SOLAR PROJECTION – BINOCULARS OR TELESCOPE

WARNING: NEVER LOOK THROUGH THE EYEPIECE WHILE A TELESCOPE OR BINOCULARS ARE AIMED AT THE SUN -- SEVERE EYE INJURY CAN OCCUR!!!

There are ***only THREE*** safe ways to view the sun:

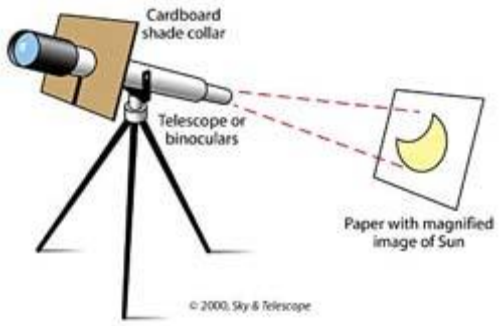
- Using a ***special Solar Filter***, made specifically for telescopes, where 99.9% of the sun's light is blocked.
- Using a ***DEDICATED Solar Telescope***, made specifically for viewing the sun, where 99.9% of the sun's light is blocked.
- ***Solar Projection***, where the image of the sun is projected onto a piece of paper.

CAUTION: Looking directly at the sun, or at the sun through a telescope or binoculars without a filter, CAN CAUSE PERMANENT EYE DAMAGE!

To Do Safe Solar Projection with telescope or binoculars:

Materials

- Heavy paper or white foam board
- Telescope or binoculars with ALL covers still in place
- Tripod to hold telescope or binoculars
- A Helper
- A Sunny day



http://www.skyandtelescope.com/observing/objects/sun/3309106.html?page=2&c=y

1. Set up the telescope or binoculars on the tripod, leaving ALL covers in place.
2. With ALL covers in place, aim the telescope (or binoculars) at the sun. Look at the shape of the shadow of the scope on the ground. It should form a perfect circle.
3. Remove the eyepiece focuser cover.
4. Place an eyepiece in the focuser, **BUT DO NOT LOOK THROUGH IT!**
5. Have a blank piece of poster board or other heavy light colored paper ready. It is helpful to mount this on a stand of some kind, to hold it steady.
6. Now remove the main cover of the telescope, or one of the covers from one side of the binoculars, not both. Leave one side covered for safety!!!
7. Hold the board or heavy paper behind the eyepiece, about 1 foot away, looking for an image of the sun on the paper. **DO NOT LOOK THROUGH THE EYEPIECE!** Holding the paper too close to the eyepiece will burn the paper.
8. You should see an image of the sun on the piece of paper. Have a helper adjust the focuser until you see a sharp image of the sun. You might also adjust the distance of the paper from the eyepiece until you get a focused image of the sun on the paper.

TO do and notice

- We will look for sunspots. These dark regions on the solar surface appear in generally predictable patterns and locations, growing larger over a few days to a few months and then fading away. Some sunspots are perfectly round while others have very complex patterns. The larger spots all have dark regions embedded in a lighter surrounding area. Some spots seem to remain unchanged for days while others change size and shape dramatically in one day.
- You may want to create a quick scale model of the Sun and Earth. The diameter of the Sun is 100 times that of the Earth. You could use a grapefruit and the tip of a ballpoint pen to about to model this. Does the tip of the pen look very large against the grapefruit? No, but the Earth is pretty big, right? Explain that some of the sunspots we will see may seem like tiny specks, but most of them that we can see are larger than the Earth! Even when a sunspot seems small, it usually only becomes noticeable to the earthbound observer when it is about the size of the Earth.
- What are Sunspots? Sunspots develop where high concentrations of magnetic field inhibit the flow of energy, producing cooler regions compared to surrounding areas. These cool areas are still hot enough to melt lead (4,000 C / 7,000 F), but as the cooler areas emit less light, they are darker than the hotter surroundings (6,000 C / 11,000 F).
- Once you have the Sun's image on the piece of paper, examine the entire solar surface carefully to see if you can find any dark spots.
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- Record on the piece of paper the total number of sunspots you see. If the sunspots are large, then make a drawing of them on the paper for comparison on another day. If possible, repeat you observations with the group daily, using a new piece of paper to record the number of spots and to compare the drawing of large sunspots.
- What did you notice? Did the sunspots change from one day to the next. How did they change? Were there greater or fewer Sunspots? Did they change size? Shape? Position?
- During your observations of the Sun, you may have noticed that the sunspots appeared to move across the surface of the Sun over a period of days. The sunspots themselves do not move significantly from where they erupt. The motion is due to the Sun's rotation that carries them across the face of the Sun. The surprising result from years of observation is that sunspot regions near the equator of the Sun move faster than regions closer to the poles. A sunspot at the equator takes only 26 days to make a complete turn around the Sun. At the poles – a far shorter distance around the Sun a sunspot takes 37 days.
- During certain years, such as 2006, the Sun is almost free of sunspots. But five to six years later, the Sun is covered in sunspots. In another five to six years, the Sun is blemish free again. This eleven-year cycle between times of high sunspot activity has been documented for over 300 years.

SOLAR PROJECTION – PAPER AND PUSHPIN

Based on - http://solar-center.stanford.edu/observe/observe.html

CAUTION! Don't EVER look directly at the Sun, with or without a telescope, unless you have the proper filters!

You can easily and safely observe the Sun by projecting it through a tiny hole onto a white sheet of paper. This simple device is called a "pinhole camera."

MATERIALS

- 2 sheets stiff white paper
- 1 pin
- A sunny day
- A helper

PROCEEDURE

1. With the pin, punch a hole in the center of one of your pieces of paper.
2. Go outside, hold the paper up and aim the hole at the Sun. (Don't look at the Sun either through the hole or in any other way!)
3. Now, find the image of the Sun that comes through the hole.
4. Move your other piece of paper back and forth until the image rests on the paper and is in focus (i.e., has a nice, crisp edge). What you are seeing is not just a dot of light coming through the hole but an actual image of the Sun.

EXTENSIONS

1. Experiment by making your hole larger or smaller. What happens to the image? What happens when you punch two holes in the piece of paper? Try bending paper so the images from the two holes lie on top of each other. What do you think would happen if you punched a thousand holes in your paper, and you could bend your paper so all the images lined up on top of each other? In fact, optical telescopes can be thought of as a collection of millions of "pinhole" images all focused together in one place!
2. You can make your pinhole camera fancier by adding devices to hold up your piece of paper, or a screen to project your Sun image onto, or you can even make your pinhole camera a "real" camera by adding film.

Related Resources

More about how light works and instructions for building more exotic pinhole cameras for observing the sun:

- Bob Miller's Light Walk - http://www.exploratorium.edu/light_walk/lw_main.html
- Cyberspace Middle School - http://www.scri.fsu.edu/~dennisl/CMS/sf/Pinhole.html
- Jack Troeger's Sun Site - http://www.cnde.iastate.edu/staff/jtroeger/sun.html