Syllabus links

Rationale for *Beyond the Thrills* excursions

Science plays an important part in our lives. Knowledge about our physical world can be gained in a relevant and fun way through a *Beyond the Thrills* excursion to Luna Park Sydney. These excursions provide a unique opportunity for students to experience at first hand the physics principles behind the **motion, forces and energy** in operation on the rides.

The various rides provide a demonstration of motion in a controlled manner on a scale that is impossible to recreate in the laboratory. Students will make observations and record their findings, and answer qualitative questions about the rides. From this they can determine and analyse the forces on the body caused by the motion of the rides and the energy transformations that occur.

Stage 6 Physics

… for 2017 Physics syllabus (2018 onwards)

Aim

To investigate the motion, forces and energy experienced on the rides at Luna Park Sydney.

Objectives related to the syllabus

Participation in this excursion, will enable students to:

- better understand the physical world and how it works
- develop an appreciation and understanding of how the principles of physics apply to the motion, forces and energy experienced on fun park rides
- gain an appreciation of how physics principles studied in the classroom apply to large-scale phenomena
- gain an appreciation of the value of working in a team to accomplish measuring and calculating tasks
- collect qualitative data about the motion, forces and energy related to fun park rides
- quantitatively analyse the motion, forces and energy related to fun park rides
- develop knowledge and understanding of fundamental mechanics (Year 11)
- develop knowledge and understanding of energy (Year 11)
- develop knowledge and understanding of advanced mechanics and electromagnetism (Year 12)
- develop knowledge and understanding of the role of evidence and prediction in the development of theories in physics (Year 12).

Outcomes related to the syllabus

A student:

- measures and record data for various fun park rides.
- describes and analyses motion on the rides in terms of scalar and vector quantities in two dimensions and makes quantitative measurements and calculations for distance, displacement, speed, velocity and acceleration (based on PH11-8)
- describes and explains events in terms of Newton's Laws of Motion, the law of conservation of momentum and the law of conservation of energy (PH11-9)
- determines the forces acting on a rider in circular motion rides and rides that fall due to gravity
- describes and analyses qualitatively and quantitatively circular motion and motion due to gravity (based on PH12-12)
- explains how magnetic interactions due to currents has been applied to magnetic braking (based on PH12-13)
- develops skills in applying the processes of Working Scientifically to the motion, forces and energy related to fun park rides, as they:
  - collect valid and reliable primary and secondary data
  - qualitatively process it
  - analyse and quantitatively process it (based on PH11/12-3, PH11/12-4, PH11/12-5)
- communicates scientific understanding using suitable language and terminology (PH11/12-7)

Syllabus content covered

See page 10: *Concepts in Beyond the Thrills worksheets for Physics Stage 6*

and page 11: *Main physics concepts covered by each ride*.

Concepts in Beyond the Thrills worksheets for Physics Stage 6	*Syllabus (2018 on)*
• Motion of an object moving in a straight line • Measure or calculate time, speed, velocity and acceleration – and analyse their relationships: $s = ut + ½\ at^2$ $v = u + at$ $v^2 = u^2 + 2as$ • Use of scalar and vector quantities • Instantaneous and average speed	Module 1: Kinematics
• Use Newton's Laws of Motion (qualitatively and quantitatively) to investigate, describe and analyse the forces between objects and the changes that result from contact force and forces mediated by fields • Inertia (Newton's 1st Law) and net force: $\Sigma F = ma$ (Newton's 2nd law) • Action-reaction forces (Newton's 3rd law): $F_{AB} = -F_{BA}$ • Component forces using: $F_x = F\cos\theta$, $F_y = F\sin\theta$	Module 2: Dynamics
• Practical investigation to explain the motion of objects on inclined planes	Module 2: Dynamics
• Use Newton's first two laws of motion to investigate, describe and analyse: – friction – acceleration of single object • Gravitational potential energy, $E_p = mgh$	Module 2: Dynamics
• Moving objects possess kinetic energy: $E_k = \frac{1}{2}mv^2$ • Law of conservation of momentum ($p = mv$), why momentum is conserved in collisions (Newton's 3rd Law) • Law of conservation of energy & energy transformations • Analyse and compare the momentum and kinetic energy of elastic collisions versus inelastic collisions • Investigate the effects of forces involved in collisions, and quantitatively analyse the interactions, using impulse ($p = Ft$) … where t is the contact time in a collision	Module 2: Dynamics
• Crumple zones, safety features of motor vehicles	Module 2: Dynamics
• Investigate uniform circular motion and the relationships between mass, speed and radius • Centripetal acceleration, centripetal force, linear (orbital) velocity (v), angular velocity (ω)	Module 5: Advanced mechanics
• Use these relationships for circular motion: $a = \frac{v^2}{r}$ $F = m\frac{v^2}{r}$ $\omega = \frac{2\pi}{T}$ • Solve problems and analyse information involving vehicles travelling around curves using: $F = m\frac{v^2}{r}$	Module 5: Advanced mechanics
• Earth has a gravitational field that exerts a force on objects	Module 5: Advanced mechanics
• Identify how eddy currents are produced (Lenz's Law) and are utilised in electromagnetic braking	Module: Electromagnetism