



## How to photograph the Moon by [John Skouros](#)

The Moon is a wonderful object to photograph, with constant changes of view throughout the lunar cycle. Capturing the detail as the 'terminator' shadow sweeps across the surface then watching the final image come together is a highly satisfying experience.

### Getting the gear

You can take good images of the Moon with just a single lens reflex (SLR) camera and a 250 mm telephoto lens. To get the best detail, you need a telephoto lens of at least 500 to 600 mm and ideally a long focal length telescope.

I use an 80 mm aperture, 600 mm focal length telescope with a heavy duty equatorial mount and a high frame rate monochrome sensor camera. A 2 x Barlow teleconverter lens increases the overall magnification and Infrared (IR) and ultraviolet (UV) filters prevent light of these frequencies swamping the image. A red filter helps reduce the effect of turbulence in the Earth's atmosphere, enhancing the visible surface detail.

### Picking the place

Choose a location that allows an unobstructed view of the Moon for several hours and try to set up far away from buildings and other sources of heat. Although the Moon can be visible at any time of day or night, the surface contrast is lower during daylight, making focusing difficult at that time.

If you want to capture a series of shots to build up a mosaic image, ensure similar light conditions throughout the entire shoot. This will reduce the amount of processing required later.

### Taking the shot

If you are using an SLR, a long focal length telescope and a tripod, then shutter speeds of 1/30<sup>th</sup> of a second are fine. Use a low ISO setting to reduce noise and underexpose slightly to prevent bright details burning out.

For detailed mosaics you can reduce the effects of atmospheric turbulence by capturing high speed shots. I take a series of audio/video interleave (AVI) files, since it is easier to deal with a handful of AVI files than thousands of individual shots. To do this, start at the terminator line and set the focus. Zoom in on the image and ensure it is as sharp as possible. Set the exposure and move around the rest of the Moon's surface, checking the camera's histogram and adjusting the shutter speed and camera gain (sensitivity) until there are no saturated areas. Your settings will probably give exposures of about 30 to 40 frames per second. Although these may make the shadow section appear very dark, it is better than having other overly bright areas.



**A Moon image taken using an SLR camera and a 1200 mm focal length telescope**

Head back to one end of the shadow and capture the first AVI. Load the file into a manual stitching program like [iMerge](#) and move the telescope to the next small section of the Moon to build up a rough mosaic. In total I record a series of about 25 AVIs, each of 1000 frames.

## Processing

Each AVI needs to be converted into a single image, which is then joined with others to produce a panorama. It takes considerable effort to do this accurately but it is well worth spending the time to get it right.

Use imaging software such as the free [RegiStax 5.1](#) program to stack the AVIs into separate high resolution images and iMerge to stitch these together. You can enhance the contrast using the curves feature of a photo-editing program like [GIMP](#) and sharpen the image with a high pass filter.



**Two stacked AVI images which will be combined together in a panoramic mosaic**

## My top tip: share the experience

On a recent birthday I set out to create this mosaic with my two children. The Moon was very low in the sky. Despite the low altitude – which can cause distortion – the image came out well. My eldest son adjusted the focus and helped capture the data. My youngest enjoyed steering the scope with the computer and watching the high magnification views appear onscreen. I did all the processing. It was great to work the telescope with the boys and to share the excitement of seeing the final image appear.



**The end result: a fully processed and stitched together mosaic**



**A team effort, stitched together with the MicroSoft Research Image Composite Editor ([ICE](#))**

The Royal Observatory Greenwich would like to thank

