Sample Math Exploration Problem - Summer 2026

National Math Camps - Camp Conway & Camp Sierpinski

This problem was on our admissions problem set last year, and it's one of our favorites. It's similar to what you can expect on Part 2 of this year's Math Exploration Problems.

Perfect Picnic Partners [1]

In this problem, the numbers 1 through n are heading to a picnic, and everyone needs a buddy to share snacks with. But there's a twist: the sum of each pair must equal a perfect square (for example, 4, 9, 16, 25, ...). Numbers are also not allowed to pair up with themselves.

If it's possible for the numbers 1 through n to pair up in this way, we say that n is a *picnic number*. For example, 4 is not a picnic number. We know that 1 has to pair with 3 to get 4, since $1+2=3$ and $1+4=5$ are not perfect squares. That means that 2 and 3 are leftover and need to pair up with each other, but $2+3=5$ is not a perfect square :-(

(a) What about 8? Is it a picnic number? If so, explain how the numbers pair up. If not, explain how you know it's not possible to pair up the numbers.

(b) Find all of the picnic numbers ≤ 16, and show that you've found them all.

(c) Can you find six picnic numbers that are ≤ 50? Try to be clever in picking which numbers to try! Any numbers that you've found in parts (a) and (b) still count here.

(d) Based on what you've figured out so far, can you make any *conjectures* (educated guesses)? For example, maybe you can make one or more statements like "If n is _____, then n is always a picnic number" or "If n is _____, then n is never a picnic number".

(e) Can you show that any of the statement(s) you wrote down in part (d) are always true?

(f) Are there any questions you're still wondering about? If you wanted to keep working on this problem, what would you try to figure out next?

(g) Are there any variations (or ways you could change the rules) of this problem that you think would be interesting to explore?

[1] Based on a Julia Robinson Math Festival (jrmf.org) problem.