# H. R. 3588

# AN ACT

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".

6 **SEC. 2. MATHEMATICAL AND STATISTICAL MODELING EDU-**

7 **CATION.**

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

9 (1) The mathematics taught in schools, includ-

10 ing statistical problem solving and data science, is

11 not keeping pace with the rapidly evolving needs of

12 the public and private sector, resulting in a STEM

13 skills shortage and employers needing to expend re-

14 sources to train and upskill employees.

15 (2) According to the Bureau of Labor Statis-

16 tics, the United States will need 1,000,000 addi-

17 tional STEM professionals than it is on track to

18 produce in the coming decade.

19 (3) The field of data science, which is relevant

20 in almost every workplace, relies on the ability to

21 work in teams and use computational tools to do

22 mathematical and statistical problem solving.

23 (4) Many STEM occupations offer higher

24 wages, more opportunities for advancement, and a

25 higher degree of job security than non-STEM jobs.

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

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

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

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

24     (9) Mathematical modeling has been a strong
25 educational priority globally, especially in China,

1  where participation in United States mathematical

2  modeling challenges in high school and higher edu-

3  cation is orders of magnitude higher than in the

4  United States, and Chinese teams are taking a ma-

5  jority of the prizes.

6      (10) Girls participate in mathematical modeling

7  challenges at all levels at similar levels as boys, while

8  in traditional mathematical competitions girls par-

9  ticipate less and drop out at every stage. Students

10  cite opportunity for teamwork, using mathematics

11  and statistics in meaningful contexts, ability to use

12  computation, and emphasis on communication as

13  reasons for continued participation in modeling chal-

14  lenges.

15  (b) DEFINITIONS.—In this section:

16      (1) DIRECTOR.—The term ''Director'' means

17  the Director of the National Science Foundation.

18      (2) FEDERAL LABORATORY.—The term ''Fed-

19  eral laboratory'' has the meaning given such term in

20  section 4 of the Stevenson-Wydler Technology Inno-

21  vation Act of 1980 (15 U.S.C. 3703).

22      (3) FOUNDATION.—The term ''Foundation''

23  means the National Science Foundation.

24      (4) INSTITUTION OF HIGHER EDUCATION.—The

25  term ''institution of higher education'' has the

1     meaning given such term in section 101(a) of the

2     Higher Education Act of 1965 (20 U.S.C. 1001(a)).

3         (5) MATHEMATICAL MODELING.—The term

4     "mathematical modeling" has the meaning given the

5     term in the 2019 Guidelines to Assessment and In-

6     struction in Mathematical Modeling Education

7     (GAIMME) report, 2nd edition.

8         (6) OPERATIONS RESEARCH.—The term "oper-

9     ations research" means the application of scientific

10    methods to the management and administration of

11    organized military, governmental, commercial, and

12    industrial processes to maximize operational effi-

13    ciency.

14        (7) STATISTICAL MODELING.—The term "sta-

15    tistical modeling" has the meaning given the term in

16    the 2021 Guidelines to Assessment and Instruction

17    in Statistical Education (GAISE II) report.

18        (8) STEM.—The term "STEM" means the aca-

19    demic and professional disciplines of science, tech-

20    nology, engineering, and mathematics.

21    (c) PREPARING EDUCATORS TO ENGAGE STUDENTS

22 IN MATHEMATICAL AND STATISTICAL MODELING.—The

23 Director shall provide grants on a merit-reviewed, com-

24 petitive basis to institutions of higher education, and non-

25 profit organizations (or a consortium thereof) for research

1 and development to advance innovative approaches to sup-
2 port and sustain high-quality mathematical modeling edu-
3 cation in schools operated by local education agencies, in-
4 cluding statistical modeling, data science, operations re-
5 search, and computational thinking. The Director shall en-
6 courage applicants to form partnerships to address critical
7 transitions, such as middle school to high school, high
8 school to college, and school to internships and jobs.

9 (d) APPLICATION.—An entity seeking a grant under
10 subsection (c) shall submit an application at such time,
11 in such manner, and containing such information as the
12 Director may require. The application shall include the fol-
13 lowing:

14     (1) A description of the target population to be
15     served by the research activity for which such grant
16     is sought, including student subgroups described in
17     section 1111(b)(2)(B)(xi) of the Elementary and
18     Secondary Education Act of 1965 (20 U.S.C.
19     6311(b)(2)(B)(xi)), and students experiencing home-
20     lessness and children and youth in foster care.

21     (2) A description of the process for recruitment
22     and selection of students, educators, or local edu-
23     cational agencies to participate in such research ac-
24     tivity.

1    (3) A description of how such research activity
2    may inform efforts to promote the engagement and
3    achievement of students in prekindergarten through
4    grade 12 in mathematical modeling and statistical
5    modeling using problem-based learning with contex-
6    tualized data and computational tools.

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

13   (e) PARTNERSHIPS.—In awarding grants under sub-
14   section (c), the Director shall encourage applications that
15   include—

16       (1) partnership with a nonprofit organization or
17   an institution of higher education that has extensive
18   experience and expertise in increasing the participa-
19   tion of students in prekindergarten through grade
20   12 in mathematical modeling and statistical mod-
21   eling;

22       (2) partnership with a local educational agency,
23   a consortium of local educational agencies, or Tribal
24   educational agencies;

1    (3) an assurance from school leaders to making

2   reforms and activities proposed by the applicant a

3   priority;

4    (4) ways to address critical transitions, such as

5   middle school to high school, high school to college,

6   and school to internships and jobs;

7    (5) input from education researchers and cog-

8   nitive scientists, as well as practitioners in research

9   and industry, so that what is being taught is up-to-

10   date in terms of content and pedagogy;

11    (6) a communications strategy for early con-

12   versations with parents, school leaders, school

13   boards, community members, employers, and other

14   stakeholders; and

15    (7) resources for parents, school leaders, school

16   boards, community members, and other stakeholders

17   to build skills in modeling and analytics.

18   (f) USE OF FUNDS.—An entity that receives a grant

19 under this section shall use the grant funds for research

20 and development activities to advance innovative ap-

21 proaches to support and sustain high-quality mathe-

22 matical modeling education in public schools, including

23 statistical modeling, data science, operations research, and

24 computational thinking, which may include—

1          (1) engaging prekindergarten through grade 12
2     educators in professional learning opportunities to
3     enhance mathematical modeling and statistical prob-
4     lem solving knowledge, and developing training and
5     best practices to provide more interdisciplinary
6     learning opportunities;

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

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

16               (A) missing or incorrect values;

17               (B) quantities of data that require choice
18          and use of appropriate technology;

19               (C) multiple data sets that require choices
20          about which data are relevant to the current
21          problem; and

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

10

1  (4) taking a school or district-wide approach to

2  professional development in mathematical modeling

3  and statistical modeling;

4  (5) engaging rural local agencies;

5  (6) supporting research on effective mathe-

6  matical modeling and statistical modeling teaching

7  practices, including problem- and project-based

8  learning, universal design for accessibility, and ru-

9  brics and mastery-based grading practices to assess

10  student performance;

11  (7) designing and developing pre-service and in-

12  service training resources to assist educators in

13  adopting transdisciplinary teaching practices within

14  mathematics and statistics courses;

15  (8) coordinating with local partners to adapt

16  mathematics and statistics teaching practices to le-

17  verage local natural, business, industry, and commu-

18  nity assets in order to support community-based

19  learning;

20  (9) providing hands-on training and research

21  opportunities for mathematics and statistics edu-

22  cators at Federal laboratories, institutions of higher

23  education, or in industry;

24  (10) developing mechanisms for partnerships

25  between educators and employers to help educators

1   and students make connections between their mathe-

2   matics and statistics projects and topics of relevance

3   in today's world;

4   (11) designing and implementing professional

5   development courses and experiences, including men-

6   toring for educators, that combine face-to-face and

7   online experiences;

8   (12) addressing critical transitions, such as

9   middle school to high school, high school to college,

10   and school to internships and jobs; and

11   (13) any other activity the Director determines

12   will accomplish the goals of this section.

13   (g) EVALUATIONS.—All proposals for grants under

14   this section shall include an evaluation plan that includes

15   the use of outcome oriented measures to assess the impact

16   and efficacy of the grant. Each recipient of a grant under

17   this section shall include results from these evaluative ac-

18   tivities in annual and final projects.

19   (h) ACCOUNTABILITY AND DISSEMINATION.—

20   (1) EVALUATION REQUIRED.—The Director

21   shall evaluate the portfolio of grants awarded under

22   this section. Such evaluation shall—

23   (A) use a common set of benchmarks and

24   tools to assess the results of research conducted

1 under such grants and identify best practices;

2 and

3     (B) to the extent practicable, integrate the

4     findings of research resulting from the activities

5     funded through such grants with the findings of

6     other research on student's pursuit of degrees

7     or careers in STEM.

8     (2) REPORT ON EVALUATIONS.—Not later than

9 180 days after the completion of the evaluation

10 under paragraph (1), the Director shall submit to

11 Congress and make widely available to the public a

12 report that includes—

13     (A) the results of the evaluation; and

14     (B) any recommendations for administra-

15     tive and legislative action that could optimize

16     the effectiveness of the grants awarded under

17     this section.

18 (i) AUTHORIZATION OF APPROPRIATIONS.—For each

19 of fiscal years 2023 through 2027, there are authorized

20 to be appropriated to the National Science Foundation

21 $10,000,000 to carry out the activities under this section.

**SEC. 3. NASEM REPORT ON MATHEMATICAL AND STATIS-
TICAL MODELING EDUCATION IN PRE-
KINDERGARTEN THROUGH 12TH GRADE.**

(a) STUDY.—Not later than 60 days after the date of enactment of this Act, the Director shall seek to enter into an agreement with the National Academies of Sciences, Engineering and Medicine (in this section referred to as "NASEM") (or if NASEM declines to enter into such an agreement, another appropriate entity) under which NASEM, or such other appropriate entity, agrees to conduct a study on the following:

(1) Factors that enhance or barriers to the implementation of mathematical modeling and statistical modeling in elementary and secondary education, including opportunities for and barriers to use modeling to integrate mathematical and statistical ideas across the curriculum, including the following:

(A) Pathways in mathematical modeling and statistical problem solving from kindergarten to the workplace so that students are able to identify opportunities to use their school mathematics and statistics in a variety of jobs and life situations and so that employers can benefit from students' school learning of data

1 science, computational thinking, mathematics,

2 statistics, and related subjects.

3 (B) The role of community-based prob-

4 lems, service-based learning. and internships for

5 connecting students with career preparatory ex-

6 periences.

7 (C) Best practices in problem-, project-,

8 performance-based learning and assessment.

9 (2) Characteristics of teacher education pro-

10 grams that successfully prepare teachers to engage

11 students in mathematical modeling and statistical

12 modeling, as well as gaps and suggestions for build-

13 ing capacity in the pre-service and in-service teacher

14 workforce.

15 (3) Mechanisms for communication with stake-

16 holders, including parents, administrators, and the

17 public, to promote understanding and knowledge of

18 the value of mathematical modeling and statistical

19 modeling in education.

20 (b) PUBLIC STAKEHOLDER MEETING.—In the course

21 of completing the study described in subsection (a),

22 NASEM or such other appropriate entity shall hold not

23 less than one public meeting to obtain stakeholder input

24 on the topics of such study.

1  (c) REPORT.—The agreement under subsection (a)
2 shall require NASEM, or such other appropriate entity,
3 not later than 24 months after the effective date of such
4 agreement, to submit to the Secretary of Education and
5 the appropriate committees of jurisdiction of Congress a
6 report containing—

7      (1) the results of the study conducted under
8      subsection (a);

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

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

14  (d) AUTHORIZATION OF APPROPRIATIONS.—For fis-
15 cal year 2023, there are authorized to be appropriated to
16 the National Science Foundation $1,000,000 to carry out
17 the activities under this section.

Passed the House of Representatives July 26, 2022.

Attest:

*Clerk.*

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# AN ACT

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