

## 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:  $6 \times 4$ ,  $8 \times 3$ ,  $16 + 8$  ...
- 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.