WAMC Lab Template

Math Concept(s): Linear Modeling

Source / Text:

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Attach the following documents:

- Lab Instructions
- Student Handout(s)
- Rubric and/or Assessment Tool

Short Description (Be sure to include where in your instruction this lab takes place):

This lab will be for students who have identified Resource Management as their CTE domain. This lab will allow students to demonstrate their understanding of linear functions in the context of changing water levels in Lake Mead. This lab will span an entire unit, with pre-assigned groups completing it as the unit progresses, and new learning is acquired.

Lab Plan

Lab Title: Modeling Water Reserves Over Time (Linear Functions Unit Lab)

Prerequisite skills: Arithmetic and fractions. Plotting data.

Lab objective: In this lab, students will plot data, work with slope, create linear functions, and apply and interpret linear contexts.

Intro demonstration:

Teacher Blurb: "The water in the tank is very important. The water, in fact, has two very important jobs which prevent the possible collapse of society. If the water gets down to the horizontal line, it will be unable to do one of its very important jobs. If the water is completely gone, it will be unable to do an even more important job."

Ask for five volunteers. Once they are up by the tank, explain that they must verbally discuss any actions they want to take, and vote on the action (majority rules) before anything is done.

Teacher opens the spigot, and moves away from the tank while saying, "Annnnnnd Go".

Likely Student Actions	Teacher Response
Shut off spigot	Turn off the lights if it results in near darkness, otherwise state that there is a new rule where the water must not be turned off, or neither important job is getting done.
Lessen flow with spigot	Carry on
Ask for how to get more water	Give previously hidden cup and tell them that they can only fill the tank every 30 seconds

- Segue into Lake Mead scenario. Ask for students to discuss parallels to demonstration (water levels vs. consequences, periodic water additions vs. annual snowmelt, number of volunteers and voting vs. local governments/interests making policy).
- Display groups, distribute summative project, and allow students to review for five minutes.
- Come back as a class, and do a "See, Think, Wonder" protocol.
- Move into remainder of lesson.

Standards: *(Note SPECIFIC relationship to Science, Technology, and/or Engineering)*

Mathematics K–12 Learning Standards:

- HSF-LEA.1.a : Prove that linear functions grow by equal differences over equal intervals…
- HSF-LEA.2 : Construct linear and exponential functions…given a graph…or two input-output pairs (including reading from a table).
- HSF-LEB.5 : Interpret the parameters in a linear…function in terms of a context.
- HSS-ID.A.1 : Represent data with plots on the real number line (dot plots…).
- HSS.ID.C.7 : Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of data.
- 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.

Standards for Mathematical Practice:

- Make sense of problems and persevere in solving them.
- Reason abstractly and quantitatively.
- Construct viable arguments and critique the reasoning of others.
- Model with mathematics.

K-12 Learning Standards-ELA (Reading, Writing, Speaking & Listening):

- SL.1 : Engage effectively in a range of collaborative discussions with diverse partners on grade 8 topics and issues, building on others' ideas and expressing their own clearly.

K-12 Science Standards

- HS-LS2-6 : Evaluate evidence for the role of group behavior on individual species' chance to survive and reproduce.

Technology

- 5.c : Students break problems into component parts, identify key pieces and use that information to problem solve.

Engineering

-

Leadership/21st Century Skills:

21st Century Interdisciplinary themes (Check those that apply to the above activity.)

☐ Global Awareness ☐ Financial/Economic/Business/Entrepreneurial Literacy ☒ Civic Literacy
☐ Health/Safety Literacy ☒ Environmental Literacy

21st Century Skills (Check those that students will demonstrate in the above activity.)

LEARNING AND INNOVATION
Creativity and Innovation
☐ Think Creatively
☒ Work Creatively with Others
☒ Implement Innovations
Critical Thinking and Problem Solving
☒ Reason Effectively
☐ Use Systems Thinking
☐ Make Judgments and Decisions
☒ Solve Problems
Communication and Collaboration
☒ Communicate Clearly
☒ Collaborate with Others

INFORMATION, MEDIA & TECHNOLOGY SKILLS
Information Literacy
☐ Access and Evaluate Information
☒ Use and manage Information
Media Literacy
☐ Analyze Media
☐ Create Media Products
Information, Communications and Technology (ICT Literacy)
☐ Apply Technology Effectively

LIFE & CAREER SKILLS
Flexibility and Adaptability
☐ Adapt to Change
☐ Be Flexible
Initiative and Self-Direction
☒ Manage Goals and Time
☐ Work Independently
☐ Be Self-Directed Learners
Social and Cross-Cultural
☐ Interact Effectively with Others
☒ Work Effectively in Diverse Teams

Productivity and Accountability
☒ Manage Projects
☐ Produce Results
Leadership and Responsibility
☒ Guide and Lead Others
☐ Be Responsible to Others

Teacher Preparation: (What materials and set-up are required for this lab?)

Materials

- (for first day demonstration) large clear container with spigot, extra tub for catching water, one or two other medium-sized cups or vessels of some kind.

Set-Up Required:

- Setup clear container with spigot filled with water in a place where everyone can see (class huddle), with a thick horizontal line drawn partially down the tank, and lid off.
- Place extra tub to catch water coming from spigot.
- Have other cups/vessels ready to go but out of sight.
- Have unit groups of four made and ready to go.

Lab Organization Strategies:

Leadership (Connect to 21st Century Skills selected):

- Cooperative Learning: Students will work in groups to implement new learning in creating solutions to analyze and interpret real world data.

Expectations:

- Students will complete this lab over the course of the unit, which will be due at the end of the unit.

Timeline:

- 4 weeks.

Post Lab Follow-Up/Conclusions:

Discuss real world application of learning from lab

- Students will learn how to plot and analyze data in the context of real world data.

Career Applications

- Sciences which require evaluating quantitative data, natural resource management and public administration.

Optional or Extension Activities

- Investigate how recent changes to water consumption policy in affected areas is projected to impact future data.

Modeling Water Reserves Over Time

Names _____, _____,
_____, _____

Lake Mead is the largest reservoir in the United States, created by the construction of the Hoover Dam in southern Nevada. The Hoover Dam provides hydroelectric power for over 1 million people in the local area, and over 25 million people in Nevada, Colorado, California, Arizona and Mexico rely on Lake Mead for their water supply. In recent years, there has been increasing concern about the water levels of Lake Mead, as low water levels could impact the capacity for how many people can be serviced by the lake and dam.

The table to the right displays the last 20 years worth of data for the depth of Lake Mead, and below is a picture of Lake Mead from 2022.

Throughout this unit, your group will be applying and analyzing this data, using the skills learned along the way.

Project Due Date: _____

Lake Mead Water Levels	
Year	**Depth (ft)**
2024	1072
2023	1057
2022	1051
2021	1074
2020	1089
2019	1085
2018	1082
2017	1083
2016	1077
2015	1081
2014	1091
2013	1111
2012	1122
2011	1106
2010	1092
2009	1100
2008	1110
2007	1118
2006	1132
2005	1140

Rubric

Marks Earned	Level Earned	Percentage Equivalent
0-20	0	50
21-24	1	60
25-29	2	65
30-34	3	73
35-37	4	78
38-40	5	83
41-43	6	88
44-46	7	93
47-50	8	100

1. Consider the set of data, which will be graphed on an xy-coordinate plane.

a. Independent Variable: $x =$ _____ [1 mark]

Dependent Variable: $y =$ _____ [1 mark]

b.) Plot your data points on a separate sheet of graph paper. Be sure to include labels for scale and units, as well as a title. [6 marks]

2. Write down two points from the data: (_____, _____) and (_____, _____).

a.) Using the graph, would you expect the slope between these points to be positive or negative? Explain how you know. [2 marks]

b.) Would the slope between every pair of points be the same as part (a)? If yes, explain how you know. If no, explain the differences. [2 marks]

c.) Draw a line connecting these two points. [1 mark]

d.) Find…

i.) the vertical change between these two points. [2 marks]

ii.) the horizontal change between these two points. [2 marks]

e.) Hence, write down the slope between these two points. [1 mark]

f.) Suppose the line between these points is extended to the y-intercept, and this line is named L_1. Find the y-intercept for L_1. [3 marks]

g.) Hence, write down the equation for L_1 in the form $y = mx + b$. [2 marks]

h.) Define the meaning of…

i.) m in the context of the problem, including units. [1 mark]

ii.) b in the context of the problem, including units. [1 mark]

i.) Suppose another line L_2 is drawn with the same slope as L_1, with a y-intercept of 2700. Write down the equation of L_2 in the form $ax + by = c$. [3 marks]

j.) Consider the x-intercept of L_1.

i.) Explain the meaning of the x-intercept in context of the data. [1 mark]

ii.) Find the x-intercept for L_1. [2 marks]

3.) Write down your equation for L_1: _____.

a.) Hoover Dam will stop generating power when the water depth reaches 950 feet (this is as bad as it sounds). Use L_1 to estimate the year in which this occurs, assuming a constant rate of change. [2 marks]

b.) Once the water depth reaches 895 feet, water will no longer pass through the dam, and people will no longer be able to rely on the water coming from Lake Mead (and yes, this is even worse than the scenario from part (j)). Hence, using L_1, find an estimate for how many years will pass between the dam not producing power, and the dam not allowing the passage of water. [3 marks]

c.) On average, one inch of depth in Lake Mead contains 2 billion gallons of water. Calculate the number of gallons of water contained between 895 feet and 950 feet. [3 marks]

d.) Each year, about 2,680,000,000,000 gallons of water are added to Lake Mead through upstream dams and snowmelt, and 196,000,000,000 gallons are lost due to evaporation. Hence, find the number of gallons available per year, which could be used without reducing the amount of water available in Lake Mead. [5 marks]

e.) Most of the water from Lake Mead is used in the agricultural industry. It is estimated that 75% of the water coming from Lake Mead is used in agriculture and other industries. Find the number of gallons of water NOT used in agriculture or other industries. [3 marks]

f.) Recall that about 25,000,000 people rely on the water from Lake Mead. Hence, find how much water each person should use per year without reducing the amount of water available in Lake Mead. [3 marks]

[Insert reflection questions here]

WAMC Lesson Plan

Name(s): Greg Richards
Email Address: grichard@cloverpark.k12.wa.us
Lesson Title: Modeling Water Reserves Over Time (Linear Functions 1: Calculating Slope)
Date: 6/25/2024
Text: STEM Correlation: Resource Management Lesson Length: 3 days

Big Idea (Cluster): STEM	
Mathematics K–12 Learning Standards: • HSF-LEA.1.a : Prove that linear functions grow by equal differences over equal intervals… • HSF-LEA.2 : Construct linear and exponential functions…given a graph…or two input-output pairs (including reading from a table).	
Mathematical Practice(s): • Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Model with mathematics.	
Content Objectives: • Students will be able to graph ordered pairs, identify positive and negative slope, and calculate slope between various pairs of points.	Language Objectives (ELL): • Students will integrate academic language into conversations and discussions. Groupembers will help each other in facilitating accurate usage.
Vocabulary: • Slope (positive and negative), rate of change, rise, run.	Connections to Prior Learning: • Arithmetic and fractions. Plotting data.
Questions to Develop Mathematical Thinking: • How can we use mathematics to analyze data?	Common Misconceptions: • Confusing vertical vs. horizontal rates of change.

Assessments:

Formative: • Mastery Checks, which assess student progress on daily components of lesson. Summative: • The standards taught in this lesson sequence will form a portion of the unit-spanning summative lab (project).

Materials:

• Copies of tasks, summative project (lab).

Instruction Plan:

Introduction: Relevant warm-up (i.e. fraction arithmetic).
Explore: Thin-sliced tasks in random groups, on vertical surfaces where students will explore and refine understanding of plotting points, identifying slope and calculating slope.
When I observe students: I will be mediating groups working well together, encouraging them to seek ideas and feedback from other students.

Questions to Develop Mathematical Thinking as you observe: How do we know a point is located in its unique location? How can we determine whether the slope between two points is positive or negative? How do we determine the units for a rate of change? How can we apply this new learning to our group-based unit project?

Answers to Questions Above: [Various, as stated by students.]

Summarize:

Day One Lesson sequence…
1. Warm-up [10 minutes]
2. Lab Intro [10 minites]
3. Initial Group Work Time [20 minutes]
4. Thin sliced tasks on vertical surfaces in random groups [30 minutes]
5. Independent work time (homework) [20 minutes]

Subsequent Lesson sequence…
1. Warm-up [10 minutes]
2. Intro to tasks [5 minutes]
3. Thin sliced tasks on vertical surfaces in random groups [30 minutes]
4. Unit project group work time [20 minutes]
5. Independent work time (homework) [20 minutes]

Career Application(s):

- Sciences which require evaluating quantitative data, natural resource management and public administration.

Leadership/21st Century Skills:

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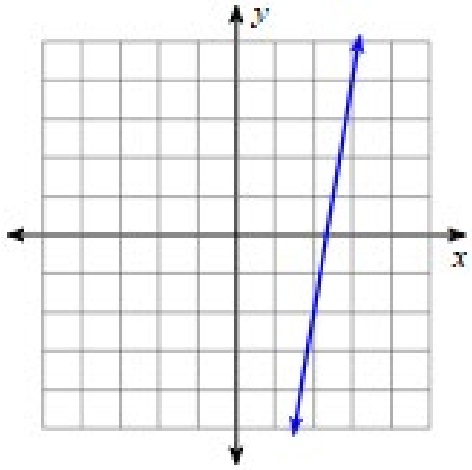
Mastery Check – Identifying Slope Graphically

Name _____ **Date** _____

1.) Consider the line pictured below.



a. Without finding the slope, explain why the slope of the line should be positive. [2 marks]

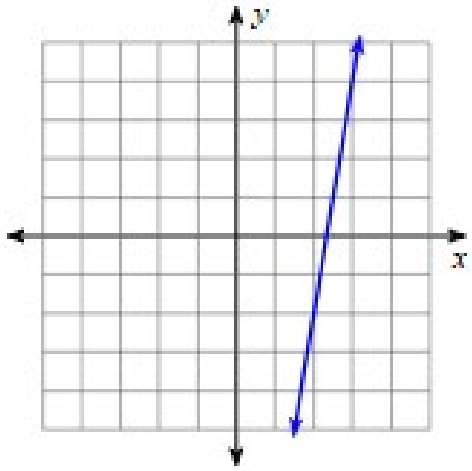
b. Draw a right triangle between two points on the line which could be used to find the slope of the line. [2 marks]

c. Write down the slope of the line. [2 marks]

Mastery Check – Identifying Slope Graphically

Name _____ **Date** _____

1.) Consider the line pictured below.



a. Without finding the slope, explain why the slope of the line should be positive. [2 marks]

b. Draw a right triangle between two points on the line which could be used to find the slope of the line. [2 marks]

c. Write down the slope of the line. [2 marks]