Dearbhú Cáilíochta agus Cáilíochtaí Éireann
Quality and Qualifications Ireland

QQI AWARDS STANDARDS.

Science and Technology

Core Competence

December 2023

Foreword

The Qualifications and Quality Assurance Act 2012 requires QQI to 'determine the standards of knowledge, skill or competence to be acquired, and where appropriate, demonstrated, by a learner before an award may be made by the Authority'. QQI award standards are based on the level indicators and award type descriptors of the National Framework of Qualifications (NFQ) and are governed by QQI Policy for the Determination of Award Standards.

Based on systematic engagement with subject matter expertise and public consultation, award standards for certain broad fields of learning were developed for QQI awards at level 1-4 on the NFQ. These standards represent an elaboration of the generic descriptors of the NFQ. They should facilitate experts in particular fields of learning to create the link between their programmes' intended learning outcomes and the NFQ. Each award standard is cumulative, the statements of knowledge, skill and competence at NFQ levels 2, 3 and 4, build on the attainment of standards at lower levels, which are not necessarily reproduced at the higher level(s). The implementation and use of these standards is subject to QQI Policy and Criteria for the Validation of Programmes and QQI Policy for the Making of Awards. Whenever an award standard changes, programmes must be updated and validated against the new standards.

These standards are not programme specifications. It is through these, however, that the relationship between a programme, its component parts and the NFQ should be evident. The standards are a reference point and a point of comparison against which individual programmes may be justified.

They are intended to provide general guidance for articulating the learning outcomes associated with a particular field of learning. In designing programmes, providers must take cognisance of the standards for specific fields of learning where they generally relate to the programme being developed. It is, however, recognised that there is a significant growth in multi-disciplinary/inter-disciplinary programmes; there are emerging fields of learning; and in addition, within each field there is the vast spectrum of programmes possible based on a wide range of purpose. In this context, it is not possible to have a standard, or multiple standards, that cater for the complete range of programmes possible. It is therefore expected that the standards for specific fields of learning will be used as reference points for the design of programmes. In designing programmes, providers can draw from more than one standard.

In drafting the standards every effort has been made to ensure that they will provide for flexibility and variety in the design of programmes and therefore encourage innovation within an overall agreed framework. It is not expected that all programmes will include every learning outcome identified in a standard. It is, however, expected that many programmes will include learning outcomes that are not included in the relevant standard.

When designing a programme, each learning outcome in the standard should be considered. Where departure from these is necessary, it should be justified in the context of the specific orientation of the programme and other facts pertaining to it. Each programme provider should be able to demonstrate how the design and content of its own programmes has been informed by the standard.

The level descriptors of the Framework, the award type descriptors and consequently the standards for the specific fields of learning are divided into three different types of learning outcomes - knowledge, skill and competence. These strands are further subdivided into eight sub-strands. Each strand/sub-strand is important. The relative weighting of each strand in a programme will vary from programme to programme. The weighting will be determined by many factors, including for example, the practical nature of a programme, or otherwise.

Each strand/sub-strand should be addressed appropriately in every programme. Where a programme is multidisciplinary or inter-disciplinary in nature, the use of more than one standard may be necessary. In such cases, the scope, depth and balance of knowledge, skill and competence should be attended to.

The titles of awards made by QQI on foot of these award standards shall be consistent with QQI Policy on the Making of Awards with an exception in the case of major awards where the named award stem shall have the following form: 'Level X Certificate in Lifelong Learning in' [specialisation].

These standards are determined by QQI under section 49(1) of the Qualifications (Education and Training) Act 2012.

AWARD STANDARDS – SCIENCE AND TECHNOLOGY (CORE COMPETENCE) AT NFQ LEVELS 1 TO 4

Purpose	The purpose of this broad award standard is to help design programmes that will equip learners with relevant knowledge, skills and competence in science and technology.
	'Competence in science refers to the ability and willingness to explain the natural world by making use of the body of knowledge and methodology employed, including observation and experimentation, in order to identify questions and to draw evidence-based conclusions. Competences in technology and engineering are applications of that knowledge and methodology in response to perceived human wants or needs. Competence in science, technology and engineering involves an understanding of the changes caused by human activity and responsibility as an individual citizen.'*
	This standard is aligned to the Key Competences for Lifelong Learning. This competence relates specifically to the "Core Competence in Science and Technology" European Commission, Directorate-General for Education, Youth, Sport and Culture, *Key competences for lifelong learning*, Publications Office, 2019. https://data.europa.eu/doi/10.2766/291008

Context	Essential knowledge, skills and attitudes related to this competence*
	Knowledge
	For science, technology and engineering, essential knowledge comprises the basic principles of the natural world, fundamental scientific concepts, theories, principles and methods, technology and technological products and processes, as well as an understanding of the impact of science, technology, engineering and human activity in general on the natural world. These competences should enable individuals to better understand the advances, limitations and risks of scientific theories, applications and technology in societies at large (in relation to decision-making, values, moral questions, culture, etc.).
	Skill
	Skills include the understanding of science as a process for the investigation through specific methodologies, including observations and controlled experiments, the ability to use logical and rational thought to verify a hypothesis and the readiness to discard one's own convictions when they contradict new experimental findings. It includes the ability to use and handle technological tools and machines as well as scientific data to achieve a goal or to reach an evidence-based decision or conclusion.
	Individuals should also be able to recognise the essential features of scientific inquiry and have the ability to communicate the conclusions and reasoning that led to them.
	Attitude
	Competence includes an attitude of critical appreciation and curiosity, a concern for ethical issues and support for both safety and environmental sustainability, in particular as regards scientific and technological progress in relation to oneself, family, community, and global issues."
	*EU Council Recommendation on Key Competences for Lifelong Learning, Official Journal of the European Union, 2018
References	C_2018189EN.01000101.xml (europa.eu)

Note: The indicators at each level build on the skills from the previous one.
The outcomes at each NFQ level include those of all the lower levels in the same sub-strand unless stated otherwise.

KNOWLEDGE				
NFQ	**LEVEL 1**	**LEVEL 2**	**LEVEL 3**	**LEVEL 4**
Knowledge breadth	Elementary knowledge	Knowledge that is narrow in range	Knowledge moderately broad in range	Broad range of knowledge
	The learner should be able to demonstrate:	The learner should be able to demonstrate:	The learner should be able to demonstrate:	The learner should be able to demonstrate:
	Basic knowledge of: • how science works • the nature of cause and effect • the Earth and space • relationships between science and mathematics.	Basic knowledge of: • scientific theory • scientific laws • the role and contribution of science and scientists • physical, biological, and chemical world.	General knowledge of: • the nature of, influence and role of science in daily life • how scientists work • how scientific ideas change over time. • Foundations of: • Earth and space • physical, biological, and chemical world • mathematics.	Knowledge and understanding of: • the nature of, influence and the role of science in daily life • how scientists work • how scientific ideas change over time • the Earth and space • physical, biological, and chemical world • mathematics.

Knowledge kind	Demonstrable by recognition or recall	Concrete in reference and basic in comprehension	Mainly concrete in reference and with some comprehension of relationship between knowledge elements	Mainly concrete in reference and with some elements of abstraction or theory
	The learner should be able to show awareness of: • everyday types of scientific data and claims • basic scientific terms.	The learner should be able to show awareness of: • the role of science in society • invention and discovery • the impact of science and technology on Earth's sustainability • basic scientific data and terms. • the concept of the 'scientific method'.	The learner should be able to show knowledge of: • the role of science in society in terms of its personal, social and global importance • scientists' contributions through invention and discovery • how society influences scientific research • how Earth processes and human factors influence the Earth's sustainability • routine laws and formulas in science.	The learner should be able to show knowledge of: • the physical, chemical, biological and mathematical world applied in science and societal settings • scientific processes, systems, strategies, hypotheses in physical, chemical, biological and mathematical settings • specified scientific skills, techniques and methods • common technological applications used in medicine • the impact of science and technology on the local and global environment • the impact of science and technology on energy sustainability.

KNOWLEDGE				
NFQ	**LEVEL 1**	**LEVEL 2**	**LEVEL 3**	**LEVEL 4**
Know-how and skill range	Demonstrate basic practical skills and carry out directed activity using basic tools	Demonstrate limited range of basic practical skills, including the use of relevant tools	Demonstrate a limited range or practical and cognitive skills and tools	Demonstrate a moderate range of practical and cognitive skills and tools
	The learner should be able to: • appreciate the significance of science • be curious about how the world works • appreciate the role of experiments in science • identify main stages in problem solving • use digital technology in creative ways • communicate basic scientific findings.	The learner should be able to: • describe the main features of scientific method • design a basic experiment • report and communicate basic scientific findings • describe how science and technology affect the world, both positively and negatively • carry out basic experiments that show scientific processes used to solve practical problems • identify routine types of technology used in science • use simple models to predict outcomes in practical situations.	The learner should be able to: • understand living things and how they interact with each other and the environment • use scientific models to explore the natural world and relationships and patterns between physical, chemical and biological observables • describe, illustrate, interpret, predict, and explain patterns and relationships in physical, chemical and biological observables • explore physical observables in relation to motion, energy, and electricity to better understand basic concepts such as length, time, mass and temperature • make and accurately record numerical observations and measurements involving calculation (for example, the area of a rectangle) and report these using the appropriate terms and language • communicate scientific findings, using scientific representations, • symbols and conventions using digital and other media • show an understanding of the concept of a scientific theory and some simple scientific laws and carry out experiments to test them. (for example, the formula relating weight to spring extension.) • understand the impact of science, technology and human activity on the natural world.	The learner should be able to: • understand applications of science and its interface with technology • undertake practical laboratory skills, with support • follow health and safety procedures in a laboratory environment • identify the role of technology in scientific activity.

Know-how and skill selectivity	Perform processes that are repetitive and predictable	Perform a sequence of routine tasks given clear direction	Select from a limited range of varied procedures and apply known solutions to a limited range of predictable problems	Select from a range of procedures and apply known solutions to a variety of predictable problems
	Be able to: • identify some routine scientific processes, tools, and techniques • try out solutions to well defined scientific questions • follow routine scientific processes • select basic digital technology to communicate with colleagues.	Be able to: • use with routine scientific processes, tools, and techniques • test solutions to well defined scientific questions • identify a limited range of routine scientific processes.	Be able to: • develop observational and recording skills • use scientific patterns of thought and 'manipulative skills' in problem solving • select appropriate digital technology to access, manage and share content.	Be able to: • select a range of appropriate procedures from solutions to solve a variety of scientific problems • evaluate and use scientific information to draw conclusions and determine solutions to predictable problems • select appropriate digital technology to communicate and report issues.

KNOWLEDGE				
NFQ	**LEVEL 1**	**LEVEL 2**	**LEVEL 3**	**LEVEL 4**
Competence context	Act in closely defined and highly structured contexts	Act in a limited range of predictable and structured contexts	Act within a limited range of contexts	Act in familiar and unfamiliar contexts
	Show awareness of some characteristics of the lifecycles of familiar things. Be curious about science and technology.	Able to identify some characteristics of the lifecycles of familiar things. Able to recognise appropriate use of language and concepts within a variety of everyday context.	Apply a limited range of digital: • technology and scientific skills • techniques • practices while in a supervised setting.	Apply a moderate range of digital: • technology and scientific skills • techniques • practices while operating within a supervised environment.

KNOWLEDGE				
NFQ	**LEVEL 1**	**LEVEL 2**	**LEVEL 3**	**LEVEL 4**
Competence role	Act in a limited range of roles	Act in a range of roles under direction	Act under direction with limited autonomy; function within familiar, homogenous groups	Act with considerable amount of responsibility and autonomy
	Awareness and basic knowledge, skill and competence in everyday science and technology.	Basic knowledge, skill and competence in everyday science and technology.	The learner should be aware of their responsibilities to: • colleagues • the wider community • the natural environment.	The learner should understand their responsibilities to: • colleagues • the wider community • the natural environment.

KNOWLEDGE

NFQ	LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4
Competence learning to learn	**Learn to sequence learning tasks; learn to access and use a range of learning resources**	**Learn to learn in a disciplined manner in a well-structured and supervised environment**	**Learn to learn within a managed environment**	**Learn to take responsibility for own learning within a supervised environment**
	Learn how to use simple digital technologies to work and communicate with others.	Learn how to work with others through digital technology.	Develop a scientific mindset through: • class • laboratory and, or off-site activities. This should foster: • investigation • imagination • curiosity • creativity. Learn how to use digital technology to support own learning.	Develop a scientific literacy and knowledge of science's: • principles • procedures • concepts • cultural and historical aspects. Develop capacity to use digital technology to manage their learning.

KNOWLEDGE				
NFQ	LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4
Competence insight	Begin to demonstrate awareness of independent role for self	Demonstrate awareness of independent role for self	Assume limited responsibility for consistency of self-understanding and behaviour	Assume partial responsibility for consistency of self-understanding and behaviour
	Show a positive attitude and curiosity about the world. Show ability to see digital technology as an enabler.	Show an awareness that scientific knowledge comes from discoveries based on systematic objective observations of the natural world. Show an awareness of: • the impact of science and technology on Earth's sustainability • the importance of staying safe online • using digital technology responsibly.	Be aware of own attitudes, preferred strategies and personal inclinations in different situations and their influence in science settings. Be responsible, safe and ethical when using digital technology.	Show respect for all and understand the need for appropriate behaviour in science settings. Reflect on learning to improve own awareness and growth in science settings.