



Personal Finance
Education Group

 NatWest

Introducing Financial Mathematics

A practical guide for Key Stage 3 and 4



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Under the new national curriculum that will apply from September 2014, schools are being given more freedom to decide what and how to teach mathematics. Until September 2014 schools are free to develop their own curriculums for mathematics, and make their own judgements about how to best meet the needs of their students.

The current national curriculum programmes of study for mathematics at key stages 3 and 4 were disapplied from 1 September 2013 and are no longer statutory. The attainment target level descriptions will be withdrawn and not replaced. The new programme of study for key stage 3 was published in September 2013. At the date of publication (October 2013), the new key stage 4 programme of study has not been finalised.

Whatever arrangements schools put in place, teachers will want to assess pupils' progress. These resources are mapped against the attainment target level descriptions, on the basis they are familiar and reliable indicators of progression, and that many schools will still use them until alternative methods are developed. Teachers will be able to decide if it is appropriate to apply the levels to their own students.

pfeg intends to update this resource as policy and practice develops in the coming months.

Introduction

‘Mathematics is a creative and highly inter-connected discipline that has been developed over centuries, providing the solution to some of history’s most intriguing problems. It is essential to everyday life, critical to science, technology and engineering, and necessary for financial literacy and most forms of employment.’

National curriculum in England¹

Mathematics and financial education go hand in hand. Managing money involves using numbers and performing calculations. Financial topics also provide real-life contexts for mathematical learning as well as wide ranging opportunities for young people to develop problem solving skills, both of which are increasingly important elements of pupils’ learning and exam specifications.

A recent survey² of teachers who deliver financial education found that **72%** of schools had taught it through mathematics, and **89%** of teachers said that teaching financial education had an impact on attainment in mathematics overall.

The important relationship between mathematics and financial education has been recognised in the new national curriculum. For example, the key stage 3 mathematics programme of study³ clearly states that mathematics is ‘necessary for financial literacy’ and the programme goes on to advise schools that:

‘Pupils should be taught to ... develop their use of formal mathematical knowledge to interpret and solve problems, including in financial mathematics.’

This means that together with the money-related elements of citizenship and Personal, Social, Health and Economic education, there are now more opportunities than ever before for young people to receive a well-balanced and rounded financial education in school.

This guidance aims to help teachers understand the connections between mathematics and financial education, provides practical help by suggesting teaching contexts, and links between the mathematics curriculum and pfeg’s Financial Education Planning Framework for 11-19 year olds.

The latter part of this guide provides practical activities and resources that can be used in the classroom to enrich the teaching of financial mathematics. These activities are built around six key themes, all of which are mapped to the national curriculum. The six themes also strongly link to the modules on the NatWest MoneySense for Schools free financial education website (<http://moneysense.natwest.com/schools/resources/>) which can be used to extend and develop learning. NatWest has been providing free financial education for nearly 20 years through a range of programmes including MoneySense for Schools. The NatWest MoneySense for Schools materials have been awarded the **pfeg** Quality Mark for educational value and impartiality.

pfeg’s suite of Financial Education Planning Frameworks aim to support the teaching, progression and assessment of financial education by setting out the key areas of financial knowledge, skills and attitudes relevant to different age ranges, across four core themes:

- how to manage money;
- becoming a critical consumer;
- managing risks and emotions associated with money;
- understanding the important role money plays in our lives.

The frameworks are designed to help teachers plan financial education flexibly across the range of subjects and learning opportunities available to them within a school’s curriculum. They are not intended to be used rigidly. Teachers may need to draw on ideas from other ages depending on the needs of their pupils. The 3 – 11 and 11 – 19 Planning Frameworks are available to download at www.pfeg.org/PlanningFrameworks.

¹ The National curriculum in England framework document – DfE – September 2013 – DFE001772013

² **pfeg** survey of teachers, April 2013

³ The National curriculum in England framework document – DfE – September 2013 – DFE001772013

What are financial capability and financial education?

Being financially capable means having the confidence, skills and knowledge we need to manage our money well, now and in the future. The development of financial capability is life-long and includes the ability to adapt our approach to money management in response to changes in our personal and financial circumstances.

Financial education in schools is a planned programme of learning opportunities and experiences designed to increase the financial capability of all pupils, from every social and cultural background. **pfeg's** Financial Education Planning Frameworks set out the key areas of knowledge, skills and attitudes for different age ranges, across four core themes:

- how to manage money;
- becoming a critical consumer;
- managing risks and emotions associated with money, and;
- understanding the important role money plays in our lives.

Learning is most effective when teaching contexts;

- focus on financial topics that are meaningful and relevant to children and young people;

- are linked to real life through the use of simulations and case studies;
- and use active learning strategies, not text books or worksheets.

Students are likely to become more financially independent as they move up the secondary age range. They may get a part-time job, make more of their own decisions about spending and saving money they have either earned or are given by parents and carers, and open a bank account.

Before they leave school they will need to consider the cost of moving on to work, training or further education, and of living independently. By the time they are 18 they can apply for a credit card or loan, will have to navigate their way through a mass of targeted advertising, and choose between an ever increasing range of electronic payment options and e-commerce platforms.

Some financial issues, such as pensions and mortgages, seem distant at this age so it can be difficult to persuade young people that they are equally important, however they will probably feature in their lives sooner than they think.

What can financial education offer mathematics?

Money is an overarching context ideal for creating rich mathematical tasks that relate to real life. Whether it is working with decimals, understanding percentage decrease or analysing data about spending habits, teachers often report about pupils that 'when it is money, they get it'.

Moreover, the use of financial topics to contextualise mathematics instantly counters the dreaded cry of 'what do we need maths for?' Young people are well aware of the need to be money savvy and of the significant role money will play in their lives. Working with 'money' validates the mathematics and makes its importance clear.

Teachers also report that students who can be hard to motivate in a 'traditional' mathematics lesson often become very engaged when money is involved. And it is not just pupils who find money helpful. Initial teacher training providers have found that using money as a context increases confidence amongst their student teachers because they can see how it will help them explain mathematical concepts to pupils when they are on their teaching practice.

How can mathematics help deliver financial education?

At the most basic level, managing money involves calculations using numbers. Numeracy skills underpin almost all our interactions with money. Without them we cannot make fully informed financial decisions.

However mathematical skills are only part of the picture. Pupils also need to consider their attitudes towards money so they can understand what drives the choices they make and how they will feel about the consequences.

A planned programme of financial education will use all the opportunities a school curriculum provides for developing financial capability – mathematics, Personal, Social, Health and Economic education and citizenship all have a role to play in helping young people make the most of the opportunities and challenges that money brings in life.



Practical links and teaching contexts

The following suggestions provide some starting points for teaching and learning activities. The table that follows on page 6 provides many more.

- Spreadsheets are central to the world of business and finance and provide a valuable tool when working with money in the maths classroom. The need to form and manipulate expressions shows clearly why algebraic skills are crucial in the workplace. For the more able, try using spreadsheets to set up numerical models for borrowing money and paying it back monthly. For younger or less proficient mathematicians, use spreadsheets to plan a trip or a party, creating 'what if' questions that challenge them to change their plans to stay within their budget.
- Insurance for mobile phones and holidays provide opportunities to use the language of probability, spark debate and lead into many associated areas such as life expectancy and variables like gender and age.
- Statistics and money can be closely linked. Try processing and displaying data on (anonymised) pocket money, or using moving averages to analyse the share price of a popular high street brand. Pupils find such tasks purposeful and interesting – relating to real-life rather than fictitious products in text-books.
- Share ownership in relation to favourite high street stores can be a great way for students to:
 - take part in a team challenge to buy and sell shares at given prices during the course of a lesson using historical shares prices;
 - research share price movements for a popular youth brand and try to establish why shares went up or down, calculating the profit or loss they might have made;
 - look at the dangers of extrapolation linked to share prices.
- Energy tariffs can be linked to straight-line graphs. Pupils will be used to graphs in the form $y=mx+c$, but often with numbers in the range 0-20. Using numbers that may be decimals and/or very large or very small will reinforce the real-life practical use of the graphs and extend graphical skills at the same time. Discussing when and how the graph might move into the negative quadrant would be interesting too, perhaps in relation to micro-electricity generation and feed-in tariffs.
- Money-related current affairs and news items can also provide rich starting points for engaging mathematical tasks. For example:
 - different forms of borrowing (e.g. banks, short term loans, credit unions, credit cards) and the role of APR;
 - comparisons between the National Minimum Wage and celebrities' salaries;
 - fluctuations in exchange rates;
 - house prices and rental costs;
 - student finance.

Teaching opportunities

Core themes from the pfeg Financial Education Planning Framework for 11 – 19 year olds		Number	Algebra
How to manage money	<p>KS3</p> <ul style="list-style-type: none"> Managing credit (debt) Financial paperwork and budgeting <p>KS4</p> <ul style="list-style-type: none"> Planned borrowing and saving Planning and budgeting 	<p>Interpreting bank statements involving negative numbers.</p> <p>Understanding debt as a negative number and carrying out calculations involving credit and debit.</p> <p>Modeling income and expenditure in a budget and using it to examine changes in circumstances. Modeling budgets using spreadsheets.</p> <p>Estimating likely investment growth and assessing upper and lower bounds to projected capital growth.</p>	<p>Forming and solving equations to represent the cost of a loan involving simple interest.</p> <p>Applying a compounding formula to calculate the increase in capital over a period.</p> <p>Expressing the APR of a loan taking into account fees and charges, either accrued once or at the end of each compounding period.</p> <p>Form expressions for and create a spreadsheet to model paying back a loan, with reference to high cost lending such as short term Loans</p>
Becoming a critical consumer	<p>KS3</p> <ul style="list-style-type: none"> Influences on spending and saving Calculating value for money <p>KS4</p> <ul style="list-style-type: none"> Financial rights and responsibilities Using 'value of money' and financial info and advice to make decisions Making choices about financial products 	<p>Shopping exercises: change, interpreting bills and receipts.</p> <p>Calculating if season tickets, for example football or train, provide value for money.</p> <p>Calculating bulk 'best buy' deals to establish if they provide value for money.</p> <p>Expressing the cost of items as a unit price for purposes of comparison.</p> <p>Comparing the cost of a holiday in this country to one overseas by adding all the various items involved. (1)</p>	<p>Forming simple expressions relating to cost of items, for example an end of term party, and using a spreadsheet to keep within a budget.</p> <p>Expressing costs in term of a linear relationship in the form $y=mx+c$, for example utility bills or phone tariffs.</p> <p>Work with formulas such as (F = final value, n= no of years, C = capital) to compare savings and investments. Rearrange and/or solve 'what-if' problems related to interest rate changes or inflation.</p> <p>Use simultaneous equations with two alternative tariffs for eg car hire.</p>
Managing risks and emotions associated with money	<p>KS3</p> <ul style="list-style-type: none"> Risk and reward Avoiding scams and identity theft Different types of insurance <p>KS4</p> <ul style="list-style-type: none"> Managing risk Dealing with fraud Insuring against risk 	<p>Comparing the cost of insurance, for example for a new washing machine over its life, to the cost of an extended warranty over the same period.</p> <p>Researching and comparing insurance premiums for products such as tablet computers, pets or holidays.</p> <p>Using standard form to express large values of money related to large-scale fraud or theft.</p>	<p>Creating a graph of insurance premiums against age according to a given algebraic rules – could be linear, or exponential depending on the horizontal axis. Might be limited in range i.e. cut-offs at certain ages. Scope to comment on issues arising.</p> <p>Examining historical graphs of share price movements and commenting on what might have happened to cause the fluctuations in share prices. (5)</p>
Understanding the important role money plays in our lives	<p>KS3</p> <ul style="list-style-type: none"> Links between work and the world of finance Personal finance, public spending and charitable giving Longer term financial planning <p>KS4</p> <ul style="list-style-type: none"> Links between work, life choices and finance Relationship between personal finance and economic citizenship Investing in my future 	<p>Planning holidays and costs attached for accommodation and travel etc, or planning expenditure for a wedding or for a first child.</p> <p>Calculating pocket money, household chores and part time work.</p> <p>Estimating total salaries including commission and bonuses, looking at the minimum wage. (2)</p> <p>Setting open-ended tasks related to budgeting and independent living, possibly involving foreign exchange (gap year, working overseas).</p>	<p>Express a value including VAT algebraically (either for buying goods or invoicing for services).</p> <p>Looking at selling items on different online auction sites with different cost profiles and expressing the profit algebraically.</p> <p>Interpreting the instantaneous gradient of a graph of gas or electric usage (kW) vs time (hrs) as representing the rate of energy usage (kW/hr) and the area beneath the graph as representing the total energy usage (kWhr). Hence calculating energy usage of several different households with differing usage profiles.</p>

Notes

Items in **bold** may be more suitable for KS4, due to either mathematical demand or appropriate content.

Highlighted items link to the activities in the second part of this resource (the number in brackets refer to the topic number).

Ratio/Proportion/Rates of Change	Geometry and Measures	Probability	Statistics
<p>Selecting appropriate mathematical tools and methods to calculate simple interest.</p> <p>Comparing loan costs or savings gains using simple interest over a year using the APR/AER.(4)</p> <p>Calculating the increase in savings capital after repeated compounding. (4)</p> <p>Exploring the cost of paying back a credit card with minimum payments using an iterative process.</p>	<p>Applying the vocabulary of money by looking at simple budgeting and shopping activities.</p> <p>Using till receipts and invoices to practice giving change and coin recognition.</p> <p>Investigating a 'grand design' or garden redevelopment project involving costs related to volumes and weights of materials.</p>	<p>Using Venn and or Carroll diagrams to categorise, for example money by colour/ shape or items by needs vs wants and high/ low value.</p> <p>Planning currency purchases on the basis of probability .i.e. when is the best time to buy Euros and why? (1)</p> <p>Understanding that there are risks attached to deploying money in a variety of ways, and knowing which investments may fall in value and be worth less than the original capital.</p>	<p>Expressing personal cash flow as a line graph with time as the x-axis.</p> <p>Showing personal expenditure with a budget as categories within a pie-chart.</p> <p>Expressing cost distributions using measures of average and spread such as median and interquartile range.</p>
<p>Establishing value for money using unit pricing.</p> <p>Understanding the proportional relationship between rates of exchange, for example currency, shares, bonds, and understanding the impact of changes in conversion rates. (1)</p> <p>Comparing unit pricing for organic or fair trade items. Calculating any 'price premium' as a proportion of the non-organic or non fair-trade equivalent.</p>	<p>Reading scales to ensure quantities are charged correctly, for example for excess luggage at an airport.</p> <p>Comparing the cost of ingredients for a home-made cake, for example 200g of flour knowing the cost per kilogram, to a shop bought cake.</p> <p>Using compound unit calculations in multi-step problems involving, for example the cost per mile for diesel/ petrol cars or to compare gas/electric bills. (3)</p> <p>Exploring the impact of changing the shape or size of a package on value for money. (6)</p>	<p>Calculating the probability of spending over £10 given a shopping basket of 4 items and probabilities linked to the price of each.</p> <p>Planning an event, for example expressing the food choices that guests might make using a tree diagram and conditional probabilities, knowing the proportion of vegetarians attending and of all attending who prefer water to fizzy drinks. Costing the combinations of food & drink.</p> <p>Looking at historical rates of inflation and assessing risks attached to cash saving vs investing on alternative items such as houses or classic cars.</p>	<p>Carrying out shopping surveys and gathering primary data relating to shopping choices and popularity of different brands.</p> <p>Taste testing premium vs value products.</p> <p>Expressing voting results graphically in bar charts or pictograms.</p> <p>Examining misleading graphs intended to influence financial decision-making, for example those with a non-zero origin.</p>
<p>Examining the depreciation of products.</p> <p>Critically comparing financial products such as savings accounts and loans on the basis of periodic (monthly or annual) compounding.</p> <p>Examining the effect of interest paid daily, monthly or annually on the final value of an account in order to compare savings or loan products.</p> <p>Countering the emotional response to student loans by calculating payback to make informed decisions about Higher Education.</p>	<p>Investigating the way that items are sold using different units in order to appear cheaper, for example carpet sold by the square yard.</p> <p>Calculating insurance premiums based on the volume or weight of valuable items, for example gold jewelry. (Increase the difficulty using more challenging geometric shapes)</p>	<p>Understanding that a financial decision may have long-term consequences and that any risk attached is a function both of probability and of consequence.</p> <p>Using the language of probability to compare the risk of possible financial losses such as a car breakdown or a lost mobile phone.</p> <p>Researching probabilities related to fraud and financial crime.</p>	<p>Plan a purchasing decisions about buying foreign currency based on historical and extrapolated conversion graphs, while understanding the dangers of making financial decisions based on the extrapolation of graphs. (1)</p> <p>Sketching trend lines in scatter plots, for example of car age vs value.</p> <p>Interpreting graphs of historical share prices and calculating potential theoretical gains. (5)</p>
<p>Exploring the impact of inflation on the growth of savings. (1)</p> <p>Calculating take home pay by calculating tax and National Insurance. Exploring international tax rates and comparing to the UK. (2)</p> <p>Examining Individual Savings Accounts (ISAs) and calculating the savings in tax over a period.</p> <p>Employing proportional reasoning to compare how long different people have to work to buy the same product.</p> <p>Calculating the growth in a pension pot over a working life with repeated compounding.</p>	<p>Linking the concepts of time and money to look at the total earning potential of different jobs over a period of years.</p> <p>Investigating tasks related to earnings linked to performance, for example a curtain maker being paid by the number of square metres of curtaining or a chocolatier making Easter eggs with different scale factors (hollow or solid). (6)</p>	<p>Exploring probabilities linked to winning money through gambling, by looking at card games.</p> <p>Introducing the concept of return on investment and calculating this based on likely interest rates from historical data.</p> <p>Understanding the need for life insurance and examining the links between life expectancy and life style choices.</p>	<p>(Anonymised) pocket money surveys and research into averages linked to the going rate for car washing or other chores that young people may engage in.</p> <p>Tracking the progress of shares online using interactive tools to vary time periods. (5)</p> <p>Expressing the growth of long-term savings, investments and pensions in the form of a line graph and exploring exponential relationships.</p>

Good practice for financial education across curriculum

High quality financial education relies on excellent leadership and management, and teaching and learning. For example:

- Senior managers are committed to quality financial education as an entitlement for all pupils.
- A senior member of staff is responsible for the monitoring, evaluation and co-ordination of financial education across the curriculum, including in mathematics, citizenship and PSHE education.
- Financial education is given dedicated curriculum time, supplemented by 'enrichment' activities.
- Teachers have a good knowledge of financial education, use up to date resources and refresh their skills through CPD opportunities.
- Lessons use contexts that are relevant to pupils and use active learning strategies including discussion and debate.
- Money is treated as a sensitive subject that needs careful handling in the classroom at all times. Ground rules and distancing techniques are used to create a safe learning environment in which pupils can, for example, talk about financial issues without the need to disclose personal information.
- Different religious and cultural approaches to money are reflected in learning activities, to meet the needs of pupils, to increase understanding between pupils from varied backgrounds and to promote respect for alternative viewpoints.
- Activities are adapted to suit pupils of differing abilities by for example using visual aids, short questions or working collaboratively in mixed-ability groups to facilitate peer group learning.
- Learning in the classroom is linked to life outside through effective inputs from external speakers such as debt advice charities and volunteers from local banks or credit unions.



Introduction

The following pages contain activities within six topic areas that exemplify how financial contexts can enrich the teaching of mathematics, while also providing stretch and challenge from the lowest levels of the curriculum up to exceptional performance.

These resources provide busy mathematics teachers with a range of activities that explore many key issues, including savings and investments, currency exchange and income.

The resources are built around six themes which strongly link to modules on the MoneySense for Schools financial education website (<http://moneysense.natwest.com/schools/resources/>) as follows:

Money – What is it? - Topic 1

Looks at currency exchange and the fluctuations of conversion rates.

Links to MoneySense

- Managing your Money - Financial Services
<https://moneysense.natwest.com/schools/resources/managing-your-money/financial-services>
- Planning Your Future – Life Choices and Savings
<https://moneysense.natwest.com/schools/resources/planning-your-future/life-choices-and-savings>

Money – Earning it - Topic 2

Looks at the world of work and how much people actually earn in take-home pay.

Links to MoneySense

- Planning Your Future – Your First Job
<https://moneysense.natwest.com/schools/resources/planning-your-future/your-first-job>
- You're in Business - World of Work
<https://moneysense.natwest.com/schools/resources/youre-in-business/world-of-work>

Money – Spending it - Topic 3

Looks at the cost of running a car.

Links to MoneySense

- Managing your Money - Financial Services
<https://moneysense.natwest.com/schools/resources/managing-your-money/financial-services>

- Credit and Debt – Borrowing Money

<https://moneysense.natwest.com/schools/resources/credit-and-debt/borrowing-money>

Money – Saving it - Topic 4

Focuses on saving and AER.

Links to MoneySense

- Managing Your Money - What is Banking
<https://moneysense.natwest.com/schools/resources/managing-your-money/what-is-banking>
- Planning Your Future - Life Choices and Savings
<https://moneysense.natwest.com/schools/resources/planning-your-future/life-choices-and-savings>

Money – Investing it - Topic 5

Focuses on share dealing.

Links to MoneySense

- Planning Your Future - Life Choices and Savings
<https://moneysense.natwest.com/schools/resources/planning-your-future/life-choices-and-savings>

Money – Being enterprising with it - Topic 6

An enterprise activity involving setting up an ice cream business.

Links to MoneySense

- You're in business - Starting a Business
<https://moneysense.natwest.com/schools/resources/youre-in-business/starting-a-business>

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Whatever arrangements schools put in place, teachers will want to assess pupils' progress. These resources are mapped against the attainment target level descriptions, on the basis they are familiar and reliable indicators of progression, and that many schools will still use them until alternative methods are developed. Teachers will be able to decide if it is appropriate to apply the levels to their own students.

pfeg intends to update this resource as policy and practice develops in the coming months.

1. The activities can be used for starter–main–plenary lesson plans and built into units of several consecutive lessons.

Teachers can choose their own starting points and run each activity in a way that suits the ability of their class.

2. The activities can be used to consolidate learning after mathematical skills have been learnt and where pupils are not learning new content but are working on problems that arise in other subjects and in contexts beyond the school.

The activities can be used in an open ended problem-solving approach. There are a number of advantages to more open-ended problem solving:

- Encouraging more independence and confidence.
- Differentiation by outcome.
- Extensive 'scaffolding' and worksheets are not required.

- Pupils can play adult work roles through simulations.
- The fostering of group working.

3. By registering for free at <http://moneysense.natwest.com/schools/resources/> you can use the MoneySense for Schools resource to extend and develop the learning contained within the activities.

The content of each theme is presented in 3 columns.

The activities all have dedicated resource sheets where appropriate, and web links are also provided for further exploration.

Each topic has links to activities within NatWest MoneySense for Schools modules and these are indicated beneath the curriculum links panel.

Left-hand column: contains references to mathematical outcomes from the Secondary National Curriculum until 2014 and Entry Level certificates and attainment target level description. References are made to the following strands from the programmes of study for mathematics: Working mathematically (W), Number (N); Ratio, proportion and rates of change (R); Geometry and Measures (G); Statistics (S) and Probability (P)

Central spine: develops the personal financial context and indicates mathematical opportunities. Exemplar questions are suggested and potential mini-projects outlined.

Right-hand column: a) gives pointers on principles for effective teaching that may be useful, particularly for less experienced practitioners and b) highlights areas where MoneySense for Schools has useful associated resources.

Money - Investing it

Topic 5: Sharing it out

Curriculum links

NCS / GCSE 'E'

Number (N)
Mental addition and subtraction of numbers to 2 decimal places, including positive and negative numbers.

NC6 / GCSE 'D'

Ratio, percentage and rates of change (R)
Percentage increase / decrease.

NC4 / GCSE 'F'

Statistics (S)
Describe, interpret and compare graphs.

Ratio, proportion and rates of changes (R):
Solve problems using direct proportion, including graphical representations

MoneySense links

Planning Your Future - Life Choices and Savings - Savings:
Link through discussion of savings accounts and investments, including stocks and shares and bonds.
<https://moneysense.natwest.com/schools/resources/planning-your-future/life-choices-and-savings/spending-planner>

Required resource sheets

- Resource sheet 11: Stock market performance game
- Resource sheet 12: Performance of two companies on the stock market
- Resource sheet 13: Reasons for the fluctuation of share values

Topic in a nutshell

Pupils experiment with a simple share-dealing simulation game. They then use historical share price data to compare company performance.

Talking investment

Can pupils think of any other way that their money can make more money, other than savings accounts?

Introduce the idea of shares – parts of companies you can buy and sell. Explain the fact that shares can go up in value, but they can also go down. Play the Stock market performance game (see Resource Sheet 11) to explore the concept of risk in share dealing. This also gives practice in mental arithmetic techniques.

The object of the game is to sharpen the mental arithmetic skills of the players. They must work in pence and pounds if they accumulate more than 99 pence. They will also have to cope with adding together positive and negative numbers. The recorders must also calculate mentally and write the running total down.

The recorders could use calculators to add together the numbers, in order to check their skills on entering sums of money as decimals and reading decimals as sums of money. Totals can alternatively be calculated by using spreadsheets.

Percentage profit/loss could also be calculated.

Discuss with the class the difference between savings accounts and share investments, teasing out the different levels of risk.

Encouraging cooperative small group work.

Using technology in appropriate ways.

NC4/GCSE 'G' (NA):
Mental addition and subtraction of numbers to 2 decimal places, including positive and negative numbers.

Curriculum links

The following table will help teachers to plan lessons and decide which themes and topics to focus on with pupils, based on the Secondary National Curriculum until 2014 and attainment target level descriptions.

Links are also displayed on subsequent pages for each separate topics.

	Money: What is it?	Money: Earning it	Money: Spending it	Money: Saving it	Money: Investing it	Money: Being enterprising with it
NC1/EL1			✓	✓		
NC2/EL2			✓	✓		✓
NC3/EL3			✓	✓		✓
NC4		✓	✓			✓
NC5		✓	✓		✓	✓
NC6	✓	✓	✓		✓	✓
NC7		✓	✓		✓	✓
NC8	✓	✓	✓			✓
NC9	✓	✓	✓			✓
NC EX	✓		✓			✓
GCSE G			✓	✓		
GCSE F		✓	✓			✓
GCSE E		✓	✓		✓	✓
GCSE D	✓	✓	✓		✓	✓
GCSE C	✓	✓	✓		✓	✓
GCSE B	✓	✓	✓			✓
GCSE A	✓		✓			✓
GCSE A*	✓		✓			✓

Individual tasks are also referenced to the Secondary National Curriculum until 2014, and suggestions made for attainment target level descriptions/ Entry Level and GCSE Grades. As a guide, the following rough equivalences are used:

- NC Level 1 – Entry Level 1
- NC Level 2 – Entry Level 2
- NC Level 3 – Entry Level 3 - GCSE Grade G
- NC Level 4 – GCSE Grade F
- NC Level 5 – GCSE Grade E
- NC Level 6 – GCSE Grade D
- NC Level 7 – GCSE Grade C
- NC Level 8 - GCSE Grade B
- NC Levels 9-10 Exceptional Performance – GCSE Grade A/A*

Money - What is it?

Topic 1: Currency exchange

Curriculum links

NC6 / GCSE 'D'

Statistics (S)

Construct and interpret appropriate tables, charts and diagrams

NC8-EX / GCSE 'B-A*'

Ratio, proportion and rates of change (R)

Compound interest

MoneySense links

Managing your Money - Financial Services - Branch Services:

Fact sheet includes discussion of currency exchange.

<https://moneysense.natwest.com/schools/resources/managing-your-money/financial-services/branch-services>

Planning Your Future - Life Choices and Savings - Spending Planner:

Activity includes cost of world trip/trekking so could link to discussion of currency exchange rates.

<https://moneysense.natwest.com/schools/resources/planning-your-future/life-choices-and-savings/spending-planner>

Required resource sheets

- Resource sheet 1: A different way of paying
- Resource sheet 2: Currency conversion graph
- Resource sheet 3: Currency conversion table
- Resource sheet 4: An example of a historic currency conversion graph

Topic in a nutshell

In this investigation, pupils compare how much spending money they will need at different destinations. They do this using the exchange rate for the relevant country. They also investigate the 'best' time to exchange their currencies.



How much will my spending money buy?

Give pupils Resource sheet 1 to read, or read it out loud to the class as appropriate. This article discusses the hidden costs of holidays and the proportion of holiday costs that is spending money.

Set the scene: Pupils are working for a holiday company. The company wants a page on its website comparing how much spending money people may need for different destinations.

The company needs a conversion graph for each currency on the page. This will allow customers to compare the costs of various items that they might buy while on holiday. They will then be able to choose a destination and know how much they need to save for a typical week's holiday.

Pupils work in groups, with each pupil picking one of the following countries:

- France
- India
- Dubai
- China
- United States

NC6/GCSE 'D' (S):

Construct and interpret appropriate tables, charts and diagrams.

MoneySense:

The Spending Planner encourages pupils to estimate costs of major expenditure and compare to typical values.

Use of appropriate technology to research currency rates.

Rich collaborative small-group task exploring a number of currencies.

Each pupil should then create a conversion graph using the axes in Resource sheet 2.

The groups must then agree a list of items they might buy in 1 day on holiday. Pupils use Resource sheet 3 to calculate the cost in their chosen currency, which they can plot onto the conversion graph and find a value in sterling. The group members can compare sterling costs and create their own appropriate graph together to compare spending costs in the different destinations.

Functional process skill
– interpreting – drawing conclusions in the light of the evidence – i.e. which country would be cheaper for the same spending money?

Being cute with currencies

Tell the pupils that, based on the relative spending costs and any other relevant considerations; the customer has decided to visit their chosen country in 18 months' time.

When would be the best time for them to buy their holiday money? What sort of graph might be suitable to show changes in exchange rates? An example is given in Resource sheet 4

Pupils use a website such as www.oanda.com/convert/fxhistory to find historical data for the last 12 months. They then use the data to create a time series graph by calculating a 3-point moving average. (This can be done using a spreadsheet if preferred.)

Pupils explore the trend line and extrapolate to 18 months' time. They then make recommendations to the customer based on their work.

Can they explain why the currency's rate fluctuates? (Homework on this using internet research could be set.)

What sort of issues might be worth bearing in mind when deciding when to buy foreign currency?

MoneySense:

The Branch Services fact sheet links currency exchange to bank branch services.

Provide pupils with the chance to explain and justify, question and disagree.

Consider the appropriateness and accuracy of making decisions based on extrapolations.

Research task: Crazy currencies

- What is hyperinflation?
- What countries have had this?
- What did it mean for them?
- What would a £100 pair of jeans cost in the UK after 1 week, 1 month or 1 year if we had hyperinflation of 1,200% per year?
- What would £100 be worth after a year?
- Let pupils carry out research to find recent examples of hyperinflation.
- Further work could focus on deflation too- is this a good thing in comparison?

NC8-EX/GCSE 'B-A*' (R):
Compound interest.

Money - Earning it

Topic 2: The world of work

Curriculum links

NC4/ GCSE 'F'	Number (N) Add and subtract decimals
NC6 / GCSE 'D'	Number (N) Multiply and divide decimals by whole numbers
	Ratio, Proportion and Percentage Increase (R) Solve problems involving percentage change
NC5 / GCSE 'E'	Number (N) Use a calculator ... to calculate results accurately and then interpret them correctly.
NC7 / GCSE 'C'	Number (R) Apply percentage change using multiplicative methods
NC8 / GCSE 'B'	Number (N) Reverse percentages

MoneySense links

Planning Your Future - First Job - Payslips:

Links through discussion of reading payslips, salary deductions, income tax.
<https://moneysense.natwest.com/schools/resources/planning-your-future/your-first-job/payslips>

You're in Business - World of Work - Freelancing:

Link to calculating tax and other deductions when you are self employed.
<https://moneysense.natwest.com/schools/resources/youre-in-business/world-of-work/freelancing>

Required resource sheets

- Resource sheet 5: Annually, monthly, weekly

Topic in a nutshell

Pupils find out about the minimum wage and calculate earnings, tax and National Insurance.

Activities include a modelling exercise involving pay rises and pay cuts, and a rich collaborative task.

Job	Average salary	Monthly salary	Weekly salary
Young farm worker	£15,000	£	£
Older farm manager	£20,000	£	£
Newly-qualified teacher	£25,000	£	£
More experienced teacher	£28,000	£	£
Army soldier (see recruit)	£15,000	£	£
Army sergeant	£24,000	£	£
Company driver	£18,000	£	£
Leisure centre assistant	£12,000	£	£
Airplane cabin crew	£19,200	£	£
Nurse	£24,000	£	£

Introduction to the minimum wage

Age range	Minimum wage per hour
Apprentice rate	£2.68
16-17	£3.72
18-21	£5.03
22+	£6.31

N.B. Information correct as at 1/10/2013

Up-to-date information about the minimum wage is available at: www.direct.gov.uk/en/Employment/Employees/TheNationalMinimumWage/index.htm

Pose a problem to the whole class to stimulate paired discussion and set the agenda for the next few lessons

MoneySense:

Pay slips: The Fact file contains plenty of information about the minimum wage and how tax is calculated

NC4/GCSE 'F' (N):

Add and subtract decimals

NC6/GCSE 'D'**(N):** Multiply and divide decimals by whole numbers**(R):** Ratio, Proportion and Percentage Increase: Solve problems involving percentage changes

Display the table of information above and use it as a basis to explore questions **at a level appropriate for the group**, e.g.:

- How much does the minimum wage rate increase when you reach your 18th birthday?
- How much would someone aged 19 on the minimum wage earn working a 40-hour week?
- How many hours would you need to work to earn £200 if you were aged 17 and on the minimum wage?
- If you are 25 and on the minimum wage, how much would you get per hour for working at 'time and a half' on Saturdays?
- If you were aged 18 and on the minimum wage and were given a 10% pay rise, what would be your new rate of pay?
- What is the percentage increase in the minimum wage hourly rate between age 21 and 22?

Pupils could be asked to work in pairs to devise 5 new questions based on this information for another pair to complete.

Jobs fair

Display material (e.g. blown-up job adverts) around the room advertising various jobs and associated annual salaries. Ideally you need about 20 different examples.

Ask pupils to compile a list of 10 jobs that interest them, write down the annual salary and calculate the gross monthly pay and gross weekly pay for each job. Use <https://nationalcareersservice.direct.gov.uk/advice/planning/jobfamily/Pages/default.aspx> for annual salary information, or Resource sheet 5 (salary information correct as at 1/10/2013).

P.A.Y.E. and National Insurance Contributions (NICs)

Do any pupils know what National Insurance is or what it helps to fund? You can explain that you pay NICs to build up your entitlement to certain social security benefits, including the State Pension. Alternatively you can ask pupils to carry out some independent research and report back.

NCS/GCSE 'E' (N):

Use a calculator to calculate results accurately and then interpret them correctly.

The type and level of NIC you pay depends on how much you and whether you're employed or self-employed. You stop paying NICs in the year you reach State Pension age. (If pupils wish to calculate their State Pension age, they can use the calculator at this address: <http://pensions.direct.gov.uk/en/state-pension-age-calculator/home.asp>.)

The following amounts apply for the 2013/14 tax year:

- If you're employed and earn above £149 a week (the 'earnings threshold') and up to £797 per week, you pay 12% of this amount as 'Class 1' NICs. You also pay 2% of earnings above £797 a week as Class 1 NICs.
- If you're self-employed, you pay 'Class 2' NICs at a flat rate weekly amount of £2.70, but only if you earn over £5725 each year. You also pay 'Class 4' NICs as a percentage of your taxable profits – 9% on annual taxable profits between £7,795 and £41,450 and 2% on any taxable profit over that amount.

MoneySense:

Payslips: The video of Paul (the plumber) is about pay deductions. His interactive payslip can be used to explore terminology and to calculate deductions

MoneySense:

Freelancing: The Going Freelance fact file gives lots of food for thought about self

Ask the pupils if they think that this is a fair system. Pupils could investigate NICs of the employed and self-employed for various annual incomes.

Use of real-life context

In 2013/14 Income Tax was charged at:

- 0% – Personal Allowance: £9,440
- 20% tax band: £9,440–£32,011
- 40% tax band: over £32,010

After being shown an example, pupils could work out annual, monthly and weekly tax amounts for perhaps 2 or 3 of the salaries from their earlier list.

They could then be asked to consider whether or not this is a fair system. Does everyone pay the same proportion of their salary in tax? This could be investigated.

Useful links

As well as the MoneySense Pay Slip resource signposted earlier, the Tax Matters website includes an exemplar payslip with rollover of definitions in its Income Tax factsheet section: www.taxmatters.hmrc.gov.uk

Also – the Fortunity game may be useful: www.pfeg.org/fortunity

A useful source of current information about Income Tax and National Insurance is: <https://www.gov.uk/browse/tax>

Extending the challenge:

NC7/GCSE 'C' (R):

Apply percentage change using multiplicative methods

Pupils could be asked to devise alternative Income Tax models, working in pairs to investigate the effect of using different allowances and percentages. They could be asked to explain and justify their model, pointing out its strengths and weaknesses, by presenting graphs and calculations to the rest of the class.

Rich Task

Ask the pupils to imagine that they run a large company with staff employed on a wide range of salaries.

Each year the company increases its profits and rewards its staff with a pay rise. How should the extra pay be shared out?

Pupils could be asked to put forward ideas for fair distribution and then asked to work in pairs to formulate their own model with exemplar calculations.

NC8/GCSE 'B' (N):

Reverse percentages.

A particular company rewarded its staff with a 10% pay rise in December 2011. In December 2012 the company was suffering from a lack of orders due to losing one of its biggest customers. To avoid redundancies, staff were asked to accept a 10% cut in pay. Did everyone revert to their 2011 wage rate?

You could also look at a system for sharing out tips in a restaurant. <http://news.bbc.co.uk/1/hi/business/8281191.stm> is an interesting background story.

Money - Spending it

Topic 3: A set of wheels

Curriculum links

NC1 / EL1	Number (N) Count and order up to 10 objects. Statistics (S) Sort objects and classify them.
NC3 / EL3	Number (N) Read, write and order whole numbers to 1000 Statistics (S) Construct and interpret bar charts
NC4 / GCSE 'F'	Statistics (S) Appropriate measure of central tendency (mean)
NC5/GCSE 'E'	Statistics (S) Describe simple mathematical relationships between 2 variables and illustrate using scatter graphs.
NC6 / GCSE 'D'	Statistics (S) Grouping data
NC6 / GCSE 'D'	Working mathematically Multi-step questions
NC 7-EX / GCSE C-A*	Algebra (A) Model situations or procedures by translating them into algebraic expressions or formulae.
NC7 / GCSE 'C'	Geometry and Measure (G) Use compound units to solve problems.

MoneySense links

Planning Your Future - Life Choices and Savings - Spending Planner:

This activity discusses buying a car.

<https://moneysense.natwest.com/schools/resources/planning-your-future/life-choices-and-savings/spending-planner>

Credit and Debt - Borrowing Money:

Could link activities about borrowing eg 'Why borrow Money' and 'Interest and APR' to buying a car.

<https://moneysense.natwest.com/schools/resources/credit-and-debt/borrowing-money>

Required resource sheets

- Resource sheet 6: Example of car prices from local paper
- Resource sheet 7: The car you drive (cards)
- Resource sheet 8: Who you are (cards)
- Resource sheet 9: The mileage you do (cards)
- Resource sheet 10: Car information sheet

Topic in a nutshell

Pupils investigate car purchase from the pages of a local newspaper. They carry out simple mathematical exercises based on data collection and investigate how much it costs to run a car per year, using a linear statement.



Buying a car

Explain to pupils that buying a car is likely to be a compromise between what they would like and what they can afford. For this exercise, they will need the motoring pages of a local newspaper (or alternatively you can use Resource sheet 7).

Pose the following simple questions:

- How many cars are there in each column?
- Ask the pupils to sort the cars into different colours. Pupils record the results of the car sort into a list or block graph.
- How many cars are there of each colour? Extract information on colour from the bar chart.
- Ask the pupils to order the cars by price. Find a car under £1,000. If you have saved up £999, how much money would you have left over after buying the car you have chosen?
- Record the colours or makes of car using a frequency table. Group the data by price.
- Identify the cheapest and most expensive; what is the price range?
- Pick 3 favourite cars and add up the prices.
- Ask the pupils to find the mean price of all the cars from their tables.
- Discuss if the mode price would be a reasonable average in this case.
- Find the median price. Is this a reasonable average?
- Use price or mileage as continuous data, construct frequency diagram choosing class widths.

Small-group work

Best answer?
Sharing answers with partner, checking.

Collaborative work.
What if?
Redesign problem.

Green motoring or not?

Set the scene: Manufacturers try to get us to buy cars by exploiting their 'green' credentials. Is there any connection between the price we pay for a car and its fuel consumption? What about engine size vs fuel consumption or emissions, or even the noise level of an engine!

The Vehicle Certification Agency publishes data on all new cars, which is downloadable from: <http://carfueldata.direct.gov.uk>

Working in groups, pupils choose 10 cars with various characteristics. They then decide which variables they are interested in and what connections they think there might be between the variables, e.g. car price and fuel consumption or engine size and emissions or noise level.

Price data for new cars can be obtained from a site such as: www.carpricechecker.co.uk (Care must be taken that the exact model, i.e. engine size is used for both consumption and price.)

Before scatter graphs are created, what would pupils predict them to look like and why? Create scatter graphs; were they right? Does the scatter graph show a correlation and if so, what type? What conclusions can they draw?

Open-ended investigation.
Working in groups, pupils pose their own hypotheses and form conclusions.

Opportunity to explore equivalence. E.g. a Ford Ka 1.2 has an engine size of 1.2L = 1200cc = 1200ml

NC1/EL1:

(N) Count and order up to 10 objects.
(S) Sort objects and classify them.

NC3/EL3:

(N) Read, write and order whole numbers to 1000
(S) Construct and interpret... bar charts

NC4/GCSE 'F' (S):

Appropriate measure of central tendency (mean)

NC6/GCSE 'D' (S):

Grouping data

NC5/GCSE 'E' (S):

Describe simple mathematical relationships between 2 variables and illustrate using scatter graphs.

Can I afford to run a car?

In this activity, pupils explore a simple statement, which incorporates a rich task and involves them in some functional skills. In answering the above question, they focus on fixed and variable costs.

Opportunity for collaborative rich task learning.
Open-ended task allows further challenge and extension.

Pupils will need:

- a car from resource sheet 8 (giving miles per gallon)
- a mileage card from resource sheet 9
- a 'who you are card' from resource sheet 8 and the following information:
- The cost of fuel (www.petrolprices.com)

NC6/GCSE 'D' (W):

Multi-step questions.

NC7/GCSE 'C' (G):

Use compound units to solve problems.

They can then calculate the cost per mile for their car and thence, the weekly cost of fuel

Note: 1 litre = 0.219960 imperial gallons.

Working from resource sheet 10, pupils can add in the extra cost of insurance, road tax and MOT to establish a weekly cost for their scenario.

Let the pupils absorb the information and take some feedback/comments, based on their yearly calculated mileage. Comparing this to the income for their character should then help to answer the question – can their character afford to run a car?

Pupils may wish to factor in the purchase price of the car and the costs of financing the purchase. MoneySense activities from Credit and Debt – Borrowing Money would be appropriate to use.

MoneySense:

The Spending Planner allows pupils to estimate the cost of buying a car amongst other items.

MoneySense:

The Borrowing Money module has videos and case studies and covers the concept of APR. A final quiz is provided to check understanding.

NC7-EX/GCSE 'C-A' (A):

Model situations or procedures by translating them into algebraic expressions of formulae.

Increasing the challenge

The activity can be further extended by considering the question; can you develop a formula that can be used to calculate the weekly cost of running the car you have?

Pupils have the opportunity to derive the direct proportionality statement:

$$R_1 \propto M$$

And solve the linear equation:

$$R_1 = kM, \text{ just considering mileage costs.}$$

They then go on to consider fixed costs and derive the linear equation:

$$R_2 = kM + C$$

Where:

R_1 = running costs due to petrol costs alone

M = mileage

C = fixed costs

R_2 = total costs including fixed and variable elements

Money - Saving it

Topic 4: Interesting money

Curriculum links

NC1 / EL1

Number (N)

Repeated addition

NC2 / EL2

Number (N)

Use standard units of money.

Working Mathematically

Consolidate numerical capability from key stage 2.

NC3 / EL3

Number (N)

Adding and subtracting positive integers.

MoneySense links

Managing your Money - What is Banking:

link through shared discussion of the services banks provide including saving schemes and interest rates.

<https://moneysense.natwest.com/schools/resources/managing-your-money/what-is-banking>

Planning Your Future - Life Choices and Savings - Spending Planner:

Link through discussion of saving options.

<https://moneysense.natwest.com/schools/resources/planning-your-future/life-choices-and-savings/spending-planner>



Topic in a nutshell

Pupils carry out research on savings to fully understand the concept of annual equivalent interest or AER.

What is saving?

NC1/EL1 (NA):

Repeated addition.

Discuss the topic, 'what is saving?' This should elicit ideas on:

- how often we can save.
- how much and where money can be saved (e.g. it could be saved at home in a money box, but what about putting it in a bank or building society?)
- how pupils could save for a special purchase
- whether the adults they know save regularly.

Present simple questions to the class, such as:

If you save £2; £2.50; £10 each week, how much would you have at the end of:

- 1 month
- 3 months
- 1 year?

Link this discussion to coin recognition by placing savings boxes in the classroom. For each pound the pupils save in the savings boxes, the teacher puts in 5 pence. Can anyone explain why? Introduce the concept of interest paid by banks and building societies.

Building on students' previous knowledge

MoneySense:

Life choices and savings:
The Savings Module has a video exploring options and a downloadable fact sheet.

Building on students' previous knowledge.

Pupils can be asked what they know about banks and building societies. One approach is to get them to brainstorm using a 'spider diagram' on a sheet of A3 paper. Pupils come up with as many examples of 'services banks provide' as they can. Relevant to this is the use of banks' savings schemes. (The MoneySense module, 'What is banking?' might be helpful).

A possible role-play scenario could be as follows:

Some pupils take on the role of savers with different sums of money to save monthly. Other pupils are bank savings advisers offering different rates of interest. Savers move from 'bank to bank', discussing the different deals on offer.

The class could discuss the exercise, i.e. who gave the best interest rate? How would this make a difference to my savings? They can do the calculation for each exchange.

Repeat with a change in interest, e.g. 10 pence or 3 pence goes into the savings box at the outset (instead of 5 pence).

Discuss with the class why some banks offer more interest than others.

Pupils can be told that banks express their interest payments as AER (annual equivalent rate). They can research this themselves or it can be explained to them: AER shows the true rate of interest you will have received by the end of the year, taking into account the regularity with which interest is added to the account. This is because the payment frequency has a compounding effect on the amount of interest you receive (i.e. compound interest). In other words, the more you save and the more often you save, the more the interest grows.

It would be interesting for pupils to research savings accounts with different types of provider such as credit unions *, banks, building societies, national savings and investments (NS&I).

You could ask them to research the key features of each account (access restrictions; interest rates; ethical considerations; stability of institution; risk of interest rate changes).

*Information about credit unions may be obtained from the website www.abcul.org.

NC3/EL3 (N):

Adding and subtracting positive integers

MoneySense:

What is banking: Accounts: What's the difference fact

Role-play to explore concepts.

Effective open-ended questioning.

MoneySense:

What is banking: Contains 'Accounts - what's the difference?', a fact file explaining alternative types of bank accounts



Money - Investing it

Topic 5: Sharing it out

Curriculum links

- NC5 / GCSE 'E'** **Number (N)**
Mental addition and subtraction of numbers to 2 decimal places, including positive and negative numbers.
- NC6 / GCSE 'D'** **Ratio, percentage and rates of change (R)**
Percentage increase / decrease.
- NC4 / GCSE 'F'** **Statistics (S)**
Describe, interpret and compare graphs.
- Ratio, proportion and rates of changes (R):**
Solve problems using direct proportion, including graphical representations

MoneySense links

Planning Your Future - Life Choices and Savings - Savings:

Link through discussion of savings accounts and investments, including stocks and shares and bonds.

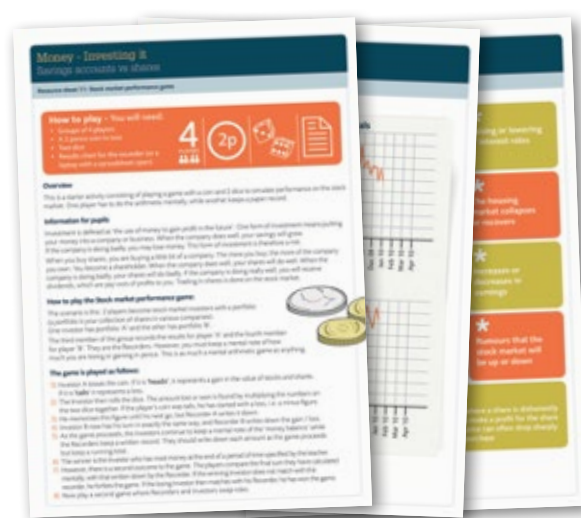
<https://moneysense.natwest.com/schools/resources/planning-your-future/life-choices-and-savings/spending-planner>

Required resource sheets

- Resource sheet 11: Stock market performance game
- Resource sheet 12: Performance of two companies on the stock market
- Resource sheet 13: Reasons for the fluctuation of share values

Topic in a nutshell

Pupils experiment with a simple share-dealing simulation game. They then use historical share price data to compare company performance.



Talking investment

Can pupils think of any other way that their money can make more money, other than savings accounts?

Introduce the idea of shares – parts of companies you can buy and sell. Explain the fact that shares can go up in value, but they can also go down. Play the Stock market performance game (see Resource Sheet 11) to explore the concept of risk in share dealing. This also gives practice in mental arithmetic techniques.

NC4/GCSE 'G' (NA):

Mental addition and subtraction of numbers to 2 decimal places, including positive and negative numbers.

The object of the game is to sharpen the mental arithmetic skills of the players. They must work in pence and pounds if they accumulate more than 99 pence. They will also have to cope with adding together positive and negative numbers. The recorders must also calculate mentally and write the running total down.

The recorders could use calculators to add together the numbers, in order to check their skills on entering sums of money as decimals and reading decimals as sums of money. Totals can alternatively be calculated by using spreadsheets.

Percentage profit/loss could also be calculated.

Discuss with the class the difference between savings accounts and share investments, teasing out the different levels of risk.

Encouraging cooperative small group work.

Using technology in appropriate ways

- Savings: original sum much safer; steady but modest returns.
- Shares: original sum could be lost; fluctuating values but historically higher returns over a longer period.

Risk and reward

Because shares can be a risky investment, they need to be looked at with special care. Use Resource sheet 12 to compare 2 different shares over an 18-month duration.

Nudge pupils into asking and answering questions such as:

- • What 'stories' do the graphs tell about each company?
- • Why do the graphs go up and down? (See Resource sheet 13 for possible reasons for fluctuations of share values.)
- • Which share would you prefer to invest in and why?
- • How many shares in ZN-C Pharmaceuticals could you buy for £1,000 at different times of the year?
- • What about Euro Intermedix?
- • If you invested £1,000 in each share in January, how much would your shares be worth 6 months, a year, or 18 months later?
- • Estimate how much the shares might be worth 2 years later.

Use Resource sheet 12 to explore the percentage profit or loss pupils could make over a year from November to November by buying and selling shares in either company. (Buying and selling in November appears to give a larger gain in Euro Intermedix, but a more careful look at the price scales reveals that the best profit is gained with ZN-C Pharmaceuticals).

Further exploration of real company share fluctuations could make use of websites containing historical share price data such as: <http://uk.finance.yahoo.com>.

Once on the Yahoo site do the following:

- Click on the 'Investing' tab at the top.
- Then click on 'Market Movers' on the left-hand side.
- Select one of the shares in the table.
- View: 'Historical prices' on the left-hand side – this gives historical share prices in a table.
- View: 'Charts - Interactive' on the left-hand side – this gives historical share prices in a graph.

It is worth playing with the graphs to exploit their interactivity. What 'stories' do the graphs tell you?

The graphs give an excellent opportunity to explore proportionality by setting challenges such as: who can find a company that grew by 20% in the last year?

Yahoo's Fantasy Trader (also from the investing tab) allows you to manage a virtual shares portfolio free of charge, as do the following sites: www.virtualtrader.co.uk and www.share.com

NC6,7/GCSE 'D,C':

(S): Describe, interpret and compare graphs.

(R): Solve problems using direct proportion, including graphical representations

NC6/GCSE 'D' (R):

Percentage increase / decrease.

NC6,7/GCSE 'D,C':

(S): Describe, interpret and compare graphs.

(R): Solve problems using direct proportion, including graphical representations

MoneySense:

Life choices and savings:
The Savings Module has a video exploring options and a downloadable fact sheet that includes info re shares and bonds

Addressing common misconceptions - opportunity to explore misleading graphs.

Using real data

Money - Being enterprising with it

Topic 6: Ice cream cones

Curriculum links

NC2 / EL2	Number (N) Understanding the place value of each digit in a number and use this to order numbers up to 100.
NC3 / EL3	Number (N) Adding and subtracting numbers with 2 digits mentally and 3 digits using written methods. Recognizing negative numbers in contexts such as money and temperature.
NC4 / GCSE 'F'	Geometry and Measure (G) Construct and interpret 2D representations of 3D shapes
NC5 / GCSE 'E'	Number (N) Calculating fractional parts of quantities. Geometry and Measure (G) Measure angles in geometric figures
NC6 / GCSE 'D'	Geometry and Measure (G) Use the properties of ...cones ... to solve problems in 3D. Calculating...volumes.. of prisms.
NC8-EX / GCSE 'B-A*'	Number (N) Calculate possible resulting errors expressed using inequality notation $a < x \leq b$ Geometry and Measure (G) Calculating...areas of sectors...and volumes of cones and spheres.

MoneySense links

You're in Business -Starting a Business - Steps to Success & Starting a Cafe:

Close links to setting up an ice-cream business.

<https://moneysense.natwest.com/schools/resources/youre-in-business/starting-a-business>

Required resource sheets

- Resource sheet 14: A brief history of ice cream
- Resource sheet 15: Types of ice cream
- Resource sheet 16: Business costs sheet
- Resource sheet 17: Your ice cream business

Topic in a nutshell

Pupils simulate setting up an ice-cream business. In the lead up to this, pupils undertake a geometric investigation into volumes related to ice creams and a monetary investigation into costs.

Alternatively, teachers can start with the enterprise as a rich collaborative task in **Scenario A**.



NC2/EL2 (N):

Understanding the place value of each digit in a number and use this to order numbers up to 100.

NC3/EL3 (N):

Adding and subtracting numbers with 2 digits mentally and 3 digits using written methods.

Recognising negative numbers in contexts such as money and temperature.

NC4/GCSE 'F' (G):

Construct and interpret 2D representations of 3D shapes

NC5/GCSE 'E' (G):

Measure angles in geometric figures

NC5/GCSE 'E' (N):

Calculating fractional parts of quantities

NC6/GCSE 'D' (G):

Use the properties of ...cones ... to solve problems in 3D.

NC6/GCSE 'D' (G):

Calculating volumes of prisms.

Ice Cream Plan

Give out Resource sheet 14 as background reading and an introduction to ice cream, and Resource sheet 15 showing different types of ice cream.

After the pupils have read through Resource sheet 14, split the class into small groups and ask them to look at Resource sheet 15. Ask them to count how many of each ice cream there are, then classify them using properties, and order them according to price.

Let the pupils do some activities about the cost of buying various numbers and mixtures of ice creams, including flakes, chocolate sprinkles, raspberry sauce, etc., and getting change.

How many ice creams can you buy with a given sum of money? Let them gather data on orders for a group of people, calculate the price and work out the change from a £20 or a £10 note.

Discuss storage temperatures of ice cream and ice-lollies. Explore the concept of negative numbers and their magnitude. (Note: It is illegal to serve ice cream that has risen to a temperature above -2.2°C .)

Let's get conical

Ask pupils to draw a cone on paper and see what they come up with, e.g. they might use a triangle to represent it or perhaps a triangle and a circle. Lead them towards the use of the standard 3D diagram.

Ask them to make a cone, using a circle with a slit and overlapping the paper. One 10cm diameter circle fits onto a sheet of A4.

They make a number of different cones with the same slope length, using different sector angles, e.g. 180° ; 120° ; 90° ; 72° ; 60° .

Let them discuss why a business would only consider making cones with these sector angles (e.g. to minimise waste). Which one would customers want to buy? Pupils choose their 'best' ice-cream cone and estimate, and then measure the angle of the sector of waffle used.

Pose questions like:

If the cost of a waffle is 60p...how much would it cost for a waffle sector with an angle of 180° ; 120° ; 90° ; 72° ; 60° ?

Tip for pupils: Buy a well-known wrapped ice-cream cone to demonstrate that the sector angle of the waffle is 60° (it fits exactly into a 60° paper cone), and the angle of the wrapping is 72° .

For the business cost activity, see Resource sheet 16.

Nice choc-ices

Ask pupils to draw a choc-ice and see what they do (e.g. do they draw 1 rectangle or a series of separate rectangles to represent the different views?). Lead them towards the use of the standard 3D diagram.

A choc-ice measures approximately $8 \times 4 \times 2\text{cm}$. Calculate the volume of the ice cream, assuming that the chocolate coating is 1mm thick. Calculate the volume of chocolate.

Use cooperative small-group work.

Develop effective questioning

Building on prior knowledge

Practical activity to actively engage pupils.

Develop effective questioning

Build on the knowledge pupils bring to a sequence of lessons

Opportunity for reflection on the strengths and weaknesses of the various possibilities

NC8-EX/GCSE 'B-A*' (N):

Calculate possible resulting errors expressed using inequality notation $a < x < b$

Ask the pupils to calculate the following:

- What are the maximum and minimum dimensions and volumes of the ice cream and the chocolate, in the choc-ice, given that the measurements are imprecise?
- If you reduce the overall size of the bar by a fixed percentage, but the thickness of the chocolate remains the same, by what proportion do the volumes of the ice cream and chocolate change?
- What if the chocolate thickness were also to be reduced by the same fixed percentage.

Extending the challenge:

If ice cream costs £1 per litre, chocolate costs £3 per litre and 1 litre contains 1,000cm³, ask the pupils to calculate the following:

- The cost of producing one choc-ice (see also Resource sheet 16 on business costs).
- The profit margins and percentage profit.
- The potential to increase profit by reducing quantities of ingredients and selling at the same price. How much could you reduce the bar by before a consumer would notice?

NC6-EX/GCSE 'D-A*' (G):

Calculating...areas of sectors... and volumes of cones and spheres.

The challenge is far greater if a cone is used instead of a choc-ice. See Resource sheet 17 for additional activities, including maximum and minimum volumes of cones, volumes of spheres, etc. Resource sheet 17 also requires the business costs in Resource sheet 16.

Rich collaborative enterprise task

Teachers may wish to use the following scenario for their pupils:

Tell them they are to set up their own ice-cream business.

- They have to produce a business plan in order to obtain funding to start up their business.
- They should look at their likely running costs and also come up with proposed prices for their ice-cream cones.
- Teachers can decide, according to the ability of the group, how much of this information the pupils should have as whether they will be manufacturing cones or choc-ices.
- Resource sheets 16 and 17 provide guidance.

Develop effective questioning

Opportunity for collaborative rich task learning.

Opportunity for enterprise activity

Encourage pupils to talk about 'how' they did the task. Did they use spreadsheets?

MoneySense:

Steps to success module: Contains a range of worksheets linked to starting your own business, including how to make a presentation on your plans.

Materials from the starter section are relevant.

MoneySense:

Starting a café module: Contains a wealth of materials for groups of pupils to take part in an enterprise challenge in this context similar to the ice-cream scenario



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