**Keyring Making**

**What you will be doing:**
You will be making a 3D keyring of your own design!

**Before you start**
2. In the upper-right corner, click on **Run Beetle Blocks**.

**3D Drawing**

In Beetle Blocks, you can make scripts to move the beetle and make it draw 3D shapes.

You can make the beetle **extrude** a path as it moves, which means it leaves a 3D trail behind it.

1. Recreate the script below.
2. Based on the descriptions given, what do you think the beetle will do? Press the green flag to find out.

Each Beetle Blocks unit translates to 1 millimeter once 3D-printed. You should keep this in mind while you are drawing your keyring to make your design practical.

You can also use the mouse buttons to move around the **viewport** in the upper right corner.

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**Script Example:**

```
when clicked
reset
start extruding lines
move 5
```

This erases drawings, places the beetle at its start position and resets any other settings.

This makes the beetle move 5 units forward in the direction it is facing.

By doing this, when the beetle moves, it will leave a 3D trail of whichever colour is selected.
Notice that the beetle and viewport are 3-dimensional (3D). As opposed to the usual 2D drawings on the X and Y axes, in 3D we also consider the Z axis.

The world has its axes (shown in the picture on the left), but the beetle has its own, separate exes (shown in the picture on the right). When the beetle turns, it turns around its own axes.

To turn, the beetle rotates around one of the exes. For example, rotating x means that only the red X line is considered, and the beetle spins around this line, as if it was rolling sideways. Rotate y means that only the green Y line is used, and the beetle spins forwards or backwards like a foosball (table football) player. Finally, rotate z means that the beetle will be turning left or right, being pinned in place by the blue Z line.

1. Create the script below. What do you think will happen when you click the green flag? Click it to find out!
2. Press the red stop button, then change the “x” to “y” (or “z”) by clicking the black arrow next to it and try to predict what the beetle will do.
3. Based on the script you created in the “3D Drawing” section, make the beetle draw lines in different directions (e.g. upwards, by rotating on the Y axis).

Congratulations, your beetle is now turning and drawing 3D lines!

[NB: you can also turn in the opposite direction by using a negative value]

If you were unable to come up with this script, check ‘Figure 1’ at the end of the worksheet.
Draw Shapes

So far we have only drawn single, straight lines. But you can also draw other shapes using moving and turning repeatedly.

1. Draw an angle by making the beetle draw a line, turn, then draw another line. What is the size of your angle? How much should your beetle turn to draw a 60 degree angle? What about a 90 degree angle?
2. Draw an arc by making the beetle draw a small line, turn slightly, then repeat this several times. You can make your shape larger by increasing the move distance, and you can make the arc wider my turning less.

Congratulations, your beetle can now draw shapes! You can combine drawing lines and turning on the X, Y and Z axes to create any shapes you can think of.

Make a Keyring

Using what you have done so far, try to come up with your own design for a keyring. It can be anything! Make sure that your creation has some way of being attached to keys, as shown in the examples.

You might want to try:

1. The inbuilt shape commands (cube, cuboid, sphere, tube and text/2D text), found in the “Shapes” menu.
2. Stopping and restarting extruding if the beetle has to move somewhere without leaving a trail behind it.
3. Using the other blocks in the "Move" menu, such as the “go to x: y: z:" block, which makes the beetle instantly change its position to whatever coordinates it is given. Or any other block you can find!

Unfortunately, no matter what colours you use, the 3D-printed keyring would all be one colour, depending on the plastic colour used by the printer.

[NB: Keep in mind that a (mostly) flat keyring is easier to print]
Congratulations, you can now make the beetle move to draw a wide range of shapes! You should also have a keyring design that you could 3D-print.

A few important things you have experienced are:

- **Extruding**—you have made the beetle draw shapes by moving and extruding a trail behind it.
- **Axes**—you have worked with the 3 axes of 3D space (height, width and depth).
- **Angles**—you have drawn certain angles by making the beetle turn.

You can always access Beetle Blocks online at beetleblocks.com, and you should play around with turning and drawing to get unusual shapes. Don’t be afraid to just mix any blocks you find in whatever way. There are other exercises on the website as well.

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**About Beetle Blocks**

Beetle Blocks is a project by Eric Rosenbaum, Duks Koschitz, and Bernat Romagosa, with additional software development by Jens Mönig. You can read more about it at beetleblocks.com/about. You can find plenty of information about the software and how to use it in the Beetle Blocks Primer, as well as some more exercises.

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**Help**

This script will make the beetle draw a line upwards, away from the grid.

To understand the orientation of the beetle, you could remove the “start extruding lines” block to see the beetle.

This script will make the beetle draw a 60 degree angle. Try to make it draw a 30 degree angle instead.

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Beetle Blocks Website: http://beetleblocks.com/
This script draws an arc of length 15 by turning 75 degrees. You can alter the values to get different arcs and even full circles.

To take a closer look at what the beetle is doing, you can click the gear symbol in the upper left corner and select Visible Stepping.
This portion draws several circles, making the bright blue pattern.

This places the beetle one layer above the light blue pattern to draw things on top of it.

This portion draws 15 squares, each at random X and Y coordinates.
After drawing each square the colour is changed.

This draws the ring to attach the keyring.

This portion draws a square.

Figure 4: Drawing the second example keyring