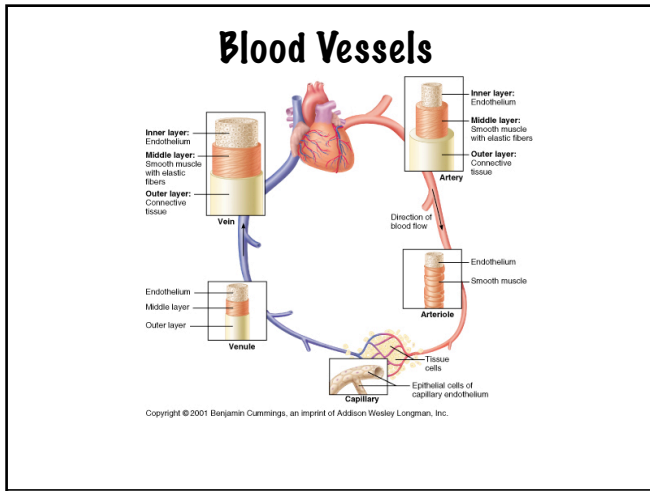


19 Blood Vessels



Overview

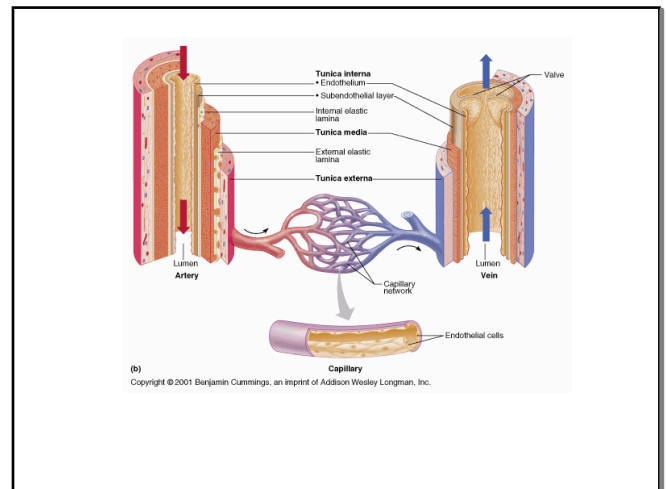
- 3 types of blood vessels
 - arteries - carry blood away from heart
"branch", "diverge", and "fork"
 - veins - carry blood toward heart
"join", "merge", and "converge"
 - capillaries - site of gas exchange
- arteries → arterioles → capillaries → venules → veins
- almost all arteries carry oxygen-rich blood
EXCEPTION: pulmonary artery (oxygen-poor blood)
- almost all veins carry oxygen-poor blood
EXCEPTION: pulmonary veins (oxygen-rich blood)

We have about 60,000 miles of blood vessels!

The diagram shows two human figures. The left figure is colored red and represents the systemic circulation, where oxygenated blood is carried away from the heart. The right figure is colored blue and represents the pulmonary circulation, where deoxygenated blood is carried toward the heart.

Structure of Blood Vessel Walls

- lumen - blood-containing space
- tunica interna (innermost)
 - simple squamous epithelium
 - minimizes friction as blood flows through lumen
- tunica media (middle)
 - smooth muscle
 - responsible for vasodilation and vasoconstriction
 - influences blood flow and blood pressure
 - thicker in arteries
- tunica externa (outermost)
 - collagen and elastin fibers, nerves, and blood vessels
 - protects and reinforces blood vessels, and anchors it to surrounding tissue



1 Vasodilation and vasoconstriction are caused by smooth muscle in the

- A lumen
- B tunica interna
- C tunica media
- D tunica externa

2 All arteries carry oxygenated blood away from the heart.

True

False

19 Blood Vessels

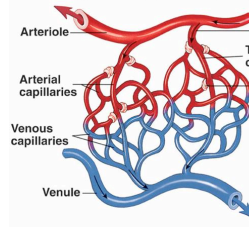
Arteries

- elastic (conducting)
 - aorta and its branches
 - large diameter (1-2.5 cm)
 - high in elastin
 - serve as pressure reservoirs
- muscular (distributing)
 - most of the named arteries
 - 1 cm (little finger) to 0.3 mm (pencil lead) in diameter
 - deliver blood to specific body organs
 - thick tunica media
- arterioles
 - smallest arteries (0.3 mm to 10 micrometers)
 - lead to capillary beds
 - determine blood flow to tissues

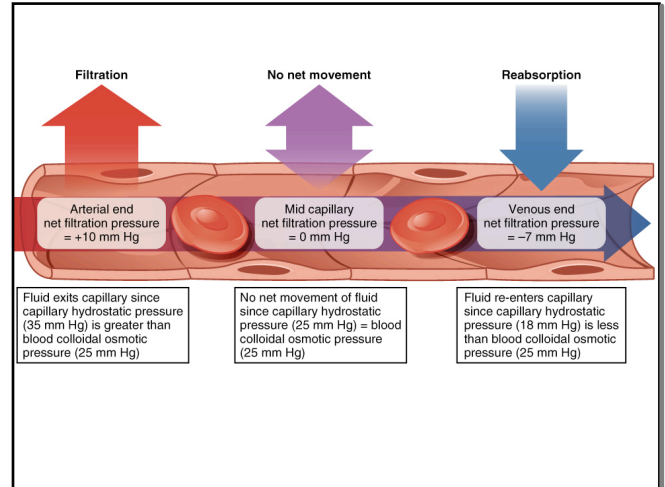
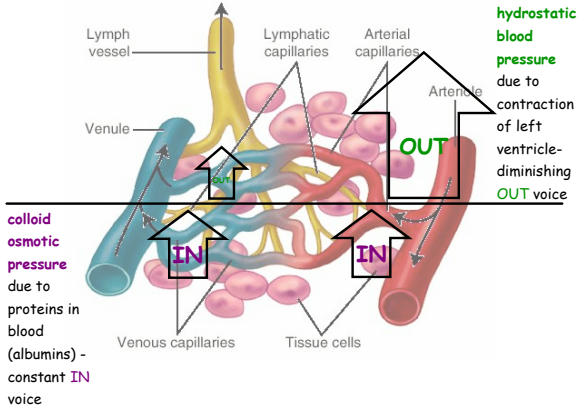


Capillaries

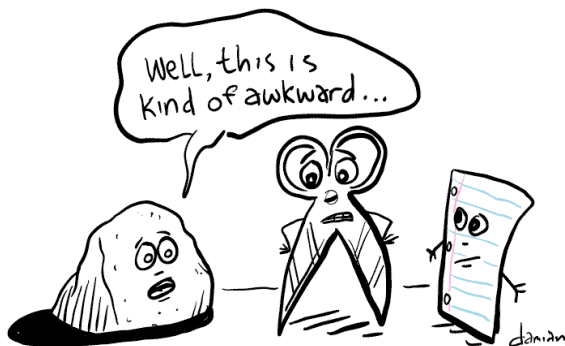
- consist only of tunica interna
 - just big enough for RBCs to pass through in single file
 - site of material exchange
 - capillary beds - interweaving network of capillaries (10-100)
 - connect arterioles to venules
- blood flow controlled by a precapillary sphincter allows blood to be rerouted during different activities



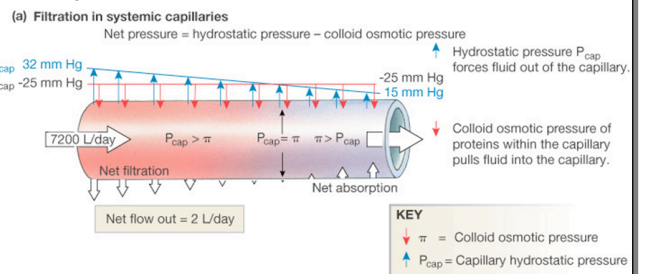
HOW DO CAPILLARIES EXCHANGE NUTRIENTS/WASTES?



BEST 2 OUT OF 3



WINNER...WHAT IS THE "IN" VOICE? HOW DOES IT CHANGE? NONWINNER...WHAT IS THE "OUT" VOICE? HOW DOES IT CHANGE?



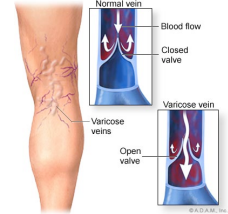
19 Blood Vessels

3 MATA: Fluid moves out of capillaries when the ___ is greater than the ___.

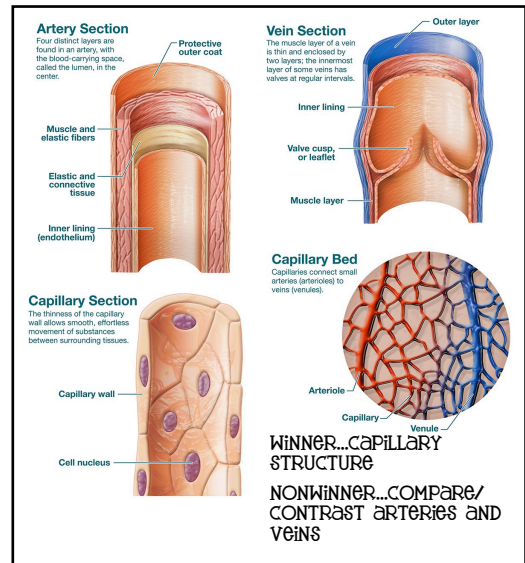
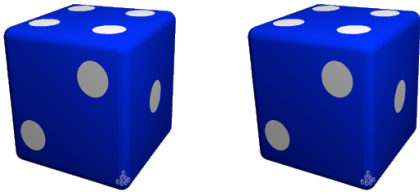
- A out voice, in voice
- B invoice, out voice
- C hydrostatic pressure, osmotic pressure
- D osmotic pressure, hydrostatic pressure

Venous System

- venules - small veins
- veins
 - thinner walls, but bigger lumens than arteries
 - serve as blood reservoirs (up to 65% of body's blood at any given time)
 - blood pressure low
 - rely on valves and skeletal muscle contraction to return blood to the heart
- varicose veins
 - weak and leaky valves cause blood to pool
 - ex. spider veins and hemorrhoids



Feeling lucky?...choose ODD OR EVEN



4 ___ are the site of nutrient exchange.

5 ___ have a larger lumen, but ___ have a thicker tunica media.

- A Veins, arteries
- B Veins, capillaries
- C Arteries, veins
- D Arteries, capillaries

19 Blood Vessels

Some Definitions

- blood flow - volume of blood flowing through a vessel, organ, or the entire circulation in a given time period (mL/min)
- blood pressure (BP) - force of blood against a blood vessel wall (mm Hg)
 - refers to systemic arterial BP (BP in major arteries near heart)
- peripheral resistance - opposition to flow
 - measures the amount of friction blood encounters as it passes through vessels
 - depends on...
 - blood viscosity - thickness or stickiness of blood (increase viscosity, increase resistance)
 - total blood vessel length - longer vessels have greater resistance
 - blood vessel diameter - smaller vessels have greater resistance (varies inversely with fourth power of the radius - $1/r^4$)

How are Flow, Blood Pressure, & Resistance Related?

$$F = \frac{\Delta P}{R}$$

- F = blood flow
 ΔP = difference in blood pressure between two points
R = peripheral resistance
- F is directly proportional to ΔP
 - when ΔP increases, blood flow speeds up (steep slide)
 - when ΔP decreases, blood flow slows down (shallow slide)
 - F is inversely proportional to R
 - when R increases, blood flow decreases
 - when R decreases, blood flow increases
 - R is more important than ΔP in determining blood flow (diameter constantly changes)

6 All of the following increase resistance EXCEPT

- A longer blood vessels
- B thick blood
- C vasodilation
- D small diameter

7 Blood flow depends on resistance and pressure differences.

- True
- False

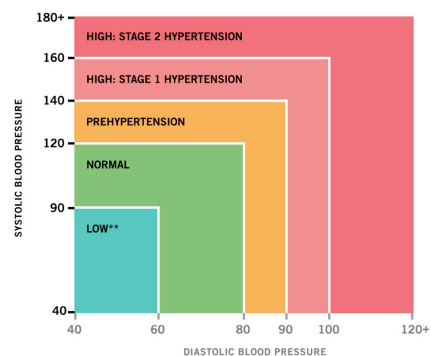
Blood Pressure

- a pressure gradient keeps blood flowing from higher (aorta) to lower (R atria) blood pressure
- measure arterial blood pressure
 - the pressure blood exerts against artery walls when the left ventricle contracts
 - systolic pressure = 120 mm Hg in healthy adults
 - arterial wall expand to accommodate blood
 - diastolic pressure = 80 mm Hg in healthy adults
 - arterial walls recoil in preparation for more blood
- BP is measured using a sphygmomanometer



Blood Pressure Chart*

vertex42



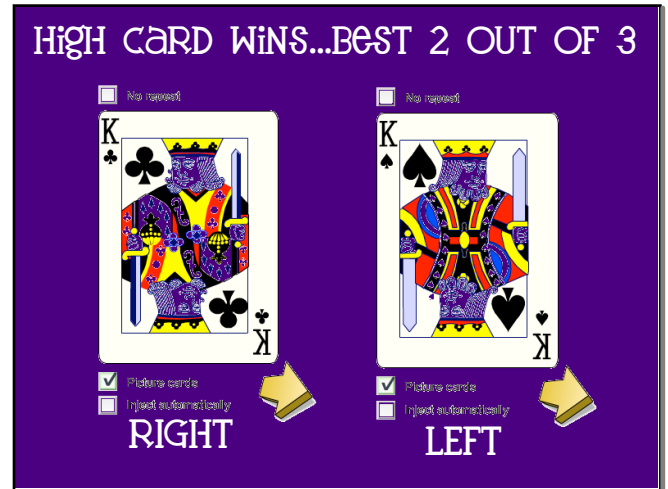
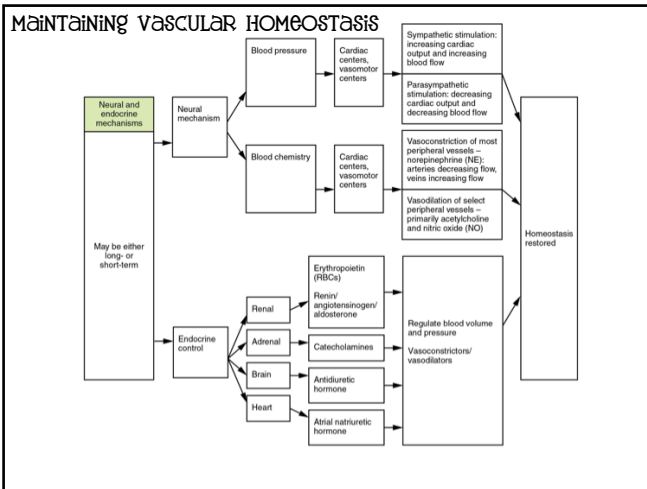
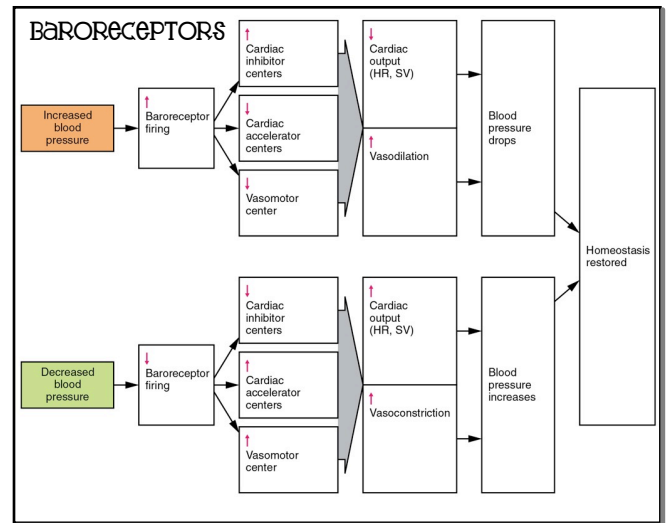
* The data used in this chart come from the "Seventh report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure" (<http://www.nhlbi.nih.gov/guidelines/hypertension/>).

** In general, having lower than normal (<20/90) blood pressure is a good thing, but you should consult your doctor or caregiver if you feel your blood pressure is too low and/or you are experiencing symptoms of [hypotension](#).

19 Blood Vessels

Maintaining Blood Pressure

- factors that influence BP
 - cardiac output, peripheral resistance, and blood volume
- requires coordinated effort of brain, heart, blood vessels, and kidneys
- neural control of BP - short term
 - vasomotor center (medulla) - controls cardiac output and blood vessel diameter
 - baroreceptor-initiated reflexes - respond to stretch and cause vasodilation (lowers BP)
 - chemoreceptor-initiated reflexes - respond to increases in carbon dioxide and cause vasoconstriction (increase BP)
- kidney control of BP - long term
 - maintain BP homeostasis by regulating blood volume
 - too much fluid, BP rises
 - too little fluid, BP drops



WINNER...WHAT IS BLOOD PRESSURE?

Normal Blood Pressure

The pressure of blood in the vessels when the heart beats: **systolic pressure**

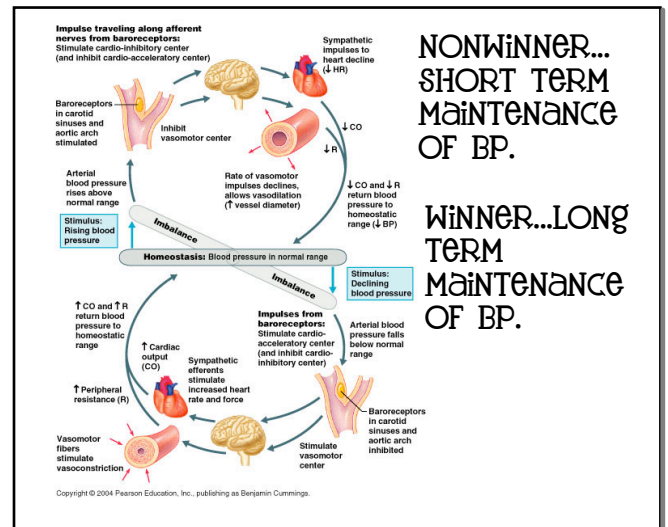
The pressure between beats when the heart relaxes: **diastolic pressure**

less than **120/80** mmHg

millimeters of mercury

- High blood pressure:** 140/90 mmHg or higher
- Prehypertension:** between 120-139 mmHg and/or 80-89 mmHg
- Normal blood pressure:** less than 120/80 mmHg

NONWINNER...HOW IS IT MEASURED?



19 Blood Vessels

8 MATA: Blood pressure

- A measures systolic over diastolic pressure
- B is normal at 120/80 mm Hg
- C is a sign of cardiovascular health
- D measures the pressure of blood against an artery wall

9 MATA: Blood pressure is maintained by the

- A brain
- B heart
- C blood vessels
- D kidneys