|  |
| --- |
|  |
| Year 12 Earth & Environmental Science |
| Excursion outline and syllabus outcomes |
| ANSTO is a leader in chemical, materials and environmental research, and produces many of Australia’s medical radiopharmaceuticals.ANSTO conducts Year 12 Earth and Environmental Science excursions, which cover specific Knowledge and Understanding content from Module 5, 6, and 7 and Working Scientifically skills from the NSW NESA Stage 6 Earth and Environmental Science syllabus. These excursions consist of:* A 75 minute interactive presentation in our Discovery Centre theatrette and display area
* A 20 minute break for students
* A 105 minute tour of ANSTO’s research facilities, including the OPAL research reactor, the Australian Centre for Neutron Scattering (ACNS), the Centre for Accelerator Science (CAS) and Environmental Radioactivity Measurement Centre

This excursion aims to develop, with examples from nuclear science at ANSTO, knowledge and understanding of the evolving Earth and understanding of the impacts of living on the Earth. The excursion provides EES students a unique experience to access working laboratories and see first-hand the techniques used to study the earth that they learn about in class. . Students will complete the excursion workbook during the excursion. |
|  |
|  |

|  |
| --- |
| **Pre-Excursion** |
| **Workbook Section: Pre-Excursion Questions 1-7** | **Syllabus Links** |
| * Atoms (naming and notation) and isotopes primer
	+ Atomic structure and nuclear science
	+ Stable verse unstable (radioactive) isotopes in nature and their use in Earth science
* Radioisotopes and radioactive decay rates
	+ Why isotopes are unstable/radioactive
	+ The concept and definition of half-life
	+ Examples of radioisotopes and their half-lives in nature
* Types and uses of radiation in Earth science and absolute dating techniques
	+ Alpha, beta, and gamma radiation
	+ X-rays and mapping elements
	+ Radiometric dating techniques
 | **Year 11** **Module 1: Earth’s resources*** describe relative and absolute dating of the geosphere
 |
| **During Excursion**  |
| **Interactive Presentation at Discovery Centre (75min)** | **Syllabus Links** |
| * Learn about ANSTO - our people, our research, and our facilities
* Experiment participation: measuring properties of alpha, beta and gamma radiation to understand the basis of absolute dating methods using spectroscopy (e.g., radiometric dating using alpha spectroscopy)
* Experiment participation: determining elements using fluorescence. Understanding how fluorescence can be used for chemical characterisation (e.g., X-ray fluorescence or XRF) and environmental reconstruction.
* Volunteer students perform the experiment with help from the Education Officer
* Case study: Environmental reconstruction and monitoring combining law of superposition, absolute dating, and element characterisation to assess water contamination
* The Education Officer leads discussions about concepts such as reliability and accuracy, dependent and independent variables, controlled variables, and sources of error
* Students record data in their workbook and discuss data at ANSTO Discovery Centre and back at school
 | **Year 11****Module 1: Earth’s resources****Rocks, Minerals, and the Rock Cycle*** investigate the physical properties of minerals that are used to assist in classification

**Year 12** **Module 5: Earth’s processes****Fossil Formation and Stratigraphy*** extrapolate how the principles of uniformitarianism and superposition as well as fossils and absolute dating can be used to date events of geological significance, for example:
	+ mass extinction events

**Sustainability*** investigate human activities that affect sustainability, including but not limited to water pollution

**Working Scientifically*** Questioning and predicting
* Planning investigations
* Conducting investigations
* Processing data and information
* Analysing data and information
 |
| **Tour of ANSTO Facilities (115min)** | **Syllabus Links** |
| Students visit the OPAL research reactor, Australian Centre for Neutron Scattering (ACNS), the Centre for Accelerator Science (CAS) and Environment Department:**OPAL research reactor**ANSTO’s neutron factory * Tour of OPAL reactor zone (foyer) and OPAL basic operations (fission as a neutron factory)
* Discussion of how neutrons are harnessed for geological and palaeontological research

**Australian Centre for Neutron Scattering (ACNS)**Revealing the invisible through neutron scattering* Reconstructing evolution through neutron 3D imaging of fossils including stromatolites
* Lithium-ion battery research for a sustainable future

**Centre for Accelerator Science (CAS)**Radiocarbon dating and environmental monitoring* Radiocarbon dating
* Climate change modelling; [historic greenhouse gas concentration](https://www.ansto.gov.au/historic-greenhouse-gases) over time
* Pollution modelling
* Nuclear weapons monitoring
* [Aerosol sampling program](https://www.ansto.gov.au/facilities/centre-for-accelerator-science/aerosol-sampling-program) (climatic influence and public health issue)

**Environmental Radioactivity Measurement Centre**Reconstructing past climates, natural hazards, and environmental monitoring * Accessing a real lab
* Chemical characterisation of rocks, fossils, and sediments with ITRAX (XRF scanning)
* Monitor the environment using stable isotopes and naturally occurring radioisotopes

e.g., Alpha spectroscopy – radiometric dating * [Bush fire records](https://www.ansto.gov.au/science/environment/reconstructing-australia%E2%80%99s-fire-history-from-cave-stalagmites) through element and isotope analyses of cave stalagmites as a basis for understanding
* [Flood and drought records](https://www.ansto.gov.au/research/programs/environment/water-research/natural-variability-hydrological-systems) through element analyses of cave stalagmites
* Food provenance
 | **Year 12****Module 5: Earth’s processes** **Development of the Biosphere*** investigate the evidence for the development of photosynthetic life, including cyanobacteria and stromatolites

**Fossil Formation and Stratigraphy*** investigate and model processes of fossil formation by examining a variety of methods in rock, including mould formations, cast formations, trace fossils

**Module 6: Hazards****Impact of Natural Disasters on the Biosphere*** investigate how human activities can contribute to the frequency and magnitude of some natural disasters, including bushfires

**Module 7: Climate Science****Evidence for Climate Variation*** identify and explain more recent evidence of climate variation, including but not limited to:
	+ ice cores containing gas bubbles and oxygen isotopes
	+ isotope ratios shown in stalagmites, stalactites, and corals

**Influence of Human Activities on Changes to Climate*** distinguish between the natural greenhouse effect and any anthropogenic greenhouse effects
* investigate any influence that human activities may have had on the environment since the Industrial Revolution, for example increases in greenhouse gases

**Learning across the curriculum*** Asia and Australia’s Engagement with Asia
* Sustainability
* Ethical Understanding
* Intercultural Understanding
* Literacy
* Numeracy
* Civics and Citizenship
* Work and Enterprise
 |