



Overview

This pod explores the relationship between improving technology and its effect on sporting records. In Activity 1.1 pupils produce a timeline of the significant changes in bicycle design over time. They scrutinise graphs in 1.2 and match quantum changes in records with significant changes in design. They speculate about future advances in bicycle design in Activity 1.3.

Footwear design has also experienced significant change over the years. In Activity 2.1 pupils carry out an investigation into grip in shoes, before researching how different materials are combined to produce shoes for specific sports in Activity 2.2.

Pupils then conduct an investigation into a bat and ball in Activity 3.2, to demonstrate that combinations of equipment must sometimes be tested together.

A whole range of variables can be explored together using 'attributes analysis' in Activity 4.1. Pupils demonstrate their ideas by making a storyboard for a promotional video in Activity 4.2.

They complete this pod by carrying out a short investigation to test a simple piece of equipment (Activity 5.1). They present their findings by designing a scientific research poster (Activity 5.2).



Pod 2 In top gear

I = Information retrieval

C = Communication

T = Teamwork

M = Modelling

P = Planning

Lesson	Activity	Learning outcomes	Learning skills	Code
1 Pedal power	1.1 Bicycle timeline	Describe some of the improvements in bicycle technology over time.	Use images to construct a timeline.	I, C, T
	1.2 The hour record	Explain why the rules of competition must change with new technologies.	Draw and interpret a line graph.	I, C
	1.3 Bikes of the future		Make an annotated diagram.	I, C
2 On the run	2.1 Get a grip!	Plan and carry out a controlled experiment.	Design a poster.	P, I, C
	2.2 Fit for purpose	Investigate the grip of a range of sports shoes. Explain how sports shoes are designed for their specific purpose.		
3 Testing equipment	3.1 Batting challenge	Design an experiment to improve a simple piece of sports equipment. Use evidence to develop an explanation.	Communicate the outcomes of an investigation.	P, I, C, M
4 Moving the goalposts	4.1 Attributes analysis	Use an attributes analysis table.	Use attributes analysis.	P, I
	4.2 Promoting your game	Design a new version of a game for a particular set of participants. Explain how any changes have affected the game.	Produce a storyboard for a video.	P, I, C, T
5 The right kit	5.1 Testing the kit	Design and carry out a scientific investigation to improve a piece of games equipment. Present research findings in an accessible format.	Use a chart to plan a fair test.	P, C
	5.2 Making a scientific research poster		Construct a table for collecting data.	I, T
			Draw line graphs and bar charts.	M
			Design a scientific research poster.	C



Overview

In this lesson pupils explore the changing technologies that have enabled bikes to travel at increasing speed over time. They plot the data for the one-hour record and discuss the bike of the future.

Lesson plan

1. Activity 1.1 Bicycle timeline (15 mins)
2. Activity 1.2 The hour record (30 mins)
3. Activity 1.3 Bikes of the future (10 mins)
4. Plenary (5 mins)

Learning skills

- Use images to construct a timeline. (I, C, T)
- Draw and interpret a line graph. (I, C)
- Make an annotated diagram. (I, C)

Learning outcomes

Pupils will be able to:

- Describe some of the improvements in bicycle technology over time.
- Explain why the rules of competition must change with new technologies.

Resources

- *Games* learning log
- Activity sheet 1.1 Bicycle timeline (cards – one per pair – need to be photocopied and cut up)
- Activity sheet 1.2 The hour record

Equipment and materials

- Graph paper

Activity 1.1 Bicycle timeline (15 mins)

Procedure

a Give each pupil a *Games* learning log. They will use this throughout the pod. Give each pair of pupils a set of bicycle timeline cards and ask them to put the cards into chronological order.

b Get two pairs to work together and agree on the correct sequence.

c Take feedback from the class and discuss the clues that enabled them to make a reasonable guess at the order, for example bike technologies, clothes.

d Show pupils the correct sequence and help them clarify some of the main changes in bicycle technology, for example pedals, chain, pneumatic tyres, gears and brakes.

Activity 1.2 The hour record (30 mins)

Procedure

a Give pupils Activity sheet 1.2 The hour record. In this race competitors cycle alone, travelling as far as they can in one hour.

b Get pupils to plot the data from the pupil sheet on a graph. They should work in pairs to help each other work accurately. Provide a template for those who have difficulty drawing the axes.

c Get pupils to work through the tasks on the sheet in pairs, then share the questions they have written.

d Discuss:

- What type of graph shows these data most clearly?
- Does joining the points in different ways make a difference to what the data show?

e Use the copy of the graph in the presentation. Get pupils to explain the story of the graph.

f Show pupils the slide of the Merckx bike of 1972 and the Boardman bike of 1996. Ask pupils to discuss:

1. Why do you think the graph shoots up in 1993?
2. Why do you think the graph comes down again in 2000?



Explain that, because technology was improving so fast, the Union Cycliste International (UCI) banned all records from 1972. To compete in the hour record cyclists need to ride a bike with the same specification as Eddy Merckx's 1972 model. Ask pupils to find out what happened to Chris Boardman in 2000.

Activity 1.3 Bikes of the future (10 mins)

Procedure

a Show the image of a concept bike for the future. Ask pupils to make a sketch of this bike and annotate it with information that describes its new features, and how they might improve performance.

Plenary (5 mins)

Discuss:

- What are the main features that have improved cycling performance?
- How do these features improve performance?
- What other sports require frequent revision of the rules to adjust to new technologies?



Overview

In this lesson pupils consider the importance of footwear in sport. They are introduced to the idea that there is a wide variety of shoes designed for specific purposes. Pupils carry out a controlled investigation to explore grip in different sports shoes.

Lesson plan

1. Introduction (10 mins)
2. Activity 2.1 Get a grip! (30 mins)
3. Activity 2.2 Fit for purpose (15 mins)
4. Plenary (5 mins)

Learning skills

- Design a poster. (P, I, C)

Learning outcomes

Pupils will be able to:

- Plan and carry out a controlled experiment.
- Investigate the grip of a range of sports shoes.
- Explain how sports shoes are designed for their specific purpose.

Resources

- Activity sheet 2.1 Get a grip!

Equipment and materials

- One computer between four pupils
- Scissors
- Newton meters x 15
- String
- Selection of sport shoes (trainer, sprint shoe, gymnastic shoe, tennis shoe)
- Laboratory weights
- Metre rulers x 15

Health and safety

Take care with weights. Do not rely on what is said here. Carry out your own risk assessment and take suitable precautions.

Introduction (10 mins)

Procedure

a Use a football boot to talk through some of the different elements of design that are important in sports footwear. Use this opportunity to revise the idea of properties and discuss why certain materials are selected to perform particular functions. For example:

Material	Where used	Why used
Kevlar	Sole of shoe	10 times the strength of leather.
Foam-blown polyurethane	Inner sole and boot trim	This gives a shoe extra cushioning.
Thermoplastic polyurethane	Inside heel of shoe and some trim	This makes a shoe both strong and pliable.
Kangaroo leather	Upper shoe especially the sides	Gives a footballer extra spring in their step. It offers good elasticity.
Cotton	Laces	Can be woven into strong flexible threads.



Activity 2.1 Get a grip! (30 mins)

Procedure

a Tell pupils that they are going to carry out an investigation to explore the grip of different types of sport shoe. Introduce the practical by demonstrating pulling a shoe along a bench with a force meter. Encourage pupils to consider issues likely to affect the results, for example the weight of the shoe, the size of the shoe (surface area in contact with the bench), how they drag it and so on. Pupils can read the force directly from the force meter and enter their results into their table.

b Ensure pupils have a workable system for taking measurements and recording results in a table.

c Allow pupils sufficient time to investigate two or three types of sports shoe.

d Get pupils to feed back to the class. Discuss:

- Which shoes had the most grip?
- How did groups vary in their approach to the investigation?
- Were there big variations between groups' results?
- Do any differences represent actual differences in results, or are they due to differences in methods used?

e Draw out the idea of needing a standard technique when repeating a procedure.

Activity 2.2 Fit for purpose (15 mins)

Procedure

a Divide the class into groups of four. Allocate each group an Olympic sport. Tell them that they will produce an advert for a sports shoe for a sports magazine. Their advert must include:

- an image of the shoe
- a description of the materials used in the shoe and an explanation of the properties of the materials
- an explanation of how the overall shoe design makes it fit for its purpose.

b Before they start, agree with the class a set of criteria for a good poster. The criteria should include features such as balance of text and images, quality of information, referencing sources of information and good design.

Plenary (5 mins)

What are the general principles of designing good sports footwear?

Are there any principles used for designing particular categories of sports footwear, for example how indoor and outdoor shoes differ, or how the playing surface affects design?



Overview

In this lesson pupils work in groups to improve a simple piece of games equipment. They consider the variables involved, and change the values systematically to come up with the best possible design. Groups then take part in a competition to demonstrate the effectiveness of their redesigned equipment.

Lesson plan

1. Introduction (5 mins)
2. Activity 3.1 Batting challenge (45 mins)
3. Plenary (5 mins)

Learning skills

- Communicate the outcomes of an investigation. (P, I, C, M)

Learning outcomes

Pupils will be able to:

- Design an experiment to improve a simple piece of sports equipment.
- Use evidence to develop an explanation.

Resources

- Activity sheet 3.1 Batting challenge

Equipment and materials

Per group:

- Aluminium foil sheets, 10 x 10cm
- G-clamp
- Metre rule
- Perspex ruler, 30cm

Health and safety

Carry our your own risk assessment.

Introduction (5 mins)

Procedure

a Divide the class into groups of four. Show pupils the slide of different types of bat. Get them to

consider the different parts of a bat, and how these affect how the ball is struck. Encourage pupils to speculate on the relationship between the different attributes of a bat and its performance, for example the heavier a bat, the further it will hit a ball.

Activity 3.1 Batting challenge (45 mins)

Procedure

- a** Explain to pupils that they will be given some simple equipment to make a bat and ball game. The ruler is the bat and the aluminium foil will be made into a ball. Show them how to assemble the equipment (as shown in diagram on next page) and tell them that they should systematically test their equipment to improve its performance for a class competition.
- b** The teams will compete to produce a specification for a 'bat' and 'ball' system that can project an aluminium foil ball exactly 1m into the air.
- c** Help pupils to identify the key variables and construct appropriate tables to collect results.
- d** Allow pupils to carry out their investigation offering support and advice when needed.
- e** When all the groups have come up with their competition design, invite them to the front. Groups compete, using their agreed specification for the standard apparatus. You will need to establish the rules for the competition, for example how many attempts, how to measure height, and so on.
- f** Before competing, each group should explain how they modified their design based on their evidence.



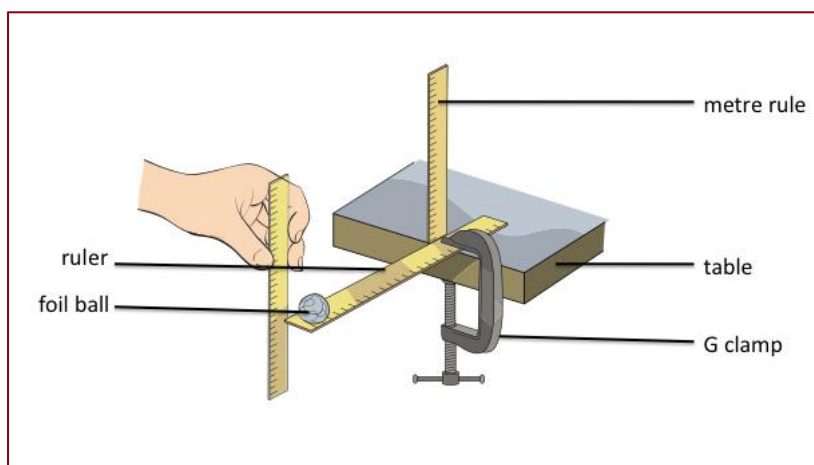
Plenary (5 mins)

Which of the three independent variables had the most effect?

Did everyone get the same results?

Is it possible to compare results between groups?

Illustration of equipment set-up





Overview

In this lesson pupils build on ideas for testing equipment developed in lesson 3. This time pupils use attributes analysis to systematically change the components of some familiar games. They design new versions of games that are more appropriate to a given set of participants.

Lesson plan

1. Introduction (5 mins)
2. Activity 4.1 Attributes analysis (20 mins)
3. Activity 4.2 Promoting your game (25 mins)
4. Plenary (10 mins)

Learning skills

- Use attributes analysis. (P, I)
- Produce a storyboard for a video. (C, T)

Learning outcomes

Pupils will be able to:

- Design a new version of a game for a particular set of participants.
- Explain how any changes have affected the game.

Resources

- Activity sheet 4.1 Attributes analysis
- Activity sheet 4.2 Promoting your game

Equipment and materials

- Access to computer (one between two pupils)
- Poster paper
- Felt pens
- Scissors
- Access to printer

Health and safety

Carry out your own risk assessment.

Introduction (5 mins)

Procedure

a Show pupils the slide of the computer specifications to illustrate how customers use tables of attributes to help them choose a product. They tend to weigh up the attributes of different products and then select the product that is right for them. Explain that tables of attributes can also be used as a stimulus for creating a new variation of a game.

Activity 4.1 Attributes analysis (20 mins)

Procedure

- a** Allocate different sports to pairs of pupils (see list in table of Olympic sports on next page) and give them Activity sheet 4.1 Attributes analysis.
- b** Get pupils to conduct an internet search to find the key attributes of their allocated sport. Pairs need to agree on these and include them in the top row of their table.
- c** Get pupils to fill in the details of these attributes in the second row of the table.
- d** Tell pupils that they are going to design new versions of their game. In each case they should describe how they think changes to values of the attributes will affect the overall nature of the game and its tactics.



Activity 4.2 Promoting your game (25 mins)

Procedure

a Tell pupils that they are now going to produce a storyboard for a video to promote their new version of the game. They could do this in pairs or small groups.

The storyboard needs to:

- present information in an engaging way (for example using cartoons, comedy script)
- be written for a named audience (for example top athletes, children, commuters)
- explain the changes to the rules
- explain why this new version is better than the old version for the new audience.

b Pupils should feed back on one other group's storyboard, for example by paired peer evaluation.

They should comment on:

- whether the new game is better than the original for its intended audience
- how successful the storyboard is in conveying the ideas behind the new games.

c If possible, pupils should have an opportunity to produce their videos in other lessons. For example, they could use time-lapse animations of models, real video or cartoon drawings with commentary.

Plenary (10 mins)

Ask groups to report back on the storyboard of the group that they have commented on.

How useful is attributes analysis in helping to generate new ideas?

Games for research

Official list of sports for Olympics 2012

Archery	Field hockey	Synchronized swimming
Athletics	Football (Soccer)	Table tennis
Badminton	Gymnastics	Taekwondo
Basketball	Handball	Tennis
Boxing	Judo	Triathlon
Canoeing	Modern pentathlon	Volleyball
Cycling	Rowing	Water polo
Diving	Sailing	Weightlifting
Equestrian	Shooting	Wrestling
Fencing	Swimming	



Overview

In this lesson pupils use the knowledge, skills and understanding they have developed in the earlier pods to design a new piece of equipment for a game. They need to set up a systematic, fair test and use their data as evidence to inform good design. They present their findings by designing a scientific research poster.

Lesson plan

1. Introduction (20 mins)
- 2a. Activity 5.1 Testing the kit (30 mins)
- 2b. Activity 5.2 Making a scientific research poster (30 mins)
3. Plenary (10 mins)

Learning skills

- Use a chart to plan a fair test. (P, C)
- Construct a table for collecting data. (I, T)
- Draw line graphs and bar charts. (M)
- Design a scientific research poster. (C)

Learning outcomes

- Design and carry out a scientific investigation to improve a piece of games equipment.
- Present research findings in an accessible format.

Resources

- Lesson 5 Briefing sheet NF Sports Equipment plc Research and Development Exercise
- Activity sheet 5.1 Testing the kit – What are the variables?
- Activity sheet 5.1 Testing the kit – Collecting data
- Activity sheet 5.2 Making a scientific research poster

Equipment and materials

- Assorted equipment as requested (see table on page 12)
- Examples of teaching posters and scientific research posters

Health and safety

Carry out your own risk assessment. Do not rely on what is said here. Some pupils may need careful supervision. You may need to discuss your plan with school management.

Introduction (20 mins)

Procedure

- a** Get pupils to summarise what they have learned so far in this pod. Tell them that they are going to work in groups. Some group members are going to use what they have learned to test equipment that could be used for an indoor game. The remaining pupils will make a scientific research poster. Both teams will work at the same time.
- b** Use the Briefing sheet to explain the scenario to pupils.
- c** Show the slide of different equipment and get pupils to draw up a list of the types of investigations they might try. The point of the investigation is to see how the performance of the equipment varies when the equipment is altered.
- d** Tell pupils that any equipment they test needs to be scaled down so that it can be used in a laboratory. They should decide on the features of the equipment that they are going to test, for example strength, speed, friction, bounce.
- e** Take feedback from the class to establish some of the features of sports and games equipment that might be varied in an investigation. The table below gives examples.



Equipment	Variables
Balls	Temperature of ball and height of bounce Type of ball and height of bounce Surface and height of bounce
Bat (real or model)	Mass of bat and distance hit Length of bat and frequency/accuracy/distance of hit
Rubber bands	Length and distance/accuracy Thickness and distance/accuracy
Straws (blow football)	Diameter of straw and ball distance/accuracy Length of straw and distance/accuracy
Tiddly winks	Diameter of discs and distance/accuracy Thickness of discs and distance/accuracy
Marbles	Diameter of marble and distance rolled Mass of marble and distance rolled
Surfaces	Type of surface and grip Type of surface and height of bounce
Paper aeroplanes	Mass of paper and distance Area of paper and distance Type of paper and distance
Skittles	Diameter and stability Mass and stability

f Divide the class into groups of six. Then let pupils divide their groups into team A, which will carry out the investigation, and team B, which will explain the investigation through the poster.

Activity 5.1 Testing the kit (30 mins)

Procedure for team A

a Give pupils in team A Activity sheet 5.1 Testing the kit – What are the variables? Ask pupils to choose a piece of equipment and form an enquiry question. For example, the variables for marbles could be ‘mass’ and ‘the distance rolled’. The enquiry question then becomes: ‘How does the mass of a marble affect the distance it rolls?’ Use the slide to discuss questions suitable for investigating balls, bats and rubber bands.

b Use the slide to explain the meaning of:

- independent variable – the variable the scientist changes
- dependent variable – the measurement that changes when the independent variable is changed

- controlled variables – the variables that the scientist needs to keep the same so that they do not interfere with the measurements or observations.

c Use the slides and Activity sheet 5.1 Testing the kit – What are the variables? to explain the difference between continuous variables and discontinuous variables. If continuous variables are being investigated pupils should use a line graph. If discontinuous variables are being investigated a bar chart should be drawn.

d Check that pupils’ plans are workable and then get them to draw their tables for collecting data.

e Give out the equipment and let groups carry out their own investigations. See the health and safety notes above.

Activity 5.2 Making a scientific research poster (30 mins)

Procedure for team B

a Give pupils in team B Activity sheet 5.2 Making a scientific research poster. Show pupils an example of a scientific poster and an advertising poster. (There are examples in the PowerPoint presentation.)

b Get pupils to describe the obvious differences before explaining in detail how scientific posters work.

Scientific research posters display information through texts and images presented in a logical sequence:

- Introduction
- Goals
- Research questions
- Methods
- Results
- Conclusions
- Discussion



c Explain that the communications team must work closely with the scientists to establish the layout of the poster. This needs to be agreed before the investigation is complete. The communications team will need to add information from the outset if the poster is to be completed on time.

d When the poster is complete ask pupils to display it in a designated area.

e Pupils then use sticky notes to leave one positive comment and one area for improvement on other groups' posters.

Plenary (10 mins)

Discuss:

- What were the most significant feedback comments left on the posters?
- What were the main benefits of dividing the tasks between researchers and communicators?
- What were the difficulties in dividing the roles like this?
- Is there a more effective way of conducting and communicating scientific research?