Lesson Title	Similar Polygons Puzzle
Length of Lesson	1 50-minute lesson
Created By	Sean Owens
Subject	Mathematics, Geometry
Grade Level	9^{th} – 12^{th}
State Standards	9^{th} - 12^{th} Pre-Algebra: 3d Transition to Algebra: 3b Algebra 1: 4a Geometry: 1a
DOK Level	DOK 2 – Transition to Algebra, Algebra 1, Geometry DOK 3 – Pre-Algebra
DOK Application	2 – Identify Patterns, Modify, Relate, Compare, Make Observations 3 – Assess, Compare, Investigate, Draw Conclusions
National Standards	9-12: B: Geometry C: Measurement E: Problem Solving
Graduate Research Element	This lesson will teach students how to use a process to reduce the area of a shape by layering similar polygons. This is the same procedure I use in my research to reduce the chip size required for a given function size.

Student Learning Goal:
After performing this lesson, students will be able to use angles of reflection to produce parallel lines.

This lesson addresses Mississippi 9-12 Mathematics standards: Pre-Algebra 3d; Transition to Algebra 3b; Algebra 1 4a; and Geometry 1a. It also addresses National 9-12 Mathematics standards B, C, and E.

State Standards: 9^{th} – 12^{th} Mathematics

Pre-Algebra – 3d: Solve real-world and non-routine problems involving congruent and similar figures.

Transition to Algebra – 3b: Apply proportional reasoning to determine similar figures and find unknown measures.

Algebra 1 – 4a: Solve real-world problems involving formulas for perimeter, area, distance, and rate.

Geometry – 1a: Apply problem-solving skills to solve and verify the solutions for in known measures in similar polygons.

National Standards: 9^{th} – 12^{th} Mathematics
B (Geometry):

- Apply transformations and use symmetry to analyze mathematical situations
- Use visualization, spatial reasoning, and geometric modeling to solve problems

C (Measurement):

- Apply appropriate techniques, tools, and formulas to determine measurements

E (Problem Solving):

- Monitor and reflect on the process of mathematical problem solving

Materials Needed (supplies, hand-outs, resources):

- Puzzle (1 per team; see Teacher's notes)
- Handout (see INSPIRE_owens_10_15_12_similar_polygons_worksheet.doc)

Lesson Performance Task/Assessment:
Students will develop a process for completing the similar polygons puzzle. Students will follow given rules (see guided practice section) to minimize the area of the puzzle.

Lesson Relevance to Performance Task and Students:
Students will work in teams to develop a process for completing the puzzle. Completing the puzzle will demonstrate the students' understanding of similar polygons. Furthermore, working to minimize the area of the puzzle with show the students' ability to generate a process for minimization.

Anticipatory Set/Capture Interest:
As an anticipatory set for this lesson, the instructor can show the students the original puzzle and ask if it is possible to reduce its size to a single square by flipping along the edges.

Guided Practice:
The guided practice section of this lesson will be instructing the students of how to attempt the puzzle and the rules that must be followed when doing so. The rules for solving the puzzle are:

1. A piece can only be moved to a piece that shares a side with it.
2. A piece can only be moved if its top layer is complete (A square with a triangle on it cannot be moved, but a square with two triangles on it can.)

Independent Practice:
During the independent portion of the lesson, teams of students (2-4) will work together to create the smallest area possible by solving the puzzle (The puzzle given in the teachers' notes can be solved to a single square following the solution below it.) Students

will fill out the provided handout (see INSPIRE_owens_10_15_12_similar_polygons_worksheet.doc). During the independent practice section, the instructor can move from team to team and provide further instruction as necessary. The instructor can bring the class back together for the closure section with 10 – 15 minutes remaining in the period.

Remediation and/or Enrichment:
Remediation: Individual IEP.
Enrichment: Have the students find a second/third path for completing the puzzle.

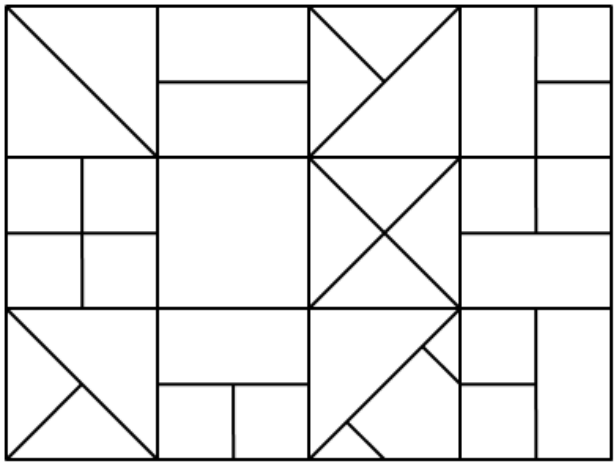
Check(s) for Understanding:
What is a similar polygon? What are rules for completing the puzzle? What is the ratio of the original puzzle to your completed puzzle?

Closure:
For the closure portion of this lesson, the instructor will poll the teams to see which team was able to produce the smallest area. The instructor can then discuss how the process used to solve the puzzle is critical in engineering today including microchip design processes.

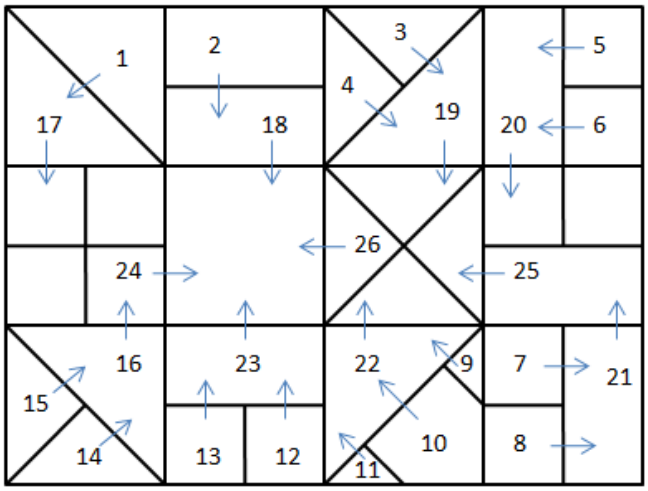
Possible Alternate Subject Integrations:

Teacher Notes:

- A puzzle design is shown below:



A possible solution for the above puzzle:



- A template of the puzzle can be made of cardboard and then individual sets made of construction paper.