

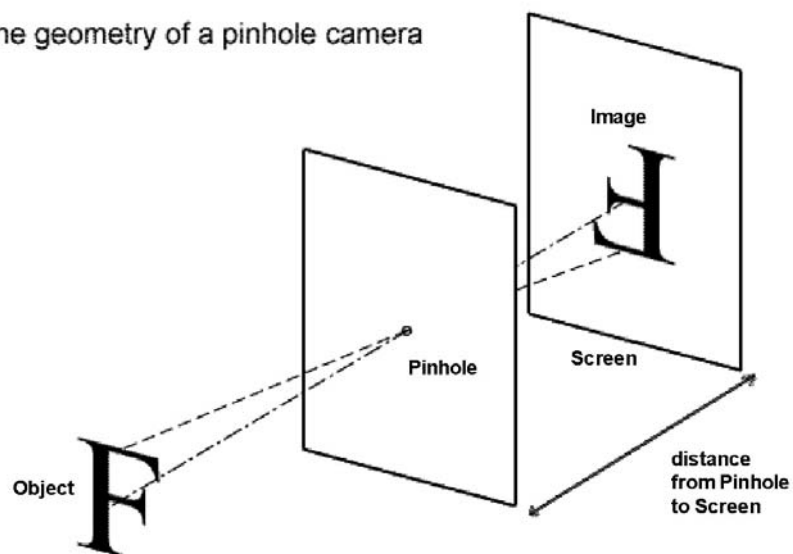
## Home Lab 2

### Pinhole Viewer Box

#### Overview

A pinhole camera, also known as camera obscura, or "dark chamber", is a simple optical imaging device in the shape of a closed box or chamber. In one of its sides is a small hole, which, via the rectilinear propagation of light, creates an image of the outside space on the opposite side of the box.

The geometry of a pinhole camera



## Activity 2 - 1: Construction of the pinhole camera

**Objective:** To understand how light rays form images using a pinhole?

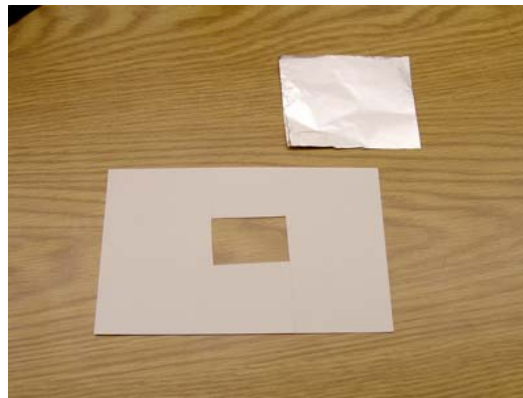
**Materials:**

- 1 large box (about copy paper box size)
- 1 smaller box (small enough to fit inside the big box)
- wax paper, aluminum foil, a few index cards, masking tape, cutting utensils (scissors/knife), ruler, meter stick
- 1 needle
- a 60-100 Watt white frosted light bulb (a white bulb that you can not directly see the wires inside)
- a desk lamp for the light bulb
- black paint (optional)

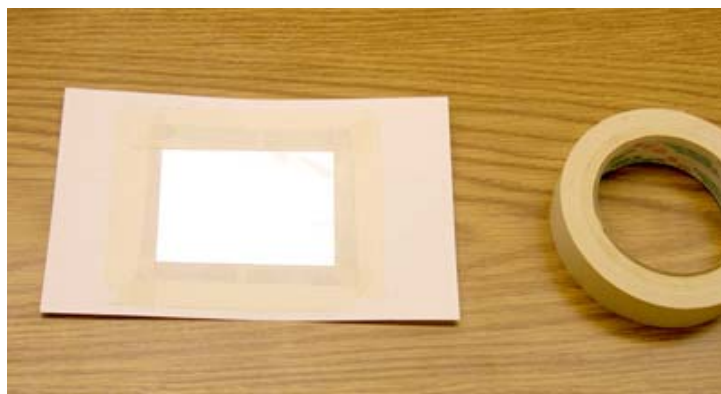
**Procedure: Making the pinhole viewer and basic set-up**

(read completely before starting)

1.) Cut a square in the index card and cut out a piece of aluminum foil slightly larger than the hole in the card.



2.) Tape the foil over the opening in the index card with masking tape (or some similar kind of tape).



3.) Lightly punch as small a hole as you can in the foil with your smallest pin (it helps to put cardboard behind the foil to keep it flat and stable and makes a hole with less ragged edges).



4.) You will need to completely close your large box to view the image inside (painting box black on the inside to reduce scattering of light is optional).



5.) Cut a small square opening in the front of the box (as shown). Place the foil with pinhole over the front opening of the box and tape it there securely. Make a viewing window by cutting out a square on the opposite side of the box.



6.) To make the image viewing screen - take your smaller box, cut a large square in one end, and tape a piece of wax paper over the opening.



7.) The wax paper will be the target screen where you will see the image. The small box can be any size as long as can easily fit inside the larger box and can stand upright as in the next picture.



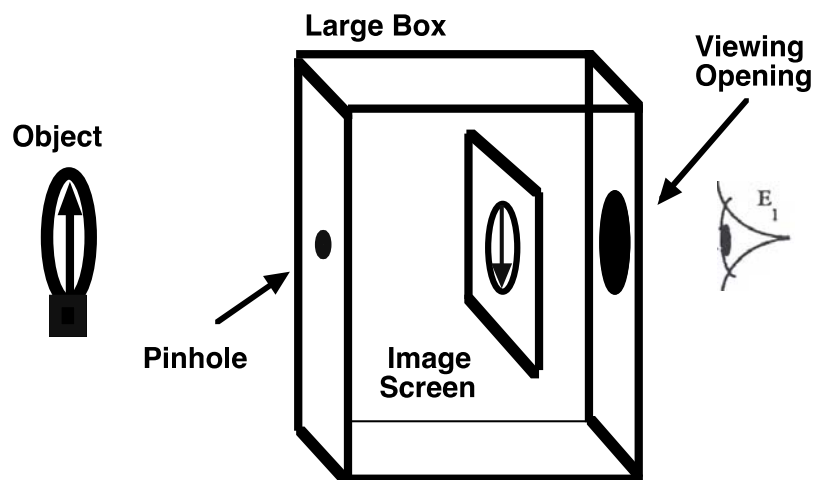
8.) Insert the small box (target screen) inside the big box (as shown). This picture illustrates the relationship between the pinhole foil (in the front of the box), the target screen (inside the box), and the back viewing opening in the back. Put the top on the big box and you are ready to go.



9.) This picture of the experimental set-up showing our closed pinhole box pointed at the object we will view (a 100-Watt white frosted light bulb). All viewing should be done in a dark room.



10.) A diagram of picture (9) showing the relative positions of the object, pinhole, image screen, viewing hole, and eye.



11.) You will need to draw a pattern on your light bulb – so when you view its image you can easily distinguish up/down, right/left on the bulb.



12.) It does not matter how you orient the bulb or what type lamp you use as long as the bulb is bright and that you can distinguish up/down, right/left on the bulb.



Date\_\_\_\_\_

13) Photograph your pin hole viewer box showing the smaller viewing screen inside the larger box and embed in your Lab02 report at this location.

14) Photograph the front of your pin hole viewer box showing the pin hole in the aluminum foil and embed in your Lab02 report at this location.



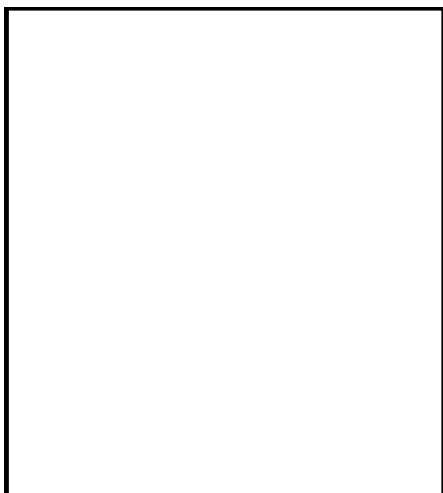
## Activity 2 - 2: Image of the light bulb

**Objective:** To view and study the image made by a pinhole.

**Procedure:**

1. In a dark room in your home or classroom (shut the blinds & turnout the lights), position the wax paper screen in the center of your pinhole box, close the box, place the pinhole in the front of the box about 50 cm from the lighted 100W bulb (the object), (see picture in step 9 in Activity 2-1).
2. Align the box until you can see a faint image of the bulb appearing on the center of the wax paper screen as viewed through the large viewing hole in the back of the box. You will need to look carefully the image may be very dim (it will help to be in the dark a few minutes). If the image is too faint to see, the pinhole may have to be enlarged slightly. Make sure you have drawn a pattern such as an upper case F on the bulb as described in the set-up section.
3. Sketch your observations in the space below including the F on the bulb or you may photograph the image and embed it in the space below. If you use a camera. you will have to turn off the flash and set the exposure for a few seconds and hold the camera very steady. This may require several attempts before you get it a good picture.

Sketch of the bulb “object” in this space



Sketch of the bulb “image” in this space



Date\_\_\_\_\_

2. Briefly describe and explain the differences you observe between the object and the image – with special attention to brightness, size, up/down, and left/right changes:

Type in your observations and explanations below:

Compare the size of the image with the size of the object \_\_\_\_\_

Compare the brightness of the image with brightness of the object \_\_\_\_\_

Compare the up/down relationship between the image and the object\_\_\_\_\_

Compare the left/right relationship between the image and the object\_\_\_\_\_

### Activity 2-3 : Effect of distance between the pinhole and lightbulb (object)

**Objective:** To study the nature of the image as the distance between the pinhole and object (light bulb) changes.

**Procedure:**

(Keep the screen in the same position in the box.):

1. Observe the image when the distance is 50 cm between the lightbulb and the pinhole then move the entire box toward the light bulb by one half the distance (25 cm) : [complete the table below with regard to brightness, size, up/down, and left/right changes.](#)

Category	Your Prediction	Observation (Describe the changes you see)	Discussion (Did your prediction confirm your observation? Why or why not?)
Size of the Image			
Brightness of the Image			
Up/Down Relationship			
Left/Right Relationship			

2. Move the box about twice the distance (100 cm) from the light bulb as it was originally: [complete the table below with regard to brightness, size, up/down, and left/right changes.](#)

Category	Your Prediction	Observation (Describe the changes you see)	Discussion (Did your prediction confirm your observation? Why or why not?)
Size of the Image			
Brightness of the Image			
Up/Down Relationship			
Left/Right Relationship			

Date\_\_\_\_\_

3. Summarize the above findings by writing a brief conclusion describing how the distance between the pinhole “lens” and the lightbulb ( object) affects the image we see. Complete diagram A on page 13 and use it to assist you in your explanation here, but do not sketch in the diagram here.

4. Keeping the edge of the front of the box on the table, tilt the back of the box slightly upward while looking through the back viewing hole. Describe what happens to the image on the screen: Does the image of the bulb look different?, Explain. For questions 4, 5, and 6, record your answers below in the table. Hint: think about what component of the pinhole camera is physically changing as you manipulate the position of the back of the box.

5. Keeping the “midpoint” of the edge of the front of the box stationary on the table, slightly move the back of the box to the right while looking through the back viewing hole. Describe what happens to the image on the screen:

6. Keeping the “midpoint” of the edge of the front of the box stationary on the table, slightly move the back of the box to the left while looking through the back viewing hole. Describe what happens to the image on the screen:

Action	Prediction	Observation (Describe the changes you see)	Discussion (Did your prediction confirm your observation? Why or why not?)
Tilt the back of box upward			
Move the bck of box to the right			
Move the back of box to the left			

7. Summarize the above findings in 4, 5, and 6 by writing a brief conclusion describing how the movement of the screen effected the position of the image on the screen:

8. On the next page are 4 diagrams that represent a 2 dimensional view of your pinhole viewer. The top (sample diagram) shows how the two rays of light from the extreme ends of an object (arrow) pass through the pinhole opening and project an image of the arrow onto the viewing screen. **Your task is to draw the same two extreme light rays from the ends of the object arrow through the pinhole and draw the resulting image that would appear on the viewing screen for the remain 3 diagrams (diagrams B and C).** **You will have to scan or digitally photograph your finished diagrams and submit the photo with this lab writeup.**

Sample Diagram

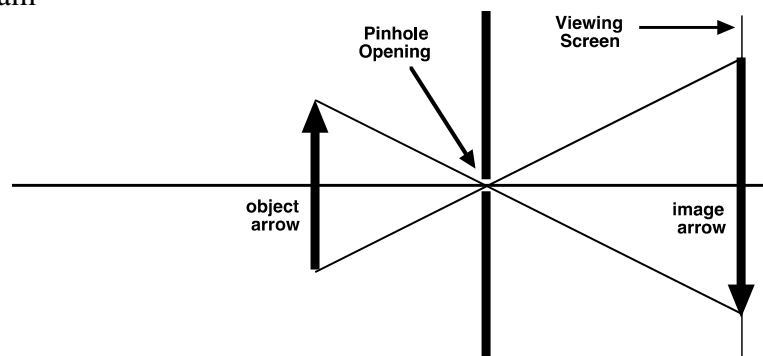


Diagram A

Diagram B

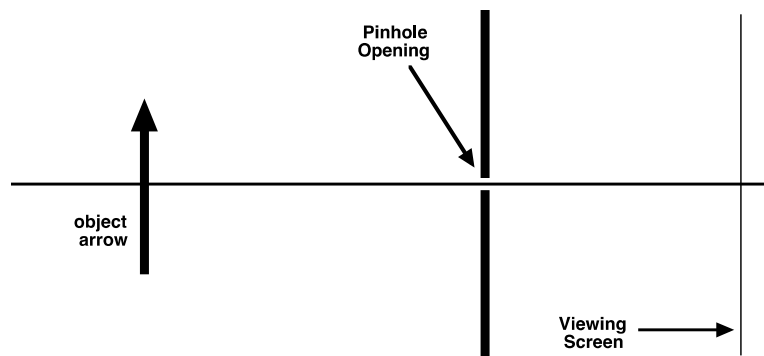


Diagram C

