

Section 4 Science

I. OVERALL OBJECTIVES

To enable students to take an active interest in natural things and phenomena, and to carry out observations and experiments with a sense of purpose, while also fostering foundations for the ability to perform investigations scientifically and their positive attitude for doing so. To enable students to deepen understanding of natural things and phenomena, and to cultivate scientific ways of looking and thinking.

II OBJECTIVES AND CONTENTS FOR EACH SECTION

[Field One]

1. Objectives

- (1) To enable students to take an active interest in things and phenomena related to matter and energy, and to acquire methods for discovering regularity and resolving problems by conducting activities which seek out and actively explore issues from among these things and phenomena.
- (2) To enable students to acquire skills for observation and experimentation by making observations and conducting experiments regarding physical events and phenomena, while also cultivating their ability to analyze, interpret, and express the results. To enable students to understand familiar physical phenomena, electrical currents and their use, and motion and energy, as well as to foster scientific ways of looking at and ways of thinking about these events and phenomena.
- (3) To enable students to acquire skills for observation and experimentation by making observations and conducting experiments on chemical substances and associated phenomena, while also cultivating their ability to analyze, interpret, and express the results. To enable students to understand the substances in their daily lives, chemical changes and atoms and molecules, and chemical changes and particles, as well as fostering scientific ways of looking at and ways of thinking about these things and phenomena.
- (4) To enable students to increase awareness concerning the connections between scientific and technological developments and human life, by conducting activities exploring things and phenomena related to matter and energy, and to foster an attitude of thinking scientifically through these activities, thereby enabling students to view nature in a comprehensive manner.

2. Contents

(1) Familiar Physical Phenomena

To enable students to understand the regularity of light, sound, and properties of force through observations and experiments on familiar objects and phenomena. To enable students to foster a scientific way of looking and thinking by relating these objects and phenomena to everyday life and society generally.

(a) Light and sound

a. Reflection and refraction of light

To enable students to discover the regularity of light when it is reflected and refracted through interfaces of materials such as water and glass, by conducting experiments on the reflection and refraction of light.

b. Function of convex lenses

To enable students to discover the relationship between the location of a body and the location and size of its image, by conducting experiments on the function of convex lenses.

c. Properties of sound

To enable students to discover that sound is produced by things vibrating and transmitted through the air and other media, as well as the fact that a sound's pitch and volume are related to how the sounding body vibrates, by conducting experiments on sound.

(b) Force and pressure

a. Function of force

To enable students to discover that exerting force on a body causes it to change its shape, to begin to move, or to change aspects of its motion, and to understand that this is expressed by the size and direction of the force, by conducting experiments that exert force on bodies.

b. Pressure

To enable students to discover that for pressure there is a connection between the size of the force and its area, by conducting experiments on pressure. In addition, to enable students to perceive the results from these in relation to the weight of water and air, by conducting experiments on water pressure and air pressure.

(2) Matter in our Daily Lives

To enable students to understand the properties of and changes in the states of matter for solids, liquids, and gases through observations and experiments, and to

impart to the students fundamentals for how to investigate the properties of substances.

(a) The forms of substances

a. Substances in our daily lives and their properties

To enable students to discover that each substance has unique properties and common properties, including density and the changes it undergoes when heated, by investigating the properties of substances in their daily lives through a variety of methods. In addition, to enable students to acquire skills such as how to operate laboratory equipment and how to record data.

b. Generation of gases and their properties

To enable students to discover the special characteristics of various types of gases, by conducting experiments that generate gases and investigate their properties, and to acquire skills such as methods for generating gases and ways to collect them.

(b) Aqueous solutions

a. Dissolving substances

To enable students to discover that dissolved substances disperse uniformly throughout a solution, by conducting observations on aspects of dissolving substances in water.

b. Solubility and recrystallization

To enable students to perceive solubility in relation to the results of student experiments that extract dissolved substances from solutions.

(c) State changes

a. State changes and heat

To enable students to discover that while the volume of substances changes when state changes, their mass does not change, by conducting observations and experiments on changes in states of matter.

b. Melting and boiling points of substances

To enable students to discover that the state of matter changes upon reaching its melting and boiling points, as well as how to separate types of substances by differences in their boiling points, by conducting temperature measurements during changes in the states of matter.

(3) Electric Currents and its Uses

To enable students to understand the relationship between electrical currents and voltage, as well as the function of electric currents, through observations and

experiments on electric current circuits. To enable students to foster elementary ways of looking at and ways of thinking about electric currents and magnetic fields in connection with everyday life and society.

(a) Electric currents

a. Circuits and electric current/voltage

To enable students to discover regularity with regard to the electric current flowing through each point of the circuit and the voltage taken on at each segment, by conducting experiments for building circuits and measuring their electric current and voltage.

b. Electric current/voltage and resistance

To enable students to discover the relationship between voltage and electric current, as well as the fact that metal wires have a resistance to electricity, by conducting experiments which measure the voltage and electric current taken on by metal wires.

c. Electricity and its energy

To enable students to discover that heat and light can be produced from electric currents, and that there are differences in the amount of heat and light generated by different electrical power, by conducting experiments that generate heat and light via electric currents.

d. Static electricity and electric current

To enable students to discover that static electricity arises from rubbing different materials together and that there is a force at work which opens or closes the space between charged bodies, as well as the fact that there is a relationship between static electricity and electric currents.

(b) Electric currents and magnetic fields

a. Magnetic fields which create electric currents

To enable students to understand that magnetic fields are expressed through lines of magnetic force, as well as the fact that a magnetic field can be produced around a coil, by conducting observations on magnetic fields via magnets and electric currents.

b. Force received by electric currents within magnetic fields

To enable students to discover that forces are at work when an electrical current is passed through a coil in a magnetic field, by conducting experiments using magnets and coils.

c. Electromagnetic induction and power generation

To enable students to discover that an electric current can be obtained by

moving coils and magnets, and to understand the difference between direct currents and alternating currents, by conducting experiments using magnets and coils.

(4) Chemical Changes and Atoms/Molecules

To enable students to understand the changes in substances and their quantitative relationship with regard to chemical combination, decomposition and so on through observations and experiments of chemical changes. To enable students to foster a way of looking and thinking which attempt to relate these things and phenomena to atomic and molecular models.

(a) Composition of substances

a. Decomposition of substances

To enable students to discover that components of the original substance can be estimated from the substance that has been broken down and generated, by conducting experiments which break down substances.

b. Atoms/molecules

To enable students to understand that a substance is made up of atoms/molecules, and that molecules are expressed with symbols.

(b) Chemical changes

a. Combination

To enable students to discover that substances are created which are different from the original substances by the reaction, by conducting experiments which combine two distinct substances. To enable students to explain chemical changes using atomic and molecular models, and to understand that the composition of the chemical compound is expressed through a chemical formula, and that chemical changes are expressed through chemical reaction formulas.

b. Oxidation and reduction

To enable students to discover that oxidation and reduction are changes which are related to oxygen, by conducting experiments on oxidation and reduction.

c. Chemical changes and heat

To enable students to discover that chemical changes are accompanied by the release and absorption of heat, by conducting experiments which produce heat via chemical changes.

(c) Chemical changes and the mass of substances

a. Chemical changes and the conservation of mass

To enable students to discover that the sum total for the mass of the reactant is equal to the sum total for the mass of the product material, by conducting experiments which measure the mass of substances before and after chemical changes.

b. Regularity of mass changes

To enable students to discover that there is a certain relationship between the mass of the chemicals that undergo a reaction, by conducting experiments which measure the mass of substances concerned with chemical changes.

(5) Motion and Energy

To enable students to understand the fundamentals of regularity in the motions of bodies and energy through observations and experiments concerning the motions of bodies and energy. To enable students to foster elementary ways of looking at and ways of thinking about motion and energy in connection with everyday life and society generally.

(a) Regularity of motion

a. Equilibrium of force

To enable students to discover the conditions when the forces reach equilibrium, by conducting experiments on two forces exerted on a body. To enable students to understand the regularity of the resultant force and components of force, by conducting experiments on the composition and decomposition of force.

b. Speed and direction of motion

To enable students to understand that motion has a speed and a direction, by conducting observations and experiments on the motions of objects.

c. Force and motion

To enable students to discover that for motion where force is exerted the speed of a body changes according to the direction of motion and the passage of time, and that for motion where force is not exerted a body moves in a straight line at a uniform speed, by conducting observations and experiments on motion where force is exerted on an object and where force is not exerted on the object.

(b) Mechanical energy

a. Work and energy

To enable students to understand work and power, by conducting experiments related to work, and to understand that the amount of energy

of a body can be measured by the work performed on one body by another body, by conducting experiments on collisions.

b. Conservation of mechanical energy

To enable students to discover that kinetic energy and potential energy turn into one another, and to understand that the net amount of mechanical energy is conserved, by conducting experiments related to mechanical energy.

(6) Chemical Changes and Ions

To enable students to understand the electrical conductivity and neutralization reactions of solutions through observations and experiments on chemical changes. To enable students to foster ways of looking at and ways of thinking about these things and phenomena in connection with ionic models.

(a) Solutions and ions

a. Electrical conductivity of solutions

To enable students to discover that there are both solutions which electric currents pass through and those which they do not pass through, by conducting experiments which pass electric currents through solutions.

b. The composition of atoms and ions

To enable students to understand the existence of ions from the fact that a substance is produced at electrodes, as well as to understand that the creation of ions is related to the composition of atoms, by conducting experiments on electrolysis.

c. Chemical changes and batteries

To enable students to discover that electric currents can be produced from electrolytic solutions, as well as to understand that chemical energy is converted into electrical energy, by conducting experiments that use electrolytic solutions and two types of metals.

(b) Acids/alkalis and ions

a. Acids/alkalis

To enable students to understand that the special characteristics of acids and alkalis depend on hydrogen ions and hydroxide ions, by conducting experiments which explore the properties of acids and alkalis.

b. Neutralization and salt

To enable students to understand that mixing acids and alkalis together produces water and salts, by conducting experiments on neutralization reactions.

(7) Science, Technology and Humans

To enable students to deepen recognition of the relationship between the use of energy resources and scientific and technological developments with human life, as well as to foster an attitude of scientifically considering and judging modalities for the conservation of the natural environment and the use of science and technology.

(a) Energy

a. Various forms of energy and its conversion

To enable students to understand that the conversion of various forms of energy is used in daily life and society through observations and experiments related to energy.

b. Energy resources

To enable students to understand that people obtain energy from hydraulic power, thermal power, and atomic energy while also recognizing that the efficient use of energy is important.

(b) Scientific and technological developments

a. Scientific and technological developments

To enable students to understand the course of scientific and technological developments and recognize the fact that science and technology enrich human life and make it more convenient and pleasurable.

(c) Conservation of the natural environment and the use of science and technology

a. Conservation of the natural environment and the use of science and technology

To enable students to scientifically consider modalities for conservation of the natural environment and the use of science and technology, while also recognizing that the creation of a sustainable society is essential.

3. Handling the Contents

(1) For Content-(1) through (7), Content-(1) and (2) are to be dealt with in Grade 1, Content-(3) and (4) are to be dealt with in Grade 2, and Content-(5) through (7) are to be dealt with in Grade 3.

(2) With regard to Content-(1), the following items should be dealt with:

(a) With regard to (1)-(a)-a., total reflection should be dealt with, and the qualitative relationships between the angle of incidence and angle of refraction in the refraction of light should also be touched on.

- (b) With regard to (1)-(a)-b., the qualitative relationships between the placement of the light source, the placement of the image, and the size of the image should be explored. In doing so, real images and virtual images should be dealt with.
 - (c) With regard to (1)-(a)-c., for the speed at which sound is transmitted the approximate speed at which it is transmitted through the air should be dealt with.
 - (d) With regard to (1)-(b)-a., the relationship between the size of the force applied to a spring and the extension of the spring should be dealt with, while also touching on the difference between weight and mass. The Newton should be used as the unit for force.
 - (e) With regard to (1)-(b)-b., the fact that pressure is exerted on a body in water from every direction should be touched on, as well as the fact that a buoyant force is exerted on such bodies.
- (3) With regard to Content-(2), the following items should be dealt with:
- (a) With regard to (2)-(a)-a., the differences between organic substances and inorganic substances, as well as between metals and nonmetals, should be dealt with. Furthermore, representative properties of plastics should be touched on as well.
 - (b) With regard to (2)-(a)-b., the fact that identical gases can be obtained by using different methods should be dealt with.
 - (c) With regard to (2)-(b)-a., this should be dealt with in connection with the particle model. Furthermore, mass percent concentration should also be touched on.
 - (d) With regard to (2)-(b)-b., the solubility curve should also be touched on.
 - (e) With regard to (2)-(c)-a., this should be dealt with in connection with the particle model, and in doing so the movement of particles should also be touched on.
 - (f) With regard to (2)-(c)-b., changes in the states of pure substances should primarily be dealt with.
- (4) With regard to Content-(3), the following items should be dealt with:
- (a) With regard to “circuits” in (3)-(a)-a., series and parallel circuits should be touched on, and two ways of connecting up electrical resistance should primarily be dealt with for each of these.
 - (b) With regard to “electrical resistance” in (3)-(a)-b., the fact that the value of resistance differs depending on the type of matter should be considered, and the

combined resistance when two types of resistance are connected should be touched on as well.

- (c) With regard to (3)-(a)-c., electrical energy should be dealt with, and in doing so the quantity of heat should be touched on as well.
 - (d) With regard to (3)-(a)-d., the fact that electric current is a stream of electrons should be dealt with.
 - (e) With regard to (3)-(b)-b., the fact that the direction of force changes when the direction of electric current and the direction of the magnetic field are changed should be dealt with.
 - (f) With regard to (3)-(b)-d., the fact that the direction of electric current changes when the direction in which the coil and magnet are moving has been changed should be dealt with.
- (5) With regard to Content-(4), the following items should be dealt with:
- (a) With regard to “atoms” in (4)-(a)-b., the fact that many types of atoms exist should be touched on by using the periodic table. In addition, basic examples should be dealt with concerning their “symbols.”
 - (b) With regard to “chemical formulas” and “chemical reaction formulas” in (4)-(b)-a., simple examples should be dealt with.
 - (c) With regard to “oxidation and reduction” in (4)-(b)-b., simple examples should be dealt with.
- (6) With regard to Content-(5), the following items should be dealt with:
- (a) With regard to (5)-(a)-b., the fact that when force is exerted on a body a force is also exerted on it from the opposite direction should be dealt with.
 - (b) With regard to falling motion from among the types of “motion where force is exerted” from (5)-(a)-c., motion along a slope should primarily be dealt with. In doing so, the fact that an object enters a free fall when the angle of the slope is 90° should be touched on. Regarding the fact that the “speed of a body changes,” this should be dealt with qualitatively.
 - (c) With regard to (5)-(b)-a., the work principle should also be touched on.
 - (d) With regard to (5)-(b)-b., friction should also be touched on.
- (7) With regard to Content-(6), the following items should be dealt with:
- (a) With regard to the “composition of atoms” from (6)-(a)-b., the fact that atoms are made up of electrons and a nucleus should be dealt with, and in doing so the fact that the nucleus is made up of protons and neutrons should also be touched on. In addition, with regard to “ions,” the fact that these are expressed in ionic formulas should be touched on as well.

- (b) With regard to “batteries” in (6)-(a)-c., the reaction that occurs at the electrodes should primarily be dealt with. In addition, typical batteries which are used in everyday life and society should also be touched on.
 - (c) With regard to (6)-(b)-a., pH should be touched on as well.
 - (d) With regard to (6)-(b)-b., the fact that there are salts which dissolve in water and salts which do not dissolve in water should be touched on.
- (8) With regard to Content-(7), the following items should be dealt with:
- (a) With regard to (7)-(a)-a., the manner in which heat is transmitted should also be dealt with. In addition, with regard to the “conversion of energy,” the fact that the net amount of energy is conserved should be dealt with, along with efficiency when using energy.
 - (b) With regard to (7)-(a)-b., the properties and use of radiation should also be touched on.
 - (c) With regard to (7)-(c)-a., the learning so far from Field One and Field Two should be applied, and this should be comprehensively dealt with in relation to (7)-(c)-a. in Field Two.

[Field Two]

1. Objectives

- (1) To enable students to take an active interest in living things and the natural things and phenomena surrounding them, and to acquire methods for discovering diversity and regularity and resolving problems by conducting activities which seek out and actively explore issues from among these things and phenomena.
- (2) To enable students to acquire skills for observation and experimentation by making observations and conducting experiments on living things and phenomena, while also cultivating their ability to analyze, interpret, and express the results. To enable students to understand the lives and varieties of living things and the continuity of life, as well as to foster scientific ways of looking at and ways of thinking about these things and phenomena.
- (3) To enable students to acquire skills for observation and experimentation by making observations and conducting experiments regarding geological events and phenomena, while also cultivating their ability to analyze, interpret, and express the results. To enable students to understand things like the composition and changes of the Earth, the climate and its changes, and the Earth and the universe, as well as to foster scientific ways of looking at and ways of thinking

about these things and phenomena.

- (4) To enable students to foster respect for life and their attitude for contributing to the conservation of the natural environment, by conducting activities exploring living things and phenomena in nature surrounding them, thereby enabling the students to view nature in a comprehensive manner.

2. Contents

(1) The lives and varieties of plants

To instill the students with fundamentals concerning how they should examine living things through observations of and experiments with nearby plants. To enable students to understand the structure and function of plants, and to deepen their recognition of the lives and variety of plants.

(a) Observation of living things

a. Observation of living things

To enable students to discover that different living things live in a variety of locations, and to acquire fundamental skills such as how to operate observational equipment and how to record the results of observations and how to examine living things, by conducting observations of living things in the schoolyard and the surrounding area of the school.

(b) Body structure and functions of plants

a. Structure and functions of flowers

To enable students to discover the basic characteristics of their structure, and to perceive them in relation to the functions of flowers, based on the records of observations which they conduct on the flower structure of various plants.

b. Structure and functions of leaves, stems, and roots

To enable students to discover the basic characteristics of their structures, and to perceive these in relation to the results of experiments concerning photosynthesis, respiration, and transpiration, based on the records of observations which they conduct on the structure of the leaves, stems, and roots of various plants.

(c) Groups of plants

a. Seed plants

To enable students to discover how plants can be classified based on characteristics of their structure, and to acquire methods for understanding plant species, considering flowers, leaves, stems and roots in relation to one another based on the records of observations.

b. Non-seed plants

To enable students to understand the differences between plants which do not produce seeds and those that do, by conducting observations of ferns, liverworts, and mosses.

(2) The Composition of and Changes in the Earth

To enable students to understand the various things and phenomena seen on the Earth's surface in relation to the changes in the Earth, as well as to deepen recognition of the Earth's changes, through observations on aspects of the Earth's activities and nearby rocks, strata, topographical features.

(a) Volcanoes and earthquakes

a. Volcanic activities and volcanic rocks

To enable students to perceive these in relation to the properties of underground magma, by exploring the shapes of volcanoes, aspects of their activities, and their eruptions. By conducting observations on volcanic rocks and plutonic rocks, to enable students to perceive the differences in their textures in relation to their origins.

b. How earthquakes are transmitted and the movements of the Earth's interior

To enable students to recognize the regularity of the size of tremors and how the ways of transmitting is based on personal experiences and records of earthquakes. To enable students to perceive the origin of earthquakes in relation to the movements of the Earth's interior, and to understand aspects of the changes in the Earth which accompany an earthquake.

(b) Overlapping of strata and aspects from the past

a. Overlapping of strata and aspects from the past

To enable students to discover regularity with regard to how strata overlap and expand based on records of these observations which they conduct outdoor and consider how strata are accumulated. To enable students to estimate past environments and geologic age by using strata and the fossils contained within them as clues.

(3) The Lives of Animals and Transitions of Living Things

To enable students to understand that the bodies of living things are made up of cells, through observations. To enable students to understand the body structure and functions of animals through observations and experiments with animals, as well as, to deepen recognition of animal life and the varieties found, and to understand the transitions in living things over time.

(a) Living things and cells

a. Living things and cells

To enable students to discover that the bodies of living things are made up of cells, as well as, to understand characteristics of the structure of plant and animal cells, by conducting observations of the tissues of living things.

(b) Body structure and functions of animals

a. Functions that support life

To enable students to perceive the mechanisms of animal's bodies for taking in and transporting the substances, in relation to the results of observations and experiments which they conduct observations and experiments on digestion, respiration and blood circulation. In addition, to enable students to understand that their bodies have mechanisms for excreting substances which they no longer need.

b. Stimulus and response

To enable students to perceive these mechanisms in relation to the sensory organs, nervous system, and motile organs, by conducting observations on aspects of the appropriate responses by animals to external stimuli.

(c) Groups of animals

a. Vertebrate animals

To enable students to discover that vertebrate animals can be classified into several groups by the comparisons and arrangement of the characteristics such as body structure and how young are born based on records of observations of such animals.

b. Invertebrate animals

To enable students to discover characteristics of these animals based on records of observations, collected through conducting observations involving invertebrate animals.

(d) Transitions and evolution of living things

a. Transitions and evolution of living things

To enable students to perceive that the body structures of currently existing living things are generated by changes in ancient living things, based on comparisons of existing living things and fossils.

(4) Weather and its Changes

To enable students to discover the relationship between meteorological elements and weather changes through observations of nearby weather. To enable students to deepen their recognition of the mechanisms and the regularity by which

climatic phenomena occur.

(a) Weather observations

a. Weather observations

To enable students to acquire observational methods and means for recording, by conducting weather observations in the schoolyard and other places. To enable students to discover the relationship between changes in factors like atmospheric temperature, humidity, atmospheric pressure, and wind direction with weather being based on these observed records.

(b) Weather changes

a. Formation of fog and clouds

To enable students to perceive the way they are formed in relation to changes in atmospheric pressure, atmospheric temperature and humidity, by conducting observations and experiments on the formation of fog and clouds.

b. Passage of weather fronts and weather changes

To enable students to perceive changes in weather in relation to warm air and cold air based on the results of observing weather changes which follow the passage of weather fronts.

(c) Japan's weather

a. Characteristics of Japan's weather

To enable students to perceive the characteristics of Japan's weather in relation to air masses by using weather maps and weather satellite images.

b. Atmospheric movements and the effects of oceans

To enable students to perceive Japan's climate in relation to atmospheric movements close to Japan and their effects on oceans by using weather satellite images and survey records.

(5) Continuity of Life

To enable students to understand the growth of living things, how they grow, multiply, and to perceive hereditary phenomena through observations and experiments on familiar living things, and also to deepen recognition of the continuity of life.

(a) Growth of living things and how they multiply

a. Somatic cell division and the growth of living things

To enable students to ascertain the process of cell division, by conducting observations of cell division, as well as, to perceive cell division in

relation to the growth of living things.

b. How living things multiply

To enable students to discover characteristics of sexual and asexual reproduction, by conducting observations on how familiar living things multiply, as well as to discover the fact that traits of parents are passed on to their children as living things multiply.

(b) Hereditary regularity and genes

a. Hereditary regularity and genes

To enable students to discover regularity when traits of parents are passed on to their children based on the results from crossbreeding experiments.

(6) The Earth and the Universe

To enable students to consider the Earth's movement through observations of nearby celestial bodies, and to understand characteristics of the sun and planets as well as the moon's movement, including on-going phases. To enable students to deepen their recognition of the universe, including the solar system and stars.

(a) Movements of celestial bodies and the rotation and revolution of the Earth

a. Diurnal motion and rotation

To enable students to relate the rotation of the Earth to the records of the observations which students conduct on the diurnal motion of celestial bodies.

b. Annual motion and revolution

To enable students to relate the Earth's revolution and the tilting of its axis to the observation records of the observations which students conduct on the annual motion of constellations and the changes in the sun's culmination height.

(b) The solar system and stars

a. Aspects of the sun

To enable students to discover characteristics of the Sun based on records of student observations and other data.

b. The moon's movement and phases of the moon

To enable students to perceive the moon's revolutions and the causes for the cycle phases of the moon in relation with one another based on records of observations which they conduct on the moon and other data.

c. Planets and stars

To enable students to understand the characteristics of the planets and stars and to perceive ways of viewing the planets in relation to the structure of the solar system based on observation data.

(7) Nature and Humans

To enable students to understand the mutual interrelationships among living things in the natural world, and the balance in nature, by exploring the natural environment, to broaden the students' awareness of the forms of connection between nature and humans, and to foster attitudes which arise from considering and judging modalities scientifically for conservation of the natural environment and the human use of science and technology.

(a) Living things and the environment

a. Balance in nature

To enable students to perceive plants, animals, and microorganisms as related to one another in a trophic aspect, and to discover that living things continue to live by preserving a balance within the natural world, by exploring the workings of microorganisms.

b. Surveys of the natural environment and environmental conservation

To enable students to understand that various factors have effects on the balance of the natural world, and to recognize the importance of conserving the natural environment, exploring the natural environment in student's nearby area.

(b) Natural benefits and disasters

a. Natural benefits and disasters

To enable students to explore benefits and disasters brought about by nature and to perceive these in a multifaceted and comprehensive manner, in order to consider the ways in which nature and humans are connected.

(c) Conservation of the natural environment and the use of science and technology

a. Conservation of the natural environment and the use of science and technology

To enable students to scientifically consider modalities for conservation of the natural environment, and the use of science and technology, while also recognizing that the creation of a sustainable society is essential.

3. Handling of Contents

(1) For Content-(1) through (7), Content-(1) and (2) are to be dealt with in Grade 1,

Content-(3) and (4) are to be dealt with in Grade 2, and Content-(5) through (7) are to be dealt with in Grade 3.

(2) With regard to Content-(1), the following items should be dealt with:

- (a) With regard to the “living things” in (1)-(a)-a., plants should primarily be studied, and the existence of microscopic living things in water should be touched on, as well.
- (b) With regard to (1)-(b)-a., angiosperms should primarily be studied. For the “functions of flowers,” the fact that after pollination ovules become seeds should primarily be dealt with.
- (c) With regard to (1)-(b)-b., the function of chloroplasts in photosynthesis should also be touched on. In addition, the functions of the leaves, stems, and roots should be related to one another in order to perceive the workings of the whole.
- (d) With regard to (1)-(c)-b., the fact that ferns, liverworts, and mosses produce spores should also be touched on.

(3) With regard to Content-(2), the following items should be dealt with:

- (a) With regard to the “volcanoes” in (2)-(a)-a., representative volcanoes should be dealt with while relating this to viscosity, and viscosity should also be dealt with in regards to the “properties of magma.” For “volcanic rock” and “plutonic rock,” representative rocks should be dealt with, in addition to which representative rocks-forming minerals should also be dealt with.
- (b) With regard to (2)-(a)-b., phenomenological aspects of earthquakes should primarily be dealt with, and the qualitative relationship between the duration of preliminary tremors and the distance from the hypocenter should be touched on as well. In addition, for the “movements of the Earth’s interior” the movement of plates in the area surrounding Japan should be dealt with.
- (c) With regard to (2)-(b)-a., representative sedimentary rocks which form strata should also be dealt with. For the “outdoor observations,” activities for observing the strata within and outside of school should be undertaken. For “strata,” faults and folding should be touched on, while facies fossils and index fossils should be touched on with regard to “fossils.” For the division of “geological periods,” the Paleozoic, Mesozoic and Cenozoic Eras of the Tertiary Period and Quaternary Period should be touched on.

(4) With regard to Content-(3), the following items should be dealt with:

- (a) With regard to (3)-(b)-a., the functions of each organ should primarily be dealt with. For “digestion,” the functions of typical digestive enzymes should be dealt with. In addition, the fact that food that has been ingested turns into substances which are absorbed through the wall of the small intestine by means of digestion should also be touched on. Regarding “respiration,” cellular respiration should also be touched on. In relation to “blood circulation,” the functions of the constituents of blood and those of the kidneys and liver should also be touched on.
- (b) With regard to (3)-(b)-b., the functions of each organ should primarily be dealt with.
- (c) With regard to (3)-(c)-a., the students should be made aware of aspects of the body surfaces of vertebrate animals and how they breathe, the development of their motile and sensory organs and the differences in how they obtain food.
- (d) With regard to (3)-(c)-b., this should primarily be handled by observing arthropods and mollusks and then comparing the body structure characteristics of these types of animals with those of vertebrate animals.
- (e) With regard to (3)-(d)-a., matters which are regarded as evidence of evolution and concrete examples of evolution should be dealt with. In doing so, the fact that characteristics have been observed in living things which are advantageous to life in their habitats should also be touched on.

(5) With regard to Content-(4), the following items should be dealt with:

- (a) With regard to (4)-(b)-a., the fact that changes in the saturation water vapor volume caused by the atmospheric temperature are connected with changes in humidity and condensation should be dealt with. The hydrologic water cycle should also be dealt with.
- (b) With regard to (4)-(b)-b., how the wind blows should also be touched on.
- (c) With regard to (4)-(c)-b., the function of the atmosphere enveloping the Earth should also be touched on, as should the size of the Earth and the thickness of the atmosphere.

(6) With regard to Content-(5), the following items should be dealt with:

- (a) With regard to (5)-(a)-a., the fact that chromosomes are replicated should also be touched on.
- (b) With regard to (5)-(a)-b., mechanisms for sexual reproduction should be

dealt with in relation to meiosis. For “asexual reproduction,” the division of single-celled organisms and vegetative reproduction should also be touched on.

- (c) With regard to (5)-(b)-a., the law of segregation should be dealt with. Additionally, the fact that the occurrence of changes in genes may alter traits, and that the actual substance of genes is DNA, should also be touched on.

(7) With regard to Content-(6), the following items should be dealt with:

- (a) With regard to the “changes in the sun’s culmination height” in (6)-(a)-b., the changes in the length of day and night and in the atmospheric temperature depending on the season should also be touched on.
- (b) With regard to the “characteristics of the sun” in (6)-(b)-a., factors like its shape, size and the appearance of its surface should be dealt with. In doing so, the effects on the surface of the Earth caused by the energy emitted from it, such as large quantities of light, should also be touched on.
- (c) With regard to (6)-(b)-b., solar eclipses and lunar eclipses should also be touched on.
- (d) With regard to the “planets” in (6)-(b)-c., matters like their size, atmospheric composition, surface temperature and the presence of satellites should be dealt with. When this is done, the fact that the Earth is furnished with the conditions to support life should also be touched on. For the “stars,” the fact that they emit their own light, and that the sun is one such star, should be dealt with. In doing so, the existence of the Milky Way System as a collection of stars should also be touched on. With regard to ways of viewing the planets regarding the “structure of the solar system,” Venus should be dealt with, along with its waxing and waning and apparent size. In addition, the fact that celestial bodies other than planets exist should also be touched on.

(8) With regard to Content-(7), the following items should be dealt with:

- (a) With regard to (7)-(a)-a., the relationship between producers, consumers and decomposers in ecosystems should be dealt with, and in doing so soil animals should also be touched on.
- (b) With regard to (7)-(a)-b., activities should be conducted which examine living things and natural environments like the atmosphere and water directly, as well as those which examine these things based on records and data. Global warming and nonnative species should also be touched on.

- (c) With regard to (7)-(b)-a., plate movement at a global scale should be dealt with. In addition, “disasters” should be examined by using records and data, touching on regional disasters as well.
- (d) With regard to (7)-(c)-a., the learning so far from Field One and Field Two should be applied, and this should be comprehensively dealt with in relation to (7)-(c)-a. in Field One.

III. SYLLABUS DESIGN AND HANDLING THE CONTENTS

1. In designing the syllabus, consideration should be given to the following:

- (1) In each grade, roughly the same amount of school hours should be allocated to each field throughout the year. In doing so, due consideration should be paid to the connection between each field and between each item so that characteristic ways of looking at and ways of thinking about each field are fostered and reinforce one another.
- (2) In accordance with the circumstances of the schools and students, sufficient time for observations and experiments and time for research in order to resolve problems should be set. In doing so, consideration should be given to enhancing learning activities for discovering questions, observation and planning experiments, as well as learning activities for analyzing and interpreting the results from observations and experiments. Consideration should also be given to learning activities where students use scientific concepts in their thinking and explanations.
- (3) Making things in order to deepen understanding of principles and laws should be undertaken appropriately according to the characteristics of the contents.
- (4) Ongoing observation and fixed-point observation of the changing of the seasons should be undertaken appropriately according to the characteristics of the contents.
- (5) Consideration should be given to active coordination and cooperation with museums, science learning centers and so on.
- (6) Based on the objectives of moral education listed in Sections I-2 of Chapter 1 “General Provisions” and in Section I of Chapter 3 “Moral Education,” instructions concerning the contents listed in Section II of Chapter 3 “Moral Education” should be given appropriately. The instructions should be in accordance with the characteristics of Science and should be related to the period of moral education.

2. In providing instruction on the contents in each field, consideration should be

given to the following:

- (1) Emphasis should be placed on observation, experiments, and outside observations. The circumstances of the regional environment and school should be utilized in order to foster the foundations for the ability to scientifically research regarding phenomena that can be observed as well as developing positive attitudes of doing so, keeping in mind that fundamental concepts can be reasonably configured in a step-wise fashion.
 - (2) Respect for life and an attitude of contributing to the conservation of the natural environment should be fostered.
 - (3) The fact that science and technology enrich our daily lives and society, as well as the fact that they serve to improve safety, should be emphasized. In addition, the fact that information developed by science research is related to a variety of different occupations should be a specific focus.
3. For the instruction on observation, experiments, and outside observations, sufficient care should be paid to accident prevention in particular; consideration should also be given to ensuring that appropriate measures are taken with regard to the management and disposal of the chemicals that are used.
 4. For the instruction in each field, consideration should be given to ensure the proactive and appropriate use of tools like computers and information and communication networks in areas such as searching for information in the course of observations and experiments, conducting experiments, data processing and experimental measurements.