What is a Glacier?

- Mass of snow and ice:
  - existing throughout the year
  - evidence of movement

- Grows:

- Shrinks:

- Moves:

Types of Glaciers

- Two basic types:
  - Alpine and Continental

- Differ in terms of:
  1. 
  2. 
  3. 
  4. 
Alpine Glaciers

- Located in mountainous regions
- Form at elevation above the snowline
- Movement is: ____________________________
Columbia Icefield, B.C.-Alberta

Valley Glacier

Cirque Glacier

Cirque Basin
Valley and Tidal Glaciers
west coast B.C., Alaska

Piedmont Glacier
location unknown

Continental Glaciers

- Large continuous mass of glacial ice, regardless of location, is referred to as a continental glacier
- Come in different sizes:
  - Largest - ice sheet (>50,000 km²)
  - Smaller - ice cap (<50,000 km²)
- If mountain tops are visible called ice field
- Movement controlled by:

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Glacial Ice Formation

- Accumulation of snow and ice, thick layers
- Weight → increased pressure at depth
- Pressure melting point at depth is reduced
- Snow → Gr. Snow → Firn → Imp.Glace → Ir. Glace

Behaves as a plastic under pressure - flows

- Process takes from a few yrs to thousands of yrs
Glacial Mass Balance

Accumulation = Precip. (all forms), snow avalanches
Glacial Mass Balance

Ablation = snowmelt, sublimation, deflation, and calving

Glacial Advance or Retreat?

Glaciers advance/grow when:
Precip. ↑ and/or temperatures ↓
Causing ↑ accumulation and/or ↓ ablation
Equilibrium line shifts towards terminus; the glacier advances

Glaciers retreat/shrink when:
Precip. ↓ and/or temperatures ↑
Causing ↓ accumulation and/or ↑ ablation
Equilibrium line shifts towards accumulation zone; the glacier retreats
Advance or Retreat?

Movement of glacial ice is NOT necessarily coincident with advance or retreat of the terminus.

Ice may be moving even when the terminus is stationary, advancing, or retreating.

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**Glacial Movement**

Rate of movement depends on:

1. Rate of ______
2. Slope of ______
3. Slope of ______
4. Temperature of ______
5. Presence of ______ at base

Rate varies - metres/day to cm/year
Faster near ______, along ______
Slowest near ______ and ______
due to ____________________

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**Glacial Movement**

Three mechanisms of movement:

1) Basal Sliding

2) Plastic Flow

3) Shearing
Ice Regelation and Plucking

Due to pressure changes at base of glacier

Glacial Erosion

Three processes account for the majority of glacial erosion:
1) Plucking
   w/ ice regelation
2) Abrasion
   polishing, scouring, striations, grooves
3) Bulldozing
   glaciotectonic features
Glaciation typically removes soil and regolith, eroding down to bedrock.
Identify and describe cirque basins, cols, horns, aretes, tarns, hanging and u-shaped valleys, paternoster lakes, fjords.
Depositional Landforms Created by Alpine or Continental Glaciation

- Moraines
  - Accumulations of till (unsorted material)
  - Terminal or end moraines: advance = ablation
  - Sequence of end moraines referred to as washboard or recessional moraines
  - Lateral vs. Medial Moraines (alpine)
Glaciofluvial deposits (sorted material)

- Glaciers develop extensive drainage systems in the ablation zone
- on = __________________
- within = ______________
- and beneath = ____________
- Sediment laden runoff deposits an _______ _______ in a process analogous to the development of a delta or alluvial fan
Depositional Landforms Created by Continental Glaciation

- Ablation of stagnant ice; = till plain
- Deposition of glaciofluvial sediments; = inverted topography after ice melts
  - Subglacial fluvial deposits result in long sinuous ridges called ________
  - Supraglacial lake deposits result in hills called ________
- Blocks of clean ice result in subsidence and depressions called _______________
Erosional and Depositional Landforms Created by Continental Glaciation

- Two general types of streamlined features:
  - **Roche Moutonnée**
    - gentle intercepting slope, steep leeward slope
  - **Drumlins**
    - steep intercepting slope, gentle leeward slope

Deposition by Continental Glaciers

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Pleistocene Glaciation

Mechanisms of Climate Fluctuation

Figure 3.3: Astronomical factors that may affect Earth's climate:
1. Earth's orbital eccentricity varies during a 100,000-year cycle, affecting temperature. Earth's obliquity cycle has a 41,000-year cycle.
2. Earth's axial precession varies during an 26,000-year cycle, affecting temperature. Earth's axial tilt varies during an 12,000-year cycle.
Glacial Lakes and Spillways