CHAMP Activity — February 10, 2014

Games on a plane!

- **Tic-tac-toe:** Let's start off with a couple volunteers that will square off to play tic tac toe on the board.

- Now, we'll break up into twos, play a game of tic tac toe. If any pair of people ties, we'll have them explain what happened on the board.

- What are some strategies for playing Tic-Tac-Toe?

- Is it better to go first or second? Why?

- If your opponent plays perfectly, can you still win?

- Is it possible to always stop your opponent from winning?

- **Pick a number:** Now, we'll play another two player games. Pick an integer between 1 and 9. Then, your opponent should pick a number from 1 to 9, but they cannot pick the one you picked. If either of you acquire three numbers that add up to nine, you win.

  Example:

	Numbers left	Player 1	Player 2
0th Turn:	1 2 3 4 5 6 7 8 9		
1st Turn:	1 2 3 4 5 6 7 9	8	
2nd Turn:	1 2 3 4 5 6 9	8	7
3rd Turn:	2 3 4 5 6 9	8 1	7
4th Turn:	2 3 4 5 9	8 1	7 6
5th Turn:	3 4 5 9	8 1 2	7 6
6th Turn:	3 4 9	8 1 2	7 6 5
7th Turn:	3 9	8 1 2 3	7 6 5
8th Turn:	9	8 1 2 3	6 **7 5 3 Win!**

- Play a game of pick a number with your neighbor.

- It turns out this game is **isomorphic** to tic-tac-toe. To show this, we need to make a **magic square**. That is make a 3×3 square, such that each row and column adds up to 15. You can only use each number, 1 to 9, once. I have started a couple below. Can you make such a magic square?

- Based on this, why is tic-tac-toe like the pick a number game?

- **Tic-tac-donut:** Here's a variation tic-tac-toe. You still take turns placing X's and O's on a 3×3 board **but** you can count 3-in-a-row that wrap around. Let's demonstrate this with some examples:

	X	O
X	O	
		X

In a regular game of Tic-tac-toe, 'O' would be about to win here, but in Tic-tac-donut, 'X' has already won, since the 'X's wrap around to the other side.

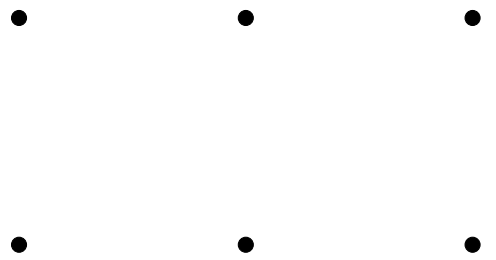
- How many extra ways of getting 3-in-a-row are there now?

- Is it still possible to always force a draw if you go second?

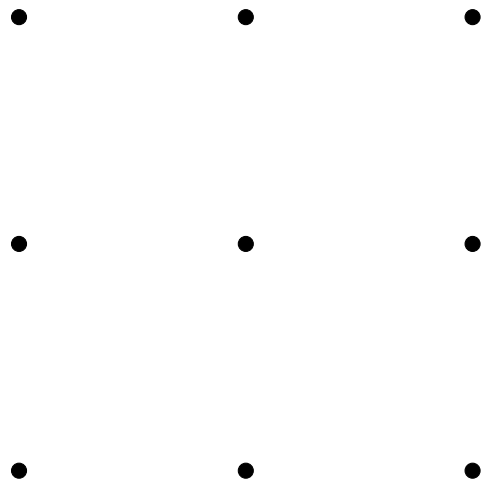
- **Battleship:** Consider a 3×3 battleship board. Each player has to 'hide' their battleship, which is 3 squares long. Then, taking turns, each player bombs the other player's board, one square at a time. The first player to totally bomb the other's battleship wins. Play this game against your neighbor.

- Does the player that goes first have an advantage? Can the player going first always win? Why or why not?

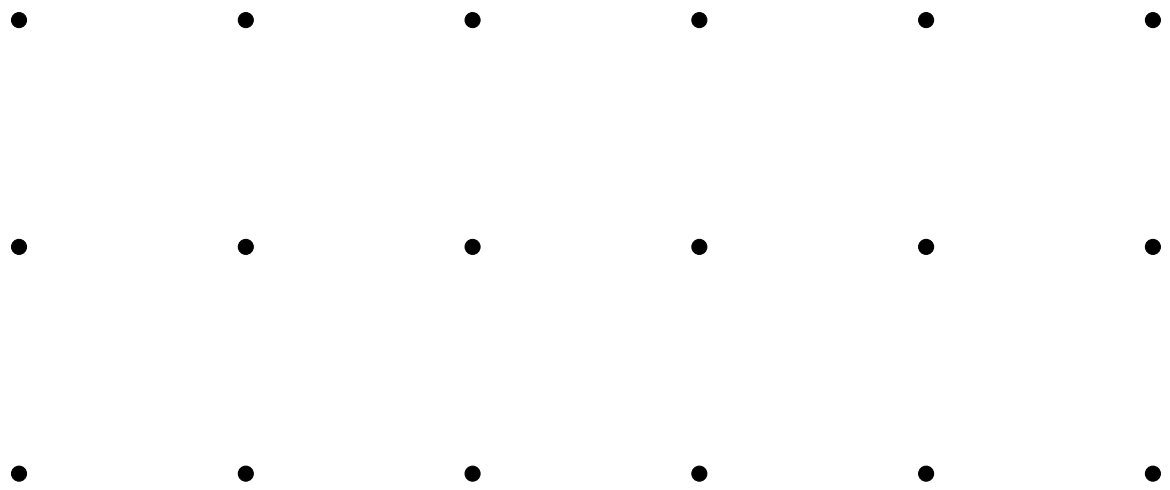
- **Dots and boxes:** Take turns drawing one horizontal or vertical line between dots. If you close a square, write the first letter of your name in it and take another turn.



- Now try it on this board:



- And this one:



- What are some strategies for winning dots and boxes?