

# SCALE MODEL OF DISCE

## Introduction:

- After reading the graphic novel, go over the description of Disce. Have participants observe the map of Disce in print or on a screen.
- Optional: Discuss how participants would feel and what they would do if they discover the ruins of the City.
- Read The Geometry of Disce.

## Materials:

- Paper (optional: reused paper)
- Map of Disce
- Tape measure
- Printouts of “The Lead Foot Wall” story
- Corrugated cardboard
- Masking tape
- Scissors



## The Geometry of Disce:

All of Disce is a giant circle.

Its area is then  $\pi * r * r$  where  $r$  is the radius and  $\pi$  is 3.14

Disce has a radius of 20 kilometers (km).

Horus has an area that is 10% of the area of Disce.

Amelia has an area that is 20% of the area of Disce.

Periculum has an area that is 22% of the area of Disce.

Tiber has an area that is 24% of the area of Disce.

The South has an area that is 24% of the area of Disce.

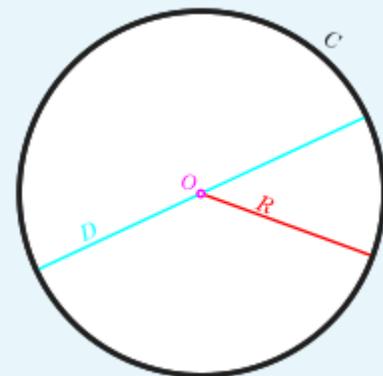
Horus always has 2,000 people inside its walls.

Amelia has a population density of 150 people per square kilometer

Periculum has 350 people living there.

The South has 667 people living there.

No one knows who or how many people live in Tiber.



- CALC-1: Participants answer the following questions:
  - How many people live in Amelia?
  - What is the radius of Horus?
  - How come less people live in Periculum than in The South?
  - What is the total population of the city of Disce? (All areas – even though no one knows about Tiber)
  - What is the population density of Horus?
  
- BUILD-1: Participants build a **scale model of Disce**
  - If the scale model is going to be 20 cm. in radius, what is the scale to Disce?
  - Using paper, a ruler, and knowing that Horus is 10% the area of Disce, let's assume Periculum, Tiber, Amelia, and the South take up equal amounts of Disce. Construct a scale model of Disce. Participants can use origami designs for this purpose. Create this challenge after careful observation of Disce's map and as a way to understand the problem our protagonists face. The materials are minimal: paper and rulers to measure. The scale is 1 km:1 inch where Disce is 40 km in diameter. The outer walls have to be 2.125 inches high and can be built with no more than 12 pieces of paper that must be folded and not cut or torn. You may choose to include towers, inner walls, including the circular walls around Horus, which is 10% the area of Disce. The tallest tower in Disce is twice the height of the outer wall of Disce. After an initial discussion and paper measurements in their groups, students should create a plan and design of their process before beginning the construction of the 3D model.

Section	Area	Population	Population density	% of Disce
Horus	152.66 Km <sup>2</sup>	2,000	15.92 People/Km <sup>2</sup>	10%
Amelia	251.33 Km <sup>2</sup>	37,699	150.00 People/Km <sup>2</sup>	20%
Tiber	301.59 Km <sup>2</sup>	?	?	24%
Periculum	276.46 Km <sup>2</sup>	350	1.27 People/Km <sup>2</sup>	22%
The South	301.59 Km <sup>2</sup>	667	2.21 People/Km <sup>2</sup>	24%
		40,716		100%

Area of Disce= 1256.6 Km <sup>2</sup>	r=20 km
Radius of Horus	r= 6.32 km

- **The Story of the Lead Foot Wall:**

Prince Allite grew up under his father's iron fist. That isn't an idiom. His father literally had a mold made of his fist. Artists took that mold and built a giant replica that was 12 times bigger in height than the actual fist. King Myter told his son that he could never take the thrown as king unless he could stand under his fist and bear the weight of his iron rule.

Prince Allite tried for ten years but could never stand the weight of the iron fist. One day Prince Allite gave King Myter a ride in his new chariot. He drove it so fast that the King screamed. King Myter hated the speed so much that he closed his eyes until it was over. When the chariot

stopped, Allite and Myter were far outside the city. Prince Allite kicked his father out of the chariot. He told his dad he could not return until he could bear the weight of Allite's lead foot. This was not an idiom either. Hidden from his father, Prince Allite had the same artists make a giant foot, the exact size and shape of Allite's foot was  $\frac{1}{3}$  the size of the model for the wall. It was made of pure lead.

King Allite returned to the city without his father. He had a wall built around the Horus, where the royal palace is located and the royal families live. That wall was 11.2 meters higher than the iron fist, so that no one could see the fist outside the royal family. He had another wall built on the outside of the city of Disce. King Allite placed the lead foot on top of the wall. At the very highest point of the foot from the ground (including the wall), it reached 30 meters. King Myter's actual fist was 0.1 meters tall. King Allite's actual foot was 0.333 meters tall from toe to ankle (when standing on his toes so his foot was upright).

- CALC-2:
  - How tall is the Iron Fist?  $0.1 * 12 = 1.2$  meters
  - How tall is the Lead Foot (not including the wall)?  $0.333 * 3 = 1$  meter
  - How tall is the wall around Horus?  $11.2 \text{ m} - 1.2 \text{ m} = 10$  meters
  - How tall is the wall around Disce?  $30 - 1 = 29$  meters
- BUILD-2: Participants build a **scale model of the Lead Foot Wall**
  - Given the information in the story, participants build a section of the wall out of cardboard that matches the description of the Lead Foot Wall. **The section should be 2 ft. long and 29 in. tall (1 in. = 1 meter) - Keep the wall for later days.**
  - To make the wall stand on its own, tabs from cardboard can be taped to each side of the wall that form triangles to keep the wall vertical. There must be gaps with no triangles from 4 inches to 8 inches from each edge. (Later we will cut holes at 6 inches from the edge.)
  - **Optional: Discuss the most common scale model sizes and the size ratios for scale models. For example they can use a scale ratio of 1:100 (one centimeter to one meter).**  
Number and bar scales: <https://m.everythingmaths.co.za/maths/grade-10-mathematical-literacy/06-scale-maps-and-seating-plans/06-scale-maps-and-seating-plans-02.cnxmplus>

#### References:

<http://futurecity.org/lb/model/a/building-scale-model-city>  
<http://en.origami-club.com/>