Ireland

Department of Education and Skills

National Council for Curriculum and Assessment

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Introduction

Overview of Education System

Ireland's education system is largely centralized. Overall responsibility for education lies with the Minister for Education and Skills, who is a member of the Irish government and responsible to the national parliament. In practice, the Department of Education and Skills (DES), together with a number of bodies under its aegis, is responsible for running the Irish education system. Almost all primary and post-primary schools are state-funded, and are required to operate under both the Education Act (1998)[1] and the curriculum, assessment, and evaluation frameworks established by the DES, based on advice from the National Council for Curriculum and Assessment (NCCA). The NCCA is a statutory body with responsibility for advising the Minister for Education and Skills on curriculum and assessment for early childhood education and for primary and post-primary schools. The inspectorate division of the DES has the responsibility of evaluating and reporting on educational provision in all primary and post-primary schools and centers of education supported by the DES. Although state-funded, the majority of schools are owned and managed by private organizations, mainly church authorities or religious orders. Individual boards of management govern each school and are expected to operate in accordance with centrally agreed procedures.

The Irish education system comprises primary, post-primary, third level, and further education.[a] In addition, children are eligible for two years of free early childhood care and education (ECCE) between the ages of 2 years, 8 months and 5 years, 6 months, or until entry to primary school.

Primary schools operate an eight year program, consisting of two preprimary years (Junior Infants and Senior Infants), followed by Grades 1 to 6. A child must be at least 4 years old at the start of the school year (September) to enroll in primary school and must have started formal education by age 6 years. Since the introduction of the ECCE scheme in 2015, most children now start primary school as Junior Infants at almost 5 years of age. In 2018, 75 percent of Junior Infants

[a] A small number of schools offer curricula other than the Irish curriculum, including the International Baccalaureate.

were at least 4 years, 8 months commencing school. The Irish primary education sector comprises state-funded primary schools, special schools, and private primary schools. The state-funded primary schools include religious schools, nondenominational schools, multidenominational schools, and *scoileanna lán-Ghaeilge* (Irish-medium schools). All state-funded schools follow the Primary School Curriculum.[2] Most private schools offer a broadly similar curriculum.

Ireland has a variety of post-primary school types, including vocational schools, comprehensive schools, and privately owned and managed secondary schools. The curriculum offered in all school types is substantially the same. Second level education consists of a three-year junior cycle followed by a two- or three-year senior cycle. The senior cycle can last three years if students opt to complete a Transition Year following completion of the junior cycle. The Transition Year consists of a year without formal examinations that enables students to experience a range of educational inputs, including work experience placements.[3] For their final two years, senior cycle students follow one of three programs, each leading to a terminal state examination—the Leaving Certificate, the Leaving Certificate Vocational Programme, or the Leaving Certificate Applied. The structure, composition, and content of the senior cycle is currently under review by the NCCA.

At lower secondary school, mathematics is taught at two levels (higher or ordinary). Three syllabus levels are offered at upper secondary school (higher, ordinary, or foundation). Science is taught at a common level to all students in combined science classes at lower secondary level, while upper secondary students enroll in individual science subjects—Physics, Chemistry, Biology, Agricultural Science, or Applied Mathematics, certified at either higher or ordinary level. Levels differ mainly in terms of depth, and all sciences have practical elements built into their syllabi.

Use and Impact of TIMSS

Ireland has participated in three previous TIMSS assessments: 1995 (at both primary and post-primary levels), 2011 (at primary level only), and 2015 (at both levels). It is likely that Irish participation in TIMSS 1995 contributed to the thinking behind the introduction of the current primary school science curriculum (1999), which represented a significant expansion of the previous curriculum (1971) in terms of skill objectives and subject content. TIMSS 2011 was underway while the National Literacy and Numeracy Strategy,[4,5] introduced in 2011, was being prepared. The strategy specifically references TIMSS as one benchmark against which to compare the performance of Irish students, within a broader strategy to enhance literacy and numeracy. The international and national reporting of TIMSS 2011[6,7] and TIMSS 2015[8] received considerable media and political attention. Some of the media coverage went beyond achievement results by highlighting the breadth of contextual data (for example, student attitudes, sense of belonging, and readiness to learn in the classroom).[9,10] The influence of the frameworks and methodologies used in developing TIMSS and PIRLS is also evident in the design and administration of the regular National Assessments of Mathematics and English Reading (NAMER) in Ireland.

The Mathematics Curriculum in Primary and Lower Secondary Grades

The mathematics component of the Primary School Curriculum[11] is for all children from Junior Infant classes (preprimary) to Grade 6. The mathematics curriculum aims to help all children to:

- Develop a positive attitude toward mathematics and to appreciate its practical applications in life
- Develop problem-solving skills and the ability to use mathematics in everyday life
- Use mathematical language effectively and accurately
- Understand mathematical concepts and processes at a level commensurate to their development and ability
- Become proficient in fundamental mathematical skills and in recalling basic number facts

In Grade 4, the curriculum is presented in five areas, known as strands—Number, Algebra, Shape and Space, Measures, and Data. The strands are interrelated, such that student understanding in one strand is dependent on and supportive of ideas and concepts in other strands. The strands are divided into strand units in which student learning is described using content objectives. Unlike the rest of the Primary School Curriculum—in which subject learning content is categorized at four levels, each comprising a two-year grade band—the content in the Mathematics Curriculum is specified in single year grades.

Exhibit 1 shows the curriculum strands and strand units for Grade 4, and provides some specific examples of the types of skills students are able to develop through their mathematical work. These skills include applying and problem solving; understanding and recalling; communicating and expressing; integrating and connecting; and reasoning and implementing.

Exhibit 1: Summary of Mathematics Curriculum for Grade 4, and Sample Skills

Strand	Strand Unit	Mathematical Learning Objective
Number	Place value	Round whole numbers to nearest 1,000
	Operations	Solve word problems involving adding and subtracting within 9,999
	Fractions	Solve problems involving fractions
	Decimals	Order decimals on a number line
Algebra	Number patterns and sequences	Explore, recognize, and record patterns in number, 0–9,999; describe sequences
	Number sentences	Translate a one-step word problem into a number sentence, and solve
Shape and Space	Two-dimensional (2D) shapes	Identify, classify, compare, draw, tessellate, and make patterns with 2D shapes
	Three-dimensional (3D) shapes	Identify, classify, and construct 3D shapes; describe relationship of 3D shapes with constituent 2D shapes
	Symmetry	Use understanding of line symmetry to complete missing half of a shape, picture, or pattern
	Lines and angles	Describe intersecting lines and their angles; classify angles as greater than, less than, or equal to a right angle
Measures	Length	Add, subtract, multiply, and carry out simple division of units of length (m, cm, km)

Strand	Strand Unit	Mathematical Learning Objective
	Area	Estimate, compare, and measure the area of regular and irregular shapes (cm^2, m^2)
	Weight	Add, subtract, multiply, and carry out simple division of units of weight (kg and g)
	Capacity	Add, subtract, multiply, and carry out simple division of units of capacity (l, ml)
	Time	Work with times and dates; add and subtract hours and minutes
	Money	Add, subtract, multiply, and carry out simple division of money (euros and cents)
Data	Representing and interpreting data	Use data sets
	Chance	Identify and record outcomes of simple random processes

The syllabus at the lower secondary level[12] comprises five strands:

- Statistics and Probability
- Geometry and Trigonometry
- Number
- Algebra
- Functions

The syllabus was introduced on a phased basis from September 2010, with all students engaging with all five strands of the revised syllabus for the first time in September 2014. The syllabus is set out in strands to provide continuity with the Primary School Curriculum. Teachers are encouraged to teach mathematics in contexts that enable learners to see connections within mathematics, between mathematics and other subjects, and between mathematics and its real life applications. In this way, students can achieve the objectives of lower secondary mathematics and develop proficiency in the following areas of mathematical competence:

- Conceptual understanding—Comprehension of mathematical concepts, operations, and relations
- Procedural fluency—Skill in carrying out procedures flexibly, accurately, efficiently, and appropriately
- Strategic competence—Ability to formulate, represent, and solve mathematical problems in both familiar and unfamiliar contexts
- Adaptive reasoning—Capacity for logical thought, reflection, explanation, justification, and communication
- Productive disposition—Habitual inclination to see mathematics as sensible, useful, and worthwhile, coupled with a belief in diligence, perseverance, and one's own efficacy

Problem solving (i.e., engaging in a task for which the solution is not immediately obvious) is integral to the lower secondary mathematics classroom. The syllabus stipulates that problem solving should not be met in isolation; rather, it should permeate all aspects of the teaching and learning experience. Problems may comprise purely mathematical matters or an applied context. In a mathematics problem solving environment, students are expected to:

- Make sense of the problem
- Make sense of the mathematics they can learn and use when doing the problem
- Arrive at a correct solution to the problem

In the lower secondary mathematics classroom, teachers focus on helping students to develop mathematical knowledge and skills through the process of solving problems, rather than on helping them to find solutions. They prioritize generating class discussion and facilitating mathematical reasoning as students engage in problem solving. Students learn to analyze problems and break them down into manageable steps, to reflect on their strategies and those of others, and to adjust their own approach where necessary.

Teachers play an important role in helping students develop these kinds of skills. By choosing tasks that present learners with a challenge, they activate learners' mathematical thinking processes, as opposed to imitative thinking processes. By encouraging them to share, explain, and justify their problem solving strategies, those that work as well as those that do not work, teachers can help learners to develop robust and deep mathematical understanding as well as confidence in their mathematical ability.

The Science Curriculum in Primary and Lower Secondary Grades

Science, together with history and geography, is part of Social, Environmental, and Scientific Education (SESE) in the Primary School Curriculum in Ireland.[13] The current curriculum was officially implemented in schools in 2003–2004, following professional development for teachers in the previous school year. The science curriculum aims to help children develop basic scientific ideas and understanding about the biological and physical aspects of the world, and the processes through which they develop this knowledge and understanding. The curriculum also aims to foster positive attitudes toward science, and to encourage children to examine and appreciate how science and technology affect their lives and the environment.

The Primary School Science Curriculum is presented as four levels, each of which covers two years of primary school. Level 3, comprising third and fourth grade science, is the relevant level for fourth grade TIMSS participants. The curriculum has a skills section and a content section.

The curriculum is designed to provide students with two key types of skill—working scientifically, and designing and making—and reflects a constructivist and collaborative approach. The curriculum emphasizes the importance of starting with children's own ideas and learning through interactions with objects and materials, and their classmates. Children "create" new knowledge and learn about scientific concepts. Working scientifically involves:

- Observing and constructing hypotheses
- Predicting
- Planning and carrying out investigations, with an emphasis on fair testing
- Recording and analyzing results
- Sharing and discussing findings
- Extending thinking to accommodate new findings

Designing and making involves looking for practical solutions to problems by exploring and assessing everyday objects in terms of their functionality, their component materials, and their design, and then using this information to plan, design, make, and evaluate artifacts or models. These activities are intended to harness and nurture children's creative and imaginative capacities.

The curriculum content is composed of four strands: Living Things, Materials, Energy and Forces, and Environmental Awareness and Care. These strands, which are subdivided into strand units, outline the concepts and ideas to be explored by children as they work scientifically, and are involved in designing and making. Children are expected to experience all Level 3 strand units over the course of the third and fourth grades. Exhibit 2 shows the strands and strand units for Level 3, and provides some examples of what children are expected to learn within each strand unit.

Exhibit 2: Summary of Science Curriculum for Level 3 (Grades 3–4), and Sample Skills

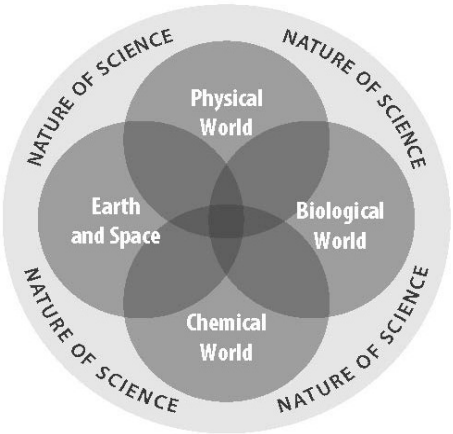
Strand	Strand Unit	Scientific Learning Objective
Living Things	Human life	▪ Be aware of names and structures of some internal and external body organs and the importance of food for energy and growth ▪ Understand physical changes in males and females to adulthood
	Plant and animal life	▪ Investigate plants and animals in local environments; be aware of those in wider environments ▪ Discuss simple food chains
Energy and Forces	Light	▪ Understand that light is a form of energy, comes from natural and artificial sources, and can be broken into different colors ▪ Be aware of the dangers of looking at the sun
	Sound	▪ Understand that sound is a form of energy, how it is made, and that it travels through materials ▪ Identify a variety of sounds in the environment
	Heat	▪ Understand that the sun is the earth's most important heat source, and that heat can be transferred ▪ Know what temperature is, and use a thermometer
	Magnetism and electricity	▪ Classify materials as magnetic and nonmagnetic, and as conductors and insulators ▪ Be aware of the dangers of electricity
	Forces	▪ Explore how objects move and are slowed down ▪ Explore how levers can help lift objects

Strand	Strand Unit	Scientific Learning Objective
Materials	Properties and characteristics	▪ Recognize that materials can be solid, liquid, or gaseous ▪ Distinguish between raw and manufactured materials ▪ Compare and group materials ▪ Investigate the use of materials in construction
	Materials and change	▪ Explore the effects of heating and cooling on solids, liquids, and gases ▪ Explore ways to separate materials
Environmental Awareness and Care	Environmental awareness	▪ Identify positive aspects of natural and built environments; recognize the interrelationship of living and nonliving elements ▪ Recognize how people's actions affect their environment
	Science and the environment	▪ Explore the application and positive contribution of science and technology to society ▪ Investigate positive and negative effects of human activities on environments
	Caring for the environment	▪ Look at ways to improve the local environment ▪ Nurture a sense of responsibility toward the earth

A revised syllabus for lower secondary level science[14] was introduced in September 2016. The course is practical and investigative, emphasizing hands-on student involvement in learning. It enables students to build on their learning in primary school and to further develop their knowledge of and about science. Students enhance their scientific literacy by developing their ability to explain phenomena scientifically; their understanding of scientific inquiry; and their ability to interpret and analyze scientific evidence and data to draw appropriate conclusions.

The lower secondary science specification focuses on the development of students' knowledge of and about science through the unifying strand, Nature of Science, and the four contextual strands—Physical World, Chemical World, Biological World, and Earth and Space, as shown in Exhibit 3. Although not compulsory, approximately 90 percent of lower secondary students take science as a subject. The curriculum provides suitable preparation but is not a requirement for the study of one or more science subjects at the upper secondary level.

Exhibit 3: Overview of the Specification for Junior Cycle Science



In lower secondary science, students learn to:

- Carry out investigations
- Communicate in science
- Develop an appreciation of the role and contribution of science and scientists to society

The learning outcomes are pursued through the contextual strands as students develop their content knowledge of science through scientific inquiry. In doing so, students construct a coherent body of facts, learn how and where to access knowledge, and develop scientific habits of mind and reasoning skills to build a foundation for understanding the events and phenomena they encounter in everyday life. This approach makes the science classroom a dynamic and interactive space, in which students are active participants in their development. They can engage not only in experimental activities and discussion within the classroom, but also in researching and evaluating information to look beyond claims and opinions to analyze the evidence that supports them.

There is a dual approach to assessment in lower secondary education, and junior cycle science students have the opportunity to display evidence of their learning through two internally assessed classroom-based assessments, an externally assessed assessment task, and an external written examination paper of two hours duration at a common level, set and marked externally by the State Examinations Commission (SEC).

Professional Development Requirements and Programs

Although teachers are expected to participate regularly in professional development, it is not compulsory. From September 2012, all newly qualified teachers, both primary and post-primary, are required to complete a national induction program that includes specific components related to teaching numeracy and assessment. The *Droichead* (Bridge) model of induction and probation for newly qualified teachers is being rolled out across primary and post-primary schools and will be the route for induction in all schools by 2020.

The Professional Development Service for Teachers and the Special Education Support Service are lead agencies for professional development at both the primary and post-primary levels, while the Junior Cycle for Teachers (JCT) offers professional development support services for those teaching Grades 7 to 9. Other resources include a national network of Education Centres and appropriate groups, bodies, and institutions that offer professional development programs from which teachers can select courses appropriate to their needs, such as the Centre for School Leadership.

The introduction of a new post-primary program in 2010, Project Maths, highlighted a need to provide an additional qualification in mathematics to established mathematics teachers who did not meet the requirements as set out in Regulation Four of The Teaching Council Registration Regulations 2009.[15] The Professional Diploma for Mathematics Teaching was developed to meet this need and was fully funded by the DES for teachers who were teaching mathematics and did not meet the requirements.

At the primary school level, additional targeted training has been provided to teachers in the implementation of the 1999 curriculum and in Mathematics Recovery in schools serving students from a socioeconomically disadvantaged background.[16] Substantial professional development supports the introduction of the most recent lower secondary mathematics curriculum that is currently being rolled out to schools. JCT currently provides professional development to post-primary teachers of graphics and technology in the junior cycle.

Monitoring Student Progress in Mathematics and Science

Section 22 of the Education Act requires schools "to regularly evaluate students and periodically report the results of the evaluation to the students and their parents."[17] Schools are required under the National Strategy to Improve Literacy and Numeracy (2011) to provide meaningful information to parents about student progress. To assist them in this regard, the NCCA produced a range of report card templates and published assessment guidelines for primary schools in 2007,[18] reflecting a wide range of assessment approaches at the primary level, such as teacher questioning and observation, conferencing, and student self-assessment.

The National Strategy requires standardized test results in English, Mathematics, and (for Irish-medium schools) Irish to be reported to parents and to the Department of Education and Skills annually. The DES requires these results at three points of the primary school cycle—second, fourth, and sixth grades. In practice, annual administration of standardized mathematics tests to all students in Grades 1 to 6 is almost universal. Individual schools choose their own assessment instruments, with the proviso that standardized tests have been normalized for an Irish population and are consistent with the Primary School Curriculum. The National Strategy does not require individual schools to publish data, nor does it allow data to be used for the compilation of school comparison league tables.

Although Ireland does not operate a national mandatory system of assessment for primary schools, it monitors standards through the regular assessment of reading and mathematics performance in a representative sample of schools. The Educational Research Centre regularly conducts national assessments of reading and mathematics on behalf of the Department of Education and Skills. The main functions of the national assessments are to assess national standards, identify factors related to test performance, and inform policy. Almost 8,200 students in Grades 2 and 6 took part in the most recent survey in 2014.[19] The next National Assessment of Mathematics and English Reading (NAMER) takes place in 2021.

In the primary classroom, assessment tools include teacher observation, teacher-designed tasks and tests, concept mapping, work samples, portfolios and projects, curriculum profiles, diagnostic testing, and standardized testing. Standardized tests are available for mathematics (including, from 2019, in an online format) but not for science. A criterion-referenced standardized assessment in science—the Irish Primary Science Achievement Tests (IPSA-T)—is available for primary schools but not widely used at the national level.

At the post-primary level, students take teacher-made assessments at the end of most terms. These assessments are generally in written format in mathematics, with some elements of practical work assessed in science in classroom-based assessments (described below). It is normal for report cards, with grades and teacher comments, to be issued after such assessments. At the end of lower secondary school, all students take formal state examinations in mathematics, at higher or ordinary level. Standardized tests of mathematics for students at the end of Grade 8 have been developed and made available for online administration since 2017 but are not mandated by the DES and have received limited uptake in schools, to date. Almost 90 percent of students choose science as a subject. The introduction of a new specification for science in 2016 means that students undertake two classroom-based assessments that are assessed by their classroom teacher in addition to a written external examination. The classroom-based assessments involve students completing science investigations and experiments.

The revised Junior Cycle Framework[20] reduces the focus on externally assessed examinations as a means of assessing students at junior cycle, and increases the prominence of classroom-based assessment and formative assessment. In each subject, two structured classroom-based assessments have been introduced that contribute to and build on the use of formative assessment in the classroom. Each assessment is drawn from a variety of assessment types that include project tasks, investigations, and practical or designing and making tasks. The new assessments were introduced to students commencing post-primary education in September 2016, for science, and in September 2018, for mathematics.

Special Initiatives in Mathematics and Science Education

Ireland has a number of mathematics and science initiatives at the primary and post-primary levels. The informal sector includes contributions from business and industry, professional organizations, foundations, social enterprises, science centers, teachers, volunteers, and government agencies. Activities include local school projects, exhibitions, science festivals, Science Week, Maths Week, and competitions at local, regional, national, and international levels. It is worth noting that many of the initiatives in Ireland that are in place to promote science receive both public and private funding.

Centers such as the National Centre for Excellence in Mathematics, Science Teaching and Learning at the University of Limerick, the Eureka Centre at University College Cork, and the Centre for the Advancement of Science and Mathematics Teaching & Learning at Dublin City University, among others, are examples of third-level institutions that work closely with teachers and students to research good practice in science education and provide professional development.

At the primary level, the Discover Primary Science and Maths Programme is part of Science Foundation Ireland's Discover Programme, which aims to increase interest in science, technology, engineering, and mathematics (STEM) among students, teachers, and members of the public. The Royal Dublin Society (RDS) Primary Science Fair and British Telecommunications (BT) Young Scientist and Technology Exhibition provide a public forum for primary schools across Ireland to

showcase STEM projects, receive feedback from experts in the field, and learn from viewing other projects at a major exhibition. Other programs include the Mathletes Challenge, which uses the Khan Academy's free online learning platform, the RDS STEM Learning Programme, a professional development program for developing teachers' conceptual and pedagogical knowledge of mathematics and science, and the Intel Mini Scientist Exhibition.

At the post-primary level, there are a number of special initiatives that support science education. For example, STEPS is an Engineers Ireland program that encourages primary and post-primary students to explore the world of science, technology, engineering, and mathematics, while promoting engineering as a career choice. Discover Sensors is a program that promotes practical inquiry-based science teaching and learning tools and techniques, and incorporates learning assessments in about 200 schools.[21] Scientific inquiry is popular with students, as evidenced by the growing popularity of events such as the BT Young Scientist and Technology Exhibition, and SciFest. Both science festivals are Irish initiatives that encourage active, collaborative, inquiry-based learning. Participation in the Young Scientist and Technology Exhibition grew from 230 students, in 1963, to just over 1,100 students in 2019. Participation in SciFest has grown from more than 1,600 students in 2008, to over 10,000 students in 2018.

The John Hooper Medal for Statistics Competition, an annual competition that is open to all post-primary schools, has recently been introduced. It is awarded by the Central Statistics Office for outstanding projects in statistics. Maths Circles is an initiative designed for post-primary students to encourage problem solving, investigation, and discovery. Maths Eyes is an initiative designed for both primary and post-primary students to encourage them to see mathematics in the world around them.

Suggested Readings

A wide range of documents are available for download from the websites of the Department of Education and Skills (www.education.ie), the National Council for Curriculum and Assessment (www.ncca.ie), and the Educational Research Centre (www.erc.ie).

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