Nim: How do you make sure you always win?

Investigation Brief:

The game of NIM is an ancient game with many variations. A simple form is to have 20 counters and 2 players. Each turn a player can take 1, 2, or 3 counters. The winner is the person who takes the final counter.

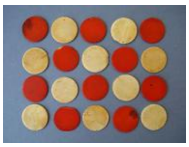
Can you figure out how to always be the player who wins?

1. Work your way through several trials and keep track of your findings.
2. Explain your strategy in words, in numbers, and a diagram such as a flow chart or table.

Resources

- 20 counters
- recording resources

Prompts and Suggestions



Think about working in an organized way so the numbers involved are clear to you. Both of these pictures are of 20 counters but one helps you see the combinations more clearly.

Think about the possible moves of each player and try to create a systematic way of recording possibilities.

If you want to win should you go first or second?

Consider how restricting your choice to taking 1, 2, or 3 counters impacts on your strategy.

Think about multiples of four, and how they can be used as part of a strategy.

Can you organize the game so there are always 5 turns?

If you go second can you make sure that each time both players have a turn, exactly four counters are

If you are stuck, try working with a small number of counters: try starting with 8 counters.

Extensions

Develop other versions of this game by adapting the number of players or the number of counters at the start or the number of counters that can be taken each turn. How do you make sure you always win? How would your strategy change if you made it the rule that the last person to take a counter loses, instead of wins?

Links

The problem solving pathway in e-ako maths (e-ako.nzmaths.co.nz) includes an e-ako called *21 stones*, and one called *More stones*. These explore versions of Nim in some depth.

For other versions of NIM you can explore these interactives and game descriptions on Nrich:

- http://nrich.maths.org/1209
- http://nrich.maths.org/2779