Math 105 Concepts in Mathematics, Probability and Statistics
Lesson Plan
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Lesson: Shake Across America and Proportional Reasoning

Timeframe: 75 minutes

Materials needed: Copies of the worksheets, Tape Measures, stopwatch, straight edge

Objectives:
Basic:
1. *Create similar ratios.*

2. *Solve a proportion with one unknown value.*

3. *Set up a proportional equation using information from a word problem.*

Advanced:
1. *Be able to identify proportional relationships graphically. Make the connection between the graph of a line through origin and whether or not the two variables plotted are directly proportional.*
2. *Be able to use proportional data to predict events outside of the data set.*
3. *Explain understandings in writing as well as verbally to peers using appropriate academic language.*

Background: The course is the second course in a three-course sequence designed for prospective elementary teachers of mathematics. Proportional reasoning is one of the key topics, and is integrated throughout the course. One of the challenges for the students is

understanding the relationship between the graph of a line *y = mx* and proportional relationships. This lesson incorporates connections between the two concepts.

Introduction to Lesson: Before class, students will watch a video on proportional relationships and graphs, followed by a short quiz. Students will also be asked to work on the "Rope" problem and bring their work to class. The main class activity, "Shake Across America" will be used to make connections between proportions and graphical representations. At the end of class, students will revisit their work on the "Rope" problem, and analyze a set of student responses.

Procedure:

Pre-Class Individual Space Activities and Resources [90 minutes]:

Steps	Purpose	Estimated Time	Learning Objective
Step 1: Watch the following video: Proportion Word Problems https://www.youtube.com/watch?v=KaxpT_R9a-c Take a short quiz on Canvas.	Reinforce to students the process of setting up and solving a word problem.	20mins.	#1, #2, and #3 (Basic)
Step 2: Watch the following video: Proportional Relationships and Graphs https://www.youtube.com/watch?v=6MguLuWryfs Take a short quiz on Canvas. *All of the Steps above are due 24 hours before the In-Class Group Space meeting.*	Introduce students to basic connections between graphs of linear functions and proportional relationships.	20 mins.	Approaching #1 (Advanced)

In-Class Group Space Activities and Resources [60 minutes]:

Steps	Purpose	Estimated Time	Learning Objective
Step 1: Launch "Shake Across America" Activity by showing the class the Hands Across America 1986 video of the event that actually took place. https://www.youtube.com/watch?v=WZorfXa5pBc	Set the stage for the activity.	5 min.	N/A
Step 2: Recreate the Shake Across America in the classroom with 12 students shaking hands. Time will be recorded at the moments the third, sixth, ninth, and twelfth person shakes hands. This data will be recorded in a table, along with distance between each group of people.	Collect data for activity.	10 min.	N/A
Step 3: Working in small groups, students will first solve this problem using ratios and proportions. (Part A)	Have students apply the concepts they learned in the individual space to a real-world problem.	15 min.	#2 & #3 (Basic)
Step 4: Working in small groups, students will then solve the problem using functions. (Part A) Students are given a chance to discuss and ask questions.	Have students extend their understanding of proportions to establish the graphical connection to a line through the origin.	20 min.	#1 and #2 (Advanced)

Step 5: Whole group share Students from each group are chosen to share and explain a selection of their solutions. Other students are encouraged to ask clarifying questions.	Reinforce the concepts by discussing understandings and findings with the whole group.	10 min.	#1, #2, and #3 (Advanced)

Closure/Evaluation [5 minutes]:
Group discussion led by instructor on the similarities and differences of the two solution methods. Use these ideas to reinforce the connections between linear functions through the origin and proportional relationships.

Assign the Proportion or Non-proportion Handout for homework.

Analysis:
Students in this class are future elementary students, and benefit from active learning situations, both for their own learning as well as a model for them when they become teachers. While they have a basic understanding of proportional reasoning, it is a challenge for them to make the connection to graphical reasoning. The in-class group space activity is designed to allow students to apply the general concepts they learned in the pre-class individual space activities to a real-world problem involving proportions and linear functions.

Post-Class Individual Space Activities:
Students will extend their knowledge from this lesson to determine whether a given problem situation has a proportional relationship or not. Students will solve the problem, and demonstrate graphically whether the relationship is proportional. If it is not, students will describe the type of relationship that exists.

Connections to Future Lesson Plan(s):
Proportional reasoning is one of the cornerstones of middle school mathematics, with strong connections to linear functions. Students will be poised to solve more difficult problems involving proportions and linear functions.

Group Space Activity
Shake Across America!

Materials: Tape measure, Stopwatch

An environmental group is organizing a "Handshake Across America." The group plans to have people line up from New York to Los Angeles and pass a handshake from east to west.

Data Collection

1. Have several members of your class form a line. Count how many people are in the line and measure its length.
2. Start a handshake at one end of the line. Use a stopwatch to find out how long the handshake takes to reach the end of the line.
3. Repeat steps 1 and 2 for four different lengths of line (i.e.- 3, 6, 9, and 12 people). Collect data from several trials.

Part A—Proportional Reasoning

4. Use your results to estimate the number of people per foot.
5. The road distance from Los Angeles to New York is 2,825 miles, or almost 15,000,000 feet. About how many people need to be in the line?
6. Now estimate both the speed of the handshake (feet per second) and the ratio of seconds per feet.
7. How long will it take to have the handshake go across America? Explain how you found your answer.
8. Explain how you can use proportions to solve this problem

Part B—Functional Reasoning

9. Using technology, produce a scatter plot of the data, with length as your independent variable and time as your dependent variable.
10. Determine the line that best fits your data.
11. How does the slope of your line relate to what you found in Part A?
12. In theory, what should the y-intercept be? Why?
13. Use your line of best fit from Part B to get an estimate of how long the handshake across America will take.

        Explain your two different methods and compare the two different answers.

**If you want the last person to shake hands in L.A. when the New Year begins, when do you need to start the hand shake in New York?

Post-Class Individual Space Assignment

The following homework assignment will allow students to apply what they learned in the Group Space activities.

For questions 1-3, state whether the relationship is proportional or not. Demonstrate and describe the relationship graphically.

Getting Things in Proportion

Q1. Leon

Leon has $40.

How many Mexican Pesos can Leon buy with his dollars?

Explain how you figure this out.

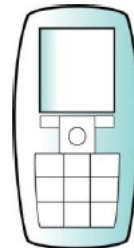| Exchange Rate |
| --- |
| $1 US = 12 Mexican Pesos |

Q2. Minna

This is the call plan for Minna's cell phone:

$15 a month plus free texts plus $0.20 per minute of call time.

Minna made 30 minutes of calls this month and 110 texts.

How much does she have to pay the phone company?

Explain how you figure this out.

Q3. Nuala

Nuala drives to her grandma's.

She drives at 20 miles per hour.

The journey takes 50 minutes.

How long would the journey take if Nuala drove at 40 miles per hour?

Explain how you figure this out.