




# Maryland State Board of Education

200 W. BALTIMORE STREET / BALTIMORE, MARYLAND 21201-2595 / (410) 767-0467

**TO:** Members of the State Board of Education

**FROM:** Tony South 

**DATE:** May 27-28, 2009

**SUBJECT:** International Benchmarking in Mathematics

---

## **PURPOSE:**

To provide the Board with information on the mathematics curricula in Singapore, one of the highest performing countries on international mathematics assessments.

## **EXECUTIVE SUMMARY:**

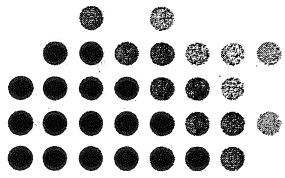
The presentation offers an international perspective on the approach to teaching mathematics in the primary grades in the United States in contrast to the approach used in Singapore, one of the top performing nations in the world on international mathematics assessments. This presentation is consistent with the call by the Chief State School Officers, Governors, Education Commission of the States, and Achieve for international benchmarking to ensure that U.S. students receive a world-class education. The presentation will identify major differences between the mathematics frameworks, textbooks, assessments and teachers in Singapore and a number of States including Maryland. It also presents some initial results from sites that introduced the Singapore mathematics textbook in place of their regular textbook.

Dr. Alan Ginsburg is Director of Policy and Program Studies within the Office of Planning, Evaluation, and Policy Development at the U.S. Department of Education. Dr. Ginsburg's international work includes Lead Shepherd (chair) of the 21-nation Human Resources Development Working Group within the organization for Asia-Pacific Economic Cooperation (APEC). He has completed studies comparing Singapore and U.S. mathematics systems; a study of what we can learn from the TIMSS and PISA results about international mathematics performance and its causes; and a newly published study of "How the Highest Performing State (Massachusetts) Compares to the Highest Performing Country (Hong Kong) in Grade 3 Mathematics."

## **ACTION:**

For information only, no action is required.



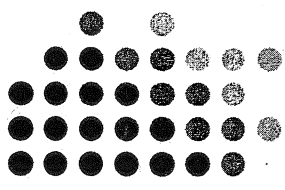


# **Singapore Math: How It Can Help Improve U.S. Mathematics Learning**

**Alan Ginsburg\***  
U.S. Department of Education  
Chair, APEC Human Resources Development

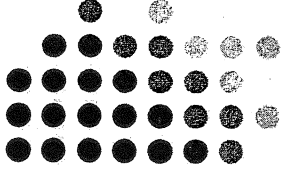
Presentation to Maryland State Board of Education  
May 28, 2009

\*Opinions are those of the presenter and do not necessarily reflect the views  
of the U.S. Department of Education or APEC



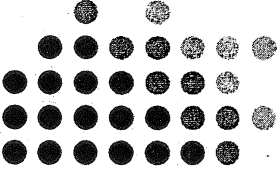
# Presentation Outline

- Importance of primary mathematics.
- Can we compare U.S. and Singapore?
- Results from U.S. pilots of Singapore Math.
- Comparing Singapore – U.S. math systems on:
  - Frameworks
  - Textbooks
  - Assessments
  - Teachers
- Singapore and other math standards online.



# Presentation Basis

- Ginsburg, Leinwand, Anstrom, and Pollock (2005). *What the United States Can Learn From Singapore's World-Class Mathematics System And What Singapore Can Learn From the United States*. American Institute for Research [http://www.air.org/news/documents/Singapore%20Report%20\(Bookmark%20Version\).pdf](http://www.air.org/news/documents/Singapore%20Report%20(Bookmark%20Version).pdf)

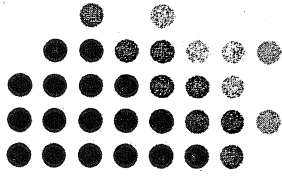


# Neglect of U.S. Primary Mathematics Performance

- *“In our K-12 we were doing okay at the 4<sup>th</sup> grade, we were doing middle-of-the-road in the 8<sup>th</sup> grade, and by 12<sup>th</sup> grade we were hovering near the bottom in international tests related to math.”*

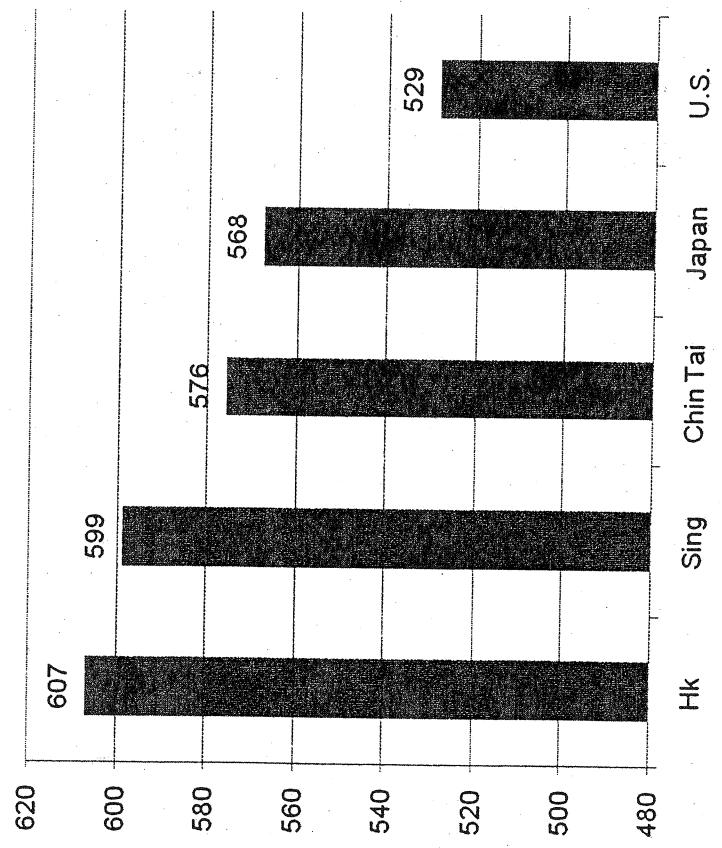
Tracy Koon, Intel's director of corporate affairs, quoted in T. Friedman, *The World Is Flat* (2005)

- NCES, National Academy of Sciences, and Business Roundtable have drawn similar conclusions about U.S. students' primary-level international mathematics performance.
- Proposals to reform U.S. mathematics instruction have largely ignored primary grades<sup>4</sup>.

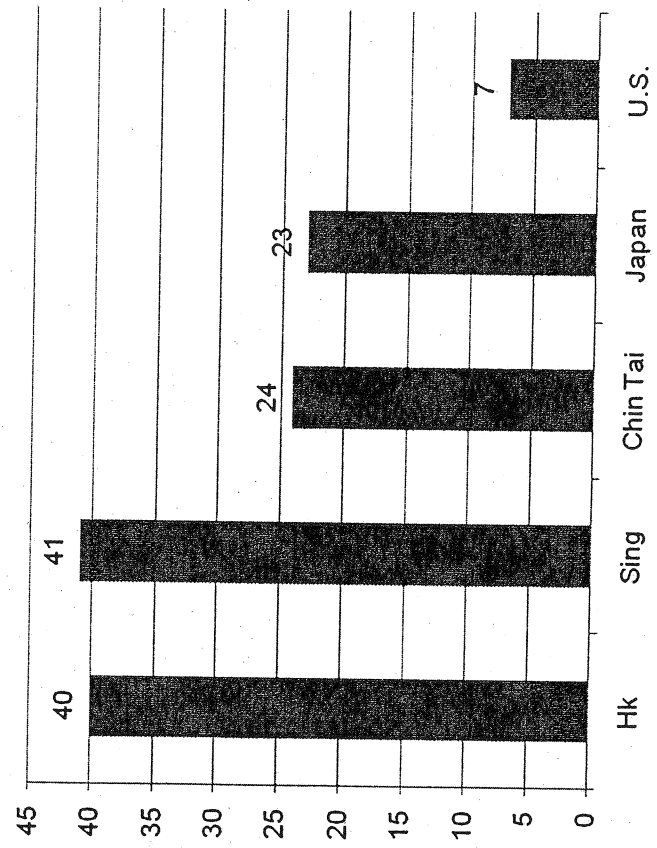


# U.S. Math Scores Are Substantially Below Asian Average at Grade 4

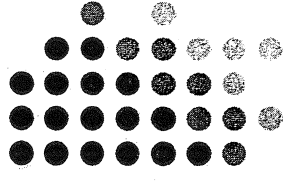
Avg. Score of High-Performing Asia & U.S. TIMSS 2007 Math, Gr. 4



% Adv. Students in High-Performing Asia & U.S. TIMSS 2007 Math, Gr. 4

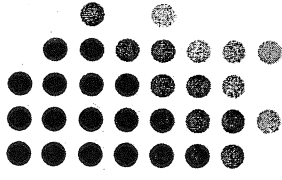


# Is Singapore too Different from the U.S. for Comparison?



- **Size:** 500,000 pupils, which is a little bigger than the Chicago Public Schools and a little smaller than Connecticut.
- **Population:** Racially diverse student body – 75% Chinese, 15% Malaysian, and 10 % Indian.
- **Expectations:** Singapore students are 2.5 times more likely than U.S. students to receive high-levels of math homework (8<sup>th</sup> grade TIMSS).

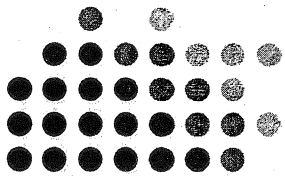
# Results From U.S. Pilots of Singapore Math



| Pilot Site                       | Characteristics                                       | Results                                                                                |
|----------------------------------|-------------------------------------------------------|----------------------------------------------------------------------------------------|
| North Middlesex, Mass            | Small district with stable population                 | Large increase in percent of high-performing students (advanced level)                 |
| Baltimore City Ingenuity Project | Program for gifted students                           | Large increase in high performing students and those above 75 <sup>th</sup> percentile |
| Montgomery County, MD            | Suburban school district with mixed income population | Two of four schools showed substantial gains                                           |
| Paterson, NJ                     | Poor school, over 40% annual student turnover         | No improvement over controls                                                           |
| Washington, DC                   | High-poverty, mostly LEP                              | Large increase in proficiency                                                          |

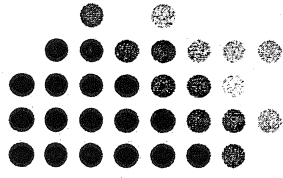
Source: Ginsburg, Leinwand, Anstrom, and Pollock (2005); DC 2008 results reported under NCLB





# Why is Singapore Math Successful in Singapore?

- The components of Singapore’s system – frameworks, texts, tests and teacher prep – are carefully aligned and reflect a higher quality than comparable U.S. components.
- See Education Commission of the States: International Benchmarking Toolkit (2009). <http://www.ecs.org/IB/compare.html>.



# Math Frameworks: Singapore's 2005 Topics and Outcomes Grades 1-6

|                  | Total<br>Topics | Avg. Topics<br>/Grade |                      | Avg. Grades<br>/Topic |                      | Avg. Outcomes<br>/Grade |                      |
|------------------|-----------------|-----------------------|----------------------|-----------------------|----------------------|-------------------------|----------------------|
|                  |                 | No.                   | Ratio<br>to<br>Sing. | No.                   | Ratio<br>to<br>Sing. | No.                     | Ratio<br>to<br>Sing. |
| <b>Singapore</b> | <b>40</b>       | <b>15</b>             | <b>—</b>             | <b>2.3</b>            | <b>—</b>             | <b>39</b>               | <b>—</b>             |
| California       | 42              | 20                    | 1.3                  | 2.9                   | 1.3                  | 51                      | 1.3                  |
| Florida          | 54              | 39                    | 2.6                  | 4.2                   | 1.8                  | 107                     | 2.7                  |
| Maryland         | 46              | 29                    | 1.9                  | 3.8                   | 1.7                  | 69                      | 1.8                  |
| New Jersey       | 50              | 28                    | 1.9                  | 3.4                   | 1.5                  | 56                      | 1.4                  |
| N. Carolina      | 41              | 18                    | 1.2                  | 2.6                   | 1.1                  | 36                      | .9                   |
| Ohio             | 48              | 26                    | 1.7                  | 3.3                   | 1.4                  | 62                      | 1.6                  |
| Texas            | 40              | 19                    | 1.3                  | 2.8                   | 1.2                  | 44                      | 1.1                  |
|                  |                 |                       |                      |                       |                      | <b>232</b>              |                      |

# Exhibit 3-5. Singapore Topic Matrix for Numbers—Primary 1 to 4 and Primary 5 and 6 (Normal Track)

P6

P5

P4

P3

P2

P1

**NUMBERS: WHOLE NUMBERS**

- |                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                             |  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| <ol style="list-style-type: none"> <li>1. Number notation and place values up to 100</li> <li>2. Cardinal and ordinal numbers</li> <li>3. Comparing and ordering</li> <li>4. Addition and subtraction of numbers within 100</li> <li>5. Multiplication of numbers whose product is not greater than 40</li> <li>6. Division of numbers not greater than 20</li> </ol> | <ol style="list-style-type: none"> <li>1. Number notation and place values up to 1,000</li> <li>2. Addition and subtraction of numbers up to 3 digits</li> <li>3. Multiplication and division within the 2, 3, 4, 5, and 10 times tables</li> </ol> | <ol style="list-style-type: none"> <li>1. Number notation and place values up to 10,000</li> <li>2. Addition and subtraction of numbers up to 4 digits</li> <li>3. Multiplication tables up to 10×10</li> <li>4. Multiplication and division of numbers up to 3 digits by a 1-digit number</li> <li>5. Odd and even numbers</li> </ol> | <ol style="list-style-type: none"> <li>1. Number notation and place values up to 100,000</li> <li>2. Approximation and estimation</li> <li>3. Factors and multiples</li> <li>4. Multiplication of numbers up to 4 digits by a 1-digit number up to 3 digits by a 2-digit number</li> <li>5. Division of numbers up to 4 digits by a 1-digit number and by 10</li> </ol> | <ol style="list-style-type: none"> <li>1. Number notation and place values up to 10 million</li> <li>2. Approximation and estimation</li> <li>3. Multiplication and division of numbers up to 4 digits by a 2-digit whole number</li> <li>4. Order of operations</li> </ol> |  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|

**NUMBERS: FRACTIONS**

- |                                                                                                                                                                    |                                                                                                                               |                                                                                                                                                                                                              |                                                                                                                                                                                                                                                           |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ol style="list-style-type: none"> <li>1. Equal parts of a whole</li> <li>2. Idea of simple fractions</li> <li>3. Comparing and ordering like fractions</li> </ol> | <ol style="list-style-type: none"> <li>1. Equivalent fractions</li> <li>2. Comparing and ordering unlike fractions</li> </ol> | <ol style="list-style-type: none"> <li>1. Addition and subtraction of like fractions</li> <li>2. Product of a proper fraction and a whole number</li> <li>3. Mixed numbers and improper fractions</li> </ol> | <ol style="list-style-type: none"> <li>1. Addition and subtraction of mixed numbers, unlike fractions</li> <li>2. Product of fractions as division</li> <li>3. Concept of fraction</li> <li>4. Division of a proper fraction by a whole number</li> </ol> |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

**NUMBERS: DECIMALS**

- |                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                      |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ol style="list-style-type: none"> <li>1. Multiplication up to 2 decimal places by a 2-digit whole number</li> <li>2. Multiplication and division up to 3 decimal places by tens, hundreds, thousands</li> </ol> | <ol style="list-style-type: none"> <li>1. Number notation and place values up to 3 decimal places</li> <li>2. Comparing and ordering</li> <li>3. Addition and subtraction up to 2 decimal places</li> <li>4. Multiplication and division up to 2 decimal places by 1-digit whole number</li> <li>5. Conversion between decimals and fractions</li> <li>6. Approximation and estimation 10</li> </ol> |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

**NUMBERS: AVERAGE/RATE/SPEED**

- |                                                                                     |                                                                                             |
|-------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|
| <ol style="list-style-type: none"> <li>1. Average Rate</li> <li>2. Ratio</li> </ol> | <ol style="list-style-type: none"> <li>1. Time (24-hour clock)</li> <li>2. Speed</li> </ol> |
|-------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|

**NUMBERS: RATIO/PROPORTION**

- |                                                                                  |
|----------------------------------------------------------------------------------|
| <ol style="list-style-type: none"> <li>1. Ratio and direct proportion</li> </ol> |
|----------------------------------------------------------------------------------|

**NUMBERS: PERCENTAGES**

- |                                                                                                                 |                                                                                              |
|-----------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|
| <ol style="list-style-type: none"> <li>1. Concept of percentage</li> <li>2. Percentage of a quantity</li> </ol> | <ol style="list-style-type: none"> <li>1. One quantity as a percentage of another</li> </ol> |
|-----------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|