

# Balance the Equation

## *A Grand Challenge for Algebra 1*

### Overview

Grand Challenges is a family of initiatives fostering innovation that historically solve key problems in global health and development for those most in need. These initiatives use challenges to focus attention and effort on specific problems. They can be traced back to over a century ago when a mathematician named David Hilbert defined a set of unsolved problems to spark progress in the field of mathematics. Each initiative is an experiment in the use of challenges to focus innovation on having an effect.

**Balance the Equation is the first-ever Grand Challenge focused on U.S. education.**

**The Bill & Melinda Gates Foundation is seeking to disrupt the deeply imbalanced system against this generation – and previous generations – of Black, Latino, English Learners (ELs), and students experiencing poverty in the United States, who we will refer to as priority students, as it relates to their Algebra 1 experience in 7th, 8th, or 9th grade, in-class or online.**

Submissions are welcome from across the globe for a chance at a **Phase 1: Planning and Prototyping** grant for US\$100,000 to develop a pilot study plan alongside our external learning partner, American Institute for Research ([AIR](#)). Upon completion of the first Phase, awardees can then apply for a **Phase 2: Pilot Study** grant for up to US\$1 million. Applicants are encouraged to consider how their solution\* could benefit from the expertise of two or more organizations in a partnership or combine with emerging or existing in-market solutions. Partnerships representing collaboration with a full-course Algebra 1 or relevant middle grades mathematics series provider are especially encouraged, as this would represent a clear go-to-market pathway.

### What is the Balance the Equation Challenge?

*When you hear the word **mathematics**, what comes to mind?*

*“Difficult.”— 8th grader*

*“Challenging.”— 9th grader*

*“A lot of work.”— 8th grader*

*“Sometimes fun.”—10th grader*

These are just a sampling of responses from 8th, 9th, and 10th grade priority students\*—students who have been disproportionately affected in education—articulated in 90-minute interviews leading up to this challenge. This current reality of mathematics, laden with internalized negative beliefs, behaviors, patterns, and values, is not for lack of student assets\* or efforts; but rather something much weightier and systemic.

\* Please see the [Glossary of Terms](#) for definition

Through this challenge, our goal is not only to bring balance to an exclusionary system that has stratified these students and tarnished the beauty of key mathematical concepts, but to also stack Algebra\* education in favor of their unique gifts and boundless capabilities. Some examples of assets articulated during our interviews include:

- **Being Goal-Oriented**

*"If you do well in math you'll do well in your career."*

10th grade English Learner\*, who wants to be an accountant

- **Building Their Own Support Teams**

*"My uncle! He's one of the best people I know who's good at math... My friends.*

*Usually if we all have a problem with the same math problem, we'll call each other."*

8th grader, when describing the important relationships she brings as a mathematician

- **Having a Strong Sense of Self**

*"Math is my best and favorite subject because of my 3rd and 6th grade teachers... My mom was living on the streets with my little sister. And my plan since I was 11, once I get a job/place, is to take care of her."*

9th grader, with a strong sense of self and clear future ambitions

Additionally, we heard from students who optimized their learning environment in response to disruptive school settings, found additional digital resources to aid their education, and were enthusiastic about the value of mathematics although it sometimes produced anxiety. Several other students we spoke to had clear future ambitions, from universities they wanted to attend and aspirational careers they wanted to pursue, to being able to financially provide for family members.

By focusing intentionally on priority students' mathematics experience — and we acknowledge there is no prototypical student — we are aligning to our belief that 'universal goals can be achieved through targeted approaches'.<sup>1</sup> Our improvements, designed for priority students, could then unlock wide reaching and transformational outcomes for all Algebra 1 students.

### **Why Balance the Equation, Why Now?**

Modern Algebra education has developed into a worldwide language, but its non-European roots have been largely neglected by historians. From Arabic, الجبر or "*al-jabr*", meaning, "reunion of broken parts",<sup>2</sup> which symbolically echoes the ethos of this challenge. With Algebra 1 serving as a pivotal inflection point in students' overall mathematics pathway, as well as being a powerful on-track indicator of college readiness, it is important we realign the social and political narrative shaping mathematical education at this critical juncture.

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<sup>1</sup> "Targeted Universalism: Policy & Practice," May 08, 2019, <https://belonging.berkeley.edu/targeteduniversalism>

<sup>2</sup> "Definition: Algebra," September 2020, <https://www.lexico.com/en/definition/algebra>

With the onset of COVID-19, available data suggest that priority students are even more vulnerable to an imbalanced classroom experience. As of May 2020, total student progress in online mathematics coursework decreased by 39.6% compared to early January 2020. Progress increased by 2% for students in high-income ZIP codes and decreased 61.6% for students in low-income ZIP codes.<sup>3</sup> During spring 2020, schools serving predominantly Black and Latino students had lower student engagement<sup>4</sup>, just 60 to 70% were able to log in regularly.<sup>5</sup> By focusing our efforts on redistributing classroom power to students and elevating their assets and deep interests, we can override the legacy conditioning and socialization that mathematics is inherently only for select students.

To understand the quality and resonance of solutions, the Gates Foundation is shifting the authority into the hands of students. Applicants will pilot their solution in communities where priority students are **50% or more** of the population. We will rely on the ongoing involvement of priority students to gather and incorporate feedback. By collaborating in this way, we can work with our learning partner, AIR, to improve solutions that yield positive outcomes for priority students.

**Potential solutions supporting priority students might look like:**

- Expanding daily practices for productive mathematical discussions to build their mathematics identity and reiterate mathematics' real-life connection in the evolving 'classroom environment' (physically or virtually; synchronously or asynchronously).
- Incorporating tasks and/or lessons that empower them and/or reflect students' culture and community, or serve to explore issues of humanity and social justice.
- Altering the focus of mathematical aptitude from "easily, quickly, and independently arriving at a correct answer"<sup>6</sup> oriented around the individual to more thoughtful, iterative approaches that promote multi-person processes and interactions.
- Adding assessment approaches that empower and humanize students and leverage more nuanced forms of data.
- Enhancing teacher professional development so educators are set up to meet the unique needs of each student, reflect upon their own biases, and build relationships that allow students to feel supported.

**At this time, we are not looking for solutions that:**

- Are focused on mathematical subjects outside Algebra 1, or specific mathematical content that exceeds the learning goals of Algebra 1.
- Are focused on policy agendas.

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<sup>3</sup> "Percent Change in Student Participation," September, 2020, <https://tracktherecovery.org/>

<sup>4</sup> "COVID-19 and student learning in the United States: The hurt could last a lifetime," June 01, 2020, <https://www.mckinsey.com/industries/public-and-social-sector/our-insights/covid-19-and-student-learning-in-the-united-states-the-hurt-could-last-a-lifetime#>

<sup>5</sup> Ibid.

<sup>6</sup> "Five Guiding Principles for Creating Inclusive Math Environments," August 31, 2020, <https://mindsetscholarsnetwork.org/five-guiding-principles-for-creating-inclusive-mathematics-environments/>

- Do not sufficiently incorporate priority students who identify as Black, Latino, English Learners, and/or students experiencing poverty in the United States.

### **What is the Challenge Timeline and Process?**

The grant process is broken into two Phases:

#### **Phase 1: Planning and Prototyping and Phase 2: Pilot Study.**

In both Phases, grantees will partner with AIR to plan for a pilot study by developing study plans that specify the mechanisms by which your solution is hypothesized to improve key priority student outcomes; including: developing a list of learning questions, determining which measures and data sources are needed to address the learning questions, and identifying Title 1 schools in which to conduct the Phase 2. Pending selection for continuation to Phase 2, grantees will continue to partner with AIR and participating sites to collect data and conduct the pilot study during the 2021-2022 or 2022-2023 school year.

#### **Phase 1: Planning and Prototyping 4 months**

*10-15 US\$100,000 awards in funding for planning and prototyping*

- Application Opens: October 7th, 2020 at 5:00AM U.S. Pacific Time
- Application Closes: November 6th, 2020 at Noon U.S. Pacific Time
- Applications Reviewed: November - December 2020
- Applicants Informed: December 2020 - January 2021
- Awardees Announced: February 2021
- Collaborate on study plan with AIR: February - May 2021

#### **Grantees from Phase 1 can then apply for**

#### **Phase 2: Pilot Study 13-24 months**

*8-10 awards up to US\$1 million in funding for prototyping and implementation*

- Application Opens: April 26th, 2021
- Application Closes: May 14th, 2021
- Applications Reviewed: May - June 2021
- Applicants Informed: July 2021
- Awardees Announced: August 2021
- Pilot studies conducted by AIR, in partnership with grantees and participating sites - Three rounds: Fall 2021, Winter/Spring 2022 (January 2022 start date) and Fall 2022

### **How Will My Application Be Assessed and By Whom?**

Alongside your responses in the official Balance the Equation application, the Gates Foundation has identified the following as critical characteristics of a successful submission:

- 1) Responsiveness of solution to priority student needs, outlined in the Area(s) of Focus.
- 2) Ability to align to a high-quality\* core curriculum as a component of a coherent mathematics instructional system. (We do not expect funded solutions to serve as standalone curriculum to replace core instruction, but rather to address student needs to expand access to core content.)
- 3) Likelihood to produce desired student and teacher outcomes.
- 4) Potential for pilot in Phase 2: Pilot Study during school year 2021-2022 or 2022-2023 alongside AIR.
- 5) Creativity and boldness of thought.

**1) Responsiveness of solution to priority students' needs outlined in the Area(s) of Focus.**

Five Areas of Focus were derived through primary research with students, teachers, and academic experts across the nation. We believe these areas have the biggest opportunity for altering the traditional classroom\* experience for priority students in order to achieve the desired outcomes. We acknowledge the interconnectedness of these areas on a student experience level, but have separated them for application purposes. Applicants will need to identify in their application to which area(s) their solution aligns.

- **Builds out Support Systems:** Facilitates the creation and maintenance of inclusive mathematics communities\*—in person or virtual—between students and adults to build relationships. These supports build critical consciousness\* among educators and an understanding about sharing power with students in co-constructing the mathematics learning community; a more expansive view of mathematics among adults and students; and promote meaningful collaboration, deep mathematical thinking, and exploration among students and adults. (S2S, T2T, S2T, S2Adult, T2SFamily)
- **Improves Relevance of Algebra Content:** Increases the relatability by using real-world examples that connect to the interests of students in the mathematics community (e.g., classroom) and increases focus on making sense of Algebraic concepts.
- **Elevates Understanding of Mathematics Language:** Improves linguistic awareness and practices by tackling mathematics vocabulary, syntax, morphology [changing word forms], argument structure, or feedback for students (in a manner that especially prioritizes emerging multilingual students, but also benefit monolingual English speakers) and/or teachers. Leverages linguistic and other assets of emerging multilingual students. Takes care not to create avoidable linguistic barriers to mathematical concepts.
- **Empowers and Strengthens Teacher Practices:** Offers new materials, tools, and strategies that empower, support, and expand teachers' knowledge and use of instructional practices that meet individual student needs, develop mathematical proficiency\*, and create positive class experiences on a daily basis.

- **Develops New or Better Feedback Mechanisms:** Explicitly applies assessment or progress monitoring data for instructional purposes to enhance access to core Algebraic content.

**2) Designed for use with a high-quality core curriculum as part of a coherent mathematics instructional system.**

Having access to high-quality curriculum materials is an important factor to increase equity\* for priority students and to dismantle the belief that ‘only a select few are good at mathematics.’ While the market is full of free and easily accessible options, today many of these solutions do not provide a full view of students, cannot easily be used together with a core curriculum, and fluctuate wildly in price point. Applicants will need to identify which of these three key components their solution covers.

- **Independent Practice:** Exercises and problems tied to core curriculum. Can be assigned in class or as homework. Provides students the opportunity to wrestle with content they have yet to master.
- **Intervention:** Designed specifically to help struggling students participate in mainstream classes or provide additional enrichment opportunities for students ready to extend their learning.
- **Assessment to Inform Instruction:** Diagnostic and interim assessments that provide data to inform instruction.

**3) Likelihood to produce desired priority student and teacher outcomes.**

We define a likelihood of addressing outcomes by a combination of:

1. Existing evidence that the solution and/or critical components of the solution can move one or more of these outcomes; and
2. A compelling, evidence-based articulation of the reasons why the solution has a likelihood of moving one or more of these outcomes ("why it will work").

We see successful solutions tackling some of the following outcomes:

**Student Outcomes**

- Increased positive experience in mathematics classrooms\*
- Increased positive identity\* as mathematicians
- Increased mathematics growth and proficiency

**Teacher Outcomes**

- Increased positive mindsets and beliefs about priority student mathematics learning
- Increased skills in adapting curricula and instruction to meet student needs
- Increased use of effective mathematics instructional practices\*

**4) Potential for pilot in Phase 2: Pilot Study for School Year 2021-2022 or 2022-2023 alongside AIR.**

AIR will work with each Balance the Equation Grand Challenge awardee to prepare and submit a pilot study plan for Phase 2. Each awardee will use their study plan as the basis of their Phase 2 proposal, as described in ‘Timeline and Process.’

**5) Creativity and boldness of thought.**

We are searching for ingenuity. Unusual ideas, unexpected approaches, immersive concepts, solutions

that surprise and delight. We are looking for solutions that will challenge mathematics education as we know it today.

### **Reviewers**

Applications will be reviewed by internal Gates Foundation staff as well as external subject matter experts and thought leaders within the realm of mathematics relevance, content, language, assessment, professional learning, instructional practices, and the deep expertise centered around the needs of our priority students.

### **Thank You to Our Contributors**

This challenge would not be possible without the many knowledgeable voices from within the educational and mathematics communities who generously provided feedback throughout the development of this challenge. We truly appreciate your involvement and thoughtful contributions.

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The Grand Challenge will launch: **5:00AM U.S. Pacific Time, October 07, 2020**. Applications will be accepted until: **Noon U.S. Pacific Time, November 06, 2020**.

For questions, please contact the Balance the Equation Grand Challenge Team at:

[balancetheequation@gatesfoundation.org](mailto:balancetheequation@gatesfoundation.org)

## Glossary of Terms

In order to facilitate a mutual understanding of terminology used throughout this challenge, definitions have been provided by the Gates Foundation based on research and intention.

**Algebra 1:** The course is historically situated between pre-Algebra and Geometry and the last truly general-purpose-college/career-ready mathematics course that most students are exposed to in the 8th or 9th grade. “Algebra moves students beyond an emphasis on arithmetic operations to focus on the use of symbols to represent numbers and express mathematical relationships.”<sup>7</sup> Algebra provides the language in which we communicate the patterns in mathematics so its foundation for students (including English Learners) is critical for continuing mathematical comprehension. Each topic within Algebra should be experienced as an integration of procedures, concepts, and applications. Algebra typically covers: seeing structure in expressions, arithmetic with polynomials and rational functions, creating equations, and reasoning with equations and inequalities.<sup>8</sup>

**Assets:** Strengths and interests that a student possesses and brings to the mathematics classroom. Assets can include skills, knowledge, connections/relationships, cultures, dreams, passions, etc.

**Critical consciousness:** We adopt the definition from the Mindset Scholars Network: educators must understand how marginalization and bias are expressed in mathematics environments and work to actively counter these processes via their instructional choices and interactions with students. Examples of what educator critical consciousness can look in practice include: confronting microaggressions, employing complex instruction, explicitly praising the contributions of students who have a minoritized identity in mathematics, or incorporating students’ uses of mathematics outside of school into their classwork. Learn more at [Mindset Scholars Network](#).

**Designed for use together with a high-quality core curriculum:** This opportunity envisions developing innovative supplemental resources that can be used as a support that expands access to core content while addressing a variety of student learning needs, and harnessing students’ identities, interests, and creativity. To maximize student impact and expand access to challenging content that is too often withheld from priority students, successful proposals will identify a specific core mathematics curriculum or course with which the new solutions are meant to be paired. Core curriculum may be a standalone Algebra 1 course, or a middle school mathematics curriculum that includes algebraic concepts in 7th and 8th grades. Solutions should set forth clear use cases: e.g., differentiation for group or individual practice; formal intervention), including potential setting (e.g., in general education classroom; in intervention settings; for use at home leveraging virtual supports).

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<sup>7</sup> "Teaching Strategies for Improving Algebra Knowledge in Middle and High School Students," July, 21, 2020, [https://ies.ed.gov/ncee/wwc/Docs/practiceguide/wwc\\_algebra\\_summary\\_072115.pdf](https://ies.ed.gov/ncee/wwc/Docs/practiceguide/wwc_algebra_summary_072115.pdf)

<sup>8</sup> "High School: Algebra » Introduction," September, 2020, <http://www.corestandards.org/Math/Content/HSA/introduction/>

**Effective mathematics instructional practices:** The IES Practice Guide [Teaching Strategies for Improving Algebra in Middle School and High School Students](#) offers recommendations. In addition, we emphasize:

- Increased ability to develop an inclusive learning environment in mathematics.
- Increased ability to support students in deeply engaging with the content (i.e., through discussion, connecting to their lives, problem solving, etc.)
- Increased ability to assess understanding and mathematics processes (i.e., problem solving.)

**Engagement:** Students that currently hold a growth mindset about their mathematical abilities, actively seek challenges, exhibit a willingness and confidence to participate in-class or help other classmates work through tasks, have extended periods of uninterrupted focus on a task or instruction, or have an enduring interest in pursuing mathematics or mathematics-related fields based on their academic goals or future aspirations despite poor instructional practices from unsophisticated educators, low-quality teaching materials, disruptive learning environments, emotional blockages, and systemic assessment pressures.

**English Learners:** Federally defined, “English Learners (ELs),” or Emerging Multilinguals, are students from homes where languages other than English are primarily spoken. ELs are a rich and heterogeneous group of learners who bring significant intellectual and cultural assets to the mathematics classroom, which is not always designed with their success in mind. Providing mathematics content that is designed to build the language of mathematics will be important to serve the nation's growing population of EL students, in ways that are culturally relevant to their linguistic assets as well as mathematically rigorous and appropriate per grade level. Please see the [Migration Policy Institute](#) or [ELSF](#) for further information.

**Equity:** Universal exposure so individual student goals can be achieved. “This requires all stakeholders:

- Ensure that all students have access to a challenging mathematics curriculum, taught by skilled and effective teachers who differentiate instruction as needed;
- Monitor student progress and make needed accommodations; and
- Offer remediation or additional challenges when appropriate.”<sup>9</sup>

**High-quality curriculum:** Evaluated and ranked in the top tier from a third-party reviewer based on a set of rigorous standards and alignment for instructional materials. Examples of reviewers include: [EdReports](#), [Instructional Materials Evaluation Toolkit \(IMET\)](#), or [Equip rubrics \(K8 math units\)](#).

**Inclusive mathematics communities:** Foster a sense of belonging and help all students to develop their identities as competent and capable learners, and to feel a sense of cultural continuity in that context. Inclusive mathematics communities recognize that some student identities have been marginalized within mathematics and actively work to move to deeper inclusion and value of all students as mathematicians. Curricular materials, assessment practices, and classroom interactions contribute to each student's experience of a mathematics community as inclusive or exclusionary. For more details, view [Mindset Scholars Network's Five Guiding Principles for Creating Inclusive Mathematics Environments](#).

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<sup>9</sup> "Access and Equity in Mathematics," April 18, 2014, <https://www.nctm.org/Standards-and-Positions/Position-Statements/Access-and-Equity-in-Mathematics-Education/>

**Mathematical proficiency:** We adopt the National Academies’ field consensus from [Adding It Up \(2001\)](#), on what it means for a student to be proficient. Mathematical proficiency has five strands:

- **Adaptive reasoning:** capacity for logical thought, reflection, explanation, and justification
- **Conceptual understanding:** comprehension of mathematical concepts, operations, and relations
- **Procedural fluency:** skill in carrying out procedures flexibly, accurately, efficiently, and appropriately
- **Productive disposition:** habitual inclination to see mathematics as sensible, useful, and worthwhile, coupled with a belief in diligence and one’s own efficacy.
- **Strategic competence:** ability to formulate, represent, and solve mathematical problems

**Minority-led organization (MLO):** We are committed to increasing the presence of MLOs in our investment portfolio. We believe that organizations that draw on diversity in the leadership and staff structures are well-equipped to serve a U.S. public school population that continues to become more ethnically and racially diverse. We define MLOs as those that meet one or more of the following criteria:

- An organizational leader (e.g., Superintendent, Executive Director, President, or Chief Executive Officer) identifying as Black and/or Latino.
- An executive leadership team (e.g., center directors, CFO) in which at least 40% of the members identify as Black and/or Latino.
- Board of Directors in which at least 40% of the members identify as Black and/or Latino.
- An organization with programmatic staff (i.e., full-time staff members that make programmatic design and implementation decisions) of which at least 40% identify as Black and/or Latino.

**Positive mathematics identity:** Mathematics identity specifically relates to an individual’s sense of being a “mathematics person,” feeling empowered to engage in mathematics.<sup>10</sup> Through this challenge we also endeavor for students to understand Algebra’s relevance to their lives today and in the future.

**Positive experience in mathematics classrooms:** This Grand Challenge seeks to increase the positive experiences our priority students are having in mathematics classrooms. Four key outcomes for students include:

- Increased sense of belonging
- Increased engagement in Algebra
- Increased enjoyment in Algebra
- Increased experiences that encourage deep mathematical thinking, exploration, and collaboration

**Positive mindsets/beliefs about priority student mathematics learning:** Positive mindsets/beliefs about priority student mathematics learning can take a variety of forms, but three key outcomes for educators/adults include:

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<sup>10</sup> Miller-Cotto, Dana and Lewis, Neil A. (2020). Am I a “Math Person”? How Classroom Cultures Shape Math Identity Among Black and Latinx Students. Working Paper.

- Increased critical consciousness (understand how marginalization and bias are expressed in mathematics environments and work to actively counter these processes via their instructional choices and interactions with students)
- Increased belief in priority students as mathematicians (therefore providing access to rigorous mathematics content and pathways)
- Increased view on the expansiveness of mathematics (i.e.: its history, participants, application and therefore how to increase relevance to priority students' lives)

**Priority students:** Black, Latino/a, English learners, and/or students experiencing poverty in the United States.

**Solution:** A solution can be a program, practice, instructional model, platform, or tool supporting priority students (and their teachers) in Algebra 1 in grades 7-9. A solution could be a new solution (that does not exist) or it could be an existing, “operable” solution. A solution could also be built through partnerships with multiple organizations. A solution must align to at least one Area of Focus and be usable explicitly with a full course Algebra 1 program that meets minimum requirements for coverage of algebraic content in grades 7-9. All solutions must be designed to support access to mastery by the end of 9th grade of the content standards typically associated with Algebra 1 courses. We also encourage you to reflect on what other components of a coherent mathematics instructional system (independent practice, intervention, and assessment to inform instruction), your solution could cover. Examples of solutions might include:

- An online independent practice tool that pairs with an existing high-quality Algebra 1 core curricula, with culturally responsive education and embedded English Learner supports.
- An after school, summer, or community-based program focused on building positive mathematics identity in Black or Latina girls in Algebra 1, in ways that tie back to the Algebra work happening in the classroom.
- An in-school tutoring intervention for 7-9th grade students that supports priority students in mathematics through both mentoring and academic rigor.

For more solution ideas, please refer to the earlier section, [\*Why Balance the Equation, Why Now?\*](#) As you innovate and create your new or existing solution we encourage you to have an eye towards (1) scalable innovations that could be equitably implemented and (2) innovations that will support systems change. If selected for Phase 2, your solution would need to be ready to be implemented with priority students by Fall 2021.

**Traditional mathematics classroom:** The integrated sum of our inherited and internalized assumptions, values, and beliefs of what it means to be ‘good at mathematics’ – a “naturally” talented individual as opposed to a collective of adept and dedicated problem solvers, quickly completing arithmetic problems through a procedural orientation (acquisition of a skill through repetition of tasks and practice) and working towards a binary right or wrong solution.