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Scientific Literacy Matters: Using Literature to Meet Next Generation Science Standards and 21st Century Skills

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Abstract

Scientific literacy matters. It matters because it is vitally important to the education and development of America's children, tomorrow's workforce, and the keepers of our future. If the future of American individual decision making, engagement in civic and cultural affairs, and valuable contributions to economic development is to be protected, it is critical that American students become more scientifically literate than they are today. Today, most Americans, including students, are considered scientifically illiterate. Recognizing the need to develop and enhance scientific literacy (also known as science literacy), science educators have worked diligently at developing new science standards, new approaches to science teaching, and new techniques aimed at engaging students in the practice of science. In this article, the use of literature is discussed as one method to augment or supplement the teaching of science. In the context of making a literature selection, a new conceptual approach is proposed that includes attention to meeting the Next Generation Science Standards while being responsive to the importance of 21st Century Skills. Additionally, a Literary Assessment Tool is shared that demonstrates how science educators can evaluate a literary selection in terms of how well it will help them to enhance scientific literacy.

Importance of Scientific Literacy

"Scientific literacy is the knowledge and understanding of scientific concepts and processes required for personal decision making, participation in civic and cultural affairs, and engagement in economic productivity. It also includes specific types of abilities." (National Academy of Sciences, 1996). It includes mathematics and technology and encompasses all scientific fields including life science, physical science, the natural world, the human-made world, and the unifying forces between them. According to the American Association for the Advancement of Science (1990), scientific literacy is required of all Americans if they are to be involved as informed decision makers in all aspects of their lives.

Most Americans, unfortunately, are considered to lack scientific literacy, which impacts the quality of their personal decision making. Take the example of making personal purchasing decisions. If Americans were more scientifically literate, they could make better purchasing decisions based on whether products, or the processes by which products are made, are environmentally friendly, e.g., question whether the products were made of recycled materials (McDonough & Braungart, 2002); question whether the manufacturing processes captured and treated polluted water before returning it to the environment (Carolan, 2013); and question whether the manufacturing company made concerted efforts at reducing its energy consumption (Odum, 2007). Being more scientifically literate in this case would mean that citizens would realize the strength of their individual decision making as it relates to their purchasing power and to their support of corporate social responsibility. When citizens lack scientific literacy, they do not understand the links between their actions and potential impacts.

Consider participation in civic and cultural affairs. If Americans were more scientifically literate, they could make better voting decisions regarding political candidates and policies purported to improve the quality of their lives, e.g., question whether a policy is founded on scientific reasoning and evidence (Pew Research Center, 2008); question whether a candidate is free of racial, cultural, or religious biases (Sagan, 2007); question whether a policy was considered from multiple scientific points of view, or from the perspectives of different disciplines (Otto & Kirshenbaum, 2008). Being more scientifically literate in this case would mean that citizens would realize that the strength of their vote impacts not only their own lives, but the lives of future generations as well. When citizens lack scientific literacy, they often disengage or choose not to vote on science-related policies that they do not understand, which results in narrowing the field of voters. Conversely, citizens with a lack of scientific literacy are vulnerable to being influenced by candidates who make false scientific claims but who are good at marketing or fear mongering, which results in broadening the field of voters, but wrongly influencing the vote.

Regarding the relationship between scientific literacy and engaging in economic productivity, Mooney and Kirshenbaum (2009) suggest America's lack of scientific literacy negatively impacts America's economic future. If the students of today are to become tomorrow's entrepreneurs, creators of innovative products and developers of entirely new industries that result in new jobs on which the American economy is to be built, then basic interest in science in today's students is essential. Unfortunately, however, only 16% of American high school seniors are currently proficient in mathematics, and interested in science-, technology-, engineering-, and math-related (STEM) careers, according to a website hosted by the U.S. Department of Education (2016). The purpose of this website is to draw specific attention to the nation's STEM-related challenges and to shore up support for educators who are attempting to increase student interest in the STEM fields. In this case, being more scientifically literate would mean that our students--our future workforce--would be better prepared to seek and accept STEM-related jobs, which are expected to increase significantly in the future. When citizens lack scientific literacy, they often lack the understanding and curiosity that would compel them to develop the new skill sets required to engage in a changing economy.

Teaching Scientific Literacy with Literature

Literature is a critical tool with which to build students' reading and comprehension skills. It can also be critical to addressing and enhancing scientific literacy. Lee, Quinn, and Valdez (2013) suggest that the discussion of science, within the context of an English language learner classroom, can become a vehicle for "content-based language instruction" (p. 6). In this context, scientific literacy and English literacy co-exist. Reading Rockets, a website for teachers of reading, notes that using literature to teach science is in compliance with the National Science Teachers Association (2016a). According to the website, "students learn science best when it is integrated with other areas of the curriculum such as reading, language arts, and mathematics." This includes reading textbooks, newspapers, magazines, online information, and children's and young adult literature, both fiction and nonfiction (Newton, Newton, Blake, & Brown, 2002; Vaughn, Sumrall, & Rose, 1998).

According to researchers, students expand their scientific reasoning and vocabulary skills (Hapgood & Palisncar, 2007), as well as their mathematical reasoning skills (McKinney & Hinton, 2010), through the use of literature. In this manner, the use of literature becomes a vehicle for teachers as they guide students in the use of their own imaginations as tools to develop and enhance their understanding of science-related knowledge. Literature is important to the teaching of science, and potentially to the teaching of all STEM disciplines, because it allows students to explore and test the limits of what is known in their own

mind's eye, a relatively safe place, while creating and imagining a world of tomorrows. There are many connections between science and literature; some that are obvious and some that are not. Science education provides a place for science and literature to co-exist, and there are standards in place to ensure this.

Next Generation Science Standards

When using literature to develop and enhance scientific literacy, science educators should attempt to meet the Next Generation Science Standards (National Science Teachers Association, 2013). In 2013, as a result of the work done by The National Science Teachers Association, the American Association for the Advancement of Science, and The National Research Council and Achieve, The Next Generation Science Standards (NGSS) were developed and consequently implemented voluntarily by several states across the country. As of 2016, there are 17 states implementing the NGSS (National Science Teachers Association, 2016b). The development of these standards was the result of a drive to nationalize science standards, and also in a response to the need to supplement the Common Core. The Common Core Standards are national English and Mathematics standards that are being implemented voluntarily by some states. As of 2016, 42 states have implemented the Common Core Standards. Unlike the Common Core Standards, however, the NGSS offer no financial incentive to states that implement them. The philosophy behind the NGSS is to create organized and coherent teaching units of science, technology, engineering and mathematics (STEM), rather than stand-alone discipline specific units.

The Next Generation Science Standards are designed based on three distinct and equally important dimensions, which are combined to form each Standard, or performance expectation. The three dimensions are: Practices, Core Ideas, and Cross-Cutting (approach).

Practices

Practices (Science and Engineering practices) describe the "doing" of science. They include such things as experimentation, pedagogy, and techniques used in the practice of science.

Core Ideas

Disciplinary Core Ideas are key ideas in science. The Core ideas place science into one of four domains, which include physical science, life science, earth and space science, and engineering.

Cross-Cutting Approach

A Cross-Cutting approach helps students explore connections among the Core Ideas which constitute common scientific themes across all four domains. According to the Next Generation of Science Standards, the "cross-cutting approach has value because it provides students with connections and intellectual tools that are related across the different areas of disciplinary content (four domains) and can enrich their application in practices and in their understanding of ideas" (p. 233).

The NGSS acknowledges the importance of literacy by providing a link to the Common Core Standards. As part of the NGSS, Appendix M is included, which is titled "Connections to the Common Core State Standards for Literacy in Science and Technical Subjects" (Appendix M, pp. 1 – 16). Clearly, the NGSS acknowledges that the sciences, including STEM, need to be taught in a coherent and united fashion, and that literacy can serve as a unifying means.

21st Century Skills

When using literature to develop and enhance science literacy while meeting the Next Generation Science Standards, science educators also should be attentive to the list of important skills that Partnership for 21st Century Skills recognize as being essential to preparing students to live in a globally connected world (Partnership for 21st Century Skills, 2008). Due to globalization transcending the way business and industry operate today, educators are being encouraged to teach students to be more knowledge- and innovation-driven so that they can one day successfully compete in the global environment (Kay, 2010). Mastering the 21st Century Skills, according to Ledward and Hirata (2011), is not an option; rather, it is an imperative if students are to survive and thrive in the global economy.

According to the Partnership for 21st Century Skills, all students need to attain sophisticated levels of 21st Century Skills, which are defined as ". . . a blend of content knowledge, specific skills, expertise, and literacies necessary to succeed in work and life" (Partnership for 21st Century Skills, 2008). The Partnership for 21st Century Skills developed a framework for the 21st century educational learning environment that focuses on proficiency outcomes in core academic content areas including: English, reading or language arts; world languages; arts; mathematics; economics; science; geography; history; and government and civics (Kay, 2010; National Research Council, 2011; Partnership for 21st Century Skills, 2008).

21st Century Themes

Four themes are identified as critical in the 21st Century Skills framework: global awareness; financial, economic, business and entrepreneurial literacy; civic literacy; and health literacy. Rather than addressing core subject areas in isolation, the 21st century framework suggests that all core subjects be taught in the context of one or more of the 21st century themes, which serve to ground the knowledge students learn in real-life situations (Kay, 2010; Partnership of 21st Century Skills, 2008).

21st Century Skills

The 21st Century Skills framework identifies three skill areas in which all core subjects must be taught including: learning and innovation skills; information, media, and technology skills; and life and career skills. In today's fast-paced globally competitive society, both knowledge and skills are deemed essential (Bell, 2010; Kay, 2010; Partnership for 21st Century Skills, 2008). Modern skill sets are vital. The U.S. Department of Education states: "…It is more important than ever for our youth to be equipped with the knowledge and skills to solve tough problems, gather and evaluate evidence, and make sense of information. These are the types of skills that students learn by studying science, technology, engineering, and math—subjects collectively known as STEM" (U.S. Dept. of Education, para. 1, 2016).

Learning and Innovation Skills

Learning and innovation skills serve as the energy for an information-based society and economy. They are what defines those students who are equipped to thrive in a global and complex world. Creativity and innovation, critical thinking and problem solving, and communication and collaboration skills drive learning and innovation and make student engagement paramount to the learning process (Bell, 2010; Partnership of 21st Century Skills, 2008). Creativity serves as the link between science and solving real-life challenges.

Information, Media, and Technology Skills

We live in an information society, with new technological advances occurring at breakneck speeds. Media tools have driven individuals to rely heavily on technology in four

areas: work, play, learning, and communicating (Lemke, 2010, November, 2010; Richardson, 2010). While data points abound in our hyper-connected world, information required to engage in informed decision making will be inaccessible to students unless they develop the necessary skills to be able to analyze the credibility and reliability of data and learn how to synthesize that data to create valued information. Skills in this area rely heavily on information literacy, media literacy, and information, communication, and technology literacy.

Life and Career Skills

Life and career skills include such topics as flexibility and adaptability, initiative and self-direction, social and cross-cultural skills, productivity and accountability, and leadership and responsibility (Mourshed, Farrell, & Barton, 2012; Partnership for 21st Century Skills, 2008; Pink, 2006). Employers today are looking beyond intellectual merit alone and trying to identify individuals with emotional intelligence, who also demonstrate leadership and problem-solving capabilities (Manpower Group, 2011; Stone, 2011).

Model to Support Scientific Literacy

The four critical areas of development identified in the Partnership for 21 Century Skills framework that include collaboration and teamwork; creativity and imagination; critical thinking; and problem solving (2008), are mirrored in the call to integrate the teaching of science. A number of researchers and councils attest to this approach (Hanover, 2011; National Research Council, 2011; Wagner, 2012). According to several studies, problem-based learning and project-based inquiry should be emphasized and fostered as an approach to teaching science as they prompt students to develop creativity while collaboratively engaging and finding solutions to genuine problems (Hong & Kang, 2010; Kind & Kind; 2007 Sterling & Hargrove, 2012).

The idea of developing and enhancing scientific literacy with the use of literature while meeting the Next Generation Science Standards and being responsive to the 21st Century Skills may seem contrived. However, just as our world increasing appears as an integrated whole, the teaching of core subjects must give way to more integrated methods of teaching. An integrative approach to teaching would more accurately represent and reflect the highly integrated world in which we live today. Integrated teaching methods better benefit students in the acquisition of knowledge and skills required to engage in critical and integrated creative problem solving.

Using literature in the teaching of science is not a new concept. In fact, evidence suggests that students benefit from learning science- and mathematics-related concepts and skills through the use of literature (McKinney & Hinton, 2010). However, what is newly presented in this paper is the idea that the teaching of science literacy can be approached through the use of literature while meeting the Next Generation Science Standards, and being responsive to critically important 21st Century Skills.

Literature is exciting because of its capacity to export students to known and imagined environments where they can test and retest ideas in their own mind's eye, a relatively safe and non-threatening environment. Literature provides students opportunities to go deep within themselves where they can confront and challenge what they think they know. Teaching science with the use of literature allows educators to unleash the power of their students' imaginations. By integrating literature with the NGSS, science educators encourage student to become scientifically literate. By integrating literature with 21st Century Skills, educators better prepare students for the global world that awaits them (see Figure 1).

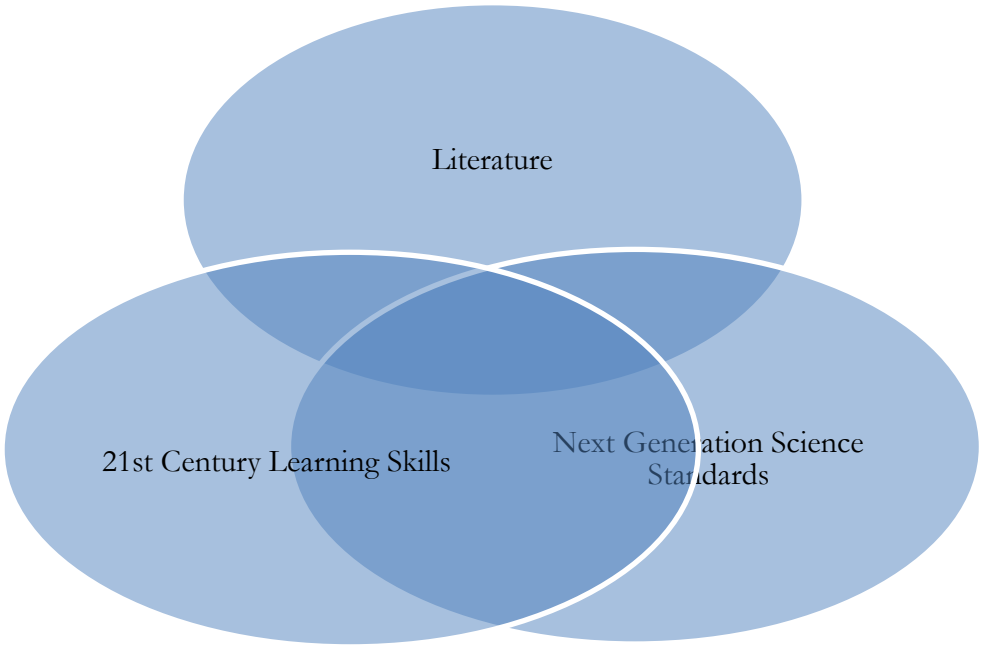

Figure 1. This figure illustrates the relationships among Literature, Next Generation Science Standards, and 21st Century Skills.

Application of Literary Assessment Tool

Based on the model presented, a Literary Assessment Tool was developed to help teachers assess the strength or merits of a literature selection based on how well it helps them to meets the Next Generation Science Standards and to be responsive to the 21st Century Skills.

Use of the Literacy Assessment Tool is demonstrated with the following literary selections: *Jonathan Livingston Seagull*, *Charlotte's Web*, *A Wrinkle in Time, Kitten's First Full Moon, Harry Potter,* and *Icarus at the Edge of Time*. Additionally, *In Perfect Pairs: Using Fiction and Non-Fiction Picture Books to Teach Life Sciences K-12*, is discussed as a resource book for those science educators who are interested in identifying lesson plans that are paired with literature selections that serve to reinforce the teaching of various science-related topics.

Jonathan Livingston Seagull (Bach, 1970). Coherent science literacy connections can be found in any sort of book, not just science books, including works of literature that initially appear to have nothing to do with science. *Jonathan Livingston Seagull* (Bach, 1970) is a story about a young male seagull that becomes bored with "seagull school" and yearns for adventure. He begins by trying to test himself, to see how fast he can fly by dive bombing. His antics soon get him into trouble at school, as he is not conforming to the rules. One day he flies so fast that he "disappears" and turns up on a foreign shore. The brilliance of this book is that nowhere in the book does it mention the topics of physics, time travel, or wormholes. Since 1970, when the book was written, much has been learned about the field of physics. However, even with this new knowledge, the mystery of physics is still present in *Jonathan Livingston Seagull*, represented in a little rebellious bird to which any student can relate. Jonathan Livingston Seagull does not question whether it is possible for him (matter) to travel near the speed of light, at which point be becomes pure energy and time will stop, and yet, that is what he does. Jonathan travels through time and space to

find himself somewhere else, in another plane of existence. The NGSS pertains to Jonathan Livingston Seagull as it aligns with Physical Science - Matter and its Interactions; Motion and Stability; and Energy - using evidence to construct an explanation relating the speed of an object to the energy of that object (http://www.nextgenscience.org/pe/4-ps3-1-energy/). It aligns with the 21st Century Skills as it addresses Themes - Global Awareness; and Life and Career Skills - Initiative and Self-direction (see Appendix: Literary Assessment Tool).

Charlotte's Web (White, 1952). Another famous book that does not deal explicitly with science is *Charlotte's Web*. Nearly every child in America has read this book and has been captivated by the wonderful story of a great love between a girl and her pet pig. What this story also demonstrates, however, are naturally occurring life cycles, from birth to death on a farm. Charlotte, the spider in the story, is in the process of spinning webs and making a home in the barn. One day she has thousands of baby spiders and they are all lifted away on strands of spider webs. As Charlotte grows weaker, she explains to Wilbur the pig that her job is finished and that she will die soon. This is not a science book, but it has a lot of life science in it for elementary school students, including life cycles and cycles of nature. The book also includes characters such as Templeton the rat, who exemplifies the role of scavengers and decomposers, factors that are present in food chains, food webs and food pyramids. The Next Generation Science Standards addressed by this book align with Life Science – Ecosystems: Interactions, Energy, and Dynamics - interdependent relationships in ecosystems; and cycles of matter and energy transfer in ecosystems. The 21st Century Skills addressed include: Learning and Innovation – Creativity and Innovation; Critical Thinking and Problems Solving; and Communication and Collaboration (see Appendix: Literary Assessment Tool).

A Wrinkle in Time (L'Engle, 1962). One of the all-time great books is *A Wrinkle in Time* (1962) by Madeleine L'Engle. It is about 13 year old Meg Murry, a rebellious but curious and smart middle school student, whose mother is a scientist - something almost unheard of at the time this book was written. Meg's father, who is also a scientist, disappears one day while working on a mysterious project. In her search for him, Meg meets her strange neighbors who help her to find her father. They tell Meg that "tesseract" (time travel) is real. This award-winning book is a fantastic introduction to the topics of time travel, wormholes, and hidden dimensions, especially to children who may be science-phobic. Investigations are being conducted of these phenomena today in the field of theoretical physics, though no experimental evidence has been discovered or measured of them to date. Although this literacy selection is best described as science fiction, it covers many of the Next Generation Science Standards including: Matter and its Interactions; Motion and Stability; and Energy. It covers many of the 21st Century Skills including: Life and Career - Leadership and Responsibility; Social and Cross-Cultural flexibility and Adaptability (see Appendix: Literary Assessment Tool).

Kitten's First Full Moon (Henkes, 2004). *Kitten's First Full Moon* is a Caldecott medal award winner, and a wonderful book for the younger set. The books is about a kitten who, upon seeing a bright full moon in the sky one night, mistakes it for a bowl of milk and tries to drink it and, in the process, experiences a series of misadventures. The book has wonderful black and white illustrations that enhance the feeling that the reader is out at night watching a little kitten set out on a quest. This book would be a natural way to bring the discussion of the phases of the moon and observations of the physical world into an early elementary classroom. The book also introduces the concept of hypotheses testing and trial and error in the quest to discover the truth. The book aligns with the NGSS including Earth – Earth's Place in the Universe; Earth's Systems. Regarding the 21st Century Skills, the book aligns with Learning and Innovation - Critical Thinking and Problem solving (see: Appendix: Literary Assessment Tool).

Harry Potter Series (Rowling, 1997). Perhaps some of the most famous children's books of all time are those in the Harry Potter series, written by J.K. Rowling. They are the stories of an English orphan who discovers he has magical wizard powers and is invited to attend a special school for child wizards. Some of the themes in the book contain such topics as alchemy, alternate universes, magic plants, potions and spells, and pseudoscience (None of these phenomena are considered scientific, but rather belong to the realm of science fiction). These books would be a wonderful source of both science content and imaginary futuristic discussions of the laws of nature and the possibility of breaking or discovering new laws as technology improves. It is also an opportunity for students to critically discuss the difference between science and science fiction. This book fits into the Next Generation Science Standards as it aligns with Matter and its interactions. Regarding the 21st Century Skills, it aligns with Creativity and Innovation, and Problem solving (see Appendix: Literary Assessment Tool).

Icarus at the Edge of Time (Greene, 2008). Brian Greene, a physicist and mathematician at Columbia University, has written a series of books on the topics of hidden dimensions, string theory (a new atomic theory) and time travel. He has also written a children's book called *Icarus at the Edge of Time* (2008). It is about a boy named Icarus, who wanders off from his constantly moving deep space home to investigate a black hole. It is based on the Greek myth of Icarus, who flew too close to the sun and crashed into the sea when his wings melted. In this book, Icarus is toying with the dangerous edge of a black hole. Knowing that gravity slows down time, Greene uses this scientific knowledge to show how Icarus comes to understand that these deep laws of physics are pulling him into a black hole. The book aligns with the Next Generation Science Standards including: Physical Sciences – Matter and its Interactions; Energy; and Earth and Space – Earth's place in the Universe and the relationship between Energy and Forces. From the 21st Century Skills, it aligns with: Learning and Innovation - Creativity (see Appendix: Literary Assessment Tool).

Reference Books for Science Teachers

Educators can find guidance in choosing literary selections in *In Perfect Pairs: Using Fiction and Non-Fiction Picture Books to Teach Life Sciences K-12* (Stewart and Chesley, 2015). In this book, authors provide science-related lesson plans that are paired with literature books. There are books written by prominent modern day scientists that serve to excite the non-science lay public. One such book is *Physics of the Impossible* by Michio Kaku (2008), who is a physics professor at City College New York. This book is divided into three parts: things that are impossible now and may be possible in the future, like force fields or teleportation; things that are impossible now and may become possible in the very far future with advance technology, like traveling at the speed of light; and things that are impossible, but if possible, would change the laws of the universe as we know them. Students can write fascinating papers using their imaginations after reading parts of this book.

Problem-based pedagogy is a good format for children to express their creativity in the classroom. Research suggests that problem-based learning is integral to fostering creativity in science (Hong & Kang, 2010; Kang & Kind, 2007). It is vital that students' creativity be nurtured, as it is a critical part of the process of learning science. The use of literature provides a platform to integrate learning and innovation across the different core subject areas as students read about adventures that excite their imagination, encourage discussion, and engages them in creative and collaborative problem-solving as they seek to overcome the challenges presented in a literary selection.

Conclusion

The lack of scientific literacy and its consequences are being felt in all areas of America and in other parts of the world today. As suggested in this article, the need to address scientific illiteracy in America is vitally important to the education and development of today's students, tomorrow's workforce, the keepers of the future. If Americans are to engage as informed citizens in their personal decision making, participate as informed citizens in civic and cultural affairs, and contribute to an ever increasing STEM-based economy, it is critical that they become more scientifically literate and in doing so, ascertain the success of their own future and that of the U.S.

Fiction and non-fiction literature can serve as the conduit to bridge core subject areas, and to support the development of scientific literacy. By choosing literary sections that meet the Next Generation Science Standards, educators can support interdisciplinary learning that enables students to make connections between core subject areas and the real world around them, as well as their imagined worlds of tomorrow (Lemke, 2010; National Science Teachers Association Board of Directors, 2011). Pedagogical techniques such as problem-based inquiry and problem-based learning connects science skills to the real world by encouraging students to explore solutions to real-life challenges, just like real scientists (Hmelo-Silver, 2004). Sterling and Hargrove (2007) state that when they engage in problem-based learning, "students are modeling the processes of science and connecting their learning to a real context" (p. 50).

According to McFarlane (2003), information rich environments incite student risk-taking and innovation propensities. Literacy rich environments serve as motivators for students that encourage them to engage in individual and group activities (WETA, 2016). There is a wonderful world of literature for use in science classrooms. Some books may initially appear to be strictly literary in nature, but look deeper. Consider their relevance in light of meeting the Next Generation Science Standards because enhancing scientific literacy, just like reading literacy, is vital to the future of America. Using any book as a science book insures that America's students will come to realize that science is fun and accessible, and that science is embedded in the very fabric of life.

Literary selections also can support the development of critically important 21st Century Life Skills as students reflect on the trials and tribulations that they vicariously experience through the characters presented in a literary selection. By mirroring real-life situations, by affording students an opportunity to live for a moment in a virtual-like reality, literature allows students to test or question their own reactions to events portrayed in a selection. In a non-threatening environment, literature allows students to test their own knowledge of science, their value systems, and their leadership abilities as they either confirm or confront the characters and situations presented in a storyline.

With the use of literature, science educators, as well as other STEM-related educators, can enhance the scientific literacy of their students. In this paper, a conceptual model and literary assessment tool is shared that helps educators to evaluate a literary selection in terms of its strengths in meeting the Next Generation Science Standards while being responsive to the importance of the 21st Century Skills. By incorporating literature in the teaching of science today, educators are helping students develop the requisite knowledge and skills required of tomorrow's *informed citizens:* citizens who will make informed personal decisions; citizens who will be engaged responsibly in civic and cultural affairs; and citizens who will make valuable contributions to economic development. Does being scientifically literate matter? You bet it does! Scientific literacy matters because it helps to protect the future of America by developing informed citizens. On a global scale, scientific literacy matters because it knows no boundary. Cutting across culture and

language, scientific literacy serves to protect the future of our entire world by developing globally responsible citizens.

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Appendix: Literary Assessment Tool
21st Century Learning Skills by Next Generation Science Standards

21st Century Learning Skills / Next Generation Science Standards	Themes • Global Awareness • Financial, Economic, Business and Entrepreneurship • Civic Literacy • Health Literacy	Learning and Innovation • Creativity and Innovation • Critical Thinking and Problem Solving • Communication and Collaboration	Information, Media and Technology • Information Literacy • Media Literacy • Information and Communications Literacy	Life and Career • Flexibility and Adaptability • Initiative and Self-Direction • Social and Cross-cultural • Productivity and Accountability • Leadership and Responsibility
Physical Sciences • Matter and its Interactions • Motion and Stability: Forces and Interactions • Energy • Waves and their Application in Technologies for Information Transfer	*J.L. Seagull* • Global Awareness • Matter and its interactions Motion and Stability Energy *Harry Potter Series* • Matter and its Interactions	*Icarus at the Edge of Time* • creativity/innovation • Physical Science/Energy *Harry Potter Series* • Creativity and Innovation Critical Thinking and Problem Solving *Kitten's First Full Moon* • Critical Thinking and Problem Solving *Wrinkle in Time* • Matter and Interactions • Motion and Stability		*J.L. Seagull* • Initiative and Self-Direction • Leadership and Responsibility
Life Sciences • Molecules to Organisms: Structures and Processes • Ecosystems: Interactions, Energy, and Dynamics • Heredity: Inheritance and Variation of Traits • Biological Evolution • Unity and Diversity	*J.L. Seagull* • Molecules to Organisms • Ecosystems: Interactions, Energy and Dynamics	*Charlotte's Web* • Ecosystems: Interactions, Energy, and Dynamics • Learning and Innovation; creativity and innovation, critical thinking and problem solving, communication and collaboration		
Earth and Space Sciences • Earth's place in the Universe • Earth's Systems • Earth and Human Activity		*Icarus at the Edge of Time* • Earth's place in the Universe *Kitten's First Full Moon* • Earth's Systems		*A Wrinkle in Time* • Initiative and Self-Direction • Earth's Place in the Universe
Engineering • Engineering by Design		• J.L. Seagull • Icarus at the Edge of Time • Charlotte's Web • Harry Potter		