ASIA SOCIETY'S GRADUATION PORTFOLIO SYSTEM

Mathematics

Partnership for
Global Learning

Mathematics Rationale

The goal of an ISSN school mathematics program is to develop an individual's capacity to understand the role of mathematics in the world; to study issues, situations, or events of global significance that call for a mathematical approach or solution, and to use mathematics to support conclusions, arguments, and decisions that lead them to act as reflective, constructive, and concerned citizens of the world.

This leads a teacher of mathematics to ask the question: What is the mathematics that students need to attain this goal? For example:

- What is the mathematics our students need to understand the world better?
- What is the mathematics that students need to know in order to solve complex problems in a complex world?
- How do we organize the mathematics content in an ISSN school to support the goals and outcomes for a graduate of an ISSN school?

To be able to describe the mathematics that we need to study, it is important that we understand that the world consists of situations, events, and phenomena:

- that can be represented, described, or quantified, entailing a solid understanding of algebra and the mathematics of generalization;
- that involve relationships among quantities, necessitating an understanding of functions and analysis;
- that are often physical/spatial and have measurable attributes, requiring a background in geometry and geometric measurement; and
- that are often inherently variable and uncertain, requiring an understanding of probability and statistics.

These domains of study constitute the basis of the mathematics program in an ISSN school. However, the right content is not enough; one must ensure that students have access to the appropriate experiences that will guide them in their use of the mathematics to study better and contribute to the world. To aid in this challenge, the GPS performance outcomes and rubric can serve as a focal point for organizing instructional experiences. The performance outcomes and rubric were developed to address the four expectations for any globally competent individual:

- that they can investigate the world;
- that they can recognize perspectives;
- that they communicate ideas; and
- that they can take action.

Within each of these expectations are specific skills, knowledge, and dispositions that will guide teachers in their decision-making for what should be taught and how it can be taught in a mathematics classroom focused on a global environment.

Asia Society®

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Investigate the World

Students use mathematics to investigate a global issue, situation, or event.

- Use mathematics to model a given issue, situation, or event.
- Explain how the parameters of an issue, situation, or event are reflected in the model.
- Use appropriate mathematical tools, procedures, and representations to explore an issue, situation, or event.
- Use appropriate strategies to produce mathematical solutions or analyses.
- Review and confirm the correctness and reasonableness of solutions or analyses both contextually and mathematically.

Recognize Perspectives

Students understand that perspective and mathematics influence each other.

- Use their mathematical data and analyses to draw conclusions, generate arguments, or make decisions.
- Collaborate to validate or verify the appropriateness of their model, tools, procedures, solutions, analyses, conclusions, arguments, or decisions.
- Evaluate their conclusions, arguments, or decisions within the context of the global community.
- Recognize and address unintended consequences or different perspectives based on different contexts—cultural, historical, political, societal, or personal.
- Maintain a clear perspective consistent with the conclusions, arguments, or decisions supported by the mathematics.

Take Action

Students translate the results of their mathematical study into appropriate actions.

- Advocate for plausible and responsible actions consistent with the conclusion, argument, and/or decision supported by the mathematics.
- Plan and engage in an action consistent with the perspective reflected in their conclusion, argument, or decision.
- Evaluate and reflect on the impact of their action on the global issue, situation, or event.

Communicate Ideas

Students communicate their mathematical thinking.

- Communicate thinking coherently and clearly using correct mathematical language and visual representations.
- Develop, explain, and defend conclusions, arguments, or decisions for diverse audiences using mathematical results and analyses, including the concepts and procedures used.
- Express mathematical ideas using the symbols and conventions of mathematics.
- Demonstrate a command of conventions of language—grammar, usage, punctuation, and so on.
- Select and use appropriate media to communicate one's mathematical ideas and message best.

Scoring Dimension
INVESTIGATE THE WORLD

How well does the student use mathematics to model and investigate a given issue, situation, or event?

The performance task does not prompt students to produce evidence for this dimension.

The student work did not provide evidence of this dimension.

Emerging

- The student is unable to use the given information to develop a mathematical model, or the model developed does not reflect the given situation.
- The student's explanation or demonstration of how mathematical relationships in the model reflect the given situation is incorrect, or is not attempted.
- The student cannot select the appropriate mathematical tools, procedures, or representations to begin exploring the problem.
- The student is unable to select a strategy or selects an incorrect strategy, and thus is unable to reach a viable solution.
- The student is unable to reach a solution, or the solution is unreasonable with respect to both the mathematical and given context.

Developing

- The student develops a mathematical model that partially fits the given situation, or does not use all the given information correctly.
- The student explains or demonstrates how at least some of the mathematical relationships used in the model reflect the given situation or fails to consider restrictions for the context.
- The student incorrectly uses appropriate mathematical tools, procedures, and representations, or correctly uses inappropriate tools, procedures or representations.
- The student selects a reasonable initial solution strategy, but can't proceed towards a solution, reaches an incorrect solution, or arrives at a partially-correct solution to the problem.
- The student does not verify the solution with respect to the mathematics or the given context, or is unable to identify errors in the solution.

Proficient/ College Ready

- The student develops a mathematical model that fits the given situation and uses all the relevant information provided.
- The student explains and demonstrates how mathematical relationships in the model reflect the given situation, using all the relevant information provided including the reasonable restrictions for the context.
- The student correctly uses appropriate mathematical tools, procedures, and representations to explore the issue, situation, or event.
- The student selects one or more appropriate solution strategies to arrive at a correct approach and solution to the problem.
- The student uses appropriate strategies to verify the solution with respect to both the mathematics and the given context.

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Advanced/ College Level

- The student uses additional contextual information or relationships in the mathematical model, or the student presents and considers several models and selects the best model for the given context.
- The student accurately explains why the model selected is the best choice, and the student can explain the mathematical limitations based on the assumptions used to create the model.
- The student uses appropriate mathematical tools, procedures, and representations to explore and analyze the problem elegantly.
- The student identifies or derives additional information to enhance the model that leads to the use of innovative approaches to the problem or to novel solutions.
- The student uses appropriate strategies to verify the solution with respect to both the mathematics and the given context, and goes beyond the scope of the task to interpret additional impacts of the solution.

Scoring Dimension
RECOGNIZE PERSPECTIVES

How well do students recognize the impact of their mathematical analyses on themselves and others?

The performance task does not prompt students to produce evidence for this dimension.

The student work did not provide evidence of this dimension.

Emerging

- No conclusion, argument, or decision is proposed, or any conclusion, argument, or decision is not supportable by the mathematics.
- The student conducts their work in isolation and, as a result, the work shows evidence of errors, inappropriate conclusions, miscommunications, or lack of clarity.
- The student is unable to identify the implications of the conclusion, argument, or decision, or the implications are incorrect and unsupportable.
- Unintended consequences and different perspectives are not addressed, or the consequences and perspectives are incorrect, unsupportable, or based on bias.
- The student's position is not evident or is inconsistent with the conclusions, arguments, or decisions supported by the mathematics.

Developing

- Any conclusion drawn, argument generated, or decision made is not supported by the mathematical data and analyses.
- The student conducts their work in isolation and fails to validate their outcomes with colleagues, an adult, or external source.
- The implications the student draws are not within the global context, and are not supported or limited in support.
- Major consequences or perspectives are missed, or the consequences or perspectives are limited in support or unsupported.
- The relationship between the student's position and the conclusions, arguments, and decisions supported by the mathematics is not well established or is unclear.

Proficient/ College Ready

- The student draws a conclusion, generates an argument, or makes a decision that is supported by the mathematical data and analyses.
- The student works with one or more partners, or verifies their work and outcomes with colleagues, an adult, or an external source.
- The student evaluates the implications of the conclusion, decision, or argument within the global context.
- The student recognizes and addresses unintended consequences and different perspectives.
- The student maintains a position consistent with the conclusions, arguments, or decisions supported by the mathematics.

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Advanced/ College Level

- The student further defends and validates conclusions, arguments, and decisions with additional mathematical analyses, with external research, or by subjecting his/her defense to public review.
- The student validates their work with professional sources or a larger, more global community.
- The student extends the implications within the global context, uses the mathematics of the given situation to support the implications, or addresses the implications beyond the context of the issue, situation, or event.
- Any acknowledgement of unintended consequences and different perspectives is supported with additional mathematical analyses or external research.
- The student's position is strengthened by additional mathematical analyses or research, or the student uses other mathematics or external research to challenge the conclusions, arguments, and decisions.

Scoring Dimension
COMMUNICATE IDEAS

How clearly and accurately does the student communicate and defend their mathematical thinking, approaches, representations, solution, and decisions?

The performance task does not prompt students to produce evidence for this dimension.

The student work did not provide evidence of this dimension.

Emerging

- The student's explanations and justifications of mathematical concepts, procedures, and relationships are difficult to follow or missing.
- No justification of the conclusion, decision, or argument using data, concepts, or procedures from the model is present, or it is inaccurate.
- Mathematical meaning is confused by the incomplete, incorrect, or misuse of the conventions of mathematics.

Developing

- The student attempts to explain and justify mathematical concepts, procedures, and relationships, but there are some omissions, brief gaps in logic, or minor errors in the sequencing of arguments that cause confusion.
- The student attempts to defend a conclusion, decision, or argument with incomplete data from the model, partially erroneous concepts or procedures, or the justification is only partially accurate.
- The conventions of mathematics are not always observed or contain minor errors, but these omissions and errors do not detract from the overall meaning.

Proficient/ College Ready

- The student explains and justifies mathematical concepts, procedures, and relationships in an organized and sequenced way using visual representations for clarity when appropriate.
- The student defends a conclusion, decision, or argument with relevant and accurate concepts, procedures, or data from the model.
- The student accurately uses mathematical terms, symbols, and conventions to express mathematical ideas.

Advanced/ College Level

- The student's explanations and justifications of mathematical concepts, procedures, and relationships, including the use of visual representations, are detailed and elegant.
- The student uses additional data, deeper analyses, or a secondary model to support and defend decisions, conclusions, or arguments further.
- The student accurately uses mathematical terms, symbols, and conventions to express mathematical ideas, and enhances meaning with the use of everyday language.

Scoring Dimension
TAKE ACTION

How well do students advocate for, engage in, and reflect on plausible and responsible actions that are supported by their mathematics?

The performance task does not prompt students to produce evidence for this dimension.

The student work did not provide evidence of this dimension.

Emerging

- Any actions advocated are not supported by the mathematics, are neither plausible nor responsible, or the student does not advocate for any action.
- The student does not plan for nor engage in an action, or the plans are not well developed and can't be put into action.
- The student does not or cannot articulate a connection between their action and the impact on the global community, nor does the student address improvements and limitations.

Developing

- The student advocates for a course of action, but it is neither plausible nor responsible, or it is not well supported by the mathematics.
- The student develops but does not execute a plan of action, engages in an action that is not well planned, or the action is planned and executed, but it is not consistent with their conclusions, arguments, or decisions supported by the mathematics.
- The connection between the student's action and the impact on the global community, or a discussion of limitations and improvements, is not well developed.

Proficient/ College Ready

- The student advocates for one or more possible courses of action that are plausible, responsible, and supported by mathematics.
- The student develops and engages in a viable, manageable, and responsible plan of action consistent with their argument, conclusion, or decision supported by the mathematics.
- The student can articulate the importance of their plan of action(s) within the context of the global community, as well as discuss the limitations and potential improvements.

Advanced/ College Level

- The student's advocacy extends beyond the scope of the task's audience to new audiences, or the courses of action extend beyond the scope of the task.
- The student plans novel or innovative actions or continues to engage in the action beyond the scope of the task.
- As a result of their action(s), the student develops new insights and can articulate the changes in their personal views, attitudes, or mathematical understanding.