التعليم فوق الجميع | education above all

Draw and calculate like an architect (Level 2)

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
Supplies Required	Paper and pencil, a ruler (for smaller measures), a tape measure (for larger measures)
Supervision required	Medium to high
Learning Outcomes	Learners should be able to: 1. Practice solving division problems using multiplication 2. Dividing and applying division on word problems. 3. Apply mathematical knowledge and skills in a real-life scenario 4. Measure length with non- standard units 5. Recognize the use of multiplication to calculate the area of rectangles 6. Scale drawing converting Foot to Digit 7. Find areas of rectangles by drawing unit squares and counting 8. Multiply using a geometric/visual method 9. Reitirate how to give directions verbally 10. Apply mathematical knowledge and skills in a real-life scenarios
Previous Learning	Familiarity with multiplication and division

Day 1

Today you will learn about creating your own house!

Suggested Duration	Activity and Description
20 minutes	• In this project, you will learn how an Architect draws floor plans, and what methods they use to calculate the size of rooms or houses. • Can you explain what a measurement is? • Let’s start by measuring the floor dimensions of this room.

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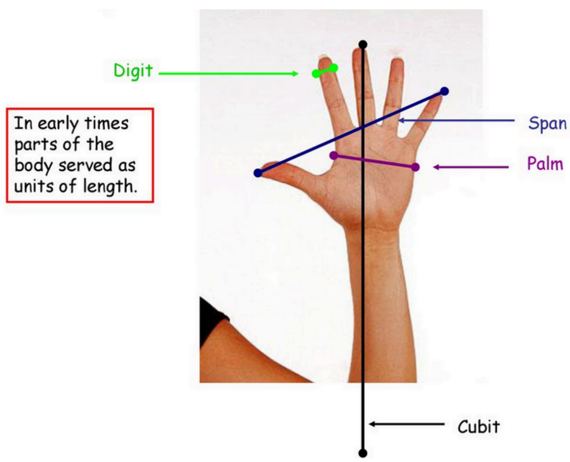
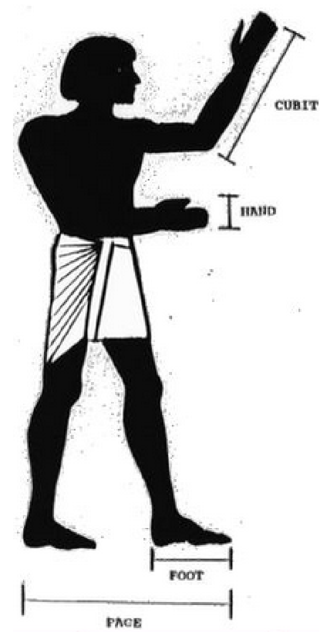
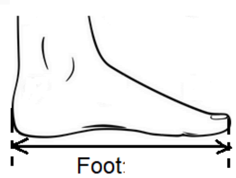
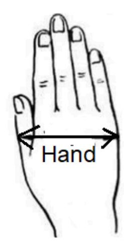
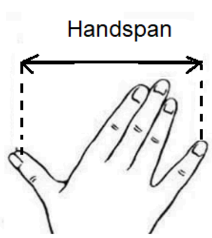
- Input: measurement is finding a number that shows the size or amount of something.
- Body parts (Non -standard units) used to measure objects
- Learners will use their body parts (non-standard units) to measure length.
- As you may know from a previous project, in ancient times people used their body parts to measure lengths.

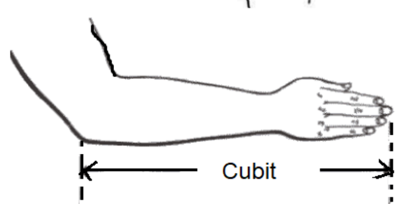












Input: Examples of non-standard units used by ancient people to measure length included: the **Foot**, the **Hand**, the **Handspan**, the **Cubit**, the **Digit**, the **Pace** etc.

	• 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 equals a **Palm** and five digits equals 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
	Activity 1: Personal Measures 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	Body part length (unit)
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?

Among other, you may notice from your findings that:

- 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 using Body Parts (Non-Standard Units) to those made using Standard Units

In this activity, learners 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**	**Actual using a ruler or tape measure**

		(cm or in)	**(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 using a ruler or tape measure?

15 minutes

Activity 3: Measuring the dimensions of a room

For this activity, learners will use mainly the **Foot**, and the **Digit** non-standard units. 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 chosen room, 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	

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<tr><td>Room side 2</td><td></td></tr>
<tr><td>Room side 3</td><td></td></tr>
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Is 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).

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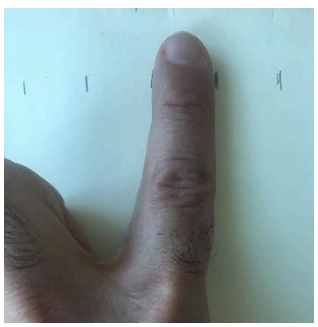
On a piece of paper, you will draw a sketch of the room
The room is much bigger than the sheet of paper, so architects usually draw a smaller sketch that looks like the actual room but smaller (something like a photograph of you compared to the real size of you).
See below how to do it:
To do this, instead of using your Foot to draw the sides of the rectangle, you use your finger: Digit.



- 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.
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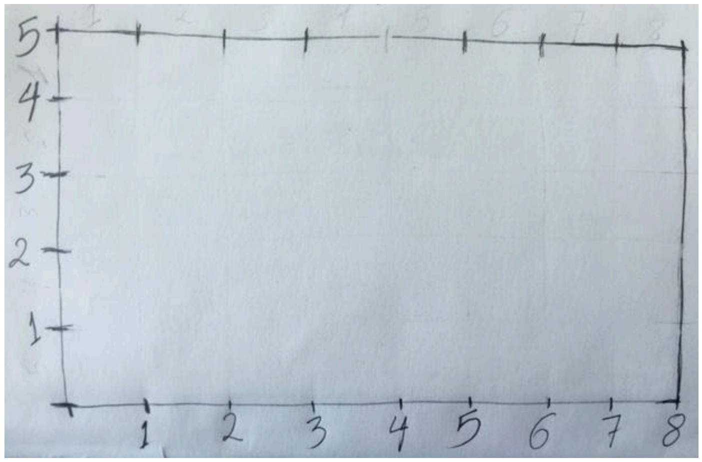

- As you also notice, we do not need to write the sizes of the other sides, as in a rectangle opposite sides are equal in size.

● Now draw the sketch of the room you chose on a sheet of paper.
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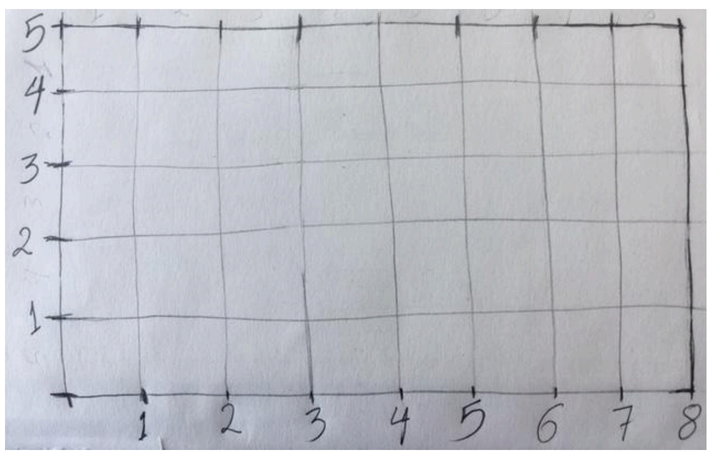
● On your sketch, create a grid using the Digit marks, as shown below:



● 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.
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● The number of squares inside the sketch is called the <u>Area</u> of the sketch.
● <u>Area</u> is the size of the floor surface inside a certain shape, which is the count of unit squares enclosed within.
● 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)
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	● 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.
30 minutes	● In scale drawing, you can choose any scale you like and mention that on your drawing. For example, in some maps the scale can be 1:10'000, which is 1 centimetre representing 100 meters. ● Try to answer the questions on the Day 1 Worksheet without using a calculator.
10 minutes	**Feedback and Reflection** ● Show your answers and discuss them with one of your parents. ● What are the three most important things I have learned so far? ● What have I found difficult? ● What additional support do I need from my family to complete this project?

Day 2

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 1Foot. ● 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. 

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	Source: https://www.tuko.co.ke/276066-3-bedroom-house-plans-designs-kenya.html What do you notice? You may notice that: 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	• Learners will draw a floor map of the house up to the scale 2 **Feet** : 1 **Digit** and then present it to the family. • Try to ensure that: - 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	• Learners present the floor map to their parents Parents will provide feedback to the learner • What they love most about the floor plan • Suggested areas of improvement The learner will use the feedback to revise the floor plan
10 minutes	• Learners calculate without using a calculator the overall area of the house using the floor map: this is done by adding the areas of the different rooms or spaces inside the house. • Learners will also calculate without using a calculator the Perimeter of the house.
5 minutes	• Present answers to one of the parents • Criteria: - Followed the methods used in this lesson, or logically deducted an own method - The answers are correct

Day 3

Today you will practice division.

Suggested Duration	Activity and Description

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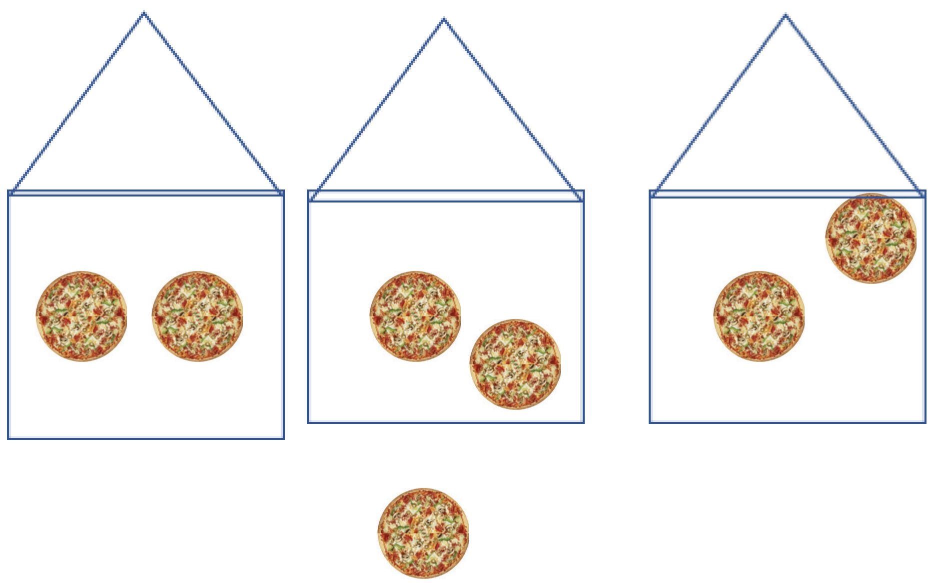
Introduction: Division is like distribution. Dividing 6÷3 is like distributing 6 candies to 3 children.
If this is the case, how many candies will each child have? (give learners enough time to reflect about this question).
Make 3 bags, one for each child:

- Then start by giving every child 1 candy, and repeat again until you run out of candies:
- The answer is 2 candies for every child. If you notice, division is about giving an equal share to everybody.
- Try distributing 15 candies to 3 children, how many will each get?
- (The learner has to figure it out. Answer is 5)
- Example: Distribute 7 pizzas in 3 families. How many will each family get?

- 7÷3= 2 Pizzas per family, with a remainder of 1 Pizza
- Another way of solving this, is to actually cut the remaining pizza and distribute it evenly on the three families. So, 1 pizza cut into 3 equal shares will result in a fraction that is $\frac{1}{3}$
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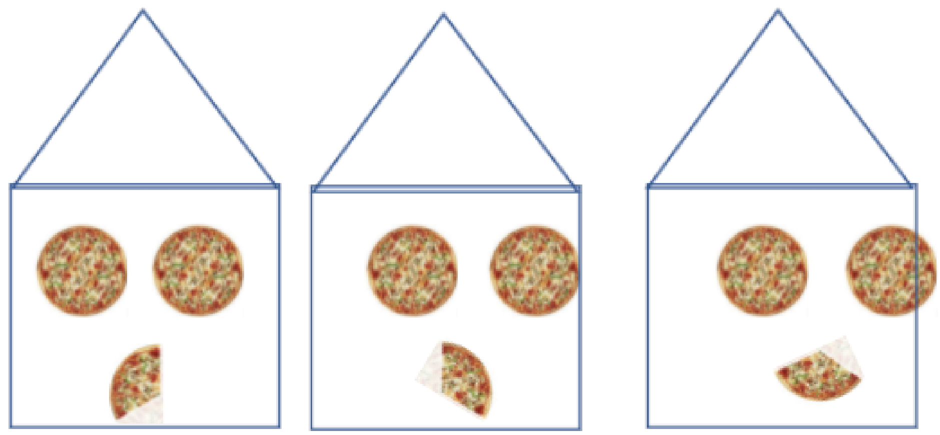
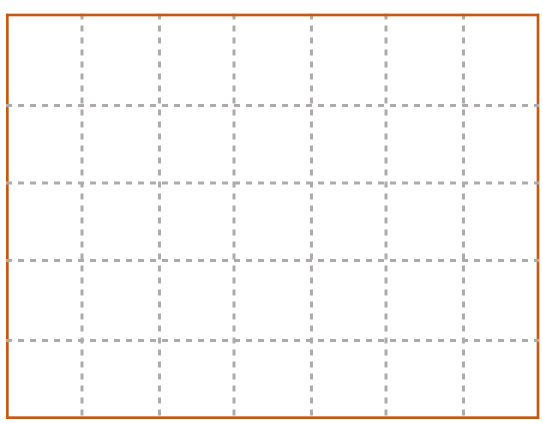
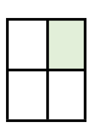
	 - This way, the answer is written as $2\frac{1}{3}$ because each family got 2 whole pizzas and one third of a pizza.
30 minutes	● Solve the Day 3 Worksheet Question 1 <u>without using a calculator</u>.
10 minutes	● Architects use the different measurements of the house to calculate the material needed to complete the house construction. For example: using the area, they can calculate how many tiles they need to cover the floor. ● For example: A room of L 7m and W 5m, is to be covered by square tiles of S= 0.5; how many tiles are required?  

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	- If you notice on the sketch above, each unit square will take 4 tiles of side 0.5. - So, the number of tiles can be calculated in 2 steps: First calculating the room Area = 7 x 5 = 35 squared m. Then multiplying the area by 4, 35 x 4 = 140 tiles. - Another Method First calculating the room Area = 7 x 5 = 35 squared m. Then calculating the tile area = 0.5 x 0.5 = 0.25 Then dividing the Area of the room by the area of the tile: 35 ÷ 0.25 - As you know 0.25 is $\frac{25}{100}$ $35 \div 0.25 = 35 \div \frac{25}{100} = 35 \times \frac{100}{25} = 35 \times 4 = 140$ tiles. - As you see above, we solved a division problem using multiplication.
15 minutes	● Now it is your turn to calculate <u>without using a calculator</u>: if you were to change the tiles in your house with square tiles of side 0.5 foot, how many tiles would you need?
5 minutes	● Show your solution and answer to one of the parents. ● Criteria: - The method is correct with logical steps - The answer is correct
10 minutes	● Solve Questions 2 and 3 on the Day 3 Worksheet <u>without using a calculator</u>, and show your work and answers to one of your parents

Day 4

Today you will do a treasure hunt!

Suggested Duration	Activity and Description
30 minutes	● Learners will hide 3 items around the house and will 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 with family members - 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 - What did you like the most about this project? - Using what you have learned in this project, what floor maps would you like to draw? (probing: playground, your school, another house, …etc) - If you were the architect to design this house, what would you change while keeping the same total area of the house?

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 without using a calculator

1. Draw a floor map of a room whose Length is 14 Feet, and Width is 12 Feet, using the scale
2 Foot is represented by 1 Digit

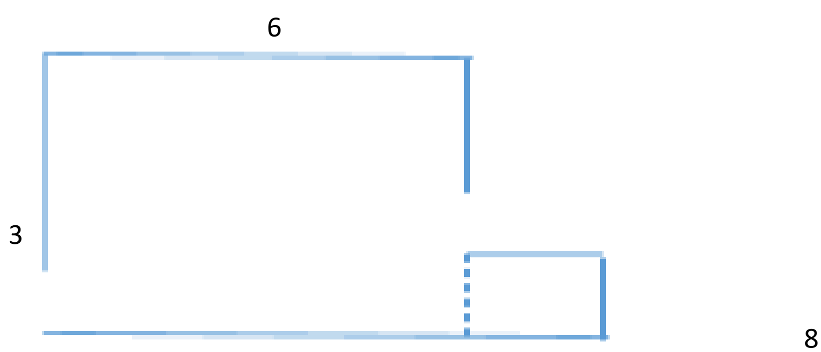
   Then find the area of this room in Squared Feet.

2. A rectangle has an area of 20 Squared Feet. Its Length is 5 Feet. What is its width?

Hint: use the formula A = L x W,

20 = 5 x ?

3. A rectangle has an area of 35 Squared Feet. One of its sides measures 5 Feet, can you find the measure of the other side?
4. Find the Area and Perimeter of the house in the sketch below. Each unit on the sketch represents 1 meter.



Day 3 Worksheet

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

1. Find the answer to the below division problems.

9÷3=

18÷3=

18÷6=

12÷2=

13÷2=

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24÷3=

25÷3=

11÷5=

23÷5=

17÷4=

23÷6=

31÷5=

19÷2=

14÷3=

29÷6=

2. The perimeter of a rectangular room is 20 m. Its Width is 4 m, what is its Length?

3. A rectangular room is 12m by 7m. How many square tiles of side 0.5 m are required to cover the floor?