Building a Recreation Center Performance Based Learning and Assessment Task

I. ASSESSMENT TASK OVERVIEW & PURPOSE:

The students will apply their knowledge of constructions and finding triangle centers to determine the best location site of a recreation center that will serve three distinct areas within a geographical location.

II. UNIT AUTHORS:

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III. COURSE:

Geometry

IV. CONTENT STRAND:

Constructions

V. OBJECTIVES:

The learner will be able to construct the inscribed and circumscribed circles of a triangle. Extension: The learner will be able to find the concurrency of medians of a triangle.

The learner will use the above information to prepare a written proposal to the City Council stating where a new Recreation Center should be built in order to serve these three communities and a justification as to why the location was chosen. The learner will support their proposal with research found on Google Maps or other map applications.

VI. REFERENCE/RESOURCE MATERIALS:

- Compass
- Patty Paper, and/or
- GeoGebra
- Computers with access to Google Maps or other map application

VII. PRIMARY ASSESSMENT STRATEGIES:

The task includes two assessment components. First, students will assess themselves using a checklist. The teacher will use the same checklist to evaluate the student's analysis and understanding of the different types of triangle centers and their application to a real life problem.
The assessment also analyzes a student's ability to check for reasonableness by providing support of their conclusions using real-life contexts.

VIII. EVALUATION CRITERIA:
The rubric provides a checklist for students and teachers in evaluating the work. Students will be graded on their solution in the context of the problem addressed, their assumptions and data used to arrive at the solution, the selection of cite to provide research for mathematical content, and their assessment of the advantages and disadvantages of the cite selected.

Actual student work will be available as benchmarks and examples of product expectations.

IX. INSTRUCTIONAL TIME:
Two ninety-minute class periods

Building a Recreation Center

Strand: Geometry

Mathematical Goals and Objective(s):

This assessment provides a real life activity in which students gain experience and discover the significance of triangle centers to include the incenter, circumcenter and centroid.

Related SOL:
G.4 *The learner will be able to construct the inscribed and circumscribed circles of a triangle.*

Extension: *The learner will be able to find the concurrency of medians of a triangle.*

NCTM Standards

Geometry Content Standards:

- Analyze characteristics and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships.
- Use visualization, spatial reasoning, and geometric modeling to solve problems.

Process Standards:

- Apply and adapt a variety of appropriate strategies to solve problems.
- Communicate mathematical thinking coherently and clearly to peers, teachers, and others.

Materials/Resources
- Compass
- Patty Paper, and/or
- GeoGebra
- Computers with access to the internet and maps such as Google Maps

Assumption of Prior Knowledge
- In order for students to be successful at this task they should have received instruction in constructing the inscribed and circumscribed circles of a triangle and be able to construct the medians of a triangle. Their decision of what center to be used should be based on their knowledge of the significance of each construction. Students should be Analysis level on the Van Hiele scale with respect to constructing and understanding the significance of triangle center concepts.

Introduction: Setting up the Mathematical Task

- Students should be placed in groups of four for this task, so that each student has a partner to work with and another pair to share during table group events.
- To get students started thinking about this task you might ask them to think about where they meet their friends when they are not in school? Have they ever visited their recreation center or neighborhood park?
- Some questions you might ask students to think about: How close is the recreation center? Do all of their friends live in the same neighborhood? What if some of their friends lived in another neighborhood?

Where would be a location that would be "central" to everyone? What is meant by "central?" If students struggle to get started, an analogy might be to remind students of the measures of central tendency: mean, median, and mode. The best measure of central tendency chosen depends on the circumstances of its use. After everyone has a moment to share in their groups, ask for volunteers from each table group to share with the whole group.

- Teacher will distribute materials and allow students to read over directions and examine rubric. The teacher will provide an explanation of the overall project including parts to be completed individually and those that may be done with a partner. The teacher will review the rubric and provide student work examples.
- Teacher will monitor student progress and provide assistance as needed as students complete the task.
- Access to computers and the internet should be provided throughout the task to support students' research of the problem at hand.

***Teacher should adjust the geographical locations mentioned in the task to be three locations in the student's community. There should be enough ambiguity in the identification of these areas so as to require some assumptions to be made on the students' part regarding the placement of points to represent each area.

Student Exploration

Students will be encouraged to use notes, textbooks, and technology to clarify aspects of the task that confuse them. Students will need to locate the neighborhoods mentioned in the task. Student discussions will include decisions about where in each neighborhood to measure from and to. Some neighborhoods may cover a larger geographic area. Access to some neighborhoods may be limited (water, bridges). As students begin to work, the teacher will encourage groups to identify the important information that they will need in order to complete this task, determine the best methods for finding this information, and divide the workload to do so. The teacher will also encourage students to reflect on prior experiences in the class and upon skills discussed in class that may be needed to complete the task. The teacher should anticipate hearing discussions of concepts like circumcenter, incenter, centroid, and medians of a triangle, and strengths and limitations of each.

Student/Teacher Actions

Students will be considering the three different types of circle centers when solving this task. Students will may use traditional geometric constructions with a compass or choose to use alternative methods shown in class involving patty paper or Geogebra. Students will also have been asked to clearly establish the assumptions that were necessary in order to arrive at a solution, i.e. how did you determine the location of each section of the city, how did you define "best location," etc. Students will then find evidence of the distance between the rec center and the three geographic areas using Google maps or other map application.

- Students might begin to express the notion that the selection of a triangle center depends on its application. Is it important that the center be equidistant from the three vertices of the triangle? Should it be the largest circle that will fit inside the triangle and touch all three sides? Should it be at the center of gravity of the triangle?

- It might be difficult for students to justify why it is the most appropriate use of center given an application. Teacher might remind students that the incenter is equidistant from the sides of a triangle, the circumcenter is equidistant from the vertices of a triangle, and the centroid, when connected by a line segment to each vertex, creates three portions that are equal in area.

- The teacher will monitor student progress and provide assistance, as necessary.

Evaluation Rubric/Benchmarks:

Students will submit a copy of the following rubric with their completed project. They will have highlighted bullets that apply to their work in the rubric, award themselves a rating of 0, 3, 4 or 5 and provide justifying comments.

Teachers will complete the same rubric highlighting bullets that apply to the student's work, award a rating of 0, 3, 4 or 5 and provide justifying comments.

Benchmark: attached

Building a Recreation Center

You work for the City Planner for *Virginia Beach**, and the City Council is considering building a new Recreation Center to serve the *Landstown, Pungo,* and *Sandbridge** areas of the city. You will submit a written proposal to the City Council stating where the new Recreation Center should be built in order to serve these three communities and a justification as to why the location was chosen. Your group will create a visual presentation for the City Council and members of the community at their next meeting. This may be a PowerPoint, a Prezi, a trifold, a poster, etc.

Include in your presentation the following:

 1. Where the Rec Center should be located so to be central to members in the three localities mentioned and how this was determined. Include research and evidence of use of mapping application.

 2. The advantages and disadvantages of the site chosen.

 3. Maps, pictures, and/or tables to support your recommendation.

*locations should be adjusted to reflect areas within the students' communities

Criteria	Attempted (3 points)	Satisfactory (4 points)	Exemplary (5 points)	Total Points
Mathematical Principles Used in Selection of Site	-site was selected with minimal mathematical support	-site was selected with some mathematical support but may be flawed or executed incorrectly	-site was selected using accurate geometric principles	
Advantages and Disadvantages of the Selected Site Addressed	-advantages and disadvantages of the selected site addressed minimally or with little/no credible research to support the assertions	-advantages and disadvantages of the selected site addressed -some important considerations may not have been addressed -assertions are based on credible, cited research	-advantages and disadvantages of the selected site are thoroughly addressed and based on credible, cited research	
Accuracy of Mathematical Solution in the Context of the Problem is Addressed	-credibility of solution arrived through chosen method is minimally addressed	-credibility of solution arrived through chosen method is addressed but may be flawed or missing some important considerations in context of the problem presented	-credibility of solution arrived thoroughly explored and discussed in the context of the problem presented	
Assumptions and Preliminary Data Necessary to Arrive at a Solution Are Presented	-preliminary research and assumptions made in describing the selection of chosen pathway to a solution to the problem are minimally discussed	-preliminary research and assumptions made in describing the selection of the chosen pathway to a solution are discussed but may be flawed or missing some important considerations	-preliminary research and assumptions made in describing the selection of the chosen pathway to a solution are thoroughly discussed and explained	

What score do you think you should receive for each section?   Your comments to support this rating:

Mathematical Principles _____/5

Advantages & Disadvantages _____/5

Accuracy of Solution _____/5

Assumptions & Preliminary Data _____/5

Total Points _____/20

Scores Awarded by Teacher: Comments:

Mathematical Principles _____/5

Advantages & Disadvantages _____/5

Accuracy of Solution _____/5

Assumptions & Preliminary Data _____/5

Total Points _____/20

Student Benchmark:

Suburban Planning Council Proposal

STUDENT WORK SMAPLE

Problem & Question

- The city council is considering building a new Recreational Center to serve the Landstown, Pungo, and Sandbridge areas of the city.

- Where should the Rec Center be located so to be central to members in the three localities mentioned?

Map

This map shows the three locations and the route to get to each one.

A = Landstown   B = Pungo   C = Sandbridge
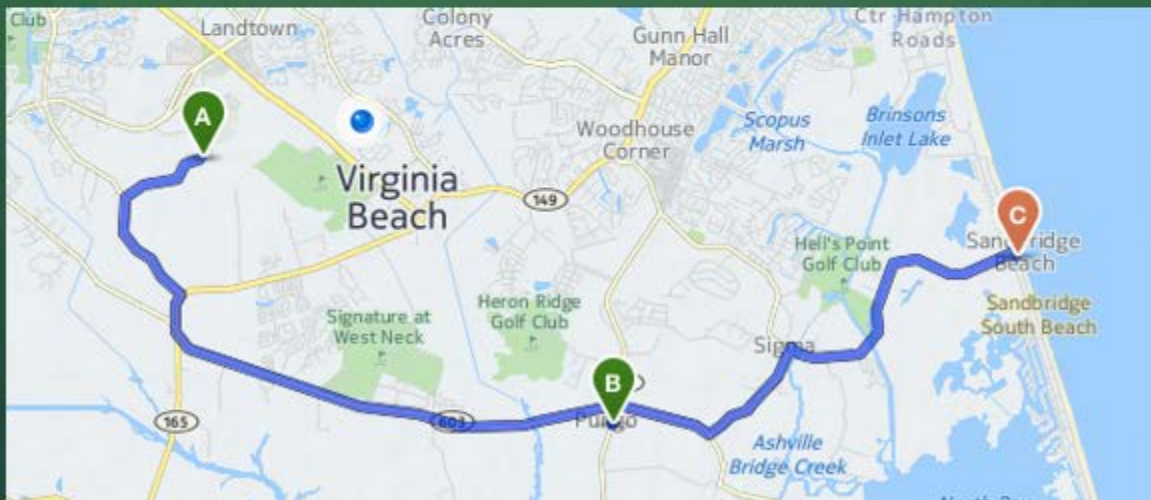
As you can see, the distances between these two points are not straight lines because the road routes are not straight. As an estimation, if all the lines were straight…

From **Landstown** to **Pungo**, the distance is **7.5 miles.**
From **Pungo** to **Sandbridge**, the distance is **5.7 miles.**
From **Sandbridge** to **Landstown,** the distance is **12.8 miles.**

I constructed a triangle using these lengths as the sides and locations as the vertices. I made the triangle to the scale of 1 mi = 1 cm.
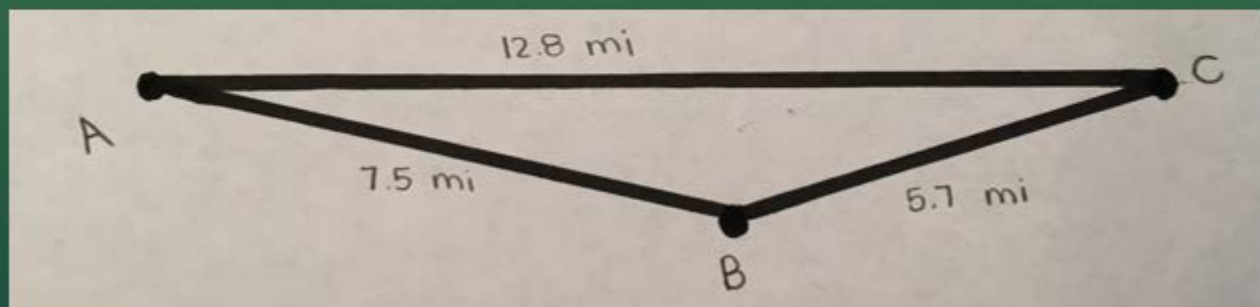
In order to find the point that will be most conveniently accessed for all three locations, we need to find the point that is equidistant to all of them. To do this, we must find the <u>circumcenter.</u> The circumcenter of a triangle is the point that is equidistant from the three vertices. We can find the circumcenter by constructing the perpendicular bisectors of each side, and then drawing the point where they intersect. Here is the circumcenter of the triangle where Landstown, Pungo, and Sandbridge are the vertices.
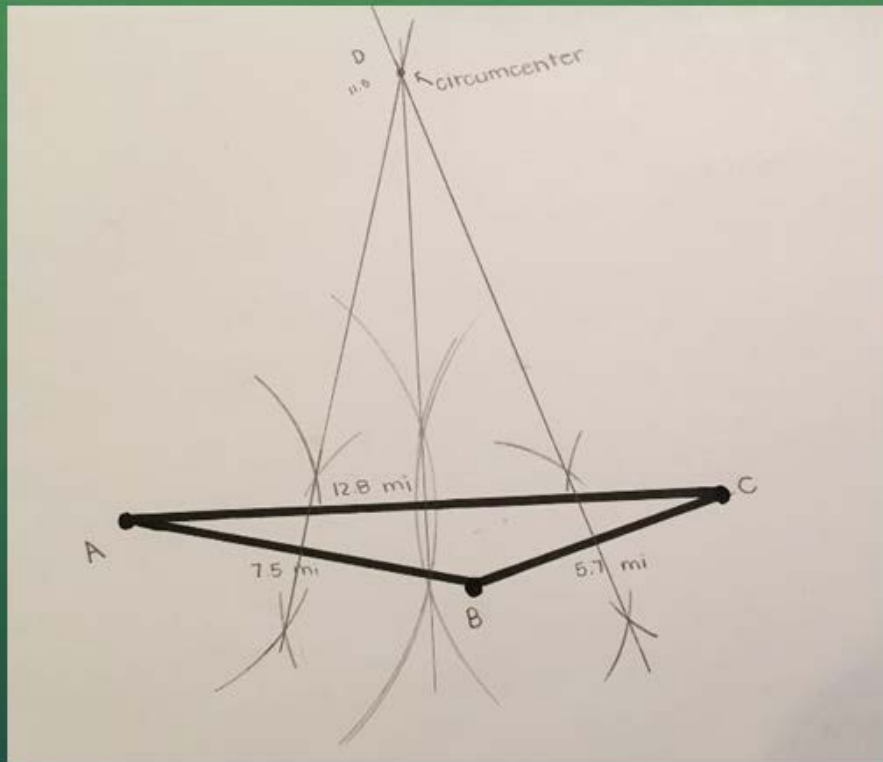
In this situation, the circumcenter does not lie inside the triangle. One might think to build this new Rec Center on this exact point, but it is actually not the best place. From each location, the circumcenter is about 11.5 miles north, which in traffic can take 20 minutes to drive.

Although this mathematically may seem like the right answer, it is not logical to drive 11.5 miles each way for a quick workout at the Rec Center. The better way to solve this problem is to place the Rec Center inside the triangle formed by these three locations. Of course, it will be much closer to point B (Pungo) than it is to the other locations, but Pungo is a large, sparse area and some people live farther South than others.

In order to get a point that was inside the triangle, I constructed the incenter- the point that is equidistant from the sides. Here is a picture (the incenter is highlighted in pink).
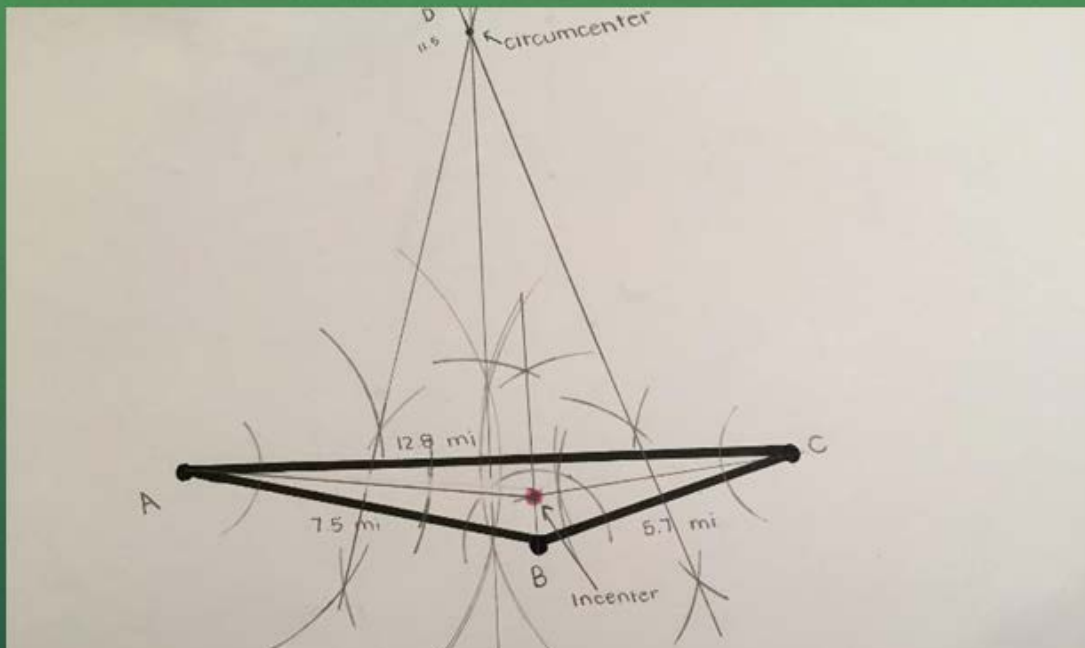
As you can see, this point is a much more central location than the circumcenter, and it is a much shorter drive for residents of all three communities. But, this is still just a drawing on paper, so I converted this point to an actual place using Google Maps.

The Rec Center will be built on
Seaboard Rd.
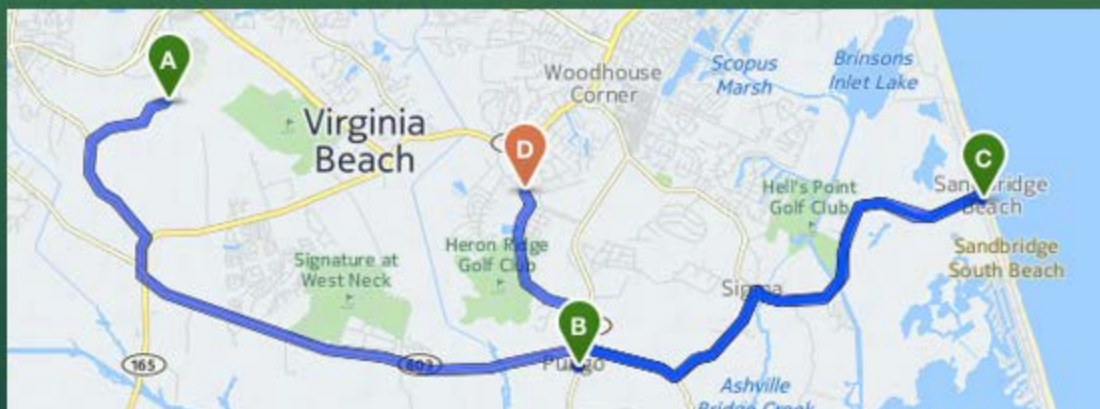
Seaboard Road, Virginia Beach, VA

I strongly believe that Seaboard Road is the best place to build our new Recreational Center. It is 5.9 miles from Landstown, 2.3 miles from Pungo, and 7.6 miles from Sandbridge Beach.

ADVANTAGES- Seaboard is a road with open space for a new building. It is centrally inside the "triangle" formed by these three localities (incenter). It is at a reasonable distance for everyone.

DISADVANTAGES- It is not equidistant from each location, because then it would be too far away (if we chose to use the circumcenter).