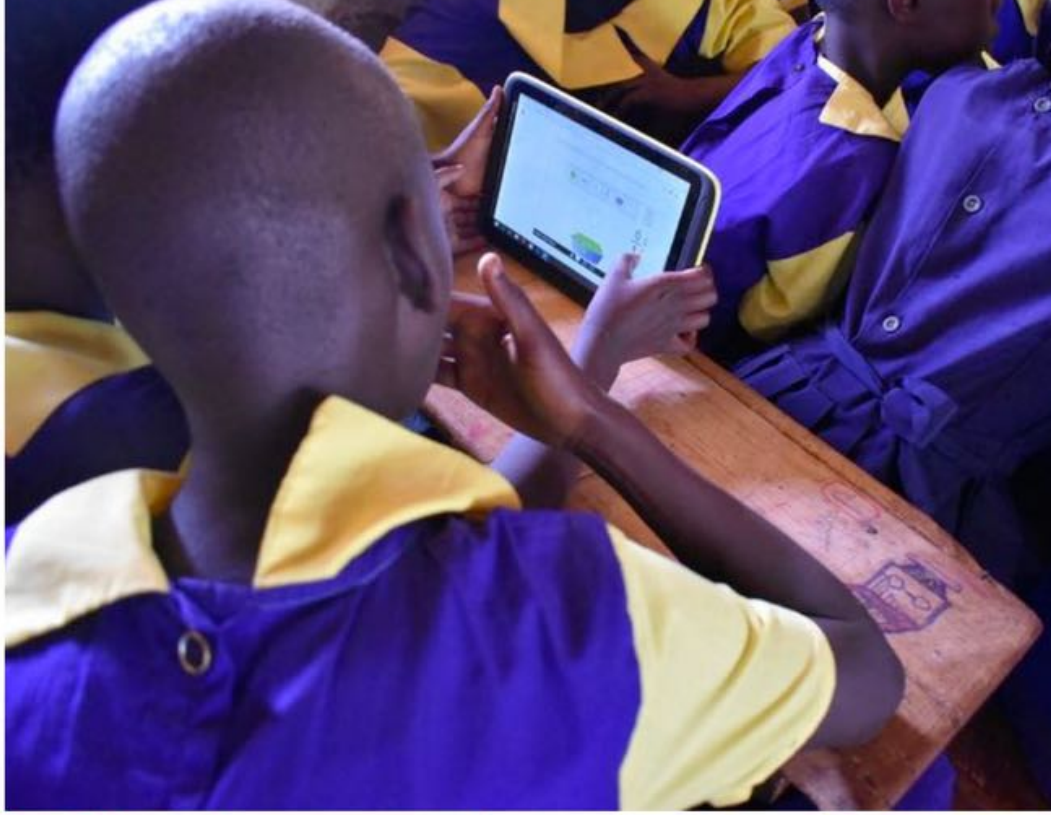
PhET INTERACTIVE SIMULATIONS
University of Colorado Boulder

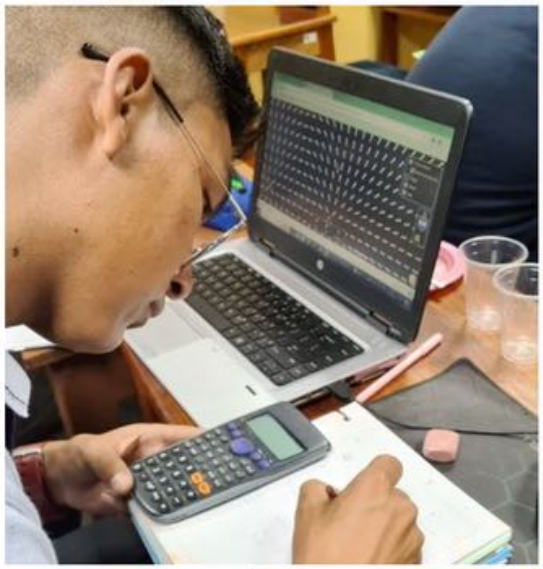
INTERACT DISCOVER LEARN

2024

# IMPACT REPORT

phet.colorado.edu






DELL

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# 2024 Report

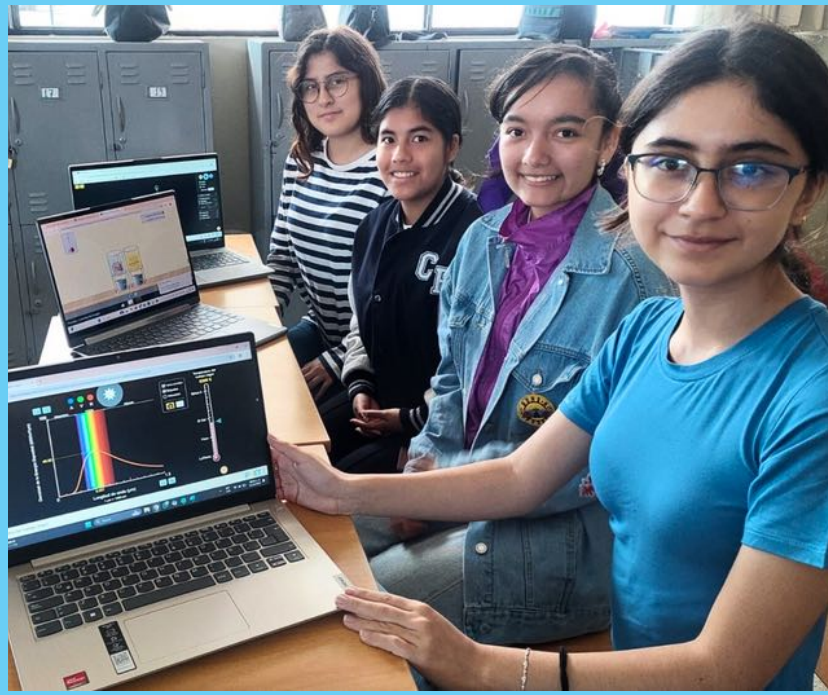
**A message from the Director**
**Dr. Kathy Perkins**

Every day, somewhere in the world, a student experiences that magical "aha" moment when a complex science or math concept suddenly becomes clear. For our team at PhET, these moments of discovery and understanding are why we do what we do. In 2024, these moments continued to grow—with over 250 million online simulation runs enabling approximately 50 million learners to explore and understand STEM concepts in deeper ways.

What makes these numbers meaningful is the human impact behind them. I'm moved by stories like the high school teacher in Kenya who shared, "Before, I felt constrained by the textbook, but now my lessons are more interactive, and my students are engaged in ways I hadn't seen before." These transformations in teaching and learning represent the heart of our mission

This year marked significant recognition of PhET's evidence-based approach, with the EdTech Digest's EdTech Award in the games for learning/simulation solution category and recognition from the U.S. National Academies of Science, Engineering, and Mathematics as one of the few grant-funded STEM education innovations that has effectively scaled. After more than two decades, our research-based design principles continue to demonstrate their value through measurable improvements in student attitudes and achievement across diverse global contexts.

The growth of our **PhET Global** initiative has been particularly rewarding, with our 67 PhET Fellows and 19 PhET Instructors creating ripple effects of change across 35 countries. Together, they've provided professional development to over 119,000 teachers, many in historically underserved regions. The ingenuity and dedication of these teacher-leaders—adapting PhET resources for local contexts, integrating them into national curricula, and supporting peer educators—exemplifies the power of our collaborative approach.



As we continue to scale, sustainability has become a strategic imperative. With careful consideration of our open education mission, we are developing innovations that generate sustainable revenue while expanding our contributions to the education community. The impending launch of **PhET Studio** represents an important step in this direction, while our commitment to technological sustainability through **SceneryStack** empowers developers worldwide to create their own accessible interactives.

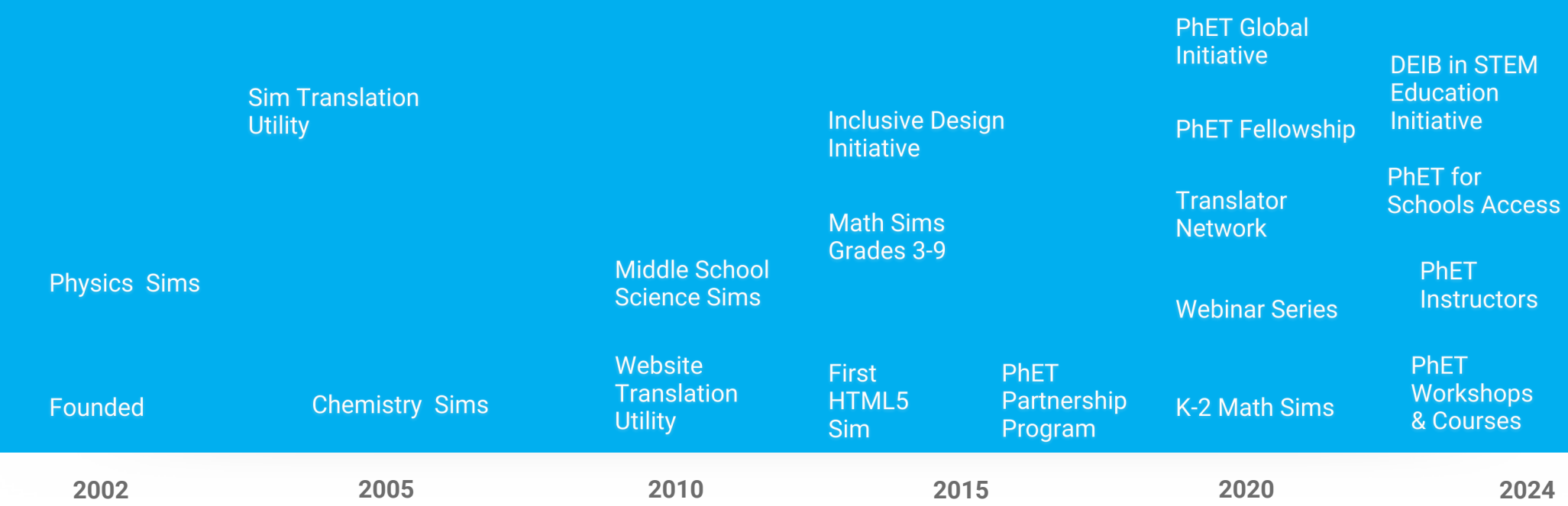
I'm profoundly grateful to our global community of learners, teachers, technology partners, researchers, and funders whose collaboration makes PhET's work possible. Together, we're bringing to life our vision of a world where science and math are inclusive, enjoyable, and empowering for all.

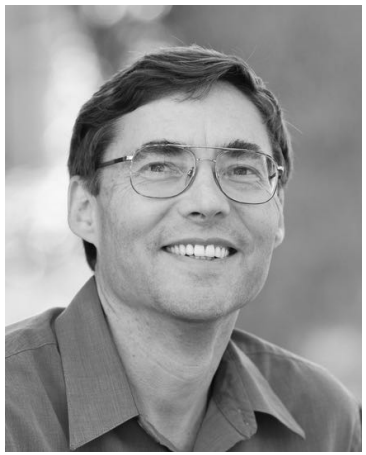
> Before, I felt constrained by the textbook, but now my lessons are more **interactive**, and my students are **engaged** in ways I hadn't seen before."
>
> **~ High school teacher, Kenya**

# About Us

Our Story, Mission, Vision, and Work

## Milestones



## About PhET Interactive Simulations

The PhET Interactive Simulations project at the University of Colorado Boulder creates free interactive simulations for science, math, and statistics learning.

PhET simulations are teaching tools that can support conceptual learning and skill development, and they are most effective when used in a teaching context that makes use of evidence-based, student-centered teaching and learning practices.

Founded in **2002**
by **Carl Wieman (Nobel Laureate)**

## Vision

PhET envisions a world where science and math are inclusive, enjoyable, and empowering.

## Mission

PhET advances science and math fluency by pioneering innovation in inclusive interactive simulations and fostering community research, design, and practices that inspire agency in teaching and learning.

## Team

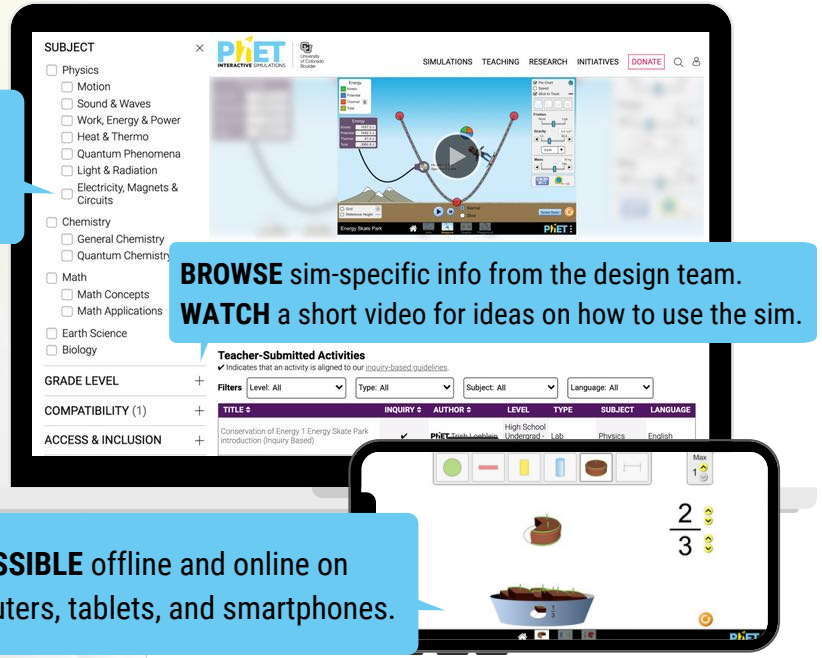
The PhET team is composed of nearly 40 members, each with deep experience in facets of science or math education, including K-12 and university teaching, education research, inclusive design, graphic design, and simulation development. Team members bring global expertise and are located across the United States, Canada, Mexico, Colombia, Nigeria, Kenya, and Austria.

Our team collaborates with hundreds of Trusted Translators, PhET Fellows, PhET Instructors, PhET Partners, and PhET Community Supporters.

# PhET has created over 170 open-access interactive simulations

**PhET Interactive Simulations** are flexible and engaging, allowing students to think more like scientists and mathematicians.

**BROWSE** sims by topic, grade level, device, and accessibility features.




**BROWSE** sim-specific info from the design team.
**WATCH** a short video for ideas on how to use the sim.

**ACCESSIBLE** offline and online on computers, tablets, and smartphones.

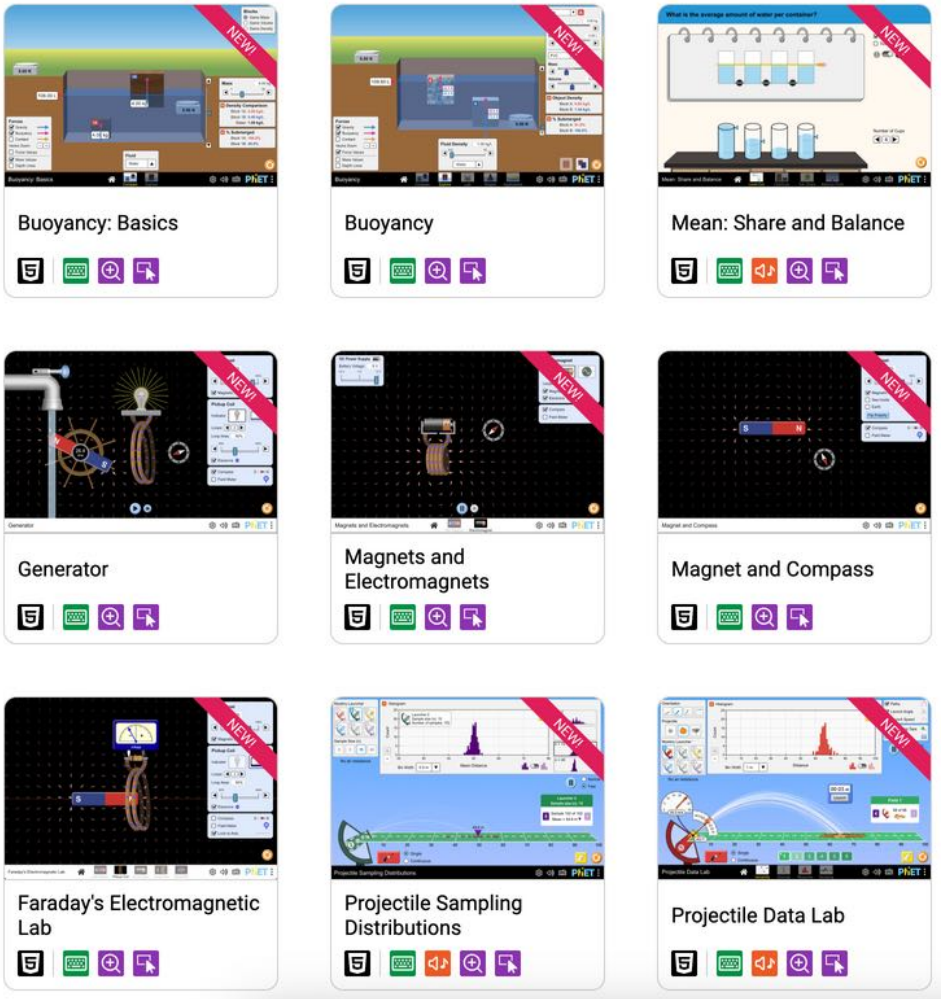
**PhET Interactive Simulations** are equitable and inclusive for learners of different languages, cultures, learning needs, and technology access.

PhET offers simulations and teacher resources in **128 languages**...




...and **regional portrayals** in select simulations to represent global cultural diversity.

PhET **expanded its collection by 9 simulations** in 2024 to now include **116 HTML5 simulations**...

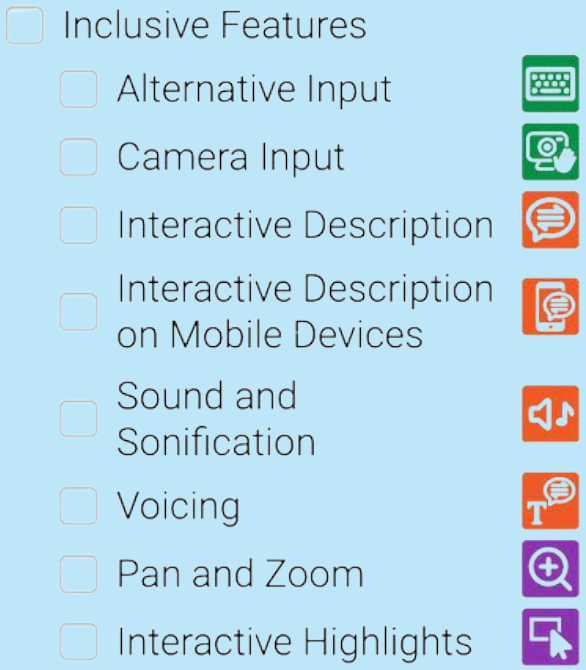



...published under a **CC-BY license** and which have **offline access** options...

...many of which have **inclusive features** to support learning differences.

**Inclusive features position what learners can see, hear, and feel, onto equal footing, resulting in learning tools that can:**

- be as effective non-visually as visually.
- empower sensorially diverse learners.
- result in new, less screen-centric, ways to learn with PhET sims.



# Strategic Lines

PhET works through five strategic lines to advance and sustain its work.

## Expanding Simulation STEM Content Coverage

PhET continues to expand coverage across math and science fields. Focus areas in the past years have included **early math**, **statistics, and data fluency**, and updating legacy simulations, including its **quantum** collection.

## Advancing PhET's Sustainability

PhET works to advance its financial, technical, and organizational and operational sustainability.

## Advancing Equity, Inclusion, and Access in STEM Education

Launched in 2013, the **Inclusive Design** initiative team brought together multiple inclusive design experts who pioneer innovative **inclusive features** that can benefit all students.

Launched in 2022, the **DEIB in STEM Education** initiative continues to provide support to underserved schools through the **PhET for Schools Access** program.

## Empowering Teachers and Advancing Pedagogy

Launched in 2021, the **PhET Global** initiative provides professional development to teachers worldwide through multiple channels including the **PhET Fellowship** and **PhET Instructors** program. PhET also provides capacity-building through its **Active Learning in STEM** and **Number Sense** courses offered via Coursera and the Verizon Innovative Learning HQ portal.

## Advancing Impact through Innovation, Collaboration, and Community

PhET leads design and technology innovation in highly interactive, multimodal, accessible simulations. It continues to sustain its foundation through the creation and maintenance of its foundational code structure, **SceneryStack**, supporting its **open source community**, and advancing educational research and ed tech products such as instrumented **PhET-iO** simulations.

# Supporters and Partners

## Key Supporters ($1,000,000+)

Gordon and Betty Moore Foundation

Yidan Prize 一丹奖

NSF

verizon

mastercard foundation

William + Flora Hewlett Foundation

Google.org

The O'Donnell Foundation

University of Colorado Boulder

C. Wieman & S. Gilbert

## Major Supporters ($100,000+)

EF+MATH supported by aerdf

Bill & Melinda Gates foundation

The Kavli Foundation

جامعة الملك سعود King Saud University
مركز التميز البحثي في تطوير تعليم العلوم والرياضيات

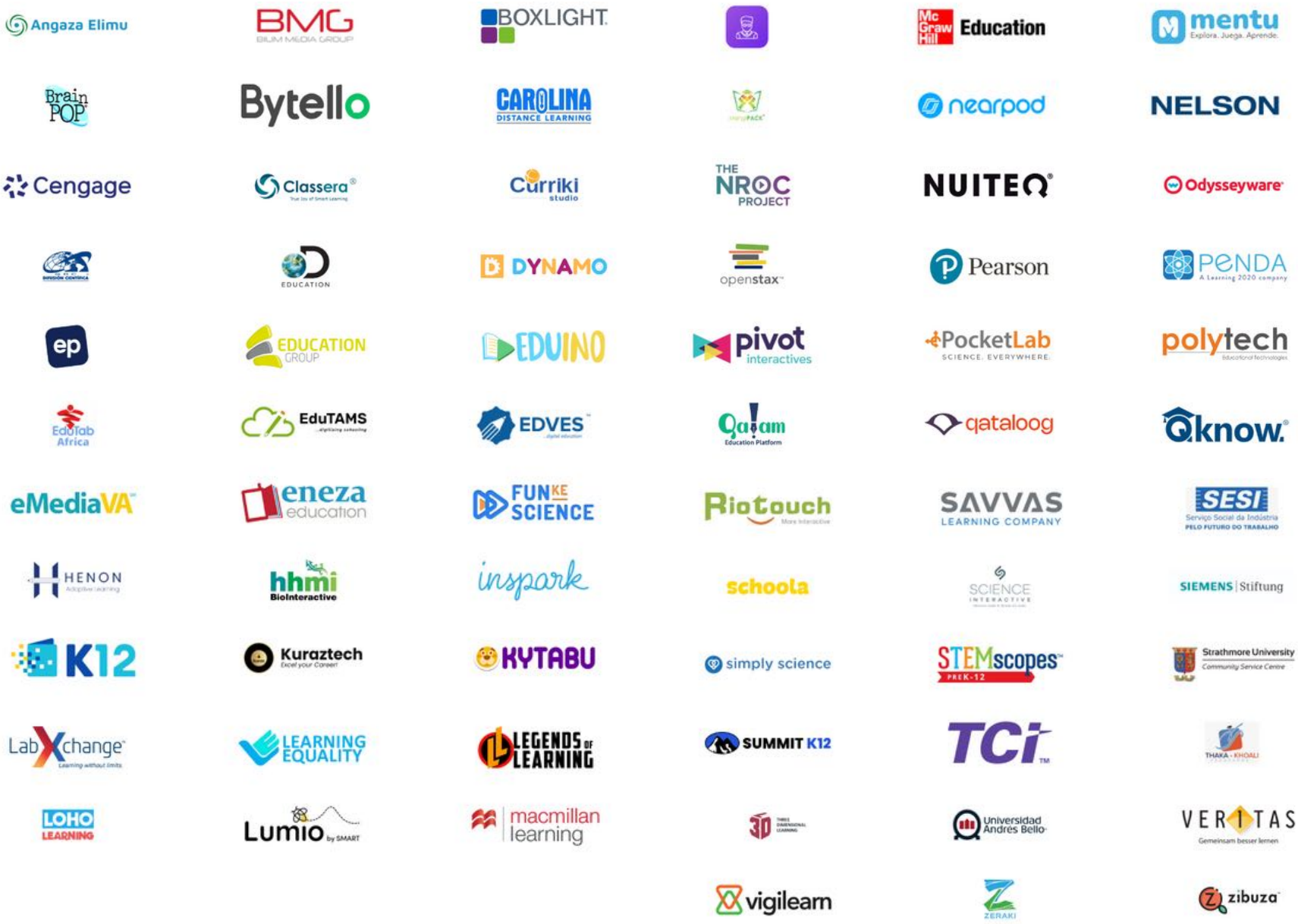
newschools venture fund

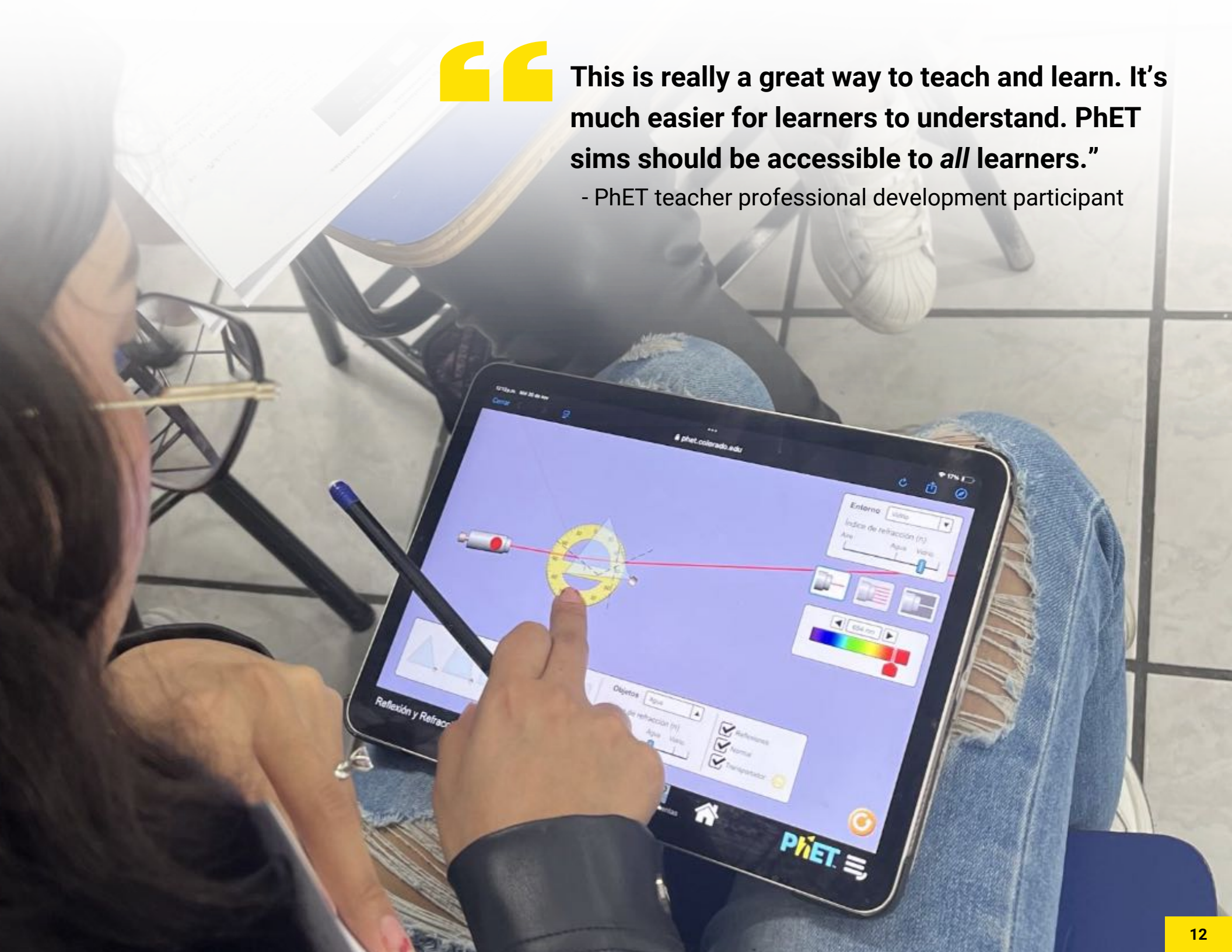
STROBE Building the microscopes of tomorrow

Schmidt Futures

# Supporters and Partners

## Licensing Partners






**This is really a great way to teach and learn. It's much easier for learners to understand. PhET sims should be accessible to *all* learners."**

- PhET teacher professional development participant

# Our Reach in Numbers

# Our Reach

**Sim Runs (Online)**

**1.7B+**

250M+ in 2024

**Languages**

**128**

7 new in 2024

**HTML5 Sims**

**116**

**72 with an inclusive feature**

9 new sims in 2024

**Teacher Activities**

**3,600+**

178 new in 2024

**Teachers Supported through PhET Programs**

**119K+**

61K+ in 2024

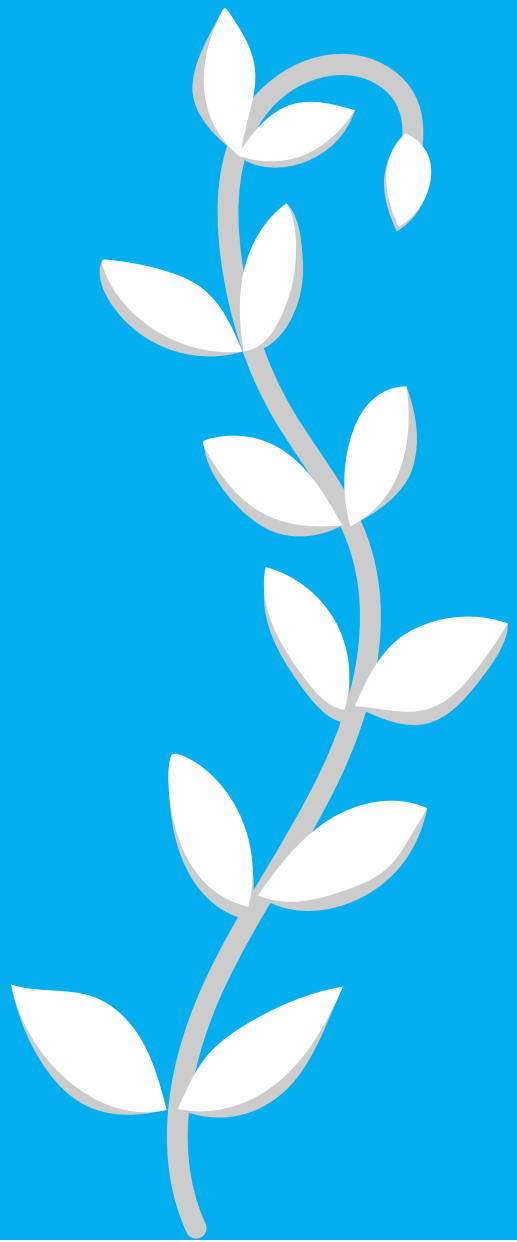
**PhET Fellows**

**67**

**PhET Instructors**

**19**

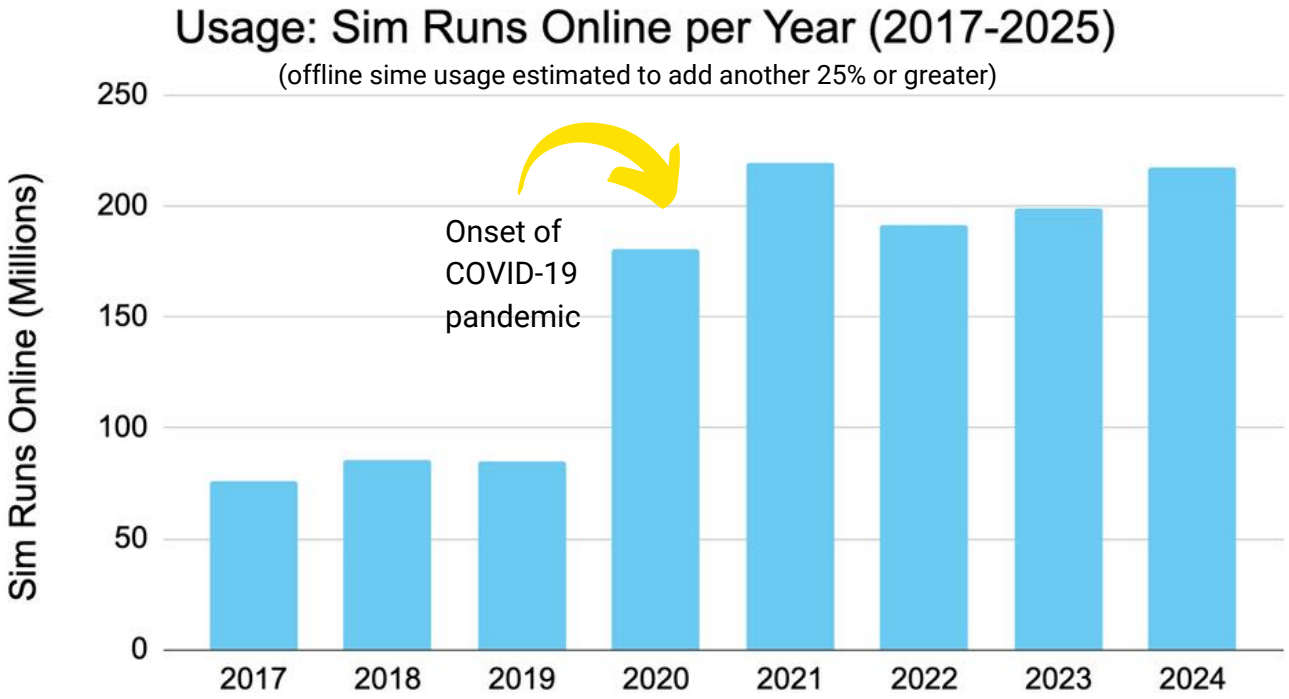
Program launched in 2024



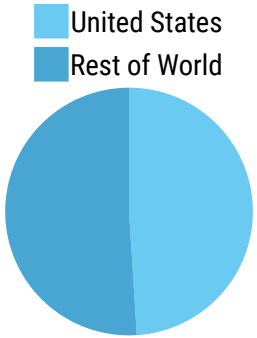
> “Now that I’m using PhET simulations, it’s the *students* who are the ones asking questions.”
>
> **- High school teacher, Colombia**

# Footprint

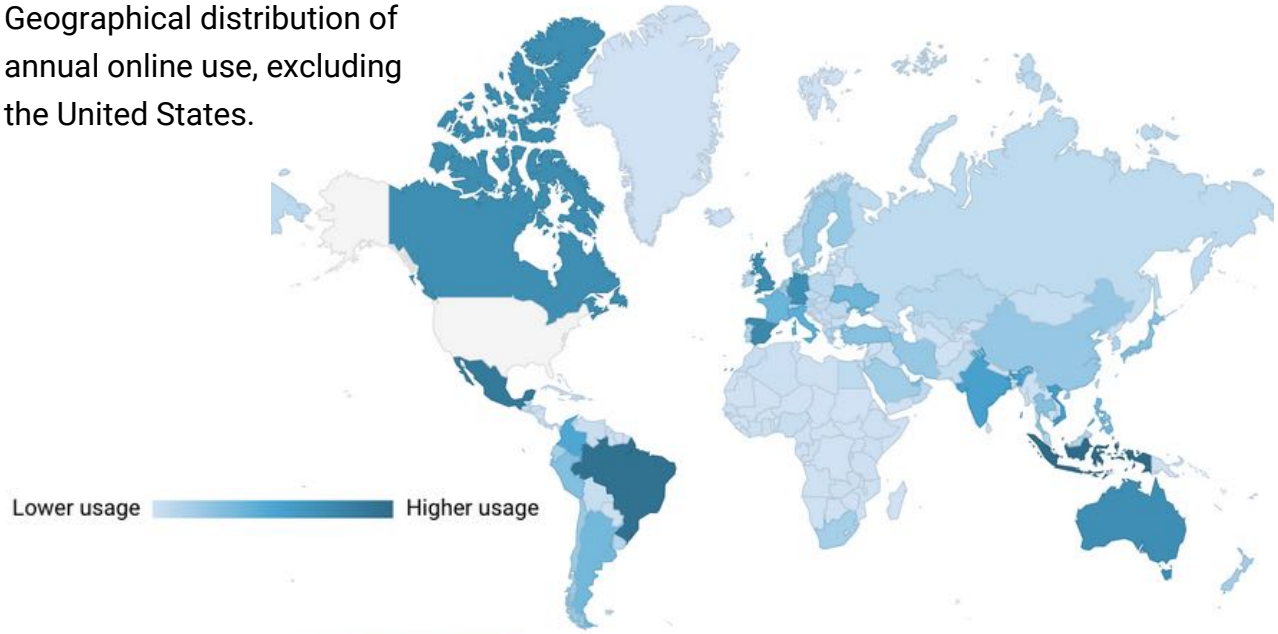
PhET documents online uses and downloads. Surveys suggest that ~50-75% of usage in some areas may be offline.



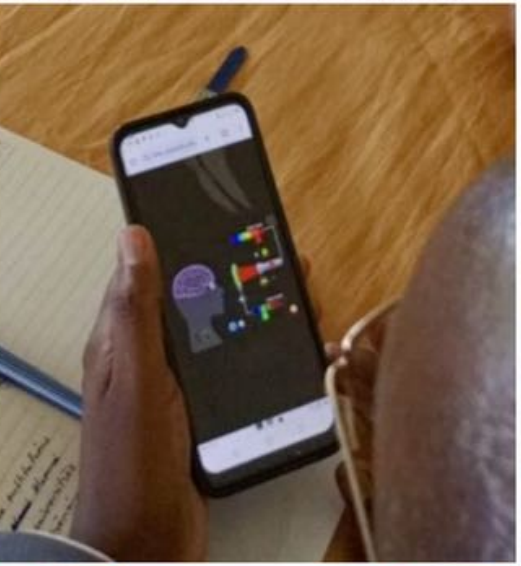

Of online usage, about 49% comes from within the United States, with just over half (51%) from other regions around the world.




Geographical distribution of annual online use, excluding the United States.




57 results
SAMSUNG




Generación 2
Añadir mutaciones
Dominante
Recesivo
Piel
Orejas
Dientes
Factores ambientales
Lobos
Comida dura
Comida blanda
Población
Proporciones
Pedigrí
Ninguno
Total

# Strategic Lines & Initiatives

2024 Advancements & Vision for the Future

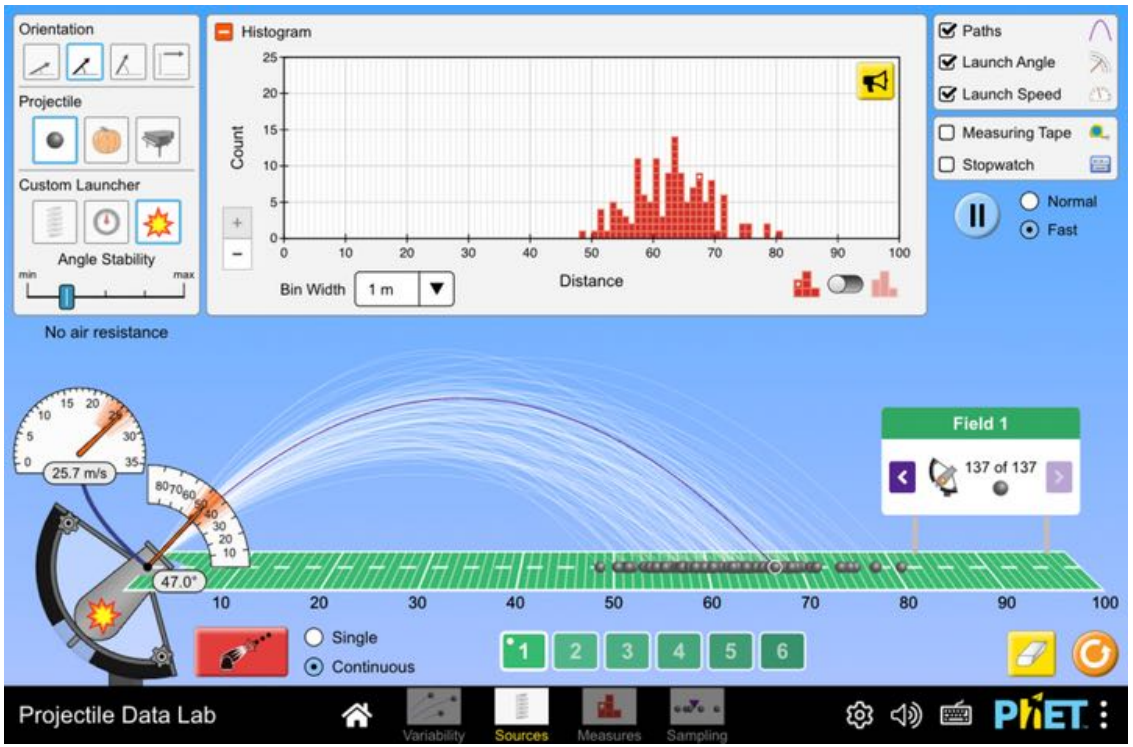
# Expanding Simulation STEM Content Coverage

PhET continues to expand coverage across math and science fields. Focus areas include **statistics and data fluency** and the **update of legacy sims**.

**Statistics and Data Fluency**
PhET is making inroads to support data intuition, literacy, and fluency. In 2024, PhET published 3 sims to support foundational statistics concepts as well as experimental data collection. We also partnered to integrate sims with Concord Consortium's open education resource, the Common Online Data Analysis Platform (CODAP).

**Next Generation PhET Sims**
In 2024, PhET re-designed and republished 6 legacy sims, including

- Buoyancy sim suite (2 sims)
- Faraday's Electromagnetic Lab sim suite (4 sims)




## Our future aspirations ...

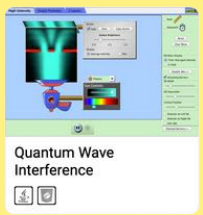
01 Build a **full suite of early math simulations**, bringing open play, exploration, and discovery to engage young learners and address equity in math literacy.

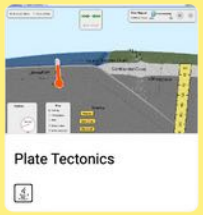
02 Provide more opportunities for students to develop **data fluency** through explorative **statistics** simulations and by adding **sources of variability** into existing science simulations.

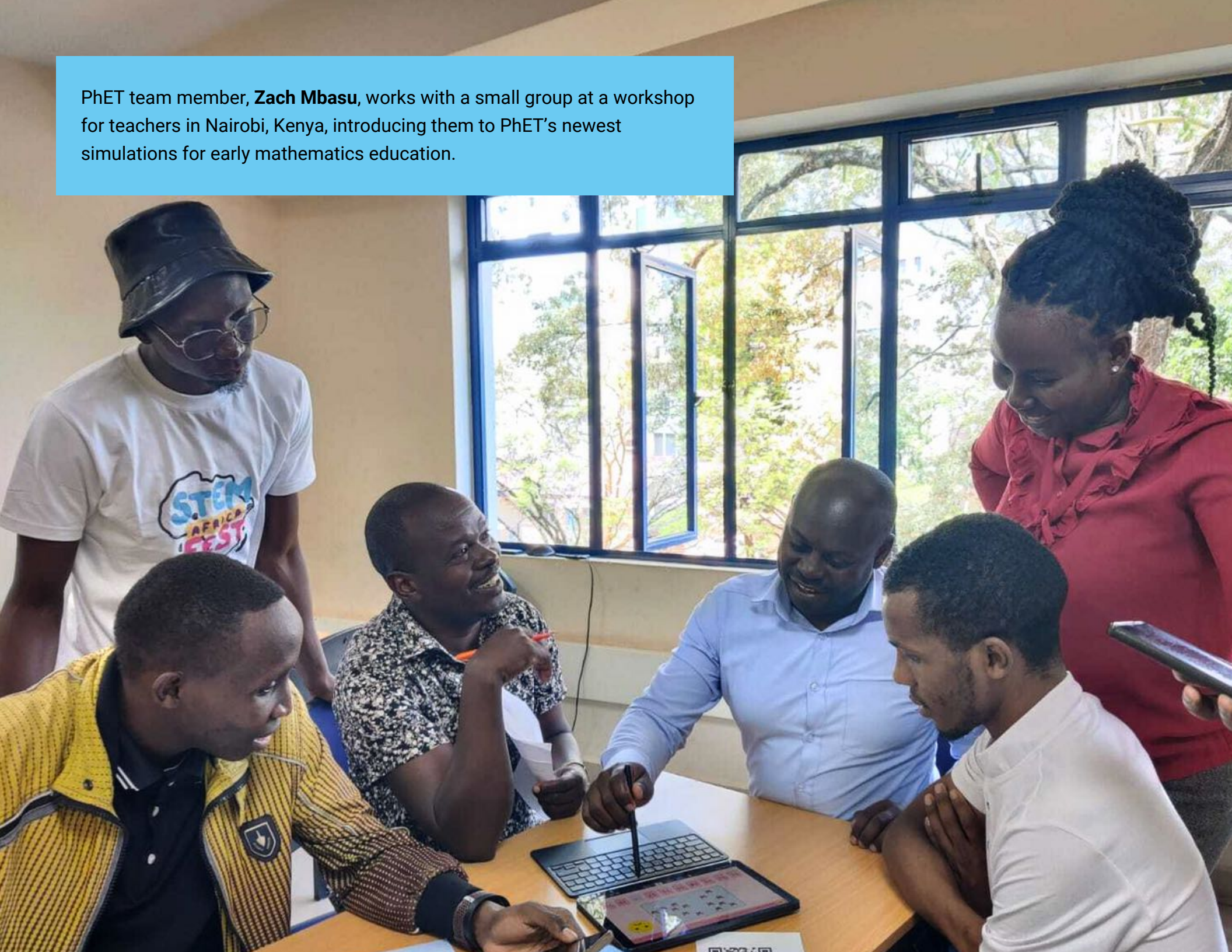
03 Design, develop and publish simulations covering **new STEM content fields**, like quantum concepts, and other gaps identified across international curricula.

04 Regain learning opportunities lost to technology changes by redesigning our remaining **legacy simulations in HTML** (50 Java and 5 Flash simulations).

Example legacy simulations.

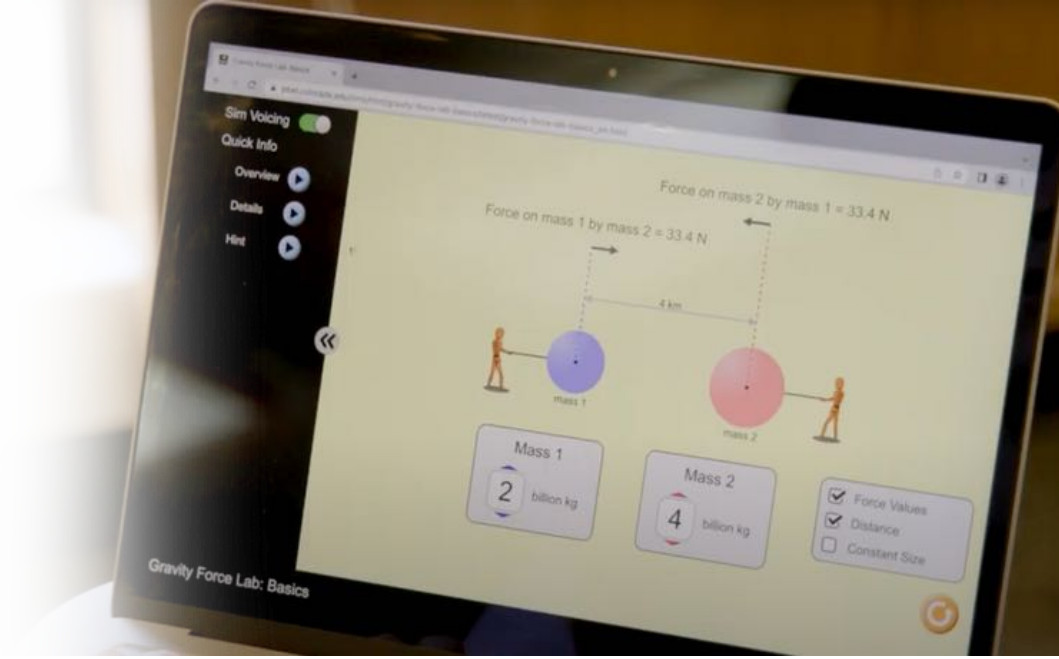



PhET team member, **Zach Mbasu**, works with a small group at a workshop for teachers in Nairobi, Kenya, introducing them to PhET's newest simulations for early mathematics education.

# Advancing Equity, Inclusion, and Access in STEM




## Inclusive Design Initiative

Launched in 2013, the **Inclusive Design** initiative team engages i research on and expands the implementation of fully inclusive simulations.

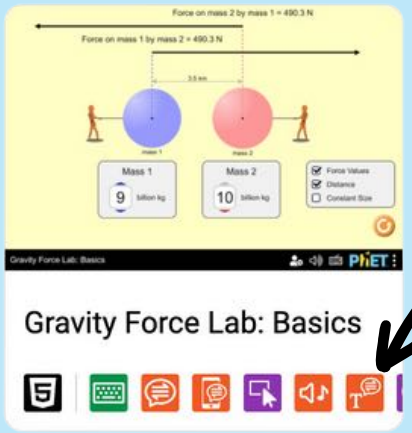
Inclusive features position how learners experience simulations t

- be as effective non-visually as visually.
- empower sensorially diverse learners.
- result in new, less screen-centric, ways to learn with PhET sims.

PhET's inclusive design is rooted in academic research. See some of our team's most recent publications:

- Hill et al., 2023
- Lambert et al., 2022
- Fiedler et al., 2022
- Smith & Moore, 2020
- Smith et al., 2018

Learn more about the Inclusive Design initiative: https://phet.colorado.edu/en/inclusive-design




**10** types of inclusive features integrated into published and prototype simulations

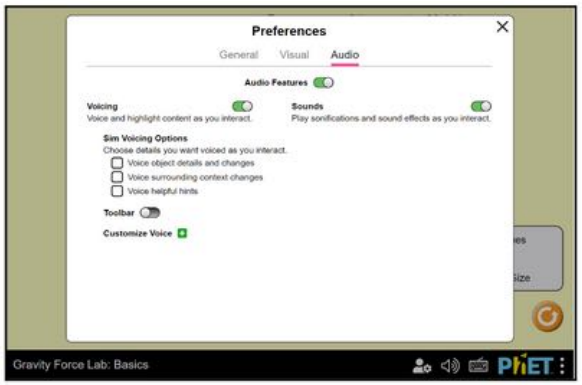
**72** simulations with one or more inclusive features

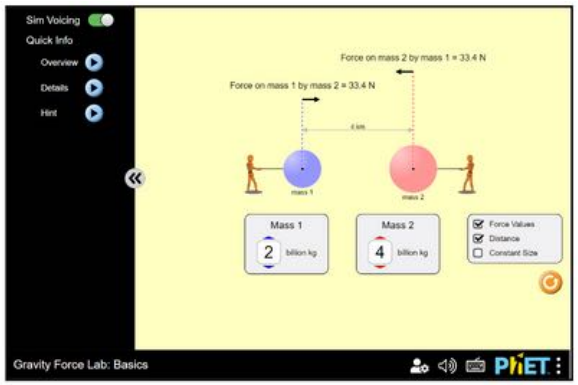
**1** tool published to explore vibratory haptics (Haptics Playground Android app)


GET IT ON Google Play

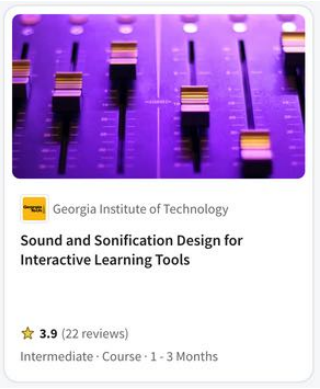
The team has pioneered a **description design framework** (Smith & Moore, 2020) for the design of **dynamic interactive** described experiences, making interactive media and sim experiences accessible via screen-reader software and web-based text-to-speech.

To share the team's learnings about auditory display design (description and sound & sonification), PhET continues to maintain two courses that are publicly available from *Coursera*.







# Diversity, Equity, Inclusion, and Belonging (DEIB) in STEM Education Initiative

Launched in 2022, the **DEIB in STEM Education** initiative has made substantial advancements to the strategic plan co-developed with the DEIB Advisory Board.

## *Recommendations for PhET Simulations*

addressed in 2024:

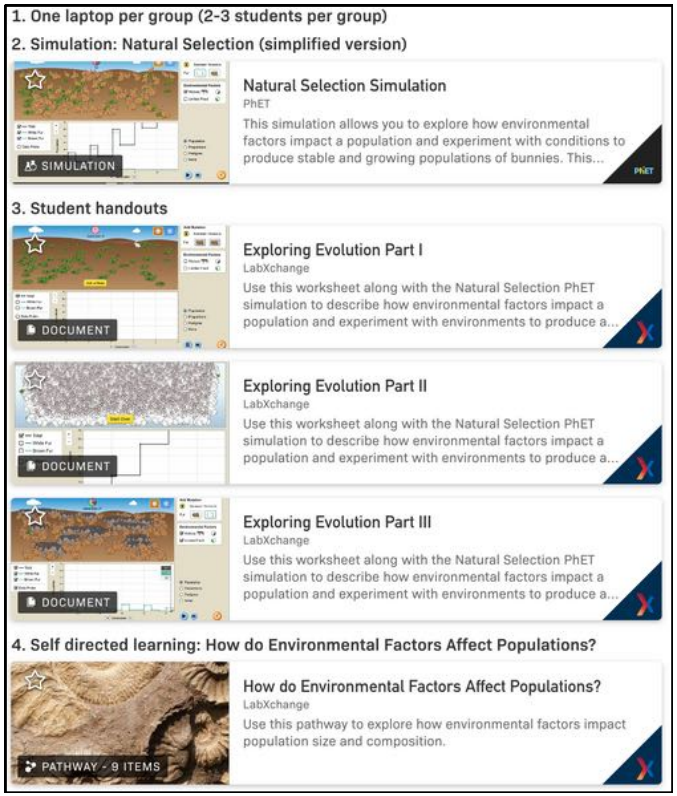
1. Multi-Platform Access
2. Multi-Content Area Access
3. Integrated Content Area Access
4. Multiple Grade Level Access
5. Diversified Character Sets
6. Inclusive Features
7. Translation Features
8. Past and Present Contributions
9. Career Connections
10. Real-World Applications

**9** new HTML5 simulations published:

- Elementary through university
- Math, statistics, physics, earth & space science
- 2 legacy simulations

**66** PhET simulations now include **dynamic locale** for in-sim language switching and/or regional portrayals.

**29** members of the PhET Fellowship engaged in partnership with LabXchange to create **PhET-anchored, equity-focused learning pathways** with other digital content, including videos, biographies, animations, etc.

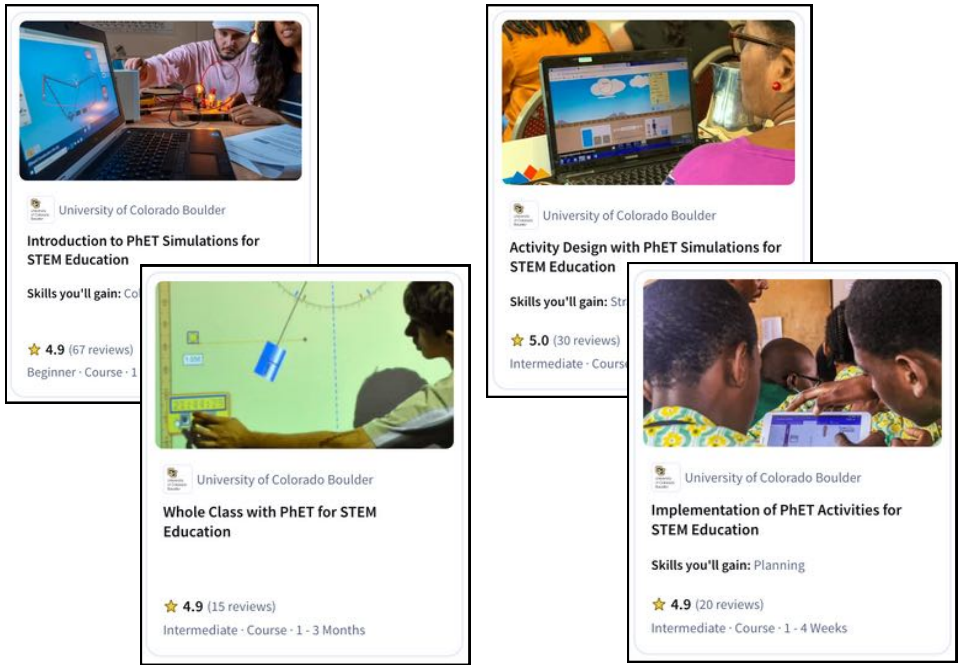


# *Recommendations for PhET Teacher Professional Development*

addressed in 2024:

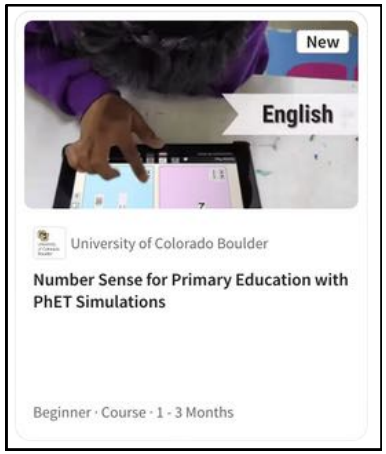
**4** courses available on Coursera through the specialization, *Active Learning in PhET with STEM Interactive Simulations*

- Revised and expanded to include alignment with the **PhET Equity Framework** for STEM education
- Used as a foundation for **equity standards** in PhET's Activities peer review process.
- Content now available in English, Spanish, and Portuguese




**1** new course available on Coursera, *Number Sense for Primary Education with PhET Simulations*

- Developed to support teachers of **emergent multilingual learners**.
- Content available in English, with imminent publication in Spanish



# *PhET for Schools Access Program*

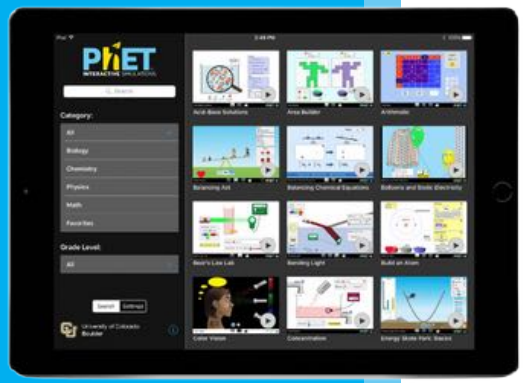
Thanks in part to a generous grant from Verizon, the PhET for Schools Access Program is providing over 400 eligible public school districts and schools **access to the PhET iOS and Android/Chromebook apps at no cost** for the 2024-2025 school year, enabling districts and schools to install the apps on school-issued compatible iPad, Chromebook, and Android devices. The PhET Apps enable anywhere, anytime use of PhET simulations, without needing an internet connection.

In the 2024-2025 school year, program participants included:

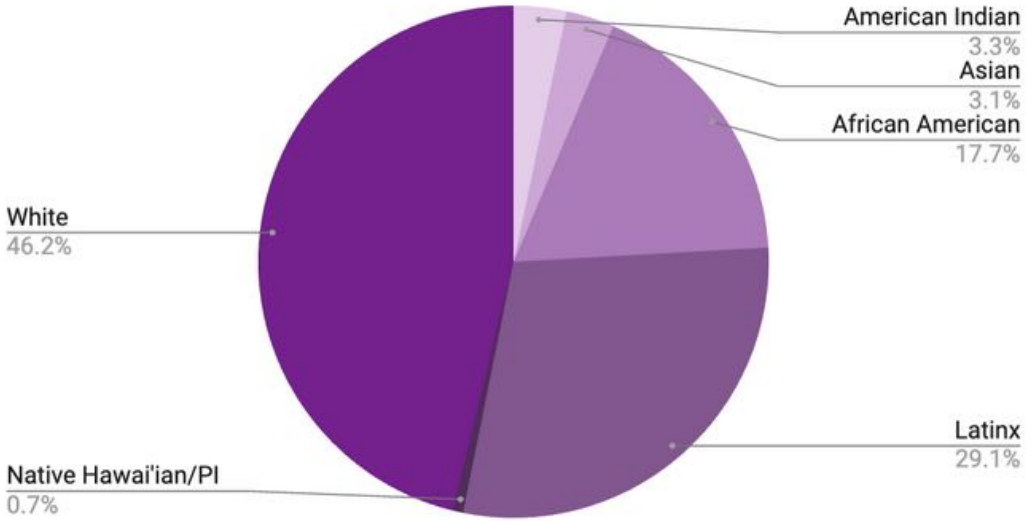
**476** individual schools

**232K** students

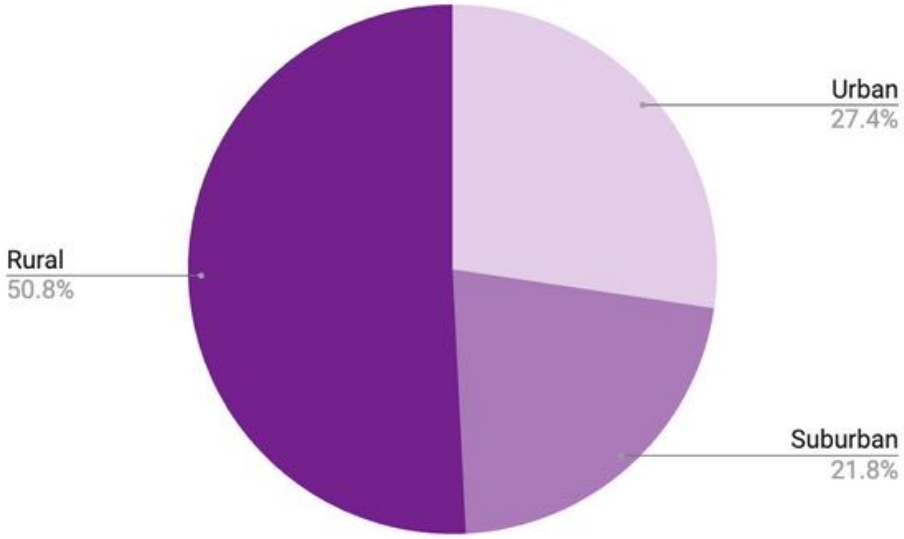
Hundreds of individuals who took one or more of PhET's **7** mini courses on the VIL HQ platform.



**Beneficiary student racial demographics.**




**Participating school location type.**



# *Localization and Contextualization*

PhET maintains a **Translator Network** that supports the translation of PhET simulations, teacher resources, and the PhET website into **128 languages**.

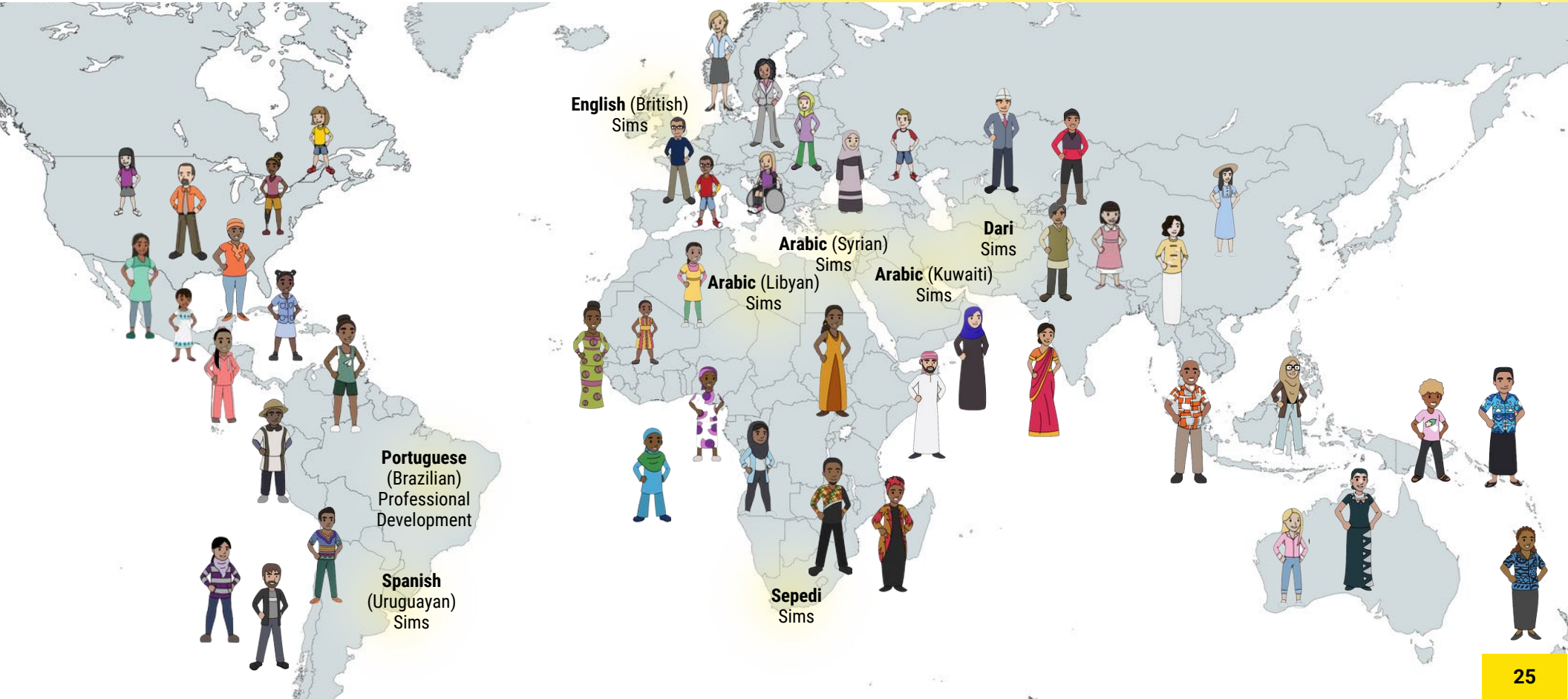
In 2024, PhET invested in its translation infrastructure to expand the number of possible languages and language variants, added translations into 7 new languages, and continued expanding the number of simulations with available **regional portrayals**.

## Our future aspirations ...

01 **Ensure that equity is at the core of PhET-based work** by continuing to advance the recommendations of the DEIB in STEM Education Advisory Board.

02 **Leverage Generative AI** to scale the accessibility of PhET simulations for students with diverse learning needs.

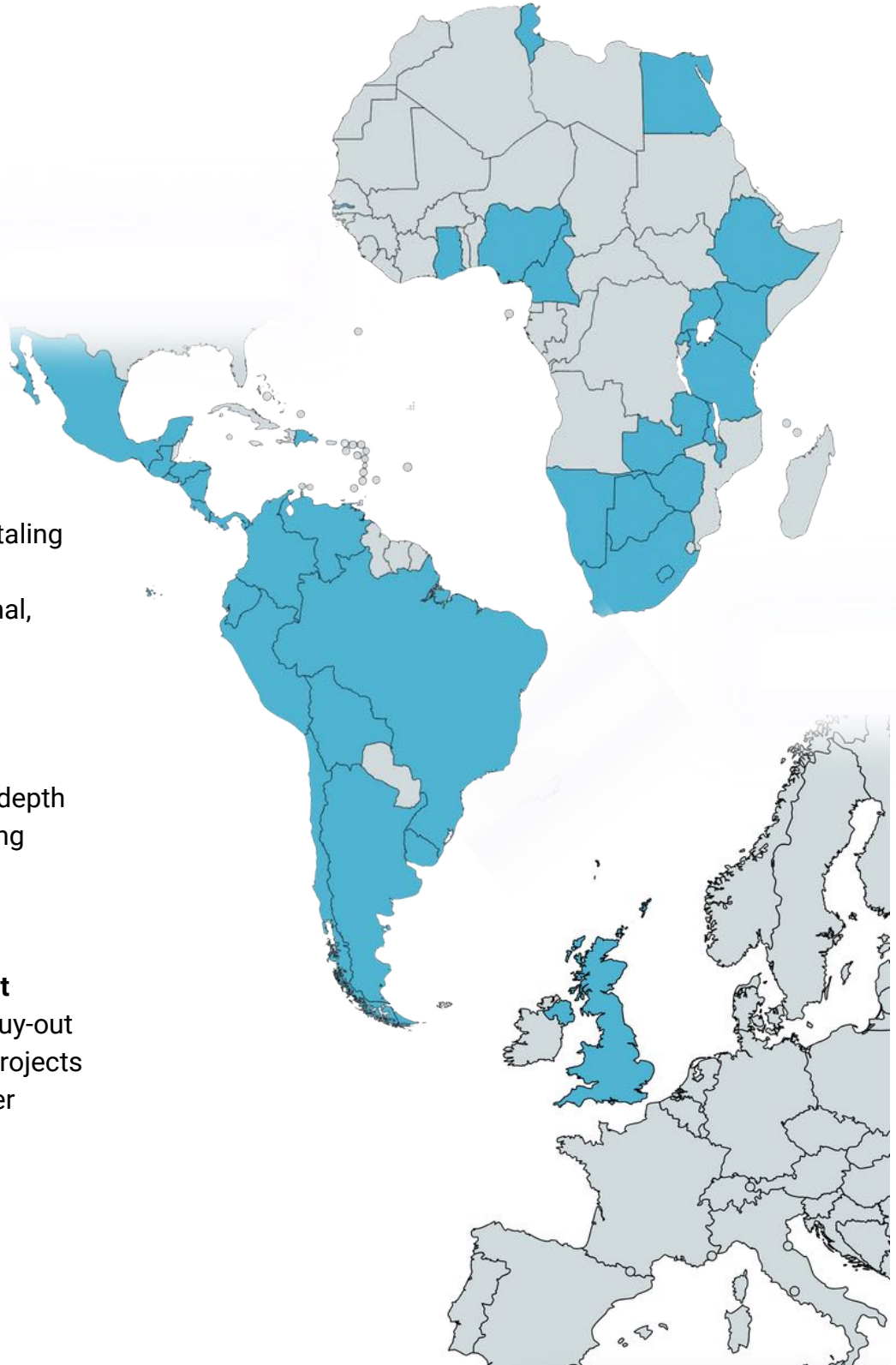
03 Expand easy mobile and offline access to PhET sims by fostering corporate and private sponsors for the mobile **PhET App.**



# Empowering Teachers and Advancing Pedagogy

## *PhET's Leadership Programs*

PhET continues to nourish a community of teacher leaders who advocate for high-quality math and science education.



**PhET Fellows (Africa & Latin America)**
In 2024, 34 exemplary educators completed the PhET Fellowship, totaling **66 PhET Fellows** representing **33 countries** since the launch of the program. Each 18-month cohort saw teachers develop as instructional, association, and policy leaders in their regions.

**PhET Instructors (Latin America)**
This program, launched in 2024, identified **19 PhET Instructors** representing **10 countries**. This program focuses exclusively and in-depth on instructional leadership, helping support teacher educators to bring PhET to professional communities.

**Ogden Trust Senior Teacher Fellows at PhET (United Kingdom)**
Throughout 2024, PhET supported the engagement of **4 Ogden Trust Master Teacher Fellows** placed at PhET. These teachers receive a buy-out of their time (typically half or one day per week) to work on special projects related to the creation of PhET-based instructional resources, teacher professional development for others, or educational research.

# *PhET Fellows*

The impact of PhET Fellows is wide-reaching and diverse. Accomplishments include the following:

- Leading PhET teacher workshops
- Training government leaders & policymakers
- Integrating PhET into university teacher pre-service programs
- Hosting conferences for professional societies
- Directly engaging with youth

> “It has been an invaluable experience, providing significant opportunities for professional growth. The leadership practice component has fostered personal and professional development, **enhancing my capacity to lead** and my ability to integrate PhET sims into classroom instruction to improve STEM education.” ~ PhET Fellow, Africa

> “I am convinced that part of **my vocation and calling is to** make an impact in my community to **improve the quality of education**, and **the PhET model is a simple and effective tool to achieve this**.” ~ Luis Mijangos, Guatemala

**Richard's H. Boni**'s 25-year journey as a science educator has been transformative, and the PhET Fellowship in 2022 marked a significant milestone.

As a chemistry teacher, he leveraged PhET simulations to enhance students' understanding of abstract concepts, yielding impressive **gains on the West African Senior Secondary Certificate Examination**.

The **PhET Fellowship opened doors** for him to transition into the Western Regional STEM Coordinator role in Ghana, where he empowers other educators and advocates for integrating PhET sims into the curriculum. His advocacy has contributed to **including PhET sims in Ghana's new senior high school curriculum** for the 2024-2025 academic year, a testament to the profound impact of the PhET Fellowship on his career and the broader education landscape.


> **The sense of community and the willingness to collaborate and share ideas have been truly inspiring."**
> ~ Richard H. Boni

## *PhET Instructors*

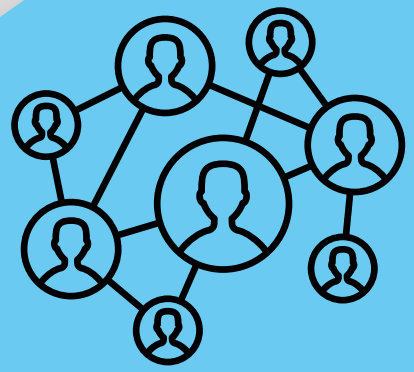
With an explicit focus on instructional leadership, the PhET Instructors program is helping to expand the leadership capacity of individuals who have already completed the *Active Learning in STEM with PhET Interactive Simulations* 60+ hour sequence on Coursera.

Moving forward, each Instructor is committed to leading an in-depth PhET workshops for their region.

"Simulations have managed to make complex concepts more accessible and understandable, **awakening in my students a curiosity and genuine interest in science**."
~ Leidy Zuluaga, Colombia

## *Ogden Trust Senior Teacher Fellows at PhET*

These Fellows are selected for their existing expertise in physics teaching, and supported to carry out individual passion projects across England.



**119K+**

teachers reached through PhET Global programs between January 2021 and December 2024.

# ***Teacher Workshops*** *- Geographical Presence*

Through PhET's Global Initiatives launched in 2021, PhET has consistently provide professional development to teachers around the world in English and Spanish, with emergent offerings in Arabic and Portuguese. PhET offers workshops and other professional development experiences through virtual workshops (on *Coursera* and *VIL HQ*, with additional workshop content on the PhET webpage), as well as in-person and blended programs through staff, PhET Fellows, and PhET Instructors.

**35** countries held **face-to-face or blended** capacity-building activities since the launch of PhET Global. Events were facilitated in coordination with PhET Fellows and/or members of the PhET team, supporting the following numbers of teachers:

**72** in the United Kingdom

**60** in Uzbekistan

**178** in Tunisia

**20** in Libya

**797** in Ethiopia

**829** in Ghana

**717** in Tanzania

**30** in The Gambia

**97** in the USA

**1,057** in Mexico

**521** in Cameroon

**31** in Nicaragua

**120** in Peru

**360** in El Salvador

**55** in the Dominican Republic

**458** in Nigeria

**111** in Zimbabwe

**149** in Uganda

**2,453** in Kenya

**282** in Colombia

**646** in Venezuela

**21** in Zambia 7

**646** in Rwanda

**60** in Mauritius

**50** in Hong Kong

**70** in Chile

**236** in Bolivia

**152** in Brazil

**46** in Costa Rica

**58** in Argentina

**100** in Namibia

**27** in Botswana

**150** in Malawi

**296** in Lesotho

**100** in the Philippines

# ***Teacher Workshops*** *- Extended In-Person Learning*

**953** teachers have participated in extended (3-100 hour) professional development (not including *Coursera* workshops) since the launch of PhET Global. These workshops were offered in a variety of formats, including on partner learning management systems and during in-person events.

These workshops typically required teachers to demonstrate mastery through...

- creation of lesson plans
- lesson demonstrations with an observing colleague
- and/or a portfolio of evidence of implementation

## *Teacher Workshops - Virtual*

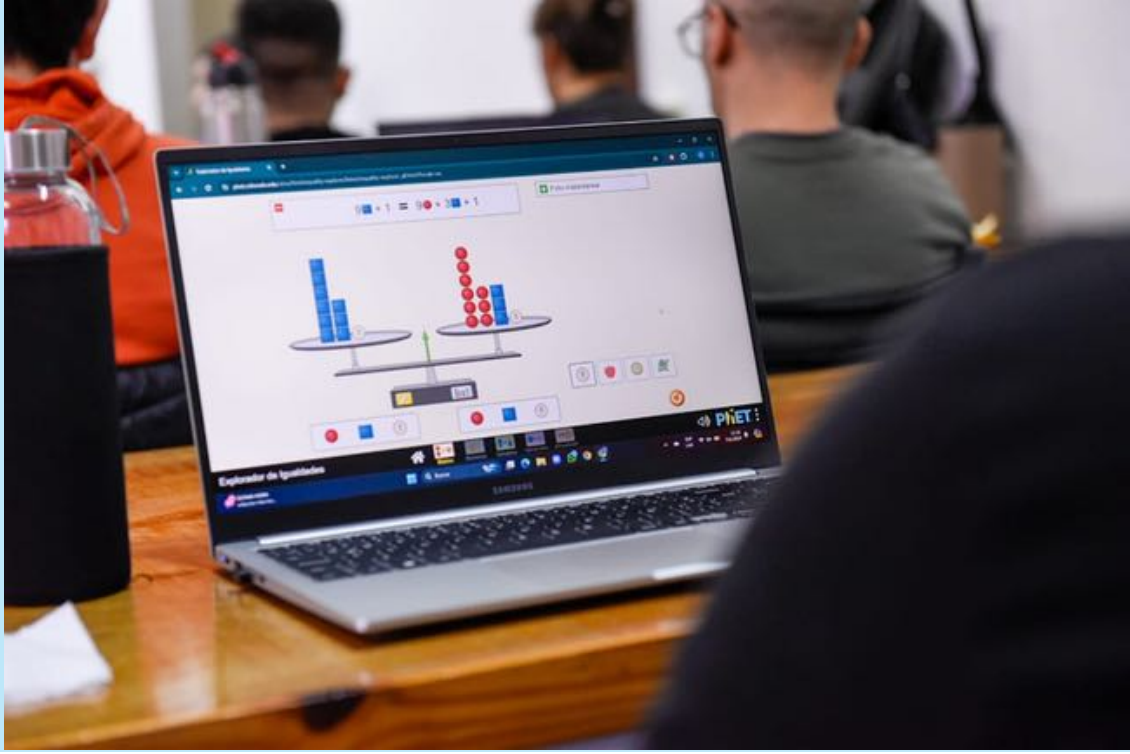
**5** courses offered via *Coursera* in 3 languages

**75** hours of professional development

**11,811** teacher enrollments (cumulative)

**1,094** teachers (cumulative) completed the specialization, providing **evidence of implementation** of PhET with their students.

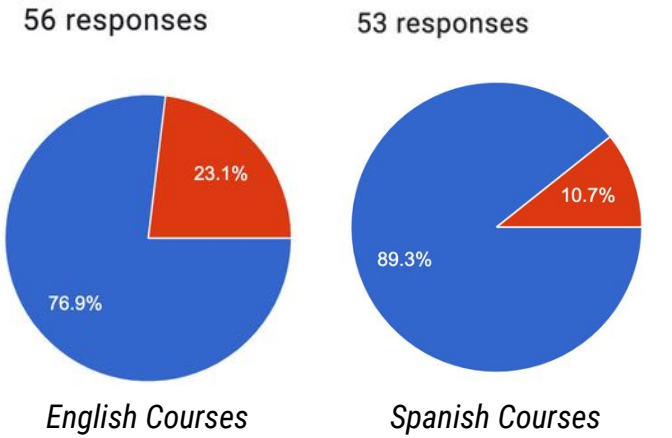
**608,761** students indirectly reached through teacher participants (cumulative)



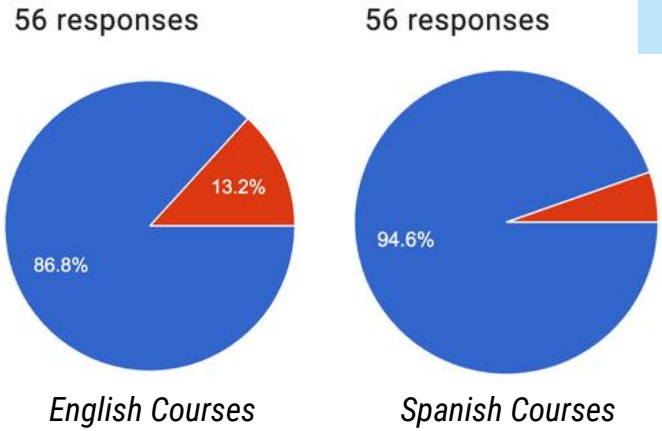
**77-95%** of teacher participants report on surveys 1-9 months after taking the course that they continued to make use of PhET simulations and active learning pedagogies.

> The assignments helped me to explore more about what PhET has to offer, both through the variety of simulations and the **teaching techniques** presented in the course."
> ~ Course participant

Have you used any **PhET resources** since taking the course(s)?




Have you used any **PhET pedagogies** since taking the course(s)?



# *Researcher and Practitioner Webinar Series*

PhET aims to improve effective pedagogical practice broadly. To enhance awareness of effective practice and bolster the reseacrh community, PhET has offered regular 1-hour webinars since the launch of PhET Global.

**Latin America "Teaching with PhET":** Monthly sessions predominantly showcase Latin American, Spanish-speaking teachers who make use of PhET, often focusing in on specific curricular topics or even individual lesson plans.

**Africa "Share & Discuss with PhET":** Monthly sessions showcase African researchers who study PhET, as well as African classroom teachers who put evidence-based strategies into practice.

**Global Conversations:** Occasional webinars outside of our regular series highlight new simulations and simulation functionalities, including this year's focus on statistics with the Center and Variability simulation.

**60,751**

cumulative teacher engagements with the Latin America "Teaching with PhET" webinar series.

**16,871**

cumulative teacher engagements with the Africa "Share & Discuss" webinar series.

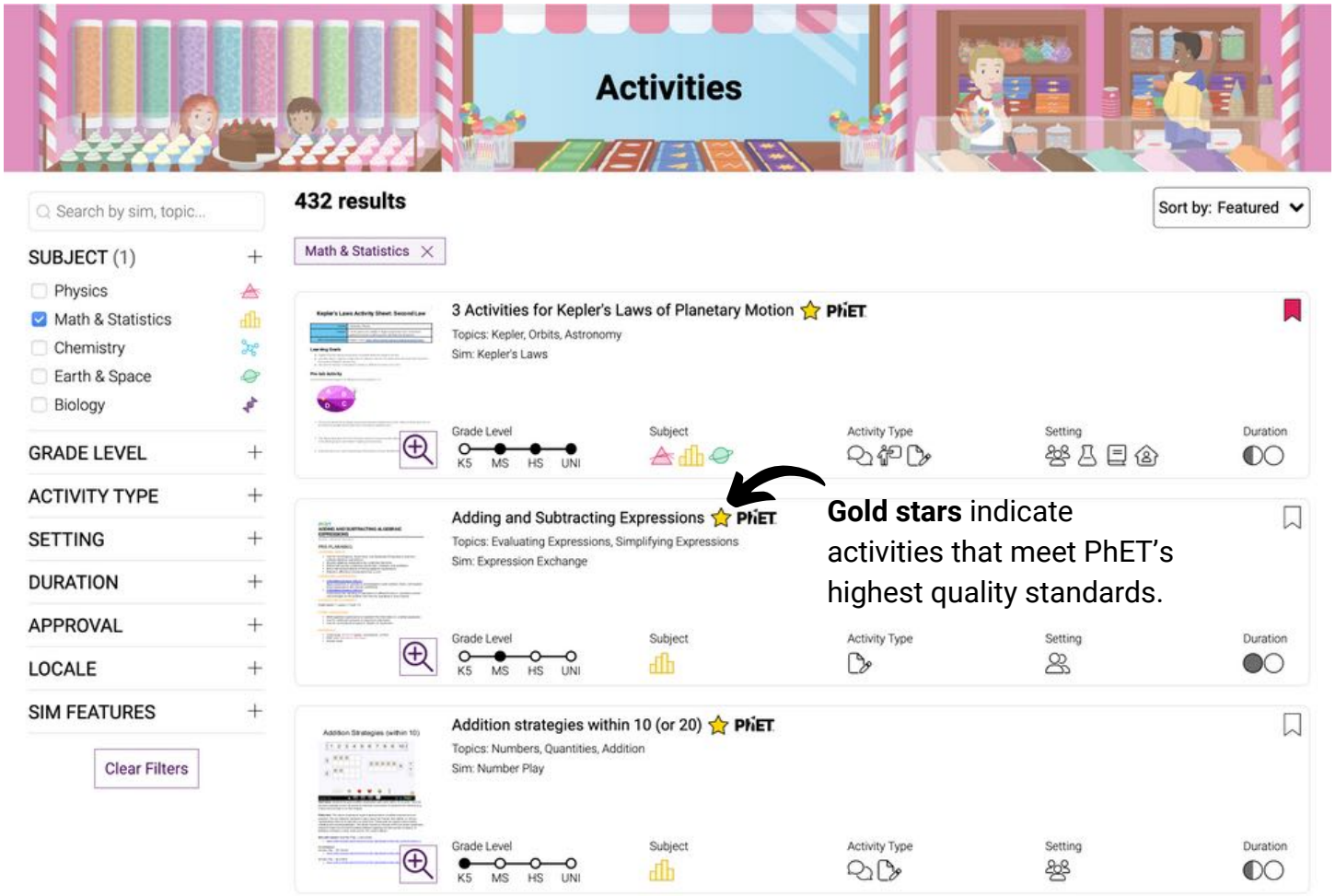
**966**

cumulative teacher engagements with global webinars.


# *Sim-based Lessons and Teaching Activities*

In late 2024, PhET completed a long-standing goal of revamping the Teaching Activities ecosystem and experience on the PhET website. It is now easier than ever for the busy teacher to find and curate a personal collection of high-quality, sim-based activities.

In addition, our community of teachers now have a host of resources to support high-quality activity creation, including an evaluation rubric and personal feedback from our new team of PhET Activity reviewers.  PhET has released new guidelines for high-quality activities, building on our Equity Framework and PhET's active learning principles exemplified in our teacher professional development.

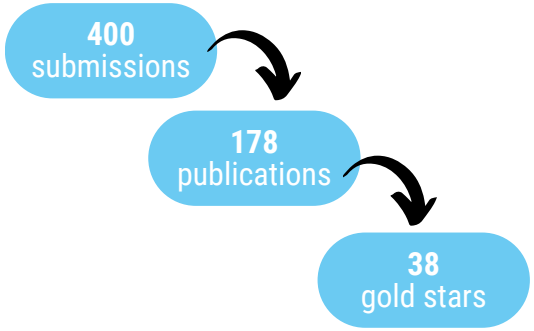



Save and categorize with **My Bookmarks**.

**Gold stars** indicate activities that meet PhET's highest quality standards.

Preview documents and get a quick overview of important activity features.

PhET supports a rigorous peer review process, using a committee of nine **PhET Reviewers**. In 2024, 400 submissions resulted in 178 publications, of which 38 received gold stars.





### Activity Contribution Requirements

#### Minimum Requirements

- Substantial use of a PhET sim as the primary learning tool
- Scientific and/or mathematical accuracy
- Unique and original, and/or gives appropriate attribution
- Achieves a "Publishable" rating in the self-evaluation rubric.

#### Gold Star Requirements

- An exemplar sim-based activity that achieves one or more of the following:
  - Promotes active learning and inquiry in alignment with PhET's Active Learning principles
  - Leverages strategies promoted in the PhET Virtual Workshop
  - Advances equity by aligning with PhET's Framework for Equity
  - Incorporates research-based methodologies for science and math
- Questioning strategies that support rich investigation, discussion, and student agency (i.e. avoids prescriptive instructions)
- Achieves a "Publish with Gold Star" rating in the self-evaluation rubric.

These activities are recognized with a gold star ⭐, displaying them at the top of activity search results.

### Ready to upload your activity?

CONTRIBUTE AN ACTIVITY

**Using PhET in your classroom?**

Browse PhET sim-based activities contributed by teachers around the globe.

**New to writing activities?**

Take PhET's self-paced Virtual Workshop to get a deep-dive on best practices for writing PhET sim-based activities.

## Our future aspirations ...

**01** Build networks of highly-effective STEM teacher leaders and change agents through sponsorships of the **PhET Fellowship** program across Africa and Latin America, with expansion into other regions.

**02** Establish the PhET team and community of Fellows as a leader in continuing teacher education, providing systemic and sustainable improvement through extended **teacher professional development experiences.**

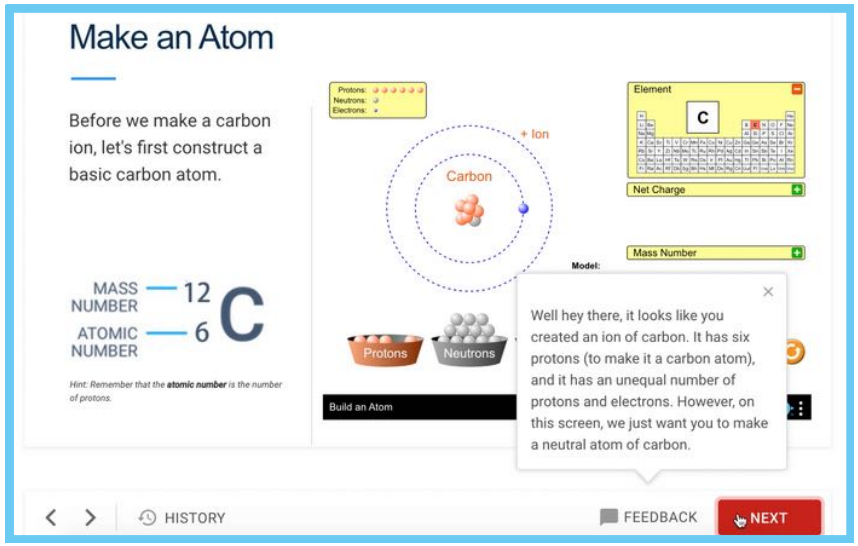
**03** Institutionalize the use of PhET simulations and active-learning strategies by supporting government agencies—in collaboration with our local PhET Fellows—to develop **curricular alignment** and **instructional supports**.


NYANG'OMA
SECONDARY SCHOOL

# Advancing Impact through Innovation, Collaboration, and Community

## *PhET-iO Simulations*

In 2024, the PhET team accelerated development of its innovative PhET-iO simulations, which are a version of PhET sims enhanced with powerful instrumentation and interoperability features. PhET-iO sims open up new opportunities for teachers and partners wanting to creating innovative student experiences. In 2024, we added 17 PhET-iO sims to reach 34 PhET-iO sims available. As a licensed product, these PhET-iO sims will help fuel our future sustainability.




With this tool:

- **Education technology companies** can create more customized, integrated, and seamless digital experience for individual learners, while giving teachers and administrators more comprehensive insight into learner activity and performance.

- **Academic researchers** can test pedagical designs, build authentic assessments of student inquiry skills, curiosity, engagement, etc., and pioneer advanced feedback based on student interactions.

- **The PhET team** can create and sell new innovative products that bring value to our teachers and partners, and help sustain our work.

Learn more about PhET-iO:
https://phet-io.colorado.edu/

### CUSTOMIZE

- Create learning scenarios.
- Hide or disable UI controls.
- Change text labels.
- Set specific values.

### INTEGRATE

- Create rich experiences.
- Record data into a table.
- Grab a screen shot.
- Monitor a goal.

### ASSESS

- Create performance tasks.
- Measure STEM practices.
- Power learning analytics.
- Drive adaptive feedback.

**34**

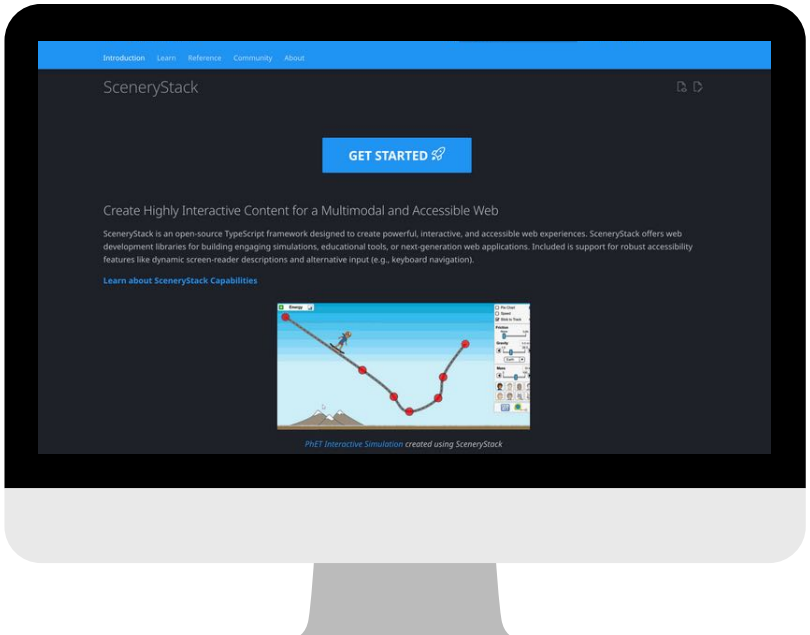
simulations enhanced with PhET-iO functionalities.

# *SceneryStack & the Open-Source Community*

PhET's commitment to the open-source community goes beyond simply releasing PhET's source code under an open license. In mid-2023, PhET launched a new open-source community - **SceneryStack** - centered on PhET's foundational common code and pioneering innovations and research in making highly interactive web media accessible for diverse learners.

In 2024, with new funding from NSF, we advanced SceneryStack and the new **scenerystack.org** website, making it easier than ever to get started building interactives with SceneryStack and to engage with a growing community of developers and designers focused on creating and advancing technologies for inclusive, multimodal web interactives (simulations, games, apps, tools).

Learn more about SceneryStack: scenerystack.org




## Our future aspirations ...

01 Accelerate the progress of **web accessibility for interactive media** through the **SceneryStack** technology, community, and inclusive design advocacy.

02 Establish SceneryStack as an **independently-governed open-source organization** that empowers designers and developers to create high-quality interactive media.

03 Realize **a full collection of PhET-iO simulations**, adding 80+ more PhET-iO simulations for use in research and education products.

04 Develop a **community of researchers** engaged in using **PhET-iO** to answer open questions about teaching, learning, and assessment.

05 Collaboratively **research the potential of Generative AI + PhET Sims** to engage students in productive inquiry and discourse through Socratic dialogue.

# Advancing PhET's Sustainability

PhET is committed to ensuring that its simulations always remain free to students and teachers. PhET continues to advance its **mission-driven business model**, through multiple revenue streams.

## Direct-to-Consumer

### Free PhET Website


Free web-based use and downloads.

### Low-Cost PhET App


$0.99 purchase for individuals

- Bulk licenses for schools / districts through the **PhET App for Schools** program.
- Private app builds for technology distribution initiatives.

## Business-to-Business

### Basic Partnership

$10,000-$20,000 per year.

- 10 hours of technical support
- Easy sim integration with a metadata service
- Hassle-free updates (maintenance, new features, new sims)
- Brand alignment, with permission to use PhET's logo in communications
- Reduced partnership cost for organizations in the developing world.

### PhET-iO Partnership

Per-student licensing, revenue share, or usage-based

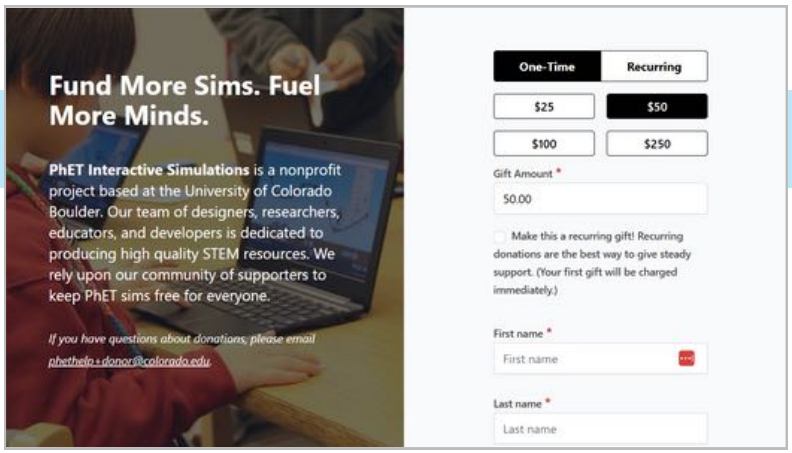
- 10 hours of technical support
- Ability to customize, integrate, and assess learner engagement with ease

## Donors

### Giving Platform

In 2024, we upgraded to a new individual giving platform. Additionally, PhET relies on the generosity of supporters through grants and large donors. See the Financials & Sustainability section of this report for more details.

SCAN ME



# PhET Studio

In 2024, we launched a new initiative to **bring the power of PhET-iO simulations to classroom teachers** through a new revenue-generating product, PhET Studio. PhET Studio will be the first product in our PhET Premium line of support services.

## New Team Member

Welcome to Linda Stegemann, our new Partnerships and Sales Specialist!

## The Making of PhET Studio

PhET Studio's development has been a first-of-its-kind launch for the PhET team, requiring new processes and demands. To ensure its success, we have:

- Conducted market research to identify where a new product would bring the most value to teachers,
- Engaged in co-design with teachers and curriculum advocates to make sure the product met their needs,
- Advanced the infrastructure necessary to manage direct sales to individuals and schools,
- Expanded our team to include individuals with deep experience with commercial STEM education technology products.

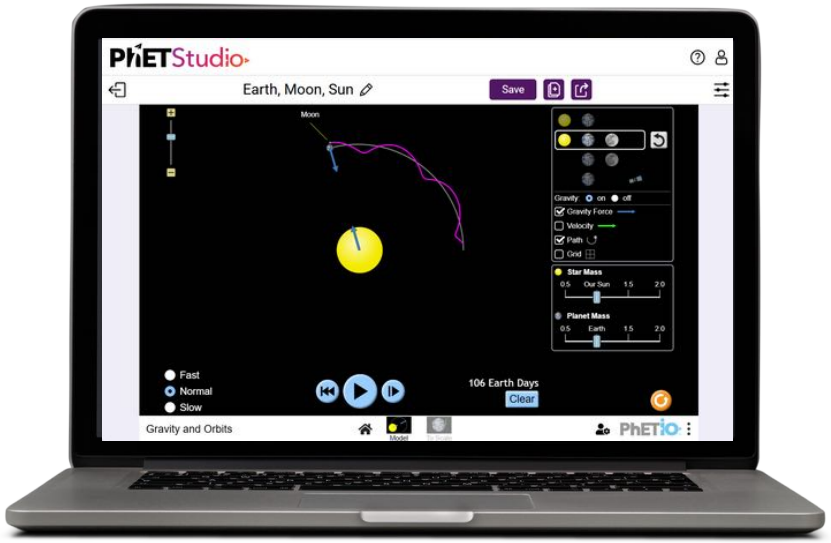
## Consumer Models

PhET Studio will be an annual license-based service with unique pricing available for teachers, non-commercial groups, and commercial groups interested in adding presets to their curriculum.

## How will Studio work?

PhET Studio will use a three-step process: Set. Save. Send.

Users will be able to **set** up simulations according to their students' needs, **save** the simulation's state as a **preset**, and then **send** this unique state to students as a shortened URL.



## Our future aspirations ...

01 **Grow PhET's partnership programs** to increase revenue and bring engaged interactivity to more education products.

02 Expand PhET's mission-driven revenue streams through **new product opportunities**, such as a consumer-facing PhET Math App, paid teacher accounts with PhET-iO access, or a strategic partnership with a large-scale assessment provider.

03 Build revenue generating activities around PhET **teacher professional development products and services**, leveraging the community of PhET Fellows.

04 **Advance PhET's infrastructure** to increase efficiency, lower costs, and maximize our opportunities.

05 **Build a Global Advisory Board** to guide, support, and accelerate PhET's work and impact around the world.

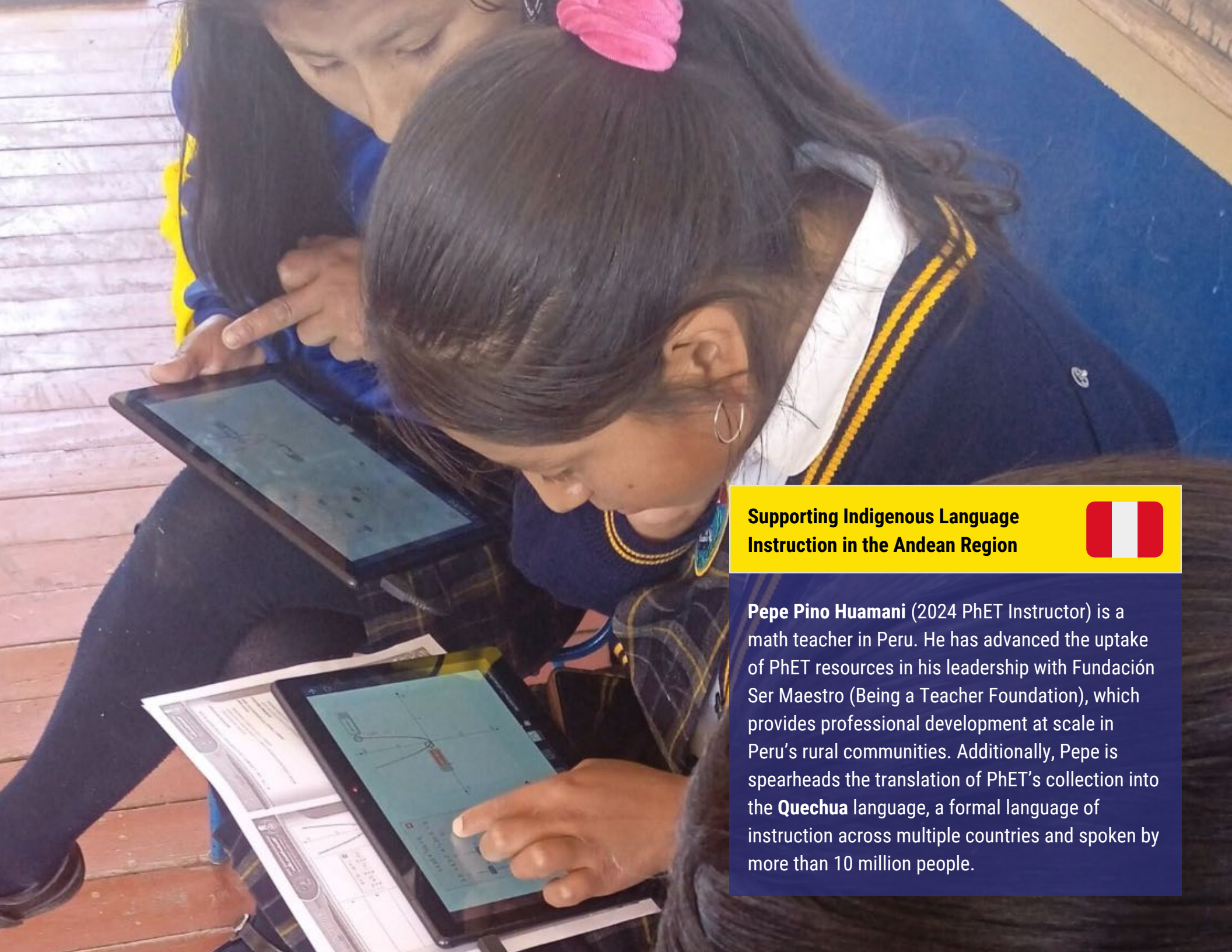
# Success Stories

Explores vignettes about PhET's impact on the following pages, and read more stories online.

# Expanding Access through Localization

## Adapting Programs for Egyptian and Libyan Contexts

**Basma Abdel-Wareth Shebeeb** (2023 PhET Fellow) has built up networks of Egyptian teachers to learn about PhET, and conducted a PhET workshop in coordination with **Souad Al-Mahd Lagha** for 190 teachers in Libya. Basma and Souad collaborated to translate PhET's professional development content into **Arabic** for the first time, making these resources accessible to educators across northern Africa.



## Supporting Indigenous Language Instruction in the Andean Region

**Pepe Pino Huamani** (2024 PhET Instructor) is a math teacher in Peru. He has advanced the uptake of PhET resources in his leadership with Fundación Ser Maestro (Being a Teacher Foundation), which provides professional development at scale in Peru's rural communities. Additionally, Pepe is spearheads the translation of PhET's collection into the **Quechua** language, a formal language of instruction across multiple countries and spoken by more than 10 million people.

# Collaborating with Government Initiatives

## Strengthening Teamwork and Partnership in Rwanda

As a program coordinator with the African Institute for Mathematical Sciences, **Jeannette Nyirahagenimana** (2023 PhET Fellow) works across 14 of Rwanda's districts to enhance educators' math and science instructional capacity. She has aligned PhET simulations to the country's competence-based curriculum and smart classrooms initiative. Her work PhET-related work has reached more than 250 STEM educators and 30 district coordinators to ensure that resources like PhET are adopted effectively.

# Supporting Foundational Math

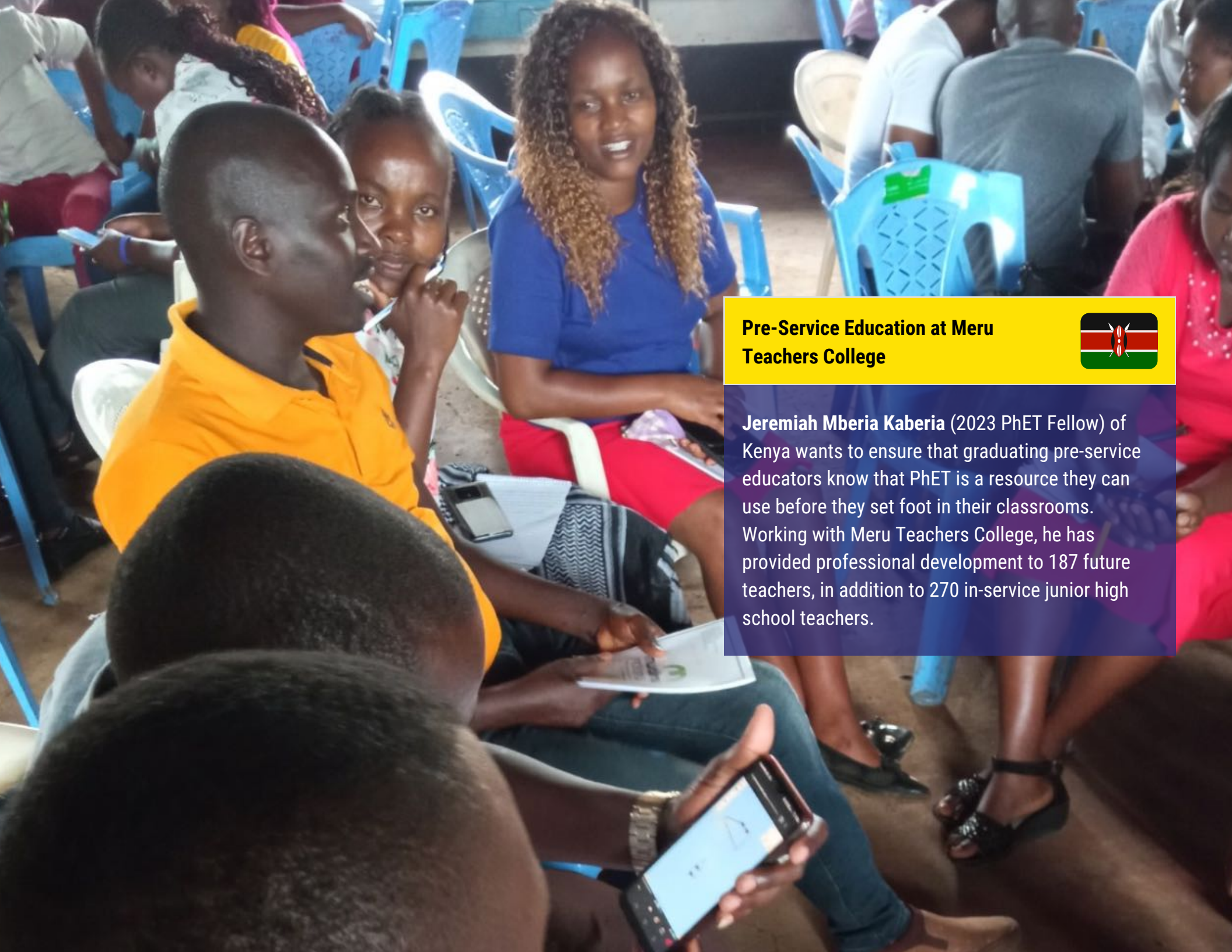

**Engaging the Youngest Learners with Simulations for Math Education**

**Jesús Villamizar** (2022 PhET Fellow) and **Leyda Carolina Moreno Granados** (2023 PhET Fellow) have collaborated for the past two years to provide support to teachers across the educational spectrum. They have held numerous workshops for early elementary teachers, providing PhET's digital resources to Venezuela's frequently under-resourced classrooms.

# Working with University Systems

## Extending and Deepening Impact with Regional Universities and Foundations

Five PhET Fellows from Argentina and Chile (**Agustina Paredes, Daniel Ammar, Maria Eugenia, Myriam**, and **Rocío Belén Lucero**) banded together to deepen and extend their work with the support of the Siemens Foundation of Argentina to provide PhET workshops to hundreds of teachers. They leveraged the infrastructure and networks of universities and local government agencies that are committed to supporting teachers in the region.



## Pre-Service Education at Meru Teachers College

**Jeremiah Mberia Kaberia** (2023 PhET Fellow) of Kenya wants to ensure that graduating pre-service educators know that PhET is a resource they can use before they set foot in their classrooms. Working with Meru Teachers College, he has provided professional development to 187 future teachers, in addition to 270 in-service junior high school teachers.

# Research & Effectiveness

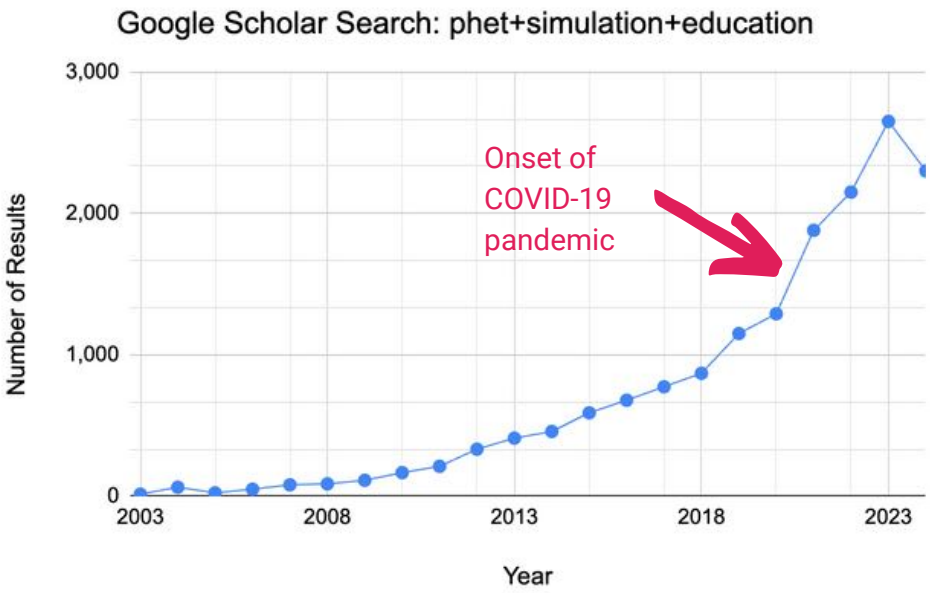
# Research

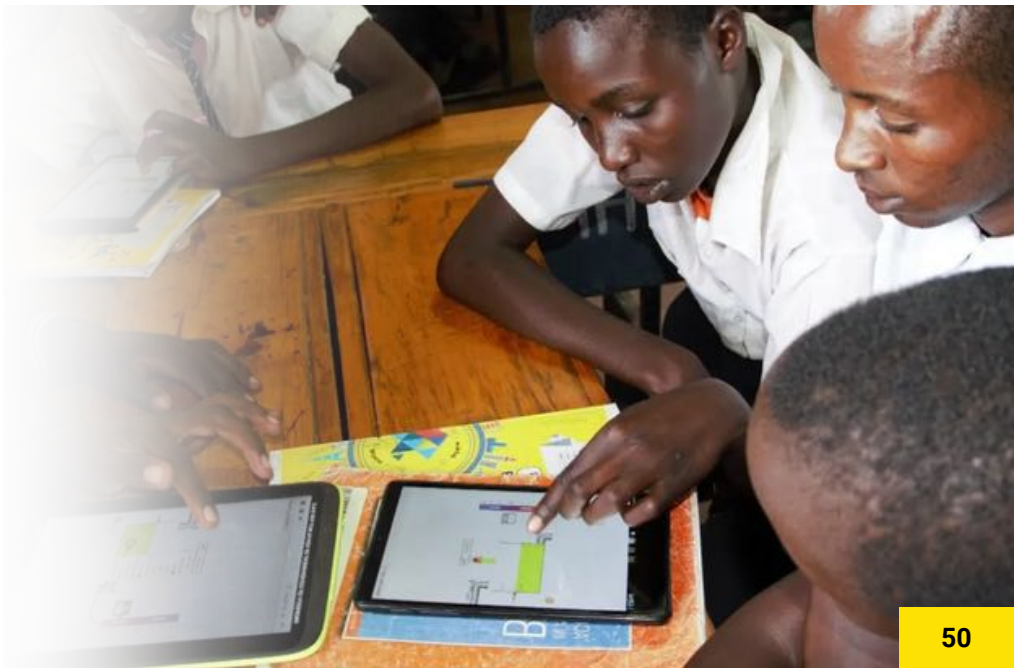
PhET simulations are based on discipline-based education research (what we know about students' assets and struggles as they learn math and science), involve students in the design process, and have garnered interest from thousands of researchers external to our team.

**14,000+** Google Scholar references to PhET simulations.

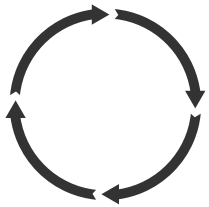
Research shows that PhET simulations...

- are **developed with research-based design** on learning.
- support teachers to **transition from teacher-centered to student-centered instruction**.
- result in **significantly higher learning gains** than traditional instruction.
- **improve students' attitudes** about learning STEM.
- support the **development of STEM process skills**.
- help **close the learning gap between males and females**.



## 01 PhET simulations... are developed with research-based design on student learning.



PhET simulations follow a cycle of design, development, and testing that makes use of design research and discipline-based education research on common student prior knowledge, learning challenges, physical and cognitive differences, and motivation. *If we do not see expected outcomes in their use of the simulation, we do not publish it, and go back to design.*

### Further Reading

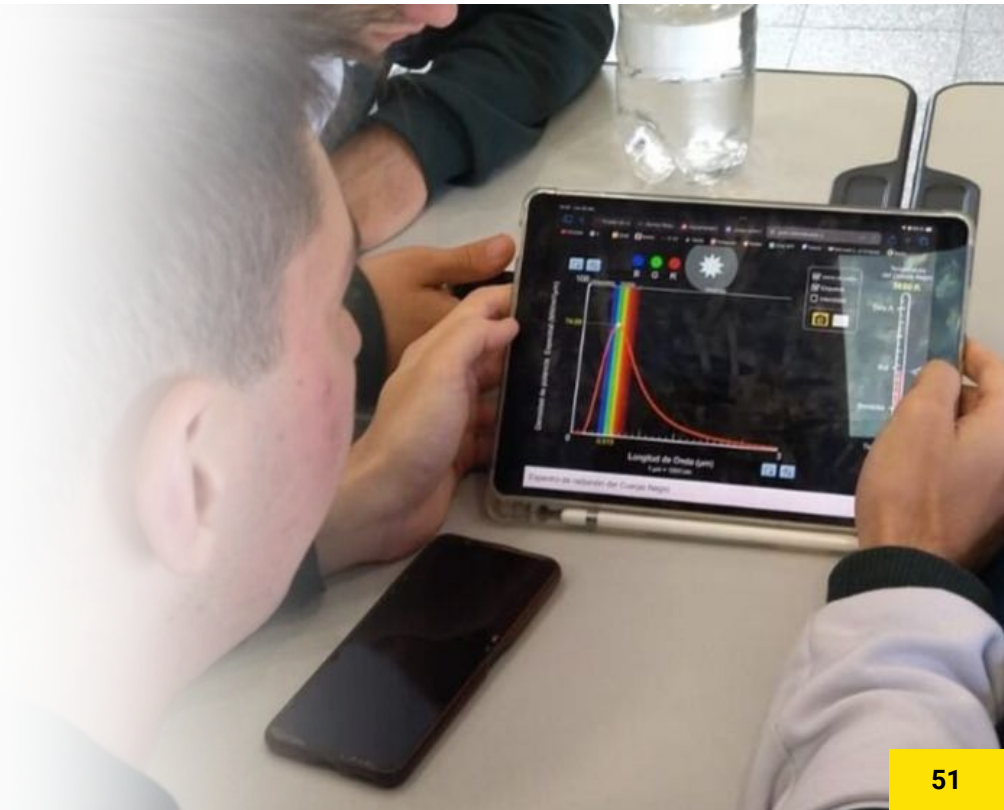
| | |
|---|---|
| **Foundational design principles** | Adams et al., 2008<br>Podolefsky et al., 2010 |
| **Inclusive features** | Moore at al., 2015 |
| **Role of play and exploration** | Johnson-Glenberg et al., 2014<br>Whitacre et al., 2018 |

## 02 PhET simulations...support teachers to transition from teacher-centered to student-centered instruction.

Teachers who make use of PhET simulations inherently see shifts in their classroom dynamics, including more student talk, inquiry, and agency.

### Further Reading

| | |
|---|---|
| **Teacher facilitation & student agency** | Atabas et al., 2020 |
| **Power of open play to center instruction on student ideas** | Moore et al., 2013<br>Podolefsky et al., 2013 |



03

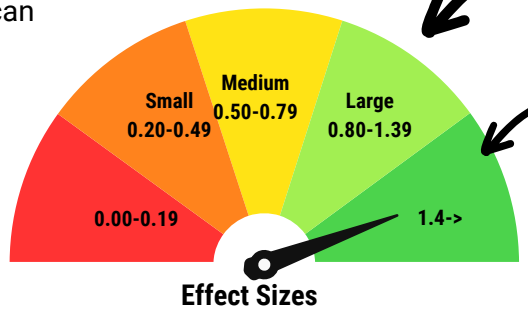
## PhET simulations...result in significantly higher learning gains than traditional instruction.

**When teachers use PhET simulations paired with active learning, inquiry-based strategies, students learn substantially more than through traditional instruction.** In many cases, using PhET simulations can be more effective than using physical equipment, especially when topics involve abstract concepts.

These findings generally hold true across

- Gender (males, females)
- Discipline (science, math)
- Socioeconomic contexts

In addition to existing research on mathematical thinking as part of science education, research exclusively on mathematics classrooms demonstrates PhET's impact on learning.




Effect sizes represent the magnitude of difference in performance by students who received the intervention (use of interactive simulations) vs. those who received traditional instruction.

### Meta-analyses

Antonio & Castro, 2023

- 15 quasi-experimental studies (85% with PhET)
- Effect sizes up to g = 1.26
- Effect size weighted average of g = 0.941

Rutten et al., 2012

- 17 quasi-experimental studies (interactive sims, generally)
- Effect sizes up to d = 1.54.

### Literature Review

Banda & Nzabahimana, 2021

- 31 quasi-experimental studies (all with PhET)
- Up to 37% higher normalized gains than control

### Early Math Fraction Concepts

Further Reading

Hensberry, 2015

- Conceptual knowledge of fractions increased significantly pre-to-post, with intervention effect size d = 1.18
- Larger effect size than the average found from a meta-analysis of studies for this topic, d = 0.28.

Aboraya, 2021

"The results showed that there is a clear positive effect on raising the level of achievement of students in abstract mathematical concepts in favor of the experimental group. … Students were found to highly favor using the simulation website."

### Math Teachers' Instructional Strategies

Findley et al., 2017

Teachers use PhET simulations to:

- Supplement lessons
- Enhance lessons
- Drive lessons

Atabas et al., 2020

- PhET sims support math teachers' shifts toward student-centered instruction.

## 04 PhET simulations...support the development of STEM process skills.

| | | |
|---|---|---|
| Further Reading | **Coordinating Representations** | Podolefsky et al., 2010 |
| | **Scientific Creativity** | Astutik & Prehanti, 2018 |
| | **Critical Thinking** | Sulisworo et al., 2019 |
| | **Science Communication** | Rosero et al., 2022 |

## 05 PhET simulations...help close the learning gap between boys and girls.

PhET simulations do not discriminate against gender: males and females demonstrate equal achievement as a result of PhET-based teaching interventions.

| | | |
|---|---|---|
| Further Reading | **Gaps in students' performance due to gender** | Ben Ouahi et al., 2021 |
| | **Effect of gender** | Pember & Achor, 2017 |

## 06 PhET simulations...improve students' attitudes about learning STEM.

Students in research studies involving PhET simulations often demonstrate high levels of engagement, and report increased motivation interest in learning about STEM in diverse socioeconomic (e.g., minority serving institutions, community colleges) and geographic contexts.

| | | |
|---|---|---|
| Further Reading | **USA** | Salame & Makki, 2021<br>Taibu et al., 2021 |
| | **Africa** | Chumba et al., 2020<br>Ramnarain & Penn, 2021 |
| | **Latin America** | Díaz-Pinzón, 2017 |

# Financials & Sustainability

...

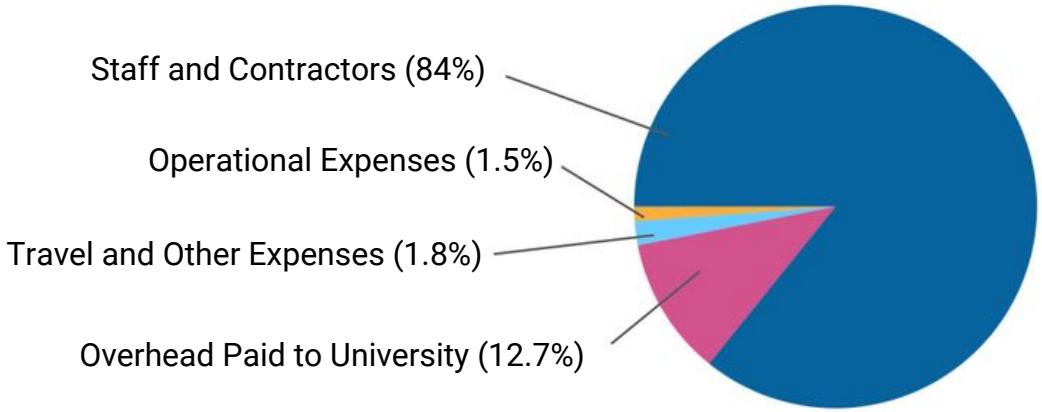
# Operations

PhET operates as a nonprofit and is a project within the Department of Physics at University of Colorado Boulder, a 501(c)(3) organization in the United States.

A portion of PhET's budget goes to university indirect costs (~13%). In return, PhET receives various services and benefits from the University of Colorado Boulder, such as human resources, legal support, research oversight, etc.

# Expenses in 2024

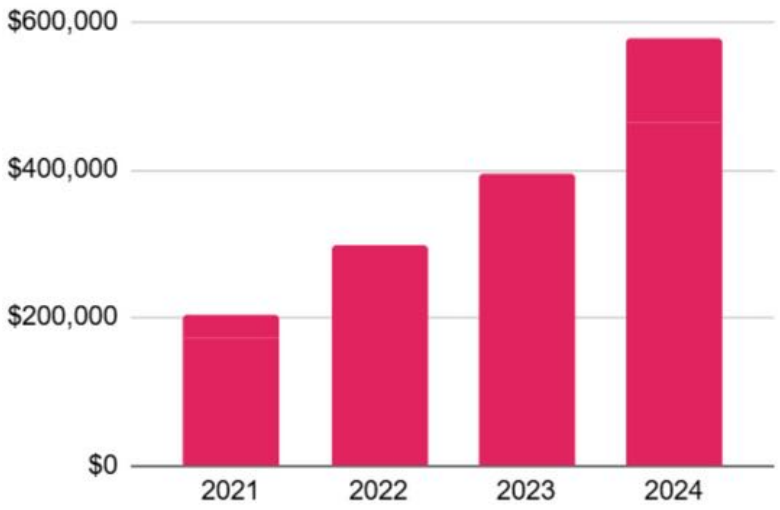
**$4.1M** total expenses




# Revenue in 2024

While PhET is largely sustained through grants, PhET continues to grow its recurring earned revenue through the PhET Partnership program and other products. With 70+ licensing partners, PhET has added substantial value to edtech products on the market, increased learner access to PhET simulations, and partially sustained PhET's mission to ensure that simulations remain free to teachers and students.

## Earned Revenue Growth




## Grant and Contract Revenue

In 2024, PhET was grateful to be supported by the following entities:

- Amgen Foundation
- Beyond100K
- Bill and Melinda Gates Foundation
- HHMI Biointeractives
- Gordon and Betty Moore Foundation
- Mastercard Foundation
- National Science Foundation
- Verizon
- WT Grant Foundation
- Yidan Prize Foundation

# Support Our Mission

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