Shading via Sine

Drawing Mathematics with Desmos | Justin Skycak

Setup. Navigate to https://www.desmos.com/calculator. Be sure to sign in so that you can save your graph.

Demonstration - *High Frequency*. Observe the graph as you type each of the following inputs. In general, the graph of $y = \sin(vx)$ looks more and more solid as v increases.

$$y = \sin(x)$$

$$y = \sin(10x)$$

$$y = \sin(100x)$$

$$y = \sin(1000x)$$

Demonstration - *Thickening a Curve*. Observe the graph as you type each of the following inputs. In general, for large v, the graph of $y = f(x) + A\sin(vx)$ thickens the curve $y = f(x)$ to have a vertical thickness of $2A$.

$$y = x + 0.1\sin(1000x)$$

$$y = x^2 + 0.1\sin(1000x)$$

$$y = x^2 + 0.5\sin(1000x)$$

$$y = \sin(x) + 0.1\sin(1000x)$$

$$y = \sin(x) + 0.5\sin(1000x)$$

Demonstration - Varying Amplitude. Observe the graph as you type each of the following inputs. In general, when v is large, the graph of $y = f(x)\sin(vx)$ shades the area between the graphs of $y = -f(x)$ and $y = f(x)$

$$y = x\sin(1000x)$$

$$y = x^2\sin(1000x)$$

$$y = (\sin x)\sin(1000x)$$

Demonstration - Shifts. Observe the graph as you type each of the following inputs. In general, the graph of $y = f(x-a)\sin(vx) + b$ is the graph of $y = f(x)\sin(vx)$ shifted right by a units and up by b units.
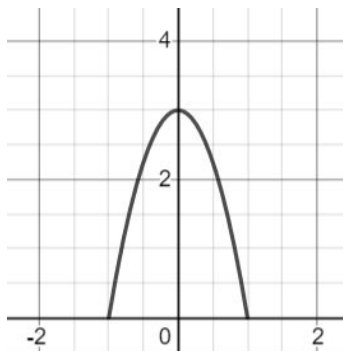
$$y = x^2\sin(1000x)$$

$$y = (x-2)\sin(1000x) + 5$$

Demonstration - Limitations. Observe the graph as you type each of the following inputs.

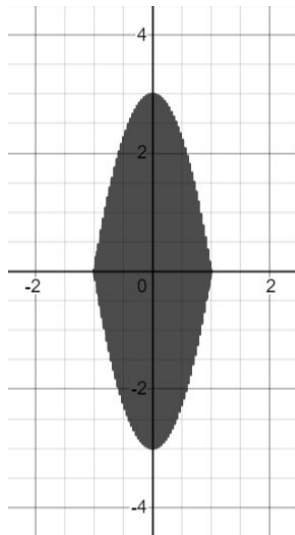$$y = \sin(1000x)\{5 < x < 10\}$$

$$y = (x - 2)^2 \sin(1000x)\{2 < x < 4\}$$

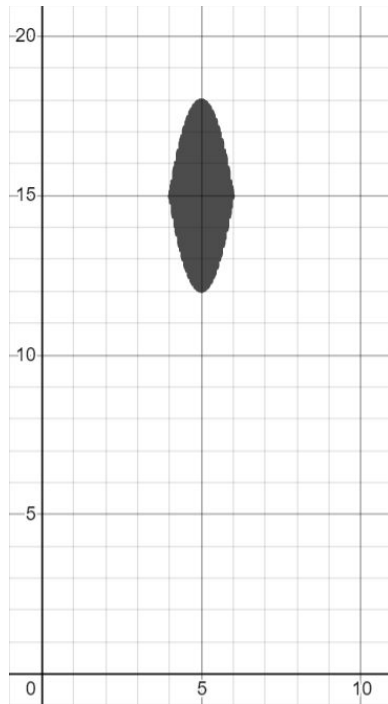$$y = \left(\sqrt{x - 3}\right) \sin(1000x) + 5\{3 < x < 4\}$$

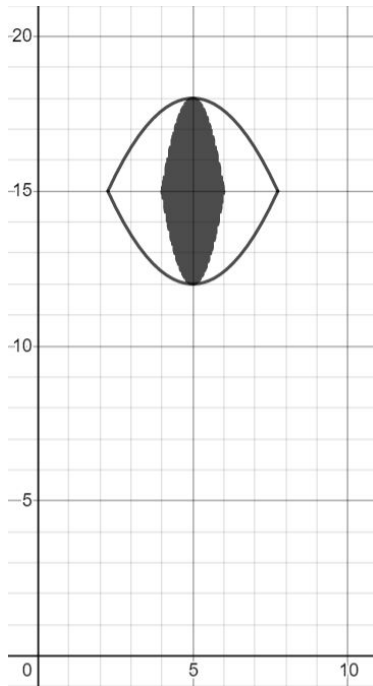**Exercise**. Reproduce the downward parabola shown below.

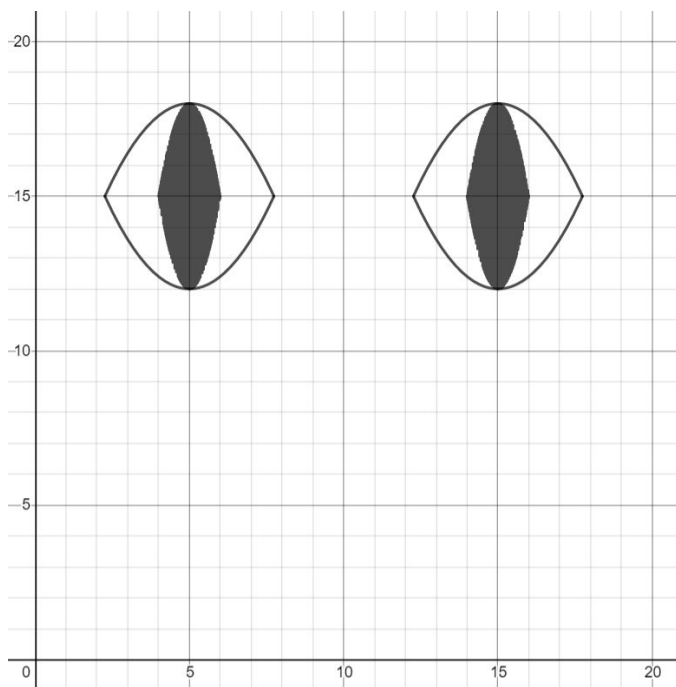***Exercise***. Use the parabola as the amplitude of a high-frequency sine function to create a shaded area.

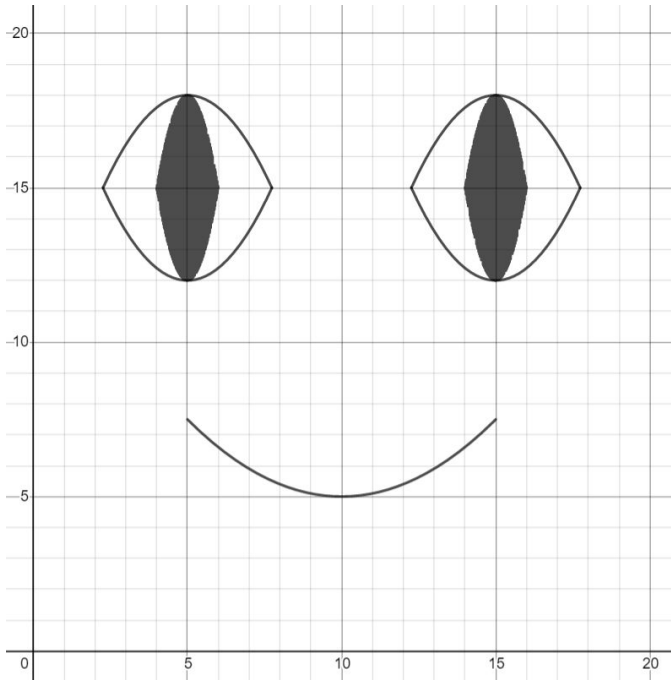*Exercise*. Shift the shaded area up and right.

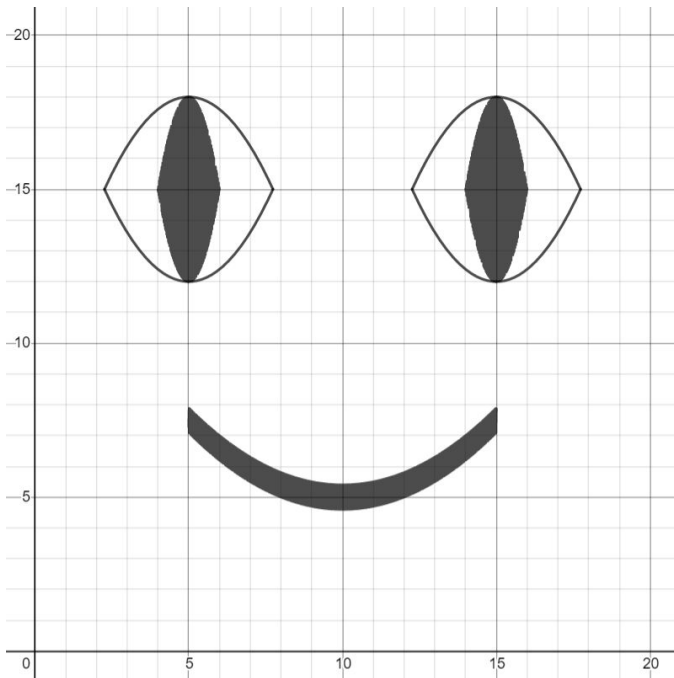***Exercise***. Draw parabolas around the shaded area to create an eye.

Exercise. Create another eye.

Exercise. Create a parabola in the shape of a mouth.

Exercise. Thicken the parabola which forms the shape of the mouth.

Challenge. Make other kinds of emoji faces, such as a sad face or a laughing face.