

Lesson Plan: Secret Agent Math - The Prime Number Protocol

Materials Needed:

- Whiteboard or large paper
- Markers (different colors)
- Notebook or paper for the student
- Pencils
- Calculator (for checking work, not for initial solving)
- Index cards for games (optional)
- A "Top Secret" envelope for the final mission
- Stopwatch or timer (optional)

Lesson Information

- **Subject:** Mathematics
- **Age Group:** 12-year-old (Year 7 Level)
- **Duration:** 75-90 minutes
- **Topic Focus:** Number Properties and Operations

Curriculum Alignment (Australian Curriculum)

- **ACMNA149:** Investigate index notation and represent whole numbers as products of powers of prime numbers.
- **ACMNA150:** Investigate and use square roots of perfect square numbers.
- **ACMNA151:** Apply the associative, commutative and distributive laws to aid mental and written computation.
- **ACMNA280:** Compare, order, add and subtract integers.

Learning Objectives

By the end of this lesson, the student will be able to:

- Decompose a whole number into its prime factors and express it using index notation.
- Calculate the square root of a given perfect square.
- Apply commutative, associative, and distributive laws to solve problems mentally.
- Solve addition and subtraction problems involving positive and negative integers.
- Synthesize these skills to solve a multi-step creative problem.

Lesson Structure

Part 1: Agent Briefing & Warm-Up (10-15 minutes)

Goal: Engage the student with the "Secret Agent" theme and review integer operations (ACMNA280).

1. **Introduction:** "Welcome, Agent. Your mission today, should you choose to accept it, is to master the 'Prime Number Protocol.' You'll need to learn how to deconstruct codes, find secret keys, and use mental shortcuts to become a master math spy. First, we need to test your

navigation skills on a number line."

2. **Activity - The Number Line Dash:**

- Draw a large number line on the whiteboard, from -20 to 20.
- Give a series of verbal instructions (missions) for the student to track with their finger or a marker.
- "Start at -3. Your target is 7 spaces to the right. Where are you?" (Answer: 4)
- "Start at 8. Your extraction point is 12 spaces to the left. Where are you?" (Answer: -4)
- "Start at -10. You move 5 spaces right, then 9 spaces left. What is your final position?" (Answer: -14)

3. **Discussion:** Briefly discuss the rules for adding/subtracting integers that they just used intuitively.

Part 2: Deconstructing the Codes - Prime Factors (20 minutes)

Goal: Teach prime factorization and index notation in a creative context (ACMNA149).

1. **Concept Introduction:** "Every whole number is either a 'primary agent' or a 'compound code.' Primary agents are **prime numbers**—they can only be divided by 1 and themselves. All other numbers are compound codes, which can be broken down into a secret string of primary agents."
2. **Activity - Factor Trees:**
 - Model how to break down the number **36** using a factor tree. Emphasize circling the prime numbers when you find them.
 - Show how the final "code" is the product of all the circled primes: $36 = 2 \times 2 \times 3 \times 3$.
 - Introduce **index notation** as the official, compact way to write the code: $36 = 2^2 \times 3^2$.
3. **Student Mission:** Give the student three "compound codes" to deconstruct. For example: **48, 80, 100**. The student must find the prime factors and write them in index notation.

Part 3: Unlocking the Vault - Square Roots (15 minutes)

Goal: Understand the concept of perfect squares and their square roots (ACMNA150).

1. **Concept Introduction:** "Some of the most secure vaults have a square door. The area of the door is a 'perfect square' number. To open it, you don't need the area—you need the length of just one side. Finding that side length is called finding the **square root**."
2. **Activity - Find the Key:**
 - Draw a square with an area of 25. Ask, "What number, when multiplied by itself, gives us 25?" The student should identify 5. Explain that 5 is the square root of 25.
 - Provide a list of "vault areas" (perfect squares) and ask the student to find the "key" (the square root). Examples: 49, 81, 144, 400.

Part 4: Agent Shortcuts - Mental Math Laws (15 minutes)

Goal: Apply associative, commutative, and distributive laws to compute more efficiently (ACMNA151).

1. **Introduction:** "Top agents don't have time for slow calculations. They use secret mental shortcuts."
2. **The Laws as Tools:**
 - **Commutative Law (Order Switcher):** Show that $5 + 13$ is the same as $13 + 5$. "It doesn't matter which order you receive the intel."
 - **Associative Law (Grouping Gadget):** Show that $(2 + 8) + 5$ is the same as $2 + (8 + 5)$. "You can group your allies in any way that makes the job easier."
 - **Distributive Law (The Smart Multiplier):** This is the most powerful tool. Model how to solve 7×18 . "Instead of doing a hard calculation, think of 18 as $(20 - 2)$. The 7 multiplies both parts: $(7 \times 20) - (7 \times 2)$. That's $140 - 14$, which is 126. Much faster!"

3. **Student Mission:** Give the student 2-3 problems to solve using the Distributive Law.
Examples: 6×23 , 9×51 .
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Part 5: Final Mission - Crack the Master Code (15-20 minutes)

Goal: A summative assessment where the student applies all learned skills to solve a final puzzle.

1. **Setup:** Hand the student the "Top Secret" envelope containing four clue cards. Explain that solving each clue will give them one number in the final four-digit code to unlock the "Master Protocol."
2. **The Clues:**
 - **Clue 1 (Integers):** "Your mission starts at an altitude of 15 meters below sea level. You descend another 25 meters, then rise 30 meters. What is your final altitude in meters?" (Answer: $-15 - 25 + 30 = -10$. First number is -10).
 - **Clue 2 (Prime Factors):** "Find the prime factors of **120**. The code is the largest prime factor you find." (Answer: $120 = 2^3 \times 3 \times 5$. The largest prime factor is 5. Second number is 5).
 - **Clue 3 (Square Roots):** "The key to the vault is the square root of **169**." (Answer: 13. Third number is 13).
 - **Clue 4 (Distributive Law):** "Use an agent shortcut (the distributive law) to mentally calculate **12×31** ." (Answer: $12 \times (30+1) = 360 + 12 = 372$. Fourth number is 372).
3. **Mission Success:** The student presents the final code: **-10, 5, 13, 372**. Congratulate them on a successful mission!

Part 6: Mission Debrief (5 minutes)

Goal: Consolidate learning and reflect on the process.

- Ask the student: "Which agent skill did you find the most useful?" "Which part of the mission was the most challenging?"
- Briefly review the four main topics and how they connect. For example, how prime numbers are the building blocks of all other numbers.

Differentiation

- **Support:** For the final mission, provide a multiplication chart or a list of the first ten prime numbers. Use smaller numbers in the problems (e.g., prime factors of 24 instead of 120).
- **Extension:** Challenge the student to create their own "Crack the Code" puzzle for you to solve. Introduce cube roots or ask them to find the prime factorization of a much larger number (e.g., 360).