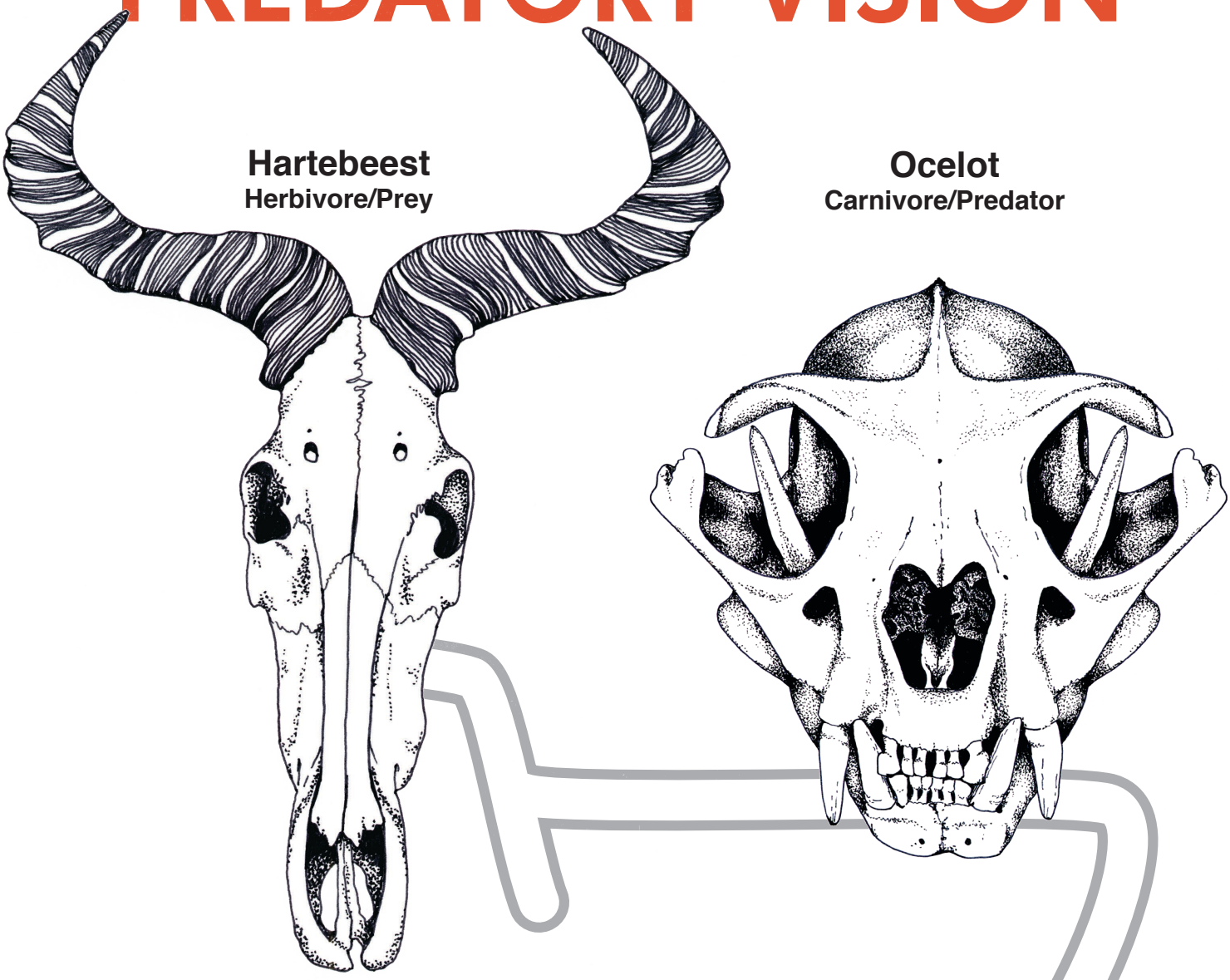
PREDATORY VISION



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Chasing Prey

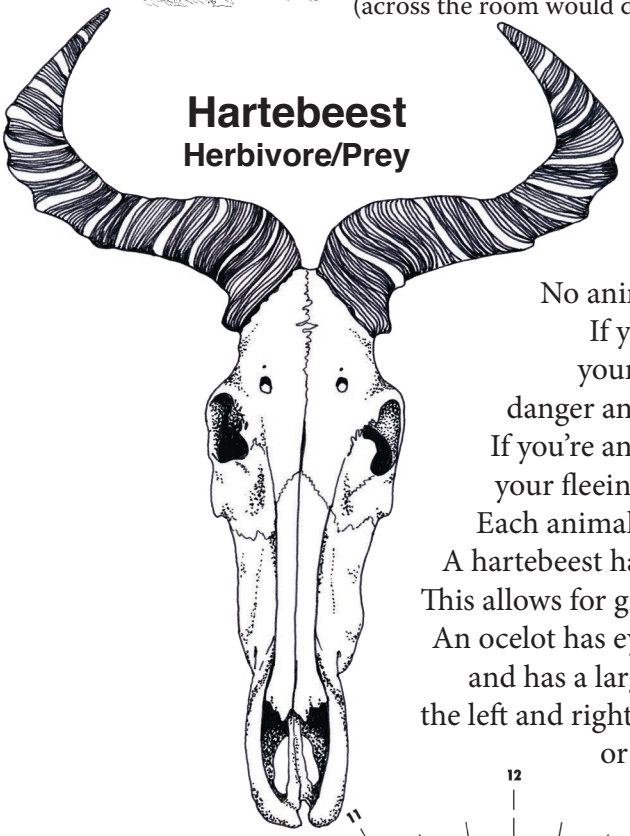
Why Do Predators Need Good Eyesight?

To be a predator is to be a carnivore (or at least an omnivore)—predators eat meat. To eat, predators need to catch their dinner first. It's hard to catch things you can't see very well, so most predators have excellent vision. But not only do predators have great distance vision, they also have a good stereoscopic vision—they see in depth. A lion jumping on an antelope has to be able to judge the distance and speed of its moving target. To achieve three dimensional vision, the eyes have to be positioned in the front of the head so that the field of view for each eye overlaps, creating a view of the same object from two separate positions. By analyzing how much shift there is in position of an object from the point of view of each eye, the brain can determine how far away that object is located in space—closer objects shift more than objects far away.

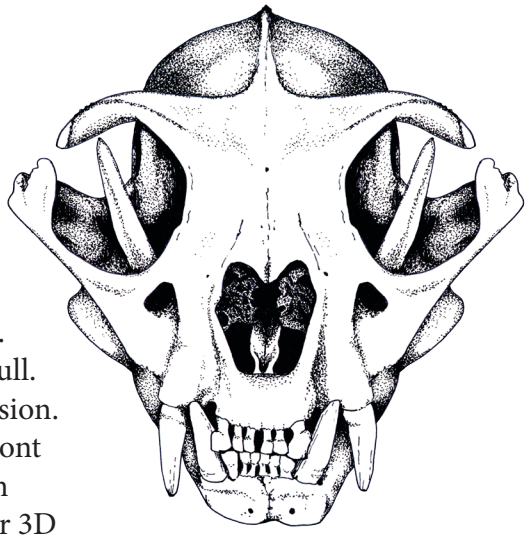
Look at an object (a finger would do) a couple feet away from your face with both eyes. And now look with each eye separately. Do you notice a shift? Now repeat the experiment for an object far away (across the room would do). Is there more or less shift?

What are the adaptations of the herbivores' eyes?

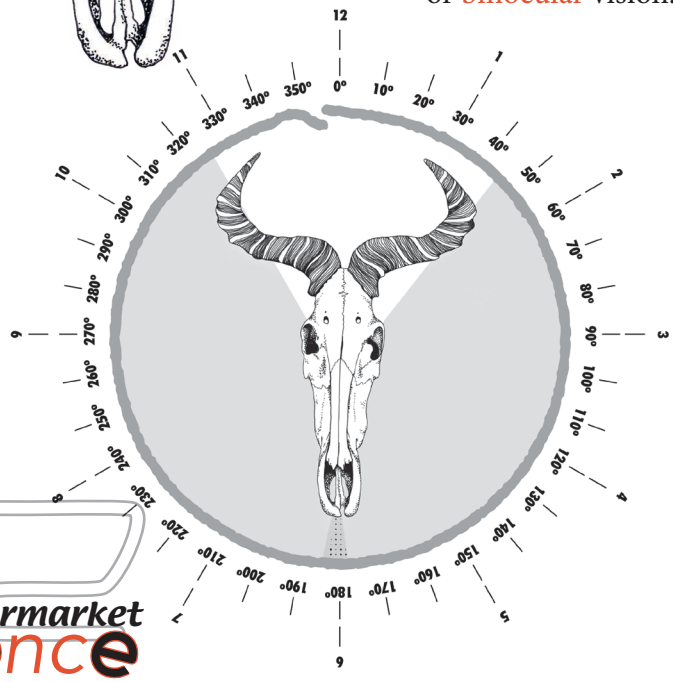
Hartebeest
Herbivore/Prey

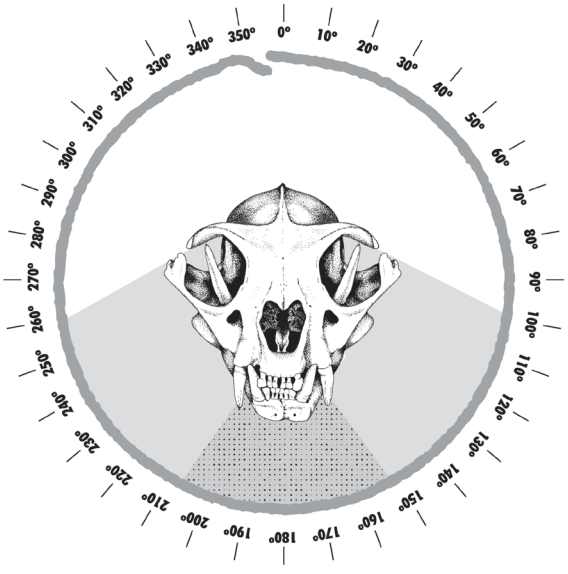


Ocelot
Carnivore/Predator



No animal wants to be eaten.
If you're a hartebeest,
your strategy is to spot
danger and then make a run for it.
If you're an ocelot, you want to track
your fleeing prey and chase it down.
Each animal has different vision needs.
A hartebeest has eyes on the side of its skull.
This allows for greater side or peripheral vision.
An ocelot has eyes that face towards the front
and has a larger area of overlap between
the left and right eye. This allows for greater 3D
or binocular vision.





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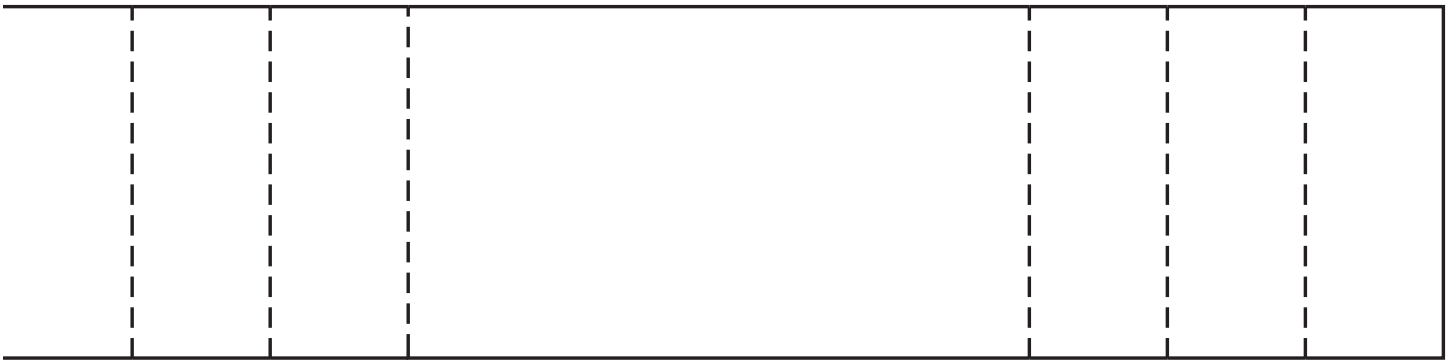
DO

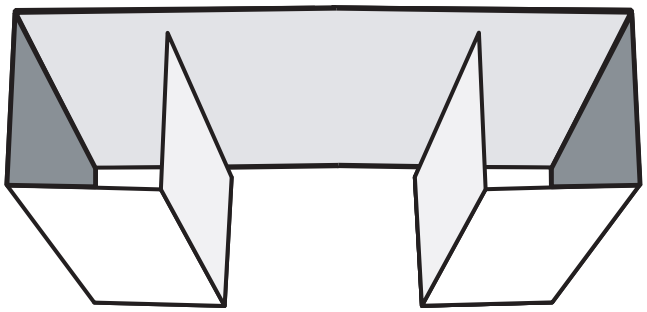
Things to Make

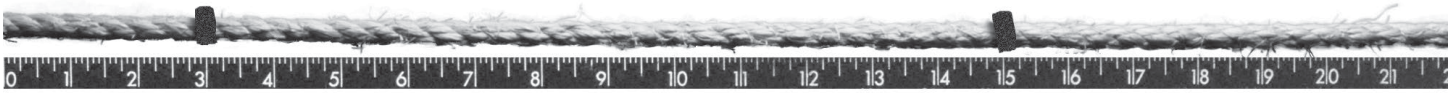
Paper Binoculars

Use a 3" x 11" strip of stiff paper and make three bends at each end. Roll the bends up to make binoculars. They'll help isolate the view from each eye. You can use an empty toilet paper roll cut in two, too.



Parent Helpers





If you don't have a long rope, use chalk to draw a wide circle on the ground and then mark it as shown. The circumference of the circle needs to be 36 feet—the diameter would then be 36÷(2π) or about 6 feet.

Marks on a Rope

Mark a 36-foot rope either every 12 inches or every 36 inches. The difference? The first marks every 10° on a circle. The second marks every hour on a clock face.

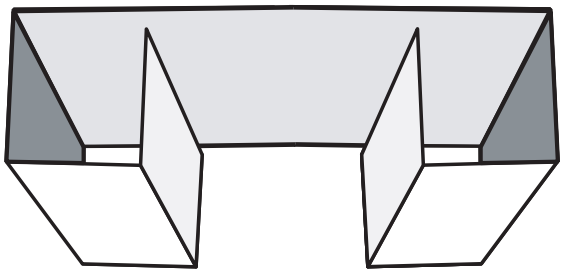
Mirrors on Sticks

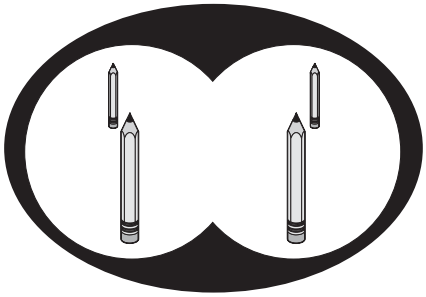
Tape mirrors to popsicle sticks. Make two. Nothing should be sharp—these go near your eyes!

If you have them, you can use two little dentist mirrors (available in any drug store):

DO

2 Eyes are Better than 1



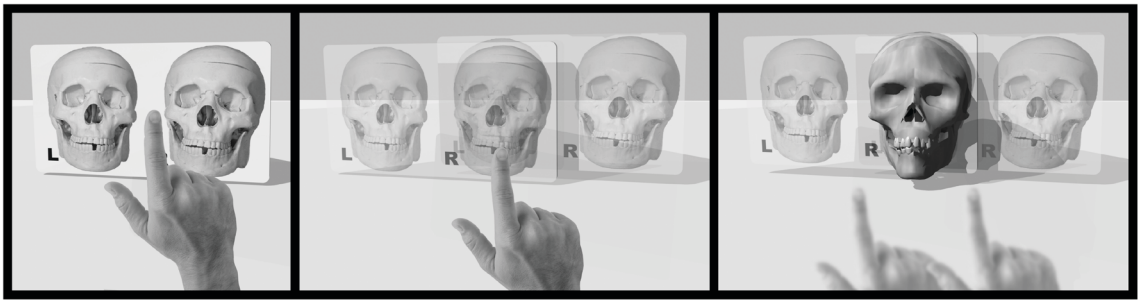


Look around using the binoculars you've made. Try covering one eye and then the other. Things that are closer will seem to shift positions more than things that are farther away.

Ever go to a 3D movie? The trick is to get a different image into each eye and the brain does the rest. Here, you cross your eyes a bit to merge the skulls.

Each eye sees an object from a slightly different perspective (from a slightly different view point). This difference allows the brain to merge the two images and form a single three-dimensional image.

Keep your head straight. Hold up your finger in the middle of the skulls and half the distance from the image to your eyes.



Focus on the tip of your finger—what's behind your finger will double so you'll see four skulls. Move your finger near and far until the two middle skulls fuse into one.

Look past the tip of your finger at the middle skull while keeping your eyes fixed. This can take some practice, but when you get it, the middle skull will look 3D.

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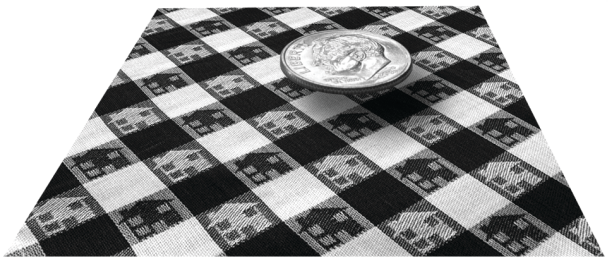
DO

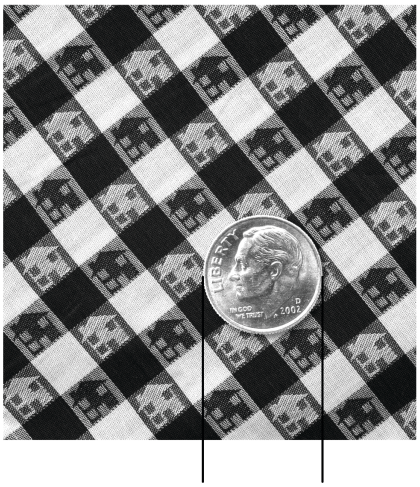
Float the Dime

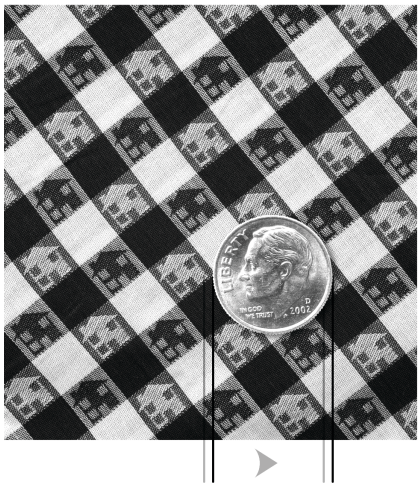


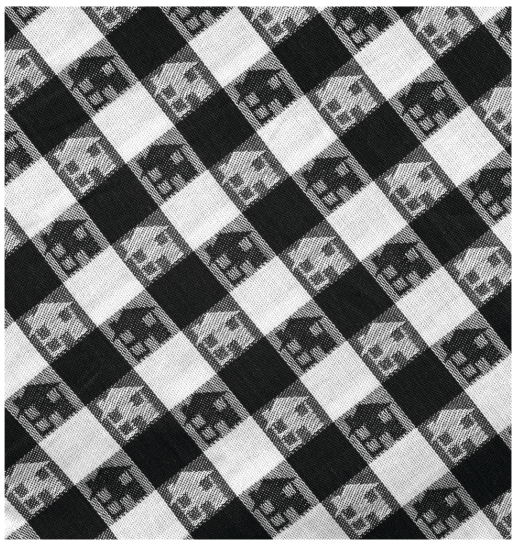
Get two dimes that look almost the same. Put one on each of the images of the empty napkins below. Place them in almost exactly the same position on each napkin, except move the one on the right square over to the right just a little bit, as shown below.

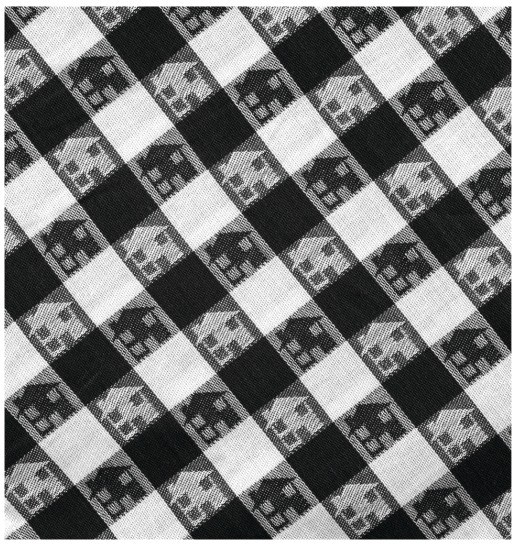
Now use the crossed eye trick from 2 Eyes are Better than 1 to make just one napkin with a dime floating over it. Move the dime around to see where it floats the best.

Can you make the dime look like it's under the napkin?









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DO

Plot Your Vision

Parent Helpers

If you don't have a long rope, use chalk to draw a wide circle on the ground and then mark it as shown. The circumference of the circle needs to be 36 feet—the diameter would then be 36÷(2π) or about 6 feet.

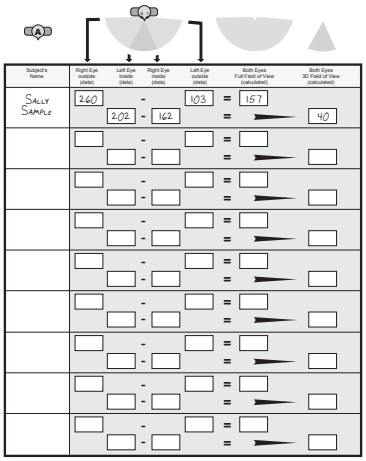
This activity is designed to measure the limits of the field of vision for each of your eyes.

Mark a 36-foot rope every 12 inches (for degrees) or every 3 feet (for a clock face). Lay the marked rope out in a circle. Subject A stands at the middle of the circle facing away from the ends of the rope. Spotter B should stand directly in front of A and make sure that *A* stares fixedly at B the entire time. A should cover the left eye with the back of the mirror stick. Spotter C should move around the circle away from B until A can no longer see C. Spotter D should move around the circle away from B until A can no longer see D. Record the positions of C and D on the included data sheet for the right eye. A should cover the right eye and then repeat. Record the new data for the left eye.

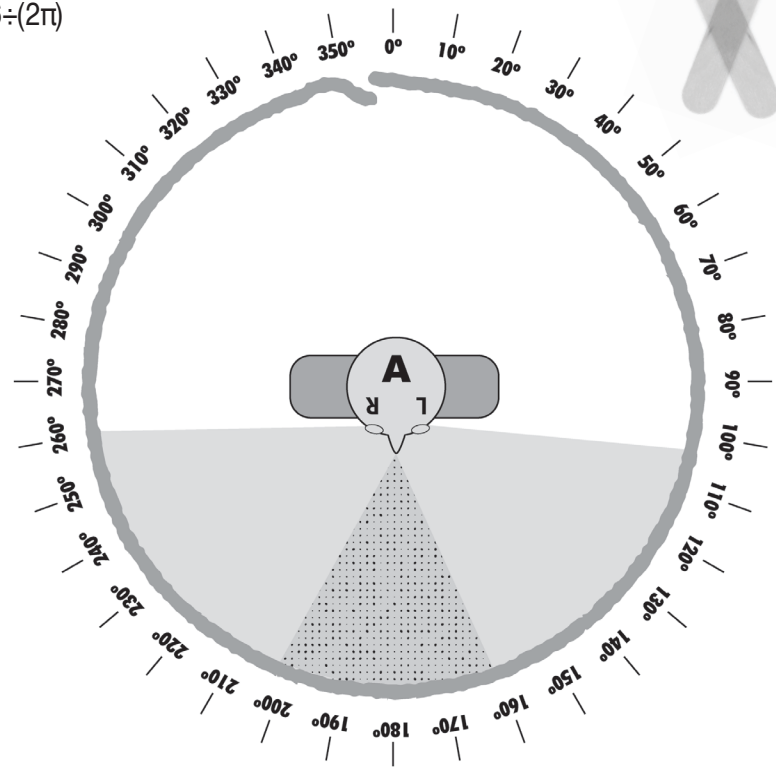
Spotters C and D should go to the limits of A's peripheral vision for each eye, as shown below. Subject A should take the mirror sticks and hold each angled in towards his or her nose.

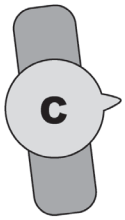
Can person A now see C and D?

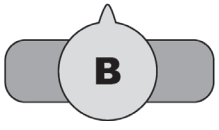
How far towards the rope ends do C and D have to move so that A can't see them?

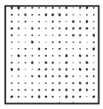


Data sheet is on the next page.









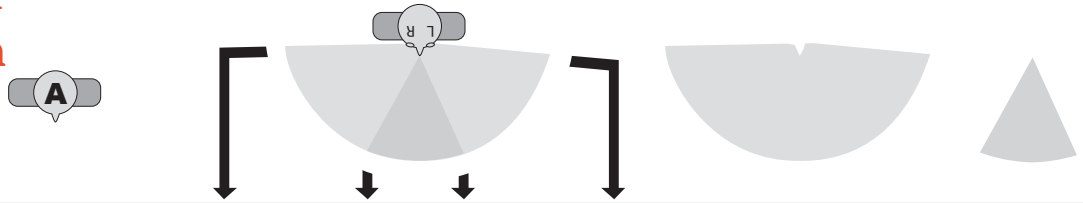
Overlap of Left and Right Eye Field of View
Area where 3-D Binocular Vision is Possible.

USE

Record Your Vision

In a group of humans, you'll find some small natural variation between individuals. But if you could test animals of different species, you'd find an enormous range in their visual fields.

Use this sheet to record data gathered during the Plot Your Vision activity.



Subject's Name	Right Eye outside (data)		Left Eye inside (data)		Right Eye inside (data)	Left Eye outside (data)		Both Eyes Full Field of View (calculated)	Both Eyes 3D Field of View (calculated)
Sally Sample	260	-		=		103	=	157	
			202	-	162		=		40
		-		=			=		
				-			=		
		-		=			=		
				-			=		
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				-			=		

LEARN

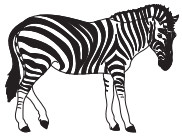
Spotting Predators

Herbivores too have several vision adaptations. The most visible is the position of the eyes—prey have their eyes located on the side of their heads. By having an eye on each side of the head, a herbivore can scan for danger in all directions at once (except for the back). Herbivores' eyes are particularly good at spotting movement—*is that a lion lurking in the grass?* But by gaining the ability to see almost all around them at once, herbivores lost the ability to see in three dimensions except for objects that are right in front of them. The depth perception right in front allows herbivores to run away from danger without tripping on a rock sticking out of the ground or other obstacles in the path.

Another herbivore vision adaptation is the development of multiple corneas. A cornea is a transparent membrane covering the front of the eye—like a lens. Sharp grass and weeds can easily scratch up a layer of cornea leading to loss of vision. For animals that spend their days bending down and sticking their eyes into the sharp grass, it's important to have extra layers of protection. We humans use goggles to protect our eyes when we work with sharp objects that can hit our eyes. The eyes on the side of the head also help prevent injuries by pointing away from the pointy blades of grass.

This is an African Lion's skull—a skull of a carnivore. Look at the type and size of the teeth and the position of the eye sockets.

A lion enjoys a meal of zebra meat.

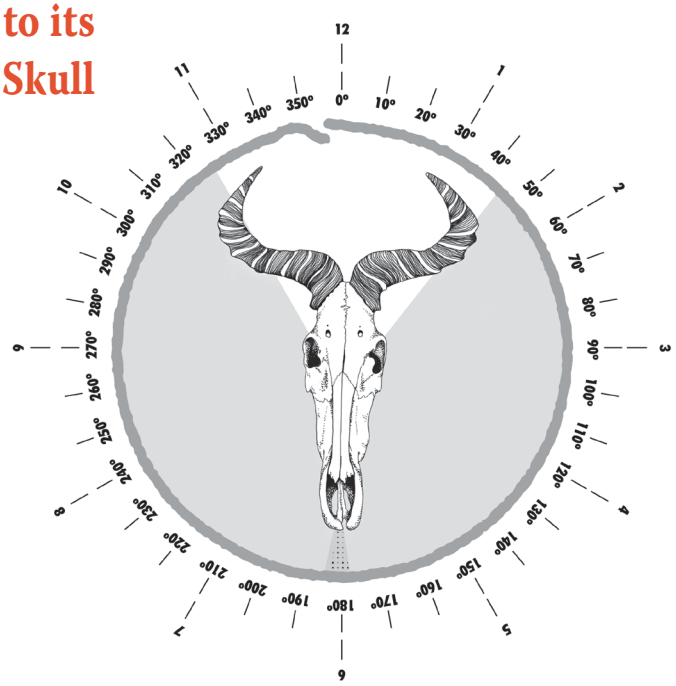


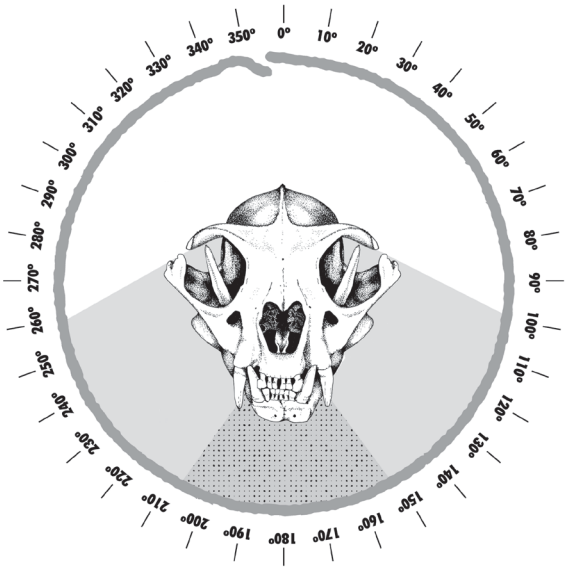
This is a zebra skull—a skull of a herbivore. Observe the back molars—these are teeth designed to grind up plants. The front teeth are good for cutting the grass and weeds. The eye sockets are positioned on the side of the head to allow zebra to check for predators in both directions and to keep the eyes from sharp blades of grass.

DO

Match the Predator to its Skull

Predators that have to catch their prey for a living have their eyes positioned in the front of their heads. This allows them to have a large overlap between the images that each eye sees. Animals that eat plants, have their eyes positioned on the side of the head to avoid poking them out with sharp blades of grass as they are leaning into it while grazing. Eyes on the side also give prey a much larger field of view, allowing the animal to better watch out for predators.





Next to each skull below write down whether you think this animal ate meat or plants. What can you tell about the position of the eyes? Pay close attention to the teeth as well.

Hint: there is only one herbivore skull shown below.