What you need is...

- Appropriate clothing
- Sturdy tripod
- DSLR with Live View or Mirrorless camera (Canon, Nikon, Olympus, Panasonic, Pentax, Sony)
- Wide-angle lens – 18mm or less
- Remote trigger
- Torch or headlamp
For time-lapse

- External Power (batteries)
- Large (32GB) CF or SD Card
- Dew heater controller and dew straps or chemical hand warmers
- Bubble level
Camera settings

- Manual Exposure Mode
- Manual Focusing Mode
- Manual White Balance at around 4000 K (Sunny WB if N/A)
- ISO 3200 or 1600 and 15 to 30 seconds exposures (Moon less than 15% illuminated)
- Widest possible lens setting (18mm with the kit zoom lens)
- Largest possible aperture (smallest f/stop) – f/3.5 with the kit lens. If the stars in the corners look like seagulls then stop the lens down to f/4
Focusing with Live View

- Set the camera to **Manual Focus**
- Set the focusing ring to the infinity mark
- Centre the camera on a bright star
- Turn on “Live View” mode
- Magnify the Live View mode as far as it goes (100%)
- Turn the focusing ring back and forth until the smallest possible star image is achieved. It may help to pay attention to dimmer stars around.
Maximum Exposure length before the stars start trailing

The 600 rule

\[ T_{\text{max}} = \frac{600}{\text{Effective Focal Length (seconds)}} \]

i.e. 18mm lens on Nikon D5100 (1.5 crop factor):
\[ T_{\text{max}} = \frac{600}{(18 \times 1.5)} = \frac{600}{27} = 22 \text{ seconds} \]

The direction is also important and the values can be increased \( \times 1.5 \) times when pointing towards a Celestial Pole.

30 sec
14mm
Octans
near SCP

30 sec
14mm
Scorpius
near Celestial Equator
With LENR on the camera does the following:

- Takes the image (30 seconds)
- Closes the shutter takes the dark frame (30 seconds)
- Subtracts the dark frame from the image removing all hot pixels and amplification glow

Some cameras (Pentax) monitor the CMOS temperature and re-use the dark frames thus reducing the gaps.

**LENR is undesirable for Time Lapse Animations or Star Trails**

Alternative – take a number of dark frames at the end of the imaging run and subtract using batch processing in Photoshop or simply use RAW image format and open in Adobe Photoshop, Lightroom or Nikon Capture NX2.
In-camera computers are getting better and better however they are still long way away from full image processing software (Aperture, Photoshop).

### RAW Image capture vs JPEG

<table>
<thead>
<tr>
<th>RAW Capture</th>
<th>In-camera JPEG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contain <em>mostly unaltered</em> data recorded by CMOS detect</td>
<td>Have all camera settings “burnt-in” to the JPEG file</td>
</tr>
<tr>
<td>Have 12-14 bits of data per pixel and more headroom for shadow detail recovery</td>
<td>Converted to 8 bit per pixel lossy compressed file with reduced dynamic range</td>
</tr>
<tr>
<td>Have <em>almost</em> no Noise Reduction applied allowing for more efficient noise reduction in computer software (Neat Video)</td>
<td>Noise reduction and sharpening are applied by an in-camera processor (some manufacturers are worse than others at obliterating detail)</td>
</tr>
<tr>
<td>Larger file size require larger SD Cards</td>
<td>Each file occupies considerably less (in excess of 50%) space than RAW files</td>
</tr>
</tbody>
</table>
Digital Cameras for Low Light Photography

- Digital cameras make low light photography easy
- Even entry level DSLRs/Mirrorless cameras have clean ISO 3200
- Kit lenses (18-55mm f/3.5) provide a usable starting point
- If you don’t have very fast f/1.4 lens then use the Moonlight or twilight

Image data:
23 July 2012, Lake Tekapo, NZ.

Sony NEX5N, kit 18-55mm lens at 18mm and f/4, ISO 3200, 15 sec, RAW file capture.

Simple Processing: RAW conversion, Noise Reduction, Colour Balance and Brightness/Contrast adjustments in Photoshop CS5

Note: The church is illuminated by 18.5% crescent Moon
Working with light

- Use crescent Moon or twilight to naturally illuminate the foreground
- Use nearby light pollution
- **Gently** light up the foreground objects with a flashlight

Note: Pebble beach and rocks are gently illuminated with a flashlight
Great Ocean Road, July 2017

- Light-painting with a smartphone screen (slightly red-coloured)
NSW Coast, July 2017

- No artificial lights
Moonlight (thin crescent Moon)
Using Light Pollution
Scouting at night, light pollution map: http://www.lightpollutionmap.info/
Context

- Stars and the Milky Way look similar from most dark sky locations
- An interesting foreground adds to the night sky image
- Ocean, mountains, silhouettes, people, etc...
- Landscape elements which work with what is in the sky work best

Note: The foreground is illuminated by a lighthouse beam
Australian Landscape
Cape Schanck, Mornington Peninsula, Victoria

Note: The signs and road are illuminated by flashlight
12 Apostles, Great Ocean Road
Star Trails

- Take multiple images (30sec-10 min) with as little gap as possible
- Set lower exposure to preserve star colours
- Stack in StarStaX (www.starstax.net)
Location and Framing

- Google Maps and Satellite images
- FoV calculator

<table>
<thead>
<tr>
<th>Lens focal length (mm)</th>
<th>Digital multiplier factor</th>
<th>Distance to subject (any units)</th>
</tr>
</thead>
<tbody>
<tr>
<td>35</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>Horizontal Angular FoV</td>
<td>54.4 degrees</td>
</tr>
<tr>
<td></td>
<td>Vertical Angular FoV</td>
<td>37.8 degrees</td>
</tr>
<tr>
<td></td>
<td>Diagonal Angular FoV</td>
<td>63.4 degrees</td>
</tr>
<tr>
<td>102.86</td>
<td>Horizontal FoV (same units as distance)</td>
<td>102.86</td>
</tr>
<tr>
<td></td>
<td>Vertical FoV (same units as distance):</td>
<td>68.57</td>
</tr>
<tr>
<td></td>
<td>Diagonal FoV (same units as distance)</td>
<td>123.62</td>
</tr>
</tbody>
</table>

- Stellarium (FoV, Perspective projection, azimuthal grid)
  
  http://www.stellarium.org

- Scouting during the day with the camera and compass

- Save locations in Google Maps for future use

Mobile App – PhotoPills (Android, iOS)
Other Mobile Apps

- Sky Map (Free - Android)
- Star Chart (Free – iOS)
- Stellarium Mobile Sky Map ($3 - Android, iOS)
- Sky Safari 5 ($4 - Android, iOS)
- Redshift ($15 - Android, iOS)
- Star Walk 2 ($3 - Android, iOS)
Predicting Clear Skies

Computer Cloud Models & Maps
Satellite Images

- www.cloudfreenight.com
- www.yr.no
- satview.bom.gov.au
- www.skippysky.com.au
- www.weatherzone.com.au
  (mobile app available)

The most accurate weather forecast method is to be there and check!
Personal Safety

- Scout the location during daylight –some locations can be quite dangerous or not accessible in the dark
- Some national parks, lighthouses, etc. can be locked at night or have access restrictions
- Let someone know where you’re going and when you plan to return
- Go with friend(s)
My latest images, videos and blog are online at www.terrastro.com

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