



Scientific Minds®

Research Supporting Science Starters & Science Sidekicks



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The Every Student Succeeds Act (ESSA, 2015) reauthorized the Elementary and Secondary Education Act of 1965 (ESEA) in order to "prioritize excellence and equity for students and support great educators." Local educational agencies are directed to create learning environments that close the achievement gap and improve overall student achievement. Both neuroscience and classroom studies provide evidence that transferable knowledge that leads to deeper thinking and application comes from a solid understanding of foundational concepts and principles (Tokuhamo-Espinosa, 2011). The research-based programs created by Scientific Minds boost student achievement by creating a solid foundation in science through online learning modules built directly from state science standards. Each program supports students and teachers with over one hundred visually engaging science modules that spiral through science objectives with strong vocabulary support as well as assessments and downloadable ancillaries. Modifications are provided for students requiring accommodations, and Spanish vocabulary is available to support English language learners. Optional online benchmark testing is available to provide the data necessary to drive instruction as it generates individualized intervention reports.

5E Instructional Model

Scientific Minds has developed its science programs using the 5E Instructional Model. In the 1980s, the Biological Sciences Curriculum Study group (BSCS) developed the 5E Instructional Model based on earlier models proposed by 20th century educational leaders such as John Dewey and Johann Hebert. The BSCS took Dewey's 6-step concept along with the "explore, invent, discover" learning cycle proposed in the early 1960s by Atkin and Karplus to create the 5E model. The five phases for the BSCS model are engagement, exploration, explanation, elaboration, and evaluation. Research reports from institutions such as the National Research Center support the effectiveness of the 5E model in creating positive interest and attitudes about science, enhancing mastery of subject matter, and developing scientific reasoning abilities (Bybee, Garner, Landes, Powell, Scotter, Taylor, & Wetbrook, 2006).

Highly Visual Learning Modules

Science Starters and Science Sidekicks are short, web-based science modules that teachers and students can use in a variety of learning environments:

- I. The science modules can be used as a daily warmup to spiral through tested science objectives throughout the year. A spiraling approach to information acquisition allows some students to master a concept immediately while providing others time and repeated opportunity to gain a thorough understanding. "Repeated exposure to information in specifically timed intervals provides the most powerful way to fix memory into the brain. Learning occurs best when new information is incorporated gradually into the memory store rather than when it is jammed in all at once" (Medina, 2008). According to the work of Jensen (1998) and followed by Sprenger (1999), "information must be repeatedly processed for long-term memory to take place." Research in effective learning and teaching even goes as far as stating that "any topic in science, mathematics, or technology that is taught only in a single lesson or unit is unlikely to leave a trace by the end of schooling" (Project 2061, 1990).
- II. The science modules can be aligned to instruction and used to introduce or review science concepts and enhance project-based learning. Each module can be viewed and discussed in 5-10 minutes. Research shows that, depending on age, the brain can only focus on a single concept for about 10-15 minutes. Students absorb information best in small yet thought-provoking chunks (Marzano, 2009).

Because "pictures are a more efficient delivery mechanism of information than text," each page of a Science Starter or a Science Sidekick is built around vivid images, graphics, or animations with minimal text per page. "If information is presented orally, people remember about 10 percent, tested 72 hours after exposure. That figure goes up to 65 percent if you add a picture" (Medina, 2008). Picture representation helps students to create mental images of new information, an encoding process that significantly improves learning (Marzano, Pickering, & Pollock, 2001). The auditory component also reinforces learning as students simultaneously read and hear text and associate it with a vivid image or animation. "If we 'say' to ourselves what is in the picture, we reinforce the visual memory with the auditory component" (Sprenger, 1999).

Vocabulary

Each science module elaborates on key vocabulary within the module. This elaboration is essential to student achievement, which increases when vocabulary is focused on specific words important to what students are learning (Marzano & Pickering, 2005, Kinzer & Leu, 2003). Science Starters at all levels offer Spanish vocabulary translations to aid English language learners.

Formative Assessment

Assessment is built into each Science Starter or Science Sidekick module. Black and William have found that effective questioning is "an important aspect of the impromptu interventions teachers conduct once the students are engaged in an activity" (2004). Each module begins with an "Engage" page that opens the lesson to collaborative discussion as it allows students to question, predict, and make connections to previous learning. Modules end with both vocabulary assessment and content assessment, which teachers can use for whole-class discussion. Research indicates that collaborative input in classroom questioning benefits all students as they become more likely to challenge expressed ideas and are forced to explain their reasoning (Daniels, Hyde, and Zemelman, 2005). Teachers can then shape classroom learning according to perceived needs.

Summative Assessment

Summative assessment is fundamental to education because to measure learning is to measure memory retrieval over time (Medina, 2008; Sousa, 2001; Sprenger, 1999). Scientific Minds' programs at all levels offer summative assessment in the form of quizzes and online benchmark testing. Quizzes and tests are aligned with state expectations as they are developed to reflect state assessments. Increasing student achievement on summative assessments is an important function of both the Science Starters and Science Sidekicks programs.

Accommodations for Students with Disabilities

The Americans with Disabilities Act (1990) and the Individuals with Disabilities Education Improvement Act (2004) hold schools accountable for the appropriate education of all children with disabilities and require schools to provide interventions and accommodations to improve learning. Scientific Minds has developed learning modules with these students in mind: the visual and auditory components support a variety of learning styles; modified quizzes are provided; and modifications are available with online testing. Modification options include larger font, reduced answer choices, and formulas appearing as needed. The online testing generates targeted intervention assignments available to both students and educators.

English Language Learners

Scientific Minds has used research in dual language instruction to develop its science programs. This research shows that creating predictable routines and signals and presenting visual images related to content both reduce anxiety and provide language support for the English language learner (Herrell & Jordan, 2004). Daily use of Science Starters or Science Sidekicks creates a predictable learning routine. Each page in a module gives a visual representation of a science concept with keywords and minimal text; this allows the student to simultaneously see, hear, and read small bits of information at a time. Science Starters for grades 6-8, biology, and chemistry offer video w/audio capability as well as Spanish vocabulary translations to aid English language learners. To support bilingual education, the elementary Science Sidekicks program offers each module in English and in Spanish.

Instructional Alignment

Teacher accounts include professional development in effective use of Scientific Minds' programs to align science instruction to tested content. In preparation for state assessments, science teachers commonly need to review information outside of their familiar teaching assignments. "Exemplary teachers in both pedagogy and curriculum are more likely to make substantial errors in content when teaching out of field" (Troupe, 2008). Science Starters and Science Sidekicks provide an autonomous framework so that teachers can confidently review information outside of what they teach every day. Both programs also aid in aligning instruction across a department from classroom to classroom, which contributes to an equitable learning environment for students.

Development of each Science Starters program is driven by state and national science standards. Modules have been developed with collaborative input and feedback from hundreds of science teachers, elementary through college, as well as administrators, post-secondary level advisors, and consulting PhD.

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