

**POLICY SURVEY
MATHEMATICS AND SCIENCE RESPONSES TO 21ST CENTURY
COMPETENCIES: PRIMARY AND SECONDARY EDUCATION**

INTRODUCTION

Educating students so that they have “21st century competencies” could require changes in education systems in a number of directions. Through this survey we hope to document current mathematics and science education policies in your country. In addition, we would like to probe your Economy on any policy changes you may have made or may plan to make in primary and secondary education to provide students with an appropriate foundation for success in the 21st Century.

1. GENERAL

1.1 What is the duration of compulsory education?

- a) Number of years: _____
- b) Starting age:_____ Starting grade:_____
- c) Ending age:_____ Ending grade:_____

1.2 Please list in the table below:

- the stages of schooling (i.e. elementary, lower secondary, upper secondary)
- the number of years in each stage
- the expected age range of children in each stage.

Stages	Number of years	Expected age range	% of Age Group Enrolled in School

2. MATHEMATICS AND SCIENCE COURSETAKING FOR SECONDARY SCHOOL GRADUATION

Secondary school graduation requirements in mathematics and science course taking represent important indicators of an Economy’s quest to provide all students with a strong foundation in mathematics and science as a means to increase their chances of being successful in the 21st Century. The following questions ask about your Economy’s graduation requirements in mathematics and science.

MATH:

2.1 In your Economy is mathematics typically taught following a separate mathematics topic sequence approach (i.e. algebra, geometry, trigonometry, statistics) or a combined approach (i.e. math I, math II, math fundamentals)? (Please check one.)

Topic Sequence Approach _____ Combined Approach _____

2.2 Does your economy have one or more sets of mathematics courses required for graduation from secondary school at the national or provincial/prefecture level? (Mark as many as apply.)

- a) No required math courses at the *national* level
- b) No required math courses typically at the *provincial/prefecture* level
- c) A single *national* set of required math courses
- d) Multiple sets of *nationally* required math courses depending on type of secondary school diploma
- e) Multiple sets of *provincially/prefecture* required math courses depending on type of secondary school diploma.

2.3 If your Economy issues multiple secondary school diplomas requiring math courses at the *national* level, please list the different types of diplomas below: _____

2.4 If your Economy has multiple *provincial* sets of course requirements, please connect us with documentation of the provincial course requirements or copy the URLs for such documents below:

2.5 If you have national course requirements, until what year in secondary education is mathematics compulsory (e.g., Grade 10)? _____

2.6 a) Please identify the mathematical topic areas that are required for the most common upper secondary general diploma and the most advanced upper secondary school diploma in the table below:

Mathematical Topic Areas	Is Topic Compulsory or Elective for <u>Most Common Upper Secondary School General Diploma</u> ? (Check One)	Is Topic Compulsory or Elective for <u>Most Advanced Upper Secondary School Diploma</u> ? (Check One)
• Linear equations and functions	Compulsory ___ Elective ___ No Answer ___	Compulsory ___ Elective ___ No Answer ___
• Quadratic equations and functions	Compulsory ___ Elective ___ No Answer ___	Compulsory ___ Elective ___ No Answer ___
• Exponential and logarithmic equations and functions	Compulsory ___ Elective ___ No Answer ___	Compulsory ___ Elective ___ No Answer ___
• Trigonometric equations and functions	Compulsory ___ Elective ___ No Answer ___	Compulsory ___ Elective ___ No Answer ___
• Geometry (plane)	Compulsory ___ Elective ___ No Answer ___	Compulsory ___ Elective ___ No Answer ___
• Geometry (analytic)	Compulsory ___ Elective ___ No Answer ___	Compulsory ___ Elective ___ No Answer ___
• Statistics	Compulsory ___ Elective ___ No Answer ___	Compulsory ___ Elective ___ No Answer ___
• Calculus	Compulsory ___ Elective ___ No Answer ___	Compulsory ___ Elective ___ No Answer ___
• Other (Please name)	Compulsory ___ Elective ___ No Answer ___	Compulsory ___ Elective ___ No Answer ___
• Other (Please name)	Compulsory ___ Elective ___ No Answer ___	Compulsory ___ Elective ___ No Answer ___

b) If topic areas above do not adequately represent your course requirements (e.g., Economy uses a combined approach not topic sequence approach), please list the required topics for graduation below.

c) What percent of your secondary school graduates receive the most common upper secondary general diploma ____%?

d) What percent of your secondary school graduates receive the most advanced secondary school diploma ____%?

2.7 What percent of students in their last year of upper secondary school take a mathematics course? ____

2.8 Please indicate the *percent* of all secondary school graduates completing the following mathematical topic areas.

Mathematical Topic Areas	Percent of Upper Secondary students of all School Graduates Completing Topic Areas
• Linear equations and functions	
• Quadratic equations and functions	
• Exponential and logarithmic equations and functions	
• Trigonometric equations and functions	
• Geometry (plane)	
• Geometry (analytic)	
• Statistics	
• Calculus	
• Other (Please name)	
• Other (Please name)	

2.9 Does your system plan to change the number or type of mathematics courses required for graduation from secondary school?

Yes ___ No ___

2.10 If yes to 2.9, please list the planned changes, the date of expected implementation, and the reason for the change (e.g., adding additional mathematical topic areas).

SCIENCE:

2.11 Does your economy have one or more sets of science courses required for graduation from secondary school?

- No required science courses at the *national* level
- No required science courses at the *provincial/prefecture* level
- A single *national* set of required science courses
- Multiple sets of *nationally* required science courses depending on type of secondary school diploma
- Multiple sets of *provincially/prefecture* required science courses depending on type of secondary school diploma.

2.12 If your economy issues multiple secondary school diploma’s at the national level, please list the different types of diplomas below:

2.13 If provincial sets of course requirements exist, please connect us with documentation of the provincial course requirements or copy the URLs for such documents below:

2.14 Please identify the science topic areas that are required for the most common upper secondary general diploma and the most advanced secondary school diploma in the table below:

Science Courses	Is Topic Compulsory or Elective for <u>Most Common Upper Secondary School General Diploma?</u> (Check One)	Is Topic Compulsory or Elective for <u>Most Advanced Secondary School Diploma?</u> (Check One)
• Comprehensive/General Science	Compulsory ___ Elective ___ No Answer ___	Compulsory ___ Elective ___ No Answer ___
• Basic Biology	Compulsory ___ Elective ___ No Answer ___	Compulsory ___ Elective ___ No Answer ___
• Advanced Biology	Compulsory ___ Elective ___ No Answer ___	Compulsory ___ Elective ___ No Answer ___
• Physics	Compulsory ___ Elective ___ No Answer ___	Compulsory ___ Elective ___ No Answer ___
• Inorganic Chemistry	Compulsory ___ Elective ___ No Answer ___	Compulsory ___ Elective ___ No Answer ___
• Organic Chemistry	Compulsory ___ Elective ___ No Answer ___	Compulsory ___ Elective ___ No Answer ___
• Earth Science	Compulsory ___ Elective ___ No Answer ___	Compulsory ___ Elective ___ No Answer ___
• Environmental Science	Compulsory ___ Elective ___ No Answer ___	Compulsory ___ Elective ___ No Answer ___
• Other (please name)	Compulsory ___ Elective ___ No Answer ___	Compulsory ___ Elective ___ No Answer ___
• Other (please name)	Compulsory ___ Elective ___ No Answer ___	Compulsory ___ Elective ___ No Answer ___

2.15 If courses above do not adequately represent your course requirements, please list graduation track requirements below.

2.16 What *percent* of students in their last year of upper secondary school take a science course? _____

2.17 Does your system plan to change the number or type of science courses required for graduation from secondary school?

Yes___ No___

2.18 If yes to 2.17, please list the planned changes, the date of expected implementation, and the reason for the change.

2.19 Can students take mathematics or science courses for college credit while in secondary school?

Yes___ No___

2.20 If yes to 2.19, please list the courses available for college credit and the percentage of secondary students that complete and receive credit for each course.

3. MATHEMATICS AND SCIENCE COMPETENCIES

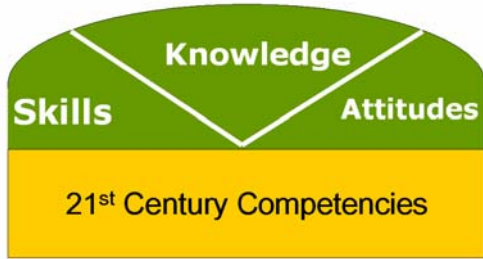
21st Century Competencies in mathematics and science are the knowledge, skills and attitudes needed to be successful in employment and society.

Knowledge refers to concepts and facts taught in different subject areas (e.g., linear algebra).

Skills refer to the real-world application of basic content knowledge to carry out meaningful activities in the appropriate manner (e.g., problem-solving, communication).

Attitudes refer to dispositions or values (e.g., willingness to learn and cooperate)

Competencies encompass the *knowledge, skills, and attitudes* needed collectively and individually to respond successfully to accomplish complex tasks and goals in our modern environment. (Note: Economy competencies may be synonymous with skills or may be more complex combinations of knowledge, skills and attitudes)



The following questions should be answered with respect to the **standards documents submitted by your Economy for math and science content analysis.**

3.1 In what year were the documents: developed? _____

In what year will the documents next be revised? _____

3.2 Are the following competencies currently priorities within your standards? If yes, please mark whether each competency is included in the standards or if it is under discussion for integration in the future.

PRIORITIES	Math			Science		
	Integrat ed into standar ds	Under discussion for increased integration into standards	Can't Answer	Integrat ed into standar ds	Under discussion for increased integration into standards	Can't Answer
Conceptual understanding						
Rigor of the content						
Procedural (e.g. computational or laboratory) skills						
Real-world problem solving						
New math in upper secondary grades (e.g., discrete math, fractals, decision math)						
Personal responsibilities and attitudes						
Teaching fewer topics with						

PRIORITIES	Math			Science		
	Integrat ed into standar ds	Under discussion for increased integration into standards	Can't Answer	Integrat ed into standar ds	Under discussion for increased integration into standards	Can't Answer
greater depth.						
Statistics and data analyses including data for scientific experiments.						
Laboratory/science experiments						
Students explaining their solutions to problems						
Discussions among students						
Discussions between students and teachers						
Amount of science in mathematics courses or increase the amount of mathematics in science courses						
Amount of group work						
Ability to think logically						
Ability to discover underlying rules and patterns						
Use of IT						
Please list other priorities not included in the list above:						

3.3 Has your Economy (the national government or a non-governmental organization) identified in a report, or other document, in the last ten years the new knowledge, skills, and attitudes that form the basis of 21st century competencies?

- a) General competencies? Yes___ No___
- b) Math? Yes___ No___
- c) Science? Yes___ No___

d) If so, please give the citation(s) for the report or document and if possible a URL on the World Wide Web where it can be found.

3.4 a) How does your Economy respond to differences among the students' level of competence in the field of mathematics in secondary education (for example, are gifted students privileged, or is there an emphasis on the needs of students incapable of keeping up with the contents of secondary education)?

Specifically, classes are common for (Check all that apply):

- b) Gifted students _____
- c) Special-need students _____

4. MATH AND SCIENCE IMPROVEMENT

4.1 What are major obstacles to improving upper secondary-level mathematics education? (Check all that apply.)

- a) Lack of student interest _____
- b) Lack of qualified teachers _____
- c) Inadequate foundation preparation in primary and lower-secondary levels _____
- d) Curriculum fails to adequately teach conceptual understanding _____
- e) Other _____

4.2 What are major obstacles to improving upper secondary-level science education ? (Check all that apply.)

- a) Lack of student interest _____
- b) Lack of qualified teachers _____
- c) Inadequate foundation preparation in primary and lower-secondary levels _____
- d) Curriculum fails to adequately teach conceptual understanding _____
- e) Other _____

4.3. Are there special policies regarding the in-service training of upper secondary mathematics teachers? (Check all that apply.)

- a) Intensive multi-week summer training _____
- b) Technical training opportunities in the private sector or universities _____
- c) Online training _____
- d) Sabbaticals _____
- e) Other _____

4.4. Are there special policies regarding the in-service training of upper secondary science teachers? (Check all that apply.)

- a) Intensive multi-week summer training _____
- b) Technical training opportunities in the private sector or universities _____
- c) Online training _____

- d) Sabbaticals _____
 - e) Other _____
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5. ASSESSMENTS: EVALUATING STUDENTS' 21ST CENTURY COMPETENCIES

5.1 Please list the assessments that students take in your economy and the levels at which they take them. If multiple assessments are administered at any given level, please list them (i.e. end of course exams, basic competency test vs. advanced competency test, or optional specialization tests).

	Name of Economy-wide Assessment (and URL for description)	Grade Level	Economy- wide (E) or Provincial (P) Assessment?
Primary Math Science			
Lower Secondary Math Science			
Upper Secondary Math Science			
Other			
Other			
Other			

5.2 a) Are students required to pass any or all of the assessments mentioned above in order to progress to the next grade? Yes___ No___

b) If yes, which assessments must students pass?

c) To what degree is the assessment(s) in 5.2b aligned with your Economy's standards?

High _____ Medium _____ Low _____ Don't Know _____

5.3 a) Are students required to pass any or all of the assessments mentioned above in order to graduate from secondary school? Yes ___ No ___

b) If yes to 5.3a, which assessments must students pass? _____

c) To what degree is the assessment(s) aligned with your Economy's standards?

High _____ Medium _____ Low _____ Don't Know _____

5.4 a) Are teachers or schools held accountable for primary or secondary students' assessment results? Yes ___ No ___

b) If yes to 5.4a, on what type of assessments (Check all that apply)?

c) Grade promotion _____ Graduation _____ University Entrance _____

5.5 a) Can students take an examination for tertiary education credit in math or science?

Yes ___ No ___

b) If yes to 5.5a, is there a single test or multiple tests?

Single _____ Multiple _____

c) If yes, to what degree is the assessment(s) aligned with your Economy's standards?

High _____ Medium _____ Low _____ Don't Know _____

d) Please list each assessment below.

5.6 a) Are students required to pass entrance examinations for admission into upper secondary school? Yes ___ No ___

b) If yes, is there a single Economy-wide assessment, regional/provincial assessment, or an individual school assessment?

Single Economy-wide Assessment _____ Regional/provincial assessment _____
Individual School Assessment _____

c) If yes, to what degree is the assessment(s) aligned with your Economy's standards?

High _____ Medium _____ Low _____ Don't Know _____

d) Please list each national assessment below.

5.7 a) Are students required to pass entrance examinations for admission into tertiary education institutions? Yes ___ No ___

b) If yes, is there a single Economy-wide assessment, multiple Economy-wide assessments, or individual university assessment?

Single _____ Multiple _____ University Assessment _____

c) If yes, to what degree is the assessment(s) aligned with your Economy's standards?

High _____ Medium _____ Low _____ Don't Know _____

d) Please list each assessment below.

5.8 Are data reported and publicly available for individual (check all that are relevant):

a) Students Reported _____ Publicly available _____

b) Teachers Reported _____ Publicly available _____

c) Schools Reported _____ Publicly available _____

d) Local government/ education administration bodies
 Reported _____ Publicly available

e) Publicly available State/Provincial/Prefecture Agencies:
 Reported _____ Publicly available

f) Please comment on how data is shared with those groups, if the groups above are accountable for the data, and how they are held accountable:

5.9 What is the role of the government in setting and administering assessments in mathematics and/or science?

Is your national government responsible for:	Math	Science	Not Applicable
Writing, reviewing, and administering primary assessments	__Yes __No	__Yes __No	
Writing, reviewing, and administering lower secondary assessments	__Yes __No	__Yes __No	
Writing, reviewing, and administering upper secondary assessments	__Yes __No	__Yes __No	
Are these assessments used as entrance exams:			
• In primary schools	__Yes __No	__Yes __No	
• In lower secondary schools	__Yes __No	__Yes __No	
• In upper secondary schools	__Yes __No	__Yes __No	
Are these assessments used for assigning students by ability grouping:			
• In primary schools	__Yes __No	__Yes __No	
• In lower secondary schools	__Yes __No	__Yes __No	
• In upper secondary schools	__Yes __No	__Yes __No	
Administering national-level assessments as a statistical indicator of overall student knowledge in math and/or science	__Yes __No	__Yes __No	
Administering national-level assessments for individual students to graduate or progress from particular grades	__Yes __No	__Yes __No	
Requiring state/ provincial governments to establish assessment of mathematics and/or science achievement in specific grades.	__Yes __No	__Yes __No	
Administering entrance examinations for upper secondary education.	__Yes __No	__Yes __No	
Administering entrance examinations for admission to tertiary education institutions.	__Yes __No	__Yes __No	
No role in assessment of mathematics and/or science achievement.	__Yes __No	__Yes __No	
Other roles (Please name)	__Yes __No	__Yes __No	

5.10 What are the priorities of your Economy’s (or if relevant provincial/state) education system in math and/or science assessments currently and in the future?

Reform Priorities	Math			Science		
	Already integrated into assessments	Under discussion for integration into assessments	Can't Answer	Already integrated into assessments	Under discussion for integration into assessments	Can't Answer
Rigor of mathematical/science content in assessments						
Emphasis on real-world problems in assessments						
Emphasis on students demonstrating and explaining their work in						

Reform Priorities	Math			Science		
	Already integrated into assessments	Under discussion for integration into assessments	Can't Answer	Already integrated into assessments	Under discussion for integration into assessments	Can't Answer
assessments						
Reporting of results disaggregated by major groups of interest such as race, minority/majority, rural/urban, or students with disabilities						
Use national assessments to benchmark diverse state/provincially administered assessments						
Assessments cover specific grades/ages						
Require state/provincial assessments to publicly report annual performance by school						
School accountability for student performance						
Increase use of online assessments						
Other						

5.11 a) Since the 1990's has a decline in academic abilities been observed among secondary-level students in the field of math and science?

Yes ____ No _____

b) If yes, when was it identified, by whom and how (e.g., did scores decline on the basis of either national or international assessment results)?

c) If yes, how is the government responding to this issue?

5.12 Would your Economy be interested in obtaining math and science assessment questions from other member Economies as part of an APEC assessment question bank?

Yes_____ No_____

5.13 Would your Economy be able to provide math and science questions to an APEC assessment question bank? (These questions would allow Economies to benchmark the difficulty of their own assessment questions against those of other developed and developing APEC Economies)

Yes_____ No_____

5.14 If the answer to 5.12 is yes, could you provide 5 mathematics questions that are correctly answered by most students (80 percent could answer); 5 questions correctly answered by typical students (half the students could answer) and 5 questions correctly answered by the most proficient students (twenty percent can answer). English translations are preferred but not required:

5.15 If the answer to 5.12 is yes, could you provide 5 science questions each that are correctly answered by most students (80 percent could answer); 5 questions correctly answered by typical students (half the students could answer) and 5 questions correctly answered by the most proficient students (twenty percent can answer). English translations are preferred but not required:
