mismathed

an exploration of how the math and science curricula align in 9th and 10th grades

Why 9th and 10th grades?

The distribution of US Students in Math and Science Courses[1]

	Alg I	Geo	Geo A	Alg II	Alg IIA	Pre-calc	Pre-calc A	Calc	AP Calc AB	AP Calc BC	AP Stat	MV Calc	Disc. Math	None
Conceptual Physics	30	2	1											
Computational Physics		13	29		1									
Chemistry		19	4	8	3									
Quant. Chem		2	2	9	30		3							
AP Chemistry				2			5	1		1				
Biology				22	2	23	13	3	2	4	2		1	1
AP Biology						2	1	2						
AP Physics							4		4					
Organic Chem						1	1		1	2				
Anat. & Phys.						5		4	2	1				
None				1	1	17	3	4	3		1		3	1

Clearly a number of students in the 9th grade are in Conceptual Physics and Algebra I. (Students in Computational Physics will have already learned the math skills they need in Algebra I the previous year.)

Also, notice the preponderance of students in Chemistry and Quantitative Chemistry who are also taking Algebra II and Algebra IIA.

Because students begin to take Biology and/or electives in their junior year, and then electives in their senior year, there isn't a great need for aligned math and science curricula at those levels. By this point, the science courses don't require great math skills (e.g. anatomy and physiology) or the courses which do require heavy math skills (e.g. AP Physics) have math prerequisites.

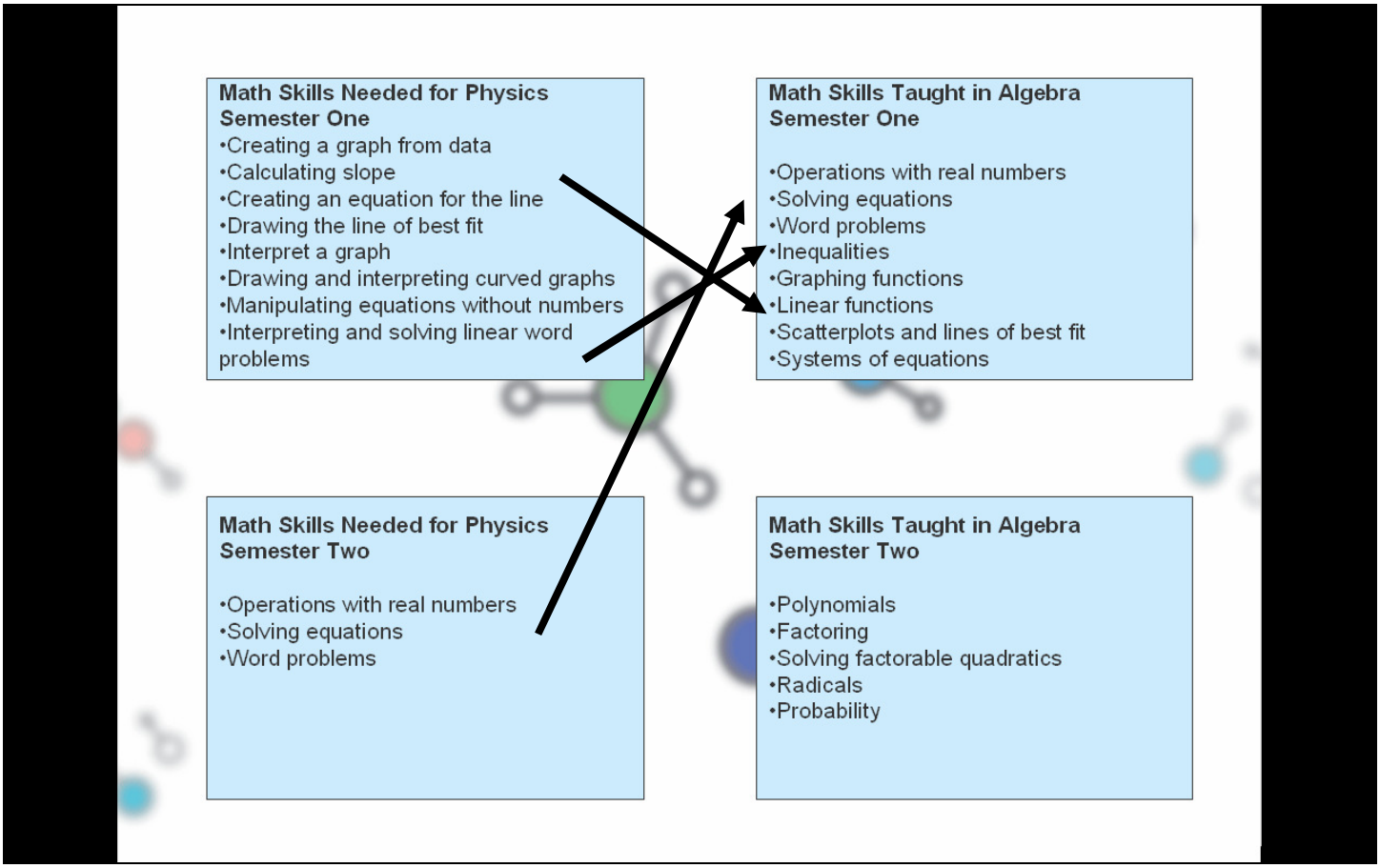
[1] Students in more than one math or science are not included. But these numbers do not affect our analysis, since we are focusing on 9th and 10th grades, when students rarely double up on math and science.

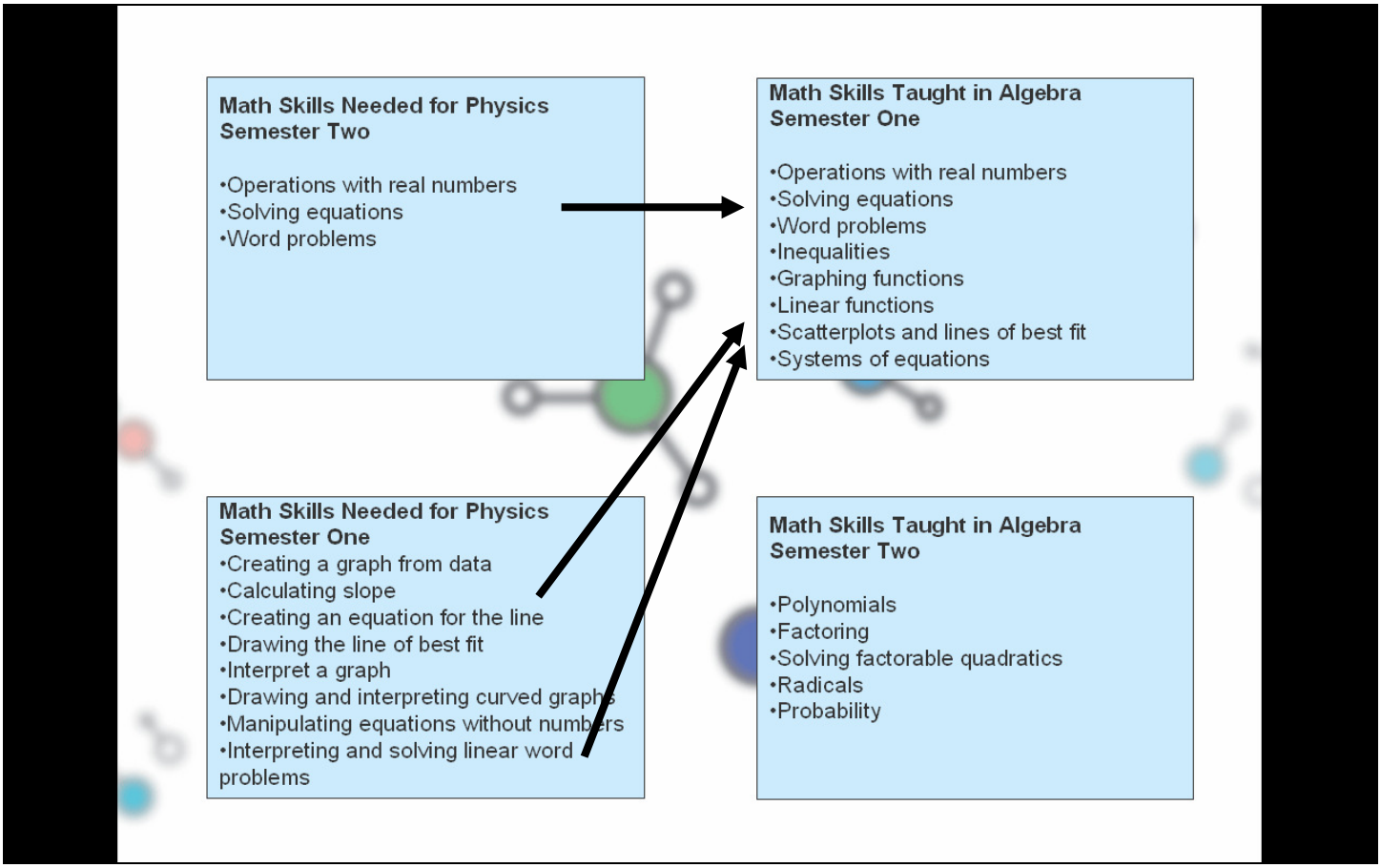
Conceptual Physics and Algebra I Recommendations

- The semesters should be flipped flopped for conceptual physics. The second semester doesn't require a lot of math. Also, Unit 5 (Newton's Laws) can be moved to be first if needed.
- Use the GUESS method in Algebra I
- Using chemistry formulas in Algebra I
- In all math classes, avoid using the word "rate" for speed. Make sure that teachers focus on saying "rate of *what*?"
- Use LoggerPro when doing linear functions unit in Algebra I
- Physics teachers should talk about using "trendline" instead of "line of best fit" when students are eyeballing a line and drawing it in themselves. When using LoggerPro to calculate the line, physics teachers should call it a "line of best fit."
- Do linear regressions on LoggerPro and graphing calculators in both Algebra I and Physics classes. Teach students how to pass data using datalinks on graphing calculators to save time.
- In Algebra I, do a review of scientific notation in the second semester (during the exponent unit). This will be useful for students in chemistry, who need to multiply and divide numbers in scientific notation.
- Fractions are used for exact numbers in math classes. In science classes, decimals are much more useful. This is a huge discrepancy – and we're both seeing students wanting to do the opposite. At the beginning of each course, we should all talk about our expectations regarding this. In math classes, we aren't doing what science classes are doing – Algebra usually deals with *exact values* not *measured values*. And vice versa. (Example: In Physics, students express their line of best fit with a decimal slope, not a fraction. In Algebra, in the first semester, students use a fraction for a slope. However in 2nd semester, Algebra students use real world data to produce a decimal slope. So if the Physics curriculum is flip flopped, this will all work out well!)
- Perhaps Algebra I and Algebra II can get data sets collected by Physics and Chemistry – data to analyze when doing linear regressions? (Physics collects quadratic data in the second semester; Algebra II can use this in the second semester when doing quadratic regressions.) If math classes use these data, we need to have the discussion regarding *exact values* versus *measured values*.
- Have physics and math teachers exchange information about how to use graphing calculators and Logger Pro.

Chemistry (any) and Algebra II (any) Recommendations

- When doing problems in Algebra II involving units, teachers should be sure to talk about why an area would be ft^2 – not just because it's an area, but *why* from the calculations we get an area. Do a dimensional analysis alongside the problem. If using problems from chemistry or physics (e.g. PV=nRT and given values for P, V, n, and R, solve for T), make sure to focus on dimensional analysis also to see how the units work out.
- In Algebra II, start with the unit on Exponents instead of Number Lines, Intervals, and Sets. Focus on exponent rules, especially giving a number of problems with scientific notation. Both Algebra II and Chemistry will be teaching these concepts at the same time. We think it is better that scientific notation is taught in both simultaneously, however it's important that we be consistent in how we're talking about it (terminology, and use of calculator – e.g. the EE button).
- In Algebra II, talk about "Factor Label Method" and exponents and unit conversions (e.g. convert *x* M/s^2 into M/min^2). Also, Middle School science should be using the "Factor Label Method."
- For Precalculus, have teacher use "balancing a chemical equation" as an example of a real-world system of equation.


Math Skills Needed for Physics Semester One
•Creating a graph from data
•Calculating slope
•Creating an equation for the line
•Drawing the line of best fit
•Interpret a graph
•Drawing and interpreting curved graphs
•Manipulating equations without numbers
•Interpreting and solving linear word problems
Math Skills Taught in Algebra Semester One
•Operations with real numbers
•Solving equations
•Word problems
•Inequalities
•Graphing functions
•Linear functions
•Scatterplots and lines of best fit
•Systems of equations
Math Skills Needed for Physics Semester Two
•Operations with real numbers
•Solving equations
•Word problems
Math Skills Taught in Algebra Semester Two
•Polynomials
•Factoring
•Solving factorable quadratics
•Radicals
•Probability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