NUMB3RS Activity: Exploring Parabolas
Episode: “Structural Corruption”

Topic: Parabolas
Grade Level: 9 - 10

Objective: Students will investigate parabolas of the form \( y = a(x - b)^2 + c \) and state the effect each coefficient has on the parabola’s graph.

Time: 20 minutes
Materials: TI-83 Plus/TI-84 Plus graphing calculator

Introduction
When a Cal Sci student apparently commits suicide by jumping off of a bridge, Charlie investigates and suspects foul play. He believes the parabolic path followed by the student terminates farther from the bridge than it should for a jumper. While Charlie was ultimately wrong in his assumption of foul play, he was correct that the body would follow a parabolic path in its descent.

This activity is intended as a means for students to discover the effects the parabola’s coefficients have on its graph. This activity makes extensive use of the Transformation Graphing App to explore properties of parabolas. This App can be downloaded for free from http://education.ti.com/educationportal/sites/US/productDetail/us_transg_83_84.html.

Discuss with Students
This activity focuses on a family of graphs called parabolas. Parabolas are a subset of the conic sections (the others being ellipse, hyperbola, and circle). While parabolas have many properties, the focus of this activity will be to observe the changes that graphs of the form \( y = a(x - b)^2 + c \) undergo when the values of the coefficients \( a, b, \) and \( c \) are changed.

Student Page Answers:

1. \( y = \{200, 184, 136, 56, -56\} \)
2. \((0, 200)\)
3. \(+3.5 \) and \(-3.5\)
4. When \( B \) is negative, the graph moves \( B \) units to the left. When \( B \) is positive, the graph moves \( B \) units to the right.
5. When \( C \) is negative, the graph moves \( C \) units down. When \( C \) is positive, the graph moves \( C \) units up.
6. When \( A \) is negative, the parabola is concave down. When \( A \) is positive, the graph is concave up. When \(-1 < A < 1\), the graph gets wider, otherwise it gets skinnier.
7. \((2, 5)\)
8. Positive values of \( A \) make the graph open upwards, and negative values of \( A \) make the graph open downwards. As the absolute value of \( A \) increases, the graph becomes narrower.
9. The graph becomes wider as the values for \( A \) approach zero i.e. 0.5, -0.01, etc.
10. When \( A = 0\), the equation \( y = A(X - B)^2 + C \) reduces to \( y = C\). The graph of any constant, \( C\), is always a horizontal line.
11. \( y = -\frac{1}{2}(x - 1)^2 + 8 \)