Activity Title:

"You Don't Have To Be A Rocket Scientist…..Just Use A TI-Nspire!"

(Pre-launch quadratic modeling in the classroom)

Time Required: 45 minutes for problem 1 (function)

45 minutes for problem 2 (parametric)

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Activity Overview:

In this exercise, students will model projectile motion in both function and parametric graphing. This was designed as an in-class modeling activity to be used prior to actually launching air-powered projectile rockets.

A set of data is given in a spreadsheet and students create model functions using a variety of methods: vertex form (then using "grab and move" to fit the curve to the data points), standard form (using matrices), and quadratic regression. The functions created are verified in the spread sheet as fitting the data well.

Students create models parametrically simulating the vertical launch of the rocket, horizontal motion per unit of time and also utilizing the angle at which the rocket was launched.

This activity is appropriate for Algebra II or Precalculus. The parametric portion determines the level at which it will be used. A portion of the activity could be used if parametric concepts have not been previously instructed.

Concepts:

- Quadratic functions and characteristics
- Various forms of a quadratic
- Representing vertical launch and horizontal flight path in parametric form.

Teacher Preparation:

This investigation usually follows the study of quadratic functions. The quadratic function is characterized by a parabolic curve, by viewing the scatter plot, we can see it will open downward. The data represents a rocket path, height per unit of time; the symmetry of the curve is obvious. The vertex will represent the height the rocket attained in t seconds. The activity includes parametric graphing, as previously pointed out. The teacher will determine the appropriateness of this activity for classes he/she instructs.

The teacher should review the various forms of a quadratic function and also methods used to create the model function in the different forms. The teacher should also review parametric graphing and any formulas that are necessary for the students to complete this activity successfully.

- This activity could be used in Algebra II either as an application of quadratic functions.
- This activity could be used as student discovery/recall of quadratic functions and the various forms of a quadratic function in Precalculus. The discovery may occur in the parametric representation.
- Students should be familiar with using the different applications available on the TI-nspire, how to insert pages, change page layouts, basic shortcut keystrokes and menu options in the various applications.
- The teacher should have a back-up document available in the event a student accidentally altered the spreadsheet of data provided on Page 1.3.
- A worksheet could be made to accompany this activity which students could complete as a hard copy for a written assignment. All answers to questions should be submitted in **sentence form** and the teacher should indicate to students the algebraic manipulation work required on the worksheet.

Classroom Management:

- This activity is designed to be student-centered. The teacher may act as a facilitator while students work independently or cooperatively. The teacher will inform students in which manner they are to work.
- The ready-to-use worksheet will provide a written assignment which can be used for daily credit points.
- The file titled *rocketsimSOL* shows the expected results of working through the activity and the screenshots are included in the step-by-step instructions.

TI-Nspire Applications:

Calculator, Graphs & Geometry, Lists & Spreadsheets, Notes

Activity Extensions:

- Students may select quadratic problem examples from internet sites and bring them in and post them for other students to complete for extra credit/ present the problem to the class.
- The actual launch of the air-powered projectile can take place outdoors, data collected and returned to the classroom. Students can complete the modeling activities on their collected data.
- The “marble launcher” can be used in the classroom as an alternative method of collecting data.
- The air-powered projectile used in the out door activity was purchased from Arbor Scientific.
- The actual outdoor launch activity consisted of a vertical launch to determine initial velocity, horizontal launch at different angles, launching at angles with altimeter measurement to create right triangle trigonometry and a probability launch activity,