First, We Need to Understand Something about Angles

If a circle has a radius of 1.0, then we can march around it by simply changing the angle that we call $\theta$.

One of the things we notice is that each angle $\theta$ has a unique X and Y that goes with it. These are different for each $\theta$.

Fortunately, centuries ago, people developed tables of those X and Y values as functions of $\theta$. They called the X values cosines and the Y values sines. These are abbreviated cos and sin.

If we were to double the radius of the circle, all of the X’s and Y’s would also double. So, really the cos and sin are ratios of X and Y to the circle radius.
First, We Need to Understand Something about Angles

\[ \cos \theta = \frac{X}{R} \]
\[ \sin \theta = \frac{Y}{R} \]

So, if we know the circle radius, and we march through a bunch of \( \theta \) angles, we can determine all of the X’s and Y’s that we need to draw a circle.

```cpp
void Circle(int xc, int yc, int r, int numsegs) {
    float dang = (2.*PI) / float(numsegs);
    float ang = 0.;
    beginShape();
    for(int i = 0; i <= numsegs; i = i + 1)
    {
        float x = xc + r * cos(ang);
        float y = yc + r * sin(ang);
        vertex(x, y);
        ang = ang + dang;
    }
    endShape();
}
```

Processing Doesn’t Include a Circle-Drawing Function, So We Add Our Own

numsegs is the number of line segments making up the circumference of the circle. numsegs=20 gives a nice circle.
5 gives a pentagon.
8 gives an octagon.
4 gives you a square. Etc.

Why \( 2\times\pi \)?

We commonly measure angles in degrees, but science and computers like to measure them in something else called radians.

There are 360° in a complete circle.
There are \( 2\pi \) radians in a complete circle.
The built-in cos() and sin() functions expect angles given in radians.
Processing has built-in functions to convert between the two:

float rad = radians(deg);
float deg = degrees(rad);

Circle, Pentagon, Octagon!

If We Move the Mouse, We Could Get:

Or, even:
void Ellipse(int xc, int yc, int rx, int ry, int numsegs)
{
    float dang = (2.*PI) / float(numsegs);
    float ang = 0.;
    beginShape();
    for(int i = 0; i <= numsegs; i = i + 1)
    {
        float x = xc + rx * cos(ang);
        float y = yc + ry * sin(ang);
        vertex(x, y);
        ang = ang + dang;
    }
    endShape();
}

And, there is no reason the X and Y radii need to be the same...

There is actually no reason the X and Y radii need to be the same...

There is also no reason we can't gradually change the radius ...

void Spiral(int xc, int yc, int r0, int r1, int numsegs, int numturns)
{
    float dang = numturns * (2.*PI) / float(numsegs);
    float ang = 0.;
    beginShape();
    for(int i = 0; i <= numsegs; i = i + 1)
    {
        float newrad = map(i, 0, numsegs, r0, r1);
        float x = xc + newrad * cos(ang);
        float y = yc + newrad * sin(ang);
        vertex(x, y);
        ang = ang + dang;
    }
    endShape();
}

We Can Also Use This Same Idea to Arrange Things in a Circle

```c
void draw()
{
    // Code...
}
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