

ANATOMY FOR YOGA TEACHERS

with Lucy Bond



ANATOMY FOR YOGA TEACHERS

Friday 26/6

- The spine
- The circulatory system

Skeletons hint - think yoga poses for most



THE SPINE

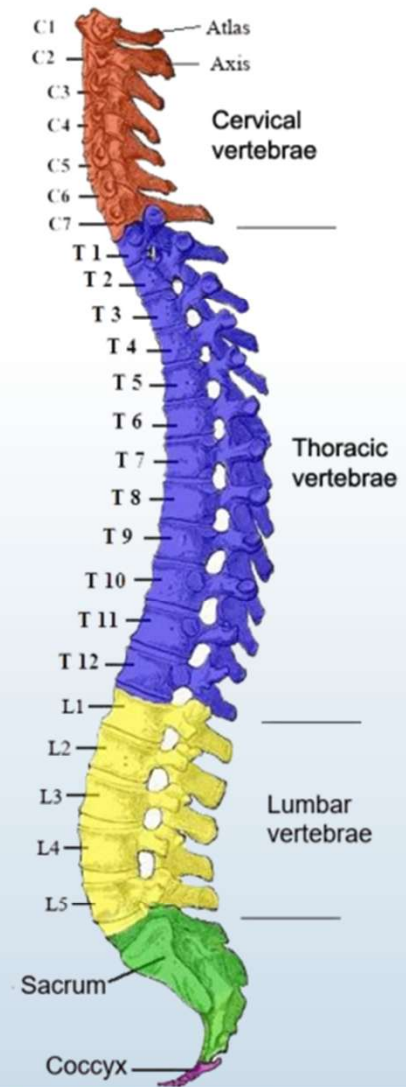


FUNCTIONS OF THE SPINE

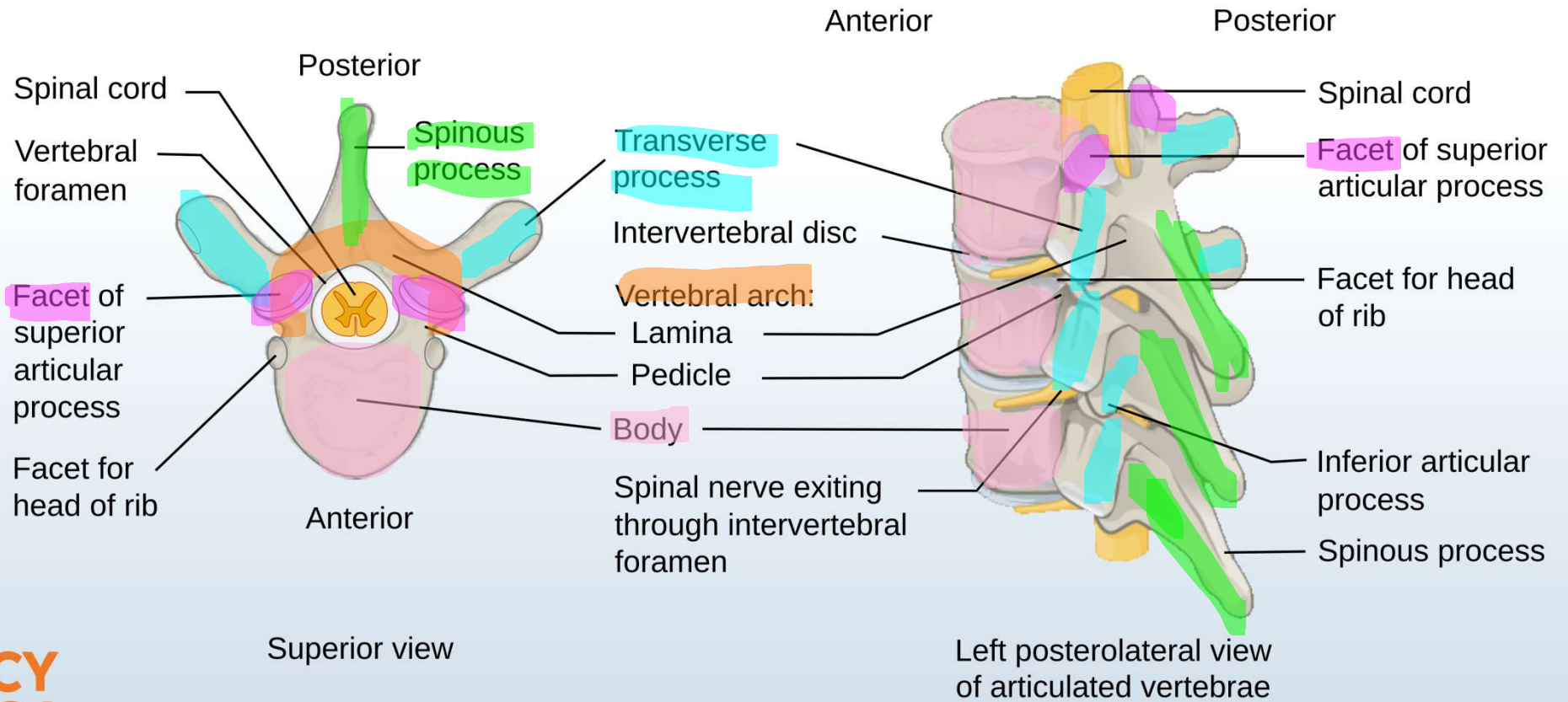
“the skeletal spine is perhaps nature’s most elegant and intricate solution to the dual demands of sthira and sukha”

Leslie Kaminoff





RWhitwam(https://commons.wikimedia.org/wiki/File:Vertebral_column.png), <https://creativecommons.org/licenses/by-sa/4.0/legalcode>





RML Mehrotra Pathology Pvt. Ltd.

16 January · 🌐



Feeling sad? Your Vertebra C6 is smiling for you.

Anatomy has its own way of cheering us up — even your bones are working hard every day to support you.

Because sometimes, science has a sense of humour too.

At RML Pathology, we believe understanding the body can be fascinating and fun.

Committed to Diagnostic Excellence

[MedicalHumour, AnatomyFun, PathologyLife, RMLPathology, HealthWithHumour, Diagnostics]

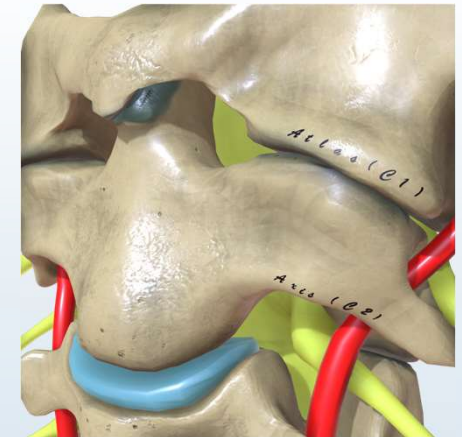
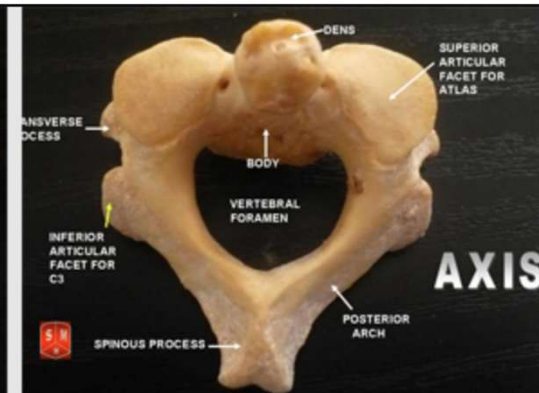
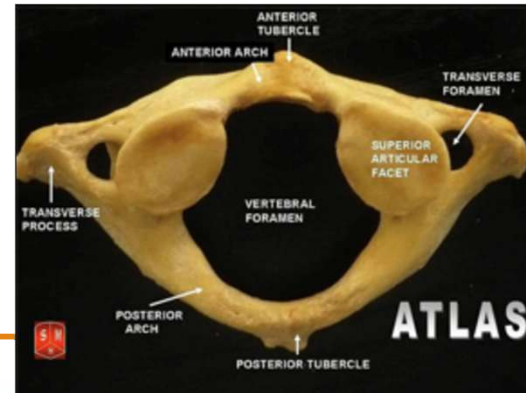


When you're **feeling sad**, remember this **Vertebra C6**
and how **happy** it is to **support you every day**



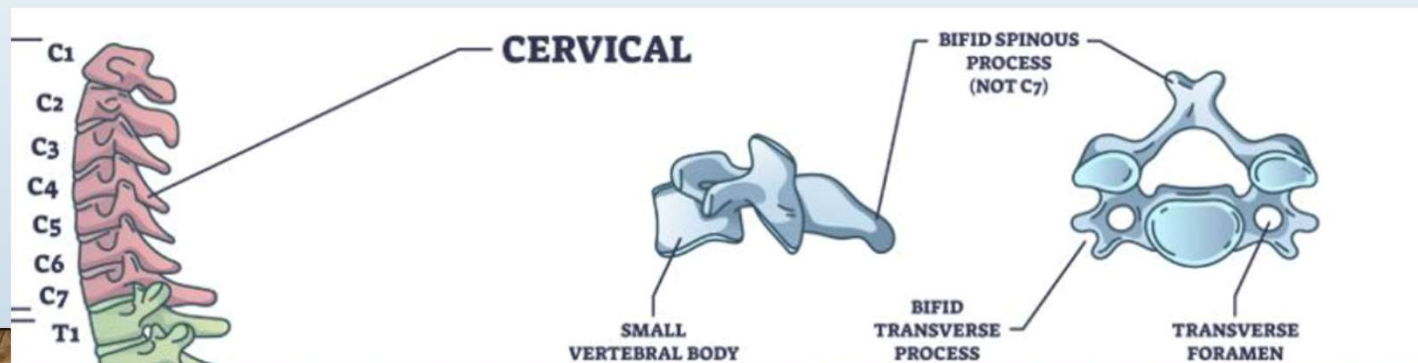
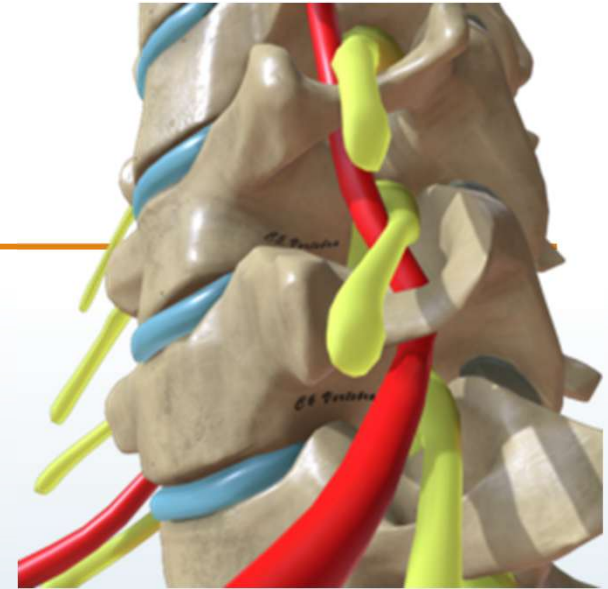
CERVICAL SPINE

- 7 vertebrae that lie in the region of the neck
 - every mammal has 7 cervical vertebrae, including the giraffe!
 - human variation here is rare
- C1 is located just below the skull and is called the atlas.
 - the atlas has no vertebral body or spinous process.
 - it is essentially a bony ring that articulates with the skull
 - 50% of the flexion and extension range in the cervical region occurs between C1 and the skull
- C2 is called the axis – it has structure called the dens projecting upwards
 - the atlas and the axis articulate to form a pivot joint
 - 50% of the rotational range in the cervical region takes place between C1 and C2
- There is no intervertebral disc between C1 and C2 - suggests these vertebrae are not designed to bear weight greater than the head or absorb shock... Headstand is an arm balance!



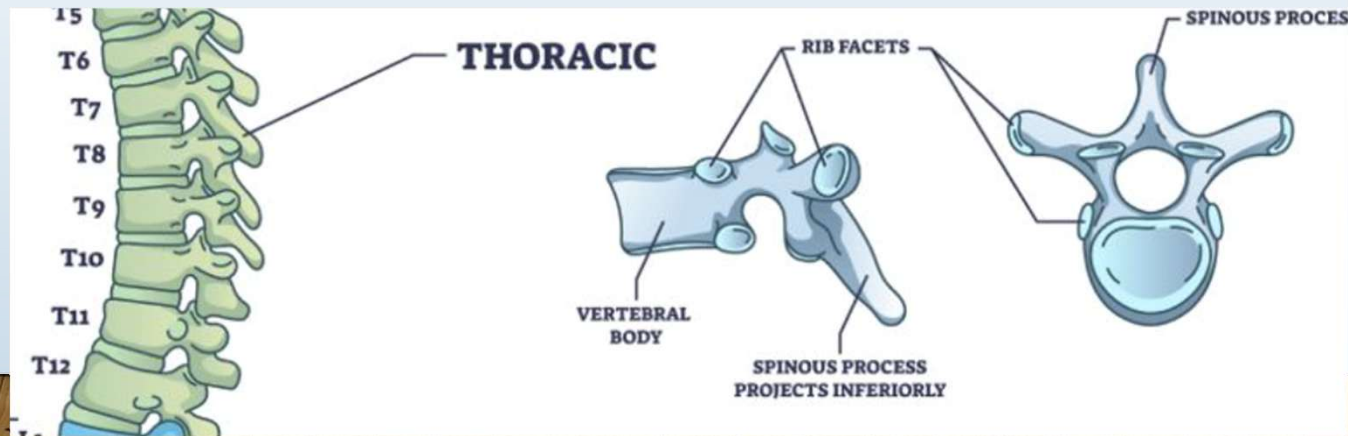
CERVICAL SPINE

- C3 – C7 have small vertebral bodies, thinner discs and short spinous processes
- These characteristics give the cervical spine the greatest range of movement
- The range of movement of the cervical spine is
 - 90° rotation
 - 70° extension
 - 80° flexion
 - 30° lateral flexion.



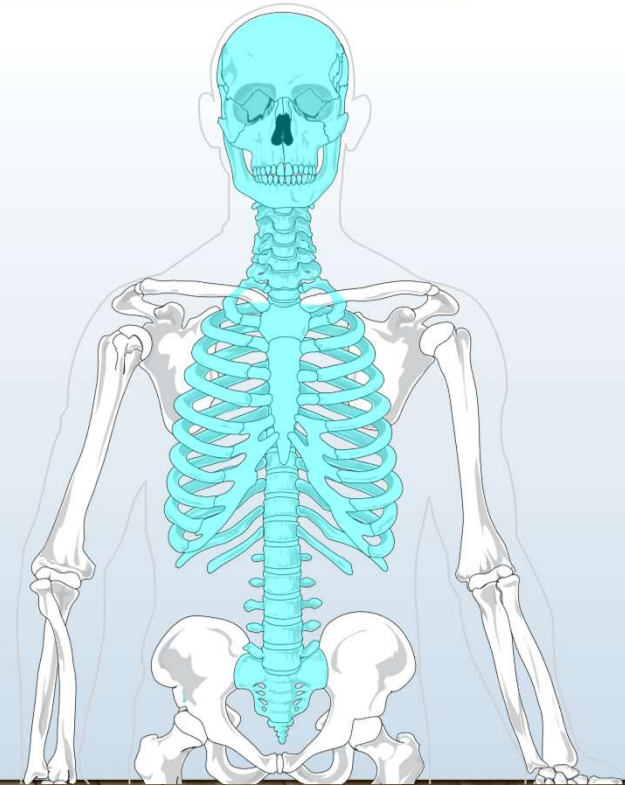
THORACIC SPINE

- an average of 12 vertebrae that articulate with the ribcage.
- thicker intervertebral discs than cervical, thin discs compared to the lumbar region
- long spinous processes limit the mobility of the thoracic spine, particularly in extension
- the orientation of the facet joints allows for a fairly large degree of rotation
- Overall range of movement for the thoracic spine
 - 35° rotation
 - 45° flexion
 - 30° extension
 - 20° lateral flexion.



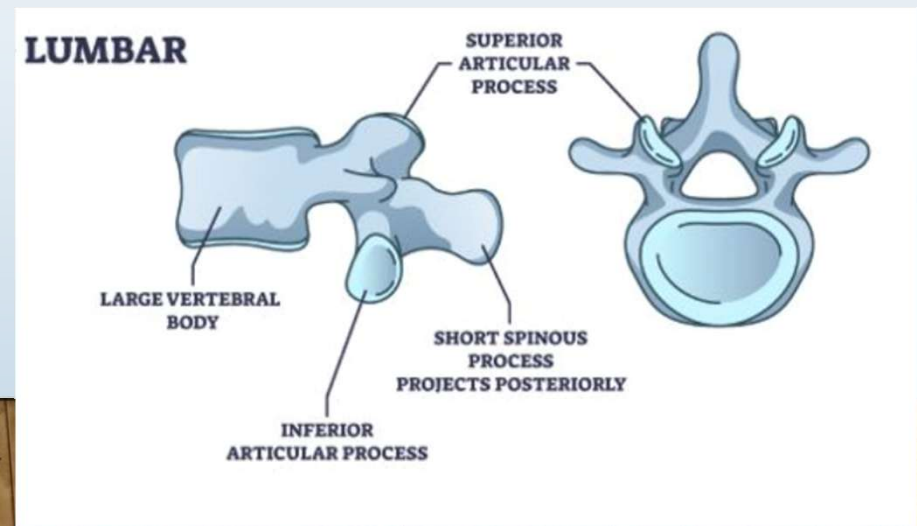
THORACIC SPINE

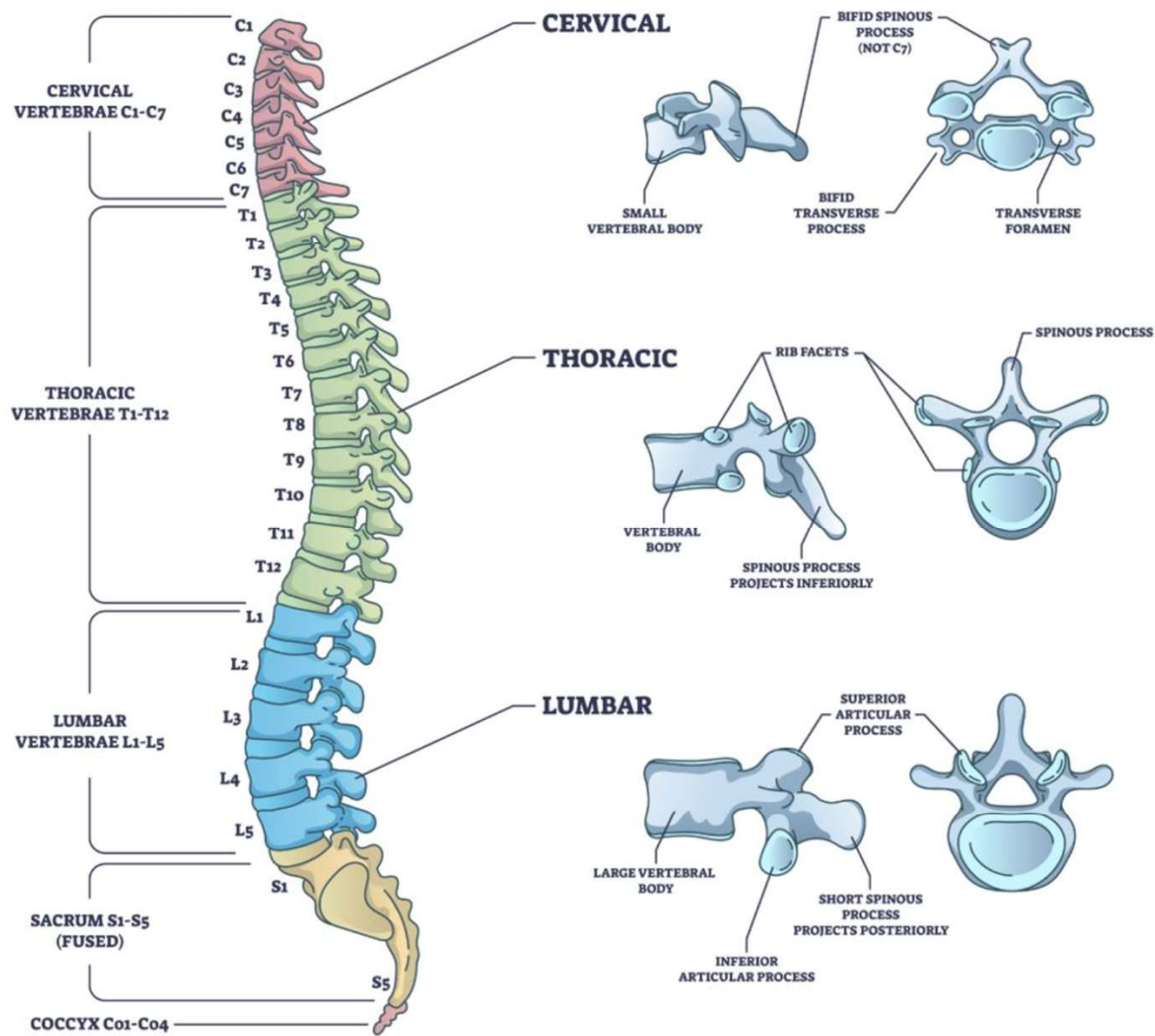
- T1 – T7 are connected to the “true ribs” which articulate directly with the sternum
- T8 – T10 are connected to the “false ribs” which only attach to the cartilage of rib 7 - their mobility is therefore greater
- T11 – T12 are connected to the “floating ribs” which have no anterior attachment. These vertebrae therefore have the greatest mobility of all the thoracic vertebrae



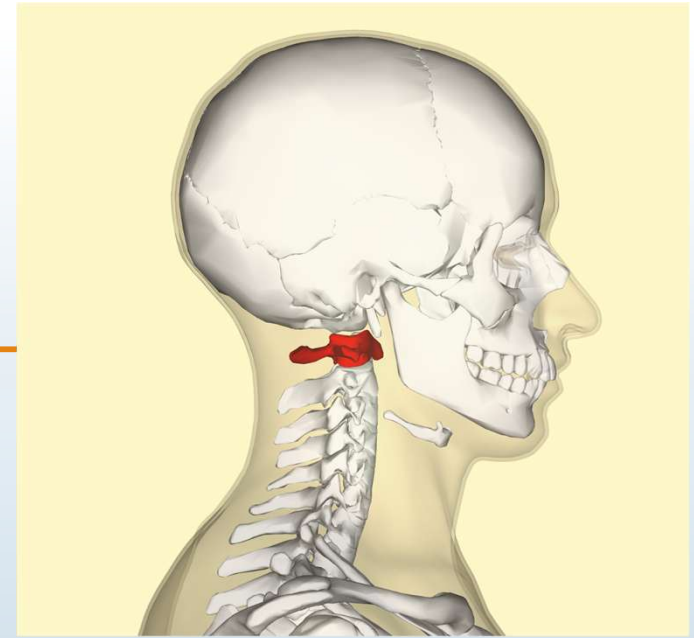
LUMBAR SPINE

- an average of 5 vertebrae that lie between the pelvis and the ribcage
- concave with wedge shaped intervertebral discs, giving a natural “lumbar lordosis” shape
- this part of the spine supports much of our body weight
 - vertebrae are big with large bodies
 - thick intervertebral discs
- shape and the orientation of the superior and inferior facets allow:
 - for 60° flexion,
 - 35° extension,
 - 20° lateral flexion
 - only 5° rotation





MOVEMENT EXPLORATION 😊

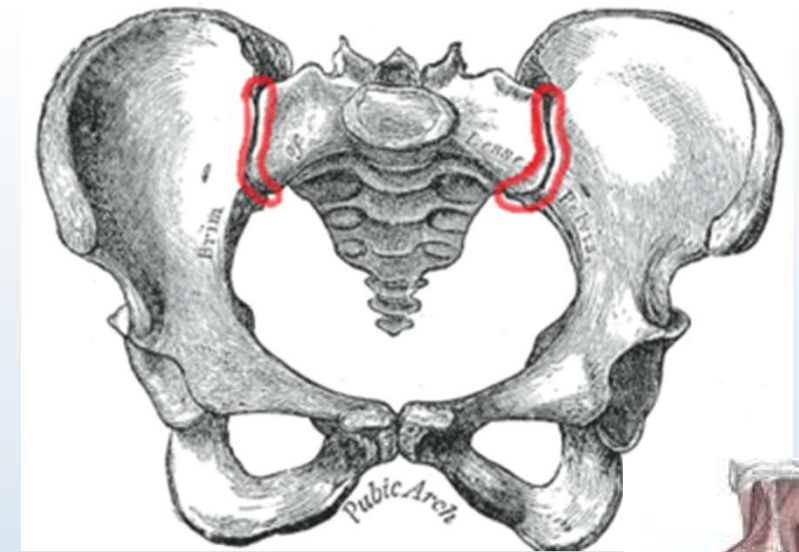


PROTECTING THE SACROILIAC JOINT DURING ROTATION

Remember, the SI joint is a joint of stability not mobility... what does that mean?

To maintain this stability:

1. move the pelvis as one unit – let the hip move back with the sacrum as an extension of the lumbar spine
2. avoid using external force in twists (if the arm is braced/bound then the lats should be for stability rather than driving the rotation)



MAJOR MUSCLES INVOLVED IN SPINAL MOVEMENT

1. Sagittal plane

Abdominal muscles (RA, IO and EO) cause **flexion**

Erector spinae cause **extension** (and resist flexion e,g, from carried weight) – often heavily assisted by gravity

2. Frontal plane

Lateral flexion is achieved by one sided contraction of obliques (I & E) and QL

3. Transverse plane

Axial **rotation** primarily achieved by coordination of opposite internal and external obliques, assisted by deep rotatores

Note: all spinal movement is assisted and stabilized by the deep spinal muscles attached to transverse and spinous processes

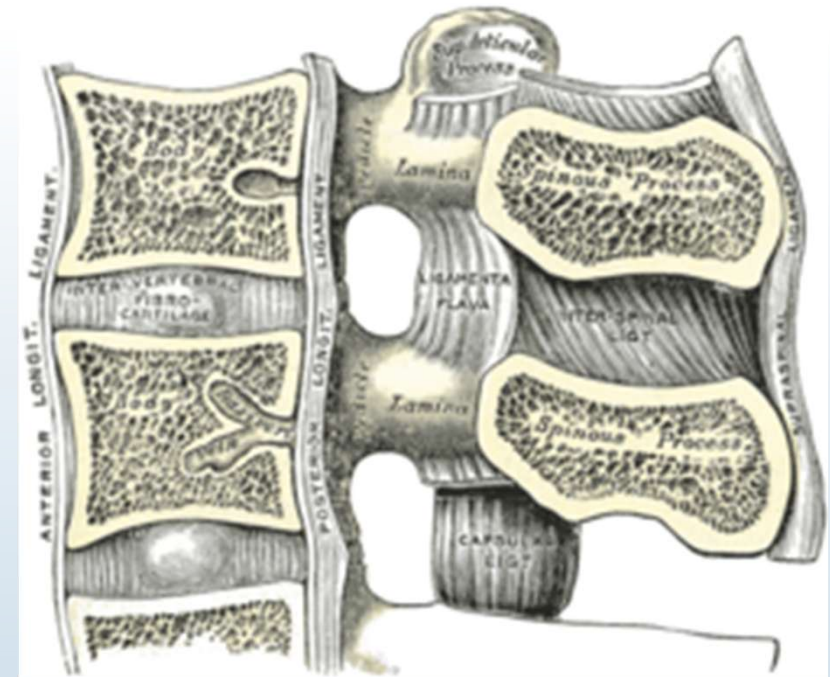


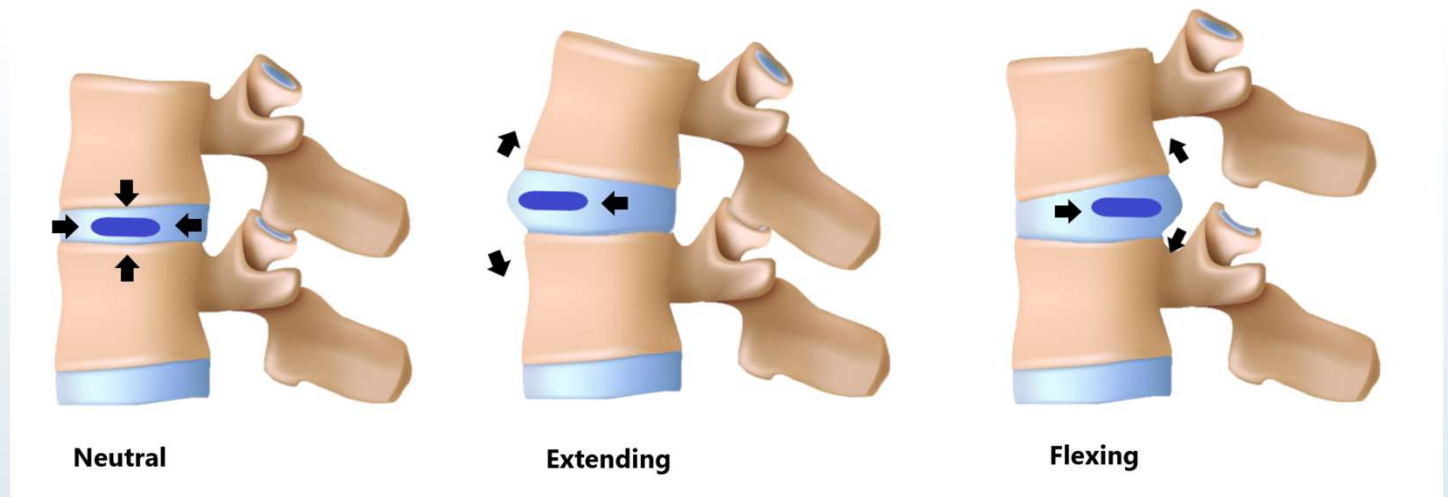
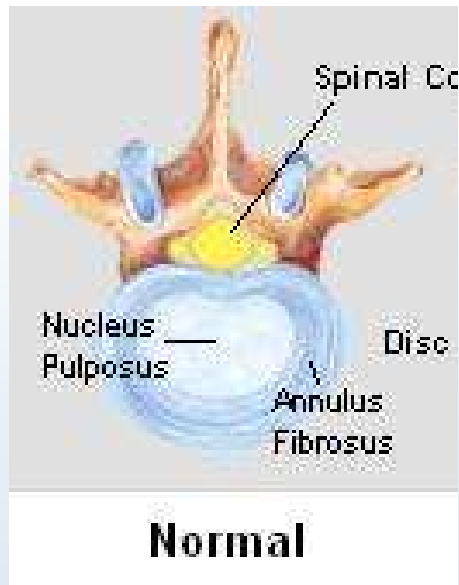
LIGAMENTS LIMIT SPINAL MOVEMENT

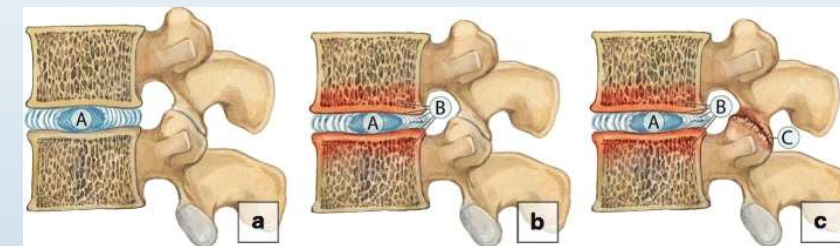
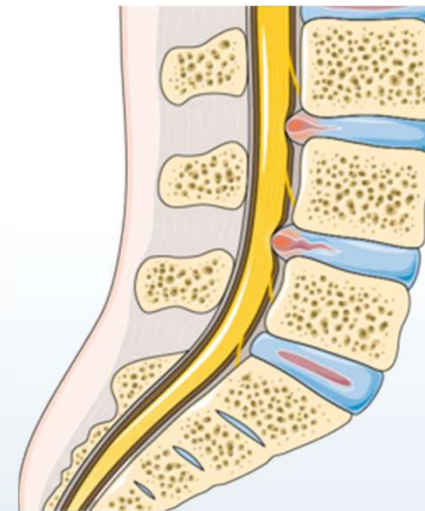
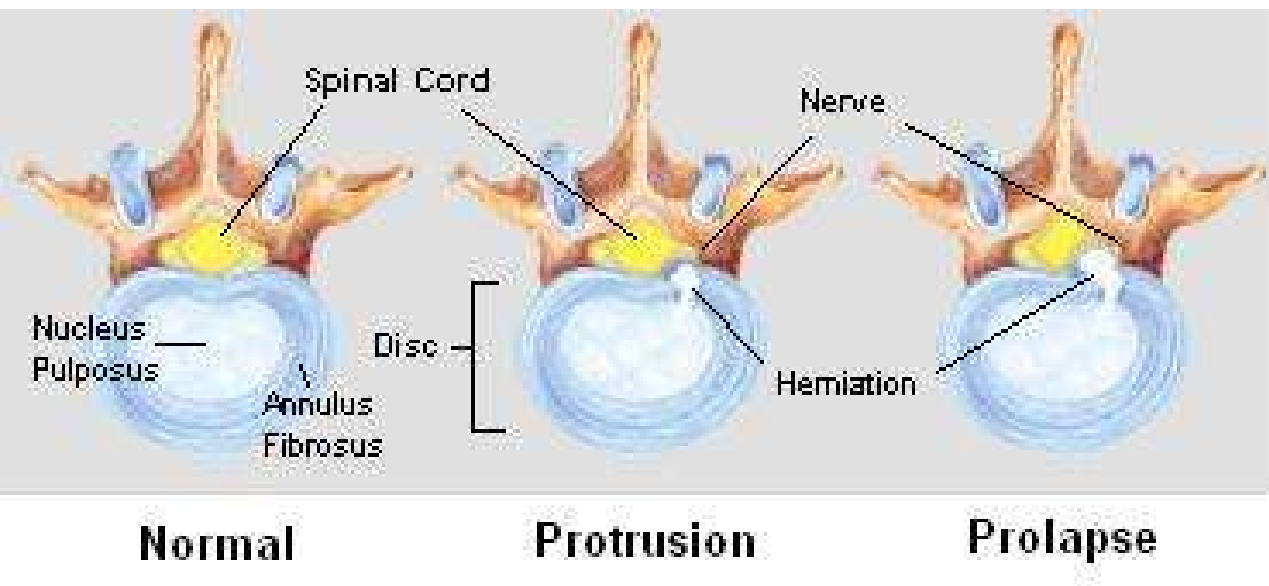
There are three ligaments that run the length of the spinal column:

1. The anterior longitudinal ligament limits extension. It is attached to the front of the vertebral bodies.
2. The posterior longitudinal ligament limits flexion and is attached to the back of the vertebral bodies.
3. The supraspinous ligament runs along the tips of the spinous processes and also limits flexion.

There are also individual ligaments connecting each vertebra to its adjacent vertebra.







⌘ Systematic Literature Review of Imaging Features of Spinal Degeneration in Asymptomatic Populations

W. Brinjikji, P.H. Luetmer, B. Comstock, B.W. Bresnahan, L.E. Chen, R.A. Deyo, S. Halabi, J.A. Turner, A.L. Avins, K. James, J.T. Wald, D.F. Kallmes and J.G. Jarvik

RESULTS: Thirty-three articles reporting imaging findings for 3110 asymptomatic individuals met our study inclusion criteria. The prevalence of disk degeneration in asymptomatic individuals increased from 37% of 20-year-old individuals to 96% of 80-year-old individuals. Disk bulge prevalence increased from 30% of those 20 years of age to 84% of those 80 years of age. Disk protrusion prevalence increased from 29% of those 20 years of age to 43% of those 80 years of age. The prevalence of annular fissure increased from 19% of those 20 years of age to 29% of those 80 years of age.

CONCLUSIONS: Imaging findings of spine degeneration are present in high proportions of asymptomatic individuals, increasing with age. Many imaging-based degenerative features are likely part of normal aging and unassociated with pain. These imaging findings must be interpreted in the context of the patient's clinical condition.

Interestingly, disc degeneration does not necessarily cause pain!

MRI Findings of Disc Degeneration are More Prevalent in Adults with Low Back Pain than in Asymptomatic Controls: A Systematic Review and Meta-Analysis

W Brinjikji ¹, F E Diehn ², J G Jarvik ³, C M Carr ², D F Kallmes ², M H Murad ⁴, P H Luetmer ²

Affiliations + expand
PMID: 26359154 PMCID: [PMC7964277](#) DOI: [10.3174/ajnr.A4498](#)

Abstract

Background and purpose: Imaging features of spine degeneration are common in symptomatic and asymptomatic individuals. We compared the prevalence of MR imaging features of lumbar spine degeneration in adults 50 years of age and younger with and without self-reported low back pain.

Conclusions: Meta-analysis demonstrates that MR imaging evidence of disc bulge, degeneration, extrusion, protrusion, Modic 1 changes, and spondylolysis are more prevalent in adults 50 years of age or younger with back pain compared with asymptomatic individuals.

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Serial case reporting yoga for idiopathic and degenerative scoliosis

Loren M Fishman ¹, Erik J Groessl ², Karen J Sherman ³

Affiliations + expand

PMID: 25568820 PMCID: [PMC4268609](#) DOI: [10.7453/gahmj.2013.064](#) [↗](#)

Results: The mean self-reported practice of the yoga pose was 1.5 minutes per day, 6.1 days per week, for a mean follow-up period of 6.8 months. Among all patients, a significant improvement in the Cobb angle of the primary scoliotic curve of 32.0% was found. Among 19 compliant patients, the mean improvement rose to 40.9%. Improvements did not differ significantly among adolescent idiopathic and degenerative subtypes (49.6% and 38.4%, respectively).

Conclusions: Asymmetrically strengthening the convex side of the primary curve with daily practice of the side plank pose held for as long as possible for an average of 6.8 months significantly reduced the angle of primary scoliotic curves. These results warrant further testing.



THE CIRCULATORY SYSTEM

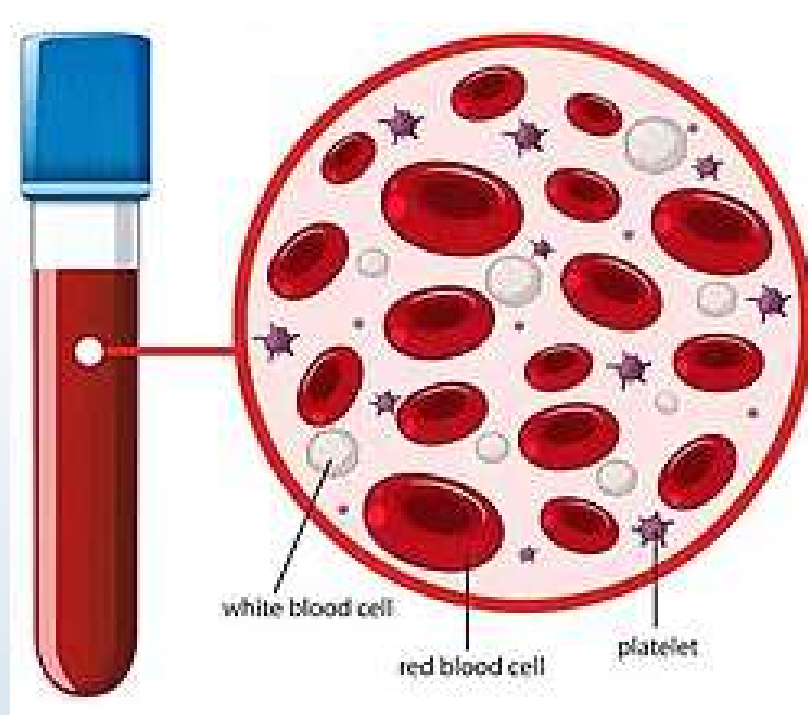
What three components make it up?



PURPOSE OF THE CIRCULATORY SYSTEM

- Transporting _____ and _____ to cells
- Removing _____ products from cells e.g. _____
- Fighting _____
- Homeostasis including regulating body _____





Plasma:

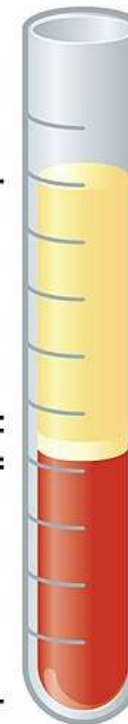
- Water, proteins, nutrients, hormones, etc.

Buffy coat:

- White blood cells, platelets

Hematocrit:

- Red blood cells



Normal Blood:

- ♀ 37%–47% hematocrit
- ♂ 42%–52% hematocrit

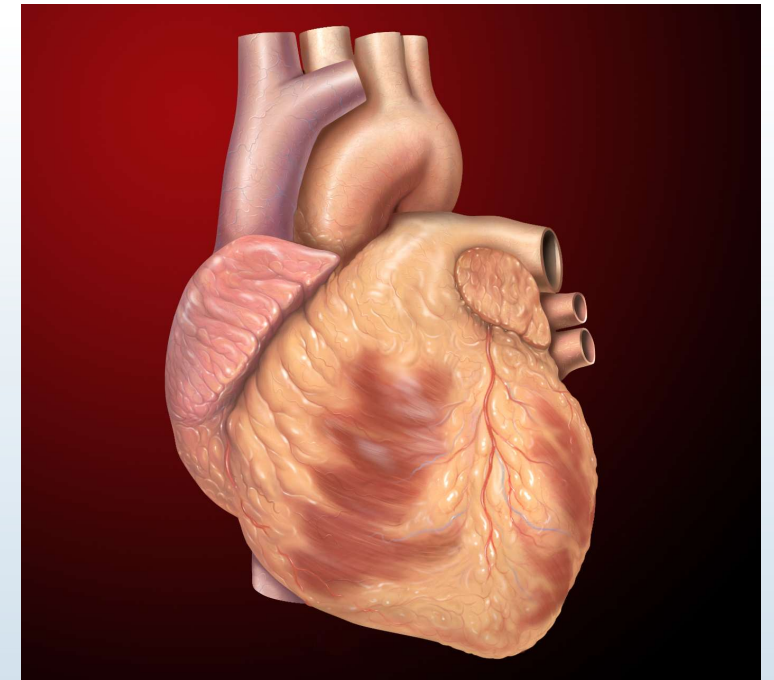


THE HEART

built for endurance:

75 contractions/minute = 108,000 contractions in 1 day= 39 million times in 1 year= 3 billion times in 75 years

- muscular organ that functions as a pump
- typically size of a fist
- positioned within rib cage behind and slightly left of sternum, above diaphragm
- largely made of specialized cardiac muscle tissue
- cannot exchange anything with the blood flowing through it so needs its own blood supply via the coronary arteries
 - disrupted supply -> heart attack
- myogenic (self stimulating via the pacemaker)



Patrick J. Lynch, medical illustrator
(https://commons.wikimedia.org/wiki/File:Heart_anterior_exterior_view.jpg), "Heart anterior exterior view", <https://creativecommons.org/licenses/by/2.5/legalcode>

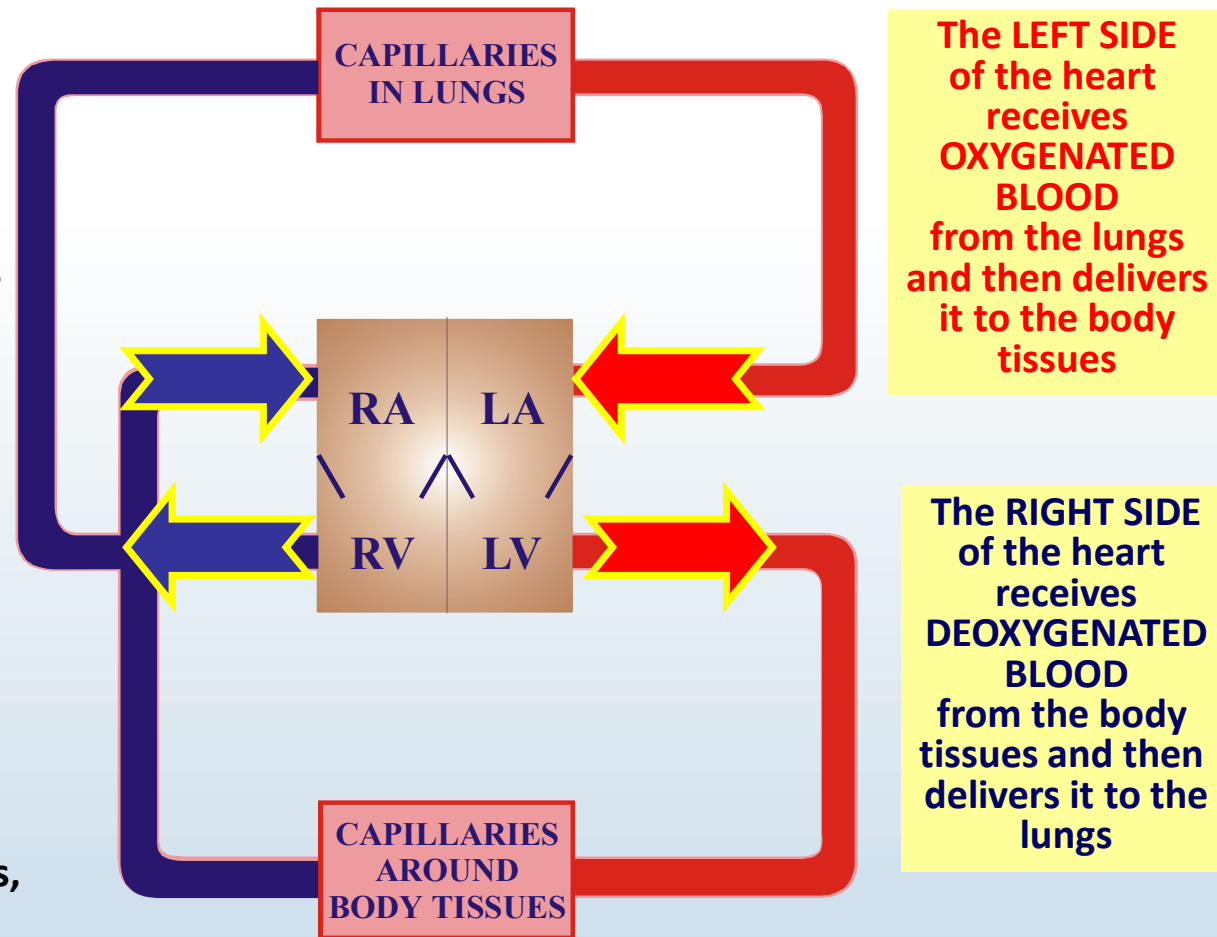
The human circulatory system is a double circulation – two 'loops'

The human heart, except, during foetal life, is completely divided into right and left sides

The heart has four chambers. The upper chambers are the right and left atrium (RA and LA), and the lower chambers are the ventricles (RV and LV)

Blood always enters the heart along veins, which deliver blood to the atria

Blood is pumped away from the heart along arteries, which originate in the ventricles



The LEFT SIDE of the heart receives OXYGENATED BLOOD from the lungs and then delivers it to the body tissues

The RIGHT SIDE of the heart receives DEOXYGENATED BLOOD from the body tissues and then delivers it to the lungs

L

Left side of the heart receives

O

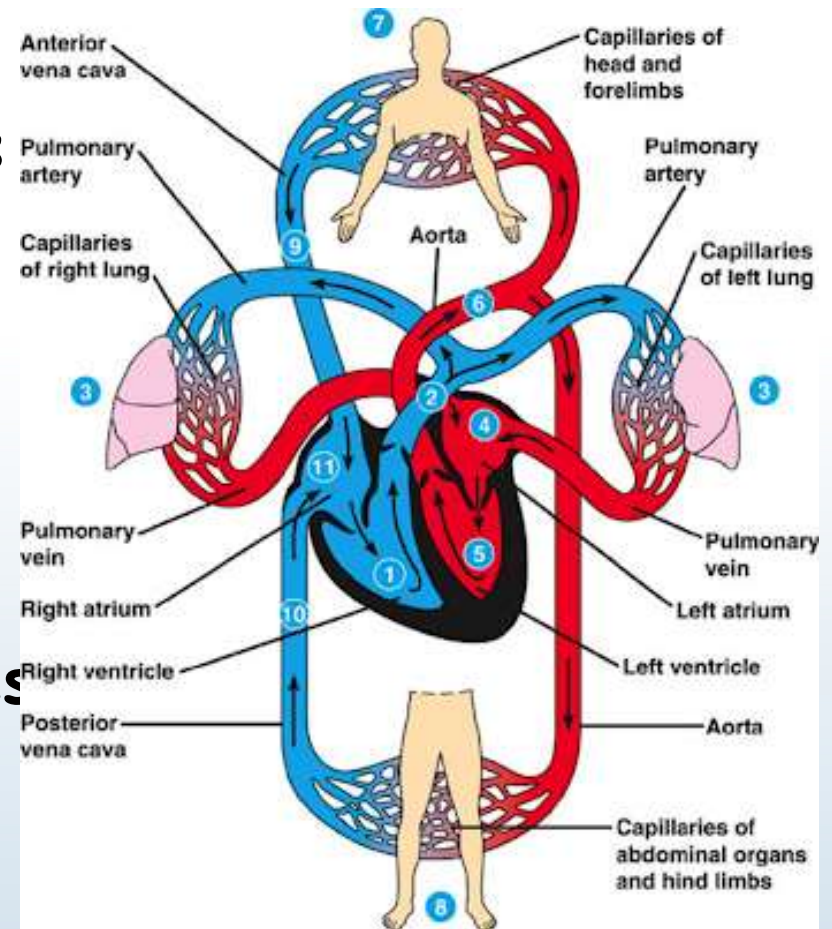
Oxygenated blood and delivers it to the body tissues

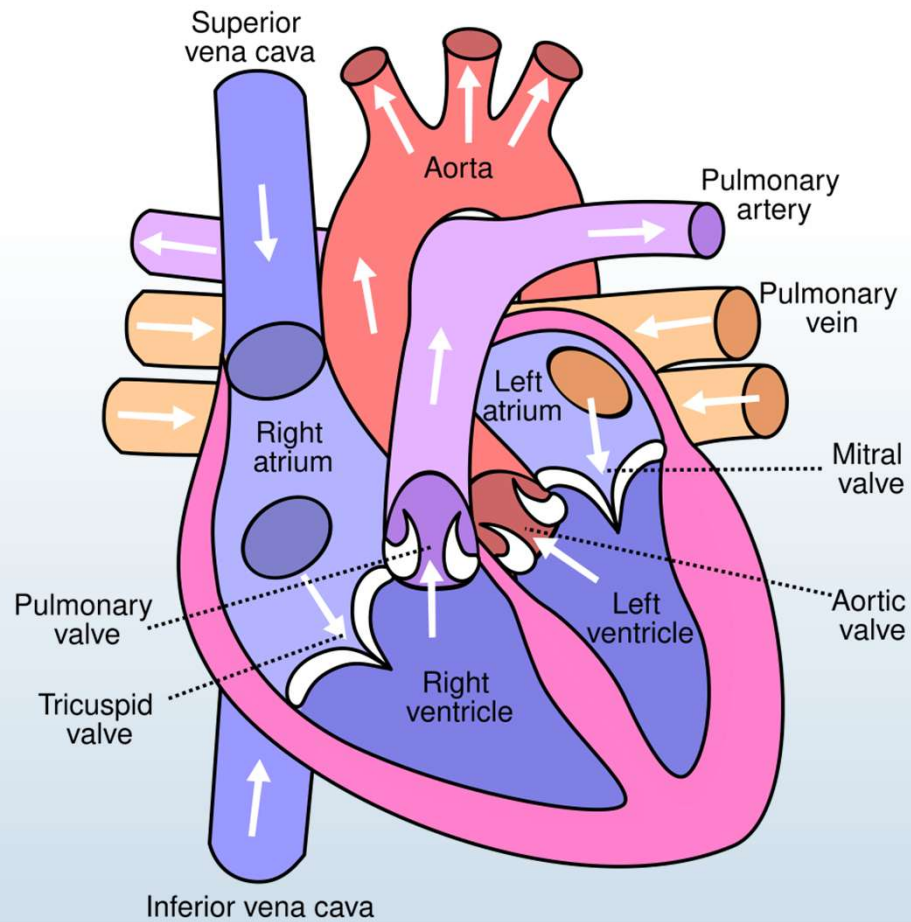
R

Right side of the heart receives

D

Deoxygenated blood and delivers it to the lungs

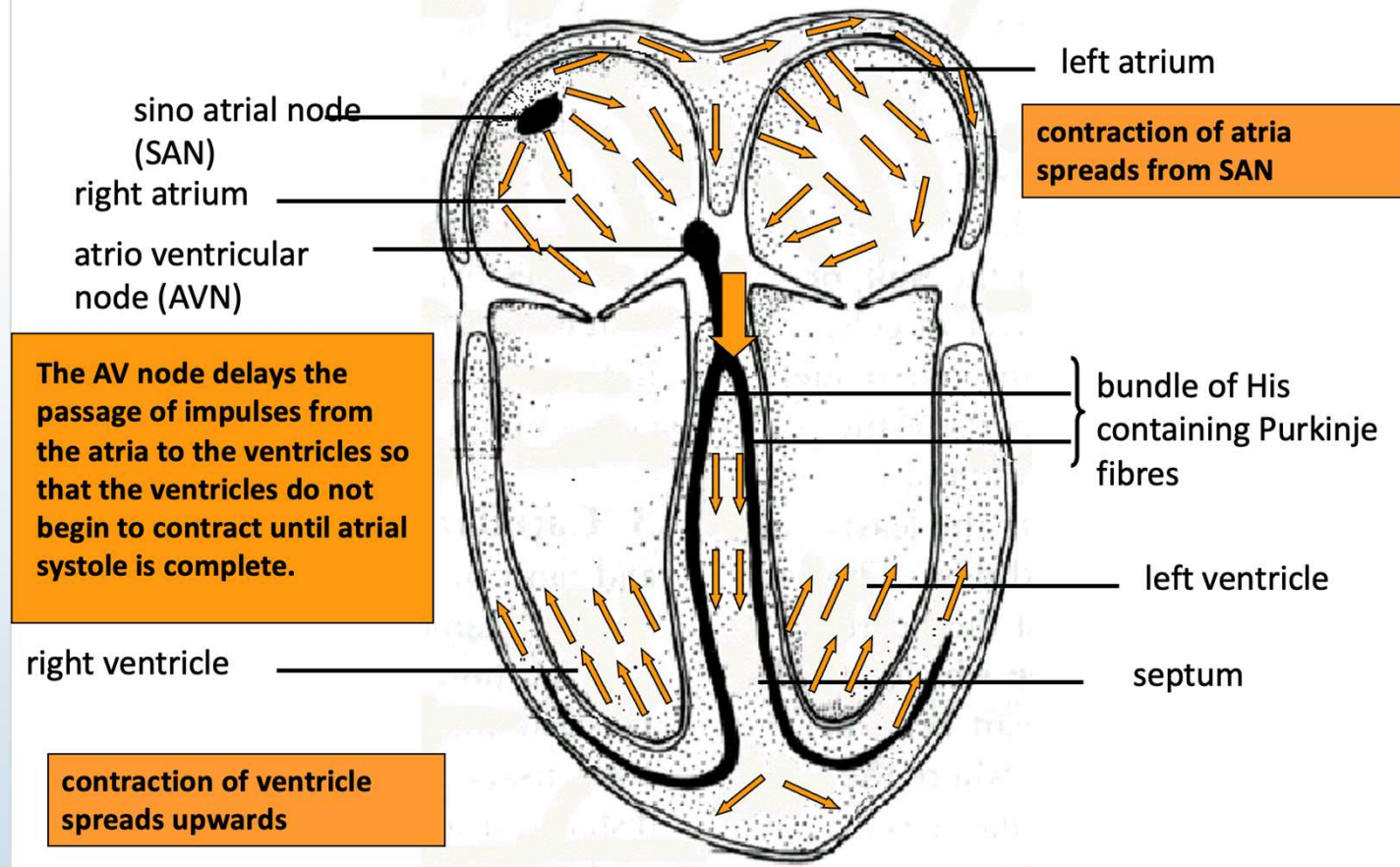




MisserWoland

([https://commons.wikimedia.org/wiki/File:Diagram_of_the_human_heart_\(multilingual\).svg](https://commons.wikimedia.org/wiki/File:Diagram_of_the_human_heart_(multilingual).svg)), „Diagram of the human heart (multilingual)“, <https://creativecommons.org/licenses/by-sa/3.0/legalcode>

Pacemaker and conducting systems of the heart



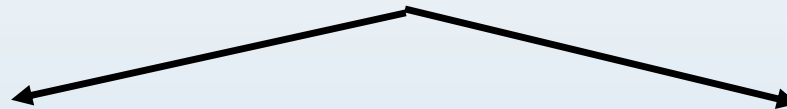
The average human heart beats about 70 times a minute, pumping 70cm^3 of blood from each of its two ventricles each time it beats. Thus in a single day, it beats 100,000 times and pumps 7,000 litres of blood around the circulation. Each heartbeat lasts for approximately 0.8 of a second.



Each heartbeat involves a series of events known as the cardiac cycle. Since the heartbeat is a cycle of events there is no absolute first or last phase



A single heartbeat may be divided into two main phases



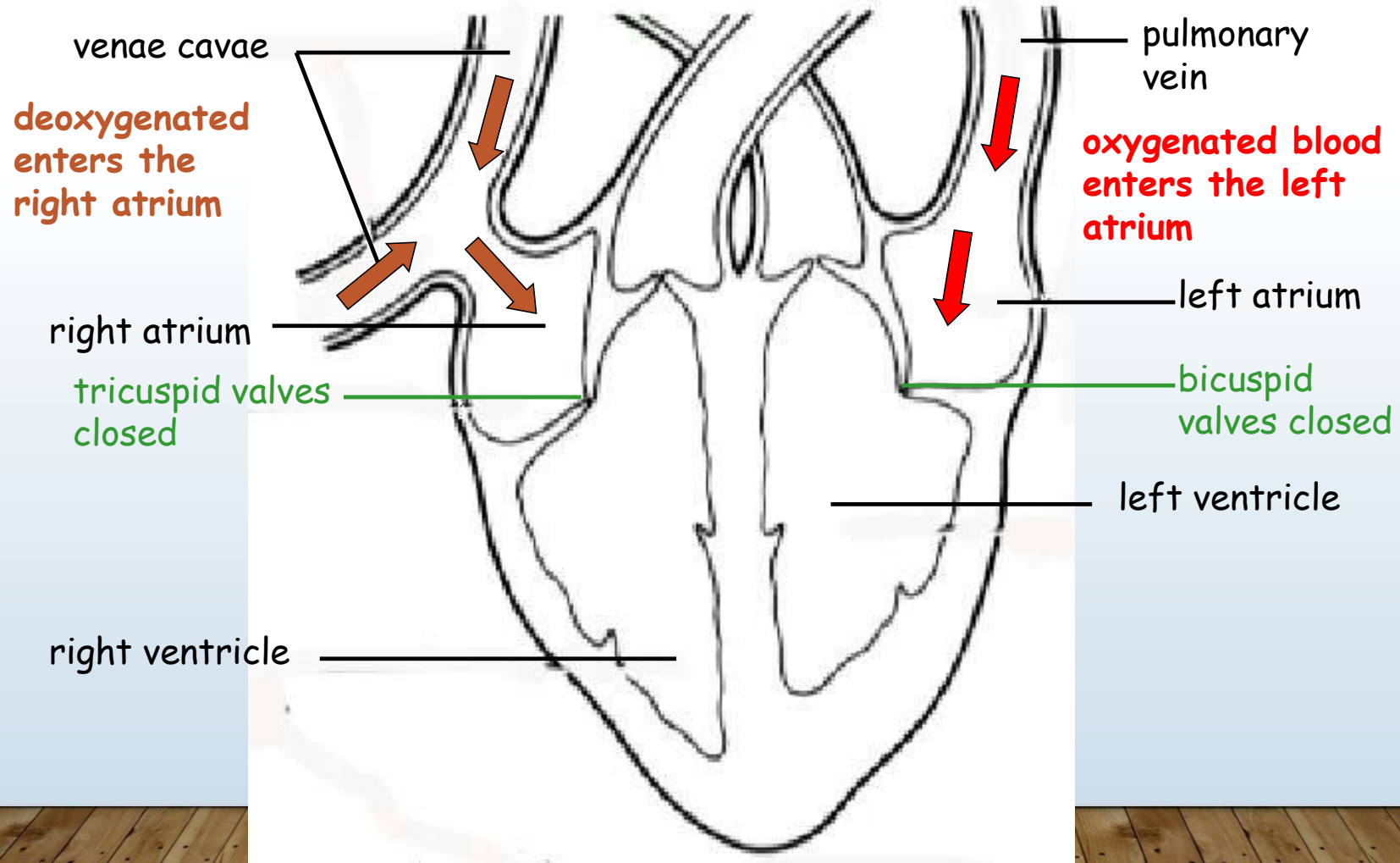
Systole describes periods when the heart is contracting (working hard)



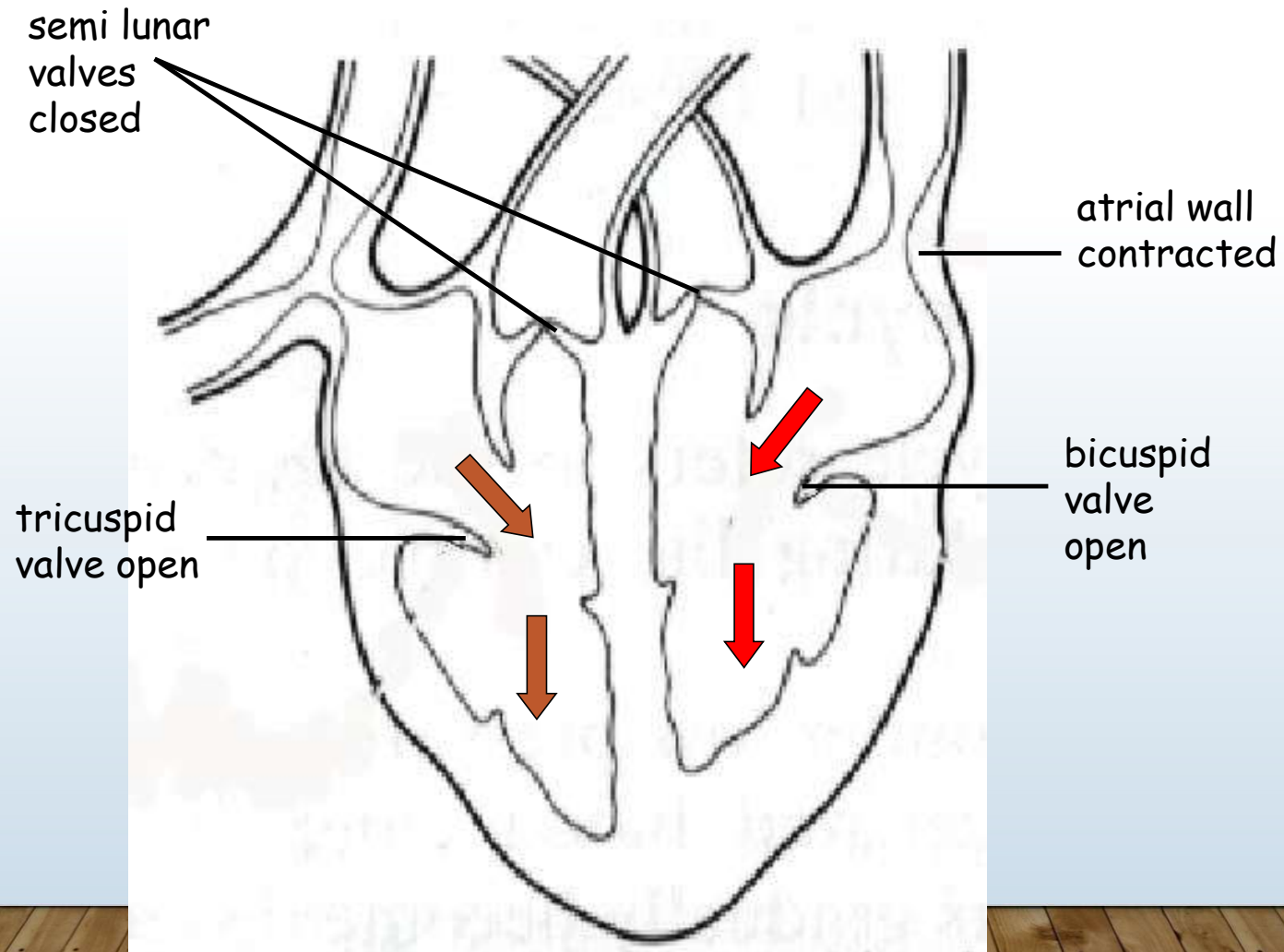
Diastole describes periods when the heart is relaxing (resting)



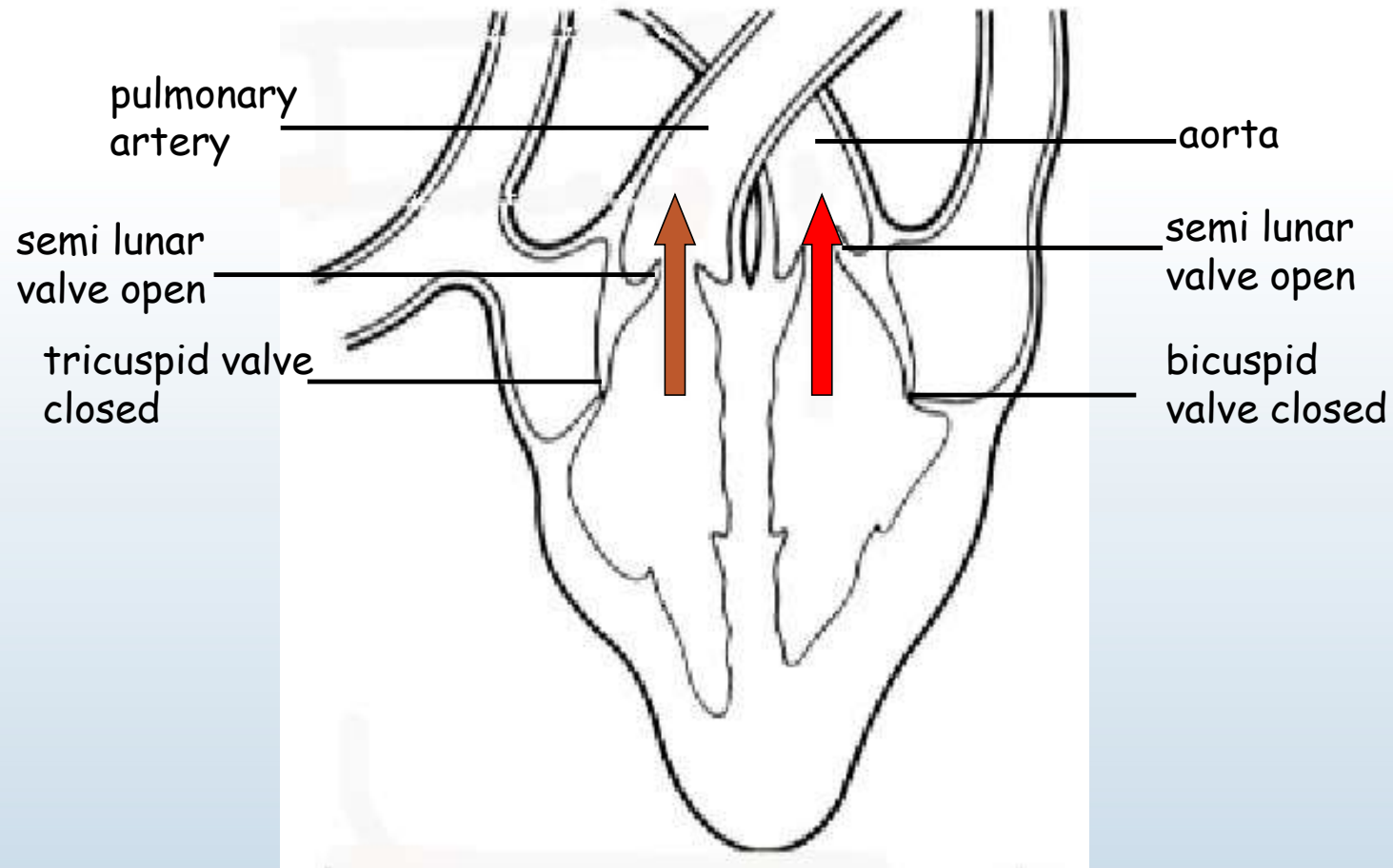
Heart in state of diastole (relaxation) and filling with blood



Atrial systole - (atrial contraction) forces blood into the ventricles

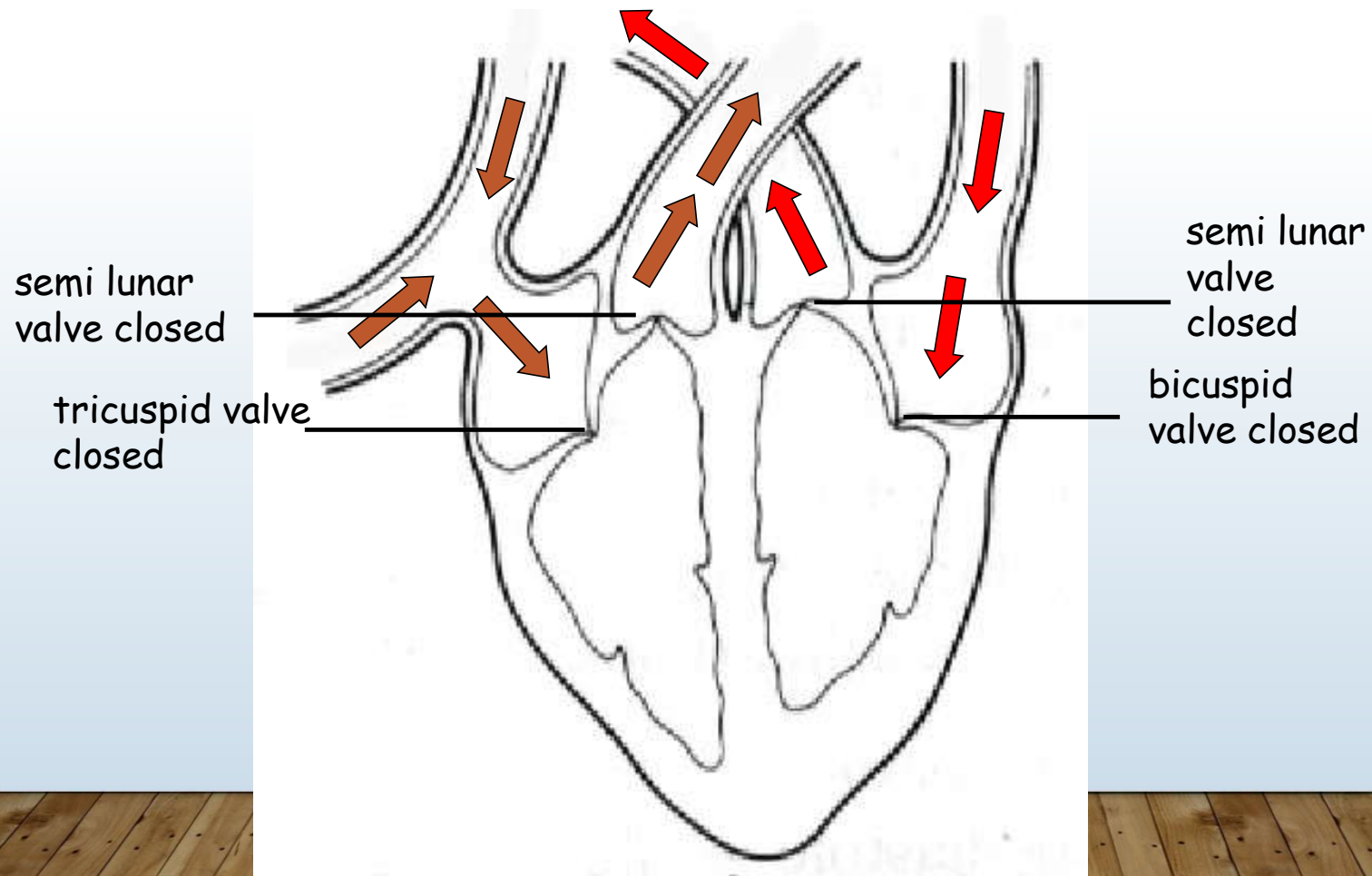


**Atrial diastole - atria relax, ventricular systole - ventricles contract.
Blood forced into aorta and pulmonary artery**



Ventricular diastole ventricular relaxation
Atria begin to refill with blood

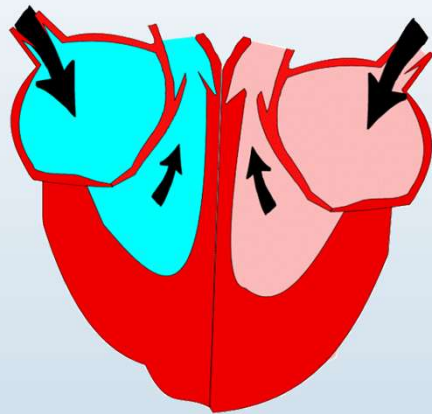
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Heart Sounds

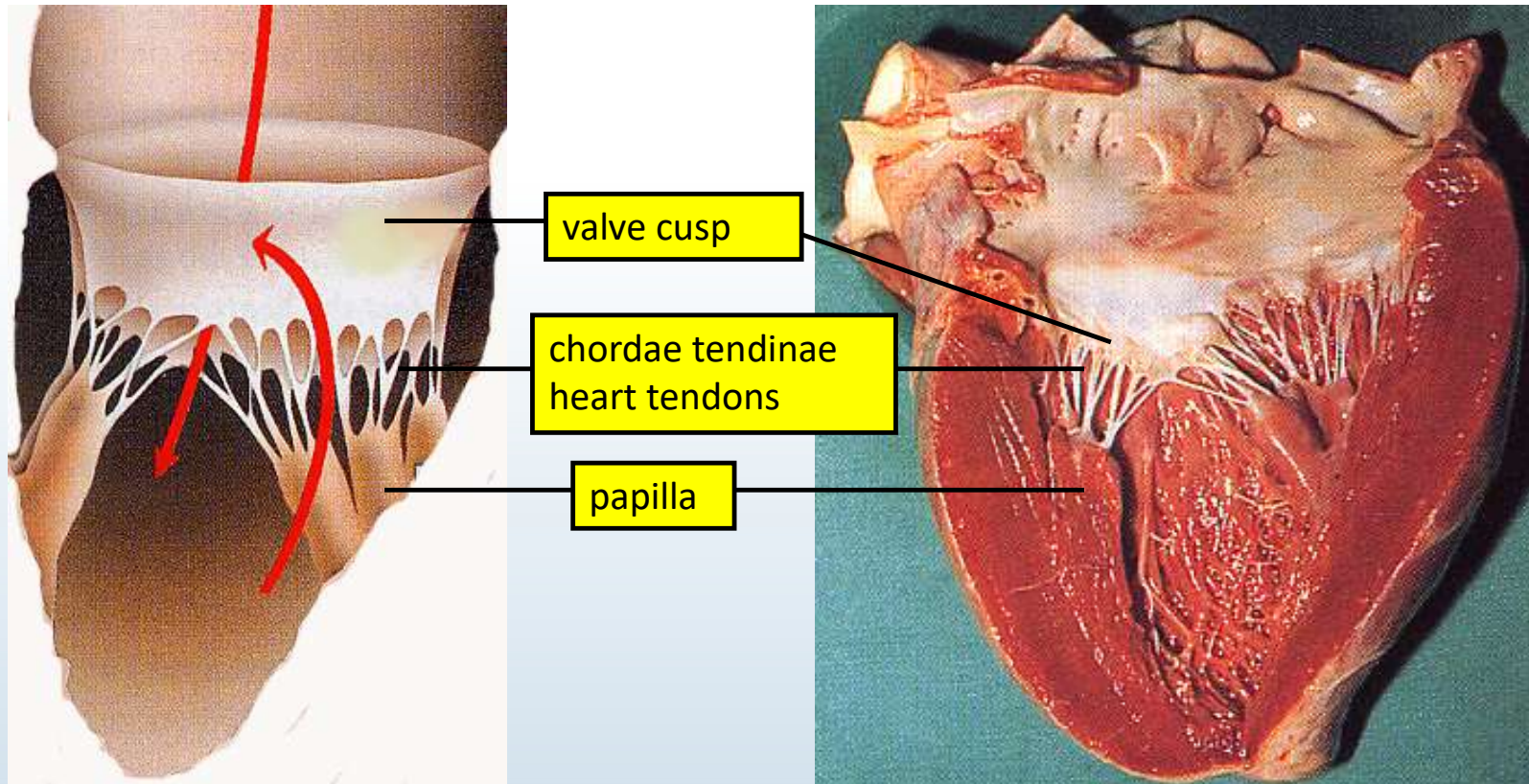
During ventricular systole blood is forced against the closed atrio-ventricular valve and this produces the first heart sound 'lub'

The impact of the backflow of blood against the semi lunar valves during ventricular diastole causes the second heart sound 'dub'



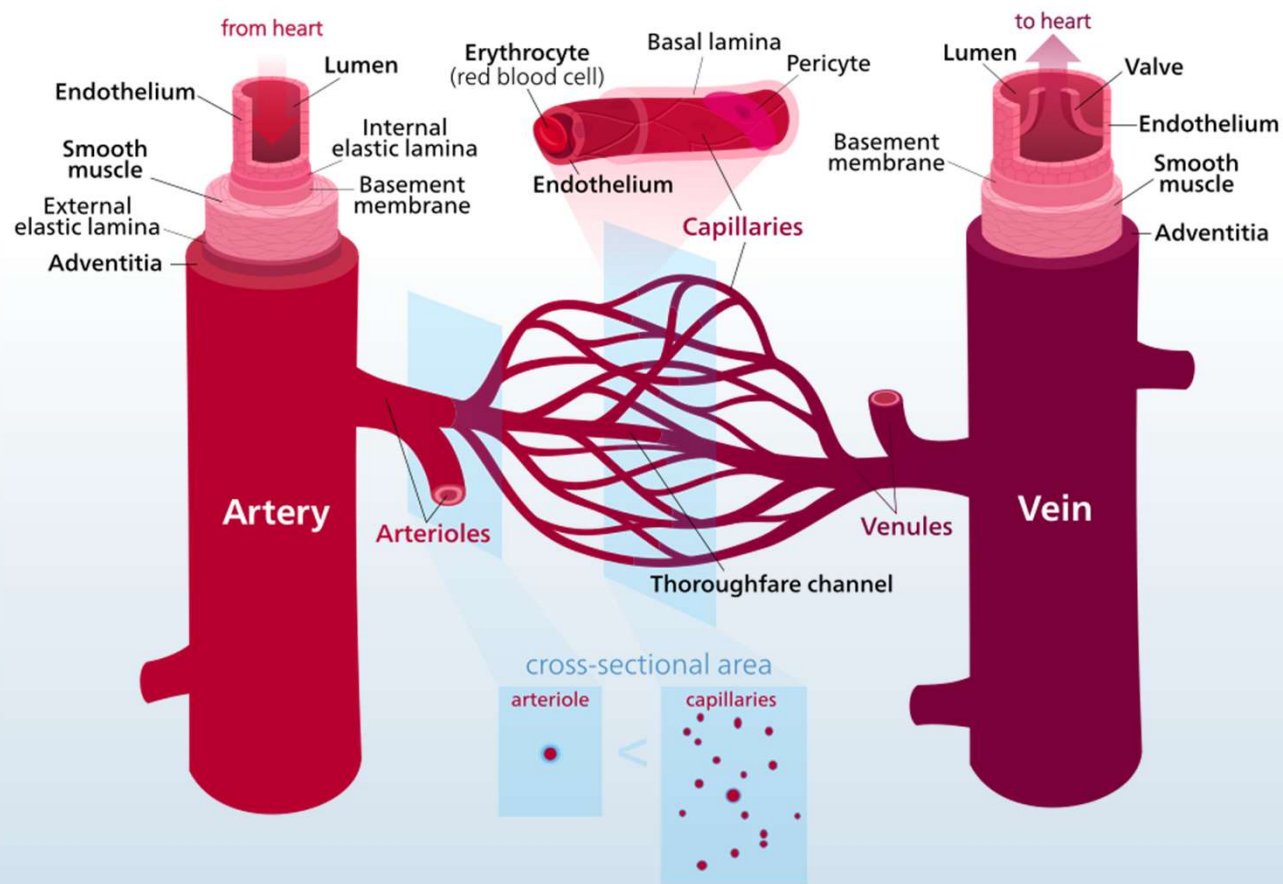
Atrio-ventricular valves

The atrio-ventricular valves open when the pressure in the atrium is higher than the pressure in the ventricle. The flexible valve cusps are pushed open.



The atrio-ventricular valves close when the pressure in the ventricle is higher than the pressure in the atrium. The flexible cusps are pushed tightly together as muscle fibres in the papillae contract at the same time as fibres in the rest of the ventricle



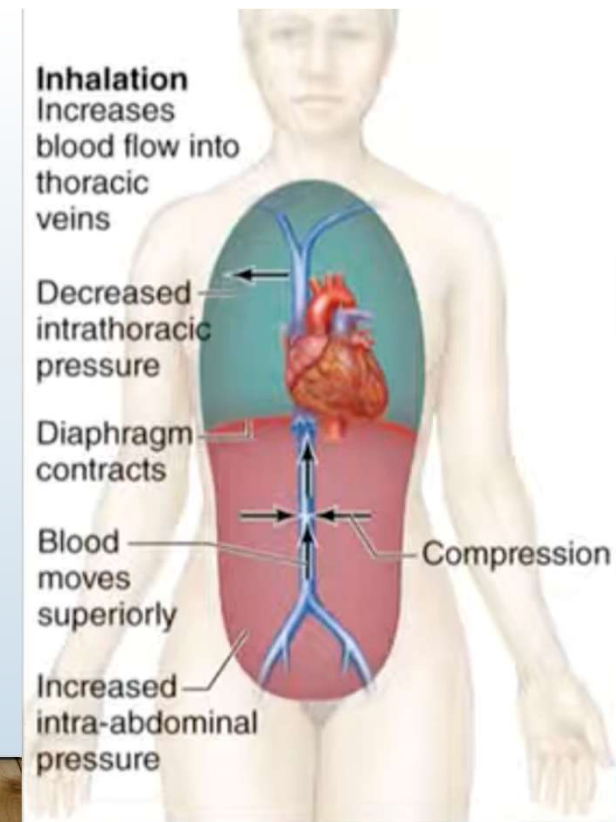
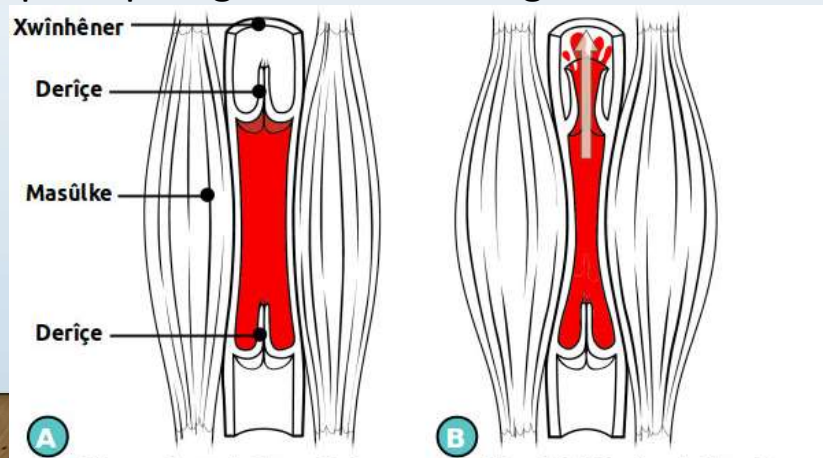


File:Blood vessels-en.svg; Kelyinsong derivative work: Begoon
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 vessels (retouched) -en“, https://creativecommons.org/licenses/by-sa/3.0/legalcode

YOGA AND CIRCULATION

Yoga can help to improve venous return in three main ways:

- inverting the body
- improving the efficiency of skeletal muscle pump
 - may prevent varicose veins worsening and alleviate discomfort
- improving the efficiency of respiratory pump thanks to slow, deep, diaphragmatic breathing



YOGA AND CIRCULATION – RESTING HEART RATE

Yoga lowers resting heart rate (Rajeswari et al. 2024)

Resting heartrate is considered a key indicator of cardiovascular health and fitness

The heart is a muscle and grows in response to exercise (left ventricular wall in particular thickens)

But this isn't the only mechanism behind the fall in RHR...



YOGA AND CIRCULATION – RESTING HEART RATE

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Research Article | Volume 14 Issue:1 (Jan-Feb, 2024) | Pages 1198 - 1204

Effect of Yoga on Resting Heart Rate and Blood Pressure: A Controlled Physiological Study

P. Rajeswari¹ , Sajja Madhuri², Rajani R³

Abstract

Background: Yoga is increasingly recognized for its cardiovascular benefits, primarily through modulation of autonomic nervous system activity. While long-term yoga practice has been extensively studied, the immediate effects of a single yoga session on resting heart rate (HR) and blood pressure (BP) remain under-explored, particularly using simple, non-invasive measurement techniques. **Methods:** Thirty healthy adults (aged 18–45 years) were randomly assigned to either a yoga group or a control group. The yoga group performed a 30-minute standardized protocol comprising Nadi Shodhana Pranayama (alternate nostril breathing), Surya Namaskar (sun salutations), and Savasana (corpse pose). The control group engaged in quiet reading for the same duration. Resting HR was measured manually via radial pulse count over 30 seconds, and BP was recorded using a manual sphygmomanometer. Baseline and post-intervention measurements were compared using paired t-tests (within-group) and independent t-tests (between-group), with statistical significance. **Results:** Participants in the yoga group demonstrated a significant reduction in resting HR by 6.2 ± 2.1 bpm ($p < 0.001$), along with decreases in systolic BP (-5.4 ± 3.2 mmHg; $*p = 0.003$) and diastolic BP (-3.8 ± 2.5 mmHg; $*p = 0.008$). Between-group comparisons confirmed that yoga elicited significantly greater improvements in HR and BP compared to the control activity ($p < 0.01$ for all outcomes). **Conclusion:** A single 30-minute yoga session significantly reduces resting HR and BP, likely due to enhanced parasympathetic activity and reduced sympathetic tone. These findings support yoga as a practical, non-pharmacological intervention for immediate cardiovascular relaxation. Further research should investigate long-term effects in diverse populations.

YOGA AND BLOOD PRESSURE

Blood Pressure (BP) is the pressure exerted on artery walls during heart contraction and relaxation

- It is what drives blood to travel throughout body
- Measured in millimeters of mercury (mm Hg)
- Written as systolic pressure (force blood exerts against artery walls when heart beats) over diastolic pressure (force blood exerts against artery walls while heart is resting between beats)
- Normal BP reading is typically defined as less than 120/80 mm Hg



YOGA AND BLOOD PRESSURE

High Blood Pressure (Hypertension) = Blood pressure is consistently too high

- Increases workload of heart and blood vessels, making them work harder and less efficiently
- Force and friction damages delicate lining of arteries
- This can signify the start of a process called atherosclerosis, a key feature of heart disease
- Yoga lowers blood pressure (Rajeswari et al. 2024)
- Students with high blood pressure that is well controlled can typically practice in same way as someone with normal BP
- Uncontrolled hypertension - get okay from health care practitioner and avoid significant inversions such as shoulder/headstand but downward dog can be practiced carefully as will not raise BP as much



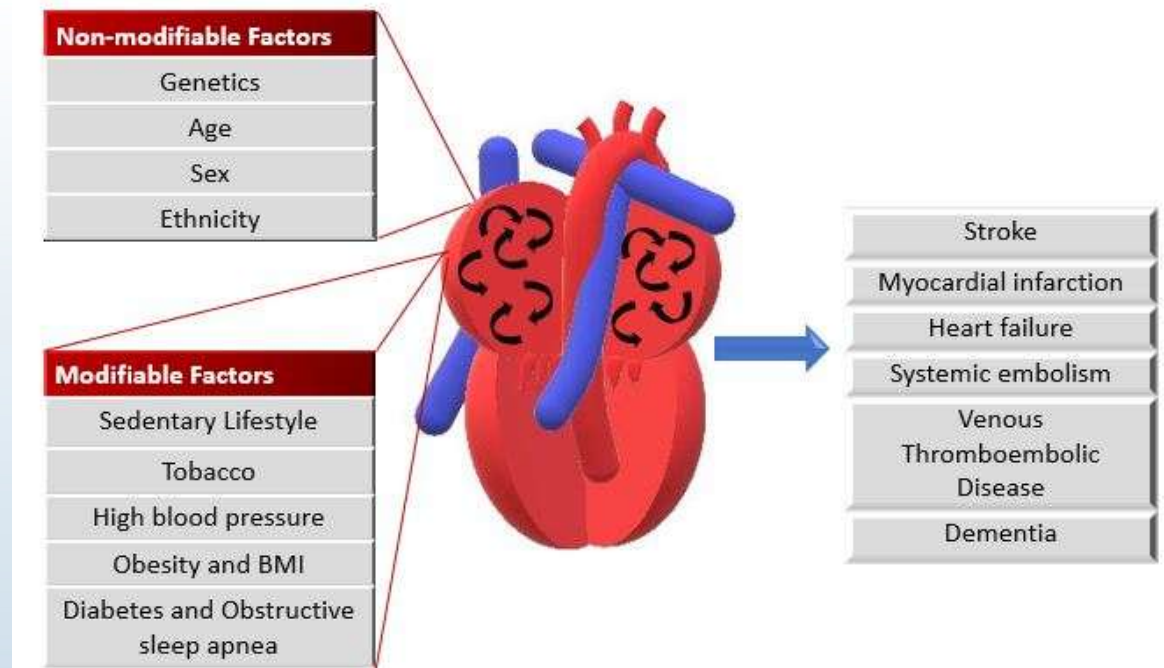
YOGA AND BLOOD PRESSURE

Low Blood Pressure (Hypotension) = pressure lower than 90/60 mm Hg

- Symptoms include dizziness or lightheadedness and nausea
- Falling BP on standing is termed postural hypotension
- Can reduce cerebral blood flow – lead to fainting
- Take plenty of time to rise back up to vertical after folding forward
- Raise hands above head to raise BP
- Not uncommon for many to feel dizzy after raising the head after practicing backbends such as Camel Pose

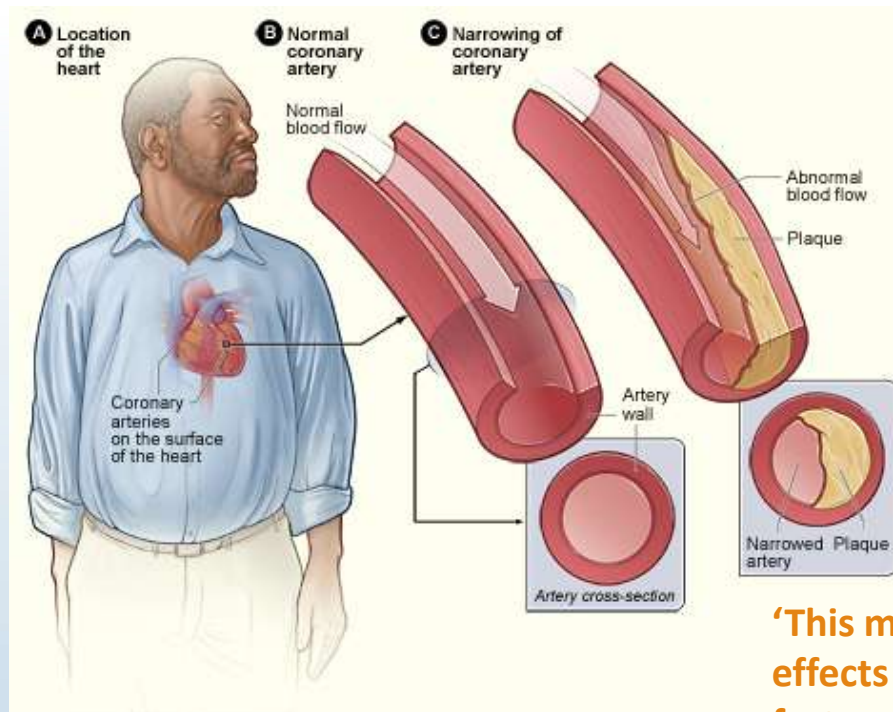


YOGA AND CARDIOVASCULAR DISEASE (HEART DISEASE)



Yaiza Rodríguez García
(<https://commons.wikimedia.org/wiki/File:RiskFactors.jpg>),
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YOGA AND CARDIOVASCULAR DISEASE (HEART DISEASE)



Doing yoga may be a good way to protect against heart disease, particularly if you cannot do more vigorous exercise, research published in the [*European Journal of Preventive Cardiology*](#) suggests.

A review 37 studies involving nearly 3,000 people found yoga was independently linked to a lowering of heart risk factors such as high blood pressure and cholesterol.

‘This meta-analysis revealed evidence for clinically important effects of yoga on most biological cardiovascular disease risk factors. Despite methodological drawbacks of the included studies, yoga can be considered as an ancillary intervention for the general population and for patients with increased risk of cardiovascular disease.’

