

# Avalanche Awareness

## Safe Travel and Decision Making in Avalanche Terrain

December 10th 2015



# Disclaimer

Navigating safely in avalanche terrain is a complex subject. This training session is by no means complete. There are a number of accredited courses offered by local guiding services. If you plan unsupervised winter travel in the backcountry it is **STRONGLY** recommended that you complete an avalanche safety course.

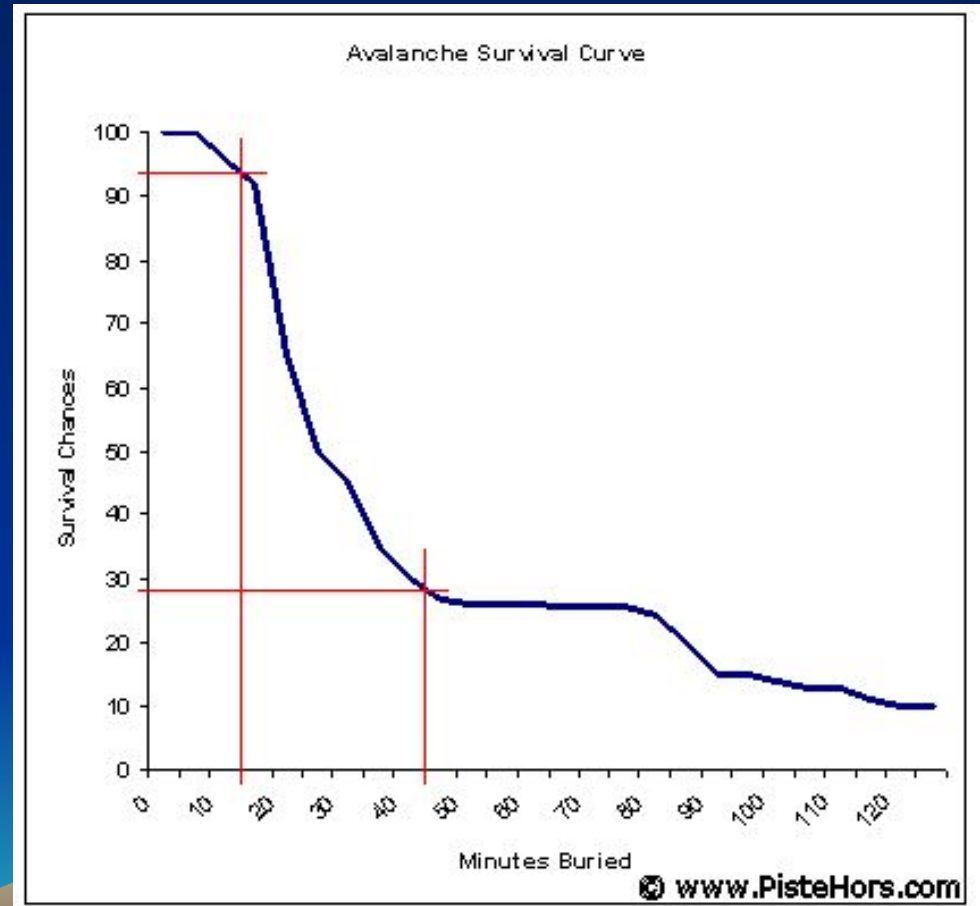
<http://vimeo.com/6581009>



# Avalanche Survival



- Asphyxiation vs. Trauma
- Trauma causes ~25% of deaths in US
- Deaths within 15 minutes are usually due to trauma
- From 15 to 45 minutes; asphyxiation
- After 45 minutes; hypothermia



# Avalanche Types

## Dry vs. Wet



### – Slab

- A slab of snow breaks away from the snowpack
- Slope shatters like a pane of glass (propagates)
- These cause most of the deaths and injuries

### – Cornice Fall

- We trigger them by walking or skiing on ridge lines
- A falling cornice can trigger a **slab avalanche**



### – Loose Snow, Sluff

- Like pouring sand down a slope
- Most often associated with higher angle terrain

# Why Do They Happen?

- Stress overcomes strength.
- Slab avalanches must have a slab and a weak layer.
- Stress of slab+trigger may overload weak layer.
- Weak layer may lose strength until it fails.



# Avalanche Terms



# The Data Triangle

- Terrain, weather, snowpack...in that order
- Nearly all fatal avalanches are human triggered
- The human aspect and SAR

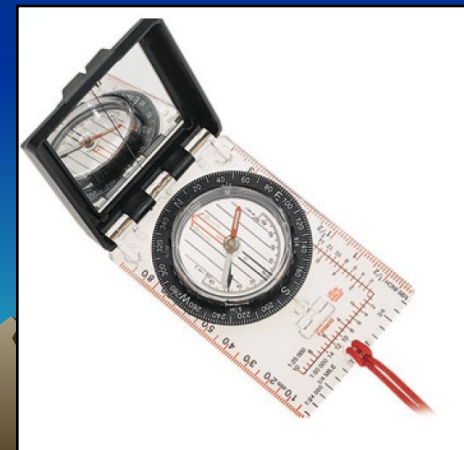
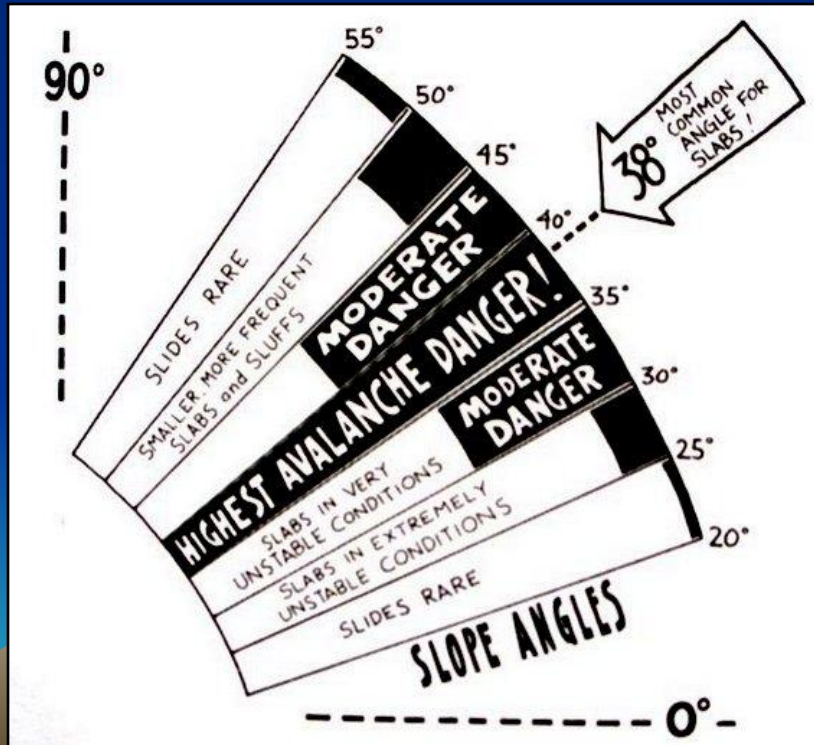


# Terrain Management

## Slope Angle

Slab avalanches generally occur on the slope angles that are best for skiing and snowboarding.

Get an inclinometer!





# Terrain Management

## Recognizing Complexity



Simple Terrain



Complex Terrain

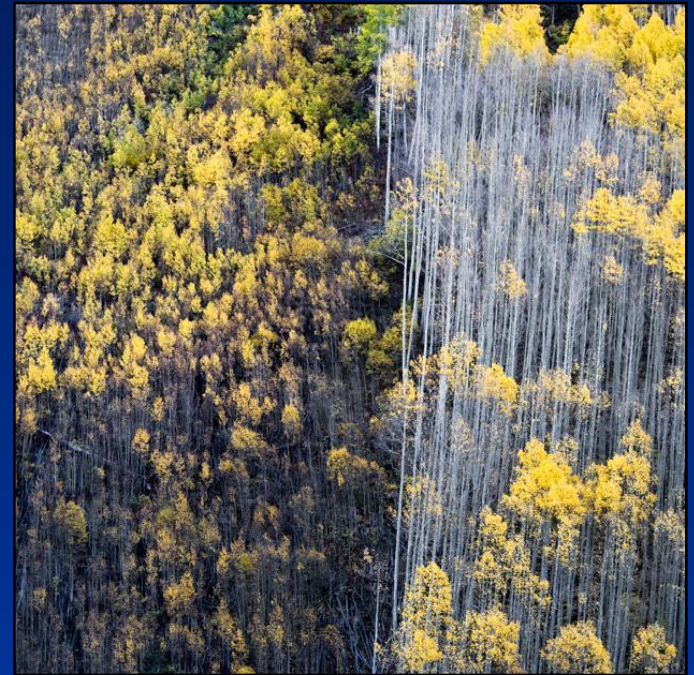
Also Consider:

- Terrain Traps
- Trigger Points

# Terrain Management

## Trees

Trees alter the snowpack, but they are generally poor anchors. Avalanches happen in the trees!



Disaster species, tree age often indicate common slide path characteristics.

# Mountain Weather

Weather is by far the most dynamic variable of the avalanche equation. It interacts directly with both terrain and snowpack.

Our focus is on **current** or **recent rate of loading**.



# Mountain Weather

## Loading - Wind Deposition



© Bruce Tremper

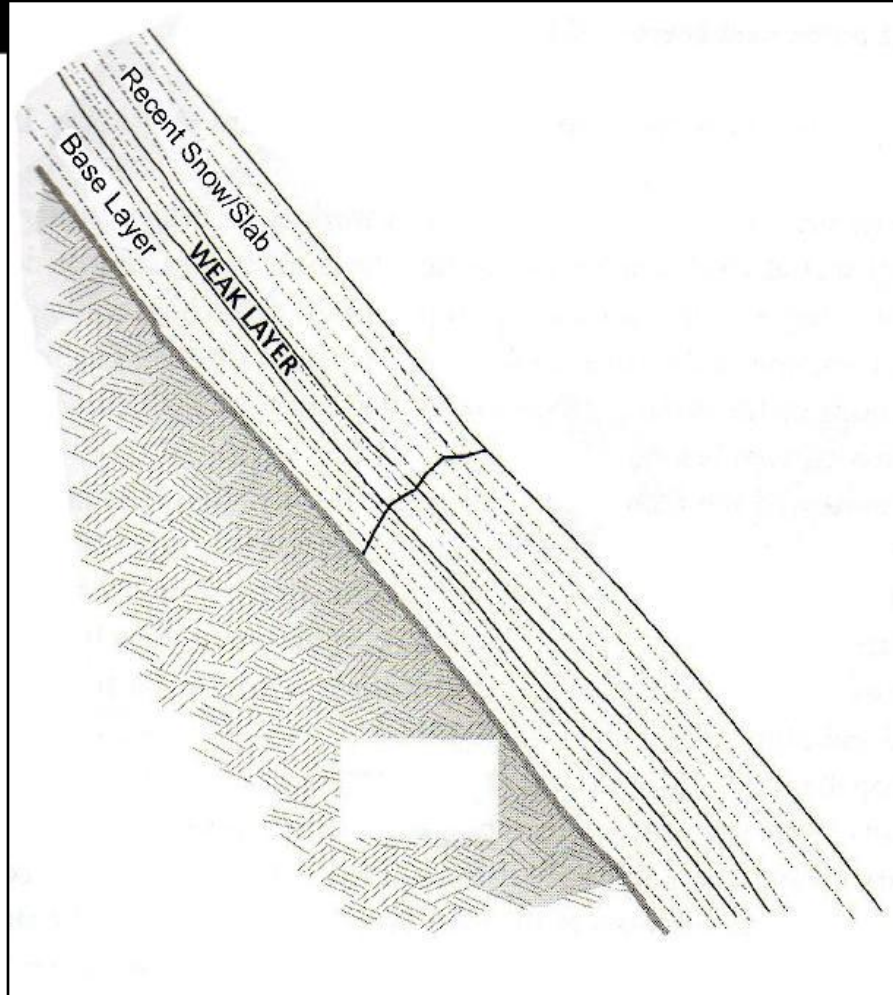
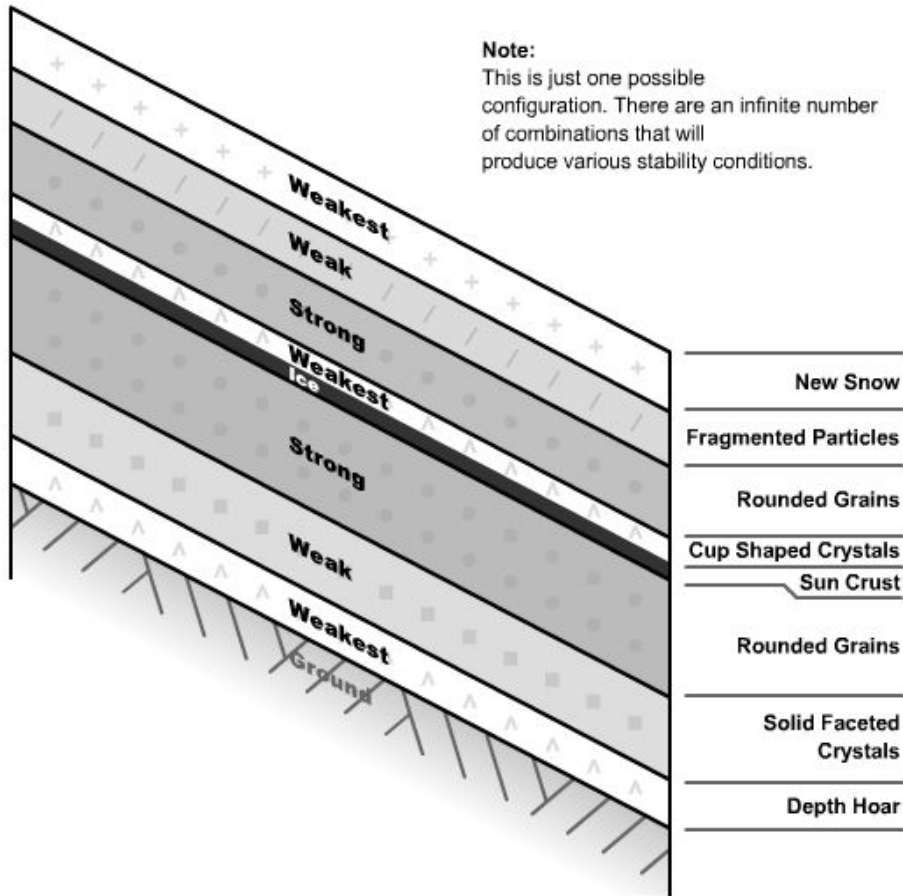
Wind

# Snowpack Structure

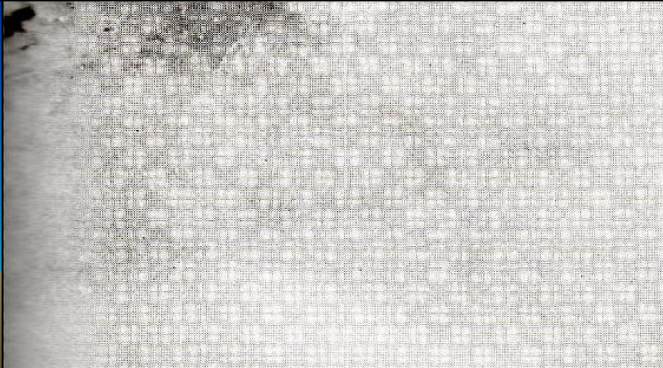
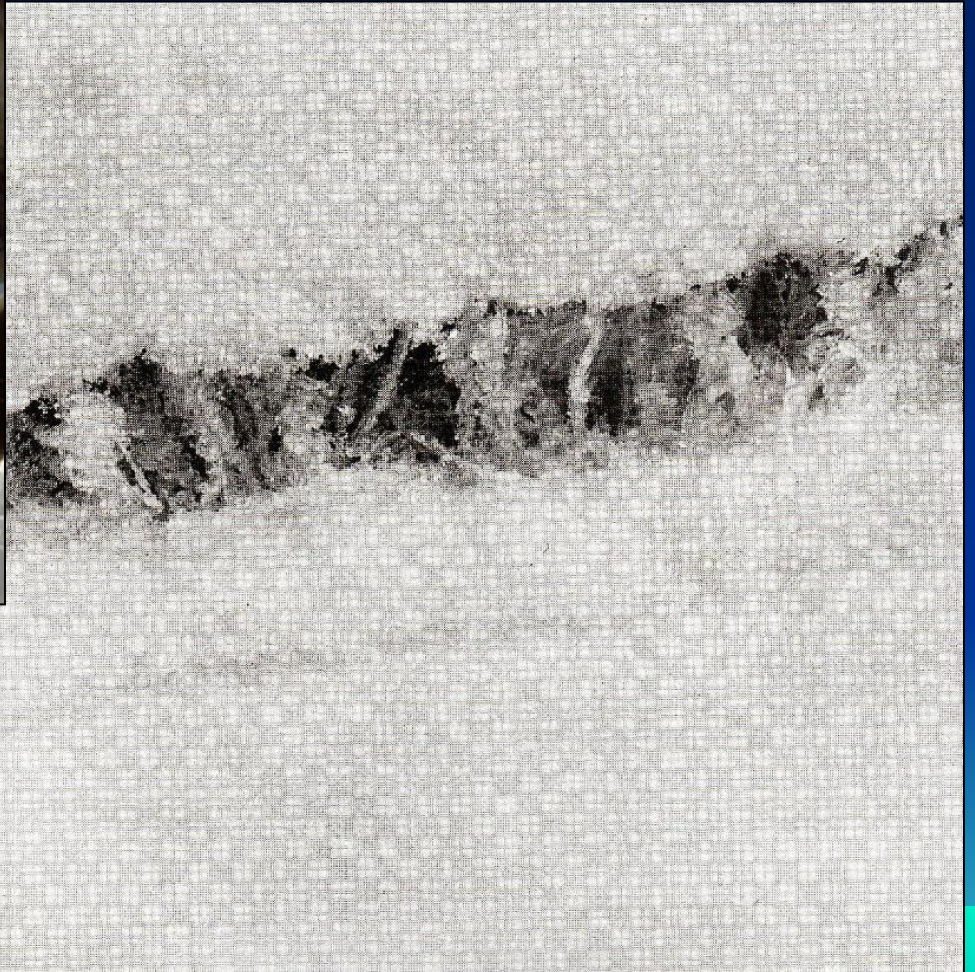
## EXAMPLE OF LAYERS IN SNOWPACK:

**Note:**

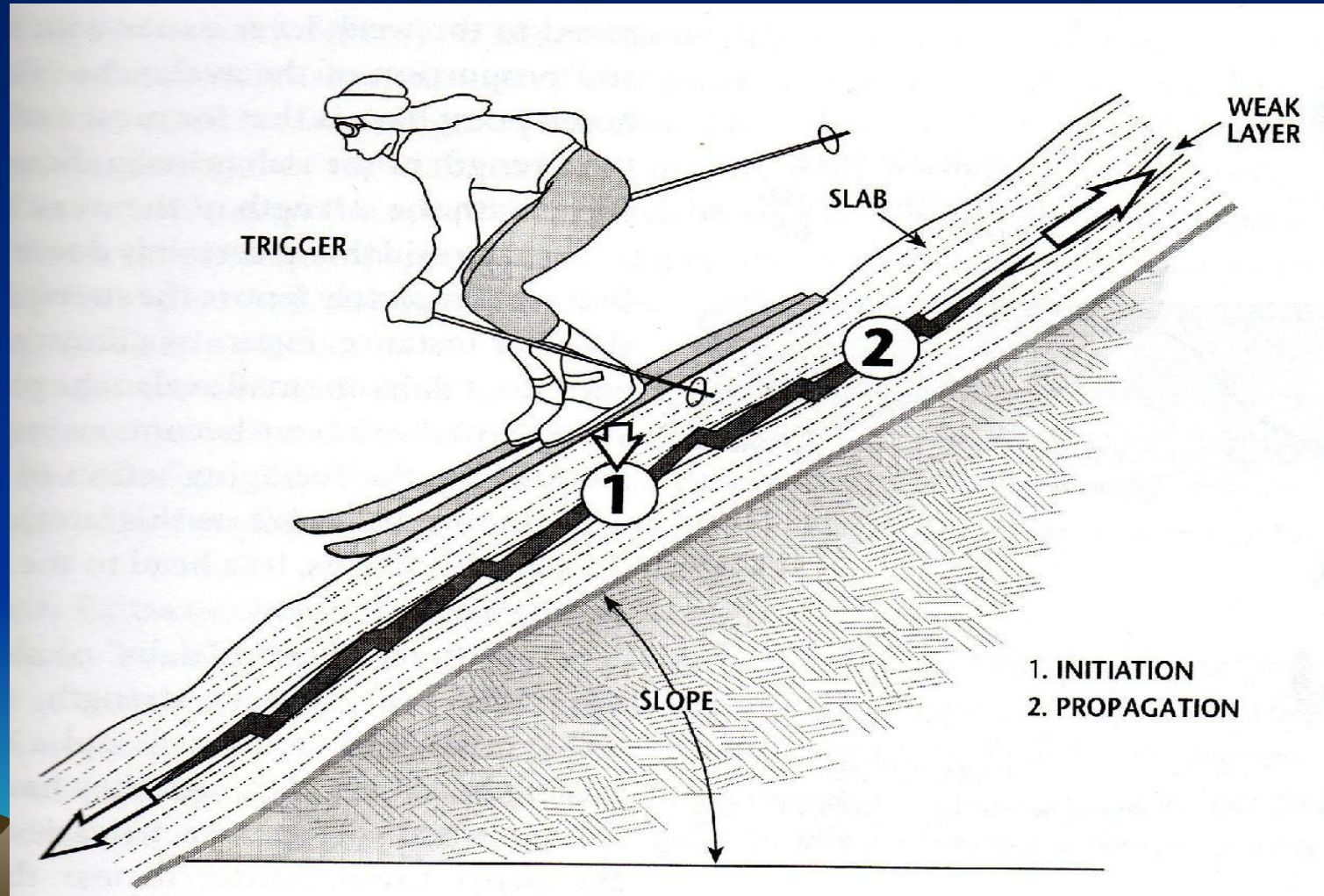
This is just one possible configuration. There are an infinite number of combinations that will produce various stability conditions.



# Snowpack Layers



# Snowpack Failure



# HUMAN FACTOR

## F-A-C-E-T-S

Psychological factors that make us make the decisions we do.

- Familiarity - “I’ve skied this line a dozen times and it has always held.”
- Aceptance - “I’m not going to be the one to chicken out/ruin the day.”
- Commitment - “We have come this far, we might as well go the whole way.”
- Expert halo - “The guide or local guy/gal must know what he/she is doing.”
- Tracks/scarcity - “Lets get the goods before someone else does; look at all the other tracks on the slope.”
- Social proof - “Those other guys, or my buddies, are ripping it - clearly it is safe.”







# RED FLAGS

## A-L-P T-R-U-T-H

- Avalanches
- Loading (wind)
- Path (obvious avalanche path)
- Terrain trap
- Rating (local forecast)
- Unstable signs (collapsing, cracking)
- THaw (rapid warming)



1. Know your weakness.
2. Know how far you are from being absolutely sure.
3. Every day, every run, every mission IS A NEW SCENARIO!

## Red Flags

Clues or warning signs that indicate snow is unstable.



## Recent Avalanches:

If there are new avalanches, more are possible



## Red Flags

Clues or warning signs that indicate snow is unstable.



### Signs of unstable snow:

- Cracking or collapsing snowpack
- “Whumphing” sounds
- Hollow, drum-like sounds on hard snow

## Red Flags

Clues or warning signs that indicate snow is unstable.



# Heavy snowfall or rain in the past 24 hours

Avalanches are often triggered the first clear day after a storm. Just because it's sunny, doesn't mean that it's safe.

## Red Flags

Clues or warning signs that indicate snow is unstable.



### Wind-blown snow

Leeward slopes can become heavily loaded even if it's not snowing.

## Red Flags

Clues or warning signs that indicate snow is unstable.



# Warming or Rapidly Increasing Temperatures

Warm temperatures and gravity can cause the snow to creep downhill and become less stable.








# Staying Safe

## Avalanche Forecast

The [Eastern Sierra Avalanche Center \(ESAC\)](#) is our local forecasting center. Their forecasts are helpful, but they are short on data.

### North American Public Avalanche Danger Scale

Avalanche danger is determined by the likelihood, size and distribution of avalanches.

Danger Level		Travel Advice	Likelihood of Avalanches	Avalanche Size and Distribution
5 Extreme		Avoid all avalanche terrain.	Natural and human-triggered avalanches certain.	Large to very large avalanches in many areas.
4 High		Very dangerous avalanche conditions. Travel in avalanche terrain <u>not</u> recommended.	Natural avalanches likely; human-triggered avalanches very likely.	Large avalanches in many areas; or very large avalanches in specific areas.
3 Considerable		Dangerous avalanche conditions. Careful snowpack evaluation, cautious route-finding and conservative decision-making essential.	Natural avalanches possible; human-triggered avalanches likely.	Small avalanches in many areas; or large avalanches in specific areas; or very large avalanches in isolated areas.
2 Moderate		Heightened avalanche conditions on specific terrain features. Evaluate snow and terrain carefully; identify features of concern.	Natural avalanches unlikely; human-triggered avalanches possible.	Small avalanches in specific areas; or large avalanches in isolated areas.
1 Low		Generally safe avalanche conditions. Watch for unstable snow on isolated terrain features.	Natural and human-triggered avalanches unlikely.	Small avalanches in isolated areas or extreme terrain.

Safe backcountry travel requires training and experience. You control your own risk by choosing where, when and how you travel.

# Safe Travel Protocols:

Never expose more than one person at a time to avalanche danger.

One person on a slope at a time (stay spread out if you must expose others).

Never descend directly above a companion or another group.

Avoid stopping in or beneath avalanche paths.

Watch each other closely from safe locations.



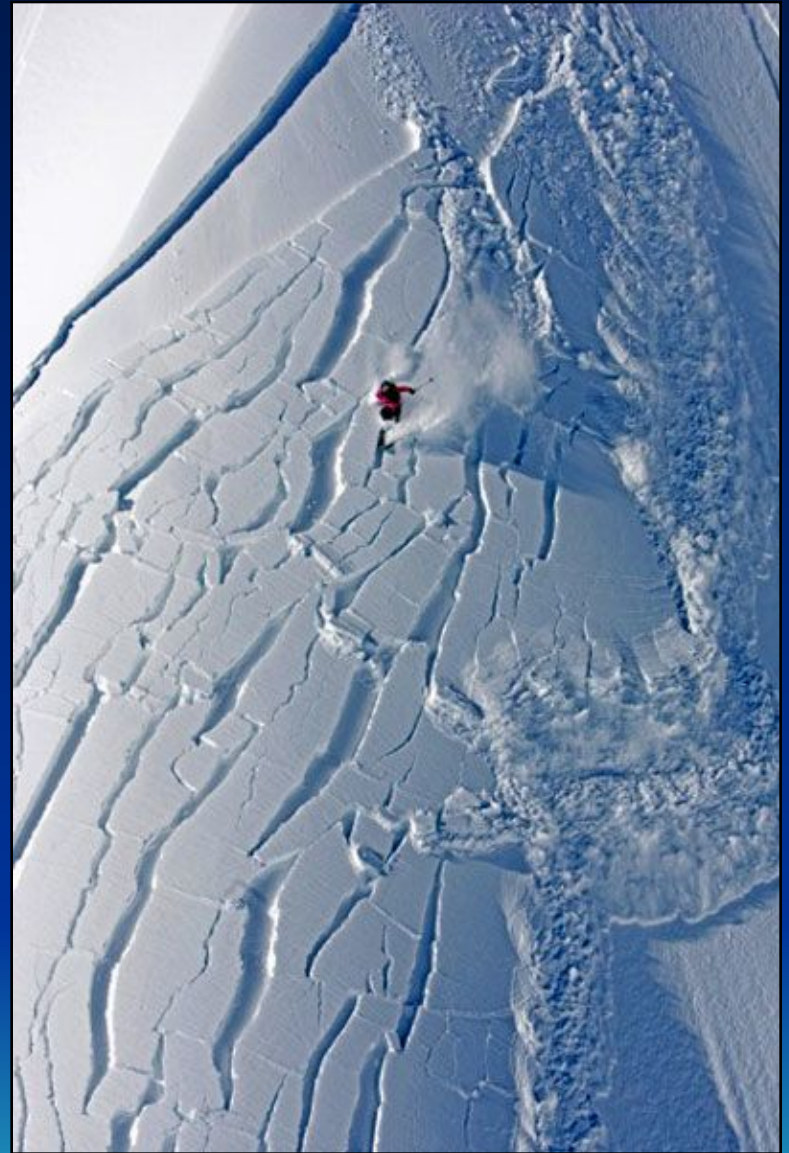


# Trip Planning

1. Get an avalanche forecast
2. Get the current weather forecast
3. Understand the strengths and weakness of the party
4. Plan the route
5. Construct a time/objective plan
6. Contingency planning

# If You're Caught...

- Yell so everyone hears.
- Try to get off the slab.
- Fight, swim to stay afloat.
- As the snow slows, try to get a hand above the surface.
- Use the other to create an airspace.
- If buried, try to stay calm and relax.



# If Someone Else is Caught...

- Alert everyone.
- Watch the victim closely.
- Identify a point last seen.
- Assess the danger of the search area.
- Verbalize a plan
- Switch beacons to “search.”
- Mark point last seen and begin search here.
- Begin beacon search.



# Rescue

## Essential Tools

- Beacon
- Shovel
- Probe



**ALWAYS!!!**

# Rescue

## Beacons

- Wear it properly, and keep it attached.
- Search along magnetic flux lines.
- Signals get stronger as you get closer.
- Range is usually at or above 40 meters.
- Always have at least 80% battery (alkaline, non rechargeable)

**\*ALWAYS** do beacon checks before leaving the trailhead! (search & send)



**DO NOT** forget to switch all rescuer beacons to **RECEIVE** or **SEARCH!**

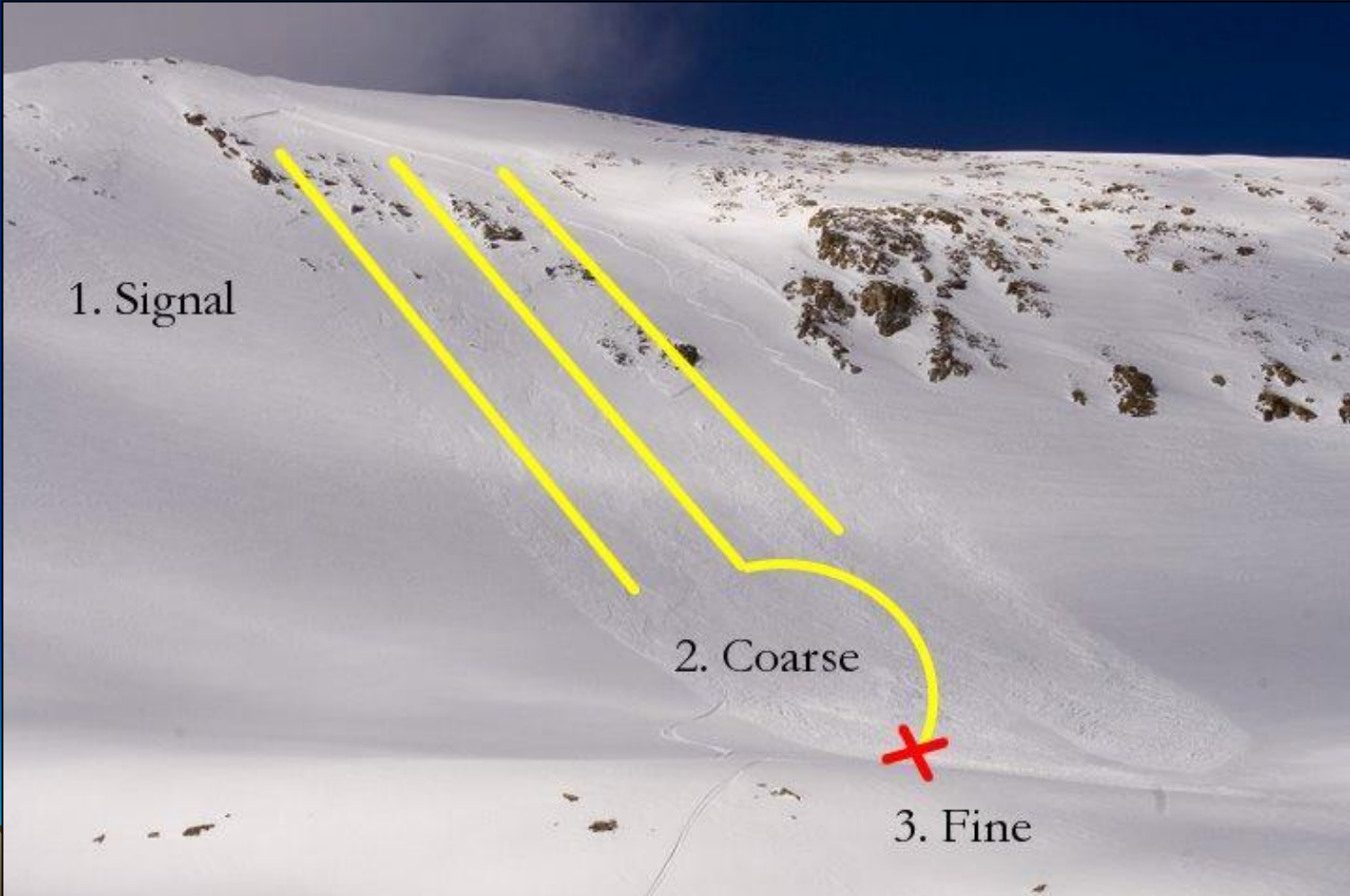
# Rescue

## Strategy - Single Searcher



# Rescue

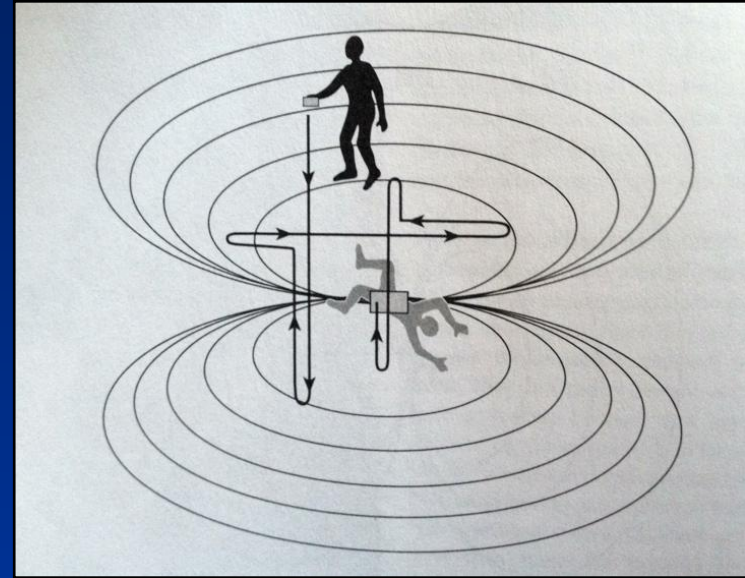
## Strategy - Multiple Searchers



# Rescue

## Fine Search

- Starts at about the ~4m mark.
- Slow WAY down!
- Transition from flux-line to grid search.
- Relax, give your beacon and yourself time to process.
- Mark the spot, note the distance.

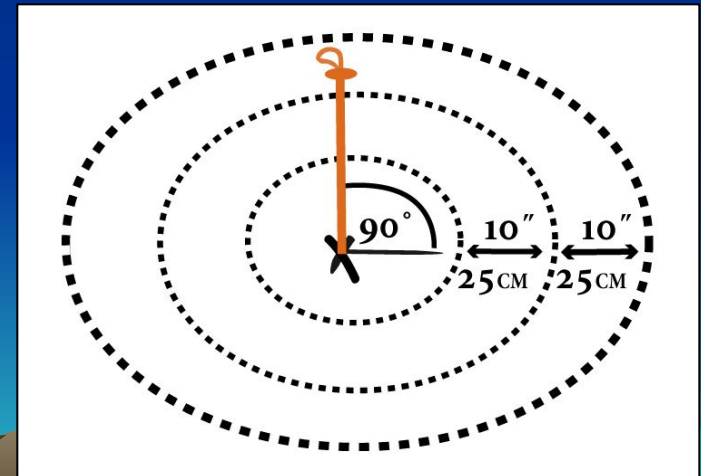
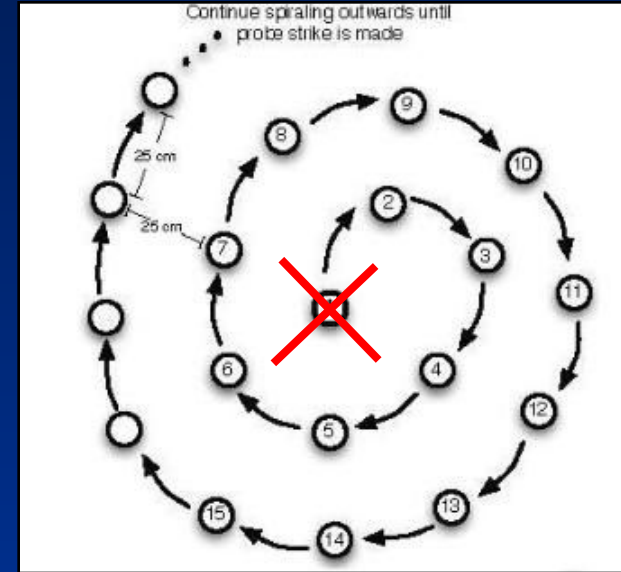




# Rescue

## Probing

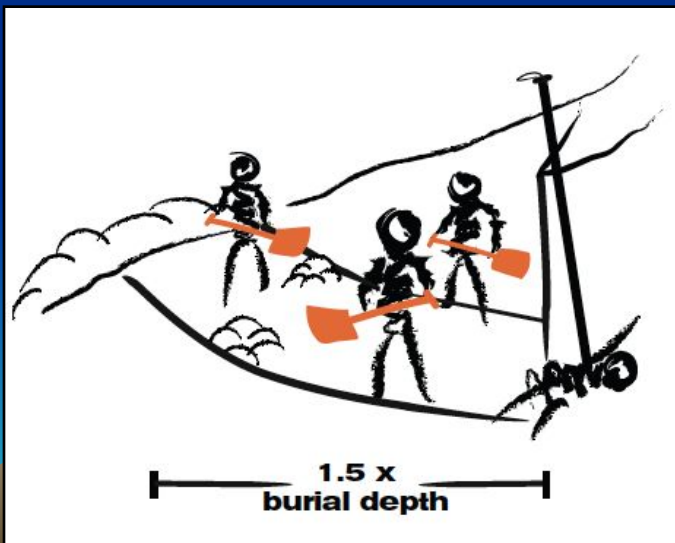
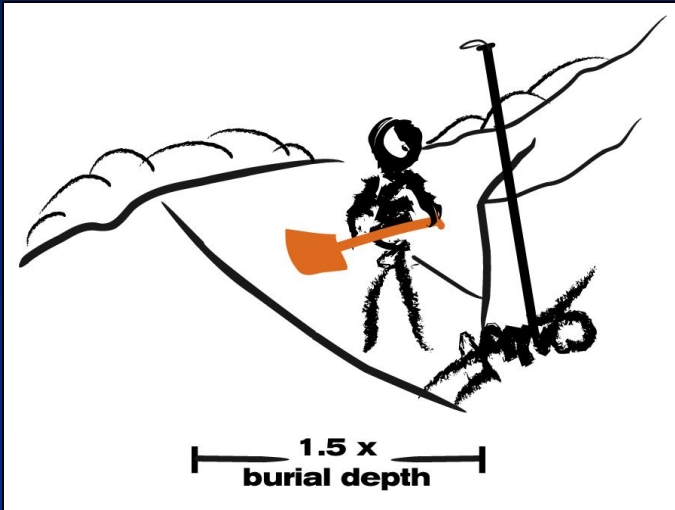
- Begin probing at lowest distance reading.
- Probe consistently and with a plan.
- Probe holes should be ~10" apart.
- Once you have confirmed the victims location, leave the probe in the snow.



# Rescue

## Shoveling

- Start 1.5x burial depth below victim.  
Do not step on top of them!
- Single rescuer -- wingspan wide.
- Two rescuers -- work side by side.
- Multiple rescuers -- V formation.
- Many rescuers -- swap out often.



# Rescue

## Shoveling

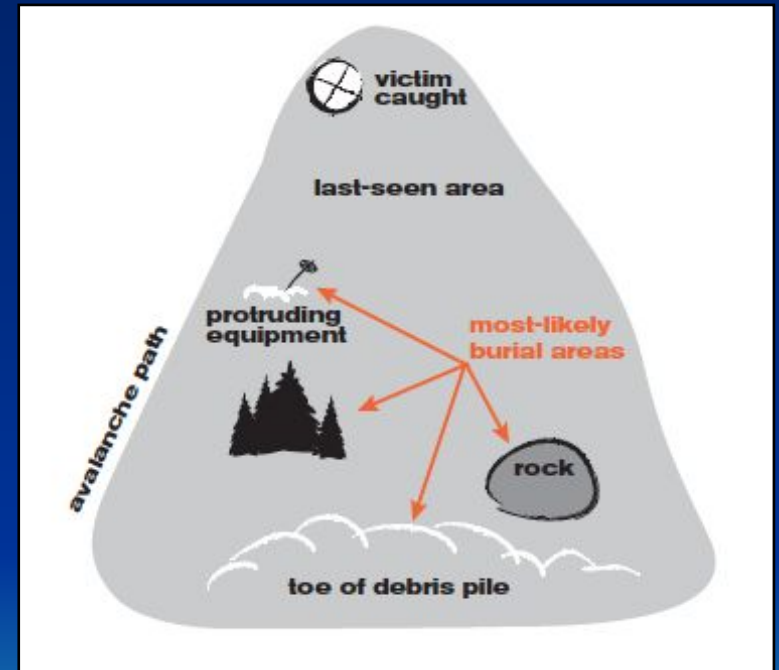


# Rescue

## Without a Beacon

### Spot Probing:

- Near trees
- Near last-seen area
- Around, especially below, equipment
- Around rocks
- At the toe of debris pile

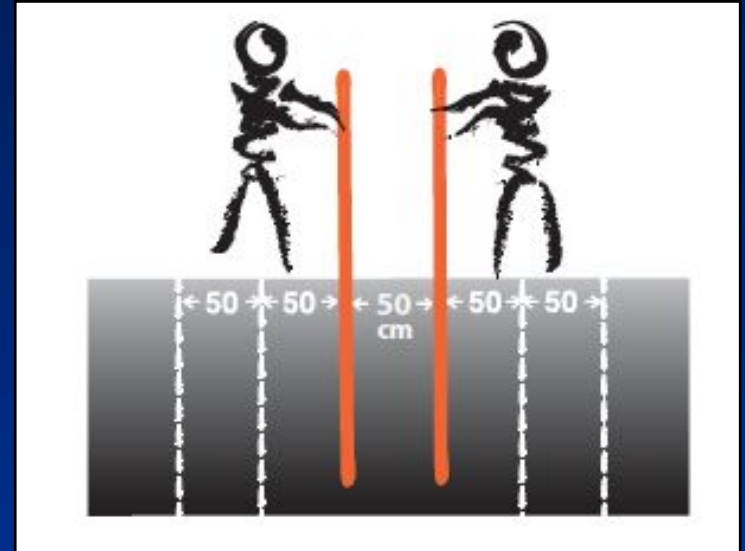


# Rescue

## Without a Beacon

### Probe Lines:

- A last ditch effort
- Line up wrist-to-wrist
- Probe left, center, right
- Then move 1 step forward
- Each probe ~50cm apart



# Additional Resources

- Forest Service National Avalanche Center <http://www.fsavalanche.org/>
- Eastern Sierra Avalanche Center <http://esavalanche.org/>
- American Avalanche Association <http://avalanche.org/>
- USDA National Resources Conservation Service's Snotel Sites <http://www.wcc.nrcs.usda.gov/snow/>
- Dept. of Water Resources <http://cdec.water.ca.gov/snow/current/snow/index.html>

Avalanche classes available through SMG, SMI, SMC

- Avy I (~3 day course)
- Avy II (~4 day course)