Giving students choice

in Units 1&2 Physics

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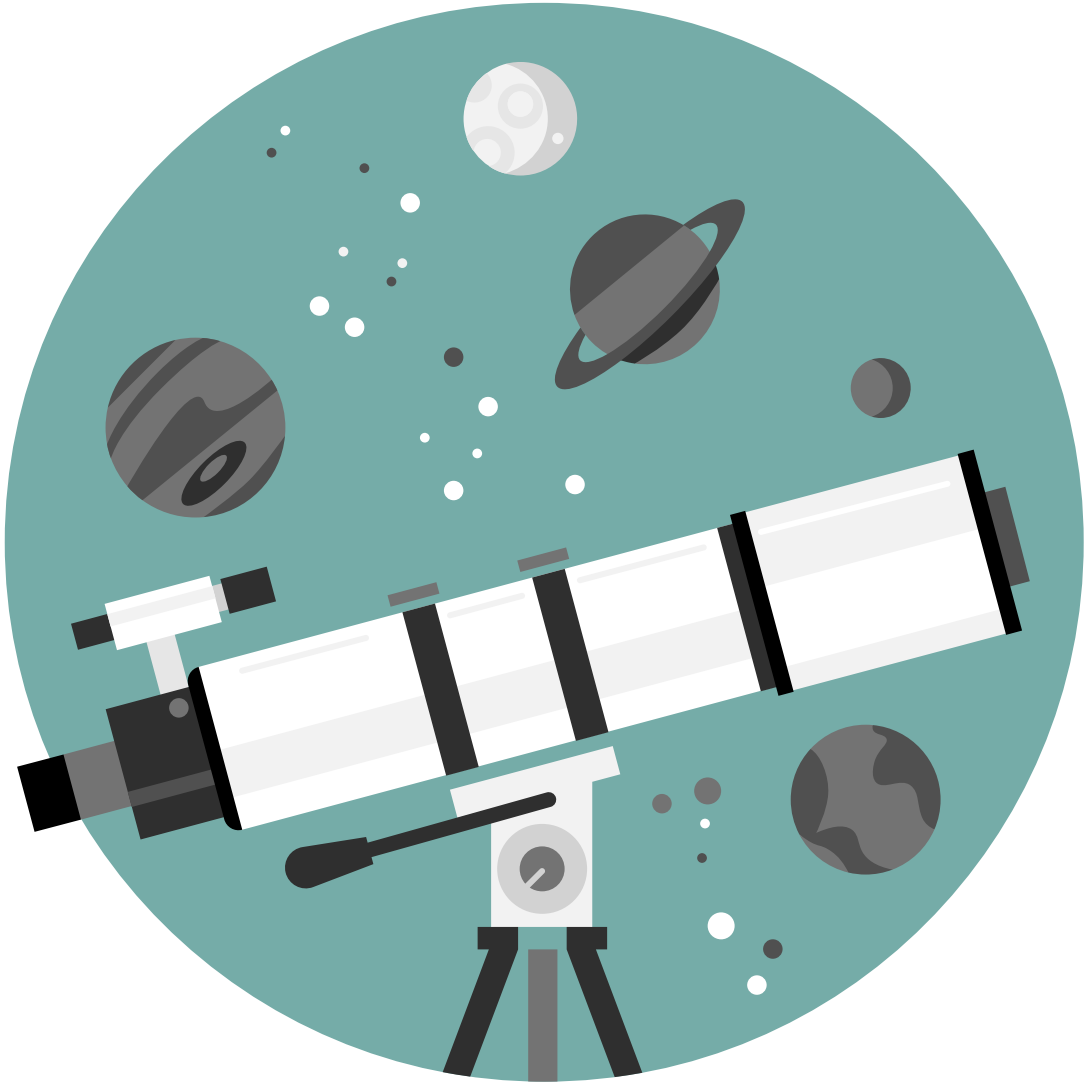
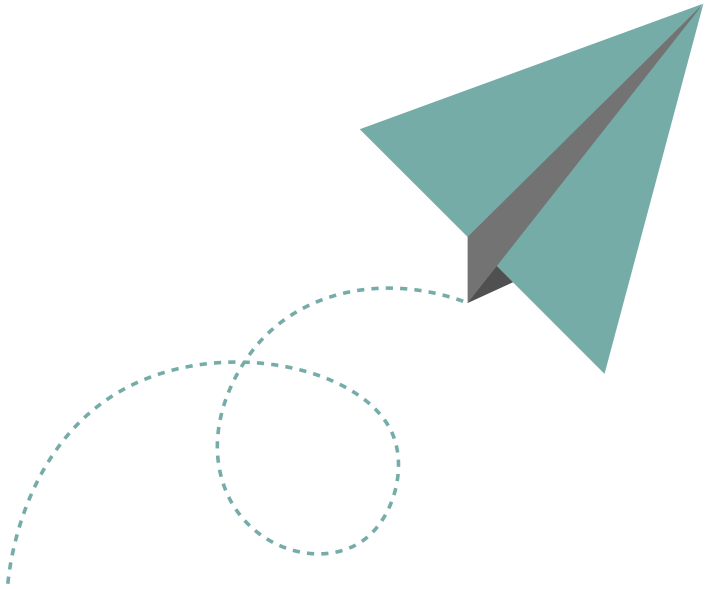
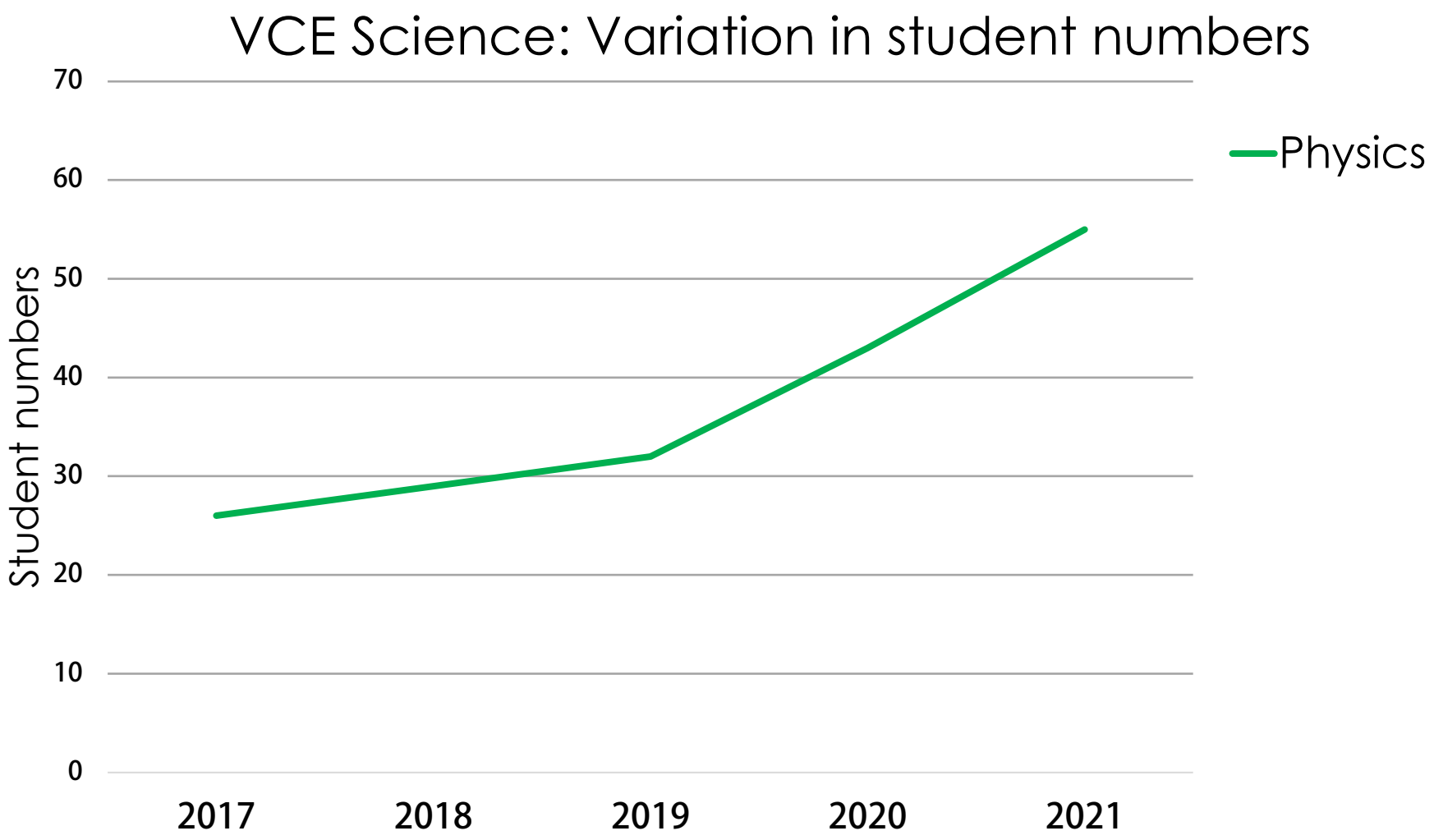


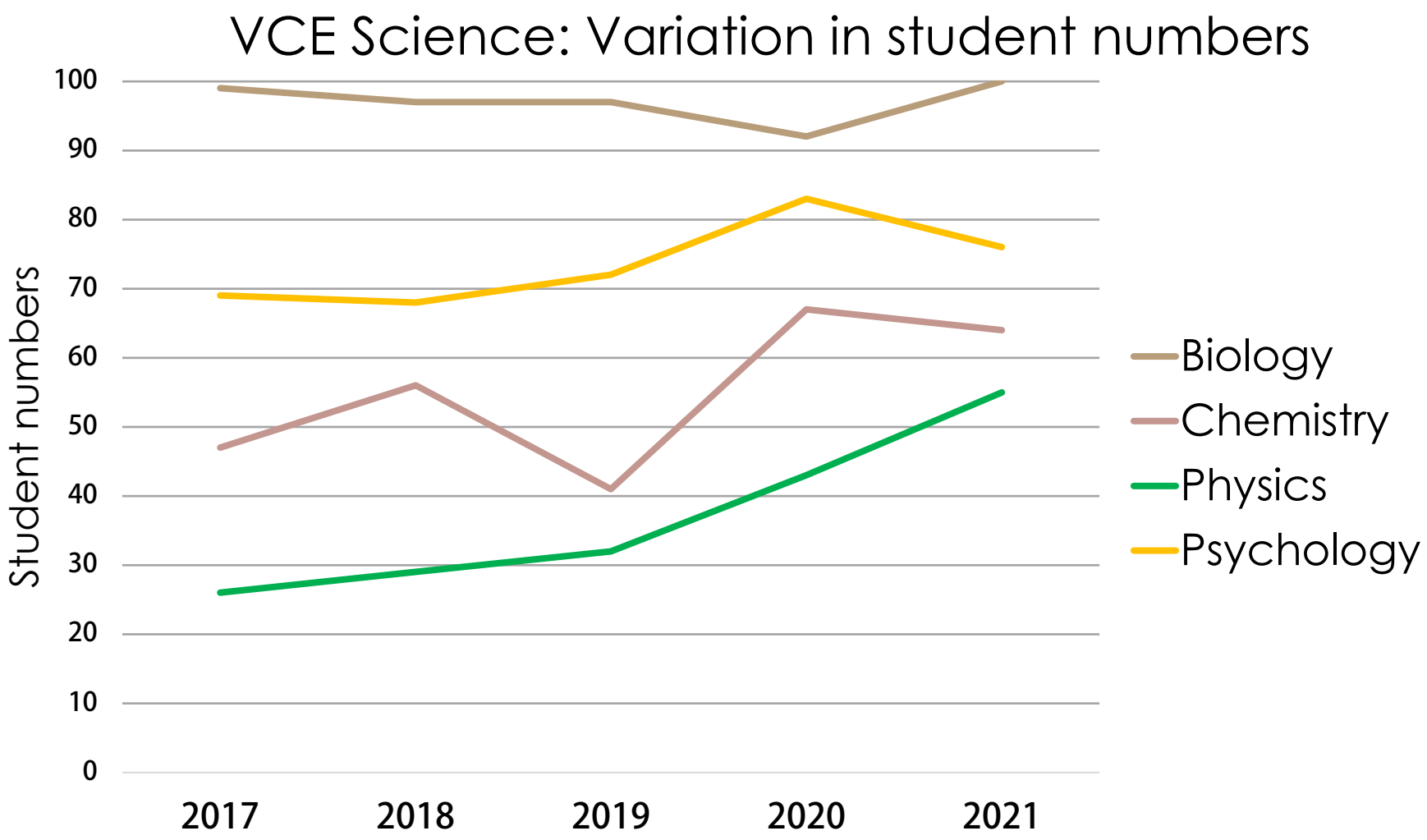
Outcomes

students are more motivated to learn when they are given choice



- Better retention between Year 11 & 12 Physics
- Students more engaged in learning – higher quality work
- Greater motivation and passion for subject.
- Greater uptake of Year 11 Physics with higher numbers of girls.


VCE Science: Variation in student numbers
Student numbers
70
60
50
40
30
20
10
0
2017
2018
2019
2020
2021
Physics


VCE Science: Variation in student numbers
Student numbers
100
90
80
70
60
50
40
30
20
10
0
2017
2018
2019
2020
2021
Biology
Chemistry
Physics
Psychology

SCHOOLS

Seven principles for a gender-inclusive learning environment

Using these principles, you can design lessons that will engage not only girls, but all your students in STEM.

Reference

- Ensure everyone gets hands on
- Learning experiences embrace context and problem solving
- Engineer collaborative learning
- Provide choice and creative opportunities to demonstrate understanding

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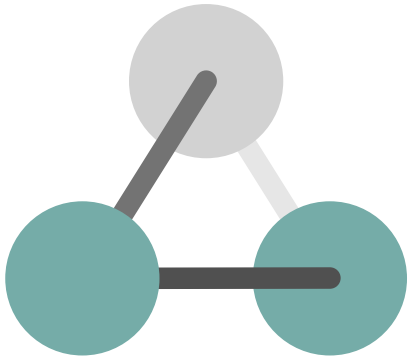
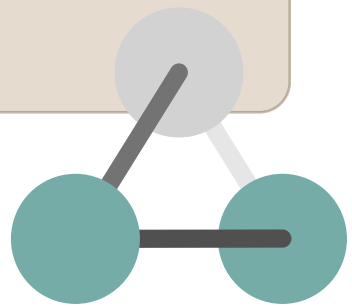
Examples



- Unit 1 AOS1 Coke Can Cooling Competition
- Unit 1 AOS2 Transducer Investigation
- Unit 1 AOS3 Particle physics
- Unit 2 AOS1 Motion – Mousetrap Car
- Unit 2 AOS2 Options
- Unit 2 AOS3 Practical Investigation



Unit 1 AOS2 Transducer Assignment

Task Objective

- To investigate how transducers work and explain how it is used in a household appliance.
- Students choose to investigate either a thermistor, a light dependent resistor or a potentiometer and then select an appliance to study.

Task Timeline

Lesson 1: Section A Voltage divider experiment

Lesson 2: Section B Transducer experiment

Lesson 3: Section C Transducers in home appliances; complete on A3 sheet

Relevant Key Knowledge Descriptors

- apply the kilowatt-hour (kW h) as a unit of energy.
- calculate and analyse the effective resistance of circuits comprising parallel and series resistance and voltage dividers
- investigate and apply theoretically and practically concepts of current, resistance, potential difference (voltage drop) and power to the operation of electronic circuits comprising resistors, light bulbs, diodes, thermistors, light dependent resistors (LDRs), light-emitting diodes (LEDs) and potentiometers (quantitative analysis restricted to use of VIR= and PVI=)
- investigate practically the operation of simple circuits containing resistors, variable resistors, diodes and other non-ohmic devices
- describe energy transfers and transformations with reference to transducers.
- model household electricity connections as a simple circuit comprising fuses, switches, circuit breakers, loads and earth
- compare the operation of safety devices including fuses, circuit breakers and residual current devices (RCDs)
- describe the causes, effects and treatment of electric shock in homes and identify the approximate

Relevant Key Science Skills

- conduct experiments; design-build-test-evaluate a device; explore operation of a device
- apply relevant occupational health and safety guidelines while undertaking practical investigations
- work independently and collaboratively as appropriate and within identified research constraints
- systematically generate, collect, record and summarise both qualitative and quantitative data
- process quantitative data using appropriate mathematical relationships, units and number of significant figures

Section A - Voltage divider experiment

Introduction

In this experiment, you will make a voltage divider. A voltage divider is used to reduce a voltage to a value needed for a part of the circuit. Voltage dividers are used to control many appliances, such as turning on heating in a home when the temperature drops.

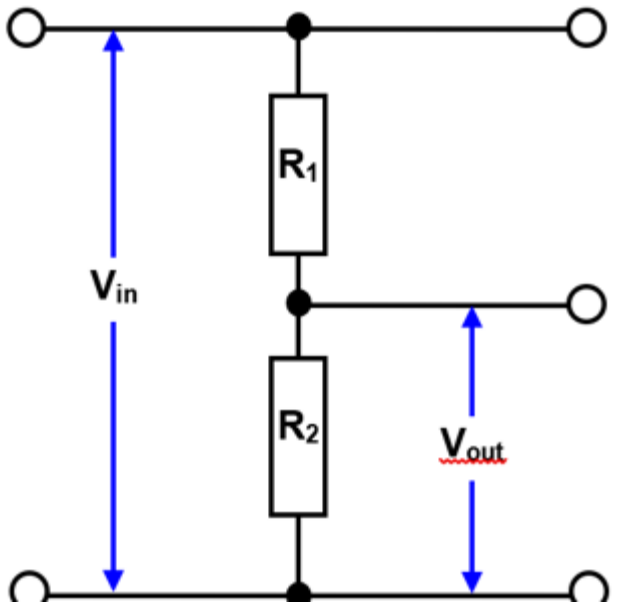
Materials

• power supply • multimeter • connecting wires	• 10 kΩ resistor • 33 kΩ resistor • 100 kΩ resistor

Procedure

**Remember to turn off the power supply when you are rewiring the circuit.

1. Use the multimeter to measure the resistance of R_1 and R_2 where R_1 = 10 kΩ and R_2 = 33 kΩ. Remember that you need to measure the resistance without any power going through the resistor.]
2. Set up the circuit shown in the diagram on the right.
3. Set the power supply to 6 V. Use the voltmeter to measure the emf of the power supply. This is V_{in}. Record the voltage into Table 1.
4. Now measure V_{out}. Record the voltage into Table 1.
5. Now calculate the theoretical V_{out} by the using the following formula: $V_{out} = \frac{R_2 V_{in}}{R_1 + R_2}$
6. Now replace R_2 with a 100 kΩ resistor and repeat steps 1 – 5.



Section B: Transducer experiments

Instructions

1. Choose from one of the following transducers.
    - Thermistor
    - Light dependent resistor
    - Potentiometer
2. Complete the relevant experiment.

Note: You only need to complete **ONE** experiment

- Thermistor experiment
- Light Dependent resistor experiment
- Potentiometer experiment

Thermistor Experiment

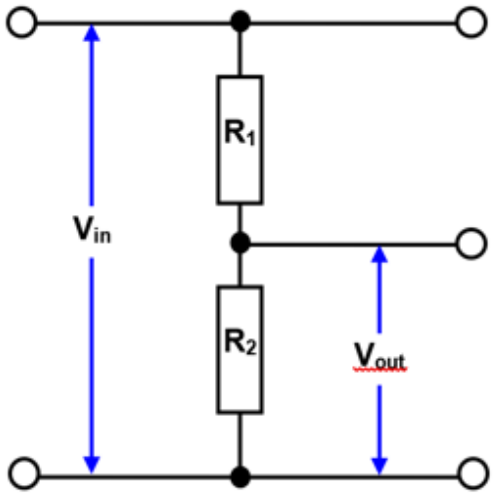
A thermistor is a transducer that converts thermal energy to electrical energy. A thermistor is a variable resistor as its resistance is reduced by heating. Thermistors are used in temperature sensors and temperature control.

Materials

- digital thermometer
- hot water
- 1 x 100 mL beaker
- thermistor
- power supply
- connecting wires
- multimeter
- 10 kΩ resistor

Procedure

1. Add hot water to a 100 mL beaker and use the digital thermometer to measure the temperature. Hold the digital thermometer between your fingers and record the temperature. Finally, measure the temperature of the room. Record your results in Table 2.
2. Immerse the thermistor in the hot water and use the multimeter to measure the resistance. Then hold the thermistor between your fingers and measure the resistance. Finally record the resistance of the thermistor at room temperature.
3. Now set up the circuit shown in the diagram on the right where R_1 is a 10 kΩ resistor and R_2 is the thermistor. Set the power supply to 6 V.
4. Immerse the thermistor in the hot water and record V_{out}. **Do not let the terminals of the thermistor touch as this will result in a short circuit.
5. Now hold the thermistor between your fingers and record V_{out}.
6. Finally, measure V_{out} when the thermistor is at room temperature.



Section C: Transducers in home appliances

Write a report on the how the transducer that you have selected is used in a home appliance. Insert your answers into the A3 grid.

On the A3 grid you will:

a) Select an application of where the component is used and explain how it is important in its operation.

Thermistor

Resources: NTC Thermistor

Example applications

- Central heating system
- Air conditioner
- Washing machine
- Fridge

Section C: A3 grid Transducers in home appliances **Name:**_____ **Partners Name:**_____ **Type of transducer:**_____

a) Select an application of where the transducer is used and explain how it is important in its operation.

applies understanding of how transducer functions in appliance
describes how transducer functions
identifies purpose of transducer in appliance
gives definition of transducer
Transducer in appliance

b) Model _____

i) Identify the power consumption (Watts) of the appliance and explain what the 'power consumption' means.

explains 'power consumption'
gives value of power consumption
identifies model of appliance
power consumption

bii) Calculate how much energy the appliance would use during one year of operation in the home.

- How many hours per week does the appliance operate?
- How many hours per year?
- Now calculate energy in kWh per annum.
- Explain energy used in kWh per annum.
- Is this appliance a high energy device compared to other appliances in the home? Explain your answer.

Compares appliances in the home
Explains energy kWh per annum
Calculates answer with units
Energy use

iii) Calculate the running cost of the appliance per year if the consumer is charged at a rate of 16.381 cents per kilowatt – hour.

- Explain what running cost per annum means.
- Describe how families could reduce the running costs of using this appliance.

Devises energy saving strategies
Explains running cost per annum
calculates answer and units
Running cost

iv) Explain how the safety devices used in the home reduce the risk of electrocution or household fires.(p94-97 textbook)

- Define Fuse
- Describe how fuse works
- Define Circuit breaker
- Describe how circuit breaker works
- Define Earthing
- Describe how earthing works
- Define Residual current device
- Describe how a residual current device works

links findings to electric shocks in homes and danger thresholds for current and duration
evaluates which safety devices most effective at saving lives
describes how safety devices operate
gives definition of devices
Safety devices

Evaluate which safety device is most effective at saving lives. Explain your answer in terms of effects of electric shock.

		applies understanding of transducer function in appliance				links findings to electric shocks in homes and danger thresholds
	compares experimental Vin with theoretical Vout	describes how transducer functions	explains 'power consumption'	explains energy kWh	explains energy cost	categorises effectiveness of safety devices
follows safety precautions	explains relationship between Vout and Vin	identifies purpose of transducer in appliance	gives value of power consumption	calculates correct answer and units	calculates correct answer and units	describes how safety devices operate
identifies risk	identifies how resistance of transducer changed with input	gives definition of transducer	identifies model of appliance	write out formula	write out formula	gives definition of devices
Analyses risk	**Compares Vin with Vout**	**Transducer in appliance**	**Power consumption**	**Energy use**	**Running cost**	**Safety devices**
A - Voltage divider experiment	B - Transducer experiment	C - A3 Sheet Transducers in the home	C - A3 Sheet Transducers in the home	C - A3 Sheet Transducers in the home	C - A3 Sheet Transducers in the home	C - A3 Sheet Transducers in the home

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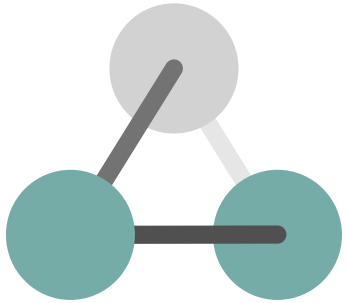


Unit 2 AOS2 Options

Task Objective

- Students were asked to take on the role of the teacher
- Develop resources which could be used in a primary school class.
- Submissions were highlighted during Family Science Night

Twelve options are available for selection in Area of Study 2. Each option is based on a different observation of the physical world. Each of the below links will direct you to the relevant MyAitken page.

One option is to be selected per group from the following:

- What are stars?
- Is there life beyond Earth's Solar System?
- How do forces act on the human body?
- How can AC electricity charge a DC device?
- How do heavy things fly?
- How do fusion and fission compare as viable nuclear energy power sources?
- How is radiation used to maintain human health?
- How do particle accelerators work?
- How can human vision be enhanced?
- How do instruments make music?
- How can performance in ball sports be improved?
- How does the human body use electricity?

How can performance in ball sports be improved?

In this option students investigate the physics of ball sports using mechanics concepts including Newton's laws of motion. Students observe and analyse motion in one and two dimensions, study associated collisions and explore the factors that maximise the projection of the ball in various sports. Students may explore ideas in a selected sport of interest or may choose a range of ball sports to investigate.

On completion of this unit the student should be able to apply concepts of linear, rotational and fluid mechanics to explain movement in ball sports.

Key knowledge

Set 1 - Motion of sports balls

- investigate and calculate theoretically and practically the transfer of momentum in elastic and inelastic collisions (limited to two dimensions) including the use of the coefficient of restitution, e
- investigate and apply theoretically and practically the coefficients of static and kinetic friction to sliding and rolling balls to calculate speeds using Newton's laws of motion and the equations of constant acceleration

Research Grid

Students have had exposure to the research grid through earlier years as they have progressed through Science.

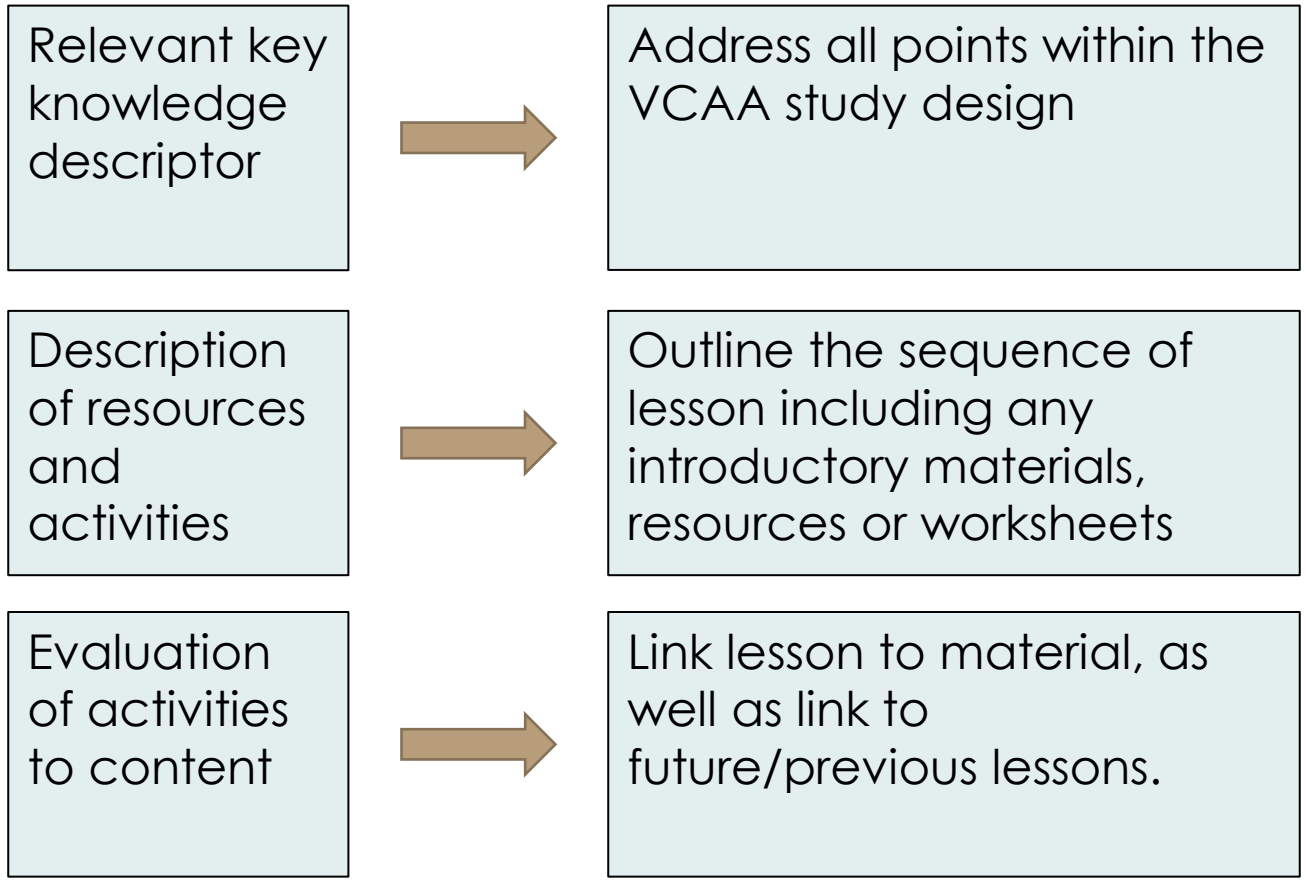
Strong responses showed links between concepts within their own subset as well as links back to the overarching theme.

Source • Use Harvard style. • Bibliography Generator on MyAitken/Library Resources. • Include intext citations in brackets. • Click here for information on how to reference sources	**P/S/T** P- primary S- secondary T- tertiary	**S/NS** scientific or non- scientific	**List the questions you are researching** (Use highlighting to make links between the question and the information)	**Evaluate validity** Provide an explanation of whether the evidence is valid. i. What are the author's credentials ii. Is the author affiliated with a recognized research institution? iii. What is the publication date? iv. Is there any bias? v. Examine evidence (Has the content been peer-reviewed or edited by a publisher?)
NASA, 'What is Lift?', 2015, accessed 1 September 2020, https://www.grc.nasa.gov/WWW/K-12/airplane/lift1.html	**T**	**scientific**	What are the forces of lift? • Lift is a type of force which opposes the weight of the aircraft to allow it to be held in the air. Lift is generated by the wings of the aircraft. • The lift force is a vector as it has a vector and magnitude • Lift is generated when the movement of flowing gas is being turned by a solid object, this causes the flow to be turned in one direction and then the lift is generated in the opposite direction. This is supported by Newton's thirds law "for every action there is an equal and opposite reaction" • If there was no fluid-which is a gas or liquid- then there is no lift generated • No fluid = no lift • Lift is also generated by difference in velocity-speed of an object in a given direction-between the solid object and the fluid, it is detrimental for motion to be present in between the fluid and object because lift acts perpendicular to motion	• This source is a reliable source as NASA is an independent agency of the United States federal government, it is responsible for aeronautics and aerospace research. • Although there are no author credentials, it is expected that th information is extremely reliable as it is affiliated with a large and recognised research institution. • The information has been peer reviewed and edited by Nancy Hall, who is a research scientist and aerospace engineer at NASA and has a master's of science degree in mechanical engineering with emphasis on fluid mechanics. • This source was last updated May 2015, so there could be mor recent findings and information that could be more reliable. • This source is deemed unbiased as it doesn't provide any opinions or thoughts that could make the information 'better' or 'worse.'

Lesson Plan

The lesson plan was designed so that a primary school teacher could pick up any series of lessons and use it in their classroom.

Students were asked to create simple activities which could demonstrate their concepts.



Relevant key knowledge descriptor	*Description of resources and activities*	***Evaluate and link activities and resources to content*** 1. Evaluate the relevance of the activity or resources to the overall aim of the lesson. 2. Identify the links between the content covered in the lesson and how the activity or resources supports the teaching of the content.
• Explain the changes in aerodynamic behaviour at supersonic speeds, including compressibility, shockwave formation and increase in drag • Explain the production of thrust with reference to Newton's laws of motion • Investigate how it is possible for an aircraft to generate lift when flying upside down	**Intro:** Content covered: -Production of thrust: -Go through notes on PowerPoint, use students to demonstrate Newton's third law **Class discussion:** -Working through diagrams on the shape of wings and eventually angle of attack to explore how planes can fly upside down **Class Activity** on shockwaves and supersonic flight Materials: -Containers of water -small model aircraft, or something that could sub in as an aircraft (could just use their hand if nothing else is available) Instructions: -Have students move the object through the water at different speeds **Class discussion**: -What happened to the waves created as the object's speed increased? -Was the object harder to move at higher speeds? -How does this apply to flight?	This lesson is the third of four lessons in the series investigating "how heavy things fly" and focuses on the generation of thrust, generation of lift when an aeroplane is upside down and changes to aerodynamic behaviour at supersonic speeds. A PowerPoint presentation (see attached) will be used to help explain the activities and concepts that will be covered in the lesson. To explain the production of thrust a number of dot points are written on the PowerPoint. A small demonstration including two students on chairs with wheels will be used to help explain Newton's third law (as stated in PowerPoint). This will give students a visual example of the law in action to aid their understanding. A second, similar demonstration will help to apply the law to the motion of an aircraft/generation of thrust as outlined on the PowerPoint. A series of diagrams are present in the PowerPoint to visually demonstrate how lift is formed, questions will be used to engage students in the lesson and lead them towards working out the content/theory on their own while being supported by the diagrams and teacher. This will help students to understand how it is possible for planes to fly upside down in certain conditions. The class activity with the water will help students understand how air behaves around an object travelling at supersonic speeds. It will give them a hands on experience of how the air may act, having the water as a substitute. Class discussion questions and notes on the PowerPoint after the activity will help them gain an understanding of compressibility, shockwaves and increase in drag at supersonic speeds by relating it back to what the felt/observed from the water in the activity.

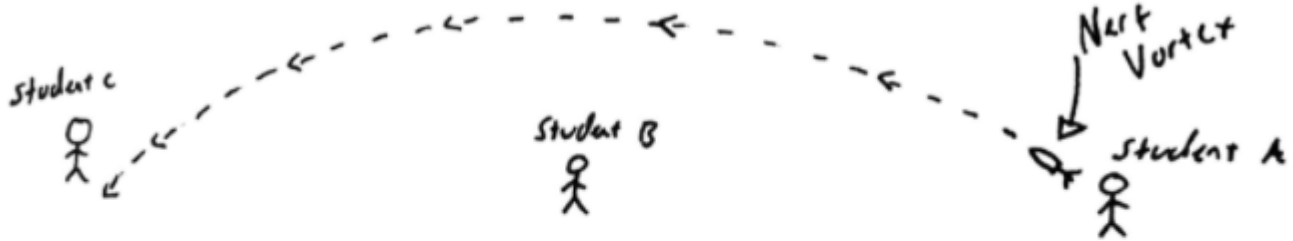
Is there life beyond Earth's Solar System?

Finding exoplanets

In P.E you may remember, or have recently used a Nerf Vortex. They make a cool whistling noise when thrown. Have you ever noticed though, that the whistle goes down in pitch, sounding lower the further it travels from you? Gather 2 of your peers and try this experiment!

Is there life beyond Earth's Solar System?

Finding exoplanets



In P.E you may remembe
when thrown. Have you
further it travels from yo

Read below after you are done.

Some of you may be in conflict with your peers, promising that you heard the complete opposite as them, or some of you may already know that in fact everyone's answer is correct. The concept you have just observed has been named 'The Doppler Effect'. The theory is that wavelengths expand the further something is from you. The easiest way to experiment this is through sound. Sound produces wavelengths, the more stretched they are, the lower the sound appears. Conversely, the shorter the wavelengths of sound are, the higher the sound appears. Scientists use The Doppler Effect for many things. In terms of astronomy, they use this method to find planets. By assessing changes in colour in stars. Yes, colour has wavelengths too, and can change depending on how far you are from it. But it is so small and immeasurable on Earth that you only see a difference when the distance is from earth to other stars.

Is there life beyond Earth's Solar System?

Spectral Shift

You are about to learn and practice your first ever method of finding a habitable planet. Scientists use this method to find the gases such as oxygen, hydrogen, helium on other planets. Can you find your first exoplanet?

ACTIVITY: Determine Which Planet is Habitable

Resources: Cellophane wrapping of colours red, green and blue -- to act as lens filters, and the image shown below.

Procedure: Use your red, green and blue filters to fill out the table provided to you by your teacher (eg. For the first planet, use a red filter and record what colour the planet appears now in the red column, then switch your filter to the green filter and record what colour that makes in the green column etc.). After you have collected all your data, use the table that has been attached below to check which series of colours mean it has oxygen in its atmosphere. If it contains oxygen, then it is habitable for us, find that planet!

Is there life beyond Earth's Solar System?

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Read below after you are done.

Now you have just learnt an important tool scientists use to find habitable planets! Though, they do not use cellophane wrapping. Instead they use special software's that calculate precisely what gas is present and how much of it is there. A very interesting factor to consider is that, just because there is no oxygen present in that planet, doesnt mean life can be present there. This is where it gets interesting: If there are a lot of gases varying gases present in a planet, there's a chance life exists there. Why is this? Well we've learnt from our own planet that we are not made up of just oxygen, we have so many different gases circulating our atmosphere. This is caused by human activity primarily, and by bacteria that emits different gases. We classify bacteria as life too. If you re-look at your results in your table, maybe as an extra you might be able to find a planet that could potentially have aliens?

Giving students choice

in Units 1&2 Physics

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Unit 1&2 Physics resources:
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