UNIT 12

Ice Climbing

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From M. Wagstaff and A. Attarian, 2009, *Technical skills for adventure programming: A curriculum guide* (Champaign, IL: Human Kinetics).

UNIT 12, LESSON 1

Introduction to Ice Climbing

OVERVIEW

A subset of mountaineering, ice climbing enjoys a rich history that evolved from forays across snow and ice slopes in the Alps to the extreme vertical ice columns of North America. This lesson provides an introduction to and overview of the history of ice climbing.

JUSTIFICATION

To understand the evolution of this growing outdoor adventure activity, students should be aware of the historical developments of ice climbing.

GOAL

To develop a historical understanding of ice climbing.

OBJECTIVES

At the end of this lesson, students will be able to

- identify the key historical figures responsible for the development of ice climbing (cognitive),
- identify the major geographic areas involved in the development of ice climbing (cognitive),
- describe the major developments in ice climbing (equipment, technique, and so on) (cognitive), and
- appreciate the history of ice climbing and how it contributes to the activity (affective).

EQUIPMENT AND AREAS NEEDED

A variety of images (photos, DVDs, and so on) that depict the history and evolution of ice climbing. You can obtain images from regional guidebooks, texts such as Yvonne Chouinard's *Climbing Ice* (1978), and recent publications such as Andy Selter's *Ways to the Sky: A Historical Guide to North American Mountaineering* (2004).

RISK MANAGEMENT CONSIDERATIONS

- This session is normally part of the introduction on the first day and frequently occurs indoors where no special risk management considerations are present.
- Should this discussion occur outdoors, check for environmental hazards specific to the teaching site and take appropriate precautions.

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LESSON CONTENT

Introduction

Ice climbing in the United States has enjoyed a rich history, especially in northern New England. Although many of the classic ice climbs were first climbed during the "Ice Revolution" of the early 1970s, new ice-climbing areas continue to be discovered. The following selected timeline of people, activities, and climbs provides a sense of that history:

- Jacque Balmat and Dr. Michael Paccard were the first to stand on the summit of Mont Blanc in 1786.
- Hazard Stevens and Philemon Von Trump ascended Mount Rainier in 1870.
- Green and Swanzy ascended Mount Bonney in the Selkirk Range of Canada in 1888.
- The headwall of Tuckerman Ravine on Mt. Washington was first climbed in 1894 by Dr. R.C. Larrabee, Herschel C. Parker, and a Mr. Andrew.
- The first 10-point crampons were created by Oscar Eckenstein in 1908.
- Konrad Cain ascended the Northeast Face and Upper Southeast Ridge of Mount Robson in 1913.
- The first technical winter ascent of Central Gully in Huntington Ravine was achieved by A.J. Holden and N.L. Goodrich in 1927.
- Samuel A. Scoville and Julian Whittlesey made the historic first ascent of Pinnacle Gully on Mt. Washington in 1929.
- Beginning in the late 1960s a series of significant ice climbs in New England marked the beginning of the "Ice Revolution."
  - Jim McCarthy, Bill Putnam, Rick Wilcox, Rob Wallace, and Carl Brandon made the first ascent of Pinnacle Gully without cutting steps. That same winter season, Sam Streibert and Al Rubin discovered the fantastic ice-climbing potential of Frankenstein Cliff. Both events occurred during the winter of 1969–1970.
  - John Bouchard made a solo first ascent of the Black Dike on Cannon Cliff in 1971.
  - John Bragg and Rick Wilcox made the first winter ascent of Repentance on Cathedral Ledge in 1973.
  - Michael Hartrich, Al Rubin, and Henry Barber ascended Twenty Below Zero Gully on Mt. Pisgah to begin development of the Lake Willoughby area in Vermont in 1974.
- Yvonne Chouinard introduced the first American-designed rigid 12-point crampons, alpine hammers, and ice axes with a curved pick during the winter season of 1969–1970.
- By 1972 Chouinard Equipment became the leader in the distribution of American-designed ice-climbing equipment, providing climbers across the country with crampons, ice screws, and ice axes that opened ice-climbing possibilities where none seemed to have previously existed. Other equipment manufacturers soon followed.
- In the Tetons, cousins Greg and Jeff Lowe ascended the Black Ice Couloir in 1971, making a significant statement of success on a long alpine ice route.

- Allan and Adrian Burgess, Bugs McKeith, and Charlie Porter made the first ascent of Polar Circus in 1976, a 1,000-meter climb.
- Bridal Veil Fall, near Telluride, Colorado, was climbed by Jeff Lowe and Mike Weis in 1974.
- Jeff Lowe and Mike Weis teamed up again to ascend the 1,000-meter Grand Central Couloir on Mount Kitchener in the Canadian Rockies in 1975.
- The ascent of steep icy pillars continued, as new climbs began to open up across North America, from the Canadian Rockies to New England (1970s and 1980s).
- Mixed climbing (climbing on ice and rock) entered the climbing scene in the 1990s and continued into the new millennium as a new wave of techniques and radical designs in ice-climbing equipment surged and climbing in general gained popularity.
- As in rock climbing, grades of difficulty were assigned to ice climbs to take into account the general steepness and length associated with them (1980s).
  - Grade 1—Low-angle water ice less than 50 degrees in steepness.
  - Grade 2—Low-angle water ice routes with short bulges up to 60 degrees.
  - Grade 3—Steeper water ice of 50 to 60 degrees, with short 70- to 90-degree bulges.
  - Grade 4—Short vertical columns interspersed with rests on 50- to 60-degree ice. This fairly sustained climbing requires good technique and stamina.
  - Grade 5—Generally multipitch ice climbs with sustained difficulties and few opportunities for rest. The steepness and length of these routes require uppermost preparation in terms of climbing knowledge, skills, and experience.
  - Grades 6 and 7—Grades of this nature are generally found on the long and steep routes characteristic of the Canadian Rockies and the alpine ranges of Europe.

Main Activity

History Report (30 Minutes)

Divide students into small teams to choose two significant developments in the history and evolution of ice climbing to report to the class.

Closure Activity

Area Ice Review (30 Minutes)

- Have students pair up and investigate the history and ice climbing routes of an ice climbing area of their choice.
- Have students report their findings to the class.

Follow-Up Activity

Ice Climbing Investigation (Time as Needed)

Give students an opportunity to research additional text and materials (especially guidebooks) on the history and development of ice climbing.

ASSESSMENT

- Check that students can identify the key historical figures responsible for the development of ice climbing by orally identifying three major figures and their contributions to the development of ice climbing.
- Confirm that students can identify the major geographic areas involved in the development of ice climbing by describing three major ice-climbing areas in North America.
- Verify that students can describe the major developments in ice climbing (equipment, technique, and so on) by having them prepare a short in-class presentation on a selected piece of ice-climbing equipment or technique.
- Assess whether students appreciate the history of ice climbing and how it contributes to the activity through group discussions.

TEACHING CONSIDERATIONS

- The amount of time that you spend on this lesson depends on the depth of understanding that you want students to have about the history and evolution of ice climbing.
- Consider providing local histories to highlight the development of ice climbing and climbing ethics prevalent in your particular climbing area.
- Consider placing text materials on reserve for students to research before and following initial ice-climbing introductions.
- Slide or PowerPoint® presentations depicting historical characteristics can add to student development and appreciation of the roots of climbing.

UNIT 12, LESSON 2

▷ Equipment and Use

OVERVIEW

The evolution of ice-climbing equipment continues through development of new designs that keep the traditional characteristics of tools fresh and new. This lesson provides an overview of crampons, ice tools, and ice protection and shows students how to recognize, use, and maintain this equipment (ropes, harnesses, slings, and cordelette are covered in unit 2).

JUSTIFICATION

Students should learn how to choose and use ice-climbing equipment to ensure their own safety and to maintain the integrity and longevity of their equipment.

GOAL

To develop students' understanding of ice-climbing equipment.

OBJECTIVES

At the end of this lesson, students will be able to

- identify and describe the parts of ice tools, crampons, and ice screws (cognitive);
- conduct the appropriate maintenance on ice tools, crampons, and ice screws (psychomotor); and
- value the importance of proper equipment maintenance (affective).

EQUIPMENT AND AREAS NEEDED

- Examples of the various types of ice tools and crampons (possibly with images)
- An assortment of ice screws
- One pair of tools, crampons, a helmet, and a harness for each student
- A pair of plastic or leather boots for each student
- Files for sharpening ice tool picks and crampons

RISK MANAGEMENT CONSIDERATIONS

- Putting on and walking in crampons is tricky for the beginner. Provide each student with adequate space to fit and stand. Initially, take a walk among obstacles on a flat surface such as in the woods. Emphasize the dangers associated with crampons. If they are not careful, students can tear clothing or injure themselves, especially the lower legs. Be sure to highlight that crampons will unnecessarily damage the environment if not used appropriately.
- Ice tools are dangerous. Be sure to set clear boundaries and give everyone plenty of space before distributing ice tools. Tell students why they need this space, because people have a natural tendency to swing ice tools once in hand.
- Ice climbers are always at risk of falling from ice. They should always wear a helmet when participating in any ice-climbing activity. Again, clear and well-established physical boundaries are a must.
- The ice tool leash should be used only when climbing. Prevent accidents by keeping tools facing the ice as much as possible.
- Place the belayer in a position that allows for some movement and protection from falling ice.
- When a climber is being lowered, be sure that the climber is in control and has the ice pick facing away from herself or himself.
- Anyone who instructs ice climbing should have a thorough knowledge of the physical environment and characteristics of ice, anchor systems, and vertical rescue techniques.

LESSON CONTENT

Introduction

This lesson identifies the parts and uses of an ice-climbing tool and how its design has evolved. The lesson also covers the characteristics, uses, and evolution of ice-climbing boots and crampons. The appropriate use of ice screws and tool leashes will be also be presented and discussed through several methods of instruction. Equipment maintenance is the final topic.

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Important Terms

crampons—Tempered steel shaped to fit the bottom of boots to provide traction in snow or ice terrain. The two most common designs are rigid (no flex) and hinged (flexible).

front points—The front one, two, or three points on modern crampons.

ice screws—Hollow, threaded, toothed alloy tubes of varying lengths used as protection and in anchor systems while climbing.

ice tools—Evolved out of a need to cover vertical ice. Traditional ice axes are too long; thus a shorter, more ergonomic tool was developed. Tools have six main parts: spike, grip, shaft, pick, adze, and leash.

ice tool leash—A piece of material attached to the tool midshaft that connects the tool to the climber by wrapping around the wrist.

Main Activities

Activity 1: Gear Introduction (15 Minutes)

When introducing equipment, you should have on hand examples of the items that you will be discussing. Although photos may be used, having each item of equipment creates a more meaningful learning experience.

Activity 2: Presentations (10 Minutes per Presentation)

Give groups of two or three students the responsibility for researching and then presenting a specific piece of equipment to their peers. Fill in areas when the presentations lack relevant information.

Each student presentation should include the following information for each item of equipment:

- History
- Purpose
- Design features
- Maintenance
- Cost
- Manufacturers
- Storage
- Environmental impact of production and possibly local options

Ice Tools Ice tools designed to climb vertical ice evolved from the traditional mountaineering ice axe. The ice axe was an instrument used to cut steps in steep (not vertical) ice before the creation of crampons.

- After crampon front points were created and vertical terrain was attempted, these long step-cutting axes became cumbersome.
- In response to a new role of facilitating the climbing of vertical ice, "axes" became "tools" and were designed to be short and ergonomically suited for use on vertical terrain. Tools range from 35 to 70 centimeters (about 14 to 28 inches) in length. The longer, more traditional tools are effective while mountaineering to cut steps, to use as a cane for balance, or to assist with belays. Shorter tools are used mainly for vertical ice because the shorter shaft is easier to swing.

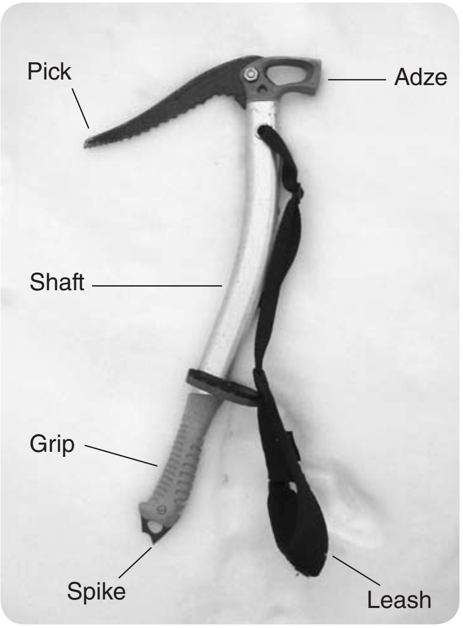

FIGURE IC2.1 Parts of an ice tool.

Tools have six parts: spike, grip, shaft, leash, pick, and adze (or hammer) (figure IC2.1).

- The spike is used for balance like a cane while approaching climbs or to assist in creating tool belays.
- The grip is where the climber holds the tool. The grip is an important feature for those with smaller hands because squeezing a large grip may be fatiguing. The grip on a traditional tool is in line with the shaft.
- The bend in the shaft of a tool serves multiple purposes: First, straight shafts cause a climber's knuckles to meet the ice far too often, resulting in sore or cut fingers. Second, when bent, the shaft allows a more ergonomic, free-swinging motion and produces much less damage to the climber's hands, especially the knuckles. Third, because of the clearance that the bent shaft provides, the climber can engage different types of terrain. Fourth, to meet the requirements of mixed climbing, gear manufacturers are developing tools to be used without leashes.
- A leashless tool (figure IC2.2) offers a distinct change of direction opposed to the shaft. A more progressive design allows the climber to employ more features on both rock and ice. Leashless tools offer two separate grips so that climbers can double grip one tool.
  - Climbers choosing to climb with leashless tools must understand "grip shift." Grip shift is the swing of the bottom half of the tool in response to gripping high on the tool. If a significant amount of swing is encountered, the tool should be reconsidered.
  - Climbers who are considering leashless tools should get out and climb with them in a variety of terrain.
- Picks are manufactured in three primary designs: straight, classic, and recurved (figure IC2.3). Classic pick designs are used more for the mountaineering axe and

FIGURE IC2.2 Leashless tool.

FIGURE IC2.3 Pick designs: *(a)* recurved and *(b)* classic.

seldom, if ever, used for vertical ice. For vertical ice, the recurved pick is the most common, because it allows good ice penetration and holding power.

- The final portion of the tool is the adze (or hammer), which, along with the pick, is attached to the shaft at the area called the head. The adze found on longer mountaineering axes was used to cut steps. The adze on a tool is still used to break away ice of poor quality or as a small shovel to sweep away crusty snow. The hammer is used for gear placement, but vertical ice climbers have rarely used it in the last decade. Mixed climbing (climbing done on routes that cover both rock and ice) has seen new and creative ways of using the adze and hammer, such as jamming in cracks to aid in upward progression on rock.

Picks can be sharpened as a maintenance measure or altered for better ice penetration. Altering the tool, however, may weaken the pick and will negate any warranty associated with it. Understanding how the pick is manufactured can be useful in the sharpening process. Three common parts of a pick can be sharpened (figure IC2.4).

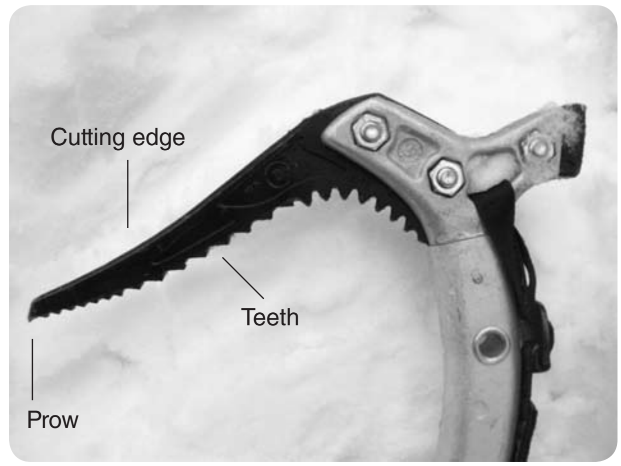

FIGURE IC2.4 Three parts of a pick can be sharpened.

- First is the cutting edge, or the top edge of the pick. The manufacturer's angles should be followed when sharpening this portion of the pick.
- Second, the front point of the pick, the prow, should be sharpened. Aggressive sharpening at this point will ensure good penetration but weaken the pick when rock is encountered.
- Third, the teeth on the pick can be sharpened. The teeth should be slightly beveled to ensure good holding performance when planted in ice. Most hanging or holding performance from a tool is on the front tooth of the pick. If a tool is difficult to extract from the ice, the front tooth has been sharpened too aggressively or the steps between the teeth are too deep.

To teach participants how to swing a tool, first give them an opportunity to try with little instruction. After students have had an opportunity to experiment, ask questions to obtain feedback. By doing so, students may bring your attention to a nuance of learning that you had not considered. After students have had a chance to experiment, break down the swing into the following parts:

- Properly position your hand on the grip.
- Be sure that the leash is an appropriate length (a full wrist snap should produce no pressure from the leash).
- Bring your hand back to your ear (tool shaft parallel to the shoulder blade).
- Keep your elbow in front of your body.
- Visually find the target.
- Swing the tool at the desired target and snap the wrist just before the pick makes contact with the ice.

A variety of manufacturers produce ice tools, ranging in price from $130 to $270. Tools should be stored in a dry place because the metal will rust and weaken if stored improperly. An additional storage strategy is to wipe down the picks with a lubricant such as WD-40.

FIGURE IC2.5 Crampons.

Crampons Before ice-climbing tools took on shorter and bent shafts, mountaineers placed crampons on their feet. Crampons are metal spikes that cut into and grip the ice to prevent falling (figure IC2.5). As an early mountaineering tool, crampons were simple but effective for covering a variety of terrain.

- Crampons are manufactured for both mountaineering and vertical ice climbing.
- Crampons come in a variety of shapes and sizes.
- The two main design features are the orientation of the front points and the distinction between rigid and hinged crampons.
  - Historically, rigid crampons were popular because they offered a stable platform for climbers to stand on. As boot design developed, so did the crampon. As a result, two-piece and hinged crampons became the favorite and are the common choice today.
  - Rigid crampons are still used, however, and are most common on rigid plastic boots.
- The front points of crampons may be configured in a variety of ways. Mono, dual, and three-pointed crampons can be seen at most crags today.
- Mono points offer an advantage when ice is thin or brittle, whereas dual points provide the beginner climber a more stable base to work from as opposed to a wobbly single point of contact.
- Three-pointed crampons have dropped out of favor in the last five to seven years. Having three points on crampons forces the climber to surrender sensitivity and often leads to overkicking in an effort to set the shorter points (the middle point is typically longer than the other two).
- Highlight the orientation of the front points. Mountaineering points are oriented parallel to the ground, whereas points for vertical ice climbing are oriented perpendicular to the ground.

Ice Screws Ice screws (figure IC2.6) have been in use since the mid-1960s and were used to test vertical terrain in the 1970s. Because of the development of reliable ice screws and other technologies, ice climbing has seen tremendous growth in the last 40 years.

- Ice screws currently range in length from 10 to 22 centimeters (4 to 9 inches) and are approximately 8 to 10 millimeters in diameter.
- Made from alloys, screws are useful tools for climbers.
- The two purposes for screws are for leading protection and setting anchors. Ice screws require specific features to be effective.
- Placing an ice screw improperly or attempting to use poor ice is worse than not placing a screw at all.
- Placing a screw takes time and energy, two things that a good ice climber conserves.
- A poorly placed screw may instill a false sense of security, take precious time, and will likely fail in the event of a fall.

- Placing an ice screw is an art and begins with the feet.
- Without a stable platform to push against, placing the screw will take extra time and considerably more effort.

  Break down ice screw placement into the following steps:

- After establishing a base, hold the screw like a gun (the hanger is at the base of your palm).
- Begin by putting the cutting edge of the screw on the ice at waist level and rotating your wrist back and forth cutting a groove in the ice.
- After a groove is cut, push in firmly while turning the screw to the right. Slowly, release your hand and quickly regrip the screw, continuing this motion.
- After the screw has bitten the ice, proceed until it is set properly in the ice.

The angle in which the screw is placed is important.

- Testing has shown that an upward angle of approximately 15 degrees is optimal in good ice (figure IC2.7).
- The strength of an ice screw is not in the tube but in the threads cut into the sides of the tube.
- Placing screws at a downward angle causes the climber to rely on the lateral strength of the screw, which is much less effective at holding a fall than are the threads.
- In some circumstances a straight or downward-angle placement must be used.
- If the ice becomes soft or slushy because of a change in weather, the strength of the threads cannot be trusted. Instead, and not ideally, the lateral strength of the tube must be relied on, and a downward angle may be the best option.

FIGURE IC2.6 Ice screws.

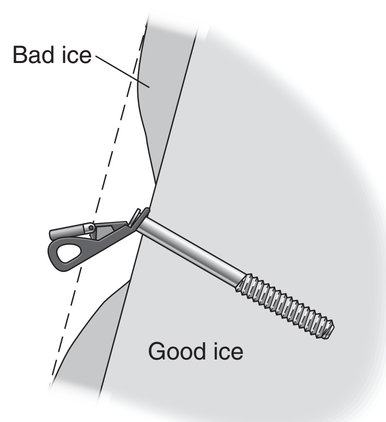

FIGURE IC2.7 Ice screw placement.

How strong are ice screws?

- The two most documented ice screw studies are the Harmston and Black Diamond study (1998) and the Luebben (1997) study.
- These studies showed that a properly placed ice screw should hold approximately 8,000 pounds (3,600 kilograms) of force. The word *should* is used in a literal sense.
- Ice is a changing medium, and leading on ice is an activity that must follow years of experience on a top rope.

Closure Activities

Allow students to manipulate gear so that they can learn how to handle and maintain it.

Activity 1: Picks and Crampons (20 Minutes)

Initiate this activity by demonstrating how to sharpen picks and crampons.

- Give students the opportunity to use a file on the picks in a controlled setting. Inquire about how filing the picks into certain shapes would help or hinder climbing specific routes.
- At this point, inquiry learning may be an appropriate teaching method.
- Ask students what each surface of the pick and crampons is designed to do.

Activity 2: Ice Screws (15 Minutes)

Only expert climbers or the manufacturer should sharpen ice screws. Each tooth of an ice screw has three or four surfaces. Given the small surface area on the teeth of screws, it would be easy to oversharpen one surface, rendering the screw in a less-than-optimal condition.

- Give each student an ice screw and ask students to find placements from the ground.
- After each student has placed a screw, take the class to a selected few to evaluate the placement.
- At this point introduce the ice features that they should be looking for to achieve good placement.
- Emphasize that solid ice is ideal, that concave surfaces hold better than convex (bulging) surfaces, that a downward angle is stronger, and that proximity to other screws is important in the event of ice fracture.

Follow-Up Activity

Student-Designed Evaluations (20 to 30 Minutes)

- Ask students to create two quiz questions to share with the class.
- Assign specific pieces of gear to each student to ensure that all the gear introduced in this lesson is covered.
- After each student has the opportunity to share quiz questions, review the quiz as a group to ensure that students understand all information.

From M. Wagstaff and A. Attarian, 2009, *Technical skills for adventure programming: A curriculum guide* (Champaign, IL: Human Kinetics).

- Be sure that all students have had an opportunity to interact with the gear in the field. Simple quizzing will not be enough to reach a real understanding. During this field time, you should be in a position to provide clear and immediate feedback.

ASSESSMENT

- Verify that students can identify and describe the parts of ice tools, crampons, and ice screws by observing their presentations in the main activity.
- Check that students can conduct the appropriate maintenance on ice tools, crampons, and ice screws by supervising and observing each student sharpen an ice axe pick and crampon during the follow-up activity.
- Confirm that students value the importance of proper equipment maintenance by having them climb first with poorly maintained equipment and then with well-maintained equipment on ice they can reach from the ground. Ask them to compare their performance with the two sets of equipment.

TEACHING CONSIDERATIONS

- You can present this lesson in two parts if the meeting time does not extend for an entire day.
- This lesson requires that students be prepared to be outside to access nearly vertical ice. Further, much of the gear being handled is sharp and dangerous.
- Students may need something to write on that the rest of the class can see. A portable whiteboard may be useful.
- You should be cognizant of the temperature and local weather to help ensure the safety of the group.
- You should also be wary of icefall at all times. Select a site where you can set clear boundaries and be able to stop or shift the activity quickly should it become necessary to do so.

UNIT 12, LESSON 3

Preparing to Climb

OVERVIEW

Ice climbing requires participants to be well prepared for a day of strenuous physical activity in cold weather. Their physical comfort relates directly to wearing proper clothing and being physically prepared. This lesson provides a set of principles that you can apply to the participant group with whom you are working.

JUSTIFICATION

Knowledge and application of the proper dress for ice-climbing activity are essential to participants' comfort and enjoyment. Physical preparedness is equally important, because ice climbing is generally a more strenuous activity than other forms of climbing.

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GOAL

To develop the students' knowledge of appropriate dress for participation in ice climbing and awareness of the principles that will aid in physical preparedness.

OBJECTIVES

At the end of this lesson, students will be able to

- identify the key components of being properly dressed for ice climbing (cognitive),
- identify the key components of physical preparedness associated with ice climbing (cognitive), and
- appreciate the contribution of thorough preparation to the overall enjoyment of ice climbing (affective).

EQUIPMENT AND AREAS NEEDED

Materials and supplies for this lesson include a full complement of clothing typically used in ice-climbing activity:

- Long underwear (tops and bottoms—lightweight to expedition weight)
- Liner socks
- Heavyweight insulated socks
- Soft-shell fabric (Scholler type) pant
- Soft-shell fabric zip jacket
- Fleece jacket
- Insulated jacket (down or synthetic)
- Gore-Tex (or similar) wind or rain pants or bibs
- Insulated gloves and mittens
- Gore-Tex shell jacket with a hood large enough to fit over a helmet
- Ski hat and balaclava
- Gaiters

RISK MANAGEMENT CONSIDERATIONS

- Students who are not outfitted with proper clothing run the risk of contracting a range of cold-related signs and symptoms, including mild hypothermia and frostbite.
- Participants who are constantly fighting against the cold will not be able to maintain focus on the essential elements of ice climbing, which are directly related to personal safety.

LESSON CONTENT

Introduction

It is not mandatory for ice climbers to experience being cold during the actual activity. Emphasize this point to students so that they arrive on the day of their first ice-climbing trip with the proper clothing.

- The range of temperatures and weather-related phenomena can vary dramatically from day to day.
- Temperatures that hover around the freezing mark are often the most difficult to dress for because students need to wear enough layers to ward off the cold but not so many layers that they overheat (and dampen underclothing) while climbing.
- Besides employing appropriate clothing items and layering, a key element to warding off cold is to strike a balance concerning nutrition, hydration, and pacing.

Equipment Preparedness

Offer these tips about staying warm:

- Wear fabrics that stay warm when wet. No cotton!
- Stay as dry as possible by applying appropriate layering principles.
- Be attentive to yourself. If you are getting cold, add an additional layer and stay active.
- Snack often on foods that are high in quick-burning carbohydrates.
- Stay hydrated; pack hot drinks such as tea in a thermos.
- Carry a minimum of two pairs of hand wear (insulated gloves and mittens). Some ice climbers carry more than two pairs, knowing that hand wear can become wet from constant contact with snow and ice.

Physical Preparedness

- Start the ice-climbing day with a few warm-up activities to allow students to ease into the physical demands of the activity and minimize any overstretching or straining of muscle groups.
- Most ice-climbing sites require a short approach (some are longer) that may afford students an opportunity to warm the core and extremities.
- Encourage students to engage in stretching activities on days when they are not climbing to enhance flexibility and range of motion.
- Daily stretching activities should take place for a minimum of 10 minutes. Taking a few minutes to engage in gentle stretching after reaching the climbing site will help muscle groups warm up through increased blood flow.
- Refer to the figures to develop a series of stretches:
  - Shoulders and upper back (figure IC3.1)
  - Arms and upper torso (figure IC3.2)
  - Knee to chest (figure IC3.3)
  - Calf (figure IC3.4)

Main Activities

Activity 1: Warming Up (10 to 15 Minutes)

Engage students in a demonstration and practice of the stretching exercises illustrated in the figures.

Activity 2: Trip Planning (20 Minutes)

Have students work together to generate an equipment and clothing list relevant to all participants and the weather that they are likely to encounter.

From M. Wagstaff and A. Attarian, 2009, *Technical skills for adventure programming: A curriculum guide* (Champaign, IL: Human Kinetics).

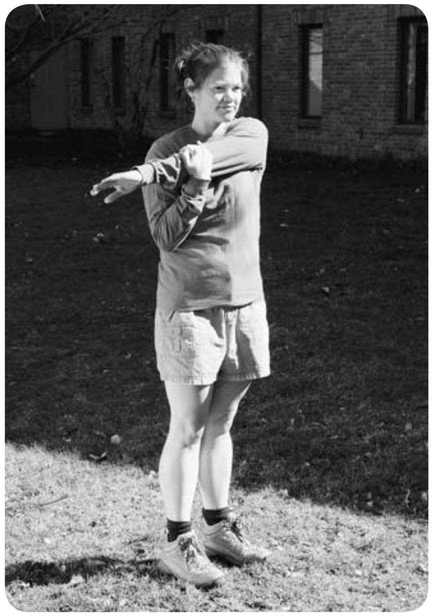

FIGURE IC3.1 Shoulders and upper-back stretch.

FIGURE IC3.2 Arms and upper-torso stretch.

FIGURE IC3.3 Knee-to-chest stretch.

FIGURE IC3.4 Calf stretch.

Closure Activity

Clothing and Equipment Shakedown (30 Minutes)

Conduct an equipment and clothing check of all students before advancing to ice-climbing activities in the field. You need to ensure that students have the appropriate type and amount of clothing layers.

Follow-Up Activity

Group Stretch (10 to 15 Minutes)

- Lead the group in a stretching session or ask a student to lead. Ask individual students to share a favorite stretching or warm-up exercise.

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- Encourage students to keep an exercise and climbing journal throughout the unit. They should record any training activity and ice-climbing outings in which they participate.

ASSESSMENT

- Check that students can identify the key components of being properly dressed for ice-climbing activity by asking them to generate a list of the clothing items necessary for a comfortable ice-climbing outing.
- Confirm that students can identify the key components of physical preparedness associated with ice climbing by asking them to demonstrate a favorite stretching exercise during the follow-up activity.
- Verify that students appreciate the contribution of thorough preparation to their enjoyment of ice climbing by asking them whether they will experience success during ice-climbing outings and then observing their response.

TEACHING CONSIDERATIONS

- You can provide a show-and-tell presentation of clothing items typically used in ice-climbing activities. This activity will provide a literal hands-on teachable moment for all students to see what they need before going into the field.
- A review of the stretching activities listed earlier with full class participation will help students adopt this activity as a regular practice.
- Consider assigning a couple of students to lead the class in stretching activities before each field day session.
- Always carry extra articles of clothing in your pack, including hats, gloves, and socks, to share with students who may be inadequately prepared.

UNIT 12, LESSON 4

▷ The Anatomy of Ice

OVERVIEW

"Ice can be formed directly from water freezing, or indirectly through the continuing metamorphosis of neve, whereby the snowpack becomes more dense. The medium is called ice when its mass becomes airtight."

Chouinard, 1978

An understanding of how ice is formed and what forces cause it to change is critical to safe and enjoyable ice climbing. This lesson teaches students how to assess ice conditions utilizing color, weather, and shape.

JUSTIFICATION

The inherent danger of ice climbing makes reading ice conditions a critical skill for climbers. The ability to read and assess ice conditions accurately will enable students to develop confidence and independence regarding route choices.

From M. Wagstaff and A. Attarian, 2009, *Technical skills for adventure programming: A curriculum guide* (Champaign, IL: Human Kinetics).

GOAL

To develop participants' ability to read and assess ice conditions independently and accurately.

OBJECTIVES

At the end of this lesson, students will be able to

- understand how ice is formed (cognitive);
- recognize the characteristics associated with colors of ice (cognitive);
- understand how changing weather influences ice conditions (cognitive);
- use the shape of the ice as a determining factor regarding tool, crampon, and protection placement (cognitive);
- use equipment properly given the characteristics of the ice (psychomotor); and
- confidently assess ice characteristics on their own when climbing (affective).

EQUIPMENT AND AREAS NEEDED

- As many different types of ice as possible or photos of many different types of ice
- Ice tools, screws, crampons, harnesses, and helmets
- A site that can comfortably accommodate the number of participants in your group (ideally all will have access to ice at ground level)

RISK MANAGEMENT CONSIDERATIONS

- Sufficient space must be available for each participant to swing tools.
- Crampon placement should be done only on a tight belay that will compensate for rope stretch. Landing on uneven terrain can be challenging and possibly unsafe for climbers new to wearing crampons.
- Take time throughout this lesson to set clear boundaries for students. With boundaries, you can pause the action quickly and position yourself where you can provide immediate feedback.
- Do not use spotting as a safety precaution if students are stepping up on crampons, even just 1 or 2 feet (30 to 60 centimeters) off the ground. Tools may flail around or an awkward fall may lead to a spotter being kicked with crampons.
- The pick will displace ice on impact. Eye protection is recommended.

LESSON CONTENT

Introduction

Ice conditions influence the use of tools, crampons, and ice screws. By learning how to read the changing medium of ice, students will be able to use each of these pieces of gear appropriately and safely.

Main Activities

You will need to support this portion of the lesson with photos because no site will have all forms of ice covered here.

From M. Wagstaff and A. Attarian, 2009, *Technical skills for adventure programming: A curriculum guide* (Champaign, IL: Human Kinetics).

Important Terms

blue ice—Solid, stable, and often hard ice.

bulge—A convex piece of ice.

cauliflower ice—Resembling the vegetable cauliflower, this ice often forms near the bottom of ice climbs and is the result of water splashing and freezing. More often than not, it is stable and strong ice, good for hooking or absorbing a good swing (figure IC4.1).

chandelier ice—Multiple icicles in close proximity to one another typically offer unstable climbing until their diameters are large enough to hold the weight of a climber. This type of ice is often found early in the season (figure IC4.2).

verglas—Smooth, rock-hard sheets of thin ice, often found in midseason.

white ice—As in whitewater, the white appearance indicates the presence of air. White ice should be climbed with caution because aerated ice is weak. White ice is most frequently seen in the early and late parts of the season.

yellow ice—The yellow color indicates that the flow of water is transporting minerals. Yellow ice should not be a deterrent to climbing, but it indicates recent flow, which usually comes with warmer temperatures. Climbers should be careful.

FIGURE IC4.1 Cauliflower ice forms at the base of ice climbs.

FIGURE IC4.2 Chandelier ice is made up of icicles in close proximity to one another.

Activity 1: Identifying Ice Features (45 Minutes)

Ice features help determine what techniques a climber needs to use. The combination of understanding ice features and being able to execute climbing techniques is what enables a climber to be successful.

- Have small groups of students provide a topographical assessment of a portion of ice, approximately 6 feet across and 7 feet high (1.8 meters across and 2 meters high). Next, have them analyze what portions of the ice will be able to absorb a tool placement. Allow them time to read the ice under controlled conditions.

- Provide each student with enough space and protective equipment to test assumptions about the ice features by swinging a tool at the ice.
- Students can offer an assessment of successful placement features. You can provide reasons why some placements were successful and others were not.
- Moving effectively on ice is often a matter of employing the proper technique in changing situations. The way that the ice reacts and your clear and immediate feedback will help students learn about varying ice conditions.
- To ensure an understanding of ice features, have students provide an explanation of what technique to use for each ice feature.
- Encourage students to explore different features found in the ice. For example, they can swing a pick at a bulge, or convex section, of ice. Then they can swing at a concave section and note the different outcomes.
- Have them repeat this experiment with chandelier, cauliflower, and different colors of ice.

Activity 2: Ice Formation (30 Minutes)

The mechanics of ice formation should be an ongoing lesson for participants. Early, midseason, and late-season ice all have distinct characteristics that climbers should understand.

When teaching about ice formation, use whatever conditions you have as a baseline. For example, if a group of climbers were to arrive in Vermont in mid-December, the teaching topic would be the characteristics of early season ice.

Early Season Ice

- Early season ice should be approached with extreme caution.
- Early season ice is often at the mercy of fluctuating temperatures.
- Early season ice is often aerated (white in color), full of chandeliers, and typically not well bonded to the rock.
- Good ice forms slowly from low volumes of water in mildly cold temperatures of 10 to 30 degrees Fahrenheit (–12 to –1 degree Celsius).
- Keeping safety as a priority over excitement for the upcoming season is tough, but express this warning to participants often.

Midseason Ice

- Midseason ice can easily be recognized by lateral ice growth.
- After ice forms in relatively warm weather, the flow is forced in new directions to create a climb that becomes well bonded and has more width.
- Often, midseason ice is still growing, leaving large holes in the middle of some routes. These holes are an excellent place to investigate the bond to the rock.
- Routes that are not forming completely typically result from climbers being on the route too soon and breaking off ice or from heavy water flow that causes melting or creates fragile chandelier ice.
- Midseason ice is more of a result of consistent temperatures than it is of ice features.

- In most regions of the country, temperatures below 30 degrees Fahrenheit (–1 degree Celsius) for an extended period ensure a strong bond between ice and rock.
- Midseason fluctuations in ice temperature regularly bring changing color to the ice. Yellow ice is an indication of recent flow. This new water flow carries with it mineral deposits from the soil that have been frozen.
- Cold temperatures also bring new colors. Blue ice is typically solid and well bonded to the rock, indicating that the temperature has been relatively stable and that new ice is not highly aerated.

Late-Season Ice

- Late-season ice holds many opportunities. Typically, temperatures are warming up, which leaves ice relatively soft and often stable.
- Many routes that were extremely difficult during the middle of the season will take picks and screws more easily, offering climbers a chance to test the skills that they have acquired throughout the season in a more forgiving environment.
- But the warmer temperatures and good climbing are not a secret. Climbers often appear in larger numbers during this time of year, so walking or standing near the base of a route is a more risky endeavor because of falling ice or gear. Climbers should have fun but be careful.

Closure Activity

The Perfect Model (10 Minutes or Longer)

After identifying a volunteer to climb, critique the volunteer's choice of route, features used, and technique.

- A discussion of ice features can follow. Be sure to answer students' questions.
- During the discussion, you should ask participants about specific ice features, colors, and weather conditions.
- Encourage students to climb a route without swinging. A no-swing climb slows the beginner climber just enough to break the pattern of looking only straight up.

Follow-Up Activity

Peer Evaluation (Time as Needed)

- Give each participant an opportunity to critique the climb of a peer. The critique should include an assessment of the route selected, features used, and how efficiently the climber moved.
- Have students participate in the single-swing test.
  - The single-swing test was developed to illustrate the mind-set required for each swing of the tool while climbing.
  - Give each student a tool and instruct the students to examine the ice for the best feature for a tool placement.
  - Each participant is allowed only one swing at the ice.
  - Assess how well each student placed the tool. After you evaluate each participant's placement, explain that climbers should use a similar focus for every swing while keeping in mind that good ice climbers keep moving.

From M. Wagstaff and A. Attarian, 2009, *Technical skills for adventure programming: A curriculum guide* (Champaign, IL: Human Kinetics).

- Have students keep an ice-conditions diary throughout the unit.
  - They should include data for ice climbs done in class and on their own.
  - The record should include date, location, ice climbs climbed or attempted, air temperature, weather and ice conditions, and color as the season progresses.
  - At the end of the ice season, they should draw some conclusions based on an analysis of the data. For example, was this a good ice season? A bad ice season? Why?

ASSESSMENT

- Check that students understand how ice is formed by asking them questions about the development of ice during their topographical assessment.
- Confirm that students recognize the characteristics associated with colors of ice by asking them to describe these through a short written quiz.
- Verify that students understand how changing weather influences ice conditions by looking at their analyses of the data generated from their ice conditions diaries.
- Check that students can use the shape of the ice as a determining factor regarding tool, crampon, and protection placement by observing them practice placements during the follow-up activity.
- Confirm that students can use equipment properly given the characteristics of the ice by observing them use equipment during the follow-up activity.
- Check that students can assess ice characteristics on their own when climbing by looking at the information generated from their ice conditions diaries.

TEACHING CONSIDERATIONS

- Make an effort to visit ice-climbing sites during early, mid-, and late season to allow your students to see how ice is formed and to familiarize them with the sites. Visit these same sites after warm spells, rain, heavy snow, or a hard freeze to examine how these factors affect the formation of ice.
- In some cases, some of this assessment can be done from a roadside with a good pair of binoculars.
- When doing site visits, be wary of icefall. Select an area where you can set clear boundaries and be able to stop or modify the activity quickly should it become necessary to do so.
- Remember to have the appropriate safety equipment with you when making these site visits.

UNIT 12, LESSON 5

▷ Low-Angled and Vertical Ice-Climbing Techniques

OVERVIEW

Most beginning ice-climbing students are capable of moving from low-angled ice to more vertical ice in a relatively short period. The key to coaching students through this transition is to focus instruction and student practice on the use of a few critical

From M. Wagstaff and A. Attarian, 2009, *Technical skills for adventure programming: A curriculum guide* (Champaign, IL: Human Kinetics).

skills that will allow them to attempt more difficult and challenging climbs with each outing. This lesson provides an overview of those key elements.

JUSTIFICATION

Students must learn the essential elements of low-angled and vertical ice climbing techniques. The use of proper technique will make the activity more enjoyable for the participant and enhance personal safety.

GOAL

To introduce students to techniques associated with low-angled and vertical ice-climbing techniques.

OBJECTIVES

At the end of this lesson, students will be able to

- identify and apply principles associated with the swing (planting the ice axe) (cognitive),
- identify and apply principles associated with the kick (planting front points) (cognitive),
- identify the principles associated with upward movement (cognitive),
- demonstrate the correct planting of the ice axe (psychomotor), and
- demonstrate the proper use of crampons (psychomotor).

EQUIPMENT AND AREAS NEEDED

- Ice axes
- Crampons
- Harness
- Helmet
- Climbing rope

RISK MANAGEMENT CONSIDERATIONS

- Students attempting to climb steep ice terrain are more likely to become fatigued than they were when working on low-angled ice slopes.
- Although students may expect to become fatigued higher up on a climb, failing to use good technique can cause falls low to the ground. As such, tight belays must be maintained throughout the climb to minimize fall potential.
- Catching a crampon point during a fall, even while on top rope, can result in anything from a sprained or broken ankle to a soft-tissue injury.
- Joint injuries are more likely to occur during vertical ice-climbing practice, particularly when a student's crampons sheer out from the ice, leaving a fatigued student hanging from the wrist loops.
- You should be familiar with techniques to provide the climber with a short-haul assist that will relieve pressure in those situations.
- Ice falling from above can be a hazard for belayers and other climbers, so you must employ appropriate climbing site management techniques.
- Dropped tools, as well as crampons becoming undone, can also be an issue.
- Students moving from using flat-footed techniques on low-angled ice to using front-pointing methods on vertical ice will find themselves pressed closer to the ice surface with the arms positioned overhead, all leading to increased fatigue.

LESSON CONTENT

Introduction

The heart of this lesson is instruction in the art of foot placement with crampons and tool placements as the ice terrain increases in steepness.

Main Activities

Activity 1: Foot Placements (10 to 15 Minutes)

- Remind students to keep their heels low to the point that the bottom of the boot surface is perpendicular to the slope of the ice. This position allows maximum penetration of the front points into the ice surface.
- Repeated kicks into the ice rarely improve crampon security.
- When encountering places to rest, students should stand on the right foot with the leg extended and arms hanging straight. The left foot is used to stabilize the diagonal.

Activity 2: Tool Placements (10 Minutes or Longer)

- Emphasize to students that they should maximize pick penetration and minimize the number of swings to produce solid ice tool placement.
- Point out that swinging with the whole arm will generate greater force and ensure solid ice placement on the first (ideally) or second swing.
- Point out that tool placements should be tested, meaning that students should weight the tool by pulling downward to ensure that the pick is stable in the ice before moving upward.
- Students can practice ice tool placements on the ground along the bottom of a vertical ice section.
- Most students will be challenged with using two tools, one in the dominant hand, and one in the nondominant hand.
- Students should understand the importance of not driving the pick of the ice axe too far into the ice. If they do this, pick removal can become difficult and add to fatigue, especially if the student is poised on the ice in a position that does not allow sufficient rest.

Closure Activity

Ice Bouldering (Time as Needed)

- Finish the lesson by having students engage in ice bouldering.
- Emphasize good axe technique and footwork.
- Encourage peer-to-peer critique of climbing techniques.

Follow-Up Activity

Practice What You Preach (Time as Needed)

Following your demonstration of vertical climbing techniques and practice by students (swinging the ice axe and ice bouldering), have students engage in a series of ice climbs. They should strive to use proper footwork and ice axe placements over the length of an entire ice climb.

ASSESSMENT

- Verify that students can identify and apply principles associated with the swing by asking them to review this skill orally with one another.
- Confirm that students can identify and apply principles associated with the kick by asking them to review this skill orally with one another.
- Check that students can identify the principles associated with upward movement by asking them to critique one another during the ice-bouldering activity.
- Verify that students can demonstrate correct planting of the ice axe by observing them during the ice-bouldering activity.
- Confirm that students can demonstrate the proper use of crampons by observing them during the ice-bouldering activity.

TEACHING CONSIDERATIONS

- Students can practice individual swing technique on vertical ice sections at the base of the ice-climbing site using both the dominant and nondominant arms without having to leave the ground.
- This procedure allows you to provide suggestions to students in an efficient manner.
- This activity can double as a good warm-up session for students before they advance into a roped climbing situation.
- Teaching proper crampon placements can be more challenging. Instructor demonstration is important. Placing students in a location where they can see the effect of proper foot position will help emphasize the importance of keeping the heels low in vertical climbing situations.
- Students will need individual coaching on crampon placement.

UNIT 12, LESSON 6

Anchors for Ice Climbing

OVERVIEW

This lesson incorporates anchor demonstrations, anchor building, and anchor assessment techniques. Students have opportunities to rehearse setting anchors in a controlled setting.

JUSTIFICATION

Understanding how to construct an effective and safe anchor is a foundational skill for continued involvement in ice climbing. Practicing this critical skill promotes climbing independence and increases awareness of climbing systems among new climbers.

GOAL

To develop an ability to set top-rope, belay, and lead-climbing ice-climbing anchors.

From M. Wagstaff and A. Attarian, 2009, *Technical skills for adventure programming: A curriculum guide* (Champaign, IL: Human Kinetics).

OBJECTIVES

At the end of this lesson, students will be able to

- understand how to use natural and artificial protection for anchors (cognitive),
- demonstrate the appropriate edge behavior when setting anchors (psychomotor),
- demonstrate the use of natural and artificial protection for anchors (psychomotor),
- develop independence through learning how to build anchors on their own (affective),
- conduct a site assessment to determine what type of anchor system is most effective (cognitive), and
- perform an accurate assessment of a site and the resources therein (cognitive).

EQUIPMENT AND AREAS NEEDED

- Two cordelettes approximately 20 feet (6 meters) long for every two participants
- One static line approximately 100 feet (30 meters) long for every two participants
- Six ice screws, each no less than 12 centimeters (5 inches), for every two participants
- Four Prusik cords for every two participants
- Six locking carabiners per participant

RISK MANAGEMENT CONSIDERATIONS

- Manage the base (or staging area) of an ice climb by making sure that participants have adequate room for gearing up and are protected from icefall. Pay close attention for the signs and symptoms of hypothermia and dehydration.
- Maintain attention to weather patterns and temperature throughout the day.
- At the top of climbs, select a site that can safely accommodate the size of the group. People should be able to move around some, and the site should allow you to maintain clear and consistent edge protection.
- Do not attempt to bring a large number of people to the top of any climb, a circumstance that often leads to inadequate demonstrations and ineffective communication. Recall that the goal is to provide students with anchor information.
- Depending on the type of anchor being constructed, setting an anchor may include using artificial protection on the vertical face of a climb in the event that natural protection is not present near the top of the route. In this event, you must use a backup belay until participants demonstrate the ability to self-protect adequately over the edge while setting anchors.

LESSON CONTENT

Introduction

This lesson focuses on how to employ materials used to set anchors. Additionally, site assessment and decision making regarding systems and edge behavior will be developed.

Important Terms

cordelette—Cord of smaller diameter and 15 to 20 feet (4.5 to 6 meters) in length used for constructing anchors.

dynamic rope—Rope manufactured to stretch when force is applied.

edge culture—How people conduct themselves on a cliff edge.

fall factor—Formula used to determine the energy put on a system in the event of a fall.

kilonewton—1,000 newtons, or 224.8 pounds of force.

master point—The point at which the anchor is equalized and meets the carabiners holding the rope.

pounds of force—The climber's weight multiplied by the length of rope (in feet) extended beyond the last piece of protection.

screamer—An extending and shock-absorbing piece used to connect the rope to protection with two carabiners.

static rope—Rope that has little stretch, less than 3 percent.

Main Activity

Anchor Building (Two Hours or More)

The first portion of the lesson should be viewed from an outdoor skills perspective. To build students' outdoor skills, you should balance directive and experiential methods. In doing so, maintain challenge and encourage students to self-assess their abilities regarding anchor building. An effective lesson will ensure that students establish good anchor-building techniques and accurate self-assessment.

Technical Functions First, break down the skill into its basic technical functions. Build on knowledge slowly while coaching anchor building. Set up the lesson for easy and early success. Be sure to empower your students. A good way to do this is to be in a physical position where you can provide immediate feedback. Anchor building is a competence and confidence builder among new climbers.

To get started, students should master knots and hitches. See unit 2, lesson 3, on knots and their applications.

Anchor Physics After students master knots and hitches, you can address the physics surrounding anchors. Strong anchors are derived from three primary factors: materials, type of protection used, and the system chosen.

- Apply the ERNEST principle (equalized, redundant, non-extending, solid/simple, timely) for building anchors. This anchor-building concept is discussed in detail in unit 2, lesson 7.
  - Being timely with anchor construction in an ice-climbing environment is important in maintaining student comfort, but it should never exceed the goal of safety.
  - Taking a half hour to set an anchor during the winter typically means that a cold group will be standing or wandering around at the base of a route waiting to climb.

From M. Wagstaff and A. Attarian, 2009, *Technical skills for adventure programming: A curriculum guide* (Champaign, IL: Human Kinetics).

- As in rock climbing, natural anchors use the natural environment for protection. Artificial anchors for ice climbing incorporate ice screws. If placed properly, ice screws offer ease, safety, and multiple options for ice-climbing anchors.
- Begin anchor coaching at ground level ("ground school"). Use a progression that allows participants to employ previous knowledge while balancing directive and experiential challenges.
- What follows is a progression designed to use natural anchors as a first means of protection, followed by a combination of natural and artificial protection. Finally, lacking natural protection, artificial protection will be used.

Natural Protection Find a large "bomber" tree, 12 inches (30 centimeters) or larger in diameter, and appropriately close to the edge. Use a cordelette with a wrap and figure-eight. This and other natural anchors are discussed in detail in unit 2, lesson 6 (see figure RC6.1 on page 189).

Combination of Natural and Artificial Protection Using two types of protection is often necessary for ice climbing. Typically, a tree or boulder will be used with the assistance of one or more ice screws. ERNEST principles still apply.

Artificial Protection Ice screws are fast, light, and strong pieces to use for anchors. But as with other pieces of equipment introduced in this unit, there is a right and a wrong way to use them.

Although studies have shown that a well-placed screw can hold more than 8,000 pounds (3,600 kilograms) of force (Leubben, 1999), this figure should not be taken at face value. Testing of ice-climbing equipment is done by professionals in controlled research conditions. The typical ice climber is far better served using knowledge gained through experience than the results of a piece of research.

What makes a well-placed screw?

- First, what is the ice quality? Like the pick of a tool placed into ice, screws require ice that is hard, well bonded to the rock, deep, concave, and able to accommodate the correct angle for the placement.
- The strength of an ice screw comes from the threads on the tube, not the tube itself (although certain types of ice may rely on the tube for strength).
- The lateral strength of a screw should rarely be relied on. Instead, as the studies suggest, the screw should be placed at an upward angle somewhere between 15 and 5 degrees, with the hanger down.
- Note several things in figure IC6.1. First, none of the screws are placed on the same horizontal or vertical plane. This arrangement is used so that an ice fracture will not affect all screws. Ice often fractures either vertically or in a slight frowning fashion laterally.
- The saying "70, 20" means that the top screw is at least 70 centimeters (28 inches) above the lowest screw and that the bottom screws are no closer than 20 centimeters (8 inches) and not on the same plane (figure IC6.2).

Closure Activity

Site Assessment (Time as Needed)

- If time and pace allows, divide students into groups of three.
- Have students conduct a site assessment to determine the appropriate anchor to use.

From M. Wagstaff and A. Attarian, 2009, *Technical skills for adventure programming: A curriculum guide* (Champaign, IL: Human Kinetics).

FIGURE IC6.1 Pre-equalized ice screw anchor.

FIGURE IC6.2 Typical ice screw formation for an artificial anchor.

- Each group sets up a top-rope climb while maintaining edge protection. After you check each anchor, ask each group to set up an additional anchor at the same location.
- Be sure to place yourself in a position where you can stop the activity at a moment's notice if the site becomes unsafe.

Follow-Up Activity

Building Anchors (Time as Needed)

Building simple and effective anchors is an art that takes practice and must be done in a variety of settings.

- After you have taught the basics of anchor building and are sure that students understand proper edge behavior, make students responsible for setting all the anchors (checked by you).
- After students have more practice, you can offer additional information about topics such as multidirectional anchor points and vertical anchors (those that are over the edge of an ice climb).
- As climbing continues, students will be exposed to different kinds of anchor-building situations.
- Use each new situation as an opportunity to expand knowledge, including mixing natural and artificial protection, using static line or cordelette, and protecting the person building the anchor.

From M. Wagstaff and A. Attarian, 2009, *Technical skills for adventure programming: A curriculum guide* (Champaign, IL: Human Kinetics).

ASSESSMENT

- Confirm that students can demonstrate the use of natural and artificial protection for anchors by observing them construct both types of anchors.
- Check that students demonstrate appropriate edge behavior when setting anchors by observing them practice this behavior while constructing anchors at the top of each climb.
- Verify that students develop independence in building anchors on their own by encouraging them to keep a climbing log for each climbing site visited and noting the types of anchors employed.
- Confirm that students understand how and when to employ the appropriate knots for building anchors by conducting a site assessment during the closure activity.
- Confirm that students can conduct a site assessment by observing them as they perform one and then by asking them a series of questions about the criteria that they used to identify the appropriate anchors.

TEACHING CONSIDERATIONS

- Conduct reconnaissance on all sites to be used for teaching before the time of instruction.
- You should be in a physical position to stop the activity at a moment's notice to ensure safety of students at all times.
- You should be in a physical position to provide clear and immediate feedback to students.
- Use concepts that are inherent to the activity while using practical teaching progressions.
- Balance directive and experiential teaching methods to accommodate all learning styles.
- Include techniques that allow students to self-assess skills critically in an emotionally safe environment.

UNIT 12, LESSON 7

▷ Safety Considerations

OVERVIEW

Safety is a common thread that instructors must emphasize across every lesson associated with ice climbing. The medium in which the activity takes place demands it. The consequences of not maintaining safety management are significant (Nicolazzo, 2002).

JUSTIFICATION

Students must understand the essential elements of safety as it applies to ice climbing.

From M. Wagstaff and A. Attarian, 2009, *Technical skills for adventure programming: A curriculum guide* (Champaign, IL: Human Kinetics).

GOAL

To develop safety awareness among ice-climbing students.

OBJECTIVES

At the end of this lesson, students will be able to

- identify the elements of safety associated with ice climbing (cognitive),
- describe the various cold-related injuries associated with ice climbing (cognitive),
- identify the common objective dangers (environmental) related to ice climbing (cognitive),
- identify the common subjective dangers (human related) associated with ice climbing (cognitive), and
- appreciate the dangers of ice climbing and act accordingly (affective).

EQUIPMENT AND AREAS NEEDED

None.

RISK MANAGEMENT CONSIDERATIONS

None.

LESSON CONTENT

Introduction

Many hazards are associated with participation in ice climbing. Exposure to hazards can be mitigated by observing the considerations outlined in previous lessons of this unit and in the unit on mountaineering. The following is a selected list of common hazards that you can review with students before each ice-climbing trip, thereby planting a seed of safety management to be applied in the field.

Main Activity

Hazard Review (30 Minutes)

Review the following list of hazards with students before engaging in an ice-climbing session. You could challenge students to generate a list of hazards that they perceive are associated with ice climbing.

- Cold injuries and illnesses—Exposure to cold temperatures for extended periods can have devastating effects on students *and* instructors. Additional information on cold-related injuries can be found in unit 9, lesson 5, and unit 11, lesson 3.
- Temperatures below 0 degrees Fahrenheit (–18 degrees Celsius) will add greatly to the challenge of maintaining adequate warmth. Lowering of the body's core temperature below 98.6 degrees Fahrenheit (37 degrees Celsius) will cause a person to enter the beginning stages of hypothermia, which will require immediate action on your part to remove the person from immediate danger and further exposure.
- Helping students continue to generate body heat while preventing them from losing that heat to the environment are the two principles that must be followed.

From M. Wagstaff and A. Attarian, 2009, *Technical skills for adventure programming: A curriculum guide* (Champaign, IL: Human Kinetics).

- Localized cooling or freezing of soft tissue from exposure to cold can result in superficial to deep levels of frostbite. The extremities (fingers and toes) are most susceptible, although exposed areas of the face and ear lobes should be closely monitored as well. Proper clothing and footwear, proper nutrition and hydration, and proper pacing during the activity will ward off the adverse effects of the cold.
- Ice that falls on climbers and belayers can result in soft-tissue and other physical injuries that are difficult to treat in a cold environment. Keeping belayers and spectators in more protected areas out of the fall line of the climber will reduce this hazard. Establishing and maintaining a well-respected helmet zone is essential.
- Moderately angled snow slopes leading to the base of popular ice climbs are susceptible to avalanches when they are loaded with snow that contains weak bonds between the layers. You should be aware of this hazard and know how to use weather and field information to make avalanche assessments in the field. You should also be aware of approaches to and from ice-climbing sites that are safe in the existing environmental conditions.
- Freeze and thaw cycles can change ice conditions. As a result, ice ratings found in a guidebook may not match with what is found on a given ice-climbing day.
- Fatigue that develops from a long day of climbing can pull students' attention away from the all-important descent from the climbing area.
- Remind students to focus on safety while descending to terrain that is more level. Before the descent from the climbing area, make sure that all ice-climbing gear is properly stowed into packs (no dangling crampons or ice axes).
- Establish and maintain appropriate student-to-instructor ratios. Ratios of 4:1 are appropriate for basic top-rope programs. Smaller ratios (2:1) are required for multipitch climbing situations.
- If group size exceeds the recommended ratios, you may be unable to perform the periodic check-ins necessary to ensure the proper care, comfort, and safety of students.

Closure Activity

Summary Safety Review (15 Minutes)

To strengthen the focus of this lesson, provide a summary of the most common safety issues that students may encounter on their next ice-climbing outing.

Follow-Up Activity

Safety Reminder (Time as Needed)

- Provide gentle reminders to students regarding safety practices while in the field. An overbearing approach will likely result in increased student anxiety.
- Quizzing students about safety considerations will help them develop a healthy and appropriate level of safety awareness.
- Have students do a hazard assessment on their next ice-climbing outing.

ASSESSMENT

- Verify that students can describe the various cold-related injuries associated with ice climbing by asking them to state each of the injuries presented.
- Check that students can identify the common objective dangers related to ice climbing by quizzing them.
- Confirm that students can identify the common subjective dangers associated with ice climbing by quizzing them.
- Verify that students appreciate the dangers of ice climbing and act accordingly by observing them and providing feedback when they are engaged in any ice-climbing activity.

TEACHING CONSIDERATIONS

- Always review the basics of safety with students before heading to the ice-climbing site.
- Consider using teachable moments while in the field to point out objective hazards as they are encountered.
- Encourage buddy checks when students are participating in an ice-climbing outing.

UNIT 12, LESSON 8

▷ Leave No Trace Considerations

OVERVIEW

Ice and snow offer unique and challenging environments to practice Leave No Trace (LNT). This lesson encourages students to discuss and implement ways in which the principles of LNT can be practiced to improve the ice-climbing experience.

JUSTIFICATION

Most parks and natural areas are realizing an increase in visitors, including winter environments beyond the ski slopes (Manning, 1999). Ice-climbing areas have become more popular. Students should understand the proactive measures that they can take to ensure the sustainability of ice-climbing areas. These measures include being a role model to beginning climbers, being considerate to other climbing parties, volunteering for area cleanups and maintenance projects, and following the rules and regulations of the sponsoring land management agency. Invite dialogue with land managers and find solutions together. Further, encourage students to join or start a local climbing organization. This proactive step assists climbers in communicating with managers and private landowners, helps them learn about sustainable climbing, and will help ensure that future climbers can enjoy the ice-climbing experience.

GOAL

To develop students' understanding of the principles of LNT while ice climbing.

OBJECTIVES

At the end of this lesson, students will be able to

- identify the basic principles of LNT (cognitive),
- understand how LNT can be utilized in an ice-climbing environment (cognitive),
- demonstrate LNT principles effectively and accurately (psychomotor), and
- develop an appreciation for the natural environment by incorporating LNT into ice climbing (affective).

EQUIPMENT AND AREAS NEEDED

- Whiteboard
- A popular ice-climbing site

RISK MANAGEMENT CONSIDERATIONS

Depending on where the lesson is conducted, use the edge protection strategies and cold-weather precautions mentioned in previous lessons.

LESSON CONTENT

Introduction

This lesson provides an overview of the Leave No Trace ethic throughout the ice-climbing season (Center for Outdoor Ethics, 2001). Share with students that sensitivity to the natural environment is an important dimension of ice-climbing participation. A lack of sensitivity may lead to unnecessary damage to an area. Incorporating thoughtful interaction with the natural world into every lesson can lead to an enhanced ice-climbing experience (Center for Outdoor Ethics, 2004).

Seasons

Each ice-climbing season has three distinct phases: early season, midseason, and late season. This lesson will address LNT for each phase.

- Early season may be met with muddy trails, unsafe ice conditions because of temperature fluctuations, and many people eager to get out on the ice. During this time of the season, climbers should wear crampons only when necessary because they are hard on trails. Keep groups small to reduce the potential for trail damage.
- Midseason often means cold temperatures and brittle or hard ice. In these conditions, climbers may take chucks of ice off routes. In consideration of others, use caution when sharing a route with other parties.
- Late season typically brings out climbers in large numbers because of the stable ice and warmer temperatures. During this phase, climbing parties should be selective in choosing a climbing site in an effort to be considerate of other climbers and to avoid overusing smaller sites.

LNT Principles

The Center for Outdoor Ethics has established seven principles of LNT. The following section applies those principles to ice climbing:

Plan Ahead and Prepare Check the weather, have extra clothing, select an appropriate site, and follow an itinerary.

Travel and Camp on Durable Surfaces

- Snow and ice are durable surfaces, but LNT is still relevant in popular climbing areas.
- Optimal conditions for ice climbing are frozen and snow-covered conditions.
- The cliff should have a winter appearance with snow, hoarfrost, rime ice, or verglas covering the rock, not just snow covering ledges.
- Vegetation as a climbing medium is best when it is frozen or covered in snow or neve. In this condition it is least likely to be dislodged.
- Rock-climbing routes that are considered classic climbs should be attempted in winter only when fully coated with snow and ice to prevent damage to the underlying rock.

Dispose of Waste Properly

- Human waste can be left to freeze and then carried out. A cathole is often not an option because the ground will be frozen. Leaving excrement on the snow or ice surface is not considerate of others. A pack it in, pack it out mentality should apply.
- Another option is to use a Wag Bag or Restop. These chemically treated bags are made specifically for disposing of human waste directly into a bag. The user then packs out the bag.

Leave What You Find Climbers should not take any plants, rocks, or interesting-looking artifacts from the site. If something strikes a participant's fancy, encourage the person to take a picture instead (either mentally or with a camera).

Minimize Campfire Impacts If a fire ring is present (a rarity in winter), use it. If not, discuss among the group whether a fire is really needed. If it is, follow LNT principles.

Respect Wildlife While climbing and camping, provide a wide buffer between your party and wildlife. If you are seeking backcountry ice, store food in canisters.

Be Considerate of Other Visitors This LNT point is by far the most applicable to ice climbing. Large groups should avoid early or late-season ice. This ice is unstable and least likely to recover quickly, leaving one fewer route for others to climb.

Leave No Trace principles—Copyright: Leave No Trace Center for Outdoor Ethics. www.LNT.org.

Main Activity

LNT Review (Time as Needed)

The initial portion of this activity requires a fairly busy ice-climbing location.

- Have participants circle up and provide each with an outline of the LNT principles. Discuss each one.
- After you believe that students have a grasp of LNT ice climbing, observe climbers in the area and make note of at least one positive and one negative LNT behavior.
- After giving students time to reflect on their experiences, share your observations on site or in the classroom.

Closure Activity

Creating a Leave No Trace Culture (Time as Needed)

After sharing all observations, provide participants an opportunity to create a class norm regarding LNT. In essence, the class will describe a Leave No Trace culture that participants want to be a part of.

Follow-Up Activity

Reinforce LNT (Time as Needed)

- Practicing LNT is an ongoing issue among all groups that use the outdoors for learning.
- Follow-up regarding LNT behavior can be done in a variety of ways.
  - You can stop and take time at each site to determine the students' appraisal of what LNT factors influence the climbing area.
  - Several students can be chosen in advance to identify LNT issues throughout the day.
  - At the end of the climbing day, those students can provide a summary of what the group did well and what the group did poorly regarding LNT, and seek feedback regarding each issue.

ASSESSMENT

- Check that students can identify the basic principles of LNT by having them recite each. When the ice season has ended, assess this topic with a written examination.
- Verify that students understand how LNT can be applied in an ice-climbing environment by having them identify LNT issues throughout the day and come up with appropriate practices to reduce those concerns.
- Confirm that students demonstrate LNT principles effectively and accurately by observing them during climbing outings and monitoring their LNT practices. Provide feedback when needed.
- Assess whether students develop an appreciation for the natural environment by incorporating LNT into their ice climbing by asking them questions that provoke thought and reflection.

TEACHING CONSIDERATIONS

- Basic teaching considerations include the availability of different sites, number of students participating, group composition, and amount of time allotted for the activity.
- You should also take into account different learning styles. For example, you can use the site for hands-on activities as well as discussion.
- Ensure that transfer occurs by explaining that LNT applies to all environments.

From M. Wagstaff and A. Attarian, 2009, *Technical skills for adventure programming: A curriculum guide* (Champaign, IL: Human Kinetics).

Ice Climbing Skills Checklist

Listed here are the ice-climbing skills that will be introduced in this unit. You are responsible for learning these skills. Periodically review this checklist to assess your knowledge and ability to perform the skills. When you are comfortable with a skill, have the instructor test your ability to perform it.

All skills must be initialed and dated by the instructor to be valid.

(Items from the rock-climbing skills checklist can be incorporated into this list to make it more complete. See unit 2, page 226, for more information.)

Climbing skills	Completed	Needs more work
Set up top-rope belays and anchors		
Hold falls and carry out lowers		
Demonstrate basic ice-climbing movement skills		
Properly place an ice screw		
Properly sharpen an ice axe pick		
Properly sharpen crampon points		

Use the ice climbing skills checklist as an additional tool to assess skills learned throughout this unit.

From M. Wagstaff and A. Attarian, 2009, *Technical skills for adventure programming: A curriculum guide* (Champaign, IL: Human Kinetics).

GLOSSARY

blue ice—Solid, stable, and often hard ice.

bulge—A convex piece of ice.

cauliflower ice—Resembling the vegetable cauliflower, this ice often forms near the bottom of ice climbs and is the result of water splashing and freezing. More often than not, it is stable and strong ice, good for hooking or absorbing a good swing.

chandelier ice—Multiple icicles in close proximity to one another typically offer unstable climbing until their diameters are large enough to hold the weight of a climber. This type of ice is often found early in the season.

cordelette—Cord of smaller diameter 15 to 20 feet (4.5 to 6 meters) in length used for constructing anchors.

crampons—Tempered steel shaped to fit the bottom of boots to provide traction in snow or ice terrain. The two most common designs are rigid (no flex) and hinged (flexible).

dynamic rope—Rope manufactured to stretch when force is applied.

edge culture—How people conduct themselves on a cliff edge.

fall factor—Formula used to determine the energy put on a system in the event of a fall.

front points—The front one, two, or three points on modern crampons.

ice screws—Hollow, threaded, toothed alloy tubes of varying lengths used as protection and in anchor systems while climbing.

ice tools—Evolved out of a need to cover vertical ice. Traditional ice axes are too long; thus a shorter more ergonomic tool was developed. Tools have six main parts: spike, grip, shaft, pick, adze, and leash.

ice tool leash—A piece of material attached to the tool midshaft that connects the tool to the climber by wrapping around the wrist.

kilonewton—1,000 newtons, or 224.8 pounds of force.

master point—The point at which the anchor is equalized and meets the carabiners holding the rope.

pounds of force—The climber's weight multiplied by the length of rope (in feet) extended beyond the last piece of protection.

screamer—An extending and shock-absorbing piece used to connect the rope to protection with two carabiners.

static rope—Rope that has little stretch, less than 3 percent.

verglas—Smooth, rock-hard sheets of thin ice, often found in midseason.

white ice—As in whitewater, the white appearance indicates the presence of air. White ice should be climbed with caution because aerated ice is weak. White ice is most frequently seen in the early and late parts of the season.

yellow ice—The yellow color indicates that the flow of water is transporting minerals. Yellow ice should not be a deterrent to climbing, but it indicates recent flow, which usually comes with warmer temperatures. Climbers should be careful.

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RESOURCES

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