CAPTURE THE MOMENT

What is the greatest moment of Thunder basketball that you remember seeing?

From watching a game live to seeing exciting moments captured in still images, the spectacle of basketball has a lot to do with our passion for the game. When we recall a great game, we may have an image in our head of an amazing dunk. Maybe we remember the excitement as the ball swishes through the net while the maker of the winning shot's hands are still in the air. We may even have posters of these moments hung on our wall or taped to our favorite folder. With a game that is constantly in motion, how do we and professional photographers capture the moment?

Pro-Tip: This series of activities will guide you through several aspects of how vision, light, and photography work together to help us enjoy a game even when we are not at the arena. You may choose to use these activities at different times, or do some, but not all of the activities.

DEVON THUNDER EXPLORERS

devon

SCIENCE MUSEUM OKLAHOMA

HERE'S WHAT YOU'LL NEED PER STUDENT GROUP:

- Cardboard box bigger than a shoe box
- White piece of tissue paper
- Empty tin soup can that is open on one side
- Rubber band
- Hammer and nail
- Sharp scissors to cut the cardboard box
- Marker
- Duct tape
- Digital camera or smartphone with camera
- Pencil
- Journal
- Basketball or something that can be dropped repeatedly

WARMUPS

Have you ever wondered how the way your eyes see a basketball game compares to how a photographer's camera captures images of it? Let's find out by making and testing a contraption called a *camera obscura*. This simple device shares characteristics with both modern digital cameras and your own eyes.

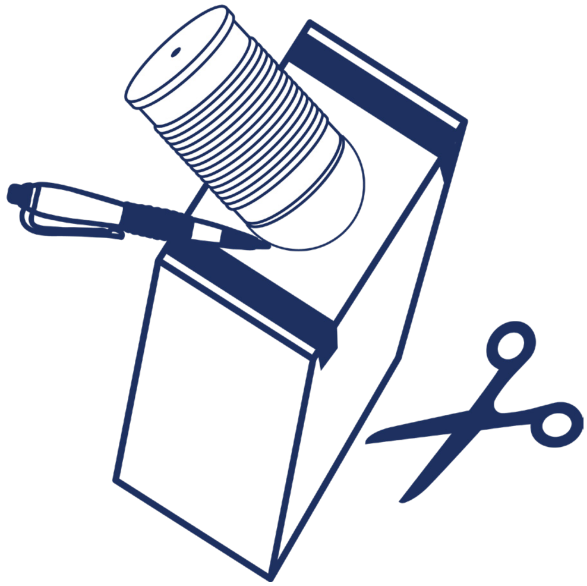
Pro-Tip: If enough materials are available, each student can make a camera obscura, but this activity works just as well if groups of five students or so work together to make one. This part can even be done as a demonstration with the entire class working together to make one.

So here's what you do:

Use the tape to cover all corners of the box and any areas where light can get in.

Use the hammer and nail to puncture a hole in the center of the bottom of an empty soup can.

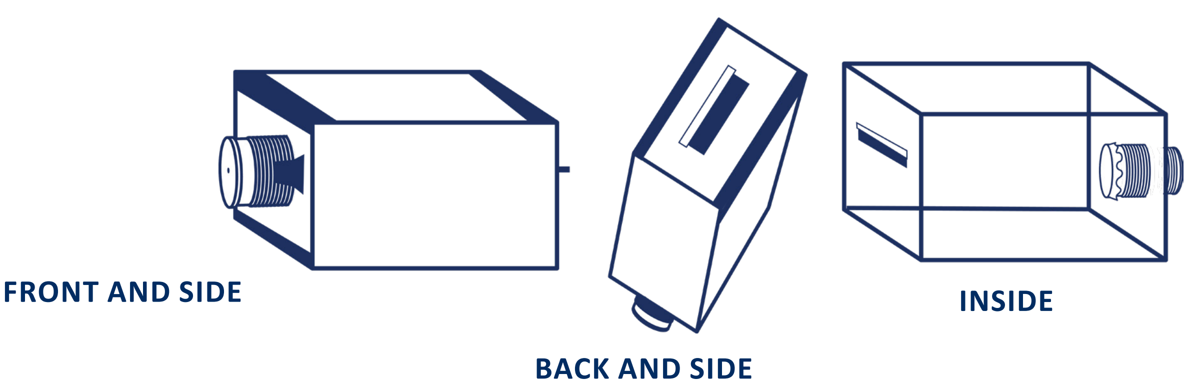
Trace the open end of the soup can in the middle of one of the smaller sides of the cardboard box, then cut a hole along the traced line.



Cover the open end of the soup can with the white tissue paper and hold it in place with a rubber band.

Insert the tissue paper-covered end of the soup can into the cardboard box. Use tape to make sure no light can get in.

Cut a hole on the opposite end of the box large enough for your eyes to comfortably look in and see the tissue paper. As you look inside the box, it will appear dark—after all, camera obscura is a Latin phrase meaning darkened chamber or box. If you find that too much light is getting in, you could use some of the extra cardboard you cut out to make a visor around the viewing area.

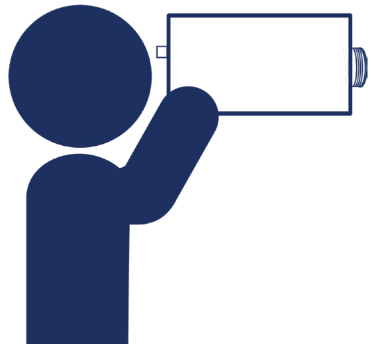


You are now ready to test your camera obscura.

After you've found a well-lit object, point your camera obscura at the object and look into the box though the viewing area. Using it outdoors or viewing something through a window with lots of natural light works best!

Pro tip: If you are wearing a hoodie, pull the hood far over your head to block out as much light as possible.

This will help you see the image crisply.



GAME TIME

Taking turns with all of your fellow students, look at your chosen, brightly-lit object through the camera obscura. Draw what you see in your journal.

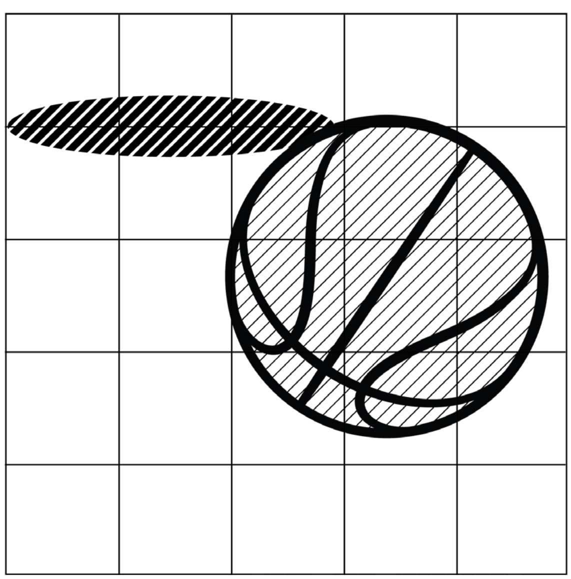
Record information about the image. Did the image appear right away or did it take a bit of time before you saw anything? Were colors muted or vibrant? Was the image upright or upside-down?

Did the camera obscura change the image in any other way?

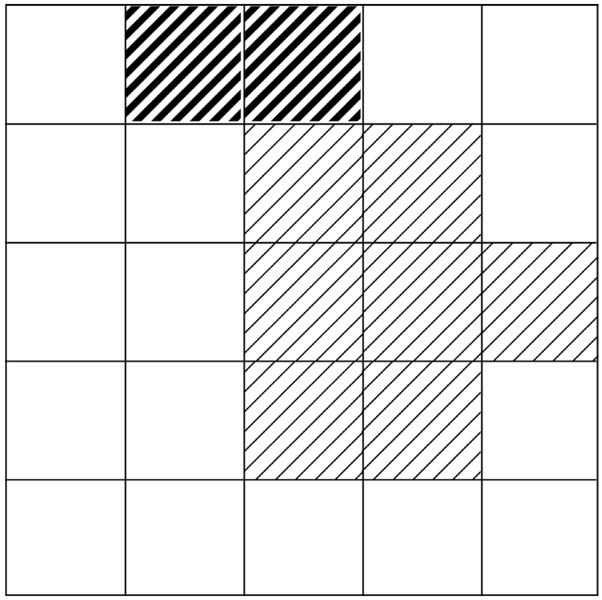
Now that you're skilled with using the camera obscura, you're going to conduct an experiment to see how it compares with a digital camera. Find an object that is easy to view and isn't surrounded by a lot of other stuff. This can be as simple as a ball or a globe on the windowsill or a basketball hoop on the playground. View the object through the camera obscura. Next, use a digital camera or a smartphone camera to capture an image of the same object.
Compare the two images. How are they the same? How are they different?

Print two copies of the 15 cm square with 3 cm grid template provided at the end of this activity.

On the first template, draw the image you see in the camera obscura over the grid bricks, making it as detailed as you can.

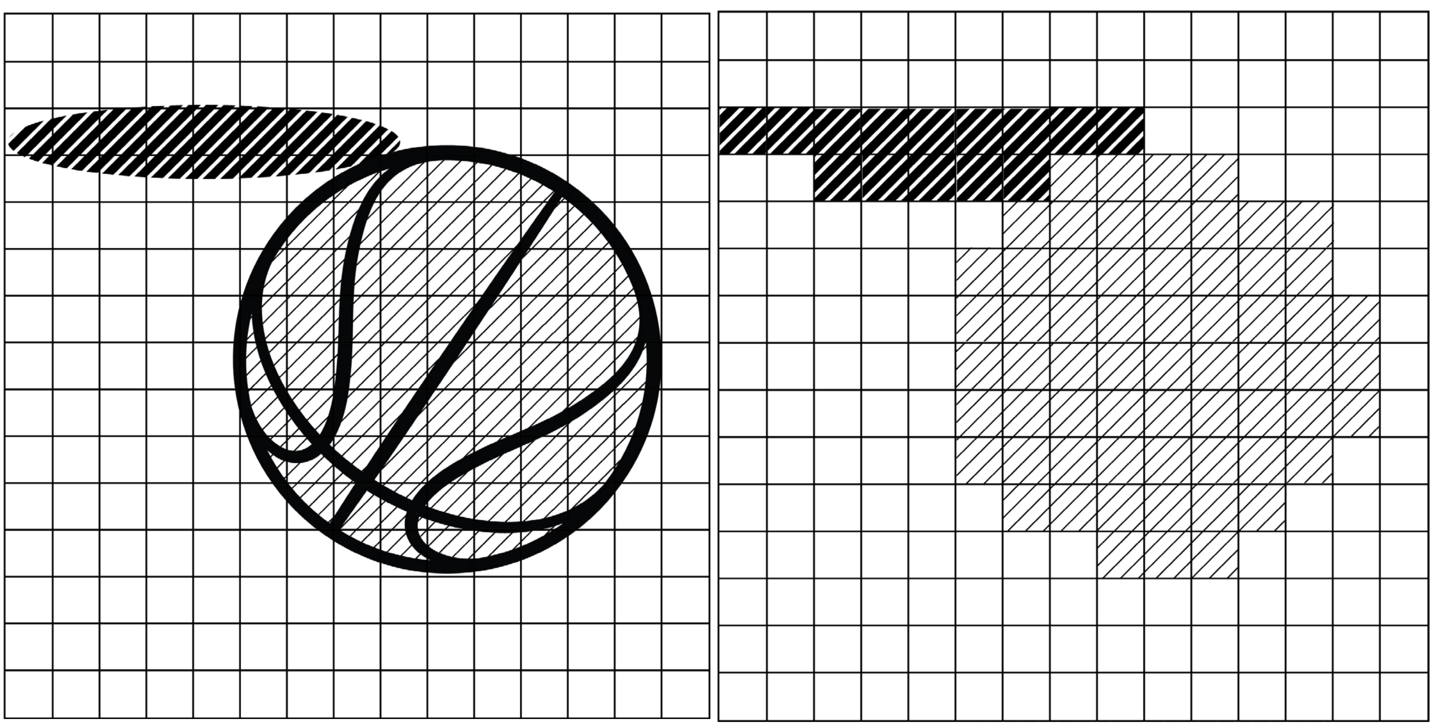


Using your first drawing as a guide, you are going to recreate the image on the second template as squares of light and dark. Look at the image in each square of the grid one piece at a time. If the square in the detailed drawing has a lot of dark parts in it, shade the entire square dark. If the square in the original is half or a little more than halfway filled with lines, shade it in lightly. If there is little to nothing in a square on your original drawing, leave that square blank on the new grid.



Compare the two drawings. Is it easier to identify the image in one? If you didn't know what the image was supposed to be, could you identify it in each drawing?

Now, print off the 15 cm square with 1 cm grid also provided at the end of this activity. Repeat what you did on the last exercise: shading in darkly squares with a lot of dark parts, shading in lightly squares that are filled halfway full with marks or light shading, and leaving squares with very little information blank.



Is the object easier or harder to identify?

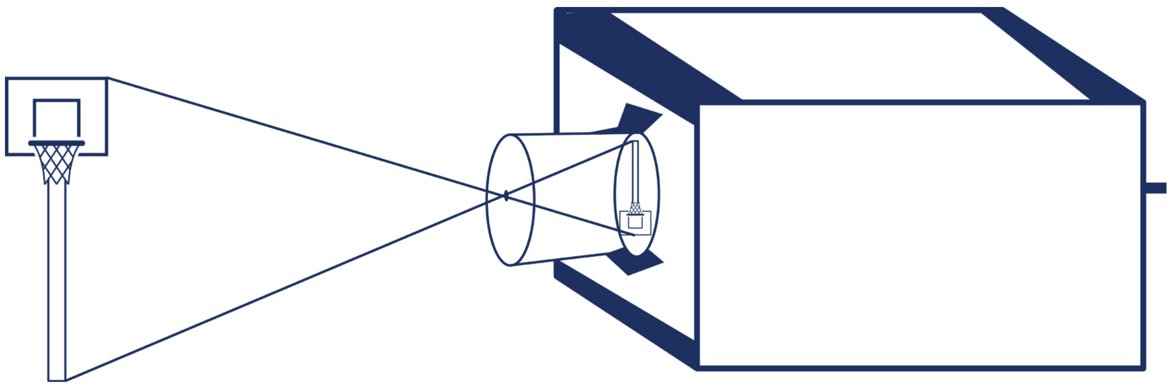
What do you think would happen if you continued to make the squares on the grid smaller and continued this same process?

Pro-Tip: There are many apps available for smartphones, like Grid#, that will place grids of columns and rows of your choosing on your photographic images. Downloading such an app could be used to help you create even more detailed grid drawings based on photographs.

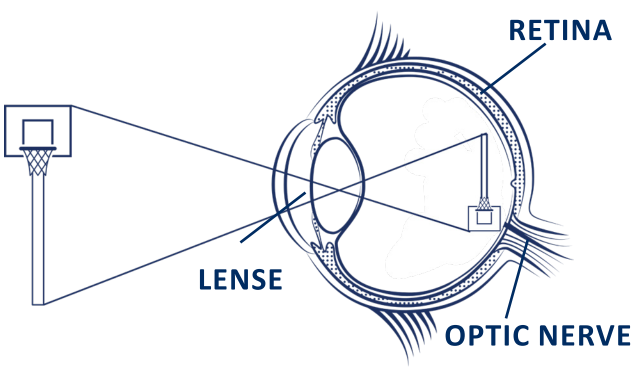
ANALYZE THE REPLAY
What happened?

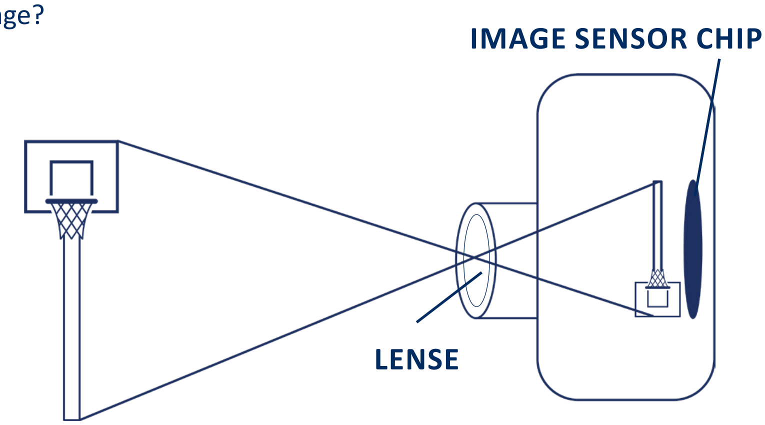
Did you notice that the camera obscura you built only allows light in through the tiny hole you put in the front of the can? How is that similar to the way light enters your eyes or your digital camera?

Light rays travel in straight lines until they hit something. When they do, some of that light bounces off and is reflected back in the opposite direction and angle from the point of impact. So, reflected light from the top of the object passes through the pinhole, continues in a straight line and ends up at the bottom of the paper membrane. The reflected light from the bottom of the object ends up on the top of the paper membrane, flipping the image upside-down.



The limited light that passes through the hole of the camera obscura can result in a blurry and dark image. Digital cameras and your eyes both have small openings that let in light, but openings are each covered by a lens. What do you think the addition of a lens does to improve the image?





The paper membrane on your camera obscura is in some ways like the retina of your eye. They both capture information from the light. In your eye, the retina contains photoreceptor cells, rods that recognize light and dark area and cones that perceive color. That information is sent through the optic nerve to the brain where it is processed into an image of the object. In a digital camera this light information is recorded on an image sensor chip as a series of numbers for each tiny dot or pixel of the picture. The numerical data is transmitted to the computer which combines the pixel data to create a picture. Both the brain and the computer in the digital camera flip the upside-down image over making it appear how we are used to seeing the world.

Think about the grid activity in Game Time. How are the grid's light and dark squares similar to the image sensor chip data and the photoreceptor cells in your eyes?

OVERTIME
Let's take it further

Up to this point, you have done activities which have illustrated how images are captured by digital cameras, our own eyes, and even a very old type of image recording device called a camera obscura. How do these relate to the difficulty of capturing an image in a fast-moving basketball game, though?

Think about the process of taking a picture. There are a lot of different steps besides just pointing and shooting! There's the light entering the camera, the image getting captured on the image sensor chip, and all the human input of pointing, framing, and taking the shot. Some steps are nearly instantaneous, or happen very quickly, like light passing into the camera. Others may take a little more time like pushing the button or tapping the screen to take a picture, or even making the decision to take a picture.

Furthermore, there are variables that make taking a picture difficult. Basketball is a very fast game. Not only are the players fast, the ball can move even faster. In order to take a picture, photographers have to anticipate what direction the player and the ball are going. Players also practice switching direction or making a pass look like a shot as strategic moves, so even a photographer may be fooled.

For this next exercise, team up with a partner. Take turns bouncing a ball, or dropping an object, while the other partner tries to take a digital image of it. Try 10 times, then switch.

Did your photographs turn out successfully? How many were successful? What was your percentage of success?

Were there any strange photos—blurred or incomplete images?

What could account for these strange images?

When you were successful in capturing the image, what actions led to this success?

COACH'S CORNER
Additional information and explanations for parents and educators

There are many variables that allow professional photographers to capture the excitement of the NBA. Just like the athletes on the court, the photographers on the sidelines have spent years mastering their craft. Their continued practice and dedication ensures that they are always improving and anticipating which way to point their camera and when to push the button to make the most exciting image.

In order to capture the action of fast-moving basketball, the photographer has to use a very fast shutter speed. The shutter speed determines how quickly light is let into the image sensor chip. The shutter must be at least as fast as 1/800th of a second. Think about the camera obscura the class built; depending on the conditions in which you are viewing, the image may be crisp or very blurry. In order to take an amazing picture, the photographer must have lots of ambient light available to use such quick shutter speeds. A professional photographer will also have the skill and experience to adjust the camera's aperture, or the hole that determines how much light is allowed into the image sensor chip. Being able to do this quickly allows the photographer to capture the moment. Additionally, ISO speed, or the speed at which the image sensor chip reads the light coming into the camera, is important.

When students were trying to capture the image of a dropping ball earlier, they may have caught an image of a misshapen ball, a blur, or even an image with no ball at all. Shutter speed, the amount of light available, and the speed at which the sensor chip processed the light information are all involved in the resulting images. Their own speed at taking the picture is also responsible.

Refined skills and the best equipment cannot ensure a great photograph. An experienced sports photographer knows that a great image features not just the player but also the ball. To take this picture the photographer must anticipate the action. Practice also teaches the photographer to partner the aperture and shutter speed to isolate the action, creating a crisp focus on the player and the ball while the background appears somewhat blurry.

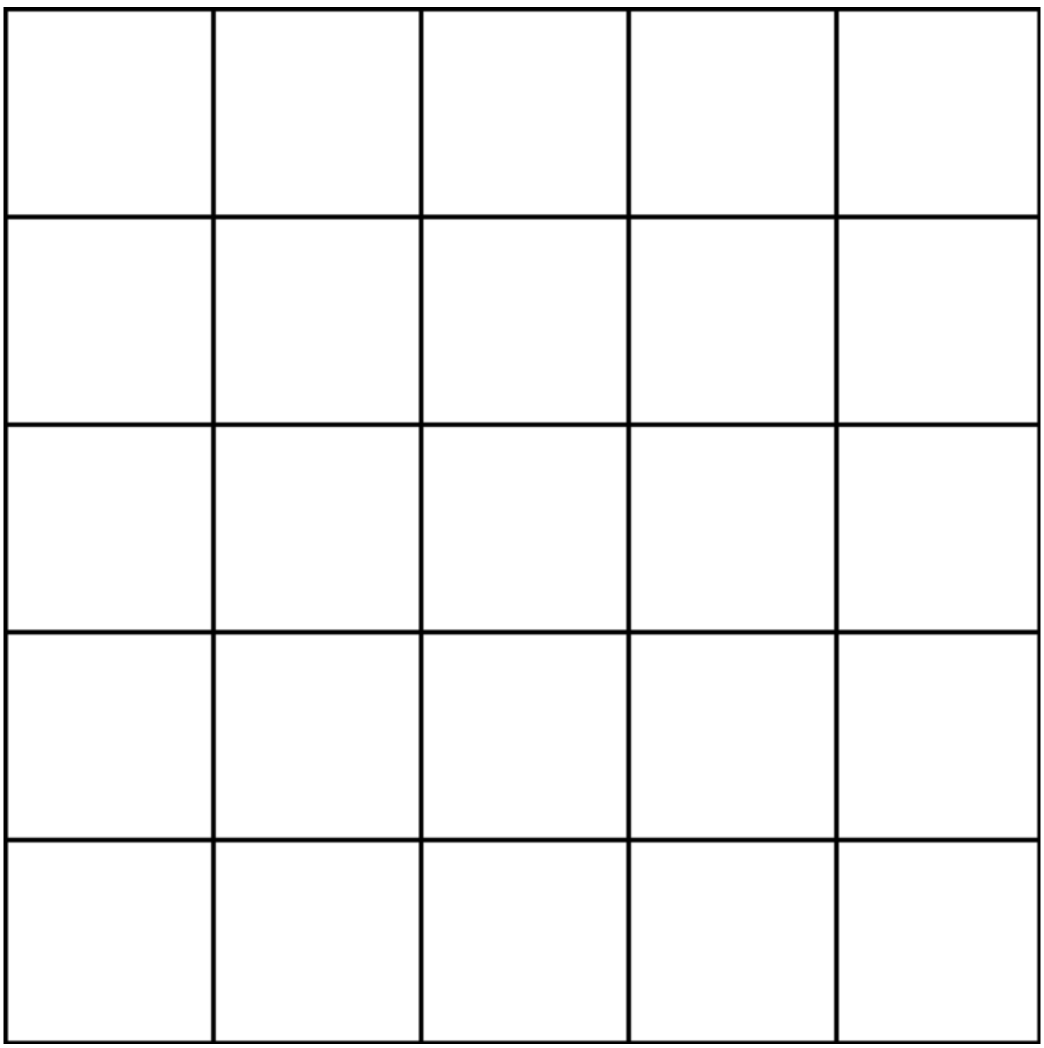
DO YOU WANT TO LEARN MORE?

Research: Cones, Digital, Lens, Light, Optic Nerve, Photoelectric Effect, Pixels, Retina, Rods, Variable

OKLAHOMA ACADEMIC STANDARDS: MATHEMATICS

STANDARD	5th Grade	6th Grade
Science		
MS-LS1-2: From Molecules to Organisms		●
MS-LS1-3: From Molecules to Organisms		●

15 CM SQUARE WITH 3 CM GRID



15 CM SQUARE WITH 1 CM GRID