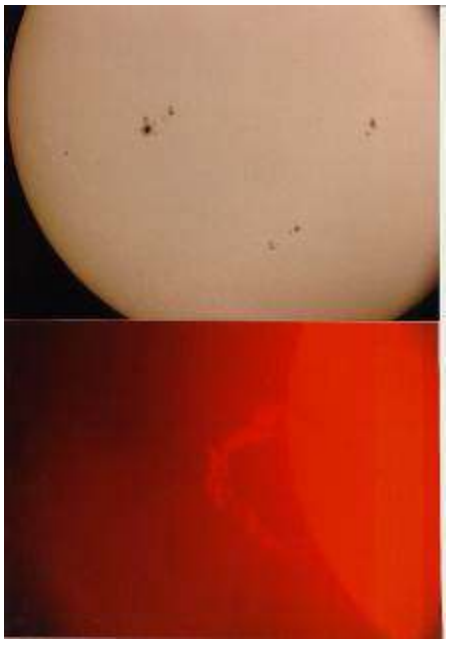
Safely Observing the Sun

Recommended Methods:

First, let me start by stating the obvious – **NEVER LOOK DIRECTLY AT THE SUN!!** Although you may find dozens of sites on the internet and many books that claim you can use items such as exposed film and welders glass – I have also found many sites that recommend not using them. I have also seen books recommending the pinhole method (a small hole poked into a piece of aluminum foil on an index card) and using this to project an image. My reasoning for not using this is that students will sometimes look through the hole despite being told not to. I actually saw a neighbor's son looking through a lens at the sun!!! Make sure to warn students – you can't say it too many times! As you can see I tend to err on the side of safety. Therefore I have used two methods with my students. The first is the Projection Method and the second uses special solar filters built for your telescope – i.e.: the Solar Filter Method.

Projection Method: With this method I am in charge of the students' viewing and can make sure they don't try to look through the telescope. All you need to view the sun is an old telescope (any kind will work – I happened to own an old Tasco – see picture to the right). If you don't own an old telescope, ask around, I'm sure someone owns one you can use. I then strap it to a camera tripod so I can adjust the height easily. Next, find a piece of cardboard and cut a small hole so that it fits tightly over the eyepiece of the telescope. This darkens the area around the projection and makes the image of the sun easier to see. To find the sun – **NEVER LOOK THROUGH THE SCOPE!** I use the cardboard to find the point where the shadow of the telescope is as circular as can be (see picture to the right). This is the point where you have perfectly aligned the scope with the sun. Take off the objective and eyepiece covers and project the image onto a white piece of paper on a firm clipboard (see picture to the right). Focus until the sun's disk is clearly visible (in the picture I used 50X so I could see a sunspot group clearly from my deck so the image is not the whole disk). Students stand in front of the cardboard (so they can't look through the scope) can clearly see sunspots (if present). The clipboard can be pulled farther away to make the image bigger but it also becomes dimmer, so there is an optimum point that you must choose. To keep students focused on the task at hand, I require them to sketch the sun as they see it (I have attached a copy of my worksheet/factsheet).

Solar Filter Method: With this method you are again in control of the students' viewing. You should buy a special filter to fit your particular telescope – don't just use any filter and tape it on to fit. (**Don't use eyepiece filters – some are not safe**!) When I purchased the 4" filter for my B&L telescope it cost about $100. I always wrap it up when not in use to avoid scratches or breakage (mine is a glass filter – see picture to the right). Below, I have listed several sources for these filters. These are not endorsements, simply companies I have dealt with in the past or heard positive things about. If you don't have a telescope dealer near you, you can try one of these companies. To find the sun, I still use the shadow technique described above. I look at the shadow of the telescope on the ground or a clipboard and position the telescope until I have the most circular shadow. Then, with the filter in place you can actually look at the sun. I again have students make sketches. The disadvantage to this method is that only one student can view the sun at a time, but the image is usually much brighter and it is easier to see features on the sun.



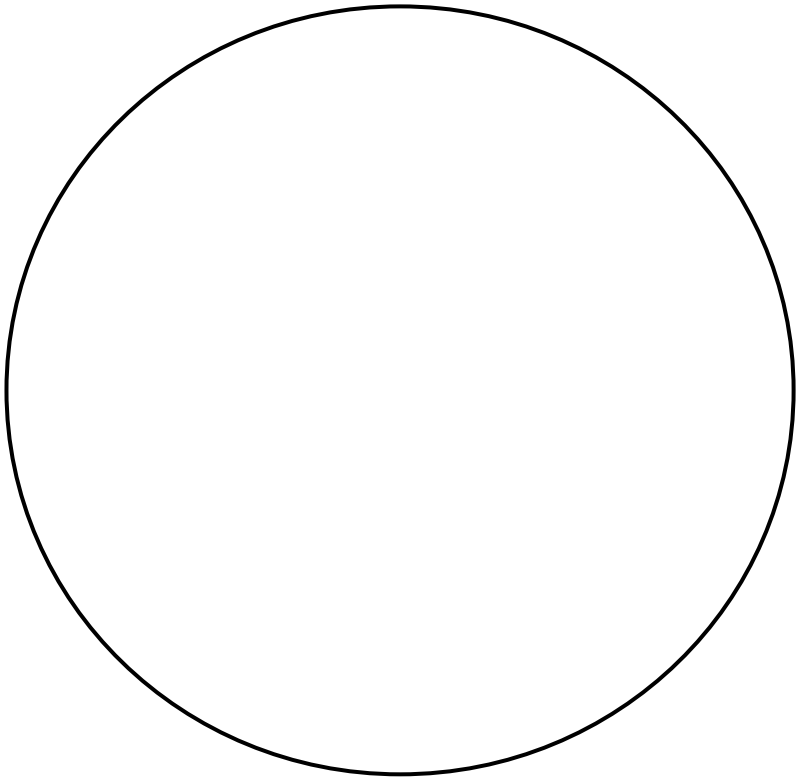
Solar Filters 2: An alternative is to bring your class to an observatory to view the sun. I managed the observatory at a community college and we hosted several school groups a year. The college has the advantage of a larger telescope (ours was a 14") and the possibility of viewing through a variety of specialized filters. The filter mentioned above allows for viewing of the Photosphere (the visible 'surface' of the sun). The college also owns a Hydrogen -alpha filter that allows the viewing of the Chromosphere (the 'lower atmosphere' of the sun)(this filter is quite expensive costing several thousand dollars on average). With this filter, students can sometimes view prominences and flares and note the relationship between sunspots and these features. As an example of what can be seen, view the picture to the right. The picture was taken several years ago through the 14" telescope. The top picture shows the Photosphere with many sunspots and the lower picture shows a spectacular prominence that was seen shortly afterwards with the H-alpha filter. Remember that the sun is roughly 100 earth diameters across and is therefore about the size of a smallish sunspot!

Resources for Filters:

Again, I am not endorsing these companies – merely offering you an option for purchasing a filter.

1) Celestron International 2835 Columbia St., Torrance CA 90503 (310) 328-9560
2) Meade Instruments Corp. 16542 Millikan Ave., Irvine CA 92714 (714) 756-2291
3) Orion Telescope Center 2450 17th Ave., PO Box 1158-S, Santa Cruz CA 95061 (408) 464-0446
4) Pocono Mountain Optics R.R. 6, Box 6329, Moscow, PA 18444 (717) 842-1500
5) Roger W. Tuthill, Inc. 11 Tanglewood Lane, Mountainside, NJ 07092 (908) 232-1786
6) Thousand Oaks Optical Box 5044-289, Thousand Oaks, CA 91359 (805) 491-364

The Sun



Sun's energy: fusion - changing H to He by putting 2 H atoms together - 3.83×10^{26}W
Earth receives about 126 W/sq.ft. (1 week ~ all known oil, coal, and gas)
Size: 432,000 mile radius
Layers of the sun:
Core: where fusion takes place
Zone of Convection: transfers heat to the surface
Photosphere: visible surface - thin - about 6,000K (~10,000 degrees F)
Chromosphere: lower part of the atmosphere - few thousand miles thick
Corona: millions of miles thick - 1-2 million degrees K
Rotation: Equator - 25 days Poles - 35 days
Surface: Granules - grainy looking features on the surface - rising currents
Sunspots: cool patches on the surface lasting from a few hours to a few months – powerful magnetic fields
Sunspot cycle: magnetic field reverses every 11 years (approx.) – sunspot maximum every 11 years
Prominence: flame-like mass of bright gas rising thousands of miles above the surface – originate near sunspots
Flare: tremendous explosive burst of light and material from the sun - 1 flare gives off as much energy as the earth consumes in 100,000 years - originate near sunspots
***Note: We will see the photosphere, granules and sunspots (?) with the solar filter. With the H alpha filter we might see flares and prominences.