Land Navigation without a Compass or GPS

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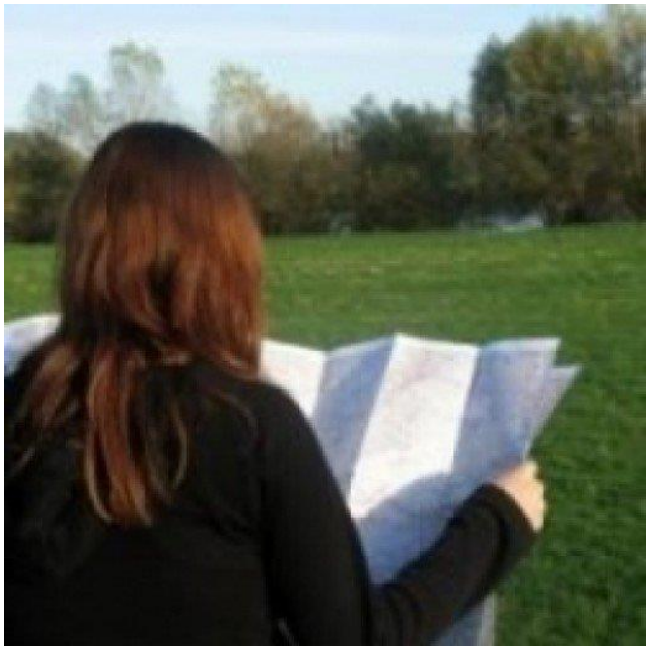


Alternative Land Navigation Techniques

Catch features. Attack points. Handrails. Aiming off. Those are just some of the terms and techniques used when practicing alternative navigation.

When I say "alternative," I'm referring to navigating without the use of instruments, like a compass, GPS or altimeter.

I'm talking about navigating with no more than a map and a mental grab bag of tools, including knowing how to read terrain and compare that terrain to features on a topographic map, using terrain to your advantage, and using the sun, moon and stars to find your way.

These and other methods of utilizing natural and man-made elements are a valuable backup to gadgets, which can malfunction or get lost or broken in the field. I use these types of alternative navigation myself, whether I'm just out hiking for fun or in the backcountry as a Search and Rescue (SAR) volunteer.

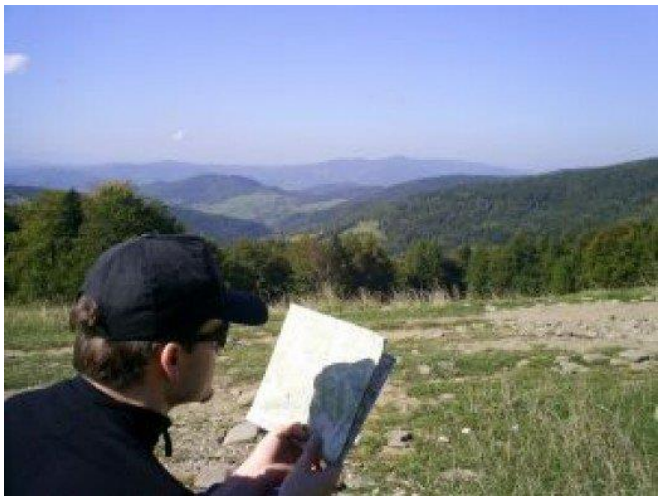
In SAR, we like our gadgetry, but sometimes we find that backcountry travelers rely on it to the exclusion of other non-battery-powered, unbreakable techniques and a "feel" for their surroundings. Their GPS suddenly dies in the field and, oops, they didn't bring a compass. And they haven't been paying attention to the map or the terrain. Next thing they know, it's getting dark and cold, and they're stuck while waiting for help to arrive. And SAR folks often rely too much on gadgets themselves, which is why we practice "alternative navigation" on an ongoing basis.

So, here I'd like to introduce some of the basic concepts that fall under the alternative navigation heading as well as provide some additional resources for learning more about these skills.

Your Map

A Must-Have Tool for Navigation

If for some reason you just had to choose one navigational tool to take with you into the backcountry, choose a map. Preferably, a topographic map.



A topographic map differs from a planometric map primarily in that a topographic shows the shape of the terrain with the use of contour lines, though it will still show planometric features such as roads, towns, urban areas, and bodies of water. Planometric maps are two-dimensional representations that don't show the shape of the terrain at all. (One example of a planometric map is a road map as you'd see in a road atlas. Forest Service maps are also planometric.)

Learning how to read a topographic map takes a little practice but overall is fairly easy once you get the hang of interpreting the contour lines and other symbols. For more information, see:

- How to read Topographic Maps by Professor of Geography, Boris Vasilev, M.S.
- Topo Map Skills by the Compass Dude
- Topographic Maps on HowStuffWorks.com

Of course, two or more navigational tools are better than one, and most weigh no more than a few ounces, so why not bring along a compass and maybe a GPS as well? But a map really should be the basis of that system.

You can order topographic and other types of maps and more from the USGS Store (http://store.usgs.gov/)

Catch Features & the Safety Baseline Navigation Technique
One way to find your way without a compass or GPS

A catch feature -- or baseline -- is any type of natural or man-made feature that lies across your route, such as a road, powerline or river, which can be effectively used to tell you you've gone too far and missed your destination.

In this photo, the power line (and "road" or swath beneath it) is an effective catch feature.

Before heading into the backcountry, look at your map and select one or more long catch features relatively near the area in which you'll be traveling. Important: These features should be easy to identify, both on your map and in the field, and should be obvious even at night. A catch feature at a distance of 2 miles from your area of travel is reasonable, while 20 miles away is of little value.

Select a feature that's long enough that it will "catch you" even if you're slightly off in direction, meaning, if the catch feature is to the south and you hike southwest, you should still run into it. Make a note of or, better yet, memorize the direction and rough distance to the catch feature/s in case your map is lost.

The best scenario is if you have two catch features, or baselines, that intersect -- such as two roads, or a road and a power line or creek -- in order to contain you in a smaller area. If you get lost, travel in the direction of a catch feature until you reach it and can re-orient yourself and get to safety. This method of containing yourself in an area with catch features and using one or more to navigate to a point is called the *Safety Baseline Technique*.

A stream can be a navigation handrail

Another Handy Technique: Using "Handrails" In Navigation
A guide to follow to your destination

A handrail is a feature along your route, such as a stream or canyon, that you can travel next to, or at least keep in sight as you move along to maintain direction. A handrail can be a natural feature or it might be something man-made, like a powerline.

Basically, if you find something that's going where you want to go, follow it. You might need to leave the handrail and contour around to your destination.

Navigate by Aiming Off

Know for sure which way to turn

The technique of aiming off means creating a purposeful error to one side, so you'll know for sure which way to turn to get to your destination. For example, you want to return to your vehicle, which is parked on a Forest Service road. The road is a catch feature, clearly identifiable on your map, and you know which direction to travel to reach the road. But you don't want to get to the road and not know whether your car is to your left or your right, so don't try to head directly towards the vehicle.

Perhaps you know that if you travel to the northwest instead of due north, you'll definitely have to walk to the east -- to your right -- to get to your vehicle. You'll want to make the error significant enough that there's no doubt about which way to turn. This may mean some extra walking perhaps, but it can be a lot less than if you try to aim directly for that vehicle, then get to the road and spend an hour walking in the wrong direction.

Other Terrain-based Methods of Alternative Navigation
You'll just need your eyes, your brain, and your map

Using check points:
Check points are recognizable features along your route which allow you to stop and check your location, such as a pond, a fence, a turn in a road, or maybe the point where a power line crosses a road. If you can pinpoint on the map what you see in the field, it can be used as a check point.

Using an attack point:
An attack point is a location from which to begin micro-navigating to a destination. An example of an attack point would be the clearly identifiable intersection of a creek and a power line. You should be able to recognize the attack point not only on your map but in the field and have no doubt you are at that point. This point should be close to your destination to be effective. Once you reach the attack point, you will want to use as many methods of navigation as you have in your arsenal to travel to your destination, such as pacing off the distance (see below), continuously checking your map and comparing terrain changes to topographic features, and so forth.

Funneling:
This means using features -- particularly catch features and handrails, such as streams, roads, powerlines or cliff edges -- to funnel you to a point. This point, or intersection of two features, can become an attack point from which to micro-navigate to a destination, such as a campsite.

Pacing for Distance
Another "tool" for land navigation

Imagine it's dark, and it's snowing heavily. And the terrain is flat, without any distinct features to guide you. In a case like that, it's helpful to have some indicator of how far you've traveled. One method is using time, though you'll have to know your general speed—i.e. 2 miles per hour--and account for any stops.

Another method, one preferred by my Search & Rescue teammates, is determining distance traveled by pacing. Here's how it works:

Measure your pace by counting each time you put a foot down on the same side, so choose your left or right before you begin. Measure a distance of 100 feet and walk it several times, counting how many paces it takes you to cover that distance. Take an average of these trials. Then multiply your 100-foot pace by 52.8 (one one-hundredth of a mile). The result will be the number of steps you take with one foot in a mile ... or your pace. (It's fine to round off for ease of use in the field.)

Most people will walk about 1,000 paces per mile, though pace will vary with terrain. Pacing is not an exact science, of course, but figuring out your approximate pacing between two points on a map and then keeping track as you move in the field will give you a good estimate of when you're getting close to your destination. It can be helpful to use beads or to pick up a pebble, let's say, each time you get to 100, to help keep count. (Remember, if you move side-to-side, don't count paces.)

Here, you see students in an Alt. Nav. class determining their pacing by averaging their results from a 100-foot distance....

Pacing for Land Navigation

One can keep track of pacing in a number of ways, including using "ranger beads" on a string (or compass lanyard), moving one over for every 100 paces. Similarly, you can pick up a pebble or other small object for every 100 paces. You can write it down or tell a partner, "That's 100 ... that's 200." Whatever helps you remember where you're at if you stop for a bit or get distracted.

Remember that paces will generally widen when going gradually downhill and shorten when going uphill. Pacing works best over "average" terrain.

Land navigation with the sun

- Is it a bird? A plane? An alien invasion?

No, these people are in an alternative navigation class, learning how to determine direction by the position of the sun. Here's how it works:

From the side of one's hand to a comfortably extended thumb is just about 15 degrees -- or 1 hour of time -- in the sky. If you know the approximate time that the sun will be at its highest point for the day in your area, then you can use this system to find due (that is, true not magnetic) south and, from there, the other cardinal points (East, West, North).

To find solar noon in your area, plug in your information at Solar-Noon.com and print your solar noon calendar.

Here in Flagstaff, Arizona, the sun never crosses the North/South meridian. It is at its highest point anywhere between 12:15 and 12:40pm, depending on the time of year, so we can use 12:30 as a general rule when determining direction by the sun.

Based on the Flagstaff example, if it's 11:30 (or close to it) in the morning, we can measure one hand width to the right to find due south. By the same token if it's 2:30pm, we'd measure two hand widths to the left to find due south. Then, we can orient our map to south (making sure map north -- the top of the map -- is facing away from the sun). Then, place a straight object on the map from your current location towards your destination, and walk in that direction.

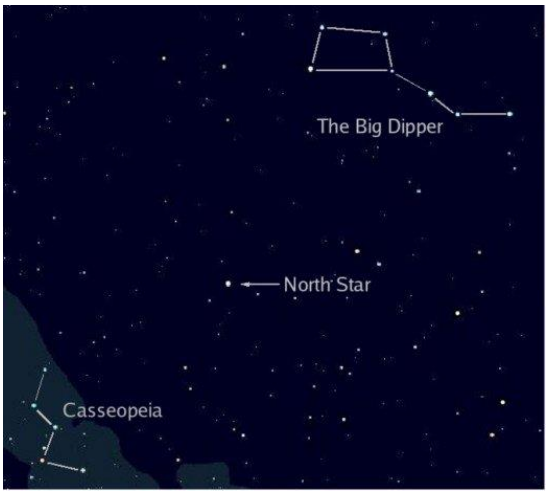
Here, you see the students orienting their maps to due south, then placing pens on the map to determine direction of travel to their desired destinations....

For a time, you can keep the sun at the same location relative to your body. Since the sun moves, however, using other types of alternative navigation (terrain features, for example) will be necessary to keep on course. One can also readjust by using the sun and time again no more than one hour later.

The key to this navigation method is that you must know your current location on the map.

Astrophysicist Jonathan Keohane from the Goddard Space Flight Center answers the question:

- When is the Sun at its highest point and how did you determine the answer?
  More on the Sun
- How to Find Direction Using the Sun and Shadows
  From eHow.com
- How do I find when the sun is at its highest point?
  Answered on YahooAnswers.com, including more helpful links
- How to Find Due South using the Sun at Any Time of Day
  A more detailed how-to about finding due south using solar noon, the sun, and your hand.



Navigating by the Stars

When it comes to celestial navigation, knowing how to locate the North star, or Polaris, is a good place start. From there, as long as you know the cardinal points on a compass -- North (0 or 360 degrees), East (90 degrees), South (180 degrees) and West (270 degrees) -- you can orient your map and yourself and travel in any direction, in part by keeping Polaris in a certain location relative to your body.

You might select another bright star in the direction you need to go and aim for it; however, all stars but Polaris move throughout the night, so Polaris is the only one you can rely on for direction for a long period of time.

More on the Stars

Learning to locate Polaris is one thing, but celestial navigation is a subject and skill one can really dive into. Here is a site I came across that might help you get started:

- Space.com
  Read "Navigating by the Stars" on Space.com. (You may have to scroll down to see the beginning of the article.)

Celestial Navigation Tricks & Tips

A 9-minute video showing several methods for finding direction using the stars and time.

Navigating by the Moon

Navigating by the moon is tricky and really provides only a rough determination of direction unless you're really an expert, meaning the moon roughly rises in the East, and sets roughly in the West. In fact, the rise and set directions for the moon can be up to 28.5 degrees to either side of true East and West.

Accurate navigation using the Moon is impractical for most of us, and even a guesstimate of direction requires knowing the times of moonrise and moonset. Not to mention that, on most nights, there will be a period when the Moon will not be visible (or the sun for that matter).

However, if the moon rises before the sun has set, the illuminated side will be roughly to the west. If the moon rises after midnight, the illuminated side will be generally to the east.

See *The Essential Wilderness Navigator: How to Find Your Way in the Great Outdoors*, Second Edition

Land Nav Task - Determine Direction without a Compass

Standards: Identified north and east within 15 degrees.

Conditions: During daylight and at night (with a clear view of the Big Dipper), given a wristwatch (not digital), the hiker must determine direction in a field environment with natural vegetation available.

Standards: Identified north and east within 15 degrees.

Note. All of the procedures given in this task give approximate directions. For accurate directions, a compass must be used.

Performance Steps

1. Determine **direction using the shadow-tip method**.
   a. Place a stick or branch into the ground vertically at a fairly level spot where the sun will cast a distinct shadow. Mark the shadow with a stone, twig, or other means (figure C-40).

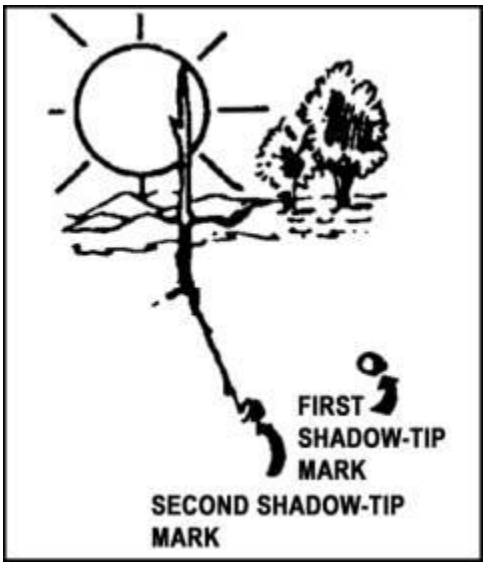


Figure C-40. First shadow-tip mark

   b. Wait 10 or 15 minutes until the shadow tip moves a few inches. Mark the new position of the shadow tip as in step 1a (figure C-41).

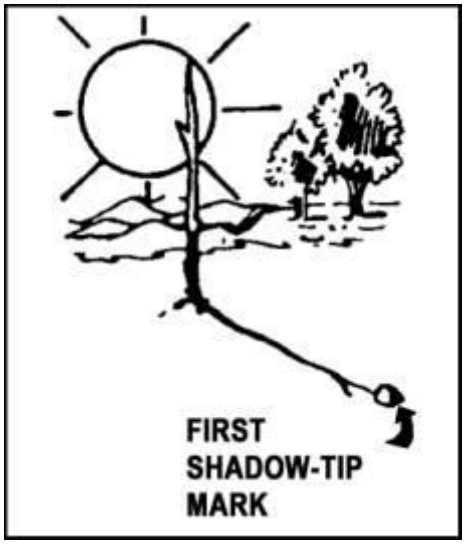


Figure C-41. Second shadow-tip mark

   c. Draw a straight line through the two marks you made on the shadow tips. This line is an east-west line (figure C-42).

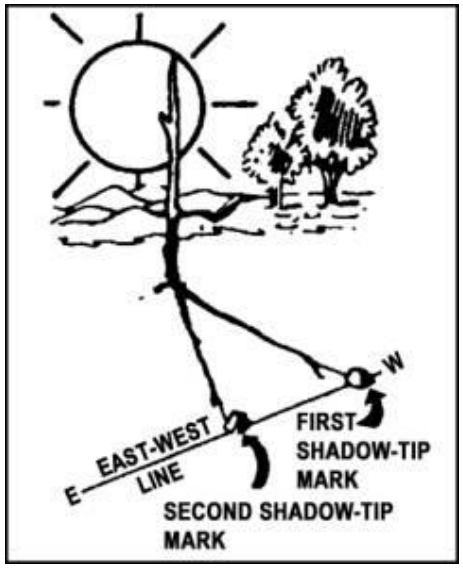
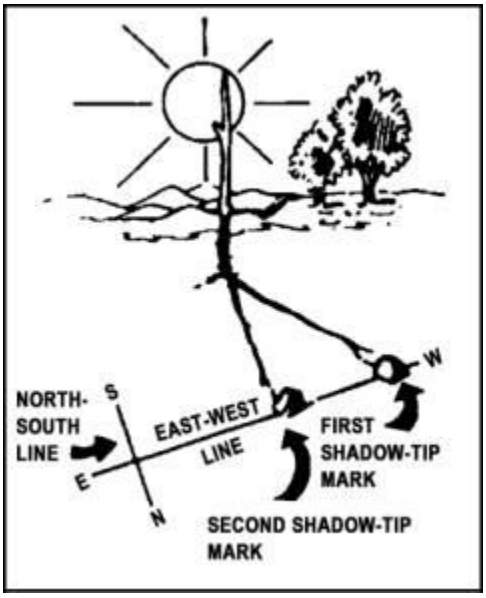


Figure C-42. East-west line

   d. Determine which is the east end of the line and which is the west end.
      (1) The sun rises in the east and sets in the west.
      (2) The first shadow tip you mark is always west and the second mark is always east.
      (3) The shadow tip moves in the opposite direction.



   e. Determine north and south. Draw a line at a right angle to the east-west line at any point (figure C-43). This is the north-south line.

Figure C-43. North-south line

2. Determine **direction using the watch method without a compass**.

a. Point the hour hand at the sun when you are north of the equator. South will be halfway between the hour hand and 12 o'clock (figure C-44).

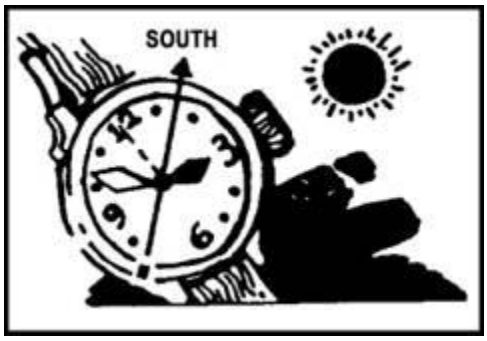
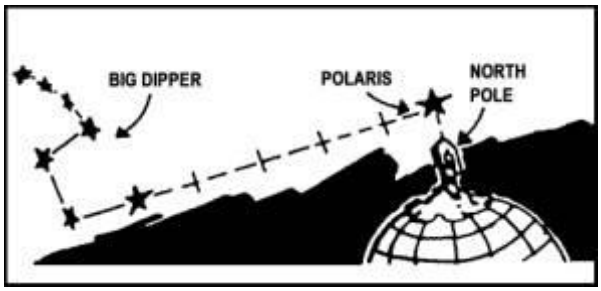


Figure C-44. Watch method

b. Point 12 o'clock at the sun when you are south of the equator. North will be halfway between the hour hand and 12 o'clock.

3. **Use the North Star method to determine direction at night**.



At night, you can locate north by finding the North Star (Polaris). First, find the Big Dipper. The last two stars in the cup point directly at Polaris, which is about five times as far out as the distance between those two stars in the cup. Facing Polaris, you are looking north, with east on your right and west on your left (figure C-45).

Figure C-45. North Star method

***Note**. During the training session, stress these four facts:*

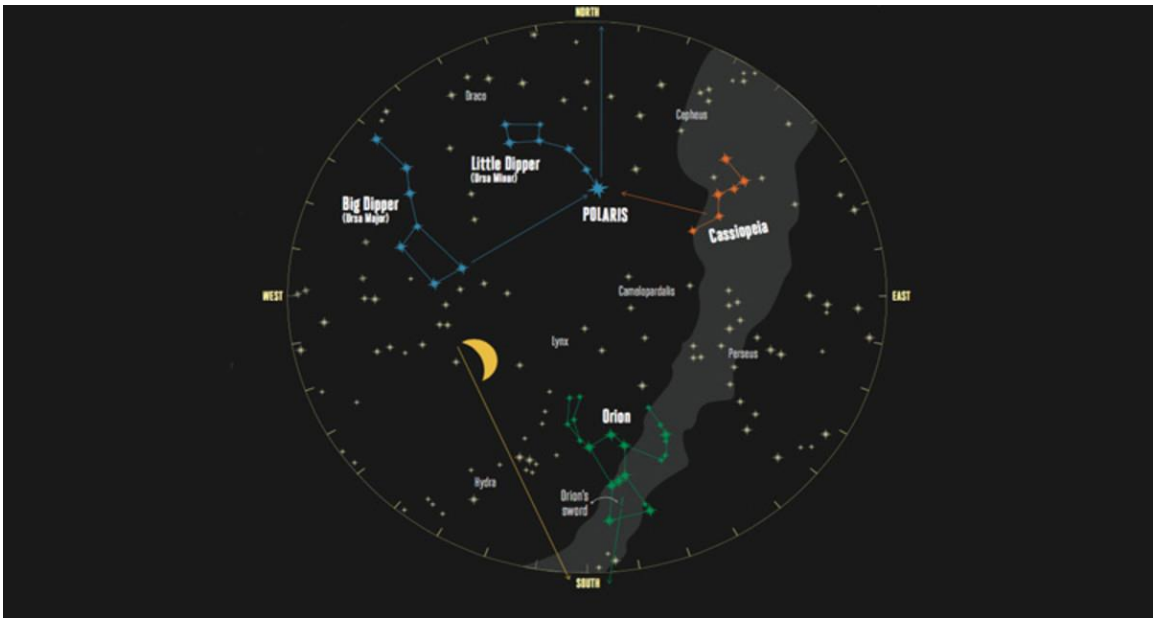
1. *The sun rises in the east and sets in the west.*
2. *When you face north, east is to your right, west is to your left, and south is to your back.*
3. *The Big Dipper is a pattern of stars that resembles a soup ladle.*
4. *The Southern Cross is the main constellation used as a guide south of the equator and the above general directions for using north and south stars are reversed.*

How to Navigate by the Stars

*Compass broken? GPS dead? These tips, from backpacker and astronomy Ph.D. candidate Melodie Kao, will ensure that you never get lost in the dark again. * by:* Amanda Hermans · Aug 2, 2016

Find North

First, find Polaris, or the North Star, which lies almost directly above the north celestial pole. You'll locate Polaris straight out from the tip of the Big Dipper's bowl, almost as if it were being poured from the giant ladle. If you hit Cassiopeia—which is shaped like a "W"—you've gone too far.



If the Big Dipper isn't visible (it could be obscured by clouds, or terrain when it's low on the horizon), you can still find Polaris by following a line bisecting the wider "V" of Cassiopeia. Polaris is also the end of the handle on the Little Dipper. Once you find it, let your eyes fall to the point on the horizon directly below. This will be close to due north.

Tip: Polaris should be the number of degrees of your current latitude above the horizon.

Find South

If the moon is a crescent and high in the sky, connect the tips of the crescent. Find where the line hits the horizon—that's south. If Orion is high in the sky and his sword is close to vertical, the point where the line made by the sword would hit the horizon also points you south.
(Note: Both of these methods yield rough estimates compared to finding north with Polaris, which is highly accurate.)

Save your Direction

If you're using one of these methods to orient yourself but will wait for daylight to hike, draw an arrow in the dirt (or use rocks or sticks) so you don't go astray come morning.

Tell Time

Imagine a giant clock in the sky, with the line you drew connecting Polaris and the Big Dipper as the hour hand. This clock is a little different than your average analog—it's a 24-hour clock and it runs counterclockwise. On March 6, it's perfectly accurate. In any other month, take the number of months after March 6, multiply it by two, and subtract it from the time you read (don't forget to add an hour during daylight savings time). If the Big Dipper isn't visible, you can use Cassiopeia. The line that connects the tip of the narrow "V" and Polaris is your new hour hand, and the date to remember is March 21.

*These tips only work for orienting yourself when you're traveling in the Northern Hemisphere.