Focus On The Lighthouse

Materials: pencil, graph paper, ruler, waxed paper, graphing calculator

Objectives: To determine the relationships among the focus, directrix, vertex, axis of symmetry, and the equation of a parabola.

TEKS: (Algebra II) d2A, B The student uses characteristics of the quadratic parent function and connects between $y = ax^2 + bx + c$ and the $y = a(x – h)^2 + k$. The student uses the parent function to investigate, describe, and predict the effects of changes in $a$, $h$, and $k$ on the graphs.

Classroom Management: Work in groups of two or three. One product per group. One 50 minute lesson

Directions:
You are in a lighthouse that is two nautical miles from the shoreline when you receive a distress signal from a lost ship. All the captain knows is that he is the same distance from your lighthouse as he is from the shoreline.
1. Assuming that the shoreline can be represented by a straight line, use graph paper, a pencil, and a ruler to determine the path along which the ship might be located and sketch the path.
2. Describe the figure from Step 1.
3. Get a sheet of waxed paper and a ruler. Mark a point $F$ on the paper, and draw a line $(l)$ about 2 inches below the point $F$.
4. Starting at the edge of the paper and taking points on the line about every $\frac{1}{4}$ inch, fold the waxed paper such that the points on the line $l$ are folded to touch $F$, sharply creasing the paper along each fold. The creases appear to be tangent to what figure?
5. Draw a line from point $F$ perpendicular to line $l$. Label the intersection point $A$.
6. Fold $A$ to $F$ and crease the paper. The vertex $V$ of the figure is the intersection of the crease and the line from $F$ to $A$. Label this point $V$.
7. What is the relationship between $FV$ and $AV$?
8. Pick a point on line $l$ and label it $D$. Draw a perpendicular line from a point on the figure to the point $D$. Label the point you chose on the figure with the letter $Q$.
9. What is the relationship between $DQ$ and $FQ$?
10. Pick another point $E$ on line $l$. Repeat Steps 8 and 9.
11. Write a definition for the figure based on your observations.
12. Use your waxed paper model to determine how to locate $F$ and line $l$ so that the figure opens (a) downward, (b) left, and (c) right. Then, carefully describe the positioning for each case.
13. Determine how to locate $F$ and line $l$ so that the figure is “narrower”, or (b) “wider”. Then, carefully describe the positioning for each case.

14. Write an equation describing the possible locations of the lost ship if the lighthouse location serves as the focal point. Justify your conclusion.

15. Write an equation describing the possible locations of the lost ship if the lighthouse is located ½ mile from the shoreline.

**Assessment:** Daily grade – 7 points per question

**Vocabulary:** Focus, directrix, vertex, axis of symmetry, parabola