PhET INTERACTIVE SIMULATIONS

University of Colorado Boulder

Photo Credit: IU Digital de Antioquia

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Interim Report

January - September 2021

Snapshot of Accomplishments

PhET Team Expanded

To address PhET's growing research activities and international outreach plans, PhET has added five new members to their team.

Lora Kaldaras
Post-Doctoral Researcher

Zachariah Mbasu
Africa Ambassador

Rebecca Vieyra
Associate Director of Global Initiatives

Sola Olateju
Africa Specialist Consultant

Nosa Oghafua
Project Strategy and International Relations Intern

New Funding

PhET has successfully acquired additional funding to bolster its global impact.

Mastercard: $1.5M (expected)
To expand the suite of PhET sims, add localization for use across Africa, and enable quality integration of sims into African education technology products and university instruction.

Organization of American States: $10,000
To develop a virtual workshop on the use of science sims for the Caribbean.

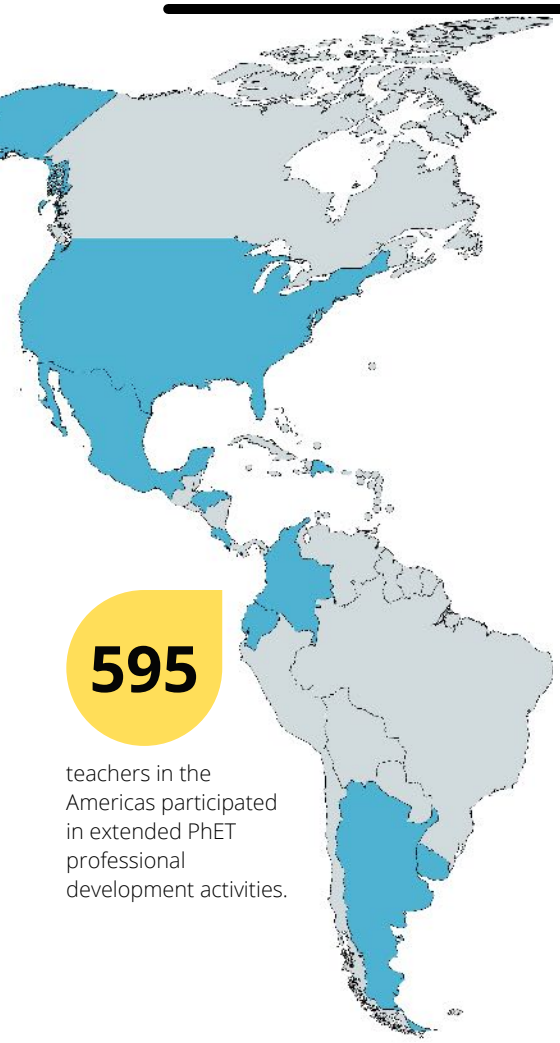
Schmidt Futures: $500K
To advance development of PhET-iO simulations as a tool for learning research and engineering.

Sims Developed and Improved

The following simulations are under development with funding from this grant:

- **Circuit Construction Kit - AC**
- **Density**
- **Buoyancy**
- **Geometric Optics**

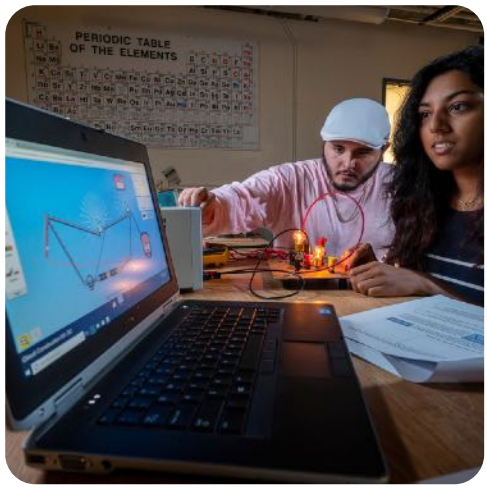
Other simulations have been identified for development, revisions, and cultural modifications.



595

teachers in the Americas participated in extended PhET professional development activities.

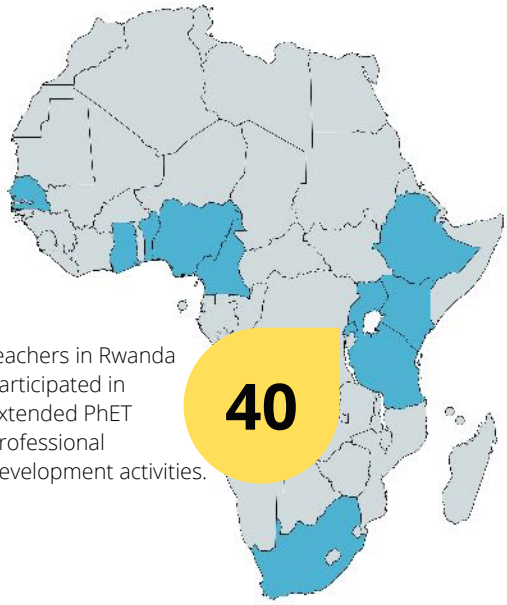
Photo Credit: IU Digital de Antioquia



Expanded Access through Teaching Materials and Workshops

24K+

teachers reached globally through short dissemination activities, such as presentations and webinars.



40

teachers in Rwanda participated in extended PhET professional development activities.

Research

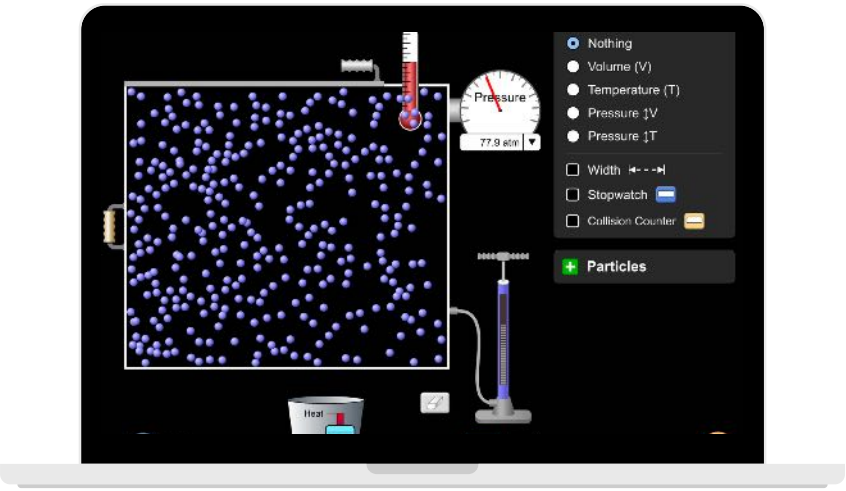
Goal 1: Build the research base on simulation-supported STEM expertise development.

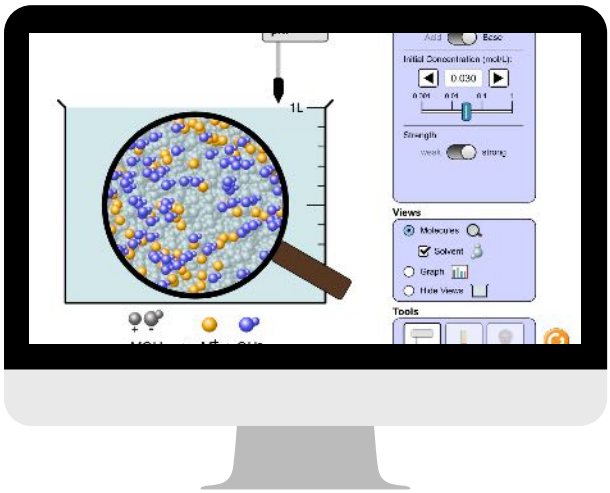
To carry out new research to examine and further advance the educational value of PhET simulations

Dr. Carl Wieman
& research team at
Stanford University

Dr. Leonora Kaldaras
Post-Doctoral
Researcher

To prepare for expanded research activities, PhET conducted an extensive search and hired **Dr. Loenora Kaldaras** as a post-doctoral research associate working directly with **Dr. Carl Wieman's Research Group** at Stanford University. Leonora (Lora) holds a Ph.D. in Education from Michigan State University and a M.S. in Chemistry from Bowling Green State University. Her work focuses on designing learning environments and assessments to support students in developing deep understanding of big ideas in science. She has worked with teachers and students in a wide range of educational settings, including middle, high school and undergraduate gateway courses in science. She is a co-author of award-winning NGSS-aligned curriculum materials for high school called "Interactions". Her research with Dr. Wieman will study student learning and instructional design strategies to support the development of conceptual understanding and bridging conceptual and mathematical understanding across scientific disciplines





Academic activities funded by this grant will support explorations to answer the following **research questions**:

- How well do students learn predictive frameworks through sim-based educational activities?
- How well does this learning process transfer?

Possible complex models for Lora's study may include Gas Laws and Acids and Bases simulations, among others.

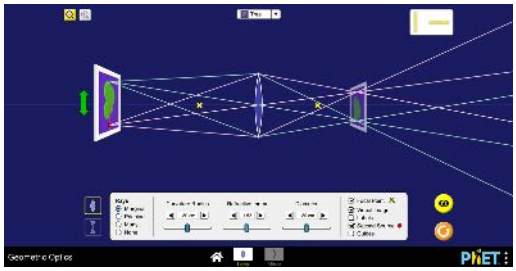
Lora's work will ultimately focus on the cognitive process of learning about fundamental science concepts and problem-solving skills. Her work will reveal the specific affordances of various sims to teach science topics, including how they can be most effectively designed as **different representations** and used to serve as **formative assessments** to:

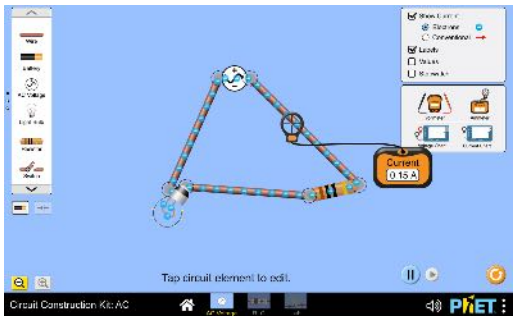
- **reveal student thinking** for teacher intervention,
- **provide feedback** for self-assessment, and
- **promote interaction and engagement**.

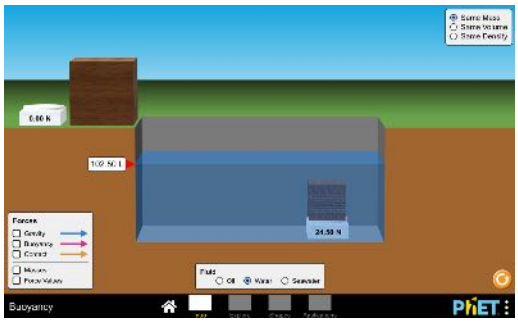
Access

Goal 2: Expand simulation content coverage and access.

To complete the design and development of 8-10 next-generation HTML5 PhET simulations for both physics and chemistry, filling in some of the most critical conceptual gaps in the current collection







Simulations

The following simulations are under development, with partial or full funding support from this grant:

- **Circuit Construction Kit - AC**
- **Density**
- **Buoyancy**
- **Geometric Optics**

The team expects to have at least three of these four simulations published by the end of 2021. Other simulations have been identified for development, revisions, and cultural modifications.

Offline Access

In January, PhET released the first version of the PhET **offline desktop app**. Users download and install the desktop app onto their Windows or MacOS computer, providing seemless use of all HTML and Java simulations without internet access.

Localization

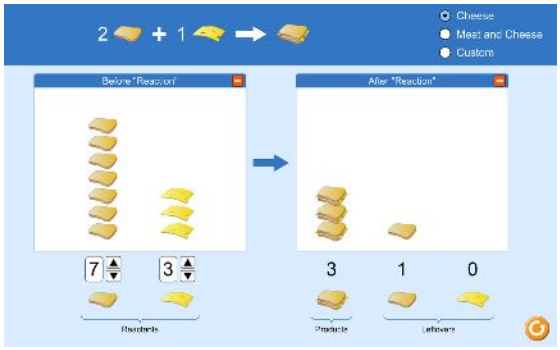
Language: As part of its plan to make PhET as accessible as possible, the team is working with its Africa specialists to identify translators for languages not currently available among PhET's 97 language options. All 90 simulations have been translated into **Yoruba**, a language spoken by approximately 52 million speakers, mostly within Nigeria and surrounding countries.

Usage Analytics: The PhET team has created two analytics reports that shed light on educational and technological tendencies across Latin America and Africa, including the following:

- Country-level usage sessions and downloads
- Traffic sources
- Common devices used, including screen resolution
- Languages

Throughout the grant, the team will track these analytics annually to observe any large-scale changes.

Culture: The team is also developing ideas for re-design of simulations that make use of analogies that lack cultural relevance in non-western cultures. For example, the **Reactants, Products and Leftovers** simulation uses sandwiches to illustrate ideas of chemical equations and limiting reactants. In cultures where sandwiches are not standard fare, this simulation will be adjusted for something more relatable, such as creating beaded necklaces with given patterns.



Teaching Materials

Goal 3: Create simulation-based lessons and teaching materials.

To create high-quality simulation-based lessons and teaching materials for each next-generation PhET simulation with a co-design approach which involves experienced secondary physics and chemistry teachers from US, Canada, Latin America, and Africa regions

Dr. Diana López
Latin America
PhET Ambassador

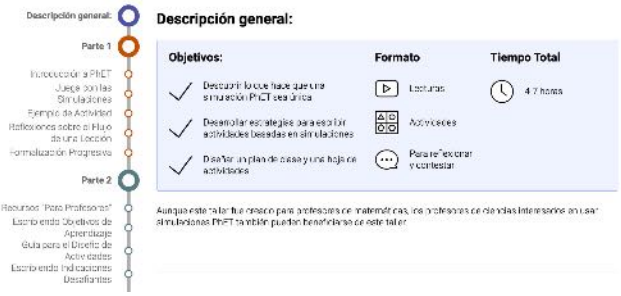
Rubén Perea Leyva **José Orozco**

In **Mexico**, two teachers have been recruited to work on national curriculum-aligned lessons, which are currently in development under the supervision of the Latin America PhET Ambassador. Other initiatives in progress include the incorporation of PhET materials into a science textbook to be adopted by 30+ schools in the state of Veracruz.

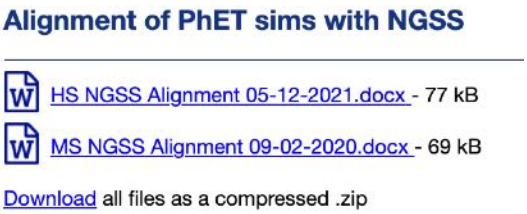
IU Digital de Antioquia
INSTITUCIÓN UNIVERSITARIA DIGITAL DE ANTIOQUIA

In **Colombia**, in collaboration with **IU Digital de Antioquia**, PhET developed **20 sim-based lesson modules** including student worksheets and teacher guides for biology, physics, and chemistry. These materials are accessible from the IU Digital Comunidad de Aprendizaje website, and also on the PhET Teacher Materials pages for their respective simulations.

To support self-paced professional development anywhere and anytime, PhET has designed and developed a virtual workshop template. This year, the **Math Virtual Workshop** was published and is now available in English and Spanish, and an English-language **Science Virtual Workshop** is under construction.



PhET has updated its **curriculum alignment** guides for the **USA's *Next Generation Science Standards*** Performance Expectations and the ***Common Core State Standards for Math***, as well as added new alignment guides for **Mexico's national science curriculum.**



Global Professional Development

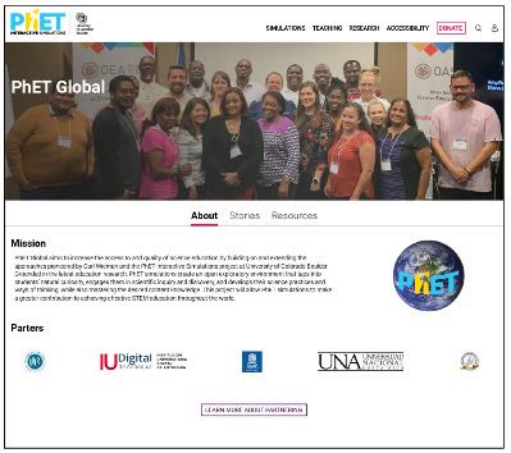
Goal 4: Support global dissemination and teacher professional development.

To enhance offline dissemination and access of PhET simulations globally and create a network of partnerships between PhET and global, regional, and local partners with an ultimate reach of at least 2,000 STEM teachers through the train-the-trainer model

Rebecca Vieyra
Associate Director of Global Initiatives

Worldwide Activities

To prepare for expanded global initiatives, PhET conducted an extensive search and hired **Rebecca Vieyra** to support activities related to global professional development, dissemination, and partnerships. Rebecca brings her experience as a STEM education-focused program manager for the Inter-American Teacher Education Network of the Organization of American States. Previously, she served as K-12 Program Manager for the American Association of Physics Teachers. Rebecca is a prior high school physics teacher, and currently a doctoral candidate in Science Education at the University of Maryland. She received the Presidential Award for Excellence in Math and Science Teaching, and is an alumna of the Albert Einstein Distinguished Educator Fellowship where she advised NASA Aeronautics on education efforts.



PhET has engaged in extensive professional development and outreach activities across the globe, including those listed below.

Worldwide Dissemination

Presentations given by Dr. Carl Wieman

Brazil
July 19: NSEF Colloquium

Canada
March 31: McGill University

Myanmar (Burma)
January 15: Parami University

Netherlands
January 28: University of Groningen

Saudia Arabia
August 16: KFUPM

United Kingdom
April 21: Cardiff-UCL DBER STEM Webinar

USA
January 15: National Partners in Science Conference
September 8: The Optical Society

Partnerships

mEducation Alliance
PhET joined a global partner in the alliance's math-focused initiative, *MathPower!*, and is participating as a panel member in its September global virtual event.

Virtual Pro
Virtual Pro - an education technology company in Colombia - has integrated PhET sims into its digital laboratories.

Worldwide Professional Development

Philippines
March 3: Hosted by MinSCAT

Publications

Times Higher Education (August 31)

World Economic Forum (20 August)

Global Professional Development

(continued)

Latin America and the Caribbean

PhET's work across Latin America and the Caribbean is carried out primarily by Dr. Diana López, a specialist in physics education who has extensive experience in teaching. Together with a number of on-the-ground partners in secondary and tertiary schools, Diana is leading initiatives to integrate PhET into undergraduate coursework, student textbooks, and teacher professional development programs.

Mexico

- May 28-29: **Benemérita Universidad Autónoma de Puebla** 3-hour online workshop "Inquiry Learning and PhET Sims" (50)
- September 2-November 11: **Universidad de San Luis Potosí/Escuela Normal** 40-hour online course "Teaching Math with PhET" for middle school math teachers (40)

Costa Rica

- July 6-8: **Universidad Estatal de Costa Rica** 3-hour online workshop "Inquiry Learning and PhET Sims" (9)

Colombia

- March 12: **IU Digital** face-to-face workshop for high school science teachers in rural regions (26)
- April 19-23: **IU Digital** online course "Active Learning" with PhET for 3,500 registrants across the hemisphere (370 completions)
- July 9-23: **IU Digital** face-to-face mini workshops for high school science teachers (60)

Argentina

- April 5-May 28: **Fenómeno Phi**, 40-hour online course "PhET and Inquiry" for middle and high school science teachers (40)

Regional Dissemination

(Educators reached in parentheses)

Argentina

- August 3: **Ministerio de Educación de Tucumán** (20,000+)

Colombia

- February 3: **Universidad de la Sabana** (80)

Costa Rica

- 13 April: **Universidad Nacional de Costa Rica** (200)

Dominican Republic

- January 21: **SoDoFi** (135)

Honduras

- July 16: **Escuela Pedagógica de Honduras** (170)

Jamaica

- September 9: **Shortwood Teachers College** (130)

Mexico

- Feb 3: **DGTEY** (1080)
- March 8 / May 26: **Ieducando/APISEC** (730)
- March 24: **Universidad de la Salle Bajío** (200)
- May 11 / June 9 / July 15: **Escuela Normal Superior de Guanajuato** (107)
- June 18: **Universidad Autónoma del Estado de Hidalgo** (30)
- August 10: **ColMeNaB** (35)
- August 11: **IEMS** (52)
- August 19: **IPN** (119)

United States

- January 11: **American Association of Physics Teachers** (10)

Regional

- August 5: **Ministerio de Educación y Cultura de Uruguay, Universidad Autónoma de Santo Domingo Dominican Republic, Ministerio de Educación de Tucumán Argentina, and Fundación Patagónica Cruzada Argentina** (552)

Global Professional Development

(continued)

Africa

Zachariah Mbasu
Africa PhET Ambassador

The PhET team has begun to lay the foundation for intensive work in Africa, adding three specialists. **Zachariah Mbasu** and **Sola Olateju** are respectively located in Kenya and Nigeria, and will advance professional development and dissemination efforts across Africa. Zach Mbasu is a prior math teacher and founder of African Maths Initiative with expertise in managing educational research projects and STEM camps across the continent. Sola Olusola brings experience disseminating and supporting the adoption of education technology solutions and teacher professional development across Africa. **Nosa Oghafua** is founder of Learnira, an organization engaged in teacher professional development using PhET sims in Nigeria, and is currently an MBA student at CU-Boulder.

Sola Olateju
Africa Specialist Consultant

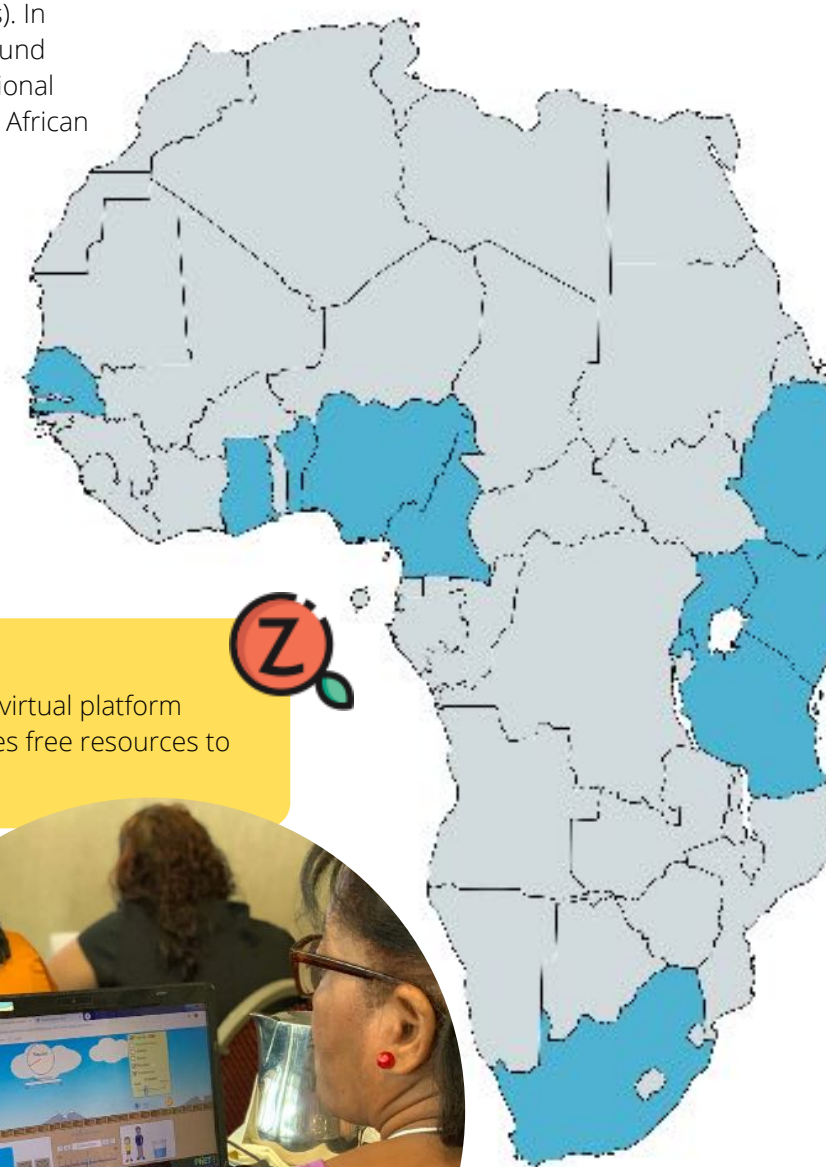
Nosa Oghafua
Project Strategy and International Relations Intern

This work will be accelerated with a substantial grant from **Mastercard Foundation** (currently in contract negotiations). In addition to funding HTML5 sim development, this grant will fund PhET partnerships for 10 African edtech companies, professional development with 12 universities, localization of sims for the African context, and a African-focused PhET webinar series.

Mastercard Foundation Network

PhET is working to establish connections with universities in the following countries:

Benin
Cameroon
Ethiopia
Ghana
Kenya
Rwanda
Senegal
South Africa
Tanzania
Uganda



South Africa

- Integration of 90 PhET simulations into **Zibuza.net**, a virtual platform funded by the **Dr. CL Smith Foundation** that provides free resources to thousands of math and science teachers.

Rwanda

- March 10-11: **University of Rwanda** 6-hour virtual workshop for 40 education faculty and leaders of a large World Bank funded curriculum project.