Shoot the sky without a telescope

These simple techniques will help you capture great pictures with just a camera on a tripod.

by Michael A. Covington

One of the biggest barriers holding back budding astrophotographers is the belief that they need a large telescope and other expensive equipment to get decent results. Nothing could be further from the truth. You don’t even need a telescope to photograph the stars. Nowadays, anyone can capture beautiful images with just a camera and a tripod. In fact, now that some of the best astrophotography software is free, you can use advanced techniques to make the most of basic, inexpensive equipment.

Shooting the stars

I got my start in fixed-tripod photography of star fields in the mid-1970s. Not by choice, mind you. This technique was my only option when I temporarily had no telescope at my disposal.

So, I attached my film camera to a tripod, aimed it at the stars, and exposed for anywhere between 5 and 20 seconds at focal ratio f/1.8. I was fascinated with pictures that showed more stars than I could see with my naked eyes and even captured a few deep-sky objects, including the Orion Nebula (M42). I was happy with the results, even if they were crude by today’s standards. With a digital camera and current software techniques such as image stacking, however, almost anyone can capture far better images than I managed 35 years ago.

To get started, all you need are a camera and a tripod or other sturdy support. The best choice is a digital single-lens reflex (DSLR) camera with a fast wide-angle lens. Some of the better non-SLR digital cameras also will do a decent job, as will a film camera with fast (ISO 800 or higher) color film.

On the next clear night, take your equipment outside and experiment. Aim your camera at the starry sky, set it to ISO 400 or 800, zoom the lens to 50mm or shorter, set the aperture as wide as possible (f/2.8 in many cases, but use f/1.8 if you have it), carefully set the focus to infinity, and expose for about 5 seconds. View the resulting image and see what you’ve got.

You’ll find that if you expose longer, say for 30 seconds, you’ll get more stars, but they’ll appear as streaks because of Earth’s rotation. Yet if the exposure is too short, you’ll get only a few stars on a pitch-black background. In the old days, photographers had to calculate the maximum exposure time before the stars started to streak, and this time varied depending on the section of sky being shot and on the lens’ focal length. Today, with instant results from digital cameras, it’s much easier to experiment.

Kill the vibration

Your tripod does not need to be rock steady (although a sturdy one certainly doesn’t hurt) because shutter vibration will last only a small fraction of the exposure time. If vibration proves to be a problem, try the old “hat-trick” technique: Hold a black card (or hat) in front of your camera.

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of the camera's lens for the first second so the camera won't record the initial shaking. You may or may not need a cable release — many digital cameras will time a 5- or 10-second exposure automatically and start it with a delay to eliminate vibration caused by touching the shutter-release button.

The camera lens matters. Don't be tempted to go with a long telephoto or long zoom lens. Such lenses magnify the effects of Earth's rotation and quickly turn stars into short lines, severely limiting the fixed-tripod exposure time.

Instead, to capture a rich star field, use a lens with a reasonably short focal length and a fast f/ratio (faster f/ratios have lower numbers, so f/2.8 is faster than f/5.6). Many DSLRs come with an 18- to 55-mm zoom lens; try it at 18mm to 30mm. Better yet, get a 50mm f/1.8 lens, which used to be the standard lens for film cameras. You'll find these relatively inexpensive lenses deliver tack-sharp images.

Manual, not automatic

Many people live happily taking snapshots in full automatic mode. But you'll have to broaden your horizons to shoot the sky. First, you'll need to take manual exposures, setting both the aperture and the duration yourself. If your camera doesn't support durations long enough, set it to “bulb” (which means “expose as long as I hold the button down”) and use a cable release to trip the shutter.

Autofocus doesn't work on stars either. Some non-SLR digital cameras will let you lock the focus on infinity (often indicated by a mountain symbol). With DSLRs, don't trust the infinity mark (∞) on the lens; especially with longer lenses, it's likely to be imprecise. Instead, use live focusing (Canon calls it “Live View”) if your camera has it. Center the view on a bright star and use maximum magnification to get the sharpest focus. If that doesn't work, take some 5-second test exposures to find the best focus by trial and error.

You also may want to turn off image stabilization. This feature typically works by detecting the inevitable motion in hand-held shots. But with a camera on a tripod, there is no motion. In this case, image stabilization on many DSLRs actually introduces motion into the final image. Experiment to see whether this feature helps or hinders your results.

Tweak your photos

The final step is to process the image digitally to improve brightness and contrast. Don't expect what comes out of the camera to be the finished product. Back in film days, we used No. 5 enlarging paper for high contrast. Today, you'll want to use Adobe Photoshop, Photoshop Elements, GIMP, or whatever software came with your camera.

Raising the contrast really brings out stars. The background in the finished picture should be dark gray, dark blue, or brown — not black. If you're still using film, find a photo store with a kiosk that will scan your negatives and let you make your own prints to give you more control.

Now it's time to see what you've captured. You can expect to record stars and planets down to 8th magnitude; if you shoot on a dark night out in the country, the limit likely will be at least a couple of magnitudes fainter. Many of the bright Messier objects will appear, as will other bright deep-sky objects. Closer to home, bright asteroids such as Ceres and Vesta and naked-eye comets will show up nicely.
Camera-on-tripod imaging also is the best way to capture wide-field displays of meteor showers and aurorae. If you live south of the equator, or simply visit there, have fun recording the Magellanic Clouds, the Eta Carinae Nebula (NGC 3372), and the Jewel Box Cluster (NGC 4755). One of my deep regrets is that I didn’t try fixed-tripod shots of Crux and Centaurus during my one and only trip to Australia.

Getting rid of hot pixels

If you’re lucky, your camera offers “long-exposure noise reduction.” This means that after each exposure, the camera takes an identical one with the shutter closed and then subtracts it. That gets rid of leakage from “hot pixels” — pixels that think they’re seeing some light when they aren’t. Otherwise, the hot pixels show up as tiny, brightly colored “stars” that don’t exist in the real sky.

If your camera lacks this feature, you’ll need to take your own dark frames (exposures with the camera’s sensor covered) and subtract them manually. You should shoot dark frames with the camera at the same temperature and ISO setting as for your star-field images and, preferably, on the same evening because sensors change as they get older. It’s best to take several dark frames and let your software average them so you subtract the effect of continuing leakage rather than momentary fluctuations.

The best way to take dark frames is to set the camera to take raw or TIFF images and do the subtraction with an advanced imaging software average them so you subtract the effect of continuing leakage rather than momentary fluctuations. The best way to take dark frames is to set the camera to take raw or TIFF images and do the subtraction with an advanced imaging software. You can also tell it to remove the effect of continuing leakage rather than momentary fluctuations.

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