Australian Government

Department of Education, Employment and Workplace Relations

MSL975014A Perform molecular biology tests and procedures

Revision Number: 1

MSL975014A Perform molecular biology tests and procedures

Modification History

Not applicable.

Unit Descriptor

Unit descriptor	This unit of competency covers the ability to isolate, purify, verify and manipulate biomolecules and their products. This work requires close attention to working with small volumes, multiple-step procedures and prevention of contamination. Personnel are required to apply a wide range of molecular biology tests and procedures.

Application of the Unit

Application of the unit	This unit of competency is applicable to technical officers working in manufacturing (e.g. macro, micro, nanotechnology, pharmaceutical and blood product), food processing, biomedical (e.g. forensics, pathology and veterinary) and environmental industry sectors. All operations must comply with relevant regulations, codes of practice, standards, test methods and enterprise procedures. Results are generally interpreted and reported to supervising scientists, medical, veterinary or other responsible officers of an enterprise, regulatory authority or legal agency. Industry representatives have provided case studies to illustrate the practical application of this unit of competency and to show its relevance in a workplace setting. These can be found at the end of this unit of competency under the section 'This competency in practice'.

Licensing/Regulatory Information

Not applicable.

Pre-Requisites

Prerequisite units		
	MSL974006A	*Perform biological procedures*
	MSL973007A	*Perform microscopic examination*
	MSL973004A	*Perform aseptic techniques*

Employability Skills Information

Employability skills	This unit contains employability skills.

Elements and Performance Criteria Pre-Content

Elements describe the essential outcomes of a unit of competency.	Performance criteria describe the performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge section and the range statement. Assessment of performance is to be consistent with the evidence guide.

Elements and Performance Criteria

ELEMENT	PERFORMANCE CRITERIA
1. Interpret and schedule test requirements	1.1. Review test request to identify samples to be tested, test method and equipment/instruments involved 1.2. Identify hazards and enterprise control measures associated with the sample, preparation methods, reagents and/or equipment
2. Receive and handle samples	2.1. Log and label samples according to enterprise procedures 2.2. Record sample description, compare with specification and note and report discrepancies 2.3. Store samples in accordance with enterprise and test method requirements 2.4. Maintain chain of custody, traceable to the worker, for all samples
3. Prepare equipment and reagents	3.1. Set up equipment/instrumentation in accordance with test method requirements and perform pre-use and safety checks 3.2. Select and collect reagents in accordance with test method requirements 3.3. Prepare and label reagents in accordance with test method requirements
4. Extract, verify and manipulate biomolecules	4.1. Produce/extract biomolecules from samples using appropriate isolation methods 4.2. Prevent contamination of samples by unwanted biomolecules 4.3. Recognise the presence of common inhibitors of biomolecular reactions and take corrective action 4.4. Quantify and qualify biomolecular yields from purified extractions 4.5. Use appropriate techniques to prepare and test a range of biomolecular samples 4.6. Use controls and reference standards to confirm the integrity of biomolecular sample preparation and procedures
5. Process data	5.1. Record test data noting atypical observations 5.2. Ensure results are consistent with reference standards and expectations 5.3. Record and report results in accordance with test methods 5.4. Interpret trends in data and/or results and report out

ELEMENT	PERFORMANCE CRITERIA
	of specification or atypical results promptly to appropriate personnel 5.5. Troubleshoot basic procedure, reagent or equipment problems which have led to atypical data or results
6. Maintain a safe work environment	6.1. Use established safe work practices and personal protective equipment to ensure personal safety and that of other laboratory personnel 6.2. Minimise the generation of wastes 6.3. Ensure the safe disposal of wastes, including hazardous wastes and tested samples 6.4. Clean, care for and store equipment and reagents
7. Report and communicate results	7.1. Record approved data into enterprise system 7.2. Keep accurate, traceable work records to protect the enterprise's intellectual property rights 7.3. Maintain confidentiality and security of enterprise information and laboratory data 7.4. Maintain equipment logs in accordance with enterprise procedures

Required Skills and Knowledge

REQUIRED SKILLS AND KNOWLEDGE

This section describes the skills and knowledge required for this unit.

Required skills

Required skills include:

- conducting work practices in an ethical and professional manner and in accordance with relevant legislation, regulation and codes of practice
- maintaining security, integrity, traceability and identity of samples, sub-samples and work records
- performing molecular biology tests and procedures
- following enterprise safety standards, procedures and practices
- identifying atypical results as out of normal range or an artefact
- tracing and sourcing obvious causes of artefacts
- communicating identified problems to a supervisor
- recording results according to enterprise procedures

Required knowledge

Required knowledge includes:

- hazards and risks in molecular biology laboratories
- common biotechnology terms
- molecular biology principles and concepts underpinning tests/procedures, such as:
  - DNA and RNA structure and function
  - protein structure and function
  - relationship between chemical and physical properties of nucleic acids and proteins and the techniques used for sampling, preparation and testing
  - replication
  - transcription, translation and gene regulation
  - relationship between structure, organisation and function of biomolecules to the storage of information in cells, chromatin, circular and linear chromosomes, RNA, genes and plasmids
  - molecular genetics (molecular nature, organisation and function of genes)
  - molecular mechanisms of DNA mutation and variation
  - DNA transfer in prokaryotes (transformation, conjugation and transduction)
  - restriction enzyme and ligase structure, nomenclature, function, specificity and stability, and cohesive versus blunt ends
- ethical issues associated with biotechnology, such as:
  - use of animals for research
  - genetic modification of organisms and food

REQUIRED SKILLS AND KNOWLEDGE

- use of gene therapy, cloning and stem cells
- in vitro fertilisation
- forensic testing of populations
- importance of commercial confidentiality, protection of intellectual property and patents
- genetic screening of humans
- sex determination and parentage testing of embryos/humans

- importance and appropriate use of validation methods, controls and certified reference materials
- enterprise and/or legal traceability requirements
- relevant health, safety and environment requirements

Evidence Guide

EVIDENCE GUIDE	
The Evidence Guide provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge, range statement and the Assessment Guidelines for the Training Package.	
Overview of assessment	
Critical aspects for assessment and evidence required to demonstrate competency in this unit	Assessors should ensure that candidates can: • conduct work practices in an ethical and professional manner and in accordance with relevant legislation, regulation and codes of practice • maintain security, integrity, traceability and identity of samples, sub-samples and work records • obtain purified biomolecules from samples • prevent/minimise DNA/RNA contamination • perform tests/procedures, such as PCR, ligation and restriction enzyme digestion with appropriate controls • follow enterprise safety standards, procedures and practices • follow enterprise procedures and test methods consistently and accurately • operate test equipment to enterprise standards and/or manufacturer's specification • identify atypical results as out of normal range or an artefact • trace and source obvious causes of artefacts • communicate identified problems to a supervisor • record and communicate results as per enterprise procedures.
Context of and specific resources for assessment	This unit of competency is to be assessed in the workplace or simulated workplace environment. This unit of competency may be assessed with: • *MSL974008A Capture and manage scientific images* • *MSL975001A Perform microbiological tests* • *MSL975008A Apply electrophoretic techniques* • *MSL975009A Apply routine chromatographic techniques* • *MSL975013A Perform tissue and cell culture techniques* • *MSL975020A Apply routine spectrometric*

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	techniques. Resources may include: • laboratory equipped with appropriate test equipment/instruments, standards and reagents • enterprise procedures, standard methods, manuals and supplier documentation.
Method of assessment	The following assessment methods are suggested: • review of test records and workplace documentation completed by the candidate • review of results obtained by the candidate over a period of time to ensure accurate and consistent results are obtained within required timelines • observation of candidate isolating, purifying, verifying and manipulating biomolecules • oral or written questioning • feedback from peers and supervisors. In all cases, practical assessment should be supported by questions to assess underpinning knowledge and those aspects of competency which are difficult to assess directly. Where applicable, reasonable adjustment must be made to work environments and training situations to accommodate ethnicity, age, gender, demographics and disability. Access must be provided to appropriate learning and/or assessment support when required. The language, literacy and numeracy demands of assessment should not be greater than those required to undertake the unit of competency in a work like environment.
This competency in practice	Industry representatives have provided the case studies below to illustrate the practical application of this unit of competency and to show its relevance in a workplace setting. **Biomedical** As part of a diagnostic service to verify progenitor status of livestock, a technician is required to extract DNA from a blood sample, perform the PCR to amplify micro-satellite DNA and prepare the sample for DNA electrophoresis and fragment size analysis. The

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	technician provides documentation to meet evidentiary standards. The technician understands the implications of the tests for the client and is careful to ensure the sample can be traced from the source, that no contamination takes place and that the results are kept confidential. **Food processing** A meat export company has commissioned a study of the effectiveness of the introduction of a 'cold-chain' process to a client country. The company requires rapid results. As part of the monitoring team, a technician is required to perform routine testing of surface swabs of meat samples for bacterial contamination using a PCR analytic technique. Although the tests are quite routine, the technician pays close attention to all aspects of the work as the consequences of invalid results would be severe for the company and laboratory. The technician also keeps comprehensive work records and maintains strict confidentiality.

Range Statement

RANGE STATEMENT	
The range statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance. Bold italicised wording, if used in the performance criteria, is detailed below. Essential operating conditions that may be present with training and assessment (depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts) may also be included.	
Codes of practice	Where reference is made to industry codes of practice, and/or Australian/international standards, it is expected the latest version will be used

Standards, **codes**, **procedures and/or enterprise requirements**	Standards, codes, procedures and/or enterprise requirements may include:
	• Australian and international standards, such as:
	  • AS 2162.1-1996 Verification and use of volumetric apparatus - General - Volumetric glassware
	  • AS 2252 Biological safety cabinets
	  • AS 3753-2001 Recommended practice for chemical analysis by ultraviolet/visible spectrophotometry
	  • AS ISO 17025-2005 General requirements for the competence of testing and calibration laboratories
	  • AS/NZS 1269 Set:2005 Occupational noise management set
	  • AS/NZS 1337 Eye protection
	  • AS/NZS 2161 Set:2008 Occupational protective gloves set
	  • AS/NZS 2210:1994 Occupational protective footwear
	  • AS/NZS 2243.3:2002 Safety in laboratories - Microbiological aspects and containment facilities
	  • AS/NZS 4501 Set:2008 Occupational clothing set
	  • HB 9-1994 Occupational personal protection
	• Australian code of good manufacturing practice for medicinal products (GMP)
	• calibration and maintenance schedules

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	• cleaning, hygiene, personal hygiene requirements • enterprise procedures, standard operating procedures (SOPs) and operating manuals • equipment startup, operation and shutdown procedures • European Union (EU) • Guide to physical containment levels and facility types • guidelines for small scale genetic manipulation work from the gene technology regulations • incident and accident/injury reports • instructions to comply with new legislation, standards, guidelines and codes • material, production and product specifications • National Association of Testing Authorities (NATA) Accreditation programs requirements • National Health and Medical Research Council (NHMRC) • National Registration Authority (NRA) • principles of good laboratory practice (GLP) • production and laboratory schedules • quality manuals and equipment and procedure manuals • quality system and continued improvement processes • safety requirements for equipment, materials or products and material safety data sheets (MSDS) • sampling procedures (labelling, preparation, storage, transport and disposal) • schematics, work flows and laboratory layouts • test procedures (validated and authorised) • Therapeutic Goods Regulations 1009 • United States Food and Drug Administration (USFDA) • validated and authorised test methods • waste minimisation, containment, processing and disposal procedures • World Health Organisation (WHO)
Hazards	Hazards may include: • electric shock (e.g. electrophoresis power

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	packs) • microbiological organisms and agents associated with soil, air, water, blood and blood products, and human or animal tissue and fluids • chemicals, such as acrylamide, temed, phenol and ammonium persulphate • mutagens, such as ethidium bromide, tumour promoters and cytotoxic materials • genetically altered organisms, transformed cultures and organisms • allergenic proteins • radioisotopes • transilluminators and other ultraviolet (UV) light sources • aerosols from broken centrifuge tubes and pipetting • sharps and broken glassware • flammable liquids and gases • cryogenics, such as dry ice and liquid nitrogen • disturbance or interruption of services
Safe work practices and hazard control measures	Safe work practices and hazard control measures may include: • ensuring access to service shut-off points • recognising and observing hazard warnings and safety signs • labelling of samples, reagents, aliquoted samples and hazardous materials • handling and storage of hazardous materials and equipment in accordance with labelling, MSDS and manufacturer's instructions • identifying and reporting operating problems or equipment malfunctions • cleaning and decontaminating equipment and work areas regularly using enterprise procedures • using personal protective clothing and equipment, such as gloves, safety glasses, coveralls, gowns, body suits and respirators • using containment facilities (PCII, PCIII and PCIV physical containment laboratories), containment equipment (biohazard containers,

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	laminar flow cabinets, Class I, II and III biohazard cabinets) and containment procedures • reporting abnormal emissions, discharges and airborne contaminants, such as noise, light, solids, liquids, water/waste water, gases, smoke, vapour, fumes, odour and particulates to appropriate personnel
Equipment and instrumentation	Equipment and instrumentation may include: • pipettes, tubes and racks • heating blocks and polymerase chain reaction (PCR) thermal cyclers • swabs • centrifuges and shakers • electrophoresis tanks and power supplies • incubation cabinets for micro-organisms and cell culture • liquid nitrogen containers • autoclaves • water baths • waste containers • fumehoods • analytical instruments, such as spectrophotometers
Reagents	Reagents may include: • DNA, RNA and proteins • enzymes (restriction, ligation and polymerisation) • buffers • agarose, starch and polyacrylamide for electrophoresis gels • commercial kits for extraction and manipulation of DNA/RNA • phenol and chloroform • ethidium bromide • cell and culture media • DNA, and protein stains • specialised probe materials, such as radioactive, chemical and chemiluminescent labels • blotting membranes

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	• chromatographic media

Molecular biology tests and procedures	Molecular biology tests and procedures may include:
	• generic skills:
	  • sample digestion, extraction, filtration, separation, dialysis, precipitation and centrifugation
	  • accurate and reliable use of micropipettes
	  • application of aseptic techniques
	  • labelling (e.g. digoxin, fluorescence, enzymes, radioactivity and antibodies)
	  • production, labelling and use of DNA probes
	  • preparation of competent bacterial cells
	• preservation and storage of samples (e.g. freezing)
	• extraction of nucleic acids:
	  • isolation of genomic and plasmid DNA and RNA from samples, such as plants, bacterial suspensions, white blood cells, cheek cells, animal and plant tissue, cultured cells and forensic specimens
	  • mini-prep and rapid method isolation of plasmid DNA
	• purification of nucleic acids and proteins:
	  • purification of DNA using cesium gradients, commercial purification buffer kits and columns
	  • purification of recombinant protein by chromatography
	• production of nucleic acids:
	  • amplification of DNA by polymerase chain reaction
	  • transformation with recombinant DNA
	  • identification of transformed organisms with appropriate selection and analytical techniques, such as selective media and insertional inactivation
	• use of enzymes:
	  • storage and handling of enzymes taking into account segregation, temperature,

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	buffers and labelling to avoid wastage, denaturation and contamination • ligation • assistance with analysis of nucleic acids and proteins: • sequencing DNA • assaying of DNA purity and concentration using spectrometric analysis • electrophoresis of restriction enzyme digests of plasmid and genomic DNA using agarose gel • DNA sequencing by Sanger method • testing using restriction fragment length polymorphism (RFLP), probes and microsatellites • detection of protein products by measuring activity, including a range of immunological assays • assistance with hybridisations: • hybridisation to screen cDNA libraries • blotting (southern blots for DNA and Western blots for protein) • cloning: • cloning and sub-cloning of genes and fragments of DNA • applications of techniques: • PCR • methods to detect gene expression, such as RNA hybridisation, immunological techniques and radioactive labelling • testing DNA for sequence variation that is either causative of, or associated with, human disease • testing blood for the presence of viruses using the polymerase chain reaction • identification of species, such as bacterial contaminants • generating data for taxonomic and ecological investigations
Corrective action	Corrective action may involve: • purification

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	• dilution • additional extraction steps
Records	Records may include: • test and calibration results • equipment use, maintenance and servicing history • photo images of gels, radioisotopes and digital images • chain of custody from sample to result • supplier certificates of analysis • quality control/analysis data
Occupational health and safety (OHS) and environmental management requirements	OHS and environmental management requirements: • all operations must comply with enterprise OHS and environmental management requirements, which may be imposed through state/territory or federal legislation - these requirements must not be compromised at any time • all operations assume the potentially hazardous nature of samples and require standard precautions to be applied • where relevant, users should access and apply current industry understanding of infection control issued by the National Health and Medical Research Council (NHMRC) and State and Territory Departments of Health

Unit Sector(s)

Unit sector	Testing

Competency field

Competency field	

Co-requisite units

Co-requisite units		