Lesson Topic: Multiplication and Division – Identify Composite Numbers

Concept/s in Focus:

- Multiplication is joining equal groups to make a total.
- The general structure of multiplication equation is factor x factor = multiple.
- Division is separating a total into equal groups.
- Factors are pairs of whole numbers that multiply together to make another whole number.
- A prime number has exactly two factors. The factors will be the number itself and one.
- A composite number has more than two whole number factors i.e. they are not prime.
- Multiplication is commutative. Swapping the order of the factors in a particular multiplicative situation will result in the same total e.g. 4 x 3 = 12 = 3 x 4.
- The numbers zero and one are neither prime nor composite.

Introduction / Teacher Background Information:

Composite numbers are the set of numbers that are not prime. Therefore composite numbers have more than 2 factors. Multiplication can be challenging for some students. Working with numbers beyond 1-digit basic facts often has a focus on written methods that do not require much thinking about the numbers being multiplied. Students tend to develop less numbers sense about multiplicative situations than about additive situations through a lack of confidence in applying their basic multiplication facts to find the products of larger numbers. Being able to estimate answers to multiplication operations is not often the focus of lessons in upper primary or beyond even though it is a valuable skill in life beyond school. This lesson provides students with an opportunity to identify composite numbers that are the product of particular pairs of numbers in a game situation. The lesson builds on the familiar game of Bingo. Students will play against each other on the same game board where they need to identify which pairs of factors will result in the composite numbers on the game board. This lesson is a variation on one from the Mathematics Curriculum and Teaching Program (MCTP, 1992) Volume 1.

Australian Curriculum links: ACMNA122

Resources:

Whole Class Activity:

- The LTD Mat folded or marked to have a 4 x 4 grid visible, or a large 4 x 4 grid marked on the floor with chalk or masking tape.
- 1 set of the Composite Number Bingo Cards – Whole Class (6 sets). This file includes cards for 6 games of varying difficulty.
- 1 copy of the Composite Number Bingo – Teacher Copy (answer sheet for each set of 6 cards)
- 10 small bean bags (or similar). 5 each of 2 different colours.
- 1 calculator

Hands-On Activity:

- 1 copy of Composite Number Bingo Activity – Game 1 per pair of students
- Enough copies of other games in the Composite Number Bingo Activity so each pair of students can play one or two more games. (Choose games to suit the ability of the students)
- 10 counters (5 each of 2 different colours) per pair of students
- 1 copy of the Composite Number Bingo Activity – Teacher Copy (answer sheet for all games)
- 1 calculator per pair of students

Independent Activity:

- 1 copy of the Composite Numbers Worksheet per student
- 1 copy of the Composite Numbers Worksheet – Teacher Copy (answer sheet).
- Highlighter / coloured pen/pencil

Whole Class Activity:

- Preparation: Spread the LTD Mat on the floor and either fold or mask off some of the Mat so a 4x4 grid is the focus. An alternative grid can be made using chalk on concrete outside or masking tape on the floor inside.
- Copy the Bingo cards and cut them into individual cards. They do not need to be copied in colour. The colour is to help keep sets of cards from getting mixed up.
- Place the first set of game cards in the grid. Ensure the rectangular number cards are in the same grid spaces as the answer sheet (for easy reference). Place the factor cards (circles) below the grid face-up so all can be seen. The arrangement of these does not matter.

- Have the class sit around the 4x4 grid.

We are going to play Bingo. Who has played bingo before?

- Invite a number of students to share their experiences of playing bingo and use their responses to highlight the rules of the game.
- Show the bean bags that will be used on the game board.

For this game you need to get 4 bean bags in a row. The row can be horizontal, vertical or diagonal. Can you see the numbers on the game board and the numbers below the game board? Who thinks they know how we will put a bean bag into a particular space on the grid?

- Accept a range of responses. Listen for mention of the answers being in the grid and the numbers below the grid need to be multiplied to find the answer and acknowledge this as the main rule for this game.
- Discuss the relationship between the numbers below (factors) and the composite numbers in the grid.

What is the relationship between the numbers in the circles and the numbers in the grid? (multiplication) *What do you call a number that can be multiplied with another number and what do you call the number that is the answer to the multiplication?*

- Listen to the terms suggested. The numbers in the circles will be factors of certain numbers in the grid. The numbers in the grid can be referred to as products (the answer to a multiplication calculation), or composite numbers because they have more than 2 factors. Each number in the grid has itself and 1 as factors as well as pairs from the factors below.

Let's play a demonstration game. Who would like to be my opposition for the first game? Everyone will help for the first game so we can see how the game works.

- Select a volunteer and let them choose which colour bean bag they want to use.

I will go first to show how it works. I am looking at the numbers in the circles and looking at the game board. I can see 15 in the bottom corner here (indicate the 15). *I know 3x5 is 15 so I will say '3 x 5 = 15'. Now* [Opposition Student Name] *needs to check my answer is right.* [Student Name] *am I right?*

- There is no need to move the factor cards. Just say the numbers (the numbers will need to be used several times in the one game).
- Focus on the student playing the game for confirmation of the correct answer even if other class members also indicate the answer is correct.

Good. So I can put my first bean bag on the number 15.

- Place a bean bag in the grid space where the number 15 card is.

Now it's your turn. Can you see two numbers in the circles here that will multiply together to make one of the numbers on the game board?

- Watch while the student chooses two numbers. Encourage the student speaks out loud as they are choosing and to state which numbers they have chosen aloud so the whole class can hear.

So you have chosen [Number 1] *and* [Number 2] *what is* [Number 1] *multiplied by* [Number 2]*?*

- Listen for the student's response and if they are correct have them place one of their bean bags on the composite number in the grid. If the student is not correct (unlikely with the whole class supporting them) they don't get to place their bean bag.
- Keep playing by taking turns to orally select 2 factors and to state the product aloud then place a bean bag onto the grid when correct.
- Model making an incorrect selection, so the class sees that the bean bag won't be placed if the pair of numbers and composite number don't match e.g.

I am going to choose 3 and 7. 3 multiplied by 7 is 28. Am I correct?

- Focus on the student playing for confirmation but it is likely the class will be quick to identify the error as well. Model missing this turn e.g.

So I don't get to put my bean bag down for this turn. I will need to be more careful next time.

- Continue playing by taking turns and making selections.
- Model some game strategies and be sure to state them aloud so the class can hear e.g.

I want my bean bag on the 18.. I need to think which numbers in the circles would multiply to make 18? You nearly have 4 in a row. I want to block you so I can win. I want to put my next bean bag on 60 so you don't win yet.

- If a player has all their bean bags on the grid but no-one has 4 in a row, the next turn players can move one of the bean bags they have on the grid to a new location by correctly stating the factors. The number of bean bags per player is deliberately only 5 to entice players to use strategies to win faster.
- Continue until one player has 4 bean bags in a row.
- Remove the bean bags from the game board and invite two other players to play the same game. Reinforce the strategies and rules of the game as they play. Ensure the players speak aloud as they play as this will be helpful when the numbers move beyond 1-digit basic facts.
- Continue with this game for some more pairs to reinforce the way the game works and to give some more students an opportunity to participate. This is the simplest game so provides the best chance for less able students to be involved once it has been played a couple of times.

- Choose another set of cards to reset the gameboard for larger numbers. Choose a set to suit the general ability of the class but with some challenge to model descriptions of strategies beyond basic fact recall. Game 2 includes 12 and 15 as the only 2-digit numbers, Games 3-6 have increasing numbers of 2-digit numbers.
- Game 3 provides some challenge but also some familiar combinations i.e. 3, 4, 8, 10, 16, 20, 31.
- Reset the game board with the cards for Game 3 (or 2 if preferred)

Who would like to be my opposition for this new game.?

- Use this demonstration to model use of strategies for larger numbers.
- Select a student to play and have them choose which colour bean bag they would like.
- Play the game and encourage the student playing to thinking aloud and model this as well e.g. model recognition of multiples of a particular number (multiples of 10)

I would like my bean bag in the top right corner so it can be in a horizontal, and vertical, and diagonal line. Now what numbers could multiply to make 620? The zero on the end means it 10 or 20 could be one of the numbers. 10x62 would be 620 but 62 isn't a number to choose from. 31 is half of 62 so it must be 20x31.

- Introduce the use of the calculator to check calculations. The player who is not having their turn can use the calculator to check the numbers suggested and check if they make the total stated. If the calculation is correct the bean bag gets placed, if they are incorrect the turn is missed.
- Note: The calculator is intended to be used to check stated calculations rather than to search for pairs that could be used for a turn in the game. When the students are playing this game in pairs during the Hands On section of the lesson it is quite likely they will try lots of combinations on the calculator even if it is stated as 'against the rules'. By reinforcing the intention is for them to predict which composite number will result from multiplying particular pairs they might think before they press buttons. However, if pairs of students end up investigating multiplication of given factors and the products made this is not a negative outcome.

- Encourage the student to talk through their choices as well.
- Listen to the strategies used by the student and highlight interesting ideas so the students can understand and learn these strategies for when they play.
- Another strategy to highlight is a focus on the digit in the Ones place and which numbers could be multiplied to result in the desired digit in the Ones place e.g.

I would like to put my bean bag on 128. I wonder which numbers will multiply to make 128? 128 has an 8 in the Ones place. I know that 2x9=18, that could give an 8 in the Ones but there is no number ending in 9 or 2 so that isn't it. 6x3 is 18 and 6x8 is 48. Maybe 3x16.. that would have an 8 on the end but will be too low. I would like to try 8x16.. I think that is 128.

- Continue playing, sharing strategies and talking about the numbers until all students have had a turn or until the rules are clear to all.
- There are cards for 6 games included with this lesson. This game can be used many times as a rotation activity or to fill short periods of time before breaks. In the MCTP project, trial teachers reported students choosing to play the game themselves during lunch breaks.

Hands On Activity:

- Have the students work with a partner so they can play the game together and discuss the numbers and strategies.
- Provide each pair of students with a copy of Game 1 (1st page of the file Composite Number Bingo Activity).
- Make 10 or 12 copies of Game 2 and 4 or 5 copies of each other game. Place these at the front of the room for students to choose from once the first game has been played as a reminder.
- Ensure each student has 5 counters and that their counters are a different colour to their opponent's colour.
- Don't hand out the calculators for this game as the factors are all 1-digit numbers except for 11. The challenge of working without the calculator initially will assist pairs of students to focus on the game structure and estimation. Of course if some students need the calculator, provide it.

- Introduce the game by reminding them about the focus and the rules i.e.

Do you remember the rules for this Composite number bingo game? What is a composite number?

- Listen to descriptions from several students. Encourage them to refer to the game board they have if they need assistance to think of what it is. The numbers in the grid are definitely composite numbers. The numbers in the circle might be but might be prime.
- Revise the rules for the game:
    - take turns to choose two factors and state which composite number these factors will result in when multiplied,
    - Talk out loud to explain thinking and so the partner can check calculations
    - If correct place a counter on the number on the game board, if incorrect miss this turn.
    - First with 4 counters in a row wins.
    - If you run out of counters with no-one winning swap one of your counters to a different space on the grid for the next turn.

- Set the students playing the game.
- Move around the room observing and listening to the discussions about the numbers. Make note of any interesting strategies worth sharing at the end of the session. Note the students' names, the strategy and the numbers they used the strategy with.
- Ask questions to gain insight into strategies being used or to guide students who get stuck choosing a pair of numbers to play e.g.

Are there any answers to multiplications using the numbers in circles that you know straight away? Is that answer in the grid? Is there a particular space in the grid you would like to put a counter? What number is in that space? What numbers could multiply together to make that number? Look at the digit in the Ones place. What numbers could you multiply together to end up with a number that has this digit in the Ones place?

- When students have completed the first game a new game can be assigned to each pair or pairs of students can choose a game to play from a selection of games at the front of the room. As the game boards do not get marked while being played, they can be played then returned to the front for other students to play. The games get more challenging as the Game number increases.
- It can be interesting when students are able to choose the level of difficulty of activities. Some confident students may wish to challenge themselves with the hardest game straight away. They might work out that this game is too hard initially, they can always return it and try another. When they have played a few games, they can be encouraged to return to the challenging game and give it another go using the strategies they learn in the other games. Other students may prefer to focus on increasing the difficulty slowly by progressing through the games in order.
- Students can change partners and play the same game or a new game with a different partner.
- Allow access to calculators as the numbers get more complex. Remind the students that these should be used to check if players have made correct choices rather than for searching for pairs that will multiply to give certain composite numbers. However, if pairs of students 'play' with the calculators investigating multiplication and the results this is not a bad 'off task' activity.

- When students have played a few games, the class can gather to share strategies for pairs of numbers aiming for related composite numbers.

- The numbers from different games can be listed on the whiteboard or the game boards can be projected for reference while students explain strategies they used.
- Ask students who were observed using interesting strategies while the games were being player to report on what they did and what they were thinking. They may need to be reminded of the numbers and even the strategy but persist with them doing the telling because explaining mathematics is a powerful skill and the class may understand it more clearly in student language than teacher language.

Independent Activity:

- Provide each student with a copy of the Composite Numbers Worksheet.
- This worksheet reflects the processes used in the games by providing a composite number and four pairs of factors. Students need to identify which pair/s of numbers will result in the composite number above when multiplied together.
- For some of the examples there are two pairs of factors that will result in the composite number, for others there is only one.
- An answer sheet is provided for the teacher. This can be carried around while the students work to assist with quick identification of students who are managing the task and those who require assistance or more learning on the topic.
- Students can highlight/colour or circle the pairs of factors they believe will result in the composite number in the box above.

- Move around the classroom as the students work asking questions to clarify understanding or to assist students who can't get started to engage in the task e.g.

Can you see a pair of numbers in the boxes that you know the answer to? Is this answer the number in the box above? What digit does the composite number at the top have in the Ones place? What two numbers in can you multiply together to get that digit in the Ones place? Think of the multiplication basic facts? Which ones have answers that have that digit in the Ones place? Can that help you choose a pair of factors for this composite number?

- When the students have finished the worksheet, the answers can be discussed as a class to identify and reinforce strategies used to estimate and calculate the multiplications or the worksheets can be collected for assessment purposes.

Understandings to look for:

- Students who can multiply 1-digit numbers and identify the composite number product in a list of products.
- Students who can use multiplication basic fact knowledge to identify composite numbers for extensions of those facts
- Students who can use strategies to identify the product of pairs of factors

Reference:
Lovitt, C. & Clarke, D. (1992) *The Mathematics Curriculum Teaching Program. Volume 1*. Curriculum Corporation: Carlton Victoria. pp 195-201