



Johnston Heights Secondary



Course outline

# Sciences 9

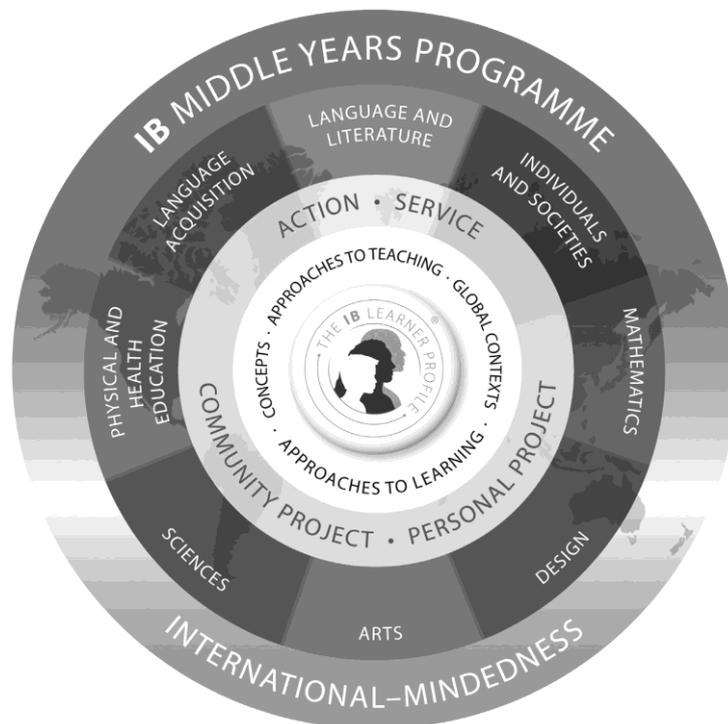
## **IB mission statement**

The International Baccalaureate aims to develop inquiring, knowledgeable and caring young people who help to create a better and more peaceful world through intercultural understanding and respect.

To this end the organization works with schools, governments and international organizations to develop challenging programmes of international education and rigorous assessment.

These programmes encourage students across the world to become active, compassionate and lifelong learners who understand that other people, with their differences, can also be right.

# Middle Years Programme Model



The MYP is designed for students aged 11 to 16. It provides a framework of learning that encourages students to become creative, critical and reflective thinkers. The MYP emphasizes intellectual challenge, encouraging students to make connections between their studies in traditional subjects and the real world. It fosters the development of skills for communication, intercultural understanding and global engagement—essential qualities for young people who are becoming global leaders.

## The MYP

- addresses holistically students' intellectual, social, emotional and physical **well-being**
- provides students opportunities to develop the **knowledge, attitudes** and **skills** they need in order to manage complexity and take responsible action for the future
- ensures breadth and depth of understanding through study in **eight subject groups**
- requires the study of at least **two languages** to support students in understanding their own cultures and those of others
- empowers students to participate in **service with the community**
- helps to prepare students for **further education**, the **workplace** and a

**lifetime of learning.**



The aim of all IB programmes is to develop internationally minded people who, recognizing their common humanity and shared guardianship of the planet, help to create a better and more peaceful world.

The IB learner profile represents 10 attributes valued by IB World Schools. We believe these attributes, and others like them, can help individuals and groups become responsible members of local, national and global communities.

### As IB learners we strive to be:

#### INQUIRERS

We nurture our curiosity, developing skills for inquiry and research. We know how to learn independently and with others. We learn with enthusiasm and sustain our love of learning throughout life.

#### KNOWLEDGEABLE

We develop and use conceptual understanding, exploring knowledge across a range of disciplines. We engage with issues and ideas that have local and global significance.

#### THINKERS

We use critical and creative thinking skills to analyse and take responsible action on complex problems. We exercise initiative in making reasoned, ethical decisions.

#### COMMUNICATORS

We express ourselves confidently and creatively in more than one language and in many ways. We collaborate effectively, listening carefully to the perspectives of other individuals and groups.

#### PRINCIPLED

We act with integrity and honesty, with a strong sense of fairness and justice, and with respect for the dignity and rights of people everywhere. We take responsibility for our actions and their consequences.

#### OPEN-MINDED

We critically appreciate our own cultures and personal histories, as well as the values and traditions of others. We seek and evaluate a range of points of view, and we are willing to grow from the experience.

#### CARING

We show empathy, compassion and respect. We have a commitment to service, and we act to make a positive difference in the lives of others and in the world around us.

#### RISK-TAKERS

We approach uncertainty with forethought and determination; we work independently and cooperatively to explore new ideas and innovative strategies. We are resourceful and resilient in the face of challenges and change.

#### BALANCED

We understand the importance of balancing different aspects of our lives-intellectual, physical, and emotional-to achieve well-being for ourselves and others. We recognize our interdependence with other people and with the world in which we live.

#### REFLECTIVE

We thoughtfully consider the world and our own ideas and experience. We work to understand our strengths and weaknesses in order to support our learning and personal development.

# Sciences 9

## Aims

The aims of all MYP subjects state what a teacher may expect to teach and what a student may expect to experience and learn. These aims suggest how the student may be changed by the learning experience.

The aims of MYP sciences are to encourage and enable students to:

- understand and appreciate science and its implications
- consider science as a human endeavour with benefits and limitations
- cultivate analytical, inquiring and flexible minds that pose questions, solve problems, construct explanations and judge arguments
- develop skills to design and perform investigations, evaluate evidence and reach conclusions
- build an awareness of the need to effectively collaborate and communicate
- apply language skills and knowledge in a variety of real-life contexts
- develop sensitivity towards the living and non-living environments
- reflect on learning experiences and make informed choices.

## Objectives

The objectives of any MYP subject state the specific targets that are set for learning in the subject. They define what the student will be able to accomplish as a result of studying the subject.

The objectives of MYP sciences encompass the factual, conceptual, procedural and metacognitive dimensions of knowledge.

Each objective is elaborated by a number of **strands**; a strand is an aspect or indicator of the learning expectation.

Subject groups **must** address **all** strands of **all** four objectives **at least twice** in each year of the MYP.

The objectives for years 1, 3 and 5 of the programme are provided in the guide and their use is mandatory.

These objectives relate directly to the assessment criteria found in the “Assessed curriculum” section of this guide.

Together these objectives reflect the holistic nature of science and the real-world work of scientists. They enable students to engage with all aspects of science, either through individual objectives or connected processes.

## **A. Knowing and understanding**

Students develop scientific knowledge (facts, ideas, concepts, processes, laws, principles, models and theories) and apply it to solve problems and express scientifically supported judgments.

Assessment of this objective must be done using tests or exams. To reach the highest level students must make scientifically supported judgments about the validity and/or quality of the information presented to them. Assessment tasks could include questions dealing with “scientific claims” presented in media articles, or the results and conclusions from experiments carried out by others, or any question that challenges students to analyse and examine the information and allows them to outline arguments about its validity and/or quality using their knowledge and understanding of science.

In order to reach the aims of sciences, students should be able to:

- i. explain scientific knowledge
- ii. apply scientific knowledge and understanding to solve problems set in familiar and unfamiliar situations
- iii. analyse and evaluate information to make scientifically supported judgments.

## **B. Inquiring and designing**

Intellectual and practical skills are developed through designing, analysing and performing scientific investigations. Although the scientific method involves a wide variety of approaches, the MYP emphasizes experimental work and scientific inquiry. When students design a scientific investigation they should develop a method that will allow them to collect sufficient data so that the problem or question can be answered. To enable students to design scientific investigations independently, teachers must provide an open-ended problem to investigate. An open-ended problem is one that has several independent variables appropriate for the investigation and has sufficient scope to identify both independent and controlled variables. In order to achieve the highest level for the strand in which students are asked to design a logical, complete and safe method, the student would include only the relevant information, correctly sequenced.

In order to reach the aims of sciences, students should be able to:

- i. explain a problem or question to be tested by a scientific investigation
- ii. formulate a testable hypothesis and explain it using scientific reasoning
- iii. explain how to manipulate the variables, and explain how data will be collected
- iv. design scientific investigations.

## **C. Processing and evaluating**

Students collect, process and interpret qualitative and/or quantitative data, and explain conclusions that have been appropriately reached. MYP sciences helps students to develop analytical thinking skills, which they can use to evaluate the method and discuss possible improvements or extensions.

In order to reach the aims of sciences, students should be able to:

- i. present collected and transformed data
- ii. interpret data and explain results using scientific reasoning
- iii. evaluate the validity of a hypothesis based on the outcome of the scientific investigation
- iv. evaluate the validity of the method
- v. explain improvements or extensions to the method.

## **D. Reflecting on the impacts of science**

Students gain global understanding of science by evaluating the implications of scientific developments and their applications to a specific problem or issue. Varied scientific language will be applied in order to demonstrate understanding. Students are expected to become aware of the importance of documenting the work of others when communicating in science.

Students must reflect on the implications of using science, interacting with one of the following factors: moral, ethical, social, economic, political, cultural or environmental, as appropriate to the task. The student's chosen factor may be interrelated with other factors.

In order to reach the aims of sciences, students should be able to:

- i. explain the ways in which science is applied and used to address a specific problem or issue
- ii. discuss and evaluate the various implications of the use of science and its application in solving a specific problem or issue
- iii. apply scientific language effectively
- iv. document the work of others and sources of information used.

## **Conceptual understanding**

A concept is a "big idea"—a principle or notion that is enduring, the significance of which goes beyond particular origins, subject matter, or place in time. Concepts represent the vehicle for students' inquiry into the issues and ideas of personal, local and global significance, providing the means by which they can explore the essence of the sciences.

Concepts have an important place in the structure of knowledge that requires students and teachers to think with increasing complexity as they organize and relate facts and topics.

Concepts express understanding that students take with them into lifelong adventures of learning. They help students to develop principles, generalizations and theories. Students use conceptual understanding as they solve problems, analyse issues, and evaluate decisions that can have an impact on themselves, their communities and the wider world.

In the MYP, conceptual understanding is framed by prescribed key and related concepts. Teachers must use these concepts to develop the curriculum. Schools may identify and develop additional concepts to meet local circumstances and curriculum requirements.

## Key concepts

Key concepts promote the development of a broad curriculum. They represent big ideas that are both relevant within and across disciplines and subjects. Inquiry into key concepts can facilitate connections between and among:

- courses within the sciences subject group (intra-disciplinary learning)
- other subject groups (interdisciplinary learning).

**Change** is a conversion/shift/movement from one state to another. Exploring change allows students to examine forces that shape the world: past, present and future. Inquiry into the concept of change invites students to consider causes, processes and consequences: natural and artificial, intentional and unintentional, positive and negative.

In sciences, change is viewed as the difference in a system's state when observed at different times. This change could be qualitative (such as differences in structure, behaviour, or level) or quantitative (such as a numerical variable or a rate). Change can be irreversible, reversible or self-perpetuating.

### Relationships

Relationships allow students to identify and understand the connections and associations between properties, forces, objects, people and ideas, including the human community's connection with the worlds in which we live. Any change in relationship brings consequences—some of which may occur on a small scale, while others may be far reaching, affecting large systems like human societies and the planet as a whole.

Relationships in sciences indicate the connections found among variables through observation or experimentation. These relationships also can be tested through experimentation. Scientists often search for the connections between form and function. Modelling is also used to represent relationships where factors such as scale, volume of data, or time make other methods impractical.

### Systems

Systems are sets of interacting or interdependent components. Everything in the known universe is a component of a system and generally also a part of multiple interacting and interdependent systems. Systems provide structure and order in both natural and human environments. Dynamic and complex in nature, systems rely on a state of equilibrium and are very vulnerable to change.

Systems in sciences describe sets of components that function due to their interdependence or complementary nature. Common systems in science are closed systems, where resources are not removed or replaced, and open systems, where necessary resources are renewed regularly. Modelling often uses closed systems to simplify or limit variables.

Other key concepts can also be important in sciences. For example, development is an important aspect in the continual growth through change that epitomizes scientific knowledge. Science offers important perspectives on the definition, measurement and meaning of time, place and space. Creativity is always important for scientists working together to extend the limits of human understanding.

## Related concepts for Sciences

Related concepts promote deep learning. They are grounded in specific disciplines and are useful for exploring key concepts in greater detail. Inquiry into related concepts helps students develop more complex and sophisticated conceptual understanding. Related concepts may arise from the subject matter of a unit or the craft of a subject—its features and processes.

The related concepts for modular sciences courses		
Balance	Consequences	Energy
Environment	Evidence	Form
Function	Interaction	Models
Movement	Patterns	Transformation

## Global contexts for teaching and learning

Global contexts direct learning towards independent and shared inquiry into our common humanity and shared guardianship of the planet. Using the world as the broadest context for learning, MYP mathematics can develop meaningful explorations of:

- identities and relationships  
**Who I am? Who are we?**
- orientation in space and time  
**What is the meaning of ‘when’ and ‘where’?**
- personal and cultural expression  
**What is the nature and purpose of creative expression?**
- scientific and technical innovation  
**How do we understand the world in which we live?**
- globalization and sustainability  
**How is everything connected?**
- fairness and development  
**What are the consequences of our common humanity?**

## Course Content and MYP Units

(See attachments)

# Sciences assessment criteria: Year 3

## Criterion A: Knowing and understanding

Maximum: 8

At the end of year 3, students should be able to:

- i. describe scientific knowledge
- ii. apply scientific knowledge and understanding to solve problems set in familiar and unfamiliar situations
- iii. analyse information to make scientifically supported judgments.

Achievement level	Level descriptor
0	The student does not reach a standard indicated by any of the descriptors below.
1–2	The student is able to: <ol style="list-style-type: none"> <li>i. <b>recall</b> scientific knowledge</li> <li>ii. apply scientific knowledge and understanding to <b>suggest solutions</b> to problems set in <b>familiar situations</b></li> <li>iii. <b>apply</b> information to make <b>judgments</b>.</li> </ol>
3–4	The student is able to: <ol style="list-style-type: none"> <li>i. <b>state</b> scientific knowledge</li> <li>ii. apply scientific knowledge and understanding to <b>solve problems</b> set in <b>familiar situations</b></li> <li>iii. <b>apply</b> information to make <b>scientifically supported judgments</b>.</li> </ol>
5–6	The student is able to: <ol style="list-style-type: none"> <li>i. <b>outline</b> scientific knowledge</li> <li>ii. apply scientific knowledge and understanding to <b>solve problems</b> set in <b>familiar situations</b> and <b>suggest solutions</b> to problems set in <b>unfamiliar situations</b></li> <li>iii. <b>interpret</b> information to make <b>scientifically supported judgments</b>.</li> </ol>
7–8	The student is able to: <ol style="list-style-type: none"> <li>i. <b>describe</b> scientific knowledge</li> <li>ii. apply scientific knowledge and understanding to <b>solve problems</b> set in <b>familiar and unfamiliar situations</b></li> <li>iii. <b>analyse</b> information to make <b>scientifically supported judgments</b>.</li> </ol>

## Criterion B: Inquiring and designing

Maximum: 8

At the end of year 3, students should be able to:

- i. describe a problem or question to be tested by a scientific investigation
- ii. outline a testable hypothesis and explain it using scientific reasoning
- iii. describe how to manipulate the variables, and describe how data will be collected
- iv. design scientific investigations.

Achievement level	Level descriptor
0	The student does not reach a standard identified by any of the descriptors below.
1–2	The student is able to: <ol style="list-style-type: none"> <li>i. <b>state</b> a problem or question to be tested by a scientific investigation, with <b>limited success</b></li> <li>ii. <b>state</b> a testable hypothesis</li> <li>iii. <b>state</b> the variables</li> <li>iv. design <b>a method, with limited success.</b></li> </ol>
3–4	The student is able to: <ol style="list-style-type: none"> <li>i. <b>state</b> a problem or question to be tested by a scientific investigation</li> <li>ii. <b>outline</b> a testable hypothesis <b>using scientific reasoning</b></li> <li>iii. <b>outline</b> how to manipulate the variables, and <b>state</b> how <b>relevant data</b> will be collected</li> <li>iv. design a <b>safe method</b> in which he or she <b>selects materials and equipment.</b></li> </ol>
5–6	The student is able to: <ol style="list-style-type: none"> <li>i. <b>outline</b> a problem or question to be tested by a scientific investigation</li> <li>ii. <b>outline and explain</b> a testable hypothesis <b>using scientific reasoning</b></li> <li>iii. <b>outline</b> how to manipulate the variables, and <b>outline</b> how <b>sufficient, relevant data</b> will be collected</li> <li>iv. design <b>a complete and safe method</b> in which he or she <b>selects appropriate materials and equipment.</b></li> </ol>
7–8	The student is able to: <ol style="list-style-type: none"> <li>i. <b>describe</b> a problem or question to be tested by a scientific investigation</li> <li>ii. <b>outline and explain</b> a testable hypothesis <b>using correct scientific reasoning</b></li> <li>iii. <b>describe</b> how to manipulate the variables, and <b>describe</b> how <b>sufficient, relevant data</b> will be collected</li> <li>iv. design a <b>logical, complete and safe method</b> in which he or she <b>selects appropriate materials and equipment.</b></li> </ol>

## Criterion C: Processing and evaluating

Maximum: 8

At the end of year 3, students should be able to:

- i. present collected and transformed data
- ii. interpret data and describe results using scientific reasoning
- iii. discuss the validity of a hypothesis based on the outcome of the scientific investigation
- iv. discuss the validity of the method
- v. describe improvements or extensions to the method.

Achievement level	Level descriptor
0	The student does not reach a standard identified by any of the descriptors below.
1–2	The student is able to: <ol style="list-style-type: none"> <li>i. <b>collect and present</b> data in numerical and/or visual forms</li> <li>ii. <b>accurately interpret</b> data</li> <li>iii. <b>state</b> the validity of a hypothesis <b>with limited reference</b> to a scientific investigation</li> <li>iv. <b>state</b> the validity of the method <b>with limited reference</b> to a scientific investigation</li> <li>v. <b>state limited</b> improvements or extensions to the method.</li> </ol>
3–4	The student is able to: <ol style="list-style-type: none"> <li>i. <b>correctly collect and present</b> data in numerical and/or visual forms</li> <li>ii. <b>accurately interpret</b> data and <b>describe</b> results</li> <li>iii. <b>state</b> the validity of a hypothesis based on the outcome of a scientific investigation</li> <li>iv. <b>state</b> the validity of the method based on the outcome of a scientific investigation</li> <li>v. <b>state</b> improvements or extensions to the method that would benefit the scientific investigation.</li> </ol>
5–6	The student is able to: <ol style="list-style-type: none"> <li>i. <b>correctly collect, organize and present</b> data in numerical and/or visual forms</li> <li>ii. <b>accurately interpret</b> data and <b>describe</b> results <b>using scientific reasoning</b></li> <li>iii. <b>outline</b> the validity of a hypothesis based on the outcome of a scientific investigation</li> <li>iv. <b>outline</b> the validity of the method based on the outcome of a scientific investigation</li> <li>v. <b>outline</b> improvements or extensions to the method that would benefit the scientific investigation.</li> </ol>
7–8	The student is able to: <ol style="list-style-type: none"> <li>i. <b>correctly collect, organize, transform and present</b> data in numerical and/or visual forms</li> <li>ii. <b>accurately interpret data</b> and <b>describe</b> results <b>using correct scientific reasoning</b></li> <li>iii. <b>discuss</b> the validity of a hypothesis based on the outcome of a scientific investigation</li> <li>iv. <b>discuss</b> the validity of the method based on the outcome of a scientific investigation</li> <li>v. <b>describe</b> improvements or extensions to the method that would benefit the scientific investigation.</li> </ol>

## Criterion D: Reflecting on the impacts of science

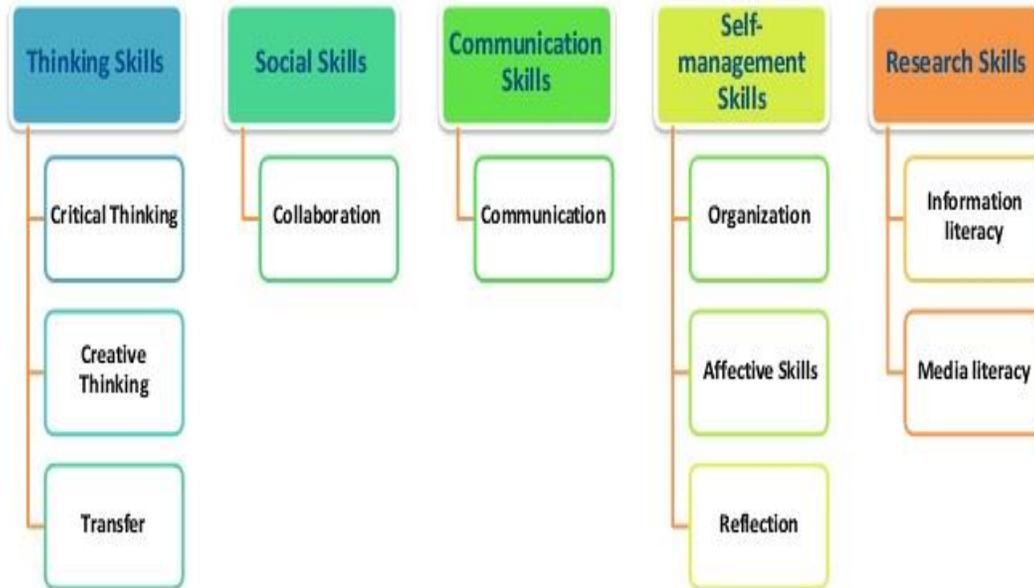
Maximum: 8

At the end of year 3, students should be able to:

- i. describe the ways in which science is applied and used to address a specific problem or issue
- ii. discuss and analyse the various implications of using science and its application in solving a specific problem or issue
- iii. apply scientific language effectively
- iv. document the work of others and sources of information used.

Achievement level	Level descriptor
0	The student does not reach a standard identified by any of the descriptors below.
1–2	The student is able to: <ol style="list-style-type: none"> <li>i. <b>state</b> the ways in which science is used to address a specific problem or issue</li> <li>ii. <b>state</b> the implications of the use of science to solve a specific problem or issue, interacting with a factor</li> <li>iii. <b>apply</b> scientific language to communicate understanding but does so <b>with limited success</b></li> <li>iv. document sources, <b>with limited success</b>.</li> </ol>
3–4	The student is able to: <ol style="list-style-type: none"> <li>i. <b>outline</b> the ways in which science is used to address a specific problem or issue</li> <li>ii. <b>outline</b> the implications of using science to solve a specific problem or issue, interacting with a factor</li> <li>iii. <b>sometimes apply</b> scientific language to communicate understanding</li> <li>iv. <b>sometimes</b> document sources <b>correctly</b>.</li> </ol>
5–6	The student is able to: <ol style="list-style-type: none"> <li>i. <b>summarize</b> the ways in which science is applied and used to address a specific problem or issue</li> <li>ii. <b>describe</b> the implications of using science and its application to solve a specific problem or issue, interacting with a factor</li> <li>iii. <b>usually apply</b> scientific language to communicate understanding <b>clearly and precisely</b></li> <li>iv. <b>usually</b> document sources <b>correctly</b>.</li> </ol>
7–8	The student is able to: <ol style="list-style-type: none"> <li>i. describe the ways in which science is applied and used to address a specific problem or issue</li> <li>ii. discuss and analyse the implications of using science and its application to solve a specific problem or issue, interacting with a factor</li> <li>iii. consistently apply scientific language to communicate understanding clearly and precisely</li> <li>iv. document sources completely.</li> </ol>

# Learning Skills in the MYP – ATL Skills



Think about how the framework above might develop all aspects of skills needed by the 21<sup>st</sup> century learner!