Make an Orbiting Planet in Scratch

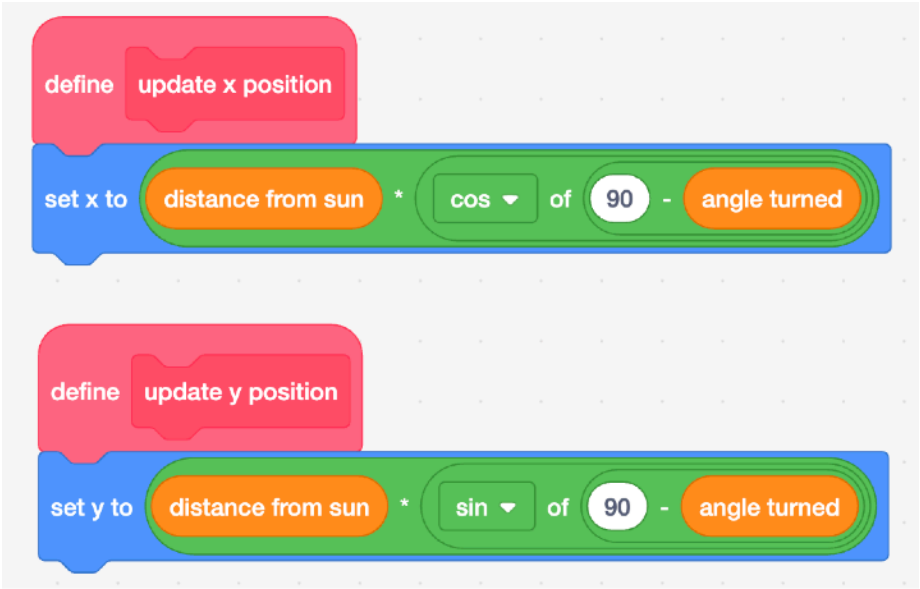
In this project you'll make a program that makes an Earth sprite orbit around a Sun sprite.

First, **sign in** to your Scratch account.

Now **click on this link** to open the starter project:
https://scratch.mit.edu/projects/1197017848/editor/

Next, make sure you click on the green Remix button to get a copy saved in your account that you can work on: Click on the **Earth** sprite. In its Code tab you'll see two red blocks with some orange and green ones below them. This code creates two red blocks that will do some slightly fancy maths for us later on.

Starting blocks



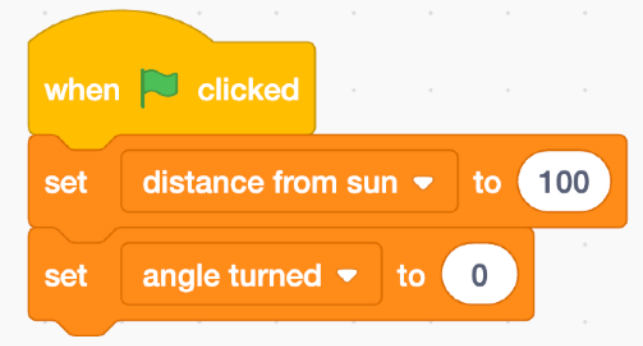
The blocks use a bit of maths called **Trigonometry**, which is all about **triangles**. It's used for all sorts of things, including working out the positions of planets and other objects moving through space.

You need to learn quite a lot of **other bits of maths** before you can do it though (usually in 3rd year at high school). So the red blocks have been added to this starter project for you.

Programmers often use code written and shared by others to do tricky stuff. This shared code is called a **package** or a **library** depending on the programming language used.

Step 1

Start by adding these blocks to the Earth sprite's code:



Step 2

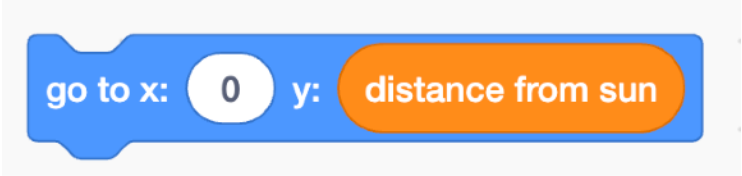
A sprite's position on the screen is made up of two numbers that tell you how many "steps" it is **from the middle** of the screen:

1. Going **across** the screen. Scratch calls this number **x**
2. Going **up or down** the screen. Scratch calls this number **y**

You can see the value of x and y for any sprite just under the stage.

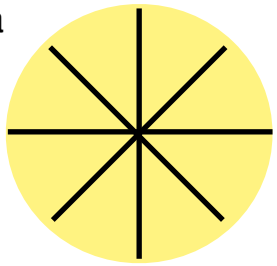
Try dragging a sprite around with your mouse or the trackpad to see how the values of x and y change.

We want the Earth sprite to always start in the middle of the screen, but the right distance away from the sun. So add this block to your code



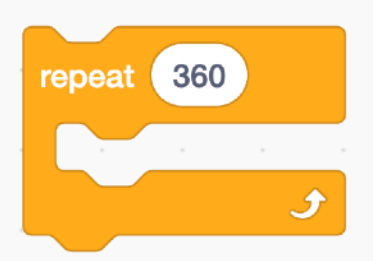
Step 3

Imagine it's your birthday and you have 7 friends round for a party and a piece of your birthday cake. This is a picture of the cake cut into slices:



The size of the **pointy end** of each slice is called an **angle** and it's measured in **degrees**. A **circle** is made up of **360 degrees**. So, if you cut your cake into 360 pieces, the pointy end of each one would measure 1 degree. Everyone would get a very small piece of cake though!

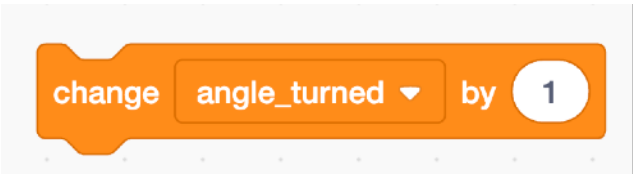
We want to move the Earth sprite all the way round the 360 degrees of the circle, 1 degree at a time. Start by adding this block to your code:



Next, we want to add the code inside the repeat block that will be run 360 times….

Step 4

Start by putting this block inside the **repeat 360** block:
This updates how far round the circle the Earth sprite has moved.

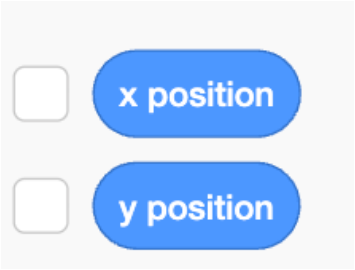


angle_turned is a **variable** that holds the size of the angle the Earth sprite has moved. A variable is like a **box** where Scratch keeps a value so it can easily find it. You can also update the value in a variable using the change block, like we do here.

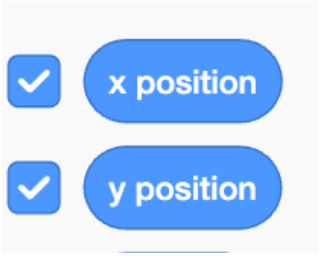
Next, click on the red **My Blocks** circle and add these blocks to your code inside the repeat block:

These blocks are the ones that will use trigonometry to work out what the new values of x and y are for the Earth sprite when it goes one more degree round the Sun.

As well as orange blocks for variables that coders create and name themselves, Scratch also has some **built-in variables**. Two of these are **x postion** and **y position**. You can find them at the bottom of the blue motion blocks.



It's these values in these variables that the red blocks are updating. If you click on the the box beside each of them a tick will appear and the values will be displayed on screen as your Earth sprite moves round.

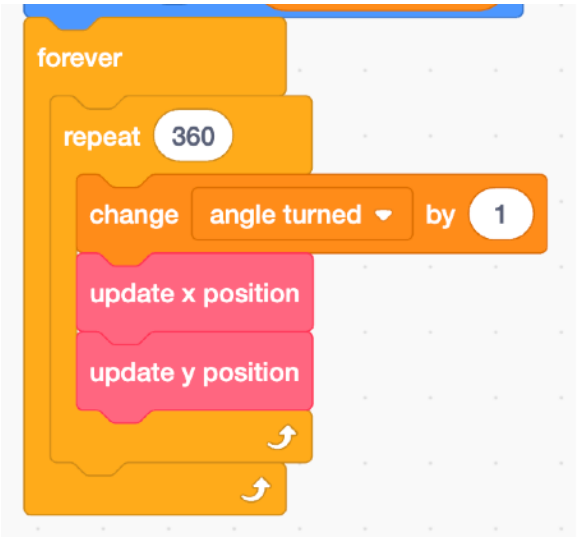


(You might notice that the numbers are quite strange-looking, with lots of places after the decimal point!)

Step 5

If you click the start flag now, your Earth sprite should move in an orbit all the way round the sun!

At the moment it stops after one orbit, which isn't very realistic. So add a forever block round the repeat 360 block and its contents, like this:



Step 6

Finally, lets make our Earth sprite rotate around its axis by adding this code:

(**Note**: This isn't exactly right, because the Earth really rotates round an axis (or imaginary line) that goes from the North Pole to the South pole.

So we'd need a sprite that showed the Earth looking down on the North Pole or up at the South Pole to be really accurate. But it still looks pretty good!)

Well done, the Earth is now orbiting the Sun!

Things to add or change

You could:

- **Change the Earth sprite** to be something else orbiting the Earth - maybe a giant doughnut…
- **Add another planet:** duplicate the Earth sprite by right-clicking on the sprite's icon and selecting duplicate. Then change the costume of the sprite and the distance from the sun.