Hassan Tanveer
Student No: 160043293
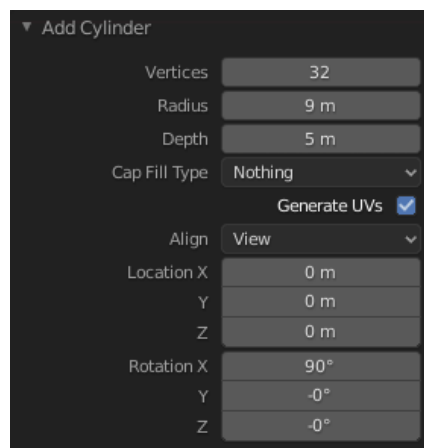
CS2420: Computer Animation – Coursework

Modelling the 2050 Discovery VI Spaceship

Envision the future centred around space exploration to find more habitable planets and life in a galaxy far, far, away. We will be modelling a 2050 concept model of the Discovery VI Spaceship which will be equipped with missile rockets and powered by eco-matter-energy sourced from rare fossil fuels.
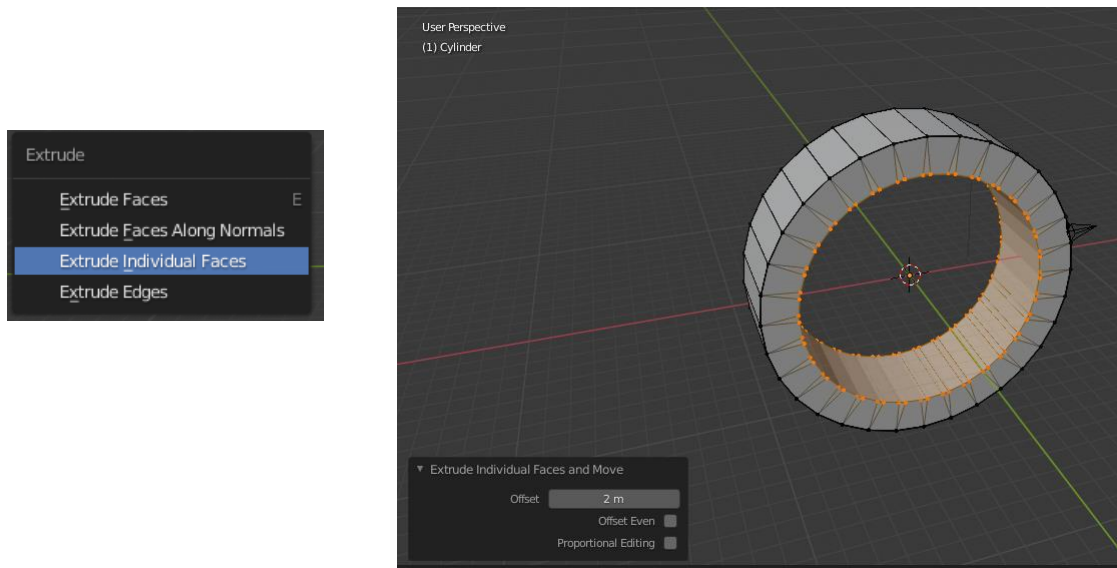
Part 1a: Modelling the Missile Ring

The missile ring we are going to create will hold the missile rockets in place.

➢ Open blender and **delete the cube**.
➢ Change the view to **Front Orthographic (NUM 1).**
➢ Add a **cylinder** (`Shift+A > Mesh > Cylinder`). Specify the properties in the panel shown in the bottom left of the screen. Set the **Radius to 9m**, **Depth to 5m**. Set the '**Cap Fill' to Nothing** and '**Align' to View**; as shown in the screenshot below:

▼ Add Cylinder	
Vertices	32
Radius	9 m
Depth	5 m
Cap Fill Type	Nothing
Generate UVs	✔
Align	View
Location X	0 m
Y	0 m
Z	0 m
Rotation X	90°
Y	-0°
Z	-0°

➢ Press **Tab** to switch to '**Edit Mode**' and make sure all vertices are selected. Select all the faces and press `Alt+E > Extrude Individual Faces.` Set the **Offset to -2m**. This should create the shape of the missile ring.
➢ **Save your progress** and **Rename** the object to **'Missile Ring 1'** in the **Outliner window**.

Part 1b: Making the Missile Rocket

Once the missile ring has been constructed, the rocket needs be created to fit inside the shuttle ring. You can hide the ring if you wish by clicking the "Eye" icon in the Outliner Window. But for reference and sizing the ring will be visible for now.

➢ Change the mode back to **'Object Mode' (Press Tab)** and change the viewpoint to the **Back Orthographic** view (`Ctrl+NUM1`).

➢ Add a cone (`Shift+A > Mesh > Cone`). Set the **Vertices to 12, 'Radius 1' to 4m, Depth to 9m** and change **'Align' to View.** Shown in the screenshot below:
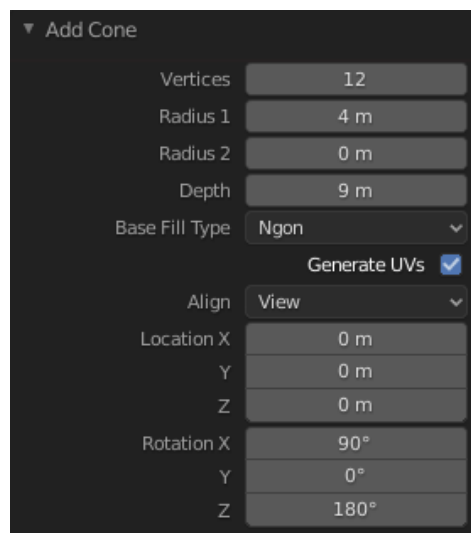
➢ Scale the cone to **1.2m**, you can use the shortcut too (`S, 1.2`).
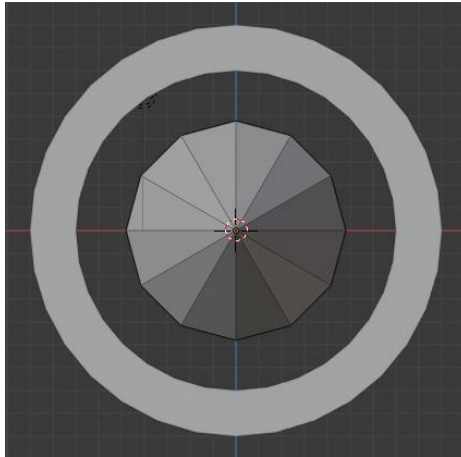
➢ Go into **'Edit Mode' (Press Tab)** and select **'Face Select Mode'** and **select the bottom face of the cone.**
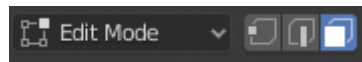
➢ With the bottom of the cone selected, **extrude the cone along the Z-axis by -18.** You can use the shortcut (`E, Z, -18`). **Extrude again along the Z-axis by -6,** (`E, Z, -6`).
➢ **Scale the bottom by 0.65**, (`S, 0.65`) to create the shape at the bottom of the missile rocket.
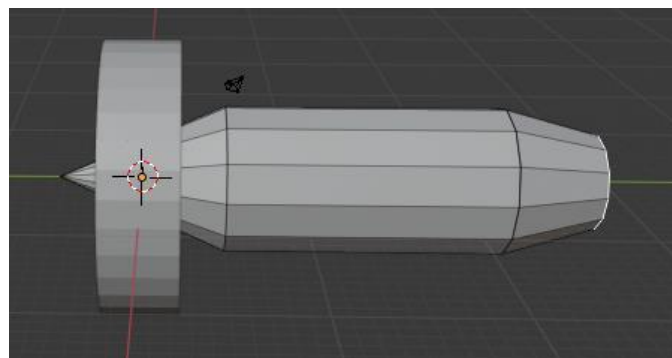
➢ **Extrude** the bottom of the missile rocket **by 24 units, (`E, 24`). Extrude again by 9 units (`E, 9`).**
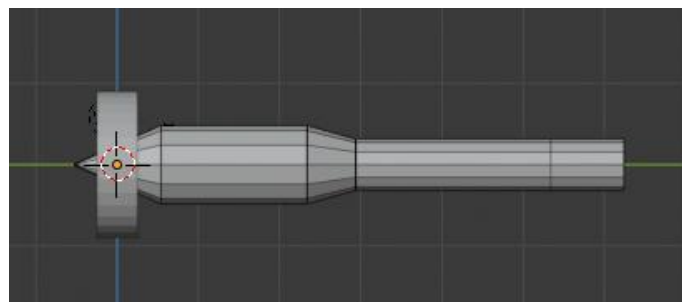
➢ Select a face from the last extrusion and **extrude by 4 units**, (`E, 4`). Repeat this step for every third face and you should have 4 extruded missile wings. **NB: *Ensure you don't have multiple faces selected at once.***
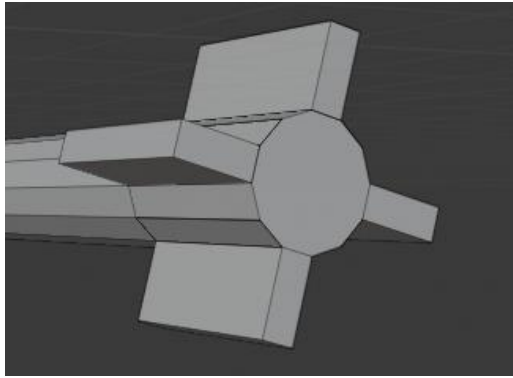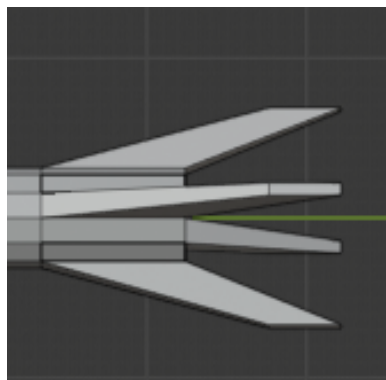
The wings need to be shaped appropriately to improve their aerodynamics and thrusting during launch.

➢ Select the top face of one of the wings and **scale it to 0.5 units**, **(S, 0.5)**.
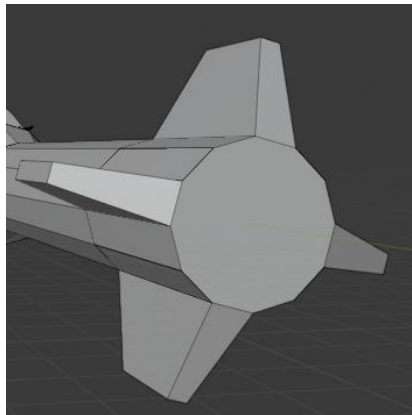
➢ Now select all the top faces of each wing (**hold Shift to select multiple faces at once**). Select the **'Move tool'** and **move the wings in the y direction by -12 units**, **(G, Y, -12).**


➢ Change the cursor back to the **'Select Box Tool'** if you used the 'Move Tool' in the last step. **Select** the **bottom face** of the missile rocket and **extrude along the y-axis by -3 units, (E, Y, -3).**
➢ With the bottom face still selected, **extrude** and then **Right Mouse Button click (RMB)** and **scale** in **by 0.7 units** (you can **hold Ctrl** to scale in increments), (**E, RMB, S, 0.7**).

➢ Then **extrude** the inner circle up into the missile rocket as far as you desire **(E, Y)**.
   NOTE: <u>This will create an empty space for the flame of the rocket which will be
   completed at the end of this tutorial. Detailing will also be completed towards the
   end of the tutorial.</u>
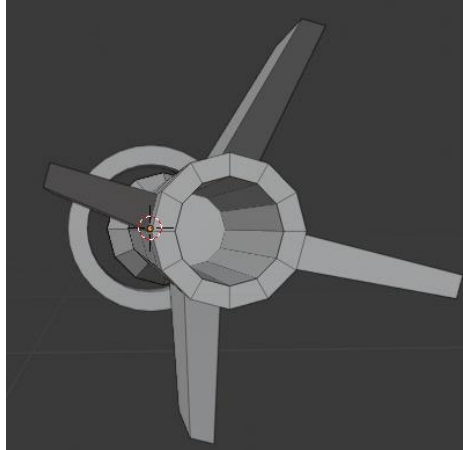
➢ Switch to **'Object Mode' (Press Tab)** and **select** the **Missile Ring** and **move it along
   the y-axis by -20 units**, (**G, Y, -20**).
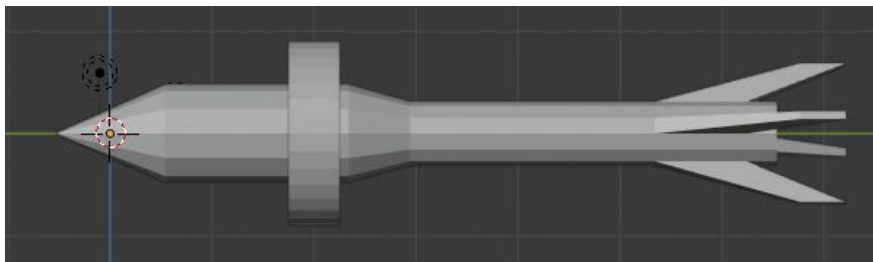
➢ **Save your progress** and **Rename** the object to **'Rocket 1'** in the **Outliner window**.

➢ To create an object that connects the missile ring and the rocket switch to **'Edit
   Mode' (Press Tab)** and **select an inner face of the ring** and **extrude by** either **-3** or **-4
   units, (E, -4). Repeat** this step 3 or 4 times until you have pipes that connect the
   two objects together, similar to the screenshot below:
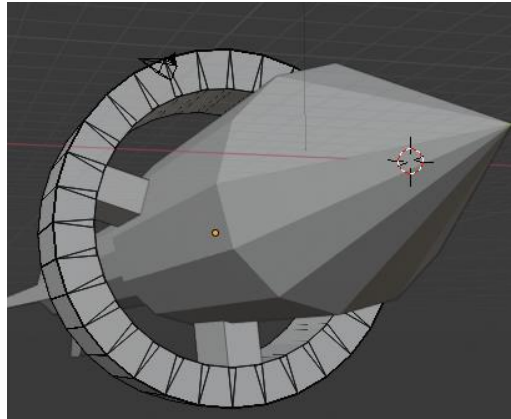
The final step for this section is to parent the two objects together. ***NB: The order of object selection is important in this step.***

➢ Make sure you're in **'Object Mode'** and **select the 'Missile Ring 1' object** in the **outliner window** and then the **'Rocket 1' object** and press **Ctrl+P** and **'Set Parent To' Object.** Your **'Outliner Window'** should look like the screenshot below:
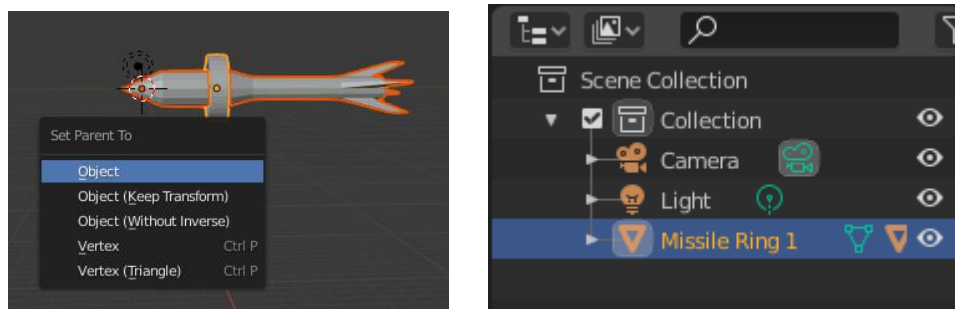

Part 2a: Modelling the Command Sphere

➢ Before creating the command sphere, **move the missile rocket by 50 units along the x-axis,** `(G, X, 50)`.

Ensure you are in object mode and your cursor is at world origin, to do this press **Shift+S** and select **'Cursor to World Origin', `(Shift+S, 1)`**.

➢ Insert a UV Sphere, `(Shift+A > Mesh > UV Sphere)`. Specify the properties in the properties panel. Set the **Radius to 30m.**
➢ **Rename** the sphere to **'Command Sphere'**.
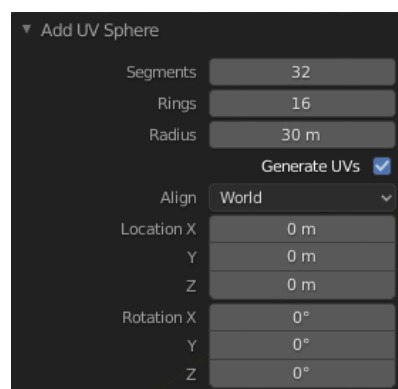
You will notice that the sphere is not smooth. To make the sphere smooth:

➢ Add a **Subdivision Surface Modifier** to the sphere and change the **'Viewport' to 2**.
 Then right click the sphere and select **'Shade Smooth'**, **(RMB > Shade Smooth)**.
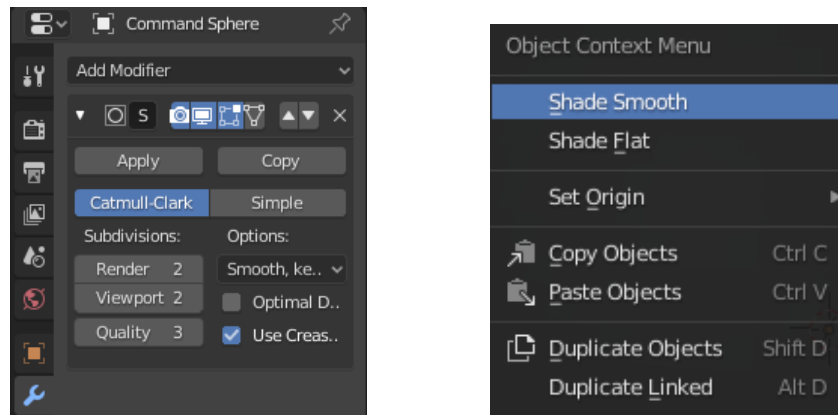
➢ **Move** the **sphere up** the **z-axis by 40 units**, **(G, Z, 40)**.
➢ Then **snap the 3D cursor** to be **'Cursor to Active'**, **(Shift+S, 3)**.

To add depth to the sphere, we want to create an illusion that the middle of sphere is indented.

➢ Switch to **'Edit Mode' (Press Tab)** and select the sphere. Use the **'Loop Subdivide'**, **(Crtl+R)** you will see a yellow selection loop and **position the loop horizontally** and **click the middle of the sphere twice**. Shown in the screenshot below:
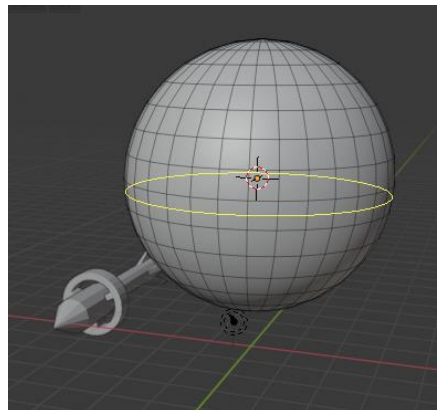
➢ From the **'Loop Cut and Slide' Properties Panel**, change the **'Number of Cuts' to 2** and **'Falloff' to Sphere.**
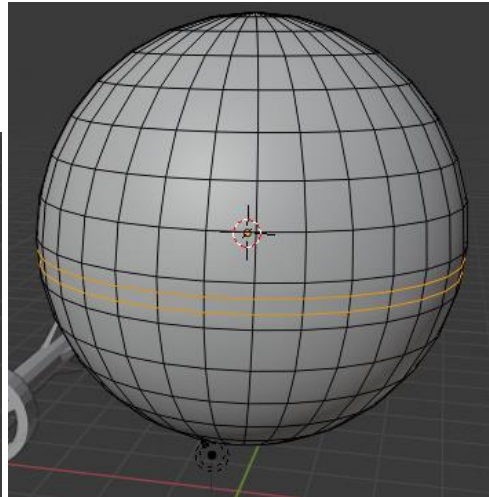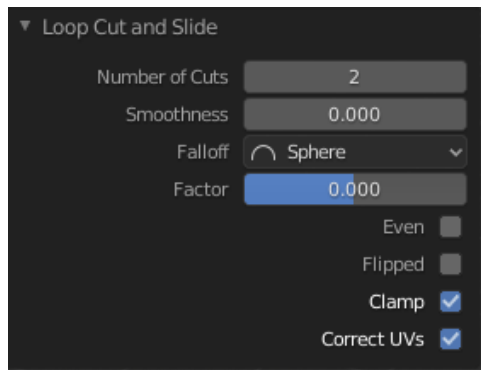
> Change to **'Face Select Mode'** and **select the faces of the cut** made by the loop subdivide but leave 7 faces on the opposite side unselected.
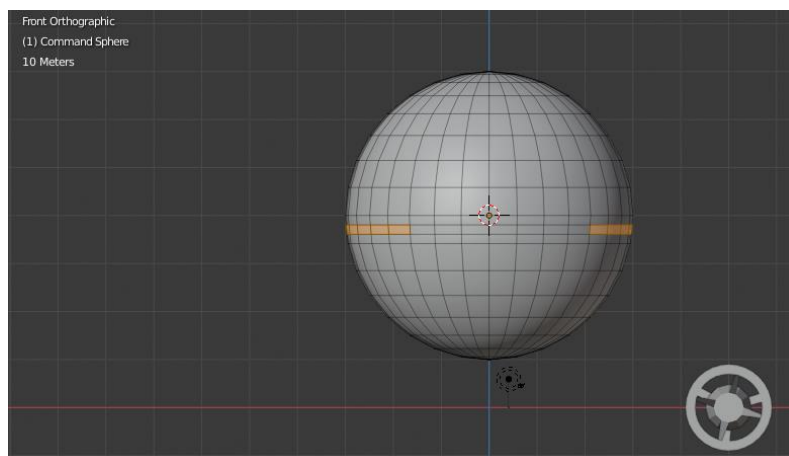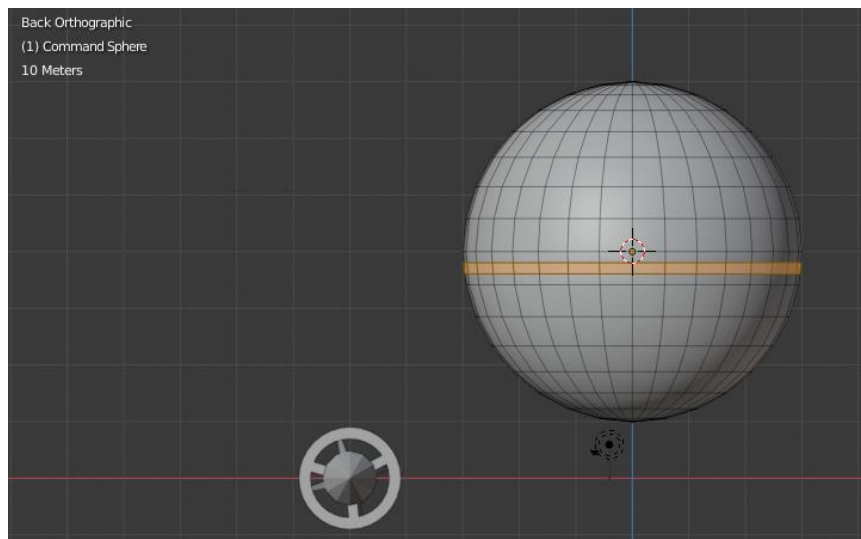
> Select the **'Inset Faces' Tool**, `(Press I)`, **turn on the 'Boundary'** option `(Press B),` you can see this under the menu header.
> **Hold Ctrl** and scale the faces inwards by **approximately -2m units** creating an indent across most of the middle of the sphere and the back not indented.
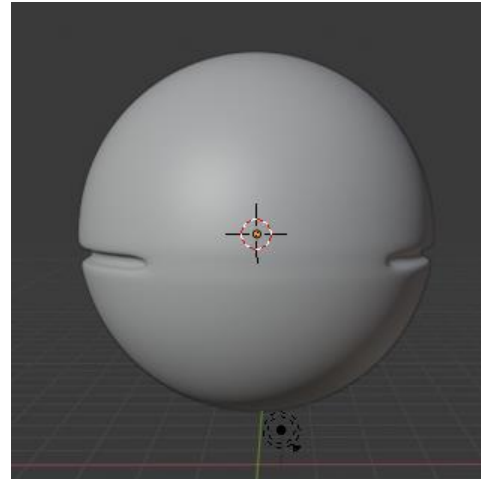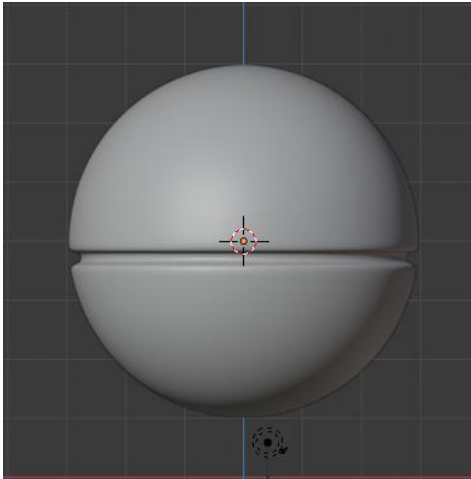
- Within the **Inset Faces Properties Panel**, tick the **'Edge Rail'** option. This will allow the vertices to sit along the original edges of the inner sphere, instead of the normal.
- You can adjust the depth of the inset in this panel if you would like a more accurate indent.
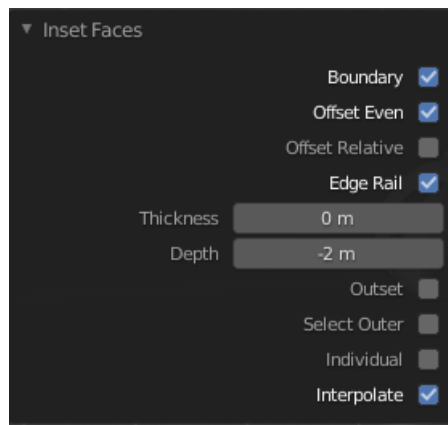
Part 2b: Creating the Command Sphere Window

- Change your viewpoint to back orthographic view **(NUM 9)**. Switch to **'Edit Mode'** and **select 8 faces of the sphere** as shown in the screenshot below:
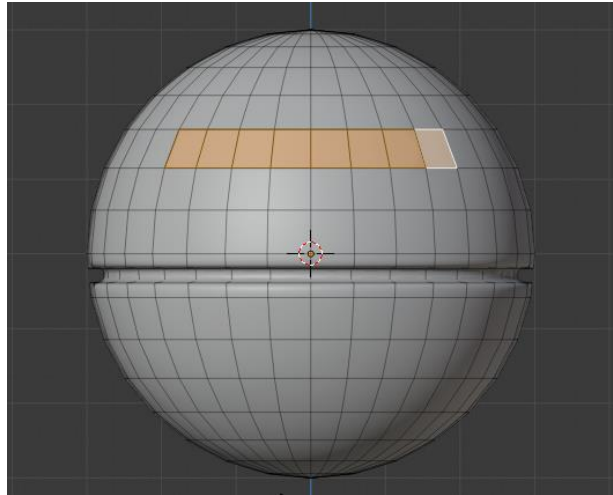
- ➢ **Press Extrude and escape** to set the border of the window panel, **(Press E, Esc).** Then scale the window towards the inside of the sphere **by 0.7 units approximately**, **(Press S, 0.7)**.
- ➢ **Extrude along the y-axis by -6 units**, **(E, Y, -6)**. Then **select** the **'Proportional Editing'** option and **'Connected'** in the **Extrude Regio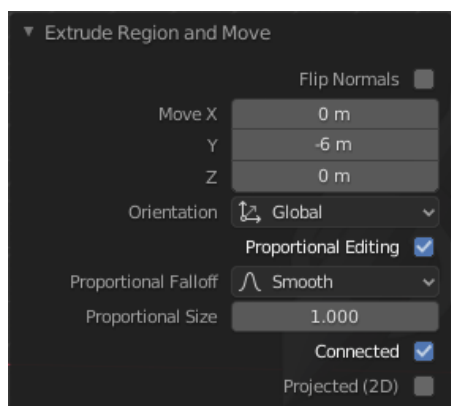n and Move Panel.** This will ensure the edges are not stretched around the corners and the extrusion is even all round.

Part 2c: Creating the Command Sphere Vents

To add more dimension to the Command Sphere we will add an escape pod unit.

- ➢ Similar to how we created the window, switch to **'Edit Mode'** and **select 12 faces on the bottom right quadrant of the sphere**.
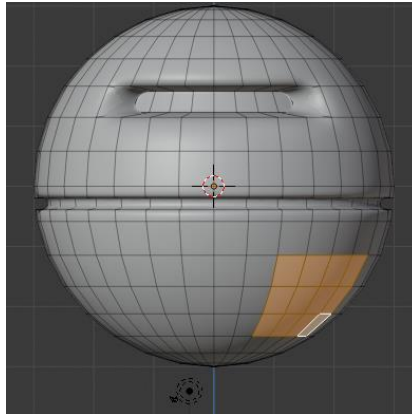
- ➢ **Press Extrude and escape** to set the border of the panel, **(E, Escape),** select the **'Proportional Editing'** in the properties panel**.**
- ➢ Then **scale by 0.9 units, (S, 0.9)** and **extrude again by -0.9 units, (E, -0.9)**.
- ➢ **Extrude further by -12 units, (E, -12).**

You will notice that the cut we have made into the sphere is not circular so we will now fix that.

- ➢ Switch to **'Vertex Select Mode'** and change your view to **wireframe**, **(Z, 4).**
- ➢ **Select the perimeter of the extrusion** and <u>not the centre vertices</u>
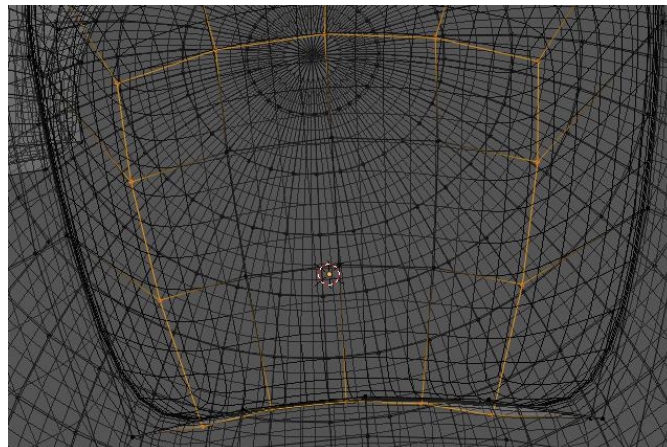
- ➢ With your vertices selected, **Press Alt+Shift+S and 1.** This will create a circle shape.

- ➢ We will now switch back to **'Solid Mode', (Z, 6)** as it will be easier to work with the outer vertices**.**
- ➢ **Select the outer vertices** of the extrusion and complete the same step as above, **(Alt+Shift+S, 1)**.
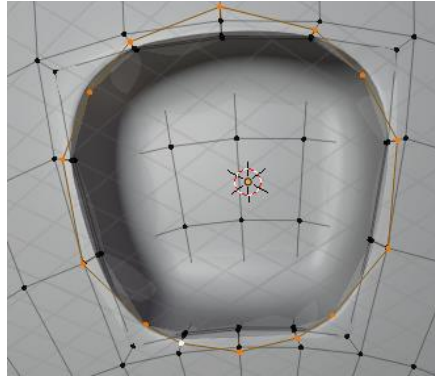

- ➢ Now **select the surrounding vertices** of the extrusion and **repeat the same step as above.**
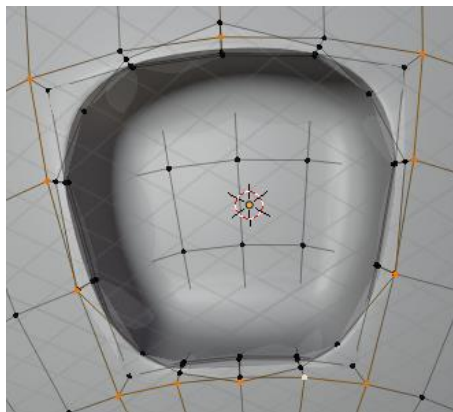
- ➢ There is **one more section of surrounding vertices** you need to **repeat the same step as above** which will make the outer shape circular, shown in the screenshot below:

- ➢ Feel free to create any additional extrusions to add more depth and detail to the **'Command Sphere'**.

Part 2d: Creating the Command Sphere Support

We will create the support holding the Command Sphere in place which will later be connected to the support rod.

➢ Switch your viewpoint to the **'Front Orthographic' (NUM1).**
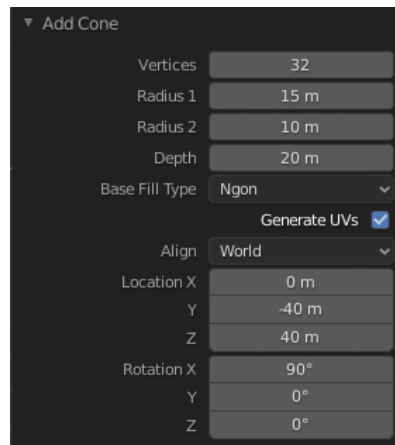➢ **Add a cone, `(Shift+A > Mesh > Cone)`,** change the **'Radius 1' to 15m, 'Radius 2' to 10m and 'Depth' to 20m.** Change the **location of Y to -40m** and **rotation of X to 90°**.

➢ Switch to **'Edit Mode'** and **select the face of the cone** facing towards the sphere. Extrude and escape the face **`(Press E, Escape),`** **scale by 0.9 units `(S, 0.9)`** and then **extrude by 1m** unit, **`(E, 0.1).`**
➢ **Repeat** this step twice but decrement the scale by 0.1 units for each repetition.
➢ **Extrude by 1m units, `(E, 0.1).`**
➢ Create a **bevel** on the last extruded face with a width of 1m unit, **`(Ctrl+B, 1)`**.
➢ **Select** all the individual faces around the top of the same side of the sphere and **extrude by 0.5m units**, **`(Select Faces > E, 0.5).`** **Scale** this by 0.9m units **`(S, 0.9)`**. Create a **bevel** here by **1.5 units, `(Ctrl+B, 0.5).`** Your model should look like the screenshot below:
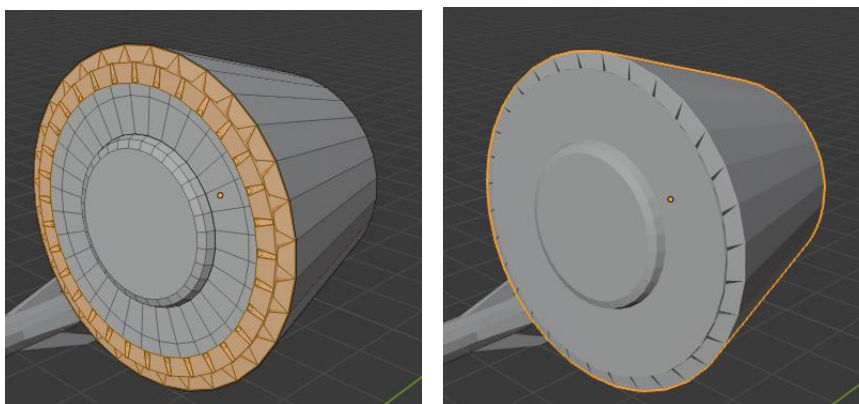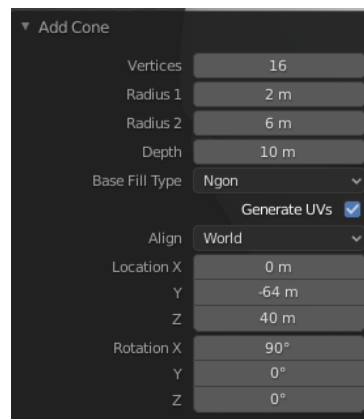

Now we will begin to create the support for the opposite side.

➢ As we have done previously, **Extrude, escape and then scale by 0.8 units, (E, Escape, S, 0.8). Extrude** once more **by 5m units, (E, 5)**.

➢ **Repeat** the extrude, escape and scale step but **scale by 1.4m units, (E, Escape, S, 4)**. Now **extrude once more by 6m units, (E, 6)**.

Click on the back face and change the 3D cursor to **'Cursor to Selected', (Shift+S > 2)**.

➢ **Add a cone, (Shift+A > Mesh > Cone).** Set the properties, **Vertices to 16, 'Radius 1' to 2m, 'Radius 2' to 6m and Depth to 10m.** Set the **location of Y to -64m** and change the **rotation of X to 90°.**

Add Cone	
Vertices	16
Radius 1	2 m
Radius 2	6 m
Depth	10 m
Base Fill Type	Ngon
Generate UVs	✓
Align	World
Location X	0 m
Y	-64 m
Z	40 m
Rotation X	90°
Y	0°
Z	0°

➢ **Select** a face of the new cone we have created and **press Ctrl+L.** We are going to adjust the position of the cone, with the **cone selected press (G, Z, 4)** and then **(G, X, 4.5). Scale** the cone **down to 0.9 units, (S, 0.9)**.

➢ **Duplicate** the cone and click, **(Shift+D, LMB). Move** it along the **X-axis by -10 units, (G, X, -10).**

➢ **Repeat** the above step.

➢ **Select** the all of first cone, duplicate and move it down the Z-axis by -10 units, **(Ctrl+L, Ctrl+D, LMB, G, Z, -10).** You should now have four cones on the back of the support.

➢ **Rename** the object in the Outliner window to **'Command Support'**.

➢ **Parent** the **'Command Support' to** the **'Command Sphere'.**
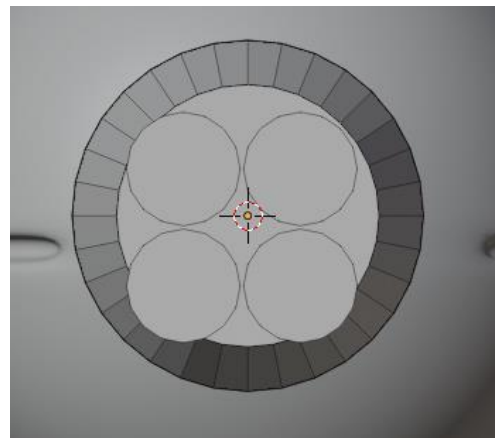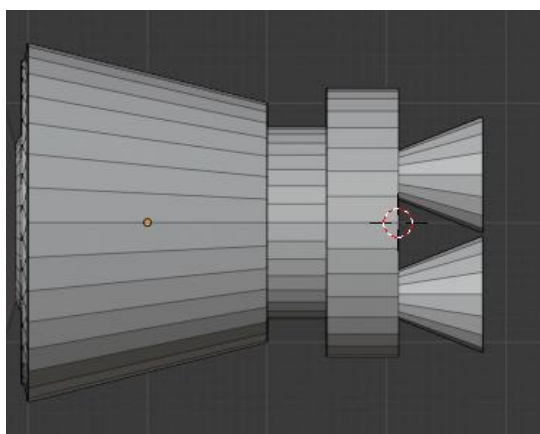
Part 3: Creating the Support Rod

➢ Switch to **'Object Mode'** and add **a plane, (Shift+A > Mesh > Plane).**
➢ **Set** the properties in the panel, change the **Size to 30m, Location of Y to -68m and Rotation of X to 90°.**
➢ **Extrude** the plane **by 2m units, (E, 2).**

Click on the back face of the plane and change the 3D cursor to **'Cursor to Selected', (Shift+S > 2).** <u>**NOTE: Alternatively, if this doesn't work use the 'Cursor Tool' to select the centre of the face of the extruded plane.**</u>

➢ **Deselect** any objects and **add a cylinder, (Shift+A > Mesh > Cylinder).**
➢ **Set** the properties, change the **Radius to 5m and Depth to 85m.** Change the **location of Y to -111m** and the **rotation of X to 90°.**

▼ Add Cylinder	
Vertices	32
Radius	5 m
Depth	85 m
Cap Fill Type	Ngon
Generate UVs	☐
Align	World
Location X	-0.0578 m
Y	-111 m
Z	40 m
Rotation X	90°
Y	0°
Z	0°

➢ **Rename** the object to **'Support Rod'**.
➢ Switch **'Edit Mode'** and in **'Face Select Mode'**, **select one** of the **cones before the plane** we placed and **duplicate it, (Ctrl L, Shift+D, LMB).**
➢ **Move** the duplicated cone anywhere in the world space so we can manipulate it, **(G, X).**
➢ With the duplicated cone selected we need to **unparent** it **from 'Command Support', (In 'Edit Mode', P > Selection).**
➢ Ensure **only the duplicated cone is selected** and **switch to a side view** where you can see the cone clearly without obstruction.
➢ Change to **'Vertex Select Mode'** and **Press B** to **Box Select one half of the cone** and **delete** it, **(B > Make Selection) then (X > Vertices).**
➢ **Select** the four corners of the back of the object and **Press F to fill** and using the **Box Select Tool** or individually selecting the vertices, **fill** the sides in too.
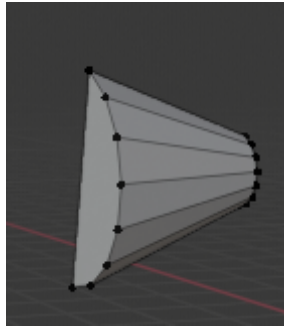
- ➢ **Select** the **even numbered faces** on the half cone. **Extrude by -0.5m units and Scale by 0.7m units, `(E, -0.5, LMB, S, 0.7).`**
- ➢ **Move** the object to the right side of the support rod and position it to connect to the pane, you may need to **rotate** too. **Scale** the object to **around 2m units**.
- ➢ **Rename** the object to **'Wing Array'**.
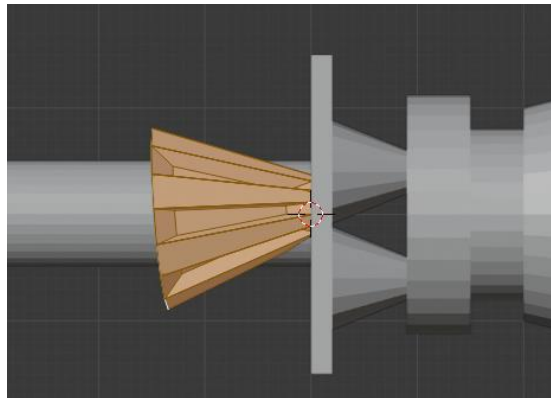
- ➢ **Duplicate** the **wing array** and **move it -14m units on the X-axis, `(Shift+D, LMB, R, X, -14).`** Then **rotate the wing on the Y-axis by 175°, `(R, Y, 175)`.** If you feel you need to realign the wings then rotate on the X-axis by around 5° and move down the Z-axis by <1m units, use the side views to help align and adjust if required.
- ➢ **Fill** in the spaces between the **two wing arrays (in Vertices Select Mode > F on selected vertices),** except for the top.
- ➢ **Select the top vertices** and **extrude in the Z-axis by 4m units `(E, Z, 4)`** and fill in the empty spaces.
- ➢ **Duplicate** the wing array and **move it along the Y-axis by -20m units, `(Shift+D, LMB, G, Y, -20).` Repeat** this step 2 more times **until you have 4 wing arrays.** Ensure the Origin is set to **'Origin to Geometry'** if the 3D Cursor origin is elsewhere, **`(In Object Mode: RMB > Set Origin, Origin to Geometry).`**

This will act as the vertebrae of the spaceship to allow some flexibility and to stabilise movement against zero-gravity.
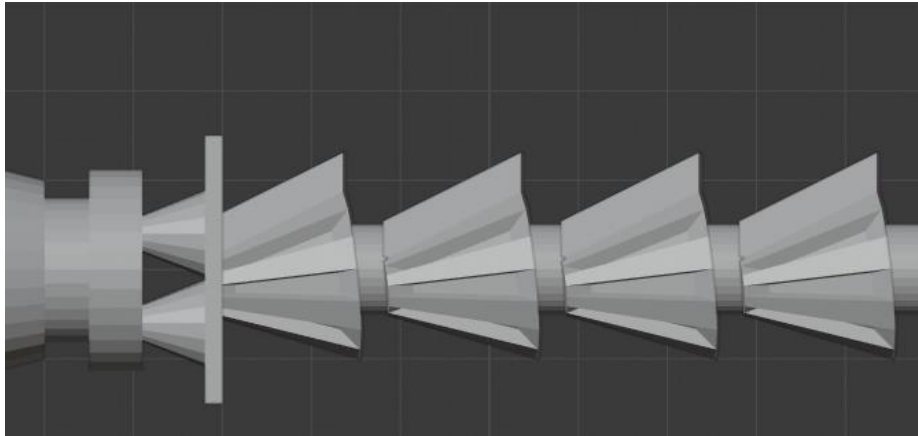
The final step for is to **parent** the '**Wing Arrays' to the 'Support Rod'**. *NB: The order of object selection is important in this step.*

➢ Make sure you're in **'Object Mode'** and **select the 'Wing Arrays' object** in the **outliner window** and then the **'Support Rod' object** and press **Ctrl+P** and **'Set Parent To' Object.** The parent link should look like the screenshot below:

Part 4a: Creating the Propulsion Unit

We will now create the **'Propulsion Unit'** which will act as an engine and hold the thrusters of the Spaceship.

➢ **Move** the 3D cursor to select the end of the cylinder using the **'Cursor Tool'.** At the end of the cylinder **add a plane** just as we did before but set the **radius to 35m units** and remember to **change the rotation of X to 90°.**

➢ **Extrude** the plane object by **-3m units `(E, -3)`. Select** the **front face of the plane** and **Extrude, Escape and Scale by 0.8 units, `(E, Escape, S, 0.8)`. Extrude again by 1m units, `(E, 1)`** and then **scale again by 0.8 units `(S, 0.8)`** creating a bevelled face. As shown in the screenshot below (the support rod and wing arrays have been hidden to show a clear picture):
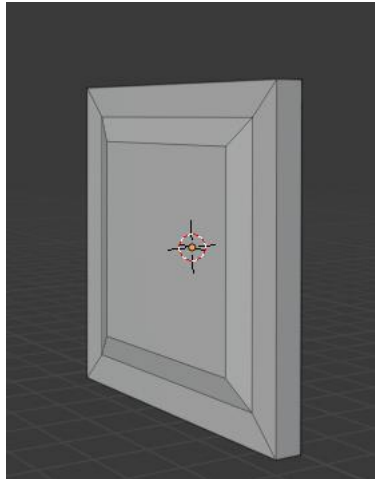
- ➢ **Select** the **back face of the plane** and **extrude by -3 units, (E, -3).**
- ➢ **Repeat** the above step and **extrude again by -5m units (E, -5).**

Now we will create the main body of the **'Propulsion Unit'.** Make sure to continuously **save** your work.

- ➢ **Move** the 3D cursor to select the new extruded plane using the **'Cursor Tool'.** In **'Edit Mode' change** to **'Vertex Select Mode'** and change the viewpoint to **'Front Orthographic' (NUM1)**.
- ➢ We're going to make an octagon shape**. Select** the **top-left vertex, extrude** and **hold Ctrl** to **extrude in increments** until you see the **X and Z values at -20m and -10m** respectively, alternatively you **can fix the values within the properties panel, (E, Ctrl).**
- ➢ **Repeat this step for the bottom-left**
- ➢ **.**
- ➢ **Select** the **two vertices** and **press F** to connect the lines together to create one side of the octagon. **Press F** again to fill the face.
- ➢ **Mirror** the shape on the opposite side of the pane. To do this add the **'Mirror Modifier'** in the **Modifier Properties** and **switch on 'Clipping'.** This will prevent vertices from moving through the mirror plane while transforming in Edit Mode. **Mirror Modifier Properties Panel** shown in the screenshot below:
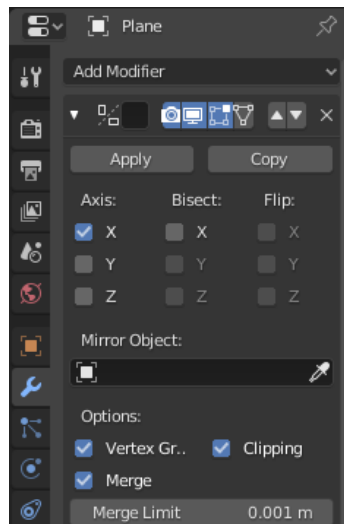
> ➢ **Change to 'Face Select Mode'** and **select the shape we just created** (you won't be able to select the mirrored as any changes made on the original shape will reflect to the mirrored shape) **and select the pane (middle square). Extrude along the Y-axis by -60m units, (E, Y, -60).**
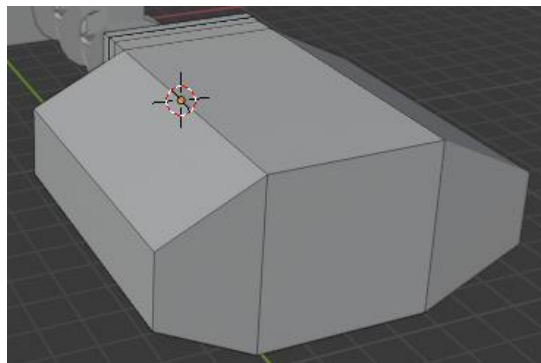
> ➢ If you change your view to see the front side of the octagon, you will notice that the side faces are not filled. **Change to 'Edge Select Mode', select an edge** and **fill it (Press F).**
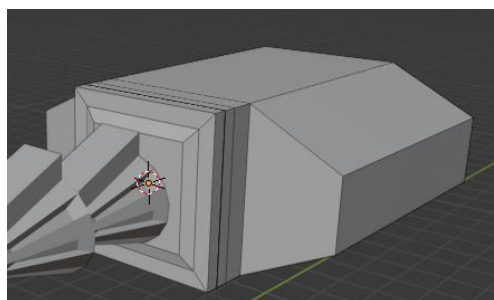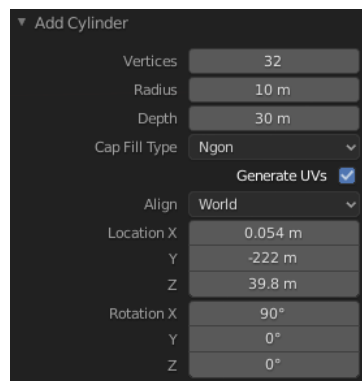

> ➢ **Rename 'Plane'** to **'Propulsion Unit'.**

Part 4b: Creating the Spring Unit

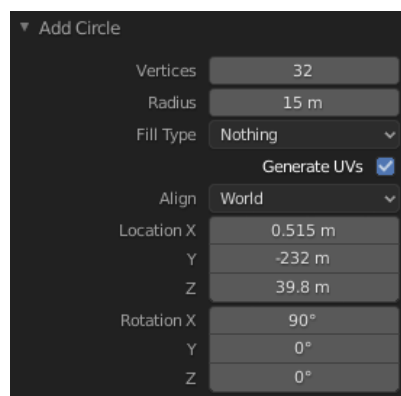Now we are going to add the thrusters to the end of the propulsion unit.

- ➢ **Change the viewpoint** to **'Front Orthographic' (NUM1)** and move the 3D cursor to select the back of the propulsion unit using the **'Cursor Tool'.**
- ➢ **Add a cylinder, (Shift+A > Mesh > Cylinder). Set** the **Radius to 10m, Depth to 30m and** change the **rotation of X to 90°.**
  - o *NB: Ensure this is a separate object from the 'Propulsion Unit' body, check in your Outliner Window. If this is not the case, then move the 3D cursor to either the World Origin or reposition it using the previous step.*

▼ Add Cylinder	
Vertices	32
Radius	10 m
Depth	30 m
Cap Fill Type	Ngon
Generate UVs	✓
Align	World
Location X	0.054 m
Y	-222 m
Z	39.8 m
Rotation X	90°
Y	0°
Z	0°

- ➢ **Move** the cylinder **along the Y-axis by -10m units, `(G, Y, -10).` Rename** the cylinder to **'Spring Unit'**.

We are going to **create a spring** for more detail on the thruster. We will be using the screw modifier to create the spring.

- ➢ Make sure your viewpoint is set to **'Front Orthographic' (NUM1)** and **move the 3D Cursor to the middle back of the cylinder ('Spring Unit'). Add a circle, (Shift+A > Mesh > Circle)** and **set** the **Radius, to 15m** and **Rotation of X to 90°. Rename** the circle to **'Spring'**.

| ▼ Add Circle	
Vertices	32
Radius	15 m
Fill Type	Nothing
Generate UVs	✓
Align	World
Location X	0.515 m
Y	-232 m
Z	39.8 m
Rotation X	90°
Y	0°
Z	0°

Since the screw modifier uses the origin of the object as the midpoint, we will need to **move** the circle **along the X-axis by 25m units, `(G, X, 25).`**

- ➢ Using the **'Modifier Properties' Panel** add the **Screw Modifier** which will be under the **'Generate' column** in the properties**.**
- ➢ **Change** the '**Screw' value to 16m, 'Steps' to 30** and **'Iterations' to 5.**
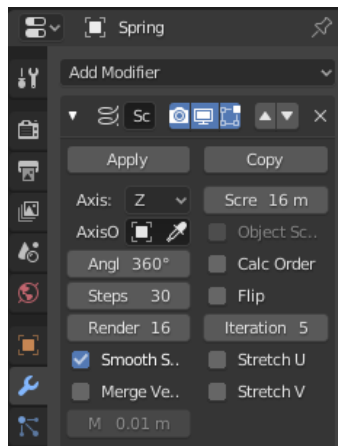
You will notice that the spring is too big! In **'Object Mode' select the spring** and **scale it down to 0.3m unit, `(S, 0.3).`**

> ➤ **Move** the spring **along the Y-axis by 10m units, `(G, Y, 10`)**.
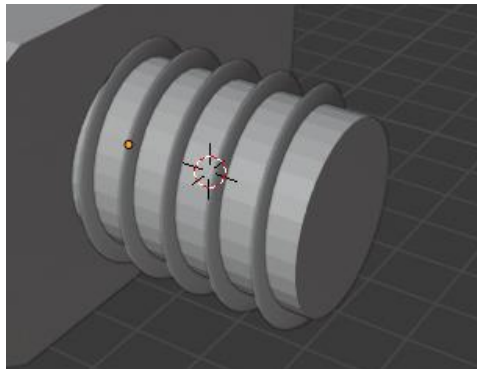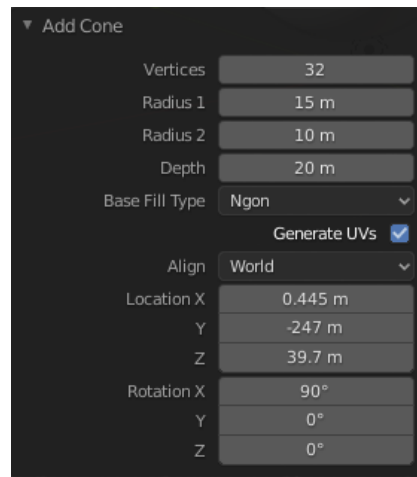

> ➤ **Parent** the **'Spring' to the 'Spring Unit'** object.

Part 4c: Creating the Thruster

Make sure your viewpoint is set to **'Front Orthographic' (NUM1)** and **move the 3D Cursor to the middle back of the cylinder ('Spring Unit' object).**

> ➤ **Add a cone, `(Shift+A > Mesh > Cone)`. Set 'Radius 1' to 15m, 'Radius 2' to 10m and Depth to 20m. Change** the **Rotation of X to 90°.**

Add Cone	
Vertices	32
Radius 1	15 m
Radius 2	10 m
Depth	20 m
Base Fill Type	Ngon
Generate UVs	✓
Align	World
Location X	0.445 m
Y	-247 m
Z	39.7 m
Rotation X	90°
Y	0°
Z	0°

➢ **Scale** the cone **along the Y-axis by 1.6m units, (S, Y, 1.6)**.
➢ **Move** the cone **along the Y-axis by -9m units, (G, Y, -16)**.
➢ In **'Edit Mode', select** the cone and **Press Crtl+R** to create a **Loop and Cut. Select the middle** and then place the **yellow ring** on the lower third (around 0.6m units on the bottom end of the cone) and **place the Loop and Cut** there. **Change** the **'Number of Cuts' to 2**. Now, **scale** the loop cuts **along the Y-axis by 0.6, (S, Y, 0.6)**. This will give the cone some shape.
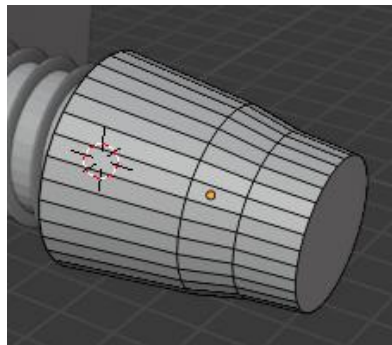
➢ **Select** the entirety of the two edges created by the loop cuts.
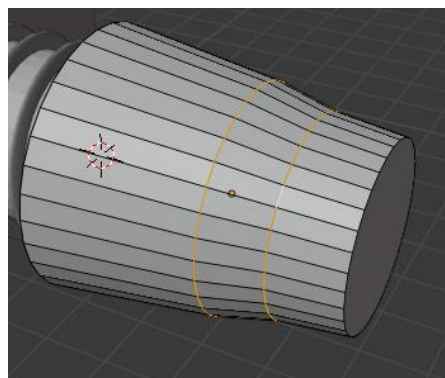
➢ **Create a bevel** with a **width of 1.3m** and **extrude by -2m units, (Ctrl+B, 1.3, Enter, E, -2).**
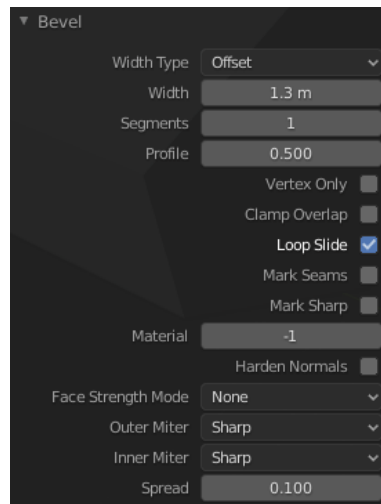
We will add detail to the back-end of the cone. **For every fourth face select**, you should have a **total of 8 selected faces, as shown in the screenshot below:**
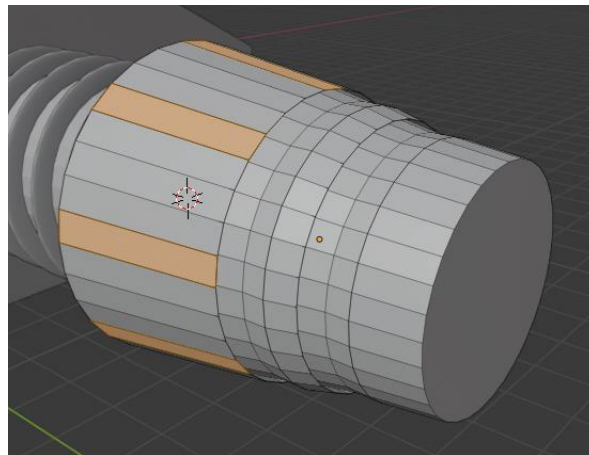

- ➢ **Extrude, Escape and Scale by 0.9m units, (E, Escape, S, 0.9).**
- ➢ With the faces still selected, **extrude again by -50m units, (E, -50).** The result should look like the screenshot below:
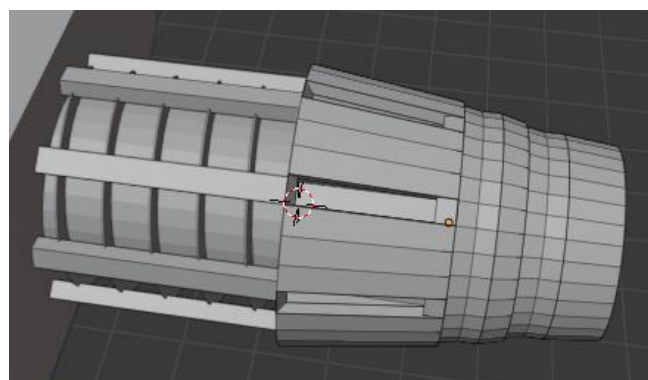
- ➢ **Select the back face of the cone** and **extrude by 2m units, (E, 2),** then **scale by 1.4m units, (S, 1.4)** and **extrude again by 3m units, (E, 3).** This will act as and create a new "plane" to work on the next part of the thruster.

Make sure your viewpoint is set to **'Front Orthographic' (NUM1)** and **move the 3D Cursor to the middle back of the newly extruded circle object.**

➢ We are going to add a hexagon to the back of the **Add a cylinder, (Shift+A > Mesh > Cylinder). Set** the **'Vertices' to 6**, **'Radius' to 10m** and **'Depth' to 75m.** **Change** the **Rotation of X to 90°.** This will create the hexagon shape.
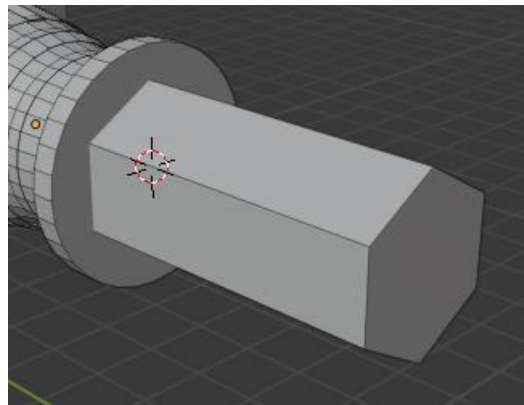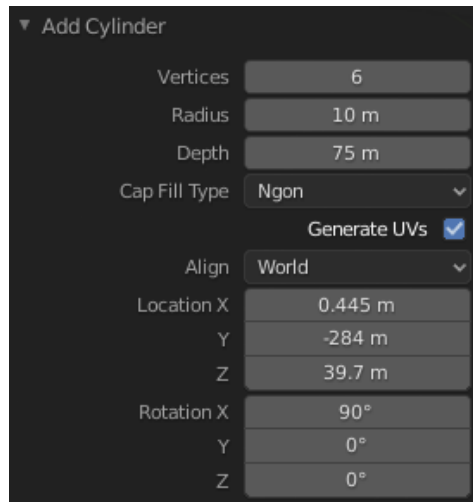

We're going to add some detail to the hexagon object.

➢ **Select** the face of the object the hexagon is connected to and **add a UV Sphere, (Shift+A > Mesh >UV Sphere). Set** the **'Radius' to 15m** and **change** the **Rotation of X to 90°**.
➢ **Move** the **Sphere along the X-axis** so we can **manipulate** it.
  o **Scale** the sphere down to **0.2m units (S, 0.2).**
  o **Move** the sphere back to sit against the circular plane to sit just a little above the hexagon object on the top-right panel.
  o **Scale** the sphere further by **0.6m units, (S, 0.6)**.
  o **Position** the sphere to get it to be halfway into the circular plane object.
 o The result should look like the screenshot below:
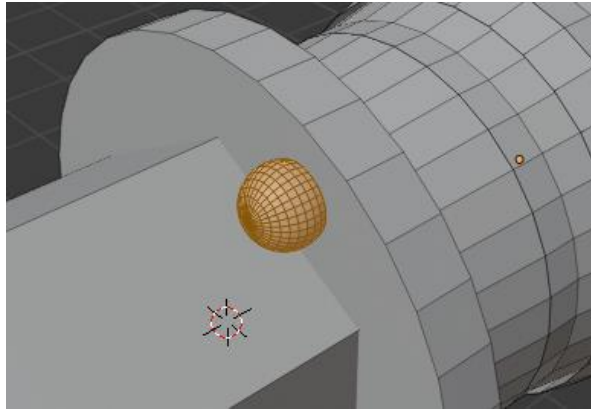
- ➢ **Change** into **'Vertex Select Mode'** and **delete** the first three inner rows of vertices, **`(X, V [Vertices].`**
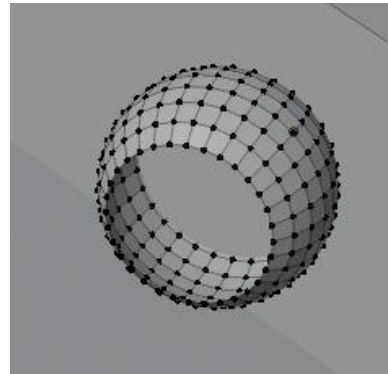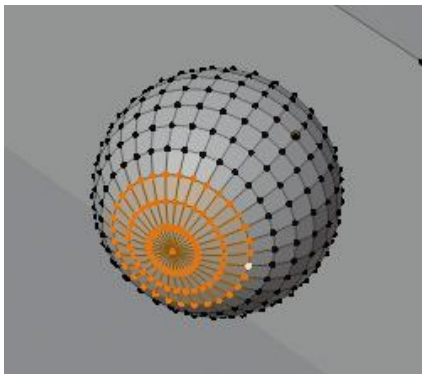
- ➢ **Move** the 3D cursor to the centre inside the sphere, using the **'Cursor Tool'**.
- ➢ **Add a cylinder, `(Shift+A > Mesh > Cylinder).`** **Set** the **'Vertices' to 32, 'Radius' to 1.1m and 'Depth' to 10m. Change** the **Rotation of X to 90°.**
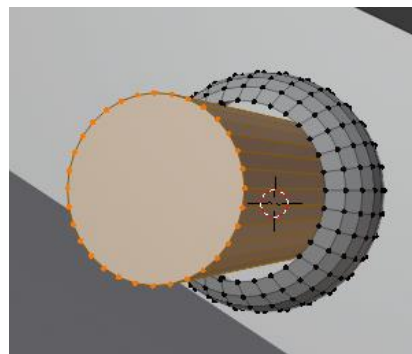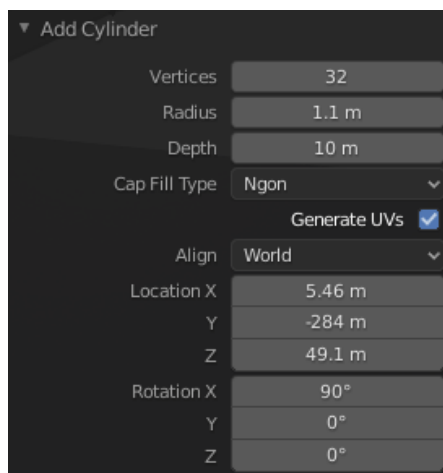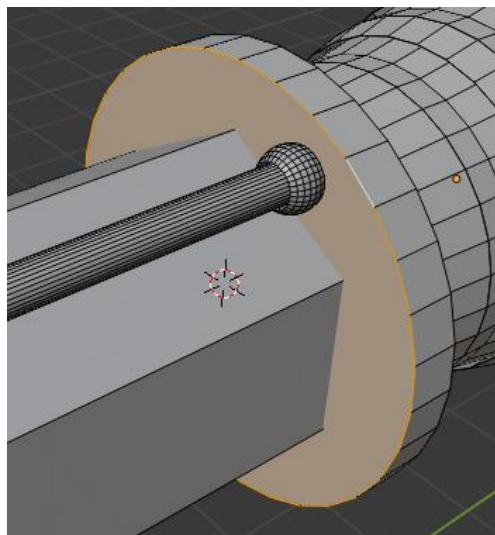

- ➢ **Scale** the cylinder **along the Y-axis by -3.7m units, `(S, Y, -3.7).`**
- ➢ **Move** the cylinder **along the Y-axis by -15m units, `(G, Y, -15)`**.
- ➢ **Reposition** the cylinder if you need to, so the cylinder is in the centre of the sphere.
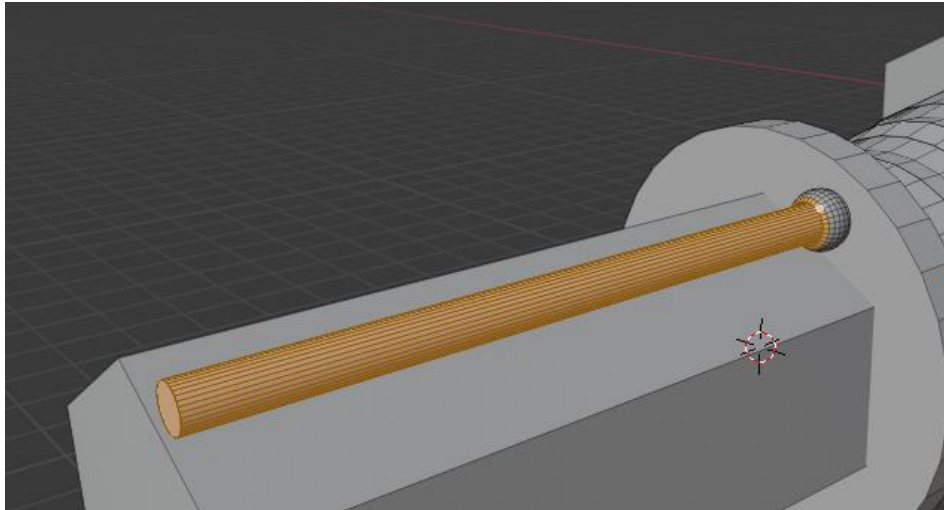
We now want to **spin** these objects **around the hexagon**.

➢ Use the **'Edge Select Tool'** and select the circular edge that the sphere object is against. Shown in the screenshot below:


➢ **Change** the cursor to **'Cursor to Selected', (Shift+S, 2 [Cursor to Selected]).**
➢ **Select** both the objects (sphere and cylinder) **(Click a face on an object, Ctrl+L, hold Shift, click a face on the other object and then press Ctrl+L).**
➢ Click the **'Spin Tool'** and then the **blue plus icon**. **Set** the properties as follows, **'Steps' to 8, Check 'Use Duplicates', 'Axis Y' to 1, 'Axis Z' to 0.** The properties panel should match the screenshot below and the **result should duplicate the object 8 times around the Y-axis of the hexagon/circular plane**.
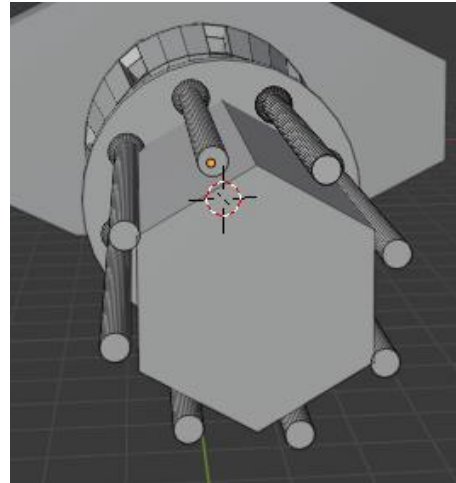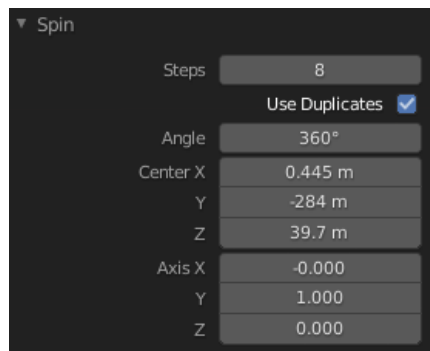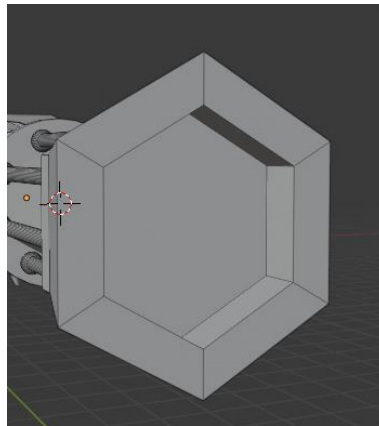
- ➤ **Select** the back face of the hexagon and **extrude by 2m units, (E, 2).**
- ➤ **Select all the faces of the new extruded hexagon** and **scale by 1.6m units, (Select Faces > S, 1.6).**
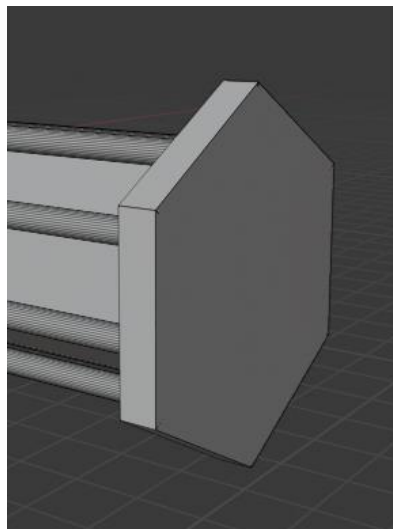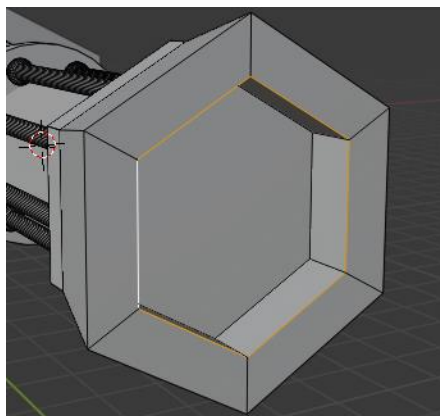

- ➤ **Select** the back face of the extruded hexagon and **extrude by 12m units, (E, 12).**
- ➤ **Scale** the **extrusion by 1.2m units, (S, 1.2).**
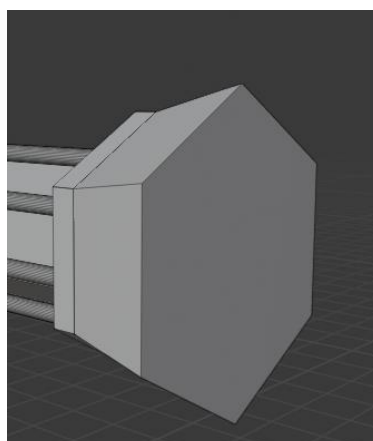
➢ **Select the back face of the hexagon again** and **Extrude, Escape and Scale along the Y-axis by 0.7m units, `(E, Escape, S, Y, 0.7)`.**

➢ **Extrude** again **along the Y-axis by 6m units, `(E, 6)`.**

➢ **Select** the outer edges of the hexagon and **create a bevel, (Ctrl+B,).**
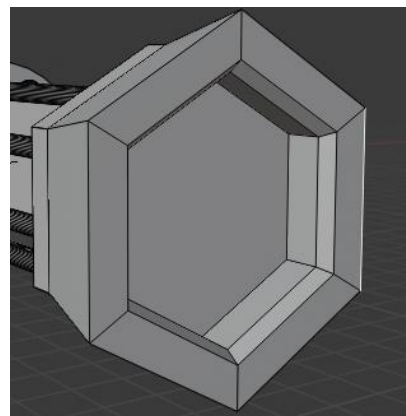
➢ **Scale** the inside of the hexagon as this will be where the energy source of the thrust will shoot out from to propel the spaceship around orbit.

   o **Scale by 0.5m units, `(S, 0.5)`.**
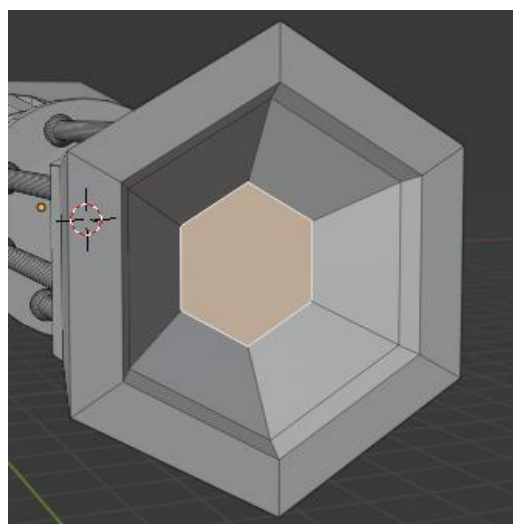
➢ **Extrude** the selected face (inner most hexagon) **along the Y-axis by -5m units, (E, -5)**.
  o If you wish to add another bevel on the inside of the hexagon (thruster) then feel free to do so.
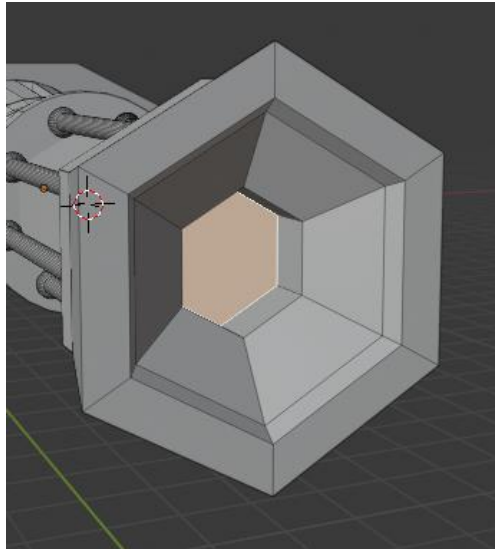
➢ **Rename** the **'Cone'** object to **'Thruster'** in the Outliner Window.
➢ **Parent** the **'Spring Unit' to** the **'Thruster'**.

Part 5a: Moving the Missile Rocket

Now that we have created the Spaceship, we need to **move** the **'Missile Rocket'** under the **'Propulsion Unit'**.
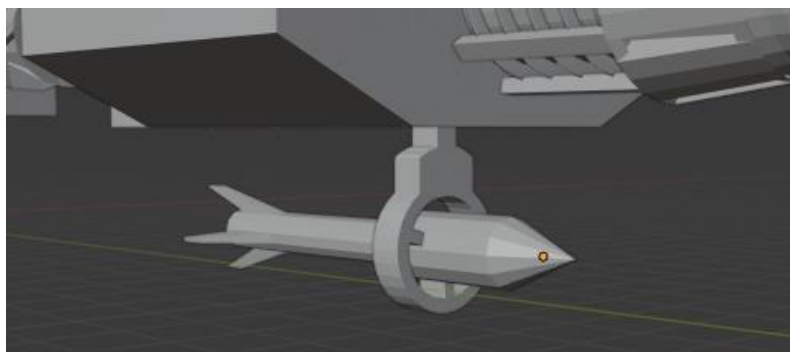
➢ **Select** the **'Missile Rocket'** and the **'Missile Ring'** and **rotate it on the Z-axis by 180°, (R, Z, 180).**
➢ **Change** the viewpoint to the **'Left Orthographic' view (Ctrl+NUM3)** and **move** the **'Missile Rocket' along the Y-axis by approximately -187m units, (G, Y, -187)** **or** just so that the entire **'Propulsion Unit' covers the rocket**.
➢ **Change** the viewpoint to the **'Top Orthographic' view (NUM7)** and **move** the **'Missile Rocket' along the X-axis by -50m units, (G, X, -50).** The rocket should be directly under the **'Propulsion Unit'** and be central to the green line (Y axis).

We need to **extrude** the top faces of the **'Missile Ring'** so the rocket can hang from the **'Propulsion Unit'**.

➢ **Extrude** 5 or 6 faces on the top of the **'Missile Ring' by -5m units, (Select Faces > E, -5).** If you wish to, <u>you can add a bevel</u> on the <u>faces you have extruded</u> and further extrude the middle faces by-3m units (as we have done previously). The result would look like this:
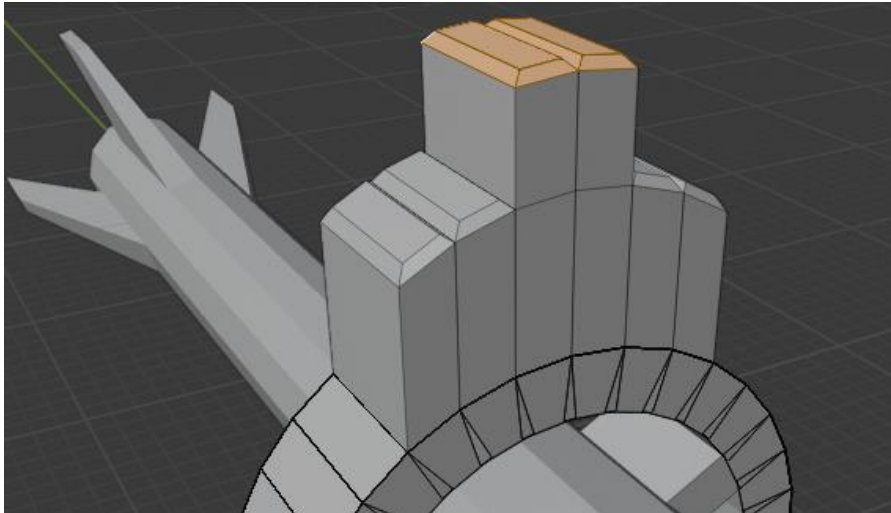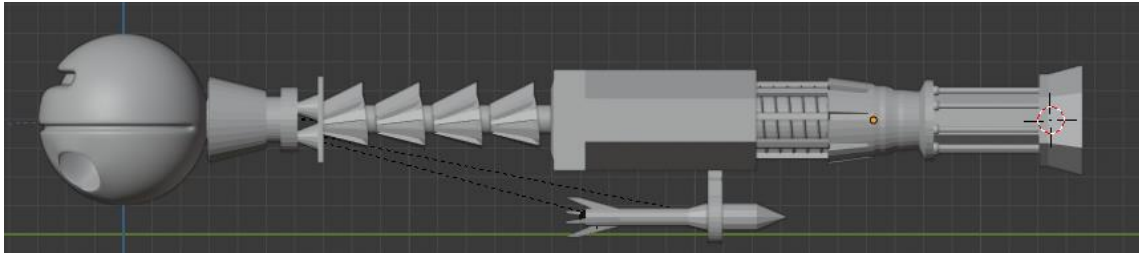
➢ **Move the 'Missile'** object **up the Z-axis by 6m units, (G, Z, 6).**

➢ If you wish to, you can duplicate the **'Missile'** object and make space (move existing missile using G, X, -13) to fit another next to our existing **'Missile'.**

   o **To duplicate and move extra rocket:**

        ▪ **(Shift+D, LMB, G, X, 26)**
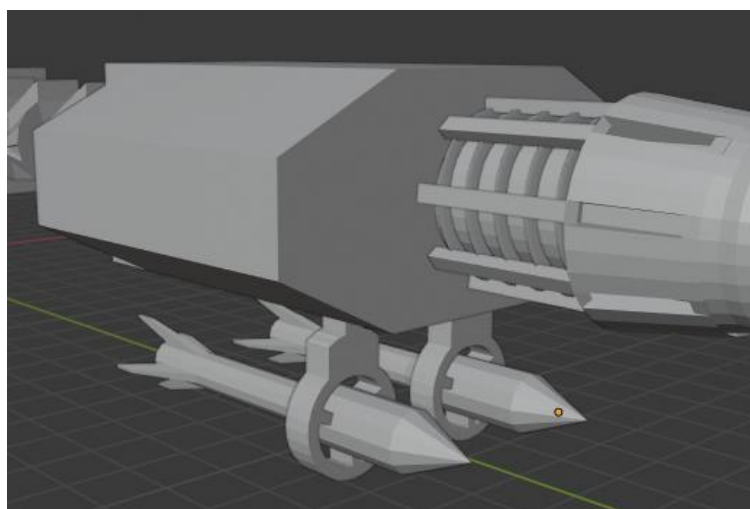
➢ **Rename** the new rocket to **'Missile Ring 2' and** the **(child)** rocket <u>**inside the parent**</u> to **'Rocket 2'.**

Part 5b: Creating the Fire and Smoke for the Missile Rocket

We are only going to add the fire and smoke to one of the **'Missile Rockets'** because this effect may cause some latency (lag) and slow down the process of the computer**.**

- ➢ **Set** the 3D cursor to **empty space we created at the start** for the flame to sit inside and **set 'Origin' to '3D Cursor'.**
- ➢ **Add a UV Sphere, (Shift+A > Mesh > UV Sphere). Set** the **'Radius' to 2m units** and **move it along the Y-axis by approximately 19m units, (G, Y, 19).**
- ➢ **Select** the **'Object' menu > 'Quick Effects > Quick Smoke.**
- ➢ **Select** the **Sphere** and **select** the **'Physics Properties'** menu**. Change** the **'Flow Type'** to **'Fire +Smoke'**.
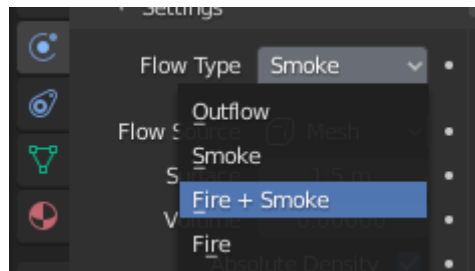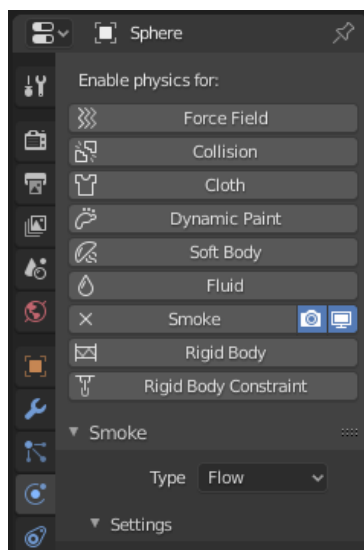

- ➢ Go into the **'Shading'** menu and **change** to **'Object Mode'** and **select** the **Domain (the box around the sphere).** This will bring up the two property menus on the bottom of the screen, as shown in the screenshot below:
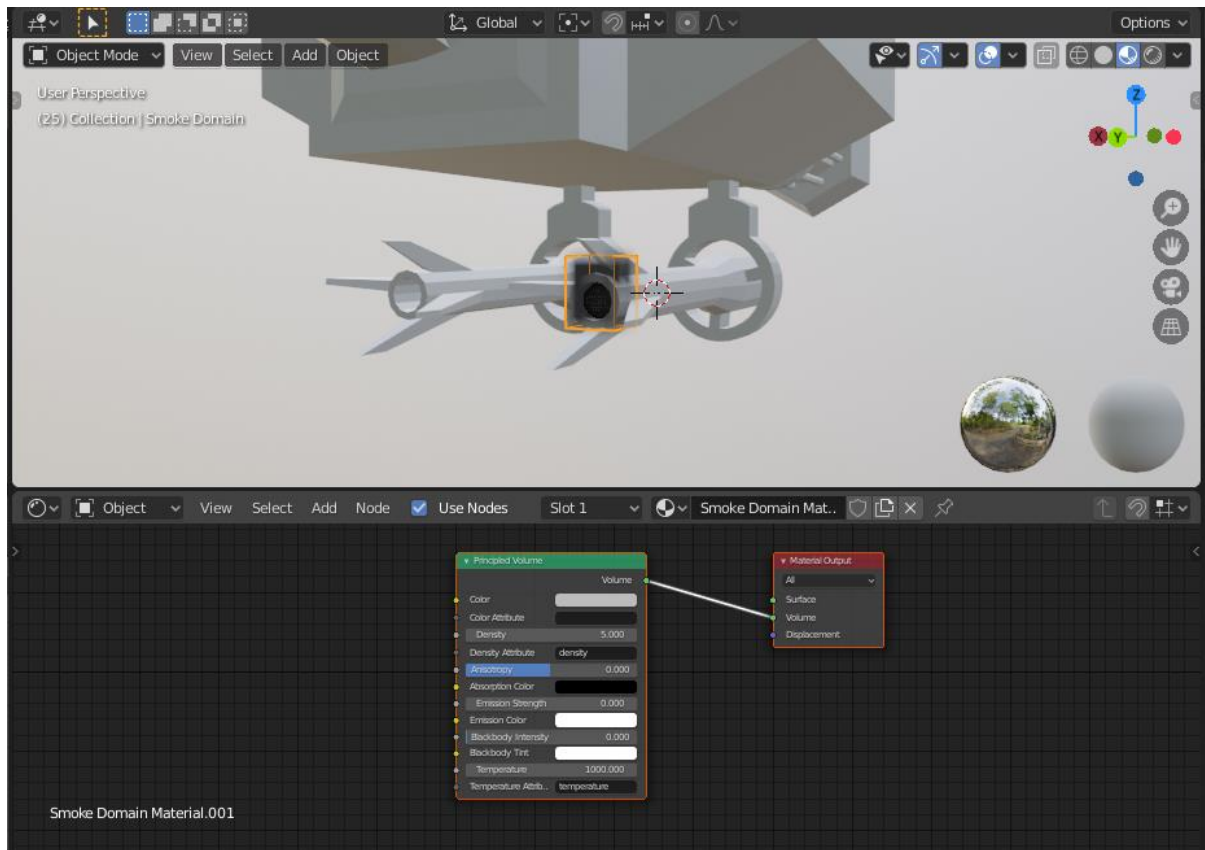
> ➢ **Add the 'value property' menu, (Shift+A, search for Value, LMB).
>   Connect** the **'Value' menu** to the **'Blackbody Intensity'** by dragging the dot to the
>   property. **Change** the **value** inside the 'Value' property to any number between 10-
>   20.
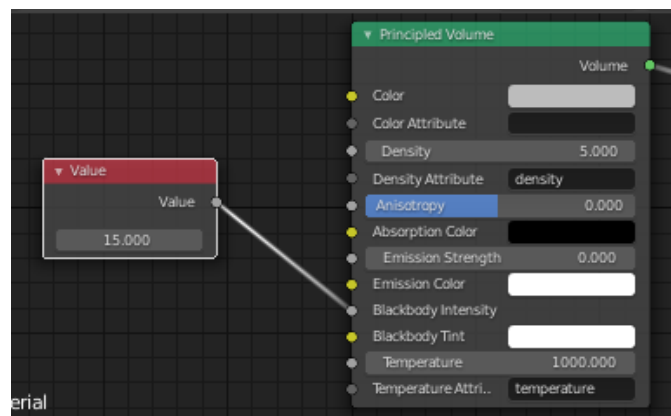
> ➢ You can go back into the **'Layout' view**. With the domain selected, go into the
>   **'Physics Properties'** tab, **check** the **'Adaptive Domain'** and **'High Resolution'.**
> ➢ **Expand** the **'High Resolution'** menu and **change** the **'Resolution Division'** to
>   anything between 2-5.
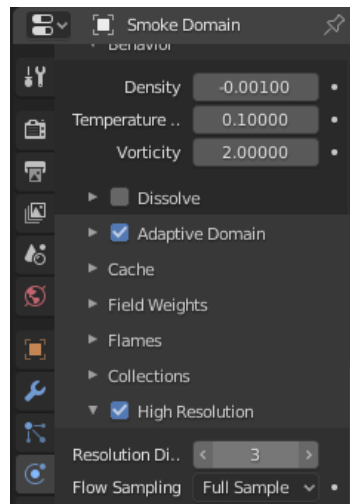
- ➢ **Select both** the Sphere and Smoke (Box) Domain and **rotate along the X-axis by -90°, (R, X, -90)**.
- ➢ **Scale** the **'Smoke Domain' by 1.3m units, (S, 1.3).**
- ➢ **Rename** the **'Sphere'** to **'FlameSphere'**.
- ➢ **Parent** the **'FlameSphere' to the 'Smoke Domain'**.
- ➢ **Expand** the **'Cache'** menu (within 'Physics Properties'), **change** the **'Simulation End'** value to 100 and click **'Bake'.** Let this complete before moving on.

NOTE: You can use this method to add fire and smoke to the **'Thruster'** too if you prefer that than the next step.

Part 5c: Creating the Energy Source for the Thruster

- ➢ In **'Edit Mode'** and **'Face Select Mode', select** the inside face of the **'Thruster'** and **duplicate** the inner hexagon face and **separate by selection** from the **'Thruster', (Shift+D, LMB, P > Selection)**.
- ➢ **Move along the Y-axis by -3m units and extrude by 1m units, (G, Y, -3, LMB, E, 1).**
- ➢ In the **'Material Properties', change** the **'Surface' property** to **'Emission'**. **Select** the colour you would like (I chose **0C008F**) and **increase** the **'Strength' value** to whatever number you desire; I have chosen 50.
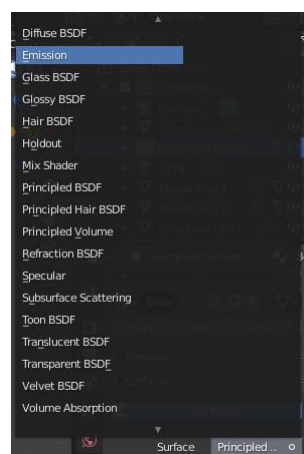
➢ **Rename** the object to **'Thruster Beam Source'.**
➢ You can **parent** the object to the 'Thruster'.
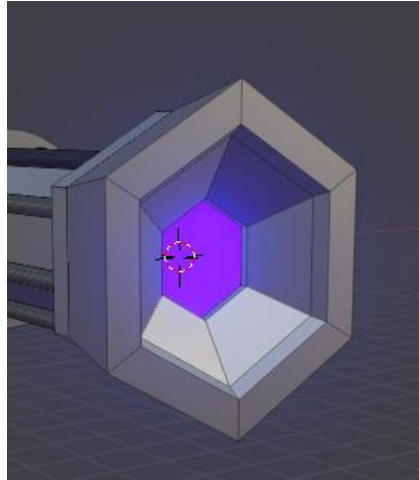

## Part 5d: Creating the Energy Beams for the Thruster

➢ In **'Edit Mode'** and **'Face Select Mode', select** the inside face of the **'Thruster'** and place the 3D Cursor in the middle (**'Cursor to Selected' – Shift+S, 2**).
➢ **Add a circle, (Shift+A > Mesh > Circle). Set** the **'Radius' to 5m** units and **change** the **'Rotation of X' to 90°. Position** the circle accordingly if you need to.
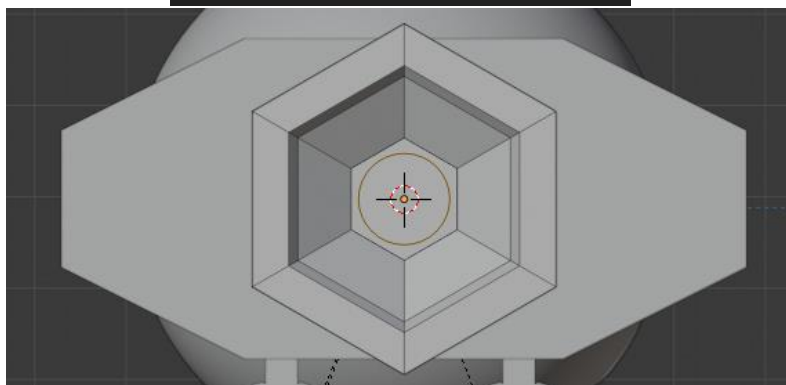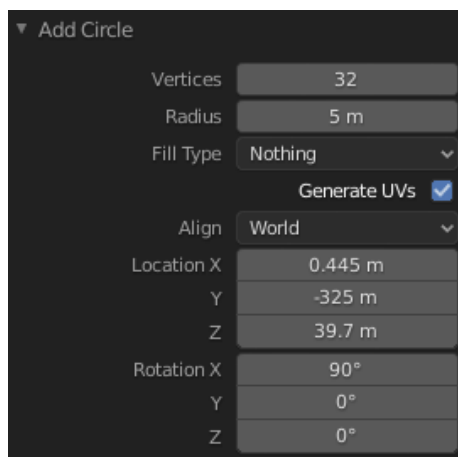
➢ **Extrude along the Y-axis by -55m units, `(E, Y, -55)`. Add 2/3 Edge Loops, `(Ctrl+R, LMB > ['Number of Cuts' = 3])`.**

➢ **Add a 'Subdivision Subsurface Modifier' in the 'Modifier Properties'. Change** the **'Viewport' to 2.**

➢ **Add a 'Wave Modifier'.**

➢ In the top-right of the screen **click 'Options'** and **check 'Origins'.** Using the **'Move Tool'** move the origin to the middle of the object as shown in the screenshot below:
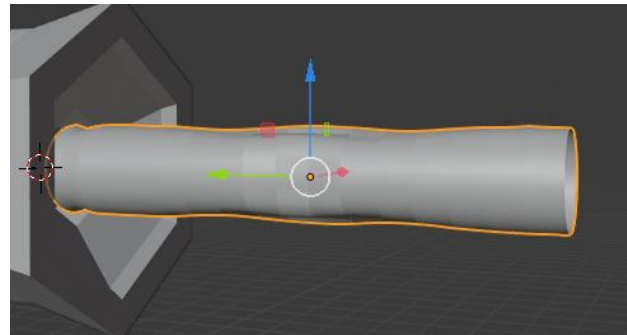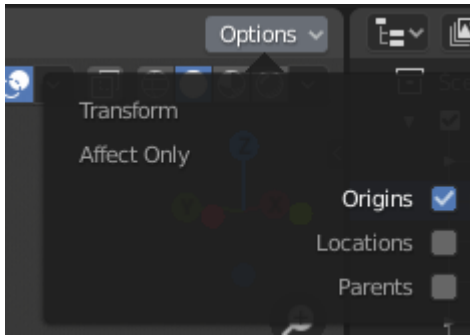
➢ In the **'Wave Modifier' properties, turn on the 'Normals'** and **change** the **'Time:'** to **-50**.
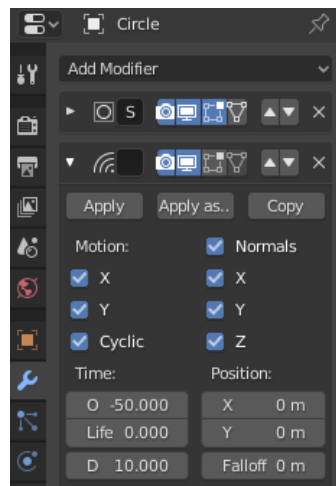

➢ Go to the **'Shading' tab** and switch to **'Rendered' mode `(Z, 8)`** and **create** a new material which should display two properties menus (similar to Step 5a: Fire and Smoke), **delete** the **'Principal BSDF' property menu `(Select Menu > Press X)`. Rename** the material to **'Energy Beam'**. See screenshot below:
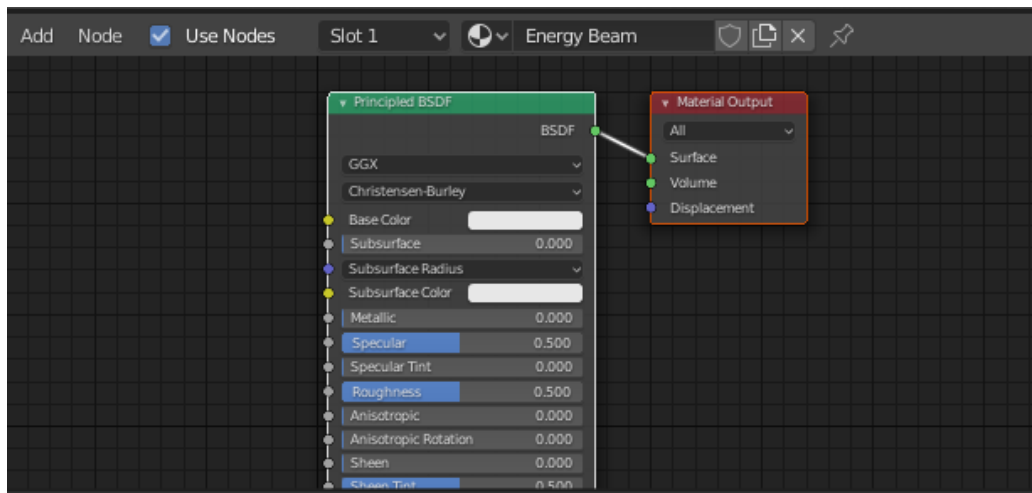
> ➢ **Add** in a **'Mix Shader Node' (`Shift+A > Search`)** and **conset nect** the **'Shader'** value to the **'Surface'** of **'Material Output'**.
> ➢ **Add a 'Transparent BSDF' node** and **connect 'BSDF'** to the first **'Shader'** value of **'Mix Shader'**.
> ➢ **Add an 'Emission' node** and **connect 'Emission'** to the bottom **'Shader'** value of **'Mix Shader'**. In the **'Emission' node**, **select** the colour you want and **change** the **'Strength'** value to **10**.

Your nodes should look like the screenshot below:
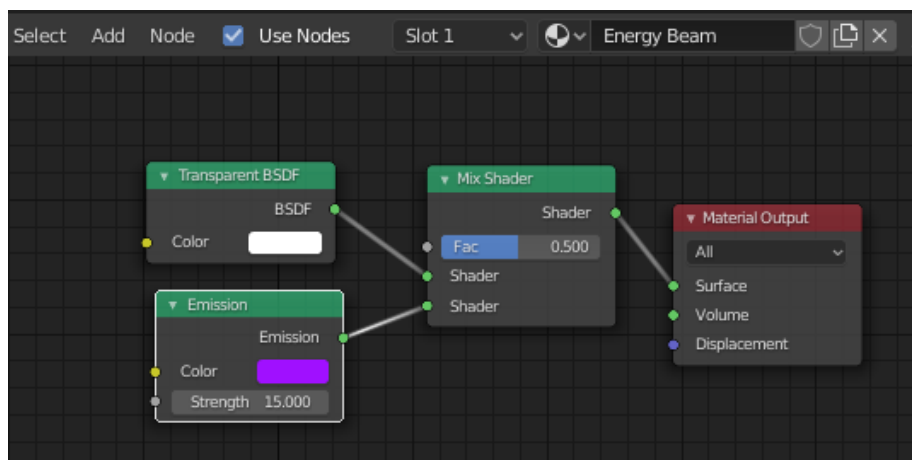
> ➢ **Add a 'ColorRamp' and 'Noise Texture' node.**
>   ○ **Turn on 'Node Wrangler':**
>   ○ **Edit > Preferences > Add-ons tab** > Search for **Node Wrangler** to enable it.
> ➢ Click on **'Noise Texture'** and **Press Ctrl+T.** This will add a **'Mapping' and 'Texture Coordinate' node.**
> ➢ **Connect** the **'Object'** from **'Texture Coordinate'** to **'Vector'** in the **'Mapping' node.**
> ➢ **Connect** the **'Colour'** value from **'Noise Texture'** to the **'Fac'** in the **'ColorRamp'**.
> ➢ **Connect** the **'Colour'** value from **'ColorRamp'** to the **'Fac'** in the **'Mix Shader'**.
> ➢ **Adjust** the **Black slider** from the **'ColorRamp'** to just over half way until you see some noise.

➢ **Change** the **'Scale'** value in the **'Noise Texture'** to **1.5. Change** the **'Detail'** value in the same node to **15**. **Change** the **'Distortion'** in the same node to **2**.
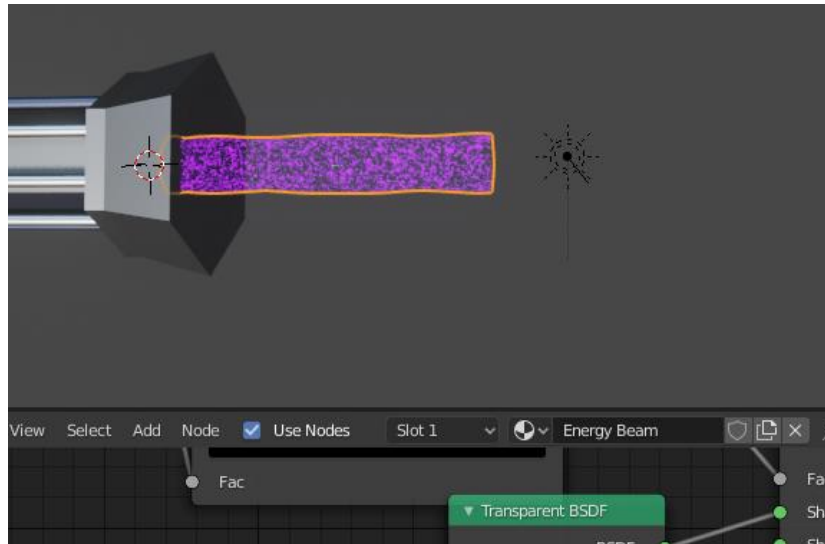
Your nodes should look the screenshot below:
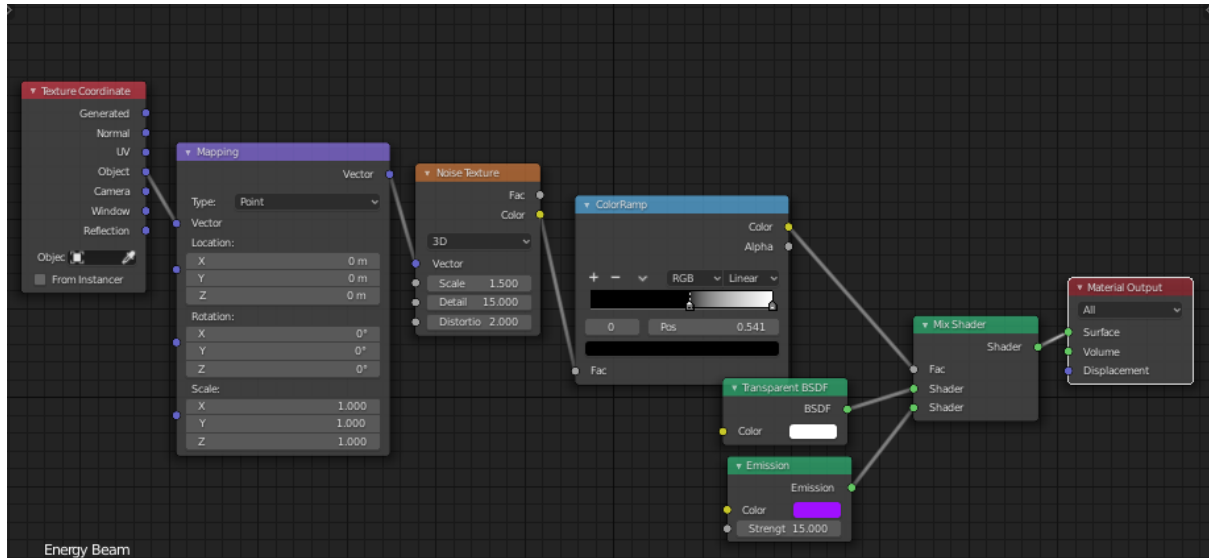
➢ **Press N** to bring up the **settings menu** and **click 'Options'. Change** the **'Blend Mode'** to **'Alpha Blend'. Change** the **'Shadow Mode'** to **'None'.**
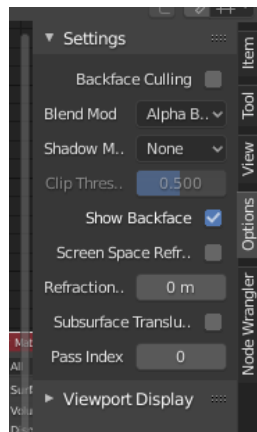

➢ In the **'Mapping'** node, **change** the **'Location of Y:'** a value of your choice, I have input **50m.**
➢ **Rename** the **'Circle'** object to **'Energy Beam'.**

- ➤ **Duplicate** the **energy beam** and **scale it down along the Z-axis** until you are pleased with it**, (Shift+D, LMB, S, Z)** and make sure to **duplicate the material** by clicking the **'New Material'** icon (highlighted in red in the screenshot below). **Change** the **'Emission Colour'** to a Hex value of **FFCCCC** and **change** the **'Strength'** to **30**.
- ➤ **Rename** the duplicated object to **'Inner Energy Beam'**.
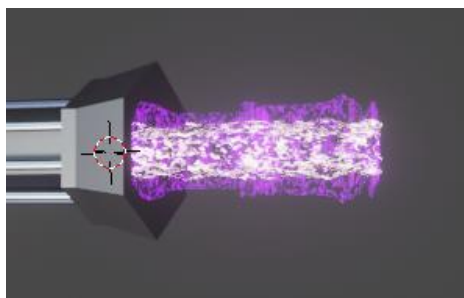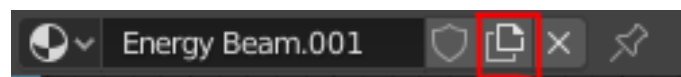
- ➤ **Duplicate** the **'Energy Beam'** once more and repeat the above steps but scale it so this becomes an outer energy beam and **change** the colour **(FF6307)** and **increase** the **'Strength'** to any number greater than 40.
- ➤ **Rename** this duplicated object to **'Outer Energy Beam'**.
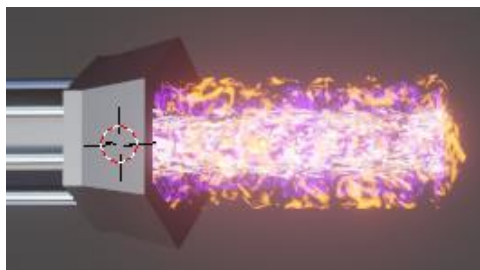

Adjust any of the settings as you wish to create your own flame, if your energy beam looks flat from a different angle, then rescale it and change the scaling of each energy beam so the colours are not mixed or overlapping.

➢ Lastly, **parent** the **'Energy Beam', 'Inner Energy Beam' and 'Outer Energy Beam'** to the **'Thruster'**.

Part 6a: Adding Colour to the Spaceship

➢ In **'Object Mode' select the 'Command Support' object of the spaceship** and go to the **'Material Properties'** tab.
➢ **Add a material** and under **'Use Nodes'** in the **'Surface'** tab, **change** the **'Metallic' value to 1** and **change** the **'Roughness'** to **0.4 or 0.5**.
➢ **Choose** the Base Colour of Hex Value **959595** and **rename** the material to **'BodyColour'.**
➢ Go into the material properties for the following objects and apply the body colour to them using the dropdown list shown in the screenshot:
   o Command Sphere
   o Support Rod
   o Propulsion Unit
   o Thruster
   o the Missiles and the Missile Rings
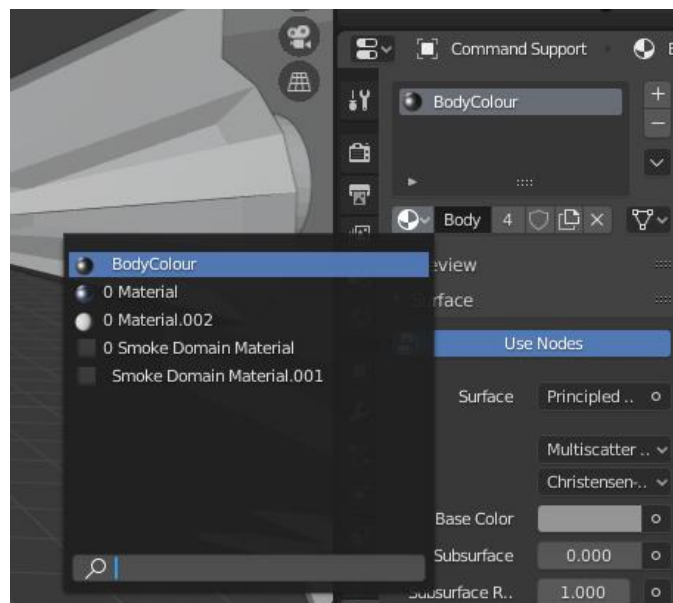
➢ **You can add accent colours to parts of the spaceship and follow the same process as stated above, I have used the Hex value C30300. Rename the material to 'Accent1'.**
➢ **You can also use a second Accent colour if you wish such as Hex value ACB9E7 or 44495C, but <u>feel free to add any colour to the spaceship wherever you would like to.</u>**

NOTE: Feel free to play around with colours as you wish, and you can implement the glow effect around the Spaceship too following the next step.

## Part 6b: Adding a Glow Effect to Command Sphere Window

➢ In **'Material Preview' (Z > 2 [Material Preview]), 'Edit Mode'** and **'Face Select Mode', select** the **inner faces.**
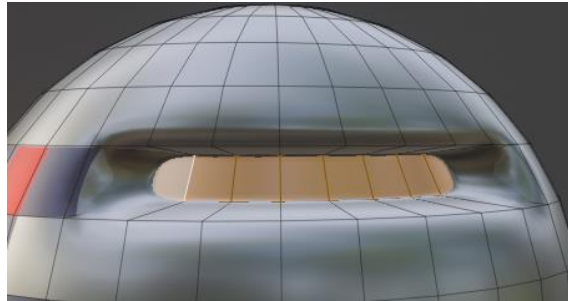
➢ **Duplicate** the faces and **separate by selection** from the **'Command Sphere', (Shift+D, LMB, P > Selection).**

➢ In the **'Material Properties', change** the **'Surface' property** to **'Emission'**. **Select** the colour you would like and **increase** the **'Strength' value** to whatever number you desire.
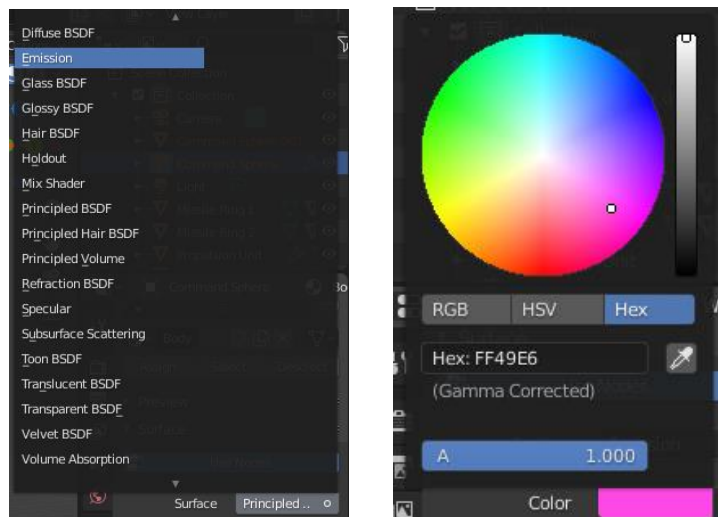
➢ Click on **'Render Properties',** make sure the **'Render Engine'** is selected to **'Evee'** and **check** the **'Bloom' property.**
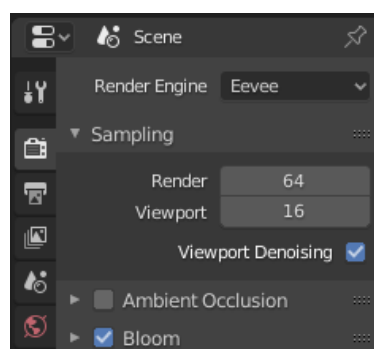

➢ **Parent** the object to the **'Command Sphere'** and **rename** the object to **'Window Light'**.
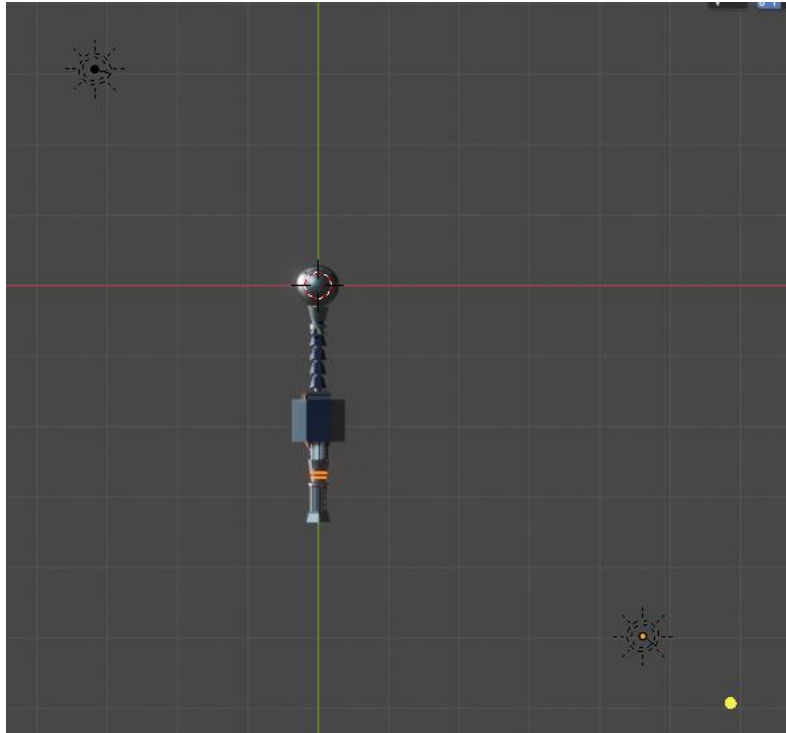
Part 7a: Setting up the Lighting

➢ In **'Material Preview' (Z, 2), select** the light object, **change** it to **'Sun' light** in the **'Object Data Properties'** panel. **Set** the **Hex colour** value to **FFF1E7, 'Strength' to 100** and **'Specular'** to **0.5**. **Adjust** the values as you see fit. **Move** it to right side of the Spaceship, as shown in the screenshot below:
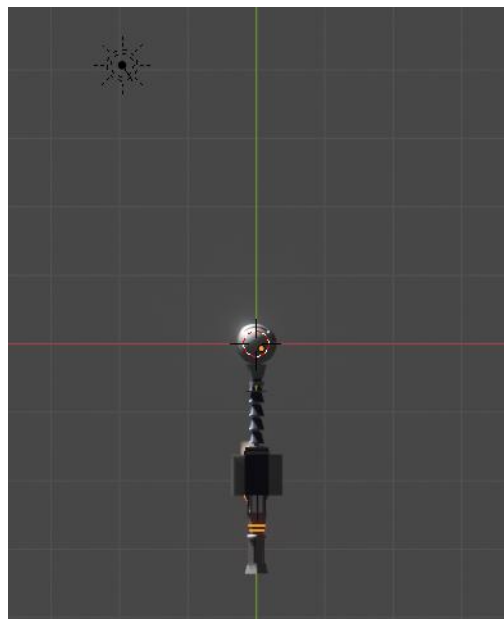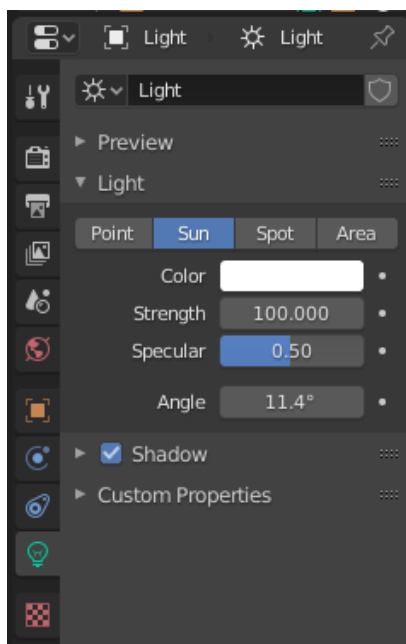
➢ **Duplicate** the light object and **move** it to the opposite corner. You can use the yellow dot on the light object to change the angle. You can adjust the values to fit your scene. I have applied a dark blue colour to contrast the light and hue from the opposite side.
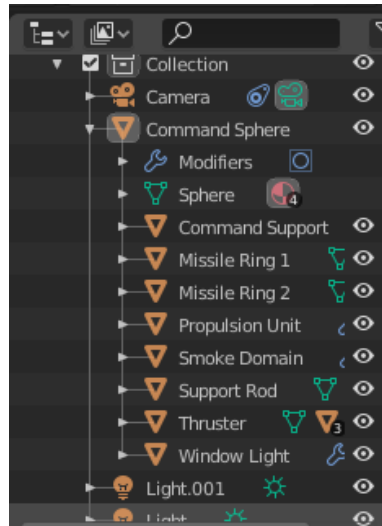
> In **'Rendered View' (Z,8), preview** what the lighting result will look like.
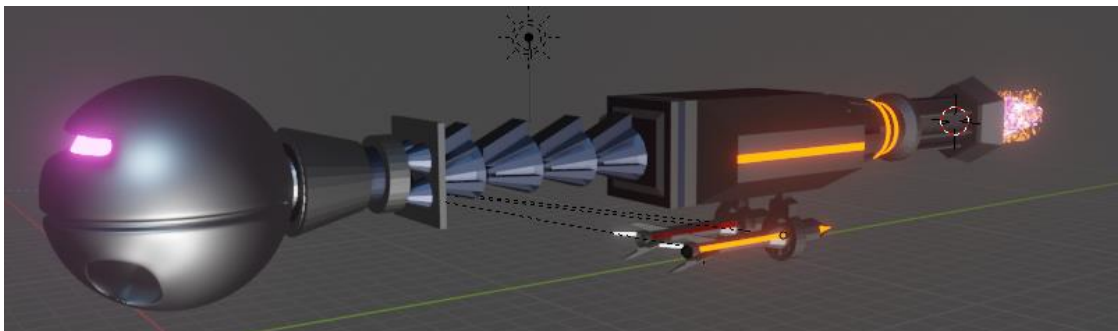
Part 7b: Setting up the Camera

> **Parent** all other objects except the **'Command Sphere'** to the **'Command Support'.**

- ➢ **Move** the camera to an angle you want, you may have to rotate the camera too. If it helps you can scale down the entire Spaceship.
- ➢ **Add** a **'Track To Constraint'** in the **'Object Constraint Properties'** and **set** the **'Target'** to **'Command Sphere',** the **'To:'** value to **'Z'** and the **'Up'** value to **'Y'.**
    - o **Feel free to create a path for the camera to follow instead of tracking or maybe do both, you could use multiple cameras.**
- ➢ **Also change** the **'Camera Object Data Properties',** set the **'Focal Length'** to **10mm.**
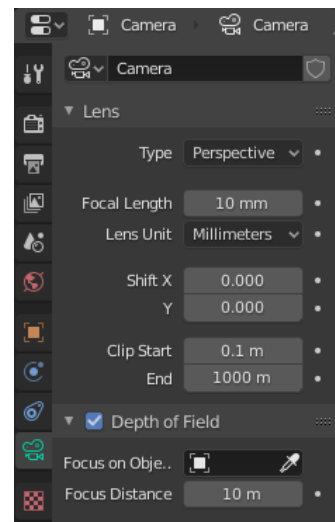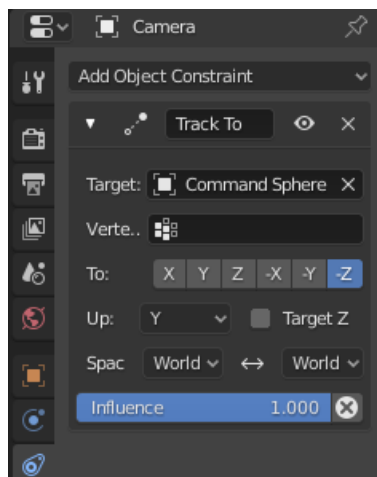

- ➢ **Press NUM0** to preview the camera and scene view, adjust if required:
    - o **Think about rotation, scaling and the axis you want the camera to move along.**

Part 7d: Adding in a Background Texture

If you would like to, you can add in a background texture of your choice. I have used this background texture: http://www.littlewebhut.com/images/backgroundstars.jpg.

To apply the background texture to the scene:

➢ Go to **'World Properties'** and click the dot next to the **'Color'** property and select **'Environment Texture'** from the list.
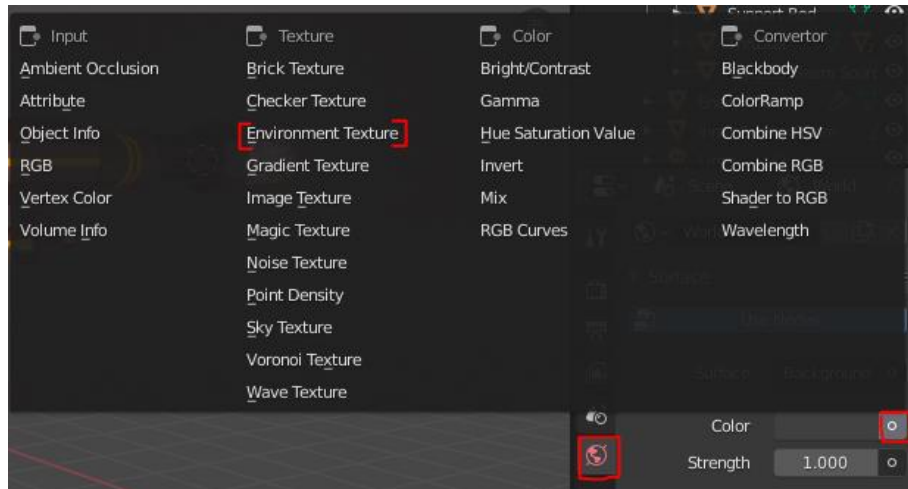

➢ Click the folder icon and locate your background texture.
➢ **Change** the **'Strength'** value to a value you are satisfied with, I have chosen 0.1.
➢ To view the background, **change** your viewport into the **'Rendered'** view `(Z, 8)`.

Your background should be applied and now finally onto the animation!

Part 7e: Adding in Audio

➢ **Change** to the **'Video Sequence Editor'** and go to **'Add' > Sound > Locate Audio File.**
➢ You can do this step after your animation to avoid hearing the music constantly.
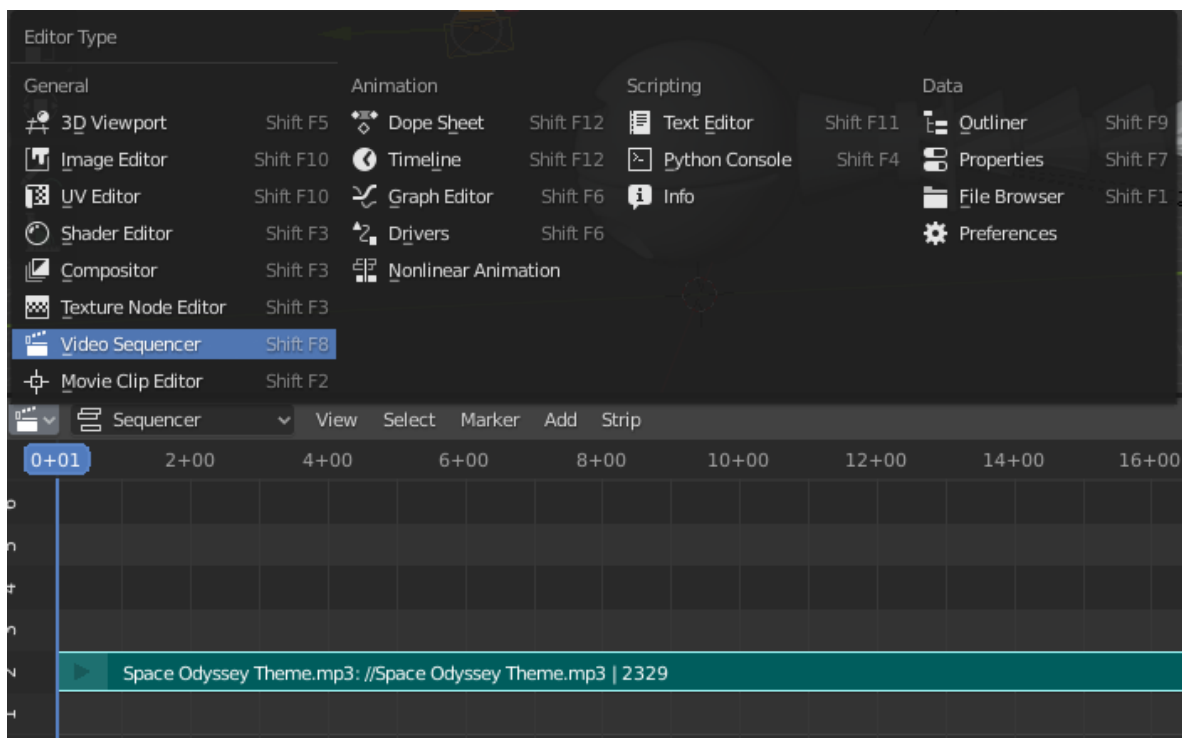
Part 8: Animating the Spaceship

After the lighting and camera has been setup, we will now animate our object.

In the **'Options'** menu (top-right), **deselect 'Origins'** as we checked the box in **'Part 5c'.** This will allow us to move objects around to animate, otherwise you will only be able to move the origins set for each object which won't allow any object movement**.**

Remember if you need more frames in your animation, adjust the settings in the '**Output Properties'.**

➢ If you would like the camera to follow a path, you can add a circle or Bezier curve **(Shift+A > Curve)** and **parent** the object to the camera and **select 'Follow Path'.**
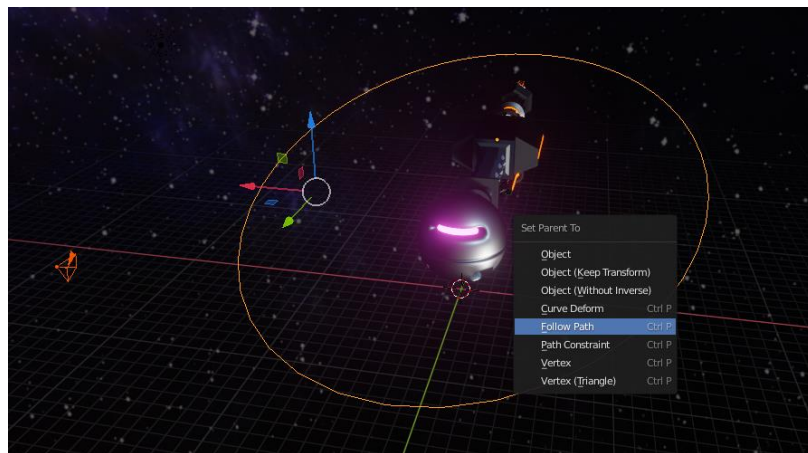

**I will be moving the camera using keyframes which I will now explain:**

➢ Click on the **'Animation'** menu tab.
➢ Click on the camera object and **Press I** to add a keyframe and **select 'LocRot'** to record the location and rotation of the camera. <u>Make sure to select a new frame for every new movement or animation and then insert the keyframe.</u>
➢ **Move** the camera again to your desired location and rotate to keep the Spaceship in view and follow the step above and place a keyframe at **around 24 frames**. **Press NUM0** to preview the camera view and angle before adding a keyframe.
➢ **Continue** to repeat this step until you reach the starting point of the camera's original location.
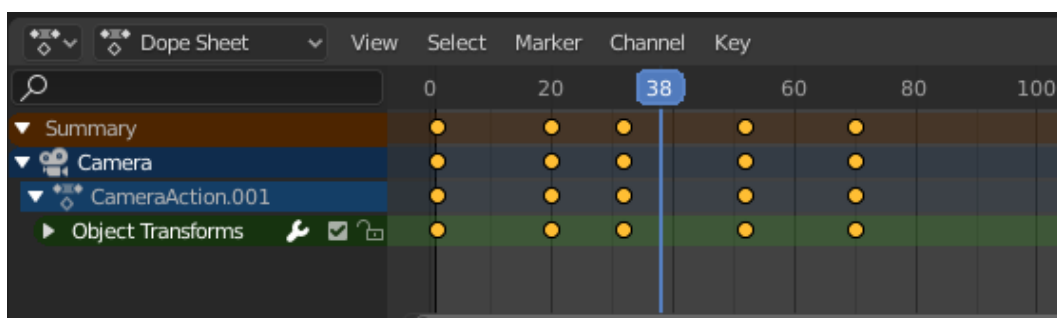
➢ For my animation I will add a keyframe at around frame 38 to launch one of the missile rockets. **Click** on the **rocket** object and **insert a keyframe** to record the **'LocRot'.** Click on a few more frames ahead and move the rocket and **insert a keyframe**. I will continue this until the rocket is out of view and then allow the rocket to circle round back to its position once the camera has gone around the entire Spaceship. This will be around the 190th frame.

➢ Around the 250th frame, **move and rotate the entire Spaceship along the Y-axis (you will have to select all objects [Select Hierarchy from Command Support and then Shift+LMB on the Command Sphere Object in the world space]).** Pan the **camera to change its angle** to view the Spaceship fly off, this will last until the 327th frame.
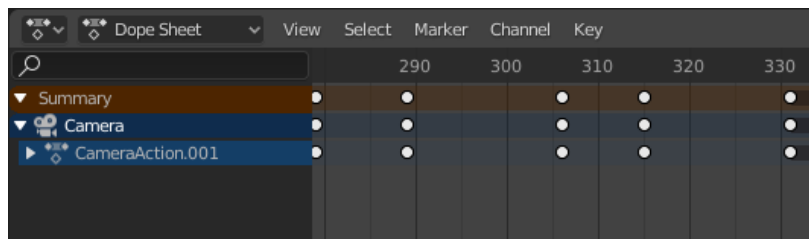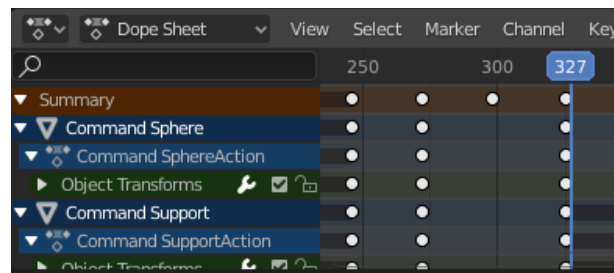
➢ Then around the 290th frame **move** the camera to view the front of the Spaceship.

➢ Straight after the 327th frame, detach (move) the **'Command Sphere'** towards the camera's position and rotate and spin on whichever axis you want to add some depth to the animation until the 430th frame.

➢ After that move the **'Command Sphere'** out of view and bring it back to attach to the Spaceship again, this should end around the 505th frame.
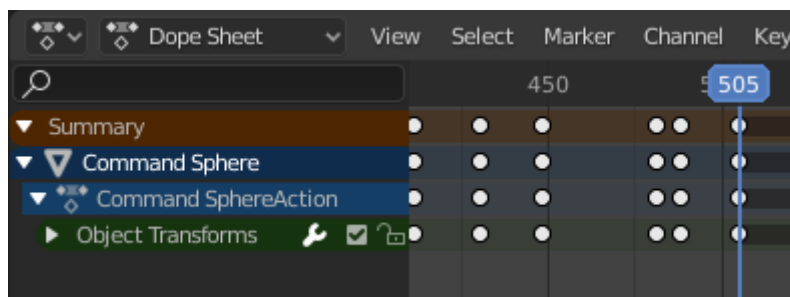
➢ Repeat the process to return the entire Spaceship back to its original position and ensure the camera follows the path. You can use a **'Follow Path'** based on a curve or you can use keyframes with a **'LocRot'** keyframe**.** This final part of the animation should take you up to around 650 frames.
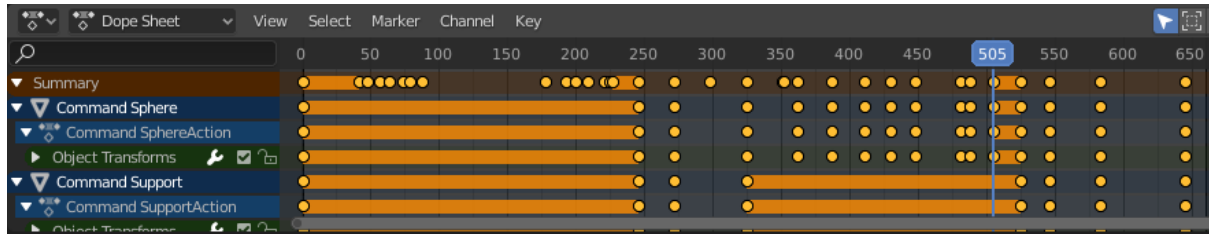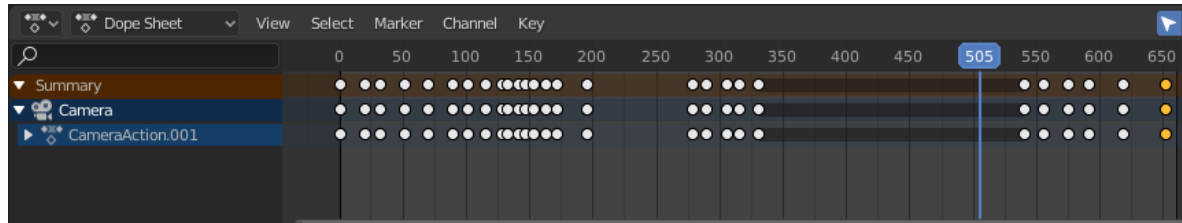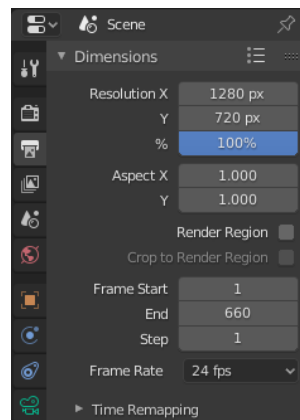
Part 9: Exporting and Rendering

Finally, we have completed the model and created an animation!

Now all we need to do is **export and render**.

- ➤ Check the settings in the **'Output Properties'** and if you need to do so change the **Resolution**.

- ➤ In **'Output'** section **set** the folder location of where you want to export the rendered animation.
- ➤ Make sure you **change** the **'File Format'** to **'FFMPEG Video'**.
- ➤ In **'Encoding'** expand the **'Video'** and **'Audio'** properties and make sure the settings are correct.
- ➤ For the audio to be included expand the **'Audio'** property and set the **'Audio Codec'** to **MP3** or whatever format your audio is in.
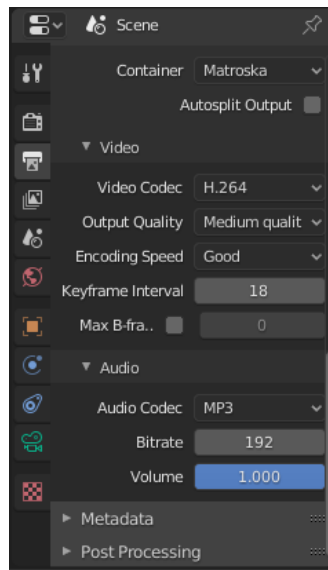
➢ **Click Render > Render Animation.**

The render may take some time but once it is complete you are finished and can view your video in your folder location!