Department of Accelerated Programs

Mathematical Studies SL
Curriculum

10.0 Credits
**IB LEARNER PROFILE**

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

<table>
<thead>
<tr>
<th>Inquirers</th>
<th>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.</th>
</tr>
</thead>
<tbody>
<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>
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<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>
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<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>
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<tr>
<td>Well-balanced</td>
<td>They understand the importance of physical and mental balance and personal wellbeing 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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</tbody>
</table>
Unit Four
Mathematical Studies Year 1

Course Description

Mathematical Studies is a course with an emphasis on applications of mathematics. It is for students with varied backgrounds and abilities. It offers students opportunities to learn important concepts and techniques and to gain an understanding of a wide variety of mathematical topics. It prepares students to be able to solve problems in a variety of settings, to develop more sophisticated mathematical reasoning and to enhance their critical thinking. The individual project is an extended piece of work based on personal research involving the collection, analysis and evaluation of data. Students taking this course are well prepared for a career in social sciences, humanities, languages or arts.
# Mathematical Studies 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>Number and Algebra</td>
<td>9 Weeks</td>
</tr>
<tr>
<td>Unit 2</td>
<td>Descriptive Statistics</td>
<td>7.5 Weeks</td>
</tr>
<tr>
<td>Unit 3</td>
<td>Logic, Sets and Probability</td>
<td>10 Weeks</td>
</tr>
<tr>
<td>Unit 4</td>
<td>Statistical Applications</td>
<td>8.5 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.
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.
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.
<table>
<thead>
<tr>
<th>Career Ready Practices</th>
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</table>
| CRP12. Work productively in teams while using cultural global competence.  
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. |
## Differentiated Instruction

### Strategies to Accommodate Students Based on Individual Needs

<table>
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<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>
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<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>- Reading partners</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
### Assessments

**Suggested Formative/Summative Classroom Assessments**

- Timelines, Maps, Charts, Graphic Organizers
- Teacher-created Unit Assessments, Chapter Assessments, Quizzes
- Teacher-created DBQs, Essays, Short Answer
- Accountable Talk, Debate, Oral Report, Role Playing, Think Pair, and Share
- Projects, Portfolio, Presentations, Prezi, Gallery Walks
- Homework
- Concept Mapping
- Primary and Secondary Source analysis
- Photo, Video, Political Cartoon, Radio, Song Analysis
- Create an Original Song, Film, or Poem
- Glogster to make Electronic Posters
- Internal and External IB Assessments
# Interdisciplinary Connections

## English Language Arts
- Journal writing
- Close reading of industry-related content
- Create a brochure for a specific industry
- Keep a running word wall of industry vocabulary

## Social Studies
- Research the history of a given industry/profession
- Research prominent historical individuals in a given industry/profession
- Use historical references to solve problems

## World Language
- Translate industry-content
- Create a translated index of industry vocabulary
- Generate a translated list of words and phrases related to workplace safety

## Math
- Research industry salaries for a geographic area and juxtapose against local cost of living
- Go on a geometry scavenger hunt
- Track and track various data, such as industry's impact on the GDP, career opportunities or among of individuals currently occupying careers

## Fine & Performing Arts
- Create a poster recruiting young people to focus their studies on a specific career or industry
- Design a flag or logo to represent a given career field

## Science
- Research the environmental impact of a given career or industry
- Research latest developments in industry technology
- Investigate applicable-careers in STEM fields
Common Core State Standards (CCSS)

HSS.ID.C.7: Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.

HSS.ID.C.8: Compute (using technology) and interpret the correlation coefficient of a linear fit.

HSS.ID.C.9: Distinguish between correlation and causation.

HSS.ID.B.6.A: Fit a function to the data; use functions fitted to data to solve problems in the context of the data. Use given functions or choose a function suggested by the context. Emphasize linear, quadratic, and exponential models.

HSS.ID.B.6.B: Informally assess the fit of a function by plotting and analyzing residuals.

HSS.ID.B.6.C: Fit a linear function for a scatter plot that suggests a linear association.

HSS.IC.A.1: Understand statistics as a process for making inferences about population parameters based on a random sample from that population.

HSS.IC.A.2: Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation. For example, a model says a spinning coin falls heads up with probability 0.5. Would a result of 5 tails in a row cause you to question the model?

HSS.IC.B.3 Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.

HSS.IC.B.4: Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling.

HSS.IC.B.5: Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.

HSS.IC.B.6: Evaluate reports based on data.
Mathematical Practices:

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Communicate the precise answer to a real-world problem.
8. Look for and make use of structure.
9. Look for and express regularity in repeated reasoning. All of the content presented in this course has connections to the standards for mathematical practices.
Course: Mathematical Studies  
Unit: 4  
Grade Level: 11

Unit Overview: Statistical Applications  
Aims of this topic are to develop techniques in inferential statistics in order to analyze sets of data, draw conclusions and interpret these. Statistical analysis involves collecting and scrutinizing every data sample in a set of items from which samples can be drawn.


<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>
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</table>
| Examine the normal distribution and its practical applications including the concept of a random variable; of the parameters of the mean (μ) and standard deviation (σ) of the bell shape and the symmetry about x=μ. | How do normal distributions relate to each other?  
How can we find examples of normal distribution in real world scenarios?  
What probability distribution patterns occur in real life situations? | ➢ Calculate and interpret measures of central tendency.  
➢ Calculate mean, media, and/or mode for simple discrete data.  
➢ Approximate mean, find modal group and median for grouped discrete data.  
➢ Calculate standard deviation | Activity: M&M Activity  
Data Collection Project:  
• Census At School: [www.amstat.org/censusatschool/](http://www.amstat.org/censusatschool/)  
Summative and Formative Assessments (Quizzes & Tests) for each topic.  
Homework and Classwork assignments based on daily lessons. | • Textbook: Mathematical Studies by Patrick Tobin  
• Textbook: Mathematical Studies SL for the IB Diploma by Caroline Meyrick and Kwame Dwamena  
• Geometer’s Sketchpad  
• Desmos Online Graphing Calculator  
• Texas Instruments TI-84 Plus Graphing Display |
<p>| CCSS: HSS.IC.A.1 HSS.IC.B.6 | | | | |</p>
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<tbody>
<tr>
<td>Calculate normal probability calculations with and without technology including inverse normal calculations. <strong>CCSS:</strong> HSS.ID.B.6.A HSS.IC.B.4</td>
<td>How do all normal distributions relate to each other? How can you find examples of normal distribution in real world scenarios?</td>
<td>➢ Normal distribution  ➢ Recognize and analyze the normal distribution and the concept of a random variable.  ➢ Parameters $\sigma$ and $\mu$  ➢ Properties of the normal distribution, such as the bell shape and the symmetry about $x=\mu$  ➢ How to draw a normal distribution curve and areas under it on the diagram  ➢ How to do normal probability calculations by using diagrams and a GDC  ➢ How to do inverse normal calculations</td>
<td>Mini project on normal probability  <strong>Activity:</strong> How many ways? Summative and Formative Assessments (Quizzes &amp; Tests) for each topic. Homework and Classwork assignments based on daily lessons.</td>
<td>Calculator  IB Question bank <a href="http://www.occ.ibo.org">www.occ.ibo.org</a>  <a href="http://www.geogebra.com">www.geogebra.com</a>  <a href="http://www.Khanacademy.org">www.Khanacademy.org</a>  <a href="http://www.illustrativemathematics.org">www.illustrativemathematics.org</a>  <a href="http://www.illuminations.nctm.org">www.illuminations.nctm.org</a>  <a href="http://www.youtube.com">www.youtube.com</a>  <a href="http://ocw.mit.edu">http://ocw.mit.edu</a>  <a href="http://www.NJCTL.org">www.NJCTL.org</a>  <a href="http://www.discoveryeducation.com">www.discoveryeducation.com</a></td>
</tr>
<tr>
<td>Analyze bivariate data and make the distinction between correlation and causation and construct</td>
<td>How do you describe the relationship between two variables?</td>
<td>➢ Analyze bivariate data  ➢ Determine dependent and independent</td>
<td><strong>Project:</strong> Classroom data scatter plot. Summative and</td>
<td>Discovery Education: High Stakes World of Statistics Series (Video Lessons) <a href="http://www.discoveryeducation.com">www.discoveryeducation.com</a></td>
</tr>
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<td>scatter diagrams to apply line of best fit passing through the mean point. <strong>CCSS:</strong> HSS.ID.C.7 HSS.ID.C.8 HSS.ID.C.9</td>
<td>Can accurate predictions be made with extrapolated data?</td>
<td>variables  ➢ Calculate correlation  ➢ Create scatter diagrams  ➢ Line of best fit</td>
<td>Formative Assessments (Quizzes &amp; Tests) for each topic.</td>
<td>Homework and Classwork assignments based on daily lessons.</td>
</tr>
<tr>
<td>Interpret correlation as positive, zero or negative and strong or weak and linear progression/regression <strong>CCSS:</strong> HSS.ID.C.8 HSS.ID.B.6.B HSS.IC.B.6</td>
<td>How can correlations be used to make predictions?  Can a strong correlation imply causation?</td>
<td>➢ Identify positive/negative/zero correlation and the strength of the correlation.  ➢ Use Technology to calculate and interpret correlation coefficient from data.  ➢ Use formula to calculate and interpret correlation coefficient from data</td>
<td><strong>Activity/Project:</strong> Predicting heights of young children. Generate the data by using the <a href="http://www.babycenter.com/child-height-predictor">http://www.babycenter.com/child-height-predictor</a></td>
<td>Summative and Formative Assessments (Quizzes &amp; Tests) for each topic.  Homework and Classwork assignments based on daily lessons.</td>
</tr>
<tr>
<td>Calculate the line of regression for y on x and</td>
<td>What are the benefits of performing a linear</td>
<td>➢ Use technology to find and interpret</td>
<td><strong>Lab:</strong> M&amp;M Lab for Chi Square test.</td>
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</tr>
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<tr>
<td>use the regression line to make predictions. <strong>CCSS:</strong> HSS.ID.B.6.C HSS.IC.B.5</td>
<td>regression analysis? In what ways can mistakes be made using a linear regression equation to make predictions?</td>
<td>regression line. ➢ Find and interpret regression line using formula ➢ Use regression line for prediction ➢ Understand and use concepts of interpolation and extrapolation.</td>
<td>Summative and Formative Assessments (Quizzes &amp; Tests) for each topic.</td>
<td>Homework and Classwork assignments based on daily lessons.</td>
</tr>
<tr>
<td>Utilize the Chi-square test for independence; formulate the null and alternative hypotheses, significance levels, contingency tables, expected frequencies, degrees of freedom and p-values. <strong>CCSS:</strong> HSS.IC.B.3 HSS.IC.B.5</td>
<td>How do you use statistical ideas to test assumptions about data? How does sample size raise the confidence level for the true mean?</td>
<td>➢ Formulate null and alternative hypotheses ➢ Interpret contingency tables for use in chi-squared test. ➢ Conduct hypothesis test using technology. ➢ Conduct hypothesis test from given information (no contingency table). ➢ Construct expected value table.</td>
<td><strong>Activity:</strong> Chi square test for independence using <a href="http://www.youtube.com/watch?v=0-U4Yr9UNBo">http://www.youtube.com/watch?v=0-U4Yr9UNBo</a></td>
<td>Summative and Formative Assessments (Quizzes &amp; Tests) for each topic. Homework and Classwork assignments based on daily lessons.</td>
</tr>
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# Unit 4 Vocabulary

<table>
<thead>
<tr>
<th>Asymptote</th>
<th>No correlation</th>
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<tbody>
<tr>
<td>Standard normal distribution</td>
<td>Correlation coefficient</td>
</tr>
<tr>
<td>Normal cumulative distribution</td>
<td>Covariance</td>
</tr>
<tr>
<td>Bivariate data</td>
<td>Regression line</td>
</tr>
<tr>
<td>Correlation</td>
<td>Significance level</td>
</tr>
<tr>
<td>Independent variable</td>
<td>Degrees of freedom</td>
</tr>
<tr>
<td>Dependent variable</td>
<td>Contingency table</td>
</tr>
<tr>
<td>Scatter diagram</td>
<td>Null hypothesis</td>
</tr>
<tr>
<td>Positive correlation</td>
<td>Expected value</td>
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<tr>
<td>Negative correlation</td>
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TOK Connections

Does correlation imply causation
Can we reliably use the equation of the regression line to make predictions?
Scientific method.

Contribution to the Development of Students’ Approached to Learning Skills

Students exercise their research skills across all disciplines.
Students are required to formulate/construct focused research questions.
Encourage students to practice effective online search skills and provide opportunities for students to reflect on how they determine the quality of a source, or analyze contradictory sources.
Provide opportunities for students to reflect on how they determine the quality of a source, or analyze contradictory sources.

Contributions to the Development of the Attribute(s) of the Learner Profile

Inquirers develop their natural curiosity. They acquire the skills necessary to conduct inquiry and research and show independence in learning. They actively enjoy learning and this love of learning will be sustained throughout their lives.

Students exercise initiative in applying thinking skills critically and creatively to recognize and approach complex problems, and make reasoned ethical decisions. Inquiry approaches: investigate unfamiliar situations, both abstract and real-world, involving organizing and analyzing information or measurements, drawing conclusions, testing validity, and considering their scope and limitations.
<table>
<thead>
<tr>
<th>Contribution to the Development of International Mindedness</th>
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<tbody>
<tr>
<td>Students can utilize statistical applications to compare various domains globally. An abundance of technological resources has made statistical data easily accessible. Students are encouraged to access the extensive websites of international mathematical organizations to enhance their appreciation of the international dimension and to engage in the global issues surround the subject.</td>
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</tbody>
</table>