SUPPLEMENTAL OXYGEN USAGE IN SPORT SKYDIVING

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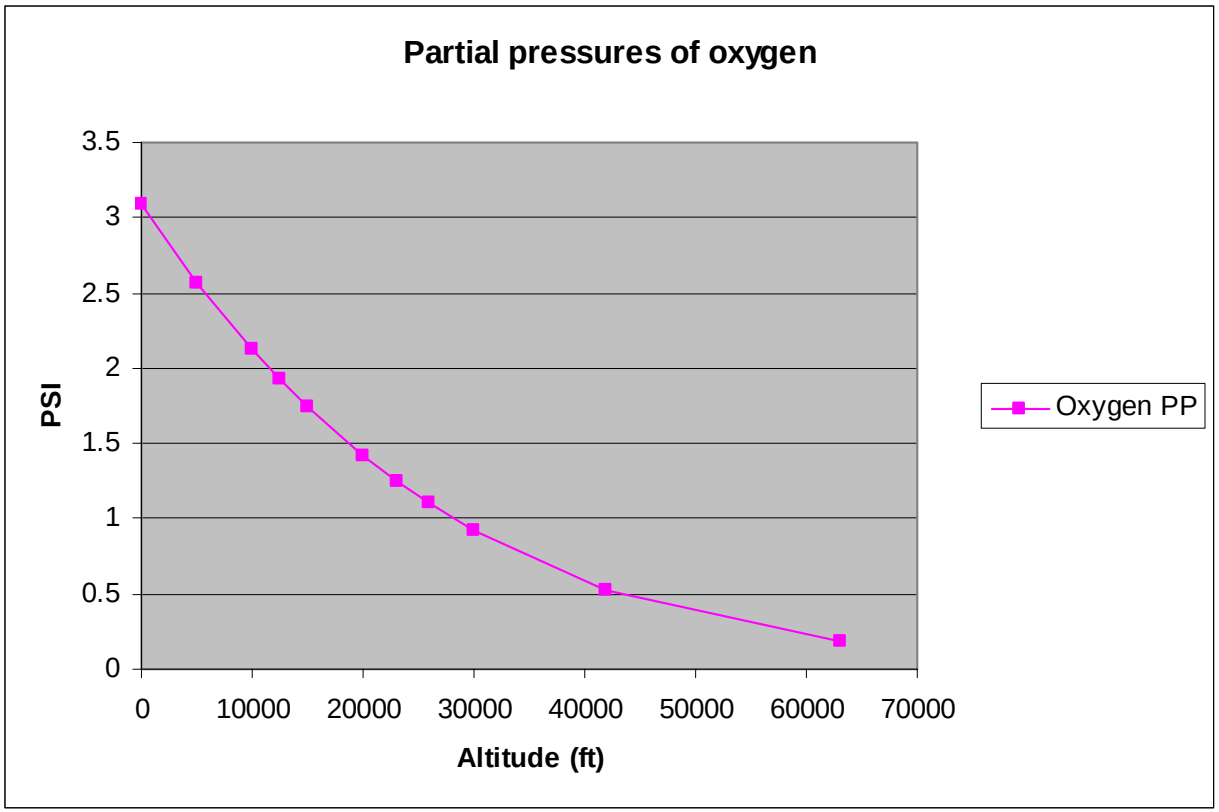
Oxygen

- Oxygen -> aerobic cellular respiration
- Atmosphere:
  - 21% oxygen
  - 78% nitrogen
  - 1% trace (CO2, argon, water vapor)
  - 14.7 PSI at sea level
- Partial pressure of oxygen – 3 PSI

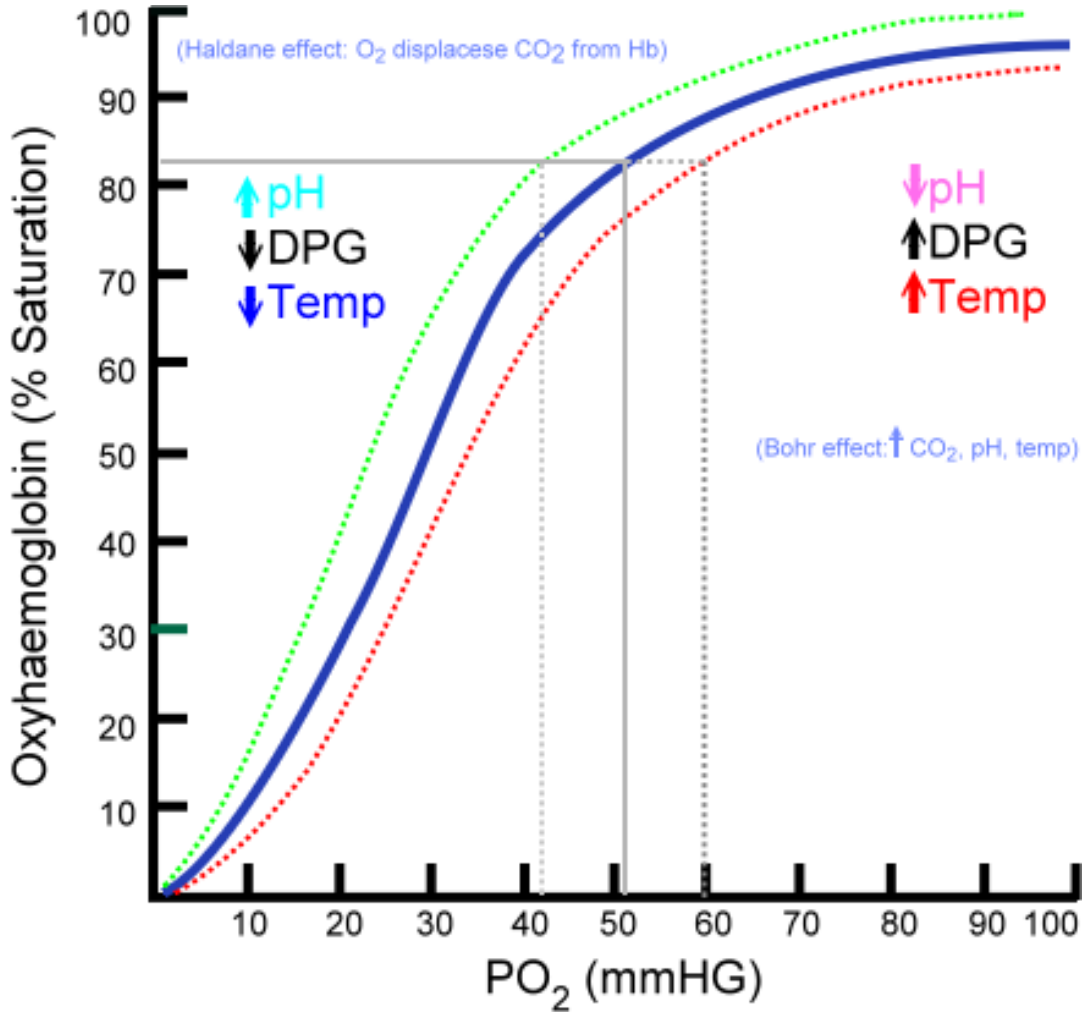
Atmospheric pressure

- Air pressure drops off with altitude
- Oxygen partial pressure drops off at same rate



Hemoglobin dissociation curve

- Hemoglobin – active transporter
- Significant change at 50mmHg (24,000 ft)



Hypoxia - symptoms

- Stages – indifferent, compensatory, disturbance
- Disturbance stage –

  Impaired vision – loss of color, tunnel vision

  Unusual sensations – ringing in ears, tingling

  Loss of judgement/mental impairment

  Muscular weakness

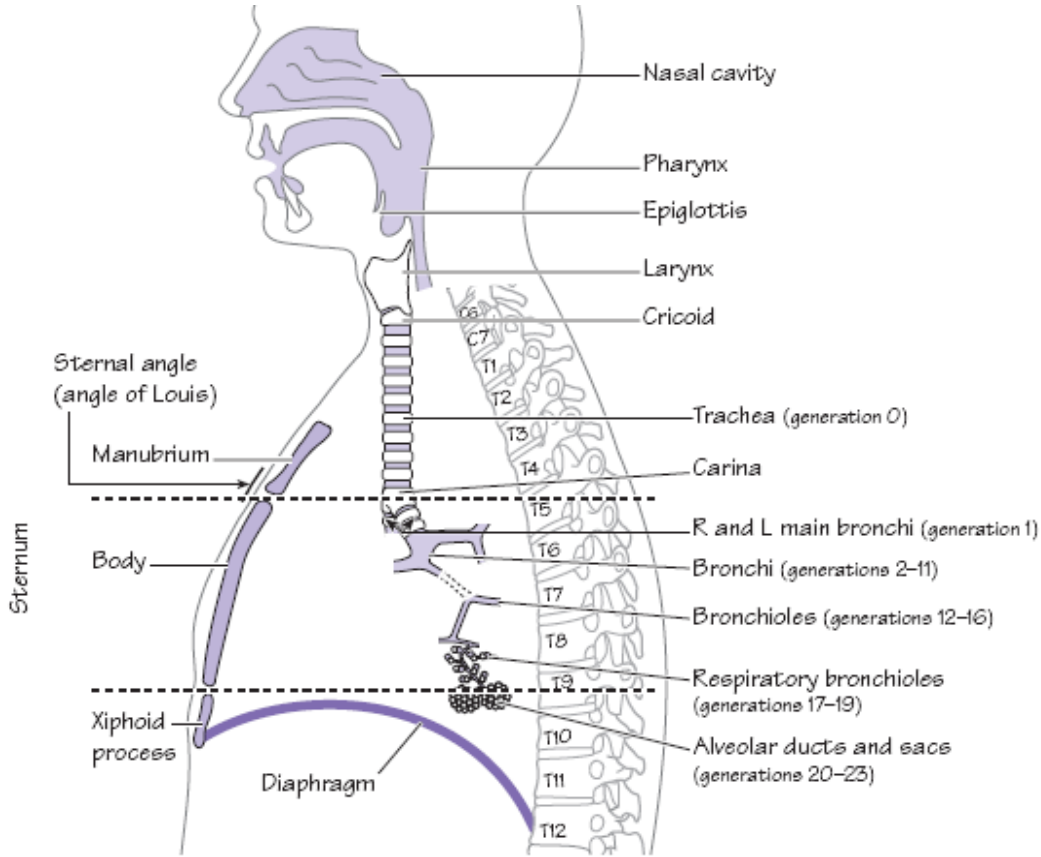
  Cyanosis

- Pulse oximeter – useful tool
  - 98-100% normal
  - 85-90% compensatory
  - Below 80% disturbance

Hypoxia mitigation without O2

- Reduce O2 needs – stay calm and relaxed
- Avoid crouching
- Breathe deeply to exchange more air
  - CO2, not O2, drives respiration rate
  - Dead space is about 150ml
  - Shallow breathing = 250ml exchanged or 30%
  - Deep breathing = 500ml exchanged or 60%

Respiratory dead space



Use of supplemental O2

- Supplemental O2 increases ppO2 in lungs
- Objective is >2 psi ppO2, not 100% O2
- Rates: 1lpm for every 10,000 feet (18,000ft = 1.8lpm) (active user)
- FAA rules:
  - 12,500 to 14,000 >30 min
  - 14,000+ all crew members
  - 15,000+ everyone
- USPA Rules:

  10,000 > 30 min

  15,000+ everyone

Use of onboard oxygen

- Time of Useful Consciousness (TUC)
  - 18,000 feet – 20 min
  - 22,000 feet – 10 min
  - 25,000 feet – 3 min
  - 28,000 feet – 2 min
  - 30,000 feet – 1 min
- Dangers:
  - Fire
  - Decompression sickness (rate of climb)
  - Undetected O2 loss

Equipment types - supplemental

- Flow regulator
  - One person per outlet
  - Best regulation of O2
- Pressure/metered orifice regulator
  - “Manifold” with several orifices
  - Can get some loss near far end
  - Simple; most skydive aircraft use this

User delivery

- Nasal cannula
  - Most reliable, most comfortable
  - “Oxymizer”
- Oral
  - Least amount of dead-air space
  - Health issues
- Helmet volume
  - Easy; simple single-tube installation
  - Some “backup” O2 during exit
  - Problems – no warning of failure, uncertain dilution
- Mask
  - Best O2 delivery for typical user

Equipment types – bailout

- Traditional “HALO” system (100% O2, prebreathable)

- Supplemental bailout

Example supplemental bailout system

2000 PSI 36 liter system (9 to 72 minutes O2)

2 lbs, 10” x 2.5”, $85 for bottle, $120 for regulator (not needed but nice to have)

.25 to 4 liters per minute with reg

Refillable from aviation tank with transfiller (approx 50 fills per tank)

Training

- Chamber rides
- Experience
  - 20K jumps readily available
  - 30K jumps now possible (WFFC)
  - Become familiar with symptoms of O2 and look for them in others

Future challenges

- 26,000 feet limit for onboard O2
- Bailout O2 higher than that
- Prebreating/acclimation