Performance Based Learning and Assessment Task

Geyser Graphical Activity

I. ASSESSSMENT TASK OVERVIEW & PURPOSE:
Individually, the student is asked to: critically evaluate the data and pose questions, express patterns through multiple graphical representations, and explain those representations in written form. In a group setting, the students are expected to share and compare their graphical representations with group members. Students are collectively expected to make predictions about future eruption times and justify their reasoning.

II. UNIT AUTHOR:
Robin Malone, Hanover County Public Schools.

III. COURSE:
Algebra Functions and Data Analysis

IV. CONTENT STRAND:
Algebraic Functions

V. OBJECTIVES:
Student will be able to: transfer between and analyze multiple representations of functions in multiple forms, select and use appropriate representations for analysis, interpretation, and prediction, and justify the reasoning for predictions of future data.

VI. REFERENCE/RESOURCE MATERIALS:
Students will use: Worksheet with image of geysers and T chart of the recorded times of eruptions

VII. PRIMARY ASSESSMENT STRATEGIES:
The task includes an assessment component that performs two functions: (1) for the student it will be a checklist and provide a self-assessment and (2) for the teacher it will be used as a rubric. An assessment list is included with the essential elements that need to be assessed in this activity. The assessment list includes: facts and questions about geysers, three graphical representations and statements, paragraph of graphical representations, and predictions of future eruptions. The self and teacher assessment, measure the representation abilities, communication skills, and the reasoning of the student.

VIII. EVALUATION CRITERIA:
The assessment list, scoring rubric and directions for individual and group work are provided in this lesson.

IX. INSTRUCTIONAL TIME:
One ninety-minute class session

Geyser Graphical Activity

Strand

Algebraic Functions

Related SOL:

AFDA.4 (The student will transfer between and analyze multiple representations of functions including: algebraic formulas, graphs, tables, and words. Students will select and use appropriate representations for analysis, interpretation, and prediction.)

NCTM Standards

- Understand relations and functions and select, convert flexibly among, and use various representations for them
- Use mathematical models to represent and understand quantitative relationships
- Analyze change in various contexts
- Communicate mathematical thinking coherently and clearly to peers, teachers, and others

Materials/Resources

Students will use: Graphing calculator, Computer access, Excel software, Graph paper, Ruler, Maple software (optional), Colored Pencils (optional)

Assumption of Prior Knowledge

The students are expected to understand and translate a given data set into multiple graphical representations. The student should be familiar with different ways to use data in a graphical representation (i.e. bar graph, and linear graph). The students may be confused about which type of graph to use and how the data may be represented differently through varying graphical representations. If possible, the students are able to draw on any prior knowledge from science of geysers, eruption patterns and trends.

Introduction: Setting Up the Mathematical Task

In this task, you will investigate the relationship between a given data set and using this set to create a graphical representation of the data in three different ways.

- Teachers will ask guiding questions to gauge the student's understanding of geysers as a context for the problem.
  For example: What is a geyser? What purposes do geysers serve? These two questions will serve as a basis of knowledge. Then as part of the instructions for individual work, the student will devise questions to ask the geyser expert.

- The classes will be structured with independent work, and then close with small group work.
- Teachers will invite students to draw upon their prior knowledge, by referencing prior lessons with graphical representations. Additionally, the teachers may want to draw in pre-existing content knowledge the students have from current science or social studies curriculum.
- Students will make their mathematical thinking and understanding public by discussing in small groups the student's rationale behind choosing a specific representation for the data set.

Student Exploration

Individual Work

Task 1 Look up and write down a few facts about geysers. Also, after gathering some information, write down at least two questions you would ask a Geyser Expert.

Task 2 Using the data in the table; create THREE graphical representations of the data to help you visualize the pattern of eruptions.

Task 3 For EACH of your THREE graphical representations, write a statement explaining what your graphs show. After comparing your three graphs, which one would you choose to be the best graph to use for making predictions of the next few eruption times?

Small Group Work

Task 4 Share and compare your graphical representation of the data with others in your group. What do you notice as you look through your group's graphical representations? Write a paragraph detailing the similarities and differences in your graphs.

Task 5 If the Strokkur Geyser has just erupted, decide as a group when you think the next two eruptions will occur. Write down your predictions and justify your work. How sure is your group of their predictions.

Student/Teacher Actions:

In this activity, the teachers will serve as facilitators of learning for the students. The teacher will present the assignment, and then have the student's respond with individual work. After this is completed, the students will be divided into small groups where they can share findings and compare them with fellow group members. As a wrap up activity, the students will discuss the key findings of these assignments and the questions about geysers that have been raised through this assignment.

Monitoring Student Responses

- Student Expectations
  - Students are to communicate new thinking and knowledge in written and graphical form.
  - Students are to compare and contrast the graphs respectfully and communicate with each other appropriately.
  - Teachers and/or students are to work together to clarify the ideas or concepts that are hard to understand.
  - Teachers are to extend the material for students that fully understand concepts and create future opportunities for exploration of these concepts.
  - The time built in for the closure of the activity is fifteen minutes. After the lesson has been introduced, the teacher has been observing the students individually as well as in groups. On the spot coaching is conducted, and if there is a question that arises frequently the teacher may pause and pose it to the class, for collective feedback.
  - The teachers can collect evidence of students' knowledge of the content by listening to group conversations and coaching when the group has trouble. The teacher should note pitfalls and frequently asked questions and then discuss these issues in the closing part of the lesson.

Assessment List and Benchmarks

Attached are worksheets and rubrics relevant to the task.

Name_____

Date _____

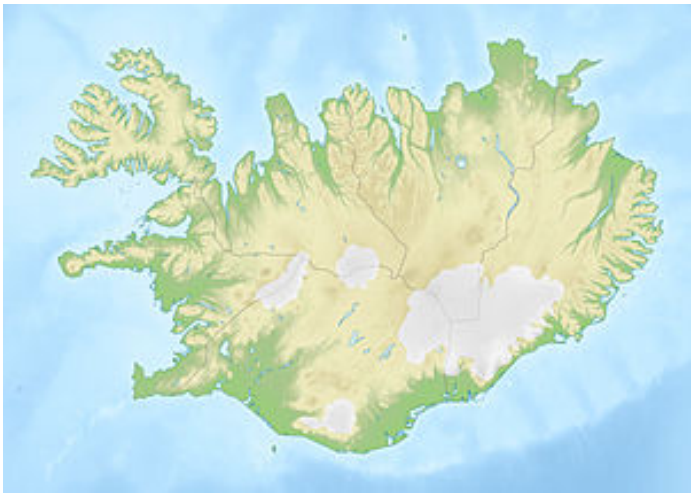
Period_____

AFDA SOL: AFDA.4

Teacher Comments:

How often do you BLOW YOUR TOP??

Strokkur Iceland



From Wikipedia

Strokkur (Icelandic for "churn") is a fountain geyser in the geothermal area beside the Hvítá River in Iceland in the southwest part of the country, east of Reykjavík. It is one of Iceland's most famous geyser, erupting about every 4–8 minutes 15 – 20 m high, sometimes up to 40 m high.

Strokkur was first mentioned in 1789, after an earthquake unblocked the conduit of the geyser. Its activity fluctuated in the 19th century; in 1815 its height was estimated to be as much as 60 meters. It continued to erupt until the turn of the 20th century, when another earthquake blocked the conduit again. In 1963, upon the advice of the Geyser Committee, locals cleaned out the blocked conduit through the bottom of the basin, and the geyser has been regularly erupting ever since.

Your Tasks:

The following chart contains data (mostly un-tampered with) of actual eruption times for the Strokkur Geyser.

Eruption Date and Time	Time Interval (Number of minutes since last eruption)
09 Oct 2013 @ 0915	4 minutes
09 Oct 2013 @ 0911	4 minutes
09 Oct 2013 @ 0907	2 minutes
09 Oct 2013 @ 0905	5 minutes
09 Oct 2013 @ 0900	6 minutes
09 Oct 2013 @ 0854	3 minutes
09 Oct 2013 @ 0851	4 minutes
09 Oct 2013 @ 0847	2 minutes
09 Oct 2013 @ 0845	3 minutes
09 Oct 2013 @ 0842	4 minutes
09 Oct 2013 @ 0838	4 minutes
09 Oct 2013 @ 0834	3 minutes
09 Oct 2013 @ 0831	7 minutes
09 Oct 2013 @ 0824	3 minutes
09 Oct 2013 @ 0821	4 minutes

Eruption Date and Time	Time Interval (Number of minutes since last eruption)
09 Oct 2013 @ 0817	5 minutes
09 Oct 2013 @ 0812	8 minutes
09 Oct 2013 @ 0804	6 minutes
09 Oct 2013 @ 0758	10 minutes
09 Oct 2013 @ 0748	3 minutes
09 Oct 2013 @ 0745	7 minutes
09 Oct 2013 @ 0738	Starting eruption data here.

Geyser Task Rubric

			Earned Assessment	
Number	Element	Point Value	Self	Teacher
1	Facts about geysers	2		
2	Questions about geysers	2		
3	Three graphical representations	6		
4	Statement for each graph	6		
5	Choice of one graph to make predictions	2		
6	Paragraph for group graph comparisons	2		
7	Prediction of next two eruptions, using graphs	2		
8	Working effectively with other group methods	2		

Scoring Rubric

Element	0	1	2
Facts about geysers	No facts	One fact	Two or more facts
Questions about geysers	No questions	One question	Two or more questions
First graphical representation	No graph	Graph is present but with errors or inaccuracies	Complete, accurate graph
Second graphical representation	No graph	Graph is present but with errors or inaccuracies	Complete, accurate graph
Third graphical representation	No graph	Graph is present but with errors or inaccuracies	Complete, accurate graph
Statement for first graph	No statement	Statement is present but with errors or inaccuracies	Complete, accurate statement
Statement for second graph	No statement	Statement is present but with errors or inaccuracies	Complete, accurate statement
Statement for third graph	Statement	Graph is present but with errors or inaccuracies	Complete, accurate statement
Choice of one graph to make predictions and	No choice of graphs	Chose a graph but it is not a good one for predictions or	Chose an appropriate

explain why you chose this graph.		with a poor explanation	graph with good explanation
Paragraph for group graph comparisons	No paragraph	Paragraph there but comparisons are weak or unsupported, or poorly constructed paragraph	Good solid paragraph, complete sentences, proper grammar, arguments are supported
Prediction of next two eruptions, using graphs	No predictions	One prediction	Two predictions
Working effectively with other group members	No collaboration is evident on tasks 4 or 5	Some collaboration is evident on tasks 4 and 5	Group members collaborate well on both tasks 4 and 5

Benchmark

Task 1:

Few interesting facts, John found about geysers.

- "A geyser is a spring from which water and steam is ejected forcefully into the air at heights ranging from less than a metre (a few feet) to over one hundred metres (several hundred feet)."

- "Geyser formation requires a particular combination of three geological aspects, water, intense heat and cracks/spaces in the ground that forms a type of underground plumbing system."

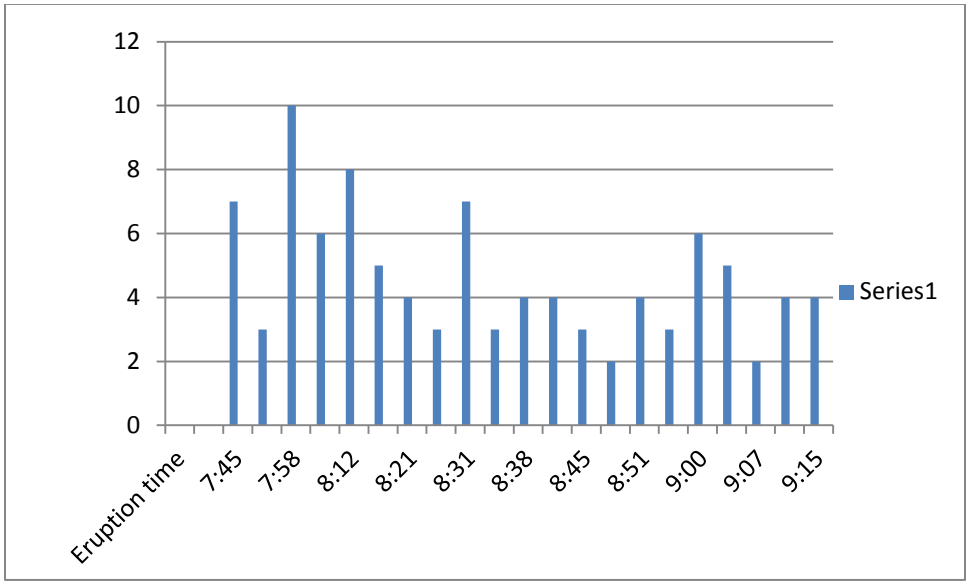
  Citation: Science Kids (*2014,May 9*). Geyser facts for kids. *Retrieved June 23rd, 2014 from http://www.sciencekids.co.nz/sciencefacts/earth/geysers.html*

John wants to ask the geyser expert a few questions.

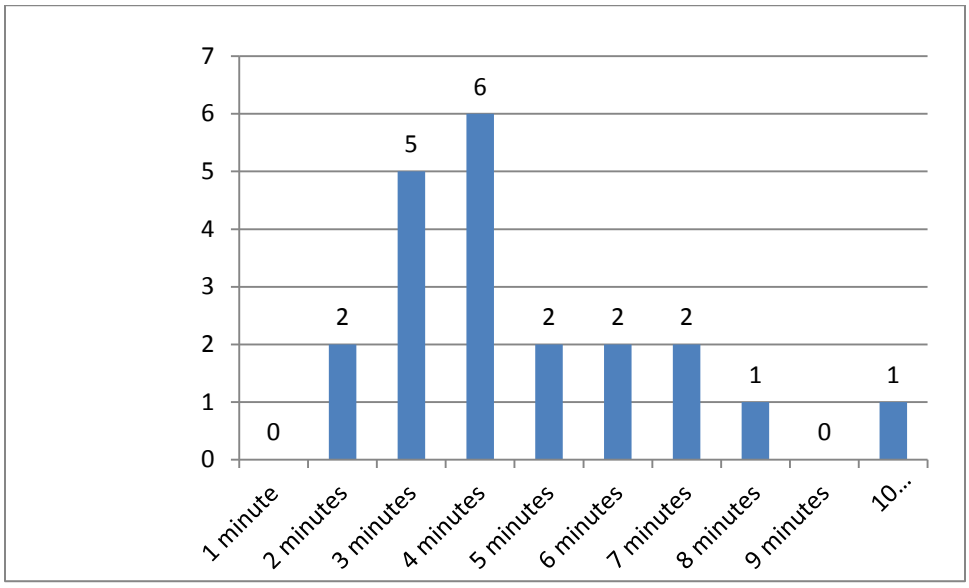
- Is there any formula to predict the time between geysers?
- What are the contributing factors that impact a geyser eruption?
- Does elevation affect the geyser times?

Task 2:

John is approaching this activity for the first time. On his own, he completes a bar graph to represent the geyser times. The range for minutes between eruption times is between 2 and 10 minutes. The times between eruptions are sporadic.



Second, John creates a histogram of the given distribution.



John notes that the time between geysers do not appear to have a definite pattern or trend.

Lastly, another graphical representation of the data that a John used is a frequency distribution.

Class (time in minutes)	**Frequency** (number of occurrences)
1	0
2	2
3	5
4	6
5	2
6	2
7	2
8	1
9	0
10	1

John uses this frequency distribution to express the distribution of times between the eruptions. The left hand column indicates the time between eruptions in minutes. The right hand column indicates the frequency, in number of occurrences of the designated times.