# Histology — tissues · Lab 3

Cartilage and bone

| | |
|---|---|
| **When** | Monday 9 November 2026, 12:15–14:30 |
| **Room** | A5/018 |
| **Teacher** | dr hab. prof. UR Agata Wawrzyniak |
| **Group** | Lab group 2 |
| **Same day** | Lecture 5, 08:00–09:30, A5/4: Cartilage and bone |

## What the lab covers

The supporting connective tissues: cartilage (hyaline, elastic, fibrous) and compact lamellar bone.

## How it is graded

- Recognising histological slides
- Attendance
- Two tests (at least 15 single- or multiple-choice questions each, one resit) and a practical in the winter semester
- A correctly completed exercise notebook
- Activity

The final practical exam: 15 slides under the microscope, a minute each, 60% to pass.

**Bring: the exercise notebook (it is graded)**

## In this pack


| | | |
|---|---|---|
| 1 | Recognising the slides (4) | page 2 |
| 2 | Practice figures: name each numbered structure (8) | page 5 |
| 3 | Key points | page 13 |
| 4 | Light-microscope checklist | page 14 |
| 5 | Self-test: 15 single-choice questions | page 15 |
| | Answers: practice figures | page 16 |
| | Answers: self-test | page 16 |


Every picture carries its author, licence and source. Licences here: CC BY 3.0, CC BY-NC-SA 4.0, CC0. A share-alike picture stays under its licence, the numbered copies too. All packs: medicine.kazimiri.com/semester-1/print/

# 1 · Recognising the slides

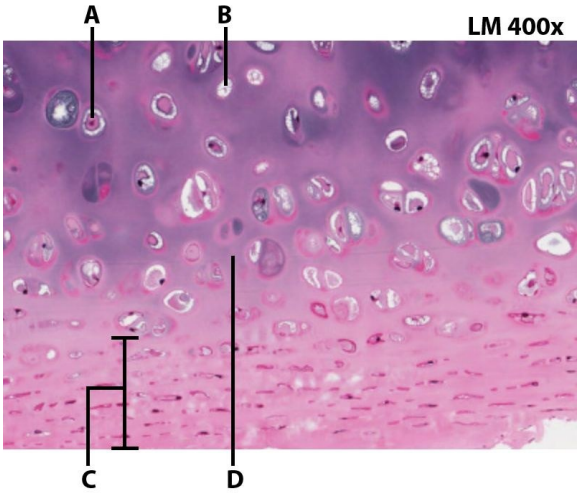
Each tissue as the Slide Box shows it: its slides, how to recognise it, and what not to confuse it with. Test yourself online: medicine.kazimiri.com/semester-1/slides/?lab=3&m=test

## Hyaline cartilage · chrząstka szklista



Hyaline cartilage (200x): chondrocytes sit in lacunae in a smooth, glassy matrix, under a fibrous perichondrium.

Berkshire Community College Bioscience Image Library · CC0 · commons.wikimedia.org/wiki/File:Connective_Tissue_Hyaline_Cartilage_(26989336187).jpg




Real slide (400x): hyaline cartilage, chondrocytes in lacunae in a smooth matrix, under a perichondrium.

Jennifer Lange; slide: Regents of the University of Michigan Medical School · CC BY-NC-SA 4.0 · med.libretexts.org/Bookshelves/Anatomy_and_Physiology/Human_Anatomy_(Lange_et_al.)/03%3A_Tissue_Level_of_Organization/3.08%3A_Anatomical_Atlas_-_Tissues

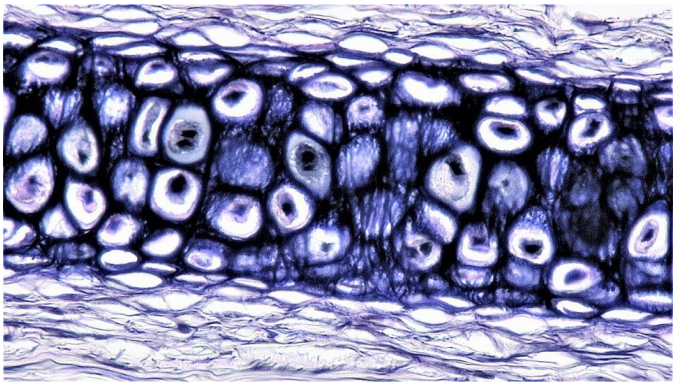
### How to recognise it

- A smooth, glassy matrix with no visible fibres.
- Chondrocytes in lacunae, often in isogenous groups of 2-4 cells.
- A perichondrium of dense connective tissue around it (except on joint surfaces).
- Trachea and bronchi, costal cartilage, articular surfaces, epiphyseal plate.

**Don't confuse with:** Elastic cartilage: dark fibres in the matrix. Bone: lamellae and canals.

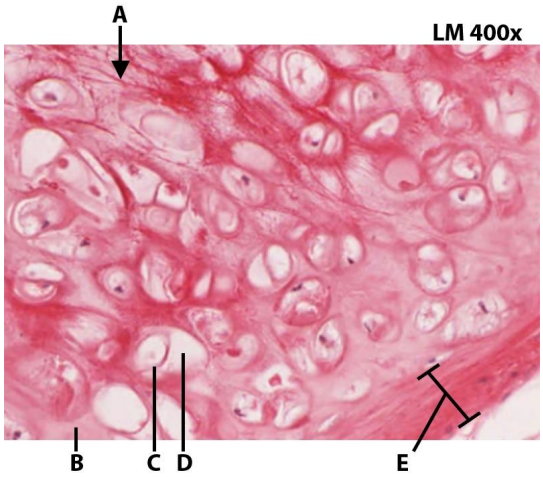
---

## Elastic cartilage · chrząstka sprężysta



Elastic cartilage (400x), stained for elastic fibres: a dark meshwork of fibres around the chondrocytes.

Berkshire Community College Bioscience Image Library · CC0 · commons.wikimedia.org/wiki/File:Connective_Tissue_Elastic_Cartilage_(41855666711).jpg




Real slide (400x): elastic cartilage, chondrocytes in lacunae among elastic fibres, under a perichondrium.

Jennifer Lange; slide: Regents of the University of Michigan Medical School · CC BY-NC-SA 4.0 · med.libretexts.org/Bookshelves/Anatomy_and_Physiology/Human_Anatomy_(Lange_et_al.)/03%3A_Tissue_Level_of_Organization/3.08%3A_Anatomical_Atlas_-_Tissues

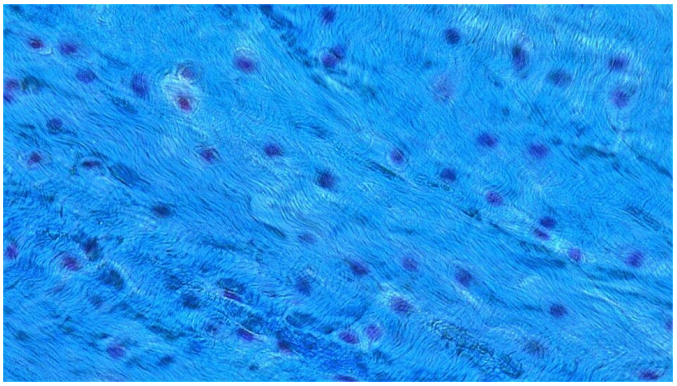
### How to recognise it

- Chondrocytes in lacunae, like hyaline cartilage…
- …but the matrix is packed with dark elastic fibres (orcein or elastic stain).
- A perichondrium. Auricle, epiglottis, external acoustic meatus.

**Don't confuse with:** Hyaline cartilage: a smooth matrix without fibres.

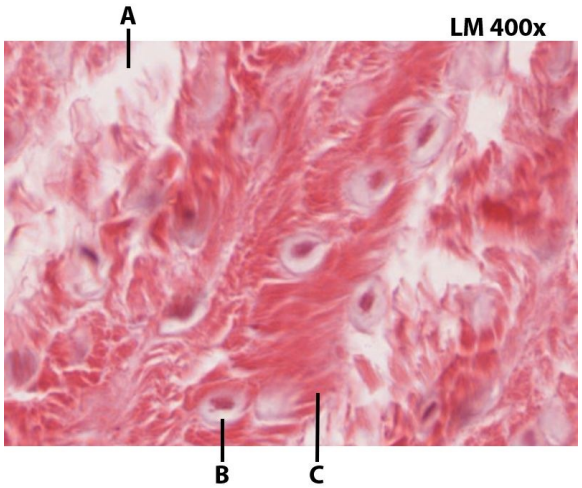
---

## Fibrocartilage · chrząstka włóknista



Fibrocartilage (400x): chondrocytes in rows between thick bundles of collagen.

Berkshire Community College Bioscience Image Library · CC0 · commons.wikimedia.org/wiki/File:Connective_Tissue_Fibrocartilage_(27988652098).jpg




Real slide (400x): fibrocartilage, chondrocytes between bundles of collagen.

Jennifer Lange; slide: Regents of the University of Michigan Medical School · CC BY-NC-SA 4.0 · med.libretexts.org/Bookshelves/Anatomy_and_Physiology/Human_Anatomy_(Lange_et_al.)/03%3A_Tissue_Level_of_Organization/3.08%3A_Anatomical_Atlas_-_Tissues

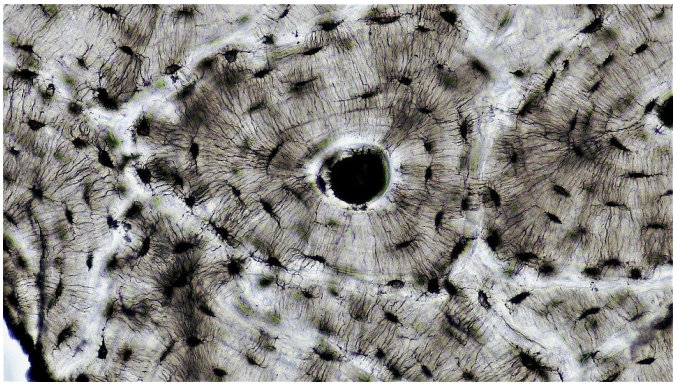
### How to recognise it

- Thick parallel collagen bundles, like a tendon…
- …with rows or small groups of chondrocytes in lacunae between them.
- No perichondrium. Intervertebral discs, pubic symphysis, menisci.

**Don't confuse with:** Dense regular connective tissue: flat fibroblast nuclei, no lacunae.

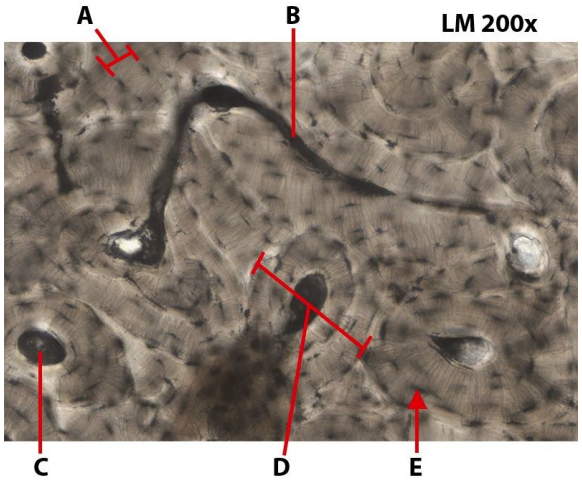
---

## Compact lamellar bone · tkanka kostna blaszkowata zbita



Compact bone, ground section (200x): an osteon, with the central (Haversian) canal ringed by lamellae, lacunae and fine canaliculi.

Berkshire Community College Bioscience Image Library · CC0 · commons.wikimedia.org/wiki/File:Connective_Tissue_Compact_Bone_(41068142774).jpg




Real slide (200x): compact bone, osteons with central and perforating canals, and lacunae in concentric lamellae.

Jennifer Lange; slide: Regents of the University of Michigan Medical School · CC BY-NC-SA 4.0 · med.libretexts.org/Bookshelves/Anatomy_and_Physiology/Human_Anatomy_(Lange_et_al.)/05%3A_Bone_Tissue_and_Skeletal_System/5.08%3A_Anatomical_Atlas_-_Bone_Tissue_and_Bone_Structure

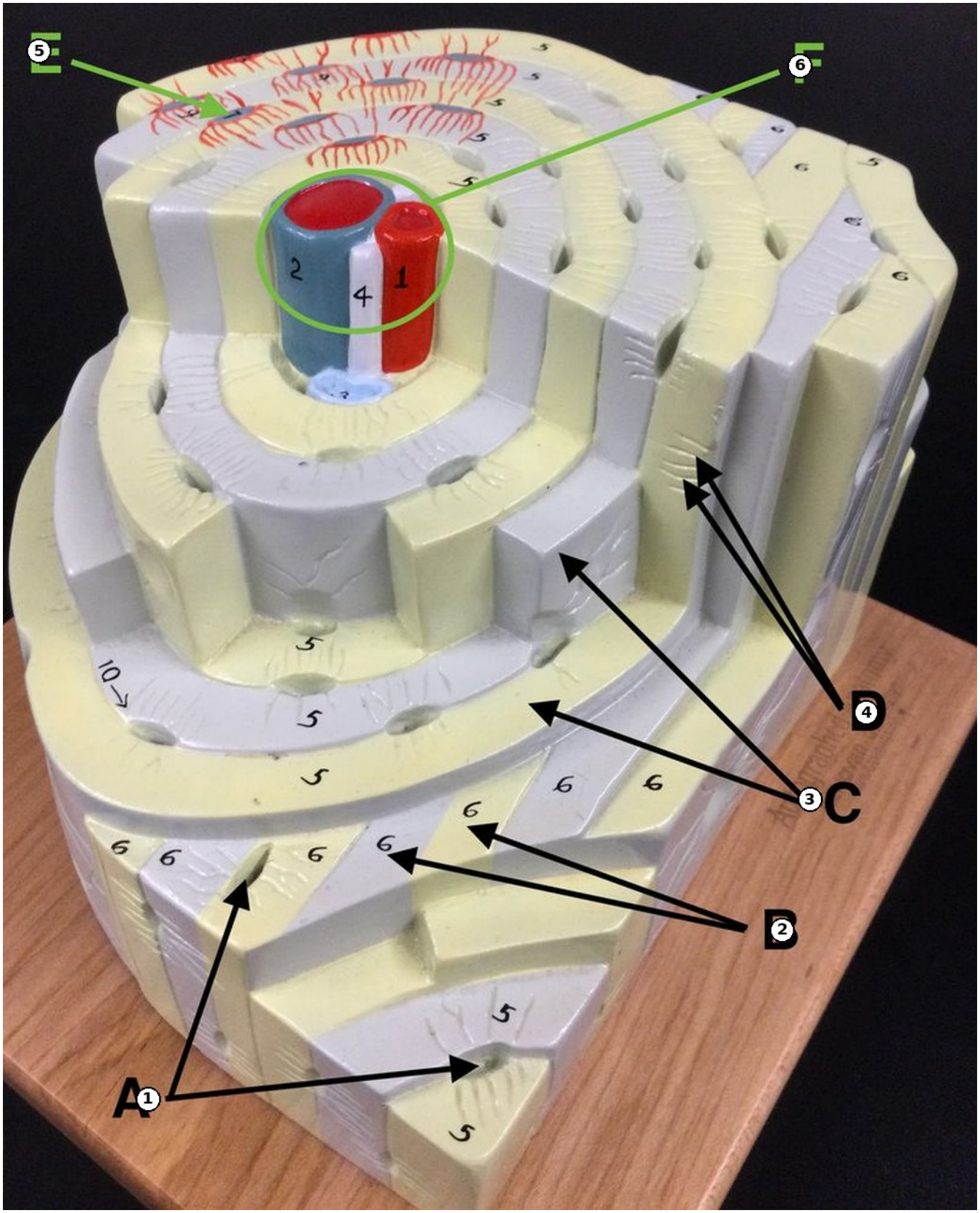
### How to recognise it

- Osteons: rings of lamellae round a central (Haversian) canal.
- Dark lacunae between the lamellae, with fine canaliculi radiating from them (clearest in a ground section).
- Interstitial lamellae fill the gaps between osteons; Volkmann canals cross them.

**Don't confuse with:** Hyaline cartilage: lacunae too, but no concentric lamellae and no canals.

---

# A model of one unit of compact bone




**1** _____ **2** _____

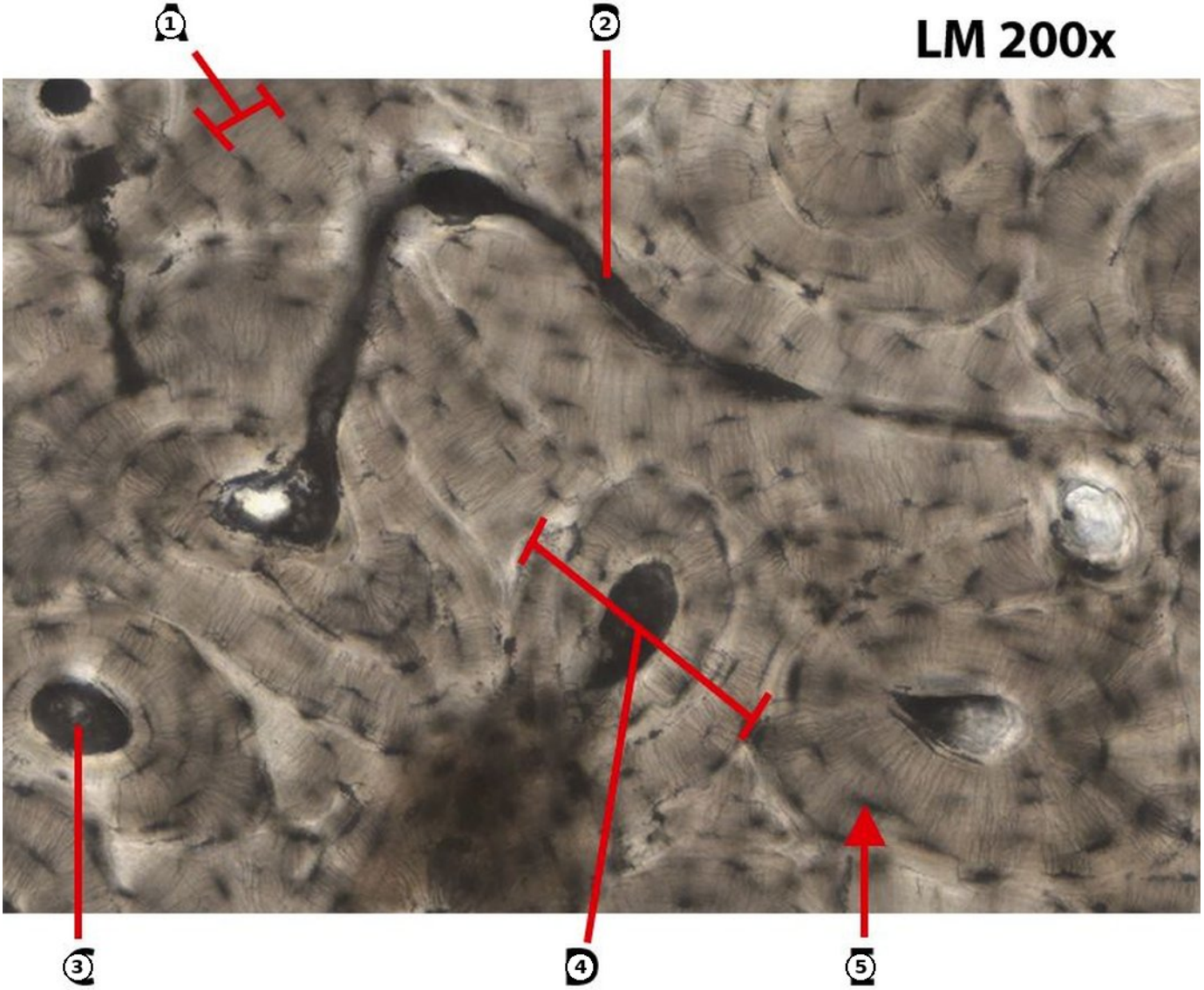
**3** _____ **4** _____

**5** _____ **6** _____

Practise online: medicine.kazimiri.com/semester-1/label/?map=subj-histology-dc42bfcddf

Credit: Jennifer Lange · CC BY-NC-SA 4.0 ·
med.libretexts.org/Bookshelves/Anatomy_and_Physiology/Human_Anatomy_(Lange_et_al.)/05%3A_Bone_Tissue_and_Skeletal_System/5.08%3A_Anatomical_A

## Compact bone, on a real slide




**1** _____ **2** _____

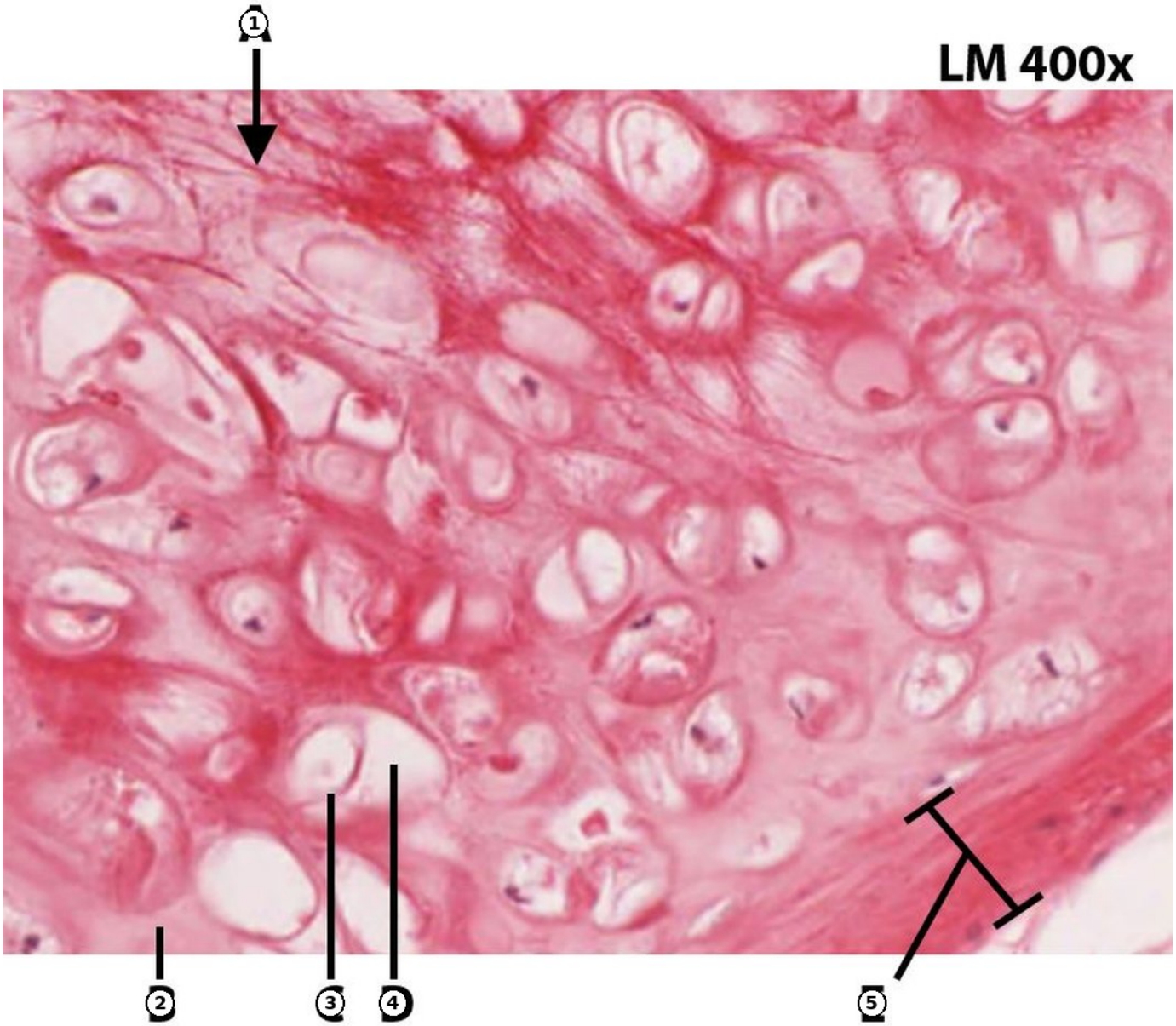
**3** _____ **4** _____

**5** _____

Practise online: medicine.kazimiri.com/semester-1/label/?map=subj-histology-919183a8f5

Credit: Jennifer Lange; slide: Regents of the University of Michigan Medical School · CC BY-NC-SA 4.0 ·
med.libretexts.org/Bookshelves/Anatomy_and_Physiology/Human_Anatomy_(Lange_et_al.)/05%3A_Bone_Tissue_and_Skeletal_System/5.08%3A_Anatomical_A

## Elastic cartilage, on a real slide




**1** _____ **2** _____

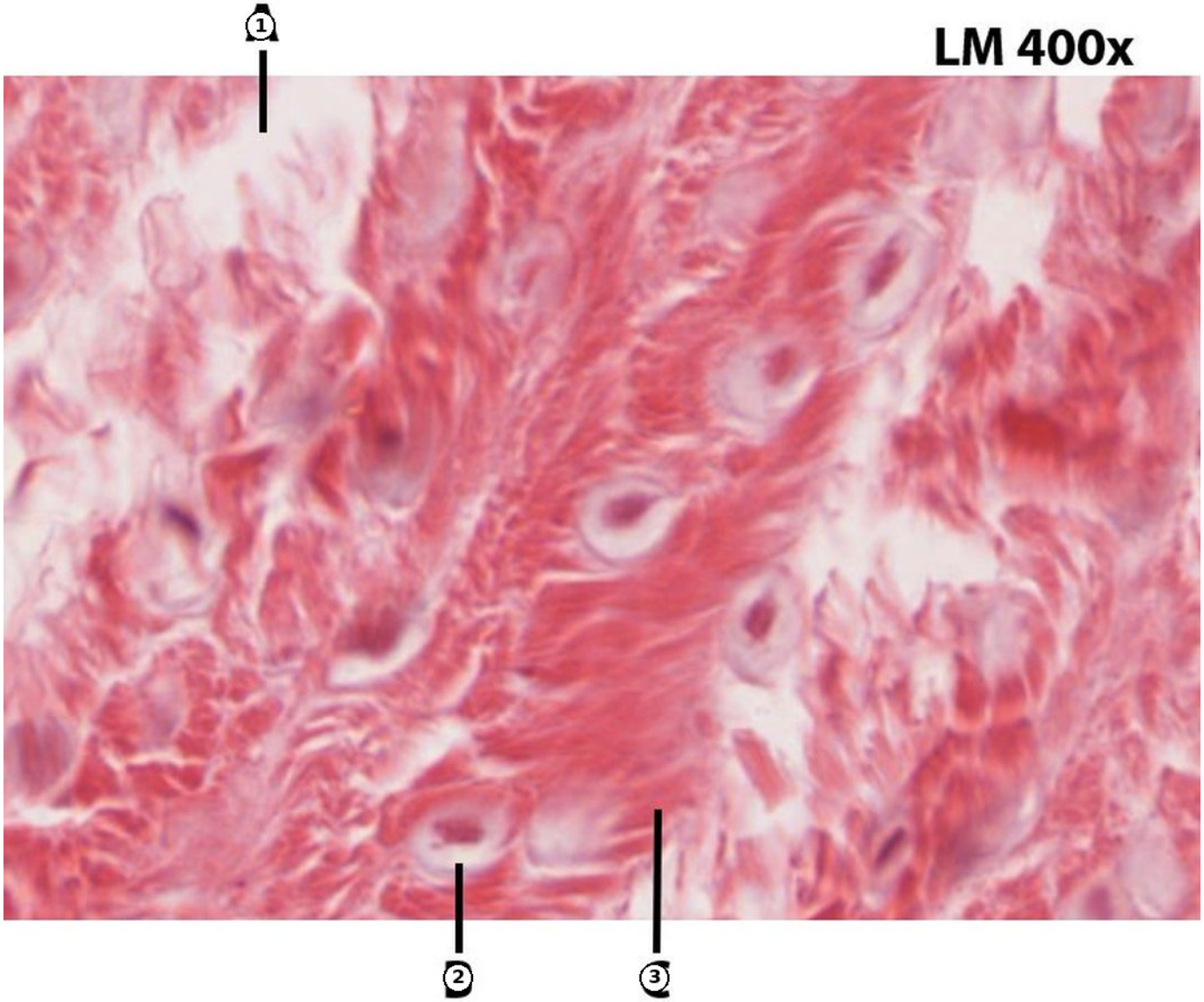
**3** _____ **4** _____

**5** _____

Practise online: medicine.kazimiri.com/semester-1/label/?map=subj-histology-572c9ee3c1

Credit: Jennifer Lange; slide: Regents of the University of Michigan Medical School · CC BY-NC-SA 4.0 ·
med.libretexts.org/Bookshelves/Anatomy_and_Physiology/Human_Anatomy_(Lange_et_al.)/03%3A_Tissue_Level_of_Organization/3.08%3A_Anatomical_Atlas_-

## Fibrocartilage, on a real slide



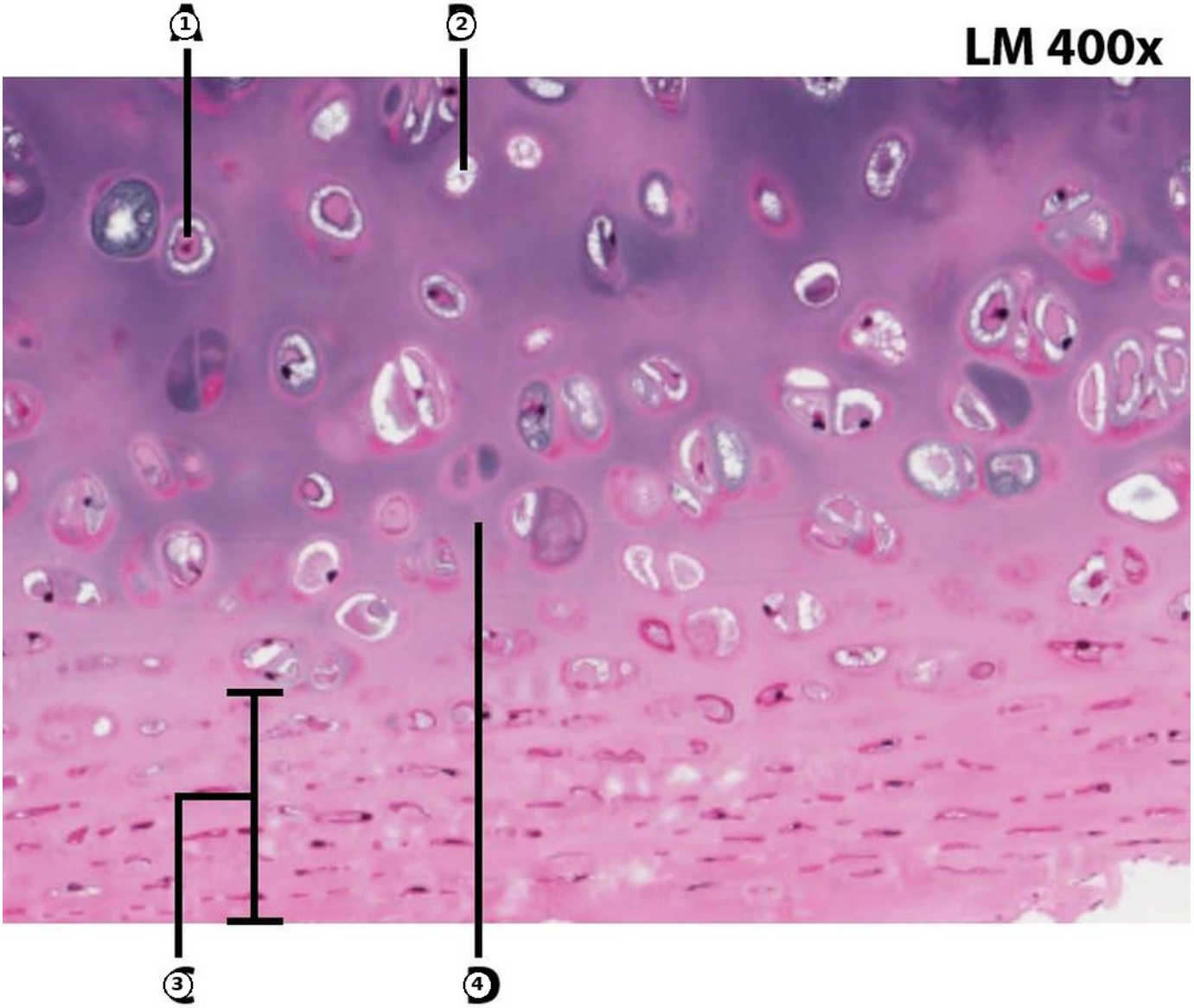

**1** _____ **2** _____

**3** _____

Practise online: medicine.kazimiri.com/semester-1/label/?map=subj-histology-f1b4f13da7

Credit: Jennifer Lange; slide: Regents of the University of Michigan Medical School · CC BY-NC-SA 4.0 ·
med.libretexts.org/Bookshelves/Anatomy_and_Physiology/Human_Anatomy_(Lange_et_al.)/03%3A_Tissue_Level_of_Organization/3.08%3A_Anatomical_Atlas_-

## Hyaline cartilage, on a real slide



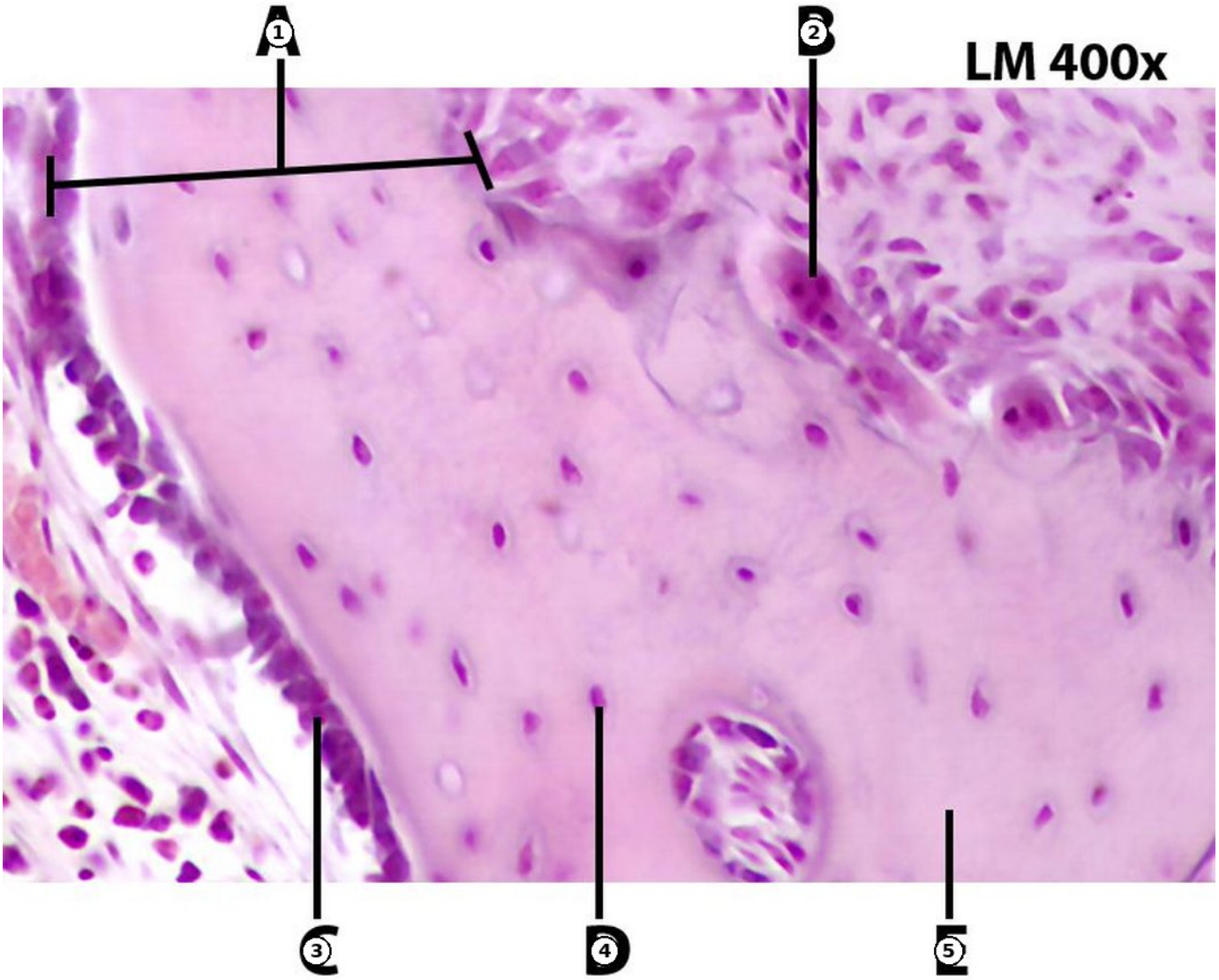

**1** _____ **2** _____

**3** _____ **4** _____

Practise online: medicine.kazimiri.com/semester-1/label/?map=subj-histology-c6ddc5b31a

Credit: Jennifer Lange; slide: Regents of the University of Michigan Medical School · CC BY-NC-SA 4.0 ·
med.libretexts.org/Bookshelves/Anatomy_and_Physiology/Human_Anatomy_(Lange_et_al.)/03%3A_Tissue_Level_of_Organization/3.08%3A_Anatomical_Atlas_-

## Spongy bone, on a real slide




**1** _____ **2** _____

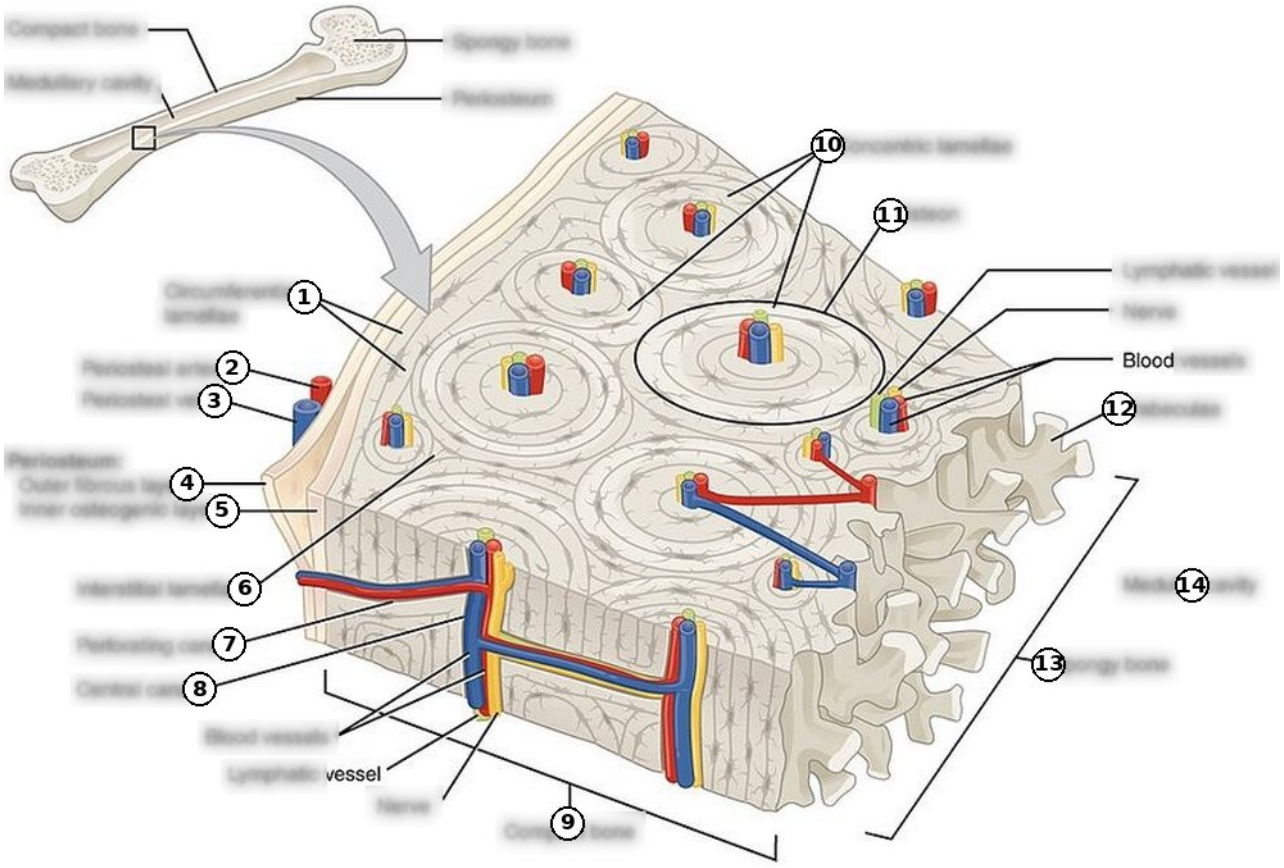
**3** _____ **4** _____

**5** _____

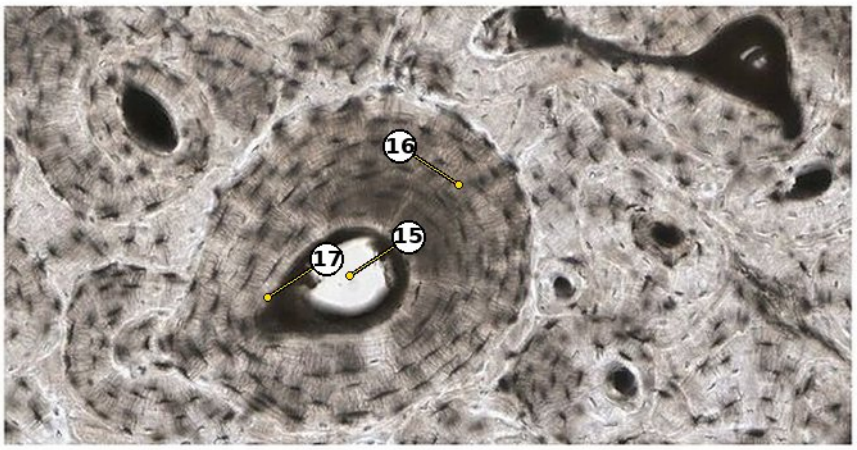
Practise online: medicine.kazimiri.com/semester-1/label/?map=subj-histology-a5ce2102fb

Credit: Jennifer Lange; slide: Regents of the University of Michigan Medical School · CC BY-NC-SA 4.0 ·
med.libretexts.org/Bookshelves/Anatomy_and_Physiology/Human_Anatomy_(Lange_et_al.)/05%3A_Bone_Tissue_and_Skeletal_System/5.08%3A_Anatomical_A

## The wall of a long bone, drawn and on a real slide




(a)

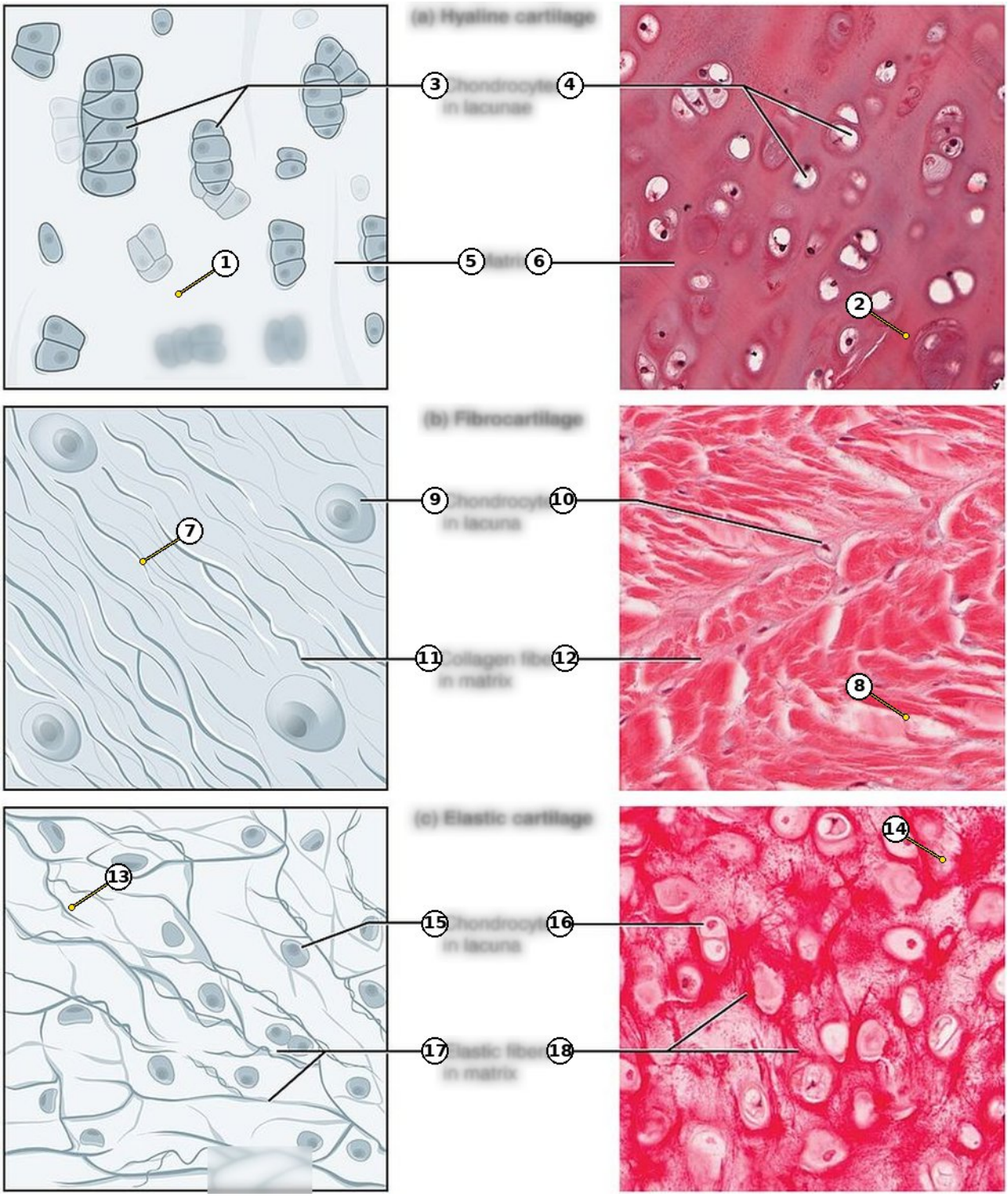



(b)

| | | |
|---|---|---|
| **1** _____ | **2** _____ | **3** _____ |
| **4** _____ | **5** _____ | **6** _____ |
| **7** _____ | **8** _____ | **9** _____ |
| **10** _____ | **11** _____ | **12** _____ |
| **13** _____ | **14** _____ | **15** _____ |
| **16** _____ | **17** _____ | |

Practise online: medicine.kazimiri.com/semester-1/label/?map=subj-histology-6acbcc2a98
Credit: OpenStax College · CC BY 3.0 · commons.wikimedia.org/wiki/File:624_Diagram_of_Compact_Bone-new.jpg

## Three kinds of cartilage, drawn and on real slides




| | | |
|---|---|---|
| **1** | **2** | **3** |
| **4** | **5** | **6** |
| **7** | **8** | **9** |
| **10** | **11** | **12** |
| **13** | **14** | **15** |
| **16** | **17** | **18** |

Practise online: medicine.kazimiri.com/semester-1/label/?map=subj-histology-b318bb3744
Credit: OpenStax College · CC BY 3.0 · commons.wikimedia.org/wiki/File:412_Types_of_Cartilage-new.jpg

# 3 · Key points

The site's key points for these classes, word for word.

## Lab 3 · Cartilage and bone

### Cartilage and bone

- Hyaline (articular surfaces, costal cartilage, trachea), elastic (auricle, epiglottis), fibrocartilage (intervertebral discs, pubic symphysis, menisci). Avascular.
- Osteoblasts lay down osteoid; osteocytes sit in lacunae linked by canaliculi; osteoclasts (multinucleated, from monocytes) resorb bone.
- Osteon: a central (Haversian) canal with concentric lamellae; Volkmann's (perforating) canals join them to each other, the periosteum and the marrow cavity.
- Intramembranous ossification: flat bones of the skull. Endochondral: long bones, growing at the epiphyseal plate.
- Cartilage matrix: collagen II (fibrocartilage also has collagen I) among proteoglycan aggregates of aggrecan on hyaluronan, which hold water and resist compression. Chondrocytes sit in lacunae, often in isogenous groups.
- Cartilage has no vessels or nerves and is fed by diffusion from the perichondrium or the synovial fluid, so it heals poorly. It grows appositionally (from the perichondrium) and interstitially (chondrocytes dividing inside).
- Bone matrix is about half mineral by dry weight (Junqueira; some books give two thirds): hydroxyapatite, a calcium phosphate, for hardness; the organic part, mostly collagen I, gives resilience.
- Compact bone is built of osteons; spongy bone of trabeculae with red marrow between them. The periosteum, anchored by Sharpey's fibres, covers bone; the endosteum lines its cavities.
- Osteoclasts resorb bone in Howship's lacunae through a ruffled border; osteoblasts become osteocytes once walled in. Parathyroid hormone increases resorption (through osteoblasts and RANKL); calcitonin reduces it.
- The epiphyseal plate, from the epiphysis: resting, proliferative, hypertrophic, calcified cartilage and ossification zones. Growth in length stops when it closes after puberty.
- Woven bone is laid down first, and in a healing fracture; lamellar bone replaces it.

# 4 · Using the light microscope: checklist

- ☐ Carry the microscope with both hands, one on the arm and one under the base. Lamp at minimum before switching on.
- ☐ Start with the lowest-power objective (4× or 10×) clicked into place. Slide coverslip up, label to the side, held in the mechanical stage.
- ☐ Centre the section over the light with the naked eye first.
- ☐ Watching from the side, raise the stage close to the objective with the coarse focus. Then, looking through the eyepieces, focus by moving the stage AWAY from the objective. Set the eyepiece distance for your eyes.
- ☐ Light: lamp brightness and the condenser's aperture diaphragm. Close the diaphragm for more contrast, open it for more resolution.
- ☐ Higher power: turn the nosepiece; at 40× use the fine focus only.
- ☐ Oil immersion (100×), only when the teacher allows it: a drop of oil on the coverslip, swing in the 100× objective, fine focus only. Never let the 40× objective touch the oil. Wipe oil off the lens and the slide with lens paper afterwards.
- ☐ Total magnification = objective × eyepiece (40 × 10 = 400×). The light microscope resolves about 0.2 µm.
- ☐ At the end: lowest objective in place, stage down, slide out, lamp at minimum and off, dust cover on.

# 5 · Self-test: 15 single-choice questions

From the site's Histology — tissues quiz (Cartilage and bone). One answer is right in each; circle it. Give yourself about a minute a question. The answers are on the last page.

**1.** Elastic cartilage is found in:

**A** intervertebral discs
**B** the auricle
**C** articular surfaces
**D** costal cartilages

**2.** Flat bones of the skull form by:

**A** endochondral ossification
**B** appositional growth only
**C** intramembranous ossification
**D** metaplasia

**3.** Which cartilage has no perichondrium?

**A** hyaline (outside joints)
**B** elastic
**C** fibrocartilage
**D** all of them have one

**4.** Cartilage heals poorly because it:

**A** has too many cells
**B** is mineralised
**C** lacks collagen
**D** has no blood vessels

**5.** In the epiphyseal plate, the chondrocytes swell in the:

**A** hypertrophic zone
**B** resting zone
**C** proliferative zone
**D** ossification zone

**6.** Osteoclasts resorb bone through a:

**A** brush border
**B** basal lamina
**C** ruffled border
**D** cilium

**7.** The matrix of hyaline cartilage is made mainly of collagen type:

**A** I
**B** III
**C** IV
**D** II

**8.** Cartilage that grows from within, as chondrocytes divide in their lacunae, grows by:

**A** appositional growth
**B** resorption
**C** mineralisation
**D** interstitial growth

**9.** The structural unit of compact bone is the:

**A** osteon (Haversian system)
**B** trabecula
**C** lacuna
**D** Volkmann canal

**10.** Canals that join the central canals of osteons crosswise are the:

**A** canaliculi
**B** Volkmann (perforating) canals
**C** Howship lacunae
**D** Haversian canals

**11.** The fresh, not yet mineralised matrix laid down by osteoblasts is:

**A** osteoid
**B** hydroxyapatite
**C** periosteum
**D** chondroid

**12.** Long bones grow in length at the:

**A** periosteum
**B** epiphyseal (growth) plate
**C** endosteum
**D** articular cartilage

**13.** Osteocytes keep in touch with each other through:

**A** canaliculi
**B** Volkmann canals
**C** Sharpey fibres
**D** cement lines

**14.** The epiglottis is made of:

**A** hyaline cartilage
**B** fibrocartilage
**C** dense irregular connective tissue
**D** elastic cartilage

**15.** The intervertebral discs' anulus fibrosus and the pubic symphysis are made of:

**A** hyaline cartilage
**B** elastic cartilage
**C** fibrocartilage
**D** dense regular connective tissue

# Answers · practice figures

### Figure 1 · A model of one unit of compact bone

**1** Lacuna
**2** Interstitial lamellae
**3** Concentric lamellae
**4** Canaliculi
**5** Osteocyte
**6** Central canal

### Figure 2 · Compact bone, on a real slide

**1** Concentric lamella
**2** Perforating (Volkmann's) canal
**3** Central (Haversian) canal
**4** Osteon
**5** Lacuna

### Figure 3 · Elastic cartilage, on a real slide

**1** Elastic fibre
**2** Ground substance
**3** Chondrocyte
**4** Lacuna
**5** Perichondrium

### Figure 4 · Fibrocartilage, on a real slide

**1** Ground substance
**2** Chondrocyte
**3** Collagen fibre

### Figure 5 · Hyaline cartilage, on a real slide

**1** Chondrocyte
**2** Lacuna
**3** Perichondrium
**4** Extracellular matrix

### Figure 6 · Spongy bone, on a real slide

**1** Trabecula
**2** Osteoclast
**3** Osteoblast
**4** Osteocyte
**5** Bone matrix

### Figure 7 · The wall of a long bone, drawn and on a real slide

**1** Circumferential lamellae
**2** Periosteal artery
**3** Periosteal vein
**4** Periosteum, outer fibrous layer
**5** Periosteum, inner osteogenic layer
**6** Interstitial lamellae
**7** Perforating canal
**8** Central canal
**9** Compact bone
**10** Concentric lamellae
**11** Osteon
**12** Trabeculae
**13** Spongy bone
**14** Medullary cavity
**15** Central canal
**16** Osteon
**17** Concentric lamellae

### Figure 8 · Three kinds of cartilage, drawn and on real slides

**1** Hyaline cartilage
**2** Hyaline cartilage
**3** Chondrocyte in lacuna
**4** Chondrocyte in lacuna
**5** Matrix
**6** Matrix
**7** Fibrocartilage
**8** Fibrocartilage
**9** Chondrocyte in lacuna
**10** Chondrocyte in lacuna
**11** Collagen fiber
**12** Collagen fiber
**13** Elastic cartilage
**14** Elastic cartilage
**15** Chondrocyte in lacuna
**16** Chondrocyte in lacuna
**17** Elastic fibers
**18** Elastic fibers

# Answers · self-test

**1 B** the auricle — Also the epiglottis.

**2 C** intramembranous ossification — Long bones form on a cartilage model (endochondral).

**3 C** fibrocartilage — Articular hyaline cartilage lacks one too.

**4 D** has no blood vessels — Cartilage has no blood vessels, so cells and nutrients reach it only slowly, by diffusion.

**5 A** hypertrophic zone — From the epiphysis: resting, proliferative, hypertrophic, calcified cartilage and ossification zones; chondrocytes swell in the hypertrophic zone before the matrix calcifies.

**6 C** ruffled border — In pits called Howship's lacunae.

**7 D** II — Chondrocytes in lacunae, fed by diffusion through the matrix (from the perichondrium, or from synovial fluid in articular cartilage, which has none), make fine type II fibrils and aggrecan: the glassy matrix of articular and costal cartilage.

**8 D** interstitial growth — Interstitial growth makes isogenous groups; appositional growth adds new cartilage deep to the perichondrium.

**9 A** osteon (Haversian system) — Concentric lamellae round a central (Haversian) canal; trabeculae belong to spongy bone.

**10 B** Volkmann (perforating) canals — Volkmann canals run across the lamellae, linking central canals with each other and the periosteum.

**11 A** osteoid — Osteoid (mostly type I collagen) mineralises with hydroxyapatite after about 10 days.

**12 B** epiphyseal (growth) plate — Cartilage proliferates at the plate and is replaced by bone on its diaphyseal side; the periosteum adds width.

**13 A** canaliculi — Their slender processes run in canaliculi and meet at gap junctions.

**14 D** elastic cartilage — Elastic cartilage (epiglottis, auricle, auditory tube) springs back into shape.

**15 C** fibrocartilage — Fibrocartilage: rows of chondrocytes between thick type I collagen bundles, where pressure and pull combine.