Navigation on Land Using Map and Compass

LO1 Part 1: Be able to show the different types of North

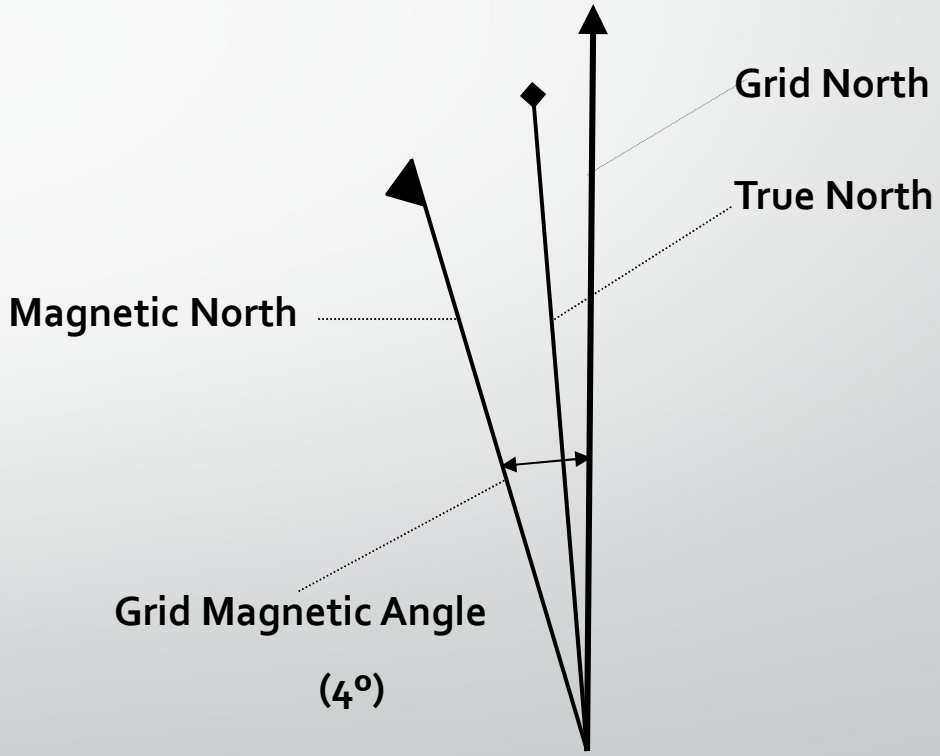
True, Grid and Magnetic North

- True North and South are at the geographical poles
- Grid North is the direction to which all Ordnance Survey Maps are orientated. We take our map bearings using Grid North
- Magnetic North is the direction a compass points to and in the UK it is located approximately 4° West of Grid North

Grid Magnetic Angle

- It is important to understand the relationship between Magnetic (or Mag) North and Grid North

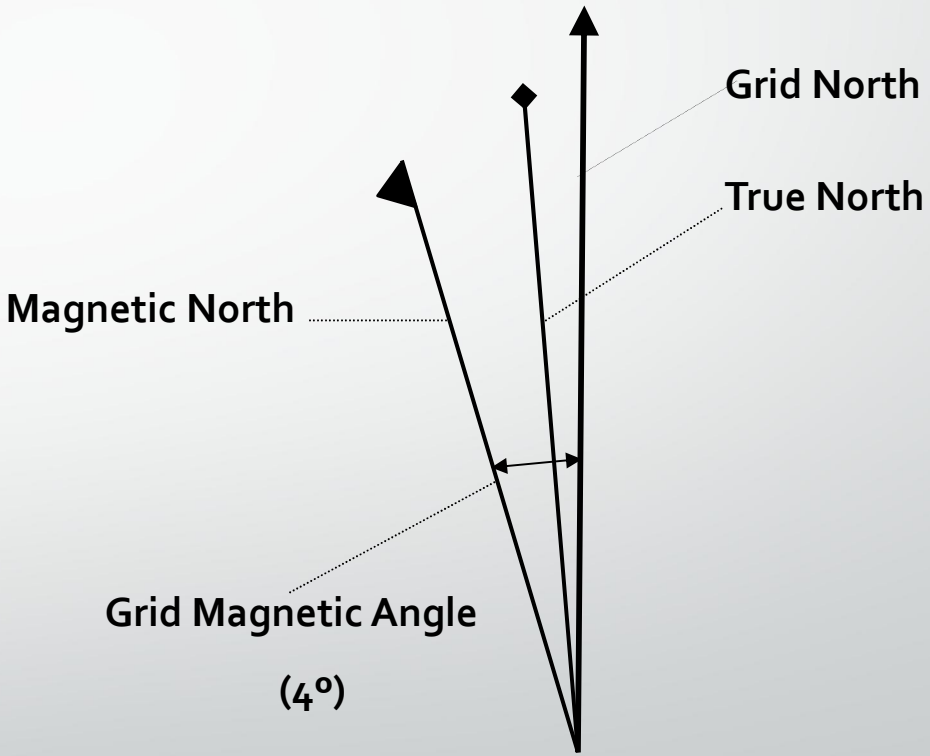
- This will become important when we start to convert bearings to and from a map



Grid Magnetic Angle cont.

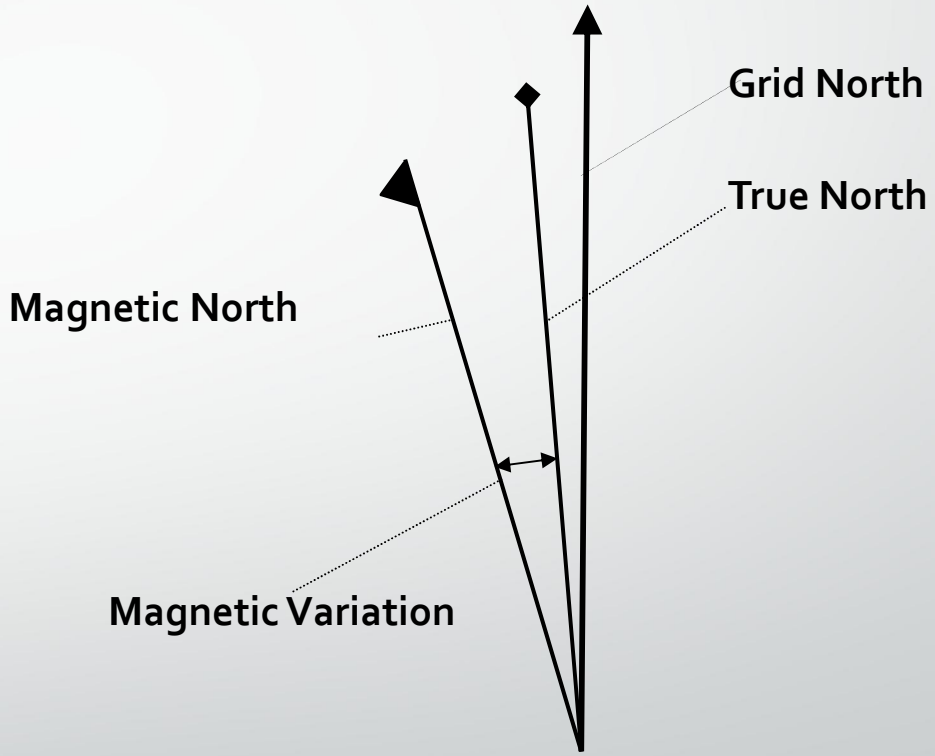
The difference in degrees between Magnetic (or Mag) North and Grid North is referred to as the **Grid Magnetic Angle** (usually 4° West in UK)

Grid to Mag → Add
Mag to Grid → Get rid

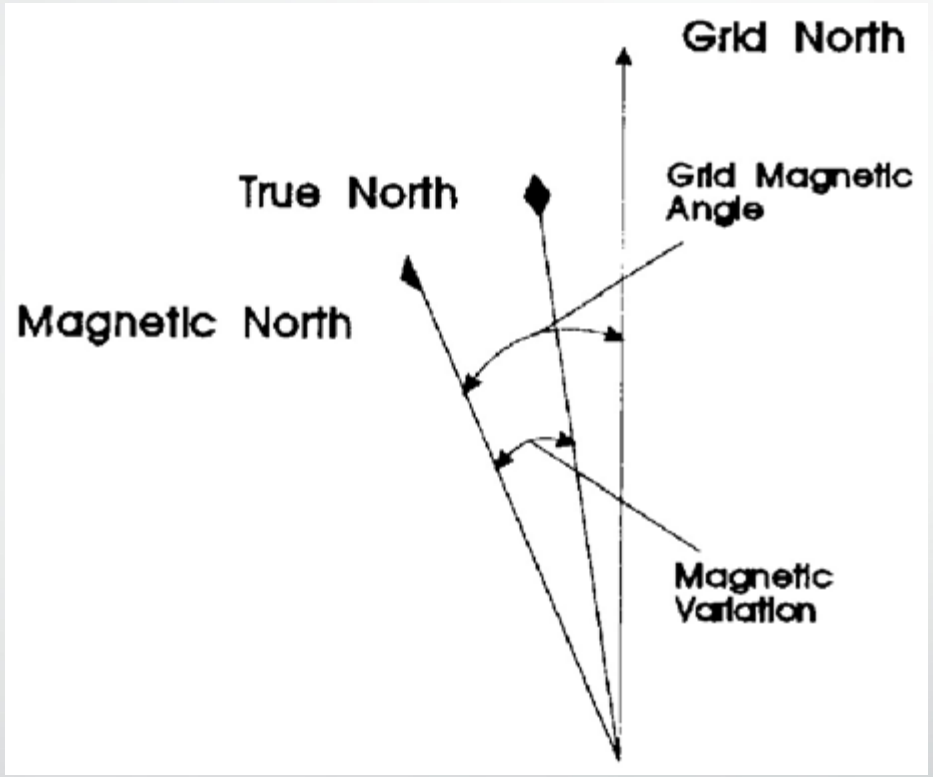


Magnetic Variation

The difference in degrees between Magnetic (or Mag) North and True North is referred to as the **Magnetic Variation** (this is not usually used for navigation)

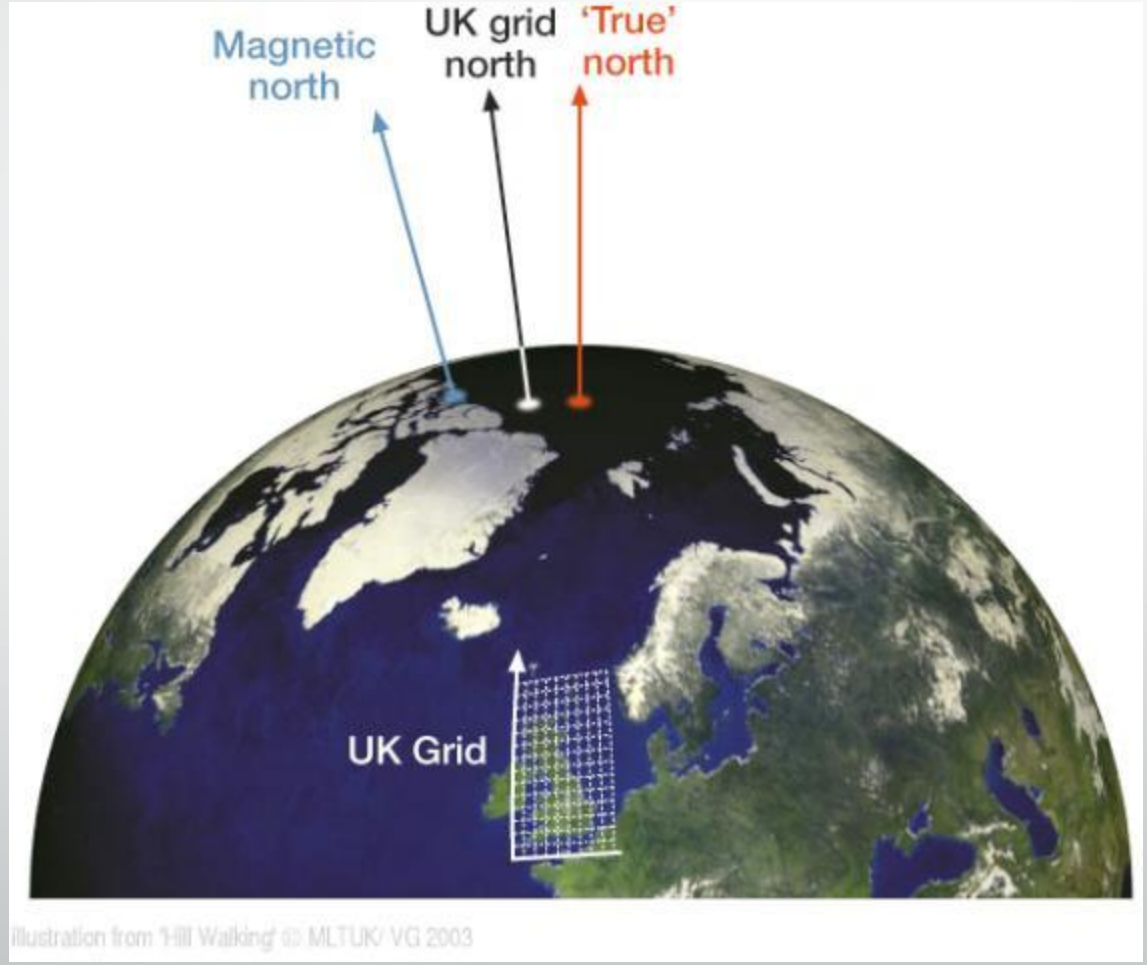


Magnetic North



The three North Poles as shown on an OS map

Magnetic North

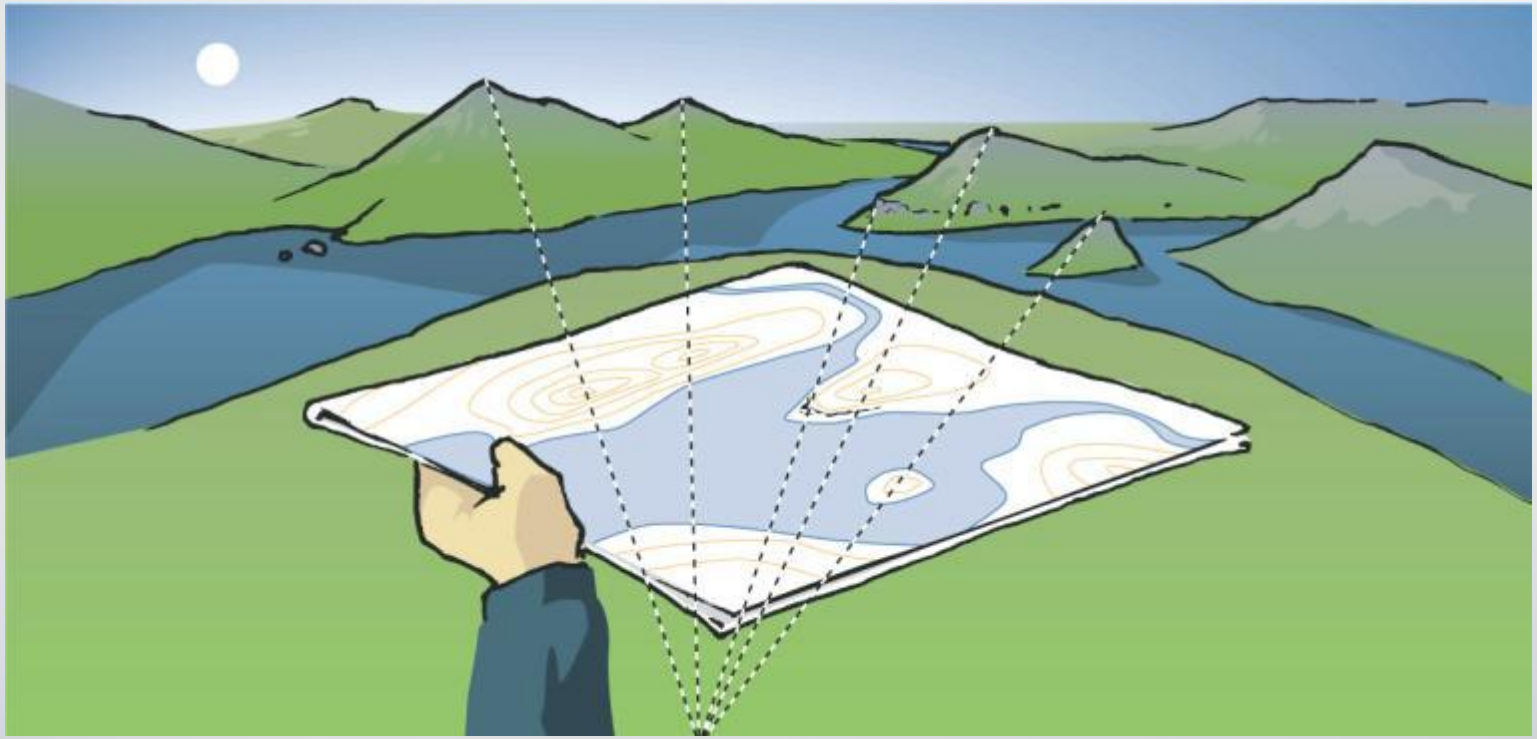


Any questions?

Navigation on Land Using Map and Compass

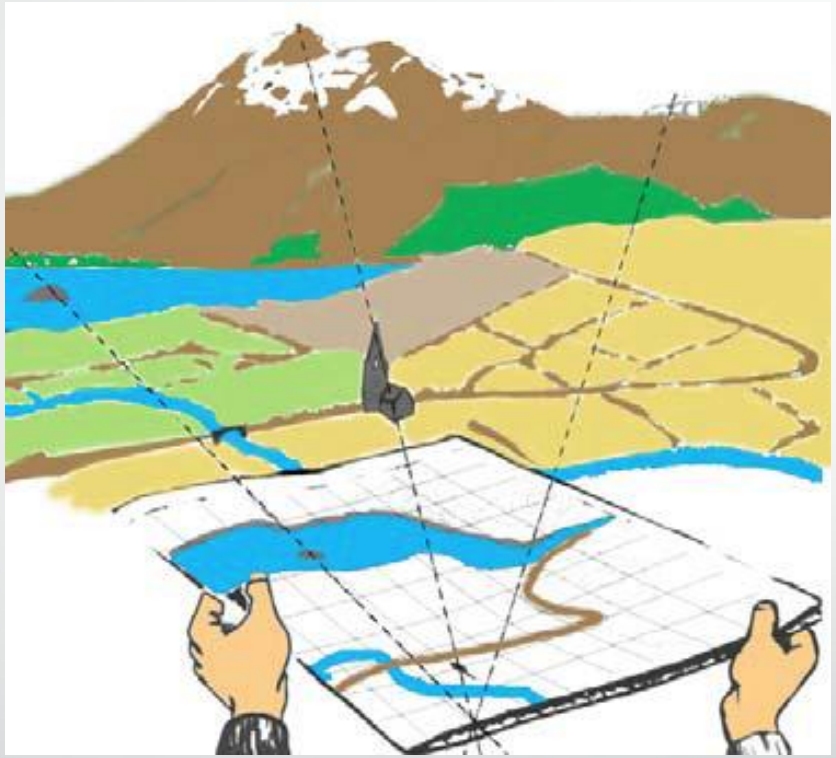
LO1 Part 2: Explain how to find true north using a map without a compass

High Vantage Point



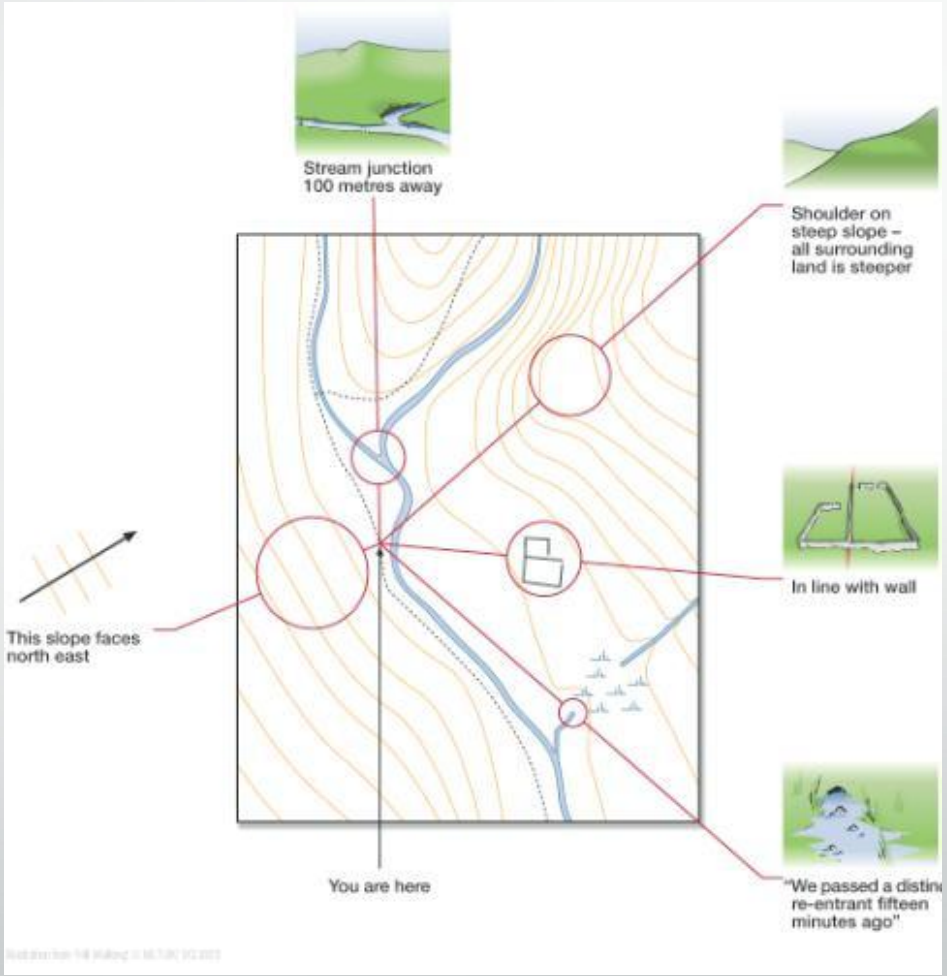
Setting the map to match features on the ground

Setting Or Orientating The Map

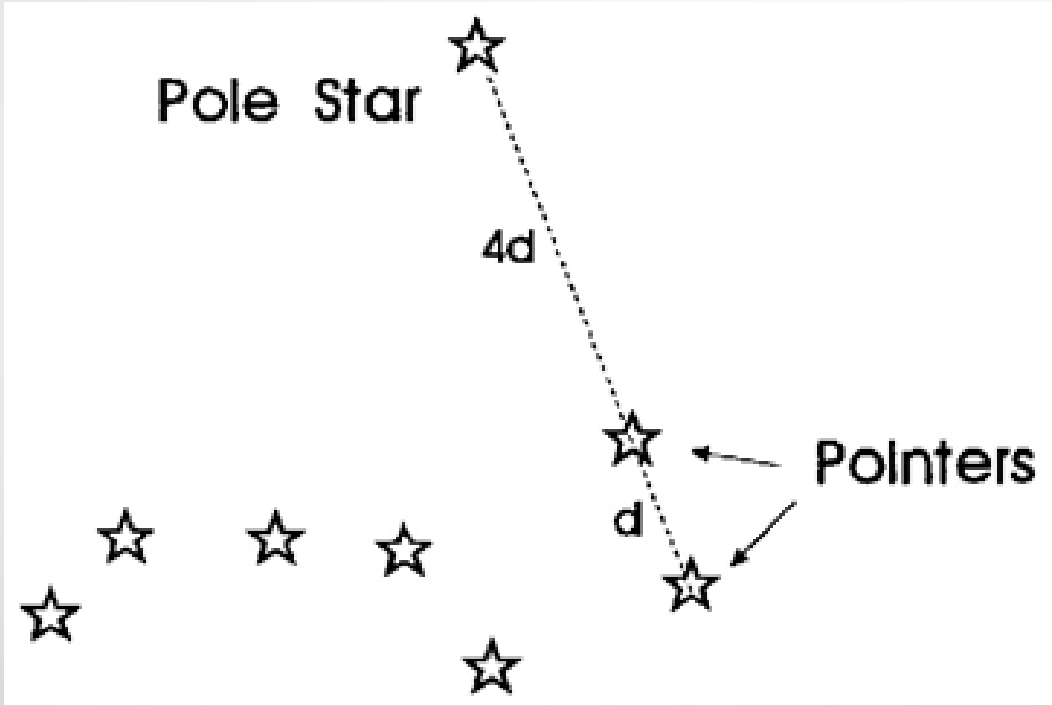


Setting the map to match features on the ground.
What features can be used in this picture?

Confirming Location

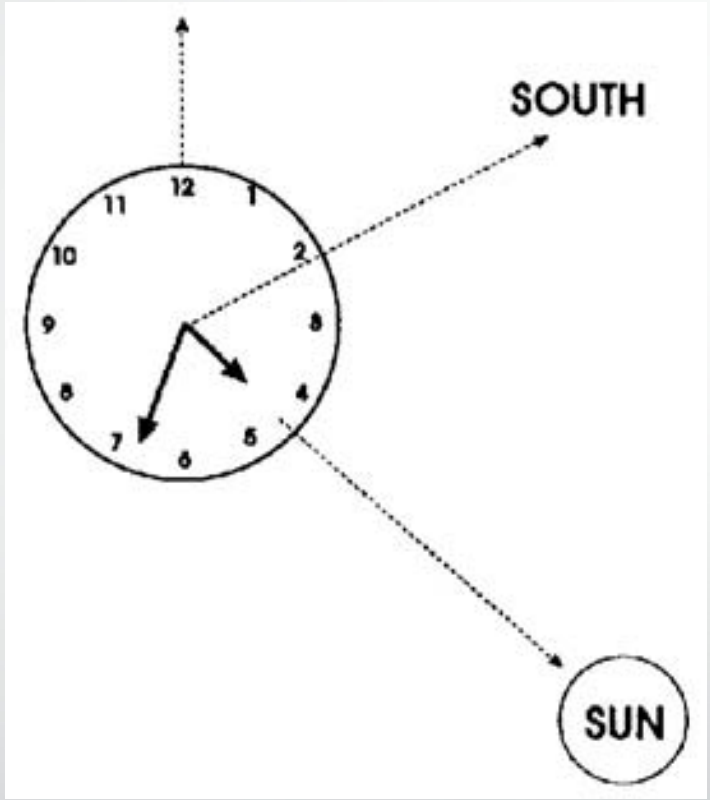


The Pole Star



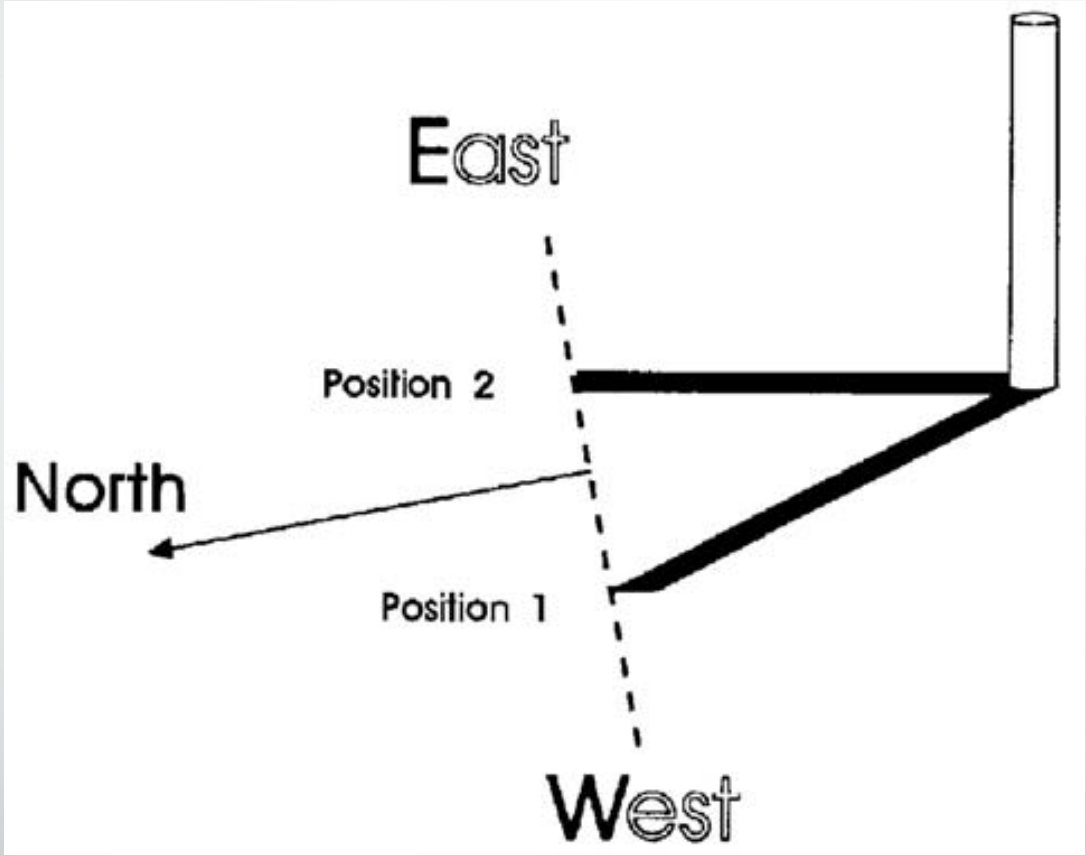
Finding true north by using the star constellation of The Plough.

Using A Watch



Orientating using a watch

Shadow Method



Using the movement of a shadow to find north.

Any questions?

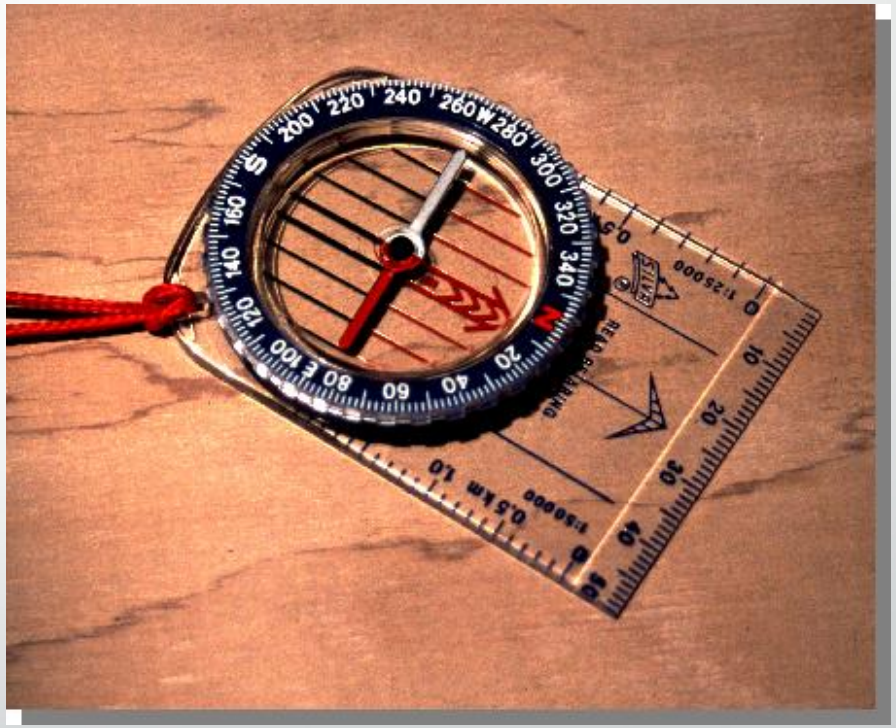
Navigation on Land Using Map and Compass

LO2 Part 1: Be able to use a map and lightweight walking compass for practical navigation.

The Compass

There are a variety of compass styles.

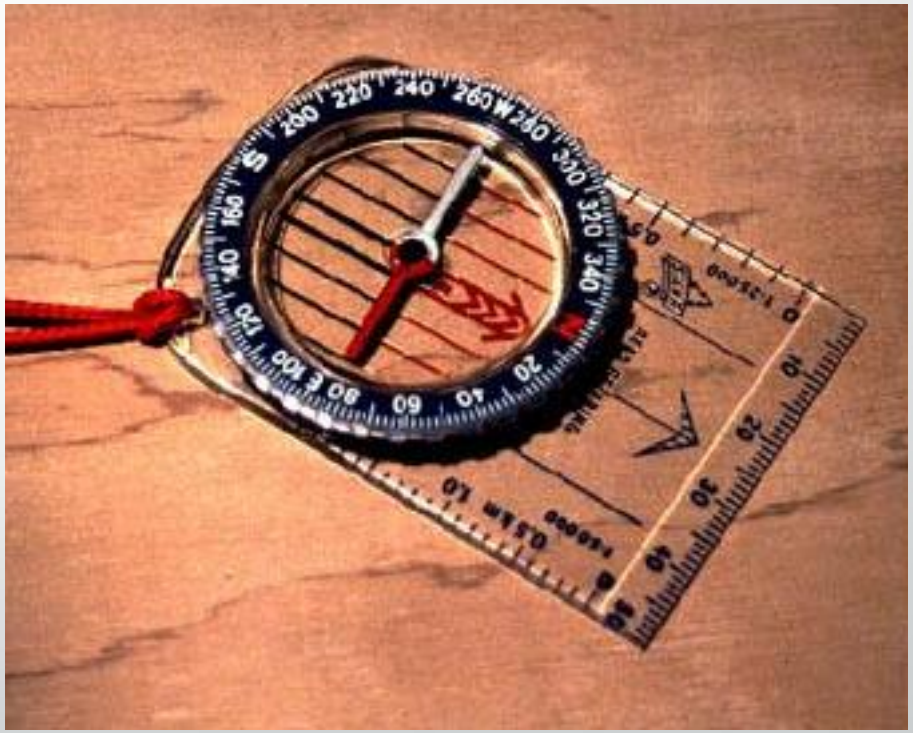
This is a Silva compass.



- Compasses were originally discovered by the Chinese 5000 years ago.
- They are made in a variety of forms for use on land, above and below the sea and in the air.
- Examples of activities in which they are used are:
  - Hill walking
  - Cycling
  - Driving
  - Sailing
  - Flying
  - Mountaineering
  - Surveying
  - Military
  - Scuba diving
  - Orienteering

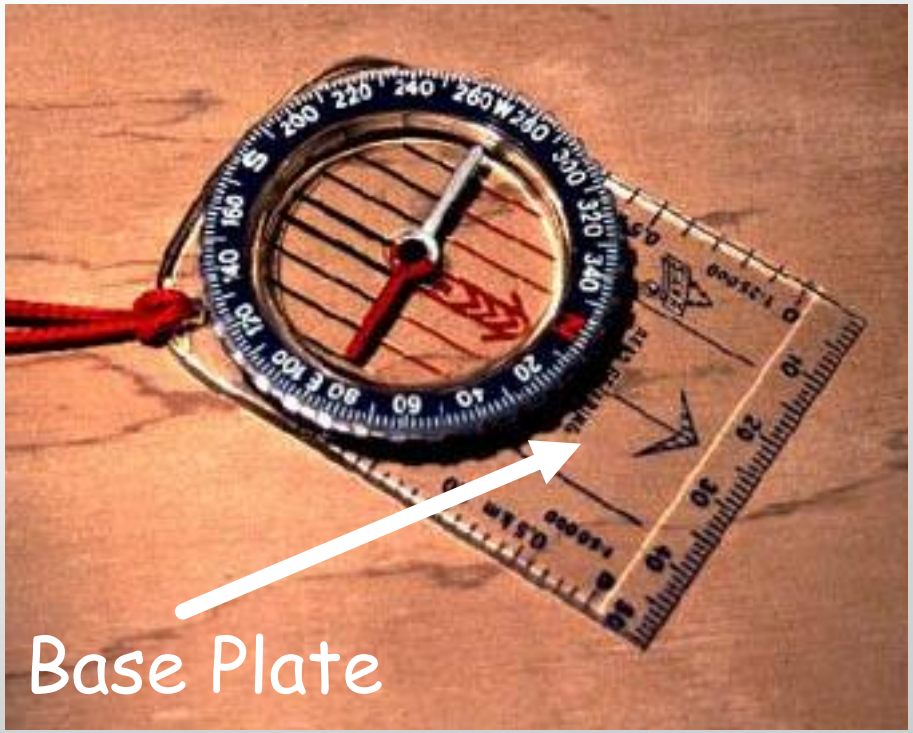
Parts of the Compass

- The compass has various components.
- We will look at each component separately to define its use.



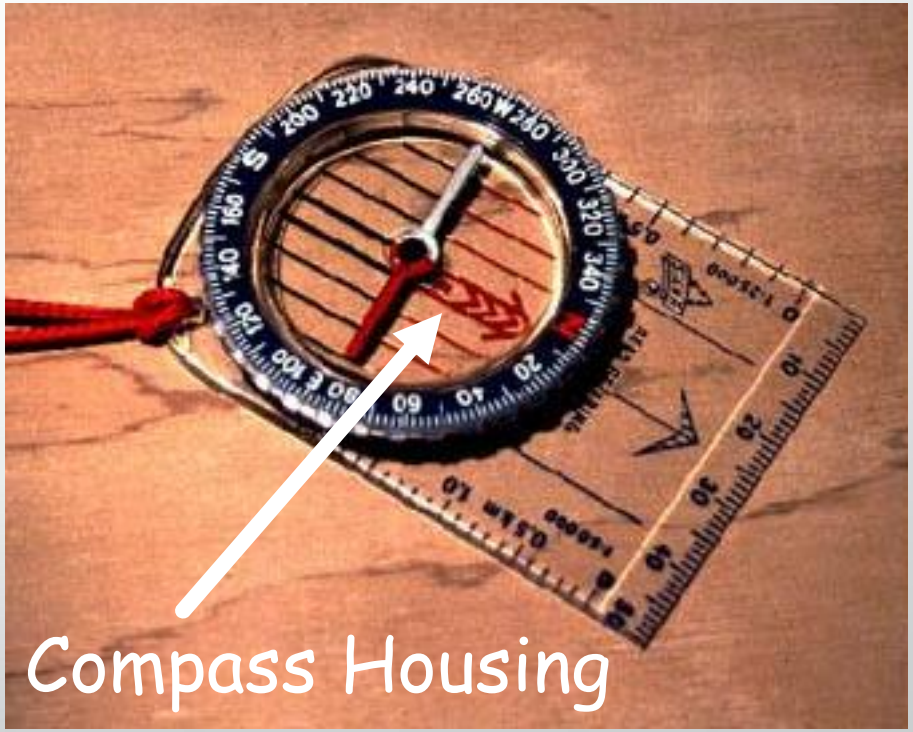
Base Plate

The base plate is the mounting for the housing and displays a variety of information e.g. scale ruler.



Compass Housing

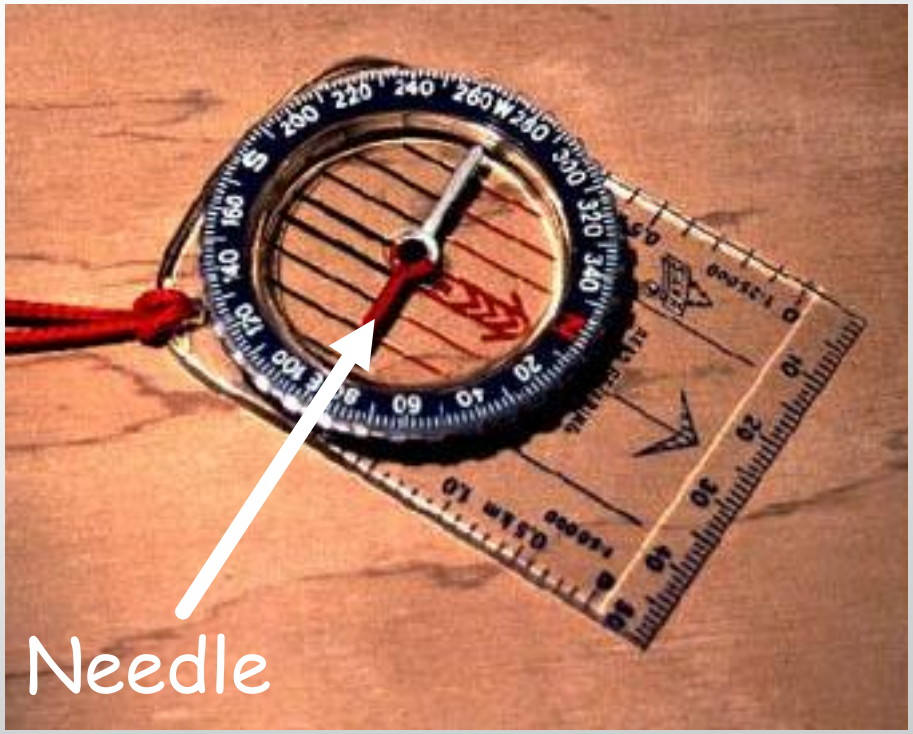
The compass housing contains a magnetic bar, called the needle and defines the points of the compass on a rotating bezel.



The Compass Needle

The needle is suspended in liquid which enables it to move freely, always settling with the red end pointing North.

Some needles are luminous to help navigation in the dark.



Direction Of Travel Arrow

The direction of travel arrow indicates the direction along which you wish to travel or take a bearing.

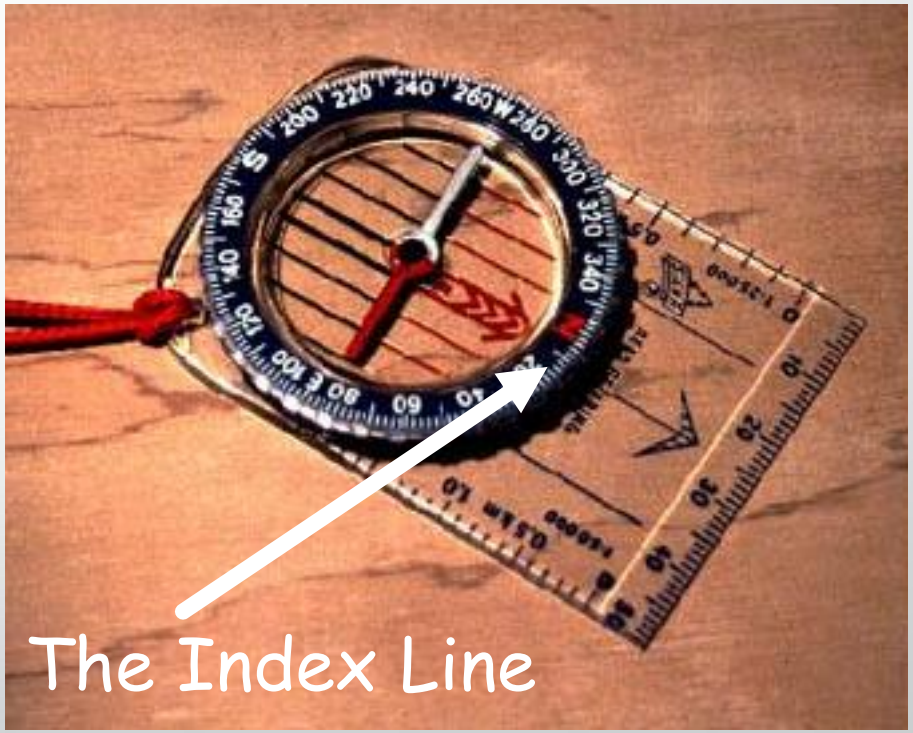
The arrow is fixed within the base plate.

The sides of the base plate run parallel to the arrow.

The Index Line

The Index Line is a fixed line within the compass housing and is in line with the direction of travel arrow.

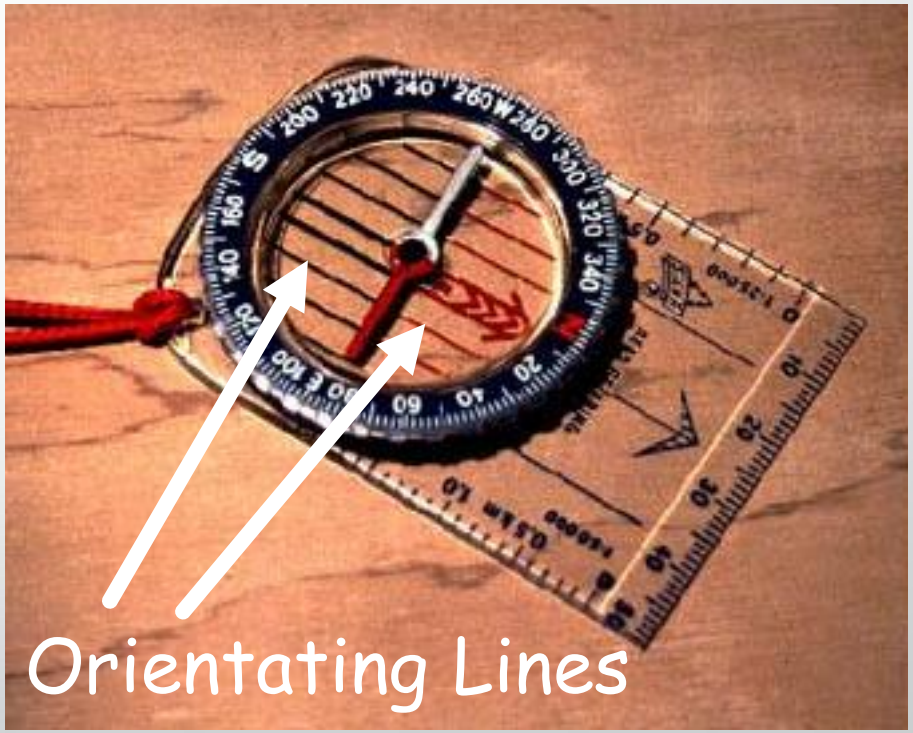
The Index Line marks the bearing you set by rotating the bezel.



Orientating Lines

The orientating lines are displayed within the rotating compass housing and are designed to be aligned parallel with the Eastings on a map.

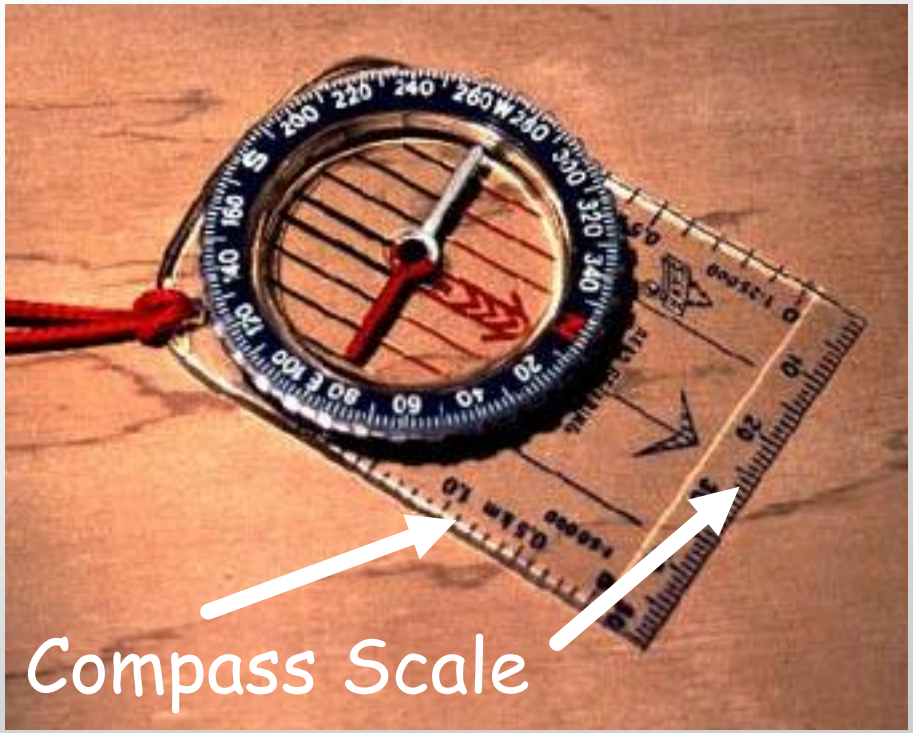
The orientating lines on some compass models show one half of the lines in red to depict North.



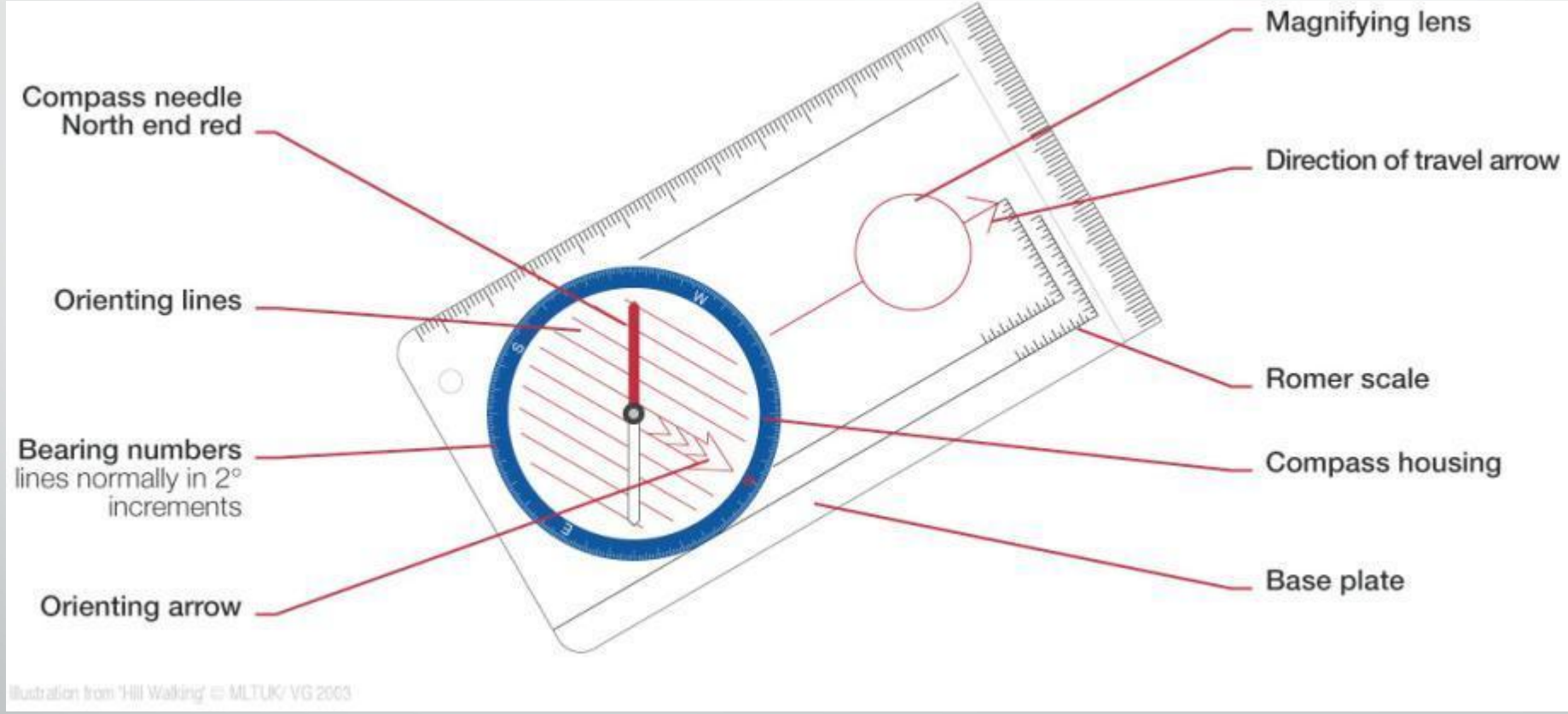
Compass Scale

Nearly all compasses have a centimeter scale along the edge of the base plate to enable you to measure distances.

Used in conjunction with the scale at the bottom of the map, the compass scale enables you to calculate the distance on the ground.

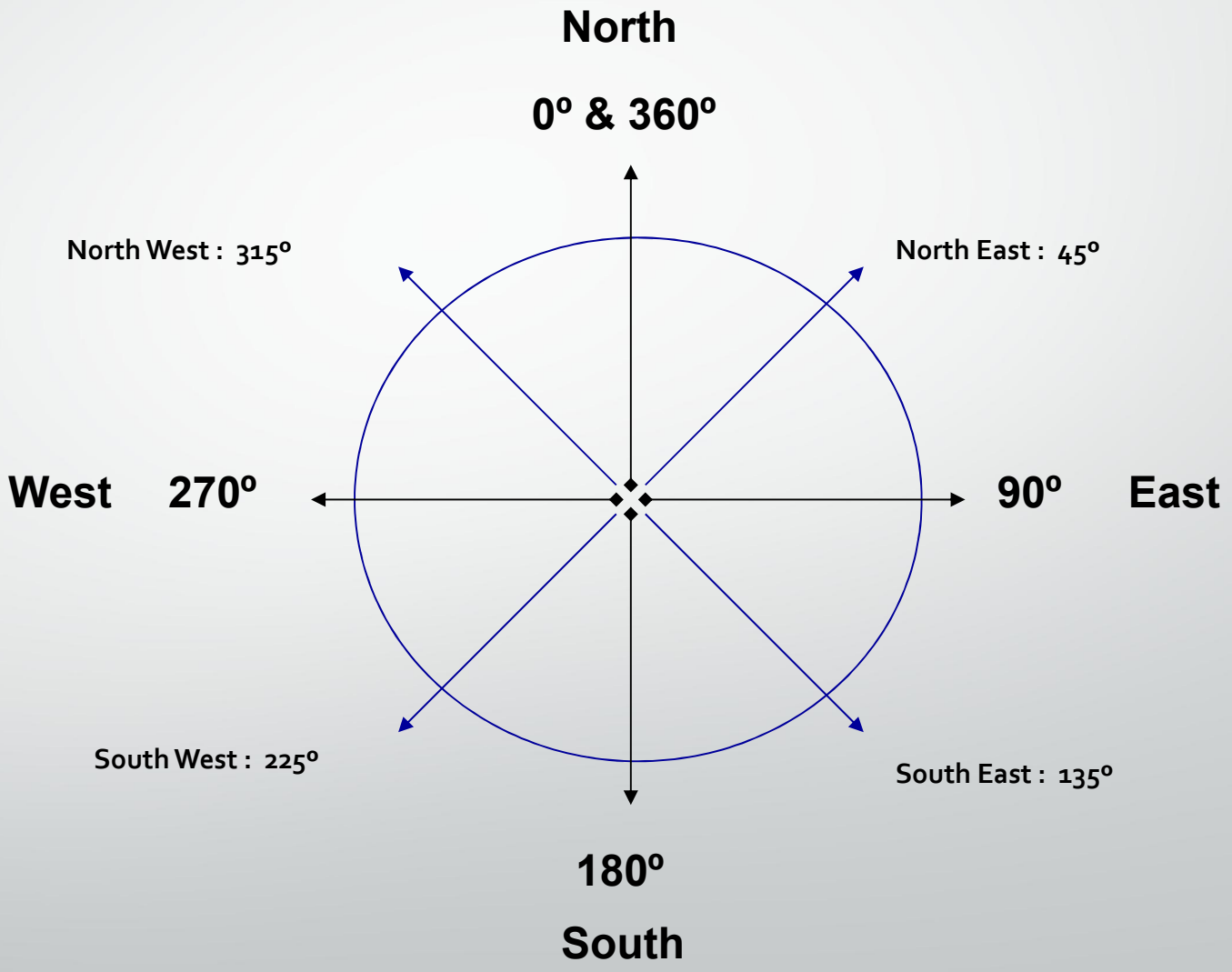


Base Plate Compass



Cardinal Points (compass points)

- Bearings are taken in degrees.
- The cardinal points are divided up into 360° and measured clockwise.



Map and Compass Work

- When working from the map we deal with **Grid Bearings**.
- When following a compass on the ground we work with **Magnetic Bearings**.
- As discussed previously there is a simple system which enables us to convert **Grid to Mag** and **Mag to Grid**.

Grid to Mag → **ADD**

Mag to Grid → **GET RID**

(usually 4° West in UK)

Points To Note

- Stand clear of metal objects when using the compass. Objects as small as a watch can make a difference.
- Hold the compass as flat as possible to allow the needle to move freely.
- Look after your compass – try to avoid dropping or knocking it.
- Store away from other compasses and electrical equipment.
- Your compass may need replacing if a large air bubble forms in the compass housing.

Setting A Compass Heading - Practical

- Use the long edge of the compass to line-up your current location and your desired location on the map.
- Turn the compass capsule until the orientating lines are parallel to the North-South grid lines (with the orientating arrow pointing North).
- The compass will now register the number of degrees between Grid North and your intended direction of travel. Grid to Mag, add 4° more.

Setting A Compass Heading - Practical

- Take the compass off the map, put 'red to bed' and walk on the bearing.
- Whilst walking, instead of looking continuously at the compass, look ahead at the horizon and walk towards a **fixed feature** which is on your heading.

Ground To Map - Practical

- Select the feature on the ground to which you wish to take a bearing.
- Hold the compass steady and level.
- Point the **direction of travel arrow** at the feature.
- Rotate the compass until 'red is in bed'.

Ground To Map - Practical

- This is your Mag bearing which you can either travel along or convert to a grid bearing.
- To plot on the map you should first locate your own position and mark it.
- Convert the Mag bearing to a Grid bearing by Mag to Grid → **GET RID**. (Usually 4° West in UK.)
- Subtract the Grid Magnetic Angle.

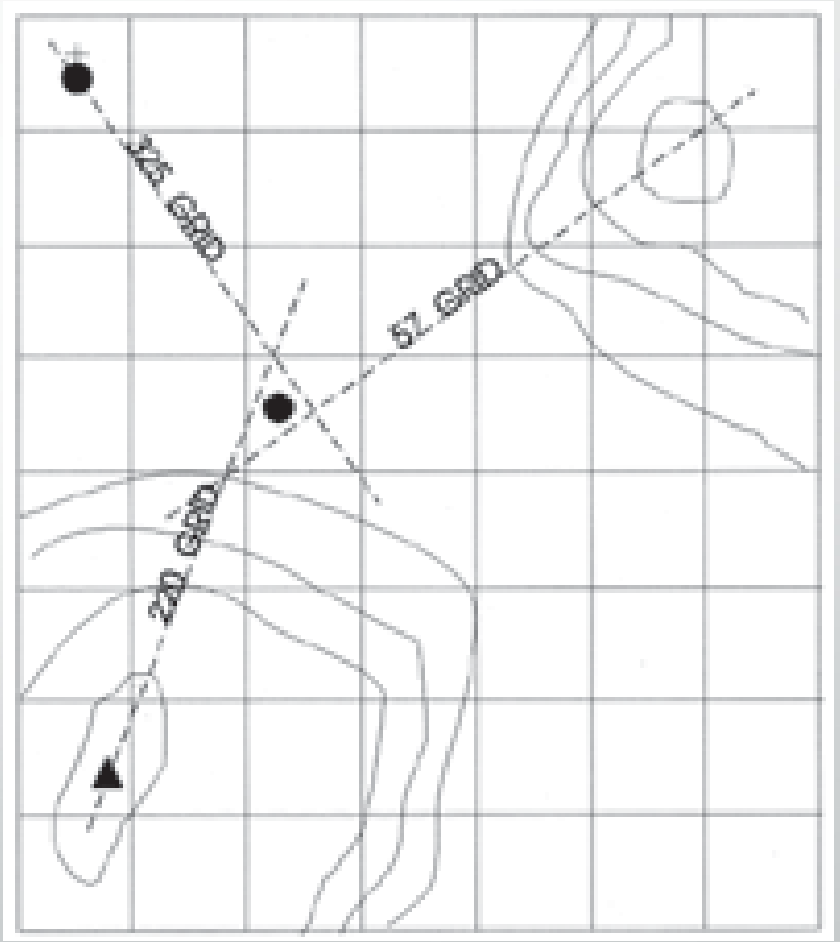
Ground To Map - Practical

- Place the compass on the map and keeping the bearing set on the housing, rotate the whole compass until the orientating lines are parallel to the map. The edge of the compass should run through your position and show the bearing on the map.

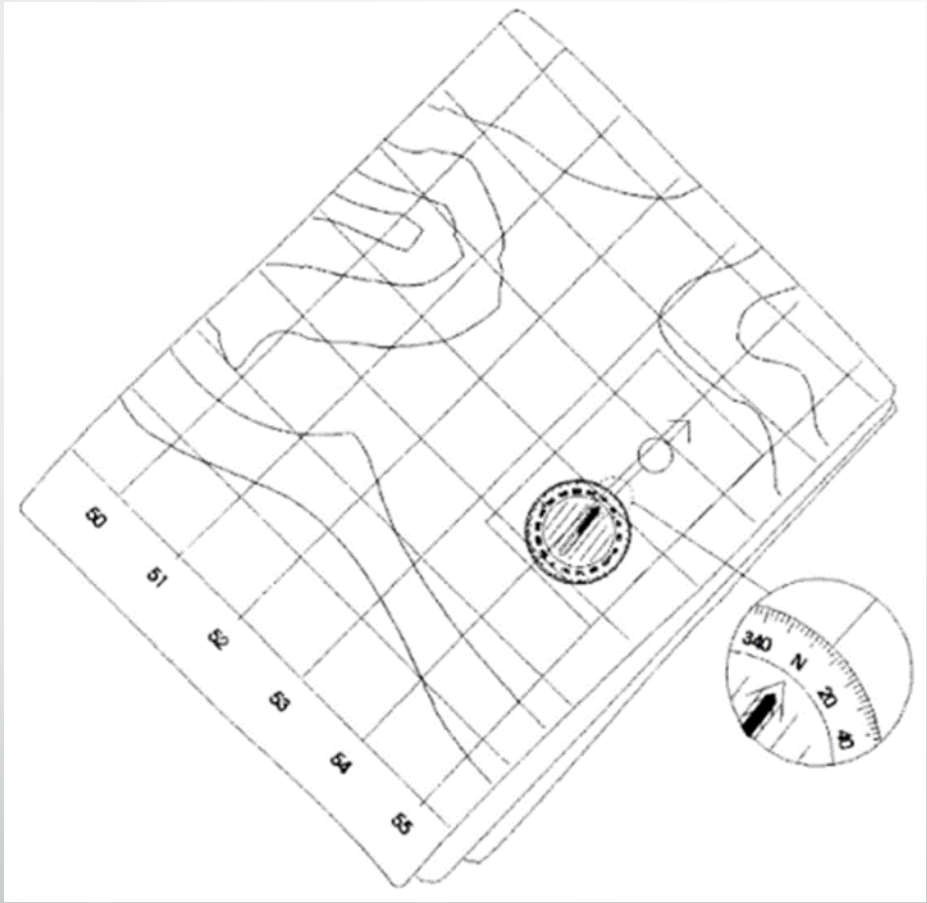
- By turning your body until 'red is in bed' you have now orientated yourself and the map.

Resection

- Take three bearings of fixed features around you.
- Draw a faint line on the map each of bearing in turn.
- Once you have taken the three bearings and drawn them on the map, your position will be in the centre of the triangle.



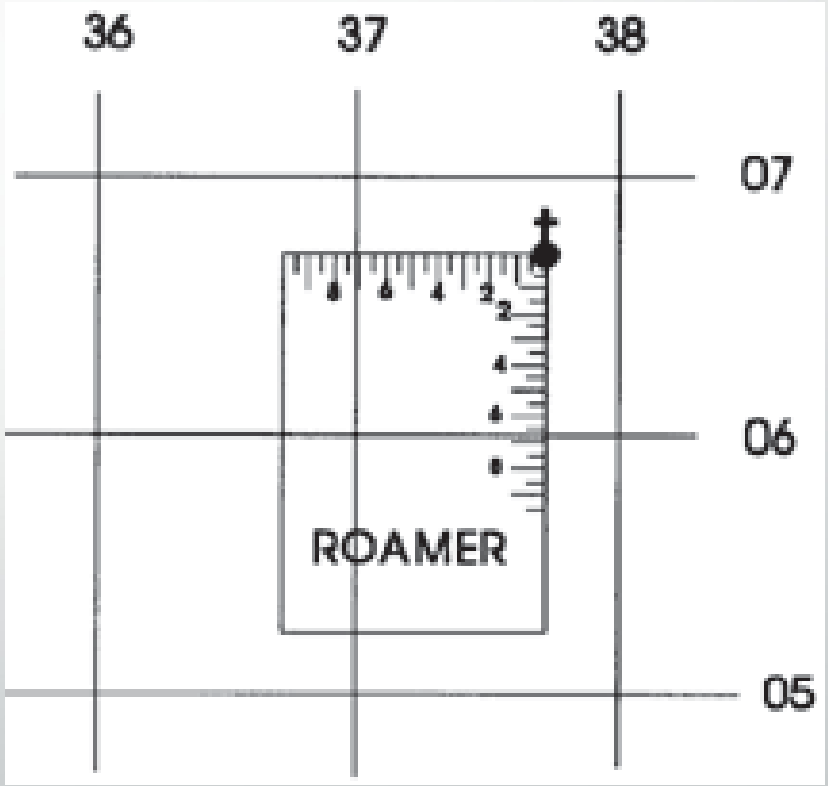
Setting The Map With A Compass
(Orientating the map)



Scales and Roamers

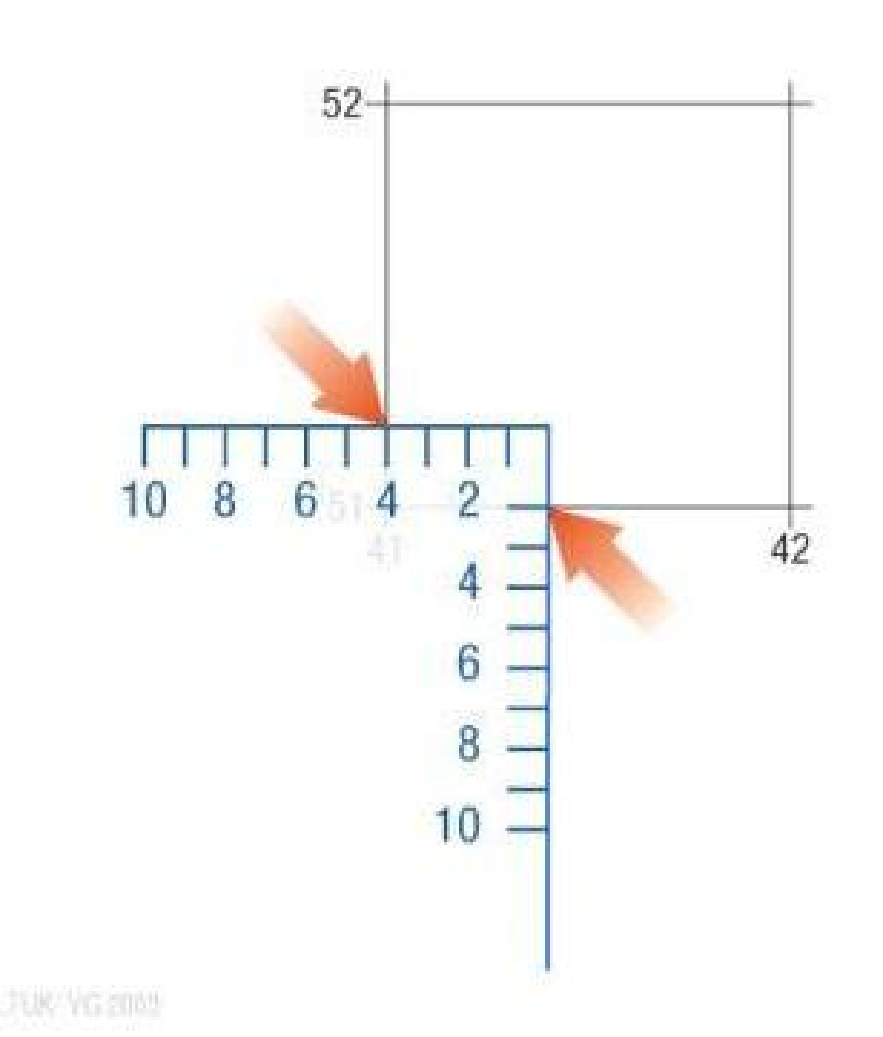
- Around the edge of the compass are a variety of different ruler markings to help measure distances on different scaled maps.

- Place the corner of the correct roamer on the map feature you want the reference of and read from the number on the scale which intersects the grid lines.



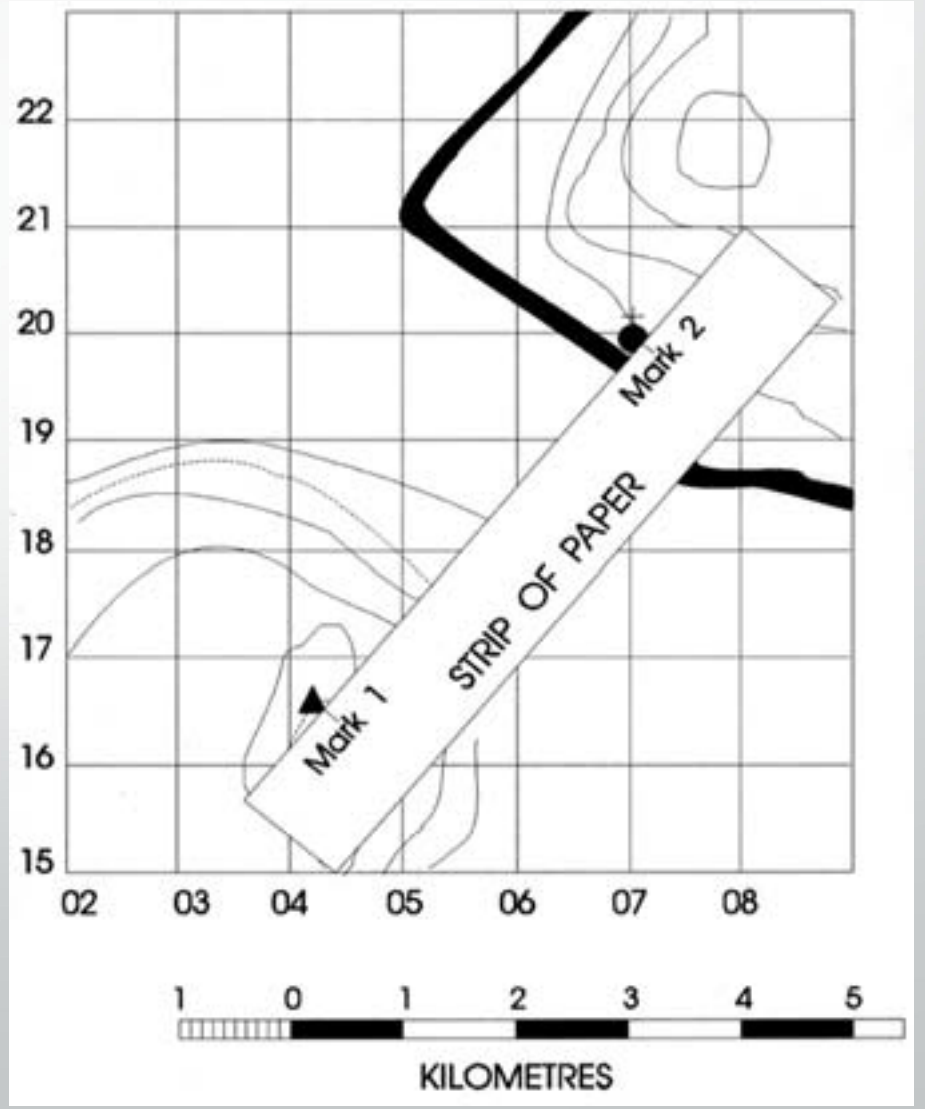
Roamer Scale

- What grid reference does this picture show?



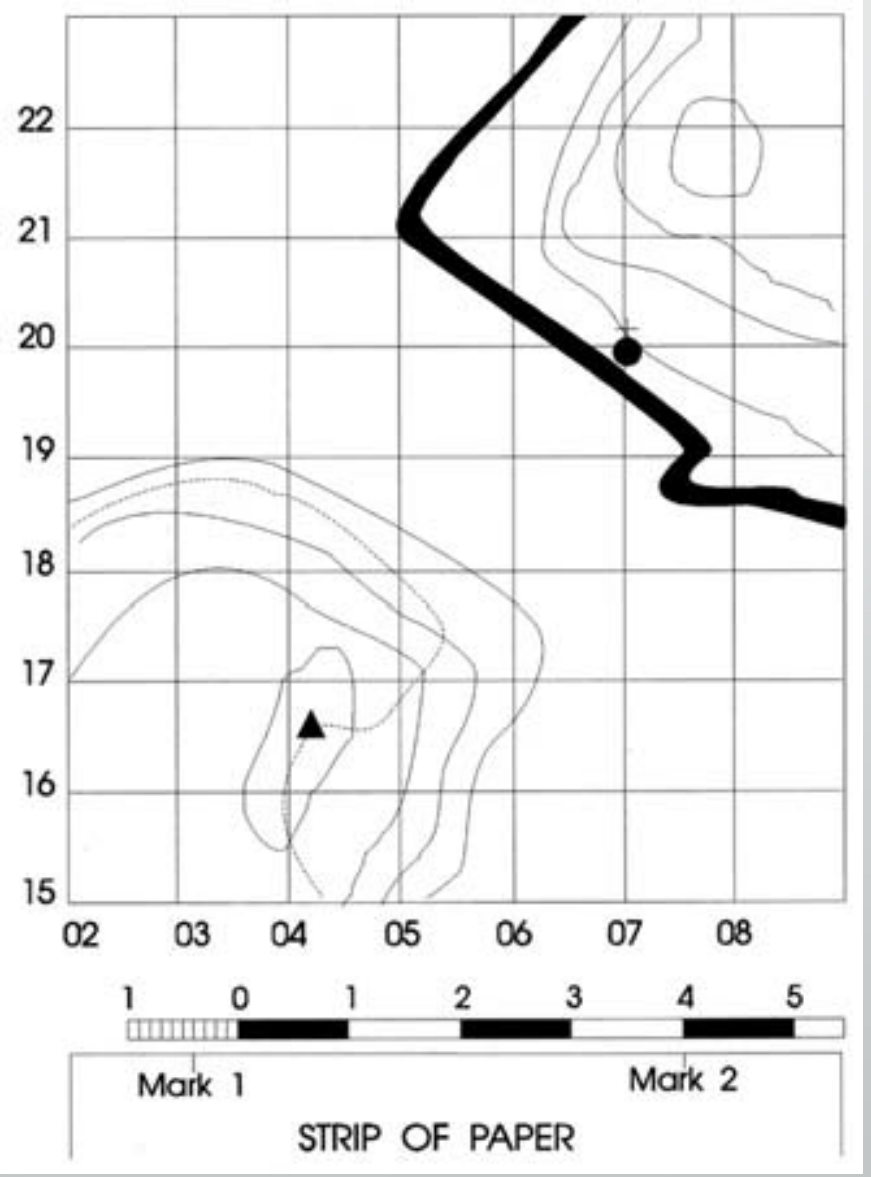
Measuring Distances On A Map

- Mark the position of the 2 features on a strip of paper.

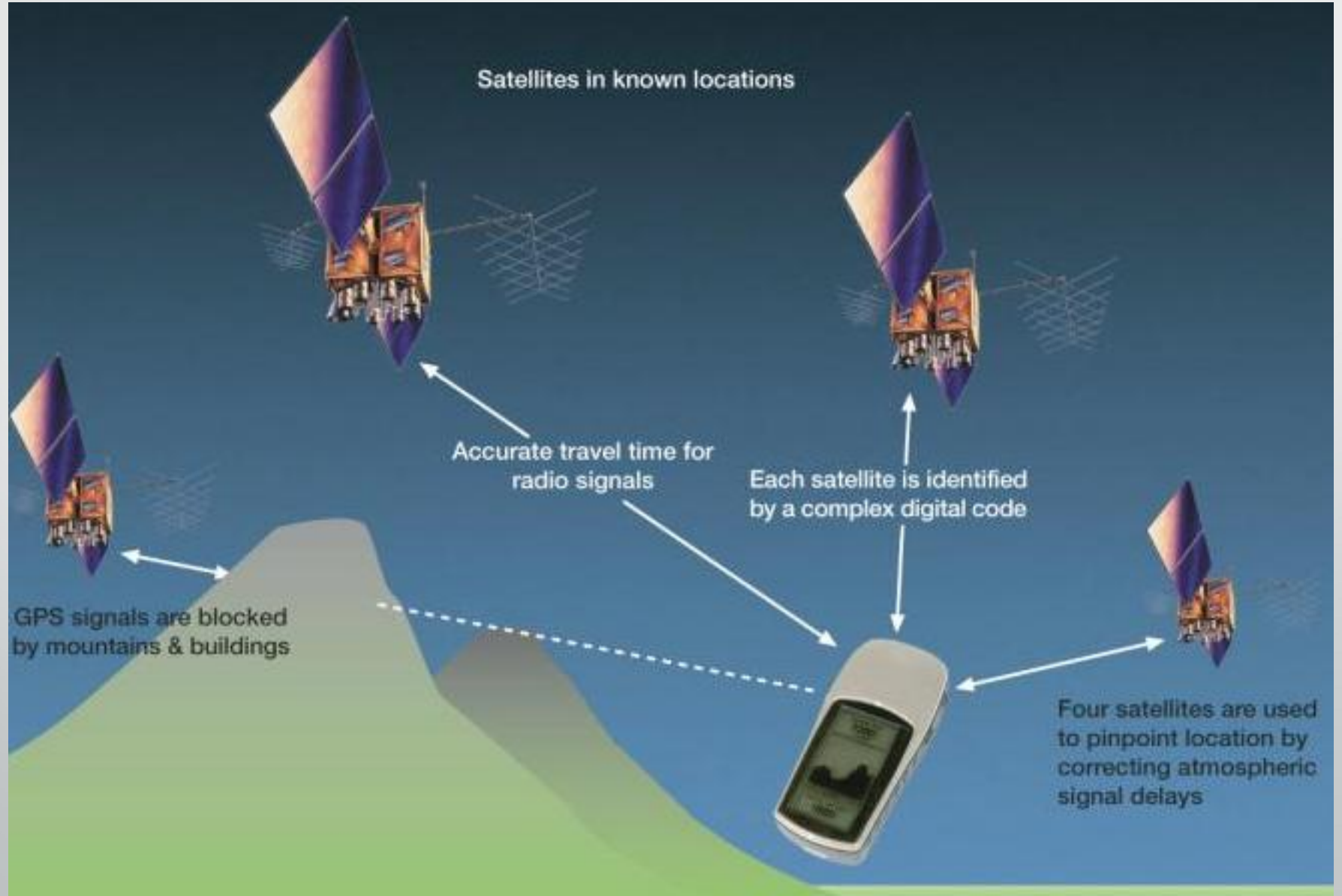


Measuring Distances On A Map

- Place the straight edge of the paper against the scale and read off the distance.



How GPS works

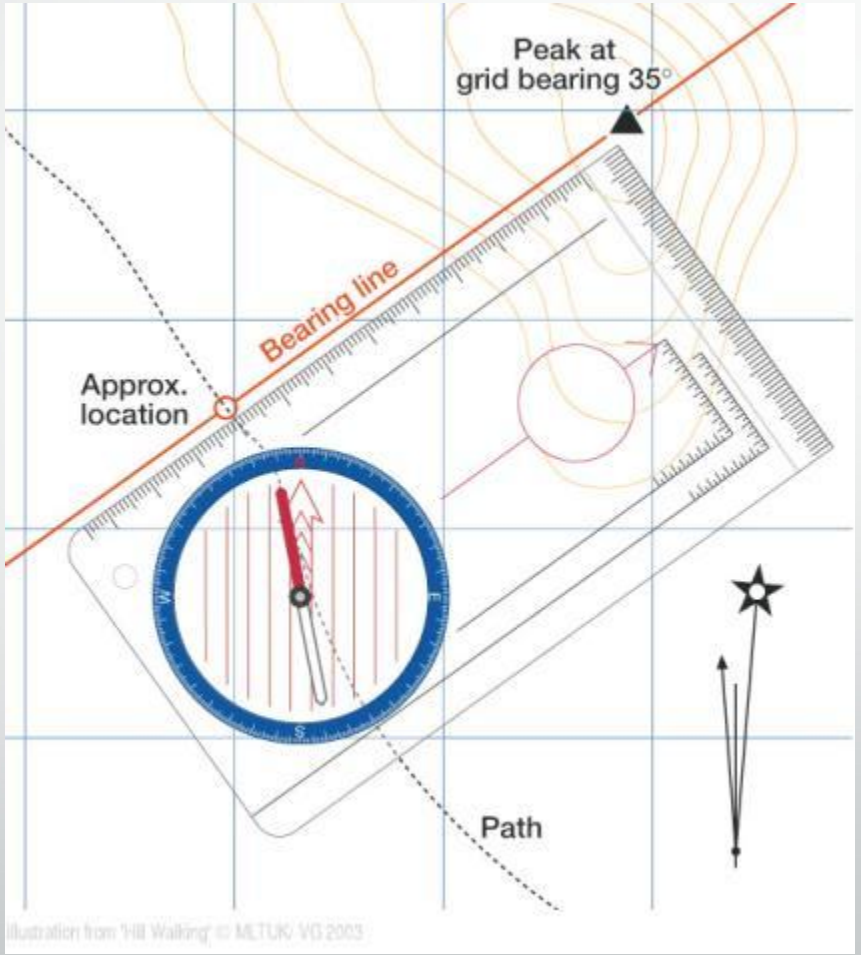


Any questions?

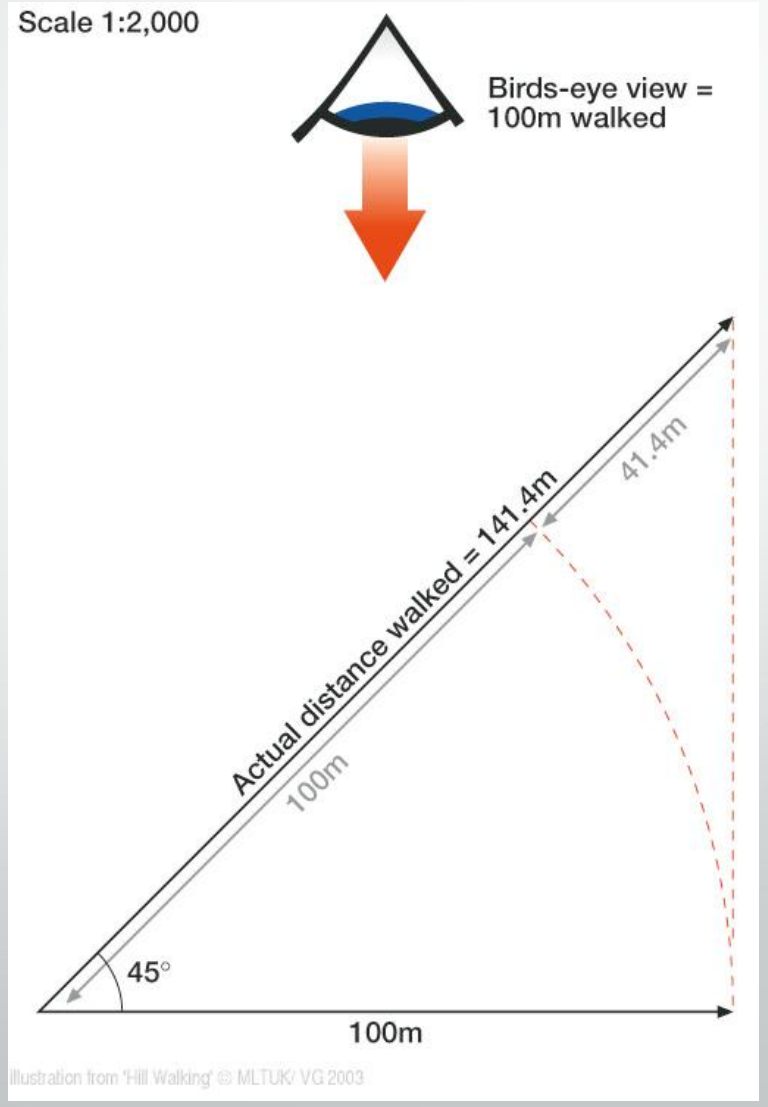
Navigation on Land Using Map and Compass

LO2 Part 2: Be able to use a map and lightweight walking compass for practical navigation.

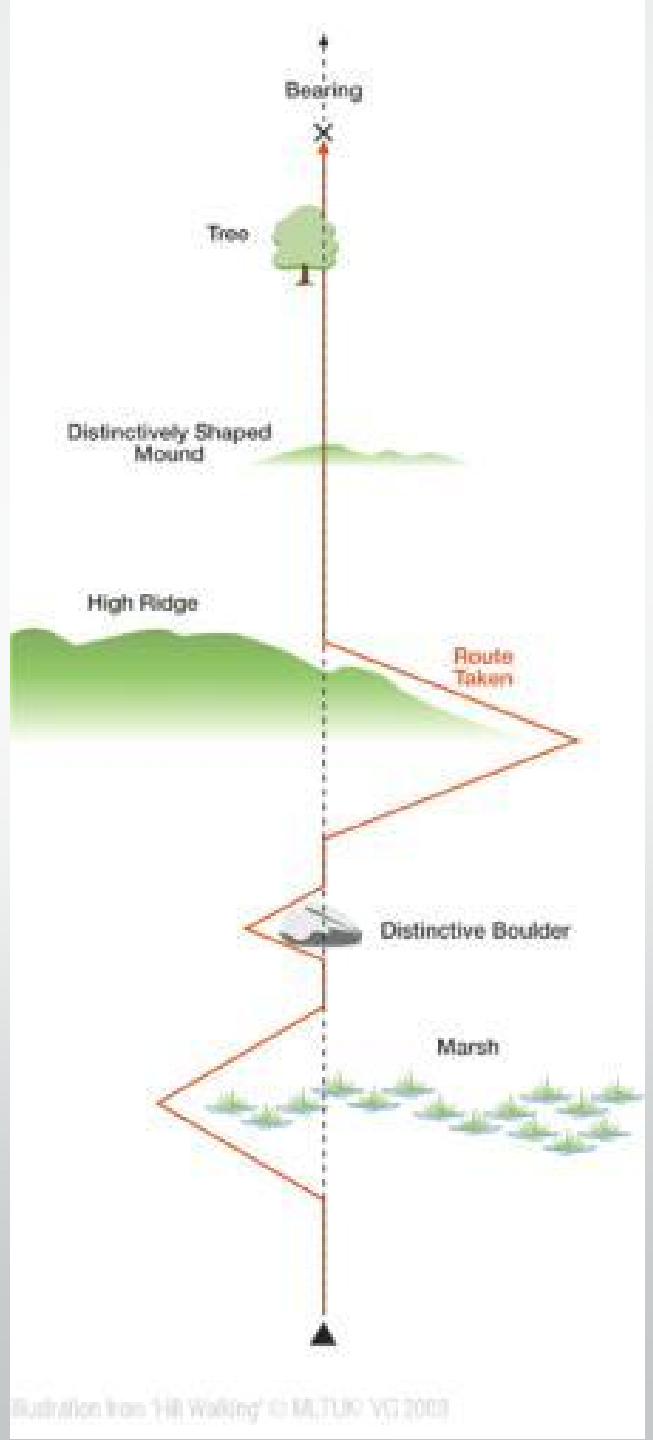
Pinpointing Position



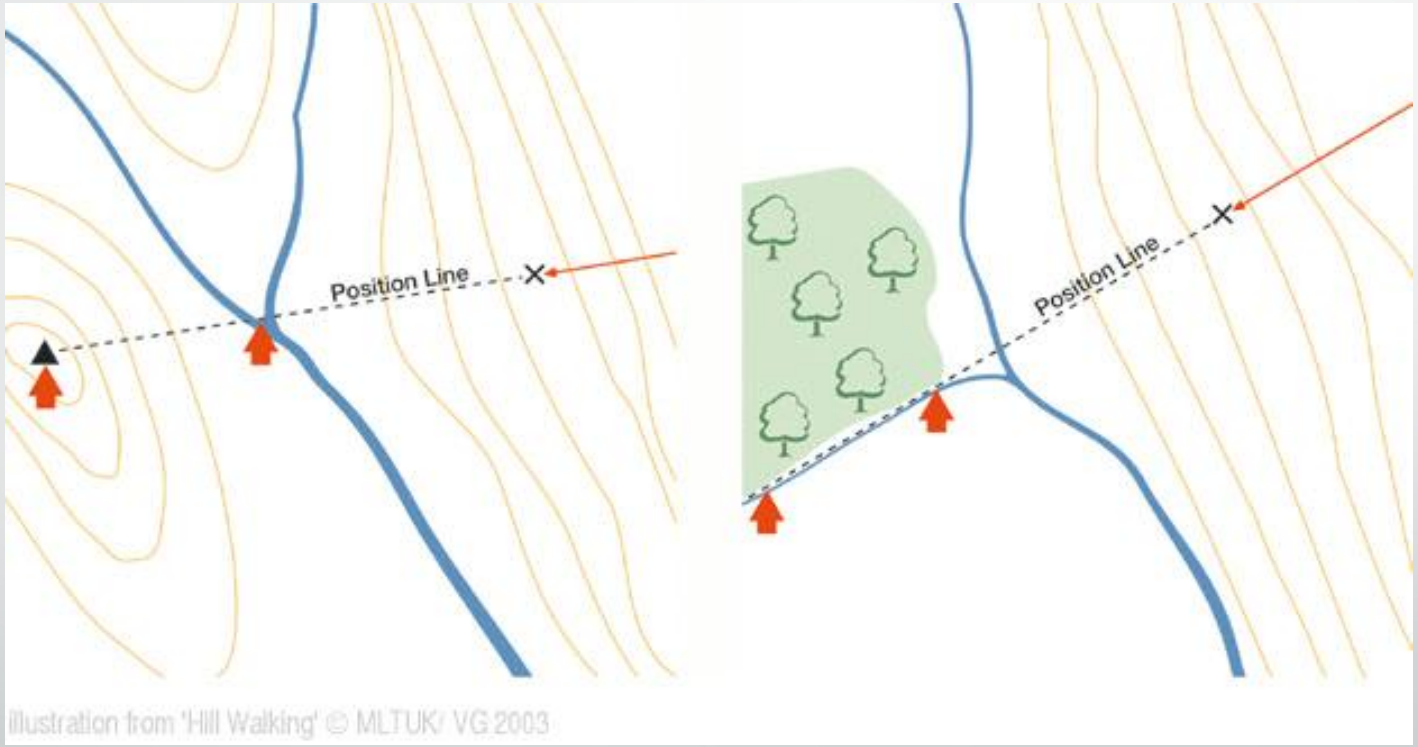
Distance Travelled



Dog Leg Detours



Spot and Line Transit



Any questions?

Navigation on Land Using Map and Compass

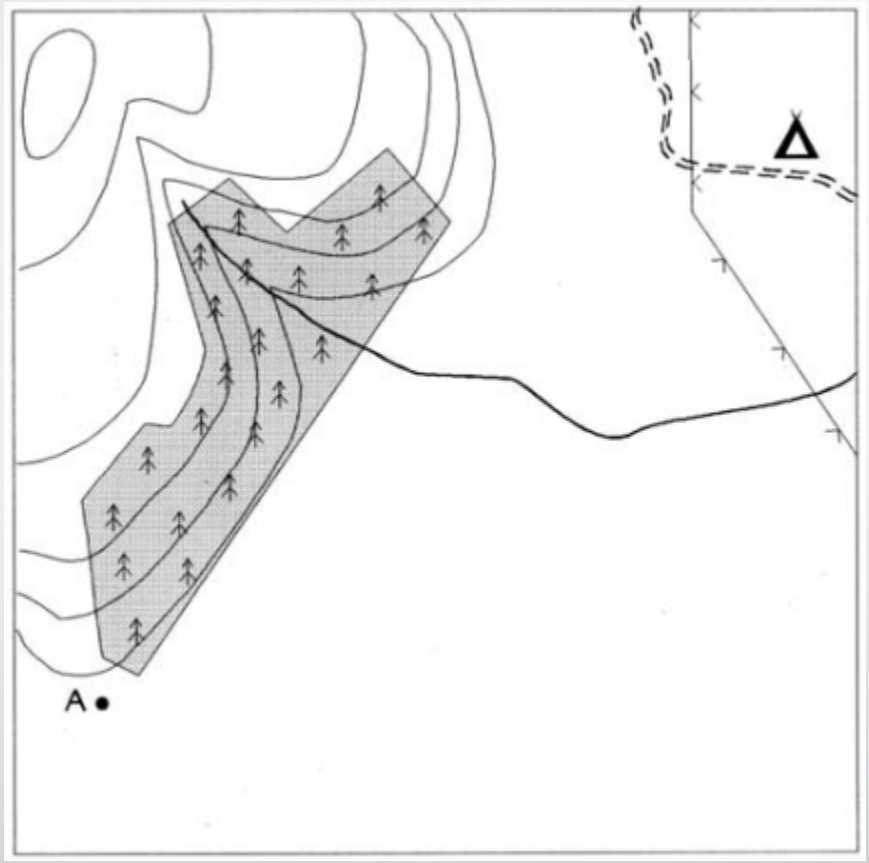
LO3: Know land navigation methods.

Naismith's Rule

Naismith calculated that it would take longer to walk a distance when it involved a climb.

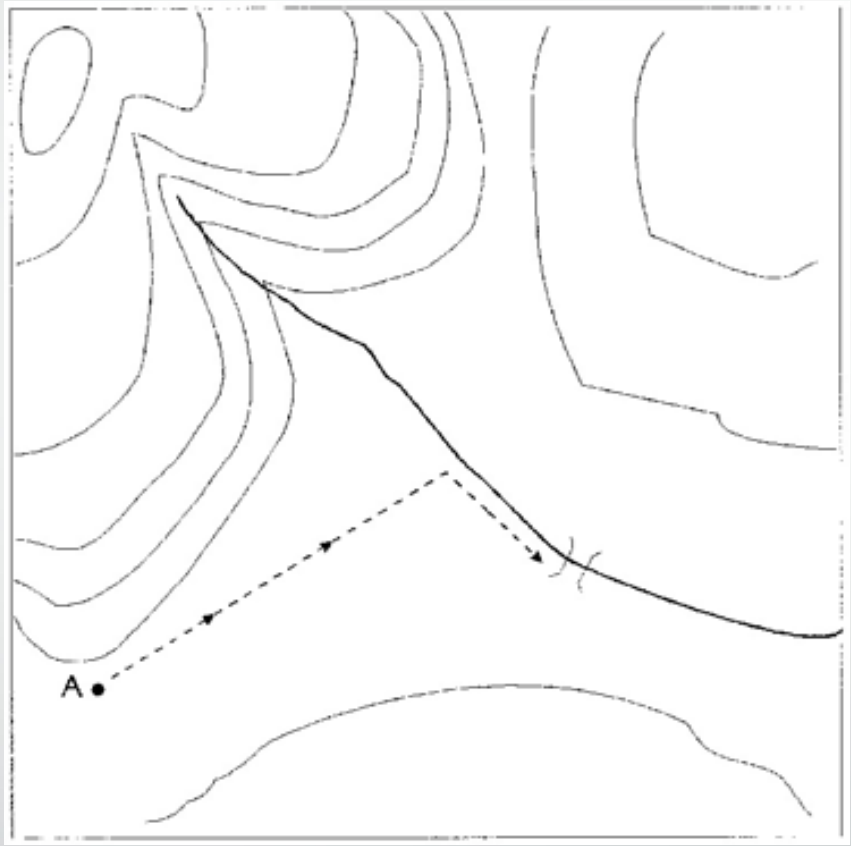
Therefore, he stated that for every 10 metres climbed, you should add 1 minute to your total distance travel time.

Handrailing



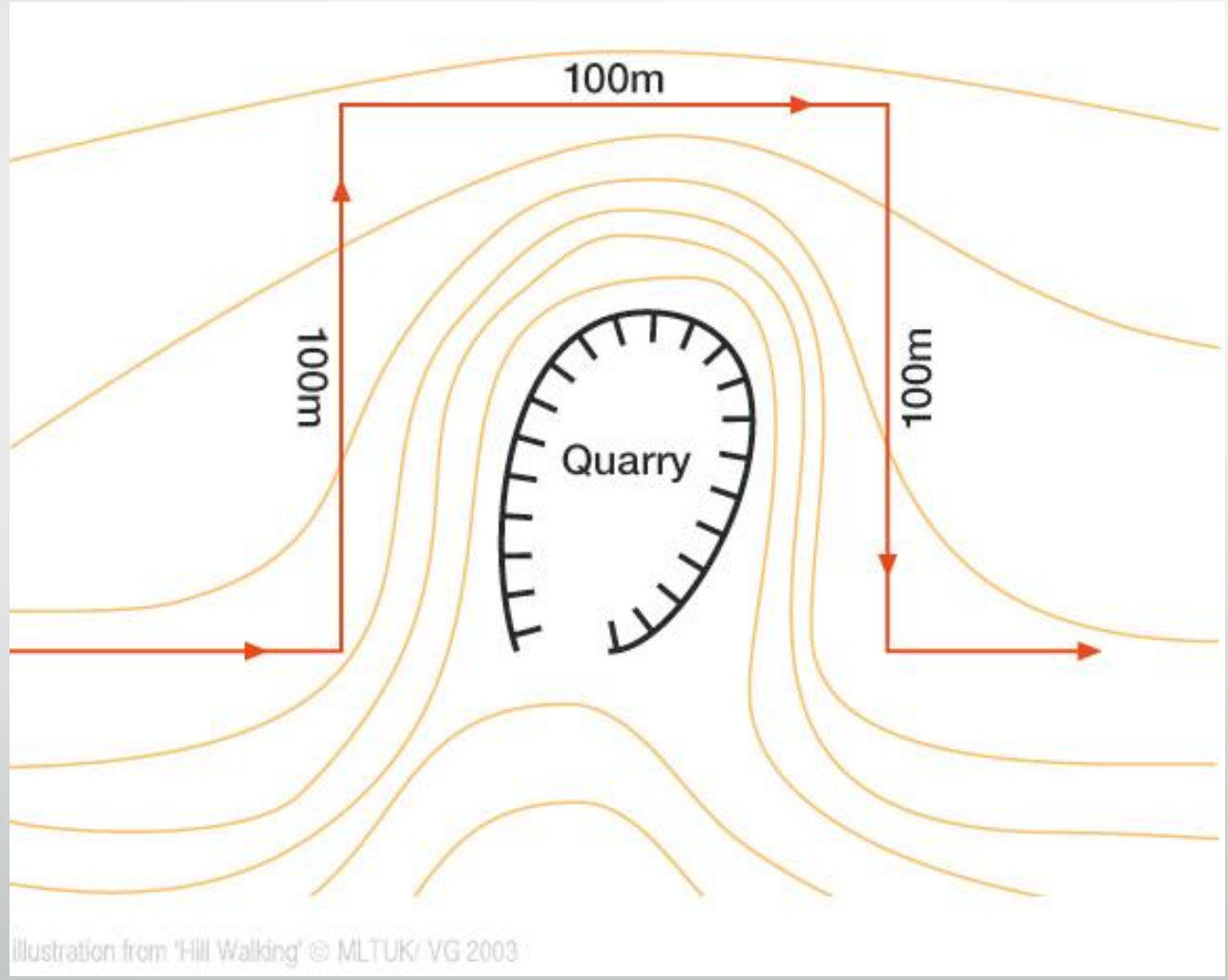
Which features would you handrail back to camp?

Aiming Off

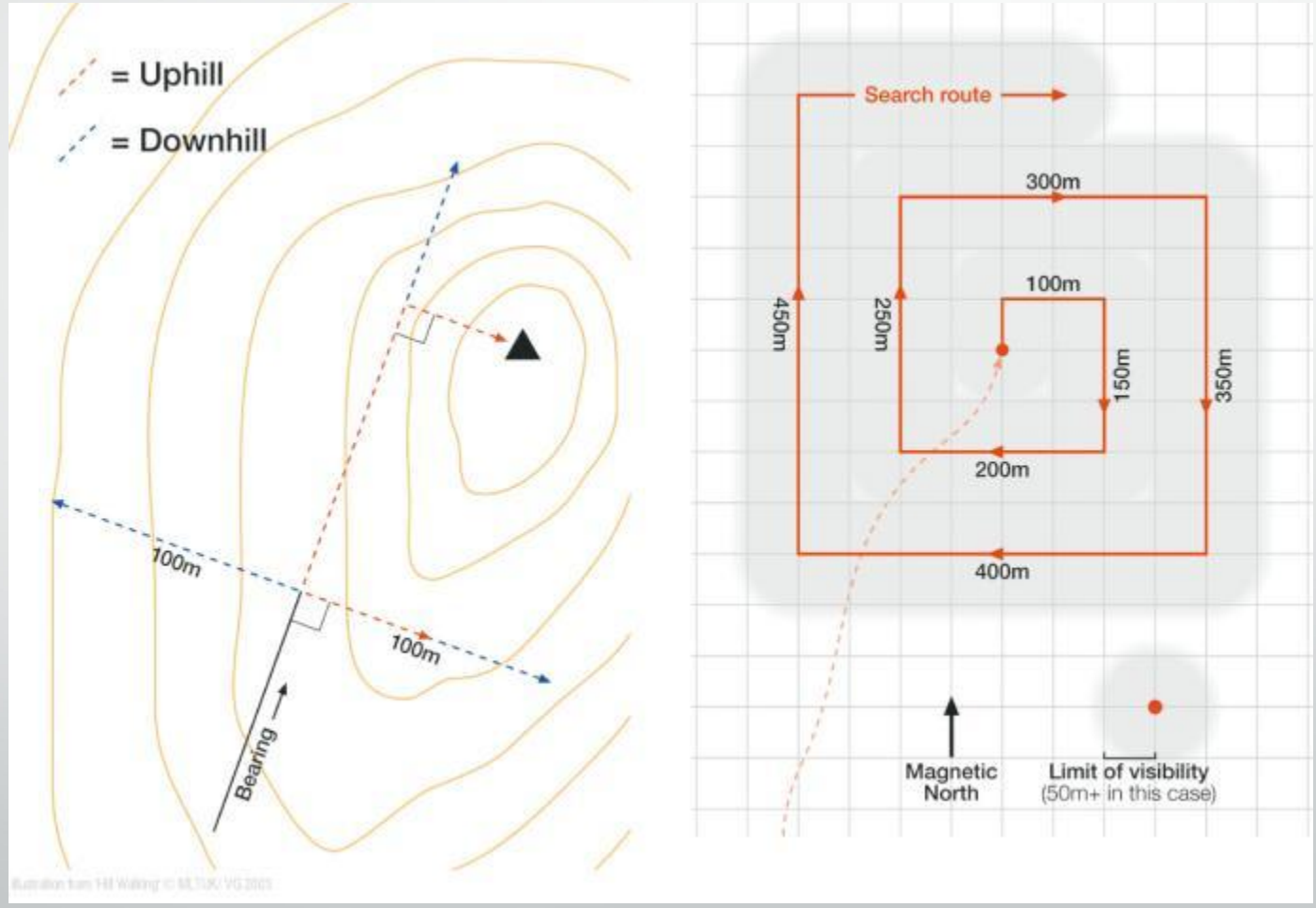


Aim to one side of the bridge so that you know which way to turn on reaching the river.

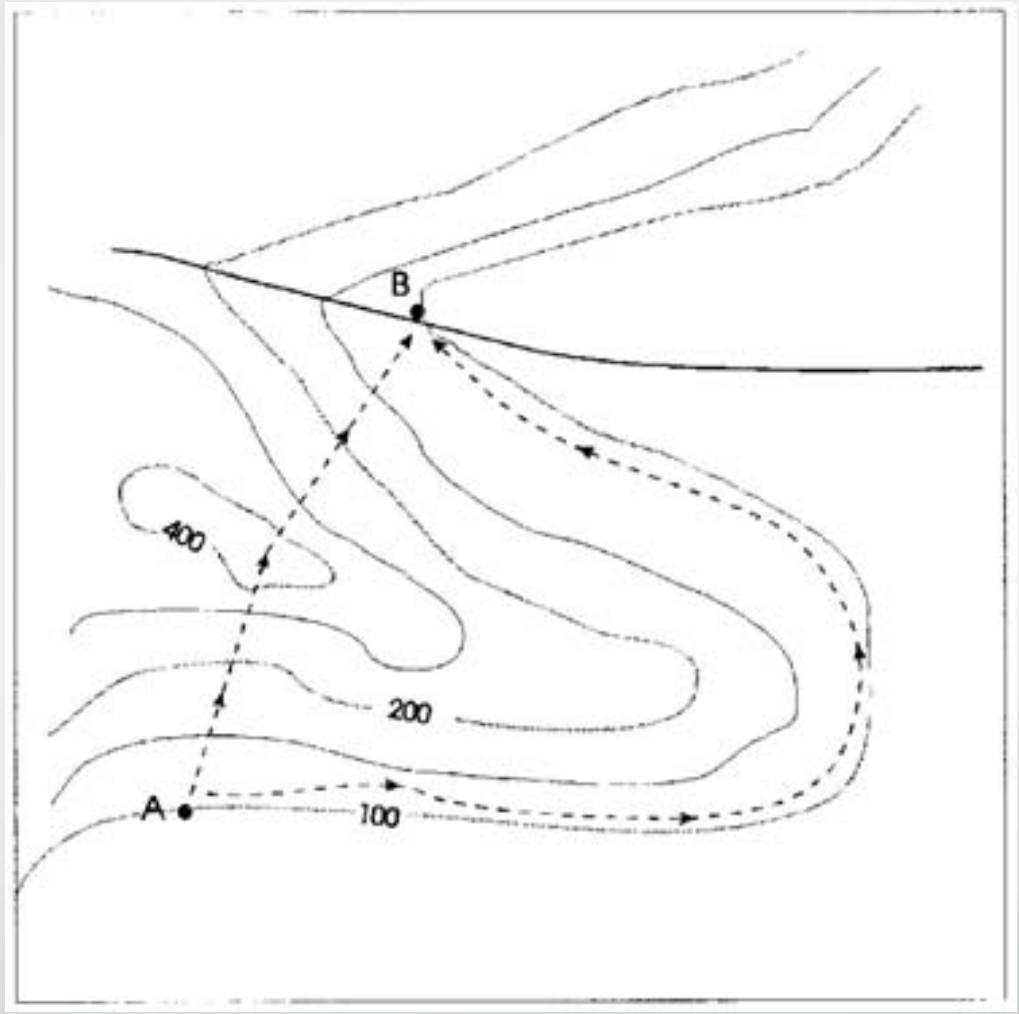
Boxing Round



Mapping Spiral

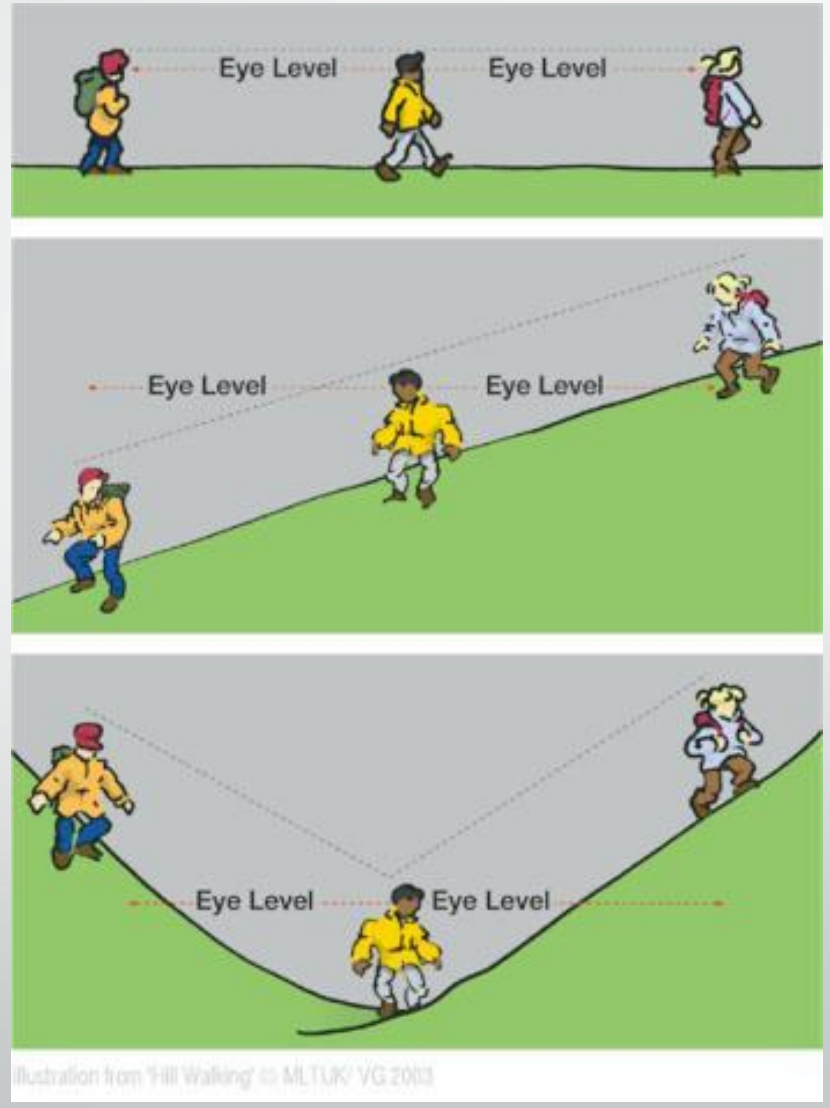


Contouring

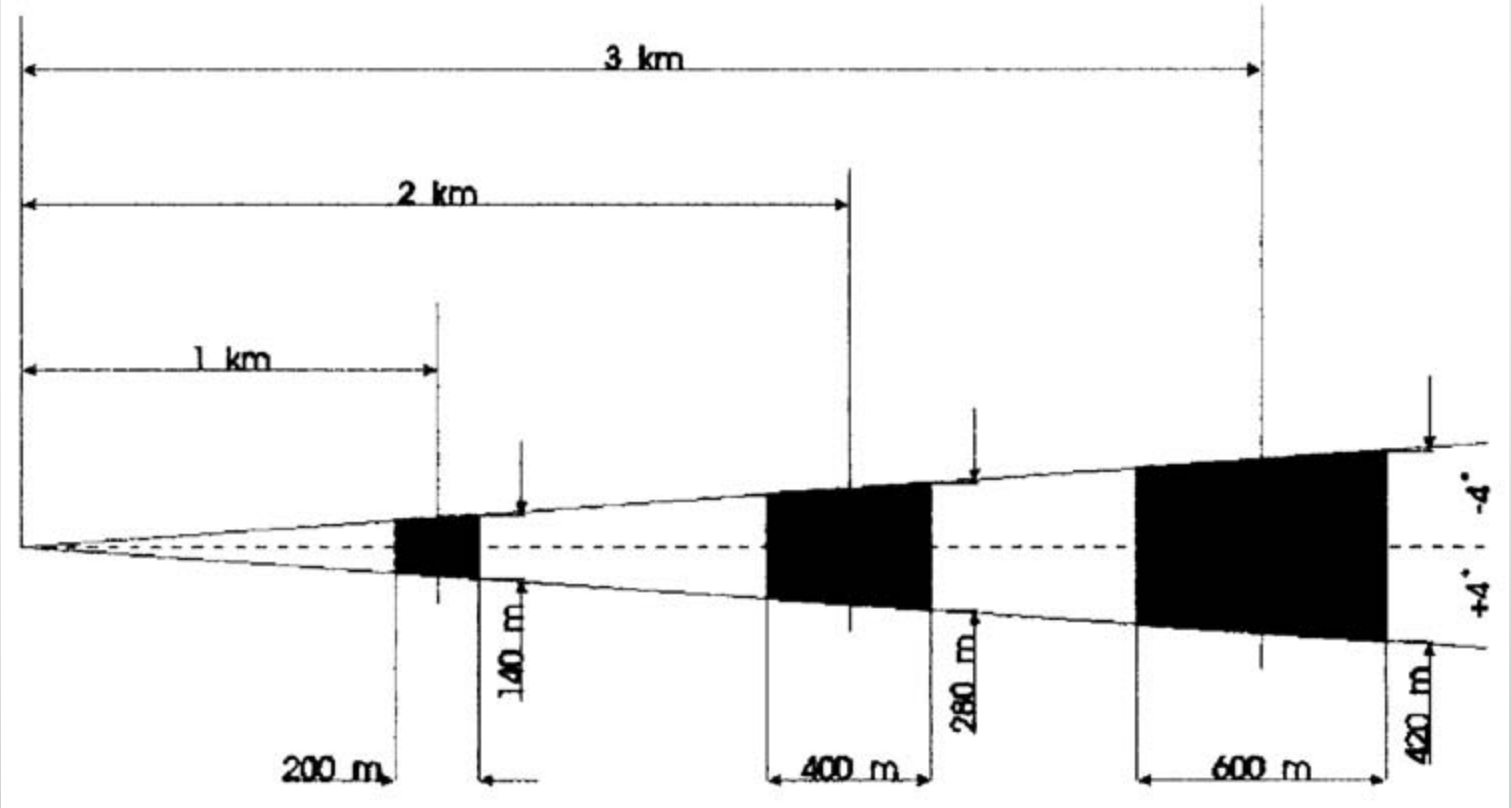


Take care when deciding the best route to follow. Contouring relies on strong navigational skills, particularly in poor visibility.

Outriggers

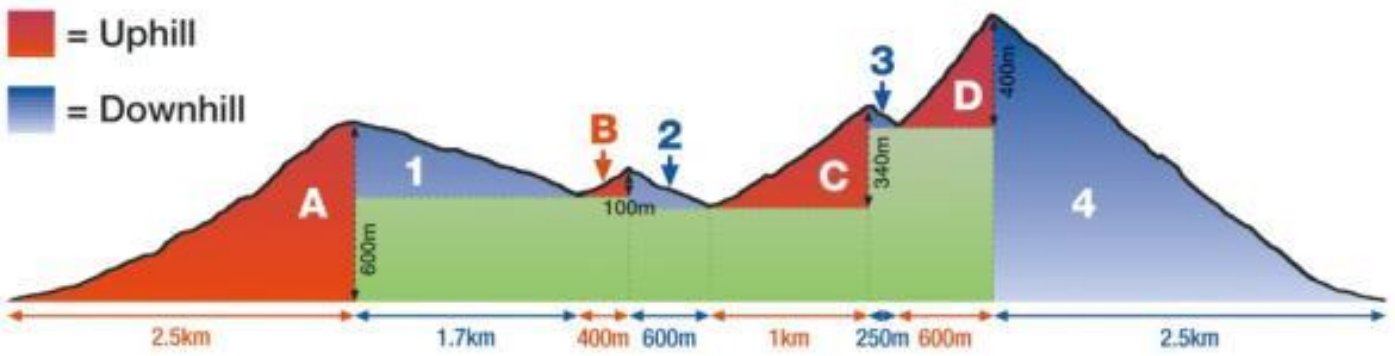


Errors



A 6° error means that on a leg of 500 metres, by the end of the leg, you would be 52 metres out from your desired location.

Calculating Timing



	Uphill			Downhill	
	Horizontal timing	Vertical timing		Horizontal timing	
A =	(2.5km → @ 5km/h = 30 min)	+ (600m ↑ @ 10m/min = 60 min) =	90 min	1 = 1.7km → @ 5km/h =	20.4 min
B =	(400m → @ 5km/h = 4.8 min)	+ (100m ↑ @ 10m/min = 10 min) =	14.8 min	2 = 600m → @ 5km/h =	7.2 min
C =	(1km → @ 5km/h = 12 min)	+ (340m ↑ @ 10m/min = 34 min) =	46 min	3 = 250m → @ 5km/h =	3 min
D =	(600m → @ 5km/h = 7.2 min)	+ (400m ↑ @ 10m/min = 40 min) =	47.2 min	4 = 2.5km → @ 5km/h =	30 min
			198 min		60.6 min

Calculating timing for an undulating ridge	
Uphill time	198 min
+ Downhill time	60.6 min
+ Breaks & lunch	90min
Total journey time	**348.6 min**

Speed and Distance Travelled

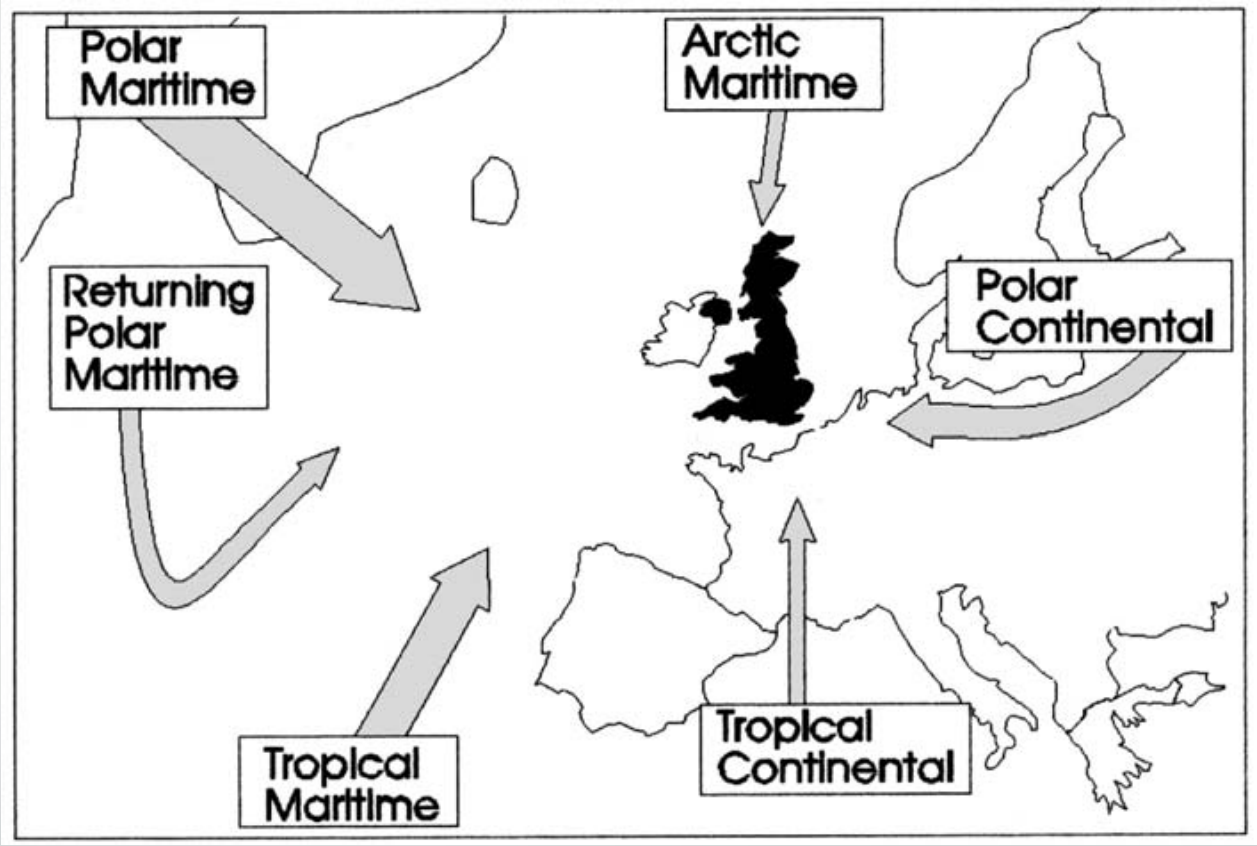
Distance travelled metres	Speed kilometres per hour			
	5	4	3	2
1000m	12 min	15 min	20 min	30 min
800m	10 min	12 min	16 min	24 min
700m	9 min	11 min	14 min	21 min
500m	6 min	7½ min	10 min	15 min
400m	5 min	6 min	8 min	12 min
200m	2½ min*	3 min	4 min	6 min
100m	1¼ min*	1½ min	2 min	3 min

Any questions?

Navigation on Land Using Map and Compass

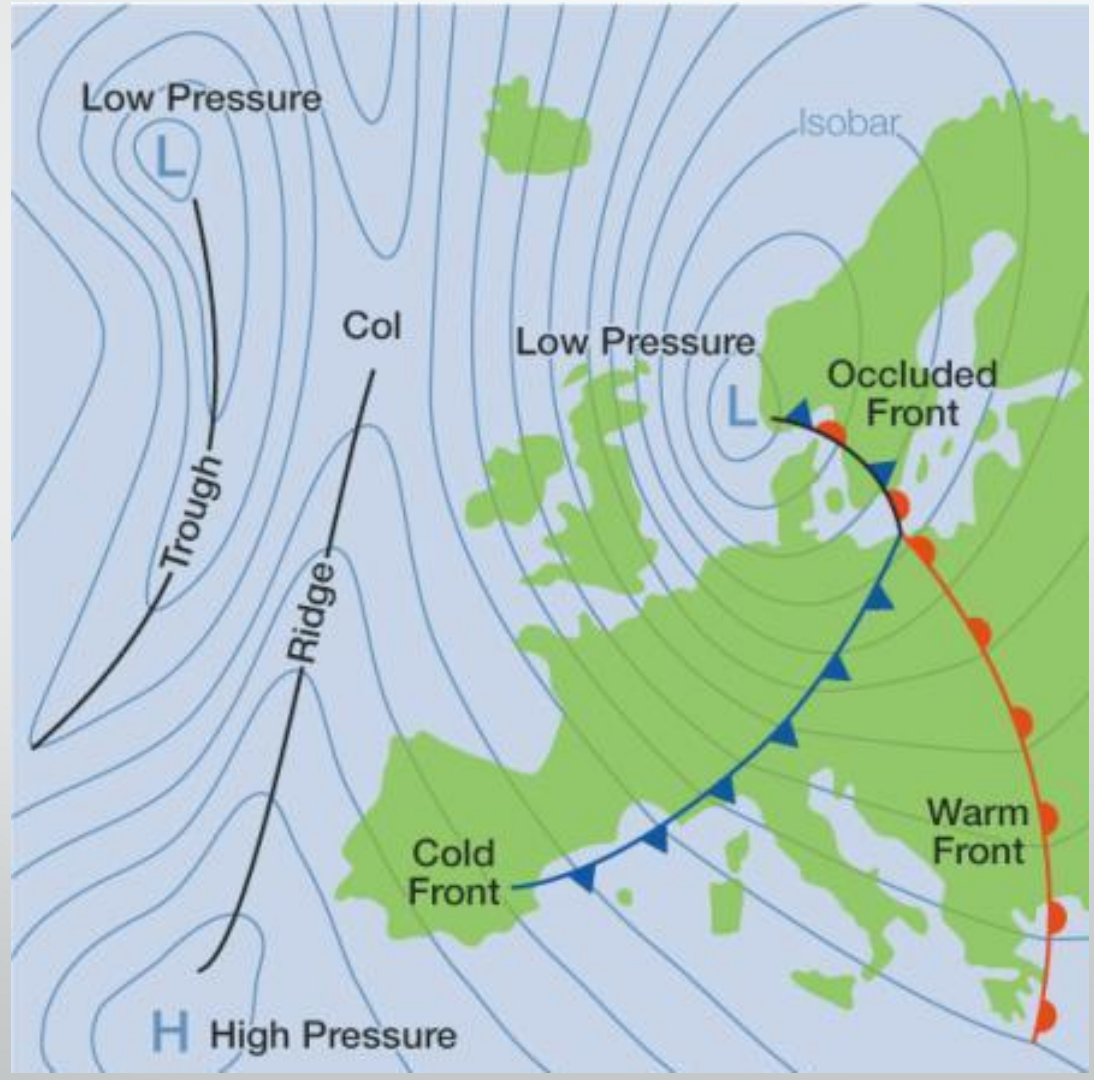
LO4: Know weather conditions that affect land navigation.

Main Air Masses

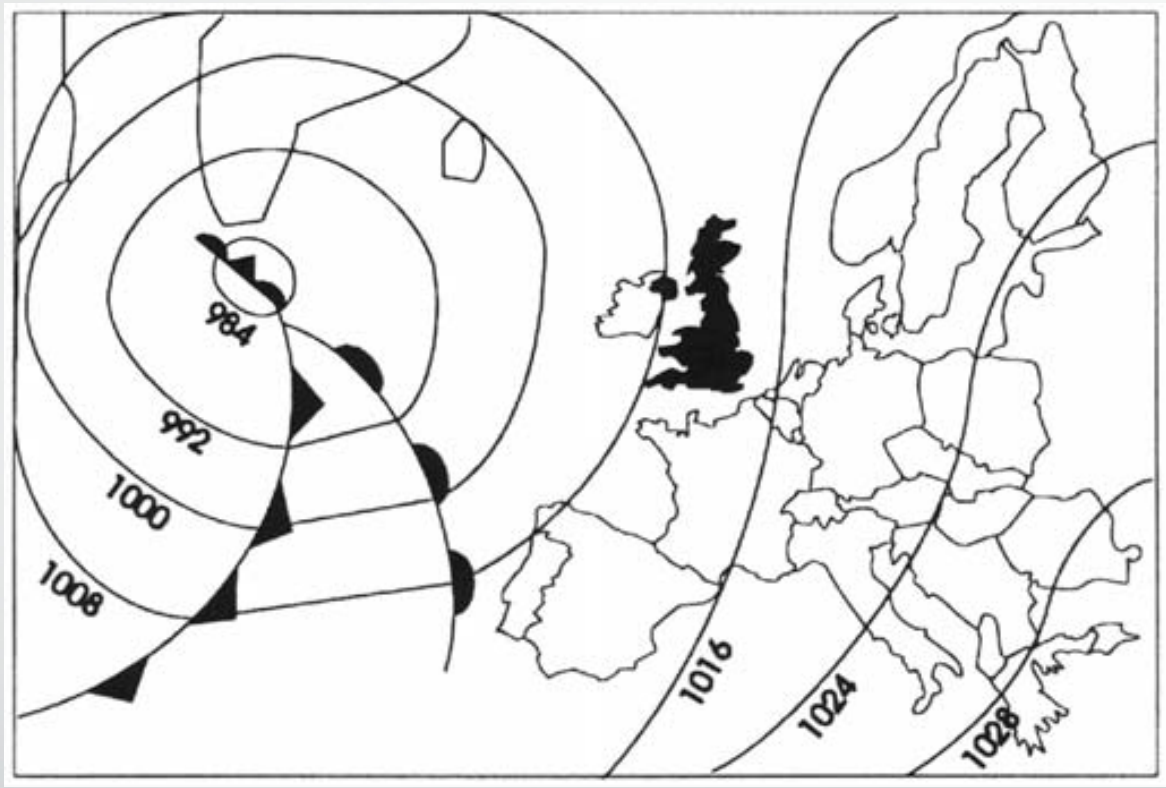


The width of the arrows indicate the frequency of occurrence.

Weather Map

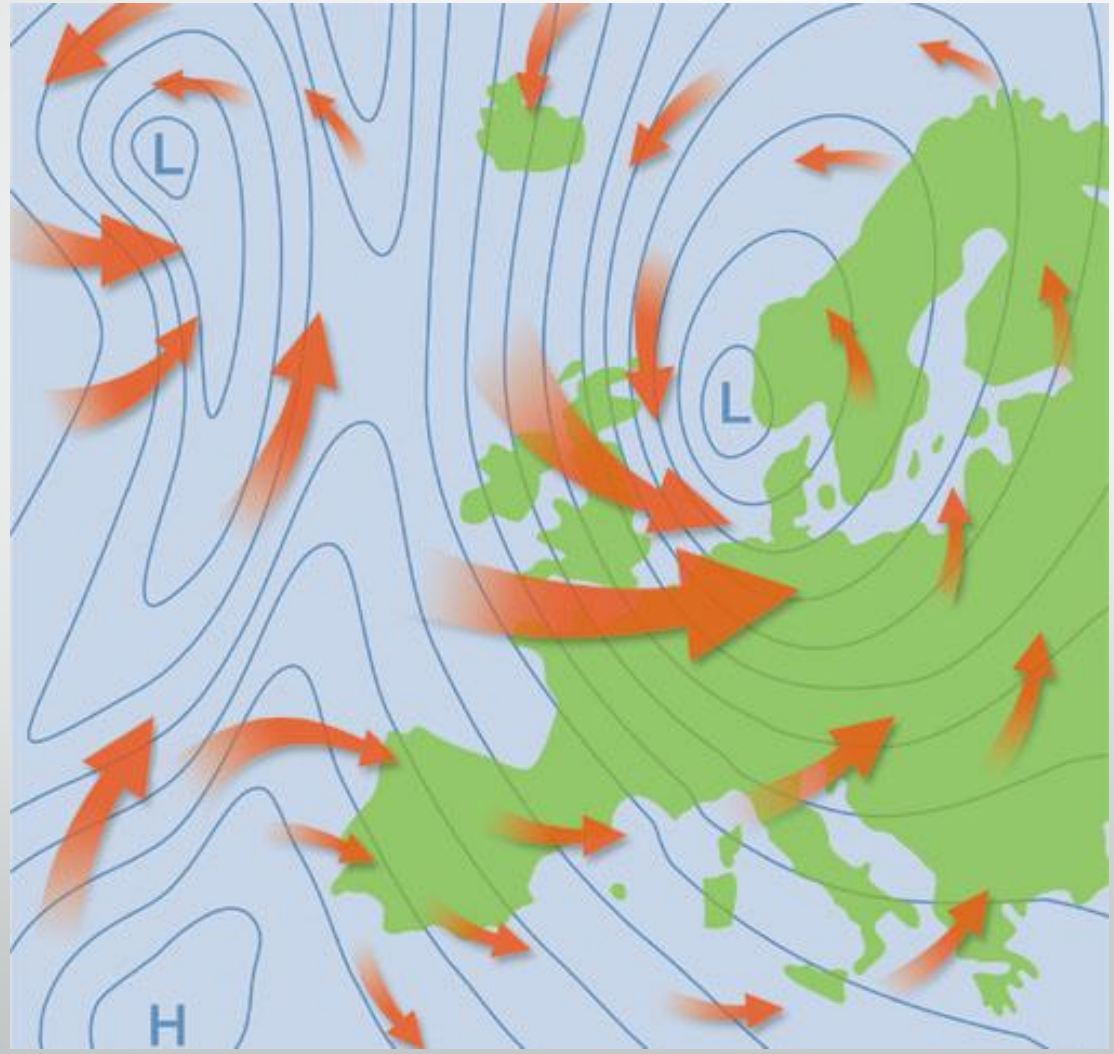

Low Pressure
L
Isobar
Col
Low Pressure
L
Occluded
Front
Trough
Ridge
Warm
Front
Cold
Front
H High Pressure

Fronts and Frontal Depressions

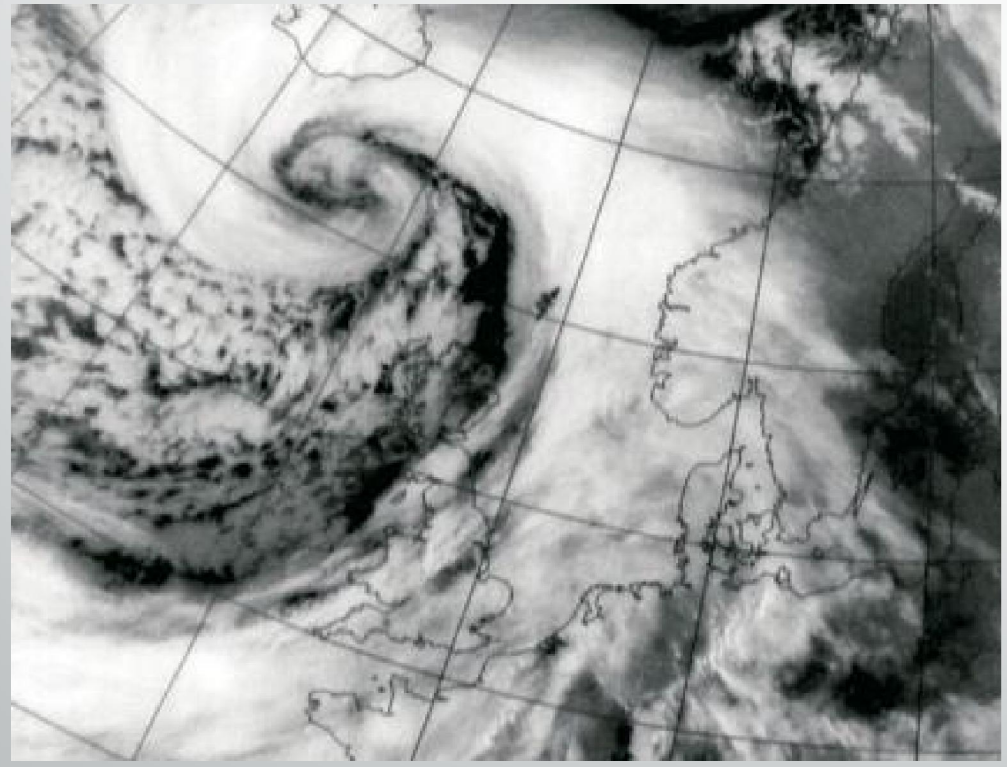


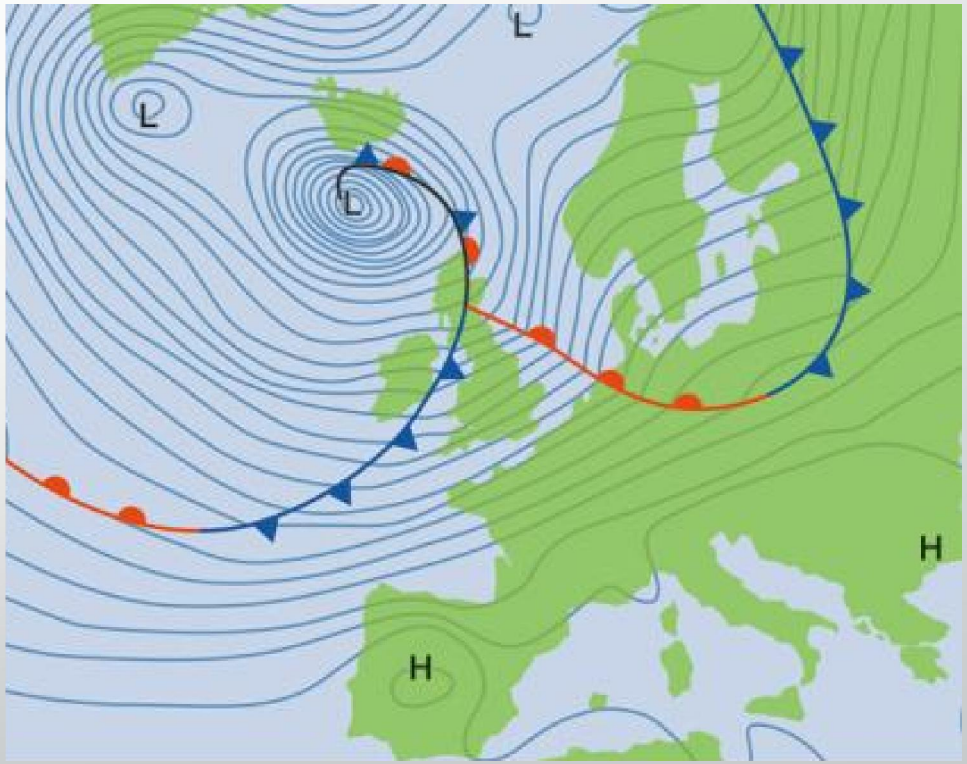
The numbers refer to the pressure in millibars.

Weather Map – Westerly Winds

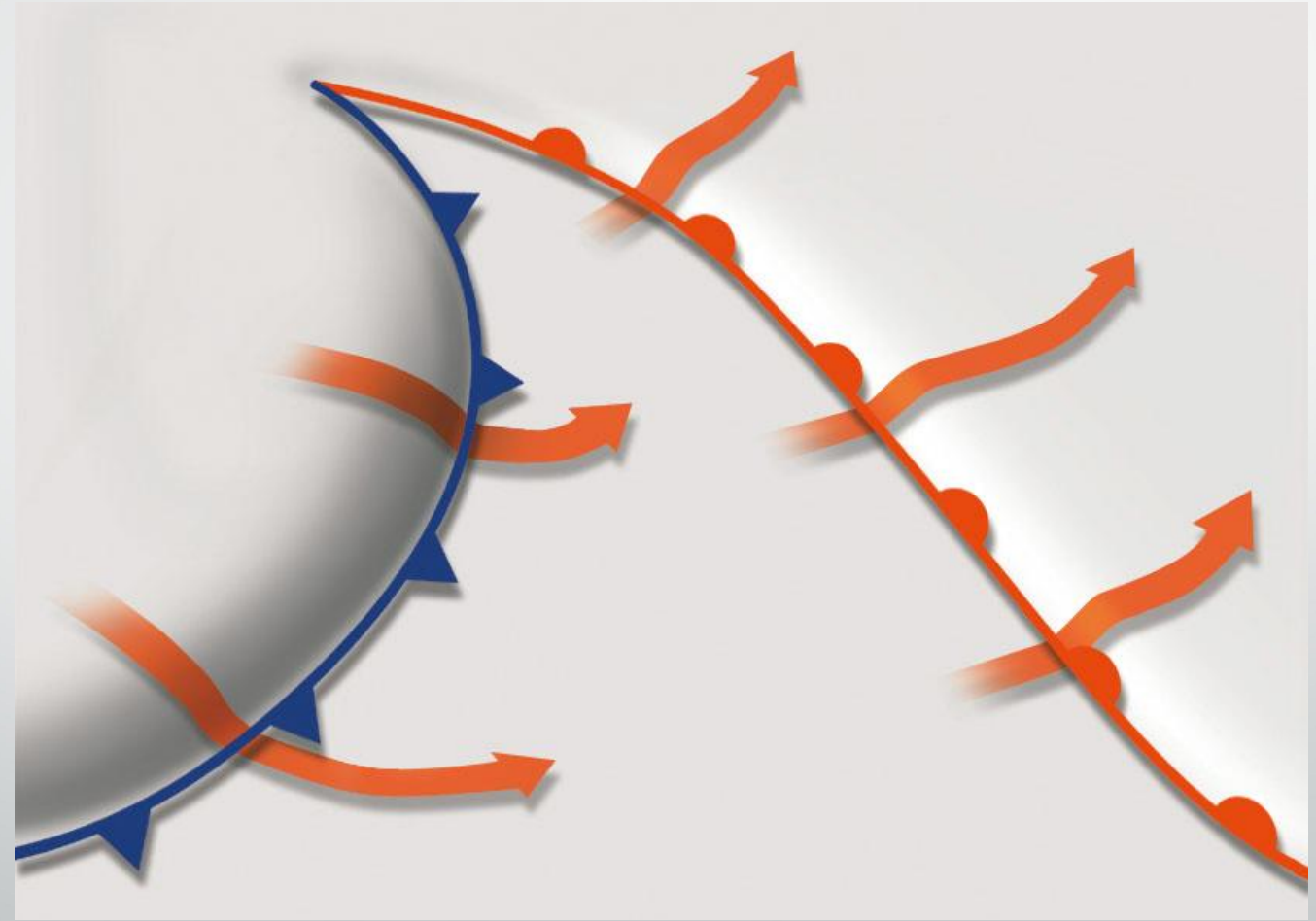


Depression Chart

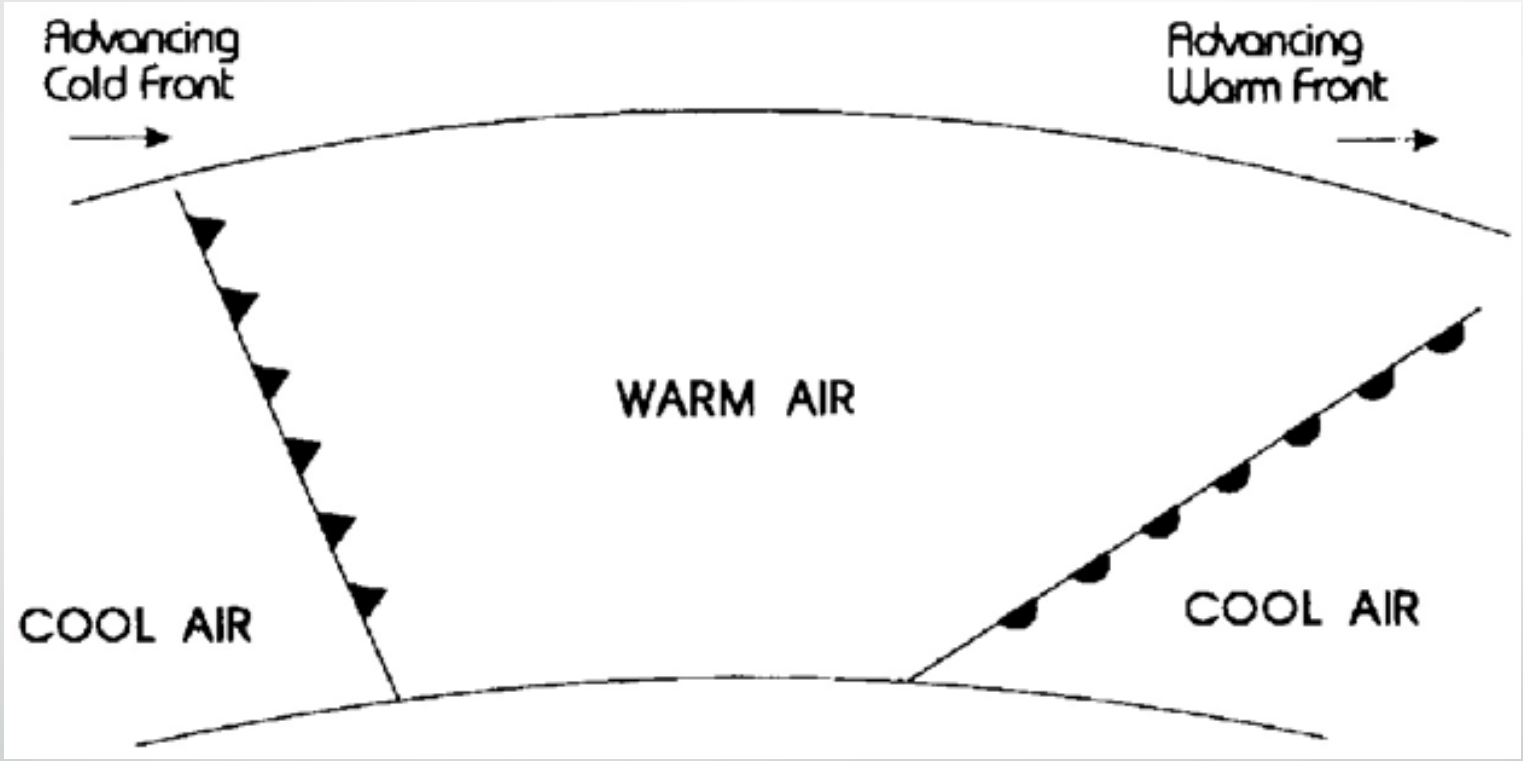




Depression

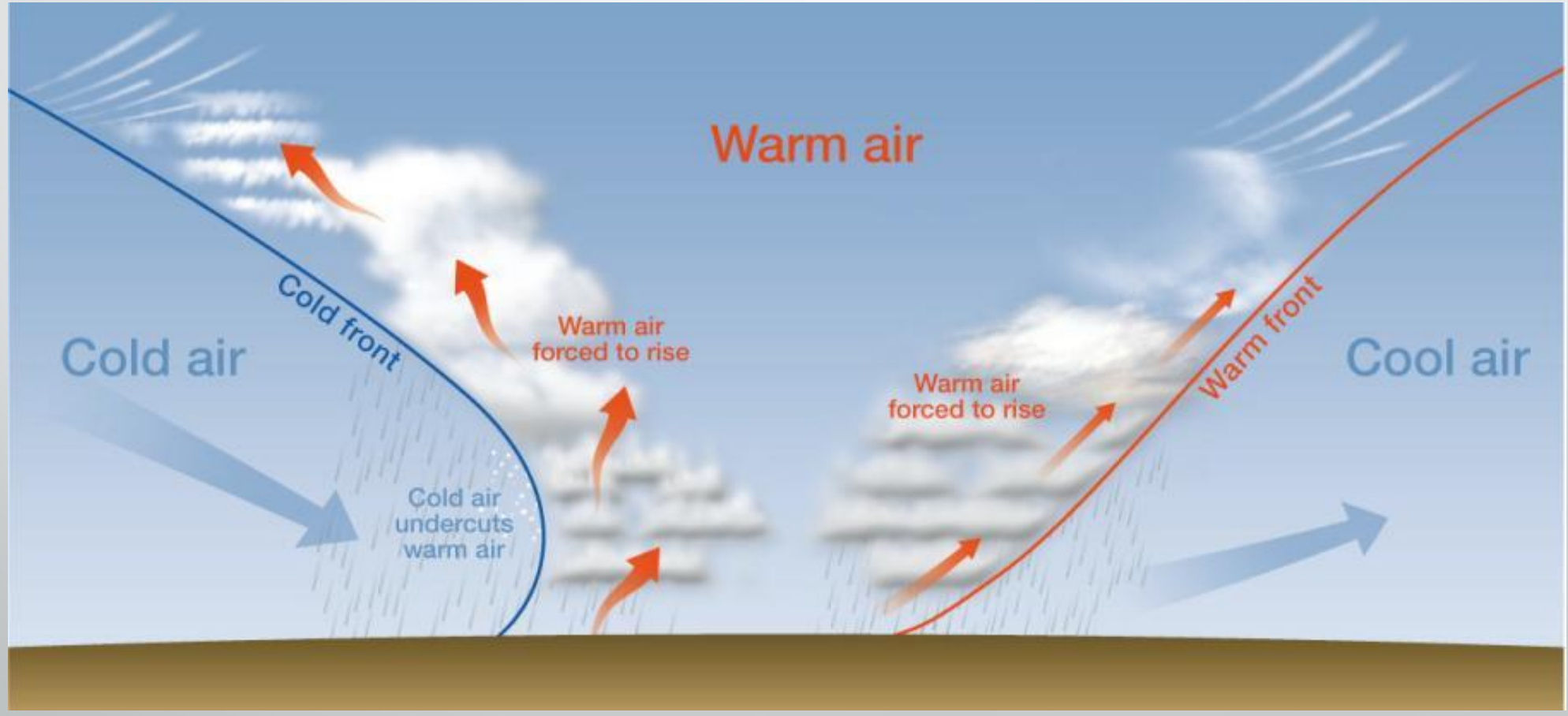


Fronts and Frontal Depressions

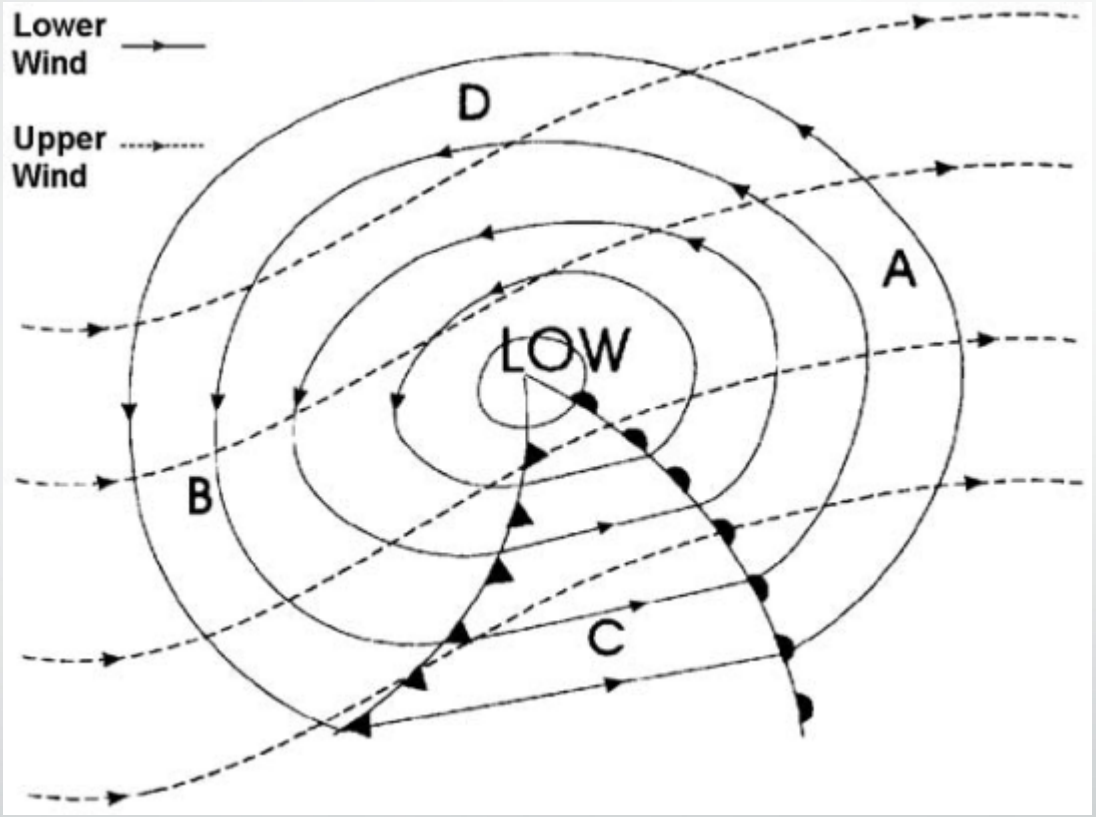


Section through a frontal system. Cold front is steeper than the warm front.

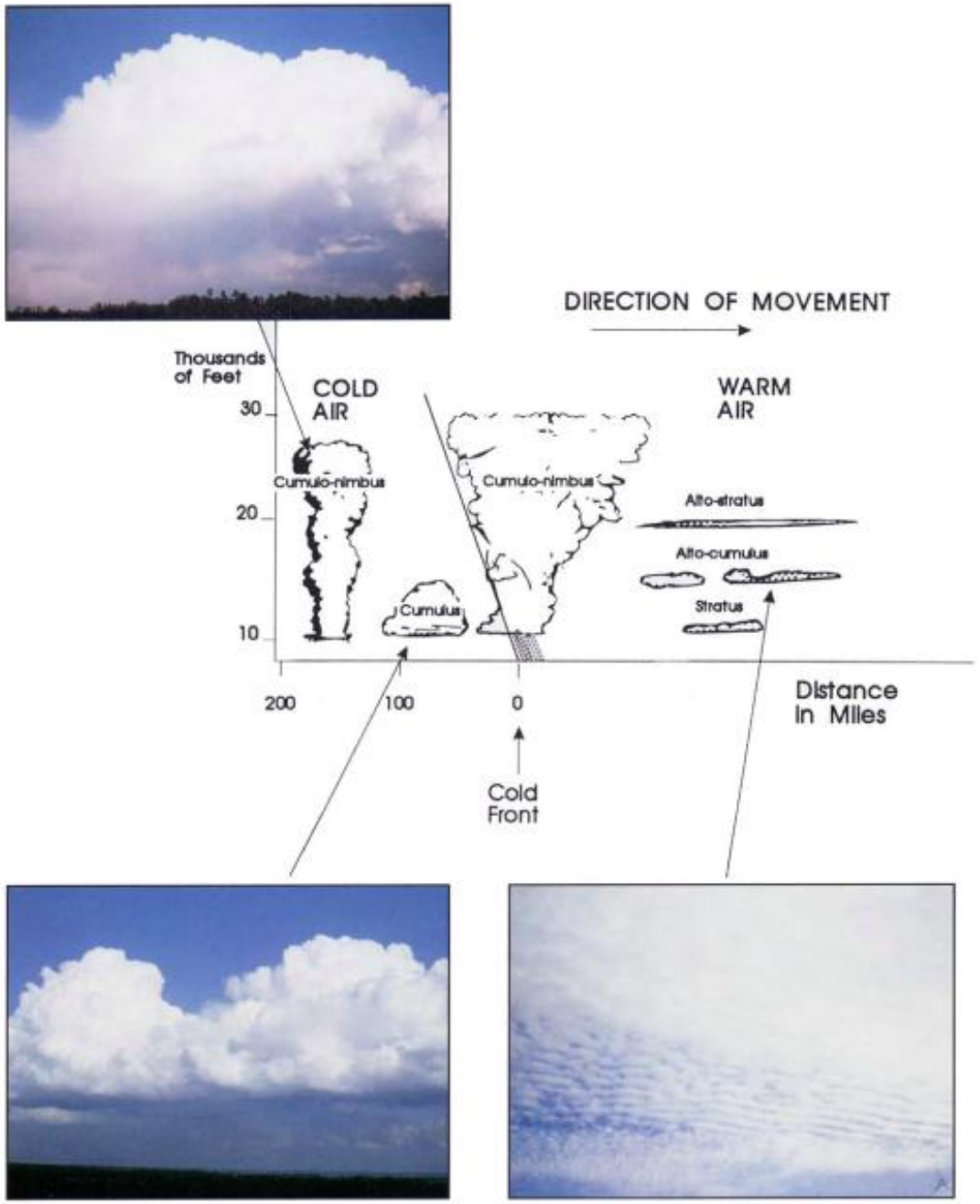
Depression Cross Section

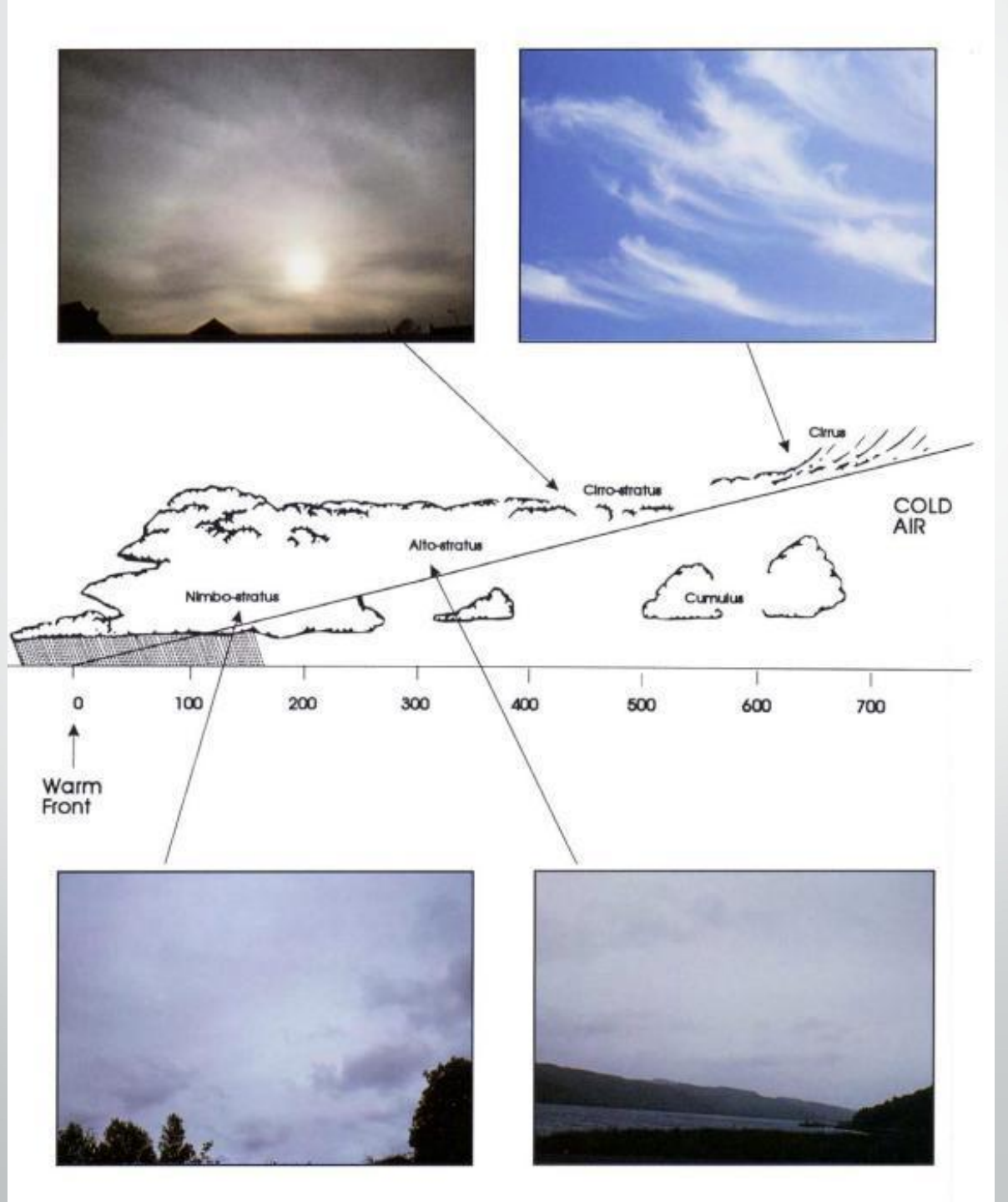


Upper and Lower Winds



Weather map showing isobars for both upper and lower winds.


DIRECTION OF MOVEMENT
Thousands of Feet
30
20
10
COLD AIR
WARM AIR
Cumulo-nimbus
Cumulo-nimbus
Cumulus
Alto-stratus
Alto-cumulus
Stratus
200
100
0
Distance In Miles
Cold Front


Cirrus
Cirro-stratus
COLD
AIR
Alto-stratus
Nimbo-stratus
Cumulus
0
100
200
300
400
500
600
700
Warm
Front

CIRRUS

ALTOSTRATUS

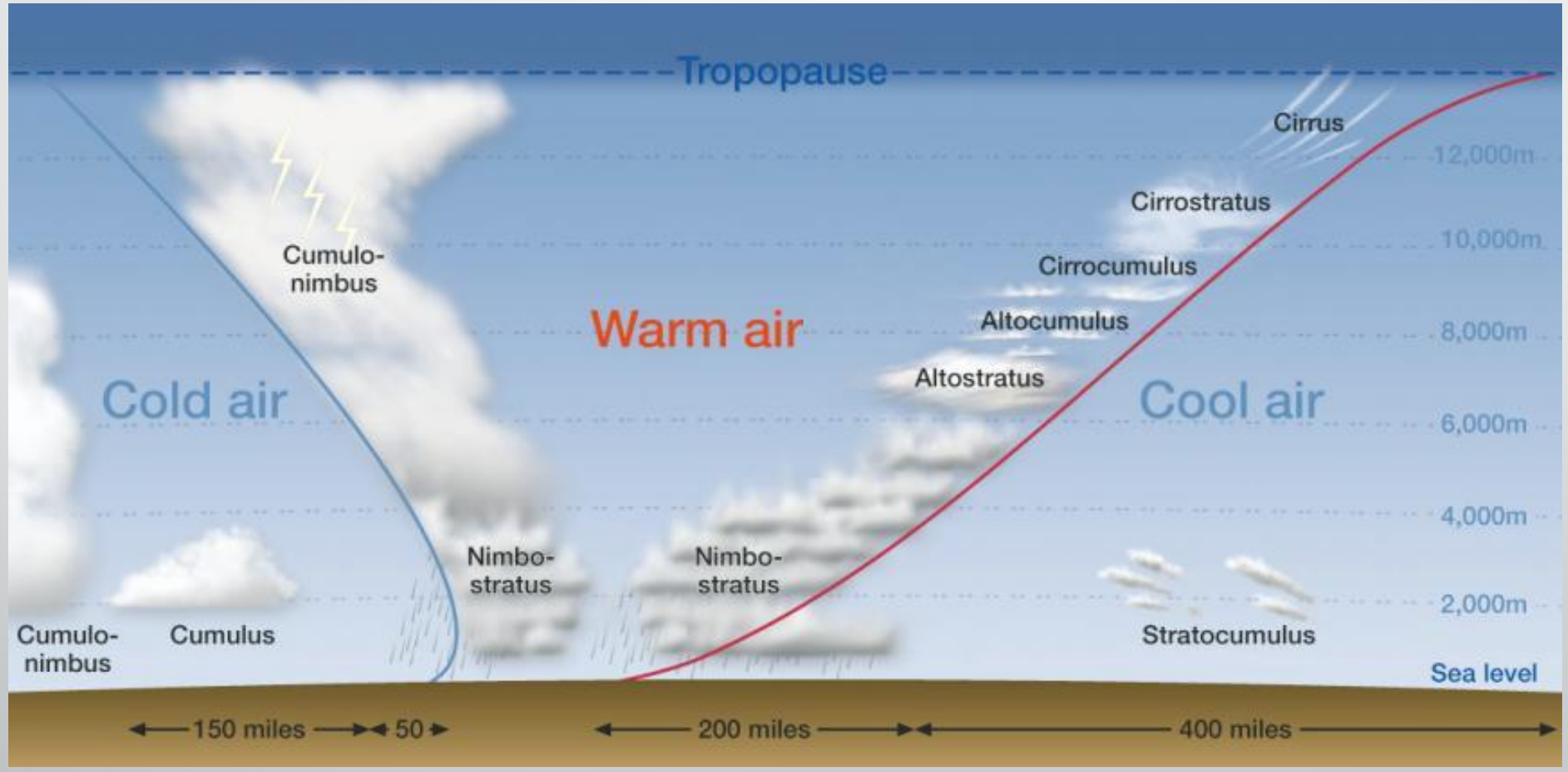
STRATUS

CUMULUS

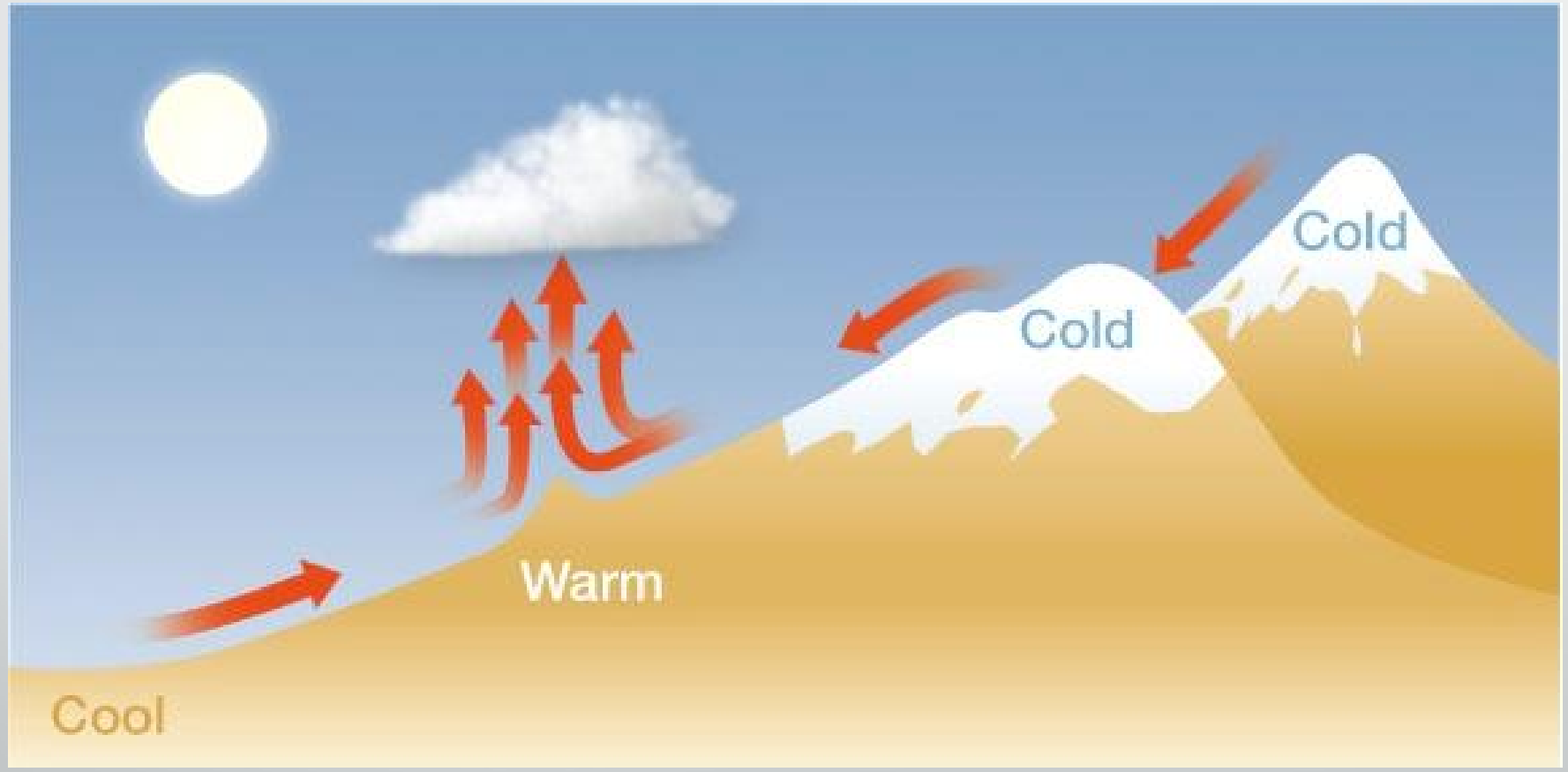
VALLEY FOG

APPROACHING FRONT

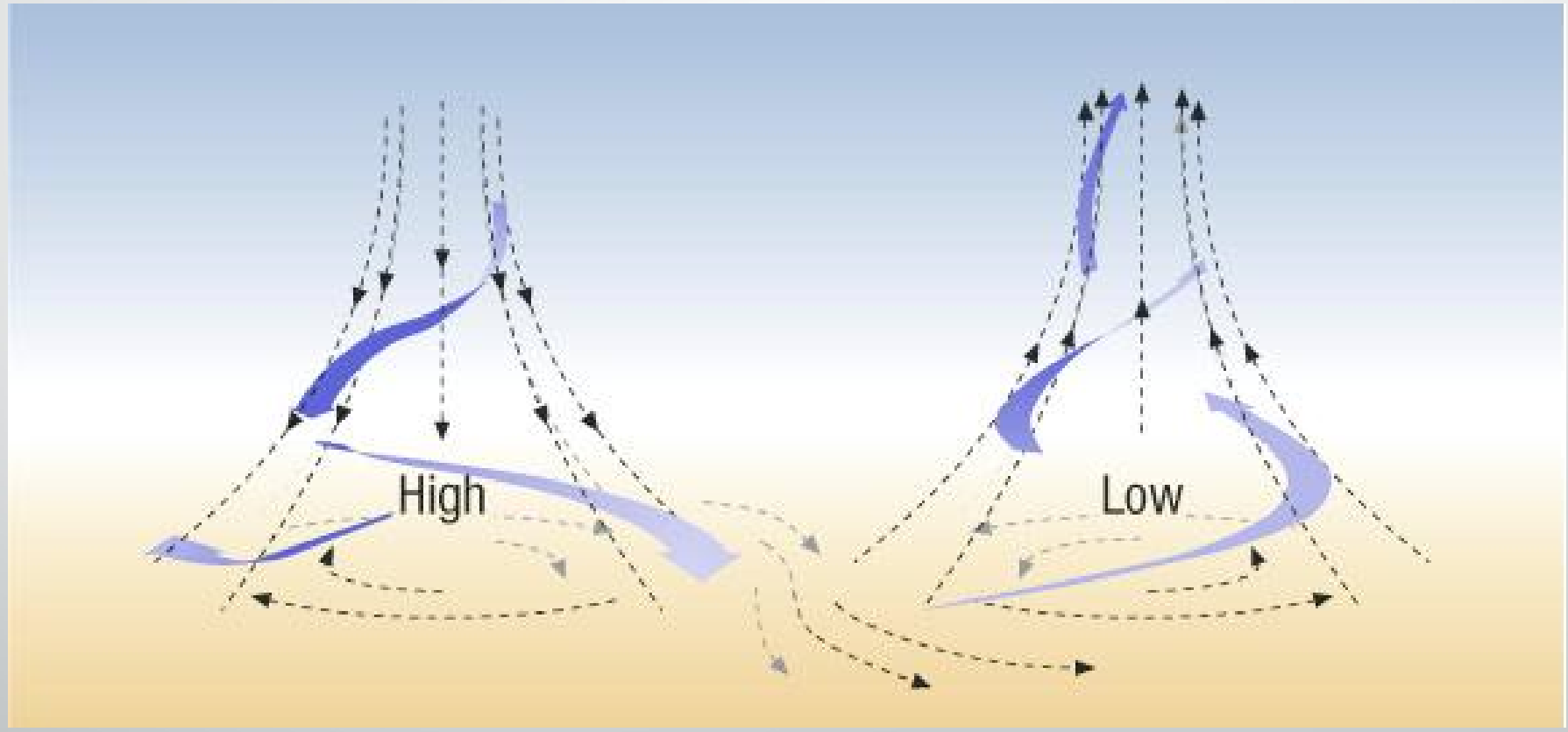
Cross Section



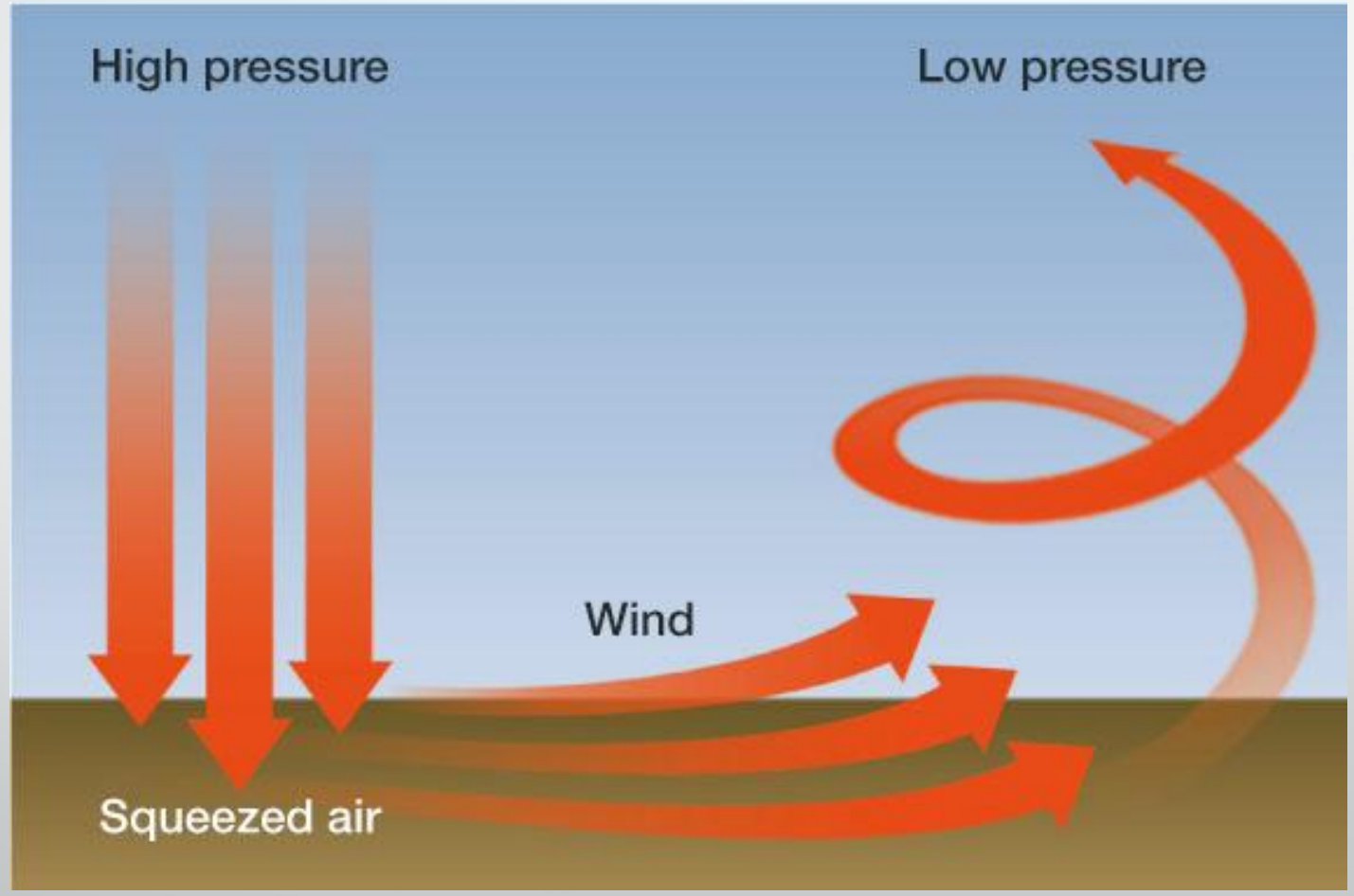
Local Warming



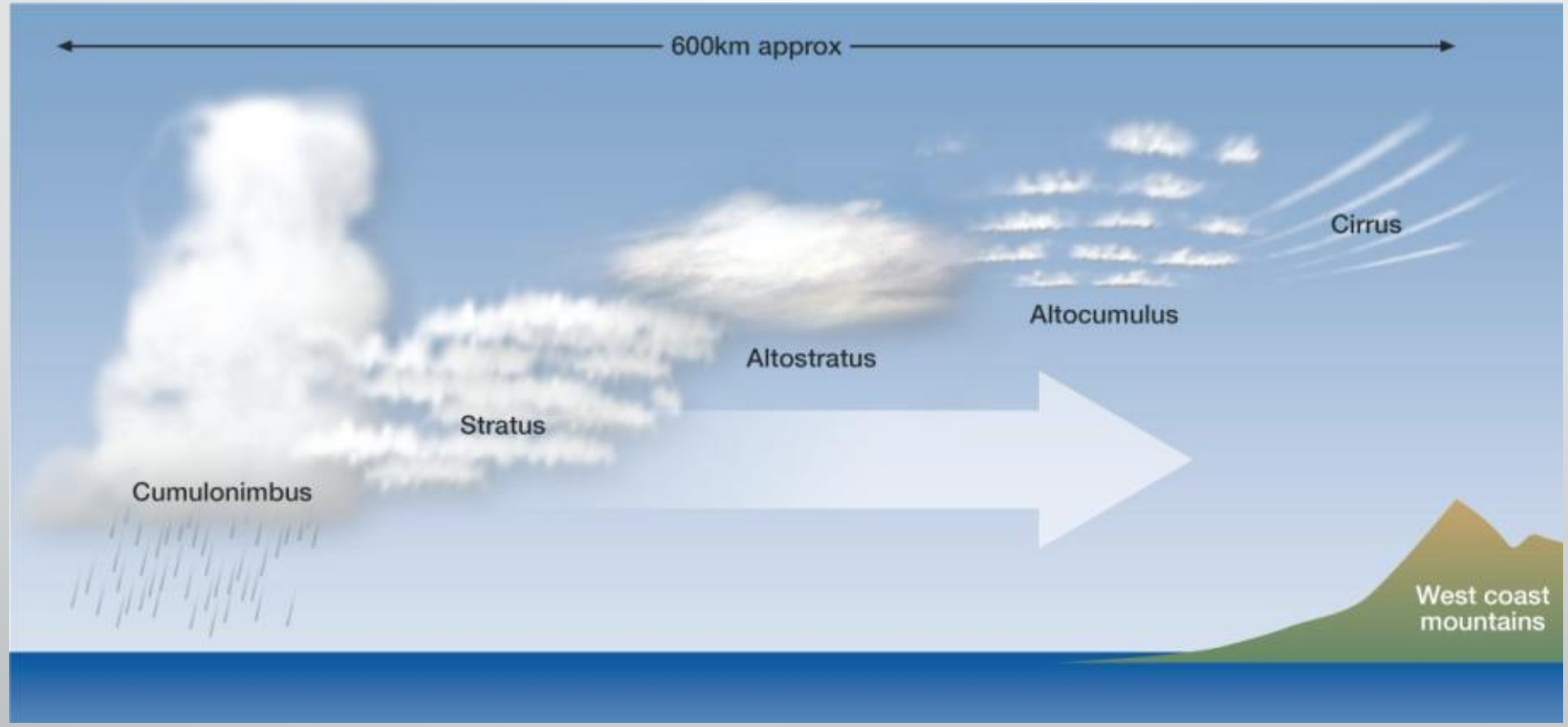
High and Low Pressure



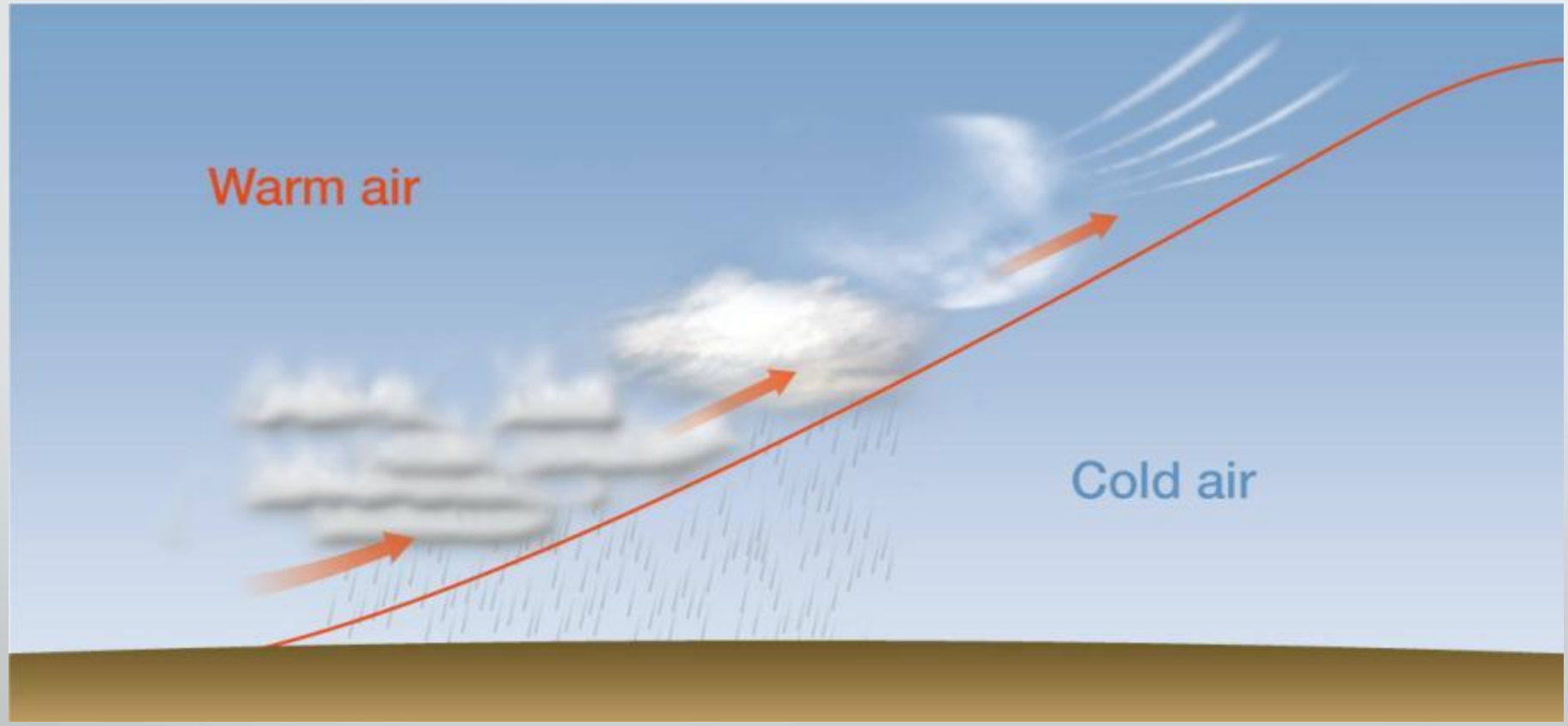
High and Low Pressure



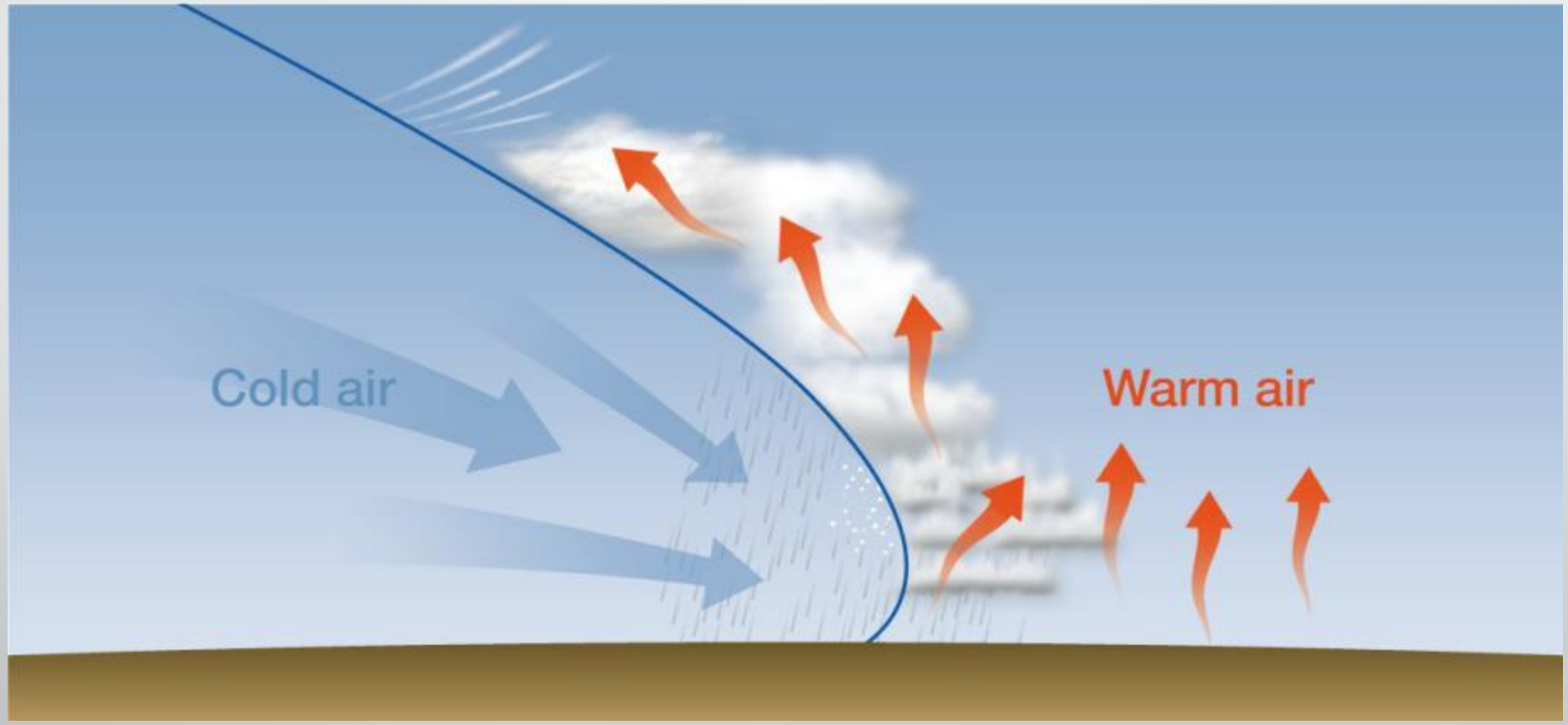
Approaching Rain



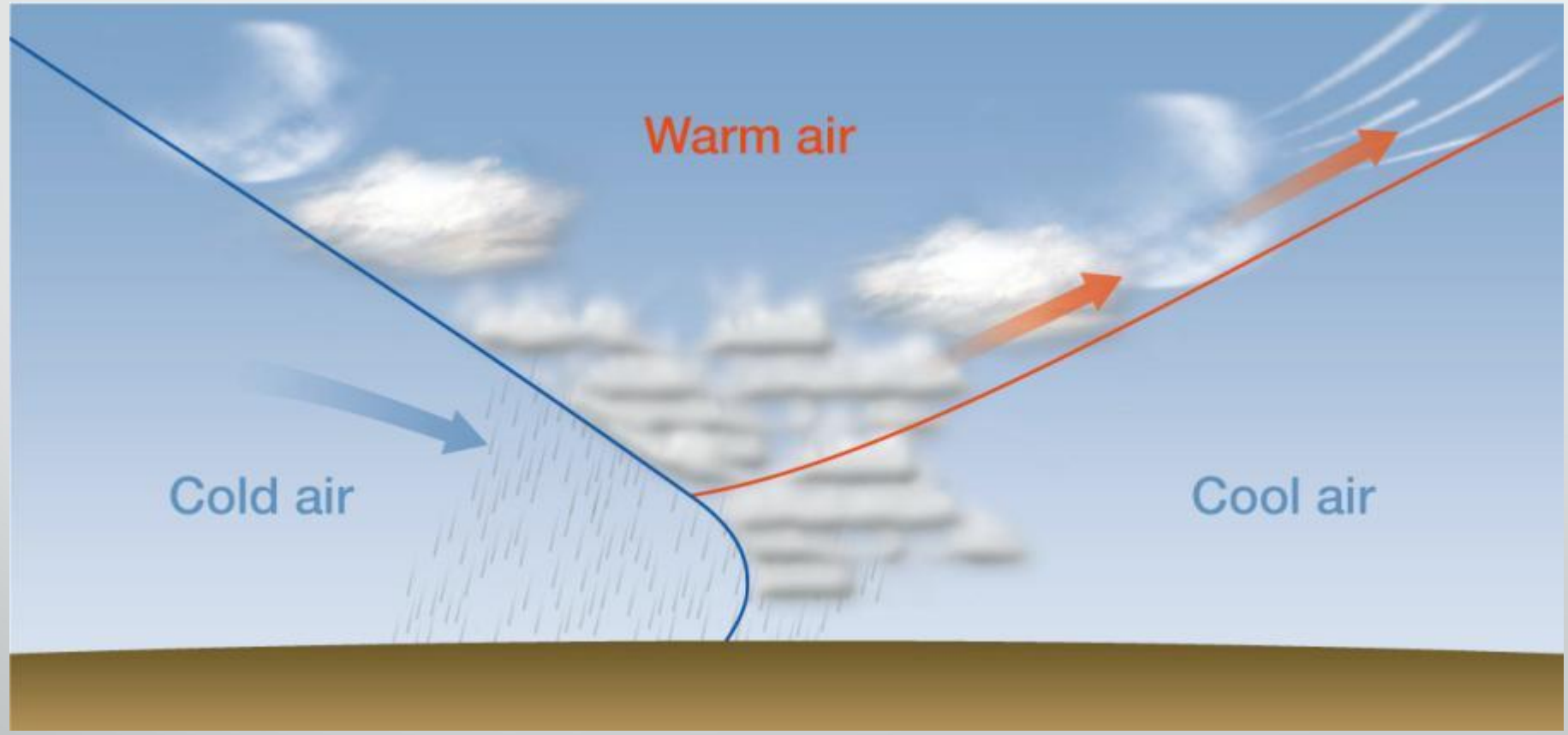
Warm Front



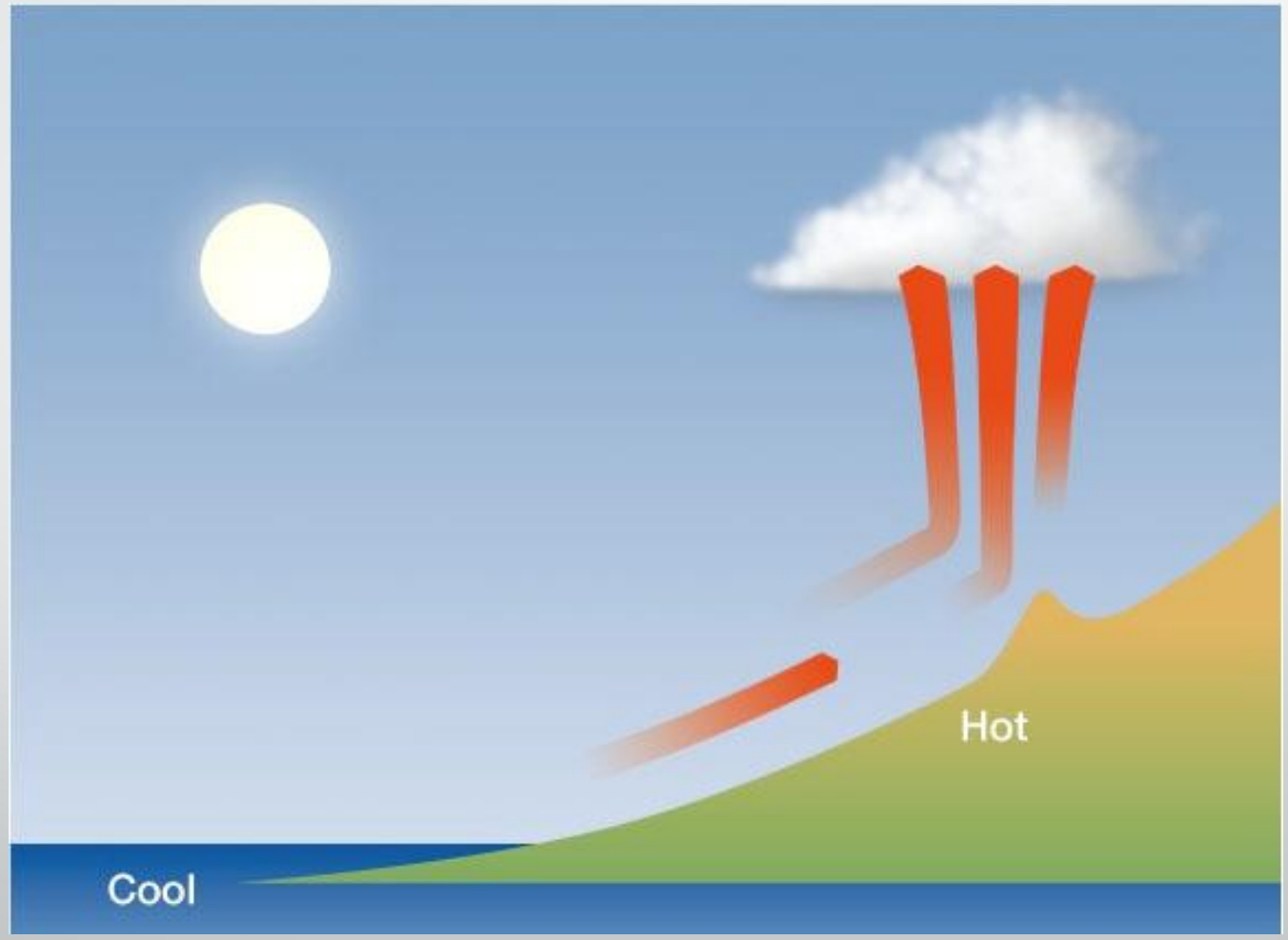
Cold Front



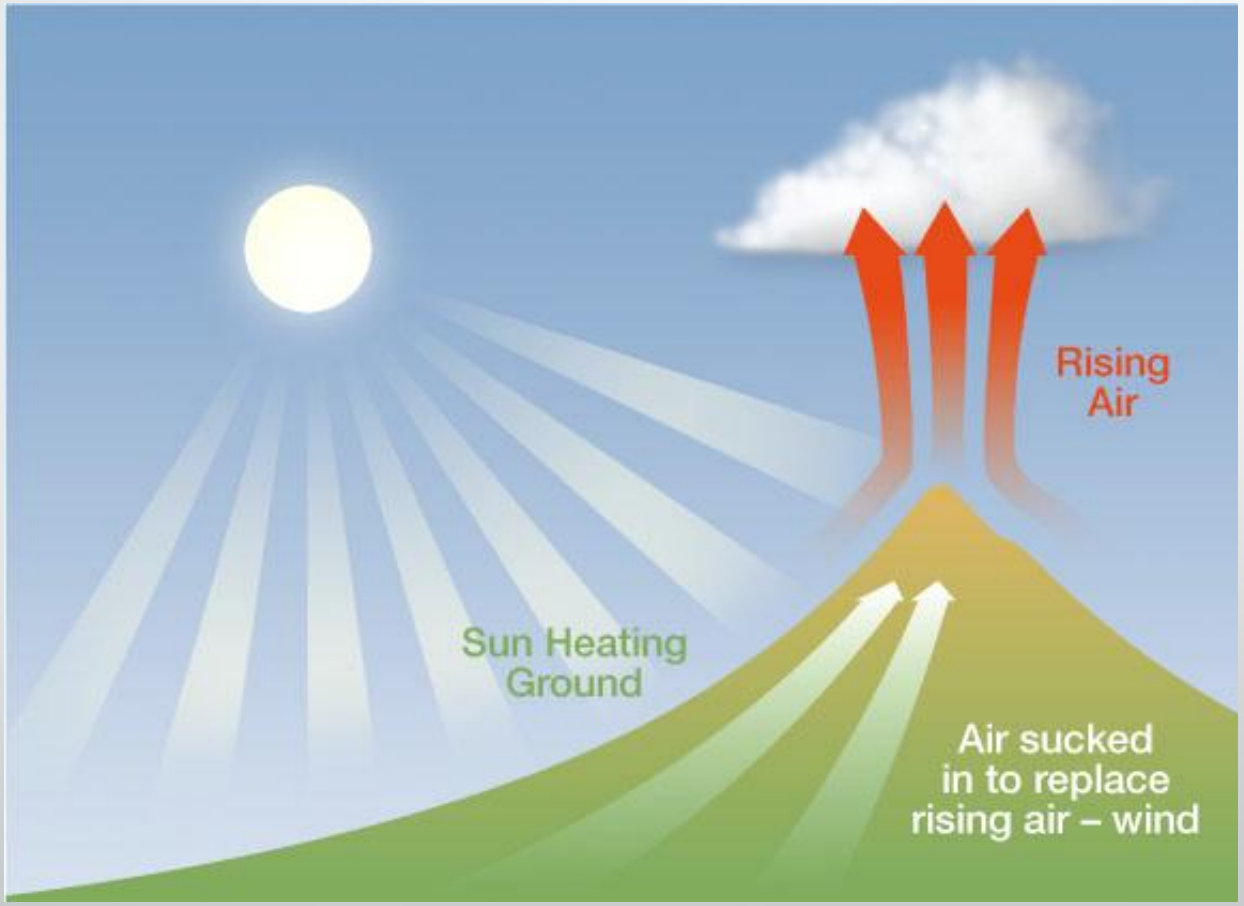
Occluded Front



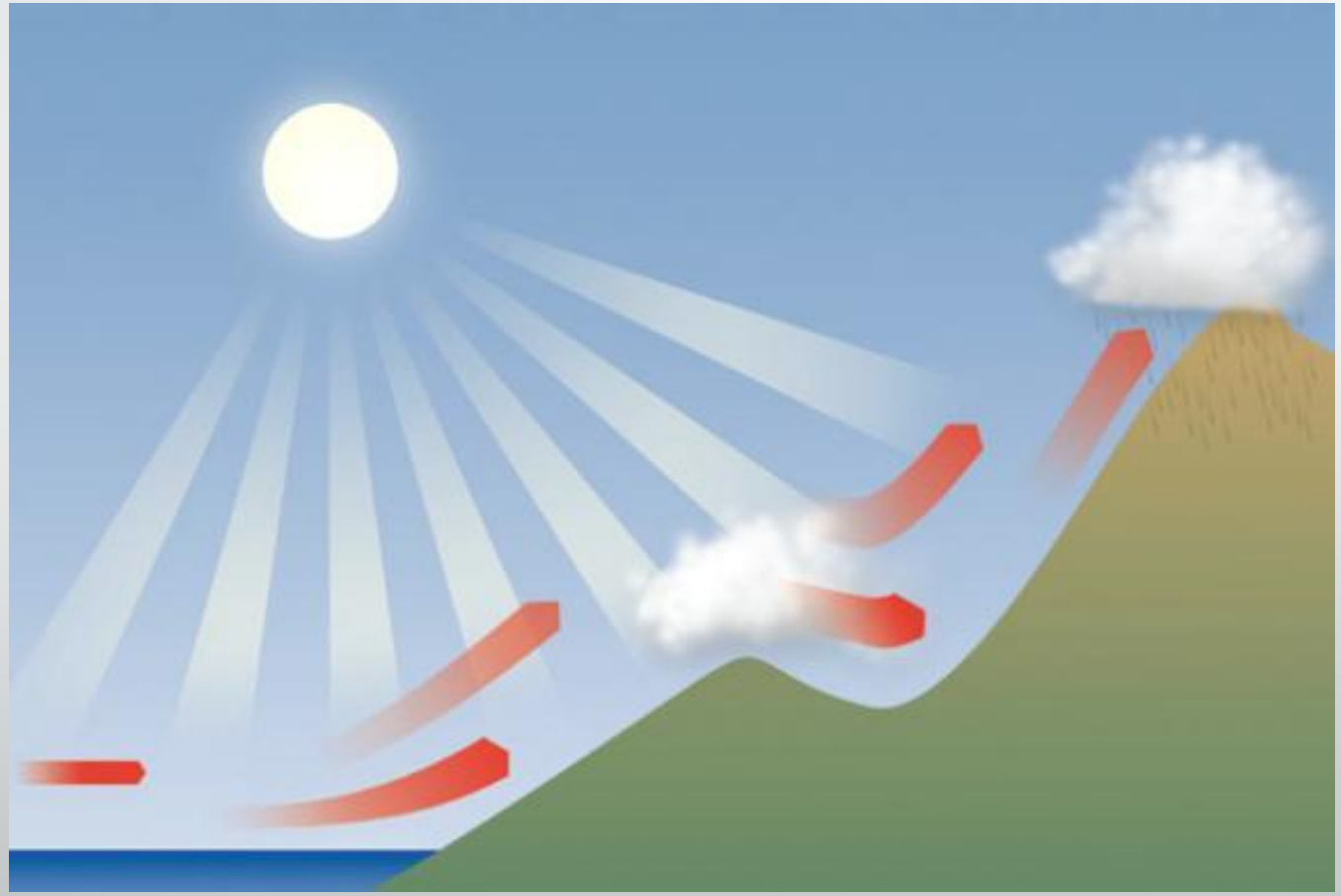
Pockets Of Air



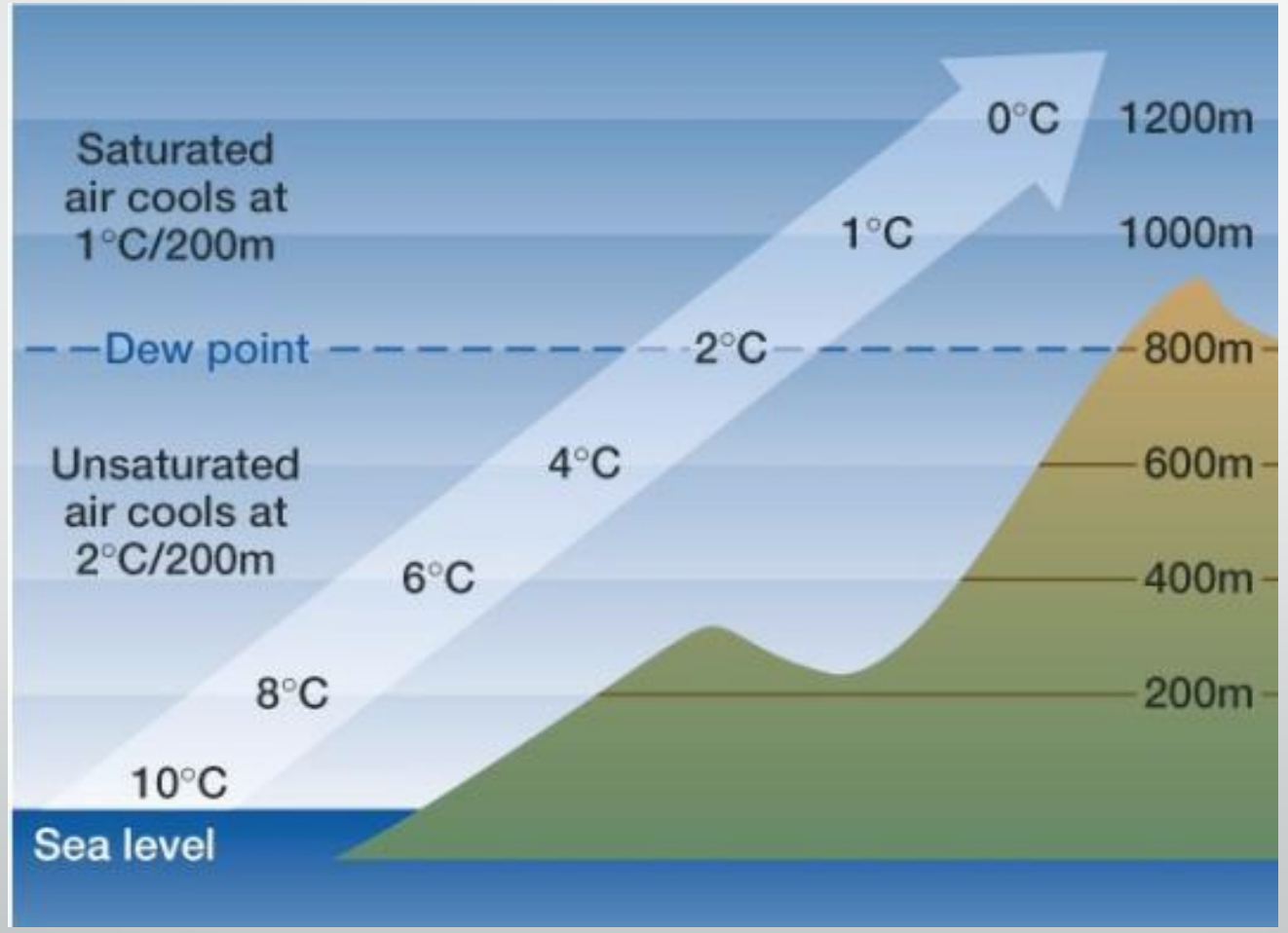
Thermals Above



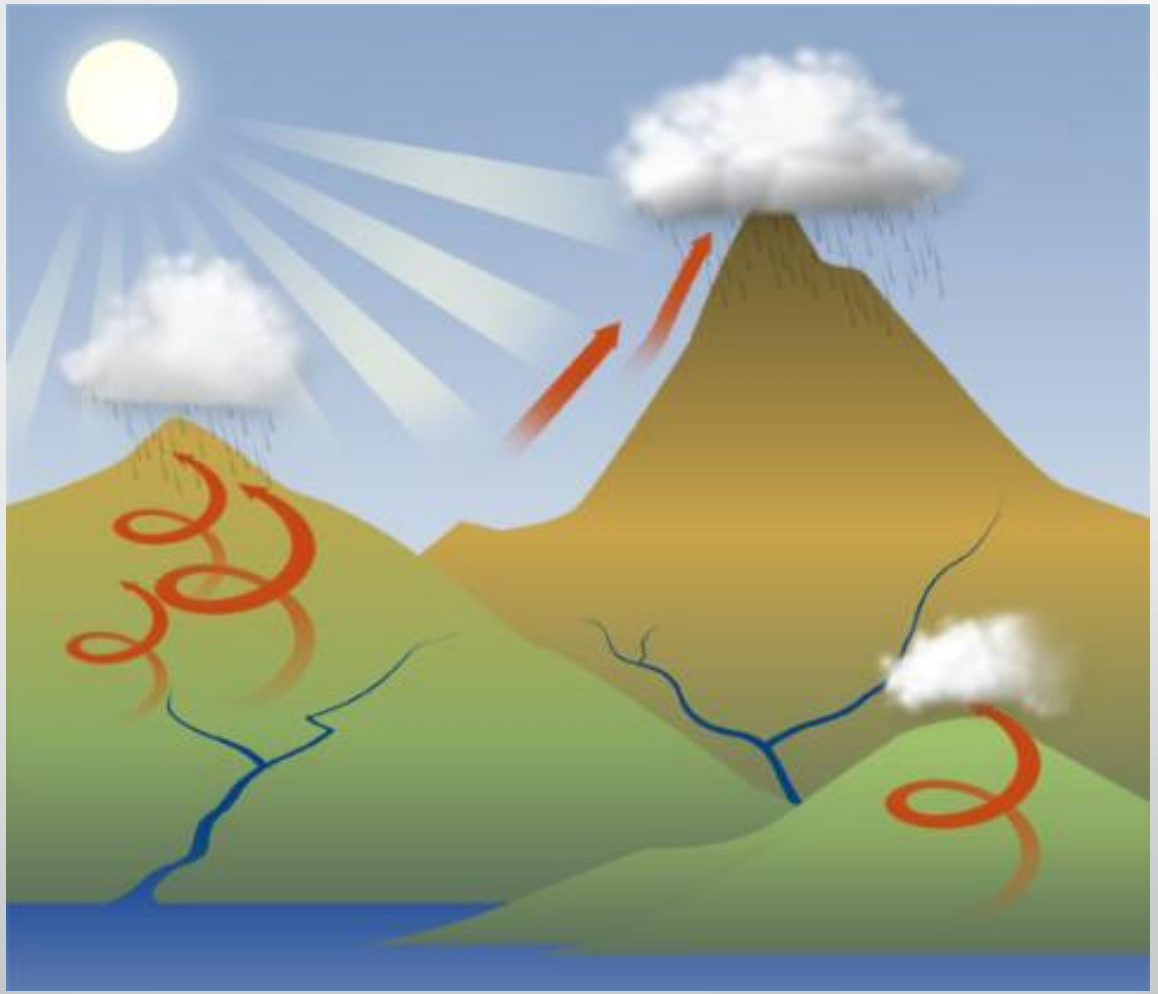
Air Rising Over Mountains



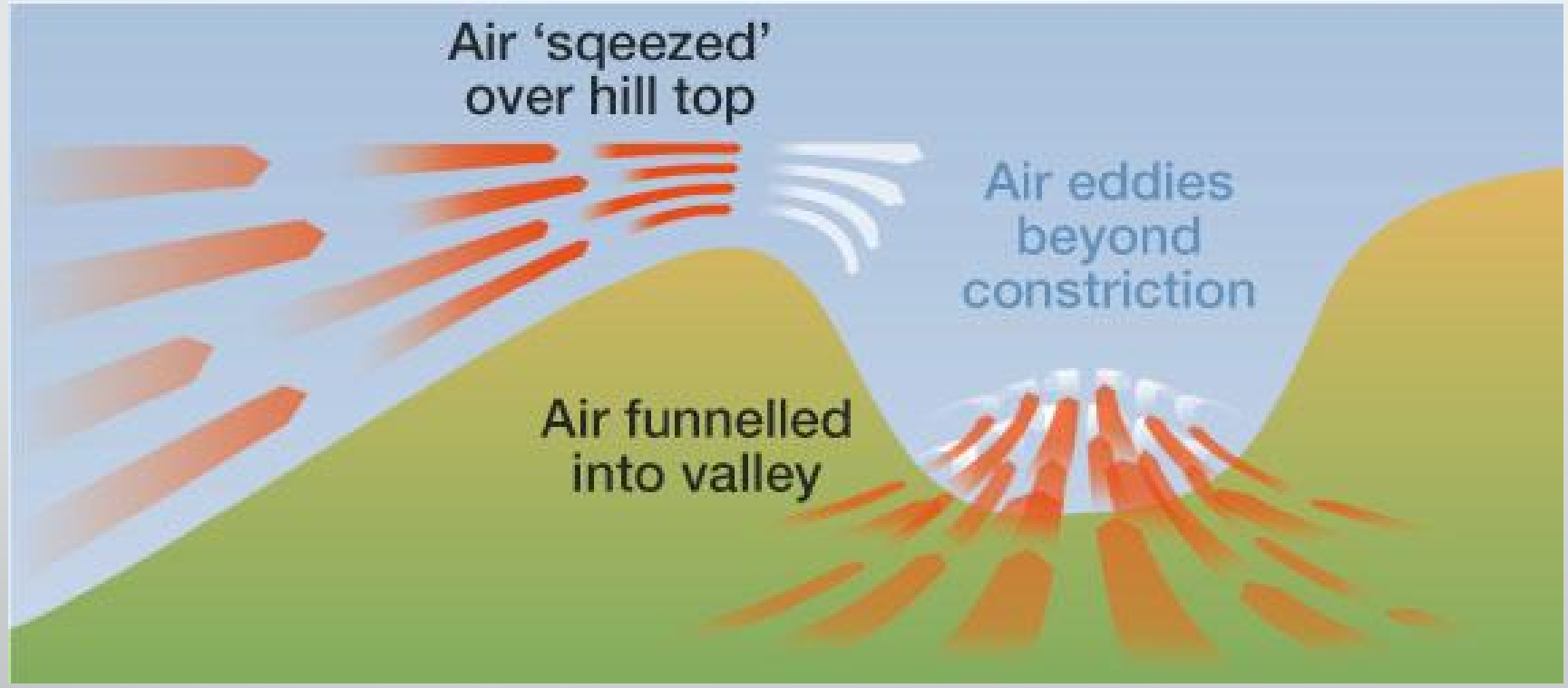
Rising Air Dewpoint



Cloudy Foothills

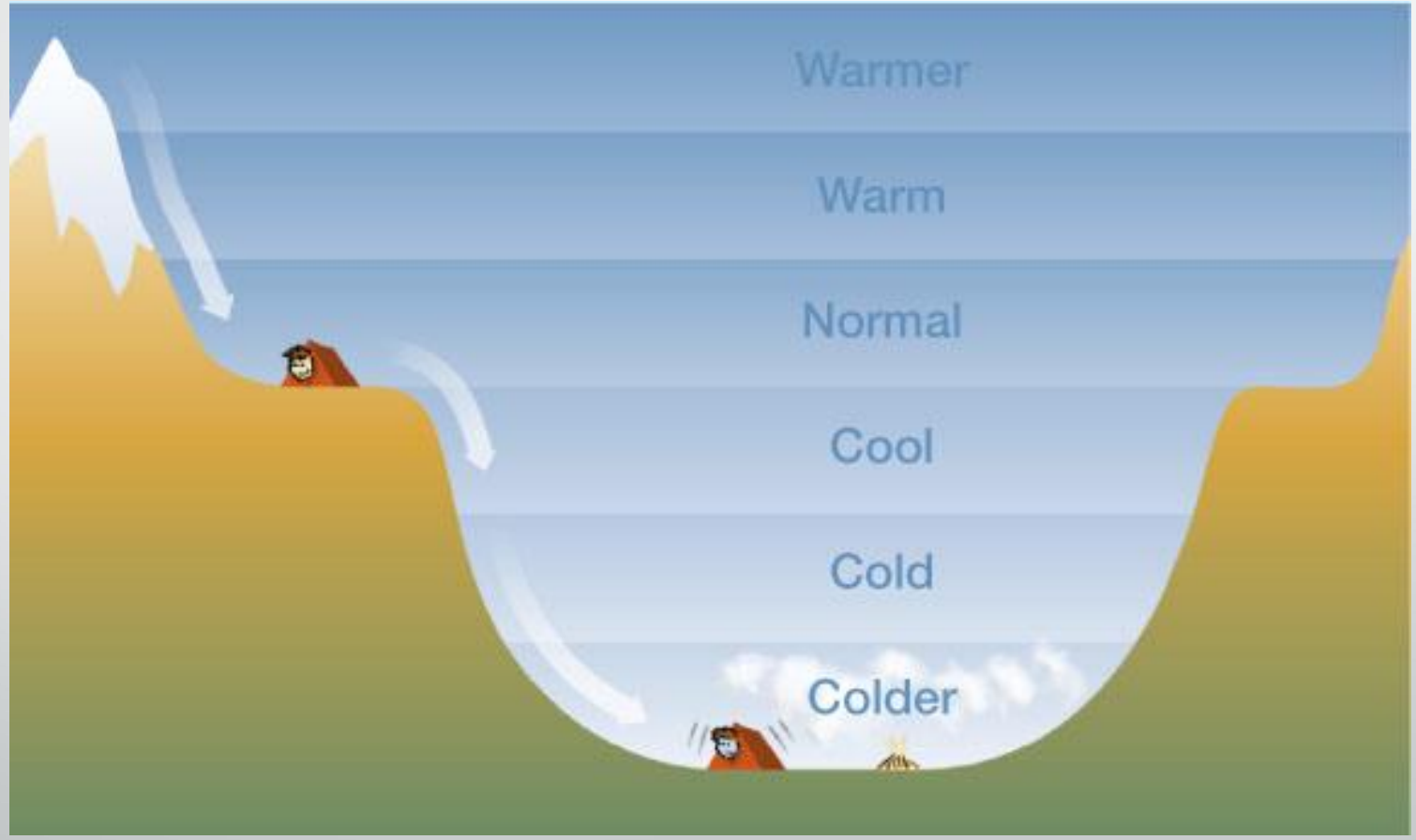


Funnels and Eddies



Banner Clouds

Temperature Inversion



Any questions?