1.4 Rabbit Run

A Solidify Understanding Task

Misha has a new rabbit that she named "Wascal". She wants to build Wascal a pen so that the rabbit has space to move around safely. Misha has purchased a 72 foot roll of fencing to build a rectangular pen.

1. If Misha uses the whole roll of fencing, what are some of the possible dimensions of the pen?

2. If Misha wants a pen with the largest possible area, what dimensions should she use for the sides? Justify your answer.

3. Write a model for the area of the rectangular pen in terms of the length of one side. Include both an equation and a graph.

4. What kind of function is this? Why?

5. How does this function compare to the second type of block **I** logos in *I Rule*?

Rabbit Run – Teacher Notes

A Solidify Understanding Task

Purpose: The purpose of this task is to solidify and extend student thinking about quadratic functions to include those with a maximum point. Students will use the graph of the function to discuss the domain and range of a continuous quadratic function in addition to identifying the maximum value and finding the intervals on which the function is increasing and decreasing.

Core Standards Focus:

F.BF.1 Write a function that describes a relationship between two quantities. *

a. Determine an explicit expression, a recursive process, or steps for calculation from a context.

A.SSE.1 Interpret expressions that represent a quantity in terms of its context.*

a. Interpret parts of an expression, such as terms factors, and coefficients.

A.CED.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

*Focus on situations that exhibit a quadratic or exponential relationship.

Related Standards: F.IF.4

Note: Graphing technology (either calculators or computer software such as Geogebra) would be useful for this task.

Launch (Whole Class):
Begin the task by familiarizing students with the context of building a rectangular rabbit pen that can be surrounded by 72 feet of fencing. Ask students to think of some possible dimensions for the pen. Be sure that they are thinking about perimeters, not areas, so that they know that a rectangle with dimensions of 8 x 9 won't work. After they have successfully found one or two possible dimensions for the pen, ask if all the different rectangles will have the same area. Compare the areas of a couple of the rectangles that they have found and tell students that the one of their jobs in this task will be to find the rectangle with the most area because that will give the rabbit the most room to move around.

Explore (Small Group):
As students are working, circulate to see that they are trying various values for the dimensions of the rectangle that have a perimeter of 72. It may help them to be systematic and organized in thinking about the possibilities for the dimensions so they can use the patterns they observe to find the relationship between the length and width and write the equation for the area.

Discuss (Whole Class):
Start the discussion with a table such as:

Length x	Width	Area $A(x)$
1	35	35
2	34	68
3	33	99
4	32	128
5	31	155
6	30	180
x	$36 - x$	$x(36 - x)$

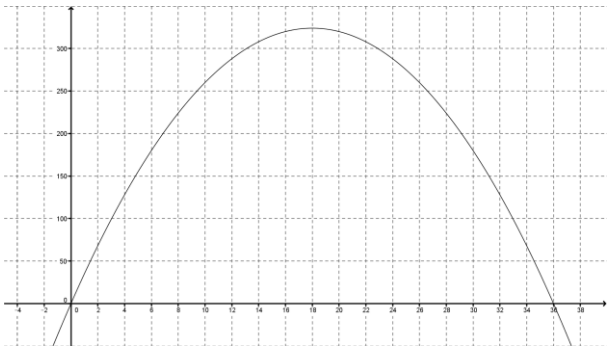
At this point, it may be useful to display the rest of the table using technology so that students can see a possible maximum value in the table. Students should notice that once they reach a length of 18, they begin to get the same rectangles, but with the length and width switched (different orientation).

Discuss the domain and range of the *A(x).* This is the first continuous context, which students may not immediately recognize. They should be able to write the domain in interval notation or set builder notation. Ask if this is a quadratic function and how they know.

Ask a student to present an equation for the function: $A(x) = x(36 - x)$. Ask students how this equation is connected to the table and how it fits what they know about quadratic functions. Ask what is different about this equation compared to other quadratics that they have seen. Since it is important for them to recognize that the x^2 term is negative, you may ask them to distribute the x to see another form of the equation.

Turn the discussion to the graph (using technology). Ask students about the features of the graph that they notice. They should come up with a list like:

- The function is continuous.
- The function increases in the interval (0,18) and decreases in (18,36).
- The function has a maximum at (18, 324).



Ask how this graph compares with the graphs of other quadratic functions that they have seen. Since this is the first full parabola they have seen, you will need to tell them that because of the limited domains that were used in previous contexts, they have only seen part of the parabolas that are representative of quadratic functions. This one opens down and has a maximum, graphs of quadratic functions can also open upward and have a minimum.

Aligned Ready, Set, Go: ***Quadratic Functions 1.4***