Expanded Square Designs

Lesson 4: Defend

Australian Curriculum: Mathematics (Year 4)

ACMMG091: Create symmetrical pictures and shapes with and without digital technologies
ACMMG087: Compare the areas of regular and irregular shapes by informal means

- Comparing areas using metric units, such as counting the number of square centimetres required to cover two areas by overlaying the areas with a grid of centimetre squares

Lesson abstract

Students adjust their designs (or describe possible adjustments) to get near half the area flipped and then ensure their evidence is detailed and organised clearly so it can be displayed for others to critique. During the feedback session, students provide constructive feedback on the strengths and weaknesses of the mathematical evidence and designs. They reflect on feedback given on their own display and on their learning throughout the inquiry.

Mathematical purpose (for students)

Evidence can be in words, in pictures and diagrams, and in numbers and calculations.

Mathematical purpose (for teachers)

Presenting the Inquiry solution backed with mathematical evidence helps convince others that the solution answers the inquiry question. To convince yourself that others' solutions are valid, it is necessary to critique the solutions and supporting mathematical evidence. Reflecting on feedback given and the learning throughout the inquiry prompts students to record ideas and concepts that are worth remembering. At the end of the Defend phase, students will be able to:

- Convince others with visual and numerical evidence that their design has approximately half the area flipped to the outside.
- Explain and justify adjustments to the design.
- Provide constructive feedback to others on the quality and accuracy of presented evidence.
- Reflect on their learning throughout the unit.

Lesson Length 75 minutes

Vocabulary Encountered

- critique

Lesson Materials

- Student Sheet 1 - Two Stars and a Wish (at least 1 per student)
- Paper for posters (A3 or poster size), scissors, glue
- Students' plans and designs from previous lessons
- 16 centimetre coloured paper squares (1 sheet per student, same colour both sides, for adjusting designs)
- Art block paper or A3 paper (white, 1 piece per student, for adjusting designs)
- Slide show *ST8_Expanded_Square_4a_Defend.pptx*

We value your feedback after these lessons via https://www.surveymonkey.com/r/CV2TXTT

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Refining the Designs

There are two options for this lesson. Choose according to time available.

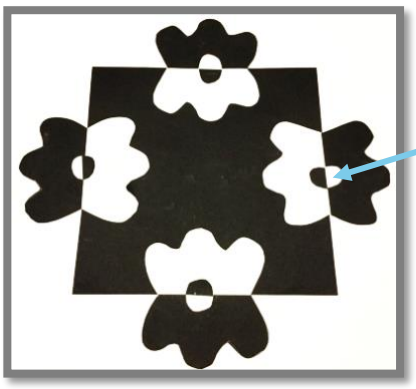
Students consider what adjustments they could make to their designs, but do not produce the adjusted expanded square. They explain the adjustments they would make on their evidence poster.

OR

Students produce the adjusted expanded square, and explain changes on their evidence poster.

Inquiry Question: How can we design an expanded square where approximately half the area of the original square is flipped to the outside?

1. Refer students to the evidence they recorded in the Develop Lesson. Have them share whether their design had approximately half the area of the square flipped to the outside and if not, possible ways they could adjust their design. If desired, show examples from slide show *ST8_Expanded_Square_4a_Defend.pptx*

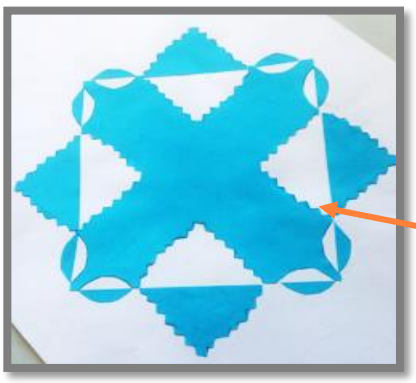


When I counted my squares, I had flipped twenty squares more than I needed. If I cut out this semicircular shape (about 2 squares) and flip it back to the original square it will give me less white space and I will be closer to having ½ of the square flipped to the outside.

Some possible design adjustments:

- Adjust the fraction flipped by increasing/decreasing the sizes of the cut-outs.
- Reduce the fraction of the original square that is flipped by cutting parts from the flipped shape and flipping them back into the original square.

2. If students want to add more detail and interest to their design, they can make small alterations to individual shapes to make them more elaborate, with little effect on the area. However, they need to be careful to keep the mirror images correct. For example, the design shown below could NOT have been made just by trimming a completed design with decorative craft scissors to make serrated edges.



My flipped area was approximately half. I changed the lines on my triangle to zigzag lines to make my design more interesting without changing the flipped area too much.

3. Inform students that today in the Defend Phase they will be:
   - Considering adjustments to refine their designs, and optionally constructing it.
   - Ensuring that their evidence is detailed and organised clearly on their poster, including explaining any adjustments from this lesson.

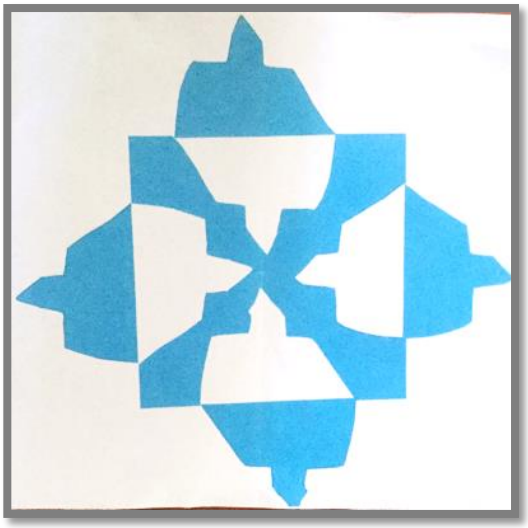
Preparing Evidence

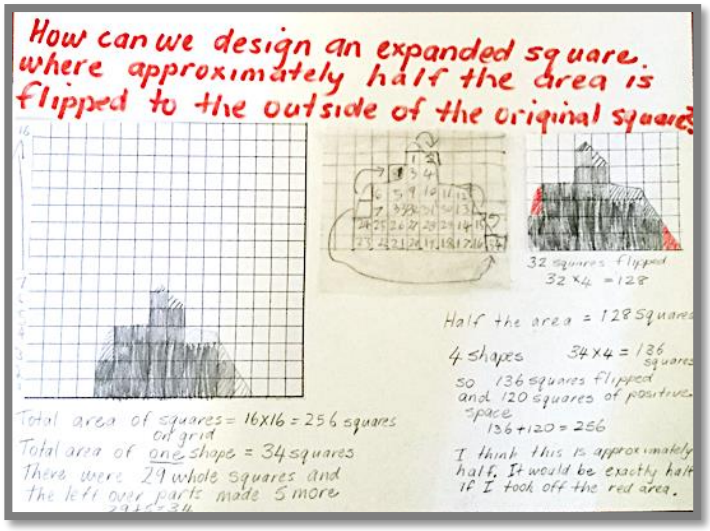
4. Provide students with a sheet of A3 paper or poster paper to organise their evidence poster. Display the Evidence Poster Checklist on Slide 4 of *ST8_Expanded_Square_4a_Defend.pptx:*
   - Inquiry question
   - Visual representation of the flipped area
   - Numerical calculations used to determine total area of the original square, half the area of the original square, and the total area flipped
   - Explanation of adjustments to make the flipped area closer to half - including numerical calculations

   If desired, show the example below (on Slide 5).

   Advise students that their posters must 'speak for themselves' as they will be displayed around the classroom and students will not be able to give any further information verbally. Highlight the importance of clear information that provides enough mathematical detail to explain their solution and convince others it is correct.

5. Allow students sufficient time to prepare their evidence poster. Ensure students add their name to both their completed expanded square and evidence poster before they display them around the room.





Feedback: Two Stars and a Wish

6. Provide all students with a copy of Student Sheet 1 - Two Stars and a Wish. Have them cut out the three response sheets they will complete as they visit the displays.
   Explain to students they are to provide constructive feedback on what was done well (stars) and what could have been improved (wish). Remind them to focus on the mathematics:
   - Visual area calculation.
   - Accurate numerical calculations.
   - Shapes used.
   - Clear mathematical thinking and justification for making adjustments to the design.

   Encourage students to **check** the **calculations** presented as evidence and to use mathematical terminology when completing the response sheets.

7. To ensure all displays are visited, allocate students to their first display and subsequently allow no more than two students at a time at each display. As far as possible, aim to get similar number of feedback

comments to all students. Allow 20 minutes for students to view and evaluate the displays.

8. Have several students share the feedback they have given, and briefly comment on what the display owner might learn from it.

9. Then ask students to hand out their feedback sheets to the display authors. Students then read and reflect on the feedback they were given for their own display.

Expected Student Response

Presenter's name: Adi		
STAR 	STAR 	WISH 
A star for correct calculations. I checked them on my calculator.	A star for explaining why you needed to flip back an area of 15 squares to the original square.	I wish the full and half squares were different colours. It was hard to work out which squares you counted as half squares.

Conclusion

10. Have students reflect on their learning throughout the unit. *What have you learnt during this inquiry that is worth recording so you will remember it*? (e.g. specific mathematical vocabulary, process to calculate areas of shapes, evidence poster etc.) Encourage students to respond creatively using words and visuals.

11. Provide time for students to share their reflections with a small group.

Two Stars and a Wish

Name: _____

Presenter's name:		
STAR 	STAR 	WISH 

Presenter's name:		
STAR 	STAR 	WISH 

Presenter's name:		
STAR 	STAR 	WISH 

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