

Want to learn to draw your own mazes? Here is a basic introduction to what you need to know.

Have fun!

The first thing to do is, have fun! Don't worry about the rules, just sit down with a pencil, a piece of paper (and an eraser) and start drawing. See what you can do. Do this a few times, draw several mazes. Enjoy yourself, and don't worry if they are really, really, lame. You're having fun, after all. And the whole point of drawing them is to see where your strengths and weakness are. So you know what to start working on to get better.

Basic Drawing Skills: Passages

Take a close look at the mazes you drew for fun, and think of how you could improve them. If you are like most beginning maze artists, the number one thing that you will have problems with is **consistent passage width**. It comes from a lack of control of the pen. Now that's not to say that all passages are always supposed to be the same width everywhere throughout a maze. Not always. But, you have to be able to draw passages of any width you want, and keep them looking tight and clean, if you want to move beyond doodling. Take a look at examples (a) and (b) in the Figure 1 at the right. See how the width of the passages are quite uniform? Whether its a straight passage (a) or a curved passage (b), the two walls of the passage remain the same distance from each other.

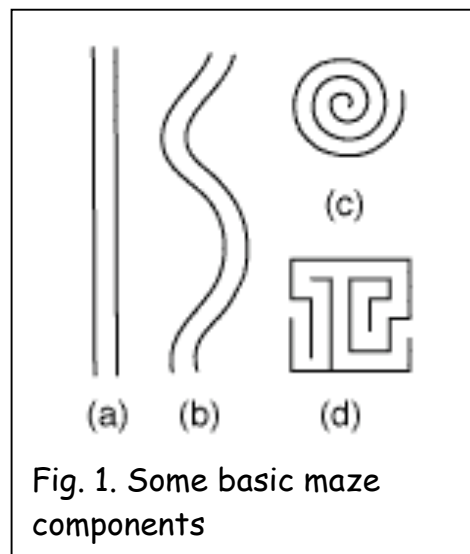


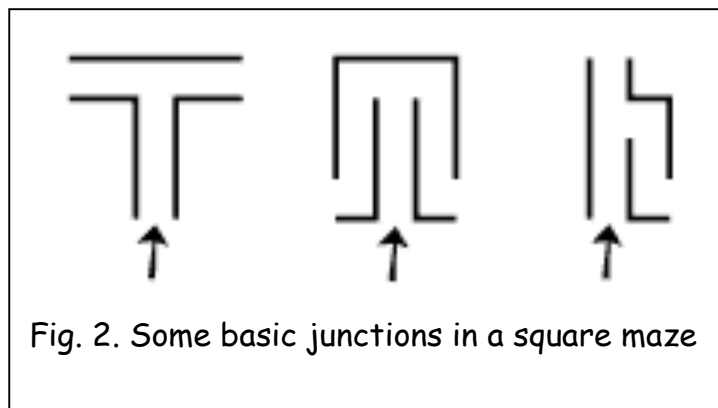
Fig. 1. Some basic maze components

So, begin by practicing this skill. Start with just drawing straight passages. And you don't have to sit around drawing boring lines all day to practice this. Draw a few mazes, but as you do, try to draw the straight passages so they are always the same width. Once you can keep the straight passages looking clean and uniform, try the same with curved passages (b). I can't emphasize enough the importance of learning to draw consistent passages. If you master this skill you are well on your way to greatly improving your maze-drawing abilities.

Junctions

The next thing to master is the junction. Junctions are where three or more passages meet, and the maze solver has to make a choice as to which passage to take. The easiest way to create a junction is simply to create an opening in the wall of an existing passage, and build a new passage off of that. One thing to look out for: make sure that any junctions you create lead to passages that people will actually take. In poorly designed mazes, there are often junctions with one passage that is so short it leads to an obvious dead end. If people can see, from the junction itself, that any particular passage leads nowhere, all you have done with that passage is waste some valuable space in your maze.

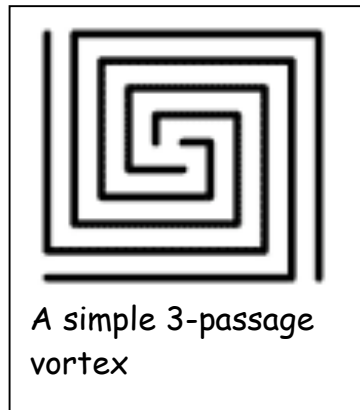
Junctions lead to new passages, and when creating junctions you should try to achieve a balance between creating passages that lead to dead ends, and creating passages that lead back into earlier passages of your maze. Although it may seem counter-intuitive, a maze where every passage leads to a dead end (except for the passage that leads to the solution) is actually not very hard to solve. The hardest mazes to solve have some passages that lead to dead ends, but others that lead back to earlier passages. Such mazes are called *multiply-connected* mazes and maze solvers can spend a lot of time going back over their tracks while trying to get through them.



The Spiral and Vortex

Take a look at the spiral design (c, Figure 1). Does it remind you of one of those rotating hypnosis wheels in a B-movie from the 1950's or the Twilight Zone? There is a reason spirals were used in all those movies: they are naturally disorienting and confusing. Learn to use them to your advantage within mazes. But before you can learn to use them, you have to be able to draw them! So practice, and every time you draw a maze, try to include some spirals.

Spirals look good, but they don't really make for challenging mazes because the center of every spiral is a dead end. But once you have mastered the basic spiral, then you can proceed to the much more useful **vortex**. A vortex consists of three or more passages spiraling into a common center. Here is a **picture of a vortex**.



One of the more effective ways to use the vortex design in a maze is actually quite simple: draw several of them, and then link them together. Have a single passageway leading into the group of vortices, and a single passageway leading out. Then make every other passageway that comes out of any one vortex, lead back into one of the other vortices. Its a simple concept, its not very hard to draw, and it makes for a very difficult area of any maze to get through.

Learn to Use Space Properly

Another common difficulty facing beginning maze artists is learning to properly fill up a blank space with a series of passages. Sure drawing a single line is not so bad, but once you start linking them together, its easy to end up with oddly shaped white space between passages that must be filled in. This is a difficult skill to master.

So what you need to learn is to be able to completely fill a space of almost any shape with maze passages. Take a look at example (d) in Figure 1. See how the entire square area is filled with consistent passages? Practice this kind of thing on your own by first drawing an empty rectangle, and then completely filling it in with passages. Try this with rectangles, then oddly shaped blobs, and any other shape you want. Learn to estimate how much space to leave open for later passages as you are drawing the initial passages.

Bringing it all Together: Bottlenecks

If you have mastered the basic drawing skills above, the next thing to work on is maze structure and strategy. I'd suggest that you begin by taking a piece of paper and dividing it into three areas. Make all the areas next to each other, with no empty spaces between them. Then make the entrance to the maze lead into one of these three areas, and the exit lead out of another. Then block off all three areas so that in order to solve the maze, you have to get through each in succession. This means creating a *bottleneck* that every solution must pass through to get from one area to the next.

In the example on the right (Fig 3) there are three areas, A, B, and C. You enter the maze in area A, but to get to area B there is only one narrow opening, and to get to area C from area B there is also only one opening. If you have learned the basic drawing skills described above, then you should be able to fill in each of the three areas with passageways, junctions and vortices. Make sure each area has a balance of passages, so that some passages lead to dead ends, but others lead to other vortices and some lead back to earlier passages. This will make it difficult for the maze-solver to find the one passage that leads to the next area.

As you get better you will have to learn how to conceal the borders of the areas by making them irregularly shaped. Much of the advantage of dividing a maze into separate areas with bottlenecks is lost if the boundaries to these areas (and thus, the bottlenecks themselves) are clearly visible.

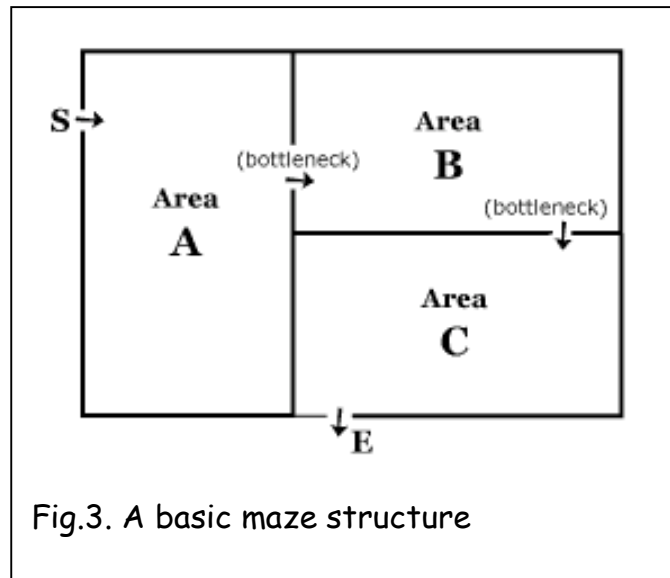


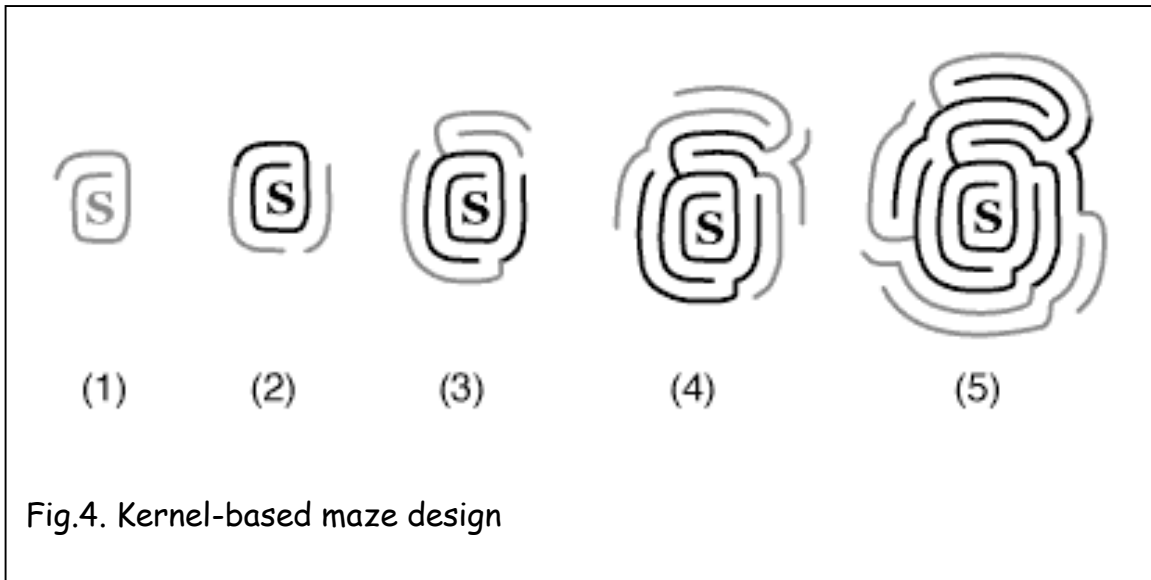
Fig.3. A basic maze structure

An Alternate Approach: Kernels

Another approach to maze structure involves using kernels. Take a look at the progression in Figure 4. In phase (1) we simply draw the start of the maze. Phase (2) extends the passage leading out of the start, but introduces a break in the outer wall as we draw. This is where an additional passage will join as you see in phase (3). Note how the new passage (in lower left) doubles back in the reverse direction the maze-solver was originally going. In the later phases (4) and (5) we simply extend the same basic techniques, adding new breaks in the walls and creating new passages. Note how some of the passages are connected back to earlier passages, so a wrong turn can lead the maze solver back to an earlier point.

One of the best (and easiest) ways to use kernels in creating a maze is to build up several kernel structures and then link them together. One kernel structure is built around the Start or Entrance, and another around the End or Exit. But you can also use a spiral, a

dead end, or a vortex as a kernel around which to build a structure. Build each kernel structure up into a complex series of passageways (with some dead ends, and with several passageways emanating from it), and then connect them all to each other. Mazes drawn in this way often have an attractive, organic appearance.



Practice, Practice, Practice

Drawing mazes is a lot of fun, especially when you put the finishing touches on one that you know is a devious puzzle. But how do you get good at it?

Well, remember the old question, "How do you get to Carnegie Hall?" Answer: Practice. So how do you learn to draw great mazes? Answer: Draw a lot of mazes. You have to like drawing mazes, because then you will want to keep drawing. And then you will get better.

Junction (or fork) - An area in a maze where three or more passageways meet, forcing the maze solver to choose between at least two alternate routes going forward. Well designed junctions utilize psychology to mislead maze solvers down incorrect passageways. For example, maze solvers tend not to take passageways that appear to go back in a direction they just came from. Making such passageways the route to the solution results in a more difficult maze.

Outer Wall (or Boundary) - The wall or barrier forming the outermost perimeter of a maze. Everything outside the Outer Wall is not a part of the maze puzzle.

Spiral - A single passageway that spirals into itself and leads to a dead end at the center of the spiral.

Vortex - Three or more passageways that spiral into each other, to a central junction, where one must then choose a passageway leading back out. Vortices are disorienting because it is difficult to predict in what direction a passageway leading out will ultimately lead. Multiple vortices linked together can be particularly confusing to navigate.

Bottleneck - A passage connecting one area of a maze to another, and that must be traversed in order to solve the maze. Every solution to the maze must go through the bottleneck.

Best-Solution (or Shortest Path) - The shortest physical route through a maze (i.e. the quickest solution if one is walking). Some mazes have more than one best solution (i.e. two or more solutions that are equally short), although this is very rare.