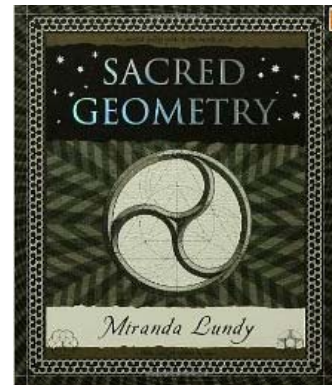
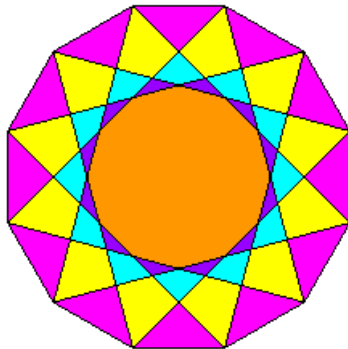


Constructing a Dodecagon from a Circle, in Google SketchUp

I am a big fan of Wooden Books, and recently I was browsing through *Sacred Geometry* by Miranda Lundy. I've had this wonderful little book for years, and always notice something new that would be cool to try in SketchUp.

This project was adapted from one of the book's 2D constructions, showing how to create a dodecagon from a circle.



All you need to complete this project is a few SketchUp tools. (Plus you need to ignore the fact that SketchUp's **Polygon** tool will create a dodecagon much more quickly!)

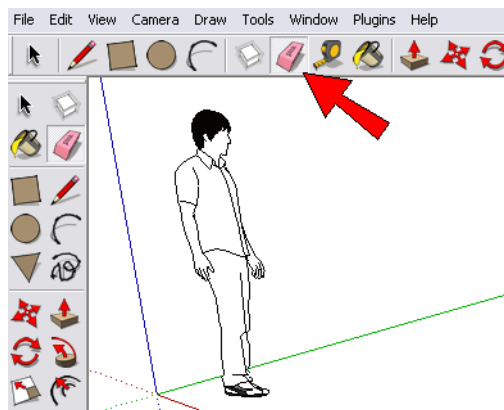
Teacher Note: All text that appears in **red** is for the teacher version only, and does not appear in the student version.

For this project, it helps to have some basic knowledge of Google SketchUp (though detailed instructions are provided). In particular, it's important to know how to zoom and pan the view. If you need more information on how to get started, and a description of some basic tools, please read 3DVinci's Getting Started Guide (PDF).

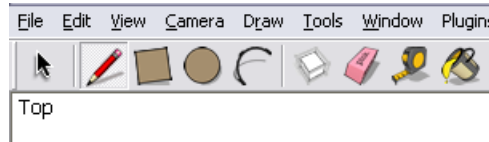
PC users: go to http://www.3dvinci.net/SketchUp_Intro_PC.pdf.

Mac users: go to http://www.3dvinci.net/SketchUp_Intro_MAC.pdf.

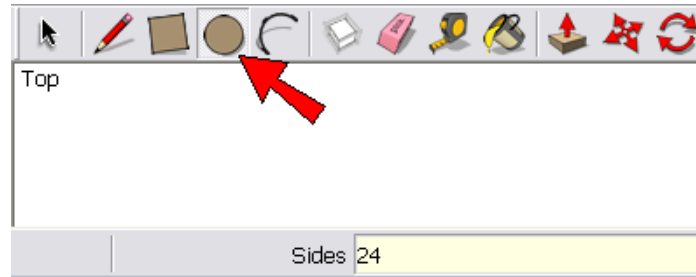
1. Open Google SketchUp. If your file contains a person standing on the ground near the origin, click the **Eraser** tool and erase him or her.



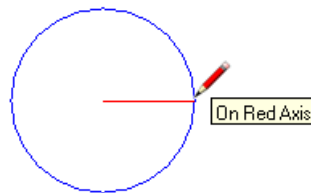
2. From the main menu, choose **Camera / Standard Views / Top**. Now you're looking down on the "ground," and the word **Top** appears in the top left corner of the SketchUp window.



3. Activate the **Circle** tool. Before clicking anywhere, look in the **Sides** field in the lower right corner. By default, the number of "sides" for a circle is 24, which is fine because we need a multiple of 6 (the reason will become clear in a few more steps). If you see a different number here, type 24 (don't click in the **Sides** field; just type and the number will appear) and press Enter.



4. To create the circle, click anywhere to place the center, then move the mouse in either the green direction (vertically) or the red direction (horizontally), and click to complete the circle.



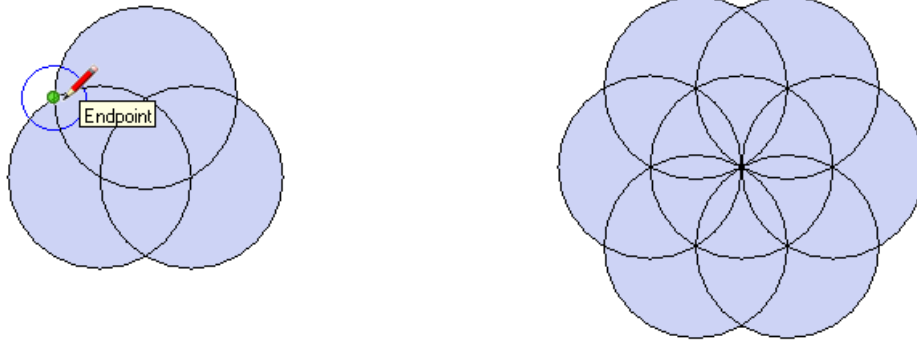
5. The next circle will be the same size as the first one. To start this circle, place its center point at the far right "endpoint" of the first circle. Then click the center of the first circle. You now have two identical circles.



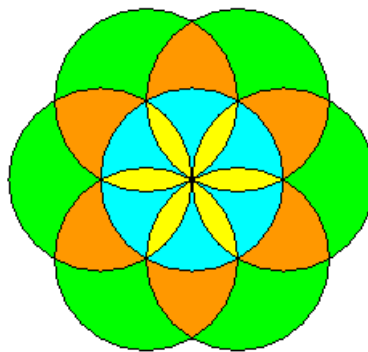
6. Now we'll continue with 5 more identical circles, going all the way around the first circle. So for the next circle, click the upper point where the two circles meet. Then click again the center of the first circle.



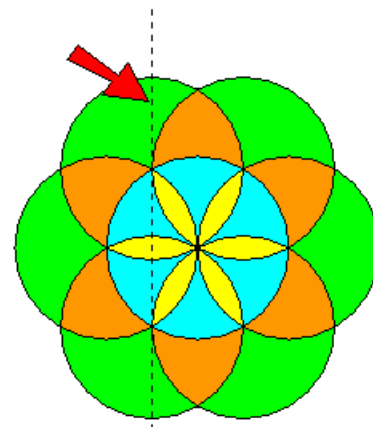
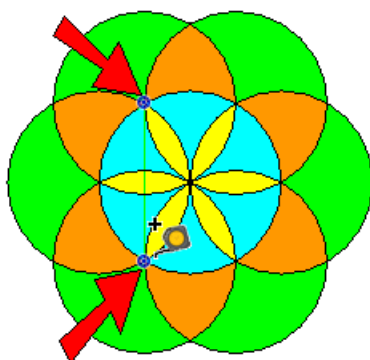
7. Keep creating circles following the same pattern. Center each circle where the previous two circles intersect, then click the center of the first circle. You should end up with 7 total circles, forming a “flower.”



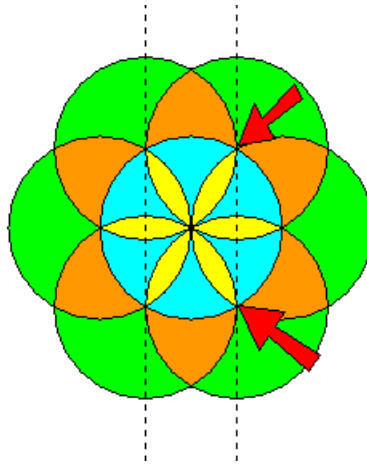
8. If you like, click the **Paint Bucket** tool to open the color selections, and paint the pattern.



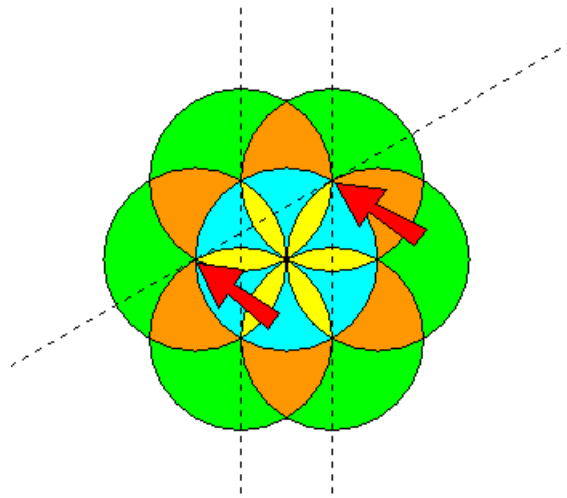
9. The flower forms some of the geometry we need to create the dodecagon. The next thing we need are a set of guide lines. Click the **Tape Measure** tool, and you should see a “plus” sign next to the cursor (if you don’t, tap the Ctrl or Option key). Click the two points shown below on the left. This produces a vertical, infinite guide line which passes through those points.



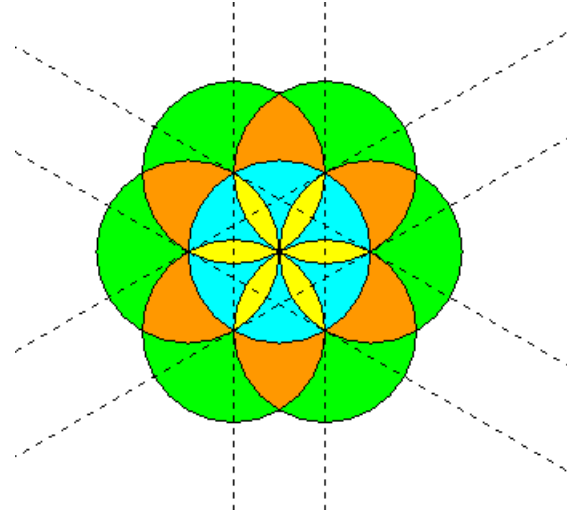
10. Create a similar vertical guide line that passes between these two points.



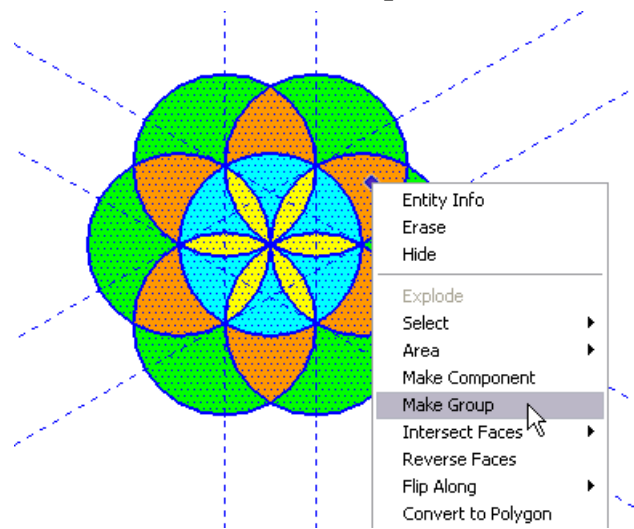
11. Now create the diagonal guide line shown below:



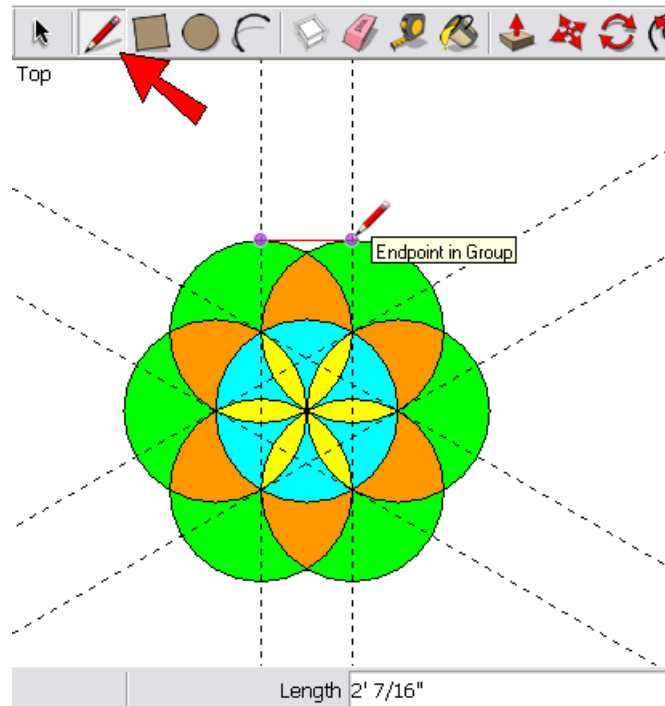
12. Continue making similar guide lines until there are 6 total.



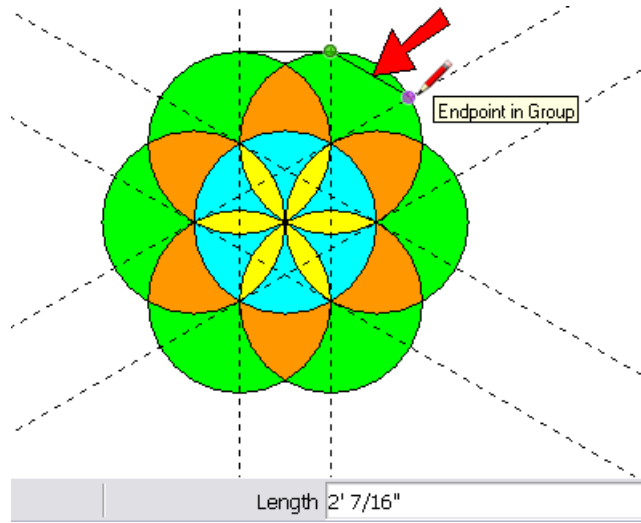
13. The construction geometry is now complete. So that all of these objects can easily be erased later, they should be made into a group. To select everything in the model so far, press Ctrl + A (PC) or Cmd + A (Mac). Then right-click on any selected face and choose **Make Group**.



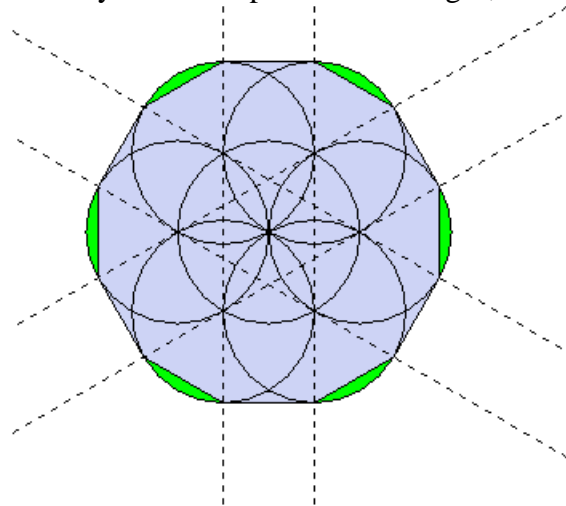
14. Activate the **Line** tool, and draw a line between the intersection points shown below. These points are where guide lines meet circles. While you're drawing this line, look at the **Length** field which tells you how long the line is.



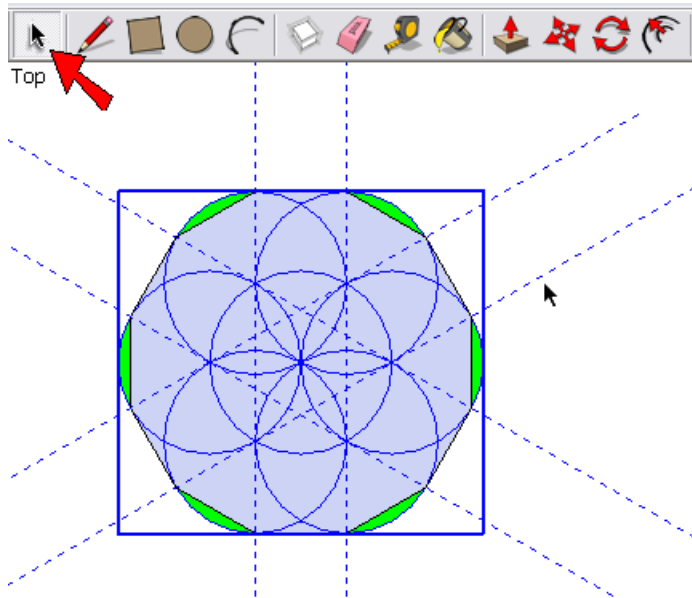
15. Continue line drawing by clicking the next intersection point. If all of your construction geometry is correct, this line should have the same length as the previous one.



16. Keep going all the way around until you've completed all 12 edges, all with the same length.



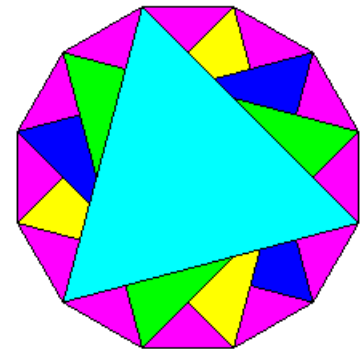
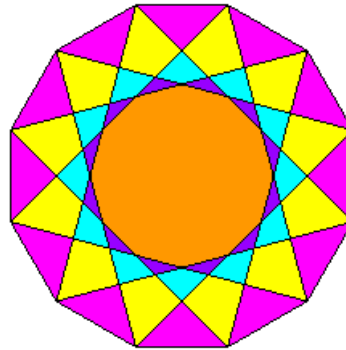
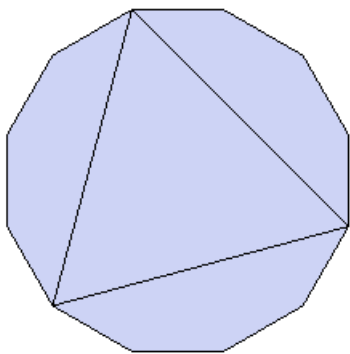
17. Now that we have the dodecagon, the construction geometry is no longer needed. Activate the **Select** tool and click a guide line, because these are the only construction objects that you can easily “reach” outside the dodecagon. This selects the entire construction group. Press the Delete key, and only the dodecagon is left.



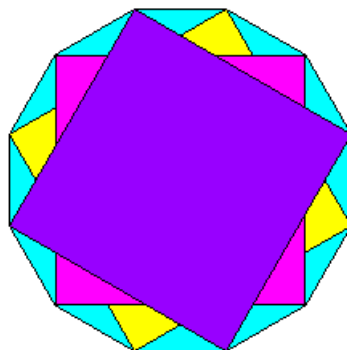
Cool Things to Try with a Dodecagon

Once you have a dodecagon, there are some neat things you can do to it, using the **Line** tool. (And you don't have to go through this construction each time - you can use either the **Polygon** or **Circle** tool to create a polygon with 12 sides!)

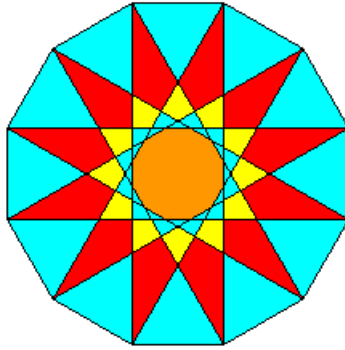
Draw one triangle inside the dodecagon. Repeat this triangle three more times inside the dodecagon and you'll get a nice sunburst pattern. Erasing certain edges makes for a nice spiral pattern.



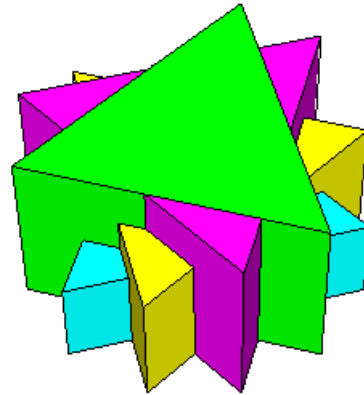
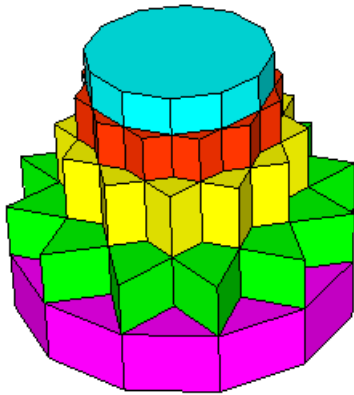
Instead of starting with a triangle as above, start with a square instead.



Or draw lines like this, for a different sort of sunburst:



If you know how to use the **Push/Pull** tool, you can make some great 3D models from these dodecagon objects.

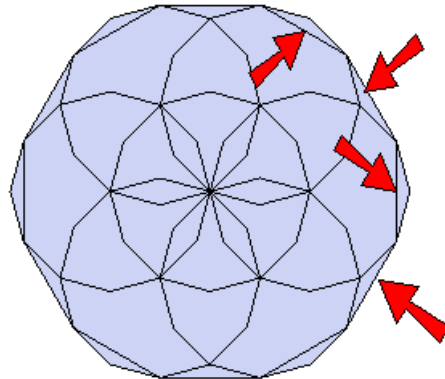
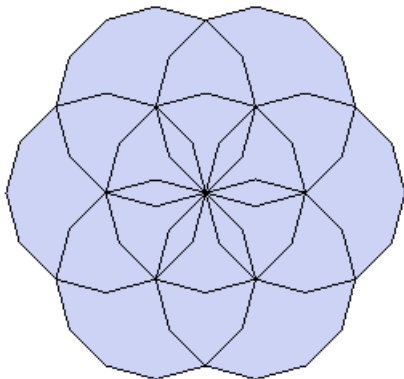


Try This

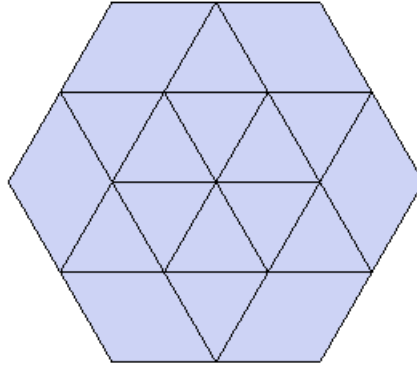
Go back to the beginning of this project. Instead of a 24-sided circle, can you get the same results with fewer sides?

Teacher Note:

As you might have guessed, if you start with a 12-sided circle instead of a 24-sided one, you can get the same results. In fact, starting this way means you can skip adding the guide lines, because the intersection points are already obvious.



The number of sides must be a multiple of 6. But if you start with a hexagon, you'll get this - not very helpful:



Teachers, Want More?

For more geometry projects using Google SketchUp, check out our GeomeTricks books. All books are available in print and as printable e-books. See <http://www.3dvinci.net/ccp0-catshow/GM.html>.

You can also sign up for our [SketchUp Project of the Month](http://www.3dvinci.net/ccp0-prodshow/POM.html) subscription. Each month you will receive three fun projects (one in math, two in 3D design) that can be used in K-12 classes. Details at <http://www.3dvinci.net/ccp0-prodshow/POM.html>.

December has two projects that have geometric elements: one on creating spiral stripes, and another that creates an ornament from a sphere and hexagons:

