

STANDARD OPERATING PROCEDURE

Procedure	Working with Carbon-14 radioactive isotopes
School/Department:	School of Molecular Bioscience
SOP prepared by:	Larissa Belov and Nick Coleman
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Section 1 - Personal Protective Equipment (PPE)

1. Lab coat or Lab gown
2. Nitrile or latex gloves
3. Proper enclosed footwear
4. Radiation/dosimeter badge
5. Perspex shield – 1 cm thick
6. Scintillation counter (Geiger Counters may not detect the presence of ^{14}C)

Section 2 – Potential Hazards and safety precautions

1. Compounds containing ^{14}C are RADIOACTIVE, and emit beta particles with energy 0.156 MeV.
2. The beta particles from ^{14}C can travel approx 22 cm through air, but are quite easily stopped by solid materials e.g. 1 cm of Perspex is sufficient
3. The half-life of ^{14}C is 5730 years. This means that any waste generated will be radioactive for a LONG TIME! Make sure you use the minimum amount of isotope possible to minimise the generation of long-lived radioactive waste.
4. The chemicals labelled with the ^{14}C isotope may also pose their own toxicity, flammability or corrosive risks separate from the radiation risk.
5. The beta particles emitted by ^{14}C barely penetrate the outer dead layer of the skin, so ingestion or inhalation pose the greatest risk (not skin exposure).
6. Some ^{14}C -labelled compounds (e.g. C^{14} -glucose) will be rapidly metabolised and the radionuclide exhaled as CO_2 . Other compounds will be eliminated via the urine, and others may persist in the body. The biological half-life varies from minutes to months, depending on the labelled compound.
7. Compounds containing ^{14}C cannot be easily monitored during its use; therefore, special precautions are needed to keep the work environment clean. Wipe testing followed by scintillation counting is the only way to ensure that your work space is not contaminated.
8. As with any lab work, no food, drink or smoking is allowed in the radiation work area. This is of special significance for ^{14}C , which really only poses a threat if inhaled or ingested.
9. Seek medical advice if radioactive material is swallowed or comes in contact with mouth or eyes.
10. All workers using ^{14}C isotopes must have been trained in either the University's Radiation Safety Training course, or an equivalent course.
11. Any work at >4 MBq activity needs to be done by (or under the supervision of) a formally-licensed radiation user ("licence to use" from NSW EPA)
12. Workers with pre-existing medical conditions (e.g. allergy, immunocompromised state, chemical sensitivity) and workers who are pregnant or expecting pregnancy must consult with their supervisor AND medical specialist AND the university's WHS services before performing this procedure. If there are any serious concerns expressed by any of these individuals, this task must not be performed.

Section 3 – Procedure

1. Before commencing work, ensure that the project has been approved by the University Radiation Safety Committee (RSC). Consult with your supervisor or local Radiation Safety Officer (RSO) if unsure.
2. If work involves more than 4 MBq activity of C^{14} , this work must be done in a registered (medium level) radiation laboratory. Work under 4 MBq activity can be done in a normal laboratory provided that a dedicated and well-labelled space is prepared, and is cleaned thoroughly during and after use.
2. Before commencing work, ensure that you have minimised the amount of C^{14} used in the experiment to the minimum necessary to achieve the desired results, and that you have calculated the amount and activity of the waste you expect to produce. Aim to produce waste with activity less than 100 Bq/gram.
== Under current laws, waste containing greater than 100 Bq/gram of radioactivity cannot be disposed of *at all*, so for ^{14}C , this means the waste stays in the University for thousands of years ==
3. Before commencing work, the user name, date, time and amount of radioactivity used must be noted

in the radiation log book.

4. Before commencing work, ensure that you know the emergency procedures and the location of spill kits, eyewashes, and safety showers.
5. Complex procedures should be tested with a full non-radioactive run-through first to minimise the risk to the worker and the generation of waste.
6. Clearly label all containers with isotope, activity, date.
7. The work space (especially bench surfaces and floor) should be checked regularly for any radioactivity. Wipe surfaces with a moistened tissue and use a Scintillation counter to measure radioactivity (**wipe test**).
8. Users must ensure their body is shielded at all times from the ^{14}C with a Perspex shield (1 cm thick).
9. Gloves should be changed regularly and disposed of into designated radioactive waste bins to prevent cross-contamination.
10. All equipment handled while working with ^{14}C isotope must be wiped down with 10% Decon and washed thoroughly. These should be labelled with Radioactive Hazard tape and dedicated to ^{14}C isotope work.
11. Surfaces must be wiped down with 10% Decon if found to be contaminated and at completion of experiments, and the wipe disposed of into designated radioactive waste bins. Isolate waste in sealed, clearly labelled containers.
12. Hands should be thoroughly washed before leaving the area.

Section 4 – Disposal / Spills / Incidents

1. Radioactive waste must be disposed of into dedicated liquid or solid waste Perspex (10 mm thick) containers in the Radiation room. NB: Each isotope has its own set of waste containers. Do not mix isotopes unless this is unavoidable.
2. All spills must be cleaned up immediately, ensuring proper shielding before commencing.
3. For radioactive spills use long tweezers to hold a pad of tissue paper soaked in Decon 90 to decontaminate surfaces.
4. Then check for residual radioactivity using the **wipe test** above.
5. Accumulated solid radioactive waste (if estimated to be at levels **<100 Bq/g**) can be disposed of (consult waste disposal officer).
6. All significant spills of radioactivity or highly toxic substances (e.g., >1L) should be reported to your supervisor, and via an online incident report.
7. All incidents and injuries should be reported to your supervisor, and via an online incident report. Near misses (hazardous situations not leading to an incident) should also be reported.
8. All radioactive waste bags need to be labelled with lab name, the date of disposal and relative amount of radioactivity it contains (high or low). Consult with the School's hazardous waste disposal officer (Ben Monaghan) regarding the appropriate paperwork.

Section 5 – Relevant safety data sheets (to be available and accessible)

1. Carbon-14 Safety data sheet from Moravek Biochemicals

Section 7 - References

1. Safe handling of Carbon-14: http://www.perkinelmer.com/CMSResources/Images/44-130686GDE_Carbon_14_FINAL.pdf
2. Carbon-14 handling precautions: http://www.nukeworker.com/study/radiation_faqs/c14.shtml

SOP Consultation, Training and Approval


Print names and enter signatures and dates to certify that the persons named in this section have been consulted/trained in relation to the development and implementation of this Standard Operating Procedure. WHS Representative (WHS Committee) certifies that consultation has taken place.

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