Year 12 Physics

Tour outline and syllabus outcomes

ANSTO is a leader in applied physics research, operating Australia's only nuclear reactor, the Australian Synchrotron, cyclotrons and linear accelerators.

ANSTO conducts Year 12 Physics excursions, which cover specific Knowledge and Understanding content from Module 8: From the Universe to the Atom and Working Scientifically skills from the NSW NESA Stage 6 Physics syllabus. These excursions consist of:

- A 120 minute tour of ANSTO's research facilities, including the OPAL research reactor, the ANSTO Nuclear Medicine production facility, the Australian Centre for Neutron Scattering, and the Centre for Accelerator Science
- A 20 minute break for students
- 70 minutes of educator-led activities and a presentation in our Discovery Centre theatrette and display area

Students will complete the excursion workbook during the excursion.

Excursion content	Syllabus links
<u>Pre-work in excursion workbook:</u> • Process information to identify properties of alpha, beta and gamma radiation • Predict the radioactivity of a sample after a period of time using a decay curve • Perform calculations to predict the energy released in nuclear decays and transmutations • Prepare questions for a Q&A session with ANSTO education officers specific to students' chosen depth study topic	● analyse the spontaneous decay of unstable nuclei, and the properties of the alpha, beta and gamma radiation emitted. ● examine the model of half-life in radioactive decay and make quantitative predictions about the activity or amount of a radioactive sample using the following relationships: $N_t = N_0e^{-\lambda t}$ $\lambda = (\ln_2)/(t_{1/2})$ where Nt = number of particles at time t, N0 = number of particles present at t = 0, λ = decay constant, t1/2 = time for half the radioactive amount to decay. ● analyse the spontaneous decay of unstable nuclei, and the properties of the alpha, beta and gamma radiation emitted. ● analyse relationships that represent conservation of mass-energy in spontaneous and artificial nuclear transmutations, including alpha decay, beta decay, nuclear fission and nuclear fusion. ● account for the release of energy in the process of nuclear fusion. ● predict quantitatively the energy released in nuclear decays or transmutations, including nuclear fission and nuclear fusion, by applying: – the law of conservation of energy – mass defect – binding energy – Einstein's mass–energy equivalence relationship $E = mc^2$

<u>Tour:</u>
 	
• Students visit the OPAL research reactor, the ANSTO Nuclear Medicine production facility, the Australian Centre for Neutron Scattering, and the Centre for Accelerator Science. We discuss how:
    • The controlled fission reaction inside OPAL is used to produce nuclear medicines, irradiate silicon and produce neutrons for research
    • Neutrons are used in diffraction experiments to investigate crystal structures of materials
    • Linear accelerators are used to conduct environmental research
    • Nuclear medicines are designed, produced and used to diagnose and treat disease
	● model and explain the process of nuclear fission, including the concepts of controlled and uncontrolled chain reactions, and account for the release of energy in the process
	● analyse the spontaneous decay of unstable nuclei, and the properties of the alpha, beta and gamma radiation emitted
	● investigate the operation and role of particle accelerators in obtaining evidence that tests and/or validates aspects of theories, including the Standard Model of matter

<u>In the Discovery Centre:</u> • Draw traces left by alpha particles, beta particles, protons and muons in the cloud chamber • Observe demonstrations of devices for measuring/detecting radiation (scintillation counter, thermoluminsecent device, dosimeter) • Observe the change in radiation count with distance from the source and interposition of shielding • Process information to learn how the Australia Synchrotron accelerates electrons to produce intense light for research purposes	Working scientifically • Questioning and predicting • Processing data and information • Analysing data and information • Conducting investigations