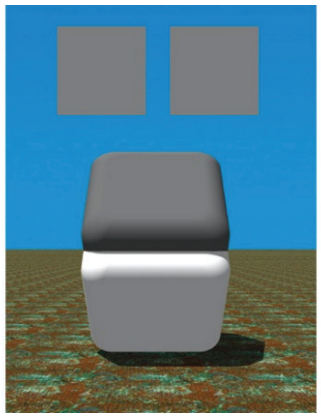
BIOLOGY& GENETICS OF THE EYE

Activity 6 - OPTICAL ILLUSIONS - GRAY BOX

Refer students to this handout in their packets called **“Shadow Illusion”**







So what’s the illusion here, 2 different color gray boxes, no big deal. Except that the boxes are the exact same color! What! How could this be? Don’t believe me? Good. It’s always best to check things like this.

Have the students try putting their finger across the middle, blocking the part where they meet. When you do that, boom! You can see they’re the same shade of gray. Or even have them cut out a section of each cube and place them on top of each other.

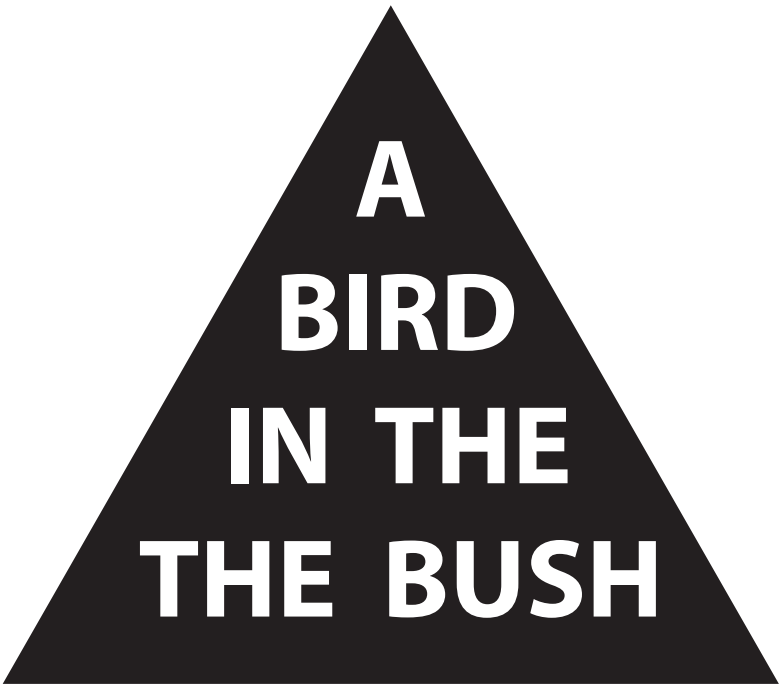
Amazing right, it’s called the Cornsweet Illusion and basically it works by contrast. When we look at something, we perceive its color and shading relative to other things in the area and how we think that it is lit. In this picture, our brain thinks the scene is three dimensional, with the light coming from above. We believe the upper box is tilted up towards the sky, making the bottom look shaded, and tilted the opposite way with just the top of it lit up. Our brain knows that when something is in a shadow, it will look darker than it really is. Because of this, our brain tries to “fix” that by lightening the color we see in the bottom square. By doing this, our brain has made us see them as two different color squares, when they never were. So your brain was tricked, which is a good thing. Most of the time when your brain makes assumptions like this it actually helps you. If you flip the paper upside down, it will probably look like the same color since your brain won’t believe the ground is on top, and therefore won’t be tricked.

Activity 6 - OPTICAL ILLUSIONS - HOLE IN HAND

1. Have your students roll a sheet of paper into a tube (long ways so it looks like a telescope)
2. Hold the tube in your right hand and look through it with your right eye. **Be sure to keep both eyes open!**
3. Look at a wall across the room and bring your left hand up to the side of the tube. Make sure that the side of your left hand is touching the side of the tube, so that they are

With this activity one of your eyes is seeing a hole, while the other eye sees your hand. Your eyes and brain work together to add the two images together, creating a hand with a hole in it! This only works if your brain is using both eyes together. Sometimes it will shut off or suppress one of your eyes (due to various potential reasons) and you will only see the hole OR your hand, not both at the same time.

READ THE TEXT IN THE TRIANGLE - FAST!



What did you read? This illusion shows us how much faster our brain works than our eyes.

Try this on your students! Reveal the image to one student at a time, and ask them to read **aloud** what they see as fast as they can. If they've not seen this trick before, they will most likely read it as "A BIRD IN THE BUSH" rather than seeing that "THE" is repeated twice. Their brain made a decision to not "see" the second word "THE" since that is not how they normally talk.

BIOLOGY & GENETICS OF THE EYE