Writing for the Science, Technology, Engineering, Math, and Health Professions

STEM-Focused English Composition

Andrew Rusnak
Writing for the Science, Technology, Engineering, Math, and Health Professions
Writing for the Science, Technology, Engineering, Math, and Health Professions

What’s a Scientist Look Like?
Learn how today’s scientists are working to update people’s perceptions of science, how it’s done and who scientists are.

Matt Berlin - Research Chemist

Rocket Scientist (for realsies)

Praveer Sharma. Developmental biologist. Speed freak.

Matt Berlin - Research Chemist

http://lookslikescience.tumblr.com/

Ph.Diva and the Mystery Band - Animation of Life in the Biotech lab

http://www.youtube.com/watch?v=ryhSGUzzz8U

http://www.youtube.com/watch?v=ryhSGUzzz8U

Post-doctoral Research Fellow - Exposure Scientist (Contaminant Exposure)
Good writers make most professions and accomplishments possible.

http://www.youtube.com/watch?v=JvAIE7owmeI  Writing In the Workplace pt. 1

http://www.youtube.com/watch?v=t1p46avxJno&feature=relmfu  Writing in the Workplace pt. 2
## Writing for the Science, Technology, Engineering, Math, and Health Professions

<table>
<thead>
<tr>
<th>Technical &amp; Science Writing</th>
<th>Function</th>
<th>Final Products</th>
<th>Audiences</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Technical Communicator/Writer</strong></td>
<td>Acts as interface between subject-matter experts, which include designers and engineers, and end users/customers. Reduces technical language for user comprehension. This includes professional job titles that don’t include “writer,” e.g. nurse, technician, paralegal, technician.</td>
<td>User documentation, design specifications, installation manuals, hardware &amp; software manuals, technical proposals, reports, presentations.</td>
<td>Various user groups ranging from mainstream to B-to-B customers, government personnel, contractors, sub-contractors.</td>
</tr>
<tr>
<td><strong>Science Writers</strong></td>
<td>Via research, acquires specific and detailed academic subject-matter expertise in physical or social sciences and publishes results in peer-reviewed journals.</td>
<td>Well researched, peer-reviewed reports for publication in peer-reviewed journals, print and/or online versions.</td>
<td>Peers who practice same academic discipline.</td>
</tr>
<tr>
<td><strong>Technical &amp; Science Journalists</strong></td>
<td>Writers and journalists who interpret the latest scientific and technical research, prepare easily digestible content for mainstream consumption in print and/or online versions.</td>
<td>Mainstream print or online news items, short and long features, blogs.</td>
<td>Mainstream, general audiences.</td>
</tr>
<tr>
<td><strong>Technical &amp; Science Public and/or Media Relations Managers/Directors</strong></td>
<td>To work as a spokesperson for a private company, government agency, non-profit, or public institution that produces, researches, or represents technical or scientific subject matter.</td>
<td>Reports, articles, press releases, presentations.</td>
<td>News outlets, mainstream public, local communities, government representatives and interests, new customers.</td>
</tr>
</tbody>
</table>
Writing for the Science, Technology, Engineering, Math, and Health Professions

The Questions in the context of the “either/or” dichotomy-driven media culture.

Conventional/Popular View of Science =
deductive reasoning, reductionism, positivism/empirical evidence, overwhelming objectivity, abstractionism, either/or, black and white, finite, cause and effect, concrete, left brain, “all the answers,” consciousness is a byproduct of neural activity, a human being is no more than a highly sophisticated computer, science is not relativistic, the immediate end to anima, the “animating principle.”

Creative “Humanistic” view of science =
inductive reasoning, subjectivity, exploration, innovation, imagination, creativity, gray matter, infinite, entrepreneurial, art, “mystery embraced,” right brain, “answers are always and forever suspect and susceptible to reinterpretation,” consciousness is a synthesis of brain, body, and environment that is always in flux, science is not value free, Feyerabend’s *Against Method*, Kuhn’s *The [Real] Structure of Scientific Revolutions*.

Should these two types of thinking be mutually exclusive when it comes to training, educating the next generation of scientists, engineers, and health professionals to think and write?

Will math help determine the *Iliad’s* historic accuracy? Image credit: G. V. Tischbein, public domain, Wikimedia Commons
If:

- As Einstein said, “Imagination is more important than knowledge”;
- Nobel laureates in hard sciences are far more inclined to practice art, music, poetry, than “regular scientists”;
- Innovation is our greatest commodity and entrepreneurial thinking will be required for all employees in the future economy;
- It is imperative that for employees of the future to be “value added” they need to bring their ideas to the table to increase efficiency, improve processes, and generate improvements;
- It is the responsibility of higher ed. to prepare students for active citizenship in a culture soon-to-be even more dominated by technology and its ethical implications;

Then what elements are critical to the methods and content, the pedagogy, of teaching STEM students to write?
Faigley and Miller found [way back] in 1982 that people in professional and technical occupations spend the most time, about 29 percent of the work week, writing. [You can bet it’s almost twice as much now.]

Writing is a “threshold skill” for both employment and promotion, particularly for salaried employees;

People who cannot write and communicate clearly will not be hired and are unlikely to last long enough to be considered for promotion;
Two-thirds of salaried employees in large American companies have some writing responsibility. “All employees must have writing ability...Manufacturing documentation, operating procedures, reporting problems, lab safety, waste-disposal operations—all have to be crystal clear,” said one human resource exec.;
Eighty percent or more of the companies in the service and finance, insurance, and real estate sectors, the corporations with the greatest employment growth potential, assess writing during hiring.

A similar dynamic is at work during promotions. Half of all companies take writing into account when making promotion decisions.

2004 Survey of Business Leaders. Writing: A Ticket to Work ... Or a Ticket Out
More than half of all responding companies report that they “frequently” or “almost always” produce technical reports (59 percent), formal reports (62 percent), and memos and correspondence (70 percent). Communication via email and PowerPoint presentations is universal; and

More than 40 percent of responding firms offer or require training for salaried employees with writing deficiencies.

2004 Survey of Business Leaders. *Writing: A Ticket to Work ... Or a Ticket Out*
The National Commission on Writing for America’s Families Schools and Colleges

Most professional employees are expected not just to write, but write well.
Despite the apparent optimism in the conclusion of The National Commission on Writing 2004 report, that “By a substantial majority, respondents report that two-thirds or more of their employees (current and new) meet company writing requirements,” (even if “a significant proportion of responding firms (about one-third) report that one-third or fewer of their employees both current and new possess the writing skills companies value”), more recent anecdotal evidence is beginning to paint a different picture, especially in the fields of science and technology.
"With this year’s application cycle in full swing, aspiring premeds across the country will be aiming to submit their applications early. While many parts of the AMCAS and other application systems involve data entry and other finite tasks, the personal statement is often the least predictable part for students—and the one most likely to derail many submission timelines.

From a recent (2011) U.S. News and World Report article
Why is the personal statement so challenging?

First, many students, particularly premeds, may not have enough writing experience under their belt from science-heavy undergraduate curricula. Second, a substantial number may not realize how much reflection and introspection it requires to prepare, edit, and polish a strong essay.”

From a recent (2011) U.S. News and World Report article
“Listen. Write. Present” Offers Communication Tips for Science Professionals

RALEIGH, NC, Jan 20, 2012
(MARKETWIRE via COMTEX) –


Unfortunately, the science-rich education required for health-care professionals leaves little room for learning how to craft a message for a particular audience. And that’s essential not only for getting jobs, but for keeping them and winning promotions, says Barnard, a communications consultant who specializes in training medical professionals to speak and write clearly and effectively.
And what do employers want?

A recent national survey of businesses and nonprofit leaders conducted by The Association Of American Colleges And Universities found:

- Nearly all employers surveyed (93 percent) say that “a demonstrated capacity to think critically, communicate clearly, and solve complex problems is more important than [a candidate’s] undergraduate major.”
- More than three in four employers say they want colleges to place more emphasis on helping students develop five key learning outcomes, including: critical thinking, complex problem-solving, written and oral communication, and applied knowledge in real-world settings.
- 80 percent of employers agree that, regardless of their major, every college student should acquire broad knowledge in the liberal arts and sciences.
Types of STEM and health writing jobs:

**Business** – Explain rules, regulations, policies, procedures, business plans, marketing overlap – annual reports;

**Science** – Explains theories, hypotheses, research, experimentation. Could be scientists, journalist, media/public relations. Social and physical sciences;

**Medical** – Software and hardware applications, policies, procedures, medical documentation, science overlap. All medical professions;
Writing for the Science, Technology, Engineering, Math, and Health Professions

Types of STEM and Health writing jobs:

**Computer** – Gaming, any software/hardware application, installation, usage, ranges from private sector to military;

**Engineering** – Mechanical, civil, electrical, chemical, aerospace, tooling (widespread needs);

**Legal** – Legal documentation, contracts, trademarks, copyrights, etc ...
There is a direct correlation between your ability to "language," your ability to read and interpret text of all manifestations, your ability to write, your ability to communicate orally, to present, and your ability to be successful in your chosen profession. The more you know about how your own mind works and how to develop and refine your language skills in the workplace, the more successful you will be. Good writers and communicators in the work environment are "go to" leaders.
What will you learn in this course:

- Grammar, mechanics, usage;
- A variety of rhetorical strategies and means to express complex scientific and technological ideas;
- Reality-directed imaginative thinking;
- Coherence, unity, sequence, organization/structure, associational logic;
- Revision, editing, proofing;
- Summarizing, quoting, paraphrasing, documenting;
- Fully utilizing digital resources and research techniques;
What will you learn in this course:

- Interviewing techniques;
- Audience and demographic analysis;
- Historical overview of science and technology writing, and philosophy of technology and science;
- The importance of a humanistic approach to writing in the STEM disciplines; and
- Drawing correlation between skills acquired and workplace applications.
What will you learn in this course (102):

- Greater challenges in reality-directed imaginative thinking;
- Rhetorical strategies and means to express even more complex scientific and technological ideas;
- Coherence, unity, sequence, organization/structure, associational logic;
- Revision, editing;
- Fully utilizing digital resources and research techniques;
What will you learn in this course (102):

- Collaborative authoring;
- Deep analysis and synthesis;
- Complex user documentation and sequential writing;
- Presentation techniques; and
- Rudimentary graphic design (the importance of visual enhancements) and/or structured authoring software/environments.
To be a good STEM writer:

**Use Reality-Directed Imaginative Thinking:**
A strong imagination contributes to working out objective scenarios and leads to sorting which facts, scenarios, and options are important and which are not, which options are possible and which are not. Which ones to apply, which ones to hold.

[http://www.youtube.com/watch?v=NugRZGDbPFU](http://www.youtube.com/watch?v=NugRZGDbPFU) WHERE GOOD IDEAS COME FROM by Steven Johnson
Science, in Dickens view, does immense good—moral, social, and intellectual—but only when it works hand-in-hand with imagination and reverence.

Dickens’ objection in *Hard Times* was not to science itself, but to the reductionist principle that imposes stultifying order and leaves no room for emotion or imagination.

“The facts of science are at least as full of poetry as the most poetical fancies,” Dickens wrote in an 1848 review of Robert Hunt’s, *The Poetry of Science.*
“Imagination is more important than knowledge, for knowledge is limited to all we know and understand, while imagination embraces the entire world, and all there ever will be to know and understand.”

—Albert Einstein

http://www.youtube.com/watch?v=KyqHqdlMcas  Creating a Culture of Innovation
To be a good STEM writer:

Find Insight and Sagacity:
A good STEM writer understands how his or her mind works, when to invoke analytical thinking, when to invoke imaginative thinking, how to recognize useful thoughts when they occur spontaneously and without invocation.
“The goal is to transform data into information and information into insight.”

—Carly Fiorina
To be a good STEM writer:

Understand ...

Data

Information

Knowledge

Wisdom

Saraswati, the Hindu Goddess of Wisdom, Music, and Dance
To be a good STEM writer:

**Learn to Analyze Audiences:**
It takes great insight to know how others think, what their needs are, how they will respond to the “whats” and “hows” of your writing. Audiences these days can range from very small, narrowly defined intra-cultural groups to larger audiences with a global reach, different culture, and ethnic background. Demographic evaluations and “user profiles” need to be thorough and comprehensive.
To be a good STEM writer:

Climb inside the mind of your audience:
Whether it’s your boss, your department, your classmates. Anticipate what they think, how they think, how they will react to what you write. Culture, gender, race, ethnicity, or age, all demographics are important.

http://www.youtube.com/watch?v=TyP0z6fW204 Refreshing Your Presentation Skills - 02 Audience Analysis
To be a good STEM writer:

Understand the principles of mechanics, grammar, narrative sequencing, and rhetoric:

Rhetoric is the art or craft of using language effectively and persuasively.
"The time to begin writing an article is when you have finished it to your satisfaction. By that time you begin to clearly and logically perceive what it is you really want to say."

Mark Twain
To be a good STEM writer:

Understand Rhetorical Strategy:
Aristotle defined three main rhetorical approaches:

**Ethos** – Relies on reputation of the author, based on character of speaker;

**Logos** – Based on logic or reason; and

**Pathos** – Based on emotion (advertisement/marketing).

http://www.youtube.com/watch?v=YtDgU2H6A8c  A Rhetorical Look at the Art of Aristotle’s Rhetoric
To be a good STEM writer:

Know that:

“In order to be a good poet, one also must be a good engineer and in order to be a good engineer, one also must be a good poet.”

—unknown
To be a good STEM writer:

The same could be said for writers for the science, technology, engineering, math, and the health professions. A good writer must have **analytical and aesthetic sensibilities** in order to anticipate audience reaction and create good reports, documents, case studies, or research articles.
To be a good STEM writer:

Learn to edit and revise:
It’s very difficult to edit one’s own work. Develop a process, learn to build in enough time in a project to set it aside for a prescribed period of time, then go back to it and edit it again. Learn proof and copy editors’ marks and symbols.
“The difference between the almost right word & the right word is really a large matter—it’s the difference between the lightning bug and the lightning.”

Mark Twain
To be a good STEM writer:

Understand graphic design and ways other than words for expressing ideas:
This is visual rhetoric. Take classes or teach yourself how to use graphics and structured authoring software. Learn PowerPoint and Publishing software.
“I believe scientists have a duty to share the excitement and pleasure of their work with the general public, and I enjoy the challenge of presenting difficult ideas in an understandable way.”

—Antony Hewish, British Radio Astronomer, Nobel Prize for Physics, 1974.
To be a good STEM writer:

It is critical not to create a false dichotomy between liberal arts/humanities and science and technology. Being a good STEM communicator means finding ways to integrate the importance of liberal arts and the humanities with science and technology.

http://www.youtube.com/watch?v=1_Kb3LUZK0c OpenLab: Art, Science, Technology and Culture
Why—since around the Age of the Enlightenment, the Age of Reason, a time when empirical evidence began to dominate the epistemological landscape—did the academic world began to split along scientific and literary lines? Why did a conflict develop between two competing views of what passes for knowledge? A debate that continues in various forms to this day?
Whose the science person and whose the literature person?


In *Literature and Science* Arnold seeks to rebuke Huxley’s call for the predominance of education to “pass from letters to science,” to transition from “mere literary instruction and education” to “sound, extensive and practical scientific knowledge.”

Advocates of the natural/physical sciences proposed to make it the “main part of education” and push literature, or, the classics, into the background.
Arnold’s claim was that “all knowledge is interesting” but that “when we set ourselves to enumerate the powers which go to the building up of human life, and say that they are the power of conduct, intellect and knowledge, beauty, and social life and manners, he (Huxley) can hardly deny this scheme, though not pretending to be scientific.”
The debate continues to this day on the value of a liberal vs. technical education. As we are wont to do, instead of seeking synthesis, we have, generally, created an either/or proposition, a one-side-or-the-other argument.
Over the years the debate has digressed into an epistemological battle for what constitutes “truth and knowledge.” Does science have all the answers? Is science “more true” than, say, literature and the humanities?
STEM-focused English comp., a place to integrate the importance of liberal arts and the humanities with science and technology.

And it is certainly ironic that a more classical definition of liberal arts denotes a curriculum that imparts general knowledge and develops the student’s rational thought and intellectual capabilities, unlike the professional, vocational, and technical curricula emphasizing specialization. The “contemporary” liberal arts comprise studying literature, languages philosophy, history, mathematics, and science.
Writing for the Science, Technology, Engineering, Math, and Health Professions

The Trivium (The three roads):

- Grammar
- Rhetoric
- Logic

The Quadrivium (The four roads):

- Arithmetic -- Number in itself
- Geometry -- Number in space
- Music, Harmonics, or Tuning Theory -- Number in time
- Astronomy or Cosmology -- Number in space and time

The 7 liberal arts of the classical world.
Writing for the Science, Technology, Engineering, Math, and Health Professions

A place to integrate the importance of liberal arts and the humanities with science and technology

Apollo was the god of both poetry and medicine
Writing for the Science, Technology, Engineering, Math, and Health Professions

A place to integrate the importance of liberal arts and the humanities with science and technology

Art and Technology share a common ancestor, *techne'* the Greek word for art, skill, or craft.
Who are the poets and who are the doctors?

Anton Chekhov
Writer

William Carlos Williams
Poet

John Keats
Poet

Were all physicians
What helps STEM writers think creatively?

...[T]he first scientist to recognize a correlation between scientific talent and non-scientific pursuits was Jacobus Henricus van’t Hoff, a Dutch Scientist who won the first Nobel in chemistry. In his essay “Imagination in Science,” he argued that the greatest scientists almost invariably display their imagination in non-scientific fields as well.

Examples include Galileo, also an artist, craftsman, musician, and writer.

van’t Hoff also was a talented flautist who wrote poetry in four languages

From: “Nurturing creativity in science takes breath of training”
March 23, 2009, Michelle & Robert Root-Bernstein, Imagine That
What helps STEM writers think creatively?

Spanish pathologist, Ramon y Cajal, one of the founders of neuroanatomy and an early Nobel winner (1906) practiced gymnastics, produced the first color photographs in Spain, painted, and wrote science fiction. When it came to recruiting students he rejected those focused solely on their science.

From: “Nurturing creativity in science takes breath of training”
March 23, 2009, Michelle & Robert Root-Bernstein, *Imagine That*
Writing for the Science, Technology, Engineering, Math, and Health Professions

What helps STEM writers think creatively?

“The far sighted teacher,” he once wrote, “will prefer those students who are somewhat headstrong, contemptuous of first place, insensible to the inducements of vanity, and who, being endowed with an abundance of restless imagination, spend their energy in the pursuit of literature, art, philosophy and all the recreations of mind and body.

Ramon y Cajal

From: “Nurturing creativity in science takes breath of training”
March 23, 2009, Michelle & Robert Root-Bernstein, Imagine That
What helps STEM writers think creatively?

“To him [or her] who observes them from afar, it appears as though they are scattering and dissipating their energies, while in reality, they are channeling and strengthening them …”

Ramon y Cajal

But what about this age of high specialization?

Donald Cram, 1987 Nobel Prize, Chemistry. Artist, poet & musician.


Roald Hoffman, 1981 Nobel Prize, Chemistry. Two collections of poetry.


From: “Nurturing creativity in science takes breath of training”
March 23, 2009, Michelle & Robert Root-Bernstein, *Imagine That*
Nobel prize winners are rarely the best academic students. They do not have high IQs that are any higher than those of scientists overall. They don’t test higher on other standardized tests.

From: “Nurturing creativity in science takes breath of training” March 23, 2009, Michelle & Robert Root-Bernstein, Imagine That
They DO bring a much wider range of skills, knowledge, talents, and methods to their work. So, instead of looking for scientific and mathematical prodigies and funneling them into early scientific specialization, we should be doing the opposite.

From: “Nurturing creativity in science takes breath of training”  
March 23, 2009, Michelle & Robert Root-Bernstein, Imagine That
The artist-scientist Jungian archetype

- Inventor, builder, dreamer;
- Hyper focused, distracted by curiosity;
- Perpetual innovator, creativity rules;
- Beholds complicated solutions, ignores simplicity; and
- Somewhat naive and bumbling.
Writing for the Science, Technology, Engineering, Math, and Health Professions

Integration

Recently
July 12th, 2011

THE CHRONICLE
of Higher Education

The Liberal Arts Are Work-Force Development

By Rob Jenkins
Two-year colleges occupy a unique position in the national debate over the value of the liberal arts.

For students who are not liberal-arts majors, the core-curriculum courses they are “forced” to take as freshmen and sophomores will probably constitute the extent of their dabbling in the liberal arts. Those who go on to study business, engineering, or computer science are unlikely, as juniors and seniors, to sign up for additional classes in literature, biology, psychology, or art appreciation.
Now consider that, according to the American Association of Community Colleges, about half of all freshmen and sophomores are enrolled at the nation’s 1,300 two-year colleges, and many of those students transfer to four-year institutions. For a large percentage of people who earn bachelor’s degrees, then, the liberal-arts portion of their education was acquired at a two-year college.
Next, factor in all of the community-college students who enter the work force after earning two-year degrees or certificates, and whose *only* exposure to the liberal arts occurred in whatever core courses their programs required.
The conclusion becomes obvious: Two-year colleges are among the country’s leading providers of liberal-arts education, although they seldom get credit for that role. Many Americans learn at a two-year college most of what they will ever learn—in a formal setting, at least—about writing, critical thinking, the history of our culture and civilization, the environment, and human behavior.
Employers rank communication and analytical skills among the most important attributes they seek in new hires, according to the National Association of Colleges and Employers.
“...[I]f science and technology are rigid, monolithic, and devoted to formulaic thinking and nothing but pure objectivity, the language used to write about them should resemble them. This point is radically false, with regard to both science and technology and to writing, and when stated this bluntly ... seems false to most people.”

Writing for the Science, Technology, Engineering, Math, and Health Professions

A place to integrate the importance of liberal arts and the humanities with science and technology

“There is more [much, much more] to technical writing [writing for science, technology, engineering, math, and the health professions] than proficiency in writing, more even than knowing facts. Technical writing should not be so heavily mortgaged to pragmatism that it lacks cohesiveness and moral purpose.”

“Technical (STEM) communication belongs to a tradition that asserts the primacy of knowing and being over willing and doing. It insists that the person thinking is more important than the tools used or the system acted upon.”

Notice the language? “Person Thinking”

“Man is thus metamorphosed into a thing, into many things. The planter [student], who is Man sent out into the field [classroom] to gather food, is seldom cheered by any idea of the true dignity of his ministry [writing]. He sees his bushel [assignment] and his cart [professor], and nothing beyond, and sinks into the farmer [student], instead of Man [student] on [in] the farm [world of ideas].

Ralph Waldo Emerson, The American Scholar
In this distribution of functions, the scholar is the delegated intellect. In the right state, he/she is, *Man/Woman Thinking*. In the degenerate state, when the victim of society, he/she tends to become a mere thinker, or, still worse, the parrot of other men’s/women’s thinking.”

Ralph Waldo Emerson, *The American Scholar*
“... I’ve seen that science itself is a fallible human activity, not a conceptual machine-tool, and that while accuracy and precision can be easily achieved, validity and meaning cannot.

The imperfections and constraints vitiating scientific knowledge stand as a warning about the limits of other sorts of knowledge—even shakier sorts—including that based on eyewitness experience.”

David Quammen, Intro. To *Boilerplate Rhino*
Writing for the Science, Technology, Engineering, Math, and Health Professions

STEM-focused English comp., a place to integrate the importance of liberal arts and the humanities with science and technology

What happens in science and technology when there is a failure of imagination? A failure of culture? A failure of “person” and “man [and woman] thinking?” What happens when writing becomes too heavily mortgaged to pragmatism? When STEM becomes too monolithic and devoted to formulaic thinking?

Can questions get any bigger?

http://www.youtube.com/watch?v=ihdlSaRGAIJk Scientific Thinking And Moral Philosophy, Richard Dawkins
“[Researchers] Winsor and Pace show several managers and engineers knew the type of O-rings used in the Challenger had already cracked under test conditions and thus might crack during launching. Memorandums were written ... a conference was held involving managers and engineers at which ... O-ring failure was discussed.

“...[T]he decision was taken to launch the Challenger. ‘Why,’ Winsor asks, did those who knew of the problem with the shuttle’s solid rocket boosters not convince those in power to stop the launch?’”

Writing for the Science, Technology, Engineering, Math, and Health Professions

STEM-focused English comp., a place to integrate the importance of liberal arts and the humanities with science and technology

And who can forget?
“For Pace, the Challenger disaster illustrates in graphic terms how human the process of communication is,’ and he urges that technical communication scholars [writers] and decision makers ‘broaden their perspectives of communication to include the human values inherent in the process.’”


http://www.youtube.com/watch?v=ljPYmSdyVZc Challenger Explosion
http://www.youtube.com/watch?v=MKG4bvZGWag&feature=related Investigation
http://www.youtube.com/watch?v=UCLgRyKvfp0 Feynman
The orbiter itself did not explode, but broke apart on ascent (65,000 ft., 73 seconds into the flight). The crew cabin tore off and in less than three minutes hit the surface of the water at about 200 MPH. It could not be determined by examining the remains of crew was dead before they hit the water.

Another example of the failure of imagination?

On July 22\textsuperscript{nd}, 2011, this full-page ad ran in USA Today:
US AIRWAYS’ UNWRITTEN POLICY:
Revenues First, Safety Second?
We know this is going to sound unbelievable, but please read on.

On July 16, 2011, a US Airways Captain with 30 years of experience stopped her flight from departing. Something was wrong with the airplane. She was deeply concerned about a balky power component that, should it continue to fail, might have eliminated all electrical power to her trans-Atlantic flight.
Despite her valid concerns, US Airways’ management pressured her to fly the airplane, over the ocean, at night. When she refused to jeopardize the safety of her passengers, US Airways’ security escorted her out of the airport, and threatened to arrest her crew should they not cooperate. Before she was removed from the aircraft, two other US Airways pilots also refused to fly the aircraft. After she was removed from the airport, three more US Airways pilots refused to fly the aircraft, citing their own concerns about the fitness of the plane. It turned out the pilots were right: the power component was faulty and the plane was removed from service and, finally, fixed. Eventually, a third crew operated the flight, hours later.
These are not failures of technology. They are failures of imagination, failures of “person thinking,” failures to include the “human values inherent in the process.”
“Liberal education contextualizes a person, places that person, places that person in a social, historical, rhetorical setting. It confers power to choose, power to design new solutions. It liberates the hurried ..., [STEM writer] from that supposed panacea, doing it the old way because no one can imagine any alternative—certainly not an alternative that requires time to develop.”

“Specialization is the price we pay for the advancement of knowledge. A price, because the path of specialization leads away from the ordinary and concrete acts of understanding the terms of which man actually lives his day-to-day life.”

“That which binds us, our common nature, is what literature has always, knowingly and helplessly, given voice to. And it is this universality which the biological sciences, now entering another exhilarating phase, are set to explore further.”

—William Barrett, *Irrational Man*  
—British Novelist Ian McEwan, *Literature, Science, and Human Nature*
Integration, evolutionary themes, the science of literature, lit. crit. based on evolutionary context does not mean the “absolute,” or even devalue deconstruction, post modernism, post structuralism, constructivism, or cultural approaches to literature.

“When science does flourish, it validates and extends as much as it overturns the uncertain knowledge derived by other means. …[L]iterature does not diminish in value, when approached from a scientific perspective. The relationship between the two bodies of wisdom should be mutually reinforcing.”

Jonathan Gottschall
Imagination becomes far more, not less, important if we have any real desire to manage this fast-changing world where genetics, nanotechnology (especially in medicine), and robotics/artificial intelligence will come to dominate our evolution, culture, brain chemistry, and, maybe, our survival.