

Appendix A: Course Placement and Sequences

Increased Rigor of Grade 8 and Algebra I/Mathematics I standards

Success in Algebra I/Mathematics I is crucial to students' overall academic success, their continued interest and engagement in mathematics, and the likelihood of their meeting California's A-G requirements. The CA CCSSM represent a tight progression of skills and knowledge that is inherently rigorous and designed to provide a strong foundation for success in the new, more advanced, Algebra I and Mathematics I courses that will typically be taken by most students in the ninth grade.

Development of these skills and knowledge depends on students being placed in the appropriate courses, with emphasis on the appropriate foundational concepts at the appropriate time, throughout their K–8 sequence and beyond. With the help of diagnostic information that is based upon rich common assessments, placement decisions should be reviewed by a team of stakeholders that includes teachers and instructional leadership (Massachusetts Department of Elementary and Secondary Education [Massachusetts] 2012).

Misplacement is common, with negative consequences for students when they are unable to keep pace with the incremental difficulty of mathematics content; students' weaknesses in key foundational areas that support algebra-readiness frequently translate into substantial difficulty reaching proficiency in higher-level mathematics while in high school (Finkelstein, et al., 2012). At the same time, students need to be appropriately challenged and engaged in order to maintain their interest and skill

25 development in mathematics throughout high school and beyond; some students will
26 take college-level courses (Advanced Placement Calculus, Statistics, or International
27 Baccalaureate) as high school seniors, and the course sequences from earlier grades
28 need to support them too. Therefore, one particular placement consideration, discussed
29 later in this chapter, examines when and under what conditions to accelerate students
30 in their mathematics sequence to reach these advanced courses while in high school.

31

32 **Challenges around Course Sequencing Involving the Transition to CA CCSSM**

33 The implementation of the CA CCSSM comes with many transitions over the next
34 several years – new instructional approaches, new instructional materials, professional
35 support for teachers, and technology readiness, among others. As well, the transition
36 from existing course sequences to new course sequences will inevitably provide
37 challenges at both the school district and school site level. While the fundamental
38 design of new courses presents its own immediate challenges, so too does the linking
39 between courses to ensure vertical articulation between grades, and even between
40 school systems where, for example, K–8 school districts feed into high school only
41 districts. In the particular case of mathematics, there is a “vocabulary” around the
42 names of mathematics courses that is likely to cause confusion not only for educators,
43 but also for parents. “Algebra 1” is a course that, prior to CA CCSSM, has been taught
44 in 8th grade to an increasing number of students. That same course name will be the
45 default for ninth grade for most students who moving forward will complete the CA
46 CCSSM for grade eight – a course that is more rigorous and more demanding than the
47 earlier versions of “Algebra 1.” Even so, we expect the changes to cause confusion. The
48 single most practical solution is to describe detailed course contents, in addition to
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49 course names, as a way of clearing up confusion until “Algebra I” as commonly used,
50 refers to a ninth grade and not an eighth grade course.

51

52 **A Brief Review of Research on Course Placement and Mathematics**

53 Prior research has shown the importance of mathematics course-taking patterns on
54 student achievement. The studies briefly described below provide some additional
55 context for the tradeoffs that are inherent in deciding how best to organize CA CCSSM
56 course sequences, and place students accordingly. Note that references to “Algebra I”
57 refer to courses that were in place under the 1997 CA standards, prior to the adoption of
58 the CA CCSSM. It is also important to note that the CA CCSSM have rigorous grade
59 eight standards—but the California standards adopted in 1997 did not have grade-level
60 specific standards for grade eight. Over the last decade, there has been a dramatic
61 increase in the number and proportion of grade eight students enrolled in Algebra I in
62 California.¹ Williams et al. (2011) report that, between 2003 and 2009, the percentage of
63 grade eight students taking Algebra I increased from 32 percent to 54 percent. While
64 the increase in grade eight enrollment in Algebra I resulted in greater percentages of
65 grade eight students achieving either *Proficient* or *Advanced* on the Algebra I California
66 Standards Test, it also led to larger numbers of grade eight students achieving *Far*
67 *Below Basic* or *Below Basic* on the test (Williams et al. 2011). Williams et al. (2011)
68 conclude that the practice of placing all eighth graders into Algebra I, regardless of their
69 preparation, sets up many students to fail. Kurlaender, Reardon, and Jackson (2008)
70 looked at students in San Francisco, Fresno, and Long Beach and found that student’s

¹ This increase was not confined to California. Similar increases in grade 8 Algebra I enrollment have occurred across the country (Walston and McCarroll 2010; Stein et al. 2011). The *Mathematics Framework* was adopted by the California State Board of Education on November 6, 2013. The *Mathematics Framework* has not been edited for publication.

71 grade point average in seventh grade and course failures in eighth grade were
72 predictive of students' high school completion. These authors also found that the timing
73 of when students take algebra is a strong predictor of students' high school success. In
74 two of the three districts that they analyzed, there was a 30 percentage point difference
75 in graduation rates between students who had completed algebra by the eighth grade
76 and those that had not.

77
78 As we would expect, and have known for some time, middle school coursework relates
79 closely to high school coursework. Findings from twenty years ago show that course-
80 taking patterns in middle school are highly predictive of course-taking patterns in high
81 school. Oakes, Gamoran, and Page (1992) stated that the courses students take in
82 junior high school are "scholastically consequential, as the choice predicts later
83 placement in high track classes in senior high school" (p. 574). More recently, Wang &
84 Goldschmidt (2003) concluded that middle school mathematics achievement is related
85 significantly to high school mathematics achievement, and that "mathematics
86 preparedness is vitally important when one enters high school – where courses begin to
87 'count' and significantly affect postsecondary opportunities" (p. 15). In a study
88 examining the National Education Longitudinal Study, Stevenson, Schiller, and
89 Schneider (1994) found that the level of mathematics that students take in eighth grade
90 is closely related to what they take in high school. They conclude "students who are in
91 an accelerated mathematics sequence beginning in eighth grade are likely to maintain
92 that position in high school" (p. 196).

93
94 However, many students who finish middle school are not actually prepared to succeed

95 in a rigorous sequence of college-preparatory mathematics courses in high school
96 (Balfanz, McPartland, & Shaw, 2002). Therefore, it is not surprising that previous
97 research has found that among the high school grades, ninth grade is a key year for
98 students in terms of future academic success. Choi and Shin (2004) examine student
99 transcripts from a large, urban school district in California. The authors found that most
100 students fall off-track for college eligibility in the ninth grade. Similarly, Finkelstein and
101 Fong (2008) found that more than 40 percent of the students did not meet the California
102 State University requirement of completing two semesters of college-preparatory
103 mathematics in the ninth grade. They conclude that students who fall off the college-
104 preparatory track early in high school tend to move further from completing a college-
105 preparatory program as they progress through high school. Neild, Stoner-Eby, and
106 Furstenberg (2008) further conclude that the experience of the ninth-grade year
107 contributes substantially to the probability of dropping out of high school, even after
108 controlling for eighth grade academic performance and pre-high school attitudes and
109 ambitions.

110

111 ***The CA CCSSM Grade 8 standards are of significantly higher rigor than the***
112 ***Algebra 1 course that many students have taken while in 8th grade.*** The CA
113 CCSSM for grade eight address the foundations of algebra by including content that
114 was previously part of the Algebra I course, such as more in-depth study of linear
115 relationships and equations, a more formal treatment of functions, and the exploration of
116 irrational numbers. For example, by the end of the CA CCSSM for grade eight, students
117 will have applied graphical and algebraic methods to analyze and solve systems of

118 linear equations in two variables. The CA CCSSM for grade eight also include geometry
119 standards that relate graphing to algebra in a way that was not explored previously. In
120 addition, the statistics presented in the CA CCSSM for grade eight are more
121 sophisticated than those previously included in middle school and connect linear
122 relations with the representation of bivariate data.

123
124 ***The New Algebra I and Mathematics I courses build on the CA CCSSM for Grade 8***
125 ***and are correspondingly more advanced than the previous courses.*** Because
126 many of the topics previously included in the former Algebra I course are in the CA
127 CCSSM for grade eight, the new Algebra I and Mathematics I courses typically start in
128 ninth grade with more advanced topics and include more in-depth work with linear
129 functions, exponential functions and relationships, and go beyond the previous high
130 school standards in statistics. Mathematics I builds directly on the continuation of the
131 CA CCSSM in grade eight and provides a seamless transition of content through an
132 integrated curriculum.

133
134 Because of the rigor that has been added to the CA CCSSM for grade eight, some
135 recalibration of course sequencing will be needed to insure students are able to master
136 the additional content. Specifically, today's students, who are similar to those who may
137 have previously been able to master an Algebra 1 course in grade eight, may find the
138 new CA CCSSM for grade eight content significantly more difficult. This provides an
139 opportunity to strengthen conceptual understanding by encouraging students – even
140 strong mathematics students - to meet the CA CCSSM grade eight standards while
141 enrolled in grade eight.

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143 Recalibrating the course placement process will require school district personnel,
144 including teachers, counselors and instructional specialists to rethink the information
145 they need for assigning students to courses, particularly in middle school mathematics,
146 where many variations may currently exist in the sequence from grade six to grade
147 eight. During the next several years, as implementation of the CA CCSSM strengthens,
148 so too will steps need to be taken at the school district and school site level to insure
149 that the sequence of courses is guiding students to CA CCSSM mastery by the end of
150 grade 8.

151

152 **Considerations around Mathematics Course Design and Placement under CA**

153 **CCSSM**

154 Designing CA CCSSM-aligned mathematics courses in middle school requires careful
155 planning to ensure that all content and practice standards are fully addressed. Some
156 students, in some courses, may move through the standards more quickly than others.
157 As noted, however, getting the pacing right will require implementing new courses and
158 examining how students progress. As noted, entering students into a course pathway
159 who are not adequately prepared can have negative consequences. A recent
160 longitudinal analysis based on California statewide assessment data revealed that
161 California's students that fail the state exam for algebra in grade 8 have a greater
162 chance of repeating the course and failing the exam again in ninth grade compared to
163 their peers who pass the state exam for general mathematics in grade eight (Liang,
164 Heckman, and Abedi 2012). Similarly, Finkelstein et al. (2012) reports that as many of
165 one-third of students in a representative sample of California repeated Algebra between
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166 grades seven and 12 (most often from grade eight to grade nine), with most not
167 improving their demonstrated mastery following the repeated course. In essence, under
168 standards prior to the adoption of the more rigorous CA CCSSM, California’s eighth
169 graders who were underprepared for algebra were still underprepared in ninth grade.

170
171 In light of these findings, school systems across the nation and in California, are
172 revisiting the criteria they use to determine mathematics placement and in the different
173 weights they assign to each criterion. Most districts typically rely on teacher
174 recommendations and course grades to determine course placement (Bitter and O’Day
175 2010, p. 6), with standardized mathematics test scores, student/parent preferences, and
176 counselor recommendations also factoring into the decision (Hallinan 2003). As Hallinan
177 (1994) notes, “[s]chools vary in the constellation of factors on which they rely to assign
178 students to tracks and in the weight they attach to each factor” (p. 80). Similarly, Oakes,
179 Muir, and Joseph (2000) note: “Increasingly, school systems do not use fixed criteria to
180 assign students to particular course levels” (p.16). Rather, teacher and counselor
181 placement recommendations include subjective judgments about “students’
182 personalities, behavior and motivation” in addition to test score performance (p. 16).

183
184 Research has also shown discrepancies in the placement of students into “advanced”
185 classes by race/ethnicity and socioeconomic background. While decisions to accelerate
186 are almost always a joint decision between the school and the family, serious efforts
187 must be made to consider solid evidence of student learning in order to avoid
188 unwittingly disadvantaging the opportunities of particular groups of students. Among the
189 considerations is the need to assess near-term mathematics readiness with the

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190 students' longer-term prospects for mastering advanced mathematics content. The
191 objective districts should follow is when, and under what circumstances, will reinforcing
192 learning through the grade eight CA CCSSM transfer to greater mathematics
193 understanding throughout high school?

194
195 In developing district level policy around course sequences and student placement,
196 districts may also turn to guidance from other education agencies. For example, the
197 Achieve Pathways Group has developed a set of clear guidelines on how placement
198 decisions and course sequences should be evaluated based on work published by the
199 Washington Office of the Superintendent of Public Schooling:

200 *1. Decisions to accelerate students into the Common Core State Standards for*
201 *higher mathematics before ninth grade should not be rushed.*

202 Placing students into an accelerated pathway too early should be avoided at all
203 costs. It is not recommended to compact the standards before grade seven to
204 ensure that students are developmentally ready for accelerated content. In this
205 document, compaction begins in seventh grade for both the traditional and
206 integrated sequences.

207 *2. Decisions to accelerate students into higher mathematics before ninth grade*
208 *must require solid evidence of mastery of prerequisite CA CCSSM.*

209 “Mathematics is by nature hierarchical. Every step is a preparation for the next
210 one. Learning it properly requires thorough grounding at each step and skimming
211 over any topics will only weaken one’s ability to tackle more complex material
212 down the road” (Wu 2012). Serious efforts must be made to consider solid
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213 evidence of a student’s conceptual understanding, knowledge of procedural
214 skills, fluency, and ability to apply mathematics before moving a student into an
215 accelerated pathway.

216 *3. Compacted courses should include the same Common Core State Standards*
217 *as the non-compacted courses.*

218 “Learning the mathematics prescribed by CA CCSSM requires that all
219 students, including those most accomplished in mathematics, rise to the
220 challenge by spending the time to learn each topic with diligence and
221 dedication. Skimming over existing materials in order to rush ahead to more
222 advanced topics will no longer be considered good practice” (Wu 2012). When
223 considering accelerated pathways, it is recommended to compact three years
224 of material into two years, rather than compacting two years into one. The
225 rationale is that mathematical concepts are likely to be omitted when trying to
226 squeeze two years of material into one. This is to be avoided, as the standards
227 have been carefully developed to define clear learning progressions through
228 the major mathematical domains. Moreover, the compacted courses should not
229 sacrifice attention to the Standards for Mathematical Practice.

230 *4. A menu of challenging options should be available for students after their third*
231 *year of mathematics—and all students should be strongly encouraged to take*
232 *mathematics in all years of high school.*

233 Traditionally, students taking high school mathematics in the eighth grade are
234 expected to take Pre-calculus in their junior years and then Calculus in their
235 senior years. This is a good and worthy goal, but it should not be the only option

236 for students. Advanced courses could also include Statistics, Discrete
237 Mathematics, or Mathematical Decision Making via mathematical modeling. An
238 array of challenging options will keep mathematics relevant for students and give
239 them a new set of tools for their futures in college and career (CCSSI 2010).

240

241 **Students Who May Be Ready for Acceleration**

242 Understanding that the CA CCSSM are more rigorous than California's previous
243 standards for mathematics, there will still be some students who are able to move
244 through the mathematics quickly. These students may choose to take an accelerated or
245 enhanced mathematics program beginning in eighth grade (or even earlier) so they can
246 take college-level mathematics in high school. However, the previous course sequences
247 for acceleration will need to be updated, considering the increased rigor of the CA
248 CCSSM. Students who are capable of moving more quickly deserve thoughtful
249 attention, both to ensure that they are challenged and that they are mastering the full
250 range of mathematical content and skills—without omitting critical concepts and topics.
251 Care must be taken to ensure that students master and fully understand all important
252 topics in the mathematics curriculum, and that the continuity of the mathematics
253 learning progression is not disrupted. There should be a variety of ways and
254 opportunities for students to advance to mathematics courses beyond those included in
255 this publication (CCSSI 2010).

256

257 We also note that maintaining motivation and engagement in advanced mathematics is
258 essential for some students who enjoy their work in mathematics and excel in
259 mathematics, and in school, as a result. Slowing down instruction or restricting access

260 to accelerated sequences may discourage and disengage some students from their
261 progress in math, and potentially other courses as well. Therefore, some students may
262 look forward to Advanced Placement (AP) Calculus or Multivariate Calculus as real
263 options for their high school senior year. For high schools that do not offer these
264 courses on a regular basis, concurrent enrollment in local colleges and universities may
265 provide some students an alternative to high school courses.

266
267 Districts are encouraged to work with their mathematics leadership, teachers, parents,
268 and curriculum coordinators to design pathways that best meet the needs of their
269 students. Enrichment opportunities should allow students to increase their depth of
270 understanding by developing expertise in the modeling process and applying
271 mathematics to novel and complex contexts. (Massachusetts 2012).

272 In the CA CCSSM, students begin preparing for algebra in kindergarten, as they start
273 learning about the properties of operations. Furthermore, much of the content central to
274 Algebra I courses of the past—namely linear equations, inequalities, and functions—is
275 now found in the grade eight CA CCSSM. Mastery of the algebra content, including
276 attention to the Standards for Mathematical Practice, is fundamental for success in
277 further mathematics and on college entrance examinations. Skipping over material to
278 get students to a particular point in the curriculum will create gaps in the students'
279 mathematical background. In order to accelerate, students must prove that they are
280 proficient in the CA CCSSM for grades K–8 (CCSSI 2010).

281
282 It is essential that multiple measures are used to determine a student's readiness for

283 acceleration. Districts should create a system for gathering evidence to determine if a
284 student is prepared for an accelerated pathway. Placement assessments that include
285 constructed responses should be used to determine students' conceptual
286 understanding. The assessments should incorporate performance items that address
287 multiple domains. In addition, the assessments should measure a student's ability to
288 demonstrate the skills included in the Standards for Mathematical Practice. Many
289 schools and districts in California use commercially produced assessments; however
290 others use valid and reliable district-created exams. A portfolio of student work may be
291 collected as evidence of readiness in addition to student grade reports and assessment
292 data from their previous mathematics courses.

293

294 One example of a widely available cognitive diagnostic assessment is the Mathematics
295 Diagnostic Testing Program (MDTP), created through the cooperation of faculty in both
296 the California State University (CSU) and University of California (UC) higher education
297 systems. The testing program was developed to provide students and teachers with
298 diagnostic information about student readiness for a broad range of mathematics
299 courses. This information can help students identify specific areas where additional
300 study or review is needed, and can help teachers identify topics and skills that need
301 more attention in courses. The MDTP tests can be administered online, and the results
302 are immediately available after test completion. Therefore, some districts are exploring
303 using the MDTP test results to assist with placement decisions.

304

305 *Examples of Accelerated Middle School Pathways*

306 Acknowledging the cautions noted above, a middle school acceleration pathway could
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307 compact grade seven, grade eight, and Algebra I or Mathematics I in middle school.

308 The term “compacted” means to compress content, which requires a faster pace to
309 complete, as opposed to skipping content. To prepare students for higher mathematics
310 in eighth grade, districts are encouraged to have a well-crafted sequence of compacted
311 courses. The Achieve Pathways Group has provided “compacted” pathways in which
312 the standards from grade seven, grade eight, and the Algebra I or Mathematics I course
313 could be compressed into an accelerated pathway for students in grades seven and
314 eight, allowing students to enter the Geometry (or Mathematics II) course in grade nine.
315 Details of the “compacted” pathway example can be found in the document *Common*
316 *Core State Standards for Mathematics Appendix A: Designing High School*
317 *Mathematics Courses Based on the Common Core State Standards*,
318 at <http://www.corestandards.org/the-standards>. (Massachusetts 2012).

319

320 *Examples of Accelerated High School Pathways*

321 Due to the critical nature of middle school mathematics, districts may choose to offer
322 high school acceleration options instead of, or in addition to, an accelerated pathway
323 that begins in middle school. Some students may not have the necessary preparation to
324 enter a “Compacted Pathway” but may still develop an interest in taking advanced
325 mathematics, such as AP Calculus or AP Statistics in their senior year. Districts are
326 encouraged to work with their mathematics leadership, teachers, and curriculum
327 coordinators to design pathways that best meet the abilities and needs of their students.
328 For students who study the eighth grade standards in grade eight, there are pathways
329 that will lead them to advanced mathematics courses in high school, such as Calculus.

330 In high school, compressed and accelerated pathways may follow a range of models.
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331 Note that the accelerated high school pathways delay decisions about which students to
332 accelerate while still allowing access to advanced mathematics in grade 12

333 (Massachusetts 2012). (See the course sequence diagrams which follow this narrative.)

- 334 1. Students could “double up” by enrolling in the Geometry course during the
335 same year as Algebra I or Algebra II;
- 336 2. Allow students in schools with block scheduling to take a mathematics course
337 in both semesters of the same academic year.
- 338 3. Offer summer courses that are designed to provide the equivalent experience
339 of a full course in all regards, including attention to the Standards for
340 Mathematical Practice.²
- 341 4. Create different compaction ratios, including four years of high school content
342 into three years beginning in ninth grade.
- 343 5. Create a hybrid Algebra II/Pre-Calculus or Mathematics III/Precalculus course
344 that allows students to go straight to Calculus in 12th grade (see Enhanced
345 Pathway).
- 346 6. Standards that focus on a sub-topic such as trigonometry or statistics could
347 be pulled out and taken alongside the traditional or integrated courses so that
348 students would only need to “double up” for one semester; or
- 349 7. Standards from Mathematics I, Mathematics II, and Mathematics III courses
350 could be compressed into an accelerated pathway for students for two years,
351 allowing students to enter the Precalculus course in the third year.

² As with other methods of accelerating students, enrolling students in summer courses should be handled with care, as the pace of the courses will likely be fast.

352 A combination of these methods and the suggested compacted sequences in Appendix
353 A of the Common Core State Standards for Mathematics (CCSSI) would allow for the
354 most mathematically-inclined students to take advanced mathematics courses during
355 their high school career.

356

357 **Students Who May Need Additional Support**

358 We expect that students across the state will find the CA CCSSM challenging at all
359 grade levels. For students who have needed additional support to meet existing
360 standards, the CA CCSSM will likely provide still greater teaching and learning
361 challenges. A common existing structural solution in California's public schools has
362 been to encourage students to repeat courses where they have not demonstrated
363 mastery. This has been frequently done between eighth and ninth grade, when
364 concerns about the mastery of pre-algebraic and algebraic content have arisen. Under
365 the CA CCSSM, it is intended that course repetition be reduced for students who need
366 additional support. An alternative is to rethink the content of existing courses in grades
367 six, seven, and eight. Alignment to earlier grades in elementary school will be essential
368 as well to examine how early-grades mathematics standards are being mastered.

369

370 Some districts in California have developed course structures that allow mathematics
371 content to be reinforced over multiple years through *expansion* – the opposite of
372 compaction. Under the CA CCSSM, it is possible that this approach will be helpful,
373 particularly with the assistance of formative testing under the Smarter Balanced
374 Assessment Consortium and other diagnostic testing. Districts should consider how
375 scheduling within the school day, within the school year, and across school years might
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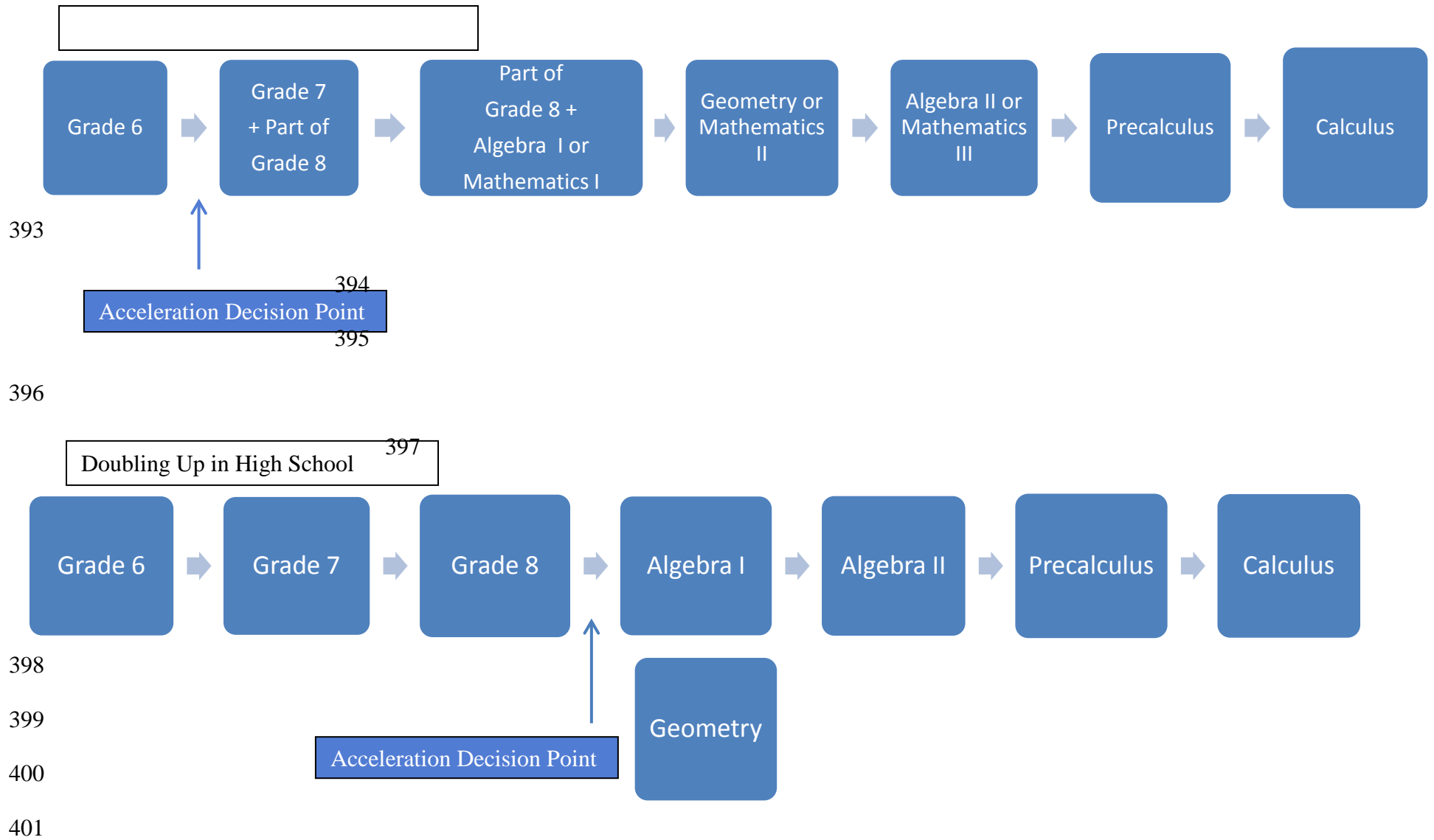
376 facilitate increased mastery on the *combined* CA CCSSM from grades six through eight.

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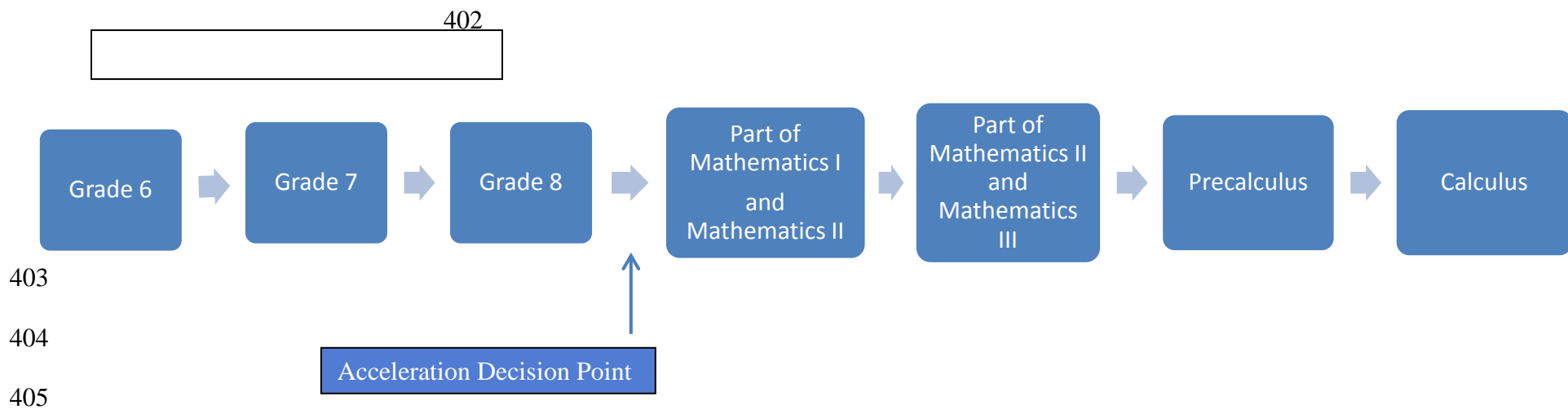
378 **Support for K–12 Teachers**

379 The increased rigor of the CA CCSSM and the demands of fully addressing the MP
380 standards will create additional opportunities and challenges for California’s K–12
381 teachers. Accelerating students who are prepared for advanced coursework will add a
382 new layer to this set of challenges. Students who follow a compacted pathway will be
383 undertaking advanced work at an accelerated pace. This creates a great challenge for
384 these students as well as their teachers, who will be teaching eighth grade standards
385 and Algebra I or Mathematics I standards that are significantly more rigorous than in the
386 past and within a compressed timeframe. Teachers must be prepared not only to
387 address new and more challenging content; but will also need to build upon their
388 repertoire of acceleration strategies. Teacher preparation programs must respond to
389 this call for additional teacher training and support. Support and professional learning
390 for experienced teachers should be provided from the district and county office levels
391 and by the California Mathematics Projects.

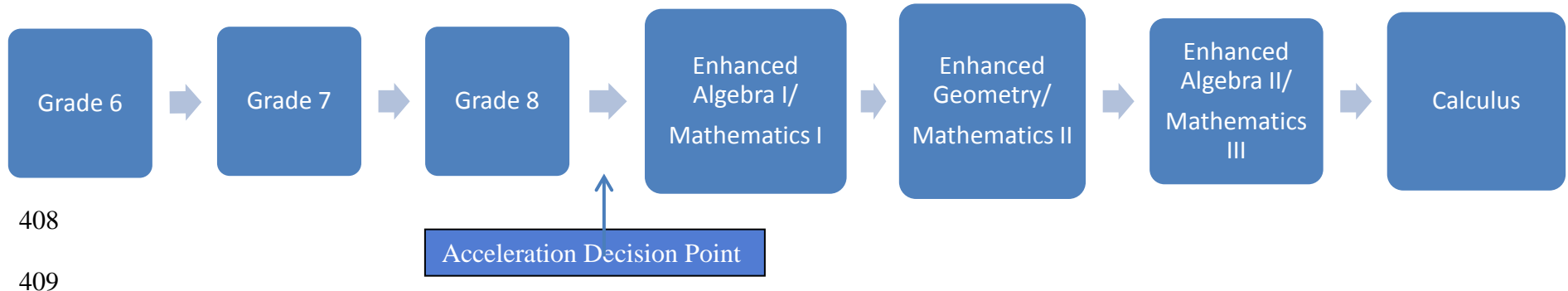
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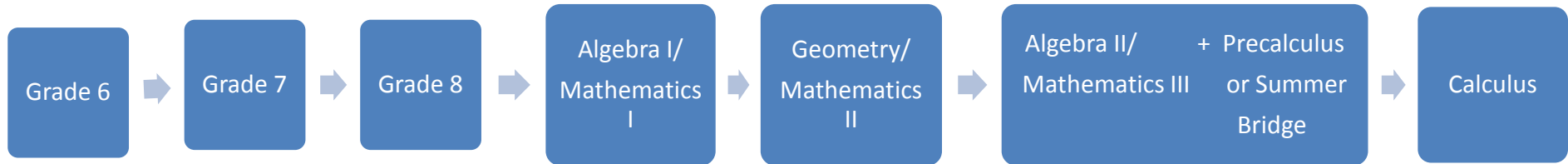
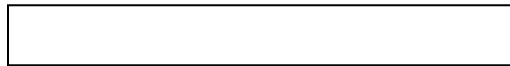
Enhanced Pathway	406	³
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³ The Massachusetts Department of Education has developed model courses for a traditional enhanced sequence. These are available at: <http://www.doe.mass.edu/candi/commoncore/EnhancedPathway.pdf>

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Acceleration Decision Point



(Massachusetts 2012)

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