

Making Fractals: Drawing, Folding, and Cutting

Chaos and Fractals

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In this lab we'll make fractals three different ways: drawing, folding paper, and cutting and folding paper. The goal of these activities is to explore and think about the relation between iteration and fractals, and more generally about different ways of making patterns.

Do these exercises in groups of two or three. Check with me as you do these, as the instructions aren't super clear. I will project some images on the screen that may help.

Drawing. We'll follow an iterative procedure similar to the procedure we used to make Koch curves. Working on graph paper may be helpful.

1. Draw a large line on a piece of paper. This is step zero.
2. For the next step, replace the line with a line that juts up and then back, making a right angle. Call this step one. You now have a shape with two line segments.
3. Repeat this process. For every line segment, replace it with a bent line. The first bent line you make should go up. Then alternate up and down as you proceed through the shape.
4. Yeah, that's confusing. Maybe the figure below will help.



Figure 1: The first three steps in the creation of a curve shape. Image by Larry Riddle. Source: <https://larryriddle.agnesscott.org/ifs/heighway/heighway.htm>

5. Keep going for 6 or 7 steps. Admire your creation.

Folding a strip of paper.

1. Take a long strip of paper and fold¹ it toward you. Then fold it toward you again.
2. Unfold the paper and note the sequence of peaks and valleys.
3. Take the paper and fold it toward you again. What sequence of peaks and valleys do you expect to have now?
4. Unfold the paper and note the sequence of peaks and valleys.
5. Repeat the above two steps as long as you can.
6. Admire your creation.

¹When making creases, make them assertively.

Folding and Cutting²

1. Oh gosh. How am I going to explain this?
2. I'll show you portions of this video (<https://www.youtube.com/watch?v=4YDHsMUQbVg>) by Cathy Yenca, known on youtube as mathycathy.
3. Keep going as long as you are able.
4. Admire your creation.

Back to Drawing

1. Start with a large line segment.
2. Replace the line segment with a trapezoid. You now have three line segments.
3. Repeat. Replace each line segment with a trapezoid. See the right-most part of the figure below. Note that the first trapezoid is inward, and then the trapezoids alternate.



Figure 2: The first three steps in the creation of another curvey shape. Image by Larry Riddle. Source: <https://larryriddle.agnesscott.org/ifs/siertri/siertri.htm>.

4. Continue this process. But at each step alternate whether or not your starting trapezoid is up or down. I.e., at step one, the first (and only) trapezoid is up. At step two, the first trapezoid is down. At step three the first trapezoid is up, and so on.
5. Admire your creation.

²When there are instructions to cut something halfway, be careful to not cut more than halfway. Err on the side of not cutting all the way. If you need to make the cut a little longer, you can. But it's not really possible to undo a cut if it's too long.