WorldSkills Standards Specification

Chemical Laboratory Technology

Manufacturing and Engineering Technology

worldskills

 WSC2019_WSSS52

THE WORLDSKILLS STANDARDS SPECIFICATION (WSSS)

GENERAL NOTES ON THE WSSS

The WSSS specifies the knowledge, understanding and specific skills that underpin international best practice in technical and vocational performance. It should reflect a shared global understanding of what the associated work role(s) or occupation(s) represent for industry and business (www.worldskills.org/WSSS).

The skill competition is intended to reflect international best practice as described by the WSSS, and to the extent that it is able to. The Standards Specification is therefore a guide to the required training and preparation for the skill competition.

In the skill competition the assessment of knowledge and understanding will take place through the assessment of performance. There will only be separate tests of knowledge and understanding where there is an overwhelming reason for these.

The Standards Specification is divided into distinct sections with headings and reference numbers added.

Each section is assigned a percentage of the total marks to indicate its relative importance within the Standards Specification. This is often referred to as the "weighting". The sum of all the percentage marks is 100.

The Marking Scheme and Test Project will assess only those skills that are set out in the Standards Specification. They will reflect the Standards Specification as comprehensively as possible within the constraints of the skill competition.

The Marking Scheme and Test Project will follow the allocation of marks within the Standards Specification to the extent practically possible. A variation of five percent is allowed, provided that this does not distort the weightings assigned by the Standards Specification.

WORLDSKILLS STANDARDS SPECIFICATION

SECTION		RELATIVE IMPORTANCE (%)
1	**Work organization and management**	**10**
	The individual needs to know and understand: • the internal and external regulatory environment for the sector • the internal business environment including one's personal role, ethical practice and codes of conduct • health and safety legislation, regulations and best practice • scientific principles for laboratory-based activities • principles for work planning, scheduling, organization and completion • the theoretical basis for applied chemistry including how to apply physical, organic and inorganic chemistry to laboratory work • principles and methods for the safe disposal or recycling of chemicals and chemically related substances	

	The individual shall be able to:
	• maintain personal health and safety at all times, including through personal protective clothing and equipment
	• perform work taking into account relevant regulations, norms, quality, safety and environmental standards
	• implement safety data sheets and the measures and procedures derived from them for
	  • handling, maintaining and repairing laboratory devices, apparatus and equipment
	  • handling, maintaining and disposing of/recycling chemicals used in laboratories
	• follow risk management systems, proactively
	• maintain good housekeeping
	• order and inventory materials to maintain supplies, within budget and budgetary procedures
	• ensure electronic equipment is fit for purpose
	• inspect structures and materials for their condition and usability
	• work independently, taking responsibility for initiating and completing tasks within the parameters of the work role
	• estimate the requirements of a piece of work in terms of time, costs, resources and materials needed for completion.
	• develop specific goals and plans to prioritize, organize and accomplish work, relative to set objectives and targets
	• investigate alternative means of resolving delays
	• adjust activities as required, keeping relevant others informed.	

2	**Communication and interpersonal skills**	**10**
	The individual needs to know and understand: • principles of communication • principles for human interactivity • the impact of one's own work on others, especially where related to diversity and equality • the specialist terminology associated with the work role and sector • the intention and purpose of statistical methods for data presentation • the limitations in reporting results • the uses of ICT, management information systems, and databases in chemical environments	

	The individual shall be able to:
	• establish and maintain interpersonal relations
	• work and interact with others including within teams
	• provide technical support to chemists or other specialists
	• communicate using a full range of techniques for speaking, writing, body language, and active listening, for formal and informal purposes
	• use specialist terminology including where these are in another language
	• obtain information from all relevant sources, citing sources as required
	• read and apply the content of technical documents relating to
	  • analyses
	  • formulations
	  • procedural instructions
	  • specifications
	  • diagrams
	• listen actively, asking questions appropriately for full understanding
	• use laboratory information and laboratory management systems, both digital and paper based
	• order information and actions according to logic or given rules
	• apply statistical techniques for data presentation
	• use a range of textual and graphical methods to inform others
	• communicate scientific information appropriately for the audience or recipient
	• prepare and give formal and informal presentations
	• seek, accept and, as appropriate, build on feedback and constructive criticism	

3	**Techniques, procedures, and methods**	**35**
	The individual needs to know and understand: • the foundations of inorganic chemistry relative to structure and bonding • the chemistry of important elements and compounds • the principles and practical techniques of organic chemistry • reaction mechanisms and functional group conversions • concepts and practical techniques in physical chemistry, including thermodynamics, reaction kinetics, conductivity, electrochemical cells and electrolysis • principles of laboratory techniques and scientific experimentation • principles of project management, and how these apply to laboratory work • the requirements for the development and validation of analytical methods and instrumentation, including understanding suitable sampling methods • trends in support for experiments, including the use of kits	

	The individual shall be able to:
	• prepare for laboratory tasks using the appropriate scientific techniques, procedures and methods
	• use specified instrumentation and laboratory equipment, including calibration as required
	• evaluate the quality of materials or products to be used
	• design or fabricate experimental apparatus to develop new products or processes
	• perform laboratory tasks using specified methodologies, including standard operating procedures
	• perform specific sampling duties including preparation and processing of samples as well as separation processes for mixtures of liquids and solids
	• perform cleaning and concentration processes such as
	  • distilling
	  • extracting
	  • evaporating
	  • chromatography
	  • potentiometry
	  • conductometry
	• use titrimetric, volumetric and gravimetric methods
	• use instrumental and electroanalytical methods such as
	  • photometry
	  • chromatography
	  • potentiometry
	  • conductometry
	  • electrophoresis
	• set up and conduct experiments, extractions, tests and analyses, using techniques such as
	  • chromatography
	  • spectroscopy
	  • physical or chemical separation techniques
	  • microscopy
	  • electrophoresis
	• determine the structures of organic and inorganic compounds
	• use synthesis techniques for organic, inorganic and polymer synthesis
	• prepare chemical solutions for products or processes, following standardized formulae, or create experimental formulae
	• take account of the need for validation of analytical procedures, methods and instrumentation, including the use of suitable sampling methods.	

4	**Data processing and record keeping**	**10**
	The individual needs to know and understand: • the rules relating to record keeping, traceability and confidentiality • procedures for maintaining the security of records, in all forms used • the capabilities of software for recording and displaying data • processes for ensuring the accuracy of information • the implications of error and inaccuracy • the required methods for referencing and citations	

	The individual shall be able to: • log and document laboratory work, including by using given house style, IT and statistical methods • process and collate digital information from automated digital machines • produce reliable, accurate data • present the results of laboratory work and problem solving clearly and concisely in written and oral form • write technical reports, using graphs and charts as appropriate • check own work for codification, categorization, calculations, tabulations and completeness • acknowledge errors, inaccuracies and shortcomings promptly • arrange for information or data to be verified or audited • archive documentation	
5	**Analysis, interpretation, and evaluation**	**15**
	The individual needs to know and understand: • principles of quality management • applications of quality management to production processes • mathematical and statistical techniques used in analysis of scientific data • the nature, probabilities, sources and types of errors • principles and methods for quality control • principles and applications for continuous improvement • the physiological implications of the work role	
	The individual shall be able to: • maintain efficient kinaesthetic and fine motor skills • apply personal techniques for sustained attentiveness and focus • follow procedures to meet the workplace's quality standards • analyse, interpret and evaluate data and identify results requiring further investigation • evaluate information to determine compliance with standards • work autonomously within the parameters of the work role • identify the meaning of outputs from the analytical techniques used and assess their importance • use correct computational, statistical and mathematical methods or formulae to solve problems • identify by analysis the underlying principles, reasons, or facts determining results.	
6	**Problem solving through the application of scientific methods**	
	The individual needs to know and understand: • principles and applications of scientific rules and methods to solve problems • principles for critical thinking and complex problem solving • the scope and limits of their role and one's understanding and expertise in relation to problem solving	

	The individual shall be able to:
	• recognize when there is either a problem or the likelihood of a problem
	• identify or detect patterns within larger and distracting material
	• apply suitable scientific methods to identify causes and achieve solutions
	• use logic and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions or approaches to problems by, for example
	  • applying general rules to specific issues to produce reasonable conclusions
	  • combining pieces of information to form reasonable conclusions or rules
	• use creative thinking and problem solving to challenge assumptions, innovate, make new proposals and build on existing ideas
	• seek advice from senior colleagues as appropriate
	• make recommendations for improved workflows or scientific solutions
	• support new investigations and follow-up experiments for routine and non-routine analytical tasks
	• take responsibility for personal development, demonstrating commitment to learning and self-improvement	

7	**Trends in applied Chemistry**	**10**
	The individual needs to know and understand: • the interdisciplinary nature of science • the role of applied chemistry in scientific developments • the growing impact of digitization • the growing importance of sustainability • new ethical concerns derived from new possibilities	
	The individual shall be able to: • install, commission and test automated laboratory systems • install and configure programs • develop simple programs • switch on, switch off and operate automated laboratory systems • optimize and implement adjustments and changes to automated laboratory systems • maintain and service automated laboratory systems • systematically search, localize and eliminate faults, defects and malfunctions on automated laboratory systems • respond appropriately to change and change management processes	
	Total	**100**

REFERENCES FOR INDUSTRY CONSULTATION

WorldSkills is committed to ensuring that the WorldSkills Standards Specifications fully reflect the dynamism of internationally recognized best practice in industry and business. To do this WorldSkills approaches a number of organizations across the world that can offer feedback on the draft Description of the Associated Role and WorldSkills Standards Specification on a two-yearly cycle.

In parallel to this, WSI consults three international occupational classifications and databases:

- ISCO-08: (http://www.ilo.org/public/english/bureau/stat/isco/isco08/)
- ESCO: (https://ec.europa.eu/esco/portal/home)
- O*NET OnLine (www.**oneto**nline.org/)