

# PYGMALION: A PAPPUS WORD GAME

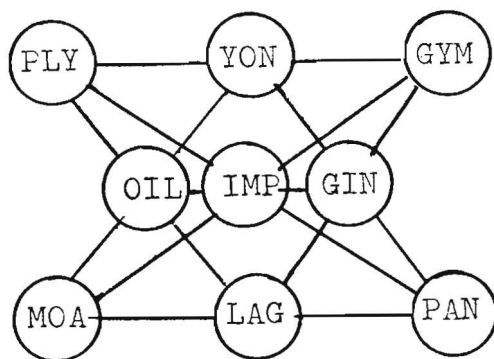
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The theorem of Pappus is a result from projective geometry about nine points and nine lines. It can be used as a basis for a word game similar to the game by David Silverman using the word stockpile ARMY CHAT FISH GIRL HORN KNIT SOUP SWAN VOTE (A. Ross Eckler, *Word Recreations* (Dover Publications, 1979), p. 113). However, unlike Silverman's game, which is a disguised version of tic-tac-toe, Pygmalion is a two-person game with a forced win for the first player that is not at all obvious to the uninitiated. Moreover, once the first version of our game is mastered, a second dual game can be played with renewed interest.

On a Pappus configuration, each point is on exactly three lines and each line contains exactly three points. In Pygmalion, letters and words take the places of points and lines, sometimes in unexpected ways. The word stockpile is GIN GYM IMP LAG MOA OIL PAN PLY YON; the letters are the letters of PYGMALION. A template of playing pieces is given at the end of the article. The page can be photocopied and the pieces pasted on eighteen index cards for playing the game. The two versions of the game are:

- I The players alternately choose words from the word stockpile; the winner is the first person to get three words with a common letter
- II The players alternately choose letters from PYGMALION; the first to spell a word in the stockpile is the winner

A Pappus configuration on which the game can be played is illustrated by the diagram at the left. It is worth mentioning



PLY	GIN	MOA
YON	IMP	LAG
GYM	OIL	PAN

that, unlike tic-tac-toe, no point (i.e., word) has a symmetrical advantage over any other. The noted graph theorist Frank Harary was one of the first to notice that Pappus could be played as a game. He describes how the first player can always win at Pappus (he uses numbers rather than words) in "Achievement and Avoidance Games on Finite Configurations" (J. Recreational Math., Vol. 16(3), 1983-84).

To solve Version 1 of Pygmalion, it is convenient to use the 3x3 grid shown on the preceding page. First note that the three rows of the grid are not in "line" on the Pappus diagram. The nine lines come from the three columns and the six 3-diagonals of the grid. The columns are, respectively, the Y-line, I-line and A-line. There are three right diagonals: M from GYM-IMP-MOA, N from YON-GIN-PAN, and L from OIL-LAG-PLY. Similarly, note that the P-line, the G-line and the O-line form left diagonals. The procedure for finding diagonals will be familiar to readers acquainted with the theory of determinants, but in any case should be memorized along with the 3x3 grid.

What is the winning strategy for the first player? Call the first player Blue and the second, Red. Blue selects any word. Then there are two cases:

- 1 Red selects a word in line with Blue
- 2 Red selects a word not in line with Blue (that is, he selects a word in the same row with Blue in the 3x3 grid)

For Case 1, Blue finds the Pappus line the two words are on, goes to the row of the 3x3 grid containing the third word of that line, and selects either of the two other entries in that row. This threatens a win that Red can only answer by selecting another word in the same row as his first word. Blue then selects the third member of that row and has a winning double threat.

As an example, follow along using the 3x3 grid as a guide:

Blue: LAG

Red: GYM (this forces the G-line and GIN is the third word on that diagonal)

Blue: MOA (he could have chosen PLY instead)

Red: PAN (forced, otherwise Blue takes the A-line)

Blue: OIL (the remaining word in the third row; he now threatens both the L-diagonal and the O-diagonal)

For Case 2, Blue selects the third word in the 3x3 grid and then plays rationally to win. For example:

Blue: LAG

Red: YON

Blue: IMP

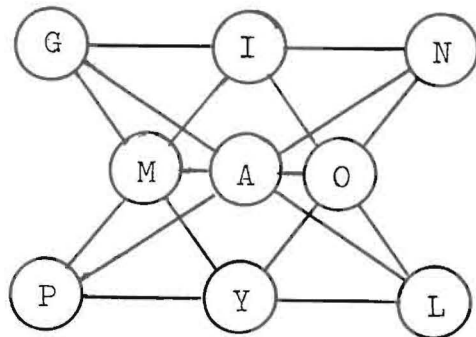
Red: OIL (threatens the O-line for Red)

Blue: MOA (answers Red's threat and counters with a winning double threat for Blue)

A few practice games should prepare any reader to be able to play Pygmalion expertly. We suggest that when playing as the second player, the expert play Case 2 since there is only

one winning response for the first player in this case. If he does not find it, it is very easy to draw the game.

To solve Version II of Pygmalion, use the Pappus diagram and the 3x3 grid given below. The winning strategy is exactly the



G	O	P
I	A	Y
N	M	L

same as before. However, the fact that the lines are now words usually makes this a harder game. Again we supply a sample game as an illustration:

Blue: Y

Red: N (on the YON line; O is the third letter of this line)

Blue: G (the only other choice in O's row is P)

Red: M (forced, otherwise Blue wins with GYM)

Blue: L (threatens either LAG or PLY)

For the reader who wants to play only an occasional game of Pygmalion, we suggest using the appropriate 3x3 grid, written on a scrap of paper, as a playing board. The players can simply circle or "triangle" their choices right on the board. It usually takes a long time for the inexperienced player to catch on to the winning strategy. As always, Version II is harder since it is more difficult to visualize the words as lines. It is also possible to transfer our strategies to the Pappus diagram for variety.

But for cutthroat Pygmalion, nothing beats playing with the cards (placed on the table at random). Can the beginner still recognize the winning plays? We can only quote Shaw's Eliza Doolittle: "Not bloody likely!"

N

O

I

L

A

M

G

Y

P

GIN

GYM

IMP

LAG

MOA

OIL

PAN

PLY

YON