Teachers' notes

Beyond the Thrills excursions

Physics is the science of how the world (and Universe) works. Luna Park Sydney is a large hands-on physics laboratory full of free falling objects, rotating systems and collisions. A *Beyond the Thrills* excursion to Luna Park Sydney will allow your students to experience the thrills of the rides and to study the motion, forces and energy transformations on the rides. Observing the laws of physics in action will allow your students to see that physics is fun, and that it is not just for geeks.

Remember, if a student is too scared or has a medical condition that prevents them from going on a particular ride(s), they can still make most of their observations and take all of the measurements with both of their feet firmly on the ground. Remember, a terrified rider will not learn any physics.

Worksheets in this book

This book contains worksheets for: • *Stage 6 Physics*

[Notes:

* Science 7-10 worksheets (general set) and Stages 4 & 5 Science worksheets are available separately.
* Stage 6 Biology or **Senior Science** worksheets are also available (if requested when making your booking.]
* Excursions are also available for **primary** students: • *Science & Technology - Beyond the Thrills Excursion* worksheets are in a separate book, along with worksheets for *Mathematics* and *English*, • other primary worksheets available are *Peer Support* and *Visual Arts*.]

Completing the worksheets

Stage 6 Physics – it is not expected that students will do the worksheets for all rides, as some involve similar physics concepts. Students should answer questions for selected rides, or alternatively, different groups could do different rides and share their findings back at school.

Physics Depth Study – based on using data from the Stage 6 Physics worksheets

A *Beyond the Thrills* excursion is great for incorporating in a Depth Study for Stage 6 Physics - as it can be used to cover a range of Working Scientifically skills and syllabus content areas.

At least one depth study must be included in both Year 11 and Year 12 – incorporating the two Working Scientifically outcomes of Questioning and Predicting, and Communicating, plus two additional Working Scientifically skills outcomes, and further development of at least one Knowledge and Understanding outcome.

Beyond the Thrills excursions give students an opportunity to collect first-hand data on a variety of rides at Luna Park Sydney. The data observed and collected needs to analysed and processed both *qualitatively* and *quantitatively*.

Teachers are encouraged to design a Depth Study that entails utilising the data collected from one or more rides to further explore one or more of the syllabus content areas.

Students need to collect their own data on the day of the excursion – and so answers are not provided for these worksheets. Students can work individually or collaboratively to further develop one or more of the concepts in either the Year 11 or Year 12 syllabuses. This will allow them to acquire a depth of understanding, and take responsibility for their own learning.

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

… as amended 2010 syllabus

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 the kinematics, dynamics, gravity, energy and electromagnetism related to fun park rides.

Outcomes related to the syllabus

A student:

- measures and record data for various fun park rides
- develops skills in collecting valid and reliable primary and secondary data
- develops skills in qualitatively processing primary and secondary data
- develops skills in analysing and quantitatively processing primary and secondary data
- describes and analyses motion on the rides in terms of scalar and vector quantities in two dimensions and takes measurements and performs calculations for distance, displacement, speed, velocity and acceleration.
- investigates qualitatively and quantitatively circular motion and motion due to gravity.
- describes the forces acting on an object which causes changes in its motion (P6)
- describes the effects of energy transfers and energy transformations (P7)
- explains events in terms of Newton's Laws and Law of Conservation of Momentum (H6)
- explains the effects of energy transfers and energy transformations (H7)
- explains how magnetic interactions due to currents is applied to magnetic braking (related to H9).
- evaluates ways in which accuracy and reliability could be improved in investigations (P12/H12)
- identifies appropriate terminology and reporting styles to communicate information and understanding in physics (P13/P13)
- draws valid conclusions from gathered data and information (P14)

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*.

Stage 6 Physics

… 2017 syllabus

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*.

Physics Stage 6 worksheets syllabus links

Concepts in Beyond the Thrills worksheets for Physics Stage 6	*Syllabus (pre-2018)*	*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	8.4 Moving About: 8.4.1 & 8.4.2	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: $F_x = F\cos\theta$, $F_y = F\sin\theta$	8.4 Moving About: 8.4.2	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, $E_p = mgh$	8.4 Moving About: 8.4.2	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	8.4 Moving About: 8.4.3 & 8.4.4 & 9.2.2	Module 2: Dynamics
• Crumple zones, safety features of motor vehicles	8.4 Moving About: 8.4.5	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)	8.4 Moving About: 8.4.2	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: $F = m\frac{v^2}{r}$	8.4 Moving About: 8.4.2.3.7	Module 5: Advanced mechanics
• Earth has a gravitational field that exerts a force on objects	9.2 Space: 9.2.1	Module 5: Advanced mechanics
• Identify how eddy currents are produced (Lenz's Law) and are utilised in electromagnetic braking	9.3.2	Module: Electromagnetism

Main physics concepts covered by each ride

Ride	*Main physics concepts*
Carousel	Newton's Laws, circular motion
Coney Island: Joy Wheel	Newton's Laws, circular motion, friction
Coney Island: Slides	Newton's Laws, gravity, friction
Dodgem City	Newton's Laws, collisions, momentum, energy transformations
Ferris Wheel	Newton's Laws, circular motion
Hair Raiser	Newton's Laws, gravity, energy transformations, electromagnetic braking
Moon Ranger	Newton's Laws, circular and pendulum motion
Rotor	Newton's Laws, circular motion, friction
Spider	Newton's Laws, circular motion
Tango Train	Newton's Laws, circular motion
Tumblebug	Newton's Laws, circular motion
Wild Mouse	Newton's Laws, gravity, energy transformations