# 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
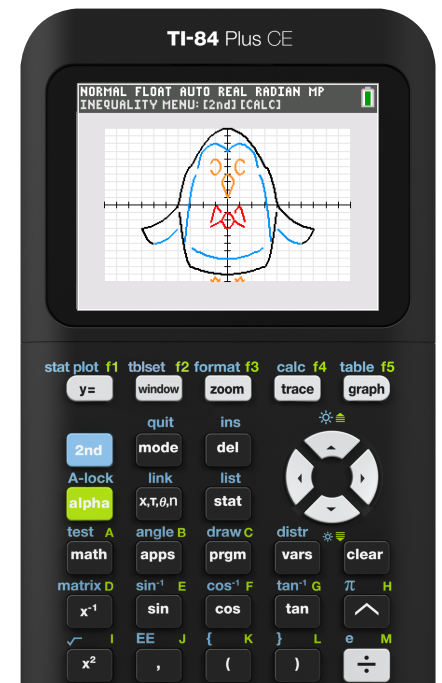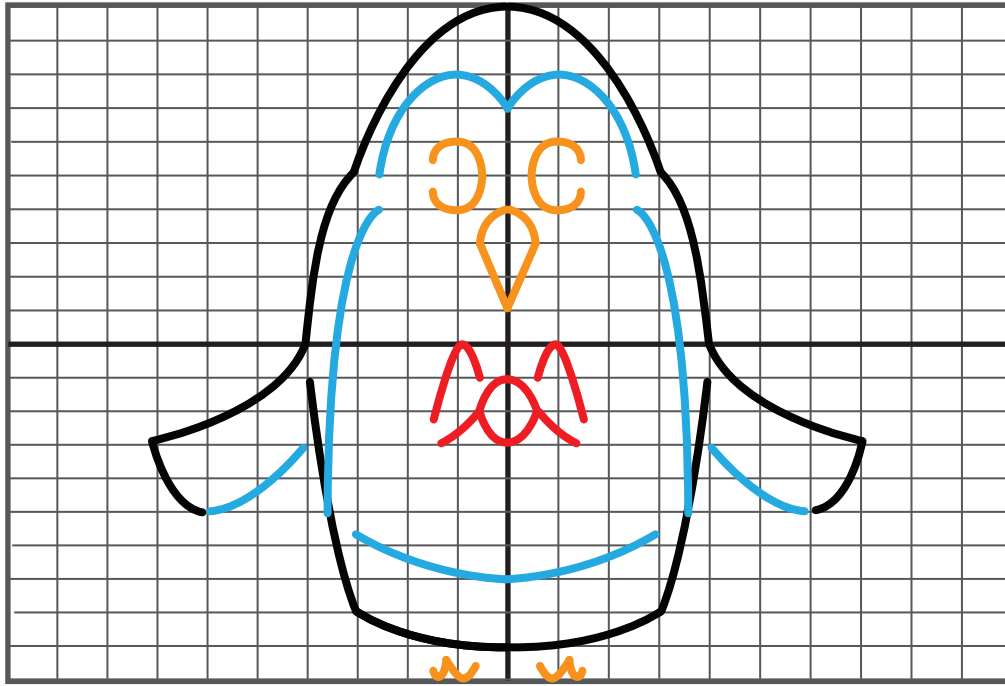
ACTIVITIES AND THEIR OBJECTIVES

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**

HOW TO GRAPH A PIECEWISE FUNCTION ON THE TI-84 PLUS CE

Name: _____   Date: _____
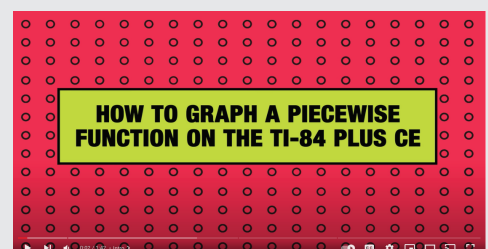
Peng-WIN functions!

Let's draw Mr. Bowtie! 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!
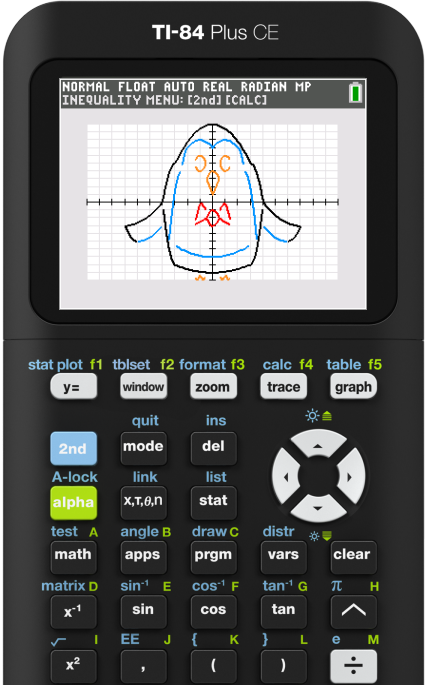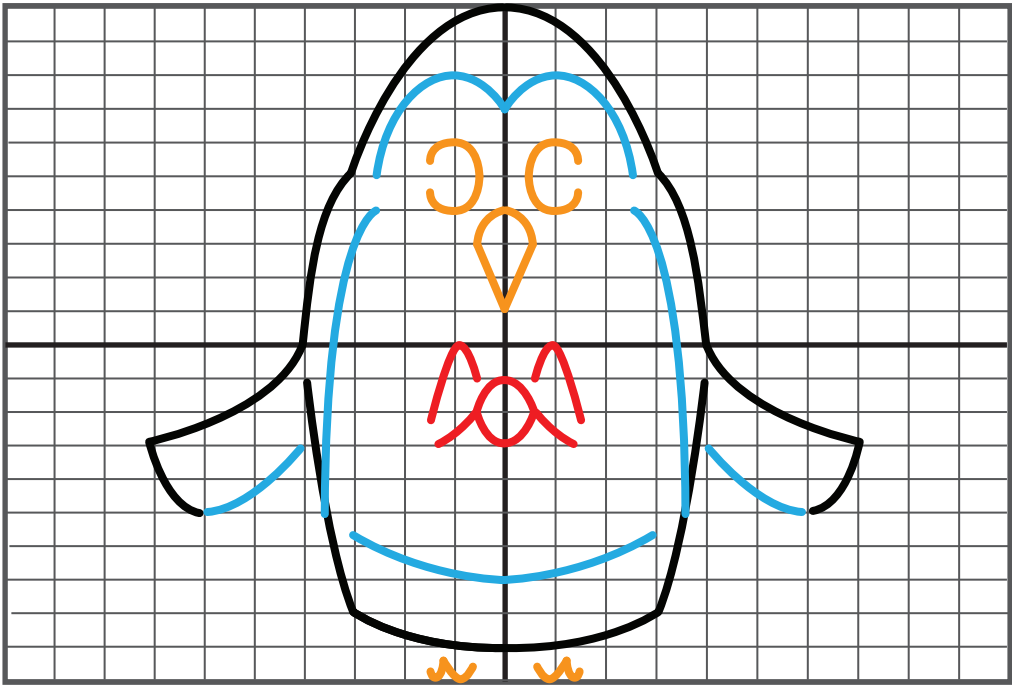
Top of body and wings (5)

_____
_____
_____
_____

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: _____

Cold feet– transformations

Brrr! This little guy is covered in snow. Help dust off the snow and reveal his full holiday self. Determine the equations needed to finish the picture. Next, enter the equations into your calculator to finish the transformation.

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)
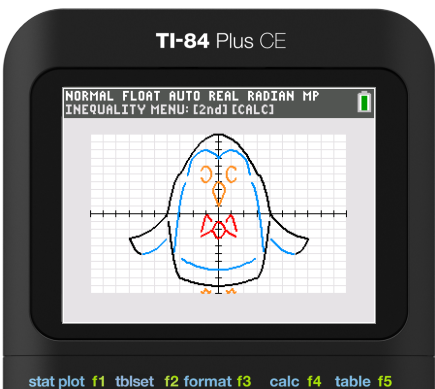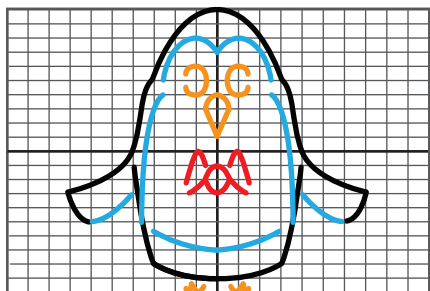
_____
_____
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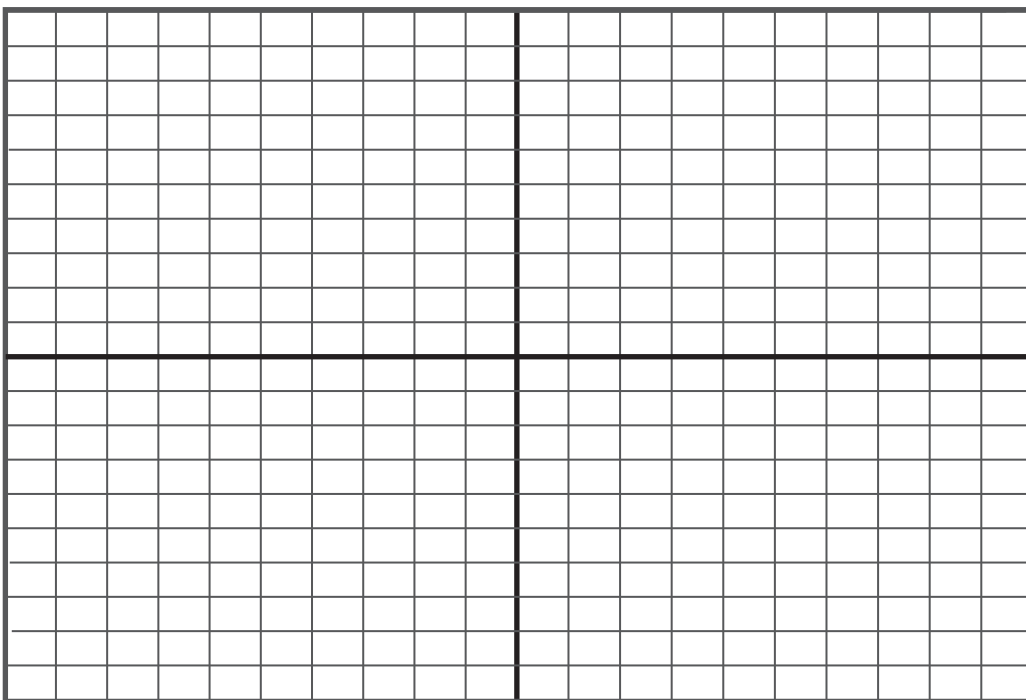**Bottom of bowtie (3)**

_____
_____
_____

Waddle you know?

Show off your math skills step by step! Use the provided design as inspiration to make your own penquin 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.

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$$f(x) = \begin{cases} \frac{1}{3}(x+7)^2 - 3; & -7 \le x < -4 \\ -5(x+3)^2 + 5; & -4 \le x < -3 \\ -\frac{5}{9}x^2 + 10; & -3 \le x < 3 \\ -5(x-3)^2 + 5; & 3 \le x < 4 \\ \frac{1}{3}(x-7)^2 - 3; & 4 \le x < 7 \end{cases}$$

Top of body and wings (black)

$$f(x) = \begin{cases} 2(x+6)^2 - 5; & -7 \le x < -6 \\ 8(x+3)^2 - 8; & -4 \le x < -3 \\ \frac{1}{9}x^2 - 9; & -3 \le x < 3 \\ 8(x-3)^2 - 8; & 3 \le x < 4 \\ 2(x-6)^2 - 5; & 6 \le x < 7 \end{cases}$$

Bottom of body and wing outline: (black)

$$f(x) = \begin{cases} -12(x+2)^2 + 7; & -\frac{5}{2} \le x < -2 \\ -(x+1)^2 + 8; & -2 \le x < 0 \\ -(x-1)^2 + 8; & 0 \le x < 2 \\ -12(x-2)^2 + 7; & 2 \le x < \frac{5}{2} \end{cases}$$

Hairline: (light blue)

$$f(x) = \begin{cases} -4(x+1)^2 + 6; & -\frac{3}{2} \le x < -\frac{1}{2} \\ -4x^2 + 4; & -\frac{1}{2} \le x < \frac{1}{2} \\ -4(x-1)^2 + 6; & \frac{1}{2} \le x < \frac{3}{2} \end{cases}$$

Top of eyes and beak: (orange)

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$$f(x) = \begin{cases} \frac{1}{2}(x+6)^2 - 5; & -6 \le x < -4 \\[2mm] \frac{1}{2}(x-6)^2 - 5; & 4 \le x < 6 \\[2mm] \frac{8}{49}x^2 - 7; & -3 \le x < 3 \end{cases}$$

Under wings and lower belly: (blue)

$$f(x) = \begin{cases} -9\left(x+\frac{5}{2}\right)^2 + 4; & -\frac{7}{2} \le x \le -\frac{5}{2} \\[2mm] -9\left(x-\frac{5}{2}\right)^2 + 4; & \frac{5}{2} \le x \le \frac{7}{2} \end{cases}$$

Sides of belly: (blue)

$$f(x) = \begin{cases} 4(x+1)^2 + 4; & -\frac{3}{2} \le x < -\frac{1}{2} \\[2mm] 4\,|x| + 1; & -\frac{1}{2} \le x < \frac{1}{2} \\[2mm] 4(x-1)^2 + 4; & \frac{1}{2} \le x < \frac{3}{2} \end{cases}$$

Bottom of eyes and beak: (orange)

$$f(x) = \begin{cases} 16\left(x+\frac{5}{4}\right)^2 - 10; & -\frac{3}{2} \le x < -1 \\[2mm] 16\left(x+\frac{3}{4}\right)^2 - 10; & -1 \le x < -\frac{1}{2} \\[2mm] 16\left(x-\frac{3}{4}\right)^2 - 10; & \frac{1}{2} \le x < 1 \\[2mm] 16\left(x-\frac{5}{4}\right)^2 - 10; & 1 \le x < \frac{3}{2} \end{cases}$$

Feet: (orange)

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$$f(x) = \begin{cases} 6x + 6\,; & -\dfrac{3}{2} \le x < -1 \\[2mm] -2x - 2\,; & -1 \le x < -\dfrac{1}{2} \\[2mm] -4x^2 - 1\,; & -\dfrac{1}{2} \le x < \dfrac{1}{2} \\[2mm] 2x - 2\,; & \dfrac{1}{2} \le x < 1 \\[2mm] -6x + 6\,; & 1 \le x < \dfrac{3}{2} \end{cases}$$

Top of bowtie (red)

$$f(x) = \begin{cases} x - \dfrac{3}{2}\,; & -\dfrac{3}{2} \le x < -\dfrac{1}{2} \\[2mm] 4x^2 - 3\,; & -\dfrac{1}{2} \le x < \dfrac{1}{2} \\[2mm] -x - \dfrac{3}{2}\,; & \dfrac{1}{2} \le x < \dfrac{3}{2} \end{cases}$$

Bottom of bowtie (red)