



# STUDENT

## The Mountaineers

Modern Wilderness Navigation Workshop:

***Version 4.8: Mar 02, 2023***

Student Name: \_\_\_\_\_ Date: \_\_\_\_\_ Instructor Name(s): \_\_\_\_\_

AGENDA			
	Group 1	Group 2	Group 3
5:30 to 6:00 PM	Arrival for Instructors and those wanting additional help		
6:00 to 6:30 PM	Check-in Table, warm-up exercise		
6:30 to 6:45 PM	Welcome and introduction		
6:45 to 9:25 PM	Module A (0:50) End at 7:35	Module B (0:50) End at 7:35	Module C (0:50) End at 7:35
	Module B (0:50) 7:40 until 8:30	Module C (0:50) 7:40 until 8:30	Module A (0:50) 7:40 until 8:30
	Module C (0:50) 8:35 until 9:25	Module A (0:50) 8:35 until 9:25	Module B (0:50) 8:35 until 9:25
9:25 to 9:30 PM	Wrap-up		

### CHECK-IN TABLE CHECKLIST:

- CHECK-IN:** Get the handouts. Get oriented. Say “thank you” to the instructors, *we are all volunteers.*
- GAIA GPS:** Confirm your iOS or Android smartphone has the Gaia GPS app properly installed:
  - Gaia GPS is installed.** Show you can locate your current position using Gaia.
  - Folder 1:** Gaia has the downloaded “Workshop Program Center Gaia Exercise” waypoints
- MAPS:** Your purchased USGS printed map (Baring). Note that USGS Index is **not** required.
- COMPASS:** Your compass has adjustable declination (these are **required** for the field trip) and the declination is set to the current location.
- ALTIMETERS:**
  - Show how to find the elevation in Gaia.
  - If you are also using a barometric (wrist-based) altimeter, confirm that it is calibrated.

## **Warm-up exercise (start as soon as you get to your table): 6:00-6:30**

Please head to the nearest discussion areas and fill it up. We strongly recommend that couples and parent/child groupings split up and go to separate discussion areas. Please discuss the pre-reading: (Outside article *Disaster in the Alps* at <https://bit.ly/2xq4arO>). **Small group table discussion questions:**

### **\*\*Please see Appendix 7 for Possible Answers\*\***

- 1. What are three root causes of this disaster?**

a)

b)

c)

- 2. Using the workflow checklist (Appendix 4), what navigation tools did they have, what was missing, and what navigation workflow preparation could have helped to prevent or mitigate this disaster?**

<u>The 5 Tools</u>	<u>Was the tool present? Was the tool prepared properly?</u>
1a) Physical map	
1b) Digital map	
2) Altimeter	
3) Compass	
4) Gaia GPS; Backup GPS for cold weather	
5) PLB or Personal Communicator	

- 3. Using the Mountaineers Ten Essentials (Appendix 5) as a guide, what other preparation could have helped prevent or mitigate this disaster?**

**Missing Essentials:**

**Planning, Communication, and Situational Awareness:**

## **Welcome!: Greeting , Introduction, and Context**

Thank you and welcome to the 2020 version of our new *The Mountaineers Modern Wilderness Navigation Workshop*.

There has been a debate at The Mountaineers in recent years regarding what to do with modern navigational tools: altimeters are now cheap, accurate, and ubiquitous; 90%+ of American adults now carry a GPS device (AKA

smartphone), and personal locator beacons and satellite communicators have become the new standard of care. In April 2015, the Seattle Climbing Committee passed a resolution encouraging two things:

- A) To encourage the Freedom of the Hills 9th Edition Revision Committee Chair to incorporate modern navigation tools and techniques as soon as reasonably practicable.
- B) To encourage the Seattle Navigation Committee Chair to update our navigation curriculum and approach to outdoor activities to include the modern navigational tools as soon as reasonably possible.

Two-and-a-half-years later, in October 2017, Mountaineering: The Freedom of the Hills, 9th edition was published. "Navigation" was still the first of The Mountaineers Ten Essentials but it was now redefined to include **FIVE TOOLS**:

1. The "**Map**" now includes the idea of physical and digital versions working together.
2. The "**Altimeter**" has risen in prominence since most mountain navigators use it 100 times more often than the compass.
3. The "**Compass**" has in no way been superseded. It has actually become *easier to use* in conjunction with GPS.
4. The now-ubiquitous "**GPS**" has become both incredibly accurate and easy to use with a smartphone app, but remember that cell phones are still fragile battery-driven devices.
5. Personal locator beacons ("**PLBs**") and **satellite communicators** have become the standard of care for all guides and educators, while some of these devices serve as backup GPS navigation.

With the publishing of "Freedom 9" covering a redefined "Navigation" and a thoroughly modernized Navigation chapter, we are now doing this major makeover of our venerable class.

#### **Overarching goals for the class:**

Modern navigation, the first of The Mountaineers Ten Essentials, now means **FIVE navigation tools**: Map (physical and digital), altimeter, compass, GPS, and PLB/Personal Communicator. Navigating in the wilderness using the most modern technique requires new skills, including:

1. How to **coordinate all the tools** to help answer the most frequently asked questions in the outdoors: "Where am I now, and how can I find my way to my destination—and back? What if I need help in an emergency?"
2. How to organize modern navigation using **workflow**
3. How modern navigation can enhance "**The Ethic of Self Reliance**" and "**Situational Awareness**."

#### **Today's Workshop portion of the Mountaineers Modern Wilderness Navigation course was developed by:**

- **Module A (Gaia GPS): Patricia McDonald**
- **Module B ("Map vs. Actual"): Stevie Russell, Otto Greule and Patricia McDonald**
- **Module C (Navigation Workflow): Steve McClure**

All modules run from 6:45 until 9:25 PM. Each group will do the modules in the order shown in the agenda above.

## Module A: NAVIGATION WORKSHOP GAIA EXERCISE (0:50)

For this Module, you will need your phone with the Gaia app, your compass, and your headlamp. Students will be divided into groups. You will be assigned specific waypoints to use for the exercise at the start of your group's launch.

### EXERCISE A1: WORKFLOW: AT HOME AND/OR WHILE STILL CONNECTED TO THE INTERNET

#### [WORK AS A GROUP, FACILITATED BY AN INSTRUCTOR, 3-5 minutes]

For your an overnight trip to the wilderness of the Cascades, discuss the “workflow” planning that you would do at home and/or while still connected to the internet

What tools would you take and how would you prepare them?

Tool	Tool Preparation
Physical map ✓	
Digital map, Gaia GPS ✓	
Altimeter ✓	
Compass ✓	
PLB/Personal Communicator ✓	

## **EXERCISE A2: NAVIGATION WORKFLOW: At the Trailhead!**

**[WORK AS A GROUP, FACILITATED BY AN INSTRUCTOR, 3-5 minutes]**

You and your friends are at the trailhead to start a wilderness hike in the Cascades. You park the car but, before you hoist your pack, you remember that there is a critical part of Navigation Workflow that needs doing at the trailhead.

What tasks do you need to accomplish at the trailhead before you start (see appendix 4)?:

<input checked="" type="checkbox"/>	<b>NAV Tool</b>	<b>Settings/Adjustments/Confirmations Made:</b>
	<b>Physical Map</b>	
	<b>Digital Map, Gaia GPS</b>	
	<b>Altimeter(s)</b>	
	<b>Compass</b>	

	<b>PLB/Personal Communicator</b>	
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## EXERCISE A3: USING GAIA GPS FOR A SHORT WALK

1. **Open Gaia app and workshop folder, confirm overlay map and set phone to Airplane Mode.** A specific datum does not need to be set for this Gaia-app-only exercise.
  - a. Enable **Location Services** on your phone.
  - b. Confirm your **Saved** folder is toggled to show **ALL** files.
  - c. Open **Workshop Program Center Gaia Exercise** folder that you previously downloaded. Add **Gaia Topo** (feet) map layer as your overlay map. Your instructor will assign waypoints and direction (clockwise/counterclockwise) to use for the exercise.
  - d. Set phone to **Airplane Mode**.
  - e. Once outside the Program Center, tap the **Locate Icon** to view your current location.
2. **Proceed to the assigned starting waypoint (*Forest, Stairs or Stonehenge*) for your group, using the following method to “follow a GPS Bearing”.**
  - a. From your current location, tap the assigned starting waypoint icon once. The waypoint name pops up. Tap this name once. The screen shows the distance to the next waypoint from your current position and provides a compass bearing.
  - b. Turn your attention from your phone to your compass. Set your compass to the Gaia-provided GPS Bearing. Proceed toward the next waypoint, “boxing the needle” to follow the bearing you have set on your compass. As you progress along the circuit, you will perform this same simple, quick set of actions: find the next waypoint on Gaia, obtain a bearing to the waypoint from Gaia, set your compass to that bearing, and then set off in the direction indicated by your compass. When in doubt, take a moment to get another GPS Bearing from your Gaia app and repeat the process, confirming you are headed in the correct direction to your next waypoint.

- c. Often an obstacle will block a direct path to your next objective. Practice navigating around obstacles (the Mountaineers building, the steep rocky wall) that prevent a straight-line path to your next waypoint. For example, walk past the edge of the building to get a clearer visual line on your next intended destination/waypoint. Once a clearer visual line is possible, obtain a new bearing to your next waypoint and use the technique detailed above in “**2.a**” and “**2.b**” to proceed. Look for environmental features that are in line with your next destination (in this workshop exercise, use stairs/streetlights/other buildings as environmental features). **Continually maintain awareness of your current location in relation to your intended waypoint or environmental feature.**
  
- d. Use **Locate Icon** to confirm you are standing at your intended waypoint.  
e. Continue around your circuit using the above technique.
  
- 3. Use Guide Me feature to demonstrate its utility in providing a visual cue to correct direction of travel.**
  - a. As you are proceeding between waypoints, your instructor will demonstrate the **Guide Me** feature on Gaia. From your current location, tap the next waypoint icon once. The waypoint name pops up. Tap this name once. From the menu, tap **Guide Me** (you may have to scroll down). A solid red path will appear on your map between your current location and your intended waypoint.
  - b. Orient your **Locate Icon** so that the tip of the arrow points toward your intended waypoint.
  - c. Start walking towards the intended waypoint, confirming that you are proceeding along the solid red path that appears on your map. Note that **Guide Me** provides a bearing and estimated arrival (using distance) to your intended waypoint.
  - d. Close **Guide Me** by tapping “X”.
  
- 4. Practice taking bearings during your circuit.**
  - a. Your instructor will pause the group during the circuit and choose 1-3 fixed objects on which to take bearings. The goal is consistency in holding your compass and obtaining accurate bearings to within  $+/- 4^\circ$ . Compare your bearing with your instructors and repeat if you are more than  $4^\circ$  off. Maintaining consistent hand and body position is important to obtain accurate bearings.
  
- 5. Continue your circuit until you have returned to the *Mount Massif* waypoint at the Program Center entrance.**

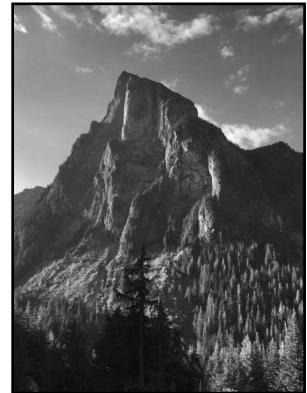
## Module B: MAPS vs ACTUAL (0:50)

MAPS NEEDED: USGS Baring (brought by student), and USGS Index (provided by Mountaineers) 7.5' series  
Answer as many questions as you can in the 45 minutes allowed.

### PHOTO 1 (BARING MAP)

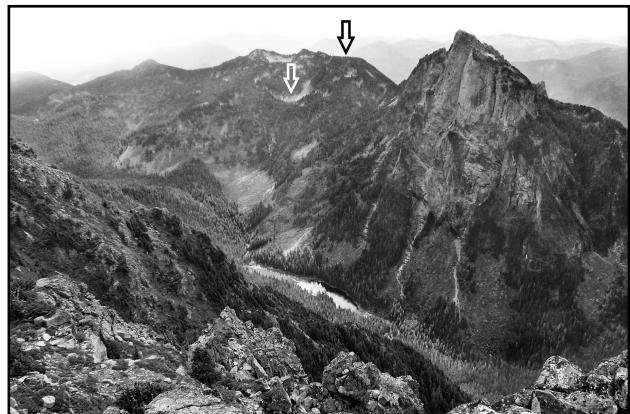
You've left the Barclay Lake trail, ascending a stream bed to climb Merchant Peak. You want to confirm you are in the correct drainage. You check your altimeter and it reads 3200 feet. The summit of a prominent peak is within a few degrees of due south of your position.

- What is the name of the peak? \_\_\_\_\_
- What aspect of the peak (direction of face) are you looking at? \_\_\_\_\_
- Pinpoint your location on the map.
- \_\_\_\_\_



### PHOTO 2 (BARING MAP)

Your altimeter reading tells you that you are above 6000 feet, on your way to the "true summit" of Merchant Peak (i.e., the summit labeled "6113" approx. 0.5 miles NW of the summit labeled "Merchant Peak"). You spy a lake and take a bearing on it: the bearing is 172°.



- What lake are you looking at? \_\_\_\_\_
- What is the prominent summit rising above the lake? \_\_\_\_\_
- What feature does the red (black as seen here) arrow point at? \_\_\_\_\_
- What feature does the green (white as seen here) arrow point at? \_\_\_\_\_

### PHOTO 3 (BARING MAP)

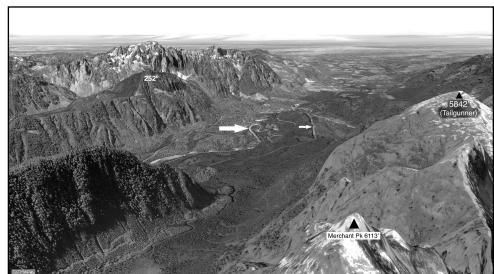
WHILE STILL ON THE “TRUE SUMMIT” (I.E., THE SUMMIT LABELED “6113”) OF MERCHANT PEAK, YOU SPY A PROMINENT PEAK TO THE NW AT ABOUT 320°, (“PEAK A”)

- What is the name of “Peak A,” the peak are you looking at? What is the summit elevation? \_\_\_\_\_
- You take another bearing from the true summit of Merchant on a prominence at 296° (“Peak B”). How would you identify **Peak B** to someone else?  
\_\_\_\_\_
- What’s the distance and general direction from **Peak B** to the summit of Peak **A** at 320°?  
\_\_\_\_\_
- You have previously named **Peak A**. The photo marks the prominence of **Peak B**. Knowing this, point to the location of **Peak A** on the photo.  
\_\_\_\_\_
- What feature does the blue (black as seen here) “V” point to?  
\_\_\_\_\_
- Based on its position relative to **Peak B**, and to **Merchant 6113'**, can you identify the feature to which the black arrow points?  
\_\_\_\_\_



### PHOTO 4 (INDEX AND BARING MAPS PAIRED TOGETHER)

You are on the true summit of Merchant peak. Looking to the W/SW, you see a line of peaks on the other side of a river.



- What is the name of the rounded peak at approximately 252°?  
\_\_\_\_\_
- Can you name the peaks behind and to the right of the rounded peak at 252°?  
\_\_\_\_\_
- Does the green (large white as seen here) arrow point to a natural or human-made feature? Can you identify it on the map?  
\_\_\_\_\_
- Does the blue (small white as seen here) arrow point to a natural or human-made feature? Can you identify it on map?  
\_\_\_\_\_

#### **PHOTO 5—REFER TO PHOTOS 3, 5, AND 6 (BARING MAP)**

**Based on your exciting scramble of Merchant Peak the week before, with its tempting views of Gunn Peak, you have decided to see if the same canyon / drainage from which you accessed Merchant will lead to a possible route to Gunn. You continue steeply all the way up that canyon to a narrow saddle or col near the 5000' contour lines, NW of the true summit of Merchant.**

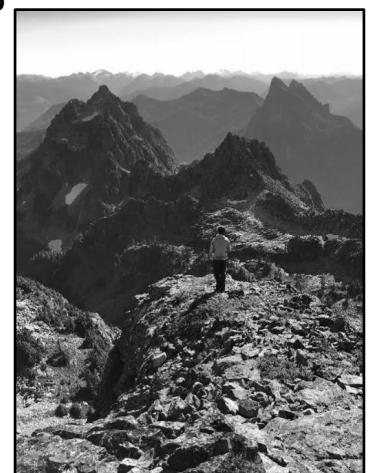


- Locate the saddle on the map. Note that on the color photo, the saddle is listed at 5200', not 5000'.
- What route would you take from the saddle to the base of Gunn Peak?

#### **PHOTO 6—ALSO REFER TO PHOTOS 3, 5, AND 6 (BARING MAPS)**

**Your party begins its approach to Gunn from the saddle and finds itself on top of a nearby summit as clouds roll in, obscuring all but the tops of a few other nearby peaks:**

- You get a bearing of 340° to Gunn Peak and 104° to the high point on the long ridge of Townsend to your east. Further to your NW, you get a bearing of 292° to a third nearby peak. What is that third peak? \_\_\_\_\_
- Where are you? \_\_\_\_\_  
\_\_\_\_\_





## **Module C: NAVIGATION WORKFLOW USING FIVE NAV TOOLS: (0:50)**

**Map, altimeter, compass, Gaia/GPS, Personal Communicator with Navigation (e.g., Garmin InReach)**

**[Instructor reads this paragraph]**

Modern navigation tools offer wilderness travelers more certainty, but coordinating physical and digital maps, altimeter, compass, GPS, and navigation-ready Personal Communicators requires careful work. It is helpful to think of this effort as a workflow that begins at home, continues at the trailhead and en route, and then wraps up after the trip.

**GOALS:** Navigation workflow, build confidence using the five tools of navigation, “Situational Awareness,” understanding how various tools contribute to staying found, reassessing your route throughout your day of travel to confirm location/best route.

**Situation:** You and a group of friends are planning a late October overnight trip to Paradise Meadow and Eagle Lake via the Barclay Lake Trailhead.

**There are four exercises below (C1, C2, C3, C4) plus an extra exercise, time permitting. We will work through the first three together and then you will work on C4 individually, with any instructor assistance as needed.**

### **EXERCISE C1: WORKFLOW—AT HOME AND/OR WHILE STILL CONNECTED TO THE INTERNET**

**[WORK AS A GROUP, FACILITATED BY AN INSTRUCTOR, 10 minutes]**

**[Instructor reads this paragraph]**

In addition to preparing the five tools of Navigation discussed in Module A, Exercises A1 and A2 above, for your an overnight trip to the wilderness of the Cascades, what additional research would you do as part of “workflow” planning at home and/or while still connected to the internet.

**[Possible Answers]**

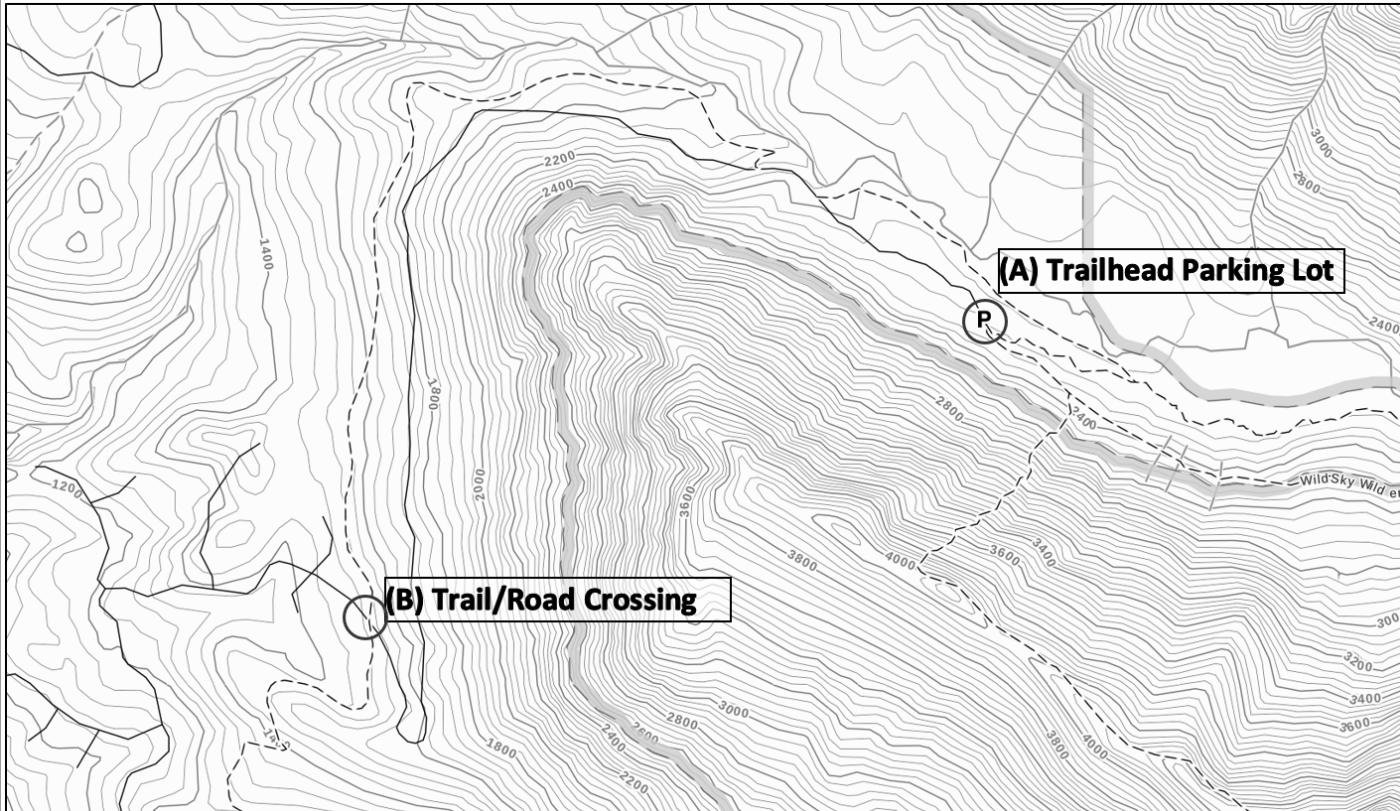
## EXERCISE C2: WORKFLOW—At the Trailhead?

[WORK AS A GROUP, FACILITATED BY AN INSTRUCTOR, 10 minutes]

**[Instructor reads this paragraph]**

You and your friends drove east on US-2, turned left off the highway at the little town of Baring, and began driving up the paved Forest Service road. (You want to be on Road NF 6024: does the USGS map give you the road number?)

As you drive on up the curving road towards the trailhead shown below, the road crosses a trail. Figuring that this could be the trailhead, you stop, but your nervous buddy is convinced that you're not at the actual trailhead.



**Q1:** Finding your trailhead during planning and at the start of your hike is critical and sometimes tricky. Find and mark with a pen or pencil points (A) and (B) from above on your USGS map. Note obvious differences below:

**Q2:** Find the waypoint labeled “Barclay Creek Trailhead” in your Gaia GPS folder titled “Workshop Waypoints.” Click “Show on Main Map.” Is it identical with the map above?

**Q3:** How can you use your navigation tools to determine if you are at A) Trailhead Parking Lot or B) Trail-Road crossing? Make some notes in the grid below and discuss with a partner:

Tool	<b>Helpful (yes/no)?</b> <b>How would you use the tool?</b>
<b>Physical map</b>	
<b>Altimeter or app</b>	
<b>Compass</b>	
<b>Digital map/GPS</b>	
<b>PLB or Personal Communicator</b>	

### Exercise C3: En Route?

[WORK AS A GROUP, FACILITATED BY AN INSTRUCTOR, 15 minutes]

**[Instructor reads this paragraph]**

You and your friends are now underway from the Barclay Lake Trailhead. The day is extremely foggy, and the trail soon turns steep. You figure it's just a small hill, but your nervous buddy thinks you're going the wrong way. You again pull out your navigation toolset:

Tool	Tool Reads	Generally, how could you use each tool to see if you are going the right way?
Physical map	USGS Baring, Wash (1965) paper map shows no trail leading up Mt. Baring.	
Digital map on Gaia GPS or Personal Communicator*	<b>DIGITAL MAP:</b> Gaia GPS, the “Gaia Topo (feet)” layer shows a trail ascending the NW ridge of Mt. Baring.  <b>GPS LOCATION:</b> WGS84, 10T E615489 N5293948; 3000 feet, or NAD27, 10T E615584 N5293750*; 3000 feet	
Altimeter	3000 feet	
Compass	Trail heads uphill generally SW; hillside generally slopes to the NE.	

\*Assumes you have a navigation-ready Personal Communicator, such as the Garmin InReach.

Where are you on the map? \_\_\_\_\_

What went wrong? \_\_\_\_\_

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## **Exercise C4: En Route!**

**[WORKING INDIVIDUALLY, FACILITATED BY AN INSTRUCTOR, 15 minutes]**

- 1) a. After spending the night at Barclay Lake, you find your way up to what you think is Eagle Lake. Can you use your altimeter (barometric or GPS-based) to confirm you are at Eagle Lake?
  - b. How can you confirm that you're at Eagle Lake rather than at Stone Lake?
- 2) a. Your goal is to climb high on the ridge that runs west from the summit of Townsend Mountain. You first want to ascend the saddle NW of Eagle Lake. How would you set a bearing in Gaia GPS using the "Follow a GPS Bearing" method?
  - b. Set a waypoint now and call it "Saddle1." What is the bearing to this saddle from your current real-world physical location (IN THIS CLASSROOM)? Set your compass to this bearing. With your arm, point the direction to the waypoint Saddle1. You are inside and so don't worry that your compass may give a different reading than others.
- 3) It's foggy again. You are part way up the hill toward Saddle1. When your altimeter reads 4300' you wonder where you are and whether you are on the direct path from Eagle Lake to the saddle. You get out your compass and take a bearing on the "fall-line" (the direction a bowling ball would roll which would be perpendicular to the topo lines). The compass reads 200°. Are you on the direct path?
- 4) Assuming you are off course and not on the direct route to the saddle, using the "Follow a GPS Bearing" technique, how would you determine the correct bearing toward the saddle?
- 5) After you arrive at the saddle, you head on up Townsend Mtn's west ridge. You stay on the ridge and through the fog, you can see a peak, the first on your route up the ridge. You check your altimeter and it reads 5200'. Can it be Townsend Mtn. ahead? \_\_\_\_\_ Where are you on the map?

How much elevation is there left to climb Townsend Mtn?

## **EXERCISE Xtra Credit: The importance of datums (See appendix 2)**

1. In Gaia GPS, set the datum to WGS84 (Settings: Units: Coordinate Datum). Where you are now (or outside if you can't get a GPS reading) set a waypoint using the "Add Waypoint (My Location)" command and enter the title TEST1. Go to the map, tap on this waypoint and then tap on the name. How far does Gaia say you are from TEST1? (It should be only a few feet) \_\_\_\_\_ . Write down the full UTM for the waypoint "TEST1" \_\_\_\_\_.

2. Now, in the Gaia settings, set the datum to NAD27. How far are you now? \_\_\_\_\_ It should not change significantly. Does that mean that the choice of datum doesn't matter?

3. Now take a look at the full UTM for the waypoint "TEST1" with Gaia set to NAD27. Write it here: \_\_\_\_\_.

Why did it change? [All waypoints and routes are always stored internally inside of GPS devices under WGS84. The GPS unit will transcribe the coordinates to other datums and display a different coordinate.]

4. Without changing your datum, manually input a waypoint for HERE1 from 1 above. How far are you from this waypoint now? [About 220 meters in Seattle.]
5. What is going on?: [This represents the shift in the global framework at this location between the earth models called NAD27 and WGS84]

## Appendix 1: New Navigation Terms

**“GPS Bearing”** A GPS Bearing is one that is derived using a GPS device. This term differentiates it from “taking a compass bearing” which is done in the field with a compass or “plotting a map bearing” which is a physical map exercise. This is a key new term needed to describe determining the bearing (and distance) to a point on the digital map. This can be done by placing a waypoint on the point or simply long-touching any Gaia GPS map to create a temporary waypoint. This term is needed to differentiate from a “map bearing” which is measured between two points on a physical map.

**“Follow a GPS Bearing” technique:** This important navigation technique uses the compass to follow a “GPS Bearing” in the field. The technique of following a GPS Bearing using a compass allows you to navigate fast in the wilderness.

**“The Mountaineers Five Tools of Navigation”** Today’s mountaineer carries five essential tools while navigating the backcountry:

1. **Map:** a physical map is unequaled for synthesizing vast amounts of data on one page, for route finding, and for being impervious to battery failure; digital maps are unequaled for ease of use (containing a “you are here” arrow), zoom, multiple map types and satellite imagery, routes from others, tracks for where you’ve been.
2. **Altimeter:** a simple-to-use instrument that works with a topographic map to help determine location. Digital wrist altimeters are of high reliability and work under any conditions.
3. **Compass:** in skilled hands, the compass is a reliable instrument to help determine your location and direction of travel.
4. **Global Positioning System (GPS) device:** this simple-to-use instrument makes navigation simple but is prone to battery failure, temperature, and breakage.
5. **Personal locator beacon (“PLB”) or satellite communicator to contact emergency first responders.**

Wilderness navigators need to carry these relatively new tools and know-how to use them. If life is threatened, they need to be able to communicate with emergency responders. ***THIS IS NOW THE LEGAL “STANDARD OF CARE.”***

**“Navigation Workflow”** Modern navigation tools offer wilderness travelers more certainty, but coordinating map, altimeter, compass, and GPS requires careful work. It is helpful to think of this effort as a workflow that begins at home, continues at the trailhead and en route, and then wraps up after the trip. See appendix 4.

**“Situational awareness”** See appendix 6.

**“Ethic of Self-reliance”** See appendix 6.

## Appendix 2: Coordinate Systems and Datums

Maps use three principal coordinate systems to describe a location on the earth:

1. Latitude and longitude (traditional),
2. UTM (used by most backcountry travelers), and
3. MGRS (used by the military).

The coordinate systems described above must be anchored to actual points on the earth, similar to surveyors' benchmarks. These anchoring points are referred to as a datum, and maps are made using many datums. Datums are important because a single set of coordinates (for instance, a latitude and longitude or UTM coordinates) will yield different points on the earth depending on the datum used. The two datums currently used on USGS topos are North American Datum 1927 (**NAD27**) and World Geodetic System 1984 (**WGS84**). The difference in position between these two datums can be as much as about 500 feet (160 meters), which is important to know when using topographical maps in conjunction with GPS devices (see "GPS" later in this chapter). NAD27 is used on "Historical" USGS topos, whereas WGS84 is used on the new "US Topo" series, and is the default system for GPS devices.

\*Excerpt from Mountaineering: The Freedom of the Hills, 9th ed., 2017, Chapter 5 (FoTH). Used with permission.

## Appendix 3: Recommended Apps

Windows Applications	Mac OS X Applications
Gaia GPS (Online mapping and data organization)	Gaia GPS (Online mapping and data organization)
CalTopo (Online mapping and data organization)	CalTopo (Online mapping and data organization)

### Navigation apps:

Android Apps	iOS Apps
Gaia GPS (required; also has an altimeter function)	Gaia GPS (required; also has an altimeter function)
CalTopo (free with online subscription)	CalTopo (free with online subscription)
Accurate Altimeter (free)	
DS Altimeter	

## "Navigation-helper" Apps

Android Apps	iOS Apps
Earthmate (use with Garmin InReach)	Earthmate (use with Garmin InReach)
GPS Essentials (declination, sun/moon, rise/set)	Compass app by Apple
GPS Status	
GPS Test	
Sky Map (planets and constellations)	
Tide Charts by 7th Gear (tides and sun/moonrise/set)	Tide Charts by 7th Gear (tides and sun/moon rise/set)
Tides Near Me - Free	
Clinometer + bubble level (works locally)	Clinometer + bubble level
Geocam Free (clinometer that measures at a distance using the camera)	
PeakFinder (Fabio Soldati)	PeakFinder GmbH

## Gaia GPS Benefit for The Mountaineers:

### Gaia GPS

Gaia GPS is offering one free year of their Gaia Premium Membership to members of The Mountaineers. Gaia can be used as a standalone service on [gaiagps.com](http://gaiagps.com), or as an enhancement to the mobile app (purchased separately for iOS or Android). To redeem this offer, [click here](#), download the app on your mobile device, and log in to your account from the app Settings to start using your Premium Membership. From: <https://www.mountaineers.org/membership/benefits/instructions-for-redeeming-member-benefits>

## Appendix 4—MODERN NAVIGATION WORKFLOW CHECKLIST\*

Modern navigation tools offer wilderness travelers more certainty, but coordinating map, altimeter, compass, and GPS requires careful work. It is helpful to think of this effort as a workflow that begins at home, continues at the trailhead and en route, and then wraps up after the trip.

### AT HOME AND/OR WHILE STILL CONNECTED TO THE INTERNET

- Research routes from guidebooks and other sources.
- Purchase relevant topographical maps, if available and time allows. Otherwise, download topographical maps from the internet from such websites as CalTopo.com or GaiaGPS.com. Customize them with collected routes, tracks, waypoints, and notes, and then print. Be sure the map includes the data, such as the UTM grid, that you will need. Using waterproof printing (laser printer ink is waterproof) and paper (e.g., Rite in the Rain) and or a waterproof map cover is important.
- Download helpful maps and satellite images to your GPS devices (e.g., Gaia GPS and Garmin inReach) at the appropriate level of detail. Include an area that surrounds the intended travel area in case plans change; the larger map can be at a lower level of detail if storage space is an issue.
- Research weather trends, road and trail conditions, and avalanche conditions (see FoTH Chapters 6, Wilderness Travel, and 17, Avalanche Safety).
- Confirm that electronics are ready: data downloaded, batteries charged, PLBs registered and the preset (“canned” or user-definable) messages on satellite communicators updated (see “Communication Devices” in FoTH, Chapter 5).
- Leave the trip itinerary, including trailhead, vehicle description, and license plate, with a responsible person (see “Organizing and Leading a Climb” in FoTH, Chapter 22, Leadership).

### AT THE TRAILHEAD

- Confirm the party is at the right place to begin the trip: Orient the map to the surroundings—do they correlate?
- Confirm location using GPS.
- Set a GPS waypoint at the trailhead.
- Set the GPS device’s datum to match that of the physical map.
- Have the party calibrate all barometric-based altimeters to the trailhead elevation using a map or GPS device.
- Note magnetic declination and adjust compasses as needed. (See FoTH, Chapter 5, “Magnetic Declination.”)
- Turn off electronics or configure them to extend battery life to last the length of the trip.

### EN ROUTE

- Actively engage the entire party in navigation, including assessing whether the current position and planned path through the landscape continue to appear safe and can be correlated to the map using multiple navigation tools. (See “The Importance of Maintaining Situational Awareness” sidebar, below.)
- Familiarize the party with the appearance of the return trip.
- Occasionally recalibrate barometric-based altimeters at known locations shown on map or a GPS device.
- Gather GPS waypoints and tracks en route if they may be helpful later, especially if the party may need to renegotiate complex terrain.

### AFTER THE TRIP

Gather together and organize all the digital and physical navigation information that will help the party—or the next party—safely navigate the same area on another trip.

\*Excerpt from *Mountaineering: The Freedom of the Hills*, 9<sup>th</sup> ed., 2017, Chapter 5 (FoTH). Used with permission.

## Appendix 5 – The Mountaineers’ Ten Essentials:

### ESSENTIAL EQUIPMENT

Certain equipment deserves space in every pack. A wilderness traveler will not need every item on every trip, but essential equipment can be a lifesaver in an emergency. Exactly how much equipment “insurance” should be carried is a matter of healthy debate. Some respected minimalists argue that weighing down a pack causes people to travel slower, making it more likely they will get caught by a storm or nightfall. “Go fast and light. Carry bivy gear, and you will bivy,” they argue. The other side of this debate is that, even without the extra weight of bivy gear, travelers still may be forced to bivouac. Each party must determine what will keep them safe. Most wilderness travelers take along carefully selected items to survive the unexpected. Whatever your approach to equipment, a checklist (below) will help you remember what to bring in the rush to get ready for a trip. Adapt this list to suit your needs, and get in the habit of checking it before each trip. The best-known list, first developed by The Mountaineers in the 1930s, has become known as the “Ten Essentials.”

### THE MOUNTAINEERS’ TEN ESSENTIALS™

The point of the Ten Essentials has always been to help answer two basic questions: First, can you prevent emergencies and respond positively should one occur? Second, can you safely spend a night—or more—outside? The Ten Essentials is a guide that should be tailored to the nature of the trip. Weather, remoteness from help, and complexity should be factored into the selected essentials. The first seven essentials tend to be compact and vary little from trip to trip, and so they can be grouped together to facilitate packing. Add the proper extra food, water, and clothes, and you’re ready to go. This brief list is intended to be easy to remember and serve as a mental pre-trip checklist:

1. **Navigation**—Modern tools have revolutionized backcountry navigation. Today’s mountaineer carries five essential tools while navigating the backcountry: map, altimeter, compass, Global Positioning System (GPS) device, and a personal locator beacon (“PLB”) or other device to contact emergency first responders. Wilderness navigators need to carry these tools and know how to use them. If life is threatened, they need to be able to communicate with emergency responders. Using multiple tools increases confidence in location and route, provides backup when tools fail, and increases situational awareness.
2. **Headlamp**—For wilderness travelers, headlamps are the flashlight of choice, freeing the hands for anything from cooking to climbing.
3. **Sun Protection**—Carry and wear sunglasses, sun-protective clothes, and broad-spectrum sunscreen rated at least SPF 30. Not doing so in the short run can lead to sunburn or snow blindness; long-term unpleasantness includes cataracts and skin cancer.
4. **First aid**—Carry and know how to use a first-aid kit, but do not let the fact that you have one give you a false sense of security. The best course of action is to always take the steps necessary to avoid injury or sickness in the first place.
5. **Knife**—Knives are so useful in first aid, food preparation, repairs, and wilderness travel that every party member needs to carry one, preferably with a leash to prevent loss. In addition, a small repair kit can be indispensable.
6. **Fire**—Carry the means to start and sustain an emergency fire. Alternatively, on a high-altitude snow or glacier climb where firewood is nonexistent, it is advisable to carry a stove as an additional emergency heat and water source.
7. **Shelter**—Carry some sort of emergency shelter (in addition to a rain shell) from rain and wind, such as a plastic tube tent or a jumbo plastic trash bag. Single-use bivy sacks made of heat-reflective polyethylene are an excellent option at less than 4 ounces.
8. **Extra food**—For shorter trips, a one-day supply of extra food is a reasonable emergency stockpile in case foul weather, faulty navigation, injury, or other reasons delay a wilderness party. An expedition or long trek may require more, and on a cold trip remember that food equals warmth.
9. **Extra water**—Carry sufficient water and have the skills and tools required to obtain and purify additional water.
10. **Extra clothes**—What extra clothes are necessary for an emergency beyond the basic garments used during the active portion of a hike or climb?

\*Excerpt from Mountaineering: The Freedom of the Hills, 9th ed., 2017, Chapter 2 (FoTH). Used with permission.

## Appendix 6 – The Ethic of Self Reliance\*; Situational Awareness\*

### ETHIC OF SELF-RELIANCE

Understanding the limits of PLBs and other communication tools is as important as understanding their usefulness: Batteries deplete; electronics fail; cell phone service is limited in most mountain locations; a rescue may not be possible due to weather conditions or availability of rescuers. A PLB or satellite communicator is not a substitute for self-reliance. No party should set out ill-prepared or inadequately equipped, nor should they attempt a route beyond their ability and assume that emergency help can be summoned. The climbers who wrote the early editions of Mountaineering: The Freedom of the Hills had no easy options for rescue in the mountains. They knew that this freedom could come at great cost and that a safe return would depend on the party's experience, preparation, skill, and judgment.

### THE IMPORTANCE OF MAINTAINING SITUATIONAL AWARENESS

Experienced navigators both respect and are wary of using a GPS device or app to navigate. Too often they see wilderness travelers “heads down” following their tiny screen unaware of their surroundings. When the navigator simply follows the GPS device and ignores cues from the passing terrain, “situational awareness”—and, therefore, safety—is diminished. The wilderness traveler using GPS must fight this tendency by using the following techniques.

**Observe.** Start by observing the surroundings and updating your mental map of the landscape. Where have you come from? Where are you now? Where are you going? What are the dangers?

**Orient.** Correlate the surroundings with the physical map to see if they are in agreement. Study myriad details, including slope, sun position, ridges, and terrain features. Then confirm your understanding using multiple tools from the navigation toolset. Confirm the elevation with an altimeter, the cardinal directions with the compass, and your position with GPS.

**Decide.** Where do you go from here? Decide on your next steps.

**Act.** Hike or Climb on! And maintain your heightened sense of situational awareness by repeating the observe-orient-decide-act cycle with close observation and by continually updating your mental map while moving through the landscape.

Maintaining situational awareness is not just a topic of navigation but of safety in general: What is happening with the weather? What is the condition of the party? How many hours of daylight remain? Maintaining a high level of situational awareness can help keep wilderness travelers on course and safe, thus enabling everyone to fully enjoy the experience.

\*Adapted excerpt from *Mountaineering: The Freedom of the Hills*, 9th ed., 2017, Chapter 5 (FoTH). Used with permission.

## Appendix 7 – Warm-up exercise; with Possible Answers

Please head to the nearest discussion areas and fill it up. We strongly recommend that couples and parent/child groupings split up and go to separate discussion areas. Please discuss the pre-reading: (Outside article *Disaster in the Alps* at <https://bit.ly/2xq4arO>). **Small group table discussion questions:**

1. What are three **root causes** of this disaster?
  - a. Under-appreciated **objective risks**: tricky route finding, cliffs, deteriorating weather
  - b. **"Expert Halo"** On their own, the skiers were all experienced enough to check the weather, research the route and question the decision to set out in the first place. But because they'd hired an expert guide, they surrendered their decision-making to his. They just did the trip, not the planning. Self-organized trips are forced to focus on planning and preparation.
  - c. Poor "**Navigation Workflow**": The group lacked four of the five tools of navigation. The one tool they had--GPS--did not have adequate backup power or the correct routes, waypoints, or maps. A dead satellite phone does not count as a tool. Following adequate Navigation workflow would likely have mitigated the navigation errors in this situation.
2. Using the workflow checklist (Appendix 4), what navigation tools did they have, what was missing, and what navigation workflow preparation could have helped to prevent or mitigate this disaster?

The 5 Tools	Was the tool present? Was the tool prepared properly?
1a) Physical map	No. Even without the correct maps on the two GPS's, the GPS location could have been used with a physical map.
1b) Digital map	No. The party did not have the proper map(s), waypoints or tracks.
2) Altimeter	No. While no wrist altimeters were mentioned, they had "GPS Altimeters" with Gaia and the Garmin, but this was not very helpful without a map.
3) Compass	No. They had no compass but it is not clear how a compass would have helped in this circumstance without a map.
4) Gaia GPS; Backup GPS for cold weather	Yes, but inadequately prepared. They seemed to have Gaia GPS only on the guide's phone but the app was not properly prepared with the correct map(s), waypoints or routes. While each party member likely had a phone, they seemed to not have apps or maps. They lacked backup power or backup GPS for cold weather.
5) PLB or Personal Communicator	No. The party had no way to contact first responders, only a dead satellite phone. A properly-prepared Personal Communicator with navigation (e.g., Garmin InReach) might have been a lifesaver.

3. Using the Mountaineers Ten Essentials (Appendix 5) as a guide, what other preparation could have helped prevent or mitigate this disaster?

**Missing Essentials:** 1) The FIVE Tools of Navigation, properly prepared using Navigation Workflow, 2) "Fire" or the ability to heat snow, 3) shelter to get out of the storm, 4) adequate food, water, and clothing.

**Planning, Communication, and Situational Awareness:** If the group had all discussed the plan (e.g., weather, risks, route, preparation, contingencies, 3rd party notifications), this group of experienced skiers might have questioned some of the decisions of the day and not lost **Situational Awareness**, following their guide blindly into the storm.