Shooting Hoops!

Dan Meyer, 3-Act Task

Prerequisite Information:

- Standard form of a quadratic: $y = ax^2 + bx + c$
- Vertex form of a quadratic: $y = a(x-h)^2 + k$
- Factored form of a quadratic: $y = a(x-x_1)(x-x_2)$
- What is a parameter?

Prelude:

Watch Parabolas and Basketball @ https://www.youtube.com/watch?v=A1R_TDTv6fg

Act 1:

1. **On your own**:

a.

Is he going to make it? Can you draw me the path of a shot that will make it? That will miss it?

b.

How about now? Can you draw me the path of a shot that will make it? That will miss it?

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Comment [1]: Teacher Note: It is beneficial for students to have a good understanding of each of these forms of quadratics in terms of how they are related to one another. They should be able to translate between forms and how to interpret the meaning of each of the parameters.

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Comment [2]: Teacher Note: This is a very short motivational video to perk students interest in the lesson.

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Comment [3]: Teacher Note: The purpose of part 1 of Act 1 is for students to come to the realization that one point and two points are not enough data for them to make a good estimate for whether the ball will go in or not. In other words, it takes three points to determine a parabola.

c.

How about now? Can you draw me the path of a shot that will make it? That will miss it?

The "answer": http://vimeo.com/16832687

2. **Work with a Partner or Team**: Watch: http://www.101qs.com/1195-will-it-hit-the-hoop
Which shots will go in the hoop? If your answer is "no", predict why the ball won't go in. Will the ball be short, long, or something else entirely?

A.

B.

C.

D.

E.

F.

G.

3. **Discuss**: What information/action would help you be surer of your answer?

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Comment [4]: Teacher Note: This is meant to be VERY quick and students just going with their first thoughts from watching the video once. Consider pausing after each shot for only a few seconds to allow students to stay caught up.

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Comment [5]: Teacher Note: Answers that are expected here are: we need to freeze the picture, "frozen" points, multiple points, coordinates, a coordinate grid, etc. If they don't come up in the course of discussion consider asking about them.

Act 2: Analyzing the Data and Mathematical Modeling

4. **Frozen Strobes**: Which shots A. – G. will go in the hoop?

For each of the following still photographs, without using technology (we will do that later) create a quadratic function model for each situation and use it to help you answer each question.

A. **Yes or No?** If your answer is "no", predict why the ball won't go in. Will the ball be short, long, or something else entirely?

B. **Yes or No?** If your answer is "no", predict why the ball won't go in. Will the ball be short, long, or something else entirely?

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Comment [6]: Teacher Note: Encourage the students to use the overhead transparency grids to help them locate points in their modeling efforts.

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Comment [7]: Teacher Note: Be sure to ask students: What does x represent in each function model? What does y represent?

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Comment [8]: Teacher Note: It is likely that you will need to remind the students of the three forms of quadratics (standard, factored, and vertex) as this part of the activity begins to unfold. You may want to do a quick review and write each on the board for them to access. This lesson is not about memorizing the forms but being able to use and translate between them.

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Comment [9]: Teacher Note: It is likely that different student groups will use different forms of the quadratic equations to do these problems. THIS IS A GOOD THING! Use the situation as a teachable moment.

Cases:
If one group presents their answer in factored form but another group has an equation in standard form ask the students to verify if they are the same thing (multiplying binomials).

Maybe a group has their answer in factored form and to check if it's the same as vertex form it requires completing the square.

*** You may want to force the issue of translating between forms of quadratics by raising an equation up as a possible answer and then asking the class to verify if it would or would not be valid.

C. **Yes or No?** If your answer is “no”, predict why the ball won't go in. Will the ball be short, long, or something else entirely?

D. **Yes or No?** If your answer is “no”, predict why the ball won't go in. Will the ball be short, long, or something else entirely?

E. **Yes or No?** If your answer is “no”, predict why the ball won't go in. Will the ball be short, long, or something else entirely?

F. **Yes or No?** If your answer is “no”, predict why the ball won't go in. Will the ball be short, long, or something else entirely?

G. **Yes or No?** If your answer is "no", predict why the ball won't go in. Will the ball be short, long, or something else entirely?

The "answers" to shots A. – G.: http://www.101qs.com/1195-will-it-hit-the-hoop

Act 3: **Using Technology: Geogebra applets**

a. Go to: https://www.geogebratube.org/student/m30849 and attempt to model a parabola onto the path of the basketball to decide whether or not the ball goes in. Be sure to write down your quadratic model to record the parameters chosen.

b. In this exercise, the programmer chose to use the vertex form $y=a(x-h)^2+k$ to model the parabola. Would it have been better to use the standard form $y=ax^2+bx+c$ or the factored form $y=a(x-x_1)(x-x_2)$ in the program? Explain.

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Comment [10]: For this exercise, encourage students to use what they know about the parameters of the vertex form of a quadratic and to not just solve the problem by constant trial-and-error. Ask students what does adjusting the "a" do and why, "k", "h"? The translations should all be built around meaning making.

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Comment [11]: Teacher Note: Focus the students on what different types of information the person "playing" with the program will have to attend to. For instance, for the standard form the focus would be on the initial value, the initial rate of change, and curvature. For the factored form, the focus would be on the horizontal intercepts and the curvature.