Welcome to the Second FMSP Enrichment Pack

The FMSP is committed to providing opportunities for Key Stage 4 students to extend and enrich their understanding of mathematics. We run a number of enrichment days at universities and other educational establishments for Key Stage 4 students across the country as well as working in schools with smaller groups. Our aim is to encourage students to consider Mathematics and Further Mathematics at A level.

This pack contains materials to help you to provide an enriching experience for your students in your classroom. The FMSP has, over the years, produced a wide variety of materials for Key Stage 4 students. The accompanying pen drive contains a selection of our enrichment, extension and problem solving materials. We hope that you will enjoy using these materials and investigate all of the resources available on our website www.furthermaths.org.uk.

Contents

Enrichment Lesson Materials

These are three stand-alone lessons (each about an hour long) which require only pre-GCSE knowledge to access. They are fully resourced with a presentation, teacher notes, workbooks which can be produced for the students and other resource sheets as needed. The topics are varied and it is envisaged that these lessons could be used as an enrichment session either within the normal school timetable, or on activity/enrichment days.

Each presentation begins and ends with slides encouraging students to think about taking Mathematics and/or Further Mathematics at A level and one set of these could be shared with the students to start discussion of the usefulness of Mathematics.

Doves and Hawks

This session introduces Game Theory in a practical way.

Students look at a game show to decide how to play and are introduced to the idea of a pay-off matrix to aid decision making.

This method of working is applied to a situation in nature when looking at interactions between different species. Students use their understanding of the previous task to predict what would happen and then take on the roles to see whether this matches their experience.

Students are introduced to ‘The Prisoner Dilemma’ and asked to apply mathematical reasoning to this problem.

Fractals

This reasonably new area of mathematics is introduced with different examples of fractals in nature and geometry. A link to the internet allows students to see the creation of and movement through fractal imagery.

The hands-on session allows students to create their own Sierpinski Triangle before finding examples of this triangle in maths with which they are probably familiar.

Students look at the Koch snowflake and discover that a shape with an infinite perimeter encloses a finite area before creating a dragon fractal.

Current varied uses of fractals from modelling systems such as earthquake prediction to mobile phone technology are shared to explain why this beautiful branch of mathematics is not just fun to look at!

Josephus Flavius

The students begin this session being wowed with the teacher's ability to read minds…

This session examines the decimal number system before moving to look at the binary number system (and the 'trick' of the mind reading is revealed). They have the opportunity to do some binary calculations before looking at how Josephus Flavius used his knowledge of the binary number system to stay alive.

Students will have the opportunity to identify and use number patterns as well as being exposed to the traditional binary mathematical joke.

Extension Materials

These are aimed at students who are working towards GCSE Mathematics and would benefit from exposure to mathematics beyond the GCSE specifications.

They are linked to topics students could expect to meet in their first year at University in a mathematics degree and are designed to demonstrate to students that this is a reasonable option for them to consider.

All tasks consist of a set of worksheets with tasks and detailed solutions.

Different topics are available on our website:
www.furthermaths.org.uk/maths-preparation

Algorithms

This session introduces the idea of an algorithm using Zeller's Algorithm which allows you to work out the day of the week of any date and the Russian peasant's Algorithm for multiplying two numbers.

The standard flow chart symbols are shared and students use a flowchart to determine that it finds the mean of a set of numbers before designing their own.

Students should be aware of calculating the arithmetic mean and use of the quadratic formula to solve quadratic functions before this activity.

Geometric Distribution

This session starts with the familiar situation of rolling dice and calculating probabilities before extending this to look at the chances of rolling a double.

Students are introduced to the idea of a Geometric Distribution and use this to calculate probabilities for darts and weather forecasting.

Students should be aware of probability and indices before this activity.

Kinematics

This is a new area to GCSE and these worksheets introduce students to the motion of an object.

Modelling assumptions are explained and students are supported through considering different situations, including the movement of car, a book falling and playing catch.

The *suvat* equations are introduced and students use these to solve problems.

Students should be comfortable with substituting into and solving equations before this activity.

Modular Arithmetic

This short activity introduces students to the idea of modulo arithmetic, using shapes to support the concept. It is further developed in tasks on the website.

Properties of Prime Numbers

This set of worksheets looks at the history of prime numbers and the search for patterns and formulae as well as their modern usage in Public Key Encryption.

Eratosthenes sieve is used as a filter for primes before Euler's function and Mersenne Primes and perfect numbers are introduced.

Students are supported in developing the concept of proof by proving that there are infinitely many primes.

Increasing Girls' Participation

Making Decisions Using Mathematics

This consists of a presentation and a teacher guide.

There is an extended activity that requires some careful preparation. It is described in detail in the teachers' guide.

Skills required: an understanding of probability including tree diagrams; the ability to understand the idea of *expectation*.

Maths Feast

The Year 10 Maths Feast is an enjoyable and challenging team competition testing mathematical, team-working and communication skills. Each year the format of the competition changes slightly so that the rounds remain interesting and exciting.

The materials in this pack are from the Practice Materials produced to give some insight into the structure of the rounds, but not the content itself. These can be used to prepare students for the competition or in mathematics classes to enrich and extend students' learning.

All solutions are provided for these materials. Also included is the teacher's booklet with instructions and a presentation which could be used to explain the rounds.

This year, we are offering schools the opportunity to run an internal Maths Feast using the actual competition materials in your school. It may be possible for us to provide materials and, if you are looking to do this for 30 or more students, someone to lead the competition. Please see our website www.furthermaths.org.uk/maths-feast for details.

Comprehension Round

This comprehension round gives students a poster on polyhedra, nets and Schlegal diagrams and a series of questions based on this information. No previous knowledge of this topic is assumed.

Countdown-style Round

This round is split into four and could be run in between rounds or put together. It is based on the 'Countdown' show.

Practical Round

This practical round is an investigation in tetrominoes. Students are given four specific tasks to complete involving the set of different pentominoes. Multilink cubes will support students in these activities.

Relay Round

This ‘relay style’ round has bursts of four questions to be answered as two pairs. Each of questions 2, 3 and 4 rely on previous answers and extra points are awarded if all four questions are answered correctly.

True or False Round

This round has six questions to answer, based on the information given in the question.

Problem Solving Materials

The FMSP has a commitment to providing materials and training to help schools improve their students' problem solving skills. Included in this pack are four series of problem solving materials.

More Problems…

This booklet has been put together to accompany the Maths Feast materials and contains problems suitable for the GCSE classroom as well as links to other websites, all of which have a problem solving focus. Solutions can be found at www.furthermaths.org.uk.

Problems for the classroom

This set of nine problems is linked to specific GCSE topics and could be used as an introduction, a review or as problem solving experience through the areas covered. Solutions are included in the booklet.

Problems on Postcards

This set of six postcards is based on the popular 'My Favourite Problem' series of posters. Solutions are available at: www.furthermaths.org.uk/favourite.

Problems on Business Cards

This set of six business cards asks real-life questions fir GCSE students to answer. Solutions can be found at www.furthermaths.org.uk/prob_solv_materials.

Why Study Maths?

The FMSP works to encourage students to study Mathematics and Further Mathematics at A level. This pack contains a Powerpoint presentation and an accompanying leaflet that can be used at parents and student open evenings.

The presentation has detailed notes at the bottom of key slides. Some slides may be omitted depending on the audience.