WAMC Lab Template

Math Concept(s): Linear Equations (+ Optional Systems)
Source / Text: Algebra 1, Jon Orr
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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):

Lab Plan

Lab Title: Trashketball: Unit Rates and Linear Equations

Prerequisite skills: Familiarity of unit rates and conversions. Students should have seen the Slope-Intercept form of an equation before and be familiar with the Desmos graphing tool.

Lab objective: Students will be gathering real data to create a model using the unit rate to write a linear equation. They will use that equation to make predictions, test those predictions, and reflect on the strengths and weakness of the model.

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

Mathematics K–12 Learning Standards:

- 6.RP.A.2 Understand ratio concepts and use ratio reasoning to solve problems.
- 7.RP Analyze proportional relationships and use them to solve real-world and mathematical problems.
- 8.EE. B Understand the connections between proportional relationships, lines, and linear equations.
- 8.EE.C Analyze and solve linear equations and pairs of simultaneous linear equations.
- HSA-REI. B Solve equations and inequalities in one variable
- HSA-REI. C . Solve systems of equations

Standards for Mathematical Practice:

- SMP 2 Reason abstractly and quantitatively.
- SMP 4 Model with Mathematics

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

- Speaking and Listening 1: Initiate and participate effectively in a range of collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.

Technology

- 1.d. Students understand the fundamental concepts of technology operations, demonstrate the ability to choose, use and troubleshoot current technologies and are able to transfer their knowledge to explore emerging technologies.

- 4.a. Students know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts or solving authentic problems.

Engineering

- HS-ETS1-2: Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

Leadership/21st Century Skills:

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

☐ Global Awareness
x 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
x Work Creatively with Others
☐ Implement Innovations

Critical Thinking and Problem Solving
☐ Reason Effectively
☐ Use Systems Thinking
☐ Make Judgments and Decisions
x Solve Problems

Communication and Collaboration
x Communicate Clearly
x 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)
x Apply Technology Effectively

LIFE & CAREER SKILLS

Flexibility and Adaptability
☐ Adapt to Change
☐ Be Flexible

Initiative and Self-Direction
x Manage Goals and Time
☐ Work Independently
☐ Be Self-Directed Learners

Social and Cross-Cultural
X Interact Effectively with Others
x Work Effectively in Diverse Teams

Productivity and Accountability
☐ Manage Projects
☐ Produce Results

Leadership and Responsibility
☐ Guide and Lead Others
x Be Responsible to Others

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

Materials

- Lots of used paper. (To make paper balls for throwing. I suggest old work, misprints, etc.)
- 2 bins per group
- Tape
- Pencil/Paper/Lab Handout
- 1 computer per group with internet access
- Measuring tape

Set-Up Required:

- Have materials ready for students. They will construct the set up during the lab. (You could do it for them to save time if needed)
- Open space, at least 9-10 feet long and as wide as you need for the number of groups participating.

Lab Organization Strategies:

Leadership (Connect to 21st Century Skills selected):

- Students will work in teams and hold roles on the teams to ensure their group can solve problems presented in the lab. They will collaborate to test and refine models.

Cooperative Learning:

- Students will be working in groups to set up the lab environment and support each other in the lab process. They will take on different roles in the group to ensure a smooth operation.

Expectations:

- Students will find a unit rate from real data and use it to write an equation and make predictions. They will test their predictions and reflect on the strengths and weaknesses of the model.

Timeline:

- This lab should take about 1 class period but can be extended to 2 periods if the options systems portion of the lab is run.

Post Lab Follow-Up/Conclusions:

Discuss real world application of learning from lab

- Unit rates are used in many real-life situations: driving/gas, hourly wages, conversions, dosing medication, etc.

Career Applications

- Construction: Unit conversions and rates. Medicine: Dosing amounts adjusted to age/weight/height, etc.

Optional or Extension Activities

- One extension is included in the lab plan itself. Students make adjustments to the model to find solutions to a system by comparing their rates to others. (Moves from unit rates and linear equations into systems of equations)

- Students can use their rates to make other predictions.
- Vary the bin size to see the difference in rates (geometry connection)
- Decide if paper ball making technique matters (tightly packed vs loose)

Lab Procedure

1. Crumple up all the scrap paper on your desk into balls. Add them to your group's bin.

2. WITH YOUR GROUP: Tape a starting line on the floor. Put your fill bin next to this line. Measure out 8 feet and tape on x on the floor. Put your empty bin on the x.

3. Practice: Each group member should take 5 practice shots from the start line. Try to throw a paper ball into the bin. Once everyone has done practicing, gather the balls back into the start line bin and replace the empty bin on the x if needed.

4. Data Gathering and Recording: Try to throw as many balls into the bin as you can in 1 minute.

    a. Each group member should gather data for 4 attempts and put their personal data into the table below.
    b. Take turns being the timer for your group.

Trial	Shots Made in 1 Minute
1	
2	
3	
4	

5. Find your average shot per minute. $Average = \frac{sum\ of\ shots\ made}{number\ of\ trials}$

6. Find your average shot per second. (Divide your result above by 60)

7. Write an equation in slope-intercept form using your average shot per second as the slope. $y = mx + b$ (Hint: what is the y- intercept? If shooting time is 0 seconds, how many will you make?)

    x = number of seconds

    y= number of expected shots made

8. WITH YOUR GROUP: Open up a Desmos calculator screen and enter all the equations from Step 7. Who is expected win a competition? How do you know?

9. How many shots do you expect to make if you shoot for 30 seconds?

10. Try it out. Shoot for 30 seconds and record your experimental results. How do they compare with the prediction in step 9? Why might your answer be different?

Possible Extension Lab Steps

11. You are now going to compete with someone from your group. The goal is to TIE. Since you both have different shooting rates, what could you change to make a tie likely? (Hint: How can you give a player a "head start"?)

12. Make the needed adjustments to your equation in Desmos and find out how long you would need to play to tie.

13. Try out your idea in step 11. How close to a tie did you get?

14. Try the process again with at least one other group member.

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