

COUNT ON US

SECONDARY CHALLENGE



GUIDANCE FOR SCHOOLS 2023

INCREASING STUDENT ENGAGEMENT IN MATHS

INTRODUCTION

The **Count on Us Secondary Challenge** is a unique, pan-London inter-school maths challenge for Year 7, 8 and 9 students delivered by the Mayor's Fund for London in partnership with the Jack Petchey Foundation. By combining a series of strategy, geometry, probability and statistics, mental arithmetic and problem-solving activities, the Secondary Challenge aims to develop students' confidence, fluency and problem-solving in Mathematics through taking part in an exciting maths competition against their peers.

The last challenge was our eighth year of the Secondary Challenge, with secondary schools from across London competing in Heats in various locations and in-person at the Final in the new City Hall, next to the Excel Centre and the London cable car. This year will be the same with a challenge in two stages:

Stage 1 **In-school activities and tournament.** All schools will use the activities with groups of students across Key Stage 3 culminating in an in-school or possibly intra-school tournament to maximise participation.

Stage 2 **Regional Heats** for all participating schools. These will be in-person events in various locations, covering different areas of London. Followed by a **Final** in which the Heat winners and other highest scoring schools will join us at new City Hall for the grand finale!

The Count on Us Secondary Challenge is supported and run by Chris Olley, who is a director of The Maths Zone, having previously been director of the secondary maths PGCE at King's College, London.

We are looking forward to another fantastic year of maths with our 2022/23 Count on Us Secondary Challenge schools!

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WHAT DOES THE COUNT ON US SECONDARY CHALLENGE INVOLVE?

The Count on Us Secondary Challenge involves a range of activities rooted in the mathematics of the Key Stage 3 National Curriculum (covering geometry, number, algebra, probability & statistics), set in engaging games, puzzles and problem-solving contexts. The materials are designed to be used in a range of ways:

1. In normal routine lessons as part of ordinary mathematics lessons.
2. For student self-directed catch-up work.
3. Within a club or other out of lesson situations.
4. In the Count on Us tournament, consisting of in-school and local school group tournaments and then the pan-London Heats and Final.

The Count on Us Secondary Challenge involves a range of schools from around London. The materials can be used with all your Key Stage 3 students. However, in each school at least 100 students are selected to engage more deeply in a range of activities from whom a team of 5 is selected. The challenge is designed to support the National Curriculum which foregrounds fluency, reasoning mathematically and solving problems. It explicitly emphasises these three ways of working. Students will develop fluency by practising hard to solve number, algebra and fraction combination problems in a fast-paced game. They will need to reason algebraically to compare and solve statements to complete a London-themed problem-solving task. They will develop their geometric reasoning skills by solving geometry problems in a specially designed game produced for the tournament. Finally, they will play as a team in the probability game of hedgehog and become human components of statistical charts to fit given data sets.

GUIDANCE FOR SCHOOLS:

This guide has been designed to provide participating schools with information and support to ensure that all students arrive fully engaged in the Secondary Challenge.

This guidance for schools:

- Gives teachers an overview of the activities and how they can be used.
- Provides ideas on how to integrate these into everyday classroom activities.

We want to ensure that your students will have had lots of opportunities to develop their maths skills in each of the key focus areas and those chosen for your tournament team will arrive at the Regional Heats ready for what will be a very competitive and exciting event.

ONLINE SUPPORT:

We have also created a Count on Us Secondary Challenge website. Visit the website at www.mayorsfundforlondon.org.uk/our-programmes/count-on-us-secondary Here you will find vital resources, notably a series of newly produced training videos designed to

show you how all the activities work with detailed instruction. Also, there are practice materials notably including example sets of materials for the algebra round.

THE CHALLENGE IN SCHOOL:

As you use the activities in school, it is very important to balance the different aspects of the Count on Us Secondary Challenge:

1. Using the materials in normal classroom lessons.
2. Supporting students to use the student guide to support their curriculum studies.
3. Providing opportunities for at least **100 students** to engage with the activities in a challenging and fun environment, where they can develop their mathematical skills with the activities.
4. Selecting **5 students** to represent the school in the Regional Heats who have been most successful with the activities. This team will need to train hard to be as successful as possible, just as they would for any competitive event.

Our experience in past tournaments showed very clearly that the schools that did best had prepared the best and that students' enjoyment and engagement depended on them having prepared properly and fully.

Before participating in the regional Heats, schools should run an internal tournament in school or with a partner school by February/March 2023. **This is really important.** Not only will your students develop familiarity with the activities and the format, it will allow you to select your team. You can run a tournament with a class, a year group or even a whole key stage. Materials to support this are available on the Secondary Challenge website. Then, you will be able to choose your final team **AFTER** you have run your school tournament!

Student Engagement Checklist:

- Share the activities with colleagues at a staff meeting so they can introduce aspects of the Secondary Challenge into their teaching in the spring and summer terms.
- Introduce activities in Year 7, 8 and 9 maths lessons to identify which students enjoy taking part in the activities and who is getting good at the challenges.
- Set up a Count on Us Secondary Challenge Club before/during/after school, where students can practise and find activities to take home.
- Run a curriculum evening for parents. Involve parents e.g. with a newsletter.
- Spread the word about your team's hard work on Twitter (@mayorsfund) and your school website. Hold an assembly to let everyone know what you've been up to.
- Run an in-school or intra-school event giving students experience of a tournament setting.
- Select your team of five participants.

WHAT DO YOU NEED TO DO FOR THE TOURNAMENT?

Spring Term: 1st half term

- Assign a lead person to take responsibility for the Count on Us Secondary Challenge, this could well be you! Assign a support person who can step in if there is an emergency.
- Introduce the activities in school using the ideas in this guide.
- Begin practising with 100 Year 7/8/9 students. The activities are designed to support the national curriculum and therefore can be used in the classroom as well as in a maths club.

Spring Term: 2nd half term

- Continue practising with your students as much and as often as possible!
- Run your in-school tournament and select a team of 5 for the Count on Us Secondary Challenge. We strongly recommend that teams should be selected from Year 8 or 9. If students have been in the team in any previous year, they are not permitted to participate again.
- Ensure that all parental consent forms for the regional Heats are completed.
- In the Heats, your lead person will need to act as a teacher judge for the geometry, 24@Game and algebra rounds.

Summer Term

- Participate in the regional Heats which will take place in different locations around London. You will be allocated a Heat according to your location. Qualifying schools will participate in the Final at the end of June.

KEY DATES:

In Person Training (for teachers new to COU): Nov 15th 2022

Online Training (for experienced COU teachers): Nov 23rd 2022

Heats: Late April - Early May 2023 TBC

Final: Late June 2023 TBC

HOW TO CHOOSE YOUR TEAM FOR THE COUNT ON US SECONDARY CHALLENGE...

You may be really surprised by who begins to shine in the different aspects of the Challenge. You may find that a student who is super quick at solving the number problems on their own is less confident about working in a team solving geometric problems. Long before you consider who your team members might be, you will be using the activities in your Count on Us group sessions and in normal lessons as well.

The final stage before selecting your team, will be to run a practice tournament in school or indeed between a local group of schools maybe within your MAT or Borough groups. You should use each of the areas of the Count on Us Secondary Challenge – geometry, number, algebra and statistics and probability. By this stage you will have allowed as many opportunities as possible for as many students as possible to get good at the activities. Practice materials are available on the Count on Us Secondary Challenge website.

Remember, teams must:

- Have **5** students total (plus at least one reserve in case of difficulties).
- Be selected from **Years 7, 8** and/or **9**.
- Have **NOT** participated in a tournament previously.
- Be mixed gender (all boys/girls schools are naturally exempted from this).

HOW WILL THE COUNT ON US SECONDARY CHALLENGE BE EVALUATED?

We will be measuring the impact of the project on students and gathering feedback about how the project could be developed for future years. This information will be gathered through evaluation forms for students and staff, to be completed at tournament events.

We will also be reaching out to schools to request a case study towards the end of the programme. If you have a student or story that would make an ideal case study, please do let us know!

SPREAD THE WORD ONLINE

We want to make sure that everyone in London knows about how fantastic your mathematicians really are. We love seeing your updates and photos on Twitter! Please keep the updates coming and remember to tag us - **@mayorsfund** and **#CountOnUs** in any online activity.

Don't forget to let your whole school community know about your students' achievements. Why not include a story on your school website?

THE COUNT ON US SECONDARY CHALLENGE ACTIVITIES

The Count on Us Secondary Challenge is designed to focus on the key elements of the new national curriculum. The principal feature is the foregrounding of three approaches:

“... students should build ... connections across mathematical ideas to develop fluency, mathematical reasoning and competence in solving increasingly sophisticated problems”. (DfE, 2014)

Get started in understanding the various rounds by watching the specially prepared training videos on our web site: <https://www.mayorsfundforlondon.org.uk/secondary-challenge-support-area/>

The Count on Us Secondary Challenge consists of 5 rounds, each designed around these key mathematical foci while developing fluency in a different content area of the mathematic curriculum. Scoring is equally weighted by topic so probability and statistics, geometry, number and algebra score one quarter of the total each.

ROUND	ACTIVITY	FOCUS	CONTENT
1a	The Game of Hedgehog	Reasoning	Probability
1b	Data-Chart-Statistics	Reasoning Fluency	Statistics
2	Geometric puzzling: Gridlines Geometry Card Game.	Fluency Problem-solving	Geometry
3	Whole number, Fractions & Decimals, Algebra & Exponents challenge using the 24® Game.	Fluency	Number
4	Story-based problem-solving activity using algebra and coding skills.	Fluency Problem-solving Reasoning	Algebra

This section of the handbook provides details and materials for each round in turn with:

1. The objectives for the round.
2. A description and rationale for the activities.
3. School based activities to (a) practise for the tournament and (b) develop the ideas mathematically.
4. Notes on the equipment you will need.
5. How the activity will work in the tournament.

ROUND 1: PROBABILITY AND STATISTICS

1. OBJECTIVES

- To develop fluency in probability and statistics.
- To develop mathematical reasoning.

2. DESCRIPTION & RATIONALE

Probability and statistics are necessarily taught for exam purposes as a series of processes. These techniques were developed and are used by professionals to find models to capture the variability in (normally very large) data sets and tools to model variables which have a random element. The two parts of this round consist of a dice game in which students make probabilistic judgements and an activity in which they need to identify models for data sets.

1. The Game of Hedgehog. The game involves rolling a single die. If you roll 2, 3, 4, 5 you score that many points. If you roll 1, your turn ends. If you roll a 6 your turn ends but you lose all the points you scored in that turn. Or you can choose to pass, ending the turn without rolling. The first to score 20 points wins. Teams will line up facing each other with one team assigned to start. Players in the team play in turn with no communication (verbal or non-verbal) allowed either rolling the die or passing. A judge will keep score. When one team has scored the final scores are recorded. Points will be awarded according to the scores with a bonus for winning (one third of the points for winning and two thirds divided in the ratio of the scores).
2. Data – Chart – Analysis. At the end of the Hedgehog round, teams will be handed an envelope containing a set of 18 cards and an answer sheet. 6 will contain details of data sets, 6 will show statistical charts and 6 will contain a summary analysis. Just before the start of the algebra round they will need to hand in their completed answer sheet for marking, so they can work on this at any time. When team members are not involved in the Gridlines and 24@Game rounds they could be doing this. They will need to organise the cards into sets with a best match of data + chart + analysis and write the card letters in 6 sets onto the answer sheet. The student workbook contains a sample set of cards to give an idea of the sorts of sets that could be used.

3. SCHOOL ACTIVITIES

In Class

The game of Hedgehog can be easily played in class. The important thing is to consider strategy. This is a modified version of the classic 'Game of Pig'. There are

online simulators which let you see the probabilities at given points of the game to consider your strategy. For example: <http://cs.gettysburg.edu/projects/pig/pigggame.html>

Once students have an idea of the strategy, they can move onto the game of Hedgehog. Then they can modify the variables in the game to see how this affects their strategy. Change the penalty for rolling a 6. Change the target score. Change the rules e.g. 1 and 2 end your turn without penalty. Of course, they cannot control random events and so the strategy has to be framed in terms of probabilities and the language of better/worse, more/less likely.

Data-Chart-Analysis will be drawn from reporting about real world events or situations. In the students guide the charts are taken from a Channel 4 article summarising analysis on climate change data. The full report is here: www.channel4.com/news/factcheck/climate-change-in-ten-graphs. The issue is how the data can be used to make the inference that is given in the analysis and how the chart is useful in illuminating this. This is complementary to the more direct method of taking small data sets, calculating statistics and drawing charts, common in exams and textbooks. But we hope gives a helpful broader view. Taking interesting data sets from any source and asking what sorts of statements you could make using this data and how you could you illustrate this effectively for different purposes e.g. social media, TV news, academic paper. This link takes you directly to download an EU book of illustrated statistics that you can use to explore: <https://bit.ly/3EhgV8R>.

Catch-Up

The catch-up tracker lists worksheets to practise the skills.

Clubs and Tournament

Once students are familiar with playing the Game of Hedgehog one versus one, they should play in teams. In previous tournament activities we have found that taking turns in a group's strategy consistently is very hard and certainly needs practice.

In clubs, students can move on to the two dice game, which takes rather longer. The strategy is more subtle and will be very helpful in developing Hedgehog strategy. Also, for one versus one, it is a much better game.

Two Dice Rules

Players take turns: throw the two dice together. Add the total. Throw again and add the total to what you had before. Keep going as many times as you like adding the total at each throw to your turn total. Winner is first to 100. BUT:

- a. If one (but not both) of the dice you throw is a 6 your turn ends and nothing is added to the score for that turn.
- b. If you throw a double 6 your turn ends and your score goes back to zero.

As with the algebra round, the Chart-Data-Analysis round cannot be practised directly. Instead we recommend that students find other reports and articles online on issues of

interest where data has been used to draw conclusions and illustrated with charts and to look at the relationships between the three components. We hope they will find this interesting to do.

4. MATERIALS

1. We supply a bag of 10 ordinary dice and one large foam di in the school resource kit.
2. In the student guide: a sample set of Data-Chart-Analysis cards for practice and familiarisation.

5. AT THE COUNT ON US SECONDARY CHALLENGE

Teams will be called out in groups of six. They will play 4 games playing each other team at least once and starting two of these games. Thus, there will be three games happening at the same time, each with its own judge. After each set of games is finished, teams will be moved to different positions to play different teams. Play needs to be near continuous, so each player plays as soon as the previous player has made their roll. If the judge determines any undue delay or indeed any verbal or non-verbal communication between players, they will first issue a warning and on a repeat occasion will award the game to the other team scored as 50-0.

The Data-Chart-Analysis envelope will be handed out as soon as all teams have completed the Hedgehog round. Answer sheets must be ready for collection immediately when called as soon as the algebra round is announced.

ROUND 2: GEOMETRY

1. OBJECTIVES

- To develop fluency in geometry.
- To develop mathematical reasoning.
- To promote problem-solving skills.

2. DESCRIPTION & RATIONALE

A key issue in problem-solving is the need to sustain the activity. Much school mathematics follows a pattern of closed questions where the solution is quickly known. With the absence of coursework from GCSE, there is little incentive to run activities over several lessons where students experience the position of the professional mathematician exploring an uncharted territory. This requires resolve and tenacity. This is beautifully explained by the mathematician Andrew Wiles in the introduction to the BBC Horizon programme 'Fermat's Last Theorem', which can easily be found with an internet search.

Round 2 requires students to use standard national curriculum skills in solving geometric problems with angle relationships, Pythagoras' theorem and area, perimeter and volume and similar figures. However, they do this in the context of a card game where situations are presented with variable values. A restricted set of numbers are available, and players must find a set of values which are one solution to the given situation. This requires a detailed knowledge of the situations and the ability to be flexible in checking different solutions.

Gridlines Geometry Game

This is a card game which has been specially designed and produced for the tournament. Three members from each team work on three geometric problems. They can work individually or collectively. They see 10 number cards which can be combined to make a large but limited variety of values. They need to find a set of values that will work as a solution to one of the geometric problems. Some of their three may not be possible with the number cards available.

- For the regional Heats, there will be five rounds, in each a set of three problems and ten number cards will be dealt and teams will try to find solutions to each problem using the number cards.
- For the Final, three team members will sit at a table with a teacher judge and play the game as presented in the rules with aim of completing the most problems in a 15-minute round. When a problem is solved, they need to explain their solution to the judge. If correct, it is replaced, and new numbers become available.

3. SCHOOL ACTIVITIES

In Class

The problem cards are coded as M for mensuration (area and perimeter), V for Volume (and similar figures), A for angle relationships and P for Pythagoras. These cards can easily be separated and shown in class settings when that topic is being taught (e.g. with a visualizer). Students can find any solution to the given card. Students can explain why what they present is indeed a solution. Groups can discuss the differences and similarities between solutions.

Catch-Up

The catch-up tracker lists (i) worksheets to practise the skills and (ii) the cards that can be used to practise under each topic heading. In using the cards, students can do as above and find any solution(s) to a given card. Then they can deal 10 number cards and see if they can construct a solution with them.

Clubs and Tournament

1. Make sure they are familiar with the geometric skills needed. These include all the requirements of the geometry section of the national curriculum for area, perimeter and volume, angle relationships, Pythagoras' theorem and similar figures. We have given links to the relevant sections of the BBC Key Stage 3 bitesize website to work through, although many other resources would be suitable.
2. Work on activities designed to help students get comfortable with using variables in describing geometric relationships. Links to three activities are given in the student guide.
3. The Gridlines Geometry game packs contain a set of cards designed to help players get started. These are coded as level 0 in the puzzle set.
4. Students are now ready to play the full Gridlines: Geometry game. The detailed rules are given in full in the student guide.
5. In readiness for the Heats, let students practise the format to be used in the Heats. Deal 3 problem cards and 10 number cards. Three students working together must solve the puzzles.

4. MATERIALS

1. We supply 4 copies of the Gridlines Geometry game in the school equipment pack. These will be needed for practice. The pack can easily be subdivided for many groups to practise, although it is important to share out the cards of different difficulty levels (shown by the blue circle, level 0, 1, 2 or 3 on the puzzle cards) according to need and readiness.
2. In the student guide:
 - a. Links to online activities.

- b. Full rules for the Gridlines Geometry game.
- c. Geometry catch-up activities.

5. AT THE COUNT ON US SECONDARY CHALLENGE

Playing the Gridlines Geometry game.

- Play an uninterrupted 15-minute round according to the game pack rules.
- As soon as any one problem card is solved, the card is put to one side for scoring and replaced to make three in play problems.
- Any number cards used in the solution are placed at the bottom of the number card pack and replaced.
- Players have three “I give up” cards allowing the replacement of any number of problem and/or number cards.
- Solutions are shown and explained to a table judge, not written down.
- Three team members are playing at any one time. They can work together or separately on one or more problems at a time as they choose, discussing freely. Substitutions can be made at any time so long as at most 3 players are working at the table.



ROUND 3: WHOLE NUMBER (SINGLE AND DOUBLE DIGIT), INTEGERS, FRACTIONS & DECIMALS AND ALGEBRA CHALLENGE

1. OBJECTIVES:

To support and develop fluency in numeracy - specifically in whole numbers, integers, fractions and decimals, and with index notation and algebraic expressions

2. DESCRIPTION AND RATIONALE:

The purpose of this round is to develop a very high level of facility with whole number arithmetic, including integers (some negative numbers), using algebraic expressions and index notation. Also, arithmetic on fractions (either in fraction or decimal notation). Our experience with the Secondary Challenge shows that the 24@Game provides a mechanism by which students practise sufficiently hard to generate quite incredible levels of facility in combining numbers. The winners can solve these puzzles pretty much instantaneously, certainly way faster than their teachers or indeed visiting maths experts!

The idea is very simple: take 4 numbers and combine them with any arithmetic operations to make the answer 24. The only difference for the Secondary Challenge is that the numbers will contain some in fraction and/or decimal form or some negative numbers or numbers formed by substituting into algebraic or index statements. You would have thought this simplicity was limiting, but it is not. A vast array of puzzles can be constructed. (Each standard box has 192 puzzles, enough to have forgotten the first one when it comes round again!)

Students need to develop a high level of fluency in number work. Being able to handle numbers of all types comfortably without need for written methods or a calculator, frees up mental processing power for problem-solving and more advanced skills. Students need to be able to extend single and double digit arithmetic to include integers without having to try to remember the 'rules' for negative numbers. They become confident and fluent with arithmetic using fractions in fraction and decimal notation. Many mathematical skills rest on a high level of fluency with the concept of 'fraction'. Notably, the study of probability is always typically undermined by weakness in working with fractions.

Fluency with algebra is also a vital component of mathematics. Students need to see an algebraic expression and simultaneously see the value of the expression with a variety of values of the variable. The algebra and exponents card set makes this a necessary skill.

3. SCHOOL ACTIVITIES:

In Class

Before anyone is ready for a tournament, it is very important to make playing the game a fun habit and regular activity. At first it can be frustrating, but just like all puzzles, students need to keep going and feel the thrill of the *Aha!* moment when they solve a puzzle.

Introducing the 24® Game Activity: Write the numbers 5, 4, 3 and 1 on the whiteboard and ask the students to get an answer of 24 using **all the numbers once and once only**. You could ask them to write the answers on their mini whiteboards. Give time for more than the quickest two or three to find a solution. Ask for solutions and write them up.

Possible solutions: $5 \times 4 = 20$ $20 + 3 + 1 = 24$
OR $5 + 3 = 8$ $4 - 1 = 3$ $8 \times 3 = 24$

Write this solution on the board and ask why it's incorrect:

$5 + 1 = 6$ $4 \times 6 = 24$

(Only three numbers used)

...and this one: $5 + 3 = 8$ $1 \times 3 = 3$ $8 \times 3 = 24$

(The number 3 has been used twice)

Initially, extract all the 1-point cards (1 dot in the corner) and 2 point cards (2 dots). These are easier than the 3 dot cards. Arrange your students in groups of 3 (you may want to engineer these!) and share out the cards. You may choose to give 1-point cards to less confident mathematicians.

Discuss the strategies they used to make 24. These could be:

- finding key number bonds: 6×4 , 8×3 , $16 + 8$...
- finding pairs: $23+1$, $25-1$, $15+9$ etc.

Important: Students should practise finding the last step of the solution to make 24 first: e.g. “3 times 8” or “15 plus 9”. This means that the focus is always on finding number patterns.

Now gradually introduce each further set of cards. Start with the one dot cards, then gradually introduce harder ones. Once students have got the general idea, 24 games cards make excellent starters in any lesson. Simply put out three cards at the front of the classroom while you take the register!

Catch-Up

The catch-up tracker lists (i) worksheets to practise the skills and (ii) the cards that can be used to practise under each topic heading. Students can either take cards to practise, or take a photo of cards to work on, or use a 24® Game app on their phones.

Clubs and Tournament

Students need to practise playing the 24@Game competitively. So, study the rules for in-person tournament play below (then check appendix 1 for the detailed rules). Make sure that students are aware of all of these and practise frequently in tournament conditions.

We would strongly suggest that you set up a school tournament so that all students have the chance to play competitively. You may use this as part of your team selection process.

4. MATERIALS:

1. We supply a collection of 24@Game card sets containing: 'Single Digits', 'Double Digits', 'Fractions and Decimals', 'Integers' and 'Algebra and Exponents' cards in the school equipment pack.
2. In the student workbook there are three activities to support this work without using the cards:
 - a. Number catch-up activities.
 - b. A getting started selection of sets of numbers to make 24.
 - c. A set of 'Torture Squares' to practise arithmetic with decimals and fractions.
 - d. Three different versions of a board game called 'Find 24' to practise finding sets of 4 numbers, including fractions and decimals, to make 24.

The torture square activity and the Find 24 games are designed to work in parallel with using the 24@Game cards. We hope you will find that they provide good practice in developing fluency with fraction and decimal arithmetic in a different context to the card game and therefore improve flexibility. However, it is very important that students get lots of opportunity to practise with the 24@Game cards as well.

5. AT THE COUNT ON US SECONDARY CHALLENGE:

Detailed tournament rules are in Appendices 1 & 2 at the back of this guide

There are five rounds each of 5 minutes in the tournament. The cards used in each round will vary. In the Heats it will generally follow the order above and in most rounds the cards will not be mixed. However, in the Final the rounds will vary considerably and rounds using mixed sets are to be expected.

Three players from each team are distributed amongst players from other teams. They sit three to a table (from different teams) and complete as many 24@Game cards as possible in timed rounds. The tournament is configured so that each player from each team competes against players from the other teams in turn, in a circle of tables, with two of the players moving in turn to the next table clock or anticlockwise. There will be five rounds each of five minutes. After the second round two substitutions **must** be made. Hence, all five players in each team participate in at least two of the five rounds.

Points are scored for winning, coming second or coming third so long as the players did get at least one card correct.

ROUND 4: ALGEBRA CHALLENGE: YOUR LONDON

1. OBJECTIVES:

- To develop problem-solving skills.
- To develop fluency in algebra.

2. DESCRIPTION AND RATIONALE:

Problem-solving is a key component of the mathematics national curriculum. Problem-solving and maths in contexts are key elements of the GCSE exams. In this round, students are placed into a story driven context where they will have to solve problems using information they have been given in a scenario based around a London theme. A vital component of the GCSE exam is that students read a complex multi-step problem and find and use the information needed to solve it. This round works in exactly that way. Students must carefully listen for or read instructions and make sense of them and solve problems to provide information and interpret it.

The final and perhaps most important area of fluency that students need to develop to be fully prepared and confident to take on A-level and further study in mathematics, is algebra. It is often said that algebra is a language and students must learn to speak it fluently. However, it is frequently taught as a series of disconnected manipulations and students struggle to make sense of its purpose. In this round, students will solve algebraic equations, manipulate expressions, evaluate functions and substitute into formulae, for the purpose of generating solutions to a code breaking activity which will provide them with information to solve a significant problem.

3. SCHOOL ACTIVITIES:

In Class

1. Explore the history of algebra and the contributions of different cultures. The excellent Wikipedia article is a good starting point for the teacher: students could choose one of the themes and research further. They could make a poster to share their work. www.en.wikipedia.org/wiki/History_of_algebra.
2. Use algebra to solve mathematical problems. Give students opportunities to solve open problems tasks from the NRich web site. Encourage them to use algebra to describe, explain and prove their findings. NRich has several themed collections of algebra activities:
 - a. 'What's Algebra All About' contains easier stage 2 problems and is a good starting point for anyone: www.nrich.maths.org/10955
 - b. 'Pattern' and 'Equations and Formulae' contain interesting practical problems at stages 3, 4 and 5': www.nrich.maths.org/9512 and www.nrich.maths.org/9516

3. It would be an excellent way to get started by taking your students on maths trips and visits around London. Notably, the Maths Zone web site www.themathszone.com/?p=641 has available trails from Parliament Square to Trafalgar Square and around the Bank of England Museum. Also, codes and computers at the museums of Bletchley Park.

Catch-Up

The catch-up tracker lists the worksheets needed to practise the skills.

Clubs and Tournament

There are three elements to solving the problem. We would suggest that each is practised independently.

1. Teams will need to access information from documents, maps, pictures and sets of instructions given in different forms. The critical skill is to look for key information from given clues.
2. Students will need to solve equations, manipulate algebra, read and interpret graphs and other algebraic problems of any type included in the National Curriculum. A complete list of the possible algebra involved is given in appendix 2 at the back of this guide.
3. There is a small collection of complete materials sets with teacher instructions from previous tournaments. We recommend that you get at least one set and set it up as an activity. One example is used in the training session. This way students will get a sense of what to expect. These are only a guide and events will differ significantly. Notably, in all previous years solving codes with a Caesar Shift Cipher was required. This year we have broadened the algebraic requirements and these codes are no longer required.

4. MATERIALS:

In the student's workbook there are details for finding Tarsia algebra problems and details for using GeoGebra to explore algebraic equations, manipulations and graphs. For practice in a team working environment similar to the competition, we would recommend solving equations using Tarsia puzzles. An excellent resource is provided by Craig Barton. Follow this link and download the Algebra set:

<http://www.mrbartonmaths.com/teachers/rich-tasks/tarsia-jigsaw.html>

Note you also need the (free) software at: www.mmlsoft.com/index.php/products/tarsia

5. AT THE COUNT ON US SECONDARY CHALLENGE:

- The Challenge will be based in a problem-solving story involving some features of London. Teams will need to solve problems and puzzles involving algebraic equations, manipulations and graphs.

- Teams will score points for the algebra problems and the puzzles they solve, plus a bonus for solving the overall problem.
- Teams will work from their group base. They will need to carefully read the information they gain access to and make sure they understand and develop a plan to solve the problem. One team member will take the role of 'runner'. Their job will be to take items to institutions and collect further items at stations staffed by a judge.
- Notice that the nature of problem-solving requires that this description is quite vague. The way each round will operate will vary as the problem to be solved varies. Expect the unexpected!

Appendix 1: Specific Details for the 24® Game Round

The basics rules of the 24®Game are the same for tournaments as they are for classroom use, but there a small number of key additions to ensure fairness, consistency and pace.

1. The pack is held by the table referee and each card is placed quickly in the middle of the special table mat once the previous card has been claimed.
2. Competitors' hands must be placed behind and under the level of the table until they are ready to claim a card.
3. When competitors claim a card, they must do so with their whole hand in the middle of the card, so it would be impossible for another hand to be claiming at the same time. There is no need to slap the table, just place the hand on the card!
4. The person claiming the card must announce the pattern immediately after touching the card. The complete solution must then be completed without pause. Any error or any changes made to the solution mean the card is removed. Although it is to the payer's advantage to give the solution in three steps, starting from the last step e.g. "3 times 8" or "15 plus 9", this is not a requirement any correct method is acceptable.
5. If a player is incorrect or hesitates or has hands above the table then they miss the next card. If this happens three times they are out for the round. The table referee keeps a tally of such instances during the round.
6. If, during the game, players seem to be stuck, if two of them agree to have a card removed then it can be. (This does not apply in the Final).
7. If a player has claimed a card before the hooter/whistle goes, they can continue presenting their solution.

Student/Teacher Movement During The 24®Game Round

The room will be arranged in a large circle of tables; one table for each team. Each table is managed by a referee (a teacher from each school).

Each player is allocated the letter A, B or C and given a scorecard which they keep for the next three rounds. Students fill in their scorecard with their name and school.

When the hooter/whistle goes, player B stays at the table, player A moves clockwise to the next table and player C moves anti-clockwise to their next table so that they are ready for the first round. For round 1 only, the teacher referee also moves one table clockwise and then stays at that table for subsequent rounds.

At the end of each round the players add up their total number of points (dots on cards correctly claimed). The winner of the round scores 7 points, the runner up scores 3 points and a scoring third place gets 1 point. The table referee records ONLY 1, 2 or 3 to show the placing. When all tables are ready the players move on to their next table. Players B always remain stationary and players A and C always move clockwise and anti-clockwise respectively. When the rounds are completed, players should wait while the table referees submit their scorecards to the tournament director.

Appendix 2: Required Algebra

Note: the numbering follows the numbering in the student workbook tracker and constitutes the content of the Key Stage 3 national curriculum with a small number of elements not included.

1. Use and interpret algebraic notation, including:
 - ab in place of $a \times b$
 - $3y$ in place of $y + y + y$ and $3 \times y$
 - a^2 in place of $a \times a$, a^3 in place of $a \times a \times a$; a^2b in place of $a \times a \times b$
 - $\frac{a}{b}$ in place of $a \div b$
 - coefficients written as fractions rather than as decimals
 - brackets
2. Substitute numerical values into formulae and expressions, including scientific formulae.
3. Understand and use the concepts and vocabulary of expressions, equations, inequalities, terms and factors.
4. Simplify and manipulate algebraic expressions to maintain equivalence by:
 - collecting like terms
 - multiplying a single term over a bracket
 - taking out common factors
 - expanding products of two or more binomials
6. Use algebraic methods to solve linear equations in one variable (including all forms that require rearrangement).
7. Work with coordinates in all four quadrants.
8. Recognise, sketch and produce graphs of linear and quadratic functions of one variable with appropriate scaling, using equations in x and y and the Cartesian plane.
11. Find approximate solutions to contextual problems from given graphs of a variety of functions, including piece-wise linear, exponential and reciprocal graphs
12. Sequences:
 - Generate terms of a sequence from either a term-to-term or a position-to-term rule
 - Recognise arithmetic sequences and find the n th term
 - Recognise geometric sequences and appreciate other sequences that arise.

ABOUT US

THE MAYOR'S FUND FOR LONDON

The Mayor's Fund for London exists to give young Londoners the skills and opportunities to get a decent job, escape the threat of poverty and play a full part in London's future.

Our work focuses on three areas:

1. Health and Well-being – Helping young Londoners to be engaged, healthy and motivated to learn
2. Core skills – Extra support for core skills which employers say are absolutely essential, particularly numeracy and literacy
3. Employment – Supporting employers to create decent and sustainable career prospects for young Londoners

www.mayorsfundforlondon.org.uk



THE JACK PETCHEY FOUNDATION

Established in 1999, the Jack Petchey Foundation makes grants to programmes and projects that benefit young people aged 11-25. The Foundation exists to raise the aspirations of young people, to help them take advantage of opportunities and play a full part in society.

The Foundation has a wide range of programmes from those that are arts based, to public speaking training, to sports focused programmes, to supporting young people in the transition from education to employment.

The geographical focus of our work is London and Essex. Since it has been established the Foundation has invested over £100 million supporting young people.

www.jackpetcheyfoundation.org.uk



THE MATHS ZONE

The Count on Us Secondary Challenge is designed and events managed by Chris Olley, director of the **Maths Zone at Education Interactive**.

www.themathszone.com

