



READY NOW

Science and Engineering

Guide to Education Technology
that is “Ready Now” for Use
In-Class, for Hybrid, or Remote
Teaching and Learning

This Digital EdTech Guide contains a variety of K-12+ education technology offerings focused on science, technology, engineering and mathematics (STEM). These applications can be used in-class, for hybrid learning, or for remote learning. This guide is intended to raise awareness of digital learning applications that may be useful to teachers, schools and districts navigating the education challenges during the COVID-19 pandemic.

The STEM applications herein cover a range of topics that includes earth science, biology, chemistry, physics, engineering, and coding skills. These programs were developed by U.S.-owned small businesses, non-profit organizations, and academic researchers that have received innovation grants from federal government programs including at the U.S. Department of Education, National Science Foundation (NSF), National Institutes of Health (NIH) and United States Department of Agriculture (USDA).

The applications use a variety of technologies, including an assortment of digital courses and learning activities, educational games, and maker platforms. These companies are using innovative technologies like virtual and augmented reality, digital models and simulations, and sensors, to engage and challenge STEM learners.

The applications in this guide were developed iteratively, with feedback from students and teachers throughout the process. These research-backed

processes evaluate the products' usability, feasibility, promise of learning and efficacy.

Many of the technologies adjust to meet the level of the student in real time, and provide information to teachers to guide practice for individual and groups of students.

Some of these technologies are already in use by hundreds of thousands of students, and have won prestigious industry awards for innovation. Others represent more recent breakthroughs and are assembling communities of enthusiastic early adopters. Each entry has information about how to access or try out the products. In cases where the product is not yet publicly available, you may be able to contact the companies about a pre-release trial of the product.

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BioDive

Digital experiences and tabletop games for science learning

[Killer Snails](#), Brooklyn, NY

Contact: Jessica Ochoa Hendrix

(jessica@killersnails.com)

INTERVENTION

Killer Snails creates imaginative game-based science curriculum supplements that are aligned to the Next Generation Science Standards (NGSS) and capture the excitement and challenges of being a scientist. Founded by a scientist, an educational psychologist, and an MBA, our vision is to empower learners to use critical skills to make a positive, tangible impact in our world. The mission of Killer Snails is to create the next generation of changemakers and to bring science out of the laboratory and into the hands of learners globally. [BioDive](#) combines virtual reality (VR) and online digital journaling to enable students to experience the life of a scientist.

Middle school students take on the role of marine biologists investigating the delicate ecosystems of venomous marine snails. Throughout their expedition, students observe, discover, and hypothesize about abiotic and biotic factors that impact marine biodiversity. BioDive takes place over a suggested 5 class periods and includes an educator dashboard so teachers can virtually view all the students' progress and provide feedback! BioDive can be used for in-class, remote, or in hybrid teaching and learning situations for grade 6- grade 12 classes. Concepts taught: Biodiversity, Energy Pyramid, Producers/Consumers, Conservation, & Scientific Investigation. Watch a [TED talk about BioDive](#).



RESEARCH BASE

Killer Snails' games are developed to reflect teacher and student voices. All games are co-developed with educators and pilot tested with students before completion to reflect best practices in pedagogical development, ease of use, content engagement, and knowledge acquisition. Research based on student and teacher responses of our existing BioDive product demonstrates feasibility of implementing a multimodal VR experiences to deliver instruction. Qualitative responses from 60 teachers who implemented BioDive Killer Snails learning games also revealed agreement that the experience helped students learn. Responses from teachers note the game helps students: "Take on the roles of scientists" "See that there are many ways to 'do' science" and "Get learners excited to apply their learning." 100% of middle school teachers indicated they would use BioDive again. Killer Snails conducted a one group pre-post pilot of BioDive with 40 schools and 2500 students in 26 states. Results demonstrated that students increased on content knowledge.

HOW TO ACCESS

[BioDive](#) combines virtual reality (works on a phone or web-enabled device) and online digital journaling (works on ChromeBooks, phones, laptops, or tablets). Access at www.killersnails.com. [BioDive will be free until September 30th, 2020](#) and licenses can be used through July 30th, 2021.

Government Awards Supporting R&D

Funding provided by the NSF SBIR program.



The Cat in the Hat Knows a Lot About That!

A PBS KIDS multi-platform media property based on “The Cat in the Hat’s Learning Library” book series by Random House and Dr. Seuss Enterprises.

Contacts: CPB-PBS Ready To Learn Initiative; Pam Johnson, Corporation for Public Broadcasting, pjohnson@pbs.org; David Lowenstein, Public Broadcasting Service, dmlowenstein@pbs.org

INTERVENTION

The Cat in the Hat Knows a Lot About That! resources in an independent study include 28 digital videos, five digital games, and hands-on activities for preschool age children and their parents/caregivers. The resources were developed to support learning by modeling science and engineering practices and language and exploring physical science and engineering content through narrative stories and interactive experiences. At the beginning of each video, two young characters, Sally and Nick, pose a question or define a problem about the natural and human-designed world they have encountered in their own backyard. The associated digital games are designed to support science and engineering learning by providing opportunities for children to explore and manipulate scientific phenomena and simulations. The real-world activities are each aligned with one of the five games and provide an opportunity for children (ideally with older family members or caretakers) to engage in related science and engineering activities.

RESEARCH BASE

Researchers at Education Development Center (EDC) and SRI conducted an eight-week randomized control trial study with a diverse sample of 454 low-income families and their 4- to 5-year-old children. The study team provided families in the treatment group with access to The Cat in the Hat Knows a Lot About That! videos, games, and hands-on activities through a tablet computer and printed hands-on activities. The videos and games were organized by six content themes: bridges; slides and friction; sorting objects; sounds and soundwaves; building and engineering; five senses and making observations. Researchers encouraged families to use the media for about one hour per week for each of the eight weeks of the study. Families also received a calendar showing a weekly focal theme, and weekly text messages about the content. Families in the control-assigned group received a tablet with a data plan. The study found that providing children with access to The Cat in the Hat Knows a Lot About That! resources had meaningful impacts on 4- to 5-year-old children’s physical science knowledge and their ability to engage with science and engineering practices. Researchers found a clear positive impact on children’s understanding of physical science concepts related to the two core ideas of matter and forces: (a) the role of material properties (strength and length) and forces in structural stability and (b) the role of material properties (texture) and forces (friction) on movement down an incline. Positive impact was also found on children’s interest and engagement in science. The results of this study indicate that educational media designed to focus on critical science and engineering concepts and skills can help young children understand those concepts and practices and that children’s experiences manipulating materials in a digital context can transfer to understanding of those practices and concepts in the physical world. For more information on EDC/SRI’s Ready To Learn research, see <http://cct.edc.org/rtl>.



The Cat in the Hat Builds That! app is available for smartphones and tablets. Content developed through the CPB-PBS Ready To Learn Initiative are freely available and accessible via [PBS Learning Media](#) and [PBS KIDS](#).

Government Awards Supporting R&D

A Ready To Learn grant – authorized by the U.S. Congress and administered through the U.S. Department of Education – was awarded to the Corporation for Public Broadcasting (CPB) and Public Broadcasting Service (PBS) in 2015.

Cell Energy, iNeuron, & SoberSloth

Learning apps that make hard STEM subjects easier to learn

[Andamio Games](#)

Contact: Dr. Katrina Schleisman

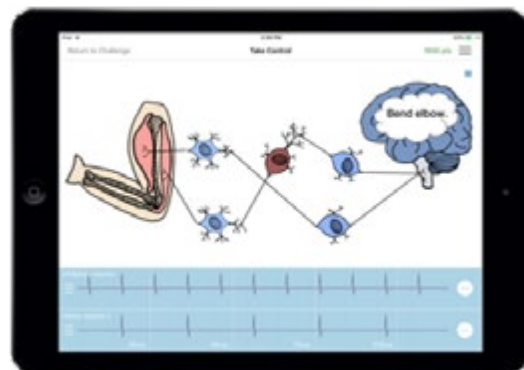
(katrina.schleisman@andamiogames.com)

INTERVENTION

We build engaging and effective STEM learning experiences for individual learners, classrooms, and group settings. Published apps integrate with the Andamio Dashboard, which enables educators to track student progress in real time and generate classroom-level reports to focus instruction on problem areas as they emerge.

Andamio's apps:

- CellEnergy: Photosynthesis Labs (Video Demo) teaches high-school cell biology through interactive challenges that engage students with key concepts of the carbon cycle, photosynthesis, and cellular respiration. Game-like elements keep teens motivated, and virtual labs provide hands-on experience of science practices in the context of cell biology.
- iNeuron teaches high-school level neuroscience through a series of scaffolded lessons and learn-by-doing challenges. Our patented group play technology turns iPads into functionally connected neurons, deepening students' understanding of how our brains change with learning.
- SoberSloth (Video Demo) teaches the neurobiology of addiction for middle and high school students in behavioral treatment for substance use disorders. Players learn about the dopamine reward pathway through a game-based interactive model in which they alter the dopamine level of their sloth avatar as it progresses through the stages of addiction and recovery.



CellEnergy was awarded a 2019 Top Pick for Learning from Common Sense Education.

RESEARCH BASE

The design of Andamio's gamified learning apps is based on years of scientific research supporting specific pedagogical techniques to improve learning, such as scaffolding, spaced practice, retrieval practice, and timely feedback. In a randomized controlled trial with 399 high-school students in 20 life science classes, students who played iNeuron for multiple class periods showed significantly increased on a neuroscience concept knowledge assessment than students who received standard neuroscience instruction. The results were published in 2018 in the peer-reviewed Journal of Science Education & Technology. For CellEnergy, a randomized controlled trial included 639 high school biology students from 4 schools. Students who used CellEnergy showed a letter-grade increase in both photosynthesis concept knowledge and science practices knowledge, significantly outperforming students who received standard instruction. The results were presented in a poster at the Connected Learning Summit conference in 2019 and are being prepared for peer-reviewed publication. Andamio's current research project will test the app SoberSloth against standard psychoeducation with 128 treatment clients at two residential substance use disorder treatment centers. Data collection is currently underway. For more information on our research, go to www.andamiogames.com.

iNeuron and CellEnergy are free for use for the 2020-21 school year.

SoberSloth will become available to beta-testers as a free web-app in Fall of 2020.

Individual iPad apps and the Teacher Dashboard are available for purchase on [the App store](#).

Government Awards Supporting R&D

Supported by six awards from the SBIR programs at the National Science Foundation and the National Institutes of Health.

ChemVLab+

Online chemistry activities that help students think like real chemists

Contacts: Dr. Jodi Davenport (jdavenport@wested.org);
Support (chemvlab@wested.org)

INTERVENTION

[ChemVLab+](#) supports high school students in developing reasoning and science practice skills aligned with the NGSS through a series of eight activities that present authentic scenarios with animated videos, problems with immediate feedback, and virtual chemistry lab experiments. By using familiar and motivating contexts, students gain experience using their knowledge to address questions relevant to their lives, such as determining safety of drinking water, or design goals, such as choosing a thermal transfer material for a solar plant. While students in early grades learn simple strategies such as manipulating one variable at a time, designing chemical experiments requires students to call on core ideas of chemistry as they consider how to connect what can be controlled and measured at the macroscopic scale to the underlying molecular processes. Providing individualized instruction with feedback, students move through activities and receive prompts to plan and carry out lab investigations. Students can request hints and will receive feedback (either explanations or additional practice) if they are on the wrong track. The web-based platform can be used for in-class, hybrid, and distance learning for high school classrooms, introductory college courses, and informal education.



RESEARCH BASE

Four design principles from research on science learning informed the design of the ChemVLab+ activities: using authentic contexts, integrating science practices, building on multiple representations, and providing formative assessment with feedback. The goal was to promote deeper conceptual understanding by prompting students to connect quantitative calculations to chemical processes at the microscopic level (e.g., the level of atoms and molecules) and to outcomes at the macroscopic level (e.g., final concentrations, color, temperature). A study with more than 1400 high school students found that students using the activities demonstrated increased learning as evidenced by improved problem solving and inquiry over the course of the activities and by statistically significant improvements from pre- to posttest. Findings were published in 2017 in the book *Learning from Dynamic Visualization* and in 2018 in the *Journal of Chemical Education*. Researchers are currently developing a second iteration of the activities to deepen and expand content from the prior ChemVLab+ materials to address the three-dimensional learning of NGSS that integrates disciplinary core ideas, science practices, and crosscutting concepts. The activities have been revised in collaboration with practicing chemists and chemistry teachers and tested for usability and feasibility in 14 classrooms with 1159 students. A pilot study is currently underway to further explore student learning outcomes. For information go to <https://chemvlab.org/research/>.

ChemVLab+ is web-based and freely accessible on the internet across platforms.

Instructions for accessing the activities can be found at www.chemvlab.org

Government Awards Supporting R&D

Institute of Education Sciences, U.S. Department of Education, through grants in 2010 ([R305A100669](#)) and 2017 ([R305A170049](#)) to WestEd; National Science Foundation through grant 1726856 to Carnegie Mellon University.

codeSpark

Teaches the ABCs of coding to ages 5- 9

Pasadena, CA

Contact: support@codespark.com

INTERVENTION

[codeSpark Academy](#) uses a text-free, game-based programming environment for children ages 5 to 9 years old to learn coding and computational thinking skills. codeSpark translates complex computer science concepts into a fun and engaging format that children can navigate regardless of their age, language, or reading level. Within codeSpark Academy, the StoryMode module allows children to create multi-



scene animated stories using code ([Video Demo](#)). Early elementary teachers with or without computer science knowledge can integrate StoryMode into their current ELA, Social Studies, Science and many other lessons. Students use coding skills to set up, move, and create interactions between characters and objects for each scene of their story. Children learn sequencing, loops, algorithms, conditionals, and events, all while creating stories that support their teacher's current lesson plan. Teachers can use StoryMode to supplement ELA with book reports ([Video Demo](#)), history lessons, or personal narratives ([Video Demo](#)). The open-ended setup of StoryMode allows teachers to choose how best to use the tool as they integrate it with their current curriculum. Teachers can review, assign, assess, and share with parents the student projects through an integration with our web-based [teacher dashboard](#). Educator resources also include a 10-lesson curriculum, unplugged activities, and getting started videos.

- Winner, Reimagine Education 2018 Education App Gold Award (2017)
- Best Apps for Teaching & Learning by the American Association of School Librarians (2016)
- Best Learning App for Tablet by Kidscreen Awards (2016)
- Best App or Product for Younger Children at the KAPi Awards (2016)

RESEARCH BASE

Research Supporting codeSpark in the Classroom: codeSpark's app is rooted in CSTA standards and years of usability, feasibility, and efficacy research.

- A 2015 study performed by KnowProgress showed that following three 30-minute play sessions of codeSpark Academy, 27 participants (age 5-8) demonstrated an increase in computational thinking skills, confidence in problem solving, and interest in STEM.
- In a 2016 study by Mobile Computing Lab, researchers found that using codeSpark Academy 1 hr/wk for 3 weeks significantly improved 69 participants' (age 6-10) computational thinking skills.
- A 2019 study of StoryMode involving 10 teachers and 94 1st and 2nd grade students found it to be easy to use and engaging for both teachers and students after integrating with three ELA lessons.
- In 2021, RAND will perform a randomized-control study with 50-60 classrooms to test the efficacy of StoryMode in teaching computational thinking concepts to first and second grade students.

codeSpark's Products: codeSpark is available on iPads, tablets, Chromebooks, and other computers (web-based). The app is free to schools and districts; home purchase is available on the App store.

Government Awards Supporting R&D

codeSpark has been supported by ED/IES SBIR awards in 2018 and 2019 and a 2019 IES research grant.

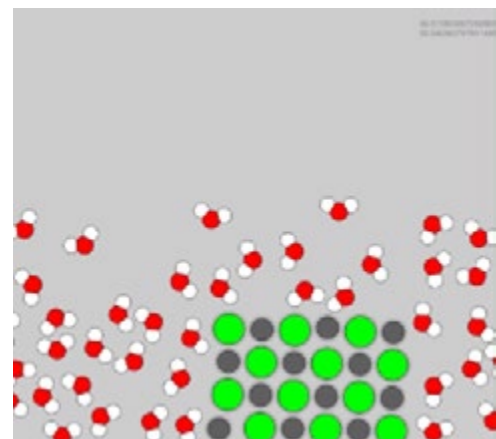
The Connected Chemistry Curriculum

University of Illinois Chicago

Contact: Mike Stieff (mstieff@uic.edu)

INTERVENTION

[The Connected Chemistry Curriculum](#) (CCC) is a comprehensive set of curriculum materials for chemistry instruction for middle and high school students. The curriculum is available online and includes multiple instructional activities to provide students with opportunities to problematize their learning, generate demand for knowledge, support refinement of understanding, and illustrate the applications of chemistry. CCC curriculum materials comprise (1) a web-based application that includes molecular-level visualizations and (2) a set of curriculum digital workbooks that center on core disciplinary concepts of chemistry. These concepts (Modeling & Matter, Solutions, Chemical Reactions, Pressure & Gas Laws, Kinetics, Thermodynamics, Acids & Bases, Equilibrium, and Nuclear Chemistry) are routinely taught in secondary chemistry classrooms across the U.S, which makes CCC especially easy to integrate into a diverse range of chemistry classrooms. Teachers using CCC materials also gain access to a large network of chemistry teachers who share feedback.



RESEARCH BASE

For over 15 years, CCC has been studied in the context of multiple interventions and through design-based implementation research. Four separate feasibility studies with 52 chemistry teachers in 9 school districts have demonstrated CCC materials can be easily integrated into local curriculum contexts. 100% of participating teachers reporting they were able to implement CCC activities to support student learning in regular and advanced chemistry. Case studies of students learning from CCC simulations individually and in groups have indicated the curriculum materials promote deep learning of disciplinary concepts and scientific modelling practices. Quasi-experimental intervention studies have also established the curriculum's efficacy for promoting learning in a variety of classrooms with statistically significant improvements relative business-as-usual methods. These studies have demonstrated that students who complete CCC activities perform better on several summative achievements compared to business-as-usual methods in chemistry classrooms. CCC has also shown promise for improving students' competency for interpreting chemistry diagrams and using different chemistry representations to demonstrate their learning. One study of 228 high school students learning from an early edition of CCC demonstrated improvements in learning outcomes compared to 680 students learning from textbooks only. These students also demonstrated a 15% increase in their accuracy for depicting chemical processes with diagrams. More recently, CCC has been shown to positively impact learning outcomes for post-secondary students as well. One study of 505 first- and second-year university students revealed that students who completed CCC activities were more likely to score higher on assessments of conceptual knowledge at the end of an academic year. This study also demonstrated that the curriculum activities involving sketching were critical for helping students make sense of the dynamic simulations.

CCC is a web-based program that can be used on any device with an Internet connection. Instructional materials are located [online](#) and can be viewed with any PDF reader.

Access to the supporting simulations is available upon [registration](#).

Government Awards Supporting R&D

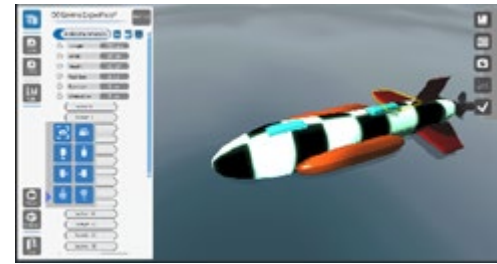
CCC has been supported by two federal awards from the US Department of Education's Institute of Education Sciences, one award from the National Science Foundation, and on award from the Camille & Henry Dreyfus Foundation.

DESCARTES, EDISON, & DAVINCI by Parametric Studio

Parametric Studio Inc, Ames, IA
Contact: Dr. Chris Whitmer
(whitmer@parametricstudioinc.com)

INTERVENTION

Parametric employs project-based learning and instruction to reinforce students' conceptual understanding, STEM skills, and problem solving with virtual and maker integrated design projects. These projects include boats, submersibles, airships, bridges, towers, RC cars, contraptions, circuits, power systems, RC gliders, and RC planes. The Parametric Design Suite is built on a set of real engineering tools for: creating complicated designs; analyzing these designs with math, science, data, and plots; simulating these designs; 3D printing or hand fabricating a prototype, and collecting test data in the real world. Students collaborate, communicate, and discuss their designs in teams and the platform contains tools for sharing design logs, files, and results with team members. The platform and supporting curricula have an emphasis on analysis, justification, documentation, practice, and communication of STEM concepts, knowledge, and skills. The web-based software platform can be used for in-class, hybrid learning, and distance learning situations for both informal situations and grade 3-12 classrooms. Parametric's game mechanics focus on collaborative and iterative design, simulation, and hands-on prototyping to helping students directly apply models made with math and science concepts in their designs. Parametric Design Suite apps include: **DESCARTES** ([Video Demo](#)), in which students in grades 3 to 5 use engineering design, apply Math and Science concepts, simulate in a sandbox game, and 3D print their own prototypes (submersibles, boats, gliders, and other machines) using standards aligned design challenges and curricula; **EDISON** ([Video Demo](#)) focuses on students in grades 6 to 9 and allows them to solve real engineering problems with gamified design projects, make and test designs involving structures, electronics, and RC cars, simulate and visualize designs in VR and AR. Teachers can customize and create their own unique project-based learning activities in EDISON; **DAVINCI** ([Video Demo](#)) guides high school student as they apply engineering, algebra, pre-calc, physics, and physical science concepts in the design simulation and fabrication of gliders and planes.



RESEARCH BASE

Parametric's platform, challenges, curricula, and apps are based on years of engineering education, teaching, and pedagogy experience at all levels from K-12 to undergraduate. Parametric's research-based approach to development mixes frequent teacher and student focus groups, frequent feature tests, and full beta and pilot tests of all aspects of the platform, applications, challenges, and curricula. We have partnered with educational research specialists at several universities to conduct several large classroom pilot tests of the platform to evaluate the usability, feasibility of implementation, and impact on outcomes for students at the upper elementary and middle school level. To date we have had over 9000 educators and student users successfully implement and use our products. In 2018-19 we conducted a quasi-experimental study with 14 classrooms and 445 students in grades 3-5, where students and teachers examining the implementation of an integrated 3-week project-based STEM curricula utilizing DESCARTES. Results showed statistically significant improvements in content knowledge related to measurement, area, volume math standards, and engineering, energy, forces, and matter related standards. Observations and surveys demonstrated the usability and feasibility in the classroom.

Parametric Design Suite apps are available for iPads, Tablets, and through the browser for Chromebooks, Windows, and Mac. The design suite program is available as a [subscription service](#) to schools, districts, informal STEM organizations, and individuals.

Government Awards Supporting R&D

Parametric Studio's software development and research has been supported by 3 awards from the Small Business Innovation Research Program at the US Department of Education and National Science Foundation.

ECO

An Online Virtual World for Environmental Literacy
and Collaborative Problem Solving

Strange Loop Games, Seattle WA

Contact: John Krajewski

John@strangeloopgames.com

INTERVENTION

[ECO](#) ([Video Demo](#)) is a multi-player ecology game to prepare middle and high school students to be environmentally literate and capable citizens. To play the game, groups or a class of students enter a shared online world featuring a simulated ecosystem of plants and animals. Students co-create their civilization by measuring, modeling, and analyzing the underlying ecosystem, and advocate for proposed plans to classmates and make decisions as a group. Students cooperate and employ science-based decision-making activities to prevent the destruction of the environment. The game includes teacher resources to support the alignment of game play to learning goals, and implementation. Eco is designed to be played during or outside of class (at home or after school) to augment traditional curriculum and instruction. Eco is designed to target science standards, focusing especially on 21st century skills of collaboration, self-directed learning, leadership, scientific argumentation, and applied learning. ECO has been played over 400,000 times a “Very Positive” rating across 4,000 reviews.



Selected Industry Awards and Recognition: 2019, ECO was invited to participate in the UN Climate Summit as an intervention to address the climate crisis: United Nations press release ([Read Here](#)), in USA Today ([Read Here](#)), and in the New York Post ([Read Here](#)); 2018, Venture Beat Magazine name ECO its Game of the Year ([Read Here](#)); 2017, ECO wins the People’s Choice award at Earth Games ([Read Here](#)); 2016, ECO wins the Grand Prize at the Climate Game Challenge ([Read Here](#)); A class of students at Hathaway Brown School produces a video story of their experience playing Eco ([Watch Here](#)); 2017, Wired UK features ECO. [Read Here](#); 2015, The Washington Post features ECO. [Read Here](#).

RESEARCH BASE

Game design and development was an iterative process, with feedback from teachers and students throughout. Several pilot implementations demonstrate the ECO was usable (the game functions) and feasible (teachers were able to integrate ECO into classroom practices and students were engaged through game play). Two pilot studies evaluated the promise of ECO to support learning. In one study with 88 middle and high schools, 44 of whom played the game and 44 who engaged in business as usual activities, who played Eco had significantly higher scores on a measure of attitudes towards the environment and on a measure of knowledge of systems than students in the control group. There were no differences between the groups on a post-test measure of content knowledge. In another qualitative study with 39 middle school students playing Eco, students engaged in discussions on STEM content, and relevant to civics education and engaging with environment systems.

ECO is available for purchase on the STEAM platform. ECO is currently available for us on PC’s with graphics card installed and is preparing to one day be available on game-streaming services like Stadia for use on any device. A limited number of licenses are available for schools interested in implementing ECO and participating in research in the 2020-2021 school year.

Government Awards Supporting R&D

ED/IES SBIR in [2014 Phase I](#) (\$149,833) [2015 Phase II](#) (\$900,000), and [2017 Phase I](#) (\$149,152).

EcoMOD

Computational modeling for elementary ecosystem science education

Harvard Graduate School of Education

Contact: Dr. Shari Metcalf

(shari_metcalf@gse.harvard.edu)

INTERVENTION

The EcoMOD 3rd grade science curriculum blends an immersive 3D virtual ecosystem and a 2D visual programming and modeling environment to support learning of ecosystem science and computational modeling. Students observe and explore a 3D virtual forest ecosystem, collecting data and traveling in time, to learn about how the forest changes as beavers build a dam. The 2D modeling tool provides a block-based programming interface for students to construct an agent-based computational model of a beaver. As students build and test their models, they observe emergent outcomes, and make inferences about ecosystem relationships.



RESEARCH BASE

Computational modeling can make scientific concepts more accessible and enhance understanding of phenomena. Research with EcoMOD found that the curriculum supported student learning of ecosystems science content, causal reasoning and computational thinking, and in modeling as a science practice. Pre-post survey data (n = 100) found significant gains in science content knowledge, understanding of the purpose of scientific modeling science self-efficacy, and computational self-efficacy. Analysis of student pairs' programming activities (n = 47) identified growth in use of computational concepts such as sequencing, loops, and conditionals. The seven teachers in our study reported high student engagement and felt that the curriculum was feasible and well-aligned with national science standards. EcoMOD was funded by NSF grant DRL-1639545 to Chris Dede, Karen Brennan and Tina Grotzer.

HOW TO ACCESS

For more information on EcoXPT, EcoMOD, and our other research, and to download the software and curriculum materials, visit our website at <https://ecolearn.gse.harvard.edu/>

EcoXPT

Authentic experimentation for understanding ecosystems dynamics

INTERVENTION

EcoXPT is a three-week middle school curriculum focused on how ecosystems work. Students explore an immersive simulation of a pond ecosystem traveling between different days and locations. They discover an environmental puzzle that they attempt to explain by using virtual tools, observing organisms in the world, and by collecting and graphing data. Students meet virtual ecosystem scientists and use authentic modes of experimentation—both in a lab and out in the world. They use an on-line concept map to make claims, collect evidence, and to offer reasoning. The full curriculum includes lesson plans, PowerPoints, a set of six Thinking Moves (aligned to the NGSS) with supporting videos, an extensive teachers' guide, and two sets of PD workshop sessions.

Harvard Graduate School of Education

Contact: Dr. Tina Grotzer (Tina_Grotzer@harvard.edu)



RESEARCH BASE

Students using EcoXPT ($n = 532$) made significant gains in understanding ecosystems content, dynamics across space and time, causality, experimental methods, and attitudes towards science. In a study ($n = 675$) comparing use of the experimental tools to a version without, tool use resulted in greater understanding of experimental methods and correlation versus causation. In a study ($n = 300$) comparing XPT to a paper-based curriculum focused on a similar ecological puzzle, students made greater gains in understanding experimental methods, and causality. Case studies ($n = 79$) contrasting EcoXPT to other technology-based programs suggest that it is especially helpful in supporting understanding of the complex dynamics of ecosystems and in the development of strong bodies of evidence. EcoXPT was funded by NSF grant DRL-1416781 to Tina Grotzer and Chris Dede, and builds on prior research with EcoMUVE, supported by IES grant R305A080514.



HOW TO ACCESS

For more information on EcoXPT, EcoMOD, and our other research, and to download the software and curriculum materials, visit our website at <https://ecolearn.gse.harvard.edu/>

ESCOLAR

Online science curriculum for middle school

University of Oregon, Eugene, OR

Contact: Dr. Fatima Elvira Terrazas-Arellanes
(fatima@uoregon.edu)

INTERVENTION

ESCOLAR (Etext Supports for Collaborative Online Learning and Academic Reading) ([see video demo](#)) supports middle-school students, including those with learning disabilities, in learning science in an engaging online environment. The ESCOLAR program is a web-based curriculum with a complete set of 15 science units aligned to all middle school Next Generation Science Standards. ESCOLAR units are intended for teachers' use in their classrooms as their core instructional materials, replacing traditional textbooks. The ESCOLAR program can also be used by home-schooled

students whose parents can monitor their children's learning and progress. Features of the curriculum include: (a) an interactive, flexible, multi-modal learning environment with built-in supports for students with various disabilities and learning styles ([see video demo](#)) and (b) teacher-friendly resources, such as an online training course and automated reports of student progress ([see video demo](#)). This free instructional technology tool gives teachers and students a rich, motivating learning environment with interactive materials, guided inquiry-based activities, opportunities to collaborate, and on-screen reading enhancements to promote comprehension of scientific text. See these resources on the [ESCOLAR website](#).



RESEARCH BASE

Research since 2009 has included case studies, a pilot study, and a randomized controlled trial, all published in peer-reviewed journals—has demonstrated the usability, feasibility, and efficacy of the intervention to support students with specific learning disorders, as well as general education students and English language learners. Results of a randomized controlled trial (published by the [International Journal of Science Education](#) in 2018) conducted with 2,303 middle school students and 71 teachers across 13 schools in two states indicated that online units effectively deepened science knowledge across all three student groups. Comparing treatment and control students on pretest-to-posttest improvement on standards-based content-specific assessments, there were statistically significant mean differences (17% improvement in the treatment group vs. 6% in the control group; $p < .001$); no significant interactions were found between treatment condition and learning disability or English learner status, indicating that these two groups performed similarly to their peers. The ESCOLAR team worked with science experts from the Biological Sciences Curriculum Study (BSCS) and local teachers to develop this curriculum.

HOW TO ACCESS

ESCOLAR can be used on any iPad, tablet, Chromebook, laptop, or desktop with an Internet connection. The program is available at no cost to the user. Watch this [video demo](#) to learn how to create an account.

Government Awards Supporting R&D

ESCOLAR has been supported by three federal awards from the National Science Foundation and the Office of Special Education Programs at the US Department of Education.

FabMaker Studio

Engineering, Design and Fabrication

[FableVision/Reynolds Center](#), Boston, MA

Paul Reynolds (paul@fablevision.com)



INTERVENTION

[FabMaker Studio](#) is a web-based design and fabrication tool that allows students from kindergarten to 8th grade the tools to design, invent, and build their own geometric constructions and working machines using low-cost materials like paper, cardstock or cardboard, and a wide range of tools from scissors to inexpensive 2D cutters, 3D printers, and laser cutters. While maker movement interventions can include more costly and time-consuming 3D printing, the FabMaker Studio web-based program has helped pioneer a low-cost alternative using paper and card stock, which is friendlier, more accessible, and highly scalable. Fabricating with paper and card stock is faster and inexpensive, which addresses the issue of time constraints and more equitable access. Because FabMaker Studio allows users to evaluate, redesign, and recreate quickly, students are able to experience the full engineering design process, while encouraging creativity, persistence, and resilience. First deployed in 2016, there have been approximately 360,000 users of FabMaker Studio from prekindergarten to high school.

RESEARCH BASE

FabMaker Studio emerged from the national Make to Learn research initiative – a collaborative of non-profit, educational, and for-profit organizations spearheaded by the University of Virginia with the goal to improve STEM education and the career pipeline. FabMaker has been widely deployed in schools and in remote learning environments – feedback from users demonstrates that the intervention is usable across settings and can be feasibly integrated as an intervention. A study of 20 middle school students using an early beta version of FabMaker Studio demonstrated a significant increase in student interest in science and technology after eight weeks using the program. In a 2018 survey with 100 students, 96.9% reported positive gains in STEM Interest and 82.1% reported that they feel like have a STEM Identity after using the FabMaker platform.

FabMaker Studio is available through FableVision Learning at:

<https://www.fablevisionlearning.com/fabmakerstudio>

It is a web-based game that is available on any device connected to the internet.

Government Awards Supporting R&D

Initially support from a [2010 ED/IES SBIR](#) award to [FableVision Studios](#) and the Reynolds Center for Teaching, Learning and Creativity; additional funding support from NSF ITEST, as well as private foundations, including MacArthur, Cisco, Motorola, Alcoa, Dassault US Foundation, and the Morgridge Family Foundation.



Happy Atoms

An award-winning serious game series that brings the middle school physical sciences to life!

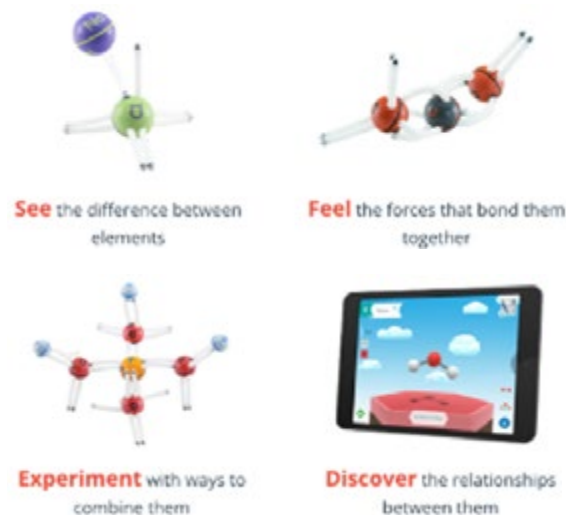
[Schell Games](#), Pittsburgh, PA

Contact: Dr. Brooke Morrill

(bmorrill@schellgames.com)

INTERVENTION

Knowledge of and comfort with chemistry is necessary to solve many real-world problems, but the way chemistry is typically taught often fails to capture students' imaginations, discouraging experimentation and discovery. Happy Atoms ([Video Demo](#)) is a physical molecular modeling set and interactive digital app that is the modern alternative to old-fashioned molecular kits used to teach bonding. The physical model sets feature 16 atoms containing individual electrons and magnetic bonding sites. The companion Happy Atoms mobile app allows users to snap a picture of what they have created and then uses proprietary vision-recognition algorithms to identify what molecule a user has made. The app both allows for open-ended and guided discovery through curated information, guided, and free-play features to continually pique players' curiosity and interest in chemistry. Designed for middle and high school chemistry with standards-aligned curricular resources on our website for free download, many younger children also enjoy simply exploring what Happy Atoms offers as they learn about atoms and molecules intuitively. Happy Atoms launched in 2016 and since has been used both by tens of thousands of children and students in classrooms and at home.



2017 Learning Technologies Awards/CloserStill Award for Most Innovative New Learning Technologies Product-International (Bronze); 2017 Reimagine Education Virtual/Augmented Reality Award (Shortlisted); 2017 Tech 50/Pittsburgh Technology Council Innovator of the Year-Consumer Product Award (Winner); 2017 Augmented World Expo (AWE) Auggie Award for Best Game or Toy (Winner); 2017 Parents' Choice Award (Silver); 2017 KAPI Award Winner for Best Educational/Learning Tool (Winner); 2016 Reimagine Education Virtual/Augmented Reality Award (Shortlisted); 2016 Techlicious Best of Toy Fair (Official Selection)

RESEARCH BASE

Teachers report that the game can easily be integrated within instructional practice, and students indicate high levels of engagement while learning with Happy Atoms. Schell Games partnered with WestEd, a nonprofit research, development, and service agency, to conduct a pilot study to evaluate of student learning outcomes. Results of a randomized controlled trial with 1,795 high school students conducted during the 2017/2018 school year suggest that that Happy Atoms provides an alternative to more traditional ways of teaching and learning chemistry. Students in the treatment group performed as well on a measure of chemistry knowledge and attitudes as students who used physical models taught by an expert teacher.

Schell Games partners with the internationally renowned and leading chemistry set and science toy company, Thames and Kosmos, to bring Happy Atoms to market on Amazon in 3 sizes: an Introductory Set, Complete Set and the Educator's Bundle (5 complete sets, 250 atoms). The companion Happy Atoms mobile app is a free download available on the App Store (iOS 10.0+) and Google Play and Amazon for Kindle Fire (Android 4.3+).

Government Awards Supporting R&D and Evaluation

ED/IES SBIR Phase I ([2014](#)) and Phase II ([2015](#)).



HoloLab Champions

A Virtual Reality (VR) Chemistry Game Show

Schell Games, Pittsburgh, PA

Contact: Dr. Brooke Morrill

(bmorrill@schellgames.com)

INTERVENTION

HoloLAB Champions ([Video Demo](#)) is an immersive virtual reality (VR) chemistry-lab game show experience designed to improve middle and high school students' skills with lab equipment and procedures. Scoop, pour, and burn your way to mastery in the HoloLAB, where game-show-style levity collides with real-world safety. Trophies commemorate achievements and adorn the immersive Hall of Brains. Your holographic host, Earl, and camera-bot sidekick, Meyer, guide you through a series of mini-labs that lead up to a final lab challenge. Can you follow written lab procedures in order to create a glowing solution? Can you use clues presented in your lab notebook to identify unknown substances? Score achievements and do your best to earn an elemental trophy along the way. If you want to focus on a specific skill instead of playing through an entire experiment, Practice Mode allows you to train for challenge in a free-form setting so you can hone your accuracy, precision, and timing skills. A comprehensive educator guide that outlines game features, curricular content, standards alignment, example lesson plans, and much more is available for free download on the [HoloLAB Champions Educator page](#). HoloLAB Champions was released as a commercial product in June 2018 and is currently available as a free download on the [Steam Store](#) and has been downloaded by thousands of users.



Awards and Recognition: 2019 Innovator of the Year: Community Tech, Tech 50/Pittsburgh Technology Council, Finalist; 2019 Serious Play Gold Award, International Serious Play Awards, Winner; 2019 Best Learning Game, Games for Change, Finalist; 2019 Games for Learning/Simulation, Ed Tech Awards, Winner; 2019 New Product or Service (2017 or Later), Ed Tech Awards, Winner; 2018 Best Ed Tech of 2018, Common Sense Education, Selection; 2018 Immersive Education of the Year, Immersive Perspective Awards, Finalist; 2018 Best Business Game, Serious Games Showcase and Challenge, Winner; 2018 Best XR Game, Serious Games Showcase and Challenge, Winner; 2018, Best AR/VR Education App or Tool, Tech Edvocate, Winner; 2018, Top Pick for Learning, Common Sense Education, Winner; 2018, The Tech Edvocate Award, The Edvocate, Nominee; 2018, VR Education of the Year, VR Awards, Winner

RESEARCH BASE

To iteratively design and develop HoloLAB Champions, Schell Games and research partner RAND Corporation conducted focus groups and held usability sessions with teachers and students at many points. Results from an laboratory out-of-class pilot revealed with 70 students students revealed that students used HoloLAB Champions for a median of 120 minutes were more enthusiastic about their experience learning chemistry lab practices and processes than students who read text and completed worksheets covering similar material. Future research to test the promise of HoloLAB Champions when implemented in a classroom and fully integrated with teacher's instructional practices is warranted.

HoloLAB Champions requires an HTC Vive or Oculus Rift VR hardware system along with a computer that meets the manufacturer-provided minimum specifications.

Due to the pandemic, HoloLAB Champions is currently available at no cost on the [STEAM](#).

Government Awards Supporting R&D

ED/IES SBIR Phase I ([2016](#)) and Phase II ([2017](#)).

Inq-ITS

Virtual labs that grade themselves -- in class or remote

Supplemental – Labs with Real time Assessment & Support for Science Practices www.inqits.com

Inq-ITS, Berlin, MA

Contacts: Dr. Janice Gobert, CEO (janice@apprendis.com) or Dr. Mike Sao Pedro, CTO (mikesp@apprendis.com)

INTERVENTION

As middle and high school students engage in virtual science inquiry with simulations, they are assessed and supported in real time on all practices, including their writing. Inq-ITS, the student platform, and Inq-Blotter, the teacher platform, ([watch video](#)) are the first systems to use patented AI for real time science assessment and learning. Inq-ITS and Inq-Blotter can be used in class or fully remote, and are designed to support all students, including ELLs and Special Education students. Inq-ITS has been used by over 60,000 students in 47 states and D.C. and teachers from 86 countries have signed up for accounts in anticipation of remote or hybrid instruction in Fall 2020.

Inq-ITS



- 2020: [Rutgers Today](#) features Inq-ITS, which was widely used during COVID19 for teaching and learning.
- 2017: [EdScoop](#) features InqITS as an example of real-time formative assessment for science.
- 2017: [Education News](#) features InqITS: [Cutting Edge Educational Technology](#)
- 2017: SIIA: Most Innovative EdTech Solution, Runner-Up

RESEARCH BASE

As middle and high school students engage in virtual science inquiry with simulations, they are assessed and supported in real time on all practices, including their writing. Inq-ITS, the student platform, and Inq-Blotter, the teacher platform, ([watch video](#)) are the first systems to use patented AI for real time science assessment and learning. Inq-ITS and Inq-Blotter can be used in class or fully remote, and are designed to support all students, including ELLs and Special Education students. Inq-ITS has been used by over 60,000 students in 47 states and D.C. and teachers from 86 countries have signed up for accounts in anticipation of remote or hybrid instruction in Fall 2020.

Government Awards

Inq-ITS and Inq-Blotter have been supported by 13 awards across programs including [ED/IES SBIR](#), the Institute of Education Science grant program, and the National Science Foundation.

LightUp

Augmented reality (AR) science labs and activities
for virtual learning

Pacifica, CA

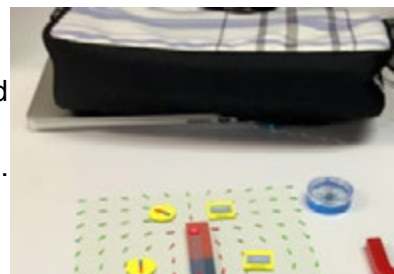
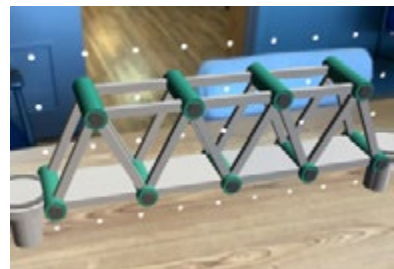
Contact: Josh Chan (josh@lightup.io)

INTERVENTION

LightUp ([Video Demo](#)) offers a suite of science labs and activities, powered by augmented reality (AR) to bring previously inaccessible STEM learning experiences into the home and classroom for middle and high school. LightUp's AR apps augment the environment around the student with simulated instruments and equipment, real-time data visualizations, and annotations, and are designed to look and feel realistic to maximize transferability of knowledge between the simulation and the real world.

Hundreds of students around the world use our apps each day to learn about biology, chemistry, physics and more. Available Now:

- Bridge Builder AR: Help us connect the world! Use Bridge Builder AR to design and build your creations, then test their limits by adding force until they break.
- Solar System 3D: See a stunning, perfectly scaled solar system in your living room.
- Animal Safari AR: With Animal Safari AR, you can go on a safari in your own backyard! Place virtual animals in the real world using augmented reality, take pictures and videos and share them.
- Magnet Lab AR: Combine the fun of real-world magnet experiments with the power of simulation to let students explore and learn in an engaging new way!
- Hololab AR: Hololab is a science adventure in the palm of your hand. Our collection of dozens of fully immersive 3D labs and educational games will inspire you to learn about the world like never before!
- Sugar by LightUp: See the amount of sugar in foods in terms of sugar cubes and donuts, just by scanning a barcode. Then, see it in your world with the magic of augmented reality.
- Globe by LightUp: See captivating visuals of real-time weather, natural disasters, demographics, and more on a 3D globe viewable on any desktop or mobile device. Use an AR-enabled mobile device, and you can bring the globe into your room with one tap.



RESEARCH BASE

LightUp's apps are based on the founding team's science classroom teaching experience, as well as research conducted at the Stanford Graduate School of Education. While research efforts are still getting underway, early pilot research has indicated the promise of LightUp's learning experiences to boost both engagement and learning outcomes. In a pilot study conducted with 54 high school science students, a majority of students surveyed indicated they would like to do more virtual labs in the future (44% strongly agreed, 44% agreed). Furthermore, a majority of students responded that they had learned something new doing the virtual lab. In late 2021, LightUp will conduct a pilot study to evaluate the effect on engagement and learning outcomes of its intervention in 10 high school science classes.

LightUp's Products: LightUp's apps are available on Apple iPhones & iPads, Android smartphones & tablets, Chromebooks, and other computers (web-based). Individual apps are available for free download on the Apple App Store and Google Play, with additional features and content available for upgrade. Visit www.lightup.io/apps to try them today.

Government Awards Supporting R&D

Supported by [2019](#) and [2020](#) ED/IES SBIR and NSF SBIR awards.

Martha Madison

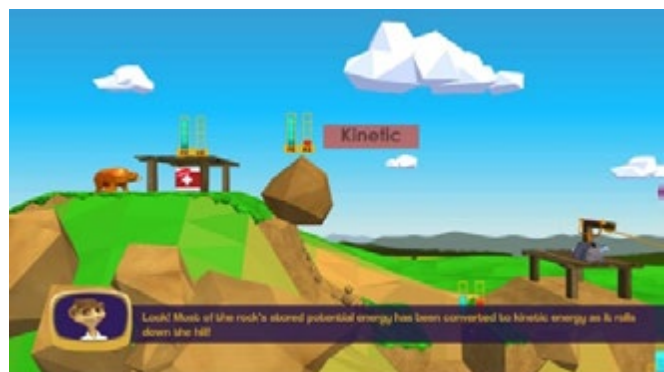
An award-winning serious game series that brings the middle school physical sciences to life!

[Second Avenue Learning](#), Rochester NY

Contact: Victoria Van Voorhis
(tory@secondavenuelearning.com)

INTERVENTION

[Martha Madison](#) ([Video Demo](#)) is a game-based curriculum for middle-school featuring 8 cooperative serious games. Each game covers a specific science concept, such as Energy (as seen above), Waves, Simple Machines, Optics, and Electricity. While playing the game, students receive instruction from meerkat scientist Martha Madison, who explains the science concepts and encourages players to apply them to the in-game challenges. All in-game challenges are directly tied to specific learning objectives and key physical science standards.



Teachers have access to a robust data dashboard to track and monitor student in-game progress and comprehension of the learning objectives. As students learn the key concepts, they can unlock sandbox-style maker spaces which allow them to build their own unique game levels, encouraging open-ended play and creation. While the game can be played in single player mode, Martha Madison is designed for two students to play cooperatively, encouraging communication and teamwork to complete challenges, as collaboration and communication are fundamental to the sciences, as they are most disciplines. The games are web-based and can be enjoyed on Windows PCs, Macs and Chromebooks. Teachers receive lesson plans and teacher guides to support implementation. Martha Madison can be use for in-class or remote teaching and learning.

The EdTech Awards Cool Tool Finalist 2018, I/ITSEC's Student's Choice Award 2017, Serious Play Bronze Medal Winner 2015, Innovations in American Government Finalist 2012

RESEARCH BASE

To evaluate the promise of the game to support learning, Second Avenue conducted both mix-method and field studies with its research partners at Rochester Institute of Technology. A [Martha Madison White Paper](#) presents findings of the research. During a study with 73 students, students from urban districts demonstrated lower perceptions of the STEM fields than students from rural or suburban districts in a pre-test. After playing the Martha Madison game, all students from urban districts demonstrated a significant increase in positive STEM discipline perception and affiliation on the post-test, effectively closing the gap with their rural and suburban peers. Nearly all communication and recorded behaviors during game play were related to active discussion of the game and science problems, indicating that students were deeply immersed and focused on the academic content and problem-solving. An additional study revealed students who played the game improved in content learning and in concept recognition, without any direct teacher instruction. Teachers have reported that the gameplay can be integrated into science instructional practice, and that students are highly engaged.

For more information on Martha Madison, head to

<https://secondavenuelearning.com/martha-madison/>

To purchase Martha Madison, please go to: store.secondavenuelearning.com

Government Awards

Supported by the National Science Foundation's SBIR program.



Molly of Denali

A PBS KIDS multi-platform series about Molly Mabray and her friends and family living in a small village in Alaska, produced by WGBH Boston.

Contacts: CPB-PBS Ready To Learn Initiative; Pam Johnson, Corporation for Public Broadcasting, pjohnson@pbs.org; David Lowenstein, Public Broadcasting Service, dmlowenstein@pbs.org

INTERVENTION

The first nationally distributed children's series to feature an indigenous lead character, *Molly of Denali* ([Video Trailer](#)) centers on Molly Mabray, a feisty and resourceful 10-year-old Alaska Native girl, and her adventures in the fictional village of Qyah, Alaska. Molly of Denali's multi-media resources are designed to foster literacy skills and support the use of informational text (IT) among 4-to-8-year-old children. An independent randomized controlled trial (RCT) conducted by Education Development Center (EDC) and SRI is underway to assess the impact of a curated subset of these resources on children's understanding of IT. Child-facing resources include animated stories and live-action interstitials, digital games, and hands-on activities; the intervention also includes parent videos that provided information about different aspects of IT and highlighted how parents can support children's learning of these skills. The 127 families in the nine-week efficacy study were provided with access to these resources via a data-enabled tablet with the PBS KIDS Molly of Denali app and a researcher-developed video app pre-installed. The intervention includes a curated set of 39 videos and 3 games, focusing on a new IT learning goal each week. Access to the videos is staggered over the course of the intervention as a means of sustaining child engagement, with bundles of new video content released every Friday. Each bundle of video content focuses on a different IT feature or skill, with two bundles at the end reviewing previous features and skills. Once released, videos are available on demand; games, activities, and parent videos are available on demand throughout the intervention. Control families were provided data-enabled tablets on which PBS KIDS and other IT apps are blocked. Participants receive 1-2 text messages per week reminding them to complete media logs (both treatment and control groups) and to use the Molly of Denali resources (treatment group only). Children's knowledge of and ability to use IT will be measured pre- and post-intervention using a researcher-designed measure. Because the study period began before widespread closures of schools and suspension of travel, the study's pre-testing took place in person, but the IT assessment was converted to a digital format and children will be assessed via video conference for post-testing.

The critically acclaimed television series *Molly of Denali* has been recognized with a 2020 George Foster Peabody Award for excellence in broadcasting in 2019, a Prix Jeunesse finalist honor, and a Parents' Choice Gold Award. Additionally, the Molly of Denali app is the winner of the [2020 American Library Association Excellence in Early Learning Digital Media Award](#).

In addition to the initial RCT, researchers are currently conducting a replication study, which mirrors nearly all aspects of the first study though pre- and post-test are taking place remotely due to COVID-19 restrictions. A report detailing findings from both studies will be available January 2021.

For more information on EDC/SRI's Ready To Learn research, see <http://cct.edc.org/rtl>.

RESEARCH BASE

Molly of Denali is available on PBS stations, PBSKIDS.org and the free PBS KIDS Video app; games can be downloaded to smartphones and tablets on the free PBS KIDS Games app.

Content developed through the CPB-PBS Ready To Learn Initiative are freely available and accessible via [PBS LearningMedia](#) and [PBS KIDS](#).

Government Awards Supporting R&D

A Ready To Learn grant – authorized by the U.S. Congress and administered through the U.S. Department of Education – was awarded to the Corporation for Public Broadcasting (CPB) and Public Broadcasting Service (PBS) in 2015.

The NIH Scientist Launch Game® App

National Institutes of Health, Dept. of Health and Human Services, Rockville, MD

Contact: Don Lockett (luCKETTD@nih.gov)

and Kristin Kramer (kramerkm@nih.gov)

INTERVENTION

The NIH Scientist Launch Game® was developed for students aged 10 and up to help them experience the challenges and excitement of being a researcher and advancing science and health. Along the way, players learn more about various diseases, experimental design, and the life of a successful scientist. The game was designed for individual play as a classroom supplement, but it can be played in the classroom using a smart TV or Zoom if using an appropriate adaptor. Some teachers offer game play to students who complete in-class assignments early so they can continue learning while others catch up. Players are asked to join the fight against cancer, heart disease or the common cold. A diverse group of boys and girls cheer players on as they work through Q&As in three levels: (1) Earn a Virtual Lab Coat by learning about the causes, symptoms, preventions and treatments of common diseases; (2) Get a Grant by reviewing a short research proposal and learning about the elements of rigorous and ethical research; and (3) Advance Health and Science by navigating through other real-life challenges. See [video demo](#).



RESEARCH BASE

The NIH Scientist Launch Game® was developed over the last five years with input from over 50 scientists and science writers at the NIH Center for Scientific Review, the National Heart, Lung, and Blood Institute; the National Institute of Allergy and Infectious Diseases; and the National Cancer Institute. From reviewing thousands of grant applications from real adult researchers, these experts baked into the game their understanding of the common challenges NIH scientists face and the common errors they make when proposing new research. We then tested and refined the game by using the kids pictured in the game as well as nearly 1,000 students who attended U.S.A. Science and Engineering Festivals and NIH Take Your Child to Work Days.



The NIH Scientist Launch Game® app is available for free from the iTunes and Google Play stores.

Related STEM products developed by the NIH Center for Scientific Review are available at www.csr.nih.gov/rocket

A larger collection of NIH STEM products for educators is available via the [NIH Science Education web page](#).

Government Awards Supporting R&D

The NIH Scientist Launch Game was supported directly by the National Institutes of Health, which offers grants to STEM education researchers seeking to develop teaching resources through the [Science Education Partnership Awards \(SEPA\) program](#). Visit the SEPA.org page to discover STEM education resources developed by this program.

Physics Playground

An educational game to promote physics understanding

Florida State University, Tallahassee, FL

Contact: Dr. Valerie Shute (vshute@fsu.edu)

INTERVENTION

[Physics Playground](#) (PP) ([Video Demo](#)) is a 2D computer game designed to assess and support middle and high school students' understanding of qualitative physics in real-time. The game covers 9 key physics competencies (e.g., Newton's 3 Laws of Force & Motion). The goal in every game level is to guide a green ball to hit a red balloon. Players are free to choose any of the 110 game levels to play with two types of levels to choose from. In *sketching levels* ([Video Demo](#)) players draw simple machines to solve levels. In *manipulation levels* ([Video Demo](#)) players adjust physics parameters to solve levels. Students use of the game level's physics in their solutions is rewarded with gold coins. Currently, researchers are focusing on designing and embedding various cognitive supports (e.g., short physics videos, like this one on *potential energy* ([Video Demo](#)) and affective supports; e.g., this *breathing exercise* ([Video Demo](#)). The game can be used for in-class, remote, or hybrid teaching and learning for 8th to 11th grade students. Resources on our [website](#).



RESEARCH BASE

A recent study showed using the embedded physics videos as a support had a significant, positive impact on students' physics learning, game performance, and enjoyment. Researchers are also examining the impact of affective supports on learning and interest in science. Researchers expect them to fuel motivation when students succeed and encourage persistence when they fail. Moreover, the researchers are finalizing a quit-prediction model to help determine if a student is going to quit in the next 20 seconds. If so, the game will intervene with a suitable affective support to help the student continue playing. Researchers will investigate the effects of several types of in-game affective supports including motivational messages and automated affect detectors (i.e., interaction-based vs. webcam-based detectors). Over the past 3 years researchers have conducted several [usability studies](#) with around 300 8th to 11th graders from K-12 schools located at various sites (Florida, Pennsylvania, and New York), and conducted one main experiment so far. In Experiment 1, researchers evaluated the effects of cognitive supports. In Experiment 2 (which is running now), researchers are investigating the delivery method of the cognitive supports (i.e., before or after playing a level). In Experiment 3 (running concurrently with Experiment 2), researchers are examining the benefits of various affective supports. In Experiment 4, researchers will examine the effects of cognitive and affective supports delivery: pre-planned delivery (based on the results from our previous studies) versus delivery using the quit-prediction model (for the affective supports) and stealth assessment machinery (for the cognitive supports). To read more about the research [see this page](#).

NPR interview with Shute (2020, "Should this exist" podcast), best [student paper award](#) at ICMI (2019), feature article in the [APA Monitor](#) (2019), and various other best paper and best student paper awards.

Physics Playground is a web-based game accessible on the internet across platforms (excluding mobile devices). The Physics Playground demo version is available [here](#). Login information is [here](#).

Government Awards Supporting R&D

Supported by US National Science Foundation ([NSF #037988](#)) and the US Department of Education's Institute of Education Sciences ([IES #039019](#)) grants in the past 4 years.



Play & Learn Science App

A PBS KIDS mobile app for preschool-aged children and their caregivers that fosters exploration of scientific concepts while developing problem-solving skills.

Contacts: CPB-PBS Ready To Learn Initiative; Pam Johnson, Corporation for Public Broadcasting, pjohnson@pbs.org; David Lowenstein, Public Broadcasting Service, dmlowenstein@pbs.org

INTERVENTION

[Play & Learn Science](#) is a free PBS KIDS mobile app designed to promote science learning for kids ages 3 to 5, and to provide parents and caregivers with guidance about engaging their child in conversation and supporting their children's inquiry and exploration during their daily lives. The app introduces basic science concepts and science and engineering practices by way of five distinct sets of in-app and hands-on activities. Each set of activities includes three digital games and a designated parent page that incorporates tips, activities, and a journal.



Winner, [2019 American Library Association Inaugural Excellence in Early Learning Digital Media Award](#)

RESEARCH BASE

A four-week study conducted by EDC/SRI explored the effect of using the app in a supportive context on children's understanding of science concepts and use of science and engineering practices; children's use of science vocabulary; child and parent-child engagement in science and engineering; and parent confidence in supporting their child's science learning. The researchers selected a subset of games and activities in the app for families to explore in a structured sequence, and texted families to remind them of the sequence. The researchers provided families with a data-enabled tablet to access the app, materials and books that elaborate on target concepts and practices, and a guide that reinforced the suggested activities and tips in the app. Families who participated in the study attended two science events at their child's school, where researchers and educators modeled the activities, tips, and conversational prompts within the app. The findings suggest that when used in a supportive context, the PBS KIDS Play & Learn Science app can benefit both children and their parents/caregivers. Child outcomes include gains in understanding of science content and in use of science and engineering practices; increases in use and understanding of science vocabulary; and increased excitement about STEM. Parent outcomes include increased parent-child engagement in science and engineering-related activities; and increases in confidence for supporting their child's science learning. The findings suggest that a high-quality digital app can be a catalyst for real-world science exploration, especially when it incorporates tips for parents and caregivers about how to mediate children's use of science-focused digital games, explicit guidance for related real-world science activities they can do at home with their children, and specific suggestions for interacting with their children in ways that stimulate science exploration, thinking, and conversation. For more information on EDC/SRI's Ready To Learn research, see <http://cct.edc.org/rtl>.

The Play & Learn Science app is [available on smart phones and tablets](#).

Content developed through the CPB-PBS Ready To Learn Initiative is freely available and accessible via [PBS Learning Media and PBS KIDS](#).

Government Awards Supporting the App

A Ready To Learn grant – authorized by the U.S. Congress and administered through the U.S. Department of Education – was awarded to the Corporation for Public Broadcasting (CPB) and Public Broadcasting Service (PBS) in 2015.

PocketLab

[Pocketlab](#), San Jose, CA
contact@thepocketlab.com

A science platform that bridges the gap between hands-on and digital science learning with sensors, kits, apps, and lesson materials for grades 3-college.

INTERVENTION

The main component of the platform are the cloud software (PocketLab Notebook) and lab measurement devices (PocketLab sensors). PocketLab Notebook can be used as a stand-alone tool or in conjunction with PocketLab sensors for experimental data collection. The PocketLab Sensors are small wireless devices that can measure properties like altitude, force, or temperature and transmit the data using Bluetooth to a smartphone, tablet, Chromebook or computer. PocketLab sensors include: PocketLab Air, PocketLab Weather, and PocketLab Voyager that cover a wide range of topics in physical, Earth, and life science.

PocketLab Air
Environmental
science sensor



PocketLab
Weather
Elementary
School, intro
to science
sensor



PocketLab
Voyager
All-in-one
physics
sensor



RESEARCH BASE

We first introduced PocketLab sensors to the market in March 2015 and our products are currently used by over 250,000 students in 63 different countries from elementary school through college. Our largest adoption is in middle school for physical science labs. The youngest student users are lower elementary schools that do hands-on weather labs. Our most advanced student users are in graduate mechanical engineering courses. User community highlights: <https://youtu.be/ZmnDmXzA2YY> In a feasibility study with 344 8th grade students who used PocketLab Notebook and PocketLab sensors for physical science experiments, students showed an increase in engagement and interest in the science activity based on student pre- and post-surveys. We began developing PocketLab Notebook in 2015 with funding from an NSF SBIR Phase I grant and continued work with an IES SBIR Phase I grant in 2017, and random control trials in an IES SBIR Phase II project from 2018 to 2020. Our user community has presented best practices at many educational conferences (Wygant, 2017; Wygant, 2017; Beard, 2016; Tangredi, 2016; Barber, 2016; Holzer, 2017; Paulis, 2018; Brownell, 2017). The PocketLab sensor and app were independently reviewed by Common Sense Education and received a 5-star rating, Best in Class, top 4% of product reviews (Pohlonski, 2016). PocketLab is conducting a pilot study in the 2020-21 school year with 1400 middle school students to measure student mastery of two of the NGSS science and engineering practices (SEP4 and SEP6) compared to a control group performing business-as-usual activities.

HOW TO ACCESS

Create a free PocketLab Notebook account at <https://app.thepocketlab.com/>
and shop the PocketLab sensors at <https://www.thepocketlab.com/>

Government Awards Supporting R&D

PocketLab has been supported by awards from the Small Business Innovation Research Program at the US Department of Education and the National Science Foundation.

Polyhedron Physics

Realistic physics simulations for distance learning.

Polyhedron Learning Media, Inc., Wheeling, WV

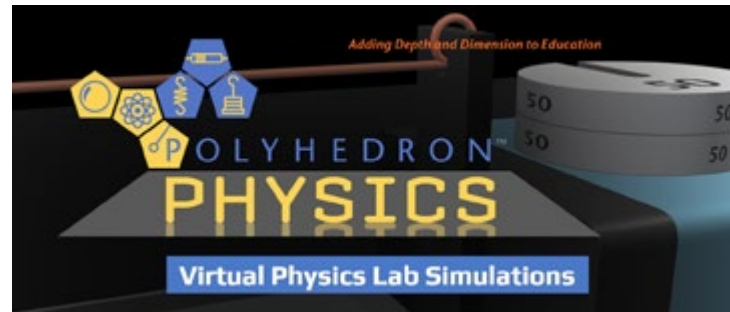
Contact: Dr. Jeanne Finstein

jfinstein@polyhedronlearning.com

INTERVENTION

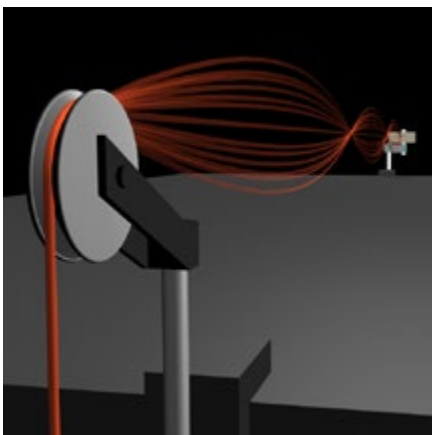
Polyhedron Physics is a set of virtual labs for introductory physics at high school and college levels. Each simulation is comprehensive, containing everything a student needs to conduct virtual physics experiments in kinematics and dynamics, thermodynamics, electricity, and light and sound. All labs are realistic, using 3D laboratory equipment and data collection tools that look and act like an actual hands-on lab.

Experimental data includes realistic variability, allowing students to use standard data analysis and error analysis techniques. The labs are flexible, with convenient access anywhere, anytime, making them an ideal option when remote learning is desirable or essential. All labs are available online, and some are also available for use on iOS devices. And, the labs are an economical option, eliminating the need for expensive lab equipment and time-consuming equipment set-up.



RESEARCH BASE

Two independent evaluations have been conducted on the use of these labs – one each at college and high school levels. Feasibility and usability were tested at each location, with the results demonstrating that the labs functioned properly and could be integrated into practice. In each study, based on a comparison of pre- and post-tests, student learning with these virtual labs was comparable to learning with hands-on equipment, demonstrating that the labs can be used to replace or supplement physical lab equipment traditionally used in introductory physics courses. The college study included 224 students, and the high school study included 168 students. In both studies half of the students used the regular labs and half used the virtual labs.



HOW TO ACCESS

The web-based version of Polyhedron Physics can be accessed at <https://polyhedronphysics.com>.

The iPad version is available through the iTunes store, with further descriptions at http://www.polyhedronlearning.com/see_apps_hsvpl.html.

The web-based version price is based on class size. The iPad labs are individually priced (\$1.99).

Government Awards Supporting R&D

Polyhedron Physics was developed with partial funding provided under contract numbers ED-07-CO-0040 and ED-IES-11-C-0029 from the Institute of Education Sciences in the U.S. Department of Education through the Small Business Innovation Research (SBIR) program.

Readorium

The Adaptive Solution for Understanding Science Text

Teaneck, NY

Contact: Harriet Isecke

(harriet.isecke@readorium.com)

INTERVENTION

[Readorium](#) ([Video Demo](#)) is an engaging and personalized online program that teaches **students in grades 3 to 8** reading strategies needed to comprehend grade-appropriate nonfiction text. Book mentors guide students through science chapter books aligned with the Next Generation and State Science Standards. Readorium's chapter books are written at 10-12 readability levels with the same information, paragraph structure, academic vocabulary, graphics, and captions. Students at all skill levels learn how to analyze text and answer the same high-level comprehension questions. All students can understand the same rich content because the readability levels of the chapters, and the support systems they receive, automatically adjust to their individual needs as they read and answer questions. Teachers and administrators can access real-time, actionable progress reports 24/7. Educators can also download a wide range of multimedia and printable instructional resources to further target instruction for individuals, groups, or whole classes based on this data. Readorium can be used fully in-class, fully remotely, or it in any hybrid teaching and learning situation.



- Recommended by the [National Science Teachers Association](#)
- 2020: EdTech Digest - [Cool Tool Finalist](#)
- 2019: Institute of Education Sciences – US Department of Education: [Success Story](#)
- 2018: International [Reimagine Gold Award for K-12 Education](#)
- 2017: CODiE finalist for [Best Cross-Curricular Solution](#)
- 2016: National CODiE [Best Reading/English/Language Arts/Instructional Solution](#)
- 2016: [Trendsetter Award](#) for innovative content by SIIA

RESEARCH BASE

Readorium was developed by reading experts and science authors nationwide based on What Works Clearinghouse studies of evidence-based instruction. These studies included the need for direct strategy instruction in context, teaching new vocabulary in multiple contexts, and differentiating comprehension instruction through scaffolding. During the project, researchers conducted three feasibility tests, and one pilot study, in over 40 classrooms in 9 socioeconomically diverse school districts in NJ and CT. All field test teachers (100%) reported that Readorium could be easily integrated into classroom practices and that they would recommend Readorium to their schools and colleagues. 81% of students agreed that Readorium was easy to use and that they were able to get help when needed. University of Connecticut researchers conducted a randomized study in 2012 with 294 students who used Readorium over 8 weeks, and 224 students who continued with business-as-usual. The Diagnostic Online Reading Assessment (DORA) by Let's Go Learn was used as a pre and post assessment measure. In subgroup analyses, positive outcomes in the DORA scores correlated with the number of Readorium books that students completed. On average, the 138 students who read 10 books or more during the 2-month pilot study gained a full year in reading comprehension on the DORA, and the more they read the greater the gain. More information is available in this [report](#).

Readorium is a web-based program that can be used on any iPad, tablet, Chromebook, laptop, or desktop with Internet connection. Readorium is available on a subscription basis to schools and districts. Individual subscriptions are available for purchase at Readorium.com

Government Awards Supporting R&D

Support by [award from ED/IES SBIR](#).

RoboCo

In-development robotics sandbox game that aims to ignite player interest in STEM fields



Filament Games, Madison, WI

Contact: Dan White

(white@filamentgames.com)

INTERVENTION

RoboCo ([Video Demo](#)) is an in-development robotics sandbox game developed by industry-leading learning game studio Filament Games. Ideal for students in grades 5-12, RoboCo serves as a PC digital robotics kit focused on fostering STEM (science, technology, engineering, and math) and robotics interest in young learners. As they form hypotheses and build robots to conquer tricky challenges, players will learn about robotics fundamentals and develop critical future-ready skills like creativity, critical thinking, communication, and collaboration. Drawing from a vast array of real robotics parts like motors, hinges, pistons, gears, and more, players will find that the creative STEM possibilities are as limitless as their imaginations. As a digitally-delivered solution, RoboCo will be usable as both an in-class intervention and for remote learning.



- Winner, 2018 Intentional Play Summit Best in Show: AR/VR
- Finalist, 2017 I/ITSEC Serious Games Showcase and Challenge
- Finalist, 2017 Reimagine Education VR/AR Award.

RESEARCH BASE

Filament Games brings a proprietary methodology for designing learning games that translate to measurable real-world outcomes. This approach is based on the foundational principles outlined by the works of former University of Wisconsin–Madison Professor and game-based learning pioneer James Paul Gee and has been refined by our team throughout our 15-year tenure in the educational games space.

In 2017, Filament Games partnered with Intel to study the usability of RoboCo in formal K-12 learning settings. In total, 20 participants interested in robotics and/or STEM were recruited for the study – 9 students, and 11 robotics teachers/coaches. Overall, teachers and coaches said the app would add value to learning robotics, and when asked whether they would like to continue using RoboCo, 8 out of the 9 students indicated that they were interested. Further research is planned as the game continues to develop.

RoboCo is currently in-development, with a planned release date of 2021. The game will be available via Steam for PC (Windows) and VR.

Educators can sign up to join the RoboCo EDU community ([signup link](#)), and register to be a part of our EDU closed alpha testing period taking place fall 2020 ([registration link](#)).

Government Awards Supporting R&D

RoboCo has been supported by 2 awards from the Small Business Innovation Research Program at the National Science Foundation.

SBIR Ph. 1 award link: <https://www.sbir.gov/sbirsearch/detail/1216941>

SBIR Ph. 2 award link: <https://www.sbir.gov/sbirsearch/detail/1644359>

SAMA

Virtual Reality for STEM Education

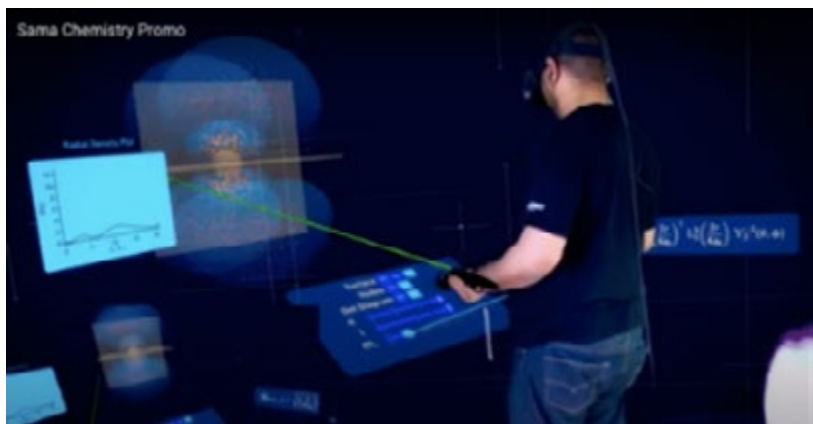
[SAMA Learning](#), San Francisco

Contact: Barbara DeHart

(barb@samalearning.net)

INTERVENTION

Sama's ([Video Demo](#)) virtual reality (VR) courses provide critical visualization, experimentation and assessment for hard to learn STEM subjects. Our lessons incorporate exposition, active learning, problem-based inquiry and assessment. VR is ideal for hard-to-learn STEM subjects not only because of the advanced visualization it inherently provides, but because it is the perfect environment to implement proven methods of teaching that can further improve learning. Sama's college level General Chemistry lessons contain instruction, narration, visualization of key concepts, exercised designed to engage the student as well as integrated assessment of mastery and include: [Balancing Chemical Equations](#), [Atomic Orbital Theory](#), [Periodic Trends](#), [Bonding \(I\) VSEPR](#) and [Hybridization](#).



RESEARCH BASE

To test the usability, feasibility, and promise of the VR interventions to support student learning, Sama has conducted three pilot studies in universities. In one study with 657 students who used the VR lessons as an additional mandated activity in a discussion section, students' scores on an assessment improve from pre-test to post test, with the students who scored the lowest increasing the most. In a second study with 27 students, students who used the VR scored significantly higher on a Chemistry Concept Inventory instrument compared to prior average performance of prior classes of students who did not have access to the VR. In a third study, 464 students performed a single VR lesson integrated into a lab activity in the freshman general chemistry course. Student attitudes towards use of VR were measured using a mixed qualitative and quantitative instrument question and response instrument. 100% of students agreed with the statement that "Adding VR to this course would help me learn more effectively", and 92% of student responded affirmatively to the statement "If given access to the VR lessons outside of class time they would use it." More information on this research can be found [here](#).

HOW TO ACCESS

Free trial versions of Sama's Chemistry course is available via Sidequest and STEAM. Send email directly to Barb@SamaLearning.Net for trial licensing information.

Government Awards

Supported by the National Science Foundation's SBIR program.

Seeds of STEM

Integrated STEM Curriculum for Preschool and Kindergarten

Worcester, MA

Contact: Mia Dubosarsky (mdubosarsky@wpi.edu),
(seedsofstem@gmail.com)

INTERVENTION

[Seeds of STEM](#) is a year-long STEM curriculum for Preschool and Kindergarten classrooms. The curriculum integrates science concepts with engineering practices and provides authentic math opportunities. Aligned with national and Massachusetts standards for PreK-K, Seeds of STEM includes eight interactive units, engaging children in solving problems “just like engineers”. The first part of each unit immerses children in learning science concepts through games, experiments, books, and songs, while the second part includes a problem related to the same science concepts.

Unit	Science Topic	Problem
1	Intro to problem solving	Help Panda get out of a box!
2	Ice and Water (solids and liquids)	Panda dropped a ring into a cup of water that froze! Help Panda get the ring out.
3	Habitats	Panda's friend is coming to visit! Create a habitat for Sally Squirrel.
4	The Five Senses	Design a toy for Panda's friend who is blind
5	Forces and Motion	Panda broke his leg! Design a device to help Panda move!
6	Properties of Materials	Design a container to send cookies to a friend who lives across a river!
7	Plant Parts and Needs	Gladys the Goat ate Panda's plant! Design a barrier to protect the Panda's plants.
8	Light and Shadow	Panda wants to play outside but it is too hot! Design a shade for Panda.

Seeds of STEM was designed in collaboration with teachers and uses everyday classroom materials.

The intervention also includes professional development training and a video library showing different activities being taught in real classrooms. The training includes a session on remote teaching of the curriculum.

Seeds of STEM video won the Facilitators Choice in the 2019 STEM for ALL Video Showcase <https://stemforall2019.videohall.com/presentations/1558>.

RESEARCH BASE

Seeds of STEM was developed over 4 years by researchers from Worcester Polytechnic Institute (WPI), the College of the Holy Cross, and teachers from the Worcester Child Development Head Start Program. The development was guided by an advisory board that included engineers, experts in early childhood education, study design, and, STEM equity. Seeds of STEM was tested in close to 40 Head Start classrooms. A pilot study involving 16 classrooms and 40 teachers found a significant increase in teachers' knowledge, reported practice, and self-efficacy after teaching the full curriculum. Children who experienced Seeds of STEM were found to have meaningful gains in problem solving behaviors and vocabulary.



Visit <https://www.seedsofstem.org/> for more information and email Mia Dubosarsky (mdubosarsky@wpi.edu) with questions.

Please note: Attending a Seeds of STEM workshop is required in order to get access to the curriculum.

Government Awards Supporting R&D

Institute of Education Sciences, U.S. Department of Education, Grant #R305A150571: <https://ies.ed.gov/funding/grantsearch/details.asp?ID=1720>

Speak Agent

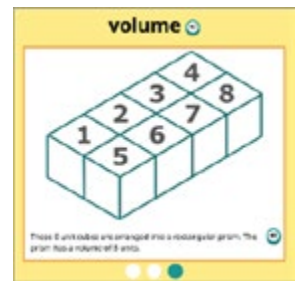
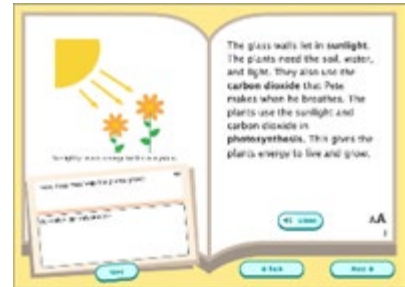
Academic Language Learning for K-8 STEM

Rockville, MD

Contact: Ben Grimley (ben@speakagent.com)

INTERVENTION

With a combination of games, visual aids, interactive stories, and collaborative speaking and writing activities, [Speak Agent](#) accelerates Kindergarten to Grade 8 students acquisition of STEM concept knowledge and communication skills. Speak Agent products include: [Elementary Math](#), [Middle-Grades Math](#), [Algebra for English Learners](#), [Elementary Science](#), and [Bilingual Early STEM](#). The program is useful for all students, including English Learners, low-SES students, and learners who experience an academic language deficit. School districts use Speak Agent as a supplemental program in both physical and virtual classrooms which delivers a suite of activities for teacher-led instruction, independent practice, and peer collaboration. A teacher dashboard that displays real-time progress, formative assessment data, and items added to the student's digital portfolio. Speak Agent offers year-round professional learning, including 1:1 teacher coaching, a PD knowledge base and video series, and a unique Academic Language Strategies course that showcases research-based instructional strategies. Speak Agent products closely align with the classroom curriculum week by week. So, when students are learning about the volume of cylinders and cones or exploring the water cycle, Speak Agent is teaching the relevant, curriculum-aligned academic language to support that.



- Winner, [2016 NewSchools Ignite ELL Challenge](#)
- Certified Product Digital Promise, [Research-Based Design](#)

RESEARCH BASE

Speak Agent a certified Research-Based Design Product by Digital Promise. Each of its 20 activity types across every product applies research-based strategies using its [academic language learning model](#). These strategies were applied to product design and development in partnership with Digital Promise's Learner Variability Project, among other research partners. As of 2020, Speak Agent serves more than 40,000 active students each week and growing. Speak Agent has consistently demonstrated feasibility, usability, and evidence of promise because it is practical to implement in real-world teaching environments. Teachers report being able to learn the basics in a 45-minute training session. Three small pilot studies have demonstrated the promise of Speak Agent to support academic concept acquisition: A [QED study](#) (N=74) in 2017-2018 by Rockman et al found that 2nd grade science students using Speak Agent acquired 40 to 52 new TEKS science concepts at a 210% faster rate than students in the control group receiving standard instruction. The effect was repeated in two 12-week phases. In 2018, Montgomery County (N=67) found similar results over a 12-week period in both science and reading. Both populations were 80% English Learner. A small-scale [pre/post study](#) by LEANLAB Education in 2019 saw significant gains among 7th graders (N=13) over 9 weeks in reading on KIPP's quarterly assessment.

Speak Agent is provided to schools and districts as an annual subscription. It runs on any computer or mobile platform and supports in-classroom use, virtual classroom use, remote independent practice, and hybrid models. Learn more at speakagent.com.

Government Awards Supporting R&D

Funding provided via awards from [ED/IES SBIR](#) and from NIH SBIR.

Verdant VR

Virtual reality investigation of biology and genetics for high school students

Lighthouse Inc, Long Beach, CA

Contact: David Sarno, CEO (david@lighthouse.us)

INTERVENTION

Verdant (see a [Video Demo](#)) is a Virtual Reality (VR)-based genetics unit for high school biology that transports students into Gregor Mendel's famed pea garden, to discover the laws of classical genetic through breeding virtual plants. The learning experience connects to the Lighthouse Web Station, where students can analyze and synthesize data they collect in their VR experiments. Teachers use Verdant by providing a VR headset to students and then creating a class with our online dashboard. Each student's Verdant account that saves their progress and lab data to the online portal. Teachers guide students through a 1-week unit on basic genetics by enabling them to experiment in their pea garden, cross-breeding plants and tracking the results, "X-raying" into the plants' genotypes, and performing longer, student-designed investigations to cultivate the most valuable 'cash crops'. The intervention can be used in-class or for remote learning.



RESEARCH BASE

In a 2020 in a study with 227 high school biology students, science learners showed statistically significant learning gains between a pre- and post-test of genetics knowledge. Participating teachers rated Verdant highly for its instructional effectiveness. Classrooms used Verdant as their genetics instruction unit for 1-2-week periods.

HOW TO ACCESS

Verdant runs on the \$399 [Oculus Quest VR headset](#). Verdant is in private beta mode, available to tech-forward teachers interested in piloting an exciting and immersive new science-learning experience with their students for no cost. Lighthouse is arranging a limited number of pilots with interested teachers. Teachers that already have full or partial class sets of Oculus Quest headsets may apply. If VR headsets are not available, please reach out to discuss the possibilities. We may be able to provide on-loan headsets in a limited number of cases.

Government Awards Supporting R&D

Funding provided via awards from [ED/IES SBIR](#) and from NIH SBIR.

Vidcode

Computer science program focused on student self-expression

New York, NY

Contact: Alexandra Diracles (allie@vidcode.com)

INTERVENTION

[Vidcode](#) is an online platform that is used in school districts to teach computer science. Through Vidcode, teachers have access to 120+ hours of curriculum which they use as either a dedicated computer science curriculum or as individual coding activities to support their existing curriculum. Students produce creative projects by following Vidcode's online tutorials. Vidcode has been developed to be as engaging a learning tool to girls as it is to boys, through qualitative conversations with girls in grades 4 through 12. Vidcode projects allow students to use their creativity and tie coding to their existing interests. The intervention can be used for fully in-class, fully remote, or in hybrid teaching and learning environments.

Vidcode's courses include: Computer Science with JavaScript, Game Development, Digital Citizenship, and Cross-Disciplinary Coding. Projects students complete in these courses include *Make a Meme* ([Video](#)), which uses meme creation to teach students about objects and the importance of sequence or the order of operations; *Stop Motion* ([Video](#)), which applies the concepts of syntax and learning to initialize and count with arrays with stop motion animation; and *Game Development* ([Example](#)), in which students learn advanced programming concepts with a focus on game design. The Vidcode teacher dashboard ([Video](#)) provides teachers real-time insights to monitor progress, explore lesson plans, and share class projects for individuals and groups of students.

2020 Parent Choice Silver Award; #1 in Global CS Standards-Alignment by the Education Alliance of Finland (2019), 2018 ISTE Best in Show, 2015 Common Sense Education Best Learning Website.



RESEARCH BASE

Vidcode's courses are based on [years of research](#) on student engagement and computational thinking skill development. Tens of thousands of teachers have successfully implemented Vidcode in classrooms, and millions of students have coded projects with Vidcode at home. WestEd conducted a pilot study to evaluate the usability and feasibility of implementation and the promise of Vidcode to improve learning. In a 2018 study with 4 classes, the 2 classes who taught with Vidcode increased in content knowledge of CS, after 10 hours of instruction, compared to the 2 classes in the control group who used other coding material. In the 2018 study of Vidcode, teachers reported that the 58 students in the Vidcode group became more familiar with the syntax of JavaScript and the overall process of debugging code, which improved student understanding of computer science and their willingness to code. For more information on Vidcode's research, see [Research on Vidcode's Learning Outcomes](#). In early 2021, Vidcode will conduct an additional pilot study to evaluate the promise of its intervention to improve students' computer science and computational thinking skills across 8 classrooms.

Vidcode's platform is entirely web-based, and is accessible on computers (including Chromebooks) and tablets. The Vidcode curriculum includes both free and paid subscription service, and is available to individuals, libraries, and schools/districts.

Government Awards Supporting R&D

Vidcode has been supported by awards from the Small Business Innovation Research Program at the US Department of Education and the National Science Foundation.