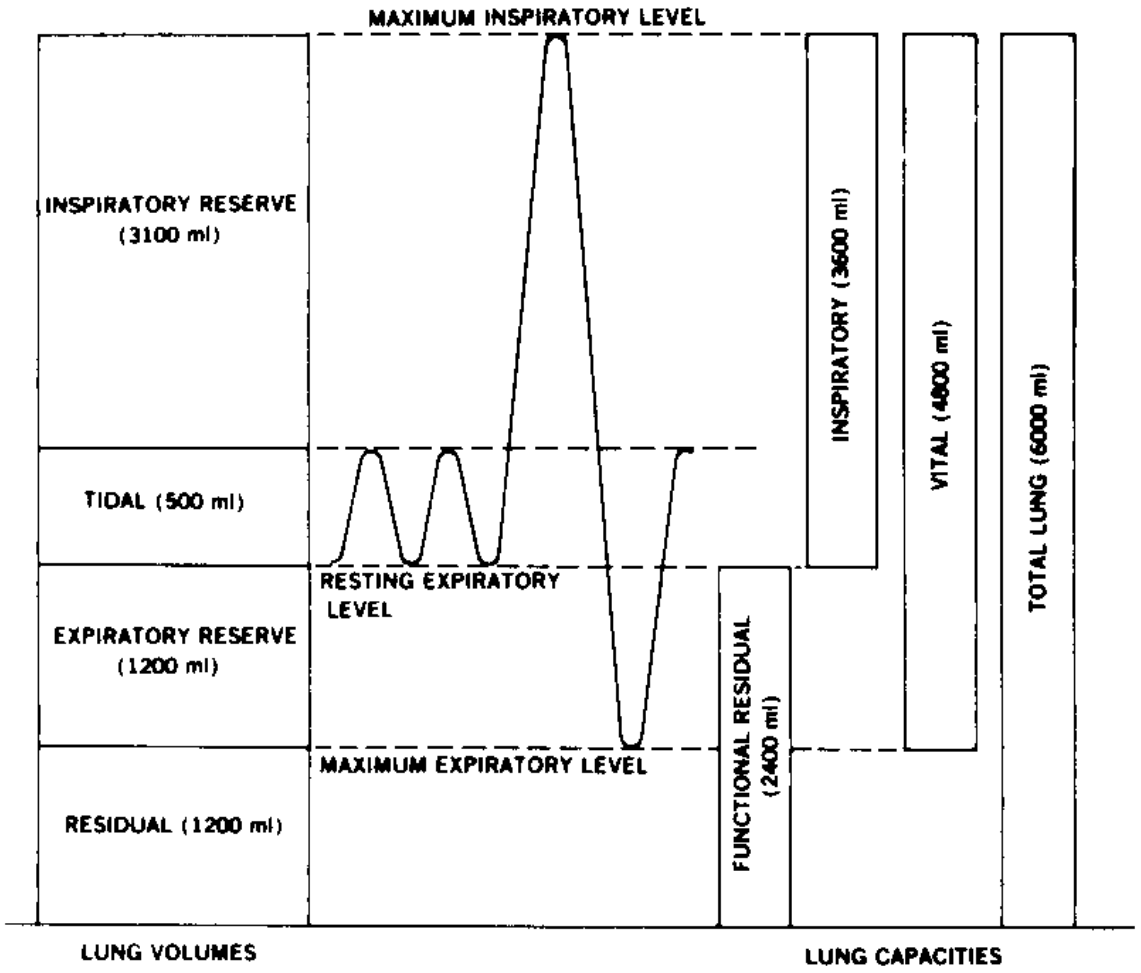
Aerospace Physiology

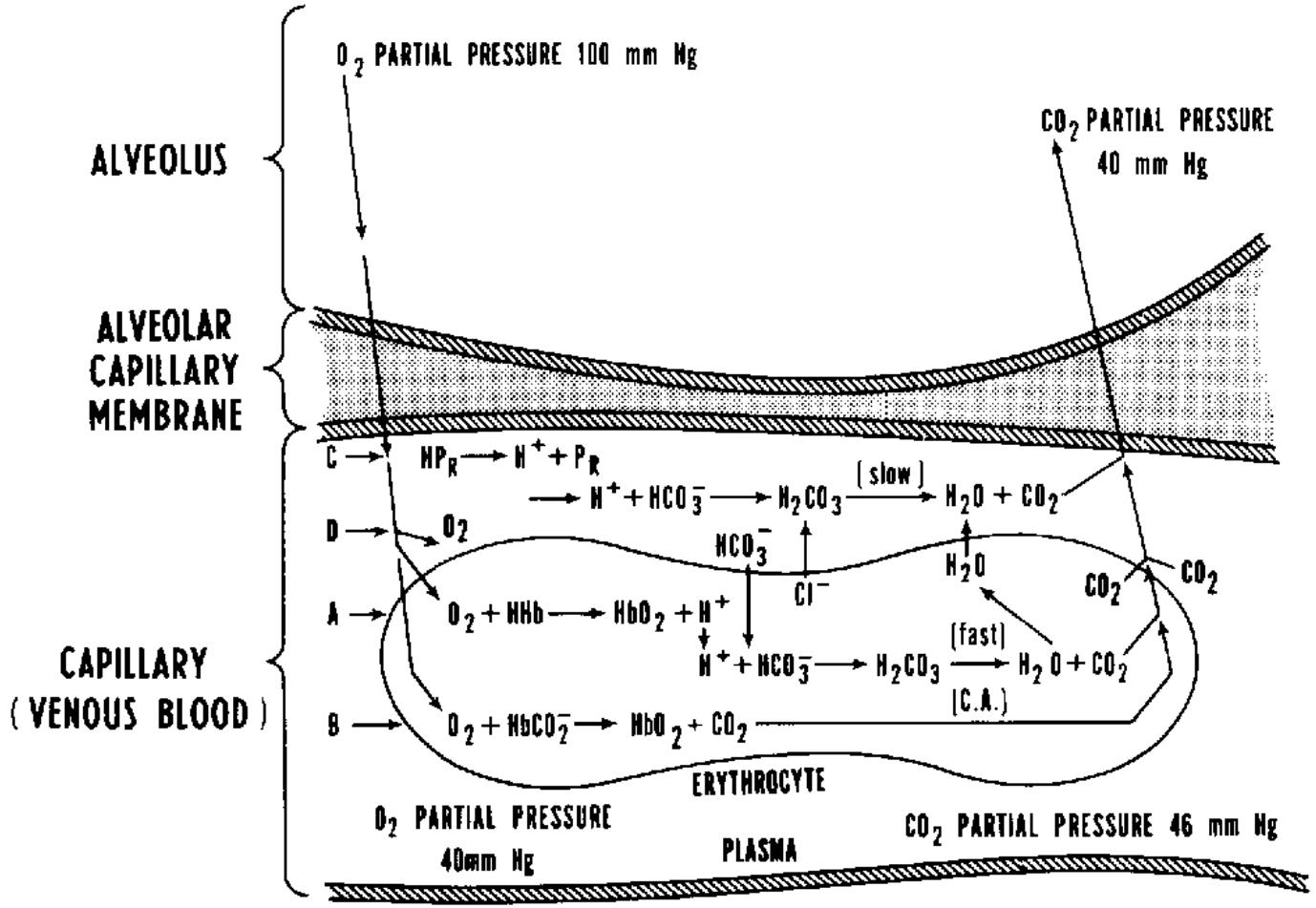
- Review of iterative design approach
- Respiratory
- Cardiovascular
- Musculoskeletal
- Vestibular
- Neurological

Lung Measurements



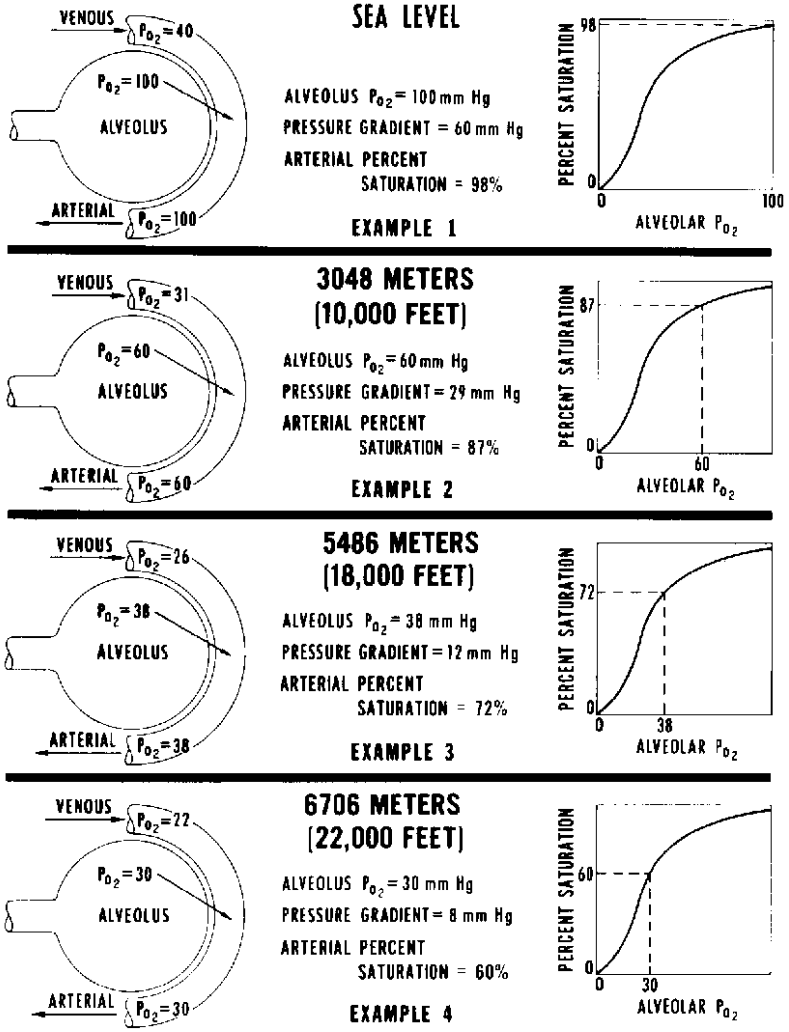
From Roy DeHart, *Fundamentals of Aerospace Medicine*, Lea & Febiger, 1985

Gas Exchange in the Lungs



From Roy DeHart, *Fundamentals of Aerospace Medicine*, Lea & Febiger, 1985

Alveolar Pressures



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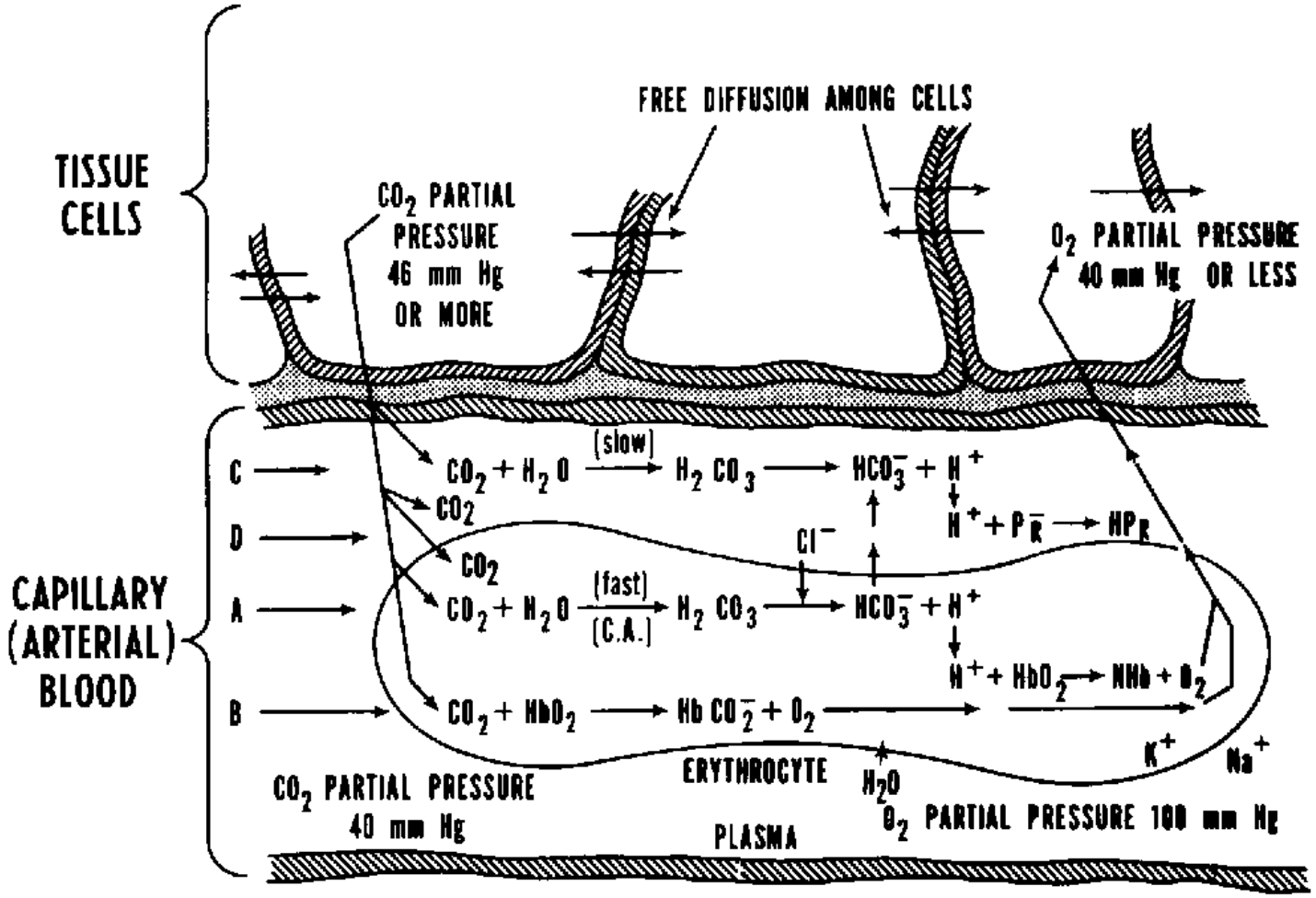
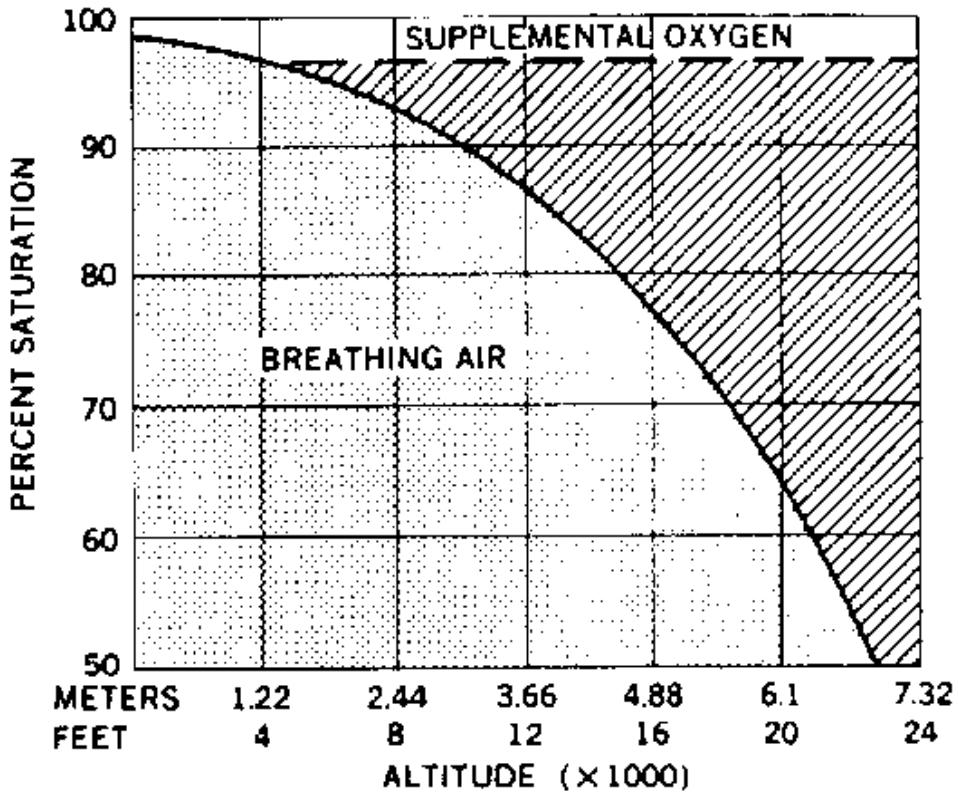
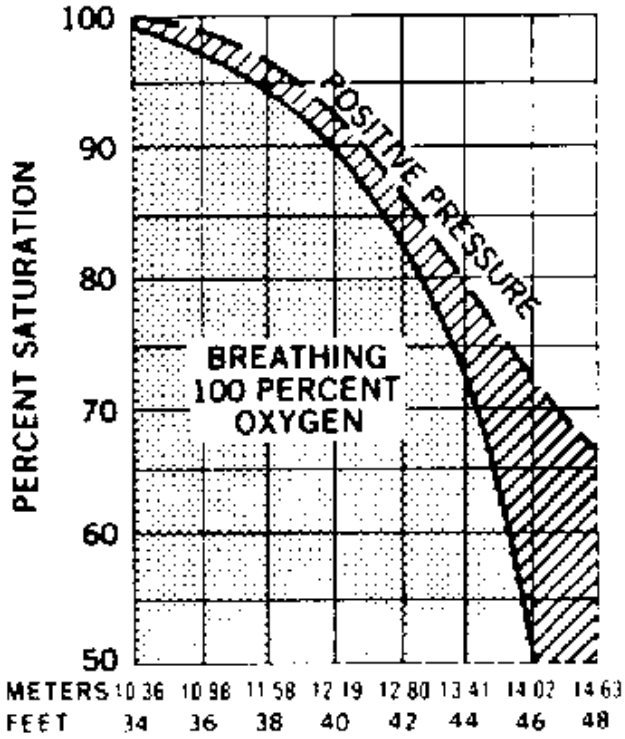
Gas Exchange in the Tissues



From Roy DeHart, *Fundamentals of Aerospace Medicine*, Lea & Febiger, 1985

Effects of Supplemental Oxygen





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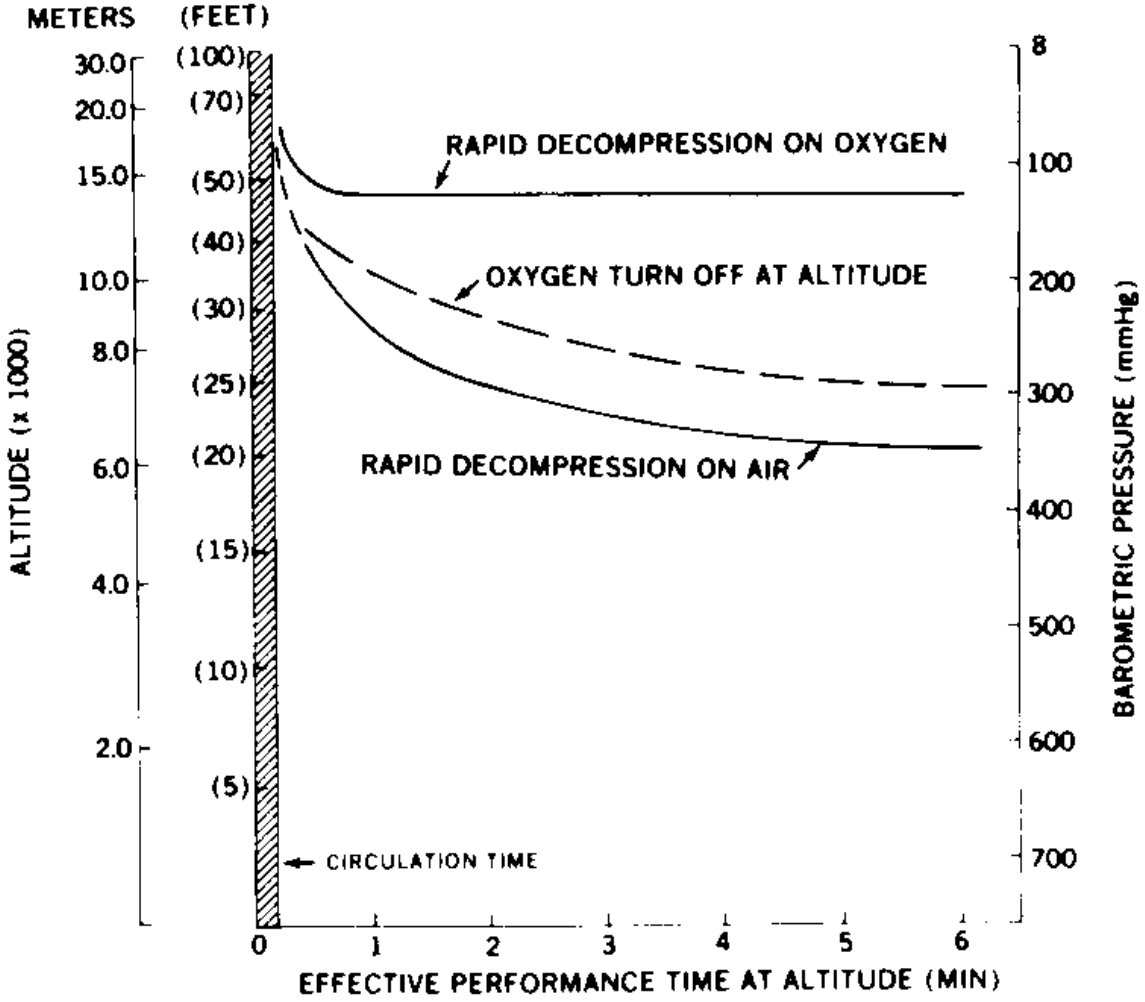
Hypoxia Effective Performance Time



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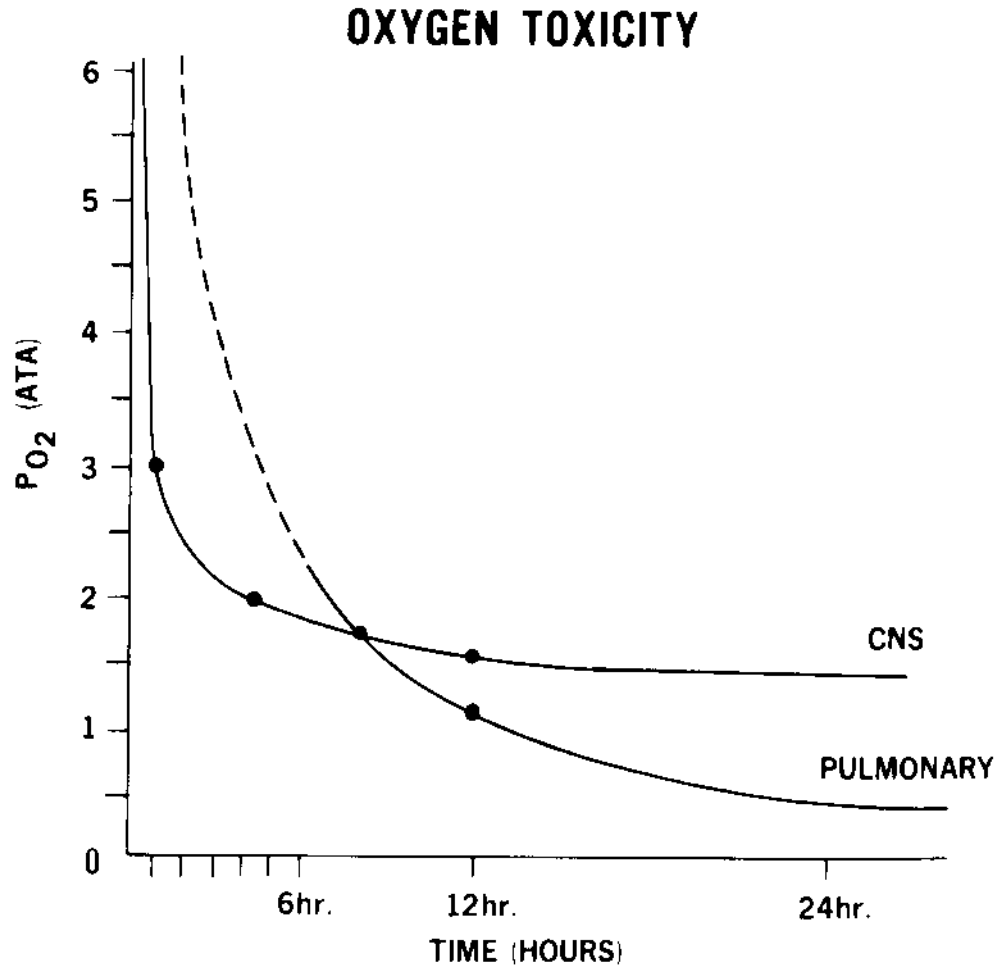
Respiratory Problems

- Hypoxia
  - Hypoxic
  - Hypemic
  - Stagnant
  - Histotoxic
- Hyperoxia
- Hypocapnia
- Hypercapnia

Types of Hypoxia

- Hypoxic (insufficient O_2 present)
  - Decompression
  - Pneumonia
- Hypemic (insufficient blood capacity)
  - Hemorrhage
  - Anemia
- Stagnant (insufficient blood transport)
  - Excessive acceleration
  - Heart failure
- Histotoxic (insufficient tissue absorption)
  - Poisoning

Oxygen Toxicity



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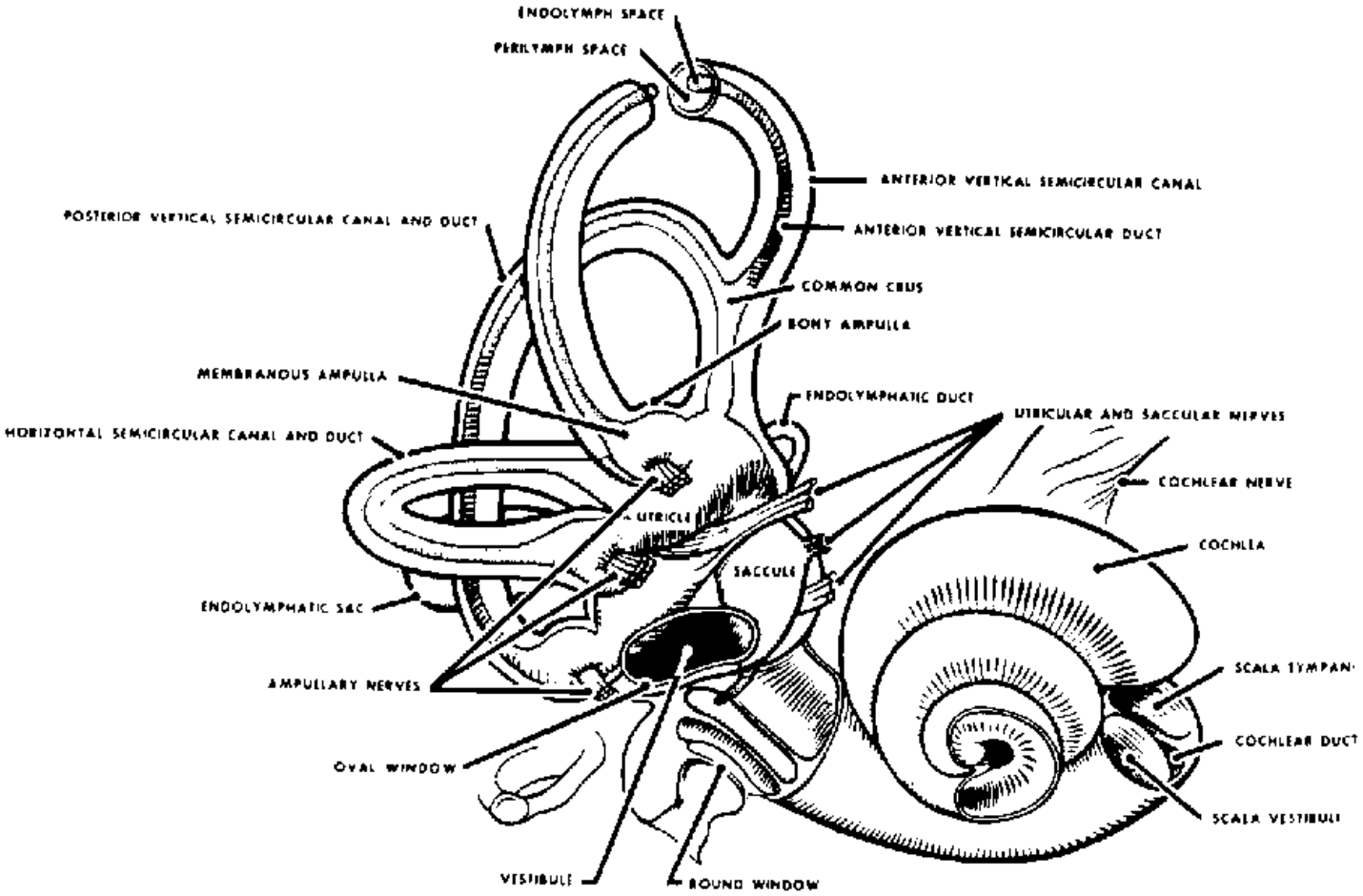
Decompression Sickness

- Release of dissolved gases in blood following pressure drop
- "DCS", "Caisson Disease", "The Bends"
- J. B. S. Haldane modeled DCS as supersaturation of dissolved nitrogen in blood:

$$R = \frac{P_{N_2}}{P_{ambient}} = 0.79\,(nominally)$$

- Experience indicates symptomatic DCS onset at levels of 1.6-1.8

Vestibular System



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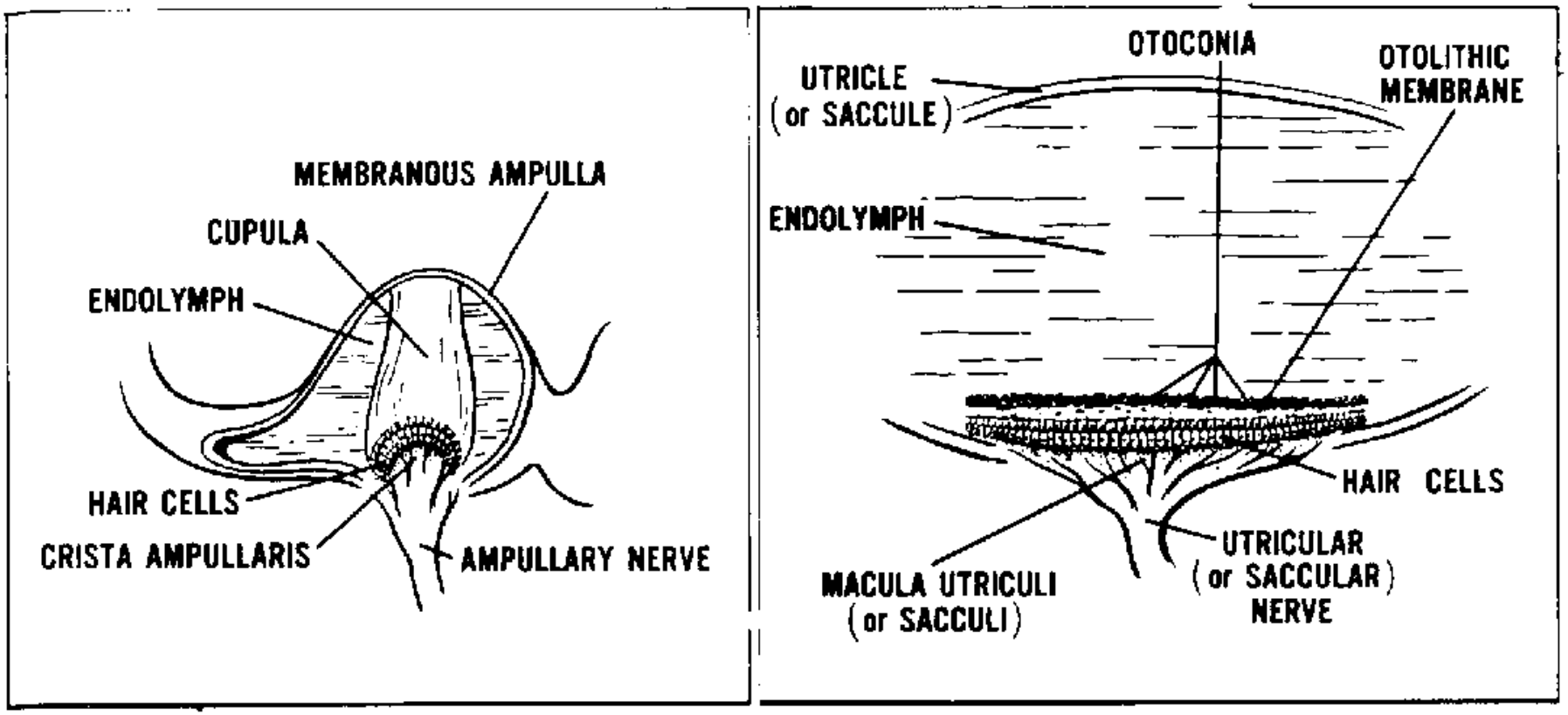
Vestibular Sense Organs



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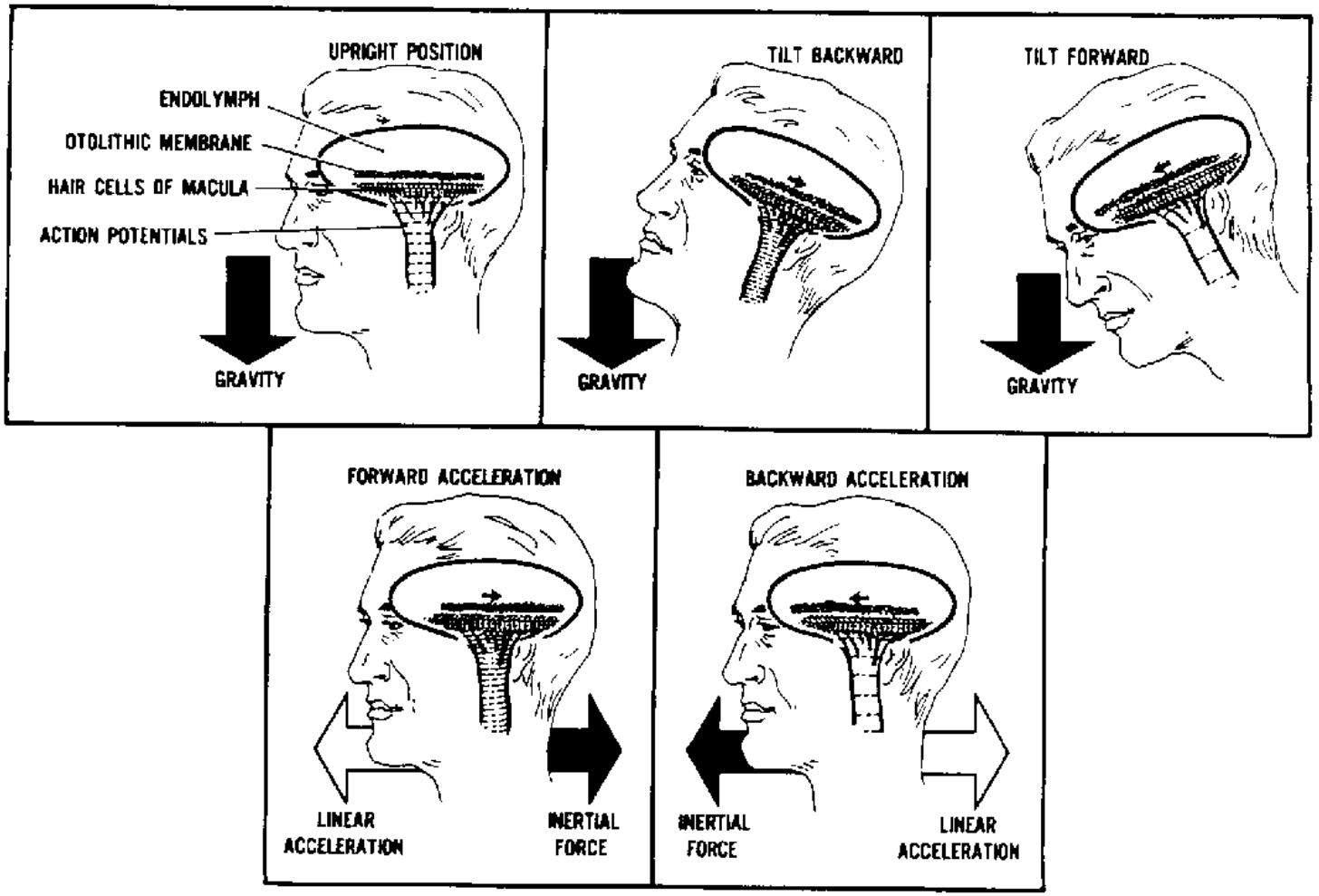
Otolith Responses



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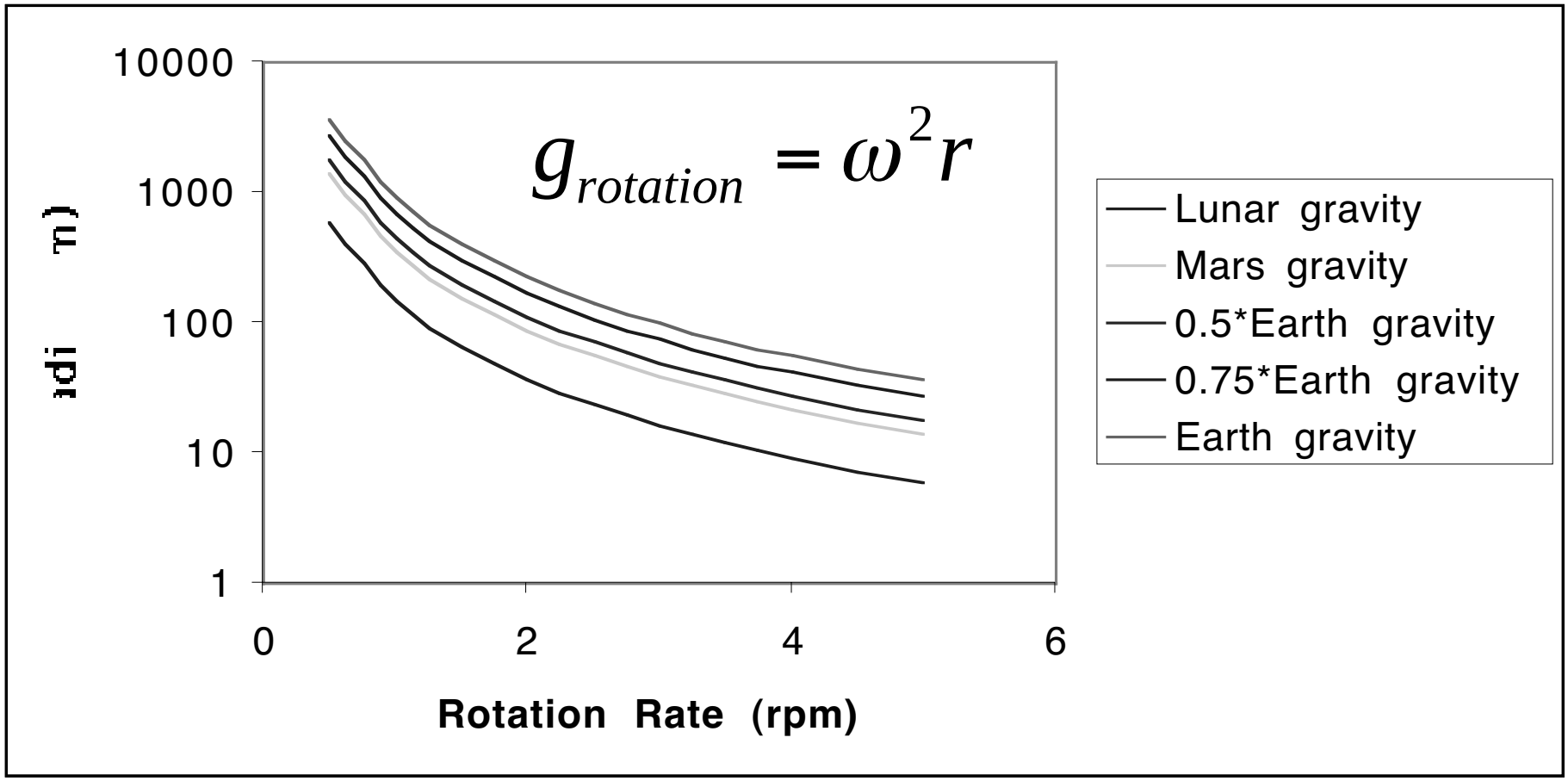
Cardiovascular

- Cardiovascular deconditioning
- Upper body blood pooling
- Changes in blood volume
- Increased calcium content

Artificial Gravity



Allowable Rotation Rates

- Select groups (highly trained, physically fit) can become acclimated to 7 rpm
- 95% of population can tolerate 3 rpm
- Sensitive groups (elderly, young, pregnant women) may have tolerance levels as low as 1 rpm

Short-Term Dose Radiation Effects

- 10-50 rem - minor blood changes
- 50-100 rem
  - 5-10% minor nausea and vomiting
- 100-200 rem
  - 25-50% nausea and vomiting
  - 50% reduction in lymphocytes
- 200-350 rem
  - Nausea, vomiting, diarrhea, minor hemorrhage
  - 75% reduction in all blood cells
  - 5-50% incidence of death

Short-Term Dose Radiation Effects

- 350-550 rem
  - Nausea, vomiting, diarrhea, hemorrhage, emaciation
  - 75% reduction in all blood cells
  - 50-90% mortality within 6 weeks
  - 6 month convalescence
- 550-750 rem
  - Nausea and vomiting within four hours
  - Mortality approaching 100%
- 750-2000 - survival time <2 weeks
- 2000+ - incapacitation within hours