

## Observing the Sun for Yourself

<http://solar-center.stanford.edu/observe/observe.html>

Classroom Activities  
Grade Level 3-5\*

Courtesy of the  
Stanford Solar Center



Partial solar eclipse image from Fred Espenak's Eclipse Home Page at NASA's Goddard Space Flight Center.  
<http://sunearth.gsfc.nasa.gov/eclipse/eclipse.html>

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### There are several ways you can observe the Sun, and hopefully sunspots, for yourself.

The easiest and safest is to project the Sun by building your own pinhole camera. If you have a telescope, you will have to equip it with a solar filter or use a solar telescope that you can access via the Web.

#### CAUTION!

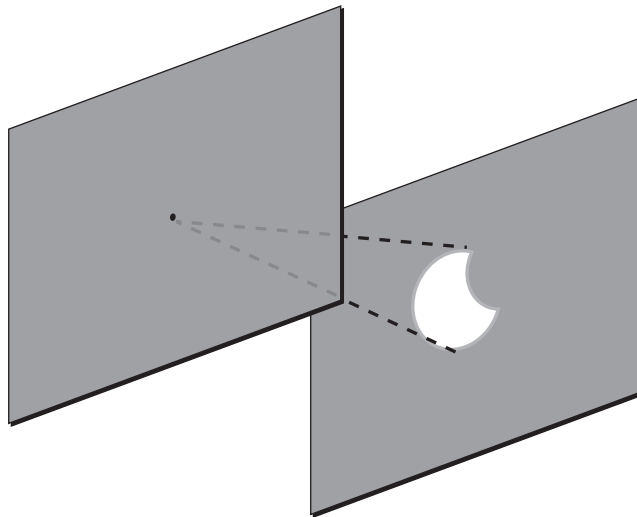
Don't EVER look directly at the Sun, with or without a telescope

(unless you have the proper filters).

\*These lessons can be adapted for higher grade levels by including telescope mirrors and observing eclipses. Teachers can also project the Sun's image through a telescope resulting in a larger image for tracking sunspots and other solar activity.

## Projecting the Sun

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."



### You'll need:

- **2 sheets** of stiff white paper
- **1 pin**
- **A sunny day**
- Perhaps a **friend** to help

**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.

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 your 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!

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.

If you want to learn more about how light works, you can join artist Bob Miller's Web-based "Light Walk" at the Exploratorium. It's always an eye-opening experience for students and teachers alike. His unique discoveries will change the way you look at light, shadow, and images!

### Related Resources

#### Bob Miller's Light Walk

[http://www.exploratorium.edu/light\\_walk/lw\\_main.html](http://www.exploratorium.edu/light_walk/lw_main.html)

Several sites give instructions for building more exotic pinhole cameras for observing the Sun:

#### 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>

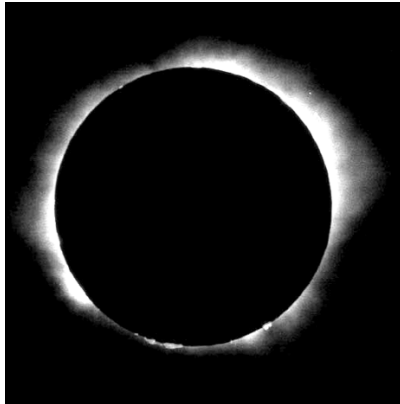
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## Using Remote Solar Telescopes

Using Mike Rushford's robotic solar observatory in Livermore, California, you can get a real-time view of the Sun by controlling a telescope from your Web browser. At cloudy times, there are other things to do as well!

Solar Eclipse © 1999 Paul Mortfield  
<http://www.backyardastronomer.com>

### Related Resources

#### Eyes on the Skies

<http://sunmil1.uml.edu/eyes/index.html>

## Using Your Own Telescope

The safest way to look at the Sun through your own telescope is **NOT** to! Looking at the Sun can cause serious damage, even blindness, to your eyes, unless you have proper filters.

Galileo Galilei used telescopes to observe and track sunspots c.1600. Picture from The Galileo Project.  
<http://es.rice.edu/ES/humsoc/Galileo/>



### Related Resources

#### Viewing the Sun With a Telescope

<http://www.sunspot.naoa.edu/PR/answerbook/telescope.html#q15>

Dr. Sunspot gives more detailed information about safely viewing the Sun with a telescope and filters.

#### Observing the Sun in H-Alpha

<http://www.4w.com/pac/halpha.htm>

This site gives technical information on how to observe the Sun with your own telescope using an H-alpha filter. Includes detailed information on what features of the Sun are best seen in H-alpha. By Harold Zirin, Peter V. Foukal, and David Knisely.

The safest practical way to see the Sun is by eyepiece projection. Line up your telescope with the Sun, but instead of looking through the eyepiece, hold a sheet of white paper behind the eyepiece. You'll see a solar image projected onto the paper. What happens when you move the paper farther back?

Experiment with the paper to get a sharp viewing contrast. You should be able to see the largest sunspots with this method.

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## Observing Solar Eclipses

A solar eclipse occurs when the Moon, during its monthly revolution around Earth, happens to line up exactly between Earth and the Sun. Why isn't there an eclipse every month? Because solar eclipses occur during a new moon, but not at every new moon. Most often the Moon passes a little higher or a little lower than the Sun. There is a solar eclipse about twice a year, when the Moon's and the Sun's positions line up exactly.



**Solar eclipse image** from Fred Espenak's Eclipse Home Page at NASA's Goddard Space Flight Center.  
<http://sunearth.gsfc.nasa.gov/eclipse/eclipse.html>

The glory of a solar eclipse comes from the dramatic view of the Sun's corona, or outer atmosphere, which we can see only when the brilliant solar disk is blocked by the Moon. The corona is not just light shining from around the disk: It is actually the outermost layer of the solar atmosphere. Although the gas is very sparse, it is extraordinarily hot (800,000 to 3,000,000 Kelvin), even hotter than the surface of the Sun! (The heating of the corona is still a mystery.) The corona shows up as pearly white streamers, their

shape dependent on the Sun's current magnetic fields. Thus every eclipse will be unique and glorious in its own way.

A solar eclipse is only visible from a small area of Earth. It's unlikely that, during your lifetime, you will ever see a total solar eclipse directly over the place you live. Many people travel long ways to experience a total solar eclipse. If you're lucky, you might someday see a partial solar eclipse (one where the Moon doesn't quite cover all the Sun's disk) nearby.

You can safely observe a TOTALLY eclipsed Sun with the naked eye, but you will need a pinhole camera, an appropriate type of welder's glass, or special Mylar glasses to safely observe the beginning and ending of a full or partial eclipse.

### Related Resources

#### Fred Espenak's Eclipse Home Page

<http://sunearth.gsfc.nasa.gov/eclipse>

#### Eclipse: Stories From the Path of Totality

<http://www.exploratorium.edu/eclipse>

#### Solar Data Analysis Center Eclipse Information

<http://umbra.nascom.nasa.gov/eclipse>

#### Eclipse Paths

<http://umbra.nascom.nasa.gov/eclipse/predictions/eclipse-paths.html>

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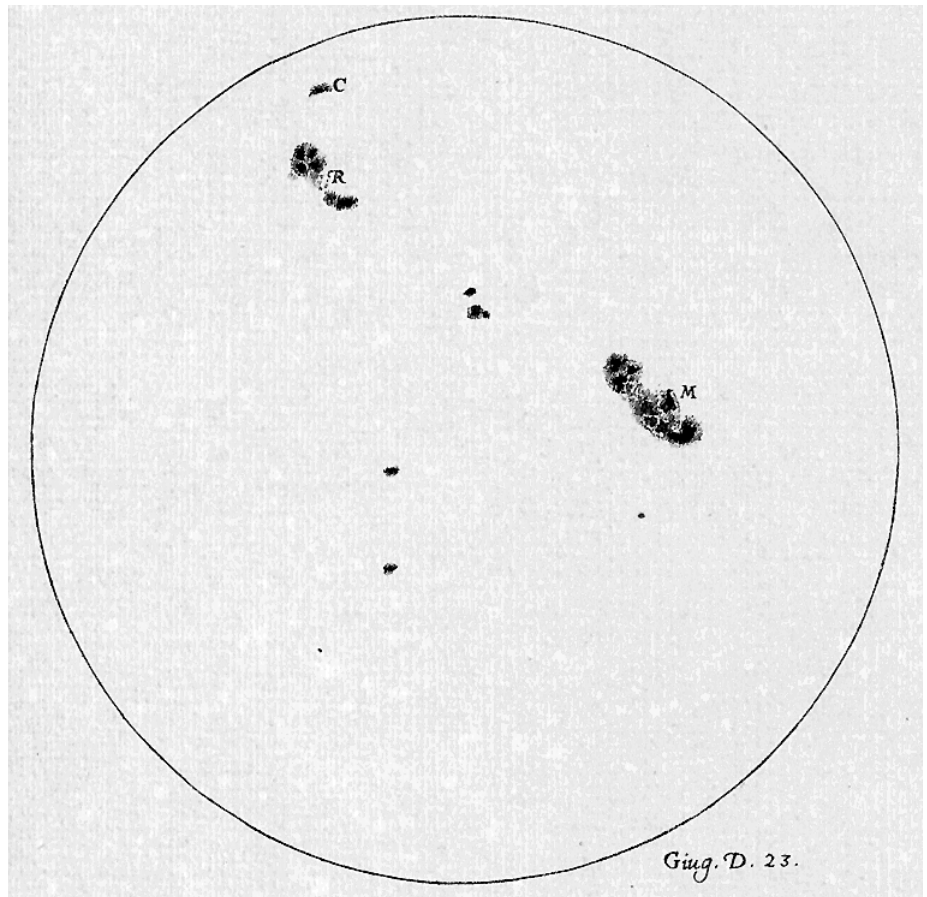
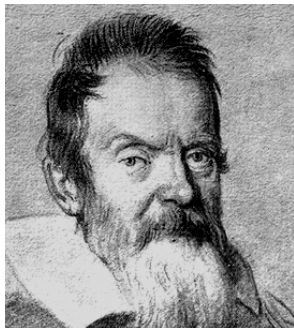
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## Sunspot Drawings

Until recently, astronomers have had to rely on drawings or sketches to document what they've seen. Charge-coupled device (CCD) cameras and other technological wonders have changed all that. Historic drawings, however, are still very important. And even today, drawings are still more accurate at recording exactly what the eye sees, unaltered by the processing of fancy electronics.



Galileo Galilei (left) and sunspot drawings (above) from The Galileo Project.  
<http://es.rice.edu/ES/humsoc/Galileo/>

### Related Resources

#### Daily Sunspot Drawing Observations at Mt. Wilson

[http://www.astro.ucla.edu/~obs/150\\_draw.html](http://www.astro.ucla.edu/~obs/150_draw.html)

#### Daily Sunspot Images from SOHO

<http://sohowww.nascom.nasa.gov/latestimages>

#### Galileo's Sunspot Drawings

[http://es.rice.edu/ES/humsoc/Galileo/Things/g\\_sunspots.html](http://es.rice.edu/ES/humsoc/Galileo/Things/g_sunspots.html)

#### Sunspots at the Exploratorium

<http://www.exploratorium.edu/sunspots>

#### These classroom activities can be found at:

<http://solar-center.stanford.edu/observe/observe.html>

Created by Deborah Scherrer, April 1997. Last revised by DKS on 2 December 1997.

Galileo's drawings of sunspots (c. 1600) still survive today. And the solar telescope at Mt. Wilson, above Pasadena, California, has been collecting sunspot drawings since 1917. The tradition continues. You can check current sunspot drawings each day at the Websites listed here, and compare them with your own.

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