

Habits of Mind Part 2

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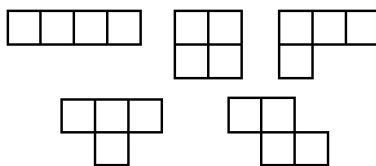
”Discovery is the privilege of the child: the child who has no fear of being once again wrong, of looking silly, of not being serious, of not doing things like everyone else.”

- *Alexander Grothendieck*

1 Tetris Plus One

A domino can be thought of as two squares joined along one side. Similarly, a triomino might be a polygon formed by joining three squares together. (In each case two matching sides must fit together exactly.) Continue in this manner; define what is meant by a tetromino (i.e. a polygon created by joining four squares together) and a pentomino (a polygon created by joining five squares together). We will say that two pentominoes are the same if one can be shifted, rotated and/or flipped to fit exactly onto the other pentomino.

Example 1 *Below are examples of tetrominoes. These may be somewhat familiar to you (see title).*



Exercise 1 *How many pentominoes are there? Find examples and sketch them below. If the one you have found is “new”, sketch it on the board.*

2 The Rubik's n-Cube

Exercise 2 *A cube with edges of length 2 centimeters is built from centimeter cubes. Suppose you paint the faces of this cube and then break it into centimeter cubes. Consider the following questions.*

1. *How many cubes will be painted on three faces?*
2. *How many will be painted on two faces?*
3. *On one face?*
4. *How many will be unpainted?*
5. *What if the edge has a length different from 2?*
6. *What if the edge length of the large cube is 3, 4 or 5 cm? What if the edge length of the cube was 20 cm?*
7. *Can you generalize this to an edge length of n cm?*

3 Code Breakers

Code Breakers is a game for two players – Player One and Player Two. Each player has their own special board (see page 4) and is given six turns.

For this game, a “code word” is a six digit number consisting of 1s and 0s. Player One will get 6 chances to choose a code word. Player One’s goal is to match the one code word that Player Two will choose. The game begins with Player One choosing a code word by filling in the first horizontal row of their board with a six digit word consisting of 1s and 0s. Player Two then looks at Player One’s first row and then places either one 1 or one 0 in the first box of Player Two’s board. At this point, Player One has chosen one code word, and Player Two has made the first entry of what will eventually be Player Two’s code word.

The game continues with Player One noticing what Player Two’s first digit is and then choosing a second code word. Player Two then chooses a second number (a 1 or a 0) and enters it in the second box of Player Two’s board. This game proceeds in this fashion, with each player’s moves visible to the other, until Player One has chosen six code words and Player Two has chosen one code word. Player One wins if one of their six code words is identical to Player Two’s code word. Player Two wins if there is no match.

Exercise 3 *Find a partner and play one round of Code Breakers. Once you have completed the game, consider the following question.*

1. *Would you rather be Player One or Player Two? Who has the advantage?*
2. *Can you describe a strategy that will always result in victory for Player One or Player Two?*
3. *Give a careful justification of the position that you take.*

	A	B	C	D	E	F
1						
2						
3						
4						
5						
6						

Player One's Game Board

	1	2	3	4	5	6
1						
2						
3						
4						
5						
6						

Player Two's Game Board