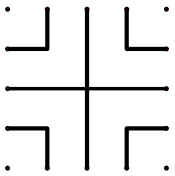
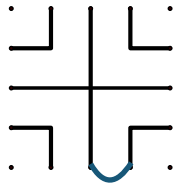
Make your own labyrinth!

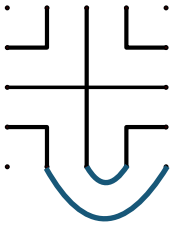


Here's how to use the diagram to make your own labyrinths. Start with the side that looks like the picture to the right. That's called the *nucleus* of the labyrinth. We are going to add eight curves to the nucleus to complete the labyrinth. Notice that there are four dots in the corners of the nucleus, but that also that the two crossing lines in the center have four endpoints and the four elbow-shaped lines have eight more endpoints, for a total of 16 places where we can connect a curve around the perimeter. We will connect them in pairs to create the labyrinth.

Start by adding a little curve that connects the bottom-most point of the central vertical line of the nucleus to the end of the elbow nearest it to the right, like so:



Next, you want to connect the nearest two unconnected points on either side of the ones you just connected, like so:



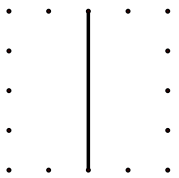
Keep going in that same fashion, always connecting the nearest points on either side of the ones you've connected so far. Always leave space between your successive curves, and don't let any of them cross. Always loop around what you have drawn so far in the same direction. (The space between your curves will become the passages of your labyrinth.)

If you're careful and keep going like this, once you have drawn eight curves (the final few of which will loop almost all the way around the nucleus), you should have connected up all of the 16 spots around the perimeter of the nucleus in pairs, just leaving one open "gap" between the top of the vertical line from the nucleus and the end of the elbow just to its left. That is the entrance to your labyrinth. Now, with the the opposite end of your pencil (so you aren't leaving any mark behind, see if you can trace the path all the way from the entrance to the center of the labyrinth that you've drawn.

Mixing it up

Every time you use this nucleus as above, you'll end up creating the same labyrinth – a labyrinth that is first known from Babylonian clay tablets over *three thousand* years old. But what if you want to try to make a different labyrinth? One way is to start by connecting a different pair of adjacent spots initially, and then proceed as above – try it! For even more new labyrinths, turn the page over.

More new labyrinths

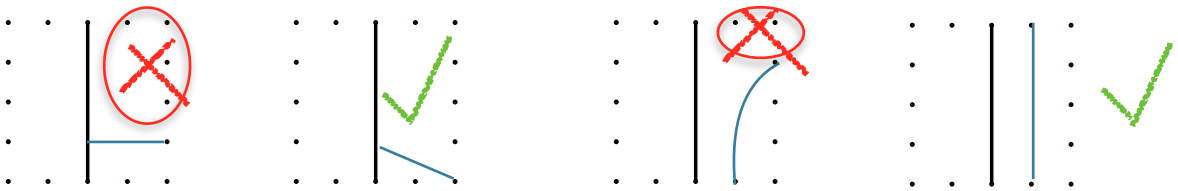


You can make even more new labyrinths by creating your own nucleus. Start with the opposite side of the labyrinth diagram, that has just a single vertical line, like this:

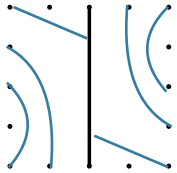
Notice how that central line divides the dots around the perimeter into two groups of seven dots each. We will add connections within those groups to complete the nucleus. In each step, you can connect any dot **either** to another dot in the same group, **or** to one of the existing lines that defines that group, as long as you keep to the following rules:

A) Don't cross any lines, and make at most one connection to any dot.
B) Don't connect a dot to an adjacent dot or to a line that ends at an adjacent dot.
C) When you draw the connection, it may split the remaining dots into two groups. If so, there must be an **odd** number of dots in each group.

Note that because of rule (B), whenever you end up with a single dot in a group, you can't make any connections to that dot, and it will end up as a "solo dot" like the corners in the first nucleus. Rule C is the most complicated, so here are a few examples that show connections that are OK and not OK:



Once you can't make any more connections (there will be at least two solo dots, and may be more), the nucleus is done. (There is an example to the right of how it might come out.)



You complete your new labyrinth from your nucleus just the same way you completed the first nucleus: connect two adjacent points on the outside of the nucleus, and then keep connecting the nearest unconnected points on either side of what's connected so far, until all are paired up, leaving just the entrance. Then you can trace your labyrinth from the entrance to the center. You'll always get to the center, but depending on the nucleus there may be parts of the labyrinth you can't reach. How many different nuclei can you find that allow you to access the whole labyrinth from the entrance?

Acknowledgments to Prof. Tony Phillips of Stony Brook University for his clear explanations of the math of labyrinths; you can find much more information at www.math.stonybrook.edu/~tony/mazes