Cascades Adventures
Trip Leader Handbook

Cascades Adventures is a service of Oregon State University Cascades Campus
Bend, OR

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Produced and published by:

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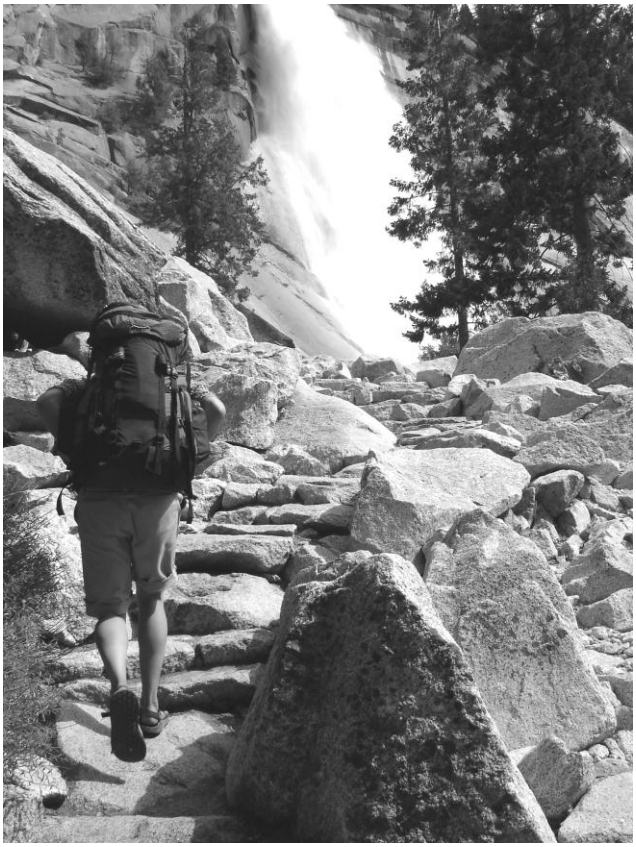
Introduction

This handbook introduces key concepts and accepted practices for leading trips for the Cascades Adventures outings program at OSU-Cascades. Trip leaders should find this to be an easy reference for their pursuit of professional development in outdoor education, and gives suggestions on how to teach skills and topics while on outings. It is not required to use the methods presented in this manual exactly, but all trip leaders must exercise care in their choice of techniques so that they align themselves with risk management protocol and specific Cascades Adventures activity policy. Readers may refer to a comprehensive list of other resources contained in appendix A for more information on any of the topics presented within.



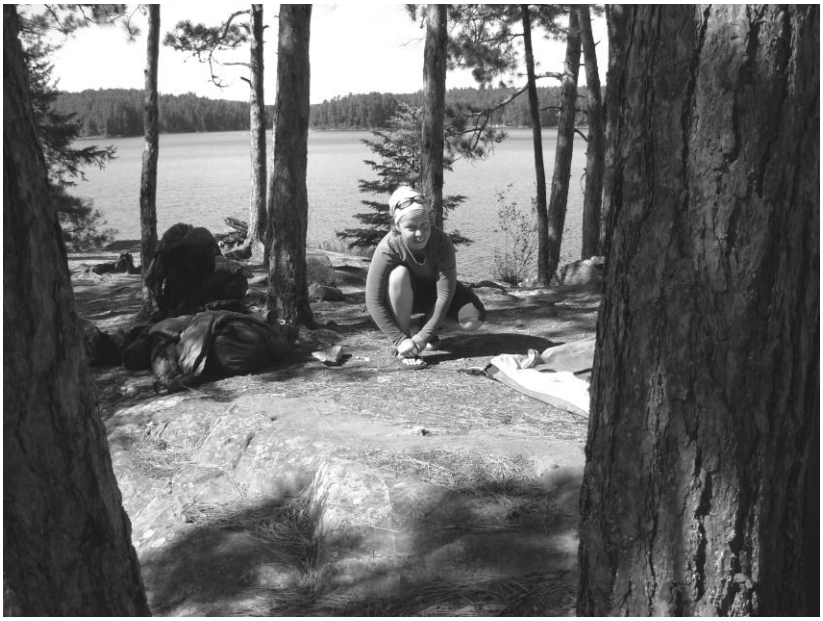
Acknowledgements

Cascades Adventures is a valuable piece of the campus community of OSU-Cascades and Central Oregon Community College. The program offers professional development opportunities for students pursuing careers in outdoor education, recreation leadership and environmental education. It is also a unique opportunity for participants from the campus community to improve outdoor skills, challenge themselves, experience wilderness adventure and work together in small group experiences. This program has grown steadily since its inception and its growth is credited to all those individuals who have contributed their physical and mental labor. Because of their contributions we have expanded program offerings, refined activity policy and shown school administrators the importance of a program like Cascades Adventures for our campus community.

Specific accomplishments of Cascades Adventures in the past year include the recruitment of many new trip leaders, the introduction of a new first-year student orientation program called Headwaters, improved resources for trip leaders and significant improvements to the Central Oregon Snowpack Report. With dedication and creativity Cascades Adventures programming will continue to expand and will be a crucial tool in the training of future outdoor leaders and the education of participants. Many thanks to the commitment and contributions of all student, faculty and outside supporters of our program!

What are the benefits of leading Cascades Adventures outings?

Trip leaders for Cascades Adventures are held to high industry-accepted standards of performance as outdoor educators. Trip leaders gain valuable insight in specific activities, as they lead and instruct groups through enriching experiences. Trip leaders are not required to be ORLT students, but they must have significant experiences in an activity, resulting in developed judgment-based decision making abilities. Trip leaders are encouraged to develop outings that are of particular interest to their own development and engage students through a variety of methods, ideas, and learning. As such, Cascades Adventures adopts an educational focus as the character of its programs, whether of an outdoor or adventure basis. In the end, the benefit of leading Cascades Adventures outings is both the professional development associated with planning and leading a trip as well as the positive contribution to the Cascades community. As well, trip leaders gain valuable experience making decisions. Judgment-based decision making stands alone as the most vital skill for an outdoor leader. While leadership styles and practices may be taught in classroom, the ability to affect decisions in specific contexts depends upon the myriad of influences particular to a specific situation. Outdoor leaders must build a repertoire of experiences to draw upon in future situations where a crucial and important decision is needed. Cascades Adventures trip leaders are presented the opportunity and responsibility to make decisions on outings, using their previous experiences and building confidence for future experiences.



Chapter One:
Outdoor Leadership

"A leader is best when people barely know he exists, not so good when people obey and acclaim him, worse when they despise him. But of a good leader who talks little when his work is done and his aim fulfilled, they will say, "We did this ourselves." -Lao Tzu

Much responsibility rests on the shoulders of Cascades Adventures trip leaders. Their role switches significantly from that of an active follower and a student of leadership and outdoor skills in the classroom, to that of a primary, responsible role model and leader while in the field with program participants. Not only do their technical skills and self care skills need to be dialed, but they also need to be able to teach them to a group, and meet all other participant needs. This chapter highlights a few crucial skills for outdoor leaders and offers a few suggestions on how to teach and model leadership.

What is leadership?

"Leadership means timely, appropriate actions that guide and support your group to set and achieve realistic goals. Great leaders create an environment that inspires individuals and groups to achieve their full potential." *–NOLS leadership Pamphlet 9/01*

"There are hundreds of combinations of character, personality, and knowledge that make for good leadership. A qualified leader in one field would not necessarily be capable in another situation. There are leaders for get-together groups in which most decisions are made through mutual agreement. There are club leaders who merely direct pre-planned schedules or have the primary goal of motivating or educating members. There are leaders for scouting, church, and civic organizations, where the wish to help and donate time might be the only requirement, and there are commercial packers, hunters, and guides whose leadership is predicated on the comfort and entertainment of clients. For our purposes, leadership is

defined as the ability to plan and conduct safe, enjoyable expeditions while conserving the environment." -Paul Petzoldt, taken from the Wilderness Handbook (pp. 145-146)

Critical Core Competencies of Effective Outdoor Leaders

Taken from Priest and Gass (pp. 3-5)

1) **Technical Skills** are competencies in the actual adventure activities or outdoor pursuits being led. Two examples include being able to climb at a certain level or standard and being able to paddle a particular grade or class of whitewater. If, as an outdoor leader, you are able to perform at a proficiency higher than that of the group members, you will probably have a much easier time in maintaining group control during these activities, giving you a greater margin of safety by providing a "cushion of competence."

2) **Safety Skills** are those competencies necessary to enjoy the adventure activity in a safe and prudent manner. Examples of safety skills include navigation, survival, weather interpretation, body temperature regulation, first aid, accident response, search and rescue, and water safety.

3) **Environmental Skills** are those competencies necessary to prevent damage to the natural surroundings. Examples of these skills include practicing and encouraging minimum-impact travel and no-trace camping, and modeling behaviors such as carrying out the garbage and not cross-cutting switchback trails.

4) **Organizational Skills** are those competencies permitting you to plan, prepare, execute, and evaluate experiences for the specific needs of particular client groups. For example, you must manage risks, arrange transportation, coordinate group food and lodging needs, schedule activities, select routes, plan contingencies, and secure necessary permits, equipment, and clothing to increase the likelihood of successful experiences.

5) **Instructional Skills** are those competencies required to teach participants appropriate technical skills related to the activity, environment, and safety. For example, teaching skiing technique in a series of progressions, teaching safety through the inquiry or discovery approach, and using effective instructional aids to teach environmental concepts are all important instructional skills.

6) **Facilitation Skills** are those competencies fostering productive group dynamics, enabling clients to work toward completing tasks while developing appropriate interpersonal relationships. For example, as an outdoor adventure leader, you will often need to resolve conflicts, communicate effectively, and foster personal trust and group cooperation. You also need to know how to debrief and guide reflection on adventure experiences to generate conditions for optimal learning.

7) **Flexible Leadership Style** means knowing how, why, and when to utilize differing leadership approaches. For example, under most conditions, group decision making is generally democratic of shared process. At other times, such as an emergency, you must be autocratic—giving directions and expecting them to be carried out. When an experience is progressing well, however, you may go beyond democratic and be abdicratic—abdicating or delegating responsibility to the group. These diverse examples highlight the need for you to learn to adapt your leadership style to suit the circumstances.

8) **Experience Based Judgment** is a required skill since you will often confront situations in the outdoors in which pertinent information is missing or vague. By considering past experiences and using sound judgment, you can appropriately substitute predictions for the missing or vague information. This type of judgment becomes extremely important when the act of delaying a decision in the hope that new information will become available might result in further problems. Sound judgment comes from surviving past judgment calls, whether good or bad, analyzing those successes and failures, and applying learning from the analysis to future situations. This generally requires that you gain plenty of intensive and extensive field experience as a leader. While wide experience does not ensure sound judgment, the lack of experience will inhibit your ability to create sound predictions as to what to do when presented with uncertain information.

9) **Problem Solving Skills** can be creative or analytical, and a combination of both might be best. Follow analytical processes to recognize problems, define difficulties, anticipate outcomes, identify several possible solutions, select the most probable one, put it into action, and evaluate its effectiveness. However, you also need to be able to use creative techniques, such as brainstorming, extended effort, attribute listing, forced relationships, and deferred prejudice.

10) **Decision Making Skills** enable you to make choices. Specifically, you must be capable of discovering and assessing multiple options as well as selecting the "best" choice for the participant. Some useful methods include gathering, screening, organizing, prioritizing, and choosing.

11) **Effective communication** is a process of two or more people exchanging information, resulting in behavioral change. The information in the form of ideas, actions, or emotions is transmitted along a pathway of audio, visual, or tactile channels. You must be able to generate, encode, link, send, transmit, receive, decode and interpret such messages. Moreover, you should be able to use feedback to confirm that the message received was indeed the same as the message sent.

12) **Professional Ethics** refer to the moral standards and value systems that you may have and that adventure programming demands. For example, "challenge by choice" (e.g.,

Schoel, Prouty, & Radcliffe, 1988) is an ethic that defines and often guides adventure programming. This ethic asserts that people have the right to choose the level of participation in activities they feel comfortable with; you should not coerce them into doing an action they are uncomfortable performing Similarly, you hold enormous power over clients; thus, it is primarily ethics that must guide you away from possible abuses of power, including, but not limited to, deception and sexual contact with clients.

A few other considerations for trip leaders…
Adapted from PCOBS instructors' manual

- The most effective teaching is by example. The attitudes you project as a leader are often mimicked by participants. Be a positive role model.

- The most productive instructor-student relationship is based on mutual respect and mutual learning. People who are treated as resourceful, competent individuals tend to respond as such.

- Communication skills are invaluable, but they are secondary to sincere openness and the desire to be involved with people.

- The line between experiential learning and uninspired teaching is a fine one. Be honest about your motives. Don't let students flounder. At some times a task oriented, directive approach is appropriate; at others, allowing students to grope around in uncertainty may be a more powerful, effective approach.

- Setting a tone of respect, courtesy, honesty, etc., is of the utmost importance and should be done at the beginning of the course. Students should be aware of our commitment to the rights of others and the need for emotional safety. It is the trip leaders' role to guard the participants' emotional and physical safety.

Chapter Two:
Essential Field Information

A: Cascades Adventures Trip Leader Responsibilities

1. Develop comprehensive trip plan for intended outing. See the trip plan template in the appendices for an example.
2. If necessary, establish a pre-trip meeting time and location that all participants can attend at least a couple days before the intended departure date.
3. Check out necessary equipment from Cascades Adventures coordinator.
4. Ensure that all participants carry appropriate gear for the outing, including sufficient food and water.
5. Instruct a curriculum of skills or topics pertinent to the outing and which meet participant needs.
6. Provide an emotionally and physically safe environment for participants and leaders.
7. Be a positive role model.
8. Provide expert level first aid care when necessary.
9. Follow all activity protocols, risk management plan and emergency action plan.
10. Ensure that all Cascades Adventures and OSU-CC policies and rules are upheld throughout the duration of the outing.
11. Check all equipment back in with Cascades Adventures coordinator.
12. Debrief outing with Cascades Adventures coordinator and complete a final trip report.

B: Group Facilitation

Taken from PCOBS instructors' manual…

- Recognize the varying needs of different participants and facilitate experiences based on their abilities, time, curriculum, and environment. The shorter the outing, the more closely you must plan high-impact activities and orchestrate the outing progression.

- From the outset, set clear expectations and limits, as well as consequences. Be firm and consistent. Do not set yourself up by issuing ultimatums that you are not prepared to follow through on.

- Explain the format and the itinerary, and keep students informed about your plans.

- Respect the attention span of the students, and pace your sessions accordingly.

- Demand involvement. You cannot emphasize team-building enough.

- Attend to each person so individuals do not get lost within the group.

- Recognize each person's needs.

- Provide periodic opportunities for processing activities and resolving conflicts or problems, e.g., nightly meetings, debriefs, individual interviews, and informal talks.

- Process activities in a different fashion than you would disseminate information or teach skills. Do not preach; rather listen, inquire, and draw participants out.

- Do not set yourself apart. Be available. Eat and sleep with participants. Share meals and camp chores.

C: Meal Planning and Nutrition

Taken from NOLS cookery…

Bulk Ration Planning Steps

1. *Determine the amount of food per person per day (ppppd), using the following guidelines*:
   - 1.5 ppppd is appropriate for hot days and warm nights. 1.5 ppppd equates to roughly 2,500 to 3,000 calories per person per day.
   - 1.75 to 2 ppppd works well when you expect warm or cool days and nights or when hiking with full packs. For moderate to active work days, 1.75 to 2 pounds is ideal and gives you roughly 3,00-3,500 calories per person per day.
   - 2 to 2.25 ppppd is good for hiking or skiing with full packs during the cool days and cold nights of early spring, late fall or winter. Two to 2.25 pounds per day is ideal for heavy workdays and cold temperatures. It gives you roughly 3,500 to 4,500 calories per person per day.
   - 2.5 ppppd is good for cold days and extremely cold nights, such as in midwinter, when you are skiing with full packs or sleds in mountain environments. Used for extremely strenuous workdays and very cold temperatures, 2.5 pounds gives you roughly 4,000 to 5,000 calories per person per day.

2. *Figure the total amount of food needed for the trip.* The formula is: Number of people x the number of days x ppppd. For example, for four people on an eight day trip at 1.75 ppppd, the total amount of food needed would equal 56 pounds.

3. *Break the total poundage into food groups.* The following chart lists the breakdown of the poundage of different foods per person per day. Added together, these numbers (known as category multipliers) should equal the pounds per person per day selected in the first step.

Food Category	**1.5 ppppd**	**1.75 ppppd**	**2 ppppd**	**2.25 ppppd**	**2.5 ppppd**
Breakfast	.24	.28	.33	.35	.38
Dinner	.27	.32	.35	.37	.40
Cheese	.19	.22	.24	.26	.28
Trail Foods	.32	.35	.37	.45	.49
Flour and Baking	.11	.13	.16	.09	.10
Sugar and Fruit Drinks	.10	.12	.14	.15	.18
Soups, bases, desserts	.06	.09	.13	.15	.19
Milk, eggs, margarine, cocoa	.21	.24	.28	.31	.33
Meats and Substitutes**	0	0	0	.12	.12

**High fat and high preservative meats are added in the winter to meet higher fuel needs.

4. *Calculate the total pounds of each food category needed for the trip.* Using the example from step 2 of four people on an eight-day trip at 1.75 ppppd and the category multipliers from the table in step 3, the calculations would be as follows:

Food Category	**Calculation**	**Rounded**
Trail Foods	.35 x 4 x 8 = 11.2 lbs.	11 lbs.
Dinner	.32 x 4 x 8 = 10.24 lbs.	10.5 lbs.
Breakfast	.28 x 4 x 8 = 8.96 lbs.	9 lbs.
Milk, eggs, margarine, cocoa	.24 x 4 x 8 = 7.68 lbs.	7.5 lbs.
Cheese	.22 x 4 x 8 = 7.04 lbs.	7 lbs.
Flour and Baking	.13 x 4 x 8 = 4.16 lbs.	4 lbs.
Sugar and Fruit Drinks	.12 x 4 x 8 = 3.84 lbs.	4 lbs.
Soups, bases, desserts	.09 x 4 x 8 = 2.88 lbs.	3 lbs.
Meats and substitutes	Only in 2.25-2.5 lb. rations	
Total Pounds		**56 lbs.**

5. *Round the numbers up or down within categories (see the last column of the table above) and make substitutions, depending on individual preferences.* For instance, if you don't want to bake, you can take that poundage (approximately 4 pounds in the example) and add it to another category such as breakfast or dinner. If you don't eat cheese, you can take some of that cheese weight (approximately 7 pounds in this example) and add it to the trail food category, where you can replace it with nuts and/or nut butters (sesame, peanut, tahini, almond). The important thing is to remember to make exchanges with similar types of foods to maintain the balance among carbohydrates, proteins and fats. If you make changes, the adjusted totals should still equal the amount determined in step 2.

Individual Meal Planning

Many leaders prefer to leave the math and complex ration planning approach behind for shorter outings especially. To plan meals for smaller groups and shorter durations do them individually.

1. Make a list of meals that you would like to eat while out in the field (ie: oatmeal, nuts and dried fruit for breakfast; trail mix, dried fruit, peanut butter, tortillas and clif bars for lunch; and rice, bean and cheese burritos for dinner.)

2. Break list down into individual ingredients.
3. Prepare the meal ahead of time to know how much you are likely to eat and multiply that amount by the number of people in your group.
4. Purchase all of the ingredients for the meal with a price goal in mind. For example spending five dollars per day per person on food supplies is usually sufficient and cost effective.

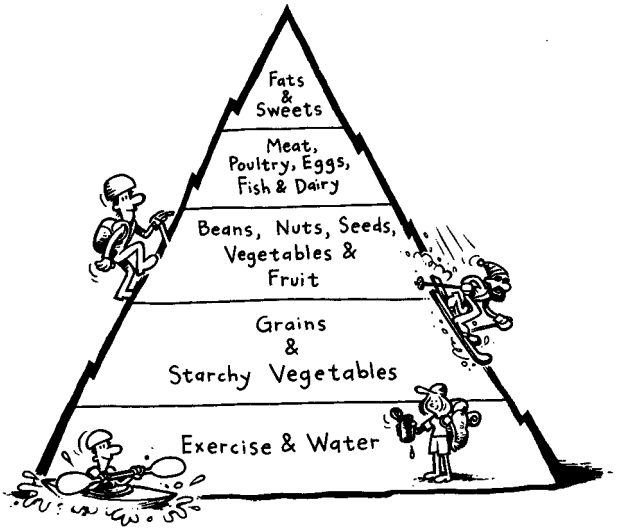
Backcountry Nutrition

Taken from NOLS Cookery…

Nutrition is important for the success of any expedition. On a basic level, adequate food and water are the nutritional considerations for survival. Most backcountry travelers agree, however, that fine-tuning nutrition to ensure the right combination of macronutrients (protein, carbohydrates and fat) that are also rich in micronutrients (vitamins and minerals) takes us beyond survival to keep us healthy and strong. After all, most of us venture into the backcountry to do more than just stay alive!

The challenge now becomes balancing nutritional needs with what is practical for the backcountry. The general nutrition recommendations found in the USDA Food Guide Pyramid must be adjusted to account for the limited resources available for food preparation and cooking, such as water and fuel. Fresh foods are a luxury when pack space and weight must be shared with gear and clothing. Cost, perishability, length of the trip or ration period, and environmental conditions must also be considered for meal planning.

In light of these considerations, as well as the increased amount of physical activity and fluid needs that accompany backcountry travel, we have modified the USDA's recommendations and devised the Backcountry Nutrition Pinnacle. These guidelines should be used alongside the bulk rationing system explained for maximum nutrition.



The Backcountry Nutrition Pinnacle

The Backcountry Nutrition Pinnacle

1. *Exercise and Water*

   At the base of the backcountry pinnacle is exercise and water. Water is the most important nutrient for both survival and optimal nutrition in the backcountry. Most days in the field we will require a minimum of two quarts of water and a variety of other fluids. Water can be supplemented with tea, drink mixes, hot cocoa and soups to meet the higher fluid needs for exercise in the backcountry. Also, fluids containing electrolytes such as sodium and chloride can help in avoiding the rare but dangerous problems related to overhydration.

   Many nutritionists recommend limiting beverages that contain caffeine, alcohol, excessive sugar, or carbonation during periods of exertion. However, current research on the effects of these beverages on hydration status is inconclusive. Moderation is probably best, given that excessive amounts of caffeine can cause the jitters and stomach upset, alcohol can impair judgment and motor skills, and excessive sugar is a poor nutritional choice.

2. *Grains and Starchy Vegetables—1 to 3 servings at meals and snacks, more on active days.*

A combination of whole and processed grains and starchy vegetables is an appropriate nutritional base for high levels of physical activity. These foods also tend to be quick and easy to prepare in the backcountry. This group is high in carbohydrates, the nutrient most easily converted to energy and your brain's preferred fuel source. While whole grains contain more vitamins, minerals, and dietary fiber than refined grains, we must often make compromises in the backcountry due to available fuel, water, and preparation time.

In addition to carbohydrates, this group contains B vitamins and iron essential for energy production, immunity, and a healthy nervous system. The grains are also a source of vegetable proteins that combine with beans, nuts, and seeds to make complete proteins necessary for building and repairing body cells.

This group appears at most meals and snacks. Serving sizes vary and are outlined below.

Serving Sizes: ½ cup cooked grains/starchy vegetables (rice, pasta, potatoes, etc.); 1 slice bread; half of a bagel; 2 cups cooked popcorn; ¼-1/2 cup of snack mixes.

Sources: Pasta, bread, cereal, rice, couscous, flour, cornmeal, pancake mix, bulgur, popcorn, potatoes, crackers, and many of the snack mixes.

3. *Beans, Nuts, Seeds, Vegetables, and Fruit—5 to 8 servings/day.*

Out of the field, fruits and vegetables form separate groups and a minimum of five servings a day from these two groups combined is recommended. In the backcountry we often rely heavily on smaller amounts of the dried fruits and vegetables and five servings each day is not always possible.

The Backcountry Nutrition Pinnalce contains one large group that includes beans, nuts, seeds, vegetables, and fruit. These plant foods are all sources of carbohydrates, dietary fiber, and many of the same vitamins and minerals.

In addition to contributing carbohydrates, the expanded vegetable group provides protein and healthy fats (in beans, nuts, and seeds). This group also supplies the antioxidant vitamins A, C, and E, many of the B vitamins, and minerals important for resistance to infections, wound healing, muscle tissue growth and repair, and overall healthy cells.

Serving sizes: 1 cup fresh fruit or vegetables; 1-2 tablespoons nut butter; ¼-1/2 cup rehydrated beans (hummus, soup, chili mixes etc.).

Sources: Dried or fresh vegetables, wild greens, garlic, tomato powder, vegetable soups, peas in oriental mix, fresh or dried fruit, wild berries, nuts, peanut butter, seeds, bean flakes, dehydrated beans, hummus, veggie burger mix, chili mix, lentil soup.

4. *Meat, Poultry, Eggs, Fish (when available), and Dairy—1-2 servings/day*

This group is a combination of the groups in the USDA Pyramid that feature calcium and protein. Milk powder, cheese, and powdered egg are common backcountry foods also high in animal protein. Calcium found in milk and cheese is important for the structure of bones and teeth as well as muscle contraction, blood clotting, and enzyme activation. In addition to calcium, milk and cheese provide the B vitamin riboflavin, an important nutrient for carbohydrate metabolism and skin health.

Other animal proteins such as jerky, summer sausage, canned chicken or tuna, and fresh fish caught from lakes and streams may supplement backcountry rations. These foods are not necessary in large amounts or required daily to meet nutritional needs.

Serving sizes: 1 ounce cheese; 8 ounces milk; 3 ounces fish; 1 egg (or powdered equivalent).

Sources: Powdered milk (cow or soy); cocoa; all cheeses; cheesecake and pudding mixes; summer sausage; jerky; fresh, canned, or dried fish; canned chicken; powdered eggs.

5. *Fats and Sweets—Use Sparingly*

Fats and sweets appear at the top of both the Food Guide Pyramid and the Backcountry Nutrition Pinnacle because we need these in the smallest amounts from a nutritional standpoint. In the Pinnacle this group includes added vegetable oil and margarine used sparingly for cooking or as a condiment.

Other types of fat appear in both the protein and vegetable groups. These fats are not part of the fats and sweets group because they are more beneficial to your health, such as the essential fats in fish and nuts, or they are accompanied by important nutrients such as the calcium and B vitamins in dairy foods. There are certain foods such as trail snacks, chocolate, and desserts that are "sweets" but appear in other categories of the Pinnacle as well because they provide some protein, carbohydrates, and other nutrients. While it is still recommended to use these foods sparingly for optimal nutrition, in the backcountry we use the carbohydrates in sweet foods and the added calories from fat to support our high activity level.

In addition to making foods more palatable in the backcountry, the fats and sweets at the top of the Pinnacle can also provide a psychological boost on the trail or at the end of a rigorous day of physical activity. Again, nutrition recommendations out of the field generally do not include using food as a "reward," but in the field this seems appropriate.

Sources: Vegetable oil, margarine, candy, chocolate, snack mixes, sauce mixes, drink mixes, cocoa, summer sausage, pudding, cheesecake.

D: Leave No Trace

Taken from www.lnt.org

Leave No Trace is an national and international program designed to assist outdoor enthusiasts with their decisions about how to reduce their impacts when they hike, camp, picnic, snowshoe, run, bike, hunt, paddle, ride horses, fish, ski or climb. The program strives to educate all those who enjoy the outdoors about the nature of their recreational impacts as well as techniques to prevent and minimize such impacts. Leave No Trace is best understood as an educational and ethical program, not as a set of rules and regulations.

There are seven principles which form the framework of the LNT message:

1. *Plan Ahead and Prepare*
2. *Travel and Camp on Durable Surfaces*
3. *Dispose of Waste Properly*
4. *Leave What You Find*
5. *Minimize Campfire Impacts*
6. *Respect Wildlife*
7. *Be Considerate of Other Visitors*

More Details and Information About the Principles…

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 groups of 4-6.
- Repackage food to minimize waste.
- Use a map and compass to eliminate the use of marking paint, rock cairns or flagging.

Travel and Camp on Durable Surfaces

- Durable surfaces include established trails and campsites, rock, gravel, 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 pristine areas:
    - Disperse use to prevent the creation of campsites and trails.
    - Avoid places where impacts are just beginning.

Dispose of Waste Properly

- Pack it in, pack it out. Inspect your campsite and rest areas for trash or spilled foods. Pack out all trash, leftover food, and litter.
- Deposit solid human waste in catholes dug 6 to 8 inches deep at least 200 feet from water, camp, and trails. Cover and disguise the cathole when finished.
- Pack out toilet paper and 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.

Leave What You Find

- Preserve the past: examine, but do not touch, cultural or historic structures and artifacts.
- 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.

Minimize Campfire Impacts

- Campfires can cause lasting impacts to the backcountry. Use a lightweight stove for cooking and enjoy a candle lantern for light.
- Where fires are permitted, use established fire rings, fire pans, or mound fires.
- Keep fires small. Only use 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.

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.
- Protect wildlife and your food by storing rations and trash securely.
- Control pets at all times, or leave them at home.
- Avoid wildlife during sensitive times: mating, nesting, raising young, or winter.

Be Considerate of Other Visitors

- Respect other visitors and protect the quality of their experience.
- Be courteous. Yield to other users on the trail.
- Step to the downhill side of the trail when encountering pack stock.
- Take breaks and camp away from trails and other visitors.

Chapter Three:
Wilderness First Aid Basics

This chapter will introduce the foundations of wilderness first aid. The approach to dealing with medical and traumatic emergencies in the backcountry is quite different from handling problems in the front country. First responders and care takers in an emergency in the backcountry are faced with fewer resources and sometimes very long and complex transports to the nearest hospital. This chapter is no substitute for professional first aid training! Use it to familiarize yourself with the thinking process that is used in wilderness first aid and to review the patient assessment system (PAS). Taken from WMI Wilderness Medicine Notebook…

Patient Assessment

Stop! Size-up the scene.

1. Survey the scene for hazards.
   Immediate danger to rescuers.
   Immediate danger to bystanders.
   Immediate danger to patients.
2. Determine the mechanism of injury (MOI).
3. Establish body substance isolation (BSI).
4. Determine the number of patients.
5. Form a general impression of the patient.
   Very Sick/Very Hurt: Rapid assessment and transport.
   Not Sick/Not Seriously Hurt: Focused history and exam, transport soon or manage in field.

Stop! Survey the patient for immediate threats to life.

Initial Assessment: This is a Stop and Fix survey!

1. Identify self and level of training, obtain consent to treat.
2. Establish responsiveness and C-Spine control: Assess for verbal or pain response and stabilize the spine.
3. **A**irway management: Look in the mouth; clear obstructions.
4. **B**reathing adequacy: Look, listen and feel.
5. **C**irculation: Assess for pulse and major bleeding; control bleeding, treat for shock.
6. **D**isability: Maintain manual stabilization of the spine unless patient has no significant MOI.
7. **E**nvironment/**E**xpose: Assess and treat environmental hazards; expose serious potential life threatening wounds.

Stop! Complete a "Focused Exam and History."

1. Patient exam: Inspect, inquire, Palpate, Auscultate from head to toe.
2. Vital Signs
   a. Time
   b. Level of Consciousness (LOC)

c. Heart Rate, rhythm and quality
d. Respiratory rate, rhythm and quality
e. Skin color, temperature and moisture
f. Blood pressure
g. Pupil response
h. Temperature

3. Patient History:
   Chief complaint
   MOI/History of present illness
   Symptoms
   Allergies
   Medications
   Pertinent medical history
   Last intake/output
   Events preceding the incident or illness

Stop! Complete patient care and SOAP note. Make evacuation decision.
Stop! Continually monitor your patient.

Head-To-Toe Examination

Look for bruising, bleeding, swelling, a pain response, or anything out of the ordinary. Ask about pain or tenderness. Feel for deformities, unusual hardness or softness, or anything out of the ordinary. Listen for unusual breathing sounds, grunts and groans from the patient. Smell for unusual odors.

Head, Face and Neck
Carefully remove hats, helmets, sunglasses etc. Run your fingers through hair. Examine the face, pressing on bones. Check eyes, nose and mouth. Check in the ears and behind and below the ears. Feel along the muscles and bones of the neck. Check for medical ID tag.
Shoulders
Check one shoulder at a time. Be sure to include upper scapula, clavicle and upper humerus.
Chest
Spread hands over sides of chest wall. Check for instability and/or asymmetry on inspiration; once high on the chest, once low on the chest. Ask the patient to take a deep breath on both checks. Press sternum.
Abdomen
Press with flattened fingers on each of the four quadrants.
Pelvis
With hands cupped on the iliac crests, press downward, then inward.
Lower Back
Reach underneath and check as much of the back as can be reached without moving the patient.
Genitals
Check as needed.

Lower Extremities
Check one leg at a time with hands encircling the extremity. Check from hip to toes. Check feet for Circulation, Sensation and Movement (CSM).

Upper Extremities
Check one arm at a time with hands encircling the extremity. Check from upper humerus to fingers. Check hands for CSM. Check for medical ID tag.
Spine and Buttocks
If the patient is lying down, protect the spine with a log roll to position the patient on their side. Check for bruises and other wounds. Reach underneath bulky clothing to palpate the spine.

Vital Signs

Time
Note the time you measured the vital signs.
Level of Consciousness (LOC)
Include in your description of LOC, the patient's initial state, the stimulus required, and the patient's response.

A + O x 4	Alert and oriented to person, place, time, and events
A + O x 3	Alert and oriented to person, place and time
A + O x 2	Alert and oriented to person and place
A + O x 1	Alert and oriented to person
V	Verbally responsive (Patient responds to verbal stimuli.)
P	Painfully responsive (Patient responds to painful stimuli.)
U	Unresponsive (Patient does not respond to any stimuli.)

Heart Rate (HR)
Beats per minute
Rhythm: regular/irregular
Quality: strong/weak/bounding/thready
Respiratory Rate (RR)
Breaths per minute
Rhythm: regular/irregular
Quality: unlabored/shallow/labored/deep
Skin (SCTM)
Color: pink/pale/red/ashen (use nonpigmented areas; nail beds or mucus membranes.
Temperature: warm/cool/hot
Moisture: dry/moist/wet
Blood Pressure
Auscultate, palpate or estimate
Systolic/diastolic
Note: BP is a late changing sign
Pupils (P)
Pupils are Equal, Round and Reactive to Light (PERRL)

Note: pupils are a late changing sign

Temperature (T)

Measured with a thermometer

Normal Vital Sign Ranges in an Adult

LOC: A + O x 4
HR: 50-100 bpm/regular/strong
RR: 12-20/regular/unlabored
SCTM: pink/warm/dry
BP: 140-90/90-60
P: PERRL
T: 98.6 F (37 C)

Patient History

Chief Complaint (CC)

"What symptom is the patient's primary concern? (e.g., pain, nausea, difficulty breathing, etc.)"

Onset: Was the onset sudden or gradual?
Provokes/**P**alliates: What makes it worse or better?
Quality: Describe the pain; sharp versus dull; constant vs. erratic.
Radiation/**R**egion/**R**eferred: Does the sensation move anywhere?
Severity: How does this rate on a scale of 1-10?
Time: How long has it been going on?

Mechanism of Injury (MOI)/ History of the Present Illness (HPI)

SAMPLE History

Symptoms: Headache? Dizziness? Nausea? Cold? Hot?
Allergies: Allergies to medications? Foods? Insects? Pollens?
Medications: Over the counter? Prescription? Alcohol or recreational drugs? Herbal?
Pertinent Medical History:
Have you ever felt this way before?
Do you have problems with your heart? Breathing? Digestion?
Do you have a history of seizures?
Are you a diabetic?

Last Intake/Output:

Food? Water?

Last output quantity and quality:

Urination?

Defecation?

Vomitting?

Events leading up to the incident/illness. (Relevent to the cause of the MOI or the HPI.)

Helpful Hints for the Patient Interview

- Act confident.
- Introduce yourself and level of training.
- Tell the patient what you are doing and why. People hate surprises.
- Don't make promises you can't keep, e.g., "Everything will be okay."
- Ask open ended questions.
- Interview all sources of information.
- Help the patient, do not take over the patient.
- Be conscious of your tone of voice, body language and eye contact.

SOAP Note

Name_____ **D**ate_____

Subjective *I have a (age, sex) whose chief complaint is (description of symptom—OPQRST. Patient states (MOI, HPI)*

_____

_____

Objective *Patient found (describe position). Patient exam reveals (describe injuries/symptoms). Vital signs at (time), SAMPLE.*

PATIENT EXAM

_____

_____

VITAL SIGNS

Time_____	_____	_____	_____	_____	_____	_____
LOC _____	_____	_____	_____	_____	_____	_____
HR _____	_____	_____	_____	_____	_____	_____
RR _____	_____	_____	_____	_____	_____	_____
SCTM_____	_____	_____	_____	_____	_____	_____
BP _____	_____	_____	_____	_____	_____	_____
P _____	_____	_____	_____	_____	_____	_____
T _____	_____	_____	_____	_____	_____	_____

HISTORY

Symptoms_____

Allergies_____

Medications_____

Pertinent Med. Hx_____

Last Intake/Output_____

Events leading to the incident/illness_____

_____

Assessment (Problem list)

_____

_____

Plan (Plan for each problem on the assessment list)

_____

_____

Anticipated Problems (Including plans on how to manage them)

_____

_____

Chapter Four:
Climate and Weather of Pacific Northwest Mountains

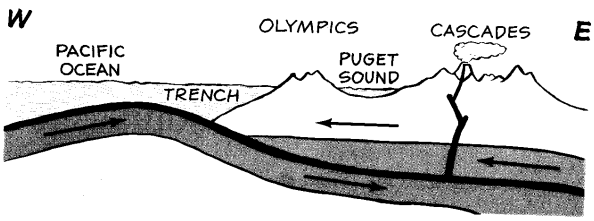
Taken from Northwest Mountain Weather

The Pacific Northwest is a region born of the fire of volcanism and sculpted by water and ice. The activity of Mt. St. Helens is just one proof that this process of building and eroding continues, that the mountains of the PNW remain geological adolescents. Understanding the geology of this region is essential to understanding its weather patterns, and understanding its weather patterns is essential to planning trips into the mountains for hiking, climbing and skiing.

The mountains of the PNW, like those elsewhere, were created by geological forces acting deep beneath the earth's surface. Our planet's continents and ocean floors are really a collection of picture puzzle—like pieces known as *plates.* These plates float on rock that is partially melted in the upper region of the earth's interior, called the mantle, and fully melted deeper within this layer. Temperatures in the mantle may range from 2,000 to 3,400 degrees Fahrenheit (1,100-1,900 C). This melted rock flows in currents as slow as cold molasses, which drive the massive plates, inch by inch.

In the Pacific Northwest, a plate making up part of the Pacific Ocean floor is colliding with and diving beneath the lighter plate that makes up our continent. Because the boundary between these colliding plates runs essentially north-south, the major mountain ranges thrust up by the collision also run essentially north-south. (see diagram below)

CLIMATE AND WEATHER OF PACIFIC NORTHWEST MOUNTAINS



Visitors flying into the PNW on a clear day enjoy a spectacular sight: the blue waters of the Pacific giving way to a rugged coast line marked by the Coast Rnage of Washington and Oregon, interrupted by the broad Columbia River and then the Chehalis River Gap in southwestern Washington. The young Olympic Mountains rise to the north, separated from British Columbia's Vancouver Island Range by the Strait of Juan de Fuca, which is the shipping thoroughfare from the Pacific into Puget Sound and Howe Sound. The Vancouver Island Range is the backbone of Vancouver Island.

A large trough runs along the east side of these ranges, beginning with Oregon's Willamette Valley and continuing into the Puget Sound Basin in Washington and the Hecate Strait and the Strait of Georgia in British Columbia. Farther east, the land rises again to form the Cascade Range, which extends from northern California through Oregon and Washington, then merges with British Columbia's Coast Mountains. There are two great valleys that carve their way through the Cascades: that of the Columbia River in Washington and Oregon, and the Fraser River Valley in British Columbia.

These mountain ranges split Washington, Oregon, and British Columbia into distinctly different climatic zone. The differences in climate and the resulting variations in plant and animal life are consequences of the way the mountain ranges interact with the region's major weather patterns.

Basic Meteorology

Temperature

The sun is the engine that drives our atmosphere. It provides the heating that, together with several other factors, creates the temperature variations that are ultimately responsible for wind, rain, and snow.

The earth's location—93 million miles from the sun—is what makes life as we know it possible. Venus, with an orbit closer to the sun, experiences average surface temperatures of roughly 800 degrees Fahrenheit, while the more distant Mars averages 81 degrees below zero.

Proximity to the sun is only one factor. The intensity of the sun's radiation varies across the earth's surface. Given a choice between Mount McKinley in Alaska and Crater Lake in Oregon for an autumn backpacking trip, for instance, a hiker with limited tolerance for cold temperatures will likely choose Crater Lake. That's because Crater Lake is closer to the equator; the sun will be more directly overhead at noon, and therefore the heating from the sun will be more intense.

This relationship between heating from the sun and the angle of the sun above the horizon also explains why summer is warmer than winter: the sun is more directly overhead. You can see how this works by shining a flashlight on this page, first from directly overhead, then at an angle. The beam of light shining from directly above the page has a smaller area to illuminate and heat than a beam striking the surface at an angle. The smaller the area illuminated by the flashlight (or the sun), the more intense the heating.

Given more intense sunlight at the equator than at the poles, the temperature differences come as little surprise. But extremes in temperature, large as they may be, are controlled by the movement of air. Differences in air temperature lead to air movement, which prevents runaway heating or cooling.

Air Pressure

Anyone who's had to chase a tent in a windstorm knows that air moves sideways. But it also rises and descends, movement that can generate or dissipate clouds.

When air rises due to heating, it's as if it were shedding extra pounds. Air has weight, and just as the reading on our bathroom scale drops when we lose weight, the reading on a barometer, which measures air pressure, falls when some of the air moves up and away.

Just as heating air makes it rise, cooling it will make it sink. Because cold air is more dense than warm air, it tends to find its way to the bottom of the atmosphere, that is, to the ground. Cold air tends to collect in low places such as valleys and canyons, making them chilly campsites on cold, windless nights.

To summarize, the sinking of cool air increases air pressure, while the rising of warm air decreases it. These pressure differences, the result of temperature differences, produce

moving air, which we refer to as wind. Air will generally move from an area of high pressure to one of low pressure.

Clouds

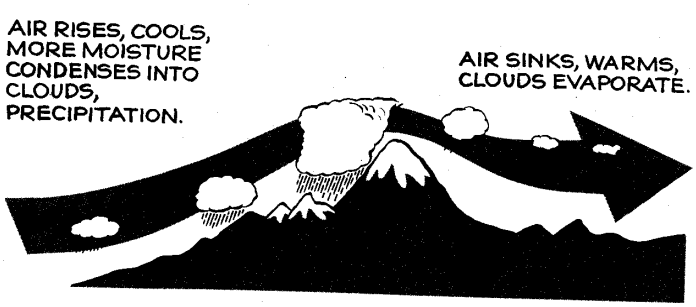
Air moving from high to low pressure carries moisture with it. As that air cools, as a result of either rising or moving over a colder surface, the moisture condenses into clouds or fog. This occurs because as air cools, its capacity to hold water vapor is reduced. For example, air at 98.6 degrees Fahrenheit, our body temperature, is capable of holding roughly thirteen times as much water vapor as it can at 30 degrees.

When that moisture-laden air is cooled, then, its capacity to hold water vapor is rapidly reduced. Not all of the water vapor will "fit," and that which "spills out" condenses into a cloud of water droplets.

When air cannot hold any additional water vapor, we say it is saturated. Meteorologists call that saturation point the *dew point.* The dew point is simply the temperature at which the air will become saturated with moisture as the air cools, and clouds will usually form. We encounter a similar effect when we see our breath on a cold day. As we inhale, our body warms the air to approximately 98.6 degrees and adds moisture. As we exhale, that warm, moist air is cooled by the colder air around us, leading to condensation of the water vapor (a gas) into water droplets (a liquid).

Therefore, the dew point is always equal to or cooler than the air temperature, never warmer. When the air temperature cools to the dw point, water vapor condenses into water droplets, and clouds or fog form. No clouds will form when the temperature is much higher than the dew point.

Relative humidity compares how much water vapor the air is holding with how much it could hold. Think of it as a measure of how saturated the air is. Relative humidity is usually expressed as a percentage; 75 percent relative humidity, for example, means the air is holding three quarters of the water vapor it's capable of holding.



The process of cooling and condensation operates on a large scale in the atmosphere as air moves from high-pressure into low-pressure systems and is lifted. The result is, a weather system that covers the entire Northwest, though mountain weather patterns are more often localized. Let's look now at large weather systems.

Large Scale Weather Systems

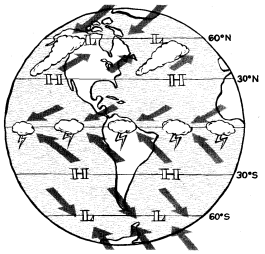
Experienced mountain travelers know that precipitation along the western slopes of the mountain ranges in the Pacific Northwest isn't always light and often encompasses the entire region in a soggy embrace. The cause? Large-scale weather systems, usually moving in from the Pacific.

The Gulf of Alaska is the factory for most of the storms that batter the Pacific Northwest. This is a natural consequence of its latitude and geography. The gulf is the battleground between air moving south from the Arctic and air moving north from the subtropics and midlatitudes, which gives birth to many of the storms that affect our recreational plans in the mountains.

Because polar and arctic air is colder and therefore more dense than air farther south, it sinks. The zone where it sinks and "piles up" is a region of *high pressure*. As the air sinks and its pressure increases, its temperature also increases. The effect is similar to what happens to football players caught at the bottom of a pile. The players on the bottom get squeezed the most, and their temperature (and possibly their temperament!) heats up. In the atmosphere, this warming within a high tends to evaporate the little moisture present in cold polar and arctic air. This is why the Arctic is classified as a desert, receiving very little precipitation—not all the deserts are covered in sand!

If our planet didn't rotate, this cold air would just continue to slide southward to the equator. Intense solar heating near the equator forces air to rise, creating a region of *low pressure* that rings the globe. Because air within this band rises, it also cools, which tends to condense water vapor into droplets that form clouds, just as your breath condenses on a cold day. Satellite pictures show a series of thunderstorms marking this equatorial low-pressure zone, which is called the Intertropical Convergence. It's a very wet area: more rain can fall in a single day within this zone than during an entire month in Washington, Oregon, or British Columbia.

But the air sinking and moving south from the pole and that risking from the equator don't form a simple loop moving from north to south and back again. The rotation of the earth is responsible for deflecting this air, creating a considerably more complicated circulation of air over our planet. (*See Figure Below)*



Some of the air risking from the equator descends over the subtropics. This sinking air creates a region of high pressure. As it sinks within this high, the earth's rotation produces a force known as the *Coriolis force*. The combination of the Coriolis forces and the effect of friction from air moving over land and water causes the air sinking within the high-pressure system to rotate in a clockwise direction in the northern hemisphere, and counterclockwise in the southern hemisphere.

Fronts

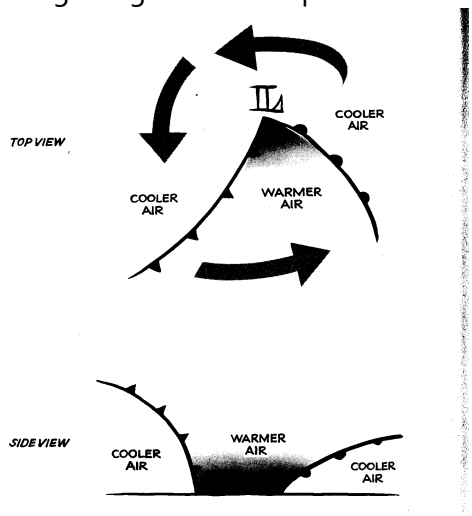
Some of the air that sinks and spreads outward from these subtropical highs picks up moisture from the oceans and moves north, eventually meeting the cold, dry air spreading southward from the pole. The boundary between these two very different types of air masses is called the *polar front,* and it rings the globe in both hemispheres.

When this boundary between different air masses doesn't move, it's also called a *stationary front*. In the Gulf of Alaska and elsewhere, it serves as a nursery for the development of storms.

During the autumn and winter months, the air moving south from the Arctic toward the Gulf of Alaska can be as cold as 40 or 50 degrees below zero. The temperature of the air over the gulf is moderated by water's capacity to absorb and retain heat. Air temperatures there may be 30 to 40 degrees above zero, yielding an impressive contrast along this polar front of as much as 90 degrees Fahrenheit.

Because of this great contrast in temperatures, the polar front is especially strong in and around the Gulf of Alaska. But it rarely remains stationary there, or anyplace else. Imbalances caused by the rotation of the earth and the differing influences of land, sea, ice, and mountains allow the cold, dry, dense air from the north to slide south, forcing some of the warm air to rise. The zone where the cold air is replacing the warm air is referred to as a *cold front.* (*see figure below)*

Conversely, farther east, warm air is forced to glide up and over the cooler air near the surface. This zone where warm air is gradually replacing cooler air is referred to as a *warm front.* (see figure below) This "wave" or bend on the stationary front may develop into a low-pressure system, with air circulating counterclockwise around the low, exactly the opposite direction of air moving around a high—again a consequence of the earth's rotation and friction.



When low pressure systems develop in the Gulf of Alaska, the counterclockwise circulation of air around the low draws warm, moist air northward from over the Pacific Ocean, and very cold air southward from the interior of Alaska.

Latitude and Weather in the Northwest

Because the *jet stream*, that fast-moving river of air high in the atmosphere that directs storm tracks, is strongest and farthest south in the winter months, that's when the Pacific Northwest receives most of its precipitation. Both Seattle and Portland receive less than 10 percent of their annual precipitation during the summer months of June, July, and August. Knowing this pattern can assist you in picking the best time of year for extended hiking, climbing, or skiing trips.

The northerly retreat of the jet stream during the summer doesn't benefit all areas equally. Although it tend to remains over southern Alaska and northern British Columbia, weak disturbances still move far enough south to make the North Cascades of Washington, the Olympics, and the Coast Mountains of British Columbia markedly cloudier and wetter than the Cascades from central Washington southward.

Mountains and Temperature

The Cascades of Washington and Oregon, and British Columbia's Coast Mountains, create more than wet and dry zones; they also play a major role in producing variations in temperature. The mountains tend to confine the moist ocean air to the west, which has a moderating effect.

During the summer months, the mountains' role as a barrier to moist ocean air permits temperatures from the Cascade crest eastward to far exceed those to the west. The average July daytime high temperature in Seattle is 75 degrees Fahrenheit, while in Yakima it's 88.

From October through March, the Cascades and British Columbia Coast Mountains usually deflect to the east the bitterly cold arctic outbreaks from Alaska and the Yukon and Northwest Territories. The average January overnight low temperature in Seattle, for example, is a relatively mild 34 degrees, while in Yakima it's 18.

This diversity in our mountains is what makes our region so special and enjoying them on foot, on skis, or on showshoes such a delight. It's all a consequence of the geological forces that shaped the Pacific Northwest, and the region's proximity to the weather factory of the Pacific Ocean. The result is not one climate zone but several, each tending to run north-south. Visualizing the big picture is important to understanding the more subtle details of Pacific Northwest weather, and using that understanding to make trips into the mountains enjoyable and safe.

Chapter Five:
Snowpack and Mountain Weather Observation

Cascades Adventures offers the only source for detailed snowpack information in Central Oregon. Sharing detailed information about current snow conditions and snow stability promotes awareness of the changing nature of snow and encourages a local culture of safety concerning the reality of avalanches in our area. Our reporting service relies on a small network of volunteer observers who are frequently out in various backcountry areas around Central Oregon. Information is organized and synthesized by office staff who present important findings along with general warnings via the Cascades Adventures web page. This chapter contains suggestions for notebook organization, field techniques and important data codes for recording observations. Cascades Adventures adheres to the observational guidelines set forth by the American Avalanche Association where this information was taken from. This chapter will also introduce basic thought processes for evaluating avalanche hazard as you travel.

The Avalanche Hazard Evaluation Process

Taken from Snow Sense by Jill Fredston and Doug Fesler

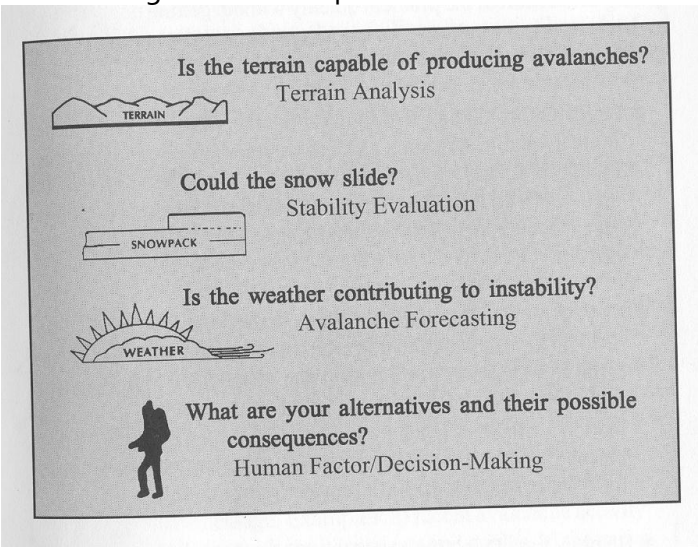
Seeking Information

Many years ago in India, there were four men who were blind. As they traveled in the forest, they came upon a large elephant. Never having encountered an elephant before, each man set about trying to examine and analyze what nature of beast was before them. One man touched a leg and concluded that an elephant must be very much like a tree trunk. Another man felt the tail and explained that an elephant must be like a rope. The third man stood by the ear as it moved back and forth and concluded that an elephant must be like a fan. The fourth man felt his way around the entire body and decided that an elephant is something enormous, almost without beginning or end.

This fable is not unlike the situation a backcountry traveler is faced with in attempting to evaluate potential avalanche hazard. **An incomplete examination of available data leads to erroneous conclusions concerning the degree of hazard present.** And the data in and of itself is not as important as the interrelationship of the data. Generally, no single piece of information will tell the whole story. But what information do we need?

The interaction of three critical variables—the snowpack, weather, and terrain—determines whether or not an avalanche is possible. However, to determine whether an avalanche *hazard* exists, we must add an important fourth variable, us. Without the presence of people or property, there is no hazard.

All the information needed to evaluate potential avalanche hazard comes from these four variables and is generally available to you through observations and tests. **The bottom line is that your hazard evaluation decisions are only as good as the data you seek, integrate, and act upon.** As you travel through the mountains, choosing routes or campsites, you need to answer the following four critical questions:



The first step is to learn to recognize avalanche terrain because then you can make a conscious decision about whether or not you want to expose yourself to possible hazard. If you decide that you do want to travel on or near steep slopes then you must seek the critical information needed to answer these questions. By doing so, you can begin to base your hazard evaluation upon solid facts rather than assumptions, feelings, guesses, or fate.

Is it safe or is it unsafe? The essential problem you are face with is one of uncertainty. The key to eliminating or reducing this uncertainty lies in gathering meaningful information upon which you can base your evaluation. This process, called the *bull's eye approach*, means getting to the heart of the problem quickly without getting bogged down by irrelevant information. The avalanche hazard evaluation process should start *before* you leave on your proposed trip:

- Begin by formulating an opinion about the potential hazard based upon available data such as local weather and snow advisories, topography, and personal observations. As you approach the area you'll be traveling in, look for clues pointing to important recent events such as strong winds, new snowfall, and avalanche activity.
- As you travel, continually fine-tune your opinion by seeking additional key information that will either support or refute it. Key information or bull's eye data is that which has a high degree of certainty in its message. Some of the most unambiguous information available is in the form of clues provided by nature. These clues reflect ongoing physical processes that affect snow stability. Stay constantly alert for clues.
- Be objective. Don't let your desire to reach a goal interfere with your evaluation. Remember, that hazard evaluation is not an event, it is a continuous process.

THE BULL'S-EYE APPROACH

Within this circle exists *all* of the information available to you whether useful or meaningless. The marginal information does little or nothing to reduce your uncertainty about the stability of a given slope. Examples: a) the air temperature is 32°F (0°C), b) the snow depth is 3.5 feet (1.1 meters), c) the slope is 800 feet high (244 meters), and d) the snow is white.

Within the smaller circle exists more *relevant* data which provides you with meaningful information but still leaves you with some uncertainty about the actual level of hazard. Examples: a) the air temperature was -4°F (-20°C) last night but is 32°F (0°C) this morning, b) 7 inches (18 centimeters) of new snow fell overnight, c) southeasterly winds gusting to 20 mph (10 meters/second) are transporting some snow, d) the slope is leeward with a measured angle of 36°.

Within the bull's-eye exists the most useful or *meaningful* information with the highest degree of certainty in its message. Examples: a) recent avalanche activity on slopes with similar aspects and angles, b) the snow on small test slopes is fracturing when jumped on, c) very easy shear test results, and d) signs of significant wind-loading including hollow-sounding snow with a rippled wind slab texture and/or shooting cracks. Best yet, perhaps the slope you are concerned about avalanches while you are watching!

IN SEEKING INFORMATION,
GO FOR THE BULL'S-EYE!

Standard Field Weather Observations

Taken from SWAG

- **Location:** Record the location and elevation. Lat/Long, field bearings or using landmarks are all acceptable means of communicating the observation location.
- **Date:** Record day, month and year.
- **Time:** Time of observation.
- **Sky Condition:** Classify the amount of cloud cover at the observation site.
    - *Clear (CLR):* No clouds.
    - *Few (FEW):* Few clouds. Up to 2/8 of the sky is covered by clouds.
    - *Scattered (SCT):* Partially cloudy: 3/8 to 4/8 coverage.
    - *Broken (BKN):* Cloudy. More than 4/8 but less than 8/8.
    - *Overcast (OVC):* Overcast. 8/8 coverage.
    - *Obscured (X):* Surface based layer such as fog obscures view.
- **Precipitation Type:** Note the type of precipitation falling.
    - *NO:* No precipitation
    - *RA:* Rain
    - *SN:* Snow
    - *RS:* Mixed rain and snow
    - *GR:* Graupel and hail
    - *ZR:* Freezing rain
- **Precipitation Rate:** Describe the rate of precipitation.
    - *S-1:* Very light snowfall. Snow accumulates at a rate of trace/hr to about ¼" per hour.
    - *S1:* Light snowfall. Snow accumulates at a rate of about ½" per hour.
    - *S2:* Moderate snowfall. Snow accumulates at a rate of a little less than one inch per hour.
    - *S3:* Heavy snowfall. Snow accumulates at about 2 inches per hour.
    - *S4:* Very heavy snowfall. Snow accumulates at more than 2 inches per hour.
- **Air Temperature:** Record the air temperature in degrees Fahrenheit. Measure at about 3 feet from the snow surface.
- **Surface Penetrability:** Measure (in inches) how far a ski boot bearing full body weight penetrates the snow surface. Do the same with a ski on the foot, bearing full body weight.
- **Wind:** Record wind direction and estimate velocity/strength. Estimate maximum gusts.
    - *Calm (C):* No air in motion.
    - *Light (L):* 1-16 mph. Light to gentle breeze; flags and twigs in motion.
    - *Moderate (M):* 17-25 mph. Fresh breeze; small trees sway. Flags stretched. Snow begins to drift.
    - *Strong (S):* 26-38 mph. Strong breeze; whole trees in motion.
    - *Extreme (X):* >38 mph. Gale force or higher.

Note: The indicators used to estimate the wind speed are rules of thumb. Observers need to develop their own indicators pertinent to the area you travel in.
Wind estimates should be averaged over a two minute period prior to the observation.
Wind direction can be described by cardinal direction or by compass bearing. Ie: 360=North

Cascades Adventures Snowpack Observations

Initial Observations

1. *Date* – record the date on which the observation was made.
2. *Time*—record the local time at which the observation was begun.
3. *Observer*—identify who made the observations.
4. *Site Characteristics*
    a. *Observation Location*- record the nearest prominent topographic landmark (mountain pass, drainage etc.), political landmark (road, town, mile, etc.), or geographic coordinates (lat/long, UTM). If observing a fracture line profile, not the location within the avalanche path.
    b. *Aspect* – record the direction that the slope faces where the observation was made (i.e. N, NE, E, SE, S, SW, W, NW).
    c. *Elevation* – record the elevation of the observation site.
    d. *Slope angle* – record the incline of the slope where you made your observation (degrees).
5. *Current Weather*
    a. *Sky Condition* – record the sky conditions as CLR, FEW, SCT, BKN, OVC or X.
    b. *Air Temperature* – record the current air temperature.
    c. *Precipitation Type and Rate* – record the precipitation type and rate according to the codes listed in the weather observation guidelines.
    d. *Wind* – record the wind speed and direction.
    e. *Boot and Ski Penetration* – Measure boot and ski penetration.

Test Profiles

Test profiles are the most common type of snow profile. There is no fixed rule about the type and amount of information collected in a test profile. Each observer must select, observe and record the parameters needed by Cascades Adventures. These parameters may change in both time and space. Test profiles are commonly observed at targeted sites and fracture lines.

Objectives of a Test Profile:

1. Identify layers of the snowpack
2. Identify the hardness and/or density of the layers in the snowpack
3. Identify weak interfaces between layers and to approximate their stability
4. Observe snow temperatures
5. Monitor and confirm changes in snowpack stability
6. Determine the state of metamorphism in different snow layers

Targeted Site:

A targeted site is selected to satisfy a particular observer's objectives. The site should be selected to target parameters of interest. Keep in mind that exposure to wind, solar radiation, elevation, and other factors produce variations in snowpack characteristics.

- Always evaluate the safety of a pit location.

- Avoid depressions, gullies or other terrain traps.
- Avoid heavily compacted areas such as tree wells, canopy sluffs, and tracks made by humans or other animals.
- Check the snow depth with a probe before digging to make sure you aren't on top of a boulder or bush. Careful probing can also give you an indication of snow layering.
- Make the pit wide enough to facilitate all necessary observations and to allow shoveling at the bottom.
- Examine the snow as you dig the pit as valuable information can be obtained during this process.
- The pit face on which observations will be recorded should be in the shade and very smooth.
- Cut a smooth observation face on an adjacent sidewall for temperature and hand hardness measurement.
- If there are two observers, the first observer can prepare the pit, while the second observer begins the observations.

Snow Study Equipment to Carry:

1. Avalanche Probe
2. Snow Shovel
3. Snow Thermometer
4. Ruler
5. Magnifying glass
6. Crystal card
7. Field notebook
8. Pencil
9. Gloves
10. Snow saw
11. Inclinometer
12. Compass
13. Brush
14. Topographic Map

Snowpack Observations

- *Snowpack Temperature (T):* Observe the temperature of the snow surface. Measure the first sub surface snow temperature 10 cm below the surface. The second temperature is observed at the next multiple of 10 cm from the previous measurement. The following measurements are taken every 10 cm from that point. Remember to calibrate thermometers before going into the field to ensure accuracy of your measurements.
- *Layer Boundaries:* Determine the location of each major layer boundary. Brushing the pit wall with a crystal card or a soft bristle paint brush will help to bring out the natural layering of the snowpack. Identify weak layers or interfaces of layers where a failure might occur. Record the distance from the layer boundary to the snow surface.

- *Snow Hardness:* Observe the hardness of each layer with the hand hardness test. Wear gloves when conducting hand hardness observations.
    - *Fist in glove (F)*
    - *Four fingers in glove (4F)*
    - *One finger in glove (1F)*
    - *Blunt end of pencil (P)*
    - *Knife blade (K)*
    - *Ice (Too hard for knife blade) I*
    - *Not observed (N/O)*
- *Grain Size:* Determine the grain size in each layer by using the crystal card.
- *Shear Quality:* Stability tests provide some indication of the load required to produce a fracture. Shear quality should be included with the results of any stability test.
    - *Q1:* Unusually clean, planar, smooth and fast shear surface; weak layer may collapse during fracture. The slab typically slides easily into the snow pit after weak layer fracture on slopes steeper than 35 degrees and sometimes on slopes as gentle as 25 degrees.
    - *Q2:* "Average" shear; shear surface appears mostly smooth, but slab does not slide as readily as Q1. Shear surface may have some small irregularities, but not as irregular as Q3. Shear fracture occurs throughout the whole slab/weak layer interface being tested.
    - *Q3:* Shear surface is non-planar, uneven, irregular and rough. Shear fracture typically does not occur through the whole slab/weak layer interface being tested.

Column and Block Tests

- *Site selection:* Test sites should be safe, geographically representative of the avalanche terrain under consideration, and undisturbed. For example, to gain information about a wind-loaded slope, find a safe part of a similarly loaded slope for the test. The site should not contain buried ski tracks or avalanche deposits. In general, the site should be further than about one tree length from trees where buried layers might be disturbed by wind action or by clumps of snow which have fallen from nearby trees (imagine a line drawn between a tree top and the snow surface, the acute angle between that line and the horizontal should be at most 45 degrees). Be aware that near the top of a slope, snowpack layering and hence test scores may differ from the slope below.
- *Shovel Shear Test*
    - Objective: The shovel shear test provides:
        - Information about the location where the snow could fail in a shear; and
        - a qualitative assessment of weak layer strength. It is best applied to identify buried weak layers, and it does not usually produce useful results in layers close to the snow surface.
    - *Collapse(STC):* Block settles when cut.
    - *Very easy(STV):* Fails during cutting or insertion of shovel.
    - *Easy(STE):* Fails with minimum pressure.
    - *Moderate(STM):* Fails with moderate pressure.

    - *Hard(STH):* Fails with firm sustained pressure.
    - *No Shear(STN):* No shear failure observed.
- *Rutschblock Test*
    - *RB1:* The block slides during digging or cutting
    - *RB2:* The skier approaches the block from above and gently steps down onto the upper part of the block (within 35 cm of the upper wall).
    - *RB3:* Without lifting the heels, the skier drops once from straight leg to bent knee position (feet together), pushing downwards and compacting surface layers.
    - *RB4:* The skier jumps up and lands in the same compacted spot.
    - *RB5:* The skier jumps again onto the same compacted spot.
    - *RB6:* - For hard or deep slabs, remove skis and jump on the same spot.
        - For soft slabs or thin slabs where jumping without skis might penetrate through the slab, keep skis on, step down another 35 cm (almost to mid-block) and push once then jump three times.
    - *RB7:* None of the loading steps produced a smooth slope-parallel failure.
- *Compression Test*
    - Objectives: The compression test identifies weak snowpack layers and is most effective at finding weak layers in the upper portion of the snowpack.
    - *Very Easy (CTV):* Fractures during cutting
    - *Easy (CT1-*CT10): Fractures within 10 light tabs using finger tips only.
    - *Moderate (CT11-*CT20): Fractures within 10 moderate taps from the elbow.
    - *Hard (CT21 to CT30):* Fractures within 10 firm taps from whole arm using palm or fist.
    - *No Fracture (CTN):* Does not fracture.

Chapter Six:
Maps and Orienteering

Taken from Mountaineering Freedom of the Hills…

The Topographic Map

Essential to off-trail travel, topos are the best of all for climbers. They depict topography—the shape of the Earth's surface—by showing contour lines that represent constant elevations above sea level. These maps are produced in many countries. Some are produced by government agencies; others are printed by private companies, with special emphasis on trails and other recreational features. Perhaps the most familiar of topographic maps in the United States are those produced by the USGS. In some areas of the Unites States, private companies produce maps based on USGS topographic maps, but they are updated with more recent trail and road details and sometimes combine sections of USGS maps. These maps are often useful supplements to standard topographic maps.

Map Scale

The scale of a map is a ratio between measurements on the map and measurements in the real world. A common way to state the scale is to compare a map measurement with a ground measurement (for example, 1 inch equals 1 mile) or to give a specific mathematical ratio (for example, 1:24,000, where any one unit of measure on the map equals 24,000 units of the same measure on the earth). The scale is usually shown graphically at the bottom of a map.

In the USGS 7.5 minute series, the scale is 1:24,000, or roughly 2 ½ inches to the mile, and each map covers and area of approximately 6 by 9 miles. In the 15 minute series, the scale is 1:62,500, or about 1 inch to the mile, and each map covers an area of about 12 by 18 miles. Mountaineers prefer the 7.5 minute maps because of the greater detail.

The 7.5 minute map is not the standard for the United States, except for Alaska. The 15 minute maps are no longer in production for the other forty nine states. For Alaska only, the standard scale is 1:63,360, 7.5 by 15 minutes. The different number of minutes covered for the east-west and north-south dimensions is due to the fact that the lines of longitude converge as they get closer to the North Pole.

Each topographic map is referred to as a quadrangle (or quad) and covers an area bounded on the north and the south by latitude lines that differ by an amount equal to the map series (such as 7.5 minutes or 15 minutes) and on the east and west by longitude lines that differ by the same amount. Each quadrangle is given the name of a prominent topographic or human feature of the area; for example, USGS Glacier Peak East.

Map Colors

Most topographic maps use colors to differentiate features. On a USGS topographic map, colors have very specific meanings:

Red: Major roads and survey information, such as section lines; sections are 1 square mile areas.
Blue: Rivers, lakes, springs, waterfalls, and other water-related features.
Black: Minor roads, trails, railroads, buildings, benchmarks, latitude and longitude lines, UTM coordinates and lines, and other features not part of the natural environment.
Green: Areas of heavy forest. Solid green indicates a forested area; mottled green indicates scrub vegetation. A lack of green does not mean that an area is devoid of vegetation, but simply that any growth is too small or scattered to show up on the map. Do not be surprised if a small, narrow gully with no green color on the map turns out to be an avalanche gully choked with impassable brush in the summer and fall, with significant avalanche hazard in the winter and spring.
White: The color of the paper on which the map is printed; it can have a variety of meanings, depending on the terrain.
White with blue contour lines: A glacier or permanent snowfield. The contour lines and edges of glaciers and permanent snowfields are in solid blue.
White with brown contour lines: Any "dry" area without substantial forest, such as a high alpine area, a clear-cut, a rock slide, an avalanche gully, or a meadow. Study the map for other clues.
Brown: Contour lines and elevations, everywhere except on glaciers and permanent snowfields.
Purple: Partial revision of an existing map.

Contour Lines

The heart of a topographic map is its overlay of contour lines, each line indicating a constant elevation as it follows the shape of the landscape. A ma's contour interval is the difference in elevation between two adjacent contour lines. In mountainous areas, this interval is often 40 feet on 7.5 minute maps, and 80 feet on 15 minute maps. Every fifth contour line is printed darker than the other lines and is labeled periodically with the elevation.

One of the most important bits of information a topographic map reveals is whether the route will be uphill or downhill. If the route crosses lines of increasingly higher elevation, it is going uphill. If it crosses lines of decreasing elevation, the route is downhill. Flat or sidehill travel is indicated by a route that crosses no lines, remaining within a single contour interval.

This is only the start of the picture that contour lines paint of an actual route. They also show cliffs, summits, passes, and other features. Climbers get better and better at interpreting these lines by comparing actual terrain with its representation on the map. The goal is that someday you will be able to glance at a topographic map and have a sharp mental image of just what the actual place will look like.

Orientation
Taken from Allen & Mike's Really Cool Backpackin' Book

Orienting the map is a god habit. This means lining up the map so the top of the map, which represents north, is literally pointing north. There are a number of ways to go about this. My favorite is to use the terrain, since it forces me to look at the features in the landscape and on the map. Pick a feature, such as a mountain, that you know is correct. Then rotate the entire map, so things line up from your position on the land. If the mountain is to the east of where you are standing, the eastern edge of the map should be facing the mountain. Double check yourself. If the map shows a stream behind you, there should be one behind you.

You can also use the sun. If it is rising or setting, then the edge of the map facing the sun is the east or the west edge respectively. A compass can easily determine north.

Handrails

A great way to navigate on or off-trail is to use "handrails." Just like a staircase has handrails to guide you, so does the natural world. Some are more obvious than others, but by studying a map closely you should be able to come up with a handrail. Visualize what the map is telling you about the terrain ahead. What features are going to stand out? If your route lies along a stream, that is a perfect handrail. The same goes with ridges or hillsides. Stairs often have landings, and so should your natural handrail. Landings tell you where you are along the way, such as the second or third floor. If your handrail is a stream and the map shows another stream coming in from the west, when you reach that stream you have hit the landing and fixed your location. This process of picking out handrails and landmarks along your route beforehand makes navigation easier. Look at your map often to check off landings as you pass them. Try to find features more and more subtle to guide you. I typically hike with my map in hand so that I can peek at it every few minutes if need be.

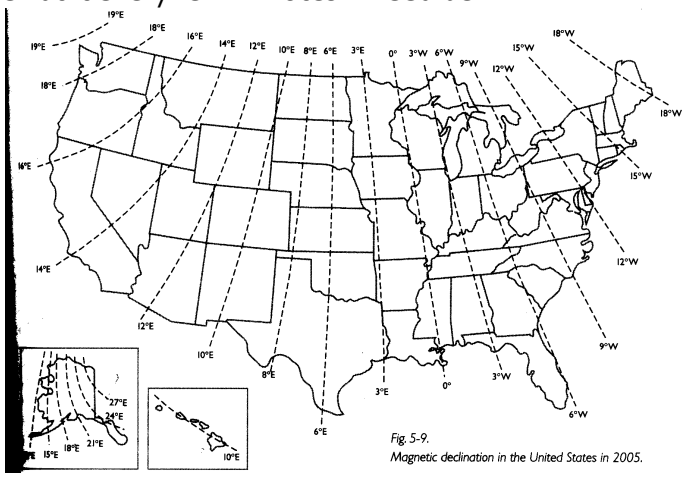
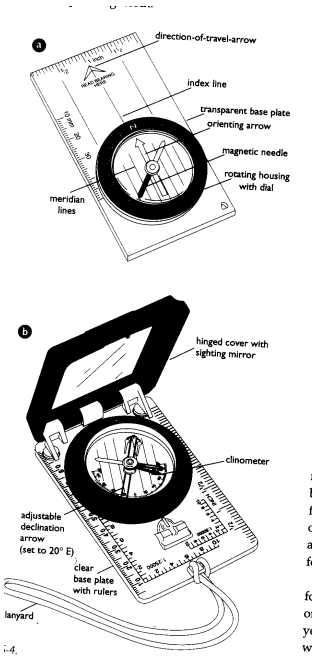


Fig. 5-9.
Magnetic declination in the United States in 2005.



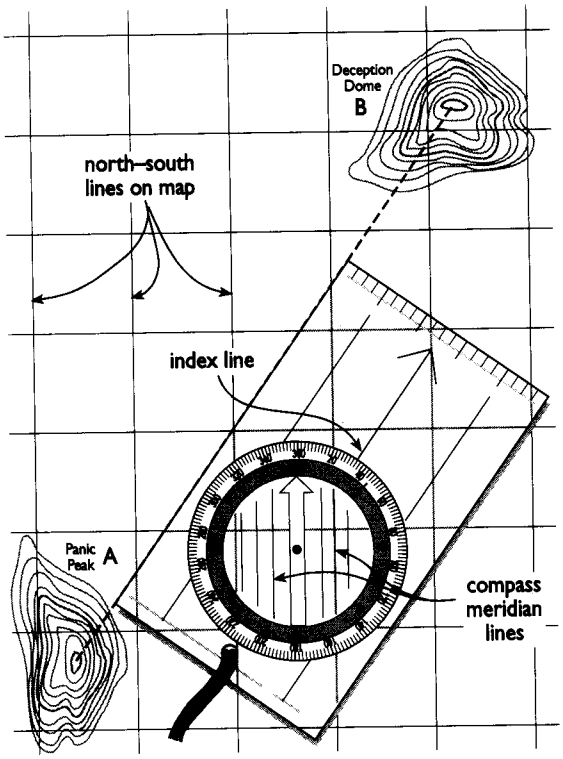
Compasses

Compasses have their use in map reading, but I caution you not to become dependent on them. They should be a tool to help with navigation, not a crutch you depend on. For a compass to be useful, you still need to be a good map reader, and as a good map reader you rarely need a compass.

The first thing to use a compass for is orienting a map. This is useful in thick trees where you can't see a lot of landmarks. In open country you are able to orient your map off topographical features that you can't see in a thick forest. At the bottom of a USGS map there is a diagram that shows true north (a star) and the magnetic declination. Set the compass to read a north bearing and place the edge of the compass along the magnetic north line. Box the needle by rotating the map and compass together and—voila—your map is now oriented to true north.

Bearings

To take a bearing, orient your map to true north. Then draw a line between your location and where you want to go. Now place the edge of the compass along that line and box the needle by turning the compass housing. The number that thte top of the compass is your bearing. To follow this bearing, keep the number set where it is and simply box your needle by turning the entire compass. The compass is now pointed in the direction you want to go. Look down the path indicated by the compass and pick out something as far away as you can see. Now walk to that object and repeat until you reach your destination.



You can also take a bearing from the field. Point the compass at the landmark of interest and box the needle by turning the housing. The number at the top is your bearing. You can walk that bearing if you want as described above, but if you can see where you want to go this seems rather silly. More likely you would use this bearing to locate that object on your map (to help you develop you map skills) or to triangulate. There may be times, however, when it is useful to take a bearing off a landmark because you may not be able to see the landmark during parts of the hike, such as when hiking in dense trees or fog.

To locate the object on your map, first orient your map to true north. Then with the bearing set at the top of your compass, place the edge of your compass at your location. Now turn the entire compass until the needle is boxed keeping the edge of your compass on your location. When the needle is boxed, draw a line along the edge of it starting from your location. You may need to extend this line beyond the compass, but somewhere along this line is the landmark you took your bearing from.

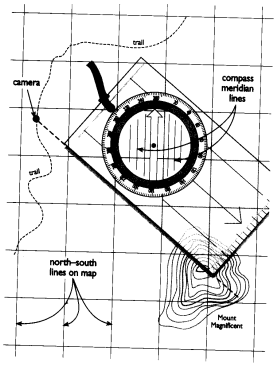


Fig. 5-7.

Simple Triangulation

Triangulation is used to help locate yourself. Usually you should be able to do this by orienting your map and looking around. In some cases you may want to use a compass. For triangulation to work, you need to take bearings from known landmarks (which takes good map skills). Take a field bearing off a landmark. Then, with the bearing set, place the edge of the compass on that landmark, on a true-north oriented map, and box the needle. Draw a line along the edge of the compass. Extend the line as far across the map as you think you need, in both directions if necessary. You are somewhere along this line. Pick another known landmark and repeat the preceding (the farther apart the landmarks the better). Where the two lines intersect is your approximate location. To get even more exact do the same with a third known landmark. The lines will form a triangle (thus triangulation) and your location is somewhere inside this triangle.

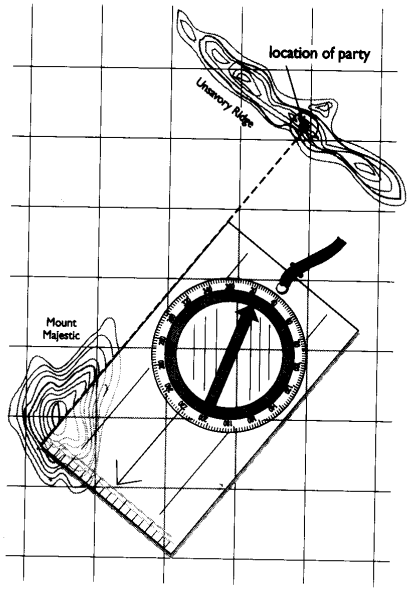


Fig. 5-14.
Orientation with line position known (magnetic needle omitted for clarity).

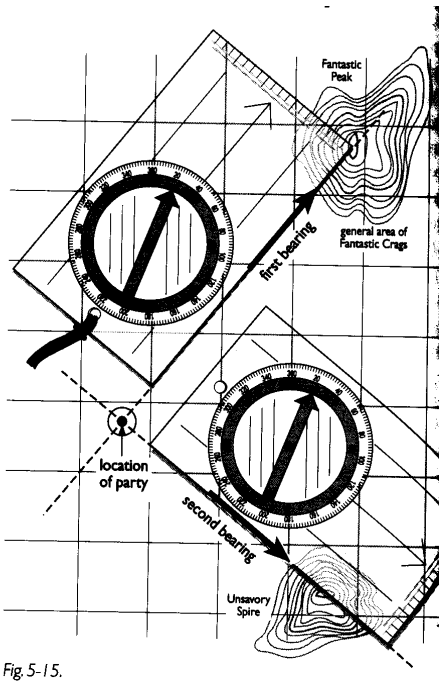


Fig. 5-15.
Orientation with area position known (magnetic needle omitted for clarity).

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Note: As long as you orient your map to true north, you do not need to calculate declination or any other such hoo-hah. Declination is beyond the scope of this book and my brain. There are many good books devoted to map and compass skills.

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Effective Leadership in Adventure Programming. By Simon Priest and Michael A. Gass. Published by Human Kinetics, University of New Hampshire, 1997.

Wilderness Medicine Handbook 9th edition. Edited by Shana Tarter, Buck Tilton & Todd Schimelpfenig. Published by the Wilderness Medicine Institute of the National Outdoor Leadership School, 2005.

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NOLS Cookery 5th Edition. By Claudia Pearson. Published by Stackpole Books, 2004.

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Appendix A: Reading List By Handbook Chapter

Chapter 1: Outdoor Leadership

Effective Leadership in Adventure Programming. By Simon Priest and Michael Gass. Published by Human Kinetics, University of New Hampshire, 1997.

The Wilderness Handbook 1st edition. By Paul Petzoldt. Published by W.W. Norton & Company, Inc., 1974.

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Chapter 6: Maps and Orienteering

Mountaineering: The Freedom of the Hills 7th edition. Edited by Steven M. Cox and Kris Fulsaas. Published by The Mountaineers, 2003.

NOLS Wilderness Navigation. By Darran Wells. Published by Stackpole Books, 2005.

Allen & Mike's Really Cool Backpackin' Book: Traveling & camping skills for a wilderness environment! By Allen O'Bannon and Mike Clelland. Published by The Globe Pequot Press, 2001.

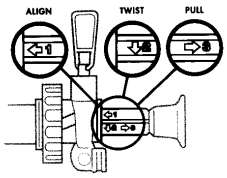
Appendix B: Cascades Adventures Equipment Instructions

MSR Whisperlite Stoves

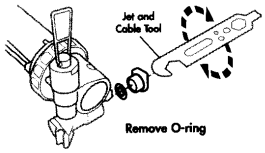
Replace O-rings and Pump Seals that are dry, cracked, or torn. Replacement O-rings and Pump Seals can be found in the Annual Maintenance Kit or the more comprehensive Expedition Service Kit, purchased separately from an MSR Dealer.

REPLACING FUEL TUBE O-RING

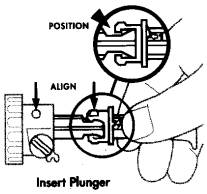
1. **Remove Plunger.**
   ↳ Align, twist, and pull.
2. **Remove Fuel Tube Bushing and O-ring with Jet and Cable Tool.**
   Remove the O-ring with the end of the Fuel Line or Safety Pin.
3. **Inspect O-ring and replace if damaged.**
   If needed, a spare red Fuel Tube O-ring is provided.
4. **Lubricate Pump Cup.**
   Use a drop of Pump Cup Oil or any mineral-based oil.
5. **Insert Plunger.**
   ↳ Hold thumb and forefinger firmly around **Arrow 1**.
   ↳ Align Plunger Bushing Tabs with holes in Pump Body.
   ↳ Push Plunger/Bushing into the Pump Body until it snaps in place.



Remove Plunger



Remove O-ring



Insert Plunger

REPLACING CONTROL VALVE O-RING

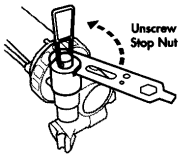
1. **Unscrew Stop Nut 2 turns.**
2. **Unscrew Control Valve 6 turns.**
3. **Unscrew Stop Nut completely and remove Control Valve Assembly.**
4. **Inspect O-ring and replace if damaged.**
   ↳ Remove Control Valve handle from stem.
   ↳ Slide Stop Nut off.
   ↳ Remove O-ring with Safety Pin.

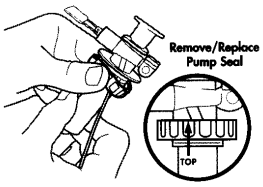
REPLACING PUMP SEAL

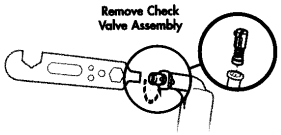
Inspect Pump Seal and replace if damaged.

CLEANING THE CHECK VALVE

1. **Turn Check Valve Assembly to remove.**
2. **Wipe any debris from Check Valve and Pump Cavity.**
3. **Reinsert Check Valve Assembly.**







⚠ WARNING

Do not disassemble the stove or Pump beyond what is described in these instructions. Do not modify the stove or Pump. Do not use the stove or Pump if any parts are missing or broken. Use parts intended for WhisperLite Internationale only.

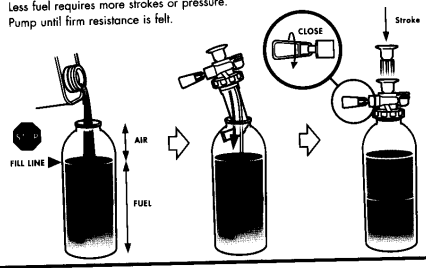
WHISPERLITE INTERNATIONALE OPERATING INSTRUCTIONS

READ, UNDERSTAND, AND FOLLOW ALL instructions and warnings in this manual before using this stove.

1

The WhisperLite Internationale is sold with two interchangable Jets so it can burn a variety of fuels. To ensure the correct Jet is installed for the type of fuel to be used, see *Fuel Information*.

1. **Fill Fuel Bottle to fill line only.**
   Air space is necessary for fuel expansion.
2. **Insert Pump into Fuel Bottle and firmly tighten.**
3. **Close the Pump Control Valve, then stroke Plunger (20-30 strokes).**
   Less fuel requires more strokes or pressure.
   Pump until firm resistance is felt.

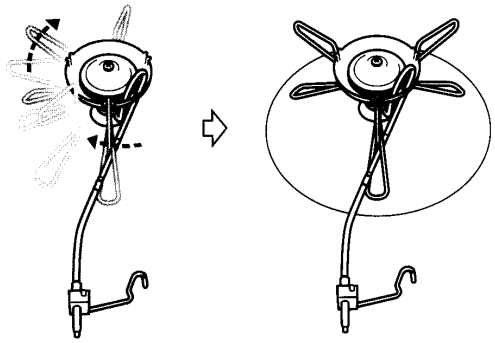


⚠ WARNING

Use MSR fuel bottles only. Non-MSR fuel bottles may leak fuel, causing fire and injury. Keep children away from stove and fuel. Never leave a burning or hot stove unattended.

2

1. **Unfold the 3 Pot Supports/Legs.**
   ↳ Snap each Pot Support/Leg into a rim detent.
2. **Place stove on the center of Heat Reflector.**

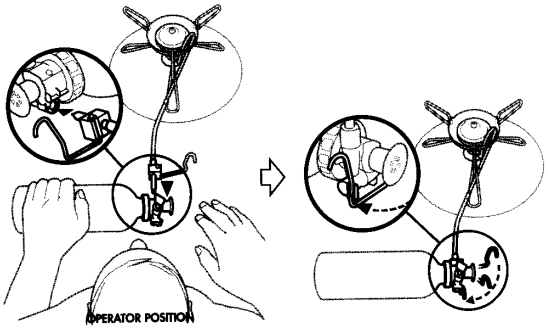


⚠ WARNING

Keep combustibles at least 4 feet (1.2 meters) away from the top and sides of a burning stove. This stove can ignite combustible materials. Use this stove for cooking food and boiling water only. Never use it for any other purpose. When temperatures are below -10 F (-24 C), O-rings may be stiff and prone to fuel leakage. Use extreme caution in temperatures below freezing.

3

1. **Lubricate the entire brass end of the Fuel Line with saliva or oil.**
2. **Completely insert the brass end of the Fuel Line into Pump.**
   Place Fuel Bottle on its side so Pump Control Valve points up.
3. **Secure the Catch Arm on Fuel Pump Groove.**
   Keep Fuel Line straight for safety.
   Keep Fuel Bottle as far away as possible from stove.

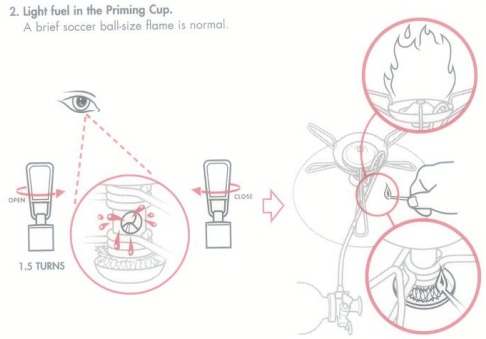


⚠ WARNING

Before every use, look for fuel on the Fuel Bottle, Pump, Fuel Line, and Burner. Do not light the stove if you see or smell fuel. See *Troubleshooting*. Never disconnect the Fuel Line, Pump, or Fuel Bottle when the stove is in use or fuel will leak, ignite, and burn you. Leaking or spilled fuel may ignite and burn you.

4 PREHEAT STOVE

1. **Release only 1/2 spoonful of fuel.**
   - Open Pump Control Valve 1.5 turns and let fuel flow through the Jet.
   - Close Pump Control Valve.
   Look for fuel in Priming Cup and on Wick.
2. **Light fuel in the Priming Cup.**
   A brief soccer ball-size flame is normal.

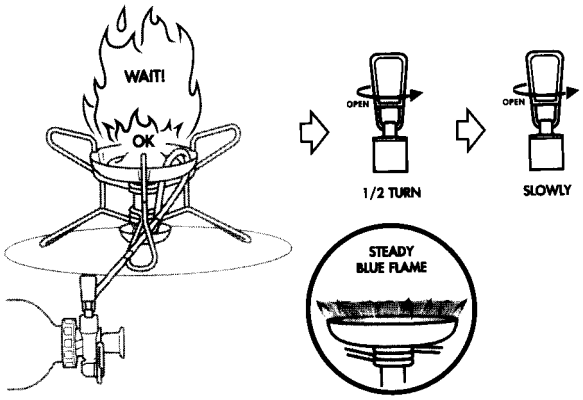


⚠ WARNING

Never place your head or body above the stove when lighting it or while stove is burning. Never use excess fuel to preheat stove. Leaking or spilled fuel may ignite and burn you.

5

1. **Wait for preheat flame to reduce in size (approximately 2 minutes).**
   If flame goes out, wait 5 minutes for stove to cool before relighting.
2. **Open Pump Control Valve 1/2 turn and wait for steady blue flame.**
3. **Slowly open Pump Control Valve.**

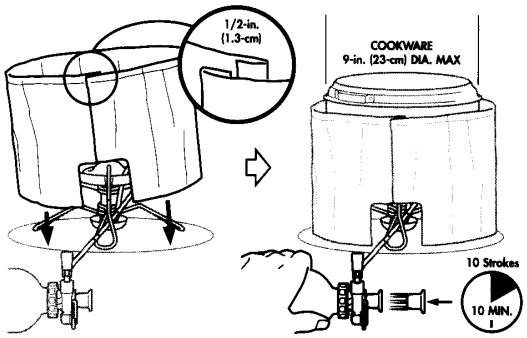


⚠ WARNING

Relighting a warm stove may cause large flames that can burn you. Let the stove cool 5 minutes before relighting. Accessible parts may be very hot. Never move a hot or burning stove.

6

1. **Set up Windscreen.**
   ↳ Fold the ends of Windscreen together.
   Leave a 1-inch (2.5-cm) gap between Windscreen and pot for optimal performance.
   Use Windscreen to improve performance in all conditions.
2. **Place pot on stove.**
3. **Maintain Fuel Bottle pressure.**
   Add approximately 10 strokes every 10 minutes to maintain performance.
   Hold Fuel Bottle firmly while pumping.



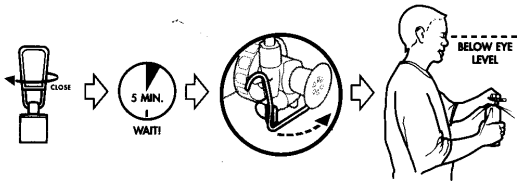
⚠ WARNING

Keep the Fuel Bottle away from the stove burner or other heat sources. Separate Burner and Fuel Bottle with the Windscreen. An overheated Fuel Bottle can explode and burn or injure you. Never use cookware with a diameter greater than 9 inches (23 centimeters). Large cookware reflects excessive heat. Never operate stove with empty or dry pots. Never use non-MSR reflectors or diffusers.

7

1. **Close Pump Control Valve.**
   Residual fuel will continue to burn with a small flame.
2. **After flames are out, wait 5 minutes for stove to cool.**
3. **Unlock Catch Arm and remove Fuel Line from Pump.**
4. **Depressurize Fuel Bottle and repack stove.**
   ↳ Hold the Fuel Bottle upright, away from your face and any sources of heat or ignition.
   ↳ Slowly unscrew pump to depressurize Fuel Bottle.

To transport or store the Fuel Bottle, the Pump may be left inside a depressurized Fuel Bottle. The Pump can also be removed and replaced with the Fuel Bottle Cap.



⚠ WARNING

Do not store Fuel Bottle near heat or ignition sources, such as water heaters, stoves, pilot lights, furnaces, and electrical devices. Keep the Fuel Bottle tightly closed in a cool, well-ventilated place. Use extreme caution when storing stove fuel.

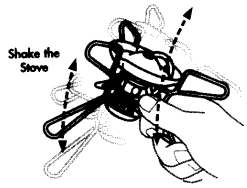
Deposits in the Jet and Fuel Line reduce fuel flow and impair stove performance. Minor deposits in the Jet can be cleared with the Shaker Needle. Major deposits may require extensive cleaning of the Jet and Fuel Line.

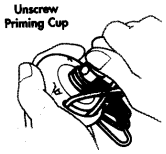
CLEARING THE JET WITH THE SHAKER NEEDLE

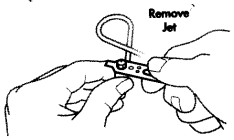
1. **Close Pump Control Valve and wait 5 minutes for stove to cool.**
2. **Shake stove up and down.**
   Shaker Needle inside Jet should rattle.
3. **Preheat and run stove.**
   If performance does not improve, perform Cleaning the Jet and Fuel Line steps.

CLEANING THE JET AND FUEL LINE

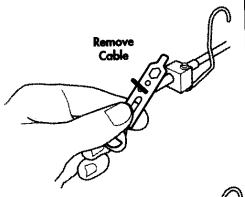
1. **Fold Pot Supports/Legs to packed position.**
2. **Unscrew Priming Cup and remove Wick.**
3. **Hold folded Pot Supports/Legs together.**
   ↳ Remove Fuel Line from Mixer Tube. Keep unattached Fuel Line threaded through leg.
4. **Rescrew Priming Cup to keep Pot Supports/Legs together.**
5. **Unscrew Jet with Jet and Cable Tool.**
   IMPORTANT: Do not bend Generator Tube while loosening Jet.

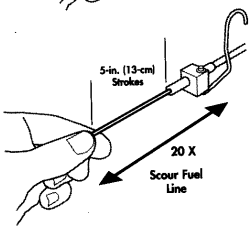






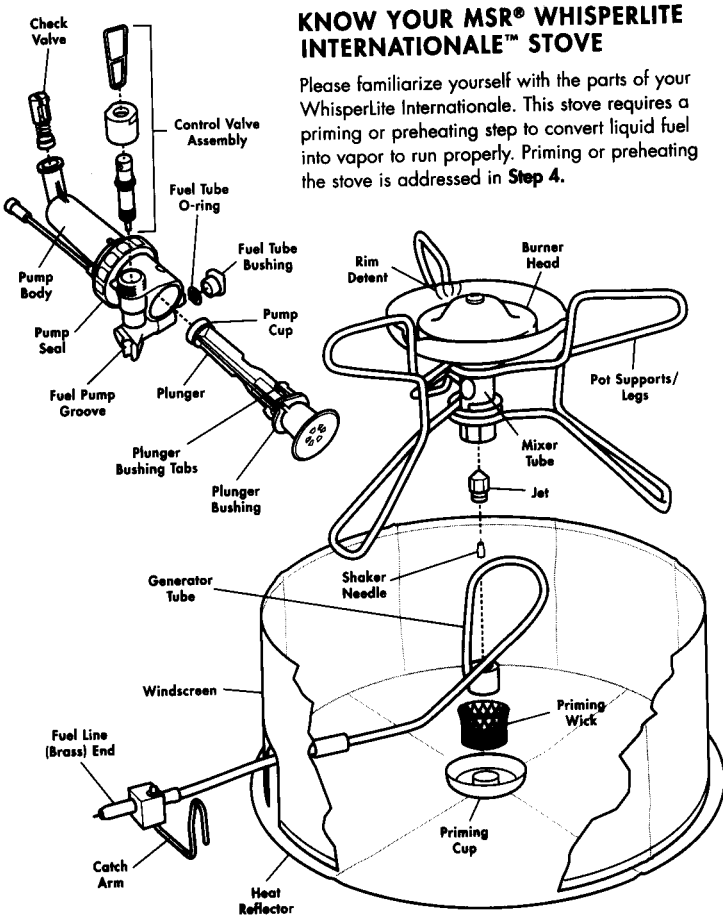
6. **Remove Shaker Needle and use it to clear Jet Orifice from top or bottom.**
   NOTE: To exchange Jets, place Shaker Needle in new Jet and reassemble stove.
7. **Scour Fuel Line.**
   ↳ Remove Cable from Fuel Line with Jet and Cable Tool. Stubborn cables can be loosened with a common lubricant (WD-40™, Pump Cup Oil, etc.).
   ↳ Fully reinsert Cable into Fuel Line.
   ↳ Move Cable in and out with 5-inch (13-cm) strokes approximately 20 times.
   ↳ Wipe Cable clean.
8. **Flush Fuel Line.**
   ↳ Remove Cable.
   ↳ Insert Fuel Line into Pump and Fuel Bottle and secure Catch Arm on Fuel Pump Groove.
   ↳ Pressurize Fuel Bottle with 15 strokes.
   ↳ Fully open Control Valve to flush 4 spoonfuls of fuel through Fuel Line into an appropriate container. (Jet uninstalled.)
   ⚠ WARNING: Keep away from ignition sources.
   ↳ Close Control Valve and remove Fuel Line.
   ↳ Safely dispose fuel when flushing is complete.
9. **Reassemble stove.**
   If stove performance is still impaired, repeat Cleaning the Jet and Fuel Line steps.





KNOW YOUR MSR® WHISPERLITE INTERNATIONALE™ STOVE

Please familiarize yourself with the parts of your WhisperLite Internationale. This stove requires a priming or preheating step to convert liquid fuel into vapor to run properly. Priming or preheating the stove is addressed in **Step 4.**



Katadyn "Pocket" Water Filter

How to get the most from your Katadyn water system.

To extend cartridge life, always use the best water source available. Keep the intake pre-filter clean and off the bottom. In extreme conditions wrap a coffee filter or bandana around the intake pre-filter. Where possible, place untreated water in a container and wait for sediment to settle out until water appears clear—then filter water from above the sediment.

If the handle is hard to push…

Lubricate the pump handle o-ring. Silicone lubricant is provided.

Remove handle collar and handle. Clean o-ring on end of handle shaft. Apply a small amount of silicone lubricant all the way around the o-ring. Reassemble.

Clogged filter…

When a ceramic filter becomes hard to pump it needs to be cleaned. Remove the filter from the housing, scrub the surface with an abrasive pad and rinse with water. Do not let contaminated water enter the output barb!

If unit pumps but water does not easily flow…

-Make sure prefilter is submerged.
- Make sure hoses aren't blocked or pinched.
- Hold pump vertically until water begins to flow.
-Clean check valve.

Appendix C: Lesson Plans by Topic

Food Planning

I. **Goal:** To have participants plan food rations for wilderness outings with an understanding of nutritional requirements involved.

II. **Objectives:**
   a. Participants will understand the importance of food in wilderness travel.
   b. Participants will be able to list and explain the body's nutritional needs.
   c. Participants will be able to list considerations in food planning.

III. **Content**
   a. **Food Plays Important Roles In:**
      i. **Staying healthy:** Keeping well-nourished plays an instrumental role in fighting illness and disease.
      ii. **Building and repairing body tissue:**
      iii. **Attitude:** Without good nutrition, disposition and attitude deteriorate rapidly.
      iv. **Energy:** Food provides the energy that allows us to take part in physical activities.
      v. **Mental Alertness:** Thought processes and decision-making ability deteriorate without good nutrition.
   b. **Specific Nutritional Needs**
      i. **Calories**
         1. A calorie is a unit of heat used to measure the energy value of food. It take one calorie to raise one gram of water one degree centigrade.
         2. Individual caloric needs range from approximately 1800 per day for a sedentary individual to over 6500 for an expedition member in extreme weather.
         3. In general, individual daily caloric needs for wilderness travelers range between:
            a. 2800 and 4000 in summer.
            b. 3800 and 6000 in winter.
      ii. **Carbohydrates**
         1. Carbohydrates provide short term energy.
         2. They should make up approximately 60% of an individual's diet.
         3. Carbohydrates are found in starches and sugars such as:
            a. Pastas (macaroni, noodles, spaghetti)
            b. Rice

c. Potatoes
d. Drink Mixes
e. Candy
f. Fruit

iii. **Fats**

1. Fats provide long term energy.
2. They should make up approximately 20-25% of an individual's diet.
3. Fats are found in:
   a. Cheese
   b. Nuts
   c. Vegetable Oil
   d. Meats
   e. Margarine

iv. **Protein**

1. The body uses protein to provide for the building of cells and tissue such as skin and muscles.
2. It should make up approximately 15-20% of an individual's diet.
3. Proteins are made up of 22 amino acids. Of these 22, all but eight are produced in our bodies. The other eight must be obtained through proteins in food.
4. Complete proteins vs. incomplete proteins
   a. Complete proteins: these include all eight of the essential amino acids that the body cannot produce. Therefore, they provide a full complement of protein. Examples include:
      i. Meats (summer sausage, pepperoni)
      ii. Fish
      iii. Soy Products (soy milk, soy nuts)
   b. Incomplete proteins: these include some, but not all eight of the essential amino acids. Therefore, they do not provide a full complement of protein. Examples of incomplete proteins include:
      i. Cereals
      ii. Vegetables and Fruit
      iii. Legumes (beans, nuts, lentils)
   c. Incomplete proteins can be made complete by combining two or more foods (e.g., beans and vegetables) together in the same meal. Although this usually happens naturally,

it is helpful to be aware of this to insure that complete proteins are consumed regularly.

v. **Vitamins and minerals:** If participants consume a variety of foods and the recommended high number of calories, vitamin and mineral intake is generally adequate. Supplemental vitamins and minerals are usually unnecessary.

vi. **Water:** Water is a critical nutritional element.

1. Water aids in digestion.
    a. It keeps cells healthy
    b. It regulates body temperature
    c. It helps to carry wastes out of the body
2. Times when the body is more susceptible to dehydration:
    a. Strenuous activity (water is lost through perspiration)
    b. Higher Altitudes (water is lost through increased respiration in drier air)
    c. Cold weather (water is lost through respiration and perspiration)
3. A minimum of 2-4 quarts in summer, and 3-4 quarts in winter should be consumed each day to prevent dehydration.

c. **Food Planning Considerations:** Depending on the objectives and length of the trip, the following criteria should be considered.

i. **Energy content:** the number of calories supplied by a food item in relation to its bulk and weight.

ii. **Nutritional balance**

iii. **Bulk and weight**

iv. **Spoilage:** the risk of food spoiling varies with the season and region.

v. **Expense and availability:** is it available, and if so, can the group afford it?

vi. **Ease of packaging and handling**

1. Can it be packaged environmentally (i.e., in plastic rather than cans which, if accidentally left behind, would be less likely to decompose or burn than plastic)?
2. How easily can it be handled without spilling, etc.?

vii. **Variety**

1. The longer the trip, the more important this becomes as a morale booster. Few people want to eat the same thing day after day.
2. The more variety, the better the chance of appealing to everyone's food tastes.

viii. **Preparation Time:** Can it be prepared in a reasonable amount of time?

ix. **Supplementary wild foods**

1. Are they available?
2. Can they be harvested legally?
3. Are participants and leaders knowledgeable enough to prevent accidental poisoning?
4. Can they be harvested without impacting the environment?

IV. **Instructional Strategies & Materials:**

a. **Timing**

i. Depending on how the course is designed, this lesson can be taught as a part of the pre-trip meeting, the shakedown or near the end of the course.

b. **Activities:** Have participants develop a meal plan and use it on the trip.

Leave No Trace Activities

Our Natural World - Quick Activity

Grabbing Your Groups Attention

Your group will be going on a Nature Scavenger Hunt. Rather than collecting objects, they will be listing ideas on paper. The hunt will help participants discover how much they have in common with the natural world and how the natural world influences their survival. This activity sets the stage for learning and embracing Leave No Trace principles.

Begin the activity by conducting one of the following:

- an excursion to an outdoor setting such as a park, canyon, river, or desert.
- an excursion to a natural setting via a slide show, color photographs, or posters.
- a mind excursion where participants imagine their favorite natural setting
- a mind excursion where participants close their eyes while you describe a natural setting.

The Activity

Give each participant a piece of paper and a pencil. Have them make three columns with the titles, Things in Nature, Things We Have in Common, How It Helps Me. Participants are to observe their environment physically if they are outdoors, or mentally if they are indoors. They must find objects in nature and tell how they are like that object. Make sure they consider less noticeable things such as air, soil, sun. For example:

Things in Nature, Things We Have in Common, How It Helps Me

- Tree. We both have an outer layer to protect us (bark/skin). A tree gives me oxygen.
- Soil. We both contain minerals. Soil helps grow my food.
- Ant . We both need shelter. They are fun to watch.

The Discussion

Have participants share one or more of their connections. Help them to discover that this personal connection is where a commitment to land stew ship begins. Land stewardship is the goal of Leave No Trace. Outline for them what they will be learning about Leave No Trace in the future.

Our Natural World - Activity Plan

A Leave No Trace activity to foster understanding of outdoor ethics.

What Your Group Will Learn

After participating in an activity to set the stage for learning outdoor ethics, group members will be capable of:

1. describing simple connections between plants and animals of an ecosystem.
2. predicting changes to an ecosystem caused by human impacts.
3. determining how to choose behaviors that protect natural resources.

Your group will play a game that will help them make connections to the natural world and understand how their behaviors can impact nature. Using a ball of string and cards that represent plants and animals, group members will construct a web of connections between all living things.

Materials

- Cards approximately 3" X 5" inches.
- Hole punch.
- Approximately 4 ft. of yarn per person.
- 100 feet of thick string rolled into a ball.
- Paper and pencil for each person.
- Symbols pictures or words to rep sent sun, clean water, clean soil and air .
- A copy of directions and Scenario Cards.

Preparation

Read the entire lesson plan and Back ground Information thoroughly. This activity will take approximately 45 minutes to complete.

- Roll up 100' of string into a ball.
- Have scenario cards available for use by leader or by individuals.
- Photocopy Scenario Cards laminate (optional), and cut into cards.
- Follow the directions listed below in Alpine Ecosystem.

Alpine Ecosystem

Write the names of the 17 plants and animals listed in the categories below on the 3" x 5" cards, one name to a card. Punch holes in each card and attach yarn long enough to loop the card over the par shoulders. Distribute all of the cards. If your group is smaller than 17, some group members will have two cards. If your group is larger than 17 you will need to add plants and animals to the ecosystem. Some ideas in berry, bear, coyote, western tanager, hum bird, grub worm. Note: This game can be played with plants and animals from other ecosystems such as a warm desert, a cold desert or a river corridor. Cards and scenarios should be created accordingly.

- plants mammals insects amphibians birds
- pine tree mouse grasshopper snake stellar jay
- aspen rabbit mosquito frog downy woodpecker
- wild flower deer ant
- downed log coyote fly
- grass

Grabbing Your Group's Attention - 5 minutes

Before people can choose to Leave No Trace in the backcountry, they often need to adopt reasons for caring for our natural world. This activity will help participants identify some of those reasons.

Have each group member, including the leader, loop a card over their shoulders. In the middle of the room place the symbols, pictures or words that represent the sun, water, soil, and air. Gather the group in a circle around these objects. Give the ball of string to one group member and explain that they are going to play a game called Equate! Relate! The game demonstrates how plants and animals need each other (connectedness) in an alpine setting and will help par pants predict how human impacts can affect those plants and animals.

Steps for Teaching the Activity - 20 minutes

"Equate! Relate!": A Game of Connections

1. Read and explain the "Equate! Relate!" game directions to the group.
2. Play the game.
3. Do the Human Impact scenario cards (see game directions).

Directions

The purpose of this game is to:

- Recognize connections among plants, and animals of an ecosystem.
- Describe human impacts on ecosystems.

Everyone assumes the role of the plant or animal listed on their card.

1. *Making Connections - Ball of String*

The person holding the ball of string looks around the circle and finds one other plant or animal that connects with the card they are holding. They describe the connection out loud, hang on to the string and throw the ball to that plant or animal. For example, the woodpecker has the ball of string, hangs onto the string and throws it to the aspen saying, "I need the aspen to provide insects to eat." The aspen catches the ball, hangs onto a section of the string with one hand and throws the ball of string with the other hand to the ant saying, "The ant needs me to find food." The ant catches the ball of string, hangs on to a section of the string and throws the ball to the downed log saying, "I need the downed log for a home."

Play goes around the circle until everyone is holding onto a section of the string. At no point should anyone let go of the string. In some cases animals and plants will have received the ball of string more than once and therefore are hanging on to more than one section of string.

Time Out For Discussion

Familiarity with the Background Information will help the leader lead the discussion.

Have the group observe the web of connections they have made. Discuss what the web demonstrates about connections in an ecosystem, including the human connection.

Plants, insects, animals, and humans owe their existence to each other. Insects pollinate plants and provide food for small animals; plants provide food and shelter for both animals and humans. Plants also help filter water that is then stored in mountains, streams, lakes, and aquifers. When one member of the web of life is eliminated, other living things are invariably affected. See the Background Information for more about the web of life.

Have each group member think about one item from the middle of the room-sun, water, soil, air-and then describe one connection they have to this resource. For example, the frog might say, "I need the water in which to lay my eggs."

2. *Scenario Cards - Human Impacts on Ecosystems*

Have the leader, one other person, or four individuals read one Equate! Relate! Scenario Card at a time to the group. Have the group discuss the question at the end of each scenario. As you discuss each scenario have participants drop their string to show how an impact to one part of the web affects another part. For example, if campers pick all the wildflowers in an area, what else will disappear (mice, coyote)? The persons holding the mice or coyote card would drop their section of string.

Note: This game can be played with plants and animals from other ecosystems such as a warm desert, a cold desert or a river corridor. Cards and scenarios should be created accordingly.

Wrapping Up the Activity - 15 Minutes

Your campers are great problem solvers! Your group knows how to have fun in the outdoors while respecting the importance of all living things. How well has each person learned to protect natural resources?

- While still in their circle, have participants summarize what they have learned from this game.
- Have participants tell one new behavior they will practice the next time they go camping or hiking.
- Have participants explain how this behavior will support the natural resources (plants, animals, soil, water...)

Congratulations on conducting a well-prepared meeting for your group!

Equate! Relate! Scenario Card

Scenario: Campsites A group of people camp on the edge of an untouched meadow because it is easy to watch wildlife. They stay for many days and leave behind a new rock fire ring, large log benches, and newly worn trails in and around their camp.

a) How might the scene of their abandoned campsite attract more campers to this area?

b) If more campers come, how might their presence affect the meadow's community of life?

Answers

a) People are often attracted to established campsites. The remains of the fire ring, benches, and trails will encourage more people to camp here.

b) If camping use becomes too heavy, some animals will be driven from the meadow.

Note: A large scale example of animal displacement can be seen in cities. How many wild animals like to live near people? The deer might want to drop the string.

Equate! Relate! Scenario Card

Scenario: Wildflowers

Three campers go out for an afternoon hike. They each return to camp with a handful of wildflowers to give to their leader.

a) Why should wildflowers be left in their natural setting?

b) How else might the campers share their love for wildflowers or their desire to present their leader with a gift?

Answers

a) Wildflowers should be kept in their natural setting as food for animals, so the flowers can reseed themselves for the next growing season and to allow other visitors the opportunity to view their beauty.

Note: If wildflowers disappear, animals in the web that depended upon them are in trouble. They should drop their string.

b) The campers could take their leader to see the flowers or they could make a drawing to give to their leader.

Equate! Relate! Scenario Card

Scenario: Firewood

A leader has asked four young campers to collect wood. The campers use axes to hack at live trees and they also peel tree bark to help start their fire.

a) How might these actions harm the trees?

b) What are alternatives to cooking with fire?

c) What might be some nighttime activities that could replace an evening around the campfire?

Answers

a) When bark is hacked or peeled from a live tree, the tree is wounded. Wounds expose trees to disease and insects which harm or kill the tree.

Note: The web is affected if the tree dies. For example, the woodpecker should drop the string.

b) Campers can cook with lightweight stoves rather than campfires, or bring prepared foods.

c) Learn about the stars; use dark shapes surrounding the campsite to stimulate story telling; go for a moonlight hike if the moon is bright.

Equate! Relate! Scenario Card

i. Air in a low pressure system is less dense than in a high, which causes it to draw winds (which are often moist) into the system. Therefore, low pressure systems often bring cloudy, stormy weather.

Scenario: Water

You have been hiking all day and stop in a campsite for the night. As you are setting up your tent you notice two tents next to the stream.

a) What could the campers in the two tents do to reduce their intrusion into your primitive outdoor experience?

b) How will these campers affect the animals that use this location at night to get their water?

c) What, if anything, might you say to these campers?

Answers

a) Hiding tents from view allows a sense of solitude.

b) The animals might be too afraid to come down to the river to drink. Also, camping so close to a stream could cause pollution from wash water and human waste entering the river.

Note: Those animals that depend upon the stream for drinking water should drop their string.

c) This is a difficult question to answer. How will your group respond?

Weather

II. Goal: To have participants predict weather in the field as accurately as possible using a compass and their senses.
III. Objectives:
    a. Participants will be able to explain why weather is difficult to predict accurately.
    b. Participants will be able to identify wind direction and use it to predict weather.
    c. Participants will be able to use different cloud formations in helping to predict weather.
IV. Content:
    a. Weather is difficult to accurately predict
        i. Atmospheric movements are mostly random in nature.
        ii. No two weather systems, masses, or fronts are alike.
        iii. Weather observers and weather stations are too far apart to get an accurate reading of regional weather.
        iv. Some weather phenomena are very localized (e.g., showers and flurries).
    b. Barometric Pressure
        i. Barometric pressure is the pressure created by the weight of air above us.
            1. Because the molecules are further apart, warm air is less dense than cold and holds more moisture.
            2. Warm air rises, cold air sinks.
        ii. As air cools and sinks, it becomes more dense and causes higher pressure. This denser air keeps other systems away, therefore skies in a high pressure system remain clear.
    c. Wind: It is virtually impossible for the weather to change without wind. It is the wind, at varying elevations, that blows in different weather.
    d. Temperature changes with change in elevation: Temperature changes can be used as a guide to determine changes in barometric pressure. If the temperature changes (over at least several hours) more than the degrees given below for every 1000ft. of elevation gained or lost, then this would indicate that the barometric pressure is changing.
        i. 3 degrees F per 1000ft. of ascent is average
        ii. 2 degrees F per 1000ft. of ascent when wet and/or windy indicates a low pressure system
        iii. 4 degrees F per 1000ft. of ascent when dry and/or calm indicates a high pressure system
        iv. 5 degrees F per 1000ft. of ascent is the theoretical maximum possible, with 0% relative humidity and absolutely still air, rarely realized in nature.
    e. Clouds
        i. Types of clouds: The types of clouds are classified according to how they are formed in the atmosphere.

1. Cumulus
    a. These are formed by rising air currents at almost any altitude.
    b. These are the classic, puffy, white clouds.
    c. These appear in the middle of a high pressure air mass, mainly building up in the afternoon. Clouds with flat bottoms above mountains indicate fair weather.
2. Stratus (stratus refers to the word layer): These sheets or horizontal layers are formed when air cools to the dew point (the point at which air becomes saturated and reaches 100% humidity).

ii. Families of clouds: Families are classified according to their altitude.
1. High: these are 20,000-25,000 ft. above the earth and consist of ice crystals.
    a. Types of High Clouds
        i. Cirrus (cirrus refers to the word streak): thin, wispy, and delicate. These don't contain precipitation but may indicate precipitation within the next 24 hours. These so-called "mare's tails" (scattered and wispy) often consist of ice crystals and often indicate approaching precipitation.
        ii. Cirrocumulus: rippled and thin. These often consist of ice crystals that reflect light and create a "halo" around the sun or moon. These are also known as a "mackerel sky." They often indicate fair weather but may also bring brief showers.
2. Middle: these are about 10,000 ft. to 6,500 ft. above the earth, but are sometimes as high as 20,000 ft. They consist of water and may contain some ice crystals.
    a. Types of Middle Clouds:
        i. Altocumulus (alto refers to the middle range): puffy, white, or gray. These indicate fair weather with precipitation likely within 8-10 hours.
        ii. Altostratus: grey or blue. These usually bring light rain or snow.
3. Low: these are about 6,500 ft. or less above the earth.
    a. Types of low clouds:
        i. Stratus: low, uniform, and thin. They consist of water droplets and may produce a fine drizzle but not a rain.
        ii. Nimbostratus: low, thick, and dark gray. These yield steady rain or snow.

iii. Stratocumulus: thick, gray, and irregular. These don't produce precipitation but often change into nimbostratus.

4. Towering: these range from low altitudes up to 40,000 ft.
    a. Cumulonimbus: cauliflower-shaped with flat, anvil-like tops. These are the classic thunderheads and produce heavy thunderstorms, rain, snow, or hail.

iii. Red sunrises and sunsets
1. A red sunset indicates that tomorrow's weather may be dry. Dry air refracts red light. This indicates that clear dry air is to the west, which is often the direction from which storms come.
2. Red sunrises are cause by reflections in moist air that may indicate rain later in the day.
3. Thus there is some truth to the saying "red sky at morning, sailors take warning. Red sky at night, sailors delight."

iv. Ground fog and/or dew
1. Fog
    a. Morning fog is the result of moisture in damp air that condenses in the cold of the night and is usually burned off by the heat of the morning sun.
    b. Late afternoon or evening fog is usually formed as moisture falls through warmer air and often indicates a coming storm.
2. Dew
    a. Since warm air holds more moisture than cold air, as air cools its relative humidity increases until the moisture in it reaches the maximum that it can hold at that temperature (this is called the dew point). If the air continues to cool, some moisture in it has to condense and may be deposited as dew.
    b. At night, the air near the surface of the earth cools. If it cools below its dew point, dew forms on the ground.
    c. Dew is most common on calm, cloudless, cool nights. Since both wind and clouds reduce the cooling rate of air near the surface of the earth, temperatures drop more slowly and the air may not reach its dew point before the sun rises again in the morning.
    d. No dew at night may indicate rain by morning. No dew in the morning may indicate rain by the next day.

v. Other factors to consider when forecasting weather
1. Season
2. Local conditions (e.g., mountains, large lakes, frost pockets, aspect, elevation, microclimate)

a. Mountain and valley winds: since wind takes the path of least resistance, winds can be quite strong in lower elevations such as valleys and mountain passes. As the wind "squeezes" through these narrow areas, it picks up speed.
b. Deserts: as very hot air quickly rises, surrounding air will rush in and fill the void, creating "heat lows" such as dust devils.

3. Since many animals are particularly sensitive to changes in atmospheric pressure, they often give signs that indicate weather changes (e.g., before a storm, some birds such as woodpeckers and blue jays are often very noisy, but insects will stop making noise).
4. Average weather conditions and historical weather patterns for the area can be obtained from National Weather Service publications. The following agencies publish weather statistics and can provide climatological summaries of regional weather.
    a. National Oceanic and Atmospheric Administration (NOAA) Weather Radio, National Climatic Center, Federal Building, Asheville, NC, 28801
    b. National Oceanographic and Atmospheric Association, Rockville, MD, 20852

V. Instructional Strategies and Materials
    a. Timing: This lesson is effectively taught using "teachable moments when changes in weather occur.
    b. Strategies
        i. Participants can choose a "weatherperson" to record temperature highs and lows and weather patterns during the course. These patterns can be studied to better understand weather systems.
        ii. This is a good lesson for students who have a special interest in meteorology to instruct.

Route Finding with Map and Compass

I. Goal: To have participants demonstrate the ability to plan and execute a safe, trailless hike.
II. Objective: Participants will be able to discuss and successfully apply compass and map skills to the planning and proper execution of a trailless hike.
III. Content:
    a. Terrain Considerations: Once participants have gained some experience and confidence in their map and compass skills, they can plan and attempt a trailless hike.
        i. The safety of the group must be of paramount concern during route planning. Obviously, dangerous obstacles such as cliffs, large rivers, and crevasses should be avoided.
        ii. Alternate routes should be planned if these areas or other questionable areas (such as swamps or bogs) are deemed unsafe to travel through.
    b. Comfort: The comfort of the group should be considered in route planning.
        i. How much elevation must be gained?
        ii. Is there water available along the route?
        iii. How thick might the forests be?
        iv. Will the terrain be very wet or insect ridden?
    c. Time and Distance: It is important to accurately predict how much time will be required to travel the desired distance.
        i. Terrain Features: Terrain features such as steep terrain, thick woods, and wet swamps all slow down travel time considerably.
        ii. Routes: Choose routes that ensure that the group has adequate time to accomplish the objective, even if a minor emergency occurs.
        iii. Establish guideposts: Select routes that allow the traveler to look for clearly identifiable land forms and features to use as guides, minimizing the opportunity for getting lost.
            1. Handrails
                a. Select land features that parallel the line of travel to the left or right.
                b. If a traveler crosses over a handrail, it should indicate that they have drifted off to the left or right of the chosen path.
            2. Backstop
                a. Select a land form to serve as a "dead end" or "gone too far" barrier.
                b. Hitting this land form indicates that a turn was missed or the objective was passed.
            3. Check points

a. Selected land or terrain forms (i.e., checkpoints) along the line of travel can be used to confirm the traveler's exact location.
b. These checkpoints can be used frequently to evaluate progress and determine on a map whether or not travel is going as planned. Travelers should use the map to keep constant track of their location.

4. Elevation Gain or Loss
    a. The gain or loss of elevation along a route must be properly estimated in order to make an accurate Time Control Plan and can be another clue about the accuracy of the route chosen.
    b. The group can count contour lines from the starting point to the destination to get an idea of the ruggedness of the terrain.
5. Distance
    a. The distance of the proposed route should be measured using a string and the distance scale.
    b. Distance naturally figures into the Time Control Plan.
6. Time Control Plan
    a. Participants should be encouraged to submit a written estimate of the time it will take to reach the objective.
    b. This estimate may be broken down into travel time and rest time if desired.
    c. This estimate can help build the participants' base of experiential knowledge.

iv. Instructional Strategies and Materials

1. Timing
    a. As their confidence builds, participants should be encouraged to plan and execute progressively more difficult trailless hikes. Planning sessions for trips should include instruction and discussion of the following:
        i. Terrain considerations in route planning
        ii. Identifying potential "handrails," "backstops," and "checkpoints."
        iii. Elevation loss or gain and counting contour lines.
        iv. Estimating distances
        v. Developing Time Control Plans
    b. Participants should be encouraged to submit written estimates or predictions for each area of concern. During debriefings, these can be compared to the actual travel experience, which helps build a base of knowledge.
    c. Use the concept of an "energy mile" to estimate travel time.

i. The average speed that a group with full packs walks on flat terrain is 2 m.p.h.
ii. At elevations up to 7,000 ft, for every 1,000 feet of elevation gained, add 1 hour.
iii. At elevations between 7,000 feet and 11,000 feet , for every 1,000 feet of elevation gained, add 1 ½ hours.
iv. For every 1,000 feet of elevation lost, add 30 minutes.