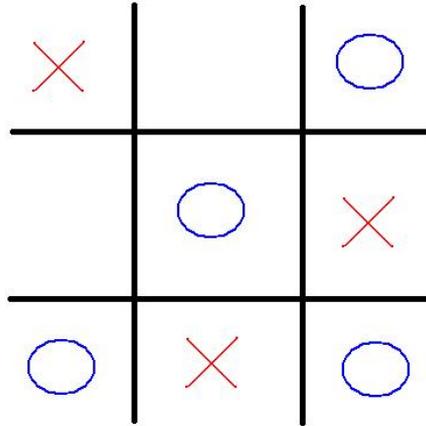


# Tic-Tac-Toe



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**Teacher Mentor:** Gina Kinser

**Goal:** Introduce high school students to logic and basic concepts of artificial intelligence and computer programming through the use of flowcharts and friendly competition in the game Tic-Tac-Toe.

**Grade and Course:** Finite Math

**Resources/materials needed:**

- A copy of the attached flowchart for each team (teams may be 1 or more students depending on class size)
- A set of game pieces for each pair of teams
- A coin or die for each pair of teams
- Laminating the flowchart and game pieces (optional)

**Lesson Source:** Original lesson (as far as I know)

**Description of Plan:** This exercise emphasizes logic and strategy through the use of flowcharts. There should be little instructional time for this lesson and more emphasis on letting the students compete against each other to learn the intricacies of the different approaches. Two teams compete against each other in what is called a match. A match is the best of 3 sets, where each set is won by the first team to win 2 games. The game pieces should be cut into individual pieces consisting of the game board (1), commands (11), and icons (10). Each team should have their own flowchart, but they will share the game pieces with the other team.

A set begins by first splitting up the game pieces among the two teams. The game pieces are divided up only once per set. Teams will be limited to only playing with the set of commands that they draw during this time. A coin or die will determine who gets to pick first from the set of 11 possible commands. The teams alternate picking

commands after that until each team has 5 commands, with one command left over that will not be used.

After the pieces have been divided, each team now has to arrange these commands on the left hand side of the flowchart (under the "Can you...?"). Do not allow the teams to see the order of the other team's commands. Each team should only know what commands the other has and not the order of them on the flowchart. This is very important to the strategy involved.

Once each team has arranged the order of their commands, the actual game of tic-tac-toe may begin. Once the game starts, *the flowcharts cannot be changed!* The players must logic out the resulting moves before the game starts and not during. The team that had to choose second for the commands starts every game this set. After each game, players may re-arrange the flowchart but they must use the same commands for the entire set! The set lasts until 1 team has won 2 games or there has been a total of 3 draws. After a set, the commands are put back into a common pile and then divided up amongst the two teams again for the next set. A match is the best of 3 sets.

BLOCK! and FINISH! are powerful commands that deserve a bit of extra attention. BLOCK! will automatically use that players turn by moving on the last number of a row/column/diagonal that has 2 opponent icons already on it. Likewise, FINISH! will automatically use that players turn by moving on the last number of a row/column/diagonal that has 2 of his own icons already on it. Both commands have strengths and weaknesses and may be exploited by the opponent.

**Example:**

Here is a sample walk through of a game. Team A rolls higher (or called the coin flip) and therefore gets first choice of the 11 commands. Team A chooses BLOCK! first. Team B then chooses FINISH! and they continue picking until they each have 5 commands. Here's a possible result.

**Team A set of commands**

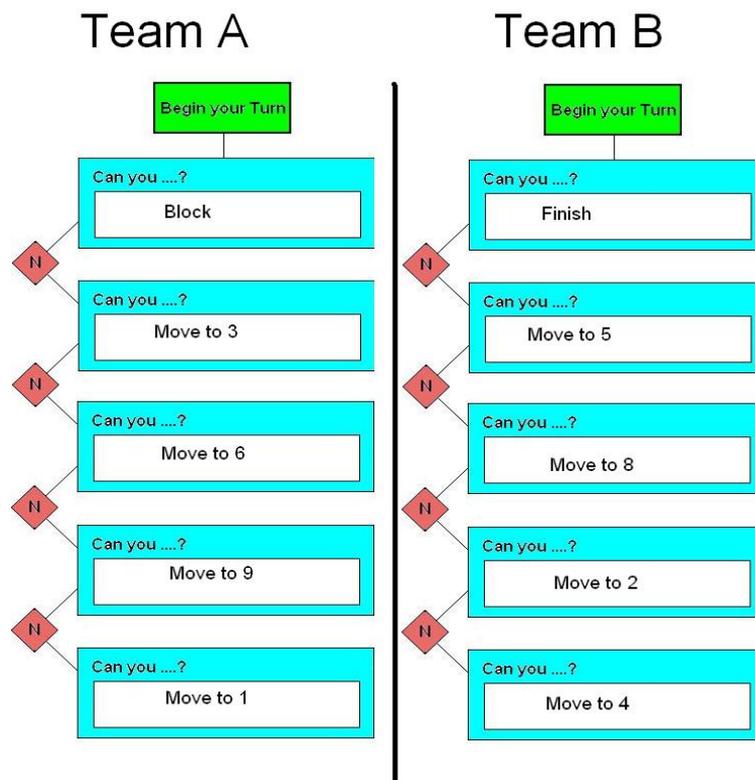
- BLOCK!
- Move to space 9
- Move to space 3
- Move to space 6
- Move to space 1

**Team B set of commands**

- FINISH!
- Move to space 5
- Move to space 8
- Move to space 2
- Move to space 4

in this case, space 7 would be the left over one.

Each team now arranges their flowchart independently of each other using the commands available to them. Here are 2 possible competing flow charts.



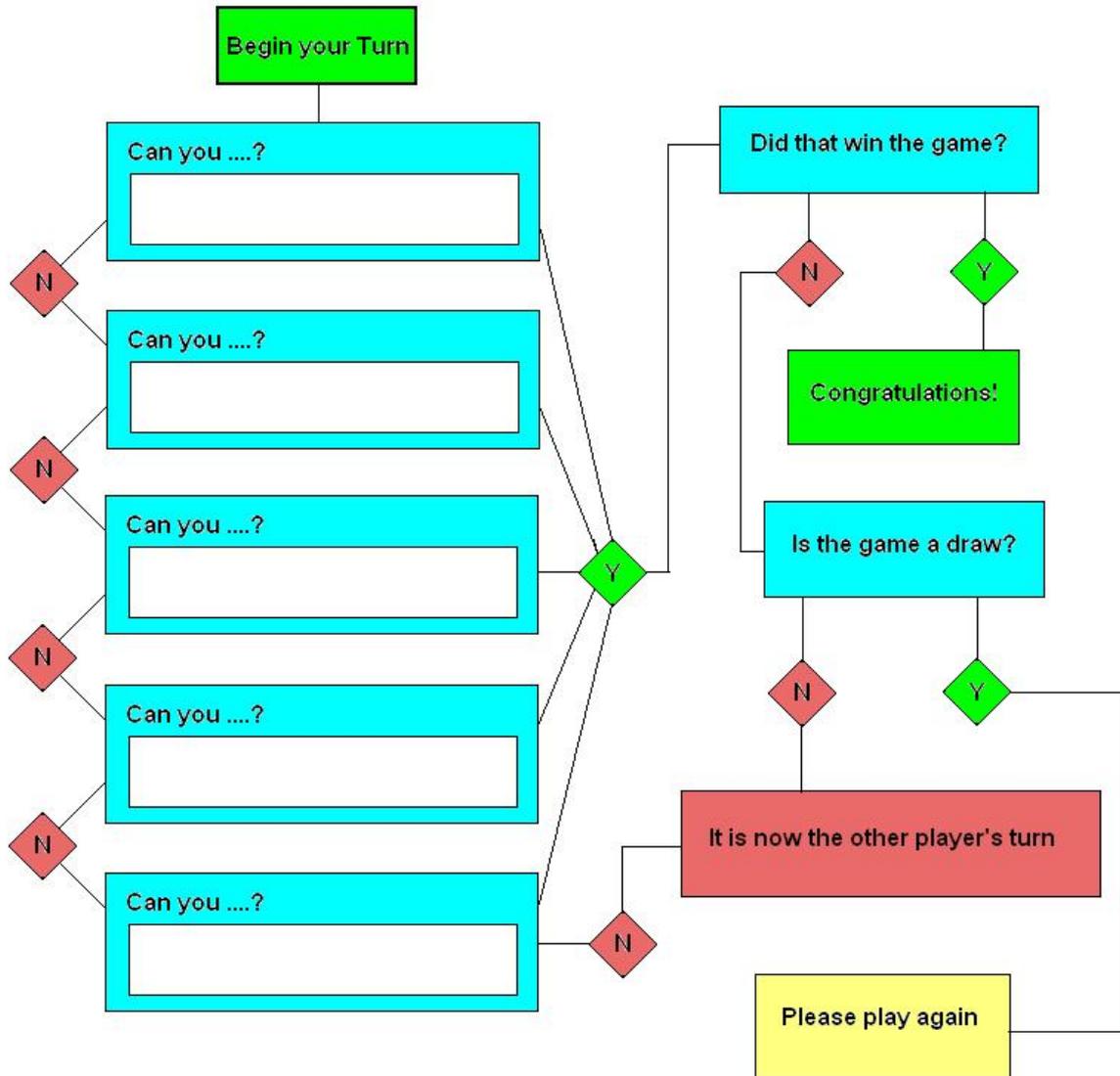
Team A is using the fact that B doesn't have a block to go for a straight forward approach down the far right column. Team B hopes that a quick move to spot 5 and the FINISH command will get them a win. Note that neither of these is a particularly strong build. Team A chose the first command so Team B gets to move first. They don't have an option to finish any row/column/diagonal and so they move to spot 5. Team A can't block anything yet so they move to spot 3. Team B follows up with a move to spot 8. Now Team uses their Block command to move to spot 2. Team B is now forced to skip over their move to 2 command and moves to 4. Team A again gets to use the BLOCK command and moves to spot 6. Here Team B has used up all of their commands and simply misses their turn. Finally Team A moves to spot 9 and wins the game. For the next game the two teams must keep the same commands but can change the order any way they like. The teams continue using these same commands until one team wins 2 games. That is the end of the set and then commands are re-picked for the next set. The match is won after a team wins two sets.

### Instructional Mode:

- Divide up the class into an even number of teams. The class size and resources available will determine the number of students on each team
- Hand out a flow chart to each team
- Hand out the game pieces to each pair of teams
- Explain the basics of how flowcharts function
- Run through an example on the board (you may choose a volunteer to play against or just use the above example)
- Let the teams compete against each other and see if anyone finds a winning strategy

**Estimated Time:** 1 class period

# Tic-Tac-Toe Flowchart



# Game Pieces

Move to space 1

Move to space 2

Move to space 3

Move to space 4

Move to space 5

Move to space 6

Move to space 7

Move to space 8

Move to space 9

**BLOCK!**

**FINISH!**

