

# FITNESS

**Fitness** is one of a series of enquiries and additional resources which together form **Beyond fair testing: Teaching different types of scientific enquiry**,

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Science Enhancement Programme



University of London

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## CONTENTS

### Teachers Guide

Overview and routes IV

#### Section 1

Activity 1.1 1

#### Section 2

Activity 2.1 4

Activity 2.2 7

#### Section 3

Activity 3.1 12

Activity 3.2 16

Activity 3.3 17

Activity 3.4 19

### Student Materials

#### Section 1

Student Activity F1.1 F1.1A to F1.1C

#### Section 2

Student Activity 2.1 F2.1A to F2.1B

Student Activity 2.2 F2.2A to F2.2D

#### Section 3

Student Activity 3.1 F3.1A to F3.1G

Student Activity 3.2 F3.2A

Student Activity 3.3 F3.3A

Student Activity 3.4 F3.4A to F3.4B

## FITNESS: OVERVIEW

**Enquiry type:** Design a system.

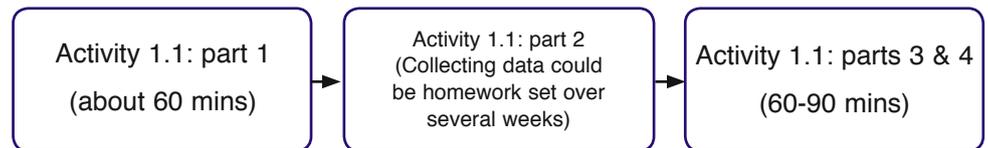
Section	Activity	Links to KS3 PoS/ Scheme of work	Links to KS4 PoS	Learning objectives Students will be able to:	Assumed prior knowledge and Understanding
1. Core enquiry	1.1	<b>Sc1: investigative skills:</b> The main emphases are concerned with Considering evidence and Evaluating. In order to do these students have to plan data collection and how to obtain evidence.	<b>How science works:</b> Data , evidence, theories and explanations Practical and enquiry skills. Communication skills. The main emphases are concerned with interpretation of data and making judgements about the quality of data and therefore the conclusions drawn from them.	<ul style="list-style-type: none"> <li>identify different types of fitness</li> <li>plan how they will measure and evaluate data to assess the level of a specific type of fitness</li> <li>manipulate data (work with tables and graphs) to look for changes in a type of fitness</li> <li>draw a conclusion based on evidence</li> <li>explain their conclusion in terms of scientific ideas</li> <li>evaluate the extent to which the conclusions drawn are supported by the evidence.</li> </ul>	<ul style="list-style-type: none"> <li>different types of fitness</li> <li>different types of food and their functions</li> <li>factors affecting fitness</li> <li>measuring fitness</li> <li>construction and analysis of tabulated and graphical data</li> <li>evaluating inferences from data</li> </ul>
2. Background knowledge	2.1	<b>Sc2: Humans as organisms</b> - nutrition <b>QCA SoW:</b> 8A Food and digestion, 8B Respiration 9B Fit and healthy	<b>Organisms and health:</b> Human health (5e)	<ul style="list-style-type: none"> <li>identify different types of fitness and</li> <li>rate different sport activities according to different types of fitness</li> <li>appreciate that different types of activities are associated with different types of fitness.</li> <li>define terms related to fitness.</li> </ul>	<ul style="list-style-type: none"> <li>terms used in relation to fitness</li> </ul>
	2.2			<ul style="list-style-type: none"> <li>name the different types of food substances (nutrients),</li> <li>identify the function of each food substance</li> <li>identify the foods in which each substance is contained.</li> <li>identify the ingredients of a balanced diet, including recommending amounts of different food groups and fluids</li> <li>describe the changes in diet that are necessary when attempting to maintain different types of fitness.</li> </ul>	<ul style="list-style-type: none"> <li>functions of different kinds of food</li> </ul>
3. Procedural understanding	3.1	<b>Sc1 Investigative skills:</b> Considering evidence Evaluating	<b>How science works:</b> Data , evidence, theories and explanations Practical and enquiry skills. Communication skills	<ul style="list-style-type: none"> <li>distinguish between information on aerobic and anaerobic fitness</li> <li>make judgements about a person's likelihood of winning a half marathon based on fitness data.</li> <li>make judgements about changes in the overall fitness of a person based on changes in indicators of different types of fitness.</li> </ul>	<ul style="list-style-type: none"> <li>differences between different kinds of fitness</li> <li>measures of fitness</li> </ul>
	3.2	<b>Sc1 Investigative skills:</b> Considering evidence Evaluating	<b>How science works:</b> Communication skills	<ul style="list-style-type: none"> <li>make judgements related to fitness by reading a pulse rate graph</li> </ul>	<ul style="list-style-type: none"> <li>interpreting graphs</li> </ul>
	3.3	<b>Sc1 Investigative skills:</b> Considering evidence	<b>How science works:</b> Communication skills	<ul style="list-style-type: none"> <li>identify patterns in a table showing levels of obesity in the population</li> <li>account for the observed patterns</li> <li>suggest what action might be needed to improve young people's fitness.</li> </ul>	<ul style="list-style-type: none"> <li>interpreting tables</li> </ul>
	3.4	<b>Sc1 Investigative skills:</b> Evaluating	<b>How science works:</b> Data , evidence, theories and explanations. Practical and enquiry skills Communication skills	<ul style="list-style-type: none"> <li>evaluate the adequacy of a protocol describing how a test was performed,</li> <li>make conclusions based on data of pre- and post-training performance. They will consider the number of readings, the variability of the data and the difference between means of values.</li> </ul>	<ul style="list-style-type: none"> <li>awareness that there is error in empirical data</li> </ul>

## FITNESS: ROUTES

This enquiry needs time for students to implement their fitness regimes. Significant effects can be seen after 3 weeks, but a longer period of implementation may give more pronounced changes, if the regime is any good!

### Route 1

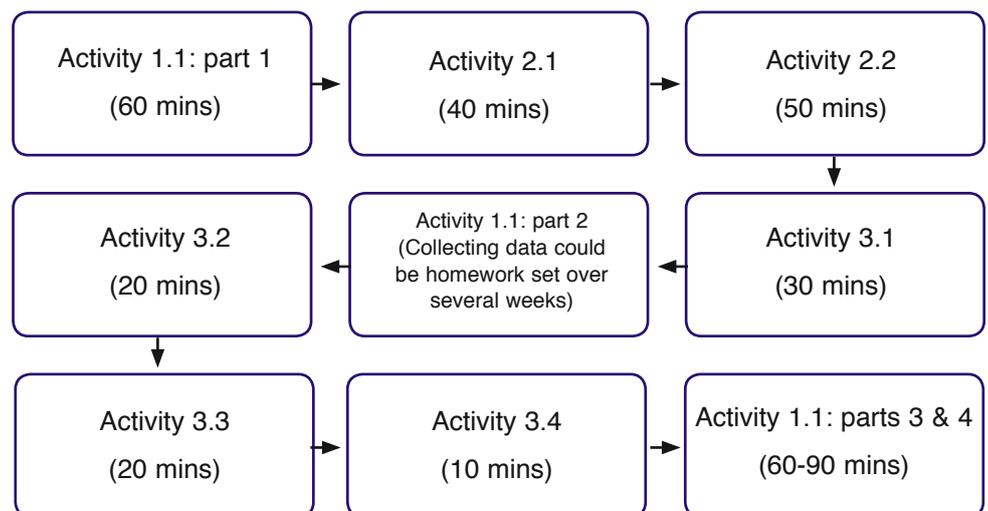
(assumes students have already identified skills and knowledge to begin activity 1.1)  
Overall time is roughly 2 to 3 hours plus homework.



### Route 2

(uses all activities from sections 2 and 3 to provide relevant knowledge and procedural understanding to begin core enquiry in section 1)  
Overall time is roughly 4 to 5 hours

**Note:** Activities 3.2 to 3.4 could be carried out for homework whilst parts 3 and 4 of activity 1.1 are being carried out.



**HEALTH AND SAFETY**

For practical activities, the Science Enhancement Programme has tried to ensure that the experiments are healthy and safe to use in schools and colleges, and that any recognised hazards have been indicated together with appropriate control measures (safety precautions). It is assumed that these experiments will be undertaken in suitable laboratories or work areas and that good laboratory practices will be observed. Teachers should consult their employers' risk assessments for each practical before use, and consider whether any modification is necessary for the particular circumstances of their own class/school. If necessary, CLEAPSS members can obtain further advice by contacting the Helpline on 01895 251496 or e-mail [science@cleapss.org.uk](mailto:science@cleapss.org.uk).

# ACTIVITY 1.1: IMPROVE YOUR FITNESS!

(CORE ENQUIRY ACTIVITY)

## WHAT STUDENTS DO

Students carry out a 'designing a system' enquiry: they design a fitness regime aimed at improving one aspect of their fitness and they also design a system to evaluate changes in their fitness.

### Learning objectives

Students will be able to:

- identify different types of fitness
- plan how they will measure and evaluate data to assess the level of a specific type of fitness
- manipulate data (work with tables and graphs) to look for changes in a type of fitness
- draw a conclusion based on evidence
- explain their conclusion in terms of scientific ideas
- evaluate the extent to which the conclusions drawn are supported by the evidence.

### Resources needed

#### Student Activity 1.1: *Improve your fitness!*

The apparatus needed will vary according to the questions that students investigate. The following list is therefore a list of core apparatus.

- Access to PE facilities: the range of facilities needed will depend on the activities students select as part of their fitness regime.
- (Optional) regular access to a computer and spreadsheet to update and analyse records.

## NOTES AND SUGGESTIONS FOR CLASSROOM ACTIVITIES

This enquiry asks students to plan, carry out and evaluate a personal fitness regime. In assigning students to groups and throughout the enquiry, be alert to the possibility that some students may be embarrassed about their level of fitness or slower progress; some students may be very competitive and may try to push themselves too hard.

Make sure you know which students may need to take special care in devising and following a suitable regime because of existing medical problems.

In order for students to have time to improve their fitness through training, it is important to allow a period of three weeks for them to work on the regime and gather evidence. During this time, you will need to timetable access to suitable facilities during lessons or arrange this access for other regular times with PE colleagues.

## Part 1: Planning

### Plenary:

In order to be able to design a fitness regime, students should know some relevant science. Ask students questions to review their knowledge of the following:

- different types of fitness,
- the quality and quantity of physical exercise which enhances specific types of fitness,
- safety issues around carrying out specific types of physical activity,
- the effect of diet on specific types of fitness.

(You might do this by providing a sheet of statements to be rated on paper or using 'traffic light' cards: 'I'm confident I know enough about this (GREEN) / I think I know about this (YELLOW) / I don't know enough about this yet (RED). The activities in sections 2 and 3 provide support on related background knowledge and procedural understanding respectively).

### Group work:

1. Arrange students in groups to discuss their fitness regime. Each student should write down their agreed regime. Students might need to consult their PE teachers about their proposed regime: if they are to do this you will need to arrange this in advance with colleagues and allow additional time.
2. Students should select and provide a detailed description of the tests they are going to use. (It is probably best if they select suitable tests from those described in Student **Activity 3.1, Exercise 2**, or from a range established in advance in consultation with PE colleagues).

## Part 2: Obtaining evidence

Students should follow their designed fitness regime for three weeks and keep a detailed record of what this involved.

The students should also keep a detailed record of the levels of fitness of each member of their group. Encourage them to use tables and / or a spreadsheet to record their results systematically. Using a spreadsheet may make it easier for students to analyse the evidence.

## Part 3: Considering evidence

The last two parts of the enquiry may take about 2 hours.

When students have finished their analysis they should be able to:

- say whether there has been an improvement in their fitness
- explain why they think their training regime has led to improvement and
- comment on other factors that may have affected their fitness (other than their regime).

## Part 4: Evaluating

Evaluating a measuring system is difficult and students will need support for this. The student sheet gives some questions to ask when evaluating the extent to which the measuring system was adequate.

When students have finished their analysis, they should be able to:

- comment on the appropriateness of their selected tests and make suggestions for improvement
- comment on the quality of the data they selected and suggest improvements in their data collection.

In order to support students in evaluating their measuring system, you might wish to use the questions in the Student sheet as a focus for either whole class discussion or group work.

For example, you could either:

- get groups to present their evaluation to the class and give the class opportunities to ask questions about the enquiry

or

- get different groups to swap their completed planning sheets. Each group could then prepare three questions to ask the other group about the enquiry, focusing on the quality of the evidence.

# ACTIVITY 2.1: WHAT IS FITNESS?

## EXERCISE 1: THINKING ABOUT DIFFERENT TYPES OF FITNESS

### WHAT STUDENTS DO

#### Note:

*Appropriate mental fitness is also important for success in sport and you may also wish to extend the discussion to include the idea of mental fitness for different sports at some point, if time allows: many students will be aware of the importance of concentration, quick reactions, or visuospatial skills, for example. It may be useful to explore how important these different aspects of mental fitness are in different sports.*

*However, it would need a different set of tests again to assess aspects of mental fitness, and for practical reasons any investigation of how a training regime might lead to improvements in mental fitness would be beyond the scope of an enquiry for KS4 science. Students who go on to study Psychology or Sports Science at post-16 may well return to investigate these aspects of fitness for sport.*

*For practical reasons, this enquiry is designed to support students in evaluating improvements in aspects of their **physical fitness only**, and the three types of fitness which are identified in the supporting sections (Sections 2 and 3) are all forms of physical fitness.*

Students describe different types of fitness involved in various sports activities and then they rate each activity in terms of the levels of each kind of fitness good performance in this sport depends on.

#### Learning objectives

Students will be able to

- identify different types of fitness
- rate different sport activities according to their relative need for different types of fitness
- appreciate that different types of activities are associated with different types of fitness.

#### Resources needed

- **Student Activity 2.1: Exercise 1: Thinking about different types of fitness.**

### NOTES AND SUGGESTIONS FOR CLASSROOM ACTIVITIES

This activity introduces students to different types of fitness and to the fact that different activities require and promote different types of fitness.

#### Individual work:

Give students the list of sports from **Student Activity 2.1: Exercise 1**. The last three lines of the table are for students to include any other sports of their choice. Ask the students to write down the type(s) of fitness they think each of the sports requires. At this stage encourage students to describe this in their own words (unless they already know the technical terms used below).

#### Plenary:

Ask students about different sports and the fitness each requires. Introduce the following terms for different types of fitness: **cardiovascular (aerobic) fitness**, **anaerobic fitness (muscle strength)**, **flexibility (agility)** and **mental fitness**. Encourage students to use them. Different students may come up with different ideas. For example, one student might say that running requires aerobic fitness whereas another that it requires muscle strength. Elicit the idea that one sport may be associated with more than one type of fitness and that different sports may be good for promoting different types of fitness. Students might also discuss particular aspects of sports: for example, they might comment on the fact that horse riding may require high muscle strength in their legs, whereas a gymnast doing the rings may need high muscle strength in their arms.

**Group work:**

Arrange the students in groups and ask each group to rate each of the activities according to the four types of fitness. Encourage them to discuss and agree as a group about their ratings.

**Plenary:**

Once different groups of students have completed the activity, ask them to explain their ratings to the whole class.

**The completed activity should look like this:**

Sport	Cardiovascular (aerobic fitness)			Flexibility			Muscle strength (anaerobic fitness)		
	High	Medium	Low	High	Medium	Low	High	Medium	Low
Weight lifting					•		•		
Gymnastics	•	•		•			•		
Running	•				•		•		
Yoga		•		•			•		
Swimming	•				•		•		
Golf			•			•			•
Football	•				•			•	
Dancing	•			•			•		
Horse riding		•				•		•	
Motor car racing			•			•			•
Snooker			•		•	•			•
Cricket		•			•			•	
High jump		•		•					
Squash	•				•			•	

The types of fitness required for different types of gymnastics may differ: for example, floor work requires high aerobic fitness whereas rings depend more on muscle strength (anaerobic).

# ACTIVITY 2.1: WHAT IS FITNESS?

## EXERCISE 2: THE 'LANGUAGE' OF FITNESS

### WHAT STUDENTS DO

Students match terms used when talking about fitness with the appropriate explanations.

#### Learning objectives

Students will be able to

- define terms related to fitness.

#### Resources needed

- **Student Activity 2.1, Exercise 2: *The 'language' of fitness.***

### NOTES AND SUGGESTIONS FOR CLASSROOM ACTIVITIES

Students are likely to know some of these definitions from their PE lessons. You could use this sheet to review their knowledge before discussing the terms they are not familiar with.

Alternatively, this activity might be set as homework to consolidate or review work done on this in class.

#### The completed activity should show these pairs

Term	Explanation of the term
Heart rate	...shows how fast the heart beats. It is measured in beats per minute. It increases when exercising
Anaerobic fitness (muscle strength)	... is related to muscles being more powerful (e.g. being able to lift more weight) or to the muscles' ability to work for longer periods.
Vital capacity	...is the amount of air someone exhales after having inhaled as deeply as possible. It indicates the person's capability to hold larger amounts of air in their lungs
Aerobic (cardiovascular) fitness	...is related to a greater amount of oxygen being delivered to muscles from the heart. It results in a person's ability to exercise for longer periods.
Tidal volume	...is the volume of air inhaled during a normal breath
Aerobic (cardiovascular) exercise	...is exercise which raises the heart rate and keeps it up for an extended period of time
Body mass index	...is a number which shows whether an adult is overweight or not. It is calculated by the following formula: $(\text{weight/kg}) / (\text{height/m})^2$
Recovery period	...is the time taken for an individual's heart rate to come back to normal after exercising.
Flexibility	...is related to a person's ability to bend and stretch different parts of their body
Resting pulse rate	... is the heart rate taken after having rested for 10 minutes or more.

# ACTIVITY 2.2: WHAT IS FITNESS?

## EXERCISE 1: WHAT IS CONTAINED IN FOOD?

### WHAT STUDENTS DO

Students sort cards to link types of food substances to their function and sources.

#### Learning objectives

Students will be able to

- name the different types of food substances (nutrients),
- identify the function of each food substance
- identify the foods in which each substance is contained.

#### Resources needed

- **Student Activity 2.2, Exercise 1: *What is contained in food?***
- Optional: Access to the internet and/or to course books with a section on nutrition.

While there is a huge amount of information on the internet on these topics, you might find the following websites useful:

1. The site of the Food Standards Agency at [www.eatwell.gov.uk/healthydiet/](http://www.eatwell.gov.uk/healthydiet/)  
The site provides information on the different food groups and the nutrients they contain and on the types of food which should be consumed when practising sports.
2. The BBC site at [www.bbc.co.uk/health/healthy\\_living/nutrition](http://www.bbc.co.uk/health/healthy_living/nutrition)  
This site provides information on the major food groups, their function and recommended amounts.
3. The site of the Vitamins and Nutrition Centre at [www.vitamins-nutrition.org/vitamins-guide/index.html](http://www.vitamins-nutrition.org/vitamins-guide/index.html)  
This site provides information on the different minerals and vitamins that are necessary for a balanced diet. As the language in this site is quite complex, we do not recommend directing students to this site, but teachers may find it a useful source of further information.
4. The Initial Catering Services site at [http://www.coolmeals.co.uk/food\\_facts/](http://www.coolmeals.co.uk/food_facts/)  
This is an interactive site which students could visit in order to learn about different food groups and their function. The link given takes students directly to food facts.

### NOTES AND SUGGESTIONS FOR CLASSROOM ACTIVITIES

This activity is about the nutrients contained in food, which students will have studied during their science lessons both at KS3 and KS4.

This activity could be carried out in class or could be set as homework.

As an extension, you might wish to ask students to research the function of other important minerals and vitamins and the foods in which they can be found.

You may also wish to distinguish between sugars (as fast energy releasers) and other carbohydrates, and to discuss when each might be useful for an athlete.

## WHAT STUDENTS DO

## Groups formed using the diet cards

Nutrient	Function	Is contained in / Can be formed from
Protein	Essential for growth, repair and replacement of cells	Meat, fish, dairy products, nuts and seeds
Carbohydrate	Most important source of energy; the excess is stored as glycogen in the liver	Pasta, rice, bread; also sugar and sugary foods such as soft drinks, biscuits and cakes.
Fat	Source of energy; also needed for organ protection and for insulation	Butter, margarine, crisps, fried food, nuts
Fibre	Helps food move through the intestines	Wholemeal bread, brown rice, vegetables, fruit
Water	Needed as a solvent for transport; regulates the body temperature by evaporating from the skin	Fruit, water, juices
Vitamin A	Needed for good vision	Formed in the body as a result of eating colourful vegetables, e.g. carrots
Vitamin C	Essential for repair of tissues; may strengthen the immune system	Oranges, lemons, grapefruits
Vitamin D	Promotes cell growth, and is needed for strong bones	Made in the body after exposure to sunlight
Mineral: Calcium	Needed for strong bones and teeth: a deficiency of this may cause rickets in children	Milk and other dairy products
Mineral: Iron	A major component of red blood cells: important for carrying oxygen	Red meat, eggs, dried fruits, lentils

Students discuss a number of general recommendations made in the UK about maintaining a balanced diet. They answer questions about necessary changes to diet required to maintain specific types of fitness.

### Learning objectives

Students will be able to:

- identify the ingredients of a balanced diet, including recommending amounts of different food groups and fluids
- describe the changes in diet that are necessary when attempting to maintain different types of fitness.

### Resources needed

- **Student Activity 2.2, Exercise 2: *Linking diet to types of fitness.***
- Optional: Access to the Internet and/or to course books with a section on nutrition.

## NOTES AND SUGGESTIONS FOR CLASSROOM ACTIVITIES

This activity builds on **Activity 2.2, Exercise 1: *What is contained in food?***

### Plenary:

Show the students the pie chart of food groups in a healthy diet and the additional recommendations for a healthy diet.

- Ask students to identify the types of nutrients that are obtained by eating foods in each of these food groups.
- Lead a discussion about the reasons why there is need for different proportions of each food group. The discussion should focus on the need to obtain all nutrients, while at the same time keeping the amount of calories consumed at a moderate level.
- Discuss the importance of the recommendation about the consumption of fluids.
- Ask students whether they think that changes in the diet may be necessary in the case of training in order to achieve specific types of fitness. You might wish to start by discussing the first of the cards with the whole class. Encourage students to make links between the type of activity involved (e.g. aerobic) and the type of food substances which might be essential for this.

**Group work:**

Arrange students into groups and assign each group to discuss two of the cards. Students discuss their cards in their group. Encourage them to write down their agreed answer.

**Plenary:**

Ask the students who have answered each card to present their answers. The rest of the class (including the teacher) could act as a 'questioning group'. The role of this group should be to ask the presenters to clarify their answers, and to justify the statements they make.

Good answers to the questions should include most or all of the following points:

**Card A**

Marathon running is a cardiovascular activity. As such, it requires food which can provide lots of energy, which is readily available to use. Carbohydrates (including sugars), fats and proteins all provide energy.

The most important fuel source is carbohydrate. This is stored in the liver and muscles as glycogen.

If the stores are low, the runner may 'hit the wall', so a marathon runner may need to eat food rich in carbohydrates, such as pasta, rice and bread, cereals and potatoes.

The runner also needs to drink adequate amounts of fluid, well above the daily recommended amounts of 6 to 8 glasses, to avoid dehydration.

**Card B**

Discus throwing needs increased muscle strength (anaerobic fitness).

In order to increase their muscle mass, athletes need to increase their intake of protein, which is the main nutrient responsible for the growth of cells, so they need to increase the consumption of food rich in protein such as meat, fish, and dairy products.

Discus throwers also need strong bones, so they need more calcium in their diet.

Calcium-rich foods are the ones which belong to the 'milk and dairy products' group.

**Card C**

Weight-lifters need to have strong muscles (anaerobic fitness), so they need a lot of protein to build up their muscles.

Foods in the 'meat, fish and alternatives' group are rich in protein.

**Card D**

Vitamin C is important for the repair of tissues and vitamin D is essential for the repair of the epithelial (lining) tissues. In addition, protein is necessary to build and repair cells. Fruits such as oranges, lemons and grapefruit provide vitamin C; vitamin D supplements or milk fortified with vitamin D can provide vitamin D. Meat, fish, nuts, seeds and dairy products are sources of protein.

**Card E**

Low levels of oxygen at high altitude stimulate the bone marrow to produce more red blood cells: red blood cells contain haemoglobin, a protein that holds onto oxygen.

By increasing the amount of their blood cells and of the amount of haemoglobin in their body, the athletes improve their maximal oxygen intake and can train harder when at sea level again, as the number of red blood cells remains increased for about six weeks.

An alternative way of increasing haemoglobin concentration (and therefore the ability of the athlete to train harder) is to increase iron intake. This is because iron plays an essential role in the production of haemoglobin. Red meats, lentils and dried fruits are foods which are rich in iron.

# ACTIVITY 3.1: USING DATA TO ASSESS FITNESS

## EXERCISE 1: WHO IS MOST LIKELY TO WIN A HALF MARATHON?

### WHAT STUDENTS DO

Students study data about four athletes and decide who is more likely to win a half marathon.

#### Learning objectives

Students will be able to:

- distinguish between information on aerobic and anaerobic fitness
- make judgements about an athlete's likelihood of winning a half marathon based on fitness data.

#### Resources needed

- **Student Activity 3.1, Exercise 1: *Who is most likely to win a half marathon?***
- **Student Activity 3.1, Exercise 2: *Fitness tests (optional)***

### NOTES AND SUGGESTIONS FOR CLASSROOM ACTIVITIES

This activity emphasises the idea that different activities need different levels of aerobic fitness and anaerobic fitness.

The **data cards** in **Student Activity 3.1: *Who is most likely to win a half marathon?*** include results for each athlete on various fitness tests: students need to make the link between an athlete's results in these tests and his or her levels of aerobic fitness and anaerobic fitness.

The **fitness tests** the data cards refer to are described in **Student Activity 3.1, Exercise 2**, and **Fitness tests**, where the tests are grouped according to type of fitness tested. You may find it helpful to give these sheets out for students to look at alongside the data cards for each athlete. For more able students, remove the information about the type of fitness each group of tests assesses before distributing the test descriptions, so that students have to make the connection for themselves.

#### Plenary:

Ask students to identify the type of fitness which is most important for winning the half marathon. Once aerobic fitness has been identified, encourage students to look for indicators of aerobic fitness (e.g. resting pulse rate) instead of anaerobic fitness (e.g. bicep size).

#### Group work:

Arrange students in groups of two or three. One member of the group may be assigned to record the group's answers. Encourage students to agree on their answers.

**Plenary:**

Once students have answered the questions in their groups, lead a class discussion about the reasons for their choices.

**Answers to questions** (These are examples; answers may vary)

1. The person most likely to win the half marathon is **Sasha**.
2. The two men are unlikely to win, because:
  - their levels of their aerobic fitness are comparatively low, as measured by their resting pulse rate.
  - Ajay's training has not been in running;
  - David has excelled in a sport requiring mainly muscle strength instead of stamina.

One of the girls is most likely to win, probably Sasha, because:

- Sasha has a lower resting pulse rate and a smaller body weight.
  - Sasha has won the women's 1500m, which is a sport requiring aerobic fitness as well.
  - Sasha's smaller bicep size does not matter much (as this is an indicator of anaerobic fitness).
  - Sasha is tall and thin, with a lower than recommended BMI. This means that she has relatively less weight to carry round and long legs.
3. Difficulties in deciding who is most likely to win could include
    - Sasha's low BMI could indicate low reserves for this stamina race.
    - The fact that Sasha is older than Helen may be a factor against her.
    - In the end the runner's determination, (in other words, their **mental** fitness), may be the decisive factor.

# ACTIVITY 3.1: USING DATA TO ASSESS FITNESS

## EXERCISE 2: HAS FITNESS IMPROVED?

### WHAT STUDENTS DO

Students study fitness data and decide whether a person's fitness has improved or not.

#### Learning objectives

Students will be able to:

- make judgements about changes in the overall fitness of a person based on changes in indicators of different types of fitness.

#### Resources needed

- **Student Activity 3.1, Exercise 2: *Has fitness improved?***
- **Student Activity 3.1, Exercise 2: *Fitness tests***

### NOTES AND SUGGESTIONS FOR CLASSROOM ACTIVITIES

This activity emphasises the idea that different types of fitness can be assessed by different tests. The tests provided are used to assess the three different types of physical fitness (aerobic, anaerobic and flexibility).

#### Plenary:

Ask a student to read the first statement from the table '**Fred's fitness tests**'. Ask students to look at the descriptions of the tests to find the relevant one. Elicit that the type of activity described in the test is an aerobic activity, which therefore requires and assesses aerobic fitness.

#### Group work:

Arrange students into groups and ask them to go through each statement. Encourage them to agree upon their answers.

#### Plenary:

Once students have answered the questions in their groups, lead a class discussion to discuss their answers. Elicit the idea that the conclusion about changes in fitness should be based on all the indicators of each type of fitness on balance. You might wish to discuss the effect of possible unreliability of individual test scores.

**Answers to questions**

1.

Results Before training and after training for 3 weeks	Type of fitness assessed	Improvement
In the step test, his heart rate changed from 124 to 116.	Aerobic	Improvement
His resting pulse rate stayed the same.	Aerobic	No change
His body mass index changed from 22 to 21.	All types of fitness	Improvement
His trunk extension changed from 50 to 52 cm.	Flexibility	Slight improvement
His shoulder lift changed from 15 to 18 kg.	Anaerobic	Improvement
His sit and reach test score increased from 8 to 9 cm.	Flexibility	Slight improvement
His score for the three-minute shuttle run remained the same.	Aerobic	No change
In the zipper test, his score increased by 1 cm.	Flexibility	Slight improvement
His score for the one-minute lateral jump changed from 135 to 150.	Aerobic	Improvement
His bicep size increased from 425 to 450 mm.	Anaerobic	Improvement

2. A paragraph explaining changes in Fred's fitness should include the following points:

- His anaerobic fitness has improved as is shown by all the measures concerning it.
- His aerobic fitness has slightly improved; some indicators have improved to some extent whereas others have not changed.
- His flexibility also slightly improved.

This suggests that the regime he followed was effective in improving his anaerobic fitness in particular.

# ACTIVITY 3.2:

## WORKING WITH GRAPHS

### INTERPRETING PULSE RATE GRAPHS

#### WHAT STUDENTS DO

Students answer questions about fitness based on a pulse rate graph.

#### Learning objectives

Students will be able to:

- make judgements related to fitness by reading a pulse rate graph

#### Resources needed

- **Student Activity 3.2: *Interpreting pulse rate graphs.***

#### NOTES AND SUGGESTIONS FOR CLASSROOM ACTIVITIES

For students to be able to answer the question meaningfully, you might find it helpful to explain that increased pulse rate means that the heart is working hard to pump blood around the body. This is not desirable as the heart muscle gets overworked. Higher levels of fitness are associated with low pulse rates and short recovery times after exercise.

#### Answers to questions

- 1 People began the activity after minute 1. This is when their pulse rate started to rise.
- 2 Maximum pulse rates: John's: 96, Stephen's: 78, Paul's: 64.
- 3 All of them exercised for four minutes (minutes 1-5). After minute 5 their pulse rate started decreasing, which means that they have stopped exercising and have started to recover.
- 4 Recovery time is the amount of time after stopping exercise until one's pulse rate becomes normal (resting pulse rate) again. It took John 4 minutes, Stephen 3 minutes and Paul 2 minutes to recover.
- 5 The fittest person is Paul. The reasons for this judgment are:
  - a) He has the lowest resting pulse rate.
  - b) His pulse rate does not rise much during exercise. (It rises by 14 beats/min; John's rises by 24 beats/min and Stephen's by 14 beats/min as well).
  - c) His recovery time is the shortest (2 minutes).

## ACTIVITY 3.3: WORKING WITH TABLES

### WHAT STUDENTS DO

Students study a table showing the levels of obesity of adults in England over a period of 15 years. Students look for patterns in the data and offer possible explanations for the observed pattern.

#### Learning objectives

Students will be able to:

- Identify patterns in a table showing levels of obesity in the population
- account for the observed patterns
- suggest what might need to be done in order to improve young people's fitness.

#### Resources needed

- **Student Activity 3.3: Working with tables.**

### NOTES AND SUGGESTIONS FOR CLASSROOM ACTIVITIES

This activity can be done in groups or could be assigned to students working individually.

Having a BMI in the 'normal' range is an indicator of good health. Increased weight in proportion to one's height is related to heart problems and other diseases. In addition, the BMI can be considered a general indicator of all types of fitness as well. This is true for cardiovascular fitness and flexibility and for sports which require both cardiovascular and anaerobic fitness (for example discus throwing). However, in purely anaerobic sports, such as weight lifting, athletes tend to be heavy in proportion to their height, with BMI indices well beyond 24 (the upper limit for being fit). This does not mean they are fat, though: the excess weight comes from well developed muscles. While keeping this exception in mind, for the purposes of this enquiry and the levels of training that the students will be involved in, BMI can be used as a good indicator of all types of fitness.

Students will have a lot to say about this topic of discussion. Through informal ways (TV, magazines, talks), but also through their PE lessons, they are likely to be aware of the issue and have a lot of knowledge about how to tackle obesity. Encourage discussion of ways in which young people can improve their fitness (physical activity, changes in dietary habits and so on). However, you should be aware that the issue of obesity might be quite sensitive for obese and underweight students alike.

**Answers to questions**

1. There is a clear pattern of increase in the percentage of obese men and women. In 2002, one fifth of the total population was obese. The percentage of overweight people has increased as well, by more in women than in men. This increase has mainly come from the decrease in the number of people being fit. In 2002, over 60% of the men and over 50% of the women were either obese or overweight. There is no dramatic change in the percentage of people being underweight, with about 5% of the population being so in 2002.
2. This pattern may be related to changes in people's lifestyles, especially in cities. These includes dietary changes (e.g. eating out, eating more fatty food, eating more ready meals, consuming fewer fresh vegetables or fruit) and changes in the amount of physical activity undertaken (sedentary lifestyles, less time spent doing sports).
3. A good answer would include changes in the physical activity and also in the diet followed.

## ACTIVITY 3.4: INVESTIGATING THE RELIABILITY OF DATA

### WHAT STUDENTS DO

Students study the protocol and the results of an aerobic test performed by two girls before and after training and draw conclusions about changes in their aerobic fitness.

#### Learning objectives

Students will be able to:

- evaluate the adequacy of a protocol describing how a test was performed,
- make conclusions based on data of pre- and post-training performance. They will consider the number of readings, the variability of the data and the difference between means of values.

#### Resources needed

- **Student Activity 3.4: *Investigating the reliability of data.***

### NOTES AND SUGGESTIONS FOR CLASSROOM ACTIVITIES

#### Plenary:

Set the scene. Explain what the two girls in the activity have done. Have two students demonstrate taking the three-minute shuttle run. Encourage them to look for aspects of taking the test which might threaten the reliability of the testing procedure.

#### Group work:

Students discuss question 1 in their groups. Ask them to write down how the information provided may be useful and what type of information they think might be missing.

#### Plenary:

Lead a discussion about the importance of keeping a protocol.

There are two main points to establish about the function of a protocol. First, it provides information about the comparability of the pre- and post- tests. Second, it provides information that can be used to interpret the data from the tests. Highlight the good and missing points of this particular protocol.

#### Group work:

Students answer questions 2, 3 and 4. Encourage them to evaluate the data in light of the protocol.

**Plenary:**

Lead a whole class discussion of the reasons why one can conclude with reasonable confidence whether there has been an improvement in the girls' fitness. The discussion should include points about the number of trials, the difference in the mean value of laps before and after training and the variability of the data. In addition, information in the protocol should be taken into account.

**Answers**

1. The protocol the girls have followed is reasonable to ensure the comparability of pre- and post-tests:

Strengths:

- they have noted down both the time and the content of the meal consumed before taking the test – both these could affect performance
- they carried out repeat readings
- they rested for 15 minutes - enough time to rest between trials due to tiredness
- they carried out the test in a repeatable way – the fact that they made sure that both feet were on the line before moving backwards is significant.

Weakness:

- Using just one way of measuring aerobic fitness is limited. If the changes in fitness are small one test may detect a difference that another test might not.

2. Probably yes.

3. The mean increase in laps is 2 (from 58.5 to 60.5). The variability in different trials is never greater than 1, so a change of 2 is significant.

4. Not sure.

5. The mean increase in laps is 1 (from 70 to 71). The variability in trials before training is 2 and after training it is 5. The variability in data is much greater than the increase in the means so the small increase in means is not significant.



## ACTIVITY 1.1: IMPROVE YOUR FITNESS!

Look at the flyer below.

Imagine you work for the Real Results Gym.

You are going to design a training programme to improve fitness in just three weeks.

The Real Results Gym  
We promise you real results.  
Look better, feel better, perform better.  
Just give us three weeks and we'll give YOU a new body!

In this enquiry you are going to design a programme to improve fitness. You need to decide:

- What aspect of fitness you want to improve and how you are going to measure improvement.
- What steps you are going to take to improve fitness.

There are four stages to carrying out the enquiry:

1. Planning
2. Obtaining evidence
3. Considering the evidence (drawing conclusions)
4. Evaluating the evidence

### Part 1: Planning

This has two aspects,

- 1 deciding on your fitness regime and
- 2 deciding on your system for measuring fitness.

#### 1 Deciding on your fitness regime

Decide and write down what type of fitness you intend to improve with your training programme.

Decide what your fitness regime will look like. Consider the following:

- What type of activities are you going to follow?
- How often?
- For how long each session?
- Will you vary the activities on different days?
- What changes to your diet are you going to make?
- Any other changes?

## ACTIVITY 1.1: IMPROVE YOUR FITNESS!

Describe your fitness regime.

Using your scientific knowledge, explain how your training programme will improve fitness.

Prepare a risk assessment for your programme.

### 2 Deciding on your system for measuring fitness

What tests of fitness are you going to use to measure levels of fitness both before and after your training programme?

You may wish to look at the **Skill Cards** (see Activity 3.1, Exercise 2) to get some ideas about tests to measure fitness. You may also wish to discuss alternative tests with your PE teacher.

Consider the following questions:

- How many tests are you going to use?
- Describe the tests you are going to use.
- How are you going to conclude that there has been improvement?

Describe your plan for measuring fitness.

### Part 2: Obtaining evidence

For this you need to

1. Establish initial level of fitness
2. Carry out your fitness regime
3. Establish final level of fitness

#### 1 Establishing initial level of fitness

- Design a results table to record the initial fitness results of your group.
- Carry out the tests and record your results. You may wish to set up a spreadsheet for your results.

#### 2 Carrying out your fitness regime

- Carry out your training programme for three weeks.
- Remember to record your results carefully.
- Bring your results to class.

#### SAFETY

*If you have been told to carry out particular warm-up activities or to perform a fitness test in a particular way, make sure that you always do this.*

*If you are using any equipment, always make sure that it is set up correctly and that you are using it safely.*



#### 3 Establishing final level of fitness

Carry out the tests for measuring fitness and record your group's final levels of fitness.

## ACTIVITY 1.1: IMPROVE YOUR FITNESS!

### Part 3: Considering evidence

You need to consider these questions:

- Has there been an improvement in fitness?
- Is there a clear improvement?
- How has the training regime led to the improvement you observed?
- Are there any other factors that might have influenced your fitness?

Describe your analysis of the data.

Write down your conclusion.

### Part 4: Evaluating

Evaluating is about looking at conclusions and at the strength of the evidence used to come to the conclusions. Look at the enquiry and think about these questions:

- **Are the tests you used appropriate for measuring the type of fitness you are interested in?**  
Would you change your measures of fitness? If so, why? If not, why not?
- **Is the data you collected good enough?**  
Did you collect enough repeated measures?  
How could you improve the accuracy and precision of your measures?  
Were there any anomalous results in your measurements? If so, can you explain them?

Write down your evaluation of the quality of the evidence and its relation to the conclusion.

## ACTIVITY 2.1: WHAT IS FITNESS?

### Exercise 1: Thinking about different types of fitness

What is fitness? Does playing football contribute to your fitness in the same way as practising yoga?

In this activity, you are going to consider different types of fitness and decide what types of fitness are needed for different sports.

1. You are going to consider several different sports activities. For each activity, write down ways in which people need to be fit if they are going to be good at the sport.
2. In the following table, the first column is a list of sports. The other columns are different types of physical fitness. For each sport, decide whether it requires a high, medium or low level of each type of fitness. Shade in (or place a tick in) the choice you think is correct for each sport. The first sport, weight lifting, has been filled in for you.

### Rating different activities

Sport	Cardiovascular (aerobic fitness)			Flexibility			Muscle strength (anaerobic fitness)		
	High	Medium	Low	High	Medium	Low	High	Medium	Low
Weight lifting			✓		✓		✓		
Gymnastics									
Running									
Yoga									
Swimming									
Golf									
Football									
Dancing									
Horse riding									
Motor car racing									
Snooker									
Cricket									
High jump									
Squash									

## ACTIVITY 2.1: WHAT IS FITNESS?

### Exercise 2: The 'language' of fitness

What is the 'language' of fitness?

In this activity, you will find out the meaning of some of the terms used when talking about fitness.

**Match the following words with the explanations in the table.**

vital capacity, resting pulse rate, flexibility, body mass index, aerobic (cardiovascular) exercise, recovery period, tidal volume, anaerobic fitness (muscle strength), heart rate, aerobic (cardiovascular) fitness

Term	Explanation of the term
	...shows how fast the heart beats. It is measured in beats per minute. It increases when exercising
	... is related to muscles being more powerful (e.g. being able to lift more weight) or to the muscles' ability to work for longer periods.
	...is the amount of air someone exhales after having inhaled as deeply as possible. It indicates the person's capability to hold larger amounts of air in their lungs
	...is related to a greater amount of oxygen being delivered to muscles from the heart. It results in a person's ability to exercise for longer periods.
	...is the volume of air inhaled during a normal breath
	...is exercise which raises the heart rate and keeps it up for an extended period of time
	...is a number which shows whether an adult is overweight or not. It is calculated by the following formula: $(\text{weight}/\text{kg})/(\text{height}/\text{m})^2$
	...is the time taken for an individual's heart rate to come back to normal after exercising.
	...is related to a person's ability to bend and stretch different parts of their body
	... is the heart rate taken after having rested for 10 minutes or more.

## ACTIVITY 2.2: FITNESS AND DIET

### Exercise 1: What is contained in food?

What is contained in food?

In this activity, you are going to find out about the different types of substances that are contained in food.

Sort the diet cards into groups. Each group should contain:

- a food substance (nutrient) card,
- a card describing the function of the food substance and
- a card with examples of how we can get the food substance.

## ACTIVITY 2.2: FITNESS AND DIET

## Exercise 1: What is contained in food?

## Diet Cards

Protein	Needed for good vision	Helps food move through the intestines	Vitamin D
Meat, fish, dairy products, nuts and seeds	Water	Wholemeal bread, brown rice, vegetables, fruit	Mineral: calcium
Vitamin A	Pasta, rice, bread; also sugar and sugary foods such as soft drinks, biscuits and cakes.	Oranges, lemons, grapefruits	Mineral: iron
Butter, margarine, crisps, fried food, nuts	Essential for repair of tissues; may strengthen the immune system	Fibre	Made in the body after exposure to sunlight
A major component of red blood cells: important for carrying oxygen	Formed in the body as a result of eating colourful vegetables, e.g. carrots	Most important source of energy; the excess is stored as glycogen in the liver	Vitamin C
Source of energy; also needed for organ protection and for insulation	Fat	Needed for strong bones and teeth	Needed as a solvent for transport; regulates the body temperature by evaporating from the skin
Fruit, water, juices	Essential for growth, repair and replacement of cells	Carbohydrate	Promotes cell growth, and is needed for strong bones
Milk and other dairy products	Red meat, eggs, dried fruits, lentils		

## ACTIVITY 2.2: FITNESS AND DIET

### Exercise 2: Linking diet to types of fitness

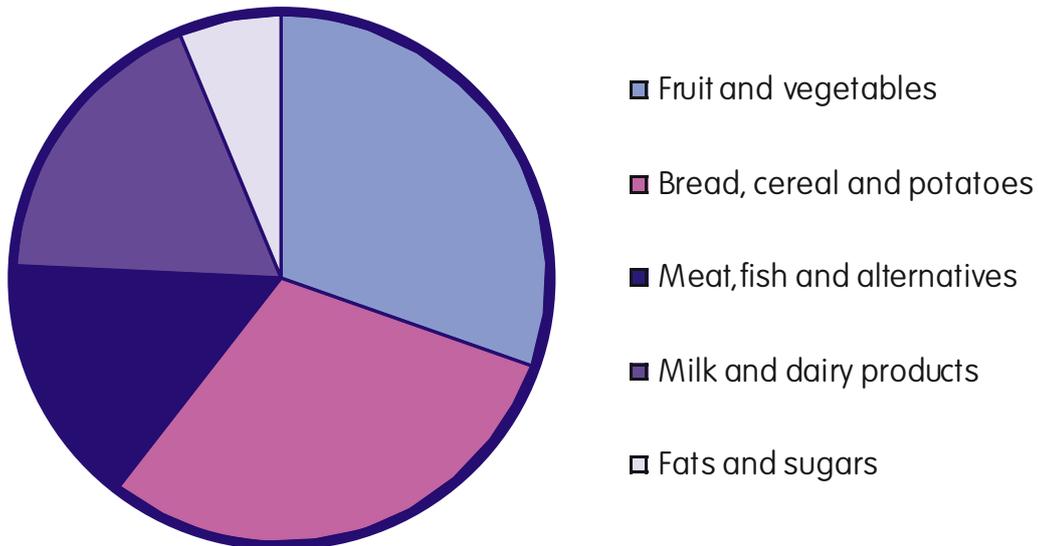
How does diet relate to fitness?

Fitness is very closely related to diet. It is essential to eat a balanced diet if we are to remain both physically and mentally fit. However, diet also needs to be adapted to individual needs.

In this activity, you will find out how diet relates to fitness.

#### General recommendations made about diet in the UK

- Individuals should have a balanced diet. The pie chart shows what a balanced diet should include, and the relative amounts of these food groups in a balanced diet:



- Adults should drink 6 to 8 glasses of fluids daily.
- Adult males should consume 2500kcal per day and adult females 2000kcal per day.

While these general recommendations are important, different types of fitness are linked with changes in diet.

In your groups, discuss the questions in cards A to E. Write down the answers you agree upon.

## ACTIVITY 2.2: FITNESS AND DIET

## Exercise 2: Linking diet to types of fitness

**A**

What changes does a marathon runner have to make to his or her diet in preparation for a race?

**B**

A discus thrower preparing for a competition needs to increase the amount of protein in his or her diet. He /she should also pay careful attention to the amount of calcium in the food.

Why does he/she need to make these changes in her diet?

What types of food should he/she eat?

**C**

Why should weight lifters eat increased amounts of meat?

**D**

A footballer may need to increase his/her consumption of vitamin C, vitamin A and protein following an injury.

Why is that?

What types of food should he/she eat?

**E**

Athletes often train at high altitude - where there is less oxygen - prior to competitions to improve their fitness.

Why would this be important, and how could someone remaining in the UK use diet to have a similar effect?

## ACTIVITY 3.1: USING DATA TO ASSESS FITNESS

### Exercise 1: Who is most likely to win a half marathon?

Who is most likely to win a half-marathon? Being fit in one area does not make you capable of excelling in all types of events.

In this activity, you will be using data to decide which of four athletes is most likely to win a half-marathon.

Use the data cards provided to answer the questions below.

1. Look at the data in the cards. Which of the four athletes would be most likely to win a half marathon?
2. Why do you think the person you chose was most suited to the race?
3. What difficulties did you have when deciding who was the most likely to win the race?

## ACTIVITY 3.1: USING DATA TO ASSESS FITNESS

## Exercise 1: Who is most likely to win a half marathon?

## Data cards for four athletes

<b>Name</b>	Ajay Patel
<b>Age</b>	25
<b>Height</b>	1.90 m
<b>Weight</b>	75 kg
<b>Bicep size</b>	425 mm
<b>Resting pulse rate</b>	55 beats/min
<b>Body mass index</b>	21
<b>Greatest achievement</b>	Gold medal in the National Rowing Championships

<b>Name</b>	David Harvey
<b>Age</b>	26
<b>Height</b>	1.73 m
<b>Weight</b>	82 kg
<b>Bicep size</b>	500 mm
<b>Resting pulse rate</b>	59 beats/min
<b>Body mass index</b>	27
<b>Greatest achievement</b>	Most capped Rugby player

<b>Name</b>	Helen Jennings
<b>Age</b>	19
<b>Height</b>	1.65 m
<b>Weight</b>	55 kg
<b>Bicep size</b>	270 mm
<b>Resting pulse rate</b>	48 beats/min
<b>Body mass index</b>	20
<b>Greatest achievement</b>	Winner of Women's International Decathlon

<b>Name</b>	Sasha Gomez
<b>Age</b>	30
<b>Height</b>	1.72 m
<b>Weight</b>	53 kg
<b>Bicep size</b>	250 mm
<b>Resting pulse rate</b>	44 beats/min
<b>Body mass index</b>	18
<b>Greatest achievement</b>	Gold medalist in Women's 1500m at World Championships

## ACTIVITY 3.1: USING DATA TO ASSESS FITNESS

### Exercise 2: Has fitness improved?

When you start training, some indicators of your level of fitness may change.

In this activity, you will be thinking about what makes you decide that a person's fitness has improved.

Fred has recently taken up a new training scheme. He used some of the tests described in the Fitness tests to assess if he was getting fitter.

1. Look at the table below and at the descriptions of the tests. Fill in the rest of the table and decide whether the statements show that Fred's fitness has improved or not.

#### Fred's fitness tests

Fitness test used	Results before training	Results after training for 3 weeks	Type of fitness assessed	Improvement
Step test.	124 beats per minute	116 beats per minute		
Resting pulse rate	60 beats per minute	60 beats per minute		
Body mass index	22	21		
Trunk extension	50 cm	52 cm		
Shoulder lift	15 kg	18 kg		
Sit and reach test	8 cm	9 cm		
Three minute shuttle run	60	60		
Zipper test	14 cm	15 cm		
One minute lateral jump	135	150		
Bicep size	425 mm	450 mm		

2. Write a paragraph explaining how Fred's fitness has changed.

## ACTIVITY 3.1: USING DATA TO ASSESS FITNESS

## Exercise 2: Has fitness improved?

## A. Fitness tests

## A. Test for all types of fitness

Body Mass Index (BMI)

- Calculate your Body Mass Index, using the formula below.

$$\text{Body Mass Index} = \frac{\text{body mass (in kg)}}{\text{height}^2 \text{ (in metres}^2\text{)}}$$

- Compare your BMI with the table below:

Category	BMI
Underweight	Less than 20
Fit	20 – 24
Overweight	25 – 30
Obese	More than 30

## ACTIVITY 3.1: USING DATA TO ASSESS FITNESS

### Exercise 2: Has fitness improved?

#### B. Tests for aerobic fitness

##### Resting pulse rate

- Sit down and locate the pulse in your wrist using your first two fingers.
- Count your pulse for 60 seconds.

##### Step test

- Step up and down on a bench 30cm high for 3 minutes at a rate of 24 steps per minute.
- Sit down and relax. Remember not to talk. Find your pulse.
- After 5 seconds, take your pulse for 60 seconds.

##### Three-minute shuttle run

- Run between two lines 5 metres apart for 3 minutes.
- Count and record the number of laps there and back.

##### One-minute lateral jump

- Keep feet together and jump sideways and back across a line on the floor as many times as possible in 1 minute.
- Count each jump.
- Record the total number of jumps.

## ACTIVITY 3.1: USING DATA TO ASSESS FITNESS

### Exercise 2: Has fitness improved?

#### C. Tests for anaerobic fitness

##### Vertical jump

- Stand side on to a wall and reach up with the hand closest to the wall.
- Keeping the feet flat on the ground, mark the point of the fingertips.
- Put some chalk on your fingertips.
- Stand away from the wall and jump vertically as high as possible, keeping your arms at your sides.
- Touch the wall at the highest point of the jump.
- Measure the difference between the reach height and the jump height.

##### Shoulder lift

- Start with the smallest weight.
- Hold the weight, keeping the arm next to the thigh.
- Keep your arm straight and lift the weight until your arm is straight out in front of you and level with your shoulder.
- Repeat with increased weights, until you cannot complete the test.
- Record the largest weight (in kg) you managed to lift to shoulder height.

##### Bicep size

- Make a fist and flex your bicep.
- Measure the circumference of your arm at its largest.

## ACTIVITY 3.1: USING DATA TO ASSESS FITNESS

### Exercise 2: Using data to assess fitness

#### D. Tests for flexibility

##### Zipper test

- Reach your right arm and hand over your right shoulder and down your spine, as if you were pulling up a zipper.
- Measure the distance between the tip of your palm and your neck.

##### Sit and reach

- Sit on the floor with your legs straight ahead.
- Place a heavy box in front of your legs. Place your feet flat against the box.
- Hold your knees flat.
- Lean forward slowly as far as possible.
- Measure the distance between your fingertips and the edge of your toes.

##### Trunk extension

- Lie face down.
- Without moving your legs and keeping your upper body straight, lift your chest as much as possible.
- Measure the distance between your shoulders and the ground.

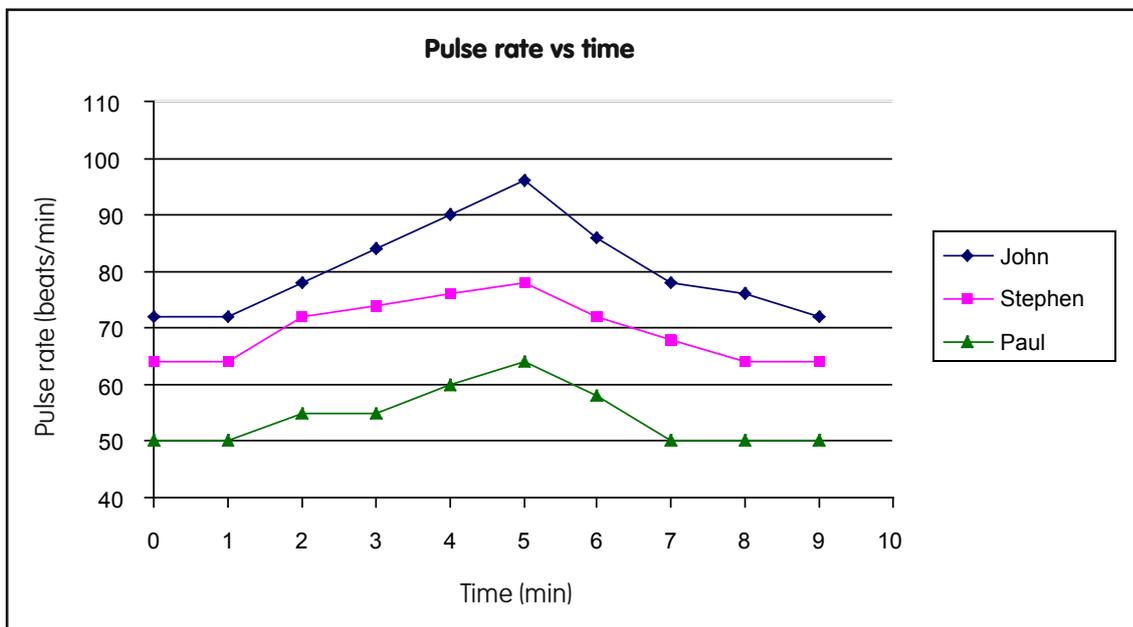
## ACTIVITY 3.2: WORKING WITH GRAPHS

### INTERPRETING PULSE RATE GRAPHS

What can you tell about a person's aerobic fitness from their levels of pulse rate?

In this activity, you will be using information about the pulse rate of three different people in order to judge their level of aerobic fitness.

The following graph shows three people's pulse rate before, during and after exercise. Study the graph and discuss the questions below in your group.



1. After how long did John, Stephen and Paul begin the activity? How can you tell?
2. What was each person's maximum pulse rate?

John's:                                  Stephen's:                                  Paul's:

3. For how long did each person exercise?

John:    Stephen:    Paul:

4. How long did each of them take to recover to their resting pulse rate?

John:    Stephen:    Paul:

5. Who is the fittest of these three people? Explain.

## ACTIVITY 3.3 WORKING WITH TABLES

How fit are we as a nation?

In this activity you will be interpreting the data from a table to work out how our level of fitness has changed within the last twenty five years.

Use the information in the table to answer the questions below.

Percentage levels of obesity in England for adults aged 16-64, during the period 1986/1987-2002.

	1986/7	1991/2	1994	1996	1998	2000	2002
<b>Men</b>							
<b>Obese</b>	7	13	13	16	17	21	22
<b>Overweight</b>	38	40	43	43	44	43	41
<b>Fit</b>	49	41	39	36	35	31	32
<b>Underweight</b>	6	6	5	5	4	5	5
<b>Women</b>							
<b>Obese</b>	12	15	16	17	22	20	22
<b>Overweight</b>	24	26	29	31	33	32	32
<b>Fit</b>	53	50	47	44	41	41	40
<b>Underweight</b>	11	9	8	7	5	7	6

Source: British Heart Foundation Website, at [www.heartstats.org](http://www.heartstats.org)

1. What pattern do you notice from the data?
2. Why do you think this pattern has emerged over the years?
3. If 10% of secondary school age children are now considered obese in the UK, what changes do you think need to be made to improve their fitness?

## ACTIVITY 3.4: INVESTIGATING THE RELIABILITY OF DATA

How reliable is the data you are using? Can you be sure about any judgments based on this data?

In this activity you will decide whether or not the procedures used by two students have allowed them to obtain reliable data which would allow them to decide whether or not their fitness has improved.

Claire and Katie designed a training programme. Before they started training they tested their aerobic fitness using the 'three-minute shuffle run'. They then used their training regime to try to get fit. After they had finished training, they tested their fitness again using the 'three-minute shuffle run'.

### Three-minute shuttle run

- Run between two lines 5 metres apart for 3 minutes.
- Count and record the number of laps there and back.

This is how they tested their fitness before and after training:

- They performed the test in the morning, between 10:00 and 11:00.
- On the morning of testing, they had breakfast at about 8:00. Their breakfast consisted mainly of food rich in carbohydrates.
- They took the test four times. After each trial, they rested for 15 minutes.
- While taking the test, they made sure that they put both feet on the line before running back.

Here are their results:

	Claire		Katie	
	Before	After	Before	After
1 <sup>st</sup> trial	59	61	70	74
2 <sup>nd</sup> trial	59	60	71	72
3 <sup>rd</sup> trial	58	61	70	69
4 <sup>th</sup> trial	58	60	69	69

**ACTIVITY 3.4: INVESTIGATING THE RELIABILITY OF DATA**

Answer the following questions:

1. Did the girls follow an adequate procedure in order to test their fitness? Explain your answer.

2. Has Claire's aerobic fitness increased?

Yes       Probably yes       Not sure       Probably not       No

3. Explain your choice for question 2.

4. Has Katie's aerobic fitness increased?

Yes       Probably yes       Not sure       Probably not       No

5. Explain your choice for question 4.