THE MATHEMATICAL ASSOCIATION OF VICTORIA

Algorithmic thinking resources

Year 5: Car rally

In this lesson students will simulate a simple random walk by manipulating sets of numbers using a given rule, for example, if a number is even halve it; if a number is odd, subtract 1 then halve it.

Level 5 - Number and Algebra | Pattern and algebra | Follow a mathematical algorithm involving branching and repetition (iteration). (VCMNA194)

MATHEMATICAL LANGUAGE

Rule, algorithm, add, multiply, divide, remainder.

MATERIALS

Warm Up Game

- Ten-sided dice
- Coloured counters
- Game Board

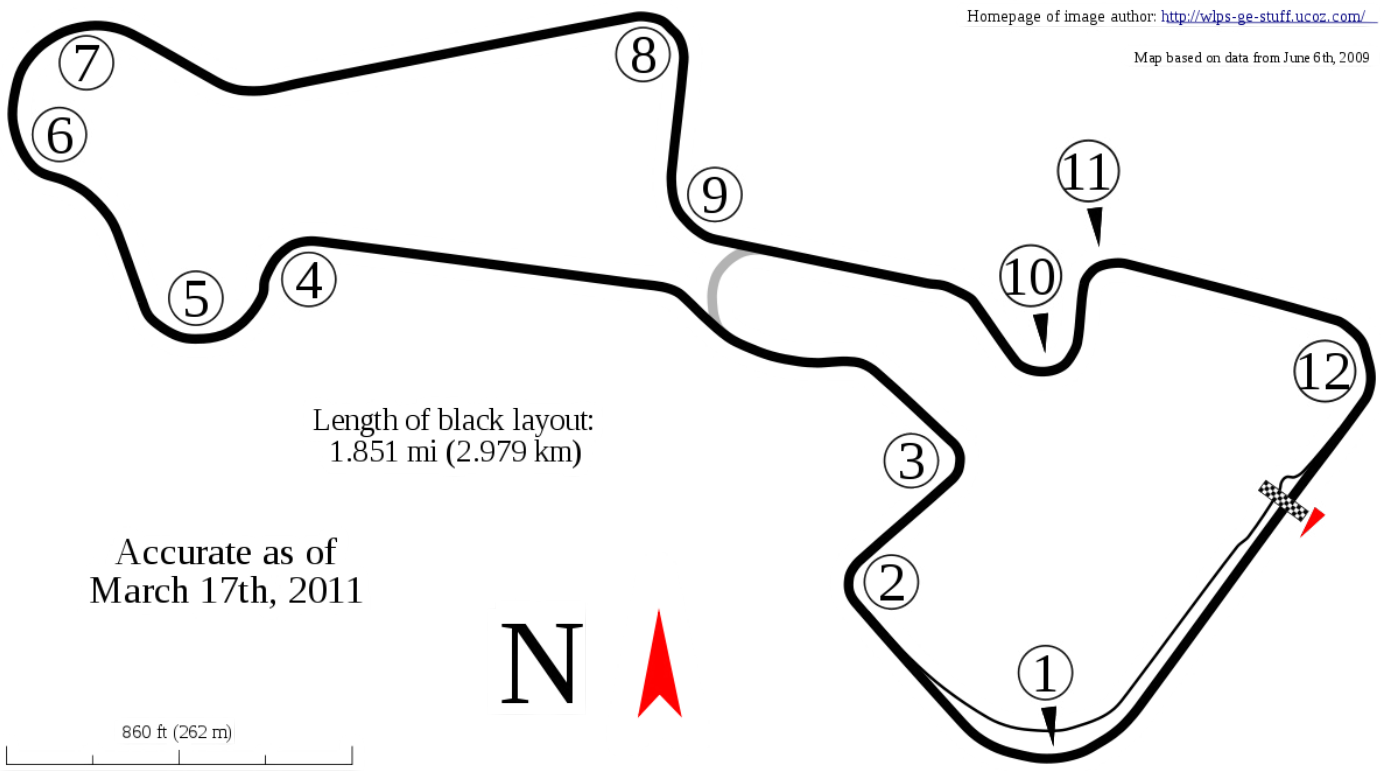
Activity

- Car Rally Map
- Counters (tokens)
- Pencils and paper

WARM UP - THE REMAINDER GAME

- Ask students to work in pairs or groups of four. Give each group a game board (See Student resource – Warm up game), a ten-sided dice, and coloured counters – a different colour for each player.
- The players place their counters on 'start'. They take turns to throw the dice. Whatever number is thrown, the player must work out how many times it goes into the number their counter is on, and how many would be remaining. The player then moves that number of spaces (that is, the remainder). For example, a player is on 'start', that is, the 35 square, and throws a six. Six divides into 35 five times with

© Mathematical Association of Victoria 2018



a remainder of five. The player moves five spaces to the 63 square. For their next throw they would look at dividing whatever number they throw on the dice into 63. For example, if they threw a nine on their next turn, they would remain on the 63 square (because nine goes into 63 without a remainder). By contrast, if they threw a six they would move three squares (because six goes into 63 ten times with a remainder of three).

- To win, a player must land exactly on the home square; that is the remainder must equal the precise number of spaces remaining.

LAUNCH

- You will need to prepare a 'track' to model the car rally map below.
- Ask the students to imagine that they are going to go on a car rally, with 20 checkpoints along the way where they need to stop. At the first checkpoint, they will get one token. They will then receive two more tokens at each successive checkpoint. Thus, the total number of tokens received overall by the students as they pass through each checkpoint fits the following pattern:

Checkpoint 1: 0 + 1 = 1 token
Checkpoint 2: 1 + 2 = 3 tokens
Checkpoint 3: 3 + 2 = 5 tokens
Checkpoint 4: 5 + 2 = 7 tokens

EXPLORE

- Organise the students into pairs, as this is how they will be travelling during the car rally. Give each pair a map that has been drawn up showing the route that the students would need to travel along, with all the checkpoints indicated. Beside each checkpoint, there will be a box where the students can record the number of tokens they will receive at each checkpoint. Give them paper and pencils, as well as some counters to help them work out the solutions (and to model the collection of tokens).
- Ask the students to calculate the number of tokens for the first five checkpoints. Ask them to then calculate how many tokens they will receive at:
  - Checkpoint 11?
  - Checkpoint 17?
  - Checkpoint 20?
- Ask the students to show how they worked out how many tokens were gained at each of these checkpoints.
- Then ask the following question: Can you find a rule to help you calculate how many tokens you will receive at each checkpoint without having to count them all?

© Mathematical Association of Victoria 2018

SUMMARISE

Choose some students to share how they worked out their solutions, including students who have come up with a rule that appears to work, such as:

$1 + 2 \times (n - 1)$ or $2n - 1$

Ask the students to go back and try these rules for different checkpoints to see if they work.

ENABLING PROMPTS

- Reduce the number of checkpoints to 10.
- Change the number of tokens at Checkpoint 1 to 2 tokens rather than 1 token.
- Ask students to act out the problem, creating a physical track with relevant checkpoints.

EXTENDING PROMPTS

- Ask the students to calculate the number of tokens for a variety of numbers beyond 20.
- Ask the students to increase the number of tokens received at each checkpoint to five (other than the first checkpoint where only one token is received). For example:
  - Checkpoint 1: 0 + 1 = 1 token
  - Checkpoint 2: 1 + 5 = 6 tokens
  - Checkpoint 3: 6 + 5 = 11 tokens
- Ask them what the rule would be for this situation?

  $1 + 5 \times (n-1)$

QUESTIONS TO ENCOURAGE DEEPER THINKING

- Is it possible to come up with a rule for every possible addition of tokens to obtain the exact number of tokens at any checkpoint?
- What strategy/ies can you use to work out the rules?
- Show some examples.

EXTENDED VICTORIAN CURRICULUM LINKS MATHEMATICS

Level 5 - Number and Algebra
Number and place value

- Identify and describe factors and multiples of whole numbers and use them to solve problems(VCMNA181)
- Use estimation and rounding to check the reasonableness of answers to calculations(VCMNA182)
- Use efficient mental and written strategies and apply appropriate digital technologies to solve problems(VCMNA185)

Pattern and algebra

- Describe, continue and create patterns with fractions, decimals and whole numbers resulting from addition and subtraction (VCMNA192)
- Use equivalent number sentences involving multiplication and division to find unknown quantities(VCMNA193)
- Follow a mathematical algorithm involving branching and repetition (iteration) (VCMNA194)

Level 5-6 - Critical and creative thinking
Meta-cognition

- Investigate how ideas and problems can be disaggregated into smaller elements or ideas, how criteria can be used to identify gaps in existing knowledge, and assess and test ideas and proposals. (VCCCTM031)

Level 5-6 - Digital technologies
Creating digital solutions

- Define problems in terms of data and functional requirements, drawing on previously solved problems to identify similarities (VCDTCD030)
- Design, modify and follow simple algorithms represented diagrammatically and in English, involving sequences of steps, branching, and iteration (VCDTCD032)

ASSESSMENT OPPORTUNITIES

Teachers can assess students using a checklist or anecdotal notes through observation. Student samples and photos of students engaging in the activity can be kept as evidence.

Any of the above-mentioned curriculum links can be assessed through this activity.

© Mathematical Association of Victoria 2018

THE MATHEMATICAL ASSOCIATION OF VICTORIA

Algorithmic thinking resources

Year 5: Car rally student resource