Name:			Date:
MISSION	**8**	**Cool Stuff**	***Materials***

There is more to your robot and graphing calculator than meets the eye. “Alfred” and “George” live inside the calculator along with an Exploding Star. A new DaVinci, Escher, or Picasso may also be discovered with the help of your calculator robot.

You need:

- ❏ 1 Norland Calculator Robot and 1 Graphing Calculator
- ❏ 1 Clothes Peg, Marker
- ❏ Graph Paper
- ❏ Drawing Paper 18" × 24"

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Alfred:

On your graphing calculator press the [2nd] key and then press [ZOOM] for format. Scroll down with the arrow keys and highlight **AxesOff**. Press [ENTER].
Press [Y=] key and enter the following equations:

```
 Plot1  Plot2  Plot3
\Y1■-.5X²+10
\Y2■-√(16-X²)-5
\Y3■-4+√(1-(X+3)
²)
\Y4■-4+√(1-(X-3)
²)
\Y5■-√((1-X²)-6
```

All keys are visible on the face of your graphing calculator. Be sure and distinguish between a negative and a subtraction sign. Don't leave out the ²) at end of equations three and four. Press [GRAPH] to see Alfred.

George:

Leave the setting as above. Press [Y=] and enter the following equations, then press [GRAPH]. Meet George.

```
 Plot1  Plot2  Plot3
\Y1■-2√(X-2)+1
\Y2■-2√(-X-2)+1
\Y3■√(25-X²)+5
\Y4■-√(25-X²)+5
\Y5■-√(16-X²)+6
\Y6■-4+√(1-(X+3)
²)+10
\Y7■-4+√(1-(X-3)
²)+10
\Y8■-√(1-X²)+6
\Y9■-X²-.25
\Y0=
```

Exploding Star:

Leave format setting as above. Press the [2nd] key and then press [ZOOM]. Scroll down with the arrow keys and highlight **5:ZSquare**. Press [ENTER]. Press [MODE] and then scroll down with the arrow keys and highlight **Pol**. Press [ENTER]. Press [Y=] and enter the following equations, then press [GRAPH] to view the explosion.

```
 Plot1  Plot2  Plot3
\r1■6
\r2■8sin(11.5θ)
\r3■5tan(5.4θ)
\r4=
\r5=
\r6=
```

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Make Your Own:

Press [2nd] and then press [ZOOM]. Scroll down with the arrow keys and highlight **6:ZStandard**. Press [ENTER]. Press [MODE] and then scroll down with the arrow keys and highlight **Func**. Press [ENTER]. Press [2nd] and then press [ZOOM] for format. Scroll down with the arrow keys and highlight **AxesOn**. Press [ENTER].
Press [Y=], delete any other entries, and then enter the following equations. When finished, press [GRAPH]. On graph paper, draw what happens to the parabola as 3 is added and subtracted. Use different colors to draw the graphs for each equation.

$\backslash Y_1 = X^2$
$\backslash Y_2 = X^2 + 3$
$\backslash Y_3 = X^2 - 3$

Insert parentheses around the second and third equations. Instead of squaring just X, square the whole expression. First predict what the graphs will look like, then press [GRAPH] and draw what happens to the parabola on graph paper.

$\backslash Y_1 = X^2$
$\backslash Y_2 = (X+3)^2$
$\backslash Y_3 = (X-3)^2$

Graph the following and draw what happens to the parabola:

$\backslash Y_1 = X^2$
$\backslash Y_2 = .5X^2$
$\backslash Y_3 = .25X^2$
$\backslash Y_4 = -X^2$

For straight lines, graph and draw the following linear equations:

$\backslash Y_1 = X$
$\backslash Y_2 = X + 3$
$\backslash Y_3 = X - 3$

Predict what the following absolute value equations will look like, then graph and draw them. (For absolute value, press [MATH], arrow over to **NUM**, and select number **1**. Press [ENTER].)

$\backslash Y_1 = abs(X)$
$\backslash Y_2 = abs(X) + 3$
$\backslash Y_3 = abs(X) - 3$

Try:

$\backslash Y_1 = abs(X)$
$\backslash Y_2 = abs(X + 3)$
$\backslash Y_3 = abs(X - 3)$

For a circle, press [2nd] and then press [ZOOM]. Scroll down with the arrow keys and highlight **5:ZSquare**. Press [ENTER]. Graph and draw the following circles and determine their radii and diameters:

$\backslash Y_1 = \sqrt{(100 - x^2)}$
$\backslash Y_2 = -\sqrt{(100 - x^2)}$
$\backslash Y_3 = \sqrt{(16 - x^2)}$
$\backslash Y_4 = -\sqrt{(16 - x^2)}$

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Make your own creation on your graphing calculator using variations of the function equations above. Write down your equations for a partner and see if they can duplicate your design.

Circular Lines

Using the robot, paper, and marker draw a circle with the circumference of approximately 36 inches. This can be accomplished by attaching a marker 5.75 inches from the robots pivot point. On most robots, a marker taped to the back is very close. (If necessary, see **Mission 4** for more on robot circle drawing.)

After you've made your circle, put 36 dots evenly spaced (one inch apart) around the circumference. Number the dots from zero to 35. Also, place the number 36 above the zero.

Make a solution table for the equation Y=X+21.

X	0	1	2	3	. . .
Y	21	22	23	24	. . .

On your "circle graph," use a straight line to connect 0 with 21, 1 with 22, 2 with 23, etc. Extend the solution table to X=36. In order to connect larger numbers, continue the number pattern around the outside of the circle. Your efforts will be rewarded by an intricate symmetrical pattern that can be enhanced by shading it with colored pencils.

The Robot Does the Work

Enter the following program into your calculator. Place your robot on a large sheet of paper with a marker on the back and have it ready to draw. Start the program. Hit the bumper to stop the robot when you're satisfied with your design.

```
PROGRAM:SCORPIO
    :Lbl A
    :Send({321,10})
    :Get (R)
    :If R<10:Goto B
    :Send ({320, 10})
    :Get (R)
    :If R<10: Goto B
    :Goto A
    Lbl B
```

This activity provides a fun way to explore functions and an opportunity to extend concepts while encouraging artistic design.

Alfred:

George:

Exploding Star: