



Curriculum Units by Fellows of the Yale-New Haven Teachers Institute

1999 Volume VII: Electronics in the 20th Century: Nature, Technology, People, Companies, and the Marketplace

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## **From Science Fact to Science Fiction: Using Scientific Research to Drive the Creative Writing Process**

Curriculum Unit 99.07.08

by June Gold

### **Introduction**

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This unit is designed and intended for use in the seventh and eighth grade classroom, as a vehicle for the teaching of both fiction writing and independent research skills. It uses the impact of rapid technological change as the context for teaching these lessons. Because of its heavy dependence on student research skills, this unit would probably not be appropriate for a younger audience, the exception being a very sophisticated learner with a love for the intellectual. Teachers of ninth and tenth grade writing, however, might find this unit useful and engaging, altering the lesson content slightly for their older learners.

In the first phase of this unit, students must gain a basic understanding of technology. They must be exposed to the concept that technology always proceeds in a linear way, (at least at the individual level), and that scientists use what they know, drawing heavily on the basic laws of nature and ideas as well as current need areas in their respective fields, to launch forward with new ideas and discoveries. Students will select an area experiencing rapid technological advances, such as computer technology or biotechnology, that they want to explore, research that particular interest, and move forward with proposals and ideas which extend the current knowledge base in the chosen field to make predictions for the future. In my unit preparations I will use a study of cloning and genetic engineering to illustrate how this project might manifest itself in the classroom. Several other topics will be introduced to provide the teacher with ideas for other directions in student research.

After demonstrating information-finding skills, (some teachers might use the "Big Six" method), students will need to use creative thinking to form their ideas for projecting the next phase of development for their topic. At this juncture of the project, emphasis will be placed on creative thinking and the synthesis of ideas, along with writing skills, to perfect the final product. Although the emphasis for research is one of science and technology, this project does not require a strong science background on the part of the teacher or the learner. The emphasis of the final product will be a science fiction story, primarily based on the research and predictions generated in the first phase of this project. It is important for the teacher to emphasize this point, as one of the primary goals of this unit will be to demonstrate the strong relationship between careful research, sound analytical thought and good fiction writing.

## Objectives and Strategies

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The pace of technological advance in the twentieth century has been stunning, beyond the imaginations of what our finest science fiction writers were predicting at the turn of the century. We have witnessed the birth of weapons capable of reducing our planet to rubble, we have seen men stride upon our nearest celestial neighbor, we have marveled at machines, the size of dimes doing the mental work of hundreds of men, and we have thrilled and been chilled by the unlocking of the very secrets of life - our genetic code - and the subsequent power that has been unleashed, enabling the creation of wonders such cross-species hybrids.

Yet as breathtaking as the pace has been it may seem glacial compared to the whirlwind to come. The scourges that have plagued modern man - heart disease, diabetes, cancer, and arthritis may be cured in the coming decades, due to our mastery of the human genome and our understanding of the details of its functions. Even more tantalizing however, is the possibility this knowledge may finally yield, the stuff of magic and legends, literally the fountain of youth that mankind has sought through the ages. The genetic secrets of the aging process are slowly being uncovered and the coming century could well see their marvels exposed. The ramifications of such advances on our society and social structures are difficult to imagine.

However, even these changes are small compared to the revolution forecast by some - the inevitable result of the invention that has come to embody twentieth century technology - an invention that will no doubt come to dominate twenty-first century life - the computer. The timid prognosticators, industry titans such as Gates, see ubiquitous computers, aiding us in all we do, reaching into our homes, and our businesses and every aspect of our waking life. The slightly more daring scientists, like Kaku, envision computers that may one day be our intellectual equals, conscious partners helping us reshape the world. The truly radical however, such as Moravec and Kurzweil, see a "postbiological" revolution, which will sweep humanity off the planet leading to the absolute triumph of technology in its very strongest sense.

The goal of this unit is to tap into the excitement and sense of awe that technological advances can bring in order to motivate students to develop both their creative writing skills and their research skills. I will try to demonstrate the strong link between careful factual research of subject matter and good fiction writing. I will use the study of scientific fact to drive the creation of science fiction. In this effort we will take our cues from forecasters such as Kaku, Moravec and Kurzweil who have tried to paint visions of the future based on their solid grounding in scientific facts. Yet the futures they describe can clearly form the basis for vivid science fiction stories. Indeed the connection between science and science fiction has always been strong, with many scientists having tried their hand at science fiction, and many of our greatest science fiction writers having come from the realm of science.

This unit is divided into four parts, with the first three parts each taking approximately one to two weeks of classroom time and the final phase lasting about two to three weeks. During the first phase I will focus on the teaching of an area of technology - biotechnology. I will begin with a lesson on cloning, using the controversy which the possibility of human cloning has generated to initiate a discussion about the source of that controversy and the possible ramifications for the future. Right from the start of the unit, I want each student to begin making connections between current technologies and future possibilities for that technology and the consequences which may evolve. In addition, I will try to impart, appropriate to their age level, a basic understanding of the science behind the technology. Each student for example, should know what DNA is and what genes are, as well as their function is in living organisms. They will learn that each cell in the human body contains in its DNA a blueprint for all the different organs and tissues in the entire body. The exact same

blueprint, which within the single celled zygote, gives rise to a newborn infant is present in most cells in fully grown adults. It is this remarkable fact which makes cloning possible. Dolly, the sheep, was cloned using a single cell from an adult sheep, which was then transferred into a developing embryo, which used the genetic material, the blueprint, from that adult cell. The second major topic of the week will be a discussion of transgenic organisms. These are organisms whose genes contain man-made mutations, mutations which are subsequently passed down to the organism's progeny. I will describe how transgenic mice, for example, have become an essential tool for scientific research and drug discovery. I will describe the rich set of techniques molecular biologists have developed over the last thirty years, which allow them to manipulate DNA, allowing them to cut pieces of it, essentially extracting genes right out of a cell and then introducing them back into new cells. Both cloning and transgenic organisms are a direct result of these scientific advances. Any discussion of transgenic organisms, of course will allow the classroom to explore an arena rich with possibilities and speculation. The goal after the first phase, is to have each student imaging and creating future scenarios, while learning about a current technology.

In the second phase, each student will have to select a given area of technology and research it. The emphasis will be on selecting an area of technology that holds tremendous possibilities for future advances, and where such advances could have significant impact on society. Artificial intelligence, virtual reality, and space travel are possible examples. During this period, some of the classroom activities described in the following section could be conducted. The goal after this week is for each student to learn some basic skills regarding how to research a topic of interest. Hopefully, each student will find a topic that is sufficiently exciting to hold their interest and will motivate themselves to do the research.

In the third phase, each student will write a brief research paper on their topic of interest. This paper will consist of two sections. In the first section, the student will describe the current state of the art in the area of technology they have chosen. In the second section, each student will try to forecast what advances will take place, in that technology, ten, twenty and fifty years in the future. The goal in this phase will be twofold. One is to teach the students the mechanics of how to write a research paper. The second goal is to promote their imagination and to get students to speculate about the future, but their speculation should be in a grounded, connected manner. Each student's future should flow naturally from the present.

Finally in the last two weeks of the unit, each student will write a short science fiction story, utilizing their area of research, as well as incorporating the predictions they may have made in their research paper. During this period the class will also read a short science fiction story. There will also be lessons on the rudiments of fiction writing. The goal will be to promote creativity and allow each student to give free reign to their imagination, but in a directed fashion. The science fiction story they write must remain connected to the previous research they have done on their topic and to the research paper they have just written. Each student must clearly move from science fact to science fiction.

## Classroom Activities

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### *Internet Research Poster*

The World Wide Web is a valuable source of information for a wide range of topics. However, students need to learn how to use the web efficiently and responsibly. This activity is successful if it is first modeled in the classroom, from beginning to end.

Begin by bringing students to the computer in small groups. Adaptive hardware is available for connecting a computer to a large screen television, or to a movie screen, which allows for easy viewing by the entire classroom. Students work alone or in pairs to research a "mini-topic" on the World Wide Web. This mini-topic should be related to the long-range goal of science fiction writing. The students will then make use of the various Internet sources available, such as commercial online services, Usenet newsgroups, Web sites, and online magazines and journals. At this point emphasis should be placed on information seeking, narrowing a topic and excluding irrelevant information. As students begin to search, they will find some sites more valuable than others. Help students to develop and apply criteria for conducting their search, and evaluating the information they find.

## Evaluation of World Wide Web Information

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### *Accuracy and Authority*

- Who is the author or producer of this site? Does the developer provide documentation for the information? Is this site affiliated with a particular institution?
- What are the credentials of the author of this site? How knowledgeable is the author, or group, on the subject matter of this site? Are the sources for any factual information listed so they can be verified in another source?
- Does this site contain documentation for the information? Is it possible to verify the information to check for accuracy?
- How comprehensive is the information provided at this site?
- Is the information free of grammatical, spelling, etc., errors?
- If statistical data is presented in graphs and charts, are they clearly labeled and easy to read?
- Is the information at this site unique and not easily accessible from another source?
- Is the date included? Does the date indicate when the information was first written, when it was placed on the web, and last updated?
- Is the information updated on a regular basis?

## *Objectivity of Information*

- Is this site affiliated with a particular institution? If so, which? Have you ever heard of this organization?
- What do you think is the purpose of this web site? Is it to persuade, entertain, inform, or perform a public service?
- If there is any advertising on the page, is it clearly differentiated from informational content? How might the advertiser be connected with the web author or producer?

## *Design*

- Is this Web site organized in a logical manner?
- Are the instructions for navigating this site clear? Can this site be used without much instruction?
- Are all the parts of this Web site workable?
- Can you navigate easily from one page to another?
- What is the purpose of the graphics; are they decorative or instructional?
- If there is a print version of this information, does it corroborate the Web site information?
- Is this a complete Web site, or is it under construction?

After students have completed the information seeking portion of this activity, they will review what they have found, and make a poster of their research sample. The poster should include the following elements:

- Student name, class information
- Topic and uncovered research
- All search engines used in information gathering
- Title, author, and date for each site visited
- Response paragraph for each site visited, explaining how the student applied the evaluation criteria to each Web site.
- Comparison paragraph of site evaluation, which weighs each site against all others
- Problems encountered while performing the Web search
- Mini-glossary of computer and Internet terminology pertinent to doing an Internet search.

Each student, or pair of students, should be afforded the opportunity to present their poster to the group, so that student may benefit from each other's research methods. While the goal of this activity is to learn how to navigate the World Wide Web to find information, student will also have begun the research for their science fiction stories.

## Internet Poster Requirement Sheet

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Name \_\_\_\_\_

Title:

Write the title of the subject you researched across the top of the poster. List the names of each member of your group.

Graphic Organizer:

As a group, brainstorm the list of the steps you took to do the following:

- log on to the Internet
- get to your search engine
- find information related to your topic, including everything that needs to be typed, the number of clicks needed to open documents, and the words you need to click on to access information.

Create a graphic organizer that presents this information so someone who has never used the Internet will be able to find his or her way to you topic.

Attach the graphic organizer to your poster. Terminology Chart:

As a group, define the following terms in your own words: Internet, World Wide Web, URL, Web page, Hyperlink, Query, Query box, Hit, Modem, Scroll bar, and Search engine (use examples). Attach the terminology chart to your poster.

Search Engine Web Page:

- Print out a copy of a search engine or Web page from the Internet.
- Highlight any words that are also on your terminology chart.
- Explain what each of these buttons do: Back, Forward, Reload, Search, and Stop. Attach this page to your poster.

## Safety Rules:

Describe four rules for safety on the Internet.

## Interesting Information:

Read through the information you printed out from the topic you researched. Each person should choose one interesting fact and write a detailed paragraph about it and then draw a picture to accompany the paragraph. Glue each paragraph to and drawing to a sheet of construction paper and attach to the poster.

Interactive Reader-Writer Notebooks Virtually all of our students read. Oh, they may not read of the type found in schools, libraries, and bookstores, but they read nonetheless. Many of our learners are reading sweatshirts, bottle and can labels, cereal boxes, bus schedules, telephone books, team sportswear, television and movie listings, and a multitude of product warnings, instructions, and labels.

When a student reads, there is a transaction that takes place inside his mind, an exchange of messages and images that are received and deposited to the existing bank of information. A successful reader decodes the message in print, interprets it by measuring it against an existing knowledge base, and evaluates the message according to a set of values he brought to the process.

Interactive notebooks are a tool for both reading and writing in the science fiction genre. Accomplished readers both read and write, and recognize each as a part of the unified whole, entitled literacy. This type of notebook is best when presented by the teacher first, perhaps by an example that was made using another science fiction short story as its base. For the example following, I will use the short story "Flourish Your Heart in This World" by Felicia Ackerman, which can be found in the book, *Clones and Clones*, edited by Martha C. Nussbaum and Call R. Sunstein.

## Summary:

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Laurel works in a hospice care center and has become very close with one of her patients, Mrs. Noll. Mrs. Noll is dying from the complications due to hepatitis, and Laurel mentions the story of her cousin, Juliana, who has recently had herself cloned, in order to bear the child she and her husband always wanted, but could not conceive. Mrs. Noll and Laurel find themselves apart for several weeks as Laurel visits Juliana and Mrs. Noll visits with her own cousin, Minnie. When Laurel returns to work, she finds that Mrs. Noll has decided to stay with her family, presumably until her death. In trying to track down dear Mrs. Noll, Laurel finds herself suspicious about the truth to the story, and investigates further. What Laurel discovers is that Mrs. Noll has undergone an experimental treatment. Under the guise of hospice care, Mrs. Noll has had herself cloned. The procedure involved making the cloned cells turn into liver cells instead of developing into a new fetus. In this way, the cloned embryo was sacrificed, and Mrs. Noll was given a new chance at life. Laurel found all this quite a bit unnerving at first, but when she realized that Mrs. Noll's decision had been fueled by Laurel's own story about her cousin, she softened her outlook. Now Mrs. Noll and Laurel can continue their relationship without the omen of imminent death encircling their activity.

## Beginning the Interactive Notebook

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After reading a science fiction short story, students need to obtain a one subject composition book. The binding on this type of book is much easier to work with than a spiral bound notebook. About one quarter to one third of the pages will need to be carefully removed, to be reserved for use as lift-flap strips, hidden panels, column panels, or pocket pages. Glue is also needed for this project. While interactive notebooks require careful planning on the part of the teacher, they are well worth the effort. Students will then use the first half of the remaining notebook to map out the story they have read. In doing this, students will develop note-taking skills while they learn to identify the elements of a story which unify it into one coherent theme. By taking notes in an interactive notebook, students must break down information into smaller chunks, and will present it in a fun, hands-on, visually interesting and organized way.

### *Types of Interactive Notebook Pages*

**Question and Answer strips:** These are horizontally cut strips which are glued to the notebook page along the left margin of a right hand page. Students can look for details in the stories they have read, and create trivia questions on the top strips. After gluing down the question strip, the student then raises this paper strip to reveal the answer, which is written directly underneath. To make the strips, use a right hand page. If there are five questions to be answered, five horizontal strips will be needed. Remember to leave room for longer questions and answers. Glue the top strip to the page behind it, only on the left margin. Remember to write the question on top, and the correct answer underneath. Students will enjoy quizzing each other with their trivia!

**Hidden Panels:** These panels are great for recording cause and effect, but can be used for other story elements. In the story summarized above, the cause would be when Laurel recounted the tale of her cousin, Juliana, who had herself cloned in order to become a parent. The effect would be that Mrs. Noll learned about cloning, and began to think about cloning as a viable option for her own condition. To make a hidden panels with a flap at the bottom, cut vertically along the inside margin, about halfway up an empty page. Fold this page up so that its bottom edge meets the top edge, and make a crease along the fold. Glue this top page to the page behind it, and when the glue is dry, write the cause of an event on the top page, and its effect underneath. Encourage students to make predictions about story outcomes as they read the interactive notebooks of other students.

**Column Panels:** These interactive pages are good for comparing and contrasting information, and for sequencing events in a story. In "Flourish Your Heart in This World," Laurel and her cousin, Juliana, were quite different. Column panels would be perfect for contrasting the practically perfect, beautiful, and highly successful Juliana, with warm, caring, down to earth Laurel, who led a much more quiet life. To make a column panel, fold a right-hand page in half vertically, bringing the outside edge in to meet the inside margin, and crease. The left-hand portion of this page becomes the inside panel, and is now glued to the page behind it. The front of the left-hand column is panel #1, the right-hand front column is panel #2, the back left-hand column is panel #3, and the remaining column, created from the right-hand half of the next page, is panel #4. In making interactive notebooks, students will usually not be using the back sides of pages.

**Double Page Spreads:** If students have a lot of information on one topic or story element, or if they want to include illustrations, they might want to try double page spreads. To make a two-page spread, tape the right-hand edges of two clean pages together. Then cut along the left margin of the top page, which allows it to be folded out, revealing an interior double page spread. To make a four page spread, tape two sets of double



pages together, with one to the left of the center of the book and one to the right. Cut carefully along the right margin of the left set of taped pages, and along the left margin of the right set of taped pages. As each set of pages is opened from the middle, a four-page spread is created.

**Pocket Pages:** By adding pockets to their interactive notebooks, students will have a place to store supplementary materials, such as cut out magazine pictures for idea making, letters written by story characters, and mock trinkets created to give extra life their note-taking projects. To make a pocket page, cut along the left margin of a clean sheet, clipping halfway down. Fold this piece down until it meets the bottom and crease. Then cut along the crease, leaving a one-half sheet in the book. Tape the side and bottom edges of this sheet to the one behind it, thus creating the pocket. As students move into the writing portion of the interactive notebook, this pockets will become a useful place for storing ideas created outside the classroom, and recorded elsewhere. Remember, you are creating authors, and much of writing is the result of frequent and sporadic thought!

### *Interactive Writer Notebook Pages*

As students are creating their interactive reading notebooks, they will need to reserve about half of their composition notebook for interactive writing. Interactive writing represents a visual form of a student's effort at organizing ideas relating to their own story that they write. This story is an extrapolation of the research paper, where students now take what they have studied about a given technology and create a version of the technology as it might appear in the future. Along with this, students need to be thinking about the elements of a good story; plot, setting, character, theme, climax, and so forth. During the creation of the interactive reading notebook, students should set up generic templates for their own stories, so that as their ideas take shape, these ideas will find an organized home in the writing section of the book. This then becomes both a way to stay organized, and a way to hold on to ideas, so that they do not get lost or forgotten. Possible template ideas might include; plot sequence column panels, personality question and answer strips, double page spreads for setting ideas, and hidden panels for the creation of each story character. Pocket pages can store ideas thought out anywhere, and written down at the spur of the moment. Creating an interactive writing notebook concurrently with an interactive reading notebook forces students to connect the two skills into a cohesive bond, one which encourages literacy. It also breaks the task of writing into smaller pieces, and makes it more manageable and enjoyable.

## **Teacher and Student Resources**

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1. Asimov, Isaac. *Robot Dreams*. New York, Ace Books, 1986.

This collection of 23 short stories represents Isaac Asimov's work from the 1940's to the 1980's. Classic Asimovian themes included are the scientific puzzle, the extraterrestrial thriller, and psychological discourse. Students will find these short stories very readable, and will enjoy the occasional illustrations, created by award winning science fiction artist, Ralph McQuarrie.

2. Asimov, Isaac. *Robots and Empire*. New York, Doubleday, 1985.

Students who are ready for a more formidable quest into science fiction writing will enjoy this book. *Robots and Empire* weaves together all three of Asimov's previous classic series: *Robot*, *Foundation*, and *Empire*. Asimov wrote this story as a sequel to *The Robots of Dawn*, but can easily be enjoyed on its own.

3. Brown, T.A. Genetics A Molecular Approach. London, UK: Chapman and Hall, 1992.

This text explains and relates the basic principles of molecular biology and genetics and is designed for modern introductory courses in genetics. It begins by describing the molecular nature of the gene, including gene structure and expression, and then discusses genetic analysis in detail. The book is divided into three parts; the gene, the gene in context of the cell, and genetic analysis and the basic principals of inheritance.

4. Cohen, Daniel. Are You Ready? The Best and Worst Predictions for the Millennium. New York: Pocket Books, 1999.

This small "pocket" book is a good idea-maker. Short chapters, each with its own theme, get student minds thinking about the possibilities for the next millenium. Each prediction is made from the knowledge of present technology, and is a short and realistic leap of science.

5. Clarke, Arthur and Gentry Lee. Rama Revealed. New York: Bantam, 1994.

Certainly students should be introduced to one of the greatest science fiction writers of our time, Arthur Clarke. Yet the addition of Gentry Lee makes this volume even more credible to this unit. Gentry Lee has served as director of science and mission planning for NASA's Viking mission to Mars, and has been partner to Carl Sagan in the design and development of the television series, Cosmos. Rama Reveled is the conclusion to the Rama series, which represent a fascinating mix of technology and humanity.

6. Crichton, Michael. The Lost World. New York: Knopf, 1995.

In this sequel to Jurassic Park, Michael Crichton takes the exploration of genetic discovery one step further, with the concept that "something has survived" the apocalypse of the prehistoric theme park.

7. Dent, Harry. The Roaring 2000s. New York: Simon and Schuster, 1998.

This work applies new research tools to the trends than have developed within the last few years to make concrete predictions into the next decade. The predictions include ideas in business, economics, and lifestyle, and can provide a sound background in which students can place their own future inventions.

8. Gates, Bill. The Road Ahead. New York: Viking, 1995.

In this book, Bill Gates gives his vision for what the future holds. This is his bird's-eye view of the undiscovered territory of the information highway. Students will even find his easy prose very readable.

9. Gilder, George. Microcosm. New York: Simon and Schuster, 1989.

This work is an overview of technology, and explores every aspect of today's unprecedented technological and entrepreneurial revolution. Microcosm contains accounts of the latest inventions, and their creators.

10. Harrison, Harry and Marvin Minsky. The Turing Option. Warner Books, 1992.

In many ways, this book is the science fiction equivalent of Ray Kurzweil's work, cited later. The Turing Option explores what might happen when the computer is combined with the brain. The fictional result explores the idea that our brains can be augmented with computer implants, and that we have the ability to create machines that reason on their own.

11. Kaku, Michio. Visions. New York: Anchor Books, 1997.

In Visions, Michio Kaku explores three pillars of the twentieth century. They are; the quantum revolution, the biomolecular revolution,

and the computer revolution. The author then explains how these revolutions will move our culture to a position where we become choreographers of nature.

12. Kuc, Roman. *The Digital Information Age: An Introduction to Electrical Engineering*. New York: PWS Publishing, 1999.

Designed as an introduction to engineering, this book provides the background needed for science fiction writers in the information age. Manageable chapters walk the non-engineering student through the necessary information needed to understand technology.

13. Kurzweil, Ray. *The Age of Spiritual Machines*. New York: Viking, 1999.

A truly amazing and visionary book, Kurzweil explains theories for the past and present development of technology, and then extrapolates his data to make predictions for technology in the 21st century. His ideas are far-fetched, and include concepts such as virtual sex, as well as unique ideas for the teaching of reading to children.

14. Lies, Betty. *My Ticket to Tomorrow*. Golden, Colorado: Fulcrum Publishing, 1997.

This is a great student choice as it ponders what life will be like in the future. *My Ticket to Tomorrow* explores topics ranging from fads, food, and space exploration, to manners and movies. The activities included are manageable and fun.

15. Moravec, Hans. *Mind Children*. Cambridge, Massachusetts: Harvard University Press, 1988.

This work explores the future of robot and human intelligence, and includes three mathematical appendices, which discuss the measuring of computer power and the outer limits of computation.

16. Nussbaum, Martha and Cass Sunstein, ed. *Clones and Clones*. New York: Norton and Company, 1998.

*Clones and Clones* is a compilation of mostly facts, and some fantasy, about human cloning. The writers include distinguished scholars and writers from a broad range of disciplines as they address this controversial issue. Cloning is represented as a very possible turning point in human history.

17. Ordway III, Frederick and Randy Liebermann, ed. *Blueprint for Space: Science Fiction to Science Fact*. Washington: Smithsonian, 1992.

This book draws on the expertise and experience of astronauts, historians, and science fiction writers to investigate how the idea of exploring the sky became a fact. Students and teachers will enjoy this work, which moves from pictographs to science fiction, from early rockets to Apollo landings. *Blueprint for Space* details how imaginary plans actually became blueprints for working spacecraft.

18. Rennie, John. *The Origins of Technology*. New York: Scientific American, 1997.

This *Scientific American* anthology is a tribute to the creativity of the practical mind as exhibited through the centuries. The issue traces a variety of technologies, for transportation, war, agriculture, and manufacturing. Ideas presented will provide inspiration to the science fiction writers in your classrooms, and will provide a base for present technology.

19. Sagan, Carl. *Contact*. New York, Simon and Schuster, 1985.

In this tightly woven fiction work, Sagan imagines the adventure of humanity's first encounter with other intelligent beings, using the universal language of mathematics. A major concept in the book, in addition to the link between humans and extraterrestrials, is the contact between each other and ourselves as we sort out our feelings regarding life outside our planet.

20. Sinetar, Marsha. *Developing a 21st Century Mind*. New York: Villard, 1997.

Marsha Sinetar describes a playful path to developing a 21st century mind, and has created a technique she calls Positive Structuring. Positive Structuring emphasizes creative, resourceful problem solving to discover what we really want. This book explores the spiritual side of entering the new millenium.

21. Stableford, Brian and Langford, David. The Third Millennium. New York: Knopf, 1985.

Like many visionaries, the authors of this book believe we can predict what fate holds in store for us in the next 1,000 years. Their entertaining work casts us as the ancestors, and our future as the historians past. The ideas presented are systematic, plausible, and realistic, even though they are science fiction.

22. Watson, James. The Double Helix. New York, Atheneum, 1968.

This is the story of the most significant discovery since Darwin first explored heredity. Students studying genetics would be well served to read the tale of the discovery of the structure of DNA.

23. Whaley, Charles E. Enhancing Thinking and Creativity With Futures Studies. New York: Trillium Press, 1991.

In order to think futuristically, students must think creatively. This book contains many activities to direct students' thinking, and utilizes the experience that students gain outside the classroom.

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