PICTURING FUNCTIONS

STAGE ONE – FUNCTIONAL FAVORITES

1. Start up Desmos at www.desmos.com.
2. Practice typing in some functions, such as the following. In each case, try to first predict what the graph is going to look like before graphing it.

   - f(x)=x
   - f(x)=x^2
   - f(x)=x^3
   - f(x)=2^x
   - f(x)=1/x
   - f(x)=sqrt(x)
   - f(x)=abs(x)
   - f(x)=sqrt(1-x^2)
   - f(x)=sin(x)
   - f(x)= { x<0:x^2 , x>=0:2-x }
   - Some more of your own choosing

STAGE TWO – PUSHING

1. Start again with a fresh Desmos window.
2. Enter f(x)=sin(x).
3. Enter g(x)=f(x)+d.
4. When you see "add slider: d", click "d" to create the slider.
5. Change the value of d in the slider. Does what you see make sense to you? Explain why the graph of g changes as it does.
6. Now change f(x) to some other functions, without changing g(x), to experiment with the results.

7. Change the f function back to f(x)=sin(x).
8. Change the g function to g(x)=f(x-c).
9. When you see "add slider: c", click "c" to create the slider.
10. Change the value of c in the slider. Does what you see make sense to you? Explain why the graph of g changes as it does.
11. Now change f(x) to some other functions, without changing g(x), to experiment with the results.

STAGE THREE – STRETCHING AND SHRINKING

1. Change the f function back to f(x)=sin(x).
2. Change the g function to g(x)=a*f(x).
3. When you see "add slider: a", click "a" to create the slider.
4. Change the value of a in the slider. Does what you see make sense to you? Explain why the graph of g changes as it does.
5. Now change f(x) to some other functions, without changing g(x), to experiment with the results.

6. Change the f function back to f(x)=sin(x).
7. Change the g function to g(x)=f(x/b).
8. When you see "add slider: b", click "b" to create the slider.
9. Change the value of b in the slider. Does what you see make sense to you? Explain why the graph of g changes as it does.
10. Now change f(x) to some other functions, without changing g(x), to experiment with the results.

STAGE FOUR – THE WORKS!

1. Delete your old sliders.
2. Change the f function back to f(x)=sin(x).
3. Change the g function to g(x)=a*f((x-c)/b)+d. (You will have to press "Tab" after typing the "b".)
4. Accept the offer to create four sliders.
5. Change the values of a,b,c,d in the sliders in lots of ways. Does what you see make sense to you? Can you explain everything you see?
6. In particular, how can you reflect the graph of f across the x-axis? Across the y-axis?
7. Now change f(x) to some other functions, without changing g(x), to experiment with the results.

STAGE FIVE – INSERTING AND MODELING IMAGES

1. Find an interesting image using Google images; for example, a fountain. Save this image on your computer or tablet. For example, with an iPad you can touch and hold the image, and then use the save option, which puts the image in your photo collection.

2. Click the "+" button and select "image". Then find the image you want to insert. Once inserted, you can adjust its size if needed.

3. Now change the f function and adjust the sliders to try to match a shape in the image, such as an arc of water in the fountain.
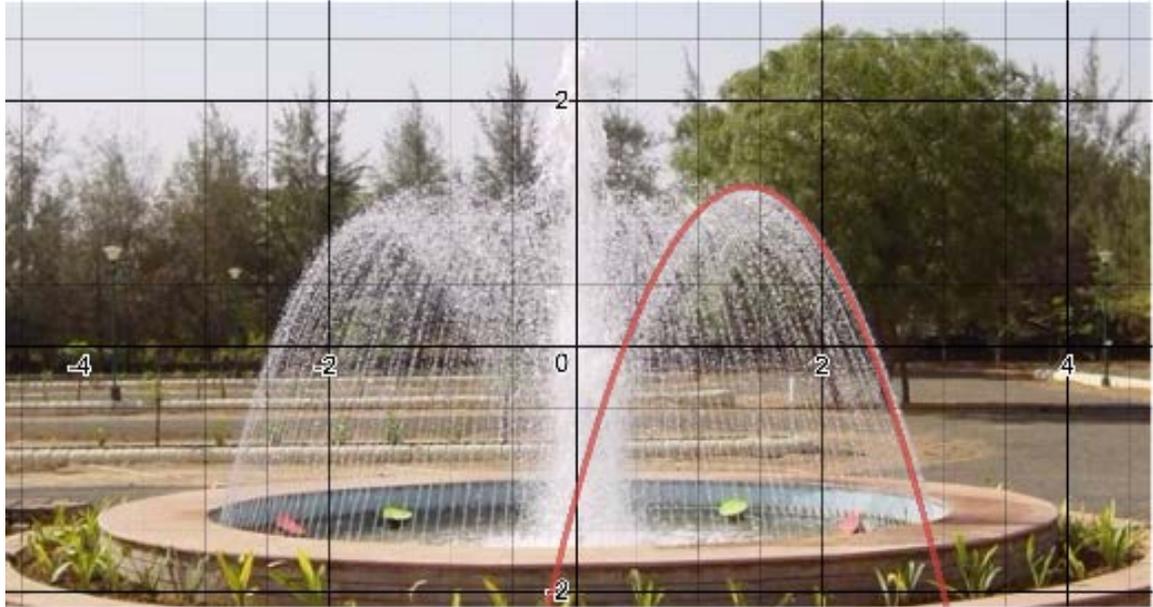
4. You may want to turn off the display of the f function by clicking the circle next to its definition. You may also want to select the wrench and click on "projector mode" for thicker lines.
5. Here are some suggestions of images to model
   - Fountains
   - Arches
   - Fences
   - Waterfalls
   - Flock of geese (but you may need to rotate the photo before inserting)
   - St. Louis Arch – Try f(x)=2^x+2^(-x)
   - Waves
   - Vibrating string
   - Other better ideas that you may think of! You might even take some photos of things around you right now.