



17. SCIENTIFIC LITERACY

©Literacies for the Digital Age to Teach in the
K-12 Classroom

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Developed for the Pier Institute: Global Youth in
the Digital Age

Yale University, July 8-12, 2013

•CHECK IT OUT. ARE YOU SCIENTIFICALLY LITERATE?

- [CLICK ON THE URL BELOW TO SEE AND TAKE THE TEST.](#)

- <http://www.csmonitor.com/Science/2011/1209/Are-you-scientifically-literate-Take-our-quiz/Composing-about-78-percent-of-the-air-at-sea-level-what-is-the-most-common-gas-in-the-Earth-s-atmosphere>

The CHRISTIAN SCIENCE MONITOR You may have an opinion on climate change, evolution education, stem-cell research, and science funding. But do you have the facts to back up your opinion? This quiz will test your basic scientific literacy. Dec. 9, 2011 BY [Eoin O'Carroll](#), Staff

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•CHECK IT OUT. ARE YOU SCIENTIFICALLY LITERATE?

- CLICK ON THE URLS BELOW TO SEE AND TAKE THE TESTS.
- <http://www.pewresearch.org/quiz/science-knowledge/> PEW RESEARCH CENTER, Science and Technology Knowledge Quiz
- <http://sciencebasedlife.wordpress.com/2012/01/07/test-your-scientific-literacy-against-the-nation/> Science-Based Life~ Add a Little Reason to Your Day, 07 Saturday Jan 2012, Test Your Scientific Literacy Against the Nation!

•SCIENTIFIC LITERACY DEFINED

- <http://pict.sdsu.edu/engauge21st.pdf> p. 20
- **“Scientific literacy is**
 - *knowledge and understanding of the scientific concepts and processes required for personal decision making, participation in civic and cultural affairs, and economic productivity (National Academy of Sciences, 1995).”*
 - the ability to read, write, think, and talk about real-world science issues (Lapp & Fisher, 2010).
<http://www.ascd.org/publications/educational-leadership/mar11/vol68/num06/Teaching-Science-Literacy.aspx>

•STATUS OF AMERICANS' SCIENCE LITERACY

- <http://www.project2061.org/publications/sfaa/online/intro.htm>

- “Most Americans are not science-literate. One only has to look at the international studies of educational performance to see that U.S. students rank near the bottom in science and mathematics—hardly what one would expect if the schools were doing their job well. The most recent international mathematics study has reported, for instance, that U.S. students are well below the international level in problem solving, and the latest study of National Assessment of Educational Progress has found that despite some small recent gains, the average performance of 17-year-olds in 1986 remained substantially lower than it had been in 1969.”

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• POLITICIANS' SCIENCE GAFFS

- http://www.huffingtonpost.com/2012/09/03/scientific-literacy-politicians-gaffes_n_1825314.html

- **"All that stuff I was taught about evolution and embryology and the big bang theory, all that is lies straight from the pit of Hell."**

- -Rep. Paul Broun (R-Ga.) 2012

Broun, a member of the House Committee on Science, Space, and Technology, is a doctor, and would have been taught many of the generally accepted principles of evolution and embryology in medical school.

- **"If it's legitimate rape, the female body has ways to try to shut that whole thing down."**

- - Rep. Todd Akin (R-Missouri), 2012

In fact, women can become pregnant from rape.

• POLITICIANS' SCIENCE GAFFS

- http://www.huffingtonpost.com/2012/09/03/scientific-literacy-politicians-gaffes_n_1825314.html
- **"And sometimes these dollars go to projects that have little or nothing to do with the public good, things like fruit fly research in Paris, France. I kid you not."**
- - former Gov. Sarah Palin (R-Alaska), 2008
- The common fruit fly is one of the most commonly used organisms in genetic research. Discoveries such as sex-linked inheritance and techniques such as gene mapping are a result of such research.

•STATUS OF EDUCATORS' SCIENCE LITERACY

- <http://www.project2061.org/publications/sfaa/online/intro.htm>
- “Few elementary school teachers have even a rudimentary education in science and mathematics, and many junior and senior high school teachers of science and mathematics do not meet reasonable standards of preparation in those fields..... “
- “Teachers of science and mathematics have crushing teaching loads that make it nearly impossible for them to perform well, no matter how excellent their preparation may have been. This burden is made worse by the almost complete absence of a modern support system to back them up.”

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•STATUS OF SCIENCE EDUCATION'S MATERIALS & METHODS

- <http://www.project2061.org/publications/sfaa/online/intro.htm>
- “The present science textbooks and methods of instruction, far from helping, often actually impede progress toward science literacy.
- They emphasize the learning of answers more than the exploration of questions, memory at the expense of critical thought, bits and pieces of information instead of understandings in context, recitation over argument, reading in lieu of doing.
- They fail to encourage students to work together, to share ideas and information freely with each other, or to use modern instruments to extend their intellectual capabilities.”

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•STATUS OF SCIENCE EDUCATION'S CURRICULUM

- <http://www.project2061.org/publications/sfaa/online/intro.htm>

- “The present curricula in science and mathematics are overstuffed and undernourished. Over the decades, they have grown with little restraint, thereby overwhelming teachers and students and making it difficult for them to keep track of what science, mathematics, and technology is truly essential. Some topics are taught over and over again in needless detail; some that are of equal or greater importance to science literacy—often from the physical and social sciences and from technology—are absent from the curriculum or are reserved for only a few students.”

• CONTINUED

• THE NEED FOR SCIENCE LITERACY

- <http://www.project2061.org/publications/sfaa/online/intro.htm>
<http://www.project2061.org/publications/sfaa/online/intro.htm>
- “.....science education—meaning education in science, mathematics, and technology—should help students to develop the understandings and habits of mind they need to become compassionate human beings able to think for themselves and to face life head on.”
- “It should equip them also to participate thoughtfully with fellow citizens in building and protecting a society that is open, decent, and vital. “

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• THE NEED FOR SCIENCE LITERACY

- <http://www.project2061.org/publications/sfaa/online/intro.htm>
<http://www.project2061.org/publications/sfaa/online/intro.htm>

“Science, energetically pursued, can provide humanity with the knowledge of the biophysical environment and of social behavior needed to develop effective solutions to its global and local problems; without that knowledge, progress toward a safe world will be unnecessarily handicapped.”

- “science fosters the kind of intelligent respect for nature that should inform decisions on the uses of technology; without that respect, we are in danger of recklessly destroying our life-support system.”

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• THE NEED FOR SCIENCE LITERACY

- <http://www.project2061.org/publications/sfaa/online/intro.htm>
<http://www.project2061.org/publications/sfaa/online/intro.htm>

“Technological principles relating to such topics as the nature of systems, the importance of feedback and control, the cost-benefit-risk relationship, and the inevitability of side effects give people a sound basis for assessing the use of new technologies and their implications for the environment and culture; without an understanding of those principles, people are unlikely to move beyond consideration of their own immediate self-interest.”

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• THE NEED FOR SCIENCE LITERACY

- <http://www.project2061.org/publications/sfaa/online/intro.htm>
<http://www.project2061.org/publications/sfaa/online/intro.htm>
- “The most serious problems that humans now face are global:the list is long, and it is alarming.”

<ol style="list-style-type: none">1. unchecked population growth in many parts of the world,2. acid rain,3. the shrinking of tropical rain forests and other great sources of species diversity,4. the pollution of the environment,5. disease,	<ol style="list-style-type: none">6. social strife,7. the extreme inequities in the distribution of the earth's wealth,8. the huge investment of human intellect and scarce resources in preparing for and conducting war,9. the ominous shadow of nuclear holocaust
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•Qualities of Science Literate Students, according to PROJECT 2061, *Science for All Americans*

- <http://www.project2061.org/publications/sfaa/online/intro.htm>
- “*Science for All Americans* is based on the belief that the science-literate person is one who is
 - aware that science, mathematics, and technology are interdependent human enterprises with strengths and limitations;
 - understands key concepts and principles of science;
 - is familiar with the natural world and recognizes both its diversity and unity; and
 - uses scientific knowledge and scientific ways of thinking for individual and social purposes.”

• ADDITIONAL QUALITIES OF STUDENTS WHO ARE SCIENTIFICALLY LITERATE

• <http://pict.sdsu.edu/engauge21st.pdf> P. 20

- Have the knowledge and understanding of scientific concepts and processes required for participation in a Digital Age society.
- Can ask, find, or determine answers to questions derived from curiosity about everyday experiences.
- Have the ability to describe, explain, and predict natural phenomena.
- Are able to read with understanding articles about science in the popular press and to engage in social conversation about the validity of the conclusions. CONTINUED

• **ADDITIONAL QUALITIES OF STUDENTS WHO ARE SCIENTIFICALLY LITERATE**

• <http://pict.sdsu.edu/engauge21st.pdf>

- Can identify scientific issues underlying national and local decisions and express positions that are scientifically and technologically informed.
- Are able to evaluate the quality of scientific information on the basis of its source and the methods used to generate it.
- Have the capacity to pose and evaluate arguments based on evidence and to apply conclusions from such arguments appropriately.

CLICK ON THIS URL FOR ADDITIONAL EXAMPLES OF SCIENTIFIC LITERACY.

- **Science for All Americans Online**
Copyright © 1989, 1990 by American Association for the Advancement of Science [click on the green links to open them]
- <http://www.project2061.org/publications/sfaa/online/intro.htm>

Chapter 1: <u>THE NATURE OF SCIENCE</u>	Chapter 6: <u>THE HUMAN ORGANISM</u>	Chapter 11: <u>COMMON THEMES</u>
Chapter 2: <u>THE NATURE OF MATHEMATICS</u>	Chapter 7: <u>HUMAN SOCIETY</u>	Chapter 12: <u>HABITS OF MIND</u>
Chapter 3: <u>THE NATURE OF TECHNOLOGY</u>	Chapter 8: <u>THE DESIGNED WORLD</u>	Chapter 13: <u>EFFECTIVE LEARNING AND TEACHING</u>
Chapter 4: <u>THE PHYSICAL SETTING</u>	Chapter 9: <u>THE MATHEMATICAL WORLD</u>	Chapter 14: <u>REFORMING EDUCATION</u>
Chapter 5: <u>THE LIVING ENVIRONMENT</u>	Chapter 10: <u>HISTORICAL PERSPECTIVES</u>	Chapter 15: <u>NEXT STEPS</u>

•The Role of Educators in Making Students Scientifically Literate

- <http://www.ascd.org/publications/educational-leadership/mar11/vol68/num06/Teaching-Science-Literacy.aspx>
- “One of the best ways for teachers to help students learn how to comprehend a science text is to model the thinking that occurs while reading graphs, charts, data tables, and data analysis sections.”
- “Science educators must generate connections among science concepts, societal issues, and the vocabulary students will meet in textbooks.”
- “Students need to understand how to evaluate data sources. ...Students need to understand where data were collected, how they were collected, and what they represent. Like scientists in the lab or in the field, the classroom scientist must learn that it's crucial to consider multiple sources of data to analyze and draw conclusions.”

USEFUL WEBLINKS FOR EDUCATORS

- <http://www.twentyfirstcenturyscience.org/?q=teaching-resources/useful-weblinks>
- **Warning:** Oxford University Press is not responsible for the content of external Internet sites. These external websites appeared to be suitable for students, but websites change and we cannot be sure that these sites do not have links to other websites or web pages that are not. Please [tell us](#) if a link doesn't work, or doesn't look as if the site is the one described.

<u>B1 You and your genes</u>	<u>B4 Processes of life</u>	<u>C5 Chemicals of the natural environment</u>
<u>B2 Keeping healthy</u>	<u>B5 Growth and development</u>	<u>C6 Chemical synthesis</u>
<u>B3 Life on Earth</u>	<u>B6 Brain and mind</u>	<u>P4 Explaining motion</u>
<u>C1 Air quality</u>		

•ENVIRONMENTAL LITERACY SOURCES

• CLICK ON THE URLS TO SEE THE LESSON PLANS

• <http://www.readwritethink.org/classroom-resources/lesson-plans/persuasive-essay-environmental-issues-268.html> Lesson Plan Persuasive Essay: Environmental Issues

• <http://www.readwritethink.org/classroom-resources/lesson-plans/critical-literacy-action-multimodal-1139.html> Lesson Plan Critical Literacy in Action: Multimodal Texts on Global Warming

• SCIENTIFIC LITERACY SOURCES

- CLICK ON THE URLS TO OPEN & SEE MATERIALS

- <http://pict.sdsu.edu/engauge21st.pdf> enGauge® 21st Century Skills: Literacy in the Digital Age, *Scientific Literacy* pp. 20-

- <http://www.nuffieldfoundation.org/twenty-first-century-science/scientific-literacy> **SCIENTIFIC LITERACY**, Nuffield Foundation

- <http://www.project2061.org/publications/sfaa/online/intro.htm> **SCIENCE FOR ALL AMERICANS online** ©1989, 1990 by American Association for the Advancement of Science.

- <http://www.ascd.org/publications/educational-leadership/mar11/vol68/num06/Teaching-Science-Literacy.aspx> *Teaching Science Literacy* BY Maria Grant and Diane Lapp, Educational Leadership, March 2011 | Volume 68 | Number 6, What Students Need to Learn