

COUNT ON US

SECONDARY CHALLENGE



GUIDANCE FOR SCHOOLS 2022

INCREASING STUDENT ENGAGEMENT IN MATHS

INTRODUCTION

The **Count on Us Secondary Challenge** is a unique, pan-London inter-school maths tournament 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 tournament was our seventh year of the Secondary Challenge, with secondary schools from across London competing in Online Heats with the top schools attending an in-person Final at the magnificent setting of Church House, overlooking Westminster Cathedral. This year we are adapting to the new normal situation in schools with a tournament in two stages:

Stage 1 **Online Training session** in January for all participating schools, clarifying expectations sharing good practice and ensuring that all teachers are confident in setting up the activities in school.

Stage 2 **In-school practice** for Years 7, 8 or 9 students. Teachers will use the activities in class and / or in clubs to give as much practice as possible, using the student workbook to use as support and as a catchup workbook, before:

Stage 3 **In-school tournament in all schools** to experience the demands of the Count on Us Challenge and to help teachers choose their team to represent the school.

Stage 4 **Count on Us Secondary Challenge Tournament** Regional **Heats** for all schools will take place (in-person if possible) in early May, with the 12 highest scoring schools progressing to the **Final** taking place w/b 4th July 2022.

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 Count on Us Secondary Challenge schools!

Laura Ferris

Count on Us Schools Project Manager

E: lferris@mayorsfundforlondon.org.uk

W: www.mayorsfundforlondon.org.uk

Chris Olley

Director, The Maths Zone

E: chris@themathszone.co.uk

W: www.themathszone.co.uk

Count on Us Challenge

E: cou@mayorsfundforlondon.org.uk

W: www.mayorsfundforlondon.org.uk

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 three 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 group tournament and then the pan-London Heats and Final.

The Count on Us materials can be used with all your key stage three students (upwards of 150 students). To progress to the tournament, we recommend at least 60 are involved in a maths club or in class 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 through four rounds. 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 formed for the tournament. Finally, the students will play as a team in the probability game of hedgehog and will match sets of statistical charts to descriptions of data sets and headline analyses in an activity called Data-Chart-Analysis.

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. Along with your tournament team arriving at the Regional Heats ready for what will be a very competitive and exciting event.

COUNT ON US RESOURCE AREA ON MFL WEBSITE:

To ensure that schools have access to as much support and information as possible, we have set up a fantastic Count on Us Resource Area on the Mayor's Fund for London website.

[CLICK HERE TO ACCESS](#)

This is available only to participating schools and is password protected:

Password for 2021-2022: ROBINSON1985

The Resource Area has four sections:

1. **Getting Started** – with the student workbook, guidance for schools, and a series of newly produced training videos designed to show you how all the activities work with detailed instruction to use in class and clubs
2. **Managing Count on Us** – where you will find guidance for in-school coordinators, including advice on how to practice in-school and choose your team.
3. **Tournament Time** – with advice on how to run an in-school tournament, as well as all the administrative forms you need over the course of this year's challenge.
4. **Additional Resources** – here you can find a trove of different resources and challenges from previous Count on Us challenges, as well as our Weekly Challenge Activities from the 2020 lockdown.

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 across Years 7, 8 and 9, targeting at least **100 students** to maximise reach.
2. Supporting students to use the student guide to support their catch-up curriculum.
3. Providing opportunities for at least **60 students** to engage with the activities in a challenging and fun environment, where they can develop their mathematical skills with the activities.
4. Selecting **five 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 at Regional Heats, schools should run an internal tournament in school or with a partner school by February/March 2022. **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.

Where schools are part of a participating Multi Academy Trust or Borough, this tournament can be an intra-MAT or intra-Borough tournament.

[Materials to support this are available on the Secondary Challenge website.](#) We recommend you 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: Jan-Feb (up to 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 and following the Student Engagement Checklist.
- Begin practising with 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: Feb-Mar (after half term)

- Continue practising with your students as much and as often as possible!
- Run your in-school tournament and select a team of five for the Count on Us Secondary Challenge. Teams should be selected from Year 7, 8 or 9. If students have been in the team in a previous year, they are not permitted to participate again.

Please send student names to the Count on Us Team before Easter:

cou@mayorsfundforlondon.org.uk

- Ensure that all parental consent forms for the regional Heats are completed.

- If we have told you that the Heats will be online, check that the facilities you will be using in school for participating (computing equipment notably including web cam and sound set up, internet access, Zoom access, photo scanning of documents and uploading and sending them) work efficiently and reliably and that you have practised using them.
- If we can run the Heats in-person, then you will need to act as a teacher judge for the Probability & Statistics, 24[®] Game and algebra rounds. More details will be provided nearer the time.

Online/in-person heats

- Participate in the online regional heats, with qualifying schools making it through to the Final.

KEY DATES:

Teacher Training:	January 2022 – 18 and 26 Jan. February date TBC
Heats:	Early May 2022 - dates TBC
Final:	w/c 4th July 2022 - date TBC

REGIONAL HEATS AND FINAL: IN-PERSON

We hope that by time we get to Easter 2022, we will be able to hold in-person Heats and Final, with all the competitive elements of previous events. Should we need to opt for a socially distanced version (as we did in the 2021 Final) or online (as we did for the Heats in 2021), we will send out further guidance and support.

As far as possible the online heats will replicate the look and feel of the in-person tournament. Students will need to prepare for online heats in the same way as they would for in-person heats and will require the same skills and knowledge.

Online Heats Format

Teams will participate in an online heat with roughly 12 schools. The exact date and time of your heat will be communicated to you in good time but could vary according to the prevailing circumstances.

SET UP – PLATFORM USED:

- Zoom - Free for schools with unlimited meeting time. Please make sure you're familiar with it.
- A Zoom link will be sent to each participating school a week before the Heats.
- Up to 12 teams in each Heat. 5 players per team plus a supervising teacher (who will observe and NOT assist their team).
- Each team will need a laptop with working webcam, on a table with enough space for the Team members to work and write at.
- MUST be 5 players at a single computer, with one person acting as scribe.

SETTING UP THE SPACE:

- The set up depends on the regulations within your school. If necessary, you will need to keep team members physically distanced.
- The ideal set up would have a laptop on a table for the team, with a large screen or whiteboard on which the Zoom tournament is also being broadcast.
- Participating players must be in view, using a web cam on a laptop facing the players. The supervising teacher may need to have access to the computer for the purposes of submitting or receiving files.
- Students should each have mini whiteboards and pens for the purposes of sharing solutions and showing answers to the screen.
- Teams **must** practise beforehand. If taking part virtually, you should test audio and video and set up equipment ready.

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 lesson 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 & 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 should:

- Have **five** 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.

We would also strongly encourage you to select a mixed gender team if possible (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 throughout the programme and academic year, when requested, and 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](#) / [@JPFfoundation](#) / [#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)

The Count on Us Secondary Challenge consists of four 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 geometry, number and algebra score one third of the total each.

ROUND	ACTIVITY	FOCUS	CONTENT
Ia	The Game of Hedgehog	Reasoning	Probability
Ib	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) practice for the tournament and (b) develop the ideas mathematically.
4. Activity sheets for school use.
5. Notes on the equipment you will need.
6. 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 AND 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 one, 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/piggame.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 this 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 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 in the student workbook lists worksheets to practice further.

Clubs and In-School 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 strategy consistently is very hard and certainly needs practice. Use large floor dice (homemade is fine) to mimic the tournament experience.

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 practiced directly. Instead we recommend that students find other reports and articles online on issues of interest where data has been used to draw conclusions, 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 in the school resource kits. For tournament practice we recommend that you make a large dice for rolling on the floor, which is what we will have for in-person events.
2. In the student workbook: a sample set of Data-Chart-Analysis cards for practice and familiarisation.

5. AT THE COUNT ON US SECONDARY CHALLENGE TOURNAMENT

In-person Events

Teams will be called out in groups of six. They will play 4 games, playing each 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.

Online Heats (where required)

Teams will play in their break-out rooms each staffed by a Count on Us judge. The screen will show a computer-generated die and a scoring sheet. Teams will play each other twice, alternating the starting team. Teams line up and when play is started, players say either “roll” or “pass”. The judge will ‘throw’ the die and mark up the score. Then the next player says either “roll” or “pass” and play continues. If a player passes or a 0 or 6 are rolled, play moves to the other team.

As soon as all teams have completed the round and returned to the main ‘room’, a link will be sent on chat to a document which will contain the 18 cards and the answer sheet for the Data-Chart-Analysis round. This will need to be printed (or in case of difficulty viewed somehow). The answer sheet will be called for and will need to be submitted by photo scanning and sending just before the algebra round.

ROUND 2: GEOMETRY

1. OBJECTIVES

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

2. DESCRIPTION AND 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 problem cards may not be possible to solve with the number cards available.

- For the online 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 in-person Final, three team members will sit at a table with a teacher judge and play the game as presented in the rules with the 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 in the student workbook lists (i) worksheets to practice the skills and (ii) the cards that can be used to practice 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 In-School Tournament

1. Make sure students 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 three 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 workbook.
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 workbook.
5. In readiness for the online heats, let students practice the format to be used in the heats. Deal three problem cards and 10 number cards. Three students working together must solve the puzzles, (practice writing their answers in a specific format in the event of online heats).

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 practice, 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. The student workbook includes:
 - 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 TOURNAMENT

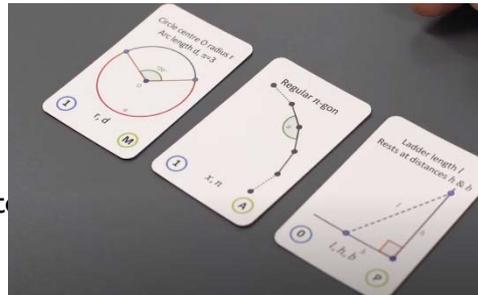
Playing the Gridlines Geometry game (for in-person events).

- 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 three players are working at the table.



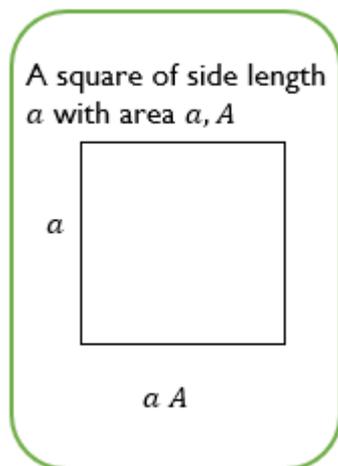
Playing the Gridlines Geometry game (for online events)

- A slide will be shown with three problem cards and 10 number cards (all three problems will have possible solutions using the given number cards).
- Teams have three minutes to find solutions to as many of the problems as they can using the number cards dealt. They write solutions in a specified format onto paper. Points are scored for each correct solution.
- There will be 5 rounds of this type. At the end of each round this paper is held up to show the teacher judge, then photo scanned and sent to the administrator.
- Unlike in normal game play, “I give up cards” are not available.
- Also, the same ten cards are available independently for each solution, so a given number card could be used in 1, 2 or 3 solutions, however, it cannot be used more than once in any one solution.
- Three team members are playing at any one time as per in-person events. All three must always be in view and only three except when in the act of substituting.



- Answers must be written in this format:

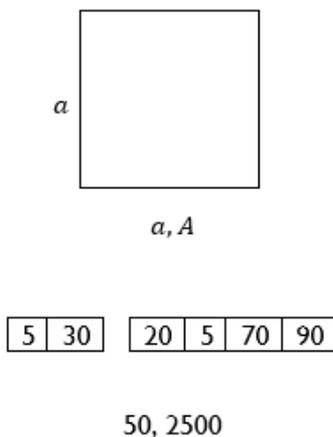
Example card



Answer Format

Problem	Make <u>a very simple rough sketch</u> of the diagram, sufficient only to identify it.
Variables	Copy the variables in order from the card.
Cards	Write the numbers on the number cards you are using (in boxes to separate the cards) in order of variable and of use. Separate sets for each variable.
Value	Write the value for each variable you are making from the number cards, in order.

Example Answer in correct format



5 30 20 5 70 90

50, 2500

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

I. 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 which students can practice sufficiently hard enough 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 the 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 one-point cards (1 dot in the corner) and two-point cards (2 dots). These are easier than the three dot cards. Arrange your students in groups of three (you may want to engineer these!) and share out the cards. You may choose to give one-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® Game 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 in the student workbook lists (i) worksheets to practice the skills and (ii) the cards that can be used to practice under each topic heading. Students can either take cards to practice, or take a photo of cards to work on, or use a 24® Game app on their phones.

Clubs and In-School Tournament

Students need to practice playing the 24® Game competitively. So, study the rules for in-person tournament play below (then check appendix 1 for the detailed rules). Compare with the changes that will be made for the online heats this year. Make sure that students are aware of all of these and practice frequently in tournament conditions. See appendix 2 at the end of this handbook for the logistics of an in-person tournament (notably this year's Final).

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 practice arithmetic with decimals and fractions.
 - d. Three different versions of a board game called 'Find 24' to practice 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 practice with the 24® Game cards as well.

5. AT THE COUNT ON US SECONDARY CHALLENGE TOURNAMENT

In-person Events (detailed 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 semi-finals and 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.

Online Events (where required)

1. Schools play two mini tournaments each with 4 schools. Three players per school are used in each mini tournament.
2. Teams are divided into three breakout rooms. Each breakout room has an assigned judge. Each of the school's three players comes into view in turn over three rounds each of two minutes.
3. So, 4 Players playing at a time. Each team ensures their first player is on view. The timer starts and a card is displayed on screen from a set of slides with mixed cards (from all allowed packs).
4. Players have mini whiteboards and pens to record answers. Players hold up an answer in the correct format. First to hold up a visible answer gets to answer. (The judge will decide if unclear). They read out what they have written. If correct, they get the point. the card is removed, and the offending player misses next card.
5. If the wrong answer is held up (or different answer said),
6. The judge keeps continuous track of dots scored by each team with a tally on a scoresheet. Teams score points for their position (1st, 2nd, 3rd or 4th) according to dots scored.
7. When the time is up, the judge monitors as teams change to their second player. Repeat the play and recording of scores for players two and three.
8. This whole structure is repeated in a different group of 4 schools. The remaining two players must be used in the second round. (One player will play in both rounds).

24® Game Answer Format

Use brackets to separate if needed by rules of arithmetic priority. e.g.

$$(3 \times 2) \times (8 - 4)$$

$$(18 \div (4 - 1)) \times 4$$

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. This 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 website. Encourage them to use algebra to describe, explain and prove their findings. NRich has a number of 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 in the student workbook lists the worksheets needed to practise the skills.

Clubs and In-School 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 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 TOURNAMENT

In-person events

- The challenge will be based on 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!

Online Heats (where required)

- This round will aim to mimic the look and feel of the in-person rounds of past years. It will aim to be theatrical and amusing. However, this should not distract participants from looking carefully at anything given, said, or shown for information.
- Some documents will be given in advance that will need to be printed and be available for the event.
- There will be sound and visuals presented in a variety of ways, e.g. slides, video, live and recorded sound. Teams must concentrate and ensure that someone is always monitoring the screen and sound for new information. Group roles will be vital to ensure nothing is missed while work also progresses away from the computer.
- All completed results should be filled in on the answer sheet as work progresses. When the time is up there will be strictly limited time to show the answer sheet on screen to the coordinator, then (photo) scan it and send to the administrator (by email).
- To prepare, we recommend using one or more of the materials packs for previous in-person algebra rounds. Also, use the Count on Us Challenge Final 2020 Activity (available on the Mayor's Fund for London website) to give a flavour for what this might look like online (although the round itself will be more like the previous in-person rounds in content terms.) **BUT please be clear, using Caesar Shift ciphers is no longer a requirement, and the scope of the algebra will be considerably greater.**

Appendix I: Specific details for the 24® Game Round

The basic rules of the 24® Game are the same for tournaments as they are for classroom use, but there are 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 player'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 are allowed to 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 one 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 scoring third place gets one 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 three 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 effort focuses on three areas:

1. **Wellbeing:** supporting children to be happy, healthy and motivated to learn
2. **Skills:** helping young Londoners to stay on track at school
3. **Employment and enterprise:** increasing awareness of opportunities, preparing young people for employment and giving them better access to employers

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 will be supported by Chris Olley, director of the **Maths Zone at Education Interactive**, and Visiting Lecturer in Secondary Maths Education at Kings College London.

www.themathszone.com

