

PENTOMINOES

ACTIVITY GUIDE

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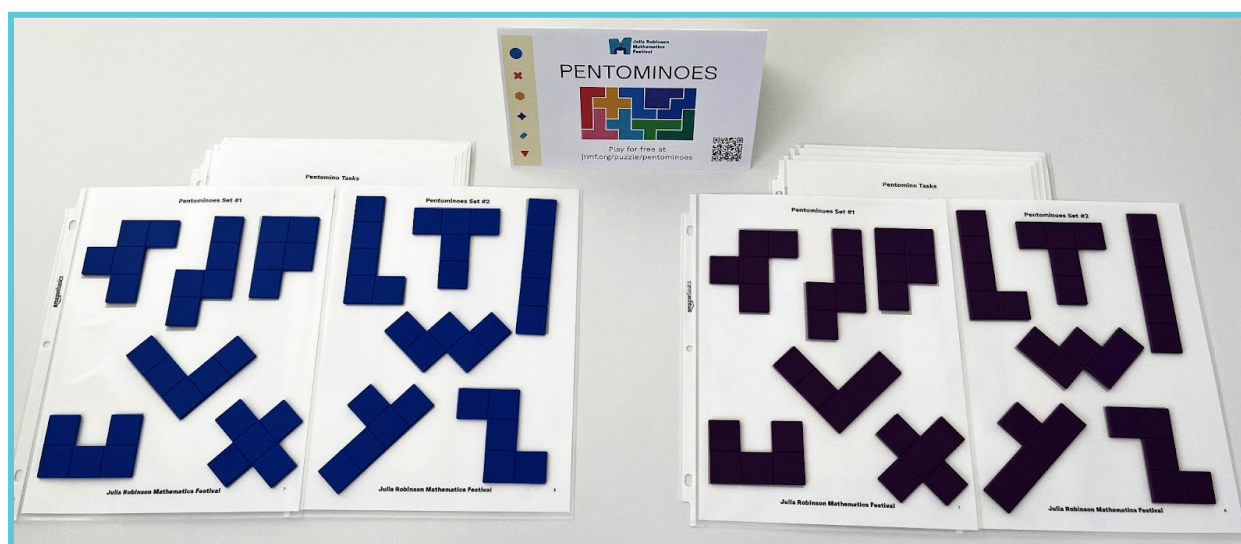
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Mathematics
Festival**

Materials and Setup

Per table (assuming 5 students per table), you will need:

Per Table	Material Preparation	
5 Pentomino sets	Each set has 12 unique pieces.	
5 copies of Pentominoes Sets sheets	2 pages each <i>print single-sided</i> (students need to be able to use both pages simultaneously.)	p. 7-8
5 copies of Tasks	8 pages each <i>can be printed double-sided in black and white</i>	p. 9-16
1 copy of Table Sign	1 page <i>print on cardstock for sturdiness</i>	p. 17

Per Table	Purchasing Materials		
5 pentomino sets	6 pentomino sets for \$24.13		
30 plastic sheet protectors	pack of 100 for \$7.67	pack of 500 for \$26.99	These are recommended in order to protect the documents that students will be handling.





Objective

Cover the shapes with different pentomino combinations.

Rules:

1. You can only use each pentomino once per challenge.
2. Pentominoes must fit inside the shape without overlapping.

Materials

Each Pentominoes table should be prepped for 5 stations.

Each station needs:

1. Pentomino set (12 distinct shapes).
2. Pentominoes sets sheets.
3. Pentominoes tasks.

How to Play

We encourage you to explore the activity yourself ahead of time.

You can try our online version [here](#).

Introduce the activity without overexplaining it and without telling what strategies students might want to use. As much as possible, avoid giving away answers. Students should be encouraged to explore, experiment, and learn from their mistakes.

1. Have ready all 12 pentomino pieces laid out on pages 8 and 9. *For younger students, have them place each pentomino on its corresponding shape on the two pages.*
2. Demonstrate the first task by asking the student to choose two pentominoes they think might cover the shape. Then ask if they can cover the same shape with two other pentominoes.
3. Have the student explore the rest of the tasks.

Beginner Version

See [here](#) for a beginner version to engage younger students or students of any age who:

1. Have strong math anxieties
2. Don't feel confident with math or math puzzles
3. Have learning differences
4. Want a gentler start to the activity

Standards

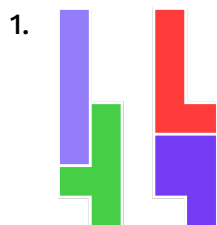
1. Make sense of problems and persevere in solving them. CCSS.MP1
2. Construct viable arguments and critique the reasoning of others. CCSS.MP3
3. Look for and make use of structure. CCSS.MP7
4. Compose two-dimensional shapes to create a composite shape. CCSS.1.G.A.2

Asking Good Questions

1. Ask questions about confidence.
 - a. When a student asks you “Is this right?”, instead of saying “yes” or “no” right away, ask them how confident they are in their answer. Here are some examples:
 - i. “Maybe. What do you think? How confident are you?”
 - ii. “On a scale of 1-5, how confident are you in your answer?”
 - b. If a student is not confident in their answer, follow up by asking “What would help you feel more confident in your answer?” or “Why do you not feel confident?” This helps you determine how best to help the student through their explorations.
2. Ask students about choices.
 - a. When a student is stuck or shows you a wrong answer, instead of jumping in and showing the student the correct answer, start by asking about the choices that the student made along the way. Here are some suggested steps to follow:
 - i. Ask students to show you what they’ve tried so far.
 - ii. When the student gets to a point where they have different choices, ask the student “What other choices can you make here?”
 - iii. Have the student make a different choice and try to solve the puzzle. This helps the student see that they have the power to make different choices during an activity, and they’ll start to do this on their own in the future.
 - iv. If you’re familiar with the puzzle or a particular solution, stop the student only when a different choice will help them get to the solution. This will help them feel successful faster without you giving away too much of the answer.
3. Ask students about strategies.
 - a. If a student is getting into the activity and has been doing it for a while, ask the student if there are any strategies they’ve come up with to help them solve the puzzle or win the game.
 - b. Follow up by asking if they think their strategies will work for all puzzles and/or larger puzzles, more complex puzzles, etc. Have the student explore more complex puzzles to test out their strategies.
 - c. This is a great way to encourage a student to dive deeper into an activity and to start looking for patterns, structure, and proofs.
4. Activity specific questions.
 - a. Are there any pentominoes you know won’t work? Why?
 - b. Are there any pentominoes that are easy to work with? Why?

Answers

Below are example solutions for each puzzle. Some puzzles may have more than one solution.



There are two other solutions. Each solution uses the orange, yellow, and purple pieces.



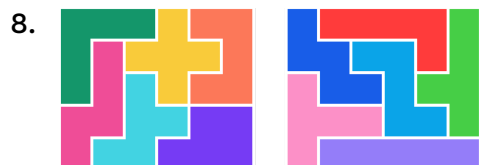
Starting at Puzzle 6, some puzzles can be very challenging for students. If students are starting to get frustrated, you can provide them with a hint by placing one of the pieces in the correct place. We recommend giving this hint only if a student is about to give up and to only give a hint like this once.



It is impossible to make a fourth copy of this shape. To make four copies of this shape, you would need to use all 12 pentominoes. However, the straight piece (light purple above) cannot fit in this shape.



It is impossible to make a third copy of this shape. To make three copies of this shape, you would need to use all 12 pentominoes. However, the X piece (yellow above) cannot fit in this shape without either isolating a square or requiring you to use more than one U piece (orange) or tall L piece (red).



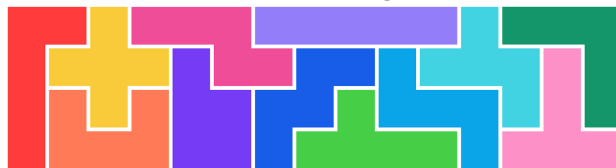
The left rectangle is made with Pentominoes Set #1. The right rectangle is made with Pentominoes Set #2.

9. There are many different ways to make a rectangle using all 12 pentominoes. Each pentomino covers 5 squares, and all 12 pentominoes cover 60 squares. So, a rectangle that uses all 12 pentominoes must have a length and width that multiplies to 60. Below are examples of a 3x20, 4x15, 5x12, and 6x10 rectangle using all 12 pentominoes. There are thousands of other solutions!

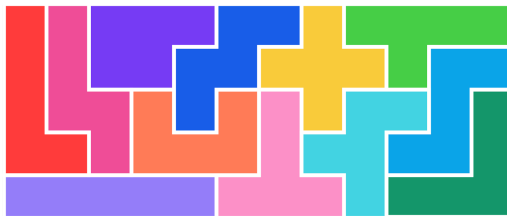
3x20 Rectangle



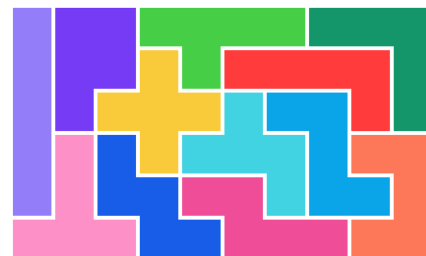
4x15 Rectangle



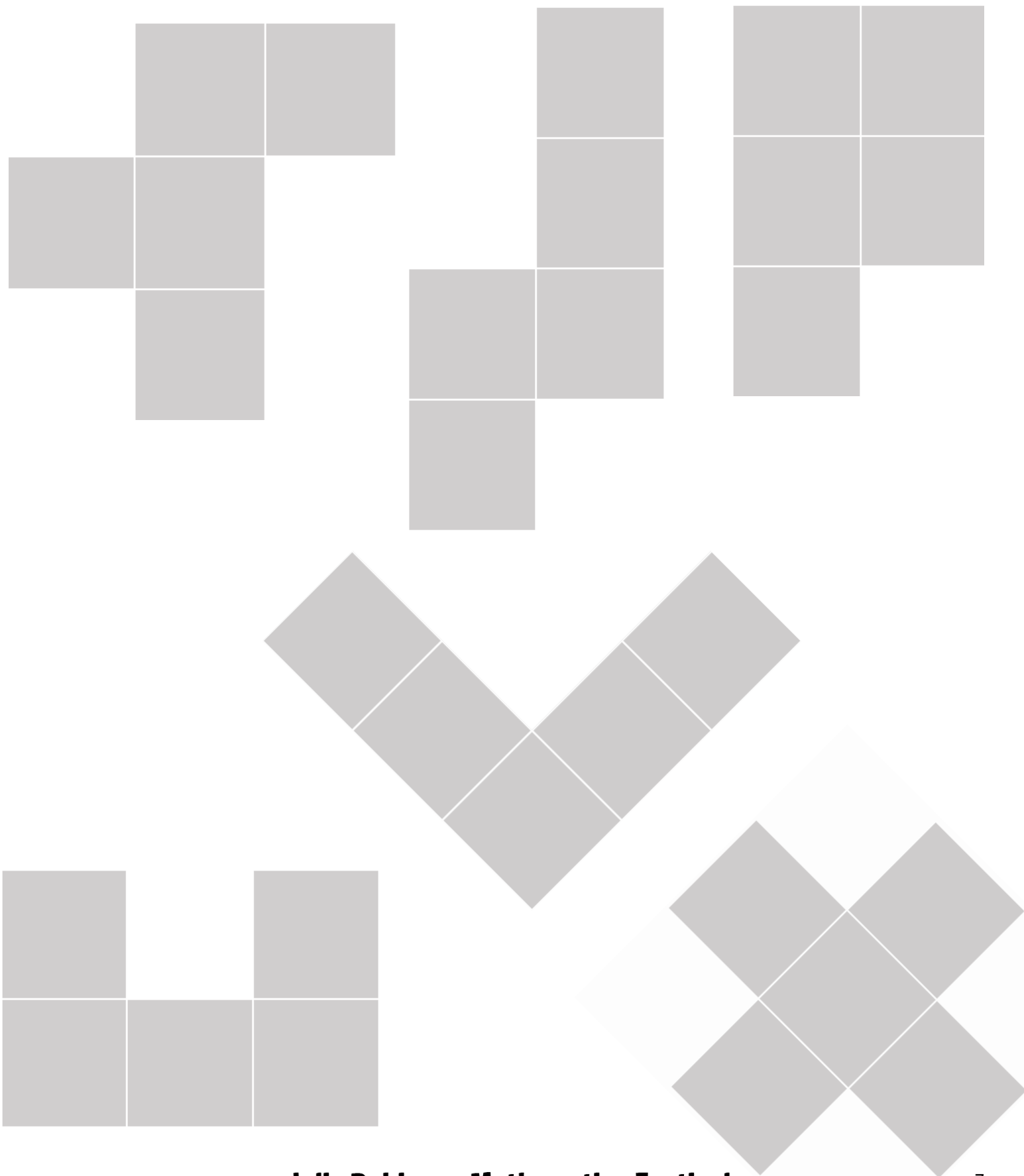
5x12 Rectangle



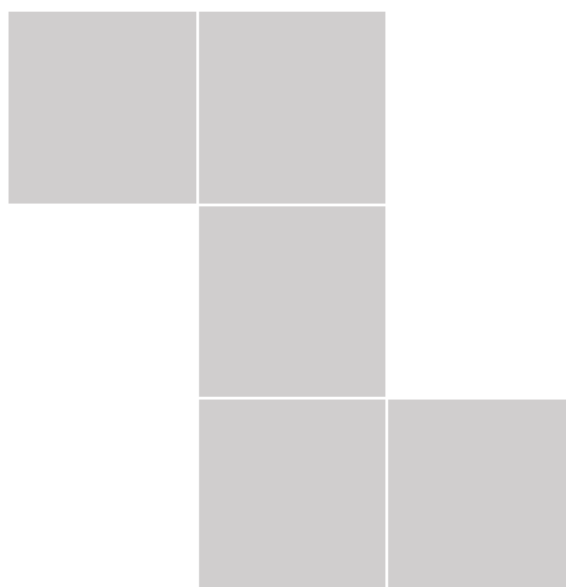
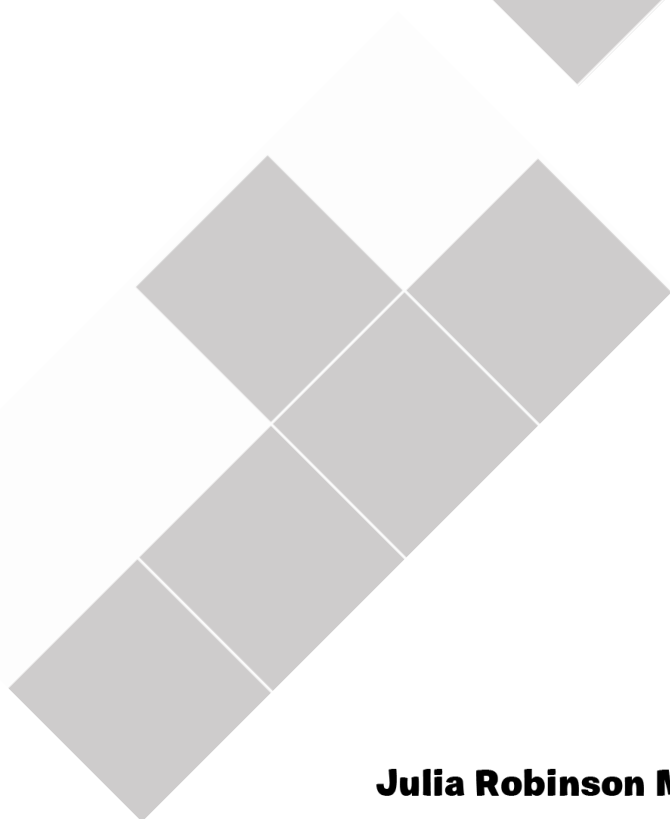
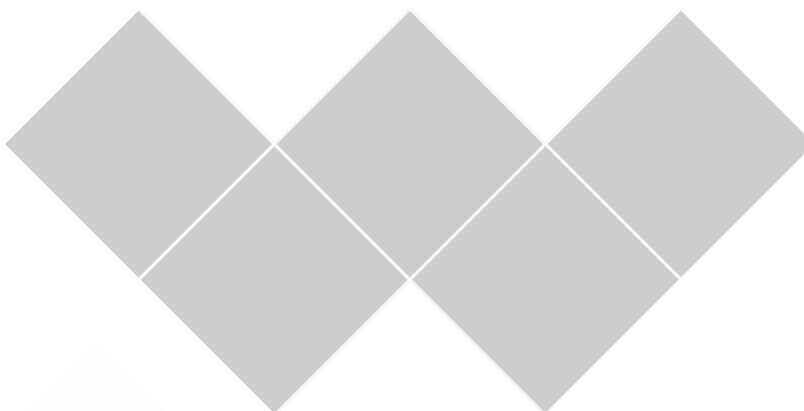
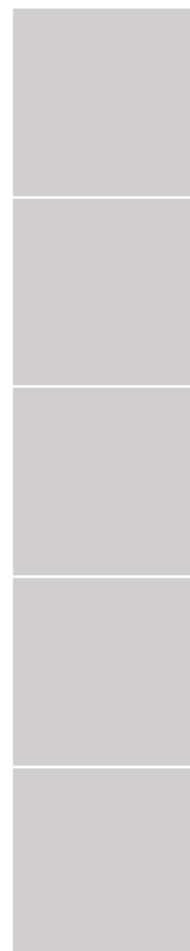
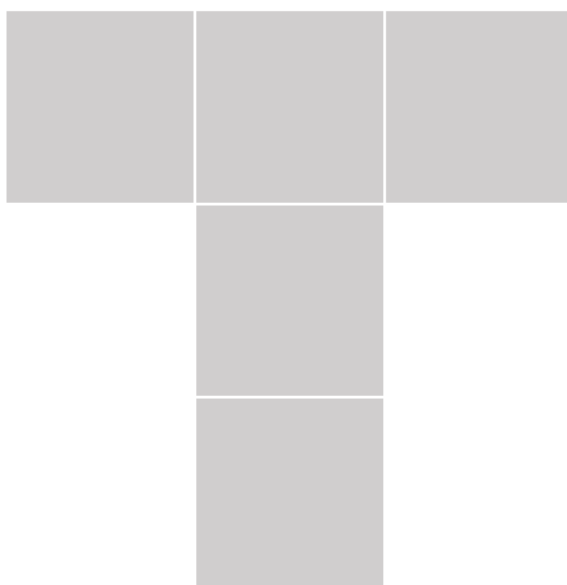
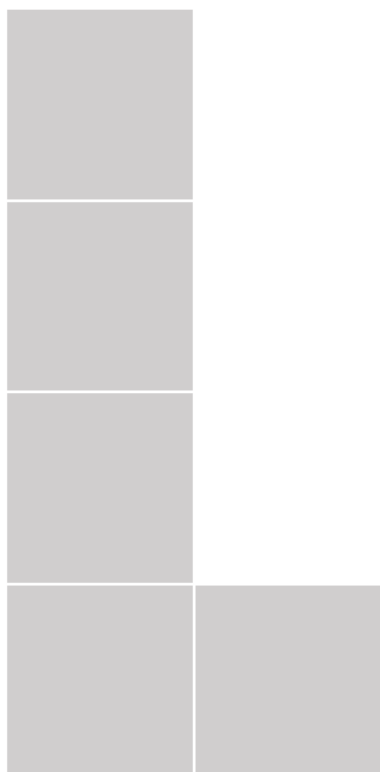
6x10 Rectangle



Pentominoes Set #1

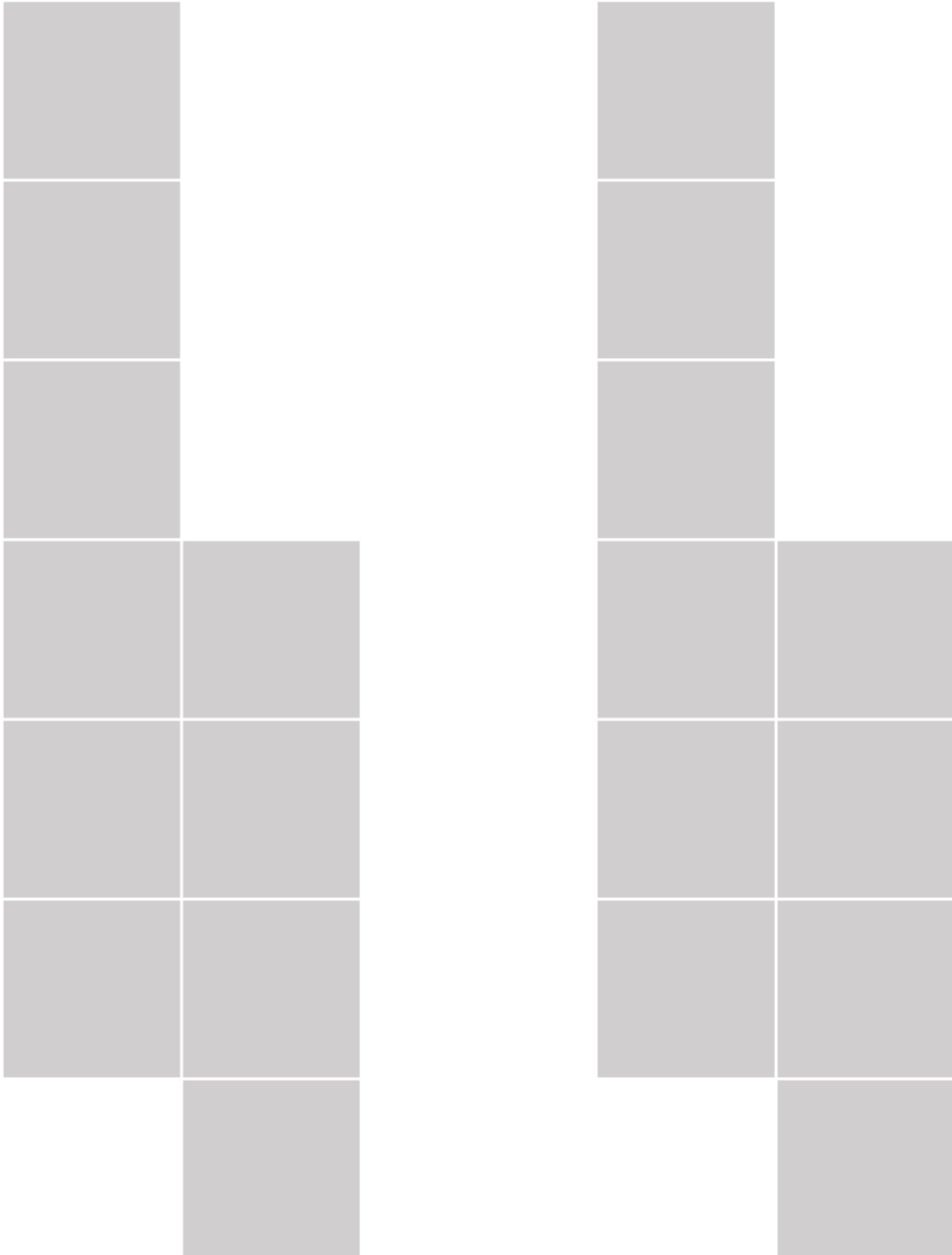


Pentominoes Set #2



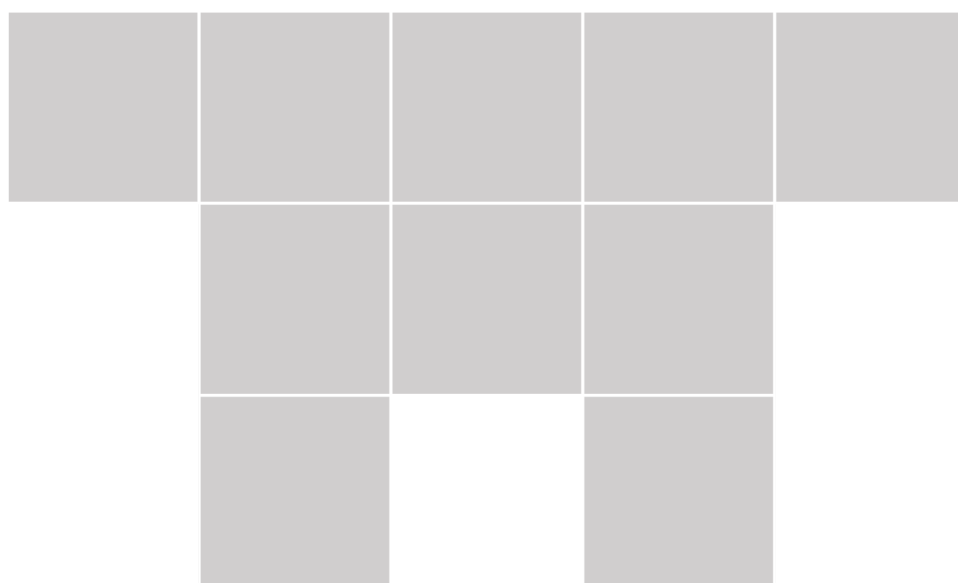
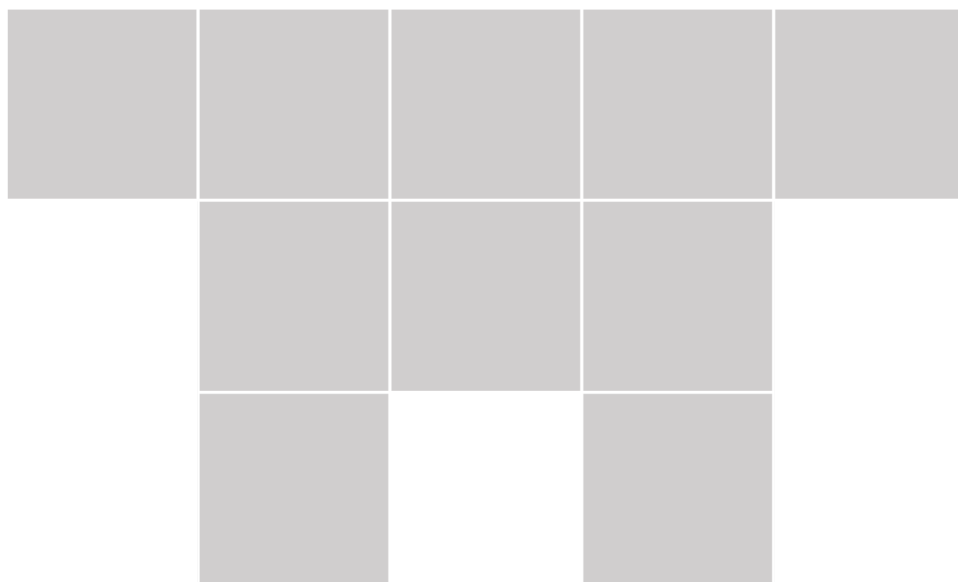
Pentomino Tasks

1. Make both shapes at the same time.



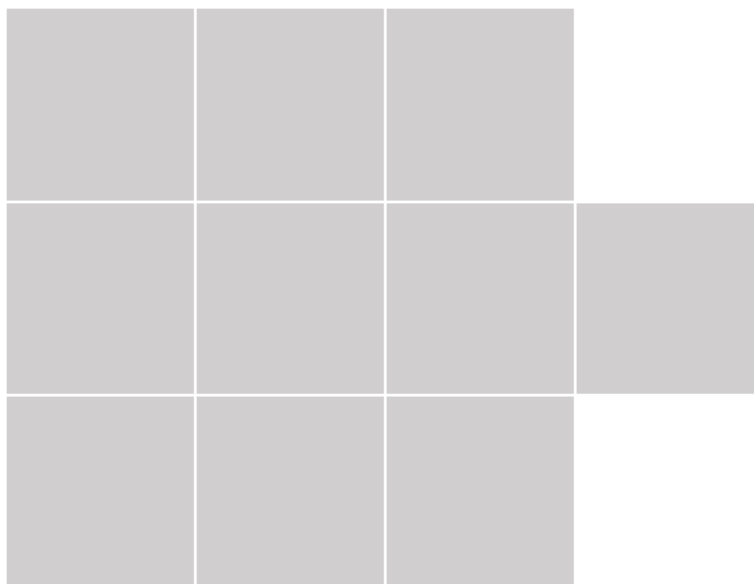
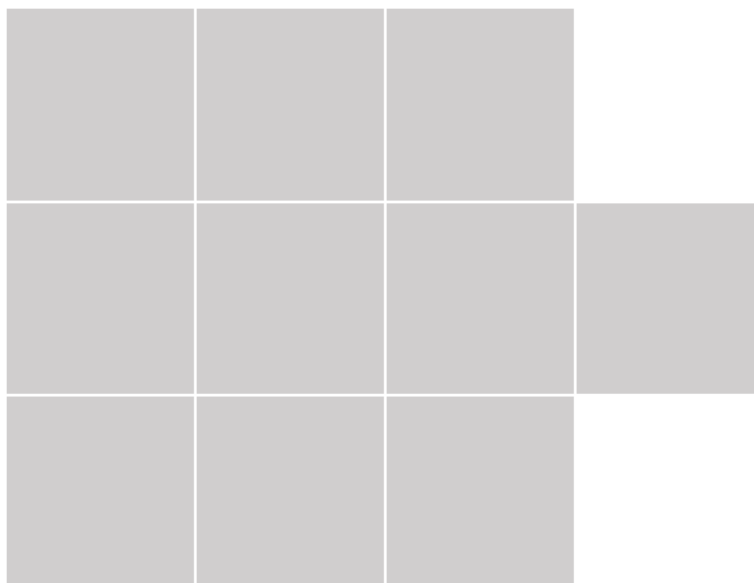
Pentomino Tasks

2. Make both shapes at the same time.



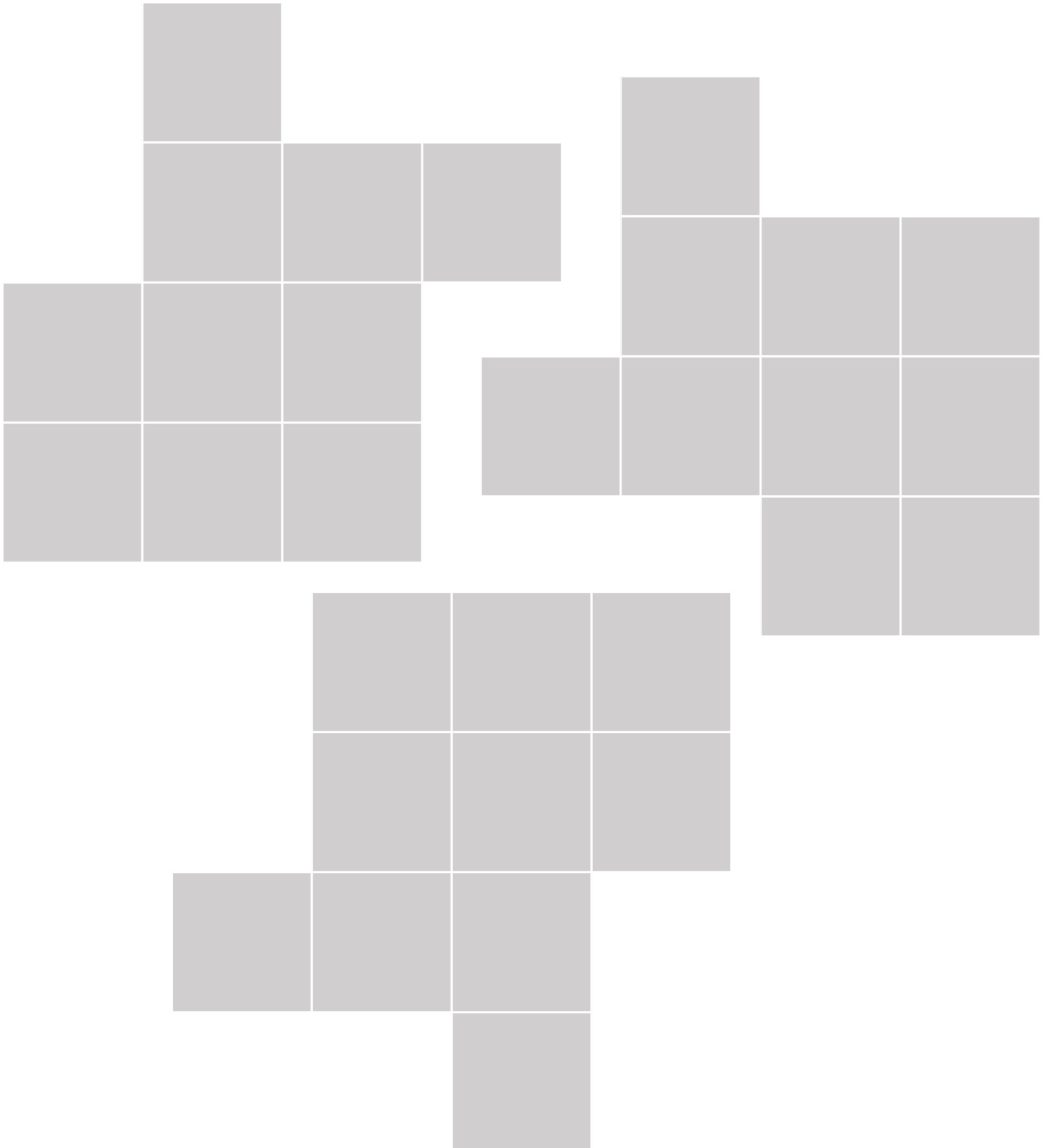
Pentomino Tasks

3. Make both shapes at the same time.



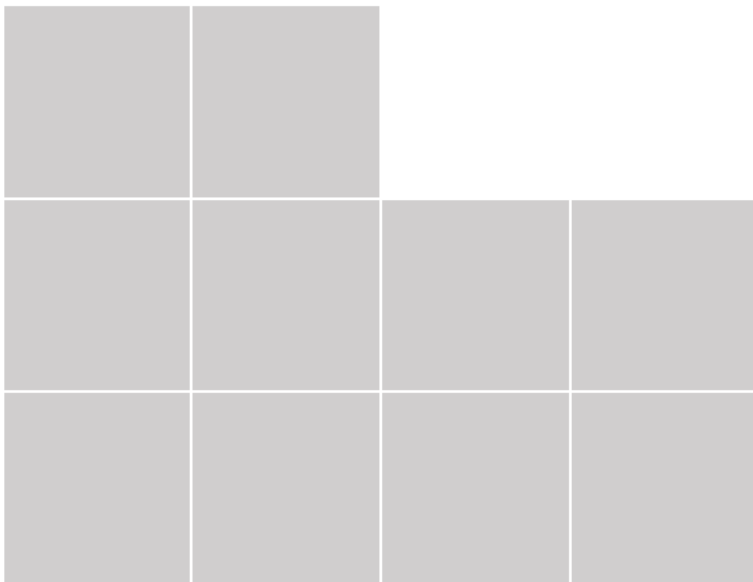
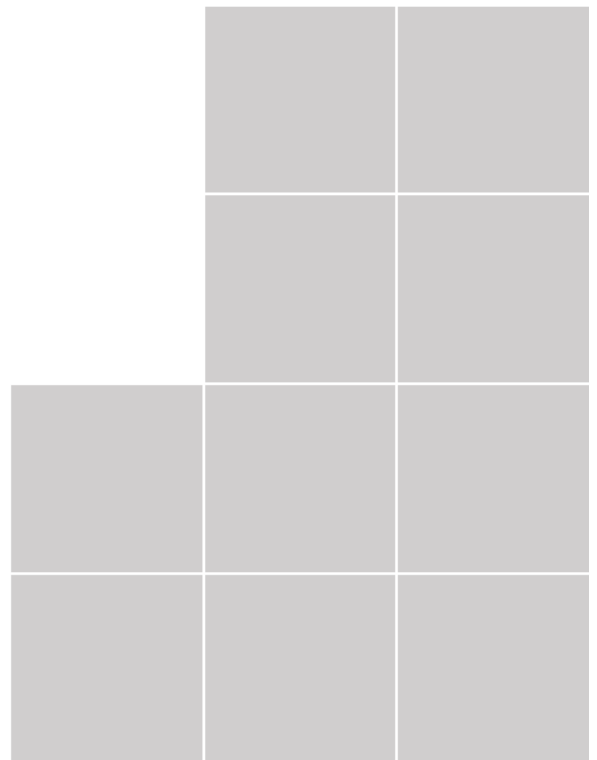
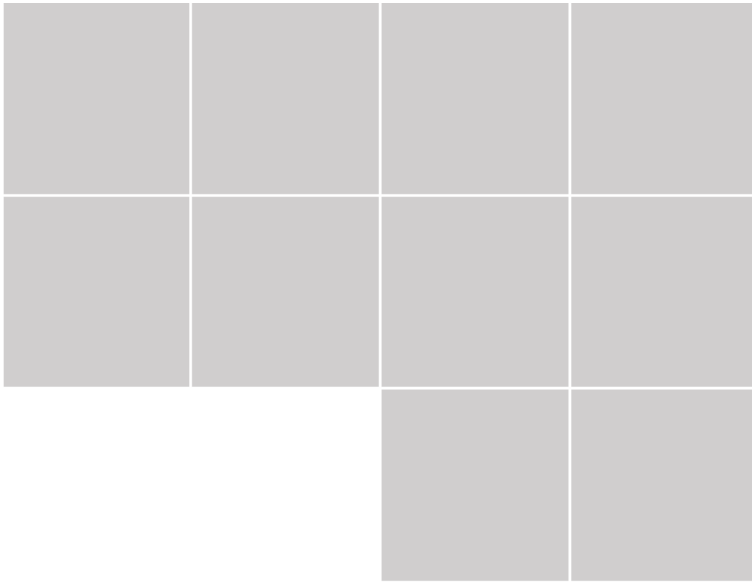
Pentomino Tasks

4. Make all three shapes at the same time.



Pentomino Tasks

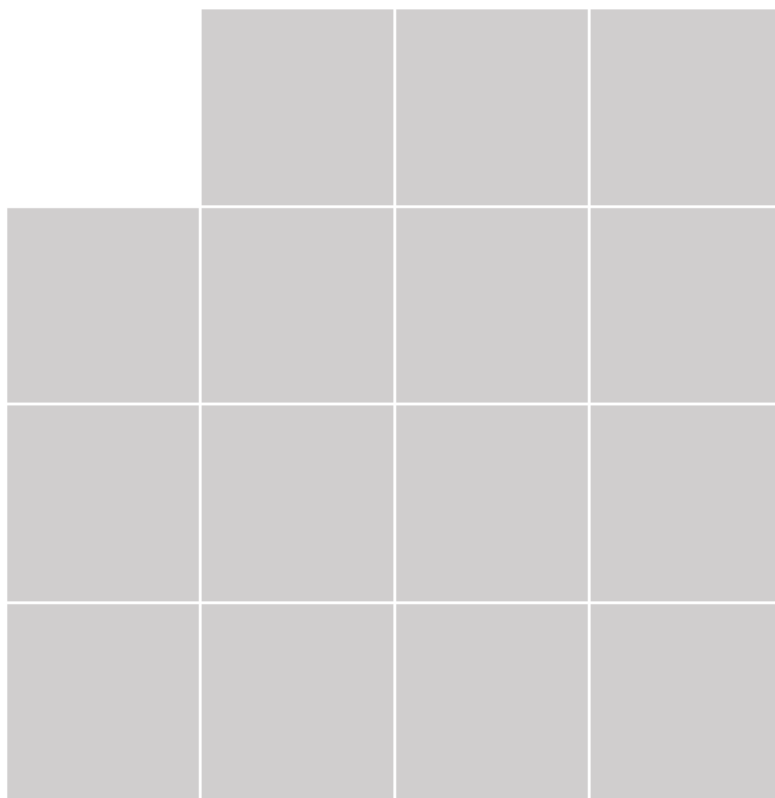
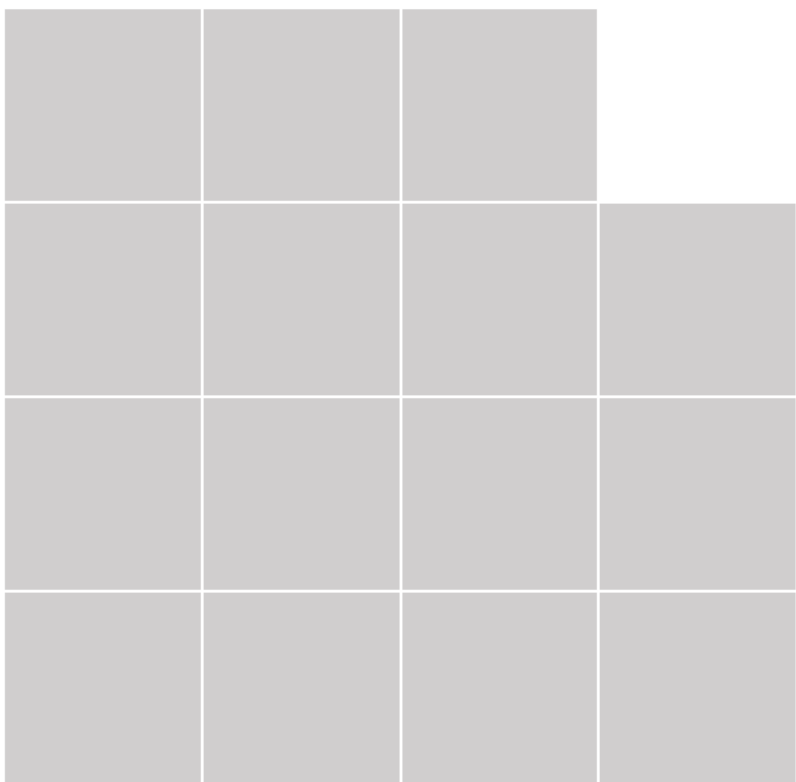
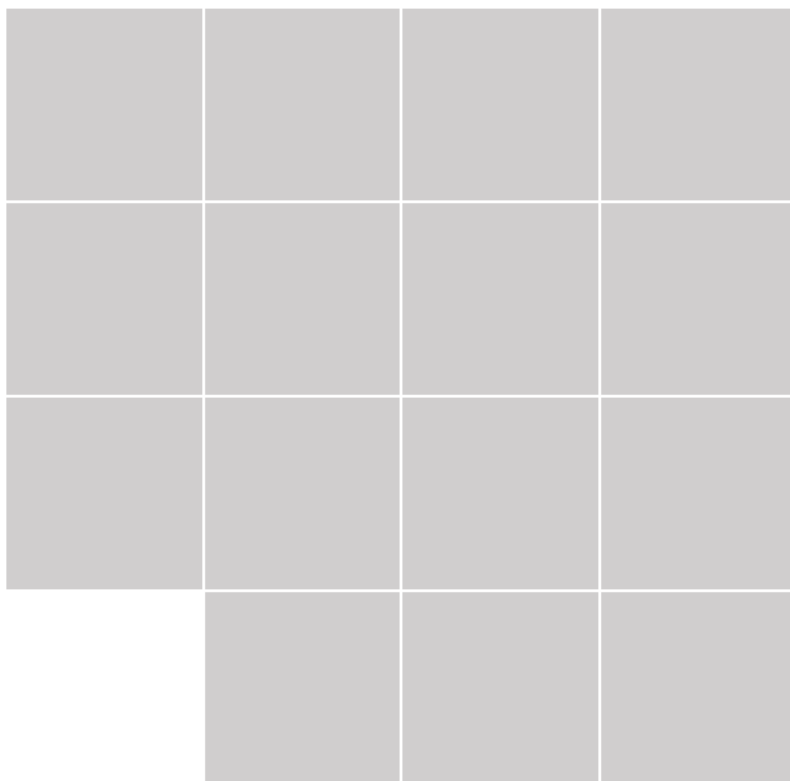
5. Make all three shapes at the same time.



Pentomino Tasks

6. Make all three shapes at the same time.

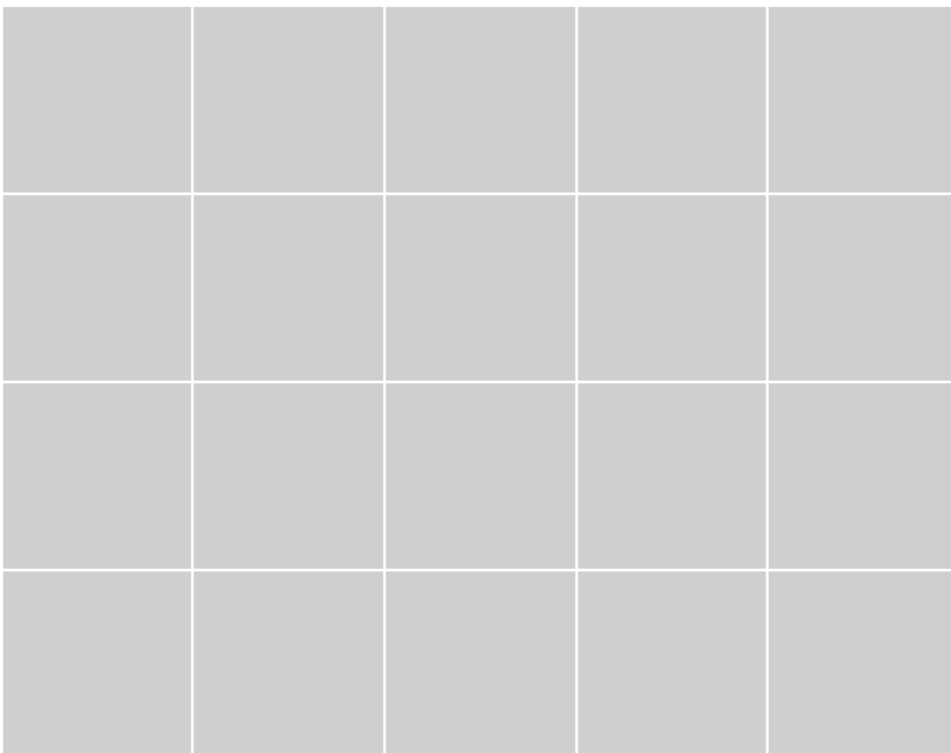
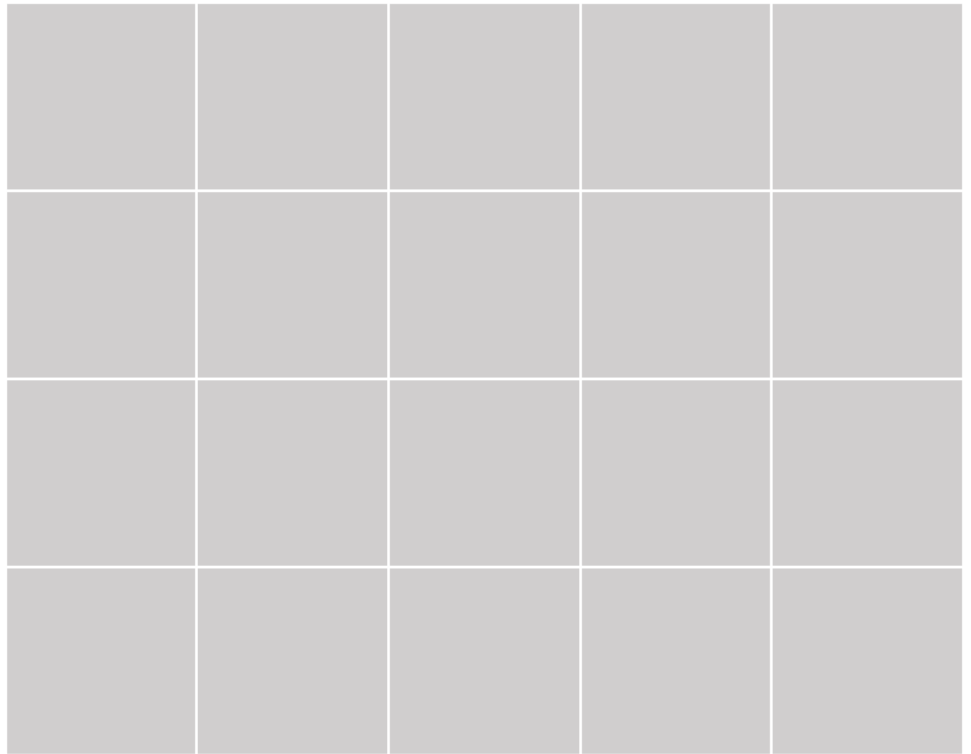
Is it possible to make a fourth shape with the remaining tiles?



Pentomino Tasks

7. Make both shapes at the same time.

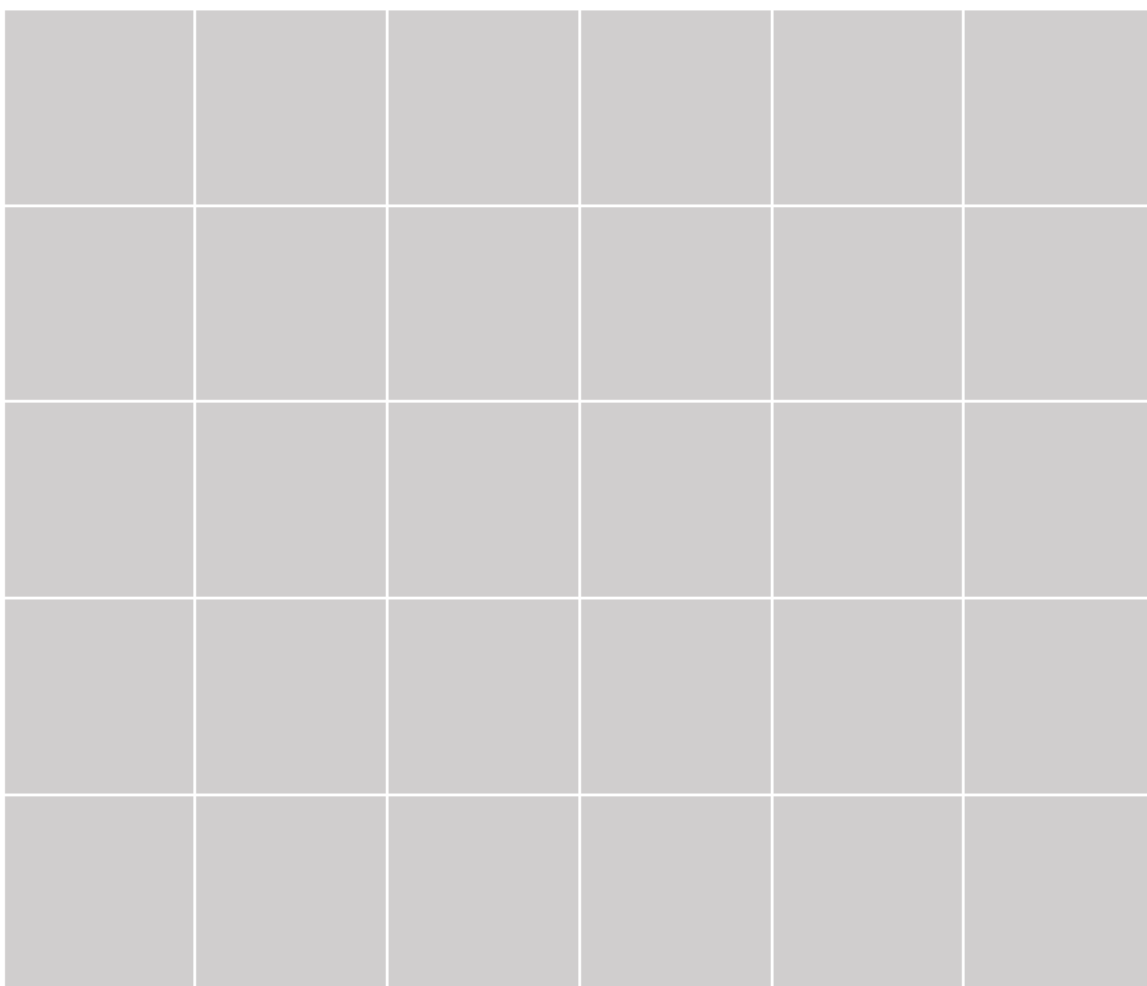
Is it possible to make a third shape with the remaining tiles?



Pentomino Tasks

8. Use the pentominoes on Pentominoes Set #1 to make the shape below.

Can you use the pentominoes on Pentominoes Set #2 to make a second 5x6 rectangle?



9. Can you make one big rectangle using all 12 pentominoes?



Play for free at
jrmf.org/puzzle/pentominoes



PENTOMINOES



PENTOMINOES



Play for free at
jrmf.org/puzzle/pentominoes

