Rich Mathematical Task – Algebra I - We're Playing Basketball

Task Overview/Description/Purpose:
• The purpose of this task is for students to demonstrate the ability to determine a curve of best fit (linear or quadratic) and make predictions given a set of data. • In this task, students will analyze data related to NBA basketball players and points scored to determine whether a linear or quadratic function will best model the data. Students analyze the curve of best fit that they calculate to answer questions and make predictions related to data.

Standards Alignment: Strand –Statistics	
Primary SOL: A. 9 The students will collect and analyze data, determine the equation of the curve of best fit to make predictions and solve practical problems, using mathematical models of linear and quadratic functions. **Related SOL: 8.13, AFDA.3, AII.9**	
Learning Intention(s): • **Content** - I am learning to collect data and analyze the data to make predictions and solve real-world problems. • **Language** - I am learning how to use mathematical terms to describe my process. • **Social** - I am learning to collaborate with peers, participate in classroom discussion, and explain my process logically.	
Success Criteria (Evidence of Student Learning): • I can use data to determine the curve of best fit. • I can analyze data and determine if a line of best fit is linear or quadratic. • I can make predictions using a set of data and curve of best fit. • I can apply a curve of best fit to answer questions related to a given set of data.	
Mathematics Process Goals	
Problem Solving	• Students will apply problem-solving strategies to determine a line of best fit and make predictions using a given set of data. • Students will be able to apply the line of best fit and solve problems related to the data.
Communication and Reasoning	• Students will communicate their thought process for determining a line of best fit. • Students will communicate how the player they select affects the curve of best fit. • Students will communicate their analysis of whether the curve of best fit is a good representation of the data.
Connections and Representations	• Students will use multiple representations to explore their situation and use models to support their learning.

Rich Mathematical Task – Algebra I - We're Playing Basketball

Task Pre-Planning	
Approximate Length/Time Frame: 60 minutes	
Grouping of Students: This task can be used as a summative assessment. • Students should complete the first part of the task in groups. Place students in groups of at least 3 but no more than 4. Consider paring students with social or language needs or math deficits with students with a high- level understanding of mathematical concepts and terminology. • Consider the level of understanding with using Desmos to complete the task. • Consider Mastery Levels of prerequisite knowledge (Beginning, Developing, and Accomplished): Create groups that contain at least one student from each of the three levels when possible. • Students who prefer to work alone should be at an accomplished level of knowledge. • After completing part 1, Students should move to work on Part 2 independently. Students can remain in their groups for sharing purposes; but should complete items a-c independently. Consider selecting a team leader for each group to field questions prior to asking the teacher for guidance. • After completing Part 2 independently, students will compare solutions and changes to the curve of best fit based on the basketball player selected.	
Materials and Technology: • Graph Paper • Rulers • Graphing Calculator • DESMOS-See directions for entering curve of best fit into DESMOS here: http://www.3plearning.com/wp-content/uploads/2016/01/Desmos_Sales_Introduction.pdf • Colored Pencils or Markers • Desmos Activity	**Vocabulary:** • Curve of best fit • Linear Equation • Quadratic Equation • Statistics
Anticipate Responses: See the Planning for Mathematical Discourse Chart (columns 1-3).	

Rich Mathematical Task – Algebra I - We're Playing Basketball

Task Implementation (Before) 5 Minutes
Task Launch: • Discuss with students the learning attentions for the task and the expectation for working in groups through Part I and Part 2. Students are expected to work collaboratively on Part I and independently with Part 2. • Discuss with students the sport of basketball and poll the students to determine the level of interest and understanding of the sport. This can determine how in-depth the conversation regarding data collection of professional athletes may need to be. • Engage students in a conversation regarding how the NBA determines who the All-Time leading scorers are and how the data is collected. Talk about why the data is not consistently related, for example, why would a player with the highest scoring rookie season not necessarily be the number one All-Time leading scorer. • Discuss with students how the equation of a curve of best fit can be affected if new data values are added to the data set.
Task Implementation (During) 40-45 Minutes
Directions for Supporting Implementation of the Task • Monitor – The teacher will observe students as they work independently on the task. The teacher will engage with students by asking assessing or advancing questions as necessary (see attached *Question Matrix).* • Select – The teacher will select students to discuss their predictions and justifications for each question. • Sequence – The teacher will select 2-3 student strategies to share with the whole group. One suggestion is to look for one common misconception and two correct responses to share. • Connect – The teacher will consider ways to facilitate connections between different student representations.

Suggestions For Additional Student Support
• Provide students with oral directions.
• Allow students to give oral justifications in place of writing.
• Provide highlighters for students who need assistance with interacting with the text.
• Provide problem solving strategy questions for non-starters.
    o After entering the data into Desmos, what type of line do you see? Linear or Curved? How does this determine what type of equation you have?
    o What are your independent and dependent variables? (Which data point is determined by the other?)
    o What does a curve of best fit that is a good representation of the data look like?

Task Implementation (After) 1*0-15 minutes*

Connecting Student Responses (From Anticipating Student Response Chart) and Closure of the Task:
• After observing the student responses, select students to present their methods for each step in Part I (1-6) with greater emphasis on 3-6. For Part 2, select students with different predictions and changes in the curve of best fit when the new player is applied.
  ▪ Select students with varied methods but correct answers and students who have correct methods but incorrect answers.
  ▪ Select students who present common misconceptions
• Connect different students' responses and connect the responses to the key mathematical ideas to bring closure to the task.
  ▪ Compare and contrast student answers to determine what strategies may still need to be identified.
      o How are strategies alike? How do they differ?
      o ________________________'s strategy could have also been solved by_____________?

- Identify and discuss important terminology to help make connections to the task.
- Create equitable opportunities for sharing work.
  - Group share - for Part I to discuss predictions and changes to the data and to discuss the changes after applying the new player.
  - Gallery Walk - to compare Part 2 changes after the new player is applied.
  - Turn and Talk - with a member of a different group to discuss changes in the curve of best fit.

Teacher Reflection About Student Learning:

- What process did students go through to determine what strategy to use? Did this lead to the correct answer? What were the common errors or misconceptions?
- How were the instructional objectives met?
  - Were students able to demonstrate the ability to determine a curve of best fit (linear or quadratic) and make predictions given a set of data?
  - Were students able to determine if the data was best reflected by a linear or quadratic function?
  - Were students able to answer questions and make predictions based on the data?
- How will the evidence that resulted from the student work further instruction?
  - What will come next, based on the responses and level of understanding from the task (i.e. group students together who had similar misconceptions and review that concept only with each group.)
- Are the students able to explain their work in writing, verbally, or orally?
- Do the students understand the vocabulary that supports their knowledge of the SOL standard?

Rich Mathematical Task – Algebra I - We're Playing Basketball

Planning for Mathematical Discourse

Mathematical Task: We're Playing Basketball

Content Standard(s): SOL A.9

Teacher Completes Prior to Task Implementation			Teacher Completes During Implementation	
Anticipated Student Response/Strategy *Provide examples of possible correct student responses along with examples of student errors/misconceptions*	**Assessing Questions** *Teacher questioning that allows student to explain and clarify thinking*	**Advancing Questions** *Teacher questioning that moves thinking forward*	**List of Students Providing Response** *Who? Which students used this strategy?*	**Discussion Order - sequencing student responses** • *Based on the actual student responses, sequence and select particular students to present their mathematical work during class discussion* • *Connect different students' responses and connect the responses to the key mathematical ideas* • *Consider ways to ensure that each student will have an equitable opportunity to share his/her thinking during task discussion*
Anticipated Student Response: Student is unable to determine if a curve of best fit is linear or quadratic.	• What shape is represented by a linear curve? Quadratic curve? • Use a highlighter to enhance the curve of best fit.	• How can you use the name of each curve (linear and quadratic) to remember the shape?		
Anticipated Student Response: Student is unable to determine the amount of points LeBron James has.	• What value, *x* or *y*, does LeBron's total points for his rookie season represent? • How would you substitute this value into the equation for the curve of best fit?	• How does knowing one value, x or y, help you determine the other?		
Anticipated Student Response: Student is having difficulty determining if the curve of best fit is a good representation of the data when the new player is entered.	• Does the data appear to be modeled best by a straight line or a curve? • How would you be able to compare how the line of best fit and quadratic curve of best fit model the data?	• How is the r^2 value affected when you enter new data value? • Through which data points does the line of best fit pass?		

Anticipated Student Response: Student is having difficulty making a conclusion regarding how a player's rookie season affects the overall career points.	• How does the amount of points in the rookie season compare to the overall points? • Is there a consistent trend in the data when comparing the rookie season to the overall points?	• How does the r^2 value factor into your curve of best fit? • When comparing the data from each player, is there a trend that can be determined?		

NAME ____ DATE ___________________

We're Playing Basketball!

The NBA keeps a record of the all-time top scorers. Many of the NBA players on the list below have had great rookie seasons. Is it possible to predict the overall points at the end of a player's career based on their rookie season? Below is a list of some of the players on the top scorer list.

Professional Player	**Rookie Season**-Points made during first year of career	**Overall Points**- Points made throughout entire career
Gary Payton	588	21,813
Robert Parrish	697	23,334
Reggie Miller	822	25,279
Jerry West	1389	25,192
Dominique Wilkins	1434	26,668
Hakeem Olajuwon	1692	26,946
Elvin Hayes	1725	26,314
Shaquille O'Neal	1893	28,596
Michael Jordan	2313	32,292
Kareem Abdul-Jabbar	2361	38,387

NBA.com/Stats | All Time Leaders

Part 1

Use the data to make predictions to determine the relationship between the points earned in a player's rookie season and the overall points earned in the career.

1. Create a scatter plot with the data in the chart above.

2. Would you use a linear or quadratic model to represent the data? Explain your reasoning for choosing your model.

3. Determine the equation of the curve of best fit that best models the data.

4. Using the equation of the curve of best fit, predict the amount of overall points LeBron James will have at the end of his career based on his rookie season total of 1,654 points. Do you believe this is a good prediction? Why or why not?

5. For a player to surpass Kareem Abdul-Jabbar, as the all-time score leader, he would need close to 40,000 points. How many points would the model show them scoring in their rookie season?

6. Do you believe your curve of best fit is a good representation of the data? Why or why not?

Part 2

Go to NBA.com/Stats | All Time Leaders and select a player not on the list above to add his scoring statistic to your data. (Once you choose a player and identify their all-time points, click on the individual's name, and change the Per Mode to Totals to see their total points for the rookie season).

a. Make a prediction on how the new player will affect the data.
b. How does this player's data affect the equation of the curve of best fit? Is the new equation of the curve of best fit a good representation of the data? Why or why not?
c. Based on the results of your new equation, what conclusion about a player's career total points can you make based off a player's rookie season total points?

Rich Mathematical Task – Algebra I - We're Playing Basketball

Rich Mathematical Task Rubric

	Advanced	Proficient	Developing	Emerging
Mathematical Understanding	Proficient Plus: • Uses relationships among mathematical concepts or makes mathematical generalizations	• Demonstrates an understanding of concepts and skills associated with task • Applies mathematical concepts and skills which lead to a valid and correct solution	• Demonstrates a partial understanding of concepts and skills associated with task • Applies mathematical concepts and skills which lead to an incomplete or incorrect solution	• Demonstrates no understanding of concepts and skills associated with task • Applies limited mathematical concepts and skills in an attempt to find a solution or provides no solution
Problem Solving	Proficient Plus: • Problem solving strategy is well developed or efficient	• Problem solving strategy displays an understanding of the underlying mathematical concept • Produces a solution relevant to the problem and confirms the reasonableness of the solution	• Problem solving strategy displays a limited understanding of the underlying mathematical concept • Produces a solution relevant to the problem but does not confirm the reasonableness of the solution	• A problem solving strategy is not evident • Does not produce a solution that is relevant to the problem
Communication and Reasoning	Proficient Plus: • Reasoning or justification is comprehensive • Consistently uses precise mathematical language to communicate thinking	• Demonstrates reasoning and/or justifies solution steps • Supports arguments and claims with evidence • Uses mathematical language to communicate thinking	• Reasoning or justification of solution steps is limited or contains misconceptions • Provides limited or inconsistent evidence to support arguments and claims • Uses limited mathematical language to partially communicate thinking	• Provides no correct reasoning or justification • Does not provide evidence to support arguments and claims • Uses no mathematical language to communicate thinking
Representations and Connections	Proficient Plus: • Uses representations to analyze relationships and extend thinking • Uses mathematical connections to extend the solution to other mathematics or to deepen understanding	• Uses a representation or multiple representations, with accurate labels, to explore and model the problem • Makes a mathematical connection that is relevant to the context of the problem	• Uses an incomplete or limited representation to model the problem • Makes a partial mathematical connection or the connection is not relevant to the context of the problem	• Uses no representation or uses a representation that does not model the problem • Makes no mathematical connections