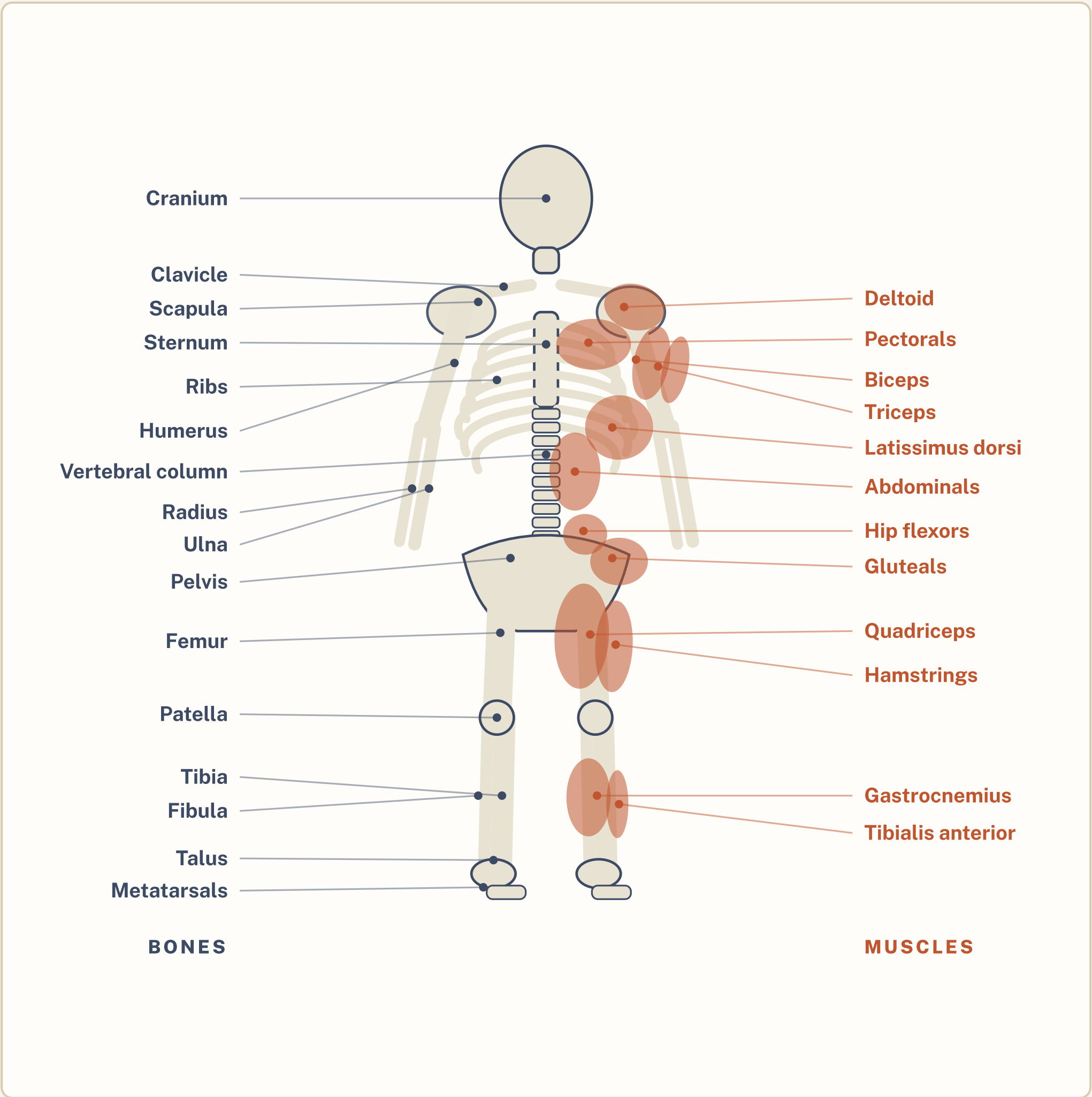


The musculo-skeletal system

Bones on the left, the muscles that move them on the right. Learn them as pairs, not as two lists.



Biceps ↔ Triceps
ELBOW
Curling a weight up, and lowering it back down under control.

Quadriceps ↔ Hamstrings
KNEE
Straightening the leg to kick, and bending it to bring the heel up.

Gastrocnemius ↔ Tibialis anterior
ANKLE
Pushing up onto the toes, and pulling the toes back up towards the shin.

Hip flexors ↔ Gluteals
HIP
Driving the knee forwards in a sprint, and pulling the leg back behind you.

Joints and movement

Four joint types. What a joint is shaped like decides what it is allowed to do.

Ball and socket

Shoulder, hip

- flexion
- extension
- abduction
- adduction
- rotation
- circumduction

The most movement of any joint, and the least stability. Every direction is available.

Hinge

Elbow, knee, ankle

- flexion
- extension

One direction only, like a door. At the ankle the same movement is called dorsiflexion and plantar flexion.

Pivot

Neck (atlas and axis)

- rotation

One bone turning inside a ring formed by another. Shaking your head for no.

Condyloid

Wrist

- flexion
- extension
- abduction
- adduction

Like a ball and socket without the rotation. Enough for a wrist flick in badminton.

THE MOVEMENT WORDS, AND WHAT EACH ONE MEANS

- Flexion** The angle at the joint gets smaller.
- Abduction** A limb moves away from the midline of the body.
- Rotation** A limb turns about its own long axis.
- Dorsiflexion** Toes pulled up towards the shin.

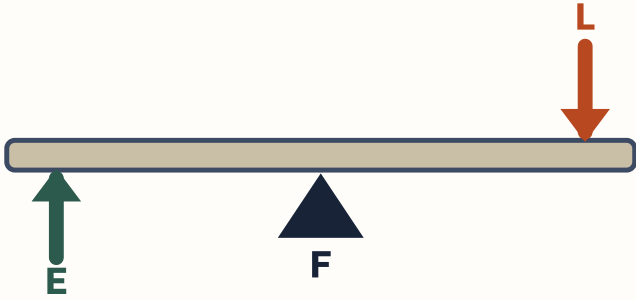
- Extension** The angle at the joint gets bigger.
- Adduction** A limb moves back towards the midline.
- Circumduction** Flexion, abduction, extension and adduction run together, so the limb sweeps a cone.
- Plantar flexion** Toes pointed away, as in a jump take-off.

Movement analysis

Two topics, six diagrams and one calculation. Get the order along the beam and the plane-with-axis pairing, and the rest follows.

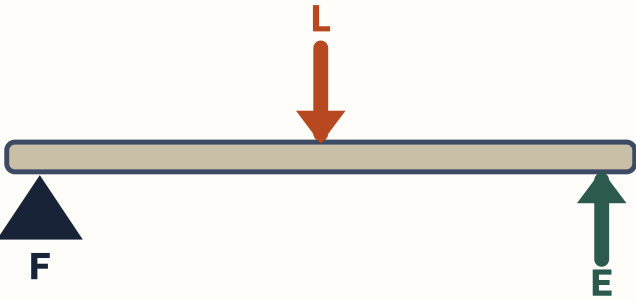
LEVER SYSTEMS — THE ORDER ALONG THE BEAM

First class
E — F — L
fulcrum in the middle



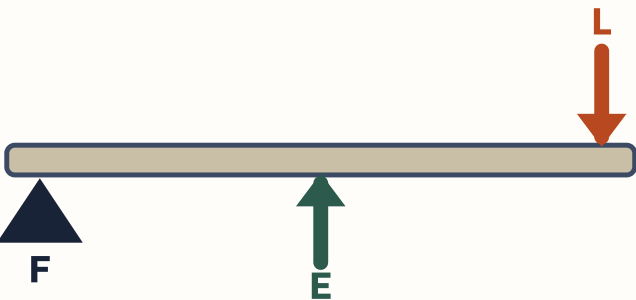
Nodding the head. The neck joint sits between the muscles at the back and the weight of the skull at the front.

Second class
F — L — E
load in the middle



Rising onto the toes. The ball of the foot is the fulcrum, body weight the load, the calf the effort. This is the class built for mechanical advantage — a big load shifted by a smaller effort.

Third class
F — E — L
effort in the middle

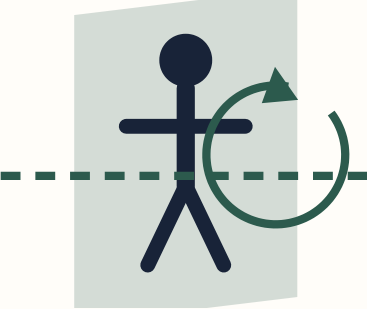


A biceps curl. Most joints in the body work this way — fast, wide movement, no mechanical advantage.

Mechanical advantage = effort arm ÷ load arm. The effort arm is the distance from the fulcrum to the effort; the load arm is the distance from the fulcrum to the load. Above 1 and the lever moves a big load with a small effort — only second class levers manage it. Below 1 and you trade force for speed and range, which is the deal almost every joint in the body makes.

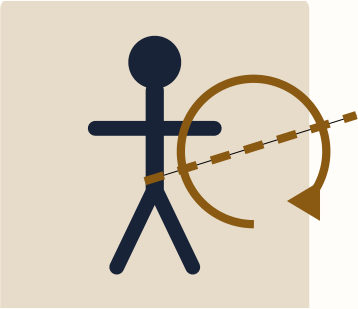
PLANES AND AXES — ALWAYS NAMED AS A PAIR

Sagittal plane
transverse axis
flexion and extension



A forward somersault, a squat, a biceps curl.

Frontal plane
sagittal axis
abduction and adduction



A cartwheel, a star jump, a lateral raise.

Transverse plane
longitudinal axis
rotation



A full twist, a discus turn, a pirouette.

Every diagram here is ours. E is effort, L is load, F is fulcrum — the three classes differ only in which of them sits in the middle.

The components of fitness

Ten components, one recognised test each. Know which ones a sport actually needs.

Cardiovascular endurance How long the heart and lungs can keep supplying working muscles. Test: Multi-stage fitness test	Muscular endurance How long a muscle can keep contracting without tiring. Test: Press-ups or sit-ups in 60 seconds
Strength The maximum force a muscle can produce in one contraction. Test: Hand grip dynamometer	Power Strength and speed together — force applied quickly. Test: Vertical jump test
Speed How quickly you cover a distance, or move a body part. Test: 30 metre sprint	Agility Changing direction at speed while staying in control. Test: Illinois agility run
Flexibility The range of movement available at a joint. Test: Sit and reach test	Balance Keeping the centre of mass over the base of support. Test: Stork stand test
Coordination Using two or more body parts together, smoothly and accurately. Test: Alternate hand wall-toss	Reaction time The gap between a stimulus and starting to move. Test: Ruler drop test

Naming the test is the easy half. Saying why that component matters in a named sport is the half the question is really asking for.

Training, and what it changes

Two acronyms, six methods, and the difference between what happens today and what happens over a year.

SPORT — THE PRINCIPLES BEHIND ANY PROGRAMME

S
Specificity
Train the way you play. A swimmer gains little from running.

P
Progression
Increase the demand gradually. Too fast and you get injured, not fitter.

O
Overload
Work harder than normal, or the body has no reason to adapt.

R
Reversibility
Stop, and it goes — and it goes a good deal faster than it arrived.

T
Tedium
Vary it. The training you are bored of is the training you stop doing.

FITT — THE FOUR THINGS YOU CAN ACTUALLY ADJUST

F
Frequency
How often you train.

I
Intensity
How hard each session is.

T
Time
How long each session lasts.

T
Type
Which method you use.

TRAINING METHODS

Continuous
Steady pace, no rest, 20 minutes or more. Builds cardiovascular endurance.

Fartlek
Continuous, but the pace keeps changing. Closer to how games are actually played.

Interval
Hard work, then rest, repeated. Builds speed and anaerobic capacity.

Circuit
Stations in rotation. Trains several components in one session.

Weight
Resistance against a load. High weight and low reps for strength, the reverse for endurance.

Plyometric
Bounding, hopping, depth jumps. Builds power.

During and just after

- heart rate and breathing rate rise
- body temperature rises, and you sweat
- muscles work harder and take more oxygen
- lactic acid builds up when the work goes anaerobic
- muscle fatigue, and the burn that comes with it

After months of training

- the heart wall thickens, so each beat moves more blood
- resting heart rate falls
- more capillaries form around the muscles
- muscles get bigger and stronger
- bones get denser and tendons and ligaments stronger

Aerobic — with oxygen. Lower intensity, longer duration. · Anaerobic — without enough oxygen. High intensity, short duration, and lactic acid is the price.