WILDERNESS TREKKING SCHOOL MANUAL

COLORADO MOUNTAIN CLUB SINCE 1912

Denver Group

SCFD
Scientific & Cultural Facilities District

Cover photo: *Teakettle* by John Streeter
Teakettle Mountain, Mount Sneffels quadrangle, Ouray County, CO

We thank National Geographic Maps for permission to use TOPO!® maps, and we thank The Mountaineers for permission to use the Ten Essential Systems.

TABLE OF CONTENTS WTS MANUAL

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Current Session Information

Dear Student,

Welcome to Wilderness Trekking School! Whether you are new to the wilderness or an experienced backcountry traveler, this school has much to offer.

Our goal is to empower you with the knowledge, skills, and confidence to travel safely in the backcountry. We will give you the opportunity to learn what kind of gear to carry, how to travel on different types of terrain, how to navigate with a map and compass, and how to balance group dynamics. At the end of the course, you will apply what you have learned to plan a graduation hike with your group. You will apply all skills using safe practices and in an open group environment.

We have an outstanding group of volunteer instructors who have stepped up to help you with these topics and challenges. They have a wealth of knowledge, and they look forward to sharing that with you. Please ask questions. Please share your experiences with us, too, as we are excited to learn from you as well.

I wish you good luck and a wonderful experience with Wilderness Trekking School.

Sincerely,
Joe Griffith
Director, Wilderness Trekking School

WTS Committee – Special thanks to the following individuals (and to past members of the committee) for their time and effort in making this training possible:

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The Electronic Version of the Manual and Supplemental Materials

The **Course Materials** (wts materials) page is the online home of links to the WTS Manual and videos. In addition, it lists Learn More pages that list supplements to many of the chapters in this manual. Consider bookmarking this page.

The manual uses the following conventions for pages on CMC.org:

- For digital users, web sites have embedded links.
- For hardcopy users, a short search phrase to enter on CMC.org follows in parentheses, plus Login if required (to avoid CMC.org's very long addresses).

Use Adobe Reader to view pdf files, downloadable free of charge at www.adobe.com.

Enhancing Your Learning with Digital Text

Many studies have shown that students have better comprehension and recall with print compared to electronic texts. A helpful strategy to overcome this is to make a point of engaging with the E-text. A few Adobe Reader features that help are:


- Comment tool in the left menu bar lets you add a note, visible when selected.


- Highlight tool enables lasting highlight, underlining, and striking-through text.


- Text tool lets you add visible text.
- Highlighting text and right clicking displays similar options plus copying (say, to a note-taking document).

Many other tools are available. Spend a little time playing with Reader to enhance your learning.

Homework

WTS encourages students to read the entire manual **now**, especially the Navigation Chapter. Review each chapter per the course schedule and homework assignments (see Homework Overview in this section). Your instructors will let you know whether to use Coassemble, the online quiz program, or the identical hardcopy quizzes distributed (and in this manual), and how to submit your work.

Wilderness Trekking School Surveys

The WTS Committee asks both students and instructors to provide their comments and ratings of the WTS course and evaluation of instructors through online surveys. WTSC values your feedback for continuing improvement of the course.

Your feedback also decides the Happiest Group each session and when WTS promotes instructors.

WTS will email links to the surveys just before the last meeting night to verify email addresses. We ask you not to complete the survey until AFTER your Graduation Hike and will send you several reminders. In fall sessions, the surveys close BEFORE Snow Travel Day so that we can report aggregate feedback to your instructors promptly. Your individual responses are anonymous.

WTS SCHEDULE – FALL 2024

Date	Time	Subject	Presenter
Before meeting 1: View video – **Gear and Hygiene**, link on Course Materials page.			
Tue, Sep 3	6:30 – 7:00	Check-in to group meeting room	
	7:00 – 9:30	Group Meeting – discussion of Basic Equipment for Hiking and Personal Hygiene, LNT, etc.	
No Field Day this week			
Before meeting 2: View video – **Map and Compass**, link on Course Materials page.			
Tue, Sep 10	6:45 – 7:00	Check-in to	**Section I homework due**
	7:00 – 9:30	Group Meeting – discuss Map & Compass,	
Field Day 1: Dry Land Travel Thu, Sep 12, Sat, Sep 14 or Sun, Sep 15		Time and Location TBD by instructors	
Tue, Sep 17 (optional tutoring) 6:30 – 9:30 – **Map & Compass Study Hall**			Joe Griffith
Field Day 2: Map & Compass Day Thu, Sep 19, Sat, Sep 21 or Sun, Sep 22		Time and Location TBD by instructors	
Before meeting 3: View video – **Emergency Situations**, link on Course Materials page.			
Tue, Sep 24	6:45 – 7:00	Check-in to group meeting	**Section II homework due**
	7:00 – 9:30	Group Meeting – discussion of Emergency Situations, Incident Management, start Grad Hike planning, etc.	
Before Field Day 3: View video **Survival Field Day**, linked from Course Materials page.			
Field Day 3: Survival Day Thu, Sep 26, Sat, Sep 28 or Sun, Sep 29		Time and Location TBD by instructors	
Before meeting 4: View video – **Weather**, link on Course Materials page.			
Tue, Oct 1	6:45 – 7:00	Check-in to group meeting	**Section III homework due**
	7:00 – 9:30	Group Meeting – discussion of Weather, continue Grad Hike planning, etc.	
No Field Day this week			
No Meeting on Tue, Oct 8			
Before meeting 5: View video – **Avalanche**, link on Course Materials page.			
Tue, Oct 15	6:45 – 7:00	Check-in to group meeting	**Section IV homework due**
	7:00 – 9:30	Group Meeting – discussion of Snow Travel, complete Grad Hike planning, WTS Wrap-up, etc.	
Field Day 4: Grad Hike Thu, Oct 17, Sat, Oct 19 or Sun, Oct 20		Time and Location TBD by students	
Field Day 5: Snow Travel Day Thu, Nov 14, Sat, Nov 16 or Sun, Nov 17		Time and Location TBD by instructors	

V3 Rev 6-7-24

EMERGENCY INFORMATION

Call 911 in case of emergency.
If cell coverage is not available, Text-to-911 may work.
(See Emergency Communications at end of Ch. 13 Survival.)

After the immediate situation is under control, notify:

CMC Emergency Call Center at 269-384-1056
Staff answers this number 24/7 and accepts collect calls.

Leave with your contacts and/or for follow up information:

Ahead of time

- Your car color, make, model, and license number
- Your medical condition(s), medications, drug allergies

For the trip

- Type of trip – day hike, backpack, climb, skiing, etc.
- Companions' names and phone numbers
- Driver's car color, make, model, and license number
- Departure date and time
- Trailhead – name and location
- Parking place (if different from trailhead)
- Route
- Destination
- Time and date to alert authorities (allow for post-trip celebration, traffic, etc.)

County Sheriff's Department Non-Emergency Phone Numbers

County	Phone	County	Phone
Boulder	303-441-4444	Jefferson	303-277-0211
Clear Creek	303-679-2376	Larimer	970-416-1985
Delta	970-874-2000	Park (Bailey)	303-838-4441
Douglas	303-660-7505	Park (Fairplay)	719-836-2494
Eagle	970-328-8500	Pitkin	970-920-5300
Garfield	970-945-0453	Routt	970-879-1090
Gilpin	303-582-5500	San Juan	970-387-5531
Grand	970-725-3343	Summit	970-453-2232
Gunnison	970-641-8000	Teller	719-687-9652

St. Mary's Parking Lot

CMC students park one behind another to save space and possibly to earn a discount.

HOMEWORK OVERVIEW AND QUIZZES

Your group meeting and field day build on the assigned **Lecture Videos** (wts videos) and section in the **WTS Student Manual** (wts manual). **Course Materials** (wts materials) has links to supplemental material for each section. **Note:** Emergencies and Snow Travel sections change order between spring and fall sessions to align with snow availability. See the **WTS Schedule** (pg. vii) for due dates.

WTS quizzes are open book and ungraded. They are designed to be a learning tool, emphasizing important topics, asking about application in the field, and stimulating analysis and interpretation of topics. They also encourage students to read and view WTS materials in time for the relevant group meeting and help the instructor know which topics need more attention. Please consider a missed question as an opportunity for a discussion with your instructors – or for asking the authors to clarify the question.

Homework for Section I – Fundamentals

- View Gear and Hygiene lecture video. See Lecture Videos (wts videos)
- Read ***CSI*** (this chapter), ***Course Overview***, and ***Section I – Fundamentals***.
- Prepare for Dry Land Travel Day (Field Day 1).
- Assess your equipment needs; start assembling the Ten Essential Systems.
- Practice knots.
- Complete Fundamentals quiz in manual or online and submit.
- If Map and Compass are new to you, start ***Section II – Navigation***.

Homework for Section II – Navigation

- View Map and Compass lecture video. See Lecture Videos (wts videos)
- Read ***Section II – Navigation***
- Continue preparations for Dry Land Travel Day (Field Day 1).
- Begin preparations for Map and Compass Day (Field Day 2).
- Plot and check all assigned points on Mount Vernon and/or any additional designated map.
- Practice knots.
- Complete Navigation quiz in manual or online and submit.

Homework for Section III – Emergencies

(Third in Fall session, last in Spring session)

- View Emergency Situations lecture video. See Lecture Videos (wts videos)
- View Survival Field Day Lecture video before your field day.
- Read ***Section III – Emergencies***.
- Prepare for Survival Day: assemble survival gear, clothing, and fire starters for testing.
- Practice knots.
- Begin preparations for Grad Hike: obtain topographic map and review WTS Grad Hike or other designated form.
- Complete Emergencies quiz in manual or online and submit.

Homework for Section IV – Snow Travel

(Last in Fall session, third in Spring session)

- View Avalanche Safety lecture video. See Lecture Videos (wts videos)
- Read ***Section IV – Emergencies***.
- Prepare for Snow Travel Day (3rd field day in spring, 5th field day in fall).
- Assemble appropriate cold weather gear. (WTS provides ice axes and helmets.)
- Practice knots.
- Continue preparations for Grad Hike.
- Complete Snow Travel quiz in manual or online and submit.

Lecture Video – Weather

(Fourth in Fall session, last in Spring session)

View before the related group meeting. See Lecture Videos (wts videos)

WTS Course Evaluation

Please help WTS continually improve by completing online Survey Monkey surveys of the WTS course and of your instructors. These are due **after** your graduation hike, but **before** Snow Travel Day in fall.

Quiz for Section I – Fundamentals

Senior Instructor: _____ Student: _____

1. How should the Ten Essentials be distributed among the group?
   A. By role – the navigator should have the map, the most trained first aider should have the first aid kit, etc.
   B. By couple – divvy up things so the stronger one carries most of the gear
   C. By group – split things up if we need only 1 copy per trip to keep weight down, like a full size first aid kit
   D. By individual – everyone should always carry all ten essentials

2. Why do we carry the Ten Essential Systems?
   A. To get a better workout from carrying a heavier pack
   B. To be prepared for an accident, emergency, or unexpected overnight stay
   C. To make the senior instructor or trip leader happy
   D. To have items that make the hike and lunch break more comfortable

3. What is the most important factor when selecting a fire starter?
   A. Needs to emit smoke for emergency signaling
   B. Needs to work the first time every time
   C. Needs to build a large bonfire for drying clothes

4. When should you eat and drink?
   A. When your hike is done, to have a better meal
   B. Only when the trip leader calls a break, to save time
   C. When you are thirsty or hungry for a while, to maximize weight loss
   D. Eat and drink small amounts frequently, to avoid dehydration and bonking

5. **True** **False** At altitude, food intake can be more difficult due to poor appetite and impaired food absorption.

6. **True** **False** Fluid losses increase at altitude due to faster breathing and drier air.

7. Summertime temperatures typically decrease _____ for every 1000 feet of elevation gain.
   A. 1-2 °F B. 3-5 °F C. 7-10 °F D. 10-15 °F

8. **True** **False** A thunderstorm develops with rapidly rising, billowing white clouds that grow into a towering thunderhead.

9. **True** **False** An approaching thunderstorm brings dark churning clouds, gusty winds from changing directions, thunder, and lightning.

10. What's a good approach to decrease lightning risk above timberline?
    A. Start early so you have already descended by the time a storm develops
    B. Assume the lightning position when you hear a thunderclap
    C. Wait to descend until a storm alert on your phone or detector device warns you
    D. Watch the other hikers and trust that it's safe if they are still heading to the peak

11. Seek shelter for 30 _____ if thunder is less than 30 seconds after lightning.
    A. Miles B. Minutes C. Seconds

12. **True** **False** Have group members spread out 50 feet apart when lightening is possible to avoid multiple casualties.

13. You are caught in a thunderstorm. Where is the safest place to be?
    A. On a ridge B. In a small cave or alcove C. Under a solitary tree
    D. In a stand of uniform height trees

14. **True** **False** Walk alongside rather than in the middle of muddy trails so you don't get your boots dirty.

15. Select a bathroom location that is at least _____ from water sources.
    A. 100 feet B. 200 feet C. 300 feet D. 500 feet

16. How deep should catholes be dug?
    A. However deep I can dig in 2 minutes B. 3-4 inches C. 6-8 inches
    D. Digging disturbs the earth, so place a large rock over top instead

17. What should you generally do if you come across a wild animal in the backcountry?
    A. Get close for a selfie
    B. Back away quietly, facing the animal
    C. Outrun your friends
    D. Pull your knife out

18. What should you do if a moose raises its hackles, licks its snout, pins back its ears, or starts charging?
    A. Move so a boulder or large tree is always between you and the animal or run away if there is nothing to shelter behind
    B. Be big by opening your jacket and raising your arms to scare the moose away
    C. Play dead and it will go away eventually
    D. Yell and throw rocks to scare the moose away

19. What should you do if you encounter a mountain lion?
    A. Be big by opening your jacket and raising your arms; fight back if attacked
    B. Run away quickly to trigger its prey drive and climb a tall sturdy tree
    C. Play dead and it will go away eventually
    D. Jump in a stream or lake because cats hate water

20. What should you do if you hear or see a rattlesnake?
    A. Use your hiking poles to move it out of your way
    B. Yell and throw rocks to scare it away
    C. Take off your backpack and use it as a shield
    D. Freeze, find any snakes nearby, then keep more than 5 ft away until the snake has moved or you have circled around it

Quiz for Section II – Navigation

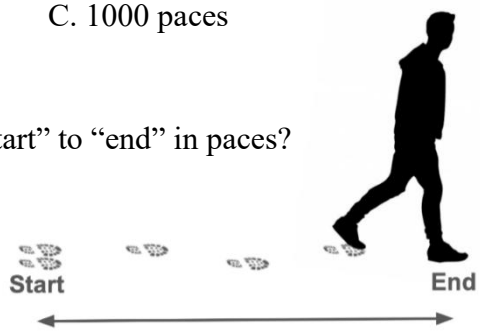
Senior Instructor: _____ **Student:** _____

1. You think you are hiking east on Wrangler's Run Trail in White Ranch Park, CO. What is a good sanity check?
   A. There should be a stream acting as a handrail just south of the trail
   B. The dashed road to the west should act as a fail safe for you
   C. Wait for a trail sign, this is a well-marked park

2. Since it's difficult to determine the date that a map was last revised, which info from the map is likely still accurate?
   A. A large cliff on the west side of the mountain
   B. A trail junction next to a man-made structure
   C. The magnetic declination symbol
   D. The vegetation locations
   E. Power line location

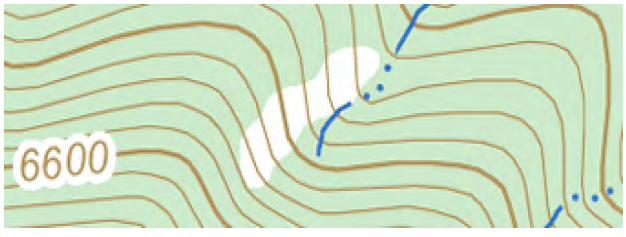
3. Your next bearing has you going 0.1 miles. Approximately how many paces is that?
   A. 10 paces B. 100 paces C. 1000 paces

4. What is the distance from "start" to "end" in paces?
   A. 1 pace
   B. 2 paces
   C. 3 paces
   D. 4 paces



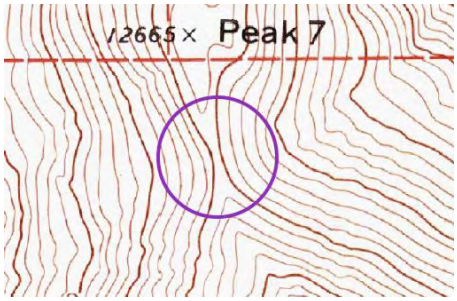
5. CalTopo, USGS, and most topographic map makers print maps in which orientation?
   A. True north is at the top on the printed page
   B. There is no standard orientation
   C. Magnetic north is at the top on the printed page
   D. True south is always to the right on the printed page

6. A friend asks you about a nearby map feature while hiking Flagstaff Mountain near Boulder, CO. What is the white blob in the center of this image?
   A. The typical snowpack in winter
   B. A clearing in woods or brush
   C. A small mesa
   D. An intermittent lake

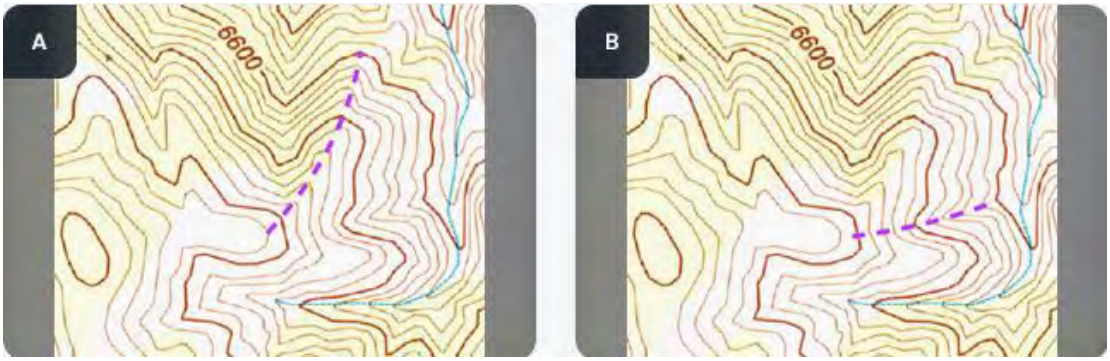


7. While fishing in the alpine lakes below Peak 8 in Breckenridge, CO you decide to climb Peak 8. Roughly how much higher would you need to climb?
   A. 400'
   B. 660'
   C. 800'
   D. 1020'

8. What map feature near Breckenridge, CO is circled in purple?
   A. Peak
   B. Mesa
   C. Valley
   D. Saddle



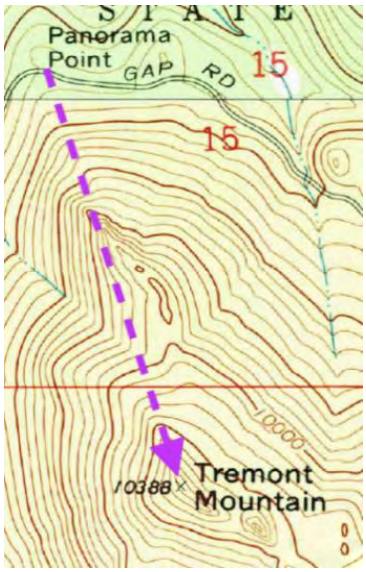
9. Which of these images from Mt. Vernon, CO has a RIDGELINE drawn in dashed purple? _____



10. As a rule of thumb, hiking off trail is _____ time and effort as hiking on trail.
    A. less B. the same C. at least twice the

Senior Instructor: _____ **Student:** _____

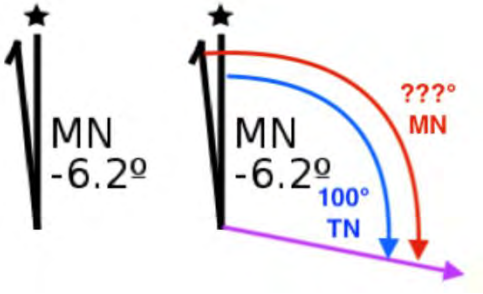
11. What is the approximate bearing of the purple arrow from Panorama Point to Tremont Mountain in Golden Gate Canyon State Park, CO?
    A. 30° true
    B. 70° true
    C. 100° true
    D. 150° true



12. Your trip leader says the next bearing for the trip is 1.3 miles at a bearing of 347°. What is wrong with this instruction?
    A. Compasses don't go up to 347°
    B. 1.3 miles is too far to navigate accurately in the backcountry
    C. They didn't say if it was N, S, W, SSE, SW, etc.
    D. They have to include which North they are using - "347° magnetic" or "347° true"

13. **True** **False** The majority of Search and Rescue missions for hikers are for people who got lost while on trail.

14. You visit some friends for a hike on the Appalachian Trail in Great Smoky Mountains National Park. The declination marking on your map is current and says roughly 6° WEST (Colorado is EAST). What magnetic bearing on the image is equal to "100° true"?
    A. 94° magnetic
    B. 100° magnetic
    C. 106° magnetic
    D. 280° magnetic



15. Why can't you set the declination on your compass permanently, so you never have to do math to convert between true and magnetic north again?
    A. Compasses never have declination adjustments, so it must be done with mental math for every bearing
    B. Declination varies by location and over time, so you need to decide for each hike how you will manage true and magnetic north
    C. Declination settings on a compass are notoriously sloppy and change with the slightest bump
    D. Declination changes significantly over a 10-mile hike in Colorado, so it's easier to adjust the math as you go

16. What direction is 315°?
    A. North B. Northwest C. Southwest D. South southeast

17. As you leave the trail for a bio break, you check your compass and see you are walking a bearing of 80° magnetic. What bearing should you follow after your bio break to arrive back at the same spot on the trail? Note: you could also walk a back bearing by keeping the white (non-red) end of the compass needle in the shed (orienting arrow).
    A. 80° true B. 180° magnetic C. 260° magnetic D. 280° magnetic

18. A trip has taken longer than expected and you're rushing to get back to the cars before dark. Your trip leader says to follow a bearing of 100° true for less than a mile. The setting sun is in your eyes, making it hard to see where to walk. What should you do?
    A. Follow the leader more closely so their body blocks some of the sun
    B. Count every pace so you make sure you hit 0.8 miles accurately
    C. Talk to the leader, they may be going the wrong direction
    D. Pick up the pace so you make it back to the cars before dark

19. You're on a hike and suddenly realize you don't know quite where you are (too soon to use the word "lost"). Whadda you gonna do? Select the LEAST useful step for figuring out your location on your map.
    A. Note the intersections with other trails, streams, or roads
    B. Follow the last bearing on your compass
    C. Compare the terrain around you with the shape and spacing of the contour lines on your map
    D. Compare the shape of the trail you're on to the one shown on your map
    E. Take a bearing on a feature that you can see both in the field and on the map

20. You're on a hike in White Ranch Park, CO and see that a trail junction on your map is 0.5 mile ahead. You've been traveling at about 2 miles per hour. Assuming that trail conditions ahead are the same as what you've just traveled, what's the soonest that you'll reach the junction?
    A. 5 minutes B. 15 minutes C. 30 minutes D. 1 hour

Quiz for Section III – Emergencies

Senior Instructor: _____ **Student:** _____

1. Who is ultimately responsible for your safety and assumed risks on a trip?
   A. The person on the trip with the most expertise
   B. The person who is most confident
   C. You are always responsible for your own safety
   D. The CMC trip leader

2. While on a solo hike, you trip and sprain your ankle so badly it can't bear weight. There's no cell service and you haven't seen anyone all day. What should you have done before leaving to ensure help is coming to get you?
   A. Packed enough food and water that you can wait until you are found
   B. Start early in the morning so rescuers have plenty of daylight to find you
   C. Print a detailed topo map so you can find the best route to crawl to the trailhead
   D. Left your trip plan with a friend or family member along with instructions of when to call-911

3. What is the first action to take when you or your group realize they are lost?
   A. Split up and all go in different directions until someone finds the trail
   B. Return to the trailhead
   C. Stop and assess your entire situation
   D. Head to a baseline to regain group orientation

4. What is a good reason to deviate from your trip plan when you can't inform your emergency contact?
   A. Trailhead parking is full
   B. Met someone who is going to a prettier place
   C. Trail is too muddy
   D. In a high-risk situation, like avalanche avoidance or forest fire

5. When should you carry a bivy or emergency shelter?
   A. On every hike
   B. Only when you think you may have an unplanned night in the backcountry
   C. Only if the forecast that night is below freezing
   D. Only if you are the trip leader

6. Which factor may PREVENT bad group decisions (e.g., crossing an unstable snow field, summiting in a thunderstorm, traveling across thin ice on a lake, etc.)?
   A. Commitment to your goal of summiting
   B. Wanting to impress others in the group
   C. Paying attention to your own warning concerns and speaking up
   D. Following the most confident and compelling voice
   E. Deferring to the person with the most expertise

7. Which has higher priority?
   A. Patient safety
   B. Your safety
8. Which is true about the Incident Manager Role during a backcountry incident?
   A. They should assist the First Aid team
   B. The trip leader always acts as the Incident Manager
   C. They should focus on coordinating and communicating between the other roles

9. Which is true about the First Aid Role during a backcountry incident?
   A. They must be first aid certified
   B. They must be able to treat the patient from memory, no apps or reference information is allowed
   C. They can ask for help from others via the Incident Manager

10. Which is true about the Get Help Role during a backcountry incident?
    A. They ensure they have everything needed before leaving, including patient information, car keys, etc.
    B. They have to hike back to the cars to achieve their mission
    C. They should leave within 5 minutes of the incident occurring to get help as fast as possible

11. Which is true about the Bivy Role during a backcountry incident?
    A. They should start building shelters and gathering food while they wait for more details
    B. They need to provide a recommendation on how many people could safely stay the night
    C. They are now empowered to go through everyone's backpacks and take inventory

12. You can survive weeks without food but only _____ without water.
    ☐ 12 hours ☐ 24 hours ☐ 3 days ☐ 12 days

13. **True** **False** Hypothermia is the #1 killer of outdoor recreationists.

14. Which tool is most useful for getting your exact coordinates in the event of an emergency?
    A. Triangulation off nearby peaks via map and compass
    B. Google or Apple maps on your phone – press on the blue dot that marks your location to see your coordinates
    C. Pacing and bearing from a known point to the location of your emergency
    D. Estimation based on latitude and longitude marks on the map

Senior Instructor: _____ Student: _____

15. The safest strategy to get away from a fire is:
    A. There's no need to change your route if you see the wind is pushing it away
    B. Stay on a ridge line so you can see the fire
    C. Hike back to the car via the fastest route
    D. Get to the other side of the ridge, away from the fire

16. What should your next step be regarding backcountry First Aid training when you graduate from WTS?
    A. Nothing, WTS has covered all the first aid training you need for day hiking
    B. Take a basic First Aid course since it's the same as Wilderness First Aid
    C. Take a Wilderness First Aid course

17. Should you provide help in an emergency?
    A. NO - you could be liable if the patient has any lasting consequences so leave any help to the professionals
    B. YES - the Colorado Good Samaritan Law provides protection from liability unless the acts or omissions were grossly negligent or willful and wanton

18. What is the best treatment for altitude sicknesses?
    A. Be sure the patient is well-hydrated
    B. Descend to lower elevation.
    C. Give the patient easy-to-digest food
    D. Make the patient sit or lie down and rest

19. What is a treatment for heat exhaustion?
    A. Swim in an alpine lake
    B. Drink fluids in the shade
    C. Eat easy to digest food
    D. Descend to a lower altitude

20. **True** **False** The treatment for hypothermia is real simple - warm 'em up.

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Quiz for Section IV – Snow Travel

Senior Instructor: _____ **Student:** _____

1. What is the primary survival strategy with respect to avalanche hazards?
   A. Wear an airbag pack so you don't get buried
   B. Don't get caught in one
   C. Use swimming strokes to stay on top of the avalanche
   D. Wear an avalanche beacon so rescuers can find you
   E. Make an air pocket so you can breathe

2. What should your next step be regarding snow travel after you graduate from WTS?
   A. Buy a beacon, probe, and shovel so you have the gear for backcountry travel in avalanche terrain
   B. Sign up for Avalanche Terrain Avoidance (ATA) or AIARE 1 to get a deeper knowledge of this challenging topic
   C. Sign up for any backcountry ski or splitboard trips with CMC since you now understand the risks

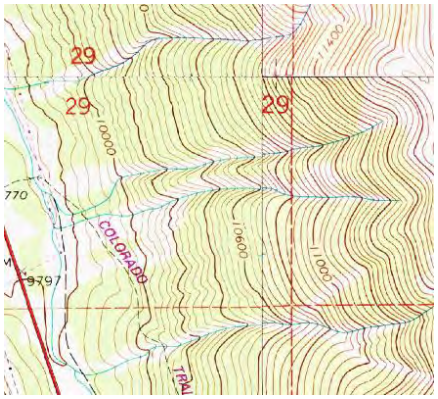
3. Which is NOT a significant hazard when traveling in snow?
   A. Tree wells, where less snow has fallen close to the trunk
   B. Exposed rocks, where the sun has weakened the nearby snow
   C. Snow bridges, where you could fall if it breaks
   D. Bears looking for food

4. What terrain hazard do these pictures show?
   A. Postholing
   B. Avalanche chute
   C. Tree well
   D. Man-eating tree

5. While traveling in late spring you come across this beautiful view. Is it a frozen lake or a meadow covered in snow?
   A. It's so flat it must be a lake
   B. Tracks indicate it's a meadow
   C. Better check my topographic map

6. Slopes that are between _____ are the most likely to avalanche.
   A. 15° and 65° B. 20° and 70° C. 30° and 45° D. 50° and 80°

7. What do the vegetation free sections along the streams indicate on the topo map near the Colorado Trail?
   A. Avalanche chutes
   B. Good spots to get water
   C. Sunny winter trails
   D. Black diamond ski runs



8. Which of the following is NOT an indicator of higher avalanche risk?
   A. Avalanches nearby in the last 48 hours
   B. Snow loading from new snow or wind in the past 48 hours
   C. Whoomph sound underfoot
   D. Less than 70% of ski runs are open at a nearby resort

9. Which is the most important resource to understand current avalanche conditions for trip planning?
   A. CAIC, Colorado Avalanche Information Center
   B. Alltrails.com for trip reports
   C. Weather.gov for snow and wind forecast
   D. Snow report for a nearby ski resort

10. **True** **False** You can NOT trigger an avalanche if you're at the bottom of a hill.

11. **True** **False** If you have complete avalanche knowledge and do everything correctly, you don't have to be concerned about being caught in an avalanche.

12. Which of the following could get you in trouble when hiking in avalanche prone terrain?
   A. Stick together in a group so you can help each other if an avalanche occurs
   B. Use your clinometer to assess local slope angles
   C. Look for evidence of avalanche slides in the terrain
   D. Print a map with color coded slope angles so you know which terrain is more likely to slide

WTS GRADUATION HIKE FORM

Complete each item in this form, adding pages as needed, and give a copy to your senior instructor. Your senior may have a different format they prefer. Select a planning coordinator, several route planners, and assignments for other tasks. Respect the ability of your group. See next page for route plan example. Refer to **Ch. 18–Graduation Hike.**

Senior Instructor _____ Group Number ____ Date of Hike _____

Destination _____ Map _____ County _____

Which instructor(s) have done the hike before? _____

Task List: (Complete this section on a separate sheet.)

Route finding should use each of these skills: ❑ Follow terrain, ❑ Follow a bearing, ❑ Follow a trail (maximum 50% of trip, trail may not show on map).

Road, trail, wildfire, or wildlife closures; fire restrictions; hunting season?

Maps: ❑Trail ❑Topo ❑Satellite ❑Slope	Role rotation for each leg
Meeting time and location	Elevation at trailhead, destination, gain
Directions to trailhead parking (distribute)	Hike distance
Mileage and drive time to trailhead	CMC Trip Difficulty Rating
Carpool set up, driver communications	Weather & lightning forecast, sunset
Coffee or restroom stop	Post-hike celebration
Expected duration	Overdue contact(s) with trip plan
Turnaround time	Ranger or sheriff phone (for emergency)
Escape route	Nearest urgent care or hospital

Terrain you expect to encounter:

❑ On-trail	❑ Boulder field	❑ Talus	❑ Underbrush/Timber
❑ Off-trail	❑ Slab rock	❑ Tundra	❑ Stream crossing
❑ Exposure (to falling)	❑ Scree	❑ Snow	❑ Willows or Marsh

Skills you expect to use:

Leadership & Teamwork	**Navigation**	**Fundamentals**	**Travel**
❑ Coordination & planning	❑ Orientation	❑ Gear	❑ Rhythm breathing
❑ Front/rear leader duties	❑ Route finding	❑ Nutrition	❑ Rest step
❑ Sustainable pace for all	❑ Follow trail	❑ Weather awareness	❑ Ice ax use
❑ Observe teammates for fatigue or difficulties	❑ Follow terrain	❑ Leave No Trace	❑ Kick step
❑ Group dynamics during hike	❑ Follow a bearing	❑ Knots	❑ Plunge step
	❑ Pacing	❑ ESP/Survival	❑ Postholing
	❑ Determining distance & elevation	❑ Medical Emergency	❑ Self-arrest
			❑ Glissade

Note: Please do NOT contact any ranger or park official individually.

The CMC Program Coordinator arranges all CMC school and trip permissions and restrictions on public lands. We may have negotiated exceptions to their published regulations with their designated official that are unknown to the person answering the phone. Ask an instructor for any details needed for trip-planning.

Graduation Hike Route Planning Example

This example table may help you get started. Your senior may have a different format that they prefer. List the attributes of each leg of your route (including return route): manner of travel, how you'll measure distance, and fail-safe features.

Leg	Skill	Roles	Start	Manner	Dist	Destination	Fail-Safe
1	On-Trail	Ldr-Sally RLdr - Joe	TH at north parking lot	West on Meadow Trail	0.5 mi	Junction with Deer Trail	Sharp bend in trail
2	Follow terrain	Ldr-Kent RLdr-Sam	Meadow-Deer Trail junction	Follow streambed	0.6 mi	Slope flattens out	Outcrop
3	Follow bearing	Ldr-Brian RLdr-Meg	Flat area	85° magnetic	0.3 mi	Intersection with 15° bearing on Sheep Peak	Terrain descends
4	View summit	Ldr-Lara RLdr-Kay	At designated bearing	Easiest route up slope	250 ft	Summit	Terrain descends
5	Etc., Continue planning route back to trailhead.						

WTS Navigation Course Map Points

Objectives – Upon completion of this task, you will be able to:

- Read a topographical map, understanding elevation and legend markings.
- Use a compass in an uncomplicated desk-top situation.

WTS teaches navigation at several different sites. All students will receive a map of the historic WTS navigation course in the Mount Vernon area. Your instructor team will tell you which points to plot, and, if needed, hand out a separate map and point descriptions for the site you will use on your field day.

Note: You need to correctly plot points 00, 06, 11, 12, and 26 to plot some other points (32, 40, 54, 58, 59, and 60).

Notice the Denver Mountain Park boundary, shown by a dashed line. WTS does not have permits for students to go into this park.

Note the **USGS Topographic Map Symbols** on the next page. They are essential for understanding a topo map and are most useful when printed in color.

See the following pages for Mount Vernon and White Ranch Open Space Map Points.

ALL students need the appropriate map with their plotted points and point descriptions on their navigation field day.

Newer trails are red lines; old trails are dashed lines. Some of the most common symbols are below. See a 4-page USGS Topo Map Symbols file, also at Learn More - Navigation.

TOPOGRAPHIC MAP SYMBOLS

VARIATIONS WILL BE FOUND ON OLDER MAPS

Primary highway, hard surface
Secondary highway, hard surface
Light-duty road, hard or improved surface
Unimproved road
Road under construction, alinement known
Proposed road
Dual highway, dividing strip 25 feet or less
Dual highway, dividing strip exceeding 25 feet
Trail

Railroad: single track and multiple track
Railroads in juxtaposition
Narrow gage: single track and multiple track
Railroad in street and carline
Bridge: road and railroad
Drawbridge: road and railroad
Footbridge
Tunnel: road and railroad
Overpass and underpass
Small masonry or concrete dam
Dam with lock
Dam with road
Canal with lock

Buildings (dwelling, place of employment, etc.)
School, church, and cemetery — Cem
Buildings (barn, warehouse, etc.)
Power transmission line with located metal tower
Telephone line, pipeline, etc. (labeled as to type)
Wells other than water (labeled as to type) — Oil — Gas
Tanks: oil, water, etc. (labeled only if water) — Water
Located or landmark object; windmill
Open pit, mine, or quarry; prospect
Shaft and tunnel entrance

Horizontal and vertical control station:
Tablet, spirit level elevation — BM △5653
Other recoverable mark, spirit level elevation — △5455
Horizontal control station: tablet, vertical angle elevation — VABM △95/9
Any recoverable mark, vertical angle or checked elevation — △3775
Vertical control station: tablet, spirit level elevation — BM ×957
Other recoverable mark, spirit level elevation — ×954
Spot elevation — ×7369 — ×7369
Water elevation — 670 — 670

Boundaries: National
State
County, parish, municipio
Civil township, precinct, town, barrio
Incorporated city, village, town, hamlet
Reservation, National or State
Small park, cemetery, airport, etc.
Land grant
Township or range line, United States land survey
Township or range line, approximate location
Section line, United States land survey
Section line, approximate location
Township line, not United States land survey
Section line, not United States land survey
Found corner: section and closing
Boundary monument: land grant and other
Fence or field line

Index contour
Supplementary contour
Fill
Levee
Mine dump
Tailings
Shifting sand or dunes
Sand area
Intermediate contour
Depression contours
Cut
Levee with road
Wash
Tailings pond
Intricate surface
Gravel beach

Perennial streams
Elevated aqueduct
Water well and spring
Small rapids
Large rapids
Intermittent lake
Foreshore flat
Sounding, depth curve
Exposed wreck
Rock, bare or awash; dangerous to navigation
Intermittent streams
Aqueduct tunnel
Glacier
Small falls
Large falls
Dry lake bed
Rock or coral reef
Piling or dolphin
Sunken wreck

Marsh (swamp)
Wooded marsh
Woods or brushwood
Vineyard
Land subject to controlled inundation
Submerged marsh
Mangrove
Orchard
Scrub
Urban area

Point	Mount Vernon Map Points		
	Starting from	**Plot**	**Description and Notes**
00	Top of Bald Mountain	154°, 0.22 miles	Elevation 7820 feet on south side of east-west-trending hill. A black triangle labeled 53 JCMD with elevation of 7988 feet marks the top of Bald Mountain.
02	Top of Bald Mountain	186°, 295 feet	On the south side of Bald Mountain at an elevation of 7,880 feet. (Use 1"=2000'.)
06	Top of Bald Mountain	45°, 0.72 miles	Top of small rock outcrop marked by closed 7320-foot contour
08	Top of Bald Mountain	117°, 530 meters	Foot of tower where power line crosses small ridge at elevation 7720 feet.
09	Cabin at north end of old trail (light dashed line) in valley east of Bald Mountain	90°, 0.1 mile	Elevation of 7140 feet on south side of northeast-trending gully about 30 feet. above the gully bottom. Cabin is now a ruin but is still clearly visible.
10	Top of Bald Mountain	270°, 0.2 miles	Red + on the map marks the section corner. This is the northwest corner of Section 11. A steel rod with aluminum cap marks the section corner.
11	(1) Point where Guy Gulch flows into Clear Creek; (2) Spring at Charm Spring	(1) 164°, (2) 64°	Top of round hill shown by closed 7240-foot contour
12	Point where Guy Gulch flows into Clear Creek	193°, 0.3 miles	Top of isolated peak shown by closed 7080-foot contour
21	Top of Bald Mountain	129°, 0.33 mile	Top of small ridge shown by closed 7800-foot contour
25	(1) Top of Bald Mountain; (2) Pt. 11	(1) 94°, (2) 186°	On a north trending ridge at an elevation of 7,585'. Point is in open forest approx. 900' south of junction of Beaver Brook and old trails.
26	Ralston School (use left side of black rectangle)	6°, 1 mile	Top of hill shown by closed 7320-foot contour.
29			Elevation 6860 feet along stream that drains north down the small valley east of Point 6 and enters Clear Creek between the letters "O" and "N" in the word CANYON
31			Elevation 6980 ft. along stream that drains north down the valley east of Bald Mountain
32	Point 12	218°, 460 meters	Elevation 7000 feet on the crest of small northwest-trending ridge

Point	Mount Vernon Map Points (cont.)		
	Starting from	**Plot**	**Description and Notes**
33	Top of Bald Mountain	62°, 0.48 mile	On the west flank of a north trending ridge at an elevation of 7,420 feet. On top of a rock outcrop approx. 350 feet from where Beaver Brook Trail crosses a drainage. Approach from north to reduce erosion.
34	a) Point 11 and/or b) Point #60	a) 170°, 1 km and/or b) 222°, 0.45 mile	On the east flank of a north trending ridge at an elevation of 7,440 feet.
37	Top of Bald Mountain	104°, 0.18 mile	Rock outcrop shown by very small closed 7840-foot contour.
38	Point where Beaver Brook Trail crosses old trail (light dashed line) in the valley east of Bald Mountain	215°, 200 feet	Near the rim of an old prospect pit not shown on the map. To find this point in the field you will want to go to the trail intersection and walk a compass bearing. (Use 1"=2000'.)
40	Point 6	70°, 0.57 mile	On flat-topped east-trending ridge bounded on three sides by a 7040-foot contour
41	Point where Guy Gulch flows into Clear Creek	136°, 0.7 mile	Section corner shown by red + on the map. This is the NE corner of section 2.
45	The spring (tiny blue circle) at Charm Spring	102°, 0.66 mile	Along an east trending ridge at an elevation of 7,300 feet and 125 feet east of the park boundary. Old phone lines in the area mark the park boundary. Point is next to a small, long rock rib.
54	Point 00	282°, 510 meters	Elevation 7680 ft. on west-trending ridge. Point is on the line between Section 10 and Section 11.
57	Cabin at north end of old trail (light dashed line) in the valley east of Bald Mountain	7°, 140 feet	Elevation 7260 feet on top of flat ridge. Cabin is now a ruin but is still clearly visible. (Use 1"=2000'.)
58	Point 11	180°, 0.17 mile	Elevation about 7180 feet on crest of flat-topped ridge
59	Point 11	17°, 300 meters	Elevation about 6900 feet on crest of ridge
60	Point 26	340°, 0.24 mile	Top of hill enclosed by 7200-foot contour
61	Point 06	294°, 300 meters	Elevation 7200 feet on gently east-sloping hillside. Point is about 75 feet from sharp bend in old trail where it crosses a northeast-trending gully.

White Ranch Open Space Navigation Map Points

Use this only if your instructors tell you that you are going to this site.

Mount Vernon CalTopo map (available from instructors if needed)

Plot points if assigned by your instructors.

See WTS Navigation Course Map Points on previous pages.

White Ranch Open Space Park map (available from instructors if needed)

Draw meridian lines, true north-south lines (lines parallel to edges of map).

Your instructors will hand out this map if you are going to this site for M&C Day.

Plot these points on the CalTopo map.

Bring your map and point descriptions on M&C Day.

	White Ranch Open Space Map Points		
Point	**From**	**Plot**	**Description**
00	Kiosk	352°, 1.5 km	West junction of Waterhole and Rawhide trails in Sourdough Springs Campground
01	Junction of Waterhole Trail, a stream, and a short road	A straight line 69º east and 249° west that intersects both east and west legs of the northern loop of Rawhide Trail	Estimate distance from Point 00 to intersection of the west leg of Rawhide and your plotted line. You will need to find this point in the field for the bearing exercise.
02	Ralston Buttes	206º, 2.2 km	7549’ peak
03	South Ralston	244º, 1.55 mile	Small rock outcrop at 7,380’ near east leg of Rawhide Trail
04	South Ralston	277º, 1.7 km	7232’ high point
05	Kiosk	121º, 0.35 mile	7370’ high point near old barn

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WTS Course Overview

Colorado Mountain Club Mission Statement

The Colorado Mountain Club (CMC)'s mission is to:

- Unite the energy, interest, and knowledge of the students, explorers, and lovers of the mountains of Colorado.
- Collect and disseminate information regarding the Rocky Mountains on behalf of science, literature, art, and recreation.
- Stimulate public interest in our mountain area.
- Encourage the preservation of forests, flowers, fauna, and natural scenery; and
- Render readily accessible the alpine attractions of the region.

Wilderness Trekking School Mission Statement

Wilderness Trekking School's mission is to guide CMC members in a supportive environment to become competent, confident, and safe backcountry day hikers in the Colorado mountains.

WTS Committee

A committee of volunteer Denver Group members whose goal is to ensure that the school provides students with a comprehensive, quality learning experience manages WTS. Its responsibilities include:

- Establishing school policies, processes, and guidelines,
- Designing the educational program and deciding the content of lecture videos and field days,
- Recruiting and retaining instructors and speakers,
- Tracking and managing student and instructor performance,
- Gathering and evaluating student and instructor feedback and implementing suggestions thought to improve the program, and
- Ensuring the safety of all participants.
- Policies and Requirements

Graduation Requirements

Students must meet the following criteria to graduate from WTS:

1. View all lecture videos, attend all group meetings, and attend all field days. (See Make-up Policy below.)
2. Complete all quizzes and homework assignments.
3. Demonstrate satisfactory participation in all classroom and field exercises.
4. Be recommended for graduation by their instructor team.

Graduation from WTS fulfills one of the requirements to take Backpacking School and Alpine Scrambling Course.

Make-up Policy

To graduate from the Wilderness Trekking School, students must view all lecture videos, attend all group meetings, and participate in all required field days.

Lecture Videos – Students can link to videos from the Course Materials page, Lecture videos link. We trust you to view all videos prior to the relevant group meeting.

Group Meetings – There isn't a practical way to make up a missed group meeting. If you miss more than two group meetings, you will need to retake the course.

Field Days – Students who miss one field day due to an emergency may get credit by attending a make-up field day. Make-up field days will be held during the current session, subject to instructor availability. The missed field day may also be taken during the next two WTS sessions without charge. If you miss more than one field day without making it up in the current or next two sessions, you will need to retake the course.

Refund Policy

Cancellation requests made prior to 7 days before the course receive full refund less 35% of fee paid up to $30. Full credit can be transferred to a future session of the same school only if the course is on the calendar at time of cancellation. Transfers do not apply to Wilderness Trekking School.
No refund will be granted 7 days or less prior to the course. No credit will be allowed for future classes.

Safety Rules

All WTS students and instructors must follow the safety rules listed below while engaged in any WTS activity. Students must also follow any other safety procedures required by their instructor team.

- Each student is responsible for having the required clothing and equipment for each field day.
- Students cannot share essential equipment. Each student must carry their own essential gear.
- All hikes must have capable front and rear leaders appointed by the instructor team.
- A student may not separate from the group during any field activity without permission from the instructor team.
- A student may not climb on a rock ledge or cliff face that is higher than their head.
- A student does not have to climb anything presenting more exposure to falling than they feel comfortable with and can safely manage.
- A student must promptly inform the instructor team if they feel impaired during any field activity due to injury, illness, or other condition.
- Students must wear helmets during all ice ax exercises.
- WTS will not use snow slopes with significant avalanche potential or cornices for snow travel or self-arrest exercises.

Important – Failure to follow the WTS safety rules is grounds for expulsion of a student or replacement of an instructor.

General Information about Group Meetings

All group meetings are at the American Mountaineering Center in separate meeting rooms for each student group with their instructor team. The night's activities usually end by 9:30 pm. Students may be asked to help restore the room to pre-meeting configuration,

General Information about Field Days

Each WTS field day is an exciting all-day event conducted in the mountains of Colorado. Students will practice and apply the information presented in the evening team meetings and the student manual at a popular hike site. Note: This is outdoor education with many stops, NOT a typical hike. Emphasis is on safety and "learning-by-doing" in a noncompetitive, team-oriented environment. Instructors demonstrate and explain the fundamentals while introducing each technique or skill. Students then can practice the technique or skill with the instructors close by to offer coaching and helpful advice.

Groups usually meet at a designated time and place to arrange carpools to the trailhead. Please follow the following carpool etiquette:

- Arrive at least 10 minutes ahead of the planned departure time.
- Wear comfortable shoes for the drive and carry your hiking boots in a plastic bag.
- Arrive with a full tank of gas in case you need to be one of the drivers.
- Each passenger should compensate the driver. Bring some small bills, as we do not expect the drivers to make change. Typically, all occupants in the car, including the driver, share in mileage costs at the rate of 30 cents per mile per car.

Each field day begins early in the morning and ends late in the afternoon. It is difficult to predict exactly when your group will return to town; therefore, please do not schedule any important engagements during the evening. We recommend that you get a good night's sleep the night before and eat a healthy breakfast the morning of the field day. Bring snacks, lunch, and plenty of water to give you the energy to handle the physical and mental demands of the day. Bring extra layers of warm clothing, as the weather in our mountain "classrooms" is often unpredictable. (See *Chapter 2 – Gear* and *Chapter 3 – Nutrition and Hydration* for guidelines and suggestions.)

The level of difficulty varies with each individual field day, typically traveling on- or off-trail for five or more miles with Trip Difficulty Rating (trip difficulty) of **Easy** (up to 8 miles roundtrip or 1,200 foot elevation gain). No hike will go beyond the **Moderate** rating (to 12 miles or 2,500' elevation gain). WTS field days are outdoor education, **not** a typical day hike. There are frequent long stops throughout the day for instruction, demonstration, and practice. You may not get in your cardio workout. Field days are rarely canceled due to harsh weather unless heavy snow triggers road closures. WTS strictly enforces the safety rules outlined above throughout each field day. Hiking with a group involves cooperation, compromise, and a positive attitude. Be considerate of each member's pace and abilities, as they may differ from yours. WTS strongly encourages groups to stop for a post-hike celebration. It is a wonderful opportunity to get to know one another and to discuss the events of the day.

For additional information about WTS, including a list of frequently asked questions, go to Course Materials and select FAQ.

CMC Code of Conduct

Colorado Mountain Club expects all people taking part in CMC activities to treat all others with respect and concern. The CMC will not tolerate abusive, sexually harassing, or discriminatory actions or communications. See the Code of Conduct (conduct). Your senior instructor will file an online report concerning student issues. (This includes reporting field incidents such as accidents, near misses, and injuries.)

CMC uses Navex EthicsPoint at http://coloradomountainclub.ethicspoint.com/ for behavioral incidents from minor grievances, to bullying, unethical behavior, or sexual harassment. You can read more about it on our Suggestion and Complaints Reporting (complaints) webpage and make a report anytime at toll-free 1-844-929-4258 or http://coloradomountainclub.ethicspoint.com/.

SECTION I – FUNDAMENTALS

CHAPTER 1 – DRY LAND TRAVEL FIELD DAY

By Tim Musil

Objective: Upon completion of this exercise, you will be able to employ safe and effective techniques for hiking on varied terrain encountered in the mountains.

Next Steps: When you want to do more.

- Backpacking School – WTS is a prerequisite.

Description of the Day

Your instructor team will choose a location that has a variety of mountain terrain and natural features to teach you different hiking techniques and to allow you to practice. Throughout the day, the group will move from place to place with emphasis on off-trail travel. Your instructors will also discuss many mountain-related topics and backcountry emergencies.

What You Will Need

Bring as many of the Ten Essential Systems as possible. Your group will be on and off-trail most of the day. You need: sturdy boots or trail shoes, sunscreen/ hat/ sunglasses, non-cotton clothing (50/50 blend shirts are OK), your ropes, a compass, lunch, and at least two quarts of water. You may also want raingear, extra insulation, gaiters, gloves, and water-friendly sandals. Your instructor will advise you on these extra items.

Skills and Subject Areas Covered

Hiking cross-country in the Colorado mountains involves traveling over richly diverse terrain, which includes boulders and rocks of varied sizes, deep forests, open fields, brush, fragile tundra, creeks, and rivers. The instructors will cover the following topics and will allow everyone to evolve their hiking abilities to a more advanced level:

- **Teamwork –** For safe and efficient travel, each group has both a front and a rear leader. The front leader navigates, sets a sustainable pace for everyone, determines the location of rest stops, watches out for the group's welfare, and keeps everyone informed. The rear leader maintains communication with the front leader and makes sure that no one is left behind. Group members must respect the front leader's directives; leaders should be benevolent and employ consensus approaches to problem-solving.
- **Trail etiquette/Right of Way –** Follow Leave No Trace (Chapter 5). Larger groups usually yield to small groups.
- **Tundra, scree, and brush** – Tundra fields and scree fields (areas of small rock) are fragile. Spread out to minimize damage. Be courteous to those behind you when pushing branches away. Protect your eyes with glasses and your skin with

adequate clothing. Zip all your pockets and secure gear; brush famously knocks things away.

- **Friction walking** – Smooth, sloping rock will provide traction if it is dry. Maximize contact between your boot soles and the rock. Walk upright with knees bent, feet parallel, and your center of mass over your feet.
- **Pacing and the rest step –** A steady pace that can be maintained indefinitely is the most efficient way to cover ground. Use the rest step during ascent to conserve energy. The rest step technique is to place one foot uphill while locking the knee of the lower leg. Support all body weight on this leg and hold this position for a moment. Now, transfer your weight to the uphill leg and lock it at the knee, supporting all your weight, as you step up with the lower leg. Hold this new position for a moment.
- **Talus –** Talus is a field of loose rocks that are four inches or larger in diameter.
    - To maintain your footing, take small, slow steps using your leg muscles to climb. As you move to the next rock, give it a nudge to see if it is stable. Do not lunge, as this may loosen your perch. Maintain your balance. Use your hands for stability and gloves to protect your hands from scrapes.
    - When loose rocks begin to fall, they accelerate rapidly. Within a few feet, they are moving fast enough to cause injury. If you dislodge a rock, yell, "Rock!" If you hear this warning, protect your head. To minimize the risk, climb one at a time or spread out – in a diagonal line or in a zigzag pattern – so that no one is directly below another climber.
- **Stream crossing –** If a stream crossing is necessary, invest some time in looking for an easy way across. Slowly moving water is safer than rapidly moving water. Cross at an angle facing upstream. Be wary of rocks and logs, which may be wobbly or slick. Sandals will allow you to wade across without getting your boots wet. If you need to wear your boots, remove your socks to keep them dry. Undo the hip belt and loosen the shoulder straps of your pack, so you can quickly shed your pack if you fall in. Remember that this makes you and your pack less stable. Use your trekking poles for stability.
- **Unplanned separation –** If you inadvertently get out of sight and sound of your group:
    - **Shout** – Call out to someone in your group.
    - **Whistle** – The club's recommended whistle protocol is at the end of Chapter 13 - Survival. Whistles give little directional information, so call out as soon as you are within voice range. (If you are injured, give three blasts, the standard emergency signal in the USA.)
    - **Develop an action plan** – Stop Think Observe Plan, hydrate, eat, adjust clothing.
        - If you are **absolutely certain** where you are and how to get to your destination or the trailhead, proceed, continuing to try to contact your group.
        - If you have the slightest doubt about your location or route, **stay put**. It is much easier to find a stationary person than one who is moving.
        - If you must move to a safer or more visible location, clearly mark the last position known to the group and your route.

  The group will look for you based on your last known location. If the group cannot find you within a reasonable amount of time, they will call 911. Search and Rescue will not look for an adult after dark, so prepare to spend the nigh

CHAPTER 2 – GEAR

By Robin M. Starr and Sarah E. Thompson, Revised Spring 2024

Objectives: Upon completion of this chapter, you will be able to:

- Obtain the necessary gear for Wilderness Trekking School.
- Describe and carry the layers to stay comfortable in the Colorado mountains.
- Describe and carry the **Ten Essential Systems.**

The Basics

Here is what you need for this course:

- **Hiking footwear**– waterproof and sturdy enough for off-trail use while carrying a pack. Verify that your boots will be adequate for Snow Travel Day.
- **Backpack** – a daypack with hip belt, large enough to hold all the basic gear, layers, and Ten Essentials, 1800–2200 cubic inches (30–40 liters) of capacity, (61 cubic inches per liter). Packs should have at least one ice ax loop.
- **Clothing layers** – carry all three – wicking, insulating, protecting.
- **The Ten Essential Systems.**

Ten Essential Systems

1. **Navigation**
2. **Sun protection**
3. **Insulation** (extra clothing)
4. **Illumination**
5. **First aid supplies**
6. **Fire**
7. **Repair kit and tools** with knife
8. **Nutrition** (extra food)
9. **Hydration** (extra water)
10. **Emergency shelter**

Other Recommended Items

Consider adding these items. Check with your instructors for their recommendations.

Altimeter and/or Watch	Insect repellent	Snow shovel
Bandana or handkerchief	Metal vessel for melting snow and cooking	Trekking poles
Binoculars	Closed cell foam pad for sitting or sleeping	Trowel to dig holes for waste; Wag-Bags
Brimmed hat or cap	Pen and paper	Resealable plastic bags
Camera		Water treatment tablets or device
Communication or signaling devices		

Also see **Bargain 10 Essentials** March-2024, from Hiking Safety in Course Materials.

Each student must carry their own equipment.

Do not depend on others to provide your essential gear.

Purchasing Your Gear

You will need boots, a backpack, and appropriate clothing – plus whatever your instructor indicates – for your first field day. Most students already own at least some suitable gear. When possible, rent or borrow before you buy. Add and upgrade items as you gain experience. It is critical that your footwear and backpack fit well. Choose them carefully and with expert help. For other items, light weight and low bulk are important considerations. REI Expert Advice at https://www.rei.com/learn/c/hiking has a wealth of information. Places to buy include:

Bent Gate	Duluth Trading Co.	Sporting goods, Surplus stores
Backcountry.com	LLBean.com	Target, Wal-Mart
Backcountry Experience	Out & Back Outdoor	Thrift stores, Play It Again Sports
Campmor.com	REI.com, REI Used	
Department stores	Sierra.com	Wornwear.patagonia.com

Dressing for the Backcountry – the Layering Concept

One of the keys to having an enjoyable and safe hike is the ability to adapt to rapidly changing mountain weather. Dressing in a system of layers enables you to add or subtract clothing as needed. Several thin layers are warmer and more versatile than one thick layer. Zippers add adaptability. Wear or carry at least one item of each type of layer depending on the forecast.

- **Wicking inner layer** – snug-fitting to transfer perspiration from the surface of your skin to the next clothing layer or air. This may be synthetic, ultra-fine (non-itchy) merino wool or treated silk. Merino wool is naturally flame-retardant.
- **Insulating mid layer** – to provide added warmth and trap warm air next to the body. This layer should be breathable to let perspiration escape. Down is lightest but is useless if it gets wet. Wool insulates when wet, but heavier pieces may dry slowly. Soft-shell fabric combines insulation and protection.
- **Protecting outer layer** – to protect you from wind, rain, and snow. Pants and a jacket with a hood should be water-repellant and breathe well to let perspiration escape – armpit zippers are highly desirable. Check whether your pack's hip belt will cover the pockets. Ponchos are less useful; they flap in the wind and may obscure your view of the trail.

Typical outerwear for summer day hikes in the Colorado mountains might be a wicking shirt and zip-off pants, a lightweight down or fleece jacket or vest, and a water- and wind-resistant shell, possibly plus rain pants. Leggings designed for hiking may have pockets and be abrasion and weather resistant. Insect repellant clothing can be useful. To prepare for weather change, carry gloves or glove liners and an insulating hat. Gaiters are good not only to keep snow from getting into the tops of your boots; they also keep out scree and protect against brush when you are hiking off-trail.

We recommend AGAINST wearing high percent cotton fabric: it holds moisture when wet from sweat, rain, or a leaky water bladder. It dries slowly and can contribute to hypothermia. On hot days, a cotton hat and/or neck cooler soaked in water may be helpful. Consider natural fabrics or flame-retardant garments since synthetics will melt if exposed to embers or flames and cause severe burns.

The Ten Essential Systems Expanded

Why do I need so much stuff??

The first reason is basic risk management and goes back to your scouting days – be prepared. A sudden downpour, a skinned elbow, a creek crossing, a twisted ankle – all are unsurprising events in the backcountry. WTS helps prepare you so that these are minor blips and not disasters. Second, if you or someone in your party cannot safely get back to the trailhead before nightfall, **you need to be able to spend a night unharmed in the backcountry**. With luck, you will never need many of the items in your pack. Consider them life insurance.

1. **Navigation (map, compass, flagging tape)**
   The foremost necessity to avoid getting lost is a topographic map (in a protective case or baggie) along with the skill to read it. The maps available at visitor centers or entrance stations are typically line drawings of trails and lack the topographic details needed for route finding. A compass is necessary, especially if you get off course or seek a particular destination in the backcountry. It is dependable, lightweight, and battery-free. A phone or GPS device is nice, but requires working batteries, user skills, connectivity, and reliable electronics. Flagging tape is useful to mark a rescue site and the return route for search and rescue.

2. **Sun Protection (sunscreen, sunglasses, lip balm, hat)**
   Sunglasses and sunscreen are indispensable at Colorado's altitude. Ultraviolet (UV) rays penetrate clouds and can burn your skin or eyes even on cloudy days. Choose polarized, wraparound lenses when possible. Your sunscreen should be rated as sun protection factor (SPF) 30 or higher and block both UVA and UVB rays. Your lip balm should be at least SPF 15. A hat or cap plus clothing with ultraviolet protection factor (UPF) offer added protection.

3. **Insulation (extra clothing)**
   In Colorado, you must plan for a change in the weather! Afternoon storms, wind, and sudden cold fronts are the norm throughout the year. Prepare for the worst conditions that you could realistically encounter, including staying overnight. Raingear, a hat, mittens or gloves, and extra socks are necessities. We lose body heat through every uncovered area; a cap is necessary for staying warm. Long underwear and a vest are light weight and take up little room. Your pack may not be waterproof. Carry a pack cover or trash bag to protect it or place your gear in a trash bag inside your pack.

4. **Illumination (LED flashlight and/or headlamp, extra batteries)**
   A reliable light source can save your life! It is essential if you need to travel or set up camp after nightfall. High output LED lights (minimum of 300 lumen) use little power and are very long-lasting. Choose a model with a switch lock and preferably with strobe and red-light modes. Strobes save battery life and red lights preserve night vision. Lithium and rechargeable NiMH batteries perform well in the cold. Rechargeable batteries may run down even when idle. Alkaline batteries perform poorly when cold – keep them insulated or close to your body. Check your lights and extra batteries regularly to be sure they are still working.

5. **First aid supplies (plus toilet paper)**
   See *Chapter 15 – Medical Emergencies* for recommended contents. Your first aid kit is for YOUR use on YOURSELF. Group trips may require combining resources based on number of people, duration, and potential risk. Zipper plastic bags (that you can use even with gloves on) make great first aid kit containers. A compact guide for wilderness first aid is helpful. Knowledge weighs nothing. CMC recommends that you know at least **basic first aid and CPR** and take a **wilderness first aid course**.
6. **Fire (waterproof matches, lighter, fire starter)**
   Starting a fire in the cold, wind, rain, and/or dark is not easy. Carry plenty of stormproof matches in a waterproof container. A windproof, water-resistant lighter can be useful, but loses performance in cold weather and at altitude. Choose fire starting methods that work the **first time, every time**. Magnesium strikers require skill. You will also need fuel that will burn for several minutes to start tinder or twigs, i.e., fuel tablets, Wetfire™, tea lights, fire ribbon, fire sticks, trioxane, petrolatum-saturated cotton balls. Try various fire starters on Survival Field Day.
7. **Repair kit and tools (knife, whistle, signal mirror, repair tape)**
   Your knife should be very accessible and operable with one hand – picture yourself trapped under a rock in a stream, needing to cut off your pack. A multifunction knife or tool is useful for cutting up tinder, basic equipment repairs, food preparation, and first aid. Your whistle to signal an emergency should be very accessible (NOT on the back of your pack) and loud enough to be heard at a distance. Your compass mirror can serve as a signaling device. An easy way to carry duct tape is to wrap it around your water bottle or trekking poles; electricians' tape is light and compact.
8. **Nutrition (enough for your expected trip plus extra food)**
   Carry enough food so that you can stay overnight. Digesting food helps keep you warm and provides energy for muscles and brain. Choose calorie dense, ready-to-eat items with a long storage life – energy bars, nuts, dried fruit, and jerky.
9. **Hydration (enough for your expected trip plus extra water)**
   Dehydration causes apathy, confusion, nausea, and fatigue, and occurs **before** you have a sensation of thirst. High altitude increases the amount of fluid lost through respiration. Cold weather or wind may cause you to underestimate the amount of fluid lost through perspiration. Carry **at least** two liters/quarts per day, enough that you can consume a few ounces every 20 or so minutes. A collapsible water container and a means for treating or filtering water will enable you to obtain an emergency supply from a local stream. See *Chapter 3 – Nutrition and Hydration*.
10. **Emergency shelter (pad, tarp and cord, bivouac sack or plastic bags)**
    To help keep an unexpected overnight stay from becoming fatal, carry at least: a hip to shoulder closed-cell foam pad for insulation, shelter (e.g., large lawn bags, space blanket, lightweight bivy sack, or lightweight tarp); and 50-100 ft. of cord for lashing and guylines.

Checking your garments: These tests will help figure out the features of your garments.

Water resistant – Droplets of water bead up on the surface.

Wicking – Garment is lightweight (hasn't absorbed water) when taken out of the washer.

Breathable – Steam from boiling water passes through the fabric.

CHAPTER 3 – NUTRITION AND HYDRATION

By Lana Dolly, Revised Spring 2024

Objectives:

Upon completion of this chapter, you will be able to:

- Name the major nutrients and describe their primary functions within the body.
- Explain the importance of adequate hydration and describe signs of dehydration.
- Select and carry the appropriate types and amounts of foods and liquids you need to sustain your energy levels during a hike in the backcountry.

Hiking in the backcountry can be a strenuous and challenging activity. Keeping yourself well-fed and well-hydrated will help give you the energy you need to manage the physical and emotional demands of your trip. You will also be less likely to become ill or injured, or to experience difficulties from heat or cold. Your entire day will be a more enjoyable experience.

Important – The information presented in this chapter aims to provide you with guidelines and suggestions; however, individual needs may vary, and it will take practice and experimentation to find what works best for **you.**

Nutrition

The primary goal of nutrition during a hike is to keep your body fueled with rapidly available energy. Place emphasis on carbohydrates, supplemented with moderate amounts of protein and fat. Use the information in the following table to guide you in selecting foods that are easy to carry and consume and will sustain your energy levels throughout your hike.

Table 2-1: The Major Nutrients

Nutrient	% of Daily Calorie Intake	Primary Function(s)	Good Sources for Hikers
Carbohydrates	60 to 70%	Primary energy source – digest more quickly than the other nutrients. Can cause spikes and dips in blood glucose. Fuel working muscles and brain, increase blood glucose levels, and aid in recovery by replacing muscle glycogen stores	Granola bars, trail mix, fruit (fresh & dried), sports bars/gels/blocks, bagels, tortillas, breads, pretzels, crackers, cookies, candy bars
Protein	15 to 20%	Tissue maintenance, growth, and repair Not readily burned as energy – used as an energy source when carbohydrate intake is inadequate to maintain glycogen stores	Tuna fish, deli meats, hard-boiled eggs, cheese, nuts, nut butters, hummus, jerky
Fats	< 25%	Digest more slowly than the other nutrients Useful for long-term energy such as providing heat retention and insulation during winter trips	Butter/margarine, mayonnaise, nuts and nut butters, higher fat meats and cheeses

Nutrition Tips

- Keep carbohydrate-rich snack foods easily accessible (i.e., in the pockets of your clothing or outside compartments of your pack). This will enable you to eat along the way without taking off your pack.
- Eat small amounts frequently as opposed to consuming large amounts less often. Don't wait for scheduled snack/meal breaks; eat when you need to.
- Add moderate amounts of protein and/or fat to your carbohydrate of choice at lunch. This will slow down the rate of absorption of carbohydrates into your system and make the energy source last longer.
- Have a healthy dinner the night before your hike that is rich in carbohydrates. Avoid foods known to cause you any gastrointestinal distress.
- Eat a healthy breakfast that is rich in carbohydrates the morning of your hike.
- Bring foods that you like and will want to eat; bring foods that taste good to you!

Hydration

The human body is composed of 60 to 70% water. Adequate fluid consumption is essential for supporting overall health. Dehydration decreases exercise performance and impairs mental acuity. An otherwise healthy adult can survive weeks without food but only **two to three days** without water.

Determining Fluid Needs

The body loses two to three liters of water each day through urination, perspiration, and exhalation. Exercise can increase fluid loss to the rate of one-half to one-and-one-half liters per hour, depending on the intensity and the air temperature. Use these figures to estimate the amount of water you may consume during a planned hike. Most day hikers carry between two and four liters.

Sports drinks may be useful as a hydration supplement on longer, more strenuous hikes. Most contain carbohydrates, electrolytes, vitamins, and/or minerals. Brands with a six to eight percent concentration of carbohydrates are the best choice for hikers. Try them at home before bringing them on a hike to decide how well you tolerate them; some people tolerate them more easily by diluting them with water.

Hydration Tips

- Drink plenty of fluids the day before and the morning of your hike.
- Limit or avoid alcohol consumption since it is a diuretic, a substance that increases the production of urine and loss of fluid from the body.
- Caffeine is a weak diuretic. Rule of thumb is to consider that a caffeinated beverage causes as much fluid loss as gain, with no net increase in hydration.
- Take a few sips of water every 15 to 20 minutes while hiking. Water should be easily accessible; hydration bladders work well as do water bottles clipped to a shoulder strap or the hip belt of your pack.

- Pale yellow or colorless urine indicates adequate hydration; darker yellow urine is a sign of dehydration.

Carry some means of water treatment in your pack. There's a wide range of options with different costs, convenience, working lives, and shelf lives. Water filters work by physically straining out protozoan cysts and bacteria. Water purifiers also reduce viruses, which are too tiny for most filters to effectively catch. Purification is needed primarily in less-developed parts of the globe. See Table 2-2 for a comparison of several different methods.

Important – Do not wait until you are thirsty to drink.
If you feel thirsty, you are already dehydrated.
Dehydration reduces physical and mental performance.

Table 2-2: Principal Water Treatment Methods

Method	Pathogens Removed*	Time Required	Pros/Cons
Physical			
Boiling	All	Minutes	Very effective method; must carry stove and extra fuel
Ultraviolet Light, pens and bottles	All	Minutes	Water must be clear to be effective; must carry extra batteries
Filtering:			
Straw, Squeeze, & Gravity Filter	P and B	Immediate to Minutes	Backflush to clean
Pump Filter	P and B	Minutes	Clogs easily with water having sediment or glacial silt
Pump Purifier, filter and removes viruses	All	Seconds	Activated carbon and other tech; Clogs easily with water having sediment or glacial silt
Chemical:			
Iodine	B, V, some P	1 hour	Unpleasant taste; less effective with cold water or water having sediment or glacial silt
Iodine w/ neutralizer	B, V, some P	1 hour	No unpleasant taste; less effective with cold water or water having sediment or glacial silt
Chlorine Dioxide tablets	All	4 hours	No unpleasant taste; tablets take longer than other methods
Chlorine Dioxide drops	All	20-30 minutes	No unpleasant taste

*** Protozoa, Bacteria, Viruses**

Effects of Altitude

Some people experience difficulties with eating and drinking at altitudes above 12,000 feet due to loss of appetite, impaired food absorption, and/or symptoms of mountain sickness. However, calorie and fluid requirements increase at higher elevations. The basal metabolic rate increases due to reduced oxygen levels and colder temperatures, and fluid loss accelerates due to more rapid breathing and drier air. Therefore, make every effort to continue to eat and drink. Carbohydrates are usually well tolerated because they digest more quickly and easily than protein or fat. Eating and drinking lightly and often works best for most people.

References

Mountaineering: The Freedom of the Hills, 9th Edition, edited by Eric Linxweiler and Mike Maude, Seattle, The Mountaineers Books, 2017.

The Backpacker's Field Manual, by Rick Curtis, New York, Three Rivers Press, 2005

Resources

How to Choose Energy Food and Drinks – REI Expert Advice

How to Choose a Water Filter or Purifier – REI Expert Advice

Nutrition and Athletic Performance: Joint Position Statement, American College of Sports Medicine; American Dietetic Association; Dietitians of Canada**.** Medicine & Science in Sports & Exercise. 48(3):543-568, March 2016

CHAPTER 4 – WEATHER

By Joe Griffith and Robin Starr

> "Storm clouds on the mountains – how truly beautiful they are! – floating fountains bearing water for every well; the angels of streams and lakes…"
>
> – John Muir, *Snow-Storm on Mount Shasta*

Objectives: Upon completion of this chapter, you will be able to:

- **Anticipate** the weather that you are likely to confront on your hikes.
- **Cope** with what happens.

Much of the enchantment, and adventure, of alpine hiking arises from the weather. The abundant life we find in the wilderness would not be possible without the water brought to the mountains by those powerful floating fountains. Our presence in Colorado depends on that water, too. The atmosphere's ever-changing moods make each hike a unique experience. When those moods turn dark, however, the weather can create deadly hazards for an unprepared hiker.

Figure 1: August in the Indian Peaks Wilderness

The clouds in Figure 1 provided a beautiful backdrop for our lunch, but they were part of a thunderstorm that had formed astride our path homeward. Fortunately, the hiker in the photo was well prepared. He was already exposed to one hazard, ultraviolet (UV) radiation, but his hat, sunglasses, long-sleeve shirt, and sunscreen gave him good protection. The thunderstorm also became a problem. Rain made the trail muddy and slick, but our hiker's trekking poles helped him avoid falls. His waterproof boots and the rain jacket in his pack kept him dry and warm, so he did not succumb to hypothermia. A good lunch also helped keep the cold at bay. We began our hike early, so we could start our descent before the storms reached the high point of our trip. The path back to the trailhead was through a valley, so lightning did not become a significant hazard. Most important of all, he was well-trained in the ways of the weather. He returned home safely because he was properly prepared.

Weather is, of course, an immense, complicated subject, so what follows is only the beginning of your education in mountain meteorology. The websites and references listed are among the most essential elements of this chapter.

Colorado's Mountain Climate

The Southern Rocky Mountains are blessed with a mild, relatively dry continental climate that is ideal for outdoor activities. The cool summer days are punctuated by occasional thunderstorms. In winter, there is plenty of powder snow for a snowpack that often lasts into late spring. Blue skies and abundant sunshine prevail throughout the year.

Because of the wide variations in the state's topography, Colorado's climate differs greatly by location as well as season. In their description of the state's climate, Doesken, Pielke, and Bliss point out: "The difference (35° F) in annual mean temperature between Pikes Peak and Las Animas, 90 miles to the southeast, is about the same as that between southern Florida and Iceland." This excellent article is at ccc.atmos.colostate.edu/climate_long.html. It is just one of many valuable resources at the Colorado Climate Center at ccc.atmos.colostate.edu.

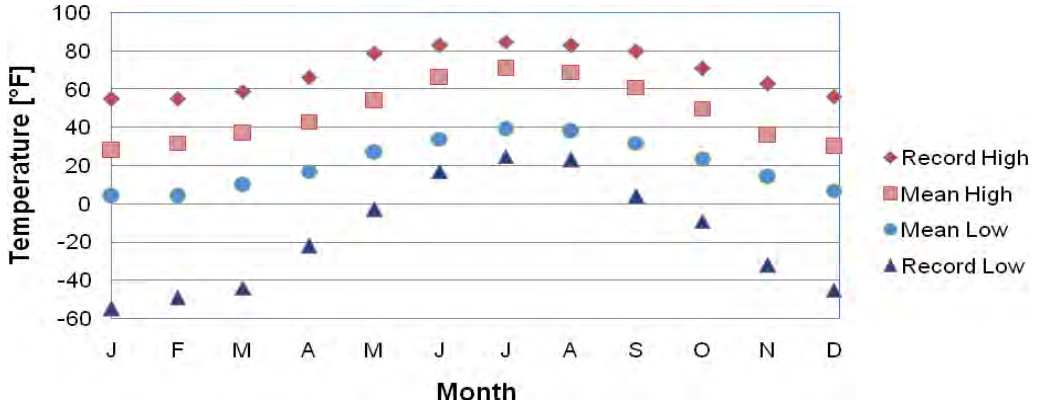


Figure 2: Temperatures in Leadville, CO

The National Climatic Data Center, ncdc.noaa.gov, maintains climate data for the entire country. Historical temperature and precipitation amount for many sites in Colorado are available there. Figure 2 is derived from data taken at the Sugarloaf Reservoir at Leadville (9738 ft. elevation). Note that all the record lows are below freezing – even for July. Summertime temperatures typically decrease 3-5 °F for every 1000 feet of elevation gain. (This is called the lapse rate.) Cold air tends to pool in mountain valleys, and a clear sky allows heat to rapidly radiate out into space. Even on a midsummer hike, you should be prepared to endure subfreezing temperatures if an overnight stay is planned or if it becomes necessary in an emergency. Snow can fall during any month in Colorado.

Since Colorado is far from major bodies of water, average precipitation throughout the year is fairly light. For Leadville, it is typically one to two inches of water equivalent per month. In the summer, water comes mainly from the Gulf of Mexico, while in the winter the jet stream brings it in from the Pacific Ocean. Again, local topography strongly affects it. Mountain peaks can get twice as much as neighboring valleys. The mountains squeeze water out of the air by forcing it upward, causing it to cool. (Rain and snow in Denver are often associated with easterly "upslope winds.") Rain in the summer usually comes from thunderstorms, which often begin to form by midmorning. The mountains affect them, too. Doesken, Pielke, and Bliss call Pikes Peak a "thunderstorm machine."

Tomorrow's Weather

Weather forecasting has improved dramatically in recent decades. Remote sensing, sophisticated atmospheric models, and high-speed computing have given meteorologists powerful tools for predicting the weather many days in advance. The Internet gives us unprecedented access to the information generated:

- National Weather Service (NWS) – weather.gov
- Storm Prediction Center – spc.noaa.gov
- University Corporation for Atmospheric Research – rap.ucar.edu/weather/
- Hydrometeorological Prediction Center – wpc.ncep.noaa.gov
- National Weather Radio (coverage maps) – weather.gov/nwr/

The Colorado Department of Transportation (CDOT) provides valuable information on road conditions at cotrip.org. Forecasts for Colorado's 14ers can be found at 14ers.com.

Forecasters can provide valuable information about large weather systems. If they predict high pressure, then expect good weather. If they warn of low pressure or the arrival of an advancing front, then be prepared for precipitation. You should **always** be prepared for precipitation.

Today's Weather – Those Clouds on the Horizon

In the mountains, weather tends to be local, and it can change with amazing rapidity. Forecasters still have difficulty predicting the weather on a fine scale in such complicated terrain. A wise wilderness traveler vigilantly observes the sky and stays alert to the possibility that the terrain is hiding the approach of bad weather. As conditions change, you need to be aware of how they may affect the remainder of your day. Will that thunderstorm reach the summit before you do? Will the developing snowstorm obscure your vision and cover your tracks in the snow? Being able to interpret what is happening in the atmosphere is an important survival skill. Jim Woodmency's *Reading Weather* offers useful instruction for sharpening that skill.

Coping

Most of us know how to cope with beautiful weather, so this section will concentrate on those aspects of the weather that cause problems. Problematic weather can put on an awesome show. Our purpose here is to teach you how to enjoy the show – as John Muir did – and survive.

Rain

Rain presents several hazards: **slippery conditions**, **hypothermia**, and **flash flooding**. Water can be a powerful lubricant. Mud and wet rocks – especially those covered with lichen – can make your footing unreliable. On most trails, it is mainly a nuisance. In a boulder field or in an area requiring friction walking, slippery rocks can make an area impassible. If your path to safety becomes slippery when wet, then you should be especially cautious about avoiding thunderstorms.

Wet clothing conducts heat from your body extremely fast. Wind and lack of sunshine make the situation worse. Staying dry is essential to avoid hypothermia. A rain jacket, rain pants, waterproof boots, and weather resistant gloves will keep you comfortable and warm. A change of clothes in a waterproof bag is also useful. Some use ponchos to

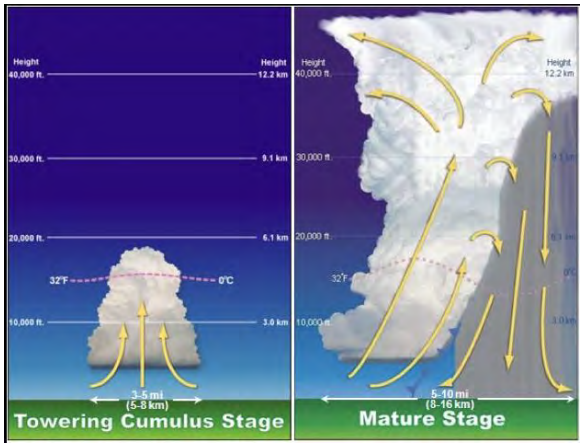
protect themselves from rain. A poncho can double as a tarp, and it can also protect your pack from rain. The main disadvantage is that it tends to billow out in the wind, so it is difficult to see the trail at your feet.

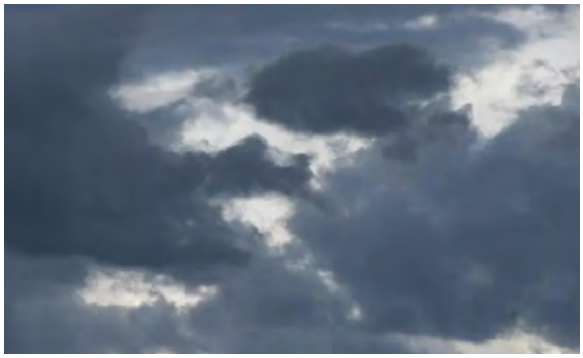
Occasionally a rainstorm will stall over a valley or canyon and dump an enormous amount of water into a confined space. One of the best-known examples in Colorado happened on July 31, 1976, when nearly a foot of rain fell in Big Thompson Canyon. The flood killed 144 people. Mike Nelson describes the weather conditions that caused it in his *Colorado Weather Almanac.* If you are in a canyon, you may not be able to see or hear the storm upstream, so you must be alert to rapidly rising water. Camping in a low-lying area during thunderstorm season can be hazardous. If you choose to do so, think ahead about your escape route to high ground.

Lightning

Thunderstorms can occur in winter, but they are most frequent from late April through late September. Colorado is one of the top states for lightning fatalities. In an average year, cloud-to-ground lightning strikes Colorado a little over a half million times, killing three Coloradans and sending eight more to the hospital. A lightning strike may seem like a frightfully random event, but much of its behavior is predictable. The Hourly Weather Forecast on Weather.gov indicates the hour that the lightning is predicted to start. You can register for alerts from your county, your hiking area, and FEMA.

Thunderstorms often begin to form by late morning. It is essential to start hikes early so you are already descending from the summit if a storm strikes. From a distance, you'll see a storm developing with rapidly rising, billowing white clouds and wind. As the storm nears, the sky darkens and fills with dark roiling clouds. Changing temperature, gusty winds from changing directions, thunder, and lightning strikes up to 10 or more miles from the storm center can occur.





Thunder is a useful tool. If you see a flash, you can measure its distance by counting the seconds between the flash and the arrival of the thunder. The speed of light is so high that the flash arrives instantaneously. Sound, on the other hand, takes five seconds to travel one mile. By counting the seconds between flash and bang and dividing by five you get the distance in miles to the strike. This technique has given rise to the **30/30 lightning safety rule**: seek shelter, in a vehicle or a building, if the flash is less than 30 seconds away (six miles) and stay there until 30 minutes have passed since the last thunderclap. The National Weather service states there

is **no safe place outside** when thunderstorms are in the area. If you hear thunder, you are within striking distance of the storm. Partial buildings, tents, shallow caves, lone trees, and ledges do not offer protection from lightning. You should also avoid streams, wet ground, wet snow, and long or tall conductors, e.g., wire fences and power line towers.

In the wilderness, you may be far from shelter, but there are ways to reduce your exposure. A group outside should spread out at least 50 feet apart to reduce the risk of multiple injuries. Lightning tends to strike the tallest objects under the cloud because the tops of these objects are closest to the cloud. Mountain peaks, ridges, and tall solitary trees are among lightning's preferred targets, so you will want to be far from them. Seek a low elevation, preferably below tree line. In a stand of trees of uniform height, you are relatively safe if the tree next to you is not significantly taller than its neighbors. Moving to a safer location is your best option.

The National Weather Service (NWS) stopped recommending the crouch in 2008. Whether you're standing or in the crouch position, if a lightning channel approaches from directly overhead (or very nearly so), you're very likely to be struck and either killed or injured by the lightning strike. https://www.weather.gov/safety/lightning-crouch.

Lightning does not have to hit you directly to cause severe injuries. A nearby strike can harm you in many ways. The flash may be bright enough to damage your vision and the sound loud enough to damage your ears. The shock wave can hurl debris at you or even directly cause trauma. Induced electric currents generated by the strike may heat metal objects hot enough to burn your skin, so put down or remove any metal objects (e.g., your watch) if you believe that a strike is imminent. The lightning current flowing through the ground may enter your body and cause severe internal injuries. You can minimize the current flowing through your body by keeping your contact points with the ground as close together as possible. Keeping your **feet together** will reduce the ground current flowing through you should there be a strike close by. Do **not** lie flat on the ground.

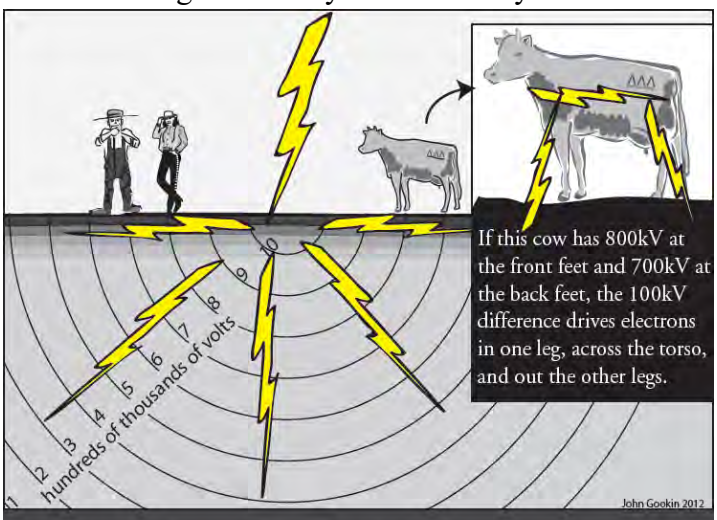
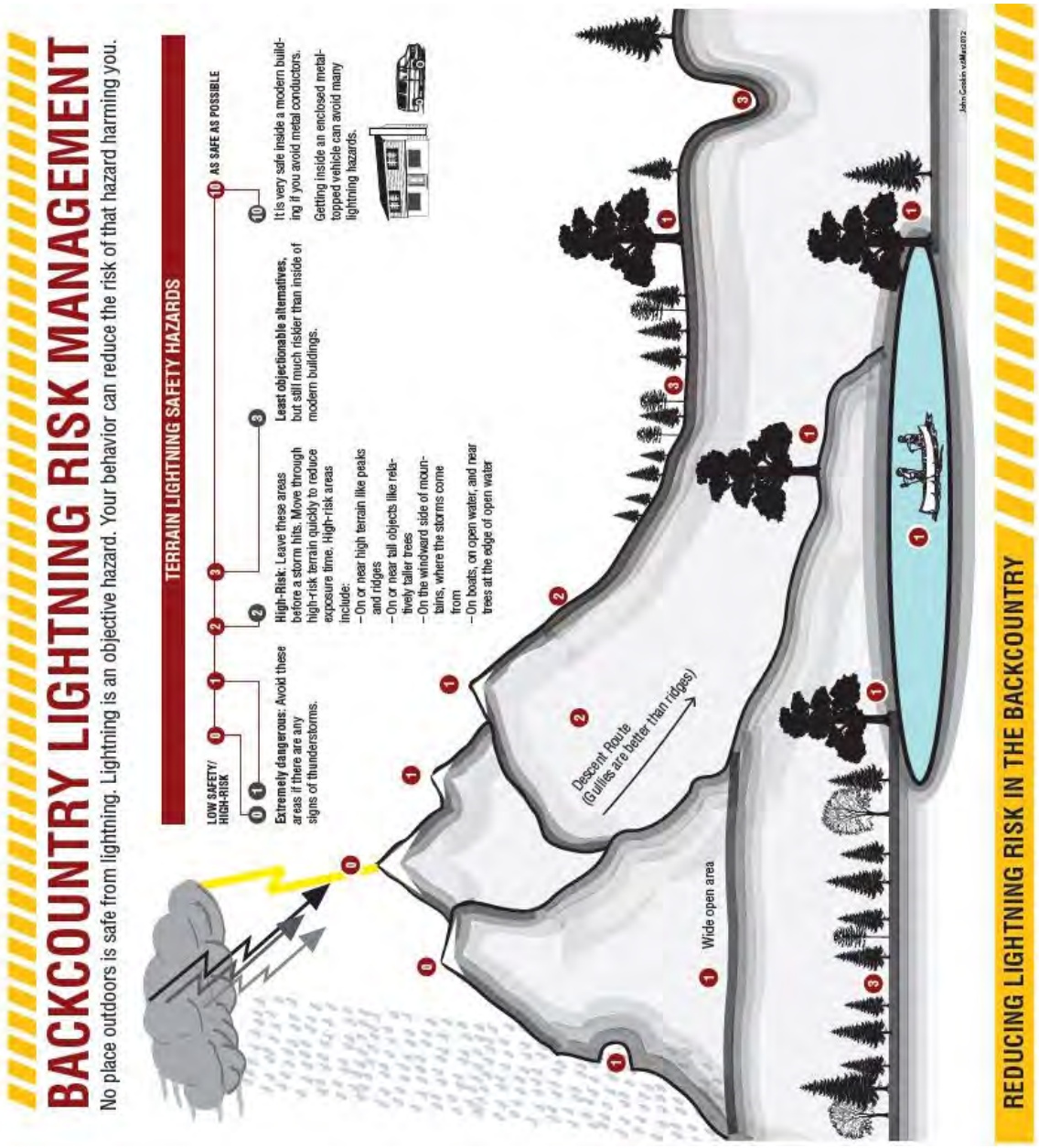


Fig 1. Ground current causes about half of all lightning injuries. A difference in voltage drives current through us. In this simplified illustration the cow has a 100,000-volt differential, one farmer has a 50,000-volt differential, and the other farmer has her feet together so her voltage difference is minimal.

Only about 10% of people who are struck by lightning are killed, leaving 90% with various degrees of injury, including intense pain and life-long debilitating injuries.

Lightning Risk Management



Snow

The main hazards in the wilderness associated with snow are avalanche, frostbite, hypothermia, and UV reflectivity (sunburn and snow blindness). These are all discussed elsewhere. On well-traveled trails, the snow often turns to ice after being packed down. In the spring, many thawing trails alternate between stretches of mud and ice, both of which are slippery. Traction devices for your boots, such as MICROSPIKES®, STABILicers™, ICEtrekkers®, or Yaktrax®, will help you avoid falls.

Wind

Mountain topography strongly affects the wind. In the winter, when the jet stream often blows directly across the Southern Rocky Mountains, wind speeds can reach 50-100 mph on mountain peaks. Such winds can produce dangerous wind chills. Valleys offer shelter if their orientation relative to the wind direction is favorable. Otherwise, they may simply funnel the wind toward you. Trees usually provide a lot of protection unless the wind is strong enough to topple the weak ones. It is a complex topic. Renner's *Mountain Weather* and Whiteman's *Mountain Meteorology* have extensive discussions of wind behavior.

Heat

As our planet warms, we have increased reports of people and their dogs dying on the trail. Excessive heat leads to dehydration and cooking of internal organs. When you exercise on a hot day, you gain heat directly from the sun **and** radiated from the surrounding rocks and ground heated by the sun. Some medications, including those used to treat allergies, high blood pressure, and mental health conditions, impair temperature regulation.

Check the forecast for your trail and heed any heat advisory. Consider what shade you'll encounter, e.g., using Google Earth Pro, and time your hike for early morning or late in the day. Carry much more water than usual. Use a bladder and tube so you can sip as you walk rather than stopping to pull out a water bottle. Carry working headlamps so you can delay your return until after sundown if necessary.

The major way the body cools is through evaporation of perspiration from the skin. Water and electrolytes, e.g. potassium and sodium, are lost in sweat. The typical American diet contains adequate potassium and much more sodium than needed. Sports drinks with low sugar (<8%) and electrolytes can be helpful. One way to monitor whether you're drinking enough is to keep your urine clear.

Wear light-colored clothing with a SPF rating, e.g., a long-sleeved shirt, a brimmed sun hat, a neck gaiter with cooling crystals. You can acclimatize by gradually increasing your heat exposure over 7-14 days. See *Hot-Weather Hiking Tips* by REI and CDC's *Heat Stress Acclimatization*.

Dogs on the Trail

Dogs are much more susceptible to heat than humans. They lose heat mainly via panting, an inefficient process, especially in flat-faced dogs with impaired respiratory tracks. Foot pads and noses perspire to help a bit. Consider – **if you are sweating, your dog may be overheating**. They will faithfully follow you to their death.

It helps to brush out the undercoat, leaving the guard hairs to shade the skin and help prevent sunburn. On a hot day, let them rest and drink often, e.g., every 15 minutes, douse them with water, and use a cooling collar. Remember that rocky trails can burn their feet,

Signs of heat exhaustion may start with lying down in shady spots. excessive panting or drooling, and progress to vomiting, diarrhea, collapse, and death. It may be best to leave your dog healthy at home.

Ultraviolet Radiation

The UV part of the spectrum lies between visible light and x-rays – more energetic than visible light but not as energetic as x-rays. The problem with UV is that it is powerful

enough to damage protein and DNA molecules. As we all know, a heavy dose of UV will produce a burn, on your skin or in your eyes, which you will feel within a few hours. A small dose does permanent harm more stealthily. The cumulative effect of many doses – large and small – may not appear for years or even decades, but the possible result, blindness, or skin cancer, can be devastating.

We cannot see or feel UV light, so to protect ourselves we must learn how it behaves. UV light is a component of sunlight, and the worst of it is filtered out by the ozone layer in the stratosphere. The lower atmosphere also removes some, so the amount of UV at the Earth's surface increases by about 4% per 1000 ft. of elevation gain. The biggest factors affecting its intensity are the height of the sun in the sky and the reflectivity of the ground. At sunrise and sunset, almost no UV reaches the surface; the time of high intensity is midday. Snow and water reflect UV light, so they can significantly increase your exposure. Weather affects the intensity of UV because clouds block some of it. The National Weather Service expresses the intensity of UV for a given day and location with their **UV Index**. Their forecasts for locations within the United States are available at https://www.epa.gov/sunsafety/uv-index-1.

Clothing and UV-blocking sunglasses provide the best protection. The brim of a hat shades your face when the UV is most intense, at midday. Sunscreens, especially those with physical blockers such as zinc oxide or titanium oxide, work well but need to be reapplied regularly.

UV light is not all bad, however. It provides a service by helping our skin make vitamin D. In winter, especially, it is possible to get so little UV that you become deficient in vitamin D. If you are careful to avoid UV exposure, you may want to supplement your diet; 400 IU is presently the recommended daily allowance.

References

Alpine Climbing: Techniques to Take You Higher, by Mark Houston and Kathy Cosley, Seattle, The Mountaineers Books, 2004.

Colorado Weather Almanac, by Mike Nelson, Boulder, Johnson Books, 2007.

Hot-Weather Hiking Tips – REI Expert Advice

Mountain Weather: Backcountry Forecasting and Weather Safety for Hikers, Campers, Climbers, Skiers, and Snowboarders, by Jeff Renner, Seattle, The Mountaineers Books, 2005.

Mountain Weather Pocket Guide: A Field Reference – by Jeff Renner, 16 pp, Seattle, The Mountaineers Books, 2017.

National Lightning Safety Council – http://lightningsafetycouncil.org/

National Oceanic & Atmospheric Administration NOAA – http://www.weather.gov/ National Weather Service forecast for your city, zip code, or summit. Enter your information into the top left search box to display forecast area icons, text, and map. Drag the map to your trailhead and click on it to reset the point forecast area.

Reading Weather – by Jim Woodmency, Falcon Guides 2022.

CHAPTER 5 – LEAVE NO TRACE

By Lana Dolly, Revised August 2023

Objectives: Upon completion of this chapter, you will be able to:

- Describe and practice the principles of Leave No Trace.
- Describe and practice proper personal hygiene in the backcountry.
- Identify and volunteer for conservation opportunities within the CMC.

Leave No Trace (https://lnt.org/) is a national awareness campaign and educational program designed to promote skills and ethics to outdoor recreationists (like us!) to help minimize our impact while we are enjoying the wilderness. The concept was developed in 1991 by the U.S. Forest Service, the National Outdoor Leadership School, and the Bureau of Land Management. The program is managed by the Leave No Trace Center for Outdoor Ethics, a nonprofit organization in Boulder established in 1994. Today, the program is supported by the National Park Service, the U.S. Fish and Wildlife Service, outdoor retailers and manufacturers, educators, groups, and organizations such as the Colorado Mountain Club, who share a commitment to protect and maintain our wildlands and natural areas.

The Seven Principles of Leave No Trace

1. **Plan Ahead and Prepare.**
    - Know the regulations and special concerns for the area you'll visit.
    - Prepare for extreme weather, hazards, and emergencies.
    - Schedule your trip to avoid times of high use.
    - Visit in small groups. Split larger parties into smaller groups.
    - Repackage food to minimize waste.
    - Use a map and compass to eliminate the use of rock cairns, flagging, or marking paint.
2. **Travel and Camp on Durable Surfaces.**

    The Basics:
    - Durable surfaces include established trails, campsites, rock, gravel, and dry grasses or snow.
    - Protect riparian areas by camping at least 200 feet from lakes and streams.
    - Good campsites are found, not made. Altering a site is not necessary.

    In popular areas
    - Concentrate use on existing trails and campsites.
    - Walk single file in the middle of the trail, even when wet or muddy.
    - Keep campsites small. Focus activity in areas where vegetation is absent.

In undisturbed areas

- Disperse use to prevent the creation of campsites and trails.
- Avoid places where impacts are just beginning.

3. **Dispose of Waste Properly.**
   - Pack it in, pack it out. Inspect your campsite and rest areas for trash or spilled food. Pack out all trash, leftover food, and litter. Burning trash is never recommended.
   - Deposit solid human waste in catholes dug 6-8 inches deep at least 200 feet from water, camp, and trails. Cover and disguise the cathole when finished.
   - Bury toilet paper deep in a cathole or pack the toilet paper out along with hygiene products.
   - To wash yourself or your dishes, carry water 200 feet away from streams or lakes and use small amounts of biodegradable soap. Scatter strained dishwater.
4. **Leave What You Find.**
   - Preserve the past: observe cultural or historic structures and artifacts, but do not touch them.
   - Leave rocks, plants, and other natural objects as you find them.
   - Avoid introducing or transporting non-native species.
   - Do not build structures, furniture, or dig trenches.
5. **Minimize Campfire Impacts.**
   - Campfires can cause lasting impacts on the environment. Use a lightweight stove for cooking and enjoy a candle lantern for light.
   - Use established fire rings, pans, or mound fires where fires are permitted.
   - Keep fires small. Use only sticks from the ground that can be broken by hand.
   - Burn all wood and coals to ash, put out campfires completely, then scatter cool ashes.
6. **Respect Wildlife.**
   - Observe wildlife from a distance. Do not follow or approach them.
   - Never feed animals. Feeding wildlife damages their health, alters natural behaviors, and exposes them to predators and other dangers.
   - Control pets at all times or leave them at home.
   - Avoid wildlife during sensitive times: mating, nesting, raising young, or winter.

7. **Be Considerate of Others.**
    - Respect others and protect the quality of their experience.
    - Be courteous. Yield to other users on the trail.
    - Greet riders and ask which side of the trail to move to when encountering pack stock.
    - Take breaks and camp away from trails and others.
    - Let nature's sounds prevail. Avoid loud voices and noises.

The member driven Leave No Trace organization teaches people how to enjoy the outdoors responsibly. This copyrighted information has been reprinted with permission from Leave No Trace: www.LNT.org.

Inclusiveness and Diversity

Leave No Trace and Black Folks Camp Too believe in a community-wide movement to create a genuinely inclusive outdoor space through combined efforts and equitable actions. The woods were an unsafe place for many Black folks for hundreds of years in America. We believe the more folks who are introduced to the outdoor lifestyle, the more folks will take care of the outdoors, and preserve it for our children's, children's, children! Commit to working toward a world in which diversity is welcome and everyone feels safe in the outdoors. Learn more about these efforts and how you can get involved by visiting https://lnt.org/unityblaze/.

The Unity Blaze represents the fire of community. It signals: "You are invited and welcomed."

Personal Hygiene

Accomplishing personal hygiene in the backcountry can be a challenge, but every effort must be made to do so. Improper hygiene and waste disposal can contribute to health problems and have a significant, detrimental impact on the environment. But you can practice good hygiene in the wilderness with some advanced planning and the proper supplies.

Basic Supplies

You can carry these items in a small stuff sack in your pack:

- Hand sanitizer
- Toilet paper
- Resealable plastic bags
- Pre-moistened wipes
- Trowel
- Baking soda, kitty litter

Basic Practices

- Wash your hands often using the hand sanitizer – it is lightweight and convenient.
- Select a bathroom location that is at least **200 feet** (70 paces) from water sources.
- Urinate on bare ground or rocks – the salt in urine attracts animals that may dig and disturb vegetation.

Proper Waste Disposal

There are two safe and ethical options for the disposal of human waste in the wilderness: burying it in a cathole and packing it out.

1. **Cathole Burial**

   Use your trowel to dig a hole that is six to eight inches deep (and at least 200 feet or 70 paces, away from water sources). Mix your waste with soil using a small stick and cover the hole thoroughly. Place used toilet paper and/or pre-moistened wipes in a plastic bag to carry out.

2. **Packing It Out**

   An increasing number of heavily used land areas are requiring visitors to pack out their waste. There are now several commercial products available, including Reliance waste bags, Restop2, and Wag Bag® (now Cleanwaste® GO). However, two resealable plastic bags can work just as effectively. Place one of the bags over your hand and scoop up the solid waste. Turn the bag inside out to envelope the waste, seal it, place it in the second bag, and seal that. The odor can be reduced by placing some kitty litter or a small square sponge saturated with ammonia in the first bag.

Girl Talk

All feminine hygiene products must be packed out, including those listed as biodegradable. In addition to the supplies listed above, you will need some small pieces of aluminum foil and some baking soda. Place the used product on a piece of foil and sprinkle with baking soda to hide the odor. Wrap it tightly and seal it in a plastic bag. Wash your hands with a pre-moistened wipe in addition to using hand sanitizer.

References

The Backpacker's Field Manual, Revised – Rick Curtis, New York, Three Rivers Press, 2005.

Leave No Trace 101 Course – online course in LNT principles, about 1 hour long, https://learn.lnt.org/courses/101.

Leave No Trace Educate With Kindness – Make outdoor recreation more inclusive, https://lnt.org/educate-with-kindness/.

Leave No Trace Skills and Ethics Booklet – downloadable pdf from Leave No Trace Center for Outdoor Ethics, 4/01, https://lnt.org/research-resources/leave-no-trace-skills-and-ethics-guide/.

Mountaineering: The Freedom of the Hills, 9th Edition, edited by Eric Linxweiler and Mike Maude, Seattle, The Mountaineers Books, 2017.

CHAPTER 6 – COLORADO WILDLIFE

By Peter Laux

Objectives: – Upon completion of this chapter, you will be able to:

- Describe how to hike with minimal disturbance to wildlife and habitat.
- Describe how to recognize potentially dangerous situations with wildlife.
- Describe how to react to contact with moose, black bear, mountain lion, and rattlesnake.

One of the joys of hiking in Colorado is the chance to see wildlife in a natural setting. A well-mannered hiker will respect wildlife and its habitat and cause minimal disturbance. A well-prepared hiker will know how to react should a wild animal appear nearby or show aggressive behavior. Reading this chapter will help you become a polite guest in the wild, and to know what to do around potentially dangerous animals.

Colorado Wildlife Habitat Stamp

If you wish to help wildlife through statewide habitat preservation, purchase a Colorado Wildlife Habitat Stamp. Required of hunters and anglers, current annual Habitat Stamps are available by phone (1-800-244-5613), online at https://cpw.state.co.us/buyapply/Pages/HabitatStamp.aspx, and wherever hunting and fishing licenses are sold.

Proper Wildlife Viewing

The Colorado Division of Wildlife has these guidelines for observing animals in the wild:

- Never approach an animal too closely. Each species has different tolerance levels for interaction with humans.
- Look for signs of agitation, aggressive behavior, warning calls, or distraction techniques. If you see such signs, you are too close. Back away slowly and quietly.
- If you come upon a young animal or eggs – do not touch them. A parent may reject its young if it smells human odors on it or in the nest.
- **Never feed wildlife** or bait it to lure it closer. Many species can be dangerous if surprised or manipulated, not to mention the fact that some species carry deadly diseases such as hantavirus, rabies, or bubonic plague.

Try not to disturb wild animals. It is a pleasure to watch them doing "what comes naturally." Allow them to continue with their activity as much as practical and pause to wait for them to move away. If you need to move on, start walking slowly, trying not to startle them. Be extra alert if the animal is potentially dangerous. Never touch a dead or injured animal.

Important – Some public areas may have temporary closures or restrictions due to seasonal wildlife concerns such as breeding, nesting, or hunting. Check with the

office or website of the wilderness, forest, park, or open space where you plan to hike to avoid a surprise.

Potentially Dangerous Animals

Most wild animals, even when surprised, will immediately try to escape from the presence of humans. A few, however, may turn aggressive and pose a threat of injury or even death. It is important to be alert to animal danger. One such instance is when you see seemingly unattended young animals nearby. Beware, the mother also is probably nearby and may be aggressive in protecting her young from any intrusion, including humans. This is especially true if you are between the mother and her young.

Descriptions of the five most potentially dangerous animals in Colorado follow. Bears, lions, and snakes are rarely seen in the wild: they usually avoid humans, especially jolly, chatty groups of CMC hikers. Moose are an exception.

Moose – Moose (Alces alces shirasi) can weigh 800-1,200 pounds, are up to 6 feet at the shoulder, and can run up to 35 mph. Moose have few natural enemies, do not fear humans, and may appear docile at first. Female moose (cows) are very protective of their young (calves). Bulls may be aggressive and territorial, especially during the breeding season (rut) in the fall. Stay back or back quietly away. Warning signs include: raised hackles, licking the snout, and ears pinned back. If you see moose do any of those things, try to find shelter behind a large rock, tree, or vehicle, or run away as fast as you can.

Black Bear – Black bears *(Ursus americanus)* can be black, brown, blonde, or cinnamon in color. They are omnivores but eat mostly plant matter. Adult males weigh up to 450 pounds. Able to run fast, swim, and climb trees, they live mostly in areas of scrub oak and aspen with abundant berry bushes. Black bears have good eyesight and keen senses of smell and hearing. They do not growl. When a mother bear makes a grunt or low barking sound, any cubs in the area will scurry up the nearest trees. Black bears hibernate from October/November to March/April each year.

Mountain Lion – Mountain lions *(Felis concolor)*, also known as cougars or pumas, are tawny to light cinnamon in color. Adult males weigh an average of 150 pounds. Ranging from the desert and plains to subalpine forests, they are most abundant in areas with many deer, their favorite food. Lions are active year-round.

If you meet a black bear or a mountain lion:

- Stop! Stay calm! Most animals will move away on their own.
- Back away slowly. Leave the animal room to escape.
- Do not run or move quickly. This may prompt it to chase you as prey.
- Stand upright. Face the animal but avoid eye contact. Try to appear larger by raising your arms or opening your jacket.
- Speak calmly yet firmly if it does not move away.
- Fight back if attacked! Use any weapon at hand including hiking poles or fists. Try to stay upright and protect your head and neck.

Rattlesnakes – The prairie or western rattlesnake (*Crotalus viridis*) lives in all parts of Colorado below about 9500 feet elevation. They average three feet in length but can grow to four feet. To distinguish a rattlesnake from other snakes, look for a thick body and large triangular head. The head is much broader than the neck, and the tail is blunt, usually with distinctive rattles on the end. They have vertical, narrow pupils and a pit on each side of the snout. Non-venomous snakes are slender, tapering to the head and narrow tail, have round pupils, and can move quickly. Most snakes gather in underground dens from October until March or April each year.

Rattlesnakes move slowly and rely on camouflage and the rattle warning for defense. If agitated, they will elevate to an "S" shaped coil and be ready to strike. A rattlesnake can strike at most a distance of one-half its body length.

If you meet a rattlesnake:

- Stop, freeze in place. Figure out its location. Check for others in the area.
- Move at least five feet away from it. Wait for it to move on, or circle around it.
- Leave the snake alone.

Mosquitoes and Ticks – Mosquitoes and ticks transmit a growing list of diseases, with West Nile and Colorado tick fever the most common in Colorado. Long sleeves, long pants, hats, and frequent tick checks help deter infection. For maximum protection, the CDC and Consumer Reports have found DEET, picaridin, and oil of lemon eucalyptus (OLE) to be effective repellants with the last two easier on materials. Permethrin insecticide is effective for treating clothing. Check with your veterinarian for protection for your dog so she doesn't bring ticks home. Follow the manufacturer's instructions.

Colorado Ecosystems

Would you like to know which animals to expect while hiking in a given area? A deeper sense of awareness and appreciation for wildlife comes with familiarity with their habitats and the area you are visiting. Most animals prefer certain living conditions. Due to Colorado's rugged geography, we are fortunate to have a variety of living conditions close to home.

Our state consists of eight life zones, or ecosystems, named for the major plant types found in each zone. Most animals are plant eaters, so wildlife varies primarily with plant life. The Colorado ecosystems, from lowest to highest elevation, with general locations, main plant types, and representative animals are:

- **Grassland –** grasses, sage, yucca on the eastern plains and in South and Middle Parks; pronghorn, coyote, rabbit, prairie dog, gopher, snakes
- **Semidesert Shrubland –** sage, shrubs, rabbitbrush in basins and broad valleys in central and western Colorado; pronghorn, coyote, fox, rabbit, snakes
- **Piñon-Juniper Woodland –** scattered short piñon pine and juniper trees on slopes and hills in western and southern Colorado; pronghorn, mule deer, mountain lion, fox, rabbit, porcupine, ringtail, snakes, elk (in winter)

- **Riparian Land –** willows near moist areas (wetlands, ponds, lakes, and streams) at various elevations; moose, beaver, raccoon, muskrat, amphibians, waterfowl, residents of surrounding ecosystem
- **Montane Shrubland –** scrub oak, berry bushes, other large shrubs on foothills and lower mountain slopes; moose, mule deer, black bear, mountain lion, turkey, fox, coyote, bobcat, skunk, snakes, grouse
- **Montane Forest –** ponderosa and lodgepole pine, Douglas fir, juniper, mountain mahogany, aspen groves, usually 5500 to 9000 feet elevation; mule deer, elk, mountain lion, black bear, porcupine, weasel, squirrel, grouse
- **Subalpine Forest –** dense, dark forests of tall Englemann spruce, subalpine fir, aspen groves, usually 9000 feet elevation to tree line (about 11,500 feet) with limber and bristlecone pine and krummholz (crooked wood) near tree line; elk, mule deer, marten, weasel, squirrel, hare, grouse. These forests keep snow and are very cold, so large animals move to lower elevations during winter.
- **Alpine Tundra –** rocky, with patches of soil and small, very fragile, ground-hugging vegetation above tree line; elk, bighorn sheep, mountain goat, pika, marmot, weasel, ptarmigan.

References

Wildlife

Colorado Parks and Wildlife and Colorado State University Extension have abundant information on wildlife, much more than we can include here.

Coping With Snakes – https://extension.colostate.edu/topic-areas/natural-resources/Coping-with-Snakes-6-501/

Living with Wildlife – https://cpw.state.co.us/learn/Pages/LivingwithWildlife.aspx

Moose Attacks are Increasing – https://www.youtube.com/watch?v=q6Qj9K_eJJE.

Moose – https://cpw.state.co.us/learn/Pages/LivingwithWildlifeMoose.aspx

Safe travel in bear country – https://www.pc.gc.ca/en/pn-np/mtn/ours-Bears/Securite-Safety/ours-humains-bears-people

Wildlife Safety Tips - https://www.rei.com/learn/expert-advice/wildlife-safety-tips.html

Ecosystems

Explore Colorado: A Naturalist's Notebook, Kruger, Frances Alley, and Meany, Carron A., Denver Museum of Natural History and Westcliffe Publishers, Englewood, Colorado, 1995. The Denver Museum of Nature & Science developed this scheme of ecosystems and summarized them in a colorful booklet.

From Grassland to Glacier: The Natural History of Colorado and the Surrounding Region, 2nd Edition, by Mutel, Cornelia Fleischer, and Emerick, John C., Boulder, Johnson Books, 1992

CHAPTER 7 – KNOTS

Revised Spring 2024

Objectives: **Upon completion of this chapter, you will be able to:**

- Demonstrate how to tie the seven knots presented in this chapter.
- Describe the uses of each knot.

Animations are <u>much</u> better than static photos for learning knots.

User-controlled online animations give step-by-step instructions. Check the websites listed under **Resources** and search the internet for the knot you want to learn. It is difficult to learn how to tie knots from static photos. We have included photos and instructions in this chapter for a select set of basic knots suitable for securing items to your pack or setting up an emergency shelter or tent. Climbing knots are beyond the scope of this course.

Learning to tie knots requires muscle memory and repetition. Practice tying them with varied sizes and textures of ropes and without looking. **Finish (dress)** the knot for maximum strength by making sure the loops are in order and pulling it tight. It is easy to forget how to tie knots – practice on occasion and review before a trip.

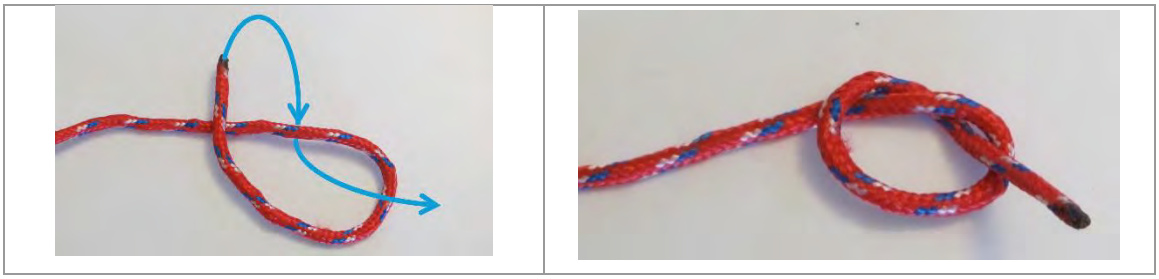
Knots and hitches create weak spots in ropes. A good rule of thumb is to assume that even a new rope will hold only 50% of its rated breaking strength. Ropes that are old or damaged by sun or chemicals will hold much less. Some ropes (i.e., nylon) will stretch when wet or warmed by the sun, allowing your tent to slowly descend during a storm or on a hot day.

Terms: **Bend** is a knot used to tie two ropes together.
Bight is a tight U-shaped fold in a rope, can use when the ends are fixed.
Capsize (spill) is when a loop deforms, usually causing the knot to fail.
Hitch is a knot tied to an object. It collapses on removal of the object.
Standing end of a rope is the long, fixed, or inactive end.
Tail, free end, or **working end** is the short, free end of the rope.

Knots for General Use and Building Shelters

<u>Overhand Knot</u>

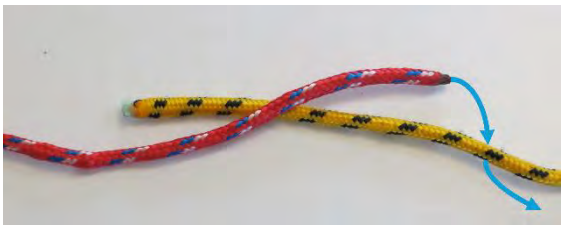
The overhand knot is secure and permanent. It is a stopper knot that prevents the rope from unraveling or ties off a different knot to make it more secure.



1. Make a loop with the rope. 2. Put free end under, then through the loop. 3. Tighten.

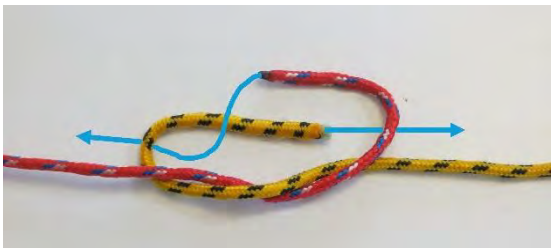
Square Knot

The square (reef) knot is a light duty knot. Use it for securing gear bundles, tying together two ropes of equal diameter, fixing broken shoelaces, tying ribbon on gifts, etc. Do **not** use the square knot to support a person. The loops can flip over (capsize) and release the load. Done incorrectly, it is a weak granny knot.



1. Place left tail over right.

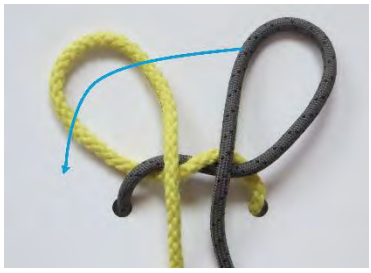
2. Pass left tail under right.



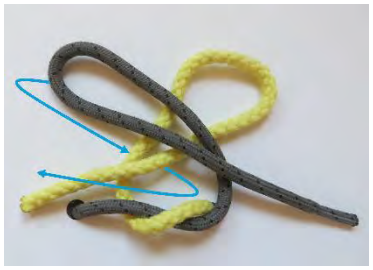
3. Bend both tails and place the "new" right over the opposite tail.

4. Pass the "new" right tail under the bend in the opposite tail and tighten.

Tying your shoes – Most of us learned to tie a granny knot. To make a more secure knot, tie a square knot, as above, but forming the ends into loops.



1. Perform steps 1 & 2 as above, then form both tails into loops (bunny ears).



2. Bend both loops, place the "new" right loop over the opposite loop

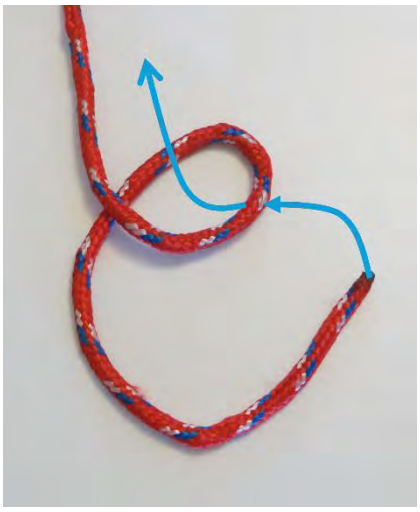
3. Pass it under the opposite loop and tighten.

Extra – For a more secure knot for your boots, do steps 1 & 2 as above, then form only the right tail into a loop. Hold the loop with your thumb and wrap the straight tail twice over thumb and loop. Then form the straight tail into a loop and push it through the bend in the opposite tail. BTW, hard round laces readily come undone.

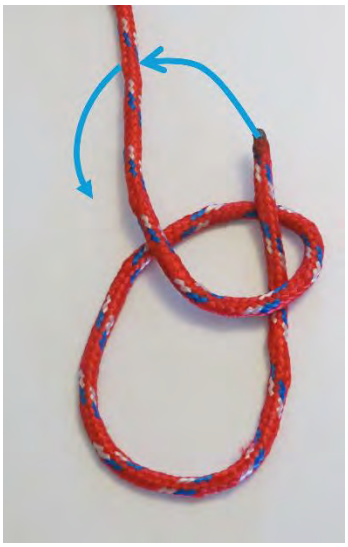
Bowline Knot

Use the bowline knot for tying a loop at the end of a rope. Run a line through the loop to secure gear, to secure a rope to the grommets in a tarp, or to attach a leash to an ice ax. Throw the loop over a branch or tree and pull the free end through the loop for a quick, temporary anchor. The bowline loop will not slip when loaded and unties easily. This knot can come loose when unloaded and vibrated and can capsize. Do **not** use the bowline to support a person.

Keep the loop that you're making in mind while you work with the small active loop.



1. Form a small active loop in the standing end, then thread the tail through it to form your desired loop.



2. Pass the tail through the active loop and under the standing end, leaving the desired loop. (The rabbit comes up through the hole and goes around the tree.)

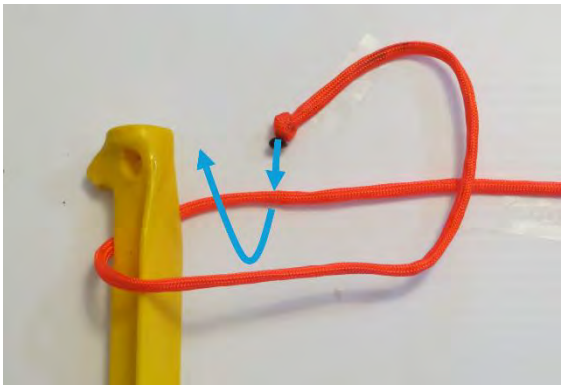
3. Pass the tail through the active loop. (The rabbit goes back into the hole.)

4. Tighten the small active loop, leaving large loop at the desired size.

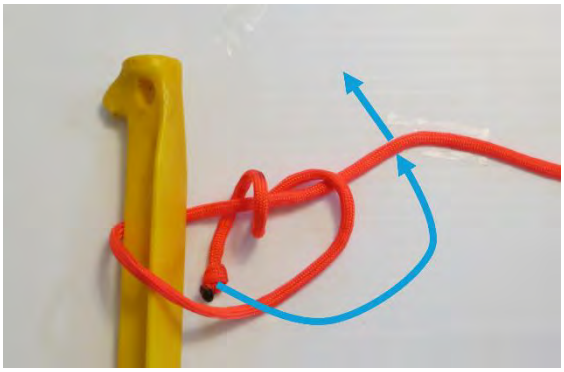
Taut Line Hitch

Use the taut line hitch for adjusting the tension or length of tent guy lines, ropes securing items to a car, or laundry lines. The hitch slides easily to tighten or loosen a line and holds securely under load. The knot slides on the straight line to adjust the slack in the line. When properly tied and tensioned, the taut line hitch is unlikely to slip.

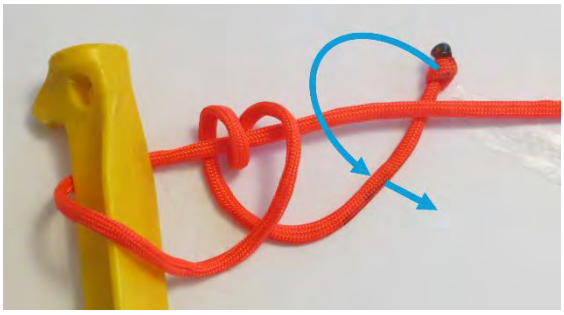
u will use the free end to make three loops over the straight standing end.



1. Form a loop over the standing end by going over it, then under it on the side of the anchor (tent stake).



2. Loop the tail over the standing end a second time then aim away from the stake and pass it under the standing end.



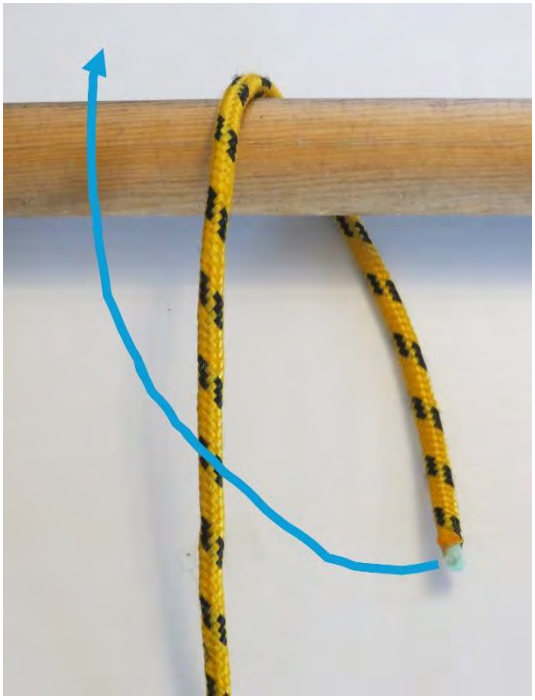
3. Loop the tail over the standing end on the side of the stake then under itself aimed away from the stake.

4. Tighten and slide the 3 loops as a unit to adjust tension.

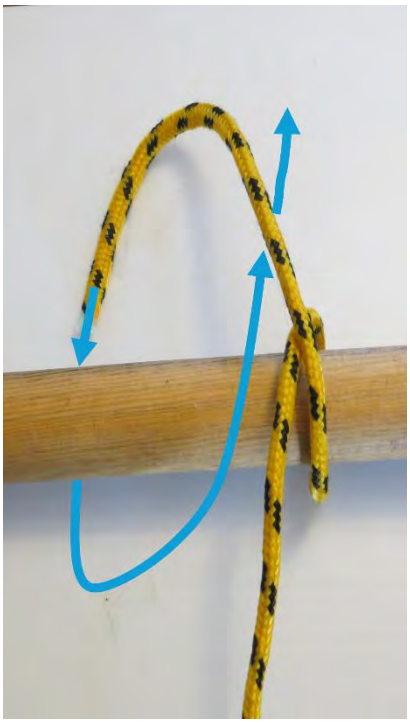
Clove Hitch

Use the clove hitch to secure the end of the rope to a fixed object, such as a tree or pole. It is more secure if the object is round. It will not slip if kept steadily loaded and adjusts easily when unloaded. Unsteady tension on the standing end can loosen it.

This is the hitch the movie cowboy does with one hand before heading into the saloon.



1. Loop the tail around the object, passing over the standing end.



2. Wrap the tail around the object again and bring the tail between the second loop and the standing end.

3. Check (dress) the knot.

4. Pull both ends tight to lock.

Advanced Knots

Figure Eight Retrace

Use the figure eight retrace (aka, figure eight follow through, rewoven figure eight) to tie a loop to a ring or to a climbing harness or to join two ropes. You can also tie this knot on a bight, say in the middle of a long rope. It is easy to remember, easy to visualize, and easy to check.

1. Form a loop with the tail over the standing end, and then bring the tail under to start a second loop.

2. Pass the tail through the first loop, forming a figure 8. Pass the tail through the item you wish to fasten.

3. Pass the tail back through the first loop, next to the rope (retracing its path).

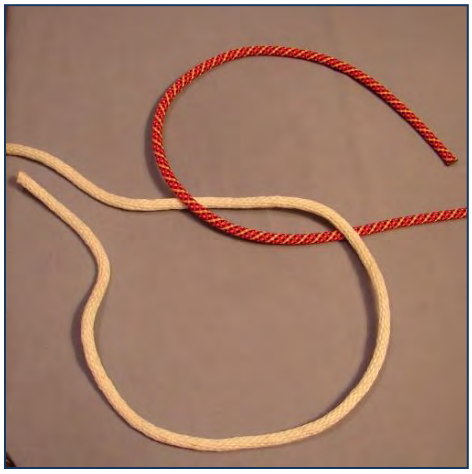
4. Continue retracing around the standing end and back through the first loop.

5. Continue retracing around the loop and back next to the standing end.

6. Pull tight.

Double Fisherman's Knot

This knot is also known as the double fisherman's bend because you can use it to bind two ropes of similar or disparate size together. It is stronger than a square knot because it does not weaken the rope as much and because it is not vulnerable to capsizing. This knot is difficult to untie after heavy loading.



1. Overlap the tail of each rope.

2. Pass one tail over, then under, both ropes toward the other tail.

3. Make a second full turn.

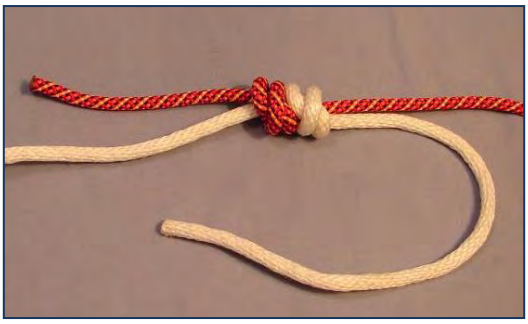
4. Pass the tail through both loops.

5. Pull the knot tight.

6. Repeat with the other tail – make a loop around both ropes toward the first knot.

7. Make a second loop toward the knot.

8. Pass the tail through the two loops.



9. Pull the second knot tight, then pull on the standing end of both ropes to tighten the two knots together.

References

The Outdoor Knots Book, by Clyde Soles, Seattle, The Mountaineers Books, 2004.

The Morrow Guide to Knots*,* by Mario Bigon and Guido Regazzoni, translated by Maria Piotrowska, New York, William Morrow, 1982.

The Illustrated Encyclopedia of Knots, by Geoffrey Budworth, Guilford, CT, The Lyons Press, 2000.

Pro-Knot Outdoor Knots – Portable Waterproof Knot Book, John E. Sherry Company, Inc., 2022.

Resources –

Alan Folsom's Knotting Page – http://www.folsoms.net/knots/, step-by-step animations

Animated Knots *by Grog* – http://animatedknots.com/, step-by-step animations

Best Knot for Boot Laces – https://www.youtube.com/watch?v=deymL_kfHuk

NetKnots.com https://www.netknots.com/rope_knots

Internet – Search for the name of the knot.

SECTION II – NAVIGATION

CHAPTER 8 – MAP AND COMPASS FIELD DAY

Revised February 2019

Objectives: Upon completion of this exercise, you will be able to:

- Employ orienting skills to locate your position on a map.
- Employ route finding skills to plan your cross-country travel.
- Employ navigational skills to stay on course to your destination.

Description of the Day

Genesee Mountain and Jeffco Windy Saddle Open Space Parks navigation course: *Current Session Information* contains Map Points (pgs. xxiii-xxiv) – descriptions of points around Bald Mountain that are on the map supplied to you. As homework before the field day, you will plot these points as accurately as you can on your map.

The day will start with a lesson on measuring distance, then a hike to a hillside where the speaker will provide instructions on map-reading and compass use. After the lecture, the individual groups will spend the rest of the day with hands-on practice using the map and compass. Students will find points assigned to their group on the map provided. In the field, the points will be as described or may be marked by brightly colored tape attached to a tree trunk or stake.

Other navigation sites: You will plot any assigned points on the Evergreen map as well as points on the map of your site provided by your instructors. Your group will carpool to your site and spend the day with hands-on map and compass practice using the map provided, completing the exercises designed for that site.

The objectives are to complete the exercises while expending the least amount of effort, leaving plenty of energy to get back and possibly to handle an emergency. Much of the day takes place off-trail, traveling over a variety of terrain.

What You Will Need

Bring the hiking gear used on Dry Land Travel Field Day, though a water crossing is not likely. Bring lunch and at least two quarts/liters of water. In addition to a compass, you will be working with the map for your site. **Please bring the map on which you have plotted all the points assigned to your group via bearings or features.** As explained in the following chapter, you will also need a pencil, pencil sharpener, and index cards. A clear plastic bag to protect the map will be helpful if it rains or snows.

Skills and Subject Areas Covered

This field day will demonstrate the concepts of orientation, route finding, and navigation. You should determine the following features during your preparation:

- **Baseline** – a long **linear feature, often distant**, that is always in the same direction from the route. It may be visible only occasionally (such as I-70, the Front Range, the plains). If you get lost, locate the baseline to help re-establish your position.
- **Handrail** – a prominent **nearby linear feature** (such as a creek, jeep road, ridge or valley, power line) that parallels the intended route. Keeping a handrail mostly in sight ("following a handrail") helps keep you on course without having to constantly refer to the map.
- **Fail-safe** – a prominent **nearby feature**, often one that crosses your route (such as a creek, power line, another trail) or a cliff that you can use as an indication that you have traveled too far, or not far enough.

Note: the term "catch line" has been used both for a fail-safe and for a baseline. Avoid using it to avoid confusion.

Orientation is the process of finding your position on the map. It is the critical "YOU ARE HERE" first step in navigation. Periodically orienting yourself during a hike is essential to prevent getting lost.

Note: WTS students may use an altimeter to determine their elevation. Compare the reading to the topo map to determine if you are on target. Remember that weather strongly affects the altimeter, causing it to change throughout the day.

Route finding is the art of choosing a suitable, efficient (time- and energy-saving) pathway to a destination. This involves selecting a route that is well within the abilities of each member of your hiking party. A direct route provides the **shortest** traveling distance, but it is often **more efficient** to take an indirect route to bypass obstacles or to walk on easier terrain. Several principles to keep in mind are:

- **Trails** may not be the most direct route but are often much easier traveling than going off-trail and therefore are the more efficient route. A surprising hazard of trails is that far more hikers become lost on-trail than off-trail. Your navigation skills are important on-trail, too. Use a trail map to learn the direction, distance, and distinctive features of the trails you choose. If the terrain you are traversing does not match what you expect from the map, then be alert to the possibility that you have taken a wrong turn.
- **Streams** are distinct lines (usually blue) on the map that can provide straightforward routes or handrails, especially those in wide U-shaped contours (wide valleys). Those with narrow V-shaped contours (i.e., narrow gullies) may be full of undergrowth and trees that make travel difficult. Note that intermittent streams (dashed blue lines) may be dry.
- **Ridges** can provide straightforward routes or handrails. You know you are traveling on a ridgeline when the ground on both side of you is lower than you are.
- **Contour lines** look easy to travel but are difficult to distinguish in the field. In addition, people tend to drift downhill, and ankles do not cheerfully bend sideways for long distances.
  - Note that contour line intervals vary on different maps.
  - Many features, such as rocky outcrops, ridges, and gullies, are too insignificant to appear on the map, yet are formidable obstacles in the field.

- **Hint:** Satellite maps zoom in to a level that displays details as small as fallen trees, rocks, and shrubs and can decrease surprises.
- **Date of the map:** Remember that changes in trails, vegetation, structures, etc. may have occurred since the creation of the map.

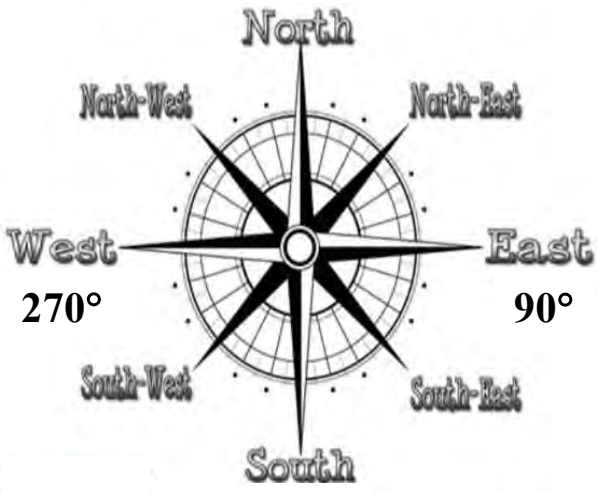
Navigation is the process of staying on course as you travel to your intended destination and back to the trailhead. Remember to look back at – or take a photo of – features such as trail junctions, stream crossings, and landmarks so you can find them if you need to go back. Good navigational skills will keep you found.

- **Orienting a map –** Align the map with the real world so that you can accurately match the map with the terrain. A straightforward way is to position yourself facing north and hold the map so that north is at the top.
- **Triangulating –** To determine your location:
  - Take bearings on two (or more) prominent landmarks in the field that you can recognize on the map.
  - Draw the bearings on the map. Your location is at the intersection of the lines.
  - If your trail is shown on the map, you can take a bearing on a single landmark and determine where the bearing line intersects the trail.
- **Determining your stronger eye –** Sight on a nearby object and, using both eyes, cover it with your thumb. Then close one eye at a time to see which one places your thumb closer to the object. This is your stronger eye. Remember to use your strong eye every time you sight.
- **Walking a bearing –** When the best route is a direct path, you need an efficient way to walk a straight line. Rather than holding your compass before you as you travel, find and go to interim points.
  - Sight to a nearby prominent feature on the desired bearing, then walk to it.
  - Leapfrogging – If there is no prominent feature or during times of low visibility, send someone out to act as the next interim point, sighting with the compass and instructing them to move right or left as needed. (**Hint:** Decide who's right or left at the start. Referencing the direction of travel is often the simplest method.)
    - For greatest accuracy, the front person can verify the bearing by sighting back to you.
    - For the greatest speed, the front person can take the next bearing so that the group can move on as soon as the position is established.
    - Be sure to stand directly in front of the object to take the next bearing to keep your route from drifting.
- **Aiming off –** When following a bearing in the field, it is common to inadvertently wander off the direct line. To avoid problems associated with this, plot a bearing that is slightly – about 5 degrees – left or right of your destination. When you come close to your destination, you will then know to turn in the correct direction, instead of having to search both left and right.

- **Boxing an obstacle –** Get around an obstacle that prevents a direct line of travel. Plot a bearing that takes you 90 degrees left or right of the obstacle, count paces until you think you are far enough to the side, then head off again using your original compass bearing. Once you have passed the obstacle, plot a new bearing that will take you 90 degrees back the same number of paces. In theory, you will now be back on your original bearing.

- **Counting Paces –** The Map and Compass Field Day begins with students determining their own pace. In this context, a **p**ace is defined as a **p**air of two footsteps, roughly 5 feet. The average is about 1,000 paces per mile on level terrain when rested. You can calculate the percentage that your own pace differs from this average, then add or subtract as needed to each count. If the target is 0.1 mile away, count off 100 paces to reach it, plus or minus your percentage. This is a very useful measure, although you must adjust for variation in people's stride length, load, fatigue level, and steepness and roughness of terrain.

Employing these concepts while traveling cross-country enables you to travel confidently and avoid taking wrong turns and getting lost. You also avoid spending unnecessary energy because good navigational decisions allow you to take the most expeditious route. On this field day, you will spend extensive time learning to read a topographic map and to use a compass.

Units of Measurement	**Compass Points**
There are 360° in a circle. 1° = 60' (minutes) 1' = 60" (seconds) 1' = 0.01667°, 1'' = 0.00028° 1 mile = 5280 fee = 63,360 inches 1 mile = 1.61 kilometers 1 kilometer = 1000 meters 1 kilometer = 0.62 mile 1 meter = 1.1 yards 1 football field = 91 meters	**360°**  **180°**

CHAPTER 9 – MOUNTAIN NAVIGATION BY MAP AND COMPASS

By Joe Griffith, Revised February 2019

Objectives: Upon completion of this chapter, you will be able to:

- Describe the basics of using **maps** including:
  - What kind of maps you need and sources for maps
  - Map scales and how to measure distances on a map
  - What the colors and symbols mean
  - What topographic maps show – contour lines, index contour lines, and contour interval
  - How to orient your map
- Describe the basics of using a **compass** including:
  - How to use the compass as a protractor to measure angles
  - How to measure bearings on the map
  - How to use the compass in the field
  - How to work with magnetic declination
  - How to find your location using intersecting bearings
  - How to follow a bearing in the field

Next Steps: When you want to do more.

- Navigation 1, Nav 2 (navigation) – self-paced online plus field day courses

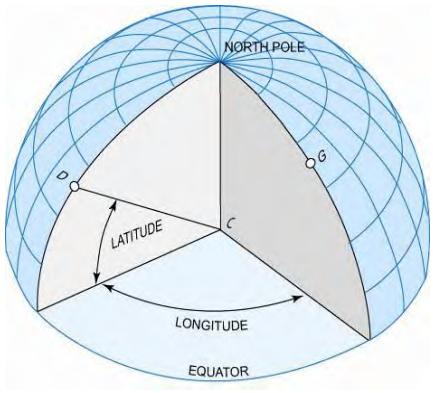
The ability to use the map and compass is one of the principal keys to safe and enjoyable travel in the wilderness. Indeed, in some emergencies, it may be the key to survival for you or for members of your party. In the Wilderness Trekking School course, we hope to introduce you to some of the fundamental skills necessary to find your way in the wilderness. These include **orientation** – finding your exact position on the map; and **navigation** – figuring out the location of your objective and staying on the right course all the way from the starting point to your destination. A third skill, **route finding**, includes the art of selecting the optimum path to your objective that is consistent with the skills, equipment, and desires of your party. Expertise in route finding depends on skill in orientation and navigation combined with broad experience in the mountains, close observation of the topography, the ability to interpret weather and snow conditions, and, sometimes, on intuition and dumb luck. To quote *The Freedom of the Hills*, it is, *"...the key to wandering at will through valleys and meadows, up cliffs and over glaciers, earning the rights of a citizen in a magic land, a mountaineer with the freedom of the hills."*

Map and compass are well suited to wilderness navigation. They are dependable, inexpensive, and easy to carry. To use them you will need to learn some (possibly unfamiliar) concepts and techniques that we cover in this manual and in the lecture videos. These concepts also apply to GPS navigation, though we do not use or allow GPS for navigation in this course. Once you have mastered these basic concepts you will find your map and compass to be powerful tools for efficiently reaching your destination.

About Maps

Latitude and Longitude

Where on earth are you? The most common way of describing the position of a point on the earth's surface is by giving its latitude and longitude – a system used ever since man realized that the earth is not flat. The accompanying drawing shows the northern hemisphere with the North Pole at the top and the plane of the equator at the bottom. The drawing shows a slice cut through the earth along two planes along the earth's axis and perpendicular to the equator. One of the planes passes through the Royal Observatory at Greenwich, England (G); the other passes through Denver (D).



The **latitude** of any point on earth is the angle between a line joining that point to the center of the earth (C) and the plane of the equator. In the case of Denver, it is about 39º 45'.

Longitude is the angle measured in the plane of the equator from the plane containing the earth's axis and Greenwich (G) to the comparable plane containing some other point, in this case Denver. Longitude is measured from 0º to 180º east or west from Greenwich, with west labeled as negative degrees. The longitude of Denver is -105º.

Parallels are the lines of latitude that form circles on the earth's surface that are concentric with the poles. Latitude is measured from 0º to 90º north or south (negative) from the equator.

Meridians are the lines of longitude that form circles of the earth's surface and intersect at the poles. Meridians are always true north-south lines. Notice that the distance between parallels is essentially the same everywhere, but the distance between meridians gets smaller the farther you are from the equator and becomes zero at the poles. When we measure a bearing, we line up the meridian lines in the rotating dial of the compass with the map meridians.

Map Scales

A topographic map is a drawing to scale of some part of the Earth's surface. The scale of the map is usually a ratio or a fraction showing the number of units of measurement on the ground represented by one of the same units on the map. For example, on a 1:24,000-scale map, one inch on the map represents 24,000 inches on the ground; one centimeter represents 24,000 centimeters, etc. If you want to calculate how many feet on the ground equal an inch on the map:

> 1 inch on the map = 24,000 inches on the ground.
> There are 12 inches in a foot, and 24,000/12 = 2000 feet.
> Therefore, 1 inch on the map represents 2000 feet on the ground.

Similarly, if you think metric (as you should if your travels take you to any country in the world besides the U.S. and Liberia) and you wish to know how many meters equal one centimeter on the map:

> 1 centimeter on the map = 24,000 cm on the ground.
> 100 cm = 1 meter, and 24,000/100 = 240 meters.
> Therefore, 1 cm on the map represents 240 meters = 0.24 km on the ground.

Maps come in a wide range of scales depending on their intended purpose. The official state road map of Colorado has a scale of 1:1,000,000. The U.S. Geological Survey (USGS) provides more detailed 22" x 27" maps covering quadrangles about 56 miles wide and 34 miles high at a scale of 1:100,000, and maps of individual counties at a scale of 1:50,000. The most detailed maps that are readily available are the USGS 7.5-minute quadrangle maps at a scale of 1:24,000**.** The USGS quad maps have been replaced in WTS by 8.5" x 11" maps customized for each class's destination areas, printed through the CalTopo.com online program. These maps are usually based on USGS data, called a scanned topo layer, plus a layer with updated trails, and sometimes with a slope angle shading layer.

If we express the scale of maps as fractions, notice that 1/24,000 is larger than 1/50,000, and much larger than 1/1,000,000. Thus, we speak of 1/24,000 as a large-scale map, and 1/1,000,000 as a very small-scale map. **Notice that as the scale of a map increases, the area it covers becomes smaller and the amount of detail it portrays becomes larger**. The scale of the map we choose for a particular purpose depends on a balance between the size of the area we are considering and the amount of detail we need. Thus, if we are planning to fly a plane from San Francisco to New York, we want a small-scale map; if we are planning a day hike in the mountains, we want a large-scale map. If we are trying to find an unfamiliar trailhead, we may want an intermediate-scale map.

Measuring Distances on the Map

If you know the scale of a map, you can measure the distance between two points on the map in inches or centimeters and then calculate the distance between the points on the ground, using the number of feet, meters, or other units on the ground that equal each inch or centimeter on the map. However, it is much easier to do it by using the bar scales on the map.

On all USGS maps, the bar scales are in the middle of the bottom margin; on commercial trail maps, they are usually found somewhere around the map margin, commonly in the legend box. These scales stand for distances on the map, commonly in feet, miles, meters, and/or kilometers. To measure the distance between two points on the map, lay the edge of a file card between the points and make pencil marks on the card opposite each of the points. Then place the card along one of the scale bars to read the distance in whatever units you choose. Note that on all USGS maps, and on many other maps, the zero on the scale is not at the end of the scale bars. In the example below, the bar to the right of zero is in large units (miles, thousands of feet, hundreds of meters, etc.), and small units are to the left of zero. To use a scale with this layout, place the right pencil mark on your file card at the end of whichever one of the major distance divisions that will place the left pencil mark in the smaller subdivisions left of zero (Figure 2).

The base of the compass also has useful scales. In the United States these usually include a scale in inches and one in tenths of a mile for a 1:24000 map. If the map has been printed correctly, then the map scales should line up with the scales on the compass.

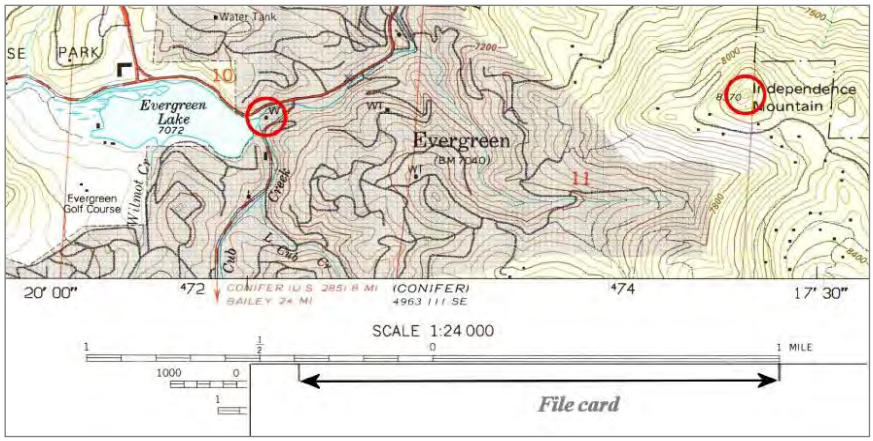


Figure 1: Measuring the distance between the two points circled in red on the map using the bar scales. The distance has been ticked off on the file card and the edge of the card placed along the mile scale bar. The distance is slightly less than 1.4 miles.

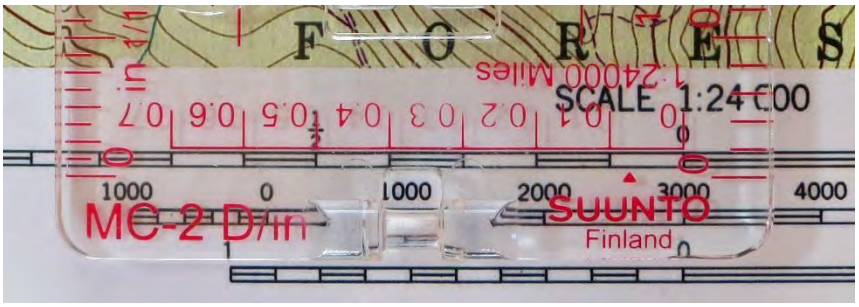


Figure 2: Verifying the map scale. On the map the top scale is in miles, with increments of 0.1 mile to the left of 0. The scale on the base of the compass coincides with it, showing that the map was properly printed to scale.

Map Symbols and Colors

USGS maps over the years have used several different conventions for marginal information and for symbols and colors. Commercially prepared trail maps usually use similar symbols and colors and provide the same marginal information, but commonly in somewhat different formats.

The latitude and longitude are marked at the corners of the map and at two intermediate places along each margin.

Scale, bar scales, contour interval, magnetic declination, and **date of last revision** are in the bottom margin.

Orientation – The sides of the map are true north-south lines; the top and bottom of the map are true east-west lines. North is at the top.

Lines and symbols – The assorted colors represent specific features on the ground:

Green shows vegetation – forested areas, scrub, etc. – dense enough to hide in.
Blue shows water – streams, lakes, swamps, permanent snowfields, glaciers, etc.
Black shows works of man – buildings, roads, trails, political boundaries, and geographic names.
Red shows section lines and major roads.
Purple on some maps shows features added from aerial photographs during interim revisions of the map.
Brown shows contours lines – the topography or the shape of the land surface.

Contours

A **contour** is a line on the land surface that connects all points that are at an equal elevation above sea level. We refer to the brown lines on the map that depict contours as **contour lines**. If you travel along a contour you will remain at the same elevation, regardless of how steep the slope. The **contour interval** is the vertical distance you must climb or descend to reach the next contour uphill or downhill. On the CalTopo maps that you'll receive of the mountains of Colorado, the contour interval is 40 feet, with heavier **index contour lines** every 200 feet. At intervals, labels on the index contour lines show the elevation. The spacing of the contour lines shows the **slope**. If the slope is gentle, you will have to hike uphill a considerable distance to reach the next higher contour – if it is steep, you will have to hike a much shorter distance. If the contour lines are on top of one another, the slope is vertical, and you will have to climb straight up. To find the slope along a trail, measure the distance along the trail between places where the index contours cross it.

The contour interval sets the resolution with which your map can show vertical variations in the terrain. In most locations, there will be many features that are shorter than the contour interval: small outcrops, ravines, depressions, and cliffs. Some of these small features may cause a wiggle in a contour line, but usually they will not appear on the map.

The general rule – **the closer together the contour lines are on the map, the steeper the slope is on the ground** – is all you need to know for most map reading. Occasionally, however, you may want to estimate the actual angle of the slope from the contour spacing on the map. For example, slopes that are between 30° and 45° are those most likely to avalanche. Clinometers used to measure slopes in the field directly give the slope angle in degrees, so most descriptions of avalanche hazard use this language to describe the terrain. Online map sites (such as CalTopo.com) display slope angle shading in degrees. When we estimate slopes from the contours on our maps, on the other hand, we use the elevation gain versus the horizontal distance, sometimes called "rise over run." To convert between these measures, *see* ***How to Estimate Slope*** in the Navigation Addendum.

Newer versions of the MC-2 have scales on the sides of the mirror housing that can be used to estimate slope (Figure 3). Make sure that you choose the correct scale and contour interval for the map.

Figure 3 Measuring the slope of an area with scales on the MC-2 compass. The lower part of this avalanche chute has a slope of 25°.

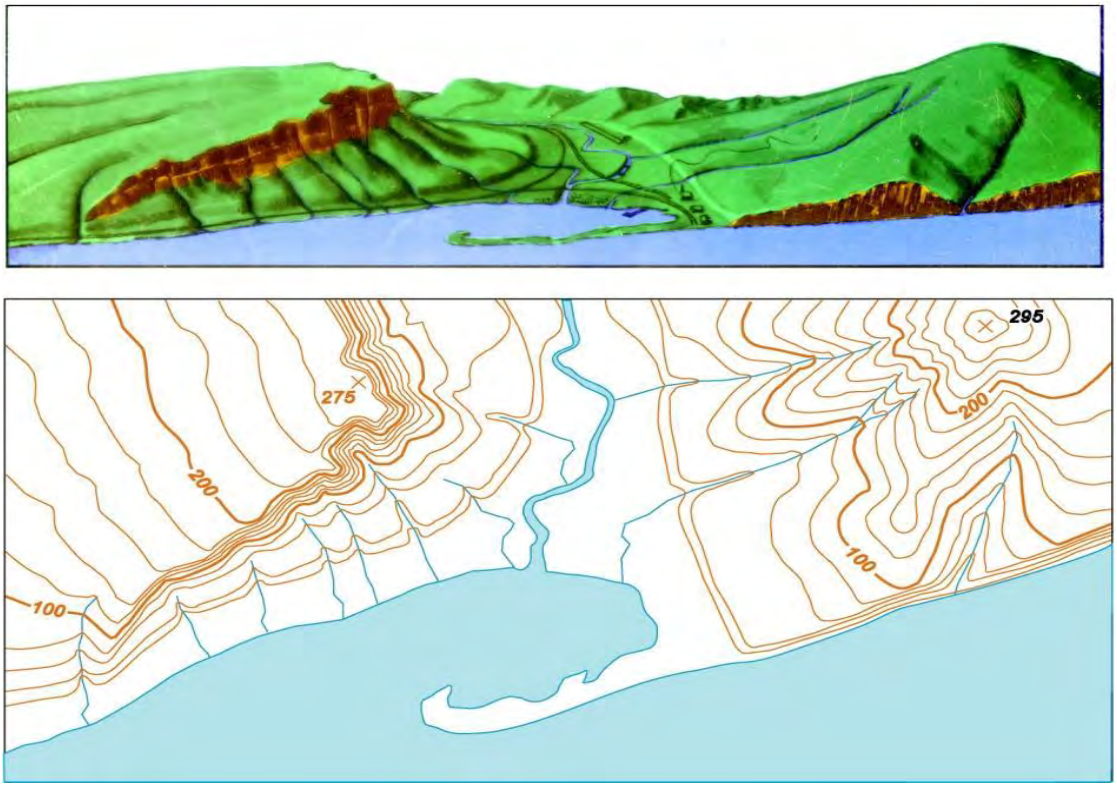


Figure 4: Perspective drawing of a landscape and contour map of the same landscape. Contour interval is 20 feet.

Reading the contours lines and learning to pick out the hills, valleys, ridges, peaks, and saddles is an essential skill that you master only through practice in the field. We will cover it in the video lectures, group meetings, and practice it in the field exercise, but here are a few simple rules that will help you begin:

- All points along a contour line have the same elevation.
- Land on one side of a contour is always higher or lower than that on the other. When you cross a contour, you are always going uphill or downhill.
- The high side of a contour is always on the same side.
- Where a contour crosses a valley, it bends into a U or V that points up the valley. On the map, you can recognize a valley because the U- or V-shaped segments of the contour lines point toward the higher elevations. If there is a stream in the valley, the U- or V-shaped contour segments point upstream.
- Conversely, where a contour crosses a ridge, it forms a U or a V that points down the ridge. On the map, you can recognize a ridge because the U- or V-shaped segments of the contour lines point toward the lower elevations (i.e., sag down the ridge).

- The shape of the U- or V-shaped contour line segments tells you the shape of the valley or ridge. U-shaped contour lines mark broad, flat-bottomed valleys or smooth rounded ridges. V-shaped segments mark narrow, steep-sided valleys, e.g., Clear Creek Canyon, or narrow, jagged ridges.
- Closed contour lines show hilltops unless they are marked with brown ticks; in which case, they mark closed depressions (see "depression contours" on the symbol sheet).
- Hourglass-shaped contours indicate saddles or passes

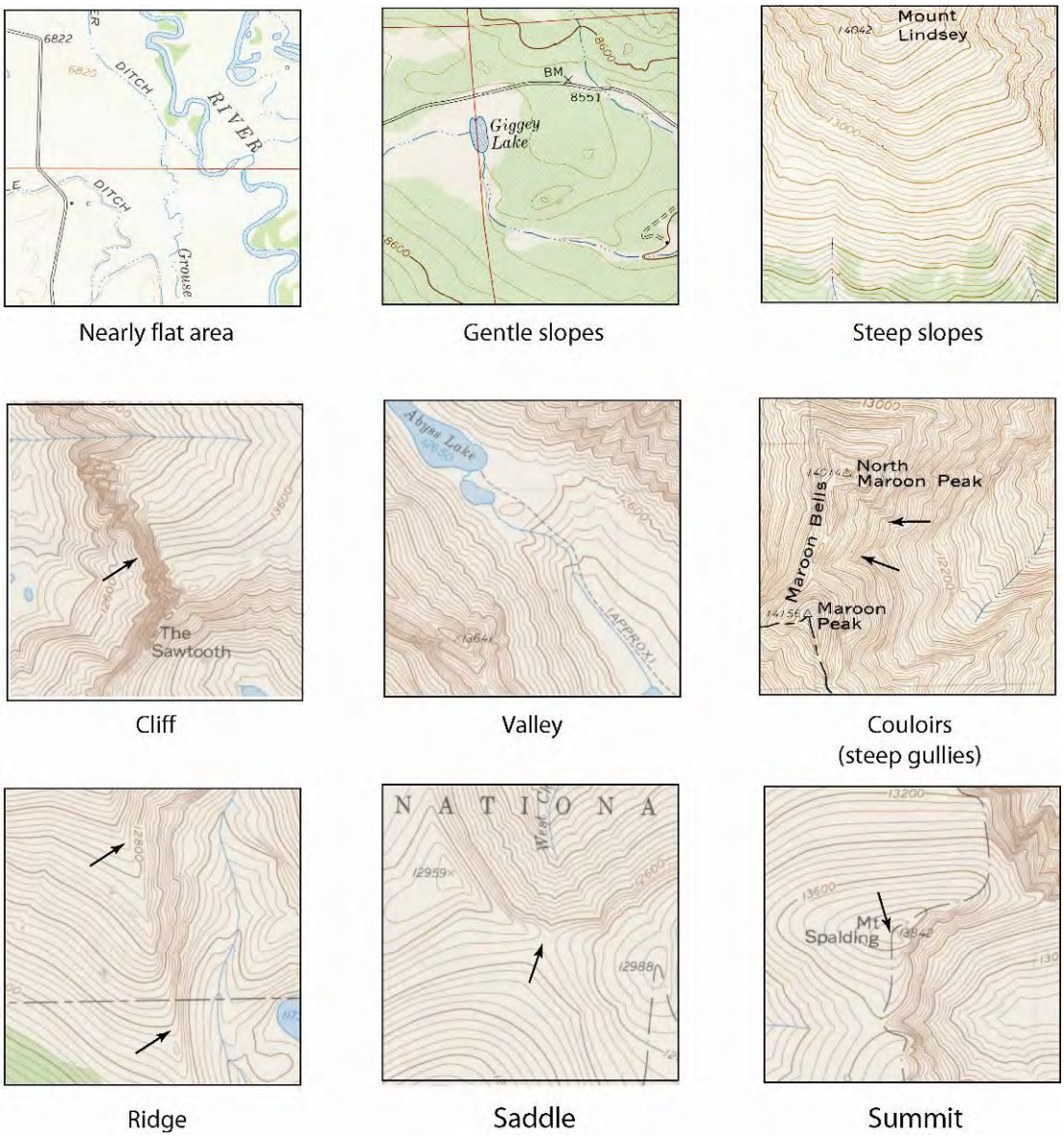
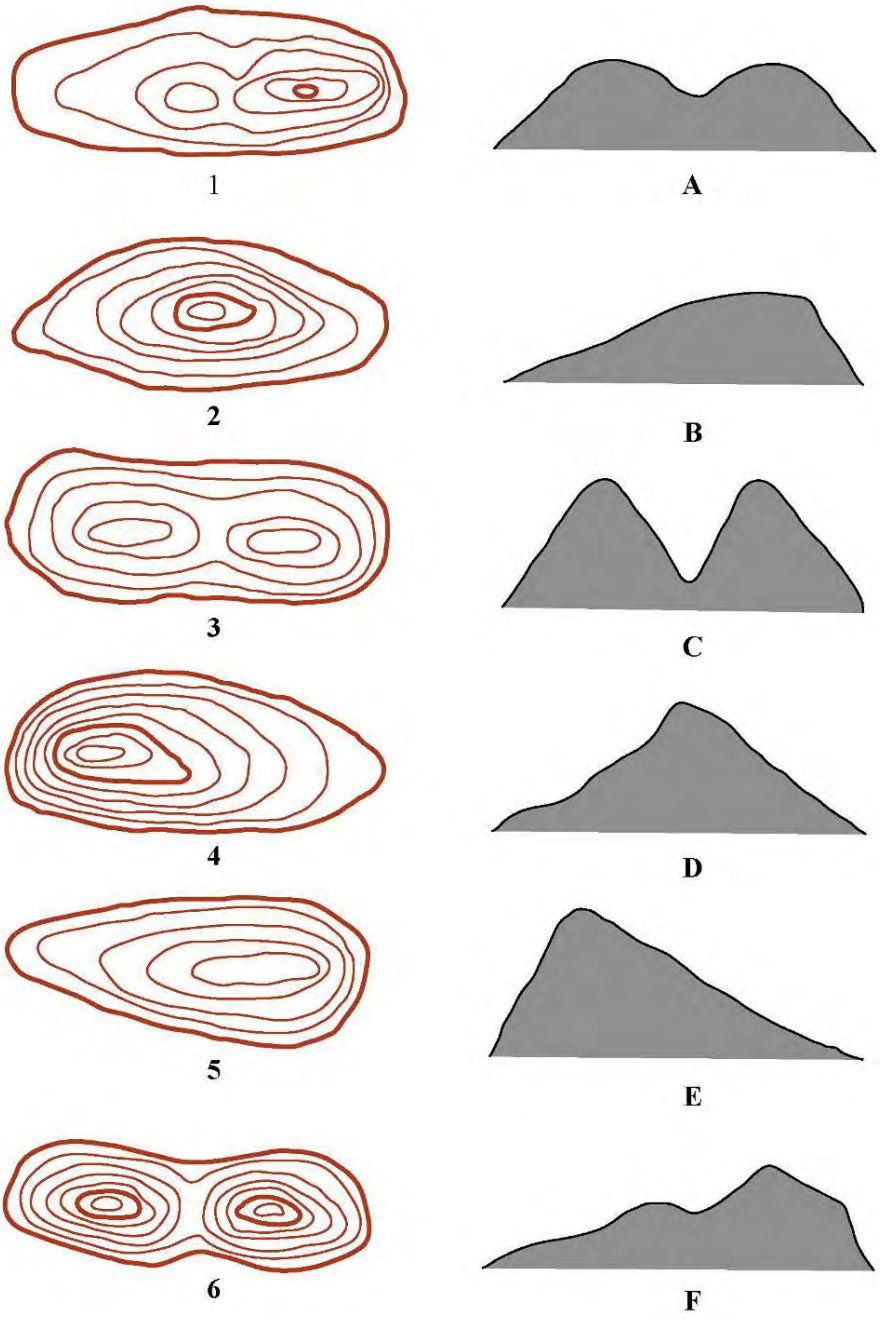


Figure 5: Some topographic features shown by contour lines. All maps are at a scale of 1:24,000 with 40-foot contour lines.

Self-Test on Contours

In the left column are a series of contour maps showing various hills. On the maps, north is up and the contour intervals are all the same. In the right column are a series of silhouettes of the same hills as viewed from the south (bottom of the page). See if you can match the silhouettes in the second column with the maps in the first column. The answers are at the bottom of the next page.



Equipment – the Compass

For the map and compass field exercise, we will give you a map and a leaflet illustrating various map symbols. You will need to obtain a compass and a few other items.

Compasses suitable for getting around in the mountains come in a bewildering array of makes, models, and prices. To simplify the WTS map and compass instruction, we have settled on using compasses that have the following features:

1. **A rectangular base and a rotating dial** with a series of parallel lines (meridian lines) that rotate with it. This allows you to use the instrument as a protractor for measuring and plotting angles on the map as well as for taking bearings in the field. The meridian lines should be no more than ¼-inch apart. There should be at least four of them inside the dial.
2. **A dial graduated** from 0° to 360° clockwise from north. Another system uses bearings that go from 0° at north to 90° at east and west, and from 0° at south to 90° at east and west. This is a perfectly good system, but for simplicity in instruction, we have chosen to use only the 0° to 360° system for WTS. Most compass models are available with either type of graduations, so be sure to check before buying.
3. **A sighting mirror**
4. **Measures** in inches/miles instead of meters

The Suunto MC-2 D/in and Silva Ranger 2.0 (not Quad) meet all WTS requirements. Please note that the military prismatic compass and its various imitations are not suitable for WTS because you cannot use it as a protractor.

Compasses that meet or exceed WTS requirements come in a wide range of prices; the higher-priced ones sport a variety of additional features, including a clinometer for measuring slope angles and a useful magnifying lens area. Some allow you to pre-set the declination, although WTS does not allow use of this feature early in the course.

If you are a novice to map-reading and backcountry travel, we suggest that you stick with a simple basic model – you can upgrade later if you want to. If you are going to take the Avalanche Awareness School, you may want one with a clinometer. Figure 6 shows the Suunto MC-2 D/in compass.

Figure 6: Suunto MC-2 D/in

In addition to your map and compass, serious map work requires a sharp pencil with a good eraser – a simple wood pencil is best, because mechanical pencils can affect the compass if held too close to it. It is also useful to have a 3 x 5" file card for marking off distance measurements. It is convenient to carry the folded map, pencil, file card, and a small piece of sandpaper (for sharpening the pencil) in a small plastic bag that will fit in your shirt pocket or an outside pocket of your pack.

Answers to self-test on contours: 1F, 2D, 3A, 4E, 5B, 6C

Using the Compass

Much of the time, you can locate yourself and navigate to your objective simply by studying the map and following it carefully. However, there are many times that the compass is an invaluable tool. A compass of the type that we use in WTS is useful as a protractor for measuring or plotting angles on the map as well as for measuring bearings in the field. Most of them also have scales on the base plate that allow you to measure and plot distances on the map. Figure 7 illustrates the principal parts of one such compass.

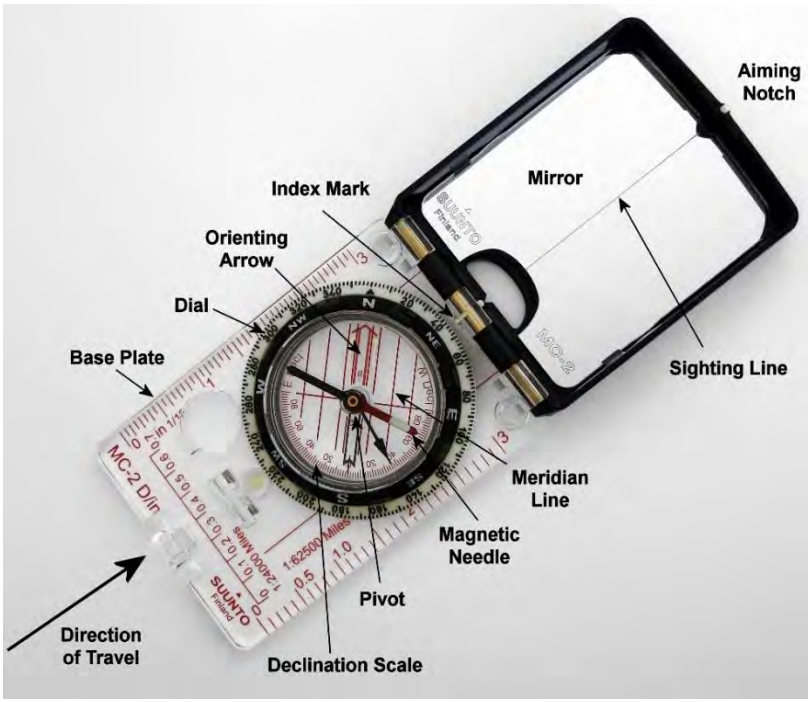


Figure 7: Principal parts of the Suunto MC-2 D/in

Using the Compass as a Protractor to Measure and Plot Angles

As you take out your compass and name the parts labeled in the figure, experiment with turning the graduated rotating dial. Hold the compass horizontal with the base closest to you and the mirror open flat and farthest from you. As you turn the dial, notice that the index mark stays stationary, but the orienting arrow and the meridian lines rotate with the dial. If you turn the dial so that the N (or zero) on the dial is directly over the index mark, the orienting arrow and the meridian lines are parallel with the long edges of the base plate and the orienting arrow is pointing away from you. If you turn the dial so that E (or 90) on the dial is over the index mark, the orienting arrow will point toward the left edge of the base plate and the arrow and the meridian lines will be perpendicular to the edges of the base plate. If you turn the dial so that S (or 180) on the dial is over the index mark, the orienting arrow and meridian lines will be parallel to the edges of the base plate with the orienting arrow pointing toward you. Similarly, if you set the dial to W (or 270), the orienting arrow and the meridian lines will be perpendicular to the edges of the plate, and the orienting arrow will point to the right edge of the base plate. As you can see from this exercise, what the dial is measuring is the angle in degrees measured clockwise from the orienting arrow (and the meridian lines parallel to it) to the direction of travel arrow (and the edges of the base plate parallel to it).

Thus, the rotating dial and the base plate are really a special type of protractor, and we can use it to measure angles between any two lines. Important note: Some compasses do not have a direction of travel arrow. In that case, the angle the compass is measuring is the angle from the orienting arrow to the long (left and right) edges of the

base plate **with the aiming notch on the mirror pointed in the direction of the second line.**

Because the map is a drawing to scale, we can measure both the distances between points on the map and the angles between lines drawn on the map (at least on maps of small areas that you'll use in WTS). We are most interested in the angle of a line between two points on the map and an imaginary line pointing north. **The bearing of a line between two points is the angle measured clockwise from a north line to the line that joins the first point to the second point.** For example, if you are standing at point A in Figure 8, the bearing to point B is 054º; if you are standing at point B, the bearing back to point A is 234°. Similarly, the bearing from point A to point C is 340º, and the bearing from point C to point A is 160°.

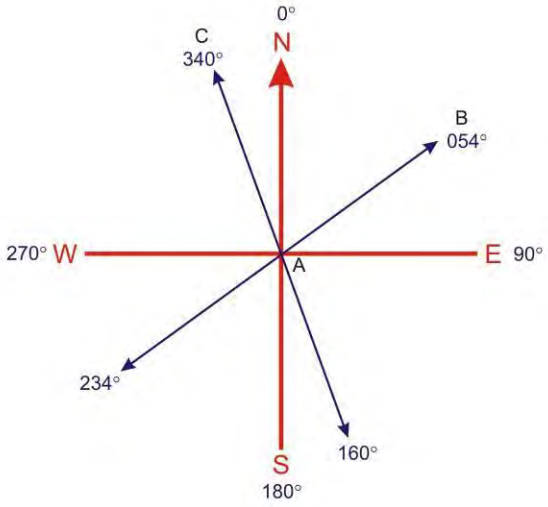


Figure 8: Bearings of lines in various directions from the intersection of the lines at point A

If we measure the angle from true north on a map, it is a **true bearing**. The bearings we measure **on the map** are true bearings, aligning with the globe's lines of longitude. For a memory device, think, "The map is true."

If we measure the angle from magnetic north with a compass in the field, it is a **magnetic bearing.** The compass needle aligns with the magnetic field produced by the earth's molten core and points to the magnetic North Pole. We sometimes want to convert between true and magnetic bearings. Those we measure with the compass **in the field** are magnetic bearings, which we usually want to convert to true bearings for use on the map.

Notice in Figure 8, that the bearing from point A to point B is in exactly the opposite direction of the bearing from point B to point A. If you know that the bearing from point A to point B is 180° or less, add 180° to get the bearing from point B to point A.

If the bearing between two points is greater than 180°, subtract 180° to get the bearing going in the opposite direction.

To avoid mistakes, especially when giving bearings over a telephone or radio, it is customary to use three digits for bearings of less than 100°. Thus, we would say **zero five four** degrees in the example above.

Drawing North-South Lines on the Map

To use the compass to measure bearings on a map (and to plot your map points), you must first draw a series of true north-south lines, or meridians, on your map.

Figure 9 shows a CalTopo map. North is at the top and the right and left edges of the map are true north-south lines. Figure 9 shows longitude tick marks across the top and bottom of the map connected by hand-drawn true north-south lines.

If your map includes these ticks, you may use them to draw the north-south lines. Otherwise, you may use a vertical edge of your map. Draw the lines using a ruler and a sharp pencil or pen. The width of the ruler is usually about the right east-west spacing for the added lines in the series. Draw these meridians carefully because any misalignment in them will affect the accuracy of your plots.

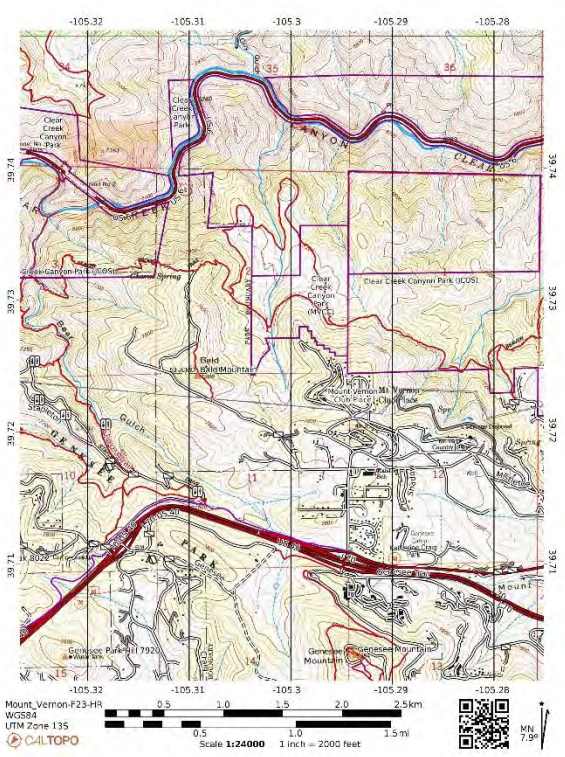


Figure 9: True north-south lines drawn on the Mount Vernon map using the longitude ticks.

Section lines, shown by thin red or black lines on the map, are supposed to be true north-south and east-west. However, because of errors in the early surveys, some section lines depart significantly from their intended directions. Check the section lines on your map carefully before using them for navigation.

How to Measure a Bearing on the Map

Step 1. Draw the line whose bearing you want to figure out on the map. For example, it might be a line joining your present position A with your destination B as in Figure 10, or a line joining a peak on which you are standing with a peak you want to identify.

Step 2. Place either of the long (left and right) edges of the compass base plate along the line with the direction-of-travel arrow or aiming notch pointing toward the feature whose bearing you wish to figure out.

Step 3. **Ignore the compass needle.** (The compass is for determining magnetic bearings in the field, not true bearings on a map.) Turn the rotating dial until the orienting arrow or any of the meridian lines are parallel to a north-south line on the map and the orienting arrow points north on the map. To do this, you may have to draw additional north-south lines or slide the compass along the bearing line to reach another hand drawn north-south line.

Step 4. Read the true bearing at the index mark on the compass base plate. On Figure 10, the bearing from A to B is 320°.

How to Draw a Line with a Given Bearing from a Given Point on the Map

This problem is just the inverse of measuring a bearing:

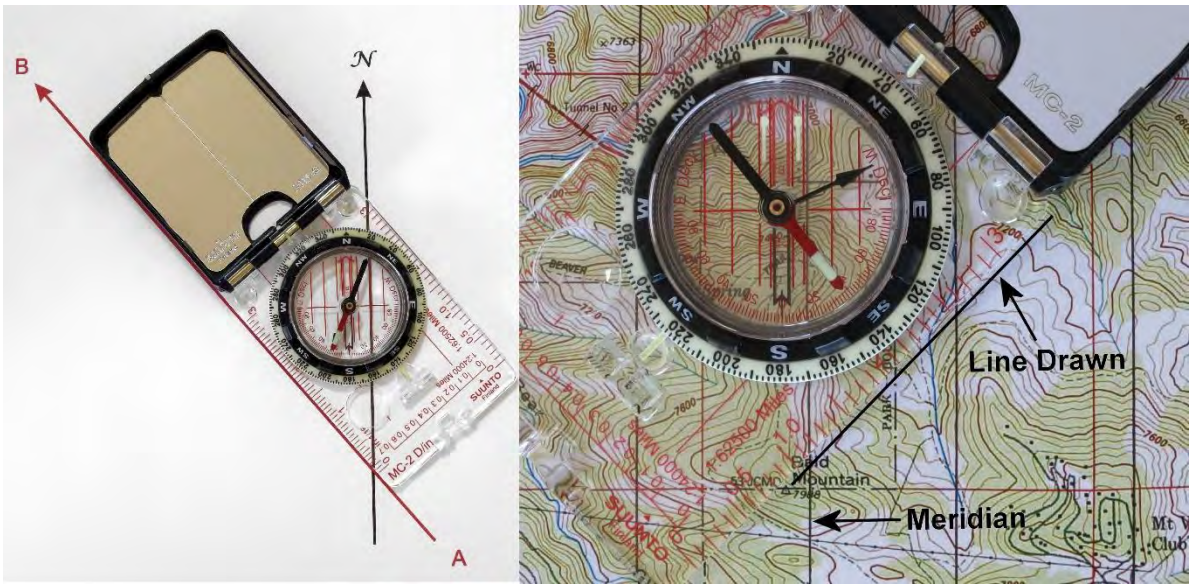
Step 1. Locate the given point from which you wish to draw the bearing and be sure that there is a north-south line conveniently located nearby. In Figure 11, the given point is the survey marker shown by a small black triangle on the top of Bald Mountain.

Step 2. Set the given bearing on the rotating dial of the compass at the index mark. In Figure 9, the bearing is 045°.

Step 3. **Ignore the compass needle.** Place the compass on the map with the orienting arrow or any of the meridian lines parallel to a north-south line on the map and the orienting arrow pointing north.

Step 4. Slide the compass along the north-south line on the map, keeping the meridian lines parallel to the north-south line until either of the long edges of the base plate passes through the point from which you wish to draw the bearing.

Step 5. Draw the bearing line along the edge of the compass in the direction of the direction-of-travel arrow (or toward the aiming notch).



How to Plot a Point on the Map Using Distance and Direction from a Reference Point

Important – You will use this technique to plot most of the points in your Map Points homework assignment.

Step 1. Locate the reference point on the map from the description given. For example, the reference point for several of the map points is the top of Bald Mountain.

Step 2. Plot the bearing from the reference point as described in the earlier section. All bearings given in the Map Points descriptions are true bearings.

Step 3. Measure distance by marking a file card using the bar scale at the bottom of the map. Notice that there are bar scales for miles, kilometers, and feet – be sure to use the right one. To measure: Place the edge of the card along the proper bar scale and make pencil marks on the card at the correct large division to the right of zero on the scale and at the correct smaller division left of zero on the scale. For example, to measure 3400 feet, make a pencil mark at 3000 feet right of zero and 400 feet left of zero. In Figure 12, the given distance is 0.72 miles, so make marks at zero and at 0.72 left of zero on the miles bar scale, (you will have to estimate the 0.02 because the scale is in tenths of miles). Then lay the card along the bearing line you drew in Step 2, with the left pencil mark at the reference point. Mark the position of the point looked for on the map at the right tick mark on the card. You may have to extend the bearing line to reach the point.

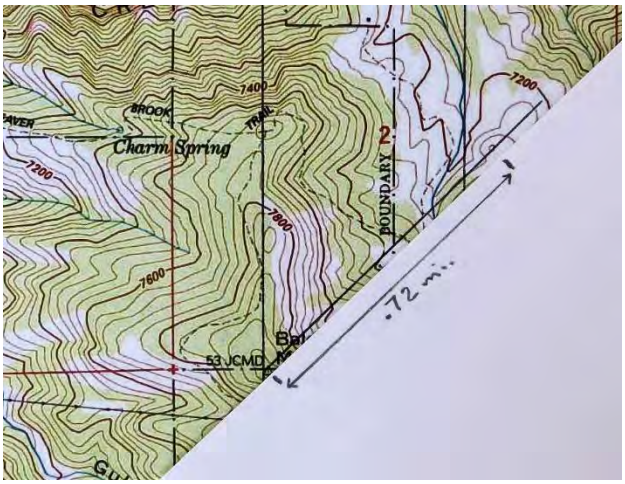


Figure 12: Plotting the position of a point on the map 0.72 miles from the top of Bald Mountain on a bearing of 045°

Step 4. Carefully check the point you have plotted and adjust its location to fit the detailed description given on the Map Points page.

Using the Compass in the Field

We use the magnetic compass needle ONLY in the field, e.g., use the magnet for moving. Do NOT use the magnet at a desk! We use the compass in the field to help orient the map, to figure out bearings, and to follow bearings measured from the map. In all these cases, we align the orienting arrow (in the compass base) with the compass needle that points to magnetic north. Thus, we are measuring bearings clockwise from magnetic north, and it is therefore necessary to allow for **magnetic declination** – the difference between true north and magnetic north.

Magnetic Declination

True north is the direction to the north **geographic pole**. However, the compass needle points to the earth's **magnetic north**. The lines of force in the earth's magnetic field converge at the north and south magnetic poles but are curved and distorted in complex patterns across the globe. The magnetic fields not only vary from place to place, but also change slowly with time. The compass needle aligns with the local magnetic lines of force. In the western U.S. and Alaska, the magnetic declination is east – that is, magnetic north lies east of true north. Along a line roughly from Wisconsin to Alabama, the declination is 0° (agonic line), and east of that line the declination is west.

Figure 13: Magnetic declination diagram on Mount Vernon map. The line with the star stands for true north; the half arrow stands for magnetic north.

All USGS quad maps and WTS maps based on USGS data include a diagram in the bottom margin giving the magnetic declination at the time the map was last revised (Figure 13). Other topo maps also give the declination at the time the map was prepared, so their declinations may be more up to date than those on USGS maps. The USGS produces maps showing the declination and rates of change of declination for the U.S. and for the world.

The best way to check the declination and rate of change anywhere in the world is to go to the **National Centers for Environmental Data**. Use the coordinates on your map or enter a ZIP code or city name to retrieve the latitude and longitude of the desired area. The Calculate button produces the current declination. For example, on the map of Mount Vernon, the 1994 map gives the declination as 11° E, but the declination in 2024 is 7.8° E, decreasing 6 minutes per year (or about 1° every 10 years). Figure 14 is a contour map for declination and shows how the magnetic declination varies across the continental United States. In the Rockies, when Denver is at 8°, Aspen is at 9° and Moab is at 10°

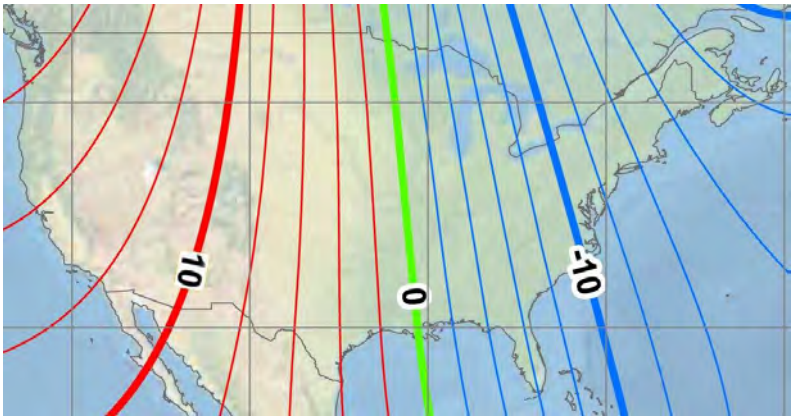


Figure 14: Declination map. The 0º declination line (agonic line) runs roughly over the Mississippi River. When west of this line, a compass needle points to the right (east) of north. See https://maps.ngdc.noaa.gov/viewers/historical_declination/)

.

To visualize this, you can determine the declination yourself by going to a point you can recognize on your map, taking a bearing on another known point, and then measuring the true bearing on the map as described above.

Converting from True North to Magnetic North and Vice Versa

When you measure the bearing between two points on the map (for example, points A and B in Figure 15), you measure the angle clockwise from the true north lines you have drawn on the map; this is the true bearing. When you measure the bearing between the same two points with a compass in the field, you measure the angle clockwise from magnetic north; this is the magnetic bearing. This example shows magnetic north east of true north, as it is in Colorado:

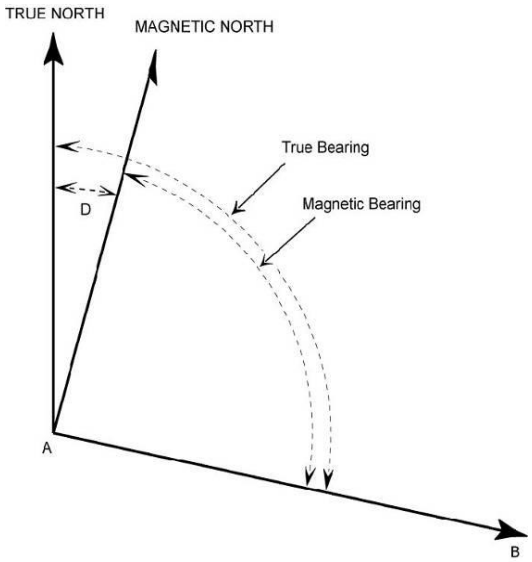


Figure 15: The true bearing from point A to point B, the magnetic bearing, and the magnetic declination.

To get the **t**rue bearing from the magnetic bearing, add the **d**eclination to the **m**agnetic bearing:

T=M+D

To get the magnetic bearing from the true bearing, subtract the declination from the true bearing:

M=T-D

If the declination was west, the sign of **D** would be reversed.

Factoring in declination – When working with a map and compass in the field, adjusting for declination is critical. Declination is the difference between true north on the map (decided by the earth's axis of spin) and magnetic north on the compass (decided by the earth's molten core). For the Front Range, the declination was about 8º east of true north in 2023. Use whichever of the following methods makes the most sense to you:

- Take the compass away from the map. (Subtract 8º from the bearing on the map.)
- Use M = T – D. (Magnetic north = True north minus Declination.)
- Picture a declination map. In Colorado, the compass needle veers toward the Mississippi River, so subtract 8º to bring your route back to the correct direction.

Some compasses allow the user to set the declination. In Figure 16 the orienting arrow has been rotated to 8° east, the 2023 value for the declination in this part of Colorado. Aligning the magnetic needle with the orienting arrow then causes the compass dial to display true north, rather than magnetic north. Shooting a bearing with this compass would give a value that can be used for plotting on a map without any added adjustment. Remember that you must **recalculate the declination** when you leave the Front Range!

Orienting the Map in the Field

Sometimes it may be helpful when following a route or recognizing landmarks to **orient** the map – that is, to turn the map so that directions on the map correspond to those in the field. [Please note that the word is **orient** not the British **orientate**.] In many cases, you can orient the map by inspection.

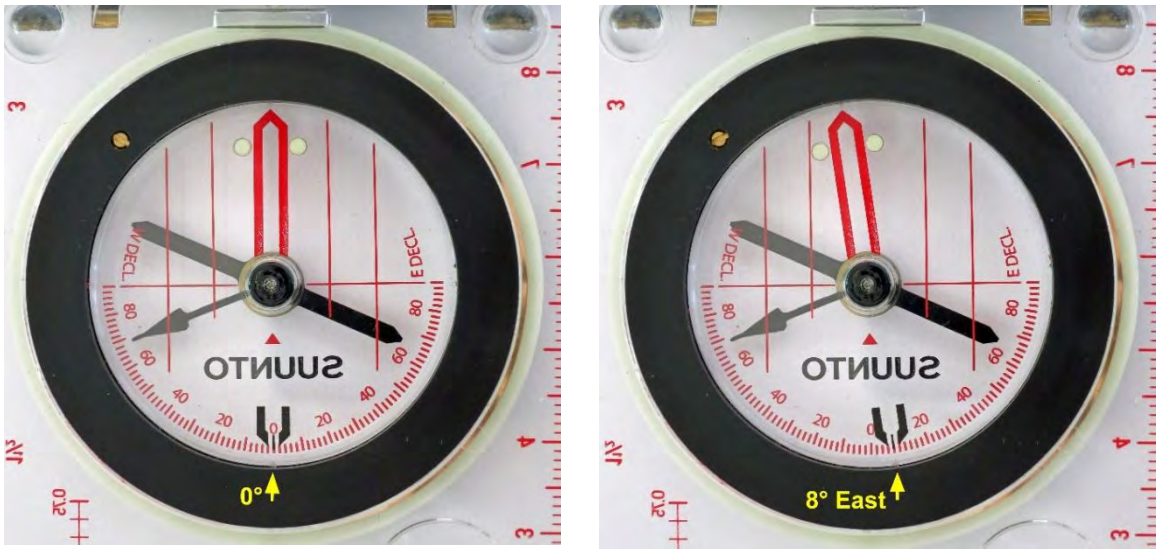


Figure 16: Declination setting. On the MC-2 one sets the declination correction from the back side of the base. On the left the declination is set to 0°**,** while on the right the declination has been set to 8° east. The red declination scale is divided into 2° increments. The yellow arrows above point to the fine black line at the south end of the orienting arrow indicating the declination value. Turn the small brass screw in the upper left quadrant of the black ring to change the value.

If you are walking down a ridge, up a valley, or along a trail, simply open the map and turn it so that the feature on the map lines up with the feature on the ground. If you know about where you are, you can also orient it by laying the map on the ground and drawing a line or laying a pencil or straight stick between your position and a landmark you recognize. Then simply turn the map so that the line or stick points toward the landmark. However, if you need to orient your map more precisely, you can do so with your compass. The steps are as follows:

Step 1. Lay your map on any relatively flat but non-magnetic surface. The ground, a flat rock, or a stump are all fine.

Step 2. Turn the compass dial so that the dial reads 0° (north) at the index mark.

Step 3. Lay your compass on the map with either of the long (left and right) edges of the base parallel to a north-south line on the map.

Step 4. Turn the map with the compass on it until the north end of the compass needle is aligned with the orienting arrow (Figure 17). With this adjustable compass, the magnetic declination has been set to 8° E. The map is now oriented.

Figure 17: Orienting the map. The magnetic needle is aligned with the orienting arrow, which has the declination correction dialed in. The edge of the base is consequently lined up with true north.

Please note that it is not necessary to have the map oriented to measure directions on the map or to plot bearings. Orienting is just a convenience in identifying map features on the ground.

How to Measure a Bearing in the Field

To figure out the direction (bearing) between you and a distant point.

Step 1. Hold the compass securely in one hand at eye level. The base of the compass must be level so that the needle swings freely. Tip the mirror to about 60° as shown in Figure 18A. Looking in the mirror, align your eye so that the sighting line in the mirror appears to pass through the center of the pivot in the compass needle (Figure 19B). If you do this, it should also line up with the center of the reflection of the direction of travel arrow.

Step 2. With the compass in this position, turn your body so that the aiming notch in the lid lines up with the feature on which you wish to take the bearing (Figure 18B). Without moving the compass, look in the mirror and rotate the dial so that the orienting arrow lies parallel to and directly under the north end of the compass needle (usually the red end).

Step 3. Without moving the dial, take the compass down and read the bearing on the dial at the index mark. If the compass allows for declination adjustment, and it is set correctly, then the reading will be the true bearing.

Step 4. If the compass does not have declination adjustment, then convert the magnetic bearing to a true bearing using the formula T= M+D.

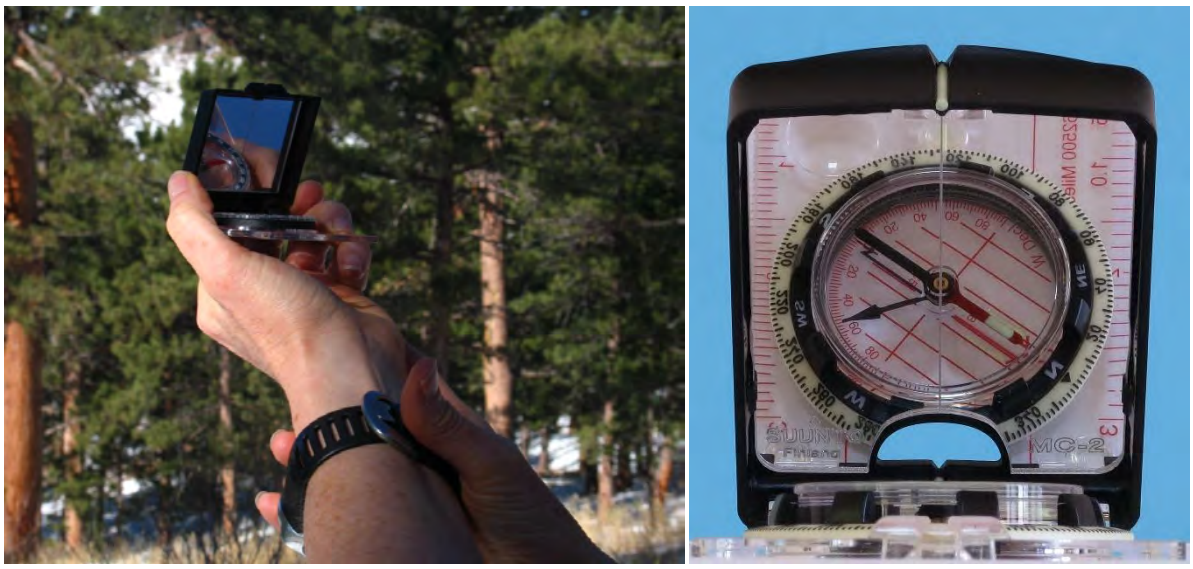


Figure 18:
A. Hold the compass in sighting position.
B. Align the sighting line with the pivot in the center of the needle and the aiming notch with the target.

How to Find Your Location on a Map Using Bearings on Recognizable Features

Step 1. Take a bearing from your location to a feature that you identify in the field and convert it to the true bearing as explained above.

Step 2. Set the true bearing on the compass dial.

Step 3. Lay the compass on the map so that the meridian lines are parallel to a north-south line on the map and the orienting arrow (or aiming notch) points toward the north edge of the map. Slide the compass along the north-south line until either of the long (left and right) edges of the base passes through the recognized point.

Step 4. Draw a line on the map along the long edge of the compass base plate from the feature that you sighted. **Extend it in the opposite direction from the direction-of-travel arrow (away from the aiming notch).** This line should pass through your position. You will probably be able to locate yourself by following the line and visualizing the topography.

Step 5. If you are still unsure of your location, name a second feature and repeat the procedure. The two lines will cross at or near your location. This method works best if the features that you sight are close to you and are located so that the lines cross at a large angle.

Step 6. Confirm your exact location by comparing the topography and other map features where the lines cross with what you can see on the ground.

How to Follow a Pre-Determined Compass Bearing – Leapfrogging

This procedure is useful for speed, especially in conditions of restricted visibility (i.e., fog, whiteout, dense timber) or where the topography is particularly confusing. We assume here that the declination adjustment is set to 0° if the compass has that capability.

Step 1. Figure out the true bearing from your location to your destination from the map as explained above. Convert the true bearing to a magnetic bearing (M=T-D).

Step 2. Set the magnetic bearing on the compass dial.

Step 3. Hold the compass level in sighting position and turn your whole body until the north end of the needle is directly over the orienting arrow. The direction-of-travel arrow or aiming notch now points to your destination.

Step 4. Pick out a landmark by sighting through the aiming notch and walk to it. Repeat the process until you reach your destination. In very restricted visibility or featureless ground (i.e., fog on a flat snow field, below a ridgeline), it may be necessary to send another member of the group forward and wave them to move right or left until they are on the line of travel. Have them hold their position while you walk to them, then repeat the procedure.

Cautions When Using the Compass

Most people are aware that iron and steel strongly affect the compass needle. You probably know not to use the compass while close to a vehicle or propped up on the head of your ice ax.

Many other things can make your compass erratic.

- GPS units, radios, cameras, cell phones, some flashlights, and headlamps
- Holding a mechanical pencil in the same hand as the compass
- Attaching the compass to a lanyard using a metal ring
- Wire fences and power lines
- Naturally-magnetic rocks – there are some on Mount Evans and on the approach to Castle Peak.
- Exposed ridges where rocks have been struck by lightning

If you are in an area where bearings are erratic or just don't make sense, move around until you find a place where the compass settles down.

Historical Note

This navigation unit was created by Jack Reed beginning in 1957 when he moved into a house at the edge of what is now the map and compass course at Mt. Vernon Country Club. The points we use today were chosen and marked by Jack over a period of several decades as he built up the navigation course. Jack was one of the CMC members who created WTS in the 1970s. He wrote the original versions of this chapter, gave the navigation lectures, and served on the WTS Committee, until retiring at the age of 80. One of the highlights of each session was a potluck dinner hosted for the instructors by Jack and Linda Reed at the end of Instructor Map and Compass Day.

References

Land Navigation Handbook: The Sierra Club Guide to Map, Compass & GPS, 2nd edition, by W.S. Kals and C. Soles, San Francisco, Sierra Club Books, 2005.

Basic Illustrated Map and Compass, by Cliff Jacobson, Guilford, Connecticut, Falcon Guides, 2008.

Wilderness Navigation, 3rd edition, by Bob Burns, Mike Burns, Seattle, The Mountaineers Books, 2015.

Staying Found, 3rd edition, by June Flemming, Seattle, The Mountaineers Books, 2001.

Be Expert with Map and Compass, 5th edition, by Björn Kjellström, Carina Kjellström, New York, Hungry Minds, 2010.

Resources

USGS Topographic Maps – available free of charge in GeoPDF® format at US Topo: Maps for America. The geospatial features of maps created before 2017 can be accessed with the TeraGo toolbar for Adobe Reader. Access Learn More - Navigation from the Course Materials page and select Free USGS Maps for detailed instructions for using these older maps. The Learn More - Navigation page also has instructions for the older maps in USTopo_HTMC_quickstart.pdf as well as for using USGS maps created after 2017 in USTopo_quickstart.pdf.

National Centers for Environmental Data at https://www.ngdc.noaa.gov/geomag/calculators/magcalc.shtml#declination.

REI Expert Advice – REI has helpful articles at https://www.rei.com/c/compasses?t=articles

Learn More - **Navigation** (learn navigation)

See helpful WTS articles and forms linked from this page.

NAVIGATION ADDENDUM

Sources for Maps

No single map displays all the features that are useful for trip-planning and hiking. Many government agencies and private organizations provide maps, in many cases free of charge or as downloadable PDF files.

The USGS is the principal mapping agency in the United States. The maps provided in this course are based on their 7.5-minute series topographic maps. The most recent USGS maps, called US Topo, are based on aerial photography, but the older drawn maps are still valuable to a wilderness traveler. High quality prints of these older maps are available for purchase from the USGS. All of them can also be downloaded free of charge as high-resolution PDF files at https://www.usgs.gov/programs/national-geospatial-program/topographic-maps. In addition, the USGS describes how to use their maps and the toolbar in the *US Topo Map and Historical Topographic Map Users Guide*, at https://www.usgs.gov/media/files/us-topo-map-users-guide.

Figure 1: Section of a trail map for White Ranch Park (Jeffco Regional Maps).

Agencies that manage parks usually provide maps, both online and at trailheads. Their websites are also valuable sources for information about local conditions, such as trail closures. For **Jeffco Open Space Parks** maps, go to https://www.jeffco.us/964/Parks .

You may obtain hardcopy maps in the open space office at 700 Jefferson County Parkway. PDF maps are also available at **Colorado Parks and Wildlife** map library page at https://cpw.state.co.us/learn/Pages/Maps-Library.aspx. **National Park Service** at https://www.nps.gov/index.htm, and **US Forest Service** at https://www.fs.usda.gov/visit/maps.

> **Note:** When printing PDF files, you can print the entire page or zoom to the desired area, then select More Options in the print dialog box to print only the Current View.

Private organizations produce hardcopy maps based on the USGS quadrangles that are frequently updated with newer roads, trails, property boundaries, and other features. National Geographic Maps provides a version of the USGS 7.5-minute quads as a four-page PDF that can be printed on letter size paper at http://www.natgeomaps.com/trail-maps/pdf-quads/. Be aware that the printout is not to scale.

NatGeo also produce the excellent TRAILS ILLUSTRATED Maps™, as does LATITUDE 40° Maps. In most cases, these maps cover a large area, for example, a large section of a mountain range or an entire park or wilderness area. Check the scale

carefully since these areas are of various sizes and the map scales vary. They usually are on waterproof material, which has some advantages, but makes it difficult to mark on the map with an ordinary pencil. The contour lines are a bit more difficult to read but shading often helps bring out the topography. In many cases, it is convenient to carry both the CalTopo map and one of the updated commercially produced trail maps.

Online Mapping Tools

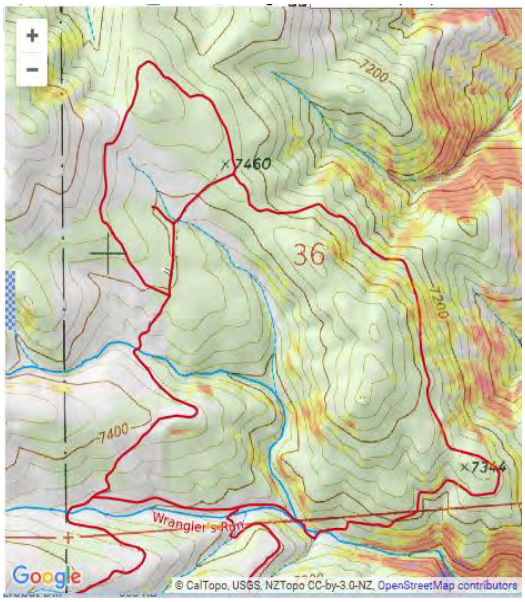


Figure 2: CalTopo map of White Ranch trails with Scanned Topo, Map Builder, and Slope Angle Shading layers.

Many websites allow you to customize and download maps of your specific site or trail. You can select from many layers showing topography, terrain, slope shading, updated trails, current trail conditions, land management, or view shed analysis.

CalTopo.com was developed for wildland Search and Rescue, shows newer trails, and is extremely versatile, including cell coverage.

AllTrails.com shows newer trails, but not smaller streams. Contour intervals are atypical at 32.8.'

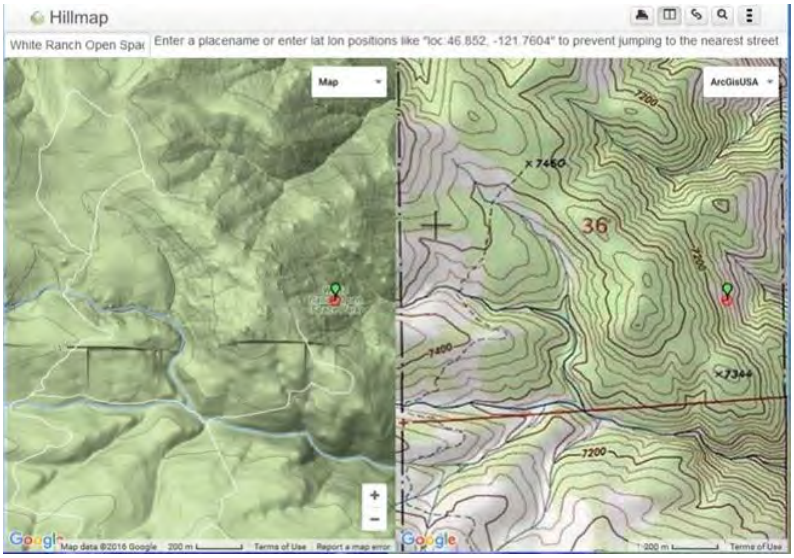
COTREX, Colorado Trail Explorer by the Colorado Parks & Wildlife has an app, newer trails, closures, and other data.

Google Maps, Google Earth, and other maps with a satellite view, display the actual terrain features and can be invaluable for trip planning.

Hillmap.com is excellent for learning and route-planning because you can view different layers side-by-side. You have your choice of multiple layers on left and right, though not every layer is available at every zoom level. Be sure to compare scales at the bottom right of each map.

Figure 3: Hillmap.com (Left) Terrain Layer; The shading distinguishes valleys from ridges more clearly than topo maps. Displays smaller streams and longstanding trails.

(Right) ArcGisUSA Layer; Based on USGS topo maps with standard contour lines and intervals. Displays small and intermittent streams and older trails.



How to Estimate Slope (See **Learn More – Navigation**)

We often need to translate between describing the slope in degrees to or from rise over run. The mathematical relationship between the two involves a simple function that can be expressed by either a table or a formula. If you are mathematically inclined, you can find the formula in Slope Calculation. If you use Microsoft Excel™ spreadsheets, the Slope Calculator Spreadsheet on the Learn More - Navigation page provides another way to convert contour spacing into slope angle. It is not necessary to have Microsoft Office™ to use it, since free software for running an Excel spreadsheet is available for the common operating systems.

Finally, when using a map in the field to recognize avalanche hazards, it is convenient to have a number memorized. The following numbers apply to 1:24,000 maps with 40-foot contour spacing. If your inches scale measures in sixteenths, 1/8-inch spacing between index contours gives a slope of 39°, which is in the middle of the hazardous range of slopes. If your inches scale measures in twentieths, 3/20-inch spacing between index contours gives a slope of 34°.

There are formulas and graphs to calculate slope angles, but it is simpler to use a table. The tables on this page are for 1:24,000 maps. See notes for using the slope scale on the MC-2 compass lid in the Contour section. The perpendicular distance (in inches) on the map between contour lines corresponds to a specific slope angle. Use the inches scale on your compass base to measure the perpendicular distance between the contour lines, and then look in the table to find the slope. Use the spacing of index contours for steep slopes (Tables 1a and 2a) and use the intermediate contour spacing for gentler slopes (Tables 1b and 2b). Table 1 gives the spacing in sixteenths of an inch, and Table 2 gives it in twentieths of an inch.

For 1/16" spacing:

Index Contour Line Spacing (inch)	3/8	5/16	1/4	7/32	3/16	5/32	1/8	3/32	1/16	1/32
Slope Angle	15°	18°	22°	25°	28°	33°	39°	47°	58°	73°

Table 1a: Slope angle vs. distance between **200-foot index contours** on a 1:24,000 quad map

Contour Line Spacing (inch)	3/8	5/16	1/4	3/16	1/8	3/32	1/16	1/32
Slope Angle	3°	4°	5°	6°	9°	12°	18°	33°

Table 1b: Slope angle vs. distance between **40-foot intermediate contours** on a 1:24,000 quad map

For 1/20" spacing:

Index Contour Line Spacing (inch)	1/2	2/5	7/20	3/10	1/4	1/5	3/20	1/10	1/20
Slope Angle	11°	14°	16°	18°	22°	27°	34°	45°	63°

Table 2a: Slope angle vs. distance between **200-foot index contours** on a 1:24,000 quad map

Contour Line Spacing (inch)	2/5	3/10	1/4	1/5	3/20	1/10	1/20
Slope Angle	3°	4°	5°	6°	8°	11°	22°

Table 2b: Slope angle vs. distance between **40-foot intermediate contours** on a 1:24,000 quad map

The table on this page uses 40-foot contour spacing, but it may be used with maps of any scale. This technique was developed by *John Aldag*, who compiled the table.

To estimate the slope of an area on your map, measure a span of 200, 400, ... 1000 feet or 1/10 mile perpendicular to the contours in the area of interest. Count all of the contour lines within that span. Find that number in the leftmost column of the table, and then read across to the appropriate span column.

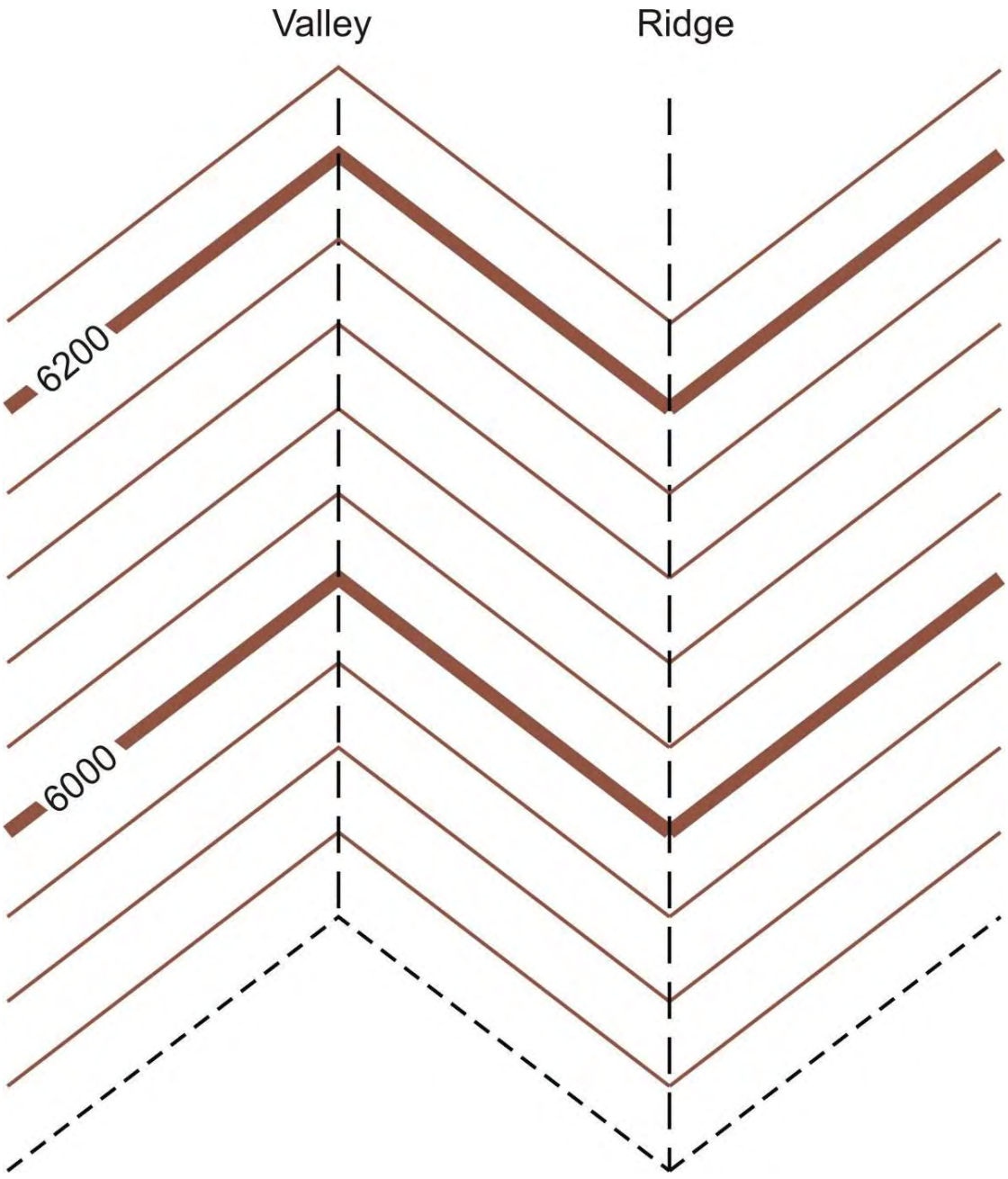
In the image below, we use the scale on a compass to count the contour lines in 0.1 mile. A count of eleven contour lines gives a slope of 37°.

This table will work on a map of any scale if the measured span is consistent with the map and the contours have 40-foot spacing. The shaded slopes are those with a high avalanche probability when loaded with snow. Taking a laminated copy of this table with you will allow you to easily estimate slopes in the field.

Slope (In Degrees) By Contour Count
Count Contours On Both Ends of Span

# 40 Ft Contours	Span (Ft)					
	1000	800	600	528 .1 MI	400	200
2	2	3	4	4	6	11
3	5	6	8	9	11	22
4	7	9	11	13	17	31
5	9	11	15	17	22	39
6	11	14	18	21	27	45
7	13	17	22	24	31	50
8	16	19	25	28	35	54
9	18	22	28	31	39	58
10	20	24	31	34	42	61
11	22	27	34	37	45	63
12	24	29	36	40	48	66
13	26	31	39	42	50	67
14	27	33	41	45	52	69
15	29	35	43	47	54	70
16	31	37	45	49	56	72
17	33	39	47	50	58	73
18	34	40	49	52	60	74
19	36	42	50	54	61	74
20	37	44	52	55	62	75
21	39	45	53	57	63	76
22	40	46	54	58	65	77
23	41	48	56	59	66	77
24	43	49	57	60	67	78
25	44	50	58	61	67	78
26	45	51	59	62	68	79

Cutout for visualizing the behavior of contours



The pattern above is designed to help you visualize the behavior of contours on ridges and valleys. Cut off the paper below the zigzag dashed line and then fold the vertical dashed lines to form a ridge and a valley. Set the folded pattern on a surface so the contour lines are level. You can then see that contours in a valley point up while contours on a ridge point down.

SECTION III – EMERGENCIES

CHAPTER 10 – SURVIVAL FIELD DAY

Revised July 2023

Objectives: Upon completion of this exercise, you will be able to:

- Employ effective responses to emergencies in the backcountry.
- Employ procedures for spending an unexpected night in the backcountry.

Description of the Day

Before this field day, view the WTS Survival video by a professional survival expert, linked from Course Materials – Lecture Videos (wts videos). Your instructors will inform you of the field location, often White Ranch Park, which is just northwest of Golden. Groups will hike to isolated areas inside the park. Your instructor teams will provide added instruction and you will practice basic survival skills under various scenarios. By the end of the day, you will have a basic understanding of how to gain control of a highly stressful and potentially chaotic accident scene and prevent matters from becoming worse. You will learn practical steps for mitigating the situation.

What You Will Need

Bring what you've assembled to date for the ten essential systems. The field exercises will demonstrate items used in emergencies – illumination, first aid supplies, fire starters, and emergency shelter – and help you choose how to complete your systems. Bring your ropes for knot-tying.

Skills and Subject Areas Covered

Everyone ventures into the mountains hoping to have an enjoyable and safe time. Most hikes go just as planned, but occasionally, something does go wrong: Far from the trailhead, a hiker suddenly becomes ill or injured. Or a sudden snowstorm strands a hiking group deep in the backcountry with only the supplies carried in their small daypacks. Or late in the day, someone becomes separated from the hiking group and cannot be found. In situations such as these, a successful outcome may depend on whether the hiking party has a solid foundation in survival and emergency management skills. Your instructors will teach the following topics to develop these skills:

- The psychology of survival: being resourceful and keeping a positive attitude
- A step-by-step process for responding to an accident (Incident Management)
- What to do when someone is lost or separated from your group
- How to prepare for an unexpected night in the backcountry:
  - Shelter-building
  - Fire craft – how to build and start a campfire
- Basic patient assessment procedures

- What to carry in a survival kit
  - Items should be reliable and high quality. A life may depend on it.
  - Think of your gear as raw materials, ideally with multiple functions.
- WTS emphasizes self-rescue and also teaches how to signal and/or go for help.
- Review of navigation skills

Before You Head out

- Leave your travel plans with a contact (See Emergency Information, p. viii).
- Do not go to a different location than the planned one.
- Leave a written trip plan in your vehicle along with an aluminum foil footprint of your boot's outsole to further assist rescuers who are skilled in human tracking.
- Discuss the SOP in the event someone gets separated from the group.

Getting Lost – Delayed Return

There are many reasons for an unplanned overnight stay: losing the trail, injury to someone in your group or coming across an injured party, underestimating the difficulty of the terrain, bad orientation, navigating, or route-finding decisions, misjudging or mismanaging your time, unexpected weather or trail conditions, bad luck. Group dynamics can include hiking with slow companions or falling into groupthink, where everyone collectively makes unwise decisions or blindly follows the designated leader.

Techniques for staying found include maintaining situational awareness. Don't zone out. All party members should know the hiking route, not just the leader. Before starting out, the leader should go over the details of the trip with all participants, show the map, and learn if anyone has an issue that could affect the success of the trip. As you hike, know the cardinal directions at all times (i.e. north, south, east, and west). Orient yourself on the map often and look back to picture the area, imagining daylight changes.

If the group is lost, **STOP**, Stop Think Observe Plan. Consider backtracking, returning to the trailhead, or heading to a baseline to regain group orientation. If you're separated from the group, think hard before moving away from the Point Last Seen. Practice "Leave Maximum Trace", such as purposely leaving obvious footprints and marking your route to help rescuers find you.

Food and Water

- Don't count on finding food. Foraging is possible but plant and mushroom identification requires training to distinguish poisonous from edible plants.
- Fishing and hunting for food in an emergency are difficult and likely wastes time that could be better spent on other activities such as shelter building.
- Staying hydrated is essential for maintaining your energy level and mental clarity. Even if you have no means of purifying untreated water, drink it anyway.

Emergency Shelter Concepts

An unexpected overnight stay may require that you rapidly construct a shelter. Select gear that you will store in your pack and carry on EVERY mountain or backcountry trip. Set up your shelter in a spot out of the wind, e.g., not on a ridge, considering that air rushes downhill after sundown. When inside the shelter, be sure to sit or lie on an insulated surface to help avoid hypothermia. Examples include a sitting pad, your pack, or several inches of dry grass, leaves, pine needles, or tree branches on the floor.

Figure 1: A tarp with ridge line cord from tree to a stake at foot. The black garbage bag protects a backpack. The tree limbs weigh down the edges of the tarp help to keep out the wind.

A tarp can be set up quickly if cord and stakes are already attached. See Figure 1 A. tree makes a convenient support if it itself is not a hazard. Check for heavy branches that might fall and consider if lightning makes attachment to a tree unsafe. A trekking pole can serve as a support for the opening. Figure 2 shows a stake secured to a grommet with a simple overhand knot. The tarp with stakes and cord weighs about 1 lb. A tarp can be used as a litter to move an injured person a short distance to a safer place.

A bivy sack is an excellent addition to a shelter to protect against hypothermia. Ultra-light weight bivys are compact and reasonably durable. Figure 2 shows two from Adventure Medical Kits®. Nylon bivys are heavier and more expensive but also more durable and may have other desirable features. For more information on shelters, see Learn More – Emergency Situations.

Figure 2: A 7.5" aluminum stake with a SOL® Emergency Bivvy on the left weighing only 4 oz.; the SOL® Escape Bivvy on the right is more substantial, breathable, and weighs 9 oz.

Staying Warm

- Bring proper clothing and follow the layering concept.
- Wear all the available clothing and put it on before you get too cold. Close all pockets and plug openings to prevent precious heat from escaping.
- Eat your available food and stay hydrated. Drink warm liquids if possible.

- Keep your arms next to your body inside your coat.
- Stuff toilet paper inside your clothing and pockets to boost the insulation.
- Build a campfire. Reflect the heat by heating rocks in the fire.
- Share body heat with your companions.
- Use chemical hand warmers.
- Heat water and place the warm water bottles next to your body.
- Exercise to generate heat; if still, insulate yourself from the ground.
- Wrap a foil space blanket around yourself, silver side in, to reflect heat.
- Try to avoid perspiring while performing tasks.

Signaling

Signaling is a two-step process: 1. Get attention (via contrast and movement) and
2. Communicate "Help!"

- Audio signals: Shout for help or use a whistle. Three whistle blasts are a distress signal. A whistle is louder and will greatly outlast your voice.
- Electronics: cell phone, satellite phone, personal locator beacon
- Visual signals:
  - Two-arm wave while standing is a distress signal. In contrast, a one-arm wave while standing is an all's well message.
  - Light from a headlamp or flashlight in a pattern of three flashes.
  - Flashes from mirror, snack wrapper, or space blanket in a pattern.
  - Flagging tape or toilet paper to mark brushes or trees.
  - Stamp down ground or snow and fill with contrasting material. Form an SOS, HELP, or X in block letters at least 10 feet in size.
  - Three evenly spaced campfires or smoke from one.
  - If a low altitude aircraft (plane or helicopter) flies by, lie down and make snow angel movements with your arms and legs.

Helicopter Rescue

If SAR determines that a helicopter is needed, you can help locate a suitable landing area. The BIM Get-Help Guide (get help) lists the guidelines with **HOTSAW:**

- **H**azards within anticipated landing area (Trees? Cliffs? Flying debris?)
- **O**bstacles (Power lines? Boulders? Stumps?)
- **T**errain (Dirt, firm snow, and grass all ok)
- **S**lope (Less than 10 degrees for hillside)
- **A**nimals, which includes people (Livestock can be unpredictable with the loud noise)?
- **W**ind and weather (At least 3 miles visibility? Wind less than 40 mph with no significant gusting?)

Stand back unless SAR specifically requests your help.

CHAPTER 11 – TEAMWORK

By Rich McAdams

Objectives: Upon completion of this chapter, you will be able to:

- Participate and positively influence team cohesiveness.
- Understand how you can contribute toward everyone's overall enjoyment and satisfaction with this course.

Although hiking, climbing, and mountaineering can be solo sports, more often they involve a collection of individuals looking for an enjoyable experience and the attainment of some common goal.

How each individual interacts, reacts, or chooses not to act can contribute either positively or negatively to that experience. Although it is not at all mandatory that participants think or act alike, behaving in a predictable fashion is a desirable characteristic for teamwork to succeed.

People experience personal growth by first observing and learning from each other, and then adopting the best traits, characteristics, behaviors, and skills.

All WTS participants have set aside time and money to attend this school, and they have specific goals, objectives, and expectations. Therefore, each individual should consider putting aside some of their personal independence for the sake of the team and teamwork.

Fundamental Expectations

WTS expects each WTS participant:

- **Be prepared** – Although we do look out for each other, expecting others to give assistance should be the exception not the rule.
- **Be on time** – Are you a no-show or simply late? Tardiness can be a sign of disrespect to the team.
- **Contribute to orderly conduct** – In terms of actions and behaviors, are you part of the solution or part of the problem?
- **Stay involved** – Listen, ask questions, pay attention, and contribute.
- **Refrain from judging others** – Although everyone is in a learning mode, we are all at different points on the learning curve, so show empathy.
- **Provide feedback** – Constructive feedback is most useful if you can offer a solution or alternative. Complimentary feedback typically can stand on its own.
- **Complete agreed-upon actions** – For a team to make progress toward its goal, it places much weight on trust. The team expects the members to do what they said they would do.
- **Practice the Golden Rule**

WTS can be much more than an opportunity to learn the many technical skills needed for safe and enjoyable backcountry travel. Successful hiking and climbing requires each

individual to operate within the framework defined by their team; the more difficult the adventure, the more important and obvious this becomes. Therefore, in addition to learning the technical skills, WTS also presents many opportunities to learn and practice the fine art of teamwork.

Learn More – **Emergency Situations** (learn emergency)
See helpful WTS articles and forms linked from this page.

Heuristic Traps

There are some caveats you should be aware of in teamwork or, for that matter, in any decision-making. A heuristic may be defined as a shortcut – a rule of thumb – that simplifies making a decision about a complex situation. Heuristics often aid in problem-solving but may not be optimal, factual, or rational. They are often listed as "human factors" in accident investigation reports. **Desire overrules judgment.**

The term "Heuristic Traps" was popularized by Ian McCammon in 2002 after he presented a study of avalanche fatalities. He found that increased education about avalanches **increased** a person's chances of dying in an avalanche. Solo travelers and groups of 6 to 10 tended to take the most risks. These factors also affect many other backcountry and mountain situations: e.g., whether to turn around due to lightning risk or impending darkness, whether it's safe to cross the river here, are we on the desired route, "summit fever," and "smelling the barn" (hurrying back to the trailhead)."

Consider how these factors may downgrade your decision-making:

- **Familiarity** – Parties traveling in familiar terrain made riskier decisions than parties traveling in unfamiliar terrain. You've skied this slope many times and it's never slid, so you minimize avalanche warning signs and ski it again.
- **Acceptance** – We want to be noticed or accepted by people we like or respect, aka peer pressure. Wanting to impress others in the group may cause you to overlook warning signs. You don't want to be the one to chicken out.
- **Consistency** – Parties highly committed to a goal – a summit or a ski slope – made riskier decisions than parties just out for a fun day. We try to maintain consistency with previous decisions.
- **Expert Halo** – We tend to trust someone more experienced or with a louder voice and allow them over-influence critical decisions for the group. You downgrade your own knowledge.
- **Scarcity –** We tend to value resources or opportunities more when there's a narrow window of opportunity. It's a blue-bird day and we drove many miles for this trip.
- **Social Facilitation** – We tend to increase risk-taking in the presence of or influenced by accounts of other people. The guidebook rated this a 3, so I must be able to do it. There're tracks across this slope, so it must be safe for me.

CHAPTER 12 – BACKCOUNTRY INCIDENT MANAGEMENT

Bringing Order to a Chaotic Situation

By Rich McAdams and Wayne Howell, June 2023

Objectives: Upon completion of this chapter, you will be able to:

- Describe the **critical roles** when managing a backcountry incident.
- Actively take part in and positively contribute to the **key activities**.

Next Steps: When you want to do more.

- **Wilderness First Aid,** (wilderness first aid) – prerequisite for BIM School
- **Backcountry Incident Management School**, Login (BIM)

Overview

Any backcountry incident can seem overwhelming with just too many moving parts. Regardless of whether it is a first aid related incident or a missing hiker, defining the typical roles and activities of an incident can significantly help transition the crisis into a more manageable problem and improve the outcome for patients and rescuers alike. The Incident Management Cards outline the four roles. These cards, made up of prioritized checklists of activities, enable individuals with only modest experience to take on the responsibilities of each critical role.

Critical Roles:

This incident management process defines four specific roles that are part of most incidents. The Incident Manager, usually the trip leader, typically assigns these roles to individuals who have skills beneficial to that role and/or are willing to help.

- Incident Manager
- First Aid
- Get Help
- Bivy

Key Activities:

- **Secure Site** – Quickly assess whether the incident site is safe. In order of priority:
  - Is the site safe for the First Aid Team?
  - Is the site safe for other members of the group?
  - Is the site safe for the patient?
- Quickly implement an **Initial Patient Assessment** to identify any life-threatening issues.
  - If needed and safe to perform, move the patient to a safer site.
  - Decide if you need help, then the best way to get that help.
  - Prepare to bivy if conditions warrant.

- Communicate, look out for others, be readily available, be compassionate, be part of the solution.

Incident Management Roles and Activities

Incident Manager role:

The IM is a single individual, the focal point, who will oversee the end-to-end management of the incident with an emphasis on organization and proactive thinking. The IM is usually the CMC trip leader, but experience and qualifications may dictate that another individual accepts this responsibility. It is good practice to identify medically qualified individual(s) at the beginning of the trip.

The IM should not immerse themselves into the details of the incident but rather have an overall understanding of the situation and provide guidance and follow up to the other roles.

First Aid role:

The FA Team ideally consists of two individuals with the requisite skills or desire to assist the patient. The two responsibilities are:

Primary First Aider: Performs most of the on-patient first aid tasks.

- **Scribe:** Documents the patient's condition, offers assurances and confidence, acts as a check and balance, and fulfills the go-fer role, if needed.

The initial objective for this team is to understand the nature of the injuries and/or ailments and to update the IM so an incident management plan can be determined. Without this fundamental patient evaluation, an ***effective*** incident management plan can be difficult to develop.

The **Initial Patient Assessment** is the first, high priority first-aid activity and consists of a visual and a hands-on quick examination of the patient. Understanding any immediate life-threatening injuries is critical, particularly if the patient is in an unsafe location. Injuries often occur in a location that is still dangerous. Slips and falls can occur when scrambling in a steep loose rock gully, while traveling through an avalanche-prone area, or when caught in an open field during an electrical storm. The IM and the FA Team will need to coordinate the plan to move the patient to a safer area, **only if** both the patient and the team can be safe during the move. Some injuries, such as a suspected spinal injury, serious bleeding, or immediate need for CPR, may require treatment where they lie and prevent relocation.

Members of the group not critical to the treatment plan should move to a nearby safe location and remain available to help if needed.

After the Initial Patient Assessment and any relocation are complete, the FA Team should perform the **Secondary Patient Assessment** to understand and document any additional patient conditions.

The FA Team keeps the IM informed about these activities and the patient's status.

Get Help role:

The Get Help Team is responsible for contacting help. They need to understand the nature of the help required, then research available options for acquiring that help: Do they have cell phone connectivity? If not, can they still text 911? Is satellite-based communication available, e.g., the Garmin InReach®? Lastly, is a hike out the only workable choice?

The nature of the help needed requires evaluation of many variables. For example:

- The patient's condition (Getting better? Stable? Getting worse?)
- A Search and Rescue evacuation recommendation (Need ASAP? Can wait until morning? Need helicopter?)
- The exact location of the incident site (GPS coordinates? Map location? Are there any apparent terrain obstacles getting to the incident site?)
- Current or expected environmental conditions (Rain? Snow? Nightfall? Temperature?)

If the Get Help Team needs to leave to get help, it is essential that they fully understand the situation prior to departure. They should decide what the on-site individuals need (food, water, gear) as well as what they need for a safe trip. They must carry what they need to contact help (car keys, working phone) and to mark the return route for the rescue team, if needed.

The Get Help Team keeps the IM informed as these activities are underway and progress being made.

Bivy role:

The Bivy Team provides shelter, fire, and water as the incident requires. They provide their services to the patient, the FA Team, and the other group members. The weather, the nature of the patient's injuries, distance from the trailhead, onset of darkness, ability to communicate with 911, and the expectation of Search and Rescue arrival all fold into the decision to implement what makes sense. It is always prudent to be proactive, that is, to get ahead of the curve. It may be better to set up a quick shelter for the FA Team and the patient, then tear down if it is not needed, rather than waiting until everyone is getting cold and wet.

The Bivy Team maintains an overall awareness of the physical condition of the entire group, leverages the resources of the group, and offers suggestions to stay warm and dry. They may need to remind group members that now is a good time to eat, drink, and add more clothing layers.

The Bivy Team keeps the IM informed as these activities are underway and progress being made.

Backcountry Incident Management is a holistic process. Not all the roles, nor activities within the roles, are pertinent every time. Understanding the end-to-end process is important for providing the onsite personnel with options, guidelines, and a means to think about any "what if" complications.

Wilderness First Aid

CMC offers Wilderness First Aid, (Wilderness First Aid), a 16 hour training that covers environmental, medical, and traumatic injuries with a focus on inclusive care and rescue, patient and bystander mental health. Graduates receive Wilderness First Aid certification.

Backcountry Incident Management School

The Colorado Mountain Club offers the Backcountry Incident Management School. Login (BIM), as one of the CMC Risk Management classes. The BIM School is a one-day hands-on outdoor session that takes a deep dive into each of the four roles and all their various activities, enabling the student to better understand and experience how to bring order to a chaotic situation. Wilderness First Aid certification is a prerequisite.

The field "textbook" for the BIM School is the 12 Incident Management Cards set. These cards are available from two sources:

1) Backcountry Incident Management & First Aid Resources and Procedures, (BIM resources), links to the 12 Incident Management card files to download and print. Since many of the cards are two-sided, the print may consist of as many as 24 pages on 8"x11" paper.
2) Trip Leader School, Day Hiker School, and Backcountry Incident Management School provide the card set in a convenient water-resistant postcard size format.

Reviewing the cards and organizing in your own head how to use them prior to needing them is very important.

References

Alpine Rescue Team is a non-profit organization of volunteers that offers services free of charge. They depend on tax-deductible contributions to ensure their ability to locate those lost and injured in the mountains. There is a wealth of information and advice on this site, especially in the Safety & Education section.

Backcountry Survival Guide is an information card to leave on your dashboard. It also lists essentials in summer and winter and safety tips.

Learn More – Emergency Situations (learn emergency)

See helpful WTS articles and forms linked from this page.

CHAPTER 13 – SURVIVAL

By John Lindner, revised April 2024

OBJECTIVES: Upon completion of this chapter, you will be able to:

- Describe the importance of hypothermia and of being prepared.
- Describe ways to stay warm, including sheltering, clothing, and building a fire.
- Summon help.

Next Steps: When you want to do more.

- **Wilderness Survival School - Denver** (survival denver) – prepare for an unexpected overnight stay in the outdoors.

Prepare for the Worst and Plan for the Best

> **Positive mental attitude: You won't survive if you don't expect to.**

Hypothermia, fire-starting, and survival-planning are the major issues relating to survival. Many other situations could test your ability to survive in the wilderness.

- Your survival kit, **with you** (not at home or back at camp), and the knowledge and ability to use all its contents under any conditions are very important.
- Avoiding panic and making the best decisions in your situation is the **most important element for increasing your survival odds!**
- Rule of Threes. Under average conditions the human body can stay alive about: 3 minutes without air, 3 hours without protection from the wind/wet/cold/heat (hypothermia/hyperthermia), 3 days without water (hydration) and 3 weeks without food (nutrition).
- The duration of an average survival emergency (an unplanned stay in the backcountry) is three days. Many factors can shorten or prolong this. Did you tell others where you are going and when you are expected back? Did you change your plans or destination without updating anyone? Are you prepared with your equipment and the skills to use them? Weather and the environment will have **major** impacts on your survival.

Hypothermia and Outdoor Survival

Hypothermia (exposure), the lowering of the body core temperature, is **the number one killer of outdoor recreationists**.

1. **Seek and create shelter from cold, wind, snow, and rain.**
   If a vehicle or manmade structure is not available, retreat to timbered areas for shelter construction and fire. Use natural shelters like the windless side of ridges, rock outcroppings, caves, slope depressions, the snow tree well around the base of a large, standing evergreen tree, dense stands of trees, or spaces under downed trees. Improvise a windbreak or shelter from stacked rocks, blocks of snow, tree

trunks, limbs, bark slabs, and evergreen boughs, or dig a snow cave or snow trench, and cover it with natural materials or a sheet of available material such as a tarp or space blanket.

2. **Conserve, share, and create warmth.**

   Put on extra clothing to conserve body heat. Since wet cotton draws heat away from your skin, remove damp cotton garments and socks. Place damp wool or synthetic clothing over dry wool or synthetic clothing. Loosen tight bootlaces and belts and any blood flow constricting items like watches and rings to increase circulation and reduce the risk of frostbite. Sit on whatever insulating material is available to minimize heat conduction from your body through clothing insulation layers compressed by your body weight. Place hands in armpits or crotch. Share body heat to minimize individual heat loss.

3. **Generate body heat.**

   Nibble on high-energy foods (carbohydrates, fruits, nuts, candy, granola bars, etc.). Avoid proteins since they digest the slowest and require the most energy and water for your body to convert to useful energy. Keep yourself hydrated but try to avoid chilled liquids since they accelerate hypothermia at the body core. Drinking warm, not overly hot, liquids helps restore internal temperature to critical internal organs in a conscious patient. Muscle activity increases internal body heat and blood circulation through extremities.

   Think – blood circulation equals heat circulation.

4. **Build a fire.**

   Find dry wood such as lower tree branches and bark from lower branches or downed timber. Once a fire is established, damp wood will burn as it dries. Build your fire in a sheltered area, with wood available nearby and protected from strong winds. In deep snow conditions, build a firebase first with large logs or the heat from the fire will melt the snow under it and it will sink to ground level. Place your fire starter on the base, surround it with small dry twigs and hold kindling above the fire starter, then place a hatch work of kindling and slightly larger wood on the branches. Light fire starter and blow lightly to help its flame ignite the kindling. Add progressively larger wood to the flame area. Consider the size of your fire. The larger you build it, the more time and energy you'll expend gathering more wood. Carry dependable fire starters and backup ignition sources. An actual emergency – which may include darkness or pouring rain – is not the time to try to read a set of instructions on a fire starter that you have never tried before. Be sure a product marketed and sold for survival use is worthy of trusting with your life (see Survival Fire Starting below). Practice these skills and master them before you need them, since under survival or hypothermia conditions your life may depend on it. Any of the following conditions – wind/adverse weather, darkness, cold, shivering hands, or the panic of being lost – can make the simplest task a struggle.

5. **Conserve your body warmth by reducing heat losses.**

   The body loses heat by respiration, evaporation, conduction, radiation, and convection.

   - To minimize heat loss by **respiration**, cover your mouth and nose with loosely woven material such as knit wool. This will pre-warm cold, inhaled air with warm moisture (normally lost) accumulated on the fabric when you exhale.
   - To reduce **evaporation** through excessive **perspiration**, wear breathable layers of clothing. Keep your insulation layers clean and dry so they provide the most benefit.
   - To avoid heat loss by **conduction**, use a closed-cell foam pad and/or other non-heat conductive material between your body and the cold and/or wet surface you are sitting, kneeling, or lying on. This insulation is particularly important if you are already wet.
   - To lower heat loss by **radiation**, keep your head, neck, hands, and feet covered with insulating layers. Warmth continually radiates off bare skin surfaces even in a still-air environment.
   - To reduce heat loss by **convection**, protect your body from the heat-robbing effects of cold wind across exposed skin.

6. **Look for hypothermia symptoms.**

   In the first stage, the patient begins shivering, moves with poor coordination, slurs speech, and shows poor judgment. By the second stage, when the body temperature is below 95 degrees, muscular rigidity replaces shivering, and the patient becomes more irrational. At this stage, the patient needs warmth immediately from external/internal sources and protection from further heat loss. The patient will not realize they are in danger and may remove clothing due to a false sense of warmth after the first stage. Avoid alcohol since it accelerates heat loss and gives a false feeling of warmth.

Survival Fire Starting

See the file Fire starting 2022-Lindner for an extensive list of fire ignition sources, fire starters, and fire accelerators as some of the many items available for use in an outdoor survival situation. This list is an example of the numerous possible options available to start a fire in an emergency. Some items were never intended to be a fire-starting item, but through improvising, they can be used with some success. Also, some of the items listed are commercially marketed for survival and/or emergency use. In actual use, especially under adverse conditions, many of these have proven undependable. It is highly recommended that you also carry a duplicate and/or backup fire-starting item for what you include in your survival kit.

Other aspects of fire-starting items that you should consider are:

- **Shelf life** – Will the item work a year or more after you buy it?
- **Reliability** – Will it work the first time and every time you need it?

- **Physical size** – Is it adding an unreasonable amount of weight or bulk to your survival kit?
- **Safety** – Are there any risks to using it?
- **Effectiveness** – Does it generate enough heat to light damp tinder?
- **Usability** – Is it **easy to use** if your hands are cold or you are shivering, if you are injured or panicky, if it is after dark or windy, extremely cold, raining, or snowing? Will it always function under these conditions? This **would not** be the time to try to read the instructions on how to use an item or to discover it does not work as you expected. **Your life may depend on your ability to start a fire.**

Before starting the fire, make sure that you have the ability to extinguish it. Keep the fire only as big as you need. A large piece of wood that has been burning for an extended period will be difficult to cool. The material that you ignite should be mostly ashes when you finish. When you are done, douse the fire with plenty of water, then stir the ashes, and douse it again. The remains of the fire should be cool to the touch after dousing. Watch the remains of the fire for at least 30 minutes before leaving the site. If possible, cover with soil to prevent wind from dispersing any unnoticed embers.
Warning – If your journey to the trailhead involves air travel, you need to be aware of the restrictions the Transportation Security Administration (TSA) places on the transportation of flammable materials. TSA prohibits cooking fuel, Fire Ribbon, and strike-anywhere matches in checked and carry-on baggage. Find a complete list at https://www.tsa.gov/travel/security-screening/whatcanibring/all.

Get to know and practice with what you have in your survival kit before you need it – your life could depend on it.

Sending for Help

If you need to send for help, review the situation and evaluate the facts as you outline information to provide to a rescue group.

- If possible, send at least two people with the geo-coordinates of the site and have them mark the route on the way out. They should note the terrain, distance, and time from the patient's location to a road or landmark.
- Once they reach cell phone coverage, they should call either the county sheriff or a park ranger, if in a National Park. These people will contact search and rescue teams. On a cell phone, call 911. You may be relayed to search and rescue from a surprisingly distant responder, especially using analog roam.

In a survival situation, there are no rewards or punishments – only consequences.

CMC Whistle Protocol

A whistle is one of the Ten Essentials that CMC recommends its members and guests always carry while hiking, backpacking, skiing, snow shoeing, climbing. It should be readily accessible on the front of your pack. A whistle is used to communicate with others in situations where human shouts cannot be heard.

Neither the initiator nor responder should cease whistle communication until the objective/the action requested is accomplished.		
Situation/Objective	**INITIATOR**	**RESPONSE**
Contact	**1 Blast (Where are you?)**	**1 Blast (I am here.)**
Regroup	**2 Blasts (Come here.)**	**1 Blast (Heard you. Coming.)**
Emergency	**3 Blasts (Help)**	**1 Blast (Heard you. Coming.)**
Recommended by DS&L Committee May 2015		

Emergency Communications

WTS wants students to become skilled with the fundamentals and does not allow cell phone or GPS device use on field days. Two major drawbacks are limited battery life and inconsistent connectivity. However, they can be priceless in case of emergency. Features appear and change at a rapid pace. See REI's Expert Advice for more information.

Smart Phones

1. **Geo-Coordinates** – Knowing your precise location is essential for rescue. With your Location Services turned ON in your phone, open Maps and press on the blue place dot that marks your location. Your coordinates will display in the top menu bar. Practice by comparing your phone reading to a topo map. Learn how to do this **before** you have an emergency.
2. **Map, Compass, and Fitness Apps** – There are many cell phone apps, such as US Topo, Gaia GPS, CalTopo, AllTrails®, MapMyFitness™, etc., that allow you to carry map, compass, weather, and other information in your pocket. If following a map, be sure you know which way is North and fix North at the top of the screen.
3. **Battery Management** – Use Airplane Mode routinely to prevent searching for signal and depleting your battery. In an emergency, put your phone into emergency or low battery mode when not communicating. Consider carrying a solar charger or power bank for your device(s).
4. **Text to 911** – While a voice call is far superior, many mountain areas lack cell coverage. Text-to-911 is available in **most** Colorado counties, including Jefferson, Douglas, Boulder, Clear Creek, Park, and part of Gilpin counties at this writing. In Colorado see https://sites.google.com/a/co911rc.org/co911rc/resources/text-to-911.
5. **LookoutAlert - Emergency Notification Service** – Sign up in multiple counties to receive warning messages about wildfires, weather alerts, or other public hazards.

Satellite Messengers

Garmin InReach®, Motorola Defy, Zoleo™, and Spot are examples that allow one- or two-way messaging, often by linking to your smart phone. They require a subscription plan. Some devices support navigation and/or weather forecasting.

Personal Locator Beacons (PLBs)

ACR ResQLink™ and rescueME send an SOS message to a network of search and rescue satellites or SAR sites. They have no subscription fee but cost more and must be registered.

RECCO® technology

A RECCO® reflector may be incorporated into clothing or gear or bought as an attachable tag. It passively reflects directional radar signals from a handheld or helicopter RECCO® detector used by hundreds of search and rescue organizations worldwide.

Learn More –

Emergency Situations (learn emergency)

See helpful WTS articles and forms linked from this page.

See Chapter 12 – Backcountry Incident Management

Consider Backcountry Incident Management School (BIM).

CHAPTER 14 – WILDFIRE

By Carol Munch

Objectives: Upon completion of this chapter, you will be able to:

- Check and plan before you head out on a trail.
- Describe what to do if you smell smoke or spot a fire while on the trail.
- Describe what to do if you are caught in a fire.

Wildfire has become a reality in our forests and one you should take precautions to avoid and prepare for should it happen to you. While the fire season has been lengthening, we usually watch for wildfires from late spring through the fall.

Check and plan before you go.

1. **Wildfire and Smoke Resources –** Check for active fires and smoke near your destination. If there are nearby fires, be more vigilant with your planning.
   - **Colorado Wildfire Map** – Fire, Weather & Avalanche Center provides an interactive real-time wildfire map of Colorado with several layer options at https://www.fireweatheravalanche.org/fire/state/colorado.
   - **Emergency Alerts –** Register with federal and local emergency managers to receive alerts in your home and destination counties. https://www.ready.gov/alerts, and https://dhsem.colorado.gov/emergencyalert
   - **ESRI** – Environmental Systems Research Institute, Inc., Wildfire maps and response, https://www.esri.com/en-us/disaster-response/disasters/wildfires
   - **Fire and Smoke Map** – view conditions by zip code. https://fire.airnow.gov/
   - **InciWeb** – Interagency all-risk incident information system at https://inciweb.nwcg.gov/. From the map of the USA, enter your specific destination, then click on the known fires for more information.
   - **Local jurisdictions** – County, state, and federal websites list recent fire activity and current fire restrictions.
   - **Mapping sites** – There are **Fire Activity** maps with several layer options at CalTopo at https://caltopo.com and Gaia at https://www.gaia.com.
   - **Weather** – Check the forecast including wind direction and speed.
2. **Gear to carry**
   - **Satellite communication** – Garmin InReach®, Zoleo™, Spot, Motorola Defy, and other devices for signaling for help may be the only effective tool.
   - **Cell phone** – Your phone may be useful, but don't rely on it. Turn it to Airplane Mode and close unnecessary apps. Consider a battery bank. In many counties, a text message transmits where there's no cell phone coverage.
   - **Maps –** Locate alternate trails in the area that may serve as escape.

- **Trail Registries –** Sign in so that someone knows that you are on the trail and what your plans are.
- **Signal mirror, orange tarp, etc.** – Consider visibility to nearby hikers, search and rescue personnel, search planes, or rescue helicopters.
- **Wool or flame-retardant shirt** – Be aware that some synthetic clothing (the hi-tech lightweight fabrics that we love) will melt and shrink-wrap to your skin, causing severe pain and burns.
- **Trip plan –** Leave a detailed plan with family or friends who can assess the danger and pass your information on to authorities.

If you see smoke or spot a fire while on the trail

- **Locate the smoke** – Smoke and ash can travel long distances: the fire may not be close. If the smoke arrives suddenly, it is probably close and it's time to get out.
- **Protect your lungs** – Breathing smoke can be deadly and can damage healthy lungs. Fire consumes the available oxygen and releases harmful particles and toxic gases that inflame your lungs and cause airways to swell and collapse. Carry an N95 NIOSH-approved mask that filters at least 95% of airborne particles in high-risk months. If not available, use a face mask or tie a bandana over your mouth and nose. The best air will be nearest the ground.
- **Fire movement** – If you can see the direction and behavior of the smoke this will give you an indication of which direction the fire is moving.
    a. If smoke is just drifting up, there's little wind, and fire may not travel fast.
    b. If the smoke is moving in one direction, the fire will probably move that way too and could move quickly. Remember wind direction many change.
    c. Light smoke usually means finer, fast burning fuels such as grassfires.
    d. Dark smoke means thick brush or timber and longer burning, with the potential to send out embers far ahead of the fire.
- **Fire behavior** – Fire travels uphill much faster than downhill and preheats the area ahead of the fire. You cannot outrun a fire!
    a. In a steep canyon, fire may quickly sweep up the canyon (chimney effect). Evacuate immediately!
    b. On a ridge, drop to the side of the ridge where the fire is not. Escape downhill and upwind.
    c. Roads or streambeds may be safer.
    d. Large open areas are safer than dense forest.
    e. An already blackened area may be safer.
    f. Be aware that the fire can change directions, so be vigilant.
    g. Use your map to find alternate trails. You may have to hike miles out of your way to reach safety. Maneuver around the flames as quickly as possible.

If you are in an active fire zone

- **Activate your emergency communication** to seek help.
- **Report the fire** – Call and/or text 911, giving your location, and estimated location of the fire.
- If the fire is imminent and you cannot escape it:
    a. Try to find a depression in a large meadow to lay down in.
    b. Clear as much flammable material from the area as possible.
    c. Dig a hole and put your face into it so you have the cleanest and coolest air to breathe. Lie face down with your feet to the fire.
    d. Consider removing synthetic clothing that might melt onto your skin and put on any natural fiber or flame-retardant clothing that you have.
    e. Getting in a lake may be an option, but drowning or hypothermia could occur. If the water is too shallow, it may not protect.
    f. A large boulder may shield you as a fire passes. A scree slope or a boulder field may have less flammable material.
    g. Do not get up until after the flames have passed. Be aware that charred areas will have active hot spots and may have falling trees and limbs.

References

Hiking Guy – https://hikingguy.com/how-to-hike/is-there-a-wildfire-on-my-hike-wildfire-tips-for-hikers/

How to plan a hike during wildfire season in Colorado – 2022 news article. https://coloradosun.com/2022/06/10/ow-to-plan-a-hike-during-wildfire-season-in-colorado/?pico=clean&utm_source=The+Colorado+Sun+Newsletters&utm_campaign=SUNRISER_20220610&utm_medium=email

LAist – https://laist.com/news/how-to-survive-a-wildfire-tips, *How to Survive: 5 Tips for Hikers Caught in a Wildfire*

NIOSH-approved N95 Particulate Filtering Facepiece Respirators – https://www.cdc.gov/niosh/npptl/topics/respirators/disp_part/n95list1-a.html. Updated weekly to verify the certification of N95 masks.

Northern California Hiking Trails – https://northerncaliforniahikingtrails.com/blog/2018/07/28/surviving-wildfire-hiking-what-do/

Outside – https://www.outsideonline.com/outdoor-adventure/hiking-and-backpacking/how-escape-wildfire-when-youre-hiking/

REI – https://www.rei.com/learn/expert-advice/wildfire-safety-tips-for-outdoor-recreation.html

Wildfire Guide Information – for public health officials plus downloadable factsheets for the public. https://www.airnow.gov/wildfire-guide-information/ **Fire & Smoke Map**

Wildfire Smoke and Face Masks – Washington State Department of Health, 1-page flyer on masks. https://www.doh.wa.gov/Portals/1/Documents/Pubs/334-353.pdf

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CHAPTER 15 – MEDICAL EMERGENCIES

By Jeanette Kehoe, DC, EMT, and Jeff Flax

Objectives: Upon completion of this chapter, you will be able to:

- Describe the initial evaluation of an injured or ill person.
- Describe the handling of common backcountry medical situations.
- **This chapter does not prepare you to administer treatment.**

Next Steps: When you want to do more.

- **Wilderness First Aid,** (wilderness aid)

WTS urges you to take a Wilderness First Aid course.
Realize that when you hike in the mountains, you might be hours (even days) away from definitive medical care. Your well-being or life – and your hiking partners' – could be up to you! Basic first aid courses teach care for only a few minutes, until the paramedics arrive. This chapter is NOT a substitute for training and practice.
– WTS Committee

Prevention

Basic first aid starts with common sense.

- Go in good physical and mental health.
- Know at least basic first aid. Preferably, know CPR and Wilderness First Aid.
- Know your route – distance, elevation gain, on-trail or off-trail, weather forecast, how long you expect to be gone, etc.
- Leave your route with someone who will contact officials if you are overdue.
- Be sure your first aid kit is up to date, including copies of the first aid report and numbers of emergency personnel in that area.
- Carry the ten essential systems.
- Make sure everyone in the group has the ten essential systems.
- Ask the group if there are any medical concerns that you should be aware of.
- Ask where others keep their medication in their packs.
- Have fun!

Good Samaritan Law

The Colorado Good Samaritan Law protects you when you offer assistance:

13-31-108 "(1) Any person licensed as a physician and surgeon under the laws of the state of Colorado, or any other person, who in good faith renders emergency care or emergency assistance to a person not presently his patient without compensation at the place of an emergency or accident... shall not be liable for any civil damages for acts or omissions made in good faith as a result of the rendering of such emergency care or emergency assistance during the emergency, unless the acts or omissions were grossly negligent or willful and wanton."

CORSAR (Colorado Outdoor Recreation Search and Rescue) Card

Dedicated VOLUNTEER search and rescue (SAR) professionals, across Colorado, are ready to mobilize to help those in the Colorado backcountry. Your Colorado Outdoor Recreation Search and Rescue (CORSAR) contribution supplies reimbursements to SAR teams for costs incurred while conducting search and rescue operations, and to provide funding for the purchase of search and rescue related equipment.
How it works: After a SAR mission concludes, the County in which the mission was conducted sends a request for reimbursement. If the subject of the mission has a CORSAR card or eligible Parks and Wildlife license or registration, a reimbursement payment is processed immediately. If the subject of the search does not have one of these certifications, the request for reimbursement is held until the end of the year. If money is available in the fund at the end of the year, the requesting county receives reimbursement. Cost is currently $3 for 1 year, $12 for 5-years.
The CORSAR card is not insurance and does not reimburse individuals or pay for medical transport. https://cdola.colorado.gov/funding-programs/search-and-rescue-fund

Recommended Contents of First Aid Kit

No first aid kit is perfect. Preassembled kits are handy but are expensive and often do not contain the most useful items. Check contents regularly and modify for the conditions of the trip. The most important item is the user. Carry only what you know how to use and might need for yourself.

Item	Quantity & Size	Use
Bandage strips	6 – 1-inch	Minor wounds
Self-adherent roll bandage	2” x 5 yards	Wrap around dressings
Cloth, Sport adhesive tape	2” wide role	Multiple uses
Elastic bandage	2”	Sprains, compression
Sterile gauze pads	4 – 4” x 4”	Larger wounds
Sanitary napkins, pads	2 ea. large & small	Severe bleeding
Clotting Gauze	1 pack or roll	Severe bleeding
Triangular bandages	36 x 36 x 52”	Slings, cravats
Cotton swabs	6 – 3”	Extract foreign body (eye, wound)
Latex gloves	2 pair	Barrier against infection
Plastic bag	1 – 12” x 18”	Hold contaminated materials
Blister bandages or moleskin, assorted sizes		Blisters
Povidone iodine swabs	2 packages	Antiseptic
Alcohol or soap pads	3 packages	Cleanse skin
Anti-inflammatory drug that you use		Headache pain, muscular pain
Antihistamine or Epi-Pen if you are high-risk		Allergic reactions

Additional useful items

N95 mask for wildfire smoke	Safety pins	Antacids
Tweezers or needle for splinters	Scissors	Pen or pencil
First aid reference book or application; Medical Emergencies chapter (see Resources)		
Your prescription drugs, clearly labeled with their name, expiration date, directions		
Your name, age, address, medical conditions, emergency contact information		

Common Backcountry Conditions

There are five types of emergencies typically seen in the backcountry:

1. Altitude-related
2. Heat-related
3. Cold-related
4. Accident-related
5. Other causes

> Backcountry first aid requires specialized training, which is beyond the scope of WTS.
>
> The objective of this chapter is to enable you to be aware of the most common conditions and to conduct an adequate patient assessment so that you can obtain appropriate care. – *WTS Committee*

1. Altitude-Related

Acute Mountain Sickness (AMS)

Signs and Symptoms may include	Treatment
Shortness of breath Nausea and vomiting Dizziness Severe headache Drowsiness Weakness Insomnia Unusual patterns of breathing during sleep Swelling in hands and face	Rest Breathe deeply and regularly. Aspirin or ibuprofen for headache. Drink fluids (not alcohol or caffeine). DESCEND to a lower elevation.

High Altitude Pulmonary Edema (HAPE)

Occurs when lungs fill with fluid that has oozed through the walls of the pulmonary capillaries. Usually begins one to four days after arrival at high elevation. Rarely occurs below 8000 feet.

Signs and Symptoms may include	Treatment
Shortness of breath with moderate exertion Weakness and marked fatigue Headache Loss of appetite or nausea and vomiting Coughing, an important early sign, usually a dry cough, which can turn into watery or frothy sputum Cyanosis (lips and nail beds turn blue) Skin may be pale and cool Bubbling or crackling sounds heard in the lungs Confusion, delirium, and irrational behavior	DESCEND to a lower elevation – a descent as little as 2000-3000 feet often results in prompt improvement. Evacuate if patient does not improve.

High Altitude Cerebral Edema (HACE)
An abnormal accumulation of fluid in the brain. Can cause death or, more rarely, permanent brain damage.

Signs and Symptoms may include	Treatment
Decreased mental function Confusion Loss of memory Inability to exercise proper judgment progressing to hallucinations, psychotic behavior, and coma Worsening headaches Vomiting Weakness or paralysis of a limb Pale and blue (cyanotic)	DESCEND to lower elevation. Assist if patient is semi-conscious or unconscious. Evacuate if patient does not improve.

2. Heat-Related

Overexposure to increased temperature plus humidity (a high heat index).

Heat Exhaustion

Signs and Symptoms may include	Treatment
Cramps (often first sign) Fatigue, exhaustion Fainting Nausea Rapid pulse and breathing Mental status change Pale, damp, relatively cool skin	Body cooling, douse or spray with water Move to shade Fluid intake, if not nauseous Loosen tight clothing.

Heat Stroke

Signs and Symptoms may include	Treatment
Irrational, confused, or combative behavior Unconsciousness Red, dry, hot skin – classic heat stroke Difficulty walking Elevated pulse rate Nausea, weakness, dizziness, thirst, or headache Internal temperature over 105º F (41º C)	Decrease body temperature immediately: Remove or loosen tight clothing. Place patient in a cool, shady environment. Cool patient with wet cloths or cool water, especially on the neck, in the armpits, and in the groin. Immediately stop efforts of cooling if shivering occurs. Monitor patient carefully. Give water in sips to a conscious patient. Evacuate by stretcher as soon as possible

3. Cold-Related

Hypothermia

Hypothermia can occur at 50-60º temperatures when clothing is wet (COTTON KILLS) or it is windy, especially if dehydration is present. Notice if your co-hikers experience a progressive decrease in mental and muscle function – mumbling, fumbling, stumbling.

Mild Hypothermia

Signs and Symptoms may include	Treatment
Complaints of cold Shivering Difficulty using hands Psychological changes, withdrawal, and apathy Core temperature above 90º F (32º C)	Replace wet clothing with dry. Place patient in a warm environment. Offer warm liquids or food if patient is conscious and able to swallow easily

Moderate to Severe Hypothermia

Signs and Symptoms may include	Treatment
Lethargy, mental confusion, or refusal to recognize the problem Uncontrollable shivering Slurred speech Stumbling Core temperature (<90° F) Progressing to: Unresponsiveness Decreased pulse and respiration Cessation of shivering Physical collapse Apparent death	If patient will be evacuated promptly: Cover patient (rather than walking patient to shelter). Treat patient very gently. Replace wet clothing with dry; cut clothing off to prevent unnecessary movement. Evacuate. If patient will not be evacuated promptly: Begin active rewarming of the core. Watch for signs of shock. Prepare for CPR. Evacuate as soon as possible.

Remember – No one is dead until they are warm and dead!

Frostbite

The extremities are the most susceptible parts of the body – fingers, toes, ear lobes, the tip of the nose. Exposed skin can freeze in 30 minutes at a temperature of 0° F and a wind speed of 15 mph, or at 5º F and a 30-mph wind. In cold conditions, notice if your co-hikers are developing discolored spots on nose or cheeks.

Superficial Frostbite

Signs and Symptoms may include	Treatment
Skin is white and waxy or discolored Loss of feeling	Dry coverage Steady warmth

Deep Frostbite

Signs and Symptoms may include	Treatment
Skin appears pale, dull, or waxy and is hard Joint movement is absent or restricted The part is numb and senseless. On thawing, the part will be very painful.	Treat for hypothermia, if present. Do not rub. Prevent freezing of unaffected tissue. Keep the frozen part frozen. If thawed, the part should not be allowed to refreeze or bear weight. Give the patient plenty of fluids. Evacuate.

Treatment – IF refreezing will not take place AND the part can be kept sterile
Immerse the part in a water bath at a constant temperature of 104º-108º F (40º-42º C). Continue thawing until the part has a pink undertone all the way to the tip. Encourage exercise of thawed toes or fingers during and after thawing. Once thawed, position the part on a sterile pad, protect blisters, and evacuate by stretcher.

For more information on wind chill, hypothermia, and frostbite, see NOAA websites at https://www.weather.gov/safety/winter and https://www.weather.gov/safety/cold-wind-chill-chart

4. Accident-Related

Assess the Patient – See Patient Assessment forms at the end of this chapter.

Conscious patient	Unconscious patient
Ask: What happened? Where does it hurt? Can you move your hands and feet? Can you feel me touching your hands and feet? Can you raise your legs and arms? Look for bruises, cuts, deformities. Feel for areas of tenderness, deformity, abnormal sensation. Determine patient's strength by having them squeeze your hand or by checking pressure against the foot.	Assess ABCs (Airway, Breathing, Circulation) and treat as appropriate. Assess LOC (Level of Consciousness, AVPU in Patient Assessment) Look for cuts, bruises, deformities. Feel for deformities, signs of sensation. Ask others what happened. Probe the soles of the feet, then the palms of the hands with a sharp object to check for response

Wounds

Goals	Treatment
Control bleeding. Prevent infection.	Direct pressure, elevation, pressure points. Irrigate wound. Close if small. Cover with sterile dressing if large.

Burns

Goals	Treatment
Prevention is the best choice. Watch for sun exposure (high altitude, reflective surfaces, low-SPF sunscreen), cooking, tent fires, etc. Signs/symptoms: Superficial (first degree) sunburn: pain and redness Partial thickness (second degree) sunburn: water-blisters appear Full thickness (third degree) burns: flame-charred skin	Stop the fire, cool the burn. Wash with soap and water, remove debris. Leave blisters intact. Remove rings, watches, or other constrictions. Apply antibiotic ointment, dry dressing, and tape. Give aspirin or ibuprofen. Elevate. Assess the depth, extent, location (i.e., face, airway). Give fluids. Check for shock. Evacuate if greater than 10% second degree burns to the face/neck, feet/hands, or genitals.

Lightning Injuries

Signs and Symptoms may include	Treatment
Burn often has a zigzag appearance. May have severe internal injuries. Assume neck and back injury. Cardiac and respiratory arrest	CPR (Cardio Pulmonary Resuscitation) Rescue breathing with jaw thrust Immobilize.

Extremity Injuries (Dislocations, Sprains, Fractures)

Goals	Treatment
Assess severity. Prevent further injury. Stop bleeding. Control pain. Look for side effects: o Closed fracture becomes open o Restriction of blood flow below fracture site o Excessive bleeding o Pain	ABCs (Airway, Breathing, Circulation) Expose injury. Cover all wounds with sterile dressing. DO NOT replace protruding bones. DO NOT straighten an angulated fracture (bone ends could lacerate tissues): splint in place. DO NOT straighten a dislocation. Note pulse below fracture site, circulation, and neurological status (movement). Remove constricting clothing or jewelry. Immobilize joints above and below fracture, or bones above and below dislocation. Check distal pulse, circulation, and neurological status every 15 minutes. Elevate injured extremity. Apply cold compresses to injury site

Splinting

Basic principles of splinting	Testing for sensation and movement
Determine location and extent of injury. Stop bleeding. Rinse off exposed bone ends; cover with sterile dressing. Straighten badly angulated limbs by gentle pulling. Remove any jewelry or clothing that will later cause constriction. Immobilize joints above and below fracture, or bones above and below dislocation. Prepare a splint, size it, and pad it. Observe below injury site for circulation and sensation. Elevate injured extremity. Apply cold compresses to injury site.	Observe below injury site for circulation and sensation. Touch hand or foot and ask: Can you feel this? Where am I touching you? Can you wiggle your fingers, toes? Have patient squeeze your hand or push and pull against your hand with foot.

Shock

Inadequate oxygen reaching the cells due to loss of blood pressure, usually from blood loss.

Signs and Symptoms may include	Treatment
Restlessness and anxiety Weak, rapid pulse Cold, clammy skin Sweating Paleness Shallow, labored, rapid respiration Nausea, vomiting Decreased blood pressure Delayed capillary refill Loss of Consciousness (LOC)	Keep patient's airway open and clear. Control all obvious bleeding. Treat patient gently; minimize movement to prevent pain. Maintain patient's body temperature, cover with a blanket. Raise feet (most of the time) Position patient to aid in the circulation of blood to the core and to aid breathing. Frequently take and record patient's vital signs. Evacuate ASAP.

Head, Neck, and Back Injuries

- Treatment of these injuries requires advanced training.
- Assume these injuries in all unresponsive patients.

Goals:

- Assess severity: ABCs, LOC, and treat as appropriate.
- IMMOBILIZE to prevent further injury.
- Monitor changes to report to medical responders.
- Treat for shock if necessary, except keep head elevated.

5. Other Causes

Blisters

Goals	Treatment
Prevention is the best choice. Prevent friction burn due to rubbing of rumpled socks. Be sure of good boot fit and dry socks.	Treat hot spots early. Cover with blister bandage, moleskin, anti-chafe cream, or liquid bandage. Leave skin intact; do not drain blister.

Evacuation Guidelines

- Does the patient need assistance standing up?
  - After any medical incident with the patient on the ground, you must first determine if it is in their best interest to try to stand. If there is ANY suspicion of a spinal injury, do not allow them to get up.
  - If it is determined that the patient should be able to stand (i.e., their injuries or medical condition are not severe enough that it would do them any harm to stand), then first have them move to a sitting position.
  - Take a couple of minutes to see how the patient feels sitting up before helping them to stand. If they feel worse sitting up, have them lie back down.
  - If the patient is fine sitting up, then have one person on either side of them and assist them in standing up.
- Can the patient walk out?
  - If the patient is capable of making a sound decision and feels they can walk out, make sure one or two people go with them and continue to reassess. If at any time you feel it is not in the patient's best interest to continue, and that they should be evacuated, discuss this with them. However, if they are of sound mind, they have the right to refuse.

Resources

Army First Aid – app for iPad at https://apps.apple.com/us/app/army-first-aid/id326842780

BIM-FirstAidGuide and MedicalReport Forms – BIM's cards to assess injured person & report form, also pp. 98-99.

BIM-Personal Information-Form – Fill out and carry in your pack, also on p. 100.

Chapter 15 – Medical Emergencies – carry for reference.

NOLS Wilderness Medicine*, 7th Ed* – https://www.amazon.com/NOLS-Wilderness-Medicine-Tod-Schimelpfenig/dp/0811739961

Learn More – **Emergency Situations** (learn emergency)

See helpful WTS articles and forms linked from this page.

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First Aid Sequence and Procedures Guide

Checklist for the primary First Aid'er

 rev. 2-20-2022

A. Scene Size-Up

1. Identify immediate hazards (avalanche, rock fall, weather)?
2. Determine **M**echanism **O**f **I**njury?
3. General impression of seriousness?
4. Number of patients?
5. First aiders and patient put on personal protective gear -- gloves, mask, eye protection.

B. Initial Assessment

1. Level of responsiveness?
2. Obtain consent to treat.
3. Protect spine if MOI suggests head or back injury.
4. **A**irway – Open? Clear any obstructions.
5. **B**reathing – Look, listen, feel.
6. **C**irculation – Check pulse. Look for severe bleeding.
7. Decision – Is protection of spine needed?
8. Expose and examine for major injuries.

C. Decision to relocate patient if necessary

1. Do not move if spinal injury expected.
2. Do not expose rescuers to imminent harm.
3. Circumstances may present rescuers with a difficult decision.
4. Use judgment weighing urgency to provide treatment, severity of injury, and presence of immediate safety hazard(s).

**** Begin Documenting all Findings on Medical Report Record ****

D. Secondary Assessment

1. **Look, listen, feel, smell, ask – Head-to-Toe Exam**
   a. Scalp? Ears? Nose? Eyes? Mouth? Neck?
   b. Shoulders? Arms? Fingers? Spine? Chest?
   c. Abdomen? Pelvis? Legs? Feet? Toes CSMs?
2. **Vital Signs**
   a. Level of responsiveness? (A+Ox?)
   b. Heart 50-100 (rate, rhythm, strength)?
   c. Respiration 12-20 normal (rate, rhythm, effort)?

   d. Skin signs (color, temperature, moisture)?
   e. Blood pressure (weak, strong)?
   f. Pupils (equal size, shape, reactivity to light)?
   g. CSM's (Check extremities. Circulation/Sensitivity/**M**otion
3. **Medical History**
   a. Chief Complaint: Problem that caused patient to need help?
      - **O**nset – Problem occurred suddenly or gradually?
      - **P**rovokes/Palliates – Illness? Accident? What makes it better or worse?
      - **Q**uality – Describe the pain: Burning? Dull? Sharp? Cramping?
      - **R**adiation/Referred – Where is pain? Does it radiate?
      - **S**everity – On scale of 1-10, with 10 being worst pain ever?
      - **T**ime/Trend – When did it start? How frequent? Deteriorating? Stable? Improving?
   b. **S**ymptoms?
   c. **A**llergies?
   d. **M**edications?
   e. **P**ast medical history?
   f. **L**ast intake/output?
   g. **E**vents recently?
4. **Mental/psychological state?** (calm, agitated, despair, scared?)
5. **Overall Assessment**
   a. Severity (life threatening, severe, moderate, low)?
   b. Trend (deteriorating, stable, improving)?
6. **Determine significant Injuries** in order of severity. What treatment and/or actions should be/were taken.
7. **Evacuation Decision**
   a. Immediate? If not immediate, when?
   b. Resources requested (litter, helicopter, special meds)?
8. **Patient Information**
   a. Name? Age? Gender? Weight?
   b. Emergency contact? Emergency phone?
   c. Emergency contact location? Relationship?
   d. Permission to call emergency contact?
9. **Retake and Document Vital Signs**
   a. Every 20 minutes if responsive.
   b. Every 5 minutes if unresponsive.

Medical Report Record (Retain at site)

For the First Aid Scribe to record the primary First Aider's findings.
The Get Help Team needs to snap a photo of this card!

 rev. 2-20-2022

1. **Secondary Assessment – Head-to-Toe Exam**
   a. Scalp? Ears? Nose? Eyes? Mouth? Neck? _____
   b. Shoulders? Arms? Fingers? Spine? Chest? _____
   c. Abdomen? Pelvis? Legs? Feet? Toes? CSMs? _____
2. **Vital Signs – Record this item #2 findings in the chart on page 2**
   a. Level of Responsiveness (Alert + Oriented x ____:
   —— A+Ox4 if conscious: (i.e., Alert+ Oriented to Person, Place, Time, Event)
   —— AVPU if not conscious: Alert to? Voice? Pain? Unresponsive?
   b. Pulse (50-100 normal. Note rate, rhythm, strength)?
   c. Respirations (12-20 normal. Note rate, rhythm, effort)?
   d. Skin signs (Note color, temperature, moisture)?
   e. Blood pressure (At radial or pedal. Note weak or strong)?
   f. Pupils (Note size, shape, reactivity to light)?
   g. CSM's (Check extremities. Circulation/Sensitivity/Motion)
3. **Medical History**
   a. **Chief complaint?** _____
   b. Symptoms? _____
   c. Allergies? _____
   d. Medications? _____
   e. Pertinent medical history? _____
   f. Last intake/output? _____
   g. Events recently? _____
4. **Mental/psychological state?** ☐ calm ☐ agitated ☐ despair ☐ scared ☐ other
5. **Overall Assessment**
   a. Severity (life threatening, severe, moderate, low)? _____
   b. Trend (deteriorating, stable, improving)? _____
6. **List significant injuries in order of severity. Indicate treatment and/or actions taken:** _____
7. **Evacuation Decision**
   a. Immediate? If not immediate, when? _____
   b. Resources requested (litter, helicopter, special meds)? _____

8. **Patient Information**
   a. Name? _____
   b. Age? _____ Gender? _____ Weight? _____
   c. Emergency contact name? _____
   d. Phone? _____ email? _____
   e. Emergency contact address/location? _____
   f. Relationship? _____ Permission to call? Y? N? Unknown?
9. **Vital Signs Record** (20 minutes if responsive; every 5 minutes if not)

TIME	Initial __:__	__:__	__:__	__:__	__:__
Level of Responsiveness -Alert? -Oriented?					
Pulse/min -Regular? -Strong?					
Respirations /min -Regular? -Easy?					
Skin (SCTM) -Color? -Temp? -Moisture?					
Blood Pressure (radial/pedal) -weak -strong					
Pupils (PERRL) -Size? -Equal? -Round? -React to Light?					
CSM's (arms/legs) -Circulation? -Sensitivity? -Motion?					

Personal Information Form

CMC'er: Complete Card and Place in Your First-Aid Kit

Name _____ Date ___/___/___

DOB ___ /___/___ Gender _____ Blood Type _____

Weight _____ Age _____

Home Address _____

City _____ State _____ Zip _____

Home phone _____ Cell phone _____

E-mail _____

PERSON TO NOTIFY Name _____

Relationship _____ Phone _____

Address _____

City _____ State _____ Zip _____

Home phone _____ Cell phone _____

E-mail _____

RELEVANT MEDICAL HISTORY (injuries, illnesses) _____

_____

Implants or medical devices _____

Medic alert tag: Y N (specify) _____

Allergies _____

Medicines currently used _____

Primary care doctor _____ Phone: _____

Notes

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SECTION IV – SNOW TRAVEL

CHAPTER 16 – SNOW TRAVEL FIELD DAY

By Tim Musil

Objective: Upon completion of this exercise, you will be able to employ safe and effective techniques for traveling on snow-covered mountain terrain.

Description of the Day

Your instructor team will select a location for this field day based on the amount of snow coverage, expected weather, and accessibility of the area for that day. They will not use or traverse avalanche-prone terrain. From the trailhead, your group will hike a short distance to the snow slopes. You will learn and practice methods for preventing a fall and for self-arresting – techniques for quickly stopping the slide – in case a fall does occur. Self-arrest exercises will cover how to react to a fall regardless of your position on the snow. Afterwards, you will learn some basic techniques for backcountry survival in winter conditions. By the end of the day, you should have a solid foundation of snow travel skills.

If you are apprehensive about using an ice ax, keep in mind that graduation from Wilderness Trekking School is allowed without performing the ice ax exercises. However, this will enhance your readiness to instruct in WTS or to take climbing and other CMC courses. We believe that you will find that learning to use an ice ax is easier than you think. The ice ax is a highly effective tool for traveling more safely on snow.

For safety, WTS pads the adze on class axes. Your instructors will help you select the appropriate size – the spike of the ax about ankle level when you stand upright grasping the head – and show you how to attach it to your pack. When needed, you will carry the ax by the head with the pick pointed backward. For self-arrest, one hand holds the head by your shoulder, and the other holds the spike near your hip while the shaft goes diagonally across your chest.

What You Will Need

Bring your ten essential systems. The school will provide ice axes and helmets. As a safety precaution, you must wear a helmet while on the snow slopes. Unless your instructors state otherwise, snowshoes will not be required. WTS does not use crampons, although your instructors will explain their purpose and use.

For safety and comfort reasons you should bring gaiters, wear extra layers of warm clothing, and bring an extra pair of gloves and socks. Since there will be slipping and

sliding on snow, your outer layer should be waterproof or substantially water resistant. Now is a good time to waterproof your boots.

Skills and Subject Areas Covered

In the Colorado mountains, snowfields stay on the slopes all year, especially on the highest peaks. With practice and good judgment, you can travel safely on snow. Proper techniques will also conserve your energy. In short, learning to travel proficiently on snow enables you to handle unexpected summer snow as well as opening the mountains to year-round hiking. You can now consider a slope you might have avoided in the past to be a better pathway to your destination and an opportunity for a fun and exhilarating glissade on the way down. You will practice techniques to develop basic snow travel abilities. Your instructors will discuss the following topics:

- Techniques for ascending snow slopes, including hiking single file and kick-stepping
- Techniques for descending snow slopes, including plunge-stepping and glissading
- Using an ice ax as a third point of contact
- Rest step and rhythm-breathing
- Avalanche risk recognition and avoidance
- Self-belay using an ice ax to prevent a fall
- Self-arrest with an ice ax to stop a fall
- Self-arrest without an ice ax to stop a fall
- Carrying and stowing an ice ax
- Choosing the proper ice ax length
- The parts of an ice ax
- Route finding on snow
- Postholing and how to avoid it
- Survival in winter conditions

CHAPTER 17 – AVALANCHE

By Joe Griffith

Objectives: Upon completion of this chapter, you will be able to:

- Describe the three factors that affect avalanche behavior.
- Recognize hazardous areas so you can avoid them.

Next Steps: When you want to do more (Winter only, check cmc.org in late fall.)

- **Avalanche Education** – Avalanche Terrain Avoidance and AIARE courses
- **Skiing Classes**
  - Backcountry Skiing and Splitboarding
  - Backcountry Nordic Ski School
  - Telemark Ski School
- **Winter Camping School**
- **Snowshoe Class**

According to the Colorado Avalanche Information Center (CAIC), between 2014 and 2022, 46 people were killed in Colorado by snow avalanches. Colorado leads the nation in avalanche fatalities. An avalanche is a violent event. Snow tumbling down a mountainside can flatten large, sturdy trees. A human caught in one of these maelstroms often does not fare well. Trauma kills more than a quarter before the snow stops moving. After 30 minutes under the snow, buried survivors of the slide have less than a 50% chance of still being alive. Those buried more than seven feet under the surface almost never survive. Consequently, **the primary survival strategy with respect to an avalanche is to avoid being caught in one.**

Although avalanches are the result of complex processes, you can usually avoid them by mastering a few simple concepts. Even the most cautious traveler faces some risk in avalanche terrain, so more advanced courses teach search-and-rescue techniques. We strongly urge you to take an avalanche awareness course and read the references at the end of this chapter. In the meantime, this chapter, the Avalanche lecture video, and the Snow Travel Field Day will help you avoid danger.

Fortunately, for those of us who enjoy the mountains in winter, many places are safe most of the time. A special set of circumstances must occur to make an avalanche possible. Avalanche experts have found three factors that affect the creation of hazardous conditions: **terrain, snowpack**, and **weather**. Once a slope is loaded with snow, an apparently insignificant **trigger** can set the whole thing in motion. Avalanche victims or their traveling companions are usually the ones who pulled the trigger.

Don't forget other terrain hazards in snow country: exposed rocks absorb heat from the sun, weakening the snow nearby so that it may not support you. Tree wells, where less snow has fallen close to the trunk, can also trap you. Be careful around rocks and trees! Also be wary around those flat areas that could be either a meadow or a lake with snow-covered thin ice.

Terrain

Terrain affects the probability, the locations, and the tracks of avalanches. The ability to understand the terrain and reliably navigate around hazardous areas will significantly improve your safety during winter travel.

A key factor influencing the probability of an avalanche is the **slope**. Very steep slopes are not a problem because snow cannot build up on them. Shallow slopes – that are far away from an avalanche chute – are also safe because there is little lateral force on the snow. **Slopes between 30° and 45° are the most treacherous.** If you prefer to think in terms of the grade of the slope, the most dangerous are between 50% and 100% grade. Slopes of 15° - 30° and 45° - 60° present a lesser but still significant risk.

In the field, clinometers will allow you to measure slopes, but you can spot hazardous locations before leaving home. A topographic map will show you areas adjacent to your planned route that are dangerous. *Chapter 9 – Mountain Navigation by Map and Compass*, tells you how to estimate slopes from the map. (Also, see links on Learn More – Navigation.) Some areas produce avalanches so often that trees cannot grow along the track. Topographic maps often show these tracks as white streaks breaking up the green of a forested slope. Figure 1 shows an area with several avalanche chutes. The red line overlaid on one of them has a slope of 33°.

The shape of a mountainside affects the avalanche track, so the danger level can vary significantly from point to point. A gully may be extremely hazardous while an adjacent ridge offers safe passage. Safe route finding is, therefore, an essential skill in winter travel. Pay close attention when this topic is covered in the lecture video and on the field day! Gullies, ledges, trees, and other abrupt features in the avalanche path can create **terrain traps** where a relatively small avalanche can bury a person deeply in snow.

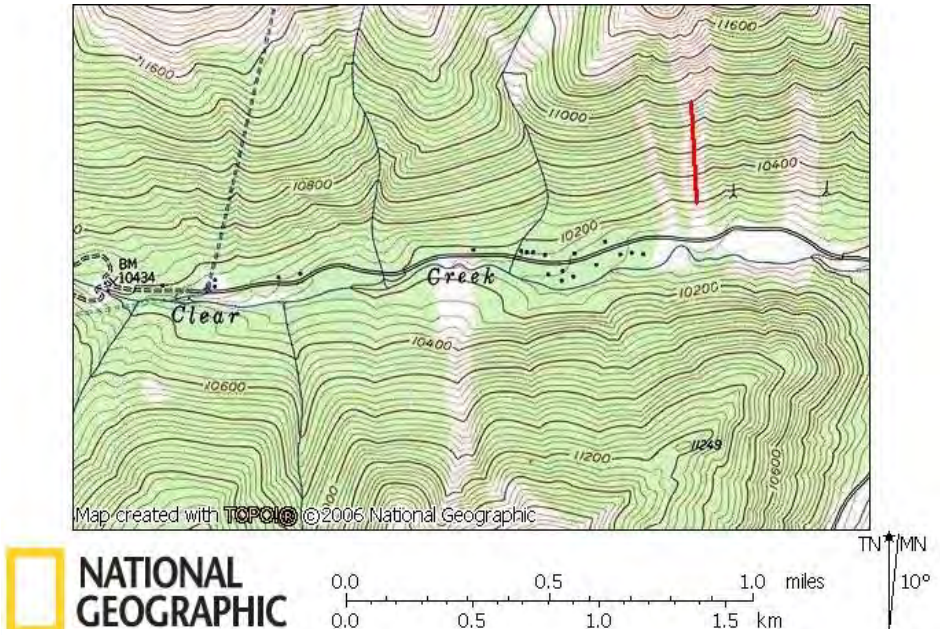
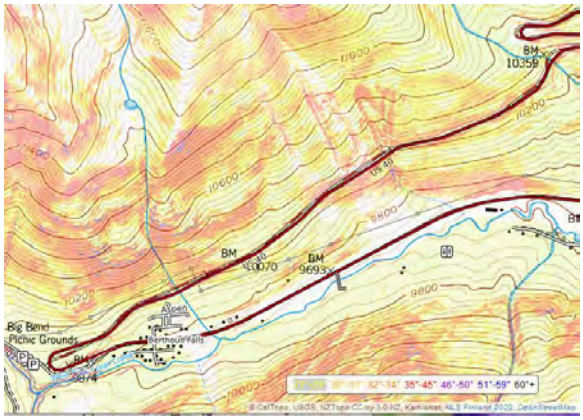


Figure 1: The average slope of the red line segment (upper right) is 65% grade or 33°. Map created with TOPO! © National Geographic Maps.

The CalTopo mapping site features a Slope Angle Shading layer that is useful for route-planning. Your map for Snow Travel Day will display this layer.



Snowpack

The snowpack, or snow cover, is the accumulated snow on the ground. Though it appears static to our eyes, it is surprisingly dynamic. Snowflakes change constantly on their way to the ground, and they don't stop changing when they become part of the snowpack. This process sometimes produces large, poorly bonded crystals known as sugar snow or depth hoar. Depth hoar weakens the snowpack. The bonding between layers affects snowpack stability, and every new layer offers opportunities for weak bonding.

A weak snowpack often gives warning. A recent avalanche in the area is an obvious clue. Sudden cracking of the snow cover is a sign that it is under stress. Some of the warnings are audible. Hollow sounding snow or a sudden "whoomph" produced by settling snow are signs that it is unstable. If these signs occur in a flat meadow, with no steep snow slopes above, they are merely useful information about the snowpack. If you are in or below avalanche terrain, however, immediately leave the area by the safest possible route. Experienced snow travelers don't wait for obvious warning signs. By digging a trench or snow pit, they can discover weak layers in the snow. An avalanche awareness course will teach you how to interpret what the layers mean.

As with terrain, it is possible to obtain an analysis of snowpack conditions before leaving home. Twice daily in winter, the Colorado Avalanche Information Center (CAIC) provides reports on the snowpack conditions, which are available via email to subscribers, by phone at 303-275-5360, or at http://avalanche.state.co.us/. The CAIC's website offers valuable links to other websites as well as educational material. Links to forecasts for other parts of North America are at http://www.avalanche.org.

Weather

Weather creates the snowpack, it alters the snowpack's properties throughout the winter, and it melts the snow in the spring. In all these processes, weather affects the probability and location of avalanches.

Conditions that rapidly deposit new snow are especially dangerous. Snowfall greater than one inch per hour adds weight to the snowpack without giving it time to settle and strengthen. High wind events can load lee (downwind) slopes with deep, unstable slabs of snow even if it is not snowing. Lee slopes loaded by windblown snow can avalanche multiple times in a storm.

Weather after a storm affects how quickly the snow settles. Depending on the time of year, the sun can either strengthen or weaken the snowpack. In late fall and early winter, gentle warming from the sun helps strengthen snow on south-facing aspects. North-facing

aspects may be slow to stabilize, so they call for special caution – especially during and after a heavy snowfall. In late winter and early spring, the sun has the opposite effect: melting can trigger avalanches on south-facing aspects.

Trigger

Under typical conditions, a ton of snow occupies a few cubic meters, so a snow slab perched on a mountainside can weigh thousands of tons. The enormous forces acting on the slab are often so finely balanced that the weight of a single human is enough to unleash the avalanche. We know this because about **9 out of 10 avalanche accidents are triggered by the victim or by someone traveling with the victim**. Disturbing the snow anywhere on the slope, even at the bottom, can set an avalanche in motion. The fact that a slope has been crossed successfully does not mean that it is stable.

The Obvious Clues Method

Because of the complexity of avalanche behavior, even those who have been formally trained often fail to recognize the danger. In the U.S., nearly half of avalanche victims have had formal avalanche training. To address this problem Ian McCammon developed the Obvious Clues Method, a rule-based approach to assessing avalanche hazard. The mnemonic **ALPTRUTh** may help you remember the seven clues, which are:

Avalanches in the past 48 hours
Loading by new snow or wind in the past 48 hours
Paths where avalanches obviously run
Traps in terrain that can be fatal
Rating of CONSIDERABLE or higher
Unstable snow signs
Thawing of the snow surface

The number of clues present in a situation provides a guide to the level of caution: normal caution for one or two clues and extra caution for three or four clues. If five or more clues are present, then travel in the area is not recommended.

What to Do If Caught

Once triggered, an avalanche develops with horrifying speed. There will be at most a few seconds to decide how to react. If possible, try to get out of the way or try to grab something that is anchored. Yell “Avalanche!” to warn those whom you will need to rescue you.

As the snow flows down the mountainside, it behaves like a fluid. Larger objects tend to float toward the surface, so current thinking is that you should keep your pack on. Struggle to keep your mouth clear of snow. As the avalanche slows, use your hands and arms to create an air space in front of your face. The bodies of some people killed by avalanches have been recovered with their mouths crammed full of snow. Expand your chest to give your lungs room to breathe. When the snow comes to rest, it becomes an almost unyieldingly solid, like concrete. Imagine being packed inside of an enormous snowball. If you find it possible to dig yourself out, then do so. Otherwise, the rules reverse: don’t yell; don’t struggle. No one can hear you scream. Struggling wastes oxygen.

In the first moments after an avalanche, rescuers must strike a balance between the urgent need to save the victims and the need to protect themselves and others. There may be more snow poised to come crashing down on the rescuers. On the other hand, buried victims will quickly suffocate. There is no time to send for help when a victim is buried.

Successful search and rescue require training, proper equipment, and careful preparation. These topics are covered in the AIARE 1 & 2 Avalanche and Rescue Schools offered by the CMC. The techniques taught there save lives. Keep in mind, however, that avalanche avoidance, as taught by the CMC's Avalanche Terrain Avoidance, should be your primary strategy. No equipment can keep an avalanche from happening; no equipment can guarantee your survival if an avalanche occurs. In addition, everyone in your group must have the proper equipment. Avalanche transceivers (beacons) can be set to transmit a signal (send mode) or to detect a signal (receive mode). An avalanche beacon will be worthless to you if you are the only person wearing one, or if you are buried alone in the snow with no one to search for you. An avalanche beacon does not make you invulnerable. You can be killed by an avalanche while you are wearing a beacon.

Snow Travel Rules

- If traveling in avalanche country, always travel with one or more avalanche-aware companions who are carrying and skilled at using rescue gear.
- In a hazardous area, spread out so that only one person is exposed at a time. Do not cross a hazardous area above others in your group. Think ahead about possible escape routes.
- Carry rescue gear so that it is securely attached: a beacon under your clothing, a probe and shovel in your pack.
- If the hazard level is high, be prepared to change your plans.
- Review Heuristic Traps on the last page of Chapter 11 – Teamwork.

References

Articles by Ian McCammon and others are available at Snowpit Technologies.

Backcountry Avalanche Safety: Skiers, Climbers, Boarders, Snowshoers, 3rd edition, by Tony Daffern, Rocky Mountain Books, 2009

REI Expert Advice has many helpful articles on avalanche safety.

Snow Sense: A Guide to Evaluating Snow Avalanche Hazard*,* 5th edition, by Jill A. Fredston and Doug Fesler, Anchorage, Alaska Mountain Safety Center, Inc., 2011.

Staying Alive in Avalanche Terrain**,** by Bruce Tremper, Seattle, The Mountaineers Books, 2018

The ABCs of Avalanche Safety, 3rd edition, by Sue A. Ferguson and Edward R. LaChapelle, Seattle, The Mountaineers Books, 2003

Learn More – Snow Travel (learn snow)

See helpful WTS articles and forms linked from this page.

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SECTION V – GRADUATION

CHAPTER 18 – GRADUATION HIKE

By Tim Musil, Revised August 2023

Objectives: – Upon completion of this exercise, you will be able to:

- Implement the planning and teamwork skills you have learned throughout this course to plan a hike with your student group.
- Complete a hike with the members of your group.

Trip Planning

Many consider the graduation hike to be the highlight of Wilderness Trekking School. It is the culmination of the weeks of hard work and effort you have put forth to learn new skills and meet new challenges. Your friends and family may now look to you for guidance in this area. You will use those skills to plan and execute your graduation hike.

Preparations for this important field day typically begin about midway through the course. Your instructor team will select a destination for your hike – it might be a mountain summit, an alpine lake, or another natural feature. Then the members of your group will work together as a team to plan and execute the hike from beginning to end.

WTS will allow ample time during the group meetings to plan and prepare for the hike. However, some of the planning may take place outside of class via email and/or additional meetings.

Your group's first step may be reviewing the Grad Hike guide recommended by your instructors and dividing the tasks. The amount of detail in a trip plan will vary depending on the complexity and difficulty of the hike. WTS provides guides to help ensure all relevant matters are covered:

- The Graduation Hike Form, in *Current Session Information*, provides a checklist.
- The trip plan template, in Word format and customizable for your trip, is on the Learn More – Navigation (learn navigation) page.

Your group should develop a trip plan to help ensure the hike goes as intended, and to identify and handle contingencies that could happen. The process of preparing the trip plan should not be rushed.

Trip planning should be conducted before every hike, even the easy ones where you think nothing could go wrong. Careful preparation can make the difference between a successful hike that goes off as planned and a hike that goes wrong from the start – the key to having a safer and more enjoyable hiking trip. Also, because the participants know that important details have already been taken care of, they can concentrate on enjoying the hike rather than worrying about a "what if something bad happens" scenario.

- **Location –** Your instructor group will select the destination and provide each student with a topo map. Obtaining and reviewing additional maps (i.e., trail,

terrain, satellite, and slope maps) will greatly enhance your route finding. (See Chapters 8 and 9 in the Navigation section.) Typical planning consists of researching guidebooks or online hiking sites, viewing maps and satellite imagery, scouting the hike (NOT your Grad Hike!), and other similar activities.

- **Route Planning –** This step should consider the capabilities of every group member. Is there deadfall, drop-offs, steep slopes, etc. that might be difficult for your weakest participant? At least half of the hike must be off-trail to allow you to employ your new hiking and navigational skills. The total distance and elevation gain of your planned route cannot go beyond the Moderate difficulty classification level. Prepare a description and map of the hiking route including mileage and elevation gain.
- **Trip Basics –** carpool meeting place and time, driving directions to the trailhead, whether the road requires high clearance vehicles, and post-trip activities.
- **Emergency Preparation –** This is empowering because the group goes into the field knowing what to do just in case. Simply stated, problems are better solved when the group is proactive rather than reactive. The first aid and bail-out procedures often require research and group discussion. Assign a first aid leader(s) and determine the location of the nearest medical clinic or hospital. Include assessing the risk of wildfire and smoke from distant fires.
- **Additional items:**
  - Name and contact information for each participant
  - Gear requirements and whether any special abilities are needed (e.g., ice ax skill)
  - Discussion of possible hazards
  - Weather forecast for the hiking area
  - Permit requirements, temporary closures, fire restrictions
  - Provide the completed trip plan to a trusted person back home so they will know whom to contact in case the group is overdue.

The plan should be written down because the contents are easily forgotten, especially under the stress of a trip gone awry. Trip participants who did not share in the plan's preparation should review it beforehand so that any questions or concerns can be addressed. Everyone should fully understand the plan because unexpected events may cause the leadership role to change.

Finally, another important benefit is that a trip plan helps the group fulfill its leave no trace responsibilities. By anticipating the demands and rigors of a trip, the group can reduce its impact on the landscape and avoid inadvertently violating land management regulations.

Description of the Day

When the big day arrives, you and your fellow students will lead the hike according to your plan. Rotate the leadership positions throughout the day so that each student serves as the front and rear leader at least once. You and your teammates will be in charge – you will set the hiking pace, call for rest breaks, make navigational determinations and, as

needed, assess conditions for making go/no go decisions. The role of your instructors will be to observe your use of good judgment in carrying out the hiking plan, and to ensure that each student is contributing to the effort of the group, and that all are following the WTS safety rules.

What You Will Need

Bring your ten essential systems, survival gear, at least one paper map, and a positive attitude.

Skills and Subject Areas Covered

Using the WTS Graduation Hike Form (in *Current Session Information*) or the trip plan template on Learn More – Navigation (learn navigation) page as a guide and working together as a team, you will learn how to plan, lead, and safely execute a trip. When you have completed the form, give a copy to your senior instructor.

This project includes the following skills and subjects:

- Teamwork
- Planning and coordination
- Cooperation and compromise
- Research
- Leadership
- Off-trail travel over varying types of terrain
- Orientation, navigation, and route finding
- Planning for an emergency or unexpected situation ("Hope for the best, but plan for the worst.")
- Setting a turnaround time to ensure that every member of the group returns safely to the cars in daylight, allowing for possible weather change or injury. Trips above timberline need to be especially attuned to lightning forecasts.
- Employing Leave No Trace practices
- Planning the post-hike celebration!

Important – To maximize the learning experience, we ask that you **do not scout** the area of your destination beforehand. Doing so will only short-change you and your teammates.

Whether the group reaches its intended destination does not determine the success of your trip. Because of a variety of factors, some of which are beyond human control, it is sometimes wise to turn back. Whether the group uses good judgment and teamwork from the planning stages through the completion of the hike itself determines your success.

Good luck. Have fun. Be safe.

Resources

CalTopo, https://caltopo.com – first developed for Search & Rescue, can display cell coverage, trails, fire activity, slope angles, etc.

Colorado Road Information, https://cotrip.org/ – road conditions, travel alerts, cameras

InciWeb, https://inciweb.nwcg.gov/– an interagency all-risk incident information management system

Weather Forecast, https://www.weather.gov/ –Enter your desired location, by ZIP code, park name, or summit, zoom the map to your trail, and click on Hourly Weather Forecast to see timing of wind, lightning, precipitation, etc.

CHAPTER 19 – NEXT STEPS

What's next after Wilderness Trekking School? If you want to hike, there are dozens of CMC hikes every week to beautiful places, ranging from wildflower hikes to challenging destinations. If you want to further your outdoor education, the CMC offers numerous schools covering a wide range of mountain-oriented, recreational sports and activities. If you want to meet more people with similar interests, the social groups and other opportunities within the club are nearly endless. If you would like to give something back to the club, many volunteer opportunities exist.

Denver Group Schools and Classes

Hiking and Scrambling Courses	Other Courses	Winter Sports Schools
Alpine Scrambling	Fly Fishing School	Avalanche Safety AIARE
Backpacking School	Knot Tying Seminar	Avalanche Terrain Avoidance
Canyoneering	Navigation I and II	Backcountry Nordic Ski School
Day Hiker School	Trip Leader School	Backcountry Ski/Splitboard
Intro to Hiking Safety		Beginner Snowshoe
New and Prospective Member Hikes		Ski Mountaineering
		Telemark Ski School
Wilderness Trekking School		Winter Camping School

Wilderness Survival Courses	Technical Climbing and Mountaineering Courses
Backcountry Incident Management School	Climbing Wall at the AMC
CPR/AED for Outdoor Enthusiasts	High Altitude Mountaineering School
Wilderness Medicine – WFA and WFR	Technical Climbing School
Wilderness Survival School	Technical Ice Climbing School

Special Interest Sections

Adventure Travel	Colorado High Peaks	Rocky Mountain Over the Hill Gang (50 & up)
Ascending Hikes	Fly Fishing	Technical Climbing
Backpacking	Mountain Biking	Trailblazers (20s & 30s)
Bobcats	Photography	Trail Running
Colorado Families		

Conservation and Trails

CMC engages in advocacy and stewardship work across Colorado to improve access to sustainable recreation opportunities and ensure conservation of natural resources on public lands. The CMC state office employs stewardship and policy experts but needs help from members to protect the places where we love to play.

Conservation Opportunities within the CMC

- Use the CMC Recreation Impact Monitoring System (RIMS) mobile application to report trail maintenance issues while you are out hiking, climbing, and skiing. See https://www.cmc.org/conservation/rims-mobile-app/rims-mobile-app.
- Attend classes, lectures, films, and trail crew days sponsored by the Conservation department.
- Add your name to the Conservation Department's E-News & Action Alert email list at https://www.cmc.org/conservation.
- Write letters, make phone calls, and vote on conservation-related issues - CMC provides information and template letters through our Action Alert emails.
- Join and help activate your group's Conservation committee - contact conservation@cmc.org for more information.

Conservation Opportunities outside the CMC

- Read the web pages and subscribe to list serves and newsletters of environmental organizations.
- Attend informational forums and public meetings.
- Write letters, make phone calls, and vote on conservation-related issues.

Your participation in conservation activities makes a huge difference!

Volunteer Opportunities

The CMC could not exist without the support of its members. Nearly all the schools, trips, and activities offered by the club are run by volunteers. Here are just a few of the many ways in which you can contribute:

- Leading hikes
- Teaching courses, including WTS!
- Writing articles for newsletters
- Conservation Committee
- Organizing social activities
- Assisting with research projects

Upon graduation from WTS and with a recommendation from your instructor team, you are qualified to join the school as an assistant instructor. If you would like to give back in that fashion, please contact the WTS director or another member of the committee. Your skills and experience are wanted here!

Hiking with the CMC

Check with your instructors to get an idea of what hike rating would best suit you. A major tenet of CMC safety is for the group to stay together. Since many leaders and hikers are intent on reaching the day's destination, sign up for trips that are well within your abilities.

Use the information in the trip description, rating, trail distance, elevation gain, and, if available, the pace and altitude to determine if the trip is suitable for you. Activity Difficulty Ratings are defined as:

Easy	or	A – up to 8 miles round trip OR up to 1200' elevation gain
Moderate	or	B – up to 1200 mi. OR up to 2500'
Challenging	or	C – up to 15 mi. OR up to 3500'
Difficult	or	D – over 15 mi OR up to 3500', possibly technical

The old A-B-C-D hike system is sometimes still in use and may be further subdivided into easy, moderate, or difficult levels. In general, pace is described as: casual, less than 1.7 to 2 mph; moderate, 2 to 2.5 mph; fast, over 2.5 mph. The designation varies between leaders. Your instructors may be able to tell you which leaders are fast (tigers), moderate, or casual (turtles).

After a hike, you may request endorsement for a badge from the leader. Badges are an electronic marker tied to your profile that denote courses taken, skills gained, benchmarks achieved, awards bestowed, and a host of administrative purposes.

To register for a trip

You can sign up to be notified of trips 1) as soon as they are posted, 2) in a daily digest, or 3) in a weekly digest by logging in, selecting MY PREFERENCES from the drop-down list under your name and image, and scrolling down to ALERTS & NOTIFICATIONS PREFERENCES. When you receive the notification email, click on the trip of interest to see its description and registration page.

Alternatively, on CMC.org, select the **ACTIVITIES GET OUTSIDE WITH US** dropdown, and select **HIKING** to display the **TRIPS** page. In the left-hand column, check one or more of your preferences.

- **I want to go…**, select Hiking and/or other activity.
- **I'd like it to be...**, select difficulty level(s); does not display trips listed with old terminology, typos or wrong case.
- **Open for Registration?** can leave blank.
- **Starting…**, enter desired date range.
- **Trip, seminar, or clinic…**, can leave blank.
- **For…,** can leave blank.
- **With this group/section...**, select one or more.
- **Advanced Search Options,** leave blank (confusing trip classifications).

After you click on **SEARCH,** the center column will display your selected trips in order by date. You can choose **LIST** or **MAP** view in upper right. The information in the right column will tell you if the trip is full and, if so, how many people are on the waitlist. It also tells you the date when registration will open, has closed, or will close.

If you are looking for a particular trip, you can enter a partial or full name of the trip or the leader's name on the TRIPS page to display their trips (may not be ordered by date).

Click on hike name (in list) or pin icon (on map), to go to the hike page with the trip description. In the right column, be sure you fit the prerequisites. If registration is still open and if you are logged in, your name will be listed under **REGISTER PARTICIPANT**. After you click on **REGISTER** at bottom right, list your **ROLE** (participant). Once you've registered, your name will be listed on the roster.

If **Availability** is **0** in trip list or there is a **"This activity is full…"** message on the trip page, it may still be worthwhile to get onto the waitlist. There is quite a lot of turnover, especially if the trip is more than a week in the future. Click on **REGISTER FOR WAITLIST**. Even trips flagged as **"Registration closed"** may yet have some late drops and leaders may have a note to contact them directly.

The CMC calendar at **Upcoming Denver Group Events** has only a partial listing of trips.

You can sign up for only one trip per day, including on the waitlist. After you register, you will receive a Trip Signup Confirmation email. Members on the waitlist will receive a notice from the trip leader to register if a slot opens.

If you find you cannot go on a hike, please cancel as soon as possible, preferably no later than 2 days before the trip. Your cancellation prompts the CMC office to contact the next person on the waitlist. Don't let a trip go out with an empty slot while a willing hiker sits at home!

Many drivers appreciate your bringing a plastic bag for your boots to decrease the amount of dirt and mud in the car.

Milage Reimbursement Guideline for Denver Group allows carpool drivers to charge each passenger a mileage rate to defray expenses, based on the price of gasoline at the time of the trip. Some vehicles are more costly to operate, so drivers are free to charge what they deem a fair rate, **30-44¢ per mile.** This is a guideline not a policy, meaning that this is a recommended, but not required, method of sharing costs. A gasoline price vs. milage fee table is at https://cmcdenver.org/membership/mileagereimbursement.

For More Information

If you are interested in learning more about any of the activities mentioned in this chapter, you go to CMC.org and select your interest area. Or you can contact the CMC office at 303-279-3080.

Backpacking School

Are you new to Colorado and want to meet "outdoorsy" people and see what the summertime Colorado mountains have to offer? Are you a complete novice at backpacking but are inspired by how refreshed your friends are after spending a weekend in the mountains? Are you looking for a skills refresher and to see what gear and techniques experienced backpackers use? Does the Colorado Trail beckon? The Rio Grande Pyramid is on your "Must Climb!" list? If only you felt more comfortable with your backpacking skills.

The Backpacking School is broken up into smaller groups to give the attention and detail needed for these topics. These groups are between 7-10 students in size with 2-4 Instructors. To organize these groups before the first class a Student Survey will be sent out before the first class.
Registration for the Backpacking School requires the completion of the Wilderness Trekking School Badge (or being a current WTS student) or WTS Waiver (link from Course Materials). See Backpacking School.

Alpine Scrambling Course – Denver

Alpine Scrambling is defined as unroped climbing over mountainous terrain. The CMC Denver Group's Alpine Scrambling Course (DEN ASC) consists of self-study material via google classroom, two online weekday evening lectures, one in-person meet up (weekday evening), snow travel clinic, and three progressive field days.

Alpine scrambling is non-technical climbing that involves off-trail travel over rock and snow. Most Colorado summits are accessible by scramble routes. You can use the skills acquired in this course to reach the summits of hundreds of Colorado 14ers and 13ers. The course requires good physical conditioning, a moderate commitment of time and energy, appropriate outdoor gear and clothing, a few items of technical climbing gear and a positive attitude. You should have some prior hiking experience in mountain terrain on trails and off-trail on moderate angle broken rock, talus, scree, and soft snow. Basic map reading and interpretation skills are also prerequisites. These skills can be attained in basic hiking courses such as the Colorado Mountain Club (CMC) Mountain Hiking School or Wilderness Trekking School. The Alpine Scrambling Course (ASC) is a good choice for those interested in climbing non-technical peaks in Colorado, that is, peaks where the easiest route does not, except under unusual conditions, require the use of technical gear such as ropes, protection gear, and the accompanying knowledge and skills. Those who complete this course will have earned the skills to confidently climb most Colorado peaks, including 14ers and 13ers, under normal conditions and be able take part in most CMC scrambling trips. The ASC is also excellent preparation for more technical climbing courses such as the CMC Basic Mountaineering Course for those who wish to learn technical climbing skills. See Alpine Scrambling Course.

Alpine Scrambling Course – NoCo

The Northern Colorado section also has an alpine scrambling course. See Alpine Scrambling Course NoCo.

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CHAPTER 20 – REFERENCES

With the ever-increasing popularity of mountain-oriented sports and recreational activities, sources of information abound. This section lists just a few of the many books, websites, and additional venues available where you can find supplemental reference material for most, if not all, of the topics presented in Wilderness Trekking School.

Books:

Alpine Climbing: Techniques to Take You Higher, by Mark Houston and Kathy Cosley, Seattle, The Mountaineers Books, 2004

Don't Die on the Mountain, 2nd edition, by Dan Allen, New London, NH, Diapensia Press, 1998

Everyday Wisdom: 1001 Expert Tips for Hikers, by Karen Berger, Backpacker Magazine, Seattle, Mountaineers Books, 1997

Hiking Safety Handbook, (hiking safety) by Art Hogling, Colorado Mountain Club Press, 2023

Hypothermia, Frostbite, and Other Cold Injuries: Prevention, Survival, Rescue, and Treatment, 2nd edition, by Gordon G. Giesbrecht and James A. Wilderson, Seattle, The Mountaineers Books, 2006

Lightly on the Land: The SCA Trail Building and Maintenance Manual, 2nd edition, by Bob Birkby and Student Conservation Association, Seattle, The Mountaineers Books, 2006

Medicine for Mountaineering and Other Wilderness Activities, edited by James A. Wilkerson, Seattle, The Mountaineers Books, 2010. More detailed than *Mountaineering First Aid* yet still easy to read.

Mountain Meteorology: Fundamentals and Applications, by C. David Whiteman, New York, Oxford, 2000

Mountaineering First Aid: A Guide to Accident Response and First Aid Care, by Jan D. Carline, Martha J. Lentz, and Steven C. Macdonald, Seattle, The Mountaineers Books, 2004. A useful lightweight companion for any hiker.

Mountaineering: The Freedom of the Hills, 9th edition, Seattle, The Mountaineers, 2017. This book is the canon for CMC's Basic Mountaineering School and an excellent sourcebook for WTS as well.

NOLS Wilderness Mountaineering, 3rd edition, by Phil Powers, Mechanicsburg, PA, Stackpole Books, 2009. This book is geared towards technical adventures but is still a useful resource for WTS students.

Secrets of Warmth: For Comfort or Survival, by Harold E. Weiss, Seattle, The Mountaineers Books, 1999

Soft Paths: How to Enjoy the Wilderness Without Harming It, by David Cole and Dana Watts, Mechanicsburg, PA, Stackpole Books, 2003

The Backpacker's Field Manual: A Comprehensive Guide to Mastering Backcountry Skills, by Rick Curtis, New York, Three Rivers Press, 2011

The Essential Outdoor Gear Manual: Equipment Care, Repair, and Selection, 2nd edition, by Annie Getchell and Dave Getchell, Jr., Camden, ME, Ragged Mountain Press, 2000

The Heat Will Kill You First: Life and Death on a Scorched Planet, Jeff Goodell, Little, Brown, and Company, 2023

Tom Brown's Field Guide to Wilderness Survival, by Tom Brown, Jr. with Brandt Morgan, New York, Berkley Books, 1983. The chapters in this book on attitude, shelter, water, and fire are very useful.

Wilderness Basics, 4th edition, edited by Kristi Anderson, Seattle, The Mountaineers Books, 2013

Wilderness First Aid Emergency Care for Remote Locations, 5th edition, by Alton L. Thygerson, *et al.,* Sudbury, Jones, and Bartlett, 2019

Internet Sites

Colorado Avalanche Information Center **CAIC –** Provides avalanche safety information and education November through May and promotes research. https://avalanche.state.co.us/

National Oceanic & Atmospheric Administration **NOAA –** National Weather Service forecast for your city, zip code, or trailhead. https://www.weather.gov/

CMC & American Alpine Club Resources

American Alpine Club Library – The library holds thousands of books on hiking, mountaineering, survival, first aid, and other subjects. It is one of the largest mountaineering libraries in the world. Members of the American Alpine Club and Friends of the American Alpine Club Library have borrowing privileges. https://americanalpineclub.org/library/

Bradford Washburn American Mountaineering Museum **BWAMM** – The only museum of its kind in the United States, introducing visitors to the world of mountaineering. Exhibits cover a diverse range of topics including climate, science, mountain cultures, and mountaineering history. https://www.mountaineeringmuseum.org/

CMC – The official Colorado Mountain Club website at https://www.cmc.org/.

CMC Press (press) – Hosts mountain-oriented books, many published by the CMC Press, as well as gear and apparel.

Denver Group – More information on Denver Group events and activities.

Wilderness Trekking School WTS

Course Materials, (wts materials)

WTS Sessions, (Login, then search wts denver) Select the link with the correct session.