Israel

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Introduction

Overview of Education System

The education system in Israel is relatively centralized under the supervision of the Ministry of Education, which determines national curricula, including a compulsory core curriculum, and implements national and international education testing policies. The K–12 education system consists of three levels: preprimary education (ages 3 to 6); primary (elementary) education (kindergarten to Grade 6 for students ages 6 to 12); and secondary education, comprising lower secondary education (Grades 7 to 9 for students ages 12 to 15) and upper secondary (senior high) education (Grades 10 to 12 for students ages 15 to 18).[1] Although most primary schools offer 6 years of education (for students ages 6 to 12), approximately 25% of primary schools offer 8 years of education. Education is compulsory for students ages 3 to 18, but this requirement is being implemented gradually and currently is fully implemented only for ages 5 to 16.

Almost all schools in the education system are public. Schools are generally divided by their language of instruction—Hebrew in the Jewish sector and Arabic in the Arab sector. Within each sector, schools are grouped under supervision frameworks that represent different cultural and religious subsectors in Israel. Within the Jewish sector, these frameworks include secular, religious, and ultraorthodox supervision; within the Arab sector, there are separate supervisory bodies for the Arab, Bedouin, and Druze populations. Under each supervision framework, the curriculum has different content and a different proportion of religious and cultural studies. However, the curricula for core subjects, including mathematics and science and technology at both the primary and lower secondary levels, have no special tracks associated with it and serve all students equally.[a]

Use and Impact of TIMSS

Israel has been participating in TIMSS for eighth grade since 1999. During this period, the curricula for mathematics and science at the primary and lower secondary levels have undergone revision, and new standards have been adopted. In mathematics, the domains covered at the primary and lower secondary levels were aligned to generate a link between the

a The information in this chapter compiles both official sources and personal communication with the Chief Inspector of Science and Technology Studies and the Chief Inspector of Mathematics Studies.

primary and lower secondary curricula. In science, topics were reorganized to fit the designated instruction hours, and a teaching sequence was determined.

TIMSS provides valid and reliable information about the Israeli education system from an international perspective. An objective comparison with other education systems in the world is a valuable resource for policymakers investigating the strengths and weaknesses of the education system in Israel. Furthermore, participation in these international studies enables Israel to learn about new and current approaches to teaching mathematics and science, and to examine its own curricula in relation to curricular approaches in other countries.

The Mathematics Curriculum in Primary and Lower Secondary Grades

Both the primary and the lower secondary mathematics curricula in Israel have undergone significant revision over the last 2 decades. In the wake of several committees that identified deficiencies in the mathematics curricula and in the pedagogical approaches to mathematics instruction, as well as achievement gaps between subpopulations in Israel, the primary school curriculum was introduced in 2006. The goal of the 2006 curriculum for primary schools is for students to learn basic concepts and structures in the Numbers and Geometry domains, as well as develop mathematical skills and abilities, such as number sense and geometric insight, computational skills, the ability to use mathematical tools to solve word problems, and conceptual understanding and knowledge of mathematical language.[2] Attaining mathematical concepts is considered a cumulative process dependent on students' ability to grasp mathematical concepts and link them to other school subjects and the real world. The primary school mathematics curriculum, up to fourth grade, includes the following topics:

- Numbers and Operation, and Data Investigation—natural numbers, the four arithmetic operations (addition, subtraction, multiplication, and division), fractions (arithmetic operations, common denominators, and decimal equivalents), percentages, and proportion
- Geometry and Measurement—geometric shapes (two-dimensional shapes, such as polygons, triangles, squares, and rectangles, and three-dimensional shapes, such as rectangular prisms); measurement of length, area, volume, angles, etc.; transformations and symmetry; properties of quadrilaterals; circles; classification of three-dimensional shapes; and computation of volume

In 2009, development of a new lower secondary curriculum began, and its implementation commenced in 2011. The curriculum integrates the mathematical knowledge learned in primary school with new and more advanced topics in lower secondary school and uses a spiral approach to curricular planning to expand on topics previously taught. This spiral sequencing enables students to return to basic ideas as new topics and concepts are continually added over the course of the curriculum to solidify and deepen understanding and knowledge. The curriculum merges three domains—Numbers, Algebra, and Geometry—and cultivates students'

ability to use multidomain problem-solving methods. The new curriculum is intended to include at least 150 instruction hours in each grade and includes recommendations concerning the allocation of instruction hours to help teachers with planning. The curriculum was implemented gradually starting in 2011 for Grade 7 and in 2013 for Grade 9. Exhibit 1 presents the allocation of instruction hours for mathematics content domains. Although mathematics literacy does not yet explicitly exist in the national curriculum, the curriculum recommends teaching mathematics in daily life contexts and integrating mathematics into other subject matters. To emphasize mathematics literacy and its integration in the curriculum within all the grade levels, teaching units focused on mathematical literacy were developed and teachers were recommended to integrate them in their instruction.

During the COVID-19 pandemic (2020–2021), some changes were introduced to the curriculum. These changes were reflected mainly by some modifications in the instructional sequences that reduced the breadth and depth of some of the topics; however, not all the main topics were affected by these changes.

Exhibit 1: Instruction Hours for Mathematics, Grades 7 to 9

Grade	Content Domain	Instruction Hours
7	Algebra	68
	Numbers	30
	Geometry	52
8	Algebra	58
	Numbers	54
	Geometry	38
9	Algebra	80
	Numbers	10
	Geometry	60

The main mathematics topics are distributed over the three grade levels of lower secondary school, as presented in Exhibit 2 (topics for Grade 8 are described in detail).[3]

Exhibit 2: Mathematics Topics, Grades 7 to 9

Grade	Content Domain	Instruction Hours	Topics
7	Numbers	30	negative numbers, fractions and decimals, and the Cartesian plane
	Algebra	68	patterns, algebraic expressions, equations, and introduction to functions
	Geometry	52	perimeter and area (rectangles, triangles, parallelograms, rhombuses, and trapezoids), volume and surface area (cubes and boxes), and measurements of length, area, volume, and angles; introduction to proofs in geometry (basic concepts of theorems of triangles and angles)
8	Numbers	54	ratio and proportion, percentage, descriptive statistics, chance, real numbers, and square roots. Ratio is a major theme later in Grade 8 and includes a variety of topics (scale, proportion, similarity of triangles, the slope of a straight line, linear functions of the form $y=mx$, percentages, relative frequency, and probability).
	Algebra	58	algebraic expressions; linear functions; solving equations, inequalities, and simultaneous equations; and using linear functions to solve problems. The concept of linear functions lays a foundation for studying methods for solving linear equations, systems of linear equations with two unknowns, inequalities, equations with absolute values, and word problems whose solutions involve these methods.
	Geometry	38	geometric shapes and Euclidean geometry, including triangle congruence, properties of isosceles triangles, similar triangles, the Pythagorean theorem (including its use in the coordinate plane), theorems, and proofs. The key concepts taught in eighth-grade geometry are isosceles triangles and similar triangles, which serve as a basis for further studies of deductive proof in geometry. Attention is directed mainly toward enhancing student awareness of the correctness and logic of statements of congruence and similarity, and why the conditions set forth in congruence and similarity theorems are necessary and sufficient.

Exhibit 2: Mathematics Topics, Grades 7 to 9 (Continued)

Grade	Content Domain	Instruction Hours	Topics
9	Algebra	80	advanced algebraic expressions and algebraic techniques, exponents and exponentiation expressions, quadratic functions and functions' attributes (graphs and properties and quadratic equations and functions in general, and understanding different kinds of functions and their graphs and properties). All topics include solving word problems and conventional and real-world problems.
	Numbers	10	probability and graphs
	Geometry	60	Euclidean geometry: theorems and proofs of triangles (isosceles, equilateral, and right triangles) and quadrilaterals

The Science Curriculum in Primary and Lower Secondary Grades

Since the early 1990s, the science curriculum in Israel at both the primary and lower secondary levels has focused on science and technology literacy and has included the mastery of significant facts, concepts, principles, and theories in science and technology; a grasp of scientific and technological processes and their impact on society; and the ability to use this knowledge to serve the needs of individuals and society. In addition to presenting central concepts and ideas of science and technology, the general objectives of the curriculum are to highlight the similarities between the two disciplines; to indicate their contributions to society and their limitations; and to develop students' intellectual competencies, such as inquiry and decision-making skills ("minds on"), as well as practical lab skills and design process ("hands on"). In general, the study of science is not compulsory beyond 10th grade. Students are not required to study toward a matriculation certificate in science and technology.

The science and technology curriculum at the primary level includes six content domains and a set of cognitive and practical skills to be attained. The content domains are Matters, Energy, The Manmade World, Systems and Processes in Living Organisms, Ecosystems, and Earth and the Universe. Each domain is divided into subdomains that contain a specified and detailed list of topics. These topics are further elaborated into content domains and specifications (milestones) for each grade level, with each one describing the scientific, technological, and societal aspects of every topic.

The topics are arranged according to six age levels, and the learning progression is planned in a spiral that takes students from one level to the next as they advance through the appropriate cognitive developmental stages. The syllabus does not define the sequencing of topics, and teachers may sequence and connect topics as they see fit.

In addition to defining content domains, the curriculum defines cognitive and performance skills (minds on, hands on). These skills are linked with recommended learning activities that combine content and skills. The cognitive skills are based on an official document, *The Renewable Learning Perception*,[b] and emphasize the scientific literacy skills of scientific orientation, scientific explanation, inquiry, and interpretation of data.

The curriculum at the lower secondary level comprises the same domains as the curriculum at the primary level (except Earth and the Universe, which is included under the geography curriculum). Building on the primary school syllabus, the science and technology curriculum at the lower secondary level defines the content domains and the cognitive and performance skills. The curriculum provides a foundation for students who will major in other disciplines and forms a basis for advanced science and technology studies for students choosing to major in these disciplines. In 2013, compulsory hands-on activities were officially defined as part of the curriculum. The main science topics are distributed over the three grade levels of lower secondary school, as presented in Exhibit 3 (topics for Grade 8 are described in detail). The curriculum also recommends that an investigative problem-solving project be integrated with the scientific contents of one of the domains in ninth grade.

Exhibit 3: Science Topics, Grades 7 to 9

Grade	Content Domain	Instruction Hours	Topics
7	Materials	12	properties and uses
		30	physical changes in matter
	Energy	8	forms and transformations
	Cell Structure and Function	8	
	Systems and Processes in Living Things	34	circulatory system
	Design Processes	8	technology
8	Electricity and Magnetism	10	electric charge and current; energy transformation in electrical circuits; electricity and safety; renewable and nonrenewable sources of energy; energy production, usage, and ecological cost
	Forces and Motion	13	interaction, forces and changes, daily use of forces, simple machines and levers, movement and speed

b See https://pop.education.gov.il/perceptions-trends/renewable-learning-concept/ for more information.

Exhibit 3: Science Topics, Grades 7 to 9 (Continued)

Grade	Content Domain	Instruction Hours	Topics
8	Materials: Elements, Compounds, and Mixtures	30	elements, the atomic model, the periodic table; material changes (chemical reactions); mixtures (excluding mixtures' separation methods and factors affecting dissolving rate); conservation of matter; energy transformations; ecological cost of the use of materials
	Cell Structure and Function	4	genetic material (DNA) in cells, function and organization in chromosomes; all cells come from other cells; cell division, mitosis and meiosis; structure-function relationship of cells; sperm and egg cells; differentiation
	Systems and Processes of Living Organisms: Reproduction	23	reproductive forms in organisms; courting behavior; human reproductive system; mate finding; fertilization; embryonic development; maturation; human intervention in reproduction and development processes; health and reproduction
	Ecosystems	13	organisms' adaptations to the environment; interactions between living organisms in the ecosystem; materials and energy transitions in the ecosystem; ecological balance and human impact
	Technological Systems	7	
	Earth Science	additional subject	astronomy, geology (internal forces) and geomorphology (external forces), climate and weather, Earth's resources
9	Materials	20	chemical bonds (ionic bonds are elective); chemical energy, carbon and its compounds; the influence of materials' usage on individuals, society, and the environment
	Cell Structure and Function	10	
	Systems and Processes in Living Organisms	30	nutrition and heredity
	Physics and Technology	40	energy and technological systems; the impact of energy uses on individuals, society, and environment

Teacher Professional Development Requirements and Programs

Professional Development Requirements

All teachers in primary and lower and upper secondary schools are required to complete at least 30 hours of professional development each academic year. The total number of learning hours teachers complete annually is adjusted according to the reform conditions they are employed under and their rank. The courses are funded by the Ministry and teachers pay only a nominal fee.

The professional development framework includes four learning areas: subject matter (e.g., language, mathematics, science and technology); pedagogical area; teacher-role programs designed to train teachers for fulfilling specific roles in school (coordinators, deputy principals, etc.); and specialized programs for areas the Ministry of Education aims to promote. Teacher learning takes place in diverse frameworks: self-study, learning communities (these professional communities consist of about 20 teachers that hold biweekly synchronous or asynchronous meetings sharing their experiences, conducting action research, and developing new materials and teaching strategies), group learning, and organizational school-based learning tailored to address the learners' and schools' needs. Professional development programs for teachers are planned in each discipline, following policymakers' recommendations, and are delivered by specialized professional development centers for teachers, teachers' colleges, and universities.

In most schools, one mathematics teacher and one science and technology teacher serve as subject coordinators, instructing other teachers and taking part in developing the school's pedagogy, assessment and learning practices, and policies. As of 2021 in primary schools and as of 2022 in secondary schools, pedagogical mentoring—conducted by experienced teachers with the goal of helping in-service teachers stay up-to-date with the content knowledge and sequencing defined in school learning programs—is purchased by schools within the GEFEN (Hebrew for "grapevine" and an acronym for Management and Pedagogical Flexibility) program (a new system for principals for planning and managing all budget issues).

Ongoing Professional Development Programs

Despite the Ministry of Education's recommendations, most primary school teachers hold only a teaching certificate and lack academic background for teaching mathematics or science. This stems from a shortage of suitable candidates for vacant positions, especially in primary schools. In lower and upper secondary schools, most mathematics and science teachers hold the required qualifications: a BSc degree (or a postgraduate science or math degree) and a teaching certificate.

Over the past few years, colleges of education have begun to offer an alternative pathway to obtaining a teaching certificate for second-career candidates (who hold a bachelor's degree and have a few years of work experience in another field). Most candidates for a teaching certificate in mathematics and science and technology come from careers in mathematics and science, such as high-tech and engineering positions. The programs for career changers are typically 2 years long and focus on the basic pedagogical component of the full 4-year program.

Some colleges of education offer a combination of a master's degree in education with a teaching certificate (MTeach). Every program requires teachers to complete an induction year before a teaching license can be granted. In-service primary school teachers can also obtain a qualification to teach science and mathematics by participating in extensive professional development programs at colleges of education.

Monitoring Student Progress in Mathematics and Science

Student progress in mathematics and science in Israel is monitored by internal and external evaluation systems. The internal evaluation system in schools is administered by school staff and constitutes the central component of the teaching-learning assessment process. The evaluation is based on schools' internal tests and assessment of student activities and projects. Student reports are distributed at least twice a year, and student achievement is reported using numerical grades (on a scale that goes up to 100), accompanied by descriptive grades.

The external evaluation system in Israel is led by the National Authority for Measurement and Evaluation in Education (known by its Hebrew acronym, RAMA). The external evaluation is designed to provide a comprehensive, diverse, up-to-date, and valid picture of the state of schools in Israel and to provide school principals with data that will help them manage resources and lead changes. In addition, it assesses the education system to determine whether it has achieved the performance indicators it has set for itself. The external evaluation system also provides important information to school inspectors and districts, the school community, local authorities, education networks, and the general public.

The external evaluation is conducted annually. The new assessment model, implemented in 2024, includes a combination of student achievement tests in different subjects and grade levels alongside questionnaires regarding school climate and pedagogical setting (administered to principals, teachers, and students). The assessment is designed so that each school is assessed in one subject area included in the national assessment scheme (mathematics, science and technology, English, 21st-century skills), creating a representative national sample for each subject area each year. Beginning in 2024, science and technology is assessed at Grade 6 and at Grade 9; mathematics is assessed at Grade 6, and beginning in 2025, it will also be assessed at Grade 9.

Special Initiatives in Mathematics and Science Education

After a decrease over several years in the number of students majoring in mathematics and the sciences, the Ministry of Education has set objectives with the goal of increasing the number of upper secondary students choosing to major in scientific disciplines and advanced mathematics, especially as a path to science, technology, engineering, and mathematics (STEM) professions. Additional efforts are being made to help low-achieving students in mathematics

to complete the basic level of three learning units[c] on their secondary school certification exam. Main initiatives in science and mathematics education implemented in lower and upper secondary schools are as follows:

- Science and Technology Future Professionals (*Atuda Madait-Technologit*)[4]—Begun in 2011, this program aims to attract students at the lower secondary level to advanced science, technology, mathematics, and computer studies beginning in seventh grade, with a view to promoting excellence in these subjects and increasing the number of students taking their certification exams at the level of five units in mathematics and science and technology. Approximately 260 schools now participate in this program. Additional instruction hours in mathematics, physics, computer science, and robotics are allocated to students in the program. Students explore topics beyond the compulsory curriculum and study topics within the curriculum in depth. Teachers in this program participate in specialized workshops, and schools are equipped to provide additional laboratory activities. At the secondary level, students in the program are expected to study advanced mathematics at the level of five units and major in two subjects within science and technology. Additional hours are allocated to learning in small groups.
- Beginning in 2016, the Ministry of Education allocated 2 extra hours in mathematics to ninth-grade students who require additional support in high-level mathematics, with the aim of strengthening them and encouraging them to fulfill their potential in mathematics.
- To prioritize the establishment of a suitable infrastructure in both subject areas, digital learning environments and spaces were developed, and dedicated teacher development activities were introduced. In mathematics, teachers direct students to use existing mathematics applets and mathematic software such as Desmos and Geogebra. Digital literacy tasks in mathematics[d] and science and technology[e] were developed by the Ministry of Education for students in secondary school, and teachers were advised to incorporate them on a regular basis in instruction. In science, the use of computers is more integral to teaching, especially for literature searches, data processing, simulations, and models.

c The extent of the width and depth of matriculation exams for all subjects is measured by learning units. For mathematics, the range is three learning units (basic level) to five learning units (highest level).

d See https://pop.education.gov.il/tchumey_daat/matmatika/chativat-beynayim/teaching-mathematics/literacy-assignments-7th-grade/ for examples.

e See https://pop.education.gov.il/tchumey_daat/teaching-units-stock/?class=103883&topic=73120&loadCount=1 for examples.

References

1 Ministry of Education, Culture and Sports. (2004). *Facts and figures.* Jerusalem: State of Israel, Ministry of Education, Economics & Budgeting Administration.

2 Ministry of Education, Pedagogical Secretariat. (2006). *Primary mathematics curriculum* (in Hebrew). http://meyda.education.gov.il/files/Tochniyot_Limudim/Math/Yesodi/mavo1.pdf

3 Ministry of Education, Pedagogical Secretariat. (2009). *Curriculum in mathematics for grades 7, 8, 9, in all sectors* (in Hebrew). Retrieved from http://cms.education.gov.il/EducationCMS/Units/Tochniyot_Limudim/Math_Chatav/TachnitLimudim/

4 Ministry of Education, Science and Technology Administration. (2014). *S&T future professionals (Atuda Madait-Technologit)* (in Hebrew). Retrieved from http://cms.education.gov.il/EducationCMS/Units/Mazkirut_Pedagogit/MadaTechnologya/atuda_madaeit_tec/information.htm