RESEARCH BRIEF

ExploreLearning®

Effective K-12 Science Instruction

Implementing Research-Validated Teaching Strategies Using ExploreLearning Gizmos

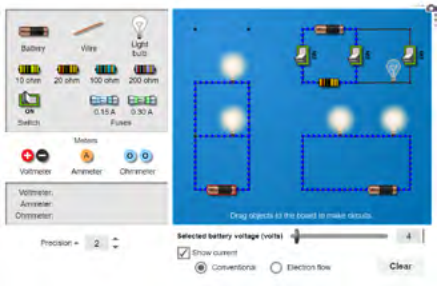
After a meta-analysis of 60+ research studies that satisfied criteria for methodological rigor, the Texas Science Initiative (TSI) identified several teaching strategies supported by broad evidence of effectiveness in improving student achievement in science. This report describes three of these strategies: **manipulation**, **inquiry-based learning**, and **technology-enhanced instruction**. Each of these strategies is associated with an **average gain of 18-24 percentile points in student achievement** and can be quickly brought to science classrooms using ExploreLearning Gizmos.

1. Manipulation

As the TSI team observed in Effective K-12 Science Instruction: Elements of Research-based Science Education:

> *Manipulation strategies require students to become active learners who participate in building their own understanding; students remember content better when they experience it for themselves.*[1]

Providing frequent opportunities for students to actively interact with abstract scientific concepts is critical to developing their understanding of these concepts in a personally meaningful, memorable way. Researchers have observed that computer-based, "virtual" simulations can provide experiences that are just as "concrete" to students as activities involving physical objects, and can in fact go beyond what is possible in the physical realm — in part because computer-based activities can dynamically link multiple representations together and optimize displays to focus students' attention on the activity's key learning objectives.

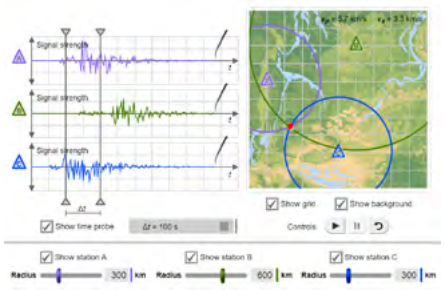


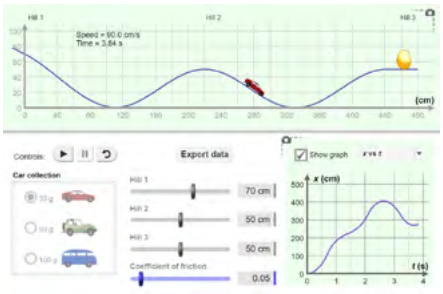
In ExploreLearning's series of Circuits Gizmos, for example, students can design, build and analyze their own electrical circuits. These Gizmos include a powerful 'visualization' feature that shows the animated flow of current through each constructed circuit. Informational overlays of this nature provide invaluable support for students learning concepts such as resistance in series and parallel circuits.

2. Inquiry-based learning

> *Inquiry provides opportunities for students to experience the nature of science by engaging them in the practices of scientists...requires them to answer scientific research questions by analyzing data...The involvement generated during inquiry encourages deep understanding.*[2]

Using ExploreLearning Gizmos, you can efficiently cover a multitude of 'classic' science experiments involving topics such as seed germination, density, friction, solubility, simple machines, and many more. Gizmos also provide you with the opportunity to go far beyond what is possible in the classroom or lab — investigating human homeostasis, observing radioactive decay, experimenting with natural selection, or using triangulation to determine the epicenter of an earthquake by analyzing the arrival of its primary and secondary waves at multiple recording stations.



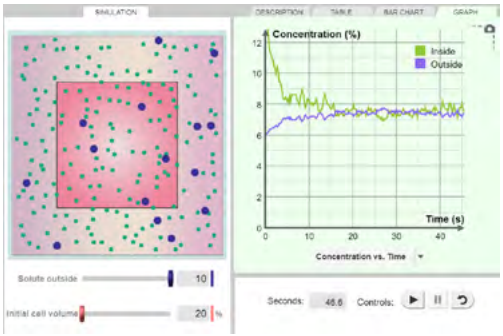


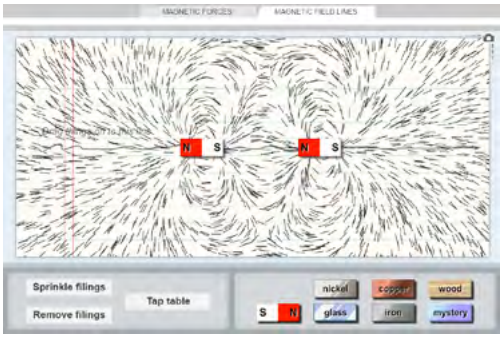
Conducting experiments and analyzing the results lies at the heart of effective inquiry-based learning in science. ExploreLearning Gizmos supply students with plenty of raw data for analysis, with live graphs, charts, and tables linked to the experiments they design. Built-in screenshot and data export features allow students to easily capture, examine and present the results of their investigations.

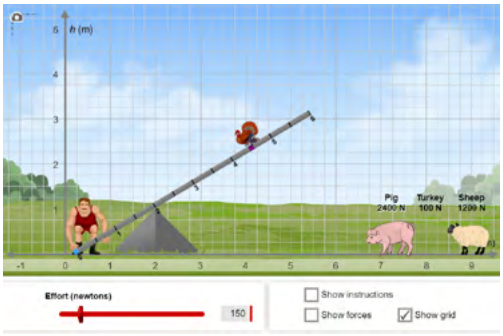
3. Technology-enhanced instruction

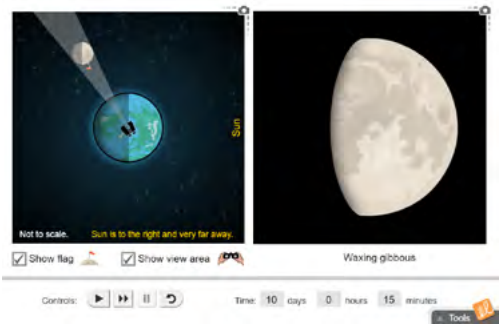
Instructional technology provides numerous ways to help teachers meet the challenge of providing effective instruction and conducting inquiry in the classroom... computers can be used for visualizations, simulations, and modeling abstract concepts... simulations enable students to manipulate variables and quickly see the results of changing the values of variables.[3]

ExploreLearning's award-winning library of Gizmos contains literally hundreds of highly visual, dynamic models and simulations of important scientific concepts, and instills them with the kind of rich interactivity that actively engages and involves your students in thought-provoking, inquiry-based learning.







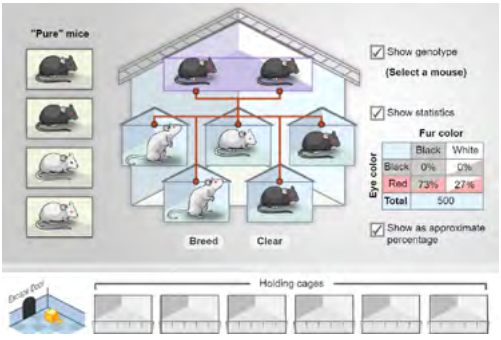


The Gizmo advantage goes beyond technology-enhanced visualization and interaction. According to the TSI report, effective educators should also contextualize scientific ideas with real-world examples and make references to things students are already familiar with or are exposed to in the media.[4] ExploreLearning's ever-growing Gizmo library provides science educators with a single source for rich, interactive content that makes it easy to connect classroom learning to news headlines and important societal issues – including earthquakes, hurricanes, eclipses, the greenhouse effect, ecosystems, genetics and heredity, and "DNA fingerprint" analysis.

To help you bring these real-world issues to your classroom in an educationally meaningful way, each Gizmo in our collection provides a comprehensive Teacher Guide containing key vocabulary, scientific background, discussion questions, environmental connections, and links to additional web resources.

Conclusion

Meta-analysis of 60+ methodologically rigorous studies in K-12 science education has identified several specific teaching strategies that lead to large gains in student achievement. ExploreLearning's award-winning library of science Gizmos makes these powerful, research-validated strategies practical for your classroom – and brings science to life for your students in an exciting, intellectually stimulating manner.



1, 2, 3, 4 : To learn more about these teaching strategies and the research on their effectiveness, see Effective K-12 Science Instruction: Elements of Research-based Science Education and Texas Science Initiative Meta-Analysis of National Research Regarding Science Teaching, available from http://www3.science.tamu.edu/cmse/tsi/