Provide Motivation Through Exciting Materials in Mathematics and Science

Unit Descriptors

GB

Lifelong Learning Programme

PROVIDE MOTIVATION THROUGH EXCITING MATERIALS IN MATHEMATICS AND SCIENCE

Unit Descriptors

English version

PROMOTE MSc

2014

2nd edition

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This work is available on the project web page:

http://www.msc4all-project.eu/

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FOREWORD to 1st edition

Project PROMOTE MSc – Provide Motivation Through Exciting Materials in Mathematics and Science is a project under the COMENIUS 2.1 programme of the European Commission.

The aim of this project is to address the problem of the shortage of young people attracted to study and enter teacher training in the mathematical and scientific subjects of the school curriculum. We want to produce and gather materials in a European collaboration which intends to motivate students and teachers to be more interested in learning mathematics and science. Materials produced will be used by lecturers with their students at training institutions and by students on practice in schools. The material will be evaluated and disseminated through the established European network.

This booklet contains all the unit descriptors for the materials collected by the project. A unit descriptor briefly lists the unit title, aims, content and includes brief notes on resources and other matters so a teacher can decide on use of the unit.

Project Team

The project participants are teacher training institutions in four European Countries: The University of Sunderland (United Kingdom), the University of Vienna (Austria), the Palacky University Olomouc (Czech Republic), and the Constantine the Philosopher University Nitra (Slovakia).

Andreas Ulovec (AT)
Coordinator

Partners: Soňa Čeretková (SK)
Neil Hutton (UK)
Josef Molnár (CZ)

FOREWORD to 2nd edition

After almost 10 years, it was time to revisit the materials, to use the numerous feedbacks that we received from teachers, and to improve the materials. For this reason we planned the project "MSc4All – Motivating Methods and Materials in Maths and Science: Dissemination" in the framework of the Lifelong Learning Programme, which allowed the project team to collect suggestions for improvements and put them into practice, as well as to produce and disseminate a second edition of the project materials. By this, we hope to come even closer to our original goal to increase the motivation to learn mathematics and science. The second editions of the project materials can be found at the webpage of the project:

http://www.msc4all-project.eu/

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MATHEMATICS

Arithmetic

Unit Title	**Mathematical investigation 3** **(Indian multiplication)**
Topic	Algebra
Name and email address of person submitting unit	Soňa Čeretková sceretkova@ukf.sk
Aims of unit	Intorducig historical system of natural numbers multiplication.
Indicative Content	4 lessons Simple algorithm of natural numbers multiplication offers many variations of investigation problems depending on level of mathematical pupils' knowledge.
Resources needed	
Teachers notes	

Unit Title	**Mathematical games and puzzles**
Topic	Algebra
Name and email address of person submitting unit	Soňa Čeretková sceretkova@ukf.sk
Aims of unit	Simple arithmetics games and puzzles based on decimal or non decimal number systems properties and properties on divisibility.
Indicative Content	4 lessons Some of the games and puzzles are very surprising; it is a big motivation for students to discover the maths formula the game or puzzle is based on.
Resources needed	
Teachers notes	

Unit title	**Mathematical Puzzle (i)**
Topic	Arithmetic
Name and email address of person submitting unit	Ruth Wainman Wainman.R@st-hilds.hartlepool.sch.uk
Aims of Unit	To develop pupils' problem solving strategies Indicative Content
Indicative content	Pupils will be presented with mathematical puzzles to solve.
Resources needed	Resource sheets Available from web site.
Teachers notes	Ideal starter or plenary activities 10 minutes

Unit title	**Mathematical Puzzle (ii)**
Topic	Number Puzzle
Name and email address of person submitting unit	Ruth Wainman Wainman.R@st-hilds.hartlepool.sch.uk
Aims of Unit	To rehearse number operations and use of brackets.
Indicative content	Laws of arithmetic
Resources needed	Resource sheet Available on Web Site
Teachers notes	An ideal starter or plenary activity 10 minutes.

Unit title	**Starter Activities to Lessons**
Topic	Arithmetic/algebra
Name and email address of person submitting unit	Ruth Wainman Wainman.R@st-hilds.hartlepool.sch.uk
Aims of Unit	Interactive starter activities to lessons for pupils aged 13–16 designed to develop mental mathematics.
Indicative content	Number operations, negative numbers and algebraic substitution.
Resources needed	Printed cards to be distributed to pupils Teachers notes
Teachers notes	The cards should be distributed to students and one student should be invited to read out his/her card. The student who has the answer to this card should then continue to read out 'who they are'. The activity can easily be adapted for other topic areas in number and algebra.

Unit title	**Max Box**
Topic	Investigation to find the maximum volume of a cuboid.
Name and email address of person submitting unit	Norman Smith Norman904@aol.com
Aims of Unit	To find the maximum volume of an open box given a square or rectangular piece of card.
Indicative content	Given a square piece of card – what is the maximum volume of an open box that can be formed by cutting squares from each corner? What if the card was a rectangle rather than a square?
Resources needed	Squared paper, rulers, pencils. Access to a computer spreadsheet may be appropriate for some students.
Teachers notes	The following questions that can be posed to students. Is the length of the square cut from each corner related to the length of the side of the original square? What happens with a rectangular piece of card? Results may be presented graphically and compared to the result found using calculus. All Pupils should be able to calculate volume and describe the concept of cubed. Most Pupils will be able to cut and fold card to produce a shape. Some pupils will be able to predict the consequences of creating a rectangle or other shapes and justify their predictions verbally.

Unit Title	**Just a fraction more**
Topic	Arithmetic
Name and email address of person submitting unit	Andreas Ulovec Andreas.Ulovec@univie.ac.at
Aims of unit	To make students familiar with the notion of fractions and allow them to be able to compare and operate with fractions.
Indicative Content	Game with fractions.
Resources needed	None.
Teachers notes	None.

Algebra

Unit Title	**Time in word problems**
Topic	Algebra
Name and email address of person submitting unit	Peter Michalička contact: sceretkova@ukf.sk
Aims of unit	Practicing the solution skills of mathematics problems with context “time”.
Indicative Content	5 lessons Age of students: 15+
Resources needed	Prepared by author.
Teachers notes	Introduced in author´s resources.

Unit Title	**Complex numbers – geometry context**
Topic	Algebra
Name and email address of person submitting unit	Dušan Vallo dvallo@ukf.sk
Aims of unit	Practising graphical interpretation of arithmetical operations from geometrical point of view, using interpretations in proof problems with interactive geometrical software.
Indicative Content	4 lessons Geometrical interpretation of complex numbers and their arithmetic gives a better understandig of their properties. Interactive geometrical software helps to enhance motivation.
Resources needed	Interactive geometrical software, GeoGebra.
Teachers notes	

Unit title	**Connect 4**
Topic	Number Investigation
Name and email address of person submitting unit	Norman Smith Norman904@aol.com
Aims of Unit	To encourage students to find relationships between Numbers and to generalise and justify their results.
Indicative content	Indicative Content Using a 7×7 grid, students will explore the connection between the size of the grid and the number of possible vertical, horizontal and diagonal 'connect 4s'.
Resources needed	A large sheet of squared paper which contains a 7×7 grid. Coloured pens or pencils are not essential but would help.
Teachers notes	The initial problem is given as the starting point for investigation. The problem can then be extended by examining: · larger square grids · rectangular grids · connecting other numbers Learning outcomes for this activity All pupils should be able to follow these simple instructions and fill out tally table to record their results. Most pupils will follow these instructions with little help, design their own tally table and record their results. Some pupils will carry out this experiment and the suggest an appropriate number for a 9×9 grid with an explanation

Unit title	**Consecutive Numbers**
Topic	Number Investigation
Name and email address of person submitting unit	Norman Smith Norman904@aol.com
Aims of Unit	To encourage students to examine and prove a relationship between consecutive numbers.
Indicative content	Take three consecutive numbers – square the middle term and multiply the first and last together and compare. Extend to five consecutive numbers …. *n* consecutive numbers.
Resources needed	Calculators available
Teachers notes	The expectation is that students would prove the results found.

Unit title	**Painted Cube**
Topic	An investigation involving shape and space and algebraic generalisation.
Name and email address of person submitting unit	Norman Smith Norman904@aol.com
Aims of Unit	To encourage students to identify patterns and to generalise and justify their findings.
Indicative content	A cube with sides of 4 cm is made up of smaller cubes with sides of 1 cm. The $4 \times 4 \times 4$ cube is dipped into a paint tin and covered in red paint. How many of the smaller cubes have: 3 faces painted red? 2 faces painted red? 1 face painted red? 0 faces painted red?
Resources needed	Calculators Cube made up of 64 sub cubes, tin of paint.
Teachers notes	What happens if we consider a cube with side n cm? The expectation is that pupils will generalise and justify their findings. Learning outcomes for this activity All Pupils should be able to carry out this experiment and produce results which can be recorded. Most Pupils will be able to design a table and record these results. Some pupils will be able to predict the consequences of creating a larger cube and justify their conclusions.

Unit title	**Sequences and Limits**
Topic	Formula Iteration
Name and email address of person submitting unit	Christine.Farnsworth@sunderland.ac.uk
Aims of Unit	To examine the behaviour of number sequences formed using an iteractive procedure and to generalise and justify the results obtained.
Indicative content	Using either a calculator, spreadsheet or LOGO software, students will examine the behaviour of a flow chart sequence i.e. input 1 $\rightarrow$ divide by 2 $\rightarrow$ subtract 3 $\rightarrow$write down the next term in the sequence $\rightarrow$ return to divide by 2 … Students will then examine the effect of changing numbers within the flowchart sequence.
Resources needed	Calculators/computer software (spreadsheets or LOGO)
Teachers notes	Students will be encouraged to prove the results found.

Unit title	**Quadratic Functions**
Topic	Algebra
Name and email address of person submitting unit	Christine.Farnsworth@sunderland.ac.uk
Aims of Unit	Students will explore connections between quadratic functions and corresponding graphs using a graphic calculator.
Indicative content	Transformations of quadratic graphs. Students will investigate graphs of the form $y = kx^2$, $y = x^2 + q$, $y = (x+p)^2$ and consider how they are related to the graph $y= x^2$
Resources needed	Graphic Calculators
Teachers notes	The use of a graphic calculator allows students to easily explore the relationship between parabolic graphs and their equations.

Unit Title	**Recursive sequences and series**
Topic	Sequences and series
Name and email address of person submitting unit	Andreas Ulovec Andreas.Ulovec@univie.ac.at
Aims of unit	Using CAS for demonstrating recursion
Indicative Content	Recursive functions, sequences and series
Resources needed	Computer with wxMaxima
Teachers notes	

Unit Title	**The smarter, the faster!**
Topic	Vectors
Name and email address of person submitting unit	Silke Fürweger fuersilke@yahoo.de
Aims of unit	The unit describes a “trivial pursuit”-like game to enable students to become familiar with addition, subtraction and multiplication of vectors
Indicative Content	Algebra
Resources needed	None.
Teachers notes	None.

Geometry

Unit title	**Estimation of π**
Topic	Shape and Space
Name and email address of person submitting unit	Christine.Farnsworth@sunderland.ac.uk
Aims of Unit	To consider a historical approach to the estimation of pi using Archimedes' Method.
Indicative content	Students will find the perimeter of an inscribed regular hexagon ($3d$ where d is the diameter of the circle) and the perimeter of a circumscribed regular hexagon ($2\sqrt{3}d$). Using a spreadsheet they will then extend the activity to investigate perimeters of polygons with 12, 24, 48, 96, …..n sides and so obtain an estimation of the circumference of the circle and π.
Resources needed	Paper, pencils, protractors, compasses, computer spreadsheet.
Teachers notes	Students should have pre-requisite knowledge of trigonometrically relationships in right-angled triangles. Materials on web site

Unit Title	**Proofs with Dynamic Geometry Software**
Topic	Geometry
Name and email address of person submitting unit	Franz Ableidinger shaggae@gmx.net
Aims of unit	Actually several units showing geometrical proofs of Pythagoras theorem, Hippocrates' moons, Thales theorem, and the binomial equation.
Indicative Content	Geometry in the plane
Resources needed	Computer with Dynamic Geometry Software.
Teachers notes	

Unit Title	**Materials for vectors**
Topic	Geometry
Name and email address of person submitting unit	Silke Fürweger fuersilke@yahoo.de
Aims of unit	Unit consists of 11 learning stations that can be used either in several particular sequences, or as single units: "From numbers to vectors", "calculations with vectors", "geometric interpretation of vectors", "vector from beginning to end", "geometric interpretation of addition", "geometric interpretation of multiplication", "length of an arrow ", "normal vectors", "dictate figures", "sinking ships", "find the fastest way".
Indicative Content	Geometry in the plane
Resources needed	
Teachers notes	

Unit Title	**Treasure hunt**
Topic	Geometry
Name and email address of person submitting unit	Andreas Ulovec Andreas.Ulovec@univie.ac.at
Aims of unit	Using software for motivational teaching of the concept of vectors in the plane.
Indicative Content	Geometry in the plane
Resources needed	Computer with Java Runtime Environment.
Teachers notes	

Unit Title	**Mathematics in the gym hall**
Topic	Geometry
Name and email address of person submitting unit	Monika Navratil monika_navratil@hotmail.com
Aims of unit	Students using their bodies to demonstrate the special points of the triangle.
Indicative Content	Geometry in the plane.
Resources needed	Gym hall or gym grounds.
Teachers notes	

Unit Title	**Circumcircle center, incircle center, barycentre**
Topic	Geometry
Name and email address of person submitting unit	Andreas Ulovec Andreas.Ulovec@univie.ac.at
Aims of unit	Using CAS for simplifying calculation of special points in the triangle
Indicative Content	Analytic geometry
Resources needed	Computer with wxMaxima
Teachers notes	

Unit Title	**Construction of Conic Sections**
Topic	Geometry
Name and email address of person submitting unit	Andreas Ulovec Andreas.Ulovec@univie.ac.at
Aims of unit	Using Dynamic Geometry Software for demonstrating the construction of ellipses, hyperbolae and parabolas.
Indicative Content	Geometry in the plane
Resources needed	Computer with GeoGebra
Teachers notes	

Unit Title	**Move it! Dynamic Geometry Software in optics (1)**
Topic	Geometry
Name and email address of person submitting unit	Andreas Ulovec Andreas.Ulovec@univie.ac.at
Aims of unit	Using dynamic geometry software for showing the refraction of light in a drop of water
Indicative Content	Optics, functions, trigonometry
Resources needed	Computer with GeoGebra
Teachers notes	

Unit Title	**Problems of roofs**
Topic	Geometry
Name and e-mail address of person submitting unit	Josef Molnár, Jana Stránská, Diana Šteflová josef.molnar@upol.cz
Aim of unit	Developing of space imagination, application of knowledge math in technical practice.
Indicative Content	5 Lessons 1.Lesson: General knowledge, types of the roofs 2. Lesson: Rectangular projection, first steps 3. Lesson: Methods of solution 4. Lesson: Forbidden eaves 5. Lesson: Yards and complicated exercises. Age of students: 15+
Resources needed	Textbooks, drawing tools (ruler, compass, protractor),
Teachers notes	Only Czech language.

Unit Title	A **Guidebook of three-dimensional Space**
Topic	Geometry
Name and email address of person submitting unit	Tomáš Fürst, tomas.furst@upol.cz Josef Molnár, josef.molnar@upol.cz Karel Pohaněl, pohanel@gytool.cz
Aims of unit	To make connections between analytical geometry, vector analysis, attitudes to construction and physics.
Indicative Content	Textbook (175 pages). Contents: Introduction, Vectors, Basic Objects and Space, Relations Among Basic Objects, Solids, Volume and Surface.
Resources needed	Fürst, T. a kol: A Guidebook of three-dimensional Space, UP, Olomouc, 2005.
Teachers notes	

Unit Title	**Geometry in Chemistry**
Topic	Geometry
Name and email address of person submitting unit	Adriana Demová contact: sceretkova@ukf.sk
Aims of unit	Applications of isomorphic mappings in chemistry.
Indicative Content	2 lessons Age of students: 18
Resources needed	
Teachers notes	• Cooperative learning, • using chemical literature or supporting materials prepared by teacher, • application of isomorphic mappings, • composition of mappings – Calye table, • demonstration of composition of mappings using a model of the water molecule.

Unit Title	**Geometry in Physics – Spherical trigonometry in astronomy**
Topic	Geometry
Name and email address of person submitting unit	Adriana Demová contact: sceretkova@ukf.sk
Aims of unit	Applications of spherical geometry.
Indicative Content	2 lessons Age of students: 18
Resources needed	
Teachers notes	

Unit Title	**Geometry in Biology – The World of Unusual Forms**
Topic	Geometry
Name and email address of person submitting unit	Adriana Demová contact: sceretkova@ukf.sk
Aims of unit	Discovering the geometrical world around us.
Indicative Content	2 lessons Age of students: 16
Resources needed	
Teachers notes	Geometrical figures and solids, disussion about topic, discovering and describing geometrical shapes and forms in nature.

Unit Title	**Geometry in Physics – Geography** **Geometry of the surface of a sphere**
Topic	Geometry
Name and email address of person submitting unit	Adriana Demová contact: sceretkova@ukf.sk
Aims of unit	Introducing the geometry of the surface of a sphere
Indicative Content	1 lessons Age of students: 17
Resources needed	Geographical maps.
Teachers notes	• Enhancing student´s ability to indicate geographical coordinates, • introducing spherical coordinates and spherical geometry.

Unit Title	**Metric space**
Topic	Geometry
Name and email address of person submitting unit	Mária Kmeťová mkmetova@ukf.sk
Aims of unit	Introducing metric space as an alternative to Euclidean space.
Indicative Content	3 lessons Geometry on square paper, coordinate system in plane, measurement of perimeter and square of simple geometrical figures. Experimental and investigative activities.
Resources needed	
Teachers notes	Teachers' role is introducing open problems leading to investigation and to construction of new type of knowledge.

Unit Title	**Points and vectors**
Topic	Geometry
Name and email address of person submitting unit	Mária Kmeťová mkmetova@ukf.sk
Aims of unit	Clarification of differences between ordered pairs of real numbers and vectors.
Indicative Content	4 lessons Cartesian coordinate system in plane, ordered pairs of real numbers, geometrical transformations, translation. Experimental and investigative activities.
Resources needed	Text prepared by author.
Teachers notes	Teachers' role is introducing open problems leading to investigation and to construction of new type of knowledge.

Unit Title	**Optic properties of conic sections**
Topic	Geometry
Name and email address of person submitting unit	Dušan Vallo dvallo@ukf.sk
Aims of unit	Broaden students' knowledge about conic sections. Introducing parametrical expressions of conic sections. Modelling situations using dynamical geometrical software Cabri Geometry II. Content includes: origin of term "conic section", points of construction in Cabri, some optic properties of conic sections, solving non-standard problems.
Indicative Content	8 lessons Discussion about different interoperations of conic sections. Create image of types of conic sections and their origin (circle, ellipse, hyperbola, parabola), construction of conic sections in Cabri, describing conic sections properties, discovering optic properties of conic sections, solving non standard problems of the topic.
Resources needed	Cabri Geometry II, Applets in Cabri Geometry II.
Teachers notes	

Unit Title	**Mathematical investigation 1 - Geoboard**
Topic	Geometry
Name and email address of person submitting unit	Soňa Čeretková sceretkova@ukf.sk
Aims of unit	To introduce non traditional geometry on the geoboard and using square paper.
Indicative Content	3 lessons Investigations on geoboard give new views of plane geometry shapes, their properties and measures. Solving simple problems allow students to discover new aspects of the planar world on the geoboard.
Resources needed	Geoboard, rubber bands, square paper, pencil.
Teachers notes	

Unit Title	**Mathematical investigation 2 - POLYDRON©**
Topic	Geometry
Name and email address of person submitting unit	Soňa Čeretková sceretkova@ukf.sk
Aims of unit	Investigation geometrical solids properties.
Indicative Content	3 lessons POLYDRON© allows easy and quick construction of different geometrical solids. Mathematical investigative problems are solved and the results illustrate important properties of solids, which are new for pupils.
Resources needed	POLYDRON© set.
Teachers notes	

Unit Title	**Geometry in my town**
Topic	Geometry
Name and email address of person submitting unit	Kitti Vidermanová kvidermanova@ukf.sk
Aims of unit	Finding geometry in your town, school, house,…
Indicative Content	4 lessons Students are asked to write a project or report which maps geometrical shapes on different parts of their surroundings.
Resources needed	PC, camera, data projector; leaflet of ICMI 10 Congress: Copenhagen the mathematics capital 2004; sources prepared by author.
Teachers notes	

Unit Title	**Be an architect!**
Topic	Geometry
Name and e-mail address of person submitting unit	Dana Pauková, Paukova@gytool.cz
Aim of unit	Repeating, extending and interconnecting knowledge in solid geometry. Cultivation key competences as cooperation, communication, flexibility, etc.
Indicative Content	6 lessons Age of students: 16+ The groups of students create their own architectonic complex.
Resources needed	Drawing tools (ruler, compass, protractor), drawing paper A4 and A3, scissors, glue, pictures of different architectures, photographs or pictures of architectural complexes (postcards or pictures from books).
Teachers notes	

Unit Title	**Exercises for promoting space imagination**
Topic	Geometry
Name and email address of person submitting unit	Josef Molnár josef.molnar@upol.cz
Aims of unit	To promote space imagination in solid geometry using exercises set at different levels.
Indicative Content	Space geometry, promoting space imagination.
Resources needed	Wire, models of solids.
Teachers notes	

Probability and Statistics

Unit Title	**My foot and statistics**
Topic	Probability and statistics
Name and email address of person submitting unit	Pavla Žufníčková, olifa@seznam.cz Josef Molnár, josef.molnar@upol.cz
Aims of unit	To show some useful terms of statistics (normal distribution, Gaussian curve, …) and practice using statistics. To work with errors of measurement, to promote cooperation and responsible work in the class, to develop work with text, to develop creativity, and to inform students about the condition of their feet.
Indicative Content	3 lessons To make a footprint (plantogram) on a piece of paper, to find a condition of the arch, to do some other measurements of foot and use it for comparison to Anthropometric tables.
Resources needed	Textbooks used at primary school, papers, pencils, computers.
Teachers notes	

Unit Title	**The estimation of probability or "is the game fair"?**
Topic	Probability
Name and email address of person submitting unit	Monika Žilková contact: sceretkova@ukf.sk
Aims of unit	This unit deals with propositions of introducing and teaching the elements of probability theory in the primary education of mathematics using stochastic games. These games are based on the estimation of chance or risk we have to undergo when participating in the game. We have to decide about the fairness of the game and choose the best strategy.
Indicative Content	2 lessons Age of students: 15+
Resources needed	1. Plocki, A.: Stochastyka 2. Rachunek prawdo-podobieństwa i statystyka matematyczna. Zarys dydaktyki, Wydawnictwo Naukowe WSP Kraków 1997, ISBN 83-87513-08-3 2. Nawolska, B.: Gra strategiczno-losowa na lekcji matematyki jako model procesu decyzyjnego. Zborník príspevkov konferencie Autentické vyučovanie a využitie medzipredmetových vzťahov vo vyučovaní matematiky, PF UMB Banská Bystrica 2000, str.81-85. 3. Nawolska, B. – Plocki, A.: Problemy i paradoksy rachunku prawdopodobieństwa zwiazane z grami Penneya. Gradient quinquagesimus 1, Fundacja rozwoju matematyki polskiej, Warszawa 2000, str.11-23

	4. Penney ,W.F.: Problem 95: Penney-Ante. Journal of recreational Mathematics, 7 (1974)
Teachers notes	It is convenient to repeat the games and to note the results. Empirical data becomes the source of mathematical argument and reflexions „a posteriori“ as well as the instrument for constructing probability space as the mathematical model of the situation. Empirical data can sometimes uncover surprising results and give doubt to our former incorrect intuitions

Unit Title	**Bernoulli sequences and aspect of probability**
Topic	Probability
Name and email address of person submitting unit	Monika Žilková contact: sceretkova@ukf.sk
Aims of unit	This unit is dealing about stochastics problems, and the relationship between Bernoulli sequences and the Lebesgue measurment, the theory of probabilty and of measurement. The Borel principe is used in probability in the computation of certain stochastics situations computation
Indicative Content	3 lessons Age of students: 18+
Resources needed	Adams, M. – Guillemin, V.: Measure Theory and Probability. Boston: Brickhäuser, 1996. ISBN0-8176-3884-9
Teachers notes	Probability theory, measurement theory, sequences, real numbers, binary sequence of number. Needed knowledge: - real numbers and their properties, - infinitive sequences, - binary sequence of real number, - Lebesgue measure of inetrval $\langle a,b\rangle$, $\big($ (a,b), $(a,b\rangle$, $\langle a,b)$ $\big)$ is the lenght of this interval (b-a).

Unit Title	**Simulating samples**
Topic	Probability
Name and email address of person submitting unit	Andreas Ulovec Andreas.Ulovec@univie.ac.at
Aims of unit	Using software for simulating samples in probability.
Indicative Content	Probability.
Resources needed	Computer with Java Runtime Environment.
Teachers notes	

Unit Title	**Normal distribution**
Topic	Probability
Name and email address of person submitting unit	Andreas Ulovec Andreas.Ulovec@univie.ac.at
Aims of unit	Using software for interpreting the graph of normal distribution and calculating probability.
Indicative Content	Probability.
Resources needed	Computer with Java Runtime Environment.
Teachers notes	

Calculus

Unit Title	**Derivation of function**
Topic	Analysis, Calculus
Name and email address of person submitting unit	Marek Varga mvarga@ukf.sk
Aims of unit	To introduce geometrical and physics application of the first derivative of elementary functions.
Indicative Content	3 lessons Non traditional interpretation and illustration of first derivative calculus by solving real world problems.
Resources needed	Text prepared by author.
Teachers notes	

Unit Title	**Excel in Mathematics Education**
Topic	Calculus
Name and email address of person submitting unit	Ján Beňačka jbenacka@ukf.sk
Aims of unit	Students explore basic skills and knowledge of calculus using applications developed by author. Visualization and dynamical approach is dominant in solving problems. Topics: Graphing functions if $D = R$ Graphing functions if $D \neq R$ Maximum and minimum of a function Calculating area, volume and length of curve
Indicative Content	4-8 lessons Age of students: 15 – 19 years
Resources needed	Excel applications developed by author.
Teachers notes	

Unit Title	**Tangents on graphs**
Topic	Calculus
Name and email address of person submitting unit	Andreas Ulovec Andreas.Ulovec@univie.ac.at
Aims of unit	Using Dynamic Geometry Software for interpretation of derivative as gradient of tangent, and tangent as special case of secant.
Indicative Content	Derivative, Tangent, Secant.
Resources needed	Computer with GeoGebra.
Teachers notes	

Unit Title	**Functions in Maths education for real life and suitable warm-up activities**
Topic	Calculus
Name and e-mail address of person submitting unit	Jana Piechová jana.horodyska@post.cz
Aims of unit	To teach Mathematics for real life, to present functions using real problems, and to show some useful and entertaining warm-up activities
Indicative Content	5 lessons Age of students: 15, 16 Linear and quadratic functions.
Resources needed	A paper box, a model of a building and a car, cards with converting of the units, and in addition some textbooks with traditional function problems.
Teachers notes	Some traditional problems are to be added for student practise, and to round off each lesson, or to be set for homework.

History of Mathematics

Unit Title	**Do you want to be a multi-confectioner?**
Topic	History of Mathematics and Physics
Name and e-mail address of person submitting unit	Pavla Žufníčková, olifa@seznam.cz Josef Molnar, josef.molnar@upol.cz
Aim of unit	To display some parts from the history of mathematics and to develop the creativity of students. Students will be able to make up a test.
Indicative Content	2 lessons To prepare an enjoyable contest and to take part in this contest.
Resources needed	Textbooks and other suitable books, box of confections.
Teachers notes	I would like to add that it is not so important to think up a really complicated question. The enjoyment of the work is more important. The students can create the test from the questions mentioned within the contest, and this might be used in the following lessons.

Didactics

Unit Title	**The Land** of **Ciphers**
Topic	Didactics
Name and email address of person submitting unit	Pavla Žufníčková olifa@seznam.cz
Aims of unit	To show a special part of mathematics - the crypto analysis. To develop creativity and to support team-work. Students will try to make a presentation of their results.
Indicative Content	2 lessons To look into the history of ciphers and codes, to create a cipher or a code, and to decipher some easy ones. Finally to organize "the conference".
Resources needed	Ciphers and clues, papers, pencils.
Teachers notes	Creativity is needed.

Unit Title	**The Spy game**
Topic	Didactics
Name and e-mail address of person submitting unit	Pavla Žufníčková olifa@seznam.cz
Aim of unit	To introduce a special part of mathematics - crypto analysis. To develop creativity and to support team-work. This project could be introduced as practice in using arbitrary subject, and to get more accustomed to the school building.
Indicative Content	3-4 lessons To take part in spy game that is prepared by teacher.
Resources needed	Papers, pencils, some ciphers and clues, “treasure”; if you want you can use costumes as decoration.
Teachers notes	This project is very time-consuming, but most students love this activity.

Unit Title	**Amusing mathematics at last!!!!!!!!!!!!!**
Topic	Didactics
Name and email address of person submitting unit	Pavla Žufníčková olifa@seznam.cz
Aims of unit	To repeat some parts of mathematics in an effective way (because teaching is the most effective way of learning). To develop creativity, to make connection between mathematics and art, to use computers and to make materials for teaching other students.
Indicative Content	3 lessons To prepare interesting material for teaching some parts of mathematics at the secondary school. (There are lots of amusing materials for the primary school, but not so many for the secondary school.)
Resources needed	Textbooks used at primary school, papers, pencils, computers.
Teachers notes	This project may be connected with studies in art.

Discrete Mathematics

Unit title	**Graph Theory and the Bridges of Königsberg**.
Topic	Graph Theory
Name and email address of person submitting unit	Christine.Farnsworth@sunderland.ac.uk
Aims of Unit	To explore the conditions for drawing a Eulerian graph and applying the findings to the 'Königsberg bridges problem'.
Indicative content	Eulerian, semi-Eulerian and non-Eulerian graphs.
Resources needed	Paper and pencils.
Teachers notes	This activity introduces historical aspects of mathematics. Euler considered the 'Konigsberg bridges problem' in more generality and published what can be thought of as the first research paper in graph theory.

Unit Title	**Graph theory**
Topic	Discrete mathematics
Name and email address of person submitting unit	Janka Melušová jmelusova@ukf.sk
Aims of unit	Introduction to graph theory.
Indicative Content	5 lessons Knowledge of graph theory is interesting because of its simplicity but strong mathematical results.
Resources needed	Text prepared by author.
Teachers notes	

Functions

Unit Title	**Drawing graphs**
Topic	Functions
Name and email address of person submitting unit	Andreas Ulovec Andreas.Ulovec@univie.ac.at
Aims of unit	Using software for interpreting graphs as a means of description for the interdependence of two variables.
Indicative Content	Functions.
Resources needed	Computer with Java Runtime Environment.
Teachers notes	

Unit Title	**Car race**
Topic	Functions
Name and email address of person submitting unit	Andreas Ulovec Andreas.Ulovec@univie.ac.at
Aims of unit	Using software for interpreting path-time diagrams.
Indicative Content	Functions.
Resources needed	Computer with Java Runtime Environment.
Teachers notes	

SCIENCE

Mechanics

Unit Title	**Kinematics**
Topic	Mechanics
Name and email address of person submitting unit	Ľubomíra Valovičová lvalovicova@ukf.sk
Aim of unit	To develop the physical creativity of students in upper classes of primary school. The laboratory work suplements the curricula.
Indicative Content	2 lessons age od students: 12–13
Resources needed	Simple aids (plastic bottle, student kit for mechanics, weights). Handbook on laboratory work prepared by person submitting unit Computer.
Teachers notes	Developing the student creativity by way of brainstorming.

Unit Title	**Dynamics 1**
Topic	Mechanics
Name and email address of person submitting unit	Ľubomíra Valovičová lvalovicova@ukf.sk
Aim of unit	To develop the physical creativity of students in upper classes of primary school. The laboratory work suplements the curricula.
Indicative Content	2 lessons age od students: 12–13
Resources needed	Simple aids (plastic bottle, student kit for mechanics, weights). Handbook on laboratory work prepared by person submitting unit Computer.
Teachers notes	Developing the student creativity by way of brainstorming.

Unit Title	**Dynamics 2**
Topic	Mechanics
Name and email address of person submitting unit	Ľubomíra Valovičová lvalovicova@ukf.sk
Aim of unit	To develop the physical creativity of students in upper classes of primary school. The laboratory work suplements the curricula.
Indicative Content	2 lessons age od students: 12–13
Resources needed	Simple aids (plastic bottle, student kit for mechanics, weights). Handbook on laboratory work prepared by person submitting unit Computer.
Teachers notes	Developing the student creativity by way of brainstorming.

Unit Title	**Mechanics of fluids and gasses 1**
Topic	Mechanics
Name and email address of person submitting unit	Ľubomíra Valovičová lvalovicova@ukf.sk
Aim of unit	By doing experiments,, the student can more quickly understand and solve problems.
Indicative Content	2 lessons age od students: 12–13
Resources needed	Simple aids (plastic bottle, student kit for mechanics, weights). Aquarium or jar or glass vessel. Handbook on laboratory work prepared by person submitting unit.
Teachers notes	The lesson can run as a competition. Students are asked to suggest good points for each demonstrated experiment. The teacher sums them up and announces the best one. It is convenient to prepare and make the experiments voluntarily, then the teacher may reward the students with sweets. It is good to recommend to students some popular scientific books before the lesson.

Unit Title	**Mechanics of fluids and gasses 2**
Topic	Mechanics
Name and email address of person submitting unit	Ľubomíra Valovičová lvalovicova@ukf.sk
Aim of unit	By doing experiments, the student can more quickly understand and solve problems.
Indicative Content	2 lessons age od students: 12-13
Resources needed	Aquarium or jar or glass vessel. Handbook on laboratory work prepared by person submitting unit.
Teachers notes	The lesson can run as a competition. Students are asked to suggest good points for each demonstrated experiment. The teacher sums them up and announces the best one. It is convenient to prepare and make the experiments voluntarily, then the teacher may reward the students with sweets. It is good to recommend to students some popular scientific books before the lesson.

Unit Title	**Damped oscillations of mechanical oscillator – solution and analysis in Excel**
Topic	Mechanics
Name and email address of person submitting unit	Ján Beňačka jbenacka@ukf.sk
Aim of unit	Differential equations with constant coefficients, the use of Excel in practice, interdisciplinary approach between mathematics, physics and informatics.
Indicative Content	2 lessons Physics: dynamics. Mathematics: differential equations with constant coefficients, calculus. Informatics: interactive graphs and solutions of equations in Excel.
Resources needed	Computer.
Teachers notes	For talented and highly motivated students in special lessons.

Unit Title	**Free fall in air and the analysis of accuracy of measurement g**
Topic	Mechanics
Name and email address of person submitting unit	Ján Beňačka jbenacka@ukf.sk
Aim of unit	Solution of differential equations with separable variables; l´Hospital rule and Excel practice, interdisciplinary approach in mathematics, physics and informatics.
Indicative Content	5 lessons Physics: dynamics, kinematics. Mathematics: differential equations, calculus, l´Hospital rule. Informatics: interactive graphs and solutions of equations in Excel.
Resources needed	Computer. Data projector.
Teachers notes	For talented and highly motivated students in special lessons.

Unit Title	**Verification of validity of Bernoulli equation**
Topic	Mechanics
Name and email address of person submitting unit	Tomáš Kozík tkozik@ukf.sk
Aim of unit	Measurement of velocity of convection in a fluid environment.
Indicative Content	3 lessons Using knowledge of fluid mechanics. Experimental work motivation. Manual ability in using measuring instruments in real practical situation practicing.
Resources needed	Computer. Data projector. Internet. Resources prepared by author.
Teachers notes	

Unit Title	**Viscous flow**
Topic	Mechanics
Name and e-mail address of person submitting unit	Renata Holubova renata.holubova@upol.cz
Aims of unit	The unit describes the basic laws in fluid dynamics. Interdisciplinary relationships are shown - e.g. blood transport. A laboratory experiment is added.
Indicative Content	Viscous flow, turbulent flow, Poiseuille's law, Reynolds number.
Resources needed	Access to web.
Teachers notes	The unit includes a laboratory experiment. The practical activity leads to the understanding of the law and its use in technology and medicine. Interdisciplinary relationships are pointed out. Further applications can be shown - e.g. transport of pollutants.

Electricity and Magnetism

Unit title	**Capacitor Discharge**
Topic	Capacitor time constant and value of C.
Name and email address of person submitting unit	Not available
Aims of Unit	Pupils are required to consider data and calculations connected with capacitance.
Indicative content	Capacitor discharge calculation work sheet.
Resources needed	Pupils require access to the worksheet either in hard copy or electronic version.
Teachers notes	This worksheet would be most useful as a plenary recapping on learning and would require approx. 10 minutes. Learning outcomes for this activity All Pupils must know the definition of potential difference and resistance. Most pupils will be able to discuss the images given on each of the 3 screen images supplied. Some pupils will be able to give the values for Constant time factor and capacitance from the information given.

Unit Title	**Electromagnetic induction**
Topic	Electricity and Magnetism
Name and e-mail address of person submitting unit	Iva Stranska renata.holubova@upol.cz
Aims of unit	Students should understand the principle, and appreciate the usefulness and applicability of electromagnetic induction, in everyday life.
Indicative Content	Students should understand the quantity magnetic flux density, the function of a capacitor and diodes (briefly).
Resources needed	Forever flashlight (torch), source of AC and DC, voltmeter, ammeter, coil (e.g. 600 turns), magnets, sheets of iron, lead and copper, model of a transformer, old moving-coil loudspeaker. Videos or access to websites with applications of the principle – optional.
Teachers notes	This unit contains teacher's materials and students' worksheets. It is divided into 5 lessons. The teacher's materials contain recommendations, solutions of the calculations and simple answers of theoretical questions which appear on the students' worksheets.

Waves

Unit Title	**Waves Around Us**
Topic	Waves
Name and e-mail address of person submitting unit	Jiri Kvapil renata.holubova@upol.cz
Aims of unit	Students should recognize various types of waves and wave phenomena in everyday life and they should know how to solve simple calculations.
Indicative Content	Sine function and its graph, oscillatory motion and its equation.
Resources needed	Radio, slinky (walking spring toy), rope, stringed instrument, video recorder, colored elastic string (length 5 meters), office clips, electric shaver or another source of oscillatory movement, stopwatch, tape measure, convex mirror, plane mirror, laser, drinking straw, glass (but a small transparent aquarium is better), water, reflectors, computer with a sound card and a microphone (if available), optical prism, various optical fibers, transparent synthetic glue, completely black Xeroxcopy (A4, for each student - if available), some flat (for A4) vessels, CD (or DVD), polarization filters.
Teachers notes	This unit contains students' worksheets and teacher's materials with recommendations and solutions of the calculations.

Atomic and Nuclear

Unit title	Absorption and transition of radiation
Topic	Atomic and Nuclear
Name and email address of person submitting unit	Michele Francis michelefrancis@washington15.freeserve.co.uk
Aims of Unit	The Unit presents students with data about radioactive sources in diagrammatic form. Students are required to answer questions about the 3 types of radiation by interpreting the diagrams.
Indicative content	Alpha, beta and gamma radiation, penetrating properties of radiations.
Resources needed	None
Teachers notes	Age 14–16 This would make an ideal starter activity revisiting previous lessons on penetration and identification of types of radiation. Learning outcomes All pupils will be able to simply calculate the difference in radiation detected taking into account normal background levels. Most pupils will be able to identify the ability of several different materials to absorb different types of radiation. Some pupils will be able to identify types of radiation based on their ability to penetrate different materials.

Unit title	**Investigating Radioactive decay**
Topic	Atomic and Nuclear
Name and email address of person submitting unit	M J O'Neill Mike.O'Neill@church-schools.com
Aims of Unit	This simulation of Radioactive decay using dice. The mathematics of the decay process is likened to the probability of dice being rolled. Graphical methods are used to analyze the data, and students are required to explain why this is a good model for radioactivity.
Indicative content	Radioactive decay, the mathematics of random processes, half-life.
Resources needed	30 Dice
Teachers notes	An excellent main activity for 14–16 year olds. Time approx. 40 minutes, All pupils must gain an insight into probability and know the odds which determine the occurrence of a 6 when rolling a dice. Most pupils will be able to plot a table of results and produce a suitable line graph to illustrate these findings. Some pupils will be able to relate the graph to the half-life of a radioactive element and calculate the half-life of the graph.

Unit title	**Nuclear Power**
Topic	Atomic and Nuclear
Name and email address of person submitting unit	Matt Chessher Mches37472@aol.com
Aims of Unit	This unit is an extended reading with appendices, which relates principles of nuclear fission to the design of nuclear reactors. It gives details of the incidents at three Mile Island and Chernobyl. Students are engaged with short in-text questions, and a more extensive, open analysis concerned with these two incidents.
Indicative content	Nuclear fission, chain reaction, nuclear reactors, units of radioactivity.
Resources needed	None
Teachers notes	

Unit title	**Nuclear Waste**
Topic	Atomic and Nuclear
Name and email address of person submitting unit	M J O'Neill Mike.O'Neill@church-schools.com
Aims of Unit	Students are required to read a short digest on the classification of Nuclear waste, and then answer associated questions.
Indicative content	Radioactive waste, activity, half-life, chemical properties.
Resources needed	None
Teachers notes	A very interesting presentation with embedded questions for pupils to work through. Suitable for 15 + pupils. Time about 45 minutes. Learning outcomes for this activity All pupils should be able to discuss the need for the correct type of storage for nuclear waste products and identify the main characteristics of storage. Most will be able to identify the various types of radiation by its properties and also use the concept of half-life to discuss storage. Some pupils will be able to evaluate the concept of safety in terms on Nuclear radiation.

Unit title	**Radiation Game**
Topic	Atomic and Nuclear
Name and email address of person submitting unit	M.J.O'Neill Mike.O'Neill@church-schools.com
Aims of Unit	.The Unit requires that students select key words from the topic of radioactive materials and construct short sentences including the chosen word.
Indicative content	Radioactivity, nuclear decay, safety issues concerned with nuclear radiation.
Resources needed	Stop clock, cards with key words written on them (provided).
Teachers notes	A good Starter or Plenary activity for students 14+ Time about 15 minutes This is an assessment which is ideally used as a plenary activity. It will allow the observer and peers to give feedback on the pupils knowledge of key words used in a radio-activity module. The task is designed to encourage pupils to define key words and be able to recall these definitions quickly.

Unit title	**Radioactive Nathanium**
Topic	Atomic and Nuclear
Name and email address of person submitting unit	Graham Tomlinson olliecat@onetel.net
Aims of Unit	The unit gives data for a fictitious radioactive element, Nathanium, and this requires students to do an elementary analysis to find it's half-life, and guides the student to graphically analyse the data using log graph methods.
Indicative content	Count rates, half-life, log graphs.
Resources needed	Pupils will need a copy of the worksheet either in hard copy or electronic form, they will also need a calculator and graph paper.
Teachers notes	This activity is a suitable main activity and would require about 35 minutes to complete. It is suitable for 14+ pupils. It would also be suitable for a homework activity. Learning outcomes for this activity All pupils will be able to calculate the rate per minute given the data provided. Most pupils must be able to Calculate the log of this data and plot this data onto a suitable graph. Some pupils will be able to use the formula provided to calculate half-life.

Unit title	**Radioactivity questions**
Topic	Atomic and Nuclear
Name and email address of person submitting unit	Graham Tomlinson olliecat@onetel.net
Aims of Unit	The unit uses six questions to give practice and reinforce ideas on radioactivity equations, and the use of half-life to date samples. The contexts are unusual.
Indicative content	Radioactive decay: decay equations; half-life
Resources needed	Pupils will need access to the 6 questions in either hard copy or electronic form.
Teachers notes	This is a good main activity which consists of 5 in-depth questions relating to nuclear decay. They may also be useful for a homework activity, Time 35 minutes. Learning outcomes for this activity All pupils will be able to identify the atomic mass and number as well as explain the difference between them. Most pupils will be able to use the data given to describe daughter products produced and describe the radioactive particle produced during this event. Some pupils will be able to evaluate the information given and calculate the Half-life of an element or predict the amount of radiation emitted given the half-life.

Unit title	**Topics for students presentations**
Topic	Atomic and Nuclear
Name and email address of person submitting unit	Martin Sidley m.sidley@mmu.ac.uk
Aims of Unit	The unit aims to enhance students' knowledge and presentation skills by giving them topics to research and make presentations to their peer group.
Indicative content	Presentation skills, research, peer assessment
Resources needed	Interactive white board, pupils access to IT.
Teachers notes	A very good homework and main activity for pupils 14+. Time approx. 7 minutes per presentation. A suggested set of web pages are given which were active at time of submission but pupils are encouraged to find their own. Learning outcomes for this activity All pupils will research a specific topic from a specified list using both text books and the internet. All students will listen to the all presentations. Most pupils will be able to construct and prepare a presentation using ICT within a specified time with very little input from the teacher. Some pupils will be able to give a well ordered insight into various appropriate topics related to atomic and nuclear physics.

Optics

Unit title	**Structural colour of insects**
Topic	Optics
Name and email address of person submitting unit	Matt Chessher Mches34742@aol.com
Aims of Unit	The extended unit (module) consists of reading material and an experiment to determine the inter-track spacing on a CD-ROM. The reading material explores the world of structural colour, used by insects and also a means of light dispersion on CDs.
Indicative content	Thin films, light interference, structural colour in insects, spectroscopy, diffraction grating.
Resources needed	Energy saver bulb, diffraction grating, optical pins. CD, paper protractor.
Teachers notes	An advanced practical activity for 16+ pupils perhaps covering several hours. Pre-requisite knowledge on interference by thin films, and diffraction by a grating including the formula for this, is required. The initial reading, which includes a good bibliography, could be set as homework. The experiment could be carried out over 2 to 3 hours. Afterwards further data analysis is required. Learning outcomes for this activity All students will be required to follow a complex presentation and discuss key terms and issues related to the nature of light. Most students will, unaided, use the formulae given to help describe phenomena such as interference. Some Students will be able to relate phenomena to what we can observe from the natural word.

Unit Title	**Move it! Dynamic Geometry Software in optics (1)**
Topic	Optics
Name and email address of person submitting unit	Andreas Ulovec Andreas.Ulovec@univie.ac.at
Aims of unit	Using dynamic geometry software for showing the refraction of light in a drop of water
Indicative Content	Optics, refraction
Resources needed	Computer with GeoGebra
Teachers notes	

Unit Title	**Move it! Dynamic Geometry Software in optics (2)**
Topic	Optics
Name and email address of person submitting unit	Andreas Ulovec Andreas.Ulovec@univie.ac.at
Aims of unit	Using dynamic geometry software for showing the path of light in a lens
Indicative Content	Optics, refraction
Resources needed	Computer with GeoGebra
Teachers notes	

Unit Title	**Forming Images**
Topic	Physics – Light and optics
Name and e-mail address of person submitting the unit	Michael Svec renata.holubova@upol.cz
Aims of unit	Students will understand how images are formed in a flat mirror.
Indicative content	Light reflects from a shiny surface in a specific direction so that the reflected angle is equal to the incoming or incident angle. Light spreading out from a point on a source reflects from the flat mirror and then spreads out further so as to appear to come from another point on the other side of the mirror called the image point. The image point is the same distance behind the mirror as the source point is in front of the mirror.
Resources needed	All of the materials are simple and can be purchased at a home improvement store.
Teacher notes	This unit is based on a series of laboratory investigations. Students should work in cooperative groups of 3-4 students. The activities require only simple mathematics and focus primarily on qualitative understanding of the content.

Energy

Unit Title	Energy in Food
Topic	Energy
Name and email address of person submitting unit	Soňa Čeretková, Soňa Švecová, Janka Melušová sceretkova@ukf.sk
Aim of unit	To explore why and how food is important for the flow of energy in the human body and find out how much energy there is in food.
Indicative Content	2 lessons age od students: 14–16
Resources needed	Internet. Computer.
Teachers notes	Developing the student inquiry and creativity. Students discover how much energy there is in food and how much energy a they need to consume per day. The aplet deals about the energy in certain samples of food. http://www.compass-project.eu/applets/1/index_EN.html Students work in small groups, analyse and compare their findings. Groups are asked to prepare posters or presentations about their findings.

Unit title	**Renewable energy Resources**
Topic	Identification of factors which are related to different types of renewable energy.
Name and email address of person submitting unit	Not Available
Aims of Unit	Pupils are encouraged to consider aspects of different renewable energy sources.
Indicative content	Solar, wind, geothermal, hydroelectricity and Biomass.
Resources needed	The pupils will need access to the work sheet either as a hard copy or in electronic form.
Teachers notes	This activity is an ideal starter, plenary or homework activity which is suitable for 11+ year olds. It should take approx. 10 minutes. Learning outcomes for this activity Al pupils should be able to identify key features of renewable energy sources by matching statements with types given in a list.

Unit Title	**Stand by to waste energy**
Topic	Energy
Name and email address of person submitting unit	Gudrun Dirmhirn gudrun_dirmhirn@gmx.at
Aims of unit	Saving energy in the household by knowing the energy consumption of electric household appliances in standby mode
Indicative Content	Natural resources
Resources needed	None.
Teachers notes	None.

Unit Title	Energy-saving lamps
Topic	Energy
Name and email address of person submitting unit	Gudrun Dirmhirn gudrun_dirmhirn@gmx.at
Aims of unit	Energy-saving lamps are more expensive, but they have a longer economic life-time and need less power than normal incandescent lamps.
Indicative Content	Making a list in the household where energy-saving lamps can be used instead of incandescent lamps, and calculating the saving in electricity consumption.
Resources needed	
Teachers notes	

Unit Title	**Rocket take-off**
Topic	Energy
Name and email address of person submitting unit	Gudrun Dirmhirn gudrun_dirmhirn@gmx.at
Aims of unit	Warm air rises.
Indicative Content	Observing and analysing.
Resources needed	Teabag, plate, pocket lighter
Teachers notes	It takes less than five minutes and everybody is impressed.

Unit Title	**Cooking safely**
Topic	Energy
Name and email address of person submitting unit	Gudrun Dirmhirn gudrun_dirmhirn@gmx.at
Aims of unit	There a lot of things we should consider: using the right pot, always use a lid, the electric kettle is the fastest way of boiling water.
Indicative Content	A qualitative experiment, where pupils should find out how to cook well and safely, making a list of hints.
Resources needed	Electric kettle, boilerplate, gas cooker, different pots (big, small, with a bumpy or flat bottoms), lids, stop watch.
Teachers notes	Plan sufficient time. Be sure that the pupils handle the hot water carefully.

Unit Title	**Cooking safely – making a series of measurements**
Topic	Energy
Name and email address of person submitting unit	Gudrun Dirmhirn gudrun_dirmhirn@gmx.at
Aims of unit	The fastest way, and the least energy consuming way, to boil water is by using an electric kettle. If you use a pot, it is important to use also a lid. Microwave cooking saves energy only if boiling a cup of water; it wastes energy boiling one litre or more.
Indicative Content	Logging data, calculating, analysing the outcome.
Resources needed	Boilerplate, electric kettle, if possible a microwave, a big pot with lid, a small pot with lid, stop watch, thermometer, measuring cup, water.
Teachers notes	Plan sufficient time. Be sure that the pupils handle the hot water carefully.

Unit Title	**The architect´s office**
Topic	Energy
Name and email address of person submitting unit	Gudrun Dirmhirn gudrun_dirmhirn@gmx.at
Aims of unit	Many different things are discussed, experiments are made; here the pupils should remember the most important facts about energy, and utilise them in a real situation.
Indicative Content	Repeating what they have learned, being creative.
Resources needed	
Teachers notes	This unit is meant for closing up the topic, and is good for revision.

Unit Title	**Personal CO_2 production**
Topic	Energy
Name and email address of person submitting unit	Gudrun Dirmhirn gudrun_dirmhirn@gmx.at
Aims of unit	It is very important to know, that every consumed kilowatt hour contributes to a rise of CO_2. The high amount of CO_2 that one person consumes annually surprises students.
Indicative Content	Calculating, self-check, marvelling.
Resources needed	
Teachers notes	

Unit Title	**Poster – tips to save energy**
Topic	Energy
Name and email address of person submitting unit	Gudrun Dirmhirn gudrun_dirmhirn@gmx.at
Aims of unit	The posters could be a summary of the project work. It is a big motivation to pin them in the school and arrange a small presentation.
Indicative Content	Summing up and presenting the results of project work.
Resources needed	Big posters, pens.
Teachers notes	

Unit Title	**Energy – Quiz**
Topic	Energy
Name and email address of person submitting unit	Gudrun Dirmhirn gudrun_dirmhirn@gmx.at
Aims of unit	Different household appliances have different installed power. The more power, the more energy is needed.
Indicative Content	Cards with different household appliances are prepared. Pupils should order the appliance cards with the least value to those with the most energy consumption.
Resources needed	
Teachers notes	It is suitable especially for younger pupils.

Unit Title	**Ventilate your room – the right way**
Topic	Energy
Name and email address of person submitting unit	Gudrun Dirmhirn gudrun_dirmhirn@gmx.at
Aims of unit	To control air movement in rooms in the right way saves energy. The pupils should learn how to do this.
Indicative Content	Filling in how cold and warm air moves; different drawings of rooms are prepared – on them pupils should mark the air flow and detect the correct and incorrect flow mechanisms.
Resources needed	
Teachers notes	

Unit Title	**Panel discussion about saving energy**
Topic	Energy
Name and email address of person submitting unit	Gudrun Dirmhirn gudrun_dirmhirn@gmx.at
Aims of unit	Pupils should remember and talk about topics they have learnt in former lessons
Indicative Content	Discussing, talking about the physical background, having own ideas on how to save energy, finding good arguments why saving energy is necessary, trying to be convincing
Resources needed	Eventually a video camera
Teachers notes	It is nice to film the panel discussion. Then it is possible to analyse the discussion later on.

Astronomy

Unit Title	**How is it to be a teacher – Astronomy**
Topic	Astronomy
Name and email address of person submitting unit	Ľubomíra Valovičová lvalovicova@ukf.sk
Aim of unit	Students try to be a teachers. This can help them better understand the topic of the lesson. This voluntary activity can improve their relationship to physics.
Indicative Content	10 lessons Age of students: 14–15
Resources needed	Students find the necessary information on the internet or in books. Computer, dataprojector, internet.
Teachers notes	The lesson isn't taught by teacher but the students. The teacher divides the themes among the students who prepare the lessons. It is convenient to have two students for one topic so neither speak for longer than 20 minutes. The teacher has to give the students sufficient time for preparation. It is best to give one month before the beginning of astronomy topic, so the students have enough time to consult with the teacher and improve their performance. In the lesson, the teacher sits at the back of the class and watches the lesson. Students may use dataprojector for presentation.

Unit Title	**Myth about the origin of time**
Topic	Astronomy
Name and email address of person submitting unit	Aba Teleki ateleki@ukf.sk
Aim of unit	The aim is to demonstrate the facts about time: it is an ultimate physics quantity. Discussion the history of discovery the attributes of time.
Indicative Content	2 lessons Astronomy, cosmology, elementary particles.
Resources needed	Computer, projector, CD “Myth about beginning of time” prepared by author.
Teachers notes	Students can find more information on internet.

Unit title	**Build a Space Dictionary**
Topic	Astronomy
Name and email address of person submitting unit	Michele Francis Michelefrancis@washington15.freeserve.co.uk
Aims of Unit	This is a simple exercise in extending student's vocabulary about key words relating to space. Three words are given with their meanings, and then the student has to give words for stated meanings and meanings for stated words. The exercise concludes by asking students to extend the dictionary with words and meanings they give.
Indicative content	Improving vocabulary and definitions related to general space terms.
Resources needed	Text books related to space and astronomy.
Teachers notes	This activity is ideal for improving pupils vocabulary and assessing their understanding of key term in Astronomy. It is suitable for pupils aged 11 + and although open ended would be good activity for a whole lesson of 1 hour or perhaps for a homework. Learning outcomes for this activity All pupils should be able to define the key words given or identify the key words from the definition given. Most pupils should be able to identify a range of important terms and find definitions for them. Some pupils will be able to discover the deliberate errors and offer corrections to them.

Unit title	**Jupiter and it's Moons**
Topic	Astronomy
Name and email address of person submitting unit	Not available
Aims of Unit	To discuss key concepts such as day length and periodicity, students must calculate day length, the occurrence of eclipses and the time taken during an orbit.
Indicative content	Orbit, eclipse and astronomical calculations
Resources needed	The students will need access to the papers either in printed hard copy or in electronic form.
Teachers notes	This is a challenging main activity suitable for post 16 students and should take approx. 45 minutes. This is a very interesting main activity which challenges pupils to conduct some detailed calculations and also consider the implications of these calculations. Learning outcomes for this activity All pupils will be able to use data to discuss theories which are proposed in the presentation. Most pupils will be able to use the data and specimen calculations provided to calculate orbit times related to the moons of Jupiter. Some Use data and instructions provided to predict scale and speed on an astronomical scale.

Thermal Physics

Unit Title	**Specific heat of water**
Topic	Thermal Physics
Name and email address of person submitting unit	Gudrun Dirmhirn gudrun_dirmhirn@gmx.at
Aims of unit	This experiment and calculation should show that the specific heat of water is very high. As a consequence warming up water needs a lot of energy. So the message is: do not waste hot water!
Indicative Content	Logging the data accurately; calculating the specific heat; thinking about energy saving with warm water.
Resources needed	Dewar flask, thermometer, water, measuring cup, stop watch, accumulator, cables, voltmeter, ammeter.
Teachers notes	The measuring time is twenty minutes so pupils have to work independently to finish in time.

Unit Title	**Boltzman law**
Topic	Thermodynamics, energy
Name and email address of person submitting unit	Daniela Horváthová dhorvathova@ukf.sk Mária Rakovská mrakovska@ukf.sk
Aim of unit	Practical test of theoretical law.
Indicative Content	2 lessons Practical verification of Boltzman law about the division of energy. Application of basic knowledge from thermodynamics in an experiment. Supporting text available for practical physics.
Resources needed	prepared by authors Computer, Excel
Teachers notes	

Unit Title	**Evaporation coldness**
Topic	Thermal Physics
Name and email address of person submitting unit	Gudrun Dirmhirn gudrun_dirmhirn@gmx.at
Aims of unit	If you hang up wet clothes, you notice that the clothes and the air get colder. This is because of the fact that the fast molecules leave the clothes.
Indicative Content	Observing what is going on, analysing the process, finding examples in real life.
Resources needed	*First experiment:* thermometer, wadding, thread, acetone. *Second experiment:* terracotta pot, plate, thermometer, wadding, water, hair drier.
Teachers notes	

Unit Title	**Convection / heat flux**
Topic	Thermal Physics
Name and email address of person submitting unit	Gudrun Dirmhirn gudrun_dirmhirn@gmx.at
Aims of unit	Heat is transported together with matter in convection. The convective flow in the tank is because cold water has a higher density than hot water. The same flow occurs also in the air.
Indicative Content	Experimenting and observing; thinking when convection is needed (heating installation) and when it should be stopped (for instance: windows).
Resources needed	*First experiment:* a big glass tank(small aquarium), 5 candles, pocket lighter, six or more ice cubes, ink and pipette, log of wood, water. *Second experiment:* convection chamber made of glass, tripod, water, ink, Bunsen burner.
Teachers notes	It takes not too much time and shows a lot. Also adequate for younger pupils.

Unit Title	**Thermal insulation**
Topic	Thermal Physics
Name and email address of person submitting unit	Gudrun Dirmhirn gudrun_dirmhirn@gmx.at
Aims of unit	Every material has a thermal conductivity. All thermal insulation materials have a low thermal conductivity. If you build or renovate a house or flat, it is absolutely necessary to use enough thermal insulation, so you can prevent a lot of heat from escaping.
Indicative Content	Experimenting and logging temperature data; making a diagram; it is possible to use the computer to analyse the data.
Resources needed	3 gas lamps, 3 nichrome®wire or thermometers, 3 stop watches, 3 grates (59 × 39 cm), 12 cardboard boxes (40 cm high), different thermal insulation materials: cork (2 cm, 4 cm), coconut fibre (4 cm), Roofmate (4 cm).
Teachers notes	Plan sufficient time.

Unit Title	**Water – a bad heat conductor?**
Topic	Thermal Physics
Name and email address of person submitting unit	Gudrun Dirmhirn gudrun_dirmhirn@gmx.at
Aims of unit	Water is a bad heat conductor.
Indicative Content	Observing, betting: What happens first – does the water boil or the ice melt?
Resources needed	Test tube, tripod, 3-4 ice cubes, wire, water, Bunsen burner, pocket lighter.
Teachers notes	

Unit Title	**U-value**
Topic	Thermal Physics
Name and email address of person submitting unit	Gudrun Dirmhirn gudrun_dirmhirn@gmx.at
Aims of unit	Pupils should acquire knowledge of a new topic, the U-value, by working independently. The definition and calculation of the U-value should be learned.
Indicative Content	Reading and understanding the information, calculating the U-value for different types of heat insulation, also using graphical methods to show the different temperatures in layers of insulating materials.
Resources needed	
Teachers notes	This is a work-sheet aimed at very able and interested pupils.

Unit Title	**The Room Comfort Consultant**
Topic	Thermal Physics
Name and email address of person submitting unit	Gudrun Dirmhirn gudrun_dirmhirn@gmx.at
Aims of unit	To feel comfortable different parameters inside a room like room temperature, wall-surface temperature, relative air humidity, have to be coordinated.
Indicative Content	Different diagrams should be interpreted and used to make a list of things you could control to be comfortable in a room.
Resources needed	
Teachers notes	

Unit Title	**Heating a house**
Topic	Thermal physics
Name and email address of person submitting unit	Gudrun Dirmhirn gudrun_dirmhirn@gmx.at
Aims of unit	Part 1: To calculate the energy demands of heating a house you have to sum up the heat-losses minus the gains. Losses: transmission losses and ventilating losses Gains: solar gains, heat emission of persons and appliances. Part 2: Calculating and comparing if the energy consumption at students' homes is low or very high.
Indicative Content	Part 1: Drawing a house, where losses and gains of heating are marked. 2nd part: Calculating the specific annual energy consumption that is needed to heat the house.
Resources needed	
Teachers notes	

Unit title	**The test tube Stirling Engine and Thermodynamic cycles**
Topic	Thermodynamics, Engineering
Name and email address of person submitting unit	Matt Chessher Mches34742@aol.com
Aims of Unit	This unit requires students to calculate work and efficiency related to the principles of thermal dynamics which underpin the Stirling engine.
Indicative content	This unit consists of a presentation with embedded questions and problems which challenge pupils to commit several calculations.
Resources needed	Pupils will require either the whole presentation as a hard copy or as an electronic version.
Teachers notes	An advanced practical activity for 16+ pupils perhaps covering several hours. To answer these questions pupils will be required to consider abstract concepts, perform calculations and write descriptively. Learning outcomes for this activity All students will be able to discuss the movement of thermal energy in terms of systems. Particularly the steam engine and water wheel example. Most students will with a little assistance be able to complete the participant activity tasks which are embedded within the presentation. Some students will unaided be able to work through the presentation unaided completing the tasks and gaining an insight into the working of the system in terms of thermal flow

Relativity

Unit title	**The special Theory of Relativity and Time Dilation**
Topic	Einstein and relativity concepts such as time, light and gravity
Name and email address of person submitting unit	Not available
Aims of Unit	This unit encourages pupils to think about Einstein's special theory of relativity. It requires pupils to absorb information and relate this to the development of a theory.
Indicative content	Gravity, time, light Relativity and Muons.
Resources needed	The pupils will require access to the paper in either hard or electronic form.
Teachers notes	This is a challenging main task appropriate for pupils who are 16+ the whole task will require at least 50 minutes. This task requires pupils to discuss and digest information and then respond to embedded questions which require calculations. Learning Outcomes All students will be able to discuss some key points of the theory of special relativity. Most students with some help will be able to attempt the embedded tasks within this presentation. Some students unaided will complete the calculations and relate these to observations and theoretical predictions.

Meteorology

Unit Title	**How is it to be a teacher – Meteorology**
Topic	Meteorology
Name and email address of person submitting unit	Ľubomíra Valovičová lvalovicova@ukf.sk
Aim of unit	Students try to be a teacher and this can help them better understand the topic of the lesson. This voluntary activity can improve their relationship to physics.
Indicative Content	10 lessons age of students 12–13
Resources needed	Internet, data projector, literature.
Teachers notes	1. lesson: Basic terms, climate and weather. 2. lesson: Layers of the atmosphere. 3. lesson: Condensation of water vapour. 4. lesson: Humidity of air. 5. lesson: Cloud and precipitation. 6. lesson: Wind and its direction. 7. lesson: Meteorological map. 8. lesson: Meteorological station. 9. lesson: Pollution of atmosphere. 10. lesson: Disasters caused by weather.

	The lesson isn't taught by teacher but the students. The teacher divides the themes among the students who prepare the lessons. It is convenient to have two students for one topic so neither speak for longer than 20 minutes. Teacher has to give the students sufficient time for preparation. It is best to give one month before the beginning of meteorology topic, so the students have enough time to consult with the teacher and improve their performance. In the lesson, the teacher sits at the back of the class and watches the lesson. Students may use dataprojector for presentation.

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