Beginning Algebra Performance Task: Keeping an Eye on Kelp

3 Act Task

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Math Content:

- Beginning Algebra

Addresses:

- Claim 4: Problem Solving/Modeling and Data Analysis

Addresses:

- Target A: Apply mathematics to solve problems arising in everyday life, society, and the workplace. (DOK 2, 3)

Possible Content Standard:

- CCSS.Math.Content.HSA-CED.A.2

Overview

The purpose of this 3 ACT task is to provide students with an opportunity to problem solve based on a real-world situation (Claim 4, Task A). Due to the nature of the task, there are a variety of mathematical approaches students can take to successfully complete the task, however the mathematical approach presented in Act Three of the task addresses CCSS HAS-CED.A.2 "Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales." This performance task is intended to be presented to students with prior knowledge of creating equations with single variables and ability to graph equations on coordinate axes. It is important to note that the area data provided in the problem is being thought of as having linear intervals, and this should be considered by students when deciding on their problem-solving approach. It would serve well as an assessment tool at the end of a unit.

The task is modeled after the 3 ACT Fill'ER Up by Graham Fletcher. In the task, students are presented with a map of a Bull Kelp bed near Squaxin Island and asked to generate their own questions that could be answered using the map. Students then decide on necessary resources for finding the solution and are given time as a group to complete their work. The task concludes by having students examine the information provided in Act Three to see if it answers their question

Grade Band
- HS Algebra

Claims
- 4

Targets
- A: Apply mathematics to solve problems arising in everyday life, society, and the workplace. (DOK 2, 3)

Content Standard if applicable
- CCSS.Math.Content.HSA-CED.A.2

Overview of task with standard addressed specified

The purpose of this 3 ACT task is to provide students with an opportunity to problem solve based on a real-world situation. The task is modeled after the 3 ACT Fill'ER Up by Graham Fletcher. In the task, students are presented with a map of a Bull Kelp bed near Squaxin Island and asked to generate their own questions that could be answered using the map. Students then decide on necessary resources for finding the solution and are given time as a group to complete their work. The task concludes by having students examine the information provided in Act three to see if it answers their question.

Learning Goal statement:

- Students will understand how to analyze complex, real-world scenarios. (Claim 4)
- Students will understand how to construct and use mathematical models to interpret and solve problems. (Claim 4)

Success Criteria

- I can apply algebra concepts to solve a problem about monitoring Bull Kelp beds. (SMP4)
- I can build a function that models a relationship between two quantities. (HAS-CED.A.2)

Step by Step:

1. Materials

- Recording sheet, scratch paper, whiteboards, math journal (if applicable) for each group
- Graph paper
- Technology to show videos/PowerPoint
- Post-it or notecard for each student

2. Pre-planning

- Students will be identifying and solving their own student generated problems based on the context provided by a video and a map of Bull Kelp bed monitoring. These elements are linked into the Keeping an Eye on Kelp presentation. Check that the links are successful prior to the lesson. The links below should also provide you access if needed:
  - Bull Kelp Monitoring Video
  - Bull Kelp Area Map, Page 30
- This lesson will include productive discussion that will open opportunities for multiple possible questions and math concepts. Prepare for this, by making predictions about what students come up with.
- Prepare access to materials such as graph paper, calculator, and scratch paper for use as needed through the task.

3. Act 1 Introduction

- Display Slide 2 from Keeping an Eye on Kelp presentation. Have volunteers read learning goals aloud. Use the Think, Pair, Share method to have students respond to the prompt: "What connections or questions come to mind in relation to these learning goals?"
- Display Slide 3, the video of community members in action collecting data about the bull kelp growth.
- Display Slide 4, the map of bull kelp growth over time for Squaxin Island with the prompt: What do you notice and wonder? Have students record ideas on their group recording sheets
- Record some group responses on class chart on slide 5
- Display Slide 6 and remind students that scientists used this map to monitor the bull kelp bed. Instruct students to work with their group to generate a question that scientists could answer using the provided map.
- Allow time for students to come to a consensus about 1 question generated from the group ideas.
- Have groups share questions with the class. Display Slide 7 of presentation. Make connections to groups who have already posed these or similar questions. Reinforce these are questions the Scientists are looking to answer. What will the area of the kelp bed be in the future, 2028 2038 2048? Is the Kelp bed increasing or decreasing over time?
- Instruct students to write the final question on Question 1 of their group recording sheets
- As a group make the prediction to the questions and write their answers on Question 2 of their group recording sheets
  - Is the Kelp bed increasing or decreasing over time?
  - What will the area of the kelp bed be in the future 2050?

4. ACT 2 Conflict

- Display Slide 8 asking students, "Do you have everything you need to solve your problem?" Give students time to create list of materials they will need on Question 3 of their group recording sheets
- Slide 9 provide area of bull kelp at specific years, equations for change over time, formula for exponential growth, example of coordinate graph
    - These elements can be provided to individual groups as information cards
- Instruct students to record their thinking and math work on the recording sheet Question 4 and other materials as needed. Inform students that this work will be collected as evidence of their learning.
- As students are working, be sure to ask questions about their thinking. Take note of different strategies students are using.
- Choose at least 3 students to share their strategies with the class during ACT 3. Make sure the strategies demonstrate math learning that align with learning goals.
- When student groups agree on an answer, instruct groups to fill in Question 5 of their group recording sheets. Remind students of access to sentence frames for complete responses.

5. Act 3 Resolution

- Display Slide 10. Allow at least 3 students to share their groups' answers with a complete description of how they completed the task. Remind students of access to discussion frames for complete responses.
- Ask questions that allow students to make connections between the different answer statements to the learning goal. For example: How were these approaches similar/different?
- Display Slide 11-12 that provides answers to the questions from our initial prediction. If a group's question was the same, have students determine possible reasons for any differences between the answers. If a group's question was different, have students determine any strategies for presented solutions that could be used to support students in finding the answer to their problem.
- Display Slide 13 and inform students they will complete this task on the provided post-it or note card and will be collected with the group recording sheet.
    - Ask students to rate their learning of the learning goals 0-5 (0 being you made no connection to the learning goals, 5 being you could teach this content) record what they learned.
    - Ask students to summarizing their learning in 1-3 sentences

Accessibility Strategies Used

- Scratch paper: Students can use blank paper to record thinking, complete calculation, create diagrams, etc.
- Graph Paper: Student are encouraged to plot their finds on a coordinate graph to represent answers and determine patterns
- Calculators: Students can use this tool to help access numbers that are more comprehendible for plotting on a coordinate graph

Things to consider

- The lesson can take different turns depending on the questions generated. Use this as an opportunity to reteach or extend different math concepts.
- The lesson can be split into 2 days where students create and find solutions to their questions on the first day and share their responses and discuss solutions on the second day.
- There is opportunity for differentiation with intentional grouping of students by skill level, however this is not essential for students to meet the learning targets.

Formative Assessment Opportunities

- Clarify learning targets throughout the lesson. This is specifically done at the beginning and end, but is helpful at any point to further students' learning.
- Evidence of student learning is found in multiple areas of the lesson. The Group Recording Sheet and individual responses are concrete options. Teacher observations, student questions, and student discussion provide additional evidence of students meeting learning targets.
- Use observations of student thinking and other evidence as an opportunity for purposeful discussions around the math concepts. These can be opportunities to reteach or extend learning of math concepts.
- Feedback based on evidence of student learning should be provided to students throughout the lesson. This can happen as the teacher circulates the room, during class discussion, or on group or individual response sheets.

Strategies Used

- 3 ACT Task
  - This is a whole-group task made up of 3 parts: Act 1 is an engaging situation that peaks students' curiosity, Act 2 is where students seek information and work towards a solution, Act 3 finishes the task by discussing solutions and tying the work back to the learning targets.
- Think-Pair-Share
  - With this strategy students are given the opportunity to examine a prompt as an individual, then with a partner or small group, and finally sharing and listening to responses among the whole class.
- Notice/Wonder
  - This strategy allows students to unpack a problem or prompt before beginning to solve the problem or respond to the prompt. The purpose is to create a common experience and provide access for all students in an environment where students share their thoughts freely because there is no expectation to find the answer.

Rubric

Rubric Components	Point Scale			Student's Score
	3	2	1	
Student understands how to construct and use mathematical models to interpret and solve problems.	Apply mathematics to solve unfamiliar problems by constructing chains of reasoning to create a model, analyze the utility and appropriateness of the model, and adjust the model accordingly.	Use models, symbols, and technology tools to represent and explain the solution.	Use models, symbols, and technology tools to represent and solve a problem.	
Student understands how to analyze complex, real-world scenarios.	Chooses and accurately sets up complex representation for information provided chooses specifically formulas beyond what was practiced in class. Correctly uses representation to find a solution to the group's question.	Chooses and accurately sets up appropriate representation for information provided. Correctly uses representation to find a solution to the group's question.	Requires support to determine appropriate representation for information provided. May or may not accurately set up representation. Requires support in using representation to find a solution to the group's question.	
Student applies algebra concepts to solve a problem.	Able to correctly create and solve multiple equations to represent multiple approaches to a solution. Provides accurate justification that supports a mathematically correct answer.	Able to correctly create and solve equation with two variables. Provides accurate justification that supports a mathematically correct answer.	Requires help to create equation and correctly solve equation. Unable to show understanding of the mathematical concept.	
Student builds a function that models a relationship between two quantities.	Creates accurate function and model for more than 2 quantities. Correctly uses the model to explain the relationship between two or more quantities. Group model and explanation are used to find solutions.	Creates accurate function and correctly model function. Correctly uses the model to explain the relationship between two quantities. Group model and explanation are used to find solutions.	Unable to create a function and/or correctly model function to show the relationship between two quantities.	

Presentation Material - PowerPoint Slides

Keeping an Eye on Kelp

3-ACT MATH TASK

BEGINNING ALGEBRA

1

- **Learning Goals:**
  - Students will understand how to analyze complex, real-world scenarios. (Claim 4)
  - Students will understand how to construct and use mathematical models to interpret and solve problems. (Claim 4)
- **Success Criteria:**
  - I can apply algebra concepts to solve a problem about monitoring Bull Kelp beds. (SMP 4)
  - I can build a function that models a relationship between two quantities. (HAS-CED.A.2)

2

Bull Kelp Monitoring Project Washington State

https://www.snocomrc.org/projects/kelp-monitoring/

3

What do you notice and wonder about this map?

Scientists use maps like this to monitor Bull Kelp beds, a natural resource of Washington state.

4

What do you notice and wonder?

Notice (I noticed _____.	Wonder (I am wondering _____.)

5

What Questions Could Be Answered Using this Map?

6

Questions Scientist are Looking to Answer

- Is the Bull Kelp bed area increasing or decreasing?
- If the change in area is constant, what will the Bull Kelp bed area be in 2028, 2038, 2048?

7

Do you have everything you need to answer your question?

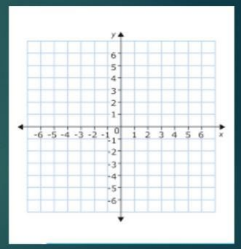
- Important number
- Formulas
- Graph Paper
- Ruler
- ???

8

Helpful Information and Tools

Year	Area
2013	9m
2018	3m

$$y = m x + b$$



Exponential Growth: $y = a(1 + r)^x$

Exponential Decay: $y = a(1 - r)^x$

a = initial value (the **amount** before measuring growth or decay)
r = growth or decay **rate** (most often represented as a percentage and expressed as a decimal)
x = number of **time** intervals that have passed

Exponential Growth

$P = P_0 e^{rt}$

P = total population after time t
P_0 = starting population
r = % rate of growth
t = time
e = Euler's number

9

Discussion Frames

- I think _____ because _____.
- I learned that _____.
- I agree because _____.
- I respectfully disagree because _____.
- Can you explain _____?
- I can see connections between _____ and _____ because_____.
- So what I think _____ is saying is that _____. Is that correct _____?

10

Resolution

Is the area increasing or decreasing?

Most Recent area – Initial Area = change

3 – 9 = -6

Negative amount shows **decreasing area**.

Year	Area
2013	9m
2018	3m

11

Resolution

Year	Area
2013	9m
2018	3m

What will the area be in 2028, 2038, 2048?

2018□2013 is 5 years time, so in 5 years the change was -6.

Y=mx+b x= area y= amount time in years m= change b=initial area

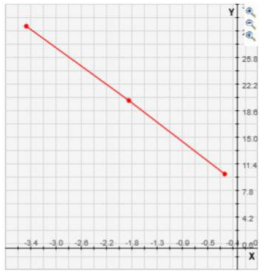
Y=(-6)x + 9

2018□2028 is 10 years

10= (-6)x +9
10-9 = (-6)x □ 1=(-6)x
1/(-6) = x □ -0.2=x

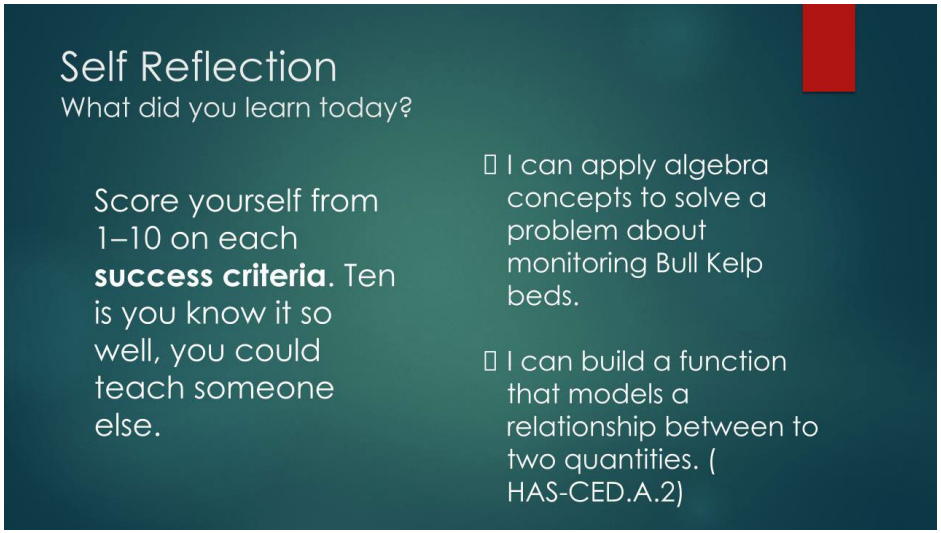
20= (-6)x +9
20-9= = (-6)x □ 11 =(-6)x
11/(-6)=x □ -1.8=x

30= (-6)x +9
30-9 = = (-6)x □ 21 =(-6)x
21/(-6)=x □ -3.5=x



http://www.shodor.org/interactivate/activities/SimplePlot/

12


Self Reflection
What did you learn today?
Score yourself from 1–10 on each **success criteria**. Ten is you know it so well, you could teach someone else.
 I can apply algebra concepts to solve a problem about monitoring Bull Kelp beds.
 I can build a function that models a relationship between to two quantities. (HAS-CED.A.2)

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Information Cards (Print per group)

Discussion Frames

- I think _____ because _____.
- I learned that _____.
- I agree because _____.
- I respectfully disagree because _____.
- Can you explain _____?
- I can see connections between _____ and _____ because_____.
- So what I think _____ is saying is that _____. Is that correct _____?

Year	Area
2013	9m
2018	3m

$$y = m x + b$$

Exponential Growth/Decay Problems

$y = ab^t$

a = initial amount
$0 < b < 1$ = exponential decay
$b > 1$ exponential growth
t = time period

$y = a(1+r)^t$

a = initial amount
r = growth rate per time period
t = time period

Exponential Growth

$$P = P_0 e^{rt}$$

P = total population after time t
P_0 = starting population
r = % rate of growth
t = time
e = Euler's number

Recording Sheet

Name:_____ Group: _____ Date:_____

Notice	Wonder

1. Group Question:

_____

_____

2. Prediction:
   a) Is the area of the Bull Kelp bed increasing or decreasing?

      _____

   b) If the rate of change is constant, what will the area of the Bull Kelp bed be in 2050?

      _____

3. Materials List:

4. Solution Thinking:

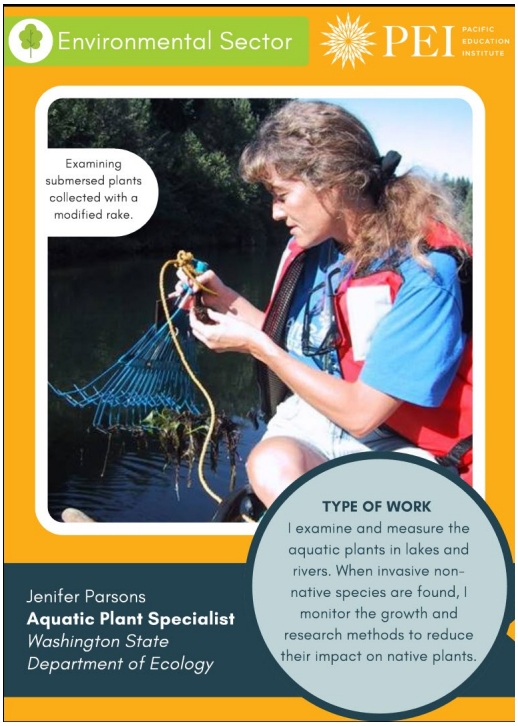
5. Final Answer:

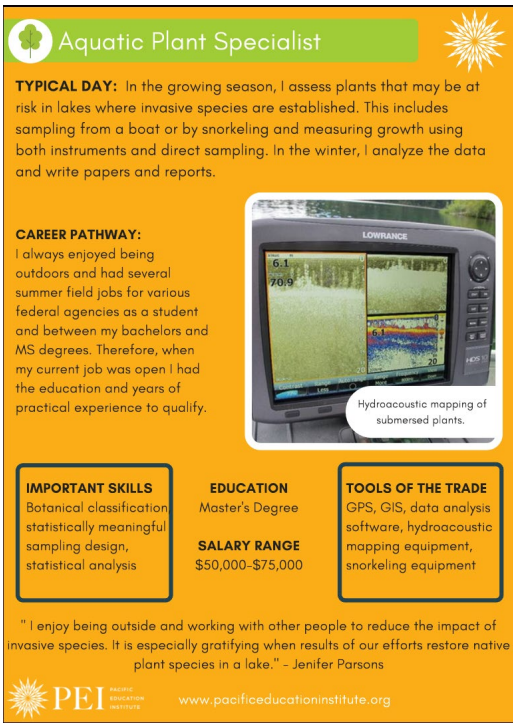
Attach Self-Reflection Notes Below

Additional Resources

Career Connections

Jenifer Parsons' career profile card can also be found on the PEI website at https://pacificeducationinstitute.org/wp-content/uploads/2020/04/Aquatic-Plant-Specialist-Jenifer-Parsons-Career-Profile.pdf





Real-life Data

The map and information presented in Keeping an Eye on Kelp came from the published paper "Bull Kelp Monitoring in South Puget Sound in 2017 and 2018" by Helen Berry of the Washington State Department of Natural Resources. Below you will find the exact data collected during her research. This information could be used as extension or differentiation to the performance task.

"Bull Kelp Monitoring in South Puget Sound in 2017 and 2018" Page 29
https://www.dnr.wa.gov/publications/aqr_nrsh_bullkelp_sps_2019.pdf?czdjh9

Table 3. Annual bull kelp bed area at Squaxin Island (2013-2018 except 2015)

year	area (ha) ± SD	% of 2013 area
2013	8.8	100%
2014	6.9	78%
2016	2.7 ± 0.18	31%
2017	1.6 ± 0.06	18%
2018	2.8 ± 0.18	32%