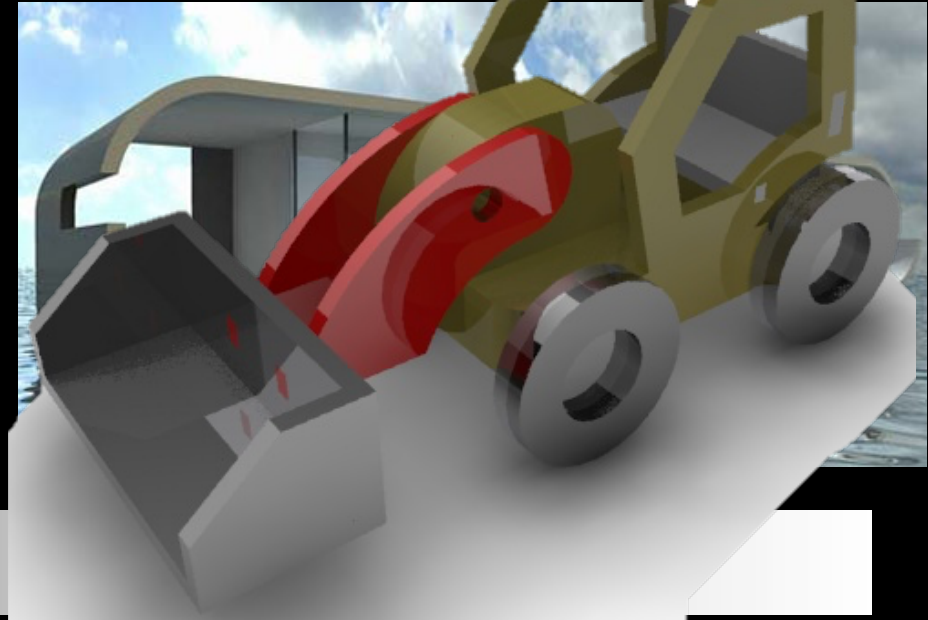CAD SKILLS

CAD TUTORIALS: FLAT-PACKED TOY

CAD Tutorial 17: Flat Packed Toy

Level of Difficulty

★★★★☆

Time
Approximately 10–20 minutes

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.

Learning Styles
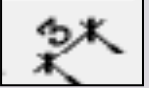
Visual : *Presentation*

Auditory: *Video*

Kinaesthetic: *Demonstration*

Sketchup Help Guide:

Computer Aided Engineering: 15. Drawing and Modification Commands

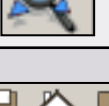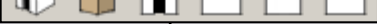| Drawing and Modification Tools	image	Description	Advantages
Modifying Tool 1. **Pencil tool**		used to draw lines in X, Y and Z direction. Can draw simple or complex shapes very quickly.	*Advantages: Allows user to draw or modify shapes very quickly and can be used to construct 3D objects faster than traditional hand drawings*
Modifying Tool 2. **Trim tool**		. allows the user to remove overlapping elements.	*Advantages: Allows user to erase overlapping lines and edges to draw complex 3D shapes very quickly.*
Modifying Tool 3. **Push/pull**		tool used to turn solid objects into 3D objects instantaneously. Typing a size allows a user to extrude or pull an object to a certain size or height	*Advantages: Allows user to draw or modify 3D shapes very quickly faster than traditional hand drawings. You can click on a face (plane) and adjust. Can be used to extrude shapes on 3D objects already drawn.*
Modifying Tool 4. **Move Tool**		used to move entire shapes or pull lines on a drawing.	*Advantages: Allows user to draw or modify shapes very quickly and can be used to construct unusual 3D shapes quickly*
Modifying Tool 5. **Dimensions tool**		used to show sizes and radius of drawn objects	*Advantages: Allows user to draw or modify 3D shapes very quickly faster than traditional hand drawings to correct size if drawn incorrectly. Drawing can be transferred onto the CNC machines directly*
Modifying Tool 6 **Extrusion Tool (follow me)**		allows the user to highlight a path that turns blue. A chosen shape will then follow the chosen path	*Advantages: Allows user to draw profiles of shapes and follow the path to draw complex 3D shapes very quickly.*
Modifying Tool 7. **Arch tool**		*You can use the **arch** tool to draw a radius from two given points.* Can be used to draw corners etc..	*Advantages: Allows user to rotate and position shapes quickly to draw complex 3D shapes very quickly.*
Modifying Tool 8. **Circle tool**		allows the user to draw different sized radius circles and chamfered corners	*Advantages: Allows user to draw profiles of shapes and follow the path to draw complex 3D shapes very quickly.*
Modifying Tool 9. **Orbit tool**		*You can use the **Orbit** tool to change the angle that you are viewing your design from. You can do the same by pressing the middle wheel of your mouse*	*Advantages: Allows user to rotate and see all angles of their design quickly*
Modifying Tool 10. **Tape measure tool**		allows the user to draw guide lines to given sizes and mark out radius etc.	*Advantages: Allows user to draw guides of shapes and draw complex 3D shapes very quickly.*

Sketchup Help Guide:

| Drawing and Modification Tools	image	Description	Advantages
Modifying Tool 11. **Square tool**		used to draw squares and rectangles.	*Advantages:* *Allows user to draw guides of shapes and draw complex 3D shapes very quickly.*
Modifying Tool 12. **Offset tool**		. *You can use the **contour** tool to draw parallel lines or lines within lines.*	*Advantages:* *Allows user to draw duplicate lines and position them within shapes quickly to draw complex 3D shapes very quickly.*
Modifying Tool 14. **Rotate Tool**		used to move rotate parts of a shape or entire shapes on x, y and Z co-ordinates.	*Advantages:* *Allows user to draw or modify shapes very quickly and can be used to construct unusual 3D shapes quickly*
Modifying Tool 15 **Scale Tool**		allows the user to select an object or part of an object and increase its sixe from the base point.	*Advantages:* *Allows user to quickly resize objects to draw complex 3D shapes very quickly.*
Modifying Tool 16 **Paint Bucket Tool**		allows the user to select a colour or materials to produce photo-realistic drawing of their object. Shadows etc. can be added.	*Advantages:* *Allows user to quickly draw objects life like using materials, textures etc...*
Modifying Tool 17 **Pan Tool**		*You can use the **Pan** tool to grab and move your object around the screen. Alternatively, you can pan by pressing the **Shift** key **and** holding down the mouse's middle wheel.*	*Advantages:* *Allows user to move and position their object quickly*
Modifying Tool 18 **Text Tool**		*You can use the **text** tool to add text to your object.*	*Advantages:* *Allows user to add 3D text by clicking on the extrude button or 2D text*
Modifying Tool 19 **Zoom Extents Tool**		*You can use this tool to automatically zoom into your entire project.*	*Advantages:* *Allows user to quickly navigate to the entire drawing if they get lost.*
Modifying Tool 20 **View Tool**		*You can use the **view** tool to quickly look at front side and top views as well as 3D views*	*Advantages:* *Allows user to complete working drawings quickly as well as enabling them to show a top view for exporting onto the laser cutter.*

1. Open Library /Designoutthebox.com/ CAD Skills/ Lesson 16 / Flat-packed Toy

Open the sketch up drawing. Once you have opened SketchUp, go to **Window** and select **Model Info**
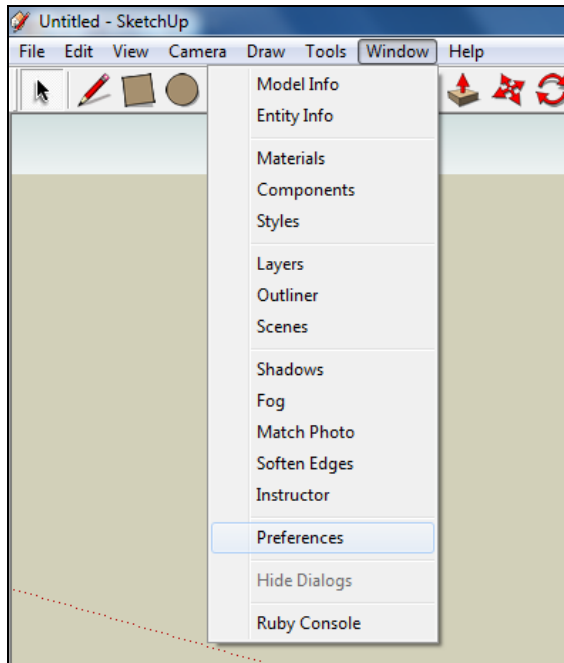
2. Select **Units** and choose **Decimal Millimetres**. We are using this template because we are doing a product design.

*Note: It is often necessary to start a new file to use the new template. Go to **File** then **New**.*
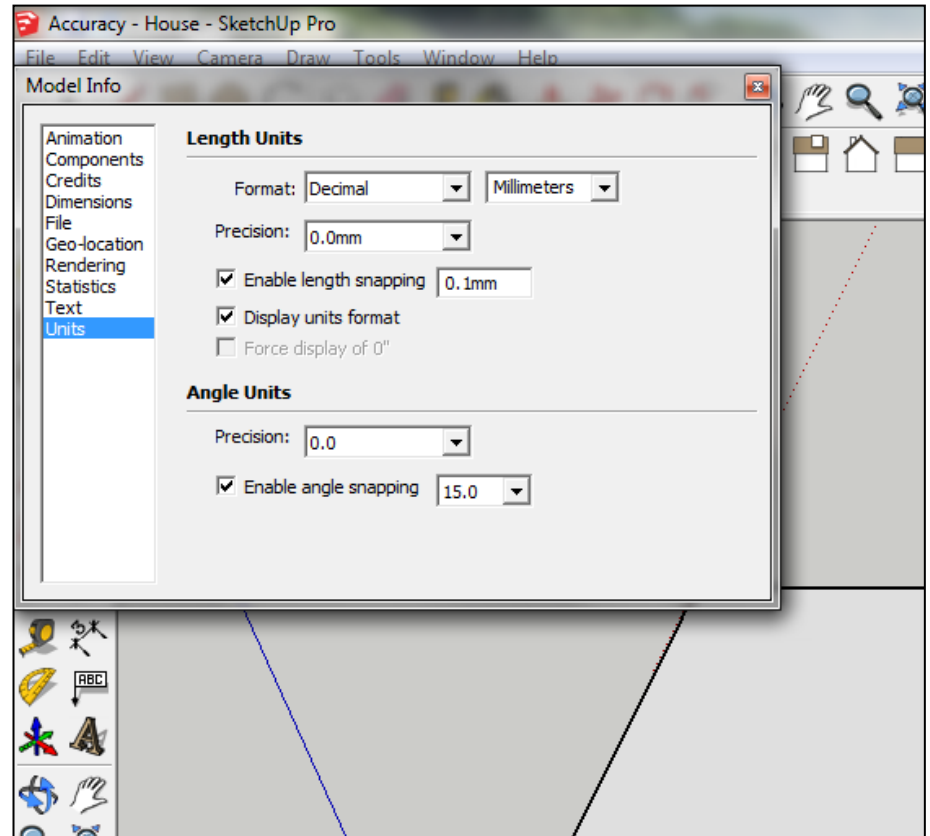
3. Now select the **View** then **toolbars** and ensure **Getting Started** and **Large Tool Set** are ticked
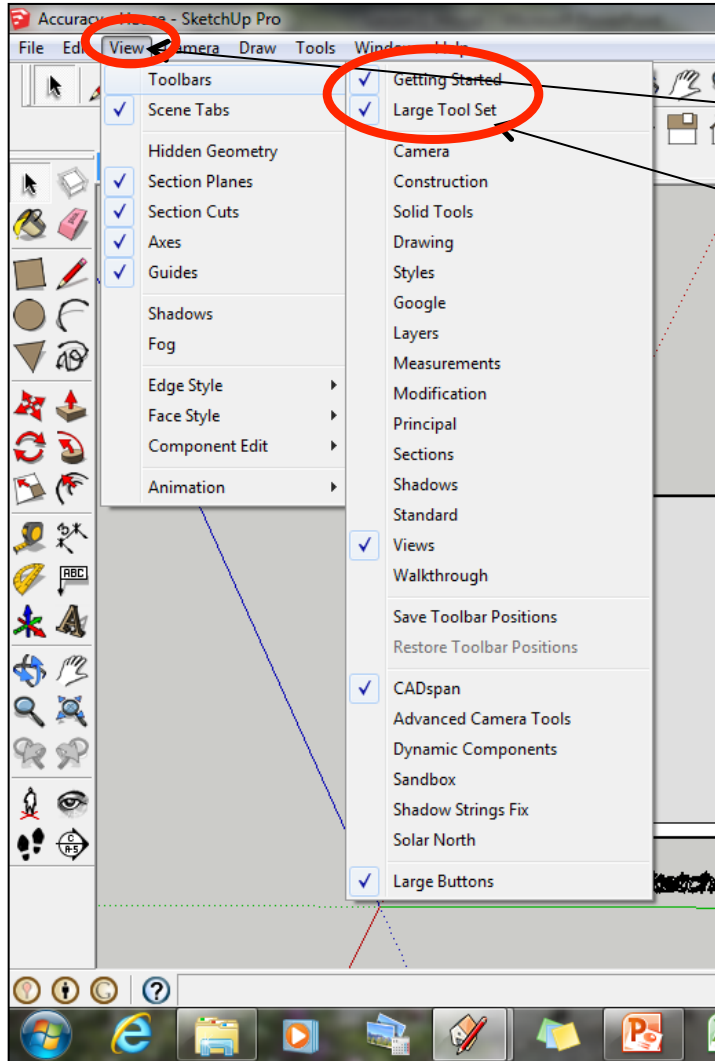
3a Select **View**

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
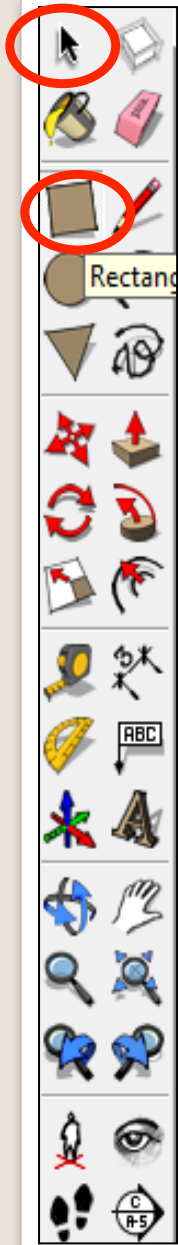

Main Activity: Wooden Toy
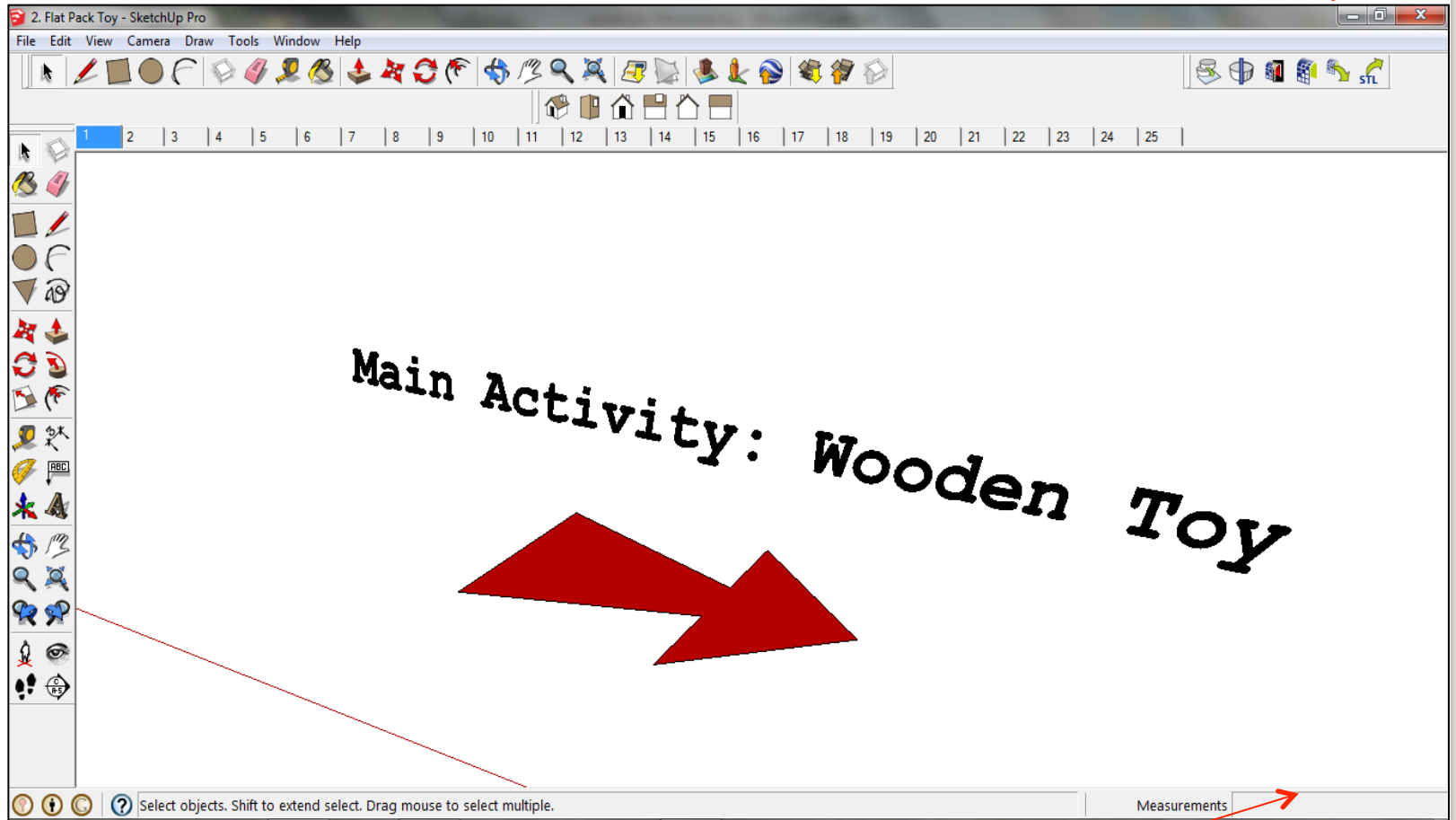
Measurements tool bar

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.***
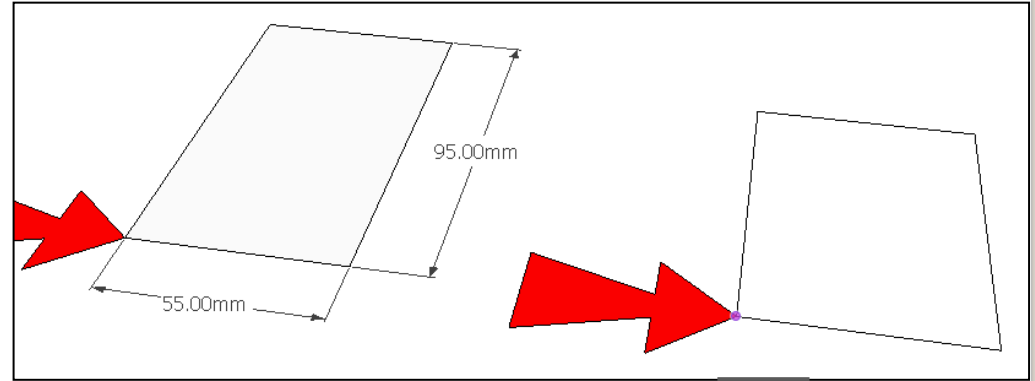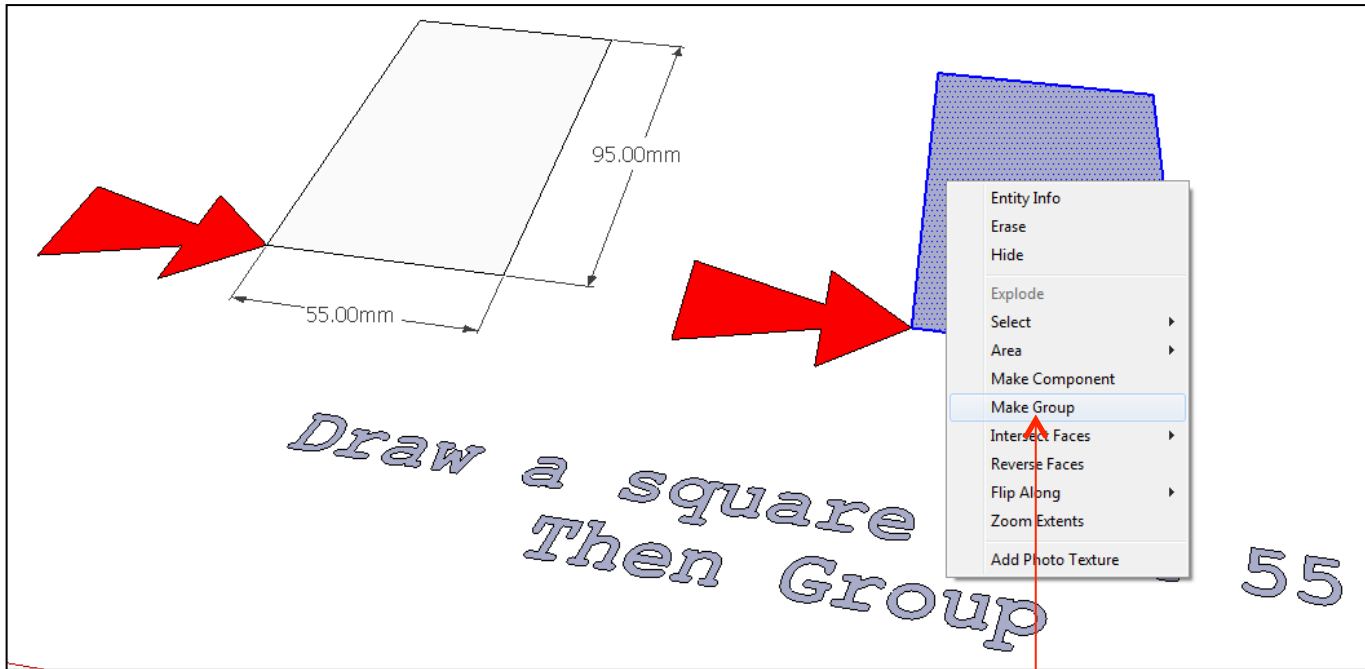

Wooden Toy
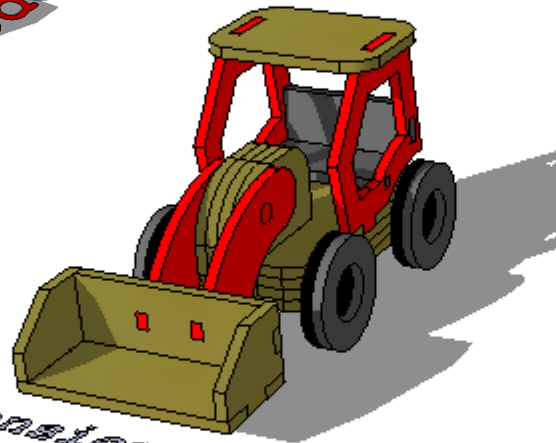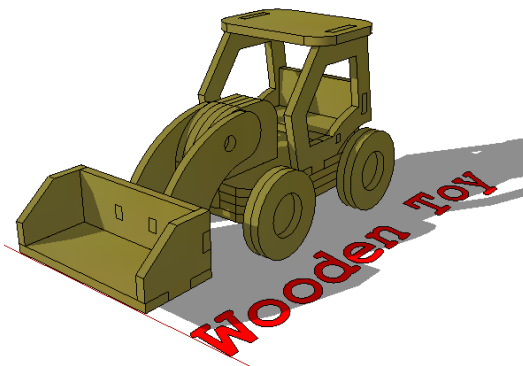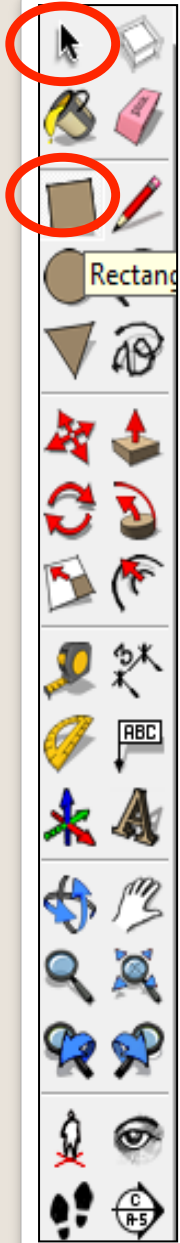
Extension Task:
Photo Realistic Render

6. Click on **Scene 7.**

95.00mm

55.00mm
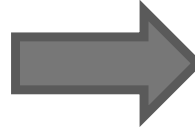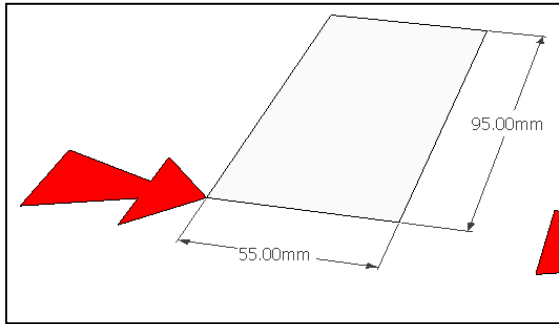
7. Click on the **square tool** and then the end of the arrow to start drawing a square**.**

95.00mm

55.00mm

95.00mm

55.00mm

Draw a square 95 x 55
Then Group

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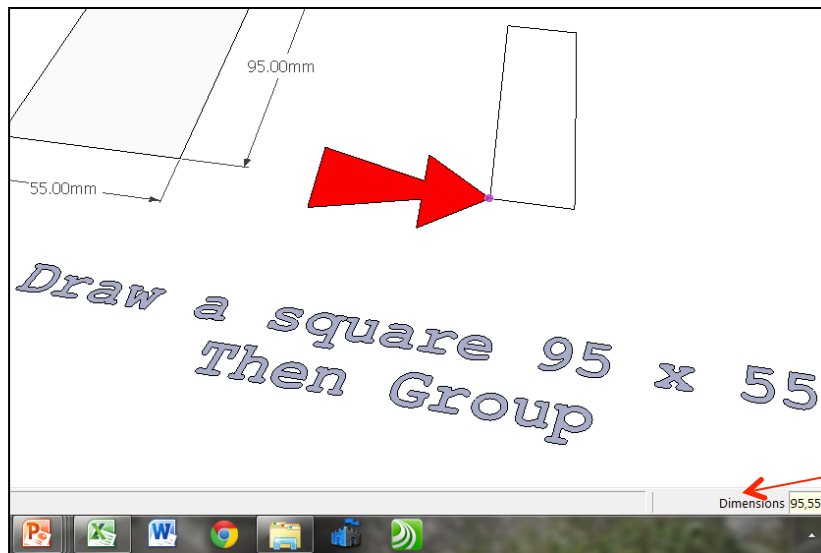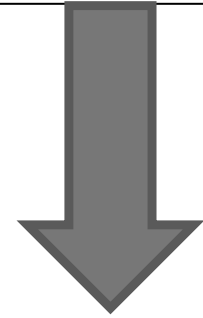
8. Start typing *95,55* and then press *enter*.

Rectang

95.00mm

55.00mm

Draw a square
Then Group

Entity Info
Erase
Hide

Explode
Select ▸
Area ▸
Make Component
Make Group
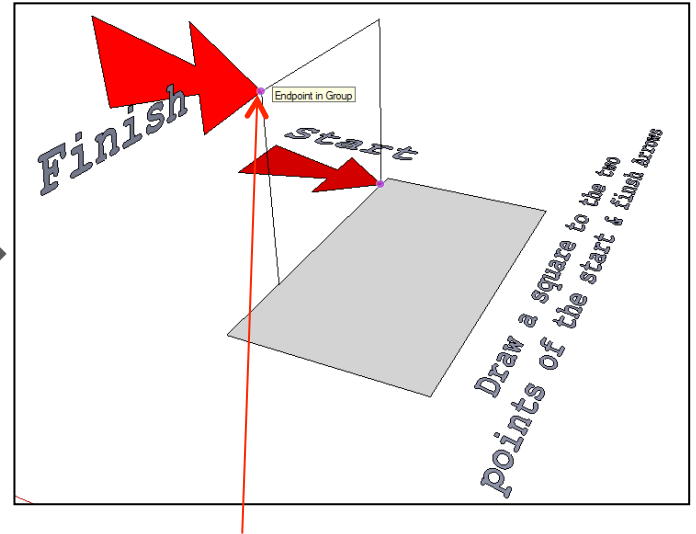Intersect Faces ▸
Reverse Faces
Flip Along ▸
Zoom Extents

Add Photo Texture

55

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

10. Click on **scene 8**

Finish Start

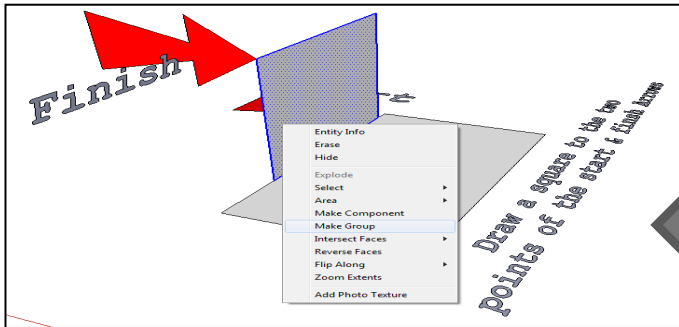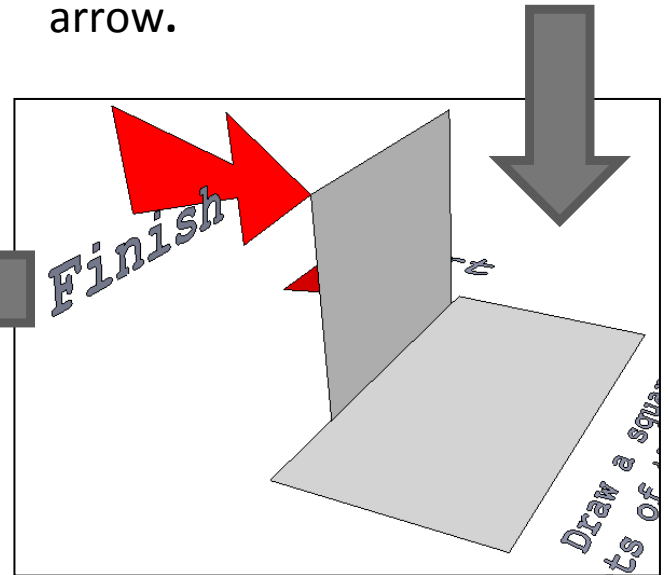Draw a square to the two
Points of the start & finish arrows

13
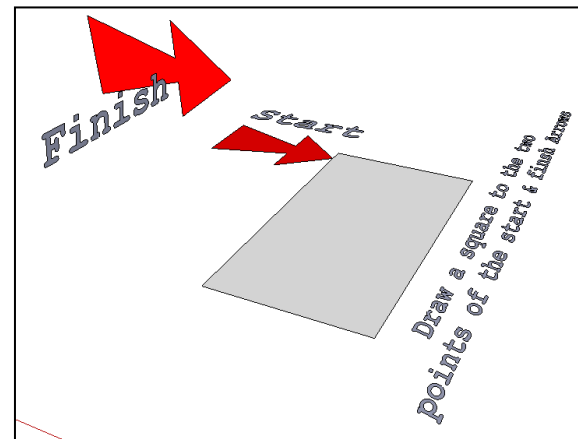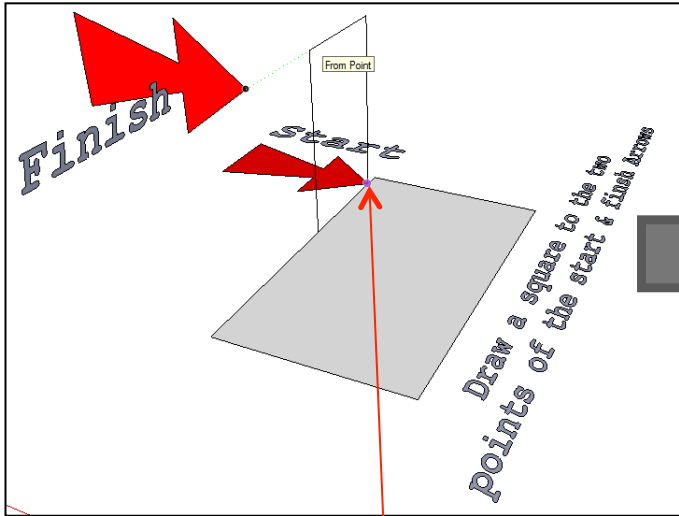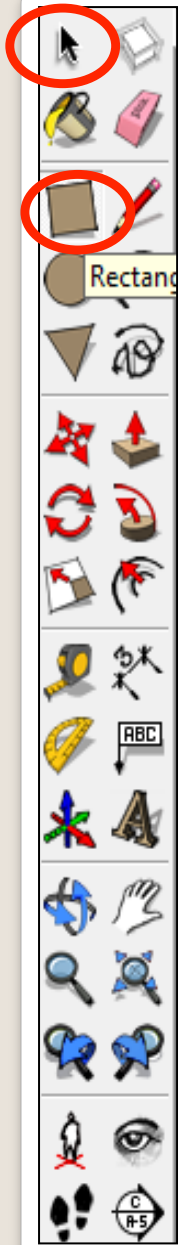
11. Click on **rectangle tool** and then ON the end of the *start* arrow**.**

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.

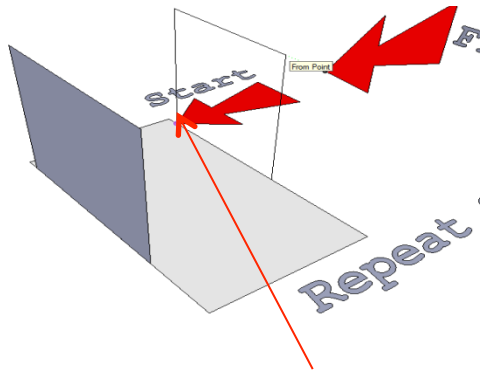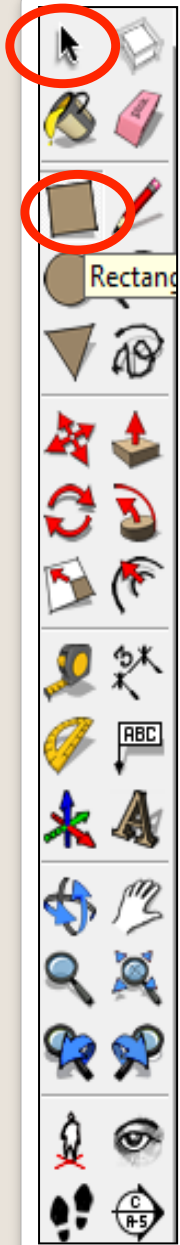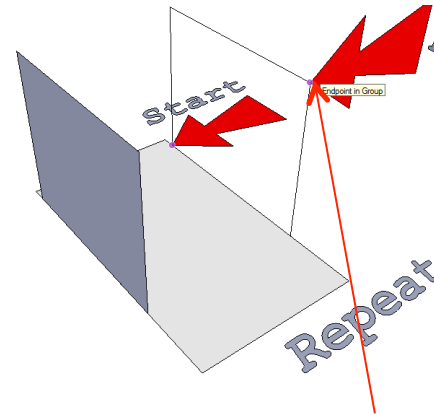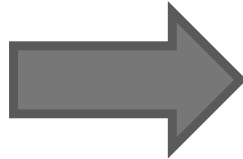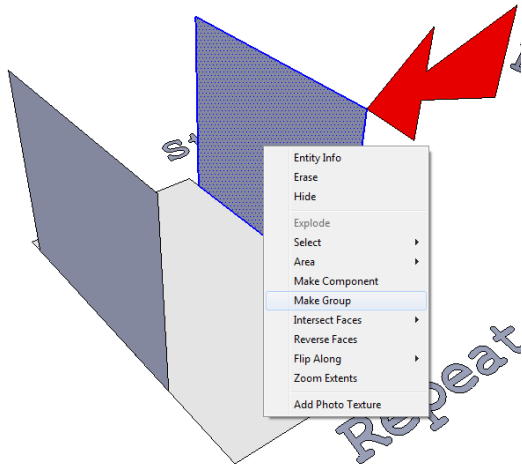14. Click on **scene 9.** Click on **rectangle tool** and then ON the end of the *start* arrow**.**

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.

From Point

Endpoint in Group

Start
Repeat

Entity Info
Erase
Hide
Explode
Select
Area
Make Component
Make Group
Intersect Faces
Reverse Faces
Flip Along
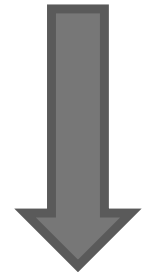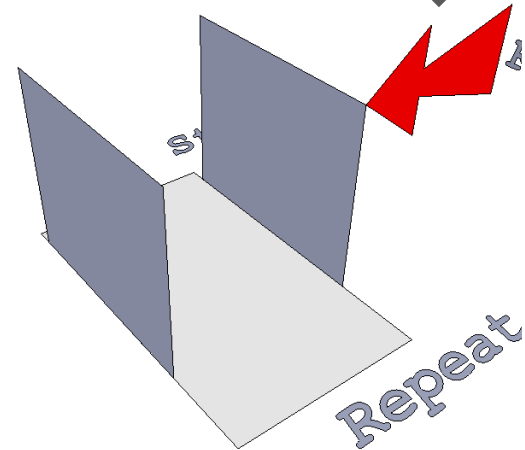Zoom Extents
Add Photo Texture

17. Click on **Scene 10**

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

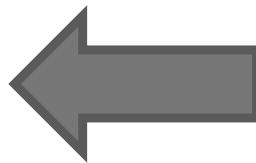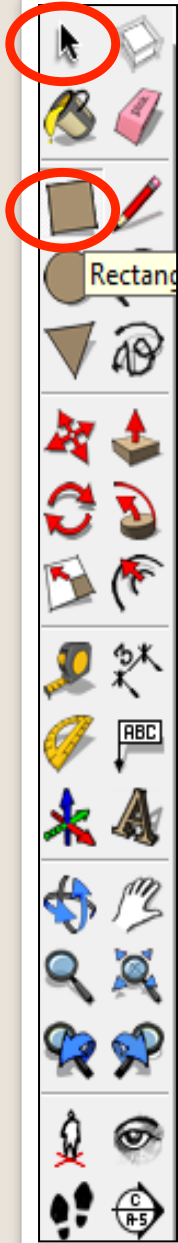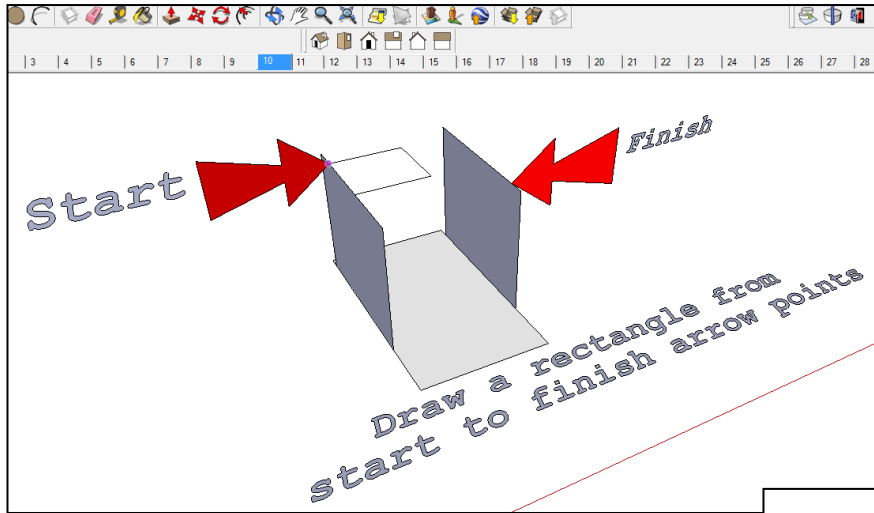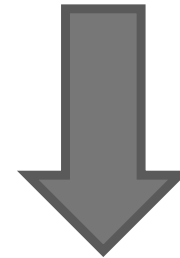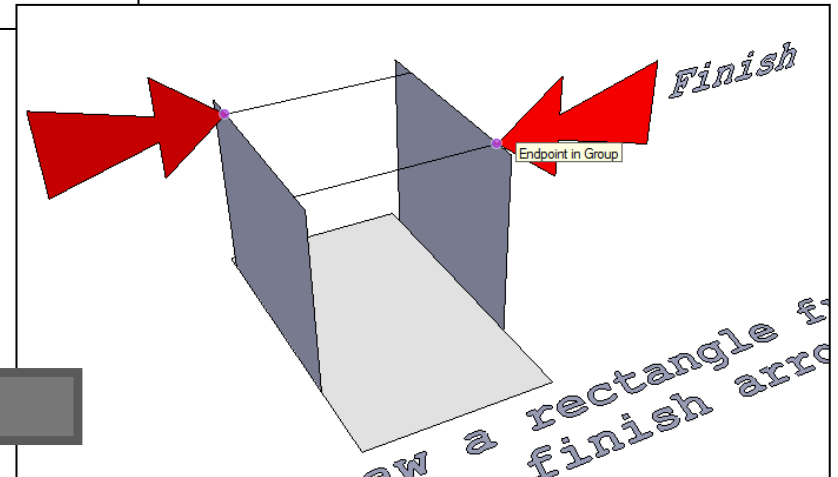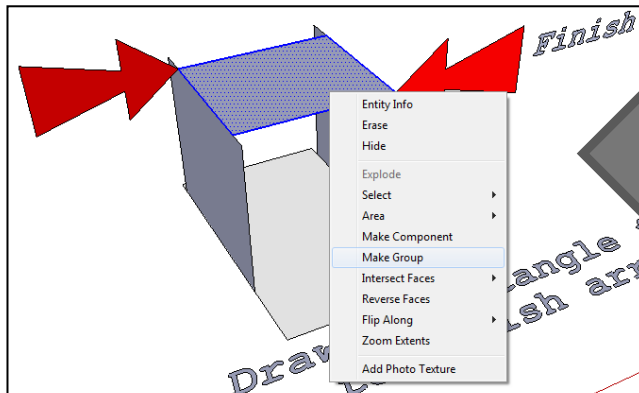20. Click on the rectangle until its all highlighted. Right click the mouse button and make group.

Entity Info
Erase
Hide

Explode
Select
Area
Make Component
Make Group
Intersect Faces
Reverse Faces
Flip Along
Zoom Extents

Add Photo Texture

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

16
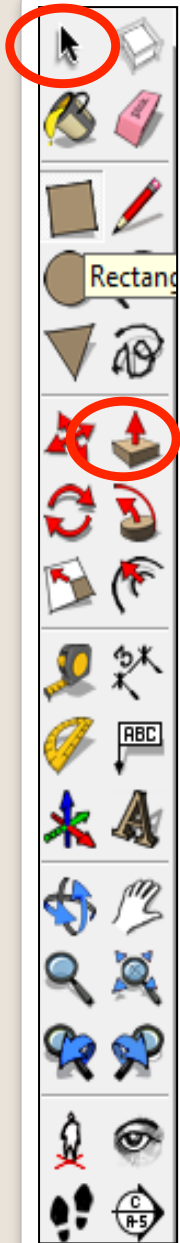
21. Click on **Scene 11.**

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
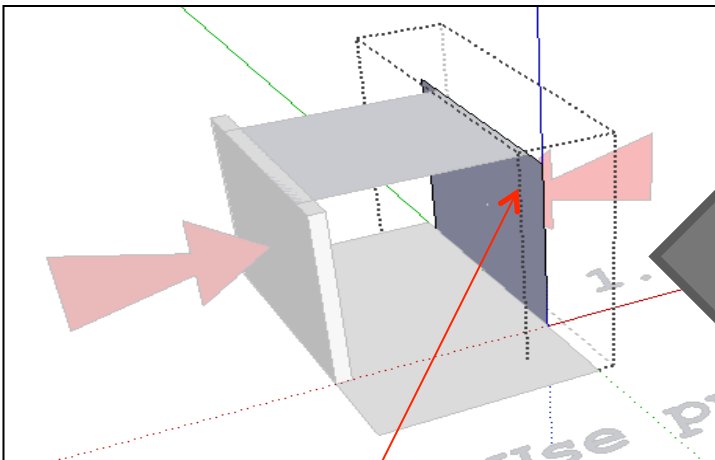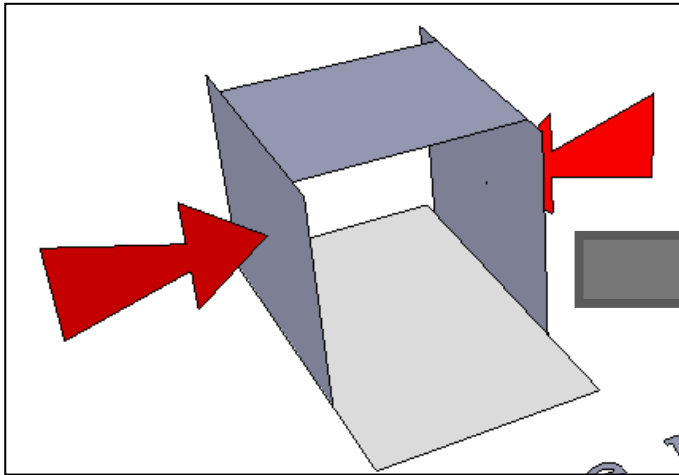
24. **Repeat** steps **22 & 23** on the opposite component.
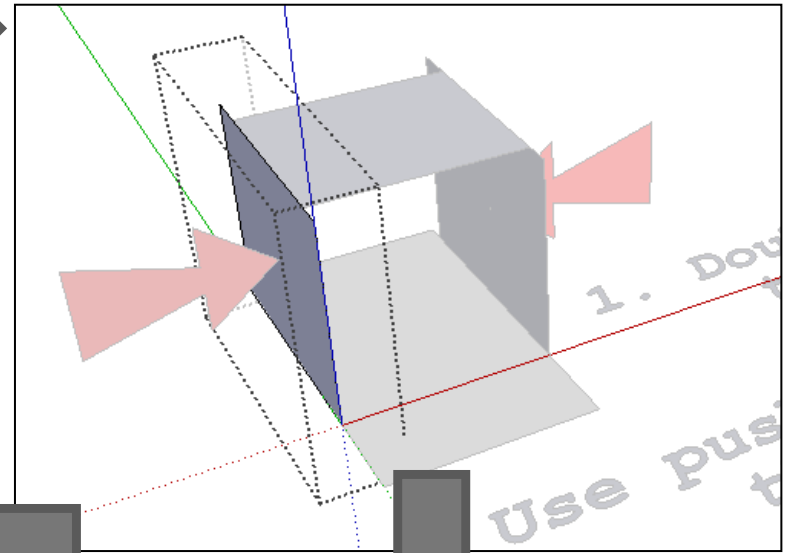
23. Use **the push pull tool** to push the component. Click **once** on the mouse button to start and then **type 4** and press **enter**
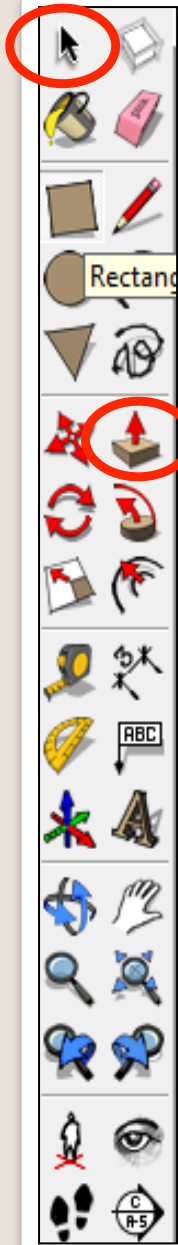
25. Click on **Scene 12.**

| 10 | 11 | **12** | 13 | 14 | 15 | 16 |

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
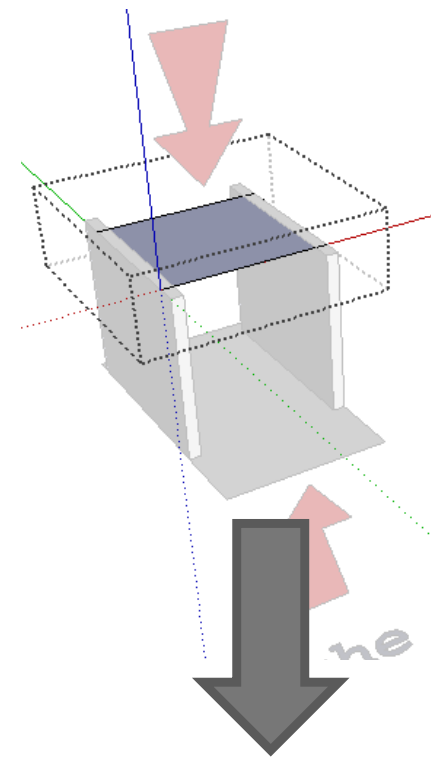
28. *Repeat* steps *26 & 27* on the opposite component.
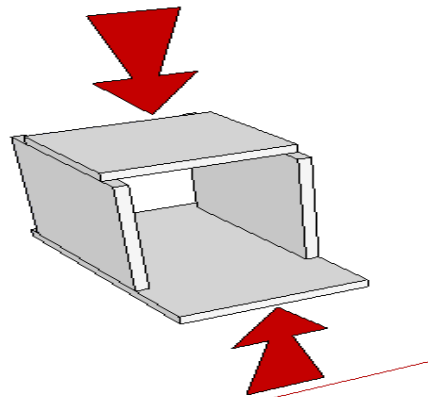
27. Use *the push pull tool* to push the component. Click *once* on the mouse button to start and then *type 4* and press *enter*

29. Click on **Scene 13.**

Double Click on the side
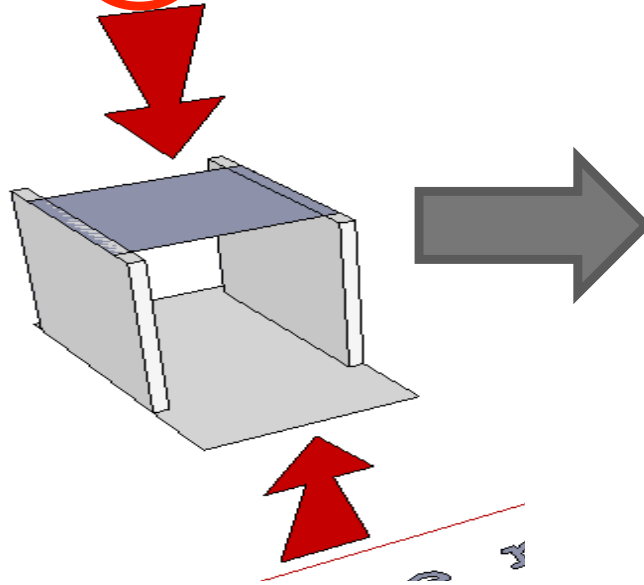Draw a side of a tractor
using pencil and arch tool
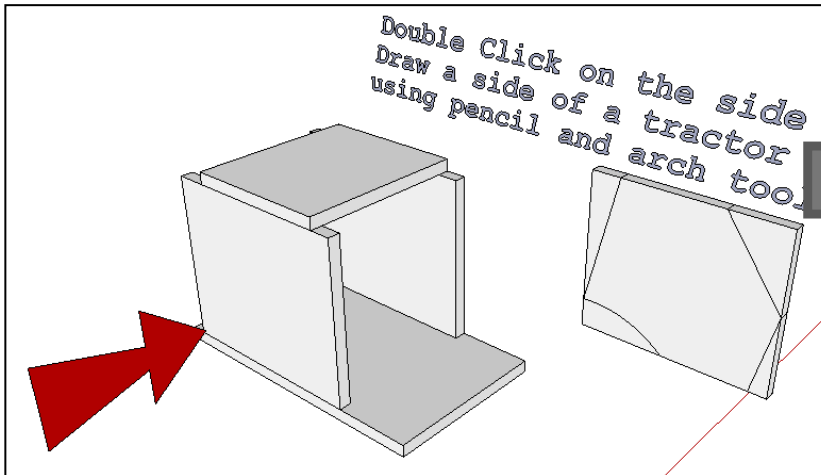
30. Double click on the side piece to **edit.** Everything should grey out and a dotted rectangle should appear around the part you are about to edit
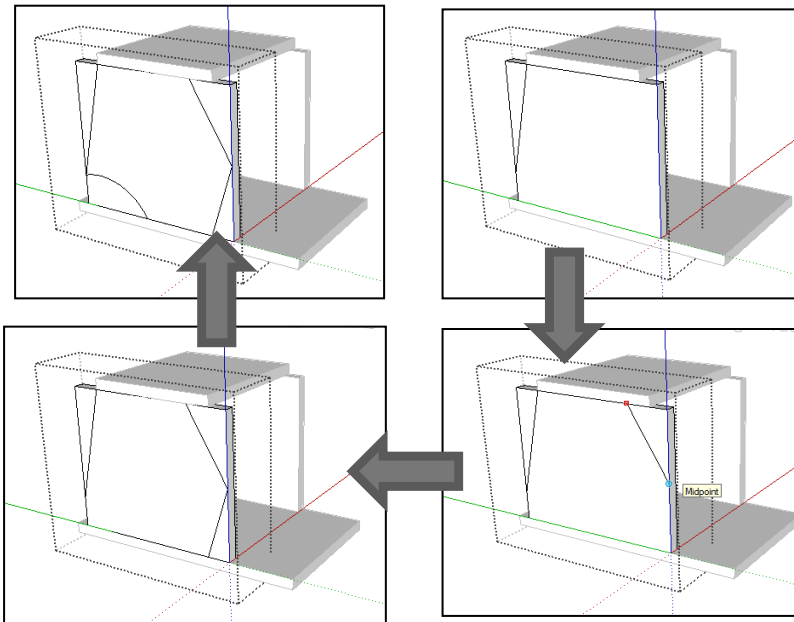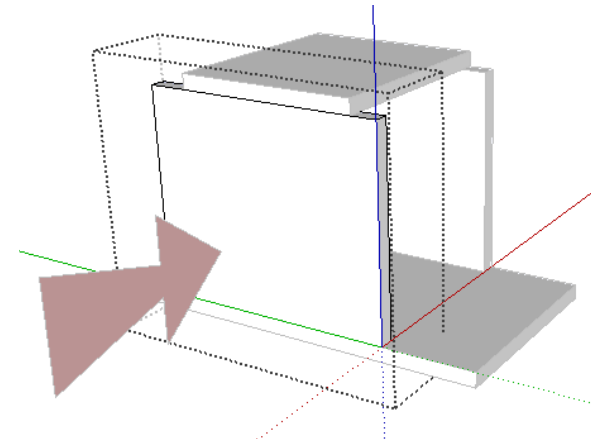
31. Use the *pencil* tool and *arch* tool to draw the side shape of the tractor.

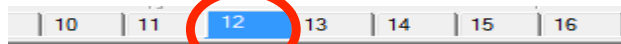Midpoint

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

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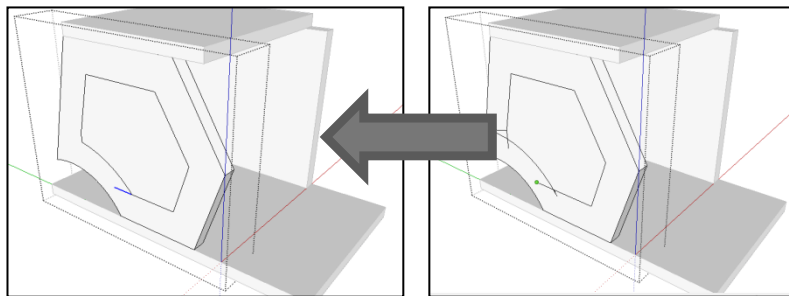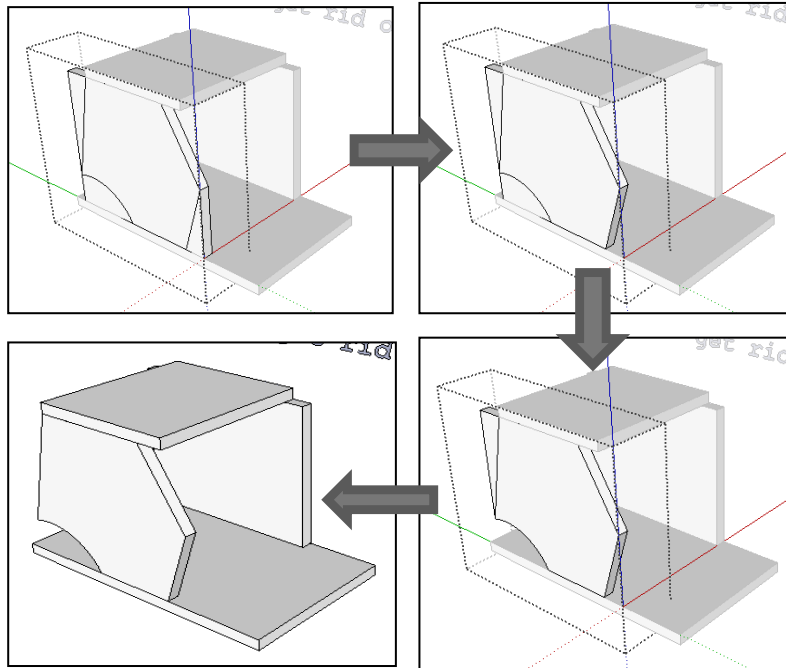
36. Use *rubber* tool to get rid of excess lines

35. Use *pencil* tool to neaten shape
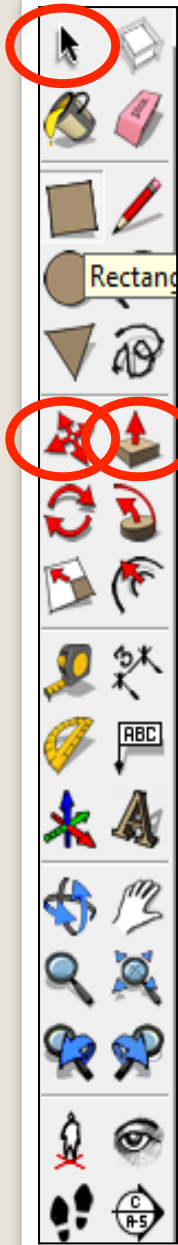
37. Use *push-pull* tool to get rid of the window

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

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

Midpoint in Group

Endpoint in Group

40. *Move* the shape along the red axis to the opposite side. Delete part not needed
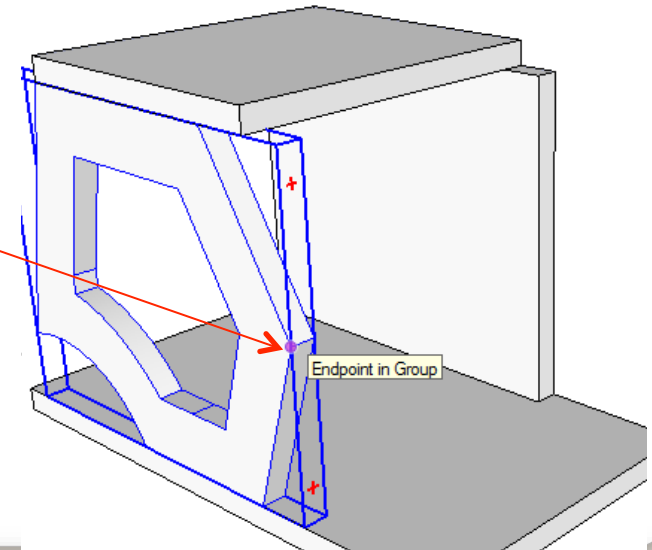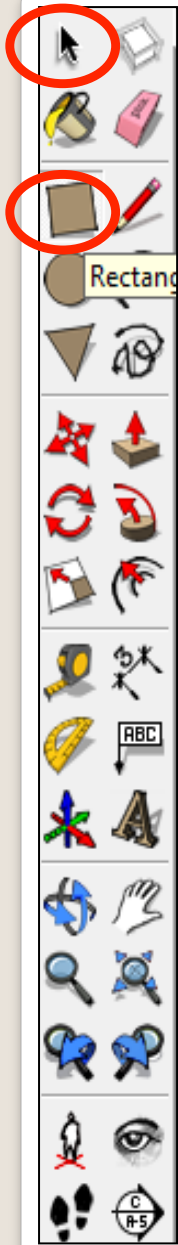
41. Click on **Scene 16.**
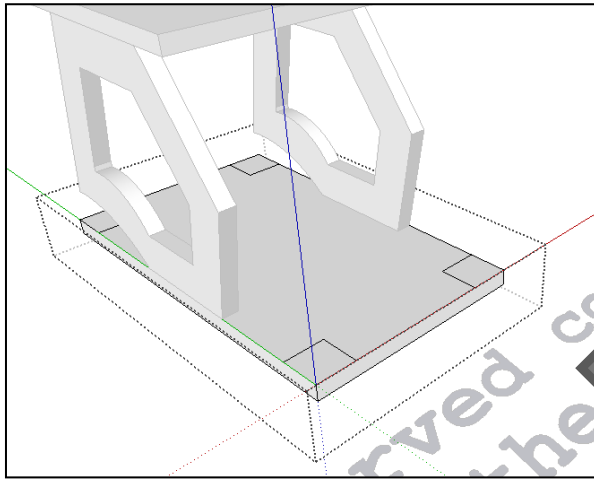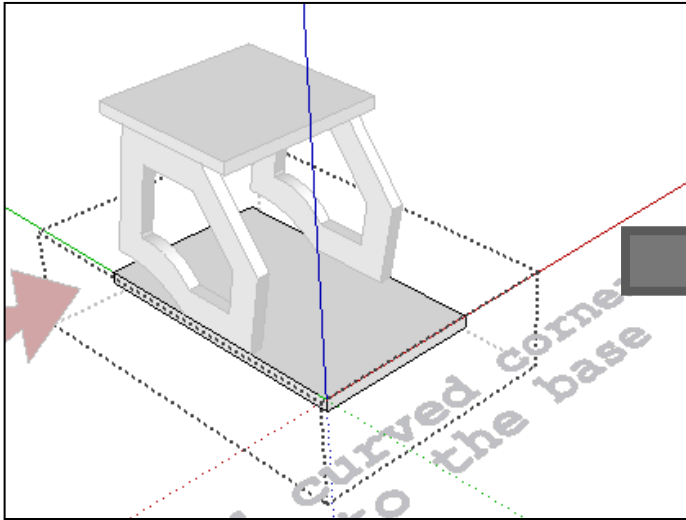
42. Double click on the base piece to **edit.** Everything should grey out and a dotted rectangle should appear around the part you are about to edit
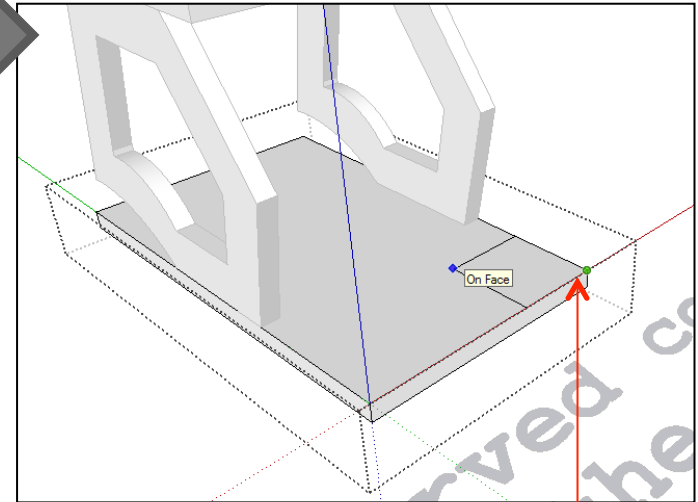

**43.** Click on the *square tool*. From the corner highlighted click to start drawing a square. Type in *10, 10* and *press enter*

44. Repeat *step 43* for all the corners
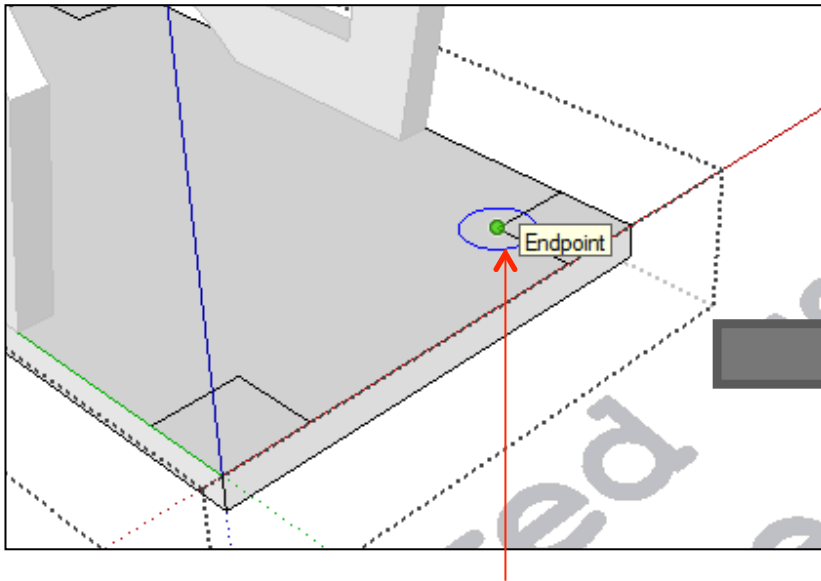
45. Click on the corner of the square shown below to complete the circle.
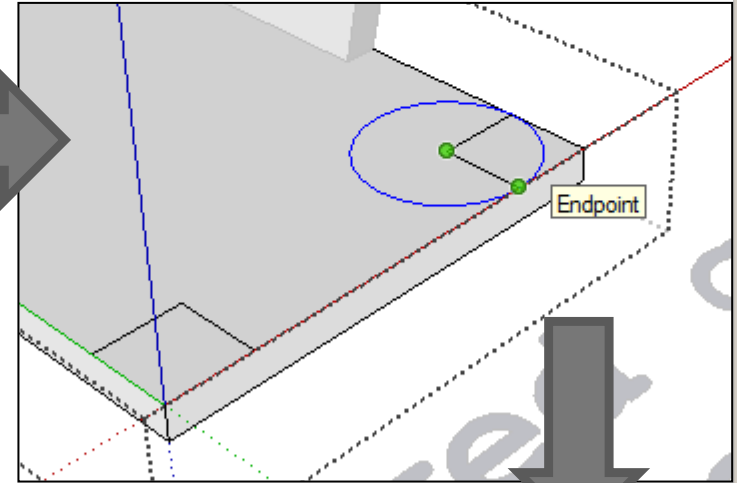
45. Click on the *circle tool* and then the corner of the square shown above.
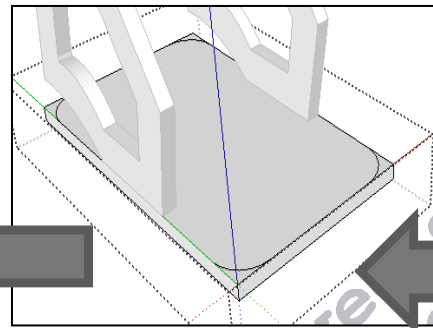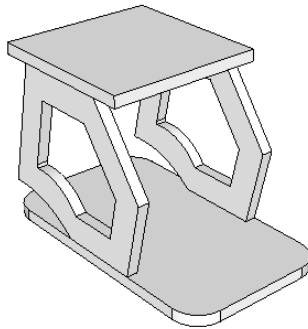
46. Repeat step 45 for the other three corners
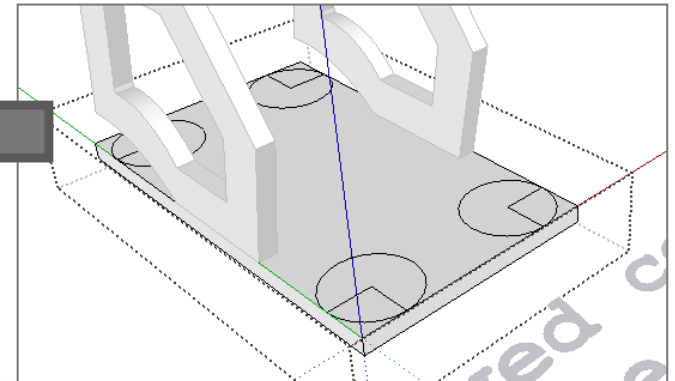
47. Use the *eraser* to clean up the edges and the *push-pull* tool to get rid of the waste
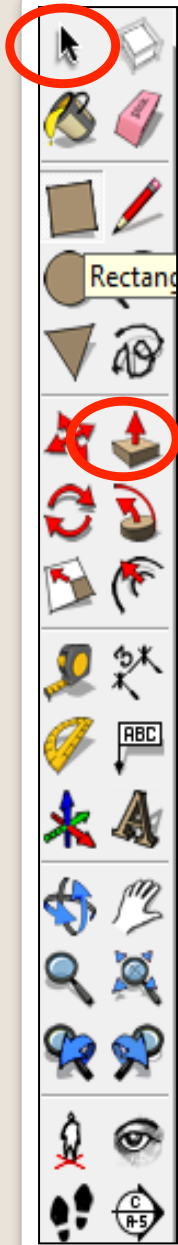
48. Click on **Scene 17.**
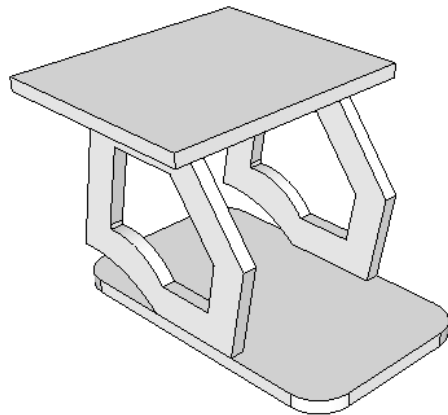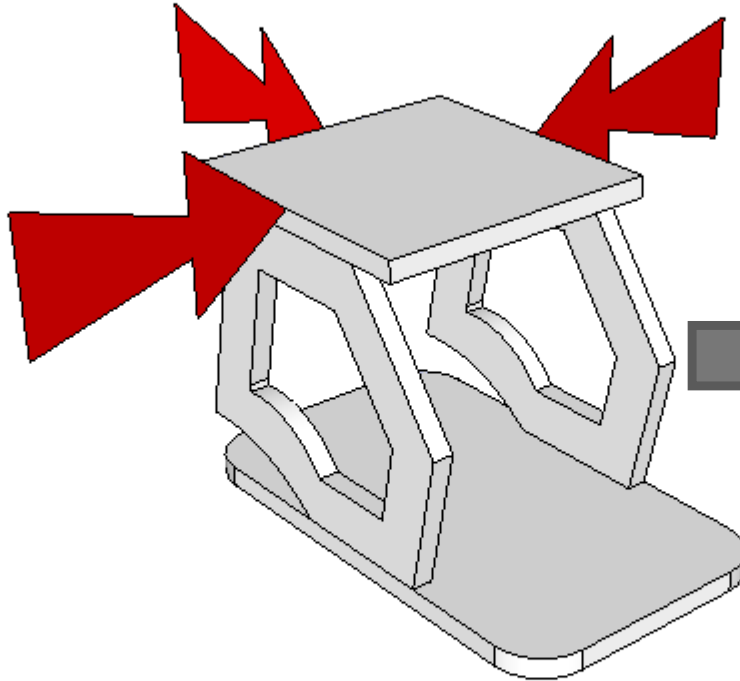
49. Double click on the top piece to **edit.** Everything should grey out and a dotted rectangle should appear around the part you are about to edit
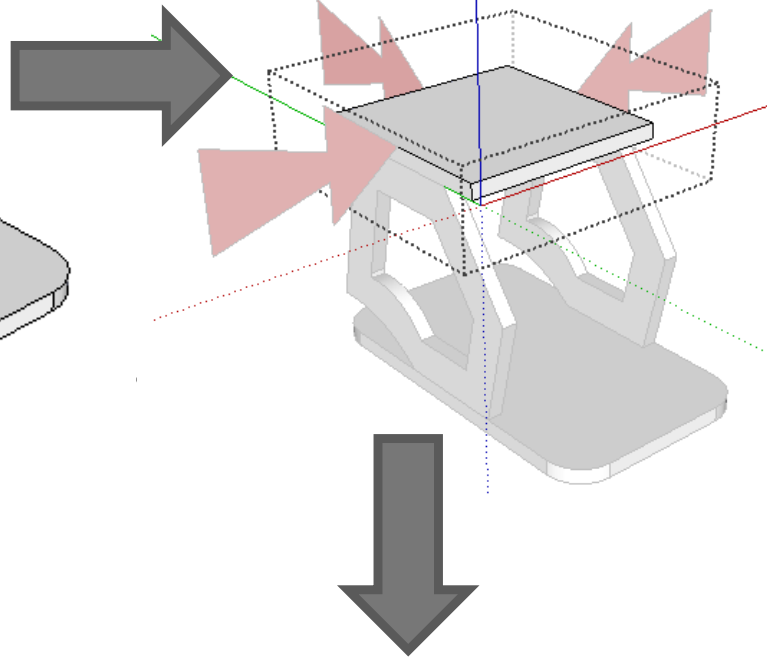
50. Click on the *push pull* tool and then pull the three edges out by *10mm*
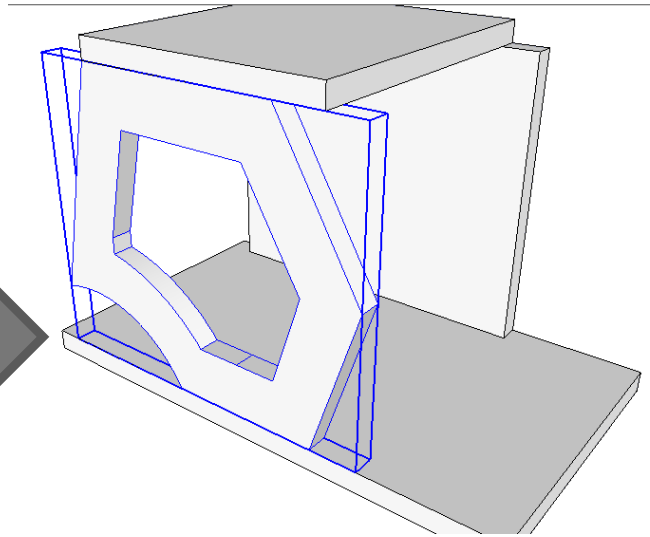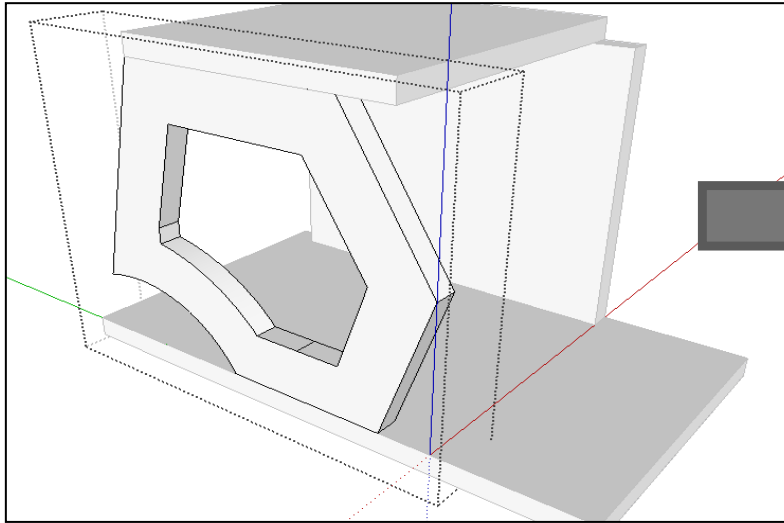
51. Click on **Scene 18.**

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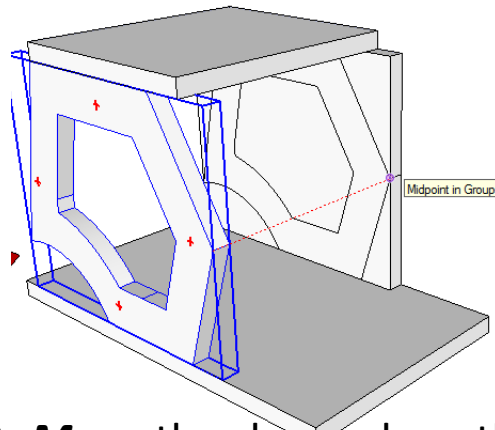
53. Click on the *square tool*. From the corner highlighted click to start drawing a square. Type in *10, 10* and *press enter*

54. Repeat step 45 for the other three corners
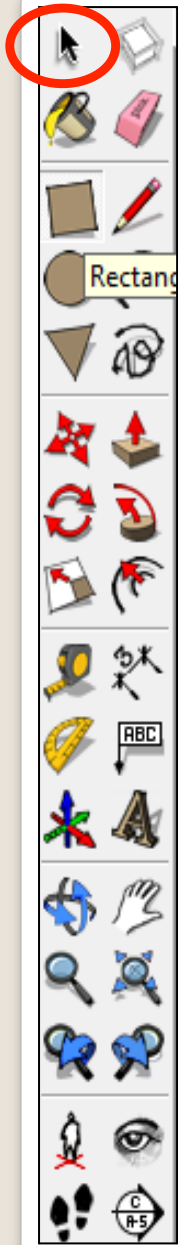
55. Click on the *circle tool* and then the corner of the square shown above.
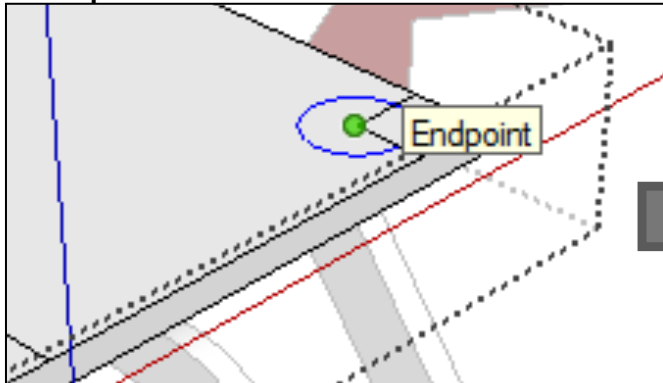
56. Click on the corner of the square shown below to complete the circle.

Endpoint

Endpoint
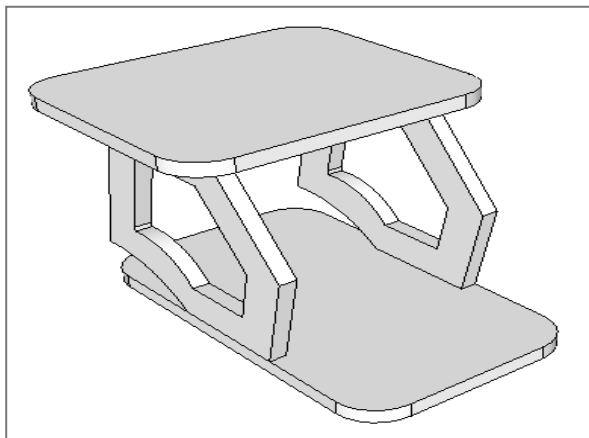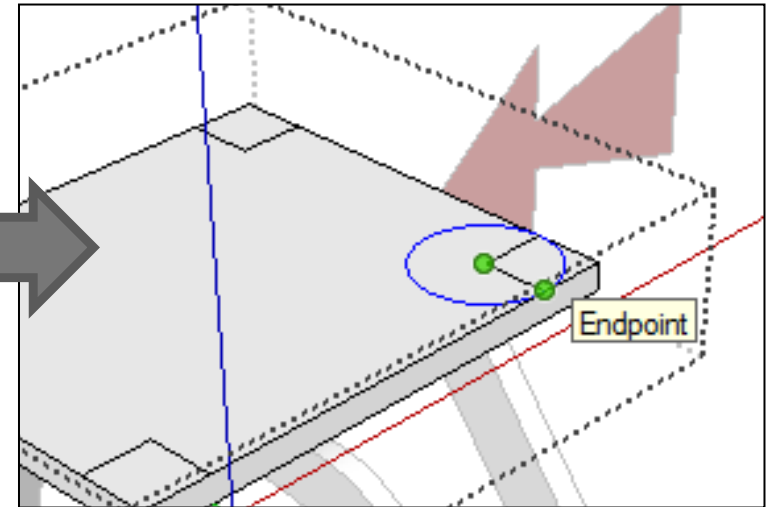
57. Repeat step 56 for the other three corners
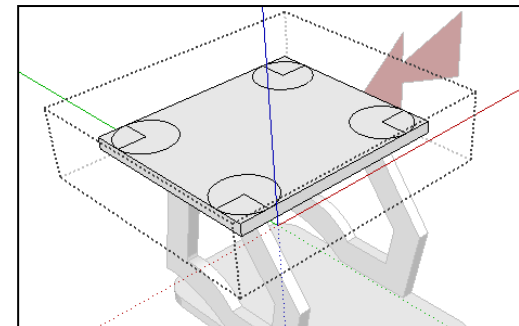
58. Use the *eraser* to clean up the edges and the *push-pull* tool to get rid of the waste

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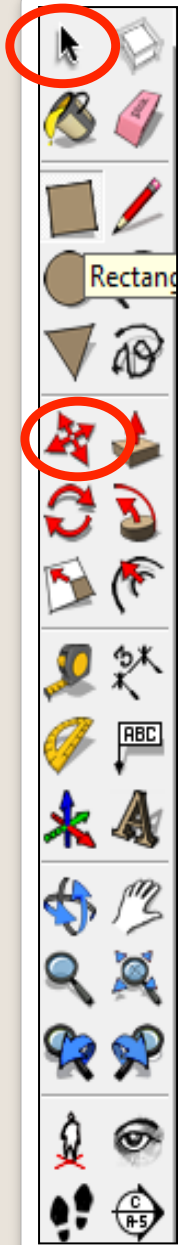
59. Click on **Scene 19.** Then using the black arrow click on the base once

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

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

Endpoint in Group

62. *Move* the shape along the blue axis and position directly underneath
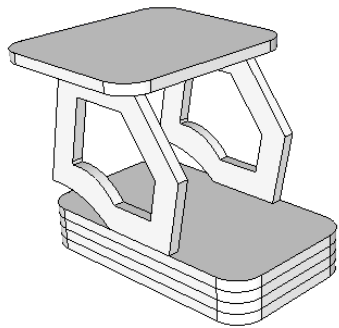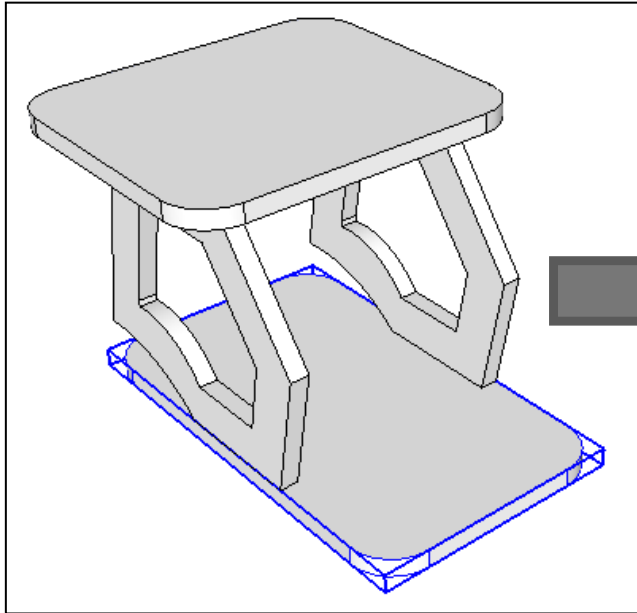
63. *Repeat* step 61 and step 62 a further two times

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

Entity Info
Erase
Hide
Lock
Edit Group
Explode
Make Component
Unglue
Reset Scale
Reset Skew
Intersect Faces ▸
Flip Along
Soften/Smooth Edges
Zoom Extents

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

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.

Entity Info
Erase
Hide
Select ▸
Soften
Divide
Zoom Extents

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

3 segments
Length: ~ 11.56mm

Endpoint

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***

Endpoint in Group

74. ***Delete*** part not needed

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

2. 3D Flat Pack Toy - SketchUp Pro

Edit | View | Camera | Draw | Tools | Window | Help

Undo Erase	Alt+Backspace
Redo	Ctrl+Y
Cut	Shift+Delete
Copy	Ctrl+C
Paste	Ctrl+V
Paste In Place	
Delete	Delete
Delete Guides	
Select All	Ctrl+A
Select None	Ctrl+T
Hide	
Unhide	▶
Lock	
Unlock	▶
Make Component...	G
Make Group	
Close Group/Component	
Intersect Faces	▶
No Selection	▶

Unhide submenu:
- Selected
- Last
- 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

75. Click on *edit* and then *unhide* / all
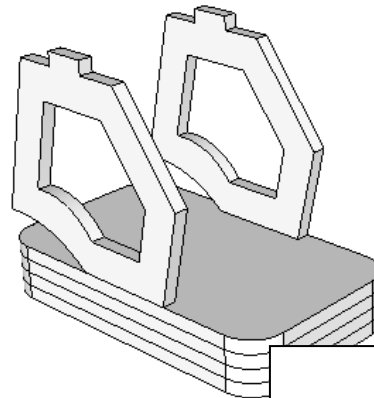
77. Draw a rectangle over the finger joints you have drawn previously

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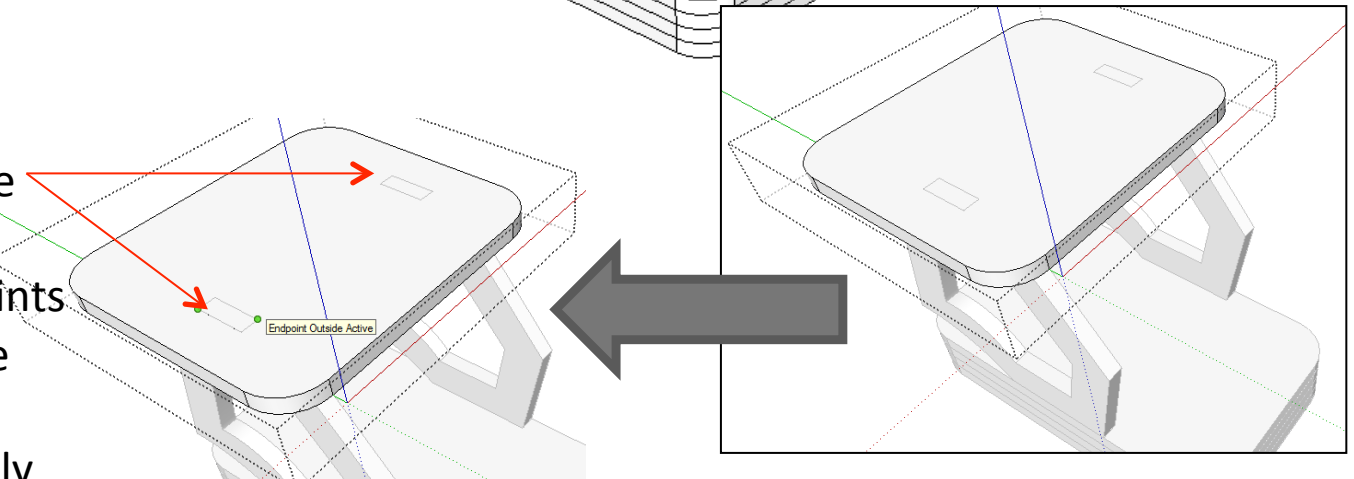
78. Use the push pull tool to push the rectangle you have just drawn by 4mm

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

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

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*

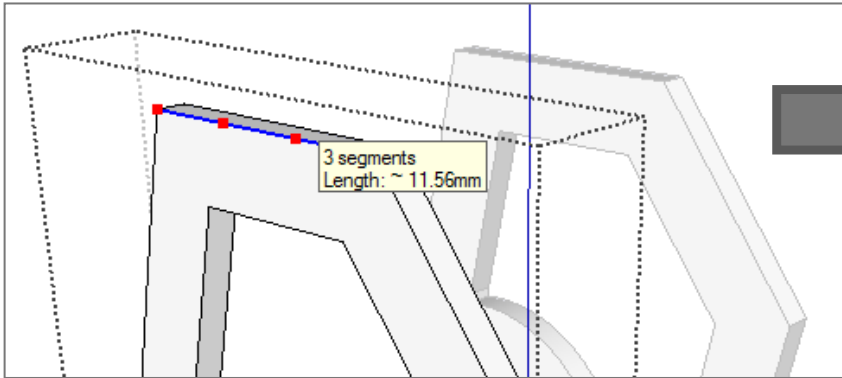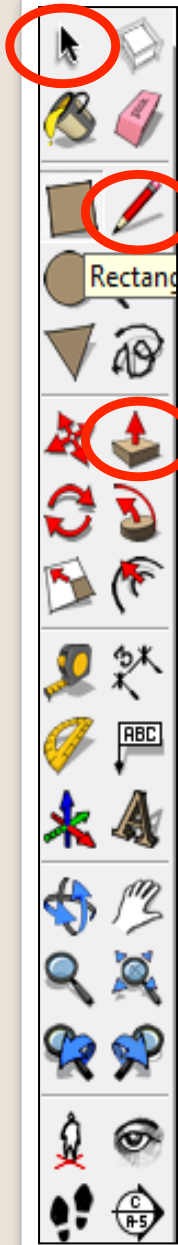86. Highlight the side piece and then click on the **move tool.**

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

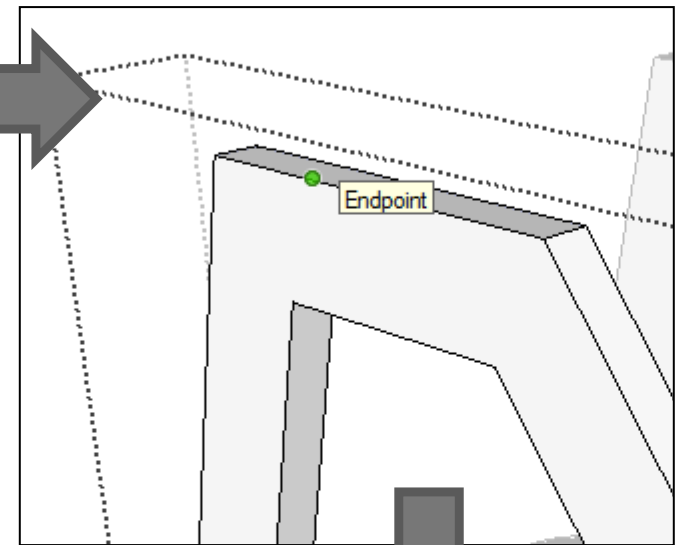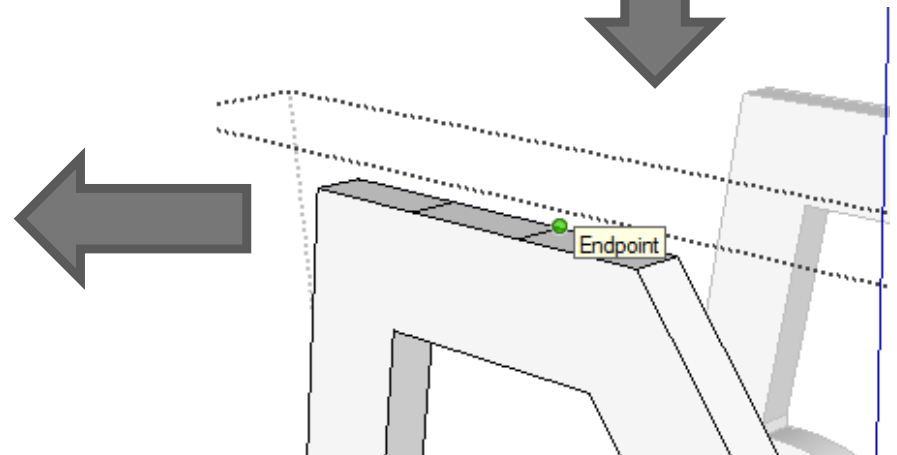88. *Move* the shape along the **red axis** and position directly opposite. *Delete* part not needed

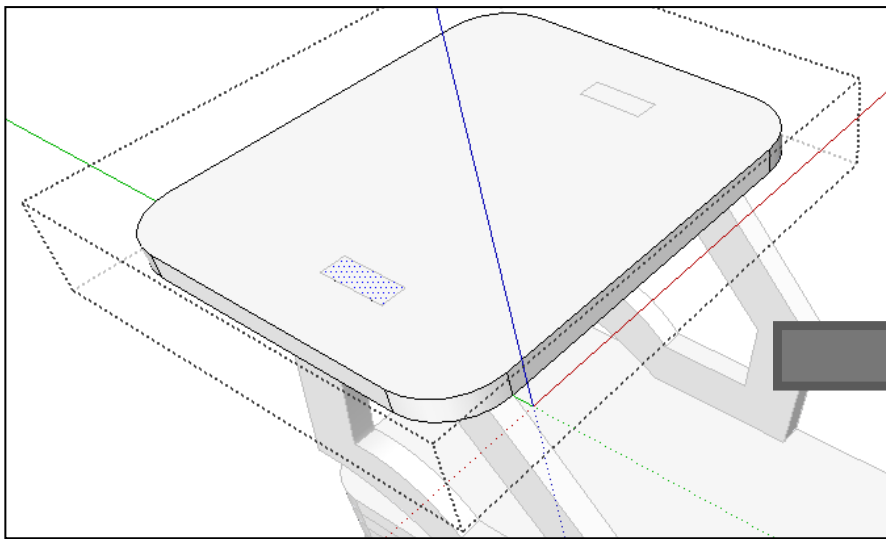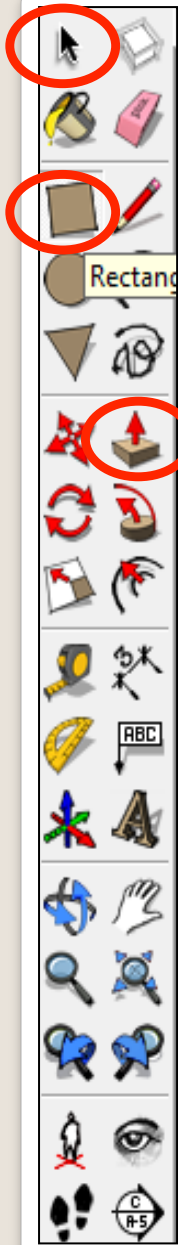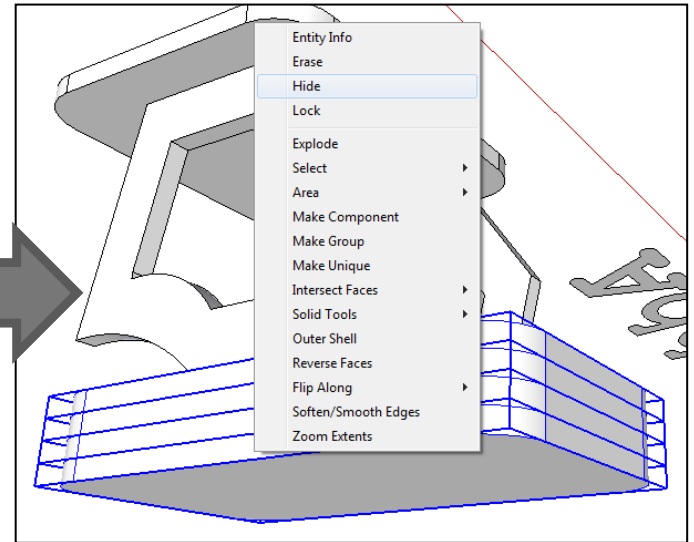89. Click on *edit* unhide all

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

Endpoint Outside Active

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
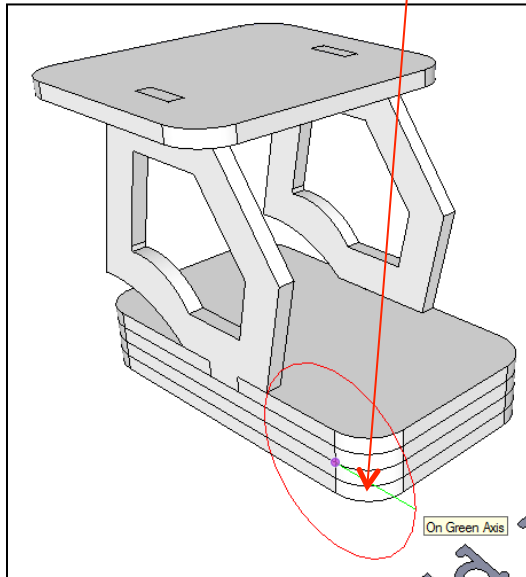
95. Type in *20* and press *enter*
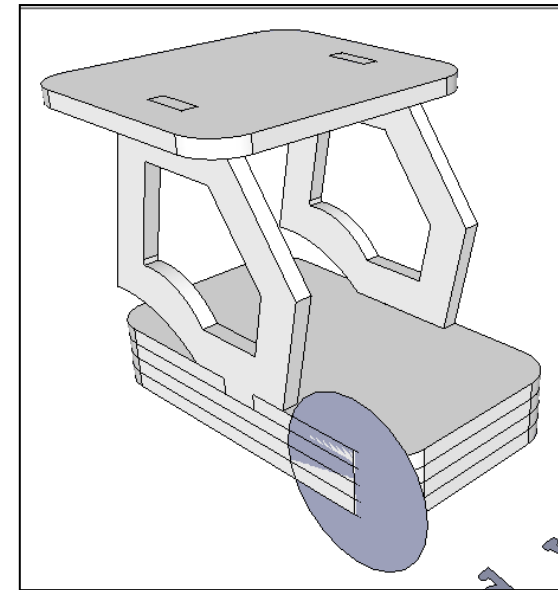
96. Use the push pull to pull the wheel out for 4mm

97. Right click and group

Entity Info
Erase
Hide

Explode
Select ▶
Area ▶
Make Component
Make Group
Intersect Faces ▶
Reverse Faces
Flip Along ▶
Convert to Polygon
Explode Curve
Soften/Smooth Edges
Zoom Extents

Add Photo Texture

On Green Axis

Rectang

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

Endpoint in Group

From Point

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.

From Point

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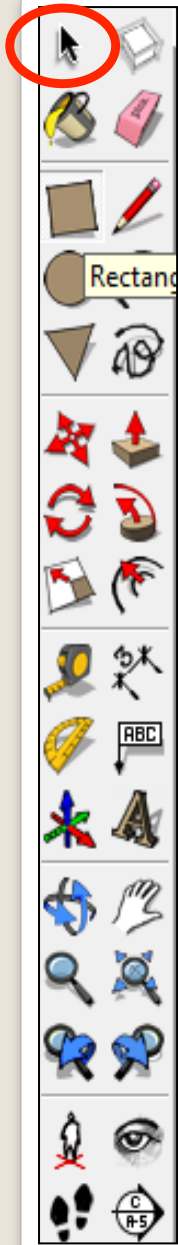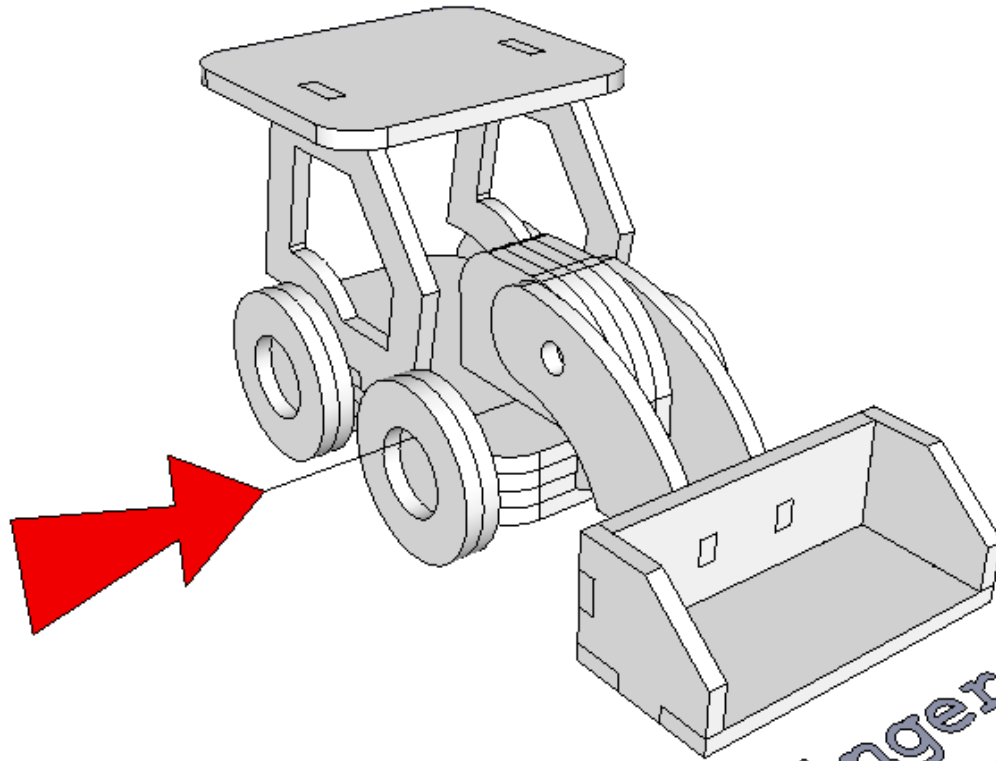
103.Click on **Scene 24.** Using the skills you have learnt design a finger joint for the bonnet parts highlighted to attach it securely to the main body.
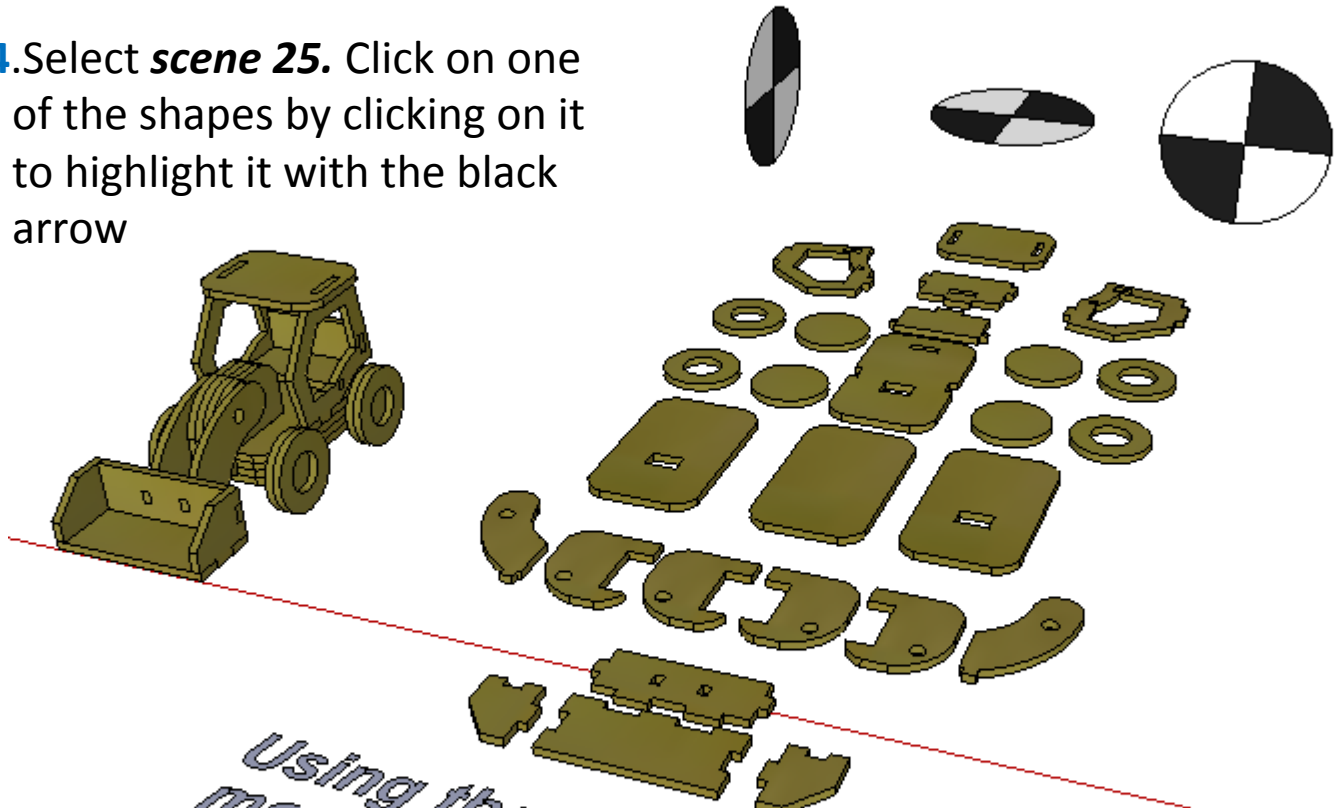

Add finger joints to secure the bonnet to the base

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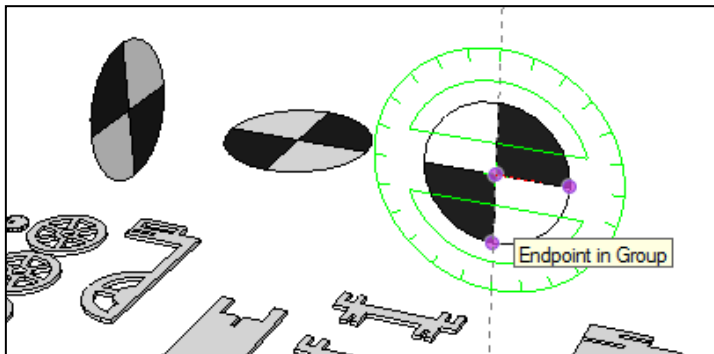
106. Pull the line out and click on the circumference of the circle shown. It will say endpoint.

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 your design

110. Complete the rest of the *scenes*

Extension

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