Department of Accelerated Programs

Mathematics SL

Year 1

Curriculum

10.0 Credits
## IB LEARNER PROFILE

IB Programs aim to develop internationally minded people who are striving to become:

<table>
<thead>
<tr>
<th>Role</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inquirers</td>
<td>Their natural curiosity is nurtured. They acquire the skills necessary to conduct constructive inquiry and research, and become independent active learners. They actively enjoy learning and this love of learning will be sustained throughout their lives.</td>
</tr>
<tr>
<td>Knowledgeable</td>
<td>They explore concepts, ideas and issues, which have global relevance and importance. In so doing, they acquire, and are able to make use of, a significant body of knowledge across a range of disciplines.</td>
</tr>
<tr>
<td>Critical thinkers</td>
<td>They exercise initiative in applying thinking skills critically and creatively to approach complex problems and make reasoned decisions.</td>
</tr>
<tr>
<td>Communicators</td>
<td>They understand and express ideas and information confidently and creatively in more than one language and in a variety of modes of communication.</td>
</tr>
<tr>
<td>Risk-takers</td>
<td>They approach unfamiliar situations with confidence and forethought, and have the independence of spirit to explore new roles, ideas and strategies. They are courageous and articulate in defending those things in which they believe.</td>
</tr>
<tr>
<td>Principled</td>
<td>They have a sound grasp of the principles of moral reasoning. They have integrity, honesty, a sense of fairness and justice and respect for the dignity of the individual.</td>
</tr>
<tr>
<td>Caring</td>
<td>They show empathy, compassion and respect towards the needs and feelings of others. They have a personal commitment to action and service to make a positive difference to the environment and to the lives of others.</td>
</tr>
<tr>
<td>Open-minded</td>
<td>Through an understanding and appreciation of their own culture, they are open to the perspectives, values and traditions of other individuals and cultures and are accustomed to seeking and considering a range of points of view.</td>
</tr>
<tr>
<td>Well-balanced</td>
<td>They understand the importance of physical and mental balance and personal well being for themselves and others. They demonstrate perseverance and self-discipline.</td>
</tr>
<tr>
<td>Reflective</td>
<td>They give thoughtful consideration to their own learning and personal development. They are able to analyze their strengths and weaknesses in a constructive manner.</td>
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</table>
Unit Three
Mathematics SL Year 1

Course Description

This course caters for students who already possess knowledge of basic mathematical concepts, and who are equipped with the skills needed to apply simple mathematical techniques correctly. The majority of these students will expect to need a sound mathematical background as they prepare for future studies in subjects such as chemistry, economics, psychology and business administration.

The course focuses on introducing important mathematical concepts through the development of mathematical techniques. The intention is to introduce students to these concepts in a comprehensible and coherent way, rather than insisting on the mathematical rigor required for mathematics HL. Students should, wherever possible, apply the mathematical knowledge they have acquired to solve realistic problems set in an appropriate context.

The internally assessed component, the exploration, offers students the opportunity for developing independence in their mathematical learning. Students are encouraged to take a considered approach to various mathematical activities and to explore different mathematical ideas. The exploration also allows students to work without the time constraints of a written examination and to develop the skills they need for communicating mathematical ideas. This course does not have the depth found in the mathematics HL courses. Students wishing to study subjects with a high degree of mathematical content should therefore opt for a mathematics HL course rather than a mathematics SL course.
# Mathematics SL Year 1

## Pacing Guide

<table>
<thead>
<tr>
<th>Unit</th>
<th>Topic</th>
<th>Suggested Timing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit 1</td>
<td>Algebra</td>
<td>4 Weeks</td>
</tr>
<tr>
<td>Unit 2</td>
<td>Functions &amp; Equations</td>
<td>12 Weeks</td>
</tr>
<tr>
<td>Unit 3</td>
<td>Vectors</td>
<td>8 Weeks</td>
</tr>
<tr>
<td>Unit 4</td>
<td>Circular Functions &amp; Trigonometry</td>
<td>12 Weeks</td>
</tr>
</tbody>
</table>
Educational Technology Standards


- **Technology Operations and Concepts**
  - Create a personal digital portfolio which reflects personal and academic interests, achievements, and career aspirations by using a variety of digital tools and resources.
  - Produce and edit a multi-page digital document for a commercial or professional audience and present it to peers and/or professionals in that related area for review.

- **Creativity and Innovation**
  - Apply previous content knowledge by creating and piloting a digital learning game or tutorial.

- **Communication and Collaboration**
  - Develop an innovative solution to a real world problem or issue in collaboration with peers and experts, and present ideas for feedback through social media or in an online community.

- **Digital Citizenship**
  - Demonstrate appropriate application of copyright, fair use and/or Creative Commons to an original work.
  - Evaluate consequences of unauthorized electronic access and disclosure, and on dissemination of personal information.
  - Compare and contrast policies on filtering and censorship both locally and globally.

- **Research and Information Literacy**
  - Produce a position statement about a real world problem by developing a systematic plan of investigation with peers and experts synthesizing information from multiple sources.

- **Critical Thinking, Problem Solving, Decision Making**
  - Evaluate the strengths and limitations of emerging technologies and their impact on educational, career, personal and or social needs.
# Career Ready Practices

Career Ready Practices describe the career-ready skills that all educators in all content areas should seek to develop in their students. They are practices that have been linked to increase college, career, and life success. Career Ready Practices should be taught and reinforced in all career exploration and preparation programs with increasingly higher levels of complexity and expectation as a student advances through a program of study.

## CRP1. Act as a responsible and contributing citizen and employee
Career-ready individuals understand the obligations and responsibilities of being a member of a community, and they demonstrate this understanding every day through their interactions with others. They are conscientious of the impacts of their decisions on others and the environment around them. They think about the near-term and long-term consequences of their actions and seek to act in ways that contribute to the betterment of their teams, families, community and workplace. They are reliable and consistent in going beyond the minimum expectation and in participating in activities that serve the greater good.

## CRP2. Apply appropriate academic and technical skills.
Career-ready individuals readily access and use the knowledge and skills acquired through experience and education to be more productive. They make connections between abstract concepts with real-world applications, and they make correct insights about when it is appropriate to apply the use of an academic skill in a workplace situation.

## CRP3. Attend to personal health and financial well-being.
Career-ready individuals understand the relationship between personal health, workplace performance and personal well-being; they act on that understanding to regularly practice healthy diet, exercise and mental health activities. Career-ready individuals also take regular action to contribute to their personal financial wellbeing, understanding that personal financial security provides the peace of mind required to contribute more fully to their own career success.


Career Ready Practices

CRP4. Communicate clearly and effectively and with reason.
Career-ready individuals communicate thoughts, ideas, and action plans with clarity, whether using written, verbal, and/or visual methods. They communicate in the workplace with clarity and purpose to make maximum use of their own and others’ time. They are excellent writers; they master conventions, word choice, and organization, and use effective tone and presentation skills to articulate ideas. They are skilled at interacting with others; they are active listeners and speak clearly and with purpose. Career-ready individuals think about the audience for their communication and prepare accordingly to ensure the desired outcome.

CRP5. Consider the environmental, social and economic impacts of decisions.
Career-ready individuals understand the interrelated nature of their actions and regularly make decisions that positively impact and/or mitigate negative impact on other people, organization, and the environment. They are aware of and utilize new technologies, understandings, procedures, materials, and regulations affecting the nature of their work as it relates to the impact on the social condition, the environment and the profitability of the organization.

CRP6. Demonstrate creativity and innovation.
Career-ready individuals regularly think of ideas that solve problems in new and different ways, and they contribute those ideas in a useful and productive manner to improve their organization. They can consider unconventional ideas and suggestions as solutions to issues, tasks or problems, and they discern which ideas and suggestions will add greatest value. They seek new methods, practices, and ideas from a variety of sources and seek to apply those ideas to their own workplace. They take action on their ideas and understand how to bring innovation to an organization.

CRP7. Employ valid and reliable research strategies.
Career-ready individuals are discerning in accepting and using new information to make decisions, change practices or inform strategies. They use reliable research process to search for new information. They evaluate the validity of sources when considering the use and adoption of external information or practices in their workplace situation.
Career Ready Practices

CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.
Career-ready individuals readily recognize problems in the workplace, understand the nature of the problem, and devise effective plans to solve the problem. They are aware of problems when they occur and take action quickly to address the problem; they thoughtfully investigate the root cause of the problem prior to introducing solutions. They carefully consider the options to solve the problem. Once a solution is agreed upon, they follow through to ensure the problem is solved, whether through their own actions or the actions of others.

CRP9. Model integrity, ethical leadership and effective management.
Career-ready individuals consistently act in ways that align personal and community-held ideals and principles while employing strategies to positively influence others in the workplace. They have a clear understanding of integrity and act on this understanding in every decision. They use a variety of means to positively impact the directions and actions of a team or organization, and they apply insights into human behavior to change others’ action, attitudes and/or beliefs. They recognize the near-term and long-term effects that management’s actions and attitudes can have on productivity, morals and organizational culture.

CRP10. Plan education and career paths aligned to personal goals.
Career-ready individuals take personal ownership of their own education and career goals, and they regularly act on a plan to attain these goals. They understand their own career interests, preferences, goals, and requirements. They have perspective regarding the pathways available to them and the time, effort, experience and other requirements to pursue each, including a path of entrepreneurship. They recognize the value of each step in the education and experiential process, and they recognize that nearly all career paths require ongoing education and experience. They seek counselors, mentors, and other experts to assist in the planning and execution of career and personal goals.

CRP11. Use technology to enhance productivity.
Career-ready individuals find and maximize the productive value of existing and new technology to accomplish workplace tasks and solve workplace problems. They are flexible and adaptive in acquiring new technology. They are proficient with ubiquitous technology applications. They understand the inherent risks-personal and organizational-of technology applications, and they take actions to prevent or mitigate these risks.
### Career Ready Practices

<table>
<thead>
<tr>
<th>CRP12. Work productively in teams while using cultural global competence.</th>
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</thead>
<tbody>
<tr>
<td>Career-ready individuals positively contribute to every team, whether formal or informal. They apply an awareness of cultural difference to avoid barriers to productive and positive interaction. They find ways to increase the engagement and contribution of all team members. They plan and facilitate effective team meetings.</td>
</tr>
</tbody>
</table>
**Differentiated Instruction**

**Strategies to Accommodate Students Based on Individual Needs**

<table>
<thead>
<tr>
<th>Time/General</th>
<th>Processing</th>
<th>Comprehension</th>
<th>Recall</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Extra time for assigned tasks</td>
<td>- Extra Response time</td>
<td>- Precise step-by-step directions</td>
<td>- Teacher-made checklist</td>
</tr>
<tr>
<td>- Adjust length of assignment</td>
<td>- Have students verbalize steps</td>
<td>- Short manageable tasks</td>
<td>- Use visual graphic organizers</td>
</tr>
<tr>
<td>- Timeline with due dates for reports and projects</td>
<td>- Repeat, clarify or reword directions</td>
<td>- Brief and concrete directions</td>
<td>- Reference resources to promote independence</td>
</tr>
<tr>
<td>- Communication system between home and school</td>
<td>- Mini-breaks between tasks</td>
<td>- Provide immediate feedback</td>
<td>- Visual and verbal reminders</td>
</tr>
<tr>
<td>- Provide lecture notes/outline</td>
<td>- Provide a warning for transitions</td>
<td>- Small group instruction</td>
<td>- Graphic organizers</td>
</tr>
<tr>
<td></td>
<td>- Reading partners</td>
<td>- Emphasize multi-sensory learning</td>
<td></td>
</tr>
</tbody>
</table>

**Assistive Technology**
- Computer/whiteboard
- Tape recorder
- Spell-checker
- Audio-taped books

**Tests/Quizzes/Grading**
- Extended time
- Study guides
- Shortened tests
- Read directions aloud

**Behavior/Attention**
- Consistent daily structured routine
- Simple and clear classroom rules
- Frequent feedback

**Organization**
- Individual daily planner
- Display a written agenda
- Note-taking assistance
- Color code materials
## Enrichment

**Strategies Used to Accommodate Based on Students Individual Needs:**

- Adaption of Material and Requirements
- Evaluate Vocabulary
- Elevated Text Complexity
- Additional Projects
- Independent Student Options
- Projects completed individual or with Partners
- Self Selection of Research
- Tiered/Multilevel Activities
- Learning Centers
- Individual Response Board
- Independent Book Studies
- Open-ended activities
- Community/Subject expert mentorships
<table>
<thead>
<tr>
<th>Assessments</th>
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</thead>
<tbody>
<tr>
<td><strong>Suggested Formative/Summative Classroom Assessments</strong></td>
</tr>
<tr>
<td>• Timelines, Maps, Charts, Graphic Organizers</td>
</tr>
<tr>
<td>• Teacher-created Unit Assessments, Chapter Assessments, Quizzes</td>
</tr>
<tr>
<td>• Teacher-created DBQs, Essays, Short Answer</td>
</tr>
<tr>
<td>• Accountable Talk, Debate, Oral Report, Role Playing, Think Pair, and Share</td>
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<tr>
<td>• Projects, Portfolio, Presentations, Prezi, Gallery Walks</td>
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<tr>
<td>• Homework</td>
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<tr>
<td>• Concept Mapping</td>
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<tr>
<td>• Primary and Secondary Source analysis</td>
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<tr>
<td>• Photo, Video, Political Cartoon, Radio, Song Analysis</td>
</tr>
<tr>
<td>• Create an Original Song, Film, or Poem</td>
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<tr>
<td>• Glogster to make Electronic Posters</td>
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<tr>
<td>• Internal and External IB Assessments</td>
</tr>
</tbody>
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## Interdisciplinary Connections

<table>
<thead>
<tr>
<th><strong>English Language Arts</strong></th>
<th><strong>Math</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Journal writing</td>
<td>• Research industry salaries for a geographic area and juxtapose against local cost of living</td>
</tr>
<tr>
<td>• Close reading of industry-related content</td>
<td>• Go on a geometry scavenger hunt</td>
</tr>
<tr>
<td>• Create a brochure for a specific industry</td>
<td>• Track and track various data, such as industry’s impact on the GDP, career opportunities or among of individuals currently occupying careers</td>
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<tr>
<td>• Keep a running word wall of industry vocabulary</td>
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<thead>
<tr>
<th><strong>Social Studies</strong></th>
<th><strong>Fine &amp; Performing Arts</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Research the history of a given industry/profession</td>
<td>• Create a poster recruiting young people to focus their studies on a specific career or industry</td>
</tr>
<tr>
<td>• Research prominent historical individuals in a given industry/profession</td>
<td>• Design a flag or logo to represent a given career field</td>
</tr>
<tr>
<td>• Use historical references to solve problems</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>World Language</strong></th>
<th><strong>Science</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Translate industry-content</td>
<td>• Research the environmental impact of a given career or industry</td>
</tr>
<tr>
<td>• Create a translated index of industry vocabulary</td>
<td>• Research latest developments in industry technology</td>
</tr>
<tr>
<td>• Generate a translated list of words and phrases related to workplace safety</td>
<td>• Investigate applicable-careers in STEM fields</td>
</tr>
</tbody>
</table>
Common Core State Standards (CCSS)

CC.9-12.N.VM.1 (+) Represent and model with vector quantities. Recognize vector quantities as having both magnitude and direction. Represent vector quantities by directed line segments, and use appropriate symbols for vectors and their magnitudes (e.g., $\mathbf{v}$ (bold), $|\mathbf{v}|$, $||\mathbf{v}||$, $\mathbf{v}$ (not bold)).

CC.9-12.N.VM.2 (+) Represent and model with vector quantities. Find the components of a vector by subtracting the coordinates of an initial point from the coordinates of a terminal point.

CC.9-12.N.VM.3 (+) Represent and model with vector quantities. Solve problems involving velocity and other quantities that can be represented by vectors.


CC.9-12.N.VM.4a (+) Add vectors end-to-end, component-wise, and by the parallelogram rule. Understand that the magnitude of a sum of two vectors is typically not the sum of the magnitudes.

CC.9-12.N.VM.4b (+) Given two vectors in magnitude and direction form, determine the magnitude and direction of their sum.

CC.9-12.N.VM.4c (+) Understand vector subtraction $\mathbf{v} - \mathbf{w}$ as $\mathbf{v} + (-\mathbf{w})$, where $(-\mathbf{w})$ is the additive inverse of $\mathbf{w}$, with the same magnitude as $\mathbf{w}$ and pointing in the opposite direction. Represent vector subtraction graphically by connecting the tips in the appropriate order, and perform vector subtraction component-wise.

CC.9-12.N.VM.5 (+) Perform operations on vectors. Multiply a vector by a scalar.

CC.9-12.N.VM.5a (+) Represent scalar multiplication graphically by scaling vectors and possibly reversing their direction; perform scalar multiplication component-wise, e.g., as $c(\mathbf{v}_{\text{sub } x}, \mathbf{v}_{\text{sub } y}) = (cv_{\text{sub } x}, cv_{\text{sub } y})$.

CC.9-12.N.VM.5b (+) Compute the magnitude of a scalar multiple $cv$ using $||cv|| = |c|v$. Compute the direction of $cv$ knowing that when $|c|v \neq 0$, the direction of $cv$ is either along $\mathbf{v}$ (for $c > 0$) or against $\mathbf{v}$ (for $c < 0$).

CC.K-12.MP.1 Make sense of problems and persevere in solving them. Mathematically proficient students start by explaining to themselves the meaning of a problem and looking for entry points to its solution. They analyze givens, constraints, relationships, and goals. They make conjectures about the form and meaning of the solution and plan a solution pathway rather than simply jumping into a solution attempt. They consider analogous problems, and try special cases and simpler forms of the original problem in order to gain insight into its solution. They monitor and evaluate their progress and change course if necessary. Older students might, depending on the context of the problem, transform algebraic expressions or change the viewing window on their graphing calculator to get the information they need. Mathematically proficient students can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends. Younger students might rely on using concrete objects or pictures to help conceptualize and solve a problem. Mathematically proficient students check their answers to problems using a different method, and they continually ask themselves, “Does this make sense?” They can understand the approaches of others to solving complex problems and identify correspondences between different approaches.

CC.K-12.MP.2 Reason abstractly and quantitatively. Mathematically proficient students make sense of the quantities and their relationships in problem situations. Students bring two complementary abilities to bear on problems involving quantitative relationships: the ability to decontextualize—to abstract a given situation and represent it symbolically and manipulate the representing symbols as if they have a life of their own, without necessarily attending to their referents—and the ability to contextualize, to pause as needed during the manipulation process in order to probe into the referents for the symbols involved. Quantitative reasoning entails habits of creating a coherent representation of the problem at hand; considering the units involved; attending to the meaning of quantities, not just how to compute them; and knowing and flexibly using different properties of operations and objects.

CC.K-12.MP.3 Construct viable arguments and critique the reasoning of others. Mathematically proficient students understand and use stated assumptions, definitions, and previously established results in constructing arguments. They make conjectures and build a logical progression of statements to explore the truth of their conjectures. They are able to analyze situations by breaking them into cases, and can recognize and use counterexamples. They justify their conclusions, communicate them to others, and respond to the arguments of others. They reason inductively about data, making plausible arguments that take into account the context from which the data arose. Mathematically proficient students are also able to compare the effectiveness of two plausible arguments, distinguish
correct logic or reasoning from that which is flawed, and—if there is a flaw in an argument—explain what it is. Elementary students can construct arguments using concrete referents such as objects, drawings, diagrams, and actions. Such arguments can make sense and be correct, even though they are not generalized or made formal until later grades. Later, students learn to determine domains to which an argument applies. Students at all grades can listen or read the arguments of others, decide whether they make sense, and ask useful questions to clarify or improve the arguments.

CC.K-12.MP.4 Model with mathematics. Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. In early grades, this might be as simple as writing an addition equation to describe a situation. In middle grades, a student might apply proportional reasoning to plan a school event or analyze a problem in the community. By high school, a student might use geometry to solve a design problem or use a function to describe how one quantity of interest depends on another. Mathematically proficient students who can apply what they know are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later. They are able to identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas. They can analyze those relationships mathematically to draw conclusions. They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.

CC.K-12.MP.5 Use appropriate tools strategically. Mathematically proficient students consider the available tools when solving a mathematical problem. These tools might include pencil and paper, concrete models, a ruler, a protractor, a calculator, a spreadsheet, a computer algebra system, a statistical package, or dynamic geometry software. Proficient students are sufficiently familiar with tools appropriate for their grade or course to make sound decisions about when each of these tools might be helpful, recognizing both the insight to be gained and their limitations. For example, mathematically proficient high school students analyze graphs of functions and solutions generated using a graphing calculator. They detect possible errors by strategically using estimation and other mathematical knowledge. When making mathematical models, they know that technology can enable them to visualize the results of varying assumptions, explore consequences, and compare predictions with data. Mathematically proficient students at various grade levels are able to identify relevant external mathematical resources, such as digital content located on a website, and use them to pose or solve problems. They are able to use technological tools to explore and deepen their understanding of concepts.
CC.K-12.MP.6 Attend to precision. Mathematically proficient students try to communicate precisely to others. They try to use clear definitions in discussion with others and in their own reasoning. They state the meaning of the symbols they choose, including using the equal sign consistently and appropriately. They are careful about specifying units of measure, and labeling axes to clarify the correspondence with quantities in a problem. They calculate accurately and efficiently, express numerical answers with a degree of precision appropriate for the problem context. In the elementary grades, students give carefully formulated explanations to each other. By the time they reach high school they have learned to examine claims and make explicit use of definitions.

CC.K-12.MP.7 Look for and make use of structure. Mathematically proficient students look closely to discern a pattern or structure. Young students, for example, might notice that three and seven more is the same amount as seven and three more, or they may sort a collection of shapes according to how many sides the shapes have. Later, students will see $7 \times 8$ equals the well remembered $7 \times 5 + 7 \times 3$, in preparation for learning about the distributive property. In the expression $x^2 + 9x + 14$, older students can see the 14 as $2 \times 7$ and the 9 as $2 + 7$. They recognize the significance of an existing line in a geometric figure and can use the strategy of drawing an auxiliary line for solving problems. They also can step back for an overview and shift perspective. They can see complicated things, such as some algebraic expressions, as single objects or as being composed of several objects. For example, they can see $5 - 3(x - y)^2$ as 5 minus a positive number times a square and use that to realize that its value cannot be more than 5 for any real numbers $x$ and $y$.

CC.K-12.MP.8 Look for and express regularity in repeated reasoning. Mathematically proficient students notice if calculations are repeated, and look both for general methods and for shortcuts. Upper elementary students might notice when dividing 25 by 11 that they are repeating the same calculations over and over again, and conclude they have a repeating decimal. By paying attention to the calculation of slope as they repeatedly check whether points are on the line through $(1, 2)$ with slope 3, middle school students might abstract the equation $(y - 2)/(x - 1) = 3$. Noticing the regularity in the way terms cancel when expanding $(x - 1)(x + 1)$, $(x - 1)(x^2 + x + 1)$, and $(x - 1)(x^3 + x^2 + x + 1)$ might lead them to the general formula for the sum of a geometric series. As they work to solve a problem, mathematically proficient students maintain oversight of the process, while attending to the details. They continually evaluate the reasonableness of their intermediate results.
### Course: IB Math SL  
**Unit:** 3 - Vectors  
**Grade Level:** 11

#### Unit Overview: Vectors

The aim of this topic is to provide an elementary introduction to vectors, including both algebraic and geometric approaches. The use of dynamic geometry software is extremely helpful to visualize situations in three dimensions.

In this unit students will explore concepts of vectors and vector applications involving distance, parallel and perpendicular lines, angles measurement and intersection points in two and three dimensional space.


<table>
<thead>
<tr>
<th>Student Learning Objectives (SLOs)</th>
<th>Essential Questions</th>
<th>Content</th>
<th>Activities &amp; Assessments</th>
<th>Resources</th>
</tr>
</thead>
</table>
| 3.1 Recall, select and use their knowledge of vectors as displacements in a plane and in three dimensions in a variety of algebraic and geometric contexts. | What are the components of and how can we perform arithmetic operations with vectors?  
How can vectors model displacement?  
How can vectors be used to find distance in two and three-dimensional space? | Vectors as displacements in a plane and in three dimensions. Components of a vector; column representation: \[ \mathbf{v} = \begin{pmatrix} v_1 \\ v_2 \\ v_3 \end{pmatrix} = v_1 \mathbf{i} + v_2 \mathbf{j} + v_3 \mathbf{k}. \] Algebraic and geometric approaches to the following:  
• the sum and difference of two vectors, the vector \(- \mathbf{v}\);  
• multiplication by a | Textbook practice problems.  
Khan Academy video and exercises  
Performance Tasks  
TOK and International Mindedness reflections  
Chapter Quizzes and Test  
Chapter 12.1-12.3 Vectors  
Chapter 17.4 (Using a graphic display calculator):  
Khan Academy |
<table>
<thead>
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</thead>
<tbody>
<tr>
<td>3.2 Recall, select and use their knowledge of the scalar product of two vectors, perpendicular vectors, parallel vectors, and the angle between two vectors in a variety of familiar and unfamiliar contexts.</td>
<td>How can vectors be used to find the measure of an angle? How can vectors represent parallel and perpendicular lines?</td>
<td>scalar, $k\mathbf{v}$; parallel vectors; magnitude of a vector, $</td>
<td>\mathbf{v}</td>
<td>$; unit vectors; base vectors; $\mathbf{i}$, $\mathbf{j}$ and $\mathbf{k}$; position vectors $\overrightarrow{OA} = \mathbf{a}$; $\overrightarrow{AB} = \overrightarrow{AB} - \overrightarrow{OA} = \mathbf{b} - \mathbf{a}$.</td>
</tr>
<tr>
<td><strong>CCSS:</strong> N.VM.3, A.REI.8</td>
<td></td>
<td></td>
<td>Google Apps for Education</td>
<td><a href="http://www.Illustrativemathematics.org">www.Illustrativemathematics.org</a></td>
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<td></td>
<td><a href="https://www.khanacademy.org/math/precalculus/vectors">https://www.khanacademy.org/math/precalculus/vectors</a></td>
</tr>
<tr>
<td>3.3 Recall, select and</td>
<td>How can vectors model</td>
<td>The scalar product of two vectors. Perpendicular vectors; parallel vectors. The angle between two vectors. Vector equation of a line</td>
<td>Textbook practice problems. Khan Academy video and exercises Performance Tasks TOK and International Mindedness reflections Chapter Quizzes and Test</td>
<td>Chapter 12.3-12.5 Vectors Geogebra software</td>
</tr>
<tr>
<td>use</td>
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<tr>
<td>Student Learning Objectives (SLOs)</td>
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<tr>
<td><strong>use their knowledge of vectors in both real and abstract contexts to model the equation of a line and the angle between two lines in three dimensions.</strong>&lt;br&gt;&lt;br&gt;<strong>CCSS:</strong> A.REI.8</td>
</tr>
<tr>
<td><strong>3.4 Construct mathematical arguments through use of precise statements, logical deduction and inference, and by the manipulation of mathematical expressions to distinguishing between coincident and parallel lines or find the point of intersection of two lines.</strong>&lt;br&gt;&lt;br&gt;<strong>CCSS:</strong> A.REI.8</td>
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### Unit 3 Vocabulary

<table>
<thead>
<tr>
<th>Vector</th>
<th>Parallel, perpendicular, skew</th>
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<tr>
<td>Magnitude (modulus, length, norm and size)</td>
<td>Laws of motion</td>
</tr>
<tr>
<td>Direction</td>
<td>Scalar product (dot product)</td>
</tr>
<tr>
<td>Scalar</td>
<td>Equilibrium</td>
</tr>
<tr>
<td>Unit vector</td>
<td>Zero vector</td>
</tr>
<tr>
<td>Base vector</td>
<td>Collinear points</td>
</tr>
<tr>
<td>Position vector</td>
<td>Negative vector</td>
</tr>
<tr>
<td>Resultant vector</td>
<td>Scalar multiplication</td>
</tr>
<tr>
<td>Vector equation</td>
<td><strong>TOK Connections</strong></td>
</tr>
<tr>
<td>Direction vector</td>
<td>Compare methods of logic using algebra, geometry, and vectors to prove the Pythagorean theorem.</td>
</tr>
<tr>
<td>Displacement</td>
<td>Which method of proof do you prefer?</td>
</tr>
<tr>
<td>Velocity</td>
<td>Which is the most beautiful?</td>
</tr>
<tr>
<td>Intersection point</td>
<td><strong>Why do humans feel the need to categorize and compartmentalize knowledge?</strong></td>
</tr>
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**TOK Connections**

<table>
<thead>
<tr>
<th><strong>Why do humans feel the need to categorize and compartmentalize knowledge?</strong></th>
<th>Compare methods of logic using algebra, geometry, and vectors to prove the Pythagorean theorem.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>How do we relate a theory to the author? Who developed vector analysis: JW Gibbs or O Heaviside?</strong></td>
<td>Which method of proof do you prefer?</td>
</tr>
<tr>
<td><strong>Are algebra and geometry two separate domains of knowledge? (Vector algebra is a good opportunity to discuss how geometrical properties are described and generalized by algebraic methods.)</strong></td>
<td>Which is the most beautiful?</td>
</tr>
<tr>
<td>Contribution to the Development of Students’ Approached to Learning Skills</td>
<td></td>
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<tr>
<td>---------------------------------------------------------------</td>
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<tr>
<td><strong>Thinking skills</strong> will be developed using open-ended tasks with multiple solution paths. During these tasks the teacher uses questioning techniques to assess and advance the student’s inquiry approach to the problem.</td>
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<tr>
<td><strong>Communication skills</strong> will be strengthened by small and large group discussion, presentations and Process Oriented Guided Inquiry Learning (POGIL [<a href="https://pogil.org/">https://pogil.org/</a>] ).</td>
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<tr>
<td><strong>Social Skills</strong>: Students will choose defined roles during group work and be accountable to the group for their product.</td>
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<tr>
<td><strong>Self-management skills</strong>: Students will be given rubrics and self-score on a regular basis providing reflections on areas of strength and opportunities for improvement. Students will also have clear deadlines including short-term deadlines for long-term projects.</td>
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<tr>
<td><strong>Research skills</strong> will be encouraged through written reflections on TOK and International Mindedness topics. Students will be required to</td>
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<tr>
<td>• correctly cite and reference sources,</td>
<td></td>
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<tr>
<td>• use the library to find sources,</td>
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<tr>
<td>• record search procedures and use Boolean search limiters</td>
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<tr>
<td>• find and document inconsistencies in various sources</td>
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<tr>
<td>• decide as to which sources are more credible and justify their reasoning</td>
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<tr>
<td>• discuss the importance of academic honesty and use turnitin.com to assess the originality of their own work.</td>
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**Contributions to the Development of the Attribute(s) of the Learner Profile**

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<tr>
<th>Inquirers: In class, students will be challenged to assess their understanding and find resources to fill in missing information they need. Students will be challenged to advance their learning through questioning techniques and self-management tools to broaden their skills (ex. Khanacademy.org). When a solution is found to a path of inquiry, students will be encouraged to find alternative solution paths and to form generalizations of the concept that will work in all cases.</th>
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<tr>
<td>Knowledgeable: Students will develop a wide range of mathematical skills and reflect on how those skills are used in the world today.</td>
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<td>Thinkers: Students are encouraged to apply the scientific method to make conjectures and devise methods to test and adjust their thinking through inquiry and interest based topics of study.</td>
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<tr>
<td>Communicators: Students will be required to communicate their reasoning using tables, graphs, diagrams, equations and verbal context.</td>
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<tr>
<td>Principled: Students will be required to cite any sources used in their work. Students will self-assess written work using turnitin.com. Topics chosen for internal assessment papers should be socially useful for the local or global community.</td>
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<tr>
<td>Open Minded: Students will organize their learning from a variety of perspectives including researching the historic evolution of the concepts and skills they acquire.</td>
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<tr>
<td>Caring: Students will be encouraged to develop a topic for the internal assessment that is focused on a socially relevant and useful application in their local community.</td>
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<tr>
<td>Risk Takers: Students will discuss the value of taking risks and reflect on readings about having a growth mindset as described by Carol Dweck in her book “Mindset.”</td>
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<tr>
<td>Balanced: Students will be encouraged to apply mathematics in CAS and TOK and make connections to their community in the process.</td>
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<tr>
<td>Reflective: Students will set specific learning goals that are measurable and time bound. Students will regularly review their progress and reflect on ways to improve their learning process.</td>
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Contribution to the Development of International Mindedness

Explore the links between vectors and Newtonian laws of motion.

Explore the role of vectors in mechanics, the “parallelogram law,” and Newtonian Physics.

Position paper: Vector theory is used for tracking displacement of objects, including for peaceful and harmful purposes.

Group 5 Aims

The aims of all mathematics courses in group 5 are to enable students to:

1. enjoy mathematics, and develop an appreciation of the elegance and power of mathematics
2. develop an understanding of the principles and nature of mathematics
3. communicate clearly and confidently in a variety of contexts
4. develop logical, critical and creative thinking, and patience and persistence in problem-solving
5. employ and refine their powers of abstraction and generalization
6. apply and transfer skills to alternative situations, to other areas of knowledge and to future developments
7. appreciate how developments in technology and mathematics have influenced each other
8. appreciate the moral, social and ethical implications arising from the work of mathematicians and the applications of mathematics
9. appreciate the international dimension in mathematics through an awareness of the universality of mathematics and its multicultural and historical perspectives
10. appreciate the contribution of mathematics to other disciplines, and as a particular “area of knowledge” in the TOK course.