Performance Based Learning and Assessment Task #1

Curve of Best Fit.

I. ASSESSSMENT TASK OVERVIEW & PURPOSE:

The task is to provide real world experience for students involving quadratic equations and specifically finding the curve of best fit using data they have gathered. The student will take measurements of how much water has drained at specific intervals, plot and then derive the equation of best fit.

II. UNIT AUTHOR:

Arthur Madeoy, Frederick County Middle School, Frederick County, VA

III. COURSE:

AFDA

IV. CONTENT STRAND:

Algebra and Functions

V. OBJECTIVES:

The learner will be able to gather data, represent properly on a Cartesian plane, and determine whether to derive the line of best fit or curve of best fit utilizing the data gathered.

VI. REFERENCE/RESOURCE MATERIALS:

Students will use a narrow stem funnel, measuring cup, graph paper, clock, and TI-84 calculator.

VII. PRIMARY ASSESSMENT STRATEGIES:

Students will be assessed on:

- Gathering the data correctly
- Analyzing the data to choose whether to derive the a line/curve of best fit
- Deriving the proper line/curve of best fit

VIII. EVALUATION CRITERIA:

See attached rubric and data sheet.

IX. INSTRUCTIONAL TIME:

This task should take one 50 minute class period.

Can I create a curve of best fit to model water drainage?

Strand
Algebra and Functions

Mathematical Objective(s)

The learner will be able to gather data, represent properly on a Cartesian plane, and determine whether to derive the line of best fit or curve of best fit utilizing the data gathered.

Related SOL

AFDA.3 The student will collect data and generate an equation for the curve of best fit to model real world problems or applications.

NCTM Standards

- Make conjectures about possible relationships between two characteristics of a sample on the basis of scatter plots of the data and approximate lines of fit
- Draw reasonable conclusions about a situation being modeled
- Model and solve contextualized problems using various representations, such as graphs, tables, and equations

Additional Objectives for Student Learning (include if relevant; may not be math-related):
Students should understand that most events in the universe do not occur at constant rates and that there is a whole branch of mathematics focused on varying rates.

Materials/Resources

Students will use a narrow stem funnel, measuring cup, graph paper, clock, and TI-84 calculator.

Assumption of Prior Knowledge

- Graphing data on a Cartesian plane
- Using scatter plots to determine if they represent a curve or a line
- Using data to find the line/curve of best fit
- Students may struggle in determining whether to use line/curve of best fit
    - ✓ To help prevent this issue, lines and curves will be reviewed before the activity

Introduction: Setting Up the Mathematical Task

In this activity you will determine if water flows out of a water tower at a constant rate or if it varies. The task will take one class period (50 minutes). You will model a water tower by funneling water into a measuring cup. This task will be done with groups of 3.

1. You will pour 8 ounces of water into the funnel which is placed above the measuring cup.
2. Using the clock on the wall, you will allow water to drain for 3 seconds.
3. Take note of the amount of water in the measuring cup.
4. Record your data in the table provided.
5. Then you will repeat the process until all the water is emptied from the bottle.

Teacher will demonstrate how to do the steps properly.

Student Exploration

Small Group Work

Students will work together in groups of 3. One student should be doing the time, another the measuring, and the third student records the data. Students should work together to interpret the data and deciding on the best type of trend line.

Student/Teacher Interactions

Students should be communicating about the task. When completed they should be asking themselves and each other (in their group) why they chose to use a line or curve of best fit. Students should also be asking why the water would flow at a rate that varies. The teacher will go around the room and ensure that the students are following procedure and using questioning to guide students in their exploration.

Monitoring Student Responses

Any group needing assistance on gathering data will be assisted. Those students who need extra help in understanding lines and curves will be given assistance.

Students will demonstrate their knowledge of the material by explaining their reasoning in choosing whether to use a line or a curve.

AFDA Name(s)_____

"Curve of Best Fit"

You will model a water tower that a farm uses to water their cattle using a 10 oz. water bottle, a bowl, a measuring cup, and a clock. You will collect data by measuring the amount of water you collect at different time intervals. You will graph your data and find the curve of best fit. Be ready to explain your model. Use your model to predict the amount of water that is collected at a time period beyond your last collected data point.

Part I

Steps

1. You will fill the water bottle with 10 ounces of water and then set the water in the bowl so that the water begins to drain.

2. Using the clock on the wall, you will allow water to drain for 3 seconds.

3. Check the measuring cup to see how much water has drained using the measuring lines on the sides.

4. Record your data in the table on the next page.

5. Then you will repeat the process until the water has completely flowed into the measuring cup.

Table

Seconds	Total Amount of Water In Measuring Cup
3	
6	
9	
12	
15	
18	
21	
24	
27	
30	
33	
36	
39	
42	
45	
48	
51	
54	
57	
60	

Part II

1. Using the data from the table, plot the points on a sheet of graph paper. Be sure to label the axes clearly.

2. Analyze the data and the graph and then find the line or the curve of best fit (You may use the ti-84 to aid you). You will have to decide which one (line or quadratic) to find based on the data.

Part III

Questions

1. What is the curve of best fit that you determined?

2. Why did you choose a line or a quadratic? Be specific.

3. Why do you think that the water flowed at the rate it did?

4. Using your equation, determine how much water would flow in 100 seconds.

Rubric For Activity

"Curve of Best Fit"

Goals	0	1	2	3
Data Gathering	No evidence	Data was found but was not correct. Did not follow proper procedure.	Data was found but not correct. Proper procedure was inconsistently followed.	Data was found and is correct and proper procedure was adhered to.
Represented Data on Cartesian Plane	No evidence	Data was improperly placed on the Cartesian plane with no reasoning behind the placement.	Data was improperly placed on the Cartesian plane but a slight mistake was made in doing so.	Data was properly placed on the Cartesian plane.
Chose correctly whether to create a line or curve of best fit	No evidence	Incorrectly/correctly chose line/curve of best fit and evidence of reasoning was flawed.	Incorrectly/Correctly chose line/curve of best fit but reasoning was to a small extent flawed.	Correctly chose line/curve of best fit and reasoning was solid.
Accurately found the equation of the line or curve of best fit	No evidence	Found incorrect line or curve equation and method in doing so was incorrect.	Found incorrect line or curve equation but method was correct and only a slight mistake was found in the process.	Found correct equation for the line or curve of best fit.
Follows Procedure and Presentable.	No Evidence.	Did not follow procedures and/or work is not neat, organized and presentable.	Followed procedure and work is neat, organized, and presentable but has minor errors.	Followed procedure and work is neat, organized, and presentable.

Assessment List: Final

			Earned Assessment	
Num.	**Element**	**Point Value**	**Self**	**Teacher**
1	Mathematics task is inquiry based	2	**2**	
2	Mathematics task is connected to the real world	2	2	
3	Mathematics task is open ended	2	2	
4	Mathematics task requires higher order thinking skills	2	2	
5	Mathematics task includes one or more performance tasks	2	2	
6	Mathematics task identifies one or more work habits	2	2	
7	Mathematics tasks are based on the AFDA SOL's	2	2	
8	The assessment list identifies all essential mathematics	2	2	
9	The assessment list identifies all performance components	2	2	
10	The assessment list includes work habits	2	2	
11	The assessment list acts as a student check list	2	2	
12	The assessment list allows for student self-assessment	2	2	
13	The assessment list allows for teacher assessment	2	2	
14	There are two mathematics tasks	2	2	
15	There are two assessment lists	2	2	
16	There are two benchmarks.	2	2	
17	The project package is well organized	2	2	
18	The project package is neat	2	2	
19	The project package is complete	2	2	
20	All recommended changes were made	2	2	

Rubric for Final

#	Element	0	1	2
1	Mathematics task is inquiry based	Not inquiry based	Somewhat inquiry based	Inquiry based
2	Mathematics task is connected to the real world	No connection to real world experiences	Connection to in-school	Connection to out-of-school
3	Mathematics task is open ended	Fully teacher directed closed task	Teacher structured but open ended task	Many entry points and multiple solutions
4	Mathematics task requires higher order thinking skills	Memorization and skill practice	Show and explain	Analysis, synthesis
5	Mathematics task includes one or more performance tasks	No performance tasks	NA	Includes one or more
6	Mathematics task identifies one or more work habits	No work habits identified	Some are identified	All work habits are identified
7	Mathematics tasks are based on the AFDA (preferred) SOL's	No SOL identified	Uses unrelated SOL	Uses appropriate AFDA SOL
8	The assessment list identifies all essential mathematics	No essential elements are identified	Some are identified	All are identified
9	The assessment list identifies all performance components	None are identified	Some are identified	All are identified
10	The assessment list includes work habits	No work habits included	Some appropriate work habits included	All appropriate work habits included
11	The assessment list acts as a student check list	Fails to act as a checklist	Check list is difficult to use	Acts as a check list
12	The assessment list allows for student self-assessment	Fails to allow for self-assessment	Self-assessment difficult to perform	Allows for self-assessment
13	The assessment list allows for teacher assessment	Fails to allow for teacher assessment	Teacher assessment difficult to perform	Allows for teacher assessment
14	There are two mathematics tasks	No tasks	One task	Two tasks
15	There are two assessment lists	No lists	One list	Two lists

16	There are two benchmarks.	No benchmarks	One bench marks	Two benchmarks
17	The project package is well organized	No evidence of organization	Not fully organized	Well organized
18	The project package is neat	Lacks neatness	Needs improvement	Neat
19	The project package is complete	Incomplete in more than one area	Incomplete in one area	Complete
20	Recommended changes were addressed	No recommended changes were addressed	Some recommended changes were addressed	All recommended changes were addressed

AFDA Name(s)_____

"Line/Curve of Best Fit"

You will model a water tower to determine whether the rate at which water flows is constant or varies. Be sure to follow procedures and all work should be neat, organized, and presentable.

Part I

Steps

1. You will fill the water bottle with 10 ounces of water and then set the water in the bowl so that the water begins to drain.
2. Using the clock on the wall, you will allow water to drain for 3 seconds.
3. Check the measuring cup to see how much water has drained using the measuring lines on the sides.
4. Record your data in the table on the next page.
5. Then you will repeat the process until the water has completely flowed into the measuring cup.

Table

Seconds	Total Amount of Water In Measuring Cup
3	1
6	2
9	2.8
12	3.6
15	4.3
18	4.8
21	
24	
27	
30	
33	
36	
39	
42	
45	
48	
51	
54	
57	
60	

Part II

1. Using the data from the table, plot the points on a sheet of graph paper. Be sure to label the axes clearly.

2. Analyze the data and the graph and then find the line or the curve of best fit (You may use the ti-84 to aid you). You will have to decide which one (line or curve) to find based on the data.

a curve

Part III

Questions

1. What is the line/curve of best fit that you determined?

$-.0058x^2 + .3751x - .07$

2. Why did you choose a line or a curve? Be specific.

The water did not flow at the same rate.

3. Why do you think that the water flowed at the rate it did?

Air pressure / gravity

4. Using your equation, determine how much water would flow in 100 seconds.

-20.56