GRADE: 8

Line Equations and City Maps

THEME	CONTENT	ART
Who Are We?	CCSS.Math.Content.8.EE.C.7.A	MA:Cn10.1.8.

KEY VOCABULARY

- Linear equation
- Variable
- X Intercept
- Y Intercept
- Slope

PACING: 1-2 DAYS

ASSESSMENT (Summative):

ELEMENTS OF MEDIA ART:
Time
Narrative
Editing

MATERIALS LIST

- Video, *Math Antics*
- *Geneva, IL City Map* image source
- Computers
- Desmos, online graphing
- Paper
- Pencils

LESSON OBJECTIVE

Students will analyze and solve linear equations to create city maps.

ESSENTIAL QUESTION

Can math play a role in the art of map making ?

21st CENTURY SKILLS:

✓Critical Thinking ✓Creative Thinking ✓Collaborating ☐ Initiative
✓Communicating ☐ Media Literacy ☐ Informational Literacy
✓Tech Literacy ☐ Flexibility ✓ Social Skills ☐ Leadership
☐ Productivity

CONTENT STANDARDS:

CCSS.Math.Content.8.EE.C.7.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).

ARTS STANDARDS:

MA:Cn10.1.8.a.

Access, evaluate, and use internal and external resources to inform the creation of media artworks, such as cultural and societal knowledge, research, and exemplary works.

WARM-UP OPTIONS (10 MIN)		
• 19- Engineering Design • 20- GIF • 21- Keyboard Shortcuts	• 22- Memes • 23- Mood Post	

LESSON OVERVIEW

A linear equation is an equation between two variables that provides a straight line when plotted on a graph. In this lesson, students will work with partners or individually to create a city map (of an imagined place). Students should demonstrate understanding of both solving and graphing linear equations. Students should be able to locate the y-intercept on the graph and plot the point and use the slope to find a second point and plot that. Students will need to connect the two points by using a ruler to draw a line.

ENGAGEMENT

City Planning

Build background knowledge of city maps by projecting googlemaps.com. First look at the cities of Windermere, Florida and Sapporo, Japan. Note how both of these cities have what is called a "grid plan" of streets. Explain that a grid plan is a city street plan where the majority of the streets run at right angles to each other (forming a grid). Then explain that city planning is actually an ancient art and that grid plans for city streets date all the way back to Roman times!

Take a moment to compare to some cities that struggle with traffic problems, such as Dubai, UAE and Atlanta, Georgia. Ask students why planning a city is so important to the flow of traffic and record some responses on the board. Why might it be important to limit the amount of traffic?

STEP 1

Linear Equations

Review and instruct if needed the vocabulary and processes for solving linear equations. Show students this video to help review concepts. Be sure that students have a firm understanding of how to translate a linear equation to a graph by plotting a point and finding the slope.

ARTFUL THINKING ROUTINE

Colors, Shapes, and Lines Routine. Have students analyze this City Map of Geneva, Illinois.

- What colors do you see?
- What shapes do you see?
- What lines do you see?

STEP 2

Interpreting and Analyzing Artwork

Now that students have an understanding of analyzing and solving linear equations, it is time to get them ready to interpret and analyze some art.

Teacher-to-Teacher

If computers are not available have graph paper for students to use to graph their equations.

If students need to be given more direction you can assign the building locations and have them determine the coordinates instead of allowing them to determine the building locations on their own.

To expand this lesson have students work "backward"- drawing city maps on graph paper and then determining the linear equation for each street.

MAIN ACTIVITY/PROJECT
Allow students the opportunity to work independently or with a partner. Explain that they will need to complete the Input-Output tables included on their City Planning resource pages. They will need to use the values from their input-output tables to graph each of the linear equations. They will use the online linear equation graph maker Desmos to create and print out their graph. Then students should utilize colored pencils to add detail to their city map. The graphed lines should represent roads. Vertical lines (lines with a slope of 0) will be "streets." Horizontal lines (lines with an undefined slope) will be "avenues." These roads should be labeled according to their x or y intercepts. **Example:** 8th Avenue, 2nd Street, etc. Roads with a diagonal slope, can be named whatever students choose. Students should then add and label points that represent building locations and record their coordinates. Students will write and present as a partner pair their city along with the linear equations, graph and an analysis of their equations. **ESTIMATED TIME: 1 hour**

CLOSURE

Reflection

Students should trade maps with another group and answer the following questions:

What are the coordinates of the library on this map?
Are all roads labeled?
What could be done to improve this map?
Would this be a good road plan for a city?

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TEACHER ASSESSMENT

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	3	2	1	0
Ability to analyze and solve linear equations as evidenced in the input and output resource page.	More than six linear equations were correctly created and solved to graph. Graph includes all necessary labels.	Four to six linear equations were correctly created and solved to graph. Graph includes most of the necessary labels.	Two or three equations were created and solved. There are no labels on the graph.	No equations were solved or graphed.
City plan designed using linear equations.	City Plan includes more than six linear equations that distinctly represent city streets and are labeled accordingly. All required city buildings are added and their coordinates are labeled.	City Plan includes between four and six linear equations that clearly represent and City Streets.	City Plan includes less than four linear equations. Some roads do not accurately represent the linear equations.	City Plan was not completed.
Written Analysis of a partner group's city plan.	Analysis accurately solves the linear equations used to create their city map with no mistakes. And provides thoughtful commentary on city design.	Analysis accurately solves most of the linear equations used to create their city map.	Analysis accurately solves a few of the linear equations used to create their city map.	No analysis was completed.

City Planning

Name: _____ Date: _____

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	3	2	1	0
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City plan designed using linear equations.	City Plan includes more than six linear equations that distinctly represent city streets and are labeled accordingly. All required city buildings are added and their coordinates are labeled.	City Plan includes between four and six linear equations that clearly represent and City Streets.	City Plan includes less than four linear equations. Some roads do not accurately represent the linear equations.	City Plan was not completed.
Written Analysis of a partner group's city plan.	Analysis accurately solves the linear equations used to create their city map with no mistakes. And provides thoughtful commentary on city design.	Analysis accurately solves most of the linear equations used to create their city map.	Analysis accurately solves a few of the linear equations used to create their city map.	No analysis was completed.

Vocabulary

Linear Equations and City Planning

Name: _____ Date: _____

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Linear Equations - the equation for a straight line
Example: y=2x+1

Slope - the measure of the steepness of a line. Reading at a slope from left to right, slopes that "go up" are positive and slopes that "go down" are negative.

Y Intercept - in a linear equation this is the location where the line crosses the vertical access.

Slope-Intercept Form - the most common form of a linear equation.

Example: $y=mx+b$

Slope Y Intercept

City Planning Warm-Up

Linear Equations and City Planning

Name: _____ Date: _____

Period: _____

Linear Equations Worksheet

Linear Equations and City Planning

Name: _____ Date: _____

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Use the input and output tables below to solve the seven equations below.

1. y=2x +1

x	Work	y	(x,y)
		6	
10			

2. y=2x+4

x	Work	y	(x,y)
		18	

3. y=1/2x-3

x	Work	y	(x,y)
-14			
		6	

4. y=x-18

x	Work	y	(x,y)
		-3	
-12			

5. y=-4x+19

x	Work	y	(x,y)
4			
		9	

6. y=15

x	Work	y	(x,y)
-9			

7. x=-11

x	Work	y	(x,y)
		-12	
		12	

Using Desmos, graph each linear equation listed above. The graphed lines should represent roads. Vertical lines (lines with a slope of 0) will be "streets." Horizontal lines (lines with an undefined slope) will be "avenues." These roads should be labeled according to their x or y intercepts. (Example: 8th Avenue, 2nd Street, etc.) Roads with a diagonal slope, can be named whatever you choose. Add and label points that represent building locations and record their coordinates.

Your City Map should include the following buildings:

- Library
- Town Hall
- Post Office
- Grocery Store
- School
- Community Center

Reflection

Linear Equations and City Planning

Name: _____ Date: _____

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Trade city planning maps with another partner group. Fill out this reflection page based on their city map.

What are the coordinates of the library on this map?

Are all roads labeled?

What could be done to improve this map?

Would this be a good road plan for a city?