

Round 3: Target Maths

1. OBJECTIVES:

To support and develop fluency in numeracy - specifically in whole numbers, integers, fractions and decimals, and with 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 single and double digit positive whole numbers, negative whole numbers, fractions (either in fraction or decimal notation), substituted into algebraic expressions and with index notation. The idea of Target Maths is very simple: take 4 numbers and combine them with any arithmetic operations to make a target number in the centre of the card. You would have thought this simplicity was limiting, but it is not. A vast array of puzzles can be constructed.

The first set consists of only single digit numbers and a whole number target in the range of 1 to 20. The next set extends the target to 40. Then one or two 2-digit numbers are introduced on a puzzle. Then one or two single digit negative numbers and a target in the range -10 to 10. Then one or two proper fractions with denominators in the range 2 to 5 and decimals in the form 0.a. Finally one or two algebraic expressions, where the value of the variable must first be found, being a whole number from 1 to 9.



Our experience with the Secondary Challenge shows that the number combination games of this type provide a mechanism by which students practice sufficiently hard to generate quite incredible levels of facility in combining numbers. Although Target Maths is new to Count on Us, the similar 24@Game has been used for many years and we expect the outcomes to be similar. Winners can solve these puzzles very fast indeed, certainly way faster than their teachers or indeed visiting maths experts!

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 require 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 unknowns. The algebra card set makes this a necessary skill and thus cause it be practiced to a high level of fluency.

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.

A comprehensive software package has been created to download from the Count on Us web site resource area. This runs on windows computers and allows for sets of puzzles to be generated according to a wide range of criteria and either simply displayed or displayed with solution entry and checking or analysed according to the range of solutions available. This provides a wealth of opportunity for classroom activities.

Introducing the Target Maths Activity: Write the numbers 8, 4, 3 and 1 on the whiteboard and, in a circle to separate it, the target of 20. Students must find a calculation to get an answer of 20 using **all the numbers once and once only together with any combination of +, −, × and ÷**. 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: $3 \times 4 = 12$ $8 \times 1 = 8$ $12 + 8 = 20$
OR $3 \times 1 = 3$ $8 - 3 = 5$ $5 \times 4 = 20$

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

$4 \times 3 = 12$ $8 + 12 = 20$
(Only three numbers used)

...and this one: $8 + 4 = 12$ $1 + 3 = 4$ $12 + 4 + 4 = 20$
(The number 4 has been used twice)

The puzzles are graded according to difficulty with a small number in one corner. 1 is the easiest and 3 is the hardest. From the set of single digit puzzles, extract all the 1 point cards and 2 point cards. Arrange your students in groups of 3 (you may want to engineer these!) and share out the cards. You may choose to give puzzles with targets within the range 1 to 20 to less confident mathematicians.

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

- finding key number bonds
- finding pairs or triples needed to fit the remaining numbers.

Now gradually introduce each further set of cards. In each case start with the one dot cards, and possibly a restricted range of targets, 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! But, do not make it competitive in class. Instead give students a long opportunity to puzzle at it. Ask for solutions at the end of the lesson, or even the start of the next one.

Clubs and Tournament

When they have become very familiar with the cards and have already developed a good level of fluency, students need to practice playing the Target Maths competitively. So, study the rules for in-person tournament play. Make sure that students are aware of all of these rules and practice frequently in tournament conditions. Also, see appendix 1 at the end of this handbook for the logistics of an in-person tournament.

4. MATERIALS:

1. We supply a collection of Target Maths card sets containing: 'Single Digits', 'Double Digits', 'Fractions and Decimals', 'Integers' and 'Algebra' cards in the school equipment pack.
2. A software based Puzzle generator to provide limitless examples of Target maths of all different types at different levels of difficulty for use in clubs for practice and in class.
3. In the student workbook there are activities to support this work including a selection of different Target Maths puzzles.

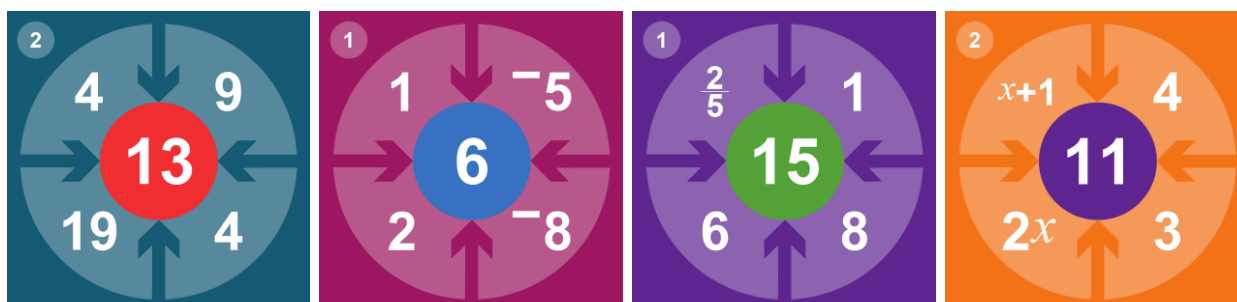
We hope you will find that they provide good practice in developing fluency with fraction and decimal arithmetic in a different context to the card game and therefore improve flexibility. However, it is very important that students get lots of opportunity to practice with the Target Maths cards as well.

5. AT THE COUNT ON US SECONDARY CHALLENGE:

There are five rounds each of 5 minutes in the tournament. Rounds 1 and 2 will have two players from each team working together to solve as many cards as they can within the time allowed. Round 1 will use the single-digit cards and round 2 the double-digit cards. (Although this will vary in the final). If a wrong or stumbled solution is given, the judge waits for 10 seconds before giving the next puzzle. If students choose to give up on a given puzzle it is returned and the judge waits 10 seconds before given the next puzzle. Points are awarded for the number of cards completed.

For rounds 3, 4 and 5 the remaining three players from each team are distributed amongst players from other teams. These will use the fractions & decimals, integers and algebra card sets. They sit three to a table (from different teams) and complete as many Target Maths cards as possible in each timed round. 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 clockwise or anticlockwise.

Points are scored for winning and for cards completed.



TOURNAMENT RULES FOR THE COMPETITIVE TARGET MATHS ROUNDS

The basics rules of the Target Maths 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 in their hand by the table referee and each card is placed quickly in the middle of the special table mat, at the start of the round or 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 by placing their whole hand on the middle of the card, so it would be impossible for another hand to be claiming it 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 say the solution immediately after touching the card. The solution must be completed without pause. Any error or changes made to the solution mean the card is removed. It is to the player's advantage and strongly recommended to give the solution last step first as described earlier.
5. If a player is incorrect or hesitates or has hands above the table then they miss the next card and re-enter play after that next card.
6. If, during the game, all players seem to be stuck, if two of them agree to have a card removed and replaced with the next card then it can be. (This does not apply in the final).
7. If a player has claimed a card before the end of the round is announced, they are allowed to continue presenting their solution.

STUDENT/TEACHER MOVEMENT DURING THE TARGET MATHS ROUND

The room will be arranged in a large circle of tables; one table for each team. Each table is managed by a referee not from the team's school (drawn from one teacher from each school).

For rounds 1 and 2, two players from each school sit at the team table, while the other three sit behind. Before round 1, the teacher referee moves two tables clockwise, so they start with no students from their own school and then stays at that table for subsequent rounds. For rounds 3, 4 and 5, the other three players from each team are each allocated the letter A, B or C. At the start of the round, 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 next round to lay against a different set of students from different schools.

At the end of each round the players count up the number of cards correctly claimed. The table referee records this number and W for the players or players who scored the highest number and thus Won the round. When all tables are ready the players move on to their next table. Players B always remain stationery and players A and C always move clockwise and anti-clockwise respectively.