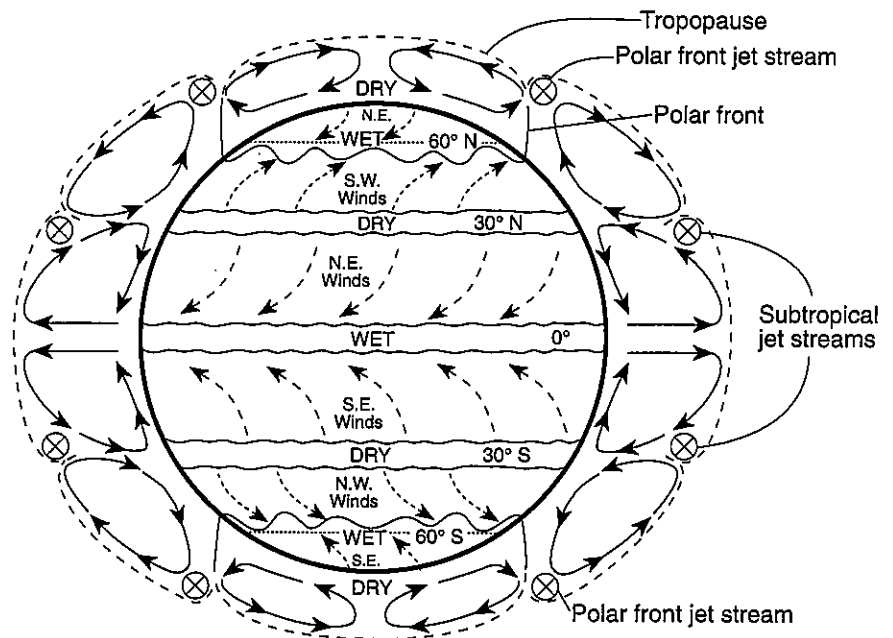


Planetary Wind and Moisture Belts in the Troposphere

Planetary Wind and Moisture Belts in the Troposphere

The drawing on the right shows the locations of the belts near the time of an equinox. The locations shift somewhat with the changing latitude of the Sun's vertical ray. In the Northern Hemisphere, the belts shift northward in the summer and southward in the winter.

(Not drawn to scale)



Overview:

Wind seems to blow from every direction. Yet, if one were to plot the direction of the wind over a long period of time, one direction would prevail. Winds are identified by the direction they come from. For example, we live in a wind belt in which the prevailing winds come from the west and southwest. This wind belt is named "The Westerlies." Throughout the Earth there are six major wind belts in which the winds move in a prevailing direction. The unequal heating of our planet sets up these wind belts and are affected by the rotation of our planet. Simply, the equator area gets "overheated," causing the atmosphere to heat up. This air expands, becoming less dense, and rises into the upper levels of the troposphere where it spreads out. At the polar regions, the cold, denser air sinks and flows to low latitude regions. This process produces large convection currents within the troposphere. This, along with the Earth's rotation, sets up these large wind belts.

The moisture belts of our planet can also be explained by the unequal heating of our planet. At the equator, the hot rising air expands, cools, and reaches the dewpoint temperature. At this temperature, condensation of the water vapor occurs, producing massive clouds that daily release large amounts of rain, forming the major equatorial rain forests. Eventually the rising air cools and begins to slowly sink. This drier, sinking air undergoes compression that causes the air to warm up. This warm, drier air descends on the Earth's surface around the 30° N and 30° S latitude regions, producing the many large desert and arid areas of our planet.

Wind is nothing more than the atmosphere in motion, but as you can see, the science and dynamics of wind is complicated, affecting weather and climate globally.

The Chart:

There are two groups of arrows: the ones inside the globe represent the major wind belts, and the ones outside the globe represent the major areas of rising and sinking air cells within the troposphere setting-up the planetary wind belts. (These arrows are really one system, but will be explained separately.)

Arrows inside the globe – From the equator to the 30° N latitude line, the wind generally blows from the northeast. This wind-belt has been named “The Trade Winds”. The next wind belt extending from the 30° N to 60° N latitude line is our wind belt, “The Westerlies”. The arrows show that the prevailing winds in this belt are from the southwest. The last wind belt in the Northern Hemisphere is located between the 60° N to 90° N latitude lines. In this northern polar region, the cold, prevailing winds are from the northeast. In the Southern Hemisphere three more wind belts are shown, making a total of six global wind belts. These wind belts extending to the top of the troposphere, have a great influence on weather and climate.

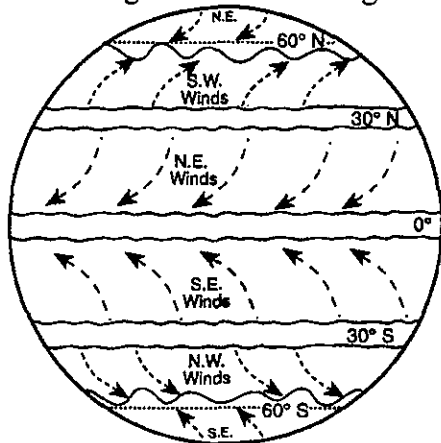
Arrows outside the globe – The unequal heating of our planet produces major atmospheric convection cells, as represented by the arrows outside the globe. At the equator the hot moist rising air cools, reaching its dewpoint temperature, eventually producing much rainfall. This is noted at the equator with the word “Wet”. The 60° N and 60° S latitude areas are also labeled “Wet”, but overall this region has much less rainfall when compared to the equatorial region. The descending arrows, representing sinking air, reach the Earth’s surface near the 30° N and 30° S latitude lines. This drier sinking air becomes compressed and warms up, producing the major deserts of our planet in these latitude regions. These deserts and arid areas are noted on the globe by being labeled “Dry”. The polar regions are also labeled “Dry”. The very cold polar air holds little moisture, which makes the polar regions some of the driest areas on Earth.

Additional information:

- The Coriolis effect is responsible for the curvature of the winds. This is caused by the rotation of our Earth.
- Planetary wind belts are responsible for moving weather systems (air masses and hurricanes). This is the reason that most of our weather comes from the west.
- This chart shows the two sets of jet streams, the polar front jet stream and the subtropical jet stream. These jet streams are narrow belts of high-speed wind.
- Planetary winds produce surface ocean currents. The wind, moving in one general direction, pushes the ocean water to produce these currents (see Ocean Surface Currents chart).
- Convergent wind zones are where planetary wind belts meet. See the equator zone, 0°. Divergent wind zones are where wind belts are moving away from each other. See the 30° N and 30° S area.
- Winds are caused by differences in atmospheric temperature and pressure. Winds blow from high to low-pressure areas.
- Sinking, dry air tends to produce dry H-pressure zones. Example: 30° N and 30° S area.
- Rising, moist air tends to produce wet L-pressure zones. Example: The equator area.

Set 1 — Planetary Wind and Moisture Belts in the Troposphere

1. The planetary winds on Earth are indicated by the curving arrows in the diagram below.



The curved paths of the planetary winds are a result of

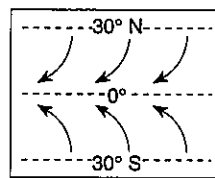
- (1) changes in humidity
 (2) changes in temperature
 (3) Earth's rotation on its axis
 (4) Earth's gravitational force 1 _____
2. Which climate conditions are typical of regions near the North Pole and the South Pole?
- (1) low temperature and low precipitation
 (2) low temperature and high precipitation
 (3) high temperature and low precipitation
 (4) high temperature and high precipitation 2 _____
3. When the eye of a hurricane is at the 43° N latitude, it most likely is being pushed by planetary winds toward the
- (1) northwest (3) southwest
 (2) northeast (4) southeast 3 _____

4. The air over the Equator generally rises because the air is

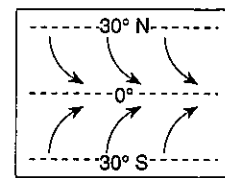
- (1) dry and cool with low density
 (2) moist and hot with low density
 (3) moist and cool with high density
 (4) dry and hot with high density

4 _____

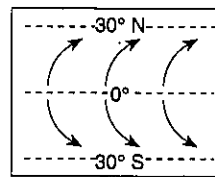
5. Which map best shows the surface movement of winds between 30° N and 30° S latitude?



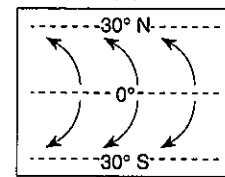
(1)



(3)



(2)



(4)

5 _____

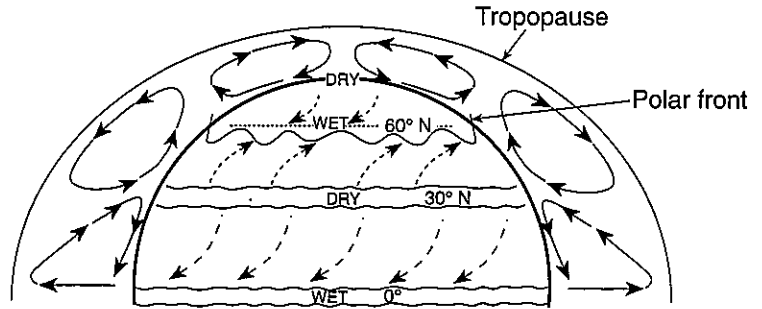
6. The planetary wind belts in the troposphere are primarily caused by the
- (1) Earth's rotation and unequal heating of Earth's surface
 (2) Earth's revolution and unequal heating of Earth's surface
 (3) Earth's rotation and Sun's gravitational attraction on Earth's atmosphere
 (4) Earth's revolution and Sun's gravitational attraction on Earth's atmosphere

6 _____

7. Explain why the equator area is the home for our planet's major rain forests?

==== Set 2 — Planetary Wind and Moisture Belts in the Troposphere ====

Base your answers to questions 8 and 9 on the accompanying diagram, which represents the planetary wind and moisture belts in Earth's Northern Hemisphere.



(Not drawn to scale)

8. The climate at 90° north latitude is dry because the air at that location is usually

- (1) warm and rising
- (2) warm and sinking
- (3) cool and rising
- (4) cool and sinking

8 _____

9. The paths of the surface planetary winds are curved due to Earth's

- (1) revolution
- (2) rotation
- (3) tilt
- (4) ocean surface currents

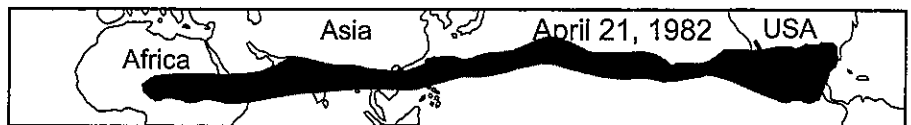
9 _____

10. If a parcel of air is heated, its density will

- (1) decrease
- (2) increase
- (3) remain the same

10 _____

Base your answers to questions 11 and 13 on the accompanying maps, which show the spread of a volcanic ash cloud from the 1982 eruption of El Chichón in Mexico, as seen from weather satellites.



11. Identify the direction toward which the ash cloud spread from April 5 to April 25.

12. State what caused the main ash cloud to spread in the pattern shown on the map of April 25, 1982.

13. Why do most hurricanes change direction when they pass over the 30° N latitude line?
