I. INTRODUCTION -- factors at work to consign snowflakes to constant change

> QUOTE: Snowflakes, for all their elaborate detail, are destined for destruction almost from the time they form. -- Marchand

A. ENERGY SOURCES ARE FROM: Beneath (soil), Above (sun, rain, fog) and include

> latent heats of <u>fusion</u> (335 joules/g H_2O) and <u>condensation</u> (2450 J/g)

B. LOW THERMAL CONDUCTIVITY (***k***) of snow slows distribution of energy which causes...

...GRADIENTS in ENERGY which ---> GRADIENT OF WATER VAPOR

II. SNOW METAMORPHISM

A. DESTRUCTIVE METAMORPHISM -- OR--: "Why does snow 'hang' over roof eves?"

1. PROCESS: Shortening of arms of snowflake crystals due to redistribution of water molecules

2. CHARACTERISTICS: spontaneous, inevitable, faster in warm air
"equi-temperature" conditions; no T gradient in snow required

3. Shortens arms of crystals --> more spherical shape, increased stability

4. RESULTS: Indicate from your study whether the following INCREASE or DECREASE

a. Snow density _____ and air space/volume _____

b. Mechanical strength of snow _____ -- snow 'hangs' over roofs, railings

c. APPLICATIONS: Snow shelters -- Inuits igloo, and Athapaskan style Quin-zhee

B. CONSTRUCTIVE METAMORPHISM -- OR-- "Why does snow 'hollow out' beneath"?

1. FACTORS -- <u>temperature gradient</u> (warmer soil to top of snowpack), and <u>pore spaces</u>

2. PROCESSES -- conduction of heat from soil --> sublimation -> vapor gradient

> greater [H_2O potential; and conc.] bottom to top

3. RESULTS
   a. Upward conduction of H_2O vapor --> diminishes crystals on bottom
   b. Recrystalization on upper layers of snowpack
   c. "Depth Hoar" -- brittle, loosely arranged crystals on bottom
   d. Increased space in <u>subnivean</u> environment for small mammal movement
   e. Increased danger of cave-ins and avalanches

C. MELT METAMORPHISM -- OR-- "What happens when any part of snowpack is exposed to above-freezing temperatures"?
OR-- "Why do we see more melting than one would expect, especially when fog forms over snow *versus* when it rains"?

1. FACTORS

a. Snow melt at surface --> heat gain of 335 J/g to become liquid
b. Downward infilt. of energy-carrying liquid and recrystalization releases 335 J/g
c. Heat Pump effect -- transport of energy decreases temp. gradient

2. QUESTION: Why does formation of FOG over snow cause faster melting than if it is raining? _____

> HINT: Compare Latent Heat of Condensation _____ Joules/g H_2O with Latent Heat of Crystallization _____ Joules/g H_2O

III. INSULATIVE VALUE

A. QUESTION: How much snow depth is enough to insulate life beneath?

1. Depends upon degree of metamorphism (which increases density)

2. Fresh snow (with lowest density) has higher THERMAL INDEX

3. EXAMPLE: 20 cm of fresh snow with density of 0.1g/cm^3 --> I_T = 200
[i.e. I_T = **z**(or thickness in cm) ÷ **G**(g/cm^3)] = [20 cm ÷ 0.1g/cm = 200 cm x cm^3/g]

4. CONCLUDE: 20-cm snowfall is enough to reach the threshold where mammals are protected from air temp. fluct. (see Fig. 5); but metamorphism will cause drop below minimum

5. BENEFIT TO SMALL MAMMALS -- See Figure 6

IV. SNOW AND RADIENT ENERGY FLOW -- OR-- "Why might snow melt first around a tree trunk, but last in a small forest clearing"?

A. Snow is natures best "_____"

1. Excellent <u>reflector</u> of shortwave -- brightness of snow!

2. Excellent <u>absorber</u> of IR (heat) from radiating objects, and excellent radiator of IR

B. RESULTS:

1. Tree trunk radiation of IR to snow --> sublimation
2. Snow also is radiating IR and reflecting light to trunk
3. Snow has NET LOSS of energy on CLEAR NIGHT
4. Coldest air layer is near snowpack --> temp. inversion (Fig 8)
5. Last snow to melt is in forest clearings --> low insolation but high IR radiation out
6. "Ice Fog" -- forms when water vapor condenses/freezes in inversion layer

V. LIGHT TRANSMISSION IN SNOWPACK

A. Increases with increasing density as destructive metamorphism rounds crystals and increases surface area for refraction and scattering

B. However, this increase (Figs. 12 and 13) is reversed as coalescence decreases surface area and hence scattering

C. Therefore, increased insolation in Jan->Apr is offset some by decreased transmission due to increasing density

D. Blue light (500 nm) has best penetration into snow (Fig 15)

E. Many questions remain about effects of light on subnivean plants and animals