Performance Based Learning and Assessment Task

How do I Prepare this Piece of Floor Tile to Lay on the Bottom of my Kitchen Sink Cabinet?

I.   ASSESSSMENT TASK OVERVIEW & PURPOSE:
This task is designed to give students an opportunity to use their knowledge of the formula for the circumference of a circle to construct an actual circle in a real life situation. Students will prepare a piece of poster board resembling a piece of floor tile, to be laid in the bottom of an under-the-kitchen-sink cabinet with a hole cut where the drain pipe is located.

II.   UNIT AUTHOR:
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III.   COURSE:
Geometry

IV.   CONTENT STRAND:

Geometry G.11 - The student will use angles, arcs, chords, tangents, and secants to solve real-world problems involving properties of circles
Geometry G.3 - The student will use coordinate methods to solve problems involving formulas for finding distance or midpoint
Measurement - Students will use visualization, spatial reasoning, and geometric modeling to solve problems; Students will analyze characteristics and properties of two dimensional geometric shapes and develop mathematical arguments about geometric relationships

V.   OBJECTIVES:
Students will develop their knowledge of measurement and properties of circles.

VI.   REFERENCE/RESOURCE MATERIALS:
Students will use a high school Geometry text book available to them in their classroom. Students will use a rectangular piece of poster board, straight edge measuring tools, measuring tapes, marking utensils, calculators, and scissors. The teacher will provide a model of a kitchen sink drain pipe, in the form of poster board with a paper towel cardboard cylinder passing through it at different points for different groups in the class.

VII.   PRIMARY ASSESSMENT STRATEGIES:
Students will be assessed on: 1) how precise are their calculations of the model; 2) accuracy of work shown to support their final product; 3) how they used a property of circles to produce their final product; 4) how adequately they explain their reasoning.

VIII.   EVALUATION CRITERIA:
Self assessments, teacher assessments, and benchmarks are attached.

IX.   INSTRUCTIONAL TIME:
This activity should take one 90-minute class period.

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Strand
Geometry G.11 - The student will use angles, arcs, chords, tangents, and secants to solve real-world problems involving a) properties of circles.
Geometry G.3 - The student will use constructions and coordinate methods to investigate and solve problems involving formulas for a) finding distance or midpoint.
Measurement - NCTM - Students will use visualization, spatial reasoning, and geometric modeling to solve problems; Students will analyze characteristics and properties of two dimensional geometric shapes and develop mathematical arguments about geometric relationships. Students will apply and adapt a variety of appropriate strategies to solve problems. Students will communicate mathematical thinking coherently and clearly to peers, teachers, and others.

Mathematical Objective(s)
The goals of this activity are: 1)to allow students the opportunity to use properties of circles involving the radius, circumference, and diameter, 2)utilize properties of linear measurement including accurate estimation and using a straight edge with precision measurements in a real life problem-solving situation, 3)to use skills of spatial reasoning, 4)to use a compass

Materials/Resources
Students will use the following: 1)classroom Geometry textbook or their reference notes, 2) data charts for record keeping, 3)A self-assessment rubric, 4)a piece of rectangular poster board, 5)a straight-edge or tape measuring tool, 6)a compass, 7)scissors, 8)an 11 x 8 ½ piece of computer, 9)coloring pencils, 10) a model of the cabinet under a kitchen sink (provided to them by the teacher)

Assumption of Prior Knowledge
Students will know how to use the formula for the circumference of a circle, and how to find the diameter or the radius of a circle when circumference is known. Students will know how to use a traditional thumb screw or ball bearing spread compass or a SAFE-T swivel wheel 6-inch long compass that has a straight edge measuring tool built in. Students will know how to use a measuring tape or straight measuring tool.

Students will be operating on Level 3, Abstraction, in the van Hiele hierarchy of Geometric performance levels. The definition of circumference and "pi" will be meaningful as well as the relationships between the variables of the formula for circumference of a circle being understood. The understandings will be logically applied while students cut out a circle that fits the size of a kitchen sink drain pipe.

Students might find it difficult to use dependable measuring principals. They may instead want to estimate their measurements in order to get their work done faster. Teacher monitoring will be necessary to ensure students are using geometric proof to arrive at their final product. Students should be using terms such as circumference, diameter, radius, perpendicular, and straight in their investigations and recording of information.

Introduction: Setting Up the Mathematical Task

The teacher will ask, "How many of you have ever had your mother or father ask you to prepare a piece of tile to place in the bottom of the cabinet under the kitchen sink?" Let the students think and respond.

The teacher will present a model of a real life situation by perhaps pulling up an internet image of such an area in the kitchen or bathroom. See below. Students will not be preparing cut-outs for the two smaller pipes for hot and cold water:
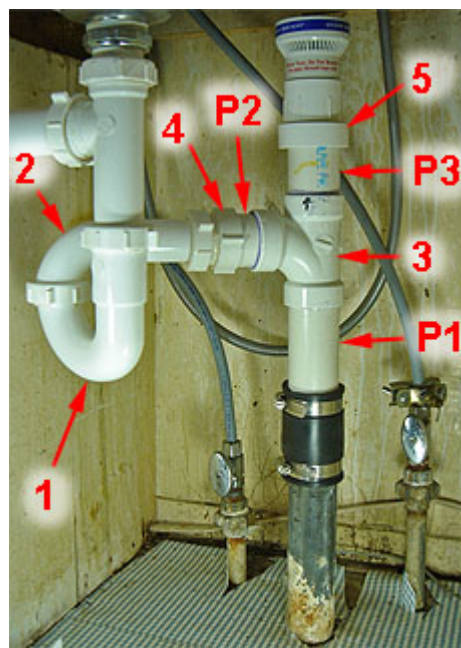
The teacher will then show the students a prepared simulated model of this situation that he/she has put made. Students will be placed in groups of two by the teacher or by their own choosing. Students will be told they must prepare a piece of poster board, serving as a piece of left over tile flooring, to be placed in the bottom of an under-the-sink kitchen cabinet that has a drain pipe. They may only use two cuts in the piece of tile: one hole to go around the pipe, and one straight cut to wrap the tile around the pipe. Students must show they used the formula for circumference of a circle and their knowledge of diameter, radius, and "pi" to prepare their piece of tile. There will be one teacher prepared model of the actual cabinet provided to each group of two students.

Each model will require different measurements. Each model will have the work "Front" on one side of it and one opening to the kitchen sink cabinet. Students will have 45 minutes to prepare their tile and complete data sheets, after which time each group will present to the rest of the class how they prepared their piece of tile and one other way they think they could have prepared it.

Student Exploration

Group Work:

Students will be working together in groups of two. All do not need to prepare their tile the same way, but they all must include how they used the formula $C = \pi d$ or $C = 2r\pi$. The teacher should be using terms such as perpendicular, straight, circumference, diameter, pi, radius, accurate, and proof.

At the end of class each group will present their final product by placing it around their model. Students will dictate how they arrived at their final product, what was difficult, what was the most fun, another way they think they might have been able to produce their piece of tile, and something they learned by preparing their piece of tile they did not know before.

Student/Teacher Actions:

Students will be talking, comparing, measuring, and cutting. There should be no trial and error cutting since this poster board is supposed to represent an expensive piece of left over kitchen floor tile. Students should not be manipulating the under kitchen sink model prepared for them by the teacher; it should be left stationary and treated as if it were the actual non-movable kitchen sink cabinet floor. They may only measure from the FRONT of the model. Students will be restricted to working within the limits of the front of the "cabinet".

Students are not restricted in how they prepare their piece of tile. However, it is expected that they will be measuring the distance between the edges of the pipe to the edge of the cabinet with accuracy, using their knowledge of straight and perpendicular (aided by the carpenter's square), and making adjustments if their "cabinet" is not made perfectly square (each corner being a right angle). Students should be finding the diameter of the circle in precise measurements (they may use centimeters or inches), and then the radius. Students should be using a compass to construct their circles to be cut out. Students should be careful to preserve neatness, as they will be graded on neatness. Students should be working together and listening to each other, confirming or correcting each other. Students will be using the calculator to arrive at precise measures for their diameter and radius.

Monitoring Student Responses

If students have difficulty thinking in terms of properties of circles and perpendicular lines, the teacher should coach them by asking such questions as how they think they might find the edges of the circle. How would they find them using the most accuracy? How would they find the diameter of the circle? How would that help them to draw a circle?

For students who complete their project and are ready to move on, allow them to proceed with another way to prepare their piece of tile and document their findings for extra points.

Assessment List and Benchmarks

Students will complete a data sheet including diagrams, formulas, calculations, and reasoning. On the next page of the data sheet they will record what tools and formulas they used. They will also record what they learned that they didn't know before that they would need to know about preparing this piece of tile, the challenges of the activity, and some fun and rewarding aspects of the activity. They will also record their thoughts about any other way they think they could have produced this piece of tile.

Students will self-assess their work using the same rubric as the teacher will use. Then, the teacher will assess their work using that rubric and giving extra credit for anyone who decided to add a pattern or appropriate artwork to the tile, as well as extra points for anyone who completed their activity and was ready to do another tile using another method.

Data Chart

1. Record formulas, calculations, diagrams, and reasoning for **_side measures_** here. Maintain order and neatness.
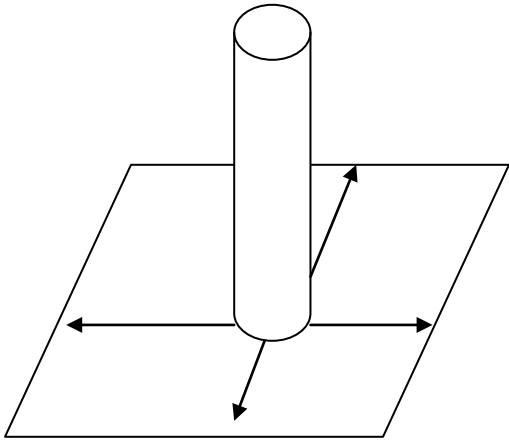
2. Record formulas, calculations, reasoning, and diagrams for **_circle measure_** here. Maintain order and neatness.
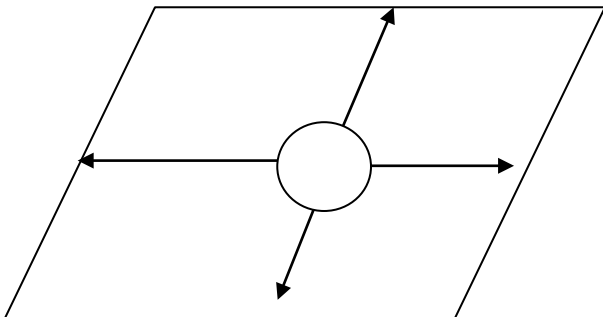
3. What measuring and construction tools did you use while preparing your piece of tile?

4. What was the most challenging part of preparing your piece of tile? This could be a difficult thinking process or decision, a difficult procedure, or both.

5. What was the most fun aspect of preparing your piece of tile?

6. What is another way you think you could have prepared your piece of tile?

7. Name one or two (or more) things you learned from this activity of preparing a piece of tile to fit into a closed space around a cylinder, that you were not aware of before? Did anything surprise you?

Performance Assessment Task – Geometry   Names_____

"Tile for Kitchen Sink Cabinet"   Date_____Block_____

Self Assessment

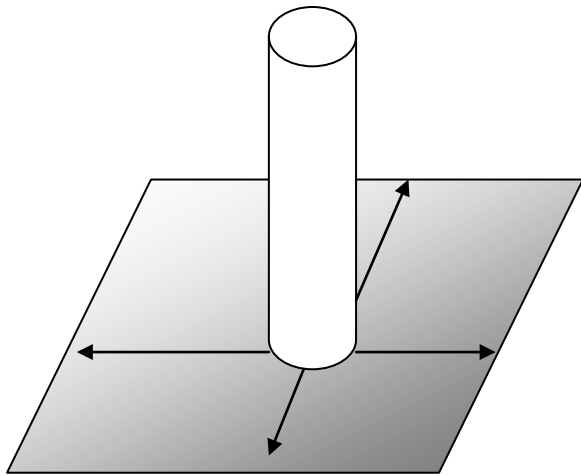|	5 points	4 points	3 points	2 points	1 point
Tile is neat, edges not frayed or bent, cuts are smooth	Tile is neat, no edges frayed or bent, cuts are smooth	Tile is neat, 3 edges not frayed or bent, cuts are smooth	Tile is neat, 2 edges not frayed or bent, cuts are smooth/rough	Tile is neat, 1 edge not frayed or bent, cuts are not smooth	Tile is neat, all edges are frayed or bent, cuts are not smooth
Tile fits flush against all 4 sides	Tile fits flush against all 4 sides	Tile fits flush against 3 sides	Tile fits flush against 2 sides	Tile fits flush against 1 side	Tile is not flush against any sides
Tile fits snug around pipe	Tile fits snug around pipe, smooth cut	Tile fits snug around 3 sides of pipe, smooth cut	Tile fits snug around 2 sides of pipe, smooth /rough cut	Tile fits snug around 1 side of pipe, smooth /rough cut	Tile fits snug around no sides of pipe, rough cut
One straight, smooth cut from edge to pipe	One straight, smooth cut from edge to pipe	One straight, rough cut from edge to pipe	One crooked, smooth cut from edge to pipe	One crooked, rough cut from edge to pipe	No cut from edge to pipe or multiple cuts
Calculations for circle cut-out clear and accurate	Diameter confirmed algebraically and using C=πd; needle position confirmed; diagram and hole clearly labeled with dimensions	One element missing	Two elements missing	Three elements missing	Four elements missing
Measurements for sides clear and accurate	2 widths, 2 lengths, left of pipe, right of pipe, front to pipe, pipe to rear	One elements missing	Two elements missing	Three elements missing	Four elements missing
Totals:					

Performance Assessment Task – Geometry   Names_____

"Tile for Kitchen Sink Cabinet"   Date_____Block_____

__Teacher Assessment__

	5 points	4 points	3 points	2 points	1 point
Tile is neat, edges not frayed or bent, cuts are smooth	Tile is neat, no edges frayed or bent, cuts are smooth	Tile is neat, 3 edges not frayed or bent, cuts are smooth	Tile is neat, 2 edges not frayed or bent, cuts are smooth/rough	Tile is neat, 1 edge not frayed or bent, cuts are not smooth	Tile is neat, all edges are frayed or bent, cuts are not smooth
Tile fits flush against all 4 sides	Tile fits flush against all 4 sides	Tile fits flush against 3 sides	Tile fits flush against 2 sides	Tile fits flush against 1 side	Tile is not flush against any sides
Tile fits snug around pipe	Tile fits snug around pipe, smooth cut	Tile fits snug around 3 sides of pipe, smooth cut	Tile fits snug around 2 sides of pipe, smooth /rough cut	Tile fits snug around 1 side of pipe, smooth /rough cut	Tile fits snug around no sides of pipe, rough cut
One straight, smooth cut from edge to pipe	One straight, smooth cut from edge to pipe	One straight, rough cut from edge to pipe	One crooked, smooth cut from edge to pipe	One crooked, rough cut from edge to pipe	No cut from edge to pipe or multiple cuts
Calculations for circle cut-out clear and accurate	Diameter confirmed algebraically and using C=π d; needle position confirmed; diagram and hole clearly labeled with dimensions	One element missing	Two elements missing	Three elements missing	Four elements missing
Measurements for sides clear and accurate	2 widths, 2 lengths, left of pipe, right of pipe, front to pipe, pipe to rear	One elements missing	Two elements missing	Three elements missing	Four elements missing
Totals:					

Teacher Model   Student Benchmark

Teacher Prepared Model of
Kitchen Sink Cabinet Area

Snug fit around pipe

One cut

Sides flush
against
cabinet
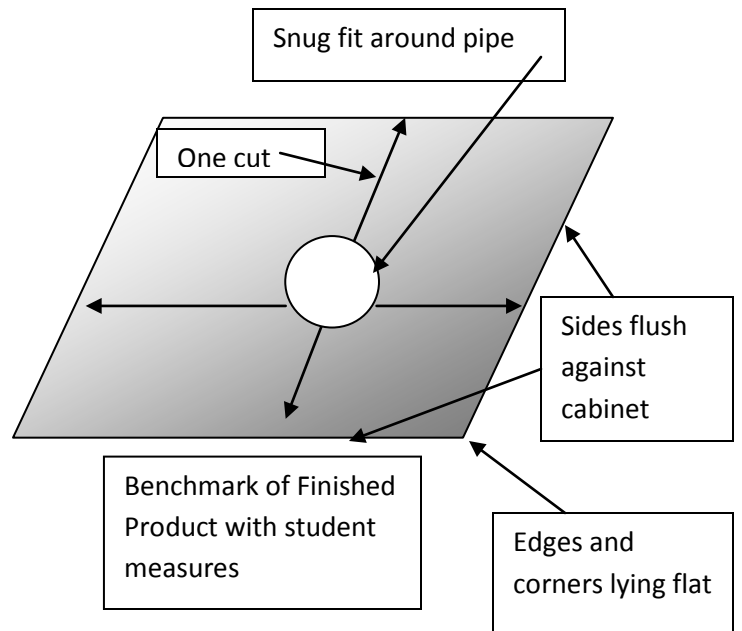
Benchmark of Finished
Product with student
measures

Edges and
corners lying flat

Data Chart

1. Record formulas, calculations, diagrams, and reasoning for **_side measures_** here. Maintain order and neatness.
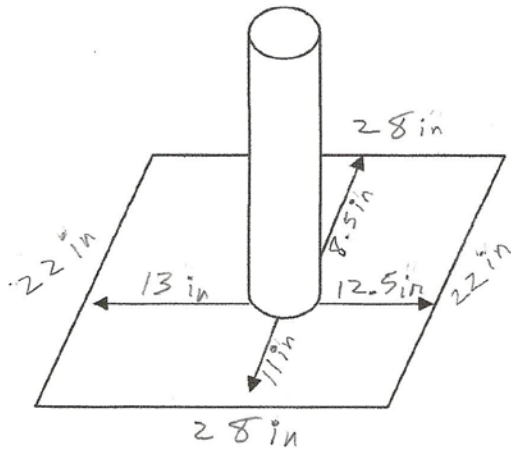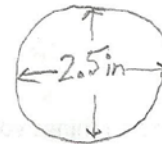

Measurements were obtained using a tape measure.
Each side and inner length and width was measured individually; no measurement was assumed.

2. Record formulas, calculations, reasoning, and diagrams for **_circle measure_** here. Maintain order and neatness.

Cut one 8.5 in slit along this line
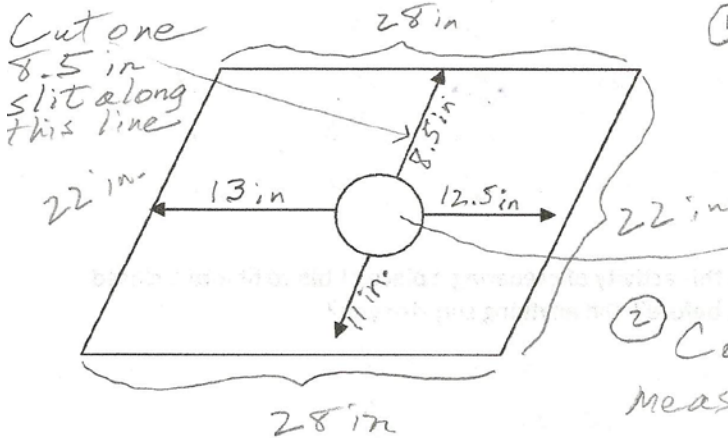
① $28 - (13 + 12.5) = 2.5\,in$

$22 - (11 + 8.5) = 2.5\,in$

② Confirm diameter using $C = \pi d$. Measure circumference using tape measure: 8 in.
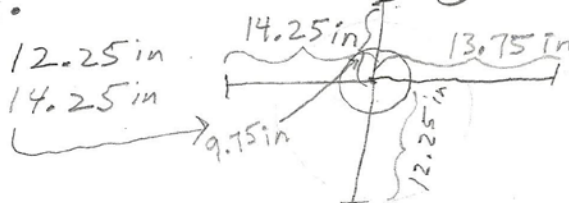
$$8 = \pi d \Rightarrow \frac{8}{\pi} = d \Rightarrow 2.546\,in.$$

Attribute difference of 0.046 to wrapping tape measure around pipe. Use diameter of 2.5. ③ Radius: $\frac{2.5}{2} = 1.25\,in.$

④ Spread compass to 1.25 in width using the same tape measure.

⑤ Place compass needle point accurately.

$11\,in + 1.25\,in = 12.25\,in$

$13\,in + 1.25\,in = 14.25\,in$

14.25 in   13.75 in

9.75 in   12.25 in

⑥ Sketch hole using compass, using 1.25 in radius.

Over→

3. What measuring and construction tools did you use while preparing your piece of tile?

- Tape Measure (metal, Craftsman)
- Calculator
- Metal Ball Bearing Compass.
- Scissors
- Marking utensil (pencil)

4. What was the most challenging part of preparing your piece of tile? This could be a difficult thinking process or decision, a difficult procedure, or both.

Centering the needle of the compass perfectly. I thought I could estimate but it required precision measurements horizontally and vertically, confirming the diameter and radius using $c = 2r\pi$ or $c = \pi d$ to place the compass needle accurately where I needed it to be.

5. What was the most fun aspect of preparing your piece of tile?

Finding the radius and confirming it using $c = \pi d$ so I could spread the compass accurately

6. What is another way you think you could have prepared your piece of tile?

I could have found a circular object with a 2.5 inch diameter, or prepared one by cutting an accurately measured circle out of cardboard, positioned it accurately, traced it, and cut out the circle.

7. Name one or two (or more) things you learned from this activity of preparing a piece of tile to fit into a closed space around a cylinder, that you were not aware of before? Did anything surprise you?

① Centering the needle of a compass on the exact spot needed to sketch a circle is not as easy as I thought it would be. Care must be taken to position accurately both horizontally and vertically.

② I was surprised to find that I would actually use $c = \pi d$ from my Geometry class to accomplish an everyday real life task in the kitchen.

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