Announcements
HR & BP Lab 4 tomorrow + Required Notebook Check. Include Nutrition Analyses. Q? Exam I? Please read Blood Chemistry Lab 5 twice < Thurs. Thanks!

Cardiovascular System
LS 2012 ch 9, Torstar Books 1984, DC 2013 Module 4, Guyton & Hall (G&H) 2011 +... 
A. Circulatory vs Cardiovascular (CV)? cf + parts 
   CV vs Lymphatic LS pp 229; DC pp 23, 31
B. CV Pulmonary & Systemic circuits 
   DC fig 4-1 p 24, LS fig 9-2b p 231
C. Arteries, capillaries, veins G&H +Torstar
D. Varicose veins? Phlebitis? DC
E. layers, box, chambers, valves, inlets, outlets 
   LS fig 9-4 p 233, fig 9-2a p 231; DC pp 23-6
F. Normal vs abnormal blood flow thru ♥ & CV system 
   Billy has a hole in his ♥ SI Fox 2009 fig 13.16, 13.17
G. Cardiac cycle & heart murmurs?

Aerobic Exercise: Heart & Blood Vessels. Strength? ACSM

Cardiovascular Diseases Intro
LS ch 9 pp 252-7; DC pp 29-30
Cardiovascular (CV) = Heart + Vessels + Blood!
NB: Figure-8 loop

Pulmonary Systemic

(a) Pulmonary circuit
(b) Systemic circuit

Pulmonary arteries
Pulmonary veins
Vena cavae
Aorta and branches
Right ventricle
Left ventricle
Arterioles
Venules
Capillary beds of lungs where gas exchange occurs
Capillary beds of all body tissues where gas exchange occurs
Oxygen-poor, CO₂-rich blood
Oxygen-rich, CO₂-poor blood

D Chiras 2013 fig 4-1b
Dual Pump Action & Parallel Circulation
Lymphatic System

1. Lymph Nodes
2. Vessels
3. Lymph

No pump!

DC 2003
Lymphatic System
Alternative System of Circulation or Drainage System

Lymph Vessels || Veins
Lymphatic System Blockage in Elephantiasis from Mosquito-borne Parasitic Filaria Worm
Lymphatics collect run-off & are parallel to venules/small veins!
Microcirculation Exchange: 10 Billion Capillaries!

No cell > 25-50 μ away from a capillary! Like having bus stops @ every other block!
Harvey
Experiments:
1-way system
of venous
valves!
Skeletal Muscle Pump

Open valve

Closed valve
The Heart
The Living Pump
Human ❤️ = 4-chambered box? 2 separate pumps?

Upper = Atria
Lower = Ventricles

RA  ➔ RV  ➔ LA  ➔ LV

Pulmonary  SYSTEMIC

Primer Pumps
Power Pumps
Aorta
Superior vena cava
Pulmonary valve
Pulmonary veins
Left atrium
Left AV valve
Aortic valve
Chordae tendineae
Papillary muscle
Left ventricle
Right atrium
Right AV valve
Right ventricle
Inferior vena cava
Septum

(a) Location of the heart valves in a longitudinal section of the heart
Heart Valves Ensure Unidirectional Blood Flow!

Mom's valve!

Right AV valve
Left AV valve
Aortic or pulmonary valve

(b) Heart valves in closed position, viewed from above

Right atrium
Right AV valve
Direction of backflow of blood
Chordae tendineae
Septum
Right ventricle
Papillary muscle

(c) Prevention of eversion of AV valves

**FIGURE 9-4** Heart valves.
Human ❤ = 4 unique valves?

2 valve sets?

**Semilunar** = *Half-moon shaped*

1. Pulmonic/Pulmonary
2. Aortic

**AV** = *Atrioventricular*

3. 🔄 AV = Tricuspid
4. 🟠 AV = Mitral/Bicuspid
Heart Valve Orientation & Scaffolding

- Pulmonary ring
- Aortic ring
- Mitral ring
- Tricuspid ring
- Muscle fiber
FIGURE 9-6
Mitral and aortic valves.
Cardiac Cycle

**Systole**
- Contract
- & Empty

**Diastole**
- Relax
- & Fill
Veins → Atria → Ventricles → Arteries

https://www.nhlbi.nih.gov/health-topics/how-heart-works
https://www.youtube.com/watch?v=zJXAlh9VDDU
Foramen ovale!

Patent or still open!
Patent or still open! Ductus arteriosus!
Heart Murmurs? An unusual or extra heart sound lub-dup, lub-dup vs lub-gurgle-dup, lub-swish-dup…

S1 = lub

S2 = dup

https://www.thinklabs.com/heart-sounds
Time-out for Questions!

+ Brief Break!
How much aerobic?

Continuous exercise

≥ 50% muscle mass

≥ Conversational pace

20-60 min/session

3-5 days/wk


Guidelines: Healthy Adults < 65 yr

Do moderately intense aerobic exercise
30 min/d, 5 d/wk

OR

Do vigorously intense aerobic exercise
20 min/d, 3 d/wk

AND

Do 8-10 strength-training exercises
8-12 repetitions/each exercise, 2 d/wk
How much strength?

- 2-3 days/wk
- 8-10 exercises for major muscle groups
- ≥ 1 set/exercise
- 8-12 (most) or 10-15 (frail/> 50-60 yr) repetitions/set
Did you know?

- Every 40 seconds, someone has a heart attack in the US!
- ~630,000 Americans die of heart disease each yr – that’s 1 in every 4 deaths. Heart disease is the leading cause of death for both men and women.
- Heart disease costs the US ~ $200 billion per yr in health care, medications & lost productivity. By 2035, CVD costs are projected to top $1 trillion annually.

Heart Disease Death Rates, 2011-2013
Adults, Ages 35+, by County

Rates are spatially smoothed to enhance the stability of rates in counties with small populations.

Data Source: National Vital Statistics System
National Center for Health Statistics

https://www.cdc.gov/dhdsp/data_statistics/fact_sheets/fs_heart_disease.htm
Coronary Circulation ≡ Crowns the Heart!
**FIGURE 9-35**

Extent of myocardial damage as a function of the size of the occluded vessel.
59 yr HTN ♀
Treatment Triad

- Exercise
- Dietary Modification
- Drugs/Surgery

NB: Last blasted resort!!
WOW!  SUPER 😊  ~ TOP 5 - 10 ~

EXCELLENT!!  ~ TOP 15 ~

GREAT EFFORT  ~ TOP 20 - 25 ~