Basic human requirements

Core Temperature
- 37°C
- 36°C
- 34°C
- 32°C
- 31°C
- 28°C

Room Temperature
- 0°C
- 20°C
- 35°C

Image by MIT OCW.
Black body at 800 K

Solar radiation at atmosphere’s boundaries

Solar radiation at sea level
Clear sky, sun at 30° above the horizon

Energy $[\text{W/m}^2\mu\text{m}]$

Wavelength $[\mu\text{m}]$
Solar radiation

- Ground Reflection: 5%
- Cloud Reflection: 20%+
- Atmospheric Absorption & Scattering: 25%

Image by MIT OCW.
Solar radiation

- Earth’s orbit
  - seasons

Image by MIT OCW.
Earth’s orbit

- seasons

latitude and elevation’s impact

Solar course

- Height above sea level
  - 0 m
  - 500 m
  - 3000 m
Parameters in incoming radiation

- **Earth’s orbit**
  - **seasons**
  - latitude and elevation’s impact
  - earth’s inertia

[Graph showing solar elevation and temperature variation with a 16°F difference for the same solar elevation.]

Critical for solar protections
Solar radiation

- Earth’s orbit
  - seasons
  - day
Solar radiation

- Apparent movement of the sun
  - lococentric (local) referential

  elevation $\eta$ ↔ latitude $L$
  azimuth $\phi$ ↔ declination $\delta$
  solar time $H_{solar}$

  $\eta_{noon} = 90^{\circ} - L + \delta$

Image by MIT OCW.
Solar radiation

- Apparent movement of the sun
  - lococentric (local) referential

Image by MIT OCW.
Solar radiation

- Apparent movement of the sun
  - lococentric (local) referential
  - cylindrical projection
Solar radiation

- Apparent movement of the sun
  - lococentric (local) referential
    - cylindrical projection
Solar radiation

- Apparent movement of the sun
  - lococentric (local) referential
    - cylindrical projection
    - stereographic projection

Image by MIT OCW.
Solar radiation

- Apparent movement of the sun
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Images by MIT OCW.
Solar radiation

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Image by MIT OCW.
Solar radiation

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Image by MIT OCW.
Apparent movement of the sun

- lococentric (local) referential
  - cylindrical projection
  - stereographic projection

Vertical sun protections

Image by MIT OCW.
Apparent movement of the sun

- lococentric (local) referential
  - cylindrical projection
  - stereographic projection

Combined protection

Image by MIT OCW.
Solar radiation

Daylight

Image by MIT OCW.
## Solar radiation

### Daylight

<table>
<thead>
<tr>
<th>Sky type</th>
<th>Clear</th>
<th>Milky-white</th>
<th>Partly cloudy</th>
<th>Whitish</th>
<th>Light grey</th>
<th>Dark grey</th>
<th>Dark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sun</td>
<td>Shiny</td>
<td>Clear</td>
<td>Partly veiled</td>
<td>Veiled</td>
<td>Still visible</td>
<td>Barely visible</td>
<td>Invisible</td>
</tr>
<tr>
<td>Global radiation [W/m²]</td>
<td>800 to 900</td>
<td>600 to 800</td>
<td>300 to 700</td>
<td>250 to 400</td>
<td>200 to 300</td>
<td>100 to 200</td>
<td>20 to 100</td>
</tr>
<tr>
<td>Diffuse component</td>
<td>10 to 20%</td>
<td>20 to 40%</td>
<td>20 to 50%</td>
<td>40 to 80%</td>
<td>50 to 100%</td>
<td>75 to 100%</td>
<td>100%</td>
</tr>
</tbody>
</table>
Atmospheric phenomena (global climate)

Wind flows and Coriolis force

Wind flow from high to low pressure zones

Subpolar low-pressure belt
Subtropical high-pressure belt
Intratropical convergences
Subtropical high-pressure belt
Subpolar low-pressure belt
Polar high

Cold front
Warm front
Convergence
Warm wind
Cold wind
E = Easterly winds
H = High pressure
L = Low pressure

Images by MIT OCW.
Atmospheric phenomena (global climate)

- Wind flows and Coriolis force
- Water
Climate

Atmospheric phenomena (global climate)

- Wind flows and Coriolis force
- Water
- Mountains

Image by MIT OCW.
Atmospheric phenomena (global climate)

- Wind flows and Coriolis force
- Water
- Mountains
- Friction

Image by MIT OCW.
Atmospheric phenomena (global climate)

- Wind flows and Coriolis force
- Water
- Mountains
- Friction
- Greenhouse effect

Image by MIT OCW.
Human needs and outside environment

- Reading assignment from Textbook:
  - “Introduction to Architectural Science” by Szokolay: § 1.3

- Additional readings relevant to lecture topics:
  - "How Buildings Work" by Allen: Chap 1
  - "Heating Cooling Lighting" by Lechner: § 5.1 - 5.6 + § 6.1 - 6.13
  - “Sun Wind Light“ by Brown & DeKay: § 1 - 6 in Chap 1A