WORKING WITH ALGEBRA
Lesson 1: Like Terms

Australian Curriculum: Mathematics – Year 8

ACMNA190: Extend and apply the distributive law to the expansion of algebraic expressions.
- Applying the distributive law to the expansion of algebraic expressions using strategies such as the area model.

ACMNA191: Factorise algebraic expressions by identifying numerical factors.
- Recognising the relationship between factorising and expanding.

ACMNA192: Simplify algebraic expressions involving the four operations.
- Understanding that the laws used with numbers can also be used with algebra.

Lesson abstract

This resource contains a collection of tasks focussing on like terms. In How Can You Make It? students create a given expression using a range of provided terms and then share their strategies. In Algebra Card Set, students place mathematical operation arrows between expressions to show the relationship between those expressions. In Composite Areas, students determine the area of various composite shapes made of squares and quadrants in terms of given areas.

Mathematical purpose (for students)

Practise operating with like terms in algebraic expressions.

Mathematical purpose (for teachers)

These tasks can develop fluency with manipulation of like terms. Tasks should be attempted by students with minimal introduction to encourage deep reasoning and communication. Students will discover that multiple expressions and equations can describe the same relationship. Teachers can create tasks using algebraic expressions with any desired complexity, and students can vary the level of complexity in their solutions.

Lesson Length 20 to 30 minutes for each task

Vocabulary Encountered

- coefficient
- expression
- index
- power
- square
- term
- trial and error
- variable

Lesson Materials

- Student Sheet 1 – How Can You Make It? (one per 5 students)
- Student Sheet 2 – Algebra Card Set (one per group)
- Student Sheet 3 - Algebra Card Set Board (one per group)
- Student Sheet 4 - Composite Areas (one per student)
- Teacher Sheet 1 - Algebra Card Set
- Teacher Sheet 2 - Composite Areas

We value your feedback after this lesson via *http://tiny.cc/lesson-feedback*

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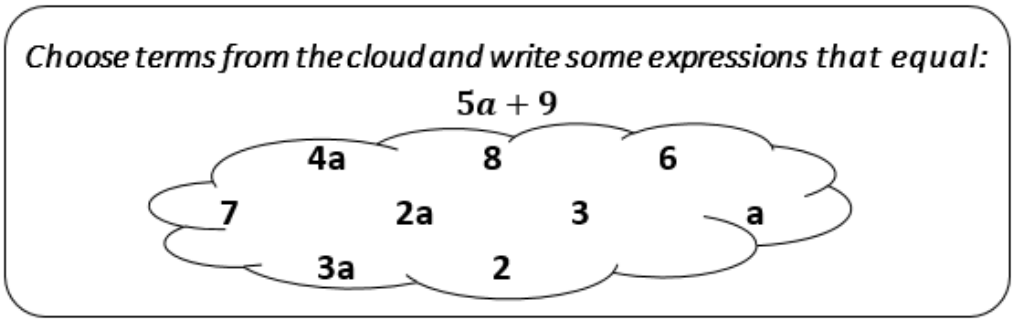
How Can You Make It?



Getting Started

- Initiate brief classroom discussions:
  - What is a variable?
  - How is 5*a* different to 5 + *a*?
  - Why does *a* + 8 + *a* + *1* = *2a* + *9*?
- Provide each student with a task card from Student Sheet 1 – How Can You Make It? (or draw it on the board) and pose the problem.

Enabling Prompts

- How can you make *5a* with the choices you have?
  - Can you do it another way?
- How can you make 9 with the choices you have?
  - Can you do it another way?

Extending Prompts

- How many different expressions for *5a* + 9 can you write?
  - Use more terms.
  - Use other operations i.e. subtraction, multiplication, division, indices, brackets.
- How many different expressions that equal 5*a* + 9 can you write using each of the terms exactly once?
- Create an expression that equates to 0 using all of the terms.

Summarising

- Encourage students to share solutions and strategies for making 5*a* + 9 in groups and with the class.

Possible solutions

- Below is a small sample of possible solutions including some options using every term.

$4a + a + 6 + 3$ $\quad 2a + 3a + 7 + 2$ $\quad 4a + 2a - a + 8 + 3 - 2$

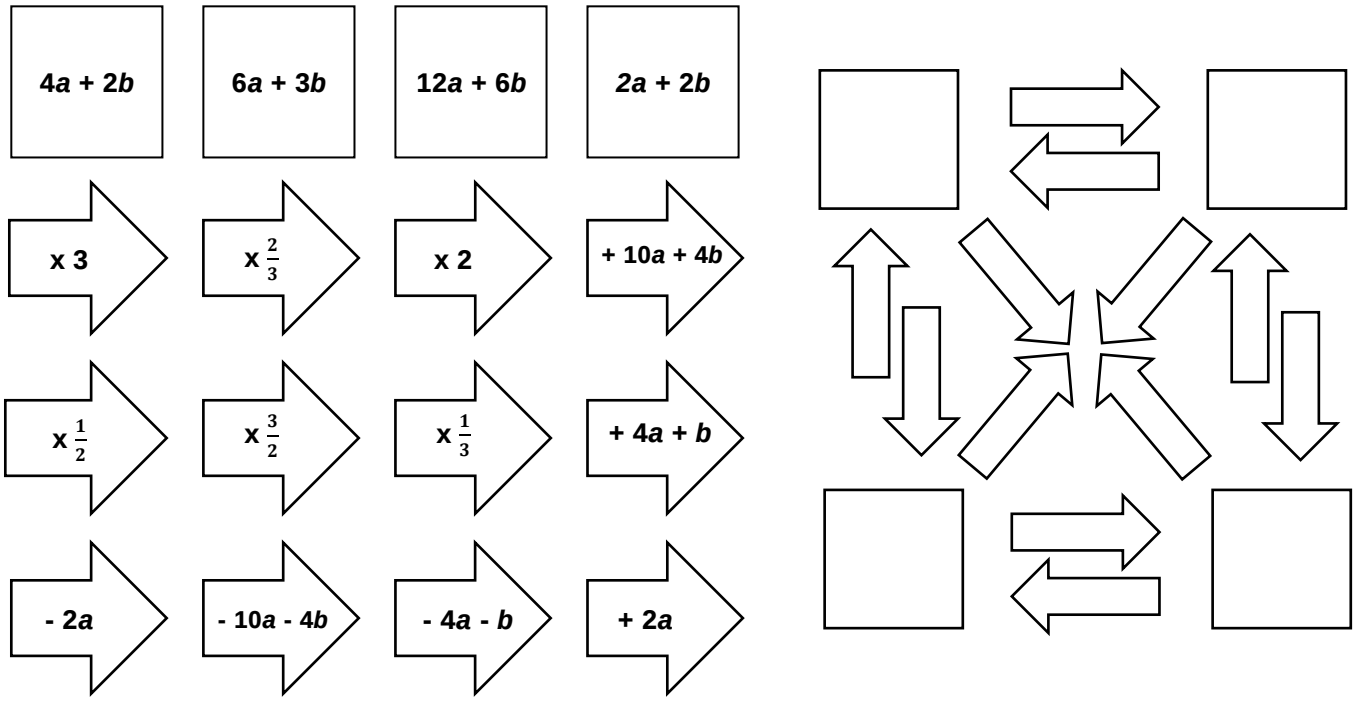
$2a + 3a + 2 \times 6 - 3$ $\quad 2 \times 2a + a + 7 + 8 - 6$ $\quad (8 - 3) \times a + \frac{6 \times 3a}{2a}$

$\frac{(4a \times a)^2}{(2a)^3} + 3a + 8 + 7 - 6$ $\quad \frac{4a \times 3a}{2a} - a + \left(\frac{6}{2 \times 3}\right)^7 + 8$

$a + 4a - 2a - 3a + 7 + 8 - 3 - 2 \times 6 = 0$ $\quad \left(\frac{4a-3a}{a} + 2 \times 3 - 6 + 7 - 8\right)^{2a} = 0$

Algebra Card Set

Students sort the expression squares and operational arrows below into an arrangement like this…



Materials Required

- Student Sheet 2 – Algebra Card Set, one per group cut into individual arrows and squares.
- Student Sheet 3 - Algebra Card Set Board, one per group.

Note: The four additional blank arrows on the student sheet can be used for students to create their own operations as an extension.

Enabling Prompts

- What do you notice about the squares? About the arrows?
- Make a start by putting two expressions into any two corners of the board.
- What do you do to one expression to change it to another?

Extending Prompts

- Create your own version:
  - Using the given expression squares, but your own operation arrows.
  - Using the given operation arrows, but your own expression squares.
  - Using your own expression squares and your own operation arrows.

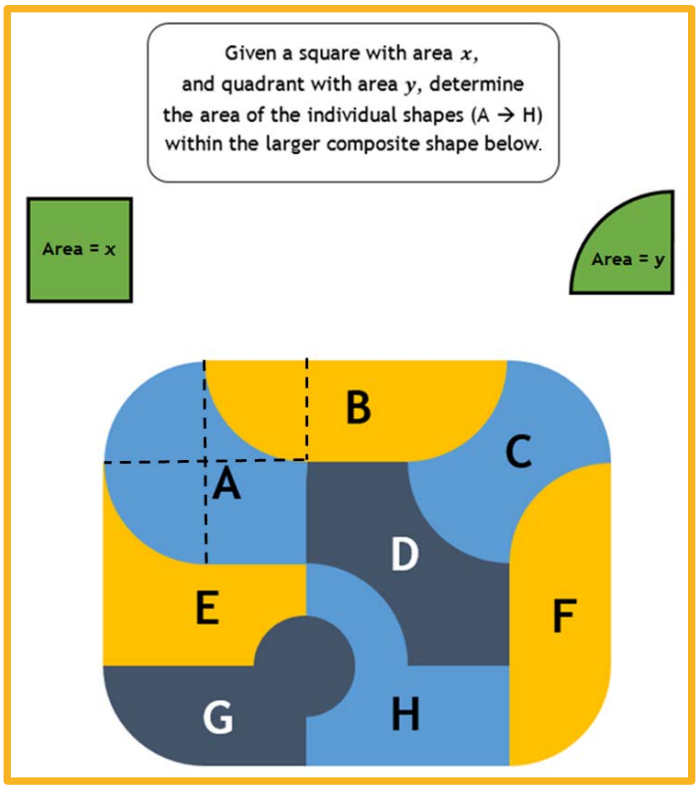
Summarising

- Encourage students to share different strategies for sorting the expressions and arrows in groups and with the class.
- The task can be used as a catalyst for similar tasks of increased complexity and to facilitate classroom discussions about the patterns they noticed.

Possible Solutions

- A possible solution is available in Teacher Sheet 1 - Algebra Card Set. Student solutions may have the expression cards in different places, but the operation arrows between two given expressions will be the same as the example solution.

Composite Areas



Materials Required

- Student Sheet 4 - Composite Areas, one per student.

Enabling Prompts

- What are composite shapes?
- Start with shape B.
- Cut out (and use) the square with area x and the quadrant with area y.
- Make some shapes with areas $2x$, $x + y$ and $x - y$.
- Use a square and quarter square to show that when the side length is halved the area is divided by 4. Students will need to understand that this is a general rule that also applies to circles. They will need this to calculate the area of the small quadrant for E, G and H.

Extending Prompts

- Explain why the area of the entire shape must be $16x + 4y$. Check that the sum of the individual areas is $16x + 4y$.
- If $x = 4$, what is y? What would be the area of each individual shape and of the entire shape?
- Maintain the total area and design your own tangram shapes using the square with area x and the quadrant with area y.

Summarising

- Encourage students to share different strategies for working out each area in groups and with the class. Start with shapes B and F which require only addition of areas.

Solutions

- Solutions are provided in Teacher Sheet 2 - Composite Areas.

re(Solve) MATHS BY INQUIRY

How Can You Make It?

Choose terms from the cloud and write some expressions that equal:

$$5a + 9$$

4a 8 6

7 2a 3 a

3a 2

Choose terms from the cloud and write some expressions that equal:

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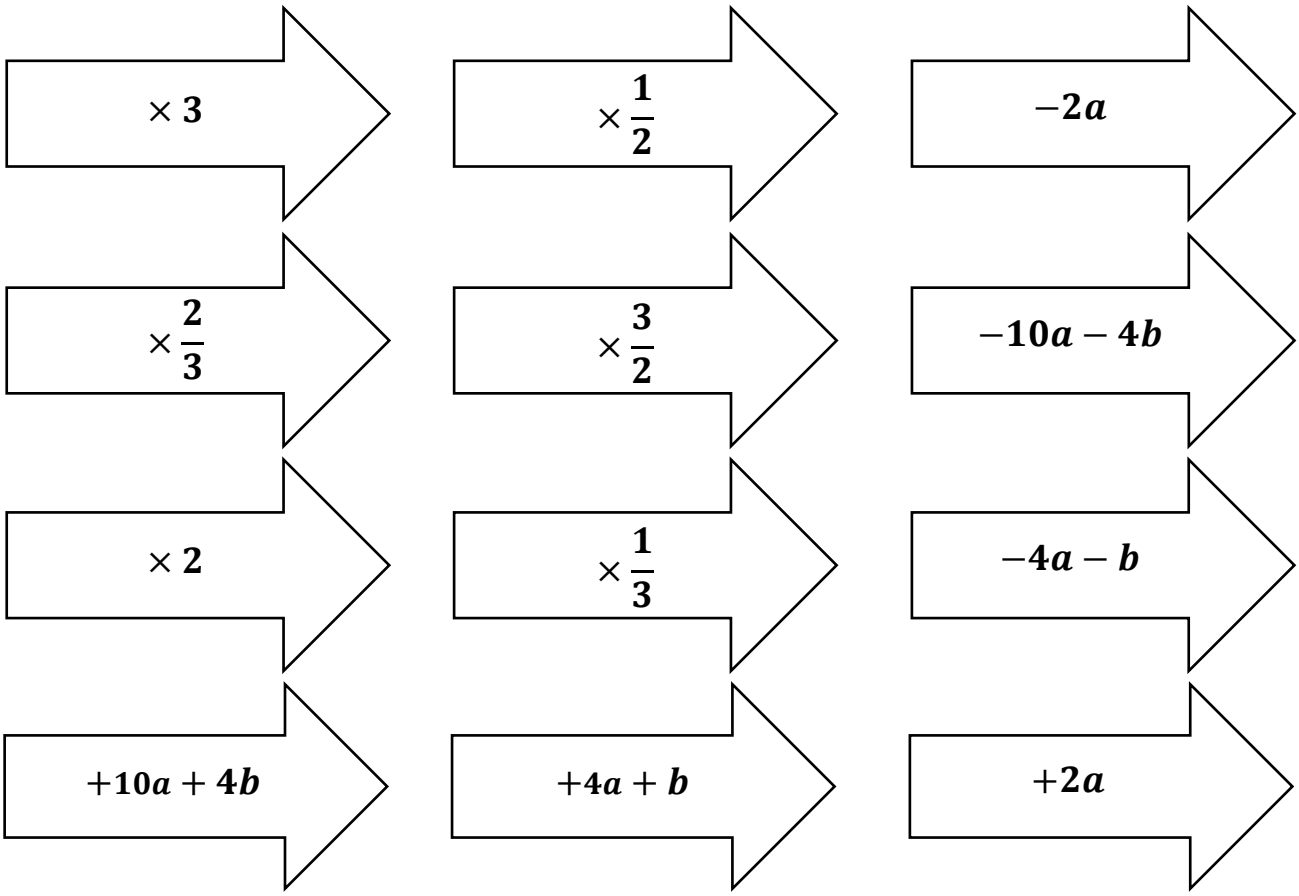
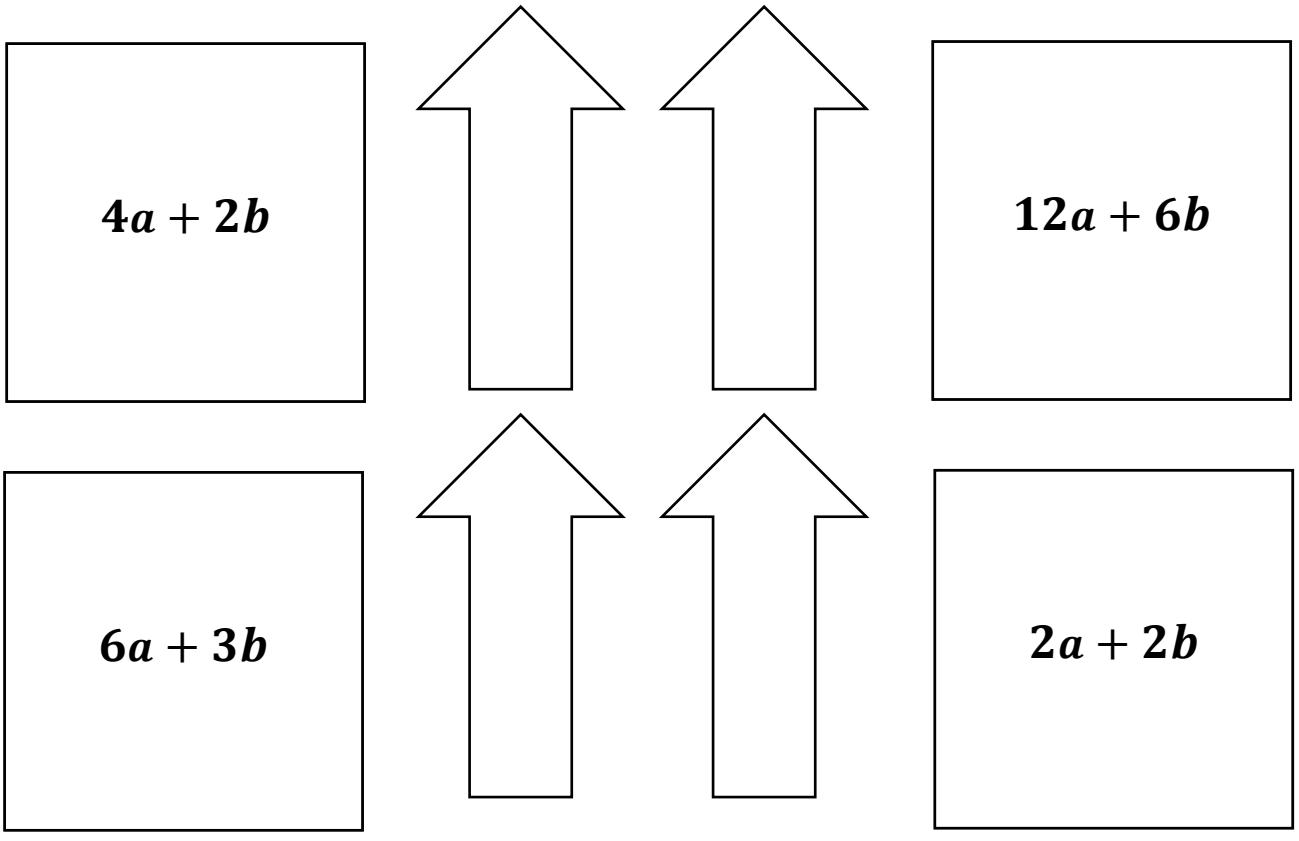
Algebra Card Set Task





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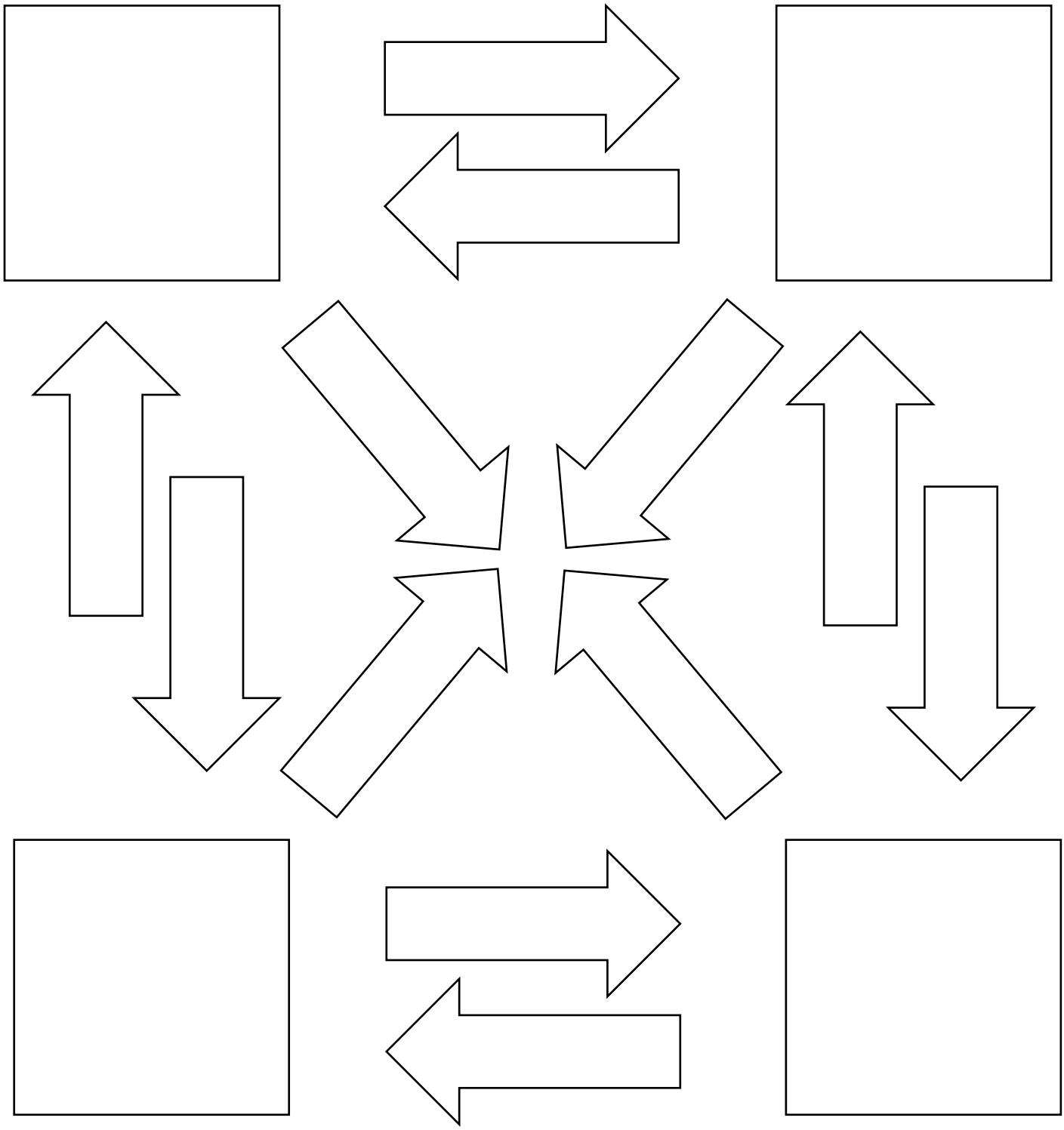
Algebra Card Set Board

Name: _____



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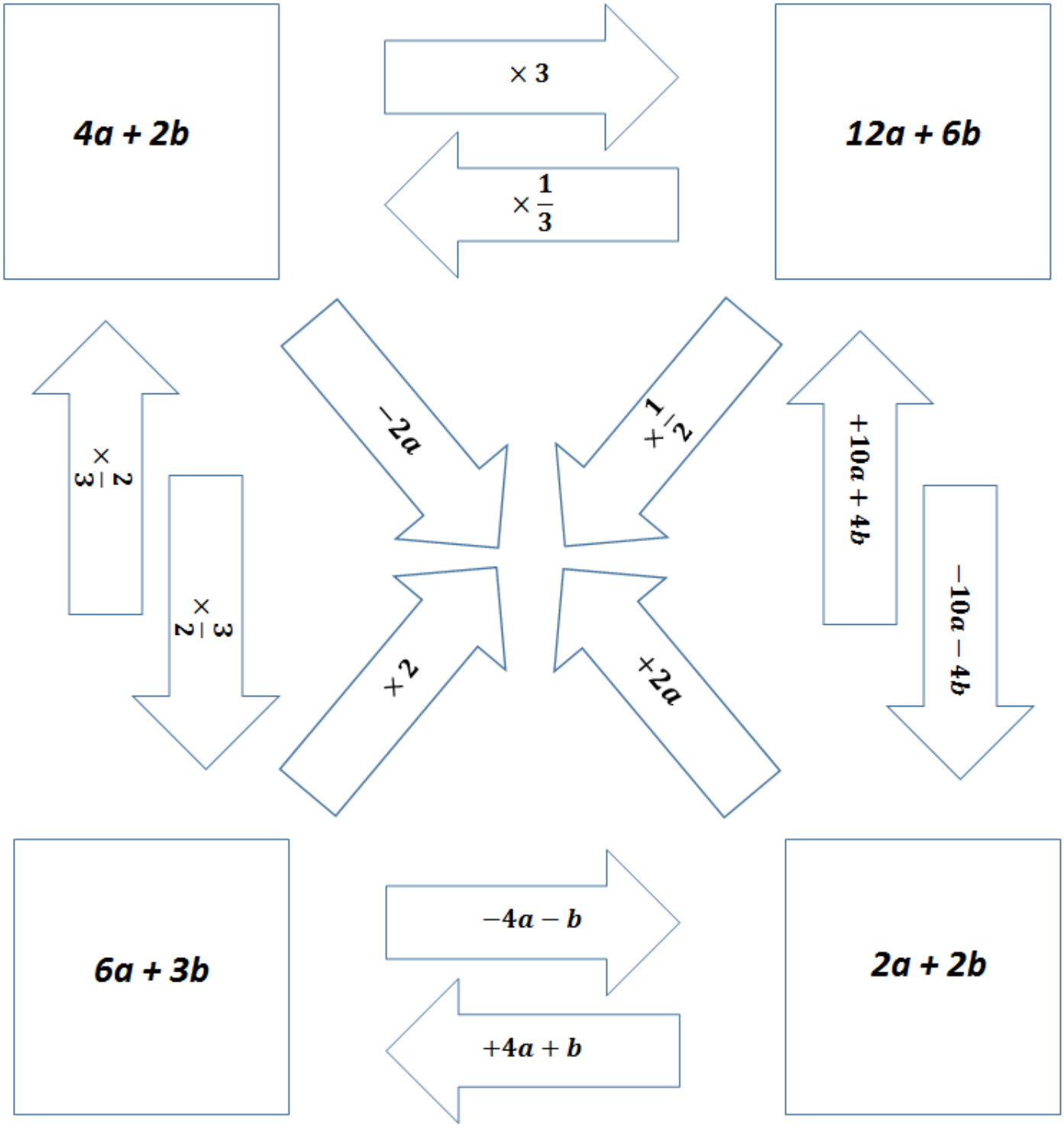
Teacher Sheet 1 - Algebra Card Set



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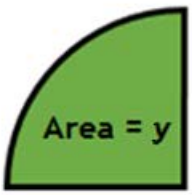
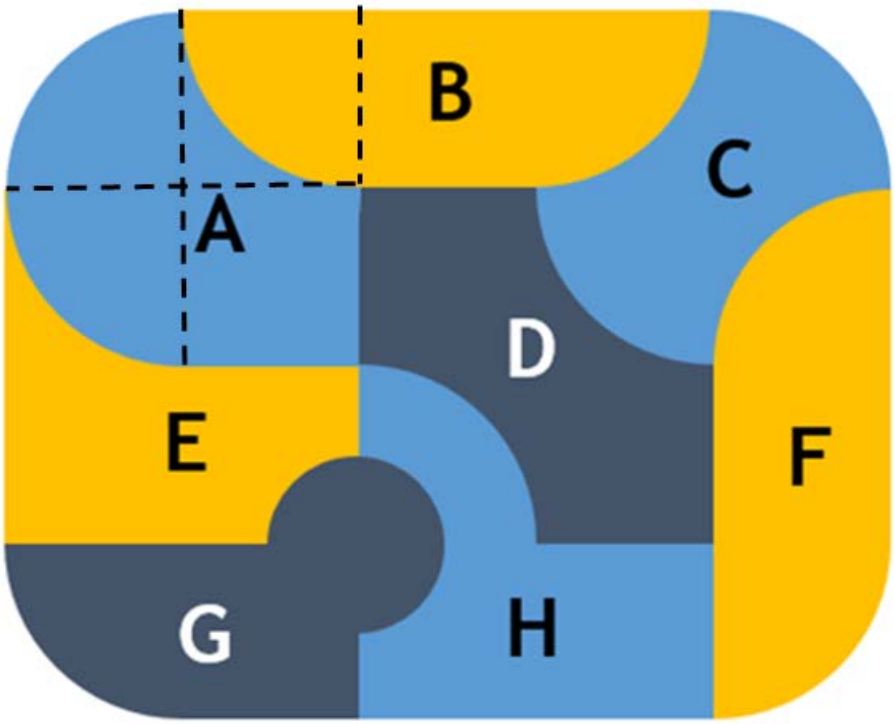
Composite Areas

Name: _____

Given a square with area x, and quadrant with area y, determine the area of the individual shapes (A → H) within the larger composite shape below.





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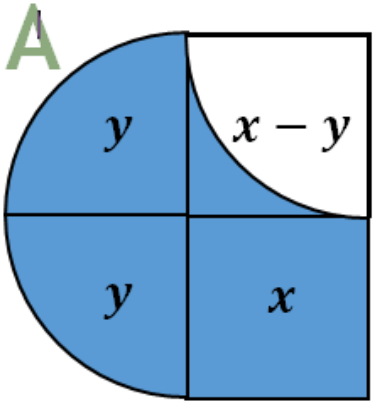
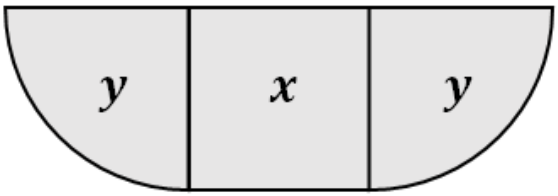
Teacher Sheet 2 - Composite Areas

A	B	C	D	E	F	G	H
$2x + y$	$x + 2y$	$2x$	$4x - 2y$	$3x - \frac{5y}{4}$	$x + 2y$	$x + \frac{7y}{4}$	$2x + \frac{y}{2}$

A



B



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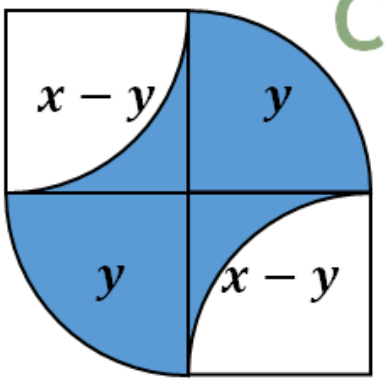

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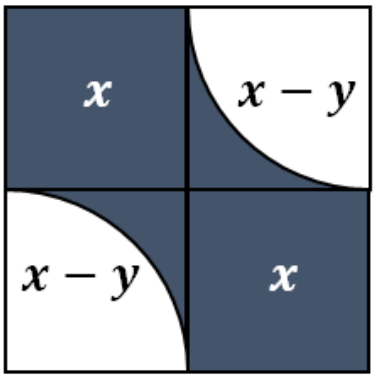

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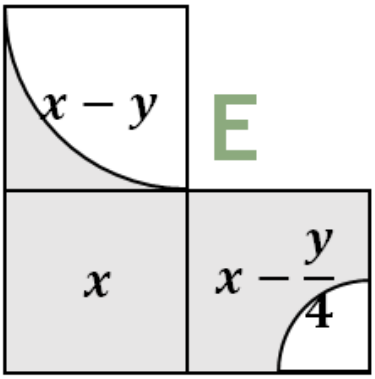

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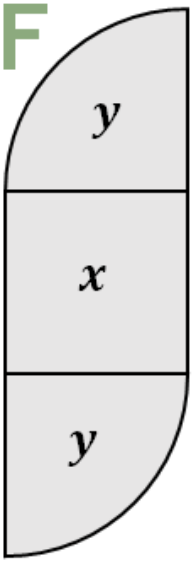

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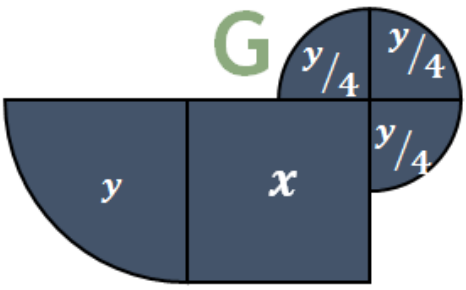
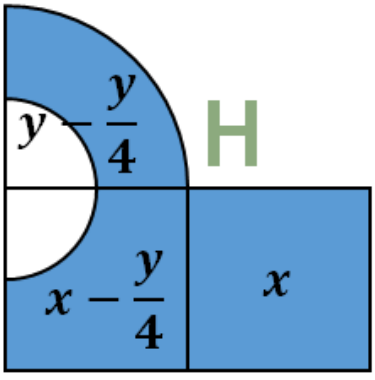


H



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