

Activity 1: Pre-match Training - Teachers' Notes

OVERVIEW

In this activity, the team coach invites pupils to analyse the performance of his players and their physical condition during a training session, and to choose which of them should play as a striker, as a mid-field player and as a defender.

There are video clips of six players, each doing five training exercises, which pupils can analyse and compare. There's also an on screen stopwatch, a heart rate monitor and an event counter for pupils to use.

This activity has a wealth of real-life data for pupils to capture. The challenge is to decide which data is useful and how best to record and make sense of it in a way that informs their decision making. When pupils come to some conclusions, they can report back verbally to the class and in their written report to the team coach.



National Curriculum Levels

This activity is aimed at those working at NC levels 4 to 6 and beyond.

Before the activity

Preview the activity and the teachers' notes and print out the necessary pupil handouts.

Organise pupil access to the software on PCs and teacher access via a digital projector and loudspeakers. There is actuality sound on the training videos pupils use during the activity, and while this is not vital, it adds to the realism, though pupils will need sound if they want to replay the team coach's introductory videos for themselves.

Decide which elements of the activity will be 'whole class' and how the pupils will work in small groups (suggest of groups of 2-3 pupils around each computer).

During the activity



Show the class the team coach's introductory video for the whole case study.



"Hello! I'm Joe Bailey, the coach of Swanscombe Tigers football club, and you're going to use mathematics to analyse the performance of my team. In these activities I want you to look at how they train, how they pass the ball and how they score goals! So choose a topic and report back to me with what you find out."



Select the 'pre-match training' activity.



Show the class the team coach's introductory video for this activity.



"Pre-match training is very important and different players, whether they're strikers, mid-field players or defenders, need different skills and abilities. What I see on the training pitch helps me make decisions about my players' fitness and their readiness to play. Today I want you to watch video clips of my players doing different training activities and analyse their performance, such as their speed, their stamina and their accuracy. Then I want you to report back to me with a 'performance profile' for each player, with your recommendations of who should play in what position in the team - and why."

Start pupils working on the activity and provide support to groups and individuals.

Organise the whole class plenary for pupils to evaluate and feedback on their work at the end of the activity.

After the activity

Consider whether there are opportunities for pupils to replicate the video training activities and associated data logging for themselves in other lessons, eg in PE or other sport skills, in order to decide who in the class would make the 'best players'.

Supporting documentation for teachers:

- **Teachers' Notes**: An overview of the activity and a more detailed lesson plan.
- **Teacher Player Profile Sheet**: This is the same as the *Pupil Player Profile Sheet*, but with all the time and heart rate data from the video clips entered in for teachers' convenience. There's also the team coach's personal analysis of his players, though this is based on his own judgment and not on the video clips. You may or may not choose to share this with your pupils, as it may give the impression there's a 'right' answer, when the pupils' analysis may be equally valid, based on the data at their disposal. You might want to provide the additional information **after** the pupils have made their selections, by saying: 'Here is some more information, does this make any difference to your selections?'
- **Extension Ideas**: Suggestions for further work using the same video content.

Supporting documentation for pupils:

- **Pupil Reference Sheet**: A brief outline of the skills needed for different playing positions and an explanation of how heart rate and fitness are linked. You might choose to make many of these points orally to the class.
- **Pupil Player Profile Sheet**: Vital statistics for each player with space for pupils to record the information they get from the video clips for the training activities they choose to analyse.
- **Pupil Report Sheet**: For pupils to report back to the team coach with their choices about which players they'd select to play in which positions. They can choose more than one player for each position.

Resources required

- A computer and projector and speakers for the teacher (essential)
- A computer for each group of 2 or 3 pupils (recommended)
...with speakers or headphones (optional)
- A copy of the *Pupil Player Profile Sheet* per group (essential)
- A copy of the *Pupil Report Sheet* per group (recommended)
- A copy of the *Pupil Reference Sheet* per group (optional)

LESSON PLAN

Start of the lesson (10 minutes)

After playing the team coach's introductory videos, establish that pupils understand the task he's set for them - to decide which of his players they'd choose for the positions of striker, mid-field player and defender, based on analysing video clips of them training.

It might be useful to have a brief discussion about the different positions played in football and some of the skills needed for each one. The *Pupil Reference Sheet* has a summary of this information. This discussion could be in groups using mini-whiteboards to record pupils' ideas, with groups contributing their responses to a whole class discussion.



Show a couple of training videos clips to demonstrate how the software operates.



Explain that there are 30 video clips showing six players doing five different activities, which correspond to what the pupils have on their *Pupil Player Profile Sheet*. Point out the in-vision heart rate monitor and time clock and explain how pupils can use the slow motion buttons to play the video frame by frame so they can read off the information they need, such as the exact time a player crosses the finish line or the maximum heart rate. There's also a counting tool to help pupils log the number of steps, jumps or 'keep-it-ups'.

Depending on the pupils' existing knowledge, a brief discussion of how heart rate is an indicator of fitness might also be useful, perhaps linked to work they've covered in PE or science. Again, the *Pupil Reference Sheet* has a summary of this information, though you might prefer pupils to devise these criteria for themselves first following a class discussion.

Teachers may need to provide other guidance as needed, for example on the use of spreadsheets and graphing packages should pupils choose to use them to display the data they capture.

Pupils working on the task (40 minutes)

Pupils work in groups of two or three to think of different ways they might collect evidence to inform their decisions. They'll need to think about which aspects of fitness and which skills are demonstrated by the different activities. Allowing pupils to explore the video at this point is helpful, even if it doesn't seem productive, because they need to have a sense of the data each training activity offers before they can decide how best to collect and use it. Also, pupils may become impatient if they can't get started on the activity that's in front of them.

After a few minutes you might ask selected groups to share their ideas with the class, particularly if some groups are struggling to come up with ideas. Alternatively you could ask probing questions of each group as they work to help them decide what to record.

To inform their decisions about the fitness of players, pupils might:

- Simply record the time that it takes each player to complete each training task
- Use a combination of the time taken to complete the task and the final heart rate
- Work out how much each player's heart rate increases during the task – either as a raw value, as a percentage of the original, or related to the time.
- Rate each player's agility on a particular task such as the 'ladder run' by using their own criteria or by reaching a consensus of opinion
- Rate each player's skill on a particular task such as the 'dribble run' or 'keep-it-ups', using their own criteria or by reaching a consensus of opinion

At the most basic level, pupils might just record the times for all players for all tasks and then make their decisions based on who's the quickest, though they may realise that the time taken for the 'keep-it-ups' is not a useful measure of that skill.

At a more advanced level, pupils might decide which aspects of fitness are most useful for the three positions required and then choose the key training activities that will give them the data they require to consider the different aspects of fitness. They can then use the information they've gathered about the players to decide who should play where.

Points to note:

- Pupils need to use the on-screen timer to read the time that the player takes to complete the exercise.
- Pupils need to read the heart rate from the screen. They may notice that this continues to increase after the activity is finished and need to decide whether to use the rate at the end of the activity or the ultimate maximum as a measure of fitness.
- There is an on-screen counter for pupils to use if they think it might be helpful to them.
- In this case the players' shirt numbers have no significance and give no indication of the positions they play in on the field!

Pupils work in their groups on the task and fill in player profile sheets as required. This may take some time because there are 30 separate clips they could look at and pupils will probably find that the task is not as easy as they'd anticipated and may not produce the data they expected. Whether pupils compare each player doing all the activities or take each activity and work through all the players is up to them, and some groups may need help to avoid random gathering of data and to focus on what they are looking for and how to capture it efficiently. For example, they could be encouraged to record all the time and heart rate information from the video onto their *Pupil Player Profile Sheet* and then they can scan all their data to see if there are any patterns..

The *Pupil Player Profile Sheet* also provides other information about the players, such as their height and weight, and pupils may notice some correlations between these and the performance data, such as some players being small and fast while others are large and slow! For some pupils, this kind of general observation will be sufficient, while others may want to use plot the data as scatter graphs to see if there is a correlation.



Towards the end of this session you may wish to run the coach's 'reminder' video.

"Now you've got the information you need, it's time to create a 'performance profile' for each player, with your recommendations of who should play in what position in the team, and why."

Pupils should finally complete their *Pupil Report Sheet* with who they've selected for what position on the field and how they made their decisions. Making these decisions may be challenging because pupils will not necessarily have all the information they'd like, but they should be encouraged to work with what they have and make the best decisions they can from the information available. One example of this is that some of the skills listed as useful for defenders were not demonstrated in the training videos, but this is a real life situation and lack of 'ideal' data is a dilemma that many people face in real mathematical investigations.

If any groups have been unable to collect useful data to make these decisions, they can be encouraged to reflect on the difficulties they encountered and how they might approach the task if asked to do it again.

Plenary (10 minutes)

Groups feed back their decisions to the rest of the class. This might be done through pupils initially voting for the players they've chosen for each position. The teacher can then select one group who have voted for the most popular choice for the position to feed back why, and then select groups that have voted for less popular players for the position to offer their reasons.

As with many investigative activities like this, there's no 'right answer', with the process of data capture and analysis being the main purpose. However, as teachers can see from their own *Teacher Player Profile Sheet*, the information from the training sessions does point to certain players being more suited to certain positions, such as tall, quick and skilful Chas being a potential striker and big, slow Ryan probably best playing in defence.

The team coach's personal analysis of his players also appears on the *Teacher Player Profile Sheet*, though this is based on his own knowledge and judgment and not on the video clips. This Information could be shared with pupils once they've made their own decisions, not as the 'correct' answers but as some bonus information for pupils to consider to see if it makes a difference to their selections.

A discussion about the difficulties pupils encountered using real data and how confident they are about the decisions they have made would be useful to help pupils understand the limitations of the methods they have employed. They might also consider what they might have gone on to investigate if they had more time.

KEY PROCESSES AND CONTENT

Processes relevant to this activity are **highlighted**

Curriculum opportunities

During the key stage pupils should be offered the following opportunities, which are integral to their learning and enhance their engagement with the concepts, processes and content of the subject.

The curriculum should provide opportunities for pupils to:

- work on sequences of tasks that involve using the same mathematics in increasingly difficult or unfamiliar contexts, or increasingly demanding mathematics in similar contexts
- work on open and closed tasks in a variety of real and abstract contexts that allow pupils to select the mathematics to use
- work on problems that arise in other subjects and in contexts beyond the school
- work on tasks that bring together different aspects of mathematical content, involving use of several of the key processes, or require using the handling data cycle
- work collaboratively as well as independently to solve mathematical problems in a range of contexts, evaluating their own and others' work and responding constructively
- use a variety of resources when solving problems or carrying out mathematical procedures.

Key processes

Representing

Pupils should be able to:

- identify the mathematical aspects of the situation or problem
- choose between representations
- simplify the situation or problem in order to represent it mathematically using appropriate variables, symbols, diagrams and models
- select mathematical information, methods and tools to use.

Analysing

Use mathematical reasoning

Pupils should be able to:

- make connections within mathematics
- use knowledge of related problems
- visualise and work with dynamic images
- look for and examine patterns and classify
- make and begin to justify conjectures and generalisations, considering special cases and counter examples
- explore the effects of varying values and look for invariance
- take account of feedback and learn from mistakes
- work logically towards results and solutions, recognising the impact of constraints and assumptions
- appreciate that there are a number of different techniques that can be used to analyse a situation
- reason inductively and deduce

Use appropriate mathematical procedures

Pupils should be able to:

- make accurate mathematical diagrams, graphs and constructions on paper and on screen
- calculate accurately, using a calculator when appropriate
- manipulate numbers, algebraic expressions and equations and apply routine algorithms
- use accurate notation, including correct syntax when using ICT
- record methods, solutions and conclusions
- estimate, approximate and check working.

Interpreting and evaluating

Pupils should be able to:

- form convincing arguments based on findings and make general statements

- consider the assumptions made and the appropriateness and accuracy of results and conclusions
- be aware of strength of empirical evidence and appreciate the difference between evidence and proof
- look at data to find patterns and exceptions
- relate findings to the original context, identifying whether they support or refute conjectures
- engage with someone else's mathematical reasoning in the context of a problem or particular situation
- consider whether alternative strategies may have helped or been better.

Communicating and reflecting

Pupils should be able to:

- communicate findings in a range of forms
- engage in mathematical discussion of results
- consider the elegance and efficiency of alternative solutions
- look for equivalence in relation to both the different approaches to the problem and different problems with similar structures
- make connections between the current situation and outcomes, and ones they have met before.

Curriculum content

Number and algebra

- rational numbers and their different representations
- rules of arithmetic applied to calculations and manipulations with rational numbers
- applications of ratio and proportion
- accuracy and rounding
- algebraic expressions, formulae, equations, inequalities and identities including index notation and the use of brackets to indicate precedence
- simultaneous linear equations in algebraic and graphical forms
- sequences, including those arising from rules, in a variety of contexts
- graphs of polynomial functions and their properties

Geometry and measures

- properties of 2D and 3D shapes and their applications, including constructions, loci and bearings, deductive reasoning and Pythagoras' theorem
- transformations, similarity and congruence including the use of scale
- points, lines and shapes in 2D coordinate systems
- units, compound measures and conversions
- perimeters, areas, surface areas and volumes

Statistics

- presentation and analysis of grouped and ungrouped data including time series and lines of best fit
- measures of central tendency and spread
- experimental and theoretical probabilities including those based on equally likely outcomes
- applying statistics to enable comparisons.