Key Stage 4 Activity

Hula Hoop Challenge

How fast do hula hoops spin? Does the hula hoop spin at the same speed when spun around the arm, leg and waist? Set your pupils this challenge to find out.

Hula hooping instructions can be found on the mathcymru website.

Introduction:

- Ask your pupils to generate a suitable hypothesis statement for this challenge.
- Ask them to predict the result and explain why have they predicted this.

What you will need:

- Hula hoop
- Coloured sticky tape
- Stop watch
- Tape measure

What to do:

- How will you ensure that the results from this challenge will be valid and reliable?
- Measure the diameter of the hula hoop in centimetres.
- Calculate the circumference of the hoop using the formula: circumference = ΠD.
- Attach a small strip of coloured sticky tape to the hoop. This will act as a marker for counting the spins.
- Reset the stopwatch to zero.
- Each pupil should spin the hula hoop around their waist.
- Count the number of spins each pupil produces. One spin is measured by the marker on the hoop returning to its start position. For ease of counting, it is recommended that at the start of each attempt the marker is positioned at the front of the hoop.
- Stop the stopwatch when the hula hoop stops moving.
- Record the number of spins to the nearest ¼ of a spin.
- Calculate the total distance the hula hoop travelled. This is found by multiplying the circumference of the hula hoop by number of spins. For example, if the circumference of the hoop is 3.5 metres and the hoop completed 4.5 turns, the total distance travelled is 3.5 x 4.5 = 15.75 metres.
- Calculate the speed of the hula hoop using the formula: speed (metres per second) = distance (in metres) ÷ time (in seconds).
- Repeat this, spinning the hoop around the arm instead of the waist.
- Repeat this, spinning the hoop around the leg instead of the arm.
- Record the results in a table.
- Calculate the average speed for each of the body parts: waist, arm, leg.
- Present your results in a bar chart. Remember to correctly label the x and y axes and give your graph a suitable title.
- What does the bar chart show?
- Were your predictions correct?
- Can you explain your results? Do they suppport the original hypothesis?
- Outline how you would carry out a follow-up study for this investigation.

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Extension Activity 1: Giant Hula Hoop

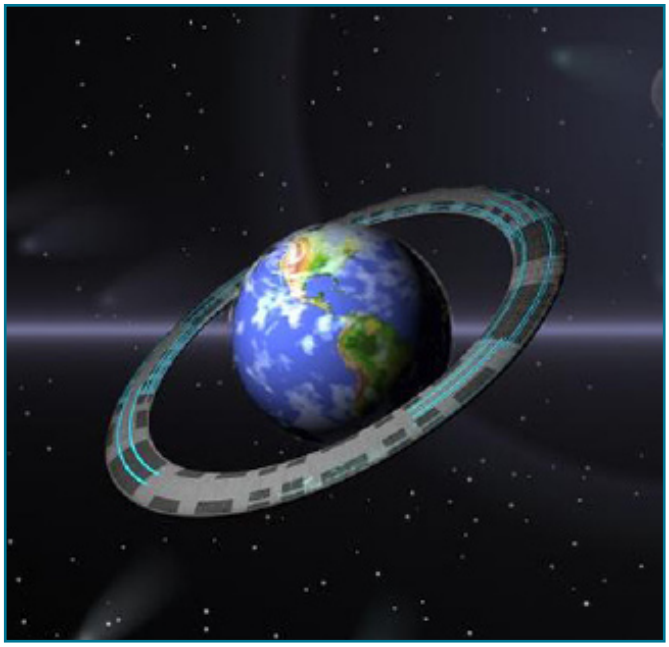
According to the hula hooping instructions, the ideal size hula hoop should have a diameter that is somewhere between your chest and waist. This is approximately two-thirds of your height.

Imagine you were to hula hoop with a hoop with the same circumference as the Earth.

What to do:

- Find out what the diameter of this hoop would be, using the formula: circumference = πD. Use the circumference of the planet around the equator.
- How tall would you have to be to use this size hula hoop successfully?
- Now use the circumference from pole to pole to calculate the diameter.
- How tall would you have to be to use a hoop of this diameter?
- Is it a different height than using the measurement around the equator? Why is this?
- Repeat this using the circumference of the moon.

[image source: www.lifeboat.com]



Extension Activity 2: Orbits

You can use the same formula for calculating the speed of your hula hoops for calculating the speeds the planets are travelling around the Sun. For this activity, assume the planets travel in a circular orbit around the Sun.

What to do:

- Select a planet from the table opposite.
- Calculate the distance (in km) of one complete orbit for the planet. To do this, use the formula: circumference = 2πr, where r is the planet's distance from the Sun.
- Calculate the time in seconds the planet takes to orbit the Sun. You will need to convert the time in the table from days or years.
- Calculate the speed the planet travels using the formula: speed (in km per second) = distance (km) ÷ time (seconds).
- Now calculate the speeds of the other planets.
- Present the results in a scattergraph, plotting distance from the Sun against planet speed. Draw a line of best fit.
- Is there a relationship between these two sets of data?
- Give one problem with assuming the planets travel in a circular orbit.

Planet	Distance from Sun (in km)	Length of Orbit
Mercury	57,910,000	88 days
Venus	108,000,000	225 days
Earth	190,000,000	365.26 days
Mars	228,000,000	687 days
Jupiter	778,000,000	11.9 years
Saturn	1,427,000,000	29.45 years
Uranus	2,869,000,000	84.01 years
Neptune	4,497,000,000	164.79 years

Answers for this activity can be found overleaf.

Key Stage 4 Activity

Curriculum Links for Challenge and Extension Activities

Skills

Solve mathematical problems

Pupils should be given opportunities to:

- Select, organise and use the mathematics and resources needed to solve problems of increasing complexity.
- Identify what further information or data may be required in order to pursue a particular line of enquiry; formulate questions and identify sources of information.
- Develop and use their own mathematical strategies and ideas creatively and consider those of others.
- Use a range of mental, written and calculator computational strategies.
- Develop their skills of estimating and measuring; recognise limitations on the accuracy of data and measurement, leading to awareness of the upper and lower bounds of numerical solutions; select an appropriate degree of accuracy.

Communicate mathematically

Pupils should be given opportunities to:

- Use a wide range of mathematical language, notation, symbols, and conventions, to explain their work, communicate findings and express mathematical ideas unambiguously.
- Generalise, explain patterns and relationships and express functions in words and symbolically.
- Read mathematical data in a range of forms.
- Explain strategies, methods, choices, conclusions and reasoning in a variety of ways.

Reason mathematically

Pupils should be given opportunities to:

- Justify how they arrived at a conclusion to a problem; give solutions in the context of the problem; confirm that the results are of the right order of magnitude.
- Interpret and use algebraic relationships and functions; predict patterns or subsequent terms in sequence.
- Evaluate results by relating them to the initial problem; develop an understanding of the reliability of results; recognise that inferences drawn from data analysis may suggest the need for further investigation.

Range

Number

Pupils should be given opportunities to:

- Use place value in whole numbers and decimals in computation and metric measurement.
- Calculate with whole numbers, negative numbers, decimals, fractions, percentages and ratios, understanding the effects of the operations.

Measures and money

Pupils should be given opportunities to:

- Extend their understanding of the nature of measurement, including the difference between discrete and continuous measures.
- Make sensible estimates of length, mass, capacity and time in everyday situations, extending to less familiar contexts.

Algebra

Pupils should be given opportunities to:

- Extend their knowledge of number operations and relationships to develop the ideas of algebra; appreciate the use of letters to represent variables or unknowns.
- Experience ways in which algebra can be used to model real-life situations and solve problems.

Handling data

Pupils should be given opportunities to:

- Specify the problem clearly, plan and collect data appropriately in order to follow lines of enquiry or to test hypotheses.
- Develop an understanding of bias and reliability.
- Calculate or estimate values of the mode, median, mean, range and inter-quartile range of discrete, grouped and continuous data.
- Compare sets of data and their distributions, using appropriate methods, including those that involve describing central tendency, dispersion and correlation.

Extension Activity 2: Answers

Mercury:	47km/sec	Venus:	35km/sec	Earth:	30km/sec	Mars:	24km/sec
Jupiter:	13km/sec	Saturn:	10km/sec	Uranus:	7km/sec	Neptune:	5km/sec