



## **Anatomy of an Avalanche**

### **Overview:**

In Canada we have been observing, documenting and studying snow and avalanches since 1885. Long before this, Canada's First Peoples avoided avalanche terrain during winter.

Today we depend on avalanche professionals to help keep us safe both recreationally and on our rails, roads and highways. Snow is much more than white snowflakes that look pretty – it is a complicated science. Avalanche professionals are out in the field daily during the snow season making observations about snow layers, snow crystals, and what these are doing with regard to the weather and temperature, which can change everything in the snowpack.

Professional avalanche workers all around the country record snow observations daily and share their information on the InfoEx (Information Exchange). All professionals can then view the information in the InfoEx and make decisions in their work, industry, backcountry, highways, railways and recreationally. Avalanche Canada uses the InfoEx to help create the avalanche bulletins they post daily.

### **Part 1 & 2 - Observation Tools & Safety Equipment**

#### **Learning Objectives:**

- To discover the instruments and tools used by avalanche professionals in the field to observe, assess and record data about snow.
- To understand what safety equipment must be carried when in avalanche terrain.
- To understand the purpose of the various safety equipment.

#### **Lesson Introduction:**

After viewing the [Learning Object Collection](#) on the tools and safety equipment used in the field by avalanche professionals (and backcountry recreationalists), you will have a better understanding of some of the tools and equipment and how they are used.

**Activity - Observation Tools:  
Knowledge Cube**

Materials needed: Scissors, glue & paper template of a cube.

Have students create a six-sided cube with six of the tool names and maybe a picture clue on it. For younger students provide pictures. In partners test your knowledge of what the tools are used for by rolling the dice and see if the other person can name the tool/equipment and describe its use.

**Activity - Safety Equipment:  
Transceiver Search**

If you have access to avalanche safety gear, bury/hide an avalanche transceiver(s) and do a search. If outside, practice probing and shoveling. When probing snow can you feel any changes in the snow, such as harder to probe versus easier? What do you think this means?

**Extension Activity:** Research the different types of snow layers to decipher this. For more information on transceiver burials and probing practice visit [www.avalanche.ca](http://www.avalanche.ca).

### **Part 3 – Snow Layer Observations**

**Learning Objectives:**

- To observe what a snow pit might look like.
- To see some avalanche observation tools being used in the field.

**Lesson Introduction:**

Snow is complex; add weather and it becomes even more complex. To get some understanding of what a snow pit looks like and what people look for in a snow pit, complete the following snow and weather labs. If you do not have snow, look at the [Avalanche Canada](#) avalanche information or view the five [Snow Science videos](#) produced by Parks Canada.

**Activity:**

**Snow & Weather Lab**

Dig your own snow pit and make observations. Follow the steps (1-10) below:

**Materials Needed:** shovel(s), measuring tool(s) appropriate for depth of snow you have. Magnifying glass/loupe, recording paper/chart and pencil, a piece of plastic/metal (a ruler would do) to view snow crystals on snow crystal chart. (optional: thermometer & compass)

**Refer to snow crystal chart**

**Refer to snow and weather log**

1. **Hypothesize** what you may find outside in your snow pit. Think about what the weather has been like. Warmer wet snow/rain versus dry light snow or warm weather versus cold weather. Write down your hypothesis.
2. **Dig your pit.**
3. **Measure** and record depth of snow. Can you see any visual layers in the snow? Record the depth of these layers from the ground up.
4. **Resistance:** What do the layers feel like? Are they hard, soft? Can you stick a fist, four fingers, finger or pencil into them with ease or difficulty? Record what resistance you get in each snow layer.
5. **Types of snow:** Carefully pull out some snow crystals from any one of the layers (write down depth the snow crystals come from) and look at them under your magnifying glass/loupe. Describe (write down) what the crystals look like under the magnifying glass/loupe. Can you ID these snow crystals? Use your snow crystal ID chart. If you have new snow and old snow, compare these too: how has the snow changed? If you have time, do this for each layer.
6. **Layer tests:** With your shovel, isolate a block of snow all the way to the ground. Insert your shovel behind the column of snow and if possible, try pulling it out towards you. Does the snow slide off anywhere? Did it slide easily or need a lot of help? Record where it slid (depth from ground): this is considered a weak layer and state if it was easy or difficult to make it slide. What did the snow crystals of the breakaway layer look like under your loupe?
7. **Weather observations:** use chart provided in the pdf document above or create your own and record the following information:
  - Time of day.
  - Air temperature (if you don't have a thermometer use internet and Environment Canada forecast temperature for the time when you do the lab)
  - Describe the weather at this time.
  - Is there wind? From what direction?
  - Is it precipitating? What kind of precipitation (snow, hail or rain)?
  - Can you approximate how much precipitation has fallen in the last 24 hours?
  - Describe where your snow pit is (i.e., is it in the sun if it is sunny, is it sheltered by trees or buildings, is it a windy spot, do you know what aspect (compass direction) it is, etc.)
8. **Sharing and reviewing information:** Discuss your findings with others once back inside. Was your hypothesis correct?
9. **Write up** your findings and decide if you think there is a high, medium or low chance of avalanche if you were in an avalanche area today. Go to the [Avalanche Canada's](#) website and pull up the avalanche information for your area or an area near you. What is the avalanche forecast for today for your area? Were you correct?
10. **Replicate:** Go back and re-dig your pit in a week or two. What has changed?

## **NO Snow? Try one of these activities:**

### **1. Avalanche Information**

Look at the [Avalanche Canada's](#) avalanche information for your area, an area near you or an area of your choice.

Look at the weather for this area on Environment Canada's website. Do this a few times in a week. Can you correlate weather with the avalanche information at all? What type of information does the avalanche bulletin provide to the public?

View the danger rating scale or print a card to help you navigate the site from:

<http://www.avalanche.ca/resources/cac/attachments/danger-scale>

Discuss in groups if you would go into the backcountry that day. If you did go, would you stick to certain terrain/area (simple, complex or challenging)? Refer to [www.avalanche.ca/cac/training/online-course/terrain/ATES](http://www.avalanche.ca/cac/training/online-course/terrain/ATES)

Or

### **2. Snow Science Videos**

**View the set of [videos about snow science](#)** on YouTube. Fill in the snow & weather log (download pdf document above) accordingly with the videos. Discuss findings as a class. Answer these questions: Would you go out into the backcountry on that day? If yes, is there a specific area you would avoid or one you would stay in?

## **Parts 4 & 5: Basic Avalanche Anatomy & Recipe for an Avalanche**

### **Learning Objective**

- To understand the most basic terminology used for avalanches.
- To understand the key ingredients of an avalanche.
- To differentiate between the two types of avalanches.

After looking at the pictures on [avalanche anatomy](#) and the [video clips](#) about the types of avalanches and recipe for an avalanche, you will have some basic terminology and knowledge around these topics.

### **Activities:**

#### **1. Create a Graphic Organizer & Poster**

In order to display your knowledge, create a graphic organizer displaying your knowledge from triggers and causes to the actual avalanche event.

### **Discussion Questions**

Which do you think is the most common trigger/cause of avalanches?

Answer: Humans = the largest trigger.

How can we reduce this without taking humans out of the backcountry completely?

### **Poster Activity**

Create a poster with a catchy slogan that will help get people to take an avalanche safety course – photograph the class’s favourites and send them to the CAA/CAC at [info@avalanche.ca](mailto:info@avalanche.ca) and they may post them on Behind the Lines ([www.facebook.com/CAC.BehindtheLines](http://www.facebook.com/CAC.BehindtheLines))

### **2. Avalanche Article & Discussion**

Find an article about a recent avalanche incident. Have students read the article or read together as a class.

Have students discuss in groups the following questions:

- What led to the incident?
- What would avalanche professionals potentially have found in the snowpack that day?
- Was there a trigger?
- What was the recipe for this avalanche?
- If there are pictures with this article of the avalanche, identify the type of avalanche if possible and the different parts of a slide path.
- Do you think there was a way this avalanche could have been avoided?

### **3. Do an Indoor Experiment/lab:**

#### **Purpose:**

- To understand slope angle involved with avalanches.
- To understand how triggers come into play with an avalanche.
- To better understand the recipe for an avalanche.

#### **Preamble:**

In order for an avalanche to occur, the snow pack must have an unstable element or layer (failure layer). Most human triggered avalanches occur on slopes angled between 30-35 degrees but they can happen at smaller and larger degrees!

#### **Materials Needed:**

- 1 cup/group of white sugar
- 1 cup/group of brown sugar
- 1 cup/group of flour
- 1 cup/group of oats.
- A free-standing board with sides to work on (doesn't have to be that big; shoe box cardboard works well).
- Newspaper/tarp to put underneath to keep area somewhat clean.
- A protractor or compass to measure the slope angle.
- Bring some raw sugar or coarse salt in order to show the class/group as a comparison as it is shaped differently).

- Lego man, or some type of weight.

**Hypothesize** at what point/slope angle in degrees each substance will slide at; write these down. Include packed versus loose. Which layer? will be the weakest? The strongest?

**Method:**

- Place a tablespoon of each of the sugars, oats and flour loose at one end of the board (the top), slowly tilt board and measure in degrees at what point each slides. Record this. Then do the same with each but pack them. Record these. Note the difference in degrees.
- Experiment with layering about two tablespoons of each and see what happens when you tilt them. Try this packed tight. Change up the layers; how does this change things? Record layers and at what point they slide.
- Try taping rocks on the board to simulate terrain; how does this change things? Record your findings.
- You could try simulating triggers – eg. Lego person, weight, tapping the end of your board etc.

**Results:**

Write up your report on your findings. Think about how this could emulate snow, packed versus loose snow (brown sugar would represent more dense packed, perhaps more stable layers versus white would be those sugar snow layers/ball bearing weak depth hoar type layers that can form early in the season because layer is exposed to clear cold weather). Relate your findings to the recipe for an avalanche.

**Culminating Activity Ideas:**

**1. Board Game**

Have students create a board game from the information in the Anatomy of an Avalanche Learning Object Collection. For example: Reach the Peak – where you must safely navigate the obstacles and choose a safe route according to the forecast. Get to the Peak by gaining avalanche safety gear and knowledge through “Safety cards”. “Avalanche cards” could be setbacks. Let the students be creative. Have a class where you play each other’s board games for review.

**2. 12-Sided Bloom Ball**

Create a Bloom Ball by combining the information in the [Learning Object Collection](#) and some additional research.

Students can create these individually or in pairs or groups.

Provide students with the template of the bloom ball (they will need 12) and remind them not to write on the flaps and only in the pentagon portion of the circle.

Here is the information needed for each circle:

1. Definition of what an avalanche is.
2. List of instruments/tools used by avalanche professionals in the field (with a graphic for use reminder)
3. List safety gear and use.
4. Snow pit: What information is found in a snow pit? Research this circle.
5. Weather: How does weather play into the snowpack? Research this circle.
6. Snow crystals. List the different types.
7. Label an avalanche with correct terminology.
8. Differentiate between the two types of avalanches.
9. Recipe for an avalanche.
10. List all possible triggers.
11. Features of Avalanche Canada's avalanche bulletin and importance of the avalanche bulletin.
12. How do you stay safe in avalanche terrain?