

SATEC

**San Antonio Technology
In Education Coalition**

Survey of Functions **Exploring Patterns and Parameters**

The Winning 3 Pointer



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II About the Math

A. Critical Mathematics

In this activity, the student will explore the height of a projectile over time. They will identify dependent and independent variables, identify reasonable values for the domain and range, create scatterplots, and use the guess and check method to fit a curve to quadratic data. Students should be familiar with how to input and view data points and how to enter quadratic equations into the graphing calculator.

B. How students will encounter the concepts

This activity allows students to connect mathematics to basketball. Students will examine the height of the ball over time as a three point shot is made. They will develop a mathematical model for this shot and explore parameter changes in the quadratic function of the form $y = x^2$.

III Setting Up

Materials:

Video clips of 3-point shots from professional basketball players

“3_Point” stack file for Scion Image (or NIH Imaging)

Lightware projector connected to computer

Graphical Analysis

SCION Imaging

Student activity sheets

IV Teacher Notes

a) Objective

- Record Data
- Represent data in tabular and graphical forms
- Identify independent and dependent variables
- State a reasonable domain and range for the function
- Write an algebraic equation that “fits” the data
- Describe how changes in an equation effect the graph
- *For the mathematical purpose of the lesson, the shot ends after the ball passes through the rim.* Therefore, that determines the domain and range.

b) Teachable Moments

c) Connections

When quadratics are studied in depth, look back at the examples given in question 10 of the student activity.

d) Classroom Management Tips

e) Pre-requisites

Understanding of Domain and Range and Independent and Dependent variables.

f) Questions

g) Supplementary Comments

Collect several examples from question 10 - both correct and incorrect - for discussion in the quadratic unit.

h) Follow-ups/extensions

i) Answers

IV TEKS

(b) Foundations for functions: knowledge and skills and performance descriptions.

(1) The student uses properties and attributes of functions and applies functions to problem situations. Following are performance descriptions.

(A) For a variety of situations, the student identifies the mathematical domains and ranges and determines reasonable domain and range values for given situations.

(B) In solving problems, the student collects data and records results, organizes the data, makes scatterplots, fits the curves to the appropriate parent function, interprets the results, and proceeds to model, predict, and make decisions and critical judgments.

(c) Algebra and geometry: knowledge and skills and performance descriptions.

(1) The student connects algebraic and geometric representations of functions. Following are performance descriptions.

(A) The student identifies and sketches graphs of parent functions, including linear ($y = x$), quadratic ($y = x^2$), square root ($y = \sqrt{x}$), inverse ($y = 1/x$), exponential ($y = ax$), and logarithmic ($y = \log ax$) functions.

(d) Quadratic and square root functions: knowledge and skills and performance descriptions.

(1) The student understands that quadratic functions can be represented in different ways and translates among their various representations. Following are performance descriptions.

(A) For given contexts, the student determines the reasonable domain and range values of quadratic functions, as well as interprets and determines the reasonableness of solutions to quadratic equations and inequalities.

(B) The student relates representations of quadratic functions, such as algebraic, tabular, graphical, and verbal descriptions.

The Winning 3 Pointer

Student Activity



Introduction

In recent years, the 3-point shot has become increasingly important in winning basketball games. This was demonstrated repeatedly in the 1998-1999 NBA season as the San Antonio Spurs chased their dream of winning their first championship. We are first going to watch several video clips of the Spurs making some of the 3-point shots that helped them win their championship. Be sure to watch the path of the ball and the shape it makes. Later in this lesson we will record data from a 3-point shot and use mathematics to analyze the path of the ball.

(Video clips)

1. Describe the path the basketball takes as it is thrown toward the basket by the player.
2. What two variables are changing as the ball is tossed in the air?
3. Which one is the independent variable?
4. Which one is the dependent variable?

You are now going to see a "stop action" shot. We will use a program called Scion Image to measure the height of the ball from the ground at certain times as the ball is shot.

- Open Scion Image.
- From the Menu bar select **File, Open** and open the file called "3-Point Shot."
- Click on *Special*, and select Load Macro. Select "**3 point_macro**".
- Click on *Special*, and follow the steps listed.

This movie was captured at 10 frames per second. How much time has elapsed every frame?

If the first frame is considered time 0, calculate the time for each subsequent trial and fill in the time column.

Get approval from your teacher before continuing. _____

Record the measurements as listed in the Results table.

Time	Height
0	

- Open the application **Graphical Analysis**.
- Turn off the "connecting lines" option.
- Enter the data for Time and Height.

The equation that fits this data is part of a family of functions called **QUADRATIC FUNCTIONS** (or polynomial functions of degree two). The most basic form of this function is $y = x^2$. It is called the **parent function**.

5. Use the Automatic curve fit option of Graphical Analysis to find the equation of the data. Equation: _____

6. What is the Domain of the data collected:

7. What is a reasonable domain for this situation? _____

8. What is the Range of the data collected?

9. What is a reasonable range for this situation? _____

10. How would this situation change if the person throwing the ball would be taller?

11. Would this have any effect on the data? On the shape of the function?

12. Describe three scenarios that would change the graph representing the ball's trajectory, and how it would compare to the original graph. Be sure you indicate how the domain and range would be different.
