

# Plentiful Possibilities for Pen, Pencil, and Paper Play

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# Motivation

- My recommended first purchases to play the best, most diverse games for the least money:
  - Playing Cards
  - Dice
  - Chess Set
  - Poker Chips (+ Chess Set = Chess-and-chip games)
  - **Paper and Pencil**

# Sampling of Common Games

- [Tic-Tac-Toe](#) (try [Connect6!](#))
- [Hangman](#)
- [Salvo](#) (marketed as Battleship)
- Picture Charades (marketed as [Pictionary](#))
- [The Dictionary Game](#) (a.k.a. [Fictionary](#), marketed as [Balderdash](#))
- [Guggenheim](#) (marketed as [Scattergories](#))

# Materials

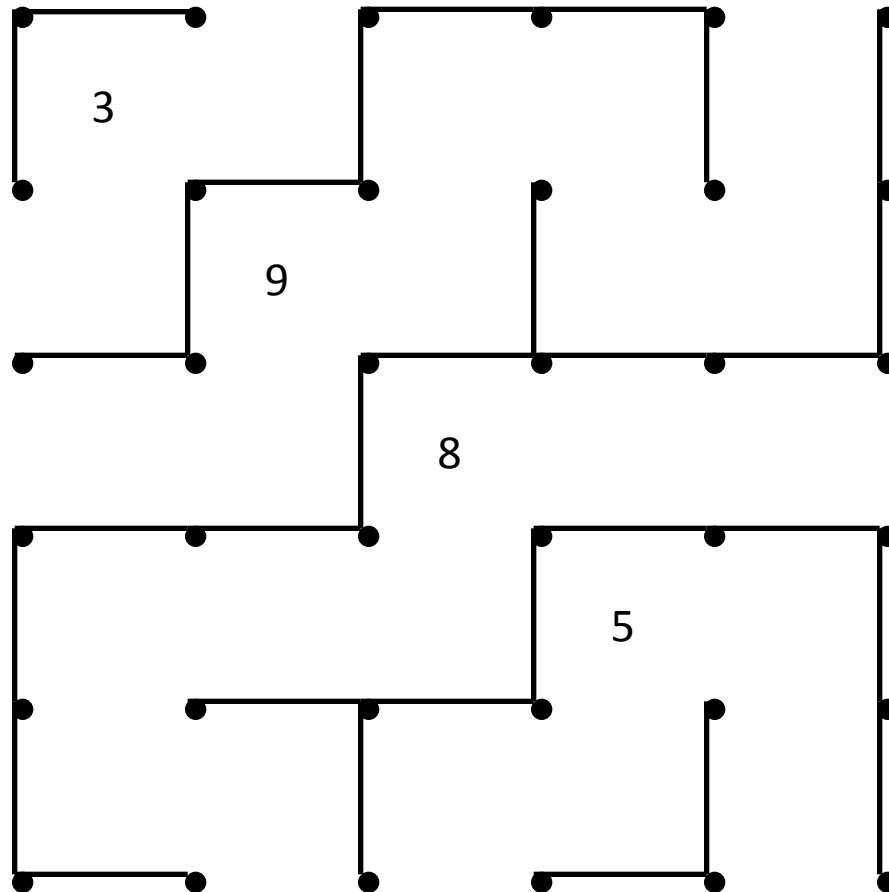
- For many games (e.g. [Connect6](#), [Salvo](#), [Pentominoes](#), [Paper Penguins](#)), graph paper is very handy
- Prefer pencil to pen to fix game rule mistakes
- Some games benefit from two colors of pencil/pen

# Dots and Boxes

- Board: An arbitrary number of dots in a rectangular grid layout. (On graph paper, dots are at intersections.)
- Move: Mark a horizontal or vertical line between adjacent dots. If this forms complete square(s), mark the square(s) with a unique player initial, and make another move.
- When all squares are claimed the player marking the most squares wins.

# Dots and Boxes: Example

- Your move:



# Dots and Boxes: Basic Strategy

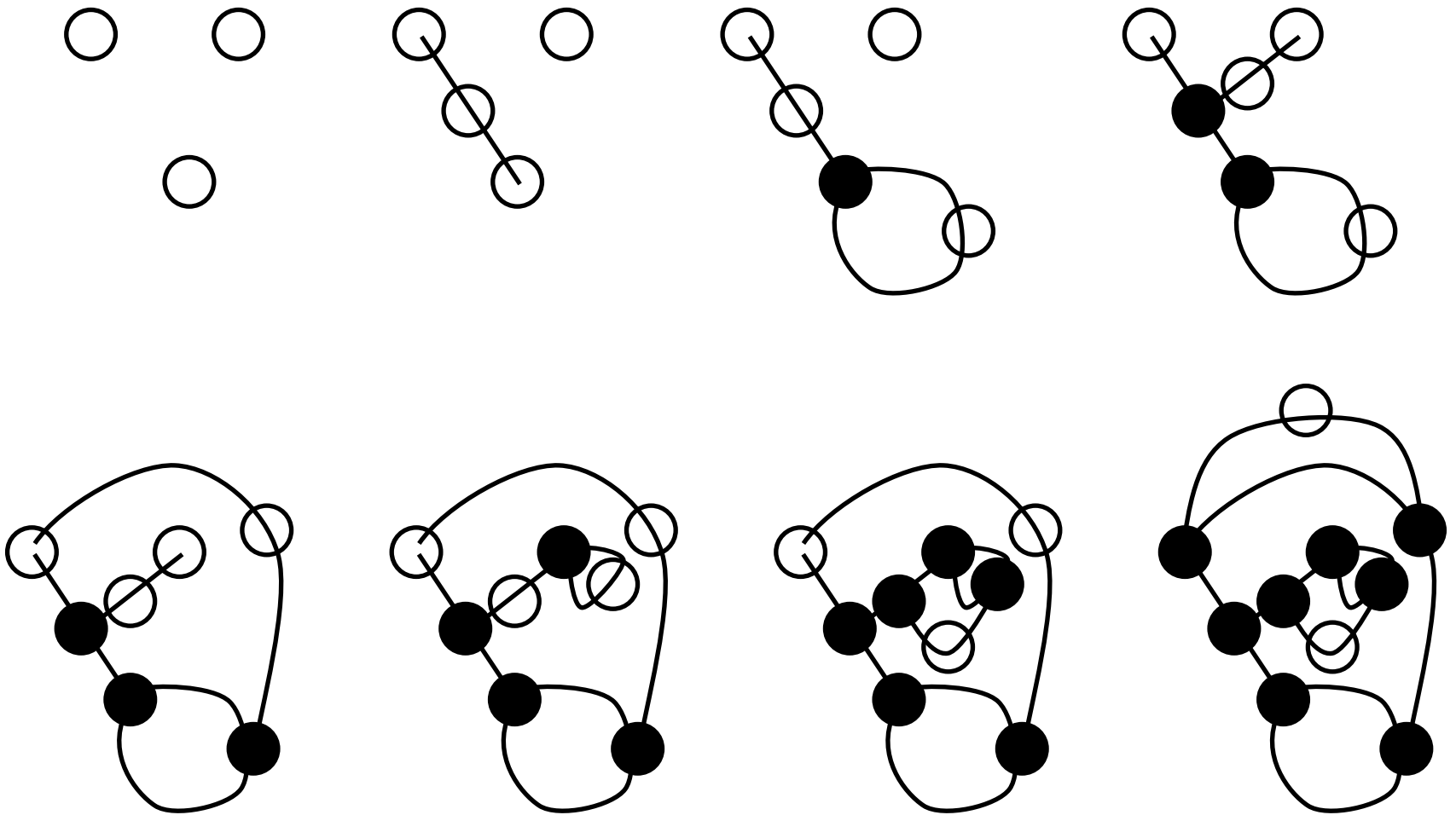
- Avoid creating third sides of squares.
- Consider the common end-game scenario where there are a number of disjoint chains of varying length.
  - Players typically take turns claiming one chain and giving away the next.
  - No brainer: Give away shortest chain to other player.
  - However, control in the endgame is key, so...
  - Leave the last two squares of all but last chain for the other player!
- Advanced strategy: Berlekamp, Elwin R. *The Dots and Boxes Game: sophisticated child's play*, 2000.

# Sprouts

- Rules:
  - Draw a number (e.g. 3) of unfilled small circles
  - On each turn, draw a (possibly curving) line between circles (or from a circle to itself), and draw a new circle splitting the new line. However:
    - Lines cannot touch or cross.
    - At most three lines may exit a circle.
    - (Fill in a three-line circle to aid visual reasoning.)
  - The first player unable to make a legal move loses.



# Sprouts: Example



# Sprouts: Variations

- Brussels Sprouts:
  - Instead of a circle, make a cross (plus); cross each new line.
  - Lines must be drawn from the ends of crosses.
  - Uninteresting game: Total moves, winner predetermined based on initial number of crosses. ( $5n-2$  moves; player 1/2 win with odd/even crosses)
- Weeds and Brambles
  - Respectively, Sprouts and Brussels Sprouts with *optional* circle/cross on new line
  - Makes Brussels Sprouts interesting
  - Complicates analysis of Sprouts
- More info: [http://en.wikipedia.org/wiki/Sprouts\\_\(game\)](http://en.wikipedia.org/wiki/Sprouts_(game))

# Jotto

- Deductive word game akin to Mastermind, Bulls and Cows, etc.
- Two players each choose a secret 5-letter word (not proper noun)
  - Others disallow repeated letters.
- Players seek to guess the opponent's word first.
- On each turn a player guesses a word, and the opponent responds with "Jotto!" if the guess is correct, or the number of "jots" otherwise.
  - A jot is the number of letters in the guess that may be used in the construction of the secret word.

# Jotto Examples

- Guess “piece” has 3 jots for secret word “crisp”.
- “Games” has 2 jots for secret word “soggy”.
- “Lulls” has 4 jots for secret word “gulls”.
- “Steak” has 5 jots (but no “Jotto!”) for secret word “stake”.

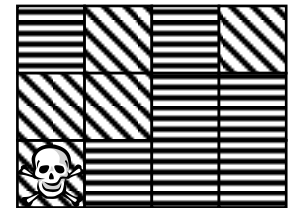
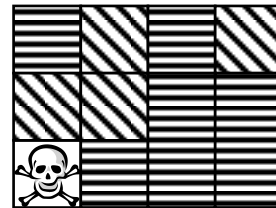
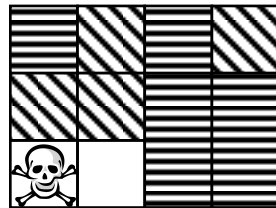
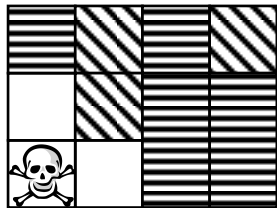
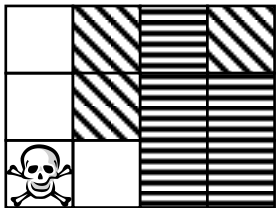
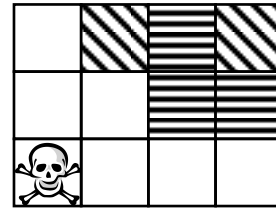
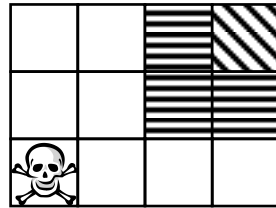
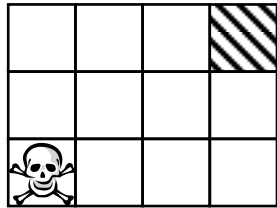
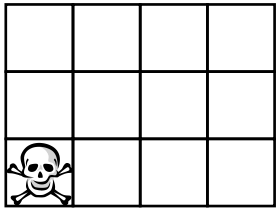
# Jotto Strategy

- Ideas for secret word choice:
  - Obscure words with many anagrams (e.g. “tares”)
  - Words with uncommon letters (e.g. “jazzy”)
  - Words with multiple letters (e.g. “lulls”)
- Ideas for guessing strategy:
  - Write down a list of letters, crossing out those that cannot occur in the secret word. (0 jots is good!)
  - Write down each guess and the number of jots.
  - In each guess, circle each confirmed secret letter, and cross out each confirmed non-secret letter.
  - Guess initial sequences of words with high letter coverage, e.g. blown-fixed-gravy-jumps-ketch.
  - Choose guesses to strategically aid in deductive process

# Chomp

- Based on a game by Fred Schuh (1952), given current form by David Gale and named by Martin Gardner.
- Draw an  $m$ -by- $n$  chocolate bar grid, and mark the lower-left corner square  $(0,0)$  as “poisoned”.
- Each turn, a player must take a “bite”, choosing an uneaten square and removing all squares above and/or to the right.
- The player that bites the poisoned square loses.

# Chomp Example



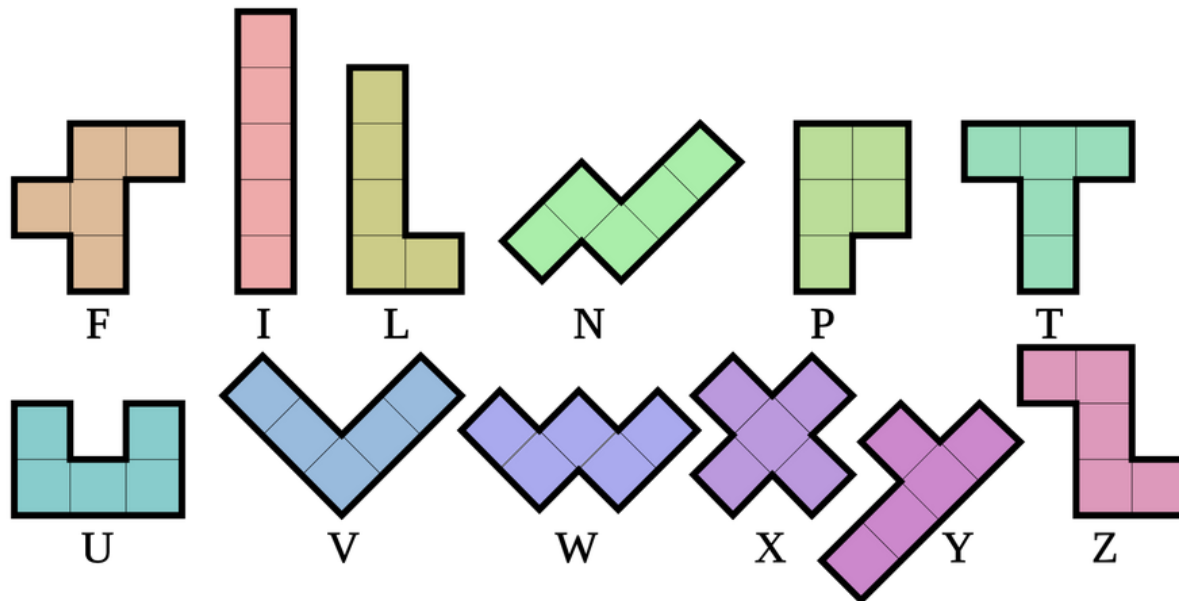
# Chomp Strategy

- Avoid allowing opponent to make symmetric “v” of squares in row 0 and column 0.
  - opponent can mirror your subsequent moves until you are forced to take the last square
  - don’t play on n-by-n boards (winning 1<sup>st</sup> play at (1,1))
- Except for 1-by-1 board, the first player can always win. Strategy stealing argument:
  - Suppose the first player takes (m-1, n-1) and the second player can guarantee a win playing at (p, q).
  - Then the first player could have guaranteed a win by playing at (p, q). (See previous example game.)



# Pentominoes

- Pentominoes (and “Polyominoes”) defined by Solomon Golomb in 1956.
  - Polyomino = figure formed by joining identical squares edge-to-edge
  - Pentomino = 5-square polyominoes
  - A way to remember the pentominos: FLIP N TUVWXYZ

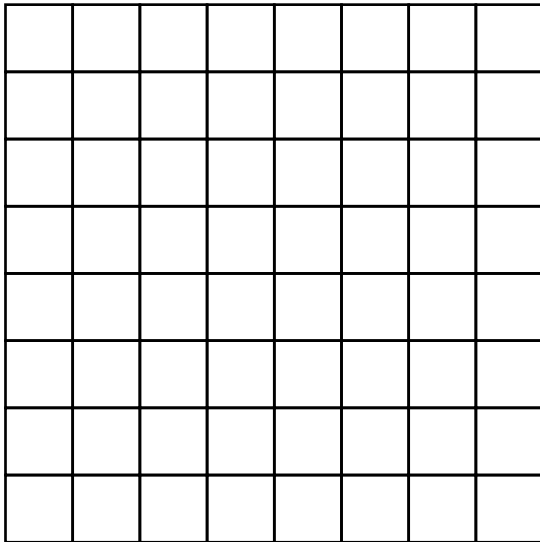


# Pentominoes Game

- On graph paper, create an 8-by-8 box, and write the letters of the 12 pentominoes to the side: FLIP N TUVWXYZ. (Each may be played once, and we'll cross each off as it is played.)
- Each turn, a player seeks to place (with rotation and flipping) a remaining pentomino into the grid, outlining it, filling it in, and crossing out its corresponding letter.
- The last player able to place a remaining pentomino wins.

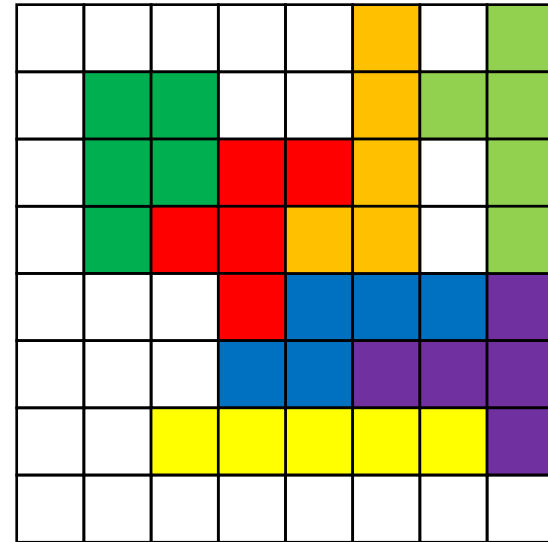
# Pentominoes Game Example

Initial Board



FLIP N TUVWXYZ

Your Move?



FLIP N TUVWXYZ

# References

- Wikipedia “paper and pencil games”:
  - category: [http://en.wikipedia.org/wiki/Category:Paper and pencil games](http://en.wikipedia.org/wiki/Category:Paper_and_pencil_games)
  - article: [http://en.wikipedia.org/wiki/Paper and pencil game](http://en.wikipedia.org/wiki/Paper_and_pencil_game)
  - Connect6: <http://en.wikipedia.org/wiki/Connect6>
- Augarde, Tony. *The Oxford Guide to Word Games*, 1984.
- Berlekamp, Elwyn R., *The Dots and Boxes Game: sophisticated child's play*, 2000.
- Berlekamp, Elwyn R., Conway, John H., and Guy, Richard K. *Winning Ways for Your Mathematical Plays*, 2<sup>nd</sup> ed., 2001. (Vol. 1: Col, Domineering, Hackenbush, Snort; Vol. 3: Dots and Boxes, pencil and paper games)
- Brandeth, Gyles. *Word Games*, 1986 (Jotto)
- Brouwer, Andries E., Chomp: <http://www.win.tue.nl/~aeb/games/chomp.html>
- Gardner, Martin. *Sphere Packing, Lewis Carroll, and Reversi*, 2009. (Hip)
- Joris, Walter. *100 Strategic Games for Pen and Paper*, 2002.
- Mohr, Marilyn Simonds. *The New Games Treasury*, 1997. (Dots and Boxes, Gomoku, Jotto, Sprouts, Picture Charades, Dictionary, Guggenheim, Crosswords)

# Other Paper-and-Pencil Games

- Domineering (<http://en.wikipedia.org/wiki/Domineering>)
- Col ([http://en.wikipedia.org/wiki/Col\\_\(game\)](http://en.wikipedia.org/wiki/Col_(game)))
- Snort ([http://en.wikipedia.org/wiki/Snort\\_\(game\)#Snort](http://en.wikipedia.org/wiki/Snort_(game)#Snort))
- Hackenbush (<http://en.wikipedia.org/wiki/Hackenbush>)
- Hex ([http://en.wikipedia.org/wiki/Hex\\_game](http://en.wikipedia.org/wiki/Hex_game))
  - See also Shannon Switching Game ([http://en.wikipedia.org/wiki/Shannon\\_switching\\_game](http://en.wikipedia.org/wiki/Shannon_switching_game))
- Join Five ([http://en.wikipedia.org/wiki/Join\\_Five](http://en.wikipedia.org/wiki/Join_Five), a.k.a Morpion Solitaire)
- Lexicant (<http://en.wikipedia.org/wiki/Lexicant>)
- Racetrack ([http://en.wikipedia.org/wiki/Racetrack\\_\(game\)](http://en.wikipedia.org/wiki/Racetrack_(game)))
- Sim ([http://en.wikipedia.org/wiki/Sim\\_\(pencil\\_game\)](http://en.wikipedia.org/wiki/Sim_(pencil_game)))
- Hip (<http://delphiforfun.org/programs/HIP.htm>)
- [Word Squares](#) (see below)
- [Paper Penguins](#) (see below)

# Word Squares

a.k.a. Crosswords, Word Exchange, Stock Exchange

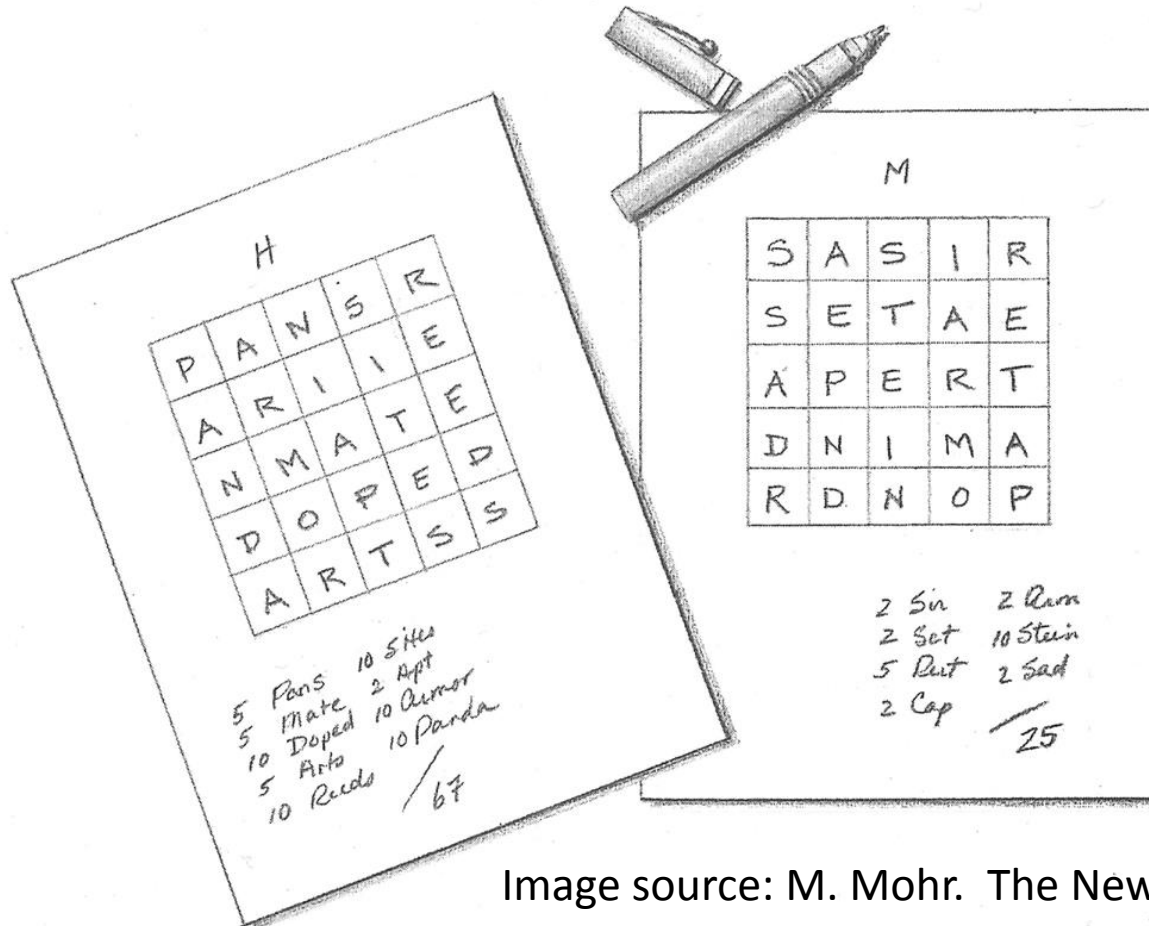


Image source: M. Mohr. The New Games Treasury

# Word Squares General Overview

- A random **letter** is announced to all.
- Each player independently places that same **letter** into a **5x5 square grid**.
- These steps are repeated until grids are full.
- The goal is to place the **letters** so as to achieve the highest scoring **words**.

# Word Squares Rules




- Each player has a pen and paper with a 5x5 grid.
- Players take turns choosing and announcing letters that each player must write into an empty grid space.
- After 25 turns, grids are scored for words formed across/down within rows/columns as follows:
  - 5 letters → 10 points; 4 letters → 5 points; 3 letters → 2 points
  - Words contained within other words do not count. E.g. one scoring TWINS cannot also score TWIN, WIN, WINS, and INS.
  - Overlapped words may score. E.g. a row/column with GAMEN would score both GAME and AMEN for  $2 \times 5 = 10$  points.
  - As in other word games, challenges are allowed, so that players should agree upon word restrictions (e.g. 3-or-more-letter Scrabble words) and a dictionary (e.g. Scrabble player's dictionary) to check challenges.



# Paper Pen-guins

- My core idea: Pen and paper “Hey! That’s My Fish!” on a square grid.
- Board: 8x8 square grid filled with random point distribution of 32 ones, 21 twos, and 11 threes. (May be generalized to other sizes with proportions 3:2:1.)
- Pen(s)/pencil(s), ideally contrasting color pencils.
- The first and second player mark square and circle pieces, respectively.

	a	b	c	d	e	f	g	h	
8	2	3	2	3	2	2	3	1	8
7	1	1	3	2	1	3	1	2	7
6	2	1	1	1	1	2	2	2	6
5	1	1	1	1	1	2	1	3	5
4	1	1	1	1	1	2	1	1	4
3	1	2	3	2	3	1	3	2	3
2	2	2	2	1	2	1	1	1	2
1	3	2	2	1	1	1	1	3	1
	a	b	c	d	e	f	g	h	

 0      0      to play

# Paper Pen-guins: Initial Placements

- Players take turns “placing” pieces by scoring point numbers and circumscribing them with player shapes, 4 per player.

	a	b	c	d	e	f	g	h	
8	2	3	2	3	2	2	3	1	8
7	1	1	3	2	1	3	1	2	7
6	2	1	1	1	1	2	2	2	6
5	1	1	1	1	1	2	1	3	5
4	1	1	1	1	1	2	1	1	4
3	1	2	3	2	3	1	3	2	3
2	2	2	2	1	2	1	1	1	2
1	3	2	2	1	1	1	1	3	1
	a	b	c	d	e	f	g	h	

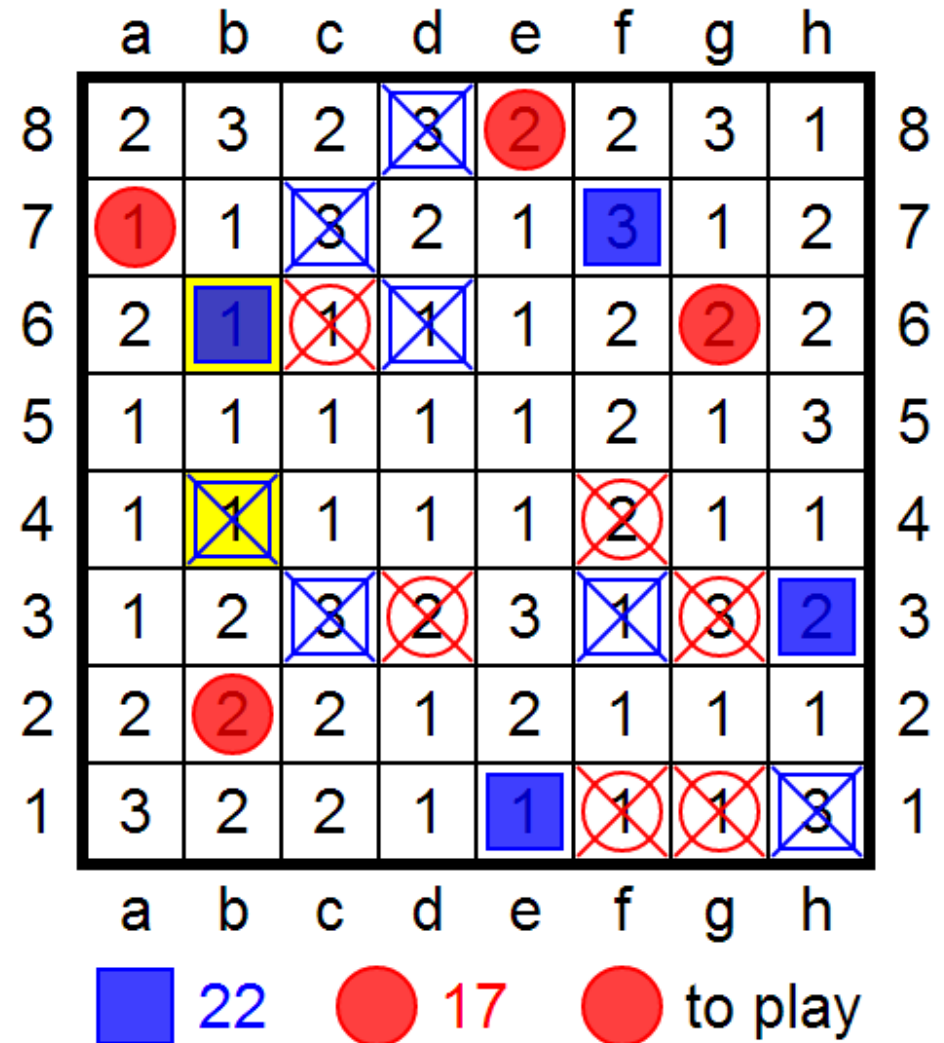
■ 10    ● 6    ● to play

	a	b	c	d	e	f	g	h	
8	2	3	2	3	2	2	3	1	8
7	1	1	3	2	1	3	1	2	7
6	2	1	1	1	1	2	2	2	6
5	1	1	1	1	1	2	1	3	5
4	1	1	1	1	1	2	1	1	4
3	1	2	3	2	3	1	3	2	3
2	2	2	2	1	2	1	1	1	2
1	3	2	2	1	1	1	1	3	1
	a	b	c	d	e	f	g	h	

■ 10    ● 7    ■ to play




# Paper Pen-guins: Move

- Following placements, players take turns making queen-like “moves”. The source position is blocked with an “X” drawn corner to corner. The destination position score number is scored and circumscribed with the player’s shape.



# Paper Pen-guins: Game End

- Play ends when neither player can move, and sometimes ends by mutual consent when end play is agreed upon.
- Players then claim remaining points as possible.
- Highest score wins.

	a	b	c	d	e	f	g	h	
8	<del>2</del>	3	2	<del>3</del>	<del>2</del>	2	3	1	8
7	<del>1</del>	<del>1</del>	<del>3</del>	<del>2</del>	1	<del>3</del>	<del>1</del>	2	7
6	<del>2</del>	1	<del>1</del>	<del>1</del>	<del>1</del>	2	<del>2</del>	<del>2</del>	6
5	<del>1</del>	1	1	1	<del>1</del>	<del>2</del>	1	<del>3</del>	5
4	1	<del>1</del>	<del>1</del>	1	<del>1</del>	<del>2</del>	1	1	4
3	<del>1</del>	<del>2</del>	<del>3</del>	<del>2</del>	<del>3</del>	<del>1</del>	<del>3</del>	<del>2</del>	3
2	2	<del>2</del>	<del>2</del>	<del>1</del>	<del>2</del>	1	1	1	2
1	<del>3</del>	2	<del>2</del>	<del>1</del>	<del>1</del>	<del>1</del>	<del>1</del>	<del>3</del>	1
	a	b	c	d	e	f	g	h	
		45		44		to play			