**Game**

*Games are a great resource. They support talk in maths and, just as important, they motivate us to persevere.*

**Red – Amber – Green**

(adapted from *Traffic Lights* at [nrich.org](https://nrich.org))

**Aims:**
- Visualise position and direction.
- Identify game strategy.

**You will need:**
- A 3 by 3 game board (see resources)
- Counters (see resources)

**Red – Amber – Green** is a game for 2 players using a 3x3 grid as the playing board.

- At the start of the game, the board is empty.
- The players take turns to play. When it is your turn, you must either:
  1. Place a red counter in an empty square, or
  2. Replace a red counter already on the board with an orange one, or
  3. Replace an orange counter already on the board with a green one.

**Green counters cannot be replaced!**

You win by completing a line (row, column, or diagonal) of three counters all the same colour. It doesn't matter who placed the first counter(s) in the line - it's the third counter of the line which determines the winner.

![Game board example](https://example.com/game-board-example.png)

Here is an example of how a game could start:

1. **Player 1** places a red counter at the top right-hand corner.
2. **Player 2** places a red counter at the middle of the bottom line.
3. **Player 1** changes a red for an orange counter.
4. **Player 2** places another red counter.
5. **Player 1** changes a red for an orange counter.
6. **Player 2** changes an orange counter for a green counter.

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Player 1 now has three choices: placing another red counter, changing the red counter for an orange or changing the orange counter for a green.
What would be the player’s best choice? Why?

Play the game several times, then think about these questions.

- How many red counters can be placed before you would lose if you didn’t change one for orange?
- How may red counters and orange counters can be on the board before you would lose if you didn’t change one for green?
- Is it better to go first or second?
- Is it better to change to green counters as soon as possible?
- The players in the example game avoided the centre square of the grid. Is that a good tactic? Why/why not?

Traffic Lights – Champions Version!

- Try playing the game on a 4 by 3 grid.
- The aim is the same. You must complete a line (row, column, or diagonal) of three counters all the same colour.
- Will the same tactics work?

HAVE A GO AT THE CHALLENGE BELOW – GO ON, YOU CAN DO IT!
Traffic light challenge

1. Take 3 counters, **one of each colour**. Place them in a line. 
   *Record* this arrangement however you like, e.g. ![counter colors]

   Now rearrange the counters into a different order and record. 
   How many different arrangements are there? 
   A good strategy is to be **systematic** in your recording.

2. This time you may use 3 counters of any colour, so you could have 2 red and 1 green or 2 orange and 1 red or all 3 the same colour. 
   How many different arrangements are possible now?

3. Predict how many possibilities if we make 4 in a row from 3 choices of colour.

   A good strategy with a problem like this us to simplify it first...
   - What if you made a row of 4 from 1 choice of colour?
   - What if you made a row of 4 from 2 choices of colour?
   - Then 4 in a row from 3 choices of colour?

**Answers**

1. 6 possibilities (3 x 2 x 1). The first counter can be one of 3 colours, the second 2 and one choice for the third.
2. 27 possibilities (3 x 3 x 3). Here each of the counters can be one of three colours.
3. 81 possibilities (3 x 3 x 3 x 3). Each of the counters can be one of three colours.
Game Board 1
(3 by 3)