Rubric: Stained Glass Surprise

Key APS Mathematics Performance Standards: Third Grade

- **Compares and measures** objects with respect to a given attribute (e.g., length, area, perimeter, volume, weight).
- **Selects and uses** standard measurement units in everyday situations.
- **Uses** money concepts in everyday situations and **makes** change for a variety of amounts up to $1.00.

Level	Understanding	Strategies, Reasoning, & Procedures	Communication
Novice	❖ **The student understands:** • That s/he is making a mobile using the Tangram shapes. • That s/he needs to determine/compare the area of each shape to find the cost of the stained glass, but cannot make any connections to the size and shapes of the Tangram pieces. ❖ **The student *does not* understand:** • That the area of each 3½ centimeter square costs 50¢, and connects that with the cost of the other Tangram shapes. • That s/he needs to calculate the total cost of the stained glass for the Tangram mobile.	❖ The student has started the task using Tangram manipulatives/representations, but does not use an effective strategy to determine the area of each of the Tangram shapes and the total cost of the stained glass. ❖ The student is developing their concept of shapes, measurement, size comparisons and area. **Sample Strategy:** The student plays with the Tangram manipulatives, traces some of the shapes onto the graph paper, and begins to make connections between the size of the square and the 2 small triangles. The student does not compare any of the other Tangram shapes. The student may write the cost of the square as 50¢, but will not connect this idea with any of the other shapes and does not calculate the cost of the stained glass.	❖ There is little or no communication, the student did not label the work, and/or their thinking is difficult to follow. ❖ **Summary:** The student cannot write/verbalize his/her final answer, and/or uses little or no math language and symbols to explain (in writing) how s/he determined or compared the area of each of the shapes and the cost of the stained glass. ❖ **Representations:** The student cannot represent the Tangram pieces using manipulatives/drawings, and has not created an efficient system (charts/t-tables/graphs) to compare the shapes of the Tangrams to each other to determine the area and cost of the stained glass.
Apprentice	❖ **The student understands:** • That s/he is making a mobile using the Tangram shapes. • That s/he needs to determine/compare the area of each shape to find the cost of the stained glass. ❖ **The student *may not* understand:** • That the area of each 3½ centimeter square costs 50¢, and connects that with the cost of the other Tangram shapes. • That s/he needs to calculate the total cost of the stained glass for the Tangram mobile.	❖ The student has started the task using Tangram manipulatives/representations, but does not use an effective strategy to determine the area of each of the Tangram shapes and the total cost of the stained glass. ❖ The student is developing their concept of area, measurement and the cost of the stained glass **Sample Strategy:** The student plays with the Tangram manipulatives, traces the shapes onto the graph paper, and begins to make connections between the size of the square, the 2 small triangles, and the other Tangram shapes. The student cannot accurately determine the total cost of the stained glass. (Student may use the manipulatives to demonstrate the following comparisons.) 1 square = 2 small triangles 4 squares = 2 large triangles 2 small triangles = 1 medium triangle	❖ The student has communicated his/her understanding of the task by labeling their work, but the task is not clearly organized and the student's thinking is hard to follow. ❖ **Summary:** The student states his/her final answer and uses some math language and symbols to explain (in writing) how s/he determined ❖ **Representations:** The student can represent the Tangram pieces using manipulatives/drawings, but has not created an efficient system (charts/t-tables/graphs) to compare the shapes of the Tangrams to each other to determine the area and cost of the stained glass.

Practitioner	**Proficiency** ❖ **The student understands:** • That s/he is making a mobile using the Tangram shapes. • That s/he needs to determine/compare the area of each shape to find the cost of the stained glass. • That the area of each 3½ centimeter square costs 50¢, and connects that with the cost of the other Tangram shapes. • That s/he needs to calculate the total cost of the stained glass for the Tangram mobile.	**Proficiency** ❖ The student must have a correct solution and demonstrate one strategy that will determine the area of each of the Tangram shapes and the total cost of the stained glass. ❖ The student has a good understanding of the task and compares the size of the 3½ centimeter Tangram square to the size of the other Tangram shapes to calculate the area and cost of the stained glass for the mobile. **Sample Strategies:** First I played with the Tangrams and then I traced them on the graph paper. I compared all of the shapes to the square because I know that the square cost 50¢. 1 square = 50¢ 1 square = 2 small triangles = 50¢ 4 squares = 2 large triangles = 50¢ + 50¢ + 50¢ + 50¢ = $2.00 (I put the triangles together to make a large square, 4 of the small squares fit inside the large square.) 1 medium triangle = 2 small triangles = 1 square = 50¢ (I put the 2 small triangles together to make one medium triangle.) 1 parallelogram = 2 small triangles = 1 square = 50¢ (This was a hard one to see but once I put the 2 triangles together on top of the parallelogram I could see that it was the same size.) Total: $2.00 + 50¢ + 50¢ + 50¢ + 50¢ = $4.00	**Proficiency** ❖ The student can represent his/her work in a clear, organized manner. ❖ **Summary:** The student states his/her final answer and uses appropriate math language and symbols to explain (in writing) how s/he determined or compared the area of each of the shapes and the cost of the stained glass. ❖ **Representations:** The student can represent the Tangram pieces using manipulatives/drawings, and has created an efficient system (charts/t-tables/graphs) to compare the shapes of the Tangrams to each other to determine the area and cost of the stained glass.
Expert	❖ **The student understands:** • That s/he is making a mobile using the Tangram shapes. • That s/he needs to determine/compare the area of each shape to find the cost of the stained glass. • That the area of each 3½ centimeter square costs 50¢. • That s/he needs to calculate the total cost of the stained glass for the Tangram mobile. ❖ **Task Extension:** The student includes a rule, equation, generalization, and/or observation (verbal or written) about their understanding of area and/or money.	❖ The student must have a correct solution and demonstrate one strategy that will determine the area of each of the Tangram shapes and the total cost of the stained glass for the mobile. ❖ The student has a good understanding of the task and compares the size of the 3½ centimeter Tangram square to the size of the other Tangram shapes to calculate the area and cost of the stained glass. **Sample Strategies:** See the 'Practitioner' Strategy **Task Extensions:** The student makes a comparison using the Tangram manipulatives to the graph paper tracing to measure the area of the Tangram shapes. **For Example:** I compared the 2 small triangles to the square. They are the same size. The small square has about 12 squares inside of its shape on the graph paper, the 2 triangles also have 12 squares inside of their shape.	❖ The student can represent his/her work in a clear, organized manner. ❖ **Summary:** The student states his/her final answer and uses appropriate math language and symbols to explain (in writing) how s/he determined or compared the area of each of the shapes and the cost of the stained glass. ❖ **Representations:** The student can represent the Tangram pieces using manipulatives/drawings, and has created an efficient system (charts/t-tables/graphs) to compare the shapes of the Tangrams to each other to determine the area and cost of the stained glass. ❖ **Task Extension:** The student includes a rule, equation, generalization, and/or observation (verbal or written) about their understanding of area and /or money.

Rubric: Stained Glass Surprise

Key APS Mathematics Performance Standards: Fourth Grade

- **Uses** both U.S. and metric tools for linear measurement, volume, and mass.
- **Selects and uses** the appropriate tool based on the type and size of the unit to be measured and **explains** the selection (e.g., square units are used for finding areas and cubic units are used for finding volume).
- **Solves** problems involving perimeter and area using a variety of techniques.

Level	Understanding	Strategies, Reasoning, & Procedures	Communication
Novice	❖ **The student understands:** • That s/he is making a mobile using the Tangram shapes. ❖ **The student *does not* understand:** • That s/he needs determine/compare *both* the area and perimeter of each shape to find the cost of the stained glass and the edging needed to make the mobile. The student will only attempt to solve for one part of the problem, either perimeter or area. • That the edging costs 5¢ for every centimeter and connect that to the perimeter of the Tangram shapes. • That the area of each 3½ centimeter square costs 50¢, and connects that with the cost of the other Tangram shapes. • That s/he needs to calculate the total cost of the edging and the stained glass for the Tangram mobile.	❖ The student has started the task using Tangram manipulatives/representations, but does not use an effective strategy to calculate the perimeters or determine the area of each of the Tangram shapes and the total cost of the edging and the stained glass. ❖ The student is developing their concept of shapes, perimeters, measurement, size comparisons and area. **Sample Strategy:** The student will only address one aspect of the task: perimeter or area. The student plays with the Tangram manipulatives, traces some of the shapes onto the graph paper, and begins to make connections between the size of the square and the 2 small triangles. The student does not compare any of the other Tangram shapes. The student may write the cost of the square as 50¢, but will not connect this idea with any of the other shapes and does not calculate the cost of the stained glass.	❖ There is little or no communication, the student did not label the work, and/or their thinking is difficult to follow. ❖ **Summary:** The student cannot write/verbalize his/her final answer, and/or uses little or no math language and symbols to explain (in writing) how s/he calculated the perimeter of the shapes and the cost of the edging, and then determined or compared the area of each of the shapes and the cost of the stained glass. The student did not state the total cost for making the mobile. ❖ **Representations:** The student cannot represent the Tangram pieces using manipulatives/drawings, and has not created an efficient system (charts/t-tables/graphs) to compare the shapes of the Tangrams to each other to determine the area and cost of the stained glass. The student did not state the total cost for making the mobile.

Apprentice	❖ **The student understands:** • That s/he is making a mobile using the Tangram shapes. • That s/he needs to determine/compare the area and perimeter of each shape to find the cost of the stained glass and the edging needed to make the mobile, but does not have enough understanding of both concepts to accurately find the perimeters and areas. ❖ **The student *may not* understand:** • That the edging costs 5¢ for every centimeter and connect that to the perimeter of the Tangram shapes. • That the area of each 3½ centimeter square costs 50¢, and connects that with the cost of the other Tangram shapes. • That s/he needs to calculate the cost of the edging and the stained glass for the Tangram mobile.	❖ The student has started the task using Tangram manipulatives/representations, but does not use an effective strategy to calculate the perimeters and/or determine/compare the area of each of the Tangram shapes. The student may attempt to find the costs of the edging and the stained glass, but will not be able to accurately total the costs. ❖ The student is developing their concept of perimeter, area, measurement, and money. ***Sample Strategy:** The student attempts to solve the task and may completely solve one part of the task, perimeter or area, but will not successfully solve both. The student may also attempt to solve both perimeter and area, but not reach a complete solution for the task (i.e., the student will find the perimeter and the areas but not accurately calculate the costs). The student has a hard time managing all of the components to the task and does not arrive at an accurate final solution.	❖ The student has communicated his/her understanding of the task by labeling their work, but the task is not clearly organized and the student's thinking is hard to follow. ❖ **Summary:** The student states his/her final answer and uses some math language and symbols to explain (in writing) how s/he calculated the perimeter of the shapes and the cost of the edging, and then determine/compare the area of each of the shapes and the cost of the stained glass. The student did not state the total cost for making the mobile. ❖ **Representations:** The student can represent the Tangram pieces using manipulatives/drawings, but has not created an efficient system (charts/t-tables/graphs) to calculate the perimeters of the shapes and the cost of the edging and compares the shapes of the Tangrams to each other to determine the area and cost of the stained glass. The student did not state the total cost for making the mobile.

*There are so many variations that can occur in the student's performance at the apprentice level. Basically the student understands that they are creating a mobile out of Tangram shapes and must calculate the perimeter, area and the costs for the material, but cannot connect all of these ideas together in some way to arrive at a final accurate solution.

Practitioner	**Proficiency** ❖ **The student understands:** • That s/he is making a mobile using the Tangram shapes. • That s/he needs to determine/compare the area and perimeter of each shape to find the cost of the stained glass and the edging needed to make the mobile. • That the edging costs 5¢ for every centimeter and connect that to the perimeter of the Tangram shapes. • That the area of each 3½ centimeter square costs 50¢, and connects that with the cost of the other Tangram shapes. • That s/he needs to calculate the total cost of the stained glass and the edging for the Tangram mobile.	**Proficiency** ❖ The student must have a correct solution and demonstrate one strategy that will determine the perimeter and area of each of the Tangram shapes and the total cost of the edging, the stained glass, and the total cost of the mobile. ❖ The student has a good understanding of this multiple step task. The student calculates the perimeters for all of the shapes to find the total perimeter and the cost of the edging. The student also compares the size of the 3½ centimeter Tangram square to the size of the other Tangram shapes to calculate the area and cost of the stained glass for the mobile. The student can find the total cost for making the mobile. **Sample Strategies:** See 'Possible Solutions' in the Teacher Instructions for a variety of student strategies. Teachers are looking for the students' ability to answer both parts of the task: the perimeter of each of the shapes and the cost of the edging, and the area comparisons for each of the shapes and the cost of the stained glass. Students must be able to find the total cost of making the Tangram mobile.	**Proficiency** ❖ The student can represent his/her work in a clear, organized manner. ❖ **Summary:** The student states his/her final answer and uses appropriate math language and symbols to explain (in writing) how s/he calculated the perimeter of the shapes and the cost of the edging, and then determined or compared the area of each of the shapes and the cost of the stained glass. The student did state the total cost for making the mobile. ❖ **Representations:** The student can represent the Tangram pieces using manipulatives/drawings, and has created an efficient system (charts/t-tables/graphs) to calculate the perimeters of the shapes and the cost of the edging and compares the shapes of the Tangrams to each other to determine the area and cost of the stained glass. The student did state the total cost for making the mobile.
Expert	❖ **The student understands:** • That s/he is making a mobile using the Tangram shapes. • That s/he needs to determine/compare the area and perimeter of each shape to find the cost of the stained glass and the edging needed to make the mobile. • That the edging costs 5¢ for every centimeter and connect that to the perimeter of the Tangram shapes. • That the area of each 3½ centimeter square costs 50¢, and connects that with the cost of the other Tangram shapes. • That s/he needs to calculate the total cost of the stained glass and the edging for the Tangram mobile. ❖ **Task Extension:** The student includes a rule, equation, generalization, and/or observation (verbal or written) about their understanding of perimeter, area and/or money.	❖ The student must have a correct solution and demonstrate one strategy that will determine the area of each of the Tangram shapes and the total cost of the stained glass for the mobile. ❖ The student has a good understanding of the task and compares the size of the 3½ centimeter Tangram square to the size of the other Tangram shapes to calculate the area and cost of the stained glass. **Sample Strategies:** See the 'Practitioner' Strategy **Task Extensions:** The student makes a comparison of the Tangram manipulatives to the graph paper tracing to measure the area of the Tangram shapes. **For Example:** I noticed in my drawing that the area of the small square was about 12 centimeter squares. Matching the 2 small triangles to the small square I realized that the area of one triangle was half of the square or 6 centimeter squares. I counted the centimeter squares inside the triangle to check if my idea was correct. There were 6 squares (counting the half squares) inside the triangle.	❖ The student can represent his/her work in a clear, organized manner. ❖ **Summary:** The student states his/her final answer and uses appropriate math language and symbols to explain (in writing) how s/he calculated the perimeter of the shapes and the cost of the edging, and then determined or compared the area of each of the shapes and the cost of the stained glass. The student did state the total cost for making the mobile. ❖ **Representations:** The student can represent the Tangram pieces using manipulatives/drawings, and has created an efficient system (charts/t-tables/graphs) to calculate the perimeters of the shapes and the cost of the edging and compares the shapes of the Tangrams to each other to determine the area and cost of the stained glass. The student did state the total cost for making the mobile. ❖ **Task Extension:** The student includes a rule, equation, generalization, and/or observation (verbal or written) about their understanding of perimeter, area and/or money.

Rubric: Stained Glass Surprise

Key APS Mathematics Performance Standards: Fifth Grade

- **Solves** problems that involve perimeter, diameter, base, height, vertices, perpendicular lines, and angles using geometric models of two-dimensional shapes.
- **Uses** measures of money and time, U.S. and metric measures of length, weight, and volume to solve problems and **makes** estimates.
- **Uses** patterns and numerical rules to represent and solve problems.
- **Counts, makes change, and solves** mathematical problems involving money.

Level	Understanding	Strategies, Reasoning, & Procedures	Communication
Novice	❖ **The student understands:** • That s/he is making a mobile using the Tangram shapes. ❖ **The student *does not* understand:** • That s/he needs calculate *both* the area and perimeter of each shape to find the cost of the stained glass and the edging needed to make the mobile. The student will only attempt to solve for one part of the problem, either perimeter or area. • That the edging costs 5¢ for every centimeter and connect that to the perimeter of the Tangram shapes. • That the area of each 3½ centimeter square costs 50¢, and connects that with the cost of the other Tangram shapes. • That s/he needs to calculate the total cost of the stained glass for the Tangram mobile.	❖ The student has started the task using Tangram manipulatives/representations, but does not use an effective strategy to calculate the perimeters, determine the area of each of the Tangram shapes, or the total cost of the edging and the stained glass. ❖ The student is developing their concept of shapes, perimeters, measurement, size comparisons and area. **Sample Strategy:** The student will only address one aspect of the task: perimeter or area. The student plays with the Tangram manipulatives, traces some of the shapes onto the graph paper, and begins to make connections between the size of the square and the 2 small triangles. The student does not compare any of the other Tangram shapes. The student may write the cost of the square as 50¢, but will not connect this idea with any of the other shapes and does not calculate the cost of the stained glass.	❖ There is little or no communication, the student did not label the work, and/or their thinking is difficult to follow. ❖ **Summary:** The student cannot write/verbalize his/her final answer, and/or uses little or no math language and symbols to explain (in writing) how s/he calculated the perimeter of the shapes and the cost of the edging. The student did not attempt to explain how s/he calculated the area of each of the shapes and the cost of the stained glass. The student did not state the total cost for making the mobile. ❖ **Representations:** The student cannot represent the Tangram pieces using manipulatives/drawings, and has not created an efficient system (charts/t-tables/graphs) to calculate the perimeters and the areas of the shapes; or the cost of the edging and the stained glass. The student cannot find the total cost for making the mobile.

Apprentice	❖ **The student understands:** • That s/he is making a mobile using the Tangram shapes. • That s/he needs to calculate the area and perimeter of each shape, to find the cost of the stained glass and the edging needed to make the mobile, but does not have enough understanding of both concepts to accurately find the perimeters and areas. ❖ **The student *may not* understand:** • That the edging costs 5¢ for every centimeter and connect that to the perimeter of the Tangram shapes. • That the area of each 3½ centimeter square costs 50¢, and connects that with the cost of the other Tangram shapes. • That s/he needs to calculate the total cost of the stained glass and the edging for the Tangram mobile.	❖ The student has started the task using Tangram manipulatives/representations, but does not use an effective strategy to calculate the perimeters and/or determine/compare the area of each of the Tangram shapes. The student may attempt to find the costs of the edging and the stained glass, but will not be able to accurately total the costs. ❖ The student is developing their concept of perimeter, area, measurement, and money. ***Sample Strategy:** The student attempts to solve the task and may completely solve one part of the task, perimeter or area, but will not successfully solve both. The student may also attempt to solve both perimeter and area, but not reach a complete solution for the task (i.e., the student will find the perimeter and the areas but not accurately calculate the costs). The student has a hard time managing all of the components to the task and does not arrive at an accurate final solution.	❖ The student has communicated his/her understanding of the task by labeling their work, but the task is not clearly organized and the student's thinking is hard to follow. ❖ **Summary:** The student states his/her final answer and uses some math language and symbols to explain (in writing) how s/he calculated the perimeter of the shapes and the cost of the edging. The student attempted to explain how s/he calculated the area of each of the shapes and the cost of the stained glass. The student did not state the total cost for making the mobile. ❖ **Representations:** The student can represent the Tangram pieces using manipulatives/drawings, but has not created an efficient system (charts/t-tables/graphs) to calculate the perimeters and the areas of the shapes; or the cost of the edging and the stained glass. The student cannot find the total cost for making the mobile.

*There are so many variations that can occur in the student's performance at the apprentice level. Basically the student understands that they are creating a mobile out of Tangram shapes and must calculate the perimeter, area and the costs for the material, but cannot connect all of these ideas together in some way to arrive at a final accurate solution.

Practitioner	**Proficiency** ❖ **The student understands:** • That s/he is making a mobile using the Tangram shapes. • That s/he needs to calculate the area and perimeter of each shape to find the cost of the stained glass and the edging needed to make the mobile. • That the edging costs 5¢ for every centimeter and connect that to the perimeter of the Tangram shapes. • That the area of each 3½ centimeter square costs 50¢, and connects that with the cost of the other Tangram shapes. • That s/he needs to calculate the total cost of the stained glass and the edging for the Tangram mobile.	**Proficiency** ❖ The student must have a correct solution and demonstrate one strategy that will determine the perimeter and area of each of the Tangram shapes and the total cost of the edging, the stained glass, and the total cost of the mobile. ❖ The student has a good understanding of this multiple step task. The student calculates the perimeters for all of the shapes to find the total perimeter and the cost of the edging. The student also finds the area of the Tangram shapes and uses those measurements to calculate the cost of the stained glass. The student can find the total cost for making the mobile. **Sample Strategies:** See 'Possible Solutions' and 'Task Proficiency' in the *Teacher Instructions* for a variety of student strategies. Teachers are looking for the students' ability to answer both parts of the task: the perimeter of each of the shapes and the cost of the edging, and the area calculations for each of the shapes and the cost of the stained glass. Students must be able to find the total cost of making the Tangram mobile.	**Proficiency** The student can represent his/her work in a clear, organized manner. ❖ **Summary:** The student states his/her final answer and uses appropriate math language and symbols to explain (in writing) how s/he calculated the perimeter of the shapes and the cost of the edging. The student also explained how s/he calculated the area of each of the shapes and the cost of the stained glass The student found the total cost for making the mobile. ❖ **Representations:** The student can represent the Tangram pieces using drawings, and has created an efficient system (charts/t-tables/graphs) to calculate the perimeters of the shapes and the cost of the edging. The student represents and measures the areas of the Tangrams and cost of the stained glass. The student can find the total cost for making the mobile.
Expert	❖ **The student understands:** • That s/he is making a mobile using the Tangram shapes. • That s/he needs to calculate the area and perimeter of each shape to find the cost of the stained glass and the edging needed to make the mobile. • That the edging costs 5¢ for every centimeter and connect that to the perimeter of the Tangram shapes. • That the area of each 3½ centimeter square costs 50¢, and connects that with the cost of the other Tangram shapes. • That s/he needs to calculate the total cost of the stained glass and the edging for the Tangram mobile. ❖ **Task Extension:** The student includes a rule, equation, generalization, and/or observation (verbal or written) about their understanding of perimeter, area and/or money.	❖ The student must have a correct solution and demonstrate one strategy that will determine the perimeter and area of each of the Tangram shapes and the total cost of the edging, the stained glass, and the total cost of the mobile. ❖ The student has a good understanding of this multiple step task. The student calculates the perimeters for all of the shapes to find the total perimeter and the cost of the edging. The student also finds the area of the Tangram shapes and uses those measurements to calculate the cost of the stained glass. The student can find the total cost for making the mobile. **Sample Strategies:** See the 'Practitioner' Strategy **Task Extensions:** The student makes a comparison of the drawings to a formula to measure area. **For Example:** When I put the 2 large triangles together I noticed that they form a square with aside of 7 centimeters. I drew that on the graph paper and counted the centimeter squares, there were 49. I remembered from my multiplication tables that 7 x 7 = 49, so I counted one side and it was 7. From that I figured out a formula for the area of a square: side x side = area. It worked for the small square too: 3.5 x 3.5 = 12.25.	❖ The student can represent his/her work in a clear, organized manner. ❖ **Summary:** The student states his/her final answer and uses appropriate math language and symbols to explain (in writing) how s/he calculated the perimeter of the shapes and the cost of the edging. The student also explained how s/he calculated the area of each of the shapes and the cost of the stained glass The student found the total cost for making the mobile. ❖ **Representations:** The student can represent the Tangram pieces using drawings, and has created an efficient system (charts/t-tables/graphs) to calculate the perimeters of the shapes and the cost of the edging. The student represents and measures the areas of the Tangrams and cost of the stained glass. The student can find the total cost for making the mobile. ❖ **Task Extension:** The student includes a rule, equation, generalization, and/or observation (verbal or written) about their understanding of perimeter, area and/or money.