Performance Based Learning and Assessment Task

Escape from the Zombie Apocalypse - Exploring Quadrilaterals through Google Maps and Google Earth

I. ASSESSMENT TASK OVERVIEW & PURPOSE:
This activity will provide a learning experience to expand and solidify students' understanding of the properties of quadrilaterals, and how to use these properties to problem solve real life situations through a performance-based task.

II. UNIT AUTHOR:
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III. COURSE: Geometry

IV. CONTENT STRAND:
G.9 The student will verify characteristics of quadrilaterals and use properties of quadrilaterals to solve real-world problems.

V. OBJECTIVES:
- Students will use maps to explore the properties of quadrilaterals.
- Students will apply knowledge of the properties of quadrilaterals including, but not limited to, parallelograms, rectangles, rhombi, squares, trapezoids, convex irregular quadrilaterals and concave irregular quadrilaterals to locate given objects with the street maps of real cities.
- Students will use properties of quadrilaterals to verify objects.
- Students will calculate perimeter and area of objects.
- Students will utilize tools in Google Maps to make measurements of real-world objects.

VI. REFERENCE/RESOURCE MATERIALS:
Google Earth/Google Maps
Calculator
Questions(see attached)
GeoGebra

VII. PRIMARY ASSESSMENT STRATEGIES:
Students will be evaluated using a pre-assessment questionnaire, a partner activity, and a formal post-assessment using open-ended critical thinking questions. Informal assessment will be students' interactions and problem solving discussions during the activity. A key will be included for map questions to help teacher guide students through problems. Sample rubrics for formal assessment can be found at:
www.rubrics4teachers.com.

VIII. EVALUATION CRITERIA:
Pre-assessment questionnaire, activity worksheet, teacher assessment, formal assessment questions, rubrics.

IX. INSTRUCTIONAL TIME: Three 90-minute class blocks

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Strand

Geometry: The student will verify characteristics of quadrilaterals and use properties of quadrilaterals to solve real-world problems.

Mathematical Goals and Objective(s)

Mathematical topics covered include identifying the defining characteristics of different quadrilaterals, and utilizing these properties to problem solve for missing data. The activities will encourage students to use the properties of quadrilaterals to solve real world problems using Google Maps and Google Earth. The mathematical goal of this task is to expand student understanding of quadrilateral characteristics, and to utilize mathematical knowledge in the real world. Specific strategies being developed are the ability to apply definitions and theory to problem solving, and to understand the value of mathematical knowledge for real life applications.

Related SOL

- (G.9) The student will verify the characteristics of quadrilaterals to solve real-world problems
- (G.9a) The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to solve problems including real-world problems, using the properties specific to parallelograms, rectangles, rhombi, squares, isosceles trapezoids, and trapezoids.
- (G.9b) The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to prove that quadrilaterals have specific properties, using coordinate and algebraic methods, such as the distance formula, slope, and midpoint formula.
- (G.9c) The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to prove the characteristics of quadrilaterals, using deductive reasoning, algebraic, and coordinate methods.

NCTM Standards

- Geometry
  - Use visual, spatial reasoning, and geometric modeling to solve problems
- Measurement
  - Understand measurable attributes of objects and the units, systems, and processes of measurement
  - Apply appropriate techniques, tools, and formulas, to determine measurements
- Problem Solving
  - Solve problems that arise in mathematics in other contexts
  - Apply and adapt a variety of appropriate strategies to solve problems
  - Monitor and reflect on the process of mathematical problem solving
- Reasoning and Proof
  - Select and use various types of reasoning and methods of proof
- Communication
  - Organize and consolidate their mathematical thinking through communication
  - Communicate their findings coherently and clearly to peers, teachers, and others
  - Use language of mathematics to express mathematical ideas precisely
- Connections
  - Recognize and use connections among mathematical ideas

- o Understand how mathematical ideas interconnect and build on one another to produce a coherent whole
- o Recognize and apply mathematics in contexts outside of mathematics
- Representation
  - o Create and use representations to organize, record, and communicate mathematical ideas
  - o Select, apply, and translate among mathematical representations to solve problems
  - o Use representations to model and interpret physical, social, and mathematical phenomena

Additional Objectives for Student Learning:
Geography/USI.2: The student will interpret maps, globes, photographs, pictures, or tables.

Materials/Resources
- City Map with Questions
- Internet Access
- Google Earth/Google Maps
- Classroom set of calculators
- Pre-Assessment Activity
- Worksheets for each of the three activities

Assumption of Prior Knowledge
- Students should be familiar with the properties of quadrilaterals including parallelograms, rectangles, rhombi, squares, and trapezoids.
- Students should be able to identify convex and concave figures.
- Students should be able to calculate area and perimeter of various quadrilaterals.
- Students should be able to identify a quadrilateral and explain why a figure is not a quadrilateral.

Introduction: Setting Up the Mathematical Task

In these activities, students will investigate quadrilaterals while exploring maps. Students will use Google Earth and Google Maps to demonstrate their knowledge of quadrilaterals when applied to a "real-world" scenario of a zombie apocalypse.

The first activity uses a map of fictional town and a series of questions that the students will answer. The activity should take approximately 60 minutes with additional time for classroom discussion and group sharing.

In the first activity, students will learn about identifying quadrilaterals in a map and how to use concepts like finding side length with a given area and using properties of quadrilaterals. Students will be given a copy of the Your Town map and the activity sheet. The teacher will ask students to work cooperatively in small groups or with a partner to discuss problem solving strategies and techniques for completing the activity. The teacher should monitor group discussions and be prepared to help guide the students toward answers without direct instructions.

Teacher prompts may be:
- Why would you want a shortcut?
- How could you use area to help?

In the second activity, the students will use Google Maps to demonstrate their knowledge of quadrilaterals as they come to the aid of a city of their choice whose managers need to protect their residents from the incoming zombies.

In this activity, students will identify various quadrilateral found within the streets of the city. They will explain how they determined each figure. They will calculate area and perimeter and compare their results to measures given by Google Maps.

Class discussion will include the concept of measurement error and how that relates to their task. In addition, students will discuss which shapes were easy to find and which shapes were difficult to find and discuss why certain figures were difficult to find. Students can compare these results with each other since they will have different cities which may result in different outcomes.

Teacher prompts may be:
- Why is that city important to you?
- How do you know this shape is a parallelogram (or other quadrilateral)?
- Why did you choose that particular region?

In the third activity students will use Google Earth to come to the aid of the Centers of Disease Control (CDC) to help stop the spread of the zombie virus in Washington D.C. Students will explore real-world scenarios in which quadrilaterals are used to solve problems.

Student Exploration

Individual Work

Once the students have finished the handout activity, have them begin to explore Google Earth and Google Maps. Prompt the students to find their home town and find a street view. Have them then answer similar questions about navigating around their home town. Prompt students to use the measurement tools in Google Earth and Google Maps which are accessed by using a Right Click. Make sure students are familiar with the controls of Google Earth/Maps.

Small Group Work
        In small groups, have the students create a map of their favorite place to visit. They must include quadrilaterals in the map to show possible paths to different attractions.

Whole Class Sharing/Discussion
        In the group discussions, have students explain how they arrived at each answer.

Monitoring Student Responses
- Expectations:
  - Students will communicate their thinking through discussions in small and large groups.
  - Students will communicate their knowledge and thinking on worksheets and formal and informal presentation.
  - The teacher can scaffold students using open ended questions and providing related examples.
  - The teacher can extend this material by encouraging students to explore pandemics and how mathematics is used to contain the spread of disease.
- Summary
  - Summary and extension questions are included in the worksheets. Large group discussion of these questions will be part of closure.
  - Formative assessment of student knowledge will be taken by observation.

Assessment List and Benchmarks
- Assessment List – Worksheets are located within each activity in this document.
  - Pre-Assessment
  - Activity 1 Worksheet
  - Activity 2 Worksheet
  - Activity 3 Worksheet
- Benchmarks of student work for each activity are located at the end of this document.

- **Journal/writing prompts**
  - What are some aspects of quadrilaterals that can help a person interpret a map?
  - Describe how you could use your knowledge transversals of parallel lines and quadrilaterals to create your own maps using Google Earth.
  - What is measurement error and how does it affect the values you calculated?
  - What is a pandemic? How are quadrilaterals used to control the spread of diseases?

Pre-Assessment

- In your own words, explain what a quadrilateral is:

- What is different about a trapezoid and a rectangle? What is the same?

- What are parallel lines? How do you know lines are parallel?

- What are perpendicular lines? How do you know lines are perpendicular?

- What are some facts you know about quadrilaterals?

Circle the shapes that are quadrilaterals.
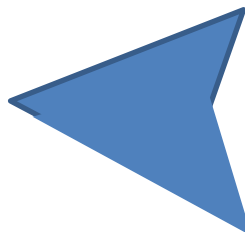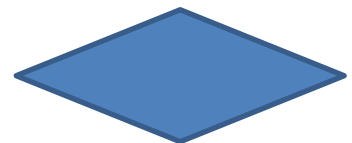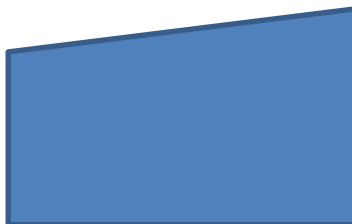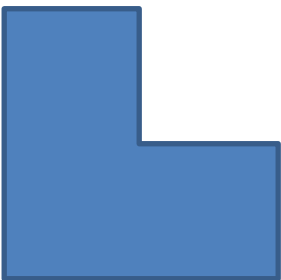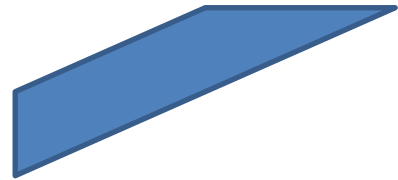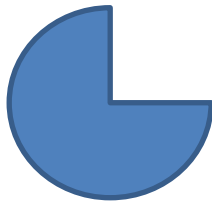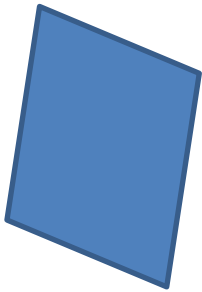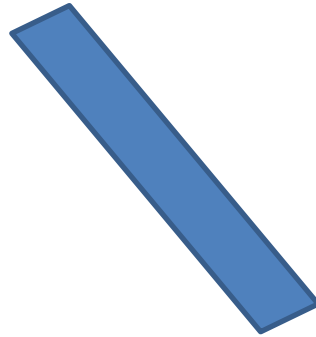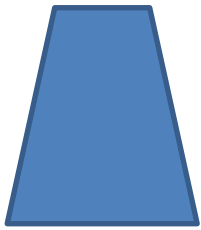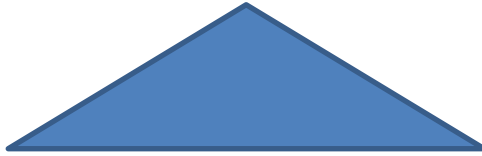
Answer Key for Pre-Assessment

The purpose of the pre-assessment is to determine the level of background knowledge of the student. This is useful to identify comprehension of terminology, definitions, and familiarity with the geometric concept of quadrilateral properties. The instructor may also use this information to detect any misconceptions or deficiency of background knowledge. Below are possible responses, however, any student responses should be acknowledged and discussed.

- **In your own words, explain what a quadrilateral is:**

  Some possible responses:

  A four sided polygon or closed figure.
  Sum of the interior angles is 360 degrees.
  A regular quadrilateral is a square.
  Some quadrilaterals have one or two pairs of parallel sides, but not all.
  Some quadrilaterals have four right angles, but not all.

- **What is different about a trapezoid and a rectangle? What is the same?**

  Possible Responses:

  Differences:

  A trapezoid has one pair of parallel sides, a rectangle must have two pairs of opposite parallel sides.

  A trapezoid does not have to have any angles congruent, a rectangle must have all four angles congruent and each equal to 90 degrees.

  The diagonals of a rectangle bisect each other and are congruent in length, a trapezoid's diagonals do not have to be congruent or bisect each other.

  Similarities:

  They are both quadrilaterals, and have the sum of the interior angles to be 360 degrees.

- **What are parallel lines? How do you know lines are parallel?**

  Parallel lines have the same slope and will therefore never intersect. Lines are parallel if one can count a rise and run (slope) of each line that is the same, thereby ensuring the two lines will never intersect.

- **What are perpendicular lines? How do you know lines are perpendicular?**

- **What are some facts you know about quadrilaterals?**

Circle the shapes that are quadrilaterals.

Activity 1 - Worksheet   Name(s):

Breaking News! It has been reported that the principal of your school has been infected by the zombie virus. The entire town is at risk for a zombie apocalypse. Your principal was last seen chasing joggers in the park. You and your friends need to find the fastest routes to safety. You find a map of your town in a kitchen drawer. Use the map to determine which routes you and your friends should take for each situation.

1.) You are at the school and need to get to safety. You have the choice of running down Pine Street or up Ridge Street. Which is a shorter distance? What does this tell you about Elm Street and First Street? Explain your answer.

2.) You are finally safe at your house when you hear the breaking news that the zombies are heading toward your friend's house. Your friend wants to run to your house because he is afraid to be home alone. He thinks it is safer to run on the roads, but you say it is a shorter distance to run a straight diagonal from each house. Who is correct? What is the difference in distance? What does this tell you about diagonals in a quadrilateral? Justify your answer.

3.) Betty is at the school and wants to join you and your friend in the safety of your house. She is not sure how to get to your house and her phone is dead so she cannot use GPS. Zombies have been reported walking down Main Street by the park. Describe two different routes Betty can take that do not include her travelling down the part of Main Street above the park. What is the distance of each route?

4.) Billy escaped the zombie joggers in the park and is at the corner of West Street and South Street. He wants to run to the mall where other non-infected townspeople have gathered for safety. He has two options:

      a.) Run through the woods up Trail 1 and Trail 2, then head east on North Street.

      b.) Run east on South Street, then head north up East End Street.

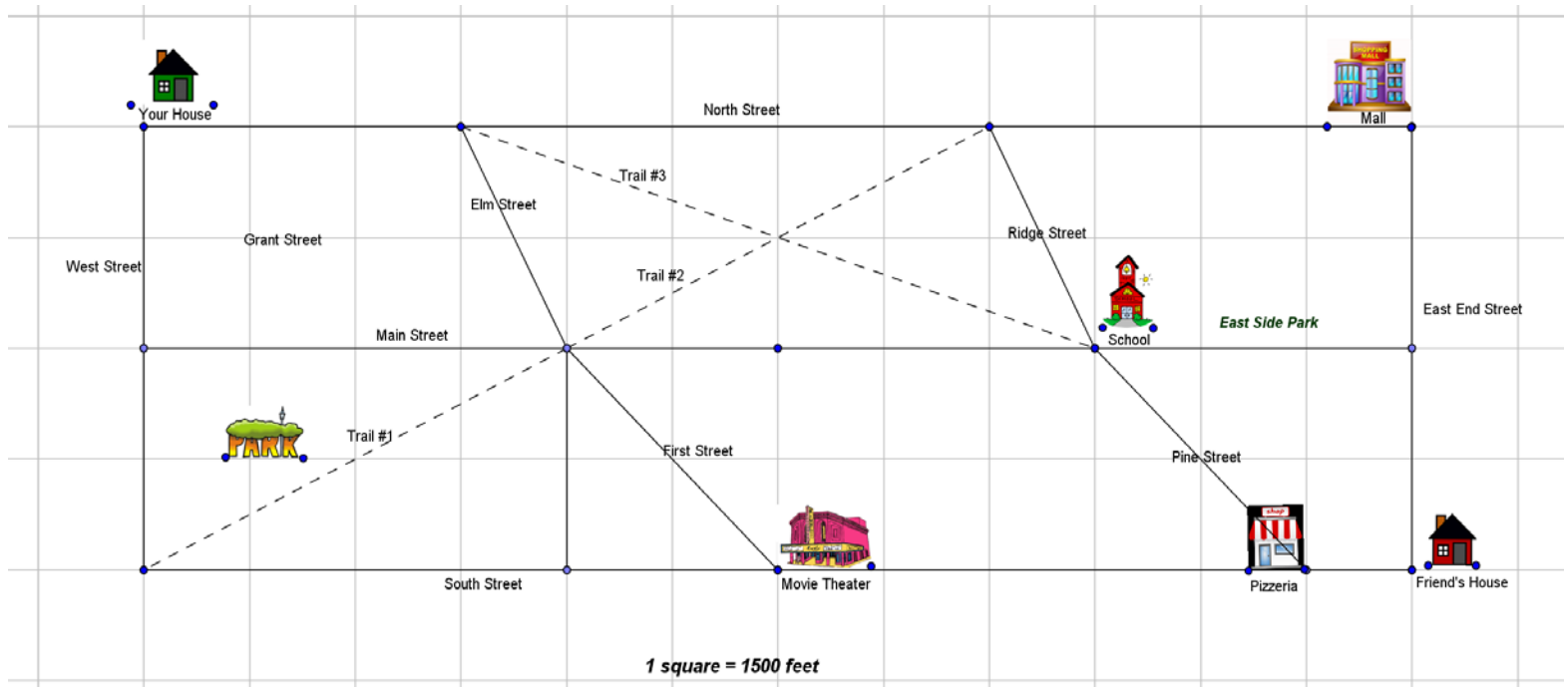Which is the shortest route? Justify your reasoning mathematically and with words.

5.) All this running has made your friend hungry. You take a chance that the pizza place will deliver a large pizza to you at your house during this zombie apocalypse. The pizza driver says he only delivers to a 3 square mile area (5280 feet = 1 mile). Does your house fall within his delivery zone? Show all work.

6.) The zombies are all migrating to the movie theater to watch a showing of the movie "Zombieland." You realize the zombies can be enclosed by a fence! A local builder says he has electric fence that can be installed quickly, but it must be attached to asphalt (roads). The area that must be fenced to enclose all of the zombies is between First Street and Pine Street, and South Street and Main Street. How many feet of fencing will be needed? What is the area the fence will enclose?

7.) The town must start cleansing the town with an anti-zombie antibody cleanser. The first area chosen is between the Mall, the School, the Pizzeria, and your friend's house. The two cleaning groups argue over how to determine the area of the odd shape. Group A states the area is two trapezoids. Group B states the area is comprised of two rectangles and two triangles.

a.) Which group is correct? Justify your answer.

b.) Is there another way to calculate the area?

Bonus Question: How many different quadrilaterals can you identify on this map?

Justify your answer.

Map of Your Town

Your House   North Street   Mall

Trail #3

Elm Street   Ridge Street

Grant Street

West Street   Trail #2   East Side Park   East End Street

Main Street   School

PARK   Trail #1   First Street   Pine Street

South Street   Movie Theater   Pizzeria   Friend's House

1 square = 1500 feet

13

Rubric for Activity 1: Zombie Town

Student Name(s): _____

| Total of 16 pts.	4	3	2	1
Effort	Stayed on task and focused on activity consistently. Implemented background knowledge. Consistently used effective and creative problem solving strategies.	Stayed on task and focused on activity most of the time. Implemented background knowledge to help problem solve. Used some creative strategies.	Needed to be refocused on task often. Used some background knowledge and problem solving strategies.	Was consistently off-task and needed to be continually refocused on activity. Did not use background knowledge or any problem solving strategies.
Completion	Attempted and completed all problems.	Attempted and completed most problems.	Attempted and completed 50% of problems.	Attempted and completed less than 50% of problems.
Reasoning/ Explanation	Valid mathematical reasoning was utilized. Explanations were effective and complete using mathematical terminology.	Valid mathematical reasoning was utilized for most of the problems. Explanations were complete using some mathematical terminology.	Valid mathematical arguments were utilized for a few of the problems with little mathematical terminology. Some explanations were incomplete or lacked effective reasoning.	Little or no mathematical terminology was utilized. Explanations are given for some of the problems without complete and valid reasoning.
Accuracy/ Computations	All answers are correct.	Most answers are correct.	Some answers are correct.	Less than 50% of answers are correct.

Comments:

_____

_____

_____

Google Maps Guide for Activity 2

Students may work in pairs or individually. Students will use Google Maps to locate and verify various quadrilaterals found in the layout of city streets.

Students may choose any city. Within their chose city, students locate an irregular quadrilateral, parallelogram, rectangle, square, trapezoid, and 4-sided non-quadrilateral.

- Students will describe the sides of each shape using street names.
- Students will us the measurement tools in Google Maps to measure the features of each shape.
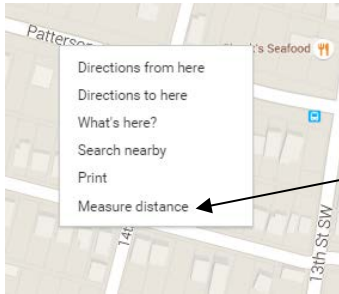
Right Click in Google Maps and this menu will appear. Choose measure distance at the bottom and follow prompts.

- Students will also record the perimeter and area provided by Google Maps and compare to their own calculations
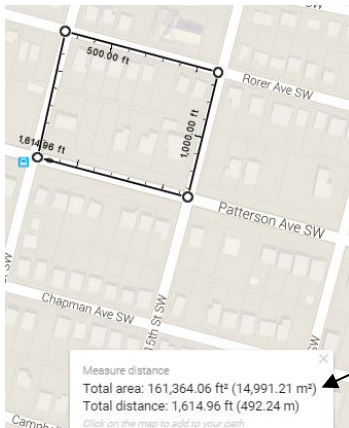
Area and perimeter given by Google Maps

- Students will use their knowledge of quadrilaterals to justify their classification of each shape.
- Students will take a screen shot or use the snipping tool to create a visual record of each shape.
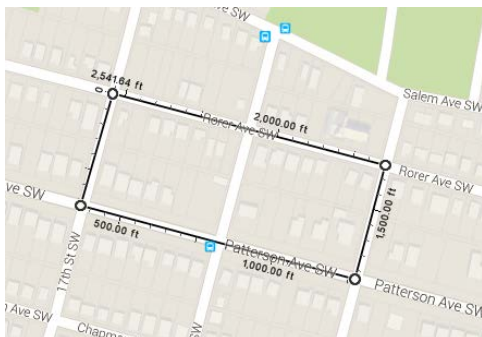
Example of a screen shot taken using the snipping tool.

Activity 2

Using Google Maps to Determine Quadrilaterals and Properties of Quadrilaterals

We Need YOUR Help!!!

Due to the zombie apocalypse, cities across the country are beginning to plan for the incoming invasion! Your task is to come to the aid of a U.S. city of your choice. The city managers know that quadrilaterals must be used to section the city off into safe zones or green zones. Unfortunately, the city managers are not very confident about what quadrilaterals are and the types of different quadrilaterals. They know that perimeter is important in order to determine how to section off green zones. They also know that area is important in determining how many people can safely take refuge in a green zone. Sadly, they do not know how to calculate perimeter and area. Your services are being sought for your expertise in all matters of quadrilaterals. You must provide examples of different quadrilaterals within the city streets and determine area and perimeter using your own calculations and with the assistance of Google Maps. Please help the cities managers to protect its residents from the incoming zombies!!

Activity 2 - Google Maps Worksheet   Name(s):

1. What city did you choose?

2. Why did you choose this city?

3. Locate the following objects in your map. Please include units! Remember to include a screen shot or use the snipping tool to present a picture of each shape.

Irregular Quadrilateral

Describe each side using street names:

Side 1	Side 2	Side 3	Side 4

Measurements from Google Maps (include units!):

Side 1	Side 2	Side 3	Side 4	Total distance	Total area

Calculate Perimeter (Show work!):

Would you classify this quadrilateral is convex or concave? Why?

What are your reasons for classifying this quadrilateral as irregular?

Parallelogram

Describe each side using street names:

Side 1	Side 2	Side 3	Side 4

Measurements (Include units!):

Side 1	Side 2	Side 3	Side 4	Diagonal 1	Diagonal 2	Height	Total distance	Total area

Calculate Perimeter (Show work!):

Calculate Area (Show work!):

What are your reasons for classifying this quadrilateral is a parallelogram?

Rectangle

Describe each side using street names:

Side 1	Side 2	Side 3	Side 4

Measurements (Include units!):

Side 1	Side 2	Side 3	Side 4	Diagonal 1	Diagonal 2	Total distance	Total area

Calculate Perimeter (Show work!):

Calculate Area (Show work!):

What are your reasons for classifying this quadrilateral is a rectangle?

Square

Describe each side using street names:

Side 1	Side 2	Side 3	Side 4

Measurements (Include Units!):

Side 1	Side 2	Side 3	Side 4	Diagonal 1	Diagonal 2	Total distance	Total area

Calculate Perimeter (Show work!):

Calculate Area (Show work!):

What are your reasons for classifying this quadrilateral is a square?

Trapezoid

Describe each side using street names:

Base 1	Base 2	Side 3	Side 4

Measurements (Include Units!):

Base 1	Base 2	Side 3	Side 4	Height	Total distance	Total area

Calculate Perimeter (Show work!):

Calculate Area (Show work!):

Justify how you know this quadrilateral is a trapezoid.

4-Sided Non-Quadrilateral

Describe each side using street names:

Side 1	Side 2	Side 3	Side 3

Measurements (Include units!):

Side 1	Side 2	Side 3	Side 4	Total distance	Total area

Calculate Perimeter (Show work!):

What are your reasons for not classifying this shape as a quadrilateral?

Additional Questions:

4. What is "measurement error"? Describe how measurement error can have an effect on the conclusions you made about the various quadrilaterals found in Google Maps?

5. Compare the perimeter and area values provided by Google Maps to those you calculated on your own. Are they different? What could explain a difference? Which values do you think are most accurate, why?

6. Which of the figures do you feel was the most difficult to find within the city map? Why?

Grading Rubric – Google Maps Activity 2

60-65 total points possible	Excellent (4-5 points)	Satisfactory (3 points)	Unsatisfactory (1-2 points)	Missing (0 points)
City Name	Included name of City and State and stated reason for their choice	Element is incomplete, for example, name and state included, but no reason provided	Element is incomplete. For example, student only includes name of the city, no state, no reason	This element is not included
Street Names	Included 4 street names for each of the 6 figures	Element is incomplete; 1-3 names missing	Element is incomplete; 4 or more names missing	This element is not included
Side Measurements	Included the measures of the 4 sides of each of the 6 figures	Element is incomplete; 1-3 measurements missing	Element is incomplete; 4 or more measurements missing	This element is not included
Additional Measurements	Included measures for diagonals and height for all 6 figures where indicated.	Element is incomplete; 1 measurement is missing	Element is incomplete; 2 or more measurements are missing	This element is not included
Measurement Units	Correct units given for each measurement. Units are consistent (student does not switch between feet and meters)	Units are missing on 1-3 measurements; units are consistent (student does not switch between feet and meters)	Units are missing in 4 or more measurements; units may be inconsistent (student switches between feet and meters)	Student did not include any units for measurements
Google Map Calculations	Included Google Map Calculations for 6 figures. Includes "Total distance" (perimeter) and "Total area" (area) with correct units	This element is incomplete; 1 values is missing; units are correct	This element is incomplete; 2 or more values are missing; units incorrect or missing	This element is not included
Area Calculation	Student includes legible work of calculation, work is free of mathematical errors, uses square units. Work	Student includes work but it is difficult to read and/or follow. Work is free of mathematical errors. Square	At least 1 calculation is missing, mathematical errors present, incorrect units, work is difficult to	This element is not included

	contains one calculation where indicated, for a total of 4 calculations	units are given	read and/or follow.	
Justify the Quadrilateral	Student gives valid and complete reasons for classification of each quadrilateral. Classification is supported by mathematical evidence. Student uses complete sentences free of grammatical errors	Student gives valid justifications for each of the 6 classifications, but does not use complete sentences. Key features of each classification are recognized.	At least one justification is missing. Student's justifications for each classification are not in complete sentences are and key features are not recognized.	This element is not included
Additional Question #4	Student includes definition of "measurement error" and describes how it applies to the project. Student uses complete sentences free of grammatical errors.	Student includes definition of "measurement error" and describe how it pertains to the project. Student does not use complete sentences and/or grammatical errors are present	Student includes the definition of "measurement error" but does not describe how it pertains to the project	Student did not answer this question.
Additional Question #5	Student describes any difference in values and provides reason for difference. Student gives opinion on which values are most accurate. Student uses complete sentences free of grammatical errors.	Student describes any difference in values and provides reason for difference. Student gives opinion on which values are most accurate. Student does not use complete sentences and grammatical errors are present.	Student states that there is a difference between the values, but does not offer an explanation	Student did not answer this question.
Additional Question #6	Student describes which figure posed the greatest challenge and	Student describes which figure posed the greatest challenge and	Student states which figure posed the greatest challenge, but	Student did not answer this question.

	supports choice with explanation. Student uses complete sentences free of grammatical errors.	supports choice with explanation. Student does not use complete sentences and grammatical errors are present.	does not offer any explanation.	
Division of Work (for students working with a partner)	Each student did half of the work	One student did significantly more work that the other.	One student did all the work.	

Activity 3
Help the C.D.C. stop the Zombie Apocalypse

The Center for Disease Control (CDC) has contacted you to help stop the spread of the zombie virus pandemic. This disaster has stopped communication within the government and you have found a working super smart watch that still connects to Google Earth. They need your help to stop the spread in Washington D.C. The epidemic in D.C. has trapped the president in the White House. You will use Google Earth to help coordinate the quarantine of the infected and open routes for the infection response team. You will also use a basic map of D.C. to record your information to send to the CDC as well as your investigator log.

Good luck with your mission!

Activity 3 - Google Earth Worksheet   Name(s):

Answer each of these questions to determine the current situation and how to guide the response.

1. The Secret Service has been able to protect the White House by setting up road fences along 17th Street and 15th Street and concrete barriers along H Street and Constitution Ave. (Turn on the roads view to help find the correct streets)

    - Using Google Earth and your map of D.C. to determine what the shape of the secured area around the white house is. Draw the secured area on your paper map as well.

    - What kind of quadrilateral does the secured area form?

    - How much road fence was used?

    - What percent of the perimeter are concrete barriers? Show all work.

    - What is the total area of the secured area? Show all work.

2. There has been a report that senators are also trapped in the Capitol Building with a small group of National Guard. The president wants to know if this report is true. Use Google Earth to determine the best route to reach the Capitol Building.

    - Use the "Get Directions" feature on Google Earth to find possible routes. Draw this route on your basic map.

    - What is the shortest walking distance?

    - How long should it take for the agent to get there?

3. Good news, the senators have a lot of National Guard members helping them hold the Capitol! With the new man power, the President has decided to start taking back D.C. Phase 1 involves making a safe zone between the White House and the Capitol. The Secret Service has 1.75 miles of road fence left.

- Can they fence off the area from the secured area to the corner of Pennsylvania Ave. and Constitution Ave.? Please explain your answer. (Hint: Use the ruler tool)

- What kind of quadrilateral is formed in Phase 1? (Make one on Google Earth and record it on your basic map as well)

- What is the total area? Show all work.

4. The Senators will need to complete Phase 2 from their spot. They think that they can create a green zone between Constitution Ave. and Independence Ave. and from 1st street to 7th street. Draw this on your basic map.

- The National Guard has 2.2 miles of road fence, is this enough to make the green zone? If not, how much more do they need?

- To keep the zombies out the National Guard needs to have a person every 50 feet. How many people does it take to hold the green zone? Show all work.

5. Now that the President and the Senators can communicate again, they have decided to find a vaccine to stop the zombie onslaught. The Federal Emergency Management Agency (FEMA) has a lab and it is close to the green zone. It is not on you basic map so use Google Earth to find it. (Be sure to turn on "Places" in your layers)

- Locate the FEMA building and determine what streets you would have to fence off to secure the building. Record the streets and the length of fence needed for each in the table.

| Side 1	Side 2	Side 3	Side 4
Length	Length	Length	Length

- What is the total area of the FEMA section? Show all work.

6. While holding the Green Zone the 7th Street fence was over run and all National Guard members on that street were exposed to the pathogen.

- How many vaccines does the FEMA lab need for the National Guard members?

- The president decides all people exposed to zombies guarding the fences need the vaccine. How many total people need a vaccine? (Hint, look at all fences only exposed to zombie attack and use the path tool.)

Basic Map

(Use this map of D.C. to help show the quadrilaterals you form while helping the CDC.)
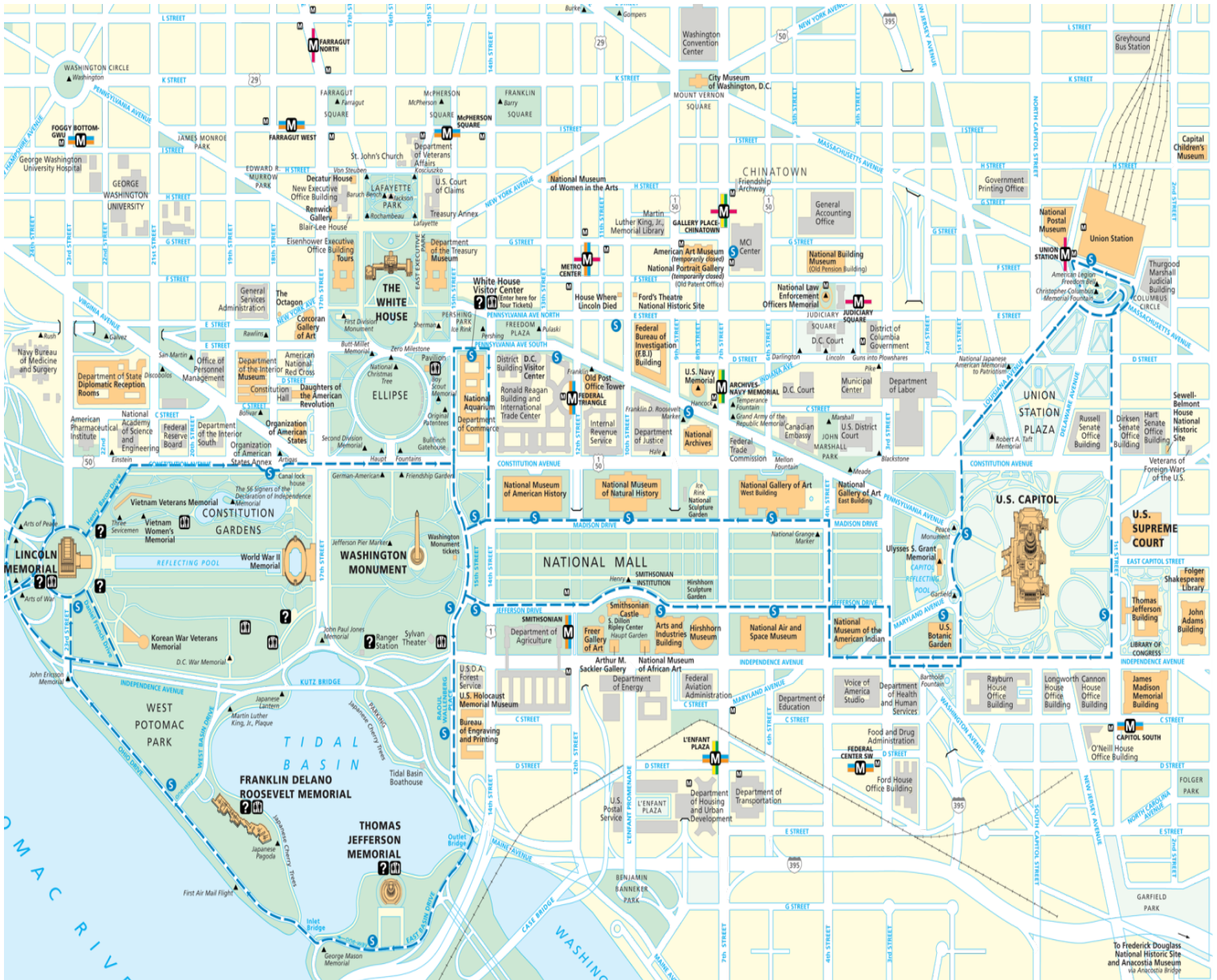
Key Vocabulary

epidemic - a widespread outbreak of an infectious disease where many people are infected at the same time.

exposure - the act of coming into contact with a disease-causing microorganism; exposure may or may not lead to infection.

outbreak - the occurrence of a large number of cases of a disease in a short period of time.

pandemic - an epidemic that affects multiple geographic areas at the same time.

pathogen - any disease-producing agent; i.e. virus, bacteria or other microorganisms.

vaccine - a substance that contains antigenic components , either weakened, dead or synthetic, from an infectious organism which is used to produce active immunity against that organism.

virus - ultramicroscopic infectious agent that replicates itself only within cells of living hosts. (common cold, flu)

(Centers for Disease Control and Prevention, 2012)

Rubric for Activity 3: Help the C.D.C. Stop the Zombie Apocalypse

Student Name(s): _____

Total of 20pts.	4	3	2	1
Problem Solving	Evidence of complete understanding of concepts and procedures associated with the problem	Evidence of understanding of concepts and procedures associated with the problem	Evidence of partial understanding of concepts and procedures associated with the problem	Limited evidence of understanding of concepts and procedures associated with the problem
Accuracy	Provided a correct solution with no errors	Provided a correct solution, or a mostly correct solution with minor errors	Provided a partially correct solution	Provided an incorrect solution.
Completion	Attempted and completed all problems.	Attempted and completed most problems.	Attempted and completed 50% of problems.	Attempted and completed less than 50% of problems.
Reasoning and Proof	Provided detailed justification of the solution	Provided clear justification of the solution	Provided partial justification of the solution	Provided limited justification of the solution
Communication	Provided a clear and detailed explanation. Used precise mathematical language.	Provided a clear and complete explanation. Used some mathematical language.	Provided an unclear or incomplete explanation. Little mathematical language used.	Provided a limited explanation. No mathematical language used.

Comments:

_____

_____

_____

Answer Key for Activity 1: Zombie Apocalypse

The answer key consists of possible student responses. Some questions have multiple answers that could be considered correct if valid mathematical reasoning is given by the student. It will be helpful for students to know the Pythagorean Theorem for this exercise, although it is not necessary.

1.) **You are at the school and need to get to safety. You have the choice of running down Pine Street or up Ridge Street. Which is the shorter distance? What does this tell you about Elm Street and First Street? Explain your answer.**

Ridge Street is the shorter distance, and Elm Street is the same distance as Ridge Street, and First Street is the same distance as Pine Street because they are opposite parallel sides of a parallelogram which by definition are congruent. This can be determined by creating a rectangle around Ridge Street, and making it the diagonal of the rectangle with area 2. Pine Street can be a diagonal of a square with area 4. The diagonal of the rectangle will be a shorter length.

Other possible answers could include creating right triangles with the streets as the hypotenuse of the triangles to derive Ridge Street is √5(1500ft) and Pine Street 2√2(1500ft).

Students could also compare the slopes.

2.) **You are finally safe at your house when you hear the breaking news that the zombies are heading toward your friend's house. Your friend wants to run to your house because he is afraid to be home alone. He thinks it is safer to run on the roads, but you say it is a shorter distance to run a straight diagonal from each house. Who is correct? What is the difference in distance? What does this tell you about diagonals in a quadrilateral? Justify your answer.**

The distance of the diagonal across the entire town is √160 ≈12.65(1500ft) = 18975ft., which is about 3.59 miles.

Other routes the friend may take include going up East End Street and west on North Street, which is 16(1500) = 24000ft., which is about 4.55 miles.

Another possible route is to the Pizzeria, up Pine Street, up Ridge Street, then west on North Street, which is 14.06(1500) = 21090 feet, which is about 3.99 miles.

There are several valid routes for the friend to take. What students should note is that when a diagonal path is taken, it shortens the total distance. Therefore, the diagonal of a quadrilateral will be less in length than the sum of the two sides. Teachers may draw on the Triangle Inequality Theorem to show it applies to the diagonals of quadrilaterals.

3.) Betty is at the school and wants to join you and your friend in the safety of your house. She is not sure how to get to your house and her phone is dead so she cannot use GPS. Zombies have been reported walking down Main Street by the park. Describe two different routes Betty can take that do not include her travelling down the part of Main Street above the park. What is the distance of each route?

There are multiple valid responses. Students can comment that whether she travels up Ridge Street and west on North Street, or west on Main Street and up Elm Street, it will be the same distance because they are parallel congruent sides of a parallelogram. Students may ask if she can travel on Trail #3 using the knowledge from the previous question regarding diagonals.

4.) Billy escaped the zombie joggers in the park and is at the corner of West Street and South Street. He wants to run to the mall where other non-infected townspeople have gathered for safety. He has two options:

        c.) Run through the woods up Trail 1 and Trail 2, then head east on North Street.

        d.) Run east on South Street, then head north up East End Street.

Which is the shortest route? Justify your reasoning mathematically and with words.

Although the trails only form a diagonal for part of the total path, it will still be the shorter distance. The distance for (a) is 13.87(1500) = 20805 feet. The distance for (b) is 16(1500) = 24000 feet.

5.) All this running has made your friend hungry. You take a chance that the pizza place will deliver a large pizza to you at your house during this zombie apocalypse. The pizza driver says he only delivers to a 3 square mile area (5280 feet = 1 mile). Does your house fall within his delivery zone? Show all work.

Students will most likely draw a rectangle with the Pizzeria at one corner and the house at the other corner to determine that the area is approximately 3.55 square miles. However, if students draw a trapezoid using Pine Street and just continue up to North Street (even though there is no street there) the area will be 2.977 square miles. Using this method, other trapezoids can be constructed with varying areas.

6.) The zombies are all migrating to the movie theater to watch a showing of the movie "Zombieland." You realize the zombies can be fenced in! A local builder says he has an electric fence that can be installed quickly, but it must be attached to asphalt (roads). The area to

enclose all of the zombies is between First Street and Pine Street, and South Street and Main Street. How many feet of fencing will be needed? What is the enclosed area of the fenced in space? Explain your answers.

Students may use the information from Question One to recognize the length of Pine Street and First Street are congruent. Therefore the perimeter for the fencing is 10+4√2 feet of fencing. The area can be found using the area formula for a parallelogram which is base times height (7500*3000) which equals 22500000 square feet. Or, students may divide the shape into a rectangle and two triangles and multiply 2[½ (3000*3000)] + (4500*3000) which also equals 22500000 square feet. Students may also "cut" the triangle from one side of the shape and "add" it to the other side to create a new rectangle and multiply 7500*3000 which equals 22500000 square feet.

7.) **The townspeople must start cleansing the town with an anti-zombie antibody cleanser. The first area chosen is between the Mall, the School, the Pizzeria, and your friend's house. The two cleaning groups argue over how to determine the area of the odd shape. Group A states the area is two trapezoids. Group B states the area is comprised of two rectangles and two triangles.**

      c.) **Which group is correct? Justify your answer.**

      d.) **Is there another way to calculate the area?**

Both groups are correct. The odd shaped area can be divided into two trapezoids with Main Street dividing the two shapes. Or the area can be divided into two rectangles with a triangle attached to each side of each rectangle.

Answers will vary as to other ways to comprise the area of the shape. Students must justify their answers. Prompt students to be creative! If possible, allow students to cut the area out and be able to "move" pieces around to create other shapes.

Bonus Question: How many different quadrilaterals can you identify on this map?

          Justify your answer.

Fifteen. Have students outline in different colors all of the different quadrilaterals.

Benchmark of Student Work Activity 2

Google Maps Worksheet

Name(s): Hannah and Cooper

1. What city did you choose? Roanoke, Virginia

2. Why did you choose this city? b/c Hannah's sister and Cooper's grandma live there!

3. Locate the following objects in your map. Please include units! Remember to include a screen shot or use the snipping tool to present a picture of each shape.

Irregular Quadrilateral

Describe each side using street names:

Side 1	Side 2	Side 3	Side 4
Liberty Rd NE	Plantation Rd NE	Murrell Rd NE	Mansfield St. NE

Measurements from Google Maps (include units!):

Side 1	Side 2	Side 3	Side 4	Total distance	Total area
940.00 ft	533.86 ft	565.60 ft	743.60 ft.	2778.19 ft	452,485.86 ft²

Calculate Perimeter (Show work!):

$940 + 533.86 + 565.60 + 743.60 = 2782.26$ ft.

Would you classify this quadrilateral is convex or concave? Why?

Convex, because the sides do not "cave" in.

What are your reasons for classifying this quadrilateral as irregular? Because all the sides are different and all the angles look different.

Parallelogram

Describe each side using street names:

Side 1	Side 2	Side 3	Side 4
Courtland Rd NW	10th Street NW	Greenland Ave NW	Lyndhurst St. NW

Measurements (Include units!):

Side 1	Side 2	Side 3	Side 4	Diagonal 1	Diagonal 2	Height	Total distance	Total area
723.19'	297.43'	731.55'	295.41'	746.52'	805.67'	290.29'	2031.95'	210,003.83 ft.²

Calculate Perimeter (Show work!): $723.19 + 297.43 + 731.55 + 295.41 = 2047.58$ ft

Calculate Area (Show work!): $(723.19)(.290.29) = 209,934.83$ ft²

What are your reasons for classifying this quadrilateral is a parallelogram? The opposite sides appear to be parallel, the opposite sides are basically equal.

Rectangle

Describe each side using street names:

Side 1	Side 2	Side 3	Side 4
Dorchester Dr. NW	Grandview Ave NW	Ravenwood Ave NW	Huff Lane NW

Measurements (Include units!):

Side 1	Side 2	Side 3	Side 4	Diagonal 1	Diagonal 2	Total distance	Total area
1037.93 ft	719.39 ft	1043.40 ft	729.22 ft	1292.74 ft	1263.67 ft	3497.46 ft	737,345.21 ft²

Calculate Perimeter (Show work!): $1037.93 + 719.39 + 1043.40 + 729.22 = 3529.94$ ft

Calculate Area (Show work!): $(1037.93)(719.39) = 746,676.46$ ft²

What are your reasons for classifying this quadrilateral is a rectangle? Opposite sides appear parallel, opposite sides are basically equal, diagonals are basically equal, 4 right angles.

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Square

Describe each side using street names:

Side 1	Side 2	Side 3	Side 4
Fleming Ave NW	Montague St, NE	Wentworth Ave NE	Brightwell St. SE

Measurements (Include Units!):

Side 1	Side 2	Side 3	Side 4	Diagonal 1	Diagonal 2	Total distance	Total area
406.62 ft	393.09 ft	408.21 ft	393.44 ft	561.07 ft	562.30 ft	1593.76 ft	158,693.01 ft²

Calculate Perimeter (Show work!): $406.62 + 393.09 + 408.21 + 393.44 = 1601.36$ ft

Calculate Area (Show work!):

$$(406.62)(393.09) = 159,838.26 \text{ ft}^2$$

What are your reasons for classifying this quadrilateral is **a square?**

The sides are all almost the same length. The diagonals are the same length. There are 4 right angles.

Trapezoid

Describe each side using street names:

Base 1	Base 2	Side 3	Side 4
Murray Ave SE	Montrose Ave SE	11th St SE	11 ½ St SE

Measurements (Include Units!):

Base 1	Base 2	Side 3	Side 4	Height	Total distance	Total area
408.05 ft	683.95 ft	457.08 ft	375.92 ft	375.92 ft	1936.09 ft	206,498.11 ft²

Calculate Perimeter (Show work!): $408.05 + 683.95 + 457.08 + 375.92 = 1925.0$ ft.

Calculate Area (Show work!):

$$\tfrac{1}{2}(408.05 + 683.95)(375.92) = 205,252.32 \text{ ft}^2$$

Justify how you know this quadrilateral is a trapezoid.

Murray Ave and Montrose Ave are parallel.

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4-Sided Non-Quadrilateral

Describe each side using street names:

Side 1	Side 2	Side 3	Side 3
Plantation Rd	Old Manner Dr.	Plantation Circle	Greenwhich Dr.

Measurements (Include units!):

Side 1	Side 2	Side 3	Side 4	Total distance	Total area
1039.68 ft	128.32 ft	675.59 ft.	733.08 ft.	2627.18 ft.	334,916.5 ft2

Calculate Perimeter (Show work!):

1039.68 + 128.32 + 675.59 + 733.08 = 2576.67 ft

What are your reasons for not classifying this shape as a quadrilateral?

Greenwhich Dr. (Side 3) is not straight, it curves like an "s". All sides must be straight to be a quadrilateral.

Additional Questions:

4. What is "measurement error"? Describe how measurement error can have an effect on the conclusions you made about the various quadrilaterals found in Google Maps? Measurement error is the difference between a measured value a quantity and its true value. This can mean that I conclude a shape is a certain type of quadrilateral when it really is not or I could say a figure is not a type of quadrilateral when it really is.

5. Compare the perimeter and area values provided by Google Maps to those you calculated on your own. Are they different? What could explain a difference? Which values do you think are most accurate, why?

My calculations were very similar to those from Google maps. The difference comes from how the measurement tool is placed on the map. I think that the Google Maps' values are more accurate because there is no human error.

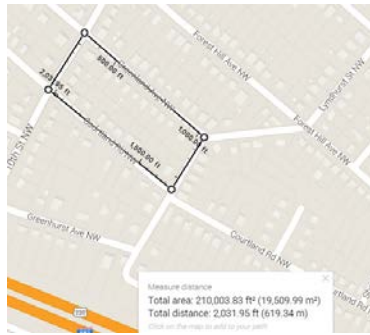6. Which of the figures do you feel was the most difficult to find within the city map? Why?

The square was the most difficult to find. I think it is hard to find squares because the grid layouts in cities is based on rectangles, not squares.
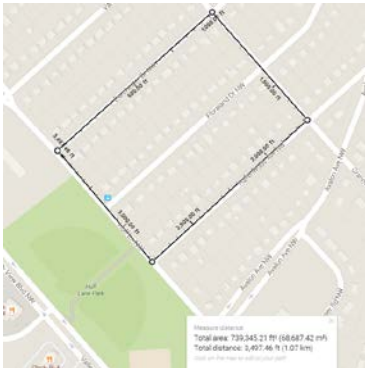
15

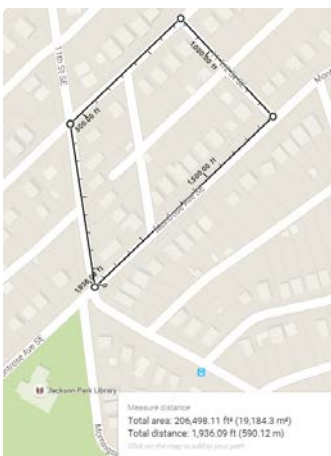Screen Shots of Figures

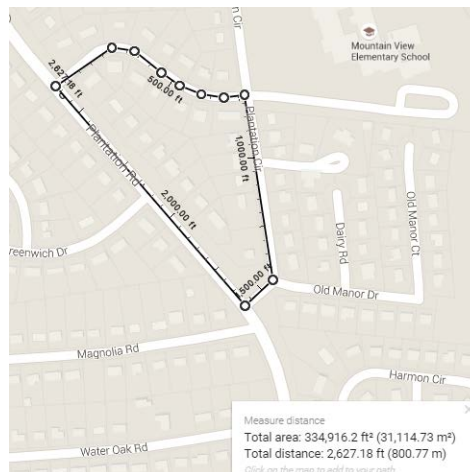Irregular Quadrilateral:
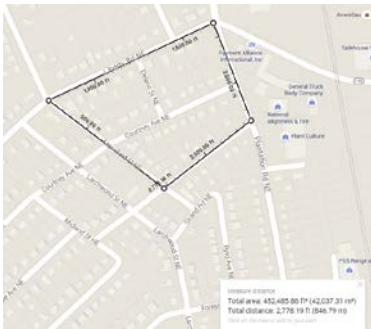
Parallelogram:

Rectangle:

Square:

Trapezoid:

4-Sided Non-Quadrilateral:

Answer Key for Activity 3: Help the CDC

The sample student response answers for activity 3 may vary based on how the students are measuring with Google Earth Pro. The numerical values may change, but should be close to the sample.

1. **The secret service has been able to protect the white house by setting up road fences along 17th street and 15th street and concrete barriers along H Street and Constitution Ave. (Turn on the roads view to help find the correct streets)**

   - **Using Google Earth and your map of D.C. to determine what the shape of the secured area around the white house is. Draw the secured area on your paper map as well.**
     See sample basic map for drawing

   - **What kind of quadrilateral does the secured area form?**
     The shape is a rectangle.

.

   - **How much road fence was used?**
     There was approximately 1.12 miles of road fence.

   - **What percent of the perimeter are concrete barriers? (Show all work)**
     Approximately 35%

   - **What is the total area of the secured area? (Show all work)**
     The values may change depending on the actual polygon that was draw. The area is approximately 0.18 miles squared

2. **There has been a report that senators are also trapped in the Capitol Building with a small group of National Guard. The president wants to know if this report is true. Use Google Earth to determine the best route to reach the Capitol Building.**

   - **Use the "Get Directions" feature on Google Earth to find possible routes. Draw this route on your basic map.**

     See sample basic map for answer.

   - **What is the shortest walking distance?**

     The shortest distance is 1.8 miles.

   - **How long should it take for the agent to get there?**
     It would take the agent about 35 minutes to get there without zombie encounter

3. **Good news, the senators have a lot of National Guard members helping them hold the Capitol! With the new man power, the President has decided to start taking back D.C. Phase 1 involves making a safe zone between the White House and the Capitol. The Secret Service has 1.75 miles of road fence left.**

- **Can they fence off the area from the secured area to the corner of Pennsylvania Ave. and Constitution Ave.? (Hint: Use the ruler tool)**

  Answers may vary: The Secret Service can fence off the new area if they only fence along Pennsylvania Ave. and Constitution Ave. They do not need to put fencing on 15th street again because it was already fenced by the secured White House area.

- **What kind of quadrilateral is formed in Phase 1? (Make one on Google Earth and record it on your basic map as well)**

  The new quadrilateral is a trapezoid. See Basic Map as well.

- **What is the total area?** Answers may vary do to measurement error.

$$A = \frac{1}{2}h(b_1 + b_2)$$

$$A = \frac{1}{2} * 0.24 * (0.22 + 0.84)$$

$$A = 0.1272 \ miles^2$$

Google Earth calculates the area at 0.12 miles[2]

4. **The Senators will need to complete Phase 2 from their spot. They think that they can create a green zone between Constitution Ave. and Independence Ave. and from 1st street to 7th street. Draw this on your basic map.**

- **The National Guard has 2.2 miles of road fence, is this enough to make the green zone? If not, how much more do they need?**
  Yes, the National Guard can fence in the green zone as long as they are not doubling up fence on Constitution Ave. with the adjacent section to the Secret Service's phase 1 area.

  2.34 - 0.22 = 2.12 total miles needed.

- **To keep the zombies out the National Guard needs to have a person every 50 feet. How many people does it take to hold the green zone? Show all work.**

  1 mile = 5280 ft.

$$2.12 * 5280 = 11193.6$$

$$\frac{11193.6}{50} = 223.872$$

They would need 224 Guard members to hold the fence

5. **Now that the President and the Senators can communicate again, they have decided to find a vaccine to stop the zombie onslaught. The Federal Emergency Management Agency (FEMA) has a lab and it is close to the green zone. It is not on you basic map so use google earth to find it. (Be sure to turn on "Places" in your layers)**

   - **Locate the FEMA building and determine what streets you would have to fence off to secure the building. Record the streets and the length of fence needed for each in the table.**

Side 1 6th Street	Side 2 4th Street	Side 3 Virginia Ave.	Side 4 Independence Ave. This side is already fenced
Length 0.17 miles	Length 0.22 miles	Length 0.13 miles	Length 0.12 miles

   - **What is the total area of the FEMA section? Show all work.**

$$A = \frac{1}{2}h(b_1 + b_2)$$

$$A = \frac{1}{2} * 0.12 * (0.22 + 0.17)$$

$$A = 0.0234 \; miles^2$$

Google Earth calculates the area at 0.0 so students must calculate by hand.

6. **While holding the Green Zone the 7th Street fence was over run and all National Guard members on that street were exposed to the pathogen.**

   - **How many vaccines does the FEMA lab need for the National Guard members?**

     Using the ruler tool the length of fenced green zone 7th street is 1670.36 ft. approximately.

     $$X \cong \frac{1670.36}{50}$$

     $$X \cong 33.4$$

     They would need to make 34 vaccines for the Guard.

   - **The president decides all people exposed to zombies guarding the fences need the vaccine. How many total people need a vaccine? (Hint, look at all fences only exposed to zombie attack and use the path tool.**
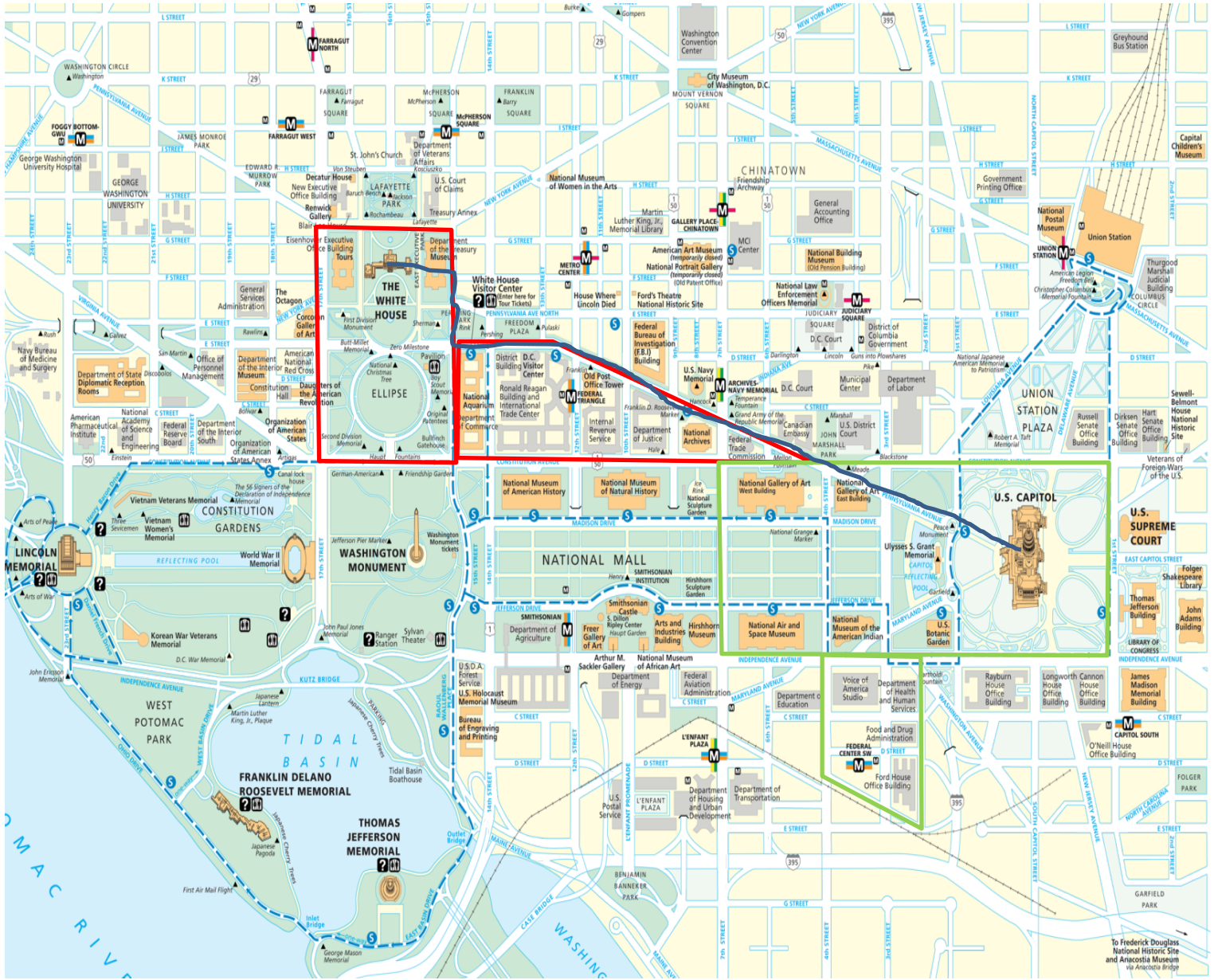
     There is approximately 29,287 ft. of fence exposed to the zombies. There may be some error in measuring the path.

     $$X \cong \frac{29,287}{50}$$

     $$X \cong 585.74$$

     They would need to make approximately 586 total vaccines. If they have already made the first batch for the exposed National Guard they would only need 552 additional vaccines.

Sample Basic Map

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Sample Student Work for Google Earth