Meteorology

5.05 Stability and Instability

References:

Air Command Weather Manual Chapter 4

FTGU pages 137-139

Review

1. What does relative humidity mean?

   Actual amount of water vapour in a volume of air compared to what it can hold if fully saturated

2. Explain how clouds are formed.

   Air rises and expands and cools – condensation of water vapour to clouds

3. Name three specific types of clouds and their abbreviations.

   Cirrus Ci, Cirostratus Cs, Cirocumulus Cc, AltoCumulus Ac, AltoStratus As, Stratus St, Nimbostratus Ns, Towering Cumulus Tcb, Cumulus, Cu, CumuloNimbus Cb

4. Name 4 types of precipitation.

   Drizzle, Rain, Snow, Snow Grains, Snow Pellets, Hail, Ice Pellets

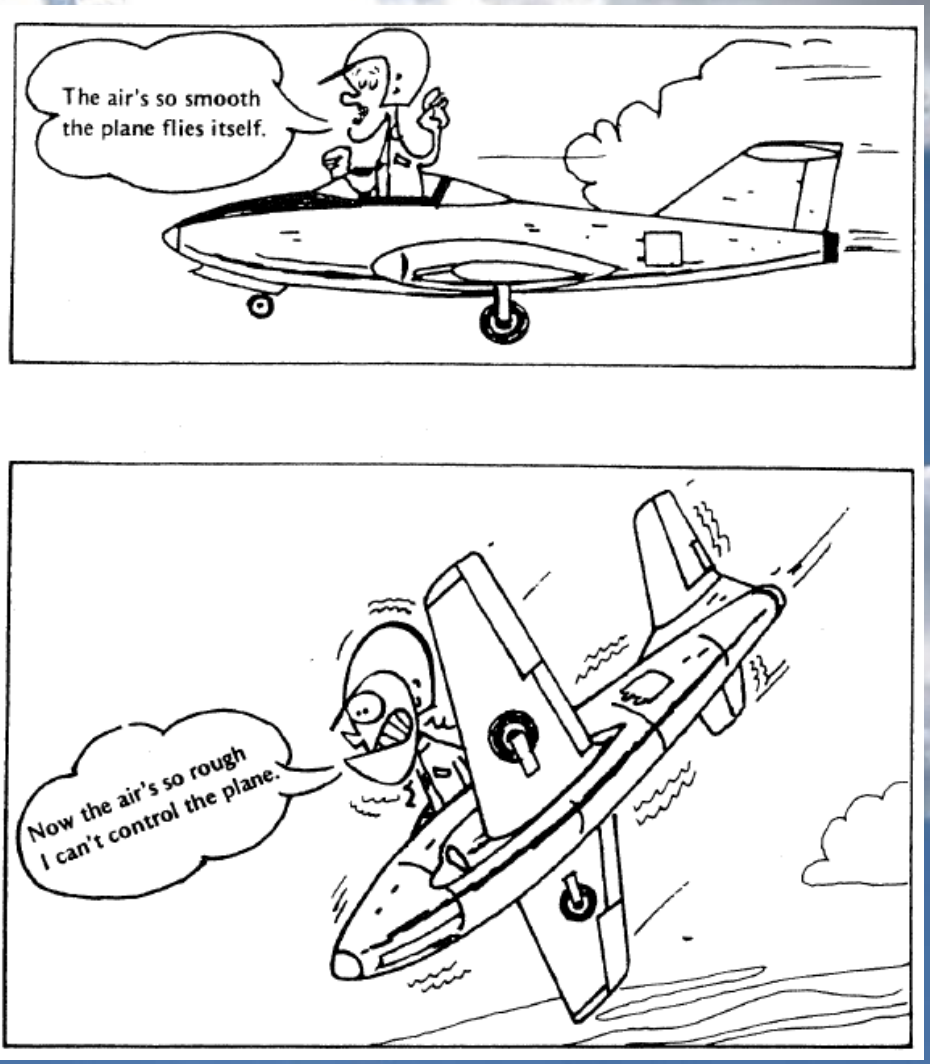
5. Define lapse rate.

   Temperature drop as you climb in elevation – 2° C per 1000 ft.

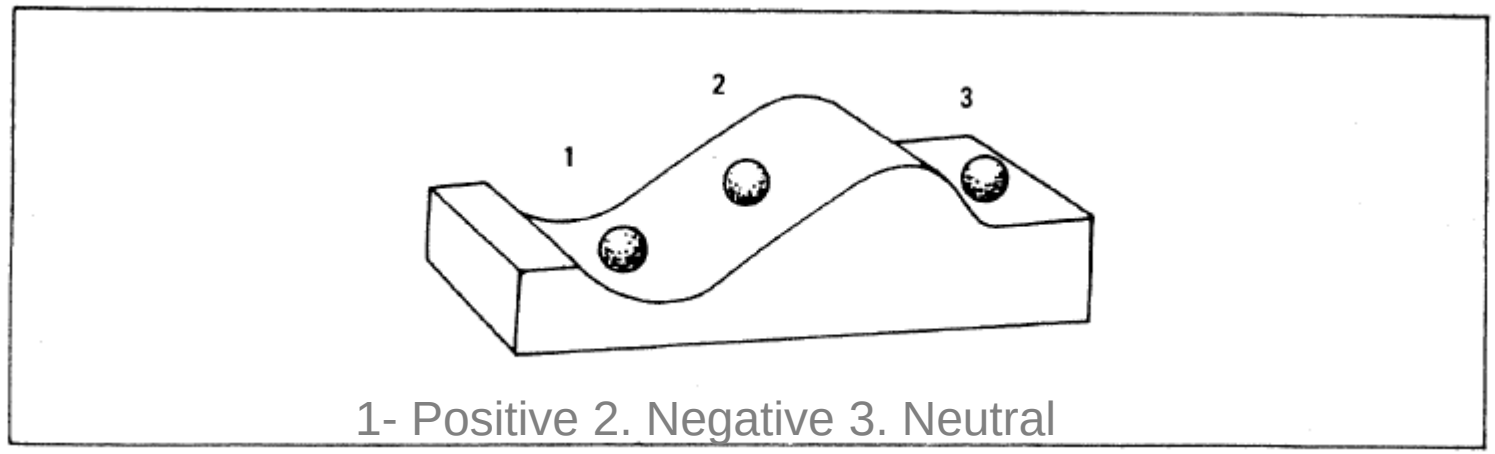
5.05 Stability and Instability

- MTPs:
  - Stability
  - Lapse Rate and Stability
  - Modification of Stability
  - Stable and Unstable Air
  - Lifting Agents
  - Subsidence

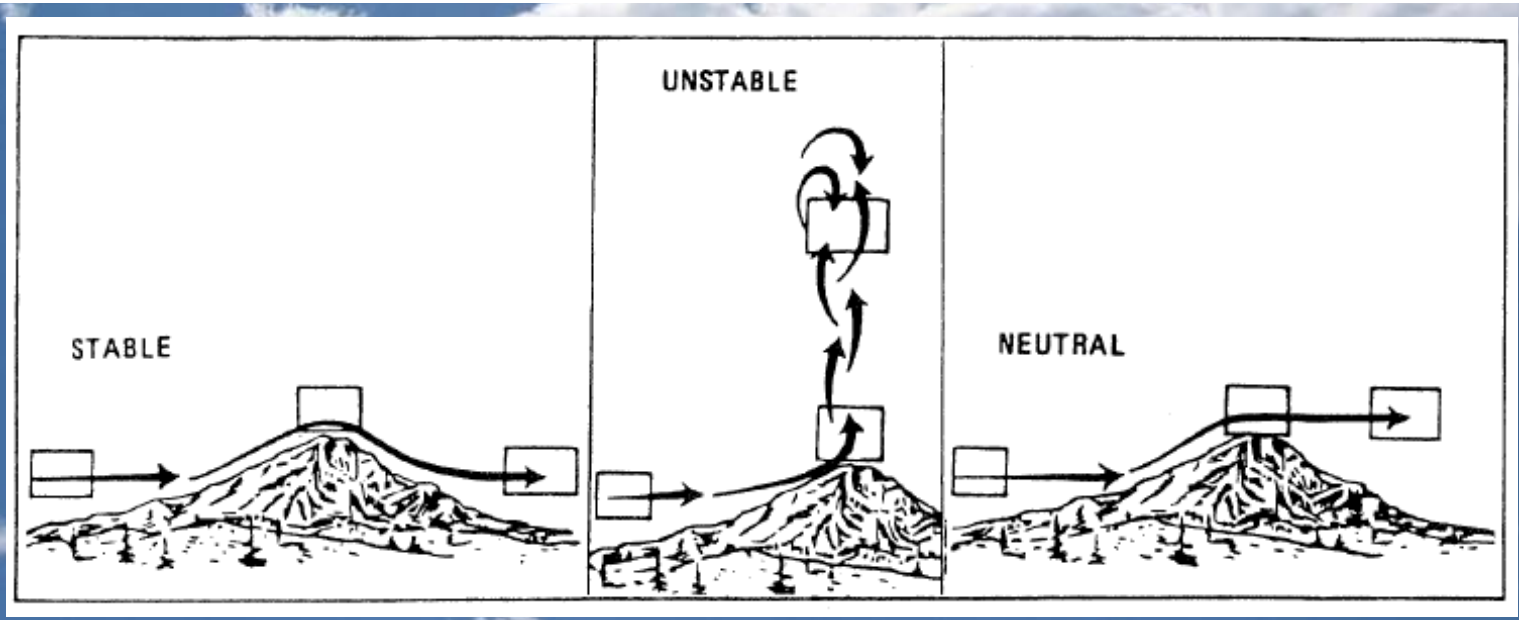
Stability


The air's so smooth the plane flies itself.
Now the air's so rough I can't control the plane.

Stability



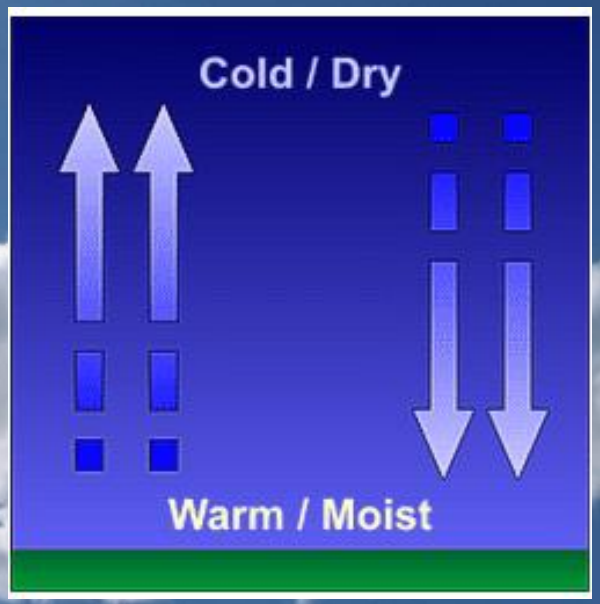
1- Positive 2. Negative 3. Neutral



Stability and Lapse Rate

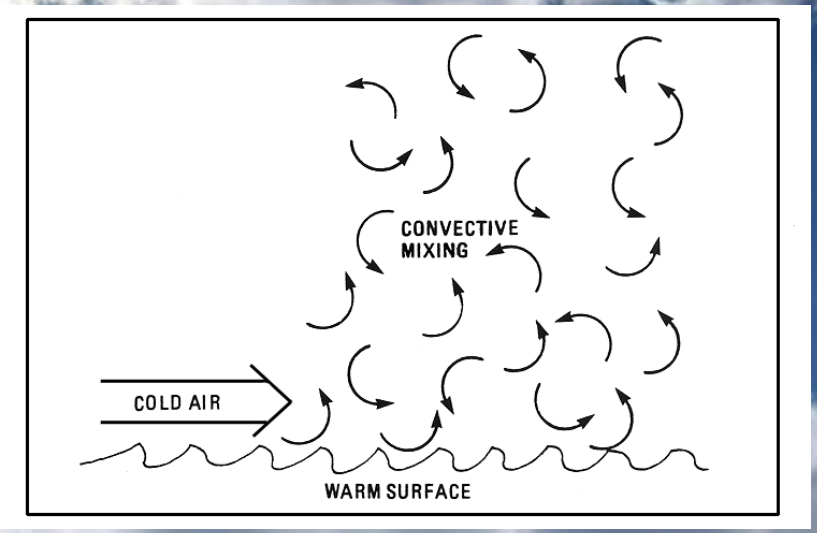
- Unstable air indicated by steep lapse rate
- Steeper lapse rate = more unstable air
- Greater than the ICAO standard

- Stable air indicated by shallow lapse rate
- Shallower lapse rate = more stable air.
- Less than the ICAO standard

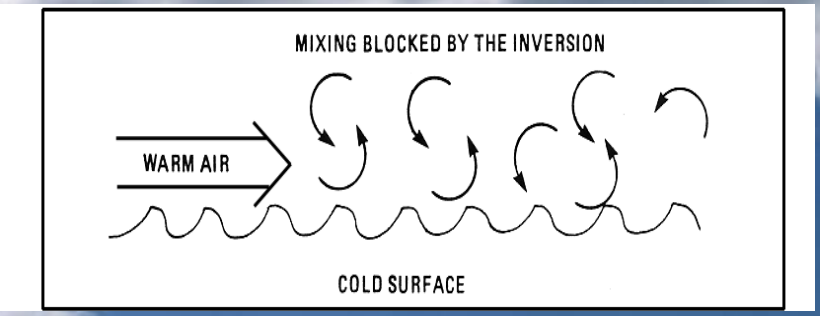


Modification of Stability

- Heating from below will cause instability



- Cooling from below will cause stability



Stable and Unstable Air

Characteristic	Stable Air	Unstable Air
Lapse Rate	Shallow	Steep
Cloud Type	Stratus Type	Cumulus Type
Precipitation	Uniform Intensity including drizzle	Showers
Visibility	Poor low level (Fog may occur)	Good, except in precipitation
Wind	Steady winds which can change with height	Gusty
Turbulence	Generally smooth flying conditions	Turbulence may be moderate to severe

Confirmation

Questions

- 1. What are the 3 types of stability?

  Positive, Negative and Neutral

- 2. What type of stability leads to smooth air?

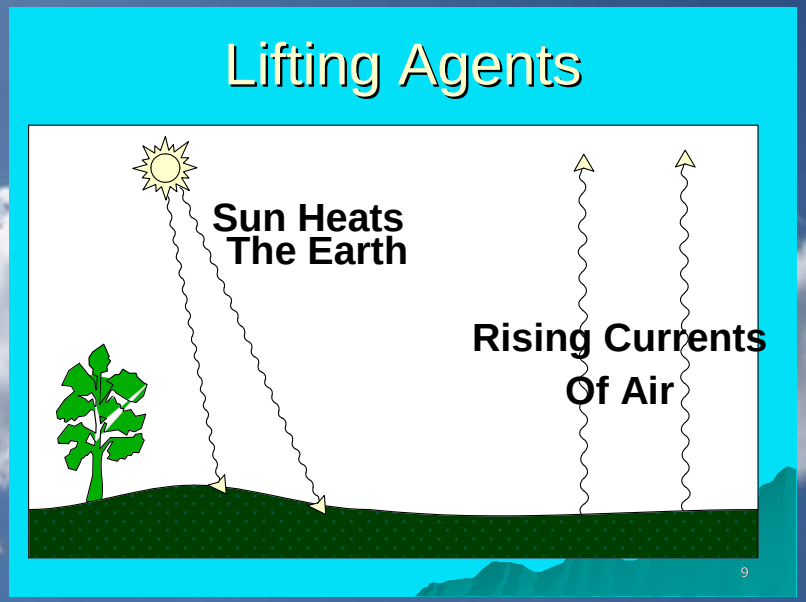
  Stable

- 3. A shallow lapse rate leads to what type of air?

  Stable air

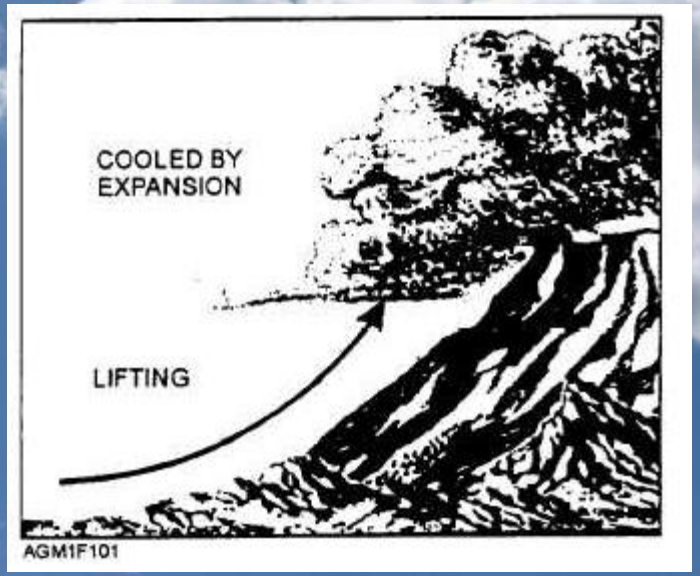
Lifting Agents

- Convection
  - Uneven heating of different types of surface
    - Especially differences between areas of land and water
  - Sun heats earth, heat radiates upwards → rising currents of air separated by areas of sinking air



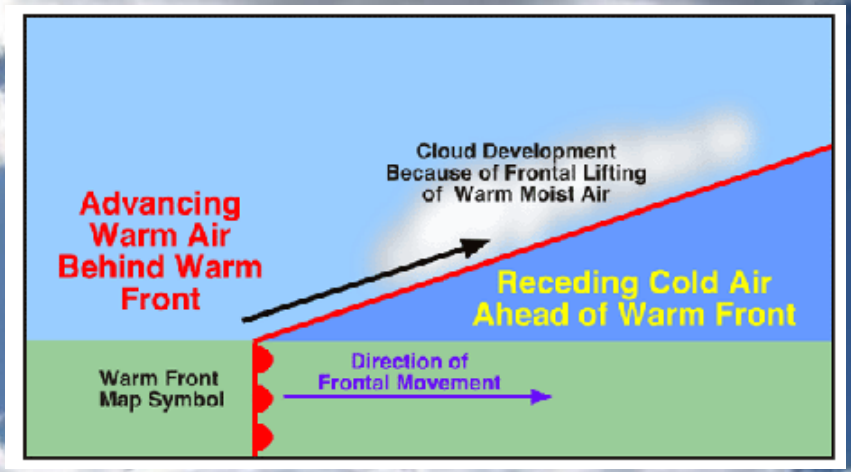
Lifting Agents

- Orographic Lift
  - Air moving up a sloping terrain (ex. mountain) will continue its upward movement
  - Unstable air will increase the amount of lift.

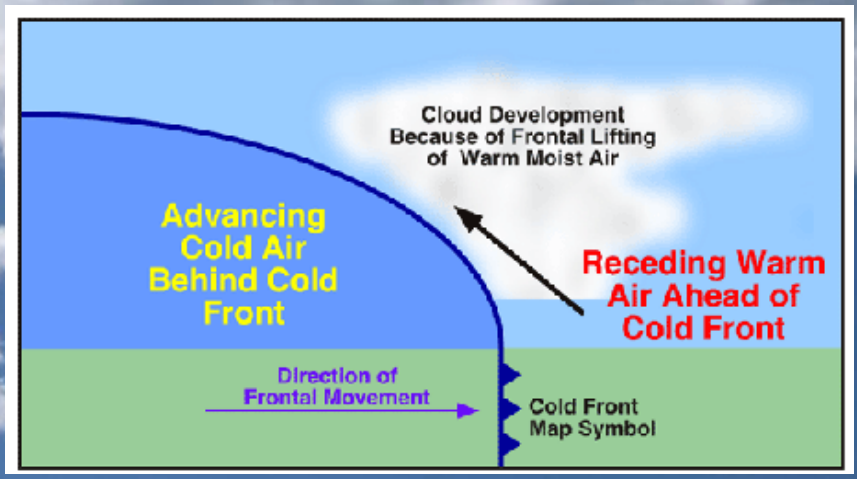


Lifting Agents

- Frontal Lift
- Warm Front
  - Warm air advances on a retreating cold air mass
  - Warm air ascends over the cold air in a long gentle slope



- Cold Front
  - Mass of cold air advances on mass of warm air
  - Undercuts the warm air, forces it to rise sharply

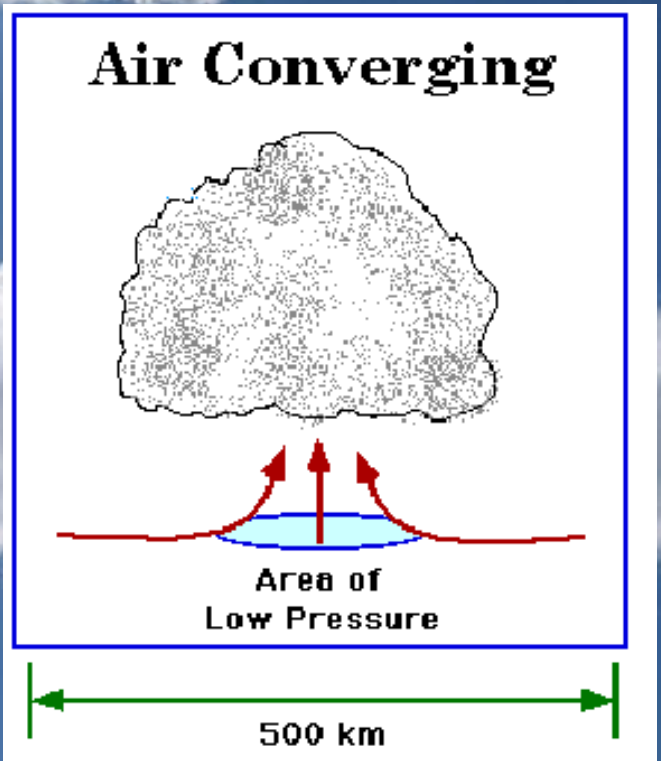


Lifting Agents

- Mechanical Turbulence
  - Also known as “eddies”
  - Friction between air and ground
  - Irregular terrain and man-made obstacles cause severe eddies
  - Usually confined to lower thousands of feet

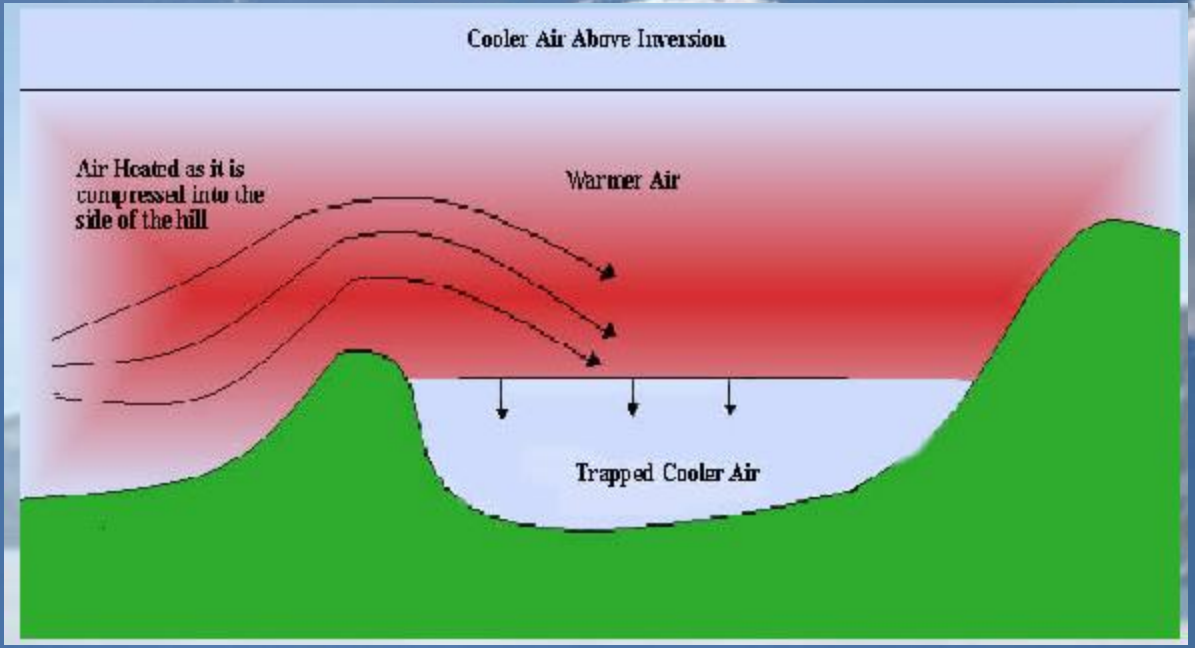
Lifting Agents

- Convergence
  - Air flows from high to low pressure
  - Air converges/meets over the centre of the low pressure
  - Excess air is forced to rise.



Subsidence

- Occurs in High pressure systems or in air flowing down the side of a mountain
- As the air descends (subsides), it reaches regions of increased atmospheric pressure and is compressed
  - As a result, its temperature rises.



Confirmation

- Name 3 lifting processes.

  Convective, Orthographic, Frontal, Mechanical Turbulence, Convergence

- What type of cloud is associated with:
  - Stable air? Stratus
  - Unstable air? Cumulus

- Why does a steep lapse rate mean the air will be unstable?

  High temperature change with elevation – air heated from below rises causing instability

- Good visibility is associated with what type of air? Stable air

Cloud to Cloud Lightning Strike