Indigenous Knowledge
Mathematics Year 6

Mathematics in nature: understanding bushfire

Classroom activity handout

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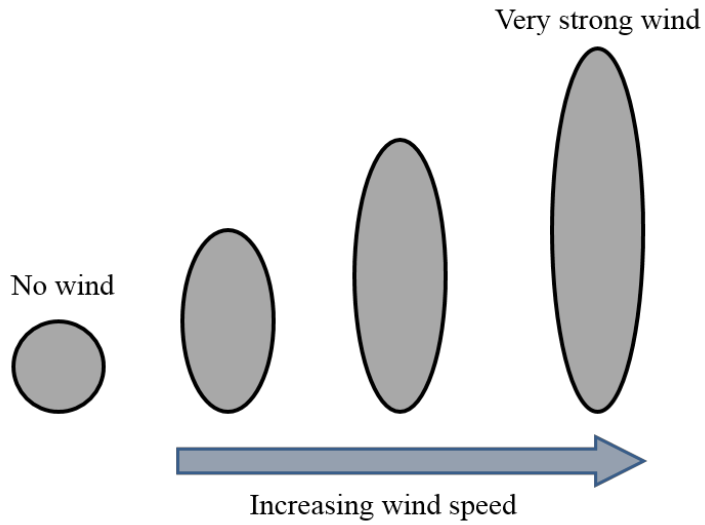
Handout

Activity 1

The strength of the wind, or the wind speed, determines the shape of a bushfire. If there is no wind, then a fire will spread in the shape of a circle. If there is a wind blowing, then the fire will make an oval shape, called an ellipse. As the wind gets stronger, the ellipse becomes more elongated, like in the picture below:



The next picture shows a photo of an actual bushfire taken from a satellite in space. Looking at the photo, answer the following questions:

(a) Do you think the wind is very strong?

(b) From which direction is the wind blowing? Express answer in terms of a compass direction.

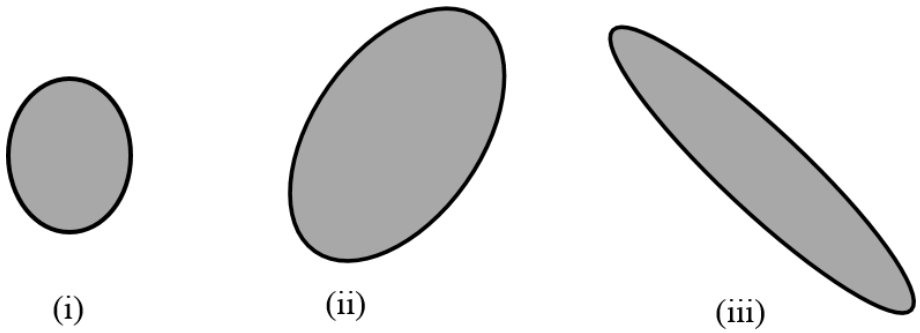
(c) Where is the fire burning the hottest?

Satellite photograph of a fire spreading across the landscape.

This picture shows the same fire with an ellipse overlaid to demonstrate how the shape of a fire can be approximated.

Activity 2

1. **T**hese ellipses represent three different fires.



   (a) On each fire draw an arrow that shows a direction the wind could be blowing.

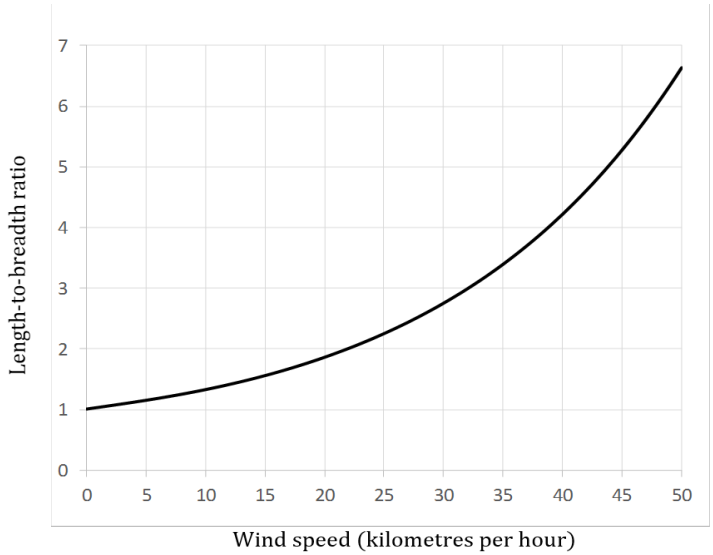
   (b) Which fire is spreading under the lowest wind speed?

   (c) Which fire is spreading under the highest wind speed?

   (d) Use a ruler to measure the length and the breadth of each fire.

   (e) Calculate the length-to-breadth ratio for each fire (give answer to 1 decimal place).

2. The graph below shows how the length-to-breadth ratio of a fire changes with wind speed.



Use the graph to answer the following questions.

   (a) If the wind speed was 20 km/h what would the length-to-breadth ratio of a fire be?

   (b) If the wind speed was 45 km/h what would the length-to-breadth ratio of a fire be?

   (c) If the length-to-breadth ratio of a fire is 6, what was the wind speed?

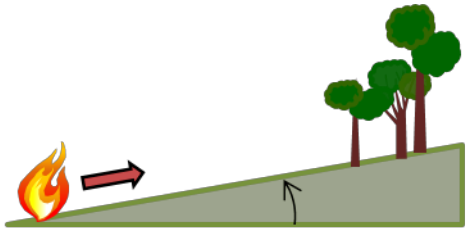
   (d) What was the wind speed for each of the fires in question 1?

   (e) Draw a diagram showing a fire that is spreading under a wind that is blowing from the north-west with a speed of 35 km/h.

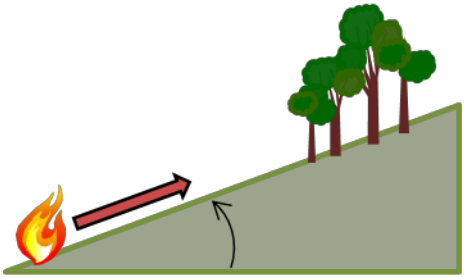
Activity 3

The steepness of a hill is described by its slope angle. In the picture below there is a fire burning on flat ground, a hill with a slope angle of 10 degrees, a hill with a slope angle of 20 degrees and a hill with a slope angle of 30 degrees.

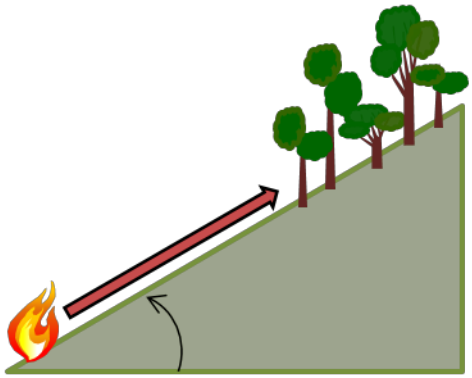
Flat ground



10° slope



20° slope



30° slope

For a person, it is harder to walk up a steep hill – but for a fire, it is the opposite! Fires spread faster up steeper hills.

In fact, a fire will spread twice as fast on a hill with a 10 degree slope than it does on flat ground. It will spread twice as fast again on a hill with a 20 degree slope, and twice as fast again on a hill with a 30 degree slope. So for every additional 10 degrees of steepness, a fire will double its rate of spread. The size of the red arrows in the picture illustrate how much faster the fire spreads on each of the hills.

Example:

If a fire spreads at 5.3 km/h on flat ground, then:

- it will spread at 10.6 km/h on a 10° slope
- it will spread at 21.2 km/h on a 20° slope
- it will spread at 42.4 km/h on a 30° slope

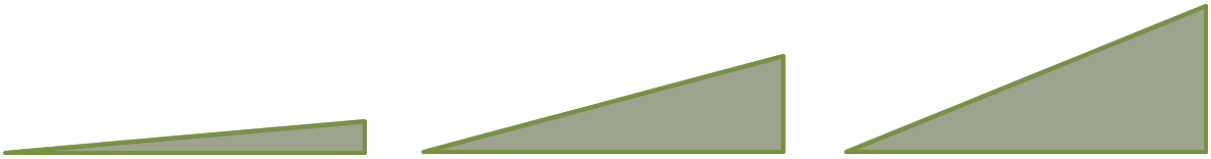
Questions:

1. If a fire spreads at 2.6 km/h on flat ground, then how fast will it spread on a 10° slope?
2. If a fire spreads at 37 metres per minute on flat ground, then how fast will it spread on a 20° slope?
3. If a fire spreads at 0.75 km/h on flat ground, then how fast will it spread on a 30° slope?
4. If a fire spreads at 24 km/h on a 20° slope, then how fast will it spread on a flat ground?

5. If a fire spreads at 170 metres per hour on a 30° slope, then how fast will it spread on a 10° slope?
6. Suppose that you can run at a top speed of 15 km/h on flat ground. If a fire is spreading at 70 km/h on a 20° slope, will you be able to outrun it when it starts burning on flat ground?
7. Suppose that we know a fire spreads a 1 km/h on flat ground (0° slope). Calculate how fast the fire will spread at 10°, 20° and 30° and fill in this table:

Steepness of hill	**Rate of fire spread**
0°	1 km/h
10°	
20°	
30°	

8. Use a Cartesian plane to plot the points in the table (use the x-axis for slope and the y-axis for rate of fire spread).
9. Use a protractor to measure how steep the following hills are.

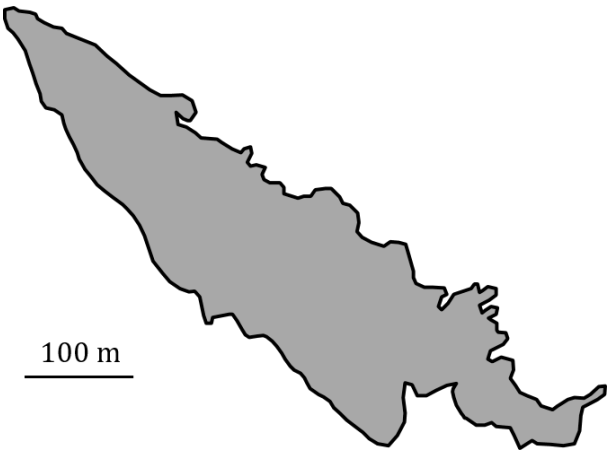


10. Use the plot you constructed in question 7 to estimate how fast the fire would travel up the three hills in question 9.

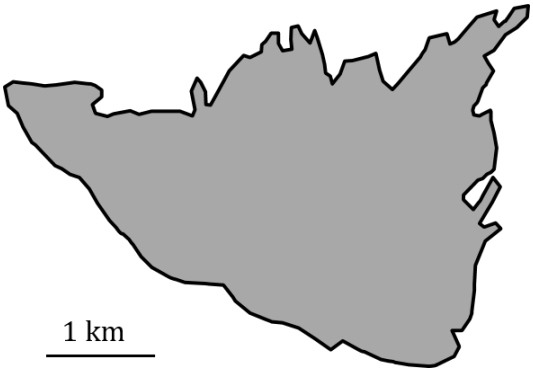
Activity 4

Use rectangles and triangles to estimate the area of these fires in hectares.

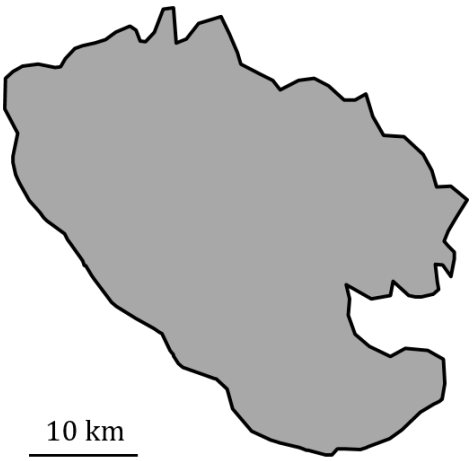
(a)



(b)



(c)

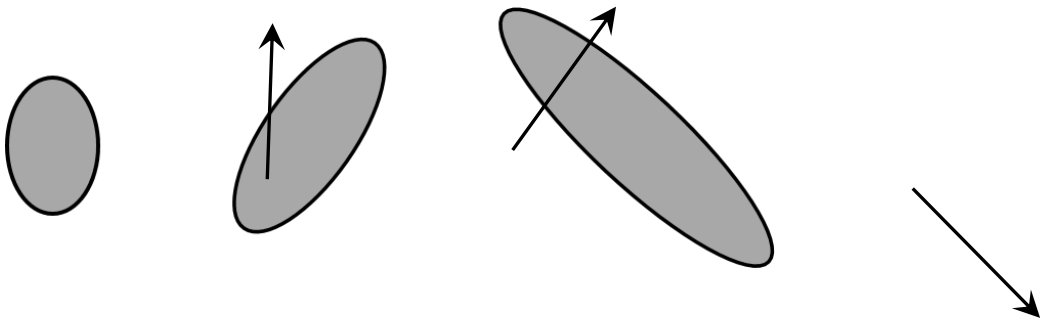


Sample answers

Activity 2

1.

(a) Note arrows could also point in the opposite direction.



(b) Fire (i) has the lowest wind speed

(c) Fire (iii) has the highest wind speed

(d) Fire (i) has length 2.1 cm and breadth 1.6 cm. Fire (ii) has length 3.9 cm and breadth 2.3 cm. Fire (iii) has length 5.5 cm and breadth 1.0 cm.

(e) (i) 1.3, (ii) 1.7, (iii) 5.5

2.

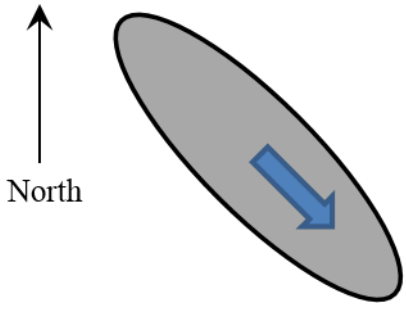
(a) 1.9

(b) 5.3

(c) 47.5 km/h

(d) (i) 10 km/h, (ii) 18 km/h, (iii) 46 km/h

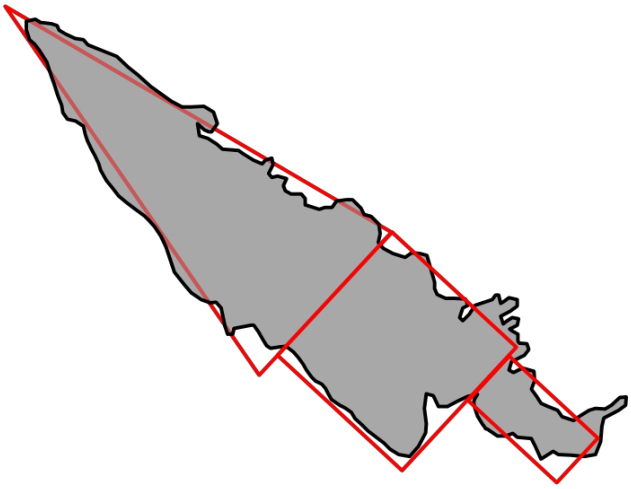
(e) 35 km/h wind corresponds to a length-to-breadth ratio of 3.4.



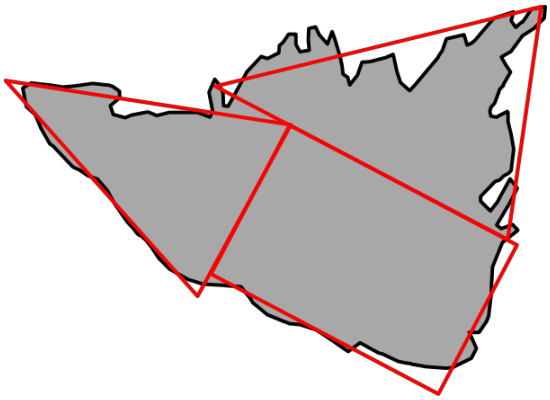
Activity 4

Requires reading the scale correctly and converting area to hectares.

(a)



(b)



(c)