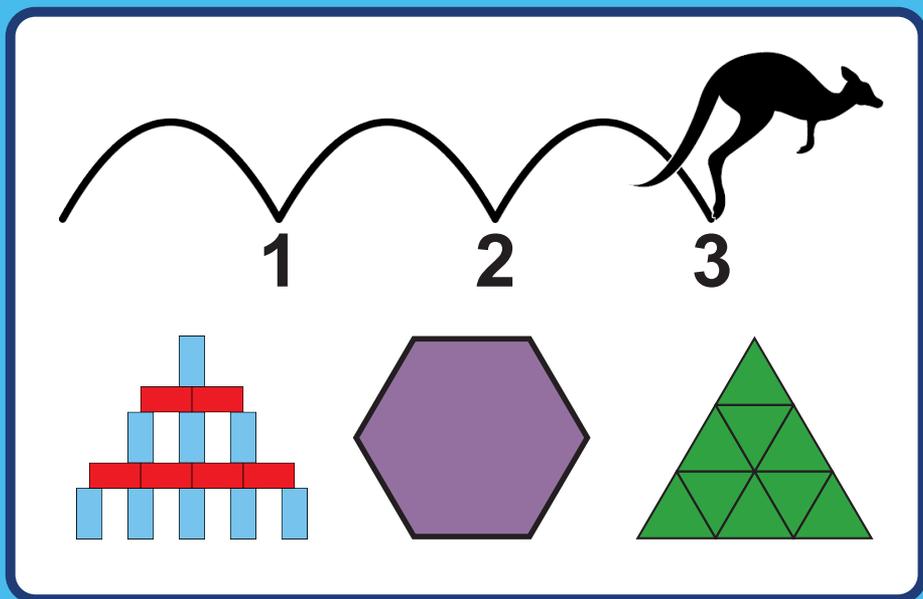




Hopping Mad Patterns



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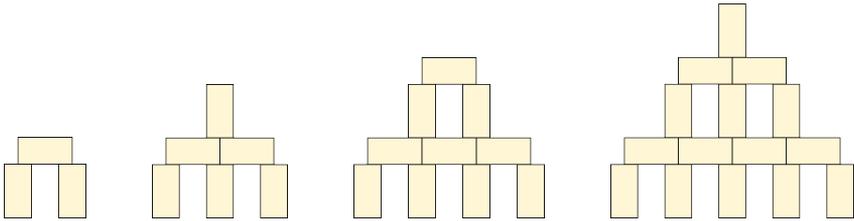
Joanna Matthiesen

President and CEO

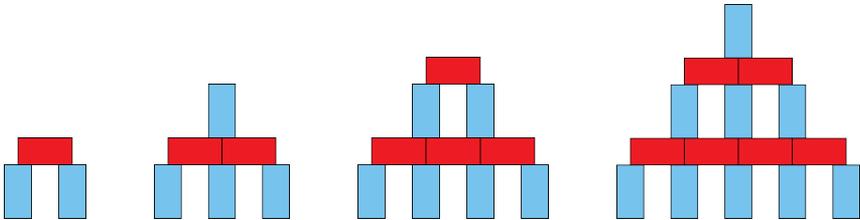
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House of Cards

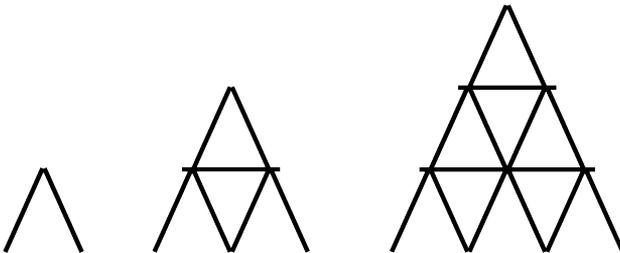
1. With blocks of dimensions 1 cm x 1 cm x 2 cm, you can build towers as shown in the picture. Below are the first four such towers. How many blocks are in the 5th tower? 6th tower? nth tower?



2. How high is a tower built in the same way using 28 blocks? More than 28 blocks?
3. Can you make a tower out of any number of blocks? If so, how? If not, for what numbers of blocks can you make towers?
4. Suppose you have the same towers, but all of the vertical blocks are blue and all of the horizontal blocks are red. How many red blocks are in the 5th tower? How many blue blocks? What about in the 6th tower? nth tower?

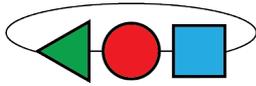


5. A tower of cards is called a house of cards. In the picture, 1-level, 2-level, and 3-level houses of cards are shown. How many cards are in a 5-level house of cards? 6-level house of cards? N-level house of cards?

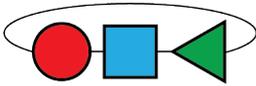


Beads on a String

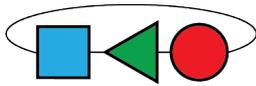
1. There are three different beads on a string. Every minute, you move the bead on the left around the string so that it ends up on the right. After 16 minutes, what do your beads look like? After 50 minutes? 100 minutes? Your beads after 1, 2, 3, 4, and 5 minutes are shown below.



1 minute



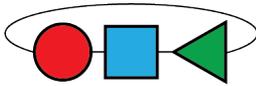
2 minutes



3 minutes

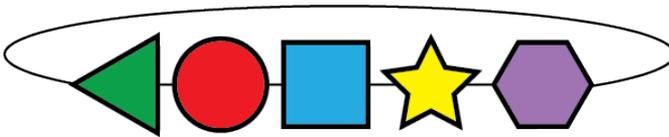
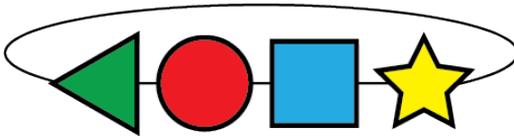


4 minutes



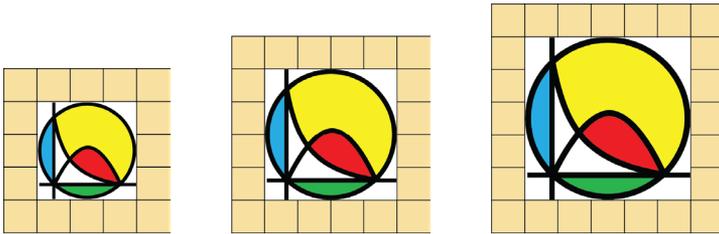
5 minutes

2. How would your answers to Question 1 change if you moved 2 beads every minute? 3 beads? More?
3. How would your answers to Questions 1 and 2 change if you started with 4 different beads on your string? 5 beads? More?

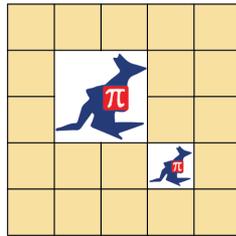


Picture Frames

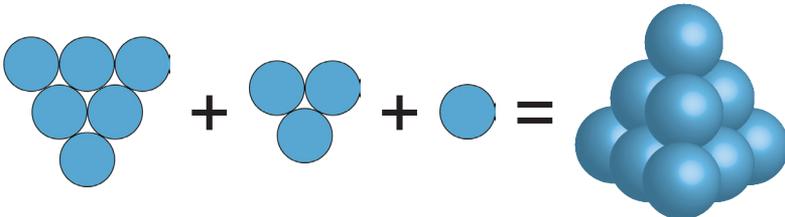
1. You're framing pictures of different sizes. Frames for 3×3 , 4×4 , and 5×5 pictures are shown below. It takes 16 blocks to frame a 3×3 picture. How many blocks does it take to frame a 6×6 picture? A 7×7 picture? A larger picture?



2. How would your answers to Question 1 change if each picture frame had a width of 2? A width of 3? A larger width?
3. Now, you're framing two different-sized pictures. If you frame two pictures like the example below, how many blocks will you need to frame a 2×2 and 3×3 picture? A 4×4 and 5×5 picture? Other sizes of pictures?

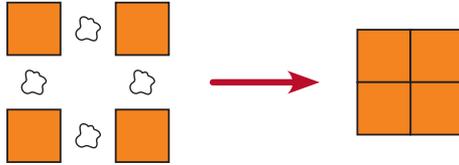


4. A 3-pyramid is a stack of 3 levels of spheres, as shown below. After the spheres are stacked on top of each other, how many spheres are visible? How about in a 4-pyramid? A 5-pyramid? A larger pyramid?

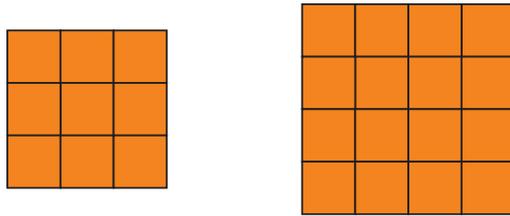


Putting the Pieces Together

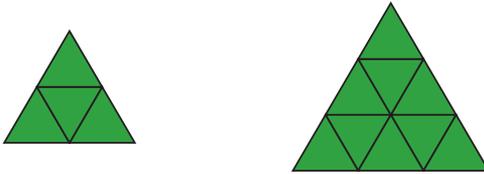
It takes four droplets of glue to create a 2×2 square.



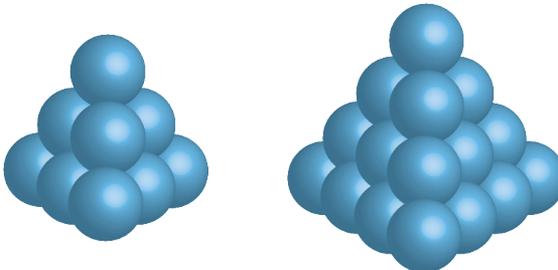
1. If you need one droplet of glue for every two squares that are next to each other, how many droplets of glue does it take to create a 3×3 square? A 4×4 square? A larger square?



2. If you need one droplet of glue for every two triangles that are next to each other, how many droplets of glue does it take to create a triangle with side lengths of 2? A triangle with side lengths of 3? A larger triangle?



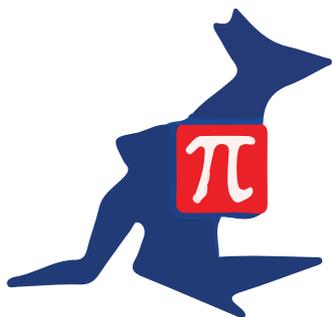
3. If you need one droplet of glue for every two spheres that are next to each other, how many droplets of glue does it take to create a 3-pyramid? A 4-pyramid? A larger pyramid?



Math Kangaroo

Math Kangaroo is the largest mathematics competition in the world, boasting over 6 million participants from 80 countries. Every student from grades 1-12 may participate. The creative Math Kangaroo questions are chosen annually by its International Math Kangaroo Committee. Registration takes place from September to December each year, and the competition is held on the third Thursday of the following March.

To learn more about Math Kangaroo in the USA, visit: www.mathkangaroo.org. To learn more about the international Math Kangaroo organization, visit: www.aksf.org.

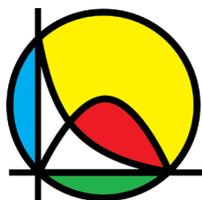


Math Kangaroo

Julia Robinson Mathematics Festival

The Julia Robinson Mathematics Festival seeks to inspire joy in mathematics through collaboration, exploration, and discovery. To this end, we engage students and educators through festive events—both in person and online—and make concerted efforts to reach and support underserved and underrepresented populations. Moreover, we pride ourselves in the quality, accessibility, and richness of our educational materials.

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Thank You!

The Math Kangaroo Organization would like to thank the Julia Robinson Mathematics Festival for compiling this booklet. We are excited to bring the love of mathematics to each and every student in the world. We are motivated to deliver to your homes and classrooms such creative and original mathematics that will inspire the next generation of inventors and leaders. More Math Kangaroo test questions, solutions, videos, and books can be found here: <https://tinyurl.com/mathkangarootests>. What others are saying about Math Kangaroo can be seen here: <https://tinyurl.com/mktestimonials>.



The Learning Center, Raduga, CA

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