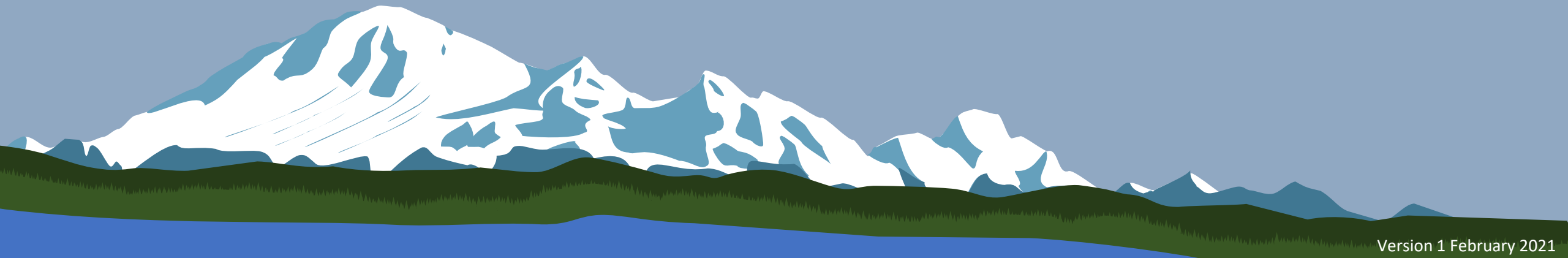


1. [Surviving the Night](#)
2. [Survival Kit](#)
3. [Wilderness Shelter](#)
4. [Fire Building](#)
5. [Water Procurement](#)
6. [Signaling](#)
7. [Navigation](#)
8. [Survival Food](#)
9. [Survival Caisals](#)
10. [Surviving the Cold](#)



Surviving the Cold

Supplemental Class – Read at Home



Surviving the Cold

Because Winter in the Mountains is Cold

Copyright Notice

**Do NOT post or share this presentation
on the WEB!**

Disclaimer

This PowerPoint slideshow was designed to be used in combination with face-to-face instruction. It discussed survival techniques. Use of any equipment or technique mentioned in the following slides are for educational use only. Most of the equipment and techniques mentioned are dangerous.

This slideshow is NOT intended to be used as an independent survival guide.

Proceed at your own risk and may god have mercy on your soul.

Surviving the Cold

Surviving the Cold Index

- [Intro](#)
- [Cold Weather Clothing](#)
- [Cold Weather Hygiene](#)
- [Snow Shelters](#)
- [Cold Weather and Fire](#)
- [Cold Weather Stoves](#)
- [Cold Weather Water](#)
- [Seawater](#)
- [Signaling](#)
- [Cold Weather Gear](#)
- [Avalanche](#)
- [Snowshoes](#)
- [Skis](#)
- [Pulks](#)
- [Surviving the Cold Resources](#)

Surviving the Cold

Surviving the Cold Intro

Surviving the Cold

Surviving the Cold

- There are several aspects to surviving in Cold Weather Environments
- Obviously, cold is your main concern
 - Cold injuries can kill or cripple
 - Hypothermia is the killer of the unprepared
- Shelter is not optional for survival in this environment
- Fire starting skills are vital for survival
- Water is often frozen

Surviving the Cold

Surviving the Cold – Things to Review

- **Hypothermia**
 - Review Cold Injuries Class
- **Frostbite**
 - Review Cold Injuries Class
- **Fire Starting**
 - Review entire Fire-Starting Class
- **High-Altitude Illness** – If you will be at high altitude
 - Review the High-Altitude Illnesses Class
- **Avalanches** – If this is a concern where you are at
 - Review the Avalanches Class

Surviving the Cold

Cold Weather Clothing

Surviving the Cold

Cold Weather Clothing

Hypothermia is the Killer of the Unprepared

Surviving the Cold

Cold Weather Clothing – 3 Ws

- **Waterproof**
- **Windproof**
- **Warm when wet**

Surviving the Cold

Cold Weather Clothing – 3 Ws

- **Waterproof**
 - Rain and melting snow causes significant heat loss
 - Very high specific heat capacity – absorbs a LOT of heat
 - High thermal conductivity
 - 0.6 vs 0.025 Watts/(meter-Kelvin) (water vs air)
 - Water conduct heat 24x more than air
 - Evaporation
 - Results in cooling of anything in contact with water
- **Windproof**
- **Warm when Wet**

Surviving the Cold

Cold Weather Clothing – 3 Ws

- **Waterproof**
- **Windproof**
 - Your body radiates heat – creates layer of warm air around skin
 - This layers of warm air is protective against frostbite
 - If you have insulation around body, it traps some of that warm air
 - Wind can blow right through clothing and sleeping bags
 - Wind blows warmed air away from body
 - Wind increases risk of hypothermia AND frostbite
 - Windchill – feeling of being colder because of wind
- **Warm when Wet**

Surviving the Cold

Cold Weather Clothing – 3 Ws

- **Waterproof**
- **Windproof**
- **Warm when Wet**
 - You will get wet
 - Rain
 - Melting snow
 - Sweat
 - Snowball down back of shirt
 - Some fabrics retain some insulation value when wet
 - Wool and Synthetics (Polyester, Nylon and Polypropylene)
 - Others lose all insulation value when wet
 - Cotton and Down

Surviving the Cold

Cold Weather Clothing

- C** Keep clothing **C**lean
- O** Avoid **O**verheating
- L** Wear clothing **L**oose and in **L**ayers
- D** Keep clothing **D**ry
- E** **E**xamine clothing for defects or wear
- R** Keep clothing **R**epaired

Surviving the Cold

Cold Weather Clothing – Clean

- Keep clothing clean
- Soiling of clothing
 - Makes insulation ineffective
 - Causes wear of clothing
 - May result in holes in fabric
- Washing clothing may be impractical in field
- Easier to keep clean than to wash
 - Don't wipe dirt off on clothing
 - Don't walk on your knees

Surviving the Cold

Cold Weather Clothing – Overheating

- Avoid overheating and perspiring
 - Perspiration leads to wet clothes
 - Wetness decreases insulation of clothing
 - Wetness leads to evaporative heat loss
- If you are getting too hot, such as when digging or walking
 - Remove layers
 - Vent clothing
 - Slow down and pace yourself

Surviving the Cold

Cold Weather Clothing – Loose

- Wear **Loose** clothing
 - Tight clothing reduces blood circulation
 - Decreased blood circulation increases risk of frostbite

- Wear clothing in **Layers**
 - Wear wicking material against skin
 - Add thicker material layers as needed
 - Layering allows for removal of layers and ventilation

Surviving the Cold

Cold Weather Clothing – Dry

- Small amounts of wetness increase rate of heat loss by 25 times
- Drying clothing may be impractical
 - Easier to stay dry than to dry out
- Fires can be used to dry clothing
 - Avoid overheating and damaging clothing
 - “Bare Hand” test
 - Place hand over/by fire where you would like to place clothing
 - Count to 3 slowly
 - If no excessive heat is noted – that’s a safe place to dry clothing
 - Take great care with drying of boots, mittens and gloves
 - Overheating causes permanent shrinkage, stiffness and cracking

Surviving the Cold

Cold Weather Clothing – Dry

- Sun and wind will sublimate water over time
 - Secure clothing outside and wait
 - Keep an eye on weather
- Freeze drying works better than you might think
 - Allow water to freeze on/in clothing
 - Shake, beat or bend frozen clothing to remove crystals

Surviving the Cold

Cold Weather Clothing – Dry

- Fabrics have a huge effect impact on staying dry
- **Cotton** fabric used for insulation is potentially dangerous in the cold
 - Holds 2700% its weight in water
 - Readily absorbs water – both outside wetness and perspiration
 - Loses ability to insulate when wet
- **Polyester** holds 0.4% its weight in water
- **Nylon** holds up to 10% its weight in water and dries quickly
- **Wool** holds 37% its weight in water and insulates somewhat when wet
- If you have a choice, select synthetic or wool over cotton fabrics

Surviving the Cold

Cold Weather Clothing – Examine

- Regularly inspect clothing for wear and damage
- Worn, damaged or soiled clothing loses its protective qualities

Surviving the Cold

Cold Weather Clothing – Repair

- If you damage your clothing, repair it
- Prompt repairs will
 - Return insulation lost from damage
 - Protect user from damage
 - Reduce risk of progression of damage
- Inuit are known for their meticulous care of clothing
 - When damage is identified, it is immediately repaired

Surviving the Cold

Cold Weather Clothing – Head

- The unprotected head loses a LOT of heat
- Cover your head to limit heat loss
- Cover your ears to reduce risk of frostbite
- If a fur lined hood is used
 - Heat insulation can be adjusted by adjusting opening in hood
 - Fur needs to be regularly shaken to remove frost build up
 - Ice can block opening, damage fur, freeze skin or melt later

Surviving the Cold

Cold Weather Clothing – Eyes

- Eyes need to be protected from UV radiation
- Need Glacier Glasses – with side protection
 - If you wear prescription glasses - [Cocoons](#) are an excellent option
- Goggles are invaluable in white out conditions
 - If they fog up, you are overheating – cool off
 - Maybe your neck gaiter is redirecting breath into goggles - adjust

Surviving the Cold

Cold Weather Clothing – Nose

- Nose gets hit with a lot of UV radiation
- Use fabric or facemask to cover nose
- [NozKon](#) and similar devices will protect nose

Surviving the Cold

Cold Weather Clothing – Scarf

- A scarf can provide excellent insulation around head or neck
 - Should be wool or synthetic
- Moisture from respirations will condense on fabric
 - Moisture will freeze
 - Ice can freeze flesh adjacent to it
 - Regularly deice this fabric

Surviving the Cold

Cold Weather Clothing – Hands

- Hands need protection from cold
- If hands get too cold, they become useless
 - Can't start fire or care for self with useless hands
- Exposed hands are at high risk of frostbite
- 1-2 pairs wool mittens or gloves worn under a waterproof shell

Surviving the Cold

Cold Weather Clothing – Feet

- Having the proper insulated boot/sock combo is vital
- Feet are almost constantly in contact with cold ground
- They are also at high risk of getting wet
 - Wetness dramatically increase risk of injury
 - Avoid water and wetness if possible
 - Waterproof boots if possible
- Keep socks dry
 - Change daily
 - Change if they become wet
- Without proper boot/sock combo, special precautions must to be taken

Surviving the Cold

Cold Weather Clothing – Feet – Rubber Bottomed Boots

- **Rubber Bottomed Shoepacs**
 - Sorel style boots are excellent
 - Bottom covered with heavy duty, waterproof rubber
 - Top made of leather or synthetic fabric
 - Generally heavily insulated
 - Good for **WET** cold environments
 - Removable liners allow you to dry out boot and insulation

Surviving the Cold

Cold Weather Clothing – Feet - Mukluks

- **Mukluks**
 - Soft and warm
 - Excellent insulation over feet and lower leg
 - Designed for **DRY**, cold conditions below 15°F
 - Not ideal for PNW winters
 - Liners should be changed daily when possible

Surviving the Cold

Cold Weather Clothing – Feet – Vapor Barrier Boots

- **Vapor Barrier Boots**
 - Old technology used by Military
 - Prevents water vapor from escaping
 - No evaporative heat loss
 - No conduction heat loss from contact with water and boot
 - No insulation loss due to wetness from sweat in boot
 - -20°F for Type I (black Mickeys)
 - -60°F for Type II (white Bunnies)
 - Don't "breathe"
 - Feet will get wet
 - Socks need to be regularly changed and dried out
 - Feet must be dried out to prevent injury

Surviving the Cold

Cold Weather Clothing – Feet

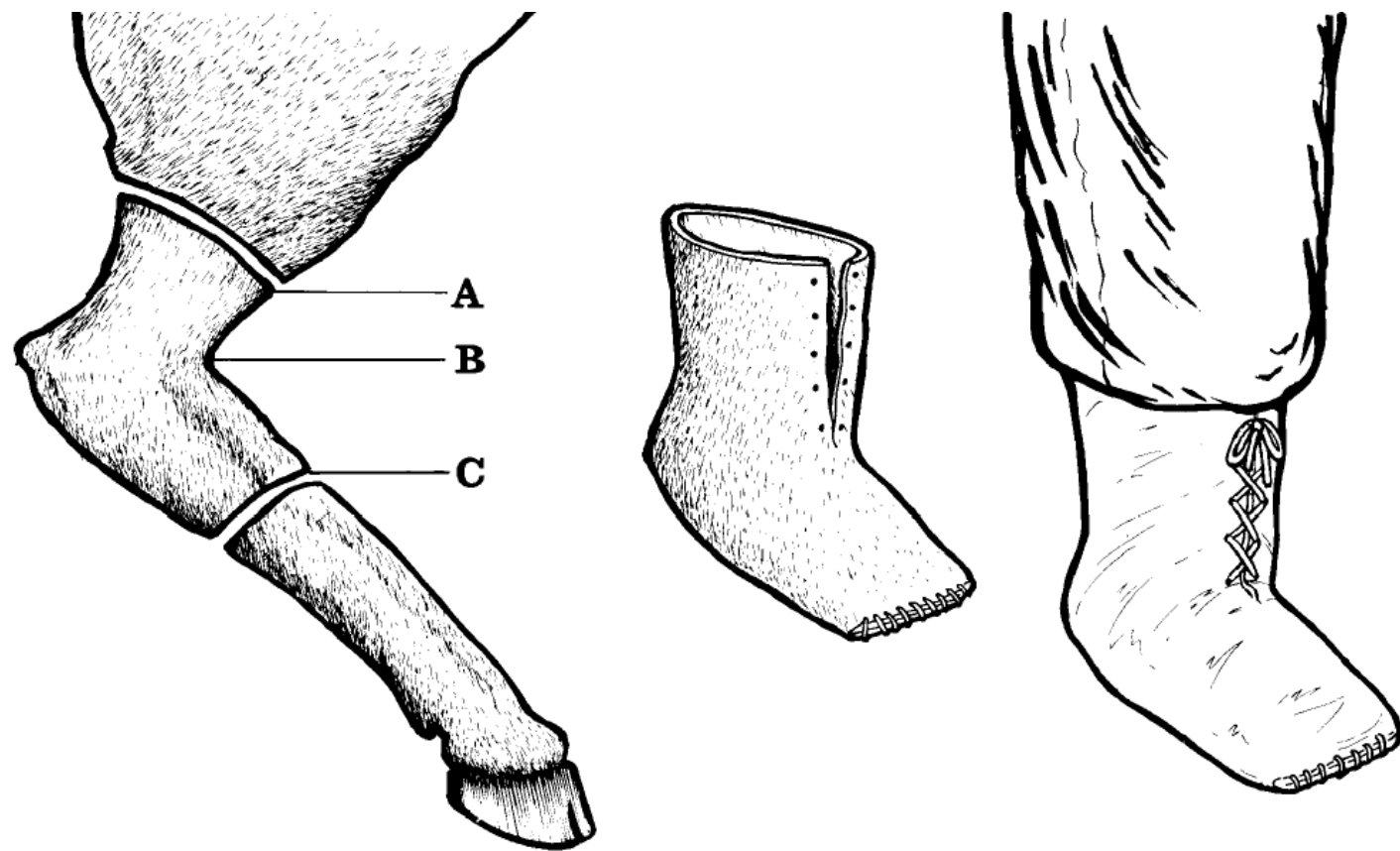
- **Gaiters**
 - Keep snow out of boots



Surviving the Cold

Cold Weather Clothing – Feet

- **Moose Hock Boots**
 - Long wearing boots
 - Minimal insulation
 - Made from hind leg of large game



Surviving the Cold

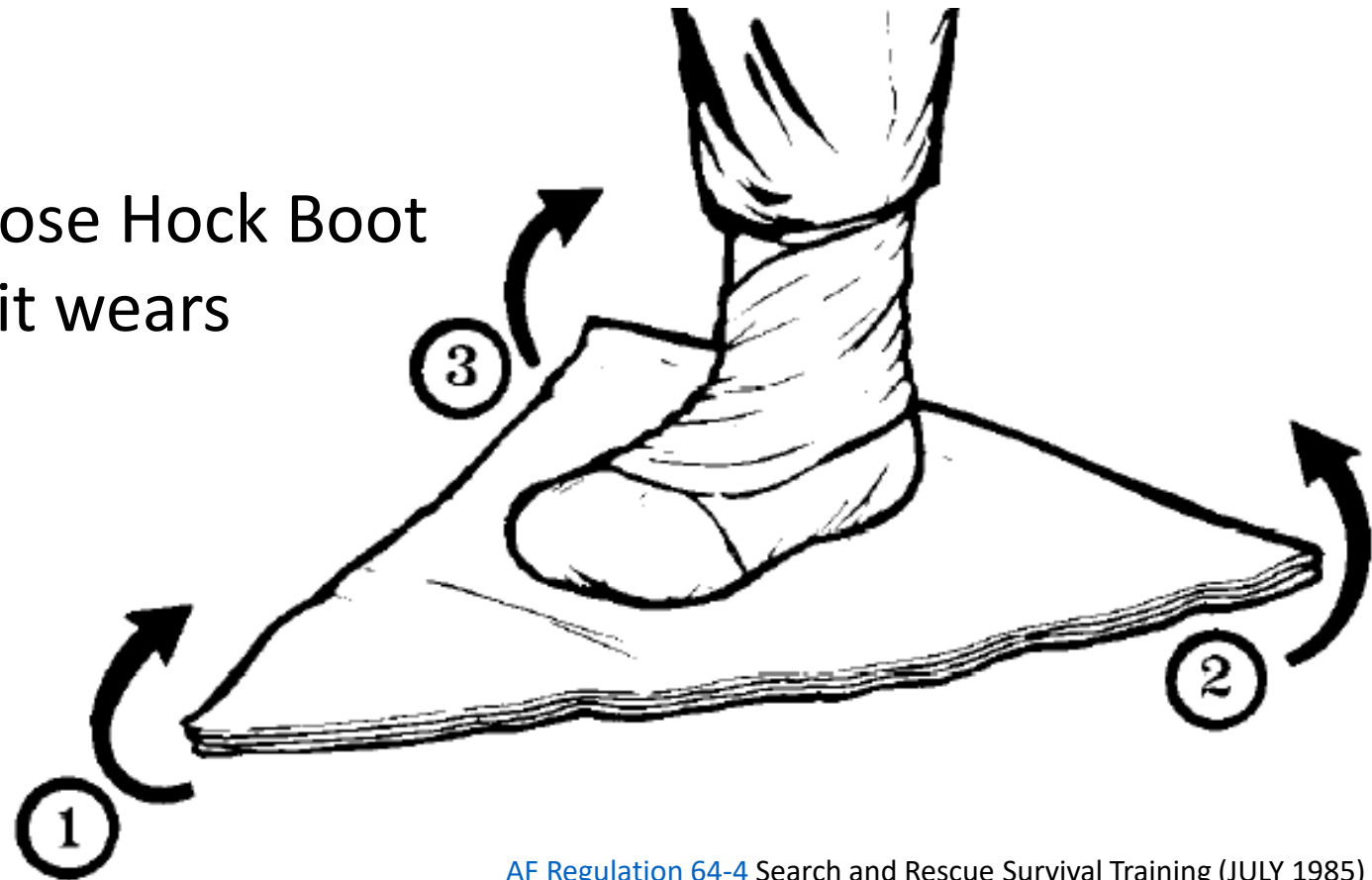
Cold Weather Clothing – Feet

- **Grass Insoles**
 - Used by northern natives
 - Grass insulates and absorbs moisture from feet
 - Grab 1-inch diameter bunch of tall grass with both hands
 - Rotate hands in opposite directions to create fluff
 - Form fluff into shoes with inner soles about an inch thick
 - Remove at night to allow to dry out

Surviving the Cold

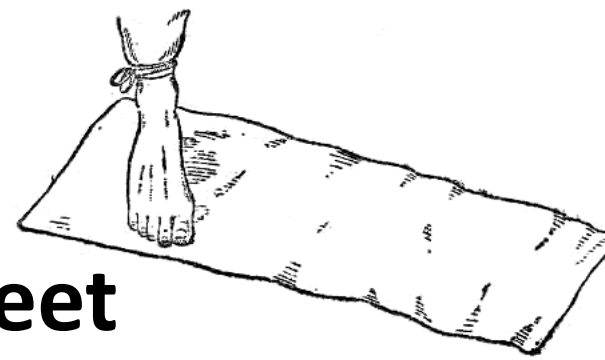
Cold Weather Clothing – Feet

- **Hudson Bay Duffle** – triangular cloth wrap
 - Hudson Bay Company sold triangular pieces of blanket to natives
 - Used to insulate feet
 - Wrap around feet
 - Place in Moccasin or Moose Hock Boot
 - Fabric can be rotated as it wears

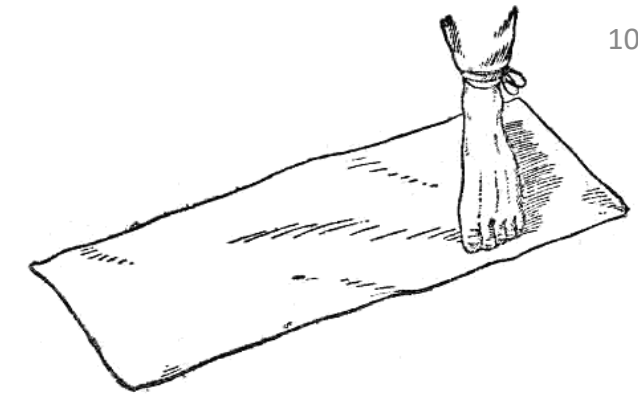


Cold Weather Clothing – Feet

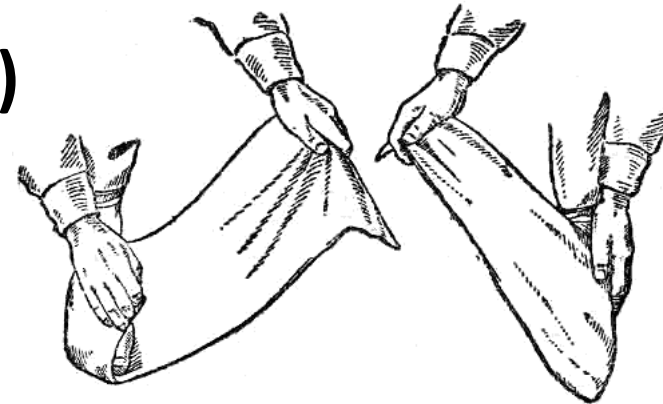
- **Портянки**
aka Russian Socks (Portiyanki)
 - Fabric wrap



Прием 1.

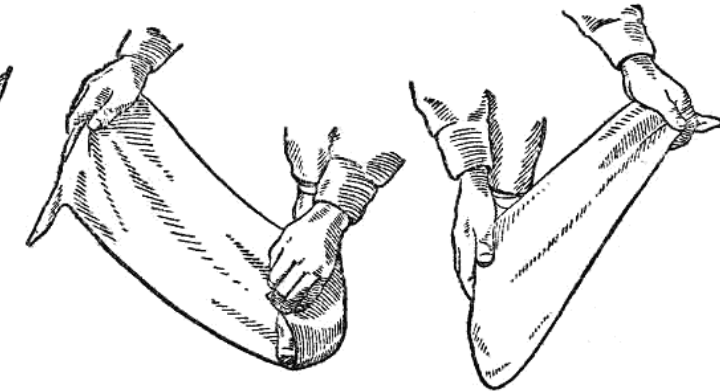


Прием 1.



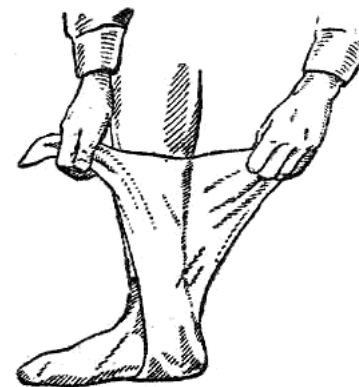
Прием 2.

Прием 3.



Прием 2.

Прием 3.



Прием 4.

Прием 5.



Прием 4.

Прием 5.

Рис. 72. Обвертывание правой ноги.

Рис. 73. Обвертывание левой ноги.

Surviving the Cold

Cold Weather Clothing – Feet

- **Double Socks**
 - Put on sock
 - Use extra padding, grass, fur, etc. over first sock
 - Fit second sock over this
 - Wrap foot in fabric and tie off around ankles



Surviving the Cold

Cold Weather Clothing – Feet

- **Vapor Barrier Socks**
 - Layer one – thin polyester socks
 - Layer two – VB layer
 - Rab Vapour Barrier Socks
 - Large sized oven bag (Reynolds)
 - Turkey sized bags and garbage bags are too big
 - Layer three – thick wool or synthetic socks
 - Layer four – boots
- These keep your boots and insoles nice and dry
 - Don't need to dry these out at night or worry about them freezing
- Use only in temps of 10°F or lower

Surviving the Cold

Cold Weather Clothing – Feet

- **Soles**
 - Durable soles can
 - Increase longevity of boots
 - Increase traction on snow, ice and frozen ground
 - Provide some insulation against cold ground
 - Improvised Soles:
 - Tires – Use paracord to create sandals or envelope
 - Wood – many designs including snowshoes
 - Make horizontal ladder of sticks on bottom for “bite”/traction
 - Cardboard warped in duct tape
 - Foam pad – ideally reinforced with wood and duct tape

Surviving the Cold

Cold Weather Clothing – Sleeping Bag

- Sleeping bag is transitional clothing
 - Used after daytime activities have ended
 - Used for sleep

Surviving the Cold

Cold Weather Clothing – Sleeping Bag – Fluff

- Most bags are compressible
 - Compressed for storage
 - Insulation comes from trapped air within sleeping bag fill
 - Must be fluffed to restore insulation value
 - When you are in your bag, the under side is compressed
 - Minimal insulation value from ground

Surviving the Cold

Cold Weather Clothing – Sleeping Bag – Pad

- A sleep system needs extra insulation from the ground
 - Air mattress
 - Allow it to self-inflate
 - Blowing into mat adds moisture, which freezes - BAD
 - Closed cell foam
 - Less insulation value per weight compared to air mattress
 - More durable - can't pop it with stick
 - Don't need to wait for it to inflate
 - Pine boughs
 - Great field expedient ground insulation
 - Try to stack 12" thick

Surviving the Cold

Cold Weather Clothing – Sleeping Bag – Wetness

- Sleeping bag needs to be kept dry
 - Wetness degrades insulation of sleeping bag
 - Wetness in a down sleeping bag = catastrophic loss of insulation
- Protect bag from wetness or snow
 - Use bivy bag if possible
 - Protect from wet ground or snow with
 - Pad and/or mattress
 - Ground cover such as tarp or space blanket
 - Natural insulation

Surviving the Cold

Cold Weather Clothing – Sleeping Bag – Wetness

- Moisture from breathing can make sleeping bag very wet
- Use a **Moisture Cloth**
 - Lightly wrapped around the head
 - Traps breath inside the cloth
 - Moisture cloth is easier to dry than a sleeping bag

Surviving the Cold

Cold Weather Clothing – Sleeping Bag – More Insulation

- Extra insulation can be gained from
 - Overbag – larger sleeping bag over primary bag
 - Bag liner
 - Easier to dry out liner than a sleeping bag
 - Wearing dry socks, mittens and other clothing
 - Place parka or trash bag over feet
 - Use other clothing under sleeping bag or as pillow

Surviving the Cold

Cold Weather Clothing – Sleeping Bag – Still Cold?

- If your sleeping system just isn't cutting it
 - Exercise
 - Flutter feet up and down
 - Beat inside of bag with hands
 - Food or hot liquids can help

Surviving the Cold

Cold Weather Clothing – Sleeping Bag – Caveats

- Avoid wearing wet clothes while in a sleeping bag
- Air out bag during day if possible
 - Larger shelters such as igloo better than snow trench
 - Turn inside out to dry/freeze and shake out crystals later
 - Ideally hold in front of fire at safe distance each day to dry out

Surviving the Cold

Cold Weather Hygiene

Surviving the Cold

Cold Weather Hygiene

- Hygiene in the cold is vital for avoiding infections and other illness
- Proper hygiene can be a challenge
 - Limited water
 - Don't want to get clothing or body wet – concern for hypothermia
 - Some would rather live in their own filth than risk getting cold

Surviving the Cold

Cold Weather Hygiene

- Face, hands, armpits, and crotch should be washed daily
 - Use water if available
 - No water – Rub with cornstarch or foot powder
 - This removes excess oil and perspiration from skin and hair
- In dry arctic - oil unprotected and exposed skin once a week
 - Suntan oil

Surviving the Cold

Cold Weather Hygiene – Feet

- Feet at risk of fungal infections
- Socks need to be changed daily
- Feet should be washed daily
 - Use water or warmed wet wipes and allow to dry
- Foot powder does a few things
 - Dries feet
 - Removes oils, moisture, some fungus and funk
 - If using medicated powder – reduces fungus on skin
- Don't sleep in same socks you wore all day
- Don't sleep with boots on unless you have no choice

Surviving the Cold

Cold Weather Hygiene – Beards

- Beards do not provide very much insulation
- They collect filth
- They collect frost and ice
- Oils from beard will decrease insulation of clothes and sleeping bag
- Shave regularly
 - Daily if water is available
 - Every 2 to 3 days if water is in limited supply
 - Shaving removes oils from skin
 - Allow time for skin to recover to reduce frostbite
 - Wait 2 hours before going out into cold or shave before bedtime

Surviving the Cold

Cold Weather Hygiene – Teeth

- Brush Teeth ideally twice a day or daily as a minimum
 - Use a toothbrush
 - Pack an extra one for that scout who forgets stuff
 - No toothbrush –
 - Use a clean piece of cloth wrapped around a finger
 - Chewed twig

Surviving the Cold

Cold Weather Hygiene – Underwear

- Underwear should be changed at least twice a week
 - Not changing them increase risk of fungal and other infections
 - Plus you get the “funk”
 - Wash as needed
 - If you can't wash underwear –
 - Crumple it, shake it, and air it for at least 2 hours

Surviving the Cold

Cold Weather Hygiene – Eating Utensils

- All eating and cooking utensils need to be cleaned after each use
 - In the cold, nasties still grow on dirty cookware
 - You don't want diarrhea in a cold environment
 - Use fresh snow to “scrub” cookware

Surviving the Cold

Cold Weather Hygiene – Urine and Feces

- Everybody Poops
- You still need to urinate and defecate in the cold
 - Consider digging a trench to sit in so you are protected from wind
- In extremely cold environments, this should be done indoors

Surviving the Cold

Cold Weather Hygiene – Urine and Feces

- **Urination**
 - Use a pee bottle or tin can
 - Use different color and shaped bottle than your water bottle!
- **Defecation**
 - Ideally have tunnel to cave bathroom
 - or use snowblock (kovik) and dispose of later
 - or a tin can and cover with snow
 - In non-survival condition –
 - Allow to freeze, seal in 2 layers of plastic and pack out
 - or in a peanut butter jar
 - Or PVC Poop Tube

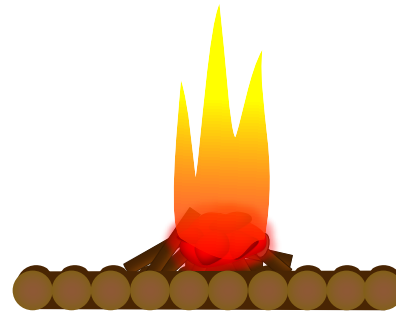
Surviving the Cold

Snow Shelters

Surviving the Cold

Snow Shelters

- Shelters are NOT optional for cold weather survival
- Your shelter will depend on the resources and skills you have available
- You should not sleep directly on snow and ice
- We will discuss Snow Shelters in this section
 - Other Shelters are covered in our Wilderness Shelters Class



Surviving the Cold

Snow Shelters – Clothing and Shelters

- Snow on clothing isn't a big deal outside
- It will become problematic if it melts
- Entering a warm shelter covered in snow will lead to wet clothing
 - Wetness is BAD
 - Returning outside - this will turn into ice and reduce insulation
- Shake off and/or brush clothing before entering a shelter
 - If snow can not be removed, leave clothing outside or in entryway
 - Allow water/snow to freeze
 - Beat out with stick

Surviving the Cold

Snow Shelters – Firearms and Shelters

- Firearms “sweat” when brought into snow shelters
- This condensation will freeze and render a firearm inoperable
- Firearms should be left outside of snow shelters in protective area
 - Do not allow snow to fall on firearm
 - Snow or ice in barrel can cause it to explode when fired

Surviving the Cold

Snow Shelters – Safety – Obligatory Safety Talk

- **Carbon Dioxide asphyxiation**
 - If you make your snow shelter air-tight, you will die
 - Your shelter **MUST** have ventilation, otherwise it's not a shelter – It's a grave!
 - High levels of carbon dioxide
 - Causes unconsciousness
 - Results in respiratory arrest within 1 minute
 - You must have 2 ventilation holes
 - One at entrance
 - One in roof
 - Fist size – use ski poles to clear holes

Surviving the Cold

Snow Shelters – Safety – Obligatory Safety Talk

- **Carbon Monoxide suffocation**
 - Use of stoves and fires in shelters results in Carbon Monoxide
 - Carbon Monoxide poisoning is a silent and DEADLY killer
 - It will sneak up on you
 - You won't notice its effect on you
 - You might notice it in someone else
 - Avoid using stoves in an enclosed area!
 - **NEVER EVER** sleep with a stove running!

Surviving the Cold

Snow Shelters – Safety – Obligatory Safety Talk

- **Hypothermia**
 - Avoid overheating while making your shelter
 - Overheating leads to sweating
 - Sweating gets you wet
 - Wetness can lead to hypothermia

 - When working on a shelter
 - Pace yourself
 - Remove layers as needed
 - Cover your head when needed to prevent snow from falling down the back of your shirt

Surviving the Cold

Snow Shelters – Safety – Obligatory Safety Talk

- **Shelter collapse**
 - Pay attention to snow quality and changing temps
 - Don't build your shelter in an avalanche zone
 - Walls in Snow Caves must be at least 12 inches thick
 - Mark roof so people don't walk on roof
 - Heavy snowfall or snowdrift can seal you in shelter
 - Keep shovel INSIDE shelter in case you need to dig out

Surviving the Cold

Snow Shelters – Basics

- Snow is a great insulator
- It can be used in MANY ways to make a shelter

Surviving the Cold

Snow Shelters – Bare Ground

- Even permafrost is generally warmer than the snow above it
- If possible, dig down to bare ground
 - Ground will radiate some heat
 - Don't lay directly on it – but it will “warm” your shelter somewhat
 - Scraping to bare earth increases shelter temperature about 12°

Surviving the Cold

Snow Shelters – Basics

- Here are some basics to snow caves:
 - Snow doesn't breathe well, especially after it ices over
 - You need adequate ventilation
 - One vent at the entrance and one in roof
 - Poorly constructed shelters can collapse on you
 - Walls should be at least 12" thick (6" of dense snow may work)
 - Arch the ceiling above you – domes are naturally strong
 - If it's smooth, it won't drip on you
 - Plan on snow settling over time – ceiling will sag overnight
 - Cold air sinks – keep bedding off the lowest level if possible
 - Mark your Shelter - make it EASY to find
 - Snow shelters can disappear when only a small distance away

Surviving the Cold

Snow Shelters – Basics – Tools

- Having the right tools are vital for building certain shelters
 - Shovel
 - A must for snow rescue and digging shelters
 - Can be used to make blocks
 - Snow Saw or Machete
 - Great for cutting into packed snow
 - Great for making blocks
 - Great for cutting in to iced over layers your shovel won't

Surviving the Cold

Snow Shelters – Basics – Improvised Tools

- You may not have the perfect tool, but can make do
 - Snowshoes
 - Can be used as a shovel
 - Ski Poles or Skis
 - Use them to carve out platforms in snow
 - Boots
 - You can kick out more of a structure than you think
 - Saves your hands from freezing or getting wet

Surviving the Cold

Snow Shelters – Basics – Improvised Tools

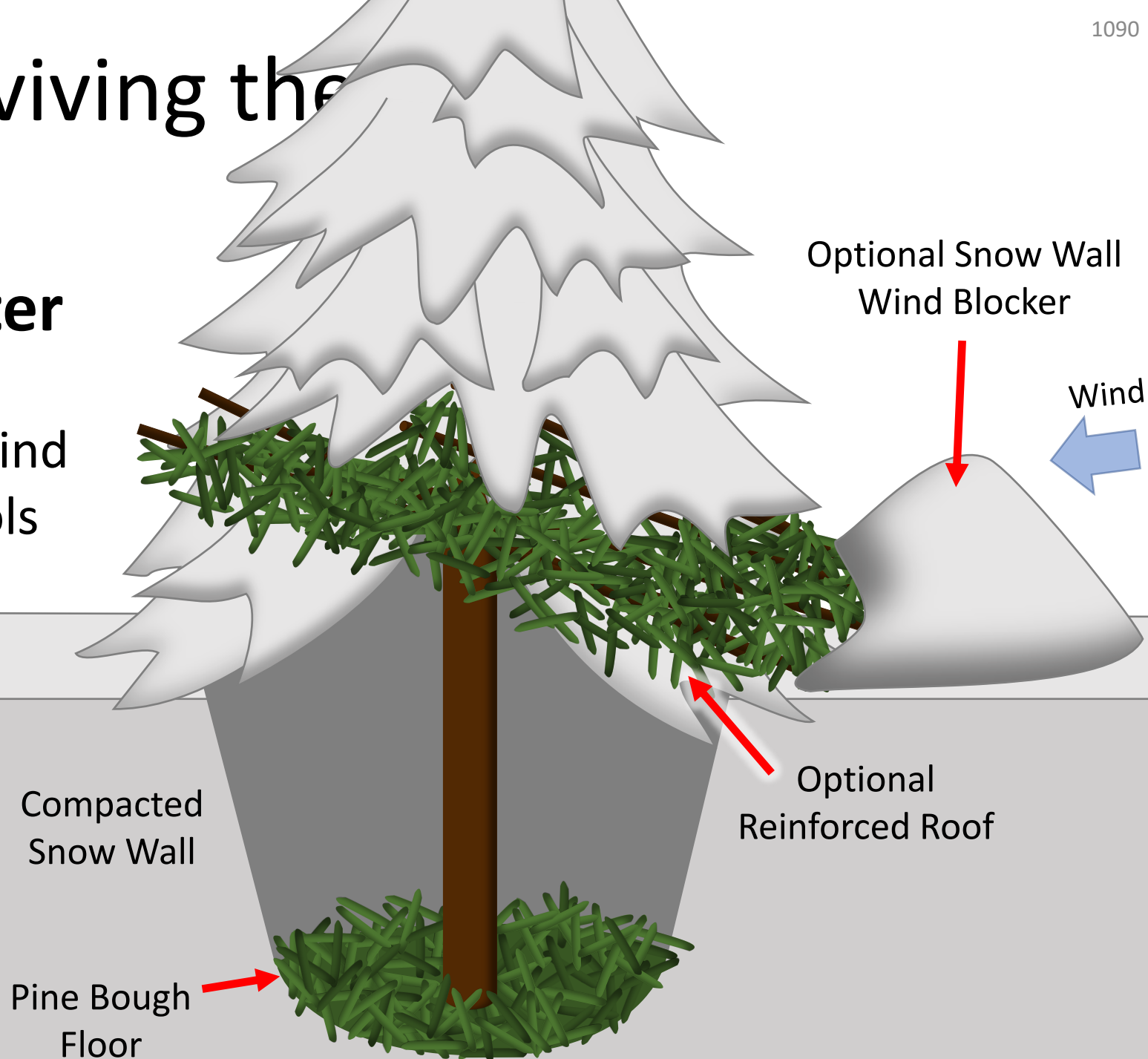
- You may not have the perfect tool, but can make do
 - Ice Axe or Wood Axe
 - Can be used to cut into hard snow
 - Can be used to cut up branches for shelter construction
 - Pots
 - Do more than you think
 - Even better when combined with axe
 - Frisbee and plates
 - Great for carving out insides of caves and shelters
 - Branches
 - Use them if that all you have

Surviving the

Snow Shelters

– Tree-Pit Snow Shelter

- Hasty shelter
- Allows for reprise from wind
- Can be made without tools

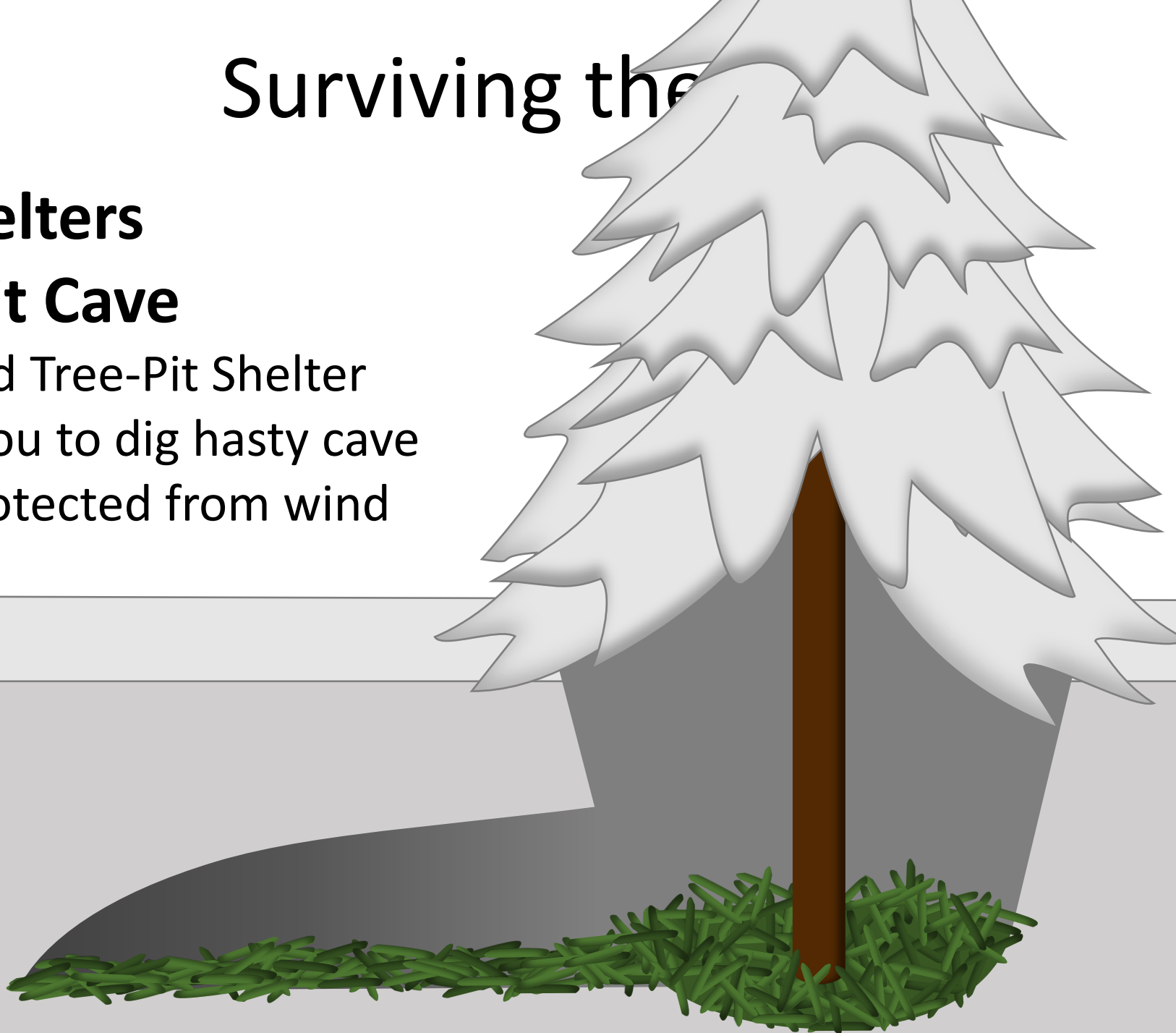


Surviving the

Snow Shelters

– Tree-Pit Cave

- Improved Tree-Pit Shelter
- Allows you to dig hasty cave while protected from wind



Surviving the Cold

Snow Shelters— Lean-To

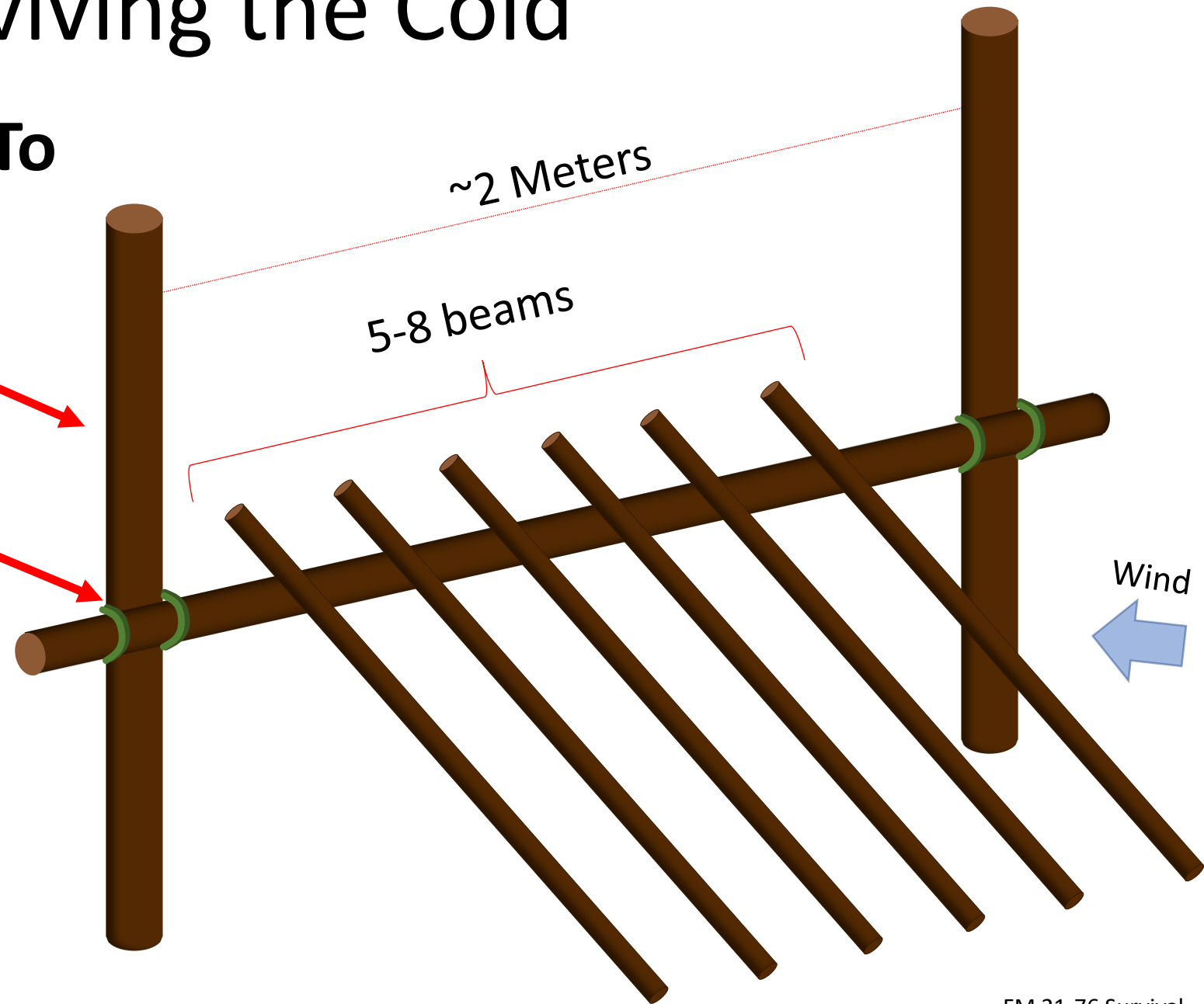
For 2 Upright Poles:

- Trees
- Y-Sticks
- Tripods

Support with:

- Tree Crotch
- Paracord

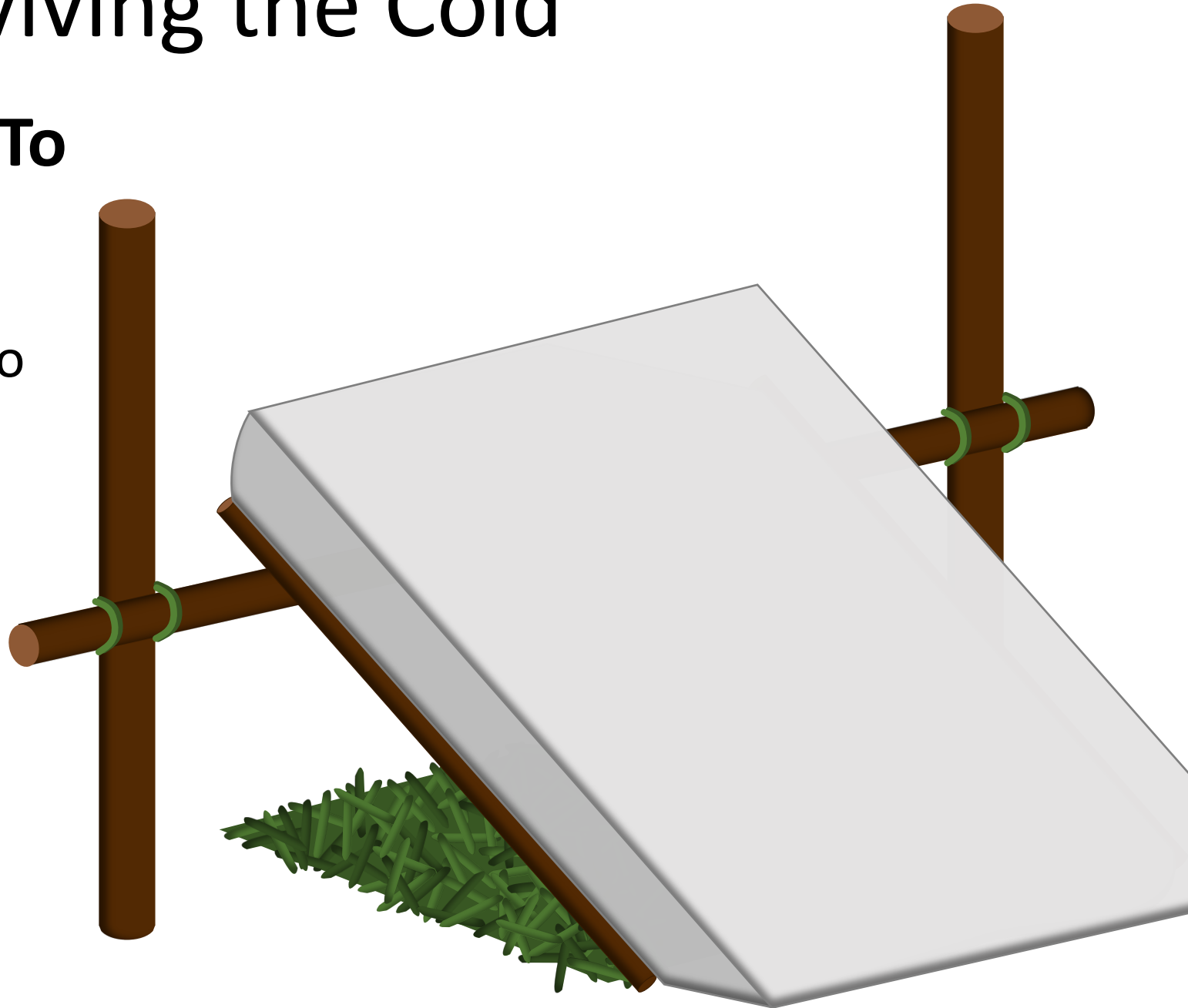
Waist-Chest
High



Surviving the Cold

Snow Shelters – Lean-To

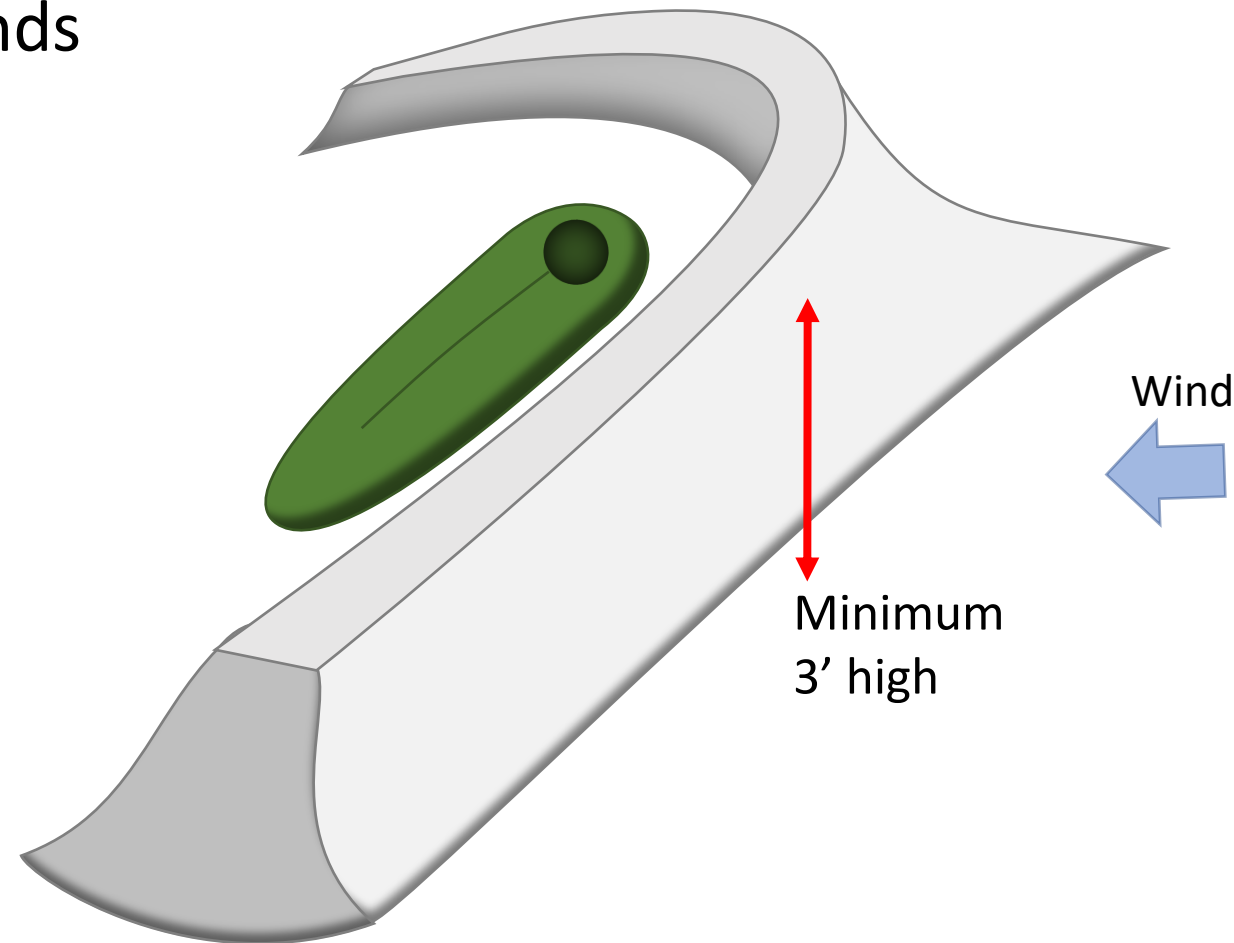
- Weave branches between beams
- Build up snow over lean-to
- Make a bed from boughs
- Cover sides if possible
- For an extended stay:
 - Consider a fire wall



Surviving the Cold

Snow Shelters – Snow Wall

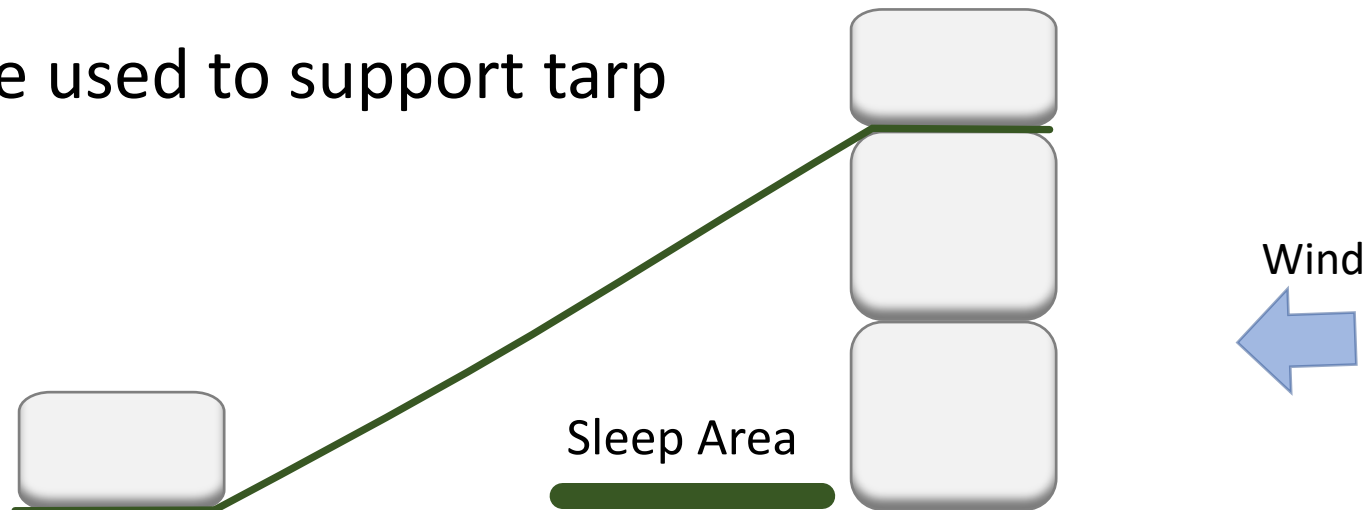
- Hasty shelter option when this is the best you can do
- Significant protection from high winds
- Also used to protect:
 - Tents
 - Shelter entrances
 - Cook areas
 - Latrines
- Ideally, use blocks of uniform size
 - Stack like LEGOs



Surviving the Cold

Snow Shelters – Snow Wall with Tarp

- If you have one, a tarp can be added
 - Secure over wall
 - Seal edge with snow
 - Skis and/or poles can also be used to support tarp



Surviving the Cold

Snow Shelters – Open Trench

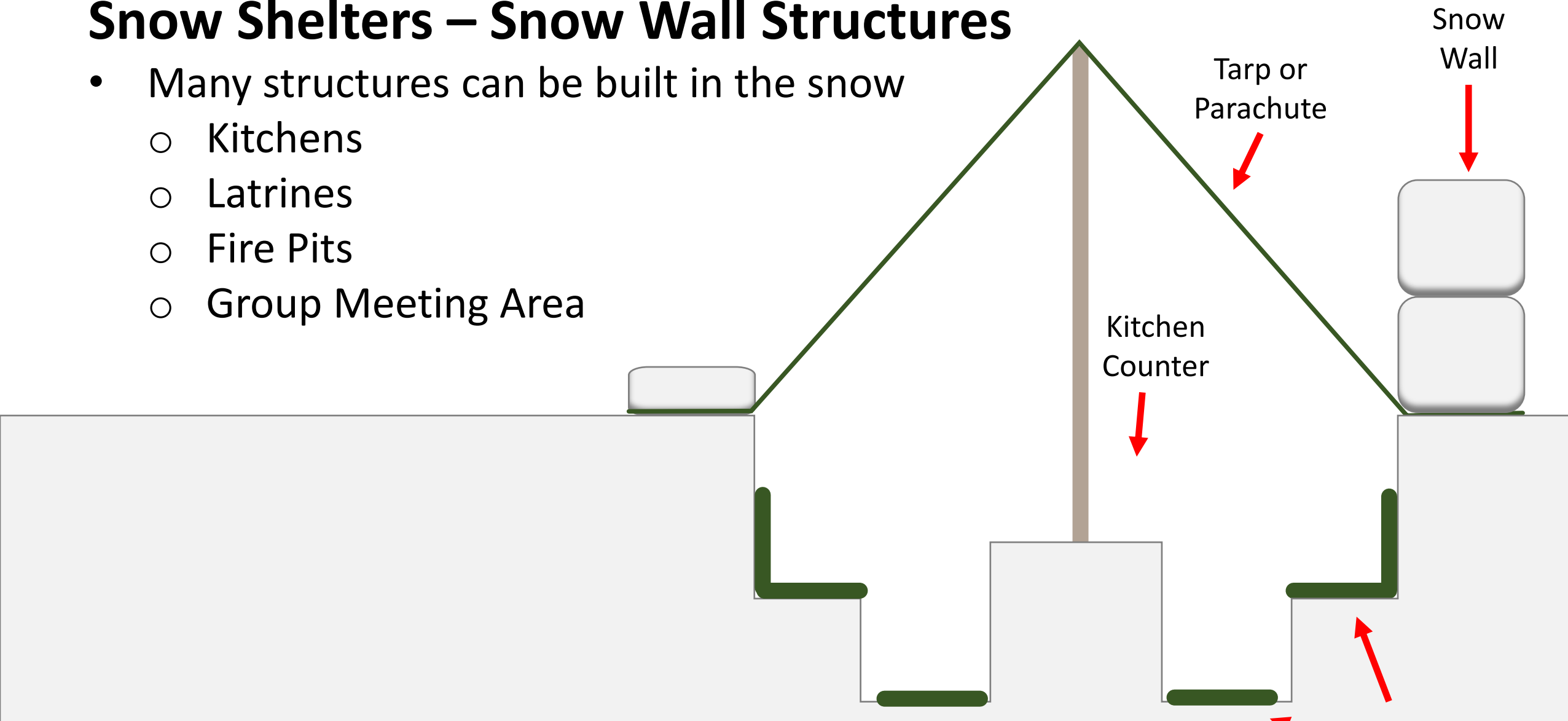
- In the open, a hasty trench can provide some reprieve from the wind
- Dig trend deep enough to shield body
- Take shelter and formulate plan



Surviving the Cold

Snow Shelters – Snow Wall Structures

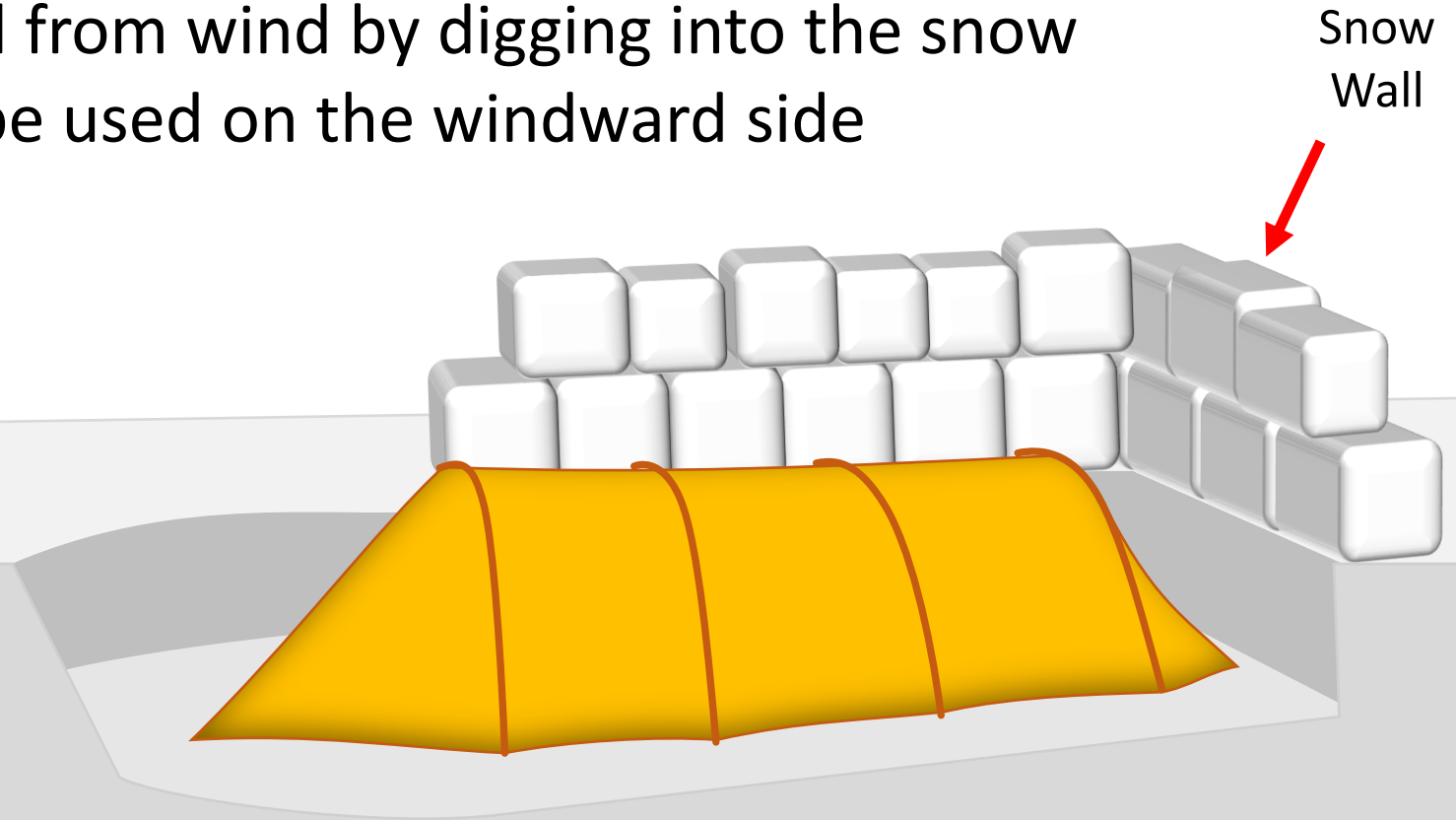
- Many structures can be built in the snow
 - Kitchens
 - Latrines
 - Fire Pits
 - Group Meeting Area



Surviving the Cold

Snow Shelters – Tent

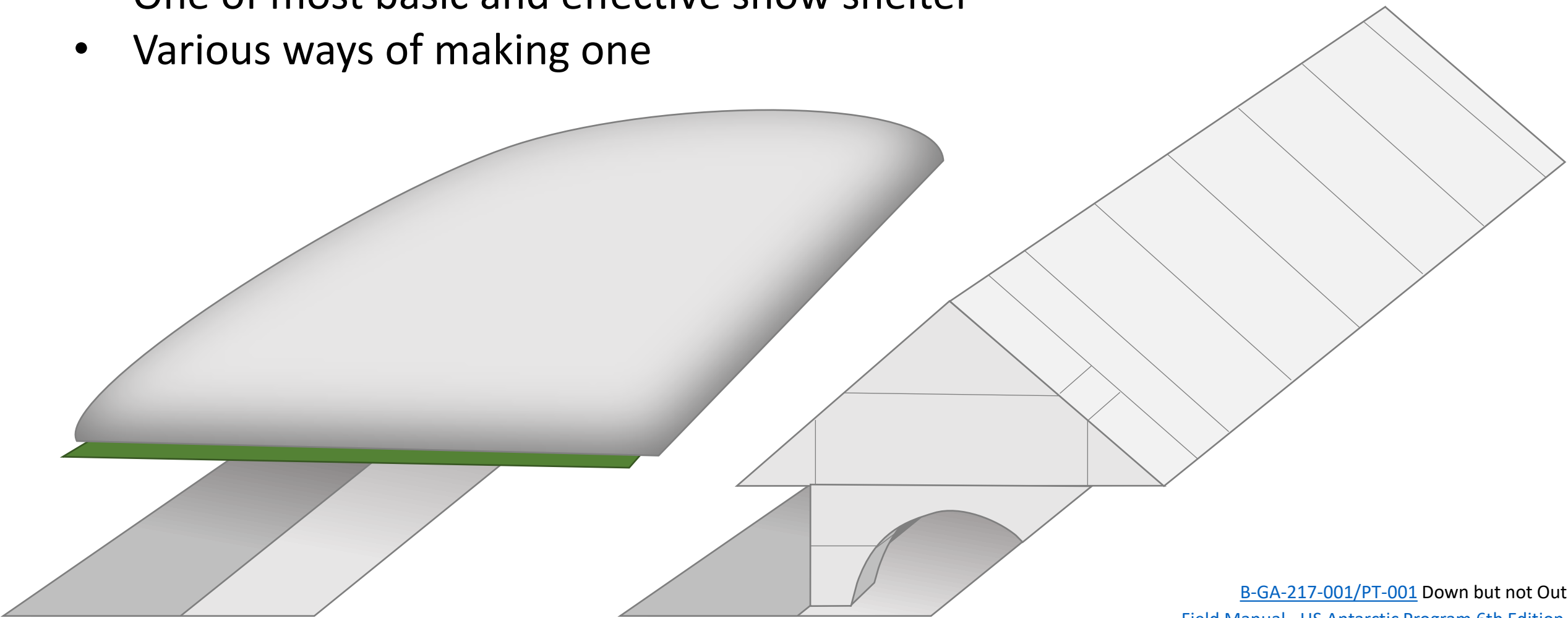
- Tents can be protected from wind by digging into the snow
- Snow blocks can also be used on the windward side



Surviving the Cold

Snow Shelters – Snow Trench (0.5-2 Hours)

- One of most basic and effective snow shelter
- Various ways of making one



Surviving the Cold

Snow Shelters – Snow Trench

- The Snow Trench is simple to make but has drawbacks
- There is little room to move
 - You can't shake out frost from your bag or clothes
 - You will start to collect moisture



Surviving the Cold

Snow Shelters – Snow Trench – Supported Roof

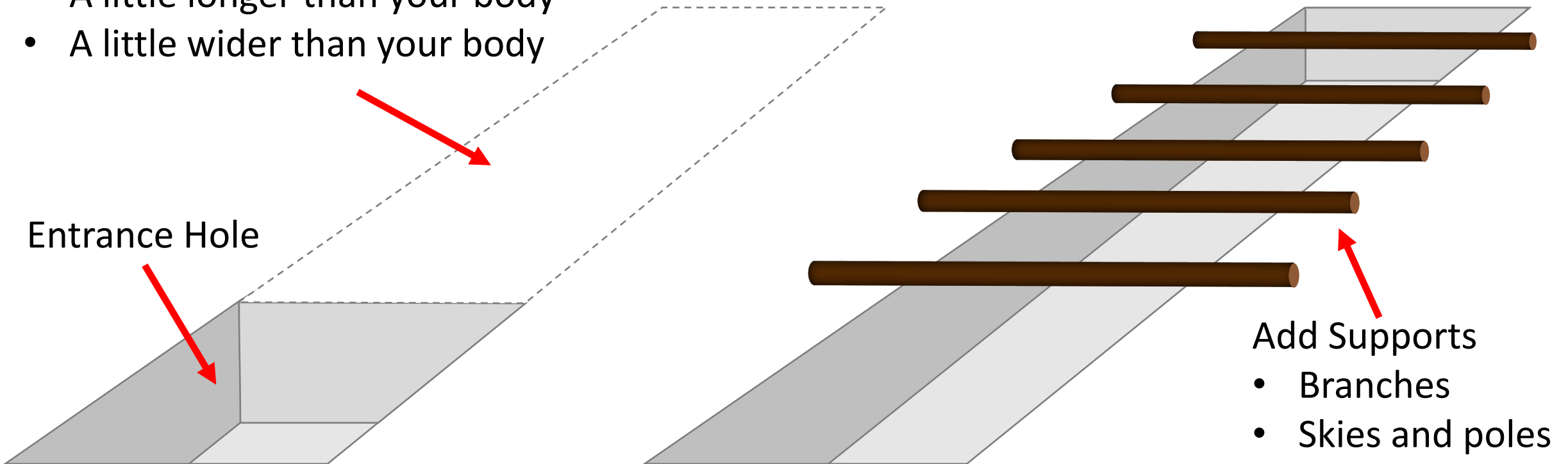
- This shelter requires supports for your roof

Dig out a trench

For a single person, make trench:

- A little longer than your body
- A little wider than your body

Entrance Hole



Add Supports

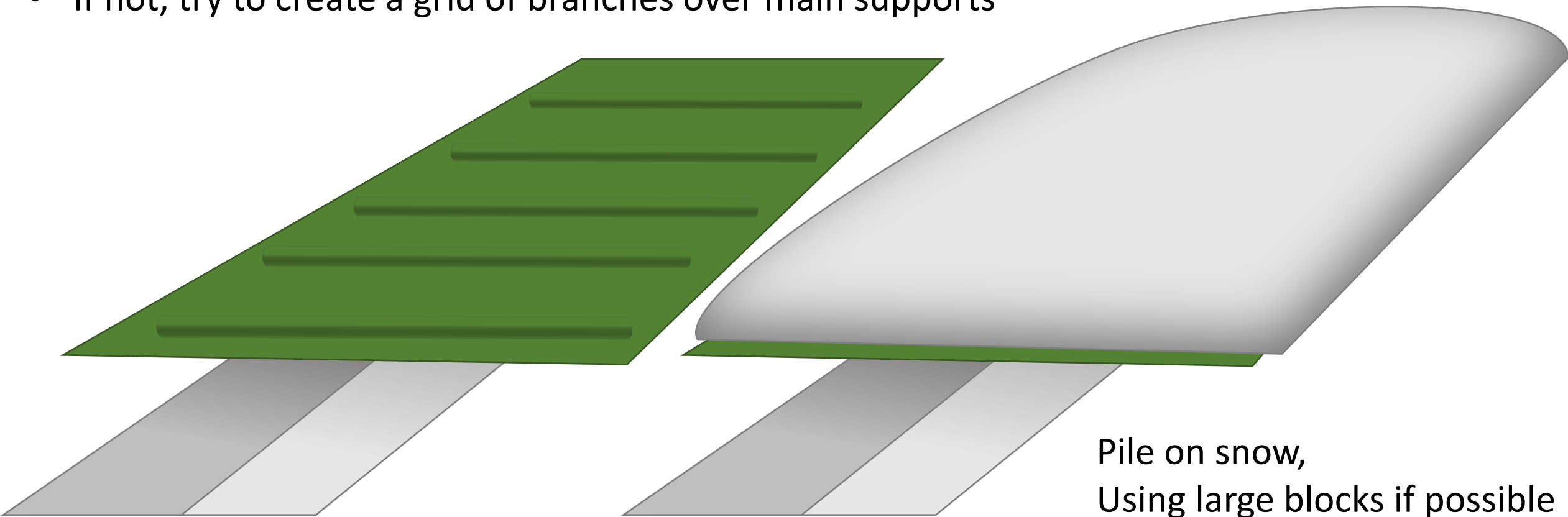
- Branches
- Skies and poles

Surviving the Cold

Snow Shelters – Snow Trench – Supported Roof

If you have a tarp

- Use it
- If not, try to create a grid of branches over main supports



Surviving the Cold

Snow Shelters – Snow Trench – UnSupported Tarp

If you don't have supports, a tarp will help shield you from wind and light precipitation

- Use snow to anchor tarp to surrounding snow



Surviving the Cold

Snow Shelters – Snow Block Shelters

- Snow is a dynamic structure
 - Snowflakes are delicate structures with many points
 - When disturbed, the points break off
 - Snow becomes compacted
 - Energy from damaged snowflakes melts the broken ends
 - The snow refreezes into cohesive structure
 - This is how you make a snowball
 - This process is referred to as sintering

Surviving the Cold

Snow Shelters – Snow Block Shelters

- Snow is a dynamic structure
 - Compacted snow is created from:
 - **Sun** causing a melt freeze cycle on the top layer of snow
 - **Wind** – creating dense Wind Slabs
 - Tundra and exposed slopes are often covered with hard slabs
 - Forested areas protected from wind often have sugar like snow with no cohesive structure
 - **Digging** up snow and remixing it
 - Technique used for building a Quinzhee
 - Used to build Igloo with IceBox tool
 - **Stomping** snow to compact it into hard pack
 - Technique used for building snow structures in forests

Surviving the Cold

Snow Shelters – Snow Block Shelters

- Snow is a dynamic structure
 - Depending on where you are and the temperature
 - Snow may be ideal for making snow blocks
 - You may need to mix up or stomped to create blocks
 - Allow at least an hour to sinter
 - If it is just too cold and shaded, blocks may not be feasible

Surviving the Cold

Snow Shelters – Snow Trench – Snow Arch Roof

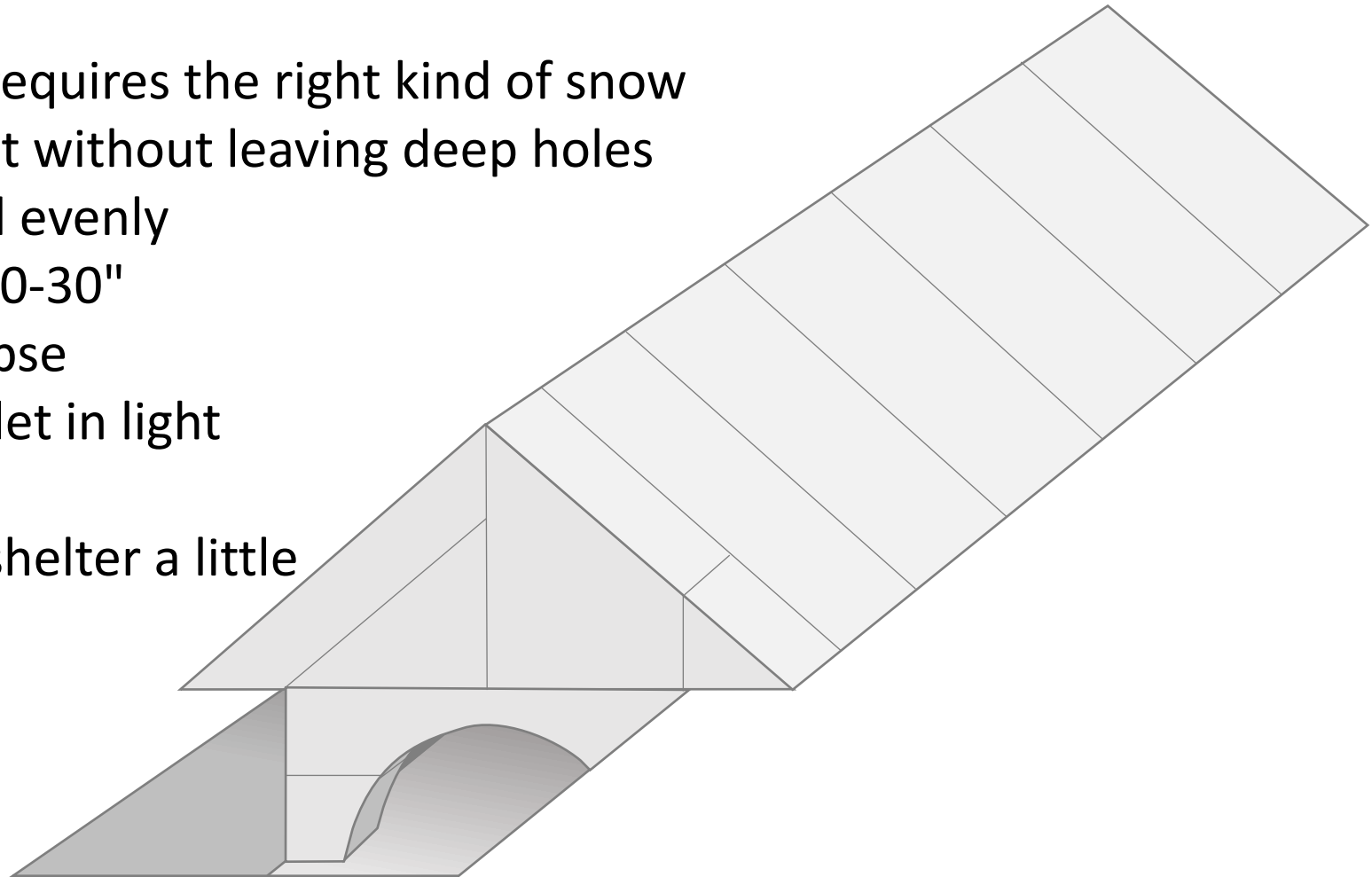
Roof Tiles

Building a roof with snow blocks requires the right kind of snow

- You should be able to walk on it without leaving deep holes
- A probe should go in easily and evenly

Roof tiles should be 18" x 4-8" x 20-30"

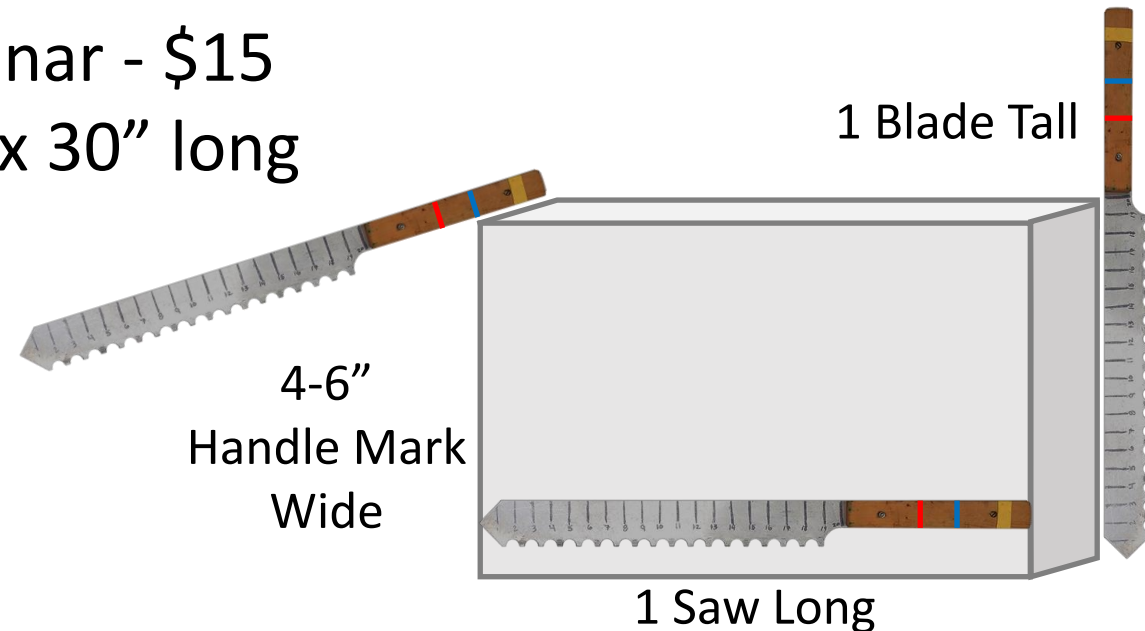
- Too thin and the roof will collapse
- Too thick and the roof will not let in light
 - Light is nice to have
 - Sunlight also heats up the shelter a little



Surviving the Cold

Snow Shelters – Snow Trench – Snow Arch Roof

- Scout Snowsaw
 - Sold by Council Winter Camp Seminar - \$15
 - 3/16" thick aluminum x 2.5" wide x 30" long
 - 4" thick blocks easier to lift
 - 6" thick blocks are stronger
 - Use 6" blocks if 4" fall apart



Surviving the Cold

Snow Shelters – Snow Trench – Snow Arch Roof

- A snow arch roof does not require a tarp or poles
- Ability to make one is dependent on snow quality

Dig out a trench for one person

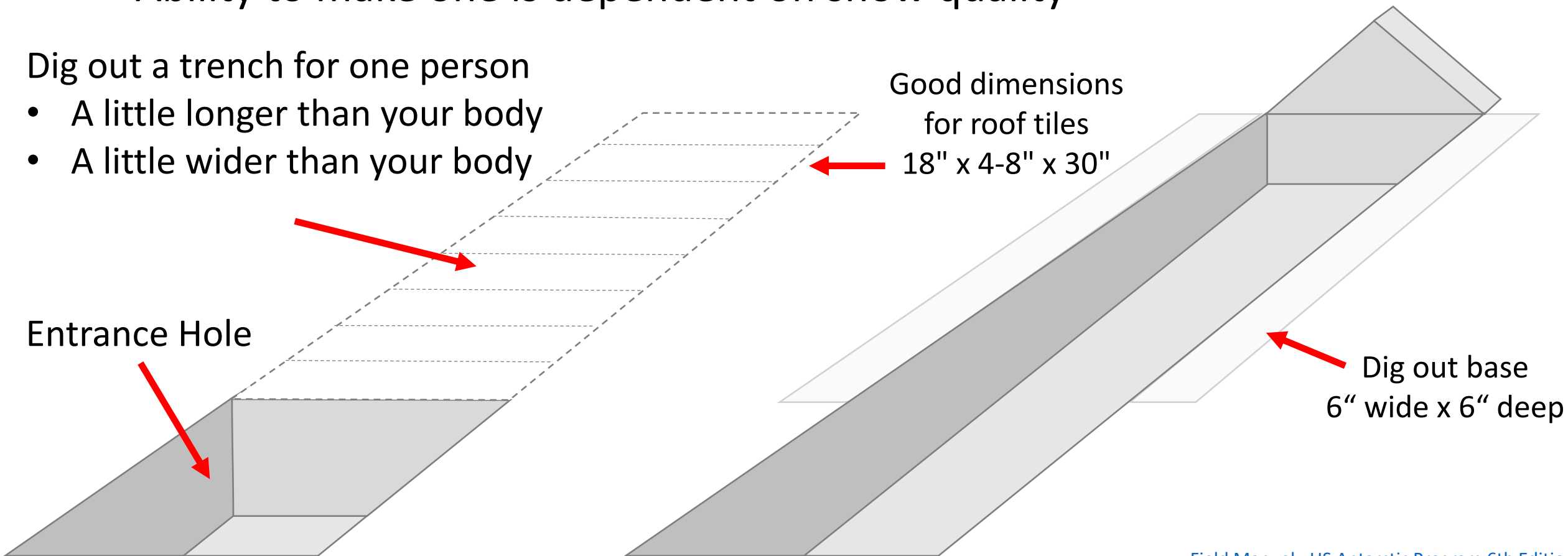
- A little longer than your body
- A little wider than your body

Entrance Hole

Create rear wall

Good dimensions
for roof tiles
18" x 4-8" x 30"

Dig out base
6" wide x 6" deep



Surviving the Cold

Snow Shelters – Snow Trench – Snow Arch Roof

Place first roof tile

Centered over Rear Wall

1st Tile

Centered over
Rear Wall

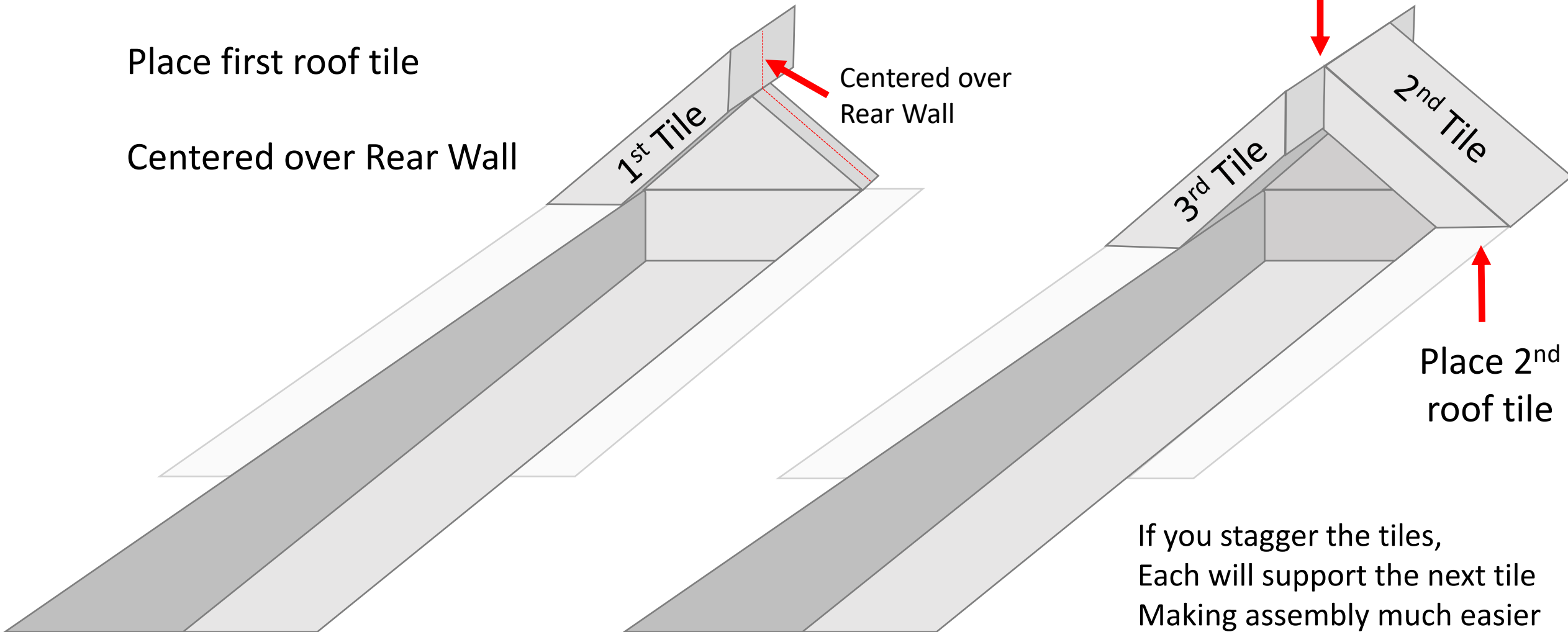
Overlap Tiles

3rd Tile

2nd Tile

Place 2nd
roof tile

If you stagger the tiles,
Each will support the next tile
Making assembly much easier



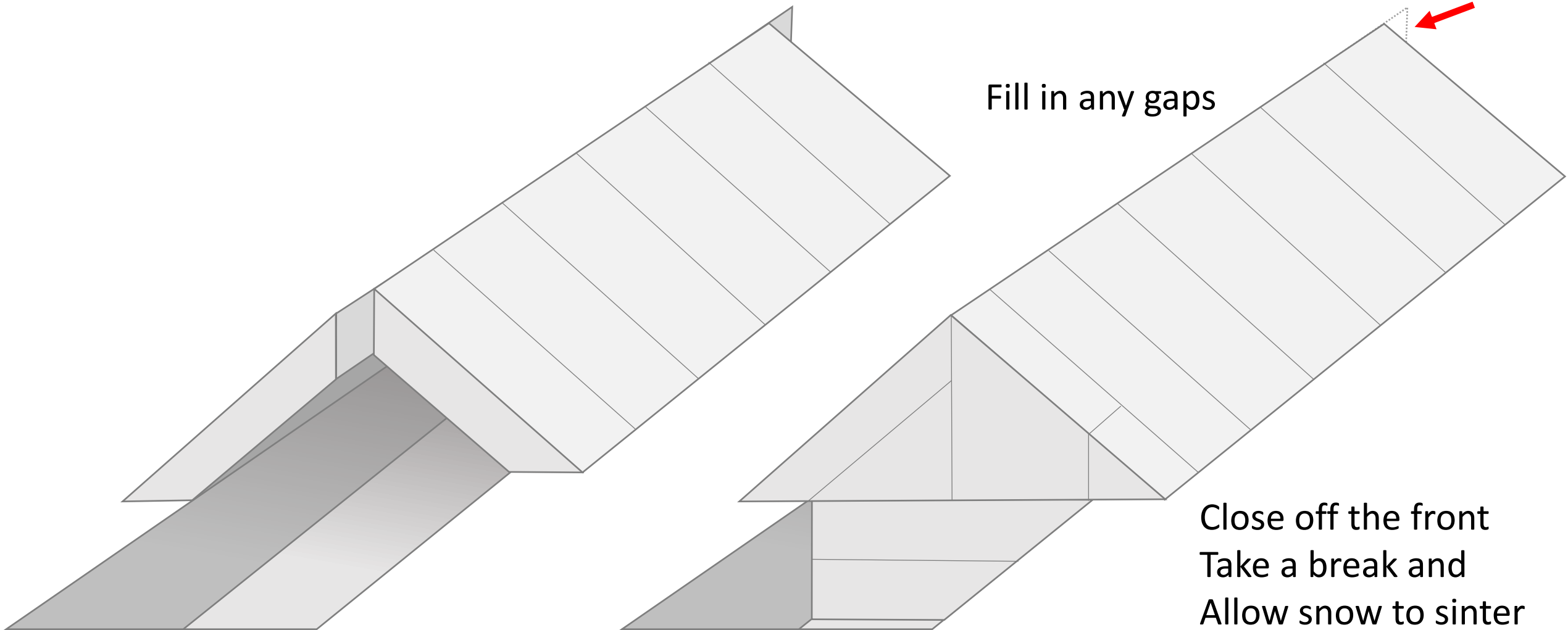
Surviving the Cold

Snow Shelters – Snow Trench – Snow Arch Roof

Trim back

Fill in any gaps

Close off the front
Take a break and
Allow snow to sinter

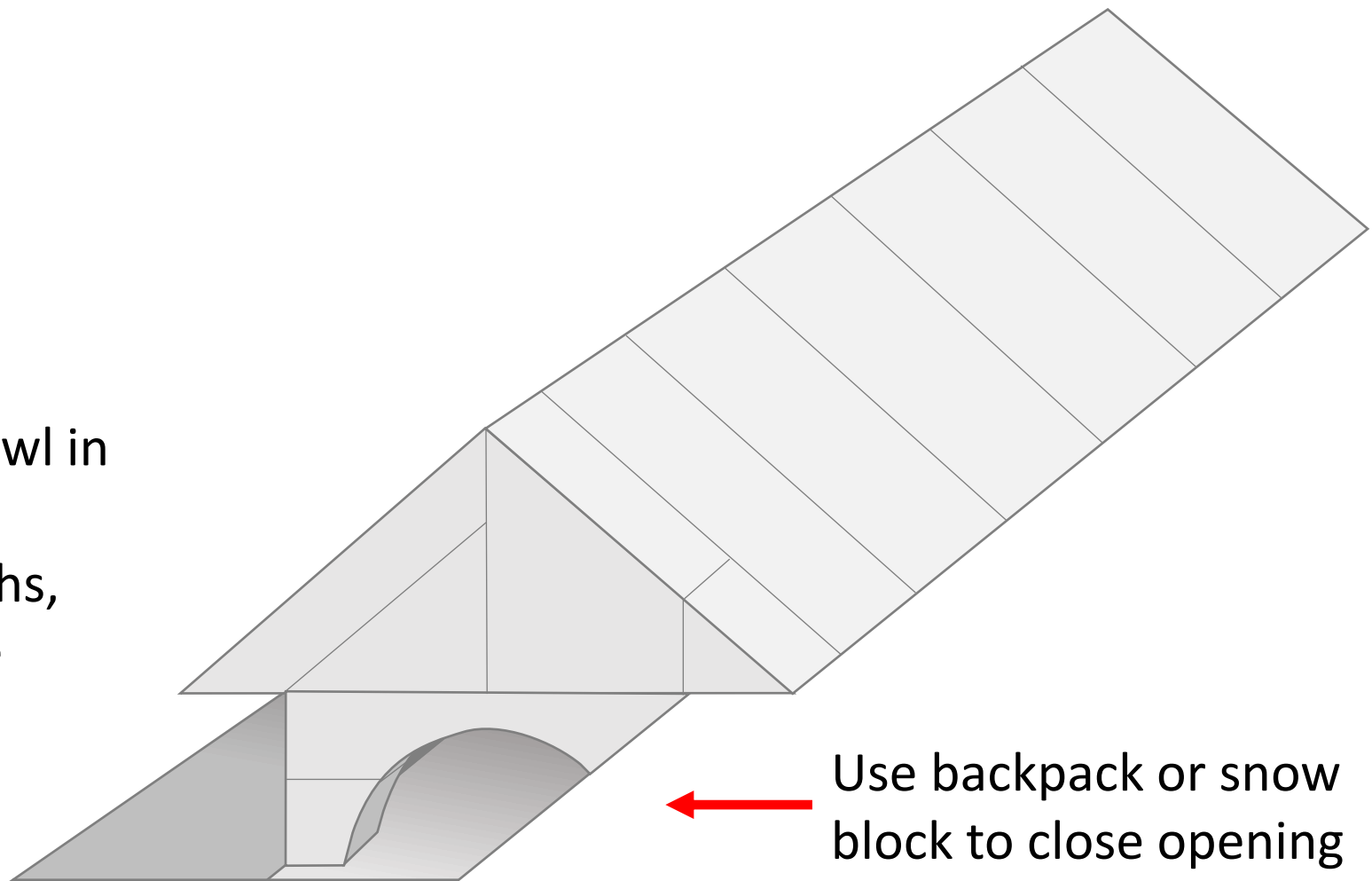


Surviving the Cold

Snow Shelters – Snow Trench – Snow Arch Roof

Cut out an opening
Just big enough to crawl in

If you have pine boughs,
cover floor to insulate



Use backpack or snow
block to close opening

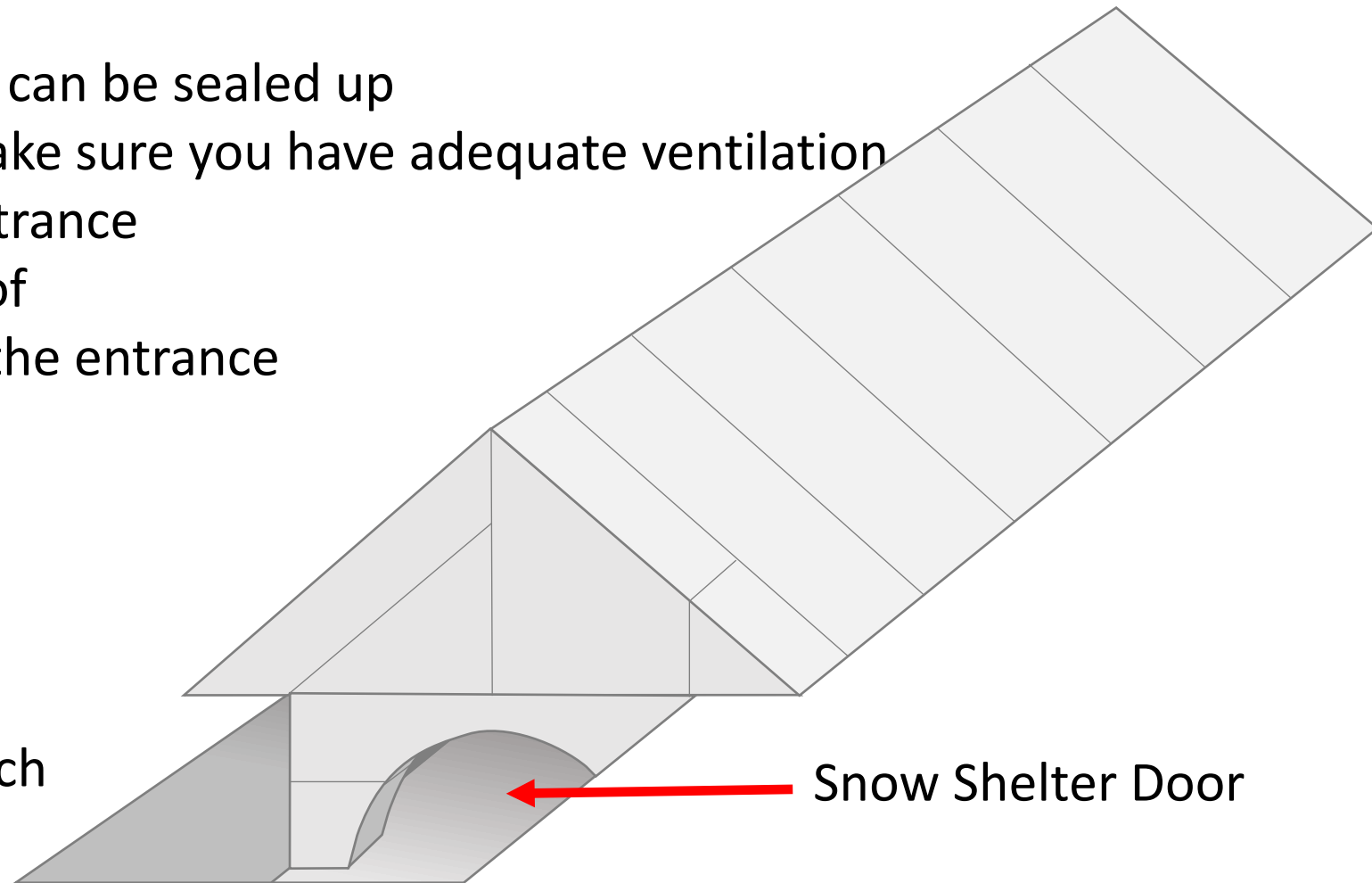
Surviving the Cold

Snow Shelters – Snow Trench – Snow Arch Roof

Snow Shelter Door

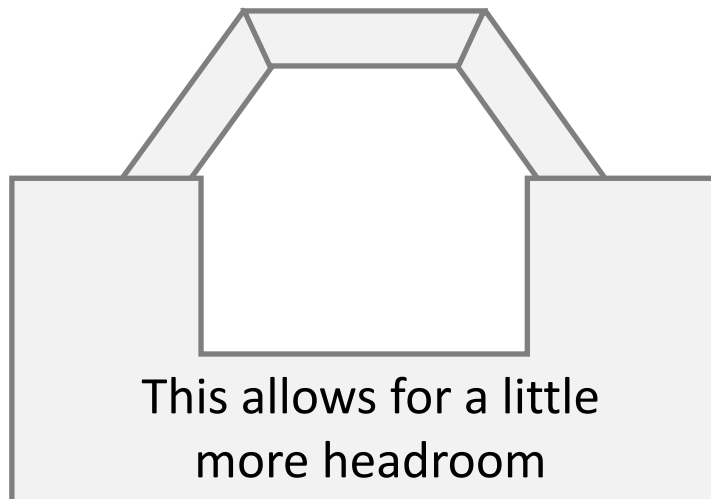
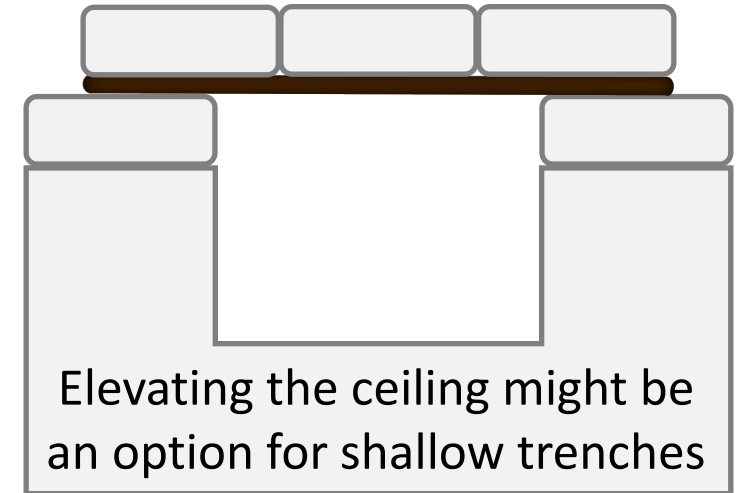
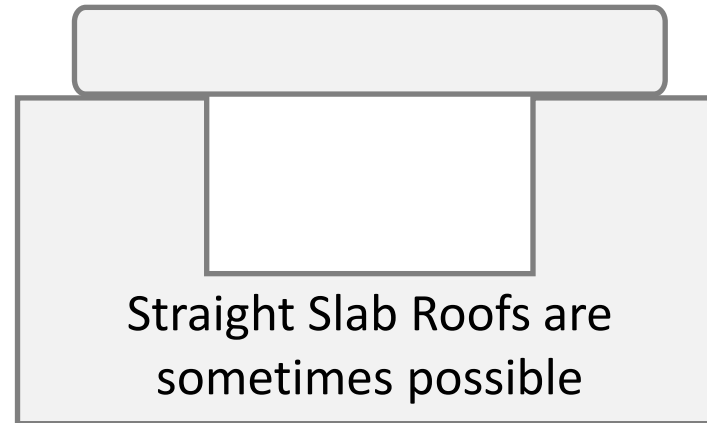
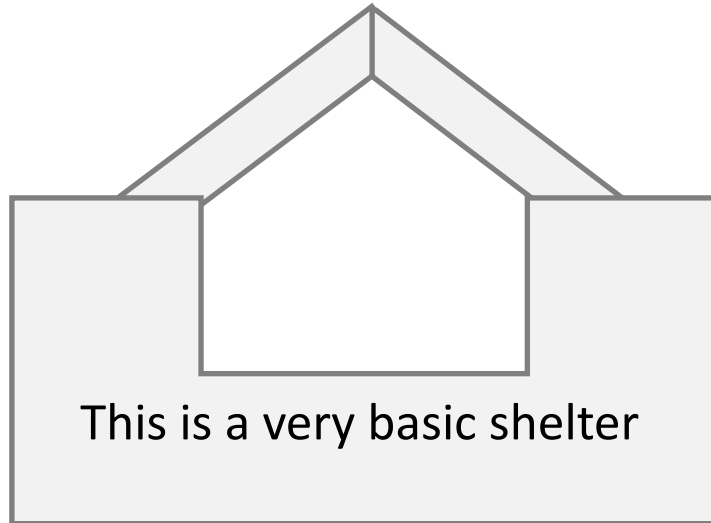
For extra insulation, the entrance can be sealed up

- When closing the entrance, make sure you have adequate ventilation
 - Tennis ball sized vent at entrance
 - Tennis ball sized vent in roof
- There are many ways to close the entrance
 - Snow block
 - Bag filled with snow
 - Backpack
 - Pulk/Sled
 - Cloth/tarp/trash bag
 - Pine boughs tied up in bunch

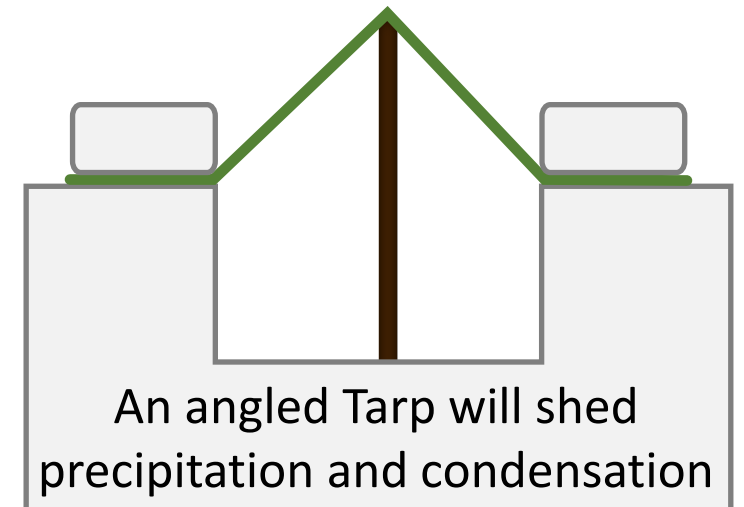
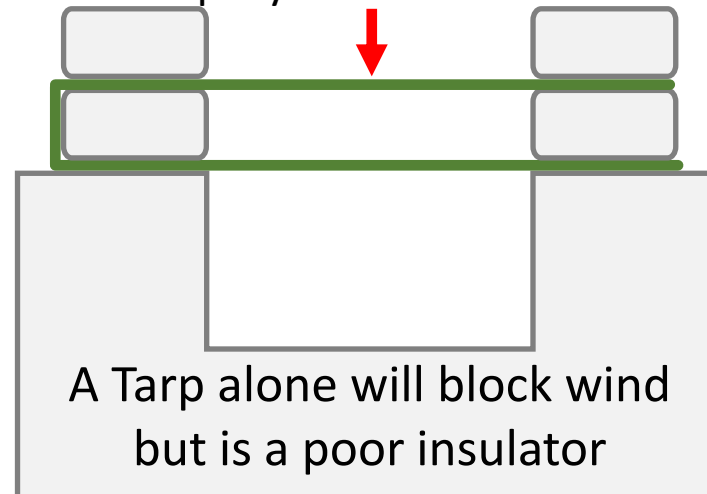


Surviving the Cold

Snow Shelters – Snow Trench – Many Variants

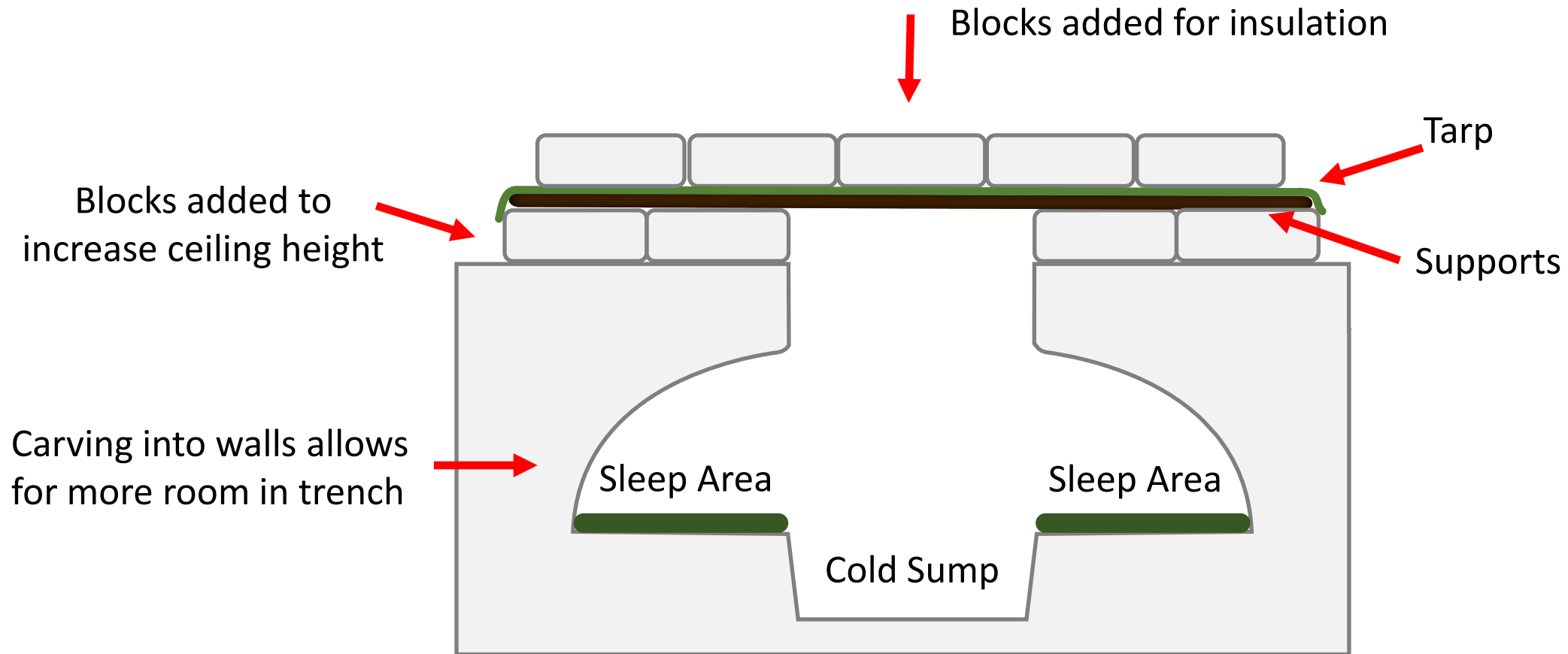


Double tarp layer adds some insulation



Surviving the Cold

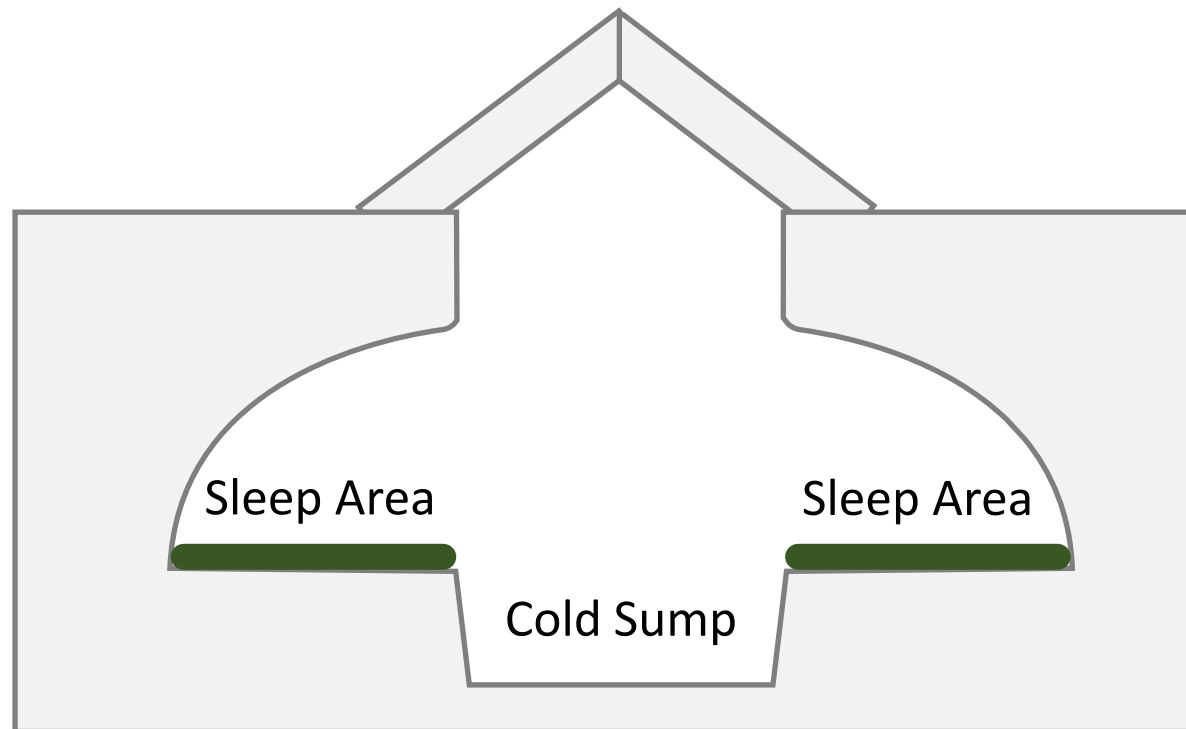
Snow Shelters – Snow Trench – Many Variants



Marine Corps Snow Coffin
good for 1-4 people

Surviving the Cold

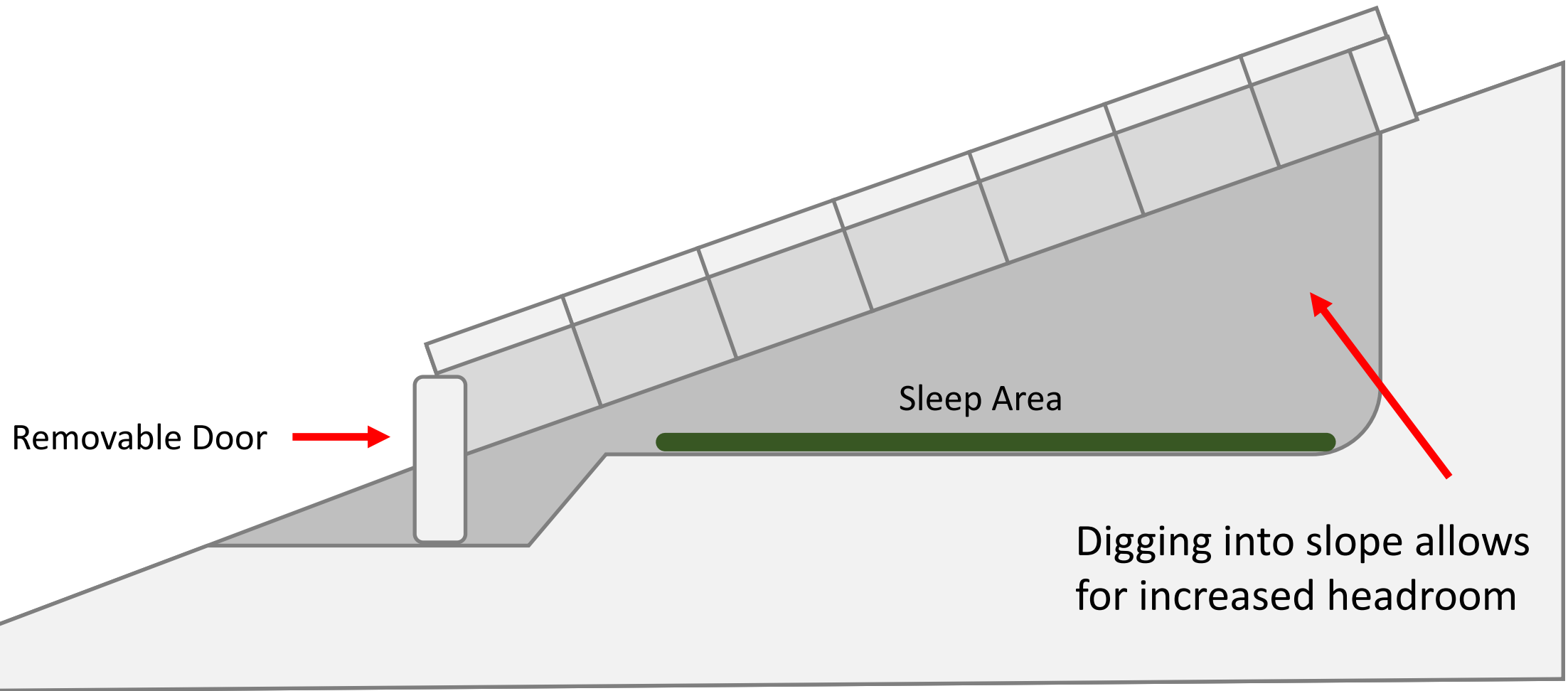
Snow Shelters – Snow Trench – Many Variants



Antarctica Snow Trench

Surviving the Cold

Snow Shelters – Snow Trench – Many Variants

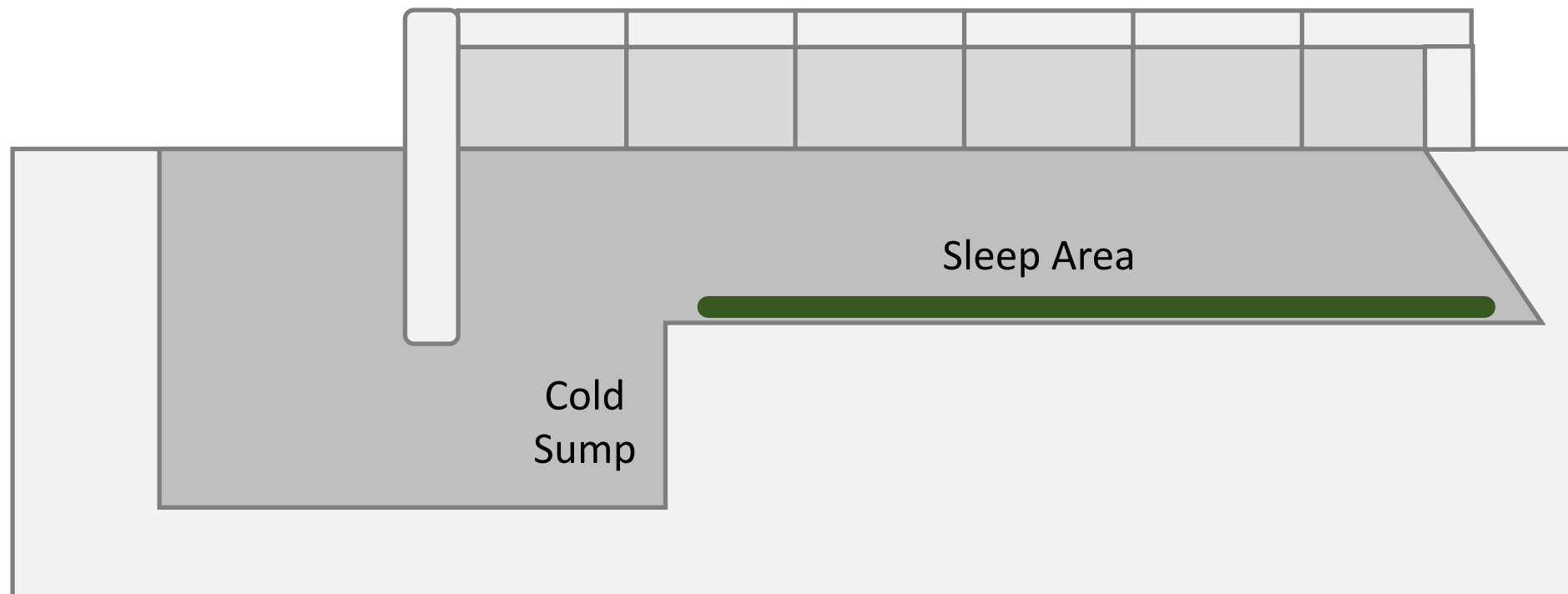
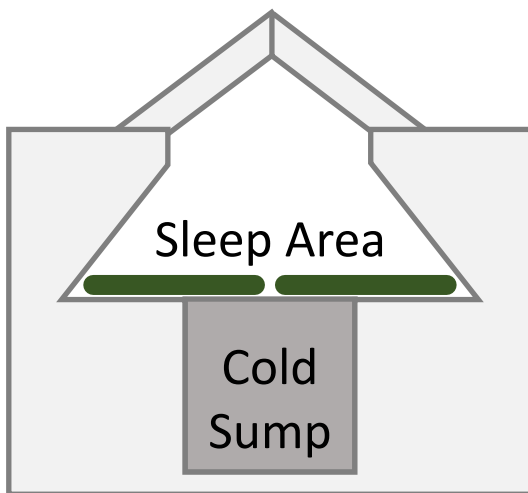


Surviving the Cold

Snow Shelters – Snow Trench – Many Variants

Mount Baker/Chief Seattle Winter Camping Seminar variant

Takes scouts 5-7 hours to construct with help



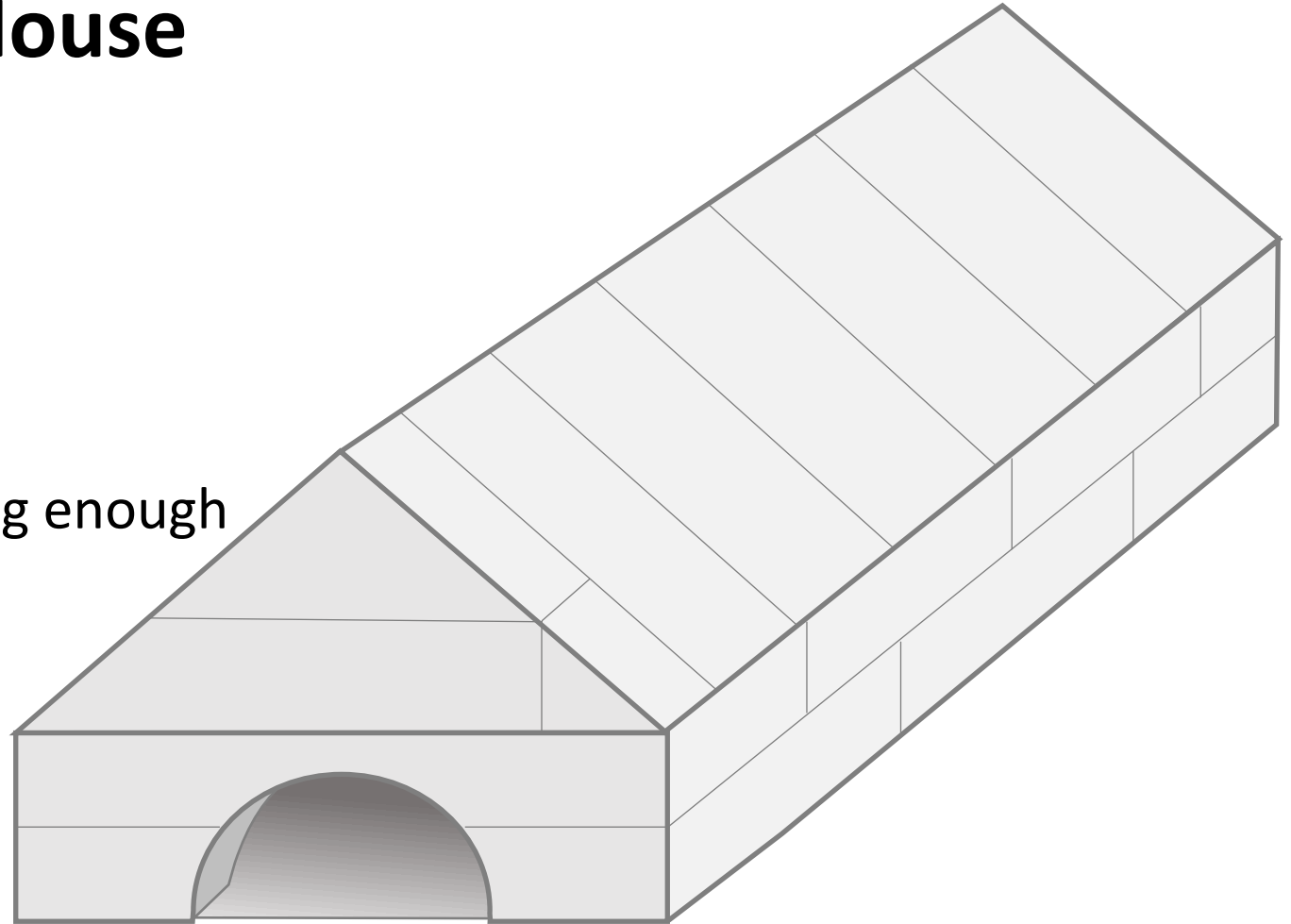
Surviving the Cold

Snow Shelters – Snow House

Like a Snow Trench without a trench

Can be built for one person

Can be built for many
if roof supports are used and are long enough



Surviving the Cold

Snow Shelters – Snow Cave

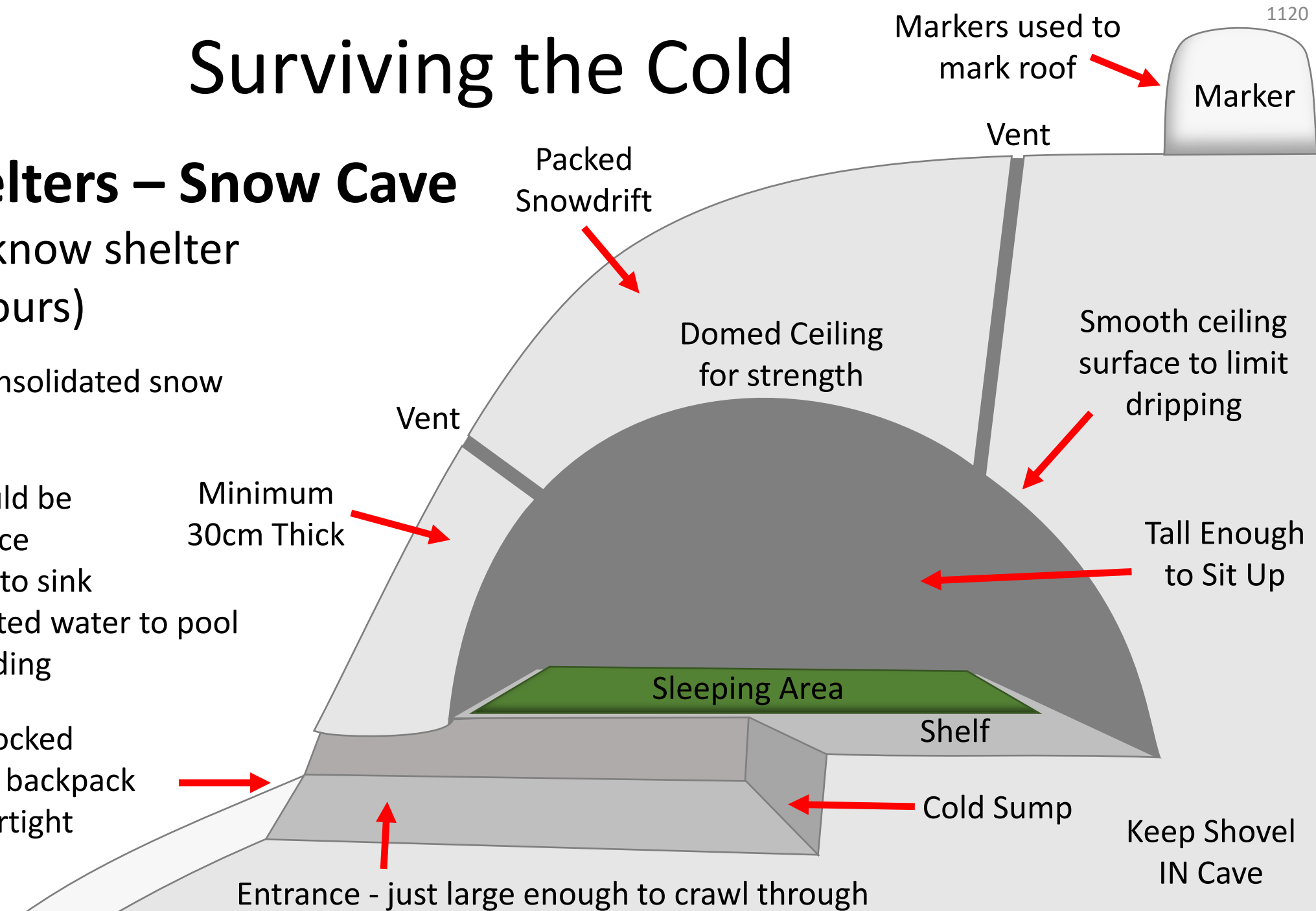
- A MUST know shelter
- (3 to 4 Hours)

Note: Wet or unconsolidated snow is liable to collapse

Sleeping Area should be higher than entrance

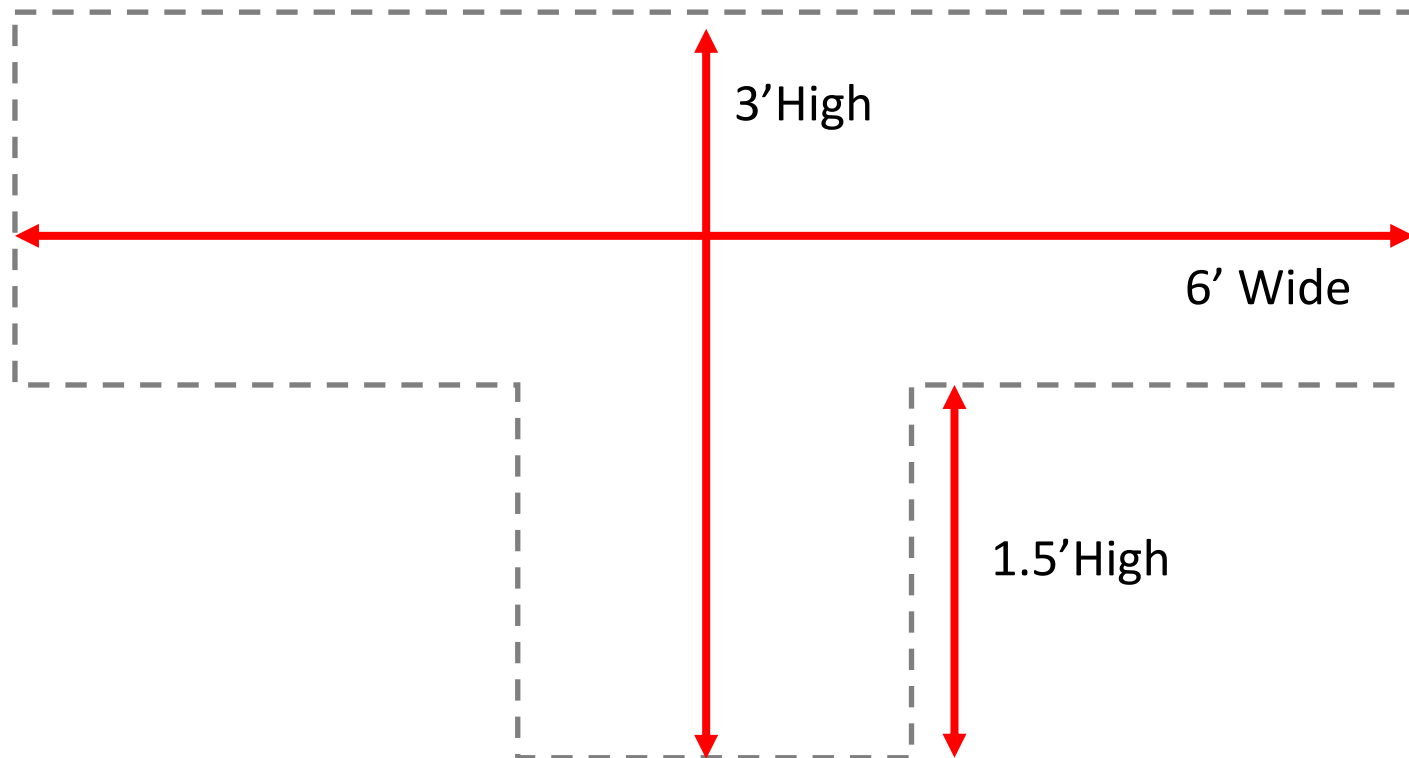
- Allows Cold Air to sink
- Helps keep melted water to pool away from bedding

Entrance can be blocked with snow block or backpack but DON'T make airtight



Surviving the Cold

Snow Shelters – Snow Cave – T Method



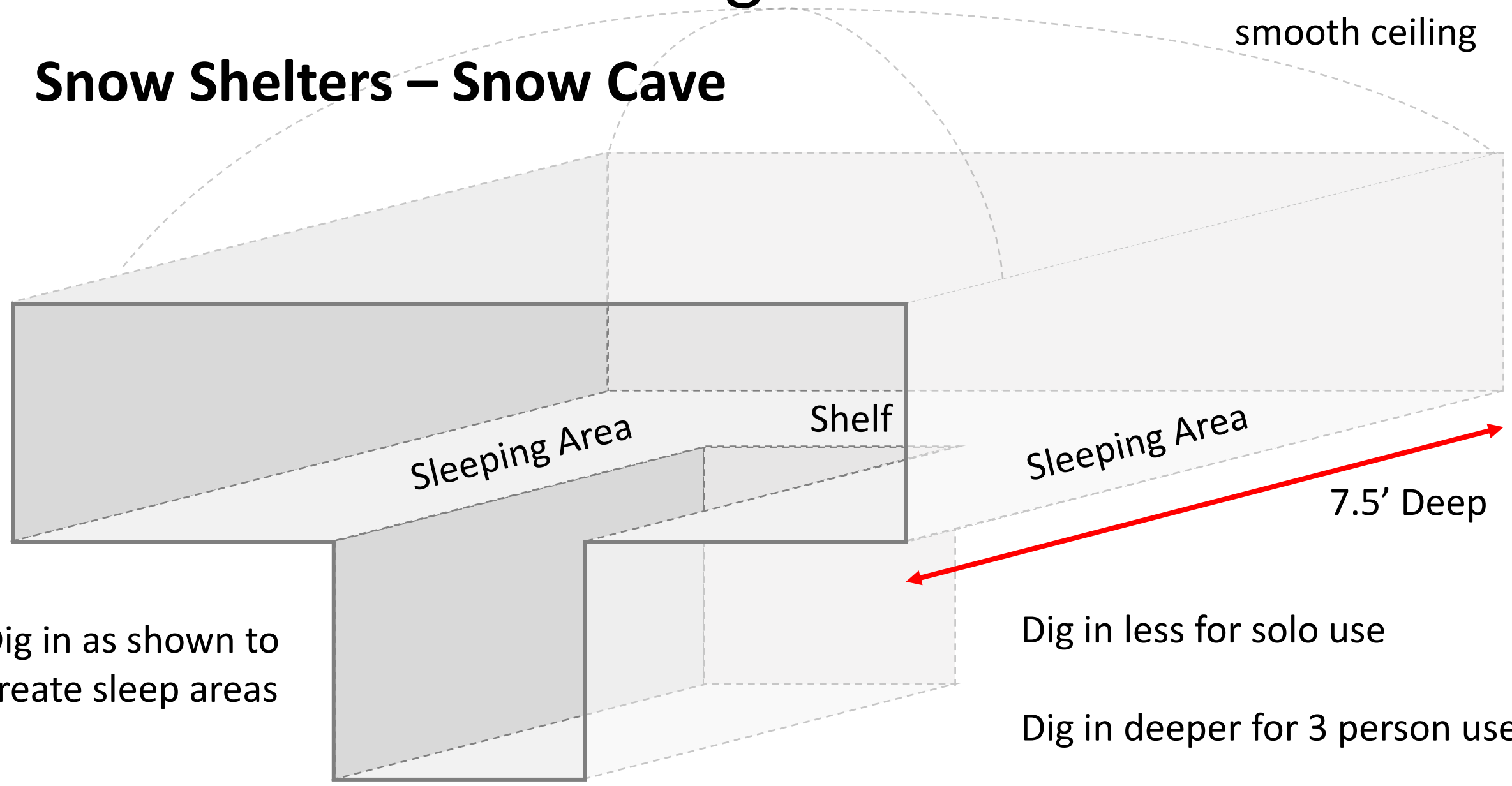
One popular way of making a cave is by digging out a:

- “T” for a 1-3-person shelter

Surviving the Cold

Snow Shelters – Snow Cave

Dome and smooth ceiling



Dig in as shown to create sleep areas

Sleeping Area

Shelf

Sleeping Area

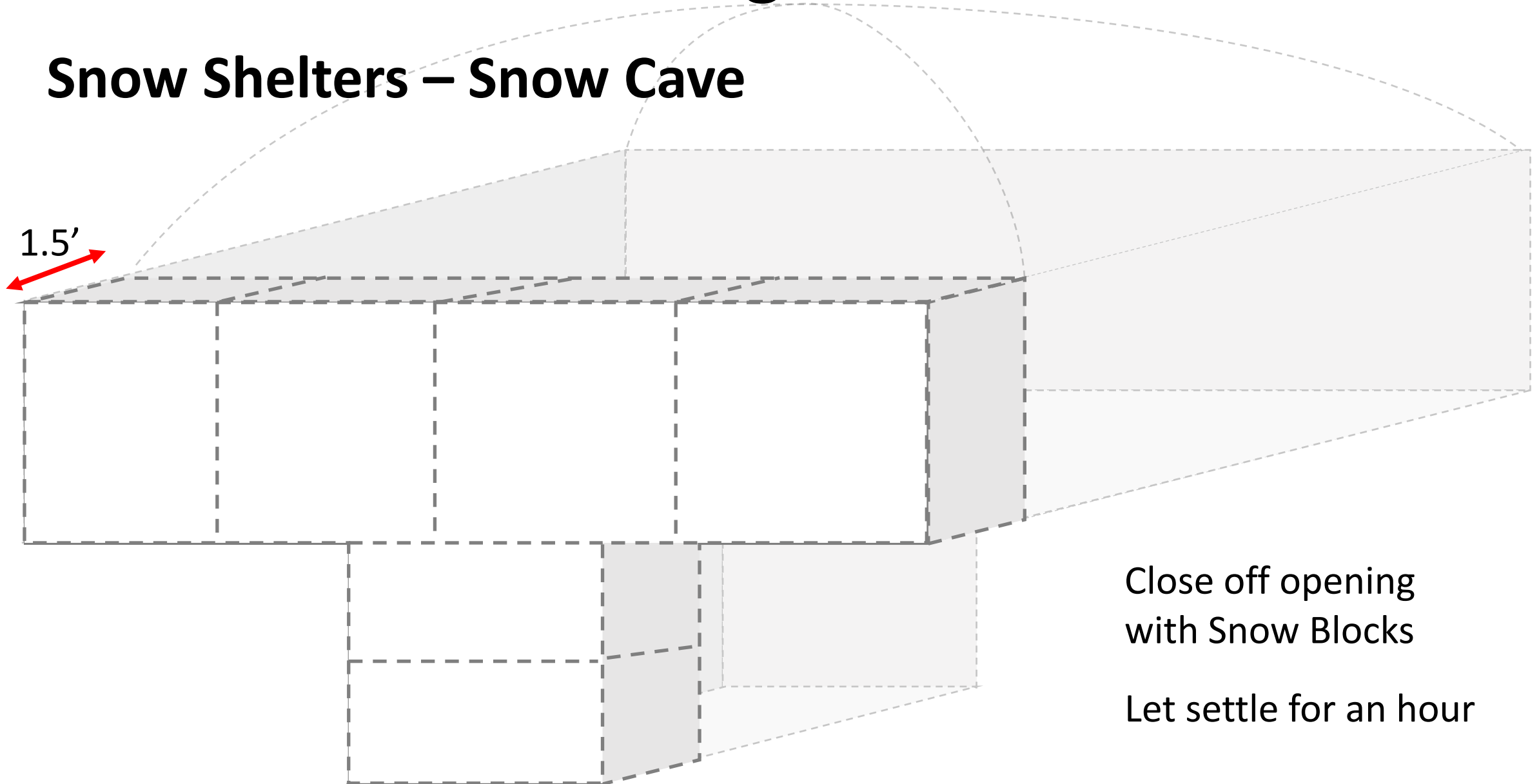
7.5' Deep

Dig in less for solo use

Dig in deeper for 3 person use

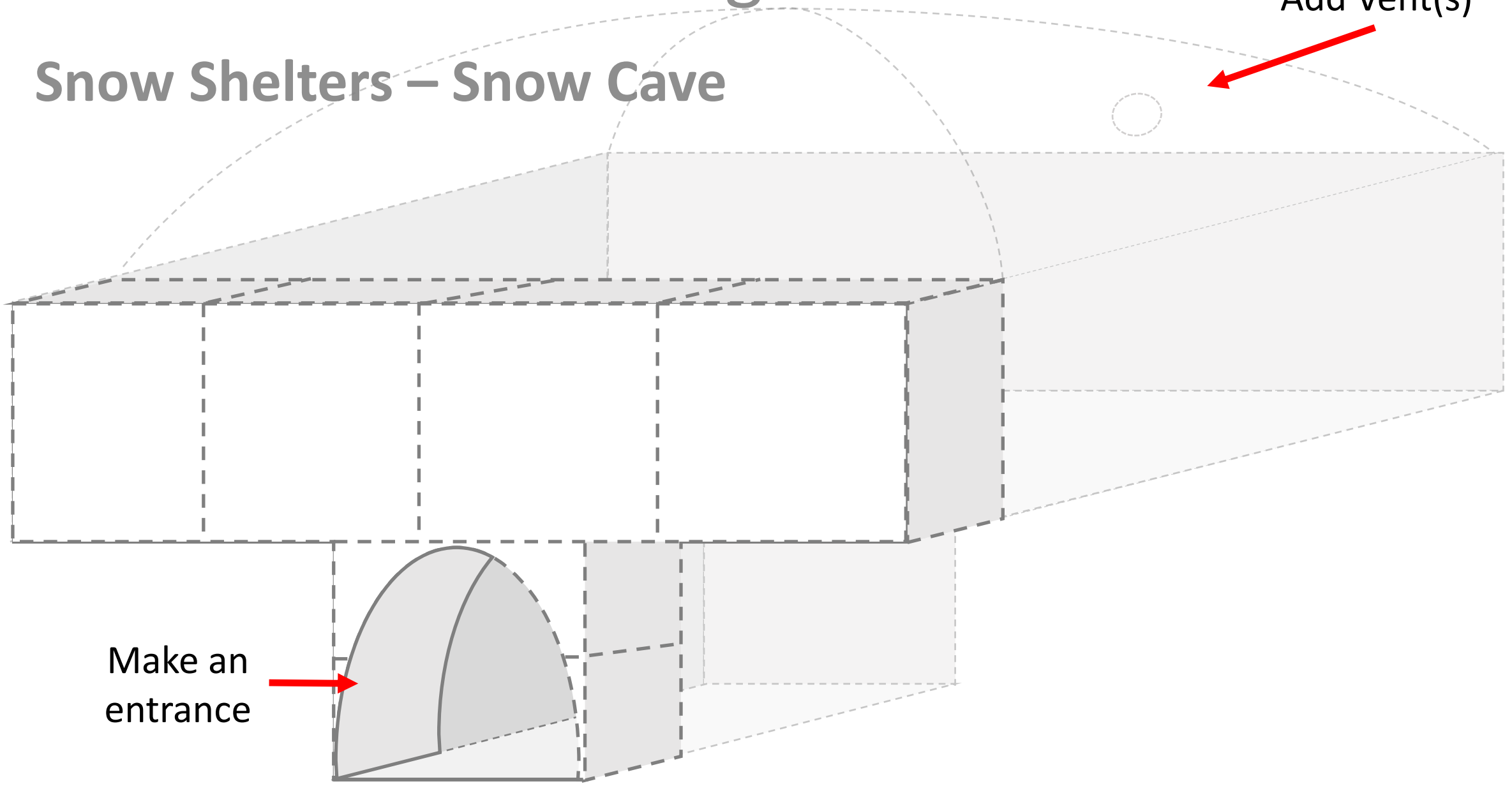
Surviving the Cold

Snow Shelters – Snow Cave



Surviving the Cold

Snow Shelters – Snow Cave



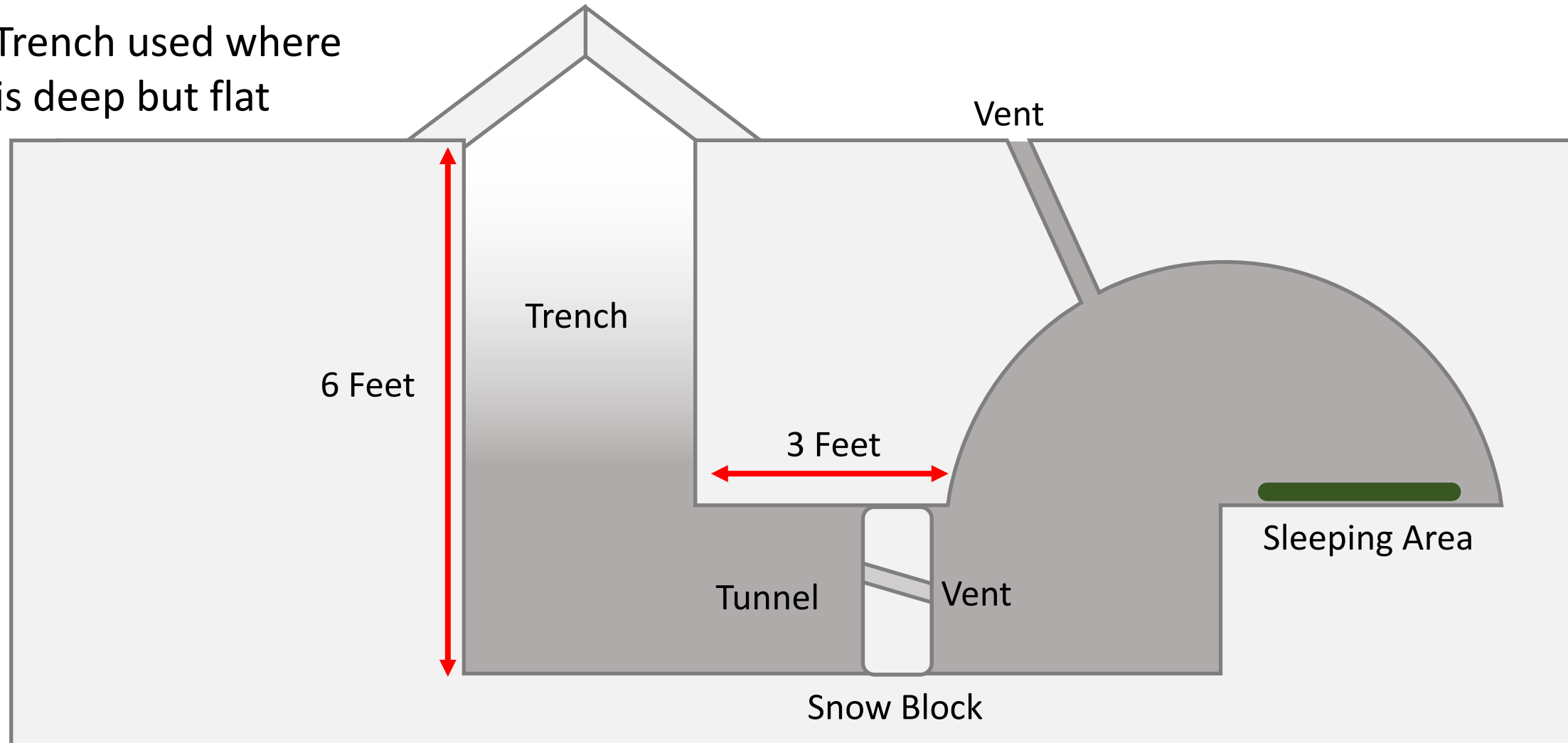
Make an entrance

Add Vent(s)

Surviving the Cold

Snow Shelters – Snow Cave/Trench

Cave/Trench used where
snow is deep but flat

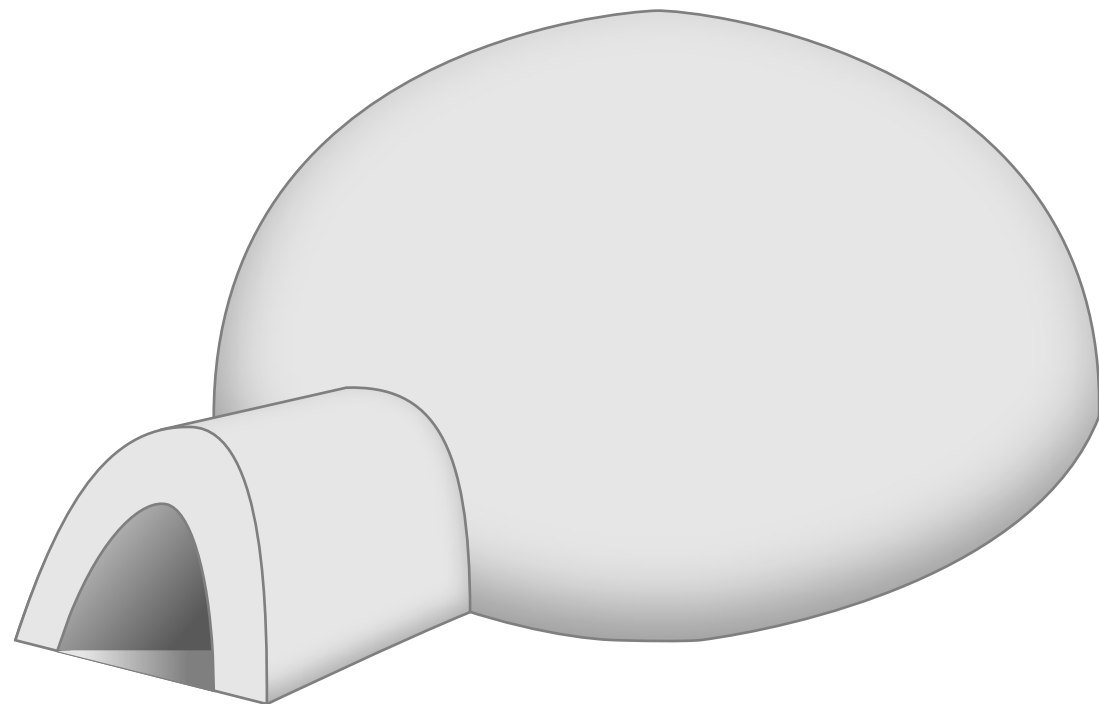


Surviving the Cold

Snow Shelters – Snowmound aka Quinzhee (2-4 Hours)

- aka Athabaskan Quinzhee, Canadian Snow Hut and Finnish Lumitalo
- A snowmound is simply a snow cave built from a mound of snow

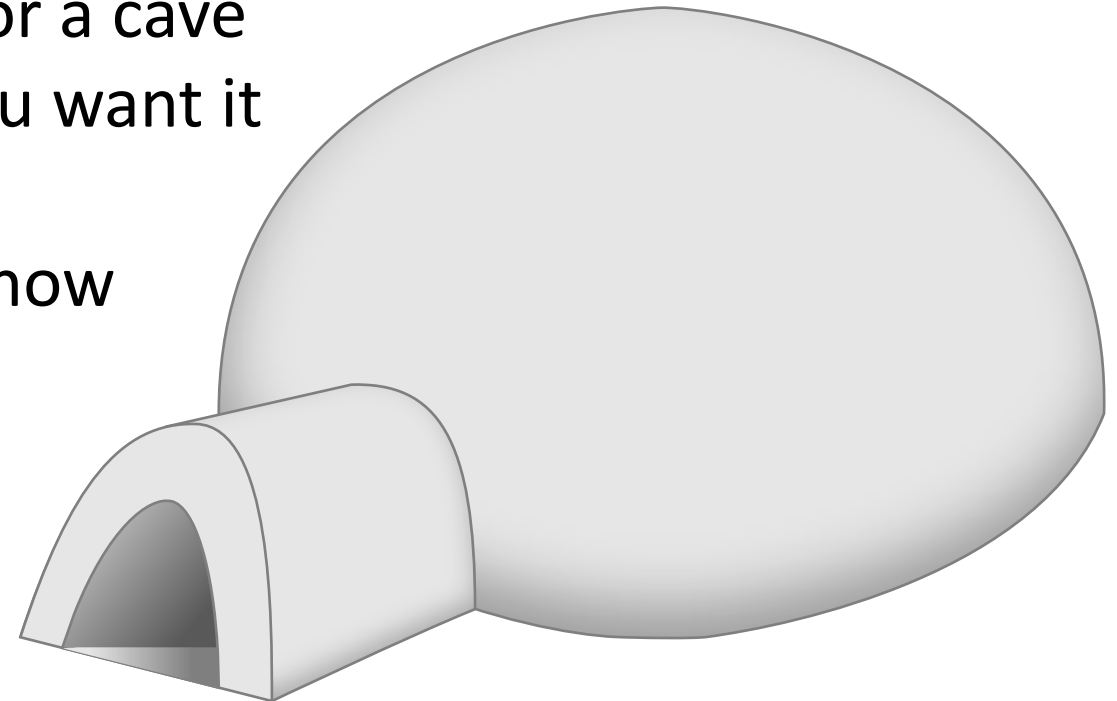
Building a Snow Hut is a LOT of work



Surviving the Cold

Snow Shelters – Snowmound aka Quinzhee

- A Quinzhee is often used
 - When the only tool you have are snowshoes for digging
 - In forested areas where snow is too fluffy for Igloo
 - Where snow is not deep enough for a cave
- Allows you to set up shelter where you want it
 - Not dependent on terrain
 - Do not need snow drifts or deep snow

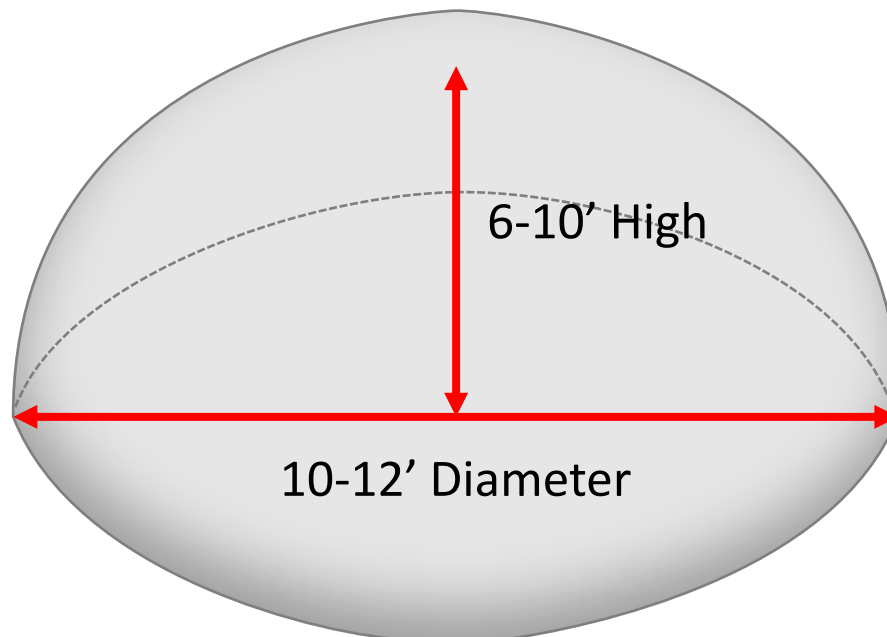


Surviving the Cold

Snow Shelters – Snowmound aka Quinzhee

Surface and deep snow should be broken up and mixed – this helps binding

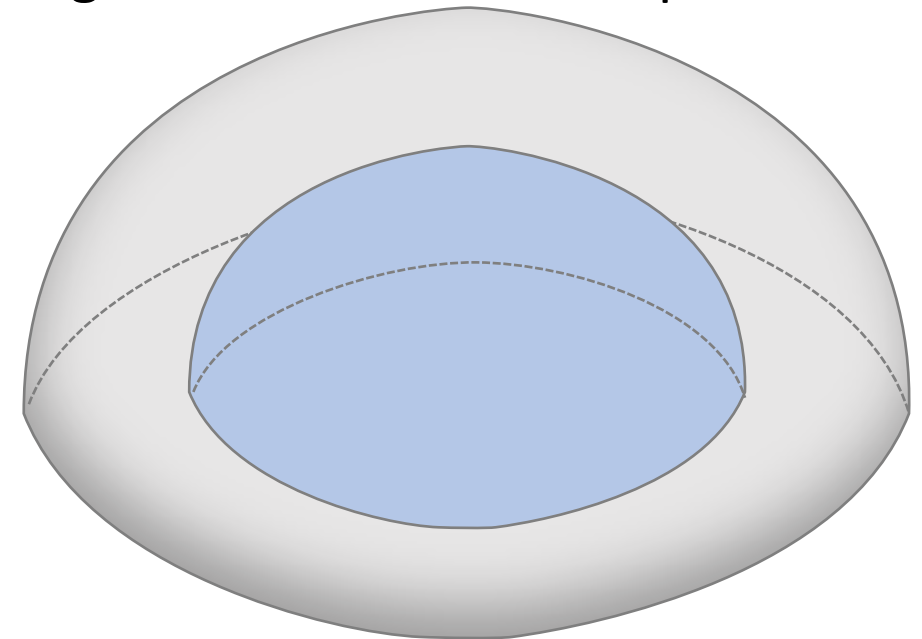
Throw into a big pile



Allow snow to homogenize and bind (sinter)
Ideally overnight – or at least an hour

Excavation is much quicker if you pile snow over something

- Backpacks and gear
- Vegetation covered in tarp

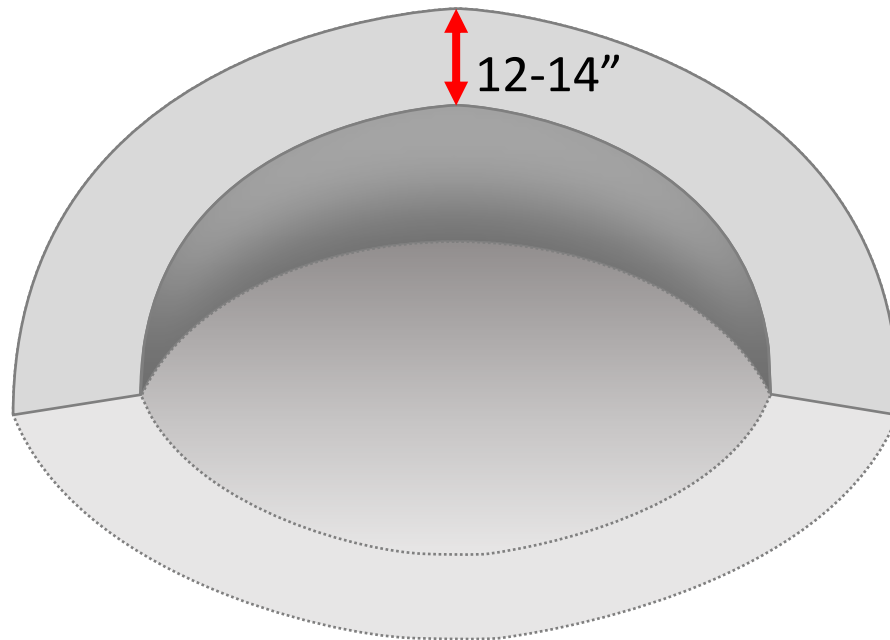


Add at least 2 feet of snow over pile

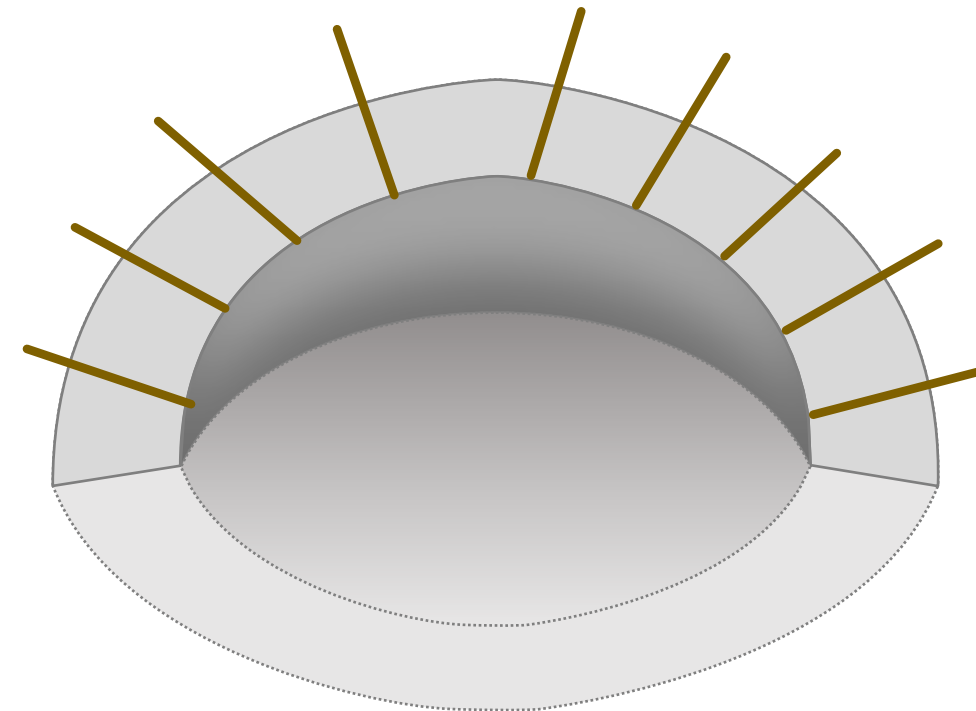
Surviving the Cold

Snow Shelters – Snowmound aka Quinzhee

Your final wall thickness needs to be at least 30cm (1')



Optional:
Place sticks into mound about 12-14''

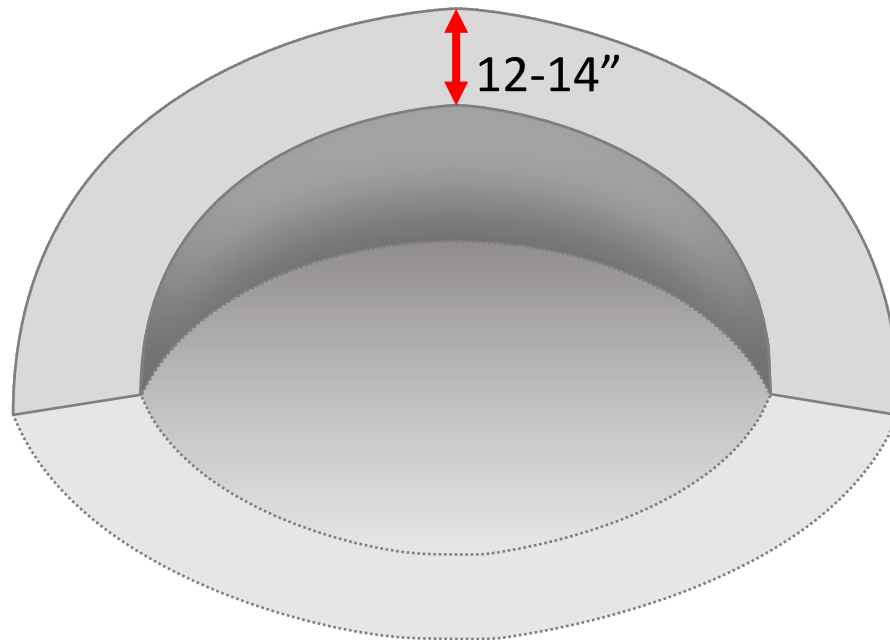


During excavation, sticks will let you know when to stop digging in that spot

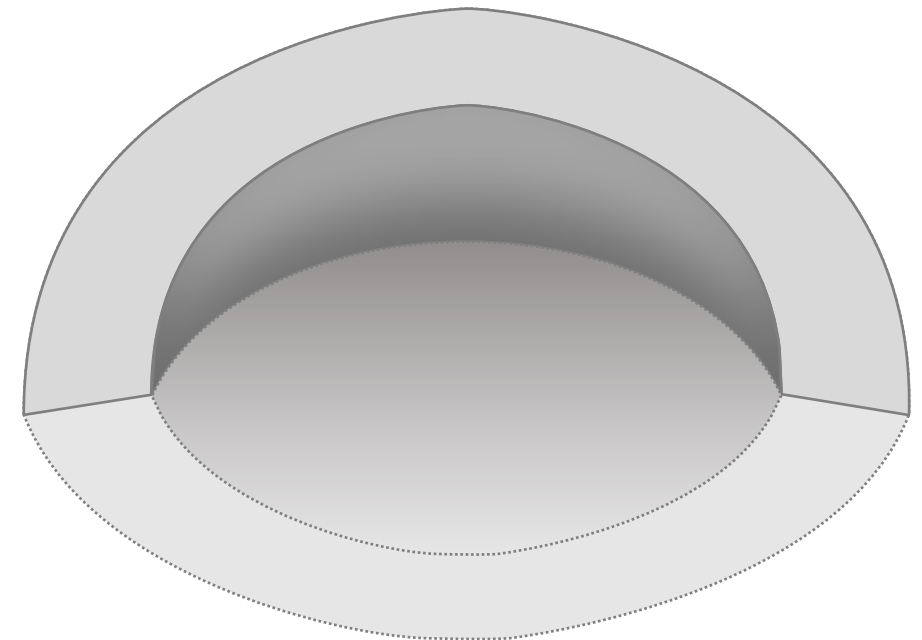
Surviving the Cold

Snow Shelters – Snowmound aka Quinzhee

Your final wall thickness needs to be at least 30cm (1')



You can use light as a gauge for digging
Daytime – blue light is correct thickness
Nighttime – look for headlamp outside



When you see light, stop digging

Surviving the Cold

Snow Shelters – Snowmound aka Quinzhee

Make a temporary large hole on side of mound

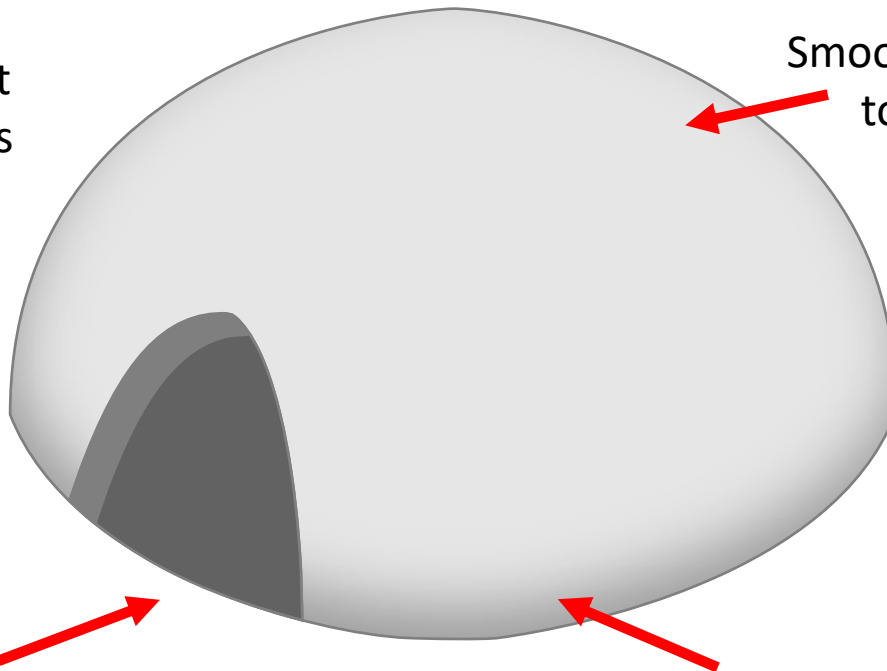
This will save an hour of excavation

Remove big blocks of snow from inside

When done, use blocks
to close hole

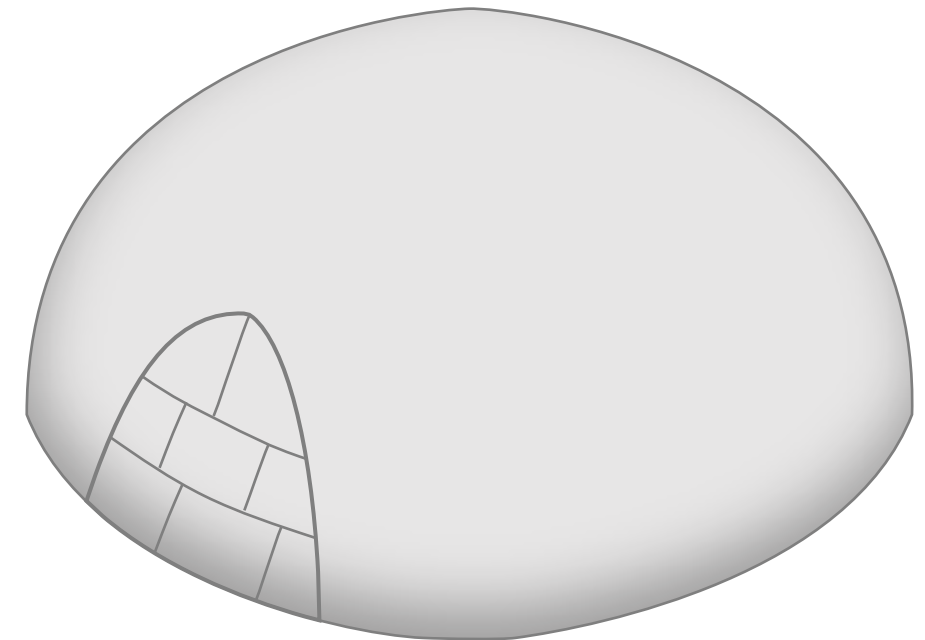
Don't forget
to add vents

Smooth the inner wall
to reduce drips



Opposite side of Entrance

Dig down if more space is needed

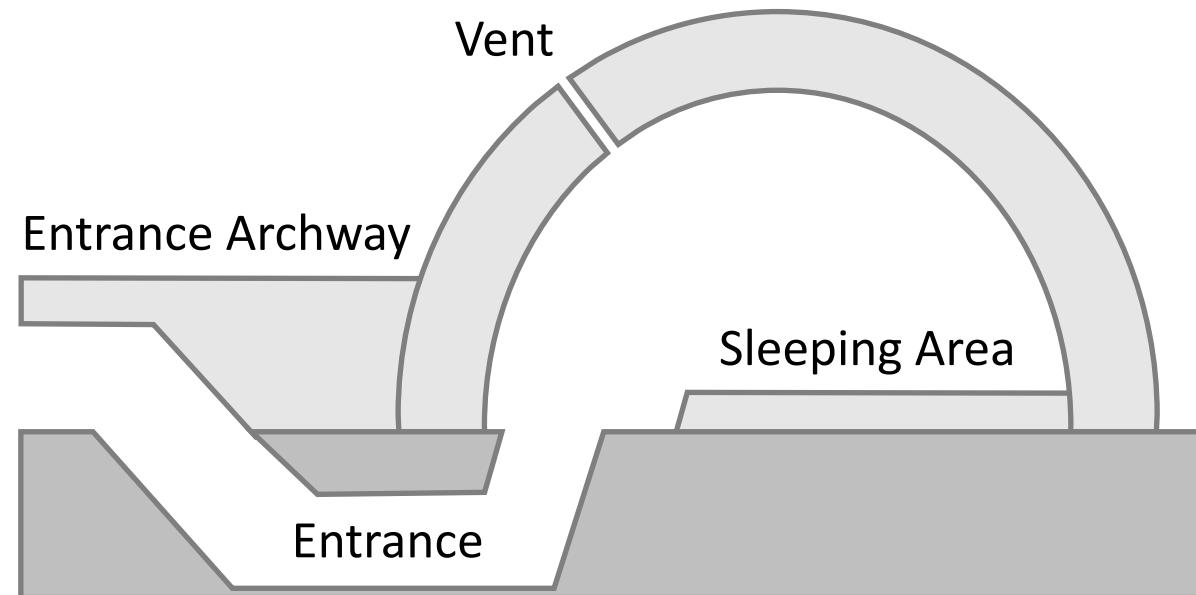
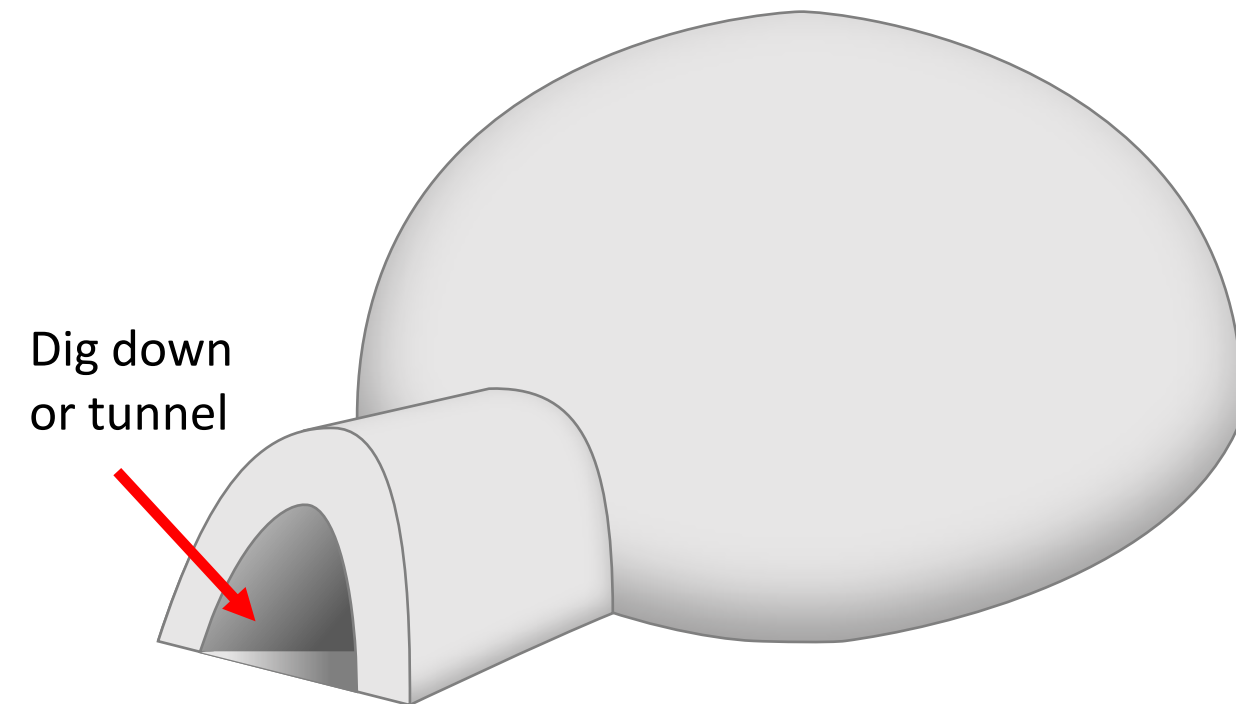


Surviving the Cold

Snow Shelters – Snowmound aka Quinzhee

Build an entrance by piling up snow or building a nice arch

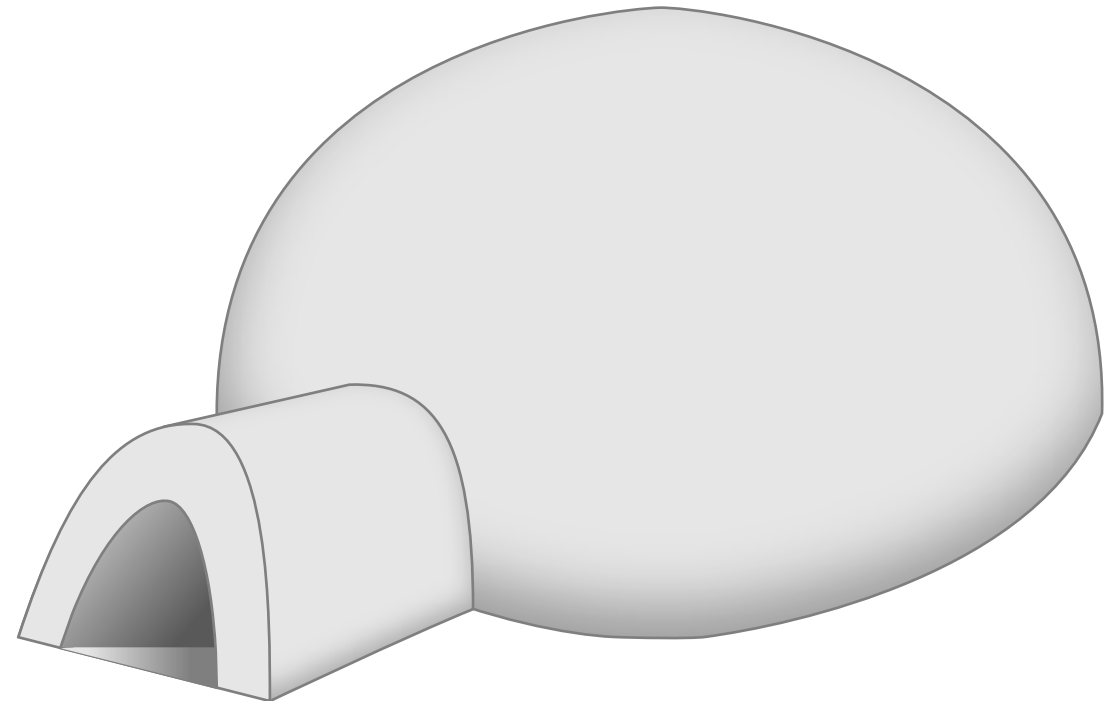
Entrance should be downhill or 90° to wind



Surviving the Cold

Snow Shelters – Snowmound aka Quinzhee

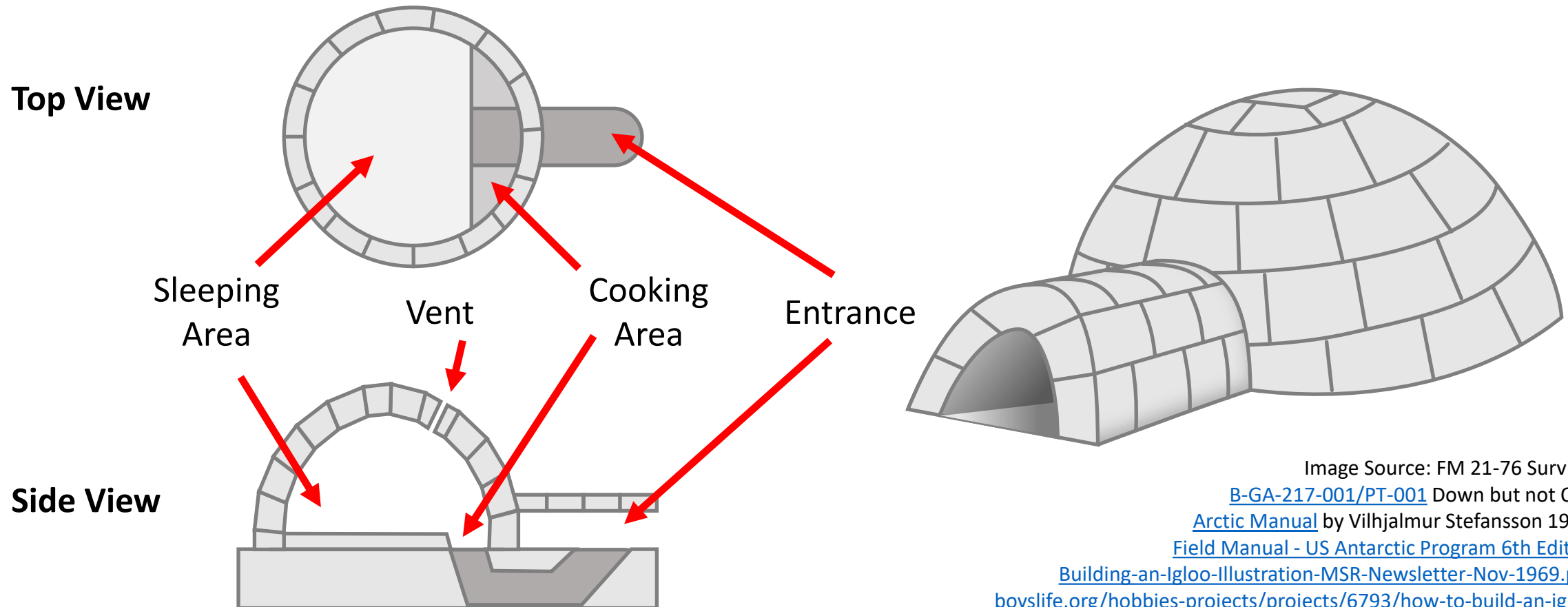
- If you break through your wall during construction
 - Use Pine boughs to patch hole
 - Build up snow over patch



Surviving the Cold

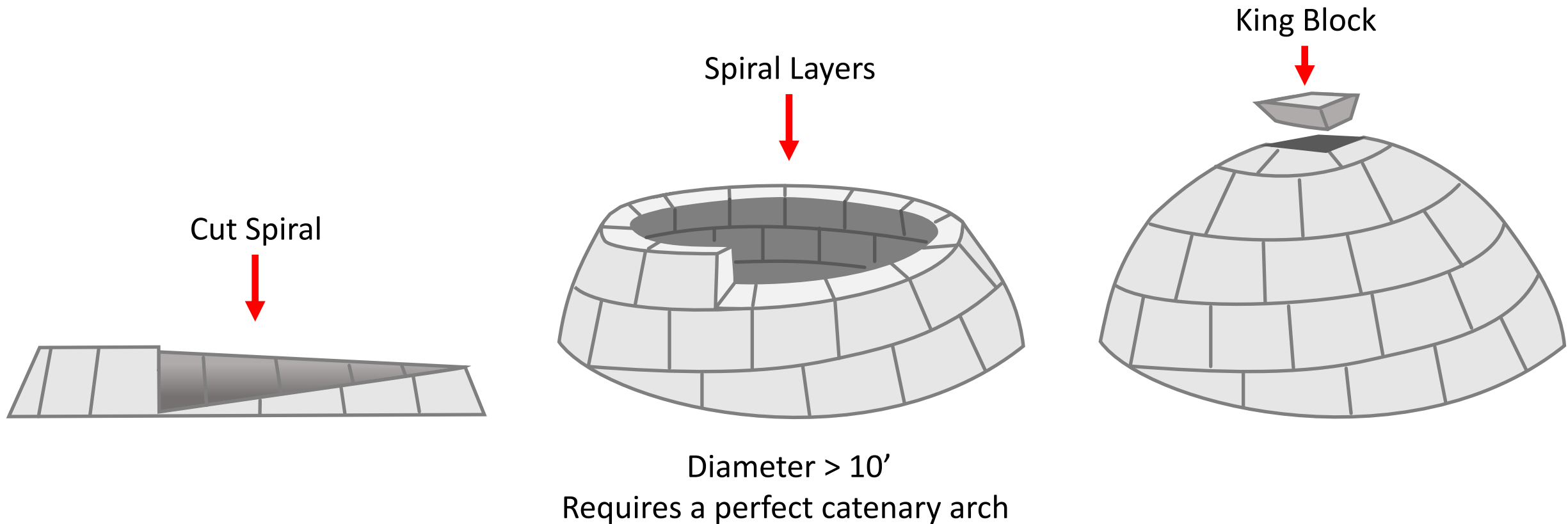
Snow Shelters – Igloo – (3 to 5 Hours)

- Used by natives of polar regions, the Igloo is a great snow shelter
- Building one takes skill



Surviving the Cold

Snow Shelters – Igloo



Surviving the Cold

Snow Shelters – Igloo – Making Blocks

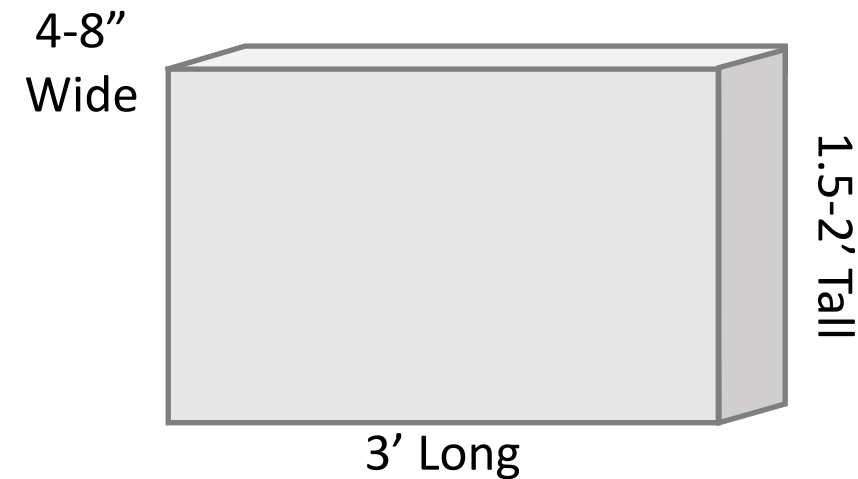
- You will need to harvest snow blocks
- For a 6' diameter igloo, you will need 50 to 80 blocks
- Snow blocks were traditionally made from wind hardened slabs on the tundra
- If snow is powdery
 - Compact it and allow to bind
 - Or use different location
- If snow doesn't bind because it is too cold
 - Consider a different shelter



Surviving the Cold

Snow Shelters – Igloo – Making Blocks

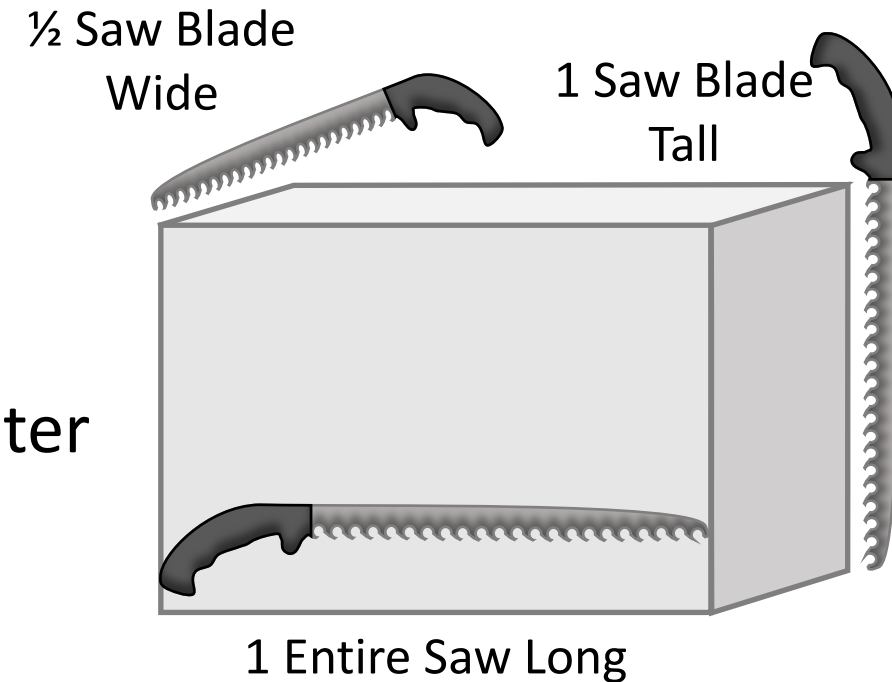
- Different sized snow blocks can be used
 - Inuit use:
 - 3' x 1.5-2' x 4-8"



Surviving the Cold

Snow Shelters – Igloo – Making Blocks

- Different sized snow blocks can be used
 - Antarctica Field Guide recommends:
 - 1 SMC Saw x 1 Saw Blade x $\frac{1}{2}$ Saw Blade
 - Thicker blocks insulate better, but don't let in light
 - Penetrating sunlight does warm the shelter

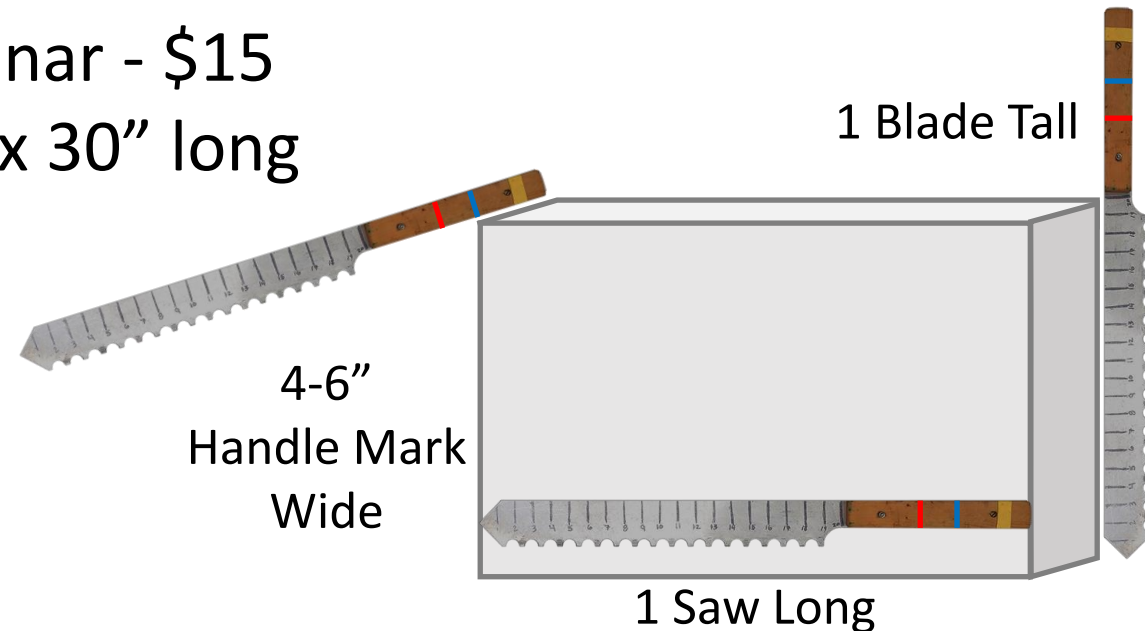


Antarctica Giant Block

Surviving the Cold

Snow Shelters – Igloo – Making Blocks

- Scout Snowsaw
 - Sold by Council Winter Camp Seminar - \$15
 - 3/16" thick aluminum x 2.5" wide x 30" long
 - 4" thick blocks easier to lift
 - 6" thick blocks are stronger
 - Use 6" if 4" fall apart

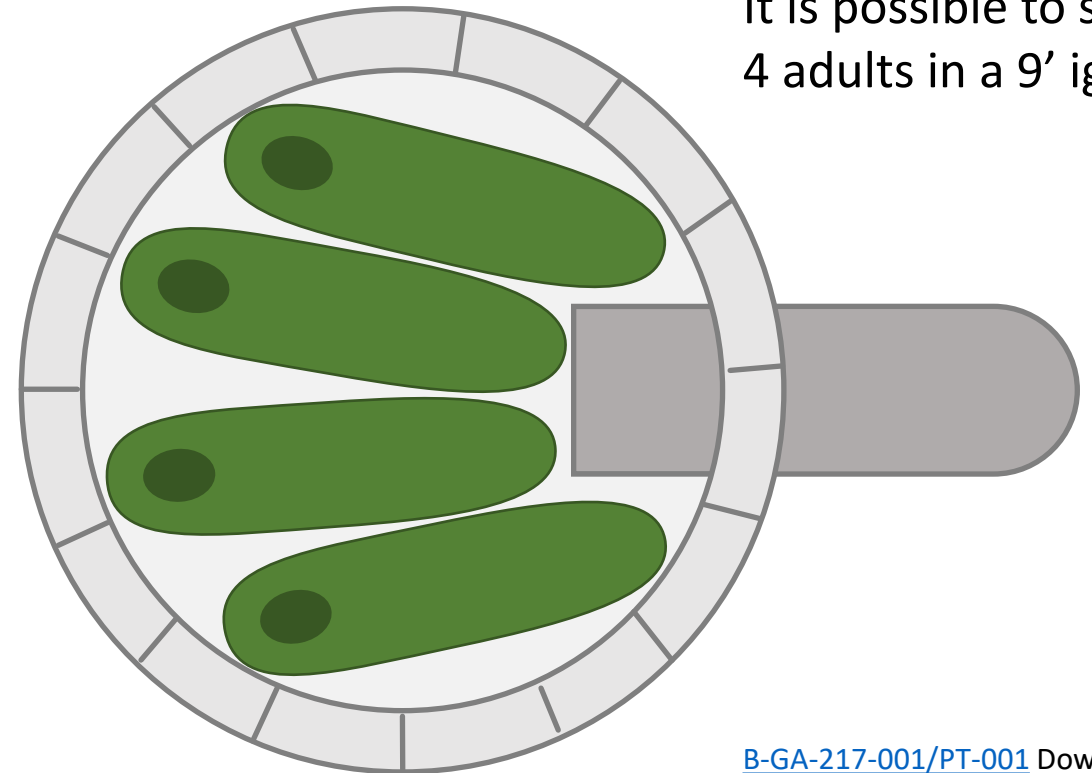


Surviving the Cold

Snow Shelters – Igloo – Determine the Size of Igloo

- A 6' Igloo is fine for one person in a survival situation
- You will want something bigger for more people
- Canadian survival manual recommends:

1 Man	2.5M	8.2'
2 Man	2.7M	8.9'
3 Man	3M	9.8'
4 Man	3.7M	12.1'
5 Man	4M	13.1'

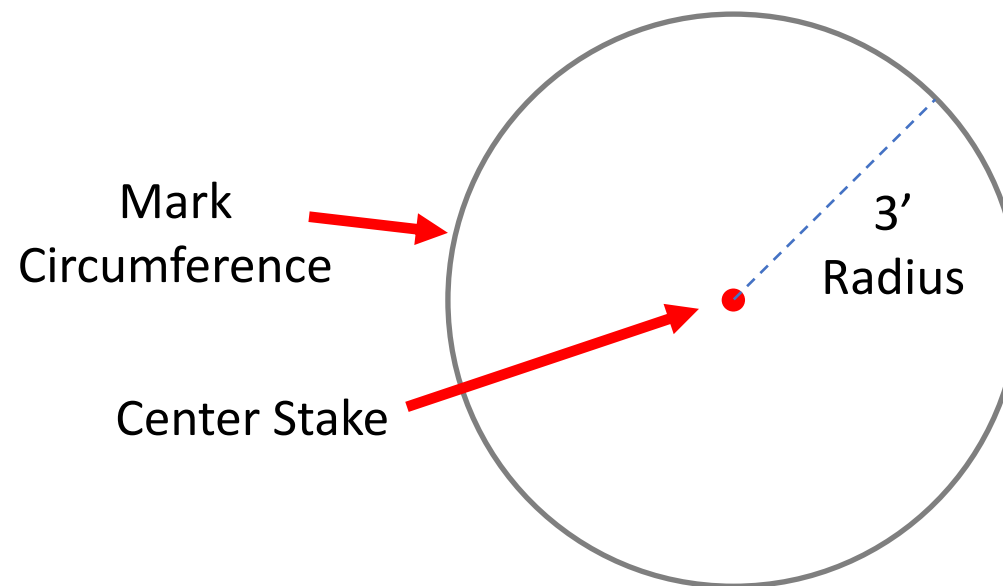


Surviving the Cold

Snow Shelters – Igloo – Marking the Perimeter

- Mark center of Igloo with a stake
- For a 6' Igloo, use 3' paracord to mark circumference of igloo

1 Man	2.5M	8.2'
2 Man	2.7M	8.9'
3 Man	3M	9.8'
4 Man	3.7M	12.1'
5 Man	4M	13.1'

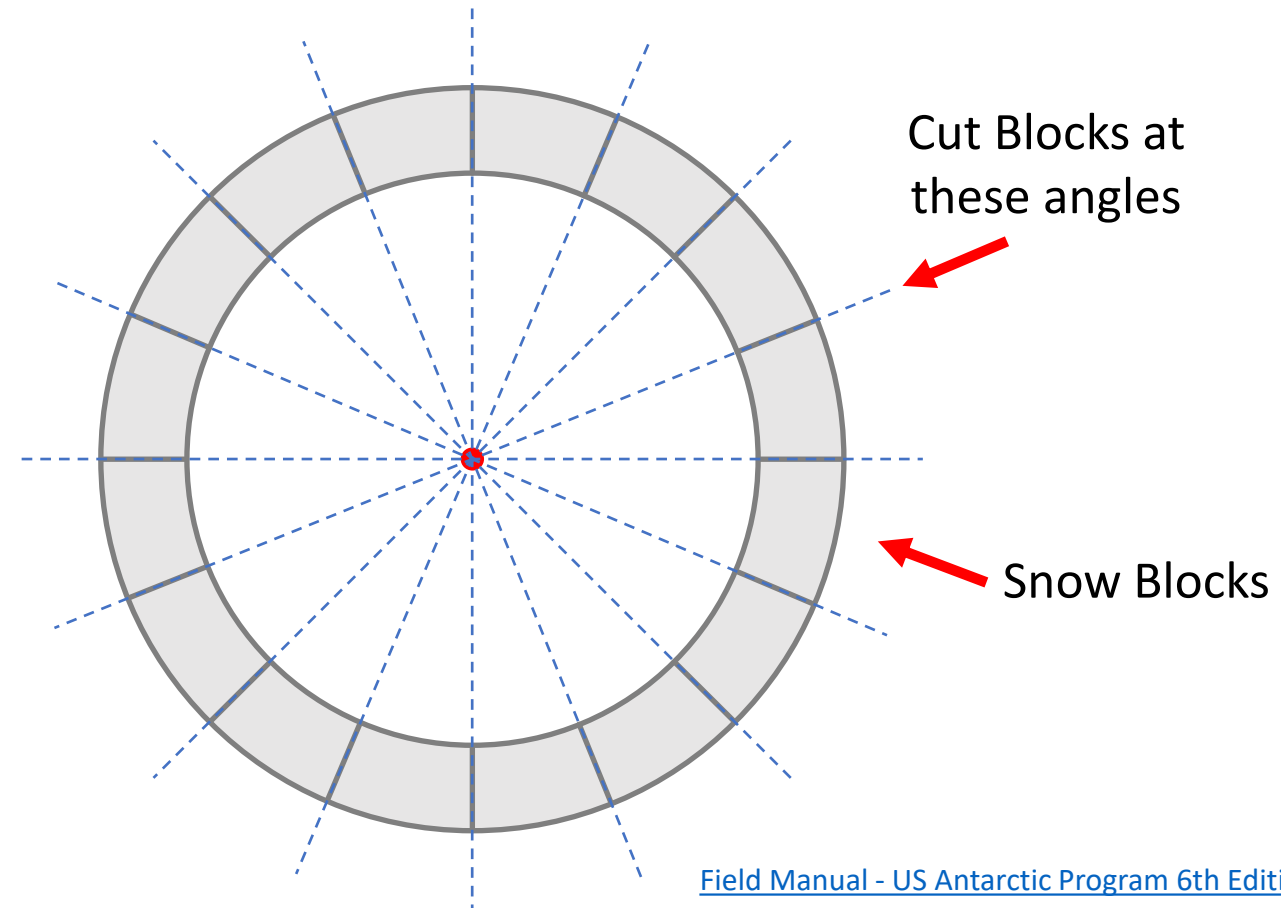


Surviving the Cold

Snow Shelters – Igloo – Laying First Flight of blocks

- Lay first flight of blocks
- Cut side of blocks by angling cut towards stake in center of igloo

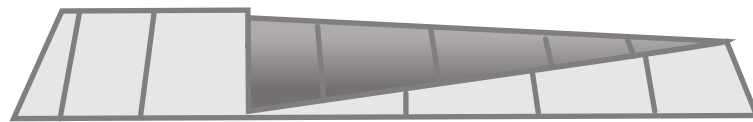
It is Vital that you make this angled cut for every block of your igloo



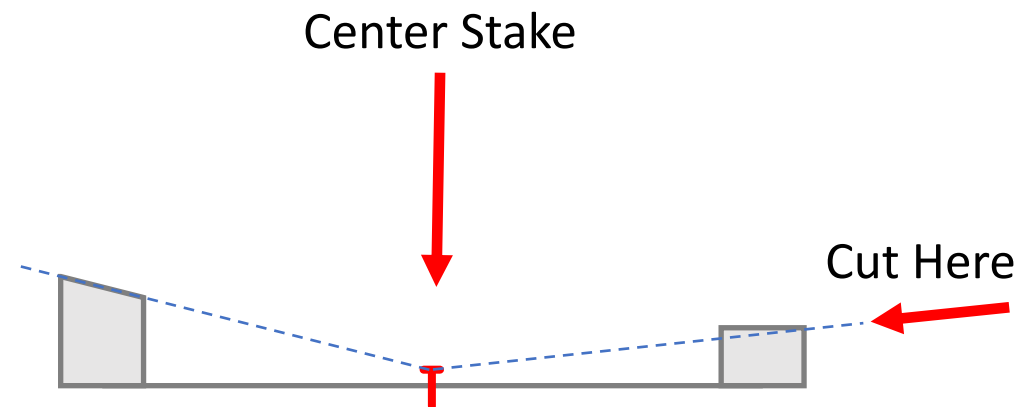
Surviving the Cold

Snow Shelters – Igloo – Initial Spiral and Angling

- Cut spiral top into first row
 - Counterclockwise if you are right-handed
 - Clockwise if you are left-handed
- Cut the top of slope so that it angles towards the center stake



Spiral Top

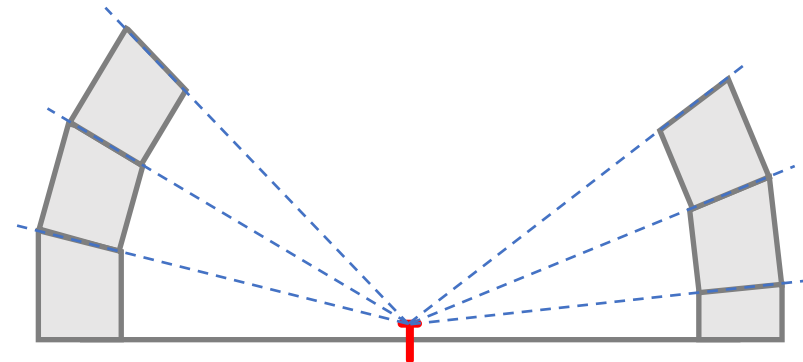
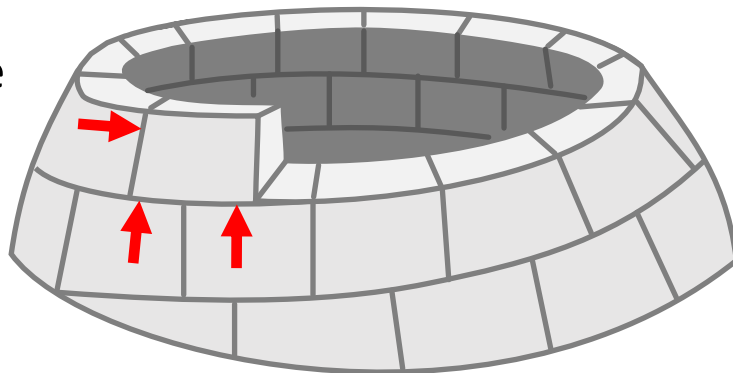


Surviving the Cold

Snow Shelters – Igloo – Subsequent Flights of Blocks

- Now lay down the next flights of blocks
- Line up the outside edge of each block with the one below
- Make side cuts that angle toward the center stake
- Trim the top so that it angles towards the center stake
 - The top surface should be continuous and smooth without bumps

When adding a block,
focus contact pressure
on these 3 points

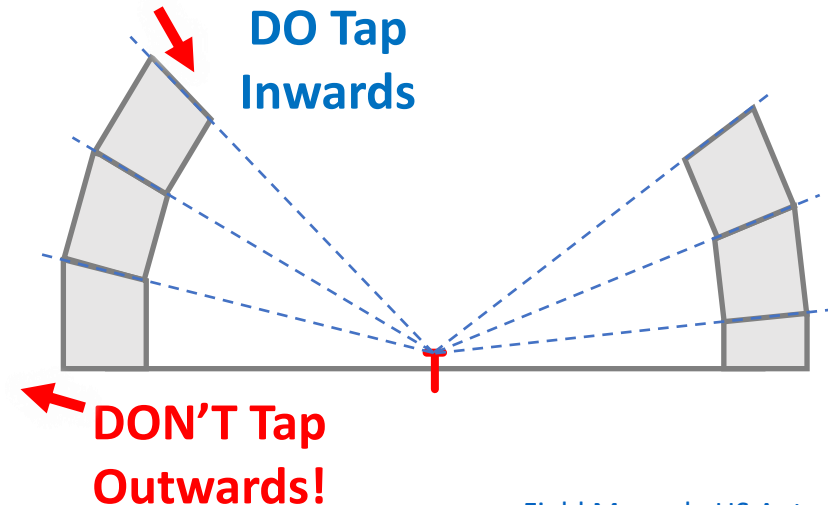
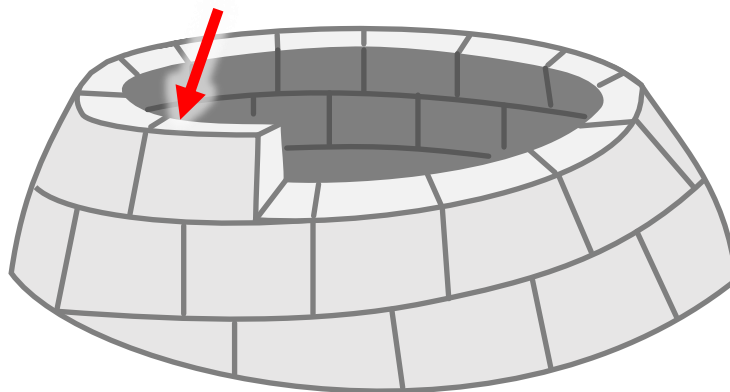


Surviving the Cold

Snow Shelters – Igloo – Caveats

- Once you get going, one person sets blocks from inside the igloo
- Don't crack or smash blocks to make them fit – cut them
- You only need to support the block you are working on
- As you lay block, gently tap the previous block towards the center
 - This locks it in place
- Don't move block outwards – this unlocks them

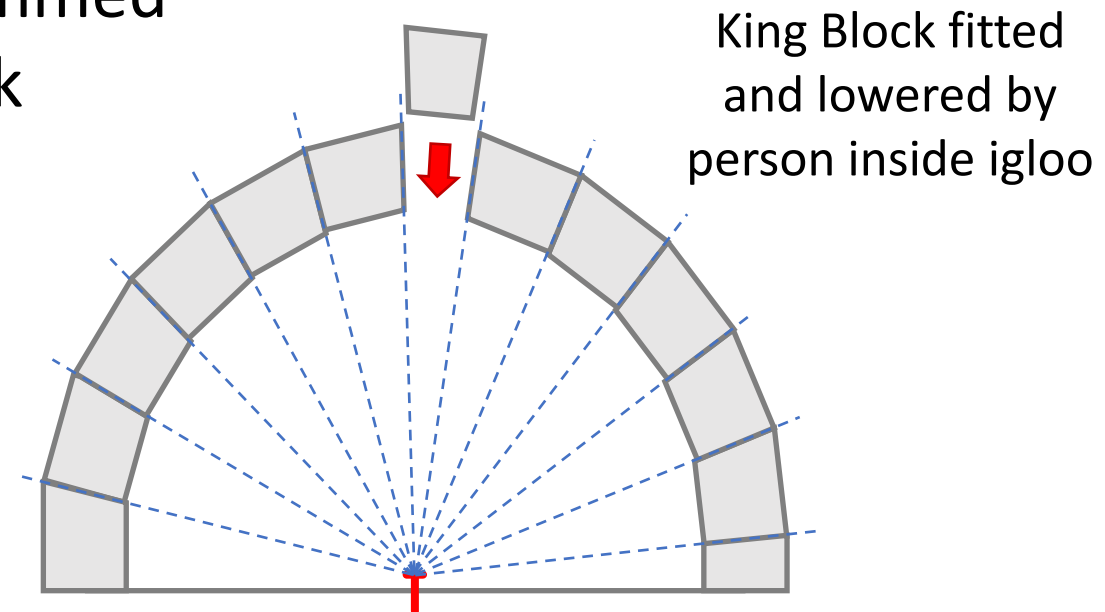
Gently tap here to
lock in place



Surviving the Cold

Snow Shelters – Igloo – King Block aka The Cork

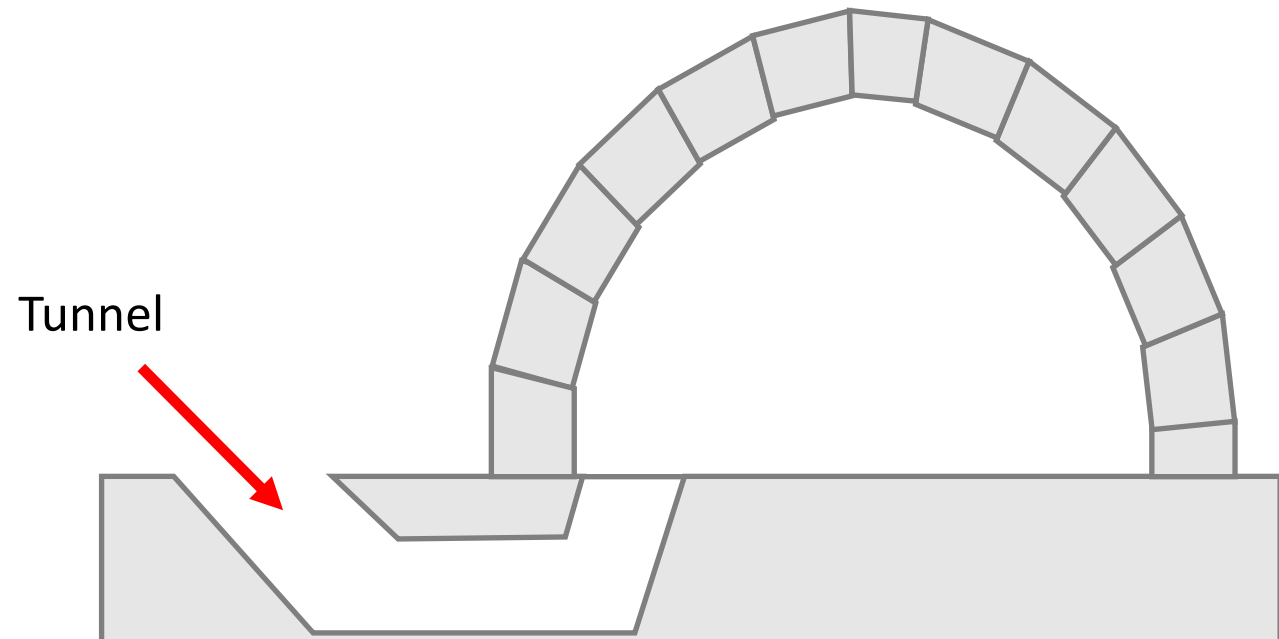
- Once you are down to a single hole smaller than a block, It's time to set the King Block
- A rectangular hole will allow you to fit the block from underneath
- King Block is lowered into hole then trimmed
- Think of it as sealing a bottle with a cork
- If you are unable to reach the top, build platform of snow to stand on
- Don't assign shortest person for this



Surviving the Cold

Snow Shelters – Igloo – Make an Entrance

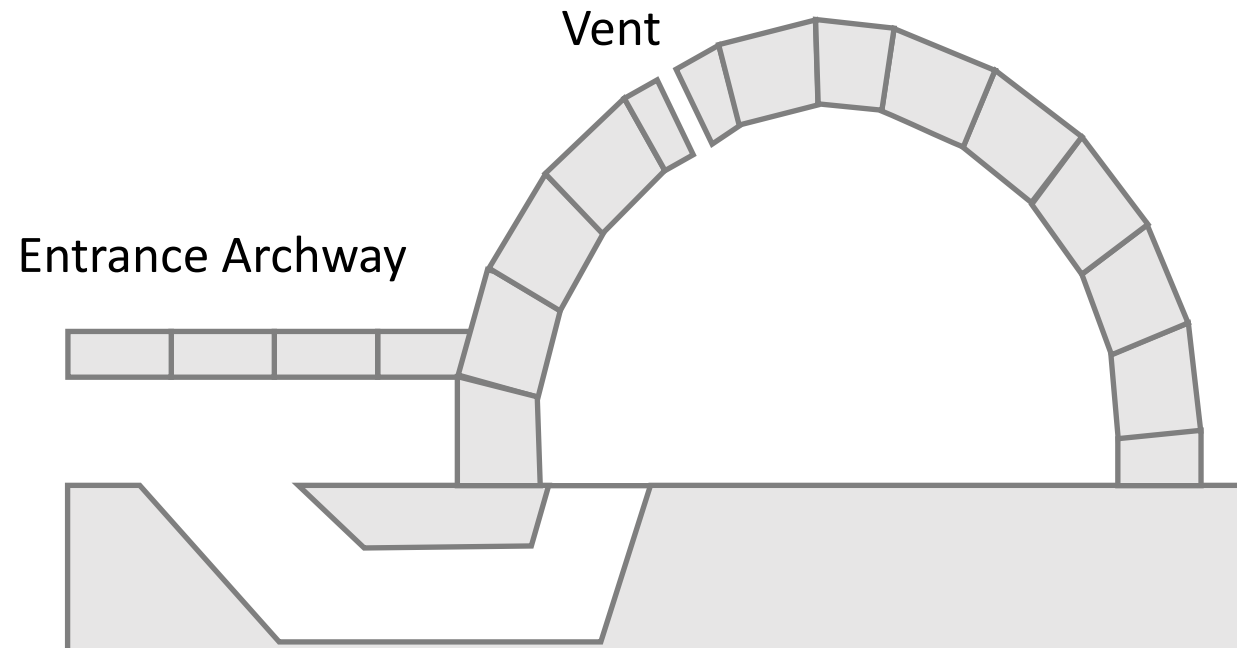
- Tunnel into the Igloo
- Make entrance as close to wall as possible to conserve sleeping space
- Entrance should always be lower than sleep area



Surviving the Cold

Snow Shelters – Igloo – Finishing Touches

- Fill in any gaps to keep the wind out
- Smooth off the inner surface to reduce drips
- Build snow wall around entrance
- Add Vent Holes



Surviving the Cold

Snow Shelters – Igloo

- Tools can be made or purchased to make Igloo building easier
- [Grand Shelters](#) makes the IceBox
- sentex.ca/~mwandel/winter/igloo.html
- Many cute tools available for building kid sized igloos

Surviving the Cold

Snow Shelters – Crevasses and Bergshrunds

- These are **VERY Dangerous**
 - Often unstable
 - False floors
 - Ice blocks can drop at any time
- In an emergency situation, they may be used for shelter from the wind
 - Many mountaineers have survived the night to share this technique
- Ledges can sometimes be chopped out for a place to stay
- Take precautions
 - Solid anchors above
 - Rope in

Surviving the Cold

Snow Shelters – TaunTauns

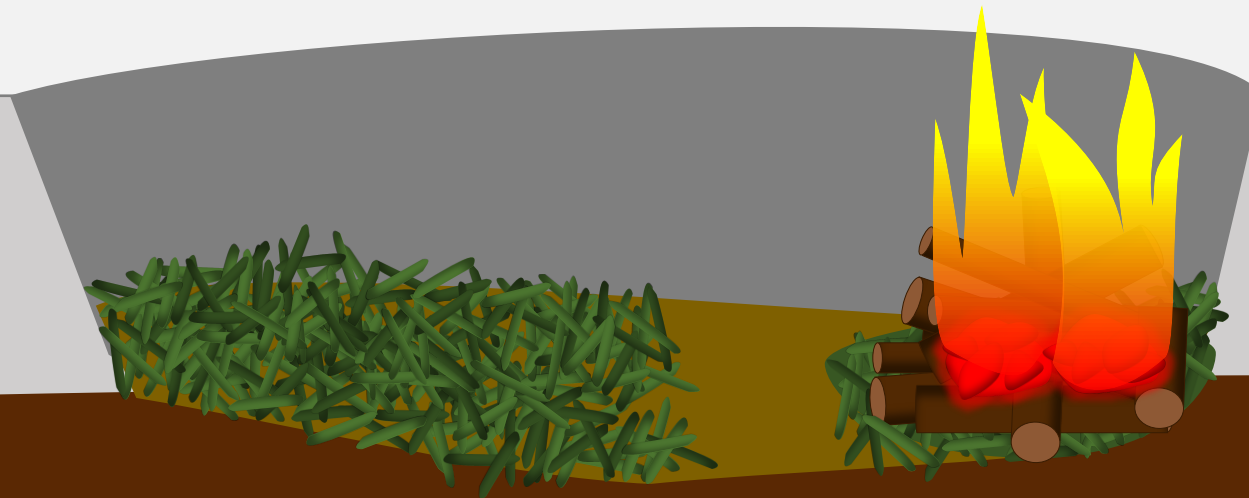
- Used for temporary shelter
- Insides are warm but wet
- Prepare to dry off immediately after exiting shelter
 - Moisture can lead to hypothermia
 - Moisture on face can instantly freeze
- TaunTauns smell worse on the inside



- 1860 - French missionary Father Joseph Goiffon used horse in similar manner to stay alive

Surviving the Cold

Cold Weather and Fire



Surviving the Cold

Cold Weather and Fire

- Fire is vital in a cold environment survival situations
- It is needed for:
 - Warmth – reduces calorie requirements
 - Drying clothing
 - Melting snow
 - Purifying water
 - Signaling
 - Cooking
 - Making tools
 - Moral
- This is covered in our Fire Building class

Surviving the Cold

Cold Weather and Fire

Fire Building is a MUST Know Skill in a Cold Weather Environment!

Surviving the Cold

Cold Weather and Fire

- Don't fool around
- Sure, you can start a fire with dry sticks and a knife
 - Know these skills
 - Show off when appropriate
 - Don't solely rely on these tricks

Surviving the Cold

Cold Weather and Fire

- Butane lighters fail at and below freezing temperatures!
 - If you carry one, keep it in inner pocket close to skin
 - Carry an alternate fire starter!



Surviving the Cold

Cold Weather and Fire

- Carry real fire-starting material
 - Quality commercial or homemade starters
 - Waterproof
 - Easy to light
 - Long burn time

Surviving the Cold

Cold Weather and Fire

- Carry real fire-starting material
 - Quality **Storm Matches** work great
 - UCO Titan Stormproof Match are incredible, but expensive
 - Burn in wind
 - Burn after getting wet (after they are dried off)
 - Burns long enough to get damp tinder started
 - Striker must be kept dry!



Surviving the Cold

Cold Weather and Fire – Axe

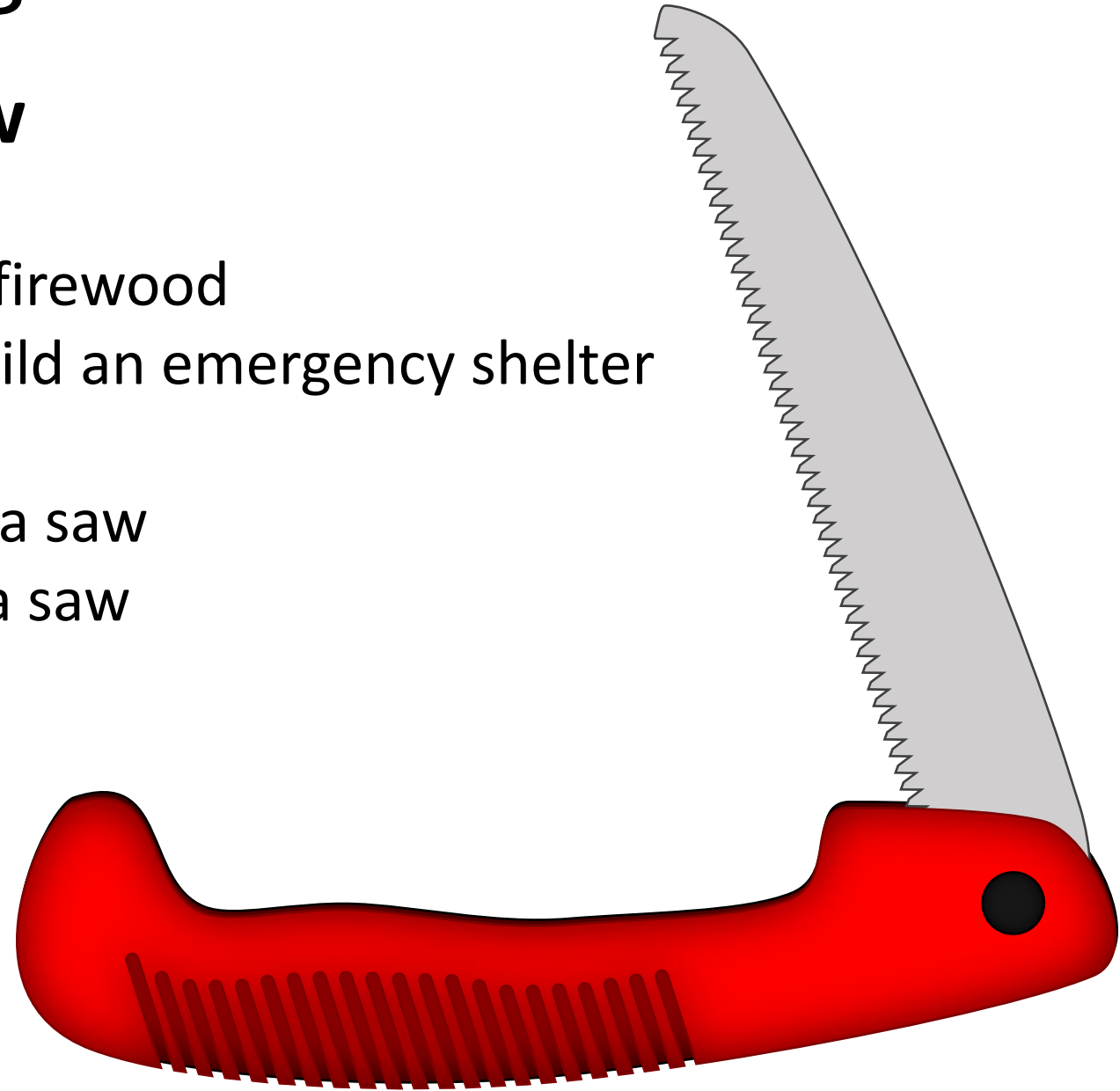
- An Axe is mandatory gear for Iditarod Mushers
- An Axe or hatchet is an incredible survival tool
 - Cuts wood into manageable length to burn
 - Chops wood into burnable sizes, kindling and tinder
 - Chops wood to get to dry insides
 - Cuts through ice, downed trees, frozen food and rope
 - Basic wilderness wood craft – like building shelters
- If you carry an axe, know how to use it



Surviving the Cold

Cold Weather and Fire – Saw

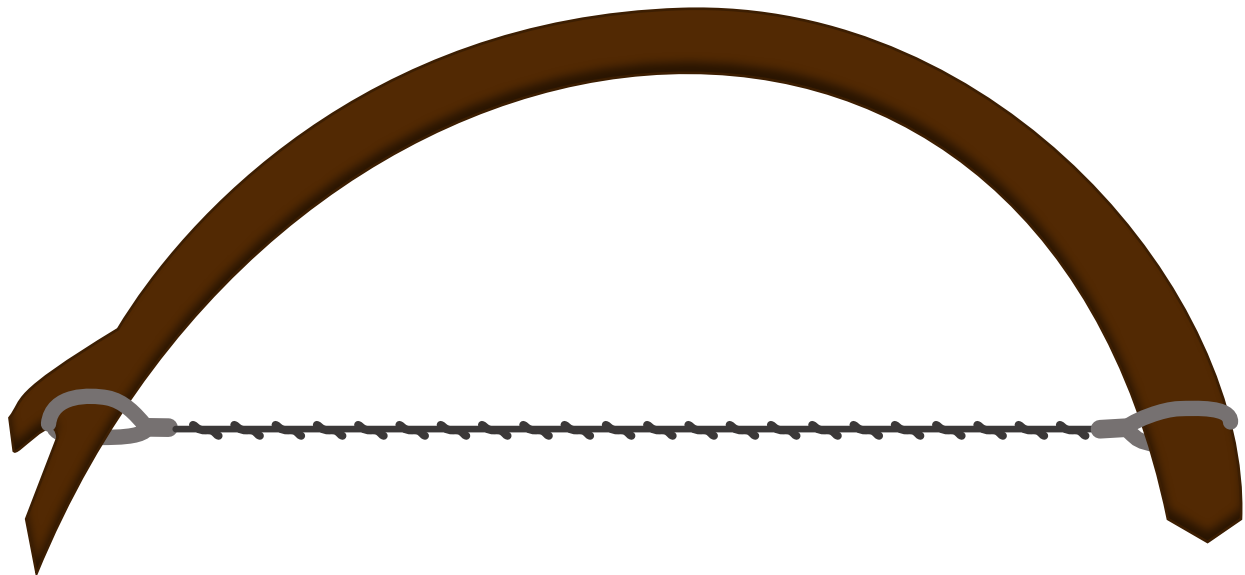
- A survival saw is easy to pack
- Good for cutting up branches for firewood
- Great for taking down limbs to build an emergency shelter
- Great augmentation to an axe
- If you don't have an axe and only a saw
 - Know how to split wood with a saw



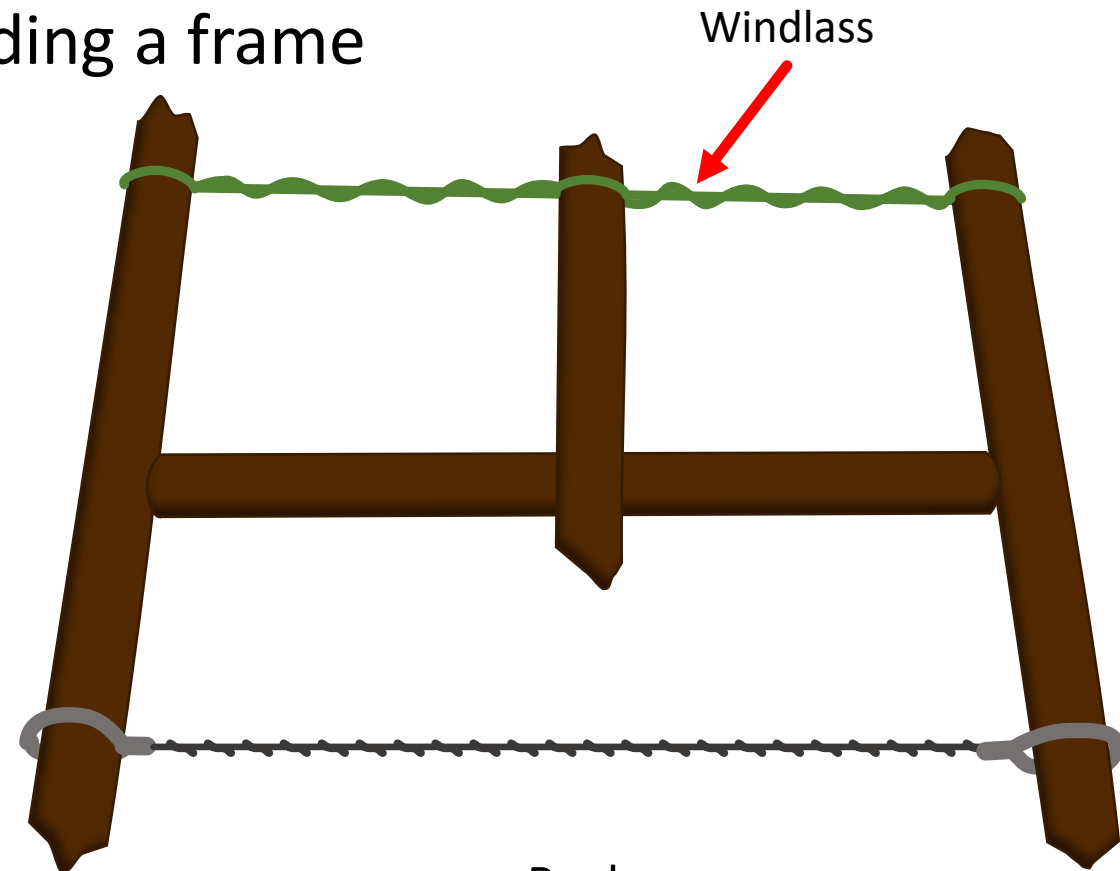
Surviving the Cold

Cold Weather and Fire – Wire Saw

- A wire saw is easy to pack and has reasonable utility
- Performance can be enhanced by building a frame



Sapling Bowsaw

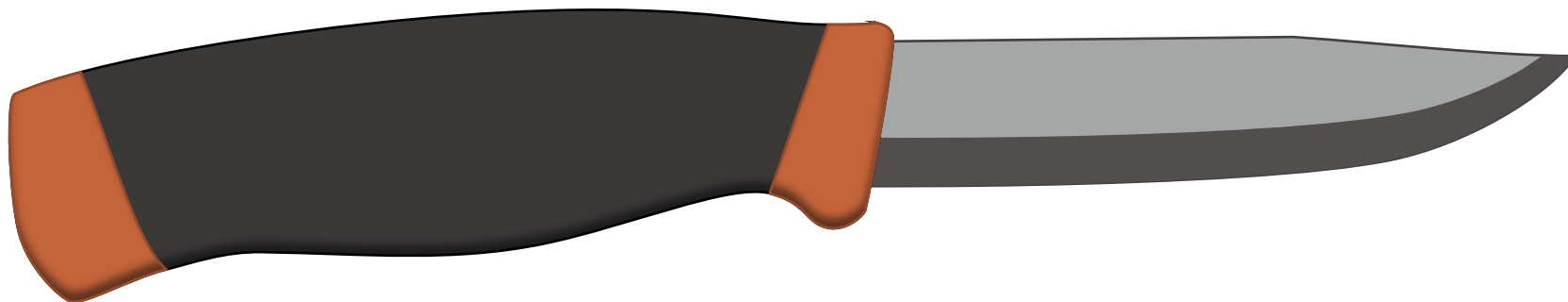


Bucksaw

Surviving the Cold

Cold Weather and Fire – No Axe or Saw

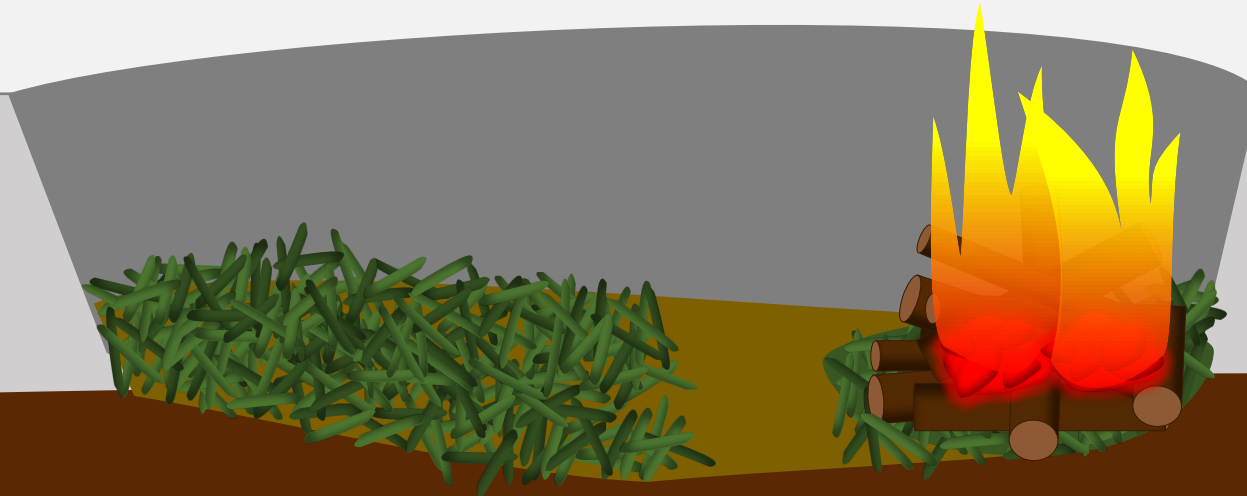
- If you don't carry an axe, know how to use your knife
 - Batoning
 - Beaver chewing around trunk
 - Using wood wedges to split
- Don't have a knife?
 - Sigh – you're probably going to die
 - Learn how to use leverage to break wood



Surviving the Cold

Cold Weather and Fire – Fire on Snow – The Pit

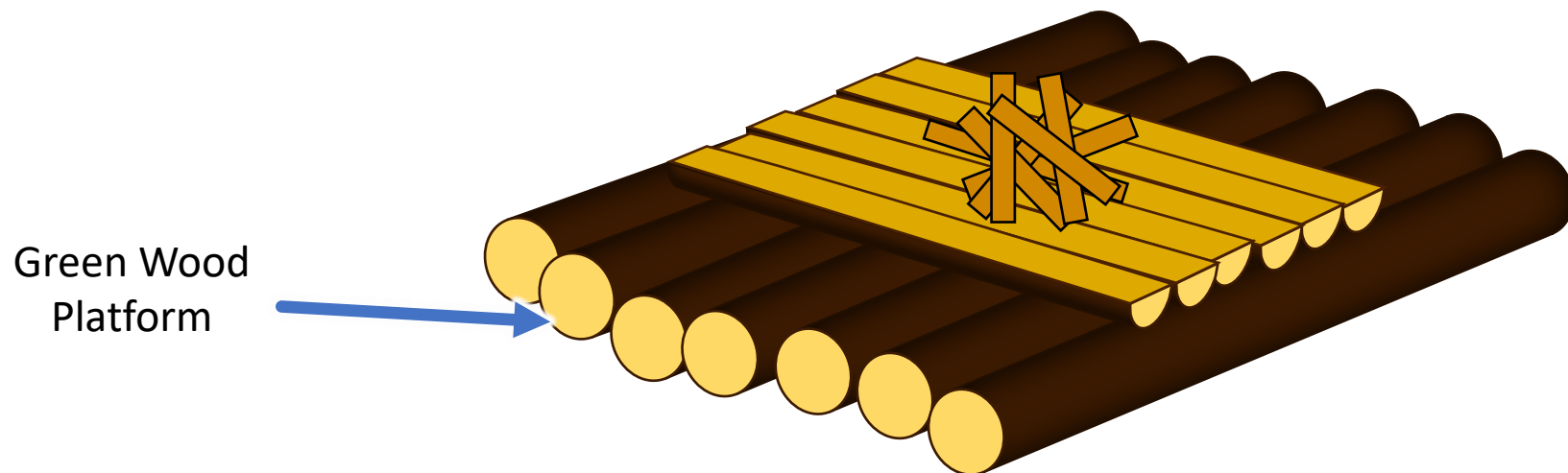
- If snow isn't too deep, dig down to firm ground
 - This prevents sinking of fire into snow
 - You may still need a platform to keep fire off of wet ground
 - You may need to dig a small trench to drain puddling water



Surviving the Cold

Cold Weather and Fire – Fire on Snow – Snow Platform

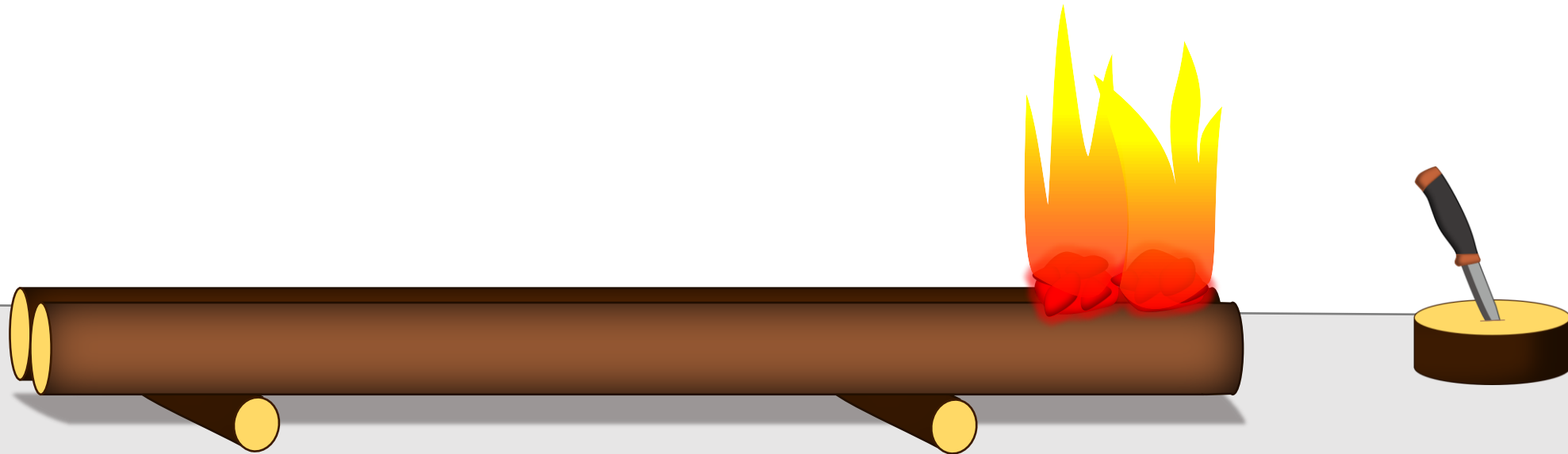
- To build fire on deep snow:
 - Create platform of green and/or larger logs
 - Ideally add a layer of rocks or dirt over logs
 - Build fire over platform
 - A platform made from large green wood should “float” over snow



Surviving the Cold

Cold Weather and Fire – Fire on Snow – Double Log Raft

- Another way to insulate fire from ground/snow
- As/if you burn through logs, move fire over unburned logs
- Logs can also be used as table, chair or even a bed

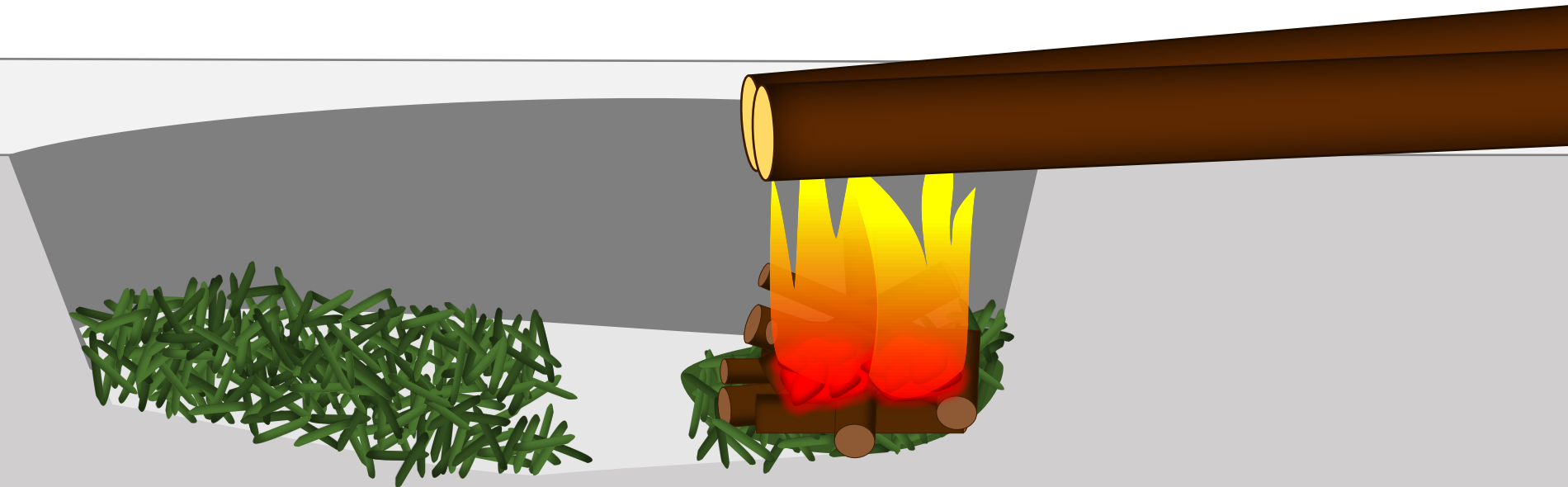


Surviving the Cold

Cold Weather and Fire – Fire on Snow – Siberian Log Fire

Hasty shelter

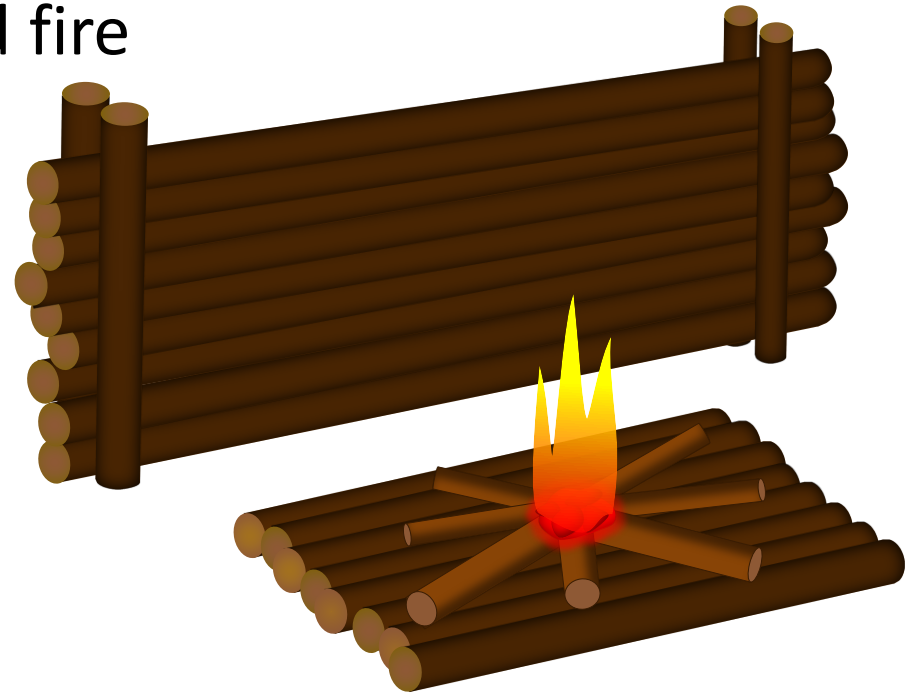
- Allows for reprise from wind
- Can be made without tools



Surviving the Cold

Cold Weather and Fire – Fire on Snow

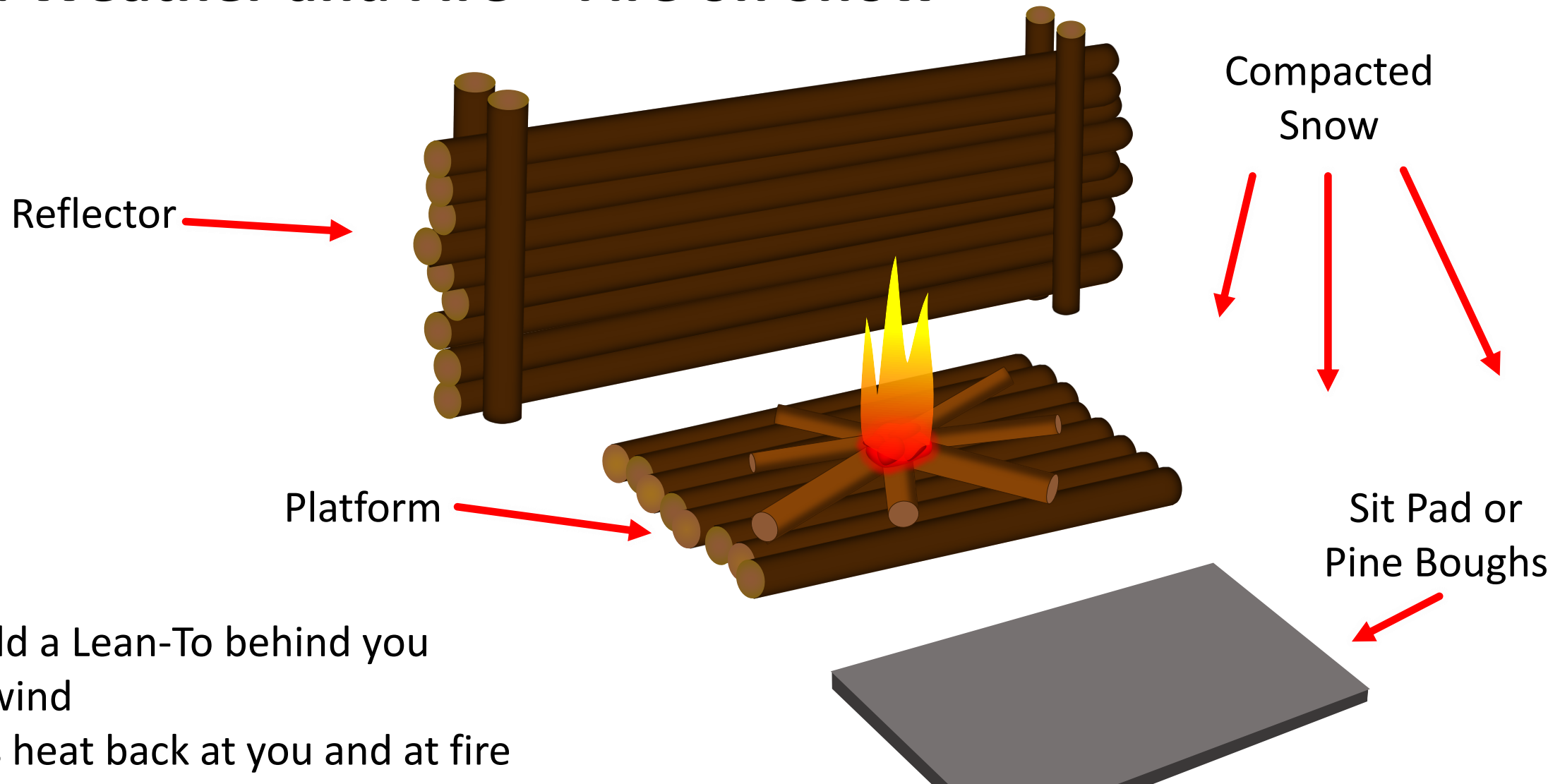
- To build fire on snow:
 - Ideally build a reflective wall behind fire
 - This reflects heat back at you and fire
 - Protects fire from wind



- Avoid building fire under tree limbs with snow on them
 - Clump of snow can fall on fire and extinguish it

Surviving the Cold

Cold Weather and Fire – Fire on Snow

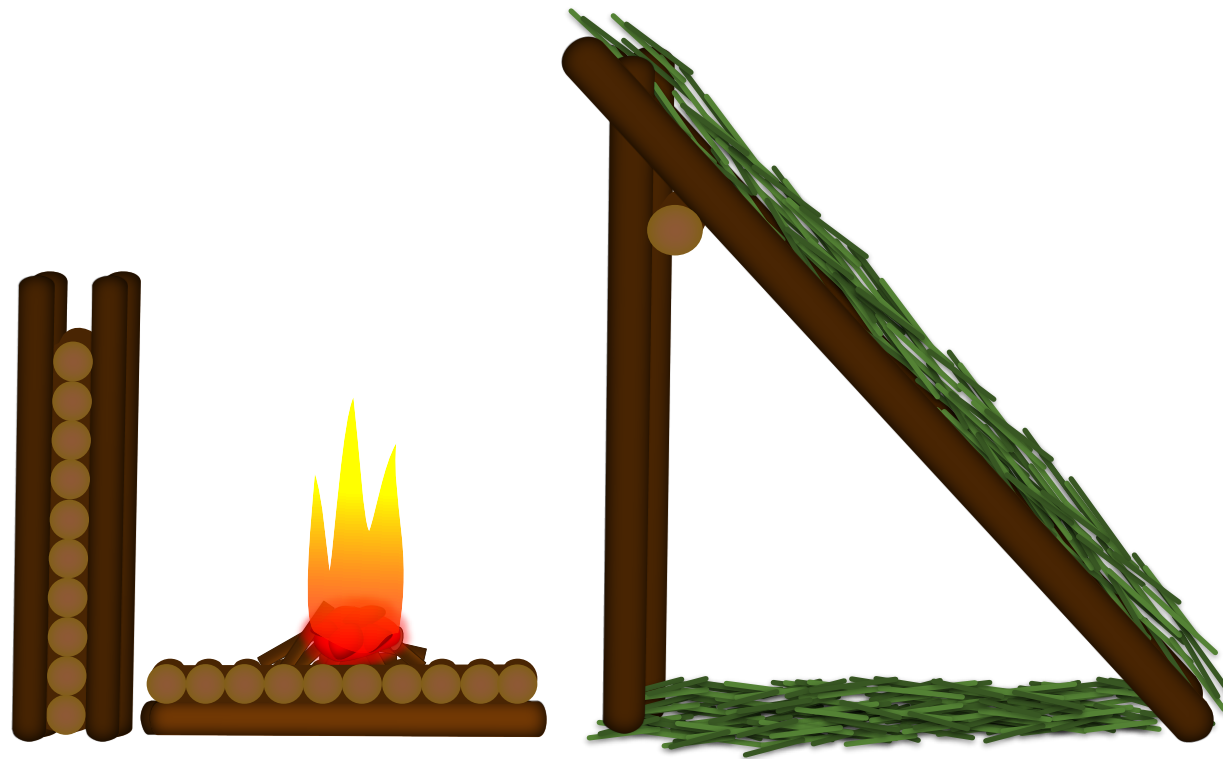


Ideally build a Lean-To behind you

- Blocks wind
- Reflects heat back at you and at fire

Surviving the Cold

Cold Weather and Fire – Fire on Snow



Heat
Reflector

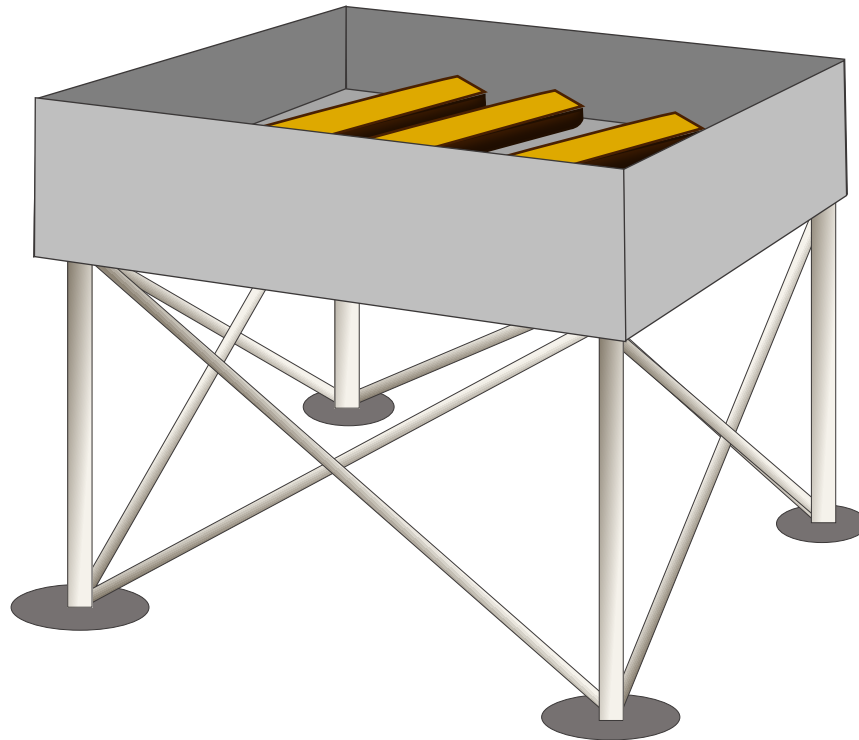
Fire
Platform

Lean To
Shelter

Surviving the Cold

Cold Weather and Fire – Fire on Snow – Fire Box

- Insulated platform can be used over or set in snow
 - Insulated bottom of platform with wood or other insulator
 - Or use legs to raise platform high enough to reduce/prevent melt



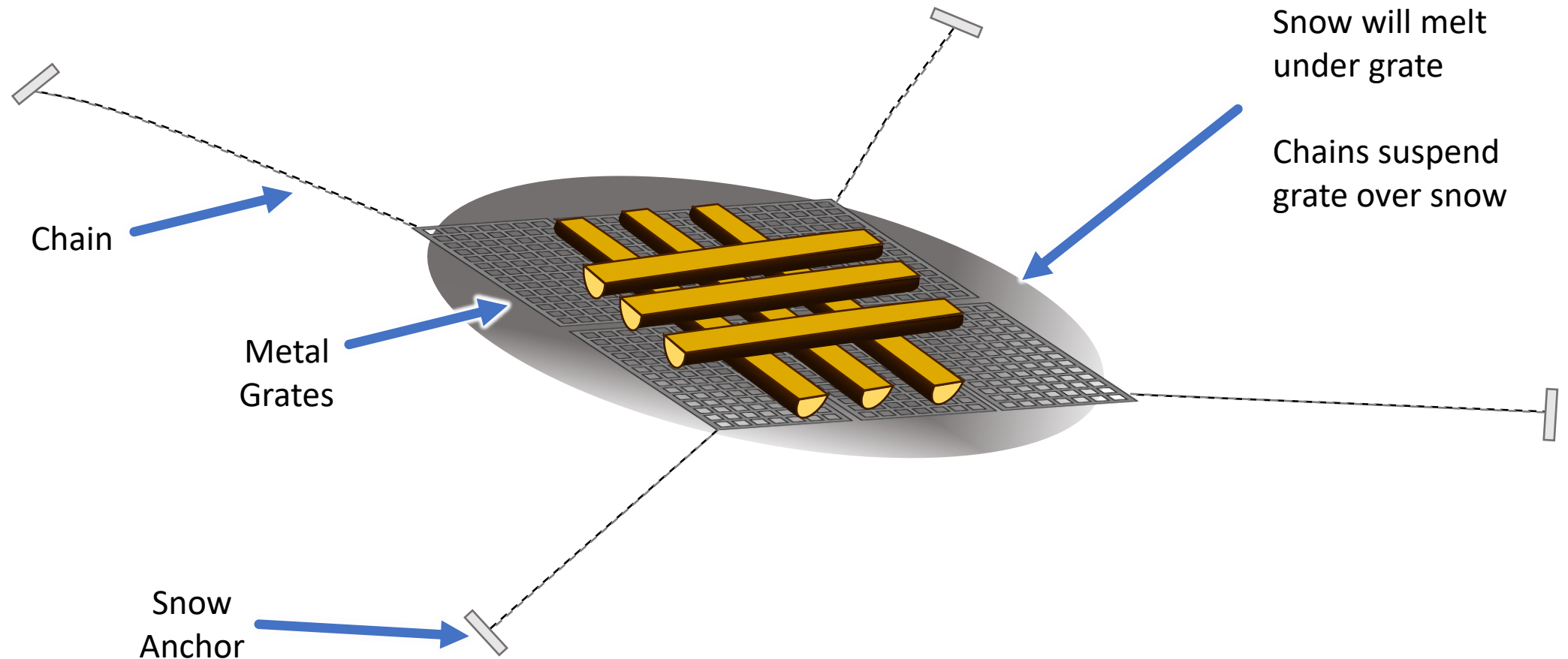
Platform can be:

- Packed in
- Fabricated from vehicle/aircraft parts or post apocalyptic material

Surviving the Cold

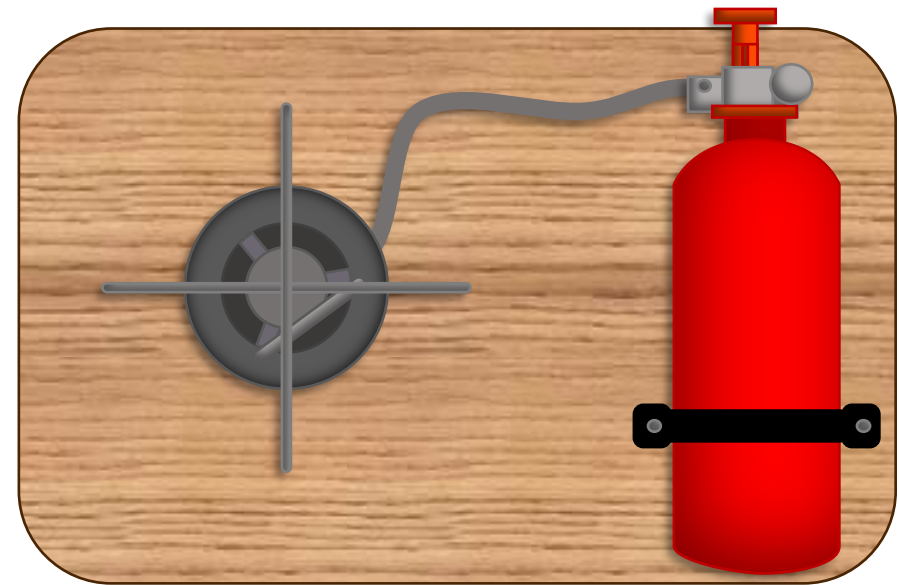
Cold Weather and Fire – Fire on Snow – Floating Fire

- A Suspended Platform such as Swedish Eldgaller Brassa På



Surviving the Cold

Cold Weather Stoves



Surviving the Cold

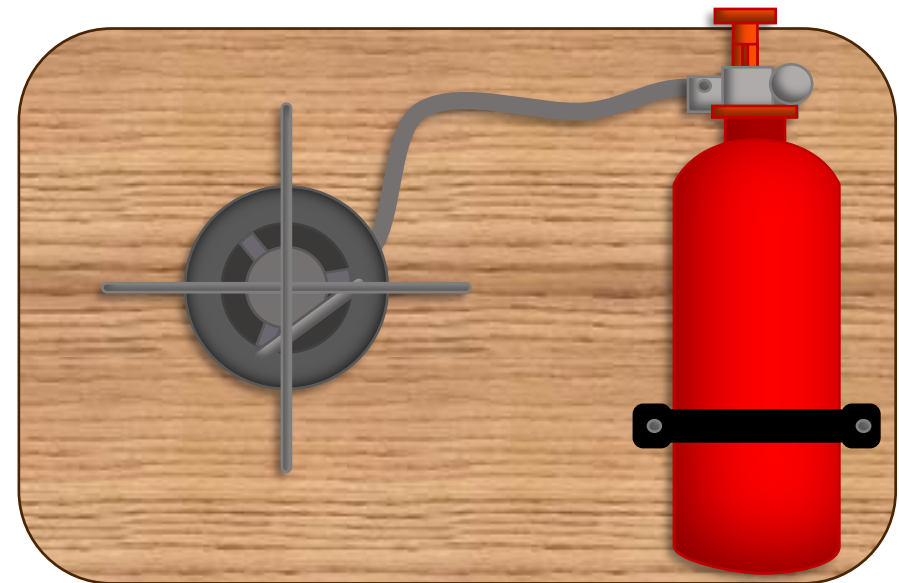
Cold Weather Stoves

- In the cold, wood and other natural fuels may be impossible to find
- In the cold, a stove is a vital piece of equipment
 - Required to turn snow and ice into life saving water
 - 0.18-0.25L of white gas per person per day
 - Without a working stove, you will die in certain cold environments

Surviving the Cold

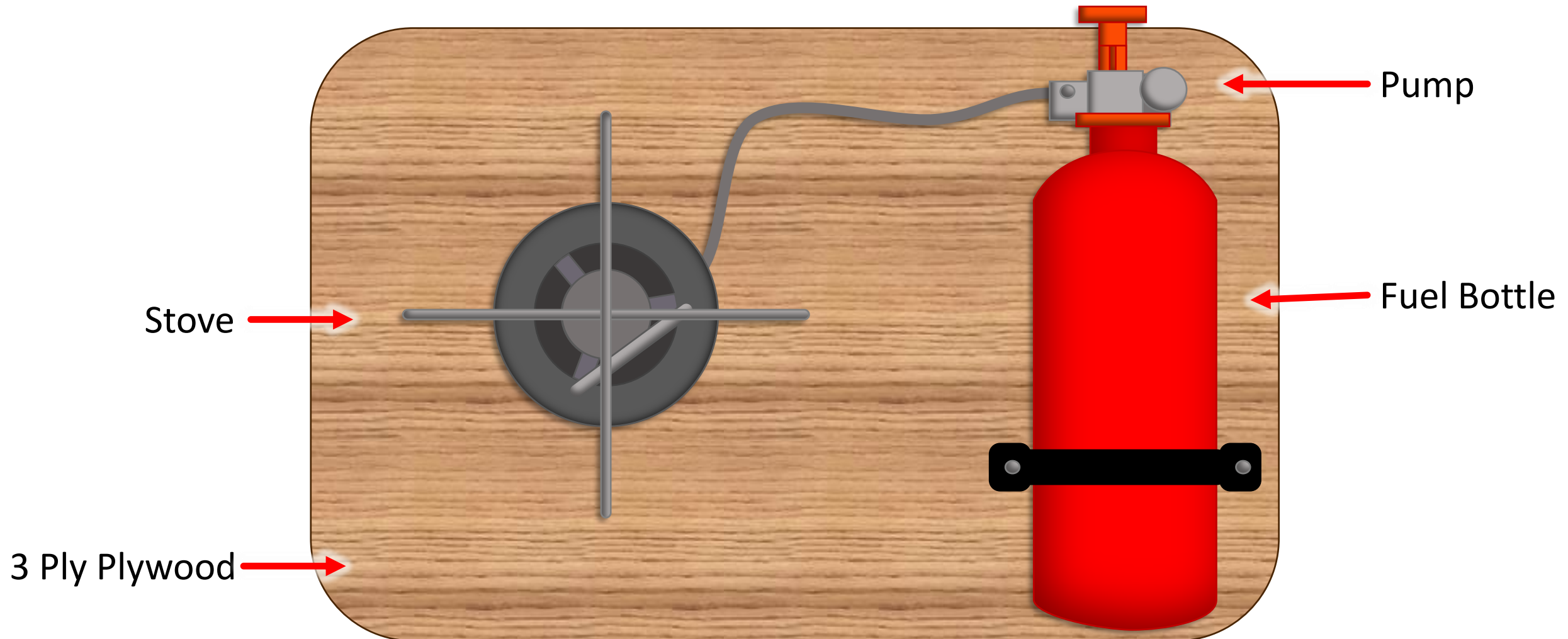
Cold Weather Stoves – Cooking on Snow – Stove Board

- If you are using a stove on snow, your stove will melt the snow below it
- You should place a platform under your stove
 - Thin sheet of plywood works fine
 - You can build a platform from wood or rocks found in your area
 - Cardboard wrapped in foil
 - Closed cell foam wrapped in foil
 - Carbon felt
 - Something wrapped in duct tape
 - Shovel
 - Old license plate
 - Snow Saw or machete can work
- Note – metal bases can still melt snow, sink and later freeze solid



Surviving the Cold

Cold Weather Stoves – Cooking on Snow – Stove Board



Surviving the Cold

Cold Weather Stoves – Stove Windscreens

- **Windscreens** are vital in cold conditions
 - Insulates heat in stove
 - Reduces fuel consumption
 - Reduces risk of blowouts from wind
- Note – Tight windscreens around stoves that sit on top of their fuel compartment (such as most gas stoves) can cause the fuel tank to overheat and subsequently **EXPLODE!**
- Note - that big pans reflect heat back down at the stove. If your fuel canister is under your pan, it can overheat and **EXPLODE!**

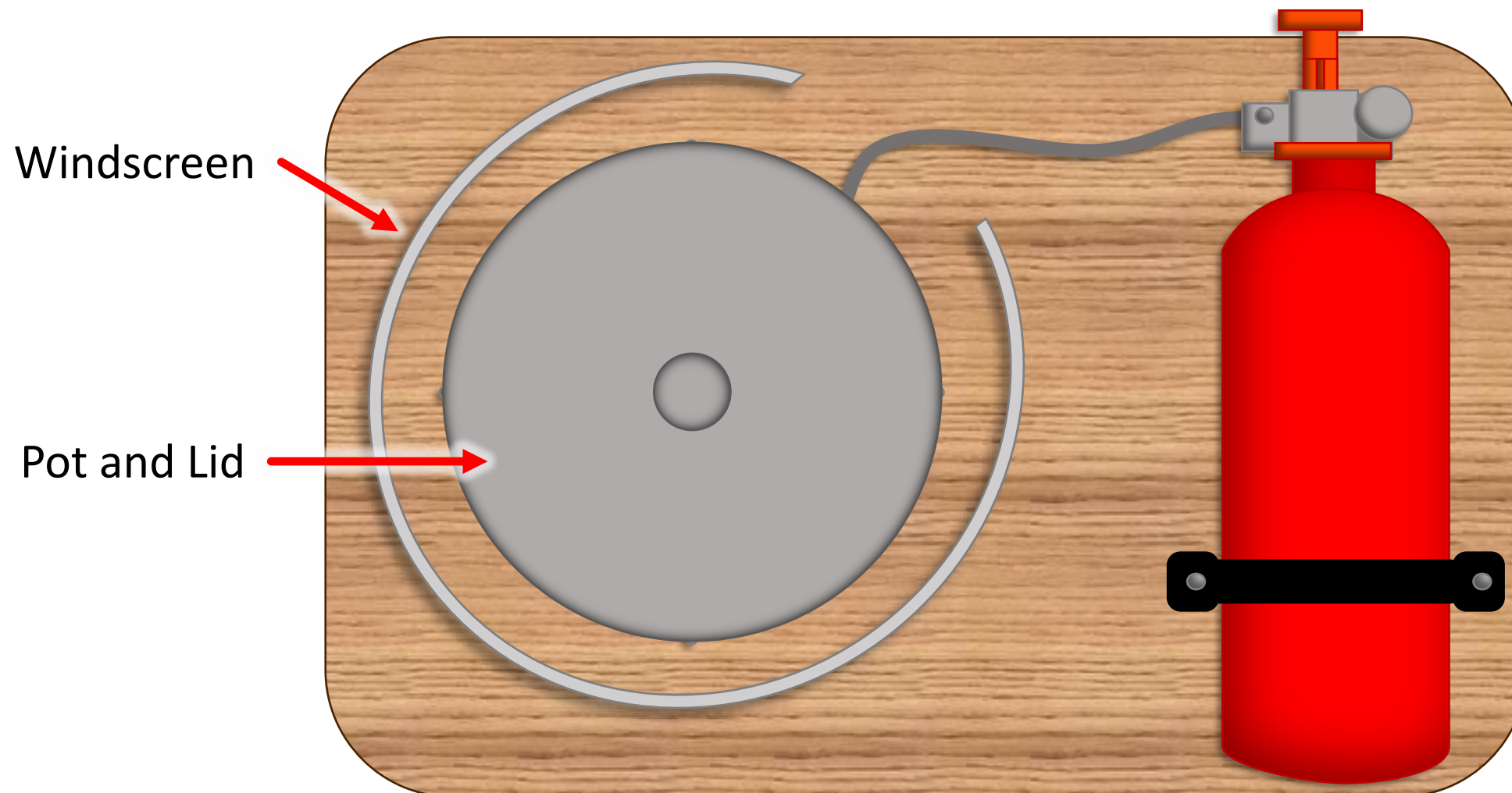
Surviving the Cold

Cold Weather Stoves – Pot Lids

- **Pot Lid** is vital for cooking in cold weather
 - Significantly reduces heat loss
 - Reduces amount of fuel needed to heat or cook
 - Decreases cook and melt times



Surviving the Cold



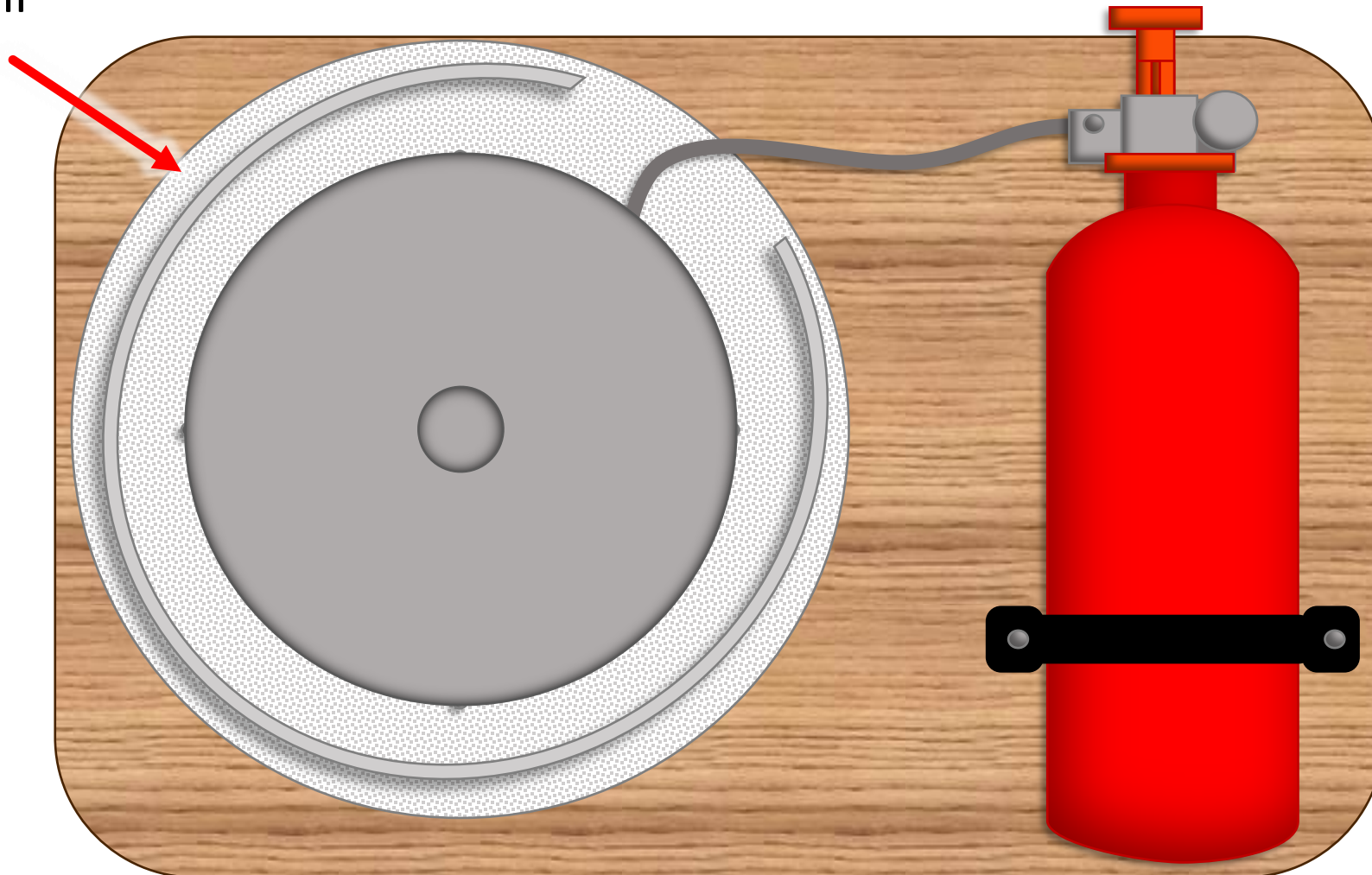
Surviving the Cold

Cold Weather Stoves – Ground Reflector

- A **Ground Reflector** reflects heat back up at pot
 - Helps a little
 - Protects ground a little

Surviving the Cold

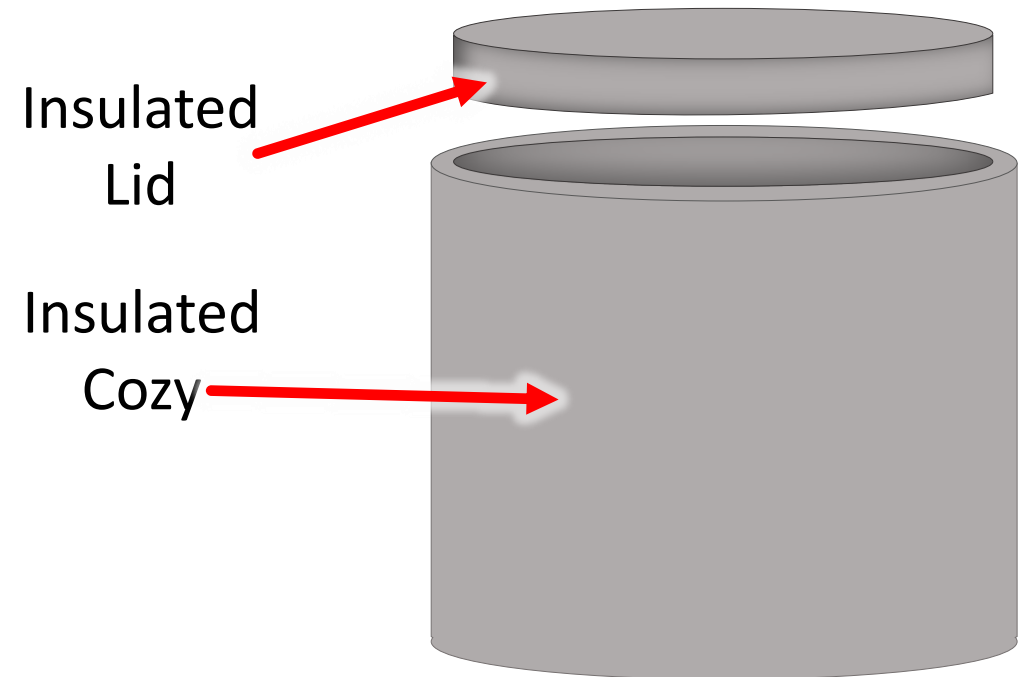
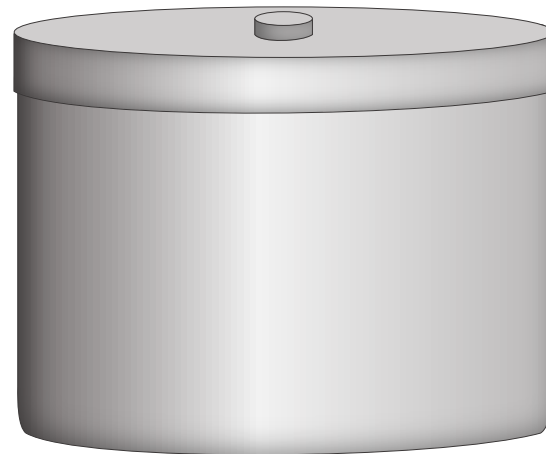
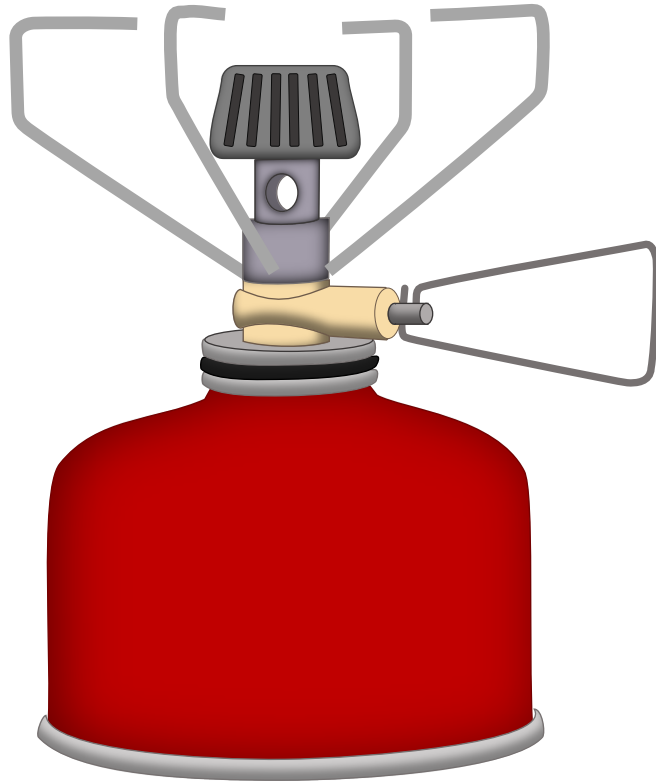
Aluminum Reflector
Sheet or Foil



Surviving the Cold

Cold Weather Stoves – Pot Cozy

- An Insulated Pot Cozy will keep pot contents warm and slows cooling
 - Works somewhat like a Dutch oven
 - Contents continue to cook/simmer after stove is put out



Surviving the Cold

Cold Weather Stoves – Tents and Snow Shelters

- All Stoves produce carbon monoxide
- Unintentional carbon monoxide (CO) poisoning causes approximately 2100 deaths in the United States each year
- Stoves should **NOT** be used in enclosed spaces, especially:
 - Tents
 - Snow Shelters such as
 - Snow Caves
 - Igloos
 - Snow Trenches
 - Snow Houses

Surviving the Cold

Cold Weather Stoves – Tents and Snow Shelters

- Liquid fueled stoves should **NOT** be used in tents
- Serious fire risk
 - Spill/Leak hazard – some pumps leak
 - Fuel leaking during stove operation = FIRE!
 - Liquid Petrol Stoves Flare UP!
 - Unexpected bursts of flames from stove
 - Can easily catch tent and any fabric nearby on fire

Surviving the Cold

Cold Weather Stoves – Tents and Snow Shelters

**Do NOT allow Scouts to use Stoves
in Tents or Shelters!**

Surviving the Cold

Cold Weather Stoves – Nitty Gritty

- **Wood Stoves**
 - Great if you have available fuel
- **Liquid Petroleum Stoves**
 - Most practical for extreme cold weather
- **Gas Stoves**
 - Requires special care at freezing temps (except propane)
- **Alcohol Stoves**
 - Poor option for heavy duty cold weather use
- **Chemical Fuel Tabs**
 - Use as fire starters
- **Candles**
 - Great for use as candles

Surviving the Cold

Cold Weather Stoves – Fuels – Natural

Fuel	Notes
Wood	Variable availability May have plenty May have none May not be allowed to harvest In an emergency, you can cut up trees Fuel can be packed in, but will be heavy
Peat	May be available if you know where to look Ireland
Other biofuels	Grasses, pine needles, cow patties, etc.

Surviving the Cold

Cold Weather Stoves – Fuels – Petrol

Fuel	Notes
Petrol Fuels	<p>Risk of contact frostbite if cold fuel touches skin</p> <p>Risk of flareups – extremely dangerous in tents!</p> <p>Great heat to weight ratio</p> <p>Usually requires a special stove with generator tube</p> <p>Stoves tend to clog over time and require maintenance</p> <p>Difficult to adjust output compared to gas</p> <p>Fuels smell</p> <p>Spilled fuel can damage gear and poison food</p> <p>Sounds like a roaring rocket (pro or con)</p>

Surviving the Cold

Cold Weather Stoves – Fuels – Petrol

Fuel	Notes
White Gas/ Coleman Fuel	Cheap and available in many big stores Burns relatively clean for a petrol fuel
Kerosene	Available worldwide Smells Smoky
Gasoline	Easy to find worldwide Explosive Contains toxic additives – do not inhale burned fumes Not recommended for stove use

Surviving the Cold

Cold Weather Stoves – Fuels – Gas

Fuel	Notes
Gas Fuels	<p>Stoves are very easy to operate</p> <p>Can adjust output from minimal flame to blowtorch</p> <p>This allows for easy snow melt and simmering</p> <p>No flareups</p> <p>Affected by cold temperatures</p> <ul style="list-style-type: none">• Fuel is stored in liquified state in canister• Must vaporize (boil) to pressurize canister + feed stove• As liquified gas vaporizes, it becomes colder• If it gets too cold, it will no longer feed the stove

Surviving the Cold

Cold Weather Stoves – Fuels – Gas

Fuel	Notes
Gas Fuels	<p>Gas fuel needs to be stored in special canisters</p> <ul style="list-style-type: none">• Butane canisters can be expensive• Special blends of gas are even more expensive• Difficult to carry, “just enough” fuel<ul style="list-style-type: none">○ Instead – need to round up to next canister• Propane canisters are large and heavy• Canisters produce trash<ul style="list-style-type: none">○ Refillable Propane canisters are available• Can be difficult to find Butane canisters in small towns

Surviving the Cold

Cold Weather Stoves – Fuels – Gas

Fuel	Notes
Propane	Vaporizes around -43°F (-40°C) at sea level Excellent cold weather fuel Great heat per weight ratio Canisters are large and heavy Stoves also tend to be large and heavy
Butane	Vaporizes around 31°F (-0.5°C) at sea level Use in cold weather requires special techniques Will completely fail to work in low temperatures
Isobutane	Vaporizes around 11°F (-12°C) at sea level Much better fuel for temps around freezing level

Surviving the Cold

Cold Weather Stoves – Fuels – Alcohol

Fuel	Notes
Alcohol	<p>Available in most hardware stores and some gas stations</p> <ul style="list-style-type: none">• Denatured alcohol – used as paint thinner• HEET antifreeze – yellow bottle is methanol• Rubbing alcohol – burns dirty in most stoves <p>Poor heat output to weight ratio</p> <p>Spills aren't nasty like petrol spills – but are a fire hazard</p> <p>Used by mushers in Iditarod</p>
Canned Heat	<p>Some have alcohol suspended in mineral matrix</p> <p>Some use a wick to control burn and use poisonous fuel</p> <p>LOW heat output</p>

Surviving the Cold

Cold Weather Stoves – Fuels – Solid Chemical Fuels

Fuel	Notes
Heat Tabs Esbit Hexamine	Found only in specialty stores Ultra light weight Simple to use – don't need a stove Low heat output Can be used safely as a Firestarter Smells like fish Blackens pots
Trioxane	Used by US military Don't touch with bare hands and then eat food Not as cheap as they used to be

Surviving the Cold

Cold Weather Stoves – Fuels – Candles

Fuel	Notes
Candles	Generally not used for cooking, but does melt snow Prone to blow outs if not protected Creates melted wax – spill hazard Open flame – fire hazard
Beeswax	Smells wonderful Burns longer than regular candles May attract bears?

Surviving the Cold

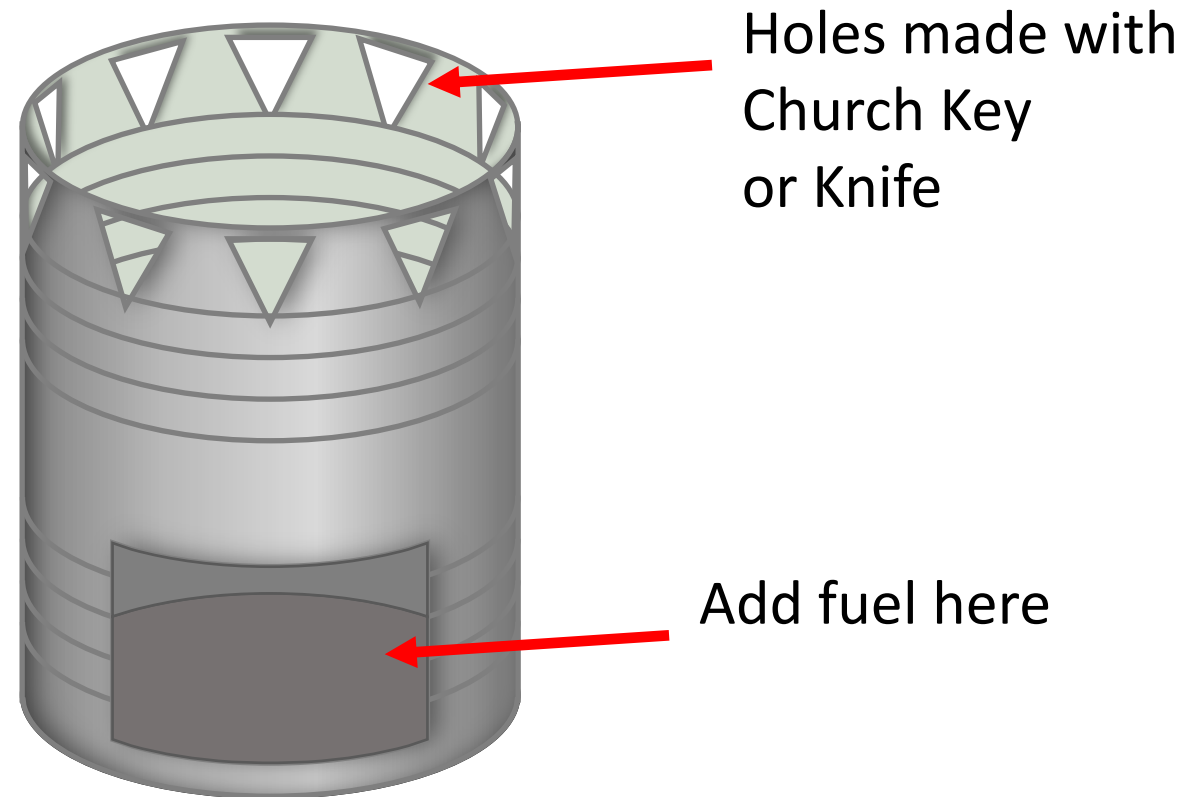
Cold Weather Stoves – Wood Stoves

- Wood stoves, small and large, increase efficiency of burning wood
 - Walls insulate and reflect heat back into fire to keep fuel hot
 - Protects fire from wind
 - Allows for better air flow
 - Allows for better gasification
 - Better ability to burn wet fuels
 - Uses much less fuel
 - Much better focus of heat
 - Faster and easier cooking

Surviving the Cold

Cold Weather Stoves – Wood Stoves

- Wood stoves can be as simple as a coffee can with holes in it
- More sophisticated stoves are of course available

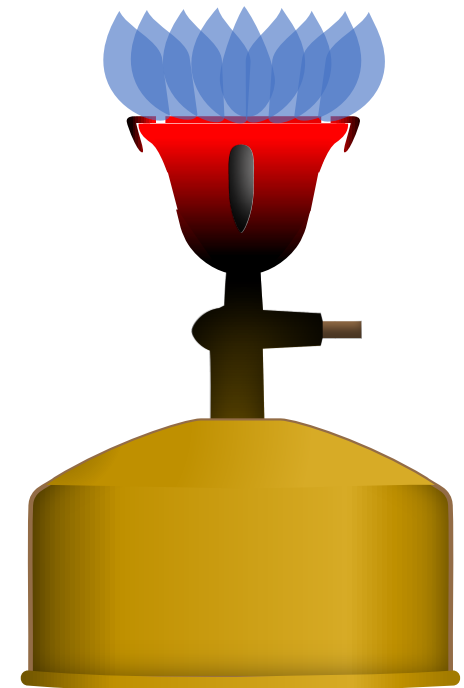


Hobo Stove

Surviving the Cold

Cold Weather Stoves – Liquid Petrol Stoves

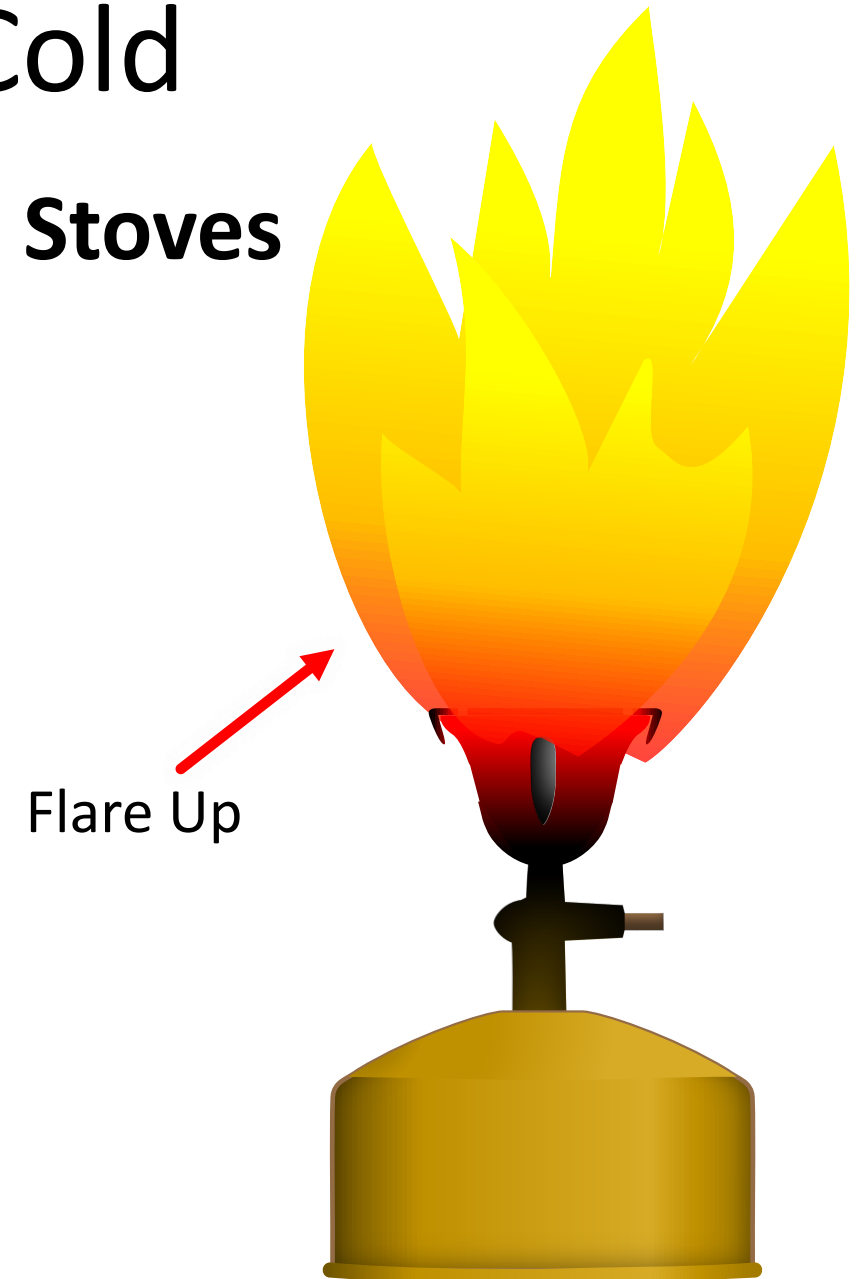
- When possible, only use White Gas
 - Other fuels cause increased clogging and flareups
- Don't use Gasoline
 - Explosive
 - Full of toxic additives
 - Leads to clogging and requires more maintenance



Surviving the Cold

Cold Weather Stoves – Liquid Petrol Stoves

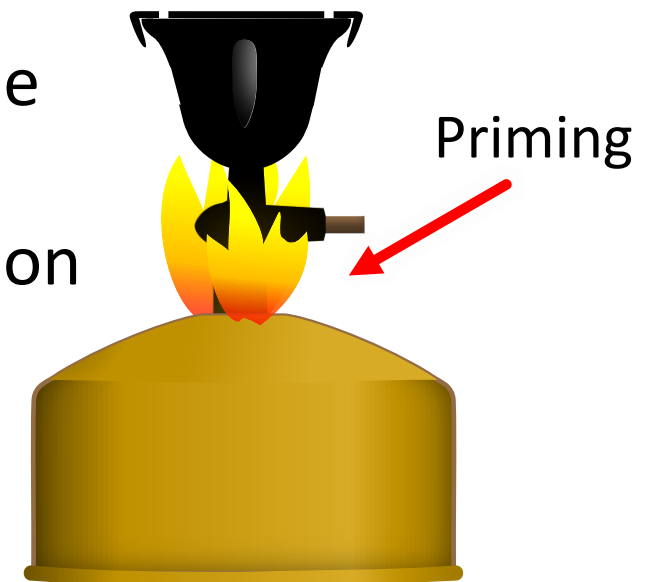
- These tend to flare up
 - Big eyebrow singeing flames
 - Especially as you start up the stove
 - If this happens in a tent, your tent can instantly catch fire
 - **Don't use Stove in Tent**



Surviving the Cold

Cold Weather Stoves – Liquid Petrol Stoves

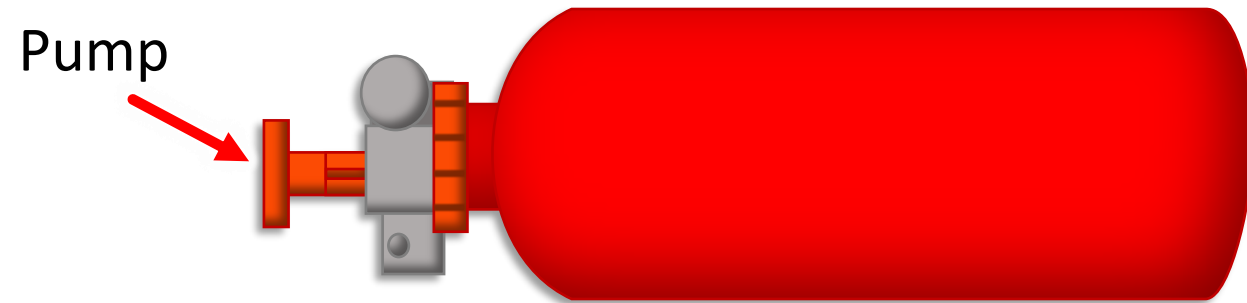
- Petrol stoves need to be primed
 - Priming preheats stove for use
 - Loosen valve to leak out some petrol to light or
 - Use priming paste or
 - Use alcohol – burns cleaner and doesn't stink
 - Light the priming fuel to heat up the generator tube
 - Heat vaporizes (boils) liquid fuel in generator tube
 - It needs to be super heated for proper stove function



Surviving the Cold

Cold Weather Stoves – Liquid Petrol Stoves

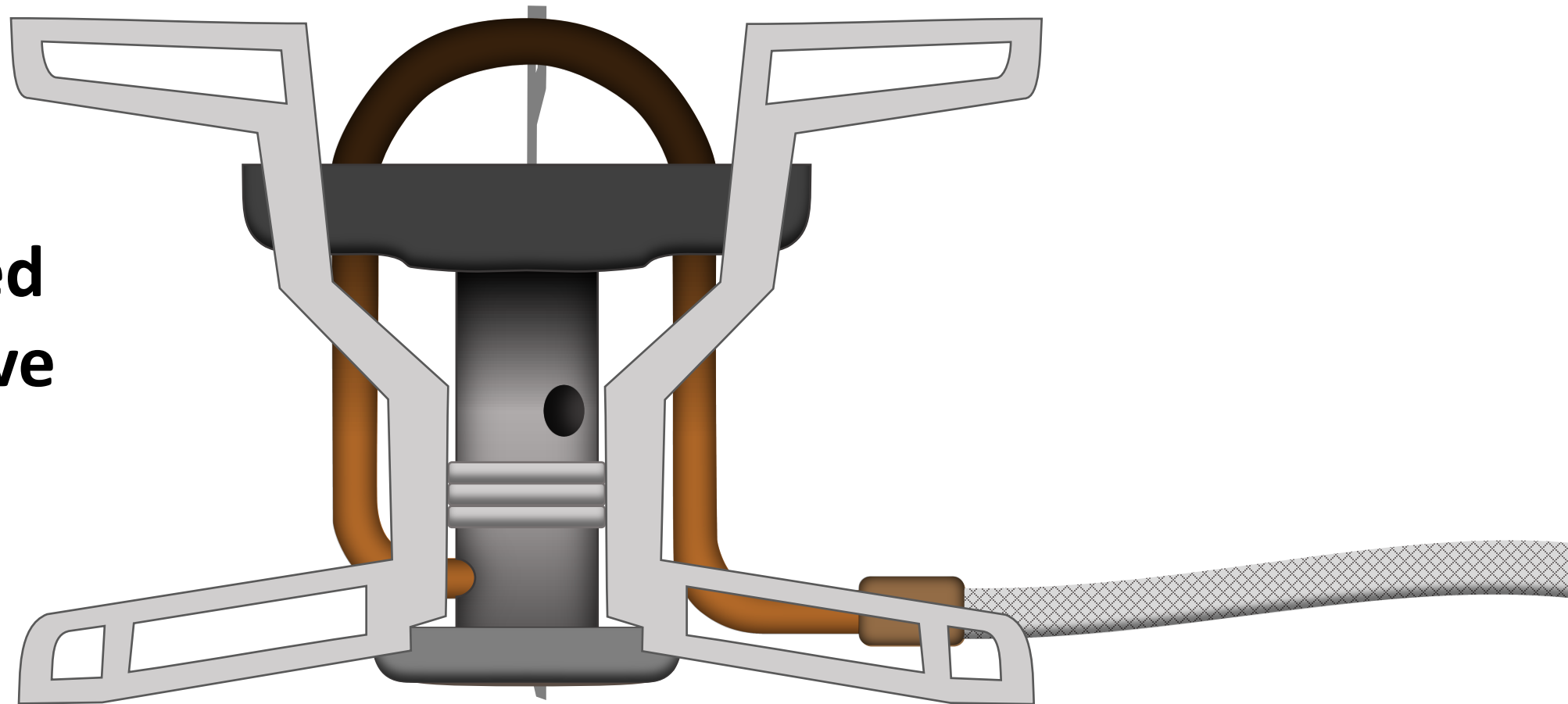
- Most petrol stoves need to be pressurized
 - Examples
 - MSR WhisperLite
 - MSR Dragonfly
 - MSR XGK
 - Primus OmniFuel
 - Optimus Polaris Optifuel
 - Pumping pressurizes the fuel bottle
 - This forces liquid fuel in tank to move to generator tube and then jet
 - Fuel in generator tube is super heated
 - Vaporized fuel is shot through a jet into plate or other atomizer
 - Hot gasified fuel mixes with air and ignites



Food

Cold Weather Stoves – Liquid Petrol Stoves

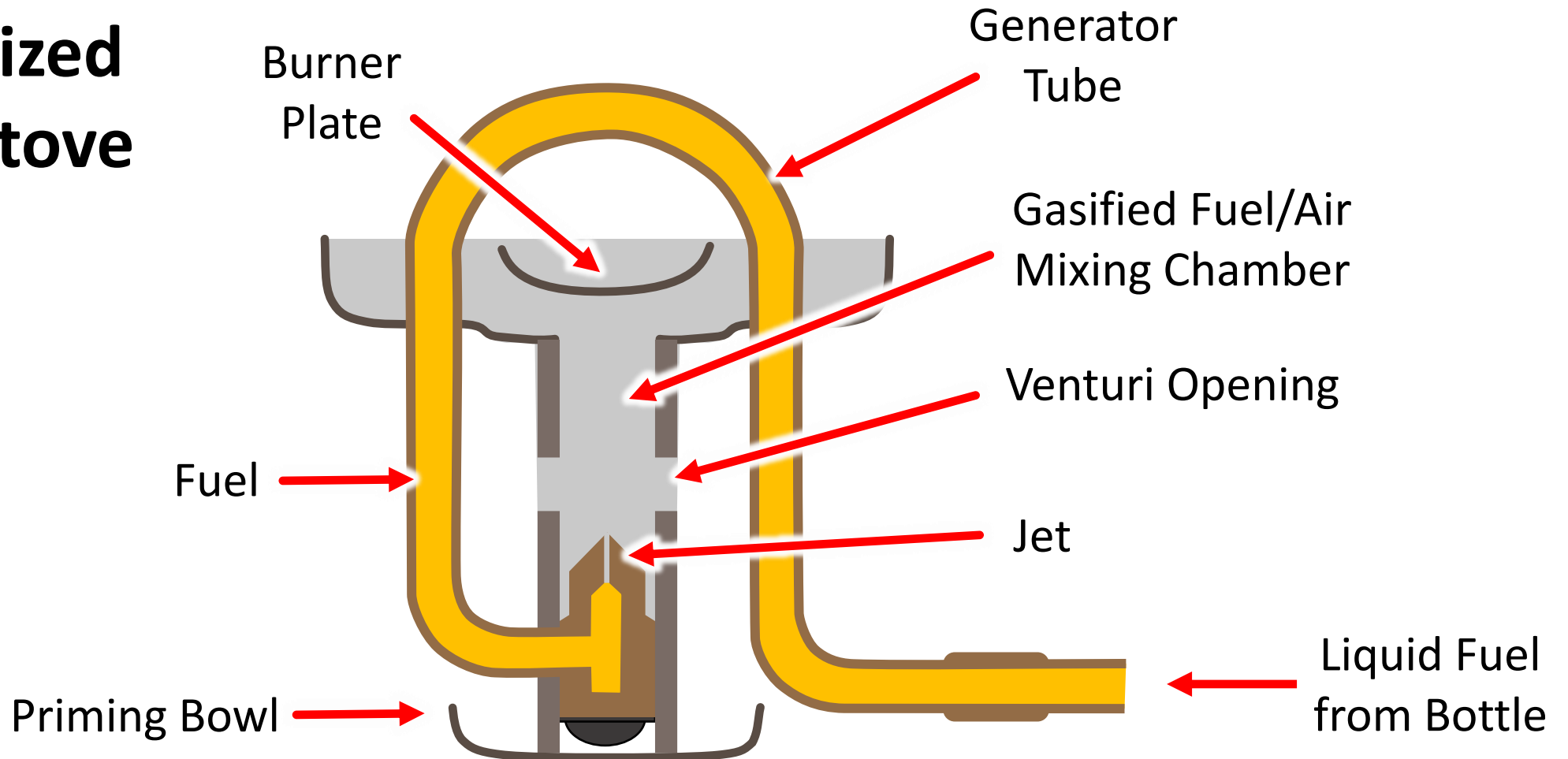
**Pressurized
Petrol Stove**



Surviving the Cold

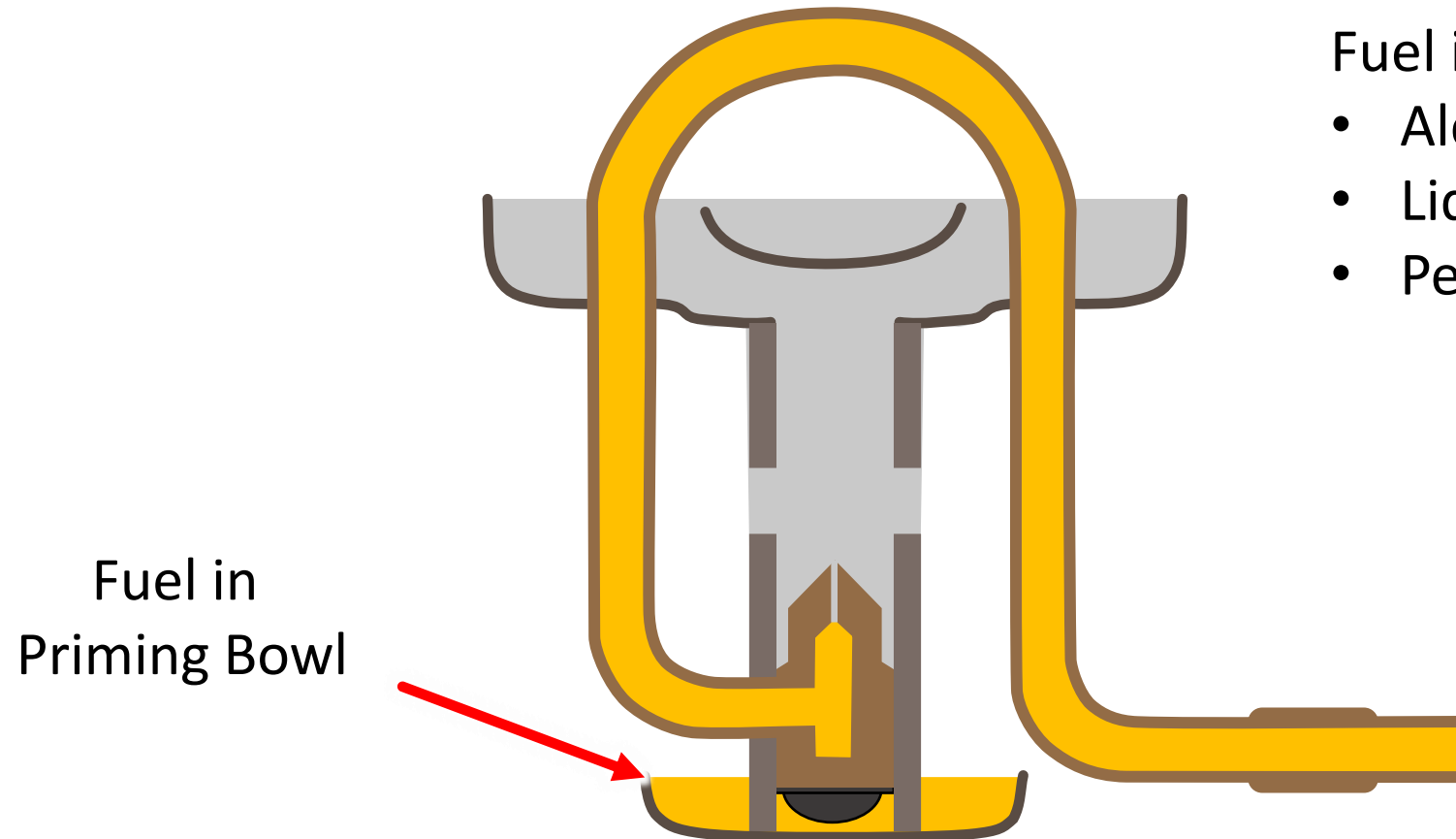
Cold Weather Stoves – Liquid Petrol Stoves - Anatomy

Pressurized Petrol Stove



Surviving the Cold

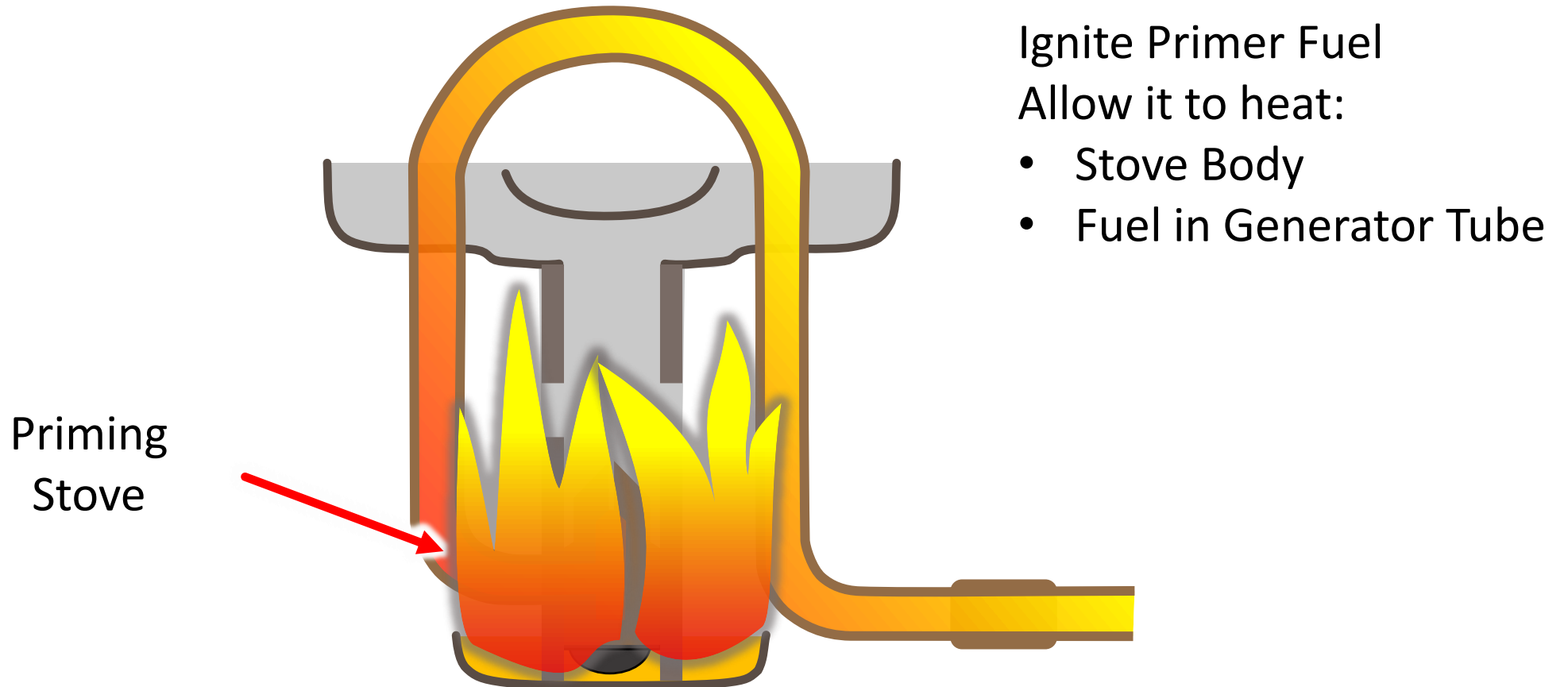
Cold Weather Stoves – Liquid Petrol Stoves - Priming



- Fuel is added to primer bowl
- Alcohol Paste
 - Liquid Alcohol or
 - Petrol Fuel leaked from jet

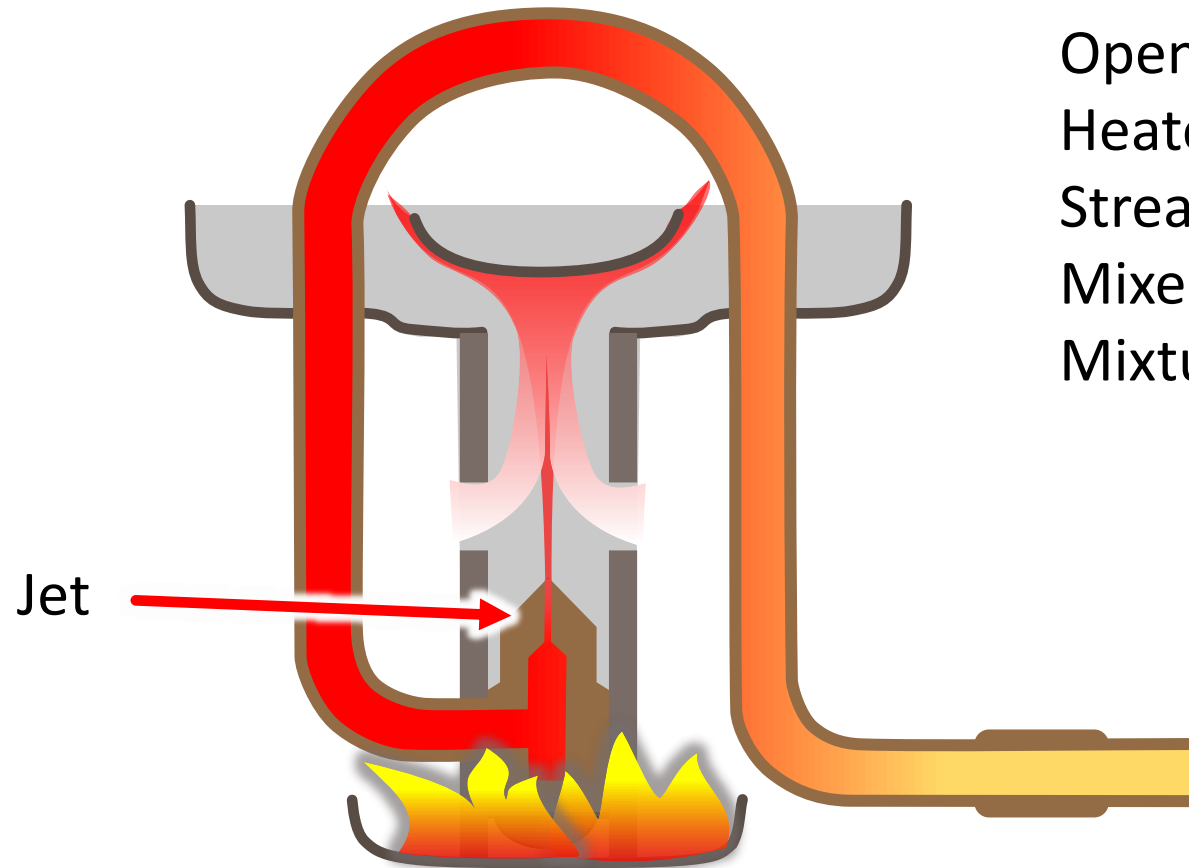
Surviving the Cold

Cold Weather Stoves – Liquid Petrol Stoves - Priming



Surviving the Cold

Cold Weather Stoves – Liquid Petrol Stoves – Operation



Open Jet

Heated fuel shoots out of jet

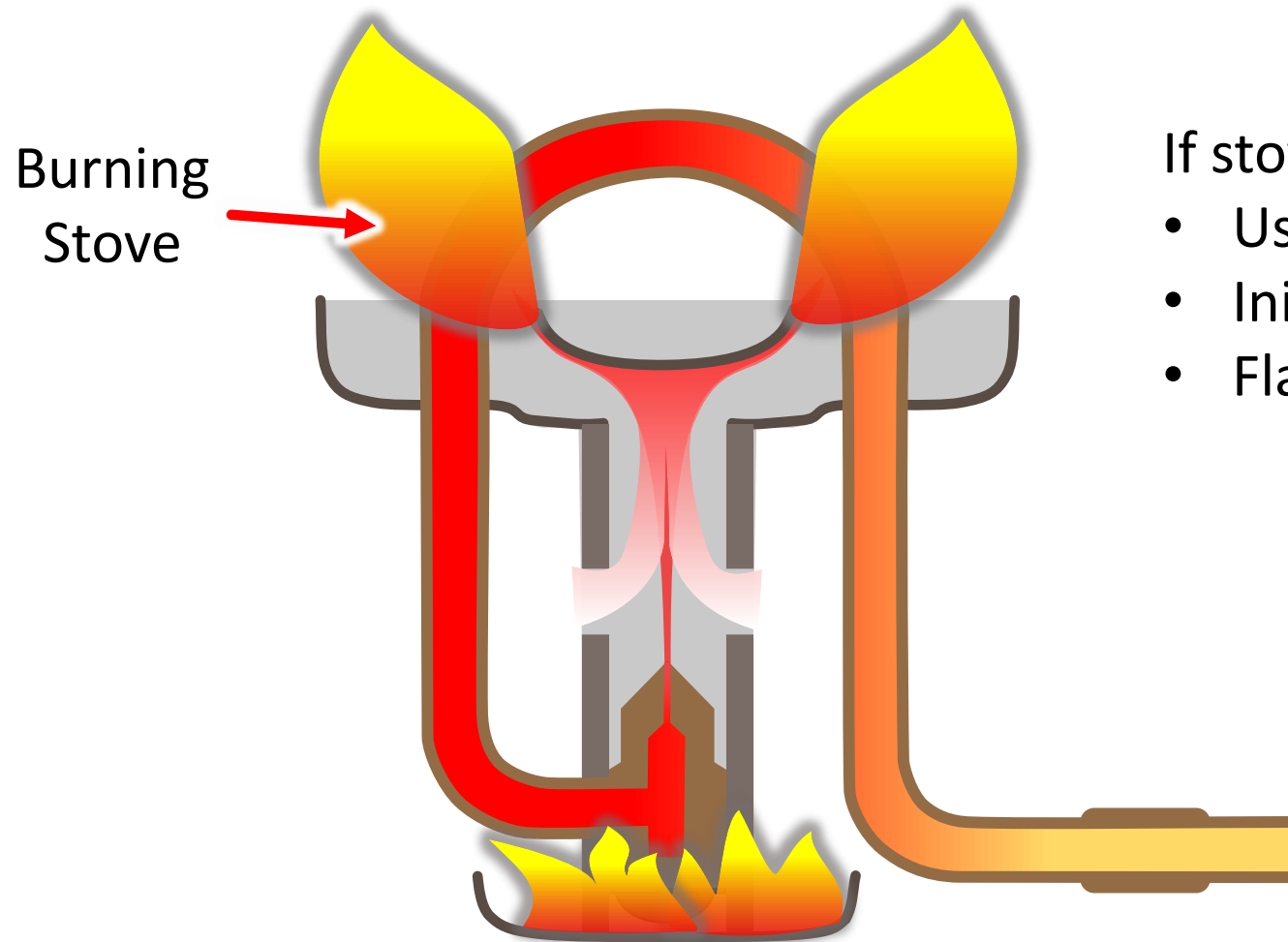
Stream of fuel draws in air

Mixed fuel/air hit burner plate

Mixture is atomized

Surviving the Cold

Cold Weather Stoves – Liquid Petrol Stoves – Operation

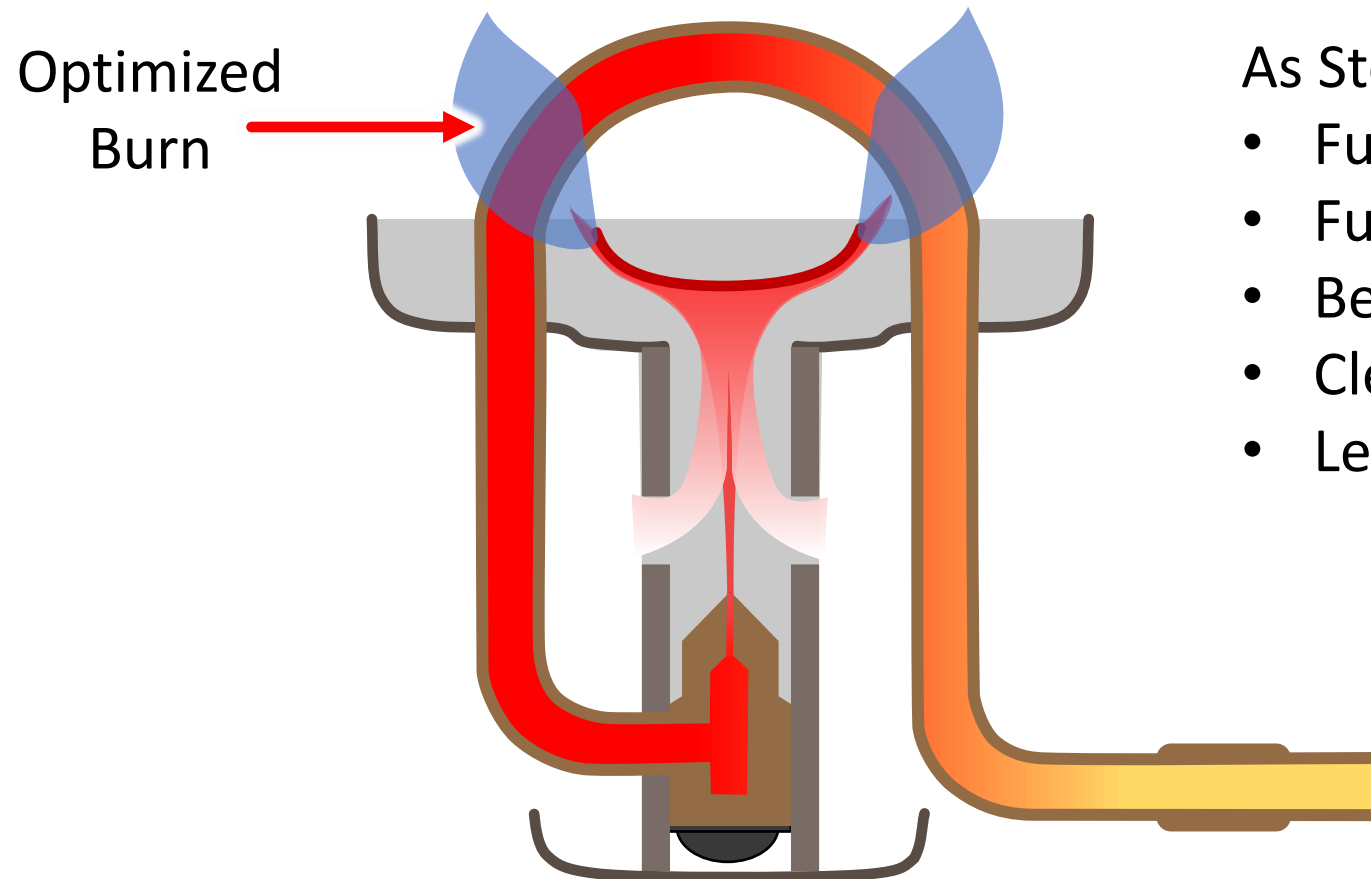


If stove doesn't self-ignite

- Use flame or spark to ignite
- Initial flame may be Yellow
- Flame may flair up a lot

Surviving the Cold

Cold Weather Stoves – Liquid Petrol Stoves – Operation

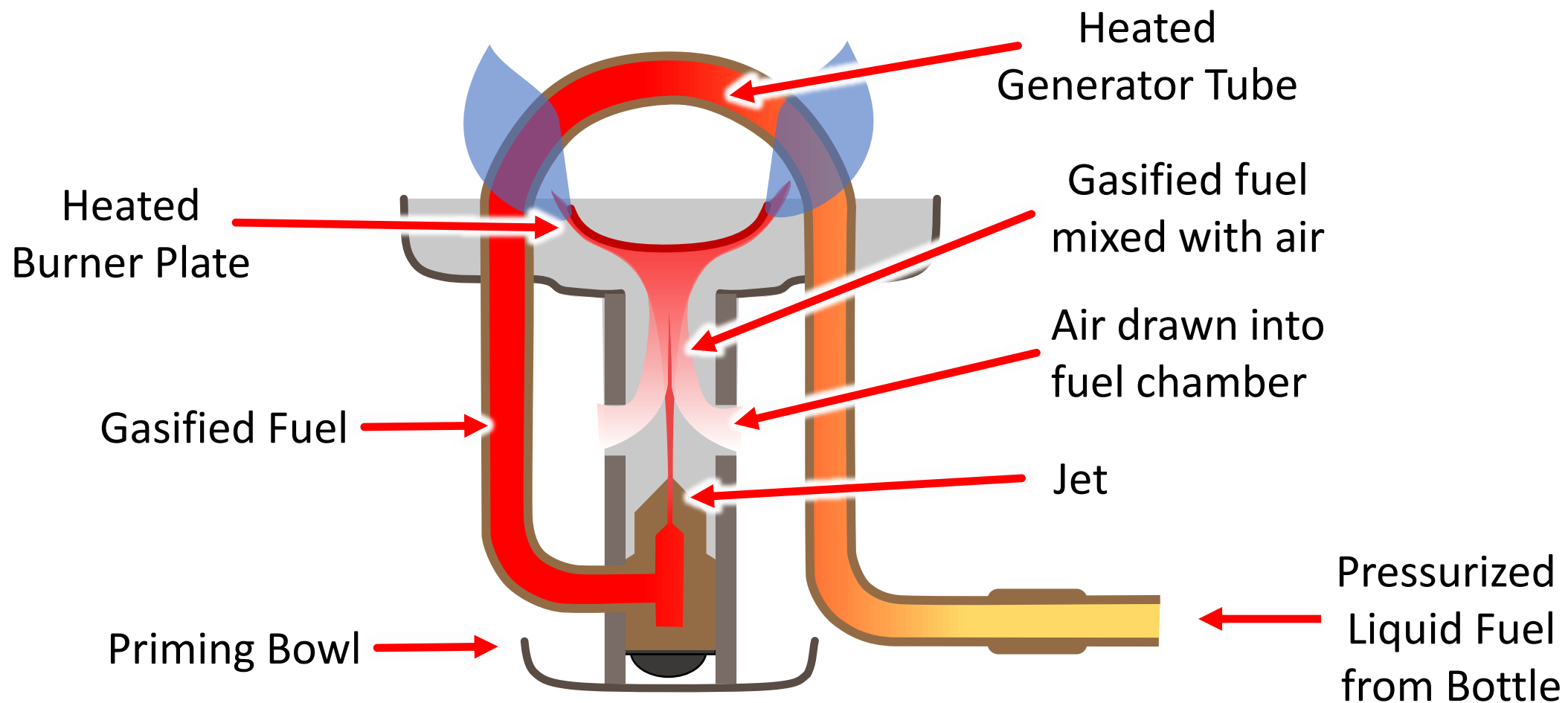


As Stove Heat up

- Fuel is heated in Tubes
- Fuel/Air mix improves
- Better atomization
- Cleaner burn
- Less flareups

Surviving the Cold

Cold Weather Stoves – Liquid Petrol Stoves - Anatomy



Surviving the Cold

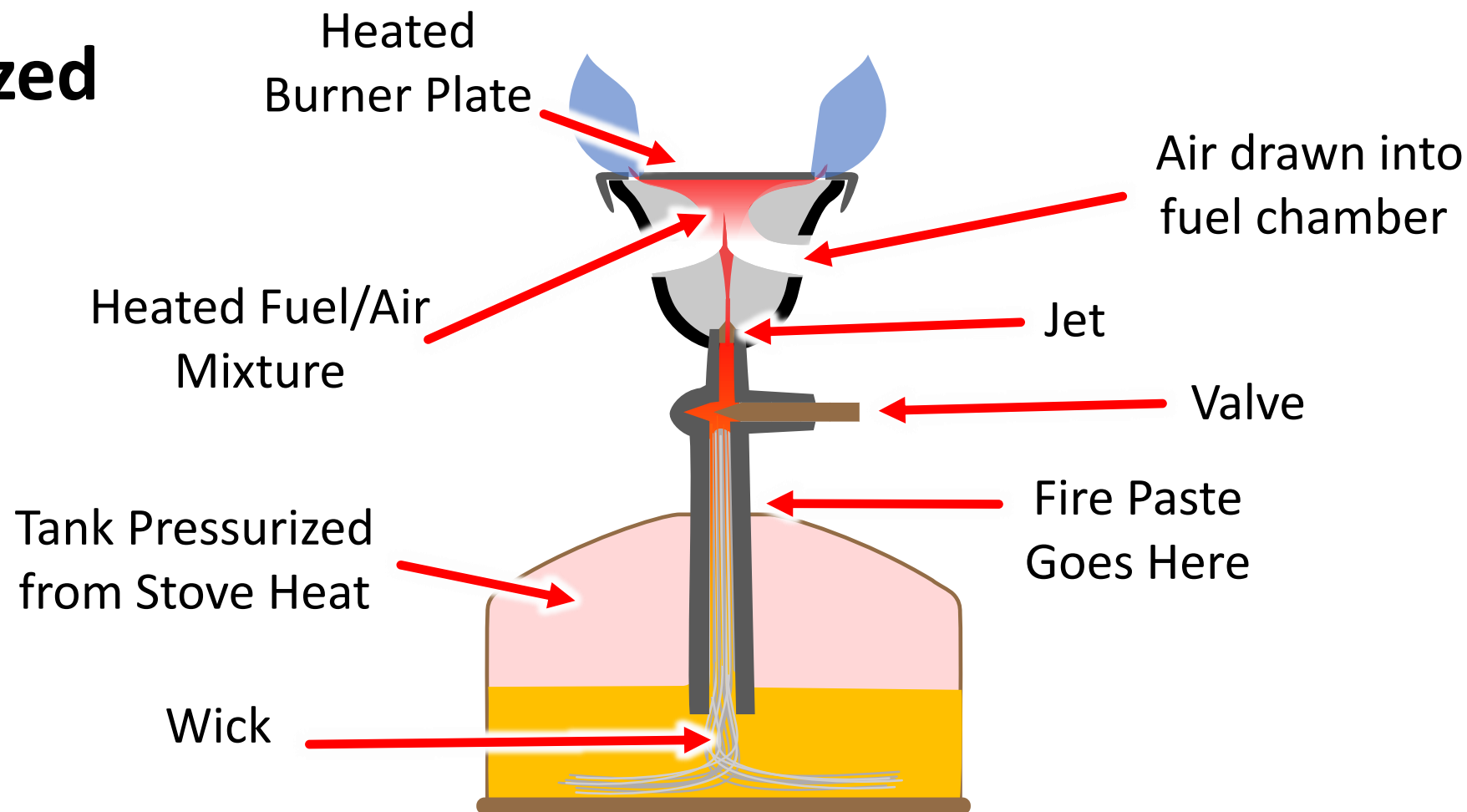
Cold Weather Stoves – Liquid Petrol Stoves

- A few old school stoves “Self Pressurize”
 - Examples
 - Optimus Svea 123 and 8R
 - Swiss Borde Kocher
 - Stove is primed, similar to pump stoves
 - Instead of using a pump to get fuel out for priming:
 - Stove may be warmed with hands to create just enough pressure to leak a small amount of priming fuel
 - NO skin to metal contact if extremely cold!
 - Priming heats up generator tube and fuel tank
 - Heated tank builds up pressure
 - Liquid fuel is forced into generator tubes

Surviving the Cold

Cold Weather Stoves – Liquid Petrol Stoves

Self-Pressurized Stove



Surviving the Cold

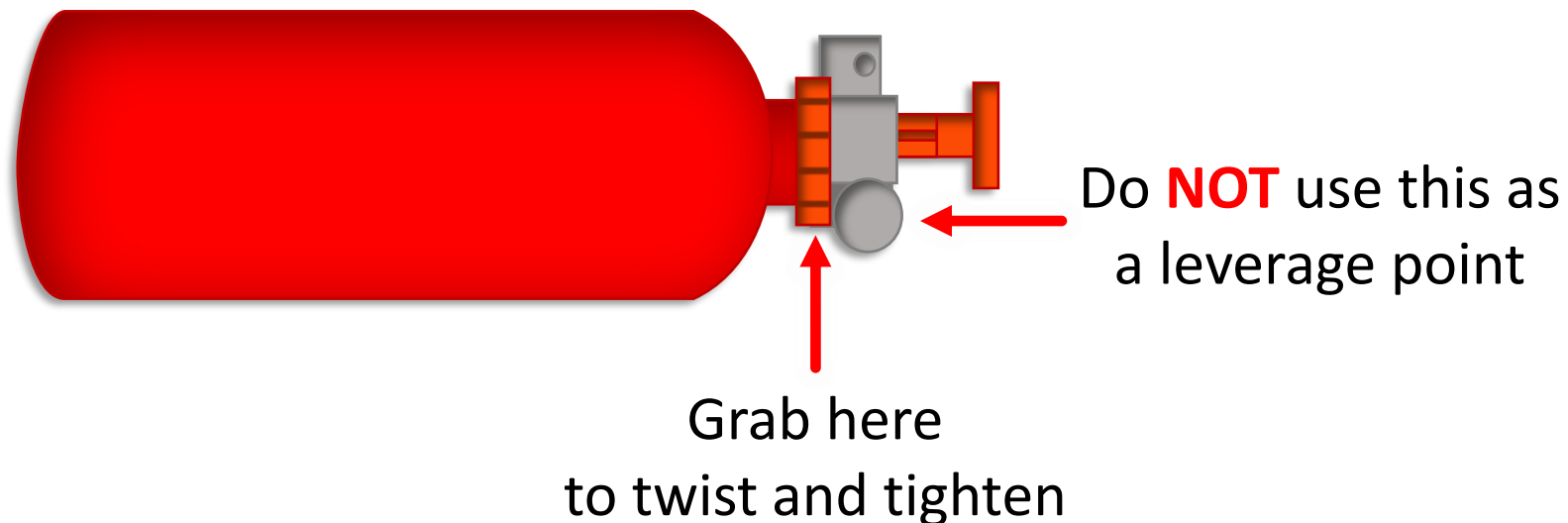
Cold Weather Stoves – Liquid Petrol Stoves Pumps

- Some pumps leak in the cold
 - O rings in pumps become less pliable in cold temperatures
 - MSR O rings made after 2000 are notorious for leaking
 - MSR makes an [Arctic Fuel Pump](#) with a cold-resistant O-ring
 - Use only below 0°C (32°F)
 - Polar explorers may carry 3 pumps
 - At least one should work without leaking
- A leaky stove gets really exciting when the leaked fuel catches on fire!
 - If you are in a tent, you'll need to throw the stove outside

Surviving the Cold

Cold Weather Stoves – Liquid Petrol Stoves Pumps

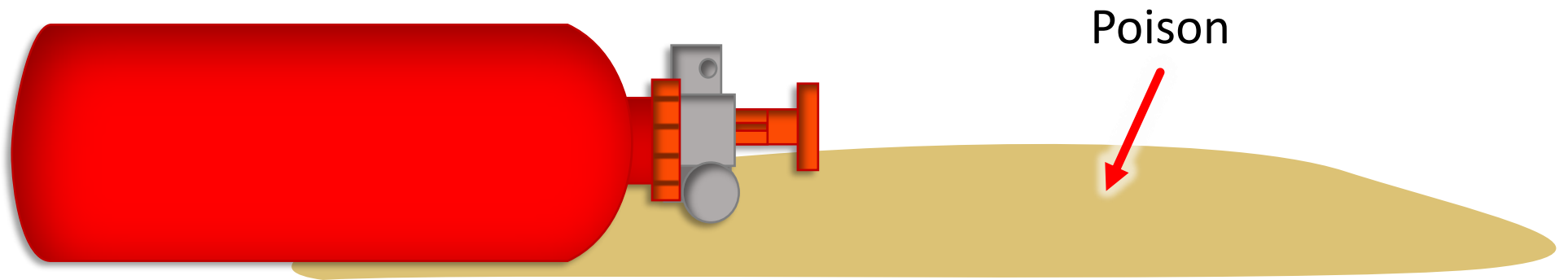
- Pumps can crack if you torque on them in the wrong place
 - Particularly a problem with older MSR pumps
 - Grabbing the On/Off Knob to twist the pump will eventually cause it to crack at base of knob/valve
 - This will cause a NASTY leak



Surviving the Cold

Cold Weather Stoves – Liquid Petrol Stoves – Food

- Store food and fuel in separate places
 - If fuel leaks on food, you will not be able to eat it
 - If fuel leaks on all of your food, you lose all of your food!



Surviving the Cold

Cold Weather Stoves – Liquid Petrol Stove Overheating

- Burner over tank stoves can overheat
 - Occurs if you wrap a windscreen too tightly around stove
 - If pressure builds up too high, the pressure relief valve will open
 - This releases hot fuel which will ignite into **FIREBALL**
 - If the pressure relief valve does NOT open, the tank will **EXPLODE**

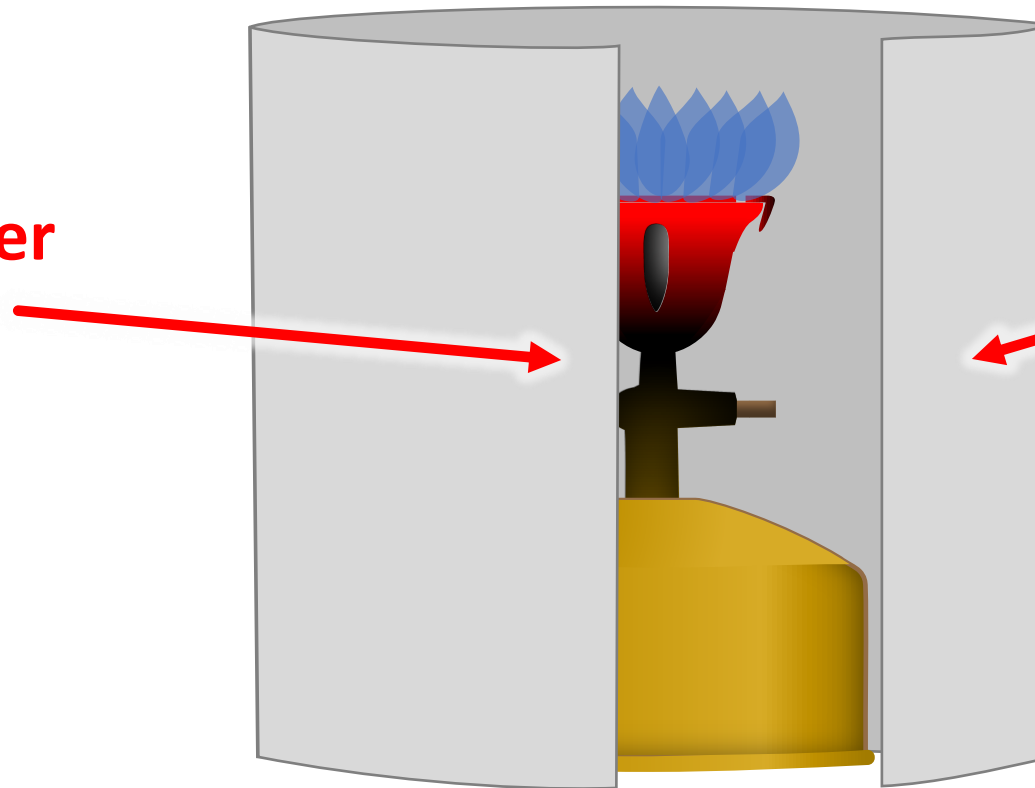
Surviving the Cold

Cold Weather Stoves – Liquid Petrol Stove Overheating

- Placing a tight windscreen around a stove-over-tank stove is Dangerous

**Heat is reflected
towards fuel canister
and is trapped**

Risk of Explosion!



**Do NOT use tight
fitting windscreen
around this type
of stove**

**The ventilated screen that
came with stove is fine**

Surviving the Cold

Cold Weather Stoves – Liquid Petrol Stoves - Polar Stoves

- All kinds of stoves have been used in polar regions
- Most popular Stoves used for Polar Expeditions:
 - **MSR XGK-EX**
 - Two basic settings – off and full blast
 - Produces a LOT of heat
 - Great for melting a LOT of snow in a short period of time
 - Noisy
 - **MSR WhisperLite**
 - Doesn't burn as hot as the XGK-Ex
 - Not as noisy as the XGK-Ex
 - More adjustable than the XGK-Ex

Surviving the Cold

Cold Weather Stoves – Gas Stoves – Propane

- Propane is an excellent cold weather fuel
- Unfortunately, weight and bulk are issues
 - Fuel comes in 16oz steel canisters
 - These weigh around 16oz empty and 32oz full
- Most propane stoves are designed for car camping
 - Very heavy compared to other backpacking stoves
- If you plan to use your stove a lot, the weight issue evens out a little

Surviving the Cold

Cold Weather Stoves – Gas Stoves – Propane - Warning

Don't Touch a propane canister with blue corrosion



Brass should NOT
be this color

Tank may have been used to make Crystal Meth

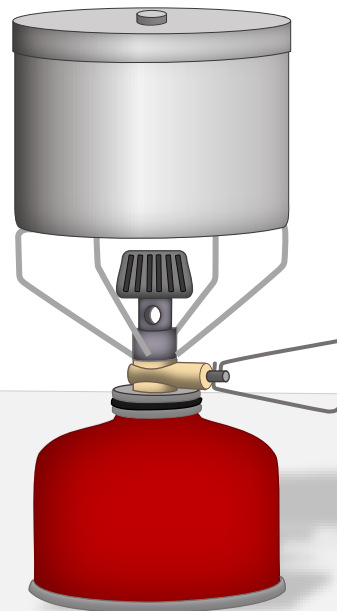
Anhydrous Ammonia damage brass

Use of damaged brass valve or fittings can result in explosion

Surviving the Cold

Cold Weather Stoves – Gas Stoves – Butane

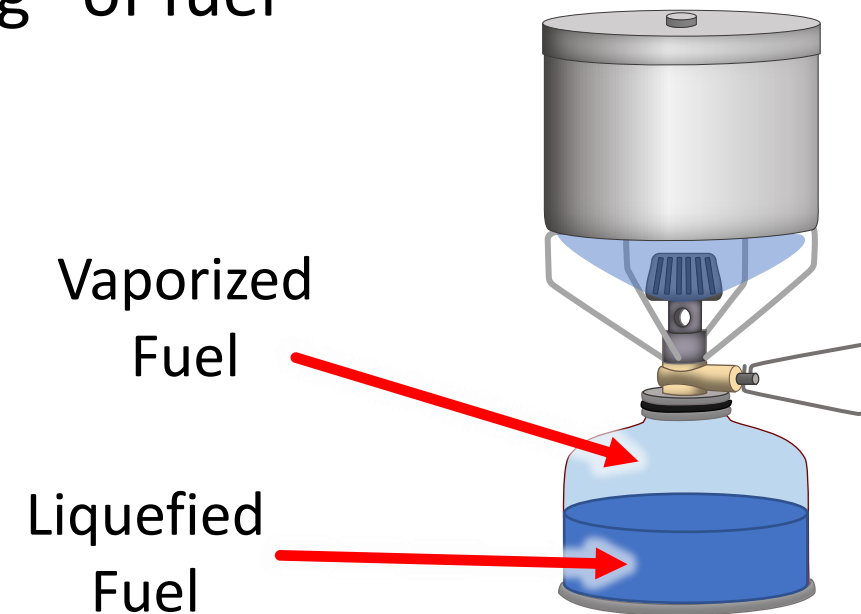
- The boiling point of butane is just around the freezing point of water
- At below freezing temperatures, butane fails to work
 - Know that as butane vaporizes in canister as it is used, it gets colder
 - It may be warm enough to start, but later freeze after using it



Surviving the Cold

Cold Weather Stoves – Gas Stoves – Butane

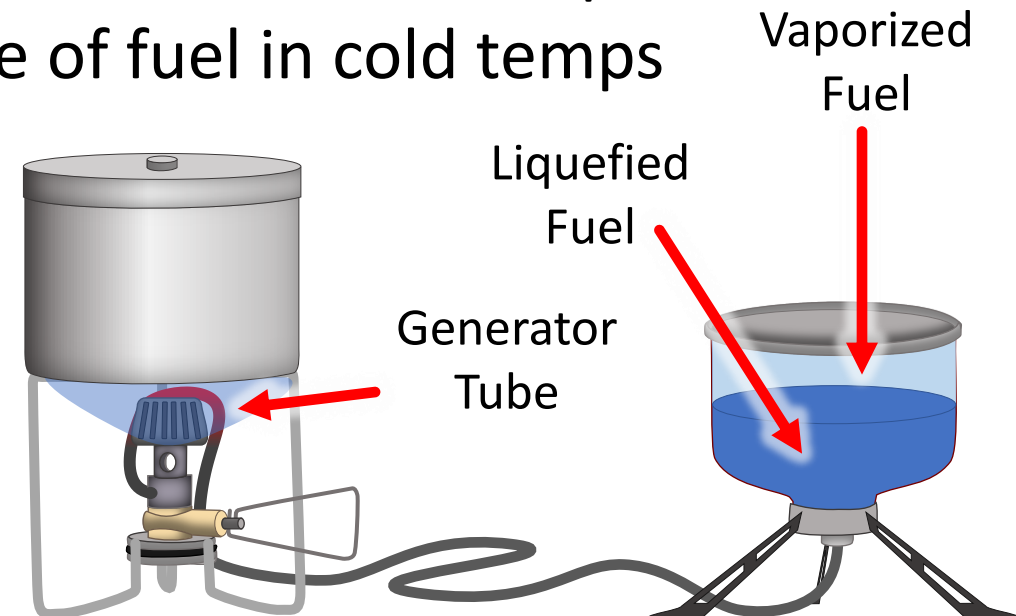
- Fuel Vaporization
 - More volatile fuels (propane and isobutane) are used up first
 - As you use up fuel, fuel is vaporized to “fill” canister
 - Vaporization results in cooling of canister (aka “freezing”)
 - Too much vaporization may result in “freezing” of fuel



Surviving the Cold

Cold Weather Stoves – Gas Stoves – Butane

- Inverted Fuel Canister
 - Inverting a canister forces liquid fuel into fuel line
 - Less fuel is vaporized in canister – so less temperature drop
 - Mixed fuels (propane and isobutane) are conserved
 - These continue to pressurized canister as fuel is used up
 - This significantly increases performance of fuel in cold temps
- Example:
 - MSR WindPro II



Surviving the Cold

Cold Weather Stoves – Gas Stoves – Butane - Warming

- Cold fuel may need be warmed before it can be used
- Pressured fuel becomes cold when used
 - Has to do with transition from liquid to gaseous state
 - Fuel needs to be kept warm for continued use

Warming fuel with anything hotter than body heat is DANGEROUS!

Surviving the Cold

Cold Weather Stoves – Gas Stoves – Butane - Warming

- Considered “safe” ways of warming fuel:
 - Place fuel canister inside your jacket but not against skin
 - Place fuel canister in bowl of shallow water
 - Water can be as warm as your body
 - Fresh urine will also work – but that’s nasty
 - **DON’T use boiling water to warm fuel!**
 - Warm water can be held in canister bottom with just the right sized plastic lid (Oreo Minis)

Warming fuel with anything hotter than body heat is DANGEROUS!

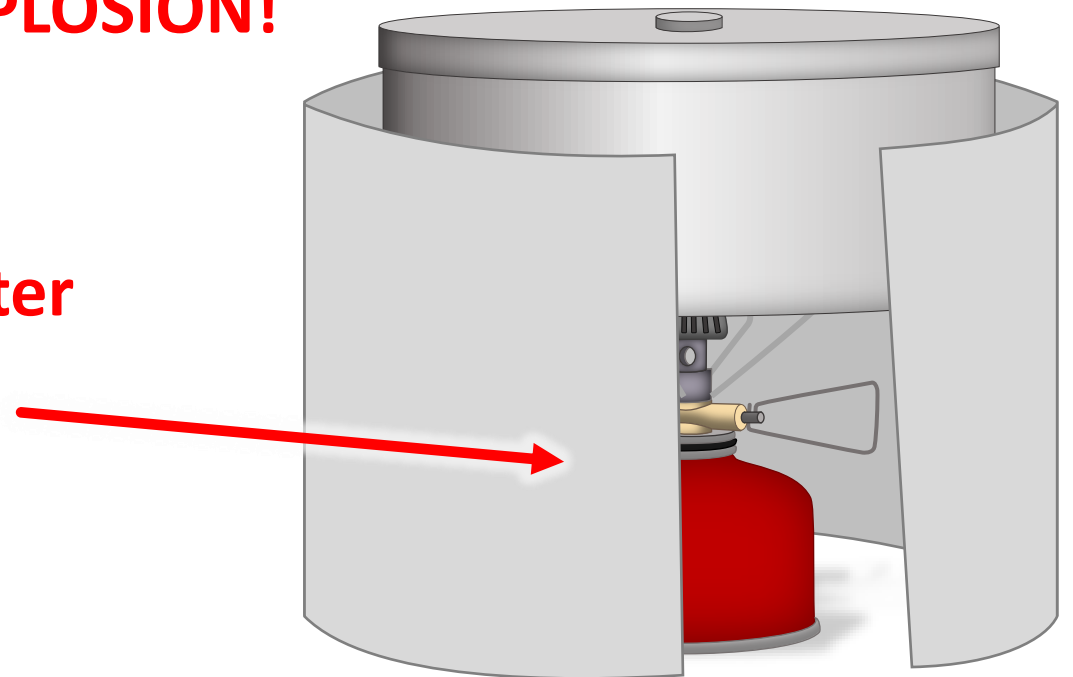
Surviving the Cold

Cold Weather Stoves – Gas Stove Overheating

- Most gas stoves are mounted over the fuel canister
- **Burner over canister stoves can overheat!**
 - Occurs if you wrap a windscreen too tightly around stove
 - If you use a large pan that reflects too much heat back at canister
 - Overheating may result in an **EXPLOSION!**

**Heat is reflected
towards fuel canister
and is trapped**

Risk of Explosion!



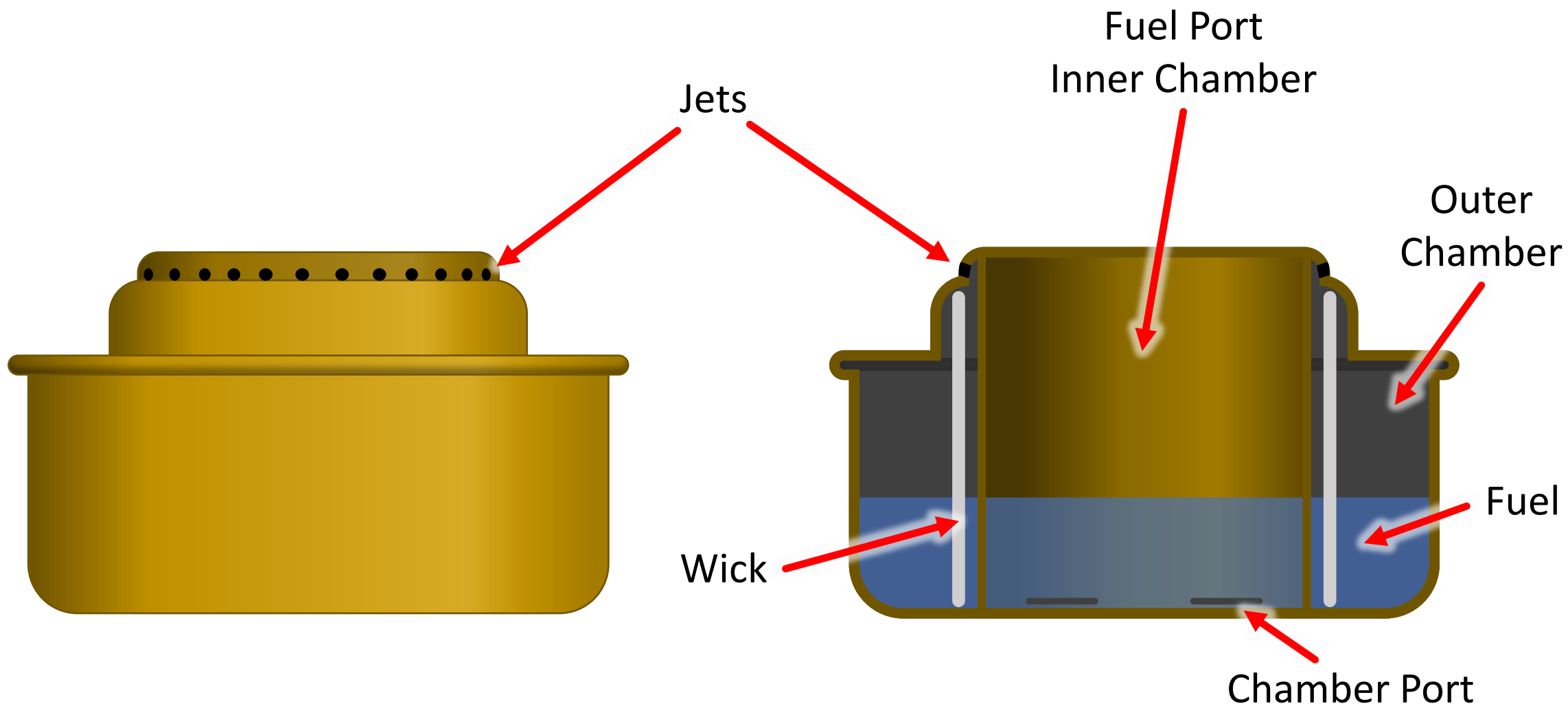
Surviving the Cold

Cold Weather Stoves – Alcohol Stoves

- Clean renewable fuel has benefits
- Used by military units in Europe
- Examples:
 - Trangia Swedish Army Stove
 - DIY stoves
- Fuels:
 - Denatured alcohol (ethanol)
 - HEET Gas-Line Antifreeze (methanol) – generally most economical
- Low heat output
- Low heat to weight ratio
 - For small trips, light weight stove makes up for extra needed fuel
 - For heavy use, such as melting snow, not the best option

Surviving the Cold

Cold Weather Stoves – Alcohol Stoves



Surviving the Cold

Cold Weather Stoves – Alcohol Stoves

- Mushers use alcohol powered stoves to
 - Melt large amounts of water quickly
 - Heat up food for dogs and musher
- No moving parts and simple design
 - Easy to light with gloved hands
 - No worry about clogs
- Requires/uses lots of fuel

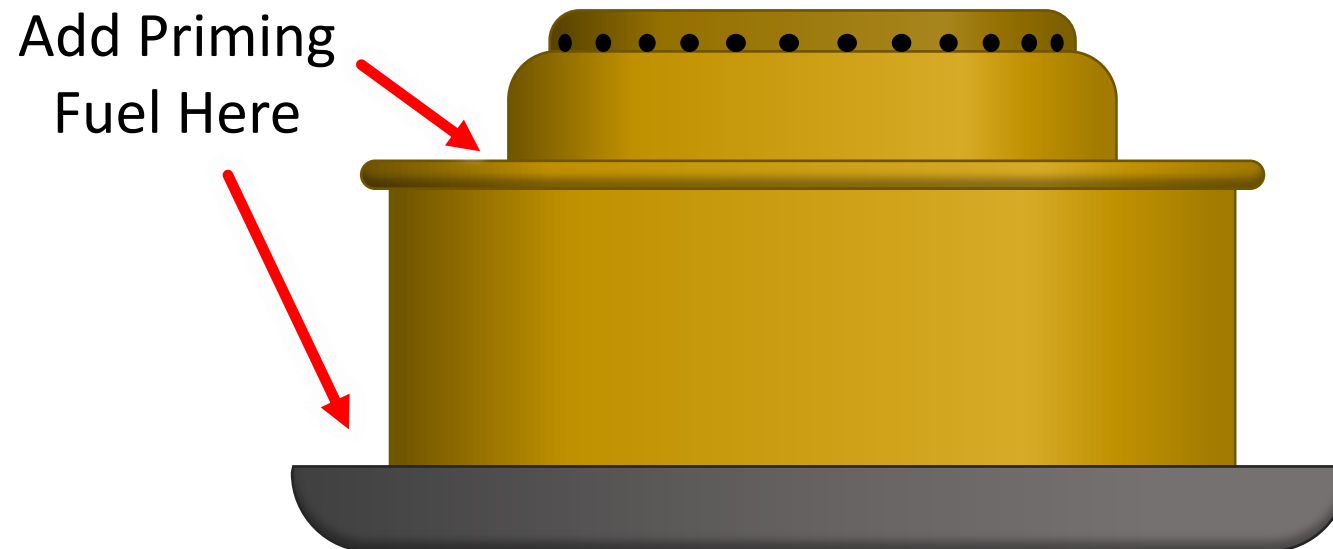


Musher Stove

Surviving the Cold

Cold Weather Stoves – Alcohol Stoves – Priming

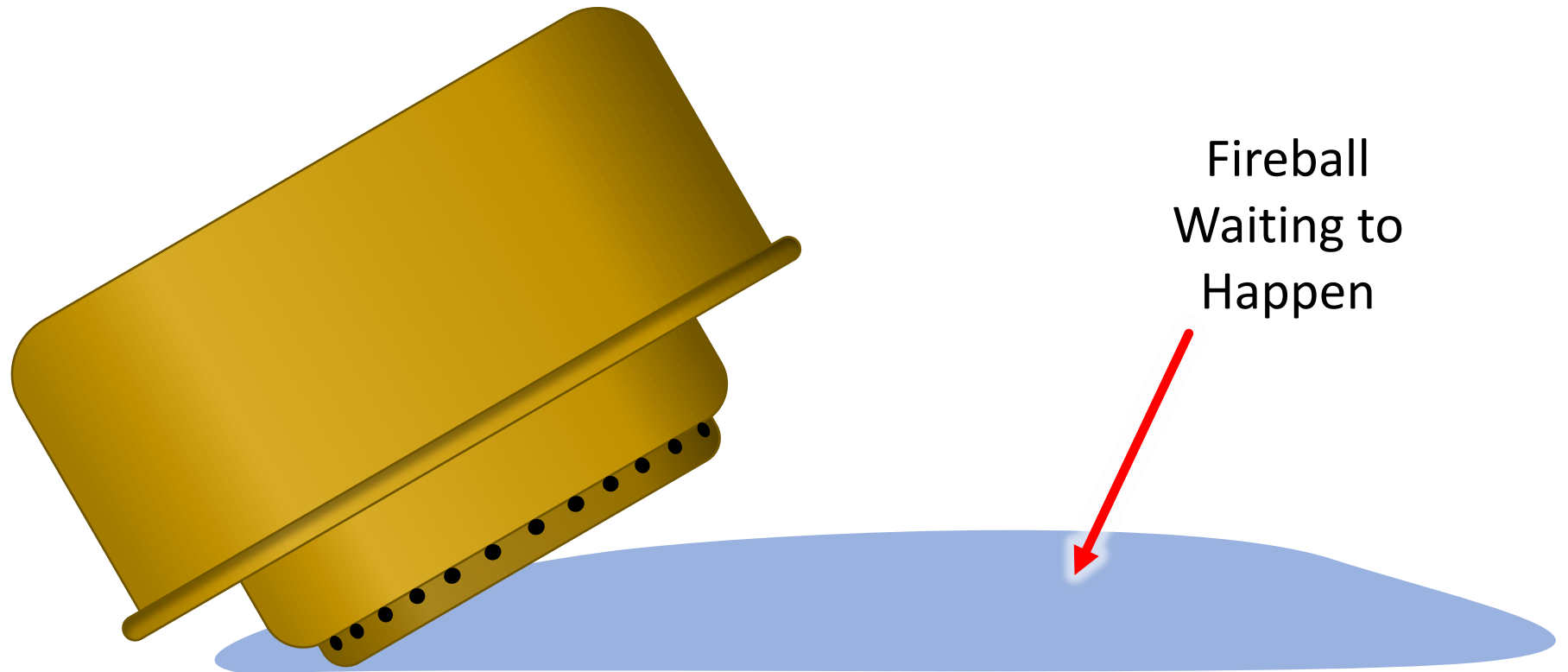
- In cold weather, alcohol stoves may need to be primed
 - Pour a little alcohol on stove or in pan under stove and light
 - This will warm stove and fuel within stove – resulting in vaporization for fuel



Surviving the Cold

Cold Weather Stoves – Alcohol Stoves – Spill Hazard

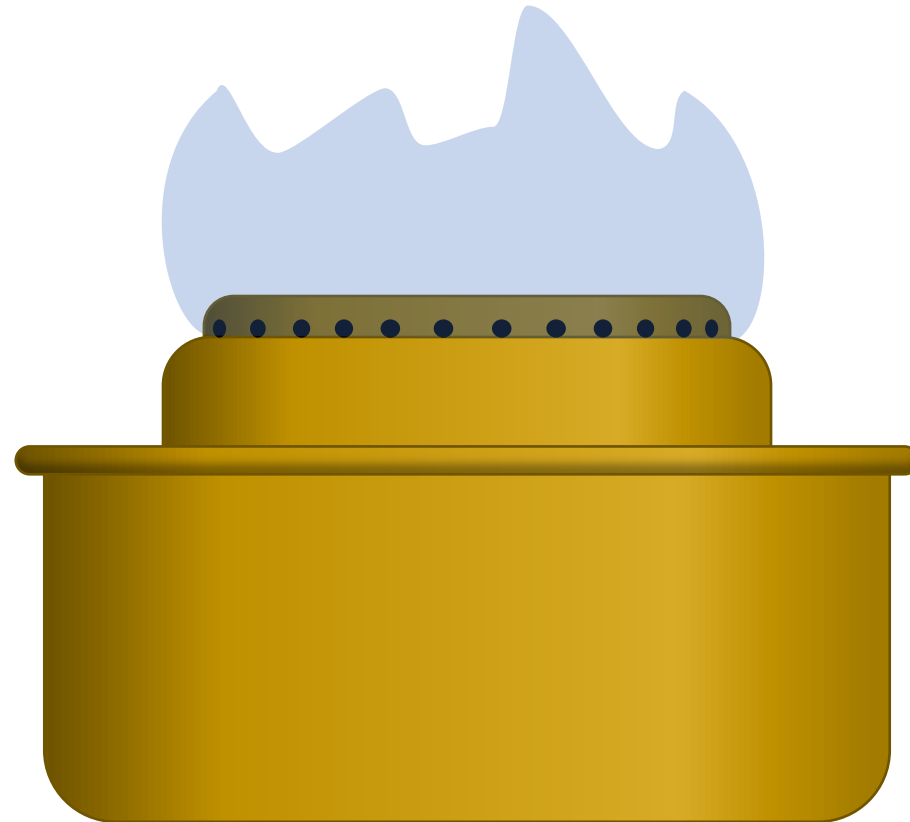
- Many alcohol stoves present a spill hazard
- If you knock over a stove, it can spill fuel everywhere
- Spilled fuel from a burning stove is an obvious burn hazard



Surviving the Cold

Cold Weather Stoves – Alcohol Stoves – Hidden Flame

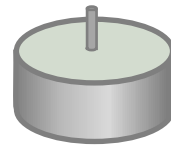
- Flames from burning alcohol is more or less invisible in sunlight
- Don't burn yourself and knock over stove



Surviving the Cold

Cold Weather Stoves – Candles

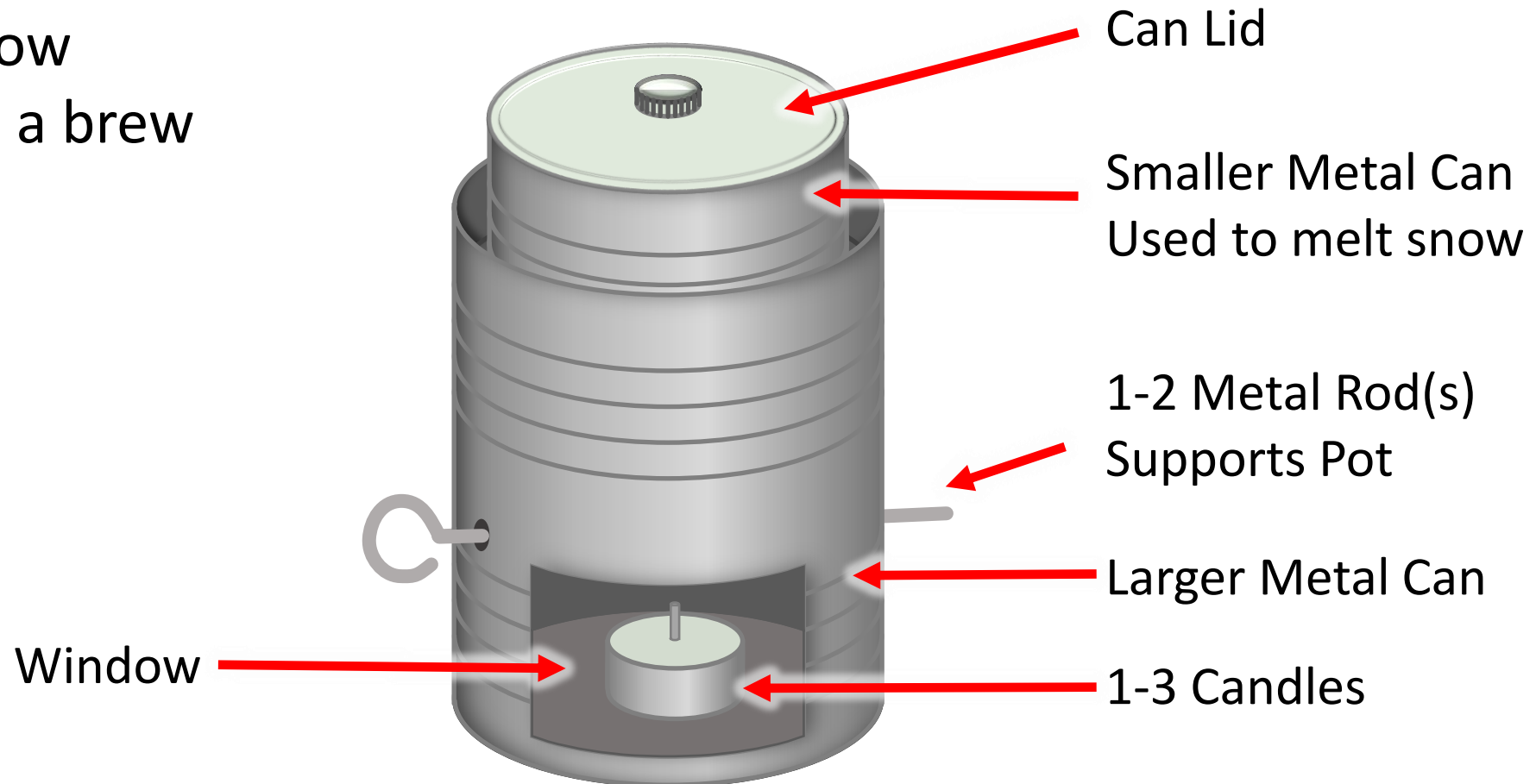
- Candles work great for use as candles
 - Provide some light
 - Provide some warmth
 - Ambiance
- Can be used to detect low oxygen levels
 - Flickering flame means you need ventilation NOW
 - Flame also hastens exhaustion of oxygen in enclosed area



Surviving the Cold

Cold Weather Stoves – Candles – YuCan Survival Stove

- Provides some warmth
- Melts snow
- Heats up a brew



YuCan Stove

Surviving the Cold

Cold Weather Stoves – Candle Stoves

- Candle stoves can be purchased or made
- Generally slow cook times
- Produces a lot of soot
- Packs well, but may melt if left in hot car in summer

Surviving the Cold

Cold Weather Stoves – Candle Stoves

- Candles are great
- Many experienced outdoorsman use them in snow shelters
 - It provides a nice light and welcomed warmth
- Many even use them in tents – although this practice is not advised
- Use of candles in a tent is Dangerous
 - **Candles can set tents, sleeping bags and other gear on fire**
 - Candles melt and can spill hot wax on gear and skin
 - Candle use requires a level of maturity that not all people possess

Surviving the Cold

Cold Weather Water

Surviving the Cold

Cold Weather Water – Need for Water

- Water is vital to life
- You need a lot of water in the cold
 - Water is lost through breathing in cold, low humidity air
 - Water is lost through digestion of food, which you need more of
 - Hard work constructing shelters, gathering wood and moving
 - Food is often dehydrated
 - Your body will also tend to dump water to keep its core warm
- You need about 5-6 quarts/liters of water per day in the cold

Surviving the Cold

Cold Weather Water – Need for Water

- Drinking based on thirst alone is unlikely to keep you hydrated
- The military uses the OVER DRINK method
 - Drink water when its available
 - Especially drink water when eating
- Can you over drink to the point of harm?
 - Yes you can
 - Don't be stupid about it

Surviving the Cold

Cold Weather Water – Liquid Water

- Unless you are in a desert, there is usually plenty of liquid water
 - Streams
 - Rivers
 - Ponds
 - Lakes
 - Swamps
- You may need to chop through ice to get it
 - Take extreme care when approaching edge of water
- It also needs to be purified before drinking

Surviving the Cold

Cold Weather Water – Ice and Snow

- Snow and Ice can be melted and purified for consumption
- Note that Freezing does NOT sterilize or purify water
- Contaminated water that was frozen is still contaminated after melting

Surviving the Cold

Cold Weather Water – Ice and Snow – Don'ts

- Try to only use pure white snow
- This should be common knowledge
 - Don't consume ploughed snow!
 - Don't eat Yellow Snow!
 - Snow collects pollutants on the way down
 - Dirt and nasties collect on snow
 - Pink snow is *Chlamydomonas nivalis* algae
 - Thought to be a laxative
 - This [study](#) suggests it isn't
 - Avoid if other options are available

Surviving the Cold

Cold Weather Water – Ice and Snow

- Snow and Ice should be melted before consumed
- Eating snow/ice drops your body temperature
 - You trade heat and energy for small amounts of water
 - It is possible to get frostbite on lips and in the mouth
- If you don't have another option, consider warming in hands first
 - Don't place in mouth until temperature reaches melting point
 - Consider risk of frostbite to hands
 - Only do so when you have excess body heat or are well insulated

Surviving the Cold

Cold Weather Water – Melting Ice and Snow - Body Heat

- Fill canteen with snow
- Place canteen in jacket, but not directly against skin
- Allow body heat to melt snow into water
- Drink and add more snow

- Wide mouth canteens are better suited for this technique
- Ziploc bags are also an option

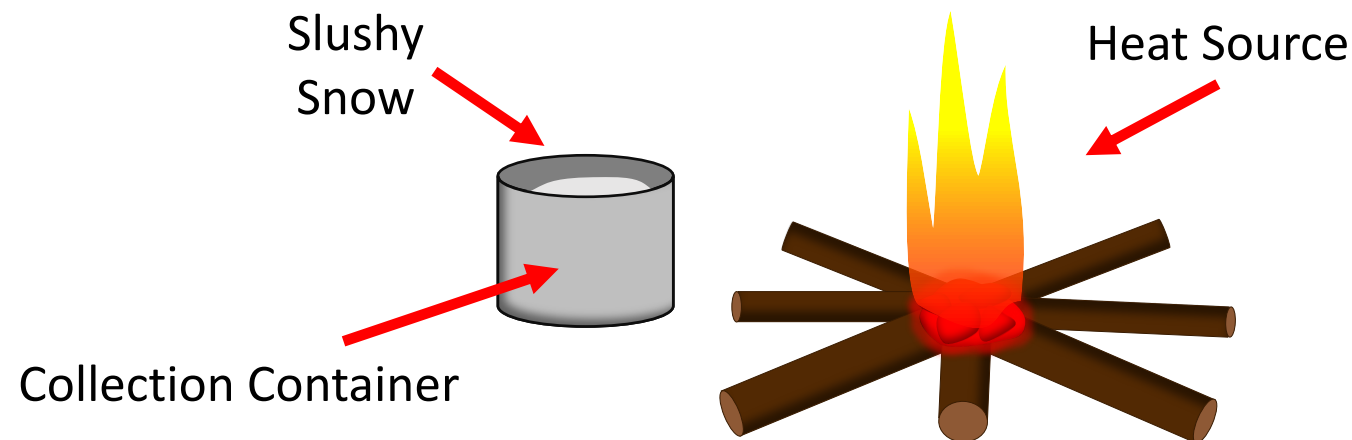
Surviving the Cold

Cold Weather Water – Melting Ice and Snow – Fire

- When melting snow, use starter water
 - Add a little water to pot and heat up
 - The water will help a lot when melting snow
 - Prevents pot scorching – and that nasty scorched taste
 - If you don't have water, gently heat up pot first to make some water

Avoid scorching your pot:

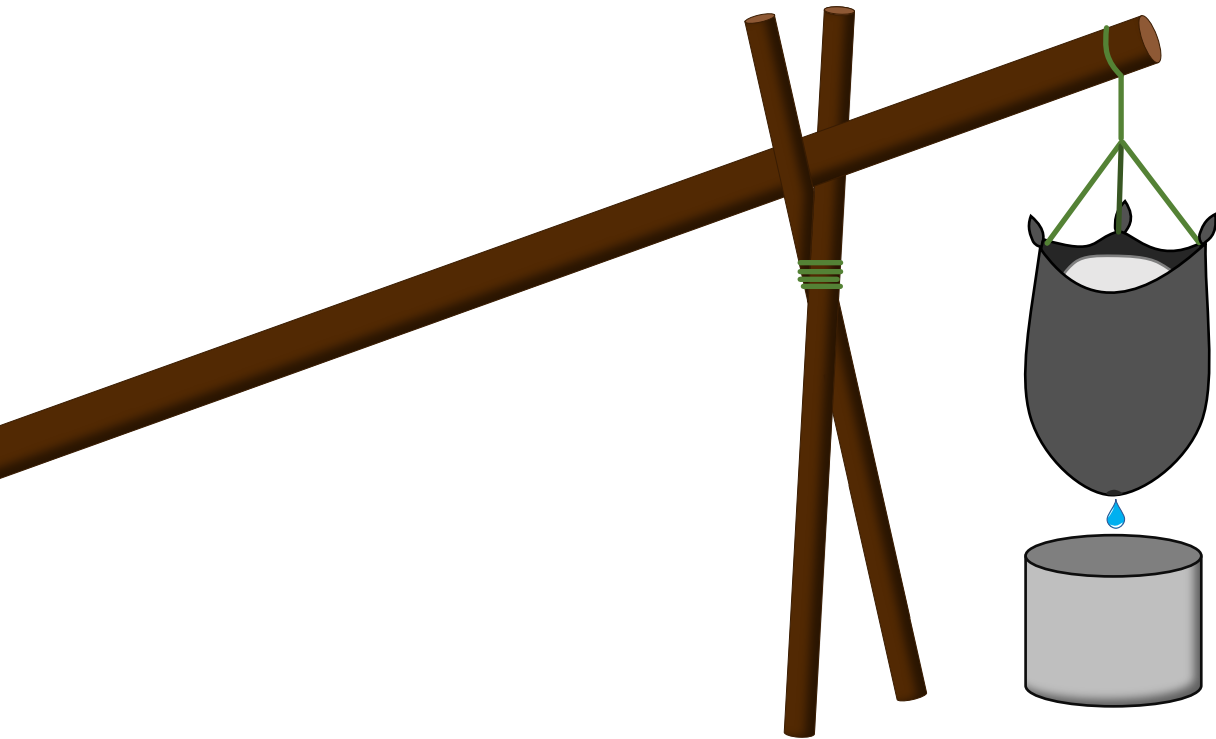
- Snow is an insulator
- Snow absorbs water
- Add snow in small increments
- Keep the mixture slushy



Surviving the Cold

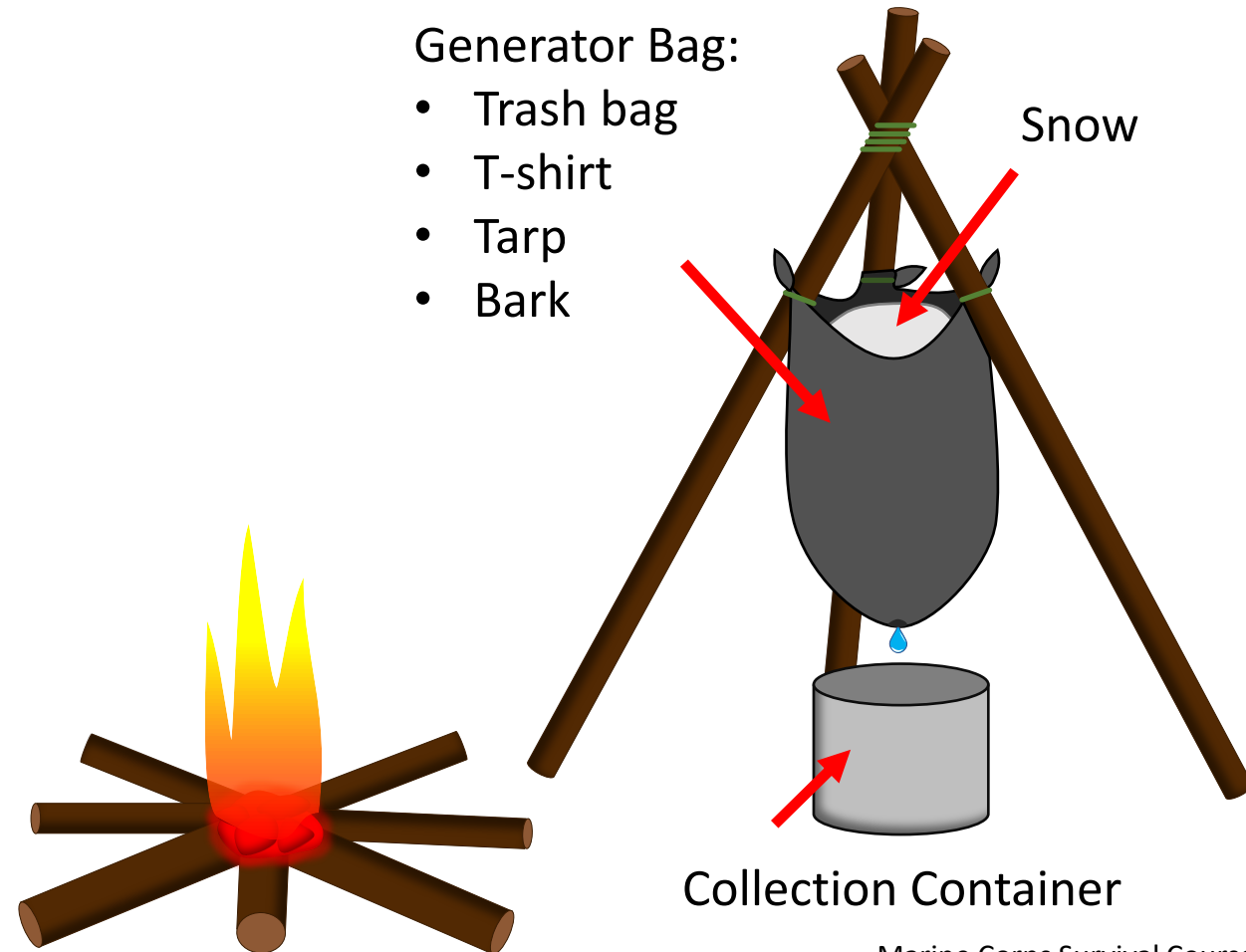
Cold Weather Water – Water Generator

- Fill with snow
- Place Safe distance from fire
- Don't let it run out



Generator Bag:

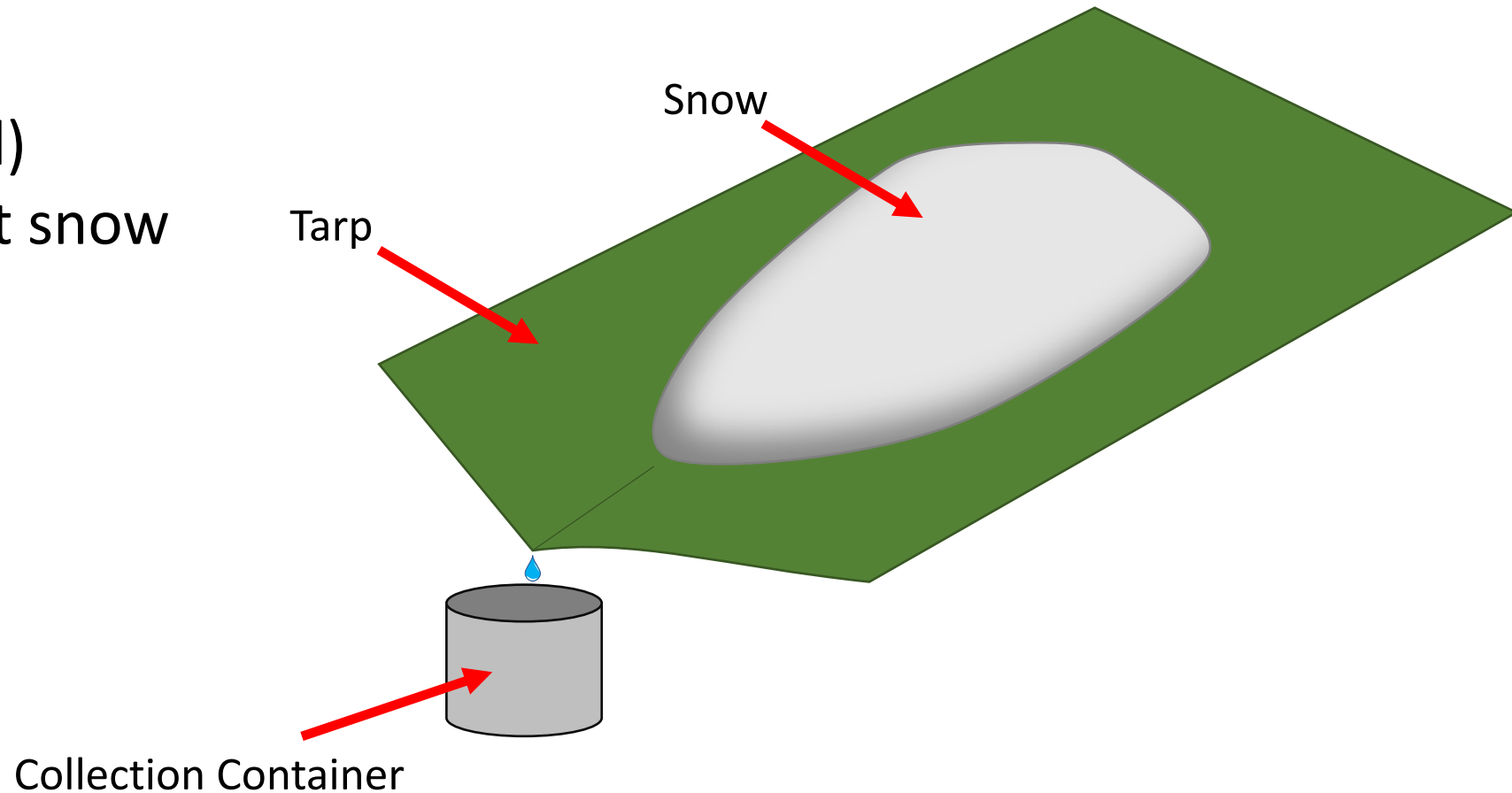
- Trash bag
- T-shirt
- Tarp
- Bark



Surviving the Cold

Cold Weather Water – Melting Ice and Snow – Solar

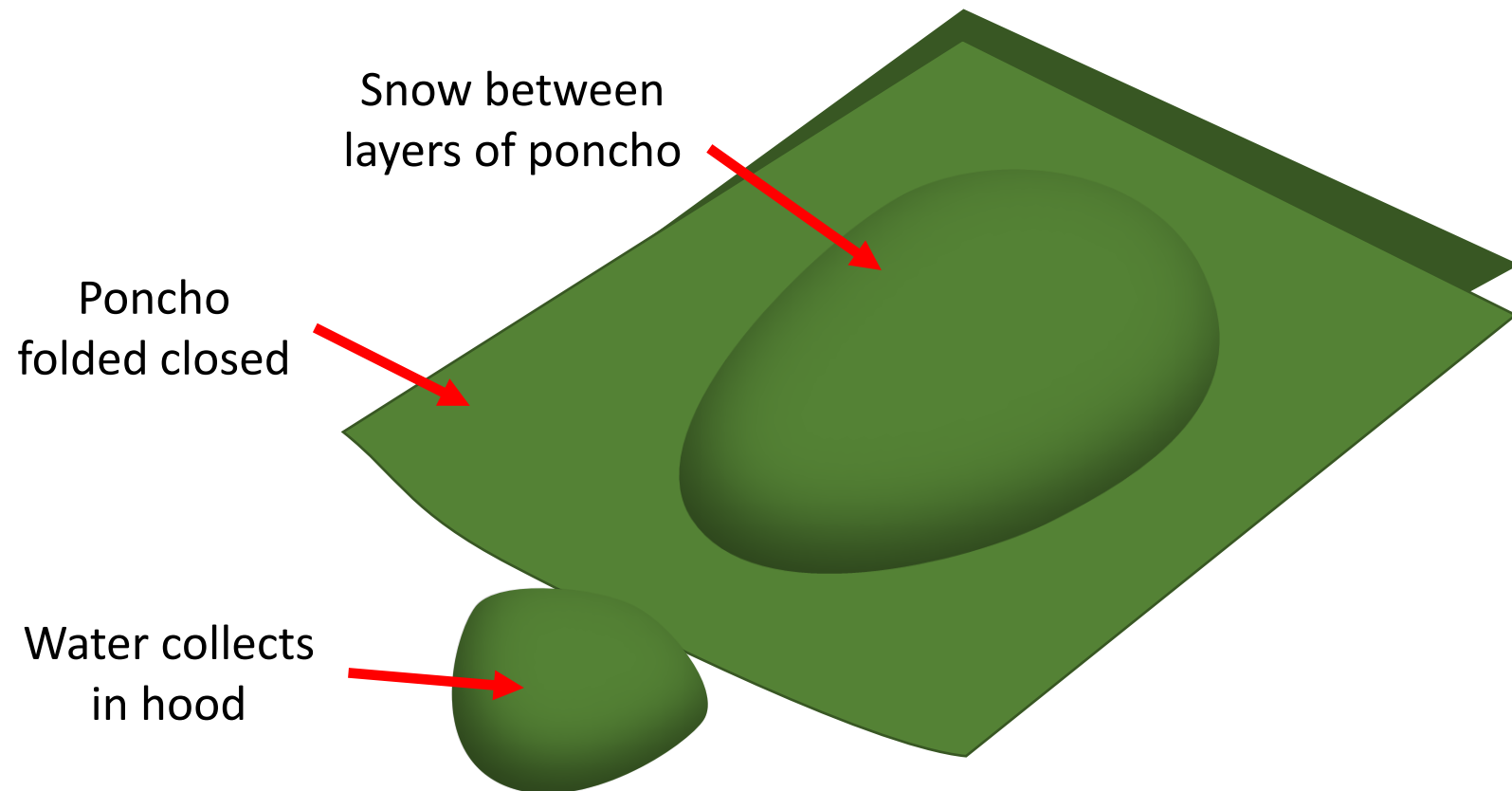
- Place snow on:
 - Tarp
 - Sleeping pad
 - Pulk (plastic sled)
- Wait for sun to melt snow



Surviving the Cold

Cold Weather Water – Melting Ice and Snow – Solar

- Poncho version



Surviving the Cold

Seawater

Surviving the Cold

Seawater

"Water, water, everywhere,
And all the boards did shrink;
Water, water, everywhere,
Nor any drop to drink."

Surviving the Cold

Seawater – Salinity

- Water has varying concentrations of salt (mainly NaCl)
 - Fresh water
<1,000 ppm (<0.1%)
 - Slightly saline water
1,000 - 3,000 ppm (0.1 - 0.3%)
 - Moderately saline water
3,000 -10,000 ppm (0.3 - 1%)
 - Highly saline water
10,000 - 35,000 ppm (1 - 3.5%)
 - Seawater
~ 35,000 ppm (~3.5%)

Surviving the Cold

Seawater – Body Sodium

- Sodium concentration in the body is measured in mEq Na/L
 - Blood is regulated at around 135-145 mEq Na/L

$$\begin{aligned} \text{ppm} &= \text{mg solute} / 10^6 \text{ milligrams solution} = \text{mg/liter} \\ &= \text{mg solute} / \text{kg solution} \end{aligned}$$

$$\text{mEq/L} = \text{ppm(mg/L)} \div \text{equivalent weight (23 for Na}^+, \text{ 35.5 for Cl}^-)$$

$$\text{ppm} = \text{mEq/L} \times \text{equivalent weight (23 for Na}^+, \text{ 35.5 for Cl}^-)$$

- “Normal” Blood has a sodium level of about 7,900-8,500 ppm

Surviving the Cold

Seawater – Salinity

- Blood has a salinity of about 8,400 ppm (<0.85%) of NaCl
- Seawater is about 4 times as concentrated
- If you drink seawater, the salt concentration in your blood increases
 - Increased sodium levels draws fluid out of body tissues – this is **BAD**
 - If sodium levels get too high:
 - Irreversible neurologic injury
 - Seizures
 - Coma and death
 - Your body tries to dump this extra sodium via your kidneys
 - Water follows sodium
 - Your Kidney can only concentrate urine so much
 - Dumping sodium results in dumping a LOT of water

Surviving the Cold

Seawater – Salinity

- Drinking seawater results in further dehydration
- Takes about 2 liters of body fluids to clear the salt in 1 liter of seawater

Do NOT drink Seawater
This will KILL you

Surviving the Cold

Seawater – Distillation

- Seawater must be distilled prior to safe drinking
 - Use a distillation kit

Surviving the Cold

Seawater – Rainwater

- If you can, collect rainwater and drink that
- Use a tarp or other appropriate items to collect rainwater
 - If water collector is crusted in salt
 - Rinse off with seawater to remove crusted salt
 - This will leave a small amount of salt on tarp – but very little

Surviving the Cold

Seawater – Sea Ice

- Grease Ice (Frazil) – **DON'T DRINK**
 - Surface crystals (Frazil) typically break down into soupy suspension
 - Looks like an oil slick
 - Mix of ice and saltwater
- New Ice (Nilas) – **DON'T DRINK**
 - Frozen Frazil with trapped seawater brine
 - Up to 4 inches (10cm) thick
 - Dark Gray or opaque with sharp edges and angles
- Congelation Ice– **DON'T DRINK**
 - Sheet of ice thickens below top layer
 - Gray to grayish white
 - Up to a foot thick (30cm)

Surviving the Cold

Seawater – Sea Ice

- Old Sea Ice
 - Salts don't freeze into ice matrix
 - It is trapped in brine pockets
 - As ice ages, pockets of brine drain from ice
 - Ice compresses and cracks around brine pockets
 - Brine drains downward via gravity
 - In summer, freshwater ponds on ice wash brine downward
 - Looks different than new ice
 - Crystalline with bluish cast
 - Shatters easily and generally has rounded corners
 - Minimal salt content
 - Drinkable after being melted down

Surviving the Cold

Signaling

Surviving the Cold

Visual Signals – Natural Materials – Snow

- Shadows can be seen from blocks or tracks in snow



Surviving the Cold

Visual Signals – Natural Materials – Snow

- Contrasting pine boughs on snow stand out



Surviving the Cold

Cold Weather Gear

Surviving the Cold

Cold Weather Gear

- There are stories of survivors who survived with the wrong gear
 - You may not have the same luck as them
- Survival in the cold often depends on being properly equipped
 - Skills and willpower alone may not be enough to keep you warm

Surviving the Cold

Cold Weather Gear – Clothing – Upper Body

- **Wicking T-shirt**
 - For hot days
 - Anything NOT cotton
- **Long sleeve Base Layer**
 - Light synthetic
- **Thin insulating layer**
 - Fits under jacket and over base layers
- **Soft-shell jacket**
 - Very versatile piece of equipment
 - Zipper allows for ventilation

Surviving the Cold

Cold Weather Gear – Clothing – Upper Body

- **Insulated parka with attached hood**
 - Vital for extreme cold weather
 - Needs to be puffy
 - Down if in dry cold environment
 - Synthetic if in wet cold environment
 - Perch Belay Parka is great for Mt. Rainier
 - You'll need something more substantial for Denali
- **Waterproof breathable storm shell jacket with hood**
 - VITAL in Pacific Northwest
 - Get one without insulation – instead, layer underneath

Surviving the Cold

Cold Weather Gear – Clothing – Lower Body

- **Long underwear**
 - Silk weight and medium/heavy weight or
 - Thick Bicycle Tights (come in different weights)
- **Soft-shell Climbing Pants**
 - Schoeller fabrics are durable and ideal for climbing
- **Waterproof breathable Storm Pants**
 - Gore-Tex or equivalent
 - Full zip sides allows you to easily put on and remove
- **Gators**
 - Protects lower pants and boots from snow

Surviving the Cold

Cold Weather Gear – Clothing – Head

- **Head and ear protection**
 - You need to cover head AND ears
 - Wool or Fleece Hat
- **Neck protection**
 - The neck needs to be protected
 - Neck Gaiter (aka Buff) – can also be used to cover head
- **Combo Head/Neck protection**
 - Balaclava
 - Facemask
 - Regular scarf – can be used to wrap head AND neck
 - Square scarf (shemagh) – many ways to wrap head and neck
 - Should be wool or synthetic

Surviving the Cold

Cold Weather Gear – Clothing – Head

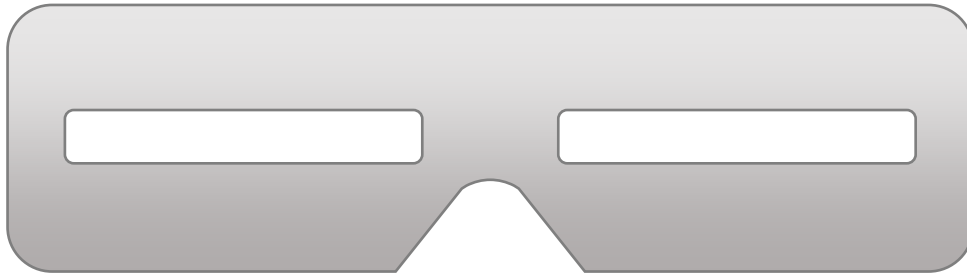
- The [Buff](#)
 - So many ways to wear
 - Great versatility
 - Wear over face
 - As moisture builds up over mouth, rotate a little
 - By the time original wet spot is back over mouth, it should be dry

Surviving the Cold

Cold Weather Gear – Clothing – Eyes

- **Glacier Glasses**

- Vital for preventing snow blindness
- Needs to protect eyes from sides – side shields
- Improvised glasses are an option, but not as good as real glasses



Improvised Glasses can be made from:

- Duct tape
- Space blanket
- Wood or cardboard
- Bone

- **Goggles**

- These can save you in windy conditions
- Example: Scott 83x Safari Facemask Goggles

Surviving the Cold

Cold Weather Gear – Clothing – Hands

- **Mittens and Gloves**
 - Mittens protect hands better than gloves
 - Glove are easier to use with tools
- **Light-weight inner synthetic gloves**
 - Example - Outdoor Research: PL 150 Gloves
- **Mid-weight Glove**
 - Example - Outdoor Research: Extrovert Gloves
- **Heavy-weight insulated gloves**
 - Example -Outdoor Research Alti-Gloves
- Glove Choices with Phil Ershler [YouTube fNVuYhsRL o](#)

Surviving the Cold

Cold Weather Gear – Clothing – Feet

- **Thin Ski Socks** – optional
 - Reduce occurrence blisters
- **Mountaineering Socks**
 - NO Cotton!!!
 - Thick wool or synthetic
 - Examples – SmartWool, Thorlo, Darn Tough

Surviving the Cold

Cold Weather Gear – Clothing – Feet

- **Boots**
 - Boots need to be insulated and waterproof
 - Boot selection is complicated
 - They **MUST** fit
 - Traditional Boots – Leather or synthetic
 - Plastic Boots - Scarpa, Koflach, Asolo and La Sportiva

Surviving the Cold

Cold Weather Gear – Sleeping Gear

- **Sleeping Bag**
 - Need a bag system appropriate for temps you might encounter
 - Synthetic vs Down
 - NO Cotton!!!
 - Synthetic – maintains some insulation when wet; dries quickly
 - Down – super light; **NO** insulation when wet
 - Example – Military Modular system (2 bags and a bivy)
 - Synthetic fabric and fill with waterproof bivy
 - Rated 4 hours sleep at -40°F
- **Sleeping Pad**
 - Full length inflatable pad works best
 - Closed Cell foam are a little more forgiving to abuse

Surviving the Cold

Cold Weather Gear – Shelter

- Shelter depends on environment
 - Tent appropriate for environment
 - Pyramid designs are better for windy and heavy snowfall areas
 - Snow shovel and saw – allows you to build shelter in deep snow
 - Tarp – multi use

Surviving the Cold

Cold Weather Gear – Trekking Poles

- **Trekking Poles**
 - Make winter travel much much easier
 - Use arms to help power through snow
 - Used to help balance
 - Use to help you get up when you sink, fall or sit down
 - Can be used for shelter
 - Horizontal beams for roof
 - Vertical poles to hold up tarp
 - Some can be used as probing poles
 - These can also be used to hold up a teepee shelter

Surviving the Cold

Cold Weather Gear – Fire

- Must have real **Fire Starter**
 - Flame
 - Waterproof
 - Storm matches vs lighter vs good ferrorod
 - Long burning, easy to light fuel
 - WetFire, Hexamine, Paraffin based starter and/or candle
- Consider carrying a road flare
 - Long burning
 - Extremely HOT
 - Use as signaling device
 - Reusable if you know how to extinguish it
 - Make hole in ground, shove, shove, shove into dirt until out

Surviving the Cold

Cold Weather Gear – Stove

- Vital for survival if you need to melt snow or keep warm
 - **Liquid Petrol Stoves** most practical for most
 - Fuel not impacted by extreme cold
 - Maintenance may be needed as well as cold weather seals
 - MSR Whisperlite – excellent stove
 - **Gas Stoves** work*
 - *Need to know how to use them in subfreezing temps
 - Don't work in the most extreme environments
 - Most work the same – avoid no-name Amazon specials
 - **Wood Stoves** conserve biofuel
 - Not useful above tree line where there's no fuel
 - **Other Stoves** are impractical for extended cold weather survival

Surviving the Cold

Cold Weather Gear – Pioneer Tools

- Tools may be needed to save your life
 - **Axe**
 - Mandatory gear for Iditarod Race
 - Used to
 - Build shelter
 - Cut up firewood
 - Free up sled
 - Kill Predators or Prey
 - Cut up vegetation, meat and even bone
 - Dig holes in snow, ice and frozen ground

Surviving the Cold

Cold Weather Gear – Pioneer Tools

- Tools may be needed to save your life
 - **Pocket saw**
 - Nice as augmentation to axe
 - Not as good or as versatile as an axe
 - Nice to have for field craft
 - Great for cutting down branches and small trees
 - Use for shelter making or firewood
 - Can be used to split wood
 - Cut halfway through wood and bang wood unit is splits
 - Cut into top of wood grain and use wedge and baton to split

Surviving the Cold

Cold Weather Gear – Pioneer Tools

- Tools may be needed to save your life
 - **Snow Shovel**
 - Mandatory in areas where avalanche is a concern
 - Required if snow shelters are only viable shelter option in area
 - Examples
 - Dedicated snow backcountry shovel
 - Doubles as emergency sled
 - Military Entrenching Tool
 - Not a great snow shovel, but has many survival uses
 - Snowshoes
 - Poor snow shovel, but you may already have them

Surviving the Cold

Cold Weather Gear – Pioneer Tools

- Tools may be needed to save your life
 - **Snow Saw**
 - Mandatory in areas where Snow Cave is vital for survival
 - Examples
 - Dedicated snow saw
 - Wood Saw
 - Works fine and affordable
 - Machete
 - Inuit used machete style blades prior to saws for Igloos

Surviving the Cold

Cold Weather Gear – Pulk

- Some sleds are just made better than other – avoid using junk
 - [Shappell](#) Jet Sleds
 - Economically priced – look for sales
 - Jet Sled Jr - Scout or individual use
 - Jet Sled 1 - Group winter camping
 - [Pelican](#)
 - Trek 45 - Scout or individual use
 - Trek 60 - Group winter camping
 - [Otter](#)
 - Heavy Duty Sleds – more durable, but also a lot heavier
 - Otter Pro Sled Mini - Scout or individual use
 - Otter Pro Sled Small - Group winter camping

Surviving the Cold

Cold Weather Gear – Paracord

- Buy it by the [spool](#)
- So many uses
 - Shelters
 - Lashings
 - Tent/tarp lines
 - Hammock
 - Fire
 - Bowline for bowdrill
 - Firestarter
 - Hold tepee together
 - Medical
 - Suturing
 - Stretcher
 - Splinting
 - Sling
 - Food
 - Fishing line
 - Fishing net
 - Troutline
 - Snares and traps
 - Hanging game
 - Bearbag
 - Weapons
 - Bow
 - Stone throwing sling
 - Monkey fist
 - Restraints
 - Attach knife to stick
 - Rope
 - Pulling Pulk
 - Rescue line
 - Hauling gear or timber
 - Snowshoes
 - Shoelaces
 - Tripwire
 - Trail markers
 - Stream crossing guide
 - Raft
 - Wood ladder or bridge
 - Rope ladder
 - Fabric repair

Surviving the Cold

Avalanche

Surviving the Cold

Avalanche

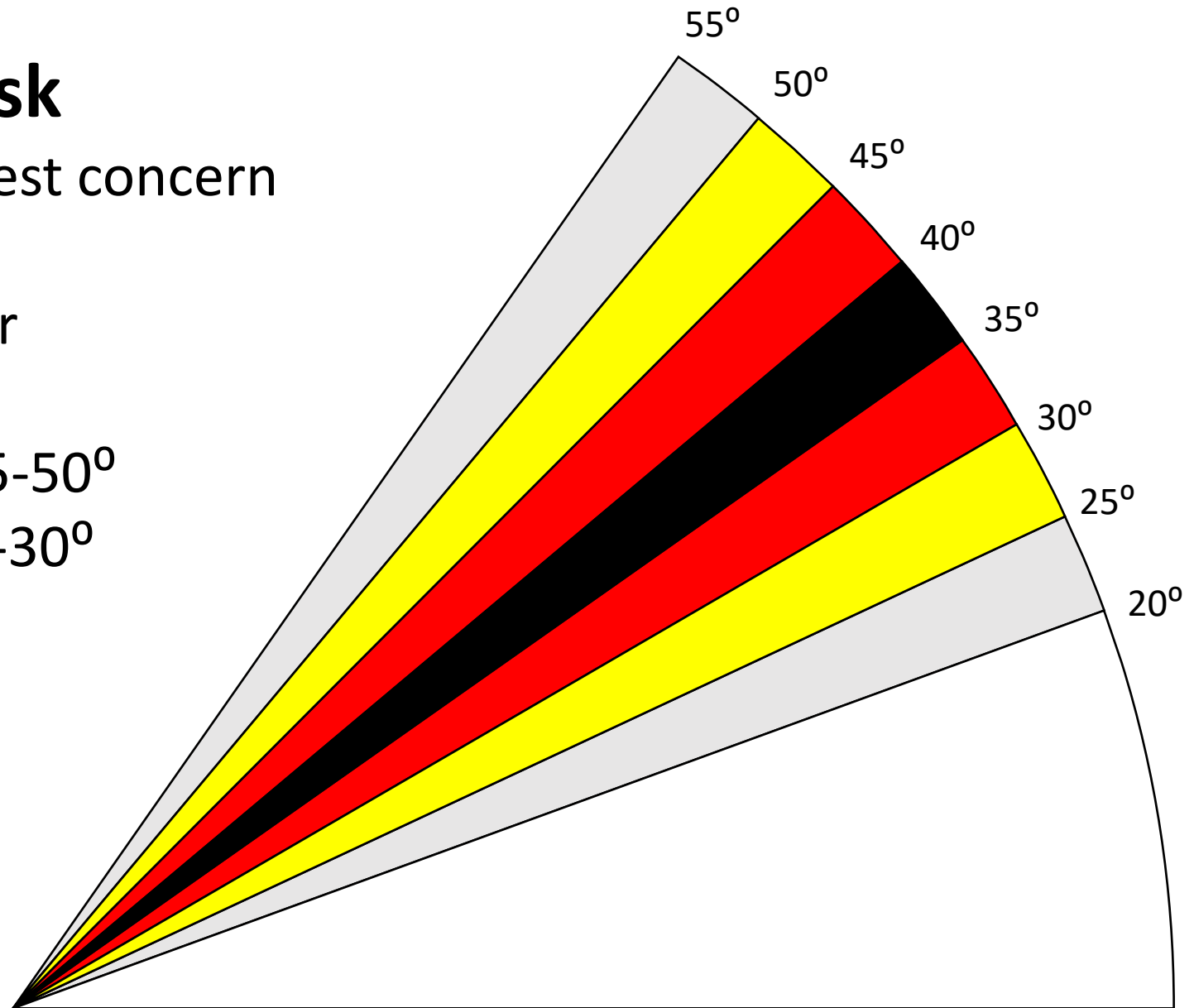
- Real and deadly threat if terrain, snow and circumstances are just right
- This is covered in much greater detail in our:

Avalanche Class

Surviving the Cold

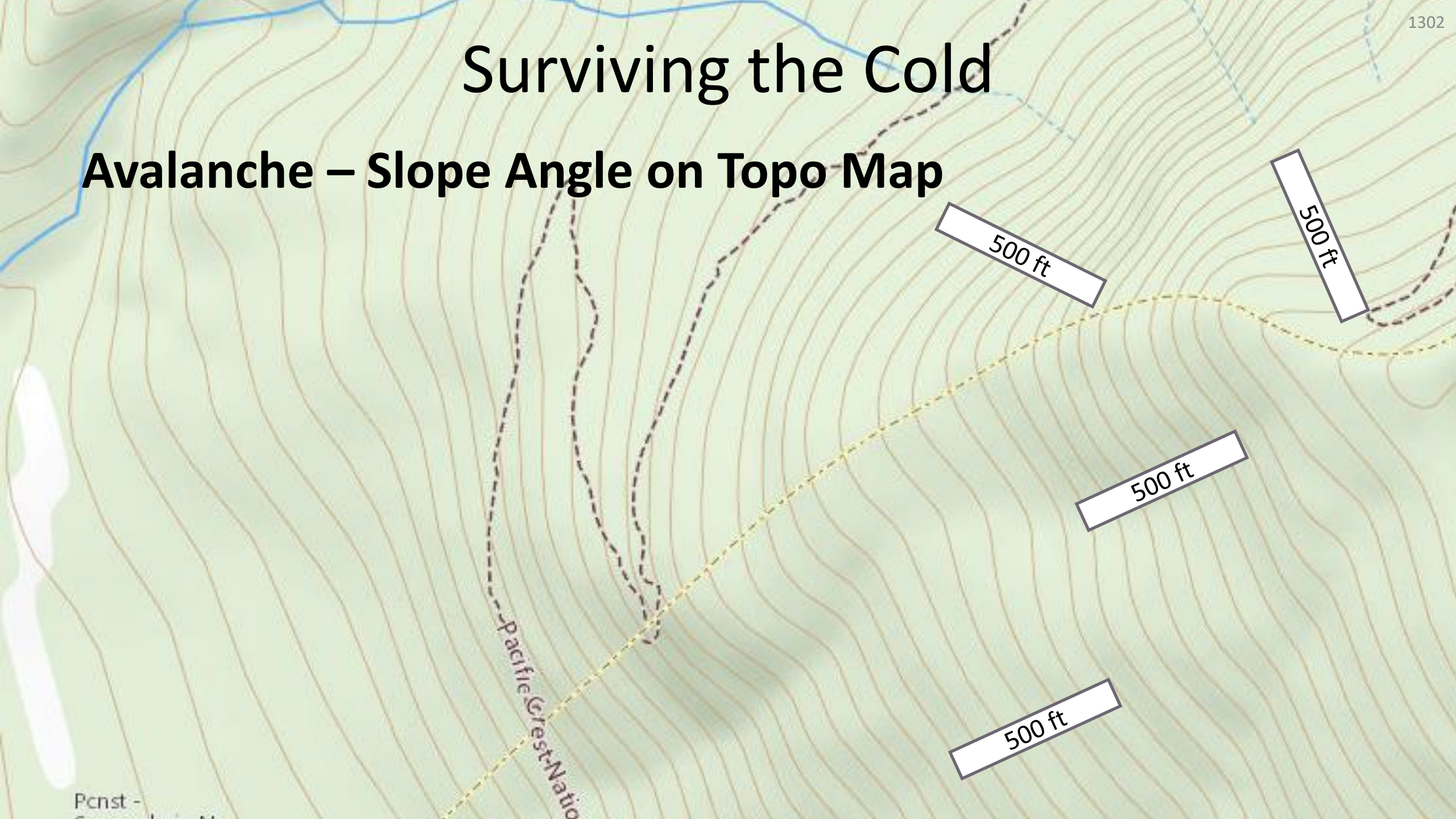
Avalanche – Slope Risk

- 38° is the angle of greatest concern
- **$35-40^\circ$ VERY Dangerous**
- $30-45^\circ$ Moderate Danger
- $25-50^\circ$ Some Danger
 - Fresh snow slough $45-50^\circ$
 - Spring melt slides $25-30^\circ$
- $>50^\circ$ or $<25^\circ$ Slides Rare



Surviving the Cold

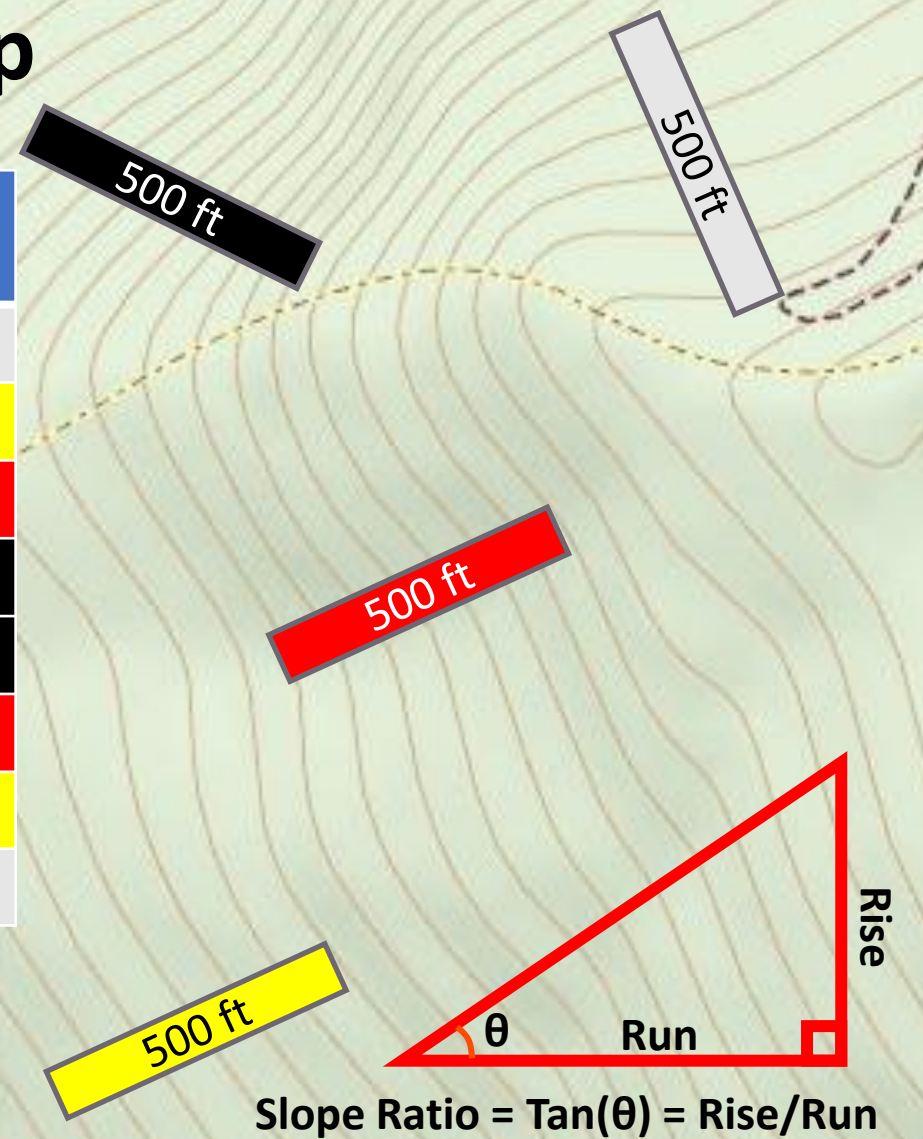
Avalanche – Slope Angle on Topo Map



Surviving the Cold

Avalanche – Slope Angle on Topo Map

Slope Angle	Slop Ratio	Rise (500' Run)	40' Lines (500' Run)	Rise (1000' Run)	40' Lines (1000' Run)
20°	0.364	182'	5	364'	9
25°	0.466	233'	6	466'	12
30°	0.577	289'	7	577'	14
35°	0.700	350'	9	700'	18
40°	0.839	420'	10	839'	21
45°	1.000	500'	13	1000'	25
50°	1.192	596'	15	1192'	30
55°	1.428	714'	18	1428'	36



Slope Ratio = $\text{Tan}(\theta) = \text{Rise}/\text{Run}$

Surviving the Cold

Avalanche – Know Before You Go

- [Northwest Avalanche Center](#)
- [Avalanche.org](#)

Surviving the Cold

Avalanche – Warning Signs

- Recent avalanche activity
- Sudden warming trend or rise in temperature
- Significant new snowfall in the last 24 hours
- Cracking of snowpack
- Blocks breaking off under your skis/shoes
- Whoomping sound
- Strong winds

Surviving the Cold

Avalanche – Avoid

- Avalanche areas should be avoided
- Know before you go what the risks are
- If you find a danger zone
 - Find another route
 - Wait it out
- If you don't have a better choice, go one at a time
 - Only one member of party will be buried
 - Others can rescue single victim or at least survive

Surviving the Cold

Snowshoes

Surviving the Cold

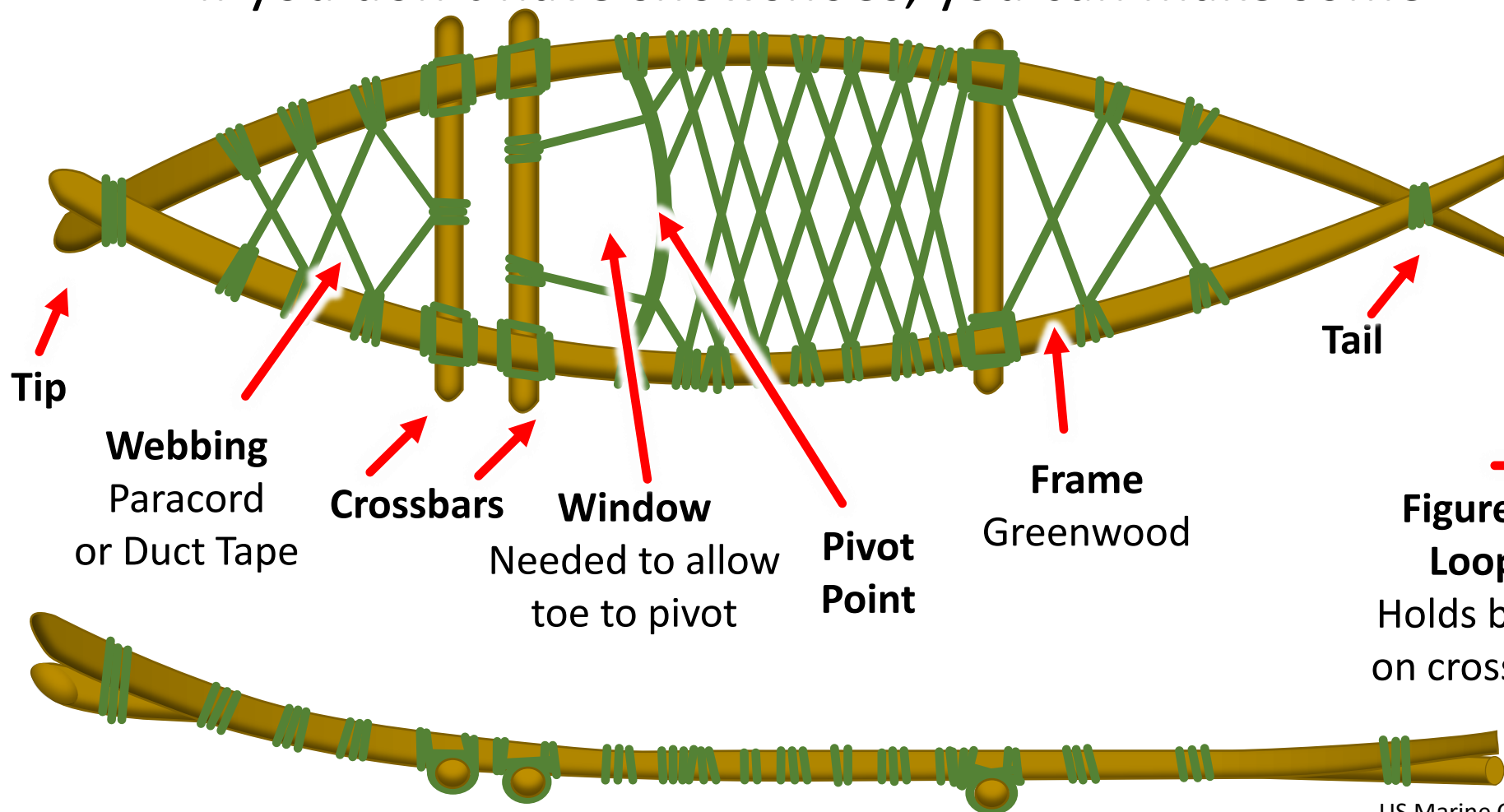
Snowshoes

- Depending on the quality of surface snow, snowshoes may be needed
 - Makes travel much easier
 - Faster
 - Less energy expended
 - Less exposure outside
 - Less risk of hypothermia
 - Less wetness from peg legging
 - Less time being stuck with legs or body in deep snow

Surviving the Cold

Snowshoes – Improvised Ojibwa aka Chippew

- If you don't have snowshoes, you can make some

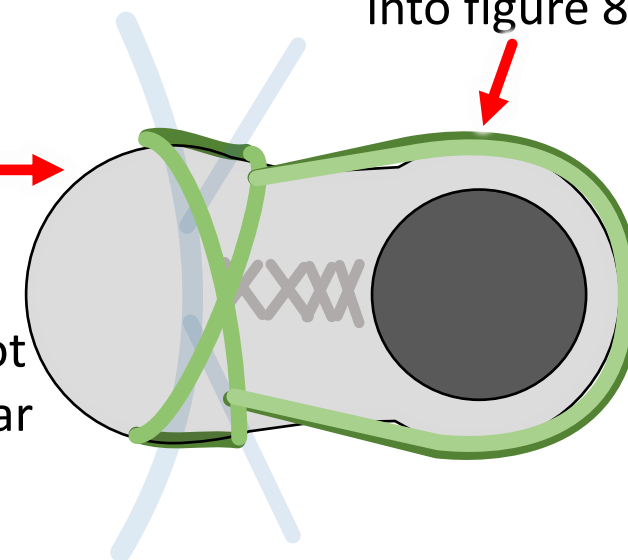


Bind boots just forward of snowshoe's center of gravity

Tail should drop when lifting foot

Heel Loop
Locks heel into figure 8

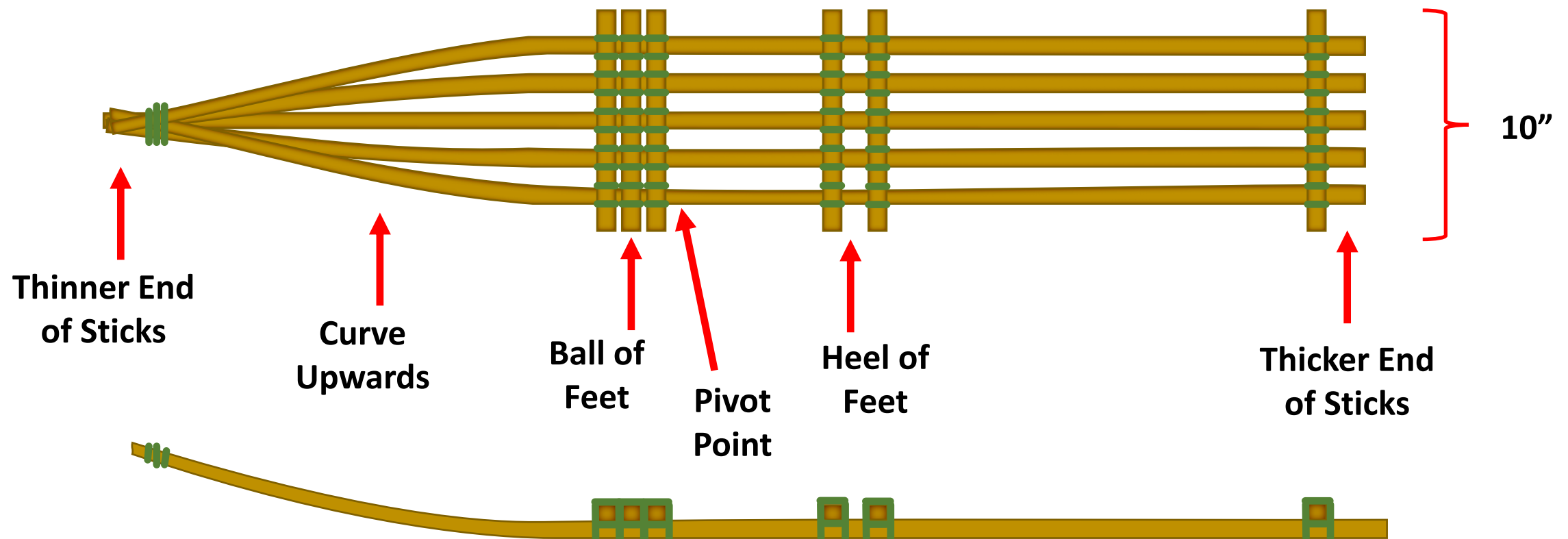
Figure 8 Loop
Holds boot on crossbar



Surviving the Cold

Snowshoes – Canadian Emergency Snowshoes

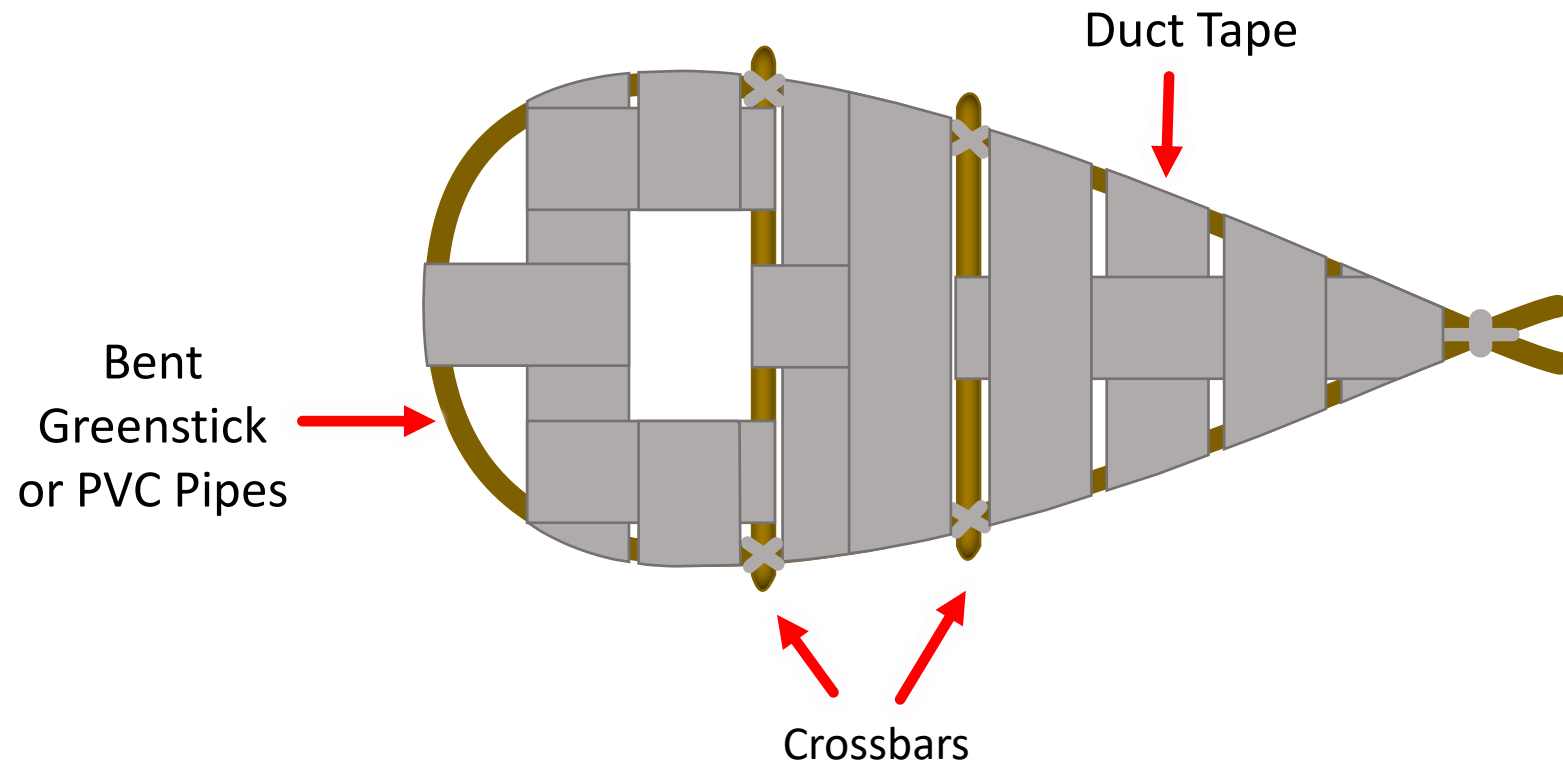
- Good option when limited cordage is available
- 6 sticks as wide as your thumb and as long as user is tall (6'ish)



Surviving the Cold

Snowshoes – Duct Tape Snowshoes

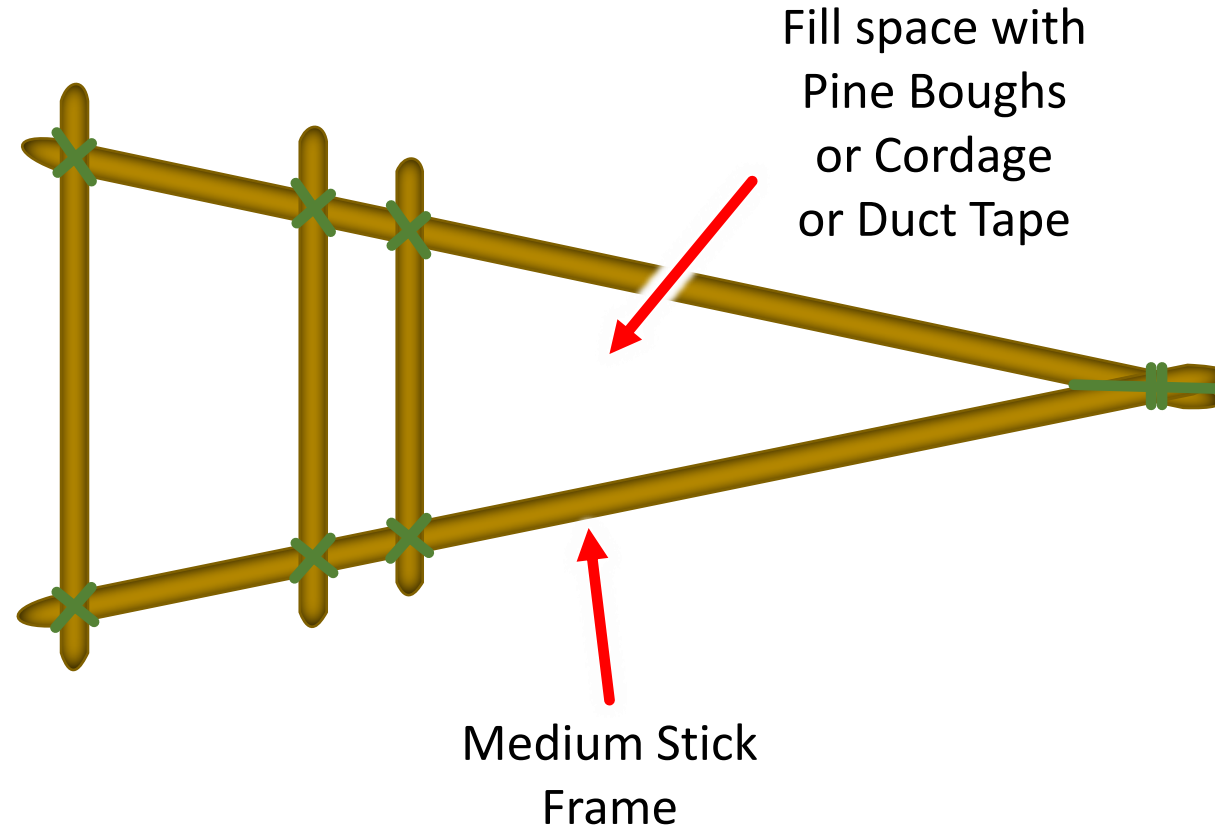
- Got Duct Tape?



Surviving the Cold

Snowshoes – Straight Stick Snowshoes

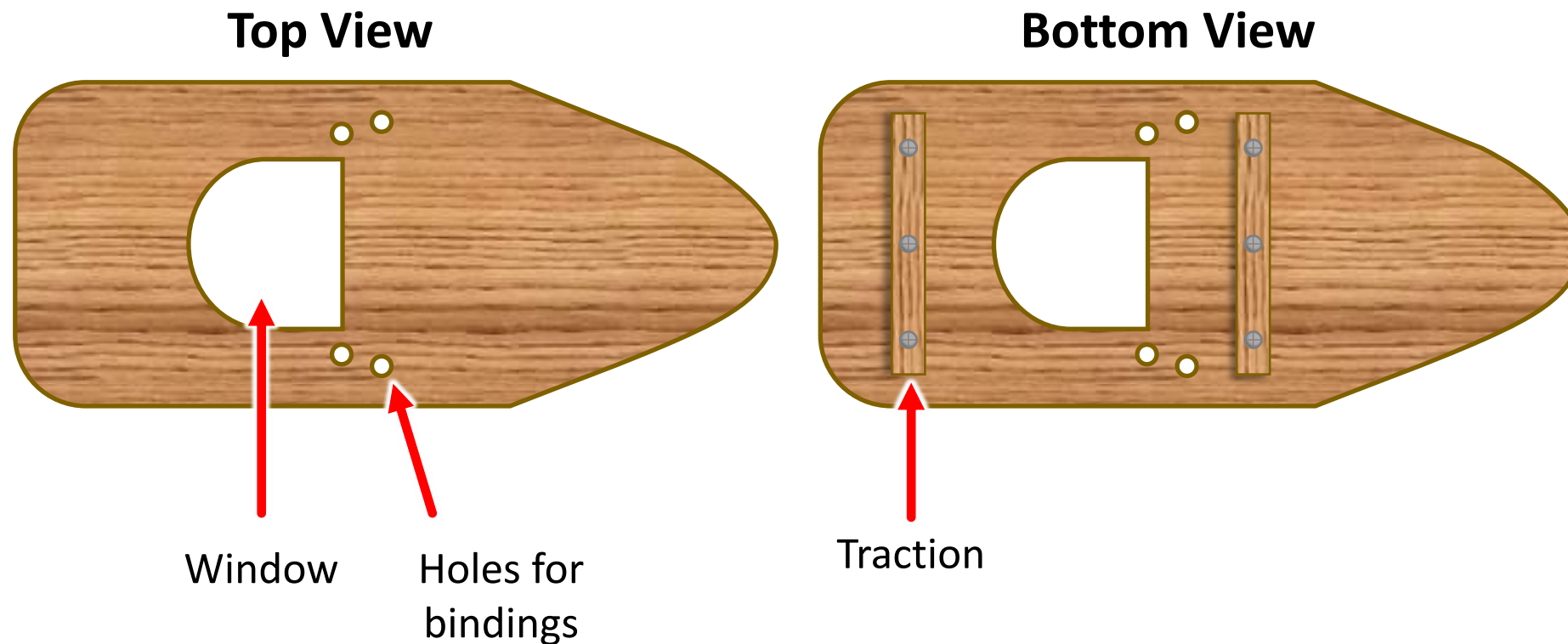
- Sticks won't bend?



Surviving the Cold

Snowshoes – Wood Board Snowshoes

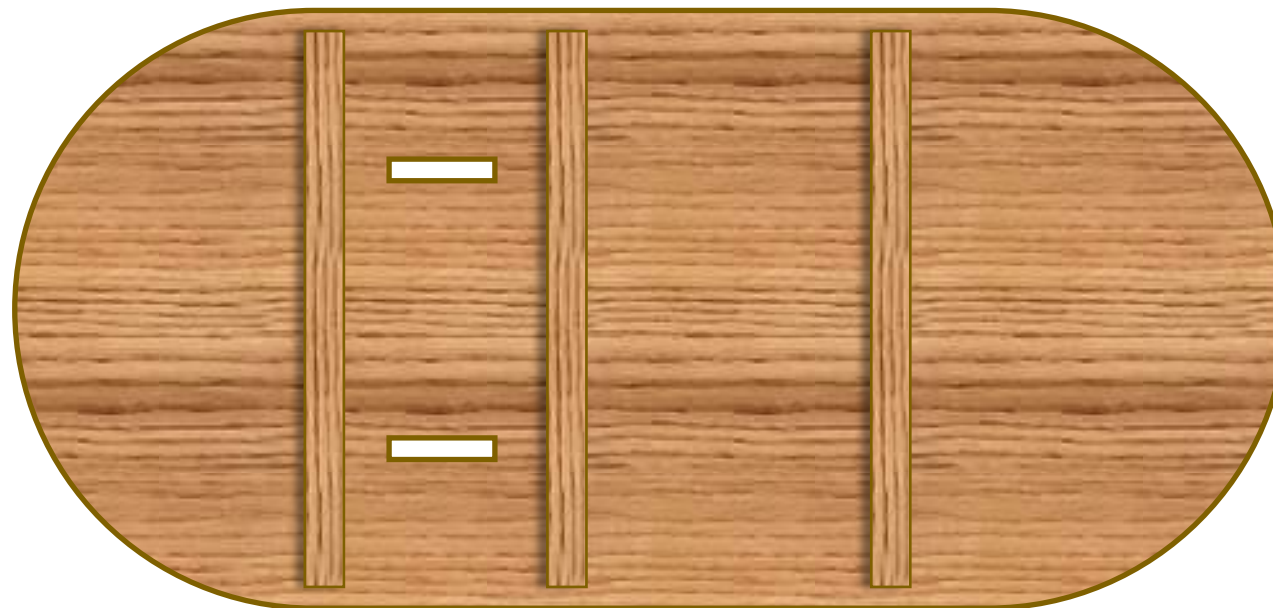
- Use Wood Board



Surviving the Cold

Snowshoes – Wood Board Snowshoes

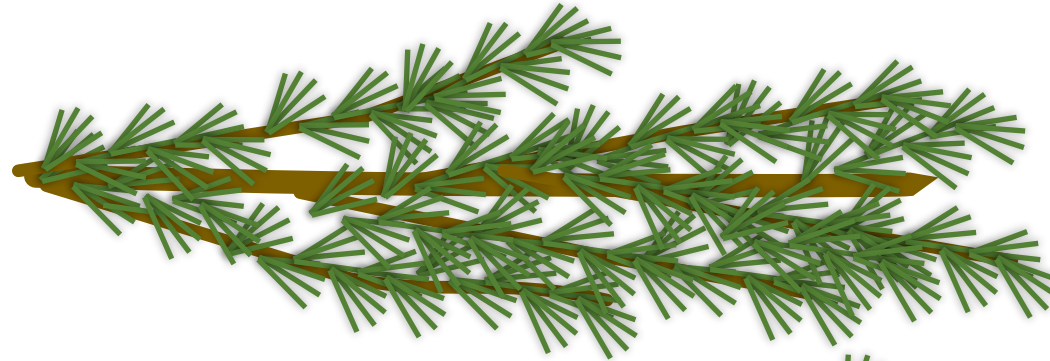
- Shackleton's Ross Sea Party used plywood from wooden crates



Surviving the Cold

Snowshoes – Pine Bough Snowshoes

- Easy to make
 - Find
 - Cut
 - Tie to boots
- Flotation is variable

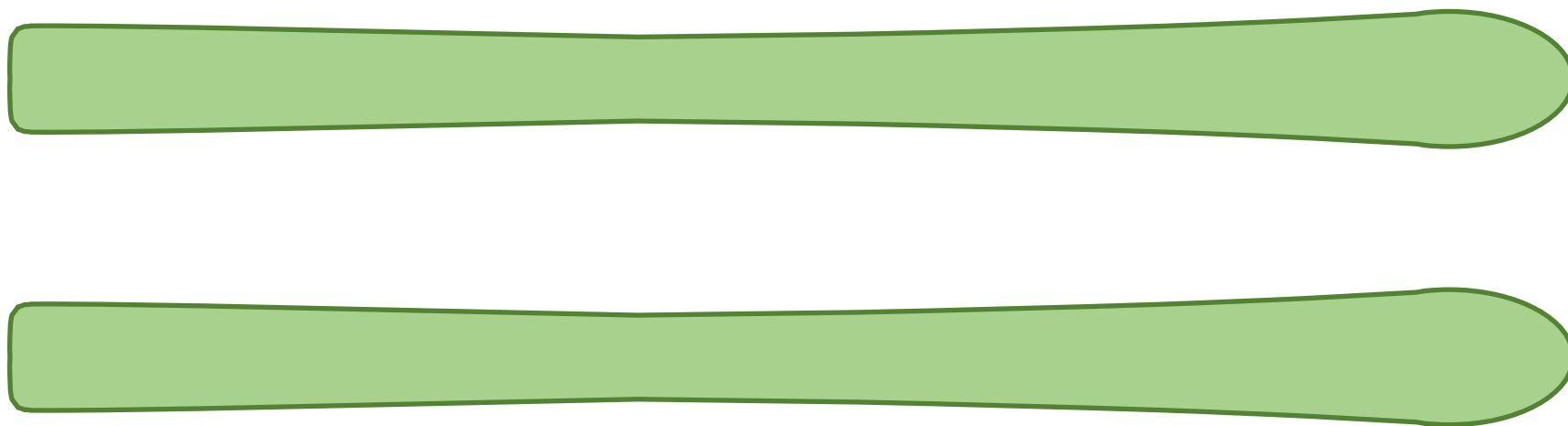


Tie several Boughs together
To increase floatation



Surviving the Cold

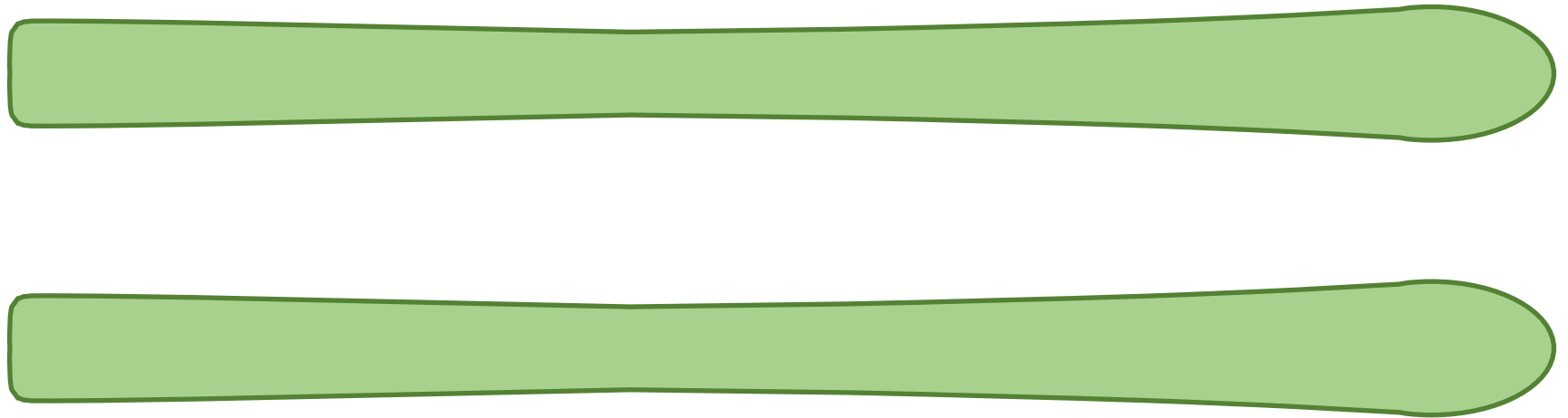
Skis



Surviving the Cold

Skis

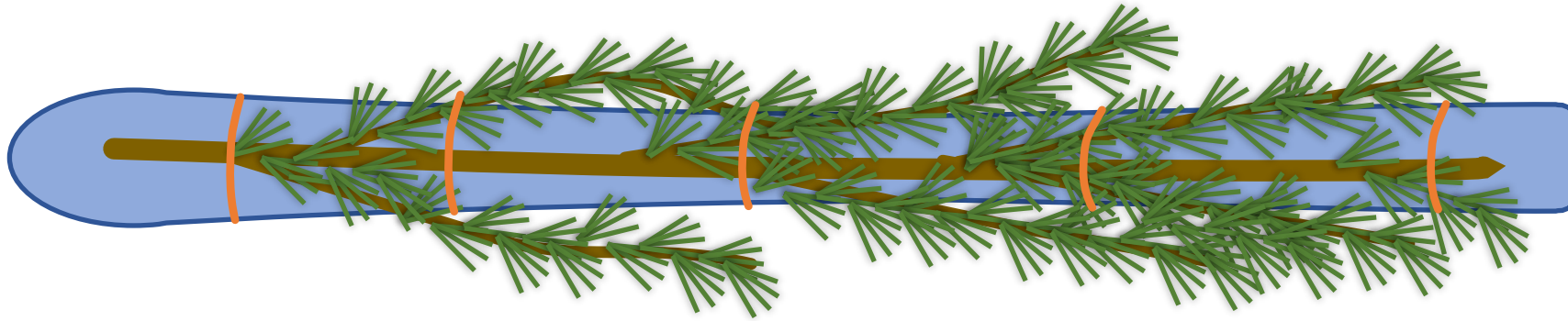
- Skis are great in certain terrain
- It is unlikely that you will be able to make a ski in the wilderness
- But there are several mods and special uses for skis



Surviving the Cold

Skis - Skins

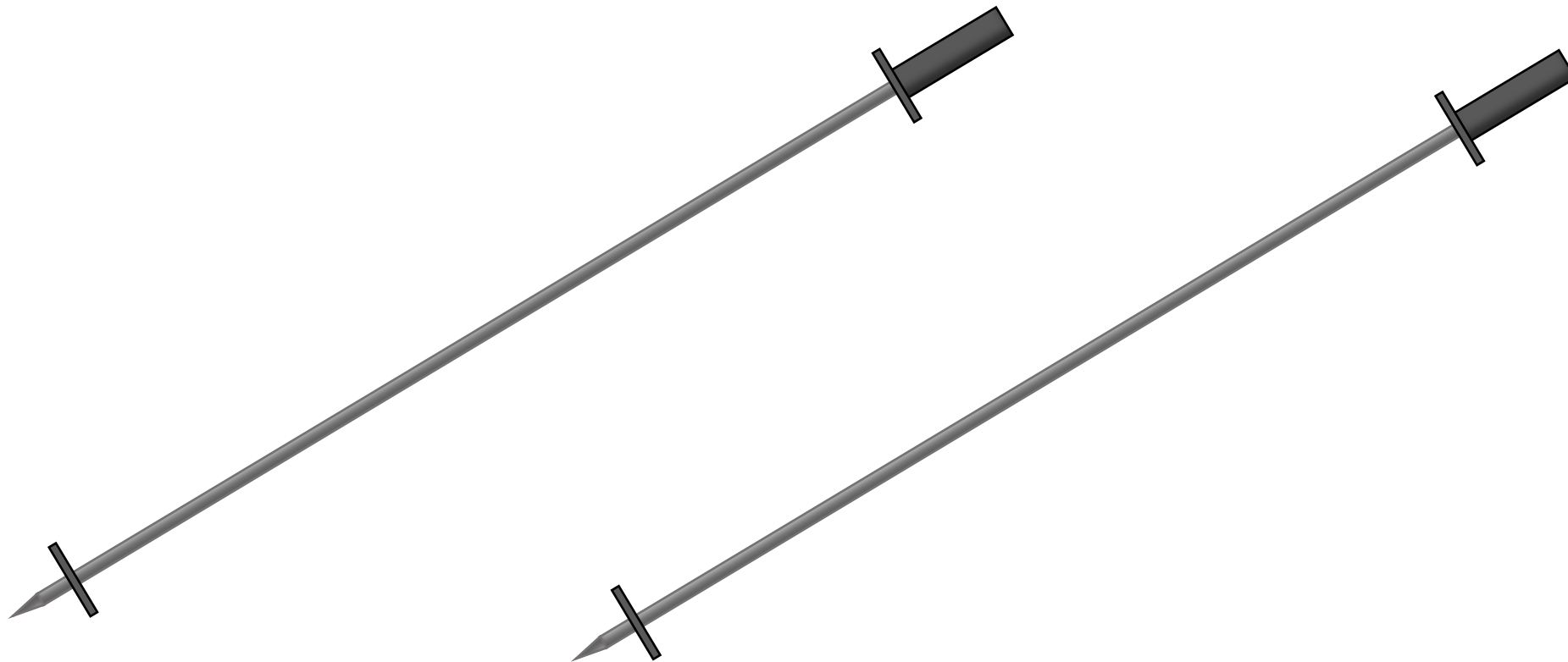
- If you need traction for your skis, tie on pine boughs



Surviving the Cold

Skis - Poles

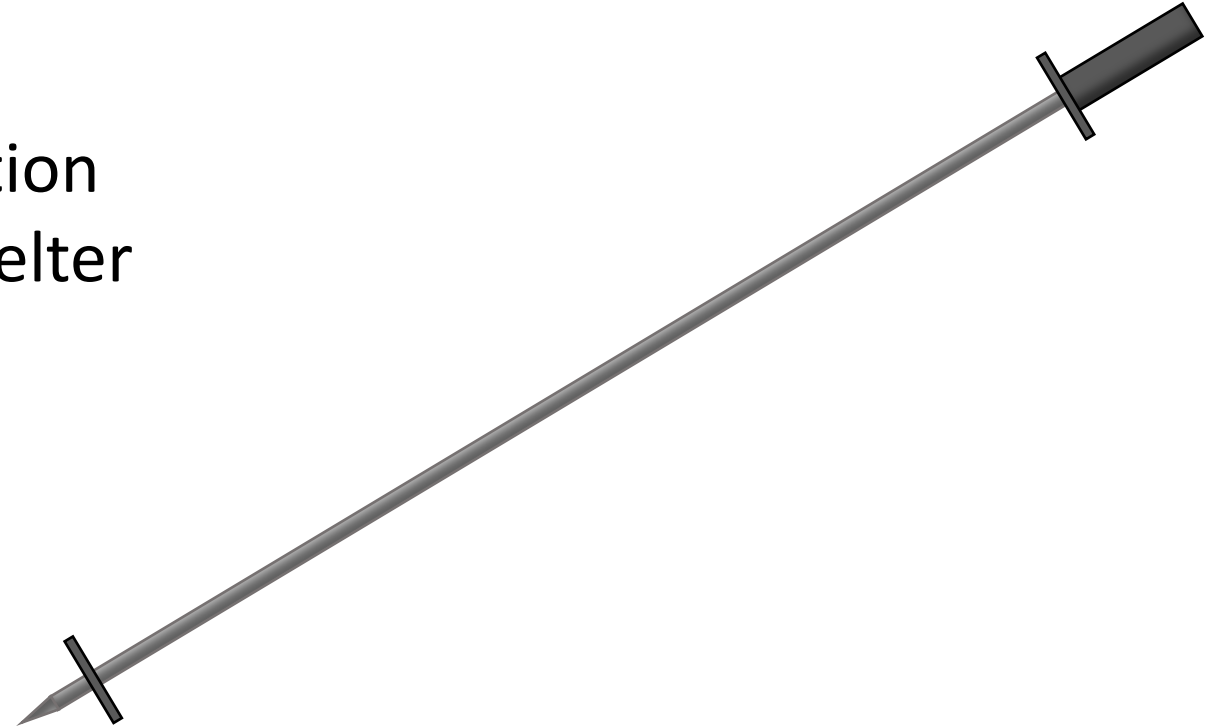
- Ski Poles have many uses



Surviving the Cold

Skis - Poles

- Ski Poles have many uses
 - Supports for spine immobilization
 - Clearing vent holes in snow shelter
 - Tarp poles
 - Roof supports
 - Emergency sleds
 - Rope Ladder
 - Light duty bridge
 - Lightsaber duals
 - Poking skunks – not recommended



Surviving the Cold

Skis – Poles – Snow Probe

- Some ski poles are designed to be used and probes
- Duct tape can work in a pinch with other poles



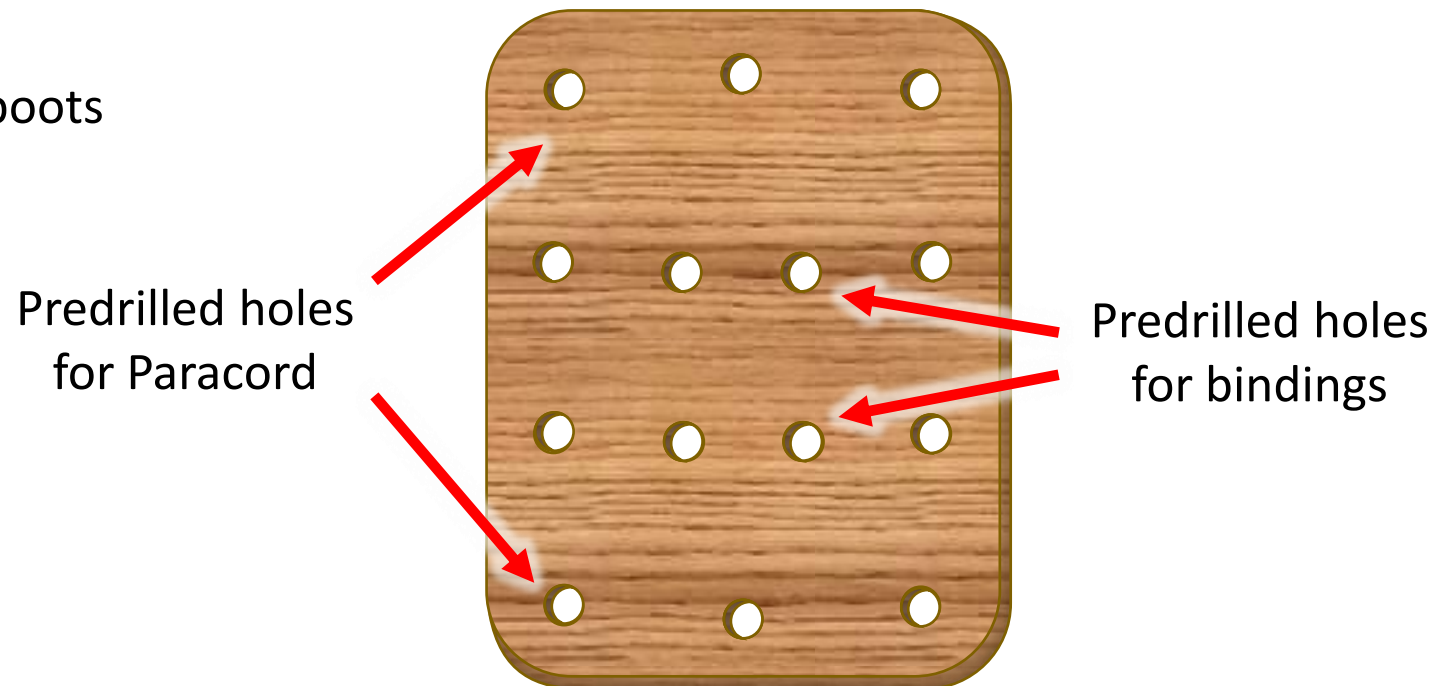
Surviving the Cold

Skis – Emergency Bindings

- Plywood with holes in it
- One of these in your pack can save your bacon

Bolt to ski

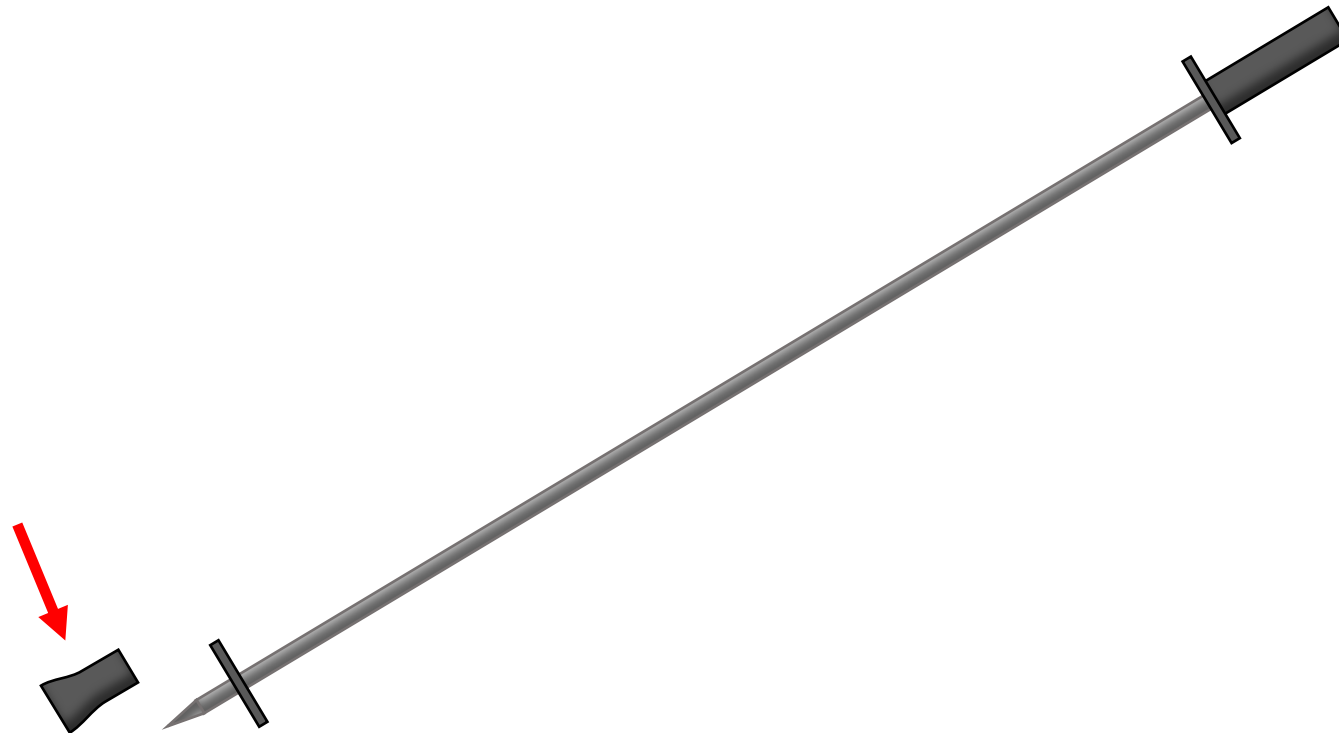
Use paracord to tie boots
to binding and ski



Surviving the Cold

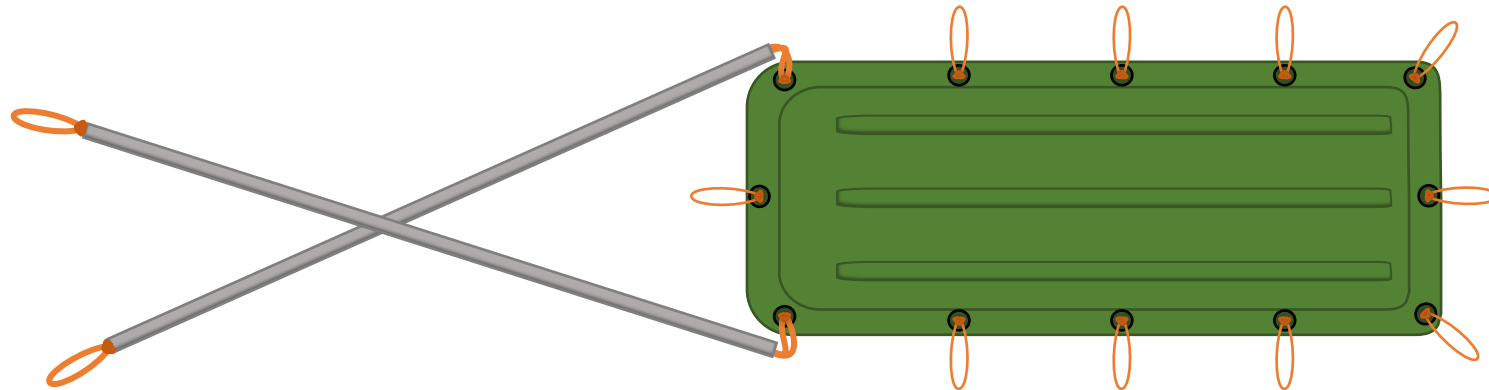
Skis – Rubber Caps for Pole

- Those stupid rubber caps for poles that you probably threw away
 - Nice to have is you use poles to hold up tarp
 - Fire Starter



Surviving the Cold

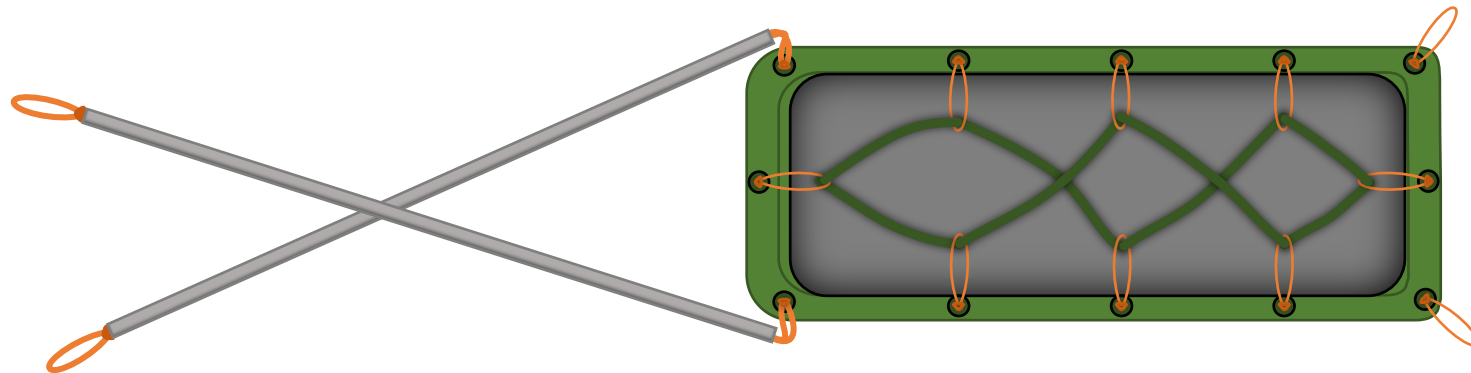
Pulks and Sleds



Surviving the Cold

Pulks

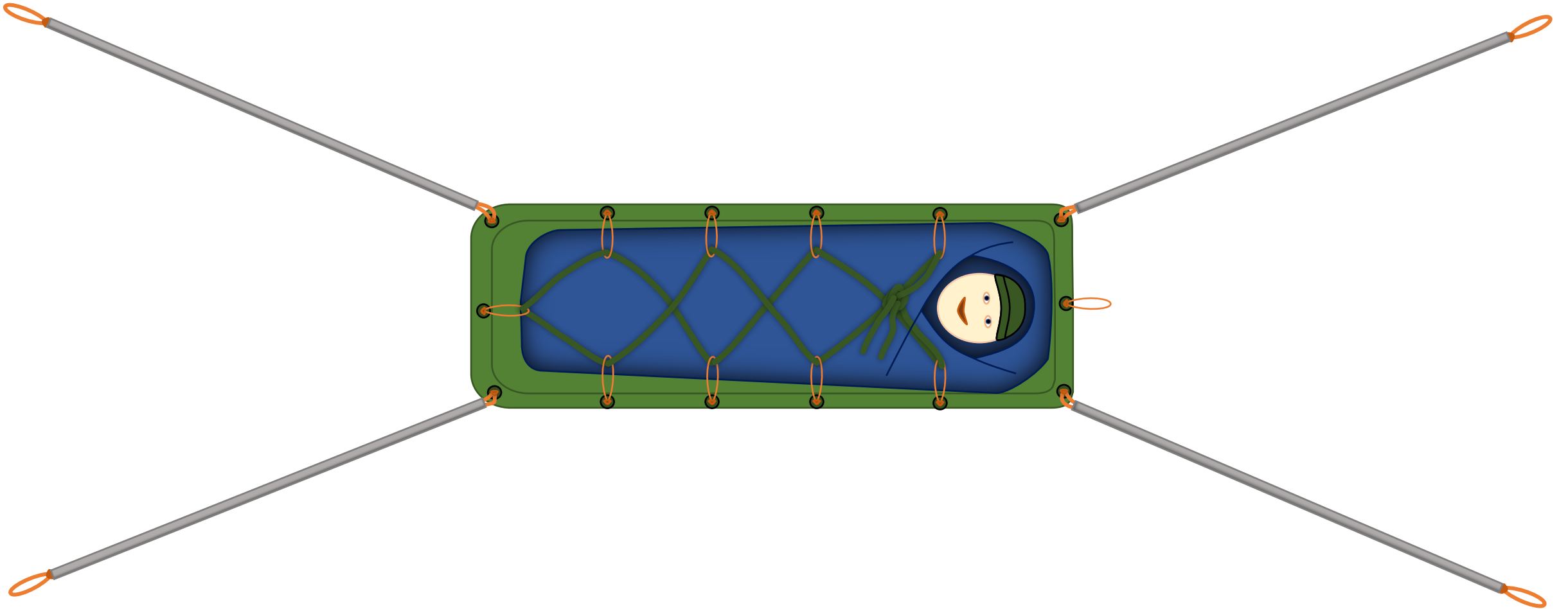
- A hauling sled can be very useful in the wilderness
 - Can haul up to 200 pounds of gear, fuel, etc.
 - Can be used to evac a victim
 - Spreads out your weight over more surface area
 - Less likely to sink into snow or collapse a snow bridge



Surviving the Cold

Akia – Rescue Toboggan

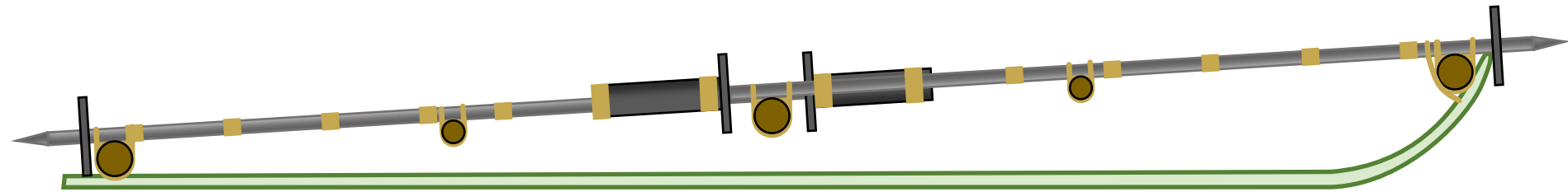
- A longer sled can be used as a Rescue Toboggan



Surviving the Cold

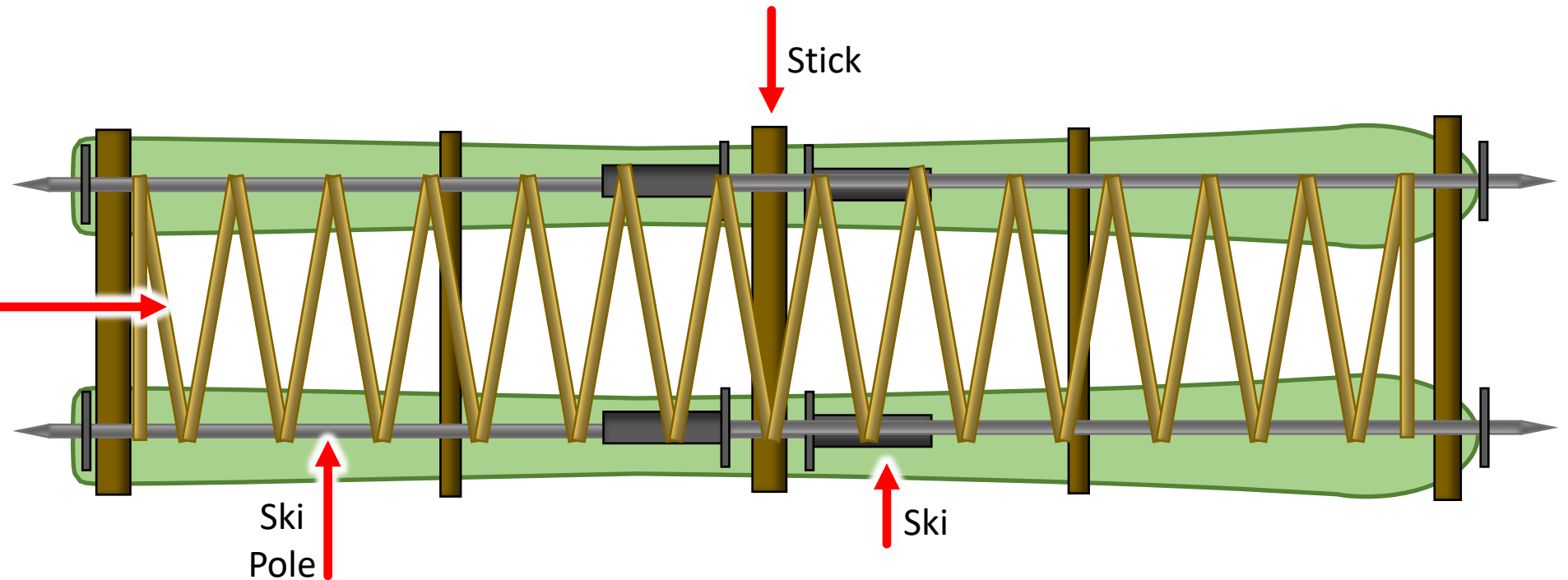
Pulks – Improvised Ski Sled

- Ski sled can be made from
 - Skis
 - Ski Poles
 - Sticks
 - Rope



Rope or:

- Paracord
- Duct tape
- Tarp



Surviving the Cold

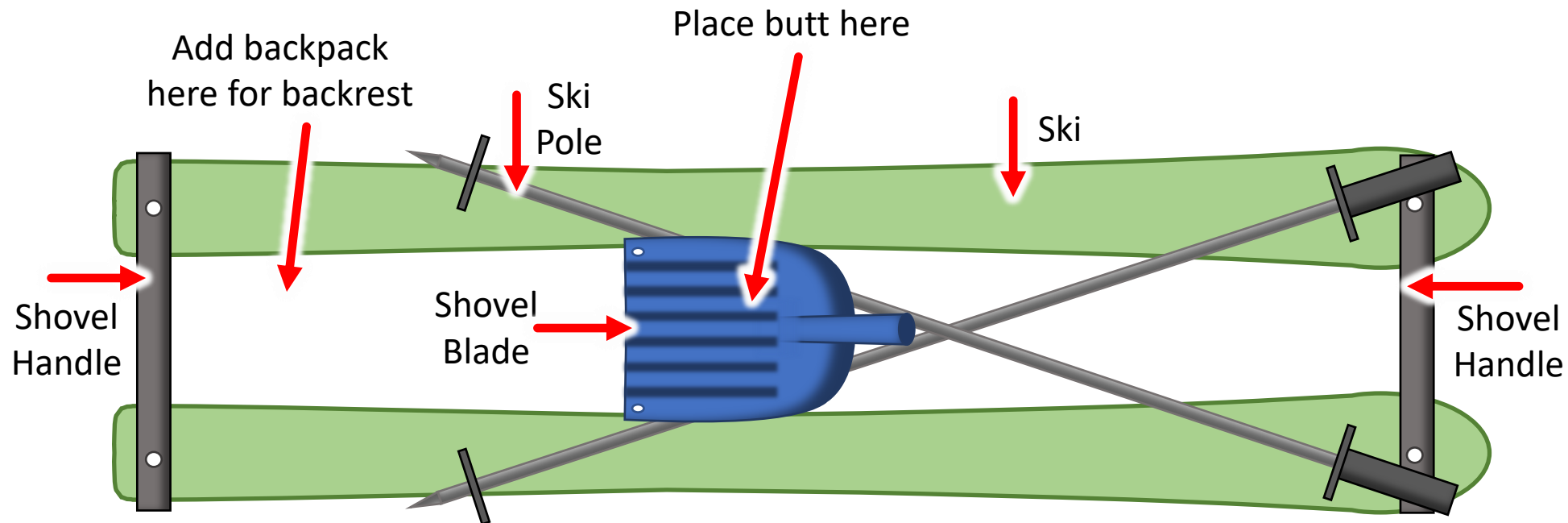
Pulks – Improvised Ski Sled Litter

- Ski sled can be made from
 - Skis
 - Ski Poles
 - Snow Shovel

Multiple ways to set up

You may need to pre-drill holes in your:

- Shovel blade
- Shovel handles
- Skis



Secure parts via:

- Paracord and/or
- Bolts and screws
- Duct tape

Surviving the Cold

Pulks – When to Use

- Choose the right terrain
 - Great for flat terrain
 - Not so great for
 - Steep slopes ($>25^{\circ}$)
 - Rocky terrain
 - Boilerplate snow
 - Narrow trails
 - Switchbacks
 - Spring Slush

Surviving the Cold

Pulks – Body Attachment

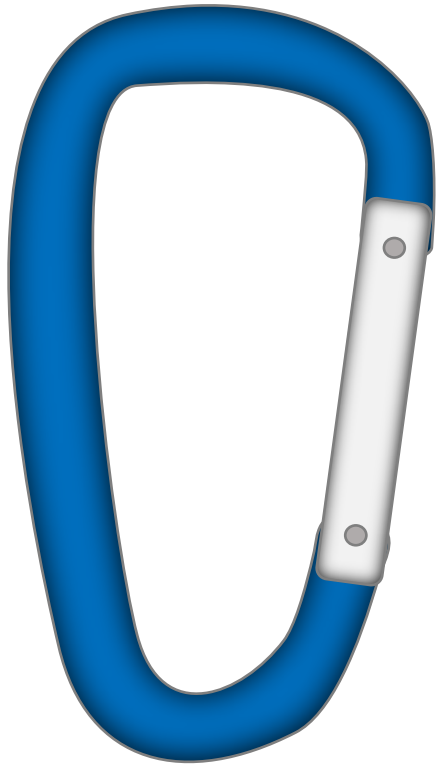
- Attach Pulk securely to body
 - Ideally, use a chest harness or sturdy waistbelt
 - If wearing a pack, attach to hip belt
 - Don't attach to pack fabric if you can avoid it
 - A thick rope tied around waist works just fine
 - Tie loops on each side to hook up to rope or pole



Surviving the Cold

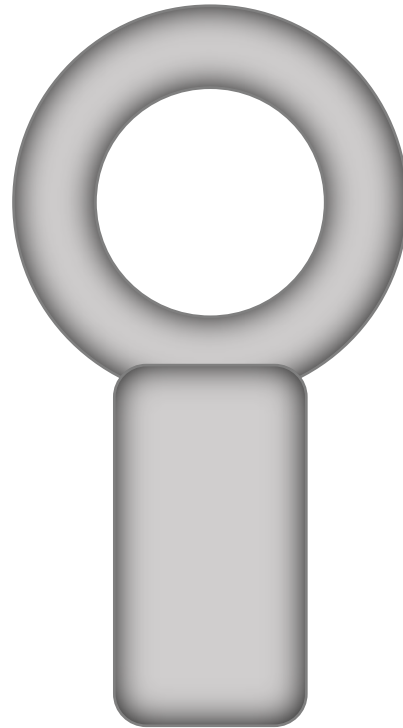
Pulks – Link Attachment

- There are several ways to attach a pole to your body and pulk



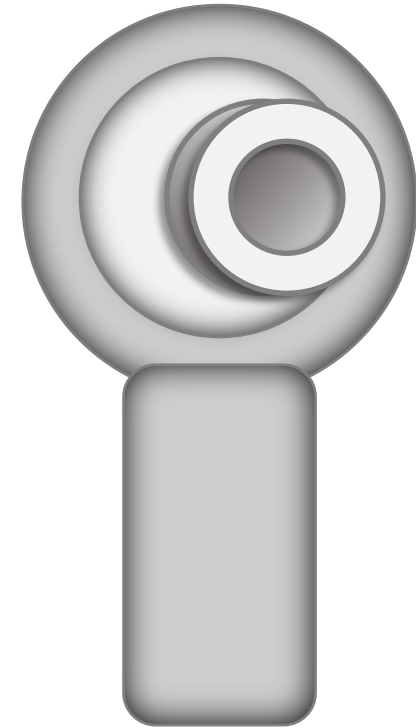
Snaplink

- Simplest attachment
- Results in a lot of slop



Eyebolt

- Run webbing through eyehole
- Lock snaplink through loop



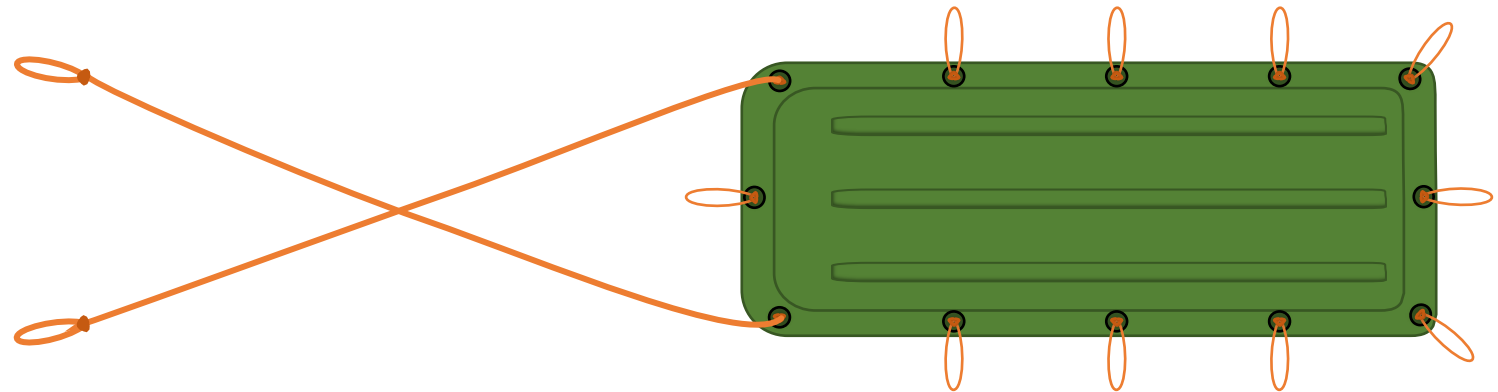
Heim Joint / Rod End

- Solid link
- More difficult to attach to belt

Surviving the Cold

Pulks – Ridged Poles or Ropes

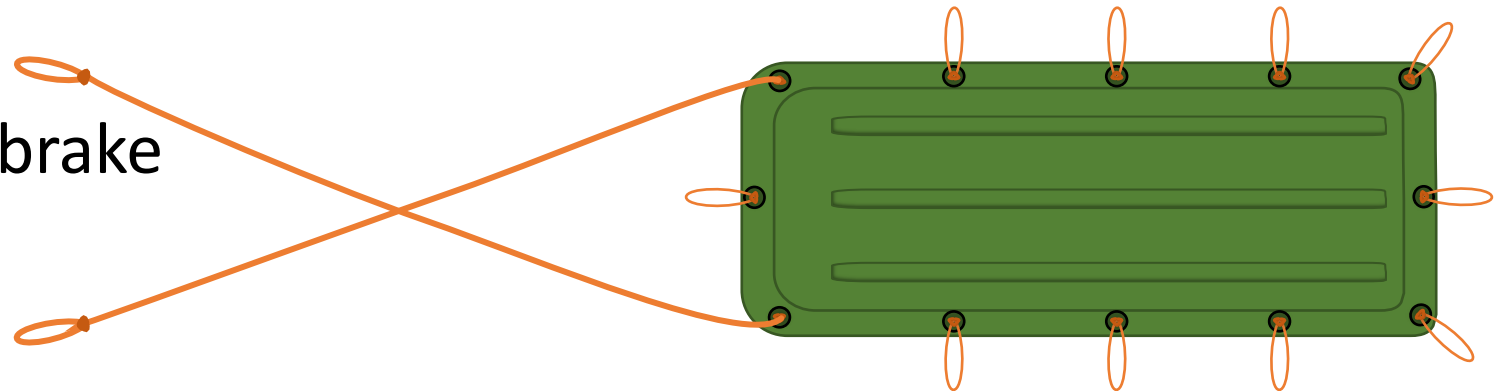
- Ridged Poles or Ropes?
- Ropes good for
 - Gentle terrain
 - Enhanced mobility
 - Absorbing shock
 - Simplicity



Surviving the Cold

Pulks – Ridged Poles or Ropes

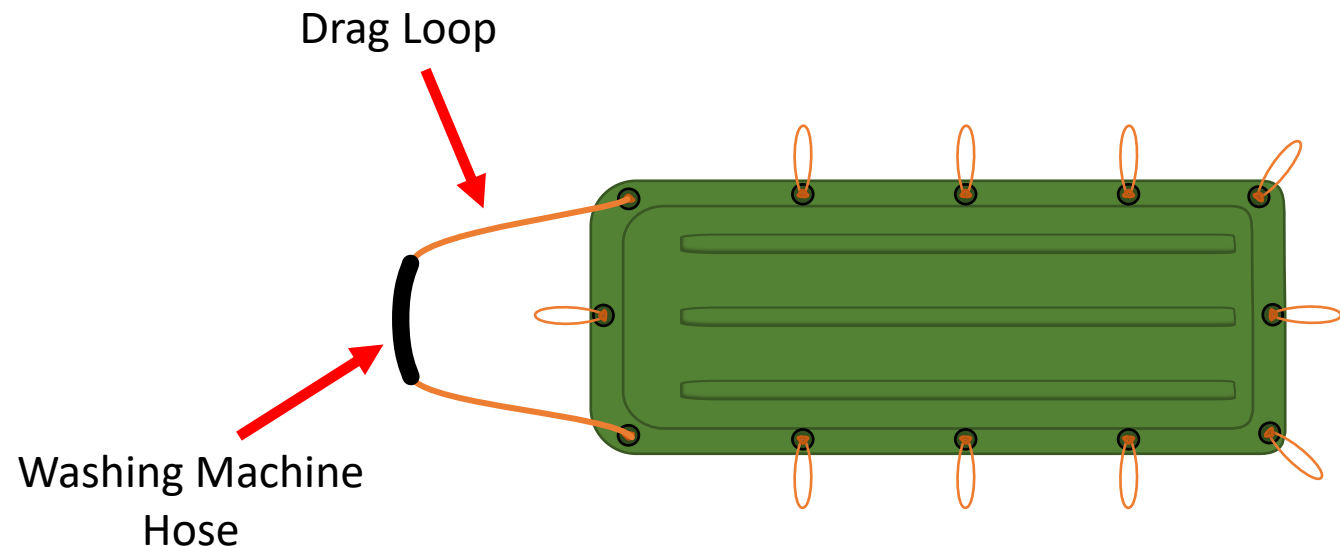
- Ridged Poles or Ropes?
- **Ropes** – going downhill
 - Avoid getting run over by your puck when on a downslope
 - Downhill control can be enhanced by:
 - Using belay line from another person
 - Releasing pulk and meeting up with it at bottom of slope
 - Riding it down – whee!
 - Flipping it over
 - Using a rope/chain brake



Surviving the Cold

Pulks – Ridged Poles or Ropes

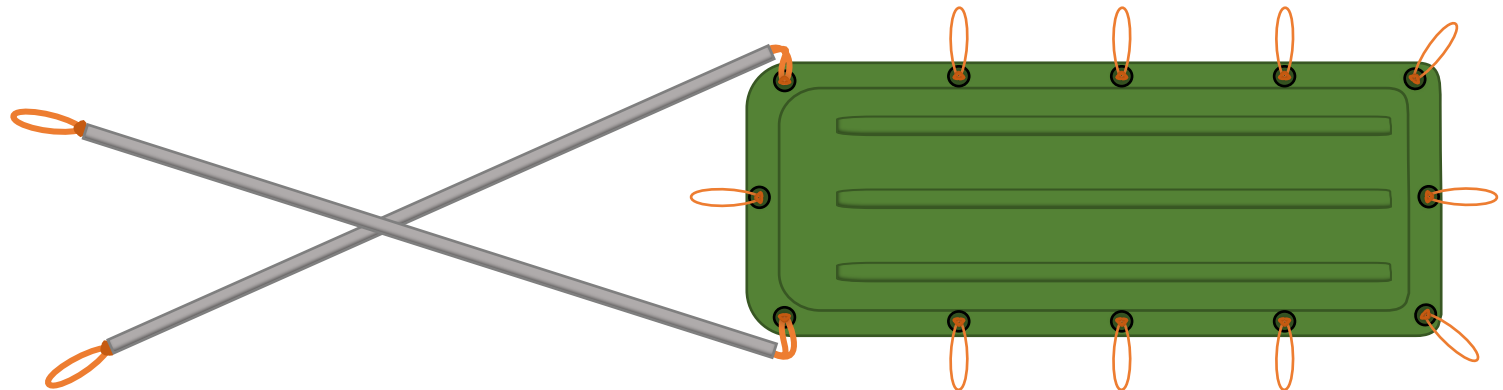
- Ridged Poles or Ropes?
- **Ropes** – difficult terrain
 - If you have difficulty steering pulk or it gets bogged down:
 - Switch to shorter drag loop or choke up on ropes



Surviving the Cold

Pulks – Ridged Poles or Ropes

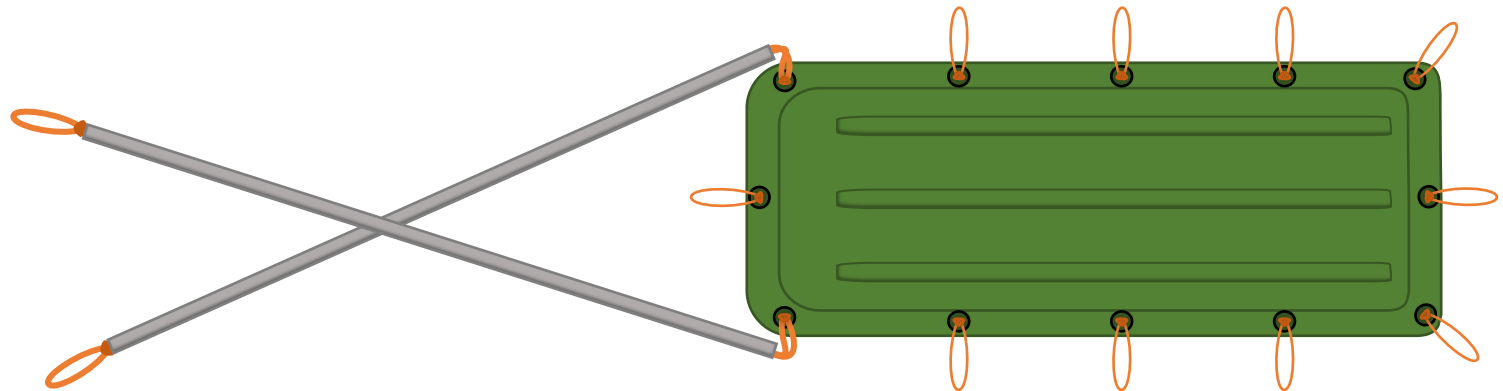
- Ridged Poles or Ropes?
- **Rigid poles** can be made from
 - 5-6 foot sections of ½" schedule 40 PVC
 - Branches
 - Length = Diagonal distance waist to rear of snowshoe/ski plus 4-8"



Surviving the Cold

Pulks – Ridged Poles or Ropes

- Ridged Poles or Ropes?
- **Rigid poles** good for
 - Controlling sled when going downhill
 - It doesn't pick up speed and knock you over
 - More difficult terrain
 - Stability on slopes

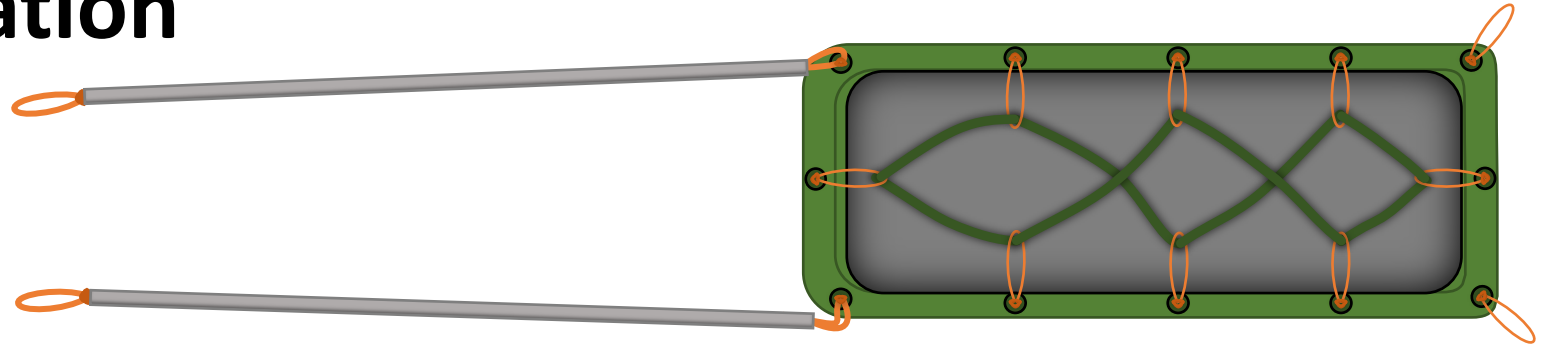


Surviving the Cold

Pulks – Poles Orientation

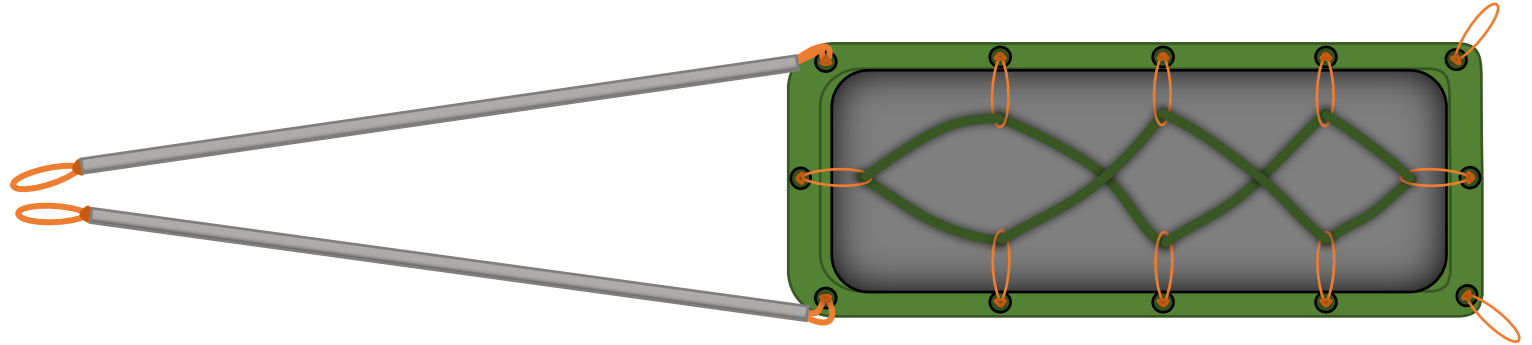
Parallel Poles

- Sled wanders left and right
- Doesn't work well



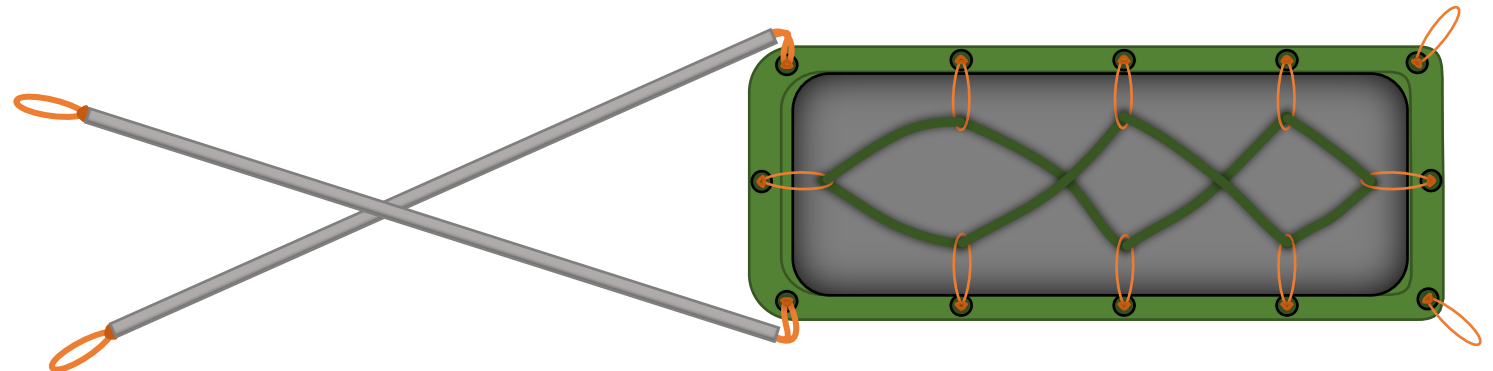
Hitch Linked Poles

- Allows you to turn around
- Poles can punch you in back



Crossed Poles

- Allows for tight turns
- Can easily steer Pulk



Surviving the Cold

Pulks – Hills

- Sometimes gravity is your enemy
- Use a Belay Line to control sled on slopes
 - Tie a rope to back corner and use second person uphill of Pulk
 - You can also rope in ski pole
- On downhills
 - One person ties in to back and snow ploughs behind pulk
 - Use a snow brake
 - Loop of rope or chain in front – dropped to drag under Pulk front
- On rougher terrain, you may need to unload sled
 - Unload and carry some/all gear on back
 - Make multiple trips with lighter Pulk

Surviving the Cold

Pulks – How to Pack

- Ideally, pack everything in a duffle or two
 - Easier to pack and unpack
 - Contents protected from environment
 - Less likely anything will fall out
 - Alternately – wrap everything in tarp burrito
- Pack heavy gear low
 - Less tipsy
- Pack heavy gear centered and to rear
 - Front needs to be a little light so you can drag Pulk over obstacles
- Don't overload your Pulk

Surviving the Cold

Pulks – Other uses

- Pulks can also be used as:
 - Emergency Shelter
 - Roof
 - Wind Block
 - Door
 - Bathtub and clothes tub afterwards
 - Shower tub, if showering in shelter
 - Throw clothes in Pulk and use shower water to wash clothes
 - Boat
 - Rescue sled – Snow litter
 - Deadfall trap
 - Glissading ride of your life

Surviving the Cold

Pulks – Resources

- [Pulk Book](#) by Ed Bouffard 10/06
- [rei.com diy-make-your-own-pulk-sled](http://rei.com/diy-make-your-own-pulk-sled)
- [YouTube Iwj hW2iETs](#)
- [YouTube DHp 12npKsY](#) – simple belt
- utahclimbers.com/misc/pulk
- skipulk.com/guides/using-pulks-with-packs
- skipulk.com/guides/using-a-pulk-as-a-game-sled

Surviving the Cold

Surviving the Cold Resources

Surviving the Cold

General Survival Resources

- [ATP 3-50.21](#) SURVIVAL (US Army September 2018)
 - Part of 3 Part set: ATP 3-50.20 (SERE), [ATP 3-50.21](#) (Survival) and ATP 3-50.22 (Evasion)
 - This set replaced [FM 3-05.70](#) Survival (2002)
 - [FM 3-05.70](#) replaced [FM 21-76](#) (1992), [FM 21-76-1](#) (1999) [FM 3-50.3](#) (2007)
- [AF Handbook 10-644](#) Survival Evasion Resistance Escape (SERE) Operations (USAF March 2017)
 - Replaces [AF Regulation 64-4](#) Search and Rescue Survival Training (JULY 1985)
Excellent resource; contains some information not in new AF 10-644
- [MCRP 3-02H](#) Survival, Evasion, and Recovery (USMC 1999)
- [Bushcraft Scouting Woodlore](#) Dr RW Oelslager
Examples of fires and cooking
- [Combat Survival and Evasion](#)
- [SAS Survival Handbook](#) 2003

Surviving the Cold

Cold Weather Survival Resources

- [Field Manual for the United States Antarctic Program](#) 6th Edition (2001-02)
Excellent information on shelters and basic operations in cold
- [Arctic & Sub Arctic Operations B GL 323 003 FP 001](#)
 - Department of National Defence and the Canadian 1974 updated 1982
 - Examples of snow shelters
- [FM 31-70](#) Basic Cold Weather Manual
 - An oldie (1968) but goody
 - Discussed very basics of cold weather environment
- [COLD WEATHER SURVIVAL](#) A Way of Life
by Frank Heyl with Harley Sachs
- [TC 21-3](#) - Soldier's Handbook for Individual Operations and Survival in Cold-Weather Areas (1986)
- [Arctic Survival](#) PAM (AIR) 226
United Kingdom Air Ministry 1953
- US Marine Corps - [MWTC Winter Survival Course Handbook](#) (2002)
- [B-GA-217-001/PT-001](#) Down but not Out
National Defence : Canadian Government Pub. Centre 1984
- [Arctic Manual](#) by Vilhjalmur Stefansson 1944

Surviving the Cold

Cold Weather Survival Resources - Medical

- Wilderness Medical Society Clinical Practice Guidelines
 - [WMS CPG for the Prevention and Treatment of Frostbite: 2019 Update](#)
 - [WMS CPG for Evaluation and Treatment of Accidental Hypothermia: 2019 Update](#)
 - [WMS CPG for Prevention and Management of Avalanche and Nonavalanche Snow Burial](#) 2017

Surviving the Cold

High Altitude Survival Resources

- [FM 3-97.6](#) (90-6) Mountain Operations - Weather
- [WMS CPG for Prevention and Management of Avalanche and Nonavalanche Snow Burial](#) 2017
- [WMS CPG for the Prevention and Treatment of Acute Altitude Illness: 2019 Update](#)

Questions?