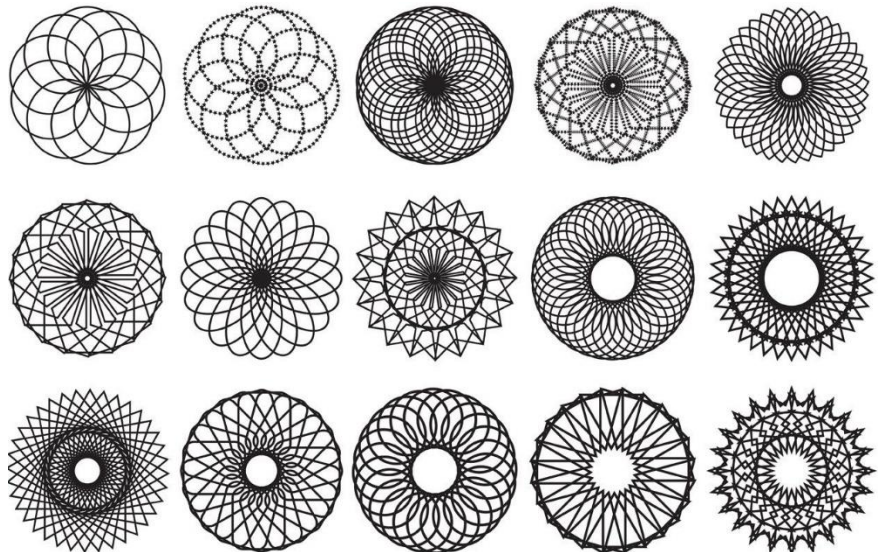
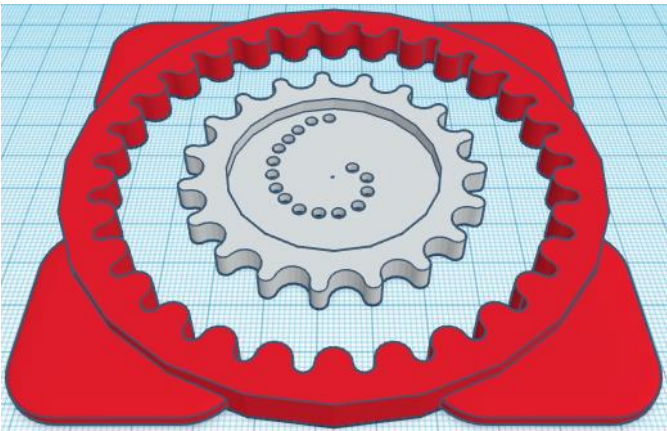




Spiro Graph

Project



Contents:

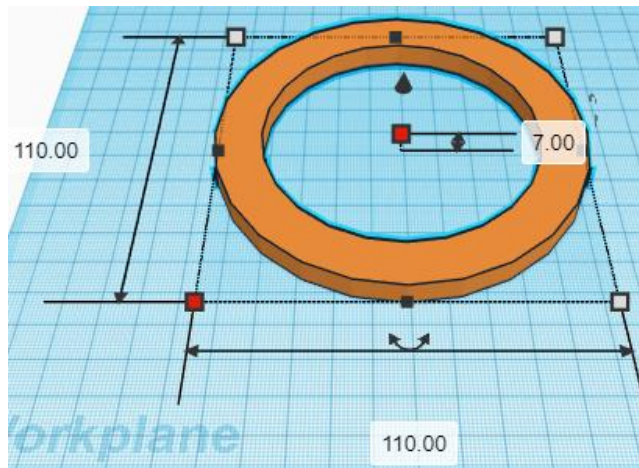
Cover.....	1
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Spiro Graph Base.....	3
Spiro Graph Gear.....	8
References.....	28
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Spiro Graph:

Base:

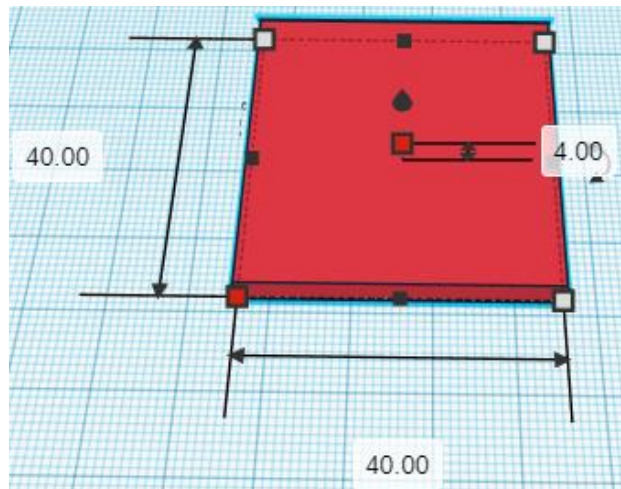
Bring in a Tube, located in Basic Shapes on the left 9 shapes down.
From now on this will be called the **Base**.

Change the dimensions to
110mm X direction,
110mm Y direction, and
7mm Z direction.

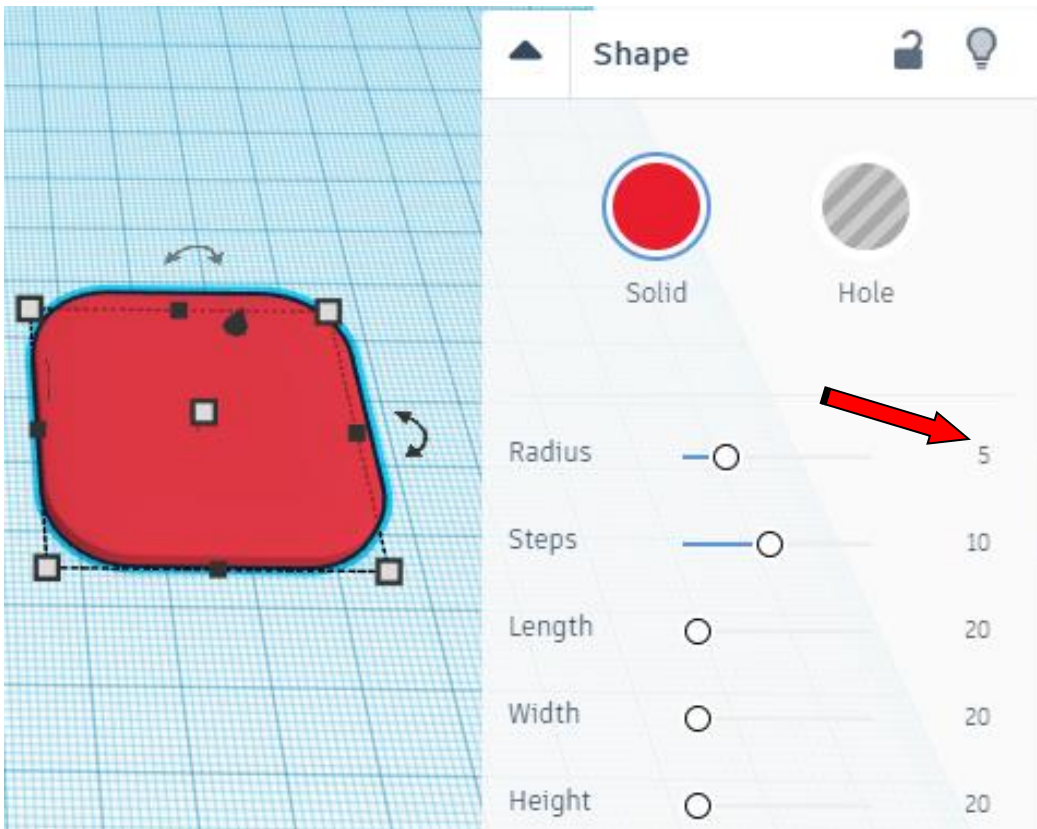


Bring in a Box, located in Basic Shapes on the left 2 shapes down.
From now on this will be called the **Base Handle**.

Change the dimensions to
40mm X direction,
40mm Y direction, and
4mm Z direction.

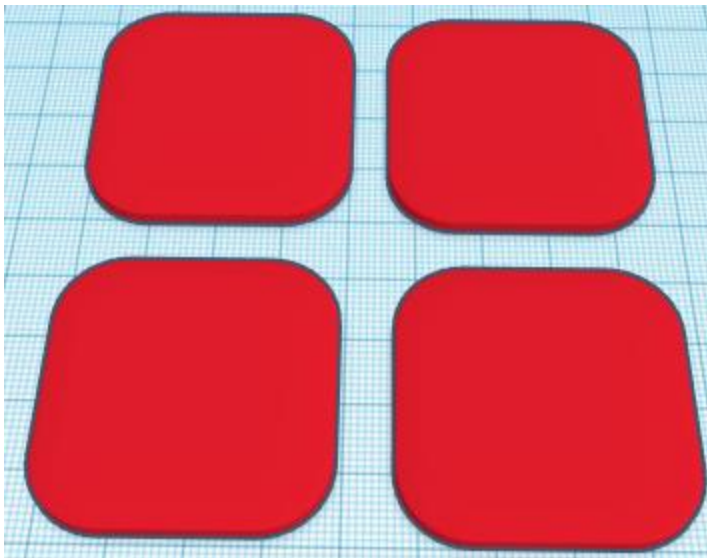


Select **Base Handle**. Change Radius to 5.



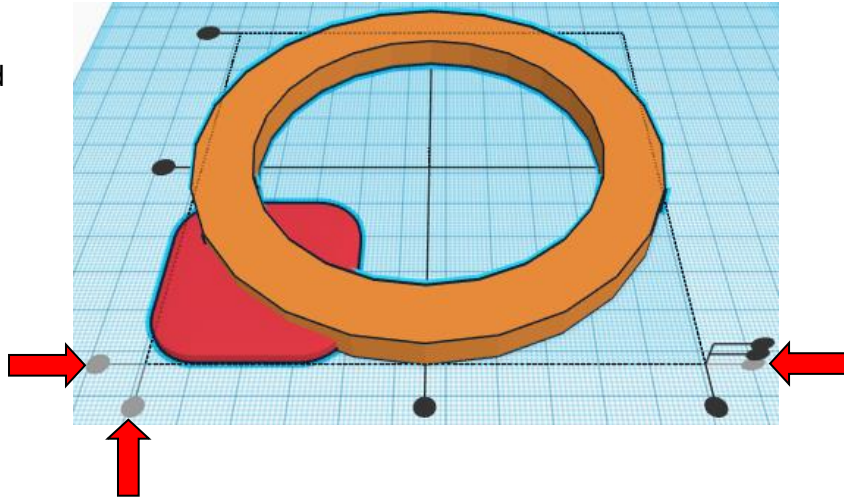
Duplicate Base Handle 3 times.

Move Base Handle to where you can see all 4 Base Handles.

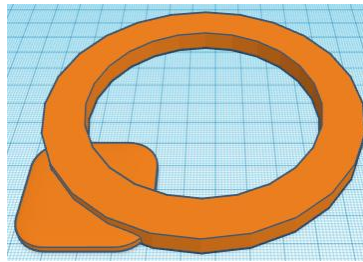


Align Base and 1st Base Handle

left in X direction,
front in Y direction, and
bottom in Z direction.

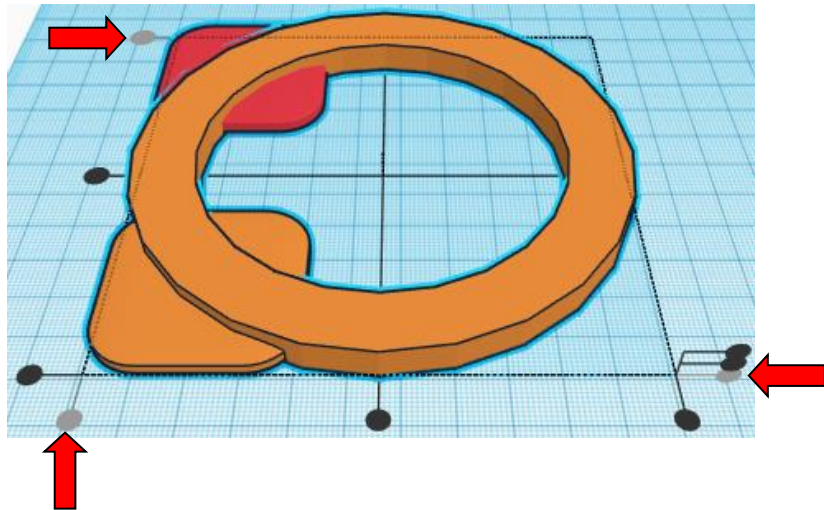


Group Base and 1st Base Handle
From now on this will be called the **Base**

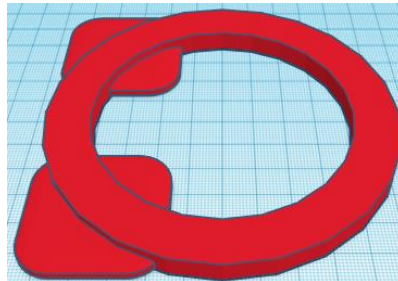


Align Base and 2nd Base Handle

left in X direction,
back in Y direction, and
bottom in Z direction.

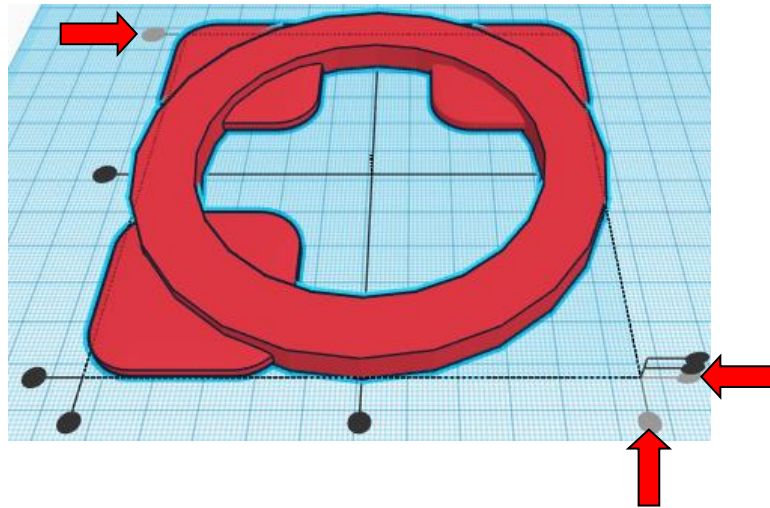


Group Base and 2nd Base Handle
From now on this will be called the **Base**

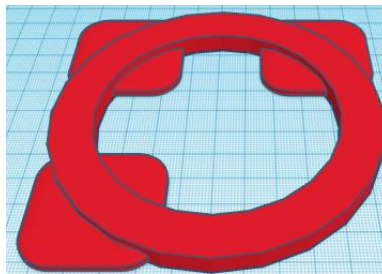


Align Base and 3rd Base Handle

right in X direction,
back in Y direction, and
bottom in Z direction.

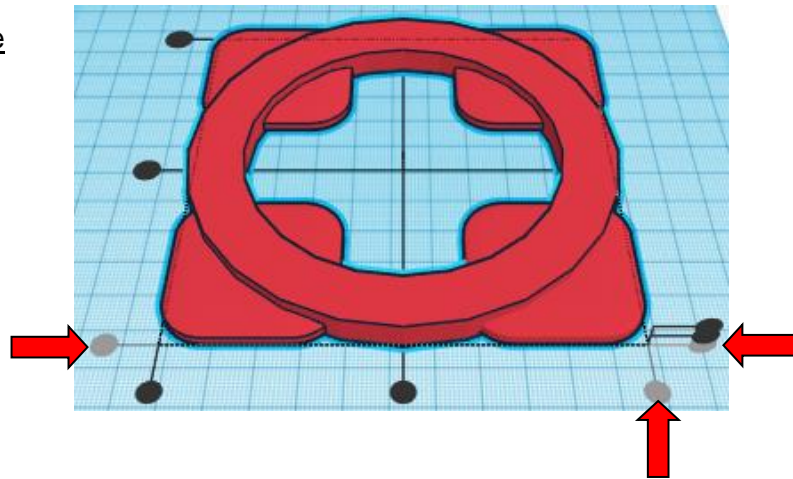


Group Base and 3rd Base Handle
From now on this will be called the **Base**

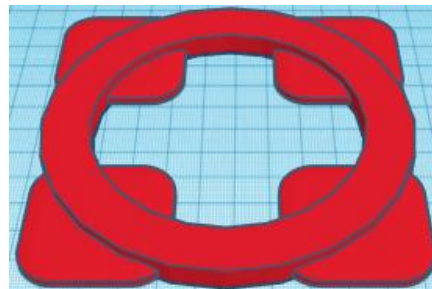


Align Base and 4th Base Handle

right in X direction,
front in Y direction, and
bottom in Z direction.



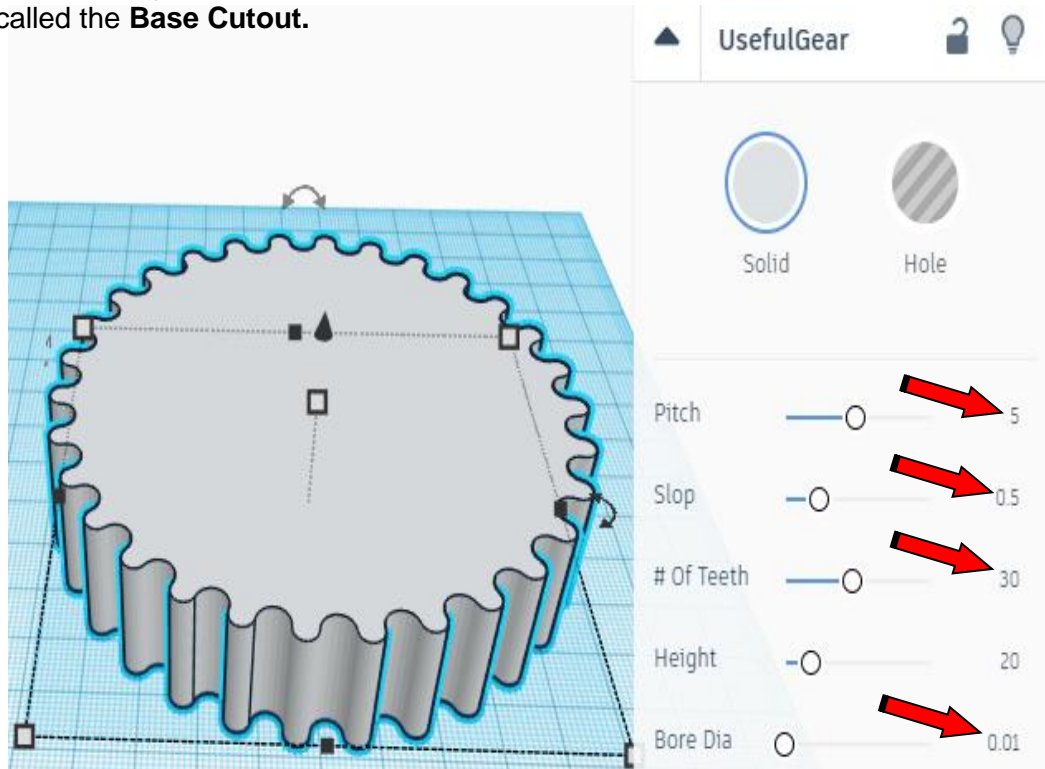
Group Base and 4th Base Handle
From now on this will be called the **Base**



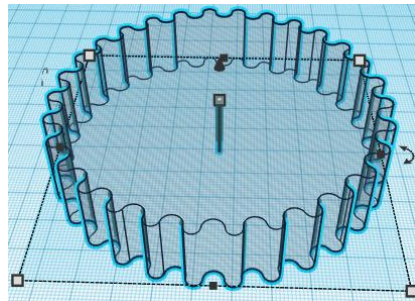
Bring in a Useful Gear, located in All, (things in All move each time that TinkerCad adds items to All), this was last seen on page 3, on the left 3 shapes down.
From now on this will be called the **Base Cutout**.

Select **Base Cutout**.

Change Pitch to 5
Change Slop to 0.5
Change # Of Teeth to 30
Change Bore Dia to 0.01

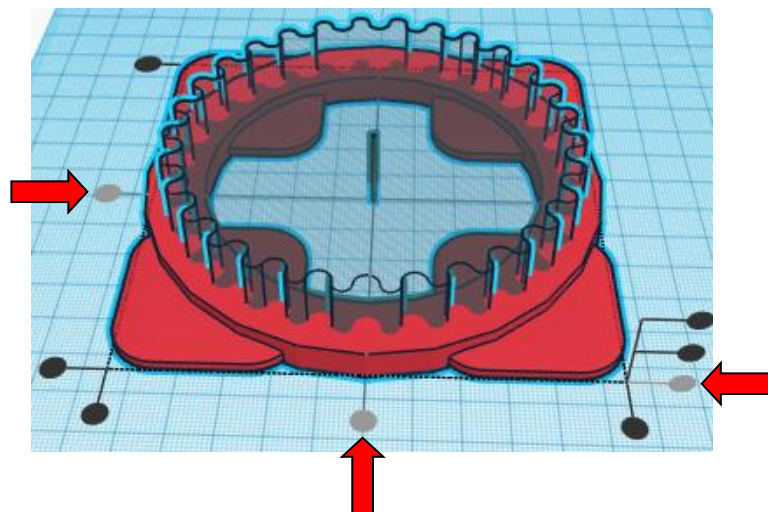


Change Base Cutout to Hole
by selecting Base Cutout and typing "h".

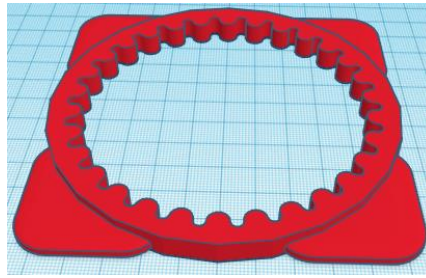


Align Base and Base Cutout

centered in X direction,
centered in Y direction, and
bottom in Z direction.



Group Base and Base Cutout
From now on this will be called the **Base**

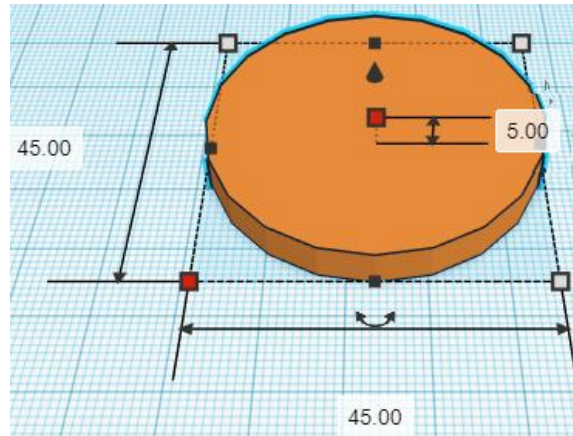


You are done with the Base!!

Gear:

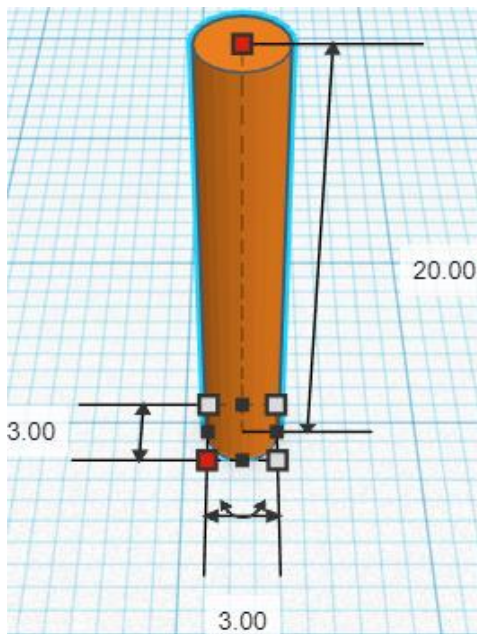
Bring in a Cylinder, located in Basic Shapes on the right 2 shapes down.
From now on this will be called the **Gear Cutout**.

Change the dimensions to
45mm X direction,
45mm Y direction, and
5mm Z direction.



Bring in a Cylinder, located in Basic Shapes on the right 2 shapes down.
From now on this will be called the **Hole**.

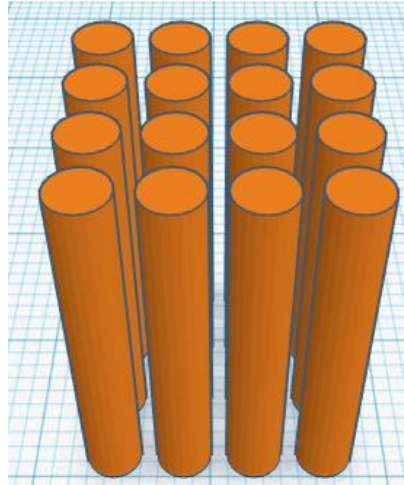
Change the dimensions to
3mm X direction,
3mm Y direction, and
20mm Z direction.



You are going to need 16 holes total!

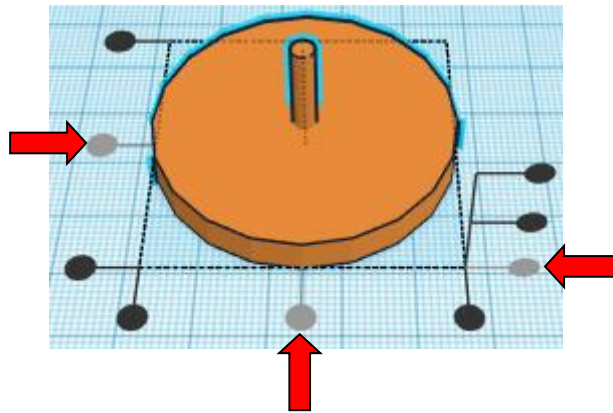
Duplicate Hole 15 times

Move Holes to where you can see all 16 Holes.



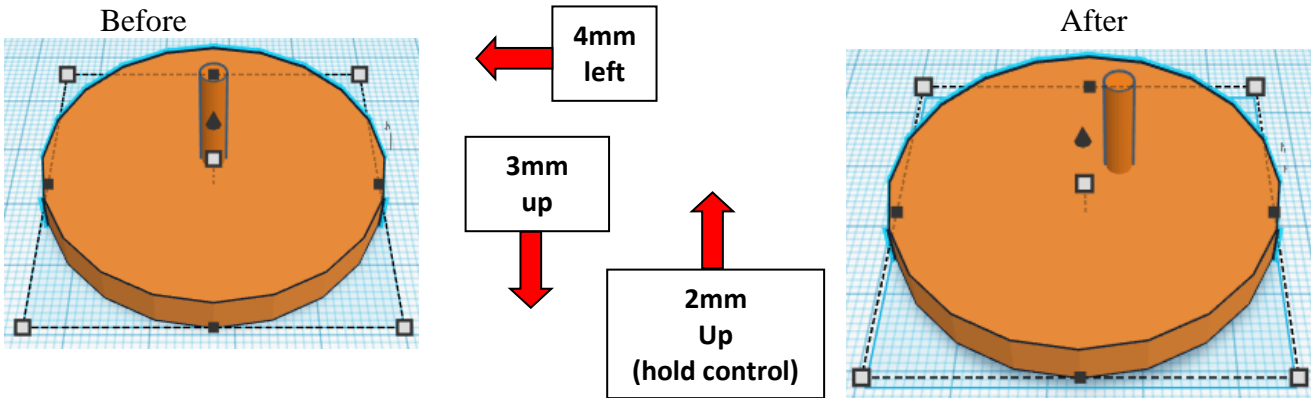
Align Gear Cutout and 1st Hole

centered in X direction,
centered in Y direction, and
bottom in Z direction.

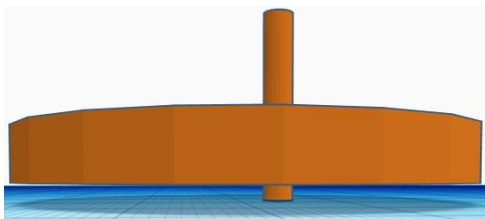


Move Gear Cutout (Must be in home view for this to work!)
move left in negative X direction 4mm
and
move forward in negative Y direction 3mm
and
move up in positive Z direction 2mm

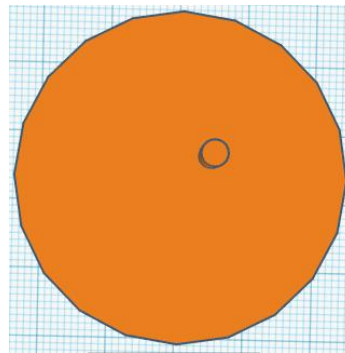
Hint: Select Gear Cutout and push left arrow key 4 times.
and
Select Gear Cutout and push down arrow key 3 times.
and
Select Gear Cutout and hold control and push up arrow key 2 times.



Group Gear Cutout and 1st Hole
From now on this will be called the **Gear Cutout**



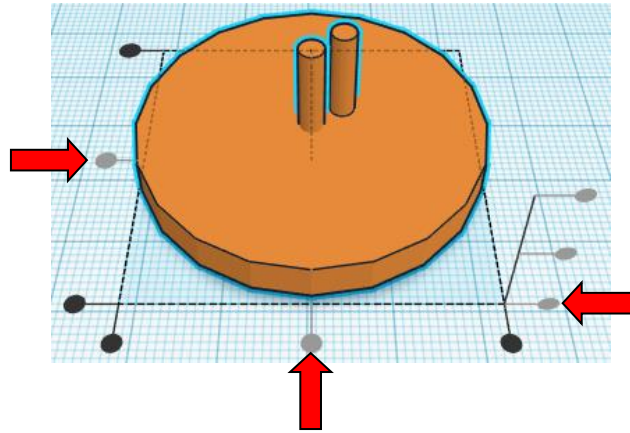
Side View



Top View

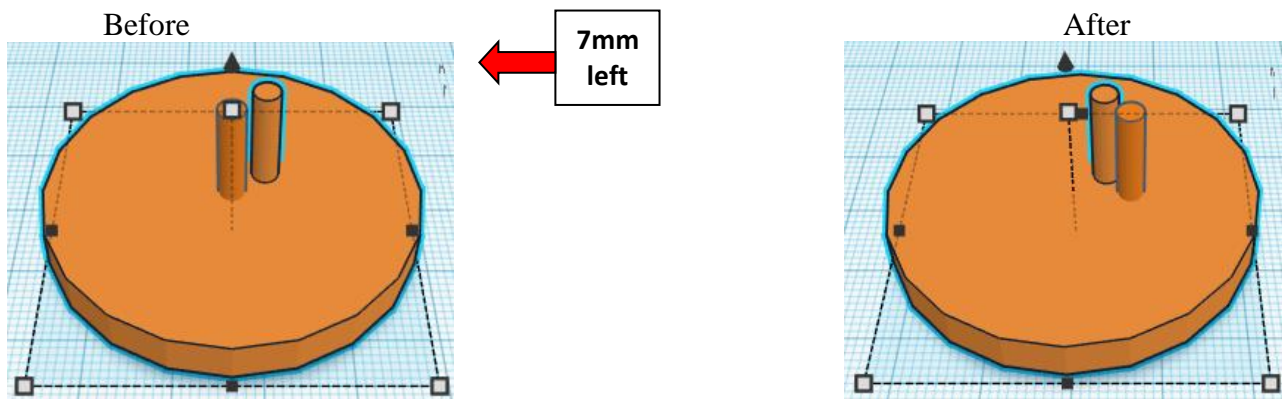
Align Gear Cutout and 2nd Hole

centered in X direction,
centered in Y direction, and
bottom in Z direction.



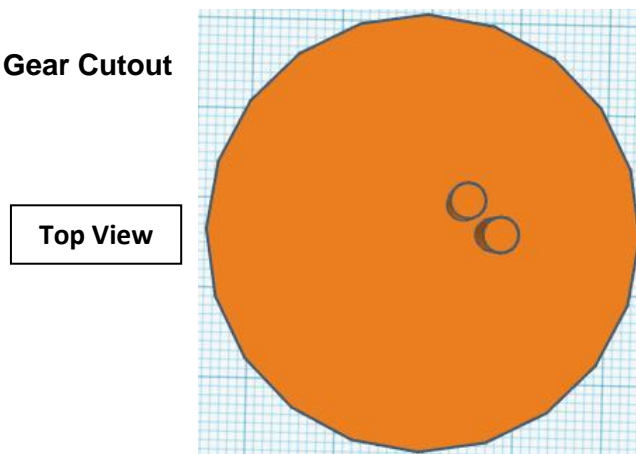
Move Gear Cutout (Must be in home view for this to work!)
move left in negative X direction 7mm

Hint: Select Gear Cutout and push left arrow key 7 times.



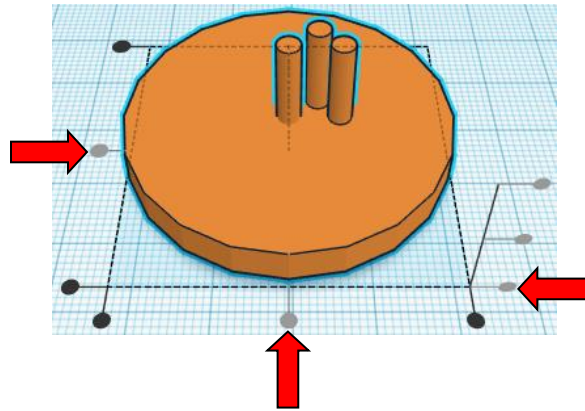
Group Gear Cutout and 2nd Hole

From now on this will be called the **Gear Cutout**



Align Gear Cutout and 3rd Hole

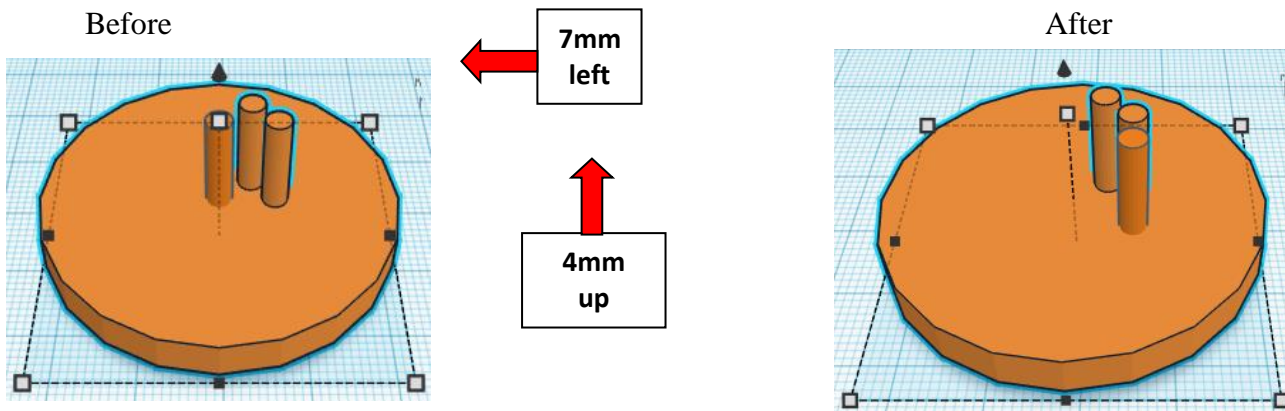
centered in X direction,
centered in Y direction, and
bottom in Z direction.



Move Gear Cutout (Must be in home view for this to work!)

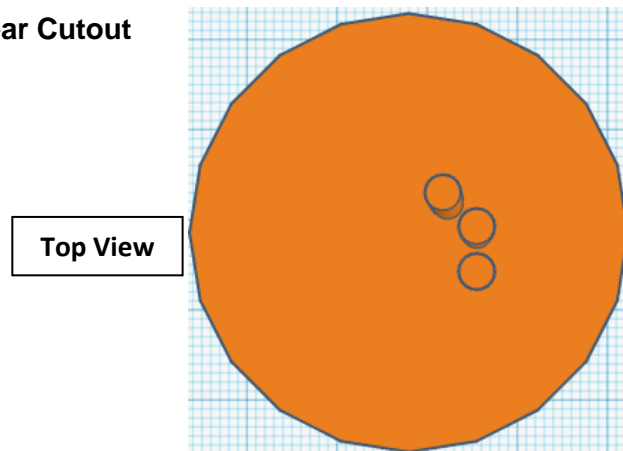
move left in negative X direction 7mm
and
move back in positive Y direction 4mm

Hint: Select Gear Cutout and push left arrow key 7 times.
and
Select Gear Cutout and push up arrow key 4 times.



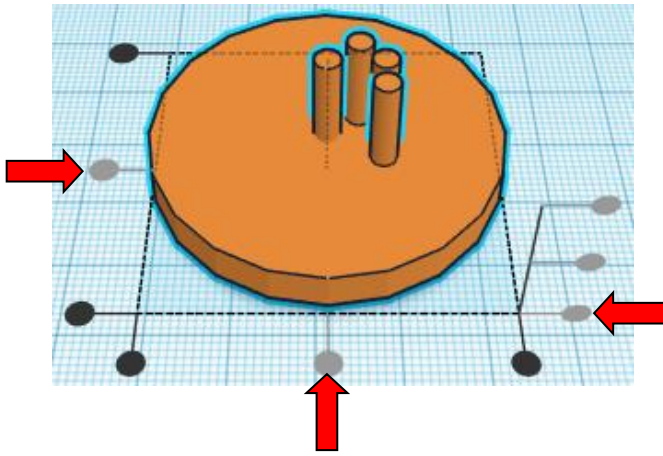
Group Gear Cutout and 3rd Hole

From now on this will be called the **Gear Cutout**



Align Gear Cutout and 4th Hole

centered in X direction,
centered in Y direction, and
bottom in Z direction.

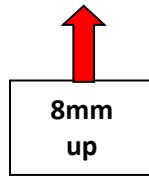
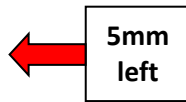
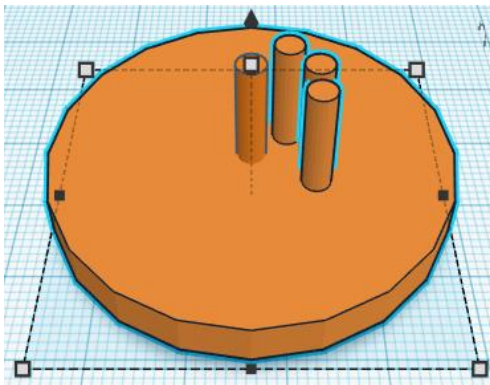


Move Gear Cutout (Must be in home view for this to work!)

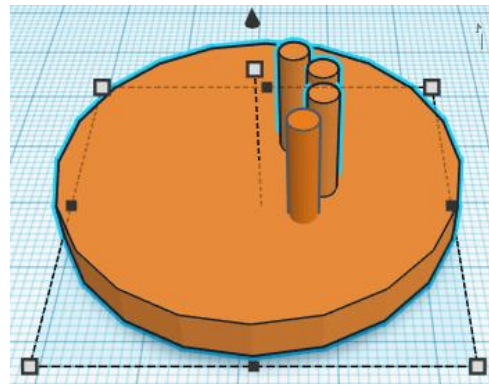
move left in negative X direction 5mm
and
move back in positive Y direction 8mm

Hint: Select Gear Cutout and push left arrow key 5 times.
and
Select Gear Cutout and push up arrow key 8 times.

Before



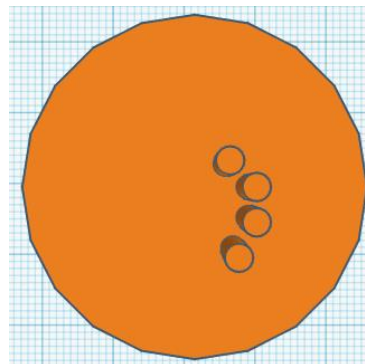
After



Group Gear Cutout and 4th Hole

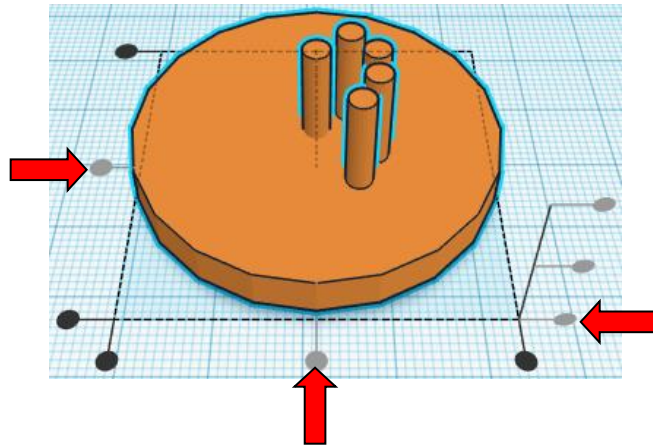
From now on this will be called the **Gear Cutout**

Top View



Align Gear Cutout and 5th Hole

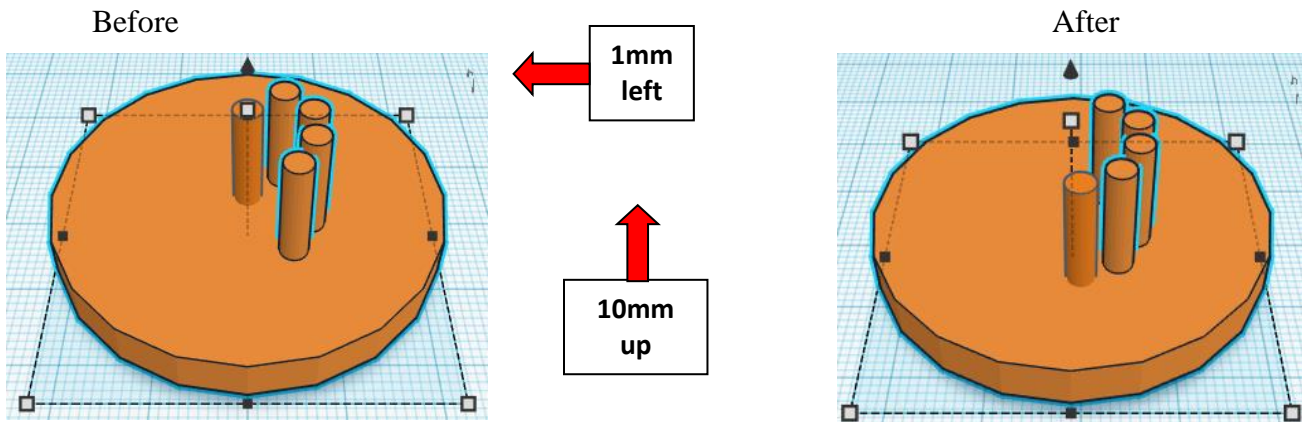
centered in X direction,
centered in Y direction, and
bottom in Z direction.



Move Gear Cutout (Must be in home view for this to work!)

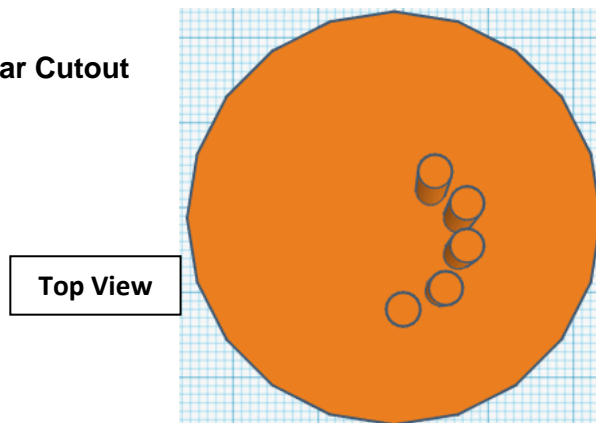
move left in negative X direction 1mm
and
move back in positive Y direction 10mm

Hint: Select Gear Cutout and push left arrow key 1 times.
and
Select Gear Cutout and push up arrow key 10 times.
or
Select Gear Cutout and hold shift and push up arrow key 1 time.



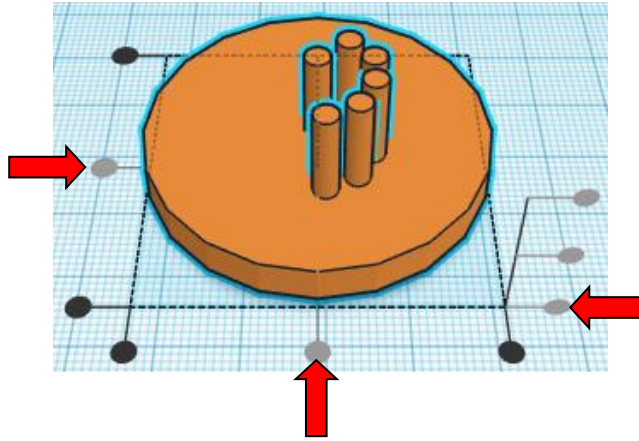
Group Gear Cutout and 5th Hole

From now on this will be called the **Gear Cutout**



Align Gear Cutout and 6th Hole

centered in X direction,
centered in Y direction, and
bottom in Z direction.

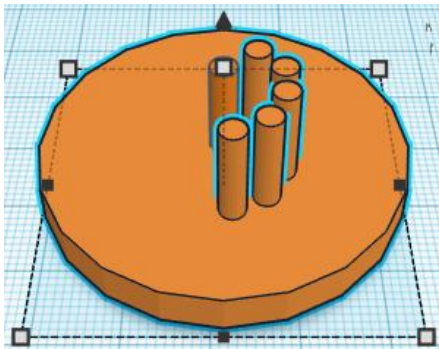


Move Gear Cutout (Must be in home view for this to work!)

move right in negative X direction 3mm
and
move back in positive Y direction 10mm

Hint: Select Gear Cutout and push right arrow key 3 times.
and
Select Gear Cutout and push up arrow key 10 times.
or
Select Gear Cutout and hold shift and push up arrow key 1 time.

Before

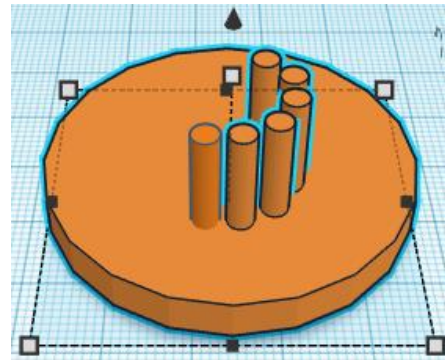


3mm
right



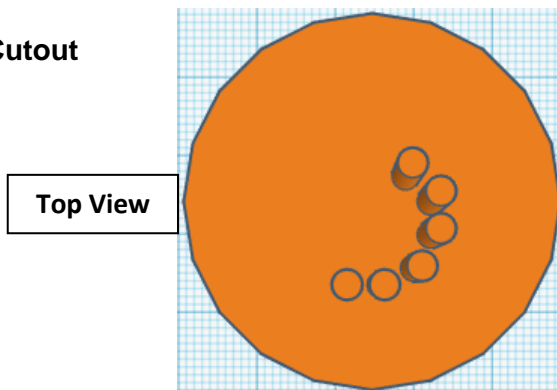
10mm
up

After



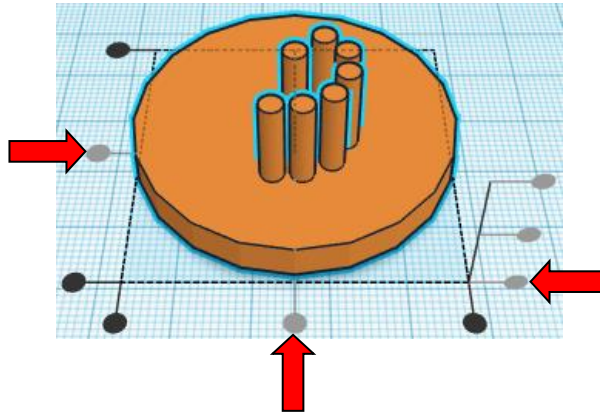
Group Gear Cutout and 6th Hole

From now on this will be called the **Gear Cutout**



Align Gear Cutout and 7th Hole

centered in X direction,
centered in Y direction, and
bottom in Z direction.

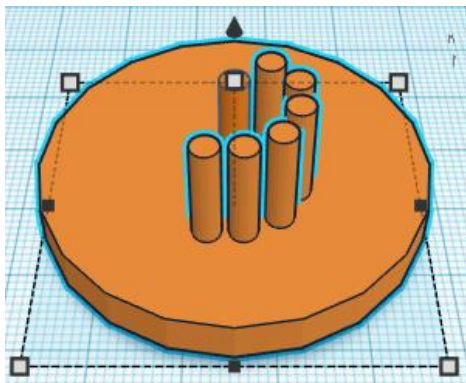


Move Gear Cutout (Must be in home view for this to work!)

move right in negative X direction 7mm
and
move back in positive Y direction 9mm

Hint: Select Gear Cutout and push right arrow key 7 times.
and
Select Gear Cutout and push up arrow key 9 times.

Before

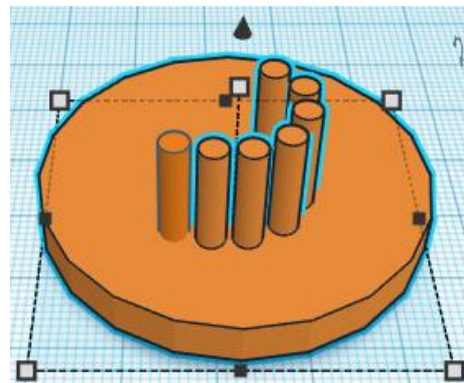


7mm
right



9mm
up

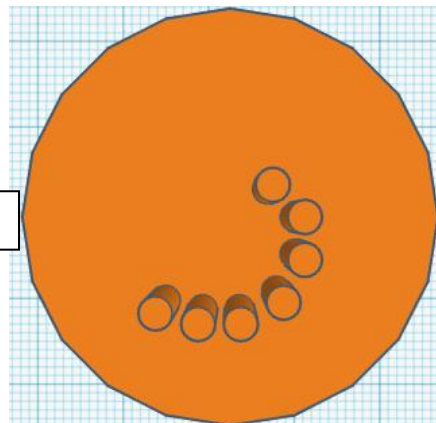
After



Group Gear Cutout and 7th Hole

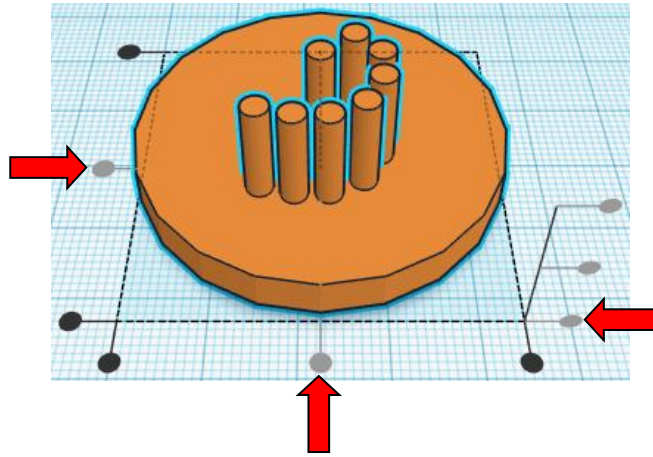
From now on this will be called the **Gear Cutout**

Top View



Align Gear Cutout and 8th Hole

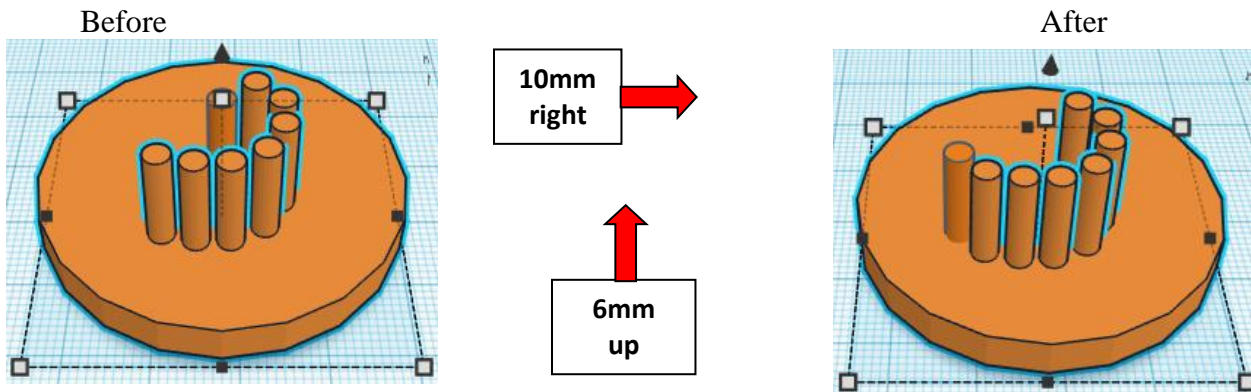
centered in X direction,
centered in Y direction, and
bottom in Z direction.



Move Gear Cutout (Must be in home view for this to work!)

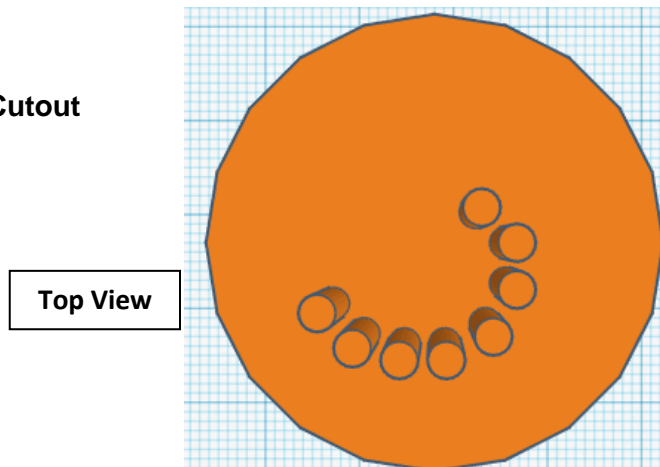
move right in negative X direction 10mm
and
move back in positive Y direction 6mm

Hint: Select Gear Cutout and push right arrow key 10 times.
or
Select Gear Cutout and hold shift and push right arrow key 1 time.
and
Select Gear Cutout and push up arrow key 6 times.



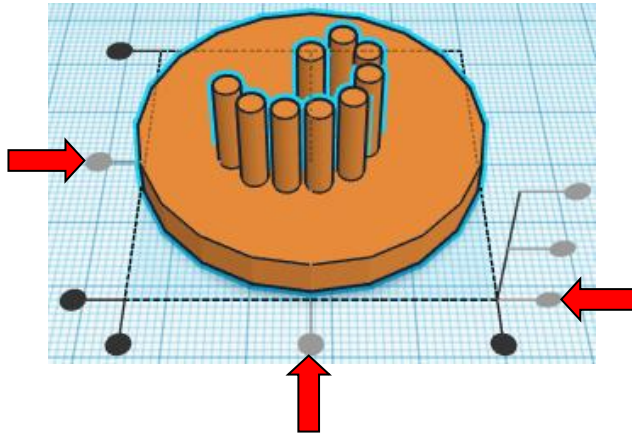
Group Gear Cutout and 8th Hole

From now on this will be called the **Gear Cutout**



Align Gear Cutout and 9th Hole

centered in X direction,
centered in Y direction, and
bottom in Z direction.



Move Gear Cutout (Must be in home view for this to work!)

move right in negative X direction 12mm
and
move back in positive Y direction 3mm

Hint: Select Gear Cutout and push right arrow key 12 times.

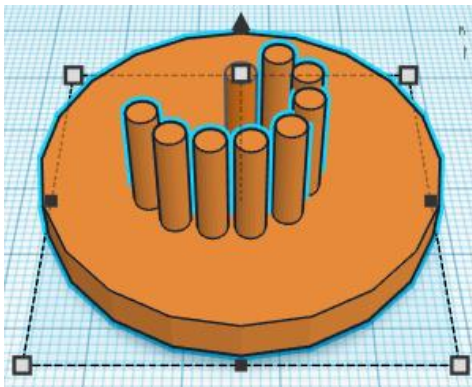
or

Select Gear Cutout and hold shift and push right arrow key 1 time, then release shift and push right arrow key 2 times.

and

Select Gear Cutout and push up arrow key 3 times.

Before

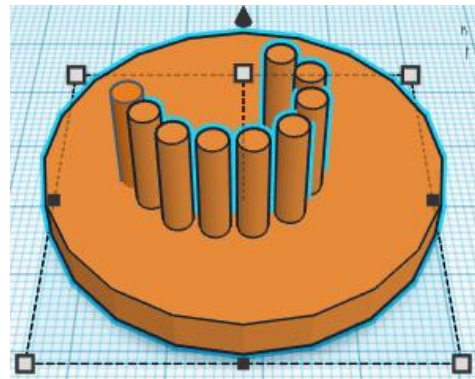


12mm
right



3mm
up

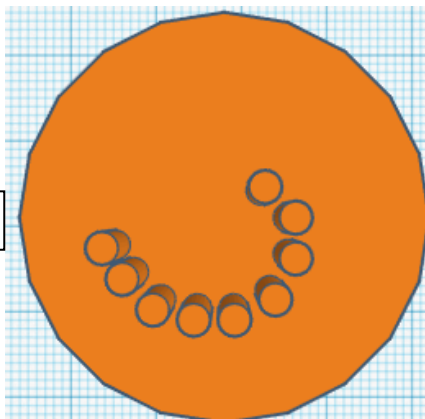
After



Group Gear Cutout and 9th Hole

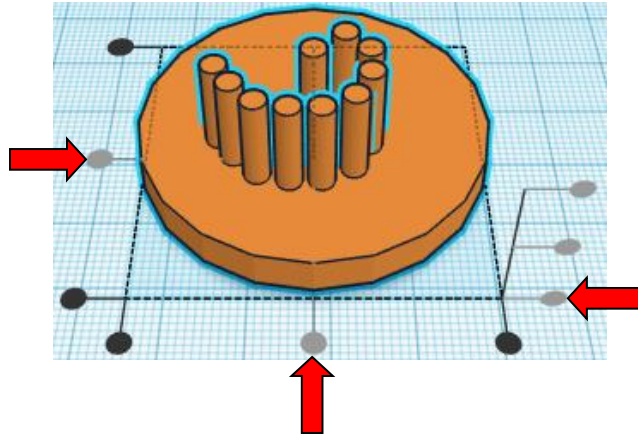
From now on this will be called the **Gear Cutout**

Top View



Align Gear Cutout and 10th Hole

centered in X direction,
centered in Y direction, and
bottom in Z direction.



Move Gear Cutout (Must be in home view for this to work!)

move right in negative X direction 13mm

and

move forward in negative Y direction 1mm

Hint: Select Gear Cutout and push right arrow key 13 times.

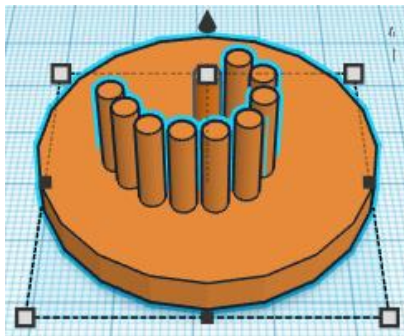
or

Select Gear Cutout and hold shift and push right arrow key 1 time, then release shift and push right arrow key 3 times.

and

Select Gear Cutout and push down arrow key 1 times.

Before



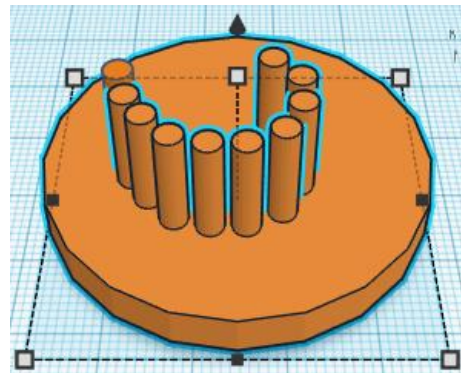
13mm
right



1mm
down



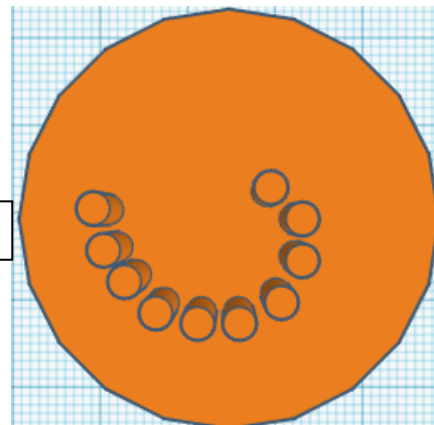
After



Group Gear Cutout and 10th Hole

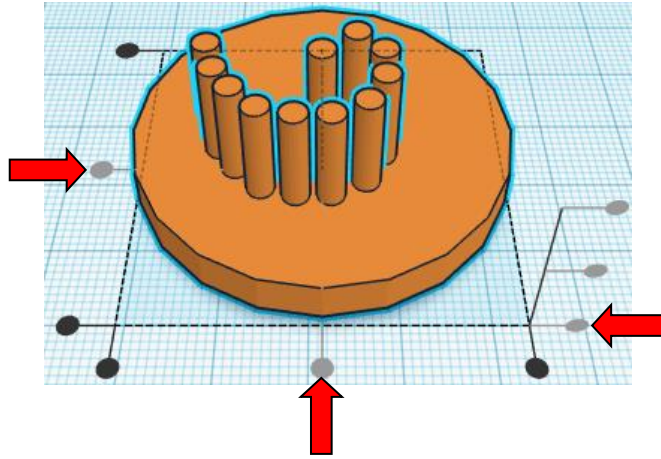
From now on this will be called the **Gear Cutout**

Top View



Align Gear Cutout and 11th Hole

centered in X direction,
centered in Y direction, and
bottom in Z direction.



Move Gear Cutout (Must be in home view for this to work!)

move right in negative X direction 13mm

and

move forward in negative Y direction 5mm

Hint: Select Gear Cutout and push right arrow key 13 times.

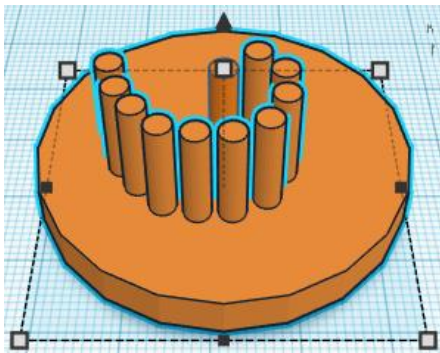
or

Select Gear Cutout and hold shift and push right arrow key 1 time, then release shift and push right arrow key 3 times.

and

Select Gear Cutout and push down arrow key 5 times.

Before



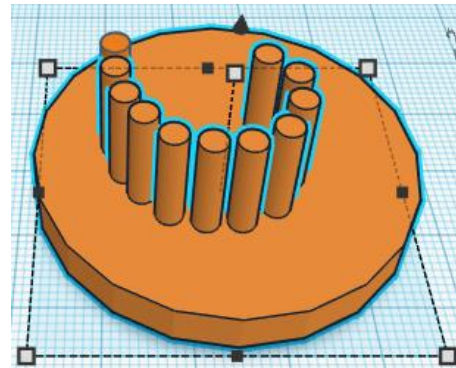
13mm
right



5mm
down



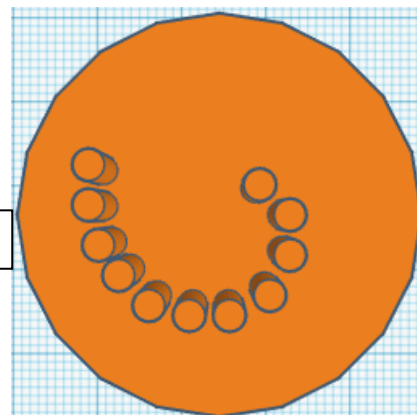
After



Group Gear Cutout and 11th Hole

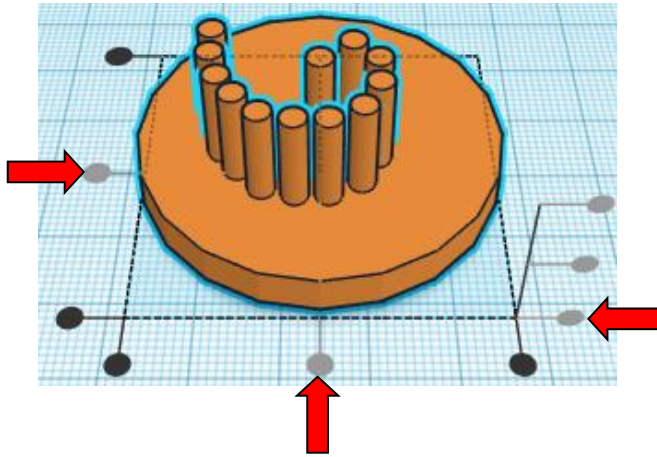
From now on this will be called the **Gear Cutout**

Top View



Align Gear Cutout and 12th Hole

centered in X direction,
centered in Y direction, and
bottom in Z direction.



Move Gear Cutout (Must be in home view for this to work!)

move right in negative X direction 12mm

and

move forward in negative Y direction 9mm

Hint: Select Gear Cutout and push right arrow key 12 times.

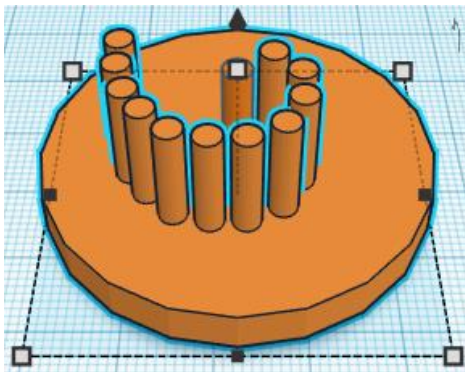
or

Select Gear Cutout and hold shift and push right arrow key 1 time, then release shift and push right arrow key 2 times.

and

Select Gear Cutout and push down arrow key 9 times.

Before



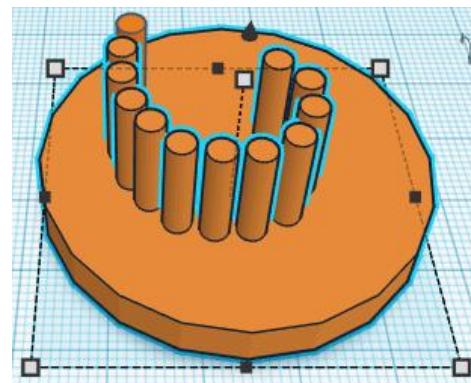
12mm
right



9mm
down



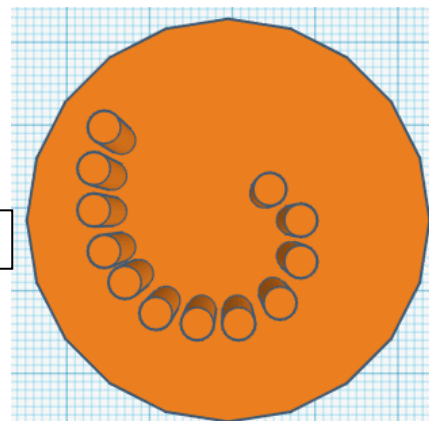
After



Group Gear Cutout and 12th Hole

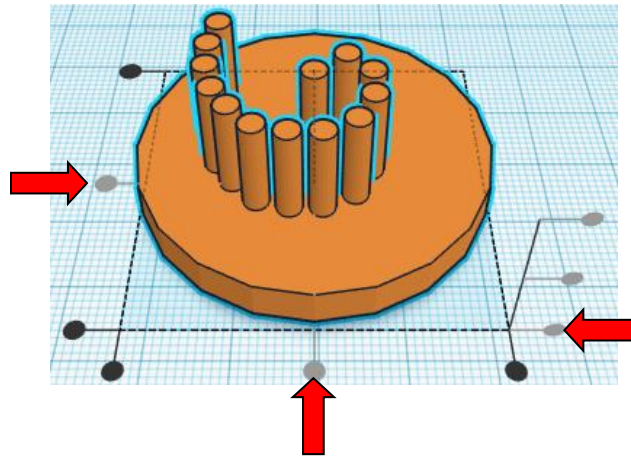
From now on this will be called the **Gear Cutout**

Top View



Align Gear Cutout and 13th Hole

centered in X direction,
centered in Y direction, and
bottom in Z direction.



Move Gear Cutout (Must be in home view for this to work!)

move right in negative X direction 10mm

and

move forward in negative Y direction 12mm

Hint: Select Gear Cutout and push right arrow key 10 times.

or

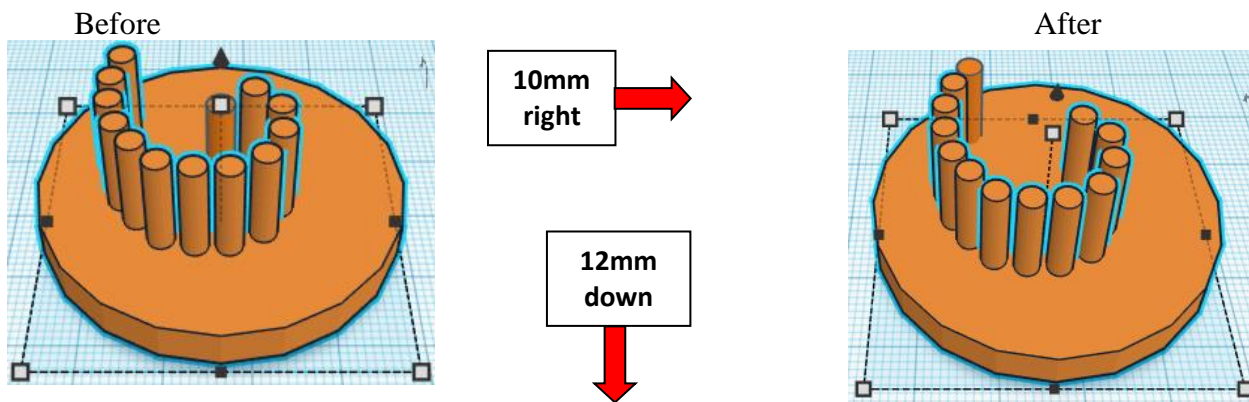
Select Gear Cutout and hold shift and push right arrow key 1 time.

and

Select Gear Cutout and push down arrow key 12 times.

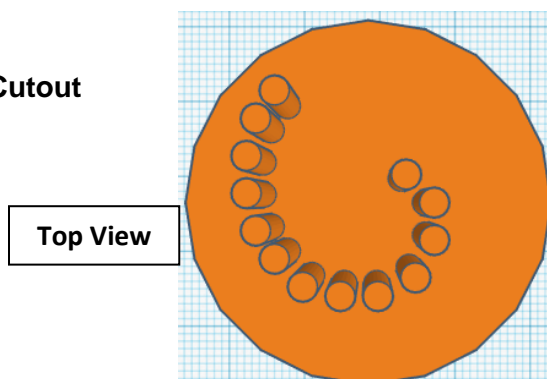
or

Select Gear Cutout and hold shift and push down arrow key 1 time, then release shift and push down arrow key 2 times.



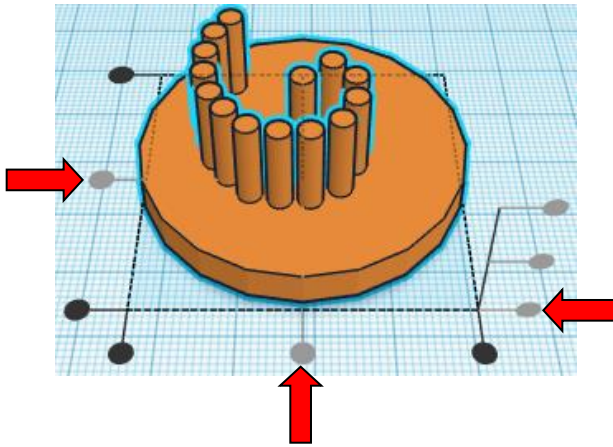
Group Gear Cutout and 13th Hole

From now on this will be called the **Gear Cutout**



Align Gear Cutout and 14th Hole

centered in X direction,
centered in Y direction, and
bottom in Z direction.



Move Gear Cutout (Must be in home view for this to work!)

move right in negative X direction 8mm

and

move forward in negative Y direction 15mm

Hint: Select Gear Cutout and push right arrow key 8 times.

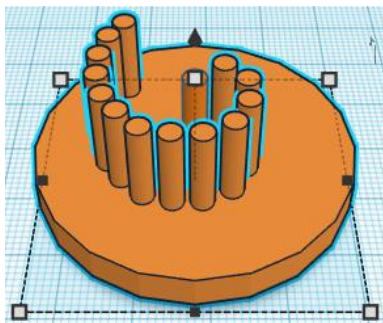
and

Select Gear Cutout and push down arrow key 15 times.

or

Select Gear Cutout and hold shift and push down arrow key 1 time, then release shift and push down arrow key 5 times.

Before



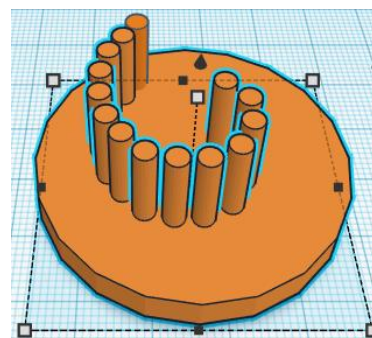
8mm
right



15mm
down



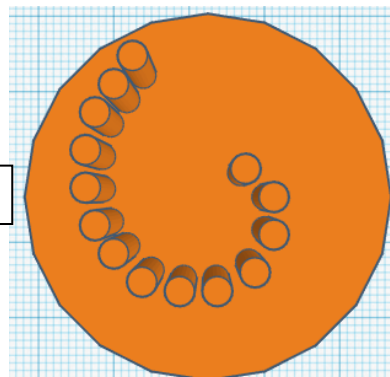
After



Group Gear Cutout and 14th Hole

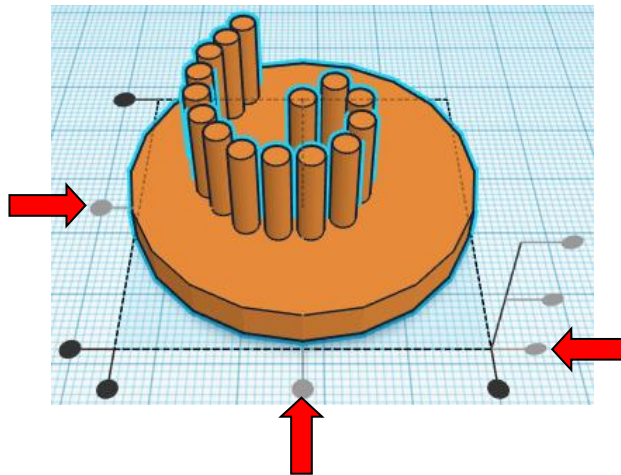
From now on this will be called the **Gear Cutout**

Top View



Align Gear Cutout and 15th Hole

centered in X direction,
centered in Y direction, and
bottom in Z direction.



Move Gear Cutout (Must be in home view for this to work!)

move right in negative X direction 5mm

and

move forward in negative Y direction 18mm

Hint: Select Gear Cutout and push right arrow key 5 times.

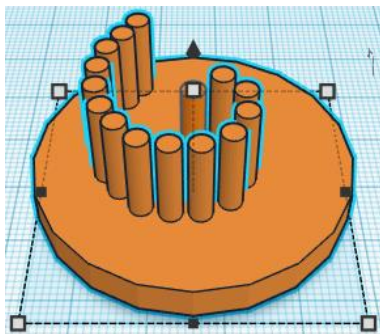
and

Select Gear Cutout and push down arrow key 18 times.

or

Select Gear Cutout and hold shift and push down arrow key 1 time, then release shift and push down arrow key 8 times.

Before



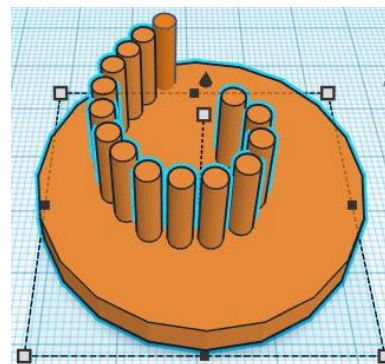
5mm
right



18mm
down



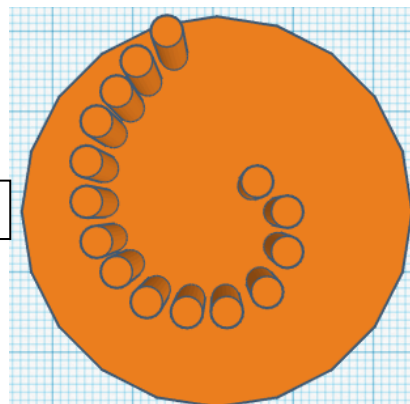
After



Group Gear Cutout and 15th Hole

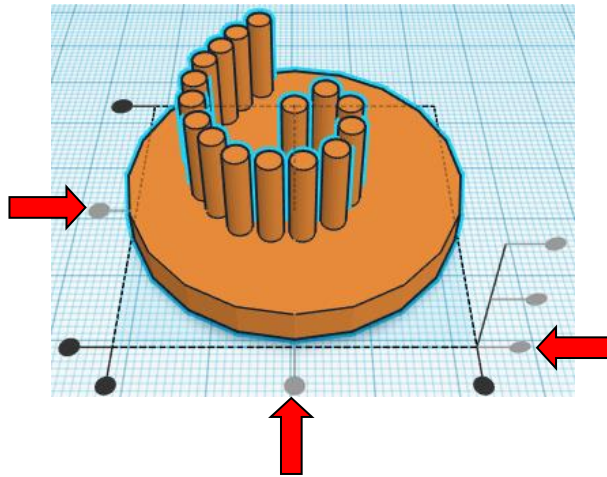
From now on this will be called the **Gear Cutout**

Top View



Align Gear Cutout and 16th Hole

centered in X direction,
centered in Y direction, and
bottom in Z direction.



Move Gear Cutout (Must be in home view for this to work!)

move right in negative X direction 1mm

and

move forward in negative Y direction 19mm

Hint: Select Gear Cutout and push right arrow key 1 times.

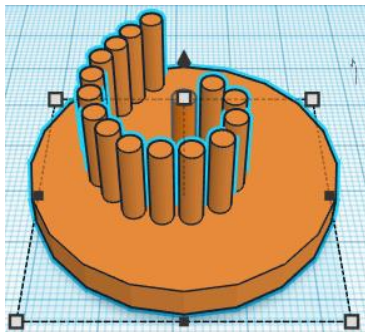
and

Select Gear Cutout and push down arrow key 19 times.

or

Select Gear Cutout and hold shift and push down arrow key 1 time, then release shift and push down arrow key 9 times.

Before



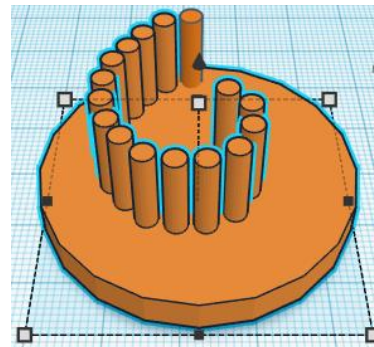
1mm
right



19mm
down



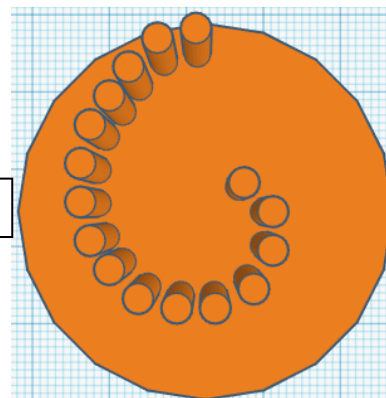
After



Group Gear Cutout and 16th Hole

From now on this will be called the **Gear Cutout**

Top View

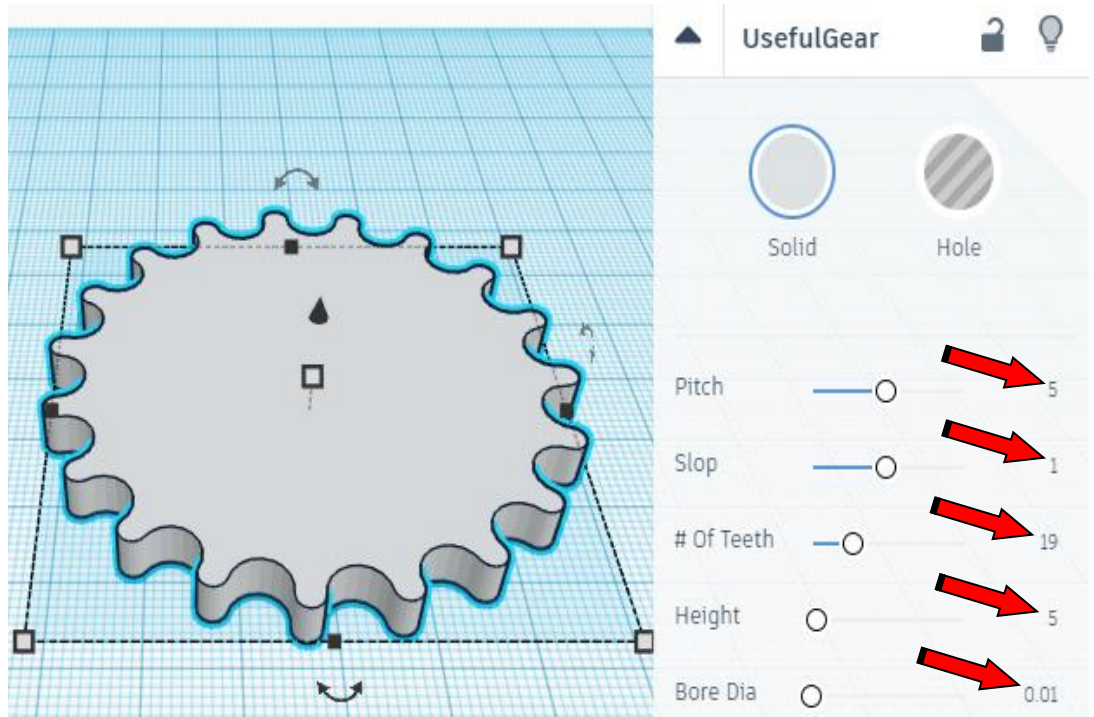


Bring in a Useful Gear, located in All, (things in All move each time that TinkerCad adds items to All), this was last seen on page 3, on the left 3 shapes down.

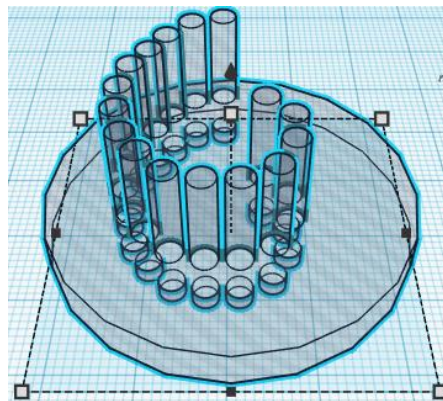
From now on this will be called the **Gear**.

Select **Gear**.

- Change Pitch to 5
- Change Slop to 1
- Change # Of Teeth to 19
- Change Height to 5
- Change Bore Dia to 0.01

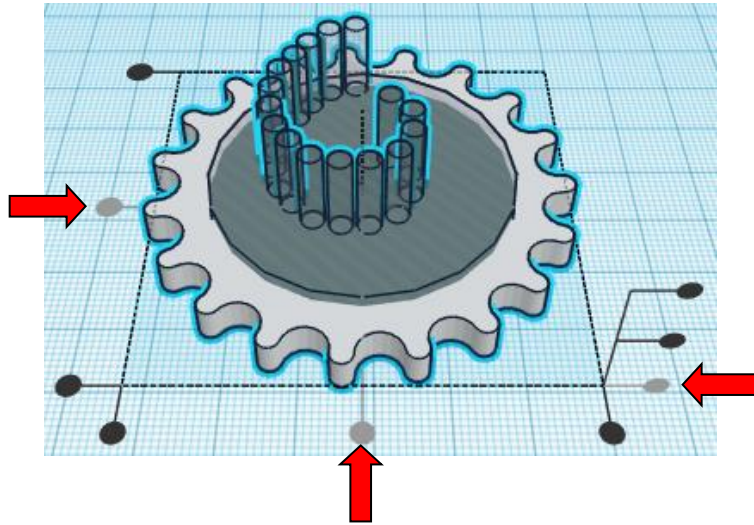


Change Gear Cutout to Hole
by selecting Gear Cutout and typing "h".



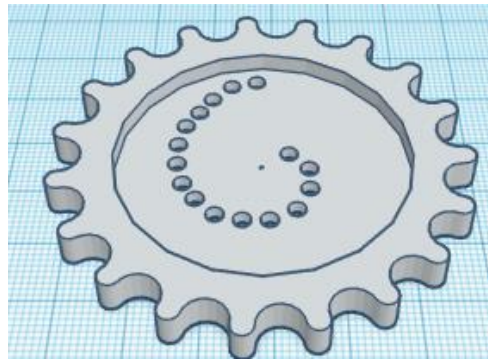
Align Gear Cutout and Gear

centered in X direction,
centered in Y direction, and
bottom in Z direction.



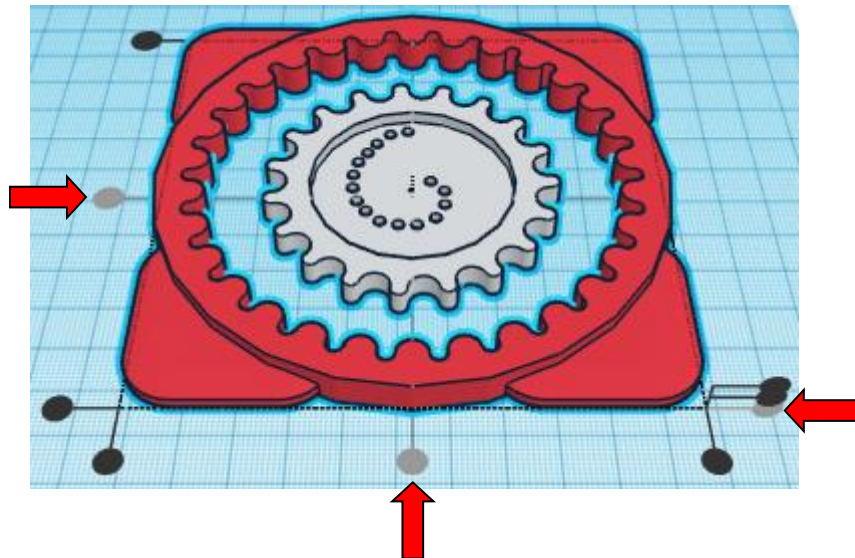
Group Gear Cutout and Gear

From now on this will be called the **Gear**



Align Base and Gear

centered in X direction,
centered in Y direction, and
bottom in Z direction.



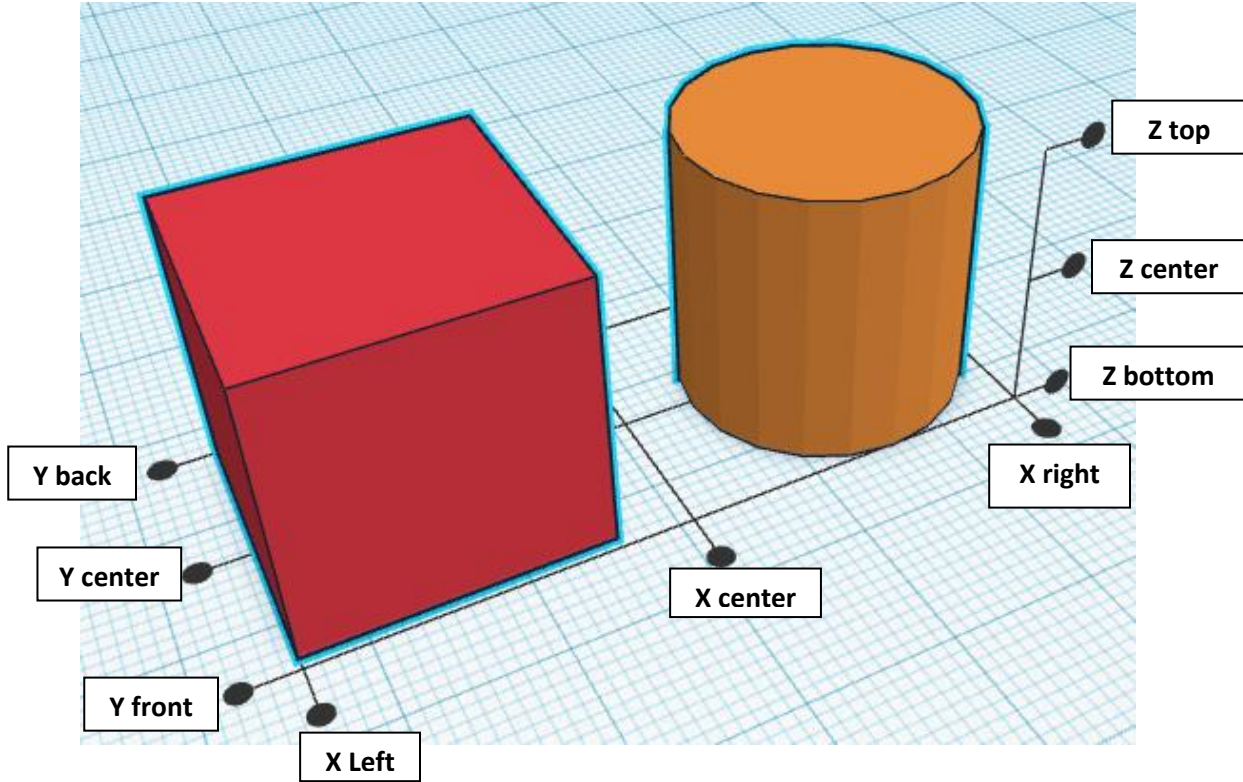
You are done and ready to print!

Reference to Aligning, Flip direction, Move direction, and Rotate direction.

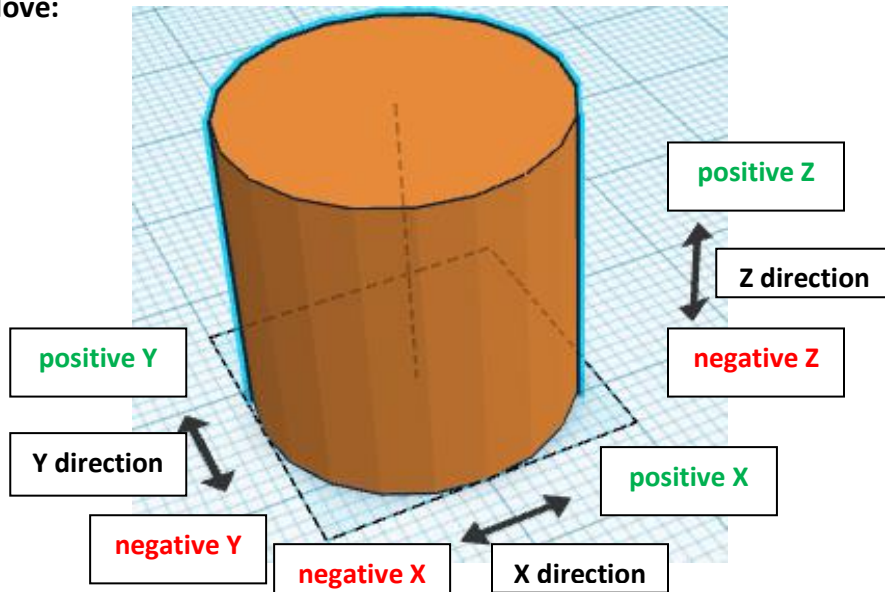
Always be in the "home view" when doing any of these!!!



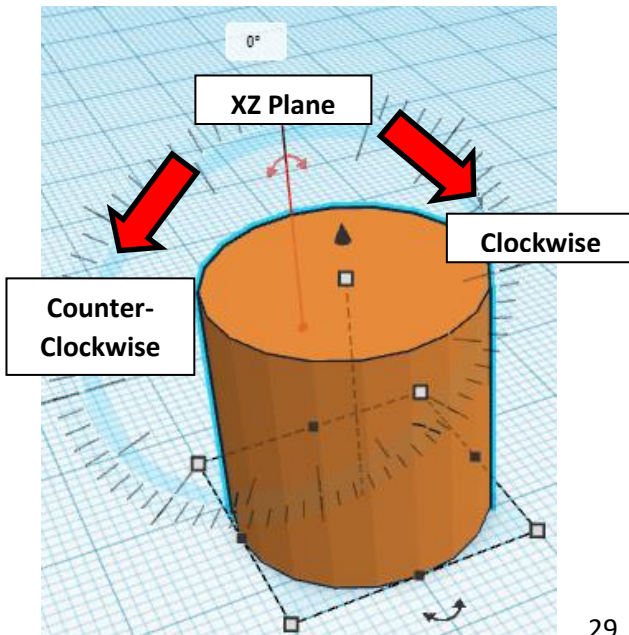
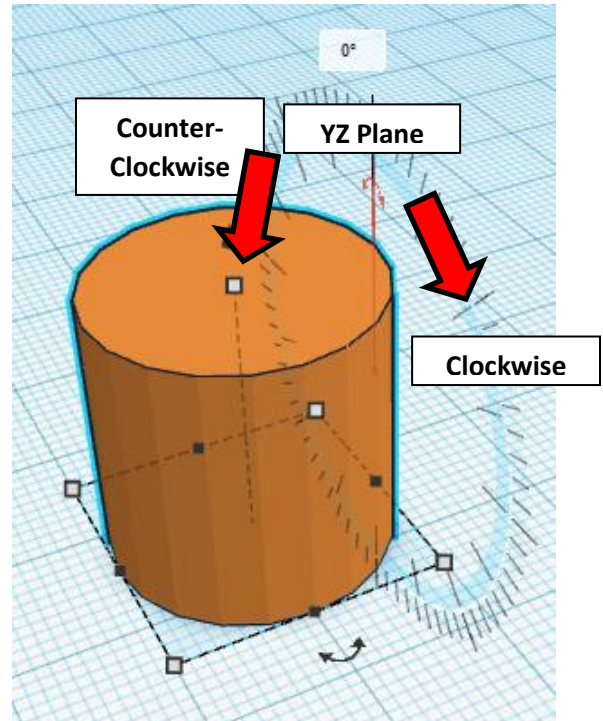
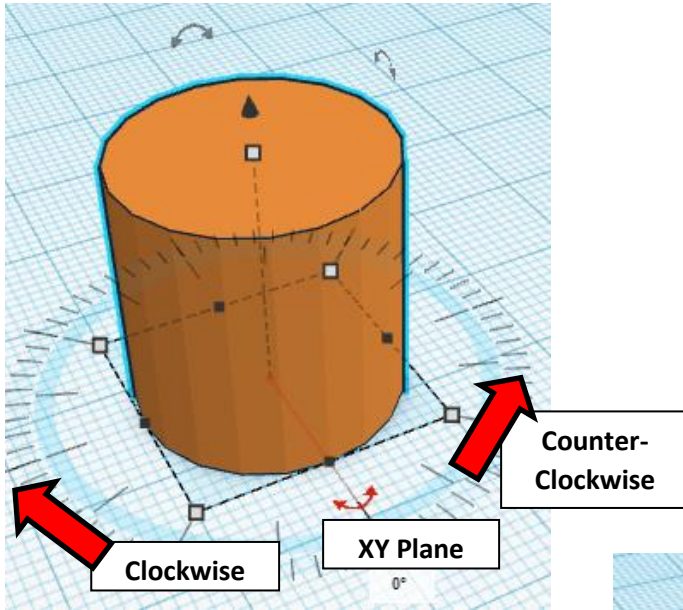
Aligning:



Flip or Mirror and Move:



Rotate:



Tool Guide

Most used Keyboard Shortcuts:

Transparency toggle	T	Duplicate object(s) in place.	Ctrl + D
Turn object(s) into Holes	H	Delete object(s)	Del
Turn object(s) into Solids	S	Undo action(s)	Ctrl + Z
Align object(s)	L	Zoom the view in or out	Mouse scroll wheel
Flip/Mirror object(s)	M	Zoom-in	+
Drop object(s) to workplane	D	Zoom-out	-
		Fit selected object(s) into view	F

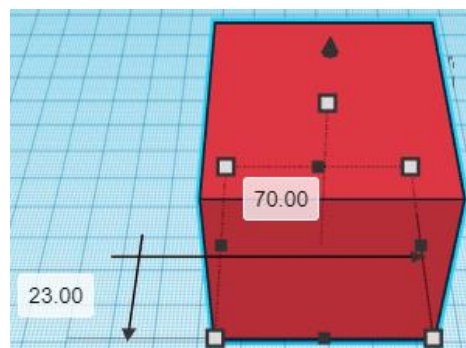
Moving Object(s):

To move object(s) with mouse:

In XY Plane
(left/right and forward/ backward)

Click and hold left mouse button on object.

Move mouse to desired location.

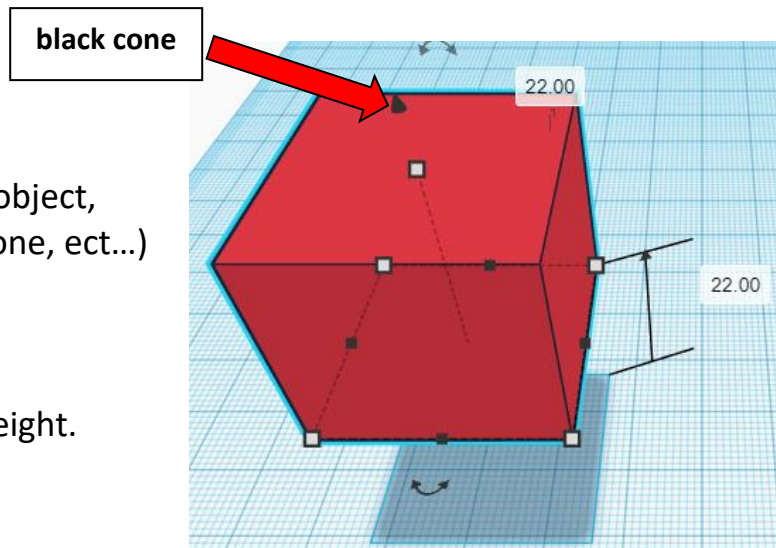


Moving Object(s) continued:

In Z direction (up/down)

Select object with left mouse button.
Notice that several shapes appear on object,
(white squares, black squares, black cone, ect...)

Click and hold left mouse button
on the black cone at top of object.
Move mouse up or down to desired height.



To move object(s) with keyboard:

In XY Plane (left/right and forward/ backward)

Select object with left mouse button.

Use arrow keys to move the object in 1mm increments.



In XY Plane (fast) (left/right and forward/ backward)

Select object with left mouse button.

Hold shift key
and use arrow keys to move the object in 10mm increments.



Moving Object(s) continued:

In Z direction (up/down)

Select object with left mouse button.



Hold control button
and use up and down arrow keys to move the object in 1mm increments.

In Z direction (fast) (up/down)

Select object with left mouse button.

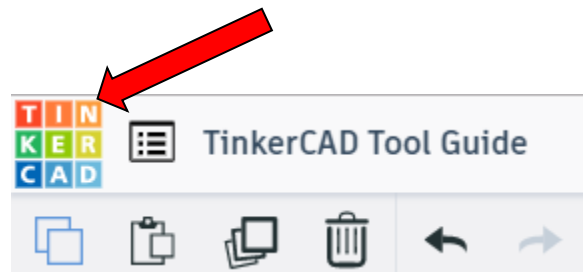


Hold control button and hold shift button
and use up and down arrow keys to move the object in 10mm increments.

Using on screen icons:

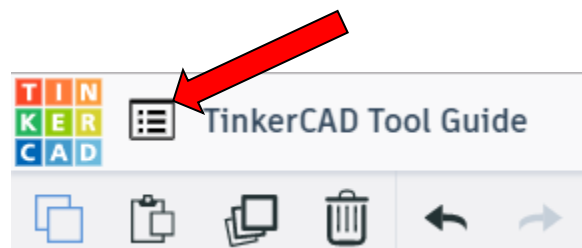
TinkerCAD main screen:

(I know this doesn't look
like an icon button, but it is)



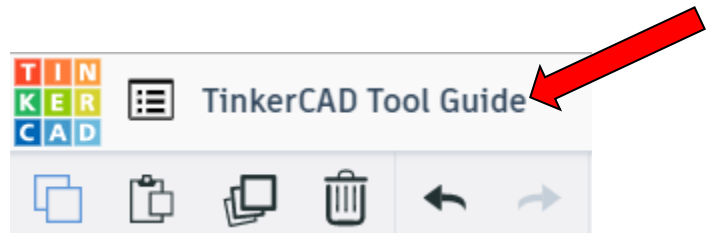
My designs:

Pulls up menu of your designs.



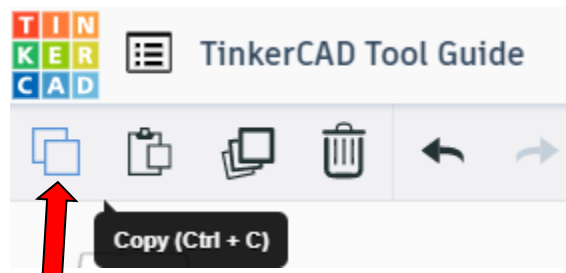
Design name:

TinkerCAD automatically names your design a random name.
Click here to change your design name.



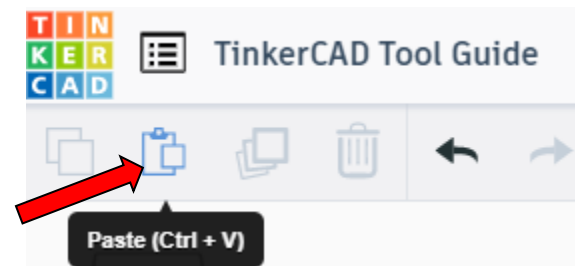
Copy:

Select shape.
Click copy or use ctrl + c
Paste to copy or go into new design and paste to copy.



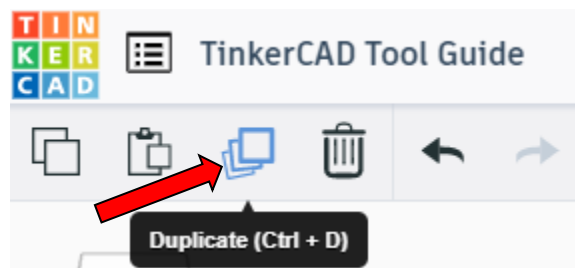
Paste:

After using copy,
click paste or use ctrl + v to paste.



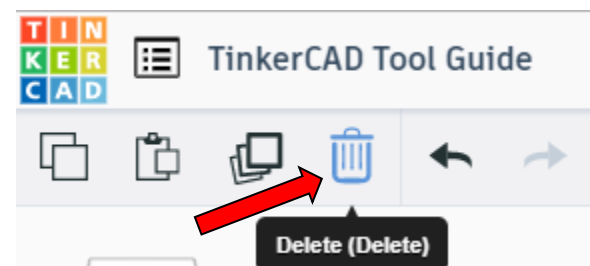
Duplicate:

Similar to copy, but can't copy to other designs.
Select shape.
Click duplicate or use ctrl + d
It will appear as if nothing happened, but if you move the shape you will see then duplicate underneath.



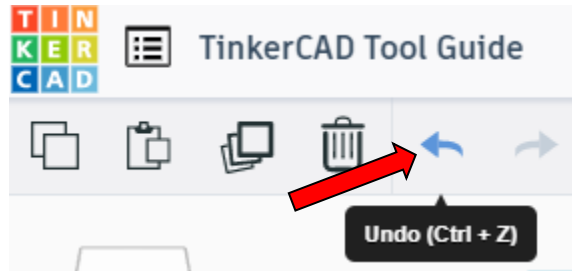
Delete:

Select shape.
Click delete or delete key.



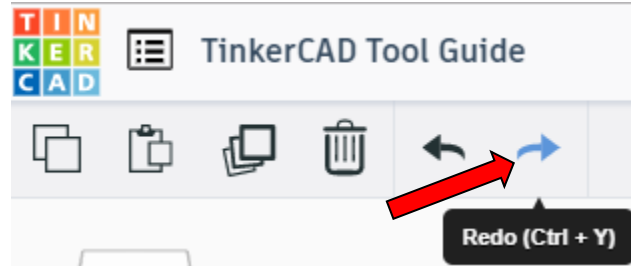
Undo:

Click undo or use ctrl + z
This will undo your last command.
This can be repeated.



Redo:

Click redo or use ctrl + y
This will redo your last undo command,
can only be used after using the
undo command.



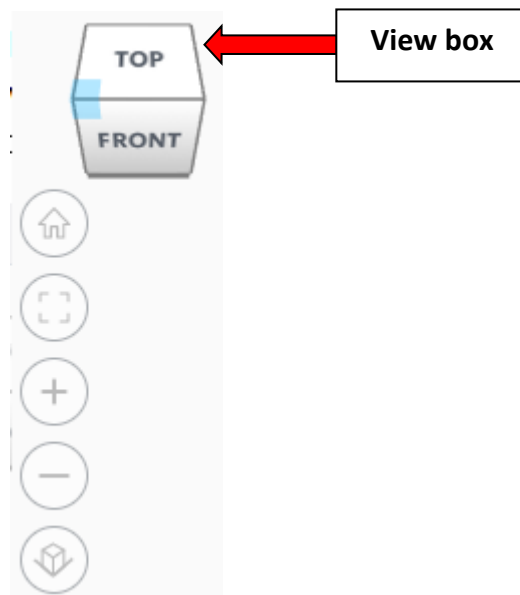
Change View:

To change view with mouse:

Right click and hold anywhere in work area. While holding right mouse button move mouse.
This will change the view of the work area.

To change view with icons:

Left click on view box.
Where you click determines
the view shown.

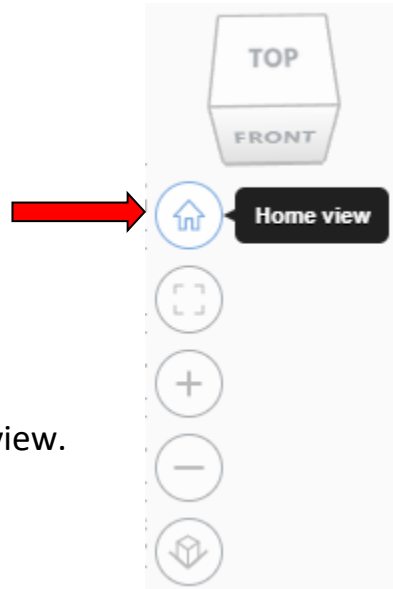


Change view to home view:

Most TinkerCAD Tutorials only work while in home view.

Click on home view icon to go to the home view.

You can also use the view box between the top and front view to change to the home view.

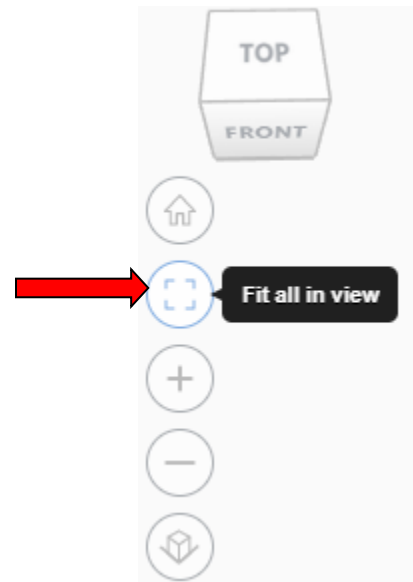


Fit all in view:

If you lose an object off the screen, you can click on Fit all in view to un-zoom to see all objects.

Fit one or more object(s) in view:

If you want to only see one or more object(s) in the view then select the object(s) and click Fit all in view or click the “f” key. This will zoom in on the object(s).



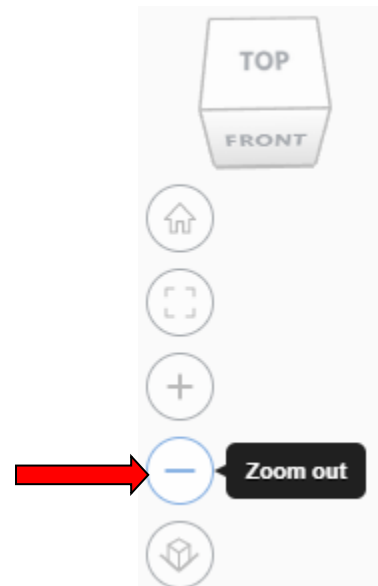
Zoom in:

Click the Zoom in icon or click the “+” key to zoom in.



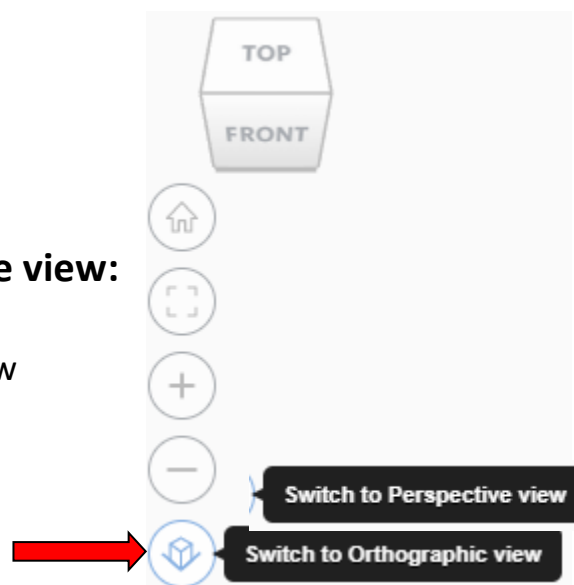
Zoom out:

Click the Zoom out icon or click the “-” key to zoom out.



Switching to orthographic and perspective view:

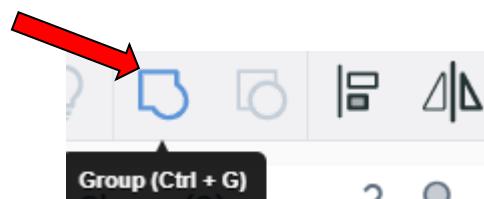
Click the Switch to orthographic/perspective view
To change to your preferred view.



Group:

To combine two or more objects into one object.

Select the objects to combine and click the
Group button or click ctrl + G



Ungroup:

After group objects, this will ungroup the object
back to separate objects.

Select the objects to ungroup and click the
ungroup button or click ctrl + shift + G



Align:

To perfectly center objects to each other or
To line up objects along their edges then use align.

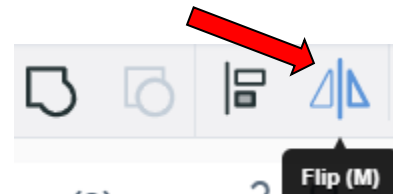
Select the objects to align and click the
align button or click "L"



Flip (Mirror):

This is mainly used for symmetric builds,
you create one half, duplicate it, then flip it
and move it in place and group it.

Select the objects to flip and click the
flip button or click "M"



Full list of Keyboard Shortcuts

MOVING OBJECT(S)

(Using keyboard)

Move along X/Y axis	← / ↑ / ↓ / →
Move along Z axis	Ctrl + ↓ / ↑
×10 Nudge along X/Y axis	Shift + ← / ↑ / ↓ / →
×10 Nudge along Z axis	Ctrl + Shift + ↓ / ↑

KEYBOARD + MOUSE SHORTCUTS

(Press and hold the keys, then click and drag the mouse)

Duplicate dragged object(s)	Alt + Drag left mouse button
Select multiple object(s)	Shift + Left mouse button
45° rotation	Shift (Hold while rotating)
Scale in one direction	Alt + Hold side handle
Scale in two directions	Alt + Hold corner handle
Uniform scale	Shift + Hold corner handle
Uniform scale in all directions	Alt + Shift + Corner handle
Uniform scale in all directions	Alt + Shift + Top handle

VIEWING DESIGNS

(With the help of a mouse or a mouse pad)

Orbit the view	Right mouse button
Orbit the view	Ctrl + Left mouse button
Pan the view	Shift + Right mouse button
Pan the view	Ctrl + Shift + left button
Zoom the view in or out	Mouse scroll wheel
Zoom-in	+
Zoom-out	-
Fit selected object(s) into view	F

OBJECT SETTINGS

Transparency toggle	T
Turn object(s) into Holes	H
Turn object(s) into Solids	S
Lock or Unlock object(s)	Ctrl + L
Hide object(s)	Ctrl + H
Show all hidden object(s)	Ctrl + Shift + H

TOOLS AND COMMANDS

Copy object(s)	Ctrl + C
Paste object(s)	Ctrl + V
Duplicate object(s) in place.	Ctrl + D
Delete object(s)	Del
Undo action(s)	Ctrl + Z
Redo action(s)	Ctrl + Y
Redo action(s)	Ctrl + Shift + Z
Group object(s)	Ctrl + G
Un-group object(s)	Ctrl + Shift + G
Align object(s)	L
Flip/Mirror objects(s)	M
Select all object(s)	Ctrl + A
Place a Ruler	R (Shift toggle midpoint/center)
Place a Workplane	W (press Shift to flip direction)
Drop object(s) to workplane	D