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REDESIGNING THE MATHEMATICS OF OPPORTUNITY:

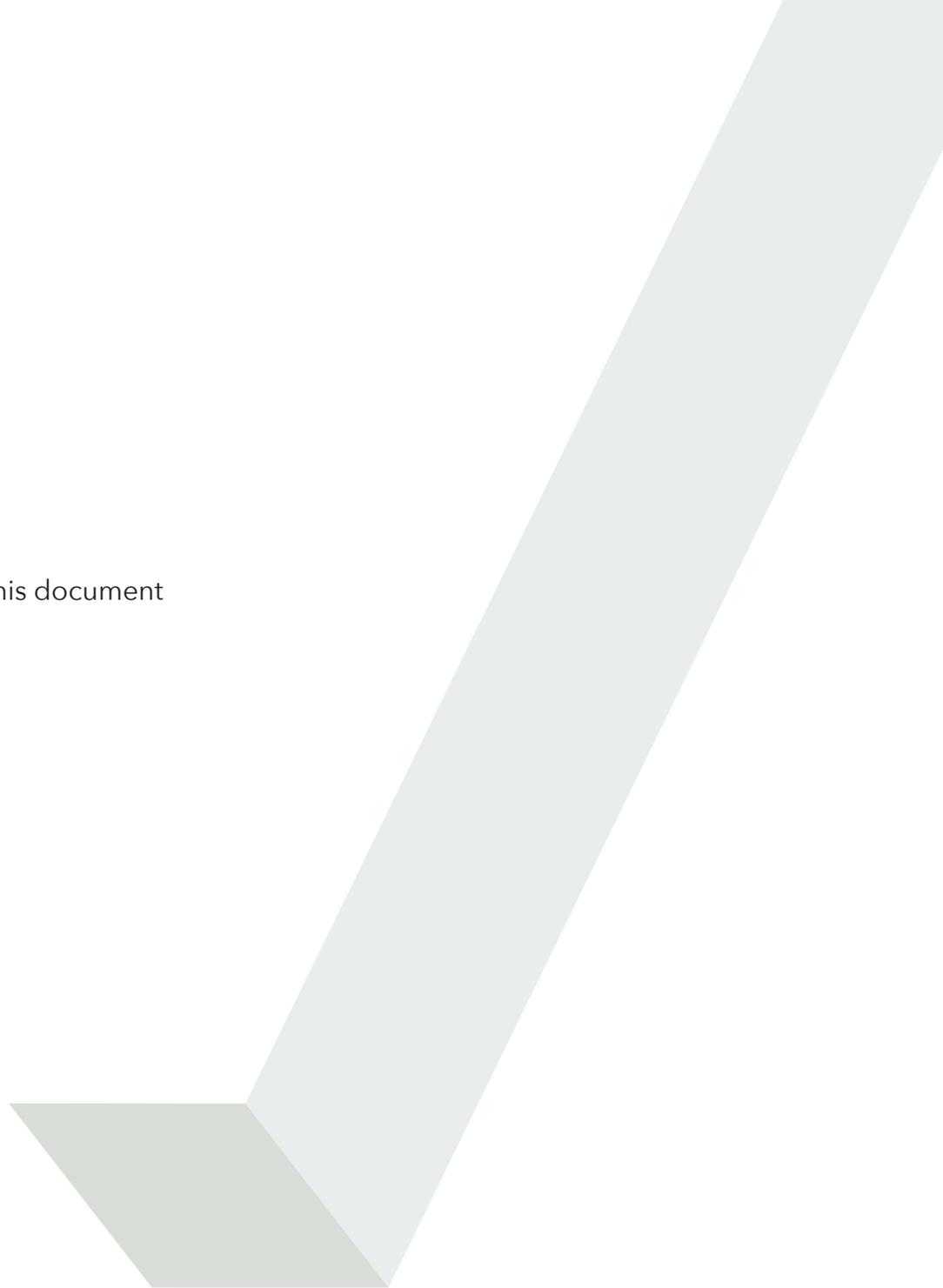
Principles for Equitable Math Pathways
To and Through College

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OVERVIEW

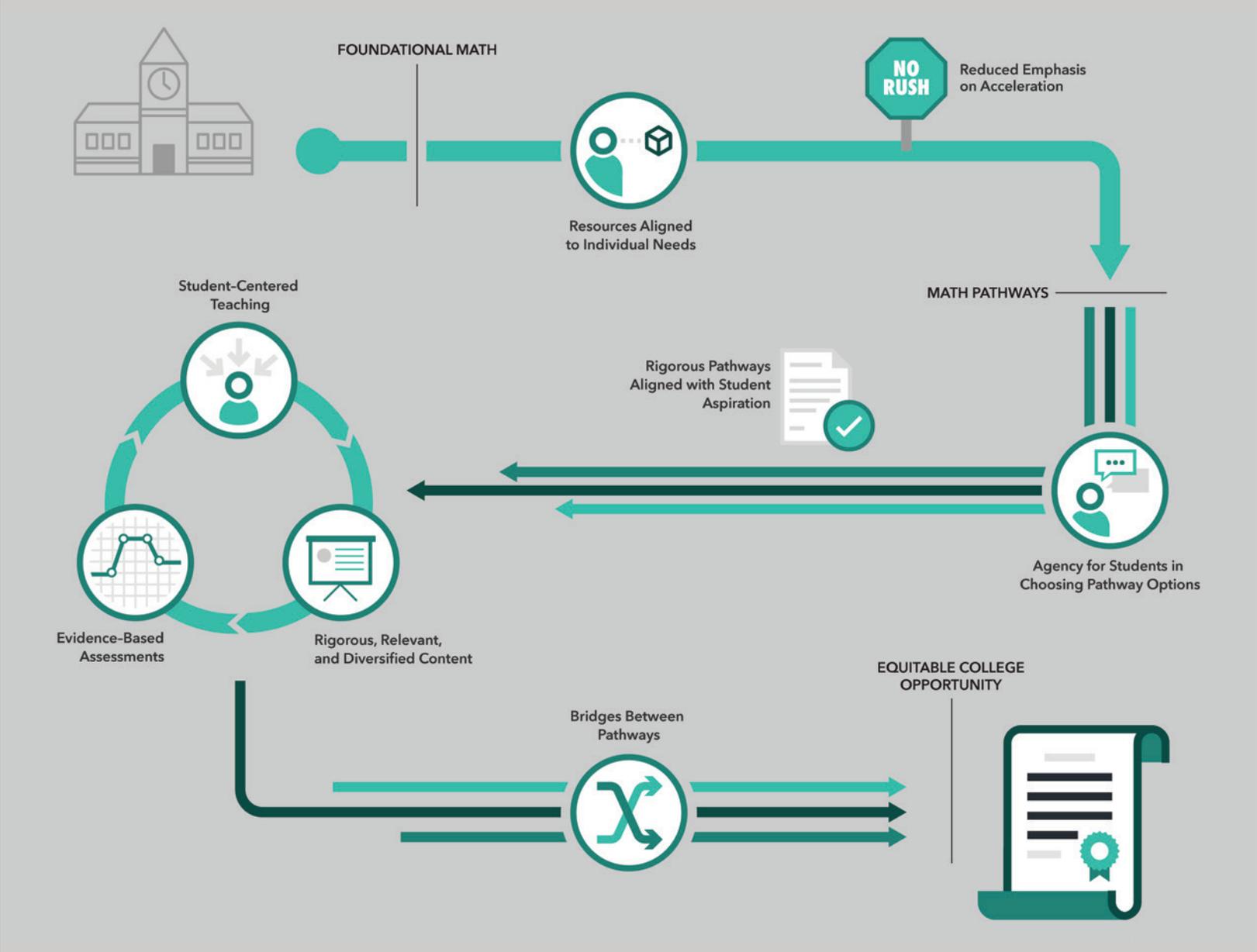
Mathematical literacy is intended to help students “expand professional opportunity, understand and critique the world, and experience, wonder, joy, and beauty,” according to the National Council of Teachers of Mathematics. Yet too few students receive these benefits. The negative classroom experiences of a vast number of students prevent many from engaging with math in meaningful ways. It also limits college opportunity, especially for students who tend to be marginalized in other ways. In short, math education, as currently constructed, is not living up to its purpose.

Fairness and equity demand that math education be re-designed to ensure that characteristics known at birth—such as race, class, ethnicity, and gender—don’t restrict students’ chances of learning mathematics and accessing the opportunities that math proficiency can afford. This re-design calls for rejecting popular misconceptions about math ability along with the use of math as a societal gatekeeper that arbitrarily restricts opportunity.

Equitable college access and success require re-thinking the content of math courses as well as the ways math is taught and tested. It also entails re-writing policies that use math as a filter, instead of as a foundation, for educational advancement. This new mathematics of opportunity must support—rather than hinder—equitable college opportunity

Just Equations’ report, [The Mathematics of Opportunity: Re-Thinking the Role of Math in Education Equity](#), discussed these equity challenges and pointed to some promising directions for policy and practice to enhance math education’s role in fostering equity. These principles for equitable math pathways are intended to further elucidate these ideas to guide educators, policymakers, researchers, and advocates in promoting, designing, and studying equity-oriented math pathways.

PRINCIPLES FOR EQUITABLE MATH PATHWAYS



PRINCIPLES FOR EQUITABLE MATH PATHWAYS

FOUNDATIONAL MATH

Math as a foundation, not filter, for equitable education success.

Resources Aligned to Individual Needs

- Integrated student supports
- Effective instructors for all students
- Equitable teacher assignment

Reduced Emphasis on Acceleration

- Delayed forks in the road
- Elimination of student tracking
- Common pathway through middle school and into high school for most students

Agency for Students in Choosing Pathway Options

- Availability of multiple high-quality options
- Transparency and awareness around options
- Advising, recruiting, and other supports

MATH PATHWAYS

Multiple options for developing quantitative literacy, beginning as early as 10th grade; including equitable access to STEM pathway, and at least one rigorous non-STEM pathway(s).

Rigorous Pathways Aligned with Student Aspirations

New options for:

- Junior year of high school
- Senior year of high school
- AP courses that don't require acceleration
- College general education mathematics

Student-Centered Teaching

- Evidence-based pedagogy, rooted in standards for mathematical practice
- Belief that all students can learn and develop positive math identity
- Culturally-sensitive instruction

Rigorous, Relevant, and Diversified Content

- Rich, engaging curriculum teaching higher order skills
- Pathways aligned with positive college outcomes
- Reduced emphasis on one-size-fits-all Calculus/STEM pathways

Evidence-Based Assessments

- Reduced reliance on timed standardized tests
- Increased use of formative and performance assessments

- Opportunities to revise work based on feedback
- Use of multiple measures for admissions, placement and other high-stakes decisions

Bridges Between Pathways

- No dead-end pathways
- Support for students to switch pathways if goals change

EQUITABLE COLLEGE OPPORTUNITY

Math equity as a condition for equitable college access and success.

For further discussion of the principles, see the following pages.

FOUNDATIONAL MATH

Math as a foundation, not filter, for equitable education success

For too long, math requirements have been used as a gatekeeper that prevents some students from accessing future educational opportunities, such as when the specific math required isn't an actual prerequisite for a student's intended course of study. Such arbitrary expectations – such as the idea that all college graduates must pass a college algebra course – disadvantage students who have had less access to advanced math or simply aren't interested in algebra-intensive fields. While there isn't complete consensus on what constitutes "foundational" math knowledge, it's generally thought to include areas like number sense; geometry; basic facility with the symbolic language of algebra; functions and their graphs; as well as elementary statistics and probability. Algebra 2 and other courses on the pathway to calculus are undergoing scrutiny because of their narrow relevance.

Resources Aligned to Individual Needs

- Integrated student supports
- Effective instructors for all students
- Equitable teacher assignment

Marginalized students, in particular students of color and low-income students, often have insufficient access to quality instruction and other learning supports. To ensure that all students can develop a strong quantitative foundation, instructional and support resources should be mobilized to meet students' needs in proactive ways (vs. offering remediation only

after students experience failure and frustration). That includes ensuring effective instructors for students who need more support, not just assigning those teachers to more advanced courses, which NCTM calls "teacher tracking."^{*}

^{*}See National Council of Teachers of Mathematics, 2018, [Catalyzing Change in High School Mathematics](#).

Reduced Emphasis on Acceleration

- Delayed forks in the road
- Elimination of student tracking
- Common pathway through middle school and into high school^{*} for most students

An emphasis among some families and students on accelerating through middle school and high school math curriculum often comes at the expense of in-depth understanding of math concepts. It can also contribute to tracking, when some students progress to more advanced math courses while others are left behind in dead-end sequences. "Tracking is insidious because it places some students into qualitatively different or lower levels of a mathematics course and, in some cases, puts students into terminal mathematics course pathways that are not mathematically meaningful and do not prepare them for any continued study of fundamental concepts," notes NCTM.^{*} "Too often, placement into different tracks is based on a variety of nonacademic factors, such as perceived (but not potential) academic ability, race, socioeconomic status, gender, language, or other expectations ascribed to students by adults." It is thus important to ensure that all students pursue math pathways that

support college readiness without closing off options. NCTM recommends a common pathway into high school for most students, noting that some acceleration may be appropriate as long as critical concepts are not “rushed or skipped” in a misguided “race to calculus.” But most students should be on a common pathway through the first or second year of high school.

*See National Council of Teachers of Mathematics, 2018, [Catalyzing Change in High School Mathematics](#).

Agency for Students in Choosing Math Pathways

- Availability of multiple high-quality options
- Transparency and awareness around options
- Advising, recruiting, and other supports

Diversifying math pathway options can open up opportunities for students in math. However, it is important that students’ pathways align with their individual aspirations, not a teacher or counselor’s assumptions about their interests or preparation level. The Dana Center notes that college students “should enroll in math pathways that reflect their academic interests and intended programs of study—not their level of preparation.”* For pathways that are introduced in high school, before students have chosen a major or program of study, all options should prepare students for college, and none should close off doors to more advanced math or to particular programs of study. Because so many students experience math anxiety, transparency as well as support in selecting a math pathway are essential to ensure that pathways aren’t used to track students.

*See [The Case for Mathematics Pathways](#) (Updated 2019)

MATH PATHWAYS

Multiple options for developing quantitative literacy, beginning as early as 10th grade, including equitable access to STEM pathway, and rigorous non-STEM pathway(s)

Traditionally, rigorous math sequences have been available only to students within STEM pathways leading to Calculus and beyond. It is important to offer rigorous non-STEM pathways to provide students multiple ways to engage in meaningful math. It is also essential that the traditional STEM sequence not be used to ration access to educational opportunity, especially for students of color and low-income students. However, non-STEM pathways must be rigorous and must not preemptively limit students’ opportunity to advance in their education or subsequently take a bridge course to a STEM field.

Rigorous Pathways Aligned with Student Aspirations

New options for:

- Junior year of high school
- Senior year of high school
- AP courses that don’t require acceleration
- College general education mathematics

The last two years of high school and entry to college are key junctures for broadening math pathways. To ensure that these pathways align with students’ interests, new rigorous options should be available in college as well as in the last two years of high school. In addition to updated content, the pathways should prioritize student-centered teaching and evidence-based approaches to assessment.

Rigorous, Relevant, and Diversified Content

- Rich, engaging curriculum teaching higher order skills
- Pathways aligned with positive college outcomes
- Reduced emphasis on one-size-fits-all Calculus/STEM pathways

To build on foundational math literacy, students should be able to access a range of math content in the last years of high school as well as in college. This requires new thinking about the role of Algebra 2 in the high school curriculum, de-emphasizing it as a requirements for all students and/or redesigning the course to remove obsolete material and de-emphasize abstract manipulation. New pathways in areas like statistics, data science, mathematical modeling, financial math, and/or quantitative reasoning should be created or expanded.

Student-Centered Teaching

- Evidence-based pedagogy, rooted in standards for mathematical practice
- Belief that all students can learn and develop positive math identity
- Culturally-sensitive instruction

Too often, math instruction has given students the impression that math is only about memorizing formulas, getting right answers, and doing it speedily. This traditional approach to teaching can impede deep engagement with mathematical concepts and contribute to math anxiety. New approaches to teaching math emphasize “promoting and valuing students’ participation in mathematical discourse—sharing

their reasoning; creating, critiquing, and revising arguments; and engaging in collaborations aimed at making sense of and using mathematical ideas.”* The Common Core State Standards include eight mathematical practices that encourage this type of instruction. Note that successfully implementing student-centered instruction requires professional learning opportunities for teachers to refine and strengthen their pedagogy.

*Robert Q. Berry, III. [Positioning students as mathematically competent learnings](#). National Council of Teachers of Mathematics blog post.

Evidence-Based Assessments

- Reduced reliance on timed standardized tests
- Increased use of formative and performance assessments
- Opportunities to revise work based on feedback
- Use of multiple measures for admissions, placement and other high-stakes decisions

Traditional testing formats contribute to the high-stakes nature of math education. Similarly, the use of tests to rank and sort students, rather than support learning, provides exposure to mathematics through the myopic lens of right and wrong, neglecting the ways in which math can be generative, creative, or interpretive. In addition, high-stakes tests (especially norm-referenced tests like the SAT) have been shown to have a disparate impact on students of color, low-income students, and students whose parents did not attend college.* Many broad-access two-year and four-year institutions are de-emphasizing

standardized tests for remedial math placements—or eliminating them altogether.

*Geiser, 2017. Norm-Referenced Tests and Race-Blind Admissions: The Case for Eliminating the SAT and ACT at the University of California. Center for Studies in Higher Education.

Bridges Between Pathways

- No dead-end pathways
- Support for students to switch pathways if goals change

Students’ math pathways, especially those chosen during high school, should not drive their educational destiny. There needs to be support and systems for students to switch pathways to meet changing goals. Students who enroll in a high school statistics or data science class, for example, should not be blocked from subsequently taking precalculus or calculus if they develop the interest in traditional math or in a STEM (science, technology, engineering and math) field. To ensure that outcome, systems should develop bridge courses or corequisite strategies that explicitly facilitate movement across pathways.

EQUITABLE COLLEGE OPPORTUNITY

Math equity as a condition for equitable college access and success.

Because inequities in math achievement have caused barriers to college access and success, equitable college opportunity requires equitable math opportunity.



ABOUT THE EQUITY PRINCIPLES

The principles highlighted here were developed by Just Equations in 2018-2019, as the result of conversations and strategy sessions with numerous advisors and stakeholders in the field, including our November 2018 Mathematics of Opportunity conference. These individuals include math educators, policy researchers, equity advocates, and education leaders. We especially acknowledge the groundbreaking work of the Charles A. Dana Center at the University of Texas at Austin as well as the National Council of Teachers of Mathematics, and refer readers to the following reports, which also contributed to the analysis that created these principles:

[Catalyzing Change in High School Mathematics: Initiating Critical Conversations](#), National Council of Teachers of Mathematics, 2018

[Principles to Guide Lasting Impact](#). Dana Center Mathematics Pathways

[The Case for Mathematics Pathways](#). Dana Center Mathematics Pathways, 2019

