

Task: Magic Squares

Suggested Timing

60–75 minutes with possible follow-up

Blackline Masters

Master 1 Project Rubric

BLM Magic Squares

BLM Magic Square Blanks

BLM Magic Square Blanks (shaded) (optional)

Mathematical Processes

✓ Communication

✓ Connections

✓ Mental Mathematics and Estimation

✓ Problem Solving

✓ Reasoning

Technology

✓ Visualization

Specific Outcomes

N6 Demonstrate an understanding of addition and subtraction of integers, concretely, pictorially and symbolically.

PR5 Evaluate an expression given the value of the variable(s).

PR6 Model and solve problems that can be represented by one-step linear equations of the form $x + a = b$, concretely, pictorially and symbolically, where a and b are integers.

Planning Notes

Introduce the task as a class. Have students work individually to answer the questions.

Note: Before beginning this task, students should have experience with adding and subtracting integers, and algebraic expressions and one-step linear equations.

You may wish to use the following steps to introduce and complete this task:

1. Discuss with students what a magic square is and how it works. Provide students with **BLM Magic Squares** and **BLM Magic Square Blanks** to complete the activity.
2. Clarify that the task is to
 - determine the integers needed to complete the magic square in #1 and identify the magic number
 - determine whether or not the number square in #2 is a magic square and explain why or why not
 - solve the two magic squares in #3 by determining the magic number, and then develop expressions for each missing number in the magic square on the right
 - create one or more new magic squares using positive and negative integers, and one magic square with a variable

3. Review **Master 1 Project Rubric** with students so that they will know what is expected.

Meeting Student Needs

- Allow concrete and kinesthetic learners to model the expressions using a cup for the variable.
- Some students may find it easier to use the shaded magic square blanks on **BLM Magic Square Blanks (shaded)**. Remind them to add every row, column, and diagonal.

Gifted and Enrichment

- Have students create a spreadsheet that can be used to verify a magic square.
- Challenge students to develop a magic square with expressions of the form $ax + b$, ax , or $\frac{x}{a}$.

Answers

Magic Squares

1. Missing numbers are in italics. The magic number is +3.

+4	<i>-1</i>	<i>0</i>
<i>-3</i>	+1	+5
+2	+3	-2

2. Tyler is correct. This is a magic square because all rows, columns, and diagonals add to 0.
3. a) The magic number is -3.
 b) $x = -1$. Sample expressions will vary. Make sure that each row, column, and diagonal adds to -3 once x has been replaced by -1.
4. Sample magic squares will vary. Check that each row, column, and diagonal adds to the same number.

Assessment of Learning	Supporting Learning
Magic Squares Introduce the task to the class. Have students work together as a class to answer #1 and then individually complete #2 to #4.	<ul style="list-style-type: none"> • Use Master 1 Project Rubric to assist you in assessing student work. For notes on how to use this rubric for this task, see below. • To view student exemplars, follow the links.

The chart below shows the **Master 1 Project Rubric** for tasks such as this one and provides notes that specify how to identify the level of specific answers for this project.

Score/Level	Holistic Descriptor	Specific Question Notes
5 (Standard of Excellence)	<input type="checkbox"/> Applies/develops thorough strategies and mathematical processes making significant comparisons/connections that demonstrate a comprehensive understanding of how to develop a complete solution <input type="checkbox"/> Procedures are efficient and effective and may contain a minor mathematical error that does not affect understanding <input type="checkbox"/> Uses significant mathematical language to explain their understanding and provides in-depth support for their conclusion	<ul style="list-style-type: none"> provides a complete solution, which may contain a missing justification in either #1 or #2
4 (Above Acceptable)	<input type="checkbox"/> Applies/develops thorough strategies and mathematical processes for making reasonable comparisons/connections that demonstrate a clear understanding <input type="checkbox"/> Procedures are reasonable and may contain a minor mathematical error that may hinder the understanding in one part of a complete solution <input type="checkbox"/> Uses appropriate mathematical language to explain their understanding and provides clear support for their conclusion	<ul style="list-style-type: none"> provides a complete solution to #1 to #4, with only integers in the magic square in #4 <i>or</i> provides a complete solution to #1, #2, #3a), and #4, with no expressions in #3b)
3 (Meets Acceptable)	<input type="checkbox"/> Applies/develops relevant strategies and mathematical processes making some comparisons/connections that demonstrate a basic understanding <input type="checkbox"/> Procedures are basic and may contain a major error or omission <input type="checkbox"/> Uses common language to explain their understanding and provides minimal support for their conclusion	<ul style="list-style-type: none"> correctly completes #1, #2, and #3a) <i>or</i> correctly completes #1, #2, and #3, but does not have an expressions in #3b) <i>or</i> completes #1, #2, and #3, without providing any justification in #1 and #2 <i>or</i> answers all questions, but does not provide any justification
2* (Below Acceptable)	<input type="checkbox"/> Applies/develops some relevant mathematical processes making minimal comparisons/connections that lead to a partial solution <input type="checkbox"/> Procedures are basic and may contain several major mathematical errors <input type="checkbox"/> Communication is weak	<ul style="list-style-type: none"> completes #1 and #2, with or without justification <i>or</i> completes #1 and #3a), with or without justification <i>or</i> completes #2 and #3a), with or without justification
1* (Beginning)	<input type="checkbox"/> Applies/develops an initial start that may be partially correct or could have led to a correct solution <input type="checkbox"/> Communication is weak or absent	<ul style="list-style-type: none"> correctly completes #1 <i>or</i> correctly completes #2 <i>or</i> correctly completes #3a)

For student exemplars, follow the links.