Math-Science Subgroup Report Recommendations

APEC Context

- Members are keenly interested in collaborating to learn from each other how to provide 21st Competencies in math/science for All.
- Members collectively represent a tremendous knowledge base of different Economy approaches and a source of experience and evidence about effectiveness.
- Ongoing APEC networking, both real (conferences) and virtually (WIKI) offers a dynamic environment to build a cumulative knowledge base of evidence about effective math/science policy and practice in certain important areas. .

Standards

- Question: How to organize math & science standards to ensure the appropriate integration of 21st Century skills into content?
- Considerations:
  - Translation and comparison of standards was useful.
  - Breakout of standards by performance skills is important.
  - Need to examine coding to ensure that standards are appropriately coded.
- Potential activities:
  - Continue *math and science standards translation and analyses*, with attention to skill levels; provide results and coding online and allow time for economies to review for accuracy and comment using Wiki.

Assessments

- Question: How to create assessments that align with standards and measure student mastery of content, including 21st Century competencies?
- Considerations:
  - Assessments make concrete what is meant in standards.
  - If economies categorize test items by skill-levels, than can tag items by level – could even specifically collect assessments items that integrate traditional knowledge with competencies.
  - Consider collecting entire assessments to gauge what Economies measure overall and how standards and assessments are linked.
  - Consider appointing experts by each economy to assist with knowledge collection and dissemination

Assessments (cont.)

- Potential activities
  - Start with development of a *bank of test items*, tagging items by difficulty and grade.
  - Consider *expanding item assessment bank* to cover the collection of a variety of specific assessment types and the collection of complete Economy assessments.
  - Share innovative assessment practices and measures of their effectiveness

Instruction

- Question: What are effective approaches to organizing and integrating mathematics and science instruction?
- Considerations:
  - Need to make connections between mathematics and science, even within mathematics and with psychology and pedagogy in teaching, -- yet mathematics and science teachers infrequently communicate and may not adequately incorporate these connections into instruction of each content.
  - Survey found Economies' employ different teaching approaches -- parallel, integrated, and sequential – but differences in approaches are often not well known.

Instruction (Cont.)

- Potential activities:
  - Examine how to strengthen *math-science connections* through synthesis of research, discussion of practice and conference.
  - Examine *different math/science instructional approaches (e.g. parallel, sequential, integrated) by* documenting use of different approaches and compare advantages and difficulties comparisons at workshop and through WIKI.

Teachers

- Question: What are effective methods to provide teachers with the professional development needed to effectively integrate the teaching of fundamental and 21st century mathematics and science content.
- Considerations:
  - Japanese Lesson Study offers a well-developed method to support continuous teacher development through collaboration, demonstration and feedback.
  - Lesson study requires that teachers develop confidence in their teaching and ability to handle wide-ranging student responses.
  - Online teacher training offers promising tools to promote ideas and train teachers in different areas. It is also a good example of potential APEC member collaboration to better understand implementation.

Teachers (cont)

- Important to understand how teachers are being trained (preservice and inservice) in order to improve teaching 21st Century content, (this is a complex question that could only be touched upon in policy surveys).
- Potential activities:
  - Continue development of *online lesson-study*, distinguishing lessons that illustrate well-researched practice from those showing change process of introducing new practices. Also draw on existing lesson videos (TIMSS).
  - Launch *multiyear collaborative work in online professional development* drawing on NSTA experience and Economy development to share process, experience and evaluation results.
  - Explore how APEC can be a venue for *external researchers* to approach APEC to facilitate non-APEC support including for study teacher development

Policies

- Question: When Economies go through periodic changes in math/science curriculum, teaching style, etc, do they have a set cycle of information/evidence gathering before decisions are made?
- Considerations: Economies need hard evidence to understand how well policies are meeting expectations.
- Potential activity. Survey economies on the availability and use of evidence to support guide policy changes in math and science.

WIKI as a Tool for Ongoing APEC International Collaboration and Debate

- Wiki technology is an important tool for *collaborative knowledge building*.
  WIKI members to even see intervention examples and others to give *feedback* on their experiences about those features of this approach that worked and those that didn't.
- Wiki's interactivity can facilitate *targeted expansion of network expertise* in particular areas of APEC member interest (e.g., interplay of math/science and 21st Century skills)
- Wiki, however, has limitations and obstacles to overcome such as maintenance, translation burden (related to cultural differences) and it is practical to start with limited version of activities and areas.

Other considerations

- Review of the past activities on Math & Science needs to be prepared and submitted to the 4th AEMM.
- Additional inputs regarding user-side aspects (e.g. students and teachers) need to be included in the report to be prepared for AEMM.
- To well reflect diversity of APEC Economies, the M&S group welcomes additional thoughts from member Economies and they will be reflected in the above mentioned report.