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| Radioactivity and its applications |
| Outline and syllabus outcomes |
| ANSTO is a leader in chemical, materials and environmental research, and produces many of Australia’s medical radiopharmaceuticals.ANSTO conducts *Radioactivity and its applications* videoconferences, which cover:* specific Science Understanding content from the Australian Curriculum for Year 9 Chemical Sciences. Science as a Human Endeavour and Science Inquiry Skills content descriptions are also addressed.
* Components of CW1 Chemical World and Working Scientifically Skills of the Stage 5 NSW Science Syllabus.

ANSTO videoconference outlineThe videoconference outlined on the following pages is for a **60 minute lesson**, however, it **can be adjusted to suit shorter or longer lesson times.**A **videoconference workbook** which complements what is presented has also been developed for students to complete during the videoconference. The workbook also includes pre-videoconference activities.Students will: * Investigate the properties of the types of radiation (alpha, beta and gamma)
* Learn about OPAL, Australia’s only nuclear reactor, and how it is used to make radioisotopes
* Understand that radioisotopes have a wide variety of uses, including in medical scans, for radiotherapy and for dating Aboriginal cultural artefacts
* Collect data during a demonstration of a radiation experiment, using low level radioactive sources and radiation detection equipment.
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**Links to the Australian Science Curriculum and NSW Syllabus**

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| **Videoconference content** | **Australian Curriculum links** | **NSW Syllabus links** |
| **Introduction to ANSTO in the context of atoms** * Introduce that ANSTO does science at the atomic scale. Explain in simple terms that we investigate and manipulate atoms using scientific instruments including nuclear reactors and particle accelerators
* Review the Bohr model of the atom (mass and charge of protons, neutrons, electrons)
* Relate the number of protons and neutrons to atomic number and atomic weight
* Define isotopes as atoms of an element with the same number of protons but different numbers of neutrons

**Investigation of alpha, beta and gamma radioactivity*** Use a scintillation counter and different types of shielding (paper, aluminium and lead) to determine the identity of three unmarked radioactive sources (alpha (Am-241), beta (Sr-90) and gamma (Co-60))
* Learn that the neutron to proton ratio determines the stability of an isotope
 | **Science Understanding (Year 9)**All matter is made of atoms that are composed of protons, neutrons and electrons; natural radioactivity arises from the decay of nuclei in atoms (ACSSU177)Elaborations* describing and modelling the structure of atoms in terms of the nucleus, protons, neutrons and electrons
* comparing the mass and charge of protons, neutrons and electrons
* describing in simple terms how alpha and beta particles and gamma radiation are released from unstable atoms

**Science Inquiry Skills (Year 9)**Select and use appropriate equipment, including digital technologies, to collect and record data systematically and accurately (ACSIS166)Use knowledge of scientific concepts to draw conclusions that are consistent with evidence (ACSIS170) | **Chemical World Stage 5**CW1 a) identify that all matter is made of atoms which are composed of protons, neutrons and electrons (ACSSU177) b) describe the structure of atoms in terms of the nucleus, protons, neutrons and electrons CW1 d) identify that natural radioactivity arises from the decay of nuclei in atoms, releasing particles and energy**Working Scientifically**WS6 a) individually and collaboratively using appropriate investigation methods, including fieldwork and laboratory experimentation, to collect reliable data (ACSIS165, ACSIS199)WS7.1 a) selecting and using a variety of methods to organise data and information including diagrams, tables, models, spreadsheets and databasesWS7.2 d) using knowledge of scientific concepts to draw conclusions that are consistent with evidence(ACSIS170, ACSIS204) |
| **Medical applications of radioactivity*** Learn how medical radioisotopes are made inside ANSTO’s OPAL reactor by bombarding target materials with neutrons
* Interpret information from short videos about examples of medical radioisotopes
* Using knowledge of alpha, beta and gamma radiation, predict the type of radiation emitted from example medical radioisotopes
 | **Science as a Human Endeavour (Year 9)**Advances in scientific understanding often rely on technological advances and are often linked to scientific discoveries (ACSHE158)Elaborations- considering how common properties of electromagnetic radiation relate to its uses, such as radar, medicine, mobile phone communications and microwave cooking**-** considering how the development of imaging technologies have improved our understanding of the functions and interactions of body systemsPeople use scientific knowledge to evaluate whether they accept claims, explanations or predictions, and advances in science can affect people’s lives, including generating new career opportunities (ACSHE160)Elaborations- investigating how technologies using electromagnetic radiation are used in medicine, such as in the detection and treatment of cancer- recognising aspects of science, engineering and technology within careers such as medicine, medical technology, telecommunications, biomechanical engineering, pharmacy and physiology | **Chemical World Stage 5**CW1 e) evaluate the benefits and problems associated with medical and industrial uses of nuclear energyCW4 e) describe examples to show where advances in science and/or emerging science and technologies significantly affect people's lives, including generating new career opportunities in areas of chemical science such as biochemistry and industrial chemistry. |
| **Radioisotopes for dating ancient cultures*** + Learn how ANSTO uses radiocarbon dating to determine the age of cultural artefacts of Aboriginal peoples, including rock art
	+ Interpret information and answer questions about using mud wasp nests to date Aboriginal rock art
 | **Science as a Human Endeavour (Year 9)**All matter is made of atoms that are composed of protons, neutrons and electrons; natural radioactivity arises from the decay of nuclei in atoms (ACSSU177)Elaborations* investigating how radiocarbon and other dating methods have been used to establish that Aboriginal Peoples have been present on the Australian continent for more than 60,000 years

**Science Inquiry Skills (Year 9)**Use knowledge of scientific concepts to draw conclusions that are consistent with evidence (ACSIS170)Elaborations* consulting Aboriginal and Torres Strait Islander Peoples’ histories and cultures that reveal scientific information about the past
 | **Working Scientifically**WS7.1 b) selecting and extracting information from tables, flow diagrams, other texts, audiovisual resources and graphs, including histograms and column, sector or line graphsWS7.2 d) using knowledge of scientific concepts to draw conclusions that are consistent with evidence(ACSIS170, ACSIS204) |
| **Perform experiment using radioactivity*** Write an hypothesis to predict how radioactivity will change with distance from a radioactive source
* Record measurements (in triplicate) of radioactivity at different distances from a radioactive source
* Graph these results and write a conclusion for this experiment
* Learn that distance is one method used by radiation workers to minimise the radiation dose they receive
 | **Science Inquiry Skills (Year 9)**Formulate questions or hypotheses that can be investigated scientifically (ACSIS164)Elaborations* revising and refining research questions to target specific information and data collection or finding a solution to the specific problem identified

Analyse patterns and trends in data, including describing relationships between variables and identifying inconsistencies (ACSIS169)Elaborations- using spreadsheets to present data in tables and graphical forms and to carry out mathematical analyses on data- designing and constructing appropriate graphs to represent data and analysing graphs for trends and patternsUse knowledge of scientific concepts to draw conclusions that are consistent with evidence (ACSIS170)Elaborations* comparing conclusions with earlier predictions and reviewing scientific understanding where appropriate
 | **Stage 5 Chemical World**CW1 e) evaluate the benefits and problems associated with medical and industrial uses of nuclear energy**Working Scientifically**WS4 a) formulating questions or hypotheses that can be investigated scientifically (ACSIS164, ACSIS198)b) predicting outcomes based on observations and scientific knowledgeWS6 a) individually and collaboratively using appropriate investigation methods, including fieldwork and laboratory experimentation, to collect reliable data (ACSIS165, ACSIS199)WS7.1 a) selecting and using a variety of methods to organise data and information including diagrams, tables, models, spreadsheets and databasesd) applying numerical procedures and mathematical concepts and using digital technologies, where appropriatee) identifying data which supports or discounts a question or hypothesis being investigated or a proposed solution to a problemWS7.2 b) describing relationships between variables (ACSIS169, ACSIS203)d) using knowledge of scientific concepts to draw conclusions that are consistent with evidence (ACSIS170, ACSIS204)WS9 b) selecting and constructing an appropriate table, type of diagram, table or graph (histogram or sector, column or line graph) to present information and show relationships clearly and succinctly using digital technologies as appropriate |