Vicphysics Teachers' Network
Units 1 and 2 Course Planning Day. Monday, 21st November, 2022

10:00 Small Group Discussion Planning Units 1 and 2
The purpose of the discussion is to encourage an exchange of ideas on possible ways to plan your course for next year.

To help with this task there are some questions below to help the groups with this process.

Also over the page is a Sample Plan for Units 1 and 2. The dot points in the tables that are in bold are new to the study design. The dot points in italics, only in Area of Study 1, have been transferred from Unit 4 Area of Study on 'How Light behaves'.

For each Area of Study there is a table with a week by week program covering all the dot points in each Area of Study.

The total number of weeks for the three Area of Study in Unit 1 exceeds the class time typically available.

This means some compromises need to be made. It may be that you can cover the dot points more efficiently than outlined here or that you decide to give less emphasis to some of the topics.

Below are some matters to consider when planning a course for Unit 1 and 2

1. Teaching order in Unit 1
   a) Which Area of Study to start with?
      Should the AoS be the most accessible or have lots of practical activities? Should it be very relevant and engaging? Should the emphasis be on an AoS with activities that are opportunities to get to know the students? Should it link with topics from Year 10?
   b) Which AoS comes next?
      Should there be a balance of theory and prac across the unit? Should the most demanding be kept to last? Are there links between AoS's e.g. using electricity in heating experiments, nuclear reactors with heat transfer?

2. Amount of class time for each Area of Study in Unit 1
   a) Should the AoS's be comparable in class time or can you give a couple of weeks extra to one? Is there a risk of losing student interest if an AoS goes for more than 5 - 6 weeks?
   b) Can any of the AoS's be easily trimmed to fit in with a Semester with several breaks?

3. For Unit 2, the significant change is this dot point in the Motion Area of Study:
   - investigate the application of motion concepts through a case study, for example, through motion in sport, vehicle safety, a device or a structure.

   a) To efficiently address this dot point, it is suggested that you adopt one of the listed possibilities as a context for the whole Area of Study and as you teach the content, you incorporate examples from that context to illustrate a concept or principle and use the context as a basis for the assessment task

      The last page has an extensive list of examples for a number of contexts.
      Can you think of other examples and resources to fill out the list?

   b) Could this be an effective and time efficient strategy for what is an important dot point?

A Sample Units 1 & 2 Course Plan

Unit 1: How Light and Heat are explained?

Dot points in italics are from Unit 4 Area of Study 1 in the previous study design. Dot points and sections in bold are new or changed.

Source of activities: https://www.vicphysics.org/teachers/unit1resources/lightheat/

Week	Key Knowledge		
	Dot Points	**Action**	**Activities**
1	• *identify all electromagnetic waves as transverse waves travelling at the same speed,* c*, in a vacuum* **as distinct from mechanical waves that require a medium to propagate** • *identify the amplitude, wavelength, period and frequency of waves* • *calculate the wavelength, frequency, period and speed of travel of waves using:* $\lambda = \frac{v}{f} = vT$ • **explain the wavelength of a wave as a result of the velocity (determined by the medium through which it travels) and the frequency (determined by the source)**	Identify Identify Calculate Explain	Introductory practical activity on light phenomena and em phenomena related to temperature to stimulate curiosity and generate context questions for later assessment Demonstration of longitudinal and transverse waves
2	• *compare the wavelength and frequencies of different regions of the electromagnetic spectrum as radio, microwave, infrared, visible, ultraviolet, x-ray and gamma waves and compare the different uses each has in society* • describe electromagnetic radiation emitted from the Sun as mainly ultraviolet, visible and infrared	Compare Describe	Spectra from an incandescent light globe as the voltage increases Demonstrations and comparisons: a) Radio waves from Van de Graff, Ruhmkoff coil, antenna b) Comparison with X-ray tubes,
3	• *investigate and analyse theoretically and practically the behaviour of waves including:* – *refraction using Snell's Law:* $n_1 \sin(\theta_1) = n_2 \sin(\theta_2)$ *and* $n_1 v_1 = n_2 v_2$ – *total internal reflection and critical angle including applications:* $n_1 \sin(\theta_c) = n_2 \sin(90^o)$	Investigate Analyse	Refraction experiment Demonstration with optical fibres and fish tank

	Dot Points	Action	Activities
4	• *investigate and explain theoretically and practically colour dispersion in prisms and lenses with reference to refraction of the components of white light as they pass from one medium to another* • **explain the formation of optical phenomena: rainbows; mirages** • **investigate light transmission through optical fibres for communication**	Investigate Explain Explain Investigate	Demonstration with prism
5	• convert temperature between degrees Celsius and Kelvin • describe how an **increase in temperature corresponds to an increase in the thermal energy (kinetic and potential energy of the atoms)** of a system: – distinguish between conduction, convection and radiation with reference to heat transfers within and between systems – explain why cooling results from evaporation using a simple kinetic energy model	Convert Describe Distinguish Explain	Introductory practical activity on heating and cooling phenomena to stimulate curiosity and generate context questions for later assessment. Convert temperatures from one scale to the other.Exp't: Keeping it Hot – design, build & test a thermos for a plastic cup of hot water from Reverse Art Truck materials.
6	• investigate and analyse theoretically and practically the energy required to: – raise the temperature of a substance: $Q = mc\Delta T$ – change the state of a substance: $Q = mL$	Investigate Analyse	Heat capacity: i) mixing liquids, ii) adding heated block to water, iii) heat capacity of thermos, iv) using a microwave oven Latent Heat: i) Add ice to hot water
7	• calculate the peak wavelength of the re-radiated electromagnetic radiation from Earth using Wien's Law: $\lambda_{max}\ T$ = constant • compare the total energy across the electromagnetic spectrum emitted by objects at different temperatures • apply concepts of energy transfer, energy transformation, temperature change and change of state to climate change and global warming	Calculate Compare Apply	Applets

Unit 1: Electricity: How can electricity be used to transfer energy?
Source of activities https://www.vicphysics.org/teachers/unit1resources/electricity/

Weeks	Key Knowledge		Activities
	Dot Points	**Action**	
1	• apply concepts of charge (Q), electric current (I), potential difference (V), energy (E) and power (P), in electric circuits • **analyse and evaluate** different analogies used to describe electric current and potential difference • investigate and analyse theoretically and practically electric circuits using the relationships I = Q/t, V = E/Q, P = E/t = VI • justify the use of selected meters **(ammeter, voltmeter, multimeter)** in circuits	Apply Analyse, Evaluate Investigate, Analyse Justify	Role play with smarties. Experiment with simple circuits. Measure V and I. Do lots of problems
2	• model resistance in series and parallel circuits using i) (I–V) graphs, ii) resistance as the potential difference to current ratio, including R = constant for ohmic devices and iii) resistors in series and parallel • calculate and analyse the effective resistance of circuits comprising parallel and series resistance	Model Calculate Analyse	Measure voltages and currents of individual resistors as well as the combinations to discover relationships. Measure resistors with multimeter to confirm relationships. CUPs activities 8, 9 Expt: Series & Parallel Circuits
3	• compare power transfers in series and parallel circuits • apply the kilowatt-hour (kW h) as a unit of energy • analyse circuits comprising voltage dividers • compare power transfers in series and parallel circuits	Compare, Apply Analyse Compare	Analyse and interpret domestic power bills with and without PV panels Expt: Voltage Dividers

Weeks	Key Knowledge		Activities
	Dot Points	**Action**	
4	• 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 I = V/R and P=VI) • 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 **resistors, light bulbs, diodes, thermistors, light dependent resistors (LDRs), light-emitting diodes (LEDs) and potentiometers in common devices**	Investigate Apply Investigate Describe	Investigate experimentally various circuit elements. including: • Resistance of a Light Globe Filament • The Diode • The Light Dependent Resistor • The Thermistor
5	• model household (AC) electrical systems as simple direct current (DC) circuits • explain why the circuits in homes are mostly parallel circuits • model household electricity connections as a simple **DC** circuit comprising fuses, switches, circuit breakers, loads and earth • compare the operation of safety devices including fuses, circuit breakers and residual current devices (RCDs)	explain model compare	Investigate a Wiring in a House Demonstration Board. Dissect a household appliance
6	• describe the causes, effects and treatment of electric shock in homes and identify the approximate danger thresholds for current and duration. Revision, Test and SAC	describe	Discuss risks and safety features SACs: Annotated portfolio of practical activities Test

Unit 1: How is energy from the nucleus utilised?

Dot points and sections in bold are new or changed.

Weeks	Key Knowledge		Activities
	Dot Points	**Action**	https://www.vicphysics.org/teachers/unit1resources/matter/
1	• **describe the properties of α, β_-, β_+ and γ radiation** • explain nuclear transformations using decay equations involving α, β_-, β_+ and γ radiation • analyse decay series diagrams with reference to type of decay and stability of isotopes	describe explain analyse	Demo: radioactive sources Marshmallow nuclei: https://www.lbl.gov/abc/marsh-nuclei/pdf-dwnlds/marsh-whole.pdf Take the particle tour: https://particleadventure.org/ Research a decay chain
2	• model radioactive decay as random decay with a particular half-life, including mathematical modeling with reference to whole half-lives • **explain the effects of *α*, *β* and *γ* radiation on humans, including:** – **different capacities to cause cell damage** – **short- and long-term effects of low and high doses** – **ionising impacts of radioactive sources outside and inside the body** – **calculations of absorbed dose (gray), equivalent dose (sievert) and effective dose (sievert)** • **evaluate the use of medical radioisotopes in therapy including the effects on healthy and damaged tissues and cells**	model explain evaluate	Prac: half-life of dice Prac: half-life of a radioactive source Take the particle tour: https://particleadventure.org/ Compare the duration between prediction and discovery

3	• explain nuclear stability with reference to the forces in the nucleus **including electrostatic force**, the strong nuclear force and the weak nuclear force • **explain qualitatively, nuclear energy as resulting from the conversion of mass** • **explain fission chain reactions including:** – **the effect of mass and shape on criticality** – **neutron absorption and moderation**	Explain Explain explain	Compare strength and range of the strong and weak nuclear forces.
4	• explain, using a binding energy curve, why both fusion and fission are reactions that produce energy • compare the processes of nuclear fusion and nuclear fission • **investigate the viability of nuclear energy as an energy source for Australia**.	Explain Compare Investigate	

Time: 4 weeks

Unit 2: Movement: How is motion understood?
Dot points and sections in bold are new or changed.
https://www.vicphysics.org/teachers/unit2resources/movement/

Weeks	Key Knowledge		Activities
	Dot Points	**Action**	
1, 2	• analyse graphically, numerically and algebraically, straight-line motion under constant acceleration: $v = u + at$, $v^2 = u^2 + 2as$, $s = \frac{1}{2}(u + v)t$, $s = ut + \frac{1}{2}at^2$, $s = vt - \frac{1}{2}at^2$ • graphically analyse non-uniform motion in a straight line • identify parameters of motion as vectors or scalars	analyse analyse identify	Various practical activities using timers, motion sensors. Do lots of problems CUPs activities 1, 2, 4
3, 4	• model the force due to gravity, F_g, as the force of gravity acting at the centre of mass of a body, $F_{on\ body\ by\ earth} = mg$, where g is the gravitational field strength (9.8 N kg^{-1} near the surface of Earth) • model forces as vectors acting at the point of application (with magnitude and direction), labelling these forces using the convention 'force on A by B' or $F_{\text{on A by B}} = -F_{\text{on B by A}}$ • apply Newton's three laws of motion to a body on which forces act: $a = F_{net}/m$, $F_{\text{on A by B}} = -F_{\text{on B by A}}$ • apply the vector model of forces, including vector addition and components of forces, to readily observable forces including the force due to gravity, friction and normal forces	model model apply apply	Do 3rd law first, then 1st, then 2nd law. CUPs activity 5, 3, 7 Do problems on free body diagrams Identify some topics involving friction, air resistance and other forces as possible practical investigations for later in the year. Exp'ts to confirm Newton's 2nd Law of Motion, i) $a \propto F$ *for constant m, ii)* $a \propto 1/m$ *for constant F.* Expt on vector addition of forces
5	• apply concepts of momentum to linear motion: $p = mv$ • **explain changes in momentum as being caused by a net force: $\Delta p = F_{net}\Delta t$** • analyse impulse in an isolated system (for collisions between objects moving in a straight line): $F\Delta t = m\Delta v$ • investigate and analyse theoretically and practically momentum conservation in one dimension.	analyse investigate analyse	CUPs activity 12.Investigate momentum transfer in collisions, e.g air track Identify some topics involving impacts as possible practical investigations for later in the year.

Unit 2: Movement: How is motion understood? continued

Weeks	Key Knowledge		
	Dot Points	**Action**	**Activities**
6, 7	• apply the concept of work done by a force using: – work done = force × displacement: $W = Fs\cos\theta$, where F is constant – work done = area under force-distance graph • investigate and analyse theoretically and practically Hooke's Law for an ideal spring: $F = -kx$, **where x is extension** • analyse and model mechanical energy transfers and transformations using energy conservation: – changes in gravitational potential energy near Earth's surface: $Eg = mg\Delta h$ – potential energy in ideal springs: $E_s = \frac{1}{2}kx^2$ – kinetic energy: $E_k = \frac{1}{2}mv^2$ • analyse rate of energy transfer using power: $P = E/t$ • calculate the efficiency of an energy transfer system: η = *useful energy out / total energy in*	apply investigate analyse analyse, model analyse calculate	CUPS activity 11 Round robin exercise of short activities on energy transfer Identify some topics involving energy transfer as possible practical investigations for later in the year.
8	• calculate torque: $\tau = r_{\perp} F$ • investigate and analyse theoretically and practically translational forces and torques in simple structures that are in rotational equilibrium	calculate investigate analyse	Identify some topics involving rotation as possible practical investigations for later in the year
1 - 8	• **investigate the application of motion concepts through a case study, for example, through motion in sport, vehicle safety, a device or a structure.**	investigate	

Total 8 weeks

Unit 2 Motion: Teaching the new dot point:

'*investigate the application of motion concepts through a case study, for example, through motion in sport, vehicle safety, a device or a structure'*

To efficiently address this dot point, it is suggested that you could adopt one of the listed possibilities as a context for the whole Area of Study and as you teach the content, you incorporate examples from that context to illustrate a concept or principle and use the context as a basis for the assessment task.

A context could also be used as an introduction to the Options.

Below are some examples of contexts and some references. There are no doubt more that will be added during the discussion.

Vehicle safety

- stopping distances, friction as a driving force, air resistance, tyre treads, skiding, cycling up and down hills, collisions between large and small cars, between bikes or scooters and pedestrians, crumple zones, air bags, head rests, cargo barriers, crash barriers, traffic accidents
- References:
  - The Physics of Traffic Accident Investigations by P K Tao
  - "Understanding Car Crashes—It's Basics Physics" Teacher's guide for grades 9-12 (ufl.edu)
  - (PDF) Vehicle Design and the Physics of Traffic Safety (researchgate.net)

Sport

- Forces in walking and running, skiing and skating, acceleration in a sprint start, Speed time graphs for sprints, dives and vertical jumps, trampolines, power developed when running up stairs, sporting impacts: bat with ball and foot with ball, sweet spots, bouncing balls, shoe design, protective sporting gear, bungee jumping, weightlifting.
- Muscles, tendons, pushing, throwing, lifting,
- References:
  - Biomechanics of Sport Techniques by Hay, J G.
  - Medical Physics by Cameron and Skofronick

Engineering

- Car suspension, bridges, awnings, cantilevers,
- References:
  - Teach Engineering website: Ignite STEM learning in K-12 - TeachEngineering

Technologies

- Flight, parachutes, trampolines