SKILL GUIDE · TRANSPORTATION

Land Navigation Without GPS

The Transportation chapter's Tier 3 Land Navigation item names dead-reckoning and terrain-reading as a genuinely different skill from following a paper map on existing roads. This is that skill: orienting a map and compass correctly, counting distance by pace, reading terrain features, and knowing which natural-navigation folklore actually holds up.

Orienting a map and compass

A baseplate compass (a flat, clear rectangle with a rotating dial) is the right starting tool, not a military lensatic compass; it's simpler to learn on and does everything a beginner needs.

1. Lay the compass baseplate along a north-south reference line on the map, either the map's own border (which runs true north-south) or a printed grid line.
2. Rotate the dial so its orienting lines match that same north-south line, with north on the dial pointing to the top of the map.
3. Holding the map and compass together as one rigid unit, turn your own body until the red end of the magnetic needle falls inside the dial's orienting arrow, a step commonly called "red in the shed." You're rotating map and compass together, not the compass alone while the map stays put.
4. The map is now oriented to match the real terrain around you: features on your left on the map are on your left in the field.

Don't skip declination, and know which direction to correct

A compass points to magnetic north, not true north, and the gap between them (declination) varies by location and shifts slowly over time. Look up the current declination for your area with NOAA's declination calculator, then either dial that correction into an adjustable-declination compass once and forget it, or manually add/subtract it every time you take a bearing. The rule for which direction: "east is least, west is best," an east declination gets subtracted from a true (map) bearing to get a magnetic (compass) bearing, a west declination gets added. Skipping this step, or getting the direction backward, is a common beginner error that gets worse the farther you travel.

Taking and following a bearing

Orienting the map tells you which way is which; taking a bearing is how you actually walk from where you are to a specific point you can see on the map but maybe not in front of you.

1. Lay the compass baseplate's edge along the straight line connecting your current position to your destination on the map, with the baseplate's direction-of-travel arrow pointing toward the destination, not back toward you.
2. Holding the baseplate still, rotate the dial until its orienting lines and arrow align with the map's own north-south lines, north on the dial matching north on the map.
3. Read the bearing in degrees where the dial meets the fixed index line on the baseplate, then apply your declination correction from the note above.
4. Hold the compass flat in front of you and turn your whole body until the needle boxes inside the orienting arrow again, the same "red in the shed" check as before. The direction-of-travel arrow now points the way to walk.
5. Pick a landmark in that exact direction, a distinct tree, rock, or terrain feature, and walk to it rather than staring at the compass the whole way; re-check your bearing once you reach it and pick the next landmark. This is what actually keeps you on line over distance.

Watch it: REI, "How to Use a Compass: Compass/Map Navigation".

Finding your own position first: resection

Taking a bearing assumes you already know where you are on the map. When you're not sure, resection finds that starting point using terrain you can actually see:

1. Identify two or three recognizable features around you that you can also find on the map, a peak, a tower, a distinct bend in a ridge or river.
2. Take a magnetic bearing to each one with your compass, correcting for declination the same way as above.
3. Convert each bearing to its back azimuth (add 180 degrees if the bearing is under 180, subtract 180 if it's over).
4. From each identified feature's position on the map, draw a line running in the direction of its back azimuth.
5. Where the lines cross is your position. Two features can work, but three lines forming a small triangle rather than a single clean intersection is a useful accuracy check, your real position is inside that triangle.

A basic fixed compass like the Suunto A-10 NH (roughly $24) is enough to learn on. A compass with an adjustable declination ring and mirror sighting, like the Silva Ranger 2.0 (roughly $75), removes the manual-

correction step and aims more precisely, worth the upgrade once the basics are solid.

Pace counting: measuring distance without a GPS

Pace counting turns your own stride into an odometer, walk a known distance, count your steps, and you have a personal conversion factor for judging distance in the field.

> **WARNING**
>
> **Two different counting conventions exist, know which one you're using**
>
> Scouting America's method counts a "pace" as one complete stride cycle, both feet, i.e. count only every time your *same* foot (say, your right) touches down, which typically comes out to roughly 62-75 counted paces per 100 meters on flat ground. The U.S. Army's FM 3-25.26 instead counts every single step, which roughly doubles that to around 120-130 per 100 meters. Neither is wrong, but mixing them mid-plan will throw your distance estimate off by half or double. Pick the double-step (Scouting) convention as the simpler default, and just be consistent.

To find your own count: measure out a known 100-meter (or 100-yard) stretch, walk it naturally at a normal pace several times, and average your count. Terrain changes your count, uphill, deep snow, and heavy brush all shorten your stride, so a serious navigator keeps separate counts for flat ground versus rough terrain. A simple pace-counting bead string (or just knots on a cord, moved one per 100 meters) keeps track without doing mental math while walking.

Reading terrain, not just the map

Certain terrain features are useful specifically because they're hard to miss, which makes them reliable navigation aids even with an imprecise pace count or a rough bearing.

Feature	What it means for navigation
Handrail	A linear feature, a stream, ridge, or fence line, that you deliberately follow alongside rather than trying to walk a precise bearing
Catching feature	A large, unmistakable feature (a road, river, or ridgeline) beyond your destination that tells you you've gone too far if you reach it
Saddle	A low point between two higher points on a ridge, often the easiest place to cross
Draw	A small valley feature that channels water downhill, usually easier walking than the surrounding slopes but can dead-end or steepen
Ridge	High ground connecting peaks; generally easier, more open walking than valley bottoms

Plan a route around these features deliberately: pick a handrail to walk beside, and set a catching feature past your destination so you know when to stop even if your bearing was slightly off. This terrain vocabulary comes from the Army's FM 3-25.26 land navigation manual, chapter 11.

Natural navigation: what actually works, and what's folklore

A lot of natural-navigation advice repeated online is exaggerated or flatly wrong. Some of it deserves the opposite correction, it's more reliable than its reputation suggests.

Method	Verdict
Moss grows on the north side of trees	Unreliable. Moss grows wherever it's damp and shaded, which depends on local tree cover, slope, and microclimate, not a consistent compass direction.
Shadow-stick method (track a stick's shadow tip to find east-west)	Genuinely one of the more reliable natural-navigation methods, usable year-round at most latitudes. Accuracy actually depends on time of day, not season: it's most accurate within about 2 hours of local solar noon, and error grows well beyond that, worst near sunrise and sunset.
Using a watch as a compass (point hour hand at sun, bisect to 12)	Works roughly, but has a documented error of about 15 degrees during Daylight Saving Time since the method assumes standard time. Correct for it by using the 1 o'clock mark instead of 12 while DST is in effect, or mentally subtract an hour from the watch first.
Navigating by Polaris (the North Star)	More accurate than its casual reputation suggests: Polaris currently sits roughly 0.5-0.65 degrees from true celestial north (slowly shrinking toward a minimum around the year 2100). The real risk is misidentifying which star is Polaris in the first place, not the star itself being imprecise.
Following a stream or watching bird flight lines to find civilization	An oversold heuristic. Streams don't reliably lead to people, and bird flight patterns are not a dependable directional signal.

Sources

- Map and compass technique, declination, terrain association vocabulary (handrail, catching feature, saddle, draw, ridge): U.S. Army FM 3-25.26, Map Reading and Land Navigation, Chapter 11
- Declination lookup: NOAA National Centers for Environmental Information
- Pace-counting convention (double-step method): Scouting America, Orienteering merit badge
- Polaris accuracy and natural navigation method reliability: U.S. Army FM 3-25.26; standard celestial navigation references
- Compass bearing procedure and declination correction mnemonic: REI Expert Advice; REI Expert Advice
- Resection technique: U.S. Army FM 3-25.26, Chapter 11
- Shadow-stick method accuracy and solar-noon timing: Salt & Prepper
- Watch-compass Daylight Saving Time correction: NITE Watches
- Current Polaris offset from celestial north: EarthSky

SKILL GUIDE · TRANSPORTATION

Basic Bicycle Maintenance & Repair

The Transportation chapter's Tier 2 names a bicycle as a genuinely practical fuel-free backup, but only if it stays rideable. Unlike a car, a bike is DIY-friendly enough that almost anyone can learn the handful of repairs that keep it running: fixing a flat, keeping the chain lubricated, and knowing when a shifting problem is dirt, not damage.

Fixing a flat: patch it or replace the tube

1. Flip the bike upside down (or use a stand). For a rim-brake bike, open the brake caliper's own quick-release first so the tire can clear the pads. If the wheel uses a quick-release skewer, pull the lever straight outward, away from the wheel, until it swings a full 180 degrees into the open position, most levers are stamped "Open"/"Close" to confirm you're reading it right; only loosen the adjusting nut on the far side if the wheel still won't clear the dropouts. For a rear wheel specifically, shift to the smallest rear cog first, then pull the derailleur body backward to slacken the chain before lifting the wheel out, guiding it down past the chain and derailleur cage as it comes free.
2. Work a tire lever under the tire's edge, hook the other end on a spoke to hold it up, then work a second lever around the rim until one whole side of the tire is off.
3. Pull the tube out and find the leak: re-inflate it slightly and listen or feel for escaping air, or submerge sections in water and watch for bubbles.
4. Check the inside of the tire itself for whatever caused the puncture (a thorn, a sliver of glass or wire) before putting a new or patched tube back in; skip this and the same object punctures the next tube too.
5. Work the tube into the tire and the bead back onto the rim mostly by hand; only use a lever as a last resort, and never a screwdriver or knife, which can puncture the tube you just installed. Inflate to low pressure first and check both sides of the tire for a visible, even line just above the rim (the bead seated correctly) before inflating the rest of the way; an uneven line usually means the tube is pinched under the bead somewhere.

Two different kinds of stick-on patches exist, and using the wrong procedure for the one you have is a real way to fail a repair. A **glueless patch** works as written: lightly scuff the area around the hole so the adhesive bonds, peel the backing, then press the patch on firmly and hold it for a minute. A traditional **rubber-cement patch kit** works differently: scuff the area the same way, apply a thin, even layer of the cement from the kit, then wait for it to dry until tacky, not press the patch onto wet cement, before applying the patch. Treat a patch as a get-you-home fix rather than a permanent one, though a properly applied patch can last a long time in practice. Replacing the tube outright is faster and more reliable when time matters, which is

why carrying at least one correctly-sized spare tube is worth more than carrying only patches. Match the new tube's diameter and width numbers to what's printed on the tire's sidewall before buying spares.

Before you can add air at all, know which of the two incompatible valve types your bike uses: a narrow, threaded **Presta** valve needs the small knurled nut at its tip unscrewed (counterclockwise) before a pump will move air, then closed again after; a wider **Schrader** valve, the same type used on car tires, just needs the cap off. Check which one your bike uses before buying a pump or inflator, some pump heads only fit one type. Inflate to the PSI (or BAR) range printed on the tire's own sidewall, not a single fixed number: road tires typically run 100-140 psi, hybrid/urban tires 60-80 psi, and mountain bike tires 30-50 psi, with heavier riders running toward the top of the range and the rear tire commonly a few psi higher than the front.

Chain care: the maintenance that prevents most other problems

Clean and re-lubricate the chain roughly every 100 to 150 miles of riding, after any wet or muddy ride regardless of mileage, or as soon as it starts sounding gritty or dry, whichever comes first. Wipe the chain down with a rag and a degreaser to pull off built-up grime, let it dry, then apply lubricant drop by drop so it reaches each link, and wipe away the excess. Excess lube left on the outside of the chain doesn't help it run smoother; it just collects more dirt, which is the opposite of the goal.

Shifting problems: usually dirt, not damage

Most shifting complaints come from a dirty drivetrain, a stretched or gunked-up cable, or a derailleur knocked slightly out of adjustment, not a broken part. Brush caked grease and grit off the derailleur's small jockey wheels and give the derailleur's pivot points a light touch of lubricant, without over-oiling them the same way the chain shouldn't be over-oiled. Clean the whole drivetrain (chain, cassette, chainrings) before assuming a shifting issue needs a real mechanical fix; a surprising share of "broken derailleur" complaints resolve with nothing more than a proper cleaning.

Riding while hauling cargo

A loaded bike, whether carrying panniers, a trailer, or a bag of supplies, handles differently than an empty one: it's slower to turn, needs more distance to stop, and is less stable at low speed, especially over the first few rides while getting used to the new balance. Practice riding loaded on a familiar, low-traffic route before relying on it for a real trip, the same reasoning this manual applies to breaking in evacuation footwear or testing a rucksack under real weight.

Quick Reference

Task	Interval / trigger	Note
Chain lube	Every 100–150 miles, or after wet rides	Wipe excess off; too much lube attracts dirt
Chain/drivetrain cleaning	Every 2–3 lube cycles	Degreaser + rag; resolves most shifting complaints
Tire check	Before every real-use ride	Check for embedded debris after any flat
Spare tube fit check	Before storing as emergency backup	Match diameter/width printed on the tire sidewall

A basic repair kit:

Item	Purpose	Note
Tire levers (2-3)	Removing the tire from the rim	Plastic is fine; keep a spare, they do snap
Patch kit	Emergency/get-home fix	Check the glue hasn't dried out before relying on it
Spare tube(s)	Fast, reliable fix	Correct size for your specific tire
Mini pump or CO2 inflator	Re-inflating after a repair	A pump never runs out; CO2 is faster but finite
Chain lube + rag	Routine maintenance	A dedicated bike lube, not household oil
Multi-tool	Minor adjustments on the road	Covers 4mm, 5mm, and 6mm hex/Allen, the sizes used on most stem, seatpost, and brake/derailleur mounting bolts, plus a Phillips or flat screwdriver bit

TIP

Dust a stored spare tube with talcum powder before it goes in the kit

A bare rubber tube left folded up for months tends to stick to itself, which makes it harder to unfold and seat correctly when you actually need it. A light dusting of talcum or baby powder inside a sealed

ziplock bag keeps the rubber from bonding to itself and doubles as a light lubricant that makes the tube easier to work into the tire during the actual repair.

Sources

- Flat repair and tube replacement steps: REI Expert Advice; GearJunkie
- Chain lubrication interval and technique: We Love Cycling; BigRing Cyclery
- Derailleur/shifting troubleshooting basics: REI Expert Advice
- Wheel removal (quick-release lever direction, rear-wheel derailleur/chain step) and tire/tube reinstallation: Park Tool; Park Tool
- Presta vs. Schrader valve types and inflation technique: BikeRadar
- Tire pressure ranges by bike type: REI Expert Advice
- Glueless vs. rubber-cement patch procedure: Park Tool
- Talcum/baby powder for storing a spare inner tube: Bike Noob