MAP4C1 Unit 2: Geometry

2.5 Investigating Optimization

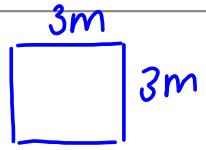
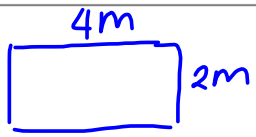
Learning Goals: I am learning to…
- ☐ Investigate the properties of optimization specific to optimizing area and perimeter.

Part A: Optimizing Area (Maximizing Area)

You are looking to build a rectangular enclosed pen for your pet. You have been given a set amount of fencing to create an enclosure to optimize the area. Why would you want to optimize the area of the enclosure?

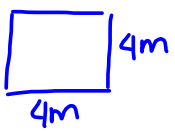
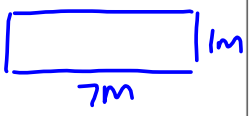
- To make the enclosure as big as possible
- To work on a budget and use as least material possible

Scenario 1: You have 12 m of fencing: Draw three **rectangular** enclosures that you could build with 12 m of fence. Determine which has the largest area.

Enclosure 1	Enclosure 2	Enclosure 3
Perimeter = 12 m **Dimensions =** 3 x 3 m **Area =** $9 m^2$	**Perimeter = 12 m** **Dimensions =** 4 x 2 m **Area =** $8 m^2$	**Perimeter = 12 m** **Dimensions =** 1 x 5m **Area =** $5m^2$
		

Given a perimeter of 12 m, the enclosure with dimensions 3m x 3m gives an optimal area of 9 m^2.

Scenario 2: You have 16 m of fencing: Draw four **rectangular** enclosures that you could build with 16 m of fence. Determine which has the largest area.

Enclosure 1	Enclosure 2	Enclosure 3	Enclosure 4
Perimeter = 16 m **Dimensions =** 4 x 4m **Area =** $16 m^2$	**Perimeter = 16 m** **Dimensions =** 6 x 2 m **Area =** $12 m^2$	**Perimeter = 16 m** **Dimensions =** 1 x 7m **Area =** $7 m^2$	**Perimeter = 16 m** **Dimensions =** 5x3m **Area =** $15m^2$
			

Given a perimeter of 16 m, the enclosure with dimensions 4m x 4m gives an optimal area of 16 m^2.

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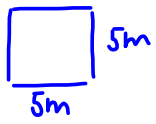
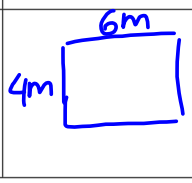
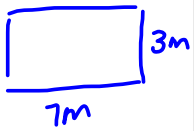
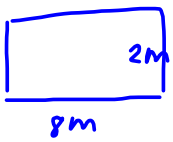
Scenario 3: You have 20 m of fencing

Draw five **rectangular** enclosures that you could build with 20 m of fence. Determine which has the largest area.

Enclosure 1	Enclosure 2	Enclosure 3	Enclosure 4	Enclosure 5
Perimeter = 20m	**Perimeter = 20m**	**Perimeter = 20m**	**Perimeter = 20m**	**Perimeter = 20m**
Dimensions = 5x5	**Dimensions =** 4x6	**Dimensions =** 3x7	**Dimensions =** 2(8)	**Dimensions =** 1(9)
Area = $25m^2$	**Area =** $24m^2$	**Area =** $21m^2$	**Area =** $16m^2$	**Area =** $9m^2$
				

Given a perimeter of 20 m, the enclosure with dimensions 5m x 5m gives an optimal area of 25 m^2.

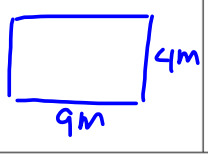
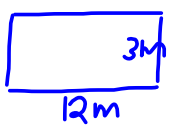
Part B: Optimizing Perimeter (Minimizing Perimeter)

You are still making an enclosure for your pet, but this time you have a limited area, which must be **36m^2.** You need to design the enclosure in order to optimize the perimeter of the enclosure.

Why would you want to optimize the perimeter of the enclosure?

- Still want a large enough area
- Reduce the amount of material needed

Scenario: You have 36 m^2 to fence: Draw five **rectangular** enclosures that you could build for a 36 m^2 enclosure. Determine which has the largest perimeter.

Enclosure 1	Enclosure 2	Enclosure 3	Enclosure 4	Enclosure 5
Perimeter = 24m	**Perimeter =** 26m	**Perimeter =** 30m	**Perimeter =** 40m	**Perimeter =** 74m
Dimensions = 6(6)	**Dimensions =** 4(9)	**Dimensions =** 12(3)	**Dimensions =** 18(2)	**Dimensions =** 36(1)
Area = 36 m^2	**Area = 36 m^2**	**Area = 36 m^2**	**Area = 36 m^2**	**Area = 36 m^2**
				

Given an area of 36 m^2, the enclosure with dimensions 6m x 6m gives an optimal perimeter of 24 m.

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Conclusions

1. What can you conclude about optimizing area given a set perimeter?

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2. What can you conclude about optimizing perimeter given a set area?

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Example: Without drawing the rectangular enclosures, use what you have learned above to determine the optimal area/perimeter for the following situations.

1. Optimize the area, given the following perimeters.

a) P = 100 cm	b) P = 360 m	c) P= 562 m

2. Optimize the perimeter, given the following areas.

a) A = 49 m^2	b) A = 112 m^2	c) A = 570 m^2