Appendix A
Primary Science Learning Standards (Cognitive Domain) from China Based on Our English Translation

Learning objectives (our translation)
1. Know that in scientific inquiry, asking and answering questions, these have to be compared with one's own findings as well as conclusions from science
2. Know that different questions need different methods of inquiry
3. Know why using instruments is more effective than relying on the senses
4. Understand that the results of scientific inquiry should be open to re-verification
5. Know that questioning the results of other investigations is part of scientific inquiry, understand that having reasonable doubt motivates the progress of science
6. Know that exchanging (ideas) and having discussions can lead to new ideas
7. Know that scientific inquiry can provide new experiences, new phenomena, new methods, and new technologies to advance research
8. Be able to raise questions about local events from different perspectives such as "what is this?" or "why is it so/why does this happen?"
9. Be able to select appropriate questions for one's own inquiry
10. Be able to compare and evaluate questions that have been raised
11. Be able to hypothesize explanations for observed phenomenon based on existing knowledge and experiences
12. Be able to distinguish between hypothesis and fact
13. Be able to propose a general outline for conducting inquiry
14. Be able to form a written plan for inquiry raised by oneself or others
15. Be able to perceive natural objects using a variety of senses and be able to describe their external characteristics using words or pictures
16. Be able to perform careful observations using simple tools (magnifier, microscopes, etc.) and express (the results) with diagrams and words
17. Be able to make quantitative measurements of objects and collect data using simple tools (ruler, dynamometer, scale, graduated measuring cylinder, thermometer, stopwatch, etc.), and make simple records
18. Be able to perform simple observational experiments with simple equipment, and make records of experiments
19. Be able to perform simple inquiry experiments with control of variables, design simple reports of experiments, and draw simple charts

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Learning objectives (our translation)
20. Be able to make simple scientific models (rock samples, insect models, volcanos, stratigraphic models etc.)
21. Be able to integrate knowledge and make objects of technology (crane model, terrarium, energy conversion device etc.)
22. Be able to consult books and other information sources
23. Be able to organize information using tables, graphs, statistics, and other simple methods
24. Be able to analyze, interpret data, and reasonably explain a phenomenon in different ways
25. Be able to consider making different interpretations of the same phenomenon
26. Be able to reflect on the process of one's inquiry and compare the results of inquiry with the hypothesis
27. Be able to choose the method(s) (language, text, graphics, models etc.) which one is good at to express the research process and results
28. Be able to evaluate(or make comments to) the research process and results, and exchange perspectives with others
29. Be able to name common plants in the vicinity and classify these common plants simply
30. Understand local plants as resources, and be able to realize the close relationship between plants and human life
31. Understand more types of plants and experience the diversity of plants
32. Know the names of common animals found in daily life, and be able to classify these animals according to different criteria
33. Make generalizations about the common features of a certain type of animal
34. Recognize several types of common animals, such as insects, fish , amphibians, reptiles, birds, and mammals
35. Understand more types of animals and experience the diversity of the animal world
36. Recognize the diversity of animal movement
37. Understand the importance of protecting animals, especially endangered animals
38. Understand the main characteristics of bacteria and their positive and negative effects on Man
39. Know that fungi belong to a class of organism which is neither plant nor animal
40. Understand that viruses are also a type of organism
41. Understand the process of plant growth through the process of growing plants
42. Describe the general process of animal development through the process of raising small animals
43. Understand that different organisms have different life processes, and experience the complexity and diversity of different life processes
44. Know that reproduction is a common characteristic of life
45. List the different modes of reproduction among commonly seen animals
46. Be able to identify the six major organs of plants, and know the functions of these various organs
47. Investigate the functions of roots and stems
48. Through observations of mammals, specimens or viewing multimedia software, identify some of their major organs
49. Know that cells are the basic units in the living body

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Learning objectives (our translation)
50. Recognize that organisms need to absorb water and nutrients from the outside world to survive
51. Design experiments to study the effects of water, sunlight, air, temperature, and fertilizer etc. on plant growth
52. Know that different animals eat different foods, and animals need the energy from food to survive
53. Understand that green plants can produce starch and oxygen in sunlight, and at the same time absorb carbon dioxide
54. Know that many biological characteristics are hereditary
55. Understand that heredity and variation are one of the major characteristics of organisms
56. Observe the appearance of plants, and make links between the results of these observations and their living environment
57. Be able to carefully observe the external features of animals, and link the results of these observation with their characteristics
58. List some specific examples of adaptations to the environment among similar types of organisms
59. Understand some properties of plants that respond to the environment, such as phototropism, hydrotropism, and geotropism
60. List some examples of how animals adapt to the environment, such as hibernation, camouflage, mimicry, etc.
61. Know that the environment has influences on biological growth and many other aspects of life
62. Know the meaning of a food chain
63. Recognize that human beings are part of nature, they not only depend on the environment, but also affect the environment, and can influence the survival of other creatures
64. Be able to explain the meaning of survival of the fittest and natural selection
65. Be able to explain the process of biological evolution, with specific organisms as examples
66. Understand what are the needs and nutritional sources for human beings, and understand the importance of complete and proper nutrition
67. Understand the process of human digestion and develop good habits of eating, drinking, and health
68. Understand the process of human respiration, and know the origin and prevention of common respiratory diseases
69. Understand the functions of heart and blood vessels and how to take care of them
70. Investigate what factors affect the rate of heartbeat
71. Understand the function of sensory organs and know that the body's various senses are responses to the outside environment
72. Know the role of the brain in language, thinking, emotions, and that it is the "command center" of human life processes
73. Understand the general process of growth across a person's lifespan
74. Understand the special characteristics of physical development among youth
75. Understand the special characteristics of physical and mental development in adolescents
76. Understand the various factors that affect health

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Learning objectives (our translation)
77. Be able to recognize the importance of developing healthy habits
78. Realize personal responsibilities for one's own health, and actively participate in exercise, paying attention to personal care
79. Be able to sense and describe the features of objects, such as size, weight, shape, color, temperature etc.
80. Be able to make simple classifications and sort objects according to their characteristics
81. Be able to measure the common features of objects (length, weight, temperature) with simple instruments (length, balance, thermometer); Be able to design simple two-dimensional recording forms, make simple quantitative records with these forms, and use the appropriate units. On the basis of this experience, roughly measure other objects. Realize multiple measurements can improve the accuracy of measurement
82. Understand that the shape or size of an object can be changed by heating or cooling; and list some common effects of thermal expansion and contraction
83. Be able to judge that objects are composed of different materials, such as wood, metal, plastic and paper; and classify those objects according to their materials
84. Recognize some properties of materials (electrical conductivity, solubility, heat conduction, floating/sinking etc.); classify the materials according to those properties. Be able to link those properties of objects to their use/purpose
85. Be able to distinguish common natural materials and artificial materials. Realize that human beings are constantly inventing new materials in order to meet their needs. Enhance sensitivity towards new objects to stimulate awareness of innovation
86. Understand that there are three common states of matter: solid, liquid, and gas. Understand that changes in temperature can make materials change their states. Know the freezing point and boiling point of water
87. Know that there are two types of changes in matter, one is a mere change of form and the other will produce new substances
88. Understand that some of the changes of matter are reversible and others are irreversible. Recognize the impact of these changes on human lives
89. Know that some substances are renewable and others are non-renewable and recognize the importance of protecting resources
90. Realize that the use of materials has both favorable and detrimental aspects on human beings, and the importance of proper use of materials. Pay attention to safety and health; know some common measures for risk prevention, safety and health
91. Realize that the use of resources will bring both positive and negative effects on the environment, and human beings have a responsibility towards the environment
92. Be able to qualitatively describe the position of an object (front or rear, left or right, near or far, etc.); understand that to determine the position of an object it needs to be referenced with another object
93. Be able to measure and record the position of an object along a linear motion at different times; be able to show the relationship between the distance and time using simple charts or graphs
94. Know that to describe the motion of an object, we need to know the position, direction, and speed
95. Know that both pulling and pushing can change the movement of objects, pulling and pushing are both forces. Forces have both magnitude and direction

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Learning objectives (our translation)
96. Know some common forces in daily life such as wind power, water power, gravity, elastic force, buoyancy and friction etc.
97. Investigate how to use a scale and lever to maintain balance
98. Know that using machines can improve work efficiency; understand how to use some simple machines such as ramps, levers, gears, pulleys etc.
99. Know that sound is produced by a vibrating object; be able to distinguish the magnitude and level of sounds
100. Know that sound needs to propagated through a material before reaching human ears
101. Be able to distinguish between musical tones and noise; understand the hazards of noise and how to prevent them
102. Know that heat energy can be transferred from one object to another
103. Know that temperature represents how hot or cold an object is; know the unit of temperature; and be able to use a thermometer
104. Understand that heat always flows from a hotter to a colder object until they are both at the same temperature. Understand some common methods of heat transfer and heat insulation
105. Understand the phenomenon that light travels in straight lines
106. Understand that mirrors or magnifying glasses can change the direction of light
107. Know that light is made up of colors; understand the phenomenon of chromatic dispersion of light
108. Recognize that electricity is a common energy source in life and work. Understand how to use electricity safely
109. Know that common electrical appliances require a complete (and closed) circuit to work; Know the function of the switch; Be able to make a simple circuit using some basic components
110. Know that some materials can readily conduct electricity, while others are unable to do so
111. Investigate the directional characteristics and poles of magnets; investigate the law that similar poles of magnets repel each other while unlike poles attract
112. Know that electricity can generate magnetism; investigate the factors which can influence the magnitude of electromagnetic force; understand the application of electromagnets
113. Know that equipment need energy to work, electricity, light, heat, sound, and magnetism are different forms of energy
114. Recognize that different forms of energy can transform into each other
115. Know the shape and size of the earth
116. Know that the surface composition of the earth is mainly water and less of that of land
117. Know that there is hot magma inside the earth
118. Understand the history of human thought regarding the shape of the earth
119. Understand the main legends and functions of globes and maps
120. Be able to classify rocks using different classification criteria
121. Know the names of the main energy producing minerals, metallic ores, and their extraction
122. Know the composition of soil
123. Be able to design experiments showing the effects of different soils on plant growth
124. Realize the close relationship between human survival and resources from the land and the importance of protecting those resources

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Learning objectives (our translation)
125. Know the distribution of natural sources of water
126. Know that water can dissolve matter
127. Realize the close relationship between water and living things
128. Know the danger from and main reasons for water pollution
129. Be able to prove the existence of air using specific methods
130. Understand the use of the properties of air by Man
131. Know the significance of air to life. Experience the significance of air to life on earth and in relation to the effects of air on plants
132. Understand the adverse impact of human activities on the atmosphere, realize the importance of protecting the atmosphere
133. Know that the weather can be described with measurable indicators (such as temperature, wind direction, force of wind, precipitation, cloudiness, etc.)
134. Observe and collect data with a thermometer, a simple wind instrument, gauge; and be able to analyze these data and draw conclusions
135. Investigate the causes of rain and snow
136. Investigate the causes of wind. Observe an experiment showing that hot air rises and generates wind; discuss the causes of wind in the natural world
137. Realize that the long-term measurement and recording of weather data is useful
138. Be able to list examples showing the impact of weather changes on animal behavior
139. Know that the earth is constantly rotating, and that one rotation requires a day, 24 h
140. Understand the theories of early human societies concerning the causes of day and night and the contribution of Copernicus
141. Investigate the influence of day and night on the behavior of plants and animals
142. Understand that the earth's surface is constantly changing
143. Understand the phenomenon of volcanic eruptions
144. Understand the phenomenon of earthquakes
145. Recognize the role of various natural forces in changing the landscape
146. Understand the influence of human activities in changing the landscape
147. Recognize the influence of the changing seasons on plants and animals
148. Understand that the changing seasons are related to the earth's rotation around the sun
149. Know that the sun is a fireball with a very high temperature
150. Understand the use of solar energy by Man
151. Understand that there would be no life on earth without the sun
152. Know the sun's daily pattern of movement in the sky
153. Recognize that the changes of temperature and shadows in the day are related to the movement of the sun
154. Be able to identify directional position using the sun
155. Know that the moon is the Earth's satellite; know the moon's daily and monthly patterns of movement
156. Understand more about the moon from a variety of media
157. Know the composition of the solar system and the order of the nine planets

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Learning objectives (our translation)
158. Know the representative constellations of the four seasons
159. Know the relationship between the solar system, galaxies, and the universe
160. Understand the history of human exploration of the universe
161. Know some important tools for exploring the universe; realize that human understanding of space has been deepened and enlarged with the progress of technology
162. Realize the arduous work that Man has done to explore the mysteries of the universe

Appendix B
Primary Science Learning Standards (Cognitive Domain) from Taiwan Based on Our English Translation

Section	Learning objectives (our translation)
	1. Topic of process skills
Observing	Grades 1–2
1-1-1-1	Use the five senses to observe the characteristics of objects (e.g., color, sound when tapped, odor, weight, etc.)
1-1-1-2	Be aware that some of properties of objects can undergo change and vary (e.g., ice melts when the temperature rises)
Comparing and classifying	Grades 1–2
1-1-2-1	Classify objects based on their features or properties (e.g., size, shading, etc.)
1-1-2-2	Compare patterns or objects to identify and communicate differences and similarities (e.g., a large and small tree although of different sizes are of the same type)
Organizing and connecting	Grades 1–2
1-1-3-1	Through a series of observations, describe how phenomena change (e.g., bean germination)
1-1-3-2	From a series of observations, comprehensively explain a significant phenomenon (e.g., a strong wind blows all the leaves on the ground, trees are blown down…)
Inducting and inferring	Grades 1–2
1-1-4-1	Be aware that events have causes, and believe that there are causal relationships
1-1-4-2	Be aware that with the same context and procedure, the results obtained should be similar or identical
Communicating	Grades 1–2
1-1-5-1	Learn how to use appropriate vocabulary to express observed phenomena (e.g., water can be described as boiling, hot, warm, cool or icy)
1-1-5-2	Attempt to understand the characteristics of objects from the description of others

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Section	Learning objectives (our translation)
Observing	Grades 3–4
1-2-1-1	Be aware that objects have identifiable characteristics and properties
Comparing and classifying	Grades 3–4
1-2-2-1	Use senses or ready-made tools to measure and do quantitative comparisons
1-2-2-2	Effectively use self-made criteria or self-made tools to do measurement
1-2-2-3	Understand that even with similar conditions, the results obtained may not be the same, and to be aware of the reasons for such outcomes
1-2-2-4	Know that if the goals (or attributes) are different, there are different ways of classification
Organizing and connecting	Grades 3–4
1-2-3-1	Describe the general features of data (eg for objects made of the same material, the greater the volume, the greater the weight…)
1-2-3-2	Be able to form predictions (eg that the ball can bounce high, because…)
1-2-3-3	Be able to control variables during experiments and make qualitative observations
Inducting and inferring	Grades 3–4
1-2-4-1	Using criteria to manage experimental data, derive conclusions
1-2-4-2	Use the results of experiments to explain or make predictions about phenomena
Communicating	Grades 3–4
1-2-5-1	Be able to use tables, graphs (such as interpretation of data and recording information)
1-2-5-3	Be able to obtain information from the telephone, newspapers, books, the Internet and media
Observing	Grades 5–6
1-3-1-1	Be able to perform procedures according to the experimental protocol
1-3-1-2	Be aware that a problem or phenomenon can be often observed from different angles and seen to have different characteristics
1-3-1-3	Distinguish the difference between original amount and the rate of change (such as temperature and temperature changes)
Comparing and classifying	Grades 5–6

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Section	Learning objectives (our translation)
1-3-2-1	Before an experiment, estimate possible changes in a "variable" in terms of amount and scope
1-3-2-2	From the amount of change and the volume change, assess the degree of change
1-3-2-3	Depending on the degree of differences, perform classifications beyond the second level
Organizing and connecting	Grades 5–6
1-3-3-1	During experiments, confirm the causes of change and perform manipulations
1-3-3-2	Find relationships between the dependent variable and independent variable
1-3-3-3	From a series of related activities, describe the main features of these activities
Inducting, judging and inferring	Grades 5–6
1-3-4-1	Organize a coherent explanation from a number of different sources of information
1-3-4-2	Identify the characteristics of data and interpret their general aspects
1-3-4-3	From displays of relevant information, suggest a possible causal relationship
1-3-4-4	Evaluate and judge the outcomes of experiments
Communicating	Grades 5–6
1-3-5-1	Use appropriate graphs to express data
1-3-5-2	Express data in an appropriate manner (e.g. the number of lines, tables, graphs)
1-3-5-3	Describe clearly the process of scientific inquiry and outcomes
1-3-5-5	Listen to other people's reports and make appropriate responses
	2. Topic of knowledge of science and technology
Knowledge level	Grades 1–2
2-1-1-1	Use the five senses to observe natural phenomena, recognise various phenomena in their natural state and state the changes. Use appropriate vocabulary to report and describe observations. Use of ready-made tables, charts, to express the observed data
2-1-1-2	Be aware that changes of state are often caused by a number of reasons, and practice how to plan and conduct inquiry (here)
Recognize common animals and plants	Grades 1–2
2-1-2-1	Select one (or a certain type of) plant and animal, observe continuously and learn how to record any major changes Be aware that plants will grow, be aware that plants have distinguishing features for identification. Note that soil is

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Section	Learning objectives (our translation)
	required for plant growth as well as sunlight and moisture in the environment. Be aware of how animals feed, what they eat, what they do, and changes in body shape occur during growth
Observe phenomena and their changes	Grades 1–2
2-1-3-1	Observe changes in phenomena (e.g., changes in the weather, states of object), be aware that changes in phenomenon must have reasons
2-1-3-2	Construct a variety of different toys, experience different kinds of "forces" and how forces can move objects, or how vibrating objects produce sounds
2-1-4-1	Recognize and use everyday technology (media, transport, safety equipment)
Knowledge level	Grades 3–4
2-2-1-1	Be aware that natural phenomena have causes. Be able to use tools such as a thermometer, magnifying glass, mirrors to help make observations, and conduct of inquiry based on these changes, and learn how to organize observations and work methods
Understand growth of animals and plants	Grades 3–4
2-2-2-1	Grow a plant, keep a small animal, and share about these experiences. Know the requirements for growing plants, learn how to provide sunlight, moisture, fertilizers, and select soil cultivation techniques
2-2-2-2	Understand the characteristic appearances of terrestrial (or aquatic) animals, their movement, and note how to improve their living environment, adjust their diets to maintain their health
Awareness of materials	Grades 3–4
2-2-3-1	Recognize that besides the physical features of objects, they also have different properties such as solubility, magnetism, electrical conductivity, etc. And apply these properties to separate or combine them. Aware that materials may be burnt, oxidized, fermented and undergo other changes due to temperature, water, air
2-2-3-2	Recognize the importance of water and its properties
Awareness of the environment	Grades 3–4
2-2-4-1	Understand how to use air temperature, wind direction, wind speed, rainfall to describe the weather. Discover that the weather will change, be aware that the amount of water vapor plays a very important role in the change in the weather

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Section	Learning objectives (our translation)
2-2-4-2	Observe that the moon rises from the east and sets in the west, and make long-term continuous observation of the phase of the moon, discover that moon phases have periodicity
Recognize uses of interactions	Grades 3–4
2-2-5-1	Use refraction, dispersion, batteries, wires, bulbs, small motors, air or water flow to design a variety of toys. Look for ways to improve toys, discuss the reasons for the change, and gain understanding into the nature of the material, and then to begin to learn about their improvement
Recognize common technologies	Grades 3–4
2-2-6-1	Understand media equipment, such as recording and video equipment
2-2-6-2	Recognize energy used for transport (such as gasoline) and transport equipment (such as locomotives, cars, tractors)
Knowledge level	Grades 5–6
2-3-1-1	Ask questions, learn problem solving strategies, study changes, observe changes and speculate causal relationships. Learn how to manage data, design tables and graphs to represent data. Learn about the relationship between independent and dependent variable, hypothesize or make a appropriate explanation
Recognize the ecology of plants and animals	Grades 5–6
2-3-2-1	Be aware of the features of plant roots, stems, leaves, flowers, fruits, and seeds. Illumination, temperature, humidity, soil influence the growth of plants. Plants vary due to adaptation to different habitats. Discover that there are many methods for plant propagation
2-3-2-2	Observe the morphology and movement of animals and their differences and similarities. Observe how animals maintain body temperature, feeding, reproduction, communicate, engage in social behavior and adapt to their habitat as part of animal ecology and life
2-3-2-3	Understand that animals have oviparous and viviparous reproductive modes. Discover that there are similarities between the parents and offspring of animals and plants as well as differences
2-3-2-4	With the knowledge of animals and plants, customize some methods of animal and plant classification
Recognize materials	Grades 5–6
2-3-3-1	Understand the properties of matter, investigate how light, temperature, and air affects the properties of matter

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Section	Learning objectives (our translation)
2-3-3-2	Investigate the properties of oxygen and carbon dioxide; the production of oxygen, understand combustion, oxidation (rust), the production of carbon dioxide and its features (dissolving in water), air pollution and other phenomena
2-3-3-3	Investigate the properties of dissolved materials, water conductivity, pH, evaporation, diffusion, expansion and contraction, and hard and soft water etc.
2-3-3-4	Recognize environments that promote the oxidation reaction
Awareness of the environment	Grades 5–6
2-3-4-1	Through long-term observation, discover changes in sun rise and the azimuth (or maximum elevation angle), at the same time at night, the constellations across the seasons are different, but they change regularly year by year
2-3-4-2	Recognize high and low pressure lines, fronts on the weather map. Observe (through data collection) the start and end of a typhoon
2-3-4-3	Know that high and low temperatures can influence the different states of water, which also causes the formation of frost, dew, clouds, rain, and snow
2-3-4-4	Know that in the living environment, air, earth and water all interact with each other
Recognize uses of interactions	Grades 5–6
2-3-5-1	Know that heat travels from a hotter to colder region, transmission methods include conduction, convection, radiation. Transmission would be different according to different materials and the nature of spaces. This knowledge can be applied to the insulation or removal of heat
2-3-5-2	Understand by making the instruments the causes of quality of sound, volume, timbre, etc. know the difference between tone and noise
2-3-5-3	Understand that the size of a force can be measured from the amount of deformation or motion of objects
2-3-5-4	Through the use of simple machines, understand that force can be used to move levers, belts, gears, fluid (pressure) and others
2-3-5-5	Understand that a current can generate a magnetic field. Make an electromagnet, understand geomagnetism and the compass. Discover that some “forces” need not have points of contact to work, such as gravity, magnetism
Recognize common technologies	Grades 5–6
2-3-6-1	Recognize the raw materials for manufacturing everyday objects (such as wood, metal, plastic)
2-3-6-2	Recognize the structure and materials for housing
2-3-6-3	Recognize information technology equipment
	3. Topic of nature of science and technology

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Section	Learning objectives (our translation)
	Grades 1–2
3-1-0-1	Able to describe observed phenomenon in one's own words
	Grades 3–4
3-2-0-1	Know that verification or testing methods can be used to check one's thinking
3-2-0-2	Be aware that if experimental conditions are the same, the outcomes will be very similar
	Grades 5–6
3-3-0-1	Be able to conduct scientific inquiry activities, and understand that scientific knowledge has been verified
3-3-0-2	Know that some phenomena (such as UFO) have difficulties of evidence collection, and cannot undergo scientific experimentation
3-3-0-3	Discover that using scientific knowledge to make inferences, confirmation of particular phenomena is possible
3-3-0-4	Be aware that "examining existing data from a new perspective" or "examining new data from existing theories", can often generate new questions
3-3-0-5	Be aware that sometimes under the same experimental conditions, there may be uncontrolled factors, thus making the outcomes different
	4. Topic of development of science and technology
Nature of S and T	Grades 3–4
4-2-1-1	Understand the importance of science and technology in daily life
4-2-1-2	Recognize the characteristics of science and technology
S and T and the environment	Grades 3–4
4-2-2-2	Recognize common household products
Nature of S and T	Grades 5–6
4-3-1-1	Recognize different aspects of science and technology
4-3-1-2	Understand equipment, materials and energy
Evolution of S and T	Grades 5–6
4-3-2-1	Recognize the science of the agricultural era
4-3-2-2	Recognize the science of industrialization era
4-3-2-3	Recognize the science of information era
4-3-2-4	Recognize domestic and external technological inventions
S and T and the environment	Grades 5–6
4-3-3-1	Understand common local transport facilities, recreational facilities and other technologies
	5. Topic of habits of thinking
Problem solving	Grades 1–2
6-1-2-2	Learn the organization of work procedures
6-1-2-3	Learn how to allocate work, how to collaborate with others to complete a project

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Section	Learning objectives (our translation)
Critical thinking	Grades 3–4
6-2-1-1	Be able to asking various questions such as “What is this?”, “How could this be?” and raise researchable questions
6-2-2-1	Be able to frequently ask oneself “How to do it?” to prepare oneself to think about a solution
Critical thinking	Grades 5–6
6-3-1-1	From the data or reports of others, raise appropriate confirmations and questions
Idea generation	Grades 5–6
6-3-2-1	Observe that different approaches can often achieve the same outcomes
6-3-2-3	When facing problems, be able to think of alternative ideas, and propose solutions
Problem solving	Grades 5–6
6-3-3-1	Be able to plan, organize inquiry activities
	6. Topic of applications of science
	Grades 1–2
7-1-0-1	Learn how to organize work, be methodical
7-1-0-2	Learn how to operate a variety of simple equipment
	Grades 3–4
7-2-0-1	Use scientific knowledge to solve problems (e.g., knowing the temperature level to consider dressing warmly)
7-2-0-2	Be able to use the spirit and methods of scientific inquiry to perform tasks
7-2-0-3	Be able to safely and properly use everyday appliances
	Grades 5–6
7-3-0-1	Be aware that experimental or scientific knowledge can predict possible events
7-3-0-3	Be able to plan, organize inquiry activities
7-3-0-4	Be aware that many ingenious instruments are often the simple application of scientific principles
	8. Topic of design and production
	Grades 5–6
8-3-0-1	Be able to use association, brainstorming, concept maps and other procedures and the development of creative ideas to express one’s decisions for product revision
8-3-0-2	Use a variety of thinking methods, ponder how objects can change function and form
8-3-0-3	Recognize and design basic shapes
8-3-0-4	Understand the prototyping process

A-B-C-D nomenclature: “A” indicates the main topic (8 in total eg 1 = process skills), “B” indicates the grade level (1 for Grades 1–2, 2 for 3–4, 3 for 5–6), “C” represents the number of the sub-topic in the syllabus and “D” shows the item number in the category

Appendix C
Primary Science Learning Objectives (Cognitive Domain) from Korea Based on Our English Translation

Items	Learning objectives (our translation)
Grade 3–4 1. Characteristics of materials and substances	
4sci 01-01	Make connections between the functions and characteristics of objects by comparing objects made of different materials and substances
4sci 01-02	Compare various characteristics of materials and substances by observing objects with the same shapes and sizes but of different materials and substances
4sci 01-03	Explain the changes in the characteristics of substances by observing the differences before and after different substances are mixed
4sci 01-04	Design various objects by choosing various materials and substances and discuss their strengths and weakness
Grade 3–4 2. Usage of magnets	
4sci 02-01	Identify the two poles of magnets by observing the forces of attraction and repulsion between magnets
4sci 02-02	Explain the unidirectional orientation of compass needles through observations
4sci 02-03	Investigate examples of the use of magnets in everyday lives and explain the functions of magnets in relation to their characteristics
Grade 3–4 3. The lives of animals	
4sci 03-01	Classify animals according to their characteristics through observing various animals
4sci 03-02	Explain how the appearance and behavior of animals are related to their habitats
4sci 03-03	Make a presentation of everyday examples of man-made objects that resemble the characteristics of animals
Grade 3–4 4. Changes of the earth surface	
4sci 04-01	Observe soils from various places and compare them
4sci 04-02	Explain how soils are produced using models
4sci 04-03	Relate the characteristics of geographical features of rivers and the ocean with the functions of streams and the ocean
Grade 3–4 5. Lives of plants	
4sci 05-01	Classify plants according to their characteristics through observing various plants
4sci 05-02	Explain how the appearance and life cycles of plants are related to their habitats
4sci 05-03	Make a presentation of everyday examples of man-made objects that resemble the characteristics of plants

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Items	Learning objectives (our translation)
Grade 3–4 6. Strata and fossils	
4sci 06-01	Observe various strata and explain how strata are formed using models
4sci 06-02	Classify sedimentary rocks according to the size of particles and explain how sedimentary rocks are made using models
4sci 06-03	Understand how fossils are formed and infer about prehistoric life and the environment through observation of fossils
Grade 3–4 7. States of substance	
4sci 07-01	Explain the characteristics of solids and liquids by observing their changes of shape and volume in different containers
4sci 07-02	Conduct an experiment that shows air occupies space
4sci 07-03	Conduct an experiment that shows air has mass
4sci 07-04	Classify everyday materials into solids, liquids, and gases
Grade 3–4 8. Characteristics of sound	
4sci 08-01	Explain objects that make sound vibrate through observation of various objects that make sound
4sci 08-02	Compare the loudness and pitch of sound
4sci 08-03	Observe how sound moves through and reflects off various objects and discuss ways of reducing noise
Grade 3–4 9. Weight	
4sci 09-01	Investigate examples of measuring the weight of objects in everyday lives and explain reasons why we need to measure weight
4sci 09-02	Compare the weight of objects through balancing activities
4sci 09-03	Investigate the relationship between the length of spring extension and a weight and explain the principles of measuring weight
4sci 09-04	Design and build a simple scale and test it
Grade 3–4 10. Lifecycles of animals	
4sci 10-01	Compare the characteristics of male and female animals and explain the different roles of male and female during reproduction
4sci 10-02	Plan observations of the lifecycles of animals, observe an animal by raising it, and express observations through writing and drawing
4sci 10-03	Investigate the lifecycles of various animals and explain that there are different types of animal lifecycles
Grade 3–4 11. Volcanoes and earthquakes	
4sci 11-01	Explain the various substances produced from volcanic activities
4sci 11-02	Understand how igneous rocks are produced and compare characteristics of granite and basalt
4sci 11-03	Make a presentation on the impact of volcanic activities on everyday lives
4sci 11-04	Understand the causes of earthquakes and discuss methods of earthquake safety
Grade 3–4 12. Separation of mixtures	
4sci 12-01	Find examples of mixtures in everyday lives and explain the necessities of separating mixtures
4sci 12-02	Separate solid mixtures by using the size of particles and magnetism

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Items	Learning objectives (our translation)
4sci 12-03	Separate mixtures of soluble and insoluble materials by filtration
4sci 12-04	Separate solids that have been dissolved in water through evaporation
Grade 3–4 13. Lifecycles of plants	
4sci 13-01	Explain the necessary conditions of germination and growth
4sci 13-02	Plan a way to observe the lifecycles of plants and observe the lifecycles by growing plants
4sci 13-03	Investigate the lifecycles of various plants and explain that there are different types of plant lifecycles
Grade 3–4 14. Changes of states of water	
4sci 14-01	Know that water can transform into water vapor or ice and observe the changes in volume and weight when water freezes and ice thaws
4sci 14-02	Know the changes when water evaporates and boils through observation and find everyday examples related to this phenomena
4sci 14-03	Observe the phenomenon of condensation of water vapor and find everyday examples related to this
Grade 3–4 15. Shadows and mirrors	
4sci 15-01	Explain how shadows are formed by observing the shadows of various objects
4sci 15-02	Observe and describe the changes in the size of shadows by varying the distance between an object and a light source
4sci 15-03	By comparing an object and its reflection in mirrors, explain the characteristics of mirrors
4sci 15-04	Investigate examples of using mirrors in everyday lives and explain the function of mirrors in relation to the characteristics of mirrors
Grade 3–4 16. The shape of the earth	
4sci 16-01	Explain the shape of the earth and its surface through investigating earth-related resources
4sci 16-02	Explain the characteristics of the ocean by comparing it with the land
4sci 16-03	Explain the roles of air surrounding the earth by giving examples
4sci 16-04	Investigate the earth and the moon, understand the shape, surface, and environments and compare the earth and the moon
Grade 3–4 17. The travel of water (integrated topic)	
4sci 17-01	Explain the water cycle and state changes in relation to various phenomena among living beings, the earth, and the air
4sci 17-02	Understand the importance of water and investigate creative ways to solve water shortages
Grade 5–6 1. Temperature and heat	
6sci 01-01	Investigate examples of measuring and estimating temperature in everyday lives and explain reasons for accurate measurement of temperature
6sci 01-02	Observe that the different temperatures of two objects will become the same after contact and explain the changes of temperature in terms of heat transfer
6sci 01-03	Compare the rate of heat transfer in different kinds of solids through observations and investigate examples of heat insulation in everyday lives

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Items	Learning objectives (our translation)
6sci 01-04	Observe convection in liquids and gases and explain heat transfer in convection
Grade 5–6 2. The solar system and stars	
6sci 02-01	Understand that the sun is the source of energy of the earth and investigate the sun and planets in the solar system
6sci 02-02	Know what stars are and investigate the major constellations
6sci 02-03	Find the North Star by using constellations in the Northern sky
Grade 5–6 3. Dissolution and solution	
6sci 03-01	Observe the phenomenon of a substance dissolving in water and explain what are solutions
6sci 03-02	Compare the amount of solute dissolving in water which is different depending on the types of solute
6sci 03-03	Conduct an experiment to show that the amount of solute dissolving differs depending on the temperature of water
6sci 03-04	Design ways to compare the relative concentrations of solutions
Grade 5–6 4. Various living beings and our lives	
6sci 04-01	Explain the types and characteristics of living beings through investigating other living beings other than animals and plants
6sci 04-02	Discuss positive and negative impacts that various living beings have on our everyday lives
6sci 04-03	Investigate and present examples of using advanced life sciences in everyday lives
Grade 5–6 5. Life and the environment	
6sci 05-01	Know that an ecosystem consists of living and non-living objects and explain how the components of ecosystems impact each other
6sci 05-02	By understanding the impact of non-living objects on living beings, explain the relationships between the environment and living beings
6sci 05-03	Perceive the importance of conserving the ecosystem and discuss our roles and actions for it
Grade 5–6 6. Weather and our lives	
6sci 06-01	Measure humidity and investigate examples of the impact of humidity in everyday lives
6sci 06-02	Understand the similarities and differences among dew, fog, and clouds and explain the formation of rain and snow
6sci 06-03	Know what are high and low pressure and explain the causes of wind
6sci 06-04	Relate the characteristics of seasonal weather to the characteristics of surrounding air around Korea
Grade 5–6 7. Movements of objects	
6sci 71-01	By observing the movements of objects in everyday lives, compare speed qualitatively
6sci 07-02	By investigating the distance and time of an object's movement, calculate velocity
6sci 07-03	Investigate and present examples of safety and safety devices on speed in everyday lives

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Items	Learning objectives (our translation)
Grade 5–6 8. Acids and Bases	
6sci 08-01	Classify various solutions in everyday lives with various criteria
6sci 08-02	Classify various solutions into acids and bases by using pH indicators
6sci 08-03	Compare the characteristics of acids and bases and observe changes when acids and bases are mixed
6sci 08-04	Investigate and present examples of using acids and bases in everyday lives
Grade 5–6 9. Movements of the earth and moon	
6sci 09-01	Explain how the location of the sun and the moon changes throughout the day in terms of the rotation of the earth
6sci 09-02	Explain how constellations change according to the seasons in terms of the revolution of the earth
6sci 09-03	Observe how the shape and location of the moon changes periodically
Grade 5–6 10. Various gases	
6sci 10-01	Produce oxygen and carbon dioxide with experimental apparatus and check and explain the characteristics of these gases
6sci 10-02	Observe the phenomena that the volume of gas changes according to temperature and pressure and find examples in everyday lives
6sci 10-03	Investigate and present various gases that comprise the air
Grade 5–6 11. Light and lenses	
6sci 11-01	By observing various colors of sunlight through a prism, explain that sunlight consists of various colors of light
6sci 11-02	By observing the phenomena of light refraction through glass, water, convex lenses, express observations through drawings
6sci 11-03	Observe objects through convex lenses and investigate the use of convex lenses
Grade 5–6 12. Structures and functions of plants	
6sci 12-01	Observe cells which are the basic units of living organisms using microscopes
6sci 12-02	By observing the whole structure of plants and doing experiments, explain the structure and function of roots, stems, leaves, and flowers
6sci 12-03	Investigate the methods of seed dispersal of various plants and explain various ways of seed dispersal
Grade 5–6 13. Usage of electricity	
6sci 13-01	By connecting batteries, bulbs, and wires, explain the necessary conditions to light bulbs
6sci 13-02	Compare the brightness of bulbs in series and parallel circuits
6sci 13-03	Discuss ways of saving electricity and how to use it safely
6sci 13-04	By making electromagnets, compare magnets and electromagnets and investigate examples of the use of electromagnets in everyday lives
Grade 5–6 14. Seasonal changes	
6sci 14-01	By measuring the sun's altitude, length of shadow, and temperature throughout the day, find relationships among them
6sci 14-02	Explain the changes of the sun's altitude, the length of day and night, and temperature change throughout the seasons

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Items	Learning objectives (our translation)
6sci 14-03	Explain through model-based experiments that seasons change because the earth revolves around the sun with the rotation axis tilted
Grade 5–6 15. Combustion and fire extinction	
6sci 15-01	Observe the common phenomena of combustion and find the conditions for combustion
6sci 15-02	Through experiments, find substances produced by combustion
6sci 15-03	Suggest ways to extinguish fire in relation to the conditions of combustion and discuss fire safety rules
Grade 5–6 16. Structures and functions of our bodies	
6sci 16-01	By understanding the features and functions of bones and muscles, explain how bodies move
6sci 16-02	Explain the types, location, features and functions of the digestive, circulatory, respiratory, and excretory systems
6sci 16-03	Know the types, locations, features, and functions of the sensory system and explain how stimuli are transmitted
6sci 16-04	By observing the changes in our bodies when exercising, explain how various systems are interrelated
Grade 5–6 17. Energy and living (integrated topic)	
6sci 17-01	Know that living beings and machines need energy to survive and move and investigate what types of energy are used in that process
6sci 17-02	Know that energy transforms into different types through examples of natural phenomena and everyday lives and discuss the ways of using energy in efficient ways

Appendix D
Primary Science Learning Objectives (Cognitive Domain) from Singapore [The Government of Singapore (c/o Ministry of Education) Owns the Copyright to This Table and the Table has been Reproduced with Their Permission]

Theme	Learning objectives
Diversity	*Recognise some broad groups of living things – plants (flowering, non-flowering) – animals (amphibians, birds, fish, insects, mammals, reptiles) – fungi (mould, mushroom, yeast) – bacteria
Diversity	*Describe the characteristics of living things – need water, food and air to survive – grow, respond and reproduce
Diversity	*Observe a variety of living and non-living things and infer differences between them
Diversity	*Classify living things into broad groups (in plants and animals) based on similarities and differences of common observable characteristics
Diversity	*Relate the use of various types of materials (ceramic, fabric, glass, metal, plastics, rubber, wood) to their physical properties
Diversity	*Compare physical properties of materials based on: – strength – flexibility – waterproof – transparency – ability to float/sink in water
Cycles	**Recognise the importance of water to life processes
Cycles	**Recognise processes in the sexual reproduction of flowering plants – pollination – fertilisation (seed production) – seed dispersal – germination
Cycles	**Recognise the similarity in terms of fertilisation in the sexual reproduction of flowering plants and humans
Cycles	**Recognise the process of fertilisation in the sexual reproduction of humans

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Theme	Learning objectives
Cycles	*Show an understanding that different living things have different life cycles – Plants – Animals
Cycles	**Show an understanding that living things reproduce to ensure continuity of their kind and that many characteristics of an organism are passed on from parents to offspring
Cycles	*Observe and compare the life cycles of plants grown from seeds over a period of time
Cycles	*Observe and compare the life cycles of animals over a period of time (butterfly, beetle, mosquito, grasshopper, cockroach, chicken, frog)
Cycles	**Investigate the various ways in which plants reproduce and communicate findings – spores – seeds
Cycles	**Describe the impact of water pollution on Earth's water resources
Cycles	*State that matter is anything that has mass and occupies space
Cycles	**Recognise that water can exist in three interchangeable states of matter
Cycles	**Recognise the importance of the water cycle
Cycles	**Show an understanding of how water changes from one state to another – Melting (solid to liquid) – Evaporation/Boiling (liquid to gas) – Condensation (gas to liquid) – Freezing (liquid to solid)
Cycles	*Differentiate between the three states of matter (solid, liquid, gas) in terms of shape and volume
Cycles	**Compare water in 3 states
Cycles	**Show an understanding of the terms melting point of ice (or freezing point of water) and boiling point of water
Cycles	**Show an understanding of the roles of evaporation and condensation in the water cycle
Cycles	*Measure mass and volume using appropriate apparatus
Cycles	**Investigate the effect of heat gain or loss on the temperature and state of water and communicate findings – when ice is heated, it melts and changes to water at 0 °C – when water is cooled, it freezes and changes to ice at 0 °C – when water is heated, it boils and changes to steam at 100 °C – when steam is cooled, it condenses to water
Cycles	**Investigate the factors which affect the rate of evaporation and communicate findings – wind – temperature – exposed surface area
Systems	**Identify electrical conductors and insulators
Systems	**Recognise that an electric circuit consisting of an energy source (battery) and other circuit components (wire, bulb, switch) forms an electrical system
Systems	**Show an understanding that a current can only flow through a closed circuit
Systems	**Construct simple circuits from circuit diagrams

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Theme	Learning objectives
Systems	**Investigate the effect of some variables on the current in a circuit and communicate findings – number of batteries (arranged in series) – number of bulb (arranged in series and parallel)
Systems	**Show an understanding that a cell is a basic unit of life
Systems	*Identify the organ systems and state their functions in human (digestive, respiratory, circulatory, skeletal and muscular)
Systems	*Identify the organs in the human digestive system (mouth, gullet, stomach, small intestine and large intestine) and describe their functions
Systems	**Identify the organs of the human respiratory and circulatory systems and describe their functions
Systems	**Recognise the integration of the different systems (digestive, respiratory and circulatory) in carrying out life processes
Systems	*Identify the different parts of plants and state their functions – leaf – stem – root
Systems	**Identify the parts of the plant transport system and describe their functions
Systems	**Identify the different parts of a typical plant cell and animal cell and relate the parts to the functions – parts of plant cell: cell wall, cell membrane, cytoplasm, nucleus and chloroplasts – parts of animal cell: cell membrane, cytoplasm, nucleus
Systems	*Observe plant parts
Systems	**Compare how plants, fish and humans take in oxygen and give out carbon dioxide
Systems	**Compare the ways in which substances are transported within plants and humans – plants: tubes that transport food and water – humans: blood vessels that transport digested food, oxygen and carbon dioxide
Systems	**Investigate the functions of plant parts and communicate findings – leaf – stem – root
Systems	**Compare a typical plant and animal cell
Systems	**Recognise that air is a mixture of gases such as nitrogen, carbon dioxide, oxygen and water vapour
Interactions	*List some uses of magnets in everyday objects
Interactions	*Recognise that a magnet can exert a push or a pull
Interactions	*Identify the characteristics of magnets – magnets can be made of iron or steel – magnets have two poles. A freely suspended bar magnet comes to rest pointing in a North-South direction – unlike poles attract and like poles repel – magnets attract magnetic materials

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Theme	Learning objectives
Interactions	*Compare magnets, non-magnets and magnetic materials
Interactions	*Make a magnet by the "Stroke" method and the electrical method
Interactions	**Recognise that adaptations serve to enhance survival and can be structural or behavioural – cope with physical factors – obtain food – escape predators – reproduce by finding and attracting mates or dispersing seeds/fruits
Interactions	**Identify the factors that affect the survival of an organism – physical characteristics of the environment (temperature, light, water) – availability of food – types of other organisms present (producers, consumers, decomposers)
Interactions	**Differentiate among the terms organism, population and community – An organism is a living thing – A population is defined as a group of plants and animals of the same kind, living and reproducing at a given place and time – A community consists of many populations living together in a particular place
Interactions	**Show an understanding that different habitats support different communities (garden, field, pond, seashore, tree, mangrove swamp)
Interactions	**Give examples of man's impact, (both positive and negative) on the environment
Interactions	**Discuss the effect on organisms when the environment becomes unfavourable (organisms adapt and survive; move to other places or die)
Interactions	**Trace the energy pathway from the Sun through living things and identify the roles of various organisms (producers, consumers, predators, prey) in a food chain and a food web
Interactions	**Observe, collect and record information regarding the interacting factors within an environment
Interactions	**Identify a force as a push or a pull
Interactions	**Show an understanding of the effects of a force – A force can move a stationary object – A force can speed up, slow down or change the direction of motion – A force can stop a moving object – A force may change the shape of an object
Interactions	**Recognise and give examples of the different types of forces – magnetic force – gravitational force – elastic spring force – frictional force
Interactions	**Investigate the effect of friction on the motion of objects and communicate findings
Interactions	**Recognise that objects have weight because of the gravitational force acting on the object
Interactions	**Investigate the effects of forces on springs and communicate findings
Energy	*Recognise that an object can be seen when it reflects light or when it is a source of light

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Theme	Learning objectives
Energy	*Recognise that a shadow is formed when light is completely or partially blocked by an object
Energy	*Investigate the variables that affect shadows formed and communicate findings – shape, size and position of object(s) – distance between light source-object and object-screen
Energy	*List some common sources of heat
Energy	*State that the temperature of an object is a measurement of its degree of hotness
Energy	*List some effects of heat gain/loss in our everyday life – contraction/expansion of objects (solid, liquid and gas) – change in state of matter
Energy	*Identify good and bad conductors of heat – good conductors: metals – poor conductors: wood, plastics, air
Energy	*Differentiate between heat and temperature – heat is a form of energy – temperature is a measurement of the degree of hotness of an object
Energy	*Show an understanding that heat flows from a hotter to a colder object/region/place until both reach the same temperature
Energy	*Relate the change in temperature of an object to the gain or loss of heat by the object
Energy	*Measure temperature using a thermometer and a datalogger with temperature/heat sensors
Energy	**Recognise that the Sun is our primary source of energy (light and heat)
Energy	**Recognise that energy from most of our energy resources is derived in some ways from the Sun
Energy	**State that living things need energy to carry out life processes
Energy	**Differentiate the ways in which plants and animals obtain energy
Energy	**Investigate the requirements (water, light energy and carbon dioxide) for photosynthesis (production of sugar and oxygen) and communicate findings
Energy	**Recognise and give examples of the various forms of energy – kinetic energy – potential energy – light energy – electrical energy – sound energy – heat energy
Energy	**Investigate energy conversion from one form to another and communicate findings

*Grades 3–4
**Grades 5–6