

Components of Fitness

Look back at pages 32-35 to recap the components of fitness. Over the next three pages, you'll look at some example sports in more detail and the components needed for sports performers to be successful.

It's Important to have High Levels of Fitness

- 1) Each sport or physical activity needs a different balance of physical and skill-related fitness components.
- 2) For a particular activity, there will always be some types of fitness which are more important than others — e.g. in weightlifting, your strength is more important than your reaction time.
- 3) To work out the importance of different types of fitness, think about the kinds of actions the performer does — e.g. a batter in cricket has to respond to the bowler (reaction time), hit the ball (coordination and power), and then run (speed and aerobic endurance).

Physical Components of Fitness Benefit Different Sports...

Component of fitness	Types of sport it benefits	Example
Aerobic endurance	Activities <u>longer than 30 minutes</u> .	Long-distance running
Muscular endurance	Activities <u>longer than 30 minutes</u> .	Long-distance cycling
Muscular strength	Activities needing <u>force</u> .	Hammer throw
Speed	Activities needing <u>fast movements</u> .	100 m hurdles
Flexibility	Activities needing a <u>wide range</u> of <u>movement</u> around a joint.	Judo
Body composition	<u>Different activities</u> need different <u>body compositions</u> .	Gymnastics (low body fat and high muscle mass)

...as do the Skill-Related Components of Fitness

Component of fitness	Types of sport it benefits	Example
Power	Activities needing <u>strong movements</u> .	Gymnastics (vaulting)
Agility	Activities needing <u>quick changes</u> of <u>direction</u> .	Skiing
Reaction time	Activities needing <u>quick decisions</u> or movement in <u>response to a stimulus</u> .	Sprinting
Balance	Activities needing <u>control</u> of your <u>body position</u> to remain <u>steady and upright</u> .	Snowboarding
Coordination	Activities needing the movement of <u>two or more body parts at once</u> .	Tennis

It may also include using sports equipment, such as a tennis racket.

Components of Fitness

You Need to Describe Components of Fitness for Different Activities

Example 1 — Badminton

Agility — players need to change direction quickly, without losing balance when returning shots.

Aerobic endurance — a typical match is longer than 30 minutes, so players need aerobic endurance to keep going for the whole match.

Power — players need power for smash shots that are difficult to return.



Speed — players need to move quickly across the court to return shots.

Coordination — players must hit their shots smoothly and accurately to control where the shuttlecock will land.

Reaction time — players need to react quickly to return fast-paced shots.

Example 2 — Kayaking

Muscular strength — kayakers need strong muscles in their arms and shoulders to produce the force needed to paddle.

Muscular endurance — kayakers need good muscular endurance to constantly use the muscles in their shoulders and arms to paddle.

Power — kayakers need both speed and strength together to paddle quickly and strongly through rough waters.



Balance — kayakers need good balance to stop their kayak from capsizing in rough waters.

Agility — kayakers need to change direction quickly to avoid rocks.

Aerobic endurance — kayakers need good aerobic endurance to paddle for long periods.

Example 3 — Rock Climbing

Power — climbers need power for a 'dyno', which involves pushing off and jumping for a rock that is out of reach.

Muscular strength — climbers need good upper body strength to lift their own body weight.

Flexibility — climbers must stretch for handholds or footholds.



Muscular endurance — climbers must grip rocks and hold their weight for long periods.

Coordination — climbers must carefully position their hands and feet at the same time.

Components of Fitness

Different Events need Different Types of Fitness

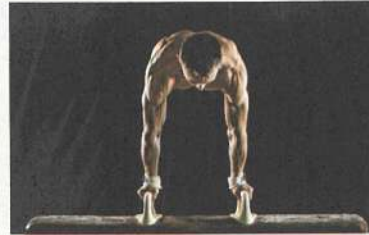
Some sports are made up of different events, such as the triathlon. Performers need different types of fitness to perform well in each event.

Gymnasts who compete on all apparatus events need high levels of most of the components of fitness.

Example — Artistic Gymnastics

In men's gymnastics, competitors who perform on the pommel horse need:

Muscular strength — gymnasts need good upper body and core strength to support the body whilst swinging on the handles.



Body composition — gymnasts need to be both light and strong, so have low body fat and high muscle mass.

In women's gymnastics, competitors who perform on the balance beam need:

Balance — gymnasts need good balance to keep their body on the beam and not lose marks for wobbling or falling.



Coordination — gymnasts need coordination to perform controlled moves using different body parts (e.g. spins) to get the best score possible.

Different Positions need Different Types of Fitness

Sometimes, the types of fitness needed can differ between positions in a team sport.

Example — Rugby Union



The backs need:

Agility — backs need to change direction quickly in order to dodge tackles.



Speed — backs need to be able to sprint with the ball to attempt to score a try.

The forwards need:

Muscular strength — forwards need to be strong to take part in the scrum and when tackling to win back possession.



Power — forwards tackle and push with speed and strength.

You've tackled these pages well...

There are lots of sports and each one needs different types of fitness. Study the sports on these pages, then think of your own examples — write down the physical and skill-related components of fitness for each one.

Principles of Training

These pages are all about the **principles** of **training** and how they are used in **training programmes**.

Training Programmes Use Four Basic Principles

- 1) A training programme is a **programme of exercise** designed to **improve performance**.
- 2) Training programmes are made up of **different ways** of **exercising** called **training methods**.
- 3) There are four **basic principles** of **training** that a **coach** needs to think about when **planning** a **training programme**.
- 4) You can remember these **four** things using the letters **FITT**:

Frequency — How **often** to train, **per week**.

Intensity — How **hard** to train.

Time — How **long** to train for, **each session**.

Type — Which **training method** to use to target the **component of fitness** that needs **improving**.

Learn the Seven Additional Principles

These **seven** principles will also help a **coach** to create a **useful training** programme.

1. Progressive Overload

Definition: Training that is **demanding enough** to make the body **adapt** (change), leading to **improved performance**.

- 1) The only way to get **fitter** is to **work** your body **harder** than normal.
- 2) This is called **overload**.
- 3) You can overload by **increasing** the **frequency**, **intensity** or **time** you spend training.
- 4) Your overload needs to be **progressive** (gradual) — you should only overload a **little bit** at a time, e.g. increase the number of lengths you swim from 25 to 30.
- 5) If you overload **too quickly** it can be **demotivating** or **lead to injury**.



2. Specificity

Definition: Training should be **specific** to the individual's **sport** or **activity**, or the **physical/skill-related fitness goals** to be improved.

- 1) A coach needs to **match training** to a performer's **sport** or **fitness goal**.
- 2) For example, if a **boxer's** fitness goal is to get **stronger**, then they need **training methods** that build **strength**.

3. Individual Differences/Needs

Definition: The programme should be designed to meet **individual training goals** and **needs**.

For example, an **unfit** person needs an **easier** programme than a **fitter** person, and a **goalkeeper** in **football** would need a **different** training programme to a **striker**.

Principles of Training

4. Adaptation

Definition: How the body **reacts** to **training loads** by increasing its ability to **cope** with those loads.

A training load is the work you do in a training session.

- 1) The **work** you do in a training session causes your body to **change** to **cope** with it.
- 2) These changes make you **fitter**.
- 3) For example, weight training makes your **muscles bigger**, so you get **stronger**.
- 4) Adaptation happens during **rest and recovery** after a training session.

See p.85-86 for more on how the body adapts to exercise.

5. Reversibility

Definition: If training **stops**, or the **intensity** of training is **too low** to cause **adaptation**, training effects are **reversed**.

- 1) If you **stop training** (e.g. due to **injury**), your **fitness level** will **decrease** back to how it was before training — it will **reverse**.
- 2) Your fitness level will also reverse if you **don't train hard enough**.
- 3) In simple terms, if you **don't use it**, you **lose it**.

6. Variation

- 1) It's important to do **different activities** in training.
- 2) The sports performer is likely to get **bored** and **lose motivation** if they do the **same activity** over and over again.

7. Rest and Recovery

- 1) A sports performer needs to **rest** to allow their body to **recover** and **adapt**.
- 2) During **recovery** the body **repairs** any **damage** caused by exercise.
- 3) This means the performer will be **fit** and **ready** for the next training session.



EXAMPLE

A weightlifting coach is designing a training programme. Describe how they could apply three principles of training in their programme.



Type: the training programme should exercise the **muscles** that the weightlifter uses, e.g. **legs**.

Progressive overload: the **amount of weight** should be **gradually increased**, so the **body adapts slowly**.

Rest and recovery: the weightlifter should be **given days off** between training to **recover**.

Revisability — keep revising or your braininess will drop...

Want to be fit? Use FITT — Frequency, Intensity, Time and Type. And remember that recovery time is part of training too, because your body needs time to adapt and repair itself, otherwise it can lead to injuries.

Heart Rate and the Borg RPE Scale®

It's useful for sports performers to know how **fast** their **heart** is **beating** during **exercise**.

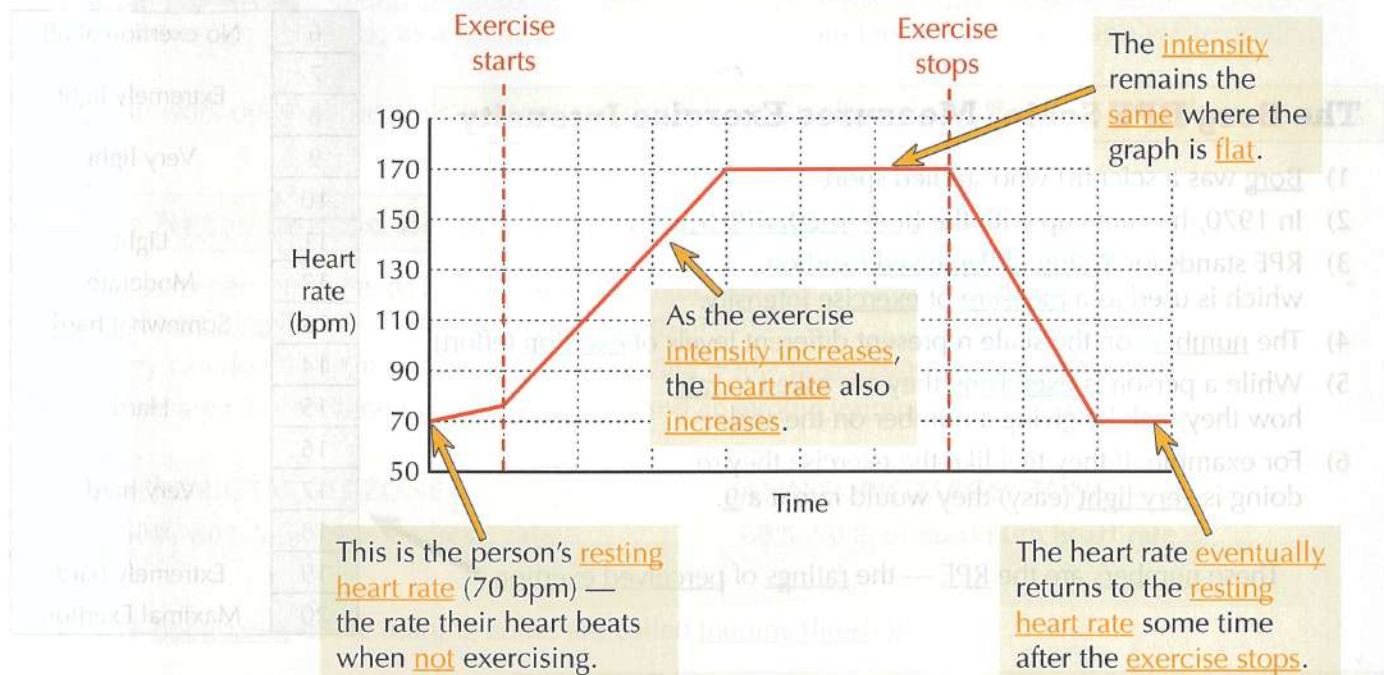
Heart Rate shows how Hard you are Working

- 1) **Heart rate** (HR) is the number of **times** the heart **beats per minute** (bpm).
- 2) Doing **exercise** makes the **heart beat faster** — your heart rate increases to **increase** the **blood** (and therefore **oxygen**) to your **muscles**.
- 3) Heart rate can show the **intensity** a sports performer is **working** at.
- 4) The **higher** their **heart rate**, the **greater** the **intensity** of the exercise.



EXAMPLE

This graph shows an example of a person's heart rate **over time** during **exercise**.



You Measure Heart Rate Manually or with Technology

- 1) You can **measure** your heart rate like this:



- 1) Place your first and second **fingers** on the **artery** on the **underside** of your wrist.
- 2) Using a **stopwatch**, count the number of **pulses** in **sixty seconds**.

Never use your thumb to take your pulse — it has a pulse of its own.

- 2) You can also **measure** your heart rate with a **heart rate monitor** or **smartwatch**.
- 3) **Apps** are another option — these measure your heart rate using a **smartphone's camera** and **light sensors**.

Heart Rate and the Borg RPE Scale®

You can Work Out a Person's Maximum Heart Rate

- 1) **Maximum heart rate** (MHR) is the **highest** number of times that the heart can **beat** in **one minute**.
- 2) Maximum heart rate is also called **HR max**.
- 3) You can **estimate** a person's **maximum heart rate** using this equation: $\text{HR max (bpm)} = 220 - \text{age}$ ← This is age in **years**.

EXAMPLE

Estimate the maximum heart rate of a 25-year-old.

$$\begin{aligned}\text{HR max} &= 220 - \text{age (years)} \\ &= 220 - 25 \\ &= \mathbf{195 \text{ bpm}}\end{aligned}$$



6	No exertion at all
7	
8	Extremely light
9	Very light
10	
11	Light
12	Moderate
13	Somewhat hard
14	
15	Hard
16	
17	Very hard
18	
19	Extremely hard
20	Maximal Exertion

The Borg RPE Scale® Measures Exercise Intensity

- 1) **Borg** was a scientist who studied sport.
- 2) In 1970, he came up with the **Borg (6-20) RPE Scale®**.
- 3) RPE stands for **Rating of Perceived Exertion**, which is used as a **measure** of **exercise intensity**.
- 4) The **numbers** on the scale represent different levels of **exertion** (effort).
- 5) While a person is **exercising** they are asked to **rate** how they feel, by giving a number on the scale.
- 6) For example, if they feel like the exercise they're doing is **very light** (easy) they would rate it a **9**.

These **numbers** are the **RPE** — the **ratings** of **perceived exertion**.

The Borg RPE Scale® can Estimate Heart Rate

- 1) To get a **rough idea** of **heart rate** (HR) during exercise, you can use the **Borg RPE Scale**.
- 2) To do this, you need to put the **rating** (RPE) from the **Borg RPE Scale** into an **equation**.
- 3) Here is the equation:

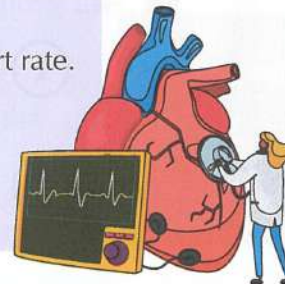
$$\text{HR (bpm)} = \text{RPE} \times 10$$

EXAMPLE

Zara has a Borg Scale rating (RPE) of 17. Estimate her heart rate.

$$\begin{aligned}\text{HR (bpm)} &= \text{RPE} \times 10 \\ &= 17 \times 10 \\ &= \mathbf{170 \text{ bpm}}\end{aligned}$$

You can also work out RPE if you know the heart rate. Just do:
 $\text{RPE} = \text{HR (bpm)} \div 10$.



It takes maximal exertion just to get myself out of bed...

Heart rate is a great measure of exercise intensity, and it's easy to measure (with or without equipment). People often overestimate how hard they are working, so RPE is a less accurate measure of heart rate.

Heart Rate Target Zones

Keeping your heart ticking within a target zone when training is helpful for improving your fitness.

Aerobic and Anaerobic Activity Depends on the Intensity

Your muscles can release energy in two ways — it depends on how hard you are exercising (intensity).

Aerobic Activity

- 1) Aerobic activity is 'with oxygen'.
- 2) When exercise isn't too intense and is at a steady rate, e.g. jogging, your heart and lungs can supply enough oxygen to the working muscles.
- 3) Muscles release energy using oxygen, and make carbon dioxide as a waste product.

Anaerobic Activity

- 1) Anaerobic activity is 'without oxygen'.
- 2) During intense exercise, e.g. sprinting, your heart and lungs can't supply the working muscles with enough oxygen.
- 3) Muscles release energy without oxygen, and make lactic acid as a waste product.

You can work out the type of activity you are doing by measuring your heart rate — see below.

Heart Rates Should be in a Target Zone when Training

- 1) A sports performer needs to exercise at the right intensity when training to maximise their improvement in fitness.
- 2) They can do this by making sure their heart rate is in a target zone.
- 3) There are different target zones for aerobic and anaerobic training:

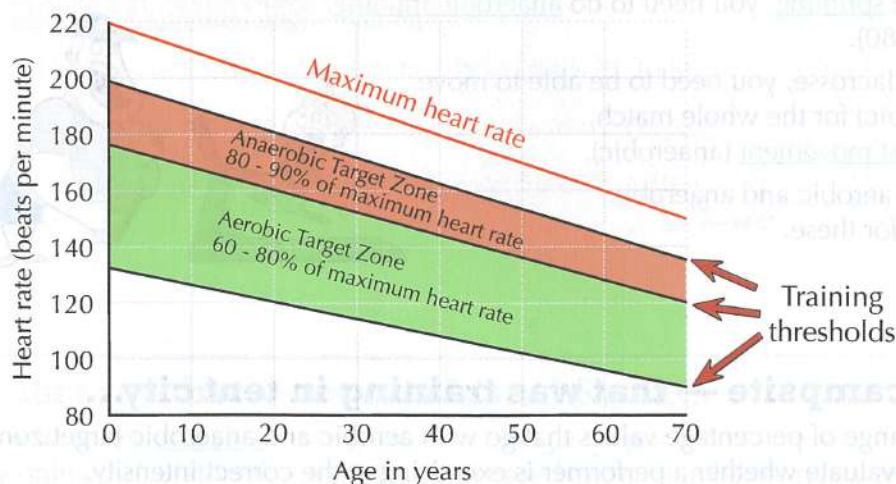
AEROBIC TARGET ZONE —
60%-80% of maximum heart rate.

ANAEROBIC TARGET ZONE —
80%-90% of maximum heart rate.

- 4) The boundaries of the training zones are called training thresholds:

- If you're a beginner, you should train nearer the lower threshold, — so around 60% for aerobic training and 80% for anaerobic training.
- Serious athletes train close to the upper threshold — so around 80% for aerobic training and 90% for anaerobic training.

Some people use 60-85% of HR Max for aerobic training, and 85-95% of HR Max for anaerobic training.



Heart Rate Target Zones

Performers Should Calculate their Target Zone

- 1) Performers need to work out the ideal target zone to get the most out of a fitness training method.
- 2) They need to know their maximum heart rate and whether they are doing aerobic or anaerobic training.
- 3) Look at the example below for how to calculate a target zone for a 20-year-old long-distance cyclist.

EXAMPLE

- 1) Find the maximum heart rate
Use the equation $\text{HR max} = 220 - \text{age}$ (see p.52).
 $220 - 20 = 200$, so their HR max is 200 bpm.

- 2) Find the thresholds
Long-distance cycling is mainly an aerobic activity,
so use the aerobic target zone thresholds.

Aerobic

Lower = 60% of HR max
Upper = 80% of HR max

Anaerobic

Lower = 80% of HR max
Upper = 90% of HR max

- 3) Multiply the thresholds by the maximum heart rate
Now calculate the aerobic target zone:
The lower threshold is 60% of the maximum heart rate — that's $200 \times 0.6 = 120$.
The upper threshold is 80% of the maximum heart rate — so $200 \times 0.8 = 160$.

For the anaerobic thresholds, you'd use 0.8 and 0.9.

So the cyclist's target zone for aerobic training is between 120 and 160 beats per minute.

Your Training Intensity Should Suit Your Activity

- 1) If you want to be good at an aerobic activity, like long-distance running, then you should do a lot of aerobic endurance training (see p.75) as part of your training.
- 2) Anaerobic training helps your muscles tolerate (put up with) lactic acid. For anaerobic activity like sprinting, you need to do anaerobic training, e.g. speed training (see p.80).
- 3) In many team sports, like lacrosse, you need to be able to move about continuously (aerobic) for the whole match, and also have spurts of fast movement (anaerobic).
- 4) You should have a mix of aerobic and anaerobic activities in your training for these.



I did a workout at a campsite — that was training in tent city...

Make sure you remember the range of percentage values that go with aerobic and anaerobic target zones. In the exam, you may have to evaluate whether a performer is exercising at the correct intensity.

Repetition Max Tests

Repetition Max (RM) tests are a way of finding your body's **upper limits**, so you can set **goals**. It's important to do these tests **safely** — make sure you have **someone with you** to act as a **spotter** when lifting heavy weights.

One Rep Max is the Maximum you can Lift Once

- 1) A **rep** (repetition) is **one** specific movement or exercise. For example, one biceps curl.
- 2) A good way to find your maximal strength is to do a **one rep max (1RM) test**.
- 3) To find your one rep max, you need to find the **heaviest weight** you can **lift safely** using a particular **muscle group**. The **heavier** this weight, the **stronger** the **muscle group**.
- 4) **Start** with a **weight** you **know** you can **lift**. Once you **successfully** lift it, **rest** for a few minutes.
- 5) **Increase** the weight you attempt in **small steps** until you reach a weight with which you **can't complete a single lift**. The last weight you managed to **successfully lift** is your **one rep max**.

You can also Work Out a Fifteen Rep Max

- 1) **Fifteen rep max (15RM)** is the **maximum weight** you can lift for **fifteen reps**.
- 2) To find your 15RM, you need to find a **weight** that is **not too heavy** (e.g. start around 50% of your 1RM), then see if you can do fifteen reps.
- 3) If you **cannot** do fifteen reps, **rest** and try again with a **lighter weight**.
- 4) If you **can** do fifteen reps with the weight, **rest** for a while and **increase** the **weight**, then **try again**. **Repeat** until you **cannot complete** the full fifteen.
- 5) Your **15RM** is the **heaviest weight** you managed to **successfully lift** fifteen times.

Resting is very important for RM tests — you won't be able to perform well if your muscles are tired from the last go.

Training Intensity is Defined Using 1RM

You can describe the **intensity** of **strength training** (see p.78) as a **percentage** of the **1RM**. For example, if your 1RM is **80 kg**, then **50%** of your 1RM would be $80 \times 0.5 = 40 \text{ kg}$.

Training for Maximum Strength

- 1) **Maximum strength** training helps muscles to lift a **large amount** in **one movement**.
- 2) For this training, you need **high loads** and **low reps**.

For example: 3 sets of 6 reps at 90% 1RM.

Training for Muscular Endurance

- 1) **Muscular endurance** training helps muscles to keep **repeating** the **same movement**.
- 2) For this training, you need **low loads** and **high reps**.

For example: 5 sets of 20 reps at 50-60% 1RM.

Or you could give this as a percentage of 15RM.



My last rest between sets lasted 5 years...

1RM tests are **not suitable** for beginners — lifting with poor form can be very dangerous. Instead, there are many online calculators that estimate 1RM based on the number of reps performed with smaller weights.

Fitness Tests

A coach uses **fitness tests** to find out about a sports performer's **fitness**.

Fitness Testing Helps Identify Strengths and Weaknesses

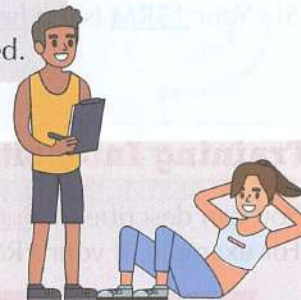
- 1) Fitness tests are designed to **measure** particular **components of fitness** (see p.32-35).
- 2) Fitness tests produce **data** (results), which can be used to:
 - Find out the sports performer's **baseline** (starting) **fitness level**.
 - **Design** a **training programme** based on what **components of fitness** need improving.
 - Find out if the **training programme** is **working**.
The sports performer is tested often to see if they are **improving**.
 - **Motivate** the sports performer and have something to **aim** for.
 - Agree appropriate **fitness goals** for the sports performer to achieve.

Coaches Need to Choose the Right Test

To choose the **right fitness test**, a coach needs to think about **three** things:

1. The Test Purpose

- 1) A coach needs to think about the **component of fitness** they want to measure. For example, a coach might want to measure an athlete's speed.
- 2) They need to choose a **test** that **measures** this type of fitness.
For example, the 30 m sprint test (see p.64) is a test that measures speed.



2. The Test Situation

- 1) A coach needs to think about the **practicality** of carrying out the test (how possible it is to carry out).
- 2) Practicality considerations include things like:
 - **cost** — how much does the test cost because of the equipment needed?
E.g. the timed plank test (p.62) is cheap — it only requires a stopwatch and a mat.
 - **time taken** — how long does it take to set up and perform the test or analyse the data?
E.g. it takes time to measure out an accurate course for the Illinois agility run test (p.67).
 - **number of people** — how many people can do the test at once?
E.g. lots of sports performers could all do an MSFT (p.60) at the same time.
- 3) The **most practical** tests use **cheap / minimal equipment** and are **set up** and **carried out quickly**.

3. The Needs of the Sports Performer

- 1) The coach needs to think carefully about the **safety** of the sports performer.
- 2) For example, they need to think about the performer's **age** and **health**.
- 3) The sports performer shouldn't do a test where they could get **injured**.
- 4) For example, someone who has a **bad back** shouldn't do a fitness test that uses their **back**.

You might find this section incredibly testing...

This section is about understanding **why** fitness tests are important — they help the coach and sports performer monitor progress and set goals. You'll be told **how** to set up fitness tests later in this Component.

Pre-Test Procedures

Pre-test procedures are things that need to be done **before** a **fitness test**. There are **four** procedures that you should know.

Equipment Needs to be Calibrated

- 1) Calibrating equipment means **adjusting** it to make sure it's **set up right** and is **working properly**.
- 2) For example, scales must be set to **zero** before a person is weighed. If they're not, they need **adjusting**.
- 3) **Calibration** makes sure the **readings** that are taken are **accurate** (as close to the real value as possible).

Participants Need to Give Informed Consent

- 1) Participants must be told the **purpose** of a fitness test and what it **involves** before they agree to take part.
- 2) Once they know these things, they can **agree to take part** by **signing** and **dating a form** before doing the test. This is called **informed consent**.
- 3) The participant can also **stop doing** the test at **any time**.

Participants Fill in a Questionnaire (PAR-Q)

- 1) The coach should know if a participant is in **good health** before doing any fitness tests.
- 2) This information is usually gathered with a **Physical Activity Readiness Questionnaire (PAR-Q)**.
- 3) It includes questions on a participant's **overall health and fitness**, for example:

- Have you ever been told you have a heart condition?
- Do you feel any chest pain when you do physical activity?
- Are you on any medication that may affect your ability to do physical activity?

The coach may ask the participant to seek advice from a doctor first if the PAR-Q reveals any issues.

- 4) A PAR-Q can reveal **injuries** or **illnesses** that may **prevent** a participant from taking part in a test **safely**, and allows the coach to select an **appropriate test**.

Participants Should do a Pre-Fitness Check

- 1) **Pre-fitness checks** also **inform** a coach about a participant's overall **fitness** and **experience**.
- 2) This might involve collecting measurements such as **height**, **weight** and **resting heart rate**.
- 3) There may also be **more questions**, e.g. to find out the **types** and **amount of exercise** the participant has done in the **past**.



Check the box to confirm you're happy to continue ...

It's really important that coaches have knowledge about a participant's health (with consent of course). This informs the coach on whether a participant is fit enough to safely carry out the fitness tests.

Carrying Out Fitness Tests

Once a coach has **chosen** an appropriate test and **completed** all pre-test procedures, they can **carry out** the test.

Fitness Tests Should Follow a Standard Procedure

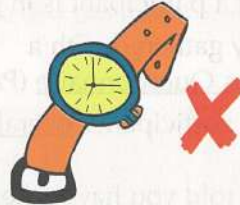
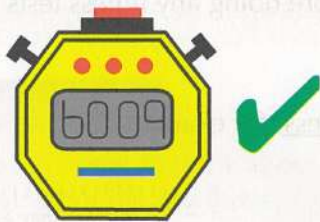
Before you start a fitness test, the participant must **warm-up**. Then the **standard procedure** of the test must be followed:

- 1) A standard procedure is a **set of instructions** describing **how** to **do** a fitness test.
- 2) The standard procedure includes the **equipment** needed for the test.
- 3) The **same** standard procedure is used **every time**, by **everyone** doing the test.
- 4) This means that the **results** can be **compared** with **other people's** results and **published national norms** for **age** and **sex**.
- 5) The standard procedures for each fitness test that you need to know about are on pages 60-71.

Results Must be Recorded Accurately

- 1) It's important to be **accurate** when **measuring** and **recording** the **results** of fitness tests.
- 2) You can do this by:

- 1) Choosing the **right equipment**. For example, to time something, use a **stopwatch** instead of the second hand on a watch. This is because a stopwatch is **more accurate**.



- 2) Always putting results into a **data table**. This keeps data organised (tidy).

Results	



5.7	21.2	11.7	21.2	2.7	11.7	21.2	1.2
21.2	27.2	18.6	17	86.2	18.6	7	
41	47	25.5	32	9.7	47	25.5	
10.2	9.7	47	47	101.3	6		
18.6	36	34					



- 3) It's also important to **measure** and **record** your results in the **right units**, e.g. cm or seconds.
- 4) This allows your results to be **compared** to other people's results and **published data**.

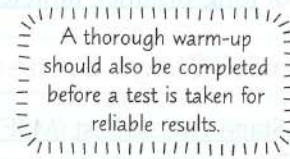
Fitness Tests Give you Data About Your Fitness Levels

- 1) You can **compare** your data from fitness tests **over time** to see how your **training** is **going** — e.g. if **each week** you're recording a **bigger distance** on a vertical jump test (see p.70), you know you're **increasing** your **leg power**.
- 2) You can also **compare** your **own performance** in a fitness test with **average ratings**. This can tell you how you **rate** compared to other people for your **age** and **sex**.
- 3) Most fitness tests will have a 'normative' **table** that you can **compare** your results with. You can find out more about **interpreting your results** on page 72.

Carrying Out Fitness Tests

Fitness Tests Need to be **Reliable**

- 1) A fitness test is **reliable** if a sports performer gets **consistent results** when they **repeat** the test under the **same conditions**.
- 2) **Different conditions** could make the test results **less reliable**.
- 3) These **factors** affect the reliability of results:



- **equipment calibration** — **equipment** must be **calibrated** before each test.
- **motivation of participant** — a participant must put in the **same amount of effort** each time.
- **environmental conditions** — the test should be done on the **same surface** and in the same **weather conditions** (if outside).
- **experience of coach** — the person running the test should **know** how to carry it out **properly**.
- **compliance with standard test procedure** — the **standard procedures** for the test should be used.

EXAMPLES

Environmental conditions

A sprinter does a **speed** fitness test **twice**:

- On the **first time** the weather is **sunny** — the **ground** is **dry**.
- On the **second time** it is **raining** — rain makes the **ground slippery**.

This makes the test results **different** and the test **unreliable**.



Motivation of participant

A climber does a **muscular endurance** test **twice**:

- On the **first time** the climber is **tired** and has **low motivation**.
- On the **second time** the climber is **well-rested** and **wants to do better**.

Again, this makes the test results **different** and the test **unreliable**.

The Fitness Test has to be **Valid**

- 1) A fitness test is **valid** if it **measures** the **component of fitness** that it's **supposed to measure**.
- 2) For example, a coach wants to measure the **strength** of a sports performer's **leg muscles**. He uses a test that measures the **strength** of the **arm muscles** (e.g. grip dynamometer test — see p.65). This test (and the results) are **not valid** for what the coach wants to measure.

Watch out — if a fitness test isn't **set up** and **done correctly**, then it's **not reliable**. This is **different** to the test being **not valid**.

Ah yes, the old “The machine wasn’t calibrated properly” excuse...

Just because a test is reliable, it doesn't mean that it's valid — that's true the other way round too. Fitness tests have to be valid and reliable to make sure the data is accurate and useful for a coach.

Aerobic Endurance Tests

The next two pages look at some fitness tests for [aerobic endurance](#). These are suitable for measuring the fitness of [long-distance athletes](#) or players of [team sports](#) which have lots of running, e.g. football.

The Multi-Stage Fitness Test (MSFT) Involves Shuttles

A [Multi-Stage Fitness Test \(MSFT\)](#) is used to predict a performer's [VO₂ max](#), which is the [maximum](#) amount of [oxygen](#) the body can use [during one minute of exercise](#).



MSFT — Standard procedure

Equipment: tape measure, cones, MSFT recording and speakers.

- 1) Two lines, [20 m](#) apart, are marked out using a tape measure.
- 2) A recording of [timed bleeps](#) is played.
- 3) On the first bleep, the sports performer must run from one line to the next. This is [one shuttle](#). Their foot must be [on](#) or [over](#) the line when the [next bleep](#) sounds.
- 4) They carry on running shuttles to the sound of the bleeps.
- 5) The bleep test has different [levels](#). As the [level increases](#), the time between bleeps gets [shorter](#). This means the sports performer must [run faster](#).
- 6) The test is [over](#) if they [can't carry on](#) or if they [miss three bleeps](#) in a row.
- 7) The [level](#) and [number](#) of [shuttles](#) completed is the [final score](#).
- 8) The results are used to find [VO₂ max](#) (in [ml/kg/min](#)) in a [published data table](#).

Reliability

The lines should be exactly [20 m apart](#) — any slight difference will make the results [less reliable](#).

Validity

If the sports performer [stops](#) [before](#) they are [too tired](#) to carry on, the results [aren't valid](#).

The Yo-Yo Test is Similar to the MSFT

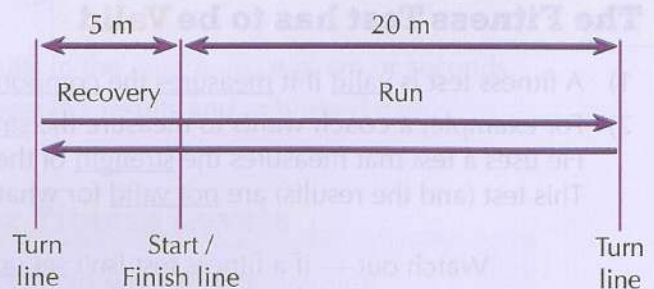
The [Yo-Yo Intermittent Recovery Test](#) is often just called the [Yo-Yo Test](#).



Yo-Yo Test — Standard procedure

Equipment: tape measure, cones, Yo-Yo test recording and speakers.

- 1) [Three lines](#) are marked out using a tape measure. The distances between the lines are [5 m](#) and [20 m](#), as shown on the right.
- 2) Performers line up on the [start line](#).
- 3) [Timed bleeps](#) are played and performers complete [20 m shuttles](#), with bleeps getting [shorter over time](#) (just like in the MSFT).
- 4) However, after [every two shuttles](#), there is a [10 second recovery period](#).
- 5) During the recovery period, performers must [jog](#) to the line [5 m away](#) and back to the start line.
- 6) Performers are [eliminated](#) like in the [MSFT](#), and the [score](#) is the [level](#) and [number of shuttles](#).
- 7) The results are used to find [VO₂ max](#) (in [ml/kg/min](#)) in a [published data table](#).



The [reliability](#) and [validity](#) factors are the [same](#) as for the [MSFT](#).

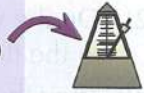
Aerobic Endurance Tests

The Harvard Step Test Uses Step-Ups

For the **Harvard Step Test**, performers step on and off a **step** or **bench**. Unlike the MSFT and Yo-Yo test, performers **don't** have to exercise until they are **exhausted** and have to **stop**.

Harvard Step Test — Standard procedure

Equipment: ruler, step, stopwatch, metronome (a device that 'clicks' at regular beats)



- 1) Set up a **51 cm** step for **men** or a **41 cm** step for **women**.
- 2) Performers do **30 step-ups** on the step **every minute** (a step every two seconds) **for 5 minutes**. (The **metronome** can help you step at the **right pace**.)
- 3) You then take **three pulse readings**: the first is taken **one minute after** you **finish** the test, the second is taken **two minutes after** and the third is taken **three minutes after**.
- 4) You put these numbers into a **formula** to work out your **score**. The results are used to find **VO₂ max** in a **published data table**.

There are different versions of the Harvard Step Test.

Reliability

- 1) The correct **step height** should be used, depending on the **sex** of the **performer**.
- 2) If a performer **can't step in time** with the metronome, the results will be **less reliable**.

Validity

People with **longer legs** may find this test **easier**, which makes it **less valid**.

You can Run or Swim the 12-Minute Cooper Test

For the **12-Minute Cooper Test**, you'll need a **running track** or a **swimming pool**. This is another **aerobic test** where performers **don't** exercise until **exhaustion**.

12-Minute Cooper Test — Standard procedure

Equipment: stopwatch.

- 1) **Run** round the track **as many times** as you can or **swim** as **far** as you can in **12 minutes**.
- 2) The **distance** you run or swim is **recorded** in **metres**. The **further** you can run or swim, the **better** your aerobic endurance.
- 3) The results are used to find **VO₂ max** in a **published data table** — the **tables** for **running** and **swimming** are **different**.



The 12-minute Cooper swim test is (obviously) most suitable for long-distance swimmers.

Reliability

How **far** a performer runs or swims can **vary** depending on how **motivated** they are.

Validity

The test requires the performer to **pace themselves**, which may mean **less experienced** performers **tire out** too **quickly**.

The Harvard staircase test — a step too far...

If you are able, try out some of the fitness tests yourself so you can experience what performers have to do. Or you could play the role of a coach and watch someone else do them while you put your feet up...

Muscular Endurance Tests

These fitness tests measure a performer's muscular endurance — they only need a stopwatch and a mat.

One-Minute Tests Measure Endurance of Muscle Groups

One-Minute Press-Up Test — Standard procedure

- 1) The sports performer begins in the start position.
- 2) On the word 'GO', they lower their chest to the floor keeping their back straight.
- 3) They then return to the start position. This is one rep (one press-up).
- 4) Another person counts how many reps the performer does in one minute using a stopwatch.
- 5) The results of this test are usually given in reps per minute and compared to a published data table.



A modified version of the test allows the knees to touch the floor.

One-Minute Sit-Up Test — Standard procedure

- 1) The sports performer lies on the mat in the start position.
- 2) On the word 'GO', they sit up, until their elbows touch their knees.
- 3) They then lower themselves back down to the start position. This is one rep (one sit-up).
- 4) Another person counts how many reps the performer does in one minute using a stopwatch.
- 5) The results of this test are usually given in reps per minute and compared to a published data table.



Reliability

Allowing press-ups or sit-ups with the wrong technique will affect the score (number of reps) on the test.

Validity

- 1) Each test only measures the muscular endurance of certain areas of the body (upper body/abdominals).
- 2) It isn't valid as a measure of overall muscular endurance.

The Timed Plank Test Measures Core Endurance

Timed Plank Test — Standard procedure

- 1) The performer supports the upper body using the elbows and forearms.
- 2) They straighten their legs and put their weight on the tip of their toes, with their hips lifted off the floor and back straight.
- 3) Once in position, start the stopwatch. The score is how long it takes before the hips are lowered.
- 4) The results are compared to values in a published data table.



Reliability

It can be difficult to judge when the performer 'fails'.

Validity

The test measures core (central body) muscular endurance, but is not valid for other muscle groups, e.g. leg muscles.

I prefer the log test — it involves lots of sleeping...

Core muscular endurance is a benefit for many physical activities and the timed plank test is a very practical test to measure it — you need minimal equipment and lots of people can take part at once.

Flexibility Tests

The tests on this page measure a sports performer's **flexibility**.

The Sit and Reach Test Measures Leg and Back Flexibility

Sit and Reach Test — Standard procedure

Equipment: tape measure, box.

- 1) The sports performer sits on the floor with their **legs straight out**.
- 2) A **box** is placed flat against the sports performer's **bare feet**.
- 3) The sports performer **reaches forward** as far as they can.
- 4) Another person measures the **distance** from their **feet** to where they **reach** with a **tape measure**.
- 5) The sports performer gets **three turns**. Their **best score** is recorded.
- 6) The results of this test are usually given in **centimetres (cm)** or **inches**.
- 7) The results are compared to values in a **published data table**.



Reliability

- 1) If the **legs** are **not kept straight** during the test, the score will be **unreliable**.
- 2) If the sports performer **hasn't warmed up** before the test, they'll get a **worse** score than they should.

Validity

- 1) The test **only** measures the **flexibility** of the **back** and **hamstrings**. It **isn't valid** as a measure of **overall** flexibility.
- 2) It doesn't account for **variations** in the **length** of a performer's **arms** or **legs**.

Calf and Shoulder Flexibility Tests are Also Used

Calf Flexibility Test — Standard procedure

Equipment: tape measure, wall.

- 1) The sports performer **stands facing** a **wall**, with one foot **in front** of the other.
- 2) They **bend** the **front knee** so it **touches** the **wall**, keeping **both heels** on the floor.
- 3) Measure the **distance** from the front of the **big toe** to the **wall**.
- 4) The performer moves **back** and **repeats** until they **fail**. The **greatest distance** without failing is their **score**.
- 5) They **repeat** the test on the **opposite** leg.

This test has no data table, so you can only compare results against yourself.

Shoulder Flexibility Test — Standard procedure

Equipment: tape measure, skipping rope.

- 1) The sports performer holds a **skipping rope** in front of them, with hands **shoulder-width apart**.
- 2) They **extend** the arms **over the head** and **behind** them to touch their **back**. The performer can **slide** the hands **apart just enough** to make this possible.
- 3) Another person **measures** the **shoulder width** and **distance between the thumbs** (in cm), then **subtracts** the first measurement from the second.
- 4) The performer gets **three turns**. Their **best score** is recorded.
- 5) The results are compared to values in a **published data table**.

Reliability

A **warm-up** of the **calves** / **shoulders** is needed for a **reliable score** in each test.

Validity

- 1) Each test **only** measures the **flexibility** of **certain areas** of the body (**calves** / **shoulders**).
- 2) It **isn't valid** as a measure of **overall** flexibility.

I'm pretty flexible — I'm free Mondays, Tuesdays and weekends...

Good flexibility is useful for most sports. Just remember that these tests are good indicators of flexibility for particular areas, e.g. the hamstrings or shoulders, but don't provide a full picture of a performer's flexibility.

Speed Tests

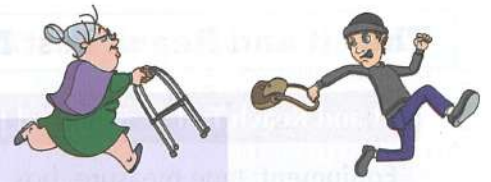
Here's another page on fitness tests — this time there are two speed tests to learn...

The 30 Metre Sprint Test has a Standing Start

30 Metre Sprint Test — Standard procedure

Equipment: tape measure, cones, stopwatch.

- 1) 30 metres is marked out on a flat running surface using a tape measure.
- 2) On the word 'GO', the sports performer runs the 30 metres as fast as they can.
- 3) Another person uses a stopwatch to time how long it takes.
- 4) The sports performer gets three turns (with a few minutes to recover in between).
- 5) Their best score is recorded.
- 6) The results of this test are usually given in seconds.
- 7) The results are compared to values in a published data table.



Reliability

- 1) If the reaction times of the person with the stopwatch are slow, the results will be inaccurate.
- 2) This makes the results less reliable.

Validity

- 1) It's a valid test for sports that involve running.
- 2) It is a less valid test of speed for sports that don't involve running. For example, swimming.

The 30 Metre Flying Sprint Test has a Running Start

The 30 metre flying sprint test is similar to the 30 metre sprint, but performers run another 30 m from a running start.

30 Metre Flying Sprint Test — Standard procedure

Equipment: tape measure, cones, stopwatch.

- 1) 60 metres is marked out on a flat running surface. Halfway along, another line is marked out to split the surface into two sections of 30 m.
- 2) On the word 'GO', the sports performer begins running as fast as they can.
- 3) Another person starts the stopwatch as they pass the 30 m mark and stops the stopwatch at the 60 m mark.
- 4) This means the performer is timed running the final 30 m from a running start.
- 5) The sports performer gets three turns (with a few minutes to recover between each one).
- 6) Their best score is recorded.
- 7) The results of this test are usually given in seconds.
- 8) The results are compared to values in a published data table.



The person using the stopwatch can't stand at both the 30 m and 60 m mark, so it is hard to judge when the performer has crossed each line, and results can be unreliable.

Otherwise, the reliability and validity factors are the same as for the 30 metre sprint test.

The athletics club's always having a laugh — must be a running joke...

These two tests start out the same — the performer runs 30 metres from a standing start. But in the flying sprint test, the performer runs for a further 30 m to measure their speed from a running start.

Muscular Strength Tests

Get a grip on this page about **two muscular strength** tests.

A Grip Dynamometer Tests your Grip Strength



Grip Dynamometer Test — Standard procedure

Equipment: grip dynamometer.

- 1) The sports performer holds the **grip dynamometer** in their **dominant hand**. (For example, if they are right handed their dominant hand will be their right hand.)
- 2) The grip dynamometer is **adjusted** to **fit** the **size** of their **hand**.
- 3) The sports performer **squeezes** as hard as they can for **five seconds**. The **reading** is **recorded**.
- 4) The sports performer gets **three turns** (with **one minute** to **recover** between each one).
- 5) Their **best score** is recorded.
- 6) The results of the test are given in **kilograms (kg)** and compared to values in a **published data table**.



Reliability

If the **grip dynamometer** isn't **adjusted** to fit the sports performer's **hand size**, the results will be **less reliable**.

Validity

- 1) The test only measures the **muscular strength** of the **lower arm** and **hand muscles**.
- 2) This means it is **not** a **valid** test for testing the **strength** of **other body parts**.

The One Rep Max Test gives your Maximum Muscle Strength

One Rep Max Test — Standard procedure

Equipment: free weights or adjustable weight machine.

- 1) The sports performer attempts **one rep** of a **heavy weight** that they know they can lift **safely**.
- 2) If they **succeed**, they rest (for 2 minutes) and **try again** with a **heavier** weight. If they **fail**, they rest and **try again** with a **lighter** weight.
- 3) The **heaviest weight** the performer can **lift** is their **one rep max** (1RM).
- 4) The results are compared to values in a **published data table**.

See p.55 for a reminder on RM tests.

You can also estimate your 1RM using online calculators, which is a safer method.

Reliability

- 1) The performer may get **tired** if they lift **too many weights** before finding their 1RM.
- 2) This means they **don't** get an **accurate** value of their **1RM**.

Validity

- 1) The test only measures the **muscular strength** of the **muscle groups** you are **targeting**, e.g. **leg strength**.
- 2) This means it is **not** a **valid** test for testing the **strength** of **other muscle groups**.

My favourite machine to use at the gym is the vending machine...

It's essential to perform the one rep max test safely — the performer needs to start with an appropriate weight (not something ridiculously heavy) and have a spotter who can assist them if they struggle.

Body Composition Tests

This page gives you a few examples of tests that can be used to measure a performer's body composition.

Body Mass Index (BMI) Estimates Ideal Weight

BMI — Standard procedure

Equipment: weighing scales, tape measure.

- 1) The sports performer's body mass (weight) is measured using scales, in kilograms (kg).
- 2) Their height is measured using a tape measure, in metres (m).
- 3) Their body mass index (BMI) is calculated using this formula:
- 4) The results of this test are given in kg/m² and compared to values in a published data table.

$$\text{BMI} = \frac{\text{body mass (kg)}}{\text{height}^2 (\text{m}^2)}$$

$$\text{height}^2 = \text{height} \times \text{height}$$

Reliability

If height and weight are not measured accurately the results will be unreliable.

Validity

- 1) People with more muscle, e.g. sprinters, have a higher body mass. This makes the test less valid.
- 2) Pregnant women carry more weight due to the baby. This means the test is not valid for pregnant women.

Bioelectrical Impedance Analysis (BIA) Uses Electrical Currents

BIA — Standard procedure

Equipment: BIA device, mat.

- 1) The sports performer lays down on a mat and electrodes are attached to the right ankle and right wrist.
- 2) A small electrical current passes through the body.
- 3) The BIA device gives out a reading, adjusted for the performer's height and weight — this is the estimated percentage (%) body fat.
- 4) The result is compared to values in a published data table.

Reliability

If the sports performer drinks more or less water than normal this can affect the results.



Waist to Hip Ratio Gives an Idea of Body Fat

Waist to Hip Ratio — Standard procedure

Equipment: tape measure.

- 1) Measure around the smallest part of a performer's waist and the widest part of the hips using a tape measure.
- 2) Divide the waist measurement by the hips measurement to find a ratio.
- 3) The result is compared to values in a published data table.

I ate a shocking cake the other day — it had electrical currants in it...

The tests on this page give estimates for body composition — they give an idea of how much of your body is made up of fat. Although they are just estimates, they are still useful for tracking fitness over time.

Agility Tests

This section looks at tests for **skill-related fitness**. The tests below will measure your **agility**.

The Illinois Agility Run Test and T-Test are Agility Courses

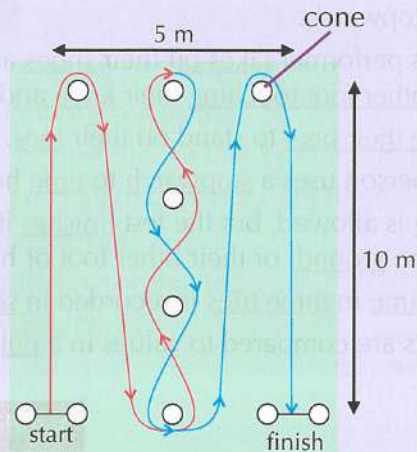
Illinois Agility Run Test — Standard procedure

Equipment: cones, tape measure, stopwatch.

- 1) **Set up the course** as shown on the **right**.
- 2) The sports performer starts by **lying face down** with their **head level** with the **start line**.



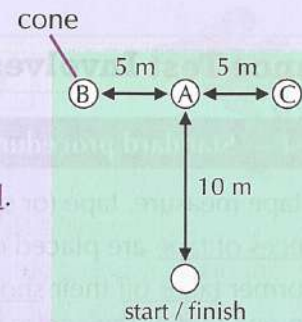
- 3) On the word '**GO**', they get up and **run the course** as fast as they can.
- 4) Another person uses a **stopwatch** to **time** how long it takes them to finish the course.
- 5) The results of this test are given in **seconds**.
- 6) The results are compared to values in a **published data table**.



T-Test — Standard procedure

Equipment: cones, tape measure, stopwatch.

- 1) **Set up the course** as shown on the **right**.
- 2) The sports performer **stands** ready at the **start cone**.
- 3) On the word '**GO**', the performer must:
 - **Run forwards** to **Cone A** and touch it with the **right hand**.
 - **Sidestep** to **Cone B** and touch it with the **left hand**.
 - **Sidestep** to **Cone C** and touch it with the **right hand**.
 - **Sidestep** to **Cone A** and touch it with the **left hand**.
 - **Run backwards** to the **start cone**.
- 4) Another person uses a **stopwatch** to **time** how long it takes them to finish the course.
- 5) The results of this test are given in **seconds**.
- 6) The results are compared to values in a **published data table**.



Reliability

- 1) A **change** in the **weather** can affect the results of both tests — it's easy to slip over in **wet conditions**.
- 2) If the sports performer is not wearing the **right footwear** they might be **slower**. This can make the results **less reliable**.

Validity

- 1) Both tests are **valid** tests of agility for sports that involve **running**.
- 2) They're **less valid** for **sports** that **don't involve running**. For example, kayaking.

The T-test is in the running to be my favourite fitness test...

Both of these agility tests use the same equipment but the courses are very different. Performers only run forwards during the Illinois agility run test, but must run forwards, backwards and sideways for the T-test.

Balance Tests

Balance is another component of fitness you can measure. Here are two tests you need to know.

You Balance on One Leg in the Stork Stand Test

Stork Stand Test — Standard procedure

Equipment: stopwatch.

- 1) The sports performer takes off their shoes and stands on their best leg with the other foot touching their knee and their hands on their hips.
- 2) They raise their heel to stand on their toes.
- 3) Another person uses a stopwatch to time how long they can hold the position for.
- 4) Wobbling is allowed, but the test finishes if their heel touches the ground, or their other foot or hands move.
- 5) The best time in three tries is recorded in seconds.
- 6) The results are compared to values in a published data table.



This test measures static balance.

Reliability

Some people might disagree with what does or doesn't count as failing the test. This means the results could be less reliable.

Validity

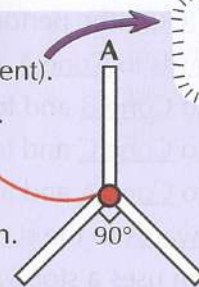
- 1) This test is a valid test in sports where you need to balance on the balls of your feet, e.g. ballet dancing.
- 2) It's less valid for sports where you don't need to balance on your feet, e.g. horse riding.

The Y Balance Test Involves Stretching in Three Directions

Y Balance Test — Standard procedure

Equipment: tape measure, tape (or specialist Y balance test equipment).

- 1) Three pieces of tape are placed on the floor to create a Y shape.
- 2) The performer takes off their shoes and stands on one foot at the centre of the Y. stand here, facing A
- 3) They stretch their free leg to one point of the Y as far as they can. They can bend their standing knee to reach further.
- 4) They repeat this three times on the same leg for each point on the Y, always facing the same direction. Then, they repeat it on the other leg.
- 5) Another person measures each attempt. If part of the performer touches the floor (apart from the foot of the free leg) the result doesn't count.
- 6) The average distances in each direction are recorded and the results are compared to values in a published data table.



This equipment has boxes that you slide along with the feet.

Reliability

Results are more reliable using the Y balance test equipment, rather than with a tape measure and tape.

Validity

- 1) This test is a valid test in sports where you need to do dynamic balances on the feet.
- 2) It is less valid for sports requiring static balances or upper body balances.

Y balance? Well, it's a useful skill for some sports...

The stork stand test is useful for testing static balance, whereas the Y balance test is better for testing dynamic balance. Think of your own examples of sports that would benefit from each type of balance.

Coordination Tests

Next up is coordination and another two tests for you to learn.

The Wall-Toss Test Measures your Hand-Eye Coordination

Hand-eye coordination is the ability of your hands and eyes to work together to do things.

The Alternate-Hand Wall-Toss Test is also called the Wall Toss Test or Wall Throw Test.

Alternate-Hand Wall-Toss Test — Standard procedure

Equipment: tennis ball, wall, stopwatch.

- 1) The sports performer starts by standing 2 m away from a smooth wall.
- 2) They throw a ball underarm using their right hand against the wall and catch it in their left hand.
- 3) They then throw it underarm using their left hand and catch it in their right hand.
- 4) They repeat this for 30 seconds and count the number of catches.
- 5) The more successful catches they make, the better their coordination.
- 6) The results are compared to values in a published data table.

The wall toss test is also useful to test reaction times.

Reliability

- 1) The test should be repeated using the same ball and same wall.
- 2) The results won't be as reliable if these conditions are not the same.

Validity

The test is less valid for sports that don't use the hands, e.g. skateboarding or football.

You Flip and Catch Sticks in the Stick Flip Test



I didn't say kick flip...

Stick Flip Coordination Test — Standard procedure

Equipment: 3 sticks (60 cm long and 2 cm thick), one with tape at one end.

- 1) The sports performer holds one stick in each hand, and rests the taped stick on the two sticks.
- 2) They try 5 half-flips — one hand flicks the taped stick so it does a half-rotation and lands back on the two sticks. The taped end lands on the other side.
- 3) They try 5 full-flips — the taped stick does a full rotation. The taped end lands on the same side.
- 4) The flip fails if the stick falls to the ground or doesn't do the correct rotation.
- 5) After all 10 attempts, the performer is scored — they get 1 point for each successful half-flip and 2 points for each successful full-flip. The maximum they can score is 15 points.
- 6) The results are compared to values in a published data table.

Reliability

- 1) Having sticks that are too light or heavy could make the test more challenging or too easy.
- 2) This makes the results less reliable.

Validity

As above, the test is less valid for sports that don't use the same types of hand movements.

Want to improve your coordination? You've got to stick at it...

It can be easier to remember the equipment needed, set-up and procedure of a fitness test if you carry it out yourself — have a go at running one of these coordination tests with a partner.

Power Tests

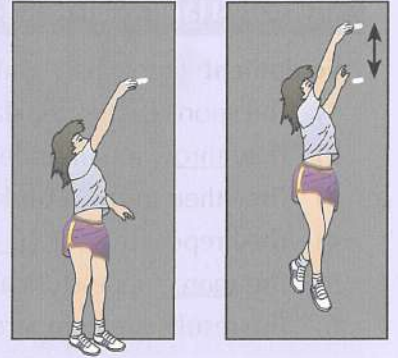
These tests all measure a performer's **power**.

Jumping Tests are a Good Way to Measure Leg Power

Vertical Jump Test — Standard procedure

Equipment: wall, chalk, tape measure.

- 1) The sports performer **reaches as high as they can** (with **feet flat** on the floor) and makes a **chalk mark** on a wall.
- 2) Next, they **jump up as high as they can**. They make **another** chalk mark.
- 3) The **distance** between the chalk is measured in **centimetres** (cm) with a **tape measure**.
- 4) The sports performer gets **three turns**. Their **best score** is recorded.
- 5) The results are compared to values in a **published data table**.



Standing Long Jump — Standard procedure

Equipment: tape, tape measure.

- 1) The sports performer stands behind a **line of tape**.
- 2) They jump **two-footed** as **far as they can**, bending their knees and swinging their arms to **push them forward**.
- 3) The **distance** between the **tape** and where the back of the performer's **heels** landed is measured in **centimetres** (cm) with a **tape measure**.
- 4) The sports performer gets **three turns**. Their **best score** is recorded.
- 5) The results are compared to values in a **published data table**.

Margaria-Kalamen Power Test — Standard procedure

Equipment: tape measure, tape, weighing scales, stopwatch, cones, stairs/steps.

- 1) The sports performer's **body mass (weight)** is measured using scales, in **kilograms** (kg).
- 2) Cones are placed on the **3rd, 6th and 9th** steps and **tape** is placed **6 metres** before the steps.
- 3) The **vertical distance** is measured, in **metres**, between the **3rd and 9th steps**.
- 4) The performer starts at the **tape** and runs **towards** and **up** the steps, jumping only on the steps **marked with cones** (3rd, 6th and 9th steps).
- 5) Another person measures the **time**, in **seconds**, to get from the **3rd step** to the **9th step**.

- 6) **Power**, in watts, is worked out using a **formula**:

$$\text{Power (W)} = \text{body mass (kg)} \times \text{vertical distance (m)} \times \frac{9.8}{\text{time taken (s)}}$$

This test has no table to compare results against.

Reliability

- 1) A **bad jumping technique** can lead to a **lower score** on each test.
- 2) This makes the results **less reliable**.

Validity

- 1) These tests measure **power** of the **leg muscles**.
- 2) This means they are **not valid** tests for testing the power of **other muscle groups**.

Revise more I tell you — sorry, all this power's gone to my head...

The Margaria-Kalamen power test has a more complicated set-up than the other power tests — if you're using the stairway of a building, make sure to close it off to others to avoid any accidents.

Reaction Time Tests

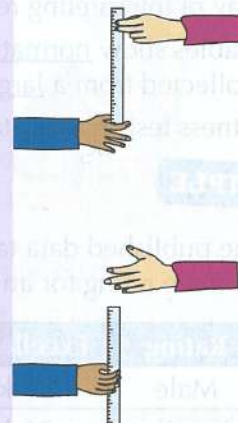
You've made it — this is the final page on the [fitness tests](#) that you need to know. These tests are used to measure the [reaction time](#) of a performer.

A Performer Catches a Ruler in the Ruler Drop Test

Ruler Drop Test — Standard procedure

Equipment: ruler.

- 1) The person [running the test](#) holds the [ruler out vertically](#).
- 2) The sports performer lightly places their [first finger](#) on the ruler, so that the [0 cm mark](#) on the ruler is in line with the [top of the finger](#).
- 3) The ruler is [dropped](#) without warning and the performer must [catch it](#) as quickly as they can.
- 4) The measurement on the ruler at the point where it was [caught](#) is [how far](#) the ruler dropped in the time it took the performer to [react](#).
- 5) The [longer](#) the [distance](#), the [longer](#) the [reaction time](#).
- 6) The sports performer gets [three turns](#). Their [average score](#) is taken as the result.
- 7) The results are compared to values in a [published data table](#).



Reliability

- 1) If a performer is [tired](#), reaction times can be [slower](#) than usual.
- 2) [Caffeine](#) (e.g. in coffee) may also affect reaction times, making results [less reliable](#).

Validity

The test only uses a [performer's hands](#), but many sports require performers to react with different [parts](#) of the body (e.g. a [sprinter](#) leaving the [blocks](#)).

You can Go Online to Test your Reaction Time

- 1) [Online reaction time tests](#) are simple ways of testing a performer's reaction time.
- 2) There are many different [websites](#) and [apps](#) that are available.
- 3) Performers must respond to a [stimulus](#) (e.g. a [changing colour](#), [flashing light](#) or [noise](#)) and [click or tap](#) as [quickly as possible](#).
- 4) The computer [records](#) the [time taken](#) to [respond](#) — it will be a [more accurate measure](#) than someone using a stopwatch.
- 5) The results can be [compared with other people](#) that use the same website or app.



Take me to your ruler...

The ruler drop test uses a visual stimulus to test reaction times. Online reaction time tests can use sound as a stimulus, which may be a more valid test for athletes that react to a starting gun, e.g. sprinters.

Fitness Test Results

You need to be able to **interpret data** from a fitness test to help you **evaluate** and **plan** fitness training.

Coaches can Compare Results to Normative Data

- 1) A **coach** needs to **interpret** (work out the meaning of) fitness test **results**.
- 2) This helps them to make a performer's **training programme better**.
- 3) One way of interpreting results is to **compare** them to **published data tables**.
- 4) These tables show **normative data** — this is **average** or 'normal' data that has been collected from a **large number of people** who have completed the fitness test.
- 5) Most fitness tests have data tables for **specific groups**, e.g. males / females of a certain age group.

When you compare results to normative data, you are **analysing data**.

EXAMPLE

The published data table below is for 16- to 19-year-olds taking the **grip dynamometer test**. Find the rating for an **18-year-old female performer** who scored **26 kg**.

Rating	Excellent	Good	3 Average	Fair	Poor
Male	> 56 kg	51-56 kg	45-50 kg	39-44 kg	< 39 kg
1 Female	> 36 kg	31-36 kg	2 25-30 kg	19-24 kg	< 19 kg

< means 'less than' and > means 'more than'.

Choose the **row** that matches the performer's **sex**.

Read along to find the **range** of numbers that includes their **score**.

Finally, go up to see which **column** this **range** is in — this is the **rating**.

So, this performer has **average grip strength** for her age and sex.

Coaches Use Data to Suggest Fitness Improvements

- 1) You can **recommend changes** to a **training programme** after **analysing data** from fitness tests.
- 2) For example, a performer has an **excellent rating** for **flexibility** and a **poor rating** for **speed**. Their training programme probably **won't** need more **flexibility training**, but will need **more activities** designed to **improve speed**.
- 3) You can **measure the effect** of training by doing **regular fitness tests** and **comparing data over time**.

EXAMPLE

Bryan's training programme aims to improve his **aerobic endurance** and **muscular endurance**.

Fitness Test	Week				
	1	2	3	4	5
12-Minute Cooper Run (distance in m)	1450	1490	1530	1600	1640
1-Minute Sit-Up Test (no. of sit-ups)	45	46	45	46	44

Bryan **improves** his **score** on the **12-Minute Cooper Run** each week. This shows his **aerobic endurance** is **improving**.

Bryan does **about the same number** of **sit-ups** each week, so his **abdominal muscular endurance** is **not** improving. His **training programme** should **change** to **improve** his muscular endurance.

I'd rate myself 'excellent' thank you very much...

In the exam, you might need to interpret fitness results, e.g. suggest the components of fitness a performer should work on given test ratings. Make sure your suggestions are appropriate for the performer's sport.

Fitness Training Methods

You need to know how to safely and effectively take part in fitness training. This includes linking the training principles to training methods. Flick back to pages 49 and 50 to see all the training principles.

Before Exercise You Should Always Warm Up...

- 1) It's important to do a warm-up before taking part in any fitness training.
- 2) A warm-up gets your body ready for exercise by gradually increasing your work rate. It also reduces the risk of injury.
- 3) A warm-up should include:



- 1) **A pulse raiser** (see p.25)
 - Light exercise that increases your heart rate, breathing rate and blood flow.
 - It helps to ease your body into exercising by gradually increasing the exercise intensity, and it increases the oxygen supply to the muscles.
- 2) **A mobiliser** (see p.26)
 - Mobilisers are low-intensity exercises that take joints through their full range of motion.
 - They reduce the heart rate and breathing rate slightly.
 - They increase the production of synovial fluid, which increases lubrication of the joints.
- 3) **Stretches** (see p.26-27)
 - The final stage stretches the muscles that will be used in the fitness training method.
 - This can involve static and dynamic stretches.
 - Stretching muscles makes them more pliable, so injuries are less likely.

...And Afterwards You Should Cool Down

- 1) A cool-down gets your body back to normal after exercise by gradually lowering your pulse and breathing rate to resting levels.
- 2) A cool-down should involve:

- 1) **Gentle exercise**
 - Gentle exercise like jogging is a great way to cool down.
 - You should gradually reduce the intensity of this exercise so that your heart rate, breathing rate and body temperature return to normal.
 - It also means you can continue taking in more oxygen to help get rid of lactic acid — a waste product that builds up during exercise.
- 2) **Stretches**
 - The muscles that have been used in the fitness training method should be stretched.
 - This helps the muscles return to pre-exercise length.
 - Static stretching while the muscles are warm helps to improve flexibility.

Fitness Training Methods

Training Methods Improve Components of Fitness

- 1) Fitness training methods are different ways of exercising.
- 2) Sports performers use these methods to improve performance.
- 3) Each method targets a different component of fitness.
- 4) For example, continuous training is a fitness training method for improving aerobic endurance.

See the next page for continuous training.

Coaches Apply Training Principles to Training Methods

- 1) Coaches design training programmes to help sports performers improve at their sport.
- 2) They apply the basic training principles and additional training principles to each training method.

EXAMPLE

Continuous Training — Cyclist (beginner)

Basic training principles (FITT):

- **Frequency** — 4 times per week.
- **Intensity** — moderate (medium).
- **Time** — each session needs to be at least 30 minutes long.
- **Type** — continuous training.

Reminder
 Frequency — how often to train.
 Intensity — how hard to train.
 Time — how long to train for.
 Type — which training method to use.

Additional training principles:

- **Progressive overload** — the intensity is moderate to match the demands of distance cycling, but should get gradually harder to overload the body.
- **Specificity** — the training improves aerobic endurance, which is important for cycling.
- **Individual differences/needs** — a beginner will have lower fitness and skill than an elite cyclist.
- **Adaptation** — the body will get fitter in the recovery between each session.
- **Reversibility** — fitness will decrease if training stops or the cyclist doesn't train hard enough.
- **Variation** — the cycling route can be varied to make it interesting.
- **Rest and recovery** — 3 days of rest per week will allow the body to recover.

Training Should Match the Required Intensity

Coaches decide on the exercise intensity, e.g. percentage of maximum heart rate (see p.53), depending on the performer's fitness and the chosen training method.

EXAMPLE

- For aerobic endurance training, the performer's heart rate needs to be in the aerobic target zone (60-80% of maximum heart rate).
- To achieve this, the exercise intensity should be moderate.

Putting on a big jumper — another great way to warm up...

You should warm up and cool down every time you take part in fitness training. It helps to prevent injuries to muscles (like strains) and makes sure that your heart rate and breathing rate gradually changes.

Aerobic Endurance Training

Aerobic endurance training is all about increasing **how long** you can keep exercising for. The next two pages cover the **four methods** of training that you need to know.

Continuous Training Means No Resting

- 1) Continuous training is where you keep doing the **same type** of exercise **without having a rest**.
- 2) The exercise needs to last for **30 minutes or longer**.
- 3) The **intensity** is **moderate** (medium). You keep going at the same **steady pace**.
- 4) It works well for sports such as **running**, **cycling** and **swimming**.

Advantages and Disadvantages:

Advantages:

- No **specialist equipment** or **set-up** is needed.
- Can be done almost anywhere, e.g. a **park**, **sports hall** or **running track**.
- **Many people** can take part at once.

Disadvantage:

- It can be **boring** doing one exercise at the same pace.



Fartlek Training is All About Changes of Intensity

- 1) Fartlek training involves **changes** in **intensity**.
- 2) There are **no rest periods** when training.
- 3) You can change the **intensity** of the training by:
 - Using **equipment** such as weights or a weighted backpack.
 - Changing the **speed** — for example, by running fast for one part and slow for another part.
 - Changing the **terrain** (type of land), e.g. a flat road, hilly grass or soft sand.

Fartlek means 'speed play' in Swedish.



- 4) You can include a mix of **aerobic** and **anaerobic** activity, so it's good training for sports that need different paces, like **hockey** and **rugby**.

Advantages and Disadvantages:

Advantages:

- No **specialist equipment** or **set-up** is needed.
- It can be made **easy or hard** to match your fitness.
- **Many people** can take part at once.

Disadvantages:

- Changes to intensity means that there **isn't a clear structure** — it's easy to **skip** the hard bits.
- It's difficult to track **progress**.

Aerobic Endurance Training

Interval Training Uses Fixed Patterns of Exercise

- 1) Interval training is where you have a work period and then a rest or recovery period.
- 2) In the work period you exercise at moderate intensity for 30 seconds to five minutes.
- 3) In the rest or recovery period you can sit down, stand still, walk or jog.
- 4) It is an ideal training method for people with low fitness because the performer can start with short work periods and long rest periods.
- 5) To develop aerobic endurance, you need to decrease the number or length of the rest or recovery periods.

Interval training can also be done at high intensity — see p.80 for more.



Advantages and Disadvantages:

Advantages:

- It can be adapted for all fitness levels.
- No specialist equipment or set-up is needed.
- Many people can take part at once.

Disadvantage:

- Rest periods can make it time-consuming.

Circuit Training Uses Loads of Different Exercises

- 1) In circuit training, you do one exercise after another in a set order.
- 2) Each exercise is called a 'station'. Circuits are timed or have a set number of exercises to complete at each station.
- 3) Only taking short rests between stations improves aerobic endurance.

EXAMPLE



- Four stations
- 30 seconds work at each station.
- 30 seconds rest between each station.
- Repeat the circuit three times.

Advantages and Disadvantages:

Advantages:

- You design the circuit, so you can match circuit training to an individual.
- The variety keeps training interesting.
- Many people can take part at once.

Disadvantage:

- It can take time to set up if lots of equipment is used.



I need some rest after that work period...

There were four main training methods for aerobic endurance for you there — make sure you know the advantages and disadvantages of each, and can list sports that benefit from these training methods.

Flexibility Training

Sports performers can improve their **flexibility** by training, which involves stretching **alone** or with a **partner**.

Static Stretching Can be Used to Improve Flexibility

- 1) **Static stretching** is when you **gradually stretch** a muscle and **hold** it in **one position**.
- 2) Static stretching can be **active** or **passive**.
 - In an **active** static stretch, you hold the stretch position **by yourself** (you apply an **internal force**).
 - In a **passive** static stretch, you use **someone else** or an **object**, such as a **wall** or a **resistance band**, to hold the stretch position (an **external force** is applied).

Advantages and Disadvantages:

Advantages:

- **Anyone** can do it, even with **little** previous training.
- No **specialist equipment** or **set-up** is needed.
- **Many people** can take part at once.

Disadvantages:

- **Poor technique** can lead to **overstretching** and **injury**.
- It is only **effective** for stretching **certain muscle groups**.

Stretching? No, I always sit like this.

Proprioceptive Neuromuscular Facilitation (PNF) Uses a Partner

- 1) Don't worry about all those long words — you can call this training method **PNF**.
- 2) It is best to use a **partner** to help you do this type of stretching:

1 The performer **stretches** the muscle as far as it can go.

2 A **partner** helps to **hold** the muscle and the performer **pushes against** them for **6-10s**. The muscle is in an **isometric contraction** — it **contracts** but **stays the same length**.

3 The performer **relaxes** the muscle whilst the partner stretches it **a little bit more**.

You can use an immovable object instead of a partner, e.g. a wall. You push against the wall in step 2 and stretch a bit further by yourself in step 3.

- 3) Muscles have a **stretch reflex** that stops them being stretched **too far**.
- 4) PNF helps you **push past** the stretch reflex, meaning muscles can be **stretched further** than normal.

Advantages and Disadvantages:

Advantages:

- It develops flexibility **more quickly** than other methods.
- No **specialist equipment** or **set-up** is needed.

Disadvantages:

- It is **not** a suitable method for **children**.
- There is a greater risk of **injury**.



I'm stretching myself thin to find a good pun here...

It's important to remember the difference between the types of static stretching. You hold the stretch position yourself in an active static stretch, but you use an object or partner in a passive static stretch.

Muscular Endurance and Strength Training

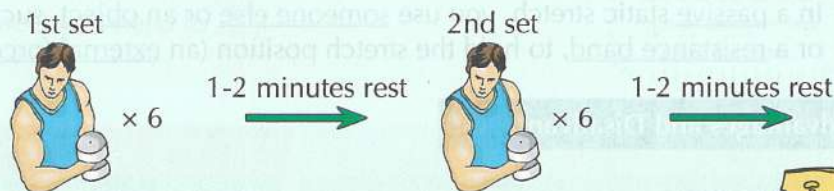
Sports performers can make their **muscles stronger** by using **weights** and **body resistance exercises**.

Weight Training is Described in Numbers of Sets and Reps

- 1) Weight training is described in **reps** (repetitions) and **sets** (a group of reps without rest).
- 2) After each set it is important to have a **rest period** of about **1-2 minutes**.

EXAMPLE

A person might do **2 sets of 6 reps**.



- 3) The **weight** and the **number of sets and reps** you should do will depend on whether you want to train **muscular endurance** or **muscular strength**:

- To increase **muscular endurance**, you use **low weight** (loads) but a **high number of reps**.
- To increase **muscular strength** you use **high weight** (loads) but a **low number of reps**.

- 4) **Free weights** and **fixed resistance machines** can be used for **muscular endurance training** or **muscular strength training**.



Free Weights are Not Attached to a Piece of Equipment

- 1) Free weights are weights that **aren't attached** to a machine.
For example:



- 2) You lift **barbells** with **both hands** and **dumbbells** with **one hand**.
- 3) Free weights can be used to target **specific muscle groups**, e.g.:
 - **biceps curls** (dumbbells) target the **biceps**
 - **bench presses** (barbells) target the **triceps**, **deltoids** and **chest muscles**
 - **squats** (barbells) target the **quadriceps** and **gluteus maximus**

You can determine the amount of weight you should lift by doing RM tests — see p.55.

- 4) It's **important** to have a **spotter** for **heavy weights** to watch you and help you **lift safely**.

Advantages and Disadvantages:

Advantages:

- You can **target** the particular **muscles** that you want to improve.
- Smaller weights can be used **anywhere**, e.g. at home.

Disadvantages:

- You need to choose a **correct weight** and use a **good technique** or you can **injure** your muscles.
- The **number of people** that can take part depends on the **equipment available**.
- Requires **specialist equipment** or **facilities**.
- **Heavy loads** are **not suitable** for **young children**.

Muscular Endurance and Strength Training

Fixed Resistance Machines Target Specific Muscles

- 1) Fixed resistance machines have **weights** attached to **pulleys**. You can **change** how heavy the **weight** is.
- 2) The **direction** you move the weight is **fixed**, which means each machine has a **set exercise** and **muscle group** that it targets.
- 3) E.g. the **seated chest press** targets the **triceps**, **deltoids** and **chest muscles**.



Advantages and Disadvantages:

Advantages:

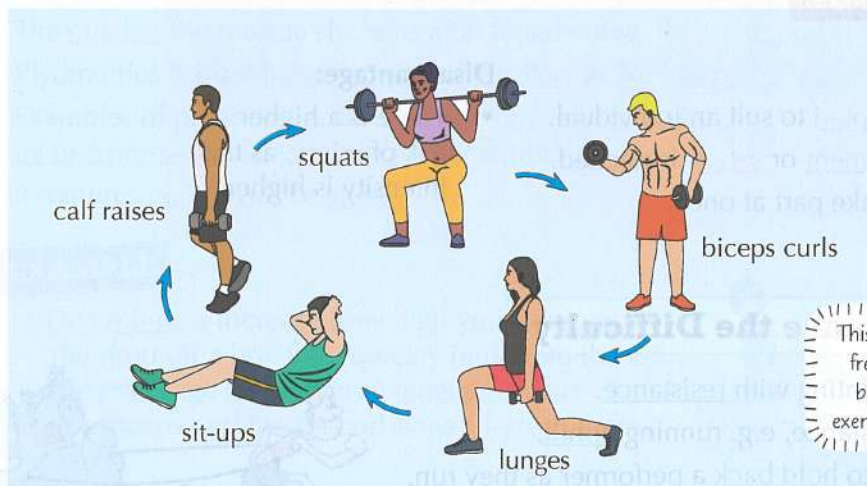
- They're great for **beginners**, because muscle movement is controlled.
- They are **easy** to use, which **reduces** the risk of **injury**.

Disadvantages:

- They only exercise **one muscle group**.
- Only **one person** can exercise **per machine**.
- Requires **specialist equipment** or **facilities** which can be **expensive**.

Circuit Training Can Develop Muscular Endurance

- 1) Circuit training (see p.76) can be used to increase **muscular endurance**.
- 2) The circuit **stations** can each target **different muscles**. This means the muscles don't get **fatigued** (too **tired**).



This circuit involves free weights and body resistance exercises, e.g. sit-ups.

Advantages and Disadvantages:

Advantages:

- They are **varied** and can be changed to make exercise more **interesting**.
- They exercise the **whole body**.
- **Many people** can take part at once.

Disadvantages:

- It can take time to **set up** if lots of **equipment** is used.
- Some circuits need specialist **equipment**.

I prefer wait training myself — far less strenuous...

Make sure you understand how weights can help improve muscular endurance or muscular strength. For endurance, do low weight, high reps. For strength, do high weight, low reps. It's that simple.

Speed Training

Speed training involves going as fast as you can for a short distance and then having lots of rest.

Acceleration Sprints Gradually Increase the Pace

- 1) In acceleration sprints you keep increasing the pace over a short distance.
- 2) You start standing still or rolling (easy jogging), then increase the pace to jogging, then striding and then to a maximal sprint.
- 3) In between each sprint you rest by jogging or walking.

Advantages and Disadvantages:

Advantages:

- Gradually increasing the pace reduces the risk of injury.
- No specialist equipment or set-up is needed.
- Many people can take part at once.

Disadvantage:

- Not suitable for sports where acceleration isn't gradual, e.g. sprinting.

Interval Training Uses Fixed Patterns of Exercise

- 1) Interval training (see p.76) can be adapted for anaerobic exercise, e.g. sprinting.
- 2) To develop speed, the work period needs to be at a higher intensity.
- 3) However, you should also increase the number or length of the rest periods.

Advantages and Disadvantages:

Advantages:

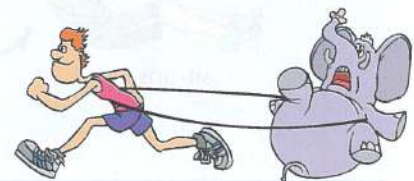
- It can be easily adapted to suit an individual.
- No specialist equipment or set-up is needed.
- Many people can take part at once.

Disadvantage:

- There is a higher risk of injury, as the intensity is higher.

Add Resistance to Increase the Difficulty

- 1) Resistance drills involve sprinting with resistance.
- 2) The terrain can provide resistance, e.g. running uphill.
- 3) Or equipment can be used to hold back a performer as they run, e.g. parachutes, sleds, bungee ropes and resistance bands.



Advantages and Disadvantages:

Advantages:

- Variety makes this method more interesting.
- It also improves muscular strength.

Disadvantages:

- If loads are too heavy, there is a risk of injury.
- Some equipment can be expensive.
- The number of people that can take part depends on the equipment available.

Don't resist learning this page — you know you want to...

Speed training is useful for many sports that involve sprinting in straight lines, e.g. in football or hockey to intercept a ball. But these sports also require changes in direction, which is where agility comes in...

Agility and Power Training

SAQ training helps to develop a sports performer's agility, and plyometrics makes you powerful.

SAQ Training Involves Speed, Agility and Quickness

- 1) Sports performers use Speed, Agility and Quickness training (SAQ) to develop their motor skills (muscle movements). It helps them practise moving quickly and changing direction.
- 2) In SAQ training, performers sprint and use agility to avoid obstacles (e.g. cones, ladders and posts). For example, a footballer may dribble around cones to practise avoiding opponents in a match.
- 3) SAQ training is helpful for sports that involve lots of quick movement, e.g. basketball and skiing.

Advantages and Disadvantages:

Advantages:

- It can be adapted to suit different sports.
- You do need some equipment, but it's not very expensive.
- Many people can take part at once.

Disadvantages:

- It can take time to set up if lots of equipment is used.
- You need to be fit — there is risk of injury if poor technique is used.

Plyometric Training Improves Power

- 1) Plyometrics develops explosive (sudden bursts of) power and muscular strength.
- 2) In the exercises the muscles lengthen and then quickly shorten, creating power.
- 3) The quicker the muscle shortens after lengthening, the more power is created.
- 4) Plyometrics is used by sprinters and hurdlers as well as netball, volleyball and basketball players.
- 5) Examples of plyometric exercises are: lunging, bounding, incline press-ups, barrier hopping and jumping.
- 6) It requires high levels of fitness.

EXAMPLE

Depth jumps increase how high you can jump. You drop off a box then quickly jump into the air. The first stage (as you land) lengthens your quadriceps and the second stage shortens them.



Advantages and Disadvantages:

Advantages:

- It can be adapted to develop specific muscle groups.
- You need some equipment (e.g. boxes or benches), but it's not very expensive.

Disadvantages:

- You need to be very fit to do it. Beginners, children and older adults shouldn't take part.
- The number of people that can take part depends on the equipment available.

What happened to the coach who overslept? They got the SAQ...

Both SAQ training and plyometric training require high levels of fitness and skill, so they're not suitable for everyone. Sports performers need a good technique and warm-up beforehand to avoid getting injured.

More Training Methods

There are a few more training methods to learn: [balance](#), [coordination](#) and [reaction time](#).

Balance Training Improves Posture and Strength

- 1) Balance training involves [balancing](#) on a [limited base of support](#).
- 2) This helps to [strengthen](#) your [core muscles](#) and improve your [posture](#).
- 3) It benefits performers across different sports by developing [control](#) and [stability](#). It can also help to [prevent injuries](#).
- 4) An example is [raising](#) your [arm](#) and [opposite leg](#) on a mat.

Balances can be static or dynamic (see p.35).



Advantages and Disadvantages:

Advantages:

- It's suitable for [all age groups](#) and [abilities](#).
- No [specialist equipment](#) or [set-up](#) is needed.
- [Many people](#) can take part at once.

Disadvantage:

- There is a [risk of falling](#), particularly for [older adults](#).

Coordination Training Uses Two or More Body Parts

- 1) Coordination training involves moving [two or more](#) body parts [at the same time](#).
- 2) It improves the sports performer's ability to move [smoothly](#).
- 3) Examples include using a [skipping rope](#) or replicating the [same movements](#) as the sport, e.g. repeatedly [hitting a table tennis ball](#) ([hand-eye](#) coordination).



Advantages and Disadvantages:

Advantages:

- It can be [adapted](#) for any sport.
- [Many people](#) can take part at once, depending on the activity.

Disadvantages:

- It requires [concentration](#) to perform well.
- You may need [specialist equipment](#) and time to [set up](#), depending on the activity.

Reaction Time Training Helps You Develop Quick Responses

- 1) Reaction time training makes you [quicker](#) at [responding](#) to [external stimuli](#).
- 2) It's helpful for [sprinters](#) and players of [racket sports](#) (e.g. responding to the opponent hitting a ball).
- 3) For example, a sports performer could practise [sprinting](#) after the sound of a [whistle](#).

Advantages and Disadvantages:

Advantages:

- No [specialist equipment](#) or [set-up](#) is needed for some activities.
- [Many people](#) can take part at once, depending on the activity.

Disadvantages:

- You often need a [partner](#) to help you to provide the [stimuli](#).
- Some equipment is expensive, e.g. [machines](#) that [fire tennis balls](#).

I can sip my tea and change the channel at the same time...

Remember, a sports performer must keep their centre of mass over their base of support to balance well. If you make the base of support smaller in balance training, it'll make it more difficult for the performer.

Choosing Training Methods

There are different factors to consider when choosing a training method for a participant.

Think About the Demands of the Sport...

- 1) Firstly, think about the area of the sport or physical activity you want to improve, including the components of fitness that are involved, and which parts of the body too.
- 2) Plan how you can recreate the demands of the sport or physical activity, e.g. using the same equipment and conditions as a competitive environment.

This is linked to the training principle of 'specificity'.

...and the Practical Considerations

Then, you should think about the practical factors involved:

Cost of equipment

Some training methods need specialist equipment, such as fixed resistance machines, which can be expensive to buy. You may have to hire equipment instead.



Location of training

Some training methods need a specific facility, such as a swimming pool or gym. Participants will need to travel to these facilities, and they will only be open at certain times of day.

Ease of set-up

Some training methods involve setting up, e.g. circuit training, which can take time. Equipment must be stored somewhere between sessions too.

Number of participants

Participants of team sports often train together. If you have limited equipment, you'll need to make smaller groups to share equipment. The number of participants you can train will also be limited by the amount of space that you have access to.

Adapt Training to Meet the Participant's Needs

You'll also need to consider the needs of the participant, including:

- **Age** — children should avoid lifting heavy weights, e.g. in muscular strength training, as it can affect their growth. High-intensity activities, e.g. resistance drills, are not appropriate for older adults.
- **Level of fitness / experience** — training methods such as plyometrics are too demanding for people with low fitness. Training methods that can be easily adapted, e.g. interval training, can be more appropriate for beginners.
- **Variety** — the training method should be interesting for the participant. For example, circuit training is varied, so can be more engaging for adolescents.

Training with other people can also be more motivating.

I'm tired after all that brain training...

Remember to consider the safety of the participant when you're choosing a fitness training method. You need to make sure the method is safe and that you've taken into account their current fitness level.

Provision of Fitness Training

You've already covered provision on pages 6-7, so this page should feel familiar... but it's important to consider how provision relates to fitness training.

There are Different Providers of Fitness Training

Public Provision

Public sector provision includes facilities or sessions run by schools or local authorities, e.g. a leisure centre or an outdoor gym in a public park.

Advantages and Disadvantages:

Advantages:

- A wide range of training and equipment is usually available.
- Facilities are open to everyone in a local community.
- Sessions are usually cheaper than those from private providers.

Disadvantages:

- Equipment and facilities can be limited or dated.
- Sometimes you have to pay to hire equipment.
- There may not be access to sports sector professionals for support, e.g. personal trainers.

Private Provision

Private provision includes profit-making individuals or companies, e.g. a personal trainer or private gym.

Advantages and Disadvantages:

Advantages:

- A wide range of training and equipment is usually available.
- Modern facilities and equipment are provided.
- Sports sector professionals are usually available to support with training.

Disadvantages:

- It is more expensive than public provision — you usually pay a membership fee.
- Facilities and training are only available where there is demand.

Voluntary Provision

Voluntary provision includes clubs and events run by volunteers, e.g. a local park run.

Advantages and Disadvantages:

Advantages:

- Training is open to everyone.
- It's usually cheap to take part.
- Facilities are usually hired from the public sector, so there is a wide range of training and equipment.

Disadvantages:

- Participants usually have to pay fees to cover costs of facilities.
- Relies on volunteers and money from sponsorship and fundraising.



I don't write these jokes for the money — I do it for the love, man...

Some methods of training may be more suited to a certain type of provision. For example, beginners might prefer to do weight training at a private gym because there is greater access to fixed resistance machines.

Long-Term Effects of Training

Training over a long period of time affects the different systems in your body.
See p.23-24 if you need a reminder on the cardiorespiratory and musculoskeletal systems.

Aerobic Endurance Training Improves the Cardiorespiratory System

Aerobic endurance training (see p.75-76) affects the cardiovascular system...

Cardiac Hypertrophy

- 1) Your heart is a muscle — when you exercise, it adapts and gets bigger and stronger. This is called cardiac hypertrophy.
- 2) A bigger, stronger heart will contract more strongly and have a larger stroke volume (it can pump more blood with each beat).



Decreased Resting Heart Rate

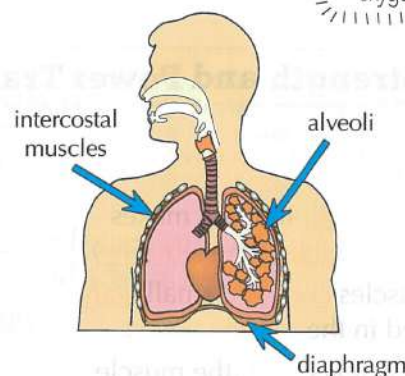
- 1) As stroke volume increases, the heart has to beat less often to pump the same amount of blood around your body.
- 2) This means that your resting heart rate decreases.

Each adaptation increases the supply of blood and oxygen to the muscles.

...and also the respiratory system.

Increased Strength of Respiratory Muscles

- 1) Your diaphragm and intercostal muscles (the muscles between the ribs) get stronger.
- 2) This improves the efficiency of your breathing — it helps you get more air in and out of your body per breath, so more oxygen can be used by the working muscles whilst exercising.



Increased Capillarisation Around Alveoli

- 1) Aerobic endurance training creates new capillaries (small blood vessels) at the alveoli ('air sacs' with thin walls) in the lungs.
- 2) This increases the rate of gaseous exchange — more oxygen can get into your bloodstream and more carbon dioxide can be removed (breathed out).

Flexibility Training Affects the Musculoskeletal System

Flexibility training causes these adaptations to the musculoskeletal system:

There is more production of synovial fluid in synovial joints, which lubricates ('oils') joints and keeps them moving smoothly.

See p.23 for more on synovial joints.

There is an increase in the flexibility of ligaments and tendons.

There is an increase in the length of muscle fibres.

These adaptations all increase the range of movement permitted at joints.



Long-Term Effects of Training

Muscular Endurance Training Changes the Muscular System

Increased Capillarisation Around Muscle Tissues

- 1) Muscular endurance training **increases** the **number** of **capillaries** around the **muscles**.
- 2) Capillaries transfer blood containing **oxygen** and **nutrients** to the muscles so that they can release energy to keep **contracting**.
- 3) They also remove **waste products**.
- 4) A higher number of capillaries means **more oxygen** and **nutrients** can be supplied to the **muscles** and **waste products** can be **removed** more quickly.

Increased Muscle Tone

- 1) **Muscle tone** means how much **tension** there is in our muscles.
- 2) It keeps our body **upright** and **stable**.
- 3) Muscular endurance training **increases muscle tone**, which allows you to **balance** more easily and improves your **posture**.



Muscular Strength and Power Training Have Similar Effects

Muscle Hypertrophy

- 1) **Muscular strength** training makes your **muscles thicker** (**hypertrophy**).
- 2) As the muscles **contract**, small **tears** are created in the **muscle fibres**.
- 3) When these tears **heal**, the muscle tissue becomes **bigger and stronger**.

Increased Bone Density

- 1) The **denser** your bones, the **stronger** they are.
- 2) Muscular **strength** and **power** training put **stress** on your bones, causing the body to **strengthen** them by adding **minerals**.
- 3) The stronger your bones, the **less likely** they are to **fracture**.

Increased Tendon and Ligament Strength

- 1) **Strength** and **power** training both increase the strength of **ligaments** and **tendons**.
- 2) This means they are **less likely** to **tear** when you exercise, which helps avoid **injury**.

Speed Training also Affects the Muscular System

Increased Tolerance to Lactic Acid

- 1) Speed training uses **lots of energy** in a **short** space of **time**.
- 2) This creates **lactic acid**, which makes the muscles **tired**.
- 3) Long-term speed training makes the muscles more **tolerant** to lactic acid, so you can train **more often** and at a **higher intensity** without getting fatigued.

My brainular system feels like it's adapting...

It's important to learn how each of these changes to the body affect performance. Some adaptations may be useful for specific sports — for example, increased tolerance to lactic acid is really helpful for sprinting.

Fitness Programmes

A **fitness programme** is an **organised plan** to help improve a performer's fitness.

Fitness Programmes Help to Achieve Aims

- 1) **Sports performers** will have **goals** or **aims** that they want to **achieve** in their sport.
- 2) A **fitness programme** should also include **objectives** — these are the things that performers **need to do** to achieve their aims.
- 3) Objectives include the **components of fitness** to improve and the **methods of training** to use.

EXAMPLE

Terry — basketball player

Aim: to improve at lay-up shots.

Objectives:

- **improve agility** (to help **move past defenders** quickly) using **SAQ training** (see p.81).
- **improve power** (to help **jump high** and put the ball in the basket) using **plyometrics** (see p.81).



You'll Need to Collect Personal Information

- 1) You need **personal information** about a performer to make a fitness programme **suitable for their needs**.
- 2) Collecting the information might involve an **interview** and **questionnaires**, including a **PAR-Q** (see p.57), to check **current fitness** and **activity levels**.
- 3) **Health conditions**, **injuries** and **physical activity history** will **affect** the types of activity a performer can do.
- 4) **Lifestyle factors** (ways people **choose** to live their life) will also have an **effect**.
E.g. if someone is a **heavy smoker** or **sedentary** (very inactive), their **ability** to carry out a **fitness programme** may be affected.

Personal information should be stored securely and never shared with others.



What? I exercise all the time...

Performers have a Level of Motivation

- 1) Performers will have a certain **attitude (feeling)** towards a fitness programme. This can be **determined** as part of the interview or questionnaire.
- 2) A performer needs a **positive attitude** to achieve **success**.
- 3) A fitness programme should also be **motivating** for a performer:
 - If a performer takes part in activities they **enjoy** and they **feel progress**, they will have **high motivation**, and will want to **train hard** and **complete the programme**.
 - However, if a programme is **too hard** (or **too easy**) for a performer, or they are **worried** about an **injury** or a **long-term health condition**, they will have **low motivation** and be more likely to **quit**.

There's more on motivation coming up (see p.89-90).

Archers seem to always be adjusting their aim...

One of the first steps with a fitness programme is deciding exactly what the performer is wanting to achieve — that may be improving a specific skill in a sport or a component of fitness (e.g. flexibility).

Fitness Programme Design

So you've collected personal information — now to **design** an **appropriate programme** for the performer.

Fitness Programmes should be Suited to the Performer

Follow these **steps** to **design** an effective **fitness programme**:

- 1 **Collect personal information** and discuss a performer's **aims** (p.87).
- 2 Carry out appropriate **fitness tests** to get a **baseline fitness level** (p.56-71).
- 3 Identify **components of fitness** that need **improving** or **maintaining** (p.72) to meet the performer's aims.
- 4 Select **appropriate training methods** (p.75-82), and apply the **principles of training** (p.49-50).

EXAMPLE

- 1 **Name:** Terry **Age:** 30 **Sex:** Male PAR-Q [✓] Pre-fitness checks [✓]
Aim: to improve at lay-up shots.

2

Fitness Test	Component of Fitness	Rating
T-test	Agility	Good
Vertical Jump Test	Power	Poor

3 His programme should include **agility training** to improve his **'Good' rating**...
 ...but should include **more** activities to **train power**, as this component was **'Poor'**.

4

	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Week 1	Plyometrics (85% MHR, 20 minutes)	Rest	SAQ training (30 minutes)	Rest	Rest	Plyometrics (85% MHR, 20 minutes)	Rest
Week 2	Rest	SAQ training (30 minutes)	Rest	Plyometrics (85% MHR, 20 minutes)	SAQ training (35 minutes)	Rest	Plyometrics (90% MHR, 20 minutes)

This fitness training programme applies **FITT principles**:

- **Frequency:** there are **3-5 training sessions** per **week**.
- **Intensity:** a **training target zone** is given for **plyometrics** training.
- **Time:** the **length** of each **session** is given.
- **Type:** SAQ training and plyometrics improve **agility** and **power**, which helps achieve his **aim**. **SAQ training** can be made **specific** to basketball, e.g. dribbling at speed around cones.

You can measure heart rate or estimate it using the Borg RPE scale (see p.52).

Additional principles of training are also applied, e.g.:

- **Rest and recovery:** there are **rest days** given each **week**.
- **Progressive overload:** there are **fewer rest days** in **week 2** and the **intensity increases over time**.

Designer fitness programme? Nah, a bit too expensive for me...

In the exam, you may be asked to evaluate a fitness programme. Think about whether the training methods are suitable for the performer in the question and if the training principles have been applied correctly.

Motivation and Goal Setting

Motivation is all about what drives you. It has lots of different positive effects on sports performers.

Motivation Makes You Want to Do Well

Motivation

Definition: The internal mechanisms and external stimuli that arouse and direct behaviour. Or, in other words, the factors both inside and outside of you that make you want to do something.

- 1) Motivation is about how keen you are to do something. It's what drives you, particularly when things get difficult — your desire to succeed.
- 2) Motivation can be either intrinsic (from within yourself) or extrinsic (from outside).

Intrinsic Motivation

Motivation from internal factors — the enjoyment and good feelings you get from taking part in a sport or activity, e.g. pride, high self-esteem, enjoying the challenge or enjoying being part of a team.

Extrinsic Motivation

Motivation through rewards from other people/things. This can be tangible (you can touch it, e.g. trophies, money) or intangible (you can't touch it, e.g. applause, praise from a coach).

- 1) Intrinsic motivation is usually seen as the most effective — you're more likely to train hard and finish a training programme if you enjoy it.
- 2) Extrinsic motivation can also be really effective. Rewards or praise about your performance can make you feel good about yourself — so you're more likely to want to perform well again.
- 3) Most people are motivated by a combination of both types of motivation.



Motivation Benefits Sports Performers in Different Ways

Increased Participation

- 1) To increase many areas of your fitness, you need to commit a large amount of time and energy to exercise.
- 2) People who are motivated are more likely to participate in exercise regularly, despite how much time and hard work it takes.

Maintained Training and Intensity

- 1) Motivation helps you to exercise at a high intensity, despite feeling tired.
- 2) You're more likely to work at maximum capacity and complete a training programme.

Improved Performance

- 1) People who are motivated are more likely to train regularly, which will help them to improve their skills at a particular sport.
- 2) This will improve their performance in competitions and matches.

Increased Fitness

- 1) Motivated sports performers are more likely to stick to a training programme and exercise multiple times a week.
- 2) This increases their fitness.

Motivation and Goal Setting

Goal Setting Can Help You Train

- 1) **Goal setting** means setting **targets** that you want to reach so you can **improve** your performance.
- 2) Goals can be short-term or long-term. **Short-term** goals are set over a period of **1 day to 1 month** and are usually **steps** on the way to **long-term** goals, which can take **months** or **years** to complete.
- 3) Sports performers set goals to **increase** and **direct** their **motivation**.
- 4) Goal setting can influence **motivation** by:

- Giving you something to **work towards** — you are motivated to work hard to achieve your goal.
- Helping you to **maintain focus** on your task and **monitor your progress**. If you can see that the training is working, you are more likely to carry on.
- Boosting your **confidence** — reaching a goal can give you a **sense of achievement**.



Goal Setting Should be SMARTER

Personal goals need to be **SMARTER**:

- | | | |
|----------|---------------------|--|
| S | Specific | ➔ Say exactly what you want to achieve, e.g. 'My goal is to swim 1000 m continuously'. |
| M | Measurable | ➔ Goals need to be measurable so that you can see how much you've progressed , e.g. 'My goal is to run 100 m in under 12 seconds'. |
| A | Achievable | ➔ You need to make sure your goal is set at the right level of difficulty . If a target's too easy, it won't motivate you. If it's too difficult, you might start to feel negative about your performance, and give up . |
| R | Realistic | ➔ It's important to make sure you have everything you need to reach your goal. This could mean having the right level of fitness and skill , or having enough resources (time, money, facilities...). |
| T | Time-related | ➔ Set a deadline for reaching your goal. This makes your target measurable and keeps you motivated . |
| E | Exciting | ➔ You need to enjoy working towards your goal and should want to achieve it. |
| R | Recorded | ➔ Your achievements should be written down so that you can see how you are progressing towards your goal. |



Chocolate biscuits — an effective form of extrinsic motivation...

There's a really handy way to remember what 'intrinsic' and 'extrinsic' motivation mean. 'Intrinsic' starts with 'in', so it comes from inside you. 'Extrinsic' starts with 'ex', just like 'exit', so it comes from outside.