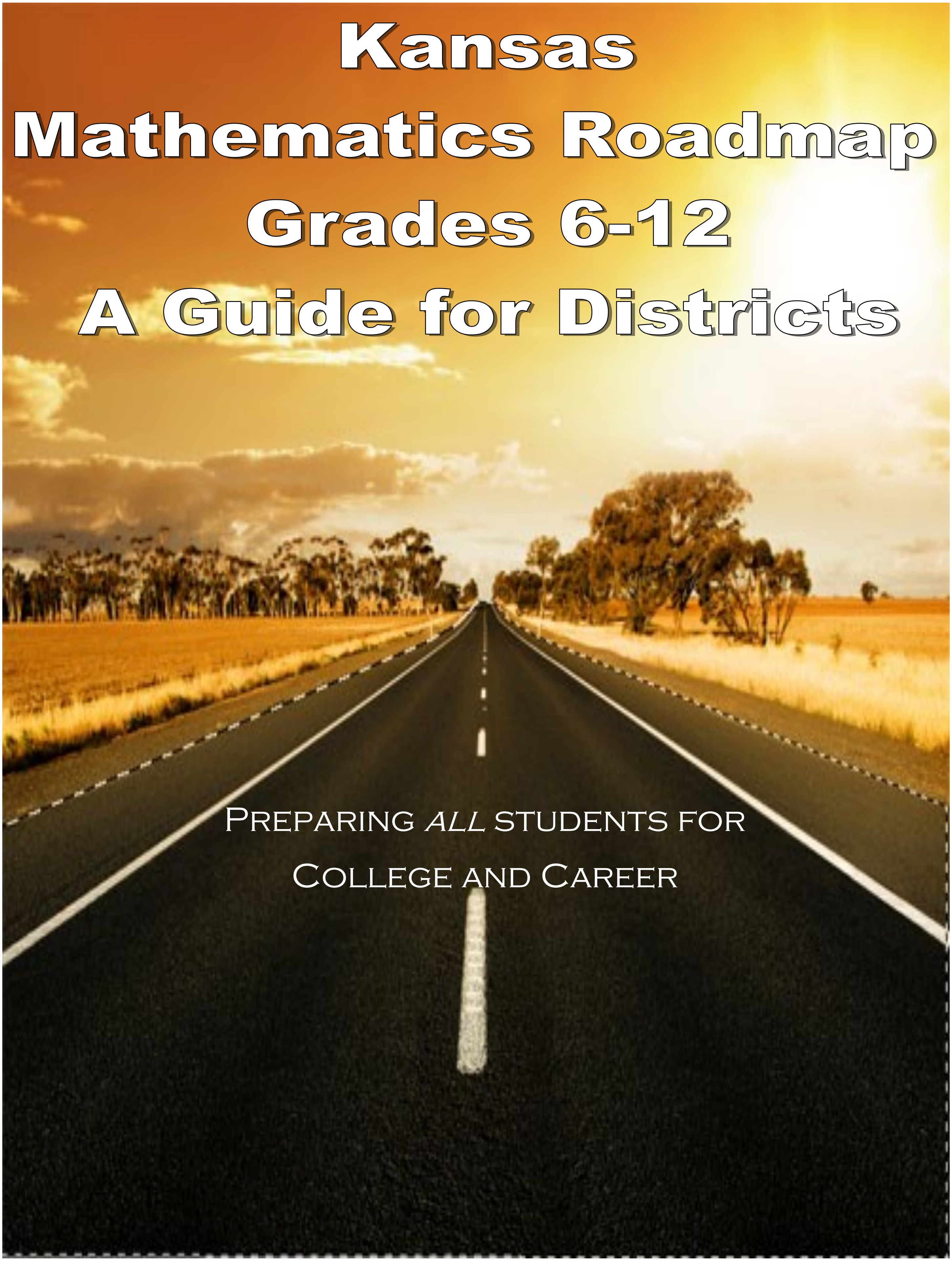


Kansas Mathematics Roadmap Grades 6-12 A Guide for Districts

Preparing *ALL* students for
College and Career

Shifting Content

Before 2010, some math topics were typically in these courses.

7th grade math	8th grade math	Algebra 1
	Integer computation Proportional thinking One/two step equations Rational signed numbers	Rational and Irrational Numbers Solving equations Linear graphs/slope Systems of equations Quadratics Functions Non-linear functions Bivariate data

With the adoption of new standards in 2010, content shifted dramatically.

7th grade math	8th grade math	Algebra 1
Integer computation Proportional thinking One/two step equations Rational signed numbers Sampling methods Probability	Rational and Irrational Numbers Solving equations Linear graphs/slope Systems of equations Functions Bivariate data	Functions Quadratics Non-linear functions Exponential functions Complete the square Prove algebraic methods Sequences Standard deviation

The above shifts are a response to research indicating that more students need access to some algebra topics earlier. Currently, many topics previously introduced in high school Algebra 1 are now considered regular 8th grade math topics. Accelerating students to Algebra 1 in 8th grade *actually* moves students to topics previously taught in Algebra 2! In light of the increased rigor at all levels, exercise caution when accelerating middle school students to Algebra 1.

Eliminating Gaps **Is anything "skippable?"**

Prior to the adoption of the KCCRS, content was perceived to be highly repetitive and redundant at the middle school level. As a result, students were accelerated using the practice of skipping one or more grade levels. In reality, this resulted in gaps in student learning creating barriers to the very thing students and parents were trying to attain- success in high-level math courses. While this practice was not truly successful with the previous standards, it is an even more questionable practice now. The chart below highlights content which is introduced at critical grade levels. Skipping any of these grade levels *will* create more significant gaps than we previously experienced. Therefore, we need a different approach to acceleration.

A sampling of content introduced, critical, or unique to a grade level:

6th grade math	7th grade math	8th grade math	Algebra 1
Ratio & rate reasoning	Analyze proportional relationships	Linear equations & functions	Linear, quadratic, & exponential functions
Fraction/decimal computation & applications	Operations on all rational numbers, including integers	Work with radicals & integer exponents	Rational exponents
Solving one step equations & inequalities	Solving multi-step equations & inequalities	Systems of linear equations	Completing the square & complex number solutions
Surface area & volume applications	Geometric constructions	Congruence & similarity through transformations	Arithmetic & geometric sequences
Univariate Data	Modeling chance & probability	Categorical & quantitative bivariate data	Summarize, represent, & interpret statistical models

District Self-Assessment

District self-assessment of current math acceleration practices:

1. Do you have acceleration practices in your district?
2. How are students being accelerated in math?
3. Why are students accelerated in math?
4. Is one of your considerations, when choosing to accelerate a student, the student's disposition and mathematical and/or career goals? How do you collect this information?
5. What other criteria are you using when making the decision to accelerate students?
6. What is your current data saying?
    a. Where are the accelerated students going in middle school/high school/college/career?
    b. Are they fulfilling the objective of being accelerated in high school/college/career?
    c. Can you backtrack your data to see if accelerated students met the goal?
    d. What was the attrition rate of students who began the accelerated route and did not meet the goals?

Next Steps

Read the white paper *Re-thinking Math Acceleration Practices* from KSDE.

This guide as been developed to start the conversation in your district. The goal is to provide you information how to help your students accelerate to Calculus *as well as* alternative roads to consider.

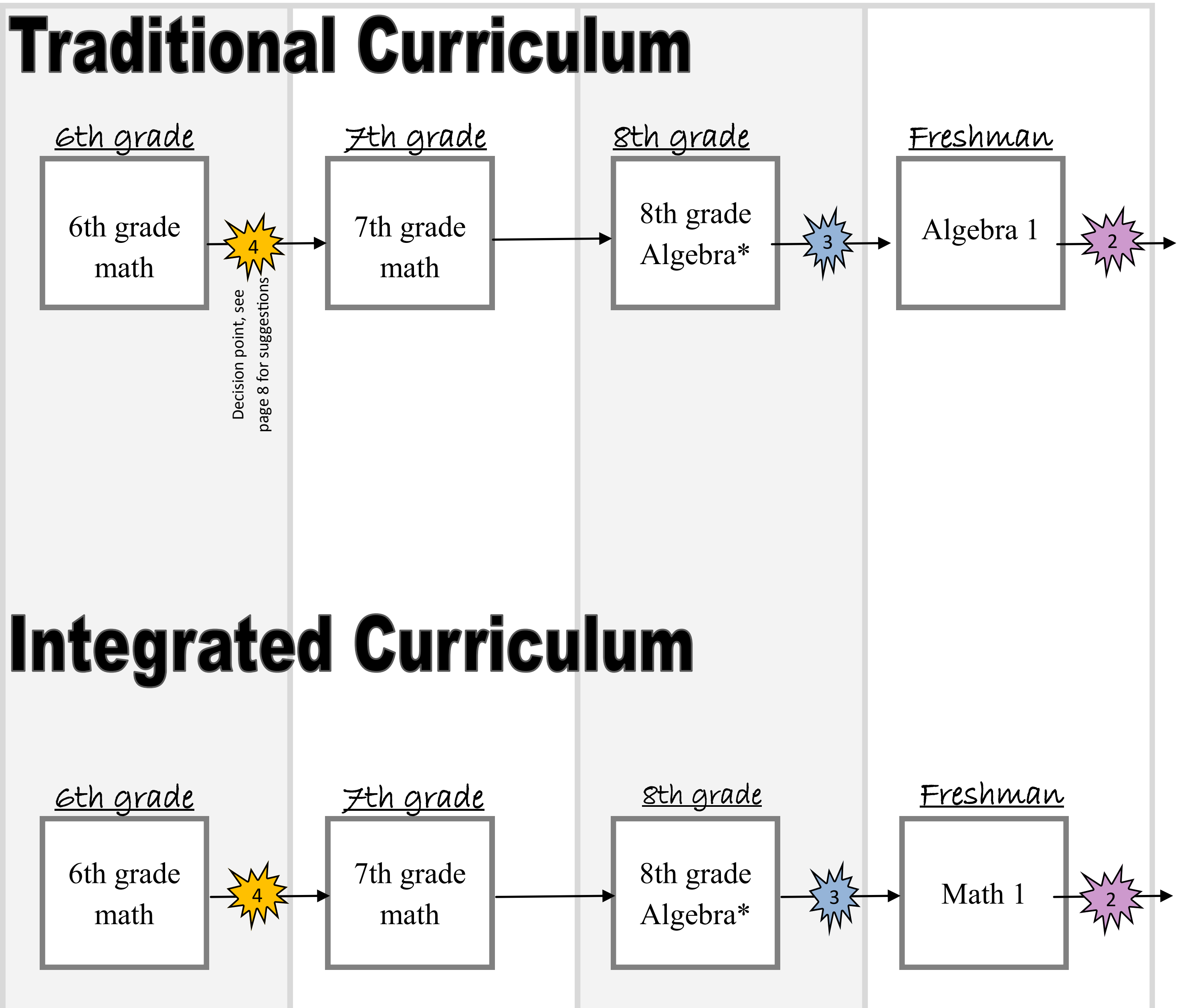
Response to District Self-Assessment:

1. Evaluate the course options (Roadmap) offered in your district. Do you have rigorous paths to prepare *all* students for college *and* career?
2. Evaluate the multiple measures, including student work habits, your district is using to identify if acceleration is appropriate for the student.
3. Do any of your policies compromise important K-8 mathematics? Could you offer options that do not compromise the depth of K-8 standards and still meet student needs?
4. What is the role of your SpEd/Gifted program and other programs that advocate for acceleration policies?
5. Based on areas of concern identified in this self-assessment, how will you roll-out changes to your current practices?

The road to advanced math has changed. Have your practices?

Mathematics

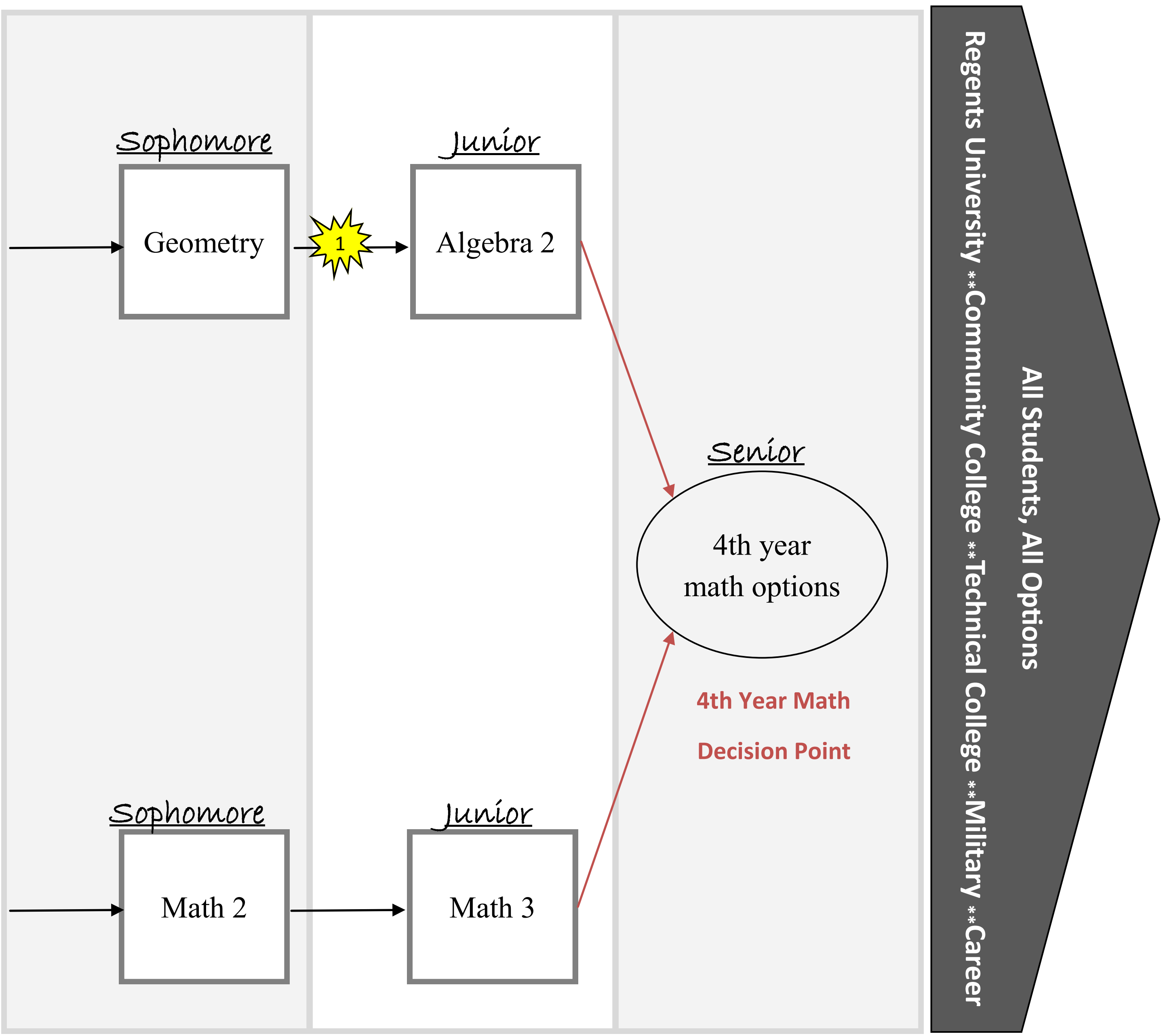
These maps to rigorous courses will prepare students for college level courses, including AP courses and College Algebra.



***8th grade algebra:** This course supports the 8th grade KCCRS math standards, which include many algebraic topics. It is *not* a replacement for Algebra 1.

Roadmap 6-12

Throughout the roadmap, you will see "Decision Points." Throughout the roadmap "Decision Points" have been inserted to indicate points were a district might choose to make acceleration an option. These options will allow for Calculus in high school. *See page 9*



Schools should continue to attend to students who are above or below grade level through additional support not included here.

The Value of 4th Year Mathematics:

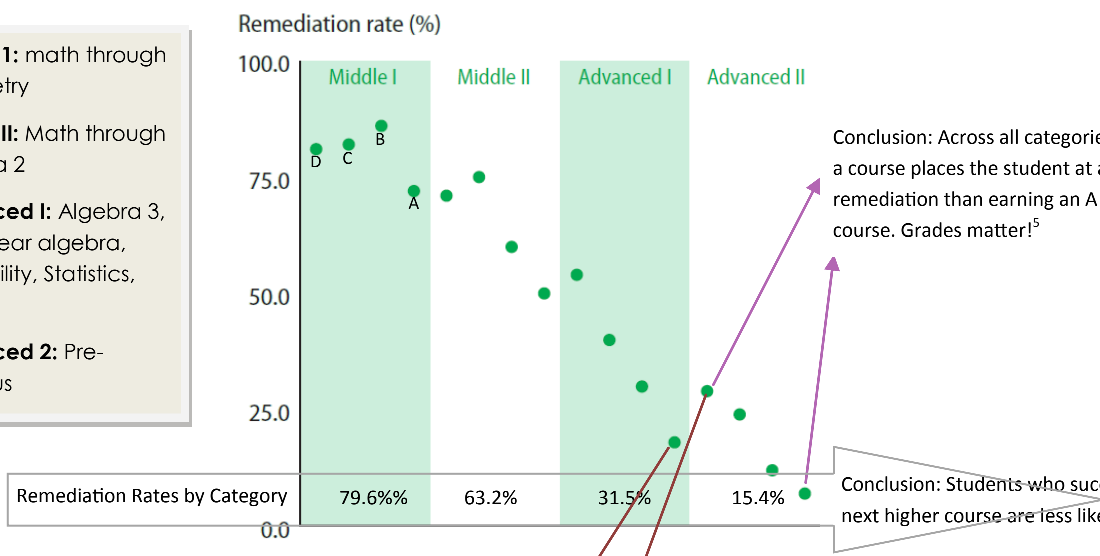
Senior slump. How can we prevent it? What are the consequences? By foregoing math senior year, many students are unprepared for college placement exams and as a result perform poorly on them. Consequently, they are required to take remedial mathematics course to regain what is lost. "Among those who fail college math placement exams are students who took math courses during their junior year but took no math their senior year. By the time they arrive on campus, they have forgotten their algebra, geometry, and trigonometry. Instead of moving on to college-level work, they must revisit topics they studied in high school" (p. 2). Schools should reconceptualize the senior year to improve preparation for placement exams and college level course work. They should redesign the senior year courses to support general education requirements in the first year of college. Finally, they should educate students on the connection between a fourth year mathematics course and placement in a credit bearing course in college.[4]

Middle 1: math through Geometry

Middle II: Math through Algebra 2

Advanced I: Algebra 3, Trig, Linear algebra, Probability, Statistics, etc.

Advanced 2: Pre-Calculus



Conclusion: Across all categories, earning a D in a course places the student at a higher risk for remediation than earning an A in the same course. Grades matter![5]

Conclusion: Students who successfully progress to the next higher course are less likely to need remediation.[5]

Conclusion: Earning an A in a lower category of courses, has a lower remediation rate than earning a D in the higher category of courses. Putting students in a course for which they are not prepared may lead to higher remediation rates.[5]

KS ACT[3] Data 2012	Percent of ACT Test takers in KS	Average ACT
Algebra 1, Geometry, Algebra 2, Pre-Calc/Trig, Calculus	5%	24.7
Algebra 1, Geometry, plus three additional years* but no Calculus	10%	22.8
Algebra 1, Geometry, plus 2 additional	60%	22.9
Algebra 1, Geometry, plus 1 additional	20%	18.5
less than 3 years of math	5%	16.7

Conclusion: Accelerating but not staying on the Calculus path does not improve ACT scores over simply taking on-grade-level math.

Conclusion: Taking a 4th year math course improves ACT scores

*it is only possible to earn three additional years through an accelerated path

The remediation rate for students who took *no* math their 4th year was 42%.

Rigorous Options for All Students

Algebraically Intensive Courses

The traditional Pre-Calculus pathway is intended for individuals planning to study in degrees in physical science, mathematics, biological science, computer science, engineering, business, or agriculture. These majors typically require students to have conceptual understanding and high levels of computational facility with algebraic and trigonometric expressions and functions. [2]

Taken after successful completion of an Algebra II-based course, College Algebra is intended for the large population of students pursuing degrees in the liberal arts and social sciences.

Pre-Calculus	Trigonometry	College Algebra
This course is a pre-requisite for Calculus. Students will extend Algebra 2 topics to analyze more complicated functions and equations. Some schools might offer this course for College Algebra credit.	This course is a pre-requisite for Calculus. Students will be introduced to common trig functions. Students will analyze and solve problems using trigonometry.	This course builds fluency with Algebra 2 content. Students will review and practice functions and equations.

Transition to College Algebra

Students who need additional work on Algebra II-based reasoning skills and quantitative literacy, a transition course may be the best option. [2] Seniors who have not earned a 22 on the ACT AND plan on attending a college or university should consider this course. This course will be piloted by KBOR in 2016-2017.

Contact Jean Redeker jredeker@ksbor.org If your district is interested in participating.

Non-Algebraically Intensive Courses

The research is clear on the benefit of students engaging in mathematics throughout all four years of high school – but that does not mean all students need to, or should, take pre-calculus or calculus while in high school. Rather, states, districts and schools need to ensure that they are offering courses that include rich and meaningful mathematics —whether in traditional mathematics courses, capstone experiences or applied/ technical courses with rigorous (and identified) embedded mathematics - particularly for students who complete the Kansas College and Career Ready Standards in 10th or 11th grade. By offering students courses that are aligned with their interests and post-high school plans, students will be able to truly see the connection between what they are learning, why they are learning it, and what it will mean for their future. [2]

Probability and Statistics	AP Statistics	QA courses
This course will help students learn to analyze data and make predictions. It will prepare students for college statistics, which is a requirement for most college majors. Statistical analysis is critical for almost all careers.	This rigorous course teaches students how to think carefully about data and make informed decisions. As an AP course, students who score high enough on the AP exam might earn college credit from their college or university.	A variety of courses have been approved by KBOR as qualifying for entrance into a Regents University. School base these decisions on a variety of factors; such as staffing and student interest. Contact your district for additional course options.
All college bound students would benefit from one of these courses.		

Fact Check! Don't assume the degree you want or the college you plan to attend will require College Algebra for your math credit. Review *updated* information at the institutions seniors might attend. Probability and Statistics *might* be the best preparation.

Acceleration to Calculus in High School

Note: It was an intentional decision to not list acceleration options prior to 7th grade. It is NOT recommended to accelerate in K-8 and should be non-existent K-6. It is critical for students to develop deep understanding and fluency.

Middle grades contain too many critical topics to include in a cohesive acceleration plan. Options for acceleration in 7-8 should be considered with extreme caution.

ENRICHMENT BEFORE ACCELERATION! Schools should consider **enriching** math practices *before* considering acceleration. Many students would benefit from deeper, more authentic math experiences. Only a *few NEED* Calculus and even fewer need to reach Calculus in high school. Acceleration practices should be based on the individual student needs and future goals and not be used to evaluate the rigor within your school district's math program.

Summer School: Schools might consider offering a course during the summer, as an acceleration option..

This section provides direction to school districts to consider when planning for ***the small percentage*** of students taking Calculus in high school. Please read the white paper Re-thinking Math Acceleration Practices additional information.

Key Points to Consider:

- Not every student needs Calculus.
- AP Statistics is a valuable alternative AP math course *which does not require acceleration.*
- College professors of mathematics prefer students enter college with a strong foundation in algebraic reasoning and trigonometry, rather than rushing to Calculus and creating weaker foundational skills.
- It is recommended that the majority of students take Calculus in college.
- Most students who take Calculus in high school retake Calculus in college.

However, recognizing that acceleration is appropriate for SOME students, this section provides guidance for reaching Calculus without creating gaps in student learning.

Compaction: When compacting courses, students cover **more content in less time.** This strategy allows students to participate in more elective courses but may not allow for students to reach proficiency and fluency with math concepts. Schools might compact:

- 2 school courses into 1 school course
- 3 school courses into 2 school courses
- 4 school courses into 3 school courses

Longer compaction schedules reduce the cognitive load for students but locks students into tracks for longer periods of time.

Simultaneous enrollment Simultaneous enrollment requires students to enroll in two math courses during the same school year. Fewer courses can be learned concurrently, so there are not many alternative organizations for this strategy. However, schools do not need separate sections for these courses so it creates less impact to the school schedule. Students will lose the opportunity for an elective credit.

Acceleration Options to Consider

This list does not include all possible options for acceleration. This list has been created to provide you some ideas to consider. Districts might need to adopt multiple acceleration practices to maximize flexibility and meet more student needs. (see pages 4-5)

Compacted:

⇒ **2:1—compact two courses into one course**

1 6 – 7 – 8 – Alg 1 – Geo – Alg 2/Trig – AB Calc

2 6 – 7 – 8 – Math 1 – Math 2/3– Pre Calc/Trig – AB Calc

3 6 – 7 – 8 – Alg 1/Geo – Alg 2 – Pre Calc/Trig – AB Calc

⇒ **3:2– compact three courses into two courses**

4 6 – 7/8 – 8/Alg 1 – Geo – Alg 2 – Pre Calc/Trig – AB Calc

3 6—7—8—Math 1/2—Math 2/3—Pre Calc/Trig– AB Calc

Pros
Maintains learning progressions Can take Calculus in HS
Cons
Extra content with no extra class time Requires unique course in master schedule Less fluid movement for students

⇒ **4:3– complete four courses into three courses:**

Content from the (+) standards are embedded within all HS courses which will prepare students to enroll directly into Calculus during senior year.

3 6 – 7 – 8 – Alg 1(+) - Geo(+) - Alg 2(+) - AB Calc

3 6—7—8—Math 1(+)—Math 2(+) - Math 3(+)– AB Calc

Simultaneous Enrollment

⇒ **Simultaneous enrollment:** Simultaneous enrollment in two courses during the same school year.

2 6 – 7 – 8 – Alg1 - Geo & Alg 2 – Pre Calc – AB Calc

1 6 –7– 8– Alg 1—Alg 2—Geo & Pre Calc—AB Calc

Pros
Can take Calculus in HS More time to cover extended content More flexibility in master schedule
Cons
Students lose an elective Taking 2 math classes simultaneously may be difficult for some students

Calculus BC

It is possible to reach BC in high school but schools should be cautious when using these options. Multiple compactions are required, increasing the possible issues students might experience.

3 6 – 7 – 8 – Alg 1/Geo – Alg 2 –summer Trig – AB Calc – BC Calc

4 6– 7/8—8/Alg 1– Alg 2– Geo & Pre Calc (simultaneous enrollment)- AB Calc– BC Calc

3 6—7—8—Math 1(+)—Math 2(+) & Math 3(+) (compacting courses into one semester each)– AB Calc– BC Calc

1. Achieve, Inc. (2013, March). *The Value of the Fourth Year of Mathematics*. Retrieved from http://www.achieve.org/files/MathWorks-FourthYearMath.pdf

2. The Charles A. Dana Center. (2014, October). *Mathematics At The Transition: Opportunities to align high school and college mathematics in Texas*. Retrieved from http://www.utdanacenter.org/wp-content/uploads/mathematics_at_the_transition_oct_2014.pdf

3. ACT, Inc. (2012). *ACT Profile Report-State: 2012 Graduating Class, Kansas* [data file]. Available from http://www.act.org/newsroom/data/2012/profilereports.html

4. Kirst, M. W. (2001, May). Overcoming the High School Senior Slump: New Education Policies. *Perspectives in Public Policy: Connecting Higher Education and the Public Schools*. Institute for Educational Leadership, Washington, DC: National Center for Public Policy and Higher Education, CA. Retrieved from http://eric.ed.gov/

5. Fong, A.B., Huang, M., and Goel, A.M. (2008). Examining the links between grade 12 mathematics coursework and mathematics remediation in Nevada public colleges and universities (Issues & Answers Report, REL 2008–No. 058). Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance, Regional Educational Laboratory West. Retrieved from http://ies.ed.gov/ncee/edlabs.

This guide for districts was created as part of a project for KSDE. The Acceleration Task Force produced:

- Parent communication website:
- Re-Thinking Acceleration white paper
- Kansas Mathematics Roadmap 6-12: A guide for districts
- Video for parent communication
- Presentations at the KSDE Conference and the Kansas Association of Teachers of Mathematics Conference

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