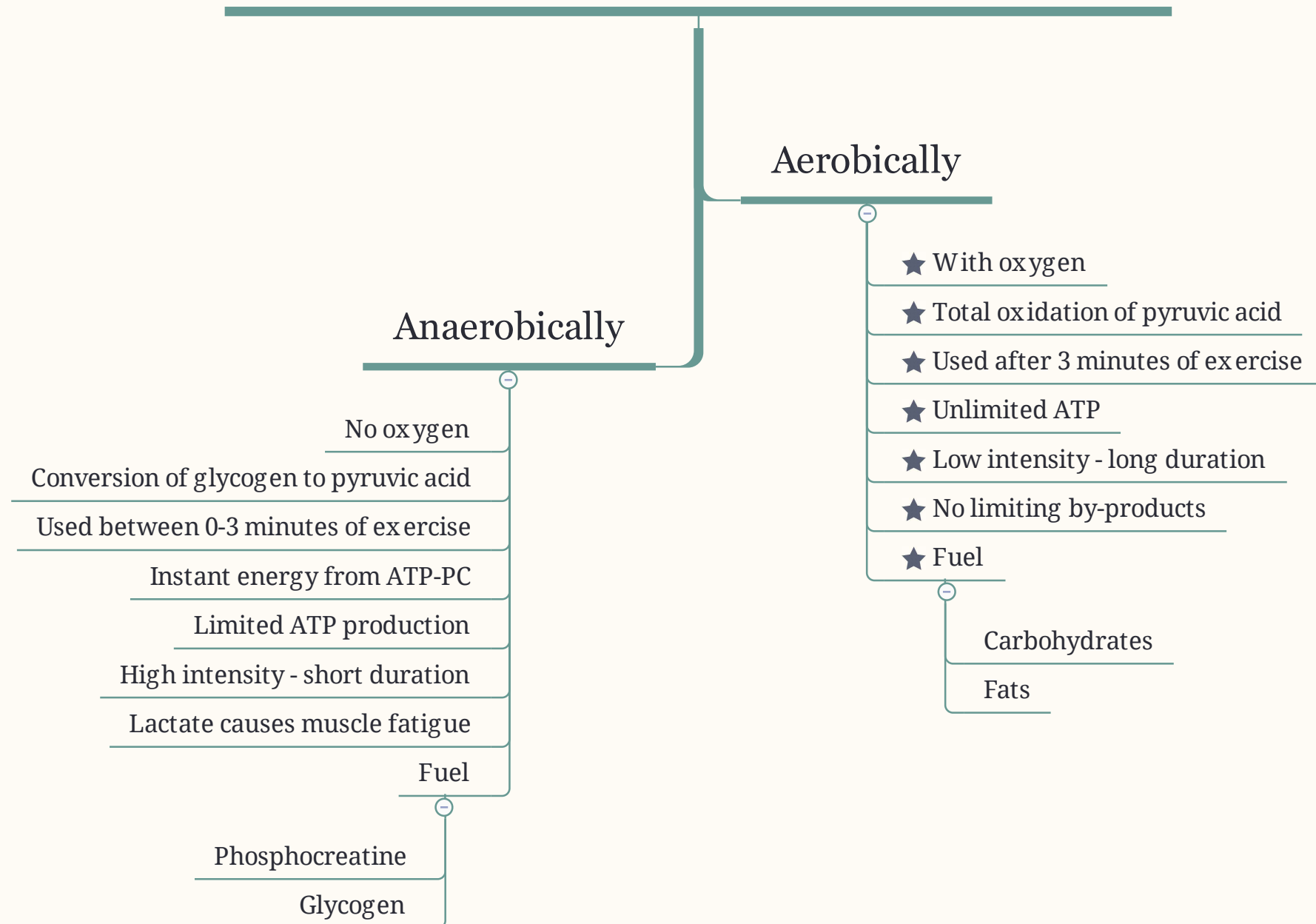
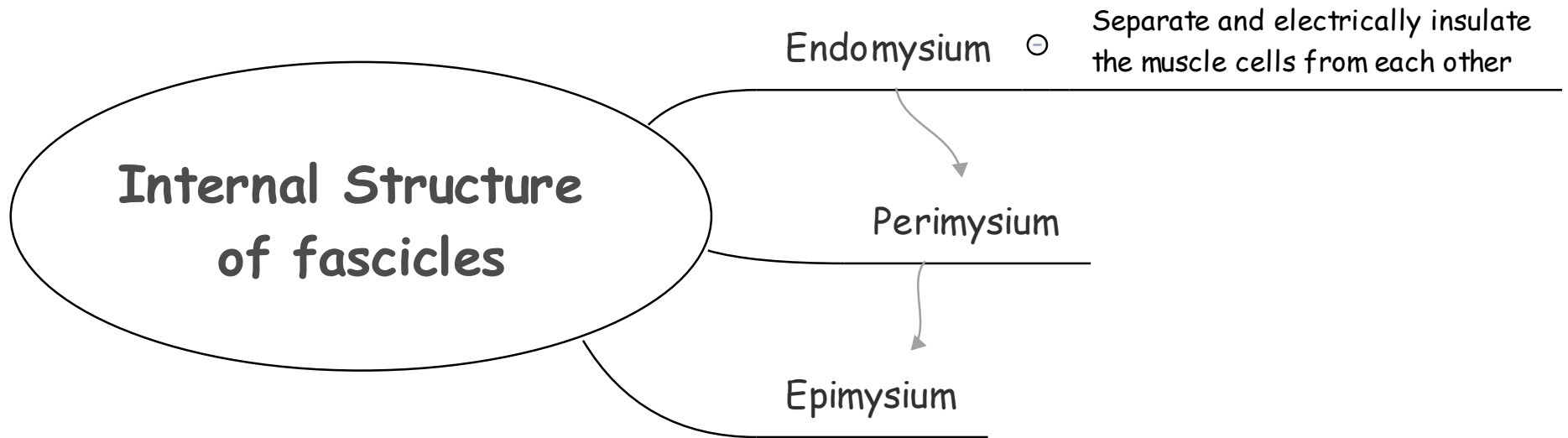


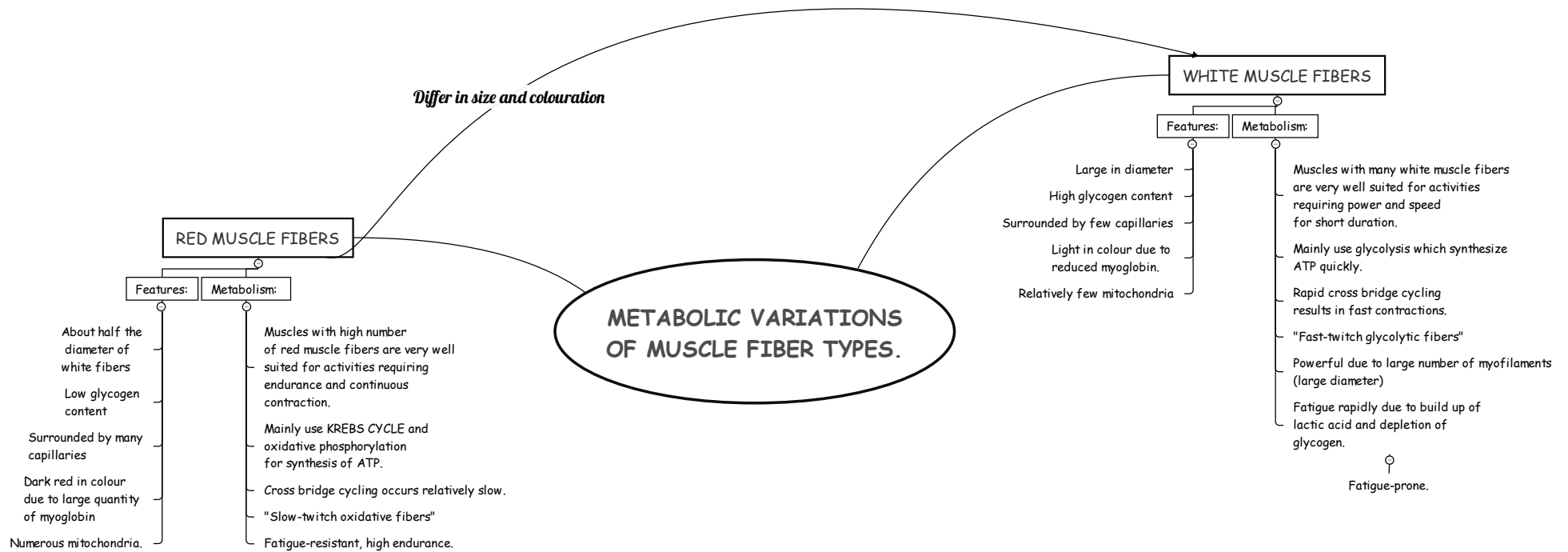
# Energy: Food converted into ATP

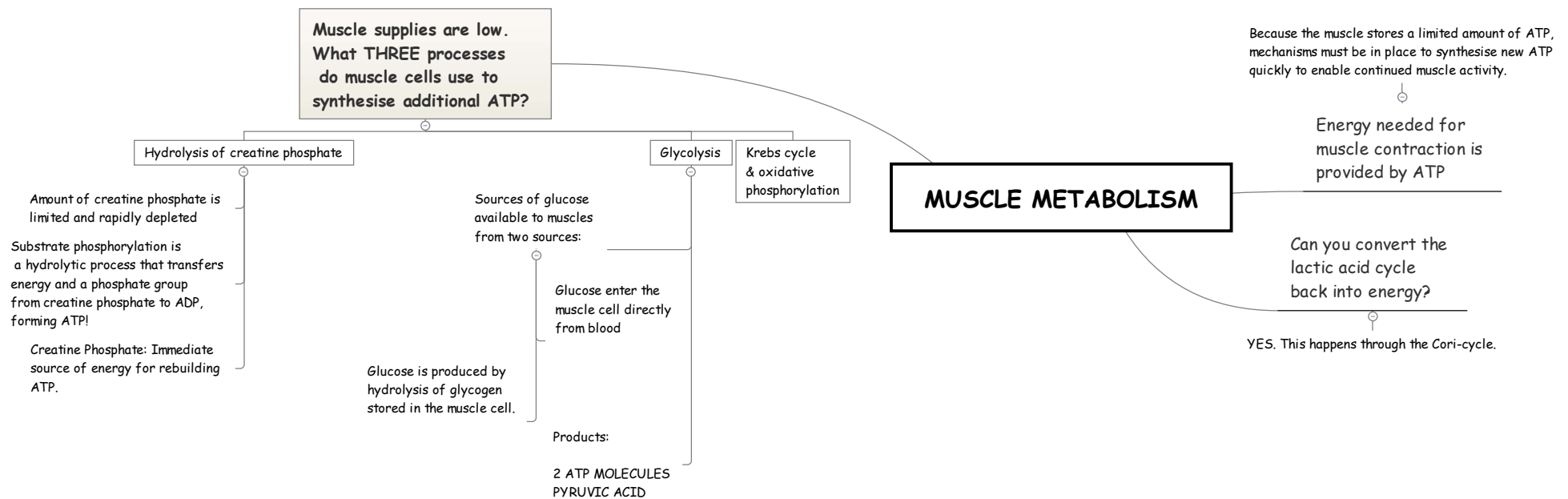




All 3 connective tissue layers bind muscle cells together

⊖ They all merge at the end of the muscle & are continuous with tendons





# OXYGEN PATHWAYS

## ANAEROBIC

In the absence of oxygen:  
Pyruvic acid is converted  
to LACTIC ACID!

Pathway PRODUCT: Lactic Acid

Excess lactic acid builds up rapidly,  
bringing about muscle fatigue.

## AEROBIC

Pyruvic acid is converted to  
Acetyl CoA

Pathway products:

Water  
Carbon dioxide  
36 ATP molecules

## Sources of OXYGEN

Oxygen enters the muscle cells  
directly from the blood.

Oxygen is stored in myoglobin,  
an oxygen-binding protein.

## RECOVERY & RESTING!

1. Lactic acid present in the cytosol is converted back into pyruvic acid, which enters the KREBS cycle  
- Producing ATP.

2. ATP is used to rephosphorylate creatine phosphate.

3. Glycogen is synthesized from glucose molecules

4. Additional oxygen rebinds to myoglobin.

## Role of ATP

Energizing the power stroke of the myosin cross bridge

Disconnecting the myosin cross bridge from binding sites on the actin at the conclusion of a power stroke

Energizing the calcium ion pump

### 6 Steps of cross bridge cycling

1. Influx of calcium, triggering the exposure of binding sites on actin

2. The binding of myosin to actin

3. The power stroke of the the cross bridge that causes the sliding of the thin filaments

4. The binding of the ATP to the cross bridge, which results in the cross bridge disconnecting from actin.

5. The hydrolysis of ATP, which leads to the re-energizing and repositioning of the cross bridge

6. The transport of the calcium ions back into the sarcoplasmic reticulum.

# Skeletal Muscles

## ○ Composition

Made up of :

Fascicles



Bundle of individual muscle cells

Surrounded by connective tissue layer



PERIMYSIUM

## Internal structure

Contractile cells

Connective tissue

Surrounded by EPIMYSIUM

Composed of orderly  
arrangement of :

connective  
tissue wrapping

## Muscle terminology ○

Muscle cell: Muscle fiber

Cell membrane: Sarcolemma

Cytoplasm: Sarcoplasm

Modified endoplasmic reticulum:

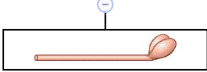
Sarcoplasmic reticulum



Involves Activities Of 5 Different Molecules & Calcium Ions

## Sliding Filament Theory

### Myosin



### Actin

- Major component of thin filament
- Actin portion of thin filament is composed of actin subunits twisted into double helical chain
- Each subunit has a specific binding site to which the myosin cross bridge binds

### Tropomyosin

- Regulatory protein that is also part of the filament
- Entwines around the actin
- In the unstimulated muscle the position of the tropomyosin covers binding sites on actin subunits and prevents myosin cross bridge binding.

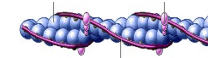
### ATP

Tropomyosin molecules must be moved aside to expose binding sites for binding with myosin

Facilitated by presence of third molecular complex: TROPONIN

Attached and spaced periodically along tropomyosin strand

### Troponin



Thin Filament

When & where do contraction of muscle cells occur?

As thin filaments slide past thick filaments. Sarcomere shortens and the thick & thin filaments overlap to a greater degree.

# Three Phases of a Muscle Twitch

## LATENT period

Sarcolemma &  
T-tubules depolarize

Calcium ions released  
into cytosol

Cross bridges begin  
to cycle, but no  
visible shortening  
of muscle

## CONTRACTION

Sarcomere shortens  
as a result of myosin  
cross bridge cycling

Speed depends on  
weight being lifted  
and fiber type  
(slow-twitch fibers  
or fast-twitch fibers)

## RELAXATION

Calcium ions actively  
transported back into  
terminal cisternae

Cross bridge cycling  
decreases and end

Tension is reduced, muscle  
returnsto original length.