Histology — tissues · Lab 5

Muscle tissue

When	Monday 23 November 2026, 12:15–14:30
Room	A5/018
Teacher	dr hab. prof. UR Agata Wawrzyniak
Group	Lab group 2
Same day	Lecture 7, 08:00–09:30, A5/4: Muscle tissue

What the lab covers

The muscle tissues, their classification and structure: skeletal striated muscle, cardiac muscle with its conduction system, smooth muscle; the mechanism of contraction.

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

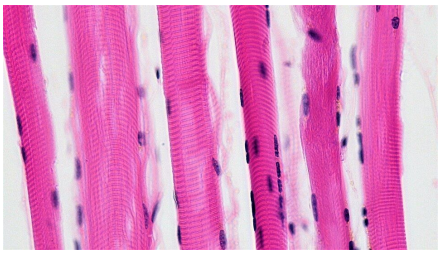
1	Recognising the slides (4)	page 2
2	Practice figures: name each numbered structure (10)	page 4
3	Key points	page 14
4	Light-microscope checklist	page 15
5	Self-test: 8 single-choice questions	page 16
	Answers: practice figures	page 17
	Answers: self-test	page 17

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1 · Recognising the slides

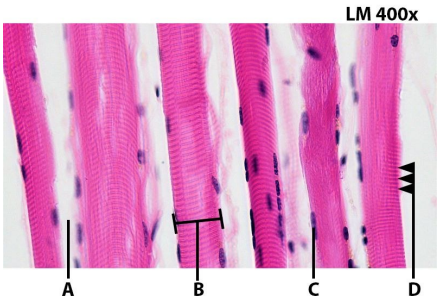
Each tissue as the Slide Box shows it: its slides, how to recognise it, and what not to confuse it with. Test yourself online: medicine.kazimiri.com/semester-1/slides/?lab=5&m=test

Skeletal muscle · tkanka mięśniowa poprzecznie prążkowana szkieletowa



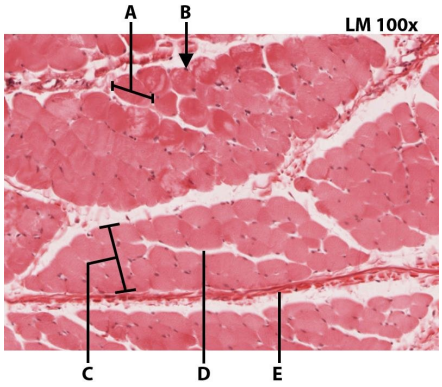
Skeletal muscle, teased fibres (200x): long cylindrical fibres with cross-striations and nuclei at the edge.

Berkshire Community College Bioscience Image Library · CC0 · commons.wikimedia.org/wiki/File:Muscle_Tissue_Skeletal_Muscle_Fibers_(40153601630).jpg



Real slide (400x): skeletal muscle in longitudinal section, striated fibres with nuclei at their edges.

Jennifer Lange; micrograph: Berkshire Community College Bioscience Image Library (public domain) · 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



Real slide (100x): skeletal muscle in cross-section, fascicles of fibres wrapped in perimysium.

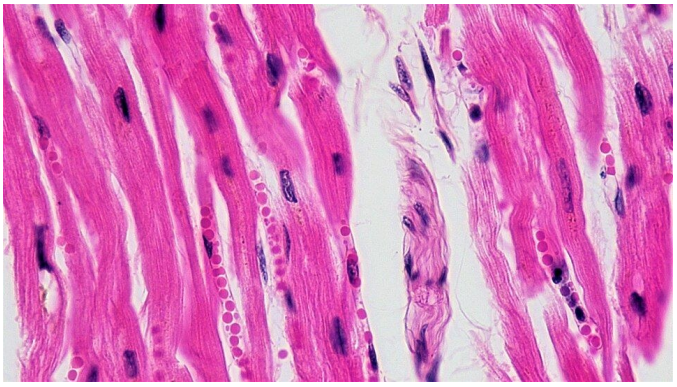
Jennifer Lange; slide: Regents of the University of Michigan Medical School · CC BY-NC-SA 4.0 · med.libretexts.org/Bookshelves/Anatomy_and_Physiology/Human_Anatomy_(Lange_et_al.)/08%3A_Muscle_Tissues_and_Muscle_Structure/8.05%3A_Anatomical_Atlas_-_Muscle_Tissues

How to recognise it

- Long, unbranched cylindrical fibres with clear cross-striations.
- Many nuclei per fibre, at the edge just deep to the sarcolemma.
- In cross-section: polygonal fibres, the nuclei at their rim, grouped into fascicles by perimysium.

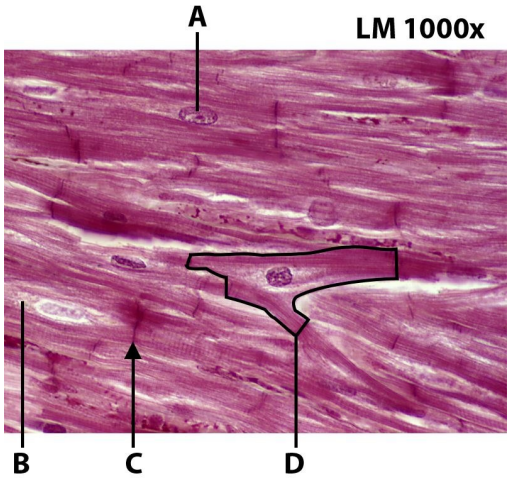
Don't confuse with: Cardiac muscle: central nuclei, branching, intercalated discs.

Cardiac muscle · tkanka mięśniowa poprzecznie prążkowana serca



Cardiac muscle (400x): branching fibres with one or two central nuclei.

Berkshire Community College Bioscience Image Library · CC0 · commons.wikimedia.org/wiki/File:Muscle_Tissue_Cardiac_Muscle_(28184529378).jpg



Real slide (1000x): cardiac muscle, branching fibres with central nuclei and intercalated discs.

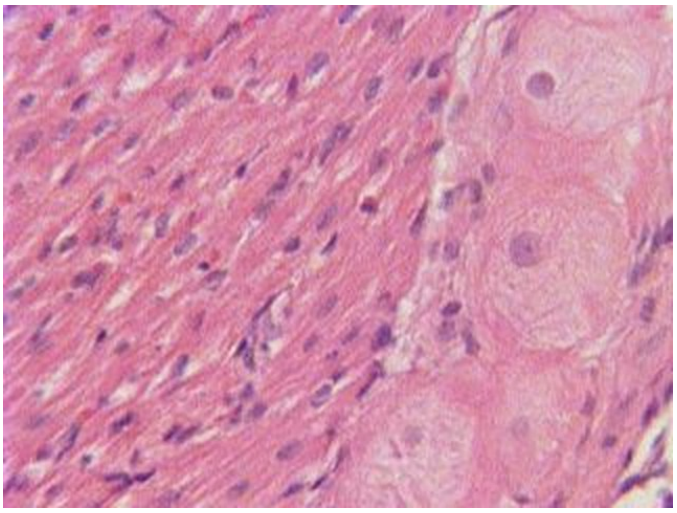
Jennifer Lange; micrographs: Virginia Commonwealth University · CC BY-NC-SA 4.0 · med.libretexts.org/Bookshelves/Anatomy_and_Physiology/Human_Anatomy_(Lange_et_al.)/03%3A_Tissue_Level_of_Organization/3.08%3A_Anatomical_Atlas_-_Tissues

How to recognise it

- Branching fibres with striations.
- One or two central nuclei per cell, often with a pale zone around them.
- Intercalated discs: dark lines across the fibres where cells join end to end.

Don't confuse with: Skeletal muscle: peripheral nuclei and no branching.

Purkinje fibres (cardiac conduction system) · włókna Purkinjego (układ przewodzący serca)



Purkinje fibres (right): large, pale cells, beside ordinary, darker cardiac muscle (left). H&E.

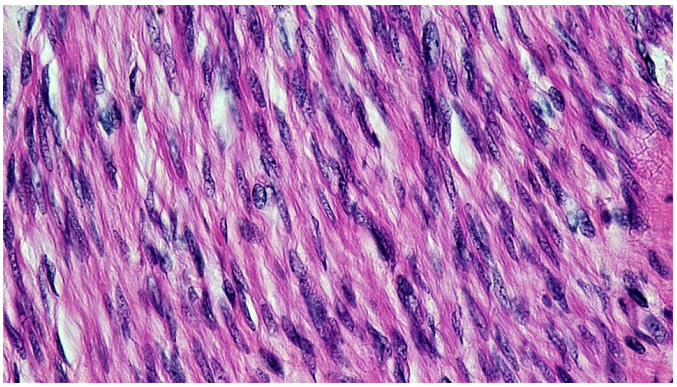
Nathanael Reveal (Nathanael) · CC BY-SA 3.0 · commons.wikimedia.org/wiki/File:Purkinje_fibers.jpg

How to recognise it

- Just deep to the endocardium (subendocardial).
- Larger and much paler than working heart muscle cells (full of glycogen).
- Few myofibrils, pushed to the edge of the cell; one or two central nuclei.

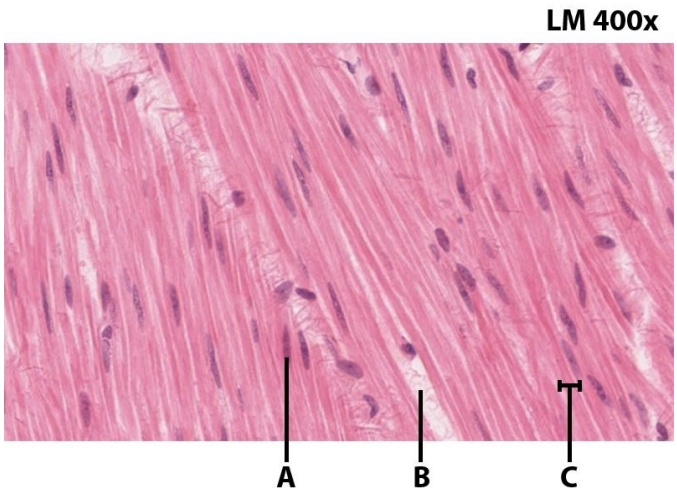
Don't confuse with: Ordinary cardiomyocytes: darker, full of myofibrils.

Smooth muscle · tkanka mięśniowa gładka



Smooth muscle (400x): spindle-shaped cells, each with one elongated central nucleus and no striations.

Berkshire Community College Bioscience Image Library · CC0 · commons.wikimedia.org/wiki/File:Muscle_Tissue_Smooth_(41894249891).jpg



Real slide (400x): smooth muscle in longitudinal section, spindle-shaped cells each with one central nucleus.

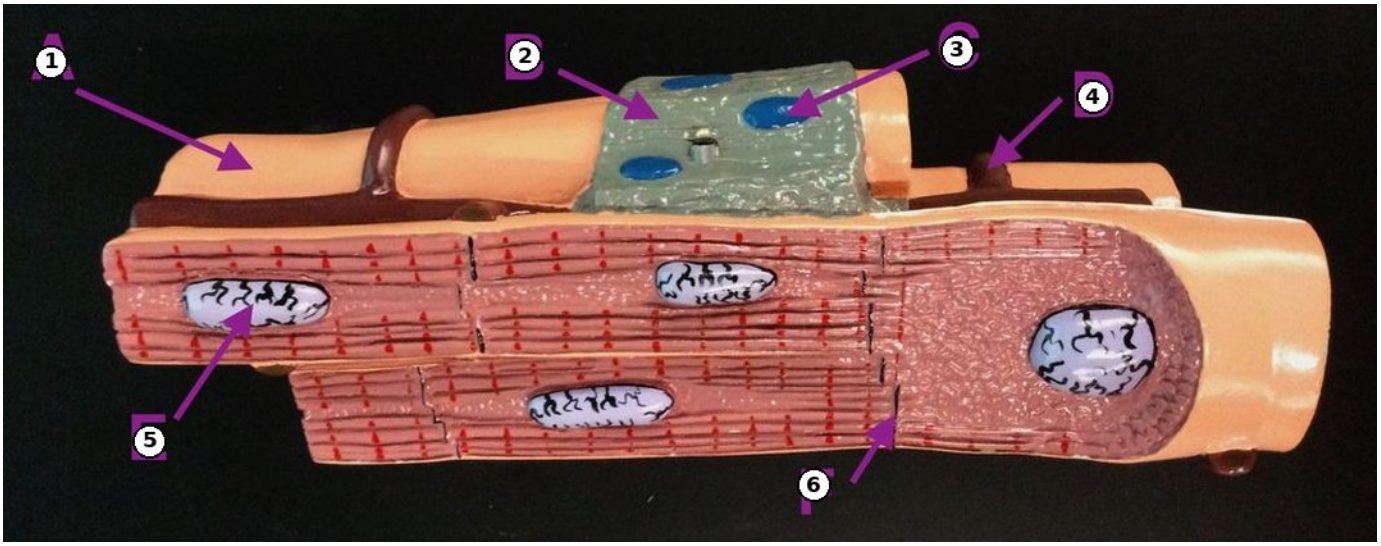
Jennifer Lange; slide: Regents of the University of Michigan Medical School · CC BY-NC-SA 4.0 · med.libretexts.org/Bookshelves/Anatomy_and_Physiology/Human_Anatomy_(Lange_et_al.)/03%3A_Tissue_Level_of_Organization/3.08%3A_Anatomical_Atlas_-_Tissues

How to recognise it

- Spindle-shaped cells with no striations.
- One central, elongated, cigar-shaped nucleus per cell (corkscrew-shaped when the cell contracts).
- In cross-section: round profiles of different sizes, only some cut through a nucleus.

Don't confuse with: Dense regular connective tissue: thin, flat nuclei between fibres, not inside cells.

A model of heart muscle



1 _____ **2** _____

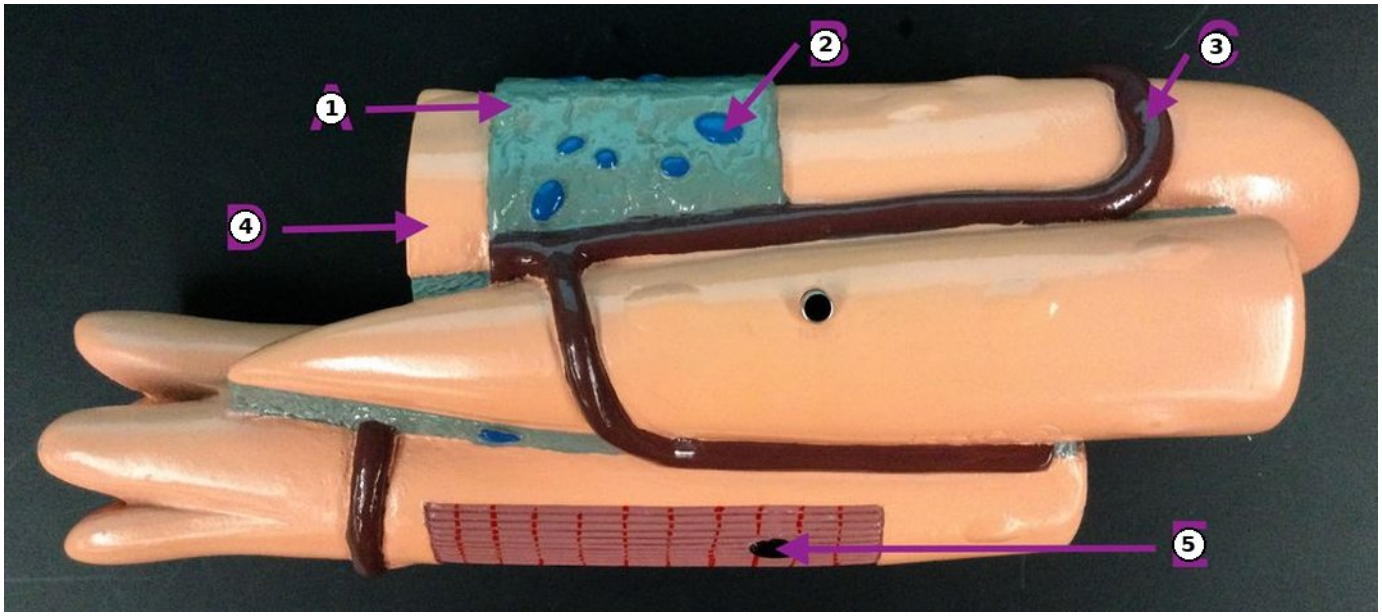
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Credit: Jennifer Lange · CC BY-NC-SA 4.0 ·
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A model of skeletal muscle fibres



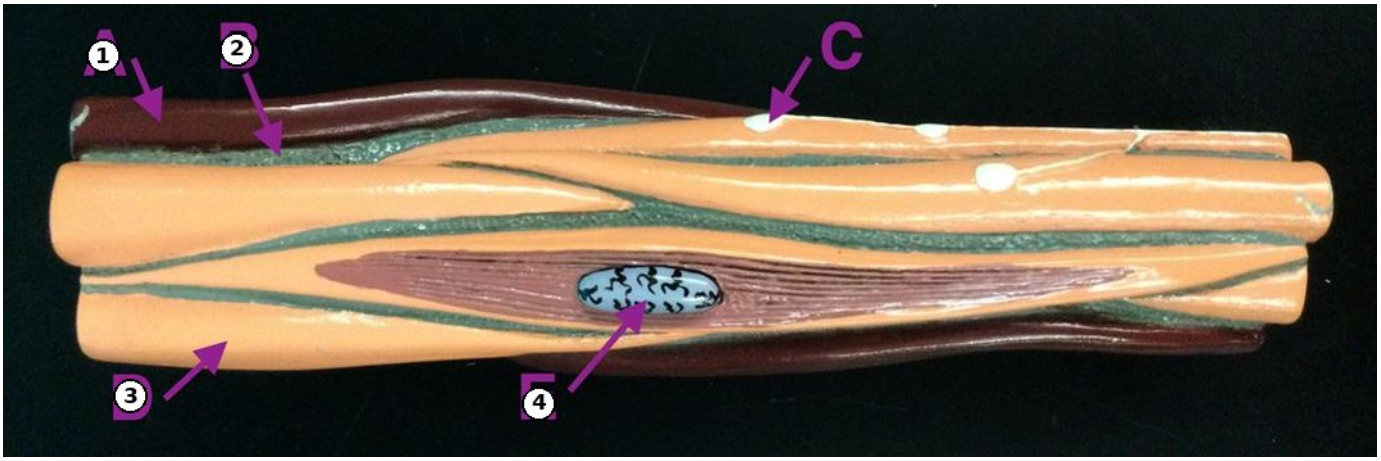
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Credit: Jennifer Lange · CC BY-NC-SA 4.0 ·
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A model of smooth muscle



1 _____ **2** _____

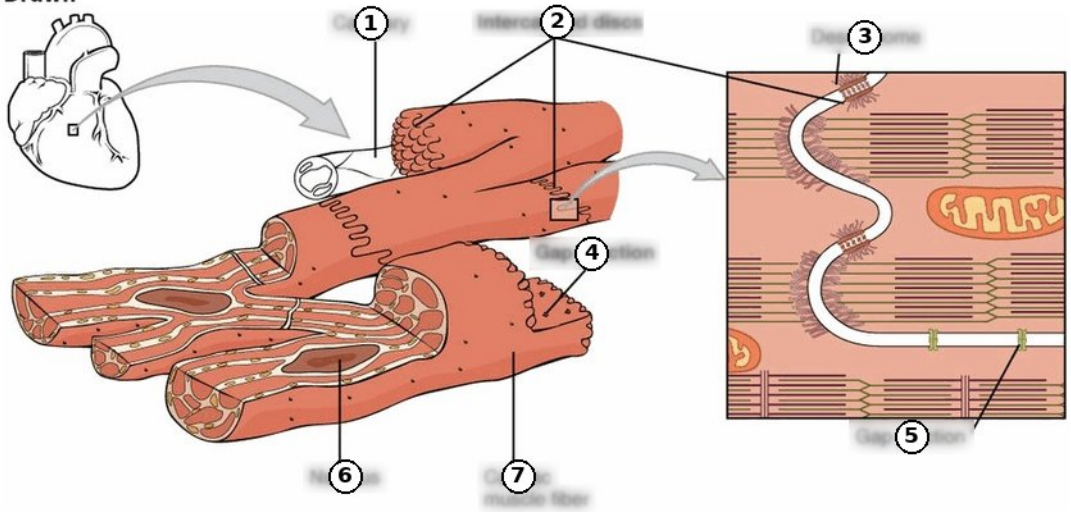
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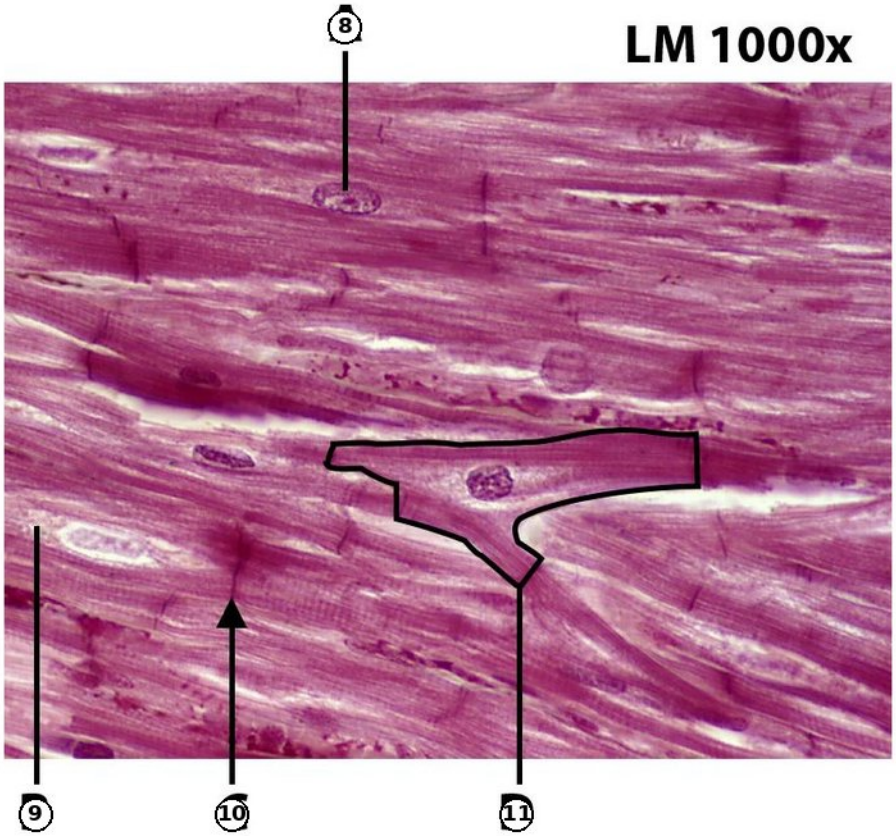
Credit: Jennifer Lange · CC BY-NC-SA 4.0 ·
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Heart muscle, drawn and on a real slide

Drawn



Real slide (light microscope)



1 _____ **2** _____

3 _____ **4** _____

5 _____ **6** _____

7 _____ **8** _____

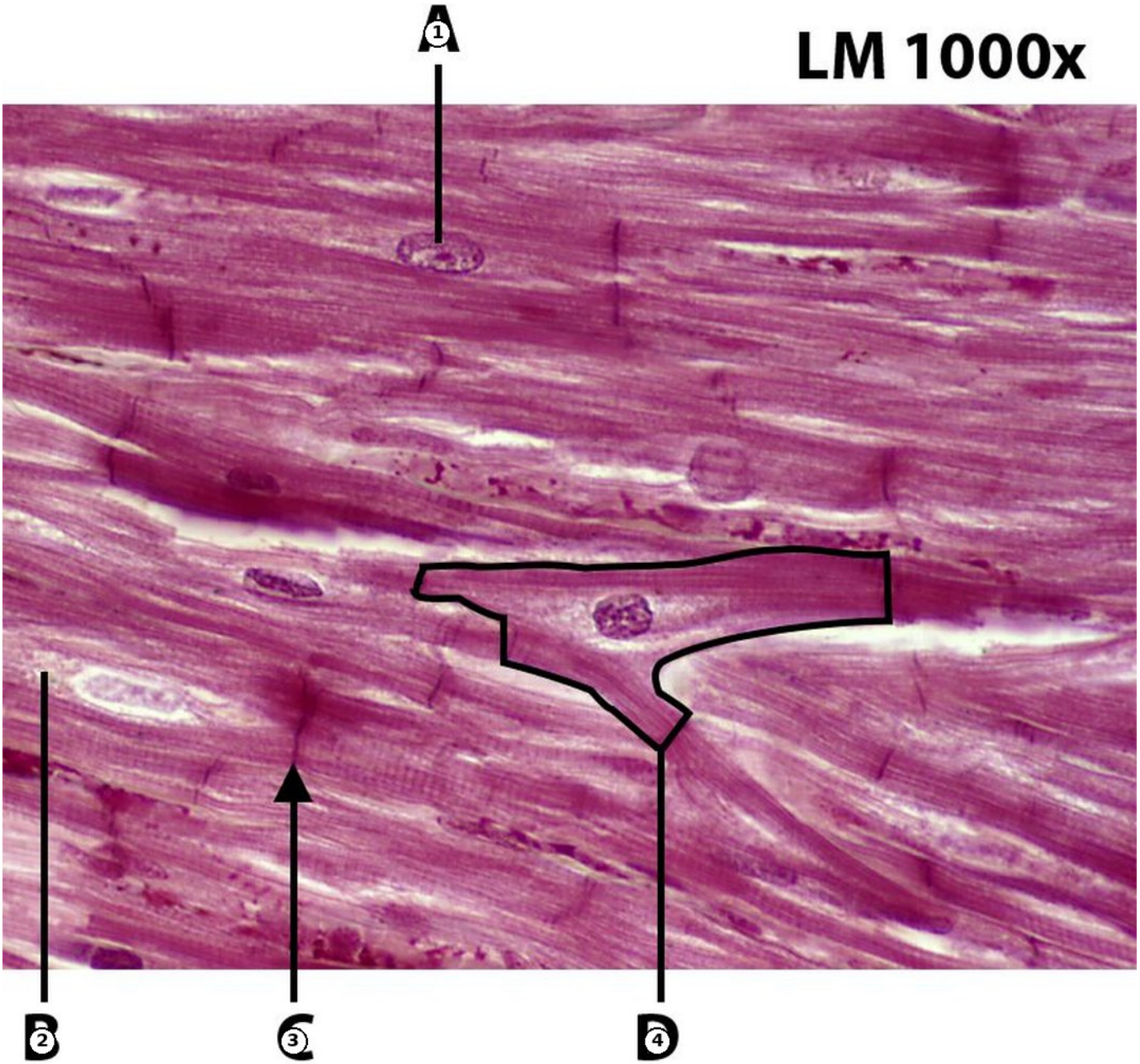
9 _____ **10** _____

11 _____

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Heart muscle, on a real slide



1 _____ **2** _____

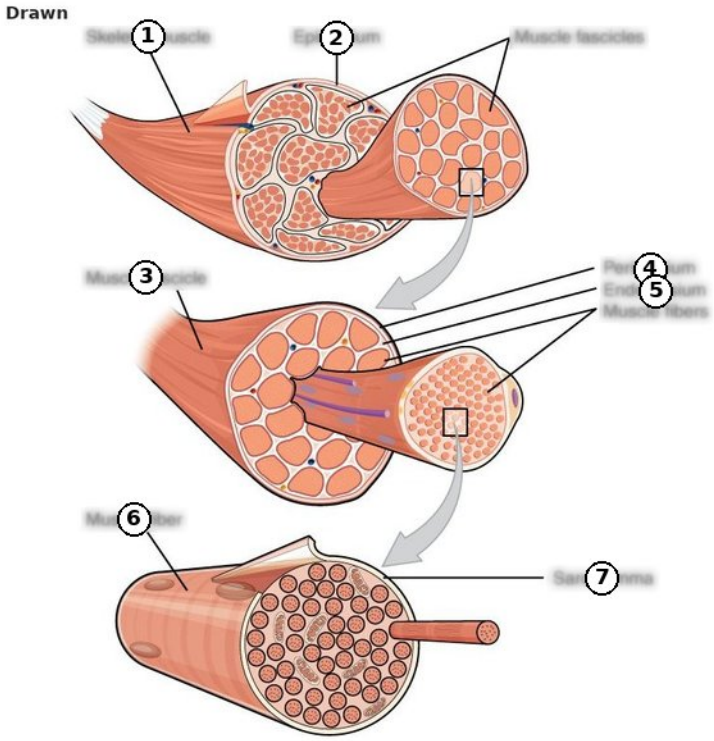
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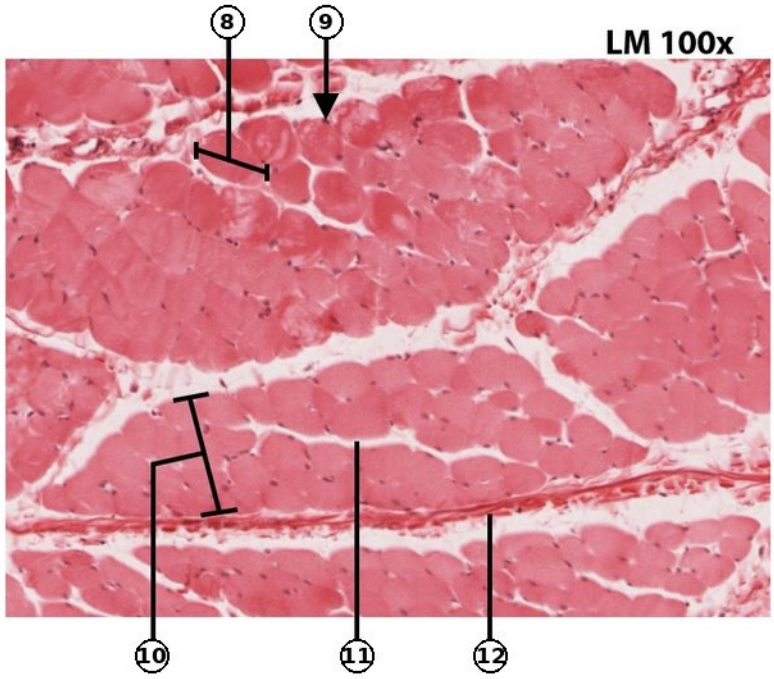
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Muscle and its wrappings, drawn and on a real slide

Drawn



Real slide (light microscope)

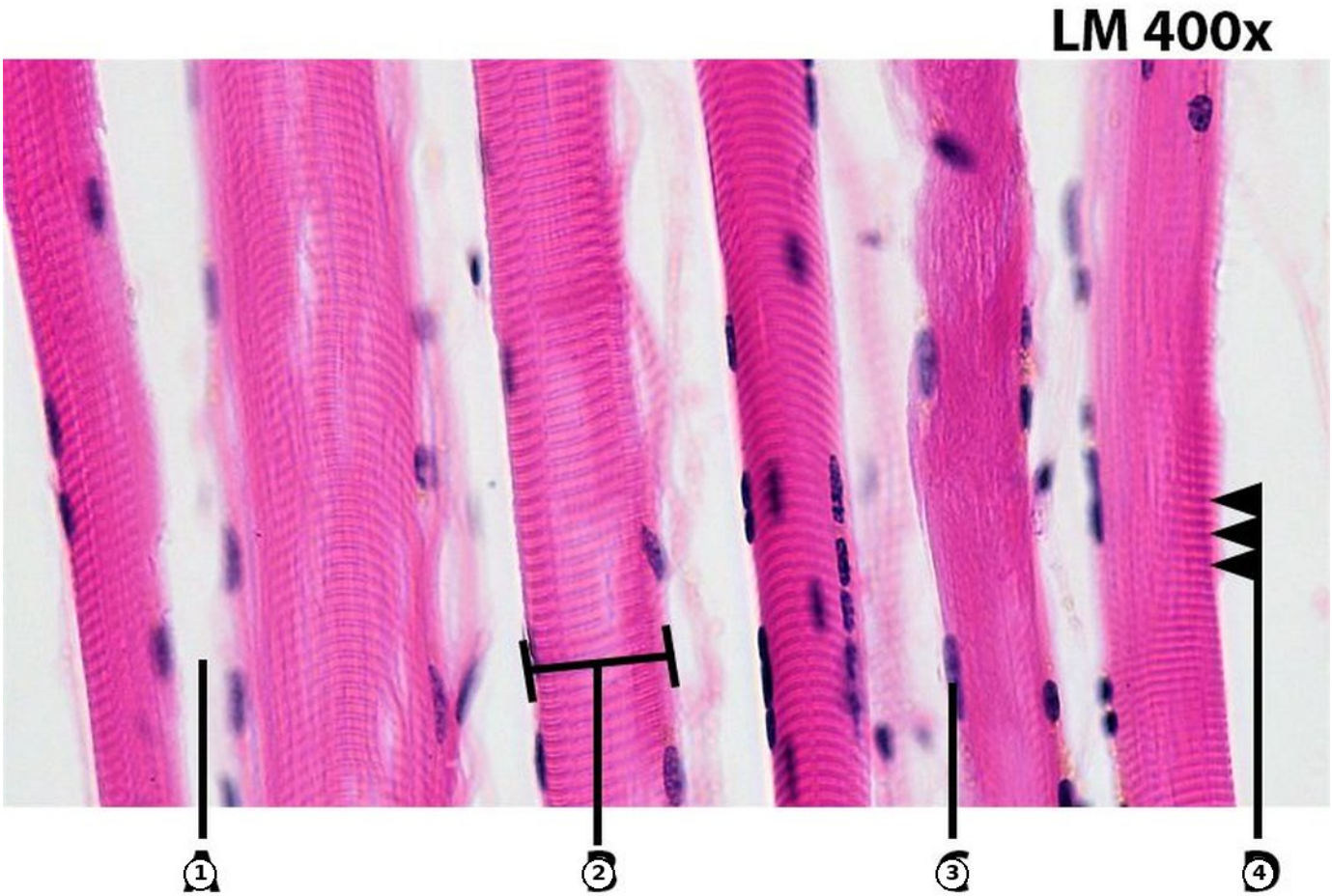


1		**2**	
3		**4**	
5		**6**	
7		**8**	
9		**10**	
11		**12**	

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

Credit: Drawn: OpenStax (CC BY 4.0); Real slide: Jennifer Lange; slide: Regents of the University of Michigan Medical School (CC BY-NC-SA 4.0); combined for this drill · CC BY-NC-SA 4.0 · commons.wikimedia.org/wiki/File:1007_Muscle_Fibes_(large).jpg

Skeletal muscle along its length, on a real slide



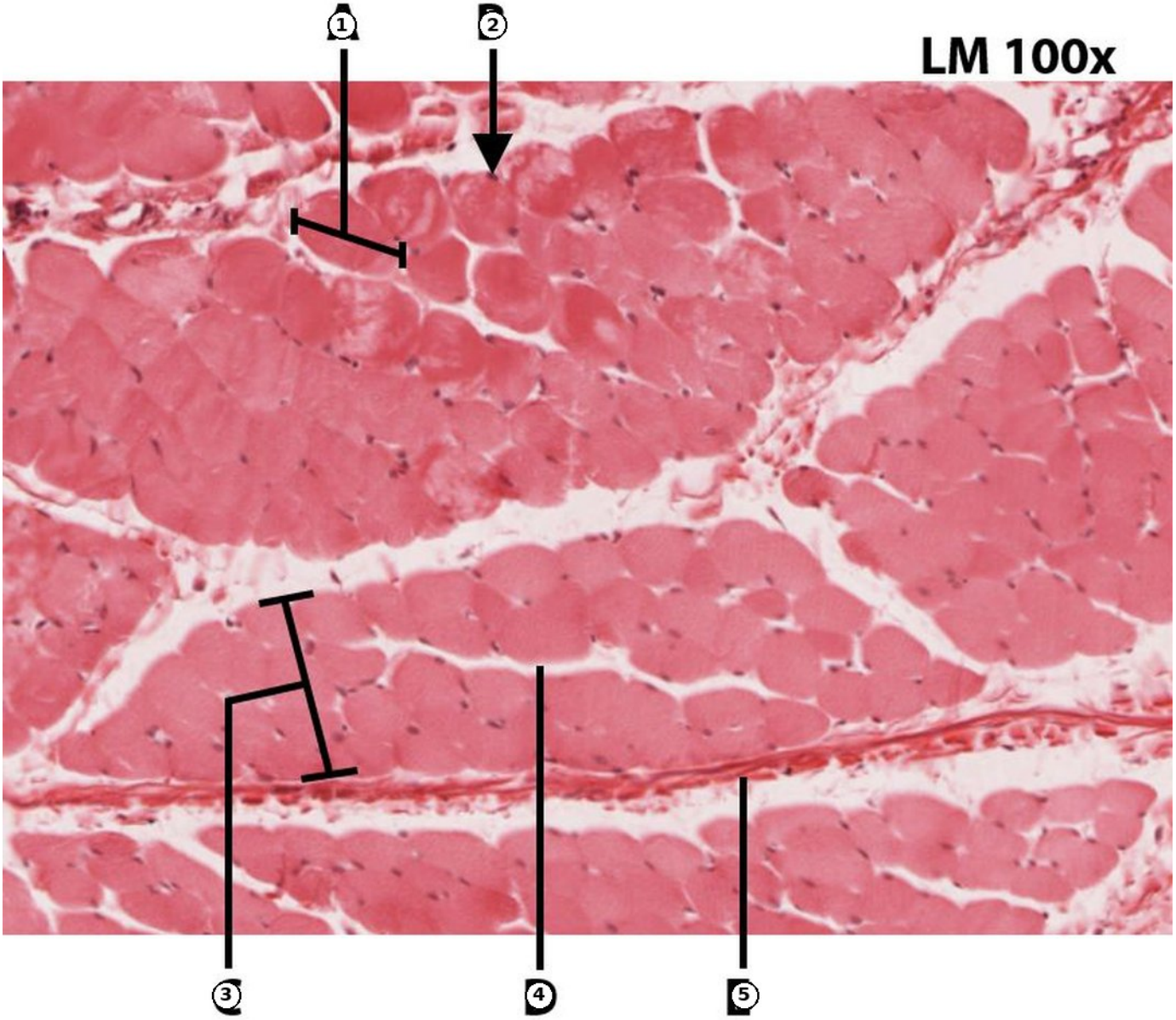
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Skeletal muscle cut across, on a real slide



1 _____ **2** _____

3 _____ **4** _____

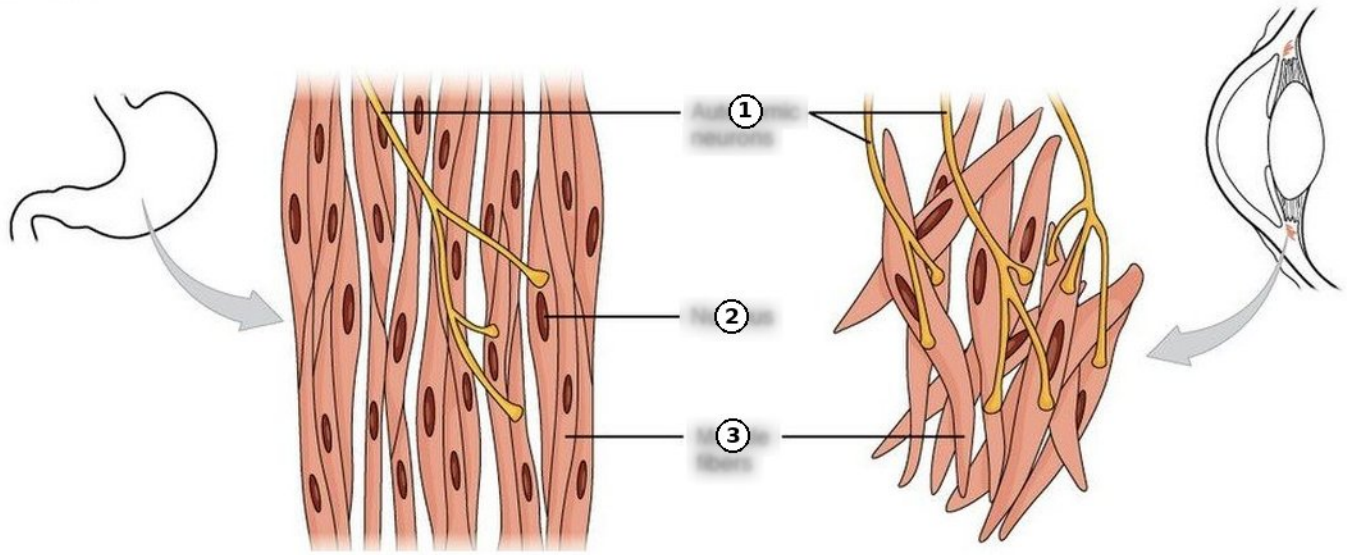
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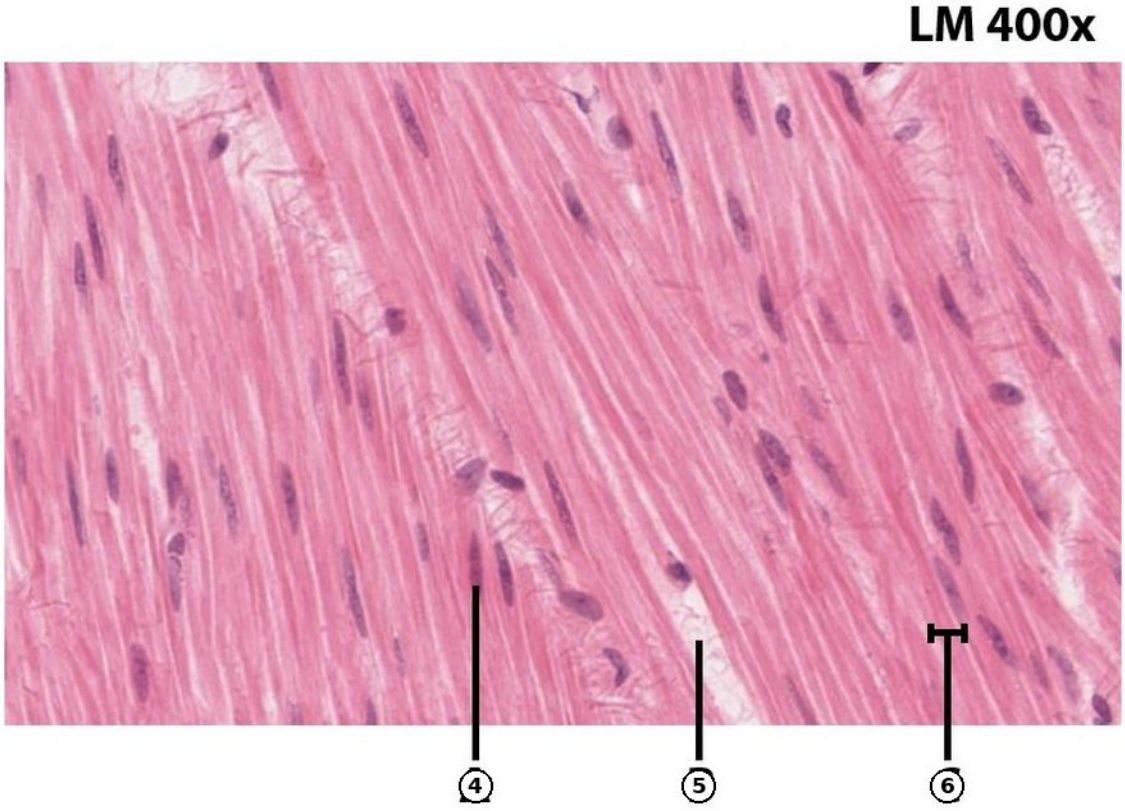
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Smooth muscle, drawn and on a real slide

Drawn



Real slide (light microscope)



1 _____ **2** _____

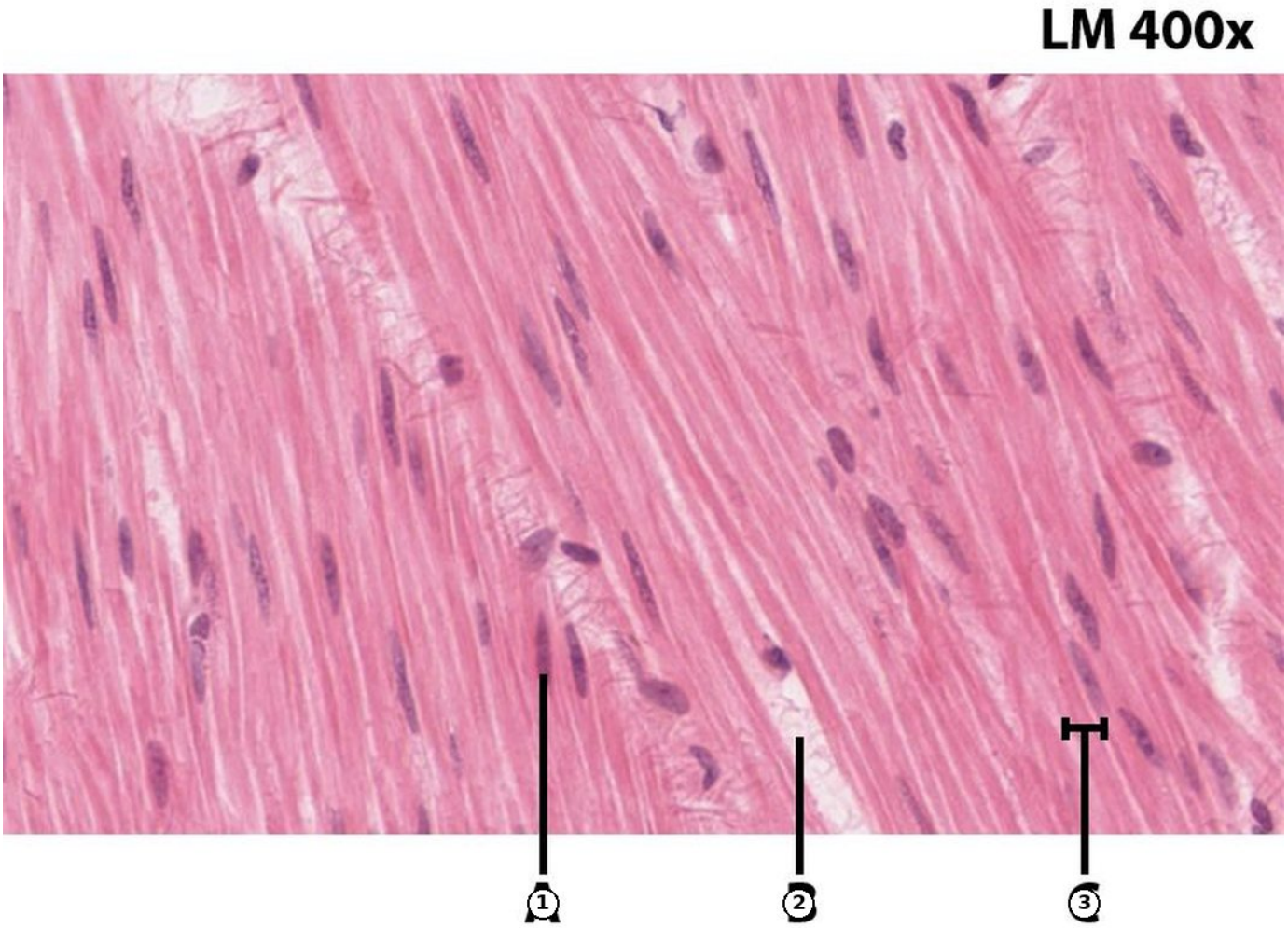
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Practise online: medicine.kazimiri.com/semester-1/label/?map=subj-histology-pair-smooth-muscle

Credit: Drawn: OpenStax (CC BY 4.0); Real slide: Jennifer Lange; slide: Regents of the University of Michigan Medical School (CC BY-NC-SA 4.0); combined for this drill · CC BY-NC-SA 4.0 · commons.wikimedia.org/wiki/File:1021_Smooth_Muscle_new.jpg

Smooth muscle, on a real slide



1 _____ **2** _____

3 _____

Practise online: medicine.kazimiri.com/semester-1/label/?map=subj-histology-06044e521f

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3 · Key points

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

Lab 5 · Muscle tissue

Muscle tissue

- Skeletal: multinucleated, peripheral nuclei, striated. Cardiac: branched, 1-2 central nuclei, intercalated discs. Smooth: spindle-shaped, central nucleus, no striations.
- Sarcomere: Z line to Z line. The A band (myosin) keeps its length; the I band and H zone shorten in contraction.
- Skeletal muscle has triads (T-tubule plus two SR cisterns) at the A-I junction; cardiac muscle has diads at the Z line.
- Skeletal muscle is wrapped in epimysium, its fascicles in perimysium, each fibre in endomysium; satellite cells repair it.
- Contraction: an action potential runs down the T-tubules; the dihydropyridine receptor opens the ryanodine receptor of the sarcoplasmic reticulum; Ca^{2+} binds troponin C, tropomyosin moves aside, and myosin heads pull on actin, using ATP.
- Fibre types: type I (slow, red, oxidative, rich in mitochondria and myoglobin) type IIa (fast, intermediate, oxidative-glycolytic) and type IIb (fast, white, glycolytic).
- Intercalated discs hold cardiac cells together with desmosomes and adherens junctions and pass the impulse through gap junctions. The conduction system (SA node, AV node, bundle of His, Purkinje fibres) is modified cardiac muscle, not nerve.
- Smooth muscle has no sarcomeres: actin filaments (and desmin intermediate filaments) anchor to dense bodies, and Ca^{2+} acts through calmodulin and myosin light-chain kinase. It contracts slowly and for long, in vessels and hollow organs.
- Skeletal muscle regenerates through satellite cells and smooth muscle by division; cardiac muscle hardly at all, so an infarct heals as a scar.

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: 8 single-choice questions

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

1. Intercalated discs are a feature of:

A skeletal muscle
B smooth muscle
C myoepithelium
D cardiac muscle

2. In skeletal muscle, the Ca^{2+} for contraction comes from the:

A T-tubules
B mitochondria
C sarcoplasmic reticulum
D nucleus

3. Purkinje fibres of the heart are:

A nerve fibres
B modified cardiac muscle cells
C smooth muscle cells
D fibroblasts

4. A sarcomere runs from one:

A M line to the next
B Z line (disc) to the next
C H band to the next
D A band to the next

5. As skeletal muscle contracts, which band keeps its length?

A the I band
B the H zone
C the A band
D the sarcomere

6. Skeletal muscle fibres are:

A long multinucleated cells with nuclei at the edge
B single cells with one central nucleus
C branched, joined by intercalated discs
D spindle-shaped, without striations

7. Smooth muscle cells are:

A multinucleated with nuclei at the edge
B branched, joined by intercalated discs
C striated with T tubules at the A-I junction
D spindle-shaped with one central nucleus and no striations

8. In smooth muscle, Ca^{2+} starts contraction by binding:

A calmodulin
B troponin C
C tropomyosin
D myoglobin

Answers · practice figures

Figure 1 · A model of heart muscle

1 Sarcolemma
2 Endomysium
3 Fibroblast
4 Capillary
5 Nucleus
6 Intercalated disc

Figure 2 · A model of skeletal muscle fibres

1 Endomysium
2 Fibroblast
3 Capillary
4 Sarcolemma
5 Peripheral nucleus

Figure 3 · A model of smooth muscle

1 Capillary
2 Endomysium
3 Sarcolemma
4 Nucleus

Figure 4 · Heart muscle, drawn and on a real slide

1 Capillary
2 Intercalated disc
3 Desmosome
4 Gap junction
5 Gap junction
6 Nucleus
7 Cardiac muscle cell
8 Nucleus
9 Endomysium
10 Intercalated disc
11 Cardiac muscle cell

Figure 5 · Heart muscle, on a real slide

1 Central nucleus
2 Endomysium
3 Intercalated disc
4 Cardiac muscle cell

Figure 6 · Muscle and its wrappings, drawn and on a real slide

1 Skeletal muscle
2 Epimysium
3 Fascicle
4 Perimysium
5 Endomysium
6 Muscle fibre
7 Sarcolemma
8 Muscle fibre
9 Peripheral nucleus
10 Fascicle
11 Endomysium
12 Perimysium

Figure 7 · Skeletal muscle along its length, on a real slide

1 Endomysium
2 Muscle fibre
3 Peripheral nucleus
4 Striations

Figure 8 · Skeletal muscle cut across, on a real slide

1 Muscle fibre
2 Peripheral nucleus
3 Fascicle
4 Endomysium
5 Perimysium

Figure 9 · Smooth muscle, drawn and on a real slide

1 Autonomic nerve fibres
2 Nucleus
3 Smooth muscle cell
4 Nucleus
5 Endomysium
6 Smooth muscle cell

Figure 10 · Smooth muscle, on a real slide

1 Nucleus
2 Endomysium
3 Smooth muscle cell

Answers · self-test

1 D cardiac muscle — With gap junctions and desmosomes.

2 C sarcoplasmic reticulum — Through the ryanodine receptor.

3 B modified cardiac muscle cells — Modified cardiac muscle cells, large, pale and rich in glycogen, with few myofibrils, that carry the impulse fast through the ventricles.

4 B Z line (disc) to the next — Thin filaments anchor at the Z discs; one sarcomere spans two neighbouring Z discs.

5 C the A band — The A band is the length of the thick filaments; the I band and H zone narrow as the filaments slide.

6 A long multinucleated cells with nuclei at the edge — Each fibre forms by myoblasts fusing; its many nuclei lie just deep to the sarcolemma.

7 D spindle-shaped with one central nucleus and no striations — Smooth muscle has no sarcomeres; its actin filaments anchor at dense bodies.

8 A calmodulin — Ca^{2+}-calmodulin activates myosin light-chain kinase; troponin is the switch in skeletal and cardiac muscle.