

INNOVATION

Through Science Awareness



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Abstract: Shifts in generations from Millennials to Generation Z have brought changes to today's classroom. In turn, these changes indicate the need for reform and innovation in education. If the goal for education remains to put contributing members into society, then educators must search for the most effective ways to prepare students to enter society today, rather than in the past. The purpose of this article is to introduce creative ways to share the lives and work of outstanding ecologists to enhance students' knowledge in both English language arts and science, while also addressing state and national standards. Integrating the lives and work of well-known ecologists or environmentalists into middle school science has the potential to enhance the understanding our students have of what it means to be a scientist. Taking these small steps to broaden students' understanding of science and scientists may inspire a young person to consider a science career for themselves someday. The nation and the state have done their parts in giving teachers the outline for student learning and success in science. Now, it is up to teachers to utilize the standards within their classrooms to make science come to life.

Keywords: science as a human endeavor, biographies, English language arts/science integration, reading, innovation in education

The Change

Educators have become aware of the shifting generations and the changes that the shift brings to the classroom. In fact, more teachers are actually a part of the shift. Those born between the years of 1981 to 1996 (The Pew Research Center, 2015, 2016; Dimock, 2019) are called Millennials. Those currently entering the teaching profession are likely within this group, and they bring diverse characteristics to the field. According to Mosier (2001), Millennials offer optimism, tenacity, collective action, and technological knowledge to the fields in which they work. This means that teachers now going into the profession may be more likely to possess the skills needed to address the demands of the current generation of students: Generation Z.

Generation Z students were born between the years of 1997 and 2012 (Dimock, 2019; The Pew Research Center, 2019a, 2019b), meaning that the youngest of the Gen Zers are most likely now in elementary schools. According to a publication by Patel (2017), Gen Zers are motivated by security, primarily because they watched their parents go through the aftermath of the Great Recession. They are also driven by solo work rather than group work, they are competitive, and they want choices more so than the Millennial generation. Predictions show that Gen Zers may opt to go straight into the workforce after public school to avoid the debt of college. Additionally, and somewhat interestingly, Gen Zers have witnessed the criticism of the previous generation's reliance on technology and opt for face-to-face interaction over emails or text messages, even though they are completely literate in technology. The Pew Research Center (2019a, 2019b) notes that this generation has grown up with social media, constant connectivity, and on-demand entertainment. There is a need for a constant hook. This may give educators some insight as to what must change in order to effectively reach these current students.

The changing generations going into both the teaching profession and students entering public schools indicate the need for reform and innovation in education. If the goal for education remains to put contributing members into society, then educators must search for the most effective ways to prepare students to enter society today, rather than in the past. The world continues to change at an alarming rate. Today's world demands that upon leaving K-12 education, students must be able to assess their surroundings, problem solve, and make informed decisions. Educators must continue the quest to most effectively prepare them to do so. The U.S. Department of Education (2004) defines innovation as "a spark of insight that leads a scientist or inventor to investigate an issue or phenomenon" (<https://www2.ed.gov/about/offices/list/oii/about/definition.html>, para. 1). This spark is usually driven by an observed need that hopefully creates curiosity and leads a person or group to seek out a better way to accomplish a task. Continuous improvement is a term with which most educators are familiar, and one that innovation must seek to achieve. The integration of science into English language arts (ELA) is an excellent way to address both state and national standards. This article seeks to provide some examples of science and ELA integration.

Where Does Science Fit In?

Science education is essential for students to learn in order to be contributing members of society. Science helps students to develop skills such as researching issues, problem solving, and critical thinking. The National Research Council (2007) evoked a sense of urgency for educators to reform and re-envision science education. The executive summary noted that science education is mandatory, especially given a climate of policy debates such as cloning, finding alternate fuels, and utilizing biometrics in the fight against terrorism. These topics require that students be proficient in science, and the Next Generation Standards (NGSS Lead States, 2013) focus on the need for students to master a smaller number of standards, and then expand upon that foundation. This is in opposition to the previous science standards, which were lengthy and often disconnected (National Research Council, 2012). The National Science Teaching Association (2016) pointed to the need for schools to adopt a conceptual shift in thinking, and the first shift includes the need for teachers to make connections between science and the real world. Although Texas is not one of the states that uses the NGSS, the Science Teachers Association of Texas (STAT) publishes current information regarding the updates and streamlining efforts to the Texas Essential Knowledge and Skills (TEKS) for science education. One of the resources to help guide the revision is *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas* (National Research Council, 2012). This report also supports the idea that students need to be well-versed in the sciences in order to become citizens who understand the contributions of science in today's world. Campbell and Riney (2009) noted that many preservice teachers may not have a strong foundation in science themselves, leading to a feeling of inadequacy or incompetence to teach science. Providing them with historical information on the subject, along with quality trade books to use in the classroom, may help to increase their confidence and willingness to teach science. This also helps the teachers understand the connectedness of science and reading. In addition, research by Grolnick and Ryan (1987) as well as Guthrie et al. (2006) has shown that "students' motivation and reading comprehension increase when the students are directed toward content goals (such as learning science) rather than performance goals (such as getting a good grade)" (cited in Hapgood & Palincsar, 2006/2007, p. 57).

The strand of science that is addressed for integration in this article

is Ecology. Students in middle school are expected to demonstrate scientific investigation and reasoning. Specifically, students are expected to use critical thinking, scientific reasoning, and problem solving to make informed decisions and know the contributions of relevant scientists. Students are expected to relate the impact of research on scientific thought and society, including the history of science and contributions of scientists as related to the content (Texas Education Agency, 2017, Science TEKS 6.3D). A recent study conducted by Tyler et al. (2017) noted that science is synergistic with English language arts (ELA) because science is naturally engaging, and students may be more motivated to engage in the required skills of ELA such as reading complex texts and formulating discussions when those skills are taught through subject matter that motivates them. Cummins (2014/2015) stated that teachers should "invite students to understand key concepts by reading, writing, and talking about the work of scientists and engineers. Engaging with compelling texts about such professionals will help students understand the richness of scientific and engineering endeavors in real-world contexts (a major goal of the Next Generation Science Standards)" (p. 68).

Ecology as a Human Endeavor: Biographical Resources to Enhance Students' Understanding of Scientists

Sharing the work of ecologists or environmentalists has many potential benefits for students. First, sharing the work of these people has the potential to dispel common stereotypes of scientists as being strictly older men working in laboratories (Chambers, 1983; Mead & Metraux, 1957). All scientists do not wear lab coats or work with boiling, colorful concoctions that explode. Those people who pursue science outdoors provide a very different example of what it means to be a scientist. Sharing about scientists who conduct most of their investigations outdoors has the potential to expand students' views of who a scientist is and what they do. In addition, teaching about the lives and work of these scientists may expand students' views of the process of science. Everything considered, sharing about these individuals may lead to a greater understanding of the nature of science itself.

Engaging Students With the Lives of Scientists

- John Muir and Theodore Roosevelt were naturalists who shared a love and passion for the outdoors. Sharing about their lives provides students with background information about the importance of conservation and the establishment of the national parks. Short books such as John Muir: *America's First Environmentalist* by Kathryn Lasky (2014), John Muir, *My Life with Nature* by Joseph Cornell (2000), or *Camping with the President* by Ginger Wadsworth (2019) are age-appropriate for middle school students. In seeking to explore and protect wild spaces, Muir and Roosevelt sought to protect the interdependent relationships inherent in existing ecosystems.
- George Washington Carver, industrious by nature, studied agriculture and used his creativity and ingenuity to find 300 uses for the peanut. Through Carver's determination, he earned a master's degree in horticulture, and he used his talents to enhance the lives of others. *Biography.com*[™] (n.d.) provides a short clip that can be shared with students at www.biography.com/video/george-washington-carver-the-peanut-doctor-26169923701.
- During lessons on weather, clouds, and climate, a discussion on Luke Howard's work on the classification of clouds provides a glimpse into the human endeavor of science. An

informative ten-minute video on Howard and clouds is available on YouTube™: www.youtube.com/watch?v=1sJZc8g5jqM (rtoumi, 2020). It is interesting to note that Howard worked as a chemist, but he had an outside interest in weather, which led to his classification system. When discussing climate change, teachers can introduce students to modern-day scientist Katherine Hayhoe. Dr. Hayhoe has a PBS Digital Series (Public Broadcasting Service, 2017) called *Global Weirding*, available at <https://www.pbs.org/video/what-global-weirding-rrfwnx/>. In her work, Hayhoe discusses the importance of simply opening up conversations and discussing climate change. Making people aware of changes on the earth is the first step towards lasting and positive change.

- Fatimah Jackson is a biologist who studies inherent chemical properties of African plants used as foods and medicines. Dr. Jackson's fascinating work is featured in the *Wonderwise—Women in Science Learning* series for middle school students: <http://wonderwise.unl.edu/> (Wonderwise, n.d.).



- Earth Day presents an opportunity to discuss the life and work of Rachel Carson, Theo Colborn, and Tyrone Hayes, who have all contributed to our knowledge of the impacts of pesticides on the environment. Carson's (2002) book *Silent Spring* and Colborn's (1997) book *Our Stolen Future* are excellent choices for middle school students. In addition, Tyrone Hayes is the subject of a book entitled *The Frog Scientist*, which is part of a series for middle school students called *Scientists in the Field* (www.sciencemeetsadventure.com/books/the-frog-scientist).
- Ynes Mexia is a celebrated Mexican-American botanist, who discovered a passion for plants in her fifties. According to CNN (2019), "She collected about 150,000 plant specimens and some estimate about 500 of those were previously undiscovered" (Cable News Network, 2019, para 9).
- Sharing the work of Maria Sibylla Merian and Anna Comstock is a terrific way to introduce study of the natural world. *The Girl Who Drew Butterflies: How Maria Merian's Art Changed Science* by Joyce Sidman (2018) and *Finding Wonders: Three Girls Who Changed Science* by Jeannine Atkins (2016) give students great background on Maria Merian. *Out of School and Into Nature: The Anna Comstock Story* by Suzanne Slade (2017) is a quick read that gives students a nice overview of Comstock's work. Both Merian and Comstock recorded the life cycles of insects and the association of insects with plants.
- Discussions about the contributions of ecologists and environmentalists from around the world, including people of all races and ethnicities, enriches the science classroom. Posting pictures and a short summary of these outstanding scientists on your

bulletin board brings attention to their accomplishments. A couple of examples of outstanding international ecologists/environmentalists include Dr. Howard Nelson and Dr. José Sarukhán Kermez. Dr. Howard Nelson is a Caribbean wildlife biologist and forester. He has invested much of his career on conservation issues including policy and management issues. More information on Dr. Nelson is available at www1.chester.ac.uk/departments/biological-sciences/staff/howard-nelson (University of Chester, n.d., para. 1-3). Dr. José Sarukhán Kermez is a research biologist in Mexico who "persuaded the Mexican government to establish a permanent top-level commission on biodiversity. The commission has bridged the traditional barriers between academic disciplines, government departments and social interest groups" (Champions of the Earth, n.d., para. 2). Further information on Dr. José Sarukhán Kermez is available at <https://www.unenvironment.org/championsofearth/laureates/2016/jose-sarukhan-kermez>.

Conclusion

Integrating the lives and work of well-known ecologists or environmentalists into the middle school curriculum has the potential to enhance the understanding students have of what it means to be a scientist. McComas (2008) stated that including historical episodes in the classroom "can humanize science by raising instruction from the mere recitation of facts to its exploration as an authentic and exciting human adventure" (p. 262). In addition, sharing about scientists in ELA has the potential to broaden students' views of what a scientist looks like. According to Llewellyn (2007), "By discussing the biographies of scientists in class, history tells the story of discoveries and dispels the stereotypical notion of what a scientist looks like or that scientists work alone in isolated laboratories. Adding the human aspect to our lessons also provides opportunities to explain the contributions made by people representing historically underrepresented groups in science." (p. 30). Taking these small steps to broaden students' understanding of science and scientists may inspire a young person to consider a science career for themselves someday. If not a career in science, it could inspire students to pursue a lifelong interest or hobby, enriching their lives for years to come.

Additionally, presenting a lesson over the lives of famous scientists ties directly into state standards. This is the kind of innovative thinking in science classrooms that is essential in order for teachers to keep up with the ever-changing generations and the growing demands for scientific-literate members of society. While it is important to note that Texas's curriculum is the Texas Essential Knowledge and Skills, the driving force behind the newest revision was the same text that was utilized in the development of the Next Generation Science Standards (Duncan et al., 2016). This communicates to teachers the need for coherent, consistent science instruction that is integrated into subjects to increase motivation for students. Additionally, both the NGSS and the TEKS emphasize to teachers that the curriculum exists, but neither dictate how the standards are actually taught. The nation and the state have done their parts in giving teachers the outline for student learning and success in science. Now, it is up to teachers to utilize the standards within their classrooms to make science come to life.

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