

VCE Physics
Some Practical and Online Activities for Units 2 and 4

Unit 2 How can motion be described and explained?

	Practical Activity	Description	Type
1	Accelerated motion	Record position vs time of a glider on an inclined air track and generate displacement and velocity vs time graphs	Experiment
2	Complex motions	Use a motion detector to describe actions such as walking. Use video analysis to investigate movement in athletics.	Class exercise Experiment
3	Motion under gravity	Drop a quadratic string, a string with pendulum bobs at distances so that they hit the ground at equal time intervals. Drop 0.5kg and 5kg masses at same time on to foam. Use ultrasound motion detector to display the motion of a bouncing basketball.	Demonstrations
4	Reaction force	Use bathroom scales to investigate the reaction force when standing, leaning or in a lift.	Class exercise
5	Combining forces	Use a Forces table to show vector addition of forces and also components of forces Use a Newton's cart on front bench to show force components.	Class exercise Demonstration
6	Newton's 2 nd law	Record position vs time of a glider on a level air track accelerated by a falling mass. Investigate acceleration for a range of values of falling masses and total mass moved. Use a Newton's cart on front bench to investigate how acceleration depends on mass for a constant force.	Experiment Demonstration
7	Hooke's Law	Measure, graph and analyse the extension of a spring produced by various masses.	Experiment
8	Energy transfer and transformations	Measure drop and rebound height of a rubber ball. (GPE, efficiency, KE) Time 10 lifts of a 2.0 kg mass from shoulder level (GPE, Power) Time the run up a flight of stairs (GPE, Power) Measure time and distance of a loaded trolley rolling down a slope (GPE, KE) Time the drop of balls of different densities from roof height (GPE, KE, air resistance) * These can be done as a round robin of short activities	Experiment
9	Momentum in collisions	Measure speeds of air track gliders before and after impact to investigate conservation of momentum. Newton's Cradle	Class exercise Demonstration

Vicphysics Online Resources

Specific Topics

Kinematics:

Traffic lights simulation

Graphs applet

File of speed records

Motion with constant acceleration applet

Dynamics

Equilibrium of three forces – Walter Fendt

Addition of vectors – Walter Fendt

Video of hammer and feather falling on the moon

Physics of kung fu

PBS website on Galileo plus applets

Road safety links

Safety of four wheel drives

Physics of rollover crashes

Study of crash data

PBS website on car safety

Inclined plane applet – Walter Fendt

Pendulum applet – Walter Fendt

Newton's 2nd law of Motion – Walter Fendt

Unit 2 Option 2.1 : What are stars?**Unit 2 Option 2.2: Is there life beyond the Earth's Solar System?**

	Practical Activity	Description	Type
1	Solar observation	Observe changes in the sun, note safety concern.	Class exercise / homework
2	Spectral analysis	Observe spectral lines in chemical samples.	Experiment
3	Doppler shift	Show Doppler shift with sound by analogy.	Demonstration

Vicphysics Online Resources

Numerous websites and applets

Unit 2: Option 2.3 : How do forces act on the human body?

	Practical Activity	Description	Type
1	Centre of Mass	Determine the position of the centre of mass of various objects from hammers to humans by various methods	Experiment
2	Compression, tension and shear	Use a range of everyday objects to demonstrate effects of compression, tension and shear. Investigate how the behaviour of living tissue under load compares with common building materials, including wood and metals	Demonstration Experiment
3	Young's modulus	Stretch copper wire to fracture	Experiment

Unit 2 Option 2.4: How can AC electricity charge a DC device?

	Practical Activity	Description	Type
1	Use of a multimeter	Measure and compare AC and DC voltages of a power pack. Measure resistance of several resistors.	Experiment
2	Use of a CRO	Measure voltages of a battery. Measure AC voltages and compare with those of a multimeter.	Experiment
3	Properties of diodes	Measure the forward and reverse bias with simple circuit to give the voltage current characteristics of a diode.	Experiment
4	Rectifier	Use diodes to construct and use both a half wave and full wave rectifier.	Experiment
5	Capacitor	Investigate the charging and discharging of a capacitor, and its use in smoothing AC.	Experiment
6	Voltage regulators	Construct and use a circuit to demonstrate the characteristics of a voltage regulator.	Experiment
7	AC to DC power supply	Construct an AC to DC power supply, use meters and a CRO to diagnose faults, and once working, evaluate its performance, then investigate the effect on the ripple voltage of changing various parameters of the circuit.	Experiment

Unit 2 Option 2.5 : How do heavy things fly?

	Practical Activity	Description	Type
1	Measuring lift and drag	Use top loading balances to measure the lift and drag on an aerofoil.	Investigation
2	Bernoulli effect	Place a table tennis ball in an air stream from an air track hose.	Demonstration
3	Propeller thrust	Use a top loading balance to measure thrust from a propeller attached to a DC motor for different values of supply voltage	Investigation

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A few NASA websites

Unit 2 Option 2.8 : How to particle accelerators work?

	Practical Activity	Description	Type
1	Electrons in Electric and Magnetic Fields	Use a magnet to deflect an electron beam in a Maltese Cross tube, a paddle wheel tube, a deflection tube and a CRO.	Demonstration
2	Modelling Synchrotron radiation with a laser	Use a laser beam to produce diffraction patterns with fibres of different sizes, two dimensional meshes and gauzes and between two bolts.	Demonstration or class exercise
5	Two Dimensional Diffraction Effects with Microwave apparatus	Model X-ray diffraction through a crystal with microwave diffraction through an array of thumb tacks	Demonstration
6	Modelling X-ray interference in a crystal with microwaves	Model the interference of X-rays from different crystal layers with microwaves reflected from two rows of coins	Demonstration

Vicphysics Online Resources

Numerous websites and applets

Unit 2 Option 2.9: How can human vision be enhanced?

	Practical Activity	Description	Type
1	Introductory activity	A series of short exercises on the properties of light that can be done over about two periods, which can be used to generate a set of questions which the study of light will provide answers. See Vicphysics.org for activities and questions	Observation exercise
2	Reflection of Light in a plane mirror	Use a plane mirror to investigate the behaviour of light.	Experiment
3	Reflection of Light in a concave mirror	Use a concave mirror to investigate the behaviour of light.	Experiment
4	Refraction of Light	Use semicircular plastic dish and glass or perspex rectangular blocks to investigate Snell's law	Experiment
5	Refraction of Light in a convex lens	Use a convex lens to investigate the behaviour of light	Experiment
6	Refraction of light in the eye	Remove the optic nerve from a bull's eye, wrap the eye in clear wrap, then view the world from the back. Remove the lens, place on a glass slide and put over text	Demonstrations
7	Optical devices	Investigate the optical properties microscopes, telescopes and spectacles	Investigation

Unit 2 Option 2.10: How do instruments make music?

	Practical Activity	Description	Type
1	Types of waves	Use a slinky to demonstrate transverse and longitudinal waves.	Demonstration
2	Samples of sound waves	Use a signal generator and a loudspeaker to produce a range of frequencies and to illustrate human frequency response.	Demonstration
3	Speed of Sound	Use stop watches to measure speed of sound by echo method.	Class Exercise
4	Intensity & Intensity Level	Use a dB meter to measure a variety of sounds.	Class Exercise
5	Reflection of waves	Use a slinky to show reflection of transverse and longitudinal pulses at fixed and free ends.	Demonstration
6	Superposition of waves	Use a slinky to show the superposition of transverse pulses.	Demonstration
7	Standing waves in air	Observe nodes formed between a speaker and a reflections from a hard barrier. Alternative equipment: Sound machine	Demonstration
8	Standing waves in air	Observe sound in a large diameter long plastic tube over a Meeker burner	Demonstration
9	Standing waves in strings	Attach a weighted string to a ticker timer	Demonstration / experiment
10	Standing waves in springs	Use a slinky to show harmonics in stretched spring	Demonstration
11	Standing waves in blades	Vibrate together 3 hacksaw blades of different lengths	Demonstration
12	Standing waves in rods	Hit rod's end on while holding at a node	Demonstration
13	Standing waves in air	Observe resonance with tuning forks above a variable length air column.	Experiment
14	Standing waves in air	Blow into the adjustable wooden organ pipe	Demonstration
15	Harmonics	Conduct a frequency analysis of various instruments	Investigation
16	Beats	Use two frequency sources to produce beats and show on a CRO	Demonstration

Vicphysics Online Resources

Numerous websites and applets

Unit 2 Option 2.11: How can performance in ball sports be improved?

	Practical Activity	Description	Type
1	Coefficient of restitution	How does the coefficient of restitution vary with ball type, impact surface and speed of impact?	Investigation
2	Friction	Transition from sliding to rolling	Investigation
3	Double pendulum	Tracker analysis of a gold swing	Investigation
4	Drag	Tracker analysis of a falling object	Investigation
5	Magnus effect	Motion of a Magnus glider	Investigation

Vicphysics Online Resources

Numerous websites and applets

Experimental Investigations

The sporting impacts of a ball with a bat
The motion of a bungee jumper
The friction of running shoes
The performance of a parachute
The motion of weightlifting
The energy of magnetic collisions
The bounce of a basketball
The motion and energy transfer of a mechanical wind up toy
The physics of walking
The physics of a sprint start
The bounce in track shoes
Kicking a football
Design of car bumper
Shock absorbers
Energy of a catapult
Sunspot activity
Online telescope observations
Spectral analysis of an incandescent lamp
Search for Pulsars through Parkes
Stellar image analysis programs
Bending of a beam
Bending of a cantilever
The creep of rubber
Properties of glued joints
Effect of reinforcing
Strength of human hair
Effect of heat treatment on metals and materials
Frequency response of an AC to DC power supply
Efficiency of an AC to DC power supply
Aerofoil design
Wind problems around buildings
Drag of objects in water
The drop in pressure with fast flow
The drag on spheres and other shapes
When does water flow become turbulent?
The sensitivity of the eye
Depth of focus of a microscope
Caustic curves
Moire fringes
Fresnel lenses

Unit 4 How can waves explain the behaviour of light?

	Practical Activity	Description	Type
1	Types of waves	Use a slinky to demonstrate transverse waves. Use a ripple tank to demonstrate wave properties	Demonstrations
2	Samples of sound waves	Use a signal generator and a loudspeaker to produce a range of frequencies and to illustrate human frequency response.	Demonstration
3	Speed of Sound	Use stop watches to measure speed of sound by echo method.	Class Exercise
4	Reflection of waves	Use a slinky to show reflection of transverse and longitudinal pulses at fixed and free ends.	Demonstration
5	Superposition of waves	Use a slinky to show the superposition of transverse pulses.	Demonstration
6	Resonance in air	Observe sound in a large diameter long plastic tube over a Meeker burner	Demonstration
7	Standing waves in strings	Attach a weighted string to a ticker timer	Demonstration / experiment
8	Standing waves in springs	Use a slinky to show harmonics in stretched spring	Demonstration
9	Resonance in blades	Vibrate together 3 hacksaw blades, various lengths	Demonstration
10	Standing waves in rods	Hit the rod's end on while holding at a node	Demonstration
11	Interference	Use a sound source connected to two speakers to produce an interference pattern in front of the speakers. Note nodal positions and measure distances to determine wavelength. Change spacing of speakers and change of nodal positions	Experiment
12	Diffraction	Use a sound source at different frequencies and with speakers of different diameters to observe the amount of spreading Use of a ripple tank to show diffraction	Demonstration
13	Diffraction of light	Investigate diffraction of light through red and blue filters with slides of single slit of varying width	Class Exercise or Experiment
14	Interference of light	Investigate interference of light through red and blue filters with slides of double slits of varying size FARLabs (Online)	Class Exercise or Experiment Experiment

Vicphysics Online Resources

General

Physclips: Animations from UNSW

The Soudry: Interactive and comprehensive website on Sound

Perimeter Institute: Resources on the Wave model

Specific Topics

Intro to waves: PhET Simulation

Huygen's Principle: Wolfram Demonstration

Waves on a String: PhET Simulation

Light as an em wave: PhET Simulation

Resonance: PhET Simulation

Tacoma Narrows Bridge Collapse (Resonance)

Rubens Tube (Standing waves in an air column)

Interference applet (Walter Fendt)

Interference of Sound: PhET Simulation

Interference and Diffraction of Waves: PhET Simulation

Unit 4 How are light and matter similar?

	Practical Activity	Description	Type
1	Diffraction of light	Investigate diffraction of light through red and blue filters with slides with single slits of varying size FARLabs (online)	Class Exercise or Experiment Experiment
2	Resolution	Investigate the limitation of diffraction in distinguishing objects	Demonstration
3	Photoelectric Effect	Discharge of electroscope with zinc plate on top with UV light	Demonstration
4	Photoelectric Effect	Investigate the effect of intensity and frequency of light incident on a metal surface on the energy of ejected electrons FARLabs (online)	Class Exercise Experiment
5	Hydrogen Spectrum	Investigate the energy levels of Hydrogen	Class Exercise
6	Energy gap in LEDs	Investigate the triggering voltage for LEDs producing light of different wavelengths	Experiment

Vicphysics Online Resources

General

Physclips: Animations from UNSW

Specific Topics

Photoelectric Effect: PhET Simulation

Photoelectric Effect: Walter Fendt applet

Franck-Hertz Experiment: Applet from Kansas State University

Diffraction of electrons: Youtube video by Hitachi

Dr Quantum animation on interference and particle-wave duality; Youtube video

Bohr model of the Atom (Standing wave model): Walter Fendt applet

Simulation of double slit experiments with single photons: Wolfram Demonstration

Possible Practical Investigation topics for 2020 with secondary data

- Bounce of a basketball
- Efficiency of a DC motor
- Motion of a parachute
- Magnetic interactions on a top-loading balance
- Electrostatic interactions on a top-loading balance
- Metal washers bounce off a spring.
- Cricket bat hitting a cricket ball
- Acceleration of a bar bell
- Motion of a balloon powered hovercraft made from a CD down an incline
- Astroblaster
- Change over of sliding ball to rolling
- A cantilever
- The bounce of a table tennis ball containing some water
- Efficiency of a bicycle dynamo with wheel speed and glove resistance
- Crater impacts of dropped steel balls
- Bounce on a trampoline
- Drag on spheres
- Sweet spot of a tennis racket
- Water powered rocket
- A ball falling through honey
- Tipcat
- Height of a jumping ring
- Magnet falling through a conducting tube
- Popping body
- Bouncing wet ball
- Saxon bowl: time is inversely proportional to the diameter squared
- Coupled pendula
- Hydraulic jump
- Poiseuille's law, speed of water flow through a tube
- Siphon – flow rate and length of tube
- Lift of a toy helicopter on a top loading balance
- Homopolar motor
- Rolling friction of ball bearings