Outdoor Pursuits Avalanche Safety Awareness Course

Weather | Terrain | Snowpack | Human

Instructors:

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- American Avalanche Association (A3), Professional Member
- 25+ years professional experience teaching and facilitating courses

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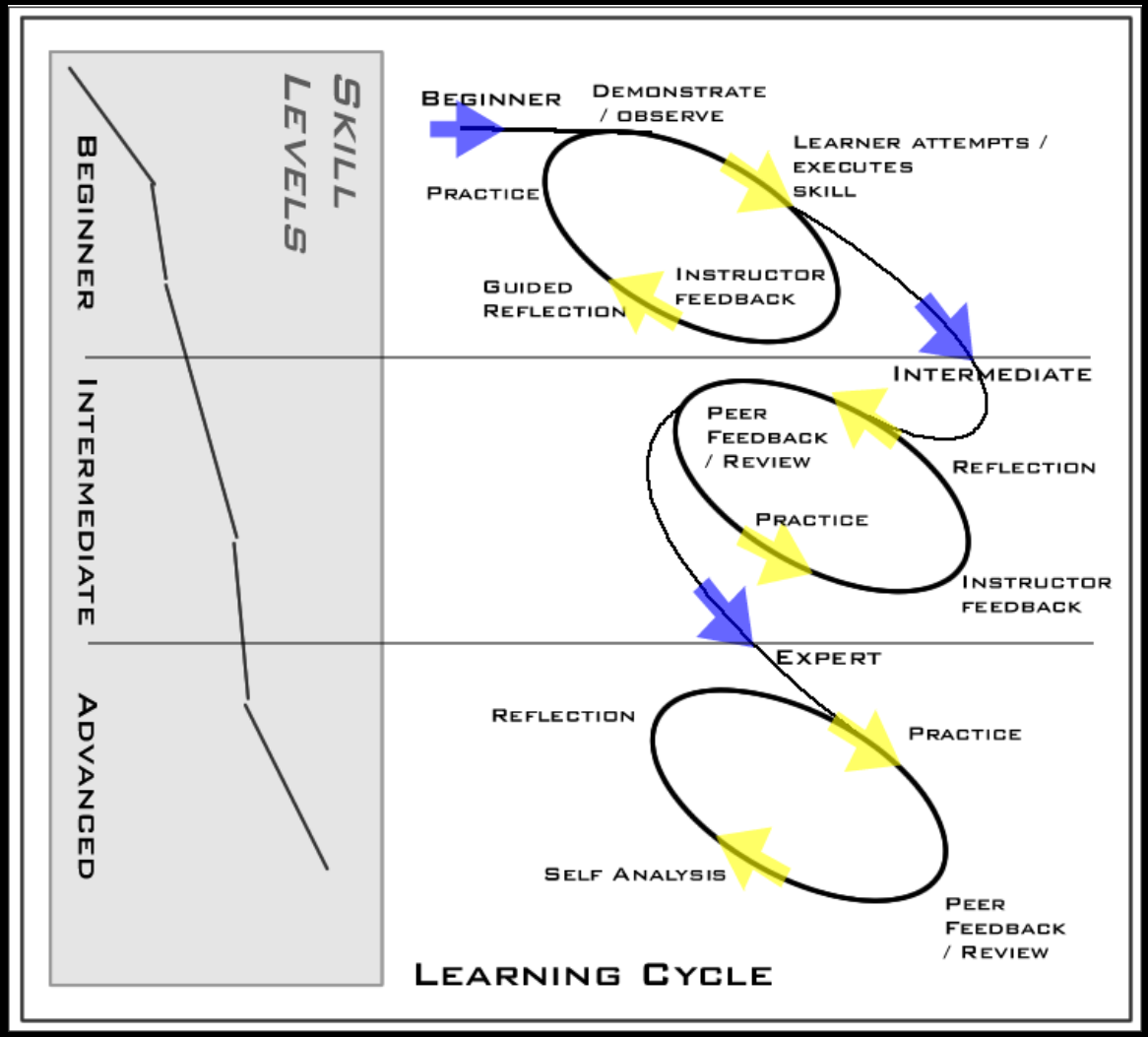
Course Design:

Classroom slide show
- Discussion
- Visual elements
- Key word or phrase on each slide

Field sessions –
- Only as strenuous as needed
- Hands on
- Provoke thought and discussion


SKILL LEVELS
BEGINNER
INTERMEDIATE
ADVANCED
BEGINNER
DEMONSTRATE / OBSERVE
LEARNER ATTEMPTS / EXECUTES SKILL
PRACTICE
GUIDED REFLECTION
INSTRUCTOR FEEDBACK
INTERMEDIATE
PEER FEEDBACK / REVIEW
REFLECTION
PRACTICE
INSTRUCTOR FEEDBACK
EXPERT
REFLECTION
PRACTICE
SELF ANALYSIS
PEER FEEDBACK / REVIEW
LEARNING CYCLE

Objectives

- Avalanche avoidance
- Rescue
- Survival
- Spark interest
- Question authority

"Culture of inquiry"

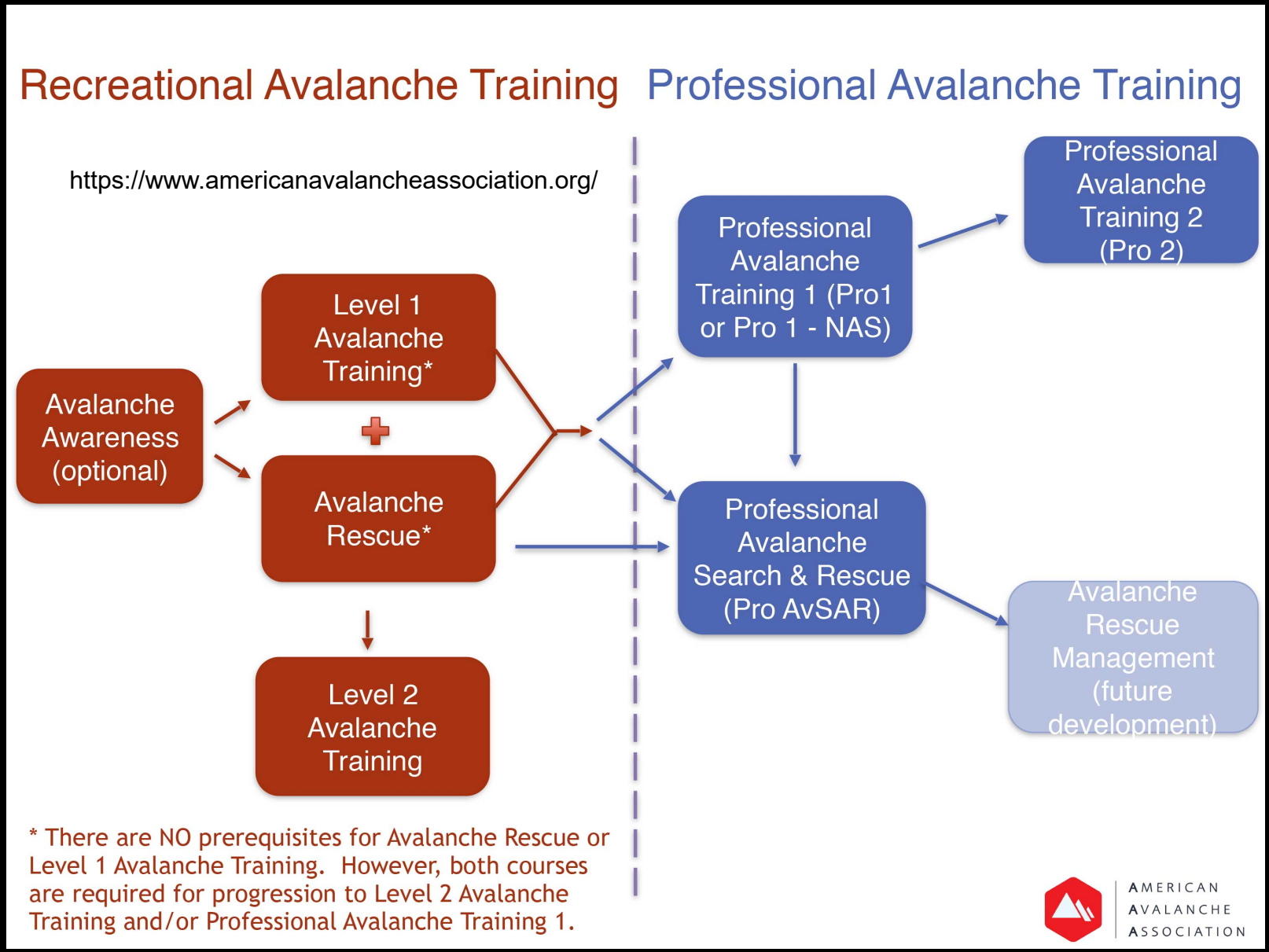
“Culture of inquiry”

Bryan’s introduction

Poorly informed decisions
Well informed decisions
More-well informed decisions

…and the outcomes

Recommended reading
Readings


Recreational Avalanche Training
Professional Avalanche Training
https://www.americanavalancheassociation.org/
Avalanche Awareness (optional)
Level 1 Avalanche Training*
Avalanche Rescue*
Level 2 Avalanche Training
Professional Avalanche Training 1 (Pro1 or Pro 1 - NAS)
Professional Avalanche Training 2 (Pro 2)
Professional Avalanche Search & Rescue (Pro AvSAR)
Avalanche Rescue Management (future development)
* There are NO prerequisites for Avalanche Rescue or Level 1 Avalanche Training. However, both courses are required for progression to Level 2 Avalanche Training and/or Professional Avalanche Training 1.
AMERICAN AVALANCHE ASSOCIATION

Avalanche Awareness Programs – Recommended Guidelines of American Avalanche Association

●GEAR – Introduce required and recommended winter backcountry travel equipment, including avalanche rescue gear, discipline specific travel gear, as well as navigation, survival, first aid & repair kit.

●RISK – Use local case histories to introduce avalanche risk to prospective backcountry travellers; detail how a risk management process can be applied to reduce avalanche risk for those wishing to travel in the winter backcountry environment.

●RESOURCES – Show where to find and how to use local weather forecast and avalanche advisory resources to anticipate backcountry conditions and hazards during a trip planning process. Define the scope and limitations of these resources as planning tools.

●TRIP PLANS – Illustrate how to build a trip plan that avoids the expected hazards and accommodates uncertainty related to the conditions, group and terrain, specifically by defining terrain to avoid and anticipating decision points and decision criteria to reduce decision bias in the field.

●TERRAIN – Illustrate local recreationally used terrain where avalanches are not possible. Illustrate local terrain where avalanches are possible, that's interspersed with non-exposed terrain. Illustrate exposed avalanche terrain, where avalanche exposure is unavoidable.

●MANAGE RISK – Model and practice avoiding exposure to avalanche terrain while travelling in the backcountry. Illustrate applying safe margins in the terrain between where avalanches are expected, and where the group chooses to travel. Emphasize group decisions and clear communication. Debrief the group's choices and the role the instructor played in facilitating the choices.

Recreational Course Guidelines
Prepared by the AAA Education Committee

-Access local avalanche bulletin and learn to understand & apply.
-Describe where and why avalanches occur. Key components for formation.
-Human Factors. Identify & apply simple decision tools to prepare for traveling in avalanche terrain.
-Apply risk management tools: safety equipment, trailhead checks, and communication.
-Learn procedures for Basic Companion Rescue: Skills Practical
-Make key observations for snowpack and weather.
-Practice snowpack tests appropriate for the current avalanche problems.
-Identify avalanche terrain in the field.
-Choose terrain appropriate for the current avalanche forecast & safe travel. Link participant objectives, to terrain and avoiding Avalanche Problem.

Video

vimeo

Avi Checklist

Alaska

Maritime ranges, glaciers & seracs are *not* included in this discussion.

Colorado

Our focus is Colorado's inner-continental range

Four Factors:

- Weather
  - Snowfall
  - Wind
  - Temperatures
- Terrain
  - Slope aspect
  - Signs
  - Terrain traps
- Snowpack
  - Layers
  - Bonding
  - Stability
  - Evaluation
- Human
  - Decisions
  - Equipment
  - Survival
  - Rescue

Weather Factor

Weather affects stability by altering the critical balance between strength and stress.

Let's consider these:

- Snowfall
- Wind
- Temperatures

Weather Factor

Snowfall

New snow adds weight which in turn can lead to instability.

"Loading"

Weather Factor

Snowfall

How a snowpack responds to loading is at least partially dependent upon the rate at which the load is applied…

…the more rapid the loading, the less time the snowpack has to adjust to additional stress.

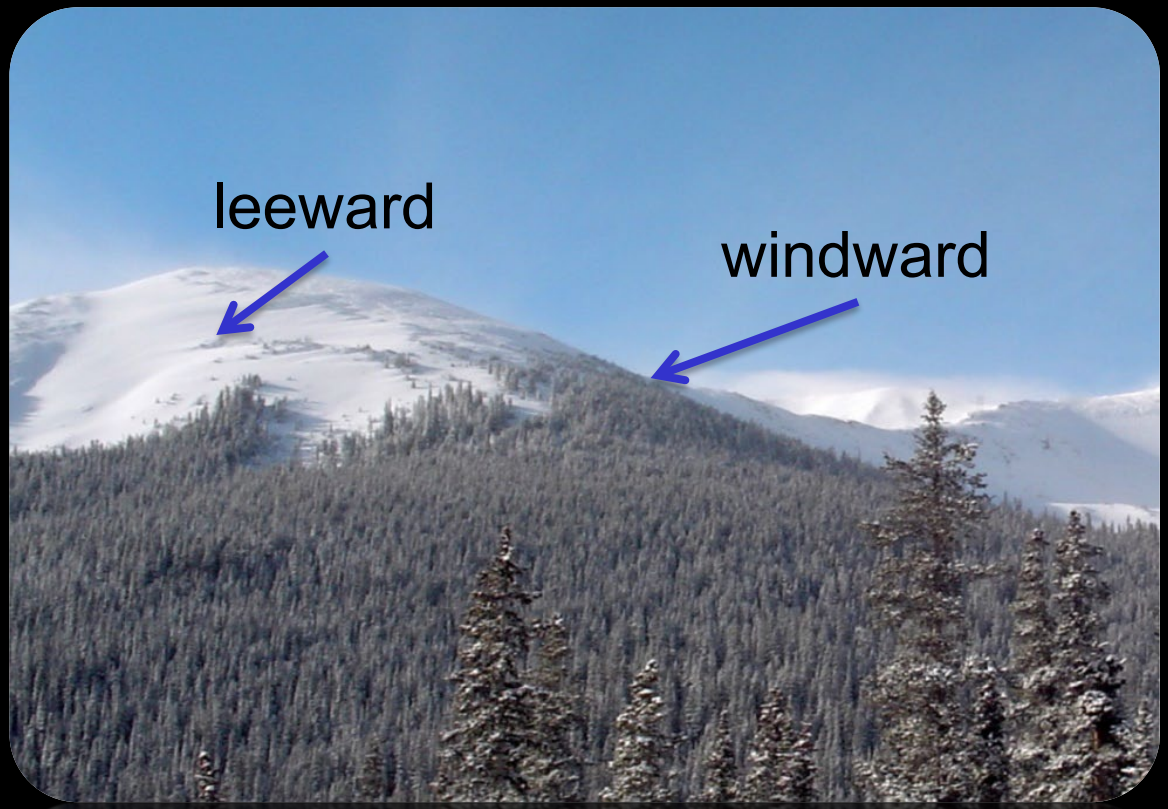
Rapid loading from heavy snows and wind events can lead to avalanches.

Weather Factor

Wind

Weather Factor

Wind



Wind is can quickly redistribute large amounts of snow

Cornice

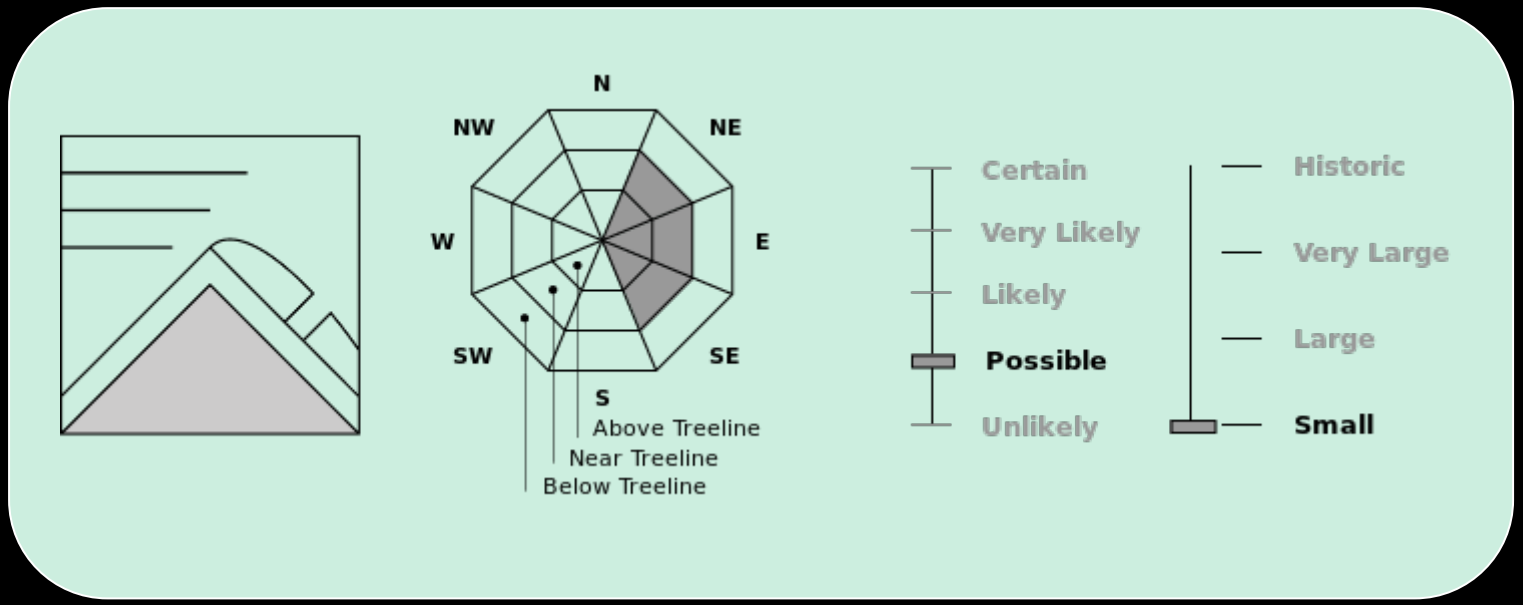
Cross-bedding

Pillowing

Weather Factor

Wind

Prevailing Westerly



Weather Factor

Wind

https://www.avalanche.state.co.us/forecasts/backcountry-avalanche/south-san-juan/

What is this telling us about the situation in the field?

What should we expect when you hit the slopes?

Weather Factor

Atmospheric and snow temp relationship

The warmer the snowpack, the more rapidly changes occur.

Warmer show is more viscous and can settle-in and form a more stable, cohesive snowpack.

Very warm snow can become supersaturated and flow on low angle slopes.

In an intercontinental climate, cold snow coupled with colder atmosphere leads to a temperature gradient in the snowpack.

Weather Factor
temperature gradient

Snowpack temperature:

At the ground = 32°

Snowpack at mid =

Snowpack at surface =

> or = 1° per 10cm = decaying snowpack (TG snow)

Weather Factor

“weather is the architect of avalanches and as such it provides the blueprint for changes in snow stability.”

-Snow Sense, Fredston and Fesler

Hasty Topic

Colorado Avalanche Information Center Weather

http://avalanche.state.co.us/forecasts/weather/zone-forecast/

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Weather Factor Links

http://avalanche.state.co.us/forecasts/weather/zone-forecast/

https://www.facebook.com/highpointwx/

https://highpointwx.com/

Terrain Factor

- Slope aspect
- Signs
- Terrain traps

Terrain and signs

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Terrain and signs

Terrain and signs

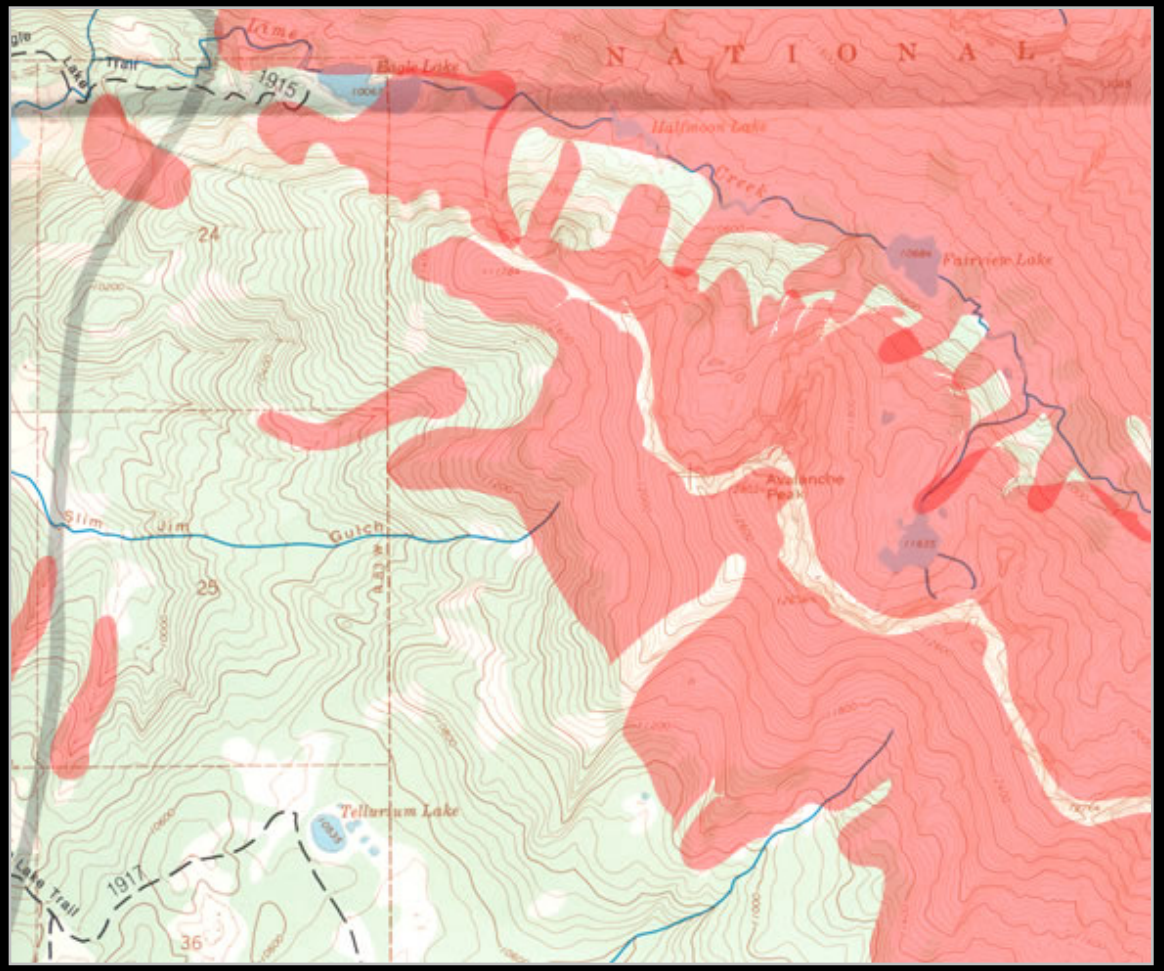
Terrain and signs

Route selection 2

Mt of The Holy Cross Quad

Terrain and signs

Route selection 2



Mt of The Holy Cross Quad

Terrain factor links

https://avalanche.state.co.us/forecasts/backcountry-avalanche/front-range/

https://www.topozone.com/colorado/

Snowpack Factor

- Layers
- Bonding
- Stability
- Evaluation

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Snowpack

Evaluating the snowpack

Bed surfaces

Snowpack

Evaluating the snowpack

Data pits

Hasty pits

Learning pits

Snowpack

Assessing the snowpack

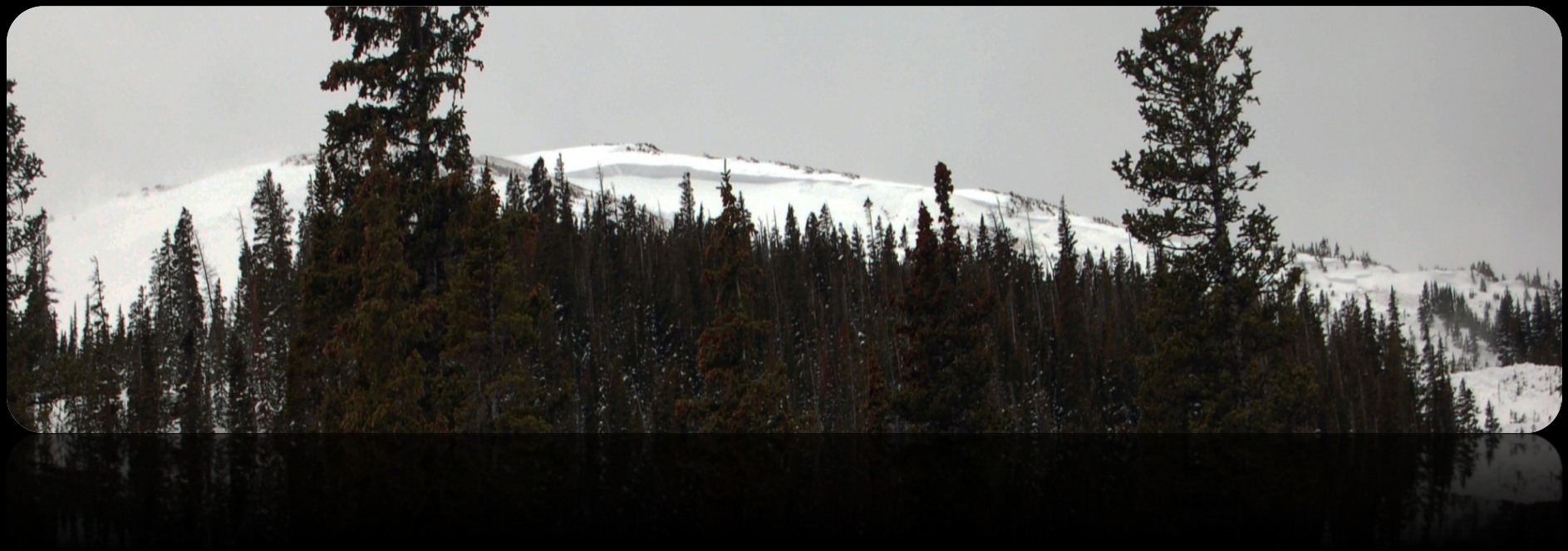
Observations

Our observation can include measurements and data

They might include looking around

Both are valuable and can inform our decisions

Snowpack



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Snowpack

Looking around

Crown

Bed surface

Stauchwall

Video

Debris field / tailings / deposition Zone

Snowpack

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Snowpack

Hasty Topic

CAIC Forecast

http://avalanche.state.co.us/

Snowpack

Overview

Increasingly unstable

Slabs form

Avalanches occur when…

…changes in snowpack or load occurs

The question of out skiing avalanches? (photo)

Snowpack

Data pits

Data pits provide professionals with time line data to aid in avalanche forecasting

Snowpack

Snowpack

Snowpack

Snowpack

Hasty pits

Hasty pits let you see into the snowpack

Evaluate:

- Bond between layers
- Bed surfaces
- Underlying layers

Dig to the ground in Colorado and all inner continental mountain ranges

Snowpack

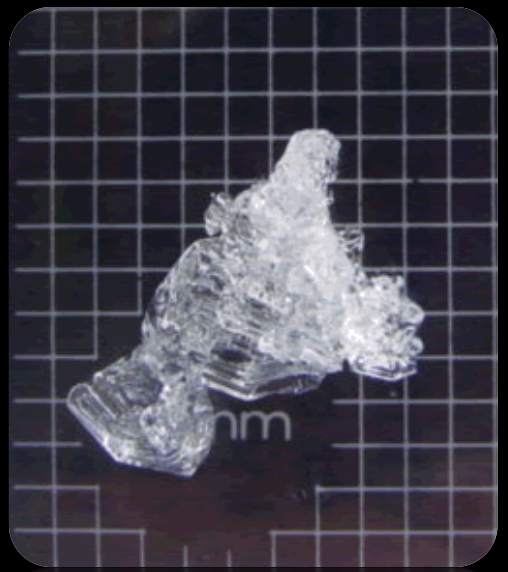
Slides occur when the bond anchoring a slab to a bed surface releases

A bed surface may be the ground or another layer within the snowpack…or a roof

Snowpack

More hasty pits

Temperature gradient = △ In snowpack (recalcitrant)



Leads to the formation of kinetic growth form crystals

Snowpack Field Tests

Assessing
the bonds between
layers

How easily do slabs slide on bed surfaces?

Rutschblock test
Video

Extended column test
Video

Shovel shear and shovel tap tests

Snowpack Field Tests

Pole pentrameter

Data pit stuff…

But now you have heard of it ☺

Hasty Pit

This is the real-life field test that can inform decisions

Pull assessments from data and learning pits as you gain experience and knowledge

We will talk about hasty pits on Sunday

Snowpack Field Tests

Snowpack temperature gradient -

What's that got to do with it?

Additional snowpack assessments – TBD

Extended column test

Propagation saw test

Other?

Snowpack Field Tests

Hand Hardness Test

Observe the hardness of each layer with the hand hardness test. Record under "R" (resistance) the object that can be pushed into the snow with moderate effort parallel to the layer boundaries.
(about 2 or 3 pounds) to push the described object into the snow.
Wear gloves when conducting hand hardness observations.
Slight variations in hand hardness can be recorded using + and - qualifiers (i.e. P+, P, P-). A value of 4F+ is less hard than 1F-. Individual layers may contain a gradual change in hand hardness value. These variations can be recorded in a graphical format (Figures 2.8 and 2.9), or by using an arrow to point from the upper value to the lower value (i.e. a layer that is soft on top and gets harder as you move down would read 4F+ $\rightarrow$ 1F).

Table 2.1 Hand Hardness Index

Symbol	Hand Test Term	Graphic Symbol	
F	Fist in glove	Very low	
4F	Four fingers in glove	Low	2
1F	One finger in glove	Medium	3
P	Sharp end of pencil	High	4
K	Knife blade	Very high	5
I	Too hard to insert knife	Ice	i
N/O	Not observed	N/A	

Snowpack Field Tests

Compression Test - Shovel Tap

Very Easy - Fractures during cutting
Easy - Fractures within 10 light taps using finger tips only
Moderate - Fractures within 10 moderate taps from the elbow using finger tips
Hard - Fractures within 10 firm taps from whole arm using palm or fist
No Fracture - Does not fracture

Compression Test – Stuff Block

Very Easy - Fractures during column isolation
Easy - Fractures during static load
Easy (drop height of 10 or 20 cm) - Fractures during dynamic load
Moderate (drop height of 30 or 40 cm)
Hard (drop height of 50 cm to 70 cm)
No Fracture - Does not fracture

Snowpack Field Tests

Rutschblock Test 1

Procedure

a) Select a safe site that has undisturbed snow and is geographically representative of the slopes of interest.

b) Observe a snow profile and identify weak layers and potential slabs.

c) Excavate a pit wall, perpendicular to the fall line, that is wider than the length of the tester's skis (2 m minimum)

d) Mark the width of the block (2 m) and the length of the side cuts (1.5 m) on the surface of the snow with a ski, ruler, etc. The block should be 2 m wide throughout if the sides of the block are to be dug with a shovel.

e) Dig out the sides of the block, or make vertical cuts down the sides using the lines marked on the snow surface.

f) Cut the downhill face of the block smooth with a shovel.

g) Using a ski or snow saw make a vertical cut along the uphill side of the block so that the block is now isolated on four sides.

Snowpack Field Tests

Rutschblock Test 2

Loading Step that produces a Clean Shear Fracture

1 - The block slides during digging or cutting.

2 - The skier approaches the block from above and gently steps down onto the upper part of the block (within 35 cm of the upper wall).

3 - Without lifting the heels, the skier drops once from straight leg to bent knee position (feet together), pushing downwards and compacting surface layers.

4 - The skier jumps up and lands in the same compacted spot.

5 - The skier jumps again onto the same compacted spot.

6 - • For hard or deep slabs, remove skis and jump on the same spot.
• For soft slabs or thin slabs where jumping without skis might penetrate through the slab, keep skis on, step down another 35 cm (almost to mid-block) and push once then jump three times.

7 - None of the loading steps produced a smooth slope-parallel failure. .

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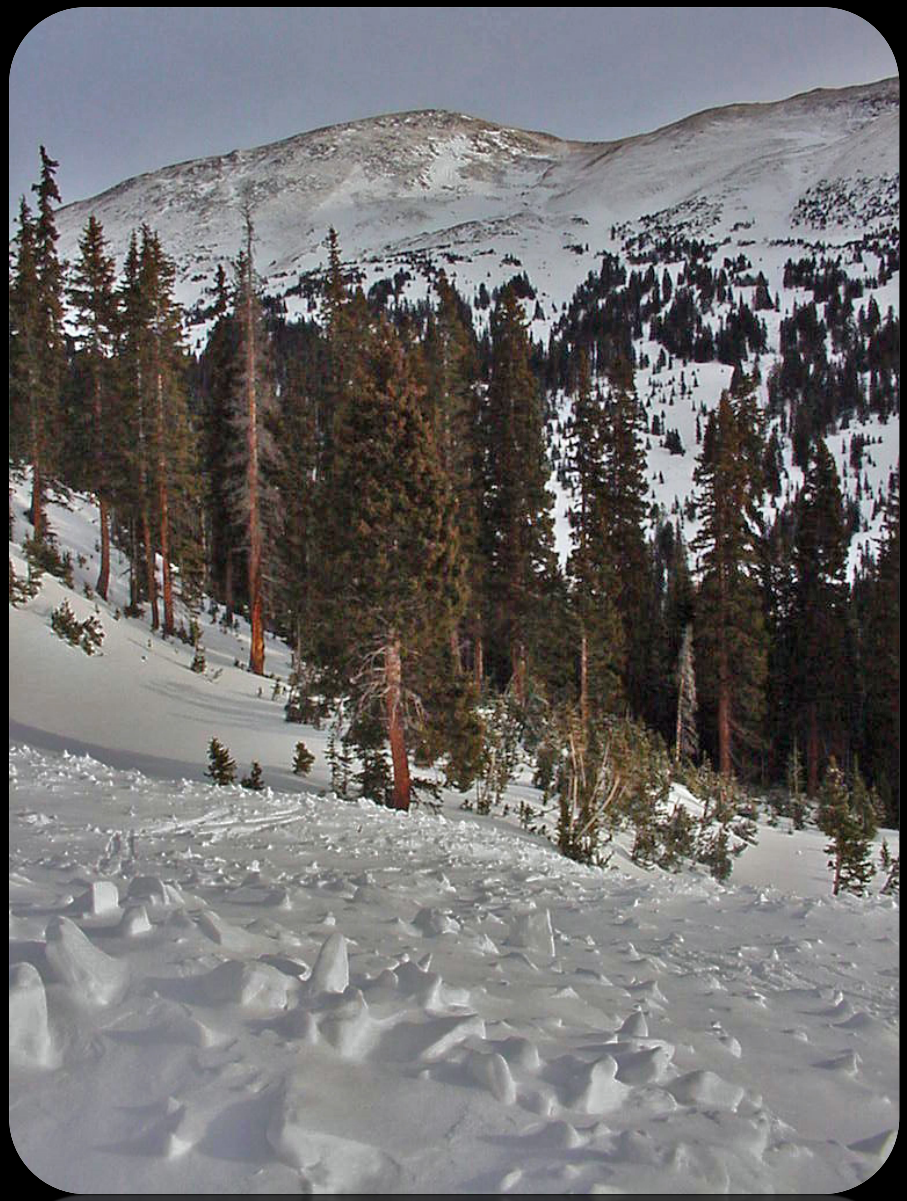
Snowpack

Hasty field tests

Ski pole penetrometer

Hasty pit

- Hand hardness
- Shovel shear Test
- Observations
  - Slab cohesion
  - Bed surface
  - Fracture type



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Snowpack Factor Links

https://www.youtube.com/watch?v=UyGLX_FgE2Q&t=1068s

https://www.youtube.com/watch?v=Gk8W8nlUMpw

https://www.youtube.com/watch?v=LZ77m2u08co

https://www.youtube.com/watch?v=OvwhuP4qtQg

https://avalanche.state.co.us/

https://aaa19.wildapricot.org/

Hasty Topic

CAIC Education

http://avalanche.state.co.us/education/caic-programs/know-before-you-go-colorado/

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Human Factor

Human Factor

Attitude
Plan
Skill Level
Partners / Group
Decision Making
Minimize Exposure
Equipment

Human Factor

Awareness + Rescue + Survival Training

Human Factor

Skill Level

Generally, two types of people get into trouble:

Novices

Non-novices

Human Factor

Attitude is one of the main causes of avalanche accidents as it leads us to filter data and warp it to our needs and desires.

Human Factor

The Plan

Route planning

Risk / reward

Who makes the plan?

Does everyone agree?

Alternatives

Human Factor

The Plan

Lead in/trailhead

Gear check

Weather

Contingency plan?

Willingness to Compromise?

Human Factor

Other Skills

-Some who die in avalanches, die of trauma
-Not all die from asphyxiation
So additional skills might be required:

CPR
WFA
WFR
OEC

ABCDEs
- Airway
- Breathing
- Circulation
- Deformity
- Environment

Prepare for Tx:
- Trauma
- Asphyxiation
- Hypothermia
- Hypoperfusion
- Shock

Human Factor

Partners / Group

Commitment, training, fitness, experience, familiarity with one another

The people in your group will be the ones trying to rescue you and then save your life. Be picky. Be a good group member. Be prepared.

Human Factor

Decision Making

Responsibility = Knowledge + Decision Making + taking action

You have a responsibility to yourself,
to your friends,
to rescue pro's

Human Factor

Minimize Exposure

One at a time

Islands of safety

Move to safety

- Minimize number of people caught
- Maximize number of rescuers / resources
- Reduces the stress exerted at one time on the snowpack

More strategies

- Don’t travel above your partner
- Don’t travel out of sight of each other
- Don’t stop in the middle of or at the bottom of steep slopes

Human Factor

Equipment
Light and fast
Safety equipment

If you are caught:

Fight for your life
Do what you can to stay at the surface
As the snow slows try to penetrate the surface

If your friend is caught:

You are your partners only hope

Use your training, intellect and experience
Dig efficiently
Give care – first aid
Evacuate

Hasty Topic

CAIC Avalanche Observations

http://avalanche.state.co.us/

Human Factor Links

https://avalanche.state.co.us/

https://aaa19.wildapricot.org/

Questions?

Logistics

Typical pre-pandemic weekend out

Saturday

- Meet-up
- Trailhead talk
- Terrain & weather
- Beacons & rescue

Sunday

- Meet-up
- Trailhead talk
- Snowpack
  - Hasty pits
  - Learning pits
  - Data pits
- More beacon work


Thank You!