

117TH CONGRESS  
1ST SESSION

# H. R. 3588

To coordinate Federal research and development efforts focused on modernizing mathematics in STEM education through mathematical and statistical modeling, including data-driven and computational thinking, problem, project, and performance-based learning and assessment, interdisciplinary exploration, and career connections, and for other purposes.

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## IN THE HOUSE OF REPRESENTATIVES

MAY 28, 2021

Ms. HOULAHAN (for herself and Mr. BAIRD) introduced the following bill; which was referred to the Committee on Science, Space, and Technology

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## A BILL

To coordinate Federal research and development efforts focused on modernizing mathematics in STEM education through mathematical and statistical modeling, including data-driven and computational thinking, problem, project, and performance-based learning and assessment, interdisciplinary exploration, and career connections, and for other purposes.

1 *Be it enacted by the Senate and House of Representa-*  
2 *tives of the United States of America in Congress assembled,*

3 **SECTION 1. SHORT TITLE.**

4 This Act may be cited as the “Mathematical and Sta-  
5 tistical Modeling Education Act”.

1 **SEC. 2. MATHEMATICAL AND STATISTICAL MODELING EDU-**  
2 **CATION.**

3 (a) FINDINGS.—Congress finds the following:

4 (1) The mathematics taught in schools, includ-  
5 ing statistical problem solving and data science, is  
6 not keeping pace with the rapidly evolving needs of  
7 the public and private sector, resulting in a STEM  
8 skills shortage and employers needing to expend re-  
9 sources to train and upskill employees.

10 (2) According to the Bureau of Labor Statis-  
11 tics, the United States will need 1,000,000 addi-  
12 tional STEM professionals than it is on track to  
13 produce in the coming decade.

14 (3) The field of data science, which is relevant  
15 in almost every workplace, relies on the ability to  
16 work in teams and use computational tools to do  
17 mathematical and statistical problem solving.

18 (4) Many STEM occupations offer higher  
19 wages, more opportunities for advancement, and a  
20 higher degree of job security than non-STEM jobs.

21 (5) The STEM workforce relies on computa-  
22 tional and data-driven discovery, decision making,  
23 and predictions, from models that often must quan-  
24 tify uncertainty, as in weather predictions, spread of  
25 disease, or financial forecasting.

1           (6) Most fields, including analytics, science, eco-  
2           nomics, publishing, marketing, actuarial science, op-  
3           erations research, engineering, and medicine, require  
4           data savvy, including the ability to select reliable  
5           sources of data, identify and remove errors in data,  
6           recognize and quantify uncertainty in data, visualize  
7           and analyze data, and use data to develop under-  
8           standing or make predictions.

9           (7) Rapidly emerging fields, such as artificial  
10          intelligence, machine learning, quantum computing  
11          and quantum information, all rely on mathematical  
12          and statistical concepts, which are critical to prove  
13          under what circumstances an algorithm or experi-  
14          ment will work and when it will fail.

15          (8) Military academies have a long tradition in  
16          teaching mathematical modeling and would benefit  
17          from the ability to recruit students with this exper-  
18          tise from their other school experiences.

19          (9) Mathematical modeling has been a strong  
20          educational priority globally, especially in China,  
21          where participation in United States mathematical  
22          modeling challenges in high school and higher edu-  
23          cation is orders of magnitude higher than in the  
24          United States, and Chinese teams are taking a ma-  
25          jority of the prizes.

1           (10) Girls participate in mathematical modeling  
2 challenges at all levels at similar levels as boys, while  
3 in traditional mathematical competitions girls par-  
4 ticipate less and drop out at every stage. Students  
5 cite opportunity for teamwork, using mathematics  
6 and statistics in meaningful contexts, ability to use  
7 computation, and emphasis on communication as  
8 reasons for continued participation in modeling chal-  
9 lenges.

10 (b) DEFINITIONS.—In this section:

11           (1) DIRECTOR.—The term “Director” means  
12 the Director of the National Science Foundation.

13           (2) FEDERAL LABORATORY.—The term “Fed-  
14 eral laboratory” has the meaning given such term in  
15 section 4 of the Stevenson-Wydler Technology Inno-  
16 vation Act of 1980 (15 U.S.C. 3703).

17           (3) FOUNDATION.—The term “Foundation”  
18 means the National Science Foundation.

19           (4) INSTITUTION OF HIGHER EDUCATION.—The  
20 term “institution of higher education” has the  
21 meaning given such term in section 101(a) of the  
22 Higher Education Act of 1965 (20 U.S.C. 1001(a)).

23           (5) MATHEMATICAL MODELING.—The term  
24 “mathematical modeling” has the meaning given the  
25 term in the 2019 Guidelines to Assessment and In-

1 instruction in Mathematical Modeling Education  
2 (GAIMME) report, 2nd edition.

3 (6) OPERATIONS RESEARCH.—The term “oper-  
4 ations research” means the application of scientific  
5 methods to the management and administration of  
6 organized military, governmental, commercial, and  
7 industrial processes to maximize operational effi-  
8 ciency.

9 (7) STATISTICAL MODELING.—The term “sta-  
10 tistical modeling” has the meaning given the term in  
11 the 2021 Guidelines to Assessment and Instruction  
12 in Statistical Education (GAISE II) report.

13 (8) STEM.—The term “STEM” means the aca-  
14 demic and professional disciplines of science, tech-  
15 nology, engineering, and mathematics.

16 (c) PREPARING EDUCATORS TO ENGAGE STUDENTS  
17 IN MATHEMATICAL AND STATISTICAL MODELING.—The  
18 Director shall provide grants on a merit-reviewed, com-  
19 petitive basis to institutions of higher education, and non-  
20 profit organizations (or a consortium thereof) for research  
21 and development to advance innovative approaches to sup-  
22 port and sustain high-quality mathematical modeling edu-  
23 cation in schools operated by local education agencies, in-  
24 cluding statistical modeling, data science, operations re-  
25 search, and computational thinking. The Director shall en-

1 courage applicants to form partnerships to address critical  
2 transitions, such as middle school to high school, high  
3 school to college, and school to internships and jobs.

4 (d) APPLICATION.—An entity seeking a grant under  
5 subsection (c) shall submit an application at such time,  
6 in such manner, and containing such information as the  
7 Director may require. The application shall include the fol-  
8 lowing:

9 (1) A description of the target population to be  
10 served by the research activity for which such grant  
11 is sought, including student subgroups described in  
12 section 1111(b)(2)(B)(xi) of the Elementary and  
13 Secondary Education Act of 1965 (20 U.S.C.  
14 6311(b)(2)(B)(xi)), and students experiencing home-  
15 lessness and children and youth in foster care.

16 (2) A description of the process for recruitment  
17 and selection of students, educators, or local edu-  
18 cational agencies to participate in such research ac-  
19 tivity.

20 (3) A description of how such research activity  
21 may inform efforts to promote the engagement and  
22 achievement of students in prekindergarten through  
23 grade 12 in mathematical modeling and statistical  
24 modeling using problem-based learning with contex-  
25 tualized data and computational tools.

1           (4) In the case of a proposal consisting of a  
2           partnership or partnerships with 1 or more local  
3           educational agencies and 1 or more researchers, a  
4           plan for establishing a sustained partnership that is  
5           jointly developed and managed, draws from the ca-  
6           pacities of each partner, and is mutually beneficial.

7           (e) PARTNERSHIPS.—In awarding grants under sub-  
8           section (c), the Director shall encourage applications that  
9           include—

10           (1) partnership with a nonprofit organization or  
11           an institution of higher education that has extensive  
12           experience and expertise in increasing the participa-  
13           tion of students in prekindergarten through grade  
14           12 in mathematical modeling and statistical mod-  
15           eling;

16           (2) partnership with a local educational agency,  
17           a consortium of local educational agencies, or Tribal  
18           educational agencies;

19           (3) an assurance from school leaders to making  
20           reforms and activities proposed by the applicant a  
21           priority;

22           (4) ways to address critical transitions, such as  
23           middle school to high school, high school to college,  
24           and school to internships and jobs;

1           (5) input from education researchers and cog-  
2           nitive scientists, as well as practitioners in research  
3           and industry, so that what is being taught is up-to-  
4           date in terms of content and pedagogy;

5           (6) a communications strategy for early con-  
6           versations with parents, school leaders, school  
7           boards, community members, employers, and other  
8           stakeholders; and

9           (7) resources for parents, school leaders, school  
10          boards, community members, and other stakeholders  
11          to build skills in modeling and analytics.

12          (f) USE OF FUNDS.—An entity that receives a grant  
13          under this section shall use the grant funds for research  
14          and development activities to advance innovative ap-  
15          proaches to support and sustain high-quality mathe-  
16          matical modeling education in public schools, including  
17          statistical modeling, data science, operations research, and  
18          computational thinking, which may include—

19               (1) engaging prekindergarten through grade 12  
20               educators in professional learning opportunities to  
21               enhance mathematical modeling and statistical prob-  
22               lem solving knowledge, and developing training and  
23               best practices to provide more interdisciplinary  
24               learning opportunities;

1           (2) conducting research on curricula and teach-  
2           ing practices that empower students to choose the  
3           mathematical, statistical, computational, and techno-  
4           logical tools that they will apply to a problem, as is  
5           required in life and the workplace, rather than pre-  
6           scribing a particular approach or method;

7           (3) providing students with opportunities to ex-  
8           plore and analyze real data sets from contexts that  
9           are meaningful to the students, which may include—

10                   (A) missing or incorrect values;

11                   (B) quantities of data that require choice  
12           and use of appropriate technology;

13                   (C) multiple data sets that require choices  
14           about which data are relevant to the current  
15           problem; and

16                   (D) data of various types including quan-  
17           tities, words, and images;

18           (4) taking a school or district-wide approach to  
19           professional development in mathematical modeling  
20           and statistical modeling;

21           (5) engaging rural local agencies;

22           (6) supporting research on effective mathe-  
23           matical modeling and statistical modeling teaching  
24           practices, including problem- and project-based  
25           learning, universal design for accessibility, and ru-

1       brics and mastery-based grading practices to assess  
2       student performance;

3           (7) designing and developing pre-service and in-  
4       service training resources to assist educators in  
5       adopting transdisciplinary teaching practices within  
6       mathematics and statistics courses;

7           (8) coordinating with local partners to adapt  
8       mathematics and statistics teaching practices to le-  
9       verage local natural, business, industry, and commu-  
10      nity assets in order to support community-based  
11      learning;

12          (9) providing hands-on training and research  
13      opportunities for mathematics and statistics edu-  
14      cators at Federal laboratories, institutions of higher  
15      education, or in industry;

16          (10) developing mechanisms for partnerships  
17      between educators and employers to help educators  
18      and students make connections between their mathe-  
19      matics and statistics projects and topics of relevance  
20      in today's world;

21          (11) designing and implementing professional  
22      development courses and experiences, including men-  
23      toring for educators, that combine face-to-face and  
24      online experiences;

1           (12) addressing critical transitions, such as  
2 middle school to high school, high school to college,  
3 and school to internships and jobs; and

4           (13) any other activity the Director determines  
5 will accomplish the goals of this section.

6       (g) EVALUATIONS.—All proposals for grants under  
7 this section shall include an evaluation plan that includes  
8 the use of outcome oriented measures to assess the impact  
9 and efficacy of the grant. Each recipient of a grant under  
10 this section shall include results from these evaluative ac-  
11 tivities in annual and final projects.

12       (h) ACCOUNTABILITY AND DISSEMINATION.—

13           (1) EVALUATION REQUIRED.—The Director  
14 shall evaluate the portfolio of grants awarded under  
15 this section. Such evaluation shall—

16               (A) use a common set of benchmarks and  
17 tools to assess the results of research conducted  
18 under such grants and identify best practices;  
19 and

20               (B) to the extent practicable, integrate the  
21 findings of research resulting from the activities  
22 funded through such grants with the findings of  
23 other research on student’s pursuit of degrees  
24 or careers in STEM.



1 which NASEM, or such other appropriate entity, agrees  
2 to conduct a study on the following:

3 (1) Factors that enhance or barriers to the im-  
4 plementation of mathematical modeling and statis-  
5 tical modeling in elementary and secondary edu-  
6 cation, including opportunities for and barriers to  
7 use modeling to integrate mathematical and statis-  
8 tical ideas across the curriculum, including the fol-  
9 lowing:

10 (A) Pathways in mathematical modeling  
11 and statistical problem solving from kinder-  
12 garten to the workplace so that students are  
13 able to identify opportunities to use their school  
14 mathematics and statistics in a variety of jobs  
15 and life situations and so that employers can  
16 benefit from students' school learning of data  
17 science, computational thinking, mathematics,  
18 statistics, and related subjects.

19 (B) The role of community-based prob-  
20 lems, service-based learning, and internships for  
21 connecting students with career preparatory ex-  
22 periences.

23 (C) Best practices in problem-, project-,  
24 performance-based learning and assessment.

1           (2) Characteristics of teacher education pro-  
2           grams that successfully prepare teachers to engage  
3           students in mathematical modeling and statistical  
4           modeling, as well as gaps and suggestions for build-  
5           ing capacity in the pre-service and in-service teacher  
6           workforce.

7           (3) Mechanisms for communication with stake-  
8           holders, including parents, administrators, and the  
9           public, to promote understanding and knowledge of  
10          the value of mathematical modeling and statistical  
11          modeling in education.

12          (b) PUBLIC STAKEHOLDER MEETING.—In the course  
13 of completing the study described in subsection (a),  
14 NASEM or such other appropriate entity shall hold not  
15 less than one public meeting to obtain stakeholder input  
16 on the topics of such study.

17          (c) REPORT.—The agreement under subsection (a)  
18 shall require NASEM, or such other appropriate entity,  
19 not later than 24 months after the effective date of such  
20 agreement, to submit to the Secretary of Education and  
21 the appropriate committees of jurisdiction of Congress a  
22 report containing—

23           (1) the results of the study conducted under  
24           subsection (a);

1           (2) recommendations to modernize the proc-  
2           esses described in subsection (a)(1); and

3           (3) recommendations for such legislative and  
4           administrative action as NASEM, or such other ap-  
5           propriate entity, determines appropriate.

6           (d) AUTHORIZATION OF APPROPRIATIONS.—For the  
7           fiscal year 2022, there are authorized out of funds appro-  
8           priated to the National Science Foundation, \$1,000,000  
9           to carry out the activities under this section.

○