Performance Based Learning and Assessment Task

Streets of Stephens City

I. ASSESSSMENT TASK OVERVIEW & PURPOSE:
Students will measure angles of street intersections to determine if parallel streets exist in Stephens City. The students will determine if some intersections are safer than others. The students will also make conjectures and investigate angle relationships.

II. UNIT AUTHOR:
Holly Legge - Sherando High School, Frederick County

III. COURSE:
Geometry

IV. CONTENT STRAND:
G.2

V. OBJECTIVES:
The task uses an investigation of the real world to measure angles, investigate angle relationships and determine if parallel lines exist.

VI. REFERENCE/RESOURCE MATERIALS:
A map of Stephens City, calculators, protractors

VII. PRIMARY ASSESSMENT STRATEGIES:
The task includes an assessment component that performs two functions: (1) for the student it will be a checklist and provide a self-assessment and (2) for the teacher it will be used as a rubric. The assessment checklist and rubric are attached.

VIII. EVALUATION CRITERIA:
Assessment will be based on the attached rubric. Students will be given the opportunity to self-assess before the teacher assesses the student's work. A benchmark of exemplary work is attached.

IX. INSTRUCTIONAL TIME:
This activity should take one 90-minute block or two 45-minute blocks.

Streets of Stephens City

Strand
Geometry, Measurement

Mathematical Objective(s)
Students will determine if two or more lines are parallel and compare any two or more angles using appropriate vocabulary, including complementary, supplementary, vertical, corresponding, alternate interior, alternate exterior, consecutive or same side interior, consecutive or same side exterior, linear pair, and transversal.

Related SOL
G.2 The student will use the relationships between angles formed by two lines cut by a transversal to a) determine whether two lines are parallel; b) verify the parallelism, using algebraic and coordinate methods as well as deductive proofs; and c) solve real-world problems involving angles formed when parallel lines are cut by a transversal.

NCTM Standards
- Use geometric ideas to solve problems in, and gain insights into other disciplines and other areas of interest such as art and architecture
- Analyze precision, accuracy, and approximate error in measurement situations
- Apply and adapt a variety of appropriate strategies to solve problems
- Communicate mathematical thinking coherently and clearly to peers, teachers, and others

Materials/Resources
- Maps of different locations in Stephens City (attached)
- Graphing Calculator
- Protractors

Assumption of Prior Knowledge
Students should be familiar with parallel lines, transversals, the angles created when a transversal crosses parallel lines and the properties these angles possess. Students should also be familiar with how to use a protractor for measuring angles. Students should be operating on at least level two of the Van Hiele scale for geometric development with respect to parallel lines which means the students should be able to recognize the angle relationships and be able to name the types of angles formed when a transversal intersects two parallel lines.

Introduction: Setting Up the Mathematical Task

In this activity, students will investigate parallel lines and angles in the context of our community using street maps of Stephens City (attached) and student worksheets to guide the task (attached). A student assessment checklist and rubric are also attached.

To introduce the task, I will begin a discussion about the streets of Stephens City and how some streets intersect while others do not. I will ask the students, "Have you ever noticed that some intersections seem safer than others? Civil Engineers design street intersections with safety in mind." I will instruct the students to read the paragraph about the types of intersections found on our roadways.

Student Exploration

I will give students a copy of a road map of a portion of Stephens City. In the first activity, students will be placed in groups of two or three and will be asked to locate and label right angles, acute angles, obtuse angles and straight angles on their maps using a protractor for measuring. The teacher will then spot check their work and distribute the handout for part two.

For part two, students will locate pairs of complementary angles, supplementary angles, and vertical angles using a protractor for measuring. Once completed, the teacher will spot check and distribute handout three.

For part three, students will first make conjectures about which streets they believe will be parallel. The students will prove or disprove their conjectures by identifying whether special pairs of angles, such as corresponding angles, are congruent.

For the duration of the activity, the teacher should walk around the room, helping students who need further assistance and keeping students on task.

Monitoring Student Responses

- Students will be communicating their thinking and new knowledge through interactions with peers and class discussions.
- If a group finishes before expected, they will complete the extension included on Student Worksheet 3.
- At the close of the activity, the teacher should reinforce the objectives through a class discussion.
- To summarize the activity, students will be asked to write briefly about the activity using a prompt.

Assessment List and Benchmarks

- An Assessment List, Rubric and Benchmark of hypothetical excellent student work are attached
- Journal/writing prompts
  Summarize what you did in this activity then add to your writing by answering the following questions.
  - We used our geometric knowledge to analyze the streets of Stephens City. How else might this knowledge be used in the real world?
  - How did this activity go for you? Did you have any complications?
  - What new knowledge did you gain by completing this activity?

Types of Intersections

There are essentially three types of road intersections: cross, T, and Y or skewed intersections. A cross intersection has four legs, usually at a 90-degree angle with one another. T intersections have three legs, also usually at a 90-degree angle with one another. Y or skewed intersections have three legs, usually with one leg at an angle less than 90 degrees, much like the letter “Y”. These intersections are regulated by either traffic signals, stop signs, or yield signs. Studies have clearly indicated that cross intersections are more dangerous than T intersections and Y intersections, and that traffic signal regulation is more dangerous than stop sign regulation. This is the expected result, as 4-leg intersections are more complex than 3-leg cross intersections, and signalized intersections generally have higher speeds and more traffic than stop-sign intersections. Studies have also clearly shown that T intersections are safer than Y intersections. This result is logical because in Y intersections, a driver must look backwards over his shoulder or use side mirrors to merge with traffic, sometimes resulting in blind spots. T intersections, on the other hand, only require the driver to look 90 degrees to the left and right, which increase the chance that the driver will see all oncoming vehicles.

http://ceenve3.civeng.calpoly.edu/jud/New%20Senior%20Project%20Website/chapter5.html

Streets of Stephens City

Student Worksheet 1

Take a look at your map. Locate and verify types of angles by measuring them with a protractor. Locate cross intersections, T intersections and Y intersections. Record your results below and label the angle measurements on your map.

Locate, measure and label all acute, obtuse, straight, and right angles on your map.

You may need to place points and label them at all intersections in order to be able to identify your angles with three letters.

Number of cross intersections_____

Number of T intersections_____

Number of Y (skewed) intersections_____

Based on the attached crash map of Stephens City and the types of intersections identified, is your area more or less prone to accidents? Which intersections are the safest? Explain.

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Student Worksheet 2

Locate and verity pairs of complementary angles, supplementary angles, and vertical angles. Verify the angle sums by showing the angle addition for each pair of angles below. (ex. $\angle ABC + \angle DEF = 90°$)

Complementary pairs of angles:

1._____

2._____

3._____

Supplementary pairs of angles:

4._____

5._____

6._____

Vertical pairs of angles:

7._____

8._____

9._____

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Student Worksheet 3

Which streets appear to be parallel? Are they actually parallel? Make a conjecture about which streets you think are parallel and which streets could be a transversal that crosses them. Find angles with a special relationship to prove or disprove that the streets are parallel. Record your results below.

1. List the special angle relationships that are formed when a transversal line crosses parallel lines.

   _____ _____

   _____ _____

   _____

2. Fill in the Parallel Street 1, Parallel Street 2, and Transversal columns with the streets you think are parallel and the streets that are transversals.

Parallel Street 1	Parallel Street 2	Transversal	Reasoning

3. Now go back and fill in the reasoning column with a special angle relationship that verifies the streets are actually parallel. Are the streets you thought were parallel, actually parallel?

4. Why is it important to be precise when measuring?

Challenge Question: If you were outside standing at an intersection, how could you measure the angle where the two streets meet?

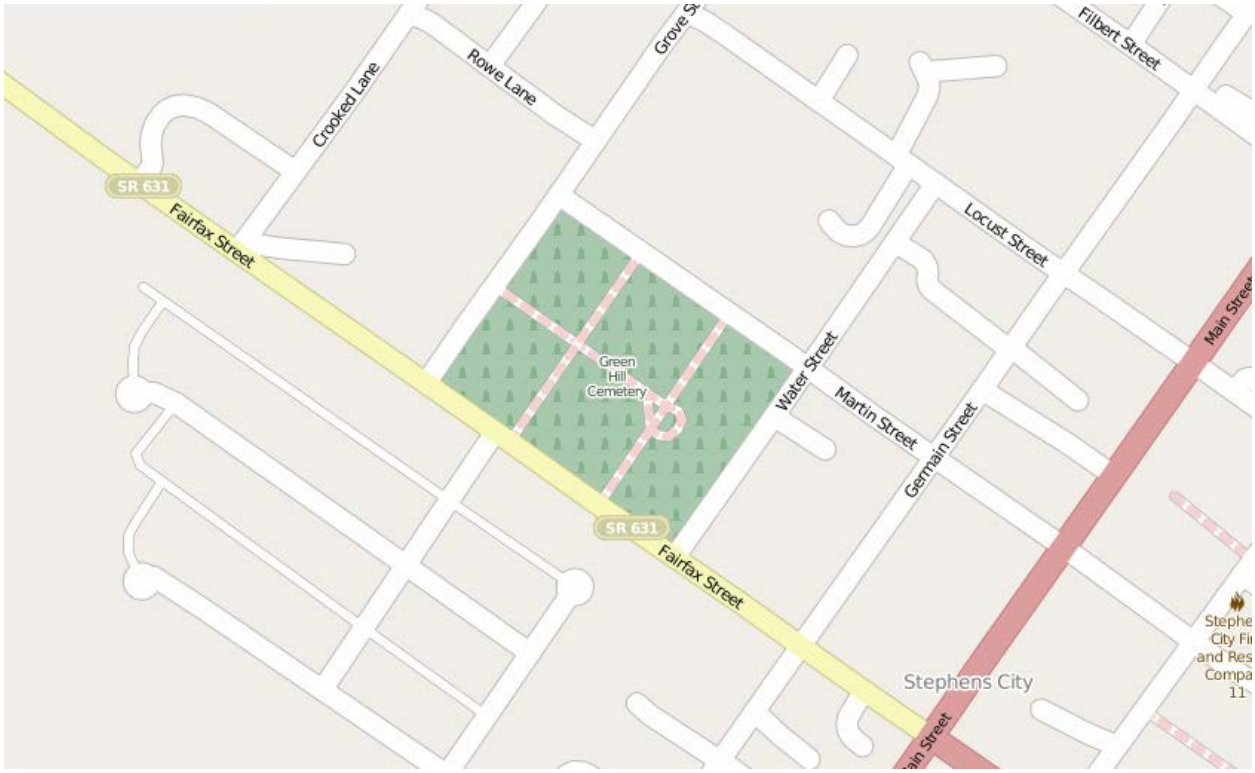
Extension Activity

Print out a street map of your choice and research the crash data for your area. Identify the total number of each type of intersection and determine if your area is prone to accidents.

Map 1

http://www.openstreetmap.org/relation/206917#map=16/39.0973/-78.2014

Map 2

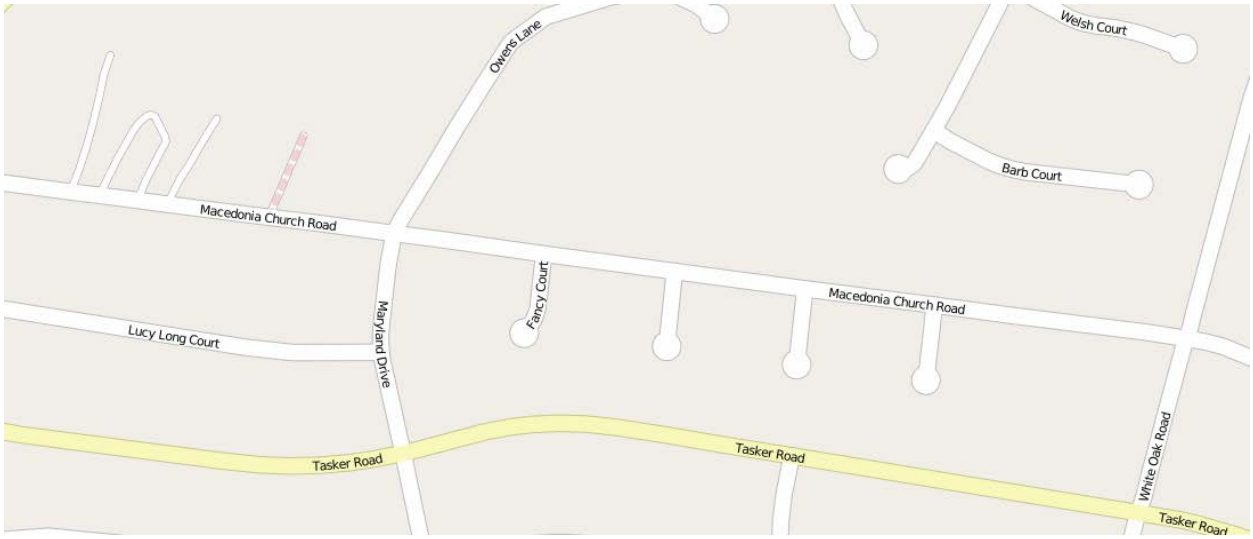


http://www.openstreetmap.org/relation/206917#map=16/39.0973/-78.2014

Map 3

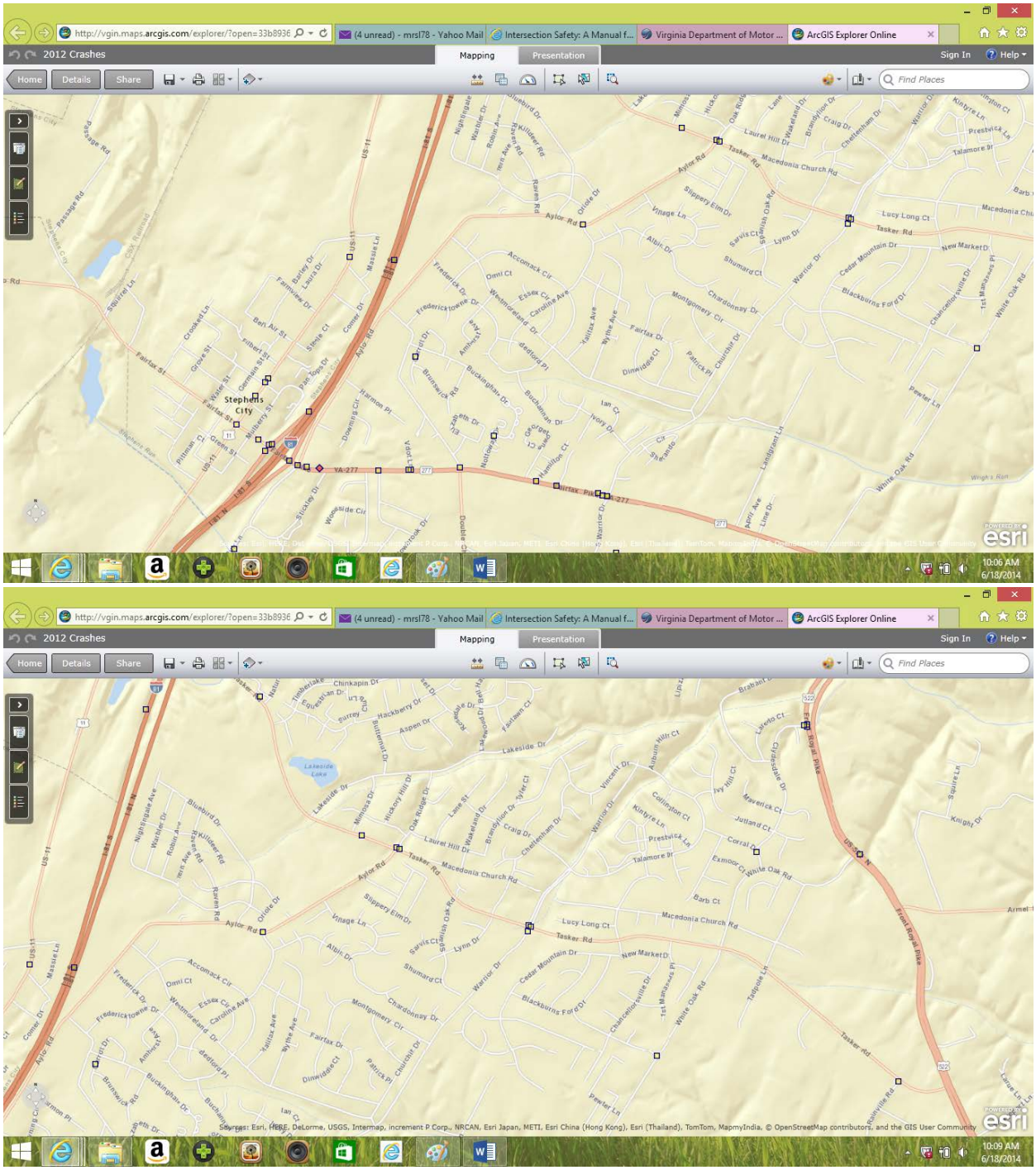
http://www.openstreetmap.org/relation/206917#map=16/39.0973/-78.2014

Map 4



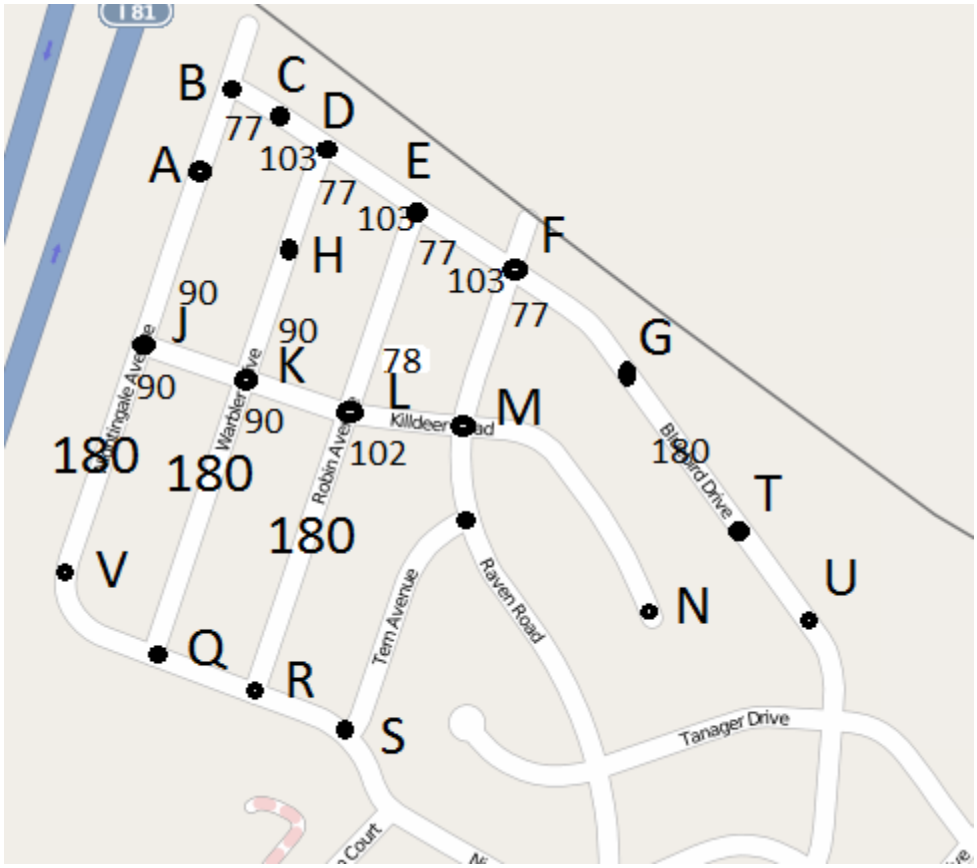
http://www.openstreetmap.org/relation/206917#map=16/39.0973/-78.2014

Crash Map of Stephens City in 2012

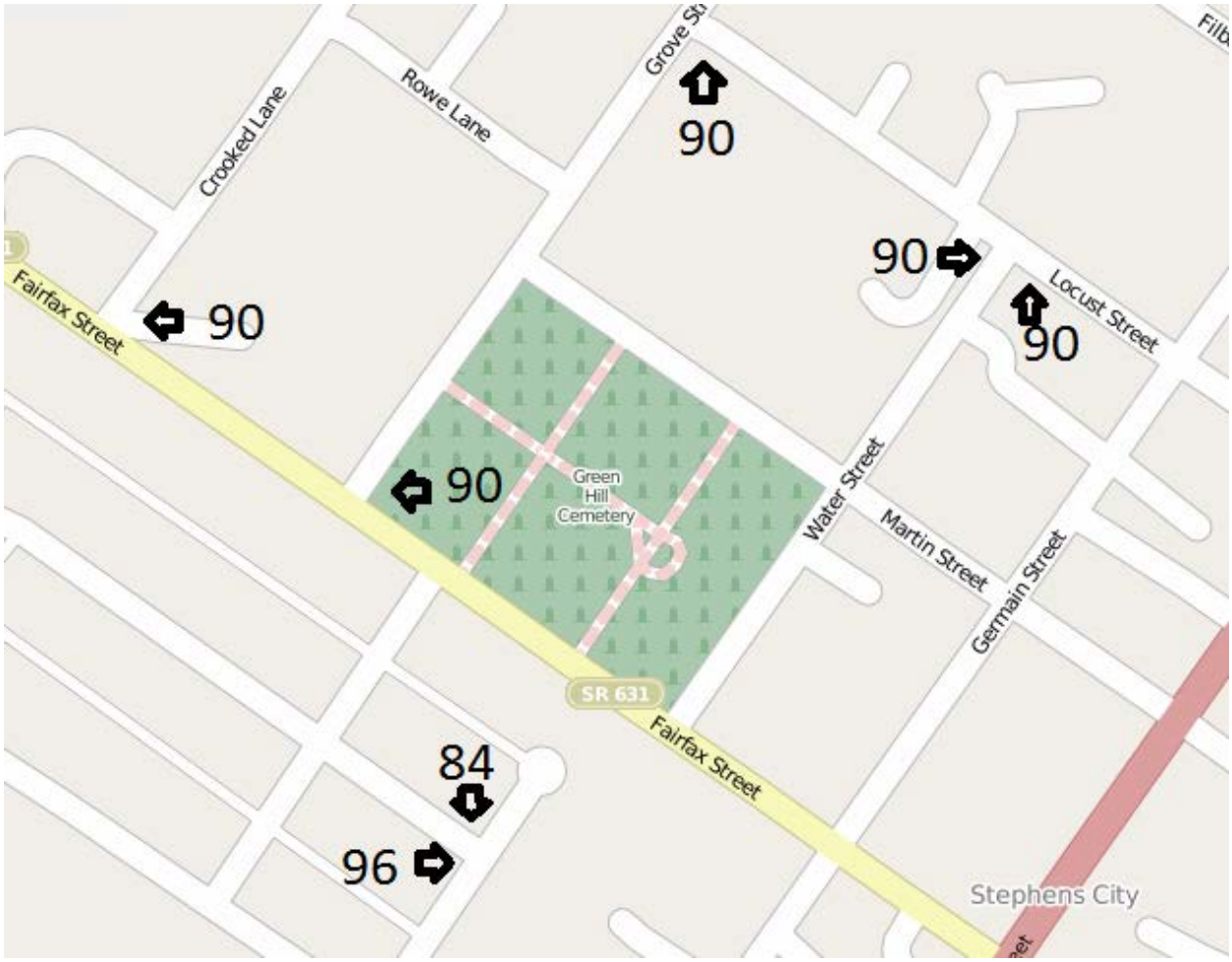


http://vgin.maps.arcgis.com/explorer/?open=33b89368a65d4c52a7741f63825b9c14

Map 1 Benchmark



Map 2 Benchmark



Assessment List: Streets of Stephens City

			Earned Assessment	
Num.	**Element**	**Point Value**	**Self**	**Teacher**
1	I listed the total number of each type of intersection on Worksheet 1	2		
2	I accurately measured and labeled each angle on the map	2		
3	I thoroughly answered the crash question on Worksheet 1	2		
4	I listed 3 pairs of each type of angle, if possible, by writing angle sum equations on Worksheet 2	2		
5	I listed all 5 special types of angles on Worksheet 3	2		
6	I completely filled in the chart on Worksheet 3	2		
7	I thoroughly answered questions 3 & 4 on Worksheet 3	2		
8	I completed the Challenge Question	2		
9	I completed the Extension Activity	2		
10	All of my mathematical calculations are accurate	2		
11	My work is neat and organized	2		
12	I stayed on task for the duration of the activity	2		

Streets of Stephens City Rubric

	3	2	1	0	Student Score	Teacher Score
Worksheet 1 Angles	All of the angles are correctly measured and labeled on the map	Most of the angles are correctly measured and labeled on the map	Few of the angles are correctly measured and labeled on the map	No angles correctly measured and labeled on the map		
Worksheet 1 Intersections	The correct number of each type of intersection is given	Miscounted the number of each type of intersection by up to 2	Miscounted the number of each type of intersection by up to 4	The number of each type of intersection is not given		
Worksheet 1 Crash Question	A thorough and sound explanation is given for the crash question.	A sound explanation is given for the crash question but may be missing a few important details.	An explanation is given for the crash question but it is lacking details and may not make sense.	No explanation is given for the crash question.		
Worksheet 2	All 3 pairs of each type of angle, if possible, are correctly identified and verified by showing the angle sums	All 3 pairs of each type of angle, if possible, are correctly identified but angle sums may be inaccurate	Missing pairs of each type of angle, angles may be incorrectly identified, angle sums may be inaccurate	No angle pairs identified		
Worksheet 3 Special Angles	All special angles are listed	Missing 1-2 types of special angles	Missing 3-4 types of special angles	No special angles listed		
Worksheet 3 Parallel Lines	Entire chart is filled in correctly with no mathematical errors	Entire chart is filled in correctly with few mathematical errors	Some of the chart is filled in correctly with mathematical errors	The chart is not filled in		
Worksheet 3 Questions 3 & 4	Answered completely and makes logical sense.	Answered completely but may lack logical sense.	One questions is answered and may not make logical sense	Questions 3 and 4 are not answered		
Worksheet 3 Challenge Question	Answered completely and makes logical sense	Answered completely but may lack logical sense	Answer is incomplete and does not make sense	No answer given		
Worksheet 3 Extension Activity	Includes a street map, a crash map, and a thorough explanation.	Includes a street map, a crash map, but explanation is incomplete.	Missing one of the maps, explanation is incomplete.	No maps, no explanation		

Final Score_____