ISB
International School Basel

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SCIENCE
CONTINUUM GUIDE

ISB Science Continuum Guide

Mission

**“We all want to learn more;
We all do it in different ways;
We all have fun learning;
We all help.”**

- ISB Student

As of June 2023

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Introduction ❯❯

Purpose of Science at ISB

The aspirations and expectations of the Sciences program at ISB are to:

- develop the **curiosity** to explore scientific inquiries and generate the motivation and enthusiasm to learn about Science and being a scientist
- develop an **understanding** of the history and nature of science and identify the connections between different Science disciplines
- develop a **sense of responsibility** regarding the impact of human or scientific actions on themselves, others and their world, arising from their knowledge and understanding of key scientific issues
- ensure students can **communicate** their understanding and conclusions
- make **connections** between students' experiences and their science knowledge to help them understand the world around them
- develop students' **problem-solving** capacity and disposition as they engage in scientific inquiry
- ensure students have the **academic competencies** and become **scientifically literate** to communicate their understanding and engage in further scientific studies or use sciences in their daily life confidently

Science Learning at ISB

In line with the philosophy underpinning all IB programmes, Science learning at ISB is based on inquiry and conceptual understanding. Whilst progressively developing key scientific skills, it is important that skills development are rooted in subject matter aiming at understanding and making sense of the physical and living world. As such, students explore the world around them, explore scientific knowledge and skills which enable them to better understand scientific concepts and ideas. An important aspect of learning science at ISB is the exposure to practical/experiential scientific exploration to support students' understanding.

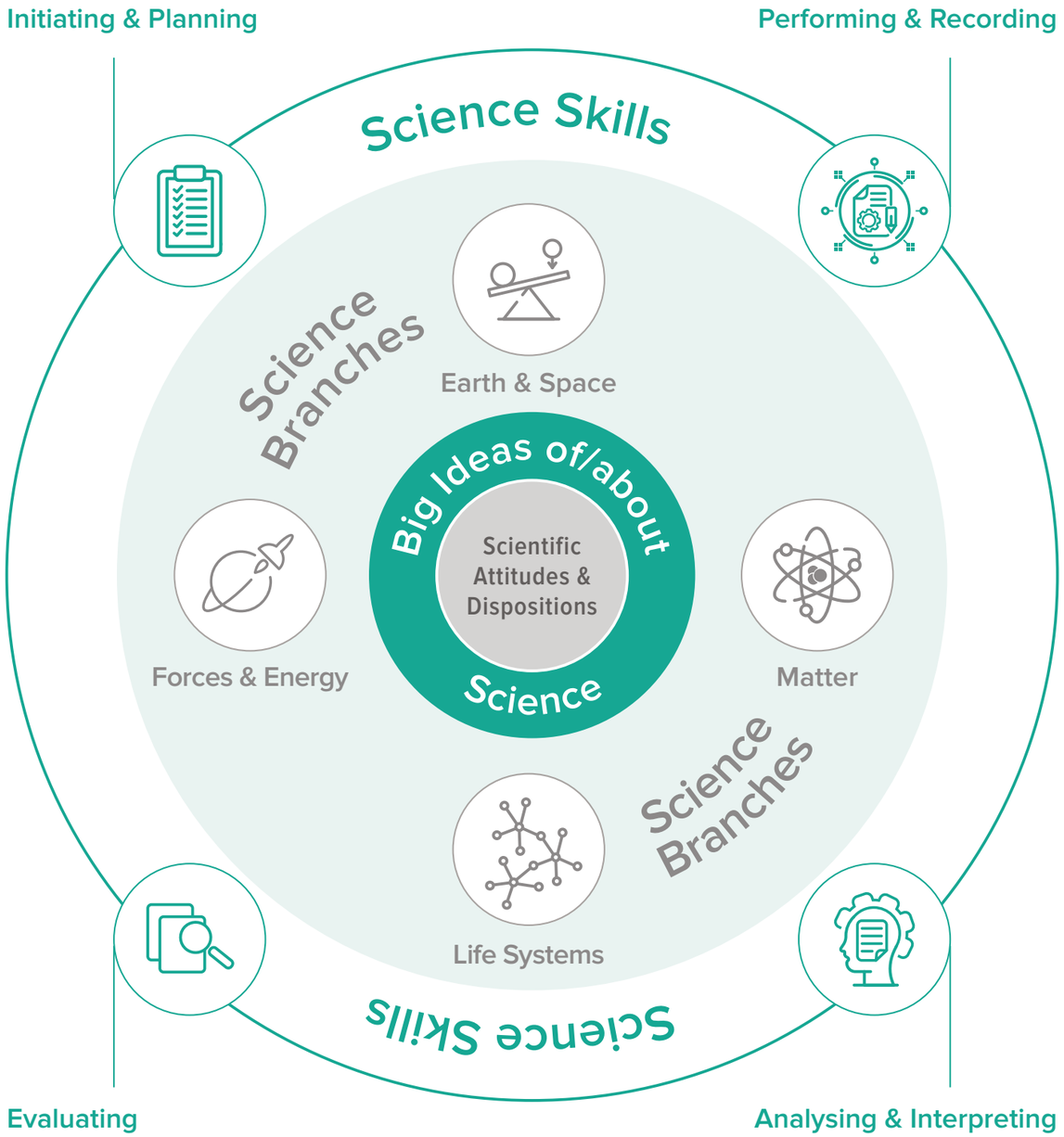
The Science continuum includes **four science branches:**

- Life Systems
- Matter
- Forces & Energy
- Earth & Space

ISB Science progression from Early Childhood to Grade 12 is organised in four categories of Science skills:

- Initiating & Planning
- Performing & Recording
- Analysing & Interpreting
- Evaluating

ISB Science Continuum



Science Branches

Life Systems

The study of the characteristics, systems and behaviours of humans and other organisms; the interactions and relationships between and among them, and their environment.

Matter

The study of the properties, behaviour and uses of materials, both natural and human-made.

Forces & Energy

The study of energy, its origins, storage, transfer, transformations and the work it can do; the study of forces; the application of scientific understanding through inventions and machines.

Earth & Space

The study of planet Earth and its position in the universe, particularly its relationship with the sun; the natural phenomena and systems that shape the planet and the distinctive features that identify it; the infinite and finite resources of the planet.

Science Skills

Initiating & Planning

Students ask questions that arise from careful observations and curiosity. They focus on making predictions that are testable and based on experience or scientific understanding. Students design experimental procedures that are safe and consider controlled variables.

Performing & Recording

Students develop the ability to select and handle appropriate equipment to collect data for a variety of tasks safely.

Analysing & Interpreting

Students process and analyse data, allowing for the interpretation of trends and patterns that can be used to inform a conclusion.

Evaluating

Students evaluate their prediction, method and data, considering improvements to their investigation.

Science Progression at ISB

How is the Science Progression organised at ISB

Science branches are bodies of knowledge through which science will be learned throughout the school. Instead of a list of content knowledge under each Science branch, the ISB continuum organises learning identifying what students will need to understand and do, using:

- **Skills and understanding students should accomplish by the end of each phase**, EC3, Grade 2, Grade 4, Grade 6, Grade 8, Grade 10 and Grade 12.
- **Science related skills** by the end of each cycle, in order to access new and more complex knowledge and experiences.
- **Big Ideas of Science** that progress in complexity throughout the school, to support students' conceptual understanding of "core disciplinary ideas".
- **Two Big Ideas about Science** that will be explored throughout their journey at our school in line with the developmental stage of the students.
  - Technological advances have helped scientific developments and understanding.
  - Applications of science often have ethical, social, economic and political implications.
- One key scientific attitude and disposition per branch, that teachers will pursue within their units to ensure students progress and can demonstrate the expected behaviours throughout their journey at ISB.

- **LIFE SYSTEMS:** All living things are connected and should be treated with care and respect.
- **MATTER:** Humans should use resources from the Earth responsibly.
- **FORCE AND ENERGY:** Humans should use energy responsibly.
- **EARTH AND SPACE:** Humans demonstrate a natural curiosity about the world around them to understand its importance in their daily lives and the future of humanity.

Teachers at ISB collaboratively plan specific units to be taught each year in each grade level, based on the skills, big ideas and scientific dispositions. Key information about units and assessments is shared with parents as units are introduced. The continuum allows all teachers to have an overview of the learning expectations throughout the school.

[1] *US Next Generation Science Standards, © 2012, National Academy of Sciences*

By the end of EC3 Big Ideas and Skills

BRANCH	BIG IDEAS
Life Systems	■ Living things (plants, animals, including humans) grow, take in food to have energy, make waste, and reproduce. ■ Living things have basic needs (air, water, food, and shelter) that are met from the environment. ■ Different kinds of living things behave in different ways.
Matter	■ Different materials have specific properties which help to determine its purpose. ■ An object is held together by its structure.
Forces & Energy	■ Every action needs energy to make it happen.
Earth & Space	■ Changes occur in daily and seasonal cycles which affect living things.

SKILLS	
Initiating & Planning	■ Ask questions that demonstrate curiosity about the world around them. ■ Make predictions about possible outcomes and simple procedures. ■ Consider that variables can change the results.
Performing & Recording	■ Use appropriate equipment for the task. ■ Follow teacher direction for safe use of materials and equipment. ■ Use senses to gather data.
Analysing & Interpreting	■ Calculations: Count the frequency. ■ Units: Determine the appropriate units. ■ Representation: Use a table and pictographs to represent data. ■ Look for and notice patterns in the world around them. ■ Describe discoveries in the world around them. ■ Make a generalised conclusion from their discoveries.
Evaluating	■ State whether a prediction was correct.

Science Progression at ISB **Grade 2**

By the end of Grade 2 Big Ideas and Skills

BRANCH	BIG IDEAS
Life Systems	■ There are many different kinds of plants and animals in the world today and many kinds that once lived but are now extinct. ■ The relationships among organisms can be represented as food chains. ■ Plants and animals adapt to meet their needs. ■ The classification of living and non-living things are based on their similarities and differences. ■ Changes to habitats (whether caused by natural or human means) can affect plants and animals and the relationships between them.
Matter	■ NONE
Forces & Energy	■ Movement is a change in the position or shape of an object. ■ Forces must act upon things to make them move or change shape. ■ Equal forces acting in opposite directions, in the same line, cancel each other and are described as being in balance.
Earth & Space	■ Weather is the result of temperature, wind speed and water (in all states). ■ Weather can be predicted by measuring and finding patterns. ■ Long-term patterns in the weather are referred to as the climate. ■ Water is constantly recycled.

SKILLS	
Initiating & Planning	■ Ask questions that demonstrate curiosity about the world around them. ■ Identify or generate a question or problem to be explored. ■ Make predictions about possible outcomes and more complex procedures. ■ Select materials and equipment to investigate a question. ■ Identify more than one variable that could affect the results.
Performing & Recording	■ Use the appropriate equipment and non standard units to collect simple data. ■ Follow teacher direction for safe use of materials and equipment. ■ Collect observational and numerical data. ■ Record simple observational and numerical data.
Analysing & Interpreting	■ Calculations: Use appropriate mathematical operations. ■ Units: Determine the appropriate units. ■ Representation: Use a table, bar graphs and pictographs to represent data. ■ Look for and notice patterns in data. ■ Describe the pattern in the data, using qualitative and quantitative wording. ■ Make a generalised conclusion from the data.
Evaluating	■ State whether a prediction was correct and provide evidence. ■ Understand the difference between a fair and unfair test. ■ Suggest ways in which the investigation could be improved.

By the end of Grade 4 Big Ideas and Skills

BRANCH	BIG IDEAS
Life Systems	■ The choices we make affect our body systems and, in turn, our overall health (link with PHE Curriculum).
Matter	■ Matter can be classified as solid, liquid or gas state. ■ When some substances are combined they form a new substance (or substances) with properties that are different from the original ones. ■ Different materials are recognisable by their properties.
Forces & Energy	■ When things that are unsupported fall downwards, they are being pulled by gravity, which holds all things on the Earth. ■ When opposing forces acting on an object are not in the same line, they cause the object to turn or twist. ■ Some energy resources are renewable and some are non-renewable.
Earth & Space	■ The movements of the bodies in the Solar System are observable and predictable. ■ Day and night are explained by the rotation of the Earth as it moves round the Sun.

SKILLS	
Initiating & Planning	■ Ask questions that demonstrate curiosity about the world around them. ■ Generate questions that can be answered through experimentation. ■ Make predictions and provide reasoning behind it. ■ Design and carry out a step-by-step method, including appropriate materials and equipment, to investigate a question. Consider repeating trials. ■ Design a fair test in which variables are controlled.
Performing & Recording	■ Use the appropriate equipment and standard units to collect simple data. ■ Use materials and equipment safely, with guidance as needed. ■ Considers the implications of the unsafe use of materials and equipment. ■ Collect and sort observational and numerical data. ■ Represent observational and numerical data in a variety of ways, using a ruler where appropriate.
Analysing & Interpreting	■ Calculations: Use appropriate mathematical operations. ■ Units: Determine the appropriate units. ■ Representation: Use a table and bar graph to represent data. ■ Determine if there is a pattern in the data. ■ Describe the pattern in the data, using qualitative and quantitative wording. ■ Make a generalised conclusion from the data.
Evaluating	■ State whether a prediction was correct and provide evidence. ■ Describe the fairness of the test. ■ Suggest possible changes to the method that would benefit the scientific investigation.

By the end of Grade 6 Big Ideas and Skills

BRANCH	BIG IDEAS
Life Systems	■ All living things are made up of cells. ■ Living organisms reproduce in a variety of ways.
Matter	■ All matter is made of particles. All the particles of a particular substance are the same and different from those of other substances. The particle theory of matter explains the physical characteristics of matter.
Forces & Energy	■ Forces can be exerted by one object on another, through direct contact or from a distance (contact and non-contact forces).
Earth & Space	■ The Earth's surface changes slowly over time. ■ There are many different kinds of rock with different compositions and properties. ■ The movements of the Earth and Moon impact natural cycles such as seasons, eclipses and tides.

SKILLS	
Initiating & Planning	■ Ask questions that arise from observation and curiosity. ■ Distinguish between an observation and an interpretation. ■ Develop a research question (that includes both the dependent and independent variables Gr6) and an outline of the investigation plan. ■ Outline a testable prediction (which includes independent and dependent variables g6) using scientific reasoning. ■ Design a logical, complete, and safe method which explains how the independent, dependent and controlled variables will be manipulated; select appropriate materials and equipment. ■ Outline how to manipulate the variables and outline how sufficient, relevant data will be collected.
Performing & Recording	■ Use appropriate materials and equipment accurately and precisely with guidance as needed. ■ Use equipment and material safely and identify potential risks. ■ Collect relevant quantitative and qualitative data. ■ Construct appropriate data tables.
Analysing & Interpreting	■ Calculations: Use appropriate calculations and processing for a given variable. ■ Units: Determine the appropriate units including conversions between metric units for length/mass, area; convert time from larger units to smaller units. ■ Representation: Use an appropriate graph and table to represent data. ■ Appropriately analyse data and graphs. When appropriate, use the graph to identify if a correlation exists between the variables. ■ Use the data collected to outline the relationship between the variables. ■ Outline the relationship between the variables.
Evaluating	■ Discuss the strengths and weaknesses of the data to validate the prediction. ■ Discuss the validity of a method based on the outcome of an investigation. ■ Describe improvements or extensions to the method that would benefit the scientific investigation.

By the end of Grade 8 Big Ideas and Skills

BRANCH	BIG IDEAS
Life Systems	■ Food provides the basic nutrients for organisms to carry out functions. ■ In the human body, systems carry out such key functions as digestion, respiration, circulation, and immunity. ■ Genetic information in a cell is held in the chemical DNA. Genes determine the development and structure of organisms and can be passed on sexually. ■ Interdependent organisms living together in particular environmental conditions form an ecosystem.
Matter	■ Atoms are the building blocks of all matter, living and non-living. The behaviour and arrangement of the atoms explains the properties of different materials. In chemical reactions, atoms are rearranged to form new substances. ■ The reactivity of elements influences their position on the periodic table and how they might react together to form new compounds.
Forces & Energy	■ Current can flow differently depending on the type of circuit (series/parallel). ■ Energy can be transformed from one store to another and transferred by different processes. ■ Light is transmitted through waves and transformed into chemical energy.
Earth & Space	■ Radiation from the Sun heats the Earth's surface and causes convection currents in the air and oceans, affecting climates.

SKILLS	
Initiating & Planning	■ Ask questions that arise from careful observation of phenomena, or unexpected results, to clarify and/or seek additional information. ■ Develop a research question and give a detailed account of the investigation, including both the dependent and independent variables and the method of measuring the dependent variable including the range of measurements. ■ Outline a testable hypothesis which includes independent and dependent variables and explain it using relevant and correct scientific reasoning. ■ Design a logical, complete and safe method which explains how the independent, dependent and controlled variables will be manipulated; select appropriate materials and equipment. ■ Describe how to manipulate variables and describe how sufficient, relevant data will be collected.
Performing & Recording	■ Use appropriate materials and equipment accurately and precisely, with guidance as needed. ■ Assess risk and ensure safety, ethical and environmental guidelines are followed. ■ Collect relevant quantitative and qualitative data. ■ Construct appropriate data tables.
Analysing & Interpreting	■ Calculations: Use appropriate calculations and processing for a given variable. ■ Units: Determine the appropriate units including conversions between metric units for volume. ■ Representation: Use an appropriate graph and table to represent data. ■ Appropriately analyse data and graphs. ■ Use the pattern identified (correlation) to describe a relationship between the variables. ■ Use correct scientific reasoning to outline the relationship between the variables.
Evaluating	■ Discuss the strengths and weaknesses of the data to validate the hypothesis. ■ Discuss the validity of a method based on the outcome of an investigation. ■ Describe improvements or extensions to the method that would benefit the scientific investigation.

Science Progression at ISB **Grade 8**

By the end of Grade 10 Big Ideas and Skills

BRANCH	BIG IDEAS
Life Systems	**Grade 9 Integrated Science** ■ All living organisms are made of one or more cells, which can be seen only through a microscope. ■ All the basic processes of life are the results of what happens inside cells. The activity in these cells is regulated by enzymes. ■ Some cells in multi-cellular organisms, as well as carrying out the functions that all cells do, are specialised. ■ Cells are often aggregated into tissues, tissues into organs, and organs into organ systems. In the human body, systems carry out key functions. ■ Living things can be classified universally (Taxonomy). Reclassification can occur with advances in technology. ■ An ecosystem is part of the environment where biotic and abiotic factors interact with each other. These can be measured and investigated. **Grade 10 BIOLOGY:** ■ The natural selection of organisms with certain features that enable them to survive in particular environmental conditions has been going since the first form of life appeared on Earth about 3.5 billion years ago. ■ The process of adaptation that occurs naturally and very slowly is speeded up by human intervention through the selection for breeding those animals or plants with the features that suit them for particular functions or environments. ■ Genetic information is passed down from one generation of organisms to another. ■ Genetic information in a cell is held in the chemical DNA. ■ Genes determine the development and structure of organisms. ■ In asexual reproduction all the genes in the offspring come from one parent. In sexual reproduction half of the genes come from each parent.

BRANCH	BIG IDEAS
Matter	**Grade 9 Chemistry:** ■ Trends and patterns in physical and chemical properties; arising from bonding and structure are used to organise elements and classify compounds. ■ Bond types in substances are related to the location of their elements in the periodic table. ■ Scientists summarize the transformation that occurs in a chemical reaction using equations. ■ Defining and classifying substances as Acids and Bases allows predictions and interpretions of chemical reactions. **Grade 9 Physics** ■ Energy transforms from one type of energy to another and can be measured. ■ Thermal energy can be used to alter the state of materials. **Grade 10 Physics** ■ Mechanical waves require a medium, non-mechanical waves (e.g light waves) do not. ■ All waves exhibit reflection, refraction and diffraction. ■ Atoms have a subatomic structure that determines its properties. ■ The radioactive decay of atoms releases particles and energy that leaves behind predictable products. ■ Radiation and nuclear energy have both dangerous and beneficial uses. **Grade 10 Chemistry:** ■ The relationship between the relative quantities taking part in a reaction determines desired quantitative data. ■ The number of atoms in a substance can be expressed using the unit ‘mole’. ■ Relative mass (atomic and molecular) allows for the comparison of substances. ■ Chemical reactions occur at different rates which can be applied to solve problems in a quantitative manner. ■ The number of Carbons and functional groups present allow organic chemicals to be classified. ■ When reactions take place, energy is transferred between the surroundings and the system; Energy is absorbed when bonds break and released when bonds form.

By the end of Grade 10 Big Ideas and Skills

BRANCH	BIG IDEAS
Forces & Energy	**Grade 9 Physics:** ■ Energy transforms from one type of energy to another and can be measured. ■ Thermal energy can be used to alter the state of materials. (Physics and chemistry). ■ Forces can be used to change the direction, shape and speed of objects. ■ Interactions between force, movement and energy can be used to explain the relationships between them. ■ Objects in circular motion can be described and predicted using set models. **Grade 9 Chemistry:** ■ Energy can be used to explain the processes we observe. ■ Energy in life systems principally originate from the Sun. ■ Nearly all Chemical reactions result in an overall energy change. **Grade 10 Physics:** ■ Waves (transversal or longitudinal) use the simple harmonic motion of particles to transmit energy. ■ Mechanical waves require a medium, non-mechanical waves (e.g light waves) do not. ■ All waves exhibit reflection, refraction and diffraction. ■ Changes in atomic nuceli release energy that can have both beneficial and harmful effects. **Grade 10 Chemistry:** ■ When reactions take place, energy is transferred between the surroundings and the system; Energy is absorbed when bonds break and released when bonds form.
Earth & Space	**Grade 9 Physics:** ■ The movement of the planets can be described using circular motion models. ■ Our universe is made of matter and energy. **Grade 10 Physics:** ■ Mechanical waves require a medium, non-mechanical waves (e.g light waves) do not.

SKILLS	
Initiating & Planning	■ Ask questions that arise from careful observation of phenomena, or unexpected results, to clarify and/or seek additional information. ■ Develop a research question and give a detailed account of the investigation, including reasons and causes of why it was chosen to be investigated. Students will include both the dependent and independent variables and the method of measuring the dependent variable including their range of measurements. ■ Suggest an expected relationship between the independent and dependent variables and provide scientific explanations. ■ Design a logical, complete and safe method which explains how the independent, dependent and controlled variables will be manipulated; select appropriate materials and equipment. ■ Explain how to manipulate the variables, and explain how sufficient, relevant data will be collected.
Performing & Recording	■ Use appropriate materials and equipment accurately and precisely with increasing levels of independence. ■ Assess risk, ethical and environmental considerations associated with the method. ■ Collect relevant quantitative and qualitative data. ■ Construct appropriate data tables.
Analysing & Interpreting	■ Calculations: Use appropriate calculations and processing for a given variable. ■ Units: Determine the appropriate units including conversions. ■ Representation: Use an appropriate graph and table to represent data. ■ Appropriately analyse data and graphs. ■ Use knowledge and understanding interpret graphs including the significance of gradients, changes in gradients, intercepts and areas; solve linear simultaneous equations. ■ Explain the data in terms of correct scientific theory and address the research question in terms of the data.
Evaluating	■ Evaluate the strengths and weaknesses of the data to validate the hypothesis. ■ Evaluate the validity of a method based on the outcome of an investigation. ■ Explain improvements or extensions to the method that would benefit the scientific investigation.

Science Progression at ISB **Grade 12**

By the end of Grade 12 Big Ideas and Skills

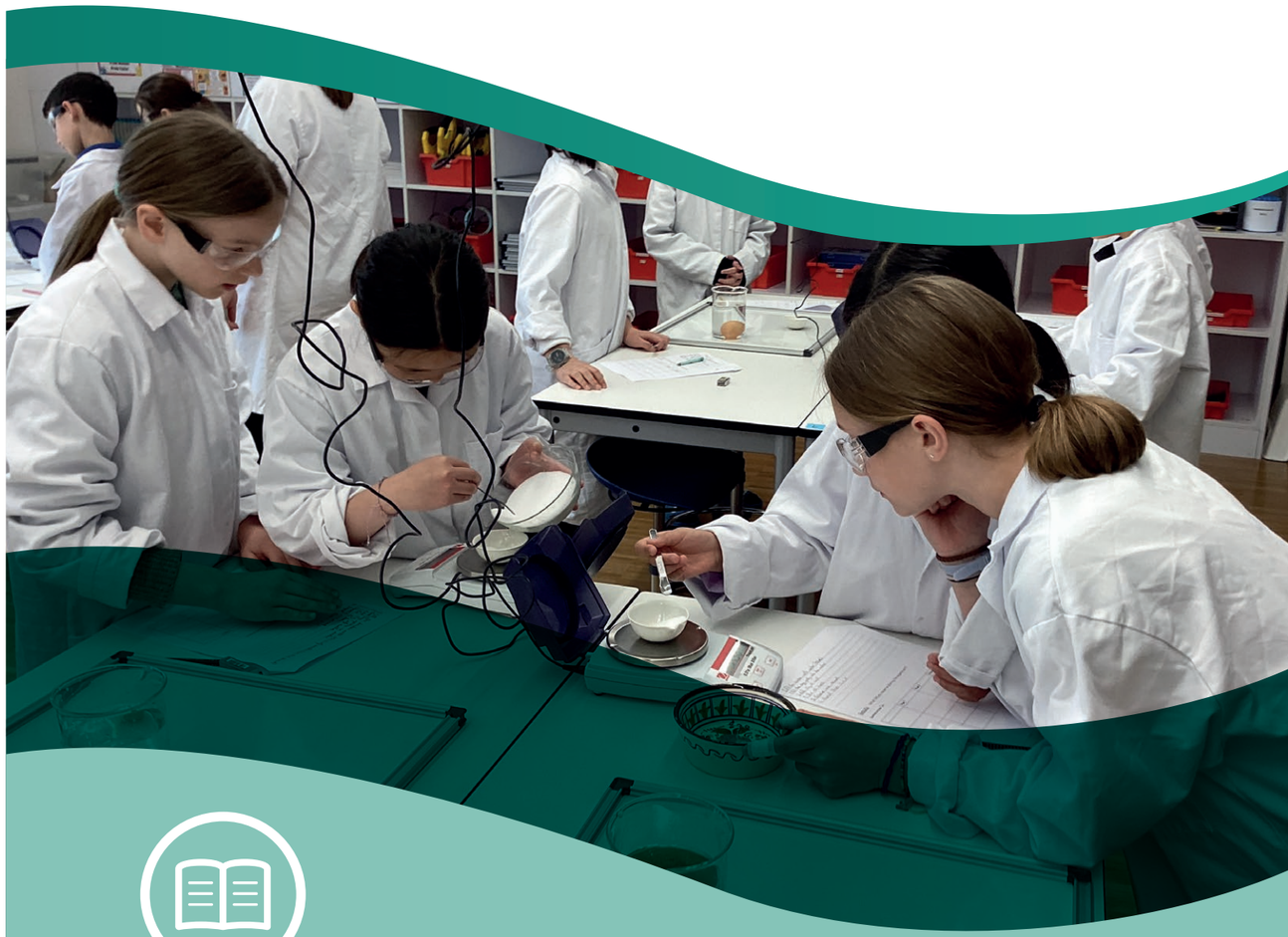
BRANCH	BIG IDEAS[1]
Life Systems Matter Forces & Energy Earth & Space	**Grade 12** (2023-2024) Students continue with the Science syllabus they started in grade 11. Themes have been shared with students. **Grade 11** (2023-2024): new syllabuses' information: ■ The new syllabus has an emphasis on Conceptual learning ■ Concept-based teaching and learning is encouraged across the continuum of IB programmes. ■ Concepts are mental representations of categories. They are constructed, modified and activated by the learner through learning experiences. Concepts do not exist in isolation but are interrelated. Conceptual understanding is always a work in progress—it is continually being developed and refined. **Please see the document provided by the IB for Biology, Chemistry and Physics** ■ Biology Roadmap ■ Chemistry Roadmap ■ Physics Roadmap

SKILLS	
Initiating & Planning	■ Identify a relevant and fully focussed research question that is clearly described. ■ Develop a research question giving a detailed account including reasons and causes. They will include both the dependent and independent variables and the method of measuring the dependent variable and the range of measurements required. ■ Express precisely and systematically the hypothesis which includes the variables and provide a correct and detailed account of the scientific reasons (theory or observations) for the hypothesis. ■ Independently research risks associated with procedures and chemicals (CLEAPSS). ■ Design a methodology that is appropriate to address the research question, taking into consideration the significant variables & factors that may influence the relevance and reliability of the collected data. ■ Devise a methodology for an investigation that is appropriate to address the research question taking into account the significant factors that influence the relevance, reliability and sufficiency of the collected data.
Performing & Recording	■ Independently select and use appropriate materials and equipment accurately and precisely. ■ Apply safety procedures when using equipment and chemicals in response to their experimental designs (CLEAPSS) whilst giving consideration to ethical (and animal experimentation policy) and environmental considerations. ■ Collect relevant quantitative and qualitative data. ■ Tabulate data including equipment uncertainties.

[1] *At the time this review was completed (February 2023) new IB Diploma Syllabuses for Sciences (except Environmental Systems and Societies) were published. Key themes for Grade 12 (previous syllabuses) are shared with students and a link to the new Syllabuses' Road Maps (examination in May 2025) are provided.*

SKILLS	
Analysing & Interpreting	■ Calculations: Use appropriate science discipline calculations and processing for a given variable, and the use of an appropriate statistical analysis to qualify the significance of the collected data. ■ Units: Determine the appropriate units including conversions. ■ Representation: Use an appropriate graph and table to represent data. ■ Appropriately analyse data and graphs; identify the equation of the best fit line and use software to analyse other trendlines. ■ Identify trends accurately, e.g. linear, proportional, positive correlation, inverse proportional, quadratic, exponential; identify the meaning of the gradient, y-intercept and/or area under simple linear graphs. ■ Draw conclusions from the trends, in response to the research question and give a detailed account of the scientific reason(s) for the trends.
Evaluating	■ Evaluate the strengths and weaknesses of the data to validate the hypothesis. ■ Discuss and explain strengths and weaknesses of the investigation in order to evaluate its relevance to the research question. ■ Discuss and explain realistic and relevant suggestions for the improvement and extension of the investigation. ■ Not until the Extended Essay. Identify appropriate academic sources, and make a judgment on the quality and reliability of the sources used.

Science Teaching at ISB



Junior School

IB Primary Years Programme (PYP):
EARLY CHILDHOOD 1-3, GRADES 1-5

- Science is taught by the Homeroom teacher.
- Science is taught within the transdisciplinary Units of Inquiry.
- Units of Inquiry integrate, where appropriate, science specific skills and big ideas. At least one unit per academic year is planned to use the lens of Science.

Middle School

IB Middle Years Programme (MYP):
GRADE 6, 7 & 8

- Taught as an Integrated Science course.
- Students in Grade 6-8 have 3 x 60 minute lessons per week.

Senior School

IB Middle Years Programme (MYP):
GRADES 9 -10
GRADE 9:

- Biology and Chemistry are taught as an Integrated Science course for 4 x 55 minute lessons per week.
- In addition students can choose Physics as an optional subject for 2 x 55 minute lessons per week.

GRADE 10:

- Biology and Chemistry are each taught for one semester for 4 x 55 minute lessons per week.
- In addition students can choose Physics as an optional subject for 2 x 55 minute lessons per week.

IB Diploma Programme (DP):
GRADE 11-12

- SL courses: 3 x 55 mins lessons per week
- HL courses: 4 x 55 mins lessons per week
- Courses offered:
  - Biology (SL/HL)
  - Chemistry (SL/HL)
  - Physics (SL/HL)
  - Environmental Systems and Societies (SL)[3]
  - Sports, Exercise and Health Science (SL/HL)
  - Computer Science (SL/HL)
  - Design technology (SL/HL)

[3] *Interdisciplinary subject, also available as an Individuals and Societies course*

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