Chapters 12, 13, 14, 15
A review of Anatomy & Physiology concepts

Figure 12.1, page 253
Chapter 12
• Anatomy of Ventilation
  – Trachea, bronchi, bronchioles, alveoli
• Fick’s Law: gas diffuses through a tissue at a rate proportional to surface area and inversely proportional to its thickness.

Inhalation
• Muscles involved
  – Diaphragm: primary ventilatory muscle during exercise

Expiration
• During rest and light exercise, expiration is predominately passive
• During strenuous exercise:
  – Internal intercostals
  – Abdominal muscles assist

Valsalva Maneuver
• Closing the glottis following a full inspiration while maximally activating the expiratory muscles.
  • Causes intra-thoracic pressure.
  • Helps stabilize chest during lifting.
  • Should be temporary!

Figure 12.11, page 266
Chapter 13
Gas Exchange & Transport

Pulmonary Disease
• Gas transfer capacity may be impaired by:
  – Thickening of membrane
  – Reduction in surface area

Oxygen in Solution
• Total blood volume ~5L = 15 mL dissolved O₂
• Hemoglobin ~98% saturated with O₂ under normal conditions

Arteriovenous O₂ Difference
• The a-vO₂ difference shows the amount of O₂ extracted by the tissues
• During exercise, a-vO₂ difference increases up to 3 times the resting value
Chapter 14
Dynamics of Pulmonary Ventilation
Figure 14.1, page 286

Neural Factors
- Medulla – contains respiratory center
- Neurons activate diaphragm and intercostals

- A neural center in the hypothalamus integrates input from descending neurons to influence the duration and intensity of respiratory cycle

Plasma PO$_2$ & Peripheral Chemoreceptors
- Peripheral chemoreceptors are located in aorta and carotid arteries (pg. 287)
- Monitor PO$_2$
- During exercise:
  - PCO$_2$ increases (exhalation)
  - Temperature increases
  - Decreased pH stimulates peripheral chemoreceptors

Integrated Regulation During Exercise
- **Phase I** (beginning of exercise): neurogenic stimuli from cortex increases respiration
- **Phase II**: after about 20 seconds expiration rises exponentially to reach steady state
- **Phase III**: fine tuning of steady-state ventilation through

- Factors influencing ability to sustain a percentage of aerobic capacity without lactate accumulation:
  - Muscle fiber type
  - Capillary density
  - Mitochondria size and number
  - Enzyme concentration

Respiratory Disease
- COPD may triple the O$_2$ cost of breathing at rest
- This severely limits exercise capacity in COPD patients

Chapter 15
The Cardiovascular System

Figure 15.1, page 307

Cardiovascular System Components
- Heart – a pump
- Arteries – distribution system
- Capillaries – exchange vessels
- Veins – collection of return system
Functions of the Heart
(Figure 15.3, pg. 309)

Functions of right side
• Receive blood returning from body
• Pump blood to lungs for gas exchange

Functions of left side
• Receive oxygenated blood from lungs
• Pump blood into systemic circulation

Blood Pressure
• Systole
  – Contraction Phase

• Diastole
  – Relaxation Phase

How to take blood pressures
(page 311)

Hypertension
• Chronically elevated blood pressure >140/90 mmHg
• Imposes a strain on the CV system
• It is a prevalent disorder

BP Response to Exercise
• Resistance Exercise
  – Straining compresses vessels
  – Peripheral resistance increases
  – Blood pressure increases in an attempt to perfuse tissues

Steady-Rate Exercise
• Systolic pressure increases with increases in workload
  – There is a linear relationship between workload and systolic BP

  • Diastolic pressure remains fairly constant

Figure 15.12, page 319
Myocardial Metabolism
• Myocardium has a significantly higher mitochondrial density compared to skeletal muscle
• This allows the heart to utilize:
  – Glucose
  – Fatty acids
  – Lactate
• Endurance exercise training increases the ability to use lactate and fatty acids for fuel
• Decreases reliance on CHO

Chapter 17
Functional Capacity of Cardiovascular System

• Cardiac Output – amount of blood pumped by the heart in a 1-minute period
• Stroke volume – amount of blood pumped in each heart beat

\[
\text{Cardiac Output} = \text{heart rate} \times \text{stroke volume}
\]

\[
(\text{ml min}^{-1})
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• See page 347!