






Nuclear reactions 1: Mines to medicine

Components

	NAME	DESCRIPTION	AUDIENCE
	<i>Mines to medicine</i> teacher guide	This guide contains background details on two videos associated with radioactivity. It suggests strategies for engaging student interest in nuclear physics.	teachers
	<i>Australia's nuclear industry</i> background sheet	This background sheet explains how uranium ore is processed into products that are used by society.	teachers
	<i>Uranium blockade</i> videoclip (3 min)	By viewing the video students may be engaged to find out more about issues associated with nuclear technology.	students
	<i>Radioisotopes in medicine</i> videoclip (4 min)	A medical physicist explains the role of nuclear physics in medicine.	students
	<i>Nuclear issues</i> worksheet	This student worksheet contains questions to be answered after viewing the videos.	students

Purpose

To **Engage** students in the topic of nuclear physics and lay the foundation for follow-up activities.

Outcomes

Students:

- relate to views expressed by opponents of uranium mining;
- express what they already know about nuclear issues, and what they want to know;
- identify main points raised by two videos, and begin to formulate opinions on the nuclear mining industry; and
- recognise some uses for products of uranium mining.

Activity summary

ACTIVITY	POSSIBLE STRATEGY
Teacher puts the videos in context using notes provided.	whole class discussion
Students view video, <i>Uranium blockade</i> , and answer questions on first part of worksheet, <i>Nuclear issues</i> .	view the videoclips and discuss content in small groups
Teacher conducts a whole class discussion and records for future reference the outcomes of a 'KW' strategy. (The 'L' component can be added as learning proceeds.)	KWL strategy
Teacher directs students to form a 'human graph' on the basis of their views from the video and KWL activity.	student activity
Students view video, <i>Radioisotopes in medicine</i> . Students may answer questions on second part of worksheet and /or teacher leads them through a KWL strategy. The 'human graph' may be used again.	student activity and/or whole class discussion through KWL
A record of the KWL discussion is placed in a prominent place in the classroom so additions can be made.	students add to the record as additional information is learned

Technical requirements

A modern browser (eg Internet Explorer 9 or later, Google Chrome, Safari 5.0+, Opera or Firefox) is required to view the video. High quality MP4 versions of the videos are available by download from the SPICE website.

The video *Uranium blockade* may also be accessed on the Australian Screen website at australianscreen.com.au/titles/walking-through-minefield/clip1/. An internet connection and Adobe Flash Player are required to view this version (this is a free download from www.adobe.com).

The teacher guide, background sheet and worksheet require Adobe Reader (version 5 or later), which is a free download from www.adobe.com. The worksheet is also provided in Microsoft Word format.

About the KWL strategy

The teacher discusses with the class the general topic of nuclear energy and technology.

Conduct a KWL exercise either as a whole class or in small groups.

K = what students already Know

W = what students Want to know

L = what students have Learned

Results of the K and W are recorded in two columns on a poster or white board and the third column (learned) is updated lesson by lesson.

About the 'human graph' strategy

Human graph: Learners literally take a stand on an imaginary graph or continuum within the classroom in relation to the question: 'Do you think that uranium ore should be mined?' The first few volunteers justify their choice of position, and then the remainder of the class joins them without comment. Students may justify their position to the students either side of them.

How to use the videos

A class discussion, based on information in this guide, may be held before the videos are shown.

The videos may be used one after the other, or viewed separately, as part of an engagement activity for this set of resources. Questions that follow are designed to prompt discussion and again may be used after each single video or after both videos have been viewed.

Uranium blockade

1. Concerned citizens are protesting at the entrance to a uranium mine site. What do you think they are protesting about?
2. Is it reasonable for demonstrators to prevent workers from going about their lawful business?
3. Should police remove demonstrators and allow mining to proceed?
4. Is a peaceful sit-in protest that prevents people from lawfully going about their work a legitimate way for people to express their opposition to a project?
5. What are some benefits of nuclear energy?
6. What concerns do you have about nuclear energy?

Radioisotopes in medicine

1. In what research is Dr Wee currently engaged?
2. What are some important uses of radioisotopes as shown in the video?
3. What are some advantages of nuclear treatments outlined in the video compared to other forms of treatment?
4. What outcomes are expected from these types of treatment?
5. List precautions Dr Wee and his colleagues take when handling potentially hazardous nuclear materials.
6. In what other nuclear energy projects has Dr Wee been involved?

If using the KWL model teachers can facilitate a class discussion after showing the videos and new information can be added to the 'L' (learned) column of the KWL table.

Students can also be asked to create a 'human graph' for each video, or after both have been shown. This activity allows them to reflect upon their beliefs about issues raised and whether their views have changed as a result of discussions and information from the videos. Students choose a position on an imaginary graph or continuum that expresses their opinion in relation to questions, such as, 'Do you think that uranium ore should be mined now that you are more informed of its uses in nuclear medicine?' Allow students to justify their chosen position to either the whole class or students around them.

Teacher notes on the videos

The following notes are supplied by The Learning Federation to accompany the video *Uranium blockade*.

- This clip shows anti-mining protesters planning to block the road to the Jabiluka uranium mine in the Northern Territory, Australia. The police arrive and hold discussions with the protesters. The sun rises, the protesters chant, trespass notices are issued and a worker tries to open a gate to get through the blockade. The Territory Response Group (TRG) arrives with bolt cutters to open the gate. They remove the protesters, who are led away by the police.
- Jabiluka 2 is the world's richest undeveloped uranium deposit and has been dogged by controversy since the inception of the Jabiluka mine project. In 1997, the Australian Government approved the project to develop the rich ore body found in the area, but the Senate passed a motion against it. The World Heritage Unit of the Federal Environmental Department and the UNESCO World Heritage Committee became involved, as did conservationists and Indigenous groups, all expressing concerns about environmental regulations, disposal of waste, radiation and the threat to the natural and cultural heritage of Kakadu National Park. In 2006, the Howard government again put pressure on Indigenous owners to allow mining.
- The clip illustrates the resistance to uranium mining in Jabiluka and shows the protesters and the kinds of activity they organised. Throughout most of 1998, environmental and Indigenous groups organised blockades to restrict access to Jabiluka. Some of their tactics and methods included organising activities at night, erecting barriers and makeshift manned towers, using human shields, resisting police, chanting and making speeches. Being filmed, whether for news or documentary purposes, is an important goal for protesters, as media coverage allows them to spread their message to a broader audience.
- The conflict between the mining company's interests and those of environmental and Indigenous groups is highlighted in the clip. With the potential value of the Jabiluka uranium reserve estimated at \$10 billion in 2006, it is clear that mining would result in significant wealth. However, mining might also damage the World Heritage-listed Kakadu National Park, and would restrict the rights and access of Jabiluka's traditional owners.
- Documentary makers sometimes juggle the desire to give a balanced view with the need to create tension within the narrative. Audience sympathies can easily be manipulated by selective shooting and editing. In this clip, director Cathy Henkel provides balance by showing the police treating protesters firmly but also engaging in nonviolent negotiations.

- Cathy Henkel has been a writer, director and producer of documentaries since 1988, also working in the industry as a cinematographer, and this clip showcases her early work as a director. In 1992, Henkel formed Hatchling Productions to create documentaries, educational videos and short films. Her 2003 documentary *The Man Who Stole My Mother's Face* won a number of accolades and awards.

Radioisotopes in medicine

The featured scientist is radiation oncology medical physicist, Dr Leonard Wee. Dr Wee works at Royal Perth Hospital and also conducts research at The University of Western Australia. The equipment located behind Dr Wee during his interview is used for treating cancer patients. This film was shot in the Perth Radiation Oncology facility, located in Wembley, Western Australia.

Dr Wee provided the following information:

My initial aspirations on entering university were along the lines of what would constitute an interesting and well-paid job at the end of it all. My change in perspective was quite sudden — I discovered study was a very enjoyable and fully satisfying journey in itself. This change was to a large degree influenced by the proactive attitude of my lecturers and supervisors.

The endpoint of a job became subservient to what was a new, interesting and novel way of viewing the world, and how to use all these useful skills in the service of other people. Skills I acquired during my time at UWA were persistence, the ability to look at a problem from many directions, being able to relate to people at different levels, and the ability to find problems as well as solutions.

My job as a radiation oncology medical physicist means I play a leading role in providing scientific veracity and mathematical accuracy for medical interventions that use high doses of ionising radiation to treat cancer. There are many things about my job that I love — my direct involvement with the clinical care of cancer patients; the varied mix of experiment, theory, research and further study; the multi disciplinary work environment; and the excellent opportunities for travel and collaborations with other medical physicists.

Being instrumental in the implementation of a cancer treatment program new to Western Australia, and my continuing involvement in the development of new treatments, are the two most satisfying achievements of my career to date.

Associated SPICE resources

Nuclear reactions 1: Mines to medicine may be used in conjunction with related SPICE resources to address the broader topic of nuclear physics.

DESCRIPTION	LEARNING PURPOSE
<p><i>Nuclear reactions</i></p> <p>This learning pathway shows how a number of SPICE resources can be combined to teach the topic of ionising radiation and nuclear reactions.</p>	
<p><i>Nuclear reactions 1: Mines to medicine</i></p> <p>Students express their opinions on a moral issue after viewing a film of demonstrators at a uranium mine and after a medical physicist explains why nuclear medicine is so important to diagnostic and therapeutic procedures.</p>	Engage
<p><i>Nuclear reactions 2: Nuclear radiation</i></p> <p>Students investigate types and properties of radiation with particular attention to penetrative characteristics.</p>	Explore 1
<p><i>Nuclear reactions 3: Nuclear decay</i></p> <p>Students manipulate variables in an interactive simulation to investigate connections between decay and half-life. An alternative procedure using dice is provided.</p>	Explore 2
<p><i>Nuclear reactions 4: Decay chains</i></p> <p>In three separate interactive simulations, students experience modelling as an alternative way of exploring nuclear decay and half-life.</p>	Explore 3
<p><i>Nuclear reactions 5: Fission and fusion</i></p> <p>Worked examples explain how to calculate mass defect and binding energy for fission and fusion reactions. The experimental ITER fusion reactor is also discussed.</p>	Explain
<p><i>Nuclear reactions 6: Nuclear medicine</i></p> <p>Students explore applications of radioisotopes in medicine.</p>	Elaborate 1
<p><i>Nuclear reactions 7: Radioisotopes in research</i></p> <p>Fact sheets illustrate the use of radioisotopes in research being undertaken at The University of Western Australia.</p>	Elaborate 2

Acknowledgements

The video *Uranium blockade* is an extract from *Walking through a minefield*, which was produced by Cathy Henkel and Jeff Canin for Hatchling Productions and the Australian Film Commission.

Science advisor: Dr Leonard Wee (School of Physics, The University of Western Australia).

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