

WAMC Lab Template

Math Concept(s): Domain: Expressions and Equations; Functions

Cluster: Analyze and solve linear equations and pairs of simultaneous linear equations;

Use functions to model relationships between quantities

Source / Text:

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Attach the following documents:

Lab Instructions

See lesson plan

Lab Plan

Lab Title: Functions and Expressions - A "Reasonable" Vaycay

Prerequisite skills:

linear equations and expressions; data plotting; research skills; data analysis/collection

Lab objective:

Students will be able to develop a travel plan that will represent a linear model with fixed and variable costs, while justifying and explaining their reasoning and methodology.

Standards:

CCSS-M:

· Common Core State Standards:

7. Solve linear equations in one variable

a. Give examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. Show which of these possibilities is the case by successively transforming the given equation into simpler forms, until an equivalent equation of the form $x=a$, $a=a$, or $a=b$ results (where a and b are different numbers)

b. Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.

8. Analyze and solve pairs of simultaneous linear equations.

a. Understand that solutions to a system of two linear equations in two variables correspond to points of intersections of their graphs, because points of intersection satisfy both equations simultaneously.

b. Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection.

c. Solve real-world and mathematical problems leading to two linear equations in two variables.

4. Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x, y) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.
5. Describe qualitatively the functional relationship between two quantities by analyzing a graph. Sketch a graph that exhibits the qualitative features of a function that has been described verbally.

Standards for Mathematical Practice:

- 2. Reason abstractly and quantitatively. 3. Construct viable arguments and critique the reasoning of others. 4. Model with mathematics.

State Standards addressed (2008 Washington State Mathematics Standards):

Reading:

- 8.5.A Analyze a problem situation to determine the question(s) to be answered.
- 8.5.B Identify relevant, missing, and extraneous information related to the solution to a problem.
- 8.5.C Analyze and compare mathematical strategies for solving problems, and select and use one or more strategies to solve a problem.
- 8.5.D Represent a problem situation, describe the process used to solve the problem, and verify the reasonableness of the solution.
- 8.5.E Communicate the answer(s) to the question(s) in a problem using appropriate representations, including symbols and informal and formal mathematical language.
- 8.5.F Apply a previously used problem-solving strategy in a new context

Writing:

- 8.1.C Represent a linear function with a verbal description, table, graph, or symbolic expression, and make connections among these representations.
- 8.1.C Represent a linear function with a verbal description, table, graph, or symbolic expression, and make connections among these representations.
- 8.1.G Determine and justify whether a given verbal description, table, graph, or symbolic expression represents a linear relationship.

21st Century Skills

Work Creatively with Others

- 1.B.1 Develop, implement and communicate new ideas to others effectively
- 1.B.2 Be open and responsive to new and diverse perspectives; incorporate group input and feedback into the work
- 1.B.3 Demonstrate originality and inventiveness in work and understand the real world limits to adopting new ideas
- 1.B.4 View failure as an opportunity to learn; understand that creativity and innovation is a

long-term, cyclical process of small successes and frequent mistakes

Reason Effectively

2.A.1 Use various types of reasoning (inductive, deductive, etc.) as appropriate to the situation

Use Systems Thinking

2.B.1 Analyze how parts of a whole interact with each other to produce overall outcomes in complex systems

Make Judgments and Decisions

2.C.1 Effectively analyze and evaluate evidence, arguments, claims and beliefs

2.C.2 Analyze and evaluate major alternative points of view

2.C.3 Synthesize and make connections between information and arguments

2.C.4 Interpret information and draw conclusions based on the best analysis

Solve Problems

2.D.1 Solve different kinds of non-familiar problems in both conventional and innovative ways

2.D.2 Identify and ask significant questions that clarify various points of view and lead to better solutions

Communicate Clearly

3.A.1 Articulate thoughts and ideas effectively using oral, written and nonverbal communication skills in a variety of forms and contexts

3.A.2 Listen effectively to decipher meaning, including knowledge, values, attitudes and intentions

3.A.3 Use communication for a range of purposes (e.g. to inform, instruct, motivate and persuade)

Collaborate with Others

3.B.1 Demonstrate ability to work effectively and respectfully with diverse teams

3.B.2 Exercise flexibility and willingness to be helpful in making necessary compromises to accomplish a common goal

3.B.3 Assume shared responsibility for collaborative work, and value the individual contributions made by each team

member

Access and Evaluate Information

4.A.1 Access information efficiently (time) and effectively (sources)

4.A.2 Evaluate information critically and competently

Use and Manage Information

4.B.1 Use information accurately and creatively for the issue or problem at hand

Apply Technology Effectively

6.A.1 Use technology as a tool to research, organize, evaluate and communicate information

Be Flexible

7.B.1 Incorporate feedback effectively

7.B.2 Deal positively with praise, setbacks and criticism

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

Materials:

- Lab sheet
- Rubric
- Computer/internet
- Graph paper

Set-Up Required:

- Standard classroom setting, with options for students to work in small groups or individuals
- Internet capabilities for each group, or a few options for students to research

Lab Organization Strategies:

Grouping/Leadership/Presentation Opportunities:

The lab will ask students to be in a group setting, or individual work if they chose. However, part of the lab requires each group/individual to work with another group/individual to compare results. The lab also requires a presentation to another group/individual as well as a presentation to the class. A discussion will be held that will allow students to discuss the merits of their vacation selection.

Cooperative Learning:

· The lab asks students to work together to research and develop their findings. An option is given to allow students to work individually, but they are still required to present to another group and to the class. The discussion at the end of the lab allows all students to work together and justify their findings.

Expectations:

· To be able to make a selection, justify and defend their vacation selection, using mathematical terminology.

Timeline:

· The lab is set up to take nine, 50 minute class periods. This lab can be extended and expanded to take longer and more in-depth research, or can be concise and minimized to be completed in a shorter amount of time.

Post Lab Follow-Up/conclusions:

Discuss real world application of learning from lab

- Research skills
- Traveling
- Working with a team/Collaborating
- Summarizing data into a visual format (graphing)

Career Applications

- Researching skills – travel agent, office manager, salesperson, project manager,
- Functions – construction/engineer, salesperson

Optional or Extension Activities

- Currency exchange and rate
- Graph costs with additional attractions
- Making a non-linear graph
- Include travel costs for two and from attractions and food
- Write a paper that will defend their destination
- Expand on activity choices
- Give a budget
- Distance traveled vs. money spent

Overview/Introduction:

Plan your ideal seven-day vacation, with an unlimited budget. You will be in a group of three or less (you may be independent). You are responsible for planning cost of travel, lodging, and food.

Requirements:

- Complete write up of destination selection and reasoning, write up of two unique attractions to visit (including cost)
- Documentation of research – locate three lodging options, and selection of one; provide reasoning for selection
- Know cost of round trip
- Know totals for: travel, lodging, food, and overall total cost of vacation

Expectations:

- Destination – Two reasons for location selection, including two attractions
- Place to sleep every night
- Food everyday
- Round-trip travel cost

Time Line:

Day 1:

Task One: Get into groups 3 or less, like-minded travelers (or independently)

Task Two: Research destinations and modes of travel – Select destination

Task Three: Research two attractions to visit – document cost and reasoning for selection.

Day 2 and 3:

Task Four: Research cost of mode of travel – document cost

Task Five: Research lodging – document cost; must find three options and explain reasoning for selection of lodging option

Day 4:

Task Six: Research food options – select a breakfast, lunch and dinner location for one day. Document costs for each meal, and multiply by seven for the week.

Day 5:

Task Seven: Graph data and costs

Task Eight: Find your fixed and variable costs.

Task Nine: Create your function using the fixed and variable costs.

Day 6:

Task Ten: Peer Evaluations- Make modifications if needed

Task 11: Use your function to determine the cost of a 21-day trip.

Day 7/8/9:

Task 12: Present and compare your data and graph with another group – Where is the breakeven point (when do you spend the same amount of money?)

Task 13: Present your groups trip, with the group you compared your data with, to the class – explain your reasoning and break-even.

See requirements for presentation; include your graph and linear equation in your presentation

Name(s): Cindy, Josh, Nicole, and Sue

Lesson Title: Functions and Expressions – “The “Reasonable” Vaycay”

Date:

Text:

Lesson Length: Nine 50-minute

classes

Domain: Expressions and Equations; Functions

Big Idea (Cluster):

- Analyze and solve linear equations and pairs of simultaneous linear equations;
- Use functions to model relationships between quantities

Common Core State Standards:

7. Solve linear equations in one variable

a. Give examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. Show which of these possibilities is the case by successively transforming the given equation into simpler forms, until an equivalent equation of the form $x=a$, $a=a$, or $a=b$ results (where a and b are different numbers)

b. Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.

8. Analyze and solve pairs of simultaneous linear equations.

a. Understand that solutions to a system of two linear equations in two variables correspond to points of intersections of their graphs, because points of intersection satisfy both

<p>equations simultaneously.</p> <p>b. Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection.</p> <p>c. Solve real-world and mathematical problems leading to two linear equations in two variables.</p> <p>4. Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x, y) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.</p> <p>5. Describe qualitatively the functional relationship between two quantities by analyzing a graph. Sketch a graph that exhibits the qualitative features of a function that has been described verbally.</p>	
<p>Mathematical Practice(s):</p> <p>3. Construct viable arguments and critique the reasoning of others.</p> <p>4. Model with mathematics.</p> <p>2. Reason abstractly and quantitatively.</p>	
<p>Content Objectives:</p> <ul style="list-style-type: none"> • The student will use real world data to represent a linear function. • The student will be able to graph data points to find breakeven points and inceptions. • The student will be able to develop a working function that can be graphed. 	<p>Language Objectives:</p> <ul style="list-style-type: none"> • Present and show reasoning/justify/defend in vacation choices • Use mathematical terminology explanations, both in written and spoken presentation • Linear functions written in $y=mx+b$ with fixed and variable costs represented
<p>Vocabulary: linear equations; variables; functions; relationships; rate of change; quantities; expressions</p>	<p>Connections Prior to Learning:</p> <ul style="list-style-type: none"> • linear equations; • data plotting; • research skills; • data analysis/collection
<p>Questions to Develop Mathematical Thinking:</p> <ul style="list-style-type: none"> • Does location dictate cost? Why? • Does cost of travel method change depending on length of stay? • What was the difference in your group's graph, compared to other groups? • What do you think would happen if you stayed longer? • What do you think would happen if you left early? 	<p>Common Misconceptions:</p> <ul style="list-style-type: none"> • Time of travel (actual time spent to get places) • Hidden costs, miscalculations of costs • One-way vs. round-trip flights • Graph comparison, locating similarities and differences

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| <ul style="list-style-type: none"> • Do you feel your destination is the best one to go to? | |
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Assessment (Formative and Summative):

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| <ul style="list-style-type: none"> • Observations- Probing questions (form) • Individual, Peer and Presentation- Rubric (sum and form) • Development of function and graphing plots (sum and form) • Applying function to 4, 7 and 21 day vacation- does function still work (sum and form) • Discussion and reasoning for their destination- using math language (sum) |
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Materials:

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| <ul style="list-style-type: none"> • Lab sheet • Rubric • Computer/internet • Library or other references • Graph paper |
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Instruction Plan:

Launch (hook):

Souvenir of travels from instructor

Graduation trips, stories of past travels

Explore: (see student lab sheet)

- Introductions: what will you do first
- Get in groups/or individual
- Expectations (timeline, what they are doing) deadlines (rubrics for when what is due) discussions/peer evaluations/self evaluations
- Make a plan
- Research

When I observe students:

- Engaging in discussions about merits of travel
- Reasoning of expectations of costs
- Note taking or copy/paste research
- Getting lost in details or skimming and missing relevance
- Trial and error, working with their created functions

Questions to Develop Mathematical Thinking as you observe:

- Does location dictate cost? Why?
- Does cost of travel method change depending on length of stay?
- What was the difference in your group's graph, compared to other groups?
- What do you think would happen if you stayed longer?
- What do you think would happen if you left early?
- Do you feel your destination is the best one to go to?
- Do you think that is reasonable?
- What role do you play in the group?

- How are you contributing your skills to the group?
- Are there any jobs that need to be completed?

Answers:

- Explain your reasoning and thinking – flight is this much.... Breakfast provided by hotel...
- Lodging is variable cost
- My destination is best because...
- My cost per day is...

Summarize:

- Class discussion

Career Application(s):

- Researching skills – travel agent, office manager, salesperson, project manager,
- Functions – construction/engineer, salesperson
- Team building
- Communication of ideas
- Presentation skills

21st Century Skills and Interdisciplinary Themes:

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

- X Global Awareness X Financial/Economic/Business/Entrepreneurial Literacy X Civic Literacy
 X Health/Safety Literacy X Environmental Literacy

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

LEARNING AND INNOVATION

Creativity and Innovation

- x Think Creatively
 x Work Creatively with Others
 Implement Innovations

Critical Thinking and Problem Solving

- x Reason Effectively
 x Use Systems Thinking
 x Make Judgments and Decisions
 x Solve Problems

Communication and Collaboration

- X Communicate Clearly
 X Collaborate with Others

INFORMATION, MEDIA & TECHNOLOGY SKILLS

Information Literacy

- x Access and Evaluate Information

- x 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

- x Adapt to Change
 x 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

- x Manage Projects
 x Produce Results
Leadership and Responsibility
 Guide and Lead Others
 x Be Responsible to Others

Self	Peer	Teacher	Task
1 2 3	1 2 3	1 2 3	Get into groups 3 or less, like-minded travelers (or independently) Group Members: _____
1	1 2	1 2 3	Research destinations and modes of travel – Select destination

2 3	3		Destination: _____
1 2 3	1 2 3	1 2 3	Research two attractions to visit – document cost and reasoning for selection. *Attach another sheet
1 2 3	1 2 3	1 2 3	Research cost of mode of travel – document cost Cost: _____
1 2 3	1 2 3	1 2 3	Research lodging – document cost; must find three options and explain reasoning for selection of lodging option *Attach another sheet
1 2 3	1 2 3	1 2 3	Research food options – select a breakfast, lunch and dinner location for one day. Document costs for each meal, and multiply by seven for the week. *Attach another sheet
1 2 3	1 2 3	1 2 3	Graph data and costs *Attach graph
1 2 3	1 2 3	1 2 3	Find your fixed and variable costs. Fixed cost: _____ Variable cost: _____
1 2 3	1 2 3	1 2 3	Create your function using the fixed and variable costs. Function: _____

1 2 3	1 2 3	1 2 3	Use your function to determine the cost of a 21-day trip. <hr/>
1 2 3	1 2 3	1 2 3	Present and compare your data and graph with another group – Where is the breakeven point?
1 2 3	1 2 3	1 2 3	Present your groups trip, with the group you compared your data with, to the class – explain your reasoning and break-even. See requirements for presentation; include your graph and linear equation in your presentation