This file contains materials and instructions for Games 1, 2 and 3 and for building and training **The Paper Cup Machine (PCM)**. It is advisable that you begin by playing between just two humans; then try to challenge the PCM.

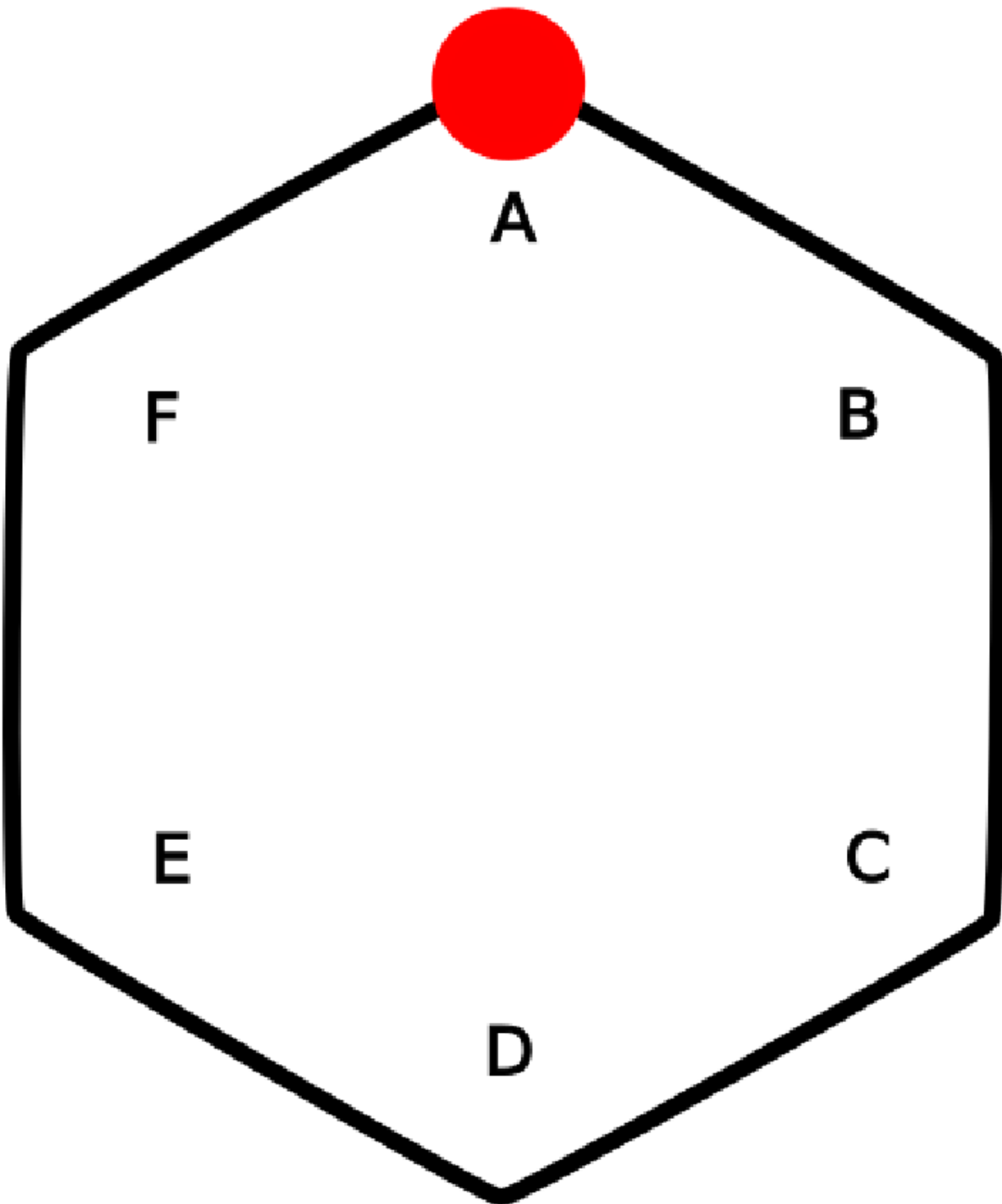*Be aware that the PCM will tend to win more and more often!*

Pg. 1: The board to play the game on.
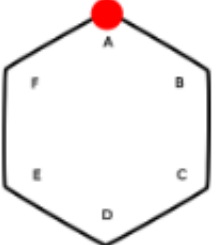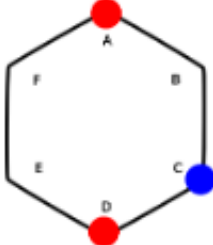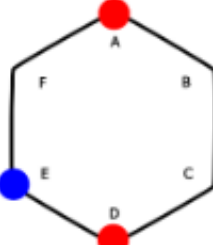Pg. 2: The labels to put on the 21 paper cups.
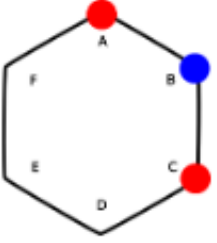Pg. 3: A supply of letters and red/blue "tokens".
Pg. 4: The instructions.
Pg. 5: Two examples of matches.
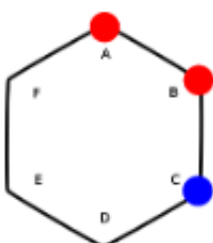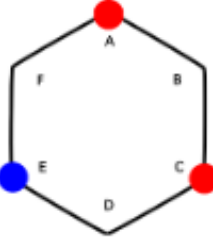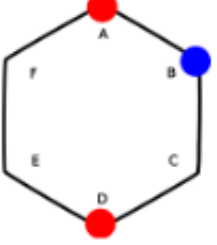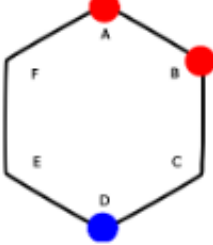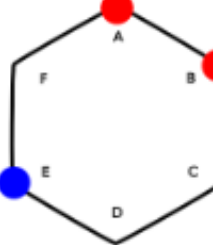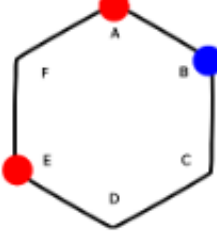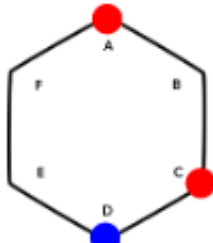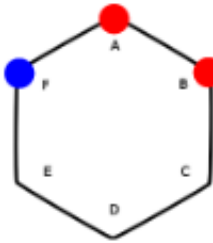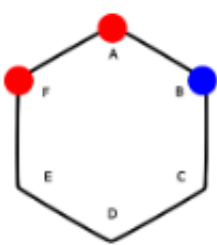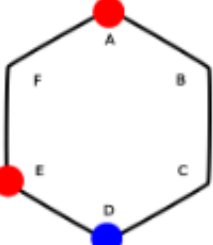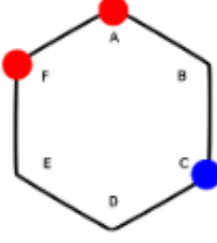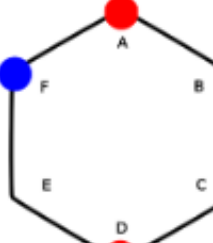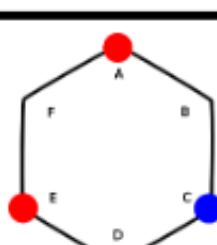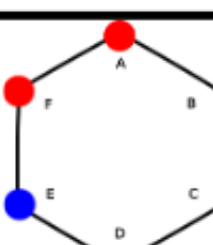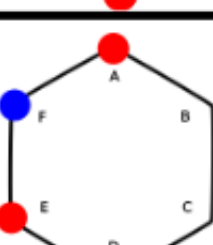
A

F                    B

E                    C

D

;

| | | | | | |
|---|---|---|---|---|---|
| | B C D E F | | B E F | | B C F |
| | D E F | | D E F | | B D F |
| | C E F | | C E F | | C D F |
| | C D F | | B E F | | C D E |
| | C D E | | B C F | | B D E |
| | B D E | | B C E | | B C E |
| | B D F | | B C D | | B C D |

| B | C | D | E | F | B | C | D | E | F |
|---|---|---|---|---|---|---|---|---|---|
| B | C | D | E | F | B | C | D | E | F |
| B | C | D | E | F | B | C | D | E | F |
| B | C | D | E | F | B | C | D | E | F |
| B | C | D | E | F | B | C | D | E | F |
| B | C | D | E | F | B | C | D | E | F |
| B | C | D | E | F | B | C | D | E | F |
| B | C | D | E | F | B | C | D | E | F |
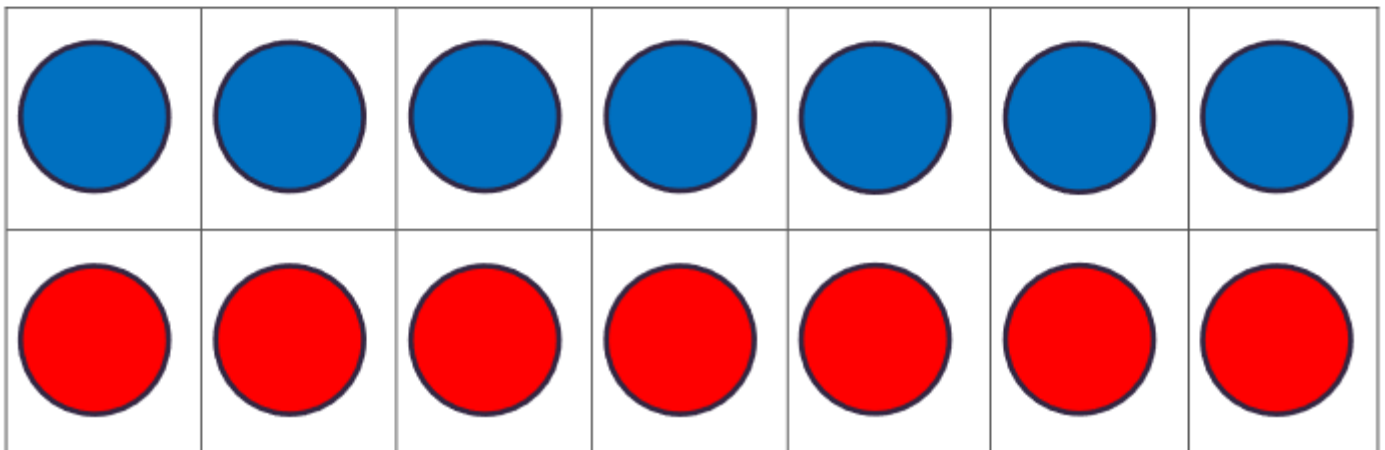
**The Games**

A 'session' is a set of $k$ 'matches' (you decide $k$ depending on the time you have). Throughout the session you only play one of the three games 1, 2, or 3.

The session is won by whoever has won the most matches.

In all three Games:

- The game is played by placing either red or blue tokens on the vertices of a hexagon board (page 1).
- Alice plays first, always placing one of her tokens on A.
- Bob and Alice play alternately, placing tokens on the vertices that are still empty.
- Alice knows what winning configuration she must make in every match of the session, but Bob DOES NOT.
- Alice wins the game if she can **compose** a winning configuration, Bob wins if he **prevents** her from doing so.
- At the end of each match the tokens are removed from the hexagon board.

In this examples Alice plays with red tokens and Bob with blue tokens: there is a stock of them on page 3.

*Game 1*

Alice must place three tokens in non-adjacent positions. The only winning configuration is: ACE.

*Game 2*

Alice must place three tokens in adjacent positions. The winning configurations are: ABC, FAB, EFA.

*Game 3*

Alice must place two tokens in adjacent positions and the third not adjacent to the others. The winning configurations are: ABD, ABE, FAC, FAD, ACD, ADE.

**The Paper Cup Machine (PCM)**

*Preparing the PCM*

Prepare a good number of small pieces of paper, each having one of the letters B, C, D, E, F on it (you can print and cut out those on page 3).

Print out and cut out the 21 labels on page 2; attach each of them to one of 21 paper cups. Each cup now corresponds to a configuration in the game when it is Bob's turn.

Place the single letters you cut out before inside the cups, as indicated on the label of each cup (e.g. in the cup marked:
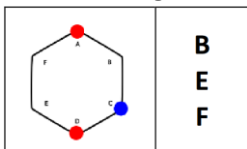


put one letter B, one letter E and one letter F).

*How to make the PCM play*

When it is Bob's turn, on the hexagon board there will be only one of the 21 configurations depicted on the labels of the cups. The corresponding cup is therefore chosen, and one of the letters in it is randomly drawn.

Bob places his token on the hexagon's vertex corresponding to the letter just drawn.

*How to train the PCM*

In each game two cups were used, and from each of them one letter was drawn.

- If Bob won the game, put each letter back in its cup and add another letter equal to the one just put back.
- If Bob lost the game, do not put the letter drawn back into the cup (remove it permanently).
- If a cup has been emptied, re-insert all the letters indicated in its label.
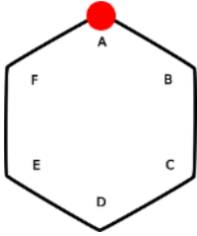
**Example of a session** (the first two matches)
Alice decides (secretly) to play Game 2.
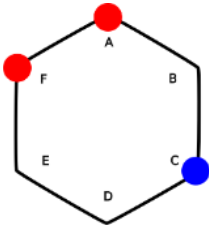
*Match 1*
Alice places a red token in A.
Bob draws (randomly) from the cup labeled:



the letter C. He places a blue token in C.
Alice places a red token in F.
Bob draws from the cup labeled:



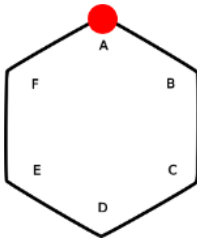the letter E. He places a blue token in E.
Alice places a red token in B and **wins the match**.
Bob DOES NOT put the letter C back into the first cup, and he DOES NOT put the letter E back into the second cup: C and E are discarded.

*Match 2*
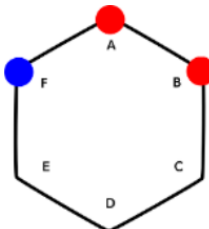Alice places a red token in A.
Bob draws (randomly) from the cup labeled:



(which now only contains the letters B, D, E, F) the letter F. He places a blue token in F.
Alice places a red token in B.
Bob draws (randomly) from the cup labeled:



the letter C. He places a blue token in C and **wins the match**.
He puts the letter F back into the first cup and adds another F. He also puts the letter C back into the second cup and adds another C.
And so on...