IB MATHEMATICS SL
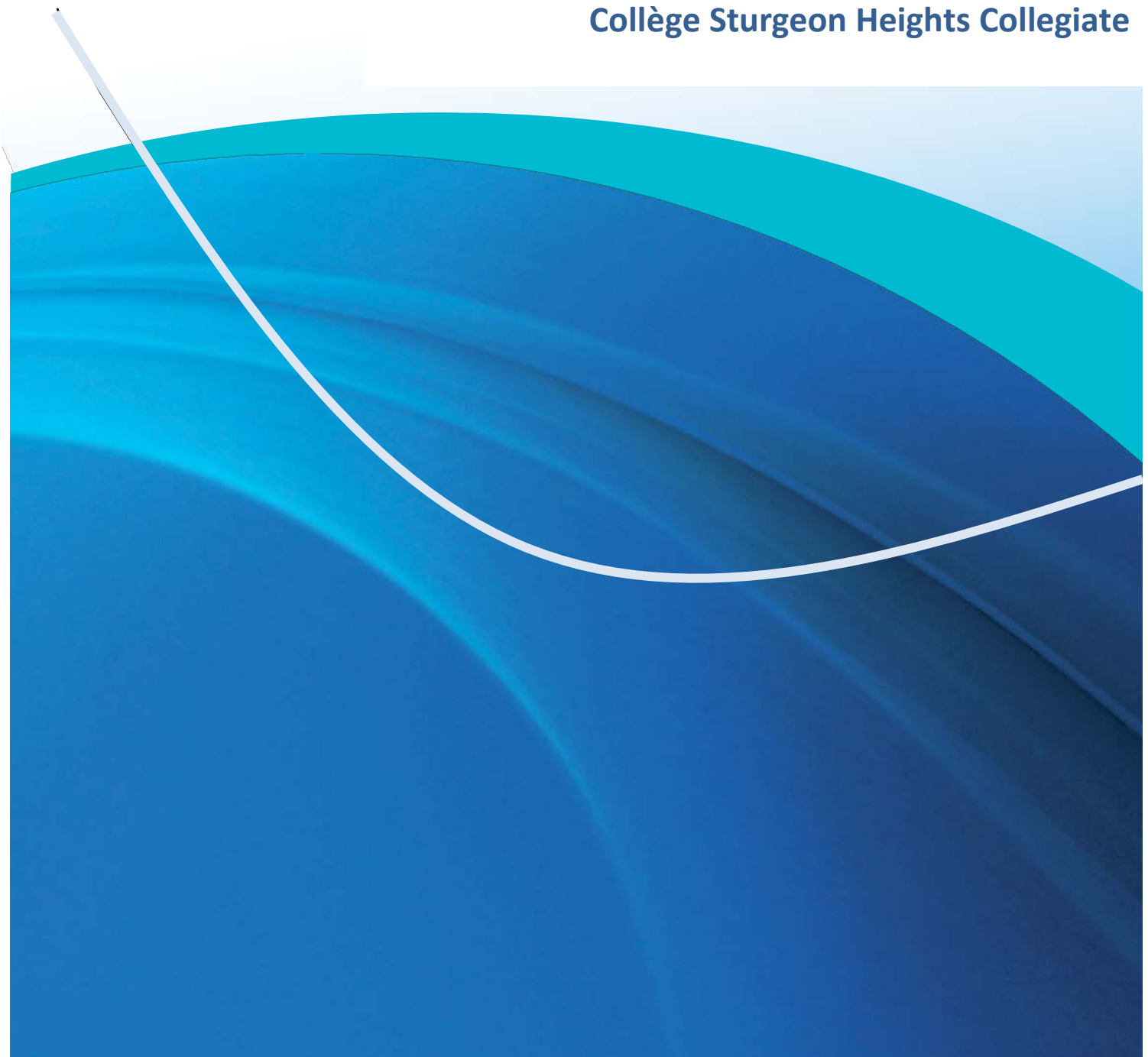
INTERNAL ASSESSMENT

Collège Sturgeon Heights Collegiate

THE EXPLORATION!

What: A written paper that explores the math behind a personal interest of your choice

Why:

- To apply and transfer skills to alternate situations, to other areas of knowledge, and to future developments
- To appreciate the moral, social, and ethical implications of Mathematics
- To appreciate the international dimensions & universality of Mathematics
- Appreciate the contribution of Mathematics to other disciples

Specifics:

- 6-12 pages, excluding graphs, diagrams, bibliography, etc
- Should take around 10 hours outside of class time. This includes research, writing a draft, editing, etc.
- All sources must be cited in a bibliography.
- Not a regurgitation of facts or a historical essay.
- The target audience is your peers. Not expected to be a formal dissertation using ostentatious vocabulary.
- Use of some sort of mathematical technology or software is strongly encouraged
- You are not expected to use any mathematics outside the level of this course.
- 20% of your IB mark, 15% of your CSHC mark

How:

In class, we will:

- look at sample explorations and critique them
- brainstorm research topics
- practice writing sample research questions
- discuss the details your exploration must include

On your own, you will:

- Write a research question/aim/rationale
- Submit your research question/aim/rationale to the teacher for feedback & approval using the IA Outline worksheet
- Find resources and write a draft version
- Have an interview with your teacher to discuss your draft
- Edit your draft and produce a final copy

When:

- ❖ Selecting topic & submitting research question/aim/rational ~ *one week*
- ❖ Writing draft version ~ *2 weeks*
- ❖ Submitting final version ~ *2 weeks*

  Note #1: After the teacher has approved your topic & question, you may not switch topics without approval.

  Note #2: No final version will be accepted late unless teacher approval due to extreme circumstance is sought before the due date.

Academic honesty:

The following are exerts from IB Academic Honesty Policy. To read more, please see: http://occ.ibo.org/ibis/documents/general/specific_interest/malpractice/g_0_malpr_sup_0707_1_e.pdf

- ❖ An authentic piece of work: Based on the candidate's individual and original ideas with the ideas and work of others fully acknowledged
- ❖ Plagiarism: The representation of the ideas or work of another person as your own
- ❖ Collusion: Allowing one's work to be copied or submitted for assessment by another
- ❖ Candidates must record the URL of all web sites from which they obtain information during their research, including the date when each web site was accessed. This includes the copying of maps, photographs, illustrations, data, graphs and so on.

Any students proven guilty of academic dishonesty may be given a 0 for their IA and thus not earn their diploma or certificate.

TIME LINE & DUE DATES

Item	Start Date	Due Date
Choose your topic		
Complete Outline Worksheet		
Write your draft		
Complete checklist		
Makes notes for interview questions		
Complete Self evaluation		
Have Interview with teacher		
Write your final copy		

IB Evaluation

COMMUNICATION	4 marks
MATHEMATICAL PRESENATION	3 marks
PERSONAL ENGAGEMENT	4 marks
REFLECTION	3 marks
USE OF MATHEMATICS	6 marks
	20 marks

CSHC Evaluation

Draft & interview		20 marks
Final version	(IB mark x 4)	80 marks
		100 marks

APPENDIX A – Syllabus outcomes

ALGEBRA

Arithmetic Sequences & Series
Geometric Sequences & Series
Sigma Notation
Exponents & logarithms
Exponent Laws
Log Laws
Binomial Theorem

FUNCTIONS & EQUATIONS

Domain & Range of Functions
Composition of Functions
Inverse Functions
Characteristics of Graphs (max/mins, intercepts, asymptotes, etc)
Reciprocal Functions
Transformations of graphs (Translations, reflections, stretches & compressions)
Quadratic Functions
Exponential Functions
Logarithm Functions
Exponential Equations

CIRCLE FUNCTIONS & TRIGONOMETRY

Radian measure
Arc length
Sinx, cosx, tanx
The unit circle
$\cos^2\theta + \sin^2\theta = 1$
Double angle identities
Graphs of sinx, cosx, tanx
Sinusoidal functions
Solving trigonometric equations graphically & analytically
Solving triangles
Sin law, including ambiguous case
Cos law
Tan law (just kidding; making sure you are still reading!)
Area of triangles (using $A = \frac{1}{2}absinC$)

STATISTICS & PROBABILITY*

***Not all these topics may have been covered before the IA.**

Concepts of outcomes, sample space, etc

The probability formula

Complimentary events

Venn diagrams

Tree diagrams

Mutually Exclusive events

Independent events (with and w/o replacement)

Concepts of population, sample, random sample, discrete vs continuous data

Frequency distribution tables and histograms

Box & whisker plots, with outliers

Concept of grouped data; interval width, upper & lower boundaries, etc

Statistical measure and their interpretations

Measure of central tendency (mean, median, mode)

Quartiles & percentiles

Measures of dispersion; range, IQR, standard deviation

Cumulative frequency graphs (Ogives)

Linear coefficient of bivariate data

Pearson's coefficient

Scatter diagrams and line of best fit

Regression equations

Probability distributions

Expected Value

Binomial Distribution; including mean and variance

Normal distribution

Z-scores

APPENDIX B – Math Technology Resources

Great software for working with graphs, diagrams, functions, spreadsheets, statistics, calculus and much, much more. www.geogebra.org

Fabulous resource for quick tutorial on many math topics. Use the search feature to find videos, applets, and notes to help you understand some of the math behind your topic. http://www.khanacademy.org/

An online graph plotter with graphing capabilities similar to those of your graphical calculators. www.fooplot.com

A really powerful search (For example, type "find antiderivative of f(x) = 3x" into the search bar.) There is an app available for iphones, etc.www.wolframalpha.com

Not sure how to do something? You tube is a great source of tutorial videos. For example, here is a video on how to create a graph using Excel. **http://www.youtube.com/watch?v=oZAZj7NIkic**

Word has an equation editor built in – this will make your life easier when it comes to word processing mathematics. You may need to install this feature. There are youtube videos and various websites that show you have to use the editor.
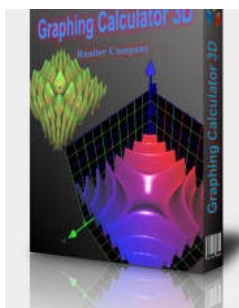
Graphing Calculator 3D . A free program that can graph in three dimensions. Can be downloaded or used online http://calculator.runiter.com/graphing-calculator/

The following sheet should be handed out to students when looking at sample IA explorations in class.

IB MATH SL IA EVALUATION CRITERION

A: COMMUNICATION (4 marks)

- Includes Introduction, rationale (Why did you choose this topic? Why is this topic of interest to you?), aim (What do you hope your reader will learn?), and conclusion
- Expressing ideas clearly
- Identifying a clear aim for the exploration
- Focusing on the aim and avoiding irrelevance
- Structuring ideas in a logical manner
- Editing the exploration so that it is easy to follow
- Citing references where appropriate
- Graphs, tables and diagrams should accompany the work in the appropriate place and not be attached as appendices to the document.

B: MATHEMATICAL PRESENTATION (3 marks)

- Using appropriate mathematical language and representation (notation, symbols, terminology)
- Defining key terms, where required
- Selecting appropriate mathematical tools & technology (such as graphic display calculators, screenshots, graphing software, spreadsheets, databases, drawing & word-processing software, etc)
- Expressing results to an appropriate degree of accuracy
- Use multiple forms of mathematical representation, such as formulae, diagrams, tables, charts, graphs and models, where appropriate.

C: PERSONAL ENGAGEMENT (4 marks)

- Thinking independently and/or creatively
- Asking questions, making conjectures, and investigating mathematical ideas
- Researching areas of interest
- Looking for and creating mathematical models for real-world situations
- Considering historical and global perspectives
- Demonstrating that you have "made the exploration their own"
- Expressing ideas in an individual way
- Addressing personal interest
- Presenting mathematical ideas in their own way.
- Asking and answering questions: "I wonder if…", "What would happen if…" "Why does that happen…

D: REFLECTION (3 marks)

- Reviewing, analysing and evaluating the exploration.
- Discussing the implications of results
- Considering the significance of the exploration
- Looking at possible limitations and/or extensions
- Making links to different fields and/or areas of mathematics
- Making connections to TOK

E: USE OF MATHEMATICS (6 marks)

- Demonstrating knowledge and understanding
- Producing work that is within the level of the course.
- Applying mathematics in different contexts
- Applying problem-solving techniques
- Recognizing and explaining patterns, where appropriate
- Looking at a problem from different perspectives
- Using logic
- Error-free mathematics

The following sheet should be handed

out to students once they have

completed their mind maps &

brainstorming and are ready to write

their research question et al.

This worksheet will be submitted to

the teacher for approval.

IB MATH SL IA OUTLINE WORKSHEET

Name: _____

Stimuli: _____

Specific Topic: _____

My Research question is:

_____

_____

_____

My Aim is:

_____

_____

_____

_____

My Rationale is:

_____

_____

_____

_____

_____

What are the math connections (syllabus topics) to your area of interest?

What are some things that you may have to research in order to answer your research question?

What are the definitions you will need to define for people not familiar with this topic?

What are some possible visual representations (graphs, tables, diagrams,…) that you might want to have?

The following sheet should be

handed out to students

when you are returning

their IA Outline Worksheet;

**once you have approved their**

research question et al.

Hints and Tips to writing a good Math Exploration

- Start with an introduction that includes your research question.

- Then state your aim and rationale.
  - Aim: What is the point of your exploration?
  - Rationale: Why did you choose this topic? What do you hope your reader will learn?

- Create an outline to help you organize your ideas and streamline your research.

- While doing your research, keep a record of each website you visited and include the date.

- If you need to round any decimal, consider the degree of accuracy. For your topic, how many decimal places are relevant? For example, while a difference of one tenth may not matter if you are talking about speed of a locomotive, it could matter if you are talking about the amount of milligrams of morphine administered to a patient.

- Use ≈ for any rounded values.

- Include page numbers for easier reference later on.

- Only use mathematics that YOU understand. Khan Academy or YouTube could help. If you still can't figure it out, it's probably too hard for this level of math. It is not your teacher's responsibility to teach you the math.

- Ask and answer personal questions ("I wonder if…, What if…)?. Make conjectures (an opinion or theory without sufficient evidence or proof).

- Use proper math vocabulary (~~plug in~~ → substitute) and notation (x^2 → x^2).

- Consider the historical and global perspectives of your topic.
  - Historical perspective: things that have happened with your topic in the past
  - Global perspective: the links between your own life and others throughout the world

- Discuss the implications of your results. (What do they mean? Why are they important? How do they affect your life?...)

- Discuss your results in the context of your topic, not just in general terms.

  Ex:

  Growth Chart
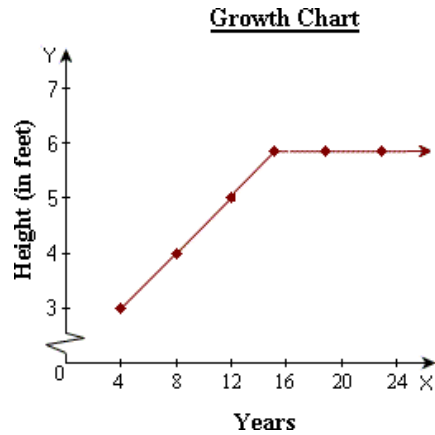
  ~~*The graph levels off at x > 15*~~

  The graph levels off after the age of 15 because that is the average age when girls tend to reach their maximum height.

- Discuss possible limitations and/or extensions of your topic.

  Limitation: a restriction, a defect or failing
  Extension: an occurrence in another area

- Make connections between your topic and different disciplines and/or areas of mathematics?

- Add "your voice" to your paper.

The following sheets should

be handed out to students

a week before their draft

is due.

IB MATH SL IA
A CHECKLIST FOR WRITING YOUR DRAFT EXPLORATION

Communication & Mathematical presentation

☐ Did you start with an introduction?

☐ Do you have a clearly written aim and rationale?

☐ Does the entire paper focus on the aim and avoiding irrelevance? Don't go off on a tangent.

☐ Does the writing flow nicely?

☐ Is your exploration coherent? (Def'n: logically organized, understandable, having clarity)

☐ Did you include graphs, tables and diagrams at appropriate places and not attach them all at the end?

☐ Have you had someone (not a student in Math SL) edit your paper?

☐ Did you cite all references in your bibliography and acknowledge direct quotes appropriately?

☐ Did you use appropriate mathematical language and representation? (No computer notation *, ^, etc)

☐ Did you define key terms where necessary?

☐ Did you use appropriate technology?

☐ Did you think about the degree of accuracy? (For your topic, how many decimal places are relevant?)

☐ Did you end with a conclusion and relate it back to your aim and rationale?

☐ Do you have page numbers?

Use of mathematics

- ☐ Did you explore unfamiliar math, or apply familiar math to a new situation?

- ☐ Did you create mathematical models for real-world situations, if this applied to your topic?

- ☐ Did you apply problem-solving techniques?

- ☐ Did you look for and explain patterns, if this applied to your topic?

Reflection

- ☐ Did you ask questions, make conjectures and investigate mathematical ideas?

- ☐ Did you consider the historical and global perspectives of your topic?

- ☐ Did you discuss the implications of your results? (What do they mean? Why are they important?...)

- ☐ Did you consider the significance of your paper?

- ☐ Did you look for possible limitations and/or extensions of your topic?

- ☐ Did you make links between your topic and different fields and/or areas of mathematics?

Personal engagement

- ☐ Did you ask and answer personal questions ("I wonder if…, What if…)?

- ☐ Did you try to think independently and creatively?

- ☐ Did you address why you think your topic is interesting or why it appealed to you?

- ☐ Did you present mathematical ideas in your own way (as opposed to copy someone else' theory)?

- ☐ Did you try to add "your voice" to the work?

- ☐ Did you relate the results to your own life?

MATH SL IA: STUDENT LED INTERVIEW

**Be prepared to do the following things during your
10 minute interview. You should have notes and/or
post-its all over your exploration.**

O *Show me:*

- *your clear aim & rationale in your opening paragraph*

- *evidence that key words are defined*

- *where/how you have used technology*

- *where you have considered an appropriate degree of accuracy*

- *where you considered historical and global perspectives*

- *where you discussed possible limitations and/or extensions*

- *that your conclusion related back to your aim & rationale*

- *your bibliography*

O *Briefly describe:*

- *how/where you used math. Be prepared to defend the level*

- *how/where you showed personal engagement and made the work your own*

Award yourself a mark and write a brief justification for each criterion.

Candidate name: _____

Stimuli: _____   Date due: _____

		Marks Earned
A: COMMUNICATION		
0	**The exploration does not reach the standard described by the descriptors**	
1	The exploration has some coherence.	
2	The exploration has some coherence and shows some organization.	
3	The exploration is coherent and well organized.	
4	The exploration is coherent, well organized, concise and complete.	
B: MATHEMATICAL PRESENTATION		
0	**The exploration does not reach the standard described by the descriptors.**	
1	There is some appropriate mathematical presentation.	
2	The mathematical presentation is mostly appropriate.	
3	The mathematical presentation is appropriate throughout.	
C: PERSONAL ENGAGEMENT		
0	**The exploration does not reach the standard described by the descriptors.**	
1	There is evidence of limited or superficial personal engagement.	
2	There is evidence of some personal engagement.	
3	There is evidence of significant personal engagement.	
4	There is abundant evidence of outstanding personal engagement.	

		Marks Earned
D: REFLECTION		
0	**The exploration does not reach the standard described by the descriptors.**	
1	There is evidence of limited or superficial reflection.	
2	There is evidence of meaningful reflection.	
3	There is substantial evidence of critical reflection.	

		Marks Earned
E: USE OF MATHEMATICS		
0	**The exploration does not reach the standard described by the descriptors.**	
1	Some relevant mathematics is used.	
2	Some relevant mathematics is used. Limited understanding is demonstrated.	
3	Relevant mathematics commensurate with the level of the course is used. Limited understanding is demonstrated.	
4	Relevant mathematics commensurate with the level of the course is used. The mathematics explored is partially correct. Some knowledge and understanding are demonstrated.	
5	Relevant mathematics commensurate with the level of the course is used. The mathematics explored is mostly correct. Good knowledge and understanding are demonstrated.	
6	Relevant mathematics commensurate with the level of the course is used. The mathematics explored is correct. Thorough knowledge and understanding are demonstrated.	

The following sheet should

be handed out to students

at the end of their interview.

Briefly describe the changes you need to make to your exploration?