



# Snow Travel, Anchors, Belays & Avalanche Awareness

Basic Climbing Course Lecture #4

April 6, 2016

William Ashby



# Topics covered this evening

- Introduction – changing seasons & new skills
- Field trip #5 – safe snow travel:
  - Know your gear
  - Using an ice axe for self-belay and self-arrest
  - Using crampons to increase security
  - Increasing protection beyond crampons
- Field trip #6 – SIG winter overnight:
  - Snow belays & anchors
  - Avalanche awareness
  - Snow camping (depending on time, . . . sent to you after the lecture)
- Guest speaker: Steve Swenson a world-renowned climber extraordinaire (!) and past President American Alpine Club)



## Changing seasons – new skills

- ▶ Transitioning from climbing on rock to travelling through snow
- ▶ Understanding the nature of the snowpack is **critical** to safe travel
- ▶ Snowpack conditions vary significantly based on multiple influences:
  - ▶ seasonality (general snow conditions)
  - ▶ mountain features such as ridgelines, slopes, slope angle, slope aspect and slope configuration)
  - ▶ Accumulating snow layers throughout the winter and their interaction with regard to avalanche risk (old weak layers, new storm slabs, etc.)
  - ▶ the amount of time & the weather conditions between major snow events (potential for introduction of weak layers such as hoarfrost)
  - ▶ the amount of recent snowfall (consistency and depth of the top-most snow layer)
  - ▶ weather conditions on the day of the climb (solar radiation, wind, precipitation, temperatures)



## Field trip #5 – introduction

- ▶ As we move into the summer climb season buried weak snow layers become incorporated, storm slabs sluff, and the snowpack stabilizes
- ▶ What's left is a thick & consistent snowpack that depending on temperature may be:
  - ▶ safe for kick-stepping during ascent and plunge-stepping during descent
  - ▶ very stiff & slippery and requiring use of crampons
  - ▶ loose & sloppy resulting in slips & slides and/or post-holing up to your thighs
- ▶ In this field trip you'll practice safe winter travel skills and we'll review these in the next several slides
- ▶ Location for field trip #5 moving from Stevens Pass to Snoqualmie Pass, . . . More details to come
- ▶ Dates for field trip #5 remain the same: April 30<sup>th</sup> / May 1<sup>st</sup> & May 7<sup>th</sup> / May 8<sup>th</sup>

## Know your gear, . . . Ice axe

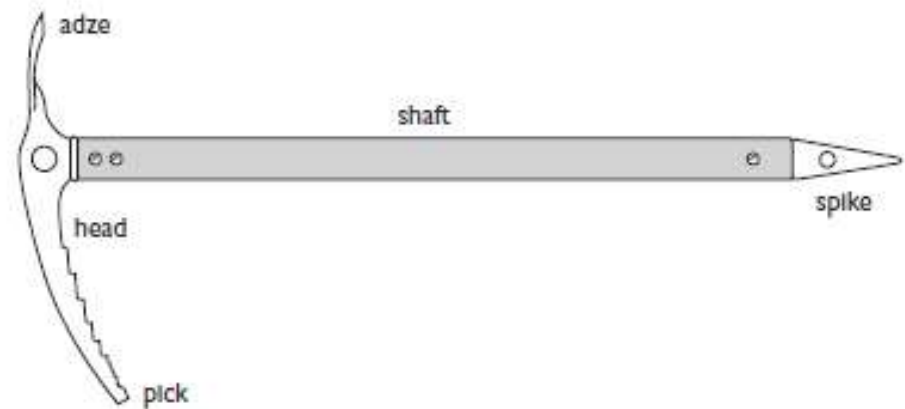
**3 Minutes**

- ▶ As a group, draw a simple diagram of an ice axe
- ▶ Label the parts of an ice axe



# Know your gear, . . . Ice axe

- ▶ As a group, draw a simple diagram of an ice axe
- ▶ Label the parts of an ice axe:
  - ▶ Head
  - ▶ Adze
  - ▶ Pick
  - ▶ Shaft
  - ▶ Spike





## Know your gear

- ▶ As a group, list the other gear you will use to ensure safe snow travel

**3 Minutes**

# Know your gear

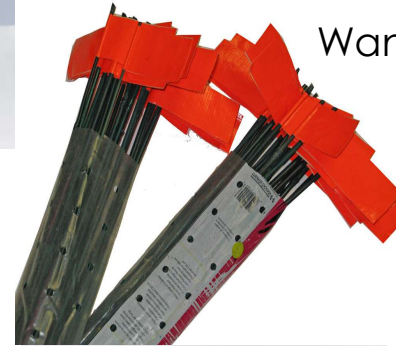
- As a group, list the other gear you will use to ensure safe snow travel



Glacier glasses



Pickets



Wands



Metal Shovel

Carabiners



Axe tether



Crampons

Rope



Sunscreen

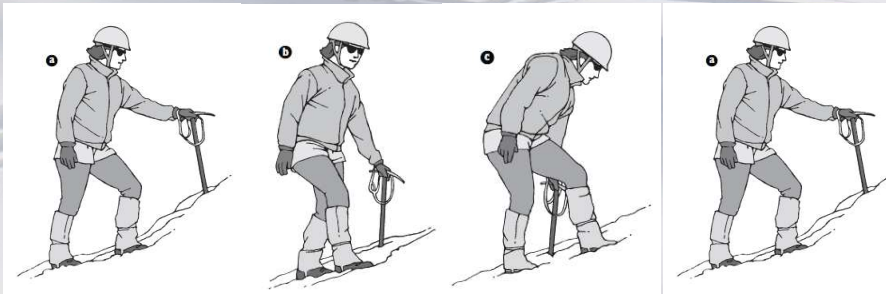


Helmet



# Ascending snow slopes

- ▶ Walking in balance:
  - ▶ Uphill foot ahead of downhill foot
  - ▶ Ice axe ahead of uphill foot
- ▶ And then to progress uphill:
  - ▶ Move downhill foot
  - ▶ Move uphill foot
  - ▶ Move ice axe
- ▶ Rest step – pause while in balance



Snowfield Peak – July 2014

# Ascending snow slopes

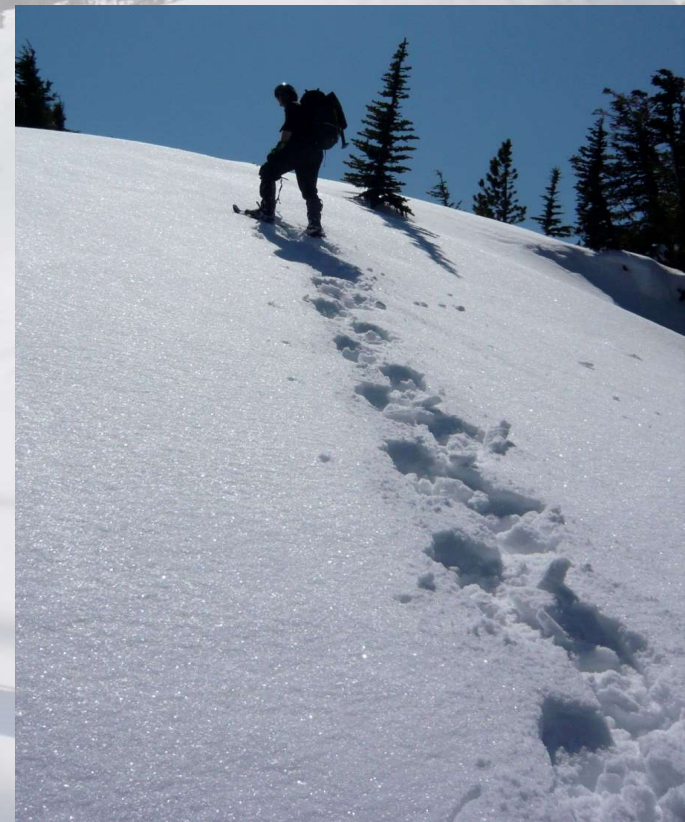
- ▶ Walking in balance
- ▶ Be mindful of overall party needs to balance cardio:
  - ▶ Approach: straight up vs. traversing



Gove Peak – March 2011

# Ascending snow slopes

- ▶ Walking in balance
- ▶ Be mindful of overall party needs to balance cardio:
  - ▶ Approach: straight up vs. traversing
  - ▶ Size of steps



Arthur Peak – April 2011

# Ascending snow slopes

- ▶ Walking in balance
- ▶ Be mindful of overall party needs to balance cardio:
  - ▶ Approach: straight up vs. traversing
  - ▶ Size of steps
- ▶ As a group list other ways to maintain party cardio balance:

**3 Minutes**



Mt. St. Helens – July 2010

# Ascending snow slopes

- ▶ Walking in balance
- ▶ Be mindful of overall party needs to balance cardio:
  - ▶ Approach: straight up vs. traversing
  - ▶ Size of steps
- ▶ As a group list how to maintain cardio balance:
  - ▶ Share kicking steps in the lead
  - ▶ Improve steps for others as you go
  - ▶ Manage pace with rest steps
  - ▶ Share gear to maximize progress of party



Mt. St. Helens – July 2010

# Descending snow slopes

- Facing out using plunge steps
- “Noes over toes”



The Brothers – July 2010

# Descending snow slopes

- ▶ Facing out using plunge steps
- ▶ Facing in using self-belay with ice axe



South Early Winter Spire – May 2012

# When to use an ice axe?

**3 Minutes**

- ▶ As a group make a list of when you would want to use an ice axe



Olympus – July 2014





# When to use an ice axe?

- ▶ As a group make a list of when you would want to use an ice axe
  - ▶ Anytime as a confidence builder (an ice axe just feels good in the hand)
  - ▶ Walking in balance
  - ▶ Plunge stepping
  - ▶ Facing in & down climbing with self belay
  - ▶ When terrain & snow conditions warrant preparation for self arrest



Eldorado – August 2013



## When to use an ice axe?

- ▶ Assess runout; what are the consequences of not stopping a fall/slide?



Clark Walrus Glacier – July 2013

# When to use an ice axe?

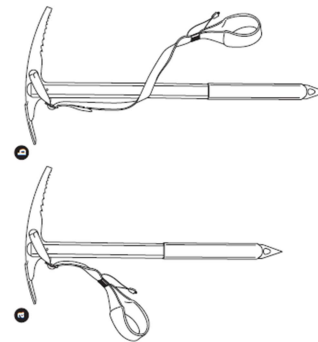
- ▶ Assess runout; what are the consequences of not stopping a fall/slide?
- ▶ Assess condition of snow:
  - ▶ A relatively thin layer of soft snow on top of a stiff layer may limit ability to stop sliding;
  - ▶ Deep soft snow may hold you in place; very soft snow on a steep slopes may slide / sluff
  - ▶ Hard snow may result in acceleration rate similar to free fall, . . . you've got one good chance to arrest (but always keep trying!)



Adams Mazama Glacier – Sept 2014

# To leash or not to leash?

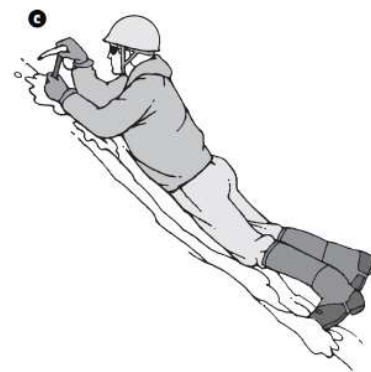
- ▶ Snug / short leash improves self-belay, but must switch wrists when traversing uphill
- ▶ Leash on harness puts loose axe at face level
- ▶ Without a leash an axe won't hit you if it gets loose, but you could lose your axe for the rest of the trip
- ▶ As conditions warrant, . . . no single correct answer



Little Tahoma – July 2011

# How to use an ice axe – “self belay”

- ▶ Plant ice axe deep in snow, grasp shaft at snow point of entry, and push down on head of axe with other hand:
  - ▶ Provides additional security when moving up/down steep snow
  - ▶ Also a quick means of catching a slip
  - ▶ Depends on relatively soft snow conditions
- ▶ Truth in advertising: this is not a “real” belay
  - ▶ Works only if you **hold onto the axe**
  - ▶ Has effective limits (snow conditions, slope angle)

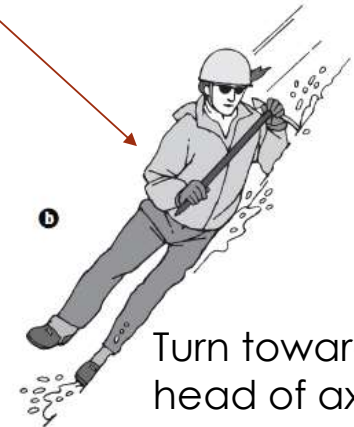


# How to use an ice axe – “self arrest”

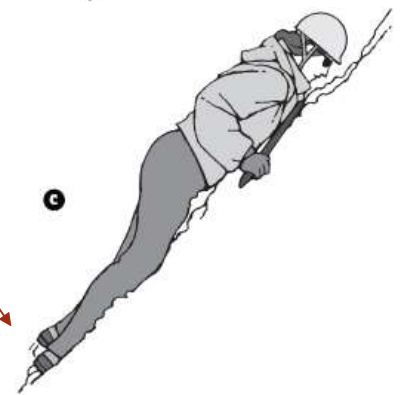
Wear Gloves!

- Get to “finish position” as quickly as possible:
  - Head uphill and facing down
  - Pick in snow near the crook of your neck
  - Chest baring down on shaft
  - Mid-section raised somewhat to increase downward force on chest
  - Wide stance and feet planted
- Four situations to consider:
  - Feet first vs. head first
  - On back vs. on stomach
- Must be muscle memory so ***practice!***
- ***Self arrest has limits:*** stiff snow & steep slope angles (but never stop trying!) at some point safe travel requires more protection

Crampons OK!!



Turn toward head of axe





# Glissading – fast & fun way down a slope

- ▶ Critical to have proper ice axe technique & stance:
  - ▶ keep pick parallel with surface and pointing away from you
  - ▶ keep head of axe outside of your legs
  - ▶ use spike as a break behind you
  - ▶ knees up & feet flat to prevent heels catching
- ▶ Assess hazards on slope and safe runout below
- ▶ Never glissade with crampons
- ▶ Never glissade on a glacier



Colchuck – June 2012

# When to use crampons?

**3 Minutes**

- ▶ As a group list reasons to strap on crampons







# When to use crampons?

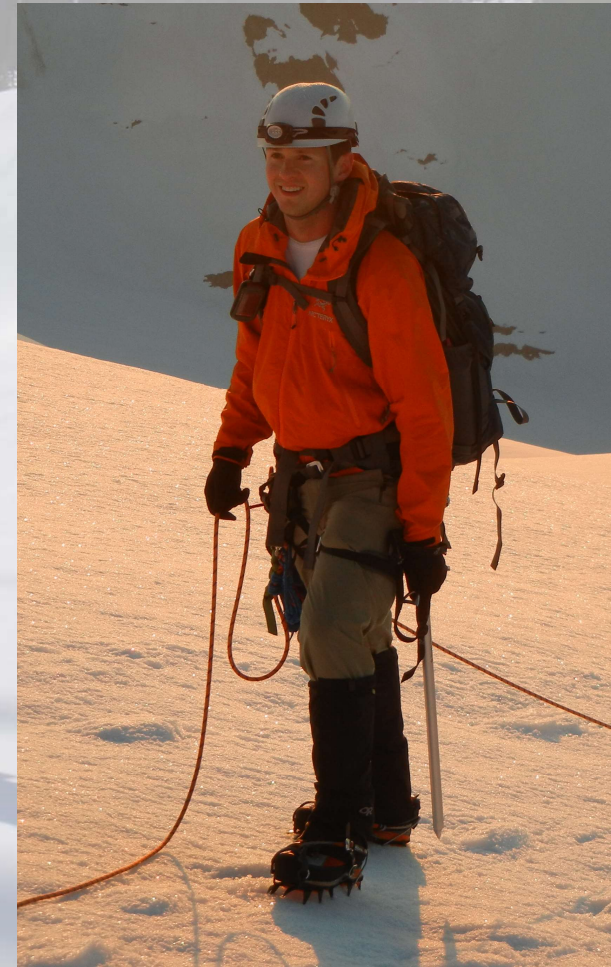
- ▶ As a group list reasons to strap on crampons:
  - ▶ No steadfast rule, . . . make decision based on skill & experience and evaluation of conditions
  - ▶ Assess runout: what if I slip?
  - ▶ Asses snow condition:
    - ▶ Crampons improve security when snow is hard / icy
    - ▶ And will likely improve traction in soft snow as well, . . . Definitely worth testing / experimenting with as you descend!
  - ▶ Will they improve my sense of security / confidence?
    - ▶ When in doubt lean in favor of using them



Olympus – July 2014

# How to use crampons?

- ▶ Fit them to your boot at home
- ▶ Strap them on and walk in them to ensure you've got the fit right and they stay on
- ▶ Walk deliberately to avoid tripping or getting snagged on pants / gators
- ▶ Ensure nothing is hanging from your harness that might snag
- ▶ Importance of not having overly sharp crampons:
  - ▶ Sharp crampons aid ice climbing
  - ▶ Sharp crampons are an unneeded hazard for most other alpine mountain climbing



Mt Baker – June 2011

# When to use additional protection beyond crampons?

- ▶ On steep slopes with snow conditions increasingly favoring use of crampons
- ▶ When the probability of successful self-arrest diminishes
- ▶ Implement roped travel with running belays through a series of pickets
- ▶ Eventually (as with climbing on rock) it becomes critical to establish fixed protection with snow anchors and “just don't #@\$# slip!!”



Si Hay Stack – March 2011

## Other snow travel hazards

- Hidden weaknesses in the snowpack:
  - Blowdown
  - Talus
  - Creeks
- Sunburn!



Silver Star – June 2013

Ten minute break!



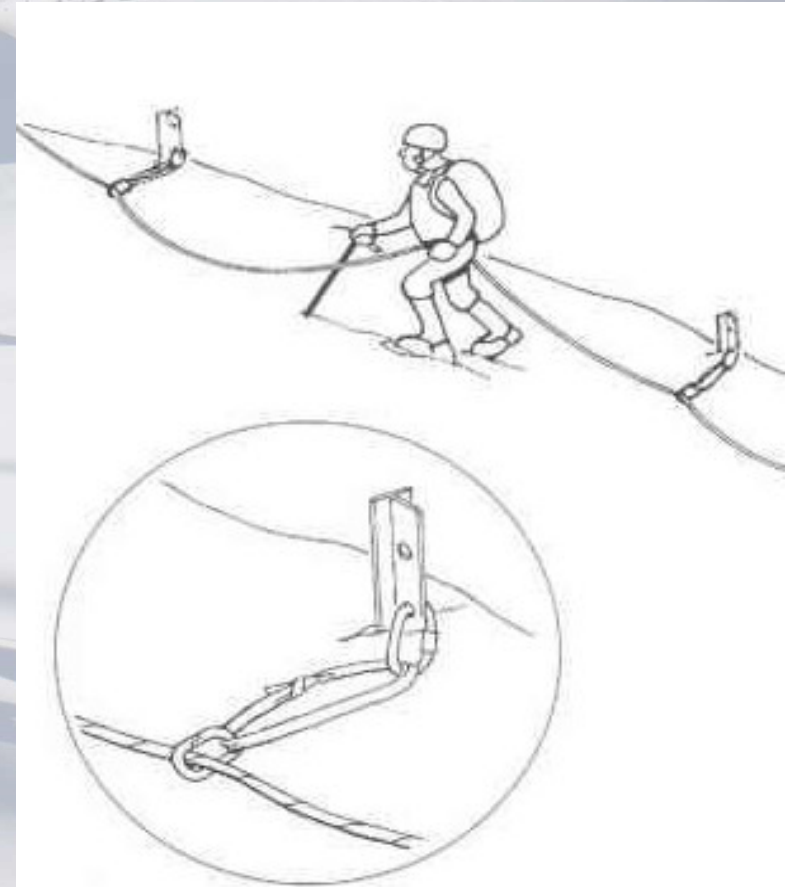


## Field trip #6 SIG snow overnight

- ▶ Snow belays & anchors – 7 slides 10 minutes
- ▶ Avalanche awareness – 8 slides 10 minutes
- ▶ Snow camping – 8 slides (in appendix)

## Quick snow belays – roped travel w/running belays

- ▶ Good alternative to keep the team moving on steep snow and/or when traversing over an exposed runout
- ▶ This technique depends on snow pack:
  - ▶ hard enough so that a picket will hold in the snow
  - ▶ soft enough so you are able to hammer in a picket



## Quick snow belays – sitting belay

- ▶ Good intuitive belay in soft snow for short slips or slides on snow
- ▶ Less appropriate when snow is hard and belay requirement is more severe

Notice he's anchored in!





## Quick snow belays – standing carabiner ice axe belay (w/belay device)

- ▶ Good alternative belay in relatively soft snow for short slips or slides on snow
- ▶ Not applicable when snow is hard and belay requirement is more severe. Must practice technique to be effective
- ▶ Even with excellent snow conditions quick snow belays have real limits, . . . worth testing at your SIG snow field trip!



A background image of a snowy mountain landscape. In the foreground, three hikers with large backpacks are standing on a snow-covered slope, looking towards a distant peak. The hiker in the middle is holding a camera up to their eye. The snow is bright white, and the sky is a clear, pale blue. In the distance, a line of evergreen trees marks the horizon. The overall scene is bright and clear, suggesting a sunny day in a high-altitude environment.

# When to use quick snow belays?

**3 Minutes**

- ▶ As a group, list reasons you would want to use quick snow belays



# When to use quick snow belays?

- ▶ As a group, list reasons you would want to use quick snow belays
  - ▶ For situations where quick response is appropriate
  - ▶ When low force-loads are anticipated
  - ▶ Getting a member of your rope over a “spicy step”

# Snow anchors - pickets

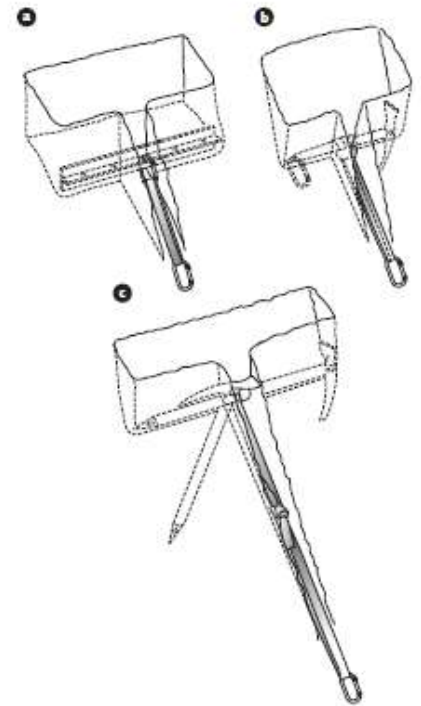
- ▶ Picket or ice axe placed in a vertical position.
- ▶ Good choice if concerned about weak horizontal layers.



Mid clip unless snow is very firm

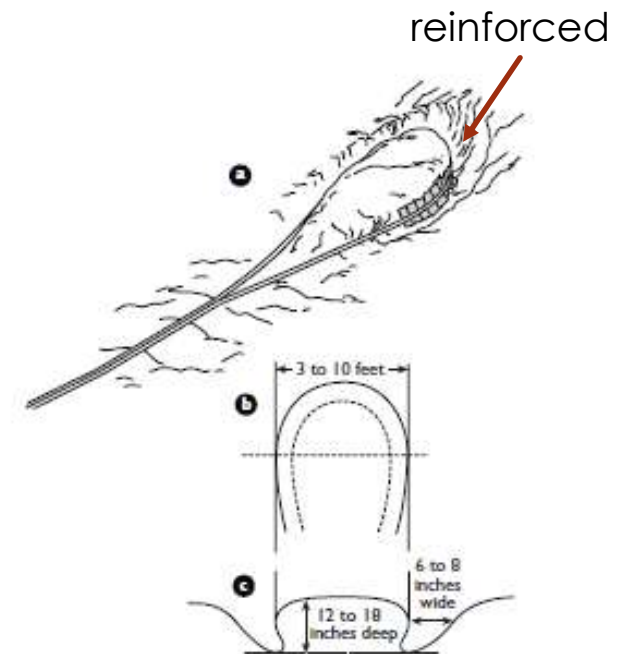
## Snow anchors – “dead man”

- ▶ Picket or ice axe buried in a horizontal position & perpendicular to slope.
- ▶ A strong anchor, but watch for weak horizontal layers (more prevalent in winter/spring)



# Snow anchors

- Snow Bollard requires snow soft enough to dig
- Takes time to construct but is surprisingly strong
- Reinforce back of bollard





## When to use snow anchors?

**3 Minutes**

- ▶ As a group, list reasons you would want to use snow anchors



## When to use snow anchors?

- ▶ As a group, list reasons you would want to use snow anchors
  - ▶ For emergency / rescue situations like crevasse rescue
  - ▶ When an unanticipated rappel is required
  - ▶ When high force-loads are likely





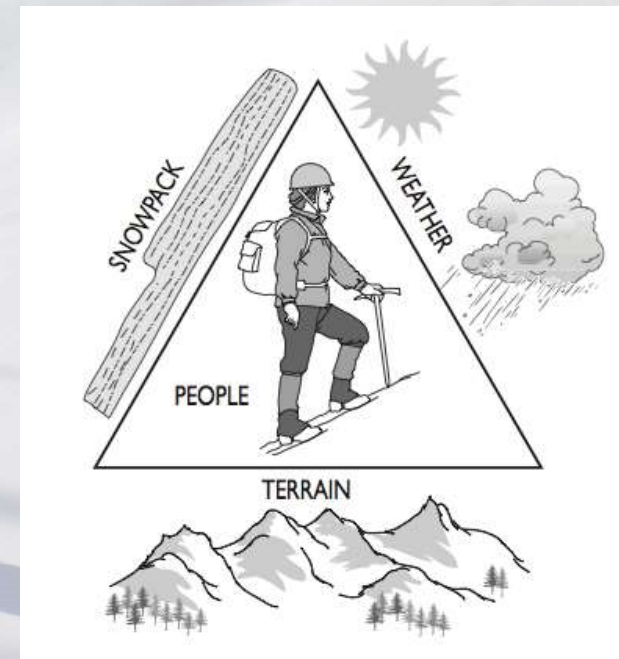
# Avalanche awareness - introduction

***“No freedom is harder to earn than the freedom of the snowy hills.”***

- ▶ Getting to interesting winter destinations frequently involves traveling on or near steep and exposed avalanche-prone slopes
- ▶ Avalanches kill about 50 people per year in North America
- ▶ Almost all avalanches involving people are triggered by the victim(s) or another member of their party
- ▶ Avalanche education can help you make better decisions about safe snow travel.

# Avalanche fundamentals

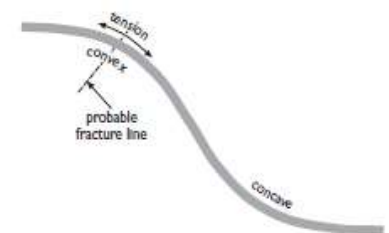
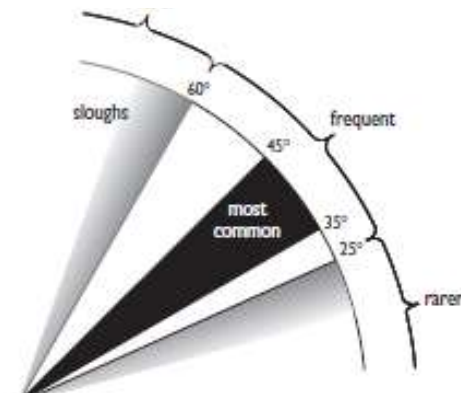
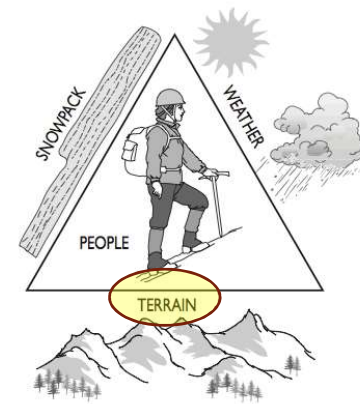
- ▶ Avalanches occur ***naturally*** when new snow deposits place too great a load on the existing snowpack
- ▶ Avalanches also are ***triggered*** when people traverse steep snow slopes and add just enough additional load to “trigger” an avalanche
- ▶ Most victims are involved in small to medium sized avalanches, none-the-less, even these create destructive forces capable of snapping trees, crushing cars, and razing buildings
- ▶ All the snow is connected, . . . your party may be traveling on a gentle slope or a road in proximity to an avalanche sensitive slope and trigger an avalanche



Factors contributing to avalanche hazard

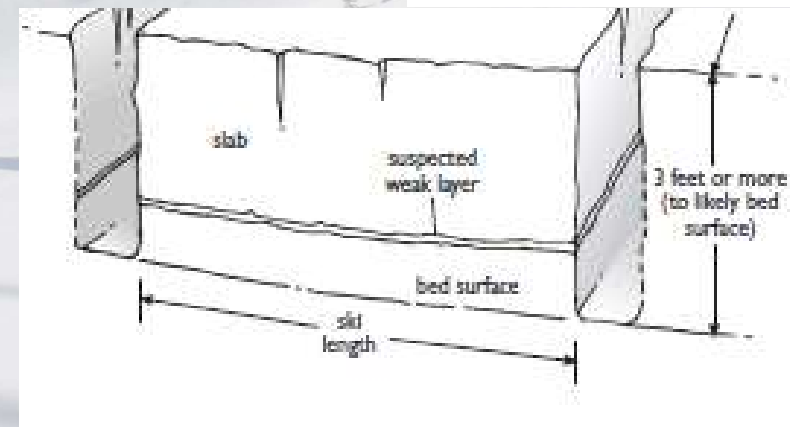
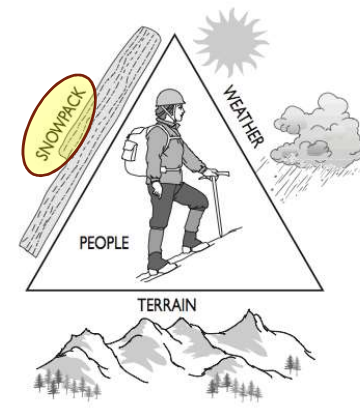
# Evaluate avalanche terrain

- ▶ Slope angle effects avi propensity:
  - ▶ Slopes between 25 & 60 degrees possible
  - ▶ More prevalent between 35 & 45 degrees
  - ▶ Most prevalent at 38 degrees
  - ▶ While underway use your compass clinometer!
- ▶ Slope aspect determines amount of sun and wind loading the slope receives:
  - ▶ In winter north aspects take longer to consolidate
  - ▶ In spring/summer south aspects get loose & wet sooner
- ▶ Slope configuration:
  - ▶ Smooth (no anchors) vs. rocky or tree covered (may cause weaknesses in snowpack)
  - ▶ Convex vs. flat vs. concave (tend to trigger and propagate where convex).



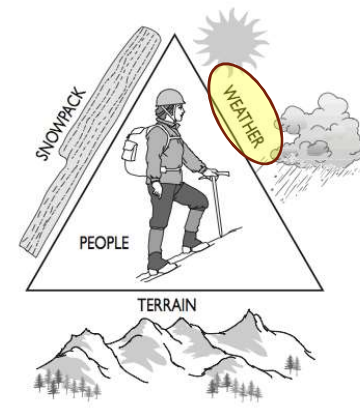
# Evaluate avalanche snowpack

- Snowpack is composed of a series of layers that build throughout the winter
- The layers have different characteristics that change over time:
  - Thickness
  - Cohesiveness
  - Strength
- Depth & distribution of weak layers contribute to snowpack sensitivity



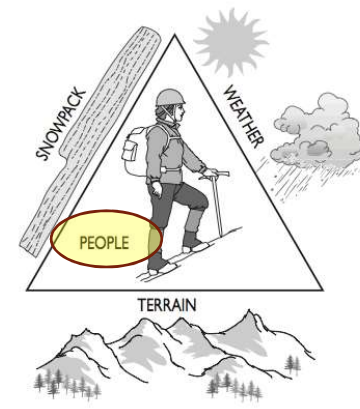
# Evaluate avalanche weather

- ▶ Fresh snow increases load on existing snowpack:
  - ▶ Especially fast snowfall (an inch per hour or a foot per day)
- ▶ Rain also increases load on existing snowpack and percolates through snowpack layers lubricating weak layers
- ▶ Wind creates wind slabs (increasing load on slopes with specific aspects)
- ▶ Temperature:
  - ▶ Warming temperatures can speed snowpack consolidation (after temps cool again), but initially may create wet-loose conditions
  - ▶ Colder temperatures will strengthen dense snow layers, but will not strengthen weak layers within the snowpack or consolidate fresh loose snow



# Evaluate avalanche preparedness

- ▶ Take the Avi 1 class to increase your avalanche knowledge
- ▶ Study terrain and plan routes least exposed to avalanche risk
- ▶ Be prepared to bivvy overnight to avoid danger
- ▶ Evaluate mental/emotional state of climbing party (including yourself):
  - ▶ Ensure those on the trip have sufficient training & equipment
  - ▶ Ensure party considers avalanche risk and balances this with desire to achieve a specific objective
- ▶ Follow snowpack trends throughout the avalanche season
- ▶ Check weather and avalanche forecasts and **use them** to revise your plan (including changing route, destination, or cancelling the trip)
- ▶ When possible, make the decision ahead of getting out on the slopes and ensure everyone on the trip participates in the decision





## Select safer routes

- ▶ Favor ridgelines
- ▶ Avoid 35 – 45 degree slopes
- ▶ Avoid runout zones below avi-prone slopes (definitely don't camp there)



## And while underway, . . .

- ▶ Continuously evaluate all avalanche factors – conditions that will increase load on snowpack and/or increase exposure to avalanche
  - ▶ Windward vs. leeward slopes
  - ▶ Shaded slopes in winter and sunny slopes in spring
  - ▶ Terrain traps (gulleys, chutes, steeps, etc.)
- ▶ Make note of conditions on similar slopes nearby
- ▶ Look for recent avalanche activity and other symptoms of instability:
  - ▶ Sluffs
  - ▶ Pinwheels
- ▶ Other major clues include:
  - ▶ Whumphing!
  - ▶ Shooting cracks!
  - ▶ Snow pluming / wind transport
  - ▶ Changing weather (new snow, new rain, wind, temperature)
- ▶ **Be prepared to alter course or retreat when conditions warrant!**





## And now a treat, . . . Steven Swenson!!

- ▶ Uniquely accomplished, world renowned and a passionate climber
- ▶ Nearly 20 expeditions to mountains in South Asia, including ascents of the North Ridge of K2 and the North Ridge of Everest **solo - both without supplementle oxygen.**
- ▶ In 2012 he and his partners made the first ascent of Saser Kangri II (7518 meters) – the **second highest unclimbed mountain in the world** for which they were awarded the prestigious **Piolet d Or.**
- ▶ **Past president of the American Alpine Club** and lives his wife, Ann Dalton in Seattle.
- ▶ Author of articles for Climbing, Rock and Ice, and Alpinist magazines as well as the American Alpine Journal.
- ▶ Contributed to the recent publication **Rock, Paper, Fire - an anthology of mountain and wilderness writing**
- ▶ Author of an as of yet untitled book on the Karakoram scheduled to be published by Mountaineers Books in the spring of 2017.



# Thank you!

- ▶ Stack chairs (10 per stack)
- ▶ Collapse tables and store in back room
- ▶ Check to ensure you have everything



# Appendix – Snow camping basics

# Where to camp?

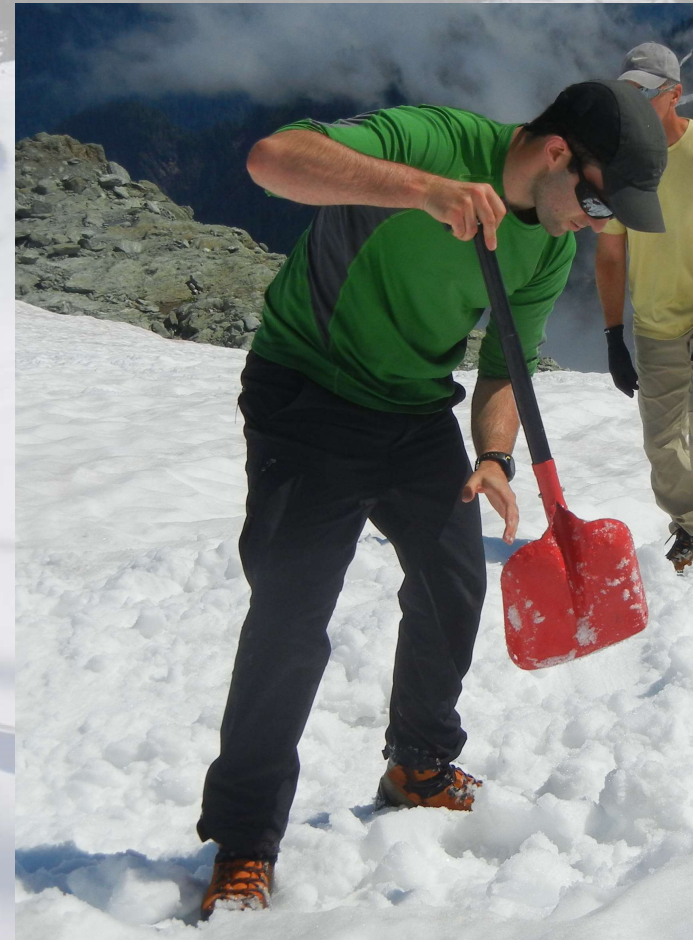
- ▶ Where there's a view!
- ▶ Close to running water
- ▶ With natural wind protection
- ▶ With natural food hanging options
- ▶ At no risk of avalanche
- ▶ When possible **not** on a glacier!



Ruth Icy – August 2014

## Setting up camp

- ▶ Dig a flat snow platform and stomp it down for your tent/bivvy



Shuksan – August 2013

## Setting up camp

- ▶ Dig a flat snow platform and stomp it down for your tent/bivvy
- ▶ For tents dig a foot well with steps down & in
- ▶ Construct a windshield wall if wind anticipated



Clark – July 2012

# Setting up camp

- ▶ Dig a flat snow platform and stomp it down for your tent/bivvy
- ▶ For tents dig a foot well with steps down & in
- ▶ Construct a windshield wall
- ▶ Dig a cooking / dining table and sitting area for the group
- ▶ Designate party separation area(s)



Baker – June 2011

# Shelter alternatives

- ▶ Depending on weather forecast, number of days out, and destination consider alternative shelter:

Option	Weight	Protection	Comfort
Bivvy	Light	Enough	Enough
3 Season	Medium	Better	Better
4 Season	Heavier	Best	Best

- ▶ Consider sharing a double tent to reduce overall party carry weight



## Nice to have amenities

- Insulation pad is a must!
- Make a pillow with stuff sack filled with extra clothing layers
- Eye shade & ear plugs
- Dry under layer to sleep in
- Music and/or an e-book on your mobile device to mimic home bedtime ritual
- Water bottle close at hand for dry-mouth & to reduce mid-sleep muscle cramps
- Pee bottle, . . .



Silver Star – June 2012

# Food at camp

- ▶ Dinner:
  - ▶ Quick hot soups (Miso) as an appetizer
  - ▶ Light freeze-dried dinners (purchased or home prepared)
  - ▶ After dinner hot drinks (cider / cocoa)
  - ▶ Something to share (cookies/chocolate)
- ▶ Breakfast:
  - ▶ Fast & easy oats
  - ▶ Instant coffee already mixed with sugar and powdered cream



Shuksan – August 2013

# Food on the go

- ▶ Lunch snacks:
  - ▶ Easy to eat and ready at hand
  - ▶ Things you'll look forward to eating:
    - ▶ Cranola & nuts
    - ▶ Dried fruits & meats
    - ▶ Cookies & sweets
  - ▶ Trace minerals to address muscle cramping
- ▶ Back at the trail head:
  - ▶ Salty crunch!
  - ▶ Ice chest for sodas

