Humid Air

▸ Water vapor in air

Trace Glasses 1%
Argon (A)
Water vapor (H_2O)
Carbon dioxide (CO_2)
Neon (Ne)
Helium (He)
Krypton (Kr)
Hydrogen (H)
Ozone (O_3)

Oxygen 21%

Nitrogen 78%

Image by MIT OCW.
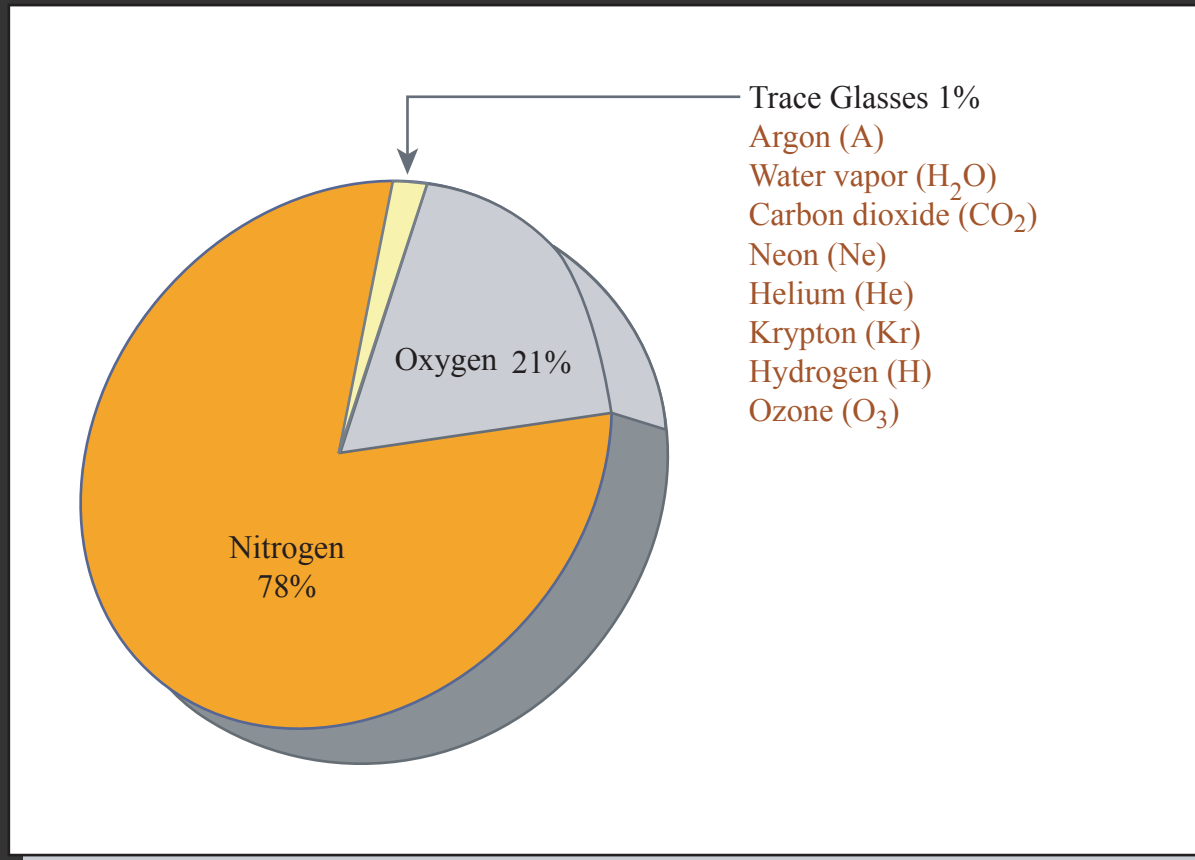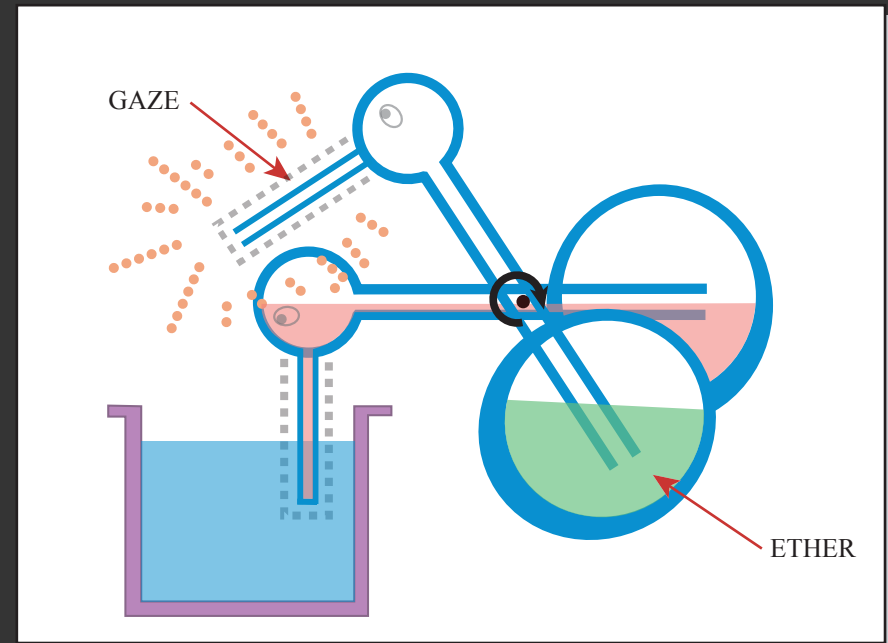
Humid Air

▸ Water vapor in air

- saturation humidity (SH) (= max AH)

- moisture content (absolute humidity AH) = kg_{vapor} / $kg_{dry\ air}$

- (partial) vapor pressure [Pa]

- relative humidity (RH)

- wet-and-dry bulb psychrometer

GAZE

ETHER

▸ Water vapor in air

- saturation humidity (SH) (= max AH)

- moisture content (absolute humidity AH) = $kg_{vapor} \, / \, kg_{dry\ air}$

- (partial) vapor pressure [Pa]

- relative humidity (RH) in [%]

- wet-and-dry bulb psychrometer

- enthalpy (H) in [kJ/kg]
  - Sensible heat vs. Latent heat

- specific volume
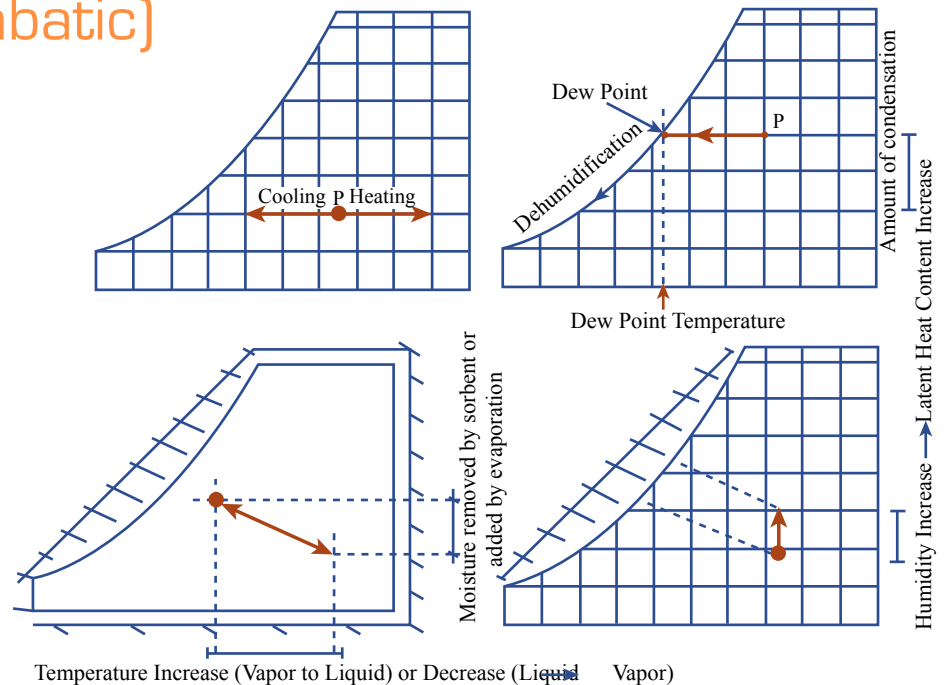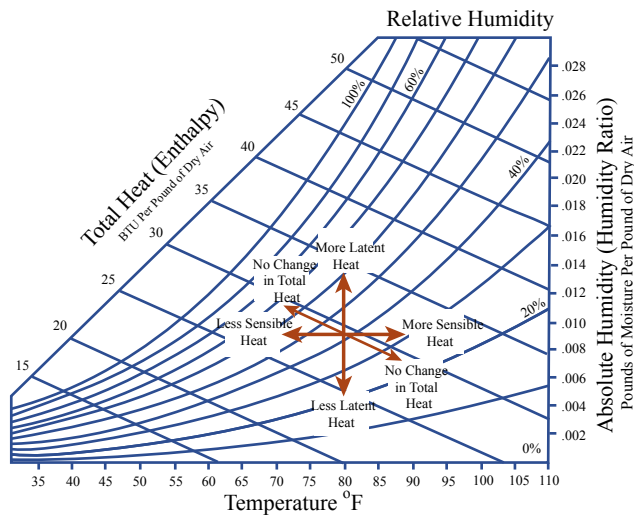
Humid Air

▶ Psychrometric chart

- **absolute humidity AH and saturation line**
- **relative humidity RH**
- **wet bulb temperature**
- **enthalpy**
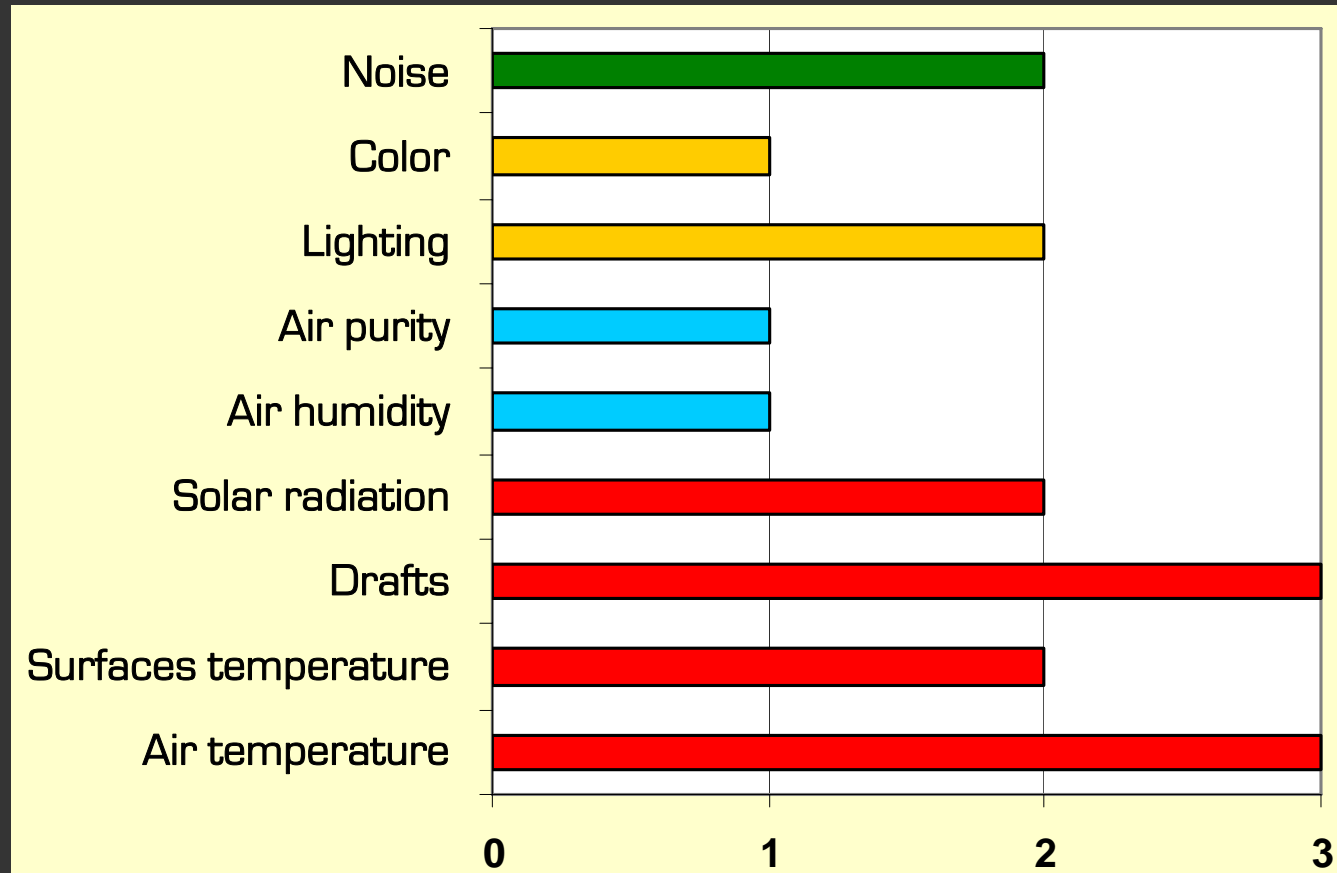- **specific volume**

Image by MIT OCW.
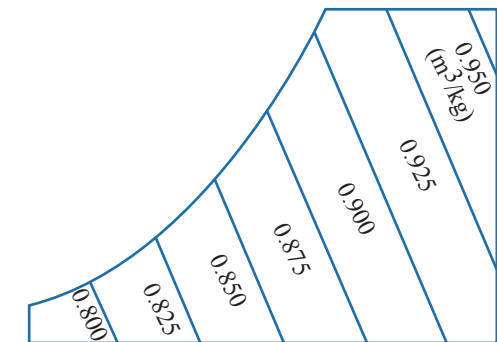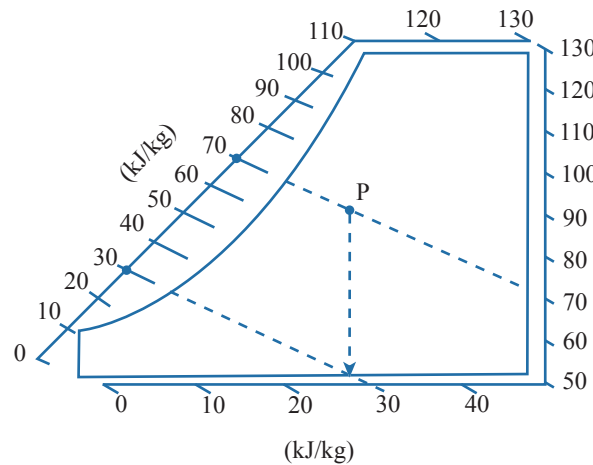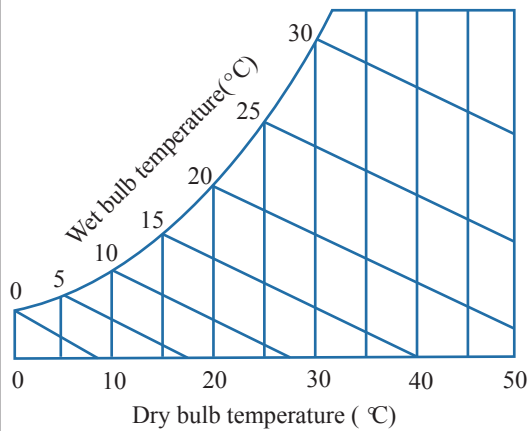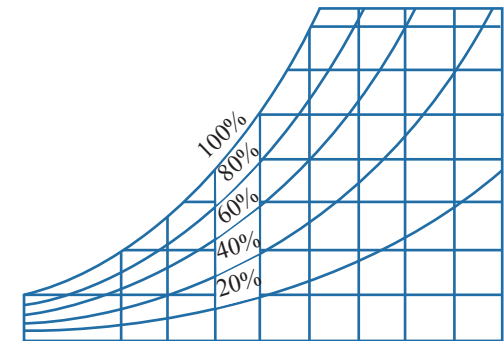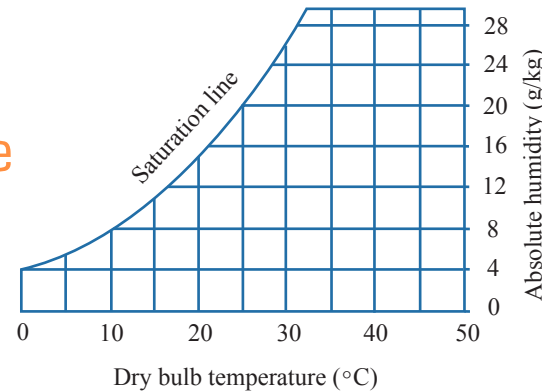
Humid Air

- ▶ Psychrometric processes
  - ▪ heating and cooling
  - ▪ dew-point then condensation
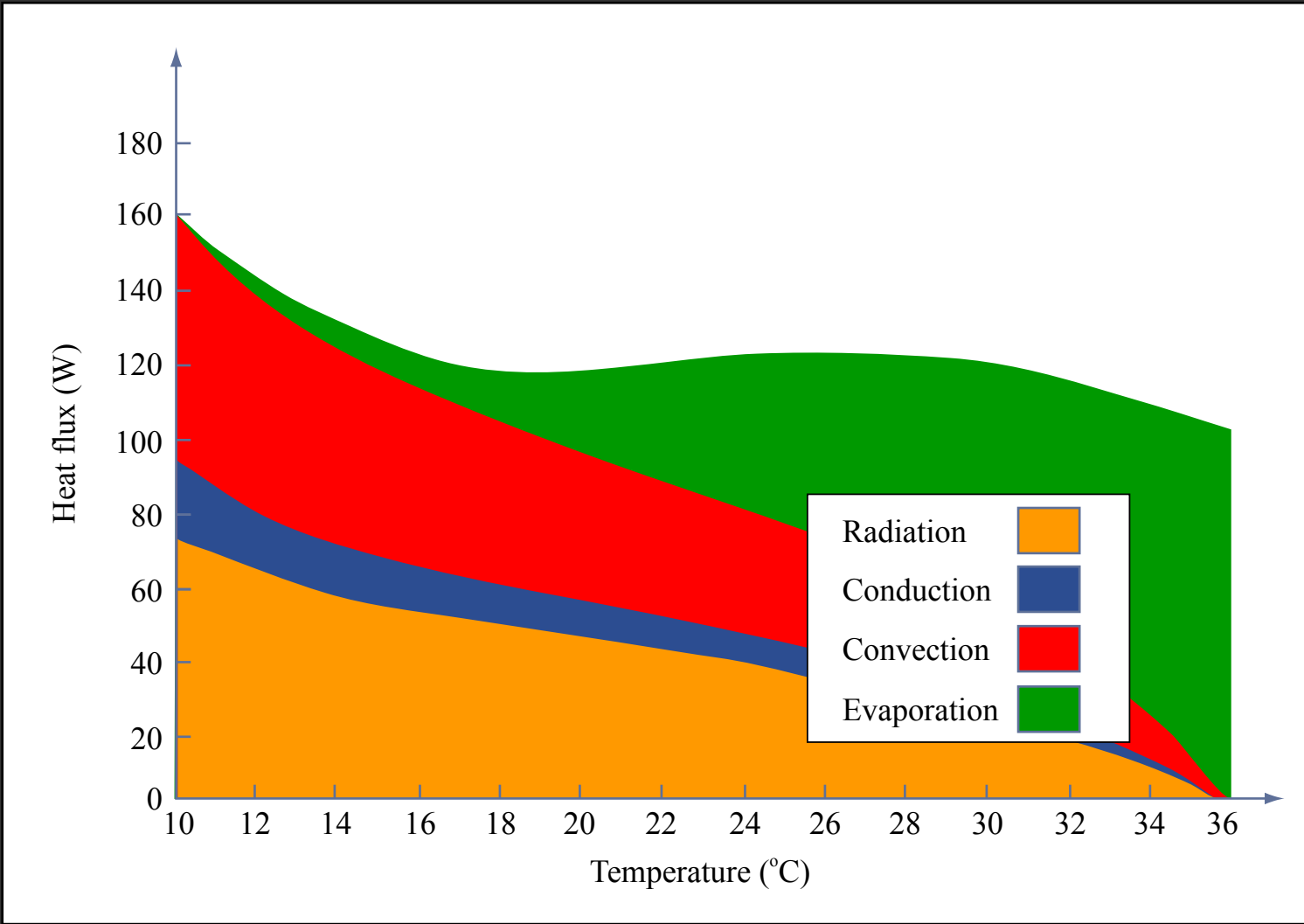 - ▪ (de)humidification (adiabatic)
  - ▪ enthalpy increase

Image by MIT OCW.

Feeling comfortable

Factors of thermal comfort

▶ Air temperature (sensitive to ΔT > 1°C)

Image by MIT OCW.

Factors of thermal comfort

▸ Air temperature

▸ ΔT between air and building surfaces (MRT) (keep < 3°C)
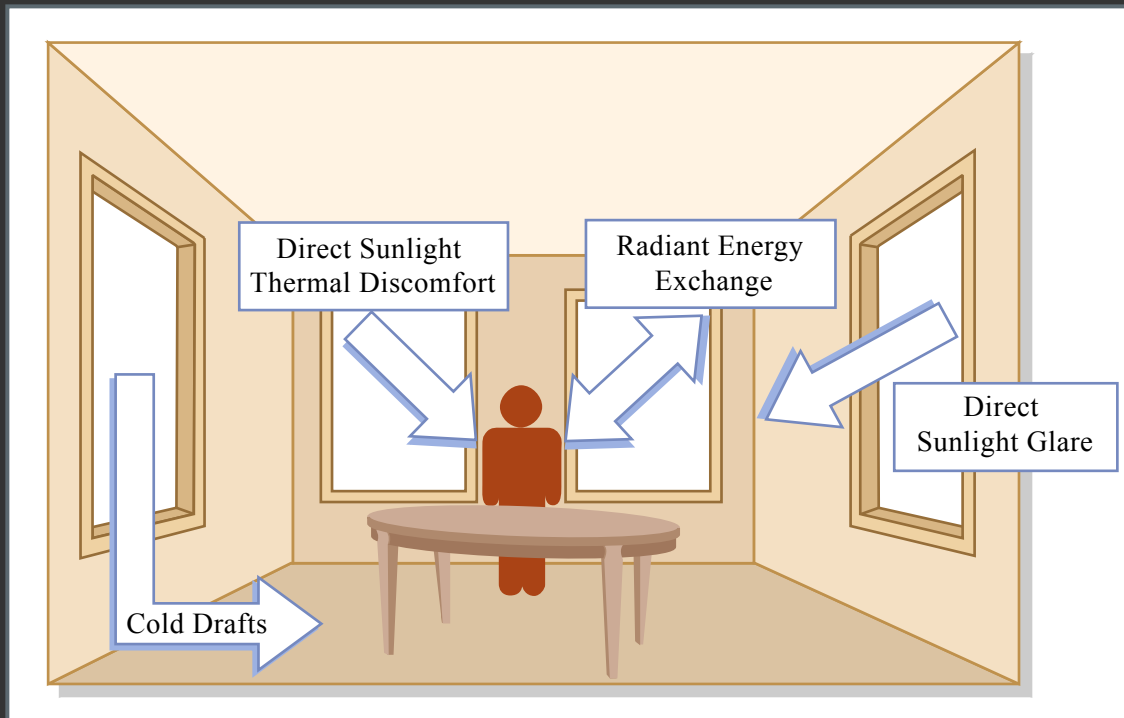
Image by MIT OCW.

Factors of thermal comfort

▸ Air temperature

▸ ΔT between air and building surfaces (MRT)

▸ Air movement (keep < 1.5 m/s unless overheated)
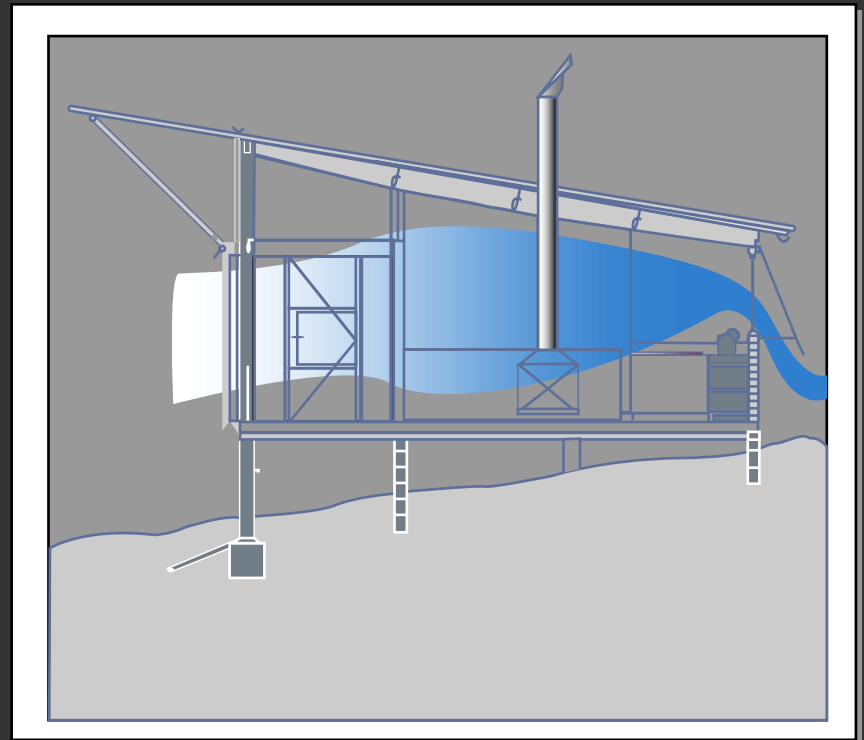
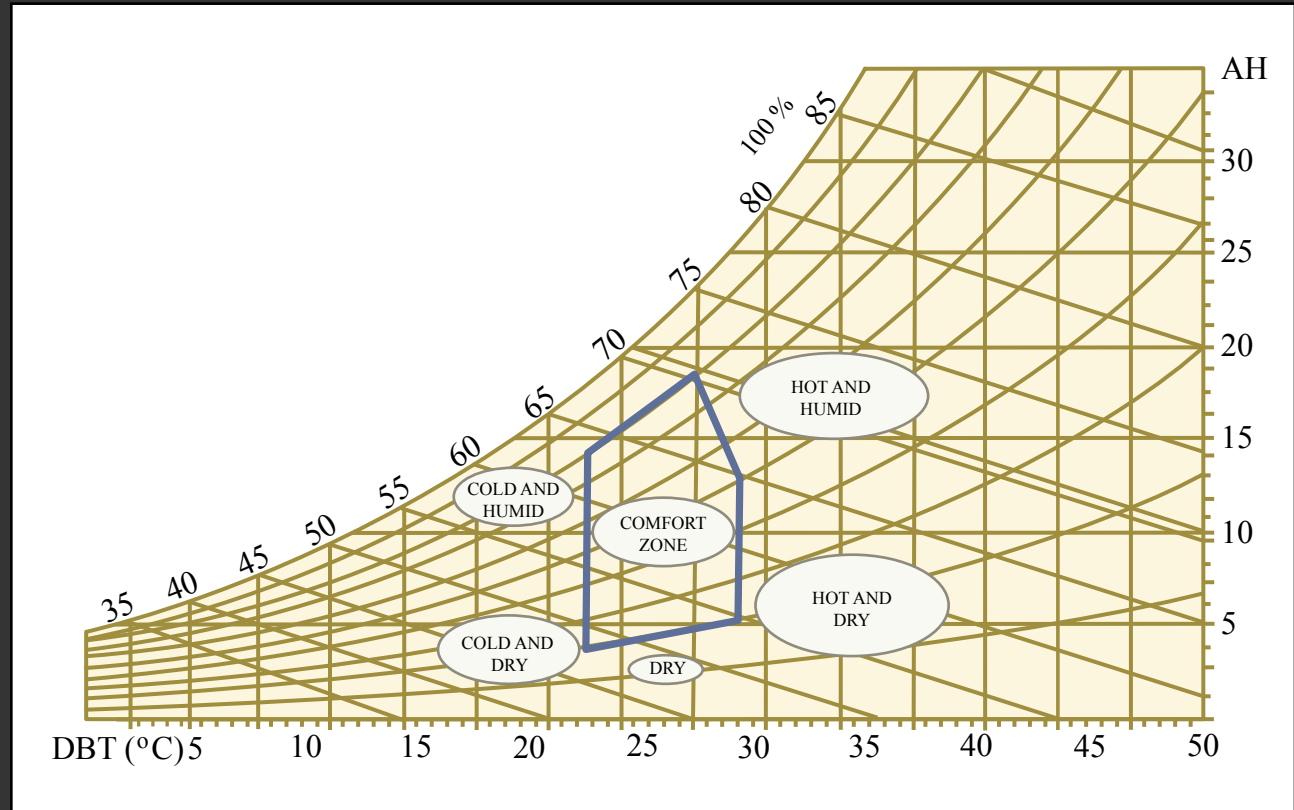Image by MIT OCW.

▸ Air temperature

▸ ΔT between air and building surfaces (MRT)

▸ Air movement

▸ Relative humidity
(30% to 65%)
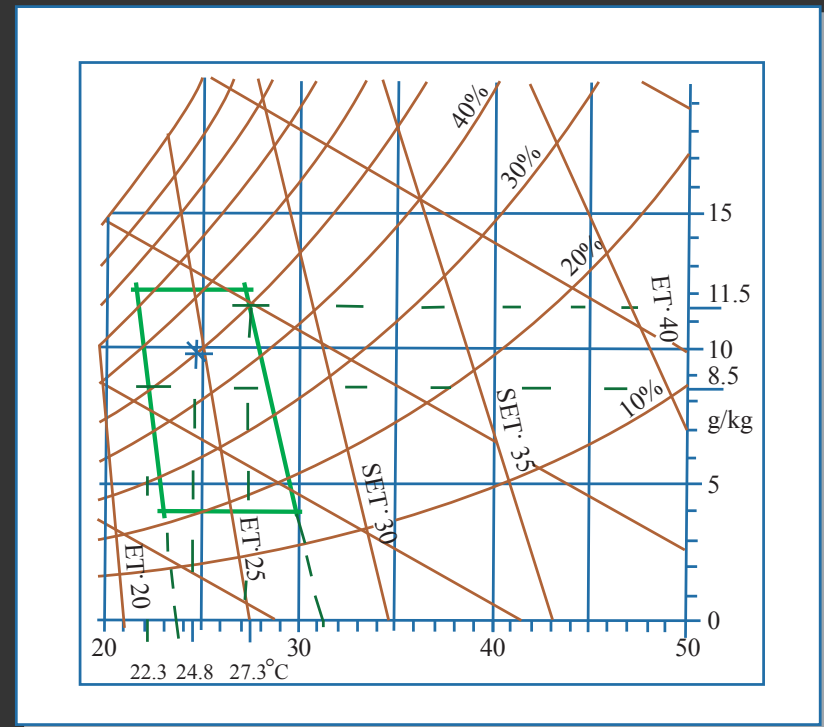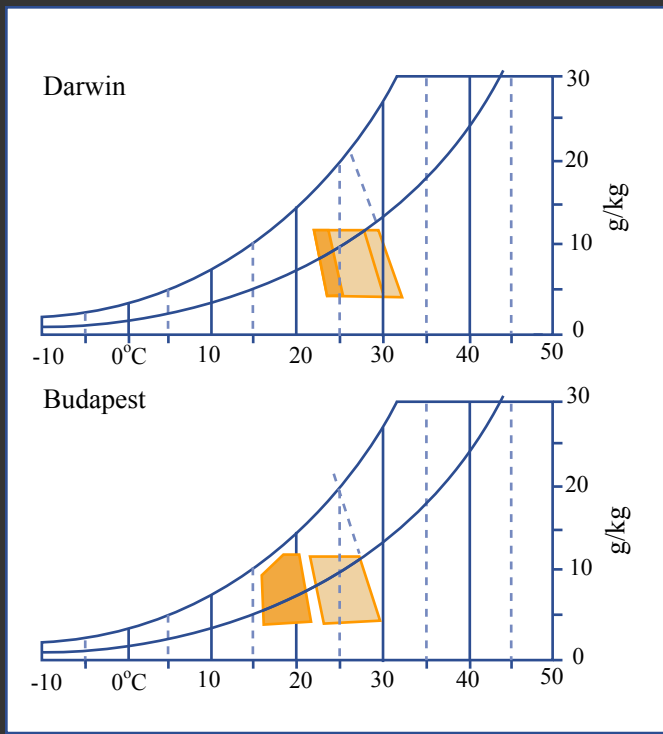
Comfort zone

- ### Standard Effective Temperature (SET)

  - SET isotherms on psychrometric chart

  - neutral temperature $T_n = 17.6 + 0.31 \times \overline{T_{month}}$ (±2.5°C for comfort)

Image by MIT OCW.

Comfort zone

▶ Standard Effective Temperature (SET)

- SET isotherms on psychrometric chart
- neutral temperature $T_n = 17.6 + 0.31 \times \underline{T_{month}}$ (±2.5°C for comfort)
- comfort zone depends on climate

Images by MIT OCW.

Comfort zone

▸ Standard Effective Temperature (SET)
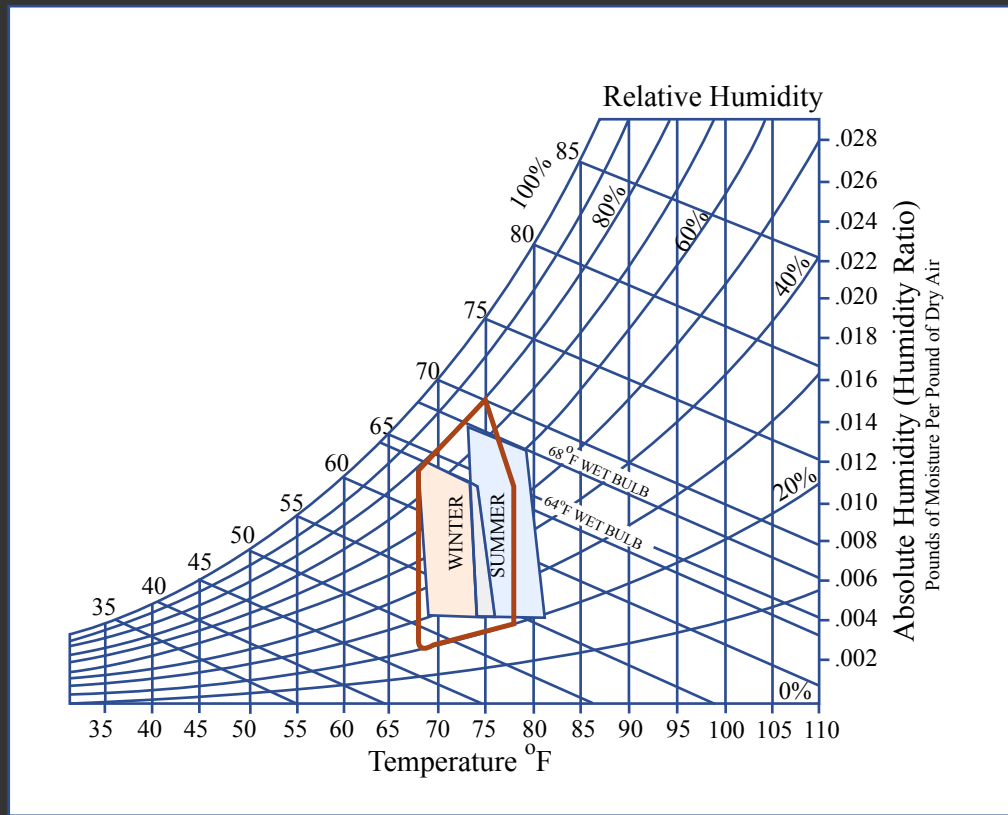
- SET isotherms on psychrometric chart
- neutral temperature $T_n = 17.6 + 0.31 \times \overline{T_{month}}$ (±2.5°C for comfort)
- comfort zone depends on climate

Image by MIT OCW.

Comfort zone

▸ Standard Effective Temperature (SET)
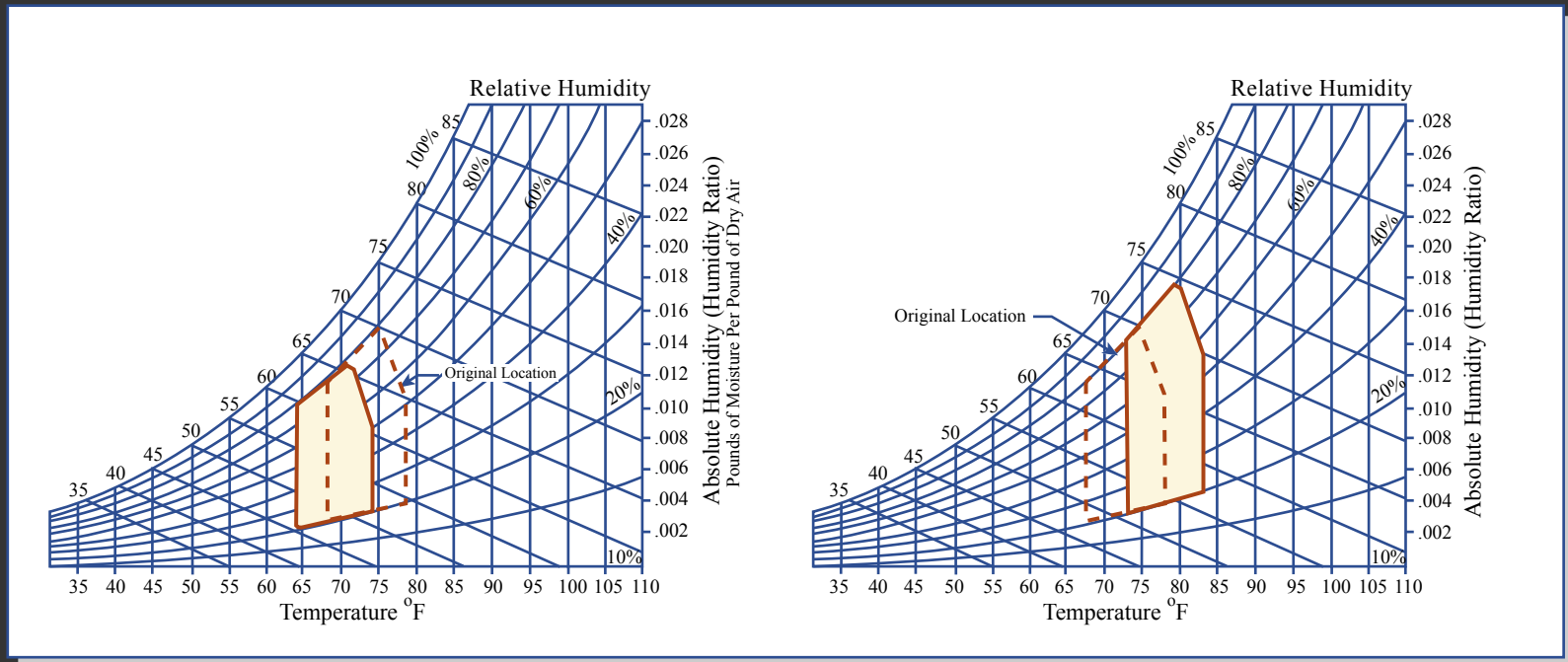
- SET isotherms on psychrometric chart
- neutral temperature T_n = 17.6 + 0.31 x T_{month} (±2.5°C for comfort)
- comfort zone depends on climate
- shift with MRT and air movement

Image by MIT OCW.

Humid Air, Thermal Comfort

▸ Reading assignment from Textbook:

  ▪ "Introduction to Architectural Science" by Szokolay: § 1.1.3 + § 1.2

▸ Additional readings relevant to lecture topics:

  ▪ "How Buildings Work" by Allen: Chap 7 + pp. 58 - 60 in Chap 8

  ▪ "Heating Cooling Lighting" by Lechner: Chap 4