Elizabeth Nelli
EMAT 6450
Final Project

Mathematics in House Design

        The purpose of this project is to solidify what students have learned in
Analytic Geometry. Students are to use formulas and other information learned
throughout the semester in geometry to come up with a house design that displays
what they have learned and incorporates this knowledge into a project that goes
beyond the classroom. Through this project, students will be able to see how the
information they obtain inside of the geometry classroom is highly relevant to every
day life outside of school. Students must not only use their geometric knowledge,
but also must incorporate their creative sides in coming up with a floor plan and
integrate other aspects of math, such as estimation and budget usage, into the
completion of this project. The purpose of this project is for students to use
geometry in a more creative way, as well as use classroom knowledge (formulas,
constructions) in a manner that is not given in a "test format." After completion of
this project, students will have a better understanding of how geometry is very
applicable in their every day lives outside of the classroom.

Project Outline	
Teacher:	Elizabeth Nelli
Class:	11th grade Accelerated Analytic Geometry
Course Unit:	Unit 10: Mathematical Modeling
Project Title:	Geometrical House Design
LESSON OVERVIEW	

Students will use their knowledge of shapes' area and surface area to complete this project. Each student must complete and turn in their own individual project, but students may assist each other with creative ideas throughout the project. Each student will individually come up with their own floor plan of a house and determine how much material (flooring, paint, wallpaper, wood, etc.) is required to complete the house in order for it to be ready for the potential buyer (a family of four). Students must also estimate the cost it will take to build the house (depending on the quality of the materials used, which is up to the student, houses with similar floor plans will vary in price). Students have a limited budget of $100,000.00, so they must find the best way to spread out their cost throughout their house. Students need to record the cost of materials and the amount of materials required the complete the house. Students must also record the measurements of each room (floors, walls, where windows and doors fit in), the area of each room and the formulas used to find the area. It is a requirement that at least one room in the house incorporates some type of tessellations (floor tiling, shower tiling, backsplash, etc.). It is also a requirement that there be at least 3 bedrooms, 2 bathrooms, a kitchen, and family room. More rooms may be added if students wish to do so, and more points will be awarded to students who go above and beyond, showing their ability to make the best use of space while sticking to the allotted budget. A final requirement is that one room in the house be of an irregular shape (a bay window, semicircle, etc.). Students must compile all their work, including a finished drawing of their floor plan, write ups of the measurements of the rooms with area, and the write up of the costs and materials used, into a folder to be turned into the teacher. This project is simply about the floor plan and aesthetic design of a house (including the outer façade). Students should not worry about pluming, electrical, roofing, or any other aspects besides the actual layout of the house and the materials needed for its completion.

STANDARDS	Common Core Georgia Performance Standards

MCC9-12.G.MG.1 Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).
MCC9-12.G.MG.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.)
MMFN1. Students will use fractions, percents, and ratios to solve problems related to stock transactions, credit cards, taxes, budgets, automobile purchases, fuel economy, Social Security, Medicare, retirement planning, checking and saving accounts and other related finance applications.
MMFG1. Students will apply the concepts of area, volume, scale factors, and scale drawings to planning for housing.
MMFG2. Students will apply the distance formula.
MMFG3. Students will apply the properties of angles and segments in circles.

| OBJECTIVE	
1. Use different area formulas to come up with the area of an irregular shape. 2. Be able to work with a budget while designing a comfortable house for a particular family size. 3. Utilize creative knowledge when designing a floor plan. 4. Understand which shapes can be used in tessellations. 5. Be able to estimate the amount of materials needed to complete a floor plan. 6. Be able to construct a floor plan. 7. Find the best use of space and money.	
ASSESSMENT / EVALUATION	
This project will be evaluated using the following: Total: 100 points worth 15% of the overall class grade. House size: 15 Stayed on budget: 15 Tessellation use: 10 Irregular shaped room: 10 Explanations and write-up of costs: 20 Creativity: 5 Accuracy of calculations/ measurements: 20 Project display/neatness: 5	
PRIOR KNOWLEDGE	Prior knowledge that is required for student's to know before project
• Area of circles, squares, triangles, etc. • How to create tessellations. • Construction of shapes with a straightedge and compass.	
MATERIALS	
• Rubric and guidelines • Compass and straightedge • Paper • Pencil • Computer access • Calculator • Colored Pencils	

Geometrical House Design Project Guidelines Sheet

You are to design a floor plan of a house. You may help each other with ideas, but ultimately, this is an individual project. There are certain requirements (listed below) that you must include in your floor plan. You have a budget of $100,000.00 to work with, and with this budget you must create a floor plan and then complete the floor plan with paint, flooring, wallpaper, a full kitchen (i.e. counter tops, cabinets, sink, stove, etc.), doors, and windows. You do not need to furnish this house, but keep in mind that the potential buyer is a family of four, so they need to be comfortable and have room to breathe. Get creative with your design! If you can find materials that are on sale, use them! This project is meant to test not only your geometric and mathematical knowledge, but also your creativity. If you want to paint a design on a wall, go for it (but be sure to include measurements!) or if you want to splurge on expensive flooring, talk about where in the budget you had to cut back in order to make this work. Be sure to keep track of EVERYTHING you are purchasing for the house. Anything unaccounted for in your cost write up will be a deduction. You must also record the area of each room, along with measurements of the walls and floors. Also, show work in your write up (meaning show the formulas used to get to the area). When taking measurements of the room, remember that you must keep in mind that doorways and windows do not make up the area of the room. Remember this in your estimations of paint and/ or wallpaper use. This project only works with the visible aspects of the house; do not worry about plumbing, electrical, roofing, etc. However, you must have an outer façade of the house, which can be any material of your choosing (brick, wood, stucco, combinations of materials).

Requirements for each floor plan:
- 3 bedrooms
- 2 bathrooms
- Kitchen
- Family room
- Incorporate tessellations at some point in the house (bathroom floor, shower tiling, kitchen backsplash, etc.)
- A room of an irregular shape (bay window, semicircle room, etc.)

Here is a sample floor plan:
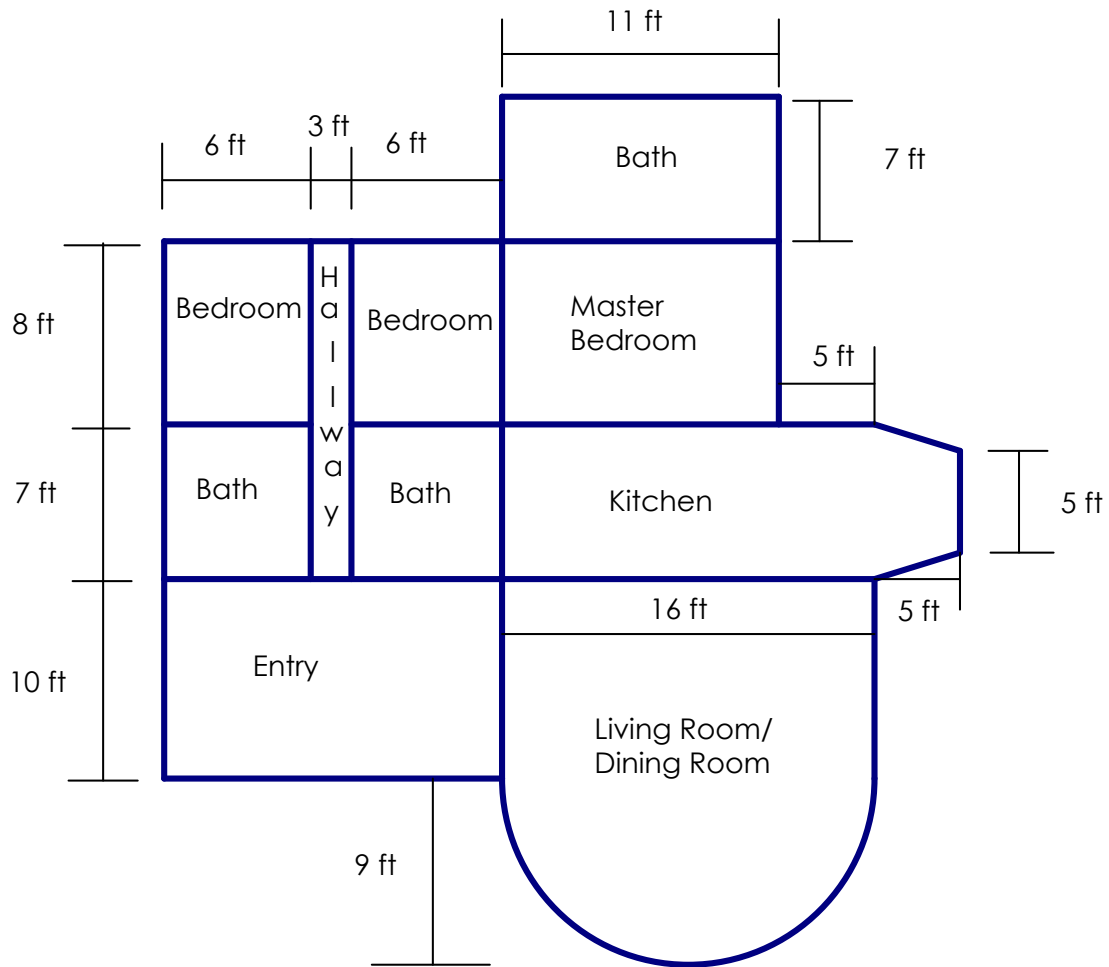
This house has a total area of 936.28 ft^2
The break down:

Left side of the house (the 2 bedrooms, 2 bathrooms, hallway, and entry): 375 ft^2
Master bed and bath: 165 ft^2
Kitchen: 135.75 ft^2
Living/Dining room: 260.53 ft^2

It is simple to calculate the left side of the house along with the master bed and bath, because they are parallelograms whose area is base times height. However, when getting into the kitchen and living/dining areas, we need to use the area of a circle and the area of a trapezoid.

Here are the calculations for the kitchen:
Square portion: (16)x(7)=112 ft^2
Trapezoid bay window: ½ x ((4.5+5)x5)=23.75 ft^2

Total: 135.75

Here are the calculations for the living/dining area:
Square portion: (10)x(16)=160 ft²
Semi-circle: ½ (64π)= 100.53 ft²

Total: 260.53 ft²

Remember, the area of a trapezoid is ½ (b_1+b_2)x(h) and the area of a semi-circle is ½(πr^2) .

Do not limit yourselves only to these shapes. This is just ONE example. Get creative and innovative! If you want to make a totally unorthodox shaped house, then do it! As long as the calculations are correct then I am fine with whatever shape your house takes on!