How close, how far?

Safety focus: estimating distances, learning how to fly a drone safely.

Curriculum focus: estimating and measuring length, units of measurement.

This lesson provides an authentic context to develop skills of estimation and measuring length. It provides an opportunity for students to connect decimal representations to the metric system and convert from centimetres to metres, and metres to kilometres. It also provides a context to investigate and become familiar with non-metric units for length, such as feet.

Flying a drone draws on a person's spatial awareness and estimation skills related to distances, in particular 30 m and 120 m. Understanding no-fly zones and the need to be at least 5.5 km from these zones draws on map-reading skills and units of measurement.

Relevant CASA safety rules

Incorporate the following messages and rules.

- Rule 1 Stay low: fly to a maximum height of 120 m (400 ft).
- Rule 2 Don't be a space invader: stay at least 30 m away from others.
- Rule 7 No-fly zones: you must fly at least 5.5 km away from a controlled airport, which generally have a control tower.
- Rule 10 Fly away don't delay: you can fly within 5.5 km of a helipad, though if another aircraft is nearby you must land quickly and safely.

Possible curriculum links:

Year 5 Mathematics

Measurement and geometry: Using units of measurement

- Choose appropriate units of measurement for length, area, volume, capacity and mass (ACMMG108).

Year 6 Mathematics

Measurement and geometry: Using units of measurement

- Connect decimal representations to the metric system (ACMMG135).
- Convert between common metric units of length, mass and capacity (ACMMG136).

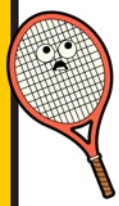
This context provides a relevant scenario in which to develop mathematical skills:

- estimating and measuring lengths with relevant measuring instruments and units
- comparison of length (for example 30 m is equivalent to the length of netball court, six large cars end to end, two buses end to end; 120 m is equivalent to a 35-storey building or 12 double-storey houses stacked one on top of the other)
- representing flying height with a bar model; describing distances to maximum flying height as a fraction and percentage of a particular flying height
- conversion between metric and non-metric units metres and feet
- convert between centimetres, metres and kilometres; recognising the equivalence of measurements such as 5.5 km and 5,500 m.

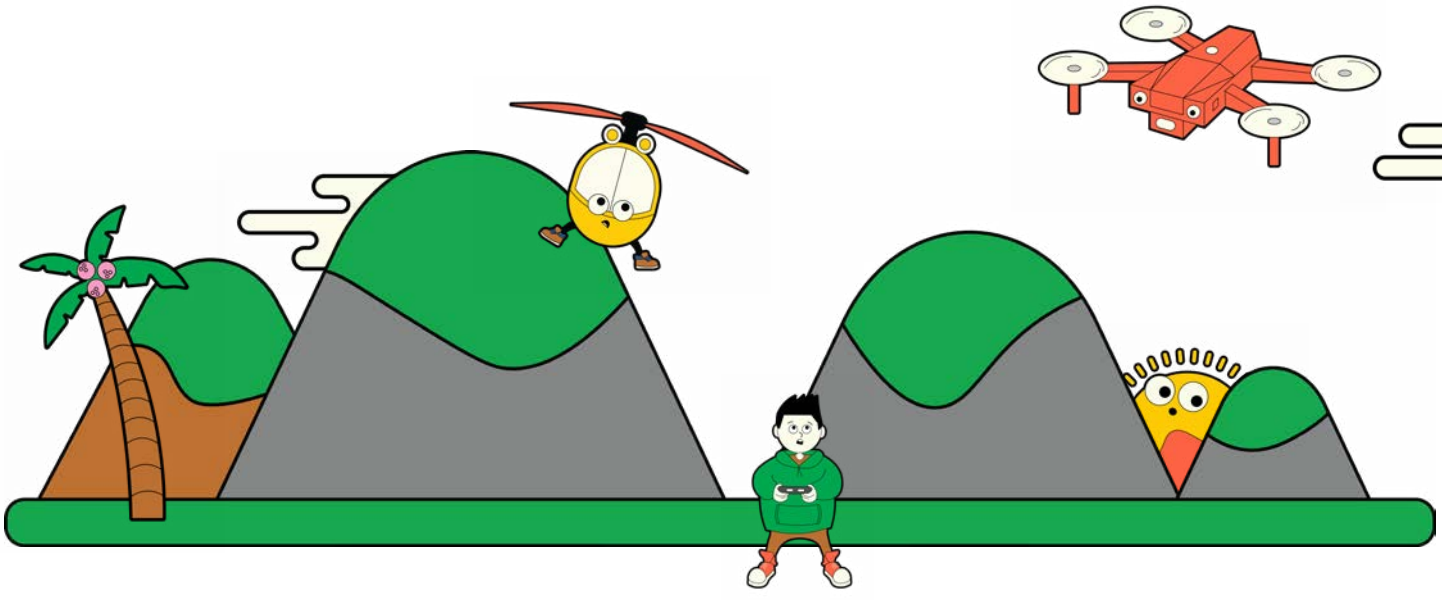
You must check the rules that apply before you fly a drone at school. For the latest requirements, visit: casa.gov.au/drones-at-school

Lesson outline

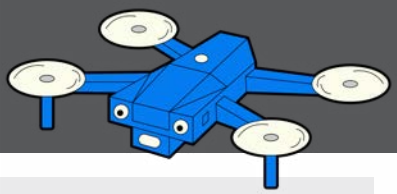
Learning phase	Task	Relevant rule
Tuning in: engage whole group	Have students share their experiences of flying a drone or seeing friends or other people flying a drone. Ask students if they are aware of any regulations about flying a drone. Gather students' responses to the questions? • How close to a person do you think you should fly? • How high are you permitted to fly? Use the CASA drone safety video or CASA rules to help explain that flying a drone requires you to make sure your drone stays at least 30 m from other people and that you are not permitted to fly it higher than 120 m. Ask: • How closely can you estimate 30 m from a particular position? • How closely can you estimate how high 120 m is above the ground? How would you work out these distances if you were flying a drone? Record students' ideas.	1, 2
Investigating: small-group activity	**Estimate and measure** Use a large open area for this task. Provide metre rulers and trundle wheels to measure distance efficiently in metres. • Estimate 30 m by walking that distance blindfolded (with a partner). Stop and measure estimated distance and compare to 30 m (repeat for 120 m). • Estimate a height of 120 m. How high above the school roof, how high above the tallest tree? Represent your ideas. • Convert 30 m to centimetres and kilometres. Do the same for 120 m. Ask students to explain why metres are an appropriate unit of measurement to use for these distances. • Provide students with the worksheet: How close, how far? As students estimate and measure, keep track of each student's progress and skills. Ensure students are using accurate measuring skills. Provide guidance where necessary. **Conversion** Ask students to come up with reasons for including a measurement of metres and feet in rule 1. • How many feet to a metre? • Represent 120 m in feet. • Convert 30 m to feet. Demonstrate and model how to convert metres into feet and vice versa. Provide students with a brief background to why aviation uses feet worldwide. **Teacher background:** Did you know? In the early years of aviation, American and British aircraft were most common, and as a result the imperial *foot* became standard for altitude measurement. However, other countries, such as China (PRC) and Russia, use *metres* for altitude measurement. The International Civil Aviation Organization specifies metres as the primary unit, with feet being an accepted non-SI alternative.	1, 2



Learning phase	Task	Relevant rule
Investigating: small-group activity	Comparison of length Now that students have estimated and measured 30 m and 120 m, they can find ways to describe that distance using local and familiar objects. • Ask students to come up with familiar objects to use as a comparison to visualise and represent 30 m (for example 30 m is equivalent to the length of netball court, six large cars end to end, or two buses end to end). • Explain that 120 m is equivalent to a 35-storey building or 12 double-storey houses stacked one on top of the other. Provide the height of a range of tall objects, for example a double-storey house (10 m), or a really tall tree (70 m), and have them figure out how much higher can you would need to fly to reach maximum height of 120 m? Students represent their ideas using the worksheet: How close, how far? Share their ideas with the whole class.	1, 2
Going further	Introduce estimation rules that develop an understanding of how to judge a distance of 5.5 km. • Estimate 5.5 km from school in any direction. Students represent their ideas using a sketch of a map. They can then check their estimation using a real map. • Convert 5.5 km to centimetres and metres. Students explain why kilometres are used in this rule as a unit of measurement.	7,10
Small-group activity	If you have drones, set up a safe area to fly the drones and estimate a distance of 30 m from the target. • If possible fly the drone no more than 120 m above the ground. • Use a drone safety app to plan a safe drone flying mission.	1, 2
Reflection	Ask students to rate their estimation skills when estimating length. Discuss the skills and knowledge that a person flying a drone needs to have in order to fly their drone safely.	



Worksheet: How close, how far?



When flying a drone you must always keep the drone 30 m from other people.

Let's see how good you are at estimating 30 m.

Work in pairs.

Estimate 30 m

1. Pick out an object, and then estimate a distance of 30 m from that object. Mark that point.
   Now measure the distance using a metre ruler or trundle wheel.
   My estimate was _____ m. This is a difference of _____ m (_____ cm)

2. Mark a starting point. Estimate 30 m walking blindfolded. Mark that point.
   Now measure the distance using a metre ruler or trundle wheel.
   My estimate was _____ m. This is a difference of _____ m (cm)

Estimate 120 m above the ground

When flying a drone you must fly to a maximum height of 120 m (400 ft).

3. Pick out an object, and then estimate a distance of 120 m from that object. Mark that point.
   Now measure the distance using a metre ruler or trundle wheel.
   My estimate was _____ m. This is a difference of _____ m (_____ cm)

4. How would you estimate 120 m above the ground? _____
   Think about the objects around you that you could use as a guide.

Equivalent to 30 m and 120 m

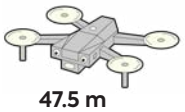
5. Choose an object describe the approximate distance of 30 m. _____
   For example, six cars end to end is equivalent to 30 m.

6. Choose an object describe the approximate distance of 120m above the ground. _____

How close to 30 m and 120 m

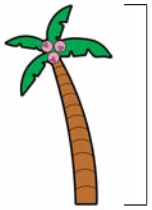
7. A drone is getting close to a person walking her dog. How much closer can the drone be before you need to steer away?

_____



47.5 m

8. A drone is at the height of this tree. How much higher can the drone be flown? _____



55 m

Non-metric units.

You may have noticed that 120 m is equivalent to 400 ft.

Some countries measure in different units called non-metric units.

9a. Match the conversions to the correct unit or equivalent measure.

a.	1 inch	1.	1.6 km	a +	☐
b.	12 inches	2.	2.54cm	b +	☐
c.	1 mile	3.	1 m	c +	☐
d.	3.28 feet	4.	1 foot	d +	☐

9b. What is longer, one mile or one kilometre? Explain your answer.

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9c. Convert 30 m to non-metric units. My answer is .....

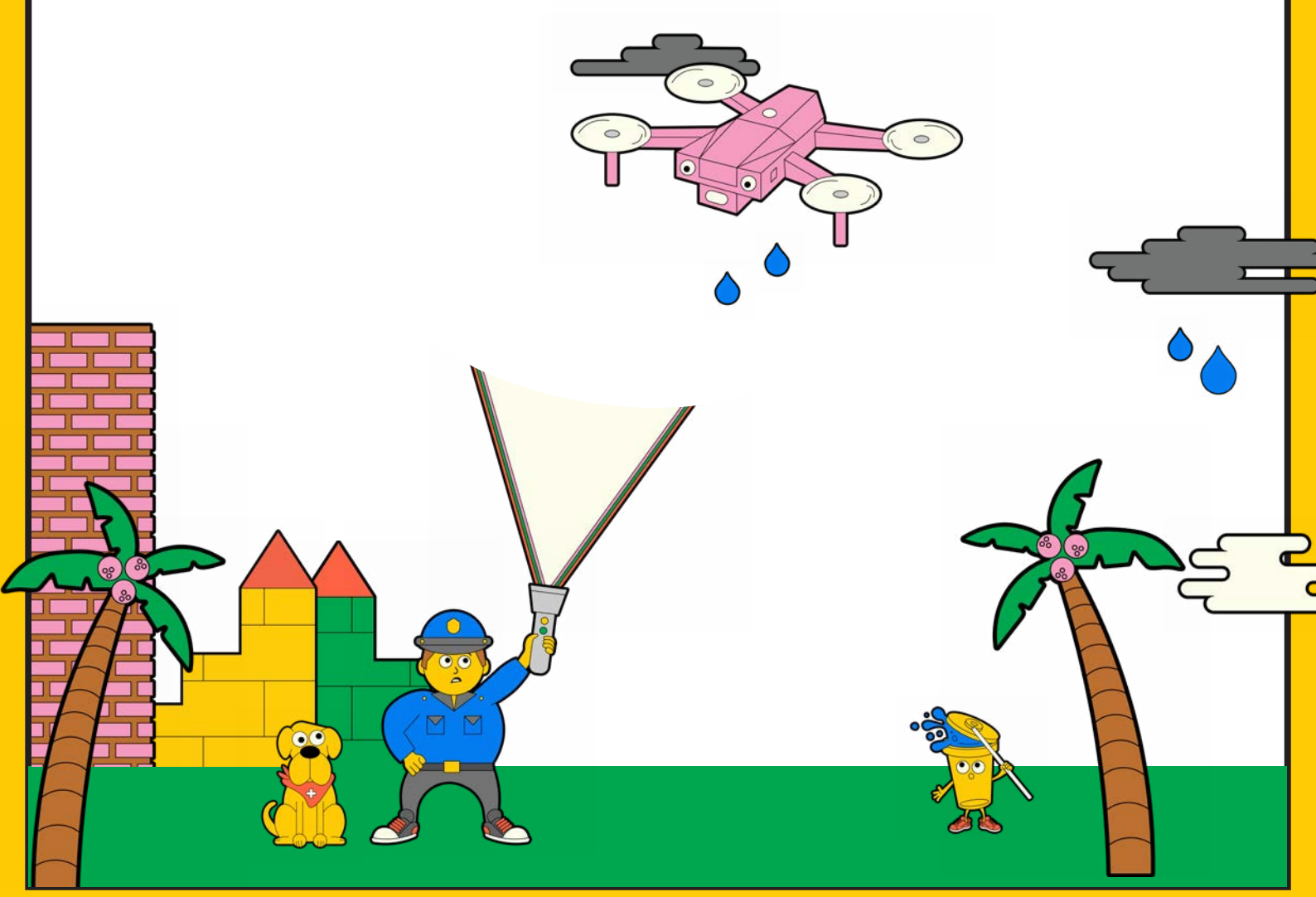
Explain how you worked this out. .....

Reflection and exit ticket

10. What did you learn about estimating and measuring length? .....

Write down 3 ideas.

1. .....
2. .....
3. .....



Notes