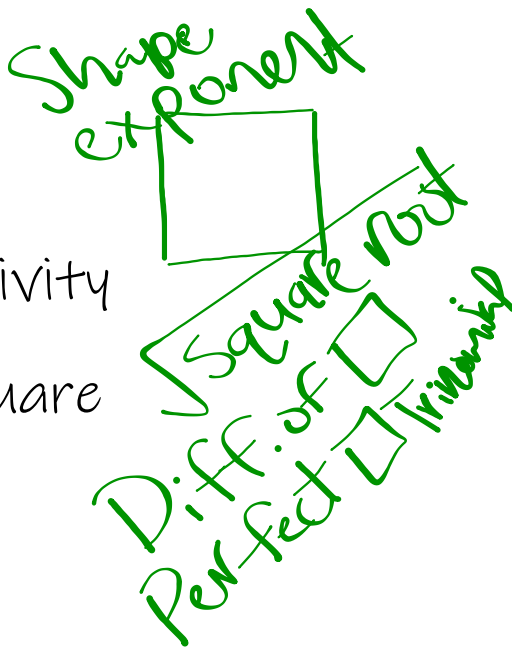
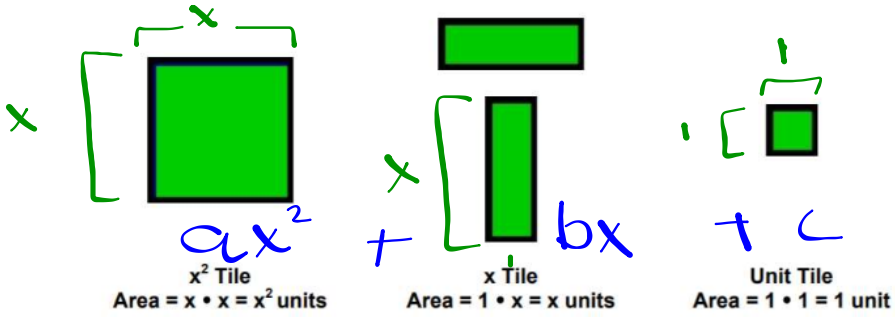
Good morning!

1. "Here"
2. Completing the Square activity
3. Practice completing the square



Solving Quadratics by Completing the Square
(using Algebra tiles)

Algebra tiles are square and rectangular tiles that we use to represent numbers and variables. There are 3 types of tiles…



x^2 Tile
Area = x • x = x^2 units

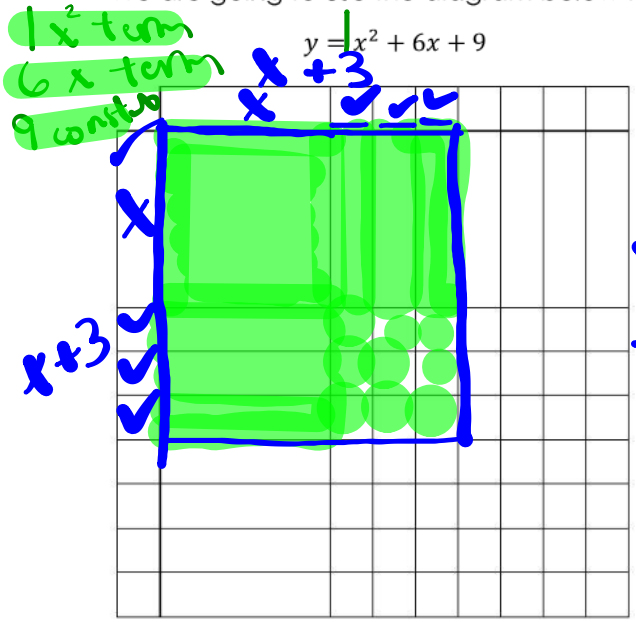
x Tile
Area = 1 • x = x units

Unit Tile
Area = 1 • 1 = 1 unit

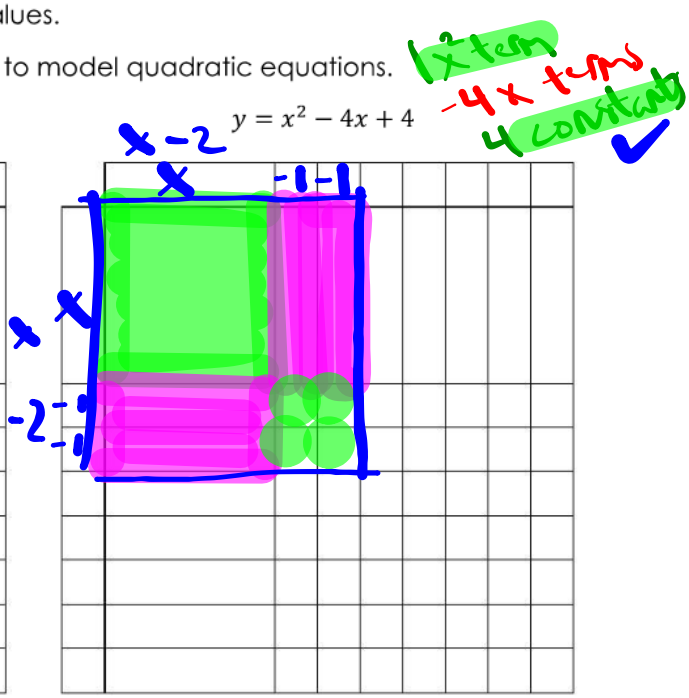
Algebra tiles are often double sided with a green side that represents positive values and red side that represents negative values.

We are going to use the diagram below to model quadratic equations.

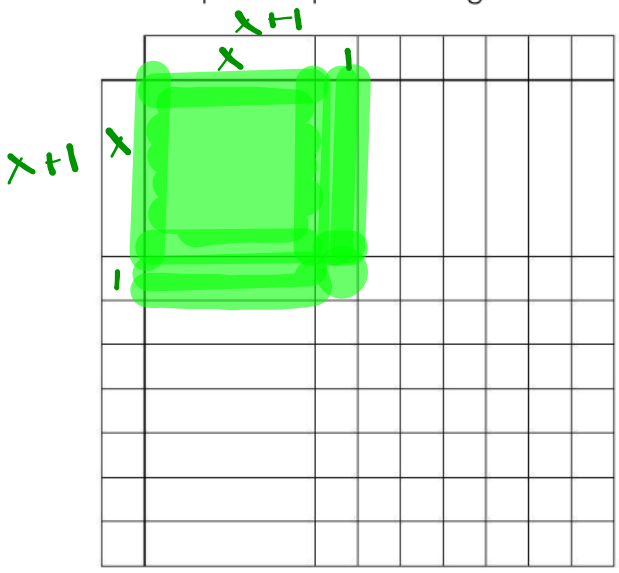
$y = x^2 + 6x + 9$



$y = x^2 - 4x + 4$



Create a partial square with algebra tiles to represent $x^2 + 2x + \underline{1}$



a) How many unit tiles do you need to complete the square? 1

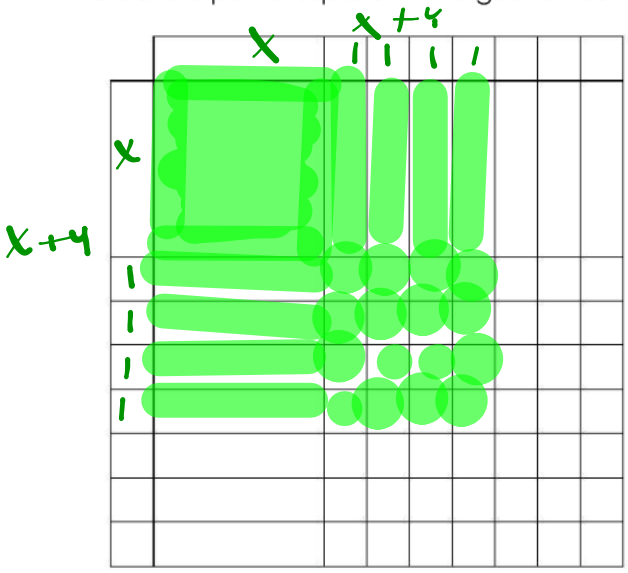
b) What are the dimensions of the completed square?

$(x+1)(x+1)$

c) Fill in the blanks below to make the following true:

$x^2 + 2x + \underline{1} = (x + \underline{1})^2$

Create a partial square with algebra tiles to represent $x^2 + 8x + \underline{16}$



a) How many unit tiles do you need to complete the square? 16

b) What are the dimensions of the completed square?

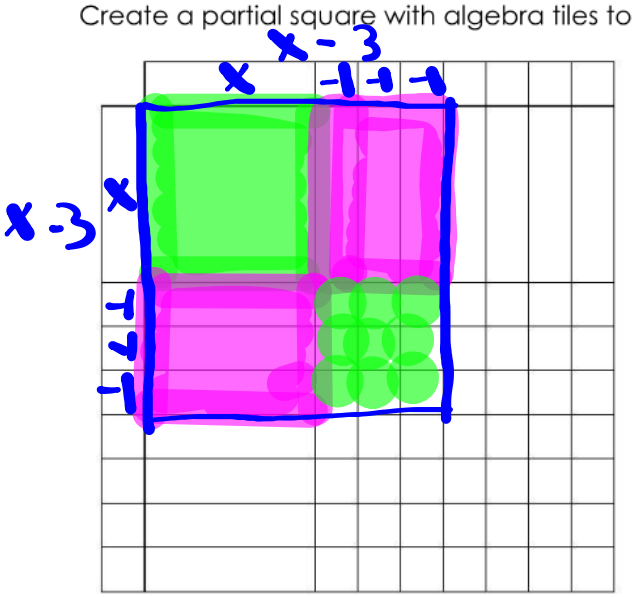
$(x+4)(x+4)$

c) Fill in the blanks below to make the following true:

$x^2 + 8x + \underline{16} = (x + \underline{4})^2$

15

Create a partial square with algebra tiles to represent $x^2 - 6x + \underline{9}$



a) How many unit tiles do you need to complete the square? 9

b) What are the dimensions of the completed square?

$(x-3)(x-3)$ $\sqrt{9} \rightarrow 3$

c) Fill in the blanks below to make the following true:

$x^2 - 6x + \underline{9} = (x \underline{-3})^2$

Using Algebra Tiles to Solve Quadratics

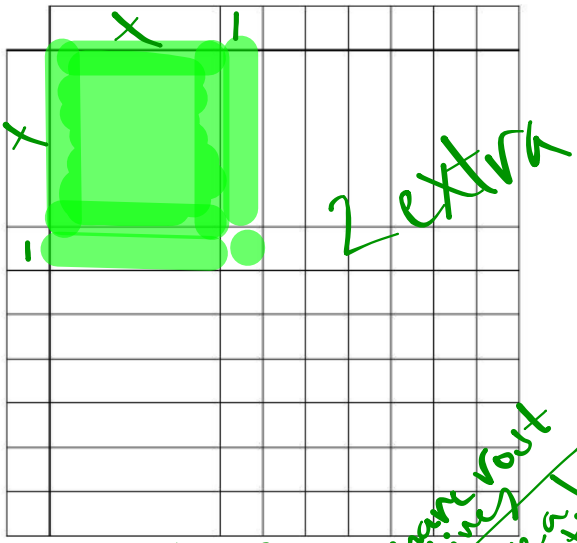
Given the equation $x^2 + 2x + 3 = 0$...

a) How many x^2 tiles do we have? 1

b) How many x tiles do we have? 2

c) How many unit tiles do we have? 3

d) Sketch the square. *(You may have extra unit tiles or you may need to borrow unit tiles)*



e) Length of the square: $(x+1)$

f) Area of the square: $(x+1)^2$

g) Unit tiles left over (+/-) or borrowed (-) 2

h) New equation: $y = (x+1)^2 + 2$

i) To solve, replace y with 0 and solve.

$0 = (x+1)^2 + 2$

$\sqrt{-2} = \sqrt{(x+1)^2}$ If square root a negative, no real solution

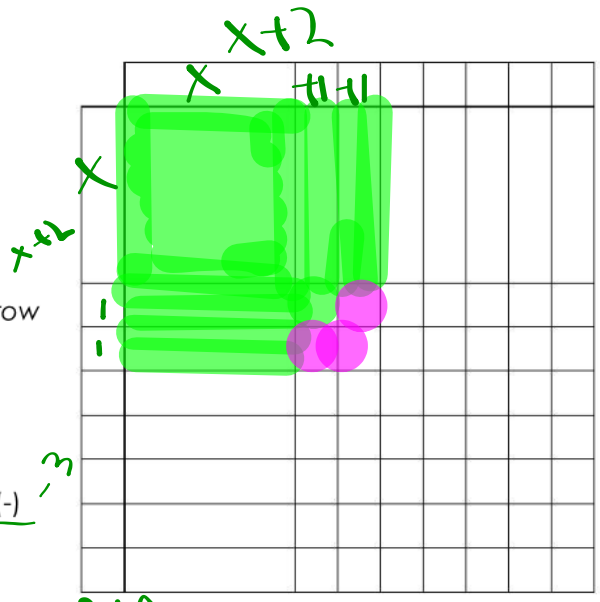
Given the equation $x^2 + 4x + 1 = 0$...

a) How many x^2 tiles do we have? 1

b) How many x tiles do we have? 4

c) How many unit tiles do we have? 1

d) Sketch the square. *(You may have extra unit tiles or you may need to borrow unit tiles)*



e) Length of the square: $(x+2)$

f) Area of the square: $(x+2)^2$

g) Unit tiles left over (+/-) or borrowed (-) -3

h) New equation: $y = (x+2)^2 - 3$

i) To solve, replace y with 0 and solve.

SOLN

$0 = (x+2)^2 - 3$

$+3 \quad +3$

$\pm\sqrt{3} = \sqrt{(x+2)^2}$

$x+2 = \sqrt{3}$ $\quad$ $x+2 = -\sqrt{3}$

$-2 \quad -2$ $\quad$ $-2 \quad -2$

$x = -2+\sqrt{3}$ $\quad$ $x = -2-\sqrt{3}$

Given the equation $x^2 + 6x + 4 = -6$...

a) Get the equation equal to zero. $+6 \quad +6$

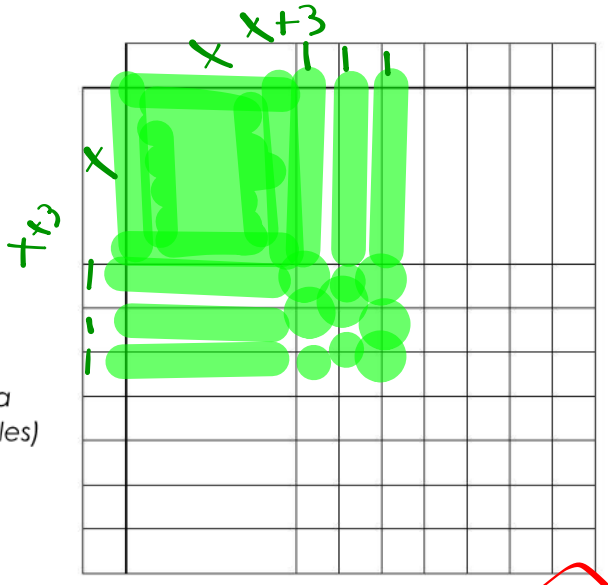
$x^2 + 6x + 10 = 0$

b) How many x^2 tiles do we have? 1

c) How many x tiles do we have? 6

d) How many unit tiles do we have? 10

e) Sketch the square. *(You may have extra unit tiles or you may need to borrow unit tiles)*



f) Length of the square: $x+3$ $\quad$ $(x+3)^2$

g) Area of the square: x^1

h) Unit tiles left over (+/-) or borrowed (-)

i) New equation: $y = (x+3)^2 + 1$

j) To solve, replace y with 0 and solve.

$0 = (x+3)^2 + 1$

$-1 \quad -1$

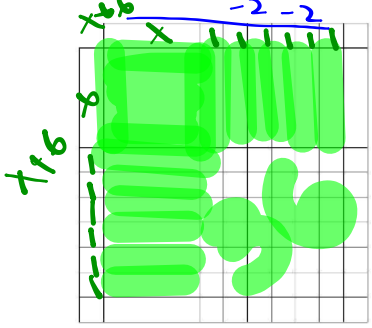
$\sqrt{-1} = \sqrt{(x+3)^2}$

NO real solution

$\pm i = x+3$

** If the equation is originally set equal to a number other than 0, get it equal to 0 first ** If a is not 1, you will need to factor out a first **

1) $x^2 + 12x + 30 = 2$



$x^2 + 12x + 28 = 0$ borrow 8

$(x+6)^2 - 8 = y$

$(x+6)^2 - 8 = 0$

$+8 \quad +8$

$\sqrt{(x+6)^2} = \sqrt{8}$

$x + 6 = \pm 2\sqrt{2}$

$x+6 = 2\sqrt{2}$ $\quad$ $x+6 = -2\sqrt{2}$

$-6 \quad -6$ $\quad$ $-6 \quad -6$

$x = -6 + 2\sqrt{2}$ $\quad$ $x = -6 - 2\sqrt{2}$

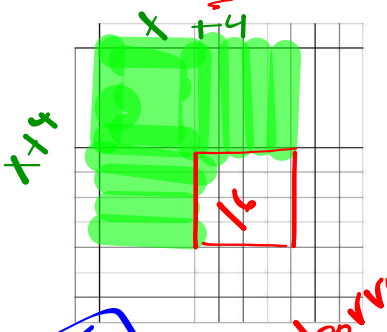
Solve by RM

$2\sqrt{8}$

$2\ 4$

$2\ 2$

2) $x^2 + 8x - 20 = 0$



$-20 + x = 16$

$+20 \quad +20$

36

borrow 36

$(x+4)^2 - 36 = y$

$0 = (x+4)^2 - 36$

$+36 \quad +36$

$\sqrt{36} = \sqrt{(x+4)^2}$

$\pm 6 = x + 4$

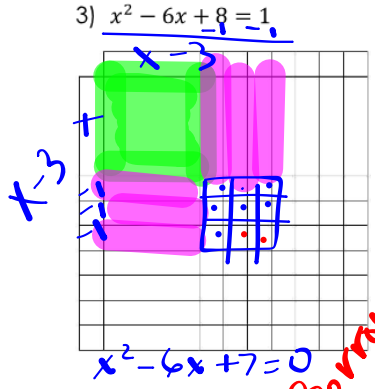
$x+4 = 6$ $\quad$ $x+4 = -6$

$-4 \quad -4$ $\quad$ $-4 \quad -4$

$x = 2, -10$

3) $x^2 - 6x + 8 = 1$

$-1 \quad -1$



$x^2 - 6x + 7 = 0$ Borrow 2

$y = (x-3)^2 - 2$

$0 = (x-3)^2 - 2$

$+2 \quad +2$

$\sqrt{2} = \sqrt{(x-3)^2}$

$x - 3 = \pm\sqrt{2}$

$x - 3 = \sqrt{2}$ $\quad$ $x - 3 = -\sqrt{2}$

$+3 \quad +3$ $\quad$ $+3 \quad +3$

$x = 3 + \sqrt{2}$ $\quad$ $x = 3 - \sqrt{2}$

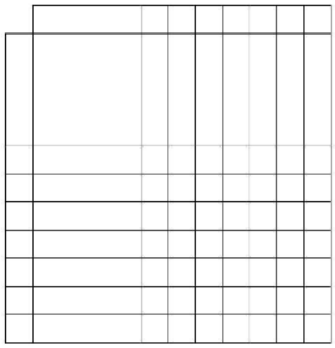
Completing the Square

- x terms, b was even
- x^2 term, a was ONE
- Treat like perfect □Trinomial
  - ↳ $\sqrt{\text{last term}}$
  - ↳ $\frac{\text{middle term}}{2}$

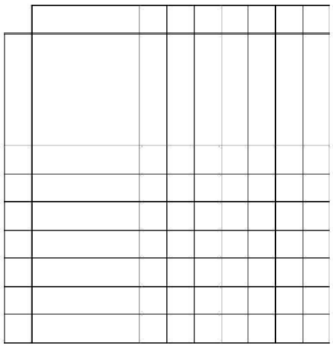
Completing the Square Practice

Complete the square to find the roots of the following functions.

1) $x^2 + 12x + 32 = 0$



2) $x^2 + 10x + 8 = 0$



draw your own diagram

3) $x^2 - 6x - 10 = 6$

4) $x^2 - 9 = 4x$

Elementary Algebra Skill

Solving Quadratic Equations: Completing the Square

Solve each equation by completing the square.

1) $x^2 + 2x - 24 = 0$

2) $p^2 + 12p - 54 = 0$

3) $x^2 - 8x + 15 = 0$

4) $r^2 + 18r + 56 = 0$

5) $m^2 - 6m - 55 = 0$

6) $m^2 - 4m - 91 = 0$

7) $m^2 + 16m - 32 = -7$

8) $r^2 - 8r = -8$

9) $n^2 = -14n - 37$

10) $n^2 - 2n = 15$

11) $x^2 + 15x + 15 = 2 + x$

12) $-3n^2 + 4n - 59 = -4n^2$

13) $5n^2 - 20n + 6 = 0$

14) $3a^2 - 6a - 34 = 0$

15) $3x^2 - x - 3 = 0$

16) $2v^2 + 5v - 7 = 0$

17) $4n^2 + 11n = 15$

18) $9a^2 - 21 = 13a$

19) $3m^2 - 10m + 11 = 4$

20) $3m^2 - 16m - 2 = -7$

Answers to Solving Quadratic Equations: Completing the Square

1) $\{4, -6\}$ 2) $\{-6+3\sqrt{10}, -6-3\sqrt{10}\}$ 3) $\{5, 3\}$

4) $\{-4, -14\}$ 5) $\{11, -5\}$ 6) $\{2+\sqrt{95}, 2-\sqrt{95}\}$

7) $\{-8+\sqrt{89}, -8-\sqrt{89}\}$ 8) $\{4+2\sqrt{2}, 4-2\sqrt{2}\}$ 9) $\{-7+2\sqrt{3}, -7-2\sqrt{3}\}$

10) $\{5, -3\}$ 11) $\{-1, -13\}$ 12) $\{-2+3\sqrt{7}, -2-3\sqrt{7}\}$

13) $\left\{\frac{10+\sqrt{70}}{5}, \frac{10-\sqrt{70}}{5}\right\}$ 14) $\left\{\frac{3+\sqrt{111}}{3}, \frac{3-\sqrt{111}}{3}\right\}$ 15) $\left\{\frac{1+\sqrt{37}}{6}, \frac{1-\sqrt{37}}{6}\right\}$

16) $\left\{1, -3\frac{1}{2}\right\}$ 17) $\left\{1, -3\frac{3}{4}\right\}$ 18) $\left\{\frac{13+5\sqrt{37}}{18}, \frac{13-5\sqrt{37}}{18}\right\}$

19) $\left\{2\frac{1}{3}, 1\right\}$ 20) $\left\{5, \frac{1}{3}\right\}$