

Teacher: Caitlyn Gironda

Topic: Discovery & Application of Properties of Points of Concurrency

Title: Combatting Local Food Insecurity

Subject/grade level: This lesson is appropriate for 10th grade students and is written for a Geometry class. Many students would concurrently be enrolled in Living Environment, New York's Biology course.

Time: This project would take place over four 80 minute block classes, meeting every other day. Students also use an online learning management system in their time outside of class.

Justification: This lesson aims to incorporate what students have learned in their Living Environment class about homeostasis, the body systems, nutrition, and the study of points of concurrency in Geometry. While students are aware they should "eat their vegetables," the beginning of this lesson will provide students a context in which they can research what happens to the homeostasis in the human body when proper nutrition is not obtained. This will include both short term and long term effects, a global crisis for many facing hunger, food insecurity, or lack of access to a balanced diet. From there, students will discover the properties of the various points of concurrency through an urban planning context. They will examine a triangular region in the local area that is defined by the USDA as a "Food Desert" and use geometric constructions to identify the orthocenter, circumcenter, incenter, and centroid of the region. Each of these points has its own properties (equidistant from the vertices of the region, for example). Students will use these properties to choose a location for a new community resource such as a grocery store or community garden. They must provide an argument for the location of the resource based on both the mathematics they've used and the context in which it is being discussed. In this way, they will address the NGSS standard asking students to "analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants." Though their solution will not directly address a global solution to food insecurity, it will address a global problem with a local solution. In this way, students will see how small solutions in their community can begin to address a larger global issue. They will also give peer feedback throughout the process, allowing them to analyze the arguments of others. Finally, they will synthesize everything they've learning through a written report addressed to the local city council. In this, they must provide a background of the problem from their research and understanding of the biological ramifications for people with improper nutrition. They will then provide their proposed solution, including mathematical argument. This will also include the impact on the community- new jobs, environmental impact of building, and other impacts from their research. Because of the depth of research into biological systems, the addressing of impact on the community of building a new resource, and the inquiry-based discovery of properties in geometry, the project provides a seamless integration of these 2 core classes with a real world context that students will find both relevant and engaging.

Materials:

- Wifi Enabled Devices
- Google Maps
- GeoGebra
- Word Processing Software
- Data from United States Department of Agriculture Food Access Research Atlas

- Compass and Straight Edge

Standards:

Common Core State Standards:

- G.CO.D.12- Make, justify and apply formal geometric constructions.
 - Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.). Copying a segment; copying an angle; bisecting a segment; bisecting an angle; constructing perpendicular lines, including the perpendicular bisector of a line segment; and constructing a line parallel to a given line through a point not on the line
 - Construct points of concurrency of a triangle (centroid, circumcenter, incenter, and orthocenter).
- G.MG.A.3 Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios)

Standards for Mathematical Practice

1. Make sense of problems and persevere in solving them
3. Construct viable arguments and critique the reasoning of others: Students articulate steps needed to construct geometric figures, using relevant vocabulary. Students develop and justify conclusions about unknown angles and defend their arguments with geometric reasons.
4. Model with mathematics: Students apply geometric constructions and knowledge of rigid motions to solve problems arising with issues of design or location of facilities
5. Use appropriate tools strategically: Students consider and select from a variety of tools in constructing geometric diagrams, including (but not limited to) technological tools.

Next Generation Science Standards:

- HS-ETS 1-1 - Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
- HS-ETS 1-3 - Evaluate a solution to a complex real-world problem based on criteria and tradeoffs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.

New York State Living Environment:

- Performance Indicator 3.5: Develop a written report for public scrutiny that describes the proposed explanation, including a literature review, the research carried out, its result, and suggestions for further research.
- Performance Indicator 1.2
 - 1.2d If there is a disruption in any human system, there may be a corresponding imbalance in homeostasis.
- Performance Indicator 5.2
 - 5.2a Homeostasis in an organism is constantly threatened. Failure to respond effectively can result in disease or death.

- o 5.2h Disease may also be caused by inheritance, toxic substances, poor nutrition, organ malfunction, and some personal behavior. Some effects show up right away; others may not show up for many years.
- Performance Indicator 7.3
 - o 7.3a Societies must decide on proposals which involve the introduction of new technologies. Individuals need to make decisions which will assess risks, costs, benefits, and trade-offs.

Lesson objective(s):

- Students will be able to identify impacts of poor nutrition on homeostasis in the human body in both the short term and long term
- Students will be able to geometrically construct the incenter, circumcenter, orthocenter, and centroid of a triangle
- Students will be able to identify the properties of the incenter, circumcenter, orthocenter, and centroid
- Students will synthesize their understandings of biological systems and homeostasis with their mathematical knowledge to design a solution to a local concern
- Students will develop a logical argument in the form of a written report, including both mathematical argument and contextual argument
- Students will critique the reasoning of others and provide constructive feedback using the “Praise Question Polish” strategy

Day 1: Engage & Explore

ENGAGEMENT

1. Teacher will begin by having students complete the following Think-Pair-Share:
 - a. How far away is the nearest grocery store to your home?
 - b. Where do you shop more- grocery stores or mini-marts?
 - c. How many fast food restaurants are near your house?
 - d. Do you think you have easy access to nutritious food? Why or why not?
2. Teacher will show video from NPR about food deserts:

<https://www.youtube.com/watch?v=kQeorPkPLmU>

 - a. Students will be asked to complete a 3-2-1 during the video using the following directions
 - i. 3 things you notice
 - ii. 2 things you wonder
 - iii. 1 things you think might relate this to mathematics
 - b. Students may be asking themselves some of the following question, especially since this experience may be different from their own:
 - i. Is this happening in my neighborhood?
 - ii. Are food deserts only in cities?
 - iii. What can I do about this?
3. Teacher will lead a group discussion about the 3-2-1 activity and create a class list of notices, wonders, and hypothesis about relationships to mathematics.

EXPLORATION

4. Students will use their wifi-enabled device to use Google Maps to explore the area near their home, looking for local farms, community gardens, food pantries,

and grocery stores. They will also look for bodegas and gas stations, along with fast food restaurants. Students will hypothesize whether they live in a food desert. This will be completed on the worksheet from “Teaching Tolerance” provided.

Assessment: Students will answer the following discussion board post for homework. Their response must be at least 5 sentences. They must also respond to at least 1 other discussion board post with a question.

“Share what you learned about your own neighborhood today with regards to access to nutritious food. Why do you think access to nutritious food is important?”

Day 2: Explore

EXPLORATION

1. Teacher will begin by sharing highlights from the discussion board and leading a class discussion about some of the most thoughtful questions.
2. Students will get into groups of 2-3 and begin to explore why access to good nutrition is important using the “Literature Review” activity
3. Students will then use Data from United States Department of Agriculture Food Access Research Atlas
<https://www.ers.usda.gov/data-products/food-access-research-atlas.aspx> to determine a food desert in their community.
 - a. Students will select a triangular region
 - b. Students must print 5 copies of this region
4. Students will complete described constructions on each of their 5 maps & complete the table included in the activity to determine the properties
 - a. Note: Students already know how to construct each of the indicated segments

Assessment: Students will answer the following discussion board post for homework. Their response must be at least 5 sentences. They must also respond to at least 1 other discussion board post with a question.

“Write 1 sentence each describing an important short term and long term impact of poor nutrition. Then write which point of concurrency you think makes the most sense for a new community resource, based on your findings from Activity 5 today.”

Day 3: Explain & Elaborate

EXPLANATION

1. Teacher will begin by sharing highlights from the discussion board and leading a class discussion about some of the most thoughtful questions.
2. Teacher will lead direction instruction about the points of concurrency and their properties, based on the student exploration from the day before.
 - a. Here is a summary of the points of concurrency, if needed:
<https://slideplayer.com/slide/10671855/>
3. Students will complete Activity #6: Assessment

ELABORATION

1. Students will begin to work on their written report to the city council. The directions and rubric are attached in Activity 7.

Day 4: Elaborate & Evaluate

ELABORATE

1. Students will complete their written report

EVALUATE

1. Students will complete peer feedback on the reports of others in the last 20 minutes of class. They will use the “Praise-Question-Polish” strategy, offering 1 piece of praise, 1 question they have, and 1 thing they think should be improved or “polished.” Students will use the peer feedback to improve their final report before submission. Final reports will be submitted at the beginning of the next class.
2. Students will be given the rubric for summative evaluation. Formative evaluation has taken place throughout via discussion boards, teacher observation, formative assessment strategies like Activity #7, and daily collection of the project packet.

iii. 1 things you think might relate this to mathematics

EXPLORE!

Activity #3: Teaching Tolerance Worksheet

Use Google Maps to complete the questions below, using your home address! The results will not be shared with anyone but Mrs. Gironda unless you choose to do so!



MIDDLE & UPPER GRADES ACTIVITY

K 1 2 3 4 5 6 7 8 9 10 11 12

What's in Store?

The chart below lists three different retail categories where you can purchase food and a series of questions/ characteristics about each. Complete the chart. Then answer the questions that follow.

My community is (check one): rural urban suburban

My community is (check one): rural urban suburban

	GROCERY STORE/ SUPERMARKET	CONVENIENCE STORE	FAST FOOD RESTAURANT
Example closest to my home			
Approximate distance from home			
Are there healthy options such as fresh fruit, vegetables, low-fat milk products, whole wheat products, and lean meats?			
Rank from 1 to 10 (1 = expensive and 10 = economical)			
How many of these are in a one-mile radius of your home?			

1. Would you characterize your community as a food desert? Why or why not?

Teaching Tolerance (2013, June 28). *Food Deserts: Causes, Consequences and Solutions* <https://www.nature.org/about-us/careers/leaf/leaf-anthology-food-deserts-lesson.pdf?redirect=https-301>

Activity #4: Literature Review

Find at least 3 sources that describe why access to good nutrition is important. Summarize your findings and be sure to cite your sources!

Source	Citation	Short Term Impact	Long Term Impact
1 (Required)			

2 (Required)			
3 (Required)			
4			
5			

Activity #5: Local Food Deserts

Go to : <https://www.ers.usda.gov/data-products/food-access-research-atlas.aspx>

Select a triangular local region that is classified as a food desert. Print 5 copies of this region, each on a whole sheet of paper. You will complete one of each of the following constructions on each map, leaving the 5th map blank (for now).

Construction #1: Incenter

Choose one of the angles in the triangle. Construct the angle bisector for this angle. Repeat for a different angle. Mark the **point of concurrency** of these 2 angle bisectors as point A.

Construction #2: Circumcenter

Choose one of the segments in the triangle. Construct the perpendicular bisector for this segment. Repeat for a different segment. Mark the **point of concurrency** of these 2 perpendicular bisectors as point B.

Construction #3: Centroid

Choose one of the segments in the triangle. Construct the median for this segment. Repeat for a different segment. Mark the **point of concurrency** of these 2 angle bisectors as point C.

Construction #4: Orthocenter

Choose one of the angles in the triangle. Construct the altitude from that angle. Repeat for a different angle. Mark the **point of concurrency** of these 2 angle bisectors as point D.

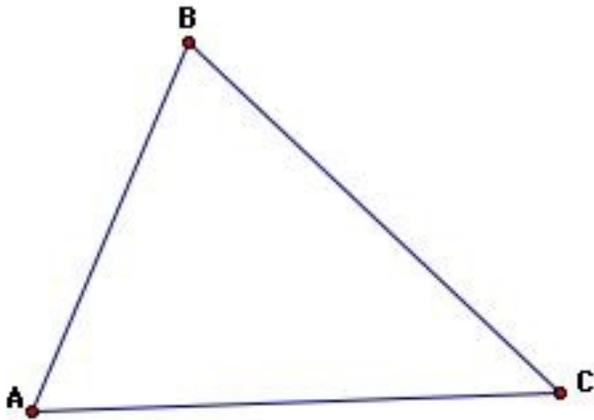
Center	Distance from Vertices	Distance from Edges	Anything Else You Notice?
Incenter			
Circumcenter			
Centroid			
Orthocenter			

EXPLAIN!

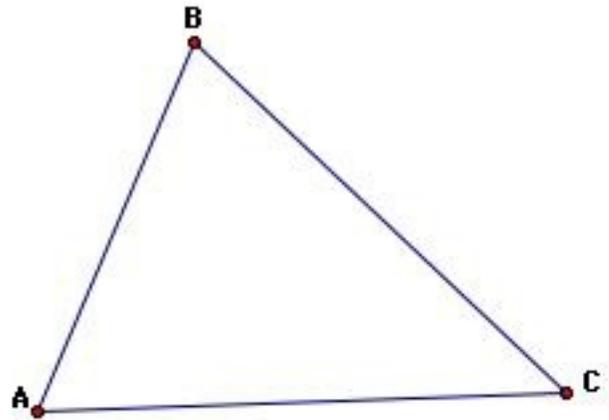
Activity #6: Formative Assessment

Construct each of the segments below. Then, name the point of concurrency formed and list it's most notable property.

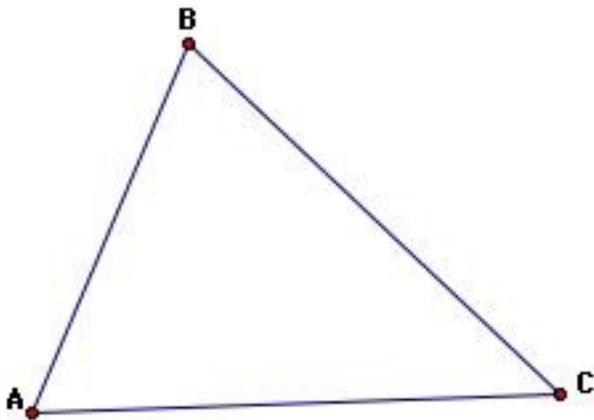
Altitude



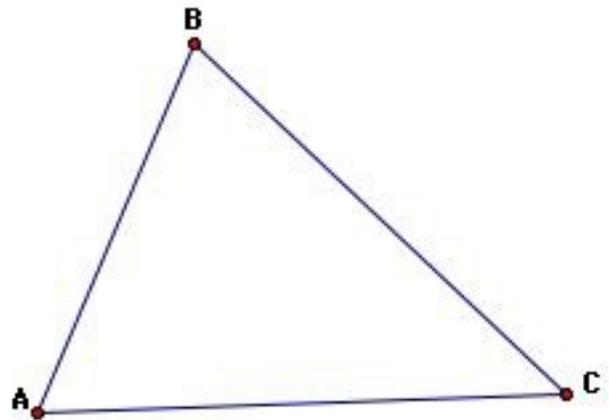
Perpendicular Bisector



Median



Angle Bisector



ELABORATE!

Activity #7: Written Report

You and your partner must complete a written report to be sent to our local city council!
It must include each of the following:

1. Introduction
 - a. Introduce yourself professionally and describe your objectives
2. Literature Review
 - a. Describe the need for the community resource you are proposing. This must include information about current access in the region, as well as both the short term and long term impacts found in your own literature review.
3. Proposal
 - a. Must include the 5th map detailing where the resource should be located, the quantitative argument for the location, and a detailed explanation of what you'd like to build.
4. Impact Report
 - a. Describe the impact building this resource has on the local community. It should include impact on health, jobs, and the environment of building. You must include at least 2 researched facts about each topic.
5. Conclusion
 - a. This should synthesize your research and proposal, linking your mathematical argument to the impact it can have on the community. This should tie your argument together.

Combatting Local Food Insecurity

Name: _____

	4. Distinguished	3. Proficient	2. Apprentice	1. Novice
Writing-Overview: Ideas, voice, conventions, fluency, organization, and word choice	Ideas presented in logical order. Unique and interesting details supported the main idea, and natural flow made writing easy to read. Used scholarly, topic-specific vocabulary and made no spelling, grammar, capitalization, or punctuation errors. Used personal style and feeling.	Most ideas presented in logical order. Details supported the main idea. Used scholarly vocabulary. Made less than 5 spelling, grammar, capitalization, or punctuation errors.	Some ideas presented in logical order. There were few details to support the main idea. Made 5 to 10 spelling, grammar, capitalization, or punctuation errors.	Ideas were not presented in logical order. Details did not support the main idea. Made more than 10 spelling, grammar, capitalization, or punctuation errors.
Research-Quality: Identify impacts of poor nutrition on homeostasis in the human body in both the short term and long term	Included facts, conclusions, and opinions from reliable sources. Included opinions of subject-matter experts.	Included facts, conclusions, and opinions from reliable sources.	Included a mixture of facts from reputable sources and opinions from unreliable sources.	Included more opinion than fact. Information was taken from unreliable sources.
Mathematical Inquiry: Uses mathematical inquiry to identify important properties of points of concurrency and supports their findings with evidence.	Student clearly constructs each point of concurrency, showing all markings. Students identifies all important properties of each point of concurrency and provides clear explanations based on evidence.	Student clearly constructs each point of concurrency, showing all markings. Students identifies most properties of each point of concurrency but may not explain how their evidence supports these conclusions.	Student clearly constructs at least 3 points of concurrency, showing all markings. Students identifies most properties of each point of concurrency but may not explain how their evidence supports these conclusions.	Student clearly constructs 2 or fewer points of concurrency or may be missing markings. Students is missing more than half of the properties.
Maps and Models-Overview: Neat, creative, and includes all required elements	The product is of exceptional quality. All components, such as scale, key, or appropriate symbols, were included. All features were identifiable and properly labeled.	Product was complete and high quality. All required components, such as scale, key, or appropriate symbols, were included. Most features were identifiable and properly labeled.	Product was nearly complete. No more than one component, such as scale, key, or appropriate symbols was missing. Some features were not properly labeled.	Product was not complete. Key features were missing. Many features were not properly labeled. Product did not resemble the subject.
Organization-Time Management: Uses time wisely	Used time well. Work was turned in early or on time.	Most work was done on time.	Some work was not done on time. Monitored progress occasionally. Did not change work habits or schedule accordingly. Worked frantically to finish project on time.	Did not use time well. Little or no work was done on time. Did not monitor progress adequately. Project was not completed on time.