Blank Activity Template

Yellow highlight = required component

Subject Area(s) Physics

Associated Unit Light and Optics

Associated Lesson Optics

Activity Title Build Your Camera

Header

Image 1

Image file: camera_lens.jpg

ADA Description: image showing a camera lens

Source/Rights: Copyright © http://www.pixarti.com/d/Camera-Lens-16.html

Caption: none

Grade Level 12 (10-11)

Activity Dependency

Time Required 45 minutes

Group Size

Expendable Cost per Group US$ 25

Summary

In this activity the students will build a basic camera using simple materials. In doing so, they will be able to explain the working principles behind the camera.

Engineering Connection

Biomedical engineers try to model the behavior of cellular organisms by looking at microscopic images of cell tissue. Electrical and computer engineers design robots and navigation systems

based on images acquired through CCD or CMOS cameras. In fact, whether it is a microscope or a camera, imaging systems are widely used in the engineering field, and their working principles obey the same optics and physics laws. Another emerging branch of optical engineering which deals with optics is Nano-photonics or Nano-optics which involves the study of the behavior of light on the nanometers scale.

Engineering Category = #1

Choose the category that best describes this activity's amount/depth of engineering content:

1. Relating science and/or math concept(s) to engineering
2. Engineering analysis or partial design
3. Engineering design process

Keywords

Camera, lens, focal length, waves, optics

Educational Standards

Texas TEKS

Pre-Requisite Knowledge

Learning Objectives

After this activity, students should be able to:

- Understand the working principles behind a lens
- Understand the working principles behind a camera

Materials List

Each group needs:

- Oatmeal box.
- Glue.
- Black paint.
- Black spray paint.
- Undeveloped film.
- Chemicals for film development.

To share with the entire class:

- None

Introduction / Motivation

As an optical engineer, you are asked to build a high resolution camera to image Nano-scale particles. You can only use the materials listed above (see Materials List) to achieve your task. And finally, you will have to report how good the images you capture using the camera you designed.

Vocabulary / Definitions

Word	Definition

Procedure

Background

Although the pin-hole camera is a simple apparatus without a lens, it gives the students useful intuition on the working of optical systems. The construction does not require sophisticated tools as can be seen in the material list.

Before the Activity

- Play the video from the website: http://www.howcast.com/videos/160199-How-to-Make-a-Pinhole-Camera, this will introduce the procedure to the students.

With the Students

1. Clean the box. Clean out the inside of the oatmeal box, making sure no oatmeal dust or oats are left inside.
2. Remove top and bottom. Remove the plastic top and bottom from the oatmeal box.
3. Glue the bottom. Add a bead of white glue around the lip of the bottom and reattach it. This will ensure no light comes in through the seam.
4. Paint it black. Spray paint the inside of the oatmeal box with black paint and let dry. Repeat if necessary. Also spray paint the bottom. Let it dry.
5. Paint the top. While the top is off, add contact paper to the box top, and then spray paint it black. Make sure it will still fit on the box.
6. Cut a door. Use the craft knife to cut a 3-sided rectangle—a long door—about 1.5 inches wide and half an inch tall into the side of the box.
7. Cut a square. Cut a 2.5-inch square out of heavy aluminum foil.
8. Poke a hole. Using the No. 16 needle, carefully poke a hole into the center of your aluminum square—then sand the hole on both sides with the sandpaper to remove any burrs.
9. Poke it again. Re-drill the same hole, and re-sand it a second time.
10. Glue the plate. Dab a little epoxy on the edges of pinhole plate with a cotton swab, making sure not to come anywhere close to the pinhole, and place the plate on the inside the oatmeal box, with the pinhole centered in the rectangle you cut earlier.
11. Tape the plate. Add a strip of electrical tape on all sides of the plate to further secure it into place. This will also help it from sliding as the epoxy dries.
12. Make a latch. Add a small piece of tape to the outside of the small door that can keep it closed, and then put on the box top.
13. Load the camera. When you're ready to load your pinhole camera for a shoot, take it into a completely dark room. While in the dark, remove the photo emulsion paper from its wrapping, and place it inside the pinhole camera, curved around the edge, emulsion-side facing the pinhole.
14. Close the camera. Close up the box tightly, making sure no light can get in.
15. Take your shot. To shoot a scene, point the doorway toward your subject and open the door for about a 20-second exposure.
16. Remove paper. After you've taken your shot, return to a dark room and remove the paper, making sure to put it back in the lightproof bag it came in.

17. Develop your film. Either develop the photo yourself in a darkroom if possible, or take the paper a local high-end camera shop to develop it for you.

Image Insert Image # or Figure # here (use Figure # if referenced in text)

Figure 1
Image file: ___?
ADA Description: ___?
Source/Rights: Copyright © ___?
Caption: Figure 1: ___?

Attachments

Safety Issues

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Troubleshooting Tips

Investigating Questions

Assessment

Pre-Activity Assessment
Class Discussion: Discuss optics principles with the students' i.e. concave and convex lenses, focal length of a lens and properties of light waves.

Activity Embedded Assessment
None

Post-Activity Assessment
Writing: The students will write a brief report describing the quality of the picture they acquired using the camera they built.

Activity Extensions

Activity Scaling

- For lower grades, this activity can be conducted by a group of four.
- For upper grades, this activity can be conducted by a group of two.

Additional Multimedia Support

References

Nano-photonics:

http://en.wikipedia.org/wiki/Nanophotonics

How to Make a Pinhole Camera:

http://www.howcast.com/videos/160199-How-to-Make-a-Pinhole-Camera

Other
None

Redirect URL
None

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