Australian Government

Department of Education, Employment and Workplace Relations

MSL975001A Perform microbiological tests

Revision Number: 1

MSL975001A Perform microbiological tests

Modification History

Not applicable.

Unit Descriptor

Unit descriptor	This unit of competency covers the ability to contribute to the culture, isolation and identification of micro-organisms, such as bacteria, fungi, viruses, protozoans, algae and parasites in order to investigate the physiology and pathology of plants and animals, monitor the natural environment, and to assist in the production of foods, pharmaceutical goods and other manufactured materials.

Application of the Unit

Application of the unit	This unit of competency is applicable to laboratory technicians and technical officers working in the biomedical, biotechnology, environmental, manufacturing and food processing industry sectors. The results of work performed by technical personnel would normally be integrated, interpreted and reported on by scientists, medical, veterinary or plant pathologists or other responsible officers of an enterprise. Although a supervisor may not always be present, the technician will follow standard operating procedures (SOPs) that will clearly describe the scope of permitted practice in modifying testing procedures, interpreting of data and for communicating test results to people outside the laboratory. It is applicable to investigations of as well as addressing the broader needs of biotechnology and tissue culture applications. 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. Receive samples and process associated request forms	1.1. Check samples and request form details before they are accepted 1.2. Return samples and request forms that do not comply with requirements to source with reasons for non-acceptance 1.3. Log samples, recording details that allow accurate tracking and chain of custody 1.4. Distribute samples for local testing or dispatch samples to other testing facilities 1.5. Store samples appropriately where testing or transport is to be delayed
2. Prepare for safe microbiological work and aseptic applications	2.1. Select work area and equipment required for the safe handling of materials that may contain micro-organisms of specified risk groups 2.2. Wear protective apparel, replacing it when contamination is suspected 2.3. Apply correct disinfection procedures to work areas before and after use 2.4. Locate relevant emergency equipment for timely response to microbiological accidents 2.5. Apply standard precautions when handling biological materials 2.6. Minimise the production and release of aerosols, using biological safety cabinets where necessary 2.7. Clean spills, and report all spills and suspected incidents to supervisor 2.8. Wash hands before and after laboratory work and when contamination is suspected 2.9. Ensure the safe disposal of biohazardous materials and other laboratory wastes in accordance with enterprise procedures
3. Process samples for direct examination	3.1. Prepare thin smears of samples for subsequent staining to enable microscopic identification of cells 3.2. Prepare liquid films of specimens for direct observation for motility or cell structure 3.3. Prepare samples to concentrate material for subsequent staining or microscopy
4. Prepare pure cultures for microbiological work and aseptic	4.1. Select culture media to maximise growth of micro-organisms and cells 4.2. Inoculate media aseptically, applying techniques

ELEMENT	PERFORMANCE CRITERIA
applications	suitable for purpose of culture 4.3. Incubate inoculated media in conditions to optimise growth of organisms and cells 4.4. Subculture on suitable media to optimise production of pure cultures
5. Perform procedures that can assist in the identification of micro-organisms	5.1. Select staining techniques to demonstrate required cellular characteristics 5.2. Stain prepared films to demonstrate diagnostically useful characteristics 5.3. Inoculate and incubate media with pure cultures to assist in the biochemical and immunological identification of micro-organisms 5.4. Perform tests on pure cultures to assist in the biochemical and immunological identification of micro-organisms
6. Estimate the number and/or size of micro-organisms in samples	6.1. Count cells in undiluted samples to indicate the dilution necessary to reliably count organisms in culture 6.2. Prepare serial dilutions of samples aseptically for culture and colony counting 6.3. Count colonies for calculating number of viable organisms per unit volume 6.4. Count micro-organisms in samples and cultures using spectrometric and electronic methodologies, where relevant 6.5. Estimate and document uncertainty of measurement in accordance with enterprise procedures, where relevant
7. Contribute to antibiotic sensitivity testing where required	7.1. Prepare inoculum suitable for antibiotic sensitivity testing 7.2. Dispense or position antibiotic discs as indicated by enterprise protocol 7.3. Incubate inoculated media under conditions to maximise growth of cultured organism 7.4. Read and record sensitivity reactions, noting phenomena that can assist in the correct interpretation of results
8. Maintain records of laboratory work	8.1. Make entries on report forms or into computer systems, accurately calculating, recording or transcribing data as required 8.2. Maintain instrument logs as required by

ELEMENT	PERFORMANCE CRITERIA
	accreditation checklists 8.3. Maintain security and confidentiality of all clinical information, laboratory data and records

Required Skills and Knowledge

REQUIRED SKILLS AND KNOWLEDGE

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

Required skills

Required skills include:

- using protective clothing and biological safety cabinets
- safely performing tasks for the culture, isolation, identification and use of micro-organisms
- not contaminatingoneself, other people, the work area, equipment or the samples or materials under test
- not contaminating media or reagents during manipulations involving transfer of cultures
- identifying artefacts or image aberrations attributable to misalignment or obstruction of light paths or condensers used in bright field, dark ground, phase and fluorescent microscopy, or with other steps in microscopic examinations
- Gram reactions
- describing bacterial colony forms on common media used in bacteriological investigations
- preparing documentation that is accurate, concise and in accordance with enterprise requirements
- reporting incidents or accidents
- disinfectingspillage and safely disposing of all contaminated materials
- decontaminating the work area upon completion of work

Required knowledge

Required knowledge includes:

- microbiological terminology, including, where relevant, that of bacteriology, parasitology, virology and mycology
- disinfection and sterilisation as applied to practical aspects of microbiology
- microbial diversity
- micro-organisms of importance in medicine, in production of foods and other manufactured goods, and in assessment of the natural environment
- cell biology and chemistry related to laboratory phenomena, such as growth and isolation of organisms for identification
- microbial genetics
- rationale for sample dilution when preparing materials for enumerating organisms and other pure culture work (e.g. Most Probable Number (MPN) technique)
- need for accurate identification of sample source (e.g. body, specimen, process line and field location)
- relevant health, safety and environment requirements

REQUIRED SKILLS AND KNOWLEDGE

Specific industry

Additional knowledge requirements may apply for different industry sectors. For example:

Biomedical and biotechnology:

- aspects of normal and abnormal anatomy, physiology, biochemistry and immunology as these pertain to the microbiological investigation of health and disease of animals and plants
- interactions of micro-organisms with hosts
- issues of pathogenicity
- antimicrobial agents and antibiotic susceptibility/sensitivity testing
- use of polymerase chain reaction (PCR) procedures in virology testing
- handling of genetically altered cells
- freezing and thawing of cultured cells
- in tissue culture settings, maintaining the proper growth or storage conditions for the preservation of pure cell culture lines
- maintaining the proper containment and preservation of genetically altered cell lines
- use of micro-organisms in enzyme, vitamin, preservative and amino acid production

Biological and environmental:

- sampling for the microbiological testing of drinking water which should conform to the guidelines published by the National Health and Medical Research Council (NHMRC) and the Australian Water Resources Council
- testing procedures for the microbiological content of water which should be guided by advice of relevant national and state/territory environment protection agencies
- aspects of ecology and other biological disciplines as these pertain to the microbiological investigation of the natural environment
- use of micro-organisms in waste and toxic spill recovery
- use of micro-organisms in site remediation
- identification of micro-organisms to assist in determining the cause, time or nature of pollution

Food processing:

- sampling and test batteries which should conform to relevant food standards code
- aspects of food, pharmaceutical and other relevant processing as these relate to the involvement of micro-organisms in the production process and the microbiological monitoring of the production process
- use of bacteria as probiotics
- multiple resistant antibiotic strains of bacteria and their relevance to the food industry
- importance of hazard analysis and critical control points (HACCP) to production

REQUIRED SKILLS AND KNOWLEDGE
processes • involvement of bacteria in food spoilage and poisoning • identification procedures for determining the source of a food poisoning event • limiting bacterial growth in foods and food preservation

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: • safely perform tasks for the culture, isolation, identification and use of micro-organisms • not contaminate him/herself, other people, the work area, equipment or the samples or materials under test • not contaminate media or reagents during manipulations involving transfer of cultures • identify artefacts or image aberrations attributable to misalignment or obstruction of light paths or condensers used in bright field, dark ground, phase and fluorescent microscopy, or with other steps in microscopic examinations • be consistently accurate in the identification of Gram reactions • be consistently accurate in the description of bacterial colony forms on common media used in bacteriological investigations • preparedata and documentation that is accurate, concise and in accordance with enterprise requirements • report all incidents or accidents • disinfectany spillage and safely dispose of all contaminated materials • decontaminate the work area upon completion of work.
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: • *MSL934002A Apply quality system and continuous improvement processes.* Resources may include: • a standard microbiology laboratory with relevant equipment, samples and reagents

EVIDENCE GUIDE	
	• enterprise procedures, test methods and equipment manuals • under duty of care requirements, off-the-job training providers will only use samples and organisms of a risk category compatible with their laboratory as defined in AS/NZS 2243.3.
Method of assessment	The following assessment methods are suggested: • review of results/data/records generated by the candidate • feedback from peers and supervisors to confirm that enterprise procedures are consistently followed and those results meet workplace requirements • oral and/or written questions associated with laboratory determinations and record keeping • integrated assessment with a case study focus, such as the isolation and identification of bacterial species in a specimen containing two or more species, by relating sample, cultural, morphological and biochemical data, and such from other relevant tests and procedures. 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** A patient's urine sample and request form have been brought to the laboratory for urgent testing. After

EVIDENCE GUIDE	
	preparation of the work area, the technical officer examines a cover-slipped preparation of the sample and notes the presence of pus cells and non-motile rod organisms. In a Gram stain he confirms the presence of pus cells and Gram negative bacilli. They inoculate a MacConkey's and a blood agar plate for growth and isolation of bacteria. After consultation with the supervisor they are asked to set up a direct culture for antibiotic sensitivity testing. The supervisor informs the clinician of the initial findings. The next morning the technical officer assists the supervisor to read the plates. The predominance of lactose fermenting organisms is noted. The supervisor asks the technical officer to set up a biochemical panel to assist in identifying the organism. The supervisor confirms the technical officer's reading of the direct sensitivities plate. Later in the day the team is able to confirm that the patient's urine is infected with Escherichia coli and that the organism is sensitive to a number of antibiotics, including a sulphonamide and a cephalosporin. **Food processing** A swollen can of tuna was received at the company laboratory for microbiological investigation. The technical officer recorded the details supplied with the can and prepared for the investigation. A range of media, including cooked meat media and nutrient broth were prepared and aseptic can opening equipment was sterilised. After the can was opened in the biohazard cabinet, the state of the contents was recorded, pH checked and Gram stains prepared and examined. The media was inoculated with the food samples and incubated at a range of temperatures under aerobic and anaerobic conditions. The can was then emptied for double seam tear down to determine the cause of the spoilage. The next day the technical officer examined the media and broth cultures. From all the data collected the technical officer and supervisor were able to determine that pre-processing spoilage had occurred, probably due to excessive delays in the process prior to can sterilisation. The results were reported to production personnel so that they could follow up the circumstances relating to the delays, and ensure that the SOP had been followed and sufficient product rejected.

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 2252 Biological safety cabinets
	  • AS ISO 17025-2005 General requirements for the competence of testing and calibration laboratories
	  • AS/NZS 2243.3:2002 Safety in laboratories - Microbiological aspects and containment facilities
	  • ISO/TS 19036:2006 Microbiology of food and animal feeding stuffs - Guidelines for the estimation of measurement of uncertainty for quantitative determinations
	  • ISO7218:2007 Microbiology of food and animal feeding stuffs - General requirements and guidance for microbiological examinations
	• cleaning, hygiene, personal hygiene requirements
	• enterprise procedures, standard operating procedures (SOPs) and operating manuals
	• 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
	• quality system and continued improvement processes
	• safety requirements for equipment, materials or products and material safety data sheets

RANGE STATEMENT	
	(MSDS) • sampling procedures (labelling, preparation, storage, transport and disposal) • schematics, work flows and laboratory layouts • test procedures (validated and authorised) • waste minimisation, containment, processing and disposal procedures
Equipment, materials and systems	Equipment, materials and systems may include: • protective and physical containment facilities and equipment for safe handling of micro-organisms personal protective equipment, such as gloves, gowns, masks and safety glasses and gloves for working with extremes of heat and cold • carbon dioxide cabinets and incubators • transfer equipment, such as inoculating loops, pipettes (quantitative and qualitative), flasks, tubes and spatulas • liquid nitrogen containers for cell storage • filtration membranes • microscopes with bright field and other relevant illumination systems and stereomicroscopes • counting chambers for micro-enumeration • colony counting devices • Bunsen burners and bench incinerators • Incubators and water baths • anaerobic jars, fermentation chambers, continuous culture systems and other devices for controlling growth environments of micro-organisms • laboratory information management systems (LIMS), databases, record and filing systems • stains, media, reagents and biological materials necessary for laboratory testing • laboratory glassware and measuring equipment • disinfecting and sterilising solutions and equipment, such as ultraviolet (UV) lamps • materials suitable for the safe containment, collection, processing and disposal of biological and non-biological wastes • autoclaves

RANGE STATEMENT	
Communication	Communication may involve: • supervisors and managers (laboratory, quality and customer service) • personnel in other laboratories in the enterprise or in other enterprises to which work may be referred • customers, patients and clients • external auditors and accreditation agencies (e.g. National Association of Testing Authorities (NATA))
Occupational health and safety (OHS) and environmental management requirements	OHS and environmental management requirements: • all work will assume the potential infectivity of samples and materials presented for laboratory processing • 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		