Te Kāwanatanga o Aotearoa
New Zealand Government

MINISTRY OF HEALTH
MANATŪ HAUORA

Radioactive Material
in Schools

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Radioactive material is used in schools for teaching and demonstration purposes as this provides students with valuable first-hand experience in understanding the principles of radioactivity and its applications. However, it is essential schools manage these sources properly to ensure safety and compliance with New Zealand's radiation safety legislation.

The school must justify the need for exposure to radiation, which means that it must establish a clear educational benefit before it obtains or uses any radiation source.

Radiation exposures must also be kept as low as reasonably achievable. Most importantly, sealed radioactive sources should be selected unless only unsealed sources can meet the educational purpose, and the activity must involve the lowest activity radioactive sources that will still achieve the desired educational outcome.

Historic exemption

A notice published in the New Zealand Gazette in July 1988 exempted schools from needing to obtain a licence and register radioactive materials used for instruction and demonstration.

The Notice of Exemption of Sealed Radioactive Materials in Schools (the Notice) was made under the Radiation Protection Regulations 1982, which were revoked on 7 March 2017 when the Radiation Safety Act 2016 (the Act) came into force. As a result, the Notice is no longer in legal effect, and all radioactive material that was previously exempt is now subject to regulatory requirements, including licensing, under the Act.

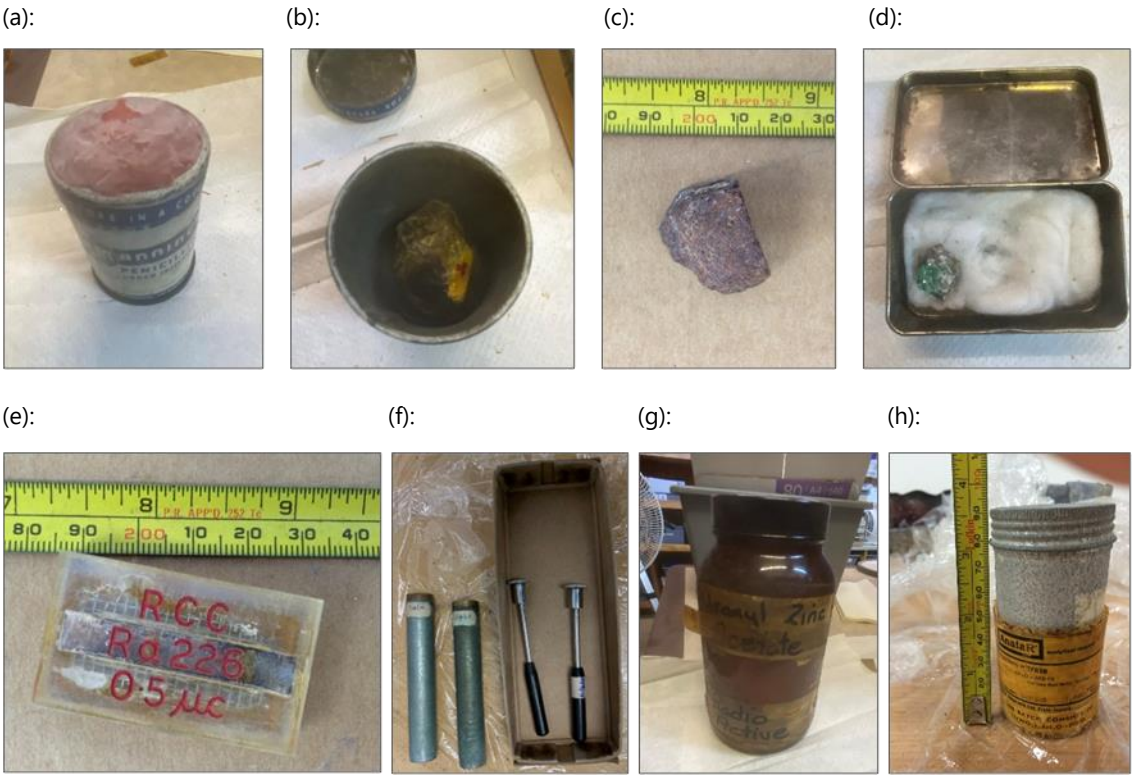
Radioactive materials commonly found in schools

The historic New Zealand Gazette notice listed radionuclides with a range of physical properties, such as: cobalt-60 (^{60}Co), strontium-90 (^{90}Sr), caesium-137 (^{137}Cs), polonium-210 (^{210}Po), radium-226 (^{226}Ra), thorium-232 (^{232}Th), uranium-238 (^{238}U), plutonium-239 (^{239}Pu) and americium-241 (^{241}Am). Most radioactive materials used and stored in schools today comprise one of these radionuclides.

Sources may be either sealed or unsealed. A sealed source is defined in the Act as radioactive material that is permanently sealed in a capsule or closely bonded and in solid form. This means that, under normal use, the radioactive material will not spread contamination. Small amounts of material are often incorporated into plastic discs, and higher activity sources may be welded into stainless steel capsules.

Unsealed sources are often in the form of powders or liquids or are radioactive rocks. A common example is uranium or thorium salts stored in glass or metal jars. These legacy sources were widely used in schools for demonstrations and experiments in the past, although the practice of using unsealed materials in secondary schools is now strongly discouraged. Figure 1 shows some sealed and unsealed sources that enforcement officers from the Office of Radiation Safety recovered from schools around New Zealand under the ARIA programme (see below).

Figure 1: Radioactive material can come in many forms.



Credit: ORS

Images (a) and (b) show a radioactive rock stored in a cylinder; (c) shows a small loose rock; while the rock in (d) is stored inside a metal tin. (e) is an example of a radium source used as an alpha emitter. Generic alpha and beta sources (f) can be stored in small tubes. Unsealed sources are often stored in glass jars (g) or other little containers (h).

Radiation sources that require registration or a source licence

The Act requires users to have a source licence to manage, control or possess radioactive material in a place with a combined activity above the 'acceptable level'. Acceptable levels for selected radionuclides are listed in Table 1 below.

All sealed sources must be registered with the Director for Radiation Safety, however unsealed sources do not require registration. The main exception to this is that all nuclear material of any quantity, whether sealed or unsealed, must be registered. Nuclear material in this context is radioactive material that contains the elements uranium, thorium or plutonium.

Note: Demonstration kits with radiation sources that have an activity below the acceptable level are readily available for purchase.

Table 1: Acceptable levels for selected radionuclides

Radionuclide[1]	Acceptable level of activity (kBq)
colbalt-60	100
strontium-90	10
caesium-137	10
polonium-210	10
radium-226	10
thorium-232	10
uranium-238	10
plutonium-239	10
americium-241	10

Depending on the age of the source and the country of origin, its activity may be recorded in units of curie (non-SI unit) or becquerel (SI unit). Common scales are microcurie (μCi) and kilobecquerel (kBq). See Appendix 1: Example scenario for a calculation of the acceptable level for a pair of caesium-137 sources and a unit conversion of μCi and kBq.

Handling and storage requirements

To minimise exposure to radiation, a trained staff member should do most of the handling, with the students only carrying out limited activities with direct staff supervision. Access to sources must be restricted to trained staff, and procedures should emphasise the three principles of radiation protection: time, distance and shielding. Sealed sources should only be handled with tongs or other tools rather than directly with the hands.

Do not handle any suspected or actual radioactive material without gloves, and wash hands after handling sources or contaminated items. Radioactive rocks can produce dust, and it can be helpful to place such rocks in suitable transparent containers.

All possible care should be taken not to spread contamination. Under normal use, a sealed source will not spread contamination, however, the containment can be damaged or degrade over time, and a sealed source may begin to leak. The best way to check if a sealed source is leaking is to conduct a wipe test (see Appendix 2: Conducting a wipe test to verify a source is sealed).

Where the sources are being stored temporarily until assessment and recovery under the ARIA programme (see below), the following conditions must be met.

- The storage cupboard must be locked.
- A radioactive warning label must be on the outside of the cupboard.
- The dose rate detected outside the cupboard must be less than 15 μSv/h.
- If 15 μSv/h cannot be achieved, a controlled area must be established which has a dose rate at its boundary that is less than 15 μSv/h. For example, position the radioactive source storage cupboard at the far end of a large storage room and put radioactive controlled area signs on the room's door.

[1] For radionuclides not listed here, refer to **Schedule 2 of the Radiation Safety Act 2016**.

For sources managed under a source licence, further requirements for storage and handling are set out in the relevant Office of Radiation Safety (ORS) codes of practice (see below).

Sources above the acceptable level

Although the use of sources below the acceptable level is preferred, a school may possess, manage and control sources above the acceptable levels if they hold an appropriate source licence.

In general, the sources must be of a design and type suitable for school science. The licence category for sealed sources is non-medical 3A, and the full requirements for this category of source licence are set out in **ORS C12: Code of Practice for Sealed Radioactive Material**[2].

A licence for unsealed sources may be granted to a school in exceptional circumstances where it is justified, and this would require a non-medical 2A source licence with use authorised separately though a use licence. The requirements associated with this category of source licence are set out in **ORS C11: Code of Practice for Unsealed Radioactive Material**[3].

For more information about regulatory requirements, including how you can apply for a licence, visit the Ionising radiation safety webpage on the Ministry of Health website at: **www.health.govt.nz/regulation-legislation/radiation**.

The ARIA programme for recovering legacy radioactive sources

The Office of Radiation Safety runs the Assessment and Recovery of Radioactive Instruments and Articles (ARIA) programme. This programme encompasses sources of radiation that were previously used in schools and are no longer required.

To request an assessment of your legacy radioactive source to see if it is eligible for recovery under the ARIA programme, either:

- email the Office of Radiation Safety at: **orsenquiries@health.govt.nz**
- or complete the Request Form - Assessment of Radioactive Instruments or Articles under the ARIA Programme.

If your source qualifies, an advisor will be in touch to arrange an on-site visit and prepare the source for shipping and disposal.

Disposing of radioactive sources

Sources with an activity below the acceptable level do not need to be treated as radioactive waste for disposal and can be placed in the normal waste stream when no longer required.

For all other sources, please email the Office of Radiation Safety at: **orsenquiries@health.govt.nz**.

[2] Ministry of Health. 2020. *Code of Practice for Sealed Radioactive Material*. Wellington: Ministry of Health. URL: **www.health.govt.nz/publications/code-of-practice-for-sealed-radioactive-material** (accessed 2 October 2024).

[3] Ministry of Health. 2020. *Code of Practice for Unsealed Radioactive Material*. Wellington: Ministry of Health. URL: **www.health.govt.nz/publications/code-of-practice-for-unsealed-radioactive-material** (accessed 2 October 2024).

References

ARPANSA. 2012. *Use of Radiation in Schools: Radiation protection series publication no. 18*. Australian Government: Chief Executive Officer of ARPANSA (Australian Radiation Protection and Nuclear Safety Agency). URL: **www.arpansa.gov.au/sites/default/files/legacy/pubs/rps/rps18.pdf** (accessed 2 October 2024).

Radiation Safety Act 2016, No 6 (as at 28 October 2021), Public Act – New Zealand Legislation. URL: **www.legislation.govt.nz/act/public/2016/0006/latest/whole.html#DLM6339517** (accessed 2 October 2024).

Appendix 1: Example scenario

A pair of radioactive sources are used for demonstration purposes at a high school. The science teacher in charge of the laboratory equipment realises they have not compared the activity of the sources against the current acceptable levels. The labels on the sources list the source as being 'Cs-137 2.5 µCi' (with Cs-137 meaning caesium-137). The teacher looks up the acceptable levels and sees they are all listed in becquerel. To check if the sources are under the acceptable level, the teacher does the following calculation:

1 µCi = 37 kBq
2.5 µCi = 2.5×37 kBq
= 92.5 kBq x 2 sources
= 185 kBq total in a 'place'.

The acceptable level for caesium-137 is 10 kBq, so the sources are over the acceptable level.

Note: Where there is more than one radionuclide present in a place, they are exempt if the summed ratios of the activity to the respective acceptable levels is less than 1.

Unit conversion

To convert from microcurie (µCi) to kilobecquerel (kBq):

1 µCi = 37 kBq

Appendix 2: Conducting a wipe test to verify a source is sealed

A wipe test involves using a clean cloth or cotton swab to wipe around the source. The swab is then checked for residual radioactive material. This can be done by either monitoring with a contamination probe or sending the sample to a lab for testing. The Office of Radiation Safety has published a guide on **Radiation Monitoring and Instrument Selection**.

A contamination probe measures in units of counts per second (cps) or counts per minute (cpm). If a contamination probe is on hand, move to a low background area away from the radioactive source, record the background level for that area and then check it against the counts coming off the wipe test sample. A standard background is less than one cps or less than 60 cpm. If the contamination probe reads a count rate of more than three times the background reading, the source is leaking. If there is no contamination, the count rate will be low, and you can assume the source is still sealed.

If no contamination probe is on hand, you can send the wipe test sample for analysis at a testing laboratory. A list of consultants that can assist with this is published on the Office of Radiation Safety's website under **Ionising radiation consultants and service providers**.

While you are waiting for the results to be processed, if you suspect the source may be leaking (for example, the casing has been damaged) or the source has not been wipe tested for over two years, it is important to treat the item as if it is a contamination risk until the results confirm otherwise. Seal the source inside a plastic bag and do not handle it with bare hands until the wipe test results return.

Unsealed material can be tested in the same way to confirm there is no contamination outside the jar or bottle or the surrounding storage area. For unsealed materials, conduct the wipe test around the outside of the container holding the source or the shelf it was stored on.

What to do if there is contamination

It is important to stop the spread of any contamination where a wipe test shows there is contamination, or an unsealed source is spilt. Using gloves, place the source in a strong plastic bag and seal it up. Clean up any contamination on bench space or in a cupboard, for example, using warm soapy water and paper towels. Discard the used towels immediately afterwards in a strong plastic bag. Always wear gloves for protection. Continue cleaning until a contamination probe reads a background level or at least no more than three times the background level.

If the results of a wipe test show there is contamination but there is no survey meter with contamination probe available, contact the Office of Radiation Safety and request assistance under the ARIA programme (see above). The Office can put you in touch with a scientist who can advise on radiation monitoring and decontamination.

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