Algebra I, Geometry, Algebra II Mathematics Standards

Washington State Board of Education

Strategic Teaching

July 23, 2008

Introductory material

Organization of document:

Core Content	▪ Describe the major mathematical focuses of each grade level or course, which are limited in number.
Additional Key Content	▪ Contains important expectations that do not warrant the same amount of instructional time as Core Content. ▪ Expected to be taught. ▪ Might be included on WASL.
Core Processes	▪ Address reasoning, problem solving, and communication. ▪ Describe the breadth and scope of what is expected in each grade or course. ▪ Are illustrated by two rich problems that include content from multiple performance expectations.

Introductory material

Organization of document:

Performance Expectation	▪ The "standards" -- what students should know and do at each grade level.
Explanatory Comments and Examples	▪ Provide detail about content parameters ▪ Sample problems that illustrate what is typical, define the limits, expand teachers thinking. ▪ Suggestions about technology use. ▪ Ideas that might be used for teaching. ▪ The examples and comments included in the standards are illustrative only. Teachers are not expected to teach using suggested methods or particular examples or to limit their teaching to what is included in the document.

Technology

- The focus of mathematics instruction should always be on the mathematics to be learned and on helping students learn that mathematics.
- Calculators and other technological tools are an important part of today's classroom.... But, technology cannot replace conceptual understanding, computational fluency, or problem-solving skills.
- Some performance expectations are to be done without using technology. Some encourage the use of technology.
- Technology is less useful in elementary school than it will be in middle and high school.
- When students become dependent upon technology to solve basic math problems, the focus of mathematics instruction to help students learn mathematics has failed.

Standards

- Are:
  - Technically the *performance indicators*.
  - Generally the entire document.
- Are Not:
  - Directions on how to teach.
  - Everything that can and might be taught.
  - Test specifications.

The new standards

- Based on:
  - March 5, 2008 standards
- Revised on:
  - National Math Panel's *Foundations for Success*
  - *Washington College Readiness Standards*
  - Achieve's ADP work, particularly Algebra II exam
  - Feedback from Math Panel
  - Feedback from members of SRI
  - Feedback from other Washington citizens

Changes: Clarified expectations

- G.2.L Describe regular and non-regular polyhedra in terms of their faces, edges, vertices, and properties.

- **G.4.I Analyze cross-sections of cubes, prisms, pyramids, and spheres and identify the resulting shapes.**

Changes: Mathematically accurate language

- A1.2.C Translate among representations of functions described by symbolic expressions ('y=" and "f(x)=)" tables, graphs, and verbal descriptions.

- **A1.3.C Represent a function with a symbolic expression, graph it, make a table using it, give a verbal description of it, and make connections among the representations.**

Changes: Pedagogy removed

- G.2.J: Make and test conjectures about geometric properties and relationships using constructions, and justify the steps in a construction using the theorems and postulates of Euclidean geometry.

- **G.3.I: Explain and perform constructions related to the circle.**

Changes: Additional content

- A1.5.D Solve quadratic equations that have real roots by using the quadratic formula.
  - http://www.achieve.org/node/842

- A2.5.A Construct new functions using the transformations $f(x - h)$, $f(x) + k$, $cf(x)$, and by adding and subtracting functions, and describe the effect on the original graph.
  - Washington College Readiness Standards

Algebra I overview

- Core Content:
  - Solving problems (5)
  - Numbers, expressions, and operations (6)
  - Types and behaviors of functions (4)
  - Linear functions, equations, and inequalities (5)
  - Quadratic functions and equations (4)
  - Data and distributions (4)
- Additional Key Content:
  - Other equations and functions (4)
- Core Processes:
  - Problem Solving (10)

Algebra I problems

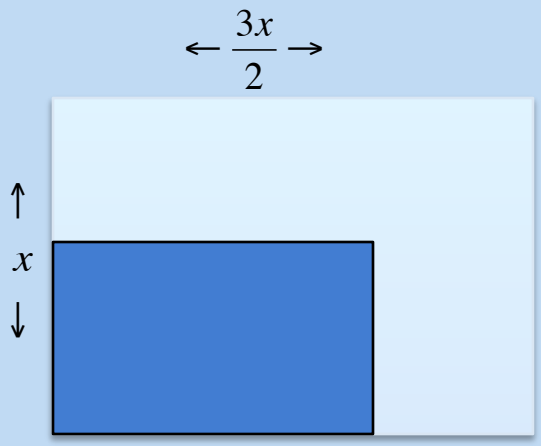
- The assistant pizza maker makes 6 pizzas an hour. The master pizza maker makes 10 pizzas an hour but starts baking two hours later than his assistant. Together, they must make 92 pizzas. How many hours from when the assistant starts baking will it take?

  - Given:
    - Assistant had been working for 2 hours and so made 12 pizzas when master pizza maker started
    - Assistant produces 6 pizzas per hour or 6h
    - Master produces 10 pizzas per hour or 10 h

    - $12 + 6h + 10h = 96$
      $12 + 16h = 96$
      $16h = 80$
      $h = 5$, so answering the question, it will be 7 hours from when the assistant starts baking.

Algebra I problems

- Joe owns a small plot of land 20 feet by 30 feet. He wants to double the area by increasing both the length and the width, keeping the dimensions in the same proportion as the original. What will be the new length and width?



20 ft. * 30 ft. = 600 sq. ft

$x * 1.5x = 1200$ sq. ft.

$1.5x^2 = 1200$ sq. ft.

$x^2 = 1200$ sq. ft.

$x \approx 28.3$ ft.

$\frac{3x}{2} \approx 42.4$

Algebra I problems

- E. coli bacteria reproduce by a simple process called binary fission—each cell increases in size and divides into two cells. In the laboratory, E. coli bacteria divide approximately every 15 minutes. A new E. coli culture is started with 1 cell. How long will it take before you have approximately 500 bacteria?
- About 2 hours and 15 minutes

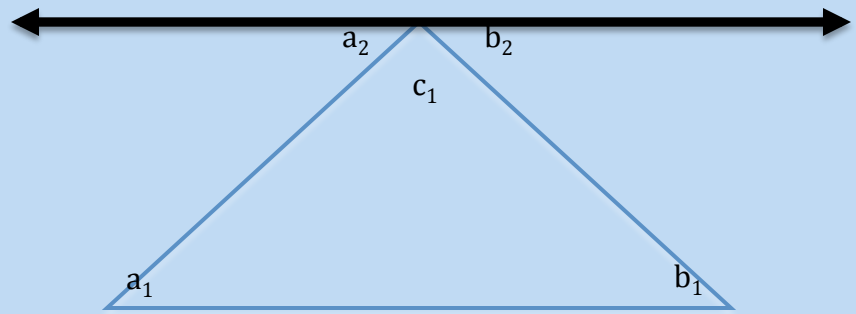
Minutes	# Bacteria
0	1
15	2
30	4
45	8
60	16
75	32
90	64
105	128
120	256
135	512

Geometry overview

- Core Content:
  - Logical arguments and proofs (5)
  - Lines and angles (4)
  - Two- and Three-dimensional figures (9)
  - Geometry in the coordinate plane (4)
  - Transformations (5)
  - Circles and spheres (4)
- Additional Key Content:
  - Measurement (5)
- Core Processes:
  - Solving problems (8)

Geometry problems

- Develop a hypothesis for the number of degrees in a triangle. Prove (or disprove) the conjecture.



Given a triangle, draw a line parallel to the base

$m\angle a_2 + m\angle b_2 + m\angle c_1 = 180° : by\ definition$

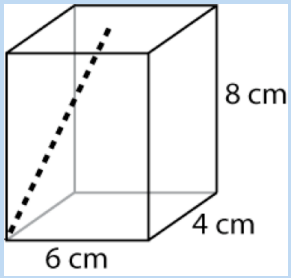
$\angle a_1 \cong \angle a_2; \angle b_1 \cong \angle b_2 :$ If two parallel lines are cut by a transversal, then the alternate interior angles are congruent.

$m\angle a_1 + m\angle b_1 + m\angle c_1 = 180° : \quad by\ substitution$

	By definition

Geometry problems

- A juice box is 6 cm by 4 cm by 8 cm. A straw is inserted into a hole in the center of the top of the box. The straw must stick out 2 cm so you can drink from it. If the straw must be long enough to touch each bottom corner of the box, what is the minimum length the straw must be?



Algebra II Dilemma

- Multiple legitimate roles
  - Prepare would-be engineer types for college calculus.
  - Serve as the terminal course in mathematics for students interested in careers that are not math -intensive.
  - Everyone in between.
- Statistics and probability
  - Increasing importance in ordinary life
  - Concern about displacement of content in traditional content courses
  - Not unique to Washington

Algebra II overview

- Core Content
  - Solving Problems
  - Numbers, expressions, and operations
  - Quadratic functions and equations
  - Exponential and logarithmic functions and equations.
  - Additional functions and equations
  - Data and distributions, and statistical experiments
- Additional Key Content
  - Linear systems, series
- Core Processes
  - Reasoning, problem solving, and communication

Algebra II problems

- A manufacturer wants to design a cylindrical soda can that will hold 500 milliliters (mL) of soda. The manufacturer's research has determined that an optimal can height is between 10 and 15 centimeters. Find a function for the radius in terms of the height and use it to find the possible range of radius measurements. Explain your reasoning.

- A fireworks rocket is launched upward from the ground with an initial velocity of 160 feet per second. The formula for vertical motion is h(t) = 0.5at2 + vt + s, where the gravitational constant, a, is -32 feet per square second, v is the initial velocity, and s is the initial height. Time t is measured in seconds, and height h is measured in feet.

  For the ultimate effect, the rocket must explode after it reaches its maximum height. For the safety of the crowd, it must explode at least 250 ft. above the ground. How many seconds should

Integrated Mathematics

- The SRI will rearrange the identical performance expectations into Integrated I, II, and III.
- Results will be shared with teachers during professional development on July 28, 29, and 30.

How would the economy look today if all homeowners understood how their mortgages work, or if America's appetite for employees proficient in mathematics and science could be satisfied domestically?

Mathematics and Science for All, *Innovator*,
School of Education University of Michigan,
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