



Design out the box

Time 60-90 mins approx

Level of difficulty ★★★★★

Lesson Objectives...

- To understand the basic tools used in SketchUp.
- To understand the advantages of using CAD
- To be able to successfully use CAD independently to complete a range of tutorials in 2D and 3D
- To develop advanced skills and problem solving skills when using Sketch Up
- To use correct dimensions when using sketch up to draw models that can be 3D printed or manufactured using CAM machines in school (i.e. Laser Cutter, 3D Router).

Lesson Outcomes...

By the end of this tutorial you will be able to...

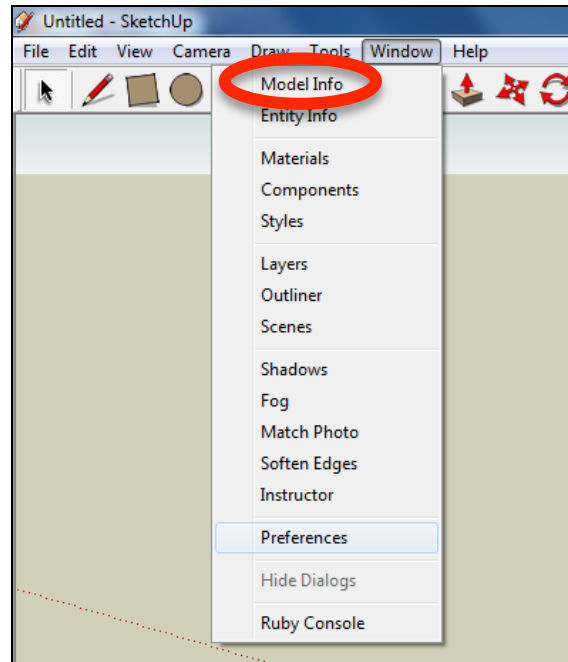
- Use the push pull and move tool
- Learn about centre lines
- Create, Move and Rotate components
- Use the offset tool to make objects and add detail
- Shape and form your design
- Draw your design to the correct size to enable it to be manufactured.

Skills to be used in this project...

Basic Skills	New and Higher Skills
Zoom tool	Rotate tool
Orbit tool	Move tool
Pan tool	Offset tool
Line tool	Arc tool
Rectangle tool	Follow Me tool
Circle tool	Paint Bucket tool
Eraser tool	Dimensions tool
Push/Pull tool	Making Components

Basic skills are those required to do very basic drawings and are detailed as part of this presentation.

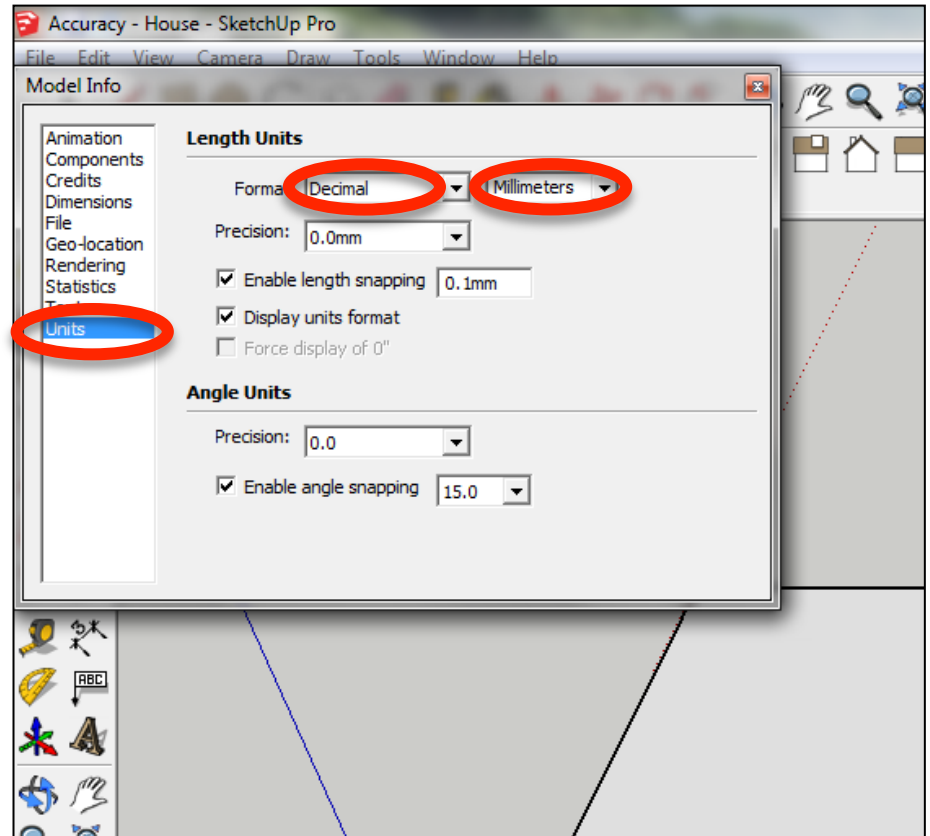
New and higher skills may be new to the novice and are the focus for learning in this presentation.



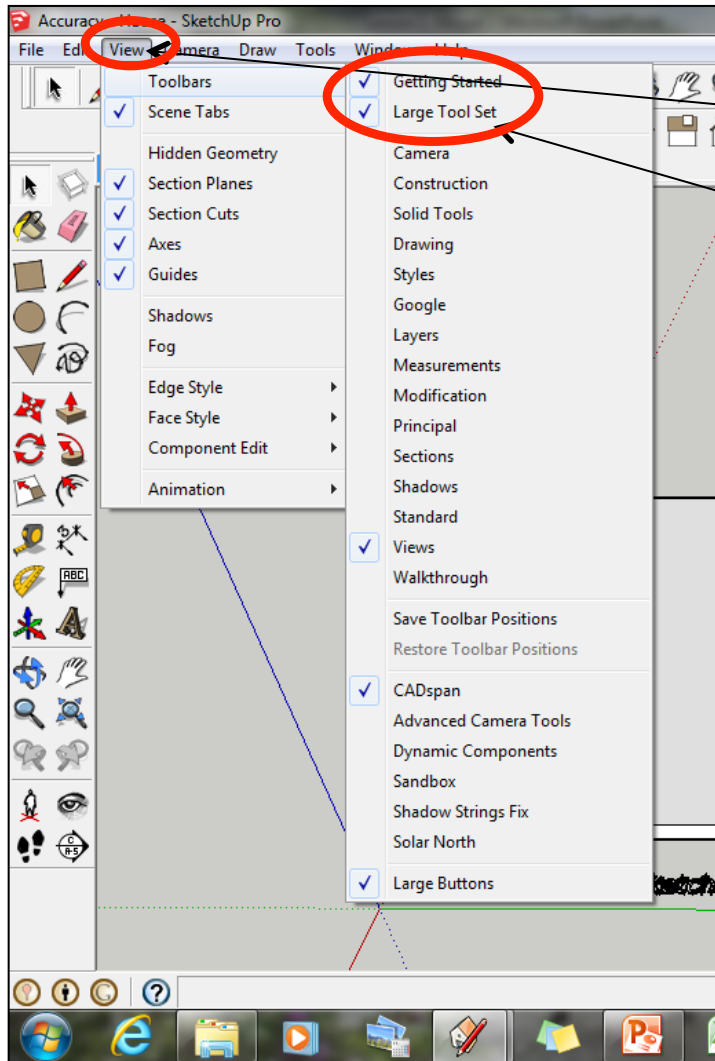
1. Open the sketch up drawing. Once you have opened SketchUp, go to **Window** and select **Model Info**

2. Select **Units** and choose **Decimal Millimetres**. We are using this template because we are doing a product design.

Note: *It is often necessary to start a new file to use the new template. Go to **File** then **New**.*



3. Now select the **View** then **toolbars** and ensure **Getting Started** and **Large Tool Set** are ticked



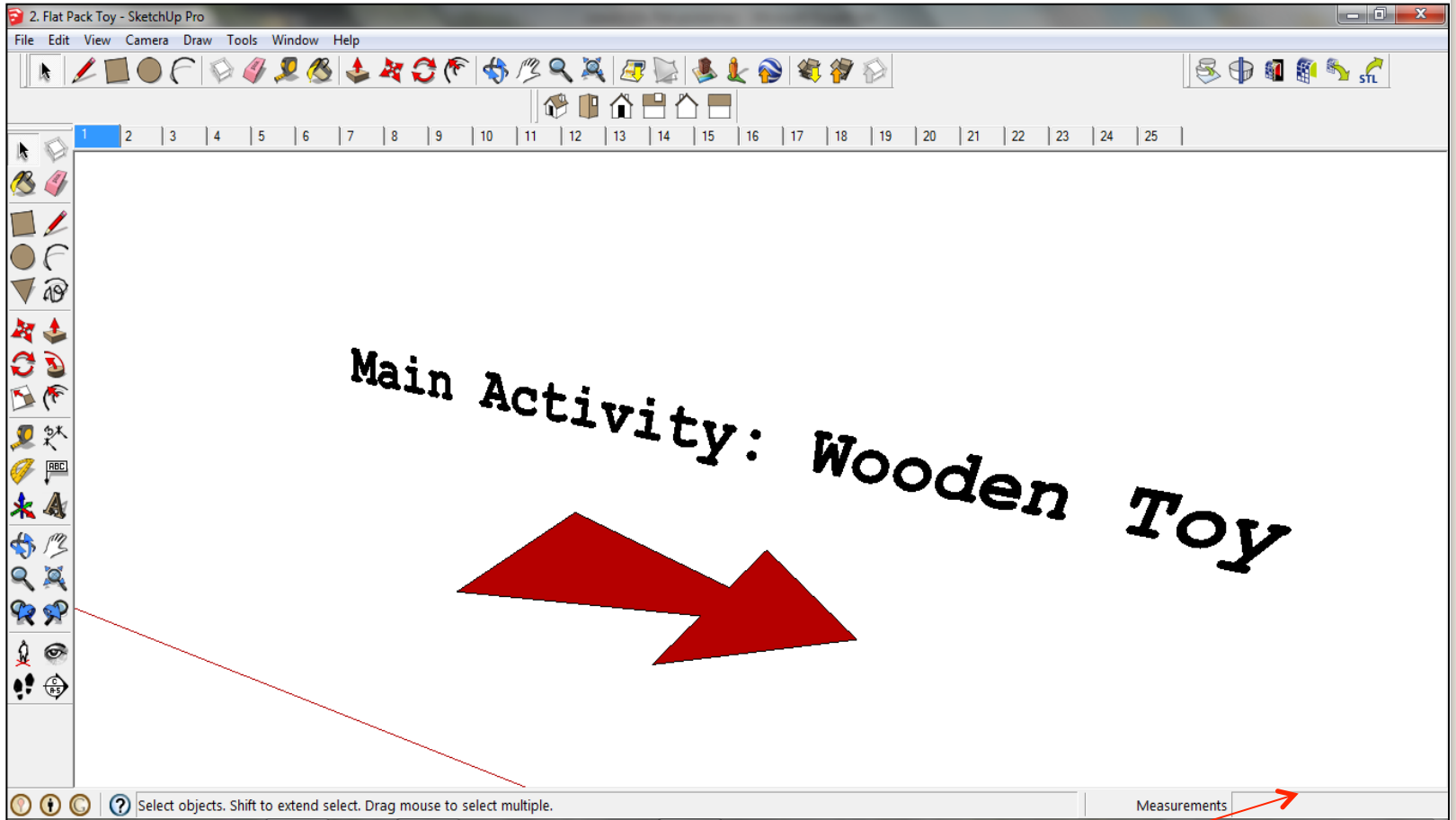
3a Select **View**

3b Tick Getting Started

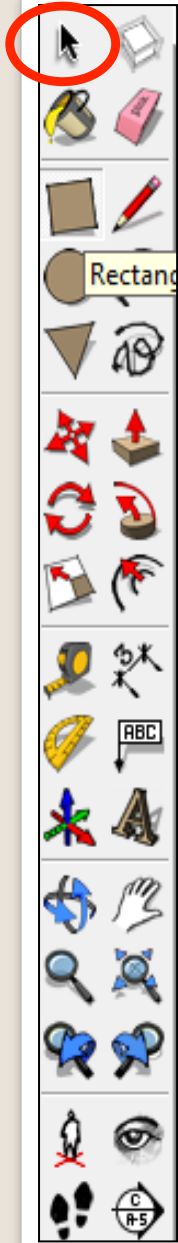
3c Tick Large Tool Set

Note: this will place a tool bar across the top (**getting started**) and the side (**Large Tool Set**)

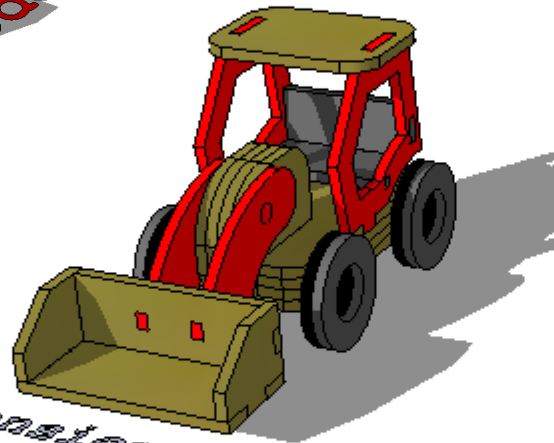
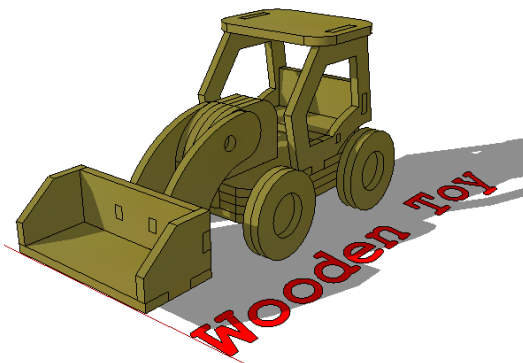
4. Ensure you can see the measurements / dimensions / tool bar in the **bottom right hand corner**. If not click on the **middle square** top right hand corner until it appears



Measurements tool bar

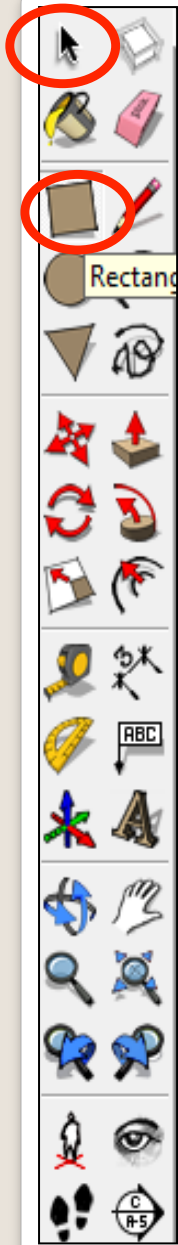


5. Click on **Scene 2**. In this tutorial you are going to design and engineer a 4mm laser ply wooden toy. This tutorial builds upon the skills of the starter task and the tutorials that you have completed so far. Once complete you can then design your own from 4mm laser ply and manufacture it. **Click on scene 3 & then 4.**

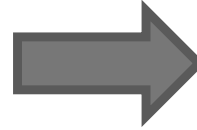
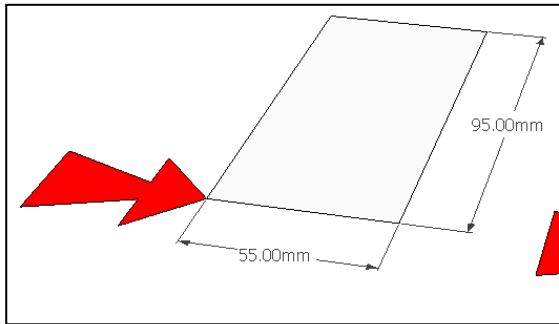


*Extension Task:
Photo Realistic Render*

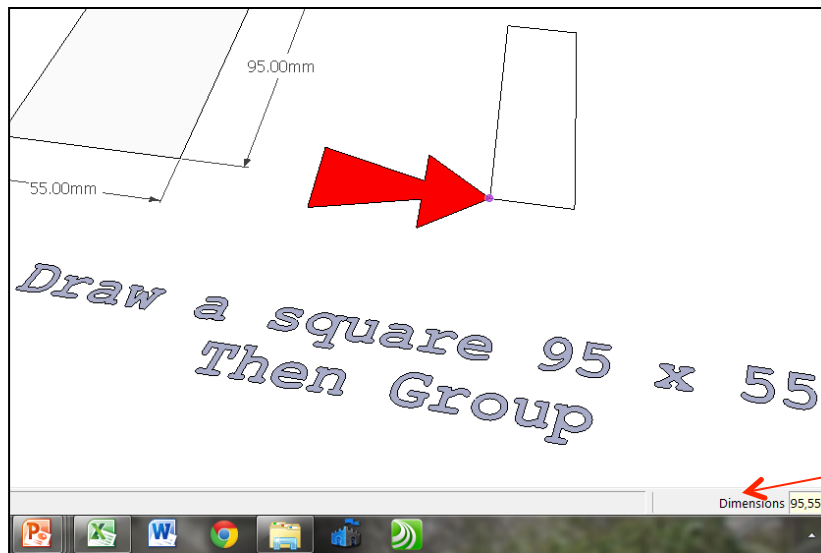
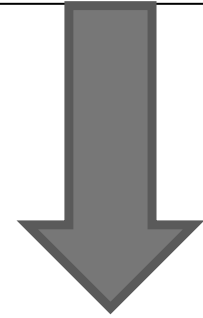
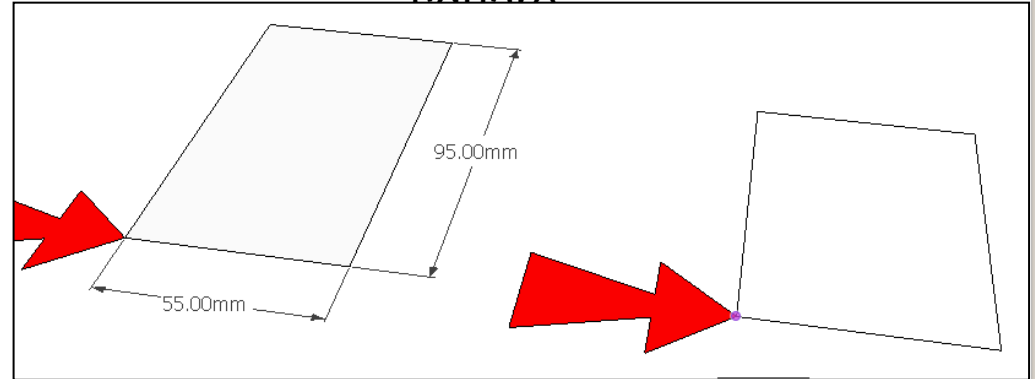




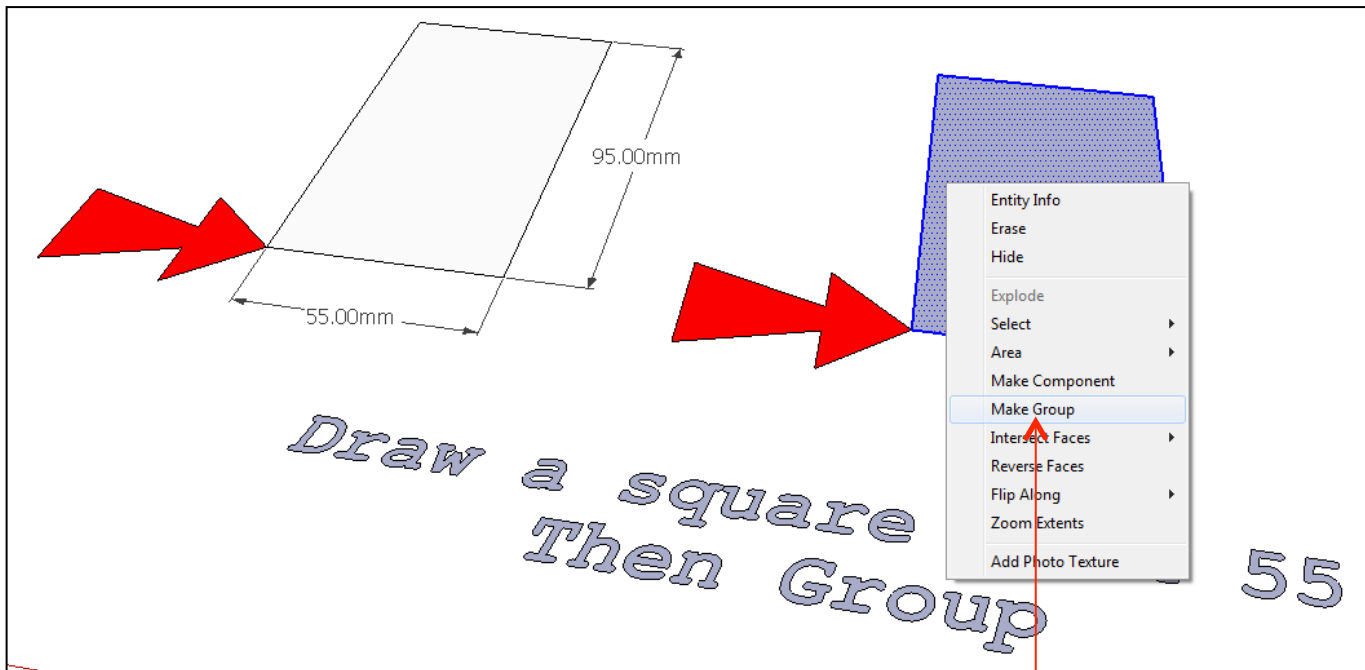
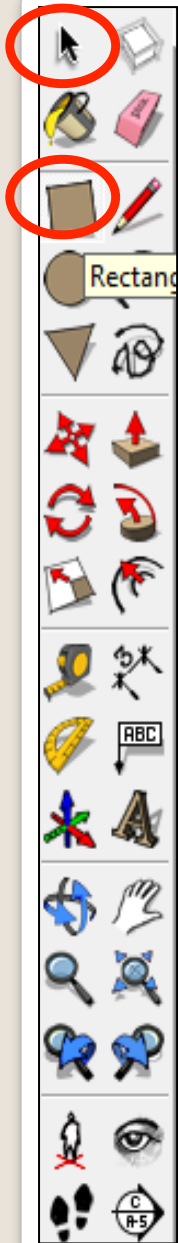
6. Click on **Scene 7**.



7. Click on the **square tool** and then the end of the arrow to start drawing a **square**.

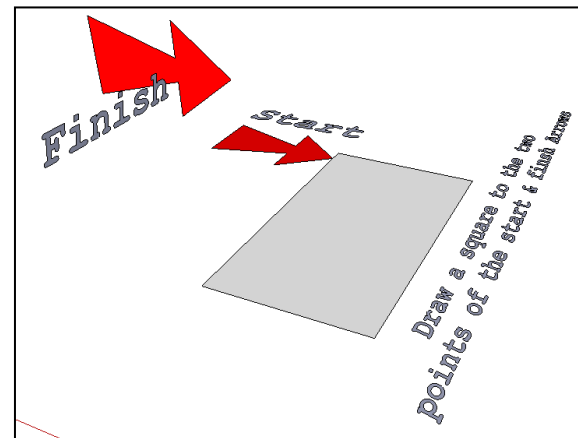


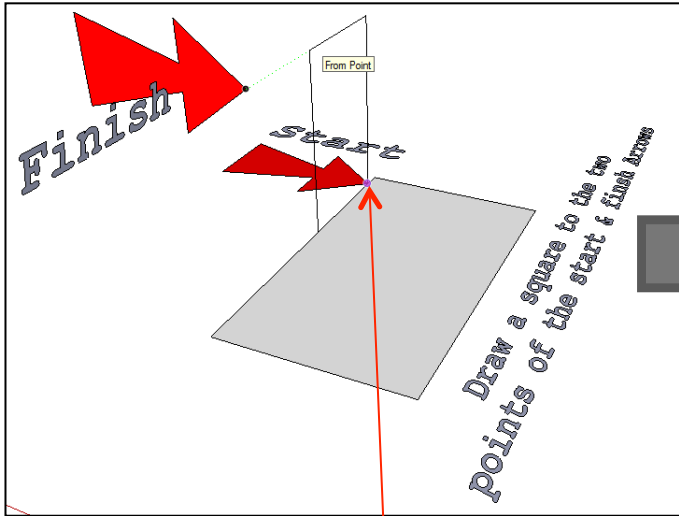
8. Start typing **95,55** and then press **enter**.



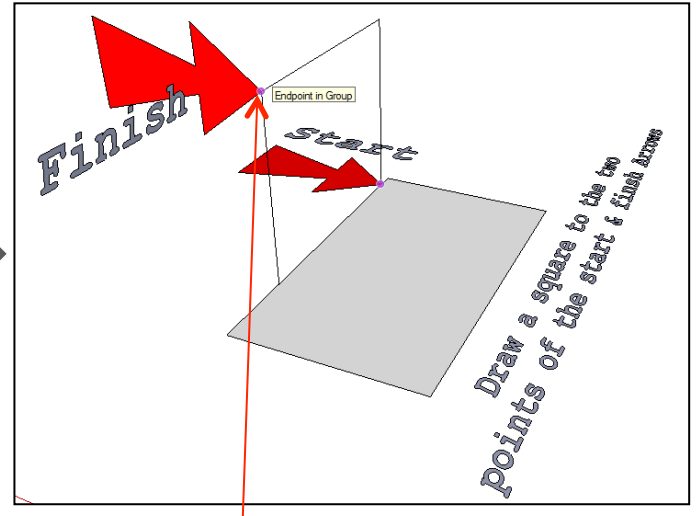
9. Click on the rectangle until its all highlighted. Right click the mouse button and make group.

10. Click on **scene**
8

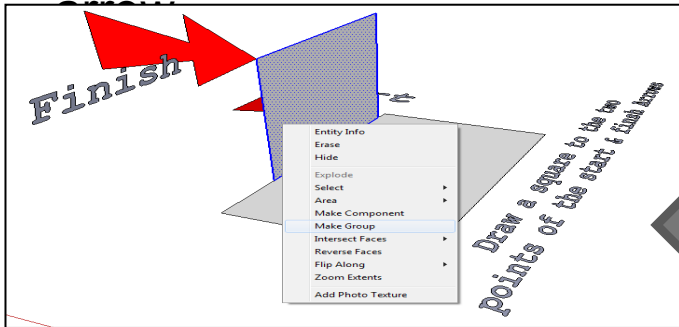




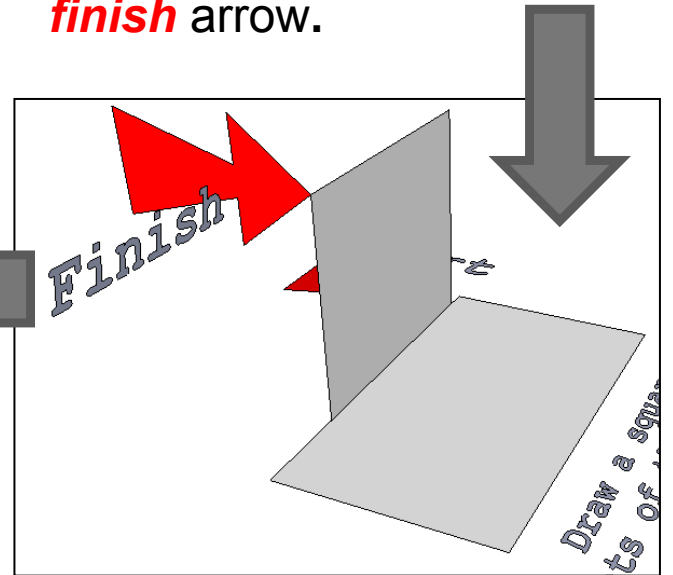
11. Click on **rectangle tool** and then ON the end of the **start**

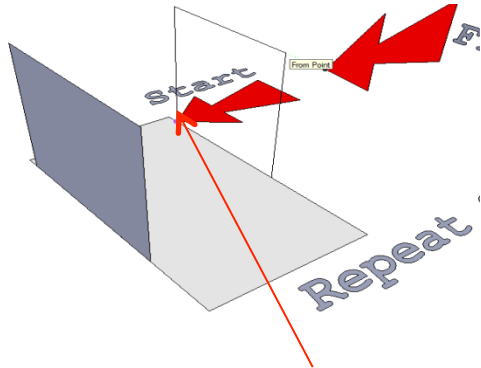


12. Click on the end of the **finish** arrow.

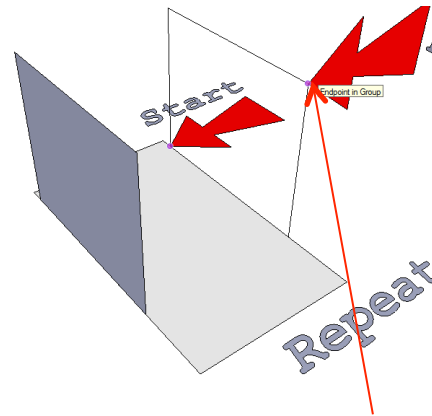


13. Click on the rectangle until its all highlighted. Right click the mouse button and make group.

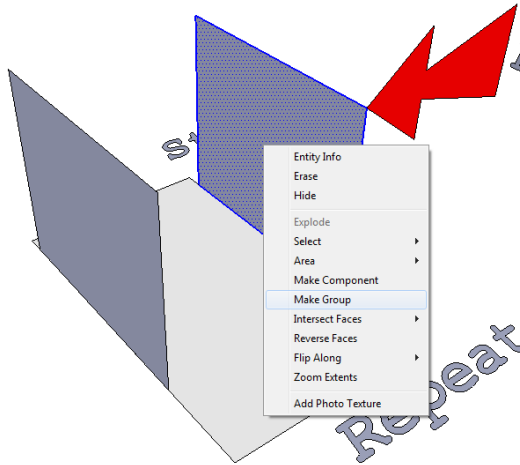




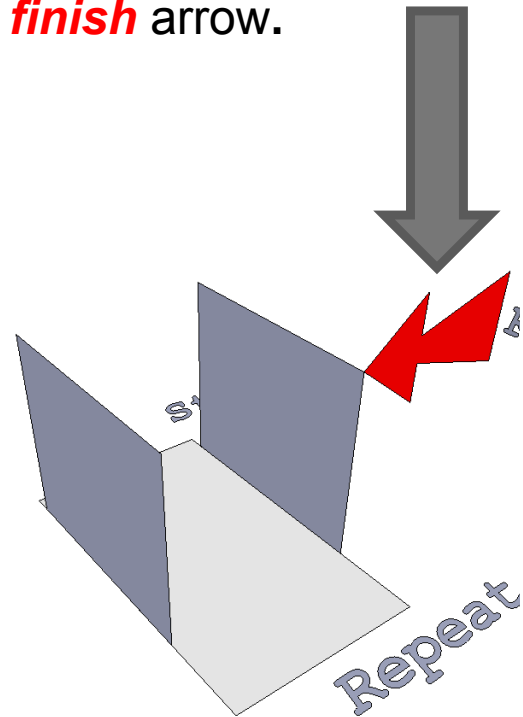
14. Click on **scene 9**. Click on **rectangle tool** and then ON the end of the



15. Click on the end of the **finish** arrow.

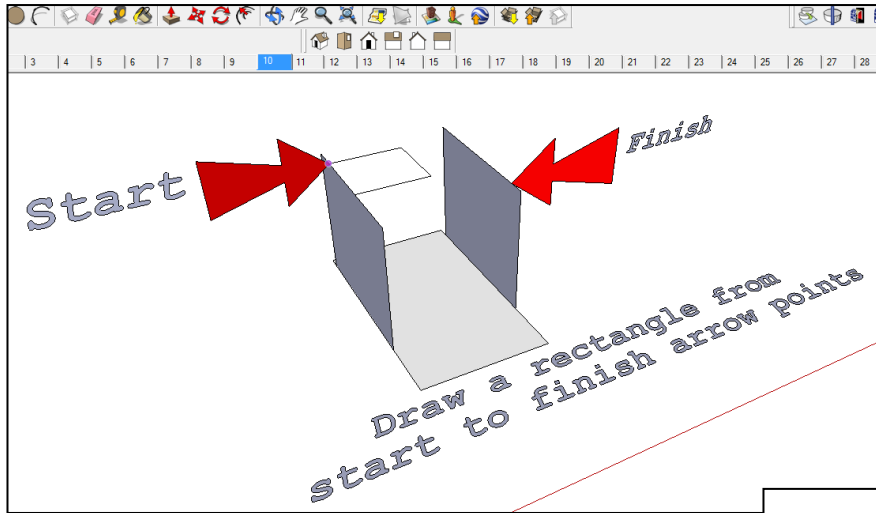


16. Click on the rectangle until its all highlighted. Right click the mouse button and make group.

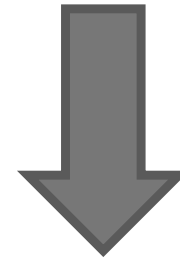




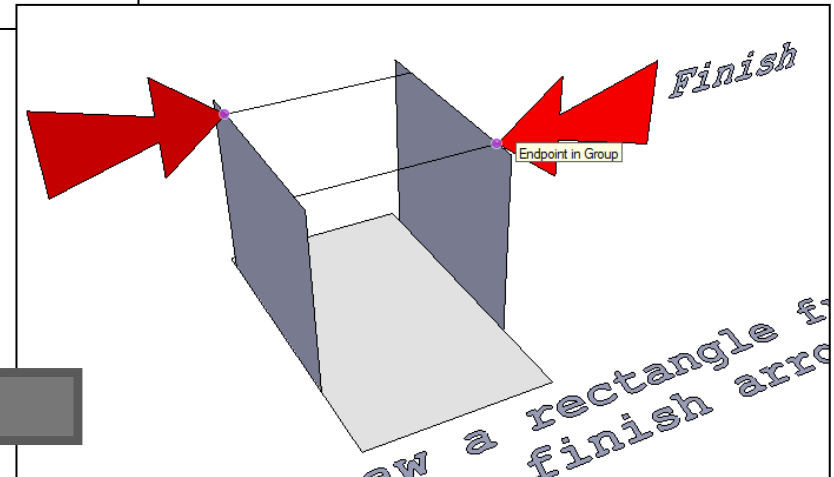
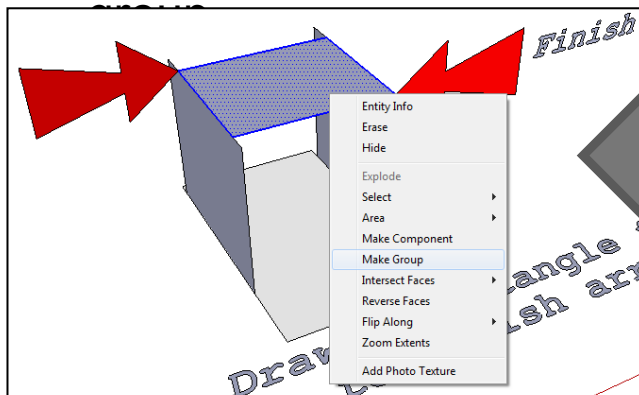
17. Click on **Scene 10**



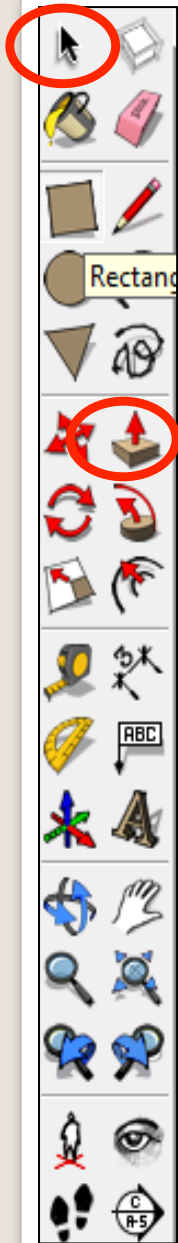
18. Click on **rectangle tool** and then ON the end of the **start** arrow.



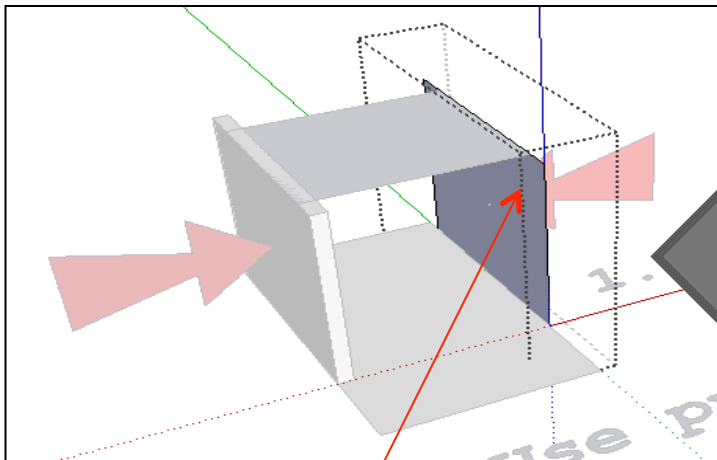
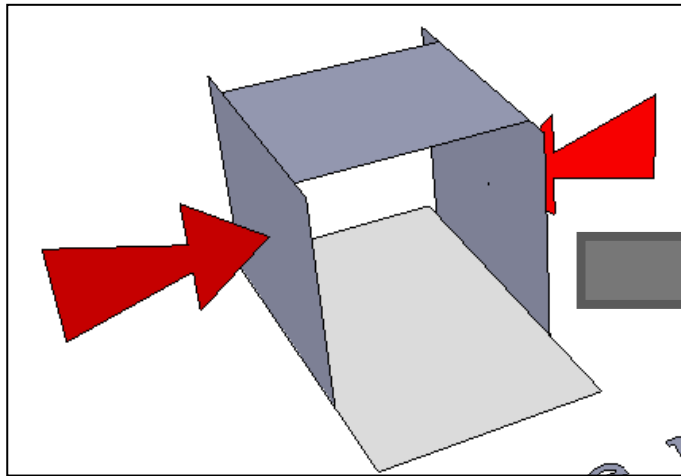
20. Click on the rectangle until its all highlighted. Right click the mouse button and make



19. Click on the end of the **finish** arrow.

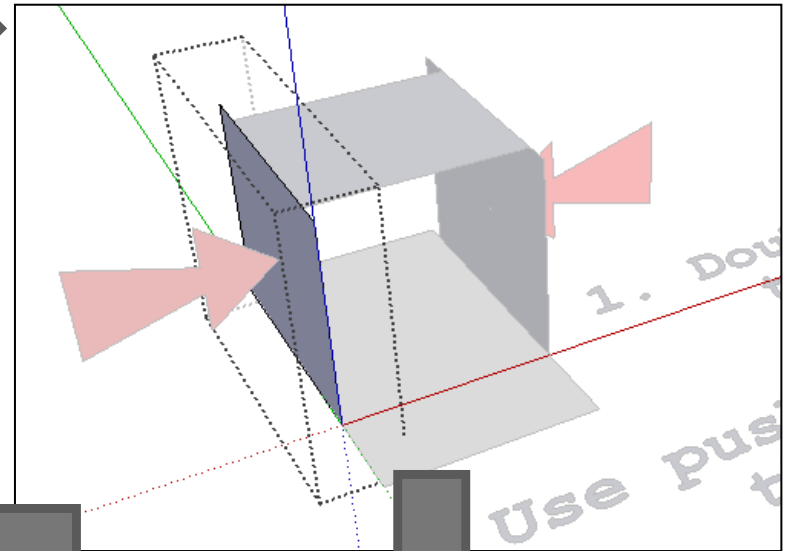


21. Click on **Scene 11**.

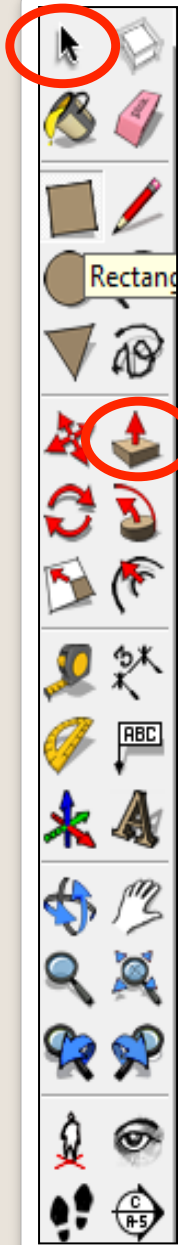


24. **Repeat** steps **22 & 23** on the opposite component.

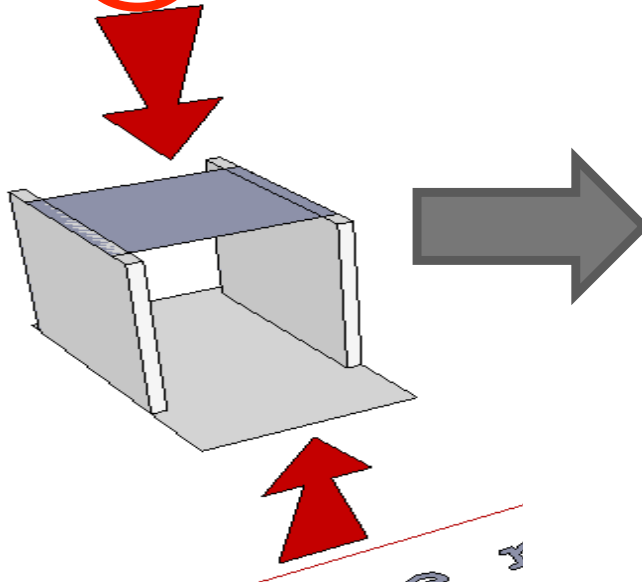
22. Double click on the side piece to **edit**. Everything should grey out and a dotted rectangle should appear around the part you are about to edit



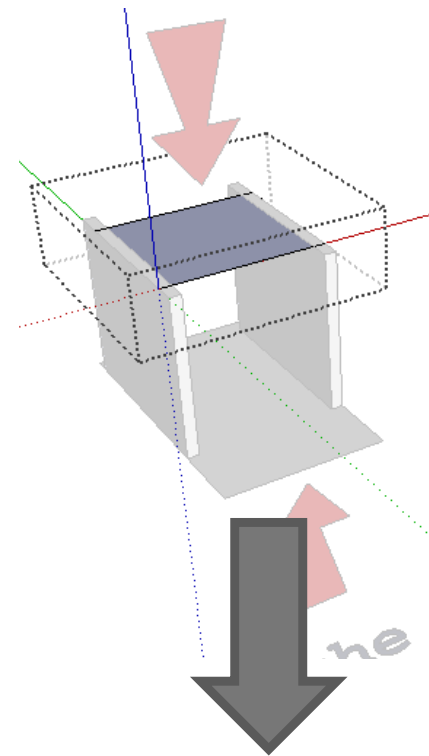
23. Use **the push pull tool** to push the component. Click **once** on the mouse button to start and then **type 4** and press **enter**



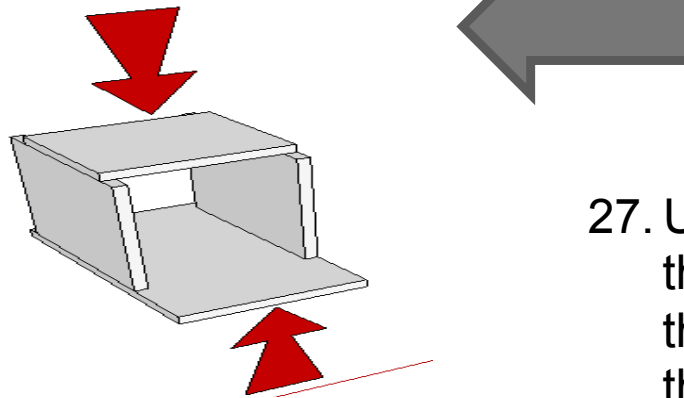
25. Click on **Scene 12**.



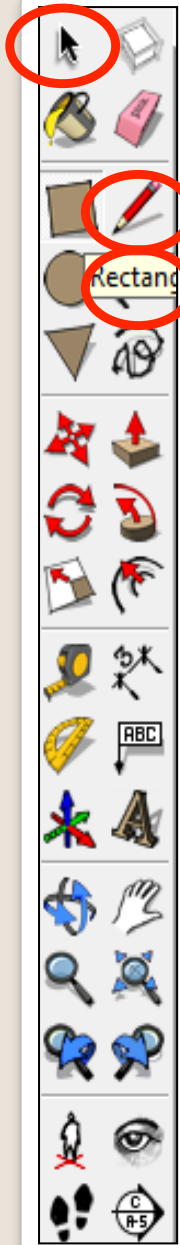
26. Double click on the top piece to **edit**. Everything should grey out and a dotted rectangle should appear around the part you are about to edit



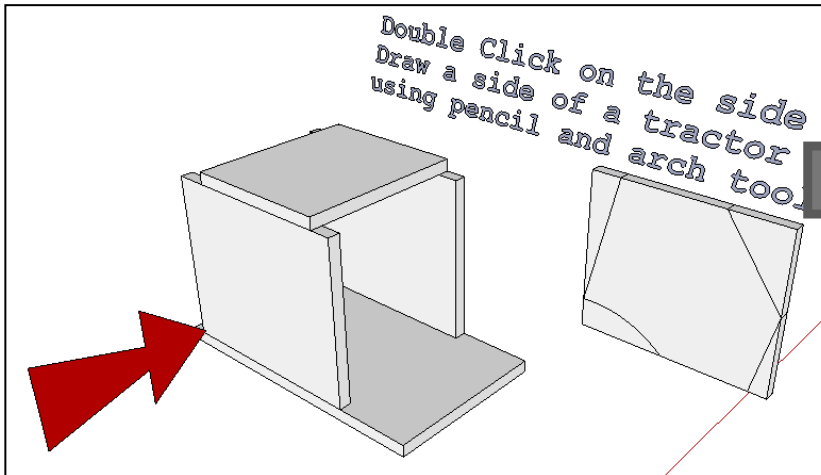
28. **Repeat** steps 26 & 27 on the opposite component.



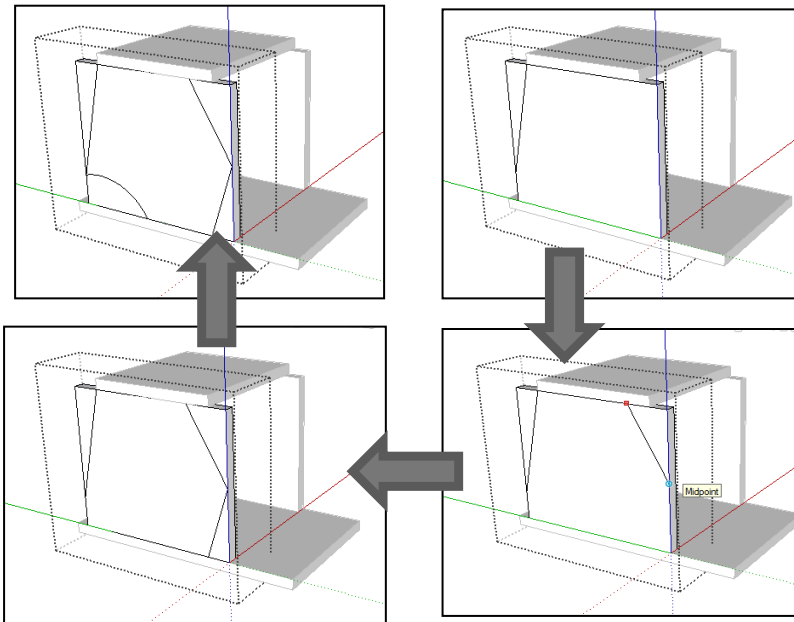
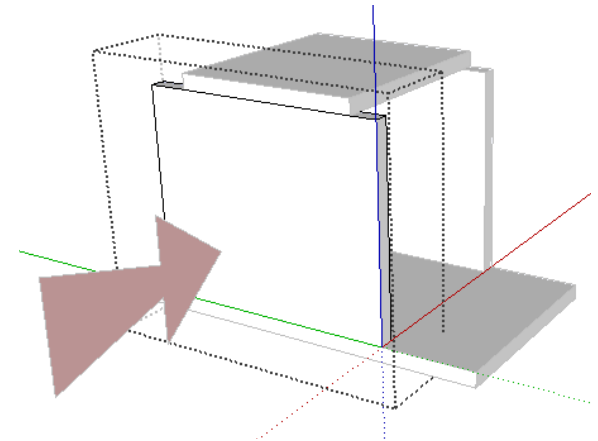
27. Use **the push pull tool** to push the component. Click **once** on the mouse button to start and then **type 4** and press **enter**



29. Click on **Scene 13**.



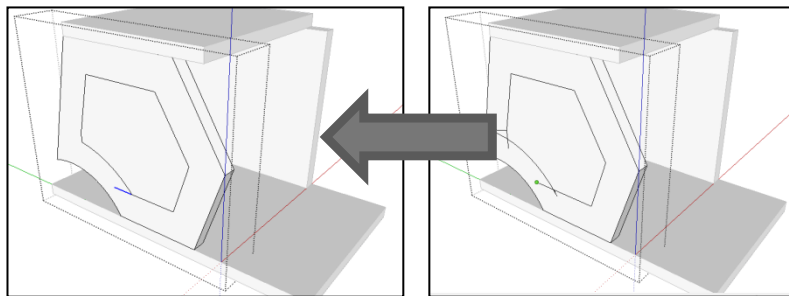
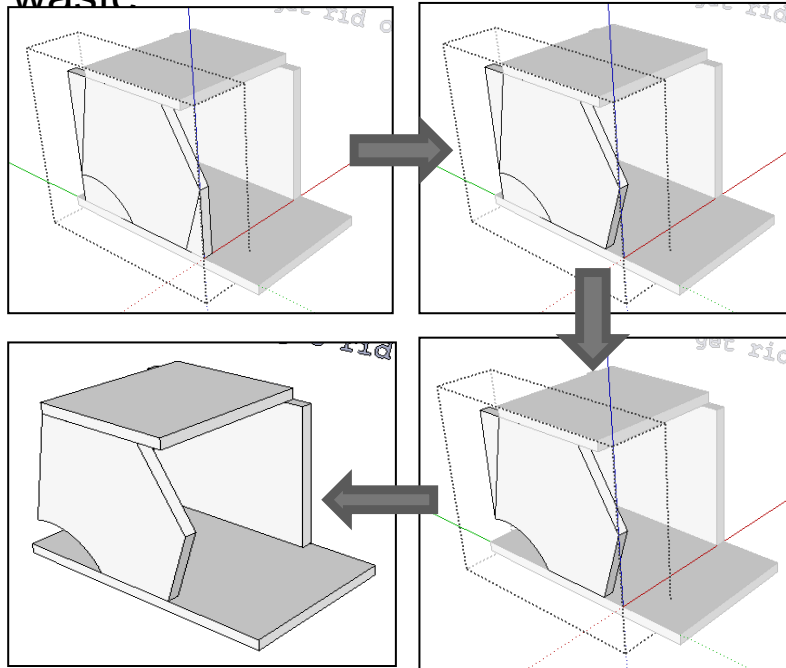
30. Double click on the side piece to **edit**. Everything should grey out and a dotted rectangle should appear around the part you are about to edit



31. Use the **pencil** tool and **arch** tool to draw the side shape of the tractor.



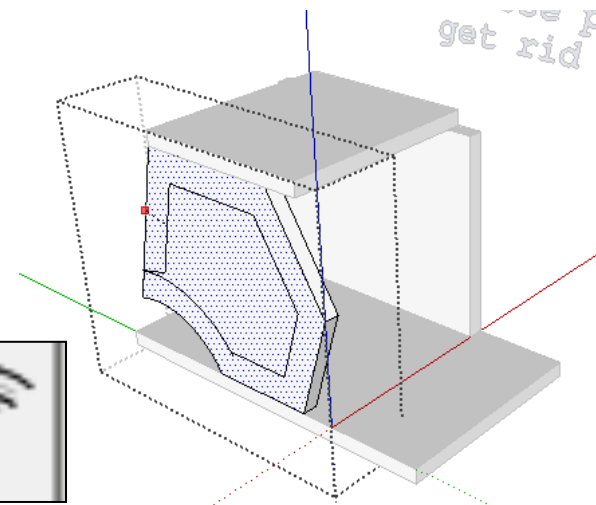
32. Use **the push-pull** tool to get rid of the waste



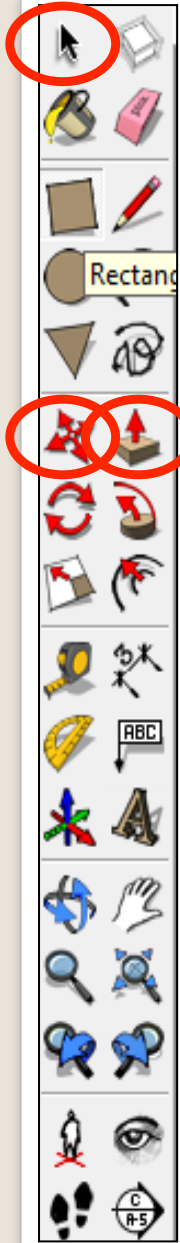
36. Use **rubber** tool to get rid of excess lines

35. Use **pencil** tool to neaten shape

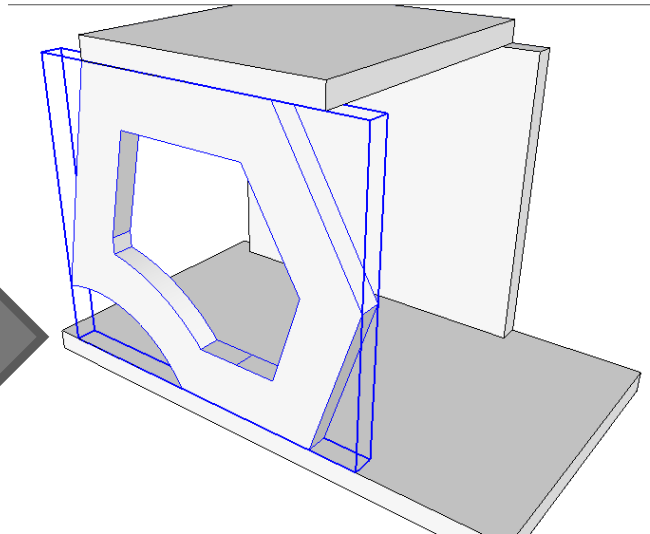
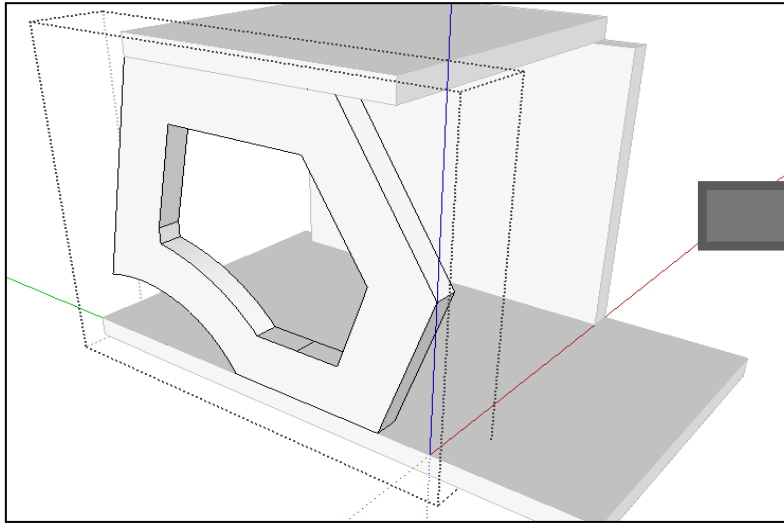
33. Double click on the side piece to **edit**. Everything should grey out and a dotted rectangle should appear around the part you are about to edit



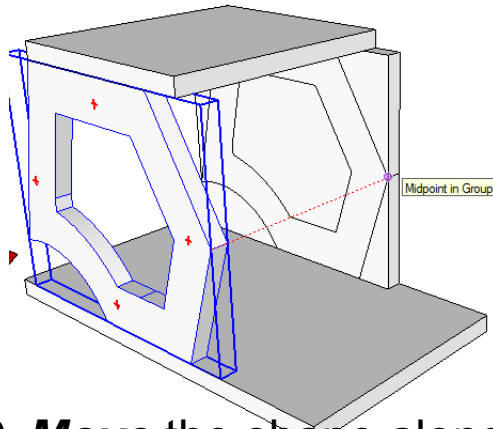
34. Use **the contour** tool to draw inside parallel lines. Type in 10 to give it a 10mm thickness



37. Use **push-pull** tool to get rid of the window

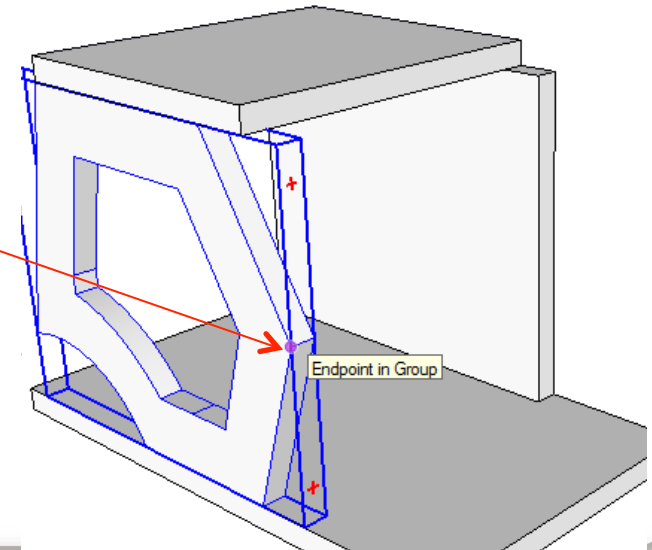


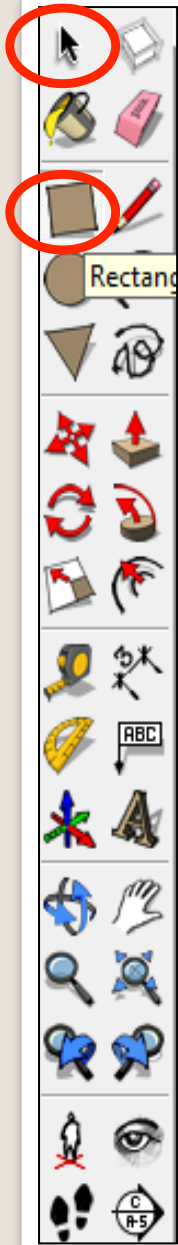
38. Click of the shape and on it again **just once using arrow tool.**



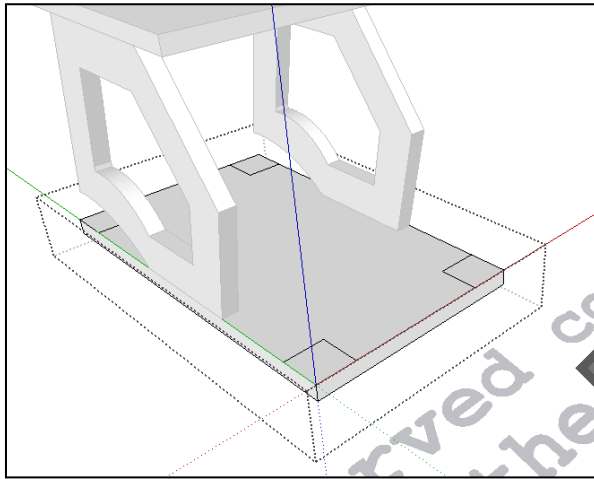
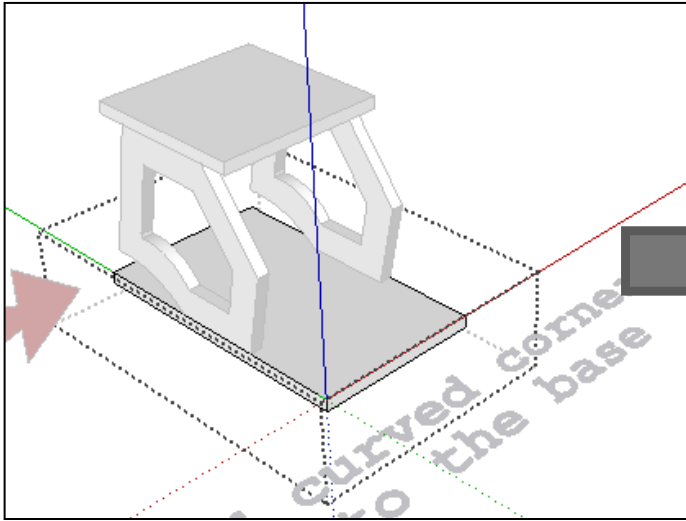
40. **Move** the shape along the red axis to the opposite side. Delete part not needed

39. Click of the **move tool** and then a corner of the shape. Press **CTRL**



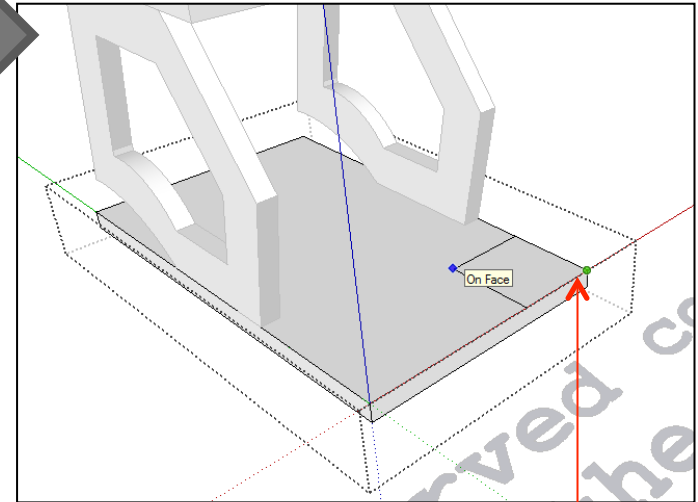


41. Click on **Scene 16**.

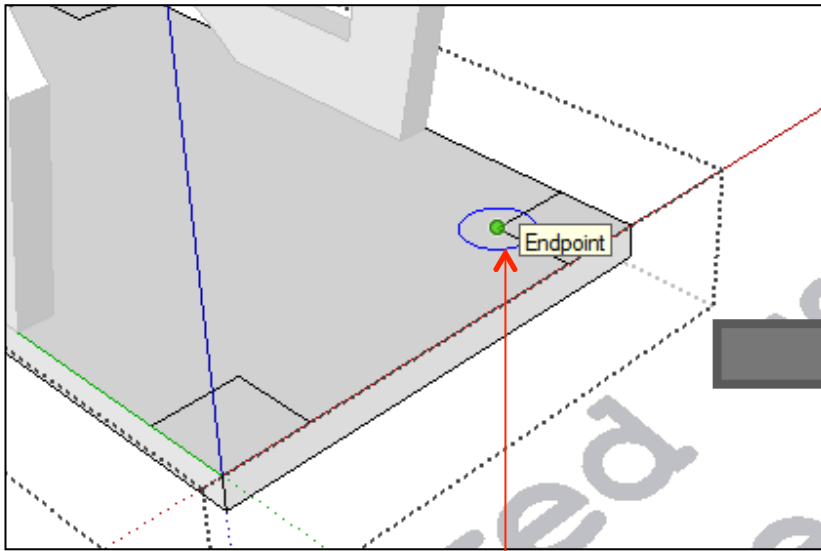


44. Repeat **step 43** for all the corners

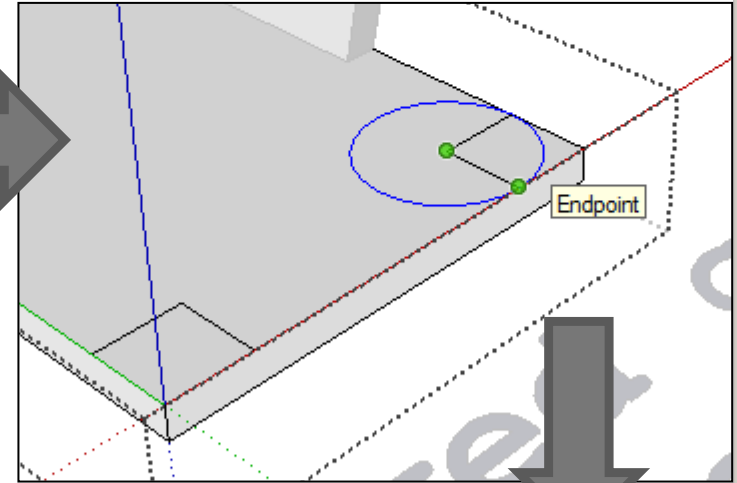
42. Double click on the base piece to **edit**. Everything should grey out and a dotted rectangle should appear around the part you are about to edit



43. Click on the **square tool**. From the corner highlighted click to start drawing a square. Type in **10, 10** and **press enter**

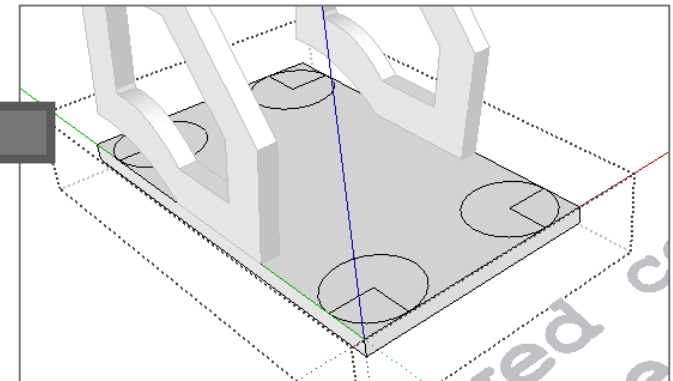
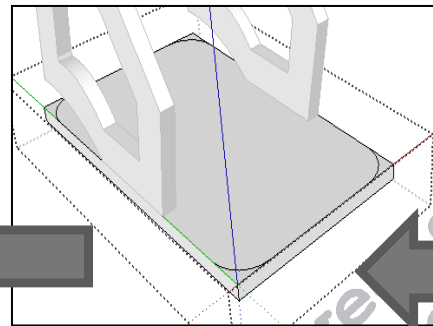
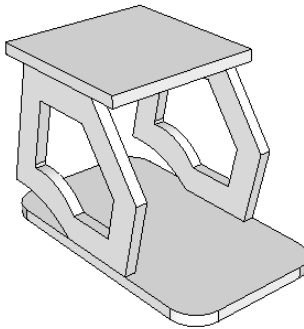


45. Click on the corner of the square shown below to complete the circle.

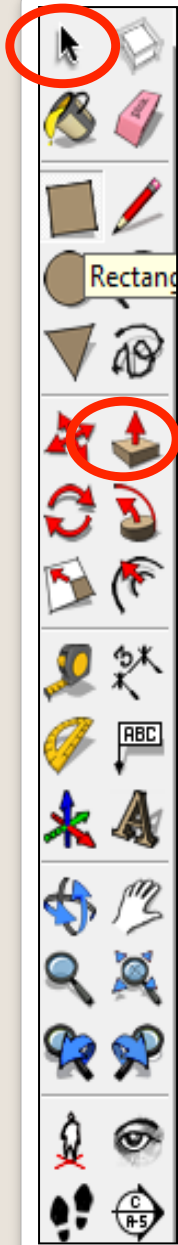


45. Click on the **circle tool** and then the corner of the square shown

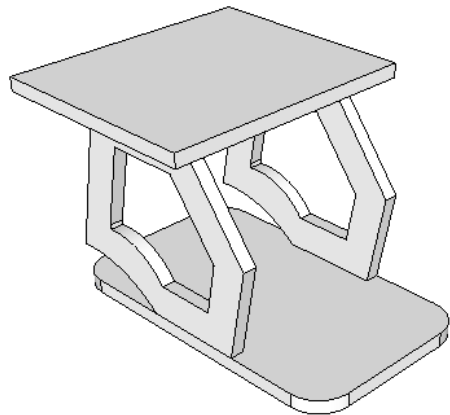
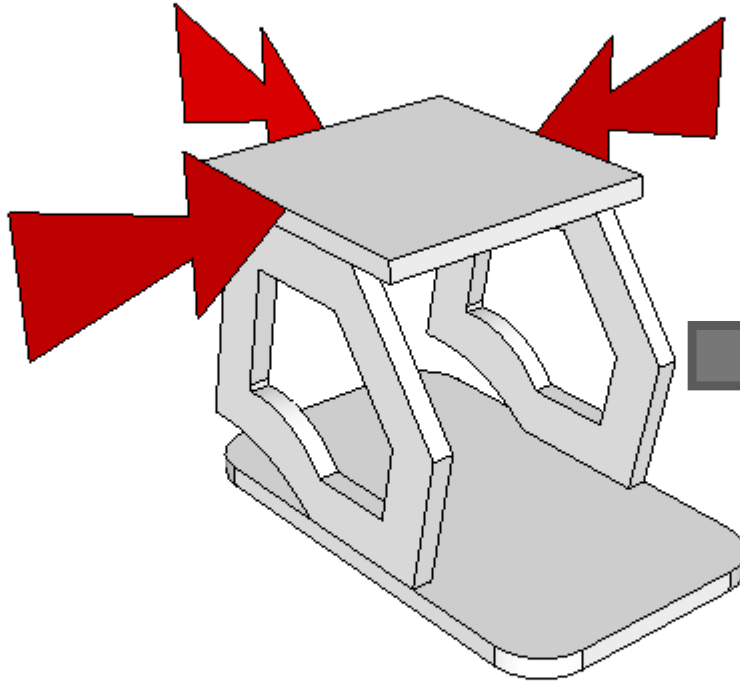
46. Repeat step 45 for the other three corners



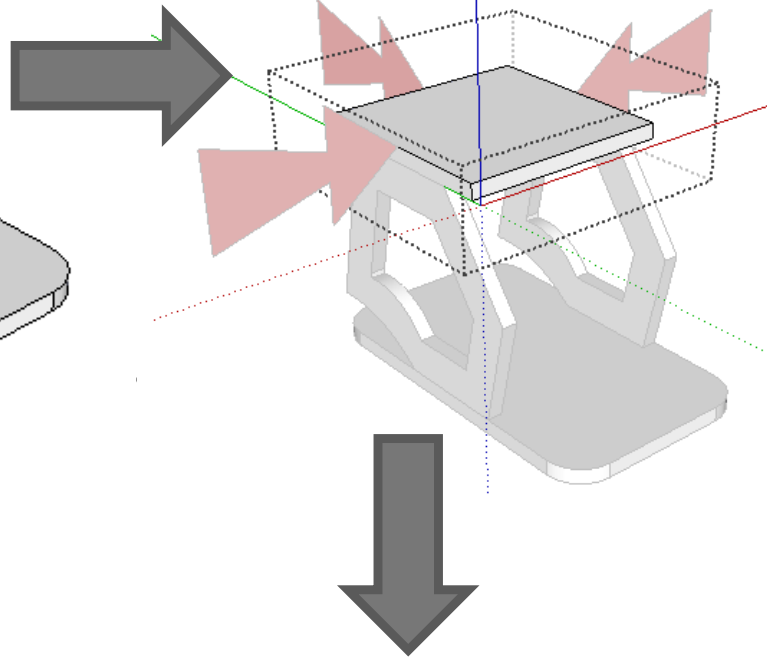
47. Use the **eraser** to clean up the edges and the **push-pull** tool to get rid of the waste



48. Click on **Scene 17**.



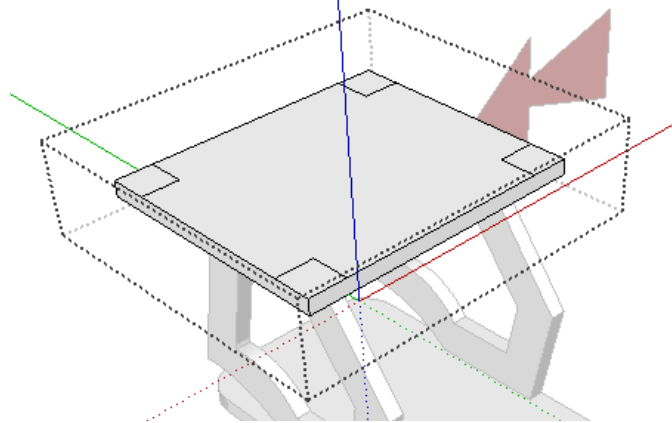
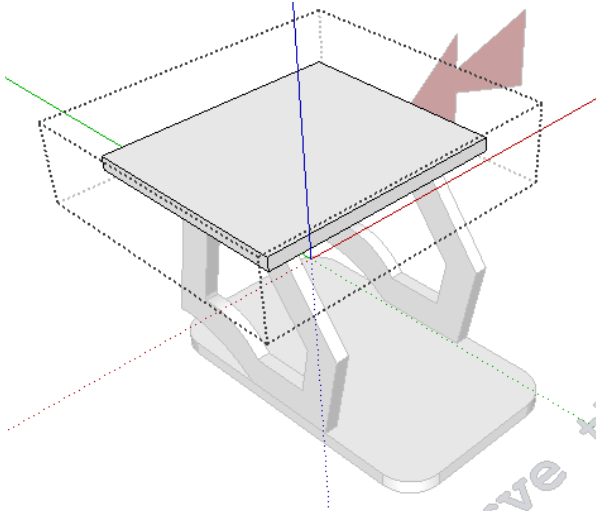
49. Double click on the top piece to **edit**. Everything should grey out and a dotted rectangle should appear around the part you are about to edit



50. Click on the **push pull** tool and then pull the three edges out by **10mm**

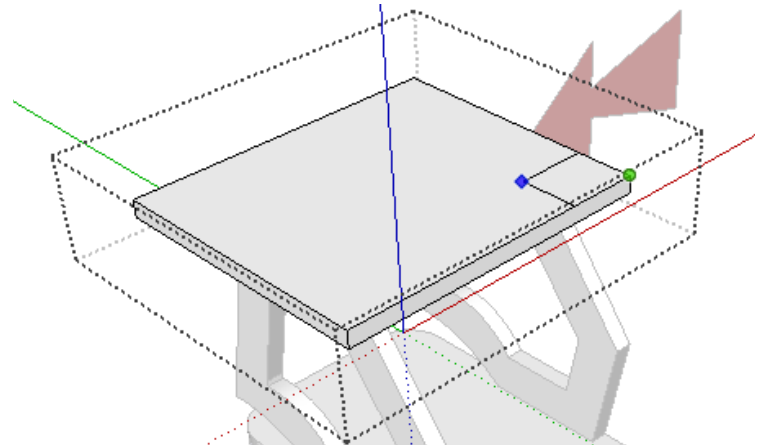


51. Click on **Scene 18**.

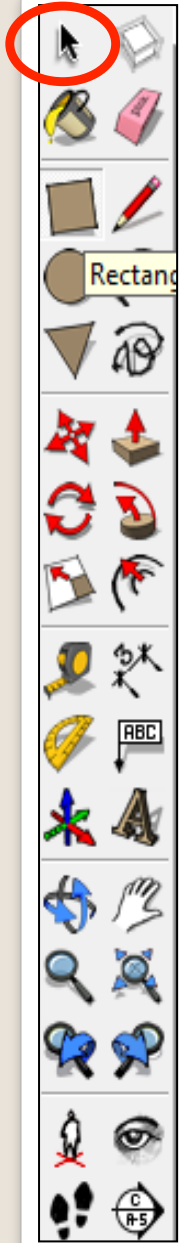


54. Repeat step 45 for the other three corners

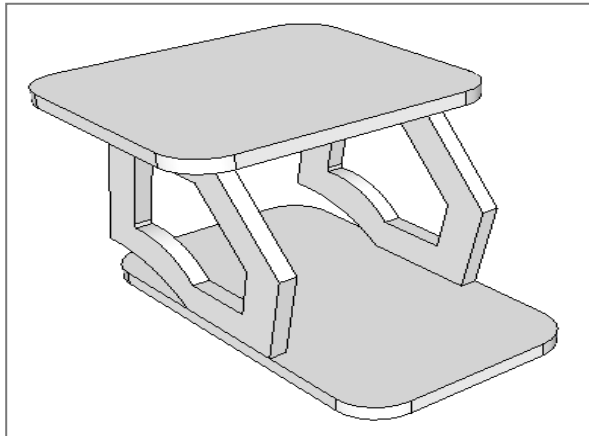
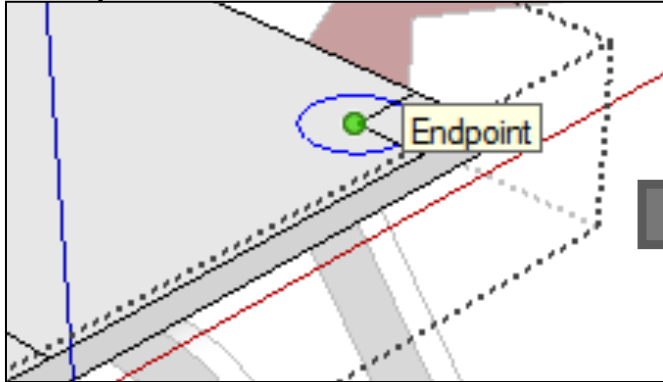
52. Double click on the top piece to **edit**. Everything should grey out and a dotted rectangle should appear around the part you are about to edit



53. Click on the **square tool**. From the corner highlighted click to start drawing a square. Type in **10, 10** and **press enter**

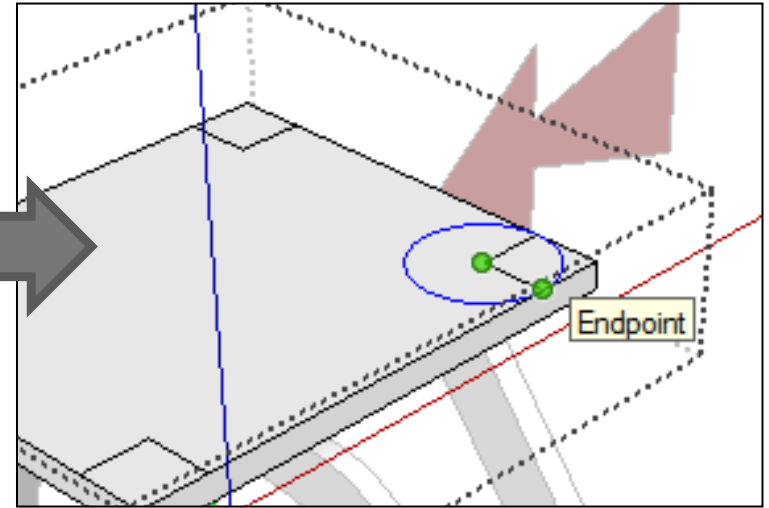


55. Click on the **circle tool** and then the corner of the square shown above.

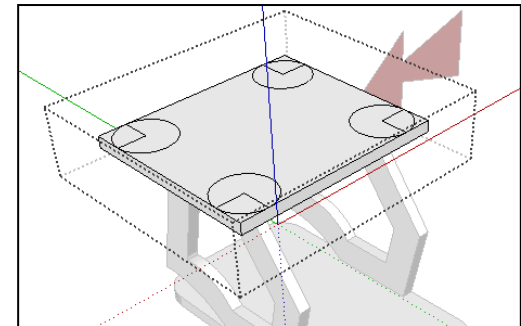


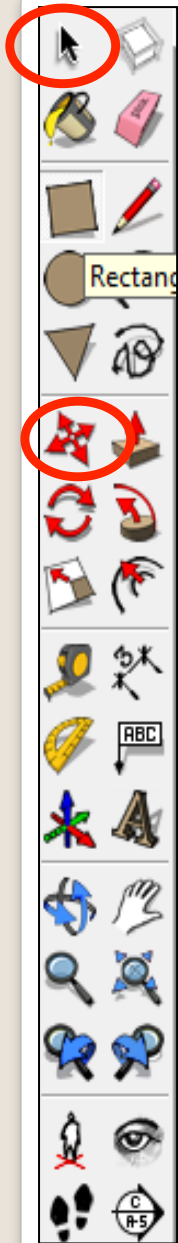
58. Use the **eraser** to clean up the edges and the **push-pull** tool to get rid of the waste

56. Click on the corner of the square shown below to complete the circle.

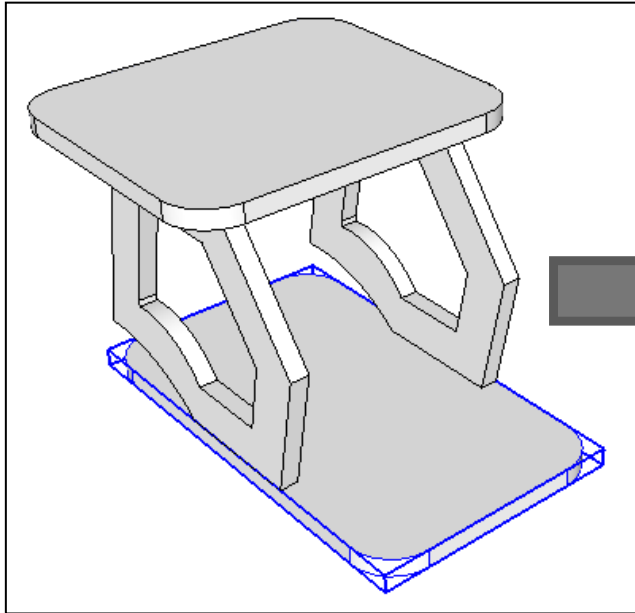


57. Repeat step 56 for the other three corners





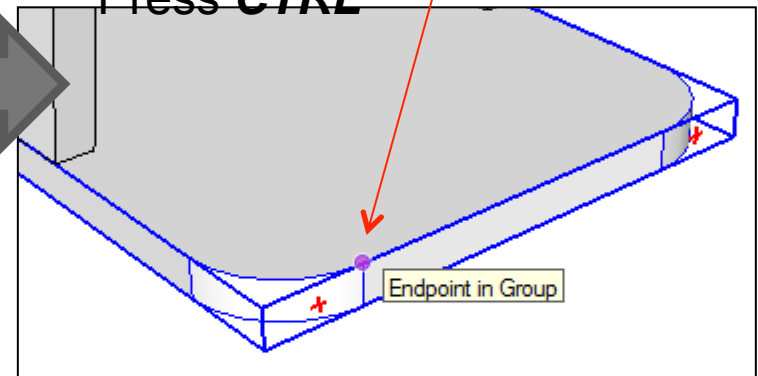
59. Click on **Scene 19**. Then using the black arrow click on the base once



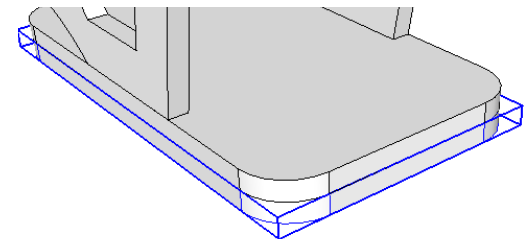
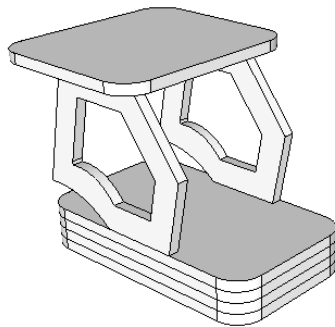
60. Click on the **move tool**.



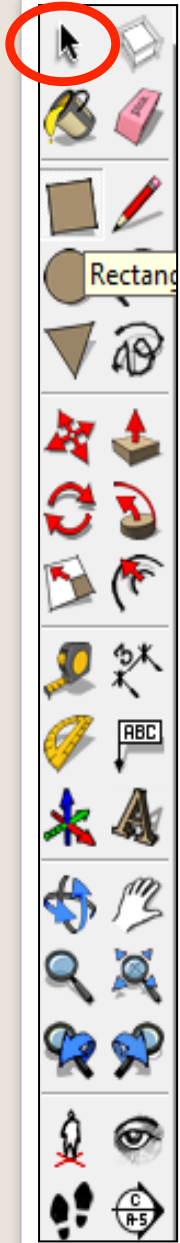
61. Click of the **move tool** and then a corner of the shape. Press **CTRL**



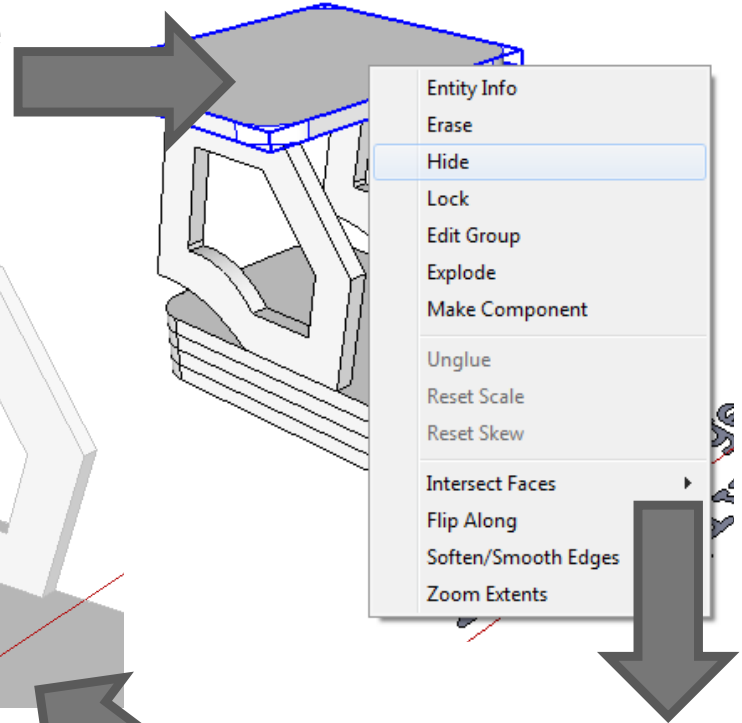
62. **Move** the shape along the blue axis and position directly underneath



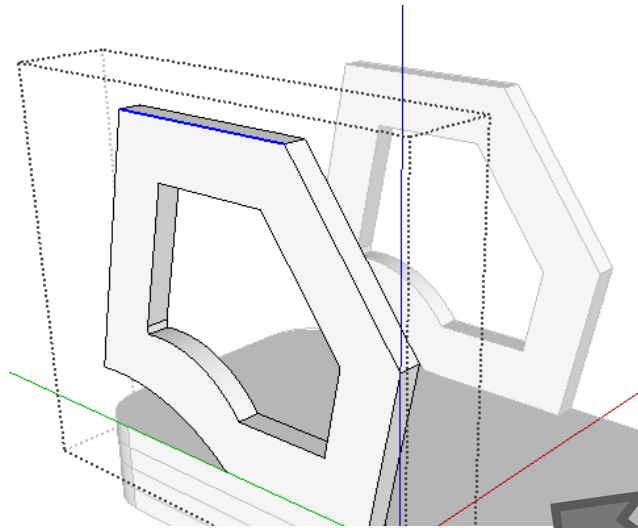
63. **Repeat** step 61 and step 62 a further two times



64. Click on **Scene 20**. Then using the black arrow click on the roof, **right click** and then **hide**.

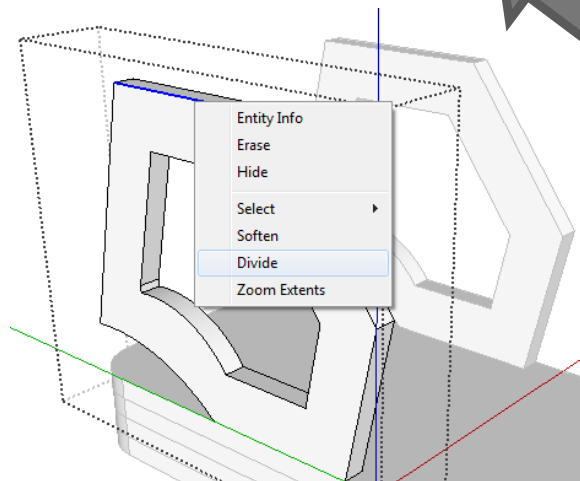


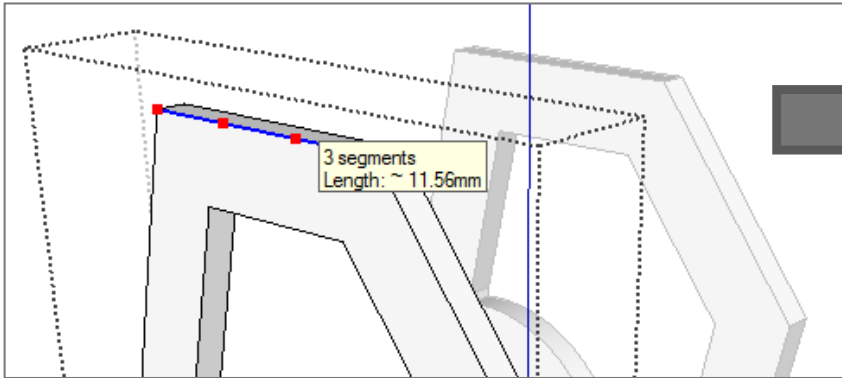
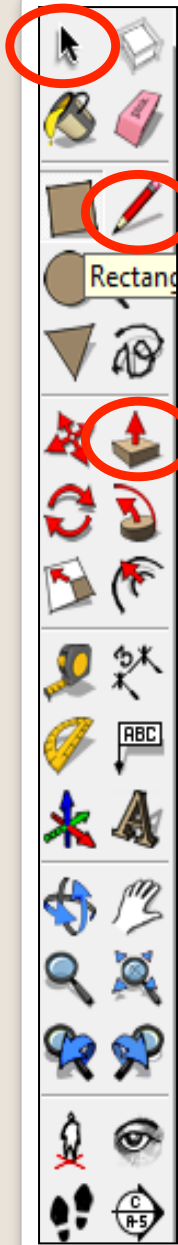
66. Click on **black arrow** tool and then the line show



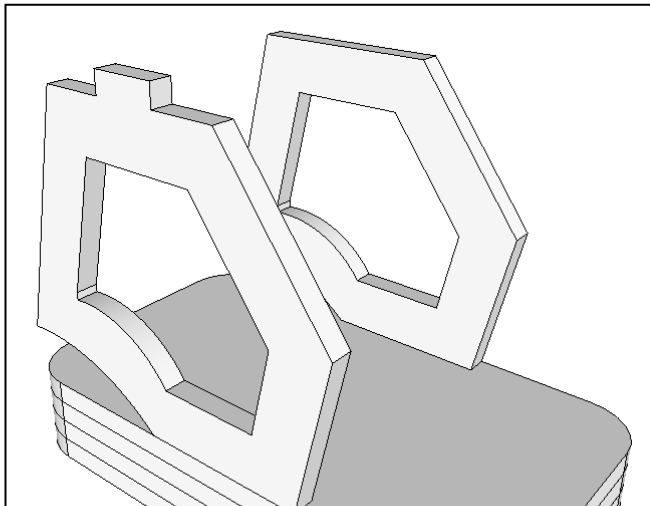
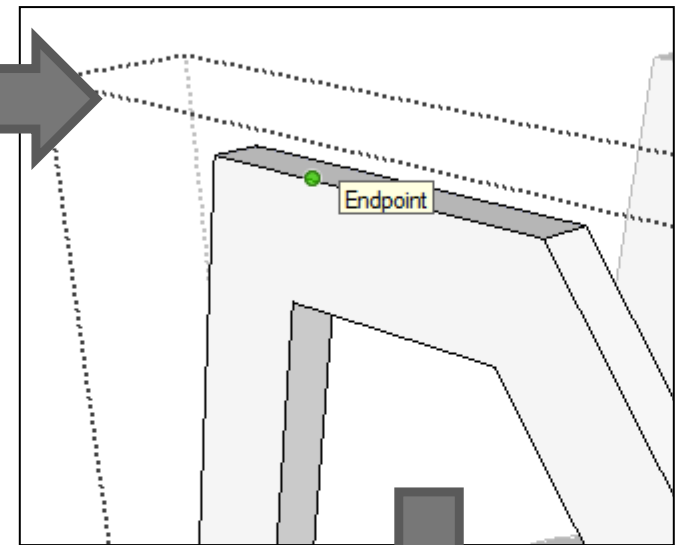
65. Double click on the top piece to **edit**. Everything should grey out and a dotted rectangle should appear around the part you are about to edit

67. Right click on the line shown and then divide by 3.

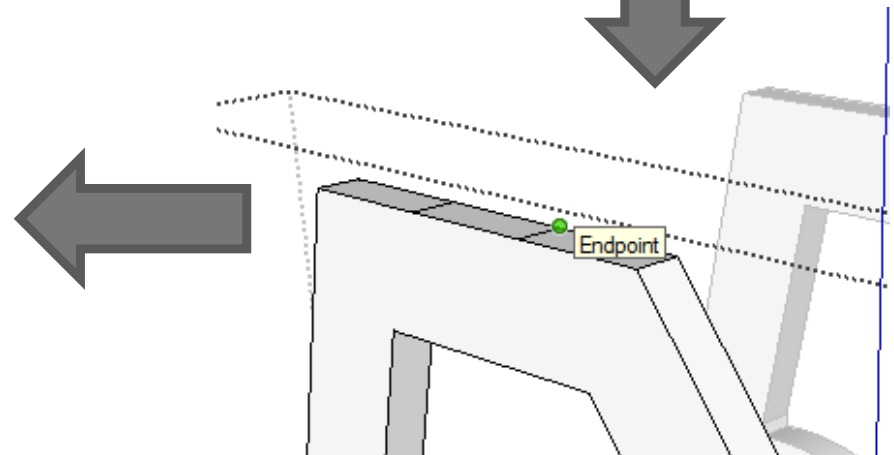




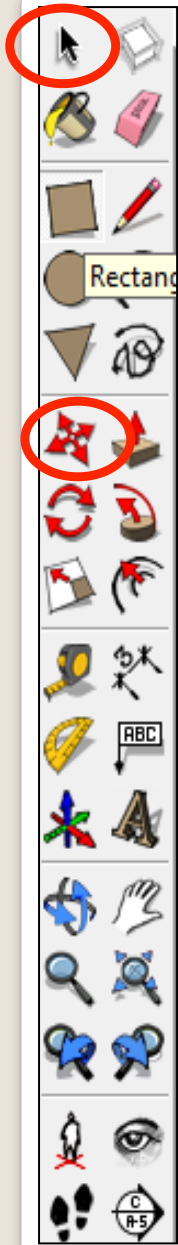
68. Using the **pencil tool** run it along the edge you have divided by 3. until it stops on the **endpoint**.



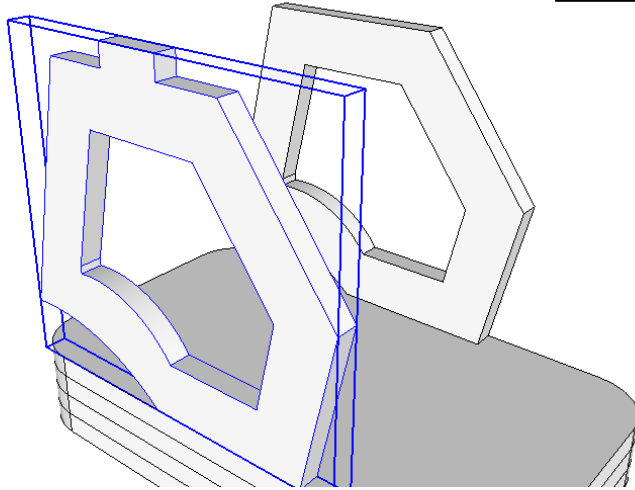
70. Using the **push-pull** tool to pull up the middle piece by **4mm**



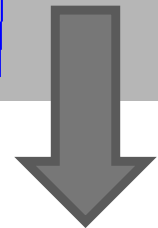
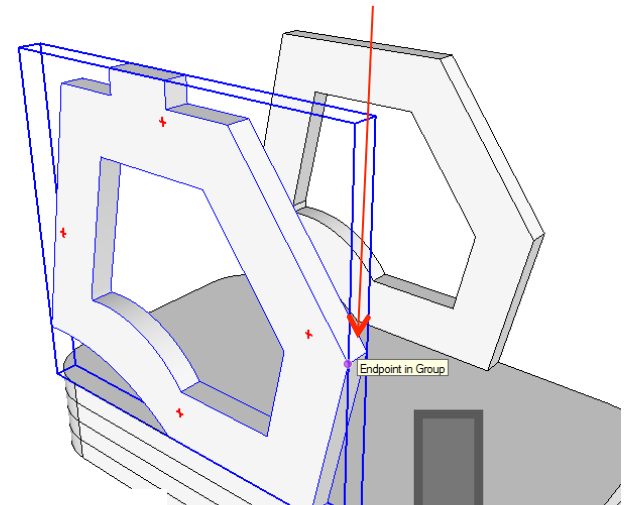
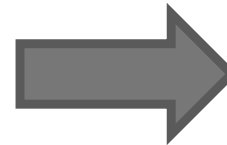
69. Using the **pencil tool** on the **endpoint** draw a line across to the opposite side. Do this for the next end point



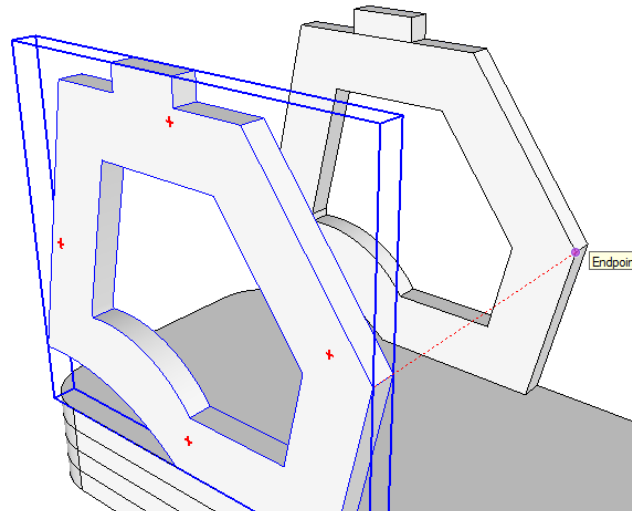
71. Highlight the side piece and then click on the **move** tool.



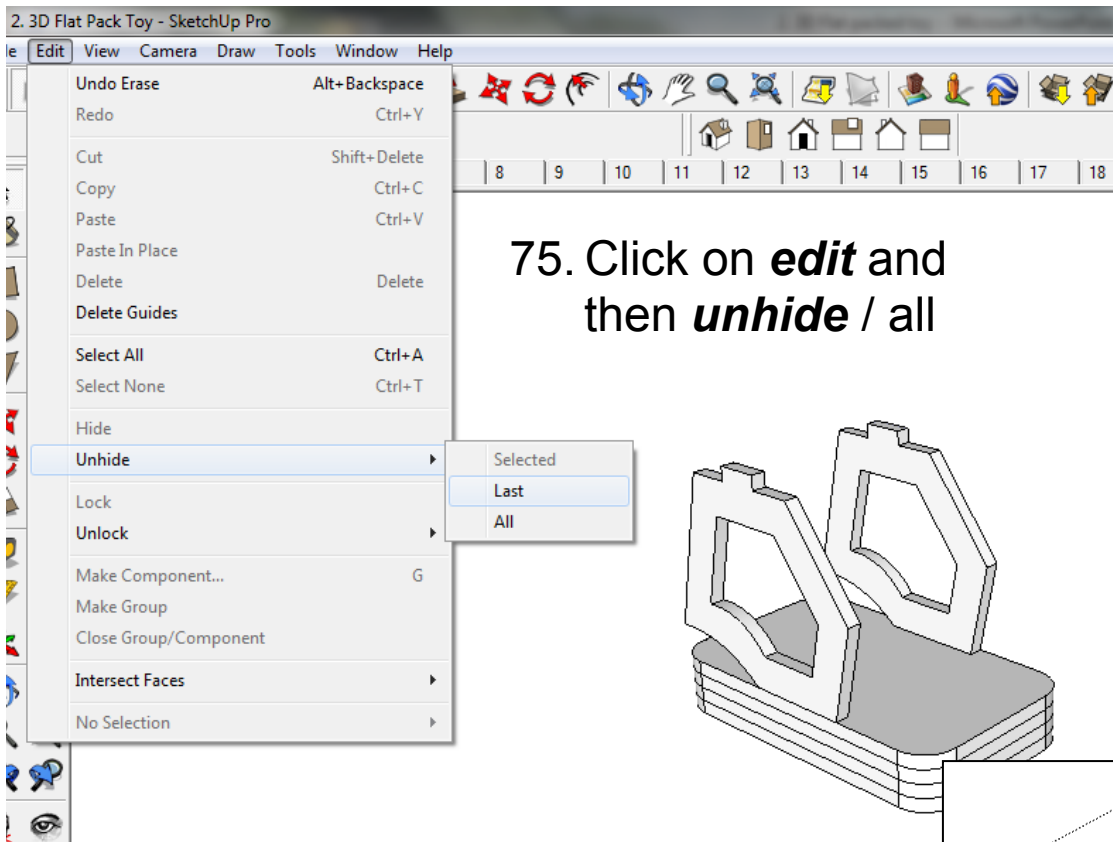
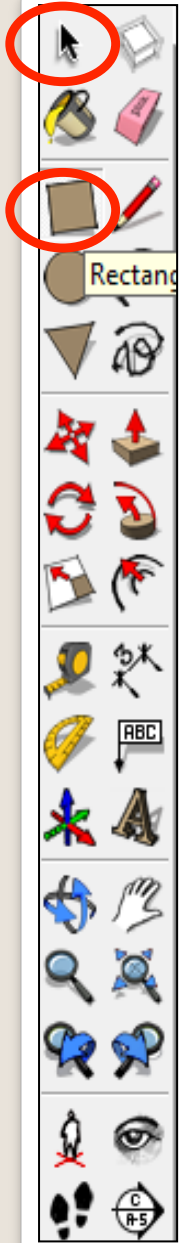
72. Click on the **move tool** and then a corner of the shape. Press **CTRL**



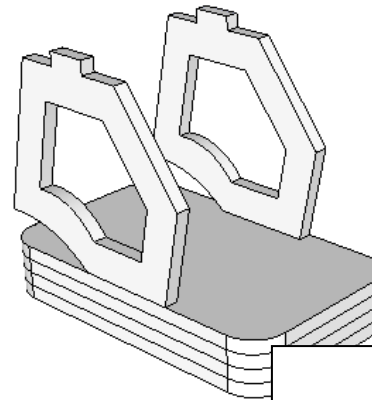
74. **Delete** part not needed



73. **Move** the shape along the **red axis** and position directly opposite

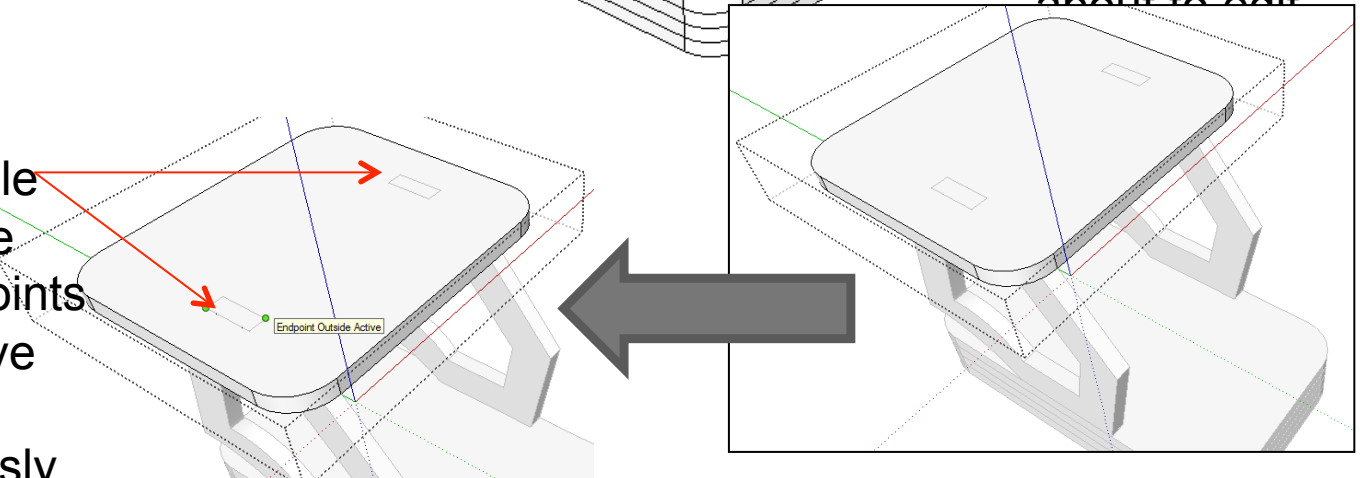


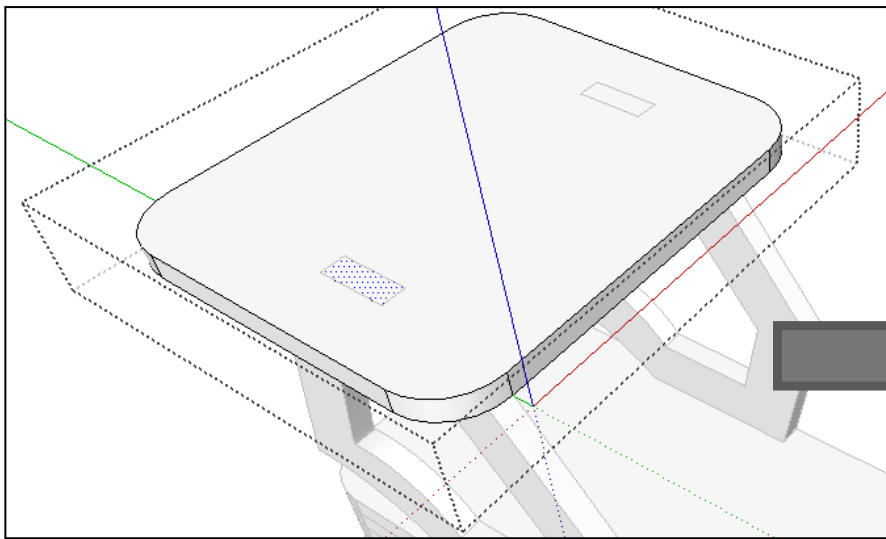
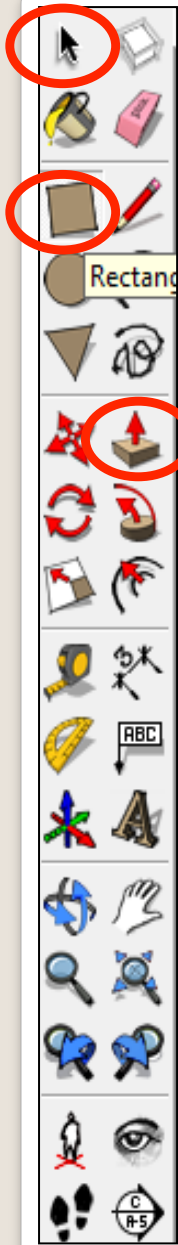
75. Click on **edit** and then **unhide** / all



76. Double click on the top piece to **edit**. Everything should grey out and a dotted rectangle should appear around the part you are about to edit

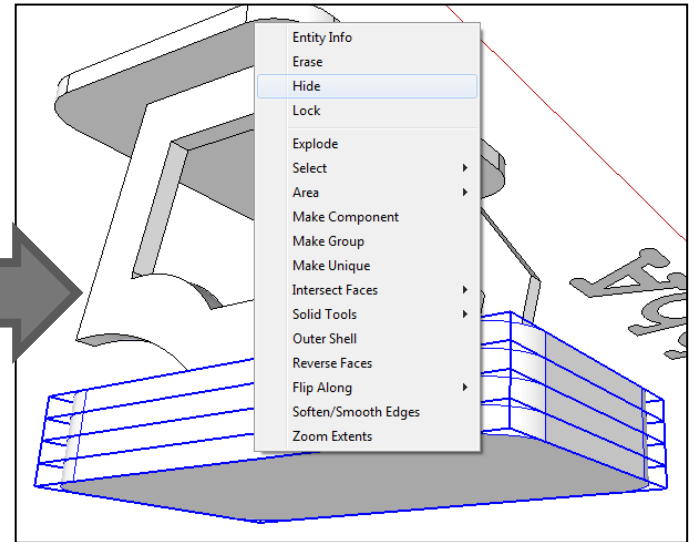
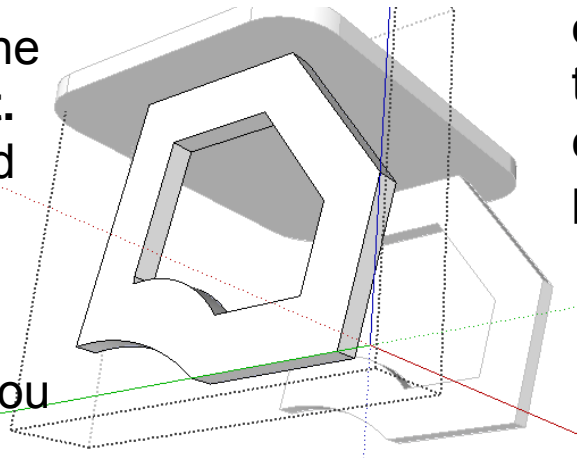
77. Draw a rectangle over the finger joints you have drawn previously



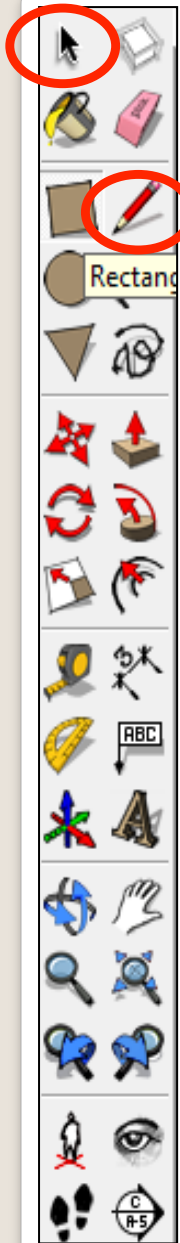


78. Use the push pull tool to push the rectangle you have just drawn by 4mm

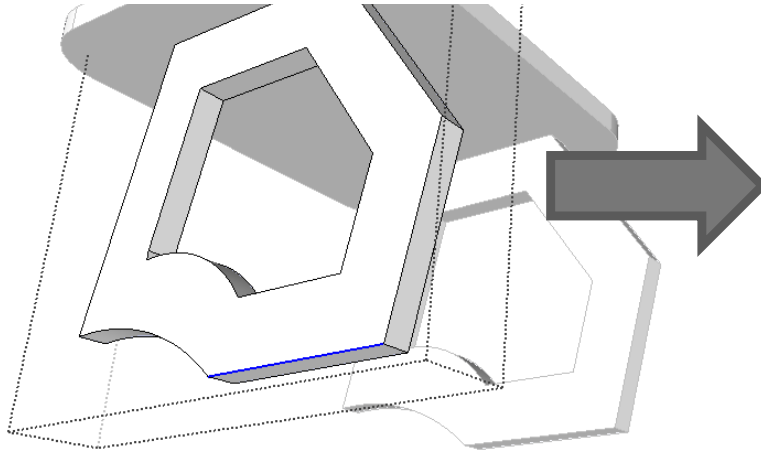
80. Double click on the side piece to **edit**. Everything should grey out and a dotted rectangle should appear around the part you are about to edit



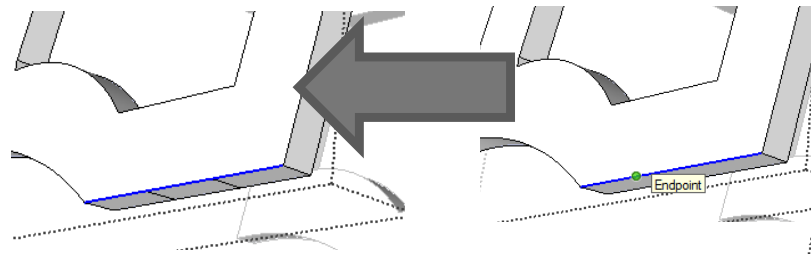
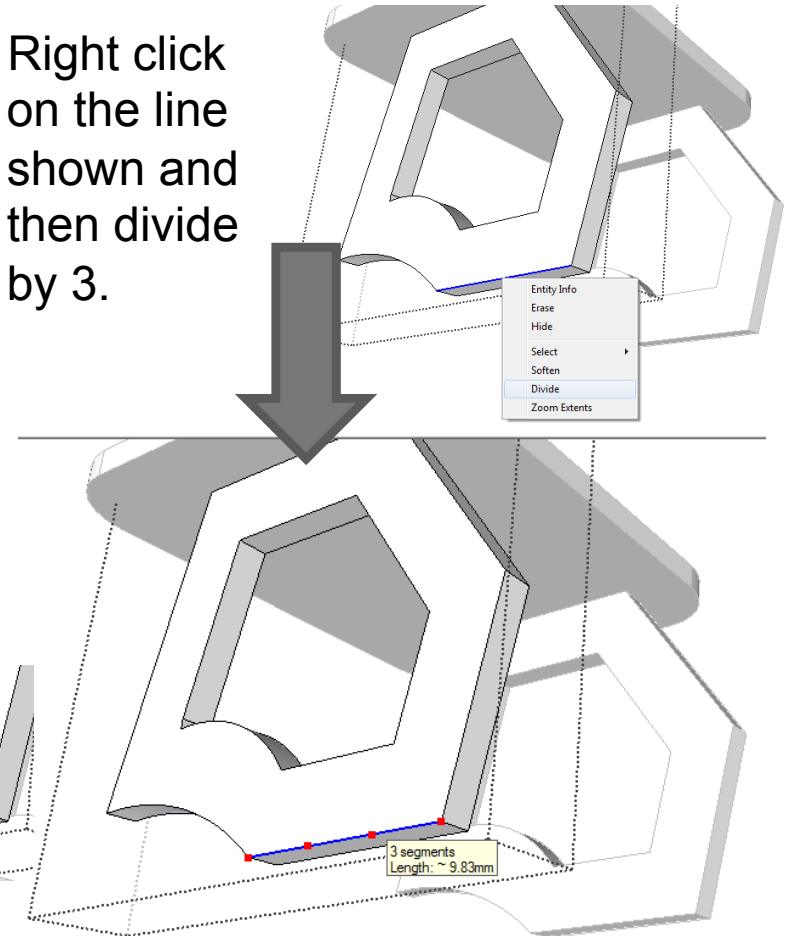
79. Click on the pieces at the bottom by clicking on each one whilst holding the shift key down. Right click and then hide the pieces



81. Click on **black arrow** tool and then the line shown

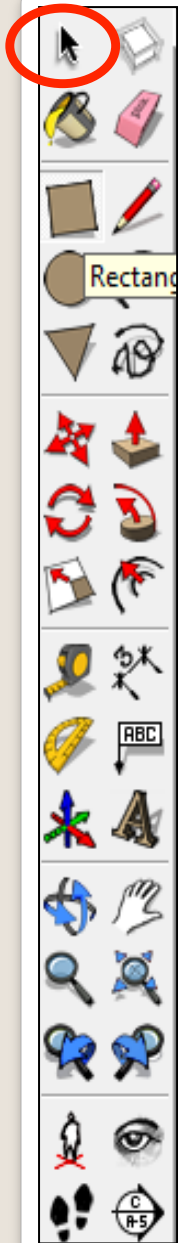


82. Right click on the line shown and then divide by 3.

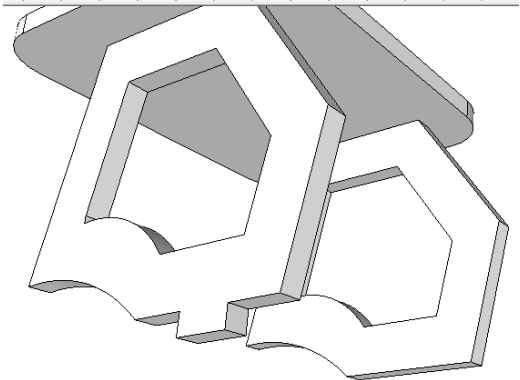


84. Using the **pencil tool** on the **endpoint** draw a line across to the opposite side. Do this for the next end point

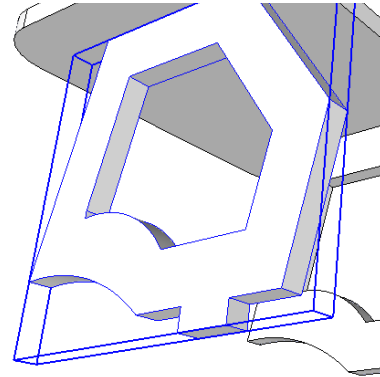
83. Using the **pencil tool** run it along the edge you have divided by 3. until it stops on the **endpoint**.



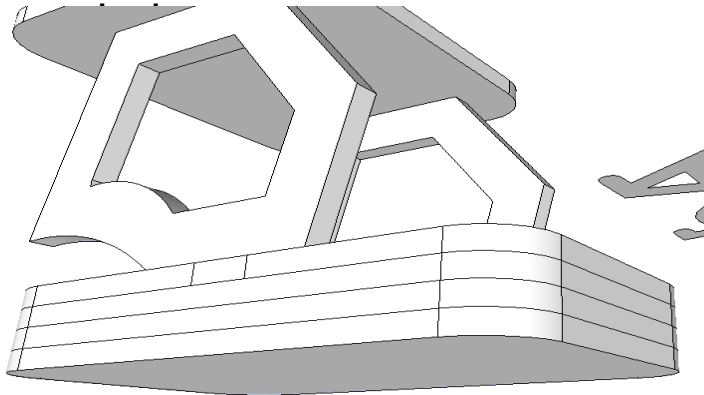
85. Using the **push-pull** tool to pull up the middle piece by **4mm**



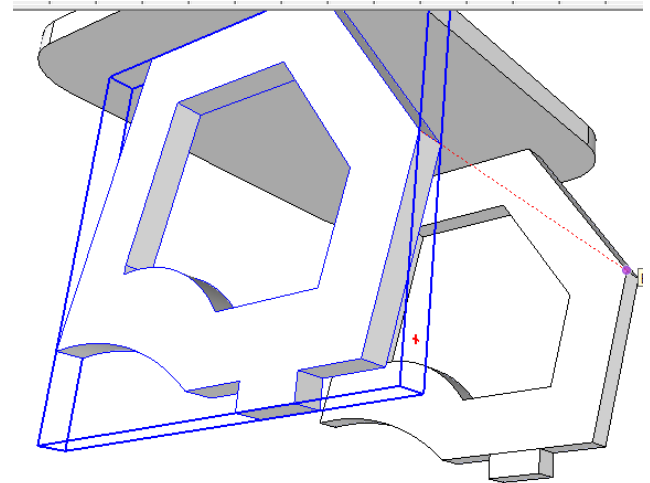
86. Highlight the side piece and then click on the **move** tool.



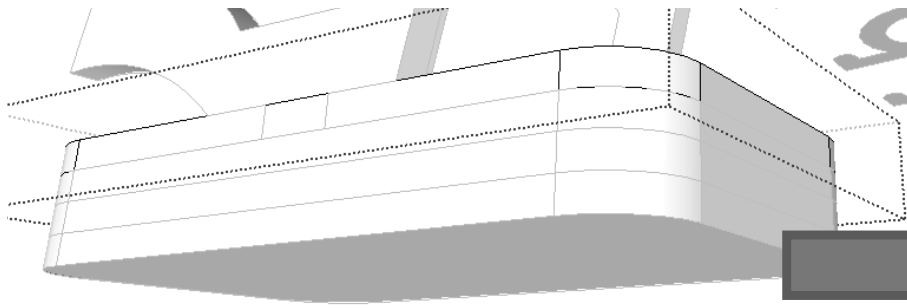
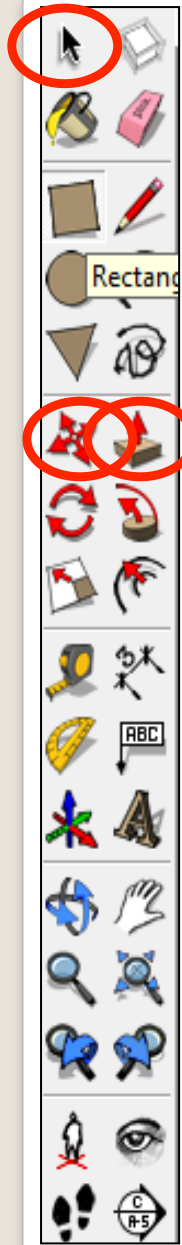
88. **Move** the shape along the **red axis** and position directly opposite. **Delete** part not



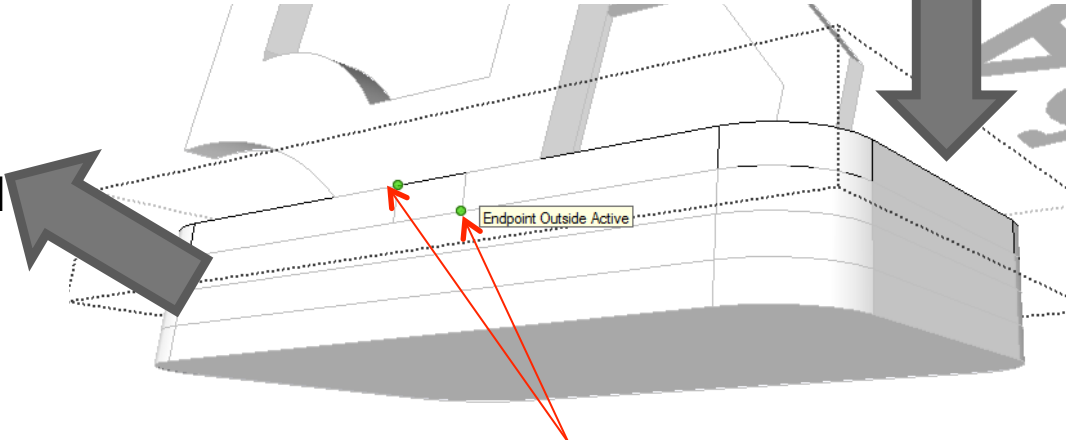
87. Click on the **move tool** and then a corner of the shape. Press **CTRL**



89. Click on **edit** unhide all

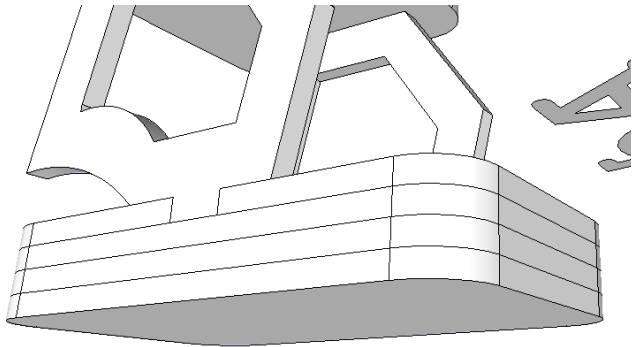


90. Double click on the top bottom piece to **edit**. Everything should grey out and a dotted rectangle should appear around the part you are about to edit

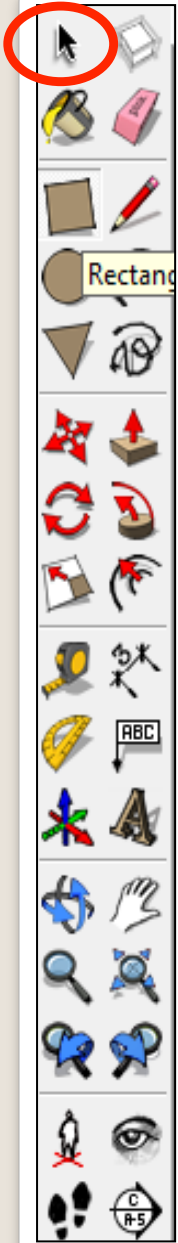


92. Use the push pull tool to push the rectangle you have just drawn by 4mm

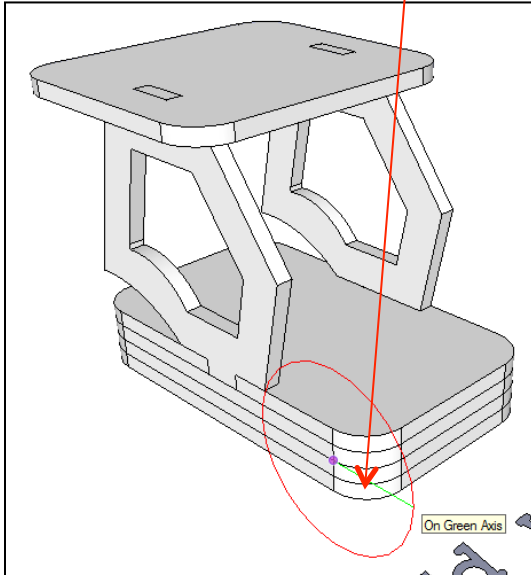
91. Draw a rectangle over the finger joints you have drawn previously



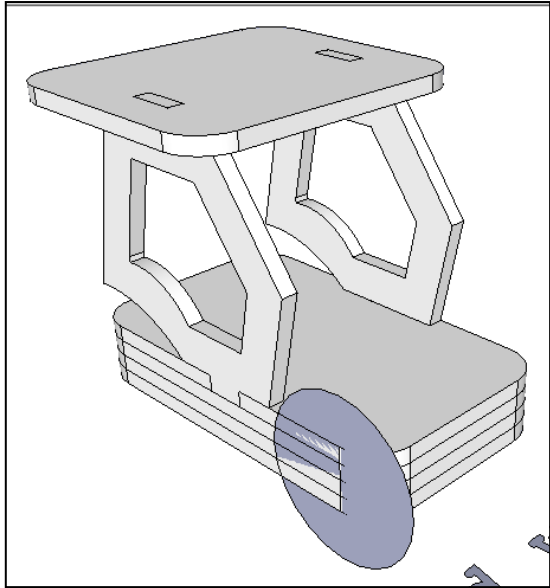
93. Repeat the process for the other side



94. Click on **Scene 21**. Start drawing a circle from the centre point shown

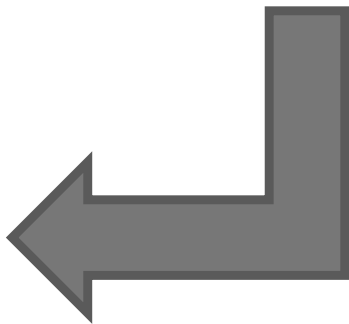
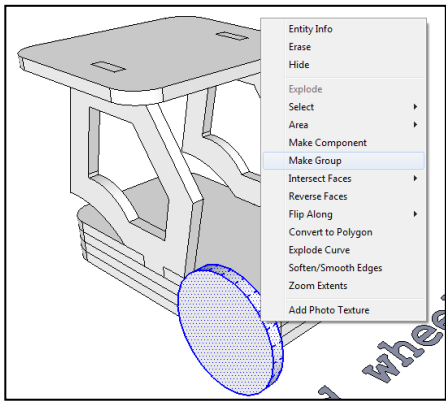


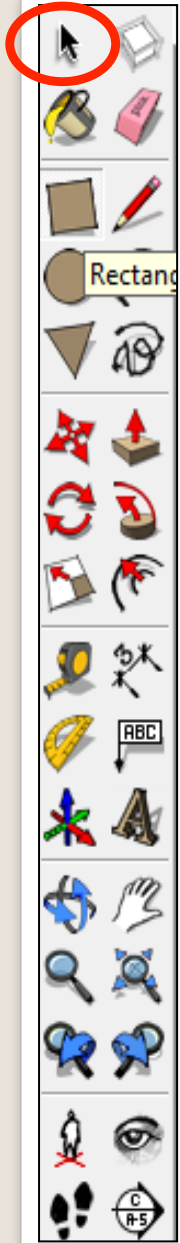
95. Type in **20** and press **enter**



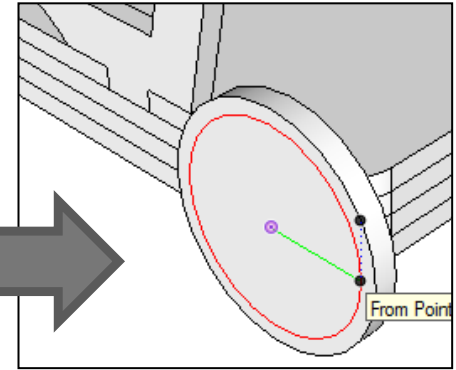
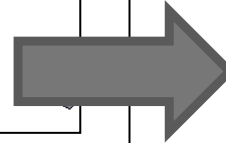
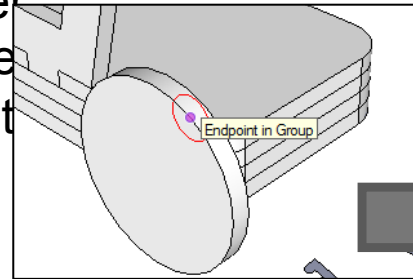
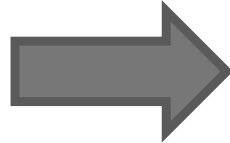
96. Use the push pull to pull the wheel out for 4mm

97. Right click and group



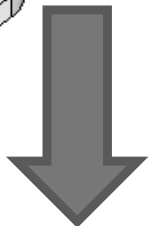
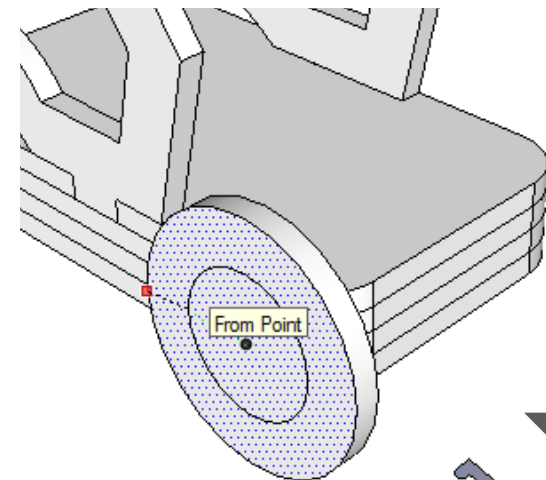
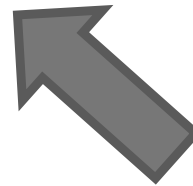
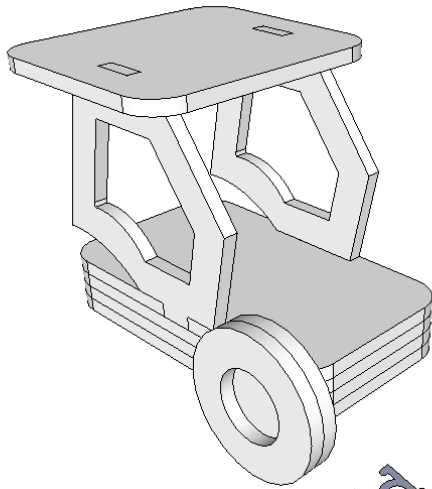


97. Using the circle tool hover around the circumference of the circle you have just drawn

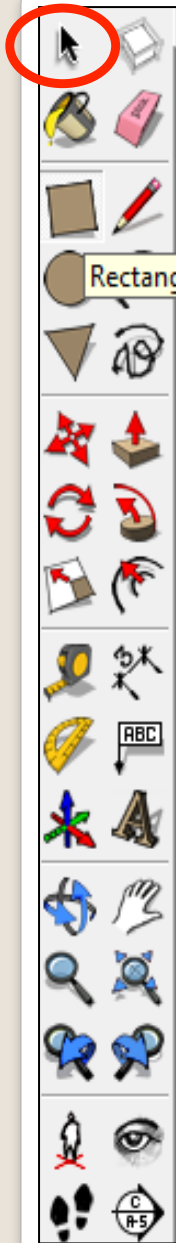


98. The circle should snap to the middle. Draw a circle directly over the top of the last.

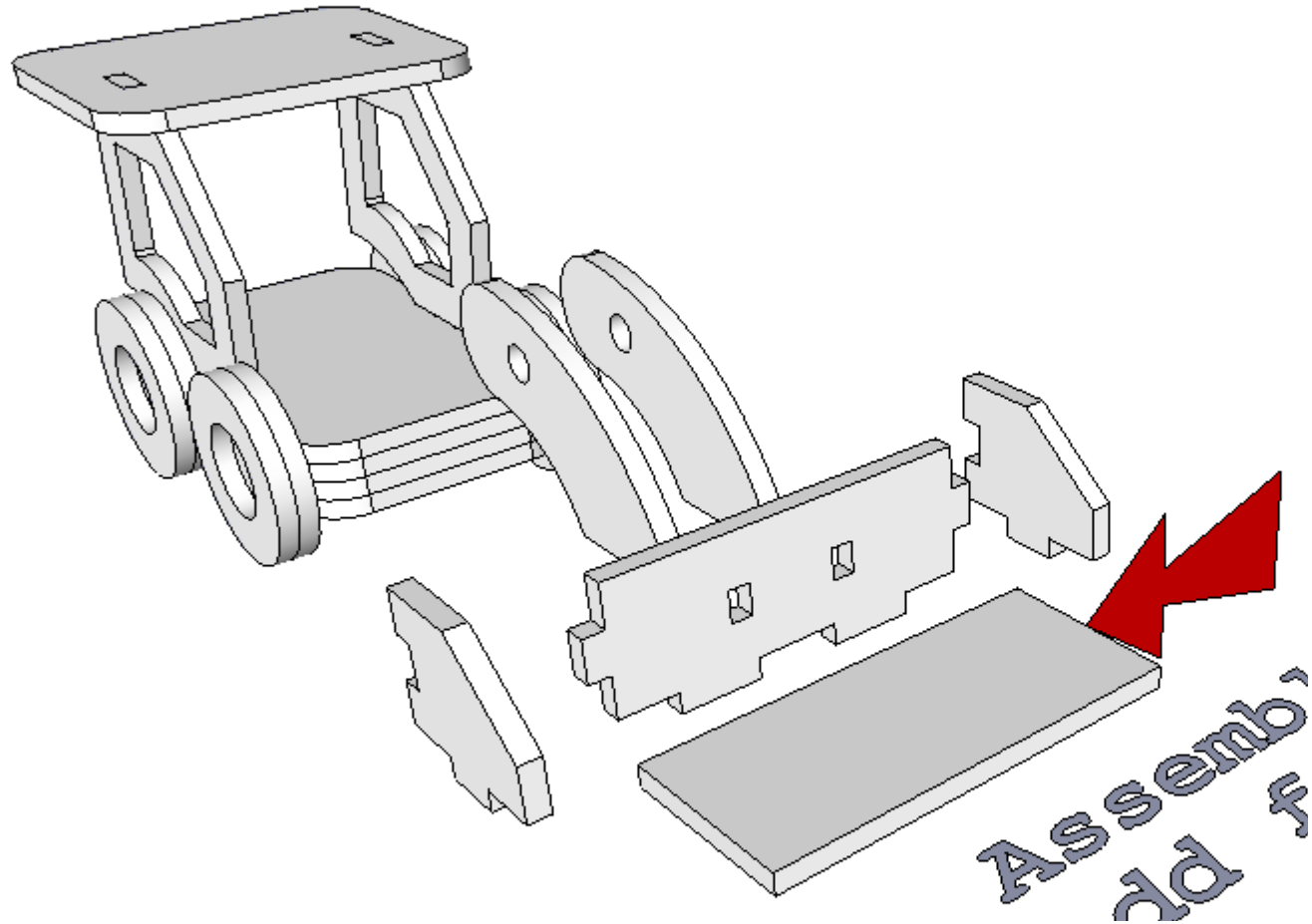
100. Use the push pull to pull the wheel out for 4mm. Group the wheel and repeat the process for 3 more.

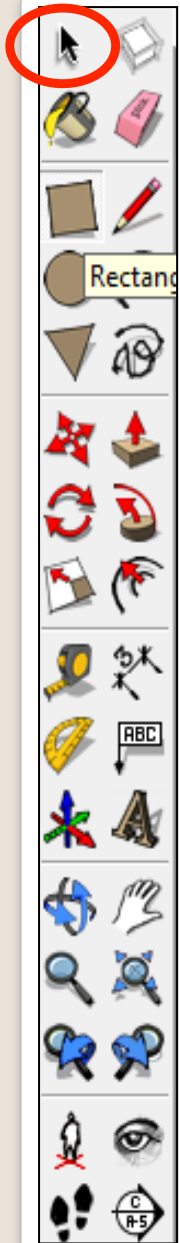


99. Use the contour tool. Click on the edge of the circle and type 10 and press enter

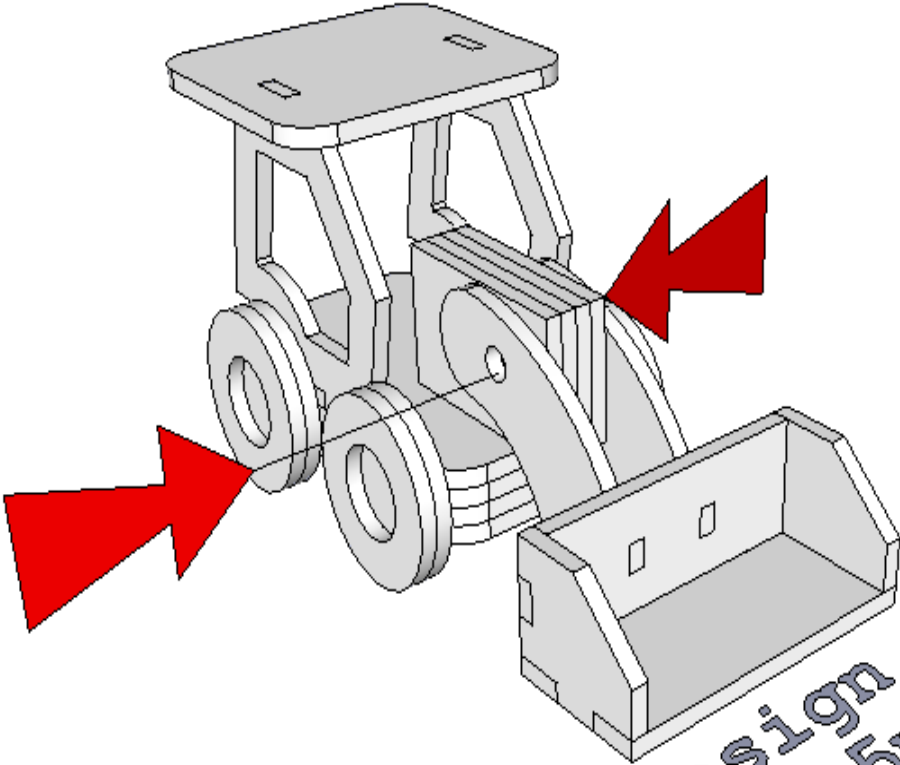


101. Click on **Scene 22**. Using the skills you have learnt assemble the bucket using the move tool and then add finger joints to the base of the bucket.

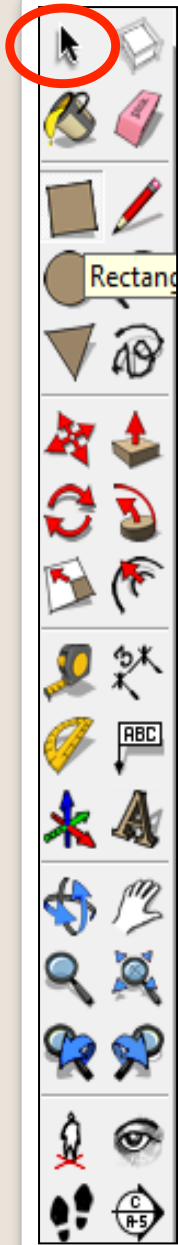




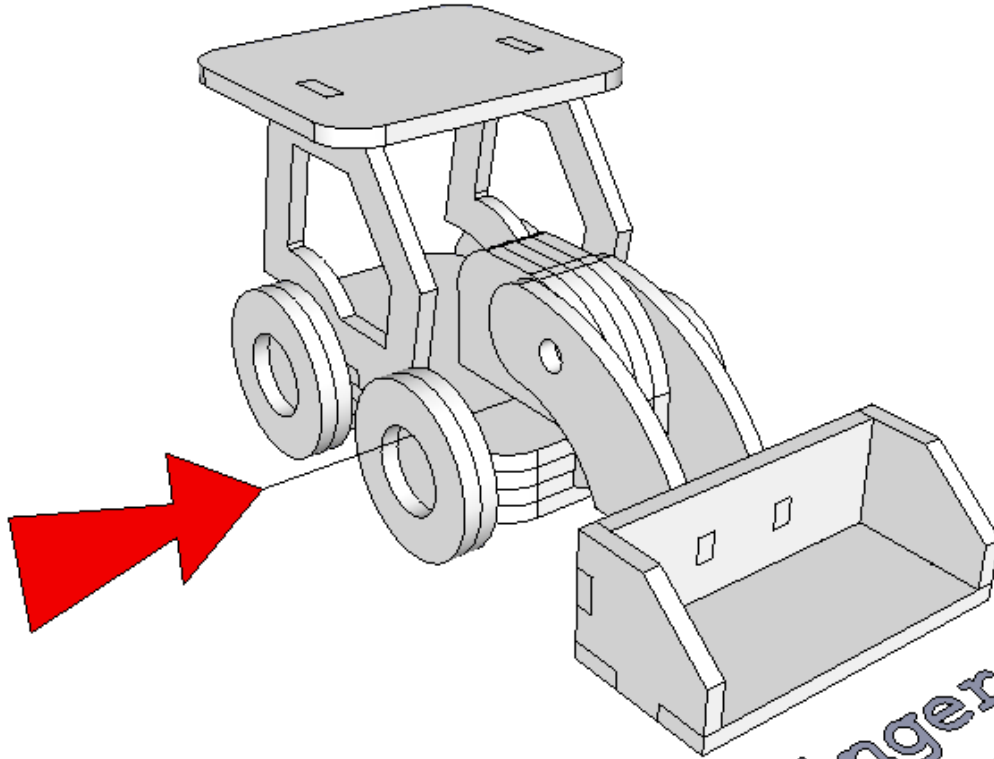
102. Click on **Scene 23**. Using the skills you have learnt design a bonnet on the parts highlighted by the arrow and a 3.5mm hole going through to place a bolt through.



Design the bonnet and add a 3.5mm radius for a bolt to fit through!



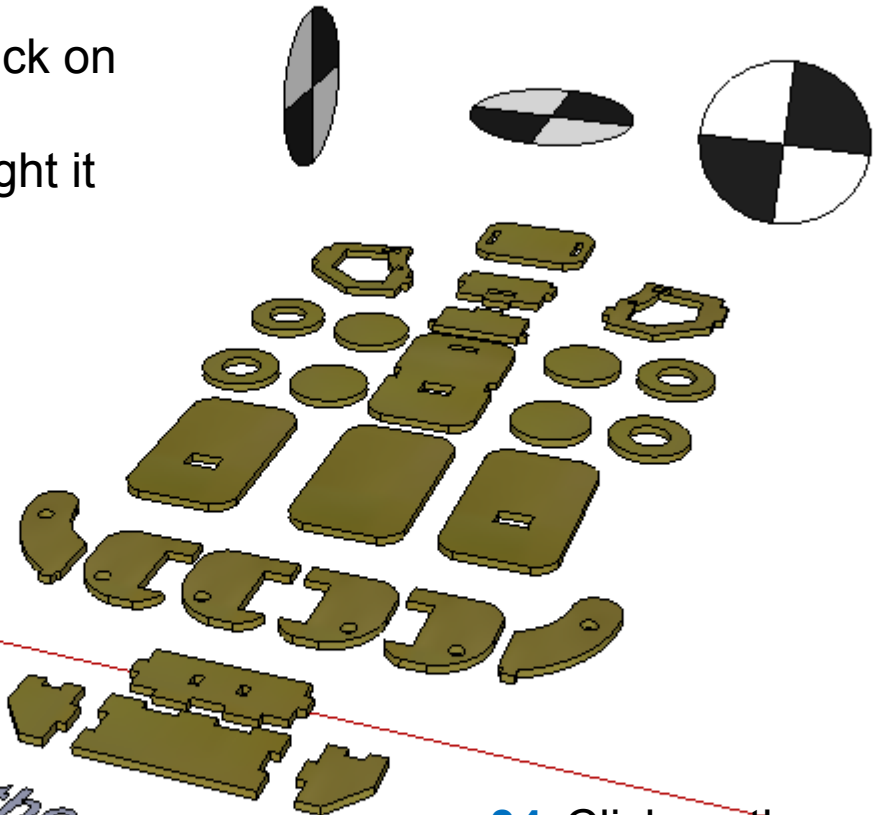
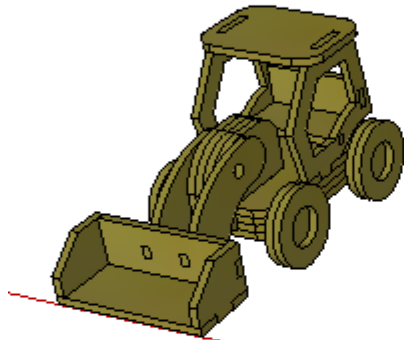
103. Click on **Scene 24**. Using the skills you have learnt design a finger joint for the bonnet parts highlighted to attach it securely to the main body



Add finger joints to secure the bonnet to the base



104. Select **scene 25**. Click on one of the shapes by clicking on it to highlight it with the black arrow



Using the rotation and move tool, assemble the toy

34. Click on the rotate tool



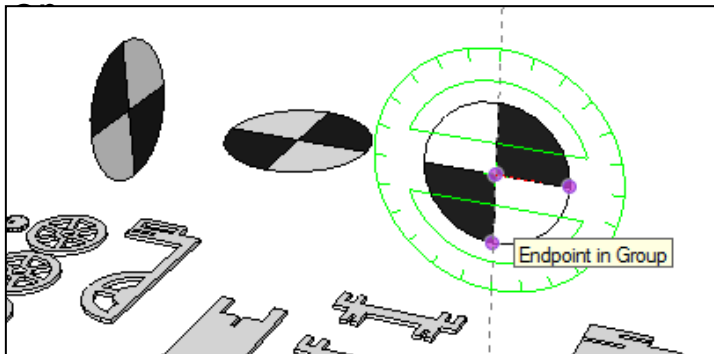
105. Position the rotate tool in the middle of the circle shown and click once. Ensure it is **green** before you click



106. Pull the line out and click on the circumference of the circle shown. It will say endpoint.

107. Start to rotate as shown

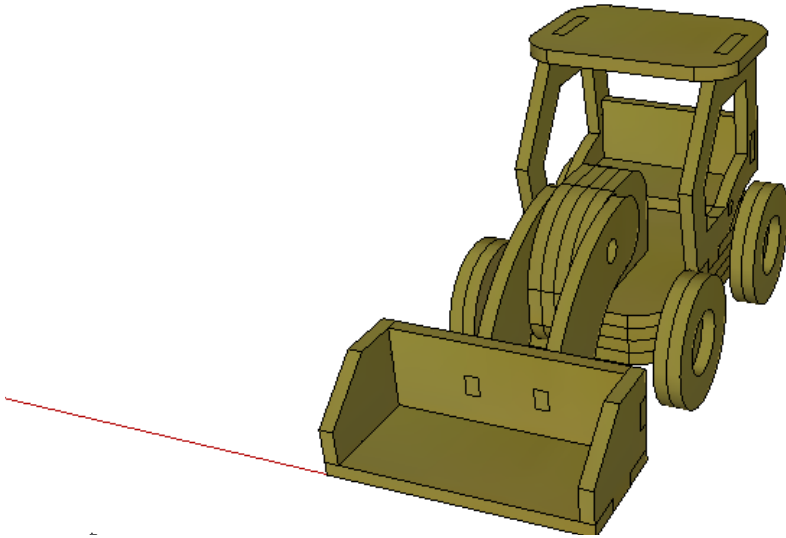
108. Type in 90 and press enter



Click on the bottom quadrant as shown.



109.Click on **scene 26**. Use the colouring bucket to render your design. If time allows use some professional software to render



110.Complete the rest of the **scenes**



Extension

- Design your own wooden toy for a child.....

