NUFFIELD STEM *GAMES*

TEACHERS' GUIDE

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Nuffield STEM *Games*

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Why *Games*?

Nuffield STEM *Games* is a cross-curricular topic that engages pupils with some of the key underlying principles behind games and competition. Pupils consider the importance of the players' preparation and new technologies in improving performance. As pupils work their way through the activities they develop an increasing body of skills, knowledge and understanding. Because the project is scaffolded, pupils gain increasing confidence as they work towards a final enquiry-based project of their own.

What is STEM?

STEM stands for Science, Technology, Engineering and Mathematics. This Nuffield STEM topic for lower secondary pupils exemplifies a skills-based cross-curricular framework which enables teachers and pupils to work on authentic, purposeful activities extending across the STEM disciplines.

Why cross-curricular STEM?

Nuffield STEM *Games* encourages pupils to explore problems in depth through a series of Science, Maths and D&T activities. In this way they develop a better understanding of how these disciplines interact in the real world.

Some of the benefits of cross-curricular working include opportunities for:

- pupils to engage with coherent and purposeful STEM learning
- pupils to practise and develop their ability to tackle complex problems
- reinforcing learning across STEM subjects.

What's in it for Science, Technology and Mathematics?

The activities in *Games* demonstrate the complementary nature of the STEM subjects. They do not explicitly teach sections of the programmes of study. The activities are constructed so that prior knowledge, skills and understanding from the individual subjects can be brought together to explore issues relating to games, competition and fairness.

The subject teacher must establish the links between prior and future learning for their own subject.

Here are some of the main topics covered in *Games*.

Science

Designing fair investigations
Forces in sport
Properties of materials
Levers and moments

Design & Technology

Using attributes analysis
Explaining the development of sports technology through time
Designing and testing equipment

Maths

Interrogate graphs, charts and tables
Plan mathematical investigations
Provide mathematical evidence
Use maths to inform design
Use mathematical models to make predictions

How will *Games* support the wider curriculum?

Over the course of the STEM *Games* topic pupils engage with the curriculum at a number of levels. They will:

- reinforce their subject understanding through engaging with concepts, processes and content for science, mathematics and design & technology
- develop their personal, learning and thinking skills by working collaboratively on a project of their choice
- explore the wider curriculum dimensions of healthy lifestyles and community participation
- develop aspects of their personal, social and health education
- develop a better understanding of their own and others' needs.

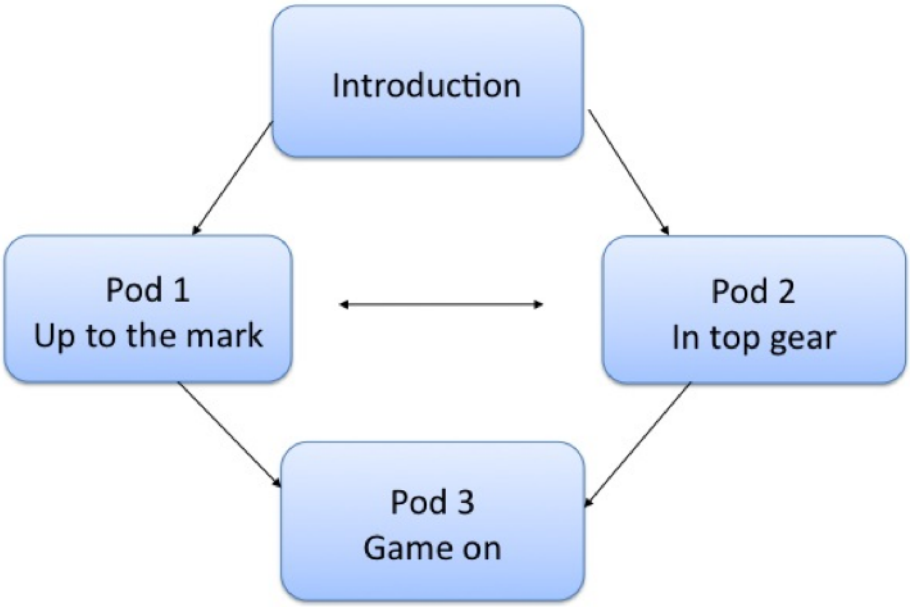
What are 'pods'?

The STEM *Games* resource is composed of 'pods'. A pod is a series of lessons organised around a particular theme or concept. Typically a pod contains an overview, teacher notes, pupil task and a pupil presentation. The activities in each pod are ideally conducted in order, to scaffold the concept development.

An introduction opens the topic with an activity that emphasises teamwork and introduces the *Games* learning log. Pods 1 and 2 are enabling pods which prepare pupils to undertake the final task (pod 3). The enabling pods start with teacher-led activities and end with a summative project task. In pod 3, pupils use their knowledge, skills and understanding to carry out an open project of their choice. Each of the enabling pods are balanced and coded according to the main skill areas (see learning skills overview below).

See the pod structure diagram on the next page.

Pod structure



Games: overview

Introduction

The introduction opens with a game that demonstrates the need for careful planning and collaboration. Teams are given feedback by a recorder who helps them understand the dynamics of the team. As a result they construct a standard operating procedure that enables them to improve their performance. They are also introduced to their *Games* learning log which they use to reflect on their learning throughout the project.

Pod 1 Up to the mark

Pupils carry out an investigation into some simple sporting techniques to establish whether practice works. They conduct research into particular sportspeople to draw up a training schedule for a week. Pupils use the example of target games to investigate whether scoring systems fairly reward skill. They then question whether points awarded in league competitions affect the tactics of games. Pupils finish by conducting a short, independent enquiry where they design a new scoring system for a familiar game.

Pod 2 In top gear

Pupils use data to investigate how changes in technology have led to improved performance in cycling. They research footwear to see how materials of different properties can be combined for specific purposes. They carry out an investigation of a bat and ball system to describe the optimum specification for equipment. Pupils then change the nature of a chosen game using attributes analysis to vary specific elements of the game. They finish the pod by conducting a small practical investigation to test or improve a piece of equipment.

Pod 3 Game on

Pupils use the learning skills they have acquired in earlier pods to carry out a piece of project work, inventing a new game. They need to have built up the necessary knowledge and skills to design and test equipment, and to develop a set of rules with a fair scoring system.

How many pods should I do?

There is a variety of delivery models for this topic. Pupils should engage with the introductory pod to gain the necessary knowledge for later pods. Each of the enabling pods (1 and 2) exemplifies one aspect of games. In any enactment of *Games*, pupils should have the opportunity to carry out their own project in pod 3.

We recommend that the shortest enactment should take about 10 hours and include:

1. introduction
2. an enabling pod
3. the project pod.

The full enactment, including all the pods, should take roughly 16 hours.

Learning skills for STEM

Games challenges pupils to conduct their own project work. For pupils to carry this out effectively and tackle complex problems, they need to develop specific learning and enquiry skills. These skills are explicitly developed within the programme. In particular they help pupils to:

- plan and organise their own learning
- formulate their own questions or design briefs
- discuss and plan collaborative work
- analyse and represent data
- develop frameworks for thinking about any topic
- record and evaluate their learning journey
- present and explain their ideas.

These learning skills are developed in context. They are coded using five categories:

I Information retrieval
C Communication
T Teamwork
M Modelling
P Planning

See the pod overviews on the next pages.

The Learning Journey: *Games* learning log

As pupils work through the pods they widen their knowledge, skills and understanding.

It is important to provide plenty of opportunities for pupils to reflect on their learning.

Pupils should be issued with a *Games* learning log at the start of each pod. This is used to reflect during learning, and to review progress at the end of each summative task.

Pod overviews

Introduction

I = Information retrieval
T = Teamwork
P = Planning
C = Communication
M = Modelling

Lesson	Activity	Learning outcomes	Learning skills	Code
1 Teamwork	**1.1** Airball challenge **1.2** Agreeing a standard operating procedure	Improve performance in a task through improved communication and cooperation. Develop a standard operating procedure.	Reflect on learning.	P, C

Pod 1 Up to the mark

I = Information retrieval
T = Teamwork
P = Planning
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M = Modelling

Lesson	Activity	Learning outcomes	Learning skills	Code
1 Practice makes perfect	**1.1** Does practice improve performance? **1.2** Presenting findings	Demonstrate that practice can improve performance. Refine ideas based on feedback. Use data to answer a question.	Plan a simple scientific investigation. Use graphics to present scientific evidence to an audience.	T, P C
2 Training camp	**2.1** Successful internet searching **2.2** Designing a training programme	Construct a training schedule for a particular sport of pupils' choice. Explain why each element of the schedule is needed.	Refine internet searching using 'phrases'.	I, C
3 Targets	**3.1** Target games **3.2** Designing a scoring system for a target game	Comment on the scoring systems of 'target' games. Adjust a standard target to produce a fairer level of skill. Develop a fair scoring system for a target. Develop an understanding of fairness.	Design and use a data collection sheet.	I, P, T
4 League tables	**4.1** How do points affect Formula 1 championship positions? **4.2** Premier league positions	Use a spreadsheet to make calculations on a league system. Calculate how different points systems might affect playing strategies.	Use spreadsheets to model a situation. Extract data from charts, tables and lists. Interpret and discuss numerical information.	I, C, M I I
5 What's the score?	**5.1** Designing a new game **5.2** Presenting the game	Design a new scoring system for a familiar game.	Make and present a poster about your new game.	P, C, I, T

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 **1.2** The hour record **1.3** Bikes of the future	Describe some of the improvements in bicycle technology over time. Explain why the rules of competition must change with new technologies.	Use images to construct a timeline. Draw and interpret a line graph. Make an annotated diagram.	I, C, T I, C I, C
2 On the run	**2.1** Get a grip! **2.2** Fit for purpose	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.	Design a poster.	P, I, C
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 **4.2** Promoting your game	Use an attributes analysis table. Design a new version of a game for a particular set of participants. Explain how any changes have affected the game.	Use attributes analysis. Produce a storyboard for a video.	P, I P, I, C, T
5 The right kit	**5.1** Testing the kit **5.2** Making a scientific research poster	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. Construct a table for collecting data. Draw line graphs and bar charts. Design a scientific research poster.	P, C I, T M C

Pod 3 Game on

I = Information retrieval C = Communication
T = Teamwork M = Modelling
P = Planning

Lesson	Activity	Learning outcomes	Learning skills	Code
Lessons 1–5	**1** What makes a great game? **2** Choosing the game **3** The game plan **4** Carrying out the project **5** Assessing the game **6** Talking a good game **7** Well played	Use an understanding of STEM to design a new game.	Agree criteria. Construct an attributes analysis chart. Use a chart to plan a project. Giving constructive feedback. Evaluate a presentation. Give a presentation. Reflect on learning.	C, T P, C, I, T P, T P, C, I, T I, C C I, C, T