Objectives

- ***Identify Systolic BP***
- ***Identify Diastolic BP***
- ***Identify Resistance***
- ***Identify Velocity and Flow***
- ***Identify Cross- Sectional area***
- ***Identify Perfusion pressure***

Resistance

- *How to relate TPR to blood pressure*
- $F = \Delta P/R$ Ohm's Law
- $CO = \Delta P/TPR$
- $R = 8nl/\pi r4$ $Poiseuille's\ law$
- $n\ \alpha\ R$
- $n =\ viscosity$

Polycythemia (high Hct)$\alpha\ n$ *; a lot of friction between the layers, because whenever blood is flowing it flows in layers when there is a lot of friction rubbing up against between those layers because increase in viscosity and slow the flow down*

Anemia $\frac{1}{\alpha} n$

$L\ \alpha\ R$

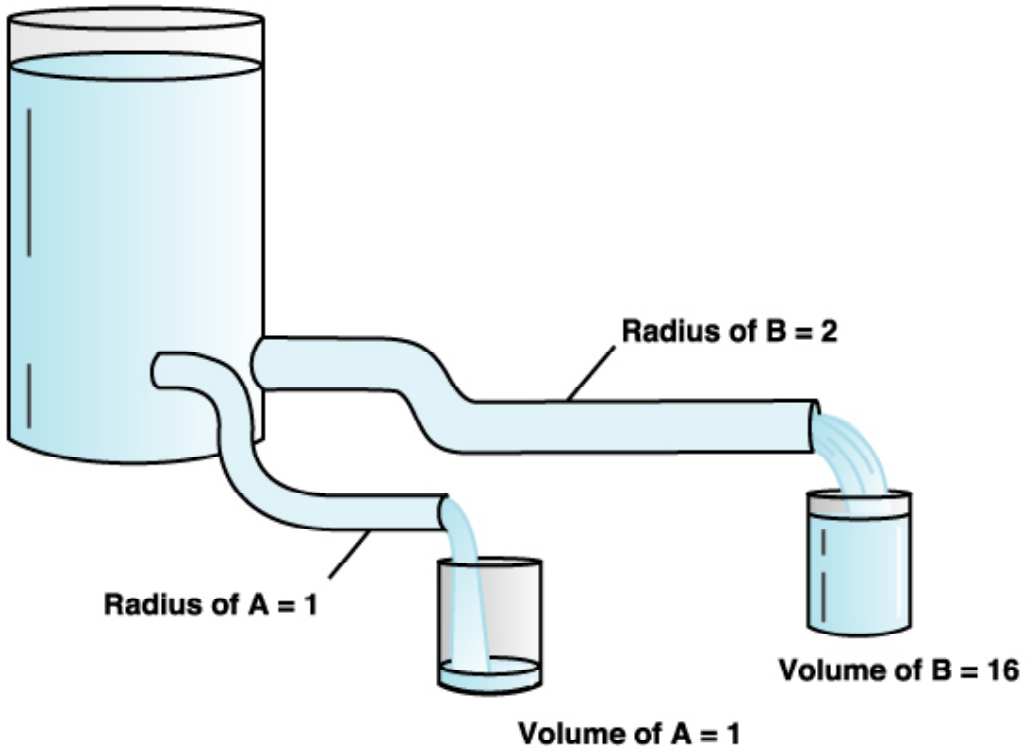
Increase in Weight and height increases in L

$r = 1/\alpha\ R$ the most important factor that affecting the R because it is raised to power 4

Vasodilation increase in r

Vasoconstriction decrease in r

Effect of radius on resistance and blood flow



Resistance ~ $\frac{1}{\text{radius}^4}$	
Tube A	Tube B
R ~ $\frac{1}{1^4}$	R ~ $\frac{1}{2^4}$
R ~ 1	R ~ $\frac{1}{16}$

Flow ~ $\frac{1}{\text{resistance}}$	
Tube A	Tube B
Flow ~ $\frac{1}{1}$	Flow ~ $\frac{1}{\frac{1}{16}}$
Flow ~ 1	Flow ~ 16

Blood pressure

❖Blood pressure =cardiac output X total peripheral resistance

- $\boldsymbol{BP = CO\ X\ TPR}$

First, we want to decide what CO and TPR is , then we get to the right meaning of BP

❖Cardiac output (Flow)= Heart rate X Stroke volume

$\boldsymbol{CO\ (F) = HR\ X\ SV}$

ml/min= Beat/min X ml/ Beat

Cardia out put

- **HR**
- PSNS -
- SNS +
- Hormones (EPI, NE) +
- IONS: Ca++, Na+ , K+ dependents on their level increase or decrease

SV

+ Preload ; Increase the blood volume returns increase diastolic volume

+ Contractility ; SNS (EPI,NE+), Hormones (glucagon,T3 and T4), IONS like Ca++

- Afterload; Hypertension, Atherosclerotic plaques , TPR

❖Anther formula relate to CO

- 1 ml= 1 Cm3
- Flow = Cm3/min

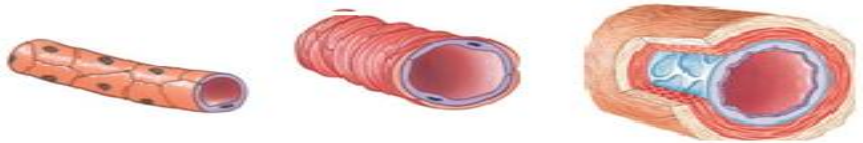
❖Anther formula relate to flow

- Velocity (Cm/min)= Flow (cm3/min)
  Cross sectional area (Cm2)
- **V= F/A**

❖How to relate this to cardiac output

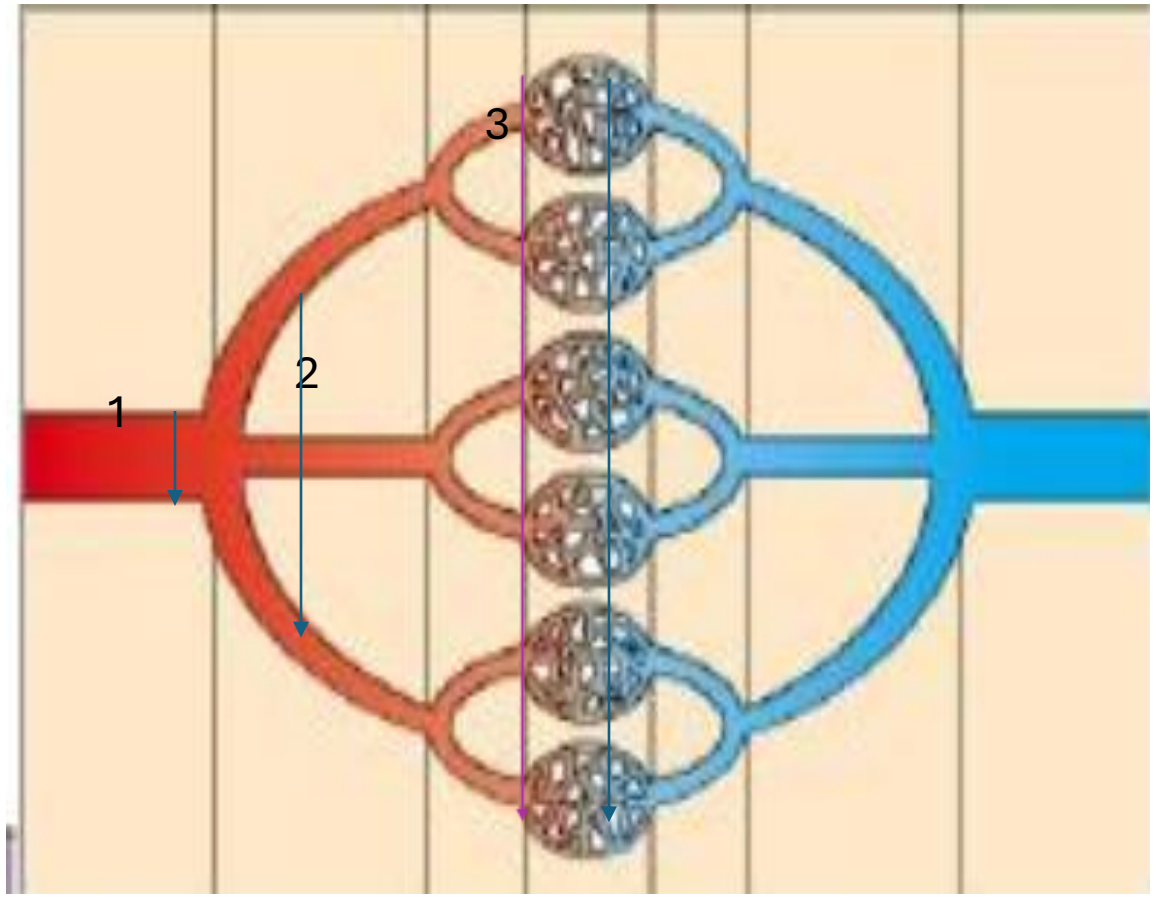
- Increase Flow (CO) Increase V
- Cross sectional area; measured in units of bier square because the blood vessels are cylinder in shape

A (πr2); Increase A Decrease V



Continued Cross – sectional area and velocity

- *This big one here is aorta (1) then the aorta splits it gives off arteries (2) then arterial branches (3) and then capillary branches ten to hundred per capillary bed (4) and after drain from the capillary bed then they go to what called venules (5) and from the venules they come eventually into the veins (6) and again to vena cava system*
- *compare the cross sectional are the capillary and cross-sectional area aorta and velocity*
- *As you increase the cross-sectional area the velocity decrease*
- *The velocity is the slowest in the capillaries and faster in the aorta*



“Conductance” of blood in a vessel and Its relation to resistance

Conductance (C_L) is a measure of the blood flow through a vessel for a given pressure difference. .

$$C = \frac{\Delta V}{\Delta P}$$

This is generally expressed in terms of milliliters per second per millimeter of mercury pressure, but it can also be expressed in terms of liters per second per millimeter of mercury or in any other units of blood flow and pressure.

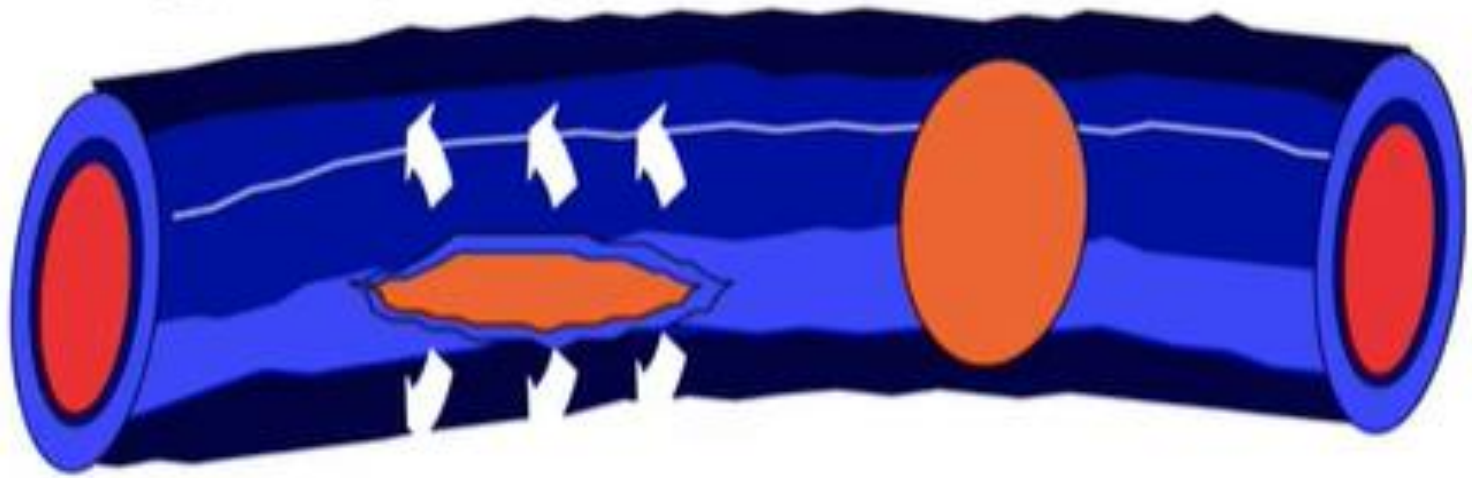
It is evident that conductance is the exact reciprocal of resistance in accord with the following equation:

Conductance= 1/Resistance

The vascular compliance is proportional to the vascular distensibility and vascular volume of any given segment of the circulation. The compliance of a systemic vein is 24 times that of its corresponding artery because it is about 8 times as distensible, and it has a volume about 3 times as great.

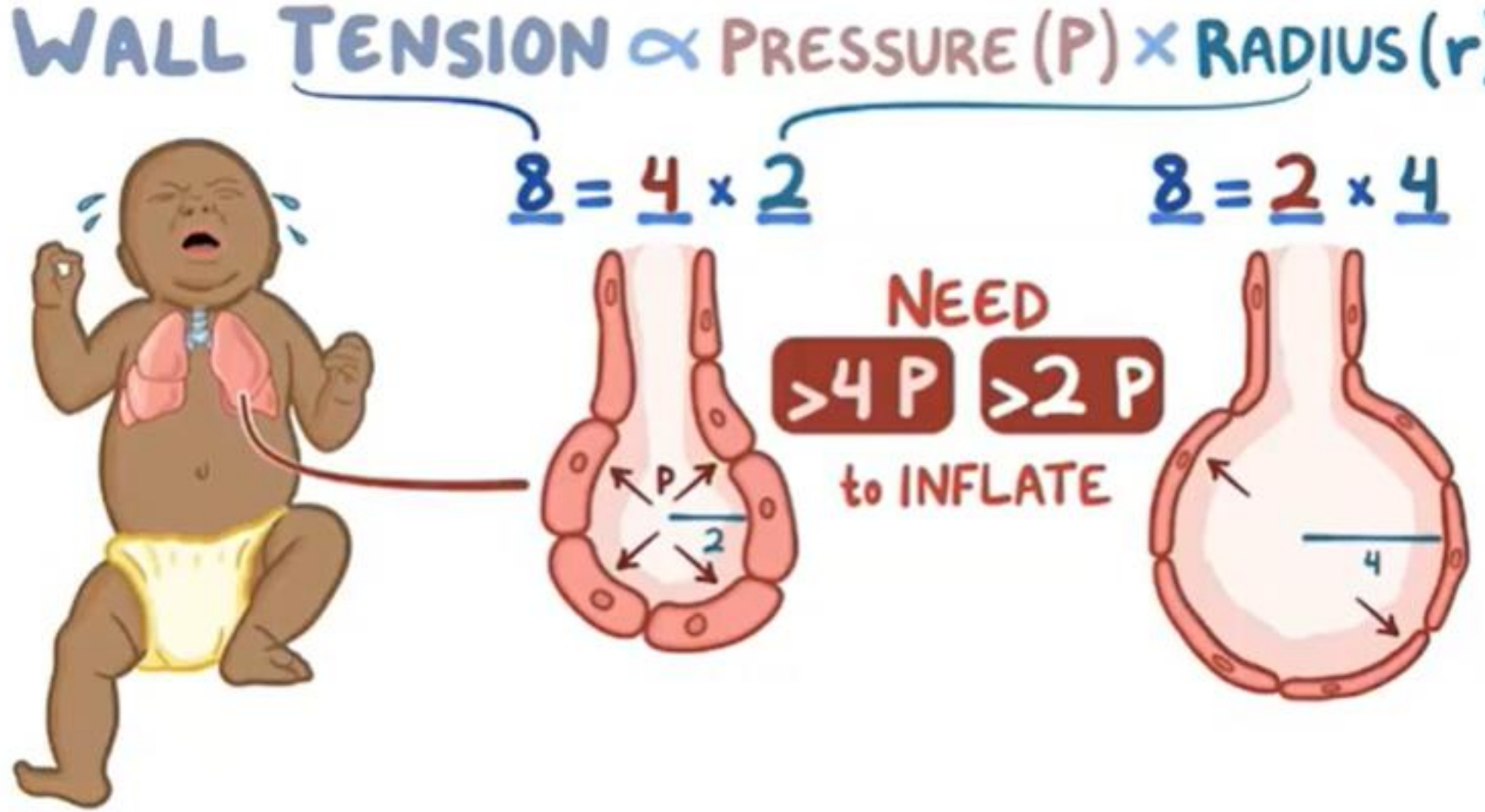
Blood flow and Laplace's law

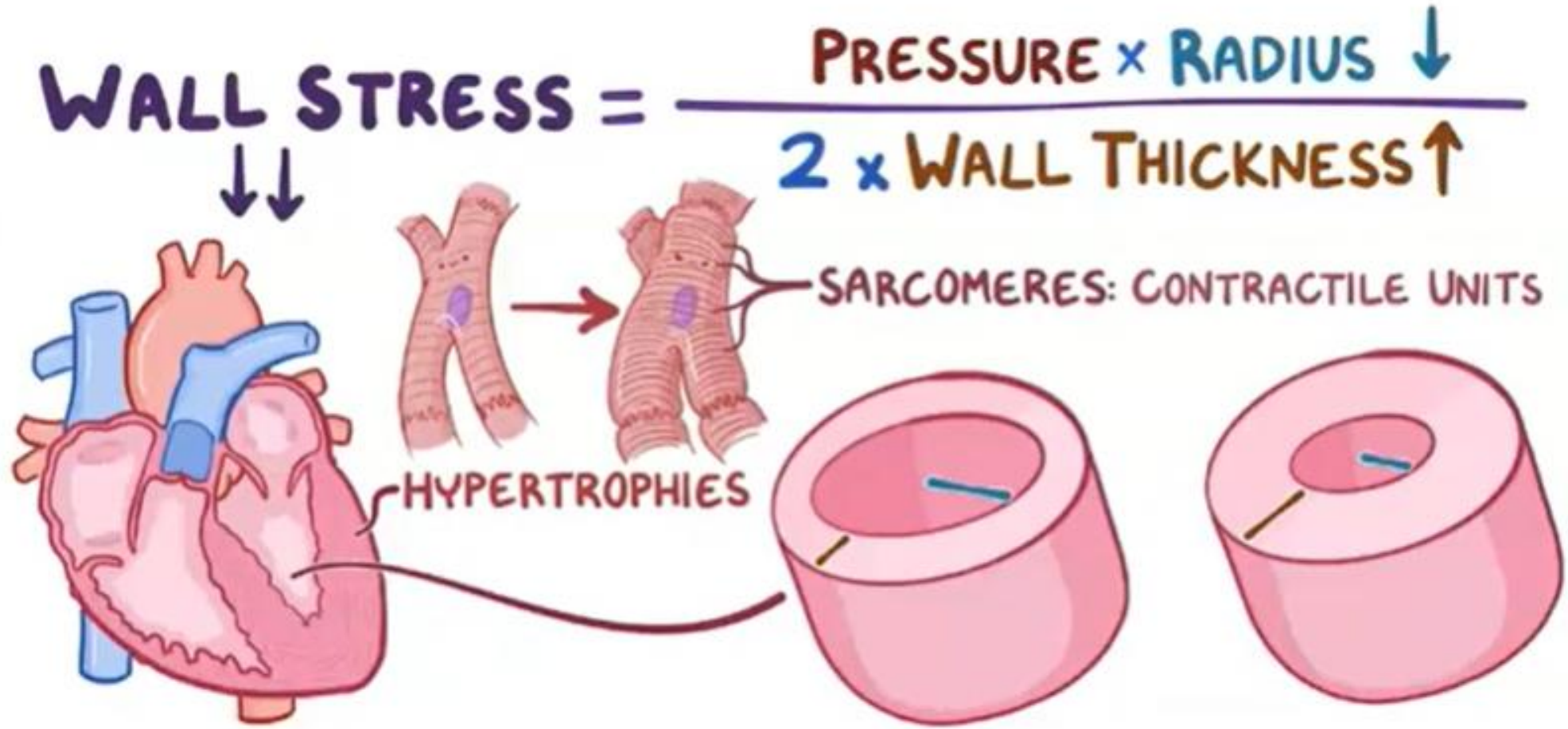
TENSION = PRESSURE X RADIUS
(dynes/cm) (dynes/cm^2) (cm)



↑ PRESSURE → ↑ TENSION → ↓ RADIUS
(to maintain tension constant)

↓ PRESSURE → ↓ TENSION → ↑ RADIUS
(to maintain tension constant)


WALL TENSION ∝ PRESSURE (P) × RADIUS (r)
8 = 4 × 2
8 = 2 × 4
P
2
NEED
>4 P
>2 P
to INFLATE
4


WALL STRESS =
PRESSURE × RADIUS ↓
2 × WALL THICKNESS ↑
↓↓
SARCOMERES: CONTRACTILE UNITS
HYPERTROPHIES