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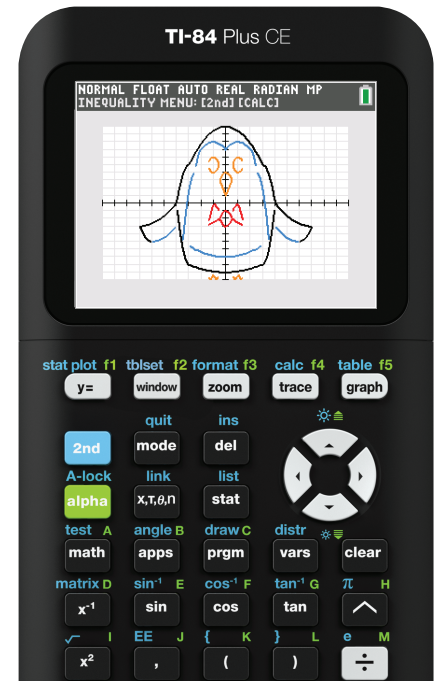
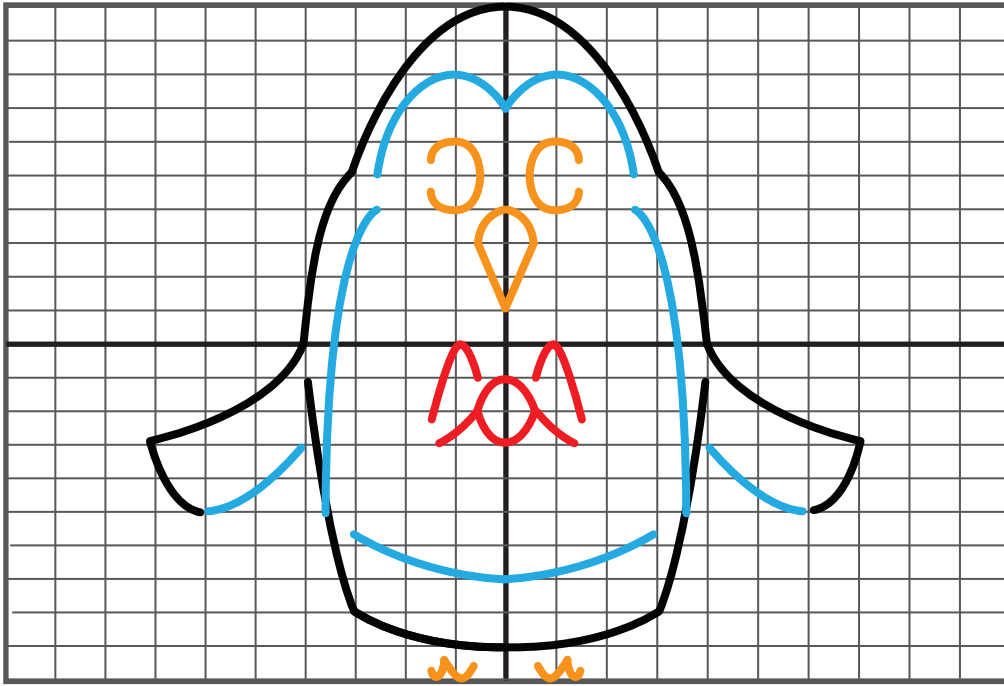
Mr. Bowtie – teacher notes

In this differentiated activity, students will use their knowledge of functions and limited domains to do one of the following:

- » Write equations to create the given image.
- » Use their knowledge of transformations to produce the rest of the image.
- » Make their own design and write the corresponding equations.

Common Core Standards:

- » CCSS.HSF.BF.B.3
- » CCSS.HSF.IF.C



ACTIVITIES AND THEIR OBJECTIVES

Peng-WIN functions!

At the end of this activity students should be able to:

- » Write equations from a graph.
- » Identify the domain of each equation (identify the domains in each piecewise function).

Cold feet - transformations

At the end of this activity students should be able to:

- » Use properties of function transformations to write the equations for the missing pieces of the image.

For this activity, use personal discretion on whether to share some, all, or none of the equations to students.

Waddle you know?

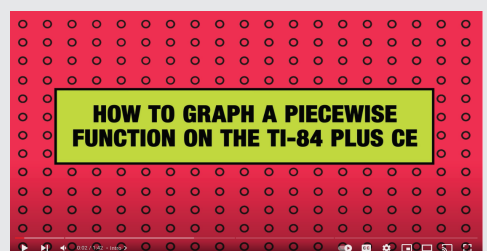
At the end of this activity students should be able to:

- » Use their extensive knowledge of functions to write equations to create a unique image.
- » Identify the domain of each equation (identify the domains for each piecewise function).

Introduction to piecewise functions

For these activities, students will need to know how to enter piecewise functions into their calculators.

You can play this quick how-to video for your class. <https://bit.ly/3SCT1fq>



Mr. Bowtie – teacher notes

Highlighted equations are the missing parts or altered domains for the transformations activity.

$$f(x) = \left\{ \begin{array}{l} \frac{1}{3}(x+7)^2 - 3; \quad -7 \leq x < -4 \\ -5(x+3)^2 + 5; \quad -4 \leq x < -3 \\ -\frac{5}{9}x^2 + 10; \quad -3 \leq x < 3 \\ -5(x-3)^2 + 5; \quad 3 \leq x < 4 \\ \frac{1}{3}(x-7)^2 - 3; \quad 4 \leq x < 7 \end{array} \right\}$$

Top of body and wings
(black)

$$f(x) = \left\{ \begin{array}{l} 2(x+6)^2 - 5; \quad -7 \leq x < -6 \\ 8(x+3)^2 - 8; \quad -4 \leq x < -3 \\ \frac{1}{9}x^2 - 9; \quad -3 \leq x < 3 \\ 8(x-3)^2 - 8; \quad 3 \leq x < 4 \\ 2(x-6)^2 - 5; \quad 6 \leq x < 7 \end{array} \right\}$$

Bottom of body and
wing outline:
(black)

$$f(x) = \left\{ \begin{array}{l} -12(x+2)^2 + 7; \quad -\frac{5}{2} \leq x < -2 \\ -(x+1)^2 + 8; \quad -2 \leq x < 0 \\ -(x-1)^2 + 8; \quad 0 \leq x < 2 \\ -12(x-2)^2 + 7; \quad 2 \leq x < \frac{5}{2} \end{array} \right\}$$

Hairline:
(light blue)

$$f(x) = \left\{ \begin{array}{l} -4(x+1)^2 + 6; \quad -\frac{3}{2} \leq x < -\frac{1}{2} \\ -4x^2 + 4; \quad -\frac{1}{2} \leq x < \frac{1}{2} \\ -4(x-1)^2 + 6; \quad \frac{1}{2} \leq x < \frac{3}{2} \end{array} \right\}$$

Top of eyes and beak:
(orange)

Mr. Bowtie – teacher notes

Highlighted equations are the missing parts or altered domains for the transformations activity.

$$f(x) = \left\{ \begin{array}{l} \frac{1}{2} (x + 6)^2 - 5; \quad -6 \leq x < -4 \\ \frac{1}{2} (x - 6)^2 - 5; \quad 4 \leq x < 6 \\ \frac{8}{49} x^2 - 7; \quad -3 \leq x < 3 \end{array} \right\}$$

Under wings and lower belly: (blue)

$$f(x) = \left\{ \begin{array}{l} -9(x + \frac{5}{2})^2 + 4; \quad -\frac{7}{2} \leq x \leq -\frac{5}{2} \\ -9(x - \frac{5}{2})^2 + 4; \quad \frac{5}{2} \leq x \leq \frac{7}{2} \end{array} \right\}$$

Sides of belly: (blue)

$$f(x) = \left\{ \begin{array}{l} 4(x + 1)^2 + 4; \quad -\frac{3}{2} \leq x < -\frac{1}{2} \\ 4|x| + 1; \quad -\frac{1}{2} \leq x < \frac{1}{2} \\ 4(x - 1)^2 + 4; \quad \frac{1}{2} \leq x < \frac{3}{2} \end{array} \right\}$$

Bottom of eyes and beak: (orange)

$$f(x) = \left\{ \begin{array}{l} 16(x + \frac{5}{4})^2 - 10; \quad -\frac{3}{2} \leq x < -1 \\ 16(x + \frac{3}{4})^2 - 10; \quad -1 \leq x < -\frac{1}{2} \\ 16(x - \frac{3}{4})^2 - 10; \quad \frac{1}{2} \leq x < 1 \\ 16(x - \frac{5}{4})^2 - 10; \quad 1 \leq x < \frac{3}{2} \end{array} \right\}$$

Feet: (orange)

Mr. Bowtie – teacher notes

Highlighted equations are the missing parts or altered domains for the transformations activity.

$$f(x) = \left\{ \begin{array}{l} 6x + 6; \quad -\frac{3}{2} \leq x < -1 \\ -2x - 2; \quad -1 \leq x < -\frac{1}{2} \\ -4x^2 - 1; \quad -\frac{1}{2} \leq x < \frac{1}{2} \\ 2x - 2; \quad \frac{1}{2} \leq x < 1 \\ -6x + 6; \quad 1 \leq x < \frac{3}{2} \end{array} \right\}$$

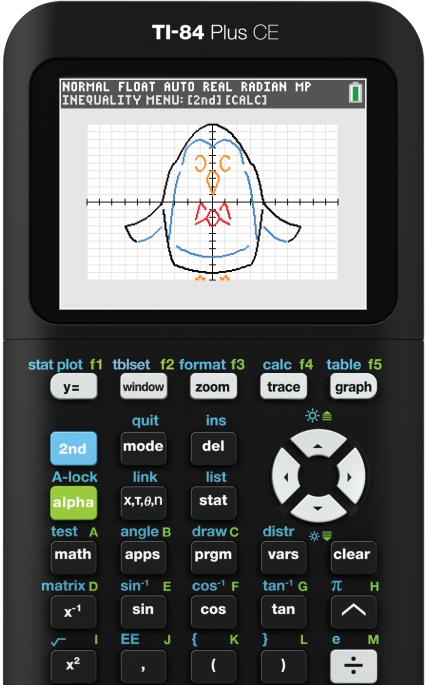
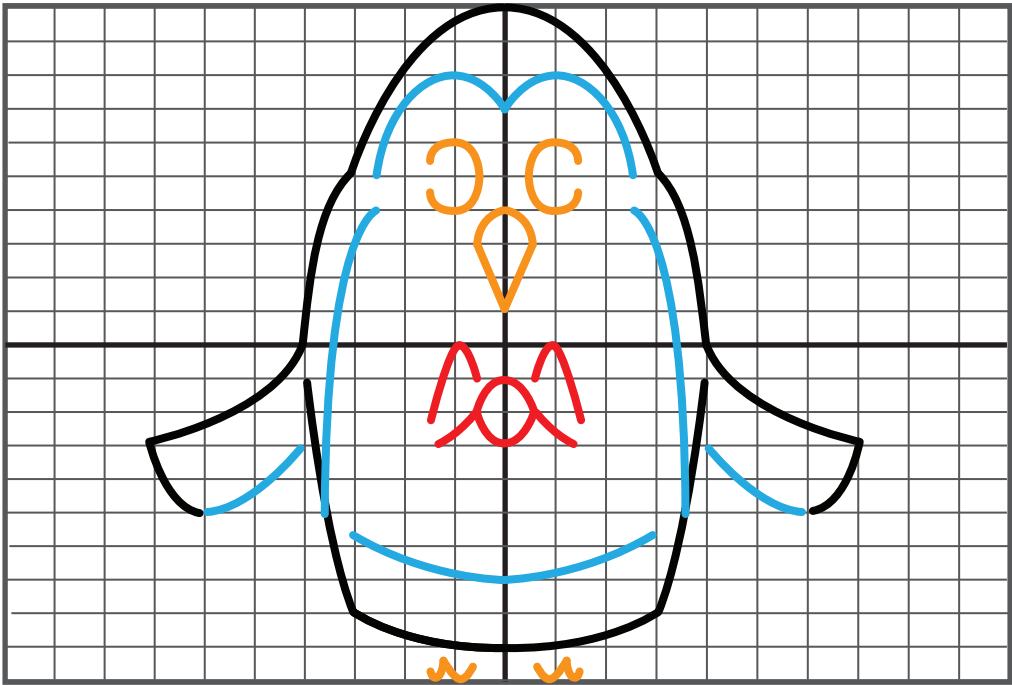
Top of bowtie
(red)

$$f(x) = \left\{ \begin{array}{l} x - \frac{3}{2}; \quad -\frac{3}{2} \leq x < -\frac{1}{2} \\ 4x^2 - 3; \quad -\frac{1}{2} \leq x < \frac{1}{2} \\ -x - \frac{3}{2}; \quad \frac{1}{2} \leq x < \frac{3}{2} \end{array} \right\}$$

Bottom of bowtie
(red)

Peng-WIN functions!

Let's draw a happy clam! First, determine the equations used to make this image. Try breaking down the image into the parts below. Hint: the number of functions used is indicated in the parentheses. Next, enter the equations into your calculator to visualize the equations all together!



Top of body and wings (5)

Bottom of body and wing outline (5)

Under wings and lower belly (3)

Top of eyes and beak (3)

Hairline (4)

Sides of belly (2)

Bottom of eyes and beak (3)

Feet (4)

Top of bowtie (5)

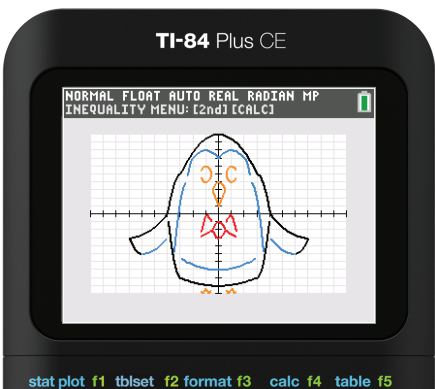
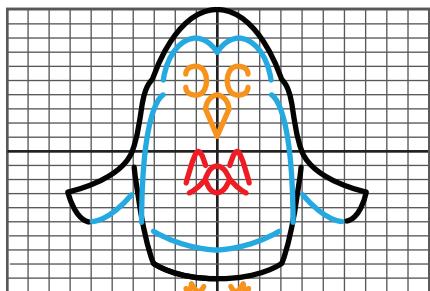
Bottom of bowtie (3)

Name: _____ Date: _____

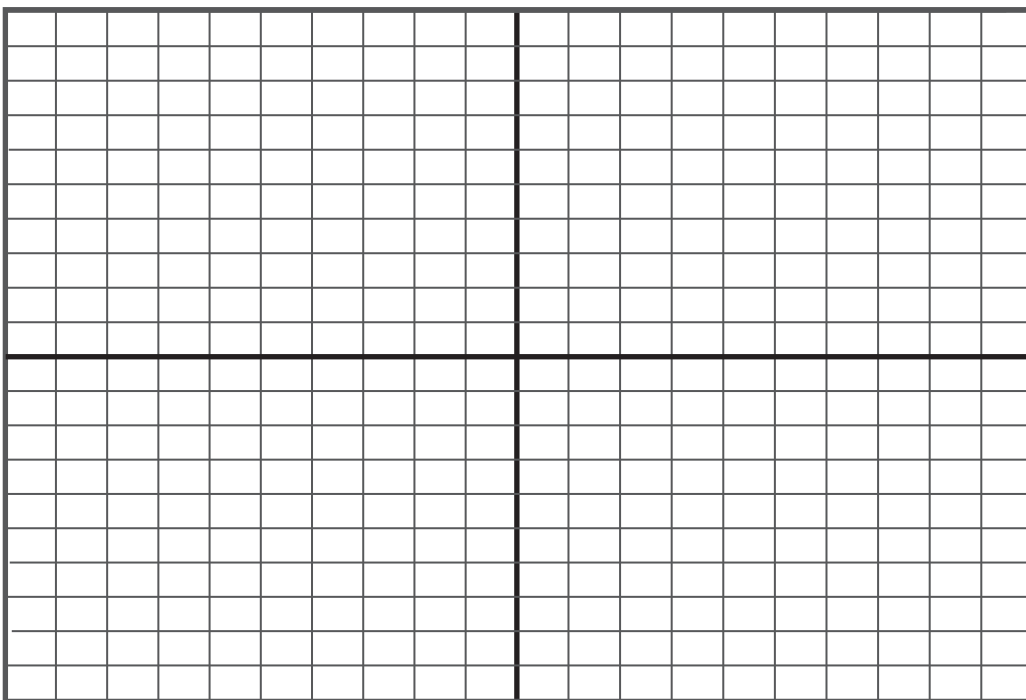
Waddle you know?

Show off your math skills step by step! Use the provided design as inspiration to make your own penguin image. Draw your idea, then try breaking it down into parts. Next, enter the equations into your calculator to visualize the equations all together!

Example:



Draw your own penguin design.



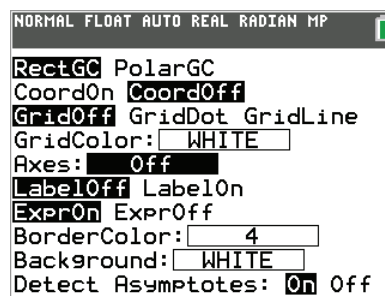
Determine your functions below. Graph them on your calculator to check your work.

Graphing tips


To prep/modify your graph screen:



You can customize colors and visibility of various graph labeling and style choices. Toggle to selections. Press enter to activate your desired setting. Experiment and discover how to customize your display.



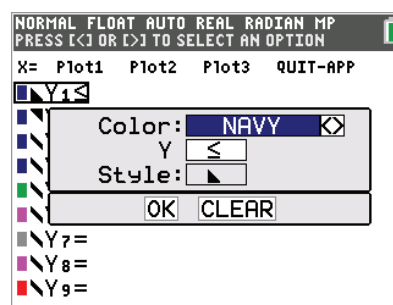
If working with Inequalities, turn on the Inequalities Application:  Select: 5: Inequalz

Enter equations into the  screen

To change colors and inequality symbols: Arrow left until the desired $Y_x =$ line is outlined with a box. Press enter.

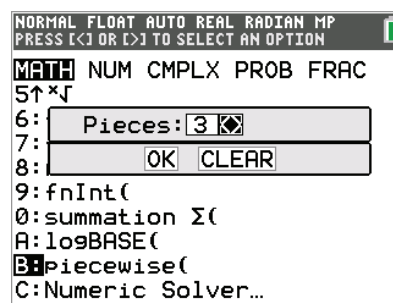
Hint: pay attention to the inequality symbols.

Use the dialogue box to select settings.

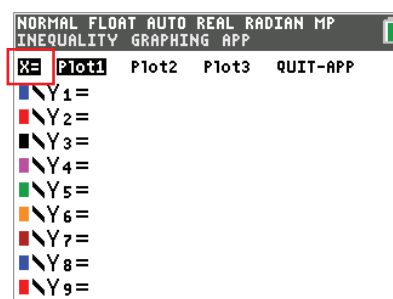


To enter multiple functions in a $Y_x =$ row, use the piecewise template:  Select: B: piecewise(

Use dialogue box to select quantity of pieces per $Y_x =$ line.



For $x=$ go to the top left corner of the functions menu and select $x=$ to toggle between the functions



 your work when all math is entered. Double check your equations.