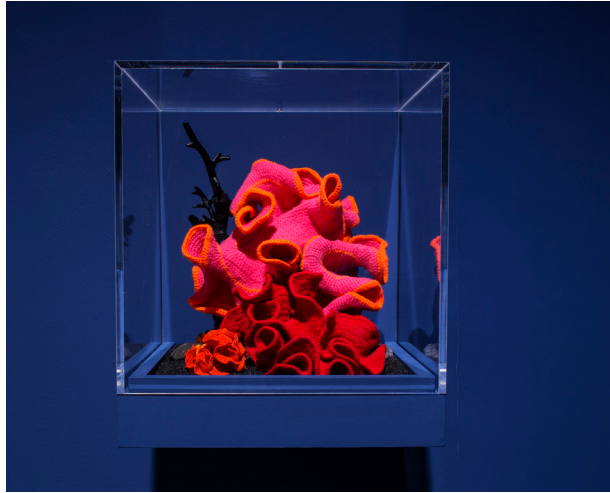


HOW TO CROCHET HYPERBOLIC CORALS

By the Institute For Figuring



Pod World – Hyperbolic at the 2019 Venice Biennale

The *Crochet Coral Reef* is a celebration of the intersection of geometry and handicraft and a testimony to the disappearing wonders of the marine world. Launched as a response to the devastation of living reefs due to global warming and ocean acidification, the *Crochet Reef* resides at the nexus of art, science, mathematics and environmentalism.

Crochet Coral Reef

A project by the Institute For Figuring created by Christine Wertheim and Margaret Wertheim

crochetcoralreef.org

HYPERBOLIC WONDERS

In coral reefs we witness an endless whimsical diversity: wavy strands of kelp, crenellated corals and curled sponges. Even those who have never seen a living reef immediately recognize the *Crochet Reef's* distinctive forms, for this woolly wonder takes its cue from nature. In both cases the ruffled shapes are variations on a mathematical structure known as *hyperbolic* geometry. Nature repeatedly emulates these forms, because they are an ideal way to maximize surface area, allowing filter feeding organisms such as corals to enhance nutrient intake.

For humans the best way to make models of hyperbolic geometry is with crochet, a discovery made in 1997 by Dr. Daina Taimina at Cornell. Nature, however, does not stick to mathematical perfection and just as there is nothing in nature that is perfectly spherical, so in nature there are no perfect hyperbolics. Living forms result from *imperfection*, deviation and aberrancy.

In 2005, Margaret and Christine Wertheim at the Institute For Figuring in Los Angeles began to develop a taxonomy of reef-like forms by building on Dr. Taimina's techniques. Instead of adhering



Coral Forest at Lehigh University Art Galleries, 2019

to a mathematically pure pattern, they began to use more freeform techniques which give the models a natural, organic look. Tightly bunched mounds of brain coral, towered spires of pillar coral, blooms of carnation coral and forests of kelp can all be mimicked.

Just as the diversity of *living* species results from variations in an underlying DNA code, so a wide range of woolen 'species' may be brought into being through modifications in an underlying crochet code. As in nature, organic-looking structures are 'born' from variation and experiment. Anyone who takes up this technique can begin to explore what is possible here. So, have fun. Go wild. Be part of an ever-evolving crochet 'tree of life.'



Bleached Reef at the 2019 Venice Biennale

The *Crochet Coral Reef* project has two parts: the community-based **Satellite Reef** program in which participants make their own local reefs; and a **Core Collection** of reef sculptures created at the Institute that travel to museums and galleries around the world.

fig.

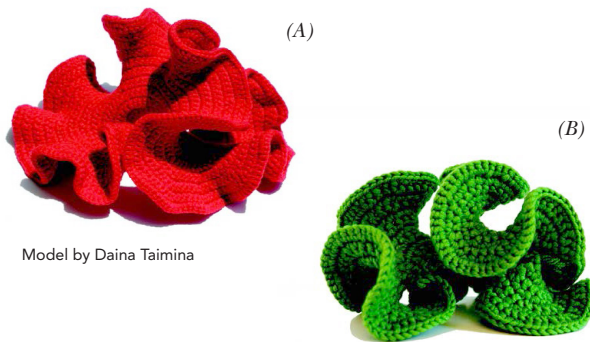
Institute For Figuring
P.O. Box 50346
Los Angeles, CA 90050
theiff.org

HYPERBOLIC CROCHET BASICS

Here we present a taxonomy of basic hyperbolic models. To crochet a hyperbolic structure you simply increase stitches at a regular rate in every row. The more often you increase, the more quickly the model will ruffle up.

HYPERBOLIC PLANE (fig. A)

STEP 1 To crochet a basic hyperbolic plane, begin with a line of chain stitches. We recommend 15 or 20 stitches for your first try. **STEP 2** After the line of chains, begin the first row by crocheting 5 stitches, then increasing in the sixth stitch. (You may use single, half double or double crochet as you choose.) Keep on repeating this pattern: crochet 5 stitches, increase 1; crochet 5 stitches, increase 1 – until the end of the row. **STEP 3** Turn around and repeat the pattern in the next row and all subsequent rows.

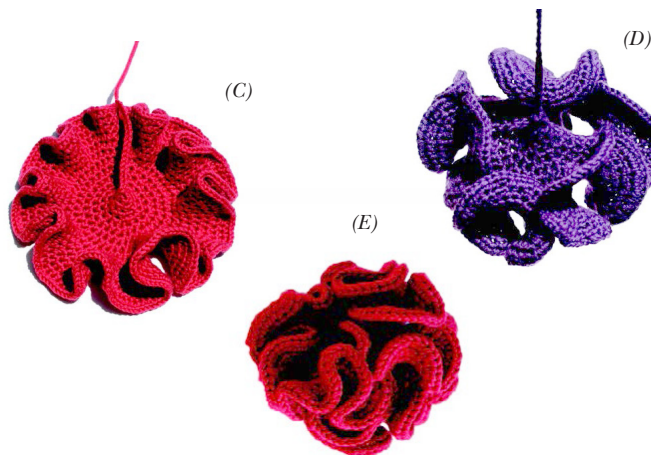


Model by Daina Taimina

MORE CURLY HYPERBOLIC PLANE (fig. B)

In our first model the rate of increase is 1 in every 6 stitches. To make a more ruffled model, increase more rapidly. In our next model the rate of increase is 1 in every 4 stitches. **STEP 1** Begin with a line of chain stitches. **STEP 2** After the line of chains, begin the first row by crocheting 3 stitches, then increasing in the fourth stitch. Keep repeating the pattern: Crochet 3 stitches, increase 1; crochet 3 stitches, increase 1.

You are encouraged to try out different rates of increase. Different types of yarn also behave in different ways. To make a structurally rigid model like a coral, use synthetic yarn and a small hook. For a floppy kelp-like model, use soft wools and a larger hook.



PSEUDOSPHERE (fig. C)

In this model you do hyperbolic crochet round a circle. **STEP 1** Begin with a line of chains. **STEP 2** After a dozen stitches, you need to turn the line into a circle. To do this, crochet 3 stitches into the last chain and then join this group of stitches into a tiny cone. **STEP 3** Begin to crochet around the edge of the cone increasing at a regular rate. Here the rate of increase is 1 in every 3 stitches.

ANOTHER PSEUDOSPHERE (fig. D)

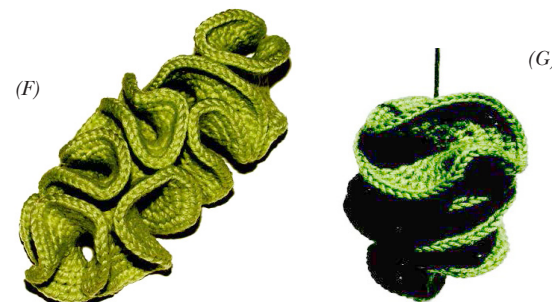
Here the rate of increase is 1 in every 2 stitches, so the model ruffles up faster. If you increase at a regular rate, you always achieve a mathematically perfect shape. This form is the hyperbolic equivalent of a cone; its tip extends to infinity.

Making a perfect pseudosphere is not necessary if you want to crochet corals (fig. E). Instead, you may start with a circle of chains and do hyperbolic crochet round this loop. **STEP 1** Crochet 4 chains. **STEP 2** Join chains into a circle. **STEP 3** Begin to crochet around the loop, increasing at a regular rate as you spiral out. Here we increase in every stitch.

All models by the Institute For Figuring, unless stated.

DOUBLE HYPERBOLIC PLANE (fig. F & G)

Here you do hyperbolic crochet around both sides of a line, working in a racetrack pattern. **STEP 1** Begin with a line of chains. **STEP 2** Crochet along one side of the chain, increasing at a regular rate. (In this model we increase 1 in every 2 stitches.) **STEP 3** At the end of the row, increase 5 stitches in the last chain, then turn around and come back along the other side, continuing to increase at the same rate. **STEP 4** Continue hyperbolic crochet around the racetrack in all following rows. This kelp-like form is in fact two hyperbolic planes joined together.



SEED-POD MODEL (fig. H)

STEP 1 To get this pretty form, begin with a line of 15 chains. **STEP 2** In the first row, crochet around the chain on both sides, increasing in every stitch. **STEP 3** In the second row, increase in 2 out of 3 stitches. **STEP 4** In the third row, increase in every second stitch. **STEP 5** In the fourth row, increase in every third stitch. And so on. There are natural seedpods with this structure.



Model by Spring Pace

Living organisms are always irregular. In order to achieve natural looking corals, it helps to vary the rate of increase within the model. We encourage you to experiment for yourselves.