Introduction to the Exploration

Group 5 (Mathematics) AIMS

(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.

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What is the Mathematical Exploration?

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- The report should include a detailed **bibliography**, and sources need to be referenced in line with the **IB academic honesty** policy. Direct quotes must be acknowledged.

Requirements and recommendations

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- Students should be familiar with the requirements and the criteria.

Assessment criteria

criterion	description	max.
Criterion A	Communication	4
Criterion B	Mathematical presentation	3
Criterion C	Personal engagement	4
Criterion D	Reflection	3
Criterion E	Use of mathematics	6

Assessment criteria

Criterion A	Communication **organization of the exploration**: → introduction → a rationale (incl. explaining why this topic was chosen) → the aim of the exploration → a conclusion **coherence of the exploration**: → logically developed and easy to follow *Graphs, tables and diagrams should accompany the work in the appropriate place and not be attached as appendices to the document.*
Criterion B	Mathematical presentation
Criterion C	Personal engagement
Criterion D	Reflection
Criterion E	Use of mathematics

Assessment criteria

Criterion A	Communication
Criterion B	Mathematical presentation → appropriate mathematical language (notation, symbols, terminology) → key terms defined, where required → multiple forms of mathematical representation, such as *formulae, diagrams, tables, charts, graphs* and *models*, where appropriate. → appropriate ICT tools such as *graphic display calculators, screenshots, graphing, spreadsheets, databases, drawing* and *word-processing software*
Criterion C	Personal engagement
Criterion D	Reflection
Criterion E	Use of mathematics

Assessment criteria

Criterion A	Communication
Criterion B	Mathematical presentation
Criterion C	Personal engagement → This criterion assesses the extent to which the student engages with the exploration and makes it their own. → thinking **independently** and/or **creatively** → addressing **personal interest** → presenting mathematical ideas in **their own way**
Criterion D	Reflection
Criterion E	Use of mathematics

Assessment criteria

Criterion A	Communication
Criterion B	Mathematical presentation
Criterion C	Personal engagement
Criterion D	Reflection $\rightarrow$ how the student reviews, analyses and evaluates the exploration $\rightarrow$ may be seen both in the conclusion to the exploration and throughout the exploration
Criterion E	Use of mathematics

Assessment criteria

Criterion A	Communication
Criterion B	Mathematical presentation
Criterion C	Personal engagement
Criterion D	Reflection
Criterion E	Use of mathematics → to what extent and how well students use mathematics → If the level of mathematics is not commensurate with the level of the course, a maximum of two (2/6) marks can be awarded for this criterion. → Sophistication in mathematics may include understanding and use of challenging mathematical concepts, looking at a problem from different perspectives and seeing underlying structures to link different areas of mathematics. → clarity of logic and language when making mathematical arguments and calculations → Precise mathematics is error-free and uses an appropriate level of accuracy at all times

Skills and strategies required by students 1

- Choosing a topic
  - Identifying an appropriate topic
  - Developing a topic
  - Devising a focus that is well defined and appropriate
  - Ensuring that the topic lends itself to a concise exploration
- Communication
  - Expressing ideas clearly
  - Identifying a clear aim for the exploration
  - Focusing on the aim and avoiding irrelevance
  - Structuring ideas in a logical manner
  - Including graphs, tables and diagrams at appropriate places
  - Editing the exploration so that it is easy to follow
  - Citing references where appropriate
- Mathematical presentation
  - Using appropriate mathematical language and representation
  - Defining key terms, where required
  - Selecting appropriate mathematical tools (including ICT)
  - Expressing results to an appropriate degree of accuracy

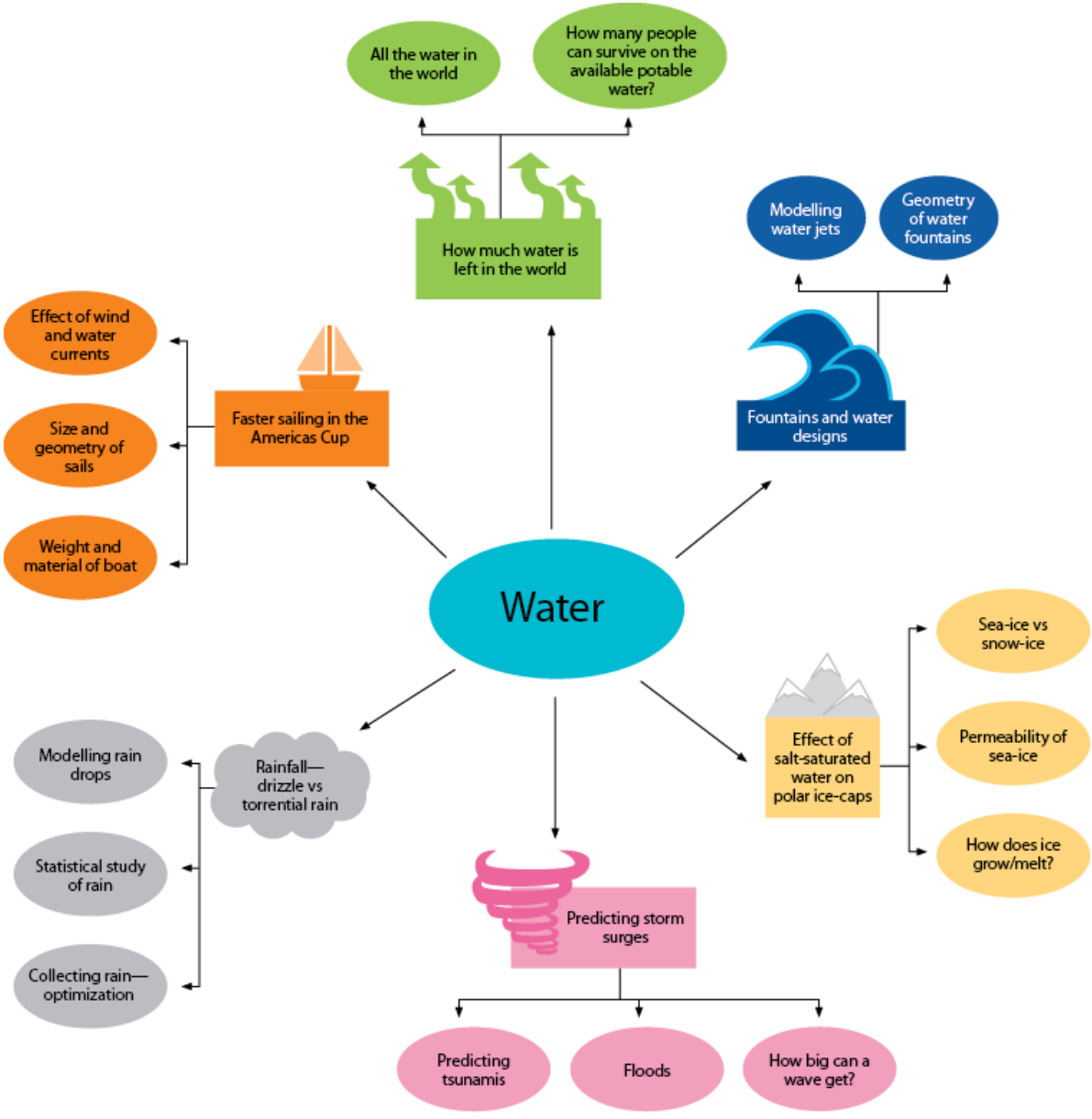
Skills and strategies required by students 2

- Personal engagement
  - Working independently
  - Asking questions, making conjectures and investigating ideas
  - Reading about mathematics and researching areas of interest
  - Looking for and creating mathematical models for real-world situations
  - Considering historical and global perspectives
  - Exploring unfamiliar mathematics
- Reflection
  - 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
- Use of mathematics
  - Demonstrating knowledge and understanding
  - Applying mathematics in different contexts
  - Applying problem-solving techniques
  - Recognizing and explaining patterns, where appropriate
  - Generalizing and justifying conclusions

Stimuli

sport	archaeology	computers	algorithms
cell phones	music	sine	musical harmony
motion	e	electricity	water
space	orbits	food	volcanoes
diet	Euler	games	symmetry
architecture	codes	the internet	communication
tiling	population	agriculture	viruses
health	dance	play	pi(π)
geography	biology	business	economics
physics	chemistry	IT in a global society	psychology

Stimuli - water



Use of technology

- any kind of calculators, the internet, data logging devices
- word processing packages, spreadsheets, graphics packages
- statistics packages or computer algebra packages

- software
  - Wolfram Alpha: www.wolframalpha.com
  - GeoGebra: www.geogebra.org
  - Graph: www.padowan.dk
  - Cabri 3D: www.cabri.com
  - spreadsheets
- websites
  - www.khanacademy.org
  - plus.maths.org

Exploration time frame

▶ choice of topic (+outline)	December
▶ outline	January
▶ draft of the Exploration	April / or June
▶ comments on draft	June / or September
▶ final version	October

Examples of students work 1

	Title
Example 1	Breaking the code
Example 2	Euler's totient theorem
Example 3	Minesweeper
Example 4	Modelling musical chords
Example 5	Newton-Raphson
Example 6	Florence Nightingale
Example 7	Modelling rainfall
Example 8	Spirals in Nature
Example 9	Tower of Hanoi

Examples of students work 2

	Title	marks
Example 1	Breaking the code	A
Example 2	Euler's totient theorem	B
Example 3	Minesweeper	C
Example 4	Modelling musical chords	C
Example 5	Newton-Raphson	C
Example 6	Florence Nightingale	B
Example 7	Modelling rainfall	A
Example 8	Spirals in Nature	A
Example 9	Tower of Hanoi	A

$\text{mark} \leq 10$
$10 < \text{mark} \leq 15$
$\text{mark} > 15$