STEAM Subject: Photography
Lab: Camera Obscura

Grades: 6-8

Learning objective: Students will be able to identify what a camera obscura is and create their own.

ENGAGE:
Ask students the following questions:

- How does light travel? *Light travels in a straight line.*
- Let's imagine you are inside a room with a window. Would you be able to see the outside image projected on the wall in front of a window? Yes, you could see the outside image inverted on the wall, if the room is able to block out light completely, and the window is covered with a small hole in the middle.

EXPLORE:

Build a Camera Obscura Activity.
You can make a camera obscura inside a room as artists used to do in the mid-1400s, or you can make a camera obscura portable with a variety of containers and boxes.

Tips:

- The **container or box** should be light-proof, or able to block out light completely.
- The window's **room** should be covered completely allowing only the light coming from the small hole.
- When you look at the screen inside the container or box, let your eyes adjust to the darkness and use your hand to block as much light as possible from the sides.

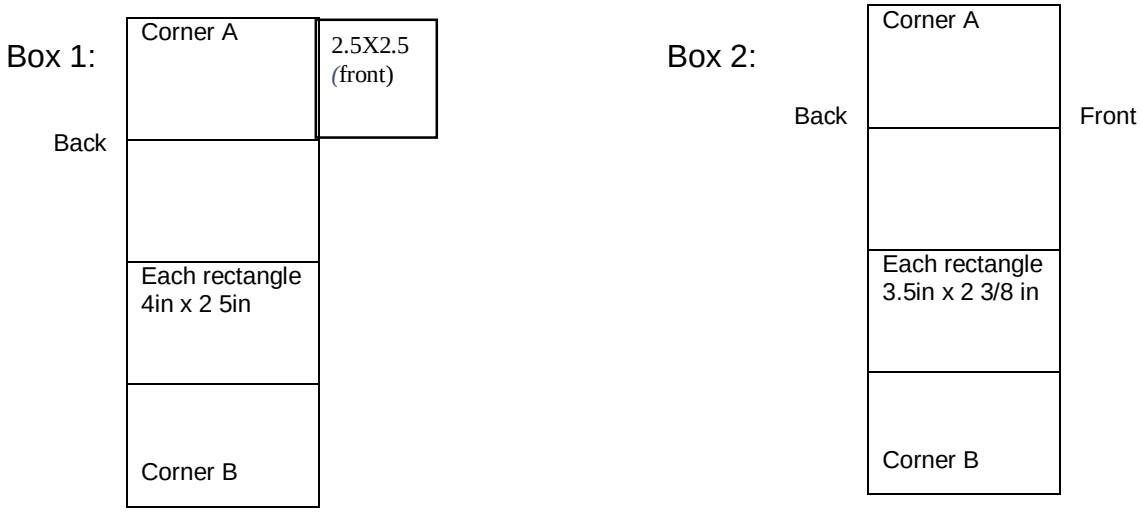
Materials needed per student:

- One 18-inch X 8-inch piece of cardboard
- One 18-inch X 6-inch piece of cardboard
- Black matte paint
- Pencil
- X-Acto knife (SAFETY: adult assistance required to handle sharp blade)
- Ruler
- One 3.5-inch X 3.5-inch piece of either parchment paper, wax paper, or tracing paper
- Needle or pin to make a hole (Adult supervision required)
- Gauze black tape or black duct tape

Directions:

1. Draw and cut the two shapes seen on the diagram below, on the cardboard pieces.
2. With the X-Acto knife, gently mark the lines on the boxes, so they can easily fold. Adult supervision required.
3. Box 2: Fold each rectangle, to create the shape of a box, then tape corners A and B together.
4. Box 1: Fold each rectangle creating the shape of a box, and tape corner A and B together.
5. Before taping the square top of Box 1, make sure that Box 2 fits inside Box 1. Make adjustments if necessary, so the smaller box can fit and slide inside the larger box.
6. On the front of Box 2, tape the 3.5-inch X 3.5-inch piece of paper.
7. Slide Box 2 inside of Box 1, so that the paper is facing the front of Box 1.
8. On Box 1, make a small hole using a needle or pin in the middle of the front of the 2.5-inch X 2.5-inch square. Adult supervision required.
9. Look inside the box, the outside image of the scene beyond the hole will be projected on the screen inverted.

Diagram:



Making a Camera Obscura Out of Recycled Containers Activity:

Materials needed per student:

- Recycled container or box
- Black matte paint
- Pencil
- X-Acto knife (Adult supervision and assistance required)
- Ruler
- Parchment paper, wax paper, or tracing paper.
- Needle or pin to make a hole (Adult supervision required)
- Gauze black tape or black duct tape

Directions:

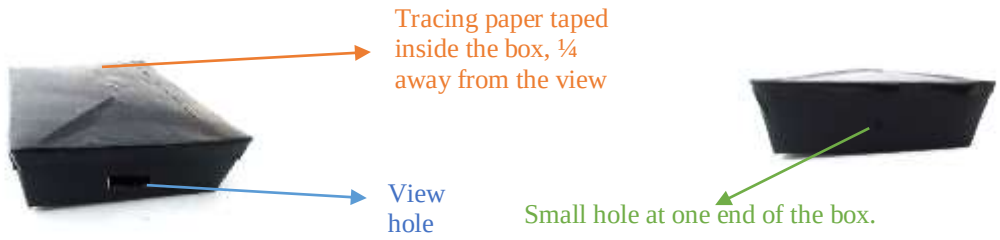
1. Watch the following video:
    a. "How to Make a Pinhole Camera": https://youtu.be/2Glok5NJEqg
2. Making a camera obscura is easy, find a container or box, and be creative.
3. Look at the samples below as a reference, notice the hole and the "screen" (parchment paper or white paper) are always located in front of each other, however, the hole to view the screen can be placed at different locations.

Square box

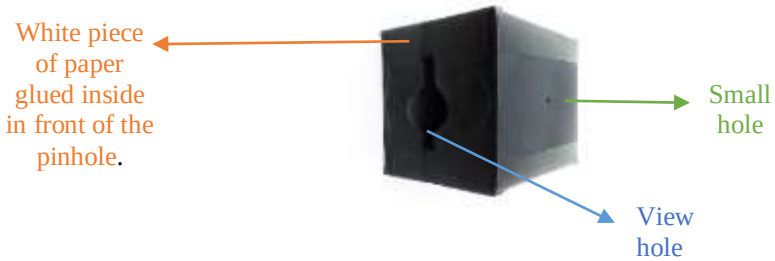
Small ice cream container

Shampoo bottle

To-go food container



Tissue box



Turn a Room into a Camera Obscura Activity:

Materials needed per room:

- Tape
- Black extra-large trash bags to cover the window
- 4-inch X 4-inch piece of cardboard
- Single hole Punch
- Scissors

Directions:

1. Watch the National Geographic video:
    a. "Making Your Own Room with a View": https://youtu.be/gvzpu0Q9RTU
2. Click on the link to get inspired by Abelardo Morrel images: http://www.abelardomorell.net/project/camera-obscura/
3. Choose a room with the most interesting view.
4. Punch a hole in the 4-inch X 4-inch piece of cardboard and taped it to the middle of the window.
5. If your black plastic bags still allow light to pass through, fold them horizontally to block the light. Tape the bags to the window and cover it completely. When you reach the 4-inch X 4-inch cardboard square, cut a small piece from the plastic bag so that the hole is uncovered, and tape the bag on the window and around the hole circumference.
6. Once your eyes are adjusted to the darkness, you can observe the outside image of the scene beyond the hole inverted on the wall.
7. You can experiment and make different sized holes on different pieces of cardboard and switch them to observe the difference.
8. You could also place the hole on different parts of your window so the light projects in a straight line into the wall.

Example:

- To cover an 80-inch X 48-inch window, I used about 12 plastic bags (42-gallon size).
- Overlap the plastic bags and use tape in between to prevent the light from passing through the gaps.

EXPLAIN:

Review STEAM Vocabulary

- **Camera Obscura:** Also known as a darkened chamber, it is a natural optical phenomenal that occurs when the light passes through a small hole, projecting an inverted image of the scene on the other side. The term also refers to the constructed device in which the optical phenomenal occurs; such as, a room, tent, box, etc.
- **Light**: Electromagnetic radiation with a specific frequency. Electromagnetic waves can be detected over a wide range of frequencies, of which the visible spectrum of colors detectable by human eyes is just a small part. Light is both a particle and a wave. When light waves enter a piece of glass (like a camera lens) at an angle, one part of the wave will reach the glass before another allowing an image to be capture.
- **Rectilinear Propagation of Light:** Technical name for when light travels in a straight line in one medium. A camera obscura is a perfect example of this rule.

ELABORATE:

Light spectrum and light properties
Watch the following videos:

- "What is Light": https://youtu.be/BUYeQa_-ojk
- "Laws of Reflection": https://youtu.be/vt-SG7Pn8UU
- "What is Refraction of Light": https://youtu.be/lkv0uZTP_zo

- Read more about the behavior of waves: https://clarkscience8.weebly.com/behavior-of-waves.html

EVALUATE:

Ask the students if they could recognize the outside view when using their camera obscura. If they made a portable one, take it to different rooms and see if the view has changed.