DRAW AND CALCULATE LIKE AN ARCHITECT (LEVEL 1)

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Description	Learners use body parts in scale drawing of floor plans and calculate area using simple counting methods
Leading Question	How can you draw floor plan sketches and calculate areas using your body parts as measuring tools?
Total Time Required	~6 hours over 4 days
Subjects	Mathematics , Art and Design
Supervision	Medium to high
Supplies Required	Paper and pencil, a ruler (for smaller measures), a tape measure (for larger measures).
Learning Outcomes	Learners will be able to: 1. Measure length with non- standard units 2. Recognize the use of multiplication to calculate the area of rectangles 3. Scale drawing converting Foot to Digit 4. Find areas of rectangles by drawing unit squares and counting 5. Multiply using a geometric/visual method 6. Reitirate how to give directions verbally 7. Apply mathematical knowledge and skills in a real-life scenarios
Previous Learning	- Counting and simple addition. - *It is preferred that learners do the "Beauty in Shapes and Measurements" project before this one.

DAY 1

Today you will learn about creating your own house!

Suggested Duration	Activity and Description
20 minutes	● Introduction: In this project, we will learn how an architect draws floor plans, and what methods they use to calculate the size of rooms or houses. ● Let's start by measuring the floor dimensions of this room.

- As you may know from a previous project, in ancient times people used their body parts to measure lengths. Learners will also use their body parts (non-standard units) to measure lengths.

To measure is to find a number that shows or represent the size or amount of something
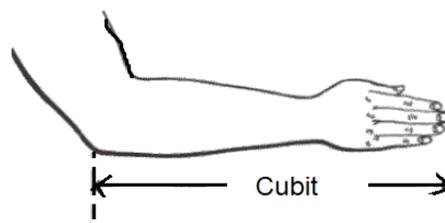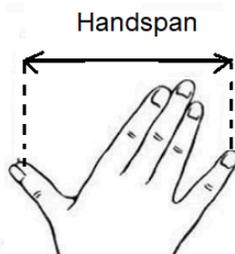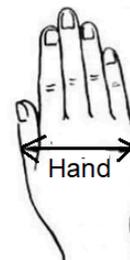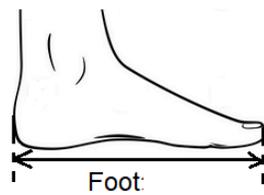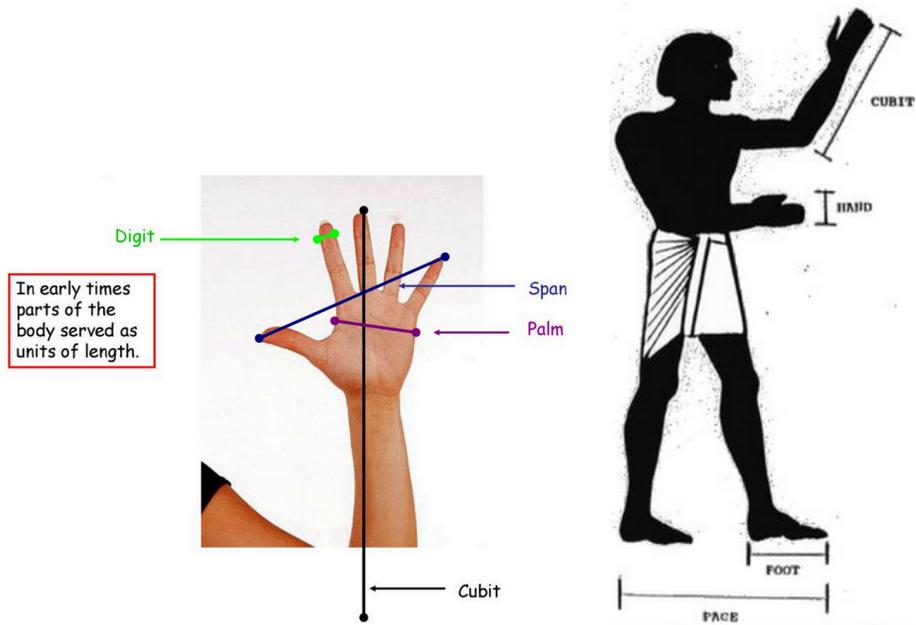
Input: examples of non-standard units used by ancient people to measure length included: the **Foot**, the **Hand**, the **Handspan**, the **Cubit**, the **Digit**, the **Pace** etc.

- The **Cubit** is a measurement equal to the length from your elbow to the tip of your middle finger when your arm is extended. Egyptians mainly used their cobits to measure objects,
- The **Foot** is a measurement equal to the length of your foot from the toe to the heel. King Henry I of England standardized this measurement to measure his foot which was 12 inches long.
- The **Handspan** is a measurement equal to the length from the tip of the thumb to the tip of the last finger when your hand is stretched out.
- The **Digit** is a measurement equal to a finger's breadth. Four digits are equal to a **Palm** and five digits are equal to a **Hand**. Greeks mainly used their fingers to measure objects. The Hand is still used to measure the height of horses.
- The **Pace** is a measurement of the distance from one step to another. The Roman Army used the Pace to judge speed.
- The **Fathom** is a measurement equal to the length between both your base fingers when you outstretch both your arms. The Fathom was used to measure the depth of water

- Repeat with the 4 sides of the room, and write down the measures in a table like the one below

| 15 minutes | **Activity 1**

In this activity, learners will measure their Cubit, Foot, Handspan, Digit, Palm, Hand, Pace, Fathom and those of two of their family members/friends and enter their findings in the table below.

Person	Personal Measure	(unit) (cm)

	Learner	Cubit	
		Foot	
		Handspan	
		Digit	
		Palm	
		Hand	
		Pace	
		Fathom	
	Family Member 1	Cubit	
		Foot	
		Handspan	
		Digit	
		Palm	
		Hand	
		Pace	
		Fathom	
	Family Member 2		

- What do you notice from your findings?
- Is there any relation between the Handspan and the Cubit?

- Each person's body part unit is different from another's body part unit. This is the reason why measuring length using body parts units is referred to as measurement of length using non- standard units.
- The Handspan is about half the Cubit

15 minutes	**Activity 2: Comparing measurements made using Body Parts (Non-Standard Units) to those made using Standard Units**

In this activity, you will use the Personal Measure (Body Parts) to measure different items and compare their results with those obtained using Standard Units.

Write down the measures in a table like the one below:

Item	Personal Measure (Body part)	Estimate using a Personal Measure (cm or in)	Actual using a ruler or tape measure (cm or in)
Length of a pencil	Digit		
Length of a foot mat	Foot		
Length from table to door	Pace		
Length of room	Cubits		

- How close are the estimates obtained using Personal Measure to actually using a ruler or tape measure?

| 20 minutes | **Activity 3: Measuring the dimensions of a room** |

In this activity, you will use mainly the **Foot**, and the **Digit** non-standard unit. Of course, you know that your foot size is smaller than the actual Foot unit used on measuring tapes (as different people have different foot sizes!)

- Pick one of the house rooms with a rectangular floor shape, preferably the smallest room in the house.
- Stand on one corner of the room you have chosen, and walk by the wall, step by step, to reach the other corner.

- You must start with the back of your foot touching the wall behind, and then place the other foot right in front of and touch the other foot, and keep counting your steps until you reach the facing wall.


- Repeat with the 4 sides of the room, and write down the measures in a table like the one below:

| Room side 1	
Room side 2	
Room side 3	
Room side 4	

- Are any of the sides equal in length to another side? Does this apply to all rectangles?

- In a rectangle, usually the measure of the longer side is called length (L); and the measure of the shorter side is called width (W).

- On a piece of paper, you will draw a sketch of the room. The room is much bigger than the sheet of paper, so architects usually draw a smaller sketch that looks like the actual room but smaller (something like a photograph of you compared to the real size of you).

- See below how to do it:

- To do this, instead of using your **Foot** to draw the sides of the rectangle, you use your finger: **Digit.**

6

- In the example below, see a sketch of a room whose Length L = 8 feet, and width W= 5 feet. The actual size of the sketch is 8 Digits by 5 Digits.
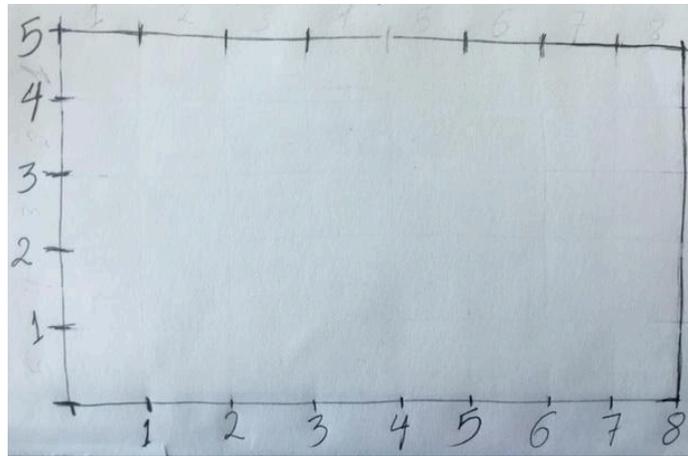

- As you also notice, we do not need to write the sizes of the other sides, as in a rectangle opposite sides are equal in size.

- Now draw the sketch of the room you chose on a sheet of paper.

- On your sketch, create a grid using the Digit marks, as shown below:
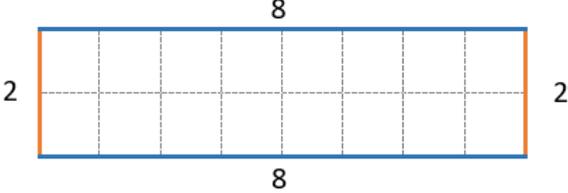
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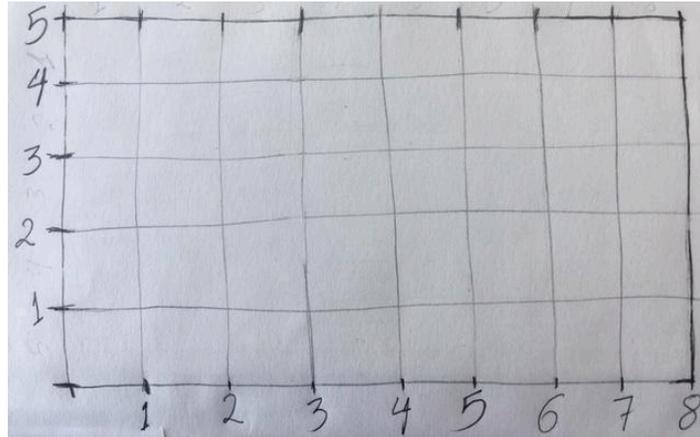
- Count the number of squares in your diagram.
- Notice that the side length of the small square is 1 digit, so we call it a unit square.

- The number of squares inside the sketch is called the Area of the sketch.
- Area is the size of the floor surface inside a certain shape, which is the count of unit squares enclosed within. Notice that a square is a special rectangle where its Length = Width

- In the example above, we saw that the sketch has 40 unit squares within, so its area is 40 squared Digits, and we conclude that the area of the room is 40 Squared Feet.

- What is the area of your sketch? (in squared Digits)

- What is the area of your room? (In Squared Feet*)
- *Foot measure used here is the Learner's foot size and not the universal Foot scale.

- Learners will answer the questions on the Day 1 Worksheet (rectangle area problems).

DAY 2

Today you will learn how to calculate the size of the rooms.

Suggested Duration	Activity and Description

10 minutes	● Yesterday you tried to draw floor plans of a room, and to use a smaller scale to represent a large drawing on a small piece of paper. Also you learned how to find the area of a rectangular room.
	
	 ● The area can also be calculated simply by multiplying Length X Width.
	
	 ● For example: in the example of the room whose Length is 8 Feet and Width is 5 Feet, the area counted was 40 Squared feet. This could have been found by multiplying 8X5 = 40.
	
	 ● Use a faster way of calculating area.
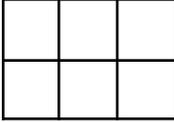	
	   - It is 6, which is equal to 3 x 2=L x W
	   o Try multiplying: The Length of your room x its Width, is it equal to the area you counted?
	   - So now we learned another way to solve multiplication questions!
	   - To find out the answer for 2 x 8, you can draw a rectangle with L=8 and W = 2, and count the squares:
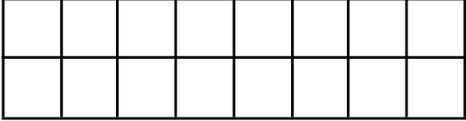	
	   - Another way of solving for 8x2 is by adding 8 + 8 (Keep 8 in our head, and then continue counting 8 places: 9, 10, 11, 12, 13, 14, 15, 16)
	   - 8x3 is by adding 8 + 8 + 8 (8 in the head, count 8 more places, then 8 more

20 minutes	● Solve Question 1 of the Day 2 Worksheet <u>without using a calculator</u>
15 minutes	● Another important thing that architects need to know is the Perimeter of the room. ● This tells us how long of a fence or walls are needed to put around any shape. ● This is calculated by adding all the measures of the sides of the shape.

- Looking at the above shape, the perimeter = 8+2+8+2 = 20 units of length.
- Calculate the perimeter of the square whose side is 5 Feet <u>without using a calculator</u>.
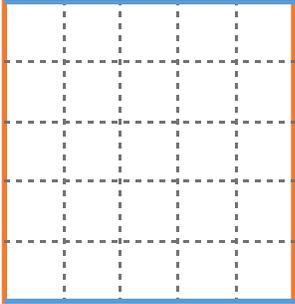
45 minutes	• Individual activity: solve the Day 2 Worksheet questions 2, 3, 4 and 5 <u>without using a calculator.</u>
5 minutes	• Discuss your solutions with a parent or older siblings.

DAY 3

Today you will draw the sketch of your house floor map.

Suggested Duration	Activity and Description
5 minutes	• Today you will draw a sketch of the house floor map using a Digit to represent 1 Foot. • When doing this, Architects imagine that the roof of the house is transparent, and we draw the map as if we are looking at the house from the top like a flying bird. • As an example, below is a simple floor map.

Source: https://www.tuko.co.ke/276066-3-bedroom-house-plans-designs-kenya.html

- **What do you notice?**
- Here are some of the things that you might notice or to which you can draw the your attention:
  - The walls are drawn on the map
  - There are some arcs to represent doors
  - The function of each room is marked (bedroom, kitchen, bathroom…)

45 minutes	- Now draw a floor map of the house and then present it to the family. - Try to ensure: - The floor map is up to scale (each 1 Foot of actual measure is represented by 1 Digit) - The map accurately represents the actual rooms of the house - The name of each room or space is written on the map (like bathroom, kitchen...etc.)
10 minutes	Parents will provide you with feedback on: - What they love most about the floor plan - Suggested areas of improvement Use the feedback to revise the floor plan
10 minutes	- Without using a calculator, figure out how to calculate the overall area of the house using the floor map. - Tip: This is done by adding the areas of the different rooms or spaces inside the house.

Day 4

Today you will play a treasure hunt game!

Suggested Duration	Activity and Description
30 minutes	● Learners will hide 3 items around the house and mark where they hid them on the floor map. They will ask 3 family members to find one of the hidden items each. ● If that was too easy, they can make it harder by hiding smaller items, and giving an approximate location.
30 minutes	● Learners will explore how we could help people navigate using verbal instructions. ● Learners will imagine how they would help a blind person who could not see the map. They will blindfold one of their family members and give them directions to go from one location to another in the house using the following verbal directions only: 　　o　Move (a number of) steps forward 　　o　Turn to the left 　　o　Turn to the right
10 minutes	● Questions for discussion will be asked by family members after the treasure hunt game: 　- How good were your directions to guide the blindfolded member? 　- Did you have to correct any of the directions you gave? Why? 　- How do you think boats navigate their way in the sea without using technology? 　- Imagine ways to help sailors navigate in the oceans when they are unable to see land. Hint: Learners can be prompted to look out into the sky and imagine the north star (the brightest star in the sky) and the direction that the sun rises (east) and sets (west).
10 inutes	● Literacy extension and Reflection questions 　- Share 2 or 3 sentences about your key learning points about measurements, Body Parts (Non-standard units), how architects work, and/or how they intend to use the knowledge acquired in the project and share these with their family. Young learners can share verbally.

Additional enrichment activities:	Draw the floor map of another space (School, playground…)
Modifications for simplification	A simpler version of this project can be to learn how to draw floor mapping of a rectangular space using simple conversion of Foot to Digit and counting the unit squares enclosed to find the area.

ASSESSMENT CRITERIA

A majority of my students were able to:

- ☐ Accurately and calearly draw the their house floor map

- ☐ answer worksheet questions correctly using methods and skills introduced in earlier activities.
- ☐ Learners are engaged and show grit while working on project tasks
- ☐ provide clear and effective verbal instructions when guiding a blindfolded family member.

APPENDIX

Day 1 worksheet

Answer the below questions <u>without using a calculator</u>

1. Draw a floor map of a room whose Length is 4 Feet, and Width is 5 Feet.

   Then find the area of this room in square feet

2. Draw a floor map of a room whose Length is 7 Feet, and Width is 7 Feet.

   Then find the area of this room in square feet.

What do we call the rectangle whose Length is equal to its Width?

3. A rectangle has an area of 20 Squared Feet. Its Length is 5 Feet. What is its width?
Hint: Keep building rows below until you reach a count of 20 squares. Then, you will find the Width!
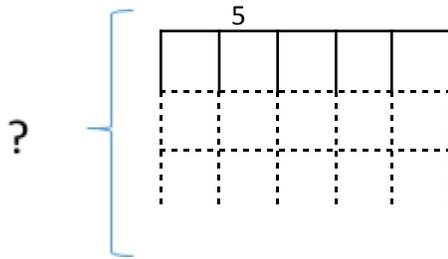
4. A rectangle has an area of 36 Squared Feet. One of its sides measures 6 Feet, can you find the measure of the other side? (Hint: see how you solved the previous question).
5. Find the area of the below shape (Hint: find two rectangles and add their areas).

Day 2 worksheet

Answer the below questions <u>without using a calculator</u>

1. Find the answers to the following multiplication questions

2 x 3=

2 x 7=

3 x 5=

2 x 9=

4 x 6 =

3 x 3=

2 x 6=

3 x 8=

2. Draw a sketch for a rectangle whose Length is 6 Digits, and width is 5 Digits.

Calculate the Perimeter and Area of this rectangle.

3. Draw a sketch for a rectangle whose Length is 7 Digits, and width is 6 Digits.

Calculate the Perimeter and Area of this rectangle.

4. Draw a sketch for a rectangle whose Length is 8 Digits, and width is 4 Digits.

Calculate the Perimeter and Area of this rectangle.

16

5. Find the area of the below shape by adding the areas of the two rectangles.