The Thorax

The Thorax

- aka: the chest cavity

Functions:

- incorporates and protects the vital organs of the body
  - heart, lungs, gallbladder, liver, spleen, kidneys, pancreas
- supports bones and muscles of the shoulder girdle

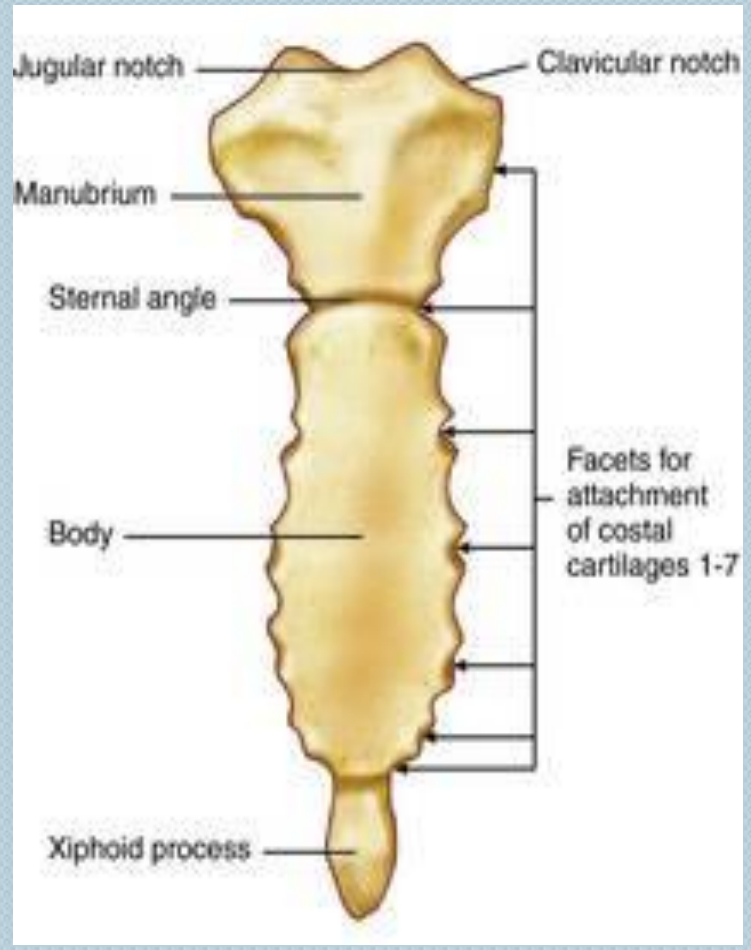
Structure:

- narrow superiorly and wider inferiorly
- flattened anterior to posterior

Bones of the Thorax

Sternum

- large, flat & narrow
- dagger shaped bone
- defines the anterior portion of the chest wall
- functions to protect the heart and major vessels
  - aorta
- made up of three bones



Manubrium

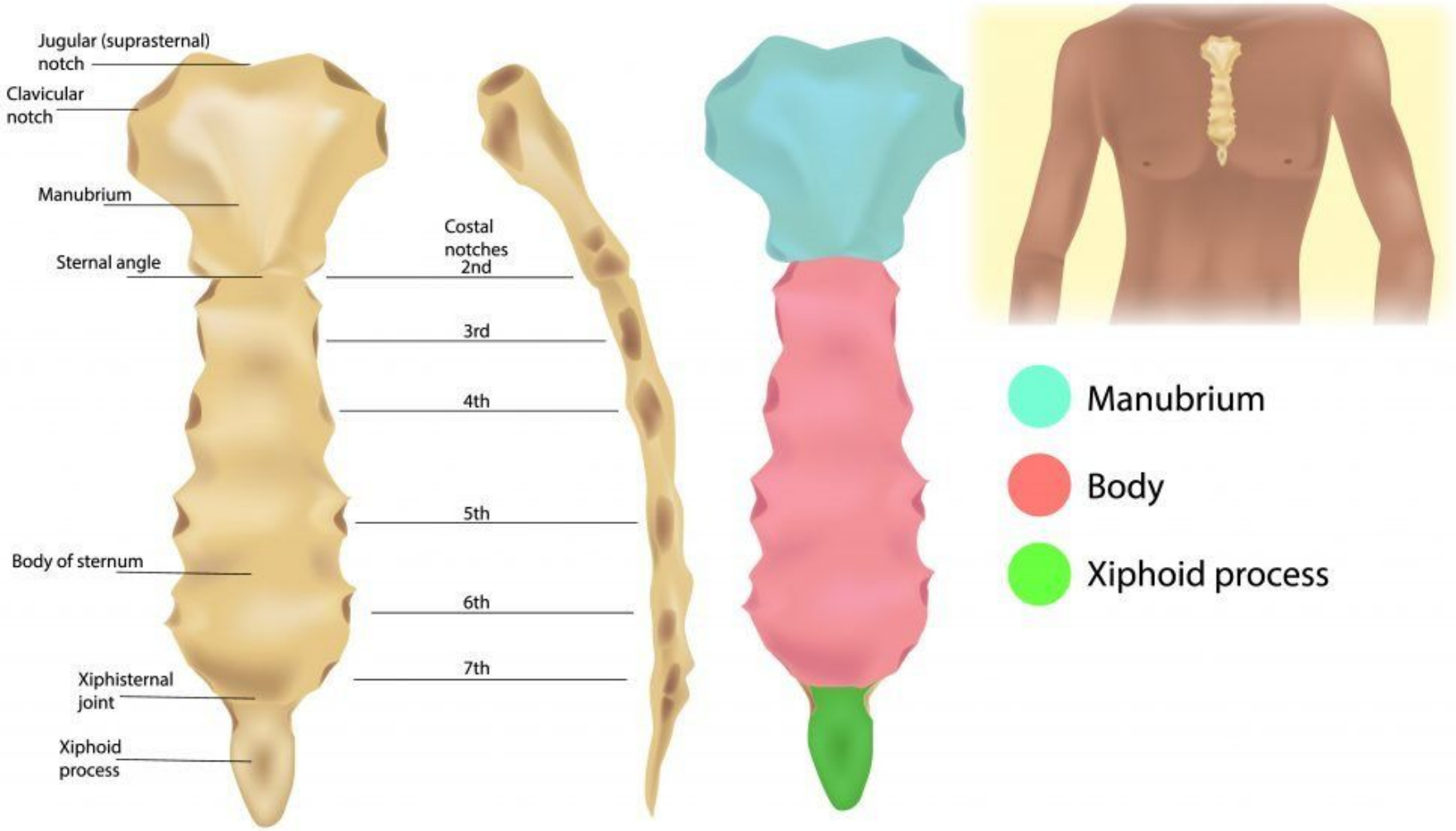
- the most superior portion of the sternum

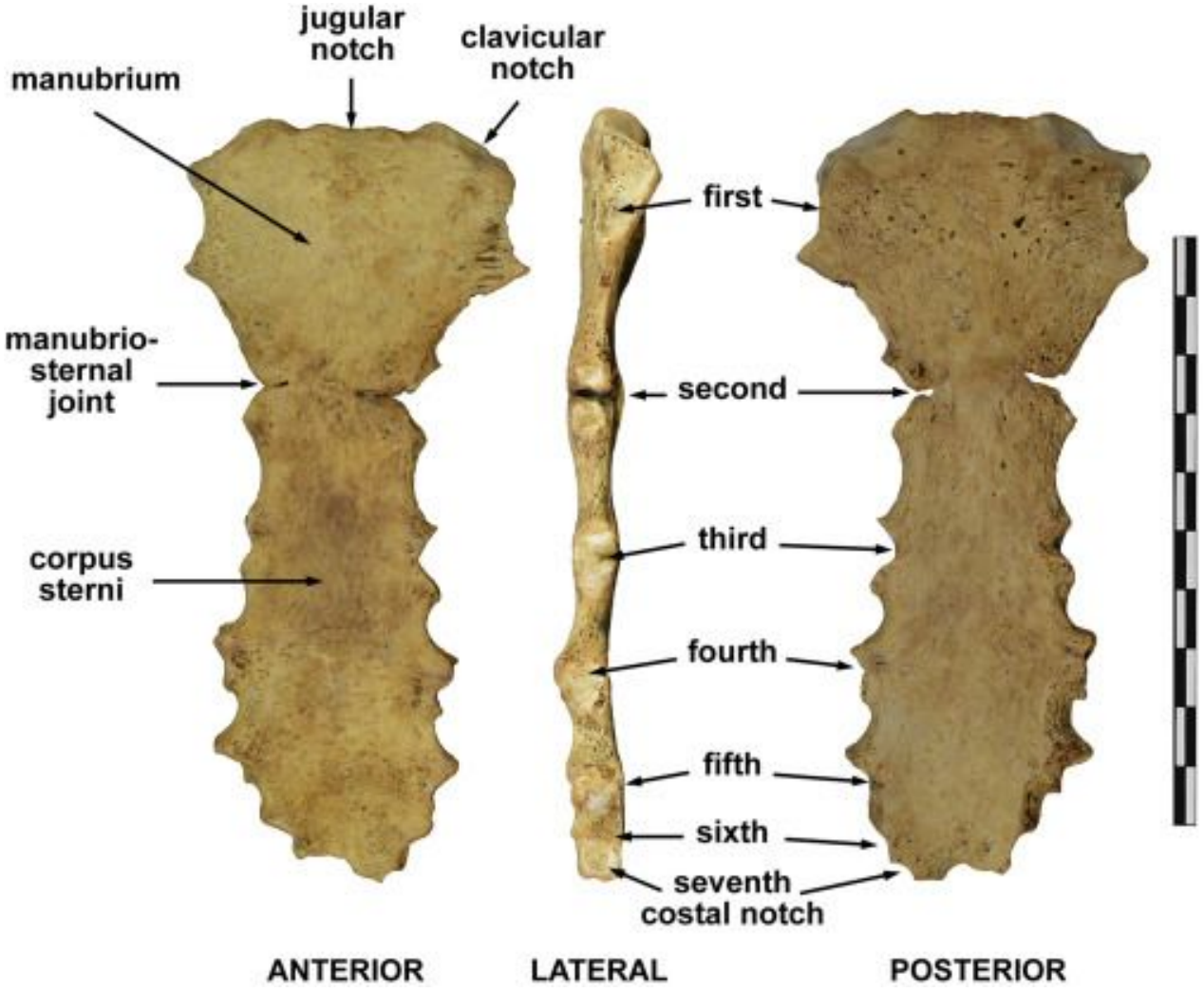
Landmarks:

- suprasternal notch (jugular)
  - middle
- clavicular notch
  - 2, laterally
  - attachment site for the clavicles
- costal notches
  - articulations for ribs
  - on the lateral aspect

Body

- the largest portion of the sternum
- divided from the manubrium superiorly by the sternal angle or angle of Louis
  - this is a site of attachment for the second rib
- most fractures of the sternum occur at the sternal angle

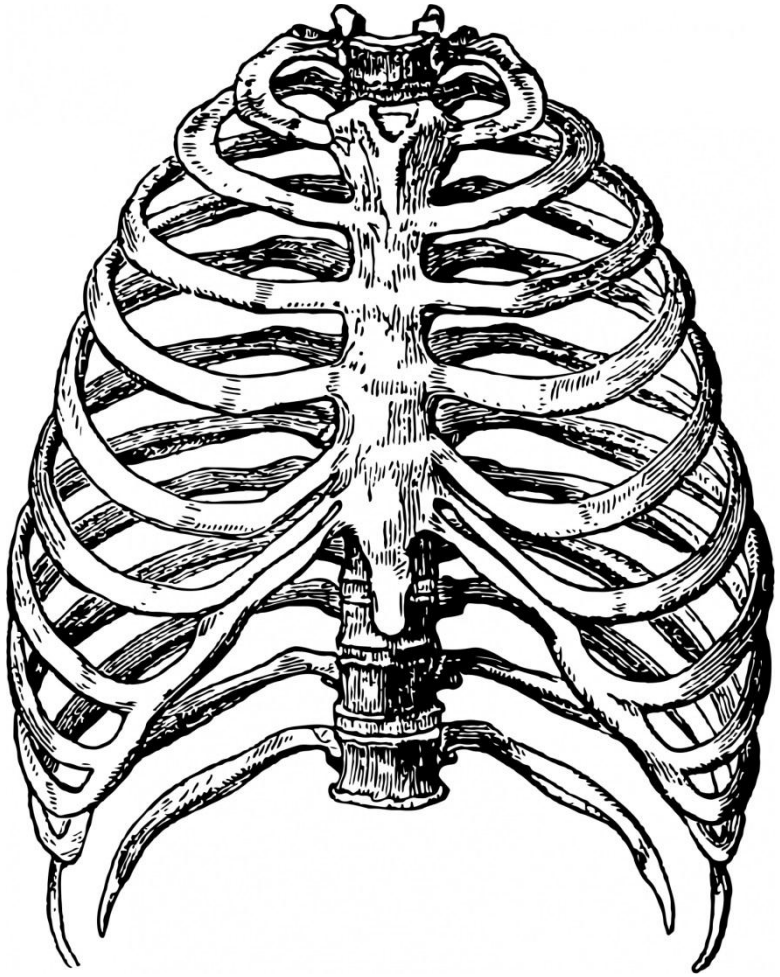

Jugular (suprasternal) notch
Clavicular notch
Manubrium
Sternal angle
Costal notches
2nd
3rd
4th
5th
6th
7th
Body of sternum
Xiphisternal joint
Xiphoid process
Manubrium
Body
Xiphoid process


jugular notch
clavicular notch
manubrium
manubrio-sternal joint
corpus sterni
first
second
third
fourth
fifth
sixth
seventh costal notch
ANTERIOR
LATERAL
POSTERIOR

Xiphoid Process

- creates an arrow at the bottom of the sternum
- it is attached to the sternum by the xiphisternal junction
- functions as an attachment site for abdominal muscles
- vulnerable to fracture during CPR
- may be:
  - fused to bone
  - hyaline cartilage

The Ribs



Ribs

- curved, flat bones
- 24 individually, 12 paired

Structure = Function

- when paired, kidney bean shaped
- the shape allows for increased respiratory capacity
- can be classified by:
  - structure
  - articulation

Typical Ribs	Atypical Ribs
include ribs 3-9	include ribs 1, 2, 10, 11, 12
general structure includes: - head, neck, body - two facets - tubercle - costal groove - costal angle - costal cartilage	differential structures to serve specific purpose

Structural

True Ribs

- include ribs 1-7
- considered true because they connect directly to the sternum via their own costal cartilage
- create synovial joints
- vertebrosternal

False Ribs

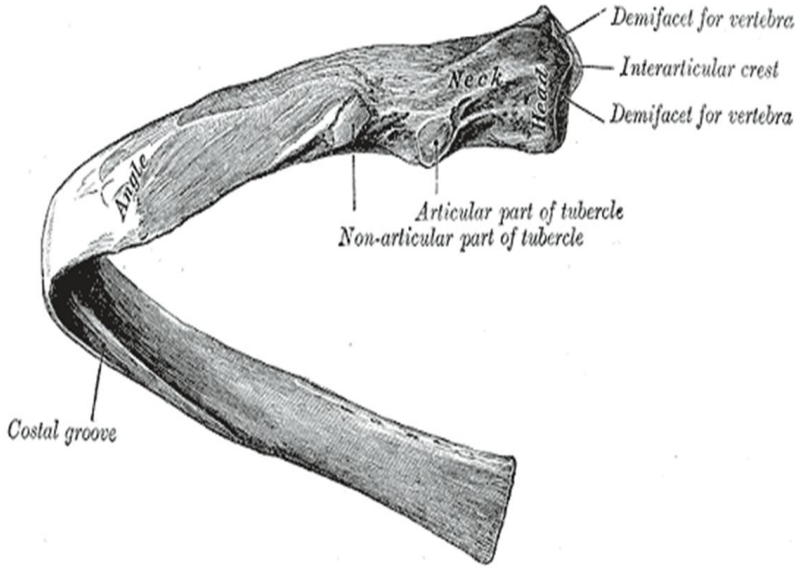
- include ribs 8, 9, 10
- considered false because they connect indirectly to the sternum via costal cartilage from the ribs above
- vertebrocostal

Floating Ribs

- include ribs 11 & 12
- floating because they do not connect anteriorly to the sternum
- blend with the abdominal muscles & function to protect kidneys
- vertebral, free ribs

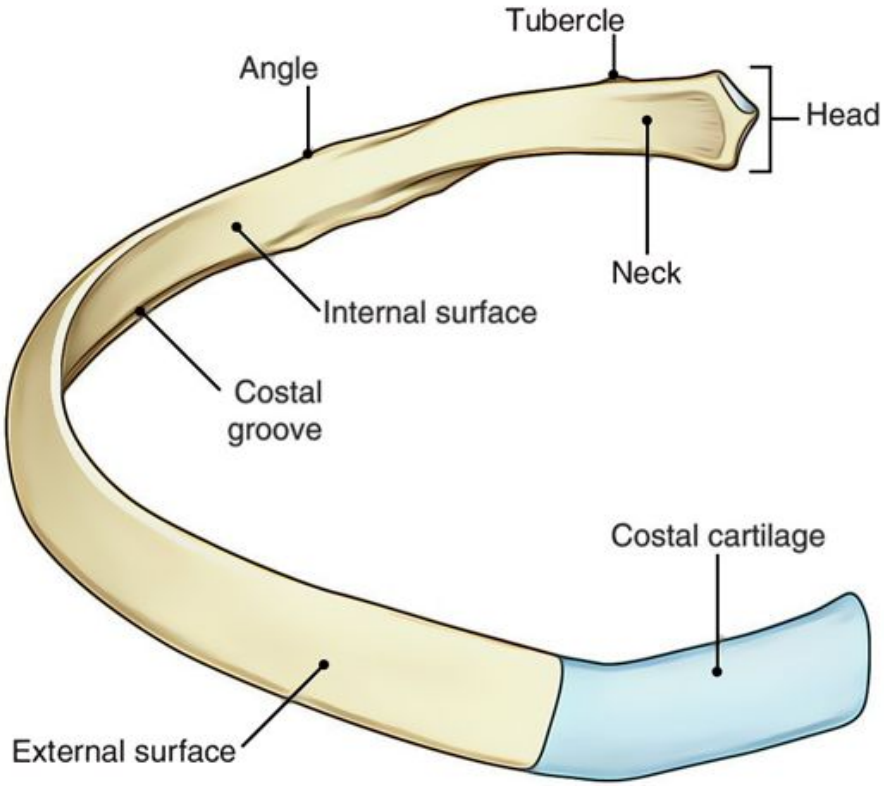
Articulation

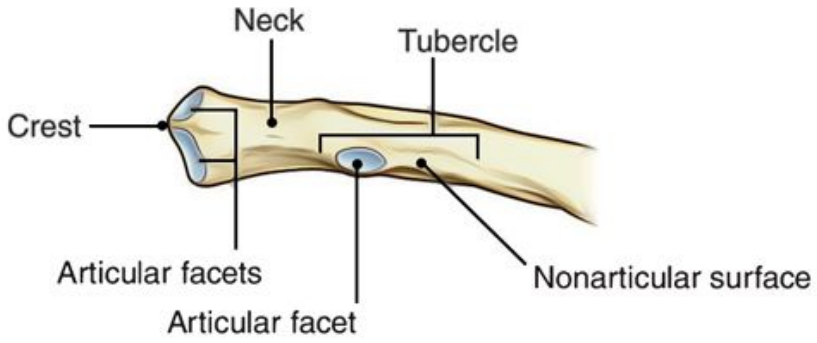
Parts of a typical rib



Head

- appears on the posterior end of the rib
- articulation:
  - thoracic vertebrae
- superior & inferior facets
  - articulate with **demifacets** of the bodies of two respective vertebrae
    - T2-9
  - Ribs 1, 10, 11 & 12
    - contain full facets & only articulate with one respective vertebra


Tubercle
Angle
Head
Neck
Internal surface
Costal groove
Costal cartilage
External surface

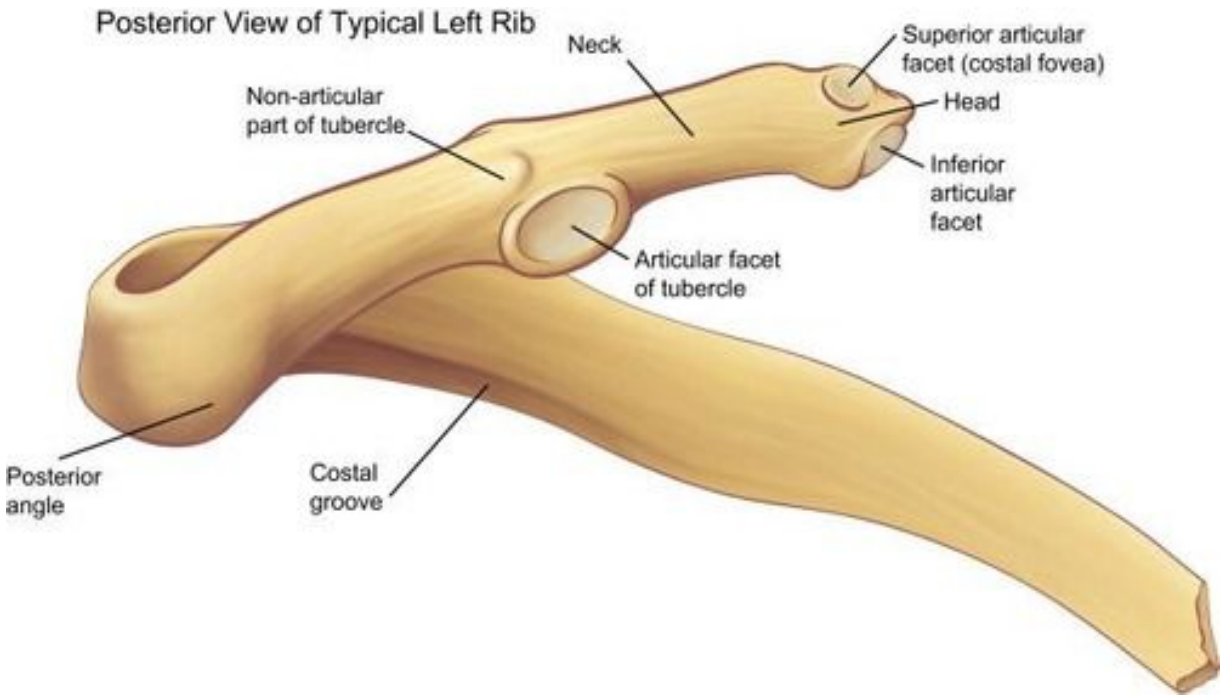

Neck
Tubercle
Crest
Articular facets
Articular facet
Nonarticular surface

Neck

- immediately posterior to the head of the rib
- unremarkable in terms of bony landmarks
- only function is to connect the head of the rib to the body

Costal Tubercle

- bony prominence that projects posteriorly; located at the junction of the neck & body of the rib
- two parts:
  - articular:
    - comes into contact with the articular facet on the transverse process of a vertebra
  - non-articular:
    - serves as a point of attachment for ligaments (costotransverse)


Posterior View of Typical Left Rib
Neck
Superior articular facet (costal fovea)
Head
Non-articular part of tubercle
Inferior articular facet
Articular facet of tubercle
Posterior angle
Costal groove

Body, Costal Angle & Costal Groove

Body

- thin, flat, & curved
- the costal angle & costal groove appear on the body
- ends with costal cartilage

Costal Angle

- the point along the shaft of the rib where it makes a sudden change in direction
- turns anterolaterally
- is a point of attachment for some of the deep back muscles

Costal Groove

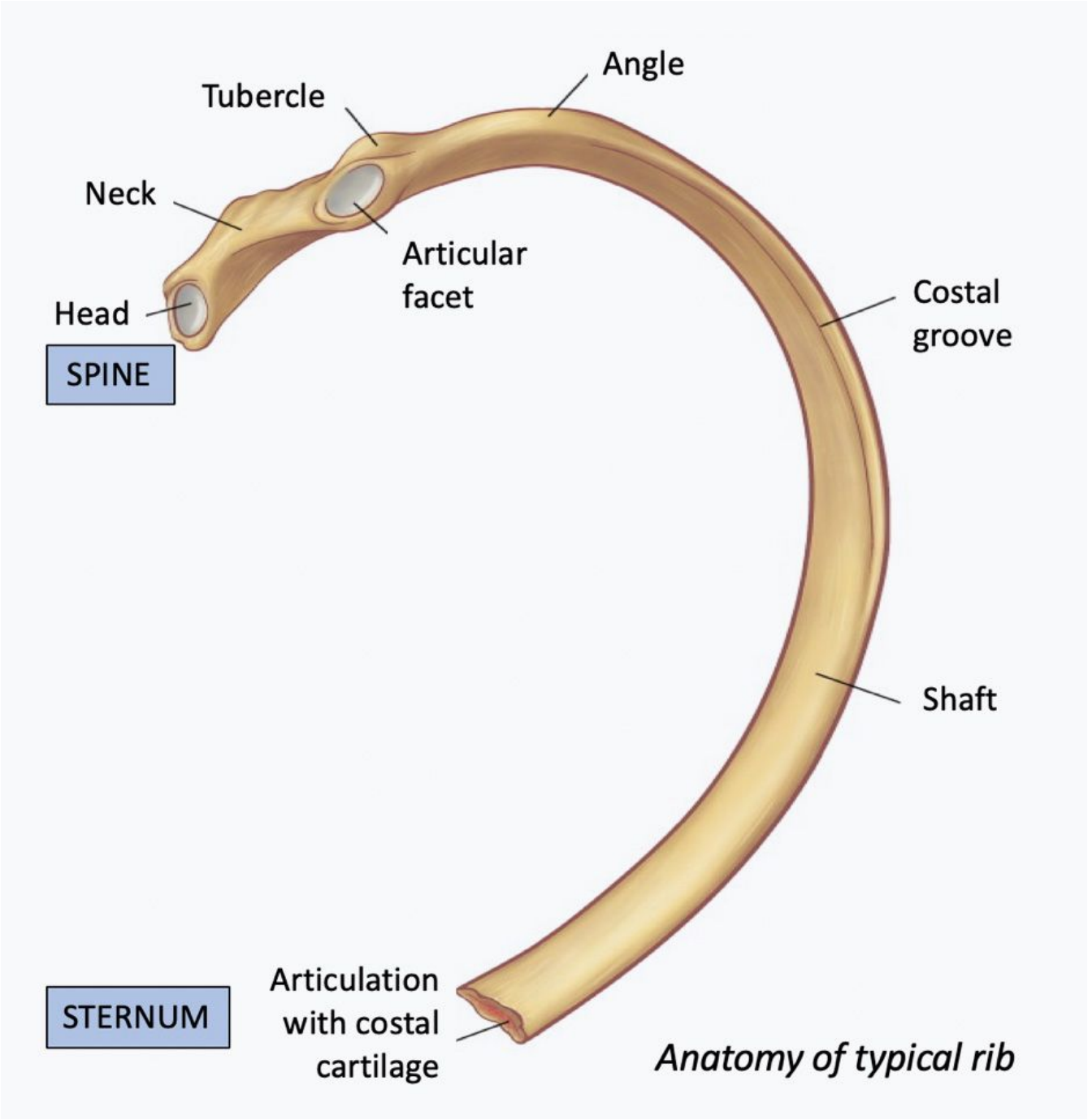
- found on the inner & inferior margin of the rib
- serves to protect the costal nerves & blood vessels

Costal Cartilage

- provides articulation to the sternum

Sternal End

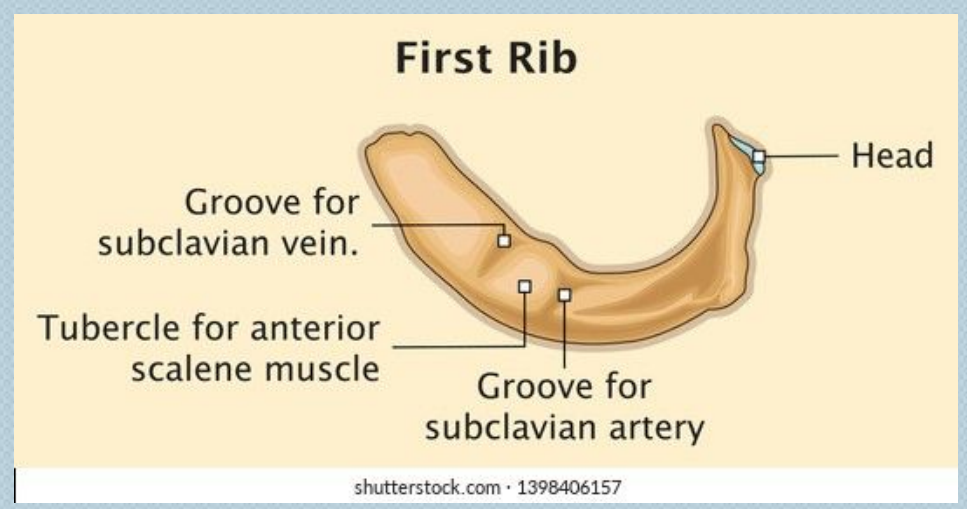
- the most anterior end of a rib



Anatomy of typical rib

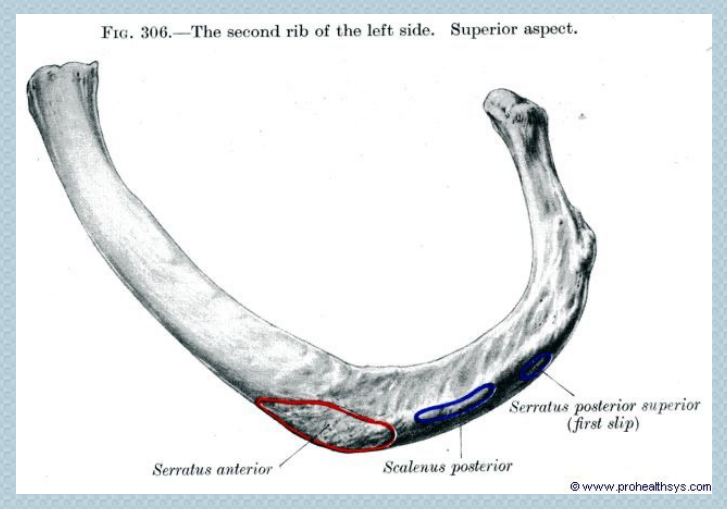
Atypical rib structure

First Rib



- shortest, widest
- has the sharpest angle
- has only one articular surface
  - articulates with T1
- 2 grooves
  - for the subclavian vein & artery
- attachment site for muscles
  - anterior scalene

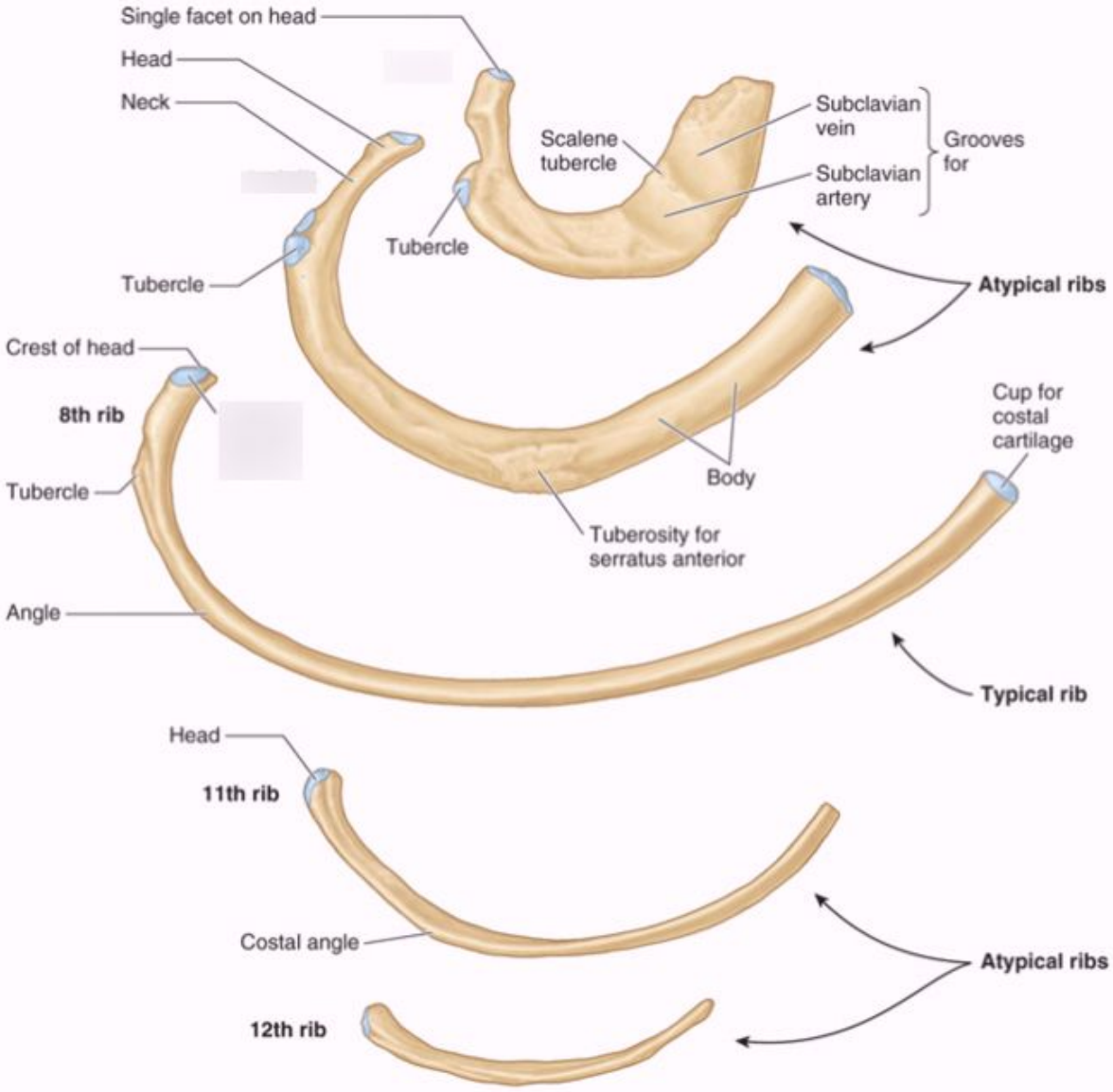
Second Rib

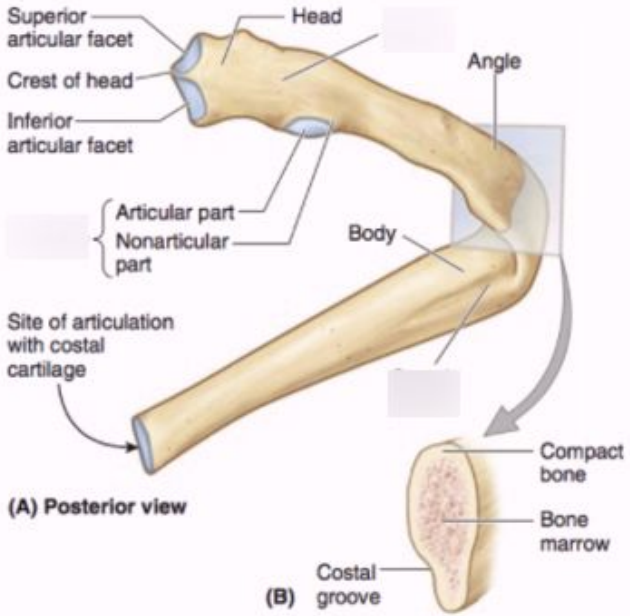


- thinner & longer than the first rib
- two facets
  - articulate with T1 & T2
- contains a roughened tuberosity*
  - superiorly
  - attachment site for serratus anterior
- also an attachment site for posterior scalenes

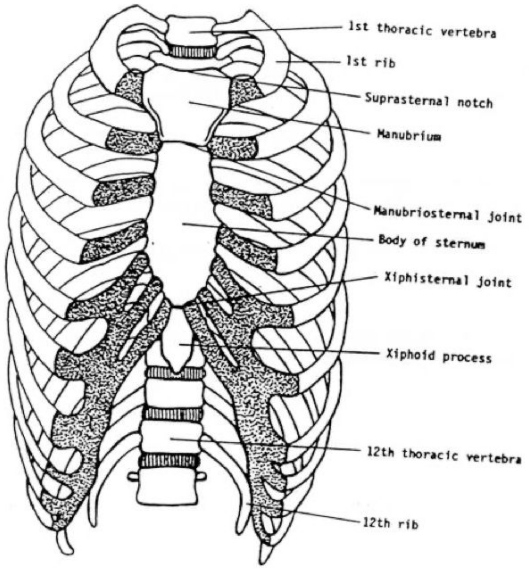
Ribs 10, 11, 12

- 10, 11, 12
  - only have one facet on the head and only articulate with a single vertebra
- 11 & 12
  - short
  - have no neck or tubercle


Single facet on head
Head
Neck
Tubercle
Tubercle
Scalene tubercle
Subclavian vein
Subclavian artery
Grooves for
Atypical ribs
Crest of head
8th rib
Tubercle
Angle
Body
Tuberosity for serratus anterior
Cup for costal cartilage
Typical rib
Head
11th rib
Costal angle
12th rib
Atypical ribs


Superior articular facet
Crest of head
Inferior articular facet
Head
Angle
Articular part
Nonarticular part
Body
Site of articulation with costal cartilage
(A) Posterior view
Compact bone
Bone marrow
Costal groove
(B)

Thorax Articulations



Articulations

Articulations:

- ribs join **posteriorly** with the respective **vertebrae** of the same number
  - ex: first T-spine vertebrae with 1st rib

- ribs join **anteriorly** via the **costal cartilage (hyaline)** to the sternum; either directly or indirectly
  - some do not connect anteriorly at all

Anterior Joints of the Rib Cage

Sternocostal Joints

- aka: sternochondral or chondrosternal joints

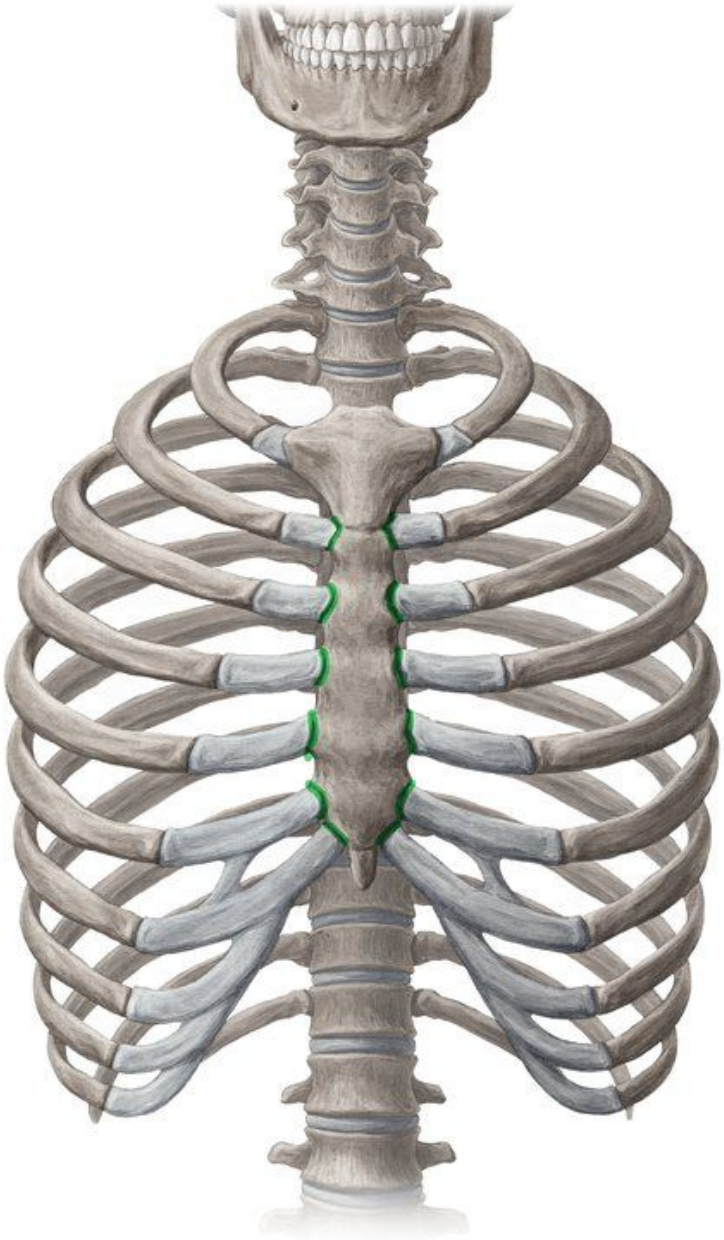
- Ribs 2-7
  - rib 1 is an exception
  - rib 2 articulates with the sternal angle of the manubrium
  - rib 7 articulates with the xiphoid process of the sternum
  - rib 3-6 articulate on the body

- articulations:
  - costal notches of the sternum (lateral border) → sternal ends of ribs 2-7

- structurally:
  - synovial, plane
- functionally:
  - diarthrotic, uniaxial

Anterior Joints of the Rib Cage

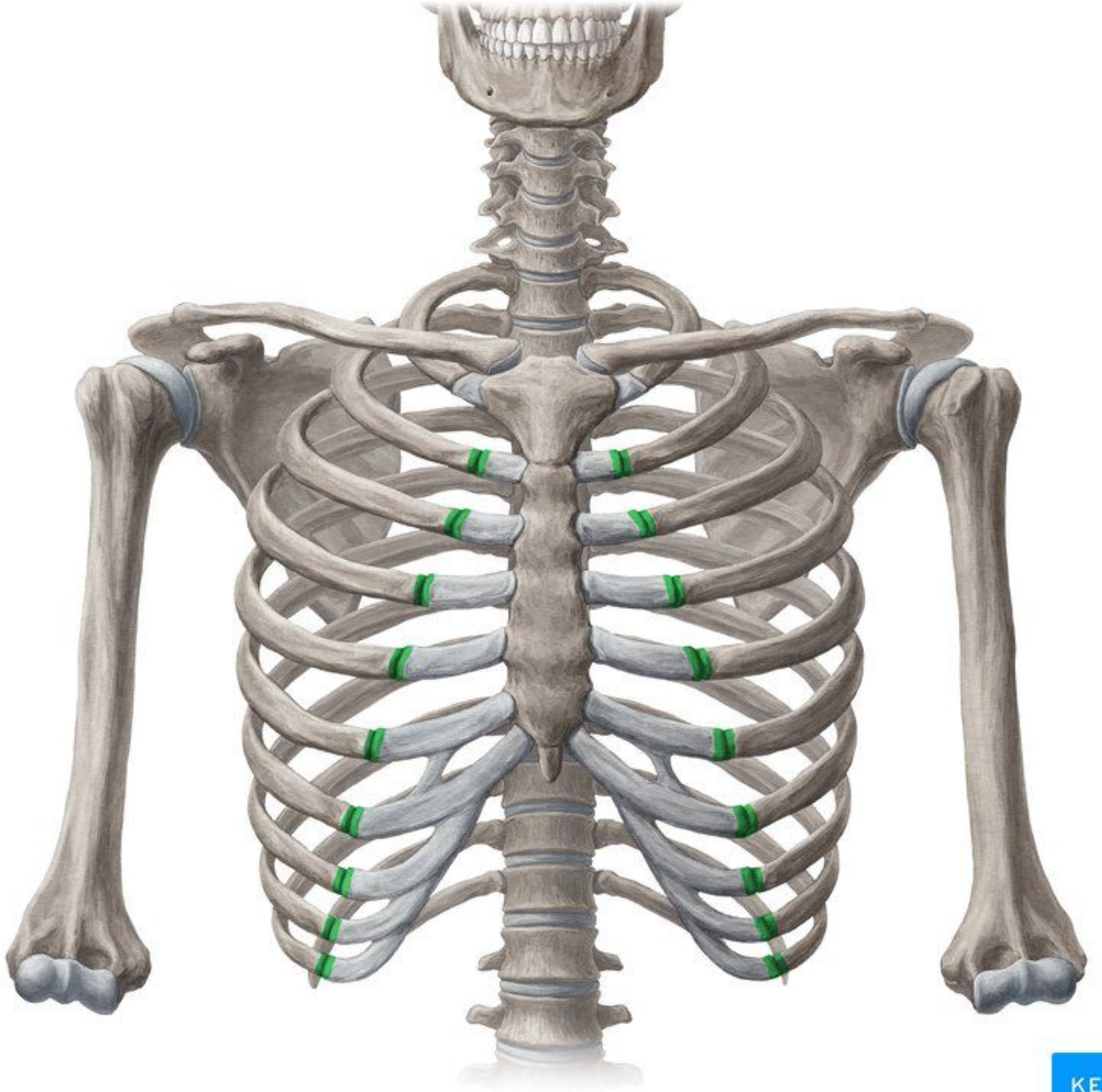
- Rib 1
- articulations:
  - costal end of the rib → manubrium
- structurally:
  - cartilaginous
- functionally:
  - synarthrotic - almost no movement



Anterior Joints of the Rib Cage

Costochondral Joints

- found in ribs 1-10
- articulations:
  - sternal end of ribs → respective costal cartilages
- structurally:
  - cartilaginous
- functionally:
  - synarthrotic (immobile)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Posterior Joints of the Rib Cage

*All 12 ribs articulate posteriorly with a vertebrae; posteriorly each rib will form two joints:

- Costovertebral Joint

- articulations:
  - ribs 2-9
    - head of the rib → superior costal facet of the numerically corresponding vertebrae & inferior costal facet the vertebra directly above
      - ex: rib 2 articulates with T1 & T2
  - ribs 1, 10, 11, 12
    - head of the rib → numerically corresponding vertebra (only one articulation)
- structurally:
  - synovial, plane
- functionally:
  - diarthrotic, uniaxial


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Posterior Joints of the Rib Cage

- Costotransverse Joint
- articulations:
  - tubercle of the rib → transverse costal facet of corresponding vertebrae
    - only the upper 10 ribs articulate in this articulation
- structurally:
  - synovial, plane
- functionally:
  - diarthrotic, uniaxial


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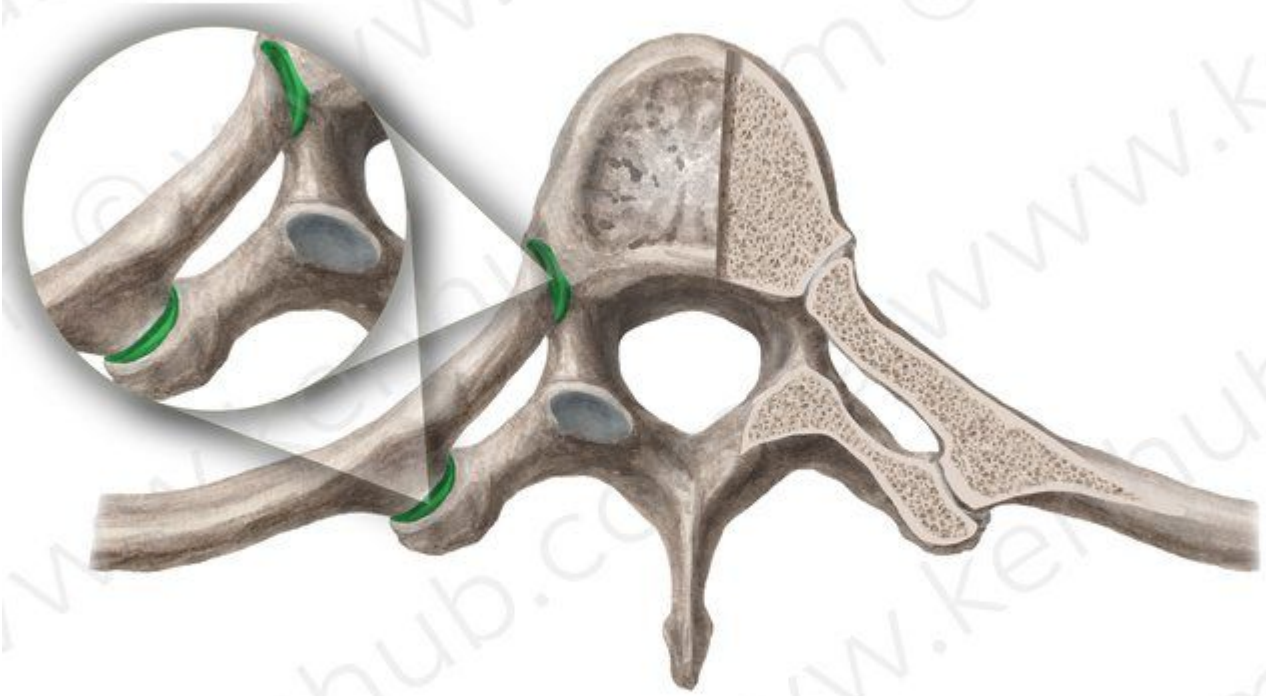


Motion during breathing

Respiration

- inspiration
  - active
- the volume (space) of the thoracic cavity is increased as the chest expands
- the pressure within the lungs drops below the atmospheric pressure outside of the lungs
- air moves from high → low pressure
- during inhalation air rushes into the lungs
- there are three mechanisms of inspiration:

Pump Handle Mechanism

- increase in anterior-posterior diameter of the rib cage
- the sternum is actively elevated during inspiration
- the shape of the ribs and their downward orientation at rest result in forward movement of the chest wall
- the costovertebral joints are what allow for this movement

Bucket Handle Mechanism

- an increase in the transverse diameter of the rib cage

- the curved shape of the ribs allow for an increase in the transverse diameter of the thoracic cavity as the ribs are elevated

Caliper

- an increase in the superior-inferior diameter of the rib cage
- the rib cage elevates in a vertical diameter
- the greatest increase vertically occurs due to the contraction of the diaphragm muscle which allows for an increase in the length of the lungs

Expiration

- exhalation
  - passive
- involves the reversal of the three mechanisms of respiration
  - decreases the volume of the thoracic cavity
- in expiration, the atmospheric pressure is higher inside the lungs than outside the lungs
- the air in the lungs is forced out as the lungs begin to relax

Rib motion

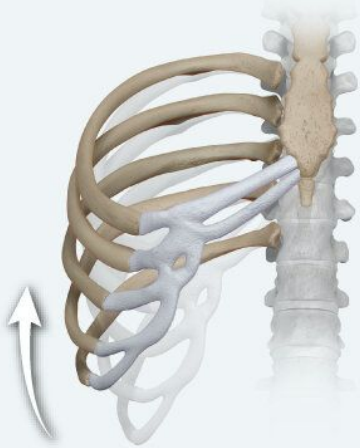
Ribs 1-5

"Pump handle" motion

- Superior/anterior (inhalation)
- Inferior/posterior (exhalation)

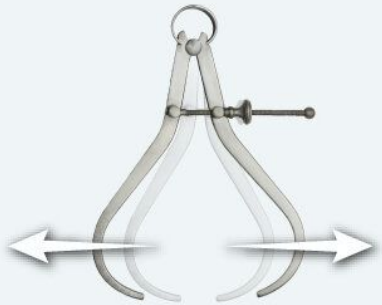
Ribs 6-10

"Bucket handle" motion



- Lateral/superior (inhalation)
- Medial/inferior (exhalation)

Ribs 11-12



"Caliper" motion

- Lateral (inhalation)
- Medial (exhalation)

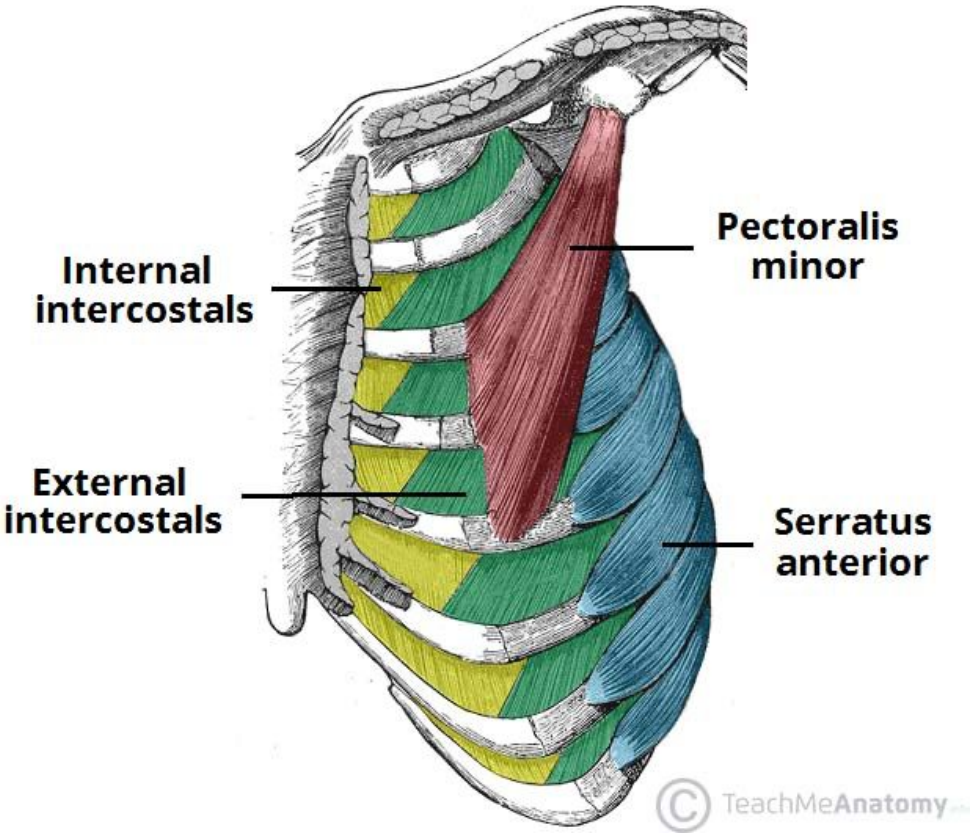
Muscles of Respiration

Muscles of Respiration

- intercostal space
  - the space between the ribs
  - occupied by intercostals muscles, nerves and blood vessels

- Intercostal muscles
  - external intercostals muscles
    - active during inspiration
  - internal intercostals muscles
    - active during FORCED expiration

[Intercostal Muscles - Function, Area & Course - Human Anatomy | Kenhub]



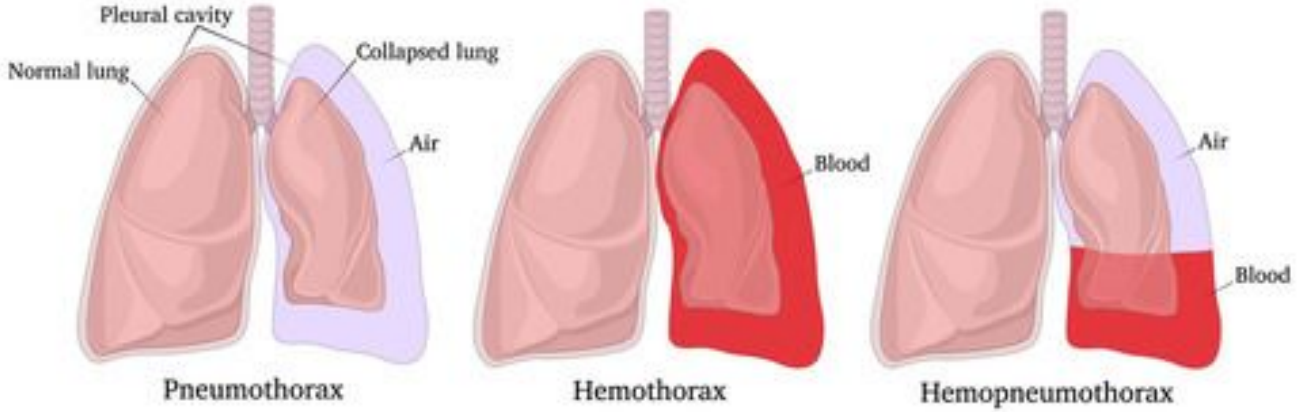
Injuries

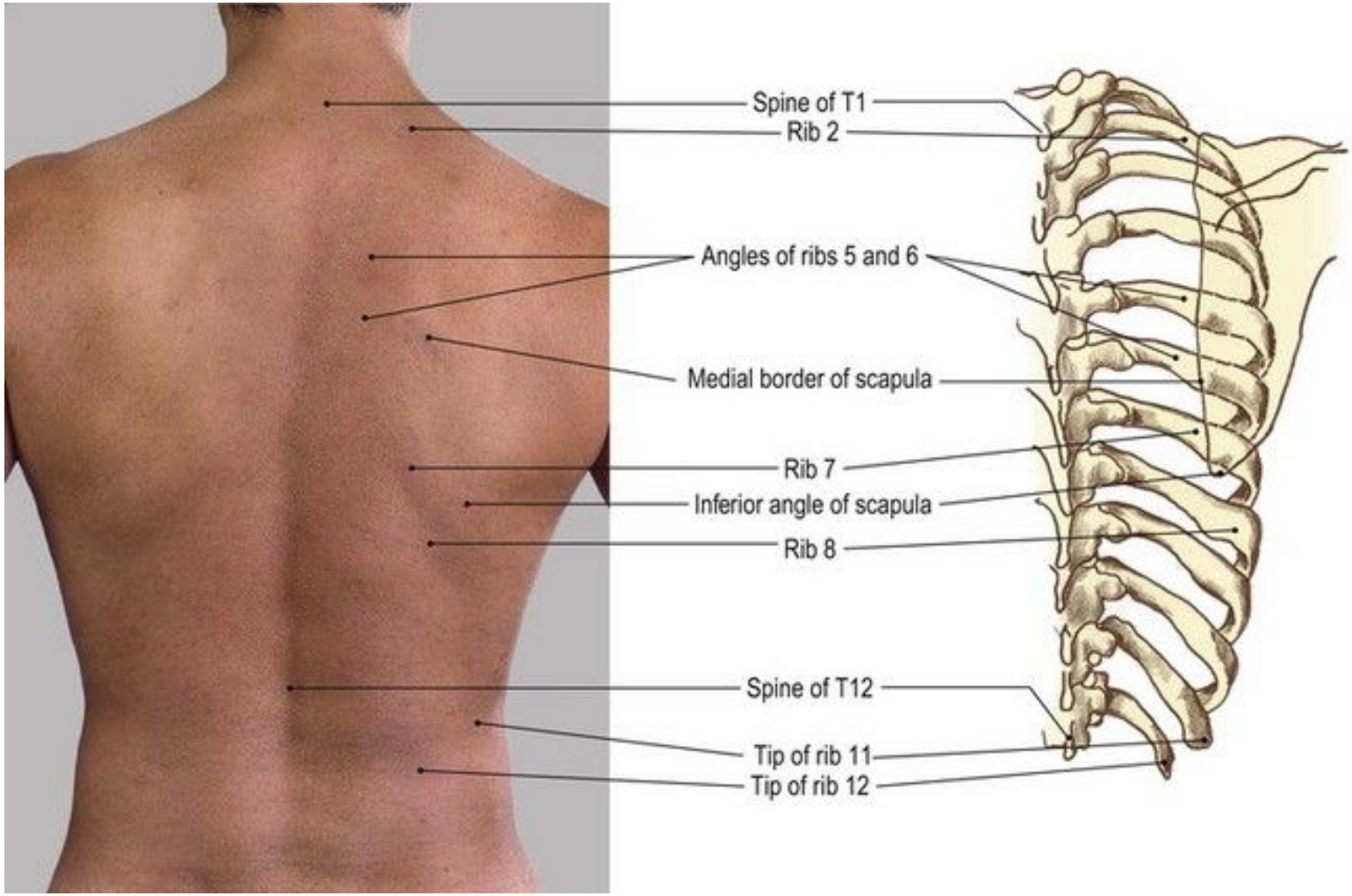
Injury to the Pleural cavity

- Pneumothorax
  - the introduction of air into the pleural cavity via sharp object; equal air pressure inside & outside of the lungs results in a collapsed lung
    - ex: bullet or broken rib

- Hemothorax
  - the introduction of blood into the pleural cavity

Pneumothorax, Hemothorax and Hemopneumothorax




Spine of T1
Rib 2
Angles of ribs 5 and 6
Medial border of scapula
Rib 7
Inferior angle of scapula
Rib 8
Spine of T12
Tip of rib 11
Tip of rib 12