

# Performance Based Learning and Assessment Task

## *A Place at the Table*

### **I. ASSESSMENT TASK OVERVIEW & PURPOSE:**

Students will create a blueprint for a decorative, non-rectangular picnic table (top only), and then use their blueprint to create a scaled model using craft sticks, balsa wood, stock paper, etc. Each picnic table will need to seat at least 5 people, with each person having at least 2 square feet of space. Once students complete their models, they will compile a list of supplies and submit a cost proposal.

### **II. UNIT AUTHORS:**

Gretchen Shaw, Patrick Henry High School, Hanover County Public Schools  
Kristin White, Varina High School, Henrico County Public Schools

### **III. COURSE:** Geometry

### **IV. CONTENT STRAND:**

Geometry (Polygons & Circles, Three Dimensional Figures)

### **V. OBJECTIVES:**

The learner will be able to create a blueprint and a scale model of an everyday item (picnic table).

The learner will be able to calculate the area of a non-rectangular polygon.

The learner will be able to determine the angles at which to cut pieces of wood to be used to create a picnic table.

The learner will be able to identify congruent angles by using properties of parallel and perpendicular lines.

The learner will be able to identify/calculate the total amount of interior and exterior angles in a polygon.

### **VI. REFERENCE/RESOURCE MATERIALS:**

Graph paper, calculators, computers, building materials for model picnic table (craft sticks, glue, balsa wood, stock paper, scissors, etc.) Access to websites of various home improvement/hardware store (Lowes, Home Depot, Ace Hardware, Harbor Freight, etc).

### **VII. PRIMARY ASSESSMENT STRATEGIES:**

Students will be assessed on 3 aspects of this project: the blueprint, the model, and the cost proposal. They will have an opportunity to self assess using the same rubric the teacher will use for grading.

**VIII. EVALUATION CRITERIA:**

Students will be assessed on their blueprints, the actual model, and the cost proposal. A scoring rubric will be used as a guideline for students to follow as well as for the teacher to calculate a grade.

**IX. INSTRUCTIONAL TIME:**

Four 90 minute blocks (1.5 for planning and design, 1.5 for construction of model, 1 for research or prices and completion of cost proposal).

# A Place at the Table

## Strand

### Geometry

#### Mathematical Goals and Objective(s)

Students will be able to apply their ability to calculate the area of polygons to a real-world situation

Students will be able to use their knowledge of interior and exterior angles to determine angle measures of inscribed shapes in the polygon.

Students will use their knowledge of parallel and perpendicular lines to determine angle measures of inscribed shapes in the polygon.

#### Related SOL

- G.5 a (order the sides by length, given the angle measures), b (order the angles by degree measure, given the side lengths), c (determine whether a triangle exists), d (determine the range in which the length of the third side must lie)
- G.9 (The student will verify characteristics of quadrilaterals and use properties of quadrilaterals to solve real-world problems.)
- G.10 (The student will solve real-world problems involving angles of polygons. )
- G.11 a (investigate, verify, and apply properties of circles), b (solve real-world problems involving properties of circles), c (find arc lengths and areas of sectors in circles)
- G.13 (The student will use formulas for surface area and volume of three-dimensional objects to solve real-world problems)
- G.14d (solve real-world problems about similar geometric objects.)

#### NCTM Standards

- Analyze properties and determine attributes of two- and three-dimensional objects
- Explore relationships (including congruence and similarity) among classes of two- and three-dimensional geometric objects, make and test conjectures about them, and solve problems involving them
- Draw and construct representations of two- and three-dimensional geometric objects using a variety of tools
- Use geometric ideas to solve problems in, and gain insights into, other disciplines and other areas of interest such as art and architecture
- Build new mathematical knowledge through problem solving
- Solve problems that arise in mathematics and in other contexts
- Apply and adapt a variety of appropriate strategies to solve problems
- Monitor and reflect on the process of mathematical problem solving
- Organize and consolidate mathematical thinking through communication
- Communicate mathematical thinking coherently and clearly to peers, teachers, and others
- Analyze and evaluate the mathematical thinking and strategies of others
- Use the language of mathematics to express mathematical ideas precisely
- Recognize and use connections among mathematical ideas
- Recognize and apply mathematics in contexts outside of mathematics
- Create and use representations to organize, record, and communicate mathematical ideas
- Select, apply, and translate among mathematical representations to solve problems
- Use representations to model and interpret physical, social, and mathematical phenomena

**Materials/Resources**

- “A Place at the Table” Worksheet and 2x4 template
- Graph paper
- Classroom set of graphing calculators
- Rulers
- Compasses
- Protractors
- Classroom computers to access websites of various home improvement/hardware store websites
- Building materials for model picnic table (craft sticks, glue, tape, balsa wood, stock paper, scissors etc.)

**Assumption of Prior Knowledge**

- Students know how to set up ratios and solve proportions
- Students know how to use scale factors to draw scale models
- Students know how to build scale model based on drawing of blueprint
- Students know how to research on the computer
- Students know how to calculate individual and total cost of items
- Students know how to determine angle measurements and side length measurements of a polygon by using measuring tools such as a ruler or protractor
- Students know how to calculate area of a polygon

## Introduction: Setting Up the Mathematical Task

The following directions can be shared with students as this activity is introduced.

- You are planning a summer outdoor feast for your family and friends. Since you do not have any outdoor tables and you have some crafty friends, you have decided that you will build a picnic table for the event. Your job is to design a non-rectangular picnic table that can seat at least 5 people with each person having a minimum of 2 square feet of space. You will need to complete the following tasks:
  - Create a blueprint of the top view of the picnic table
  - Build a model of the top of the picnic table (your friends can work out the logistics of how to support it)
  - Determine the amount of supplies you will need (type, size, length, etc of wood, nails/screws, etc.)
  - Determine the total cost to create one picnic table top
- You will have a total of 4 (90 minute) blocks to complete this task.
  - 1.5 blocks for planning and design
  - 1.5 blocks for construction
  - 1 block for research and completion of cost proposal
- You will split into groups of 3 or 4. Brainstorm some ideas for different shapes of picnic tables that are not rectangular. Be sure to think of how you can have at least 5 people seated.
- Make sure you think about, and discuss the following questions: What makes a picnic table usable? What shapes provide optimum space for eating? What can you do to make your picnic table “look nice” or be aesthetically pleasing? What are some things that would make your picnic table impractical to make or use?
- You will work in small groups where discussions and cooperation will produce better results. You and your group mates will need to agree on design aspects and delegate responsibilities while building the model.
- You will complete three separate activities in order to reach the intended goals. The activities build on each other and must be completed sequentially.
- This activity is designed to be completed at the end of the year, after all units have been covered. This will allow you to draw from all of your previous experiences and lessons in order to put together a plan for your picnic table.
- Your teacher can provide examples of non rectangular picnic tables in case you are having trouble coming up with an initial design.
- You will make your mathematical thinking and understanding public through the completion of the blueprint. It will show evidence of your planning and working with angle measures in various polygons. By meeting the requirements for a minimum of 2 square feet per person, you will demonstrate your ability to work with area formulas.

## **Student Exploration**

### **Small Group (3-4 students per group)**

Students can be grouped with peers of varying ability levels. This will encourage cooperation and communication across multiple Van Hiele levels.

### **Student/Teacher Actions:**

- Days 1-2: Students will brainstorm and determine the shape of their picnic table. Students will complete the “A Place at the Table” worksheet as well as the blueprint for their table top. Students will begin to create their model for their picnic table top. Teachers will help students create the blueprint as needed.
- Day 3: Students will finish their picnic table top models. Teachers will help students with their constructions.
- Day 4: Students will research the cost of supplies for their actual picnic table. Students will determine the total cost to create one picnic table top. Teachers will give students ideas of websites to use while shopping for supplies.

### **Monitoring Student Responses**

- Students will complete the attached worksheet describing the shape of their picnic table, supplies they would need to create the actual picnic table, and a sketch of what the tabletop will look like with the supplies added on.
- Students will create a blueprint of their tabletop and use the rubric to monitor their own progress.
- Students will build a scale model of their tabletop and use the rubric to monitor their own progress.
- Students will determine the total cost of supplies needed to create one picnic table top and use the Cost Proposal worksheet and rubric to monitor their own progress.
- Students will share their picnic table ideas with their classmates.

### **Assessment List and Benchmarks**

- Students will complete the attached worksheet.
- Students will complete a blueprint for their tabletop.
- Students will create a model of their picnic table top.
- Students will use the attached rubrics as a guide and teacher will use them for the grade.
- Students will share their tabletop ideas with their classmates.

Group Member Names: \_\_\_\_\_

## A Place at the Table

You are planning a summer outdoor feast for your family and friends. Since you do not have any outdoor tables and you have some crafty friends, you have decided that you will build a picnic table for the event with the extra 2x4s (2x4s have an actual measurement of 1.5 in x 3.5 in, but for this project, we can assume they are 2inx4in) you found in the garage. Your job is to design a non-rectangular picnic table that can seat at least 5 people with each person having a minimum of 2 square feet of space.

You will need to complete the following tasks:

- Create a blueprint of the top view of the picnic table
- Build a model of the top of the picnic table

After completing your table with the extra supplies you found in your garage, you decide that your picnic table top is amazing and want to make more for the people in your family. In order to do this, you will need to draw up a cost proposal that includes:

- The amount of supplies you will need (type, size, length, etc of wood, nails/screws, etc.)
- The total cost to create one picnic table top

As you work through this project, you will need to complete and turn in the following items:

1. What shape will your picnic table be? How many people will sit at it? Sketch a picture of it.
2. What additional supplies do you want to use to create your picnic table? Why?
3. Using graph paper, create a scaled blueprint of the top view of your picnic table, ensuring that it seats at least 5 people having a minimum of 2 square feet per person. Make sure you note what your scale factor is and mark the important measurements (lengths, angles).
4. Calculate the total area of your picnic table.
5. Calculate the area per person of your picnic table.

[illegible]



Group Members \_\_\_\_\_

## Cost Proposal

For each item on your supply list (question 2), please research the price and complete the following price chart. Since prices may change daily, please take a note of the date that you find the prices.

Date Found	Quantity	Description (include website)	Unit Price	Total Price

Total Price: \_\_\_\_\_

Attach this cost proposal to your answers from your "A Place at the Table" questions.

Group Member Names: \_\_\_\_\_

### A Place at the Table Grading Rubrics

Blueprint	1	2	3	Student Score	Teacher Score
Accuracy of Design	Angle measures are missing or made up.	Some angle measures are accurate and appropriately labeled.	All angle measures are accurate and appropriately labeled.		
Aesthetics of Design	There is no design evident.	There is a planned design, but it is sloppy, or not fully carried out.	The planned design is present and neat.		
Functionality of Design	The plan would be impossible to carry out, or use in real life.	The plan would be impractical, but not impossible to use.	The plan is both possible and practical.		

#### Blueprint

Student Total	Teacher Total
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Model	1	2	3	Student Score	Teacher Score
Accuracy	The model has multiple modifications, does not resemble the plan.	The model follows the plan with a few modifications.	The model follows the plan without modifications.		
Presentation	The model is incomplete or poorly constructed.	The model is complete, but has minor flaws.	The model is complete and well constructed.		

#### Model

Student Total	Teacher Total
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<b>Cost Proposal</b>	1	2	3	Student Score	Teacher Score
Materials List	Materials and quantities are missing or incomplete.	All materials are listed, but quantities are missing.	All materials are listed, including quantities.		
Price List	Prices are made up, totals are missing	Prices are accurate, but there are mistakes in totals.	Prices are accurate and correctly totaled.		
Questions from “A Place at the Table” worksheet	Questions are not answered, answers do not make sense.	Almost all questions are answered.	All questions are completely answered.		

**Cost Proposal**

Student Total	Teacher Total
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**Final Score**

	Student Scores	Teacher Scores
Blueprint		
Model		
Cost Proposal		
Total	/24	/24

## Examples of non-rectangular picnic tables

<http://www.hometone.com/beautiful-wooden-picnic-tables.html>



<http://www.hometone.com/beautiful-wooden-picnic-tables.html>



<http://www.lolwot.com/20-amazing-photos-of-borders-from-around-the-world/3/>



<http://mentalfloss.com/article/24290/9-strange-periodic-tables>



Group Member Names: Student Work Sample example

## A Place at the Table

You are planning a summer outdoor feast for your family and friends. Since you do not have any tables and you have some crafty friends, you have decided that you will build picnic tables for the event with the extra 2x4s (2x4s have an actual measurement of 1.5inx3.5in, but for this project, we can assume they are 2inx4in) you found in the garage. Your job is to design a non-rectangular picnic table that can seat at least 5 people with each person having a minimum of 2 square feet of space.

You will need to complete the following tasks:

- Create a blueprint of the top view of the picnic table
- Build a model of the top of the picnic table

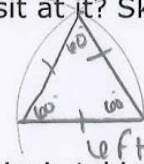
After completing your table with the extra supplies you found in your garage, you decide that your picnic table top is amazing and want to make more for the people in your family. In order to do this, you will need to draw up a cost proposal that includes:

- The amount of supplies you will need (type, size, length, etc of wood, nails/screws, etc.)
- The total cost to create one picnic table top

As you work through this project, you will need to complete and turn in the following items:

1. What shape will your picnic table be? How many people will sit at it? Sketch a picture of it.

Our picnic table will be an equilateral triangle that will seat 6 people.



2. What additional supplies do you want to use to create your picnic table? Why?

We will need something to cut the 2x4s, a tape measure to measure each section, a speed square to mark the angles, wood screws with proper bits, and PPE (glasses + ear plugs).

3. Using graph paper, create a scaled blueprint of the top view of your picnic table, ensuring that it seats at least 5 people having a minimum of 2 square feet per person. Make sure you note what your scale factor is and mark the important measurements (lengths, angles).

See graph paper

4. Calculate the total area of your picnic table.

$$9\sqrt{3} \approx 15.59 \text{ ft}^2 \text{ (calculations on graph paper)}$$

5. Calculate the area per person of your picnic table.

$$\frac{3\sqrt{3}}{2} \approx 2.6 \text{ ft}^2 \text{ (calculations on graph paper)}$$



# Student Work Sample

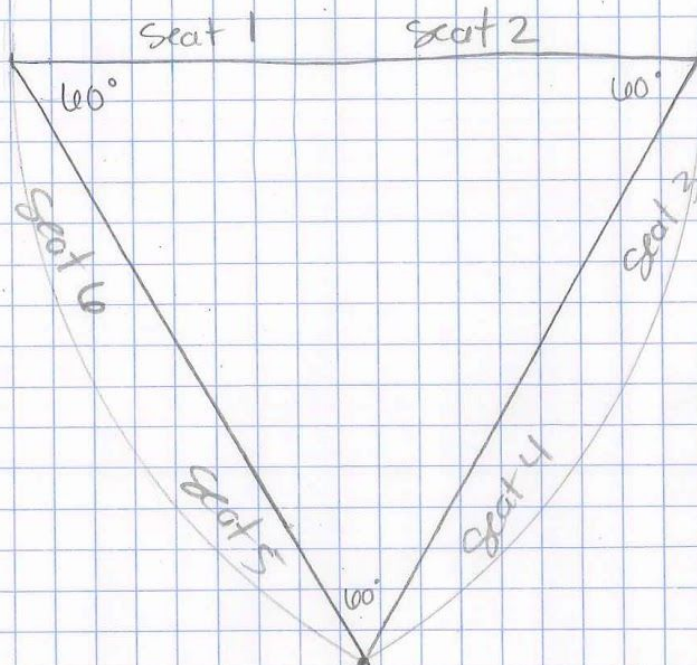
each block  $\rightarrow$  4in

Equilateral Triangle - Room for 6

6 ft sides

3 blocks = 1 ft

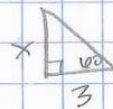
$3 \times 6 = 18$



$$\text{Area } \Delta = \frac{1}{2} b h$$

$$b = 6$$

$$h = 3\sqrt{3}$$



$$A = \frac{1}{2} (6) (3\sqrt{3})$$

$$9\sqrt{3} \text{ ft}^2$$

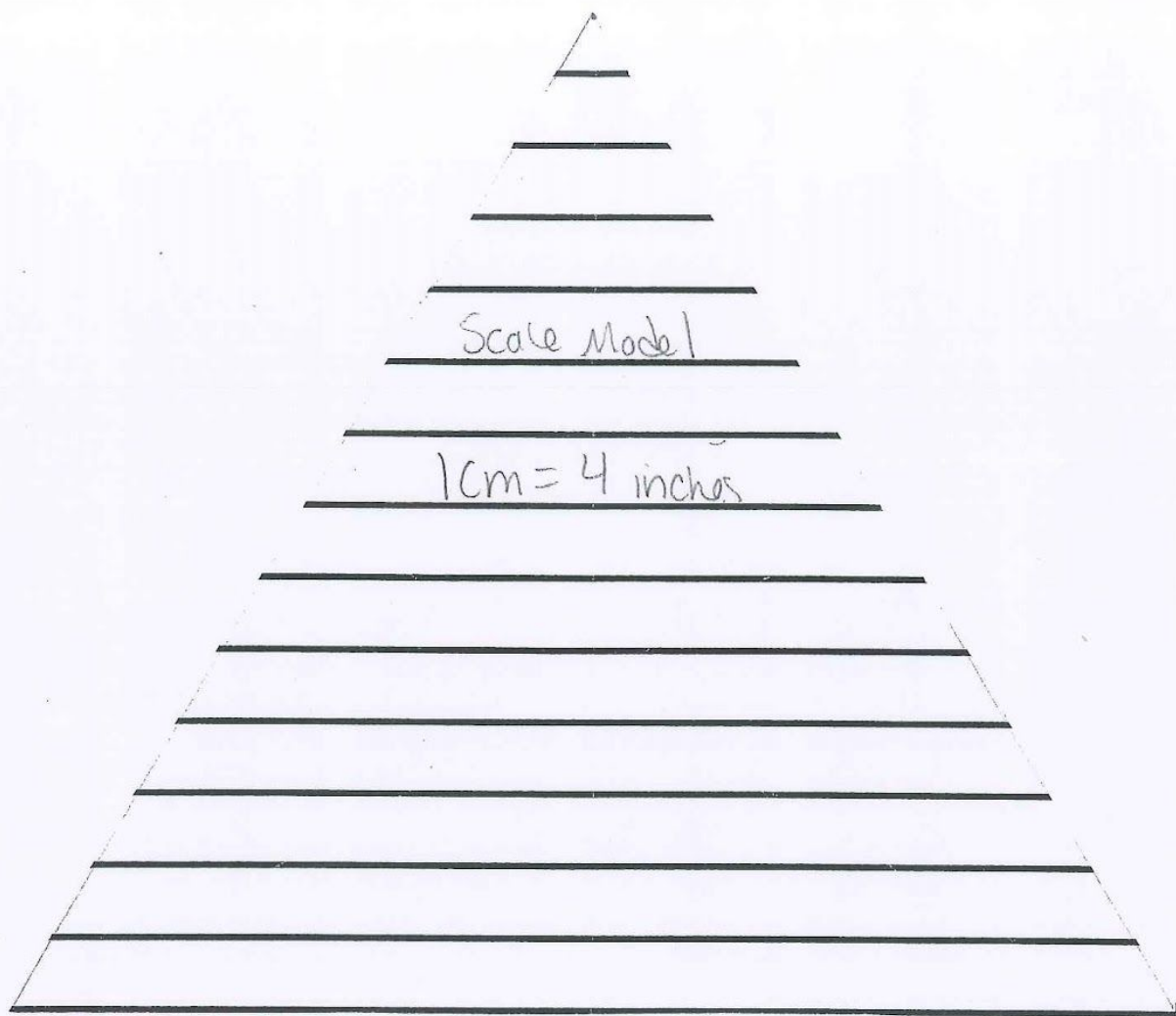
$$\frac{15.59 \text{ ft}^2}{6}$$

Each person has

$$\frac{3\sqrt{3}}{2}$$

$$\text{or } 2.6 \text{ ft}^2$$

14 sections of  $2 \times 4$  cut @  $60^\circ$  angle



Group Members Student work sample example

## Cost Proposal

For each item on your supply list (question 2), please research the price and complete the following price chart. Since prices may change daily, please take a note of the date that you find the prices.

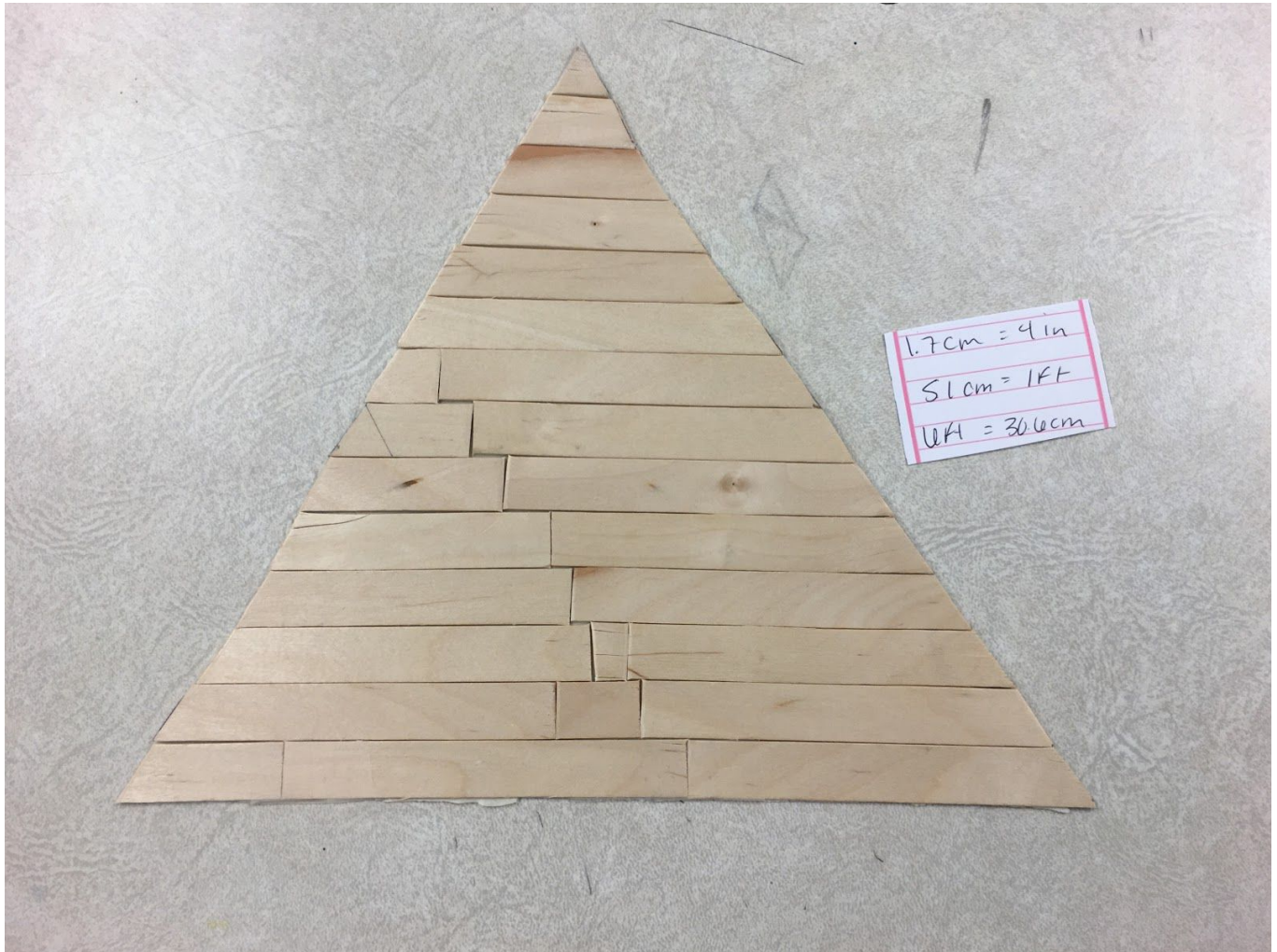
Date Found	Quantity	Description (include website)	Unit Price	Total Price
June 2016	7	2x4 x12 top choice whitewood lumber (lowes.com)	\$ 5.07	\$ 35.49
June 2016	1	Dewalt circular saw blade (lowes.com)	\$ 19.98	\$ 19.98
June 2016	1	Stanley 25 ft tape measure (lowes.com)	\$ 7.98	\$ 7.98
June 2016	1	Swanson tool co. Speed Square (lowes.com)	\$ 9.98	\$ 9.98
June 2016	1	Dewalt 100 piece screwdriver bit set (1/2 price, lowes.com)	\$ 24.98	\$ 24.98
June 2016	1	3M safety eyewear (lowes.com)	\$ 5.98	\$ 5.98
June 2016	1	Safety works ear plugs (lowes.com)	\$ 1.70	\$ 1.70
June 2014	1	GRK 100 ct #9 2.5in int/ext wood screw (lowes.com)	\$ 10.16	\$ 10.16

Total Price: \$ 116.25

Attach this cost proposal to your answers from your "A Place at the Table" questions.



This model was created using craft sticks. 1.7 cm represents 4 inches, meaning 1 foot is 5.1 cm, and 6 feet (the length of each side) is 30.6 cm.



This is a picture of a student's work from a modified version of "A Place at the Table"

# Table top Project

by SPENCE

7. Calculate the area per person of your picnic table.

2.79 ft

$$\frac{2.2 \times 2.5}{2} = 2.75$$

$$4.41 \div 1.86 = 2.37$$

Each side of the table top equals 2.5 ft but as a scale factor each side equals 7 inches each angle of each equilateral triangle inside the hexagon equals 60 degrees I am creating a symmetrical pattern using angle constructions. I used red and blue as my table colors to explain my school spirit. "60 PARTISANS"

6. Calculate the total area of your picnic table.

16.29 ft

8. Using graph paper, create a blueprint of the top view of your picnic table, ensuring that it meets the 2 square foot minimum of 2 square feet per person.

My table holds 6 people

□ = 5ft

What shape will your picnic table be? How many people will sit at it? Sketch a picture of it. (No need to worry about being to scale, we'll do that on graph paper).

Hexagon  
6 people

1. Redraw your picnic table below and sketch the shape of your staples being used on it. Ex.

What supplies do you want to use to create your picnic table? Why?

Protractor to make exactly a 120 degree corner have nails saw drill screws sand paper