Spira Mirabilis

Finding the Spiral tool

The Spiral tool is part of ShapeWizards suite called MagicBox (the other tools in the suite are Pursuit, Shell, Sphere). You can install all these tools at once by downloading and opening MagicBox.rbz, or you can install individual tools by downloading and opening separate tool files (Spiral.rbz,...). Regardless of what method you choose, the tool icon will always end up in ShapeWizards toolbox.

By default, this toolbox is a floating window and can appear anywhere on the screen. If you can't locate it, make sure that the menu item View/Toolbars/ShapeWizards is checked off and that the toolbar was not put so far from the window center that it was clipped out of the view. If you still can't see it, restart Sketchup. That will not be required often, but it can happen when you install several tools incrementally, or update a tool that has already been installed.

Unless docked, the ShapeWizards toolbox looks like this:

![ShapeWizards toolbox]

In this tutorial, the toolbox is docked at left vertical edge of Sketchup window, so that it doesn't interfere with the graphics.

Your first spiral

1. Start with an empty drawing, delete the Sketchup figure if necessary.
2. Select top view by clicking on Camera/Standard Views/Top
3. Activate SpiraMirabilis tool by clicking on the SpiraMirabilis icon in ShapeWizards toolbox. If you can't locate it, move the mouse over the tool-box and the tool-tip will tell you. Alternatively, you can also activate the tool by invoking Tools/ShapeWizards/Spira Mirabilis command. After the SpiraMirabilis has been
activated, the prompt at the bottom will change to “SpiraMirabilis: Push right mouse button for menu options”.

4. Open the SpiraMirabilis context menu by pushing the right mouse button and select Create/Center + Free-Hand from the menu. The prompt will change to “SpiraMirabilis: Specify spiral center.” and the cursor tip will be augmented by a small yellow dot representing the center of the spiral you are creating. As you move the mouse around (without clicking), the VCB box (value control box) at the bottom of Sketchup window will show running coordinates of the yellow dot in current units.
5. Move the cursor to the origin and **click**. That will fix the center of the spiral to \([0,0,0]\) and the prompt will change to “Specify start point.”. The yellow dot will be replaced by radius line connecting the spiral center to the current cursor position. Move the cursor away from the center and **click**. That will define the starting point of the spiral.

6. Move the mouse around the center counter-clockwise(without clicking) as indicated by the yellow arrow on the next picture and **click**.

7. The yellow curve will turn black which indicates end of the process. You just created your first logarithmic spiral.
How to make changes

There are 5 different ways to mold the spiral shape to your liking.

8. Click on the spiral you just created. It will turn blue to indicate that it was selected. Open the context menu by pushing right mouse button and choose **Change/Point** from the menu.

9. The spiral will be highlighted with yellow color (indicating active state) and a small blue/red mark – location widget - appears on the spiral. As you move the cursor around, the location widget moves with it and changes its color from one end of the spiral to the other. The location widget gives you 2 pieces of information.

   - The location of the point you are changing.
   - The end of the spiral which will be moved as you relocate the chosen point.
10. Push the left mouse button and drag the point around.

11. When you release the button, you will see this:

12. Another way for defining the spiral shape is to treat it as a 'constrained' curve, which reflects more or less the mathematical definition. Select the curve again and choose Change/Turns from the context menu.
13. The spiral's color will change to yellow and a radius line appears connecting the location widget with the center.

14. Push down the left mouse button and drag-rotate the radius clock-wise to a position indicated on the next picture.

15. Release the button to produce new spiral.
16. The bend function determines how the spiral 'bends', leaving the other shape characteristics unchanged. Click on the spiral and select **Change/Bend** from the context menu.

17. Move the location widget closer to the endpoint, push left mouse button and drag the widget to the center. As you drag it, the spiral will become more like a circle.
18. The final shape looks like this:

19. The spiral is a 2D curve, but it can be stretched into 3D by applying the **stretch** command. Change the viewpoint to Camera/Standard Views/ISO, select the spiral and invoke the **Change/Stretch** function from context menu. Move the **location widget** close to the end you want to move up (it will assume blue color at one end, red color at the other end)

20. Push left mouse button down and drag the location widget up.

21. Upon releasing the button, the 3D spiral appears. In spite of being a 3D entity, you can still use all function as if it was just a 2D curve. Let's demonstrate this by increasing the number of turns. Select the spiral by single click and open **Change/Turns**. Move the mouse around to place the location widget at a desired place.
22. Push the left mouse button down and drag-rotate the radius around the vertical axis in clock-wise direction few times. You should end up with a picture like this:

23. Notice that the overall height didn't change, only the number of turns did. There are more parameters to explore, but we need to change the style to do that. Select the spiral and set style to Style/Flat. The spiral will change from a curve to a flat band.

24. Zoom in really close, select the spiral and active Change/Width.
25. Push down the left mouse button and drag the arrow down to make the width large. When you are done, zoom out.

26. Let's try a few more style changes. The next one in line is UP. While the FLAT style puts all the faces on a plane parallel with XY, the UP style faces are all vertical. Select the spiral and invoke Style/Up.
27. Zoom in, select the spiral and select **Change/Height** from the context menu.

28. Move the location widget to a convenient place, push the left mouse button and drag the yellow arrow up. The height will increase as you move the mouse.

29. Release the mouse button, zoom out and enjoy your creation.
To demonstrate the resolution functions we need to use a slightly different object.

1. Select the spiral on the screen and invoke **Delete** from the **context menu**
2. Change the viewpoint to **Camera/Standard Views/Top**
3. Select **Create/Center+Turns** from **context menu**.
   4. Fix the spiral center to origin (click on \([0,0,0]\))
   5. move the mouse away a click again to define the starting point, then rotate the radius and produce a spiral segment by clicking at the endpoint – see the picture bellow.

5. Select the spiral segment and apply **Style/Profile/Circle** on it, and this what you should see on the screen:

6. It is a circular tube bent to spiral shape. Change the viewpoint to **Camera/Standard Views/ISO** and zoom in. The black curve underneath is the spiral spine and it is rendered to remind you that the SpiraMirabilis tools is active.
7. Select the tube and activate **Settings/Resolution/Number of spine segments** from the context menu.

8. The current number of liner segments along the spine is currently as shown in the VCB box is 32. Change it to 8 by typing it over.

9. The tube is now modeled and rendered as 3 segments along the spine direction, because the number you typed in refers to the whole turn (360 degrees), while the tube in the scene is slightly more than ¼ of that. Let's do the same to the profile resolution. Select the tube and activate **Settings/Resolution/Number of cross segments**. The current value is 12 as shown in the VCB box. Type in 4.
Visibility

10. With the square tube still on the screen, let's go back to the original round tube. Select the tube and change the number of cross segments back to 12. Select it again and change the number of spine segments back to 32. Select the tube again and invoke Settings/Visibility/Show long edges from the context menu.

11. That will cause only the longitudinal edges to be shown, while the cross edges will be hidden. This is quite useful when painting faces with color (see the next paragraph).
**Drawing in space**

The objects in the previous paragraphs were created on the XY plane, but you can create spirals on any plane derived from any face in the scene. Here is a simple example.

1. Starting with an empty drawing, set viewing direction to **Camera/Standard Views/ISO**.
2. Create a box by pushing up a rectangle created in the XY plane.

3. Activate the SpiraMirabilis tool, select **Create/Center+Turns** from the context menu and **click** on the center of the front-facing face. Move the mouse away and specify the starting point by one **click**. Rotate the mouse around the center until the spiral looks similar to the following picture:

4. Finish the creation by one more **click**.
5. That's your spiral. Select it and choose **Style/Up** from the context menu.

---

**Spiral objects and groups**

SpiraMirabilis tool (the Spiral tool in short) creates spiral objects which can be manipulated and modified by the Spiral tool and by other Sketchup tools as well. A spiral object is a group of faces and/or edges augmented by a set of hidden attributes accessible only to Spiral tool. You can purge the attributes from the group by invoking the the Release command, which will transform Spiral object into a regular Sketchup group.

A Spiral tool treats a Spiral object differently from any other Sketchup tool. Whereas a Sketchup tool treats a Spiral object as group of connected faces, a Spiral tool treats it as a parametrically defined entity with faces generated algorithmically. The distinction between these two incarnations of the same object is graphically represented by two different ways of highlighting. If you select a Spiral object as a group of faces (accessible to standard Sketchup tools), the object will highlight as a group with blue/red frame around it. If you select the same object as a parametrized entity (accessible to Spiral tool), the object itself will turn blue and there will be no frame.

How do you tell which case applies when? The rule is simple – if the Spiral tool is active, all
Spiral objects will be treated as parametrized entities, in all other cases the Spiral objects will be treated as standard groups of faces.

When the Spiral tools is active, the only selection method available is one-click selection. There is no multiple selections, or any other kind of selections, you can select only one object at a time. Let's illustrate this on an example.

1. Start with an empty scene. If it's not empty, deactivate the Spiral tool by clicking on the select arrow in the upper left corner of Sketchup window and erase all entities.
2. Set the viewpoint to Camera/Standard Views/Top.
3. Create a Spiral object using any method available, for example Create/Center+Turns
4. Select the spiral and invoke Style/Flat from the context menu.
5. Select the spiral, open context menu and select Copy.
6. A new copy appears overlaying the original. Push down the left mouse button and drag the copy away. When you release the button, you should see two identical spirals next to each other.

7. Click on the left spiral. It will turn blue indicating that a) it is selected, b) it is a parametric entity and not just a group of faces. Here what you should see on the screen:

8. Bring up the context menu by pushing the right mouse button and invoke Release.

9. The Release function deletes all hidden attributes and turns the Spiral into a regular Sketchup group. Both spirals look the same though, so how do we tell the difference? First, the black spine is missing, which is an indication that the spiral is just a regular Sketchup group and second – if you click on it, you'll get an error message.
10. Let's explore what happens when the Spiral tool is **not** active. Deactivate the Spiral tool by clicking on the **select arrow** in the upper left corner of Sketchup window and then click on the left spiral. Bring up the right mouse button menu and click on **Entity Info**. The name of the group is empty, which indicates that this is a regular Sketchup group. The other indication of that is that the group frame is blue (the group is unlocked).

11. Now click on the right spiral. The group frame will turn and the name of group will change to “ShapeWizard's *SpiraMirabilis*”. This is an indication that the group is actually a parametric entity accessible from the Spiral tool.
Face painting

Putting color or textures on individual faces is a manual process, but it can be greatly helped by using edge visibility settings.

1. Erase the spiral group on the left (regular Sketchup group) and active Spiral tool.
2. Select the spiral and invoke Settings/Visibility/Show long edges

3. Let's start painting. Click on Sketchup paint bucket too in the Sketchup's main toolbar. Since only one tool can be active at a time, Spiral tool will automatically deactivate and the paint bucket will become active. A color pallet window will appear next to the main Sketchup window. The cursor will change to paint bucket cursor and when you right-click on the Spiral object, it will appear as a locked group.

4. Using right mouse button, unlock the group and open it for editing. Once the group is opened, you can start painting faces. Select a color from the pallet (for example yellow) and click on the spiral.
5. Since all cross edges are invisible, the color will spread over neighbor faces until it hits an edge that is visible. Edges visibility is a convenient way to control which faces are to be painted with the same color. Had you left the cross edges visible, you could have painted the spiral like this (try it).

6. There is another way to spread color around. Select the spiral and make cross edges visible by invoking Settings/Visibility/Show cross edges (unless you already done so)

7. Open the point bucket and paint the first face green and the last face yellow.
8. Active Spiral tool and invoke the **color spread** command (without selecting the spiral). When the prompt change to “Pick first face”, pick the green face, and when it reads “Pick second face”, pick the yellow face. The result should look like this:

![Spiral geometry](image)

**Spiral geometry**

Spira Mirabilis is a planar curve, also known as logarithmic spiral, equiangular spiral or growth spiral. This tool adds a 3rd dimension to the definition, allowing the curve to stretch into space. If you think of the spiral as being defined in the XY plane, then each point on the curve is lifted up in the Z direction by an amount proportional to the curve length from its starting point.

The spiral plane is defined implicitly by the first click of any creation operation. If you click on a face, the plane in which it lies will become the spiral plane. You can also click on an edge or a vertex and the spiral plane will be derived from one of the surrounding faces. Once the spiral plane is established, it is fixed as long as you stay in the Spira Mirabilis tool. It is possible to move the spiral on the plane just by dragging it, but not to move or rotate the plane itself. You'll have to leave the tool and use standard Sketchup tools to do that.

Click on empty space will define the spiral plane as one of Sketchup main coordinate planes.

Since this tool was designed to facilitate direct graphical input in coordinate-free fashion, entering explicit positions plays a secondary role. If you need to position the spiral at some specific location, you need to make its plane parallel to one of the Sketchup coordinate planes. This will allow you to use keyboard input for entering numerical coordinates in a meaningful way.
A spiral object consists of two graphical components:

- A thick black curve on the inside of the spiral.
- A band of faces hugging the spiral from the outside.

The thick curve is the spiral spine, which represents the mathematical definition of the curve. The band of faces is attached to the spine to make it look better. The spine exists and is visible only when the Spira Mirabilis tool is active; as soon as the tool deactivates, the spine disappears.

The spiral is an oriented entity, it has a start and an end. Usually, you can manipulate the curve without taking into account its orientation, but some values like length are orientation sensitive. If you need to change the spiral orientation, use Change/Orientation from the context menu.

**Copy, Delete, Release**

Copy function creates a copy of a spiral object, including its hidden attributes, which Sketchup Copy may or may not do. The copy initially overlaps the original spiral, but you may drag it away immediately without selecting it. Just push the left mouse button down and move the mouse.

Delete function is functionally identical to Sketchup Erase function, except there is no need to deactivate the Spiral tool to execute it.

Release function removes all hidden attributes and turns Spiral object into regular Sketchup group. Use it when you are satisfied with the result and want to decrease the object size.

**Default values and other notes**

- When you create a new Spiral object, most of the parameters are set automatically to default values. You can define default values in the same way as you specify parameter values for a specific object. The rule is this:
  
  If there is a Spiral object selected, all values entered will be applied to that object
  If there is no Spiral object selected, all values entered will be taken as default values

- To find out which of the parameter values can be defined as defaults, open the context menu when nothing is selected and look at the menu items. The black items displayed in black, can be defined as defaults, those that are grayed out cannot be defined as defaults.

- Numerical entries in the VCB box can be of 3 types – numbers, points, vectors. Positive values allow incremental editing, which means that if you prefix the entry with a sign, the entry will be
added to or subtracted from the current value shown in the VCB box. A point can be entered as a triple of numbers \(x,y,z\) or \([x,y,z]\). A vector has to be entered as \(<x,y,z>\). The coordinates refer to the global Sketchup coordinate system.

➢ A selected Spiral object can be moved around by dragging. Place the cursor on a selected Spiral object and drag it away in the same way you would drag away a copy of the object.

➢ A useful tip: If you see some faces missing or being cut into by the front clipping plane, press Ctr-Shift-E to update the scene extents. That should fix it.

➢ To increase or decrease the number of turns while creating a new spiral, press F2 or F3.

➢ **How to uninstall Spiral tool?** Delete *Spiral* directory in Sketchup's *Plugins/ShapeWizards* directory.

➢ **How to uninstall all ShapeWizards tools?** Delete the file *shapewizards.rb* and the directory *ShapeWizards* in Sketchup's *Plugins* directory.