Atmosphere :

~~[illegible]~~ Jupiter is ringed by many cloud bands. They move rapidly, but remain <u>fixed</u> in latitude

Cloud colors correlate with altitude :

blue regions deepest

brown

white

red regions coolest

- Planet is rotating rapidly : about 10 hour period at equator.
  Differential rotation (slower @ poles)
  STRONG winds (~400 mph)

- Chemistry gives colors to clouds

  ammonia NH_4 water H_2O

  ammonium sulphide ..... UV light from Sun dissociates molecules, sulphur thought to be responsible for orange, brown, yellowish tones.

- Great Red Spot – larger than Earth anti-cyclone that has been blowing for ~ 300 years

Weather on giant planets

Uranus has very few features in its atmosphere

Jupiter has most

Saturn & Neptune are intermediate

Axial tilt:

How might the differences in axial tilt help explain this?

A Seasons: the solar flux on Jupiter's equator does not change much during its orbit, while the other planets get varying amounts at different times. This makes it harder for long-term weather patterns to set up.

The Coriolis effect [redacted] in [redacted]

The Earth rotates as a solid body – everywhere on its surface goes round once in 24 hrs

(note that this isnt true for Jupiter, whose equatorial regions go around once in 9h 55 min, while regions closer to the pole take longer)

So different parts of the Earth's surface rotate at different speeds.

If a cannonball is fired due N from the equator, it will land E of N because it travels over land which moves less rapidly than the equator.

Q. If a projectile is fired due S from the equator, which direction will it be deflected ?

This has an effect on winds in the Earth's atmosphere :

- warm air rises from equatorial regions, creating low pressure
- winds from N of equator move to equalize pressure
- Coriolis effect causes them to move westward – 'NE trades'

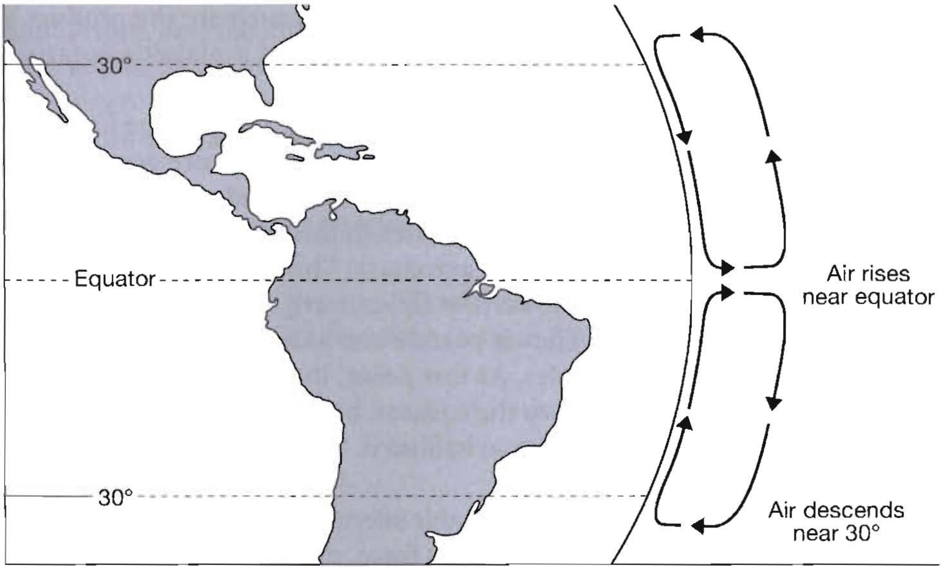

Figure 5.3 This simplified figure shows how convection acts in an atmosphere. Hot parcels of air near the surface at the equator become less dense and rise, pushing other air out of the way. Once they have risen, they give off their heat and start to cool. Once they have cooled, they begin to descend, now further from the equator after having been pushed away in their own turn. Finally, back near the surface they move equatorward to take the place of air that has risen, heating up as they go and beginning another cycle. These cycles, shown in cross-section as circles, are called "Hadley Cells." Similar cells exist further away from the equator as well.

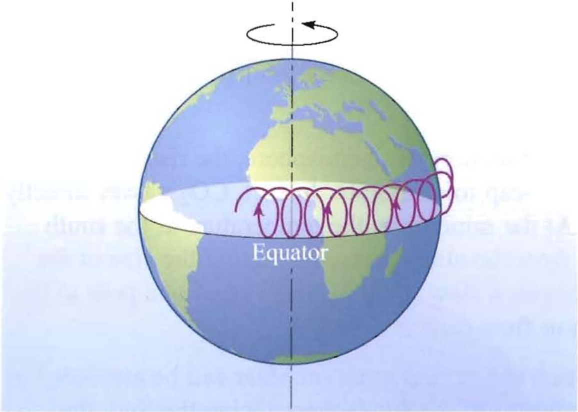

Figure 5.37 The Earth's rotation causes the Hadley cell to spiral. A piece of atmosphere that remains in the Hadley cell follows this flattened and tilted spiral path. This figure shows part of the tropical cell in the Northern Hemisphere; the vertical component is exaggerated.

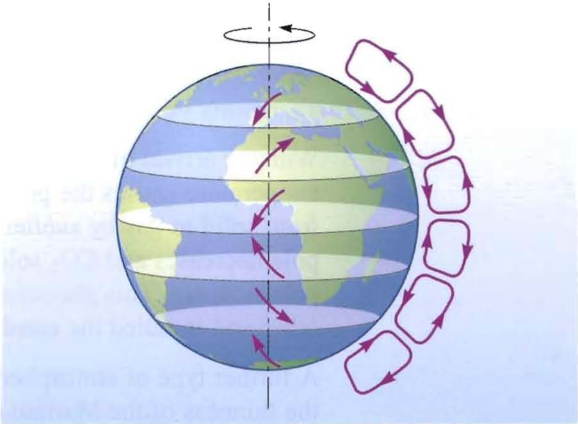

Figure 5.38 On Earth, three atmospheric circulation cells occur in each hemisphere. The tropical cells are the most persistent. The intermediate cells are driven by neighbouring cells in a direction contrary to that expected for a Hadley cell. Arrows indicate the directions of surface winds, i.e. the motion at the bottom of the cell.

In the giant planets, their fast rotation means that winds caused by the Coriolis effect are very strong

Also, Jupiter is much bigger than the Earth; so there are more atmospheric convection cells.

Much more energetic 'weather' due to
- larger size
- internal heat generation via gravity
- very rapid rotation

MARS

Small : radius 3397 km

[cf 6378 km Earth

[but 2435 km Mercury

mass 0.1 × M_{earth}

Gravity on surface

$3.7\ m/s^2$ Mars

$9.9\ m/s^2$ Earth

$3.7\ m/s^2$ Mercury

Density

$3.94\ g/cm^3$ Mars

$5.5\ g/cm^3$ Earth

$5.43\ g/cm^3$ Mercury

Atmosphere : pressure 1% of Earth's & most atmosphere – extremely thin!

0.6% of Earth's atm. pressure

- similar in composition to Venus:

  CO_2 + N_2 dominate

- atmospheric pressure changes with seasons: CO_2 freezes out to polar ice caps in winter, (H_2O ice underneath)

- cold: 210 – 240 K (@ surface 220K)

- still a lot going on: dust storms, & high winds

Q

We have discussed the origin of atmospheres of terrestrial planets, their loss (via 2 different processes), ~~and~~ the origin of weather / winds, and the trapping of CO_2 by rocks.

How might you apply all these topics to Mars' atmosphere, both now & in the past?