WestFest
SCIENCE & SUSTAINABILITY
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Solar Safety and Eclipses

Materials:

Solar Eclipse Glasses	Push pin (in pencil topper)
White card stock	Paper Plate
Black construction paper	Penny

Activities:

1. Safe Solar Observing
    a. Eclipse Glasses
    b. Pinhole Imaging
2. Big Sun, Small Moon?

Safe Solar Observing

Instructions for the Safe Use of Eclipse Glasses/Solar Filters/Viewers

- Always inspect your solar filter before use; if scratched, punctured, torn, or otherwise damaged, discard it. Read and follow any instructions printed on or packaged with the filter.
- Always supervise children using solar filters and eclipse glasses.
- If you normally wear eyeglasses, keep them on. Put your eclipse glasses on over them or hold your handheld viewer in front of them.
- Stand still and cover your eyes with your eclipse glasses or solar viewer before looking up at the bright Sun. After looking at the Sun, turn away and remove your filter — do not remove it while looking at the Sun.
- Do not look at the uneclipsed, partially eclipsed, or annularly eclipsed Sun through an unfiltered camera, telescope, binoculars, other optical device, or your eyes.
- Similarly, do not look at the Sun through an unfiltered camera, telescope, binoculars, or any other optical device while using your eclipse glasses or handheld solar viewer in front of your eyes — the concentrated solar rays could damage the filter and enter your eyes, causing serious injury.

- Seek expert advice from an astronomer before using a solar filter with a camera, telescope, binoculars, or any other optical device; note that solar filters must be attached to the front of any telescope, binoculars, camera lens, or other optics.
- Sunglasses are NOT safe to use to view the Sun.

What should I see?

Once your eclipse glasses are over your eyes and you turn toward the Sun, you should see an orange orb in the sky. The Sun is the only thing bright enough in the sky for you to see with your eclipse glasses on. The Sun is always active but sometimes more than others, at times of high activity there may be numerous dark spots on the Sun called sunspots. When there are large numbers of sunspots, or they are very large themselves, they are easy to see with your unaided eye. If you cannot see anything other than a glowing Sun, you should go to the NASA Solar Dynamics Observatory website (https://sdo.gsfc.nasa.gov/data/) for a current image of the Sun. There is a lot of data there from colors of light our eyes cannot detect but if you search for the HMI Intensitygram, you will see an image of the Sun that is looking at the same layer of the Sun as our eyes. There you can see what sunspots are on the surface of the Sun and give yourself an idea of how easy they might be able to see. You can also learn more about solar astronomy by clicking on “Outreach” and “Outreach Home.”

Pinhole Imaging

Safe Pinhole Imaging

- All of the above safety rules apply to ANY viewing of the Sun. NEVER look at the Sun with your unprotected eye or with any equipment including your pinhole viewer.
- Pinhole imagers allow for safe viewing of the Sun by looking away from the Sun and are ideal for larger groups.

Equipment

- White cardstock (screen)
- Black construction paper (camera)
- Pushpin (pinhole maker)

Instructions (Inspired by NASA JPL - https://www.jpl.nasa.gov/edu/learn/project/how-to-make-a-pinhole-camera/)

1. Find your Solar Viewing equipment and flatten out the sheets of paper. The thick white paper will be your screen that you can set on a table outside or on the ground. We will use the black construction paper to make our pinholes and “image” the Sun on the white paper. You can also use the ground (concrete or something flat and light colored, as your screen.
2. Use the pushpin to make a single hole in the middle of one of the pieces of construction paper, you have two if you want to experiment later with designs, size of hole, or where you want to poke the hole. Push the pin back into the pencil topper so you don’t lose it.

3. Place your white card stock on the ground. Now hold your black construction paper with the hole in it flat. Make sure you can see through the hole. Stand with the Sun behind you and view the projected image on the card stock below! The farther away you hold your camera, the bigger your projected image will be. You may start a few inches away and explore how high you can get the paper and still see the image of the Sun.
4. To make your projection a bit more defined, try putting the bottom piece of card stock in a shadowed area while you hold the other piece in the sunlight.
5. You can experiment with how large or small to make your pinhole. You should be able to see sunspots if there are any on your image. You can also experiment with multiple holes making multiple images of the Sun and creating your own designs.
6. During the 2024 eclipse you will see trees making images of the Sun with the pinholes between their leaves making the ground look like this:

User:Ellywa, CC BY-SA 3.0, via Wikimedia Commons

Big Sun, Small Moon? - https://www.nisenet.org/diy-sun-science-app

The Sun and the Moon are very different sizes, but they appear to be the same size in the sky. This activity will investigate “angular size” or how big things appear based on their distance from us and their physical size. It is using this concept that you have seen people hold mountains, the Sun, or buildings in pictures. This is also the reason we have Solar Eclipses where the Moon blocks some or all of the Sun. 2. Reminder: NEVER look directly at the Sun!

Equipment

- Penny
- Paper plate

Instructions

When you see a Total Solar Eclipse, like the one in Ohio on April 8, 2024, you will notice that the Moon is able to cover the entire Sun. We are using a penny and a plate to investigate why the Sun and Moon look like they're the same size.

1. Grab a penny and the paper plate from the Activity Kit box. Instead of a plate and penny, you can create your own Sun and Moon out of construction paper or use other objects from around your house that are different sizes. You will need a partner to help you with this activity or you may need to tape your plate against a wall during the activity.
2. Hold both the penny and the plate at arm's length. The plate will look much larger than the penny when they are at the same distance.
3. While you hold the penny at arm's length, have your friend hold the plate and walk backwards away from you four steps. When your friend stops, close one of your eyes and look at both the penny and the plate as though they are next to each other. Does the plate look smaller than before, compared to the coin?
4. Predict how far away your partner will have to walk away from you until the penny and plate appear the same size to you. Then have your partner step backward slowly and safely until the coin and plate look the same size to you. How far away did your partner have to walk? Was your prediction correct?
5. If you have ever seen a picture of a Solar eclipse, you may have noticed that the Moon is able to cover the entire Sun. The Sun is actually 400 times larger than the Moon! So how can these objects appear to be the same size? Objects that are farther away always look smaller, but a small object and a big object can look the same size if they are the right distances away from you. In fact, the Sun is about 400 times further away from Earth than the Moon!
6. Another experiment to do is to close one eye and look at an object far away, like your experiment partner if they step farther away or a distant tree. Use your fingertips to mark the top and bottom of the object like you are pinching it.
7. Now look at an object that looks bigger and again move your fingertips to the top and bottom of the object. Your fingertips should be farther apart. Astronomers do something very similar to this to measure the size of stars and planets as they appear to us. Astronomers call this idea the "angular size" of an object, for the angle that is formed by the size an object appears to us when observing it from Earth.
8. The Sun and Moon have roughly the same angular diameter which is why we have Total Solar Eclipses!!!

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THE OHIO STATE UNIVERSITY

Resources

- Total Solar Eclipse Safety - https://solarsystem.nasa.gov/eclipses/2024/apr-8-total/safety/
- DIY Sun Science App - https://www.nisenet.org/diy-sun-science-app
- DIY Sun Science - https://lawrencehallofscience.org/science-apps/diy-sun-science/
- How to Make a Pinhole Camera - https://www.jpl.nasa.gov/edu/learn/project/how-to-make-a-pinhole-camera/
- Ohio Eclipse Total Solar Eclipse 2024 - https://eclipse.ohio.gov
- American Astronomical Society Eclipse Page - https://eclipse.aas.org/
- How to View a Solar Eclipse Safely - https://eclipse.aas.org/eye-safety