Spring 2020

Knitting Math: Geometric Shapes

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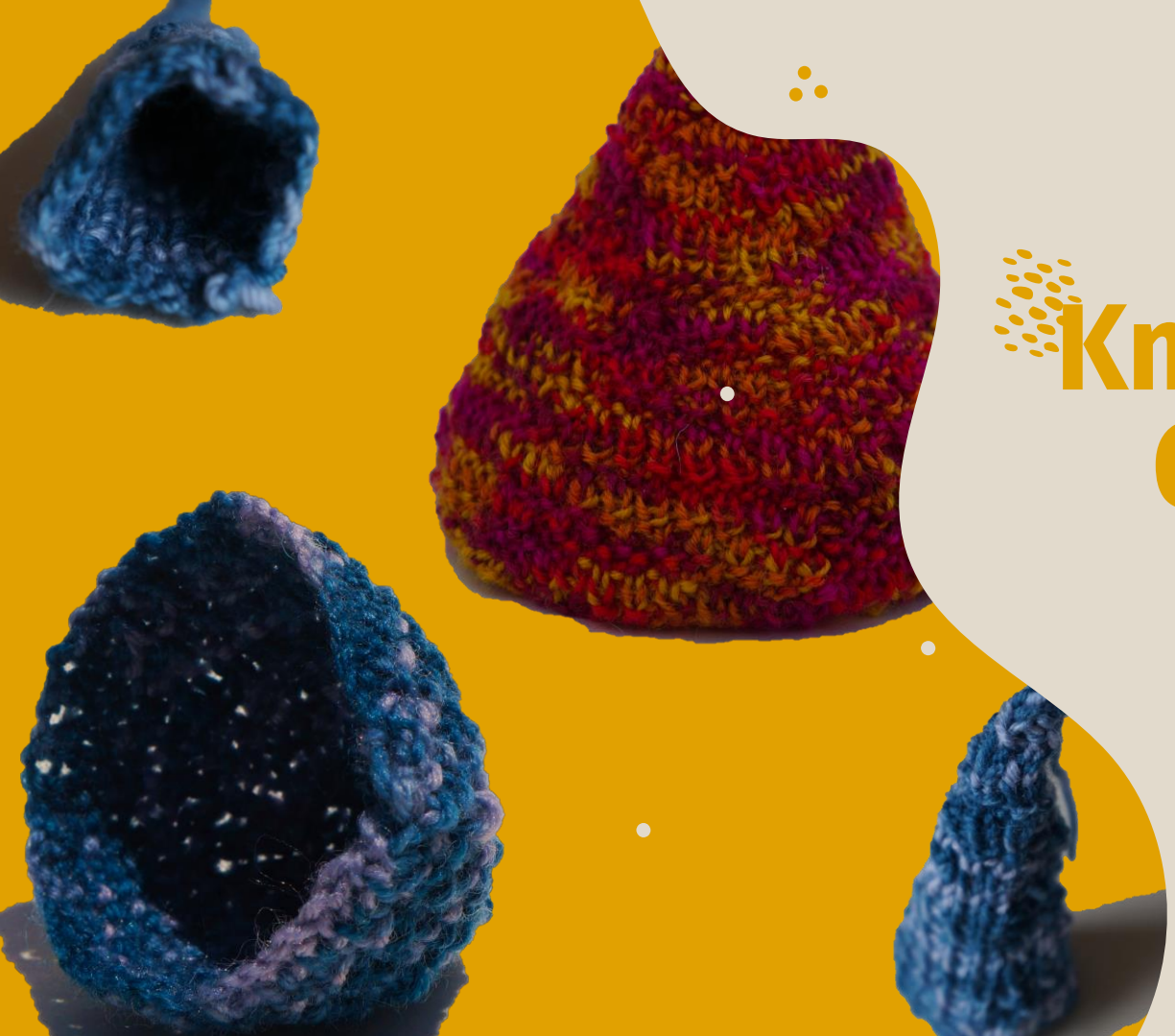

Knitting Math: Geometric Shapes

How the world of math and knitting collide through cones and paraboloids

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04

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05

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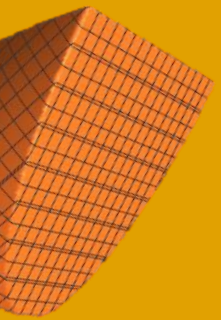
Takeaways from this presentation & project.

01

KNITTING AND MATH?

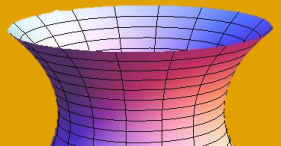
Knitting and math are connected in many interesting ways.



MATHEMATICS

Geometric shapes are all around us. Through calculus, we can create equations to describe all of these shapes.

Might we be able to describe these shapes in a similar way, through knitting?



KNITTING

Mathematical knitting has been used to describe algebraic concepts, mobius bands, and hyperbolic planes.

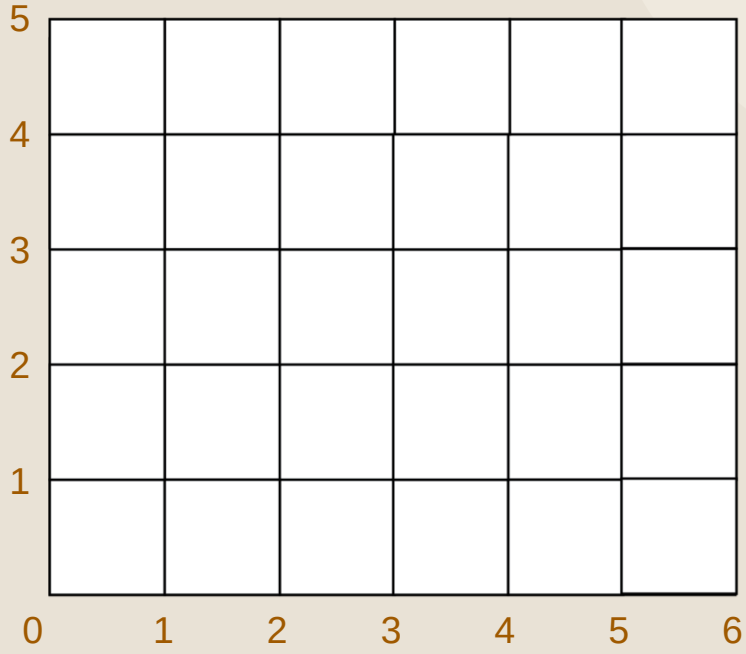
Can we use knitting to explore other shapes and surfaces?

Mathematical Knitting

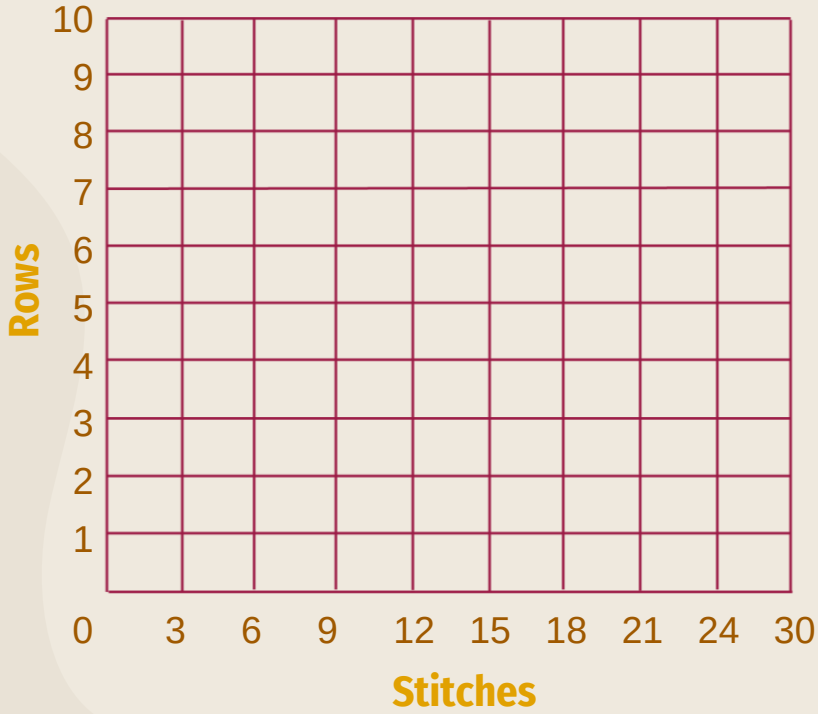
- Typically creating complex shapes
- Led in a large part by sarah-marie belcastro

COORDINATE SYSTEMS

INCHES



KNITTING



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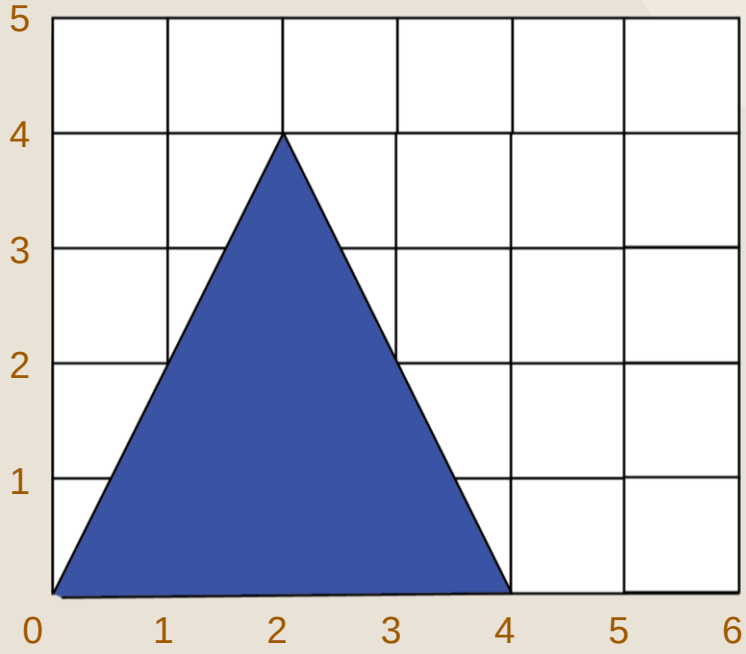
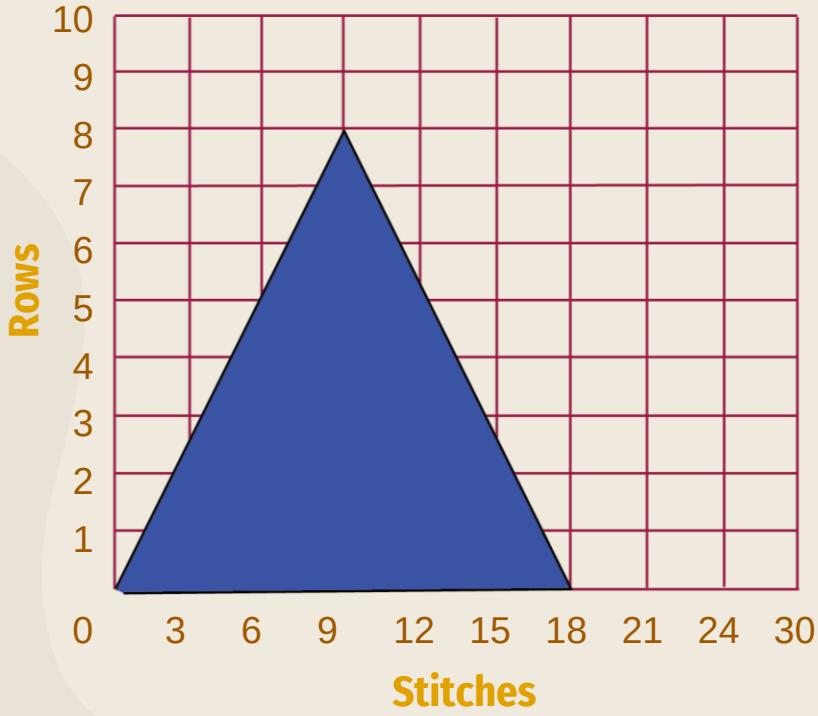
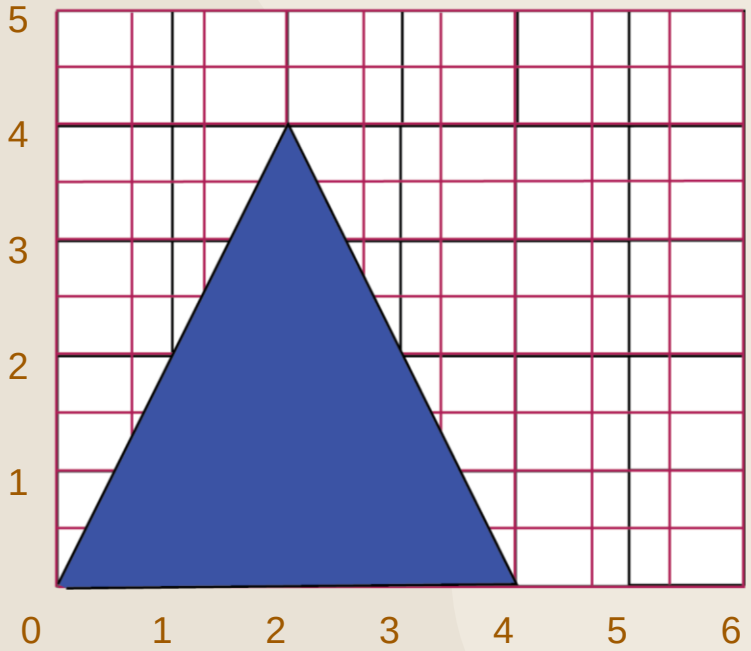


KNITTING



COORDINATE SYSTEMS

INCHES & KNITTING



02

KNITTING METHOD

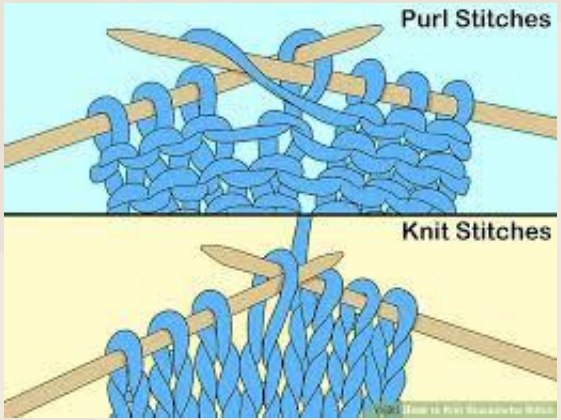
Knitting choices for making mathematical shapes.

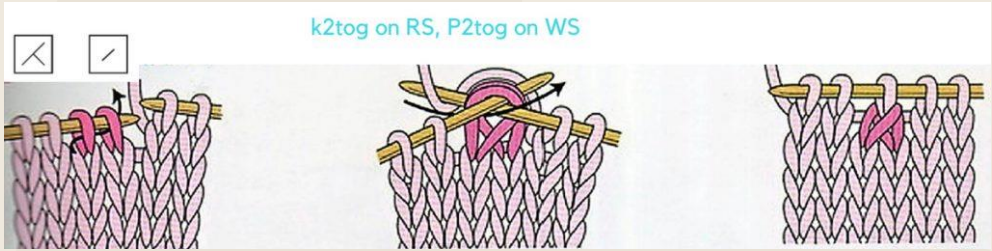
KNITTING TERMS & IDEAS

01

TYPES OF STITCHES & STITCH COMBINATIONS

- Knit Stitch
- Purl Stitch
- Knit Two Together
- 1x1 Rib



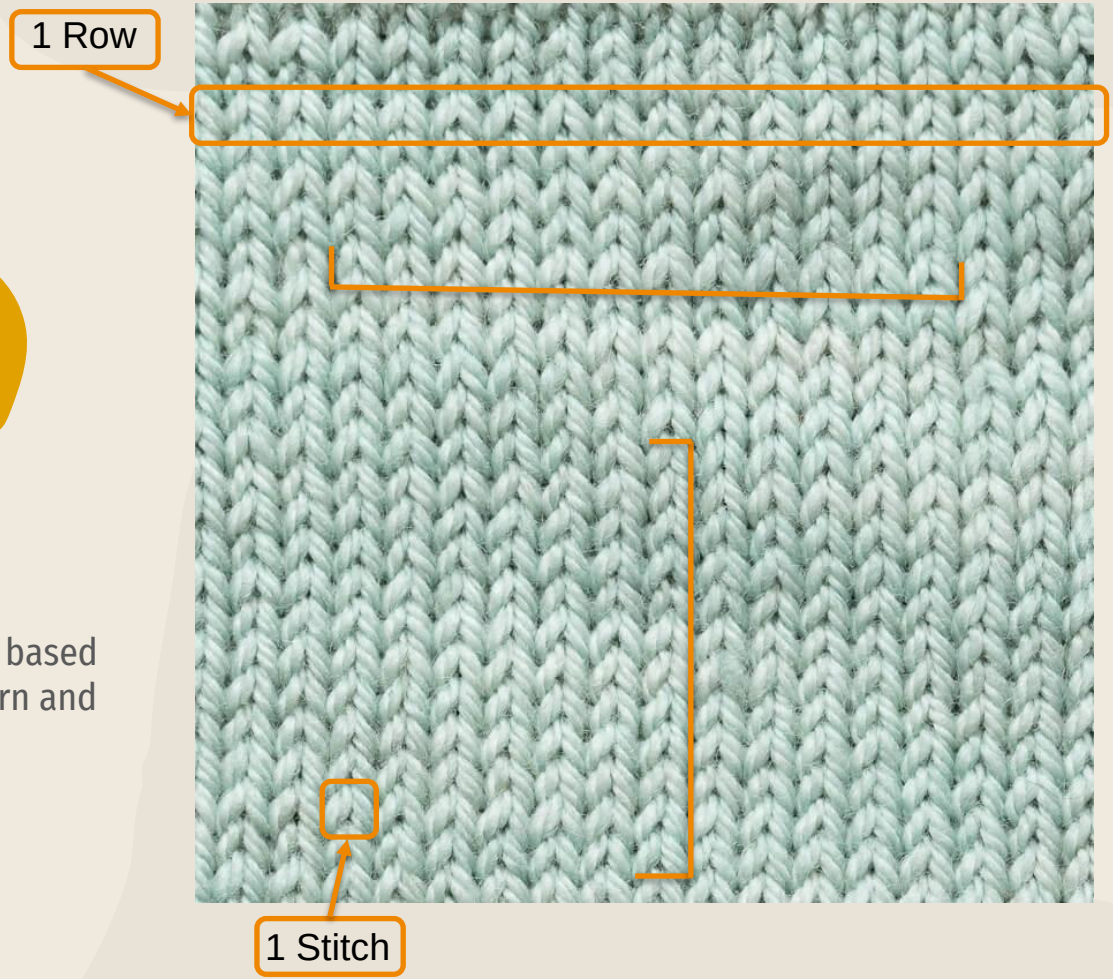


KNITTING TERMS & IDEAS

02

GAUGE

The size of stitches based off of the size of yarn and needles.



THE FIRST TEST CONES

Cone #1

THE FIRST TEST CONES

Cone #1

THE FIRST TEST CONES

THE FIRST TEST CONES

THE FIRST TEST CONES

THE FIRST TEST CONES

THE FIRST TEST CONES

Cone #1

Cone #2

Cone #3

STITCH CHOICES

To get rid of the curl at the end of the cone, use the 1x1 rib.

03

CONSIDERATIONS

How math in knitting is limited and requires creative solutions

ALL OR NOTHING

In mathematical equations and measurements, we often use decimal points.

Stitches and rows are either 0 or 1, there is no such thing as a 0.253 of a stitch or ½ of a row.

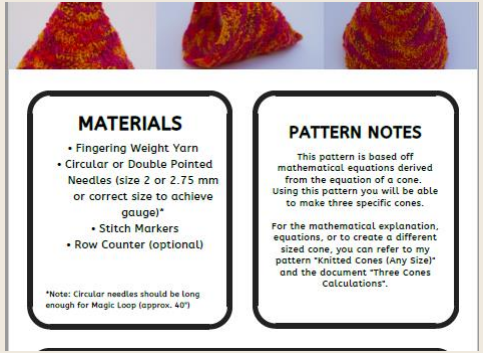
GAUGE

If you have a larger gauge, decreasing by one stitch changes the dimensions of a shape much more than a smaller gauge.

ABOUT PATTERNS

THE LANGUAGE OF KNITTING

While I could write notes to myself or create an Excel spreadsheet that tells me how to create a mathematical shape, patterns have their own expectations and use a specific language.



MATERIALS

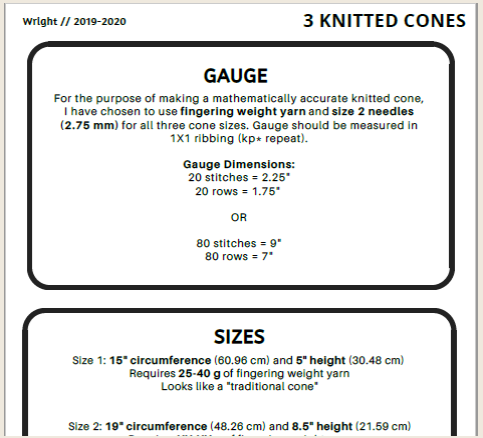
- Fingering Weight Yarn
- Circular or Double Pointed Needles (size 2 or 2.75 mm or correct size to achieve gauge)*
- Stitch Markers
- Row Counter (optional)

*Note: Circular needles should be long enough for Magic Loop (approx. 40")

PATTERN NOTES

This pattern is based off mathematical equations derived from the equation of a cone. Using this pattern you will be able to make three specific cones.

For the mathematical explanation, equations, or to create a different sized cone, you can refer to my pattern "Knitted Cones (Any Size)" and the document "Three Cones Calculations".



Wright // 2019-2020 — 3 KNITTED CONES

GAUGE

For the purpose of making a mathematically accurate knitted cone, I have chosen to use **fingering weight yarn** and **size 2 needles (2.75 mm)** for all three cone sizes. Gauge should be measured in 1X1 ribbing (kp× repeat).

Gauge Dimensions:
20 stitches = 2.25"
20 rows = 1.75"

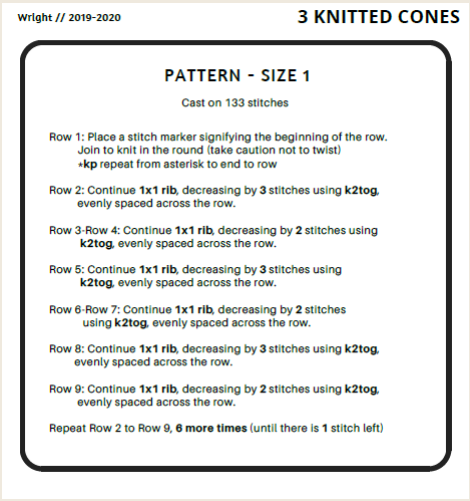
OR

80 stitches = 9"
80 rows = 7"

SIZES

Size 1: **15" circumference** (60.96 cm) and **5" height** (30.48 cm)
Requires **25-40 g** of fingering weight yarn
Looks like a "traditional cone"

Size 2: **19" circumference** (48.26 cm) and **8.5" height** (21.59 cm)



Wright // 2019-2020 — 3 KNITTED CONES

PATTERN - SIZE 1

Cast on 133 stitches

Row 1: Place a stitch marker signifying the beginning of the row. Join to knit in the round (take caution not to twist) ×**kp** repeat from asterisk to end to row

Row 2: Continue **1x1 rib**, decreasing by **3** stitches using **k2tog**, evenly spaced across the row.

Row 3-Row 4: Continue **1x1 rib**, decreasing by **2** stitches using **k2tog**, evenly spaced across the row.

Row 5: Continue **1x1 rib**, decreasing by **3** stitches using **k2tog**, evenly spaced across the row.

Row 6-Row 7: Continue **1x1 rib**, decreasing by **2** stitches using **k2tog**, evenly spaced across the row.

Row 8: Continue **1x1 rib**, decreasing by **3** stitches using **k2tog**, evenly spaced across the row.

Row 9: Continue **1x1 rib**, decreasing by **2** stitches using **k2tog**, evenly spaced across the row.

Repeat Row 2 to Row 9, **6 more times** (until there is **1** stitch left)

Wright // 2019-2020 — 3 KNITTED CONES

PATTERN - SIZE 1 (CONTINUED)

END OF CONE

Cut yarn such that there is a 2" (5cm) tail.

Pull yarn through the final stitch and tie a knot. Gently pull until secure. Weave in ends.

Use your fingers to shape the cone. Stuffing with fabric or stuffing can help create a cone shape.

04

CONES

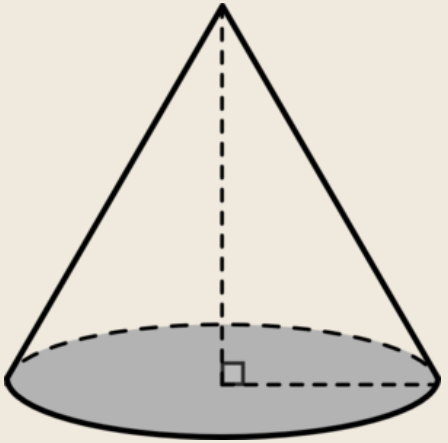
The choices and method used to create a generalized cone pattern

ABOUT CONES

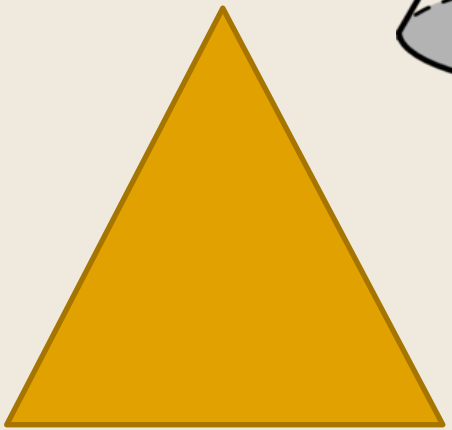
ITS ALL IN THE SLOPE

The constant slope of a cone is what characterizes its shape.

To translate this to knitting terms, we need to decrease stitches at a constant rate.



Cone



Cross-Section of a Cone

OUR PROCESS

01

CONVERT

Change all the dimensions to stitches and rows.

02

DECREASES

Determine the average number of decreases per row.

03

TYPE

Determine how many rows have an extra decrease.

04

SPACING

Space out decrease rows as evenly as possible.

CHOOSING WHEN TO ROUND

Knitting works in absolutes but mathematics does not. When do we round?

- When we are converting measurements from inches/centimeters to stitches and rows, we want to be as precise as possible. Therefore, we **do not round values** or **use rounded values** in these calculations.

- When we are working within the rows and stitches, we are only able to work in absolutes. Therefore, it is more effective to **round values** and **use rounded values** in calculations.

$$Q = \frac{2\,\pi\,(rst)}{hrw}$$

Use unrounded values of rst and hrw

example:

$$Q = \frac{2\,\pi\,(50.9288)}{137.142} = \frac{319.99508}{137.142} = 2.3333$$

rounded down Q = 2

rounding down examples:

if Q = 8.9257 then rounded down Q = 8

if Q = 4.1289 then rounded down Q = 4

** You can also just record the number before the decimal to get rounded down Q!

Spacing Rows

1. Choosing to Round Down Average Stitch Decrease

Q represents the number of decreases, on average, per row

$48 = 2 * 2 * 2 * 2 * 3$

$88 = 11 * 2 * 2 * 2$

48 and 88 have a greatest common factor of 8 meaning you can divide 48 and 88 by 8.

$\frac{48}{8} = 6$ and $\frac{88}{8} = 11$

This tells us the number of rows to put in one set of rows which can be repeated (in total) the same amount as the greatest common factor.

1 rotation uses 6 rows with 3 decreases per row and 11 rows with 2 decreases per row.

In total this rotation will be completed 8 times.

Spacing

3	2	2	3	2	2	3	2	2	3	2	2	3	2	2	3	2

= 6 rows (with 3 decreases per row) and 11 rows (with 2 decreases per row)

In the pattern, write out this rotation of rows and repeat 7 times (or one time less than the greatest common factor). Then you will have completed the rotation 8 times in total (or equal to the greatest common factor).

Spacing Rows

2. Greatest Common Factor

If the number of “typical rows” has a greatest common factor, it’s your lucky day!

example 2 (Using the dimensions of Size 2 cone from "Three Knitted Cones":

23 rows with **1** decrease per row → 20 rows + 3 rows

73 rows with **2** decreases per row → 70 rows + 3 rows

96 rows with a decrease

Section 1 | Section 2

Now we will space out the rows with different decreases in Section 1

$20 = 2 * 2 * 5$

$70 = 7 * 2 * 5$

Section 1 shares a greatest common factor of 10 therefore we will complete the rotation of this section 10 times.

$\frac{20}{10} = 2$ and $\frac{70}{10} = 7$

therefore

1	2	2	2	1	2	2	2	2

= 2 rows (with 1 decrease per row) and 7 rows (with 2 decreases per row)

Now we will space out the "remainder" rows (e.g. the 3 from 23 and the 3 from 73) in Section 2

Because there are 3 rows with 1 decrease per row and 3 rows with 2 decreases per row in Section 2, we can space them as:

therefore

1	2	1	2	1	2

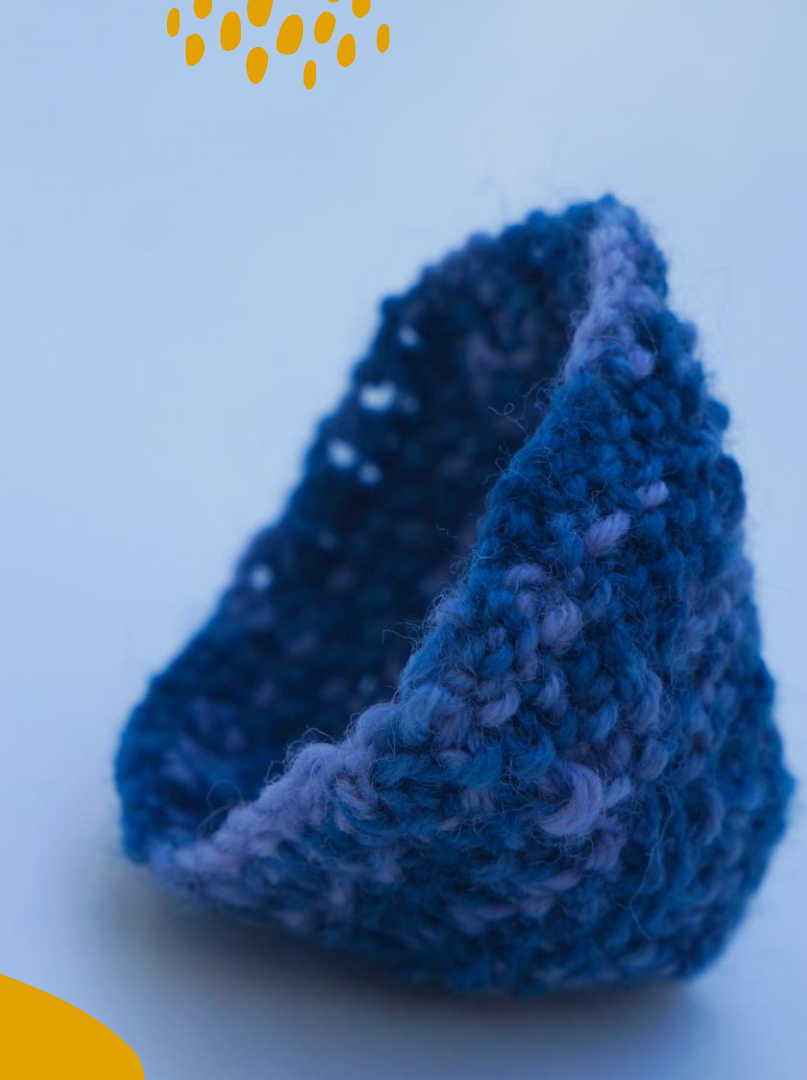
= 3 rows (with 1 decrease per row) and 3 rows (with 2 decreases per row)

This is not always going to be very even. The maximum number of rows you should have in section 2 is 8 so you should be able to visualize spacing these rows. Do your best to separate them evenly but if it is uneven, do not worry. You can also distribute half of the rows in the section 2 to the start of the cone and the second half to the end of the cone.

Spacing Rows

3. Creating Sections when the Numbers Aren't So Nice

If the number of "typical rows" has a greatest common factor, it's your lucky day!



05

PARABOLOIDS

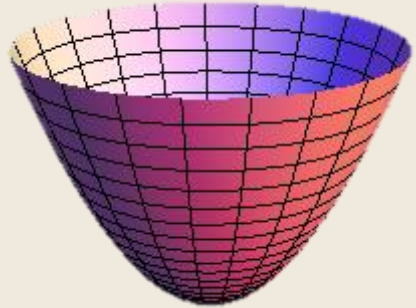
The choices and methods used to create a generalized paraboloid pattern.

ABOUT PARABOLOIDS

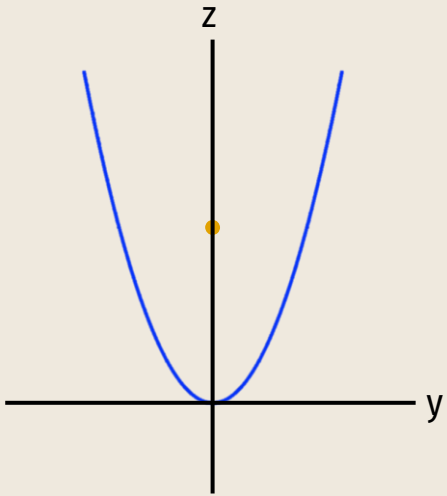
A CHANGING SLOPE

The exponentially changing slope of a parabola characterizes its shape.

To translate this to knitting terms, we need to decrease stitches at a different rate depending on the row.



Paraboloid



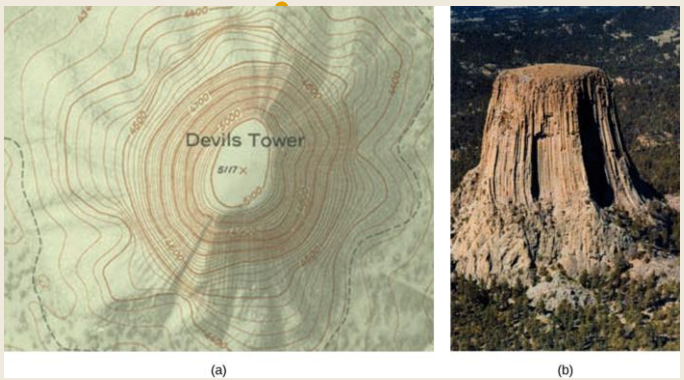
Cross-Section of a Paraboloid

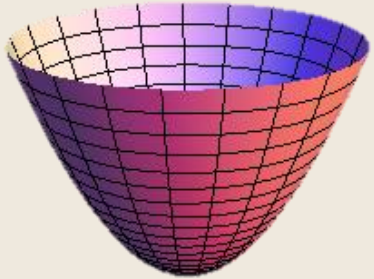
ABOUT PARABOLOIDS

A CHANGING SLOPE

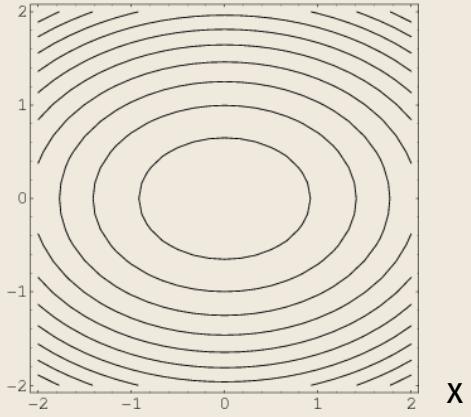
In mathematics, we often use level planes to describe how the slope is changing.

We can do the same thing in knitting by finding the circumference of each row.





Paraboloid



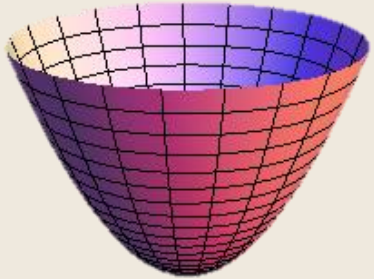
Level Planes of a Paraboloid

ABOUT PARABOLOIDS

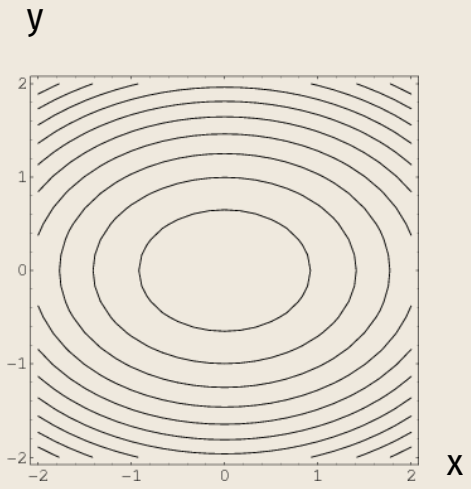
A CHANGING SLOPE

In mathematics, we often use level planes to describe how the slope is changing.

We can do the same thing in knitting by finding the circumference of each row.



Paraboloid



Level Planes of a Paraboloid

06

FINAL THOUGHTS

The implications of this project and my takeaways.

FINAL THOUGHTS

01

ABSOLUTES

The intersection of math and the world of absolutes is interesting and allows for creativity.

02

MATH & ACCESSIBILITY

Math is not always an accessible subject but can be related and taught in more than one form.

03

MORE SHAPES

What else can we do with knitting and math?

SHARING KNITTING PATTERNS

Ravelry

- Many creators post their patterns on Ravelry for others to make and review.
- Community of creating and testing new ways of knitting/crocheting
- To find out more about my project or download my patterns, visit my Ravelry page.

Thanks!

What questions do you have?

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