

# Avalanche Skills Training, Level 1

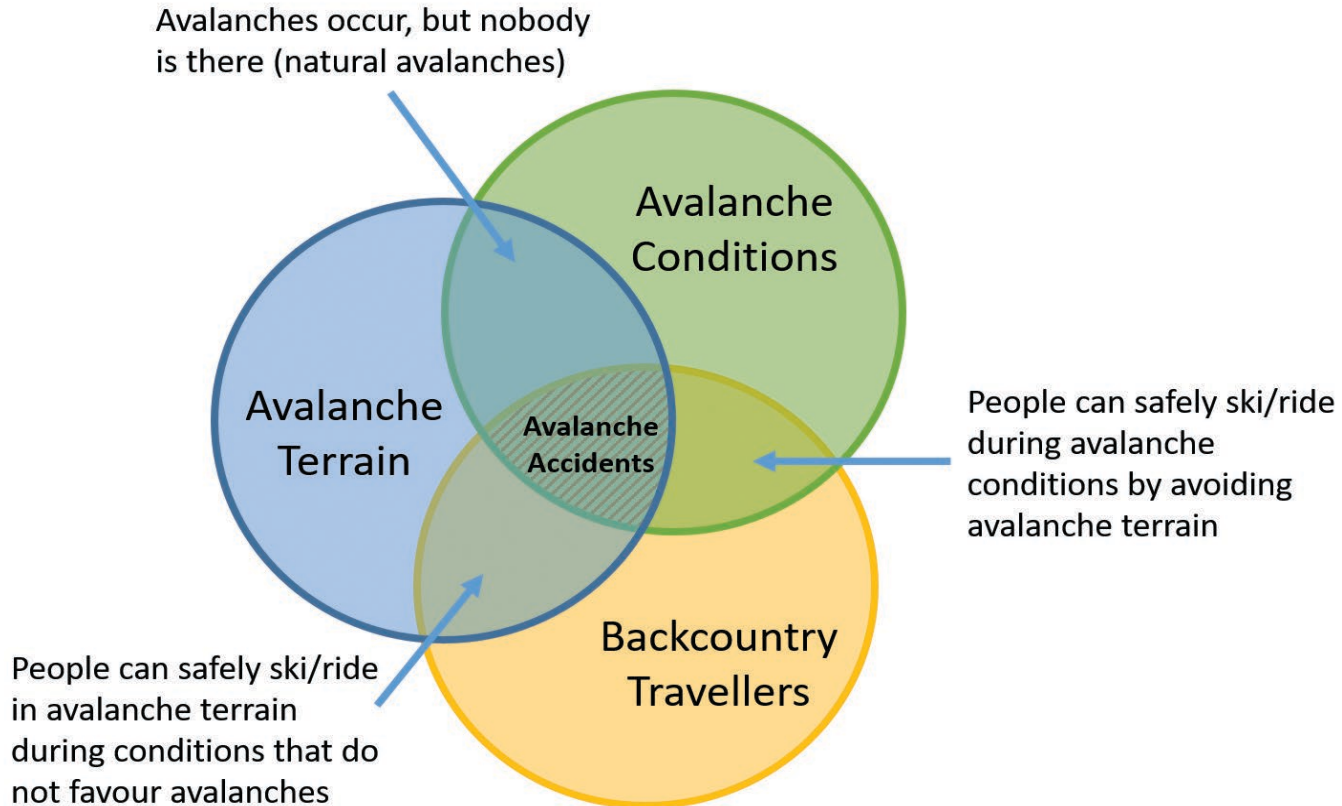


**Summit Mountain Guides**

# AST 1 Course Learning Objectives:

- Describe avalanche formation and release using basic terminology
- Recognize avalanche terrain
- Complete a backcountry trip plan using all available resources
- Describe techniques to minimize risk when traveling in avalanche terrain
- Demonstrate a basic companion rescue

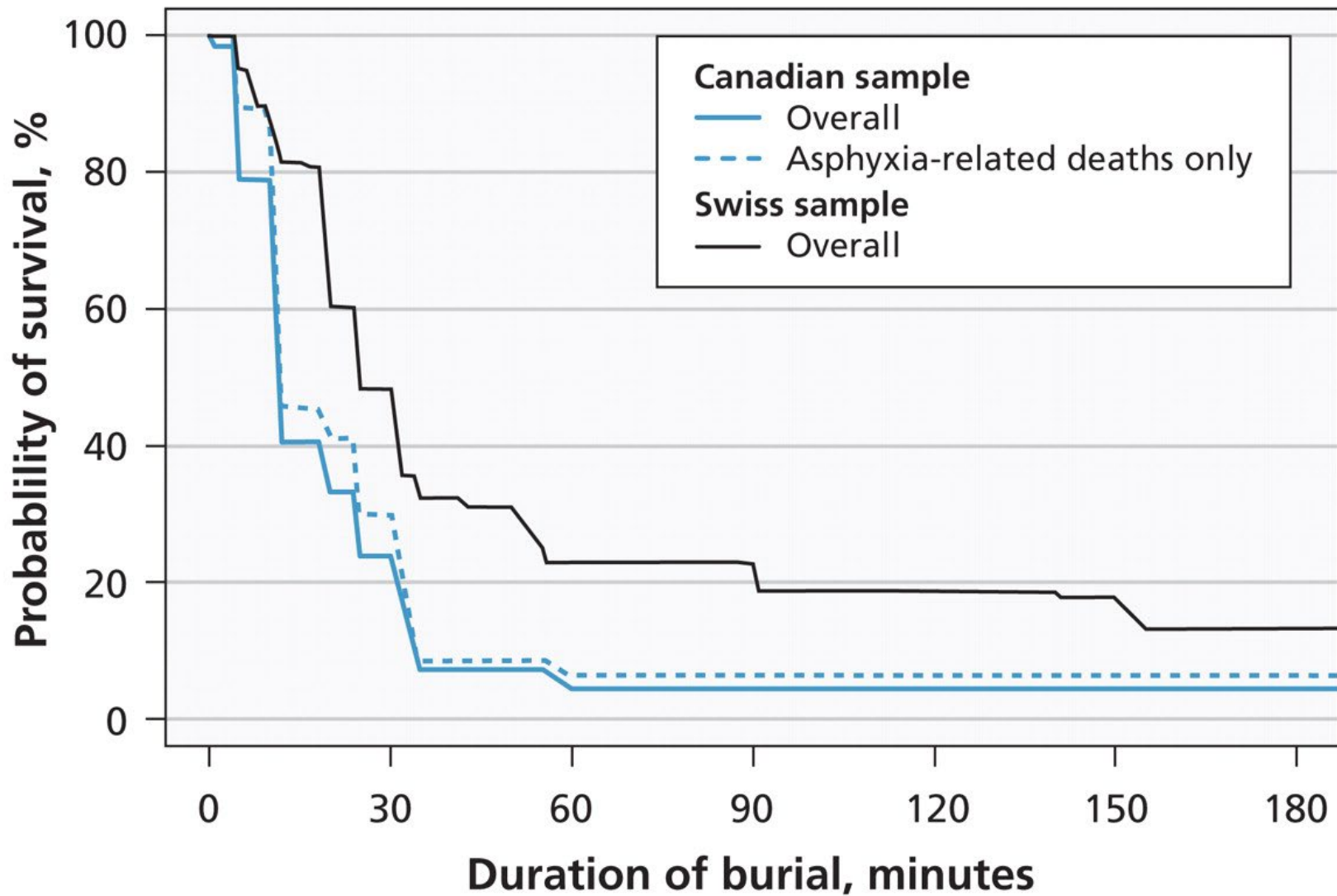
# Terrain Conditions People Circle



**Sound avalanche decisions requires us to assess avalanche conditions, make good terrain choices and evaluate risk. This concept is the foundation of the AST program.**

# Daily Process





# Decision Making Competence & Human Factors

Lets start by introducing risk concepts and discuss some of the tools available for making decisions in the backcountry.

## ❖ What makes a competent decision maker?

- Practical & theoretical knowledge
- Judgment
- Problem solving skills
- Communication ability
- Good attitude & behavior

# Human Factors

- Have you ever noticed your decision making process being affected by others?
- Similarly, have you ever noticed how you can impact your group's decision making process?

See Human Factor intro video & MEC link

# Avaluator & Trip planner

- Lets look at your Avaluator Booklet
  - Introduction to the Trip Planner (see AC website)
  - Introduction to the Slope evaluation card



# Establishing your Personal Avalanche Risk Comfort

The level of risk you expose yourself is a personal choice. The different colors on the Avaluator can help you make an *informed* decision about risk (see booklet).

Remember, there is always some level of risk associated with winter backcountry travel. There are no 100% safe trips.

# Avalanche Basics

To understand and manage avalanches, we must learn how the snowpack & avalanches form.



By the end of this lesson, you will have a better understanding of:

- ❖ **Snowpack layering**
- ❖ **Common signs of instability**
- ❖ Stress vs. Strength concept
- ❖ **Common triggers**
- ❖ **Avalanche types and Characteristics**
- ❖ **Avalanche Sizes**



# Snowpack Layering

Snowpack consists of snow layers formed by:

- Storm events
- Sun, wind, rain  
on surface layers
- Metamorphism
  
- The interaction between the layers has  
formation & release



# Common signs of instability

The Snowpack often displays visible and audible sounds of instability:

- Whumpfs
- Cracking
- Hollow sounds
- Difficult trail-breaking
- Avalanches



# Stress vs. Strength concept

Snow can fracture when:

- Strength of bonds that hold snow together are overcome by stress that overloads the snowpack
- Enough bonds fracturing at once result in a failure
- The strength varies highly and depends on many factors (terrain, load size, layer strength, etc.)



# Common triggers

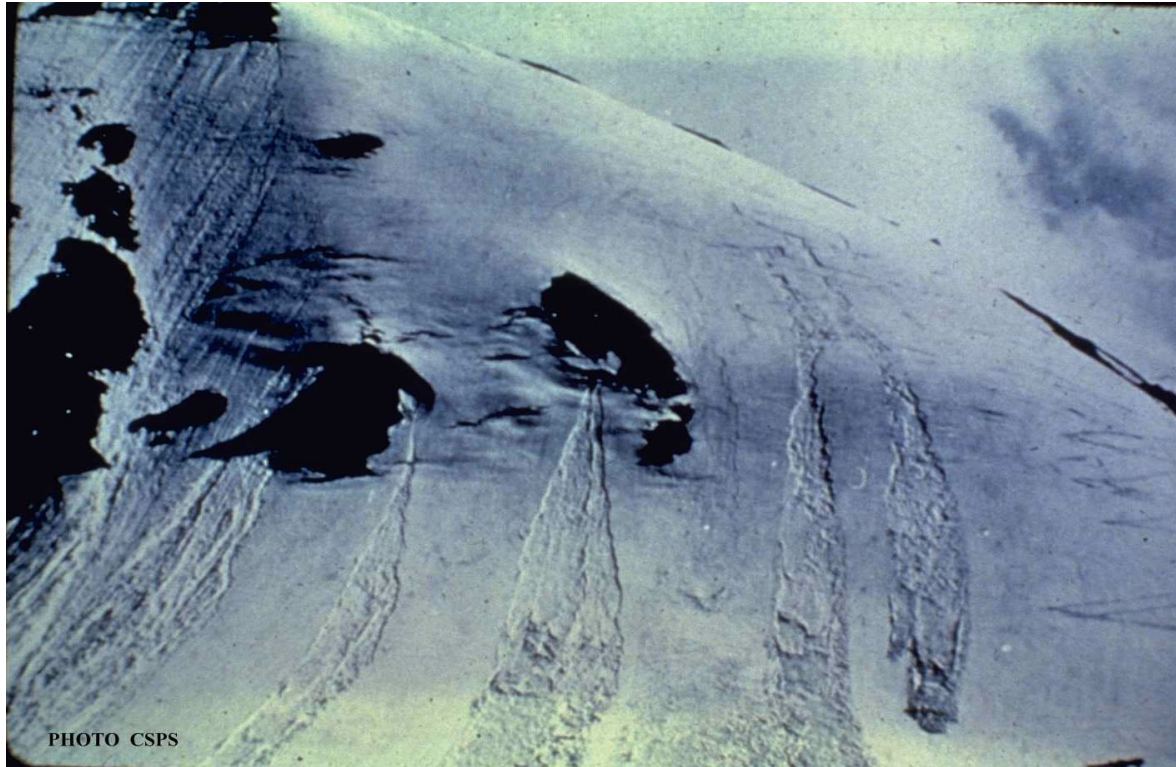
A trigger is the source of **stress** that can cause an avalanche.

Common triggers are:

- Natural
- Human



There are two types of avalanches



Loose snow avalanche (dry or wet)



# Slab Avalanches

Avalanches have a gliding,  
flowing & powder motion

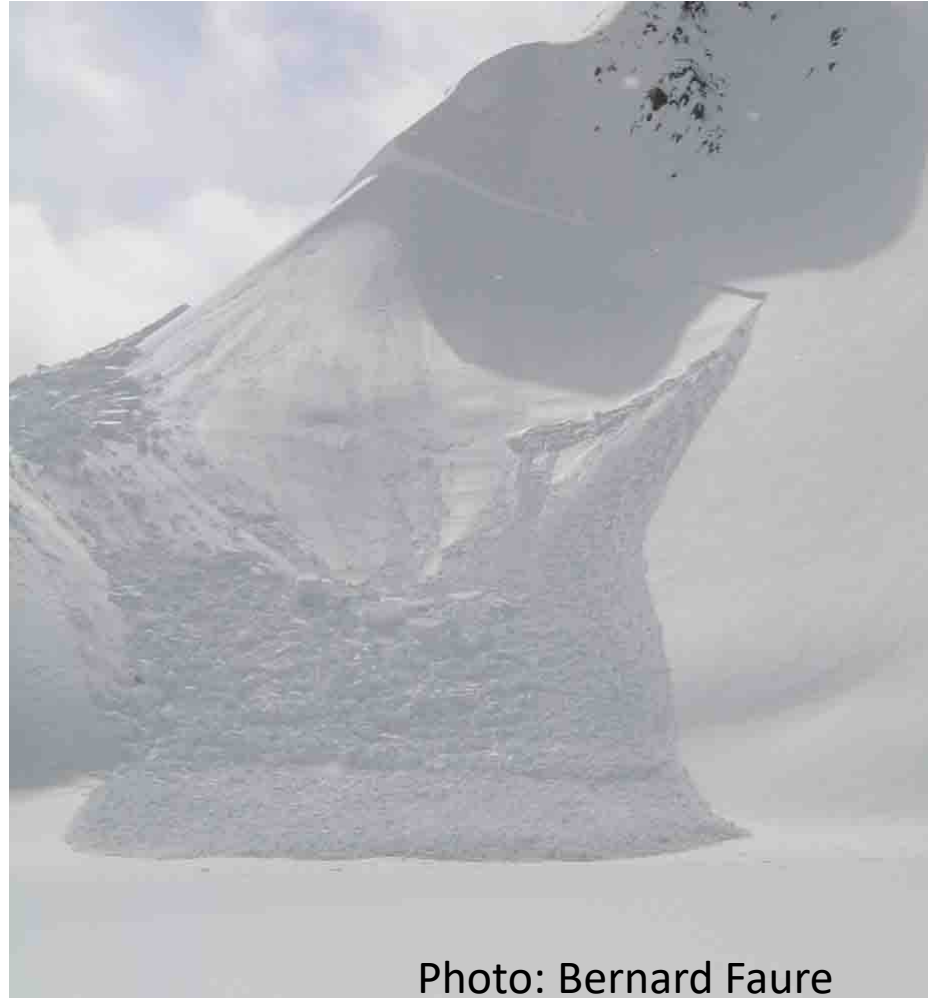
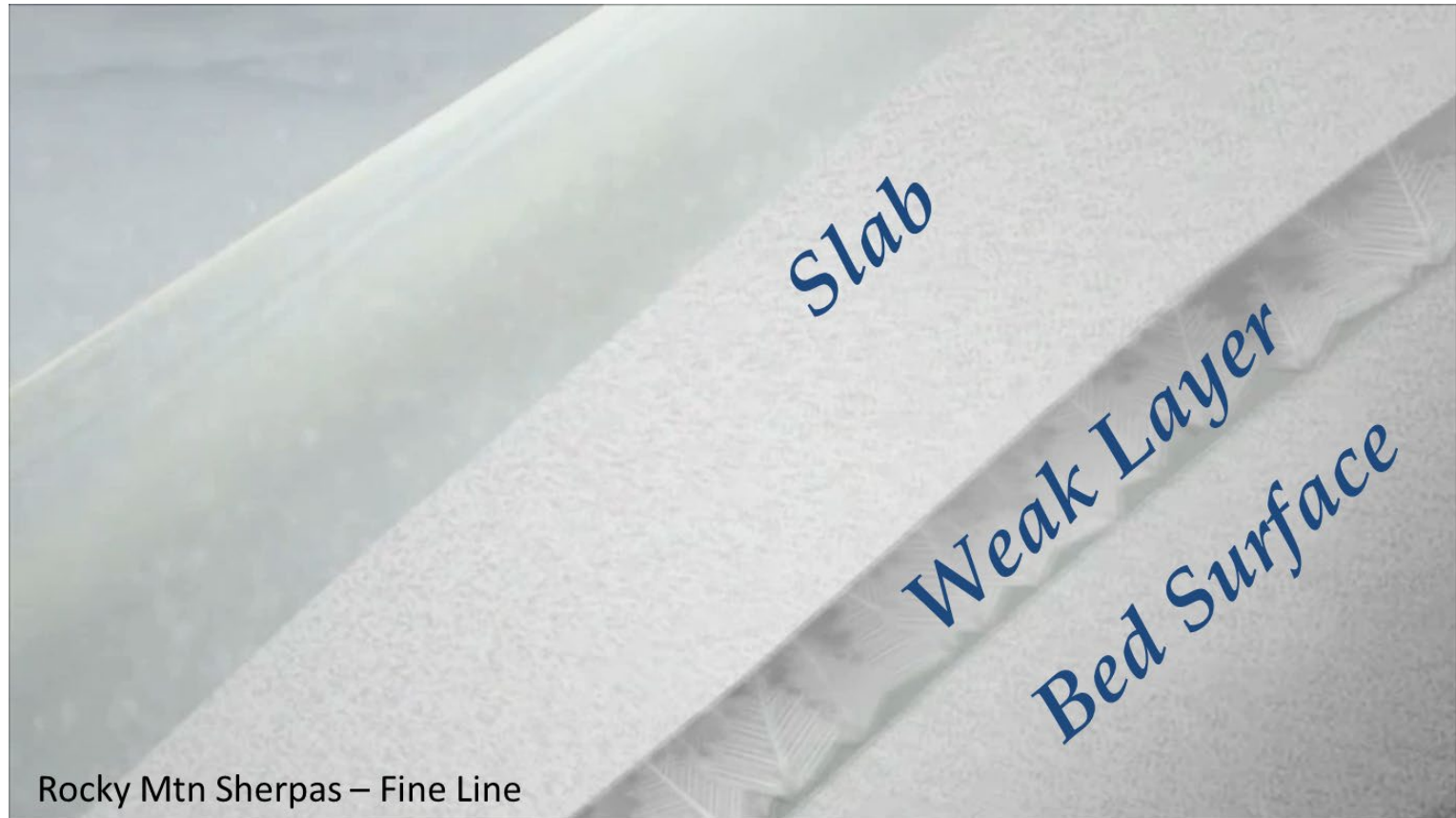


Photo: Bernard Faure

# Slab Avalanches



# Avalanche Sizes

<b>Destructive Size</b>	<b>Avalanche destructive potential (definition)</b>	<b>Typical mass</b>	<b>Typical impact pressure</b>	<b>Typical path length</b>
<b>1</b>	Relatively harmless to people.	<10 t	1 kPa	10 m
<b>2</b>	Could bury, injure, or kill a person.	10 <sup>2</sup> t	10 kPa	100 m
<b>3</b>	Could bury and destroy a car, damage a truck, destroy a wood frame house, or break a few trees.	10 <sup>3</sup> t	100 kPa	1000 m
<b>4</b>	Could destroy a railway car, large truck, several buildings, or a forest area of approximately 4 hectares.	10 <sup>4</sup> t	500 kPa	2000 m
<b>5</b>	Largest snow avalanche known. Could destroy a village or a forest area of approximately 40 hectares.	10 <sup>5</sup> t	1000 kPa	3000 m

(see ASTH book page 29 for table)

# Avalanche Terrain

For safe backcountry travel, it is essential to recognize avalanche terrain.



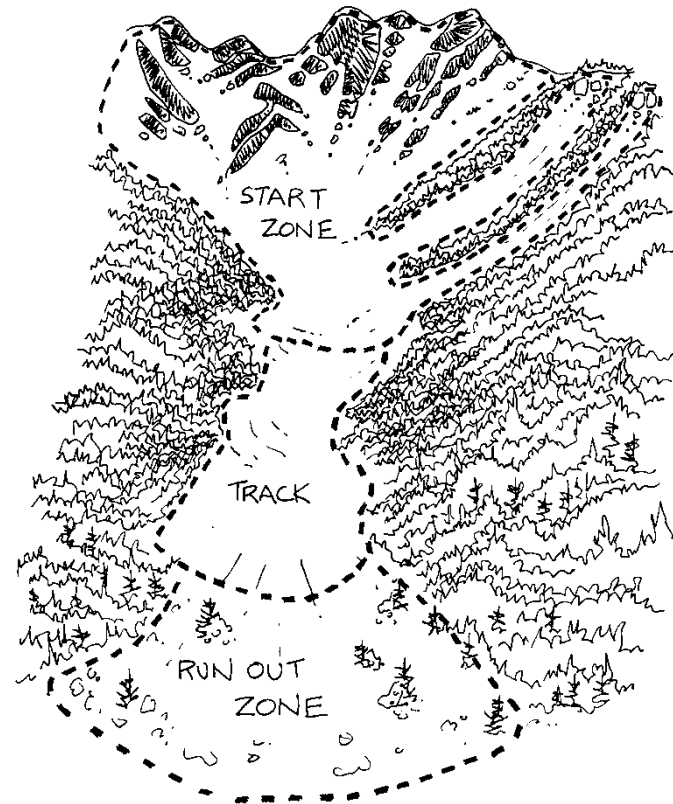
By the end of this lesson, you will better understand:

- ❖ **Avalanche paths and features**
- ❖ Characteristics of the start zone
- ❖ **Common trigger points**
- ❖ Characteristics of the track
- ❖ Characteristics of the runout zone
- ❖ **Poorly defined avalanche paths**
- ❖ **Evidence of past avalanches**

Lets watch the “*Choosing terrain*” video

## Avalanche paths and features:

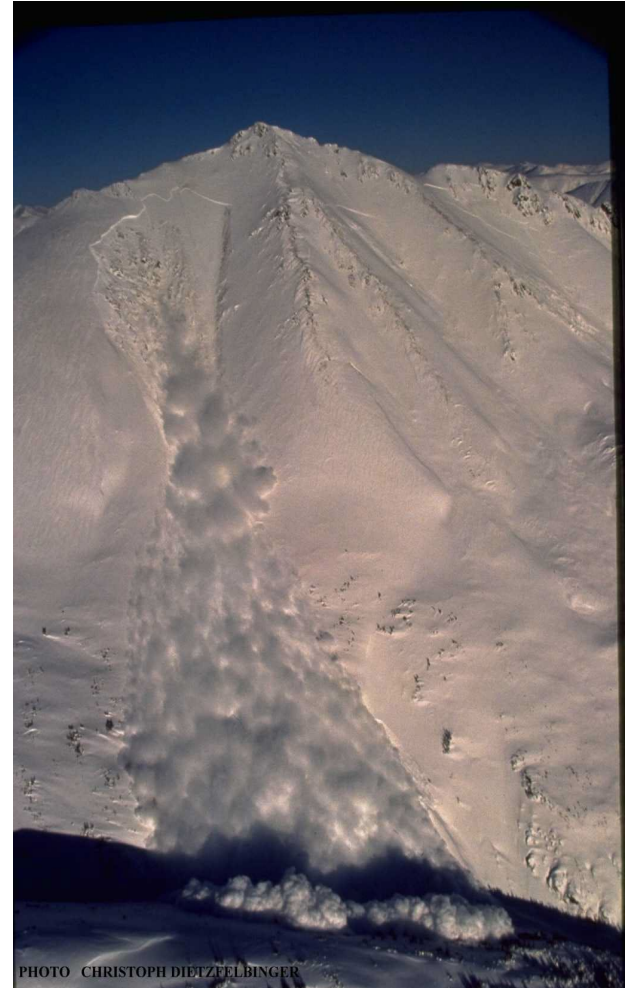
- Start zones
- Track
- Runout zone



## Start-Zone Characteristics:

Where avalanches initiate. This is closely related to:

☐ Incline, Aspect & Exposure in relation to **wind, sun, elevation & ground roughness**



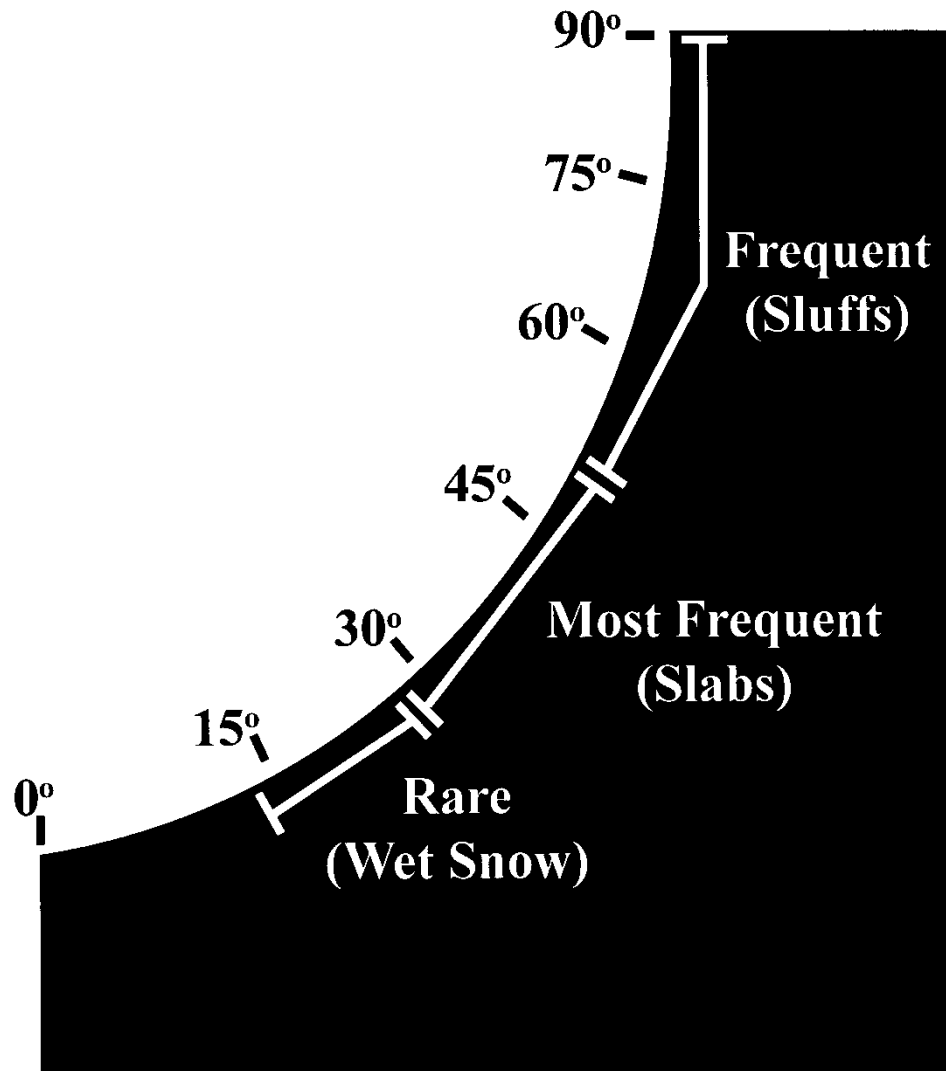
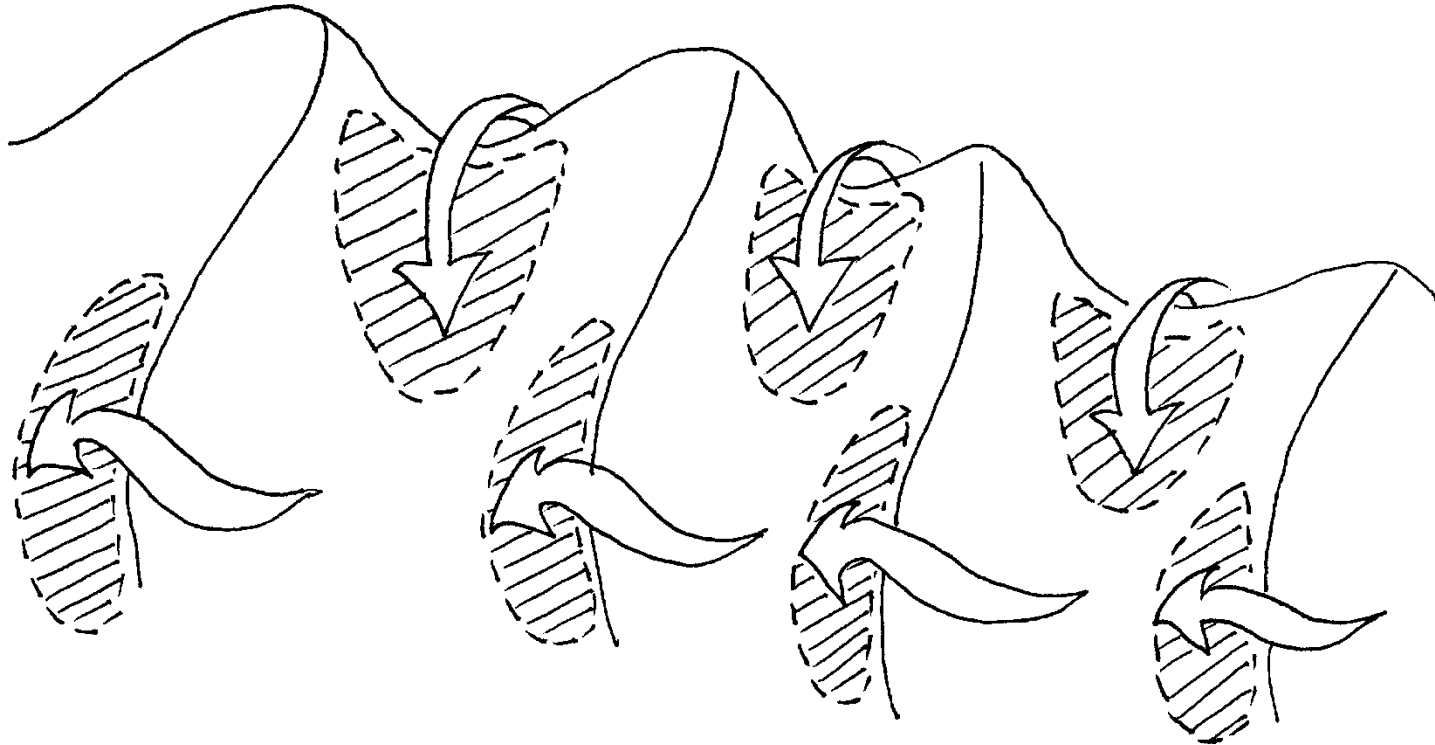
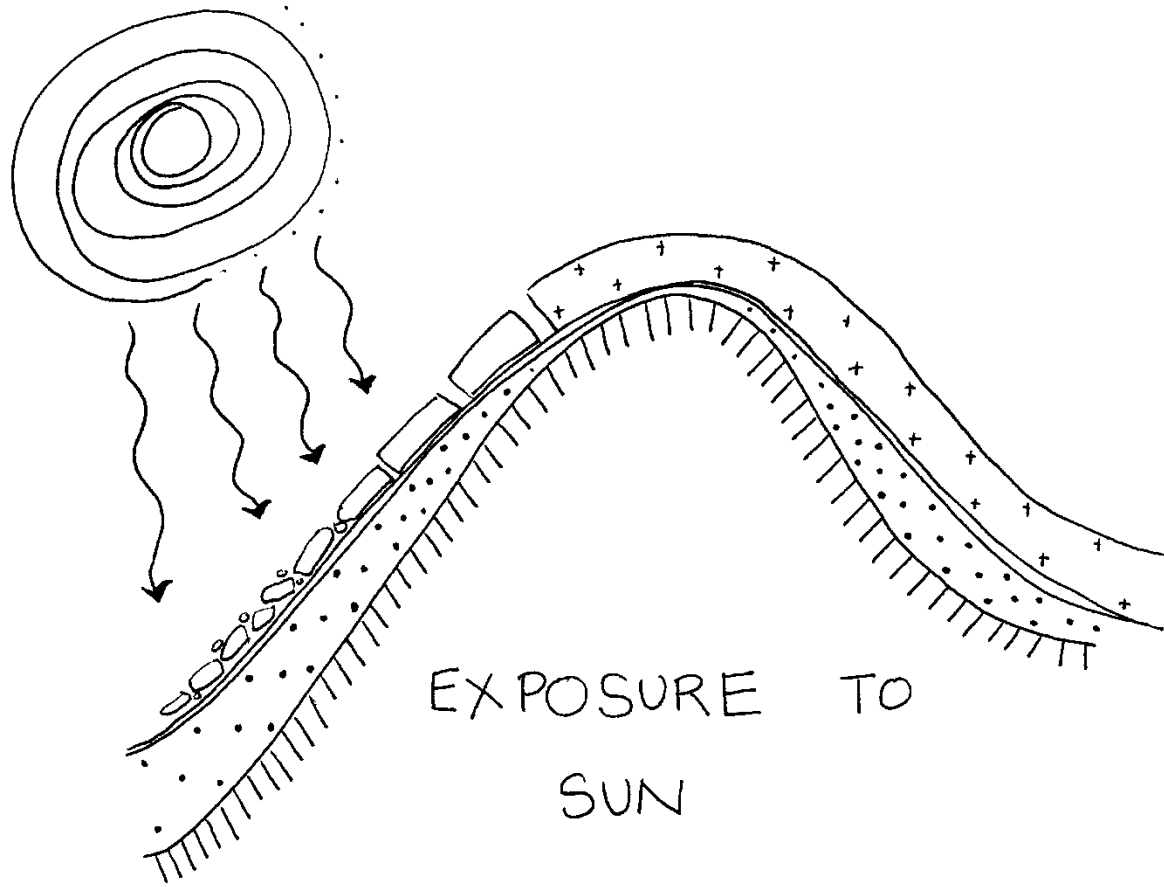


Illustration: Canadian Avalanche Association





**Illustration: Canadian Avalanche Association**



**Illustration: Canadian Avalanche Association**

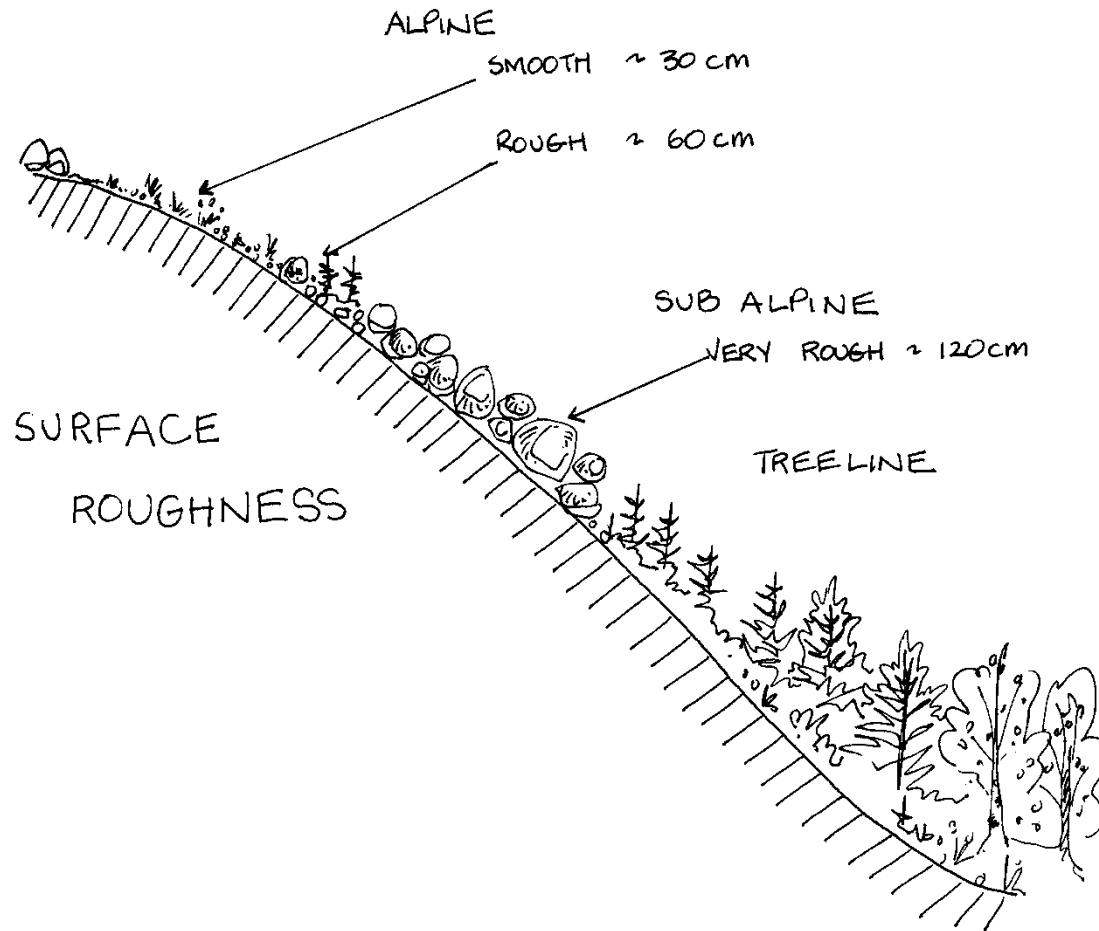


Illustration: Canadian Avalanche Association

Do you know what is happening at start zone elevation?

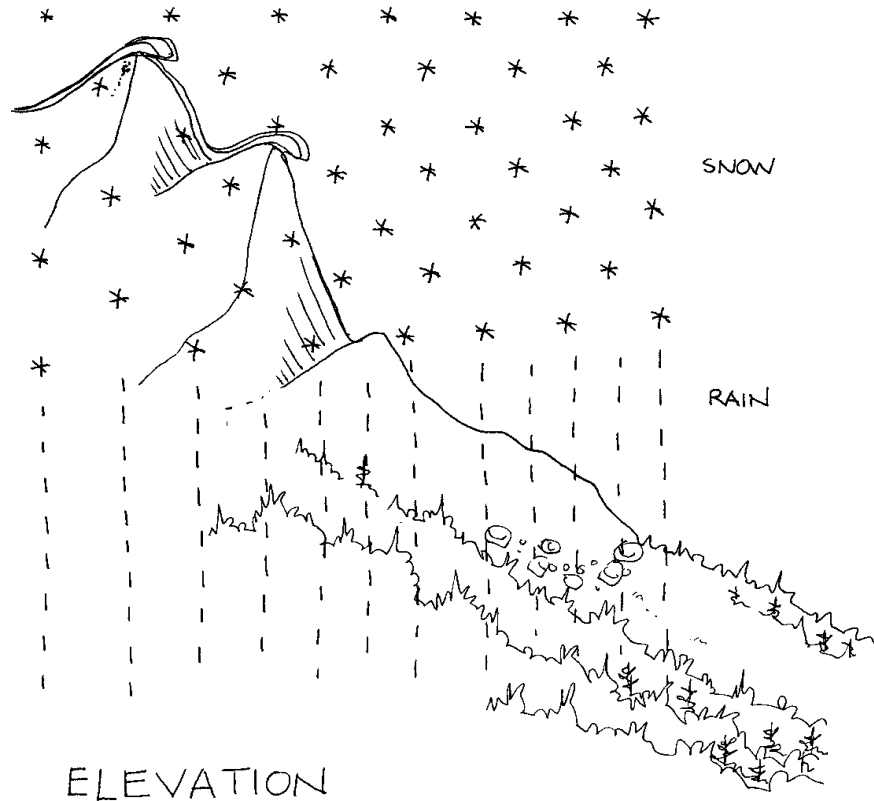


Illustration: Canadian Avalanche Association

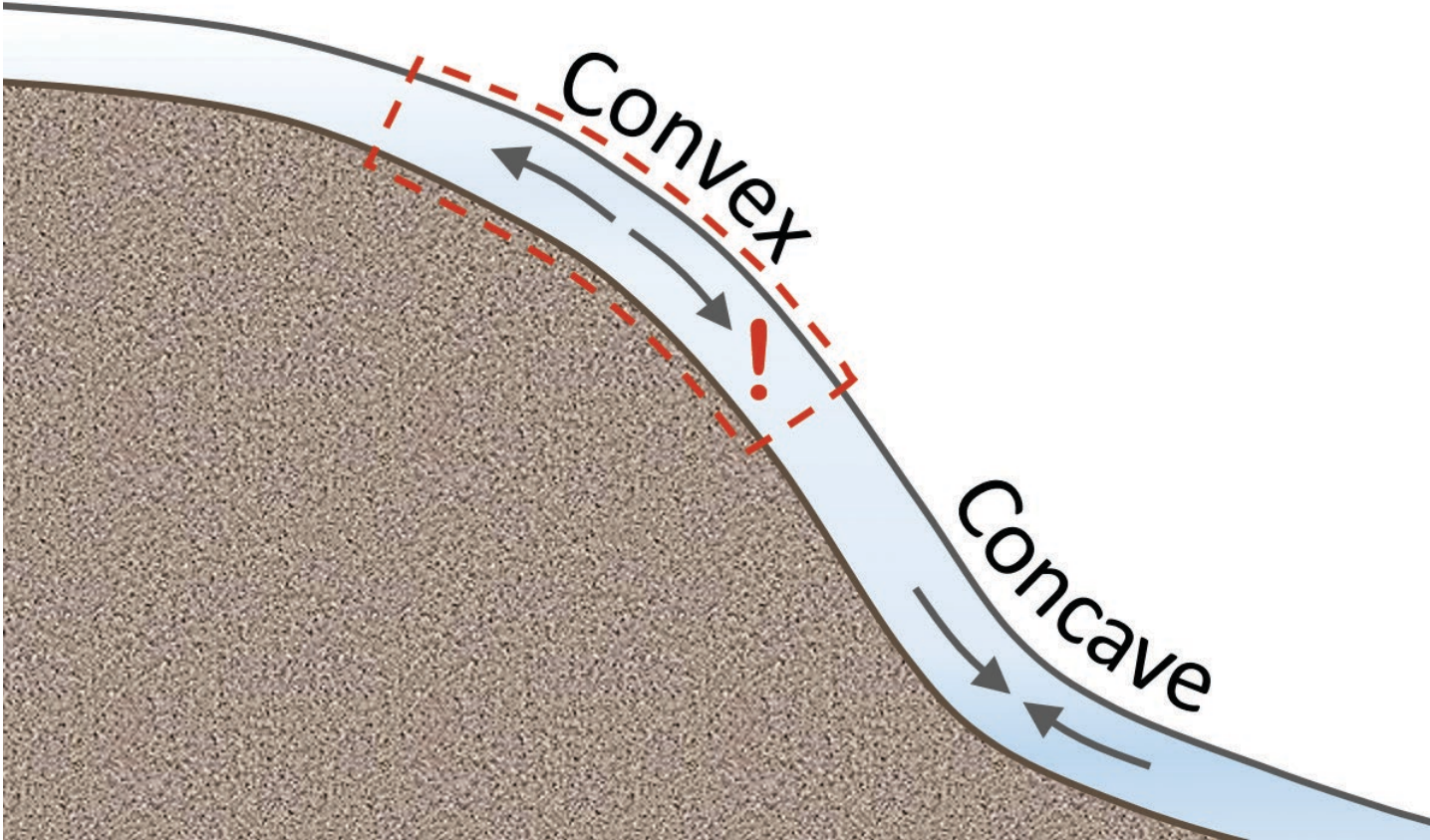
## Common trigger points:

- Convexity
- Toe of rock face
- Below cornice
- Shallow snowpack areas
- Points of weakness (trees, rocks emerging from snow)

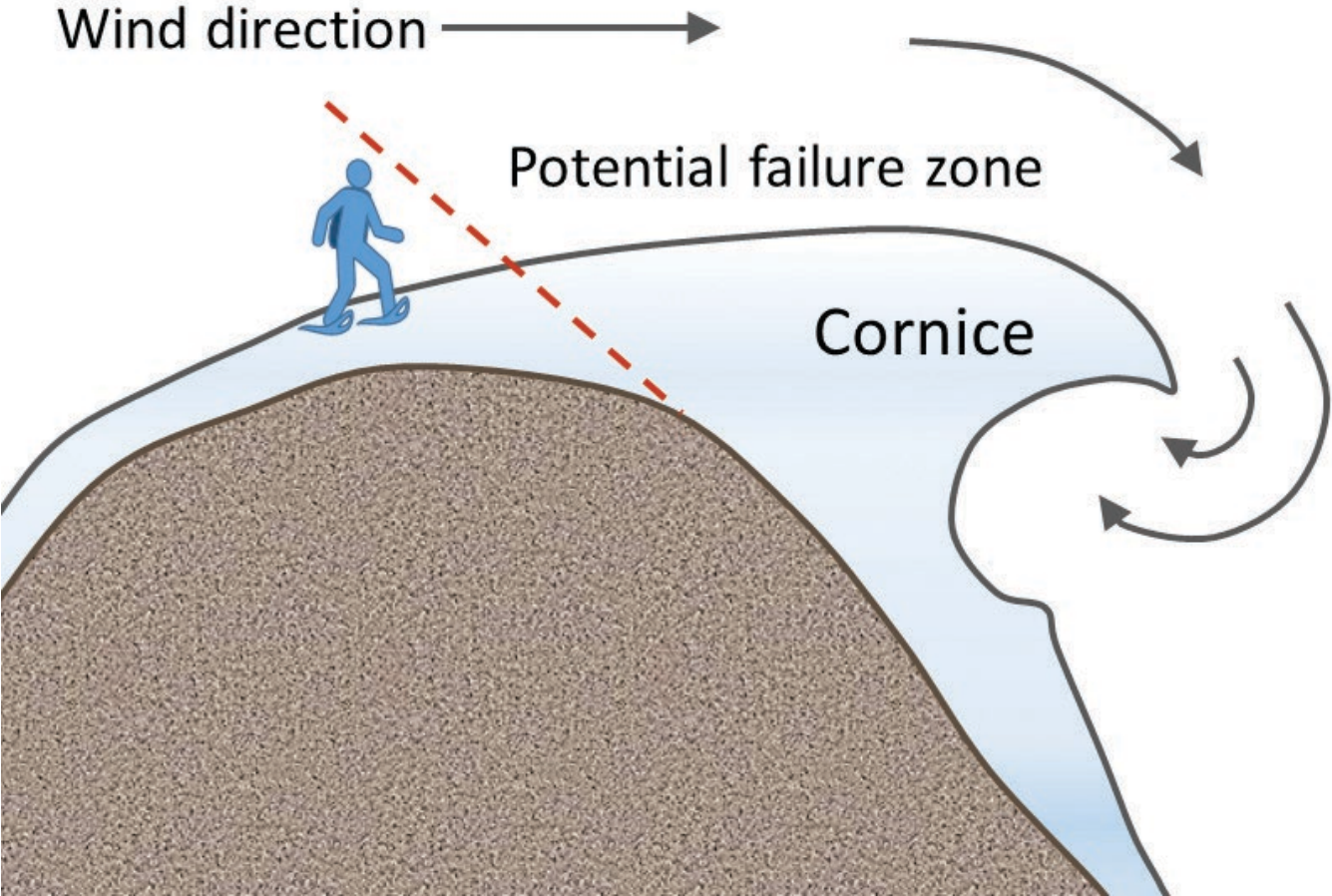


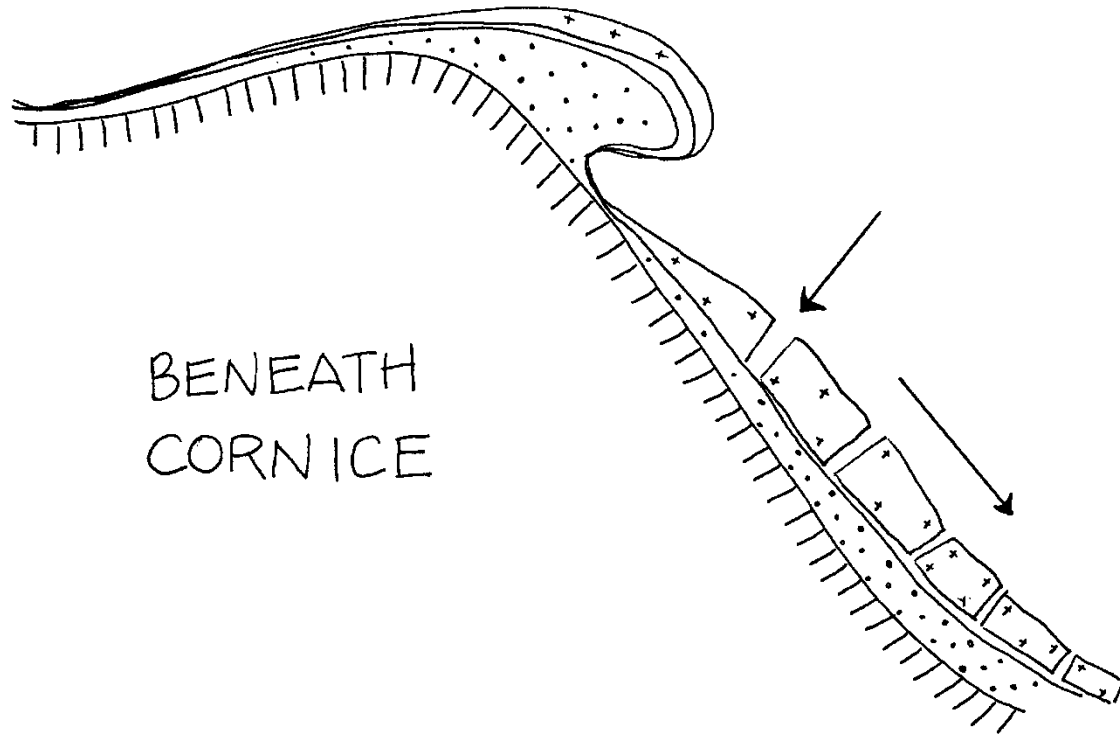
Photo: Dave Smith

# Convex and Concave Slopes



# Cornice Development





BENEATH  
CORNICE

**Illustration: Canadian Avalanche Association**



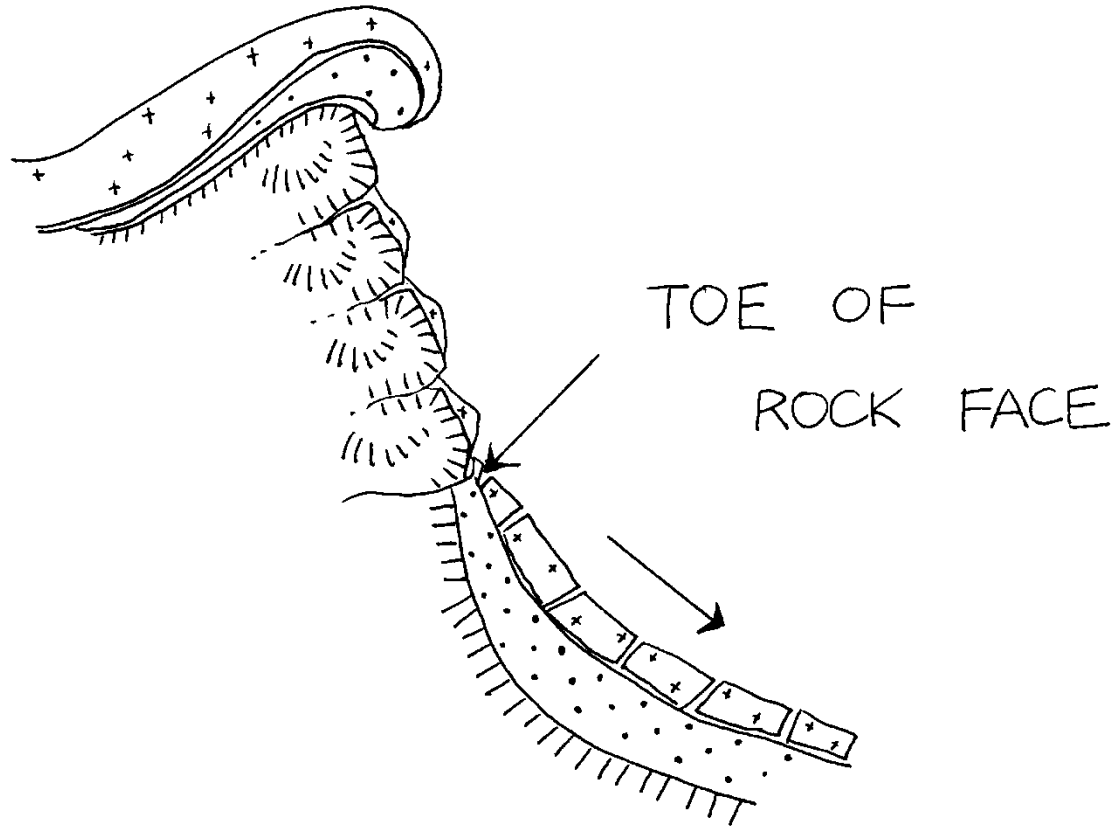
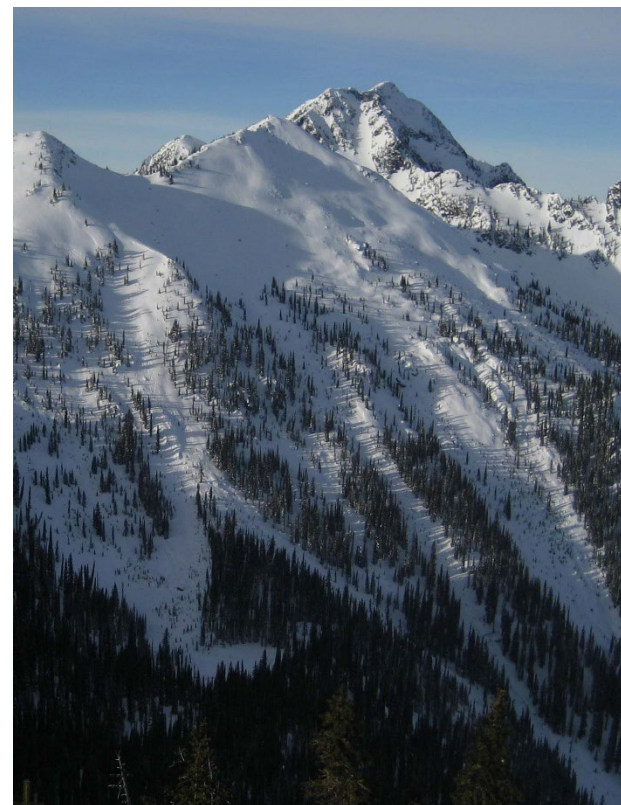


Illustration: Canadian Avalanche Association

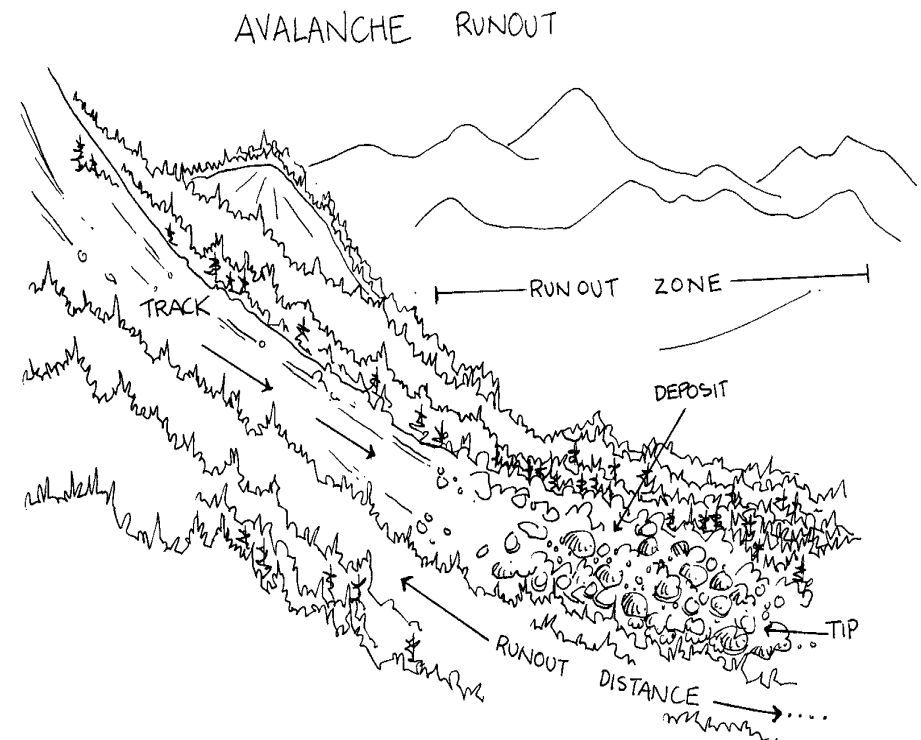
## Key Track Characteristics:

- Maximum destructive area
- Can continue to gain mass
- Wet avalanche follow terrain
- Dry ones overrun terrain
- Large avalanches can overrun historical boundaries



## Key Runout-Zone Characteristics:

- ❑ Avalanche slows down
- ❑ Bulk of debris
- ❑ Incline decrease
- ❑ Large avalanches can overrun historical boundaries



## Poorly defined avalanche paths

- Many locations where avalanche occur do not display the classic characteristics displayed above
- It is important to recognize poorly defined & small terrain features the can produce avalanches
- These, associated with **terrain traps** can magnify the consequence of being caught

## Evidence of past avalanches

- Avalanches and debris
- Tree age variation
- Scars & broken limbs
- Snow plastered on trees
- Mounds & blocks
- Groves & filled gullies
- Hard snow surface



# Terrain Traps

By the end of this lesson, you will have a better understanding of common terrain traps:

- Gullies, depressions & crevasses
- Cliffs & icefalls
- Sharp transition from steep to flat
- Trees, rocks, other obstructions

## Why do terrain traps magnify the consequences of being caught?

- Increase dept of burial
- Higher impact forces
- Greater potential for traumatic injuries
- Reduce chances for escape



Photo: Bernard Faure

# Avalanche Terrain Exposure Scale (ATES)

By the end of this lesson, you will have a better understanding of:

- How the Avalanche Terrain Exposure Scale works
- The difference between Simple, Challenging & Complex terrain
- Where to get information about ATES rated & unrated trip

Video “ Understanding the Avalanche Bulletin”



## What is the ATES?

- ❑ The ATES was developed by Parks Canada to help backcountry users assess the severity of the terrain encountered on a trip.
- ❑ It has 3 main classes that describe the exposure of terrain to potential avalanche hazard
- ❑ The ATES ratings are compiled by professionals who consider 11 weighted terrain parameters in ranking terrain.

ATES ratings allows backcountry travelers to use the Avaluator to support their trip planning and decision-making in the field.

## Avalanche Terrain Exposure Scale – Public Model (Source: Parks Canada)

Description	Class	Terrain and Exposure Criteria
<b>Simple</b>	<b>1</b>	Exposure to low angle or primarily forested terrain. Some forest openings may involve the runout zones of infrequent avalanches. Many options to reduce or eliminate exposure. No glacier travel.
<b>Challenging</b>	<b>2</b>	Exposure to well defined avalanche paths, starting zones or terrain traps; options exist to reduce or eliminate exposure with careful route finding. Glacier travel is straightforward but crevasse hazards may exist.
<b>Complex</b>	<b>3</b>	Exposure to multiple overlapping avalanche paths or large expanses of steep, open terrain; multiple avalanche starting zones and terrain traps below; minimal options to reduce exposure. Complicated glacier travel with extensive crevasse bands or icefalls.

## Avalanche Terrain Exposure Scale Technical Model v.1-04 (Source: Parks Canada)

	Simple	Challenging	Complex
<b>Slope angle</b>	Angles generally < 30°	<b>Mostly low angle, isolated slopes &gt;35°</b>	<b>Variable with large % &gt;35°</b>
<b>Slope shape</b>	Uniform	Some convexities	Convoluted
<b>Forest density</b>	Primarily treed with some forest openings	Mixed trees and open terrain	Large expanses of open terrain. Isolated tree bands
<b>Terrain traps</b>	Minimal, some creek slopes or cutbanks	Some depressions, gullies and/or overhead avalanche terrain	<b>Many depressions, gullies, cliffs, hidden slopes above gullies, cornices</b>
<b>Avalanche frequency (events:years)</b>	1:30 ≥ size 2	1:1 for < size 2 <b>1:3 for ≥ size 2</b>	1:1 < size 3 <b>1:1 ≥ size 3</b>
<b>Start zone density</b>	Limited open terrain	Some open terrain. Isolated avalanche paths leading to valley bottom	Large expanses of open terrain. Multiple avalanche paths leading to valley bottom
<b>Runout zone characteristics</b>	Solitary, well defined areas, smooth transitions, spread deposits	Abrupt transitions or depressions with deep deposits	Multiple converging runout zones, confined deposition area, steep tracks overhead
<b>Interaction with avalanche paths</b>	Runout zones only	Single path or paths with separation	<b>Numerous and overlapping paths</b>
<b>Route options</b>	Numerous, terrain allows multiple choices	A selection of choices of varying exposure, options to avoid avalanche paths	<b>Limited chances to reduce exposure, avoidance not possible</b>
<b>Exposure time</b>	None, or limited exposure crossing runouts only	<b>Isolated exposure to start zones and tracks</b>	<b>Frequent exposure to start zones and tracks</b>
<b>Glaciation</b>	None	<b>Generally smooth with isolated bands of crevasses</b>	<b>Broken or steep sections of crevasses, icefalls or serac exposure</b>

## Rated Terrain

The following agencies have produced lists of trips with ATES ratings:

- Parks Canada
- Alberta Parks
- Avalanche Canada

Remember, not all trips are rated.






# Avalanche Danger & Forecasts

Understanding the avalanche danger ratings & forecast helps us make better decisions and planning. In this lesson we will look at:


- ❖ International Avalanche Danger Rating Scale
- ❖ Avalanche Forecasts: access & limitations
- ❖ Resources available if no avalanche danger rating or forecast.

# North American Public Avalanche Danger Scale

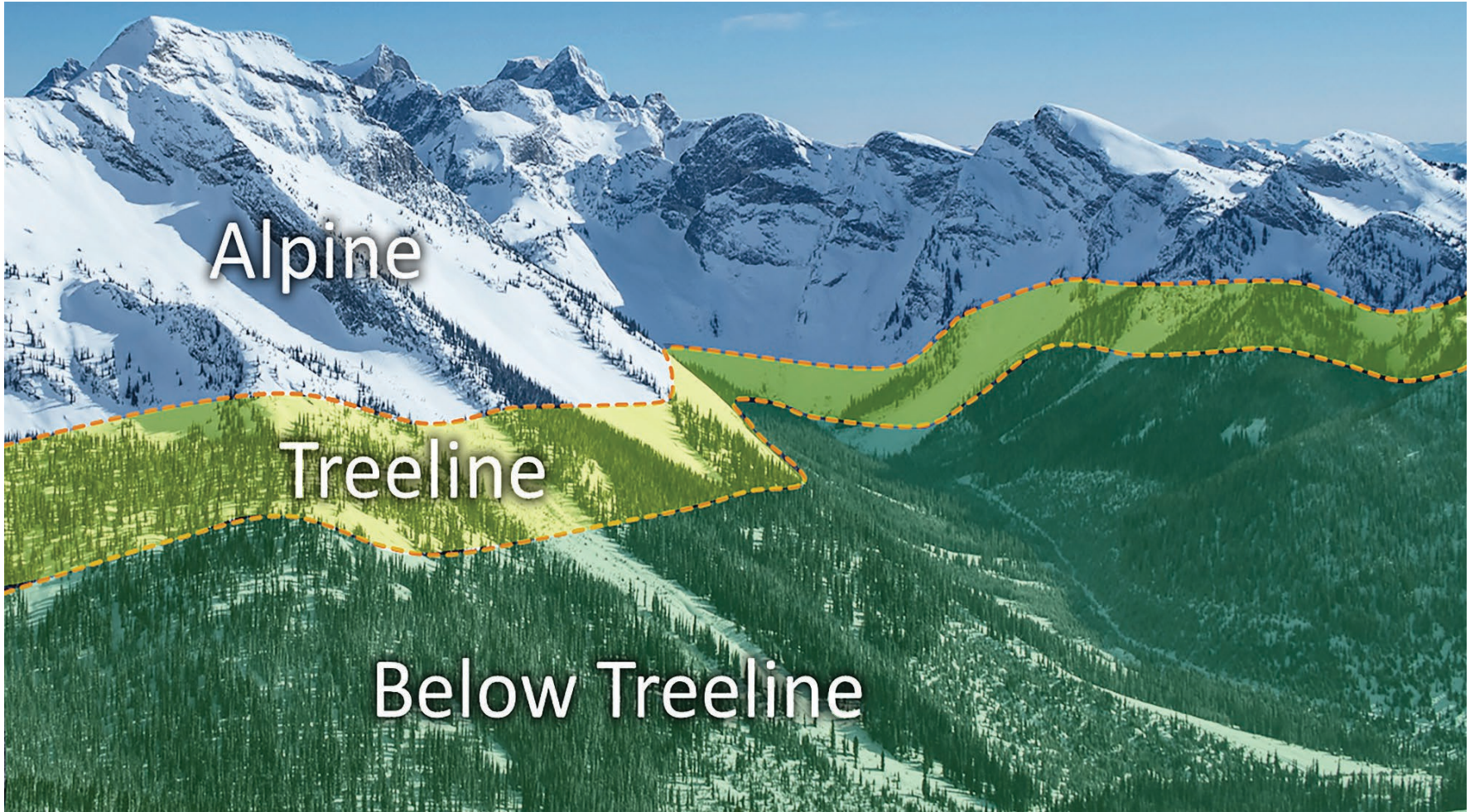
Avalanche danger is determined by the likelihood, size and distribution of avalanches.

Danger Level		Travel Advice	Likelihood of Avalanches	Avalanche Size and Distribution
<b>5 Extreme</b>		Avoid all avalanche terrain.	Natural and human-triggered avalanches certain.	Large to very large avalanches in many areas.
<b>4 High</b>		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.
<b>3 Considerable</b>		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.
<b>2 Moderate</b>		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.
<b>1 Low</b>		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.

<b>No Rating</b>		Insufficient information to establish avalanche danger rating. Check zone forecast for local information.
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# Elevation Bands



# Bulletin Regions in Western Canada



See current Bulletin: <http://www.avalanche.ca>



## **Regional Forecast production and limitations:**

- North Columbia, South Coast, Etc.
- Strength: Very accurate throughout the region in the short term
- Weakness: Local variation of conditions (local inaccuracy)
- They tend to be less accurate when extrapolating into the future due to large forecast area

## **Local Forecast production and limitations:**

- Whistler, Whittewater, Etc.
- Strength: very accurate locally
- Weakness: relatively controlled nature of the forecast area (high use, blasting)
- They are not as accurate outside the ski area boundary

## Avalanche Danger Trends

When viewing the 3 day danger trend, what are some factors that may require further investigating?

- Is the danger trend rising or falling?
- What are the driving changes? (new snow, mod-strong winds, rising temps, solar radiation, etc.)
- What if the weather forecast is not accurate?

## Watching the weather and weather forecast:

- Avalanche conditions rely heavily on weather forecasts
- Mountain weather is difficult to predict, even for professionals; specially when forecasting larger areas and forecasting 24hrs in advance
- It is worth watching the weather no matter what the danger rating trend is but specially if the trend is changing.
- As the day of your trip nears, keep an eye on the forecast and actual weather conditions
- Is the weather arriving sooner or later then anticipated?
- Is it worse or better than anticipated?
- These changes can have a significant impact on the changing avalanche conditions
- Good weather information can be found at: [www.weatheroffice.ec.gc.ca](http://www.weatheroffice.ec.gc.ca)

## More on watching the weather and weather forecast:

- Where else can you find weather information?
  - Many ski area snow report
  - Tourism offices
  - Parks offices
  - Professional avalanche operation (Kootenay pass, Whitewater, etc.)
  - The Association of Canadian Mountain Guides (MCR report)
  
- What should you do if the weather conditions are driving a change in avalanche danger?
  - Revise your plan
  - Look for updated avalanche danger ratings and weather forecasts
  - Find experienced people to discuss local danger

# Keywords in Avalanche Danger Forecast

- The avalanche danger forecast that accompanies the danger rating can provide valuable trip planning information
- When reading the avalanche forecast applicable for your trip, what should you be looking for?
  - ✓ *Recent avalanches & Avalanche activity* (within 48hrs)
  - ✓ *Whumpfing, easy test results & pop and drop* (in snowpack structure)
  - ✓ *Thawing, melting with sun, rain or warm temps* (in snowpack structure)
  - ✓ *New loading from rain or snow* (within 48hrs)
  - ✓ *New slabs, wind slabs or wind loading* (within 48hrs)
  - ✓ *Deep instability & persistent weak layer* (in snowpack structure)
  - ✓ *Isolated wind slabs* (in periods of Mod or Low hazard)
  - ✓ *Variability*
  - ✓ *Steep terrain, convex features & terrain traps* (under travel advisory)

# How should this affect you planning?

	Friday	Saturday	Sunday
Alpine	Considerable	High	High
Treeline	Moderate	Considerable	High
Below Treeline	Low	Considerable	High

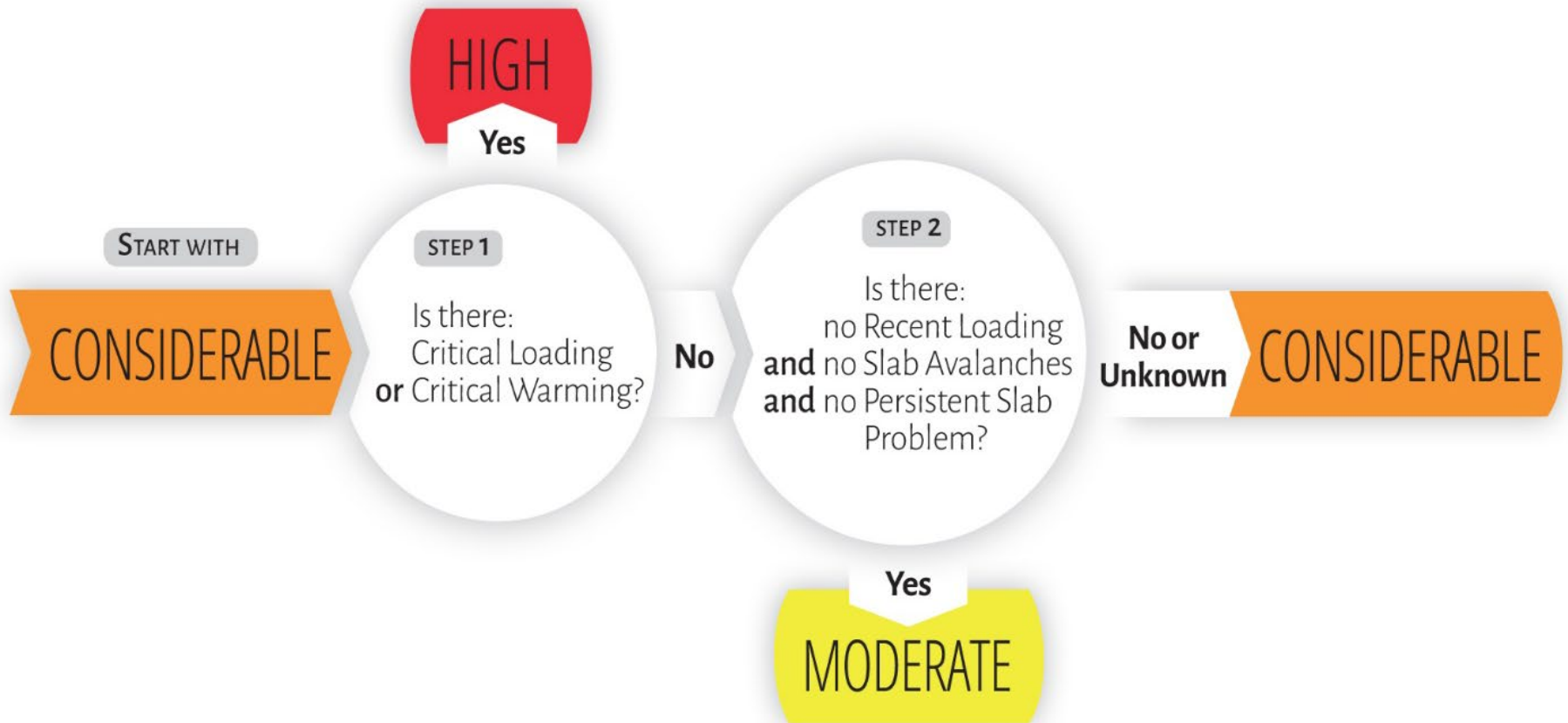
**Travel Advisory:** The variable winds and temperatures in the recent storm has created a variable snowpack at upper elevations. A high degree of caution is warranted in the Alpine today, especially on steep, convex terrain features. At treeline, danger will rise over the weekend as loading from snow increases and windslabs form in exposed areas. Below treeline, forecast rising temperatures on Saturday and rain on Sunday will cause a rapid increase in danger as the upper layers of the snowpack thaw. This might not be the best weekend to head into the hills. If you do decide to go out, stay on simple, low angle terrain and avoid terrain traps like gullies, creeks, and depressions.

## **What if there is no Avalanche bulletin:**

- Recreationist with basic training are at greater risks
- Local experts, Ski patrols, etc. Be aware of their training, local experience, resources and last time they were out
- MIN reports on AC website
- MCR reports on the ACMG website



# Dangerator Flow Chart



# Companion Rescue

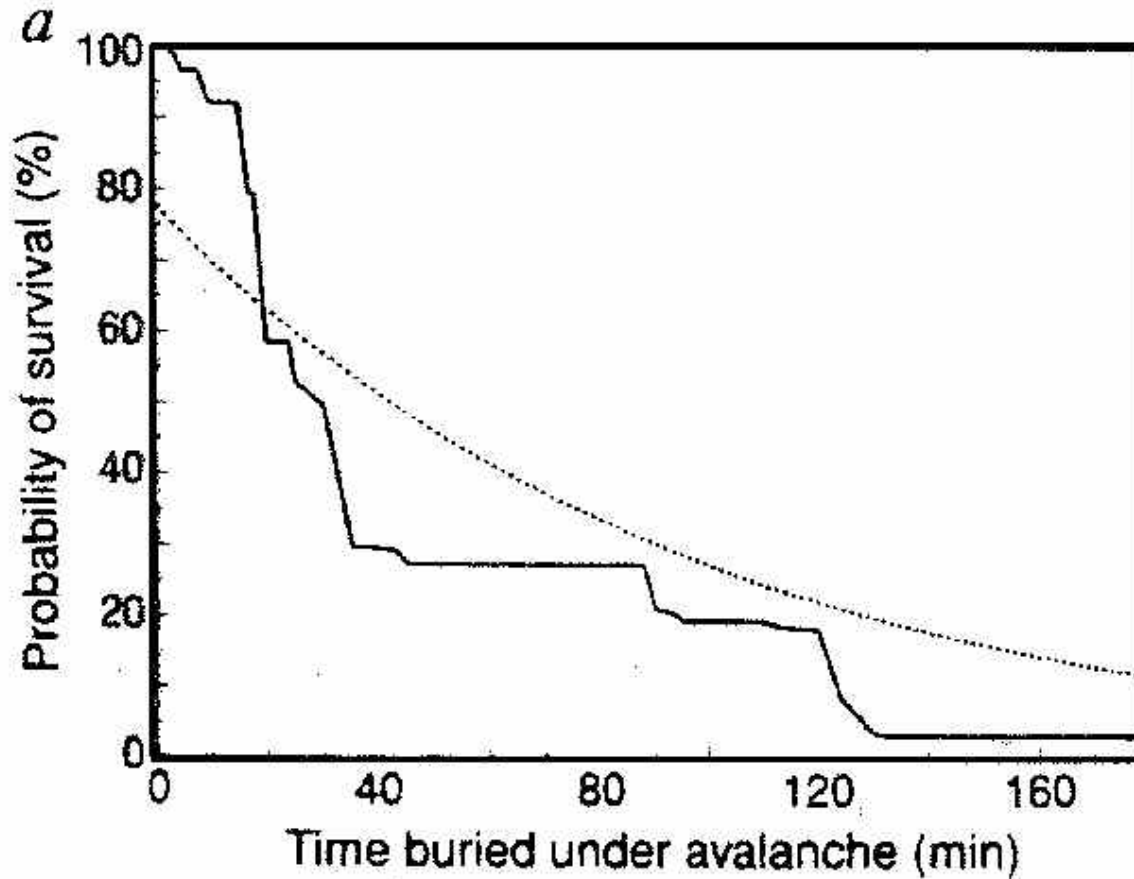
With some ideas of avalanche formation and danger we can reduce our risk but we need to also ensure we have the skills to carry out a rescue in the event of an avalanche...



Lets watch *“Emergency Self Rescue”*

# Companion Rescue

Survival statistics



# Companion Rescue

By the end of this lesson, you will have a better understanding of:

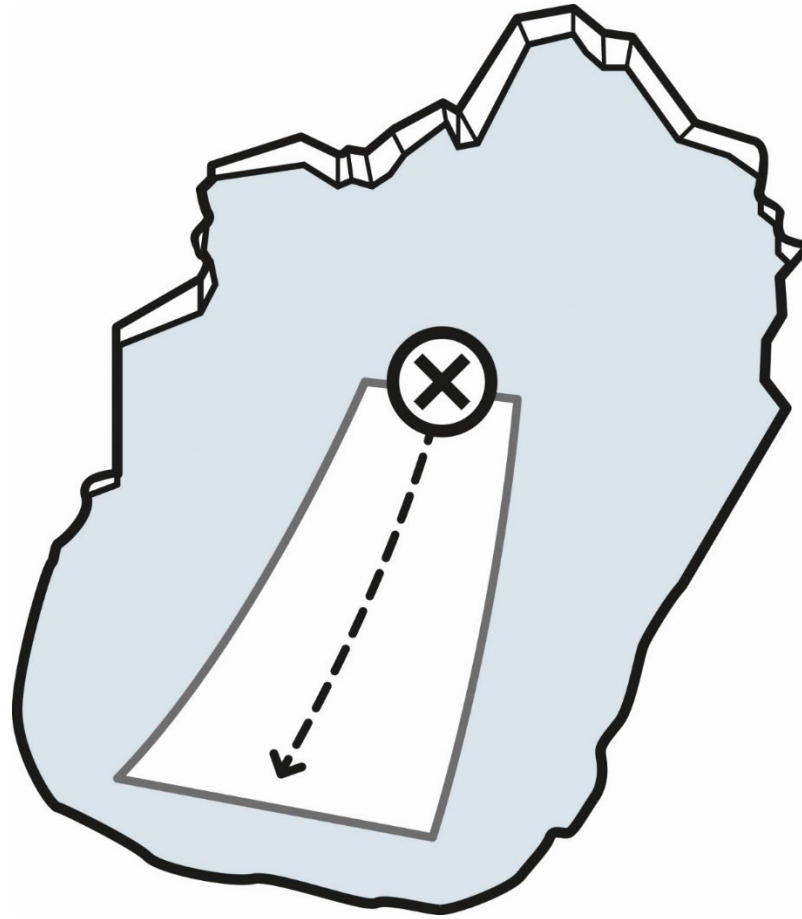
- Urgency of avalanche rescue
- What to do if caught in an avalanche
- Transceivers search technique
- Probing technique
- Shoveling technique
- Basic Avalanche Triage
- Companion rescue

# Companion Rescue

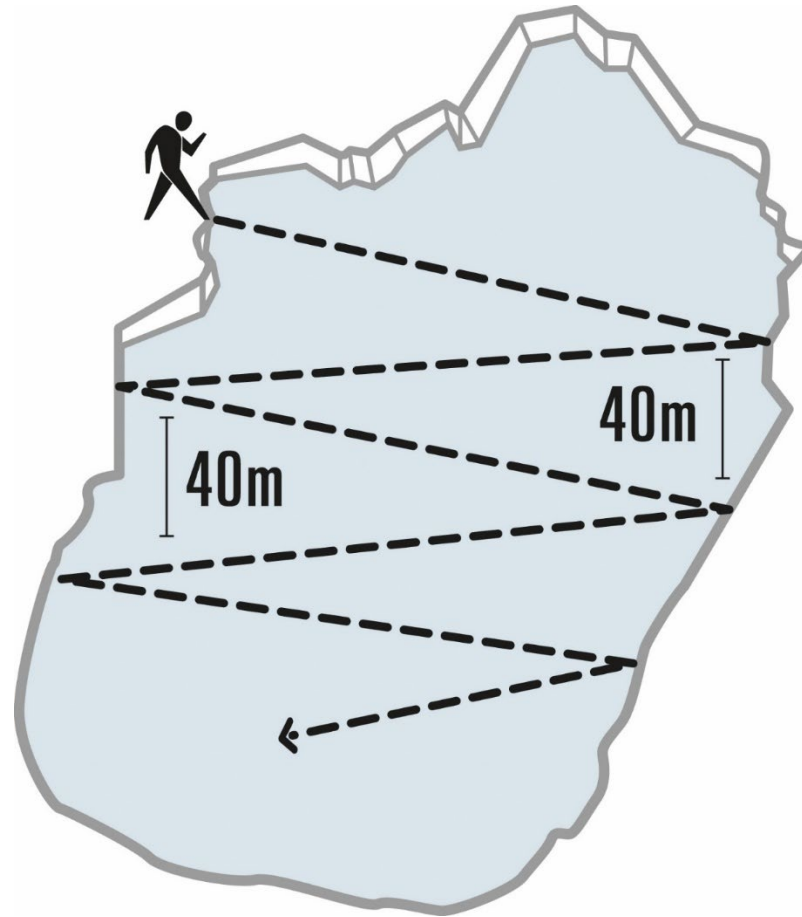
## What to do if caught in an avalanche:

- Yell “avalanche”!
- Ski out (aim for high ground, grab trees)
- Get rid of skis, poles & large pack
- Keep small packs
- Swim facing downhill
- Fight for surface
- Create an air pocket
- Remain calm

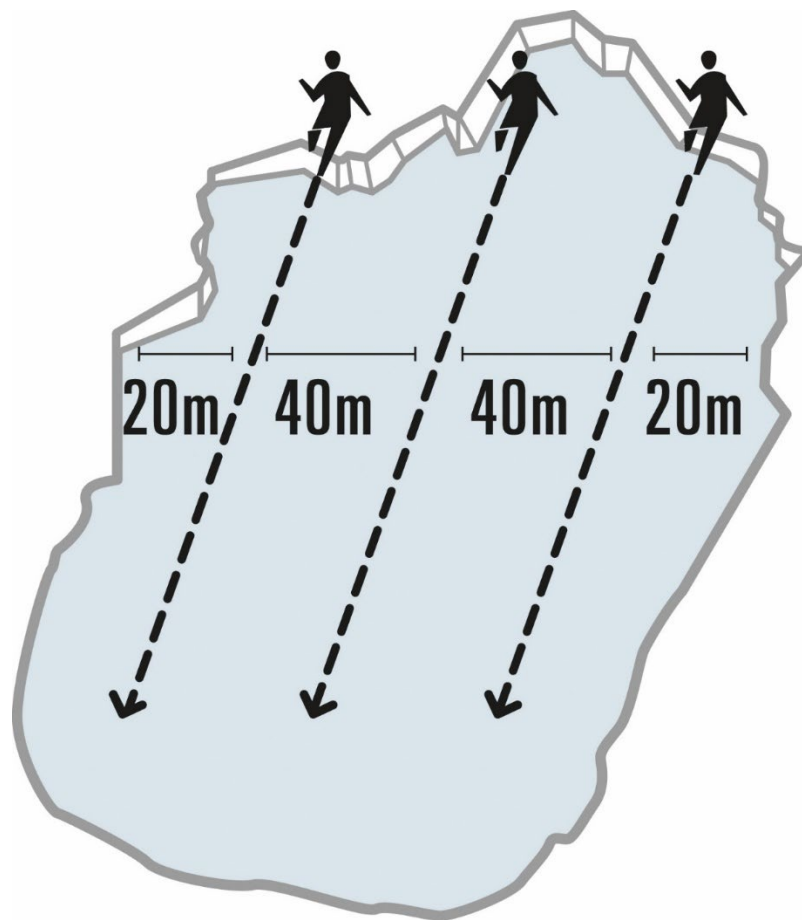
# Last Seen Point



# Single Searcher

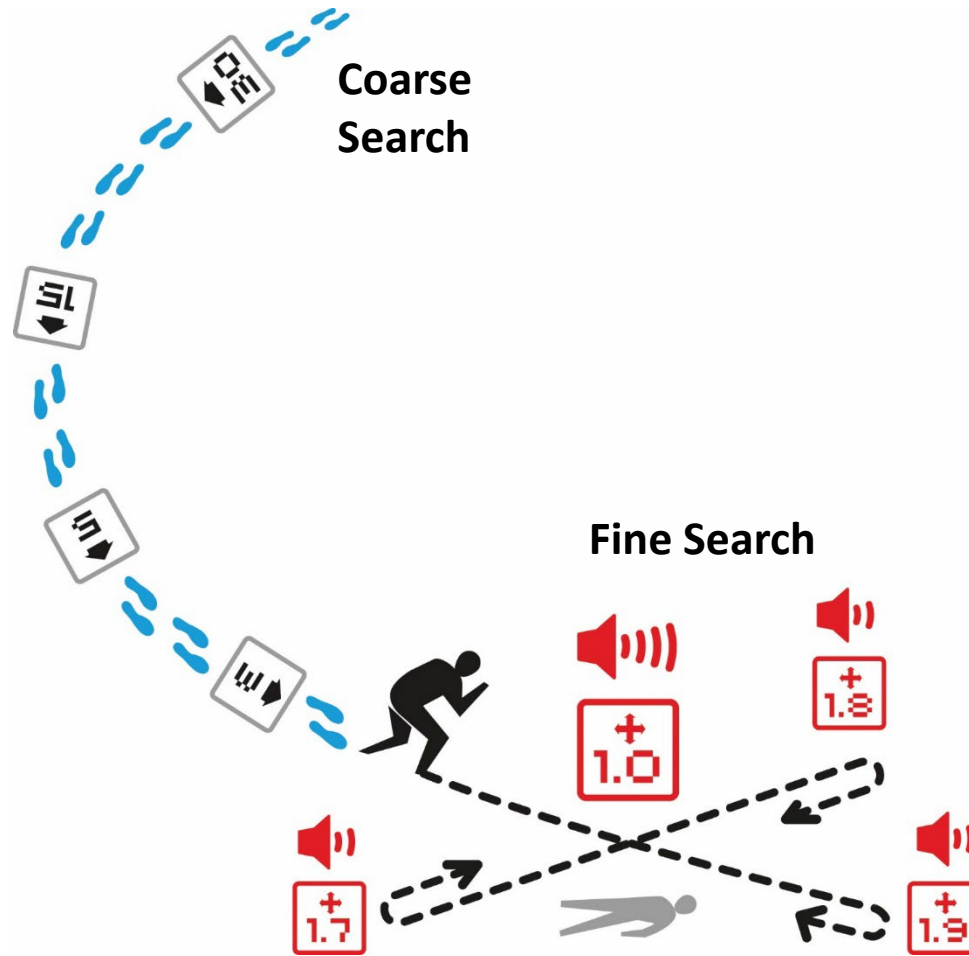


## Multiple Searchers





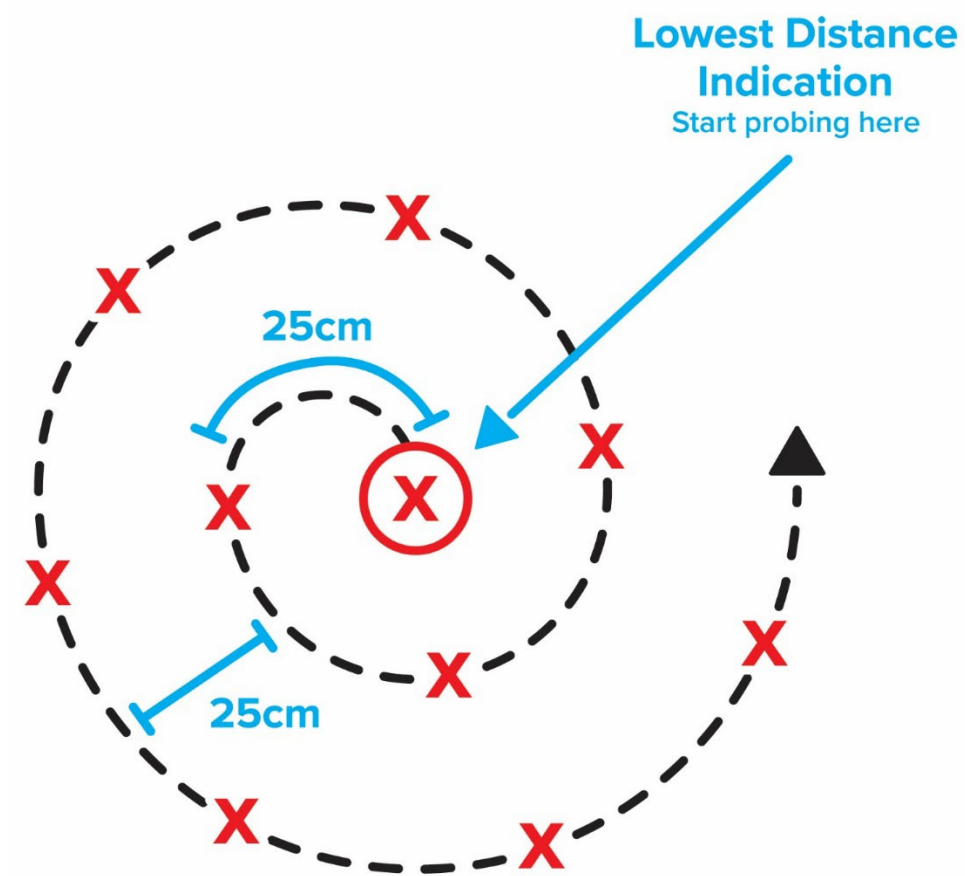
# Coarse to Fine Search



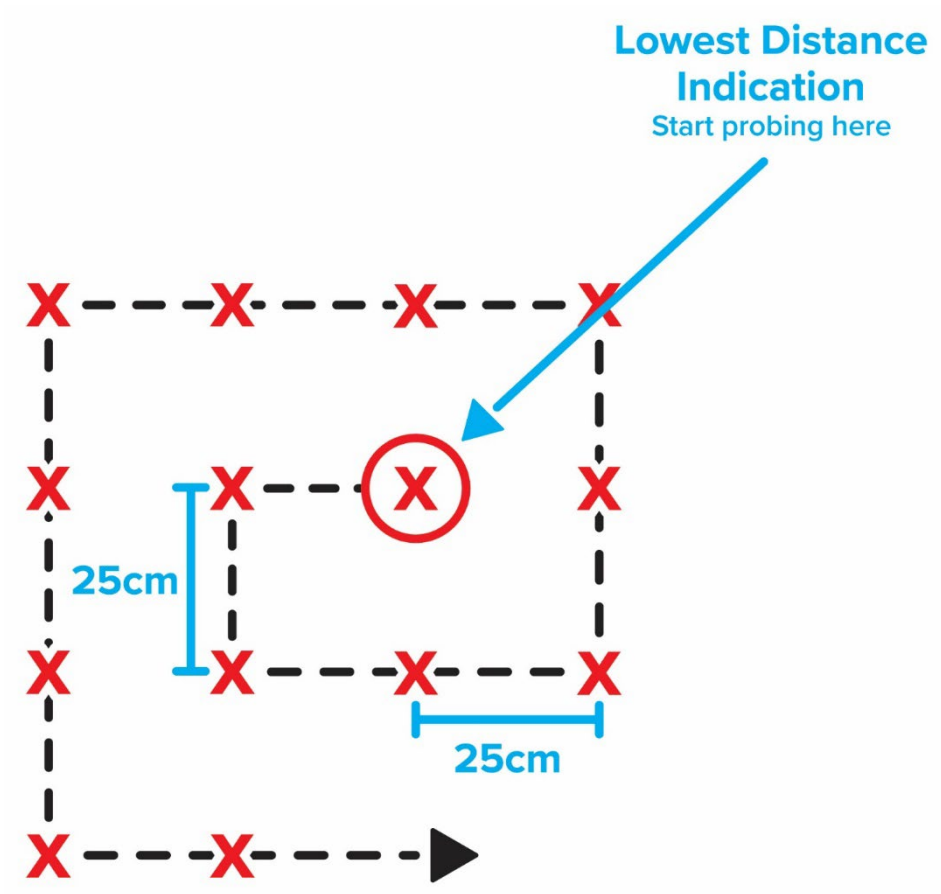
## Probe Perpendicular to Slope



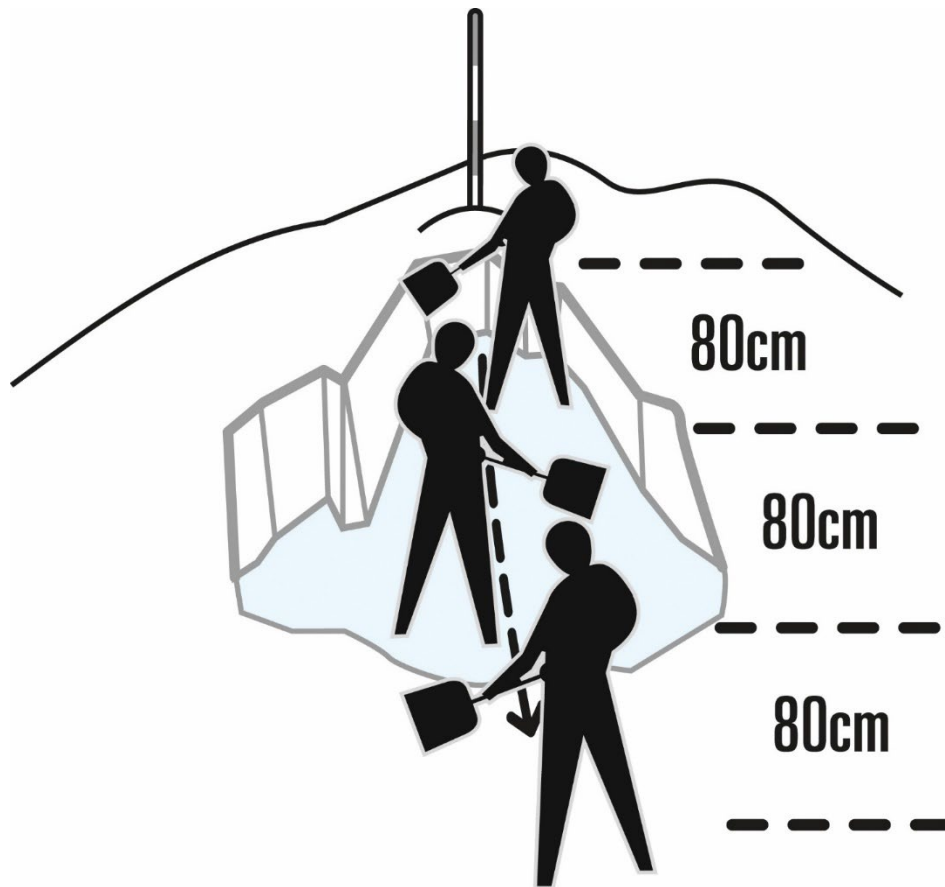
# Spiral Probing



# Grid Probing

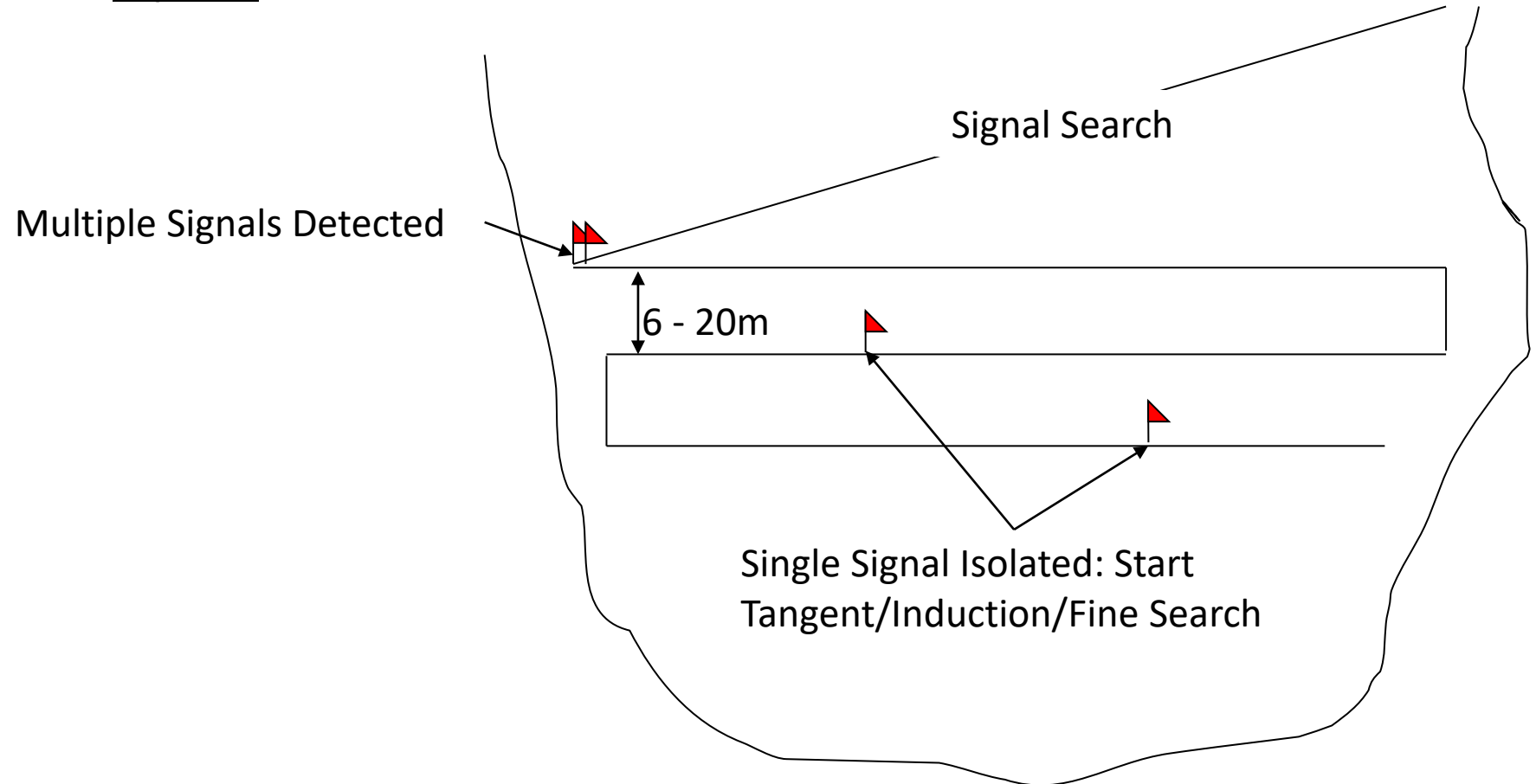


# Conveyor Shovelling



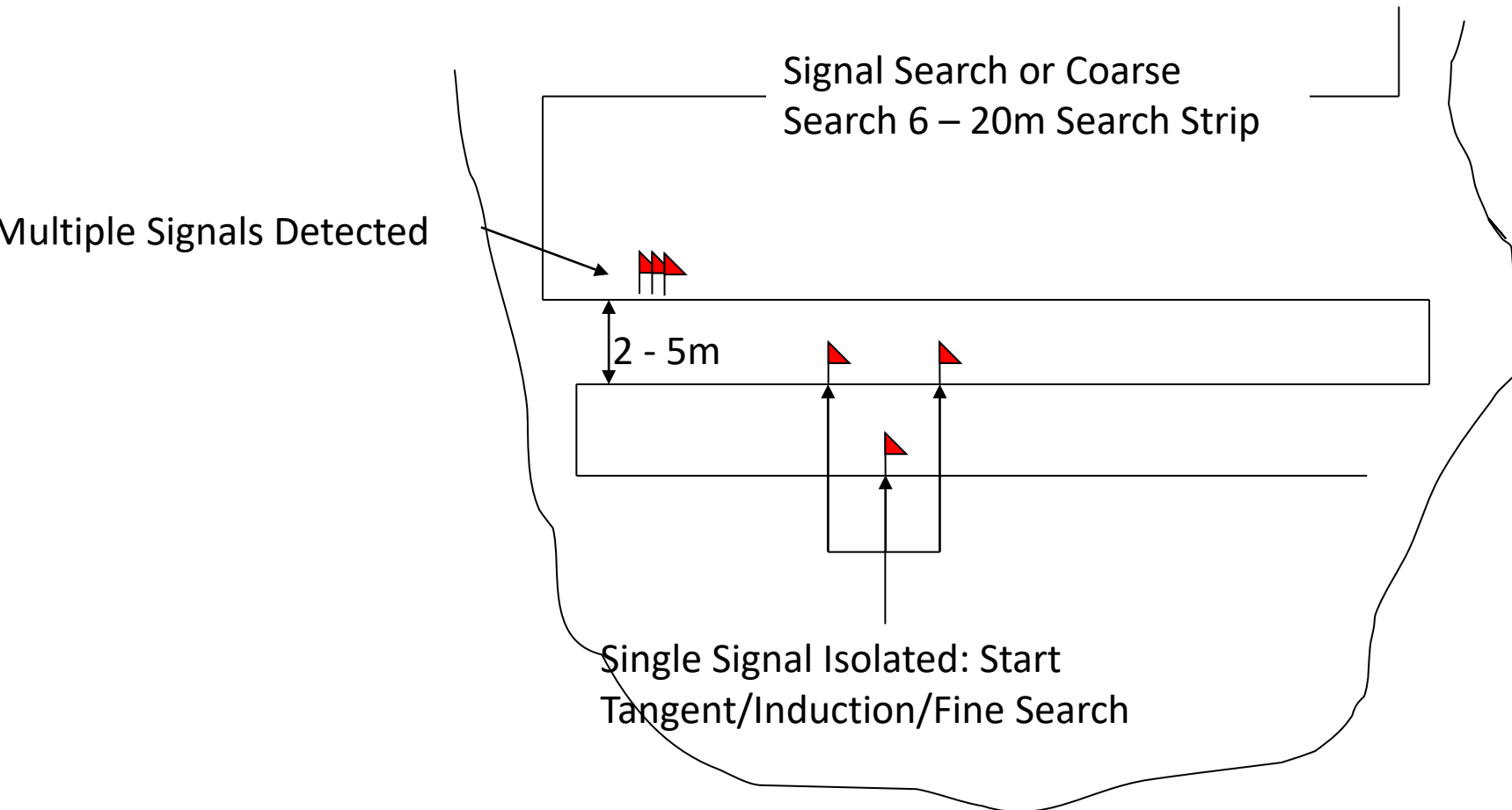
# Companion Rescue

- Coarse Search Strip Width 6 – 20m: Multiple Burial, Far Apart



# Companion Rescue

- Coarse Search Strip Width 2 - 5m:  
Multiple Burial, Close Together



# Companion Rescue

## Basic Avalanche Triage:

If more than one victim, the following are steps to take in order of priority:

- Attend to victims on the surface first (ABC's, heavy bleeding, etc.)
- Then attend to buried victims (shallow burial first, deeper ones later)
- Medical care once extracted, regular triage apply (ABC's, heavy bleeds, hypothermia, etc.)



# Decision Making Factors & Trip Planning

**Many variables could affect our day tomorrow, lets review:**

- ❖ Human Factors
- ❖ Specific factors that often contribute to accidents
- ❖ How to do a Personal & Group Self Assessment
- ❖ How to Plan a Route or Trip
- ❖ Equipment & Emergency Plan

# Specific factors that often contribute to accidents

What are people having difficulty recognizing?

- Weak layers deep in the snowpack
- The effect of wind or the effect of rapid temperature change
- Snow can lose strength very quickly on sun exposed slopes
- Wide slab propagation or triggering avalanches from flat terrain
- Terrain traps or that small slopes can have serious consequences
- Avalanche runout potentials
- Leaving a member of the party behind
- Allowing a member of the party to go back on their own
- Travelling alone
- Distractions, such as photo/video session

Recognition comes with experience. General awareness will help you make better decisions...

## Doing a Personal & Group Self Assessment is important

- What should we consider before heading out on a trip?
  - What is the motivation for this trip? Are you willing to turn around?
  - Does your group communicate well together?
  - Is your group properly skilled & equipped?
  - Are human factors likely to influence decision making?
  - How much experience do you have? Think back to the competence levels
  - Am I comfortable with my trip companions? Is the group size manageable?
  - Are the conditions adequate for our route?
  - Do I know how to use my equipment? How about my companions?
  - Do I really know what to do if the avalanche hit?
  - Do my companions really know what to do if the avalanche hit?

## How to Plan a Route or Trip:

Considering the trip planer and our avalanche risk comfort zone, lets plan a route for tomorrow. What are some other tools that can help us planning?

- Maps
- Guidebooks
- Photos
- Google Earth

Using the visual aid, lets identify the **Avalanche terrain**, some **Terrain traps** and **Route options** to avoid avalanche terrain or minimize exposure

# Equipment & Emergency Plan

We now have a well thought-out plan. In this lesson we will focus on:

- ❖ Equipment
- ❖ Emergency Plan



# Equipment & Emergency Plan

## Personal Equipment

- Transceiver, probe, and shovel
- Spare parts for personal equipment
- Long underwear and socks
- Fleece or soft-shell jacket
- Windproof jacket and pants
- Toque
- Gloves or mitts
- Day pack
- Lunch and snacks
- Thermos and/or water bottle
- Sunscreen and lip protector
- Goggles or sunglasses
- Toilet paper
- Pocket knife
- Headlamp
- Camera
- Money and personal ID
- Medications

# Equipment & Emergency Plan

## **Group Equipment**

- Waterproof matches or lighter
- Fire starter
- High-energy food
- Foam pad
- Bivi sack/ emergency shelter
- Rope and parts for improvised toboggan
- Map, compass, pencil
- Altimeter
- GPS receiver\*
- Two-way radios\*
- Satellite phone\*

# Equipment & Emergency Plan

## **Repair Kit**

- Mini-tool or screwdriver and pliers
- Spare parts for all major equipment items
- Hockey tape/duct tape
- Wire
- Cord
- Needle and thread



# Equipment & Emergency Plan

## **Frist-Aid Kit**

- Triangular bandages
- Pressure bandage
- Sterile pads
- Adhesive bandages (small and large)
- Alcohol wipes
- Butterfly bandages
- Aspirin or acetaminophen tablets
- Adhesive tape
- Scissors

# Equipment & Emergency Plan

## **Snow study kit**

- Snow saw
- Knotted cord for cutting rutschblocks
- Inclinator
- Magnifier
- Crystal screen
- Ruler
- Field book and pencil
- Thermometer

# Equipment & Emergency Plan

## **Emergency Plan** (see trip plan handout)

Your plan should include the following information:

- Your route, current avalanche conditions, and weather forecasts
- Group members (and, ideally, phone numbers of each)
- Your vehicle's license plate number
- Where you plan to park
- Time you will leave
- Time you expect to return
- When & how you will communicate with the outside world
- A contingency plan

# Safe Travel & Group Management in Avalanche Terrain

## **Consider these good travel habits:**

- **Continuously look ahead, planning your route in detail whenever possible**
- **Don't rely on other people's tracks or on the fact that you had a successful trip to the same area last year - they don't necessarily mean that a slope is safe**
- **Communicate safety measures in advance and announce them clearly so that everyone is aware of them. (Shouting at a spaced out group is not effective.)**
- **Check on the pace of the group. (Will you reach your objective?)**
- **Check on the condition of group members. (Is fatigue a problem?)**
- **Upgrade your snow stability evaluation with each new piece of information.**

- Terrain:

- Travel on the gentlest practical terrain.
- Changing direction, resting, regrouping, etc. should be done in the least exposed terrain.
- Whenever possible, travel on ribs and ridges rather than gullies or bowls.
- Be aware of slopes & other users above that may not be visible from your present position.

- Avalanche observations

- Look for signs of fresh or recent avalanches on slopes similar to the ones that will be encountered on the route.
- This is the most reliable indicator of snowpack instability.

- Snow observations

- Perform stability tests and test the profiles at safe, representative locations to track changes over time and terrain.

- Feel for changes under your feet and observe your track. If it has sharp edges or if cracks form around it, you may be in soft slab snow.

- Weather observations
  - Observe signs of past and present wind activity.
  - Are there drifts around trees and rocks?
  - Are there wind ripples on the surface?
  - Is the snow blown off the trees?
  - Does the snow feel hard and hollow?
  - Be aware of changing temperature, precipitation, radiation, and wind (overtime & changes in elevation).



- Listen to your gut, are the human factors affecting your decision?



- Talk with your group about the information gathered and changing situation throughout the day