STEM 7: NAVIGATION
INSTRUCTIONS

WIND SPEED AND AIRSPEED

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A navigator needs to take account of wind to stay on course. In this activity you will build an anemometer and explore how wind speed , ground speed and airspeed are linked.

WHAT YOU'LL NEED

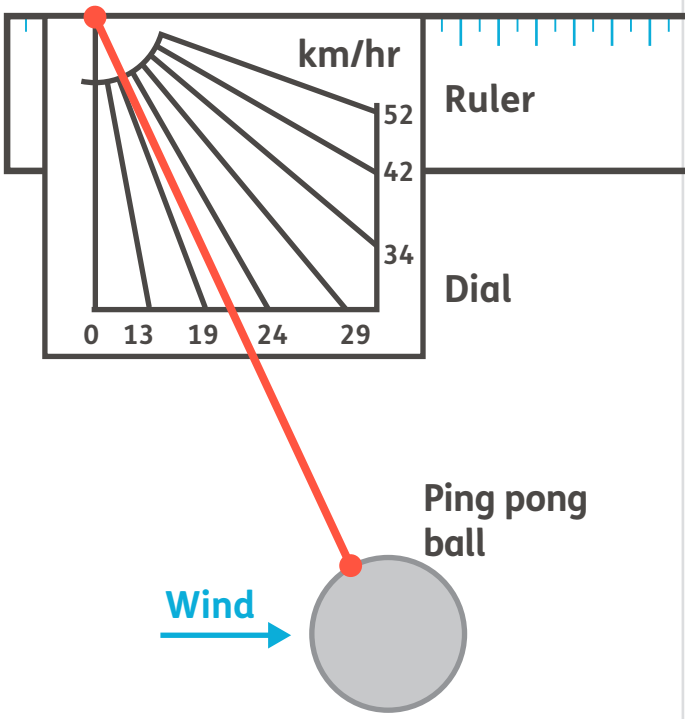
- A4 sheet of paper
- 30 cm ruler
- Protractor and ping pong ball
- Thread or thin string
- Scissors and sticky tape
- Clamp stand and boss
- Access to a fan or hair dryer (if available)
- Two drawing pins or map pins
- Thick cardboard or corkboard
- Copy of Navigation Chart

WIND SPEED

Wind speed is how fast air moves over the ground. It can be measured using an instrument called an anemometer and described using the Beaufort scale.

Wind speed	Beaufort number	Description
0-1 km/hr	0	Calm
2-5 km/hr	1	Light air
6-11 km/hr	2	Light breeze
12-19 km/hr	3	Gentle breeze
20-29 km/hr	4	Moderate breeze
30-39 km/hr	5	Fresh breeze
40-50 km/hr	6	Strong breeze
51-61 km/hr	7	Near gale
62-74 km/hr	8	Gale
75-87 km/hr	9	Strong gale
88-101 km/hr	10	Storm
102-117 km/hr	11	Violent storm
>117 km/hr	12	Hurricane

PING PONG BALL ANEMOMETER



WHAT YOU NEED TO DO

1. Build an anemometer.

a) The anemometer shown above is drawn to scale (half the actual size). A full size anemometer dial is 10cm x 9cm. Use a ruler, paper and protractor to make a full-size version of the dial.

b) Use tape to attach one end of a string to a ping pong ball and the other end to back of your dial.

c) Stick your dial to a 30cm ruler and clamp the ruler in position so that the string is vertical and points to zero.

d) Blow gently on the ping pong ball to measure the wind speed of your breath. If you have access to a hairdryer and/or fan measure their wind speeds as well.

WIND SPEED AND AIRSPEED

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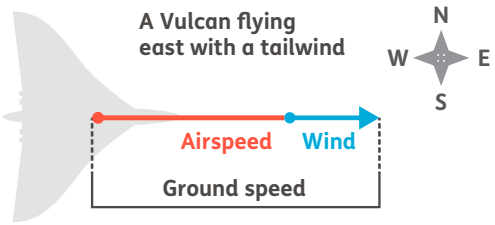
GROUND SPEED AND AIRSPEED

Ground speed is how fast an aircraft travels over the ground. Airspeed is how quickly an aircraft moves through the air. They are not always the same speed because of wind.



2. Plot your course and plan your mission

a) On your Navigation Chart draw a line connecting point A (Ascension Island) and F (the Falklands). Work out the angle measured clockwise from north. This is angle is your **course**. Write it in the table.

b) The airspeed arrow is 15 cm long and represents an airspeed of 750 km/hr. The smaller arrow is 2 cm long and represents the wind. It is drawn to the same scale. Work out the **wind speed** in km/hr. Write it in the table.

c) Cut out the airspeed and wind arrows and stick the Navigation Chart to a piece of cardboard or corkboard.

d) Use a drawing pin to connect the airspeed arrow to the Navigation Chart by putting the pin through point A on both the arrow and the chart.

e) Connect the wind and airspeed arrows together using a pin through point B on both arrows.

f) Your ground speed is represented by the distance between the tail of the airspeed arrow and the tip of the wind arrow. Make both arrows point towards the Falklands. This is a **tailwind**. Work out your **ground speed** and write it in the table.

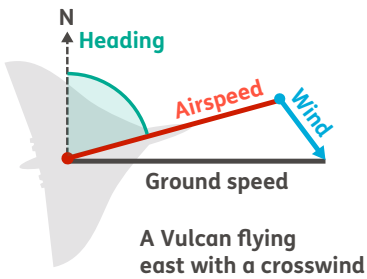
g) If your mission covers 6300 km how many long will your mission take? Record your **flight time** to the Falklands in the table.

h) Turn the wind arrow to point in the opposite direction. This is a **headwind**. Work out your new ground speed and flight time and write it in the table.

i) Which type of mission takes longer, one with a tailwind or one with a headwind? Which would require more fuel?

HEADING

Heading is the angle from north that the aircraft points. This is not always in the same direction as the aircraft travels.



CROSSWIND CHALLENGE

Can you accommodate for a westerly and easterly wind?

- Start by pointing the wind arrow due east. This represents a westerly wind (blowing from west to east). Work out the angle measured clockwise from north that the Vulcan must point to still arrive at the Falklands. This angle is your heading.
- What is the heading for an easterly wind?
- If your mission covers a distance of 6300 km how long will it take with a westerly wind? How long will it take with an easterly wind? Which would require more fuel?