Oman

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Introduction

Overview of Education System

For centuries, the government of the Sultanate of Oman has understood the importance of education in leading comprehensive development of the country, and it directed its education policy toward expanding education and making it accessible to all. In the present stage of the country's development, the government's priority is to improve the quality of education. The need now is to promote innovative knowledge and appropriate values so that Omani human resources possess the required competencies to make a positive contribution to national development.

Recognizing the importance of ensuring that education keeps pace with rapid developments in knowledge, technology, and the economy, the late Sultan Qaboos bin Said stressed the need for Omani students to develop awareness and responsibility, as well as the importance of helping students acquire experience and skills to reach higher cognitive levels. At the annual sitting of the Council of Oman in 2011 and 2012, he emphasized the revision of education policies, plans, and programs to keep pace with the changes that the country is going through. His Majesty Haitham bin Tarik continues the efforts established by his predecessor, stating, "He built a sturdy and constant framework for education—at all its levels—and specializations that are tapped by generations of citizens who relished knowledge and expertise. This is reflected in Oman Vision 2040, which focuses on developing the different levels of the educational system[,] and improving educational outcomes has become necessary to build Omanis' confidence in their identity and commitment to their social values."[1,2,3,4]

The Ministry of Education is responsible for managing education at all stages (Grades 1 to 12). Ministry responsibilities include developing educational policies, curricula, and schoolbooks; developing methods to assess student performance; and overseeing and providing technical and administrative support for teaching and administrative personnel in schools. The Directorates of General Education across all governorates are responsible for implementing the Ministry's plan. In return, the Ministry is working toward conferring more financial and administrative powers on these directorates.[5,6,7]

In 1998, the Ministry of Education began a project to reform the basic education system into one that emphasizes a student-centered, active learning pedagogy and formative continuous assessment. Activity-based learning is central to the new basic education system, and resources for hands-on activities are incorporated into the mathematics and science curricula to provide for active learning classrooms. Exhibit 1 presents the structure of the basic education system.

Exhibit 1: Structure of Basic Education

Level	Grades	Structure
Cycle One	1–4	• coeducational • 1,600 minutes per week • 175 days per year
Cycle Two	5–10	• separate boys' and girls' schools • 1,600 minutes per week • 207 days per year (includes examination days)
Postbasic (Secondary)	11–12	• separate boys' and girls' schools • 1,600 minutes per week • 207 days per year (includes examination days)

The Ministry of Education is also responsible for approving the curricula of all private schools in Oman. Monolingual schools deliver instruction in Arabic; bilingual schools deliver instruction in Arabic and English. International schools use various languages of instruction and follow the educational program of their particular country (e.g., India, Sri Lanka, France, Pakistan, the United Kingdom, the United States).

Schools are free to select their curriculum and learning resources, but the curriculum must be submitted to the Ministry for approval, and students are required to participate in standardized testing. The number of private schools has been growing in recent years, but compared with neighboring Gulf countries, the private sector continues to play a relatively small role in Oman, which means the government continues to assume most of the cost of providing education.

Use and Impact of TIMSS

The Sultanate of Oman participated in TIMSS 2007, TIMSS 2011, TIMSS 2015, and TIMSS 2019 with the objective of developing and improving the quality of education. All four cycles had a direct impact on curricula and assessment in the Omani education system as follows:

- curricula—The scope and sequence of both the mathematics and the science curricula were revised completely for all grades. The Cambridge Curriculum (a customized curriculum by Oman) was introduced and implemented gradually in all public schools.
- assessment—The low performance of Omani students in TIMSS 2007 and TIMSS 2011 was attributed mainly to their lack of familiarity with the types of questions

(and the phrasing of questions) in the assessments. Subsequently, the Ministry has developed an assessment system that focuses on educating teachers in the following two main aspects of question development:

- classification of questions—Teachers have been trained on classifying questions into the four cognitive domains of knowledge, understanding, application, and reasoning. Students are assessed according to these domains in both mathematics and science. A new training program has been introduced in the 2023–2024 academic year to develop items based on the cognitive domains with the aim of creating an item construction community.
- format and wording of questions—Teachers have been trained to develop questions inspired by TIMSS and to incorporate them into classroom instruction daily, specifically in implementing the Cambridge Curriculum for mathematics and science.

The results of TIMSS 2019 indicate the positive impact of these initiatives. Although student performance was again below the international average in TIMSS 2019, performance in both grades and in both assessed subjects improved.[8]

The Mathematics Curriculum in Primary and Lower Secondary Grades

The Ministry of Education has gradually introduced the Cambridge Curriculum for mathematics in Grades 1 to 12 in all public schools. The implementation of this new curriculum started in Grades 1 to 4 in academic year 2017–2018, Grades 5 and 6 in 2018–2019, Grades 7 and 8 in 2019–2020, Grade 9 in 2020–2021, Grade 10 in 2021–2022, Grade 11 in 2022–2023, and Grade 12 in 2023–2024.

The mathematics curriculum has been developed around the following strands: Number and Number Theory; Number Operations; Geometry, Trigonometry, and Spatial Sense; Measurement; Prealgebra and Algebra; and Data Management and Probabilities. All learning outcomes correlate to a specific level of achievement in the strand for each grade level as follows:

- Number and Number Theory—This strand emphasizes students' developing number sense. The curriculum states that this development is best accomplished by students searching for and understanding the many patterns and relationships among numbers. Being able to use estimation and mental calculation strategies is paramount. It is critical that students have an understanding of the concepts of whole and rational numbers. Integers, negative rational numbers, and irrational numbers are introduced in later grades. The curriculum also incorporates calculator skills and appropriate calculator use. Calculators are considered tools for studying number patterns, solving realistic problems, and eliminating tedious computations.
- Number Operations—The ability to perform mathematical operations with confidence reflects the development of number sense. The curriculum introduces addition,

subtraction, multiplication, and division sequentially throughout the grade levels for each of the number systems. Specific operations are taught in an iterative manner, reinforcing concepts developed in previous grades.

- Geometry, Trigonometry, and Spatial Sense—The development of geometric concepts and spatial awareness is best accomplished through the continuous integration of geometry in the curriculum. Students learn these concepts by actively manipulating, drawing, constructing, and creating geometric shapes and objects and making connections to the real world. Geometry should be experiential and reflected in the students' environment as an exciting and applicable element of mathematics.
- Measurement—The development of measurement sense is emphasized when students are actively engaged in the processes of comparing, estimating, and measuring. Regular integration with other school subjects such as science, physical education, art, and social studies makes this strand one in which applicability can be easily demonstrated.
- Prealgebra and Algebra—Patterns and models are the links students need to make connections between mathematics and the world in which they live. Exploring patterns and models leads students to develop mathematical competence and gain an appreciation for the beauty and power of mathematics. It is essential for students in the early grades to explore patterns to develop an understanding of the concept of variables and of algebraic thinking. Algebra extends the study of operations and relationships of numbers to the use of variables. It provides the ability to represent mathematical rules using symbols. Given suitable instruction, students in Grades 5 to 10 can learn some of the fundamental aspects of algebra. Students should understand the concept of functions as rules or mapping that assigns to each member of one set a member of another set. The practical applications of functions and graphs should be taught, especially as they relate to science. This strand emphasizes developing an understanding of basic concepts rather than manipulating symbols or using terminology.
- Data Management and Probabilities—This strand emphasizes the use of graphs, tables, and lists related to numbers and statistics. Students learn to manipulate data. This strand also includes the subject area of probabilities, which is related to the analysis of chance of occurrence for events.
- Problem-Solving—This strand involves applying techniques and skills and understanding strategies to solve mathematical problems.

Exhibit 2 lists the main topics for Grade 4.[9]

Exhibit 2: Main Mathematics Topics for Grade 4

Unit	Title	Topics
1	Number and Problem-Solving	1. Numbers and the number system 1.1. Reading, writing, and partitioning numbers 1.2. Ordering, comparing, and rounding four-digit numbers 1.3. Multiplying and dividing by 10 and 100
		2. Addition and subtraction (1)[a] 2.1. Addition 2.2. Subtraction 2.3. Partitioning to add and subtract
		3. Multiplication and division (1) 3.1. Learning and using multiplication facts 3.2. Using doubles 3.3. Multiplying a two-digit number by a single digit
		9. The number system and properties of numbers 9.1. Decimal numbers in context 9.2. Positive and negative numbers 9.3. Odd and even numbers
		10. Addition and subtraction (2) 10.1. Adding and subtracting near multiples of 10 10.2. Choosing the most efficient subtraction strategy
		11. Multiplication and division (2) 11.1. More multiplication 11.2. Dividing two-digit numbers by single-digit numbers
		18. Special numbers 18.1. Special numbers
		19. Fractions and division 19.1. Exploring fractions 19.2. Fractions, decimals, and mixed numbers 19.3. Fractions and division
		20. Ratio and proportion 20.1. Ratio and proportion

a Numbers in parentheses are for topics that are spiraled into the curriculum unit multiple times. The number indicates when the topic is mentioned, e.g., (1) signifies the first time the topic is mentioned in the curriculum unit, (2) signifies the second time the topic is mentioned, etc.

Exhibit 2: Main Mathematics Topics for Grade 4 (Continued)

Unit	Title	Topics
2	Measurement and Problem-Solving	4. Weight 4.1. Measuring weight
		5. Time (1) 5.1. Telling the time (1) 5.2. Using timetables
		6. Area and perimeter (1) 6.1. Area (1) 6.2. Perimeter (1)
		12. Angles, position, and direction 12.1. Angles and turning 12.2. Position and direction
		13. Symmetry 13.1. Shapes and symmetry
		14. Two-dimensional and three-dimensional shapes 14.1. Two-dimensional shapes 14.2. Three-dimensional shapes
		21. Capacity 21.1. Measuring capacity
		22. Time (3) 22.1. Measuring time 22.2. Calculating time
		23. Area and perimeter (3) 23.1. Area and perimeter
3	Handling Data and Problem-Solving	7. Graphs, tables, and charts (1) 7.1. Tally charts and bar charts 7.2. Pictograms
		8. Carroll and Venn diagrams 8.1. Carroll diagrams 8.2. Venn diagrams
		15. Length 15.1. Measuring length
		16. Time (2) 16.1. Telling the time (2) 16.2. Using calendars
		17. Area and perimeter (2) 17.1. Area (2) 17.2. Perimeter (2)
		24. Graphs, tables, and charts (2) 24.1. Tables and bar charts 24.2. Frequency tables and tree diagrams
		25. Venn and Carroll diagrams 25.1. Carroll diagrams (2) 25.2. Venn diagrams (2)

Exhibit 3 lists the learning objectives for Grade 8.[10]

Exhibit 3: Learning Objectives for Grade 8 Mathematics

Unit	Title	Learning Objectives
1	Integers, Powers, and Roots	1. Add, subtract, multiply, and divide positive and negative numbers. 2. Estimate square roots and cube roots. 3. Use positive, negative, and zero indices and the index laws for multiplication and division of positive integer powers. 4. Consolidate use of the rules of arithmetic and inverse operations to simplify calculations. 5. Clarify the concept of union of two or more sets and use symbols.
2	Place Value, Ordering, and Rounding	1. Recognize the equivalence of 0.1, $\frac{1}{10}$, and 10^{-1}; multiply and divide whole numbers and decimals by 10 to the power of any positive or negative integer. 2. Round numbers to a given number of decimal places or significant figures; use to give solutions to problems with an appropriate degree of accuracy. 3. Extend mental methods of calculation, working with decimals, fractions, percentages, and factors, using jottings where appropriate. 4. Use the order of operations, including brackets, with more complex calculations. 5. Consolidate use of the rules of arithmetic and inverse operations to simplify calculations. 6. Multiply by decimals, understanding where to position the decimal point by considering equivalent calculations; divide by decimals by transforming to division by an integer. 7. Recognize the effects of multiplying and dividing by numbers between 0 and 1.
3	Nets and Angles	1. Understand a proof that indicates: • the angle sum of a triangle is 180° and that of a quadrilateral is 360° • the exterior angle of a triangle is equal to the sum of the two interior opposite angles 2. Solve geometric problems using properties of angles, of parallel and intersecting lines, and of triangles and special quadrilaterals, explaining reasoning with diagrams and text. 3. Draw simple nets of solids, e.g., cuboid, regular tetrahedron, square-based pyramid, and triangular prism.

Exhibit 3: Learning Objectives for Grade 8 Mathematics (Continued)

Unit	Title	Learning Objectives
4	Fractions	1. Consolidate writing a fraction in its simplest form by canceling common factors. 2. Add, subtract, multiply, and divide fractions, interpreting division as a multiplicative inverse, and canceling common factors before multiplying or dividing. 3. Extend mental methods of calculation, working with decimals, fractions, percentages, and factors, using jottings where appropriate. 4. Solve word problems mentally.
5	Equations, Expressions, and Formulae	1. Know the origins of the word *algebra* and its links to the work of the Arab mathematician Al-Khwarizmi. 2. Construct and solve linear equations with integer coefficients (unknown on either or both sides, with or without brackets). 3. Apply the index laws for multiplication and division to simple algebraic expressions. 4. Construct algebraic expressions. 5. Simplify or transform algebraic expressions by taking out single-term common factors. 6. Add and subtract simple algebraic fractions. 7. Derive formulae and, in simple cases, change the subject; use formulae from mathematics and other subjects. 8. Substitute positive and negative numbers into expressions and formulae. 9. Expand the product of two linear expressions of the form $x \pm n$ and simplify the corresponding quadratic expression.
6	Area, Perimeter, and Volume	1. Convert between metric units of area, e.g., mm^2 and cm^2, cm^2 and m^2, and volume, e.g., mm^3 and cm^3, cm^3 and m^3; know and use the relationship 1 cm^3 = 1 ml. 2. Solve problems involving the circumference and area of circles, including by using the π key on a calculator. 3. Calculate lengths, surface areas, and volumes in right-angled prisms and cylinders.
7	Probability	1. Know that if the probability of an event occurring is p, then the probability of it not occurring is 1 – p. 2. Find probabilities based on equally likely outcomes in practical contexts. 3. Find and list systematically all possible mutually exclusive outcomes for single events and for two successive events. 4. Compare estimated experimental probabilities with theoretical probabilities, recognizing that: • when experiments are repeated, different outcomes may result • increasing the number of times an experiment is repeated generally leads to better estimates of probability

Exhibit 3: Learning Objectives for Grade 8 Mathematics (Continued)

Unit	Title	Learning Objectives
8	Percentages	1. Solve problems involving percentage changes, choosing the correct numbers to take as 100% or as a whole, including simple problems involving personal or household finance, e.g., simple interest, discount, profit, loss, and tax. 2. Recognize when fractions or percentages are needed to compare different quantities. 3. Extend mental methods of calculation, working with decimals, fractions, percentages, and factors, using jottings where appropriate.
9	Ratio and Proportion	1. Simplify ratios, including those expressed in different units; divide a quantity into more than two parts in a given ratio. 2. Use the unitary method to solve simple problems involving ratio and direct proportion. 3. Compare two ratios; interpret and use ratio in a range of contexts. 4. Recognize when two quantities are directly proportional; solve problems involving proportionality, e.g., converting between different currencies.
10	Equations and Inequalities	1. Construct and solve linear equations with integer coefficients (with and without parentheses, negative signs anywhere in the equation, positive or negative solution); solve a number problem by constructing and solving a linear equation. 2. Solve a simple pair of simultaneous linear equations by eliminating one variable. 3. Understand and use inequality signs (<, >, ≤, ≥); construct and solve linear inequalities in one variable; represent the solution set on a number line. 4. Use systematic trial and improvement methods to find approximate solutions of equations such as x2 + 2x = 20.
11	Graphs	1. Construct tables of values and plot the graphs of linear functions, where y is given implicitly in terms of x, rearranging the equation into the form y = mx + c; know the significance of m and find the gradient of a straight-line graph. 2. Find the approximate solutions of a simple pair of simultaneous linear equations by finding the point of intersection of their graphs. 3. Construct functions arising from real-life problems; draw and interpret their graphs. 4. Use algebraic methods to solve problems involving direct proportion, relating solutions to graphs of the equations. 5. Find the midpoint of the line segment AB, given the coordinates of points A and B.

Exhibit 3: Learning Objectives for Grade 8 Mathematics (Continued)

Unit	Title	Learning Objectives
12	Shapes and Bearings	1. Calculate the interior or exterior angle of any regular polygon; prove and use the formula for the sum of the interior angles of any polygon; prove that the sum of the exterior angles of any polygon is 360°. 2. Know and use the Pythagorean theorem to solve two-dimensional problems involving right-angled triangles. 3. Use bearings (angles measured clockwise from the north) to solve problems involving distance and direction.
13	Processing and Presenting Data	1. Calculate statistics for sets of discrete and continuous data; select the most appropriate statistics for a problem (range, mean, median, and mode and, for grouped data, the modal class).
14	Real-Life Graphs and Compound Measures	1. Solve problems involving measurements in a variety of contexts. 2. Draw and interpret graphs in real-life contexts involving: • one component with more than one stage, e.g., travel graphs • more than one component, e.g., travel graphs with more than one person 3. Use compound measures to make comparisons in real-life contexts, e.g., travel graphs and value for money.
15	Frequency Tables and Diagrams	1. Construct and use: • frequency tables with given equal class intervals to gather continuous data • two-way tables to record discrete data 2. Draw and interpret: • frequency diagrams for discrete and continuous data • simple line graphs for time series 3. Interpret tables, graphs, and diagrams for discrete and continuous data, and draw conclusions, relating statistics and findings to the original question.

The Science Curriculum in Primary and Lower Secondary Grades

The Ministry of Education has also introduced the Cambridge Curriculum for science in Grades 1 to 12 in all public schools. Similar to the mathematics curriculum, the implementation of this science curriculum has been gradually implemented in Grades 1 to 4 in academic year 2017–2018, Grades 5 and 6 in 2018–2019, Grades 7 and 8 in 2019–2020, Grade 9 in 2020–2021, Grade 10 in 2021–2022, Grade 11 in 2022–2023, and Grade 12 in 2023–2024.

The science curriculum learning outcomes are designed to support student acquisition of three overarching areas—knowledge, skills, and attitudes—needed for developing scientific literacy. These outcomes are described below.[11]

Exhibit 4 shows the units and learning objectives of the Grade 4 science curriculum.

Exhibit 4: Learning Objectives for Grade 4 Science

Unit	Title	Learning Objectives
1	Humans and Animals	1. Distinguish that humans and some animals have bony skeletons inside their bodies. 2. Identify that bones have different shapes and sizes. 3. Conclude that bones are joined together to form the skeleton. 4. Distinguish that skeletons grow as humans grow and support and protect the body. 5. Describe muscles and their role in animals with skeletons. 6. Explain the role of drugs as medicines. 7. Describe how medicines prevent, cure, or alleviate symptoms of illness. 8. Identify ways in which medicines are taken. 9. Describe how medicines work by killing germs or by replacing missing substances in the body.
2	Living Things and the Environment	1. Describe how different animals are found in different habitats and are suited to the environment in which they are found. 2. Distinguish how different animals are found in different habitats and are suited to the environment in which they are found. 3. Describe ways that people affect the environment, for example, river pollution and recycling waste.
3	Solids, Liquids, and Gases	1. Identify states of matter: solids, liquids, and gases. 2. Distinguish that matter is made up of particles. 3. Describe particles of the three states of matter. 4. Relate the distance between particles of matter to their properties. 5. Describe shapes of the three states of matter. 6. Distinguish boiling, freezing, and melting. 7. Distinguish that different solids have different melting points.
4	Sound	1. Describe how sound travels through materials. 2. Distinguish how well sound travels through solids, liquids, and gases. 3. Relate sound to vibration of particles. 4. Distinguish that trapping sound vibrations can make sound louder. 5. Describe the relationship between the size of vibration and the type of sound produced (soft or loud). 6. Name the instrument for measuring sound.

Exhibit 4: Learning Objectives for Grade 4 Science (Continued)

Unit	Title	Learning Objectives
4	Sound	7. Identify "decibels" as the unit of volume of sound. 8. Distinguish materials that can muffle sound and which cannot. 9. Identify pitch of sound and relate it to speed of vibrations of particles. 10. Apply concept of pitch on common musical instruments.
5	Electricity and Magnetism	1. Describe the flow of current in a circuit. 2. Identify the components of a simple electric circuit. 3. Distinguish open and closed circuits. 4. Describe what would happen when bulbs are added or removed from a circuit. 5. Identify voltage as the unit that describes the strength of electricity. 6. Relate voltages of cells and batteries to functioning of components of an electric circuit. 7. Identify mains of electricity in relation to high voltage. 8. Describe safety measures to be taken around electricity. 9. Describe materials that are attracted to magnets. 10. Identify poles of a magnet. 11. Identify attraction and repulsion as forces. 12. Compare strength of magnets. 13. Distinguish alloys and give examples.

The scientific inquiry section of the curriculum framework is based on four main strands, with objectives students are expected to achieve at each stage. Scientific inquiry skills are taught alongside other content. Learners are expected to acquire these skills through various learning activities. The strands are as follows:

- Ideas and Evidence—Students should learn how to collect evidence in a variety of contexts and to test ideas or predictions based on scientific knowledge.
- Plan Investigations—Students should be able to suggest questions that can be tested, make predictions, and communicate. They should be able to design a fair test, plan how to collect sufficient evidence, choose equipment, and decide which variables to measure.
- Obtain and Present Evidence—Students should be able to make relevant observations and comparisons in a variety of contexts; measure temperature, time, length, and force; begin to think about the need for repeated measurements of, for example, length; and be able to present results in drawings, bar charts, and tables.
- Consider Evidence and Approach—Students should be able to identify simple trends and patterns and suggest explanations for some of them, explain what the evidence shows and whether it supports predictions, communicate this explanation clearly to others, and link evidence to scientific knowledge and understanding in some contexts.

Exhibit 5 shows the units and learning objectives of the Grade 8 science curriculum.

Exhibit 5: Learning Objectives for Grade 8 Science

Unit	Title	Learning Objectives
1	Plants	1. Explore how plants need carbon dioxide, water, and light for photosynthesis in order to make biomass and oxygen. Use the word equation for photosynthesis. 2. Describe the absorption and transport of water and mineral salts in flowering plants; understand the importance of water and mineral salts to plant growth. 3. Describe how the structure of a leaf is adapted for photosynthesis.
2	Elements and Compounds	1. Describe the structure of an atom. 2. Understand that elements are made of atoms. 3. Give chemical symbols for the first 20 elements of the periodic table and compare their structures. 4. Describe trends in groups and periods. 5. Distinguish between elements, compounds, and mixtures. 6. Explain the idea of compounds. 7. Name some common compounds, including oxides, hydroxides, chlorides, sulfates, and carbonates.
3	Light	1. Use light traveling in a straight line to explain the formation of shadows and other phenomena. 2. Describe how nonluminous objects are seen. 3. Describe reflection at a plane surface and use the law of reflection. 4. Investigate refraction at the boundary between air and glass or air and water. 5. Explain the dispersion of white light. 6. Explain color addition and subtraction, and the absorption and reflection of colored light.
4	Food and Digestion	1. Identify the constituents of a balanced diet and the functions of various nutrients. Secondary sources can be used. 2. Understand the effects of nutritional deficiencies. 3. Recognize the organs of the alimentary canal and know their functions (including mouth cavity, teeth, esophagus, stomach, small intestine, large intestine, anus). Secondary sources can be used.
5	Material Changes	1. Use word equations to describe the reactants and products of common reactions, including oxidation and reactions with acids. Secondary sources can be used. 2. Describe chemical reactions that are not useful, e.g., rusting. 3. Describe conservation of mass in chemical reactions.

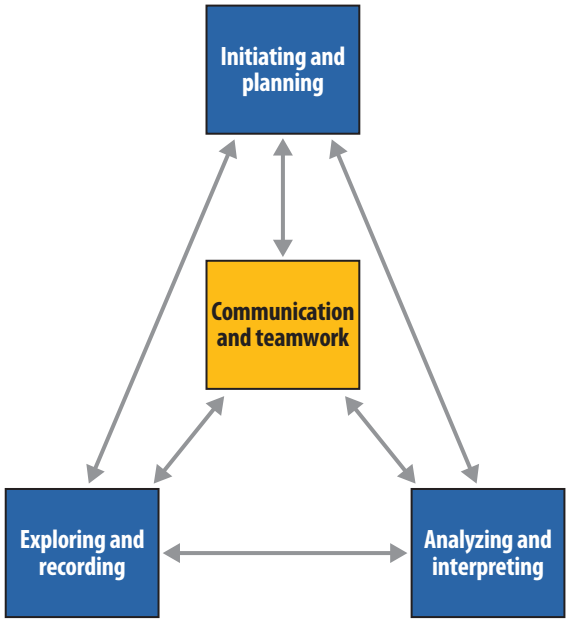
Exhibit 5: Learning Objectives for Grade 8 Science (Continued)

Unit	Title	Learning Objectives
6	Forces in Motion	1. Calculate average speeds, including through the use of appropriate apparatus. 2. Interpret simple distance/time graphs. 3. Determine densities of solids. 4. Know that forces can cause objects to turn on a pivot and understand the principle of moments.
7	The Circulatory System and Gas Exchange	1. Recognize and model the basic components of the circulatory system and know their functions. 2. Understand the relationship between diet and fitness. 3. Recognize the basic components of the respiratory system and know their functions. 4. Explain gaseous exchange. 5. Define and describe aerobic respiration and use the word equation. 6. Describe the effects of smoking. Secondary sources can be used.
8	Salts	1. Explain how to prepare some common salts by the reactions of metals and metal carbonates and be able to write word equations for these reactions.
9	Sound	1. Explain the properties of sound in terms of movement of air particles. 2. Recognize the link between loudness and amplitude, pitch and frequency, using an oscilloscope.
10	Reproduction and Development	1. Discuss how conception, growth, development, behavior, and health can be affected by drugs. 2. Discuss the physical and emotional changes that take place during adolescence. 3. Describe the human reproductive system, including the menstrual cycle, fertilization, and fetal development.
11	Magnetism	1. Describe the properties of magnets. 2. Recognize and reproduce the magnetic field pattern of a bar magnet. 3. Construct and use an electromagnet. 4. Describe electrostatics and the concept of charge, including digital sensors. 5. Interpret and draw simple parallel circuits. 6. Model and explain how common types of components, including cells (batteries), affect current. 7. Explain how current divides in parallel circuits.

Students will develop the skills required for scientific and technological inquiry, solving problems, communicating scientific ideas and results, working collaboratively, and making informed decisions. Exhibit 6 depicts four broad areas of skill outlined in the curriculum framework as follows:

- initiating and planning—This area encompasses the skills of questioning, identifying problems, isolating variables, and selecting variables for investigation.
- exploring and recording—This area encompasses the skills of setting up an experiment or investigation, making observations, and collecting and recording data.
- analyzing and interpreting—This area encompasses the skills of examining observations and data, presenting them in a way that can be interpreted, drawing conclusions, and evaluating and applying results.
- communication and teamwork—In science, as in other areas, communication skills are essential at every stage where ideas are being developed, tested, interpreted, debated, and agreed upon. Teamwork skills are also important because the development and application of scientific ideas is a collaborative process in the classroom and in society.

Exhibit 6: Skill Areas in Grade 8 Science Curriculum Framework



Each group of skills is developed from Grade 1 to Grade 10, with increasing scope and complexity. It is expected that students will

- ask questions about objects and events in their immediate environment and develop ideas about how these questions might be answered;
- observe and explore materials and events in their immediate environment and record the results;

- identify patterns and order in objects and events studied;
- work with others to share and communicate ideas about their explorations;
- ask questions about objects and events in the local environment and develop plans to investigate those questions;
- observe and investigate their environment and record the results;
- interpret findings from investigations using appropriate methods;
- work collaboratively to carry out science-related activities and communicate ideas, procedures, and results;
- ask questions about relationships between and among observable variables and plan investigations to address the questions;
- conduct investigations into relationships between and among observations, and gather and record qualitative and quantitative data;
- analyze qualitative and quantitative data, and develop and assess possible explanations; and
- work collaboratively on problems and use appropriate language and formats to communicate ideas, procedures, and results.

Attitudes are generalized aspects of behavior that are modeled for students by example and reinforced by selective approval. Attitudes are not acquired in the same way as skills and knowledge. They cannot be observed at any particular moment but are evidenced by regular, unprompted manifestations over time. It is expected that students will be encouraged to

- recognize and appreciate the contribution of science to their understanding of the world;
- show interest in and curiosity about objects and events within their immediate environment;
- willingly observe, question, and explore;
- consider their observations and their own ideas when drawing conclusions;
- appreciate the importance of accuracy;
- be open-minded in their explorations;
- work with others in exploring and investigating;
- be sensitive to the needs of other people, other living things, and the local environment;
- show concern for their safety and that of others in carrying out activities and using materials;
- appreciate that the applications of science and technology can have advantages and disadvantages;
- appreciate and respect that science has evolved from different views held by women and men from a variety of societies and cultural backgrounds;

- show a continuing curiosity and interest in a broad scope of science-related fields and issues;
- confidently pursue further investigations and readings;
- consider career possibilities in science- and technology-related fields;
- consider observations and ideas from a variety of sources during investigations and before drawing conclusions;
- value accuracy, precision, and honesty;
- persist in seeking answers to difficult questions and solutions to difficult problems;
- work collaboratively in carrying out investigations as well as in generating and evaluating ideas;
- be sensitive and responsible in maintaining a balance between the needs of humans and a sustainable environment;
- evaluate and determine the consequences of proposed actions, projecting beyond personal experience;
- show concern for safety in planning, carrying out, and reviewing activities; and
- become aware of the consequences of their actions.

Teacher Professional Development Requirements and Programs

Professional Development Requirements

A bachelor's degree is the current minimum qualification for teaching. Previously, teachers of students through Grade 6 earned diplomas at teacher education colleges, but these institutions have been converted into applied sciences colleges. Teacher education is now a 4-year or 5-year program that is offered in Oman at a college of education at Sultan Qaboos University, as well as four private universities. Courses in these programs aim to help future teachers understand, analyze, and evaluate the teaching process while encouraging a high level of professionalism. The specialized and professional components of teacher education programs are integrated, and student teachers are expected to demonstrate specialized knowledge and skills with consideration of students' individual needs and abilities. Practicum, which involves "micro," or peer, teaching, takes place within the college during the fifth to seventh semesters of the program; during the seventh and eighth semesters, student teachers participate in a teaching practicum outside the college for 2 days per week. The first cohort of teacher education students at these universities graduated in 2011. Currently, all employed teachers are from these universities.[12]

Ongoing Professional Development Programs

In an attempt to bring about fundamental change in classrooms, the Ministry has established the Specialized Institute for the Professional Training of Teachers (SIPTT). The institute opened officially in 2014 in a newly adapted temporary facility that houses 56 training classrooms, a library, a science laboratory, meeting rooms, and a restaurant. It is responsible for meeting the

training requirements for all professionals who are involved directly in the classroom learning process (e.g., teachers, school principals, and supervisors) and for providing training at different stages of their career development. To ensure the program has a direct impact on student standards, the following principles have been taken as a basis for program design:

- comprehensive—a high proportion of teachers and supervisors from selected subjects and specialties and participation by all schools
- sustained—2-year programs to embed knowledge, skills, and attitudes
- integrated—face-to-face training using a range of active learning methods, online learning that enables participants to engage with the institute while in the workplace, and workplace training to provide practical opportunities to develop skills and embed practice
- coherent—developed using international best practices and research and to include all Ministry priorities and initiatives
- accredited—by a qualification from a recognized authority and allowing for credit accumulation leading to the award of higher degrees as teachers progress through their career
- supported—through ongoing contact, monitoring, and evaluation by trainers

The Ministry has developed professional standards for teachers, principals, vice principals, and supervisors. These standards are an important development in helping to clarify roles and evaluate staff performance, and in determining appropriate staff development programs.

The professional development structure in the SIPTT has two main functions:

- to maximize the effectiveness of staff in their existing role by
  - ensuring ongoing professional development according to need and
  - providing individual responsibility and accountability through assessment and a licensing system.
- to provide a fair and accurate system to inform career progression based on
  - experience and
  - judgments of effectiveness of staff in their current roles.

Participation in Accredited and Assessed Professional Development Activities

The SIPTT focuses on literacy and numeracy by providing the following five strategic training programs that target teachers of mathematics, science, Arabic, and English:

- Math Experts—for teachers of Grades 5 to 10
- Science Experts—for teachers of Grades 5 to 10
- Field Two Experts—for teachers of Grades 1 to 4
- Arabic Experts—for teachers of Grades 1 to 4
- English Experts—for teachers of all grades

These programs emphasize higher-order thinking skills, 21st-century skills, professional standards, inquiry-based learning, and the establishment of active learning communities through the application of active learning strategies, assessment for learning, and assessment as learning.

The SIPTT's long-term programs are designed to be sustainable, feasible, and accredited for all teachers in Oman, as the institute's main purpose is to improve student outcomes through the professional development of the education workforce. All institute strategies and operations will support the production of research evidence to inform future development facilitated by the organizational structure and the institute's online learning platform.

The SIPTT promotes and develops a national dialogue about the education profession, as well as debate and collaboration through face-to-face activities and collaborative tools in the online learning platform. The online learning platform enables teachers to share ideas, resources, and good practices, and to celebrate success. This collaborative approach will, in turn, raise expectations among educators, students, parents, and the wider community.

The SIPTT offers strategic programs for mathematics teachers, science teachers, and field two teachers. These programs extend for 2 years and include three main components: face-to-face training, online learning, and workplace learning. They focus on helping teachers design and implement various activities in teaching science and mathematics subjects that provide opportunities for learners to develop 21st-century skills. They also aim to train teachers to implement formative assessment strategies in a way that achieves the continuous development of students' performance, develop students' higher-order thinking skills based on the international standards of teaching and learning, and use information and communications technology (ICT) tools in teaching.[13]

In addition, in 2022, higher-order thinking skills programs were designed for teachers of mathematics and science, which include examples of questions from TIMSS and from the curricula. Teachers were trained to analyze these questions and classify them according to the different levels of Bloom's taxonomy. During these programs, teachers discussed the difficulties that students may encounter in answering and solving such questions.

Monitoring Student Progress in Mathematics and Science

The Center for Educational Assessment and Measurements (CEAM) prepares student assessment documents for every subject area at every grade level.[14,15] These documents specify assessment arrangements and criteria. Assessment arrangements differ by grade level. Exhibit 7 presents assessment arrangements for Grades 1 to 12.[16,17]

Exhibit 7: Assessment Arrangements

Grades	Examinations	Continuous Assessments	Scoring	Administration
1–4	–	100%	–	–
5–9	40%	60%	school level	regional level
10	60%	40%	school level	regional level
11	60%	40%	school level	regional level
12	70%	30%	central level	central level

In Cycle One schools (Grades 1 to 4), the focus is on internal formative and summative assessment using a broad range of evidence, including, for example, oral presentations, teachers' observations, projects, and short tests, coupled with evaluative information collated in student-led portfolios. No formal examinations are administered at this stage. Students receive an overall score out of 100 and a grade from A to E (A representing 90–100% and E representing 49% or lower).

The evaluation of student performance in Grades 5 to 12 (Cycle Two and postbasic) is based on an accumulation of results over the academic year, beginning in the first semester. Results from continuous assessment and an examination administered at the end of the first semester in January are collated into an overall grade out of 100 in each subject area. Overall grades below 50 are considered failing, and grades at or above 50 are considered passing. Examination and continuous assessment results from both semesters are weighted equally when calculating the overall average for the year. The examinations in Grades 5 to 9 are administered at the regional level. Examinations for Grade 12 are administered at the central level, and examinations for Grades 10 and 11 are administered at the regional level.[18] The examinations for Grade 12 are scored centrally, while the examinations for Grades 5 to 11 are scored by schools.

In Cycle One (Grades 1 to 4), students receive four report cards per year—three descriptive reports on student achievement in each subject identifying strengths and weaknesses and a final report card. The final report card is issued at the end of the school year and includes both letter grades and numeric grades for each subject. In Cycle Two and postbasic education (Grades 5 to 12), students receive four report cards per year, of which two are descriptive (one in the middle of each semester) and two present letter grades (A to E) and numeric grades for each subject (one at the end of each semester).[19]

In Cycle One, there is no grade retention. Students who receive a failing grade (E) continue to the next grade level with planned remedial help and an individual progress plan. In Grades 5 to 10, advancement to the next grade depends on the number of basic subjects passed or failed (i.e., Islamic, Arabic, English, mathematics, science, and social studies). Students who receive a failing grade in one, two, or three basic subjects must retake the corresponding examinations. Students who fail an examination retaken in one or more basic subjects must repeat the grade. Students with a grade average of E across the two semesters in more than three basic subjects do not have the option of retaking examinations and must repeat the grade. Students who

repeat a grade and then again fail one or more of the basic subjects at the end of the year are permitted to progress to the next grade level with a remedial plan in place.

Moreover, national tests are implemented to measure students' knowledge and acquired skills after completing Cycle One (Grade 4) and Cycle Two (Grade 10) as well as Grade 7. These tests are implemented yearly only for a randomly selected sample. The students in the sample are assessed based on the basic subject outcomes of the curricula applied in public and private schools in the Sultanate of Oman in the following:

- Arabic (reading and writing) and mathematics at the end of Cycle One (Grade 4)
- Arabic, English, mathematics, and science in Cycle Two (Grade 7)
- Arabic, English, mathematics, and science at the end of Cycle Two (Grade 10)

These tests are accompanied by a set of questionnaires to measure the factors affecting students' performance. The results of this assessment provide information and data on the level of students' achievement and progress in these subjects. These results are used as indicators for developing and improving the education process.

The national tests aim to provide information, statistical indicators, and accurate data on the quality of teaching and learning processes for decision-makers and those in charge of the education process to set appropriate development plans, strategies, and procedures and to raise students' achievement levels through

- extrapolating the education level of students by knowing what students have acquired of basic knowledge and skills in Arabic language, mathematics, science, and English language based on national standards, and based on benchmarking with international standards;
- providing comprehensive scientific information about the classroom, school, educational curricula, evaluation, and the quality of education at the education cycle, and identifying the positive and negative factors that may affect the achievement level of students;
- providing comprehensive information about teachers' training needs;
- assisting teachers and assessment specialists measuring the level of students' achievement and monitoring students' progress by comparing students' results in achievement exams with the national tests;
- maintaining international trends in assessing students' achievement and monitoring their progress by comparing the results of national tests with the results of international tests;
- providing performance indicators for students at the national level in scientific and language subjects as one of the global competitiveness criteria for the economy; and
- providing data to academic researchers who are interested in aspects of teaching and learning.

The following set of statistical reports are published:

- a report for subject experts that includes the results of the psychometric analysis of the test items
- a report for decision-makers that includes data and statistical indicators on the extent to which students acquired the basic skills for each education cycle or grade
- a report on students' performance on national tests at the student, grade, school, governorate, and national levels

Note: For national tests, test items are field tested and analyzed, and the psychometric indicators are used for item improvement. (More details of this can be found in the *National Test Framework & General Assessment Framework*. These documents are in Arabic.)[20,21]

Special Initiatives in Mathematics and Science Education

There are many initiatives and programs that aim to improve performance in mathematics and science, such as the Oman Science Festival, National Science Week, Scientific Innovations Competition, STEM OMAN, GLOBE Environmental Program, Shell Explorers, Future Engineers, Innovation of the First Cycle, the International Science and Engineering Exhibition (ISEF), the Scientific Competition of Sheikha Fadia Al-Saad Al-Sabah, scientific Olympiads (mathematics–physics–chemistry–biology), National Olympiad for Programming, the Robot Olympiad, STEMinds, the Petroleum Development Oman (PDO) Renewable Energy Award, the smart application development competition, robotics and artificial intelligence competitions, drone competition, and the STEMA (science, technology, engineering, mathematics, and art) Zone initiative.

These initiatives and programs aim to communicate science to students and community members in an easy, interactive, and thought-provoking manner. They aim to encourage students to realize the importance of science in life. They also stimulate curiosity for exploration and inspire innovation among students by studying the main activities according to educational experiences that focus on linking education to daily life; developing students' creative and critical-thinking skills; and creating a positive attitude toward science, innovation, and scientific research. The abovementioned initiatives also help improve students' skills in designing, building, and programming robots; enhance students' STEM skills; and develop students' problem-solving skills. The scientific Olympiads recognize students who are proficient in scientific subjects to form national teams with the aim of participating in national, regional, and international scientific Olympiads.

For example, the Oman Science Festival is a motivational scientific event that presents STEM to members of society in general, and to students in particular, in an exciting and interactive manner. National Science Week (STEM) is a national scientific initiative focused on simplifying science and making it fun and entertaining by implementing a group of events and activities in the fields of STEM. It is an opportunity to motivate and stimulate the passion of teachers and students. Omani students also participate in the ISEF. This international competition is considered the largest scientific demonstration in the world. More than 2,000 male and female students from 90 countries participate annually by competing in several scientific fields to win prizes.

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