

Earth-Sun Relations

The Atmosphere

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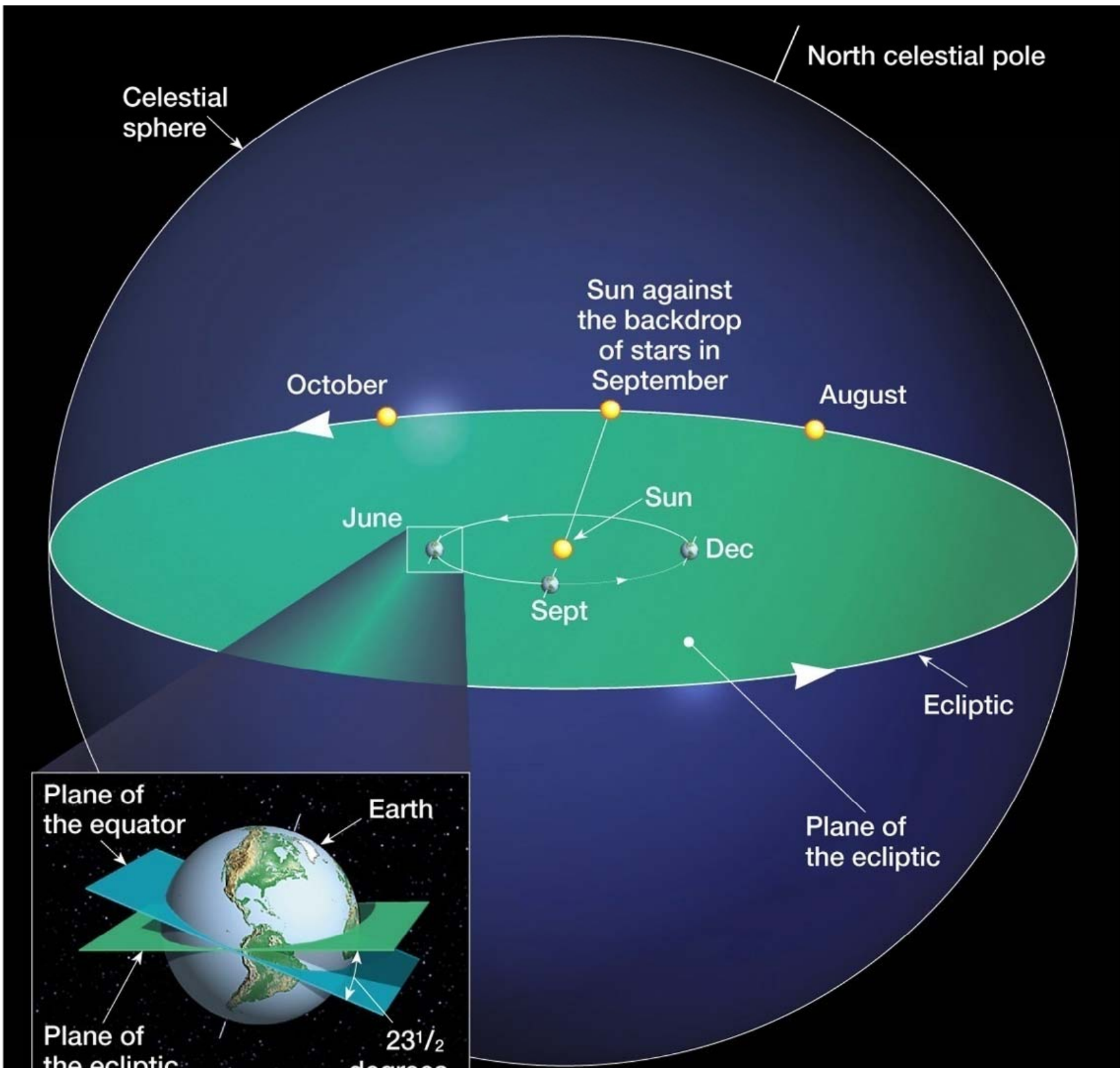
Earth-Sun relations

Earth motions

- Rotates on its axis
- Revolves around the Sun

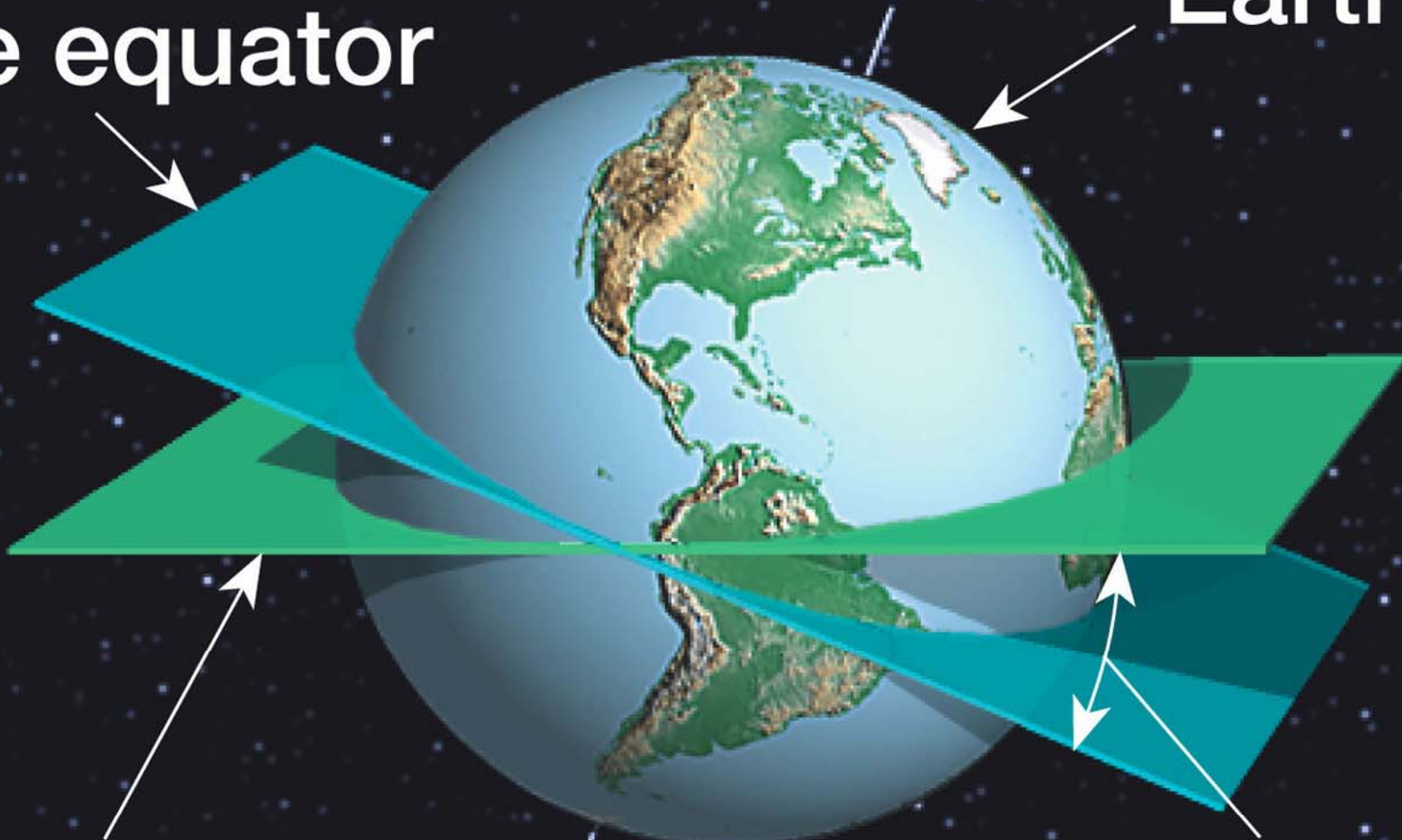
Seasons—Result of constant axial tilt

- Changing Sun angle
- Changing length of daylight



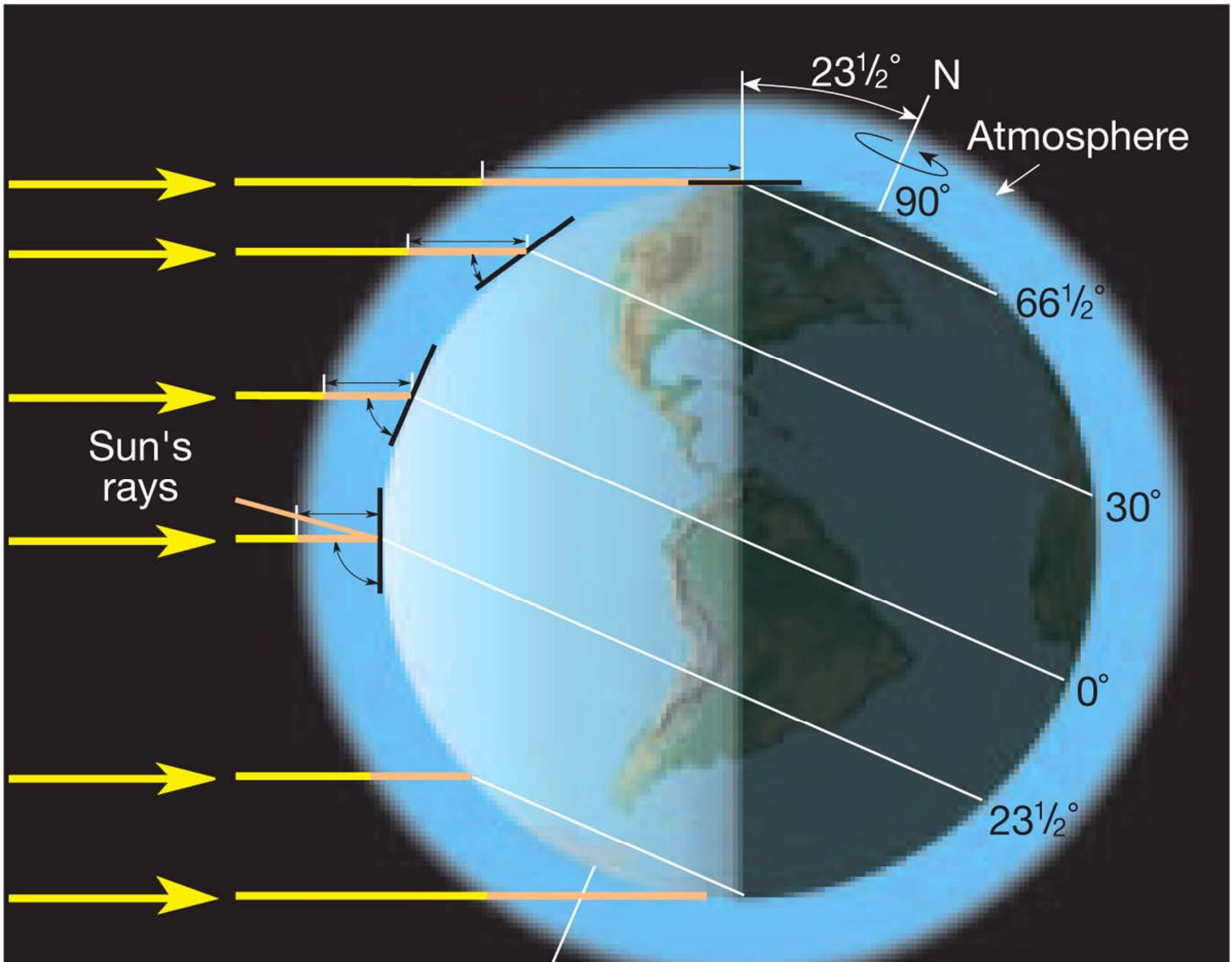
Plane of
the equator

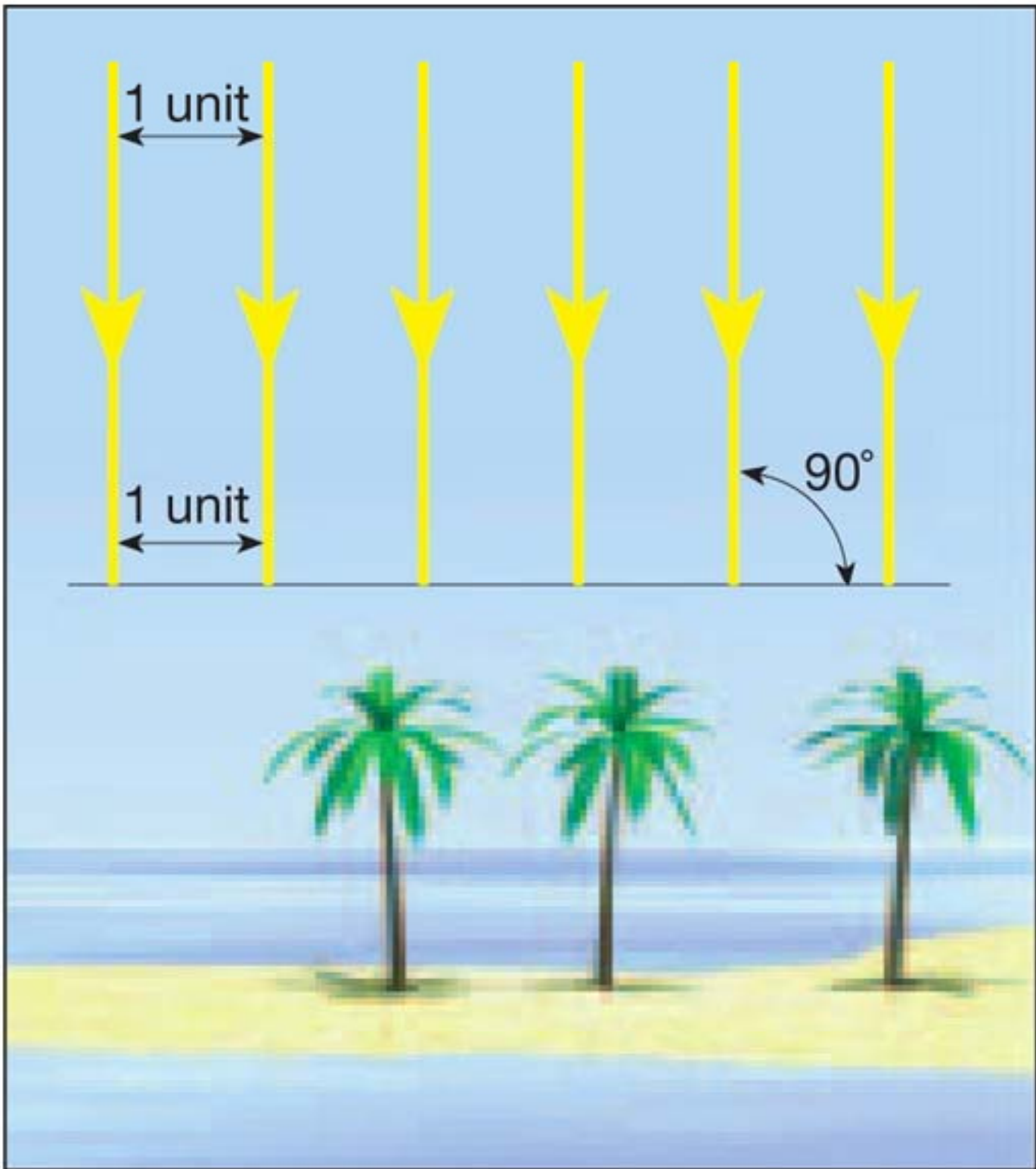
Earth

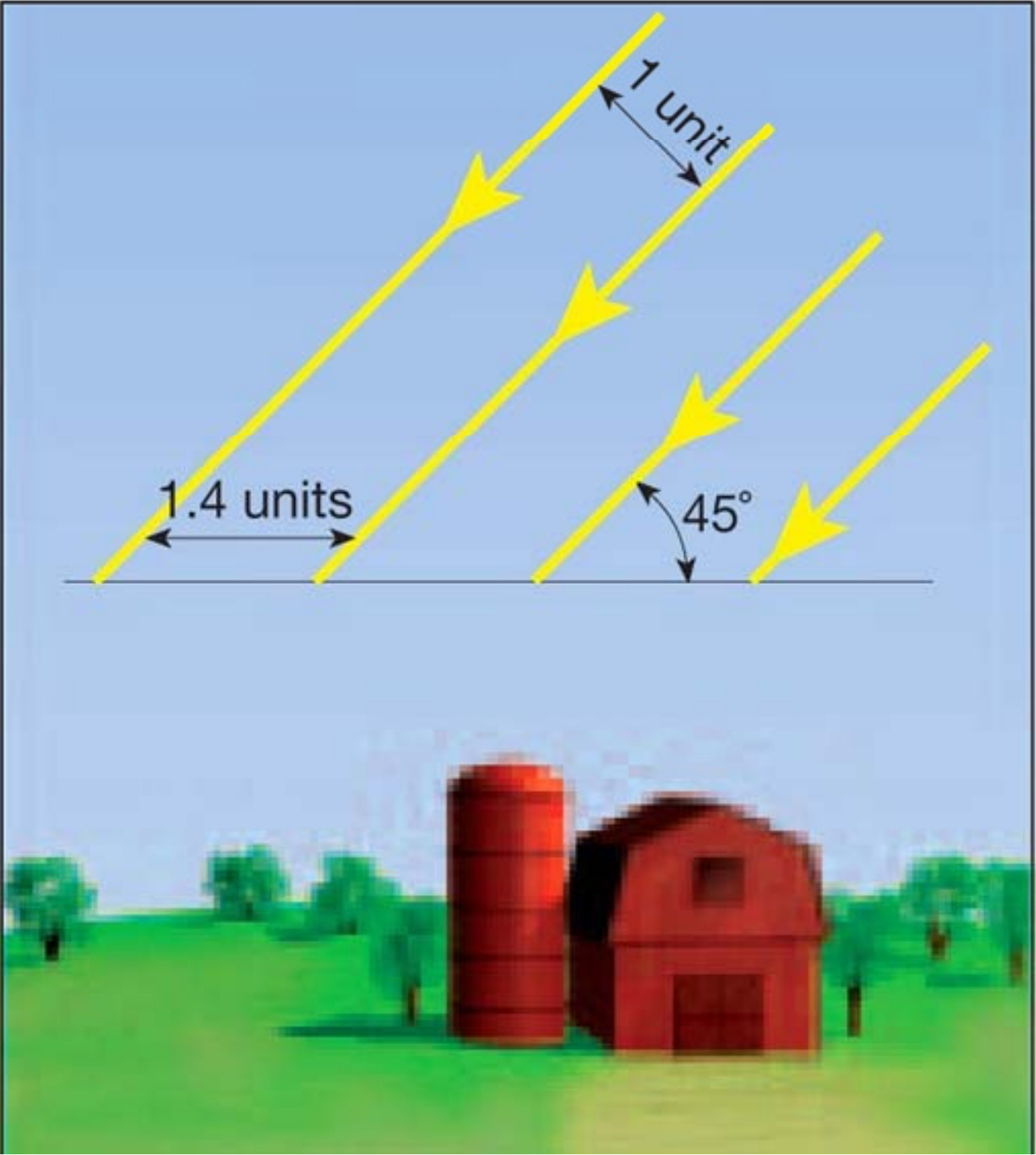


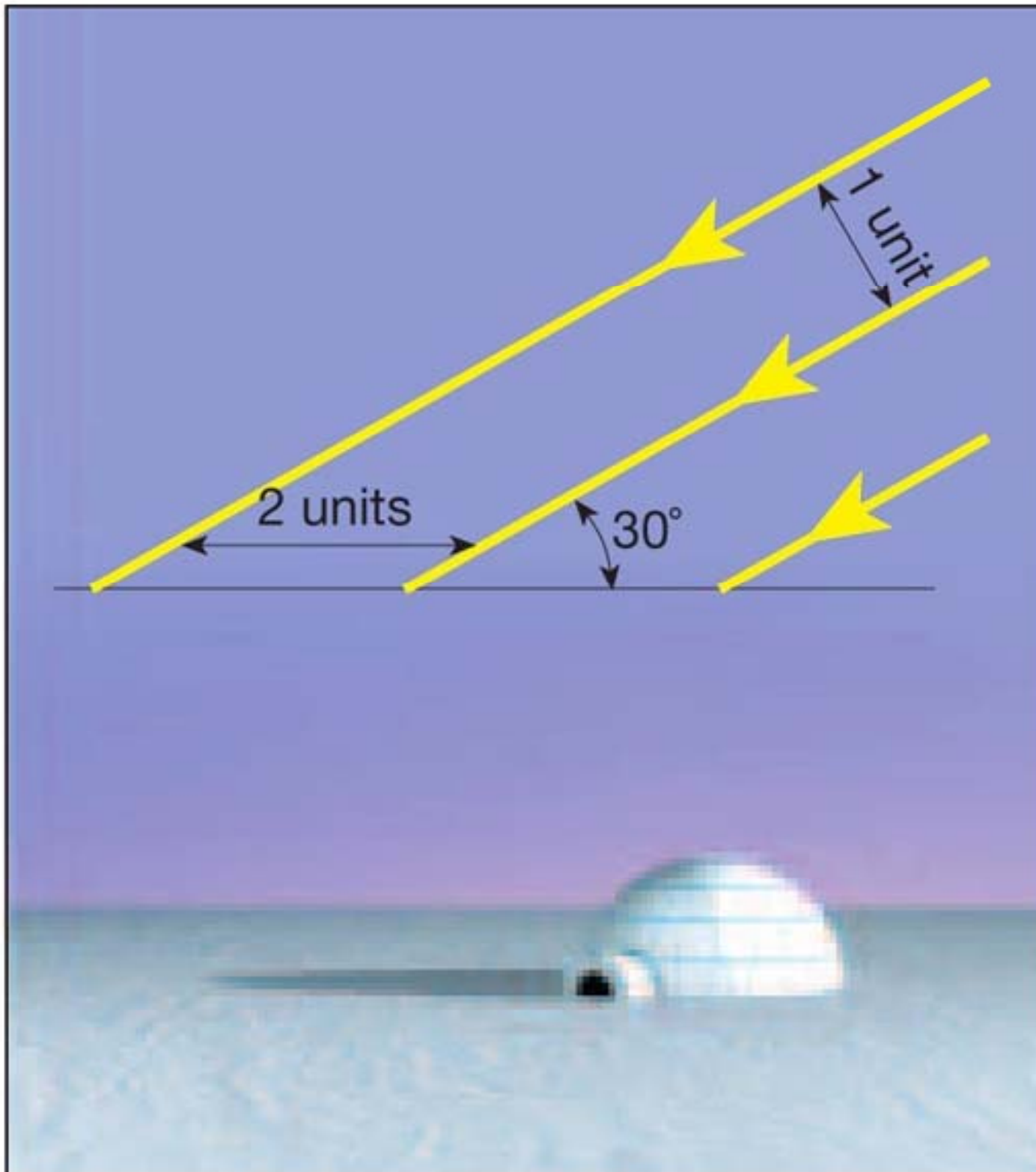
Plane of
the ecliptic

$23\frac{1}{2}$
degrees

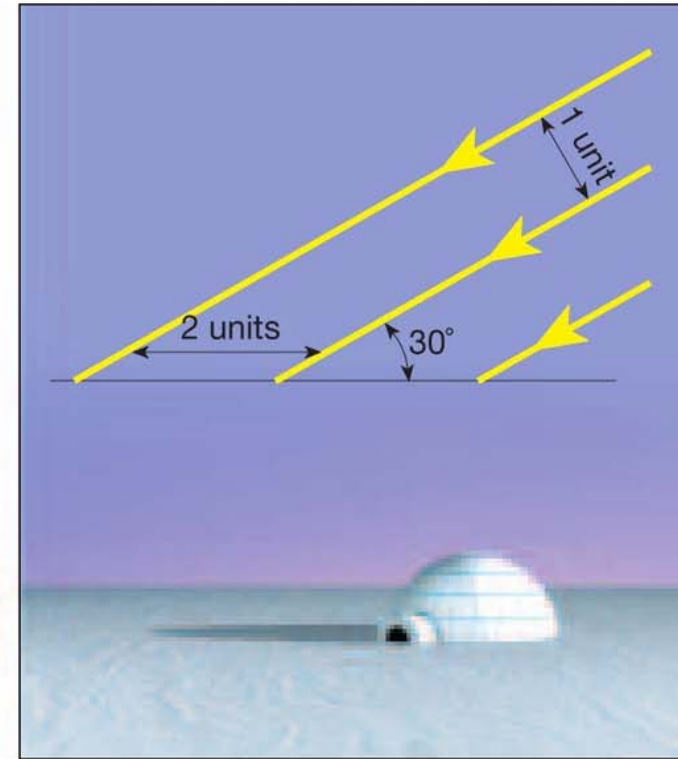
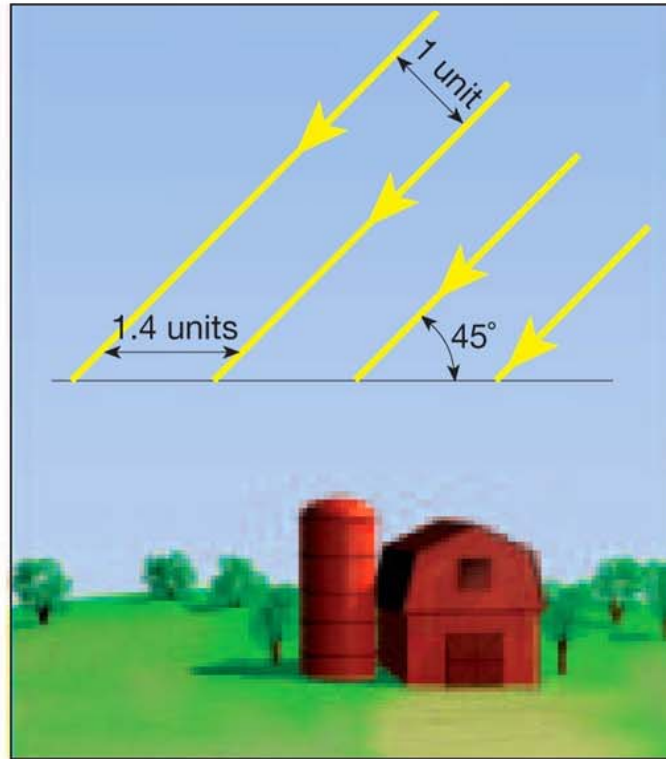
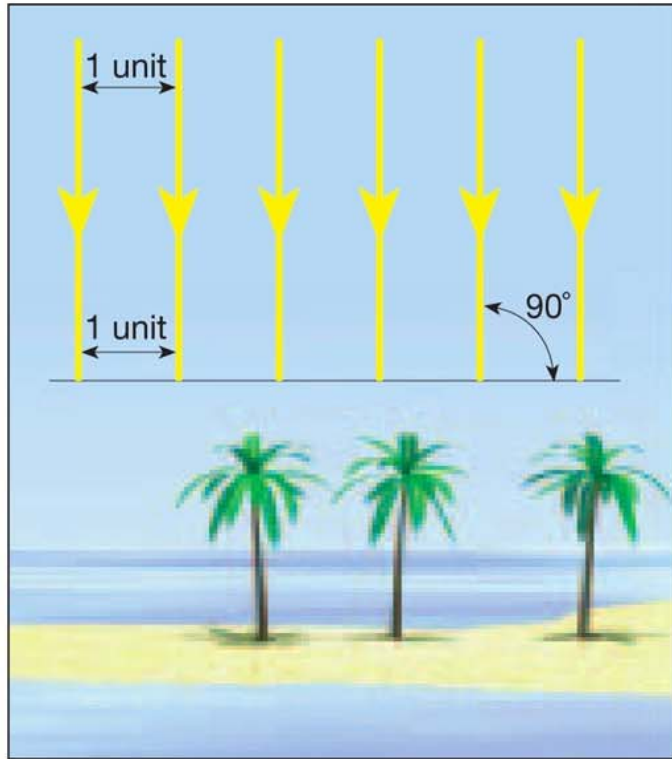




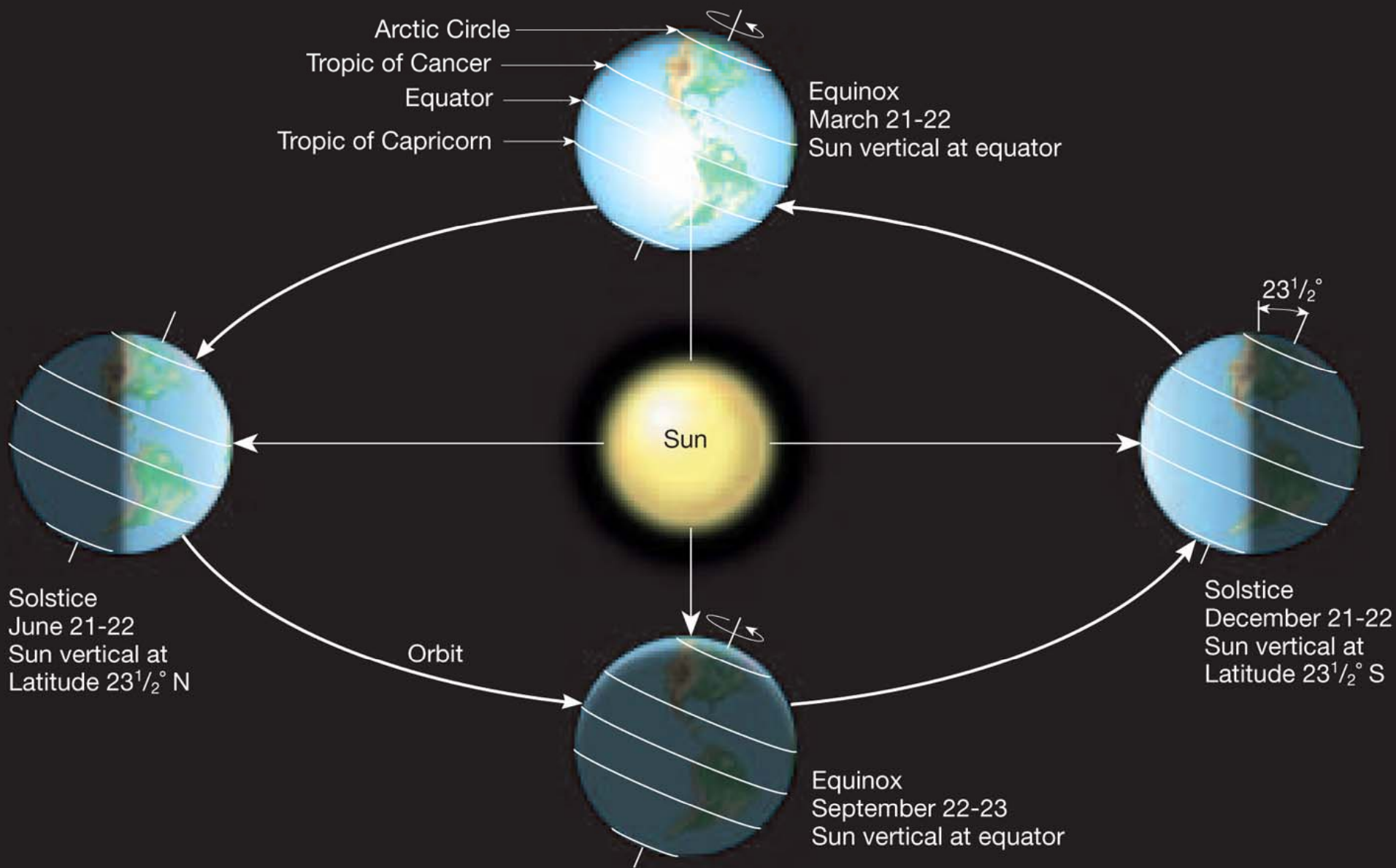




Sun Angle with Latitude



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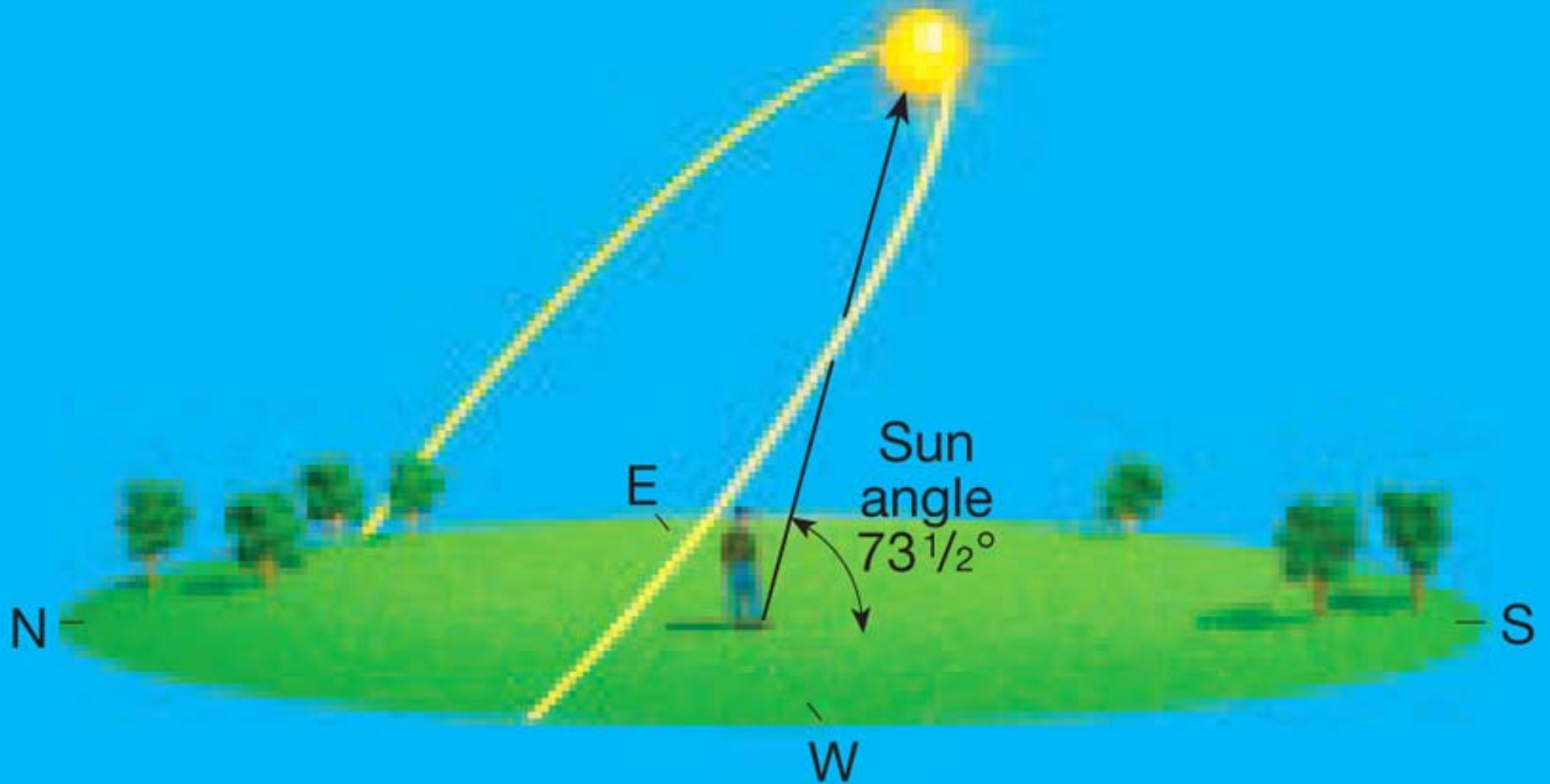
Earth-Sun relations

Special days

- **Solstice**—Sun's vertical rays are located at the Tropic ($23\frac{1}{2}^{\circ}$ latitude)
 - June 21-22
 - December 21-22
- **Equinox**—Sun's vertical rays located at the Equator (0° latitude)
 - March 21-22
 - September 21-22

June 21-22

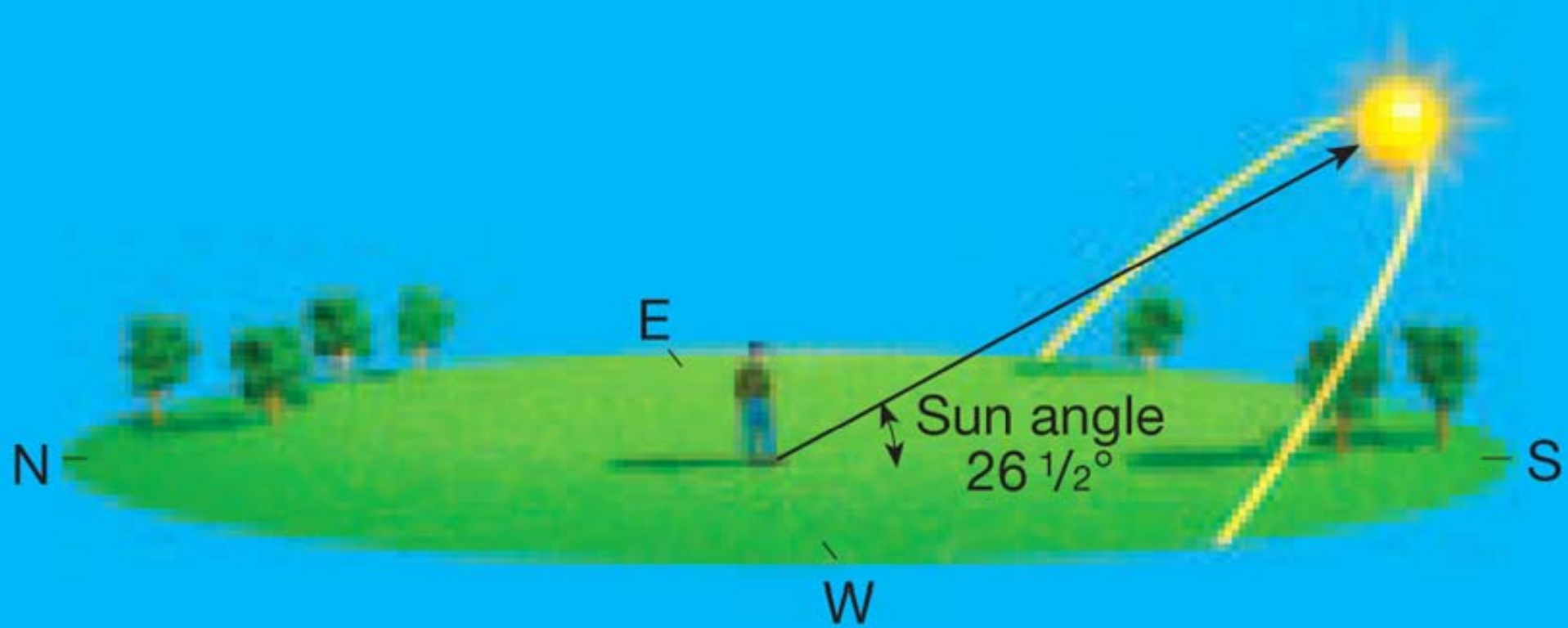
Longest day



A. Summer solstice

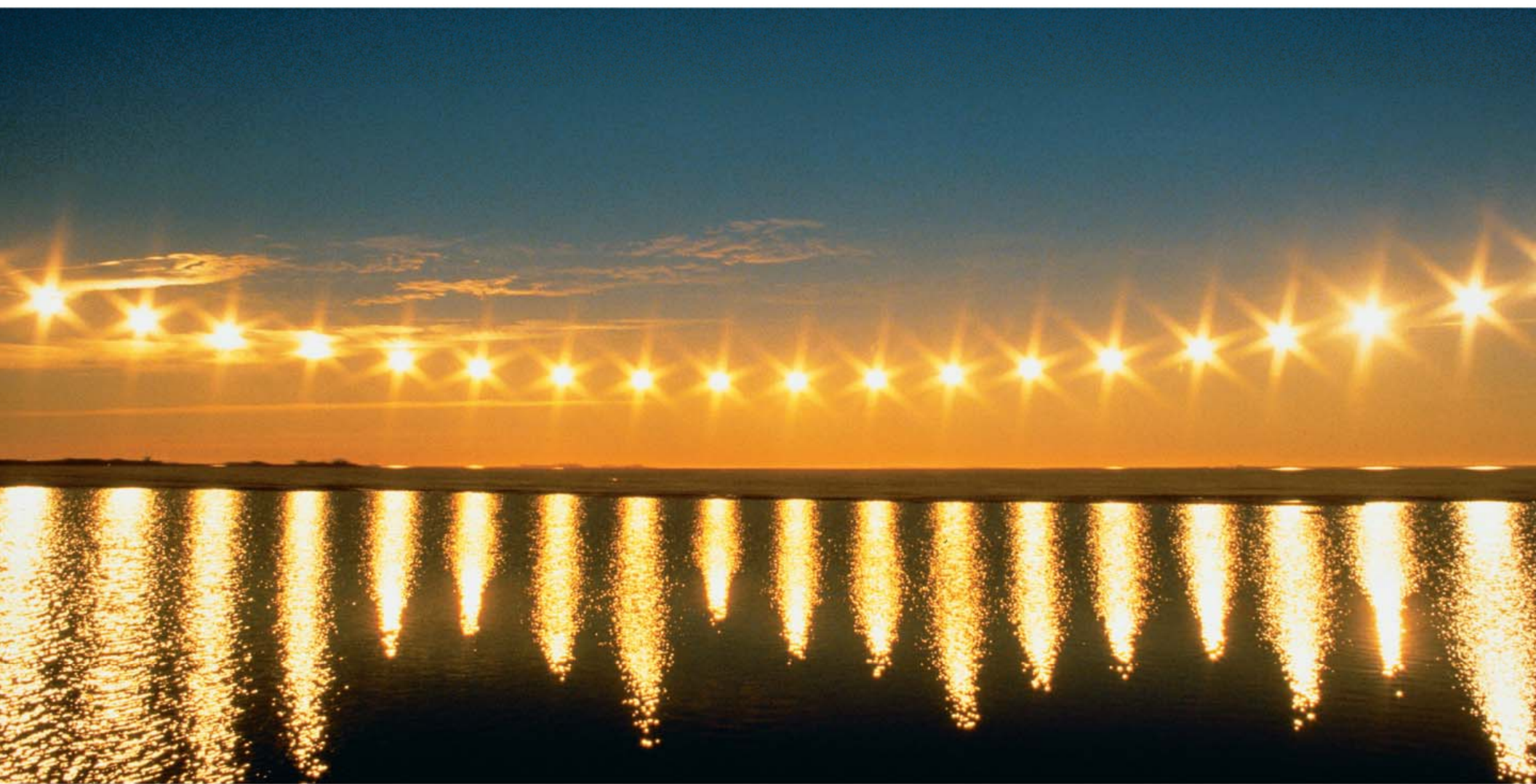
December 21-22

Shortest day

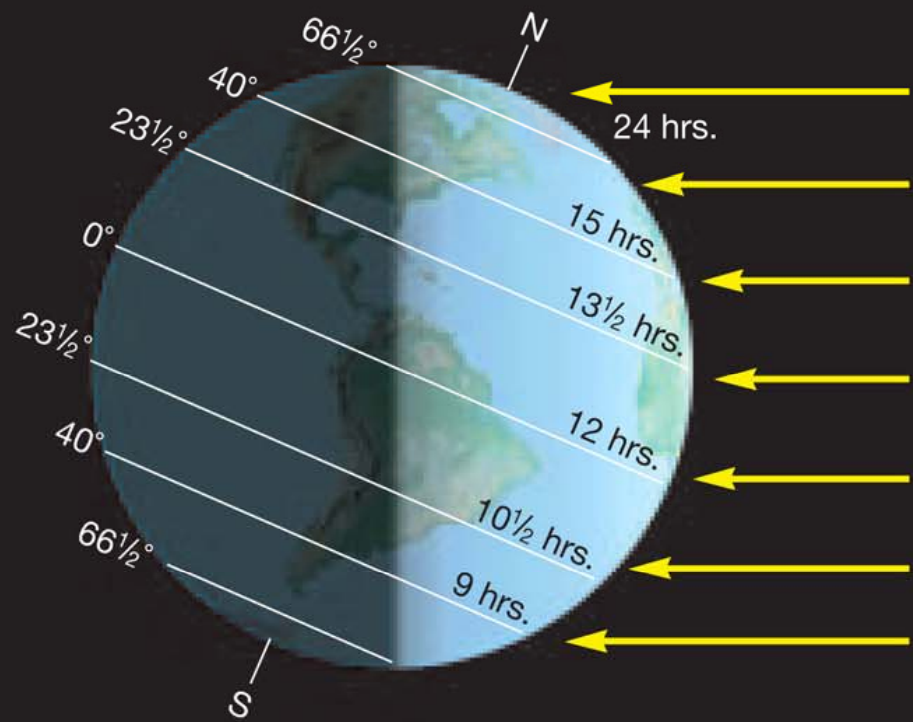


B. Winter solstice

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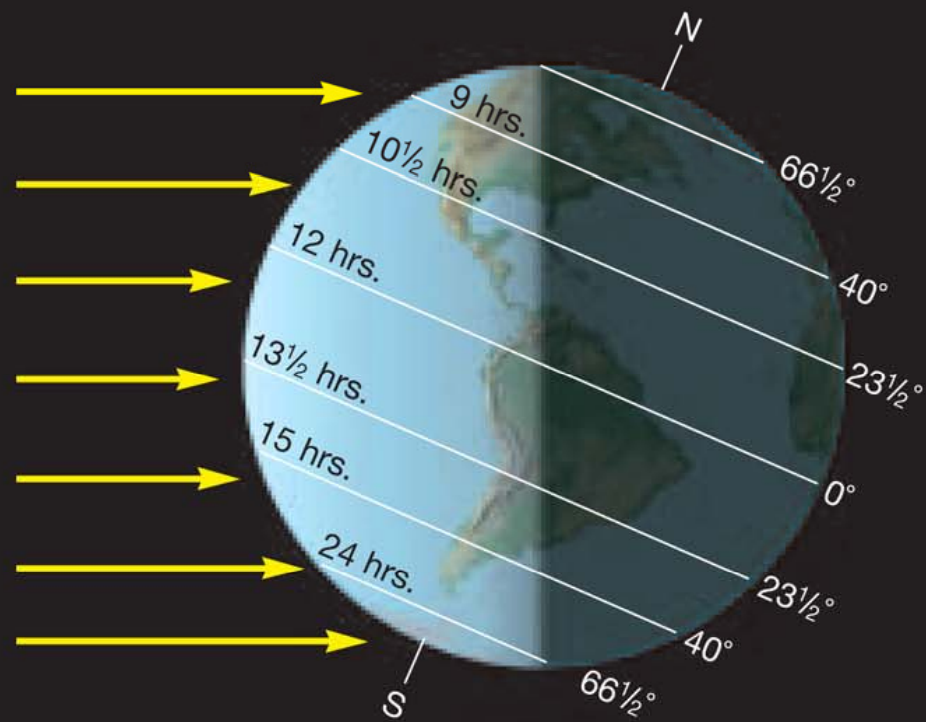


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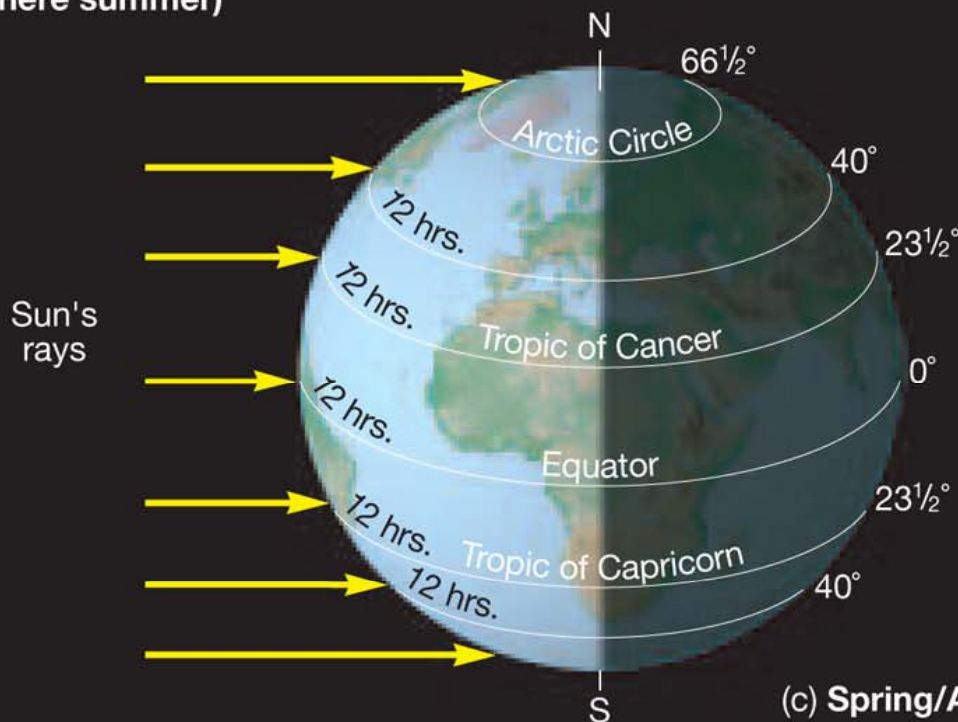


(a) June Solstice
(Northern Hemisphere summer)

Sun's rays



(b) December Solstice
(Northern Hemisphere winter)



(c) Spring/Autumnal Equinox

Atmospheric heating

Heat is always transferred from warmer to cooler objects

Mechanisms of heat transfer

- Conduction
- Convection
- Radiation (electromagnetic radiation)

Mechanisms of heat transfer

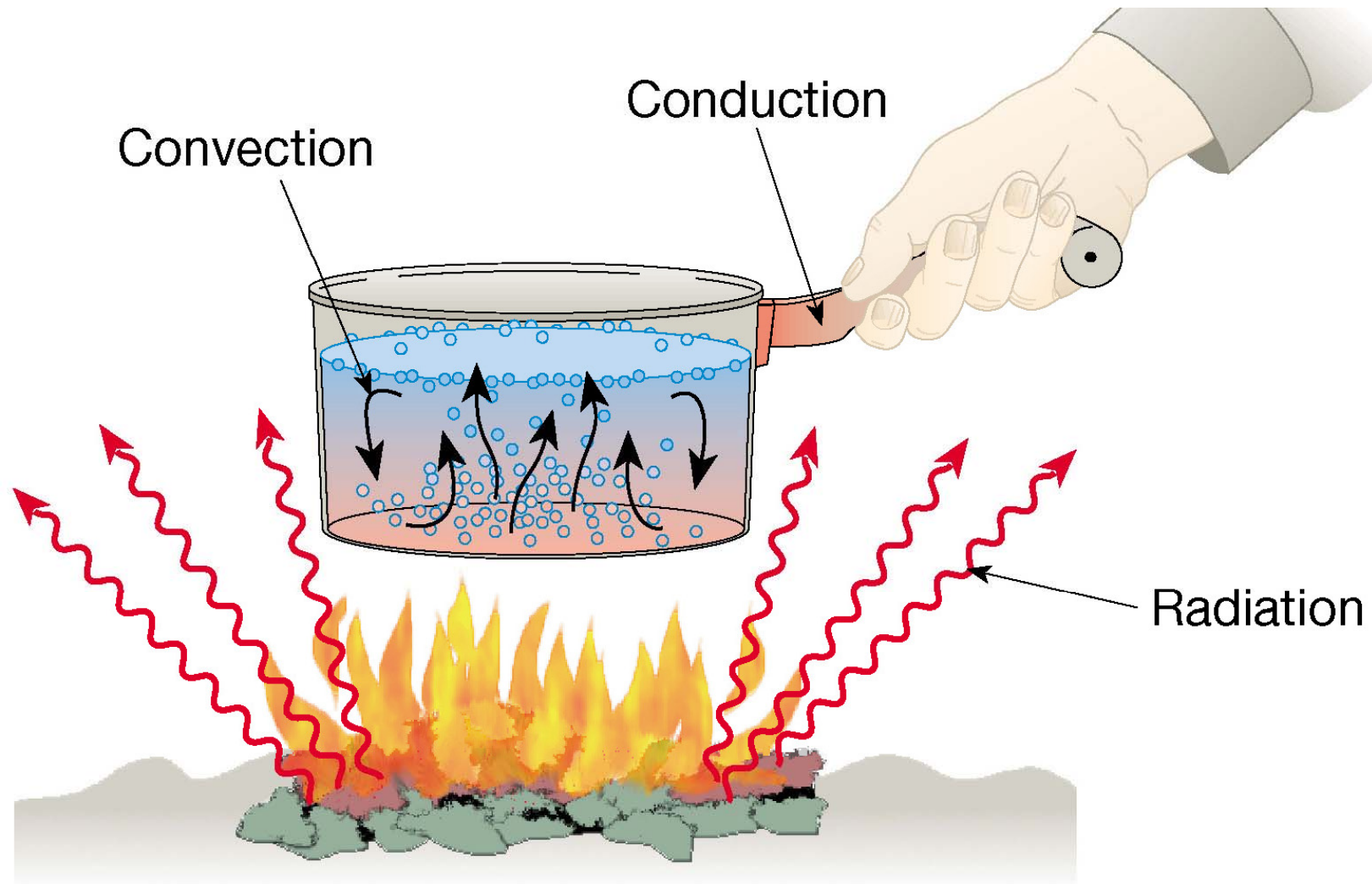
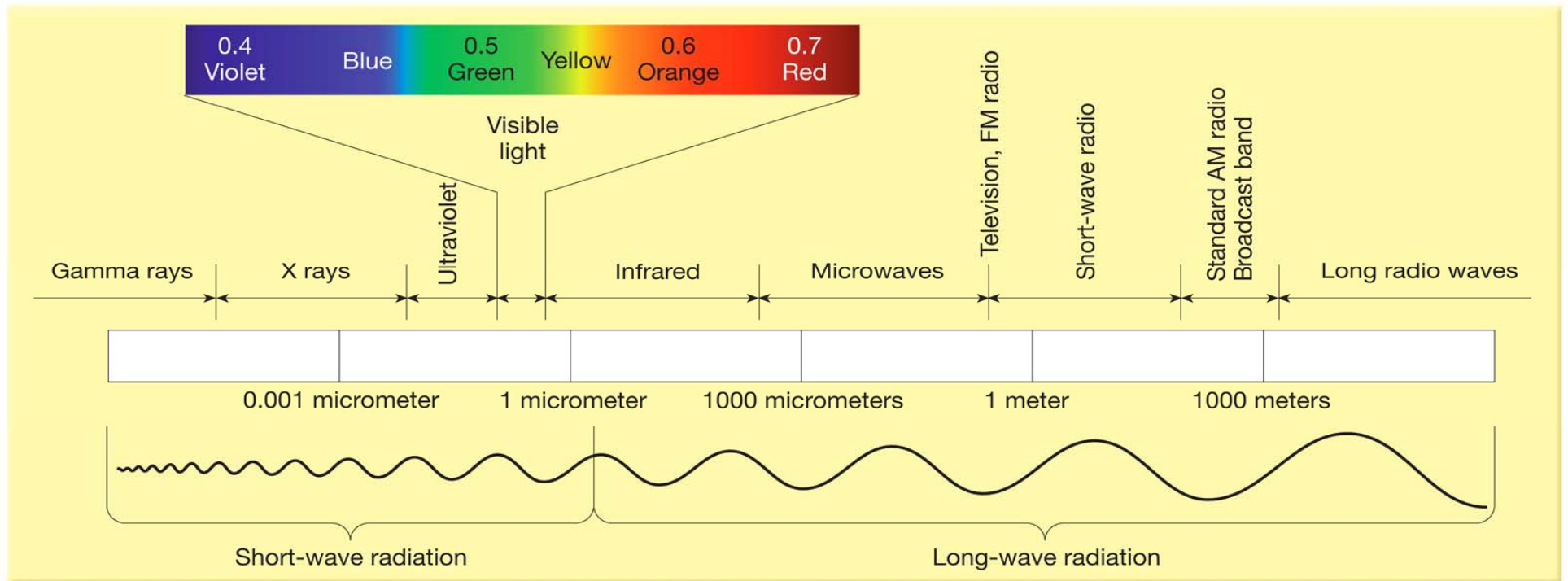


Figure 16.16

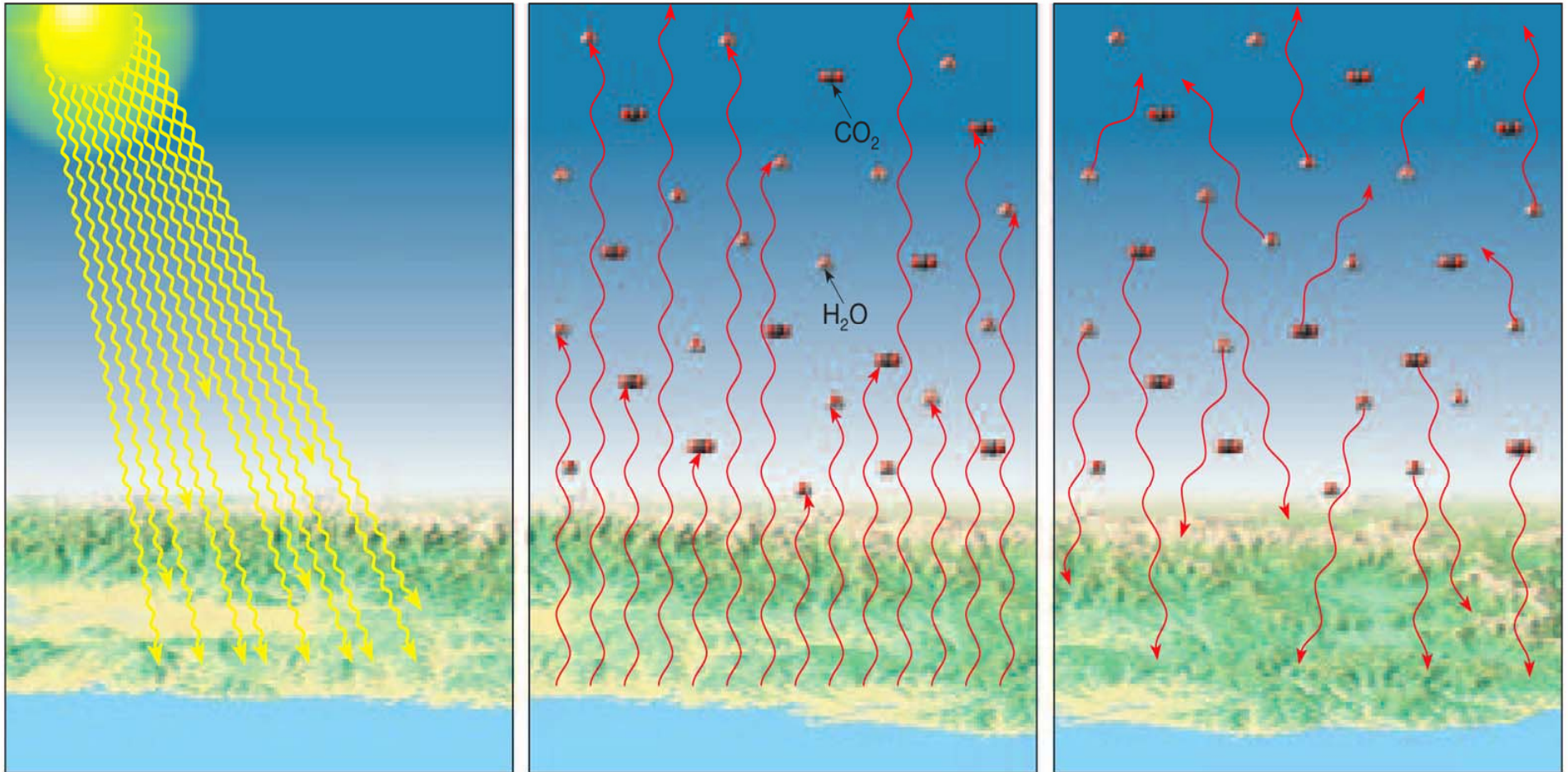
The electromagnetic spectrum



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Figure 16.17

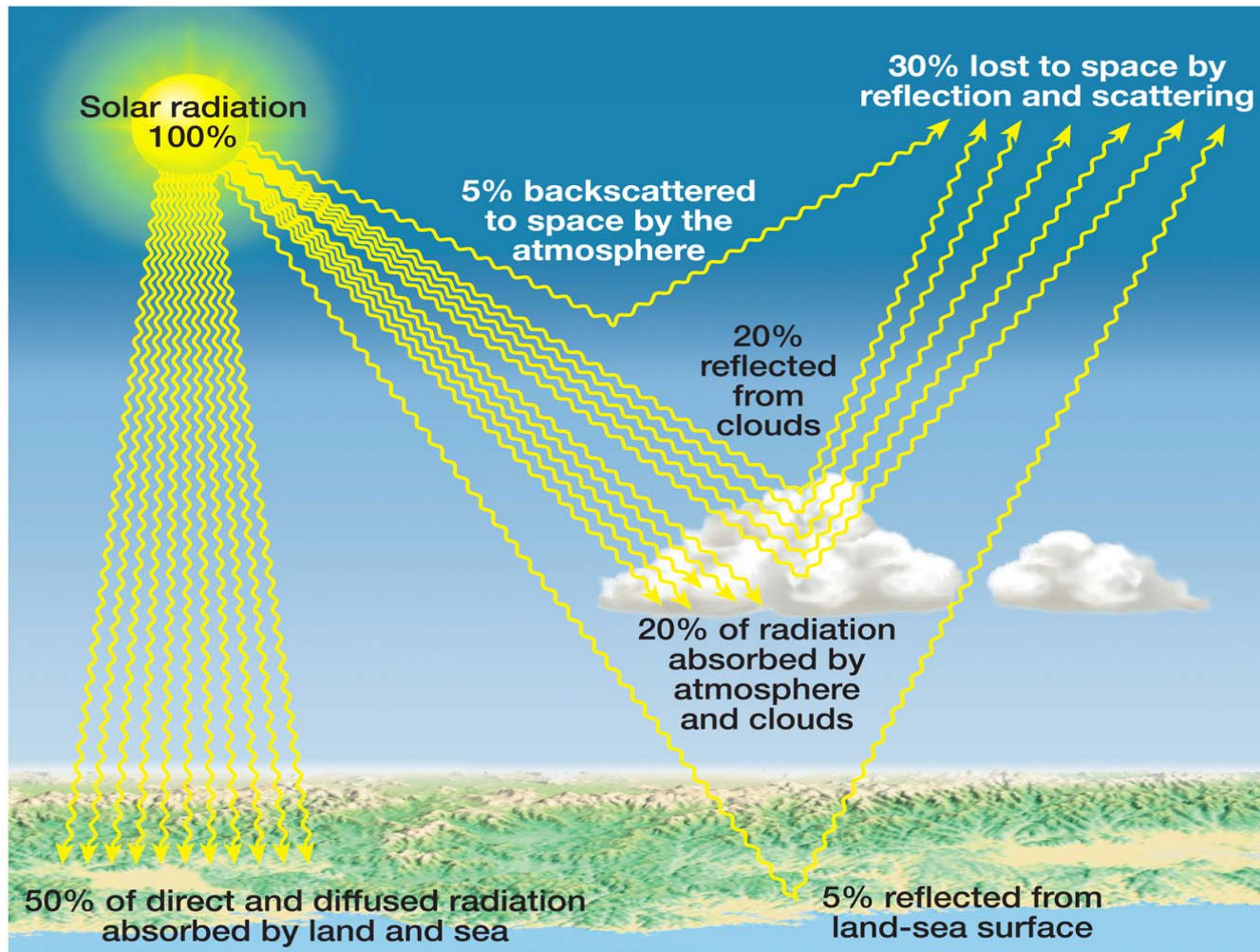
The heating of the atmosphere



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Figure 16.21

Average distribution of incoming solar radiation



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Figure 16.19

Proportional volume of gases that compose dry air

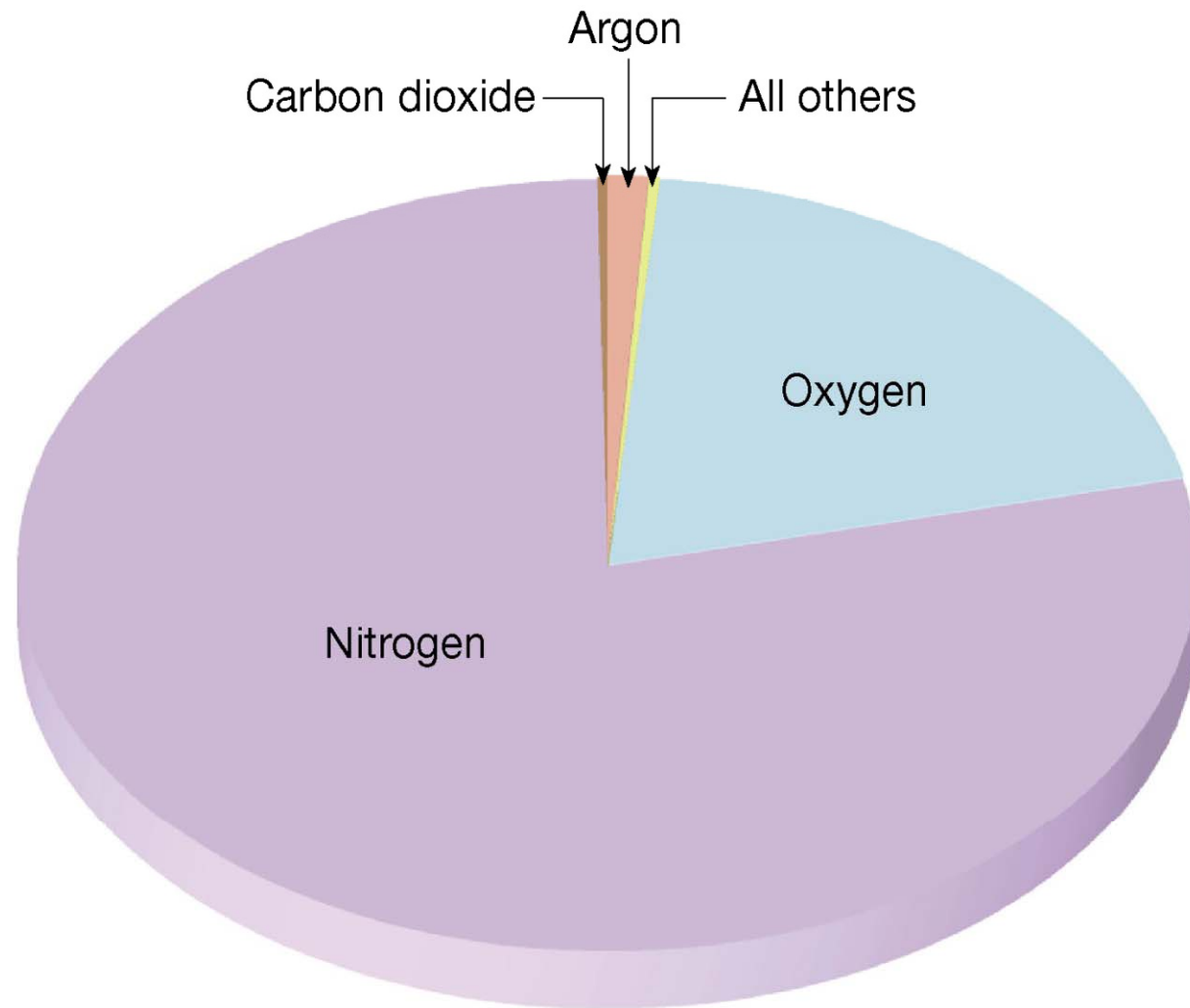


Figure 16.3

Composition of the atmosphere

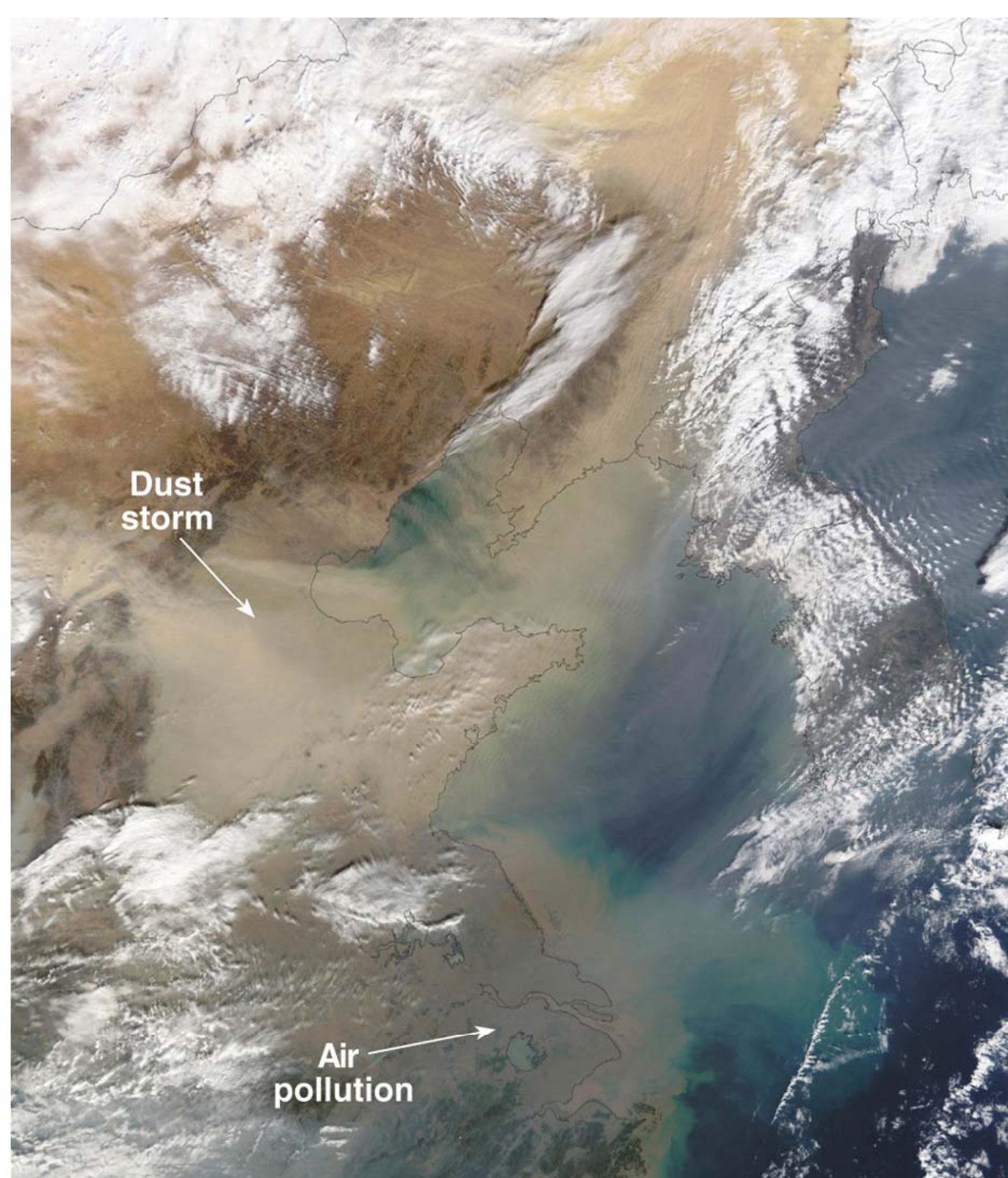
Air is a mixture of gases

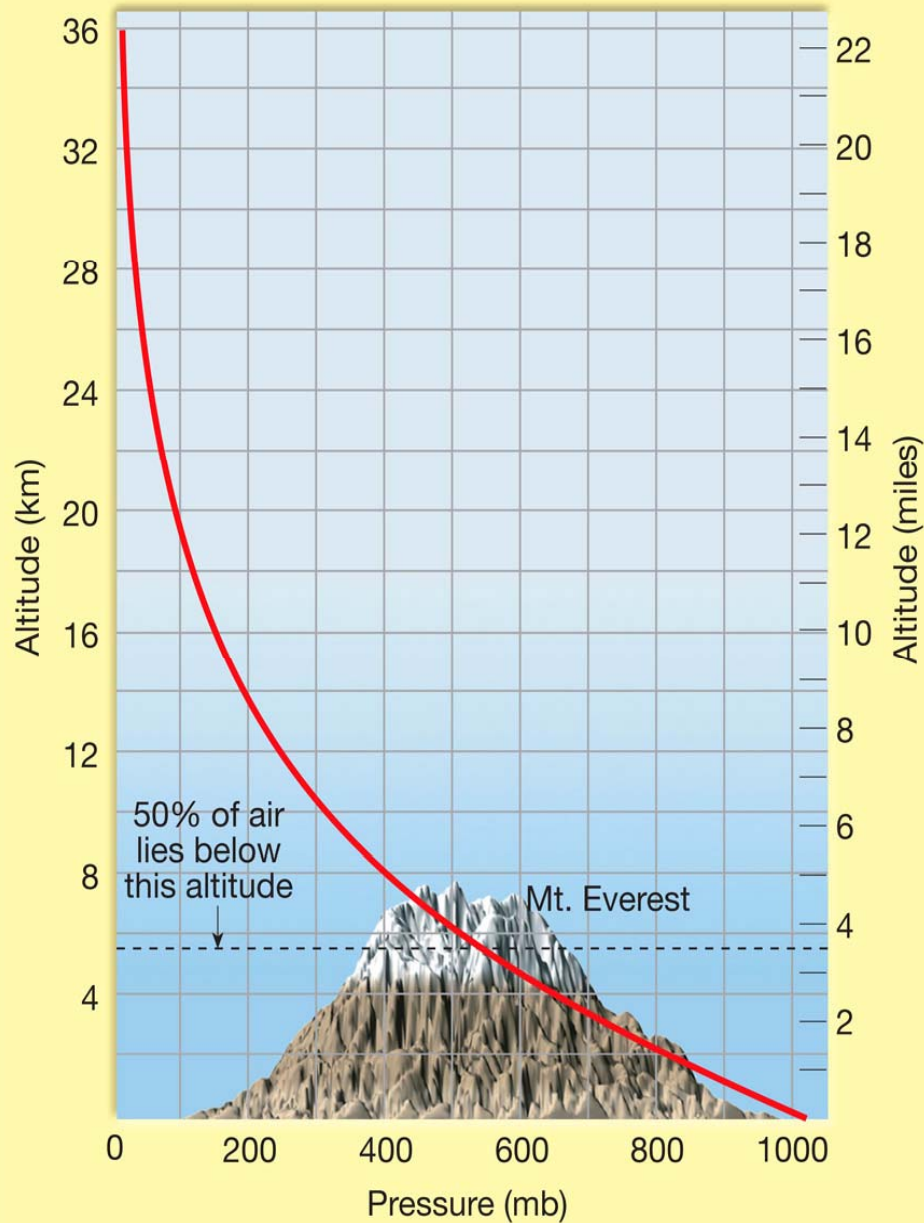
Major components of clean, dry air

- Nitrogen (N) – 78%
- Oxygen (O₂) – 21%
- Argon and other gases
- Carbon dioxide (CO₂) – 0.036% – absorbs heat energy from Earth

Variable components of air

- Water vapor
- Aerosols
- Ozone

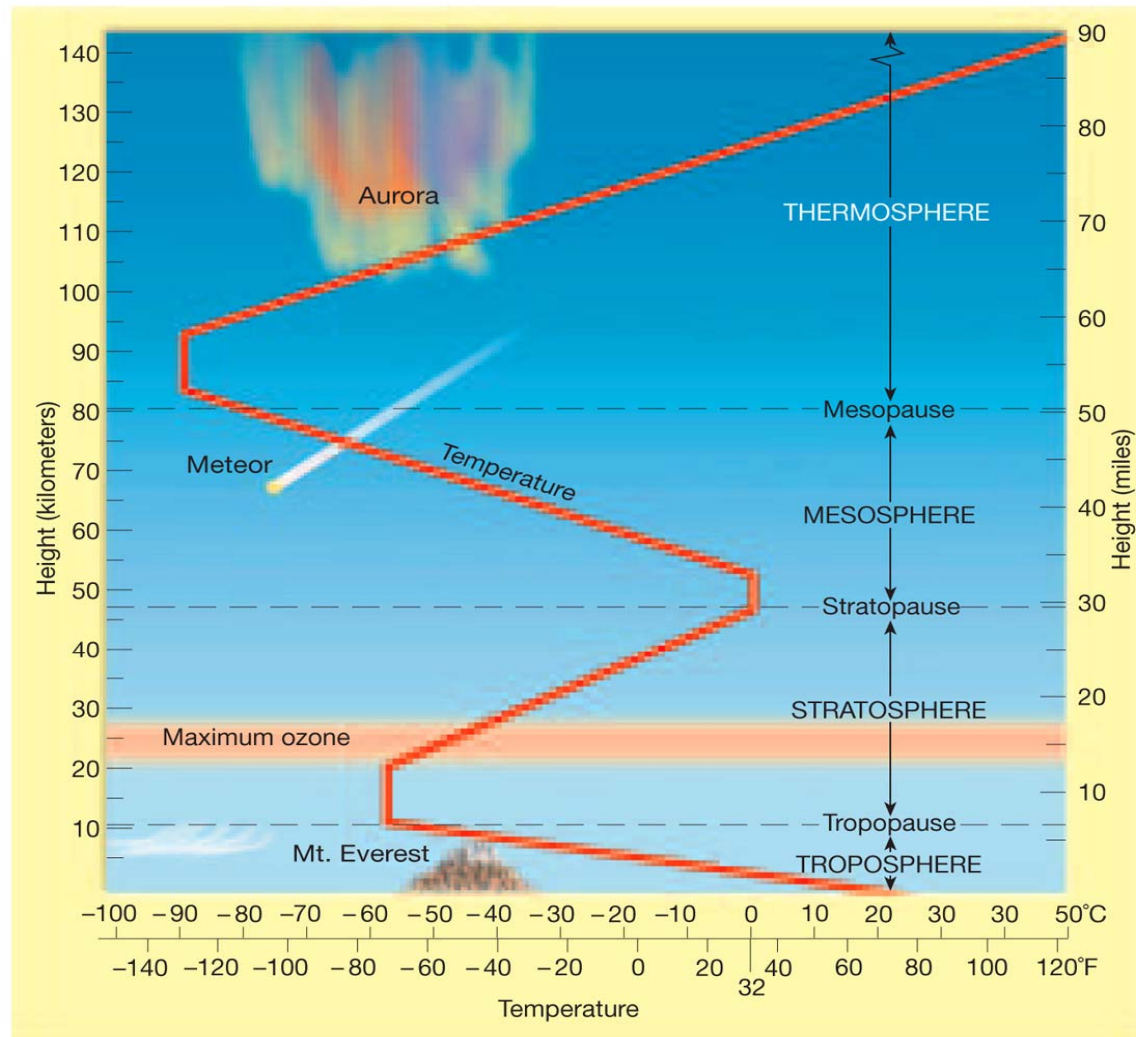




Atmospheric pressure variation with altitude

Figure 16.5

Thermal structure of the atmosphere



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Figure 16.7

Atmospheric layers based on temperature

- **Troposphere**
- **Stratosphere**
- Mesosphere
- Thermosphere