

## Science and Science Fiction: Methods for Evaluating Interdisciplinary and Intermedia Assignments

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Supplementing classroom instruction with online materials and learning activities is becoming less avant-garde and more of an expectation for faculty members in higher education. The use of Blackboard, WebCT, or proprietary software, like Georgia Institute of Technology's Sakai installation (T-Square), has become a requirement, rather than an option. Citing both Project Tomorrow's "Speak Up 2008" report and "Visions 2020.2," a report based on a survey sponsored by the U.S. Department of Commerce, the Department of Education, and NetDay, a nonprofit organization in California, the *Chronicle of Higher Education* concluded in their "The College of 2020: Students" report that the students of 2020 "are restless with the traditional forms of learning and eager to incorporate into their educations the electronic tools that have become omnipresent in their lives: their smartphones, laptop computers, iPods, and MP3 players (Van Der Werf and Sabatier 7). Faculty intent on reaching such students must devise nuanced methods of course delivery and revise course assignments to more comprehensively account for these shifting paradigms. As these alterations are made, faculty must also devise new systems of evaluating student work when it reaches beyond the discipline-specific learning outcomes to include technical writing and digital design components. In constructing an interdisciplinary course on the intersections between science and science fiction at Embry-Riddle Aeronautical

University, one of my goals was to create assignments that challenged students' technical prowess, as well as their skills with writing and critical analysis. Requiring students to learn or improve upon their HTML skills by developing webpages, rather than traditional essay assignments, allowed me to more easily convey the idea of technical languages as having their own rhetorical principles. The complexity of the projects required a staged evaluation process that ultimately challenged students to work far beyond the assignment "requirements," as they began to truly explore the boundaries between different modes of discourse.<sup>1</sup>

### **Developing an Interdisciplinary Course for Studying Science Fiction**

The upper-level humanities course, *Traversing the Borders: Science and Science Fiction*, fills a type of experimental niche at Embry-Riddle by instructing students in interdisciplinary research through the overlapping fields of scientific inquiry and fantastical fiction that at times informs or draws upon the actual scientific endeavors students are pursuing. The discipline-specific learning outcome from the university outline that is unique to this course states that students should be able to "conduct primary and secondary research focused on a single reality-altering event, gathering, analyzing, and interpreting information generated from a variety of traditional disciplines and integrative professions." The events chosen by the students may be as varied as science fictional accounts of extra-terrestrials to scientific projects developing space elevators or eBooks. Beginning the semester with space exploration in science fiction, I find the apparent diversity of my students' interests in their approaches to Jules Verne's *From the Earth to the Moon* or Joe Haldeman's *The Forever War*. To further challenge students in interdisciplinary work and thought, the course requires that they compose websites in HTML

with hyperlinks or superscripted footnotes for outside research. These alternative writing assignments, which allow a certain freedom of direction, cover topics as varied as political satire, the physics described in a novel to support spacecraft being developed, and the societal issues faced by different characters in futuristic settings. Students' interests range from the sciences to the social sciences to the humanities. My goal is to guide the students to different research methods that will reveal the intersections between the fiction and the narrative discourses that occur outside that fiction in our own scientific disciplines and historical observations, while also teaching students to compile that research in new and interesting ways that support an original viewpoint.

This approach to interdisciplinary learning and research works especially well with projects that utilize hypertext references, embedded images and videos, and other web based design components. In her article on interdisciplinary pedagogy, Nowacek comes to understand interdisciplinary thought as “the shift from a recognition of the coexistence of multiple but apparently independent activity systems to an awareness of the overlap and interanimation of those activity systems” (495). What better example of the overlap of these systems than Gibson's *Neuromancer* and the computer terminology that was birthed in that novel before the Internet or “cyberspace” came into existence. And how better to compose nuanced writing on such a work than through a markup language, like HTML, that requires students to understand a real computer language and use it to display a comprehensive compilation of research that could be used to convey a student's perspective on cyber-terrorism or advancements in artificial intelligence. Nowacek goes on to call interdisciplinary studies “a type of abnormal discourse that can empower individuals in limited but powerful ways by making visible previously invisible

connections and constraints, even as it may obscure others” (496). In exposing these invisible connections through our study of science fiction texts that posit discoveries we have seen come to fruition and in teaching the HyperText Markup Language of the Internet, I intend to empower students to uncover the connections that may be obscured, from faulty observations and theories to possibilities for scientific inquiry that are still unmade. At a technical institution like Embry-Riddle, such obfuscations need to be researched, understood, and overcome by students pursuing research in fields that require a certain degree of imagination blended with pragmatism. An aerospace engineer must be able to apply methodology, while also upending it when necessary to create new processes to meet new engineering problems and designs.

## **HyperText Markup Language for Writing and Research Projects**

Having students submit projects in HTML was a vital part of the course’s interdisciplinary aims (see [Appendix 1](#)). While there are some limitations to the amount of instructional time that may be spent in highly technical areas for a class as broad as this one, most students have some familiarity with a simple markup language like HTML, if from no other source than social networks or blogs. To feel more proficient in the area, I purchased my own HTML handbook and then experimented in Notepad with different concepts from the book. Like my students, I ultimately found it easier to Google how-to directions for certain complex tasks than locating them in the guide, but the guide was useful as a refresher on setting up a page. I worked with my university’s IT Department to procure a faculty webpage and learn how to use the SSH Client required to transfer files to a university supported web page.

Once I felt proficient with basic HTML coding, I found that supplementing my course with simple instructions for creating a generic HTML document did not take an excessive amount of time away from instruction but did offer students a foundation for composing in a technical language that could give them additional insight to the technical fields they were researching for the class. Heba explains how, “By coding documents electronically, we are not just ensuring that the information we are presenting online is accurate, concise, and clear, but when using markup languages, we are also, in a metaphorical sense, ‘teaching’ our computers to communicate with one another through these languages” (277). Students in my science fiction class were constantly engaged with a new language, one being deconstructed in the novels they read and the classroom discussions on everything from Turing machines to the manipulation of cyberspace by punk hackers. In requiring students to use a markup language, like HTML, to complete their projects, I was attempting to engage them in an analysis of the language behind the websites they view on a daily basis to more accurately understand the complexity of computer speak.

Each of the three major assignments for the class required students to research a sub-topic related to one of the three focal areas of the novels from class (space exploration, computing technologies, and nanotechnology) and compose a webpage or website exploring that topic in fiction and reality. Students were given a general prompt for the assignment to guide them through topic selection, organization, research, and formatting concerns and a basic guide to the HTML components required for the assignment. The HTML guidelines instructed students on how to create an HTML document in a text editing program; open and close the HTML on the page; set up a running title, heading, and subheadings for the page; format paragraphs; create

hyperlinks; make footnotes; format an attribution to the student as author; and troubleshoot for any problem punctuation marks or errors in spacing after the page is completed. In addition to these basic directions, I set up a discussion board forum on the class Blackboard page with threads covering a variety of optional HTML choices, including background color, tables, headings, aligning text and images, embedding images and video from online or from a student's personal computer, color tags, and background sound. I left the discussion board open for students to post their own advice. One student from the Honors program who required additional coursework created her own PowerPoint explaining how to use HTML to make a multi-page website and posted it on the discussion board. Another student shared a free website that offers a split screen text editor to show the HTML and the website composition simultaneously. Other students used the discussion board to post questions and offer assistance to one another, creating a strong learning community. My initial concern that I was asking for too much in these projects was allayed by the overly ambitious projects that students completed. I found myself contending with computer programming majors who wanted to incorporate their own homemade style sheets or Java scripts into their pages. Despite my own limitations in those areas, I found their work fascinating and learned from the students, as well.

Before the evaluation process commenced, students completed an in-class topic discovery assignment, a hard copy of a rough draft for general comments on organization and writing, and a final draft that they uploaded in a file or folder format to the class Blackboard assignment page.

## **Summative Evaluation Methods**

The complex nature of the web projects students completed for this course required a new evaluative method that would assess students' performance in multiple areas, including writing, research, and web design. The first evaluative tool I developed was a summative evaluation rubric to correspond with the course learning outcomes and my expectations of the students' writing and research skills from the course instruction. A summative evaluation, for this course, is defined as the final evaluation of a student's work with an attached score after which no further revisions are permitted. The only exception to this rule was the permission I gave to students to submit any post-evaluation revisions by the end of the semester before the webpages were published on the class website for the general public to view. These alterations did not affect a student's score on the assignment. Developing the summative evaluation was important to complete before deciding upon formative evaluations that would be used to guide students toward the final evaluation of their work. In creating three major projects with the same summative evaluation measures, I considered the first two projects to also work as a type of formative evaluation, in that students could apply any criticism received towards the remaining project(s). These summative evaluations covered six areas that were crucial to the types of learning outcomes students should achieve in an upper level humanities course that fulfills an interdisciplinary research goal: selecting a project topic that makes innovative connections between a topic covered by the science fiction and that same area of inquiry in the "real world," fully developing supporting details that explain the connections being made, choosing appropriate sources for hyperlinks or endnotes that fill in parts of your discussion, organizing ideas clearly in a cohesive and coherent manner, avoiding grammatical and spelling mistakes,

and formatting the page design to make it easy to read and aesthetically pleasing. The topic selection and choice of supporting details counted for ten points more than the other categories, which all counted equally toward developing a final evaluative score on the project. The areas were each described in a simple analytic grading rubric with four columns for each of the six areas (See [Appendix 2](#)).

Not only do students have to demonstrate their understanding of the content in the course by applying it to a new topic of their choosing, but they're also having to demonstrate an understanding and application of web design and coding techniques that some students may not have encountered prior to entering the course. Evaluating students' performance in these areas is especially difficult, given that some students may have demonstrably advanced websites, due to prior experience with HTML, but poor writing skills, while other students may write excellent studies on a topic with strong research materials, but demonstrate limited understanding of displaying that information in an interesting format on their webpage. To round off the challenge of evaluation, students are demonstrating their analytical skills of the component parts within their topic, their writing skills in conveying information, and their research skills in comprising a list of strong links to illustrate components on their page.

The evaluative methods begin with a student's ability to discover and present research on a topic that could be considered compelling to an online audience. In *The Rhetoric of Cool*, Rice examines the ways in which "digital culture" and its "rhetorical moves" "challenge and disrupt print-oriented conventions and structural logic" (21). By drawing upon "post-World War II American culture, a culture largely shaped by an emerging electronic apparatus based on television, film, the transistor radio, and, of course, the computer," Rice concludes that "[t]he



figures [he] draw[s] upon could not have produced the rhetorical work they did within any other kind of apparatus; their work is technologically fashioned by implicit and explicit forces” (21). Technology and culture are indeed interacting to produce a new stream of narrative with its own unique rhetorical challenges. Students in the class needed to demonstrate an understanding of this new stream of narrative in their projects and were evaluated, in part, on whether they successfully performed in this area. For example, a student describing two authors of science fiction (George Lucas and Jules Verne) and a seemingly unrelated piece of aerospace technology (missile defense systems that use lasers), simply because there were lasers in the *Star Wars* films, failed in the summative evaluation to have produced the kind of compelling narrative that a website permits a user to create. That project seemed to have three disjointed focal points that were under-developed without clear connections in the writing or research that would offer a digitally enhanced understanding of the content. However, a successful project titled “Come Sail Away,” made interesting connections between the development of space sails and the historical concept of sailing as exploratory in Verne’s own lifetime. That particular project drew on literary and historical research in sailing, as well as scientific research on new technology that may be able to harness solar energy for momentum in the vacuum of space with fascinating images and hyperlinks to broaden a viewer’s understanding of both the topic and its inter-connectedness to themes in literature and historical conceptions of sailing. Students who were evaluated “in the middle” in this area tended to offer more direct comparisons without delving into the significance of the need for the technology, the ethics behind it, or its historical relevancy. For example, a mediocre project explained what a Gundam was in Japanese Animation and then proceeded to show different Gundam-like technologies being used by militaries. Even though the

topic is narrow and the connections are well-developed, this project appeared more like a report or encyclopedic entry than an intellectual discussion of such technological uses. To make a comparison to current websites, this report offered more of a Wikipedia approach to a topic with a survey of information and links to outside sources. Those types of web presentations are extremely useful and educational, but they do not require the level of creativity or critical thinking about the topic that this project was to have achieved through an evaluation of that material, rather than a compilation of the material. In fact, one of the five pillars of Wikipedia is to have a neutral point of view in the presentation of information, which disrupts print-oriented conventions by allowing users to edit and by offering hypertext connections but does not offer the single-user the ability to offer an original and possibly disruptive narrative perspective. In the case of these examples, the portion of the webpage that made a project “most compelling” was the student’s analysis of the topic and research. Analysis requires a student to engage with the topic and make a nuanced argument about that topic.

The summative evaluation also included the students’ use of interdisciplinary research through hyperlinked and/or notated sources provided on the webpage. Greene from The Campus Computing Project explains, “Over the past three decades, technology has transformed the kinds of content—elements of the knowledge base—that inform professionals. It has also transformed core notions about access to the content” (5). Greene goes on to show how this transformation has “*expanded and enhanced* the research methodologies that inform the professions and professional practice,” “*transformed* the way we convey that knowledge, from the traditional text formats to simulations and visual learning,” and “*facilitated* access to the content—the knowledge base of professional practice—via digital content and the Internet” (5). Students have

the misfortune, in many cases, of entering this enhanced digital research field without the skills necessary to determine the efficacy of different types of information for different sorts of academic work. The projects in this upper-level, interdisciplinary science fiction course challenged students to rhetorically analyze the sources they found and use the ones they deemed most reputable from their analysis. For example, a student writing on transistor computers linked to an ongoing project in the Computer Science Department at the University of Manchester, thus giving further reading on research in that field to viewers of his website. Other links to the Department of Energy or NASA would also give more rhetorical ethos to a student's work than links to Wikipedia or the Internet Movie Database, regardless of the validity of the specific pages being linked. Students were aiming for the website to look somewhat scholarly, yet they were still allowed a certain degree of freedom to play with digital sources outside traditional scholarship to make their websites interactive and engaging. One student managed to find a free online program to generate his own Hal 9000 from *2001: A Space Odyssey* for a subsidiary page on a website exploring artificial intelligence.

The uses of embedded materials and direct links to other websites also require that students' design elements be evaluated. Web projects have their own inherent challenges when it comes to readability and clarity. Students must consider font colors and styles, hyperlink colors, text and image alignment, and contrasting background images or colors when developing websites. To make the page work aesthetically, many students employed tables and borders for text and images to give their websites a clearer and more professional appearance (see [Appendix 3](#)). Some students also created their own navigational buttons that needed to have appropriately contrasting colors or images to make them readable and user-friendly. Students most often

scored poorly in this area when the page was illegible or when images and/or videos were haphazardly represented throughout the page without bylines or spacing before and after the text portions, frequently left-aligned to leave a lot of blank space on the page. Most errors in this category were corrected by the second project, and the third project had few, if any, blatant design errors. Rice argues, after describing how Plato's *Gorgias* reveals rhetoric to be mechanical, not ethical, "embracing the role of technology's mechanics is necessary for those of us who want to serve as rhetorical producers and teachers of production in the twenty-first century" (368). Rice finds that many academics still have negative attitudes toward the role of technology and, therefore, proposes "that we conceptualize rhetorical producers as *logo mechanics*, or creators who can imagine, improvise, and enact the material deployments of meaning and its operation" (372). In designing their webpages, students in this course needed to understand the mechanics of their rhetoric on two different levels: the level of language and design presentation. Many students chose designs to specifically enhance the rhetoric of their page through neo tech fonts or running displays of binary code in the background.

### **Formative Evaluation Methods**

In developing formative means of evaluating student work for the major web projects, I considered how best to require students to complete the type of freewriting that best permits an exploration of ideas and the drafting that offers them the kind of time and feedback necessary to improve upon design, organization, and writing technique. Formative evaluations consist of the feedback given to students that is intended to aid students in improving their skills and performance prior to a summative evaluation of their work. Such evaluations further a student's

ability to self-regulate his or her learning and be more proactive in achieving learning outcomes, as can be seen in Nicol and MacFarlane's "Formative Assessment and Self-Regulated Learning: A Model and Seven Principles of Good Feedback Practice." This description of formative evaluation by Calfee and Miller gives a compelling outline of the philosophy behind such evaluative methods in the composition classroom:

Formative evaluation entails relatively informal procedures for obtaining information that can guide improvement in student learning. The primary goal in the classroom setting is to establish the degree to which the student is making progress—and, if he or she is not, to find out how to help the student begin to move ahead. . .Formative evaluation searches for the conditions that support success, which can include helpful advice from the teacher, can also open the way to explore interest and motivation, opportunities to cooperate, and various accommodations. . .Formative evaluation is richly qualitative, creating portraits that can be viewed from different perspectives. (274)

In keeping with these principles, I gave content evaluations of students' freewriting activities and comprehensive evaluations of content, proposed design, and writing technique for drafts of student projects. Each of the readings from the science fiction in the course was accompanied by a required written response that allowed students the opportunity to consider the connections that they would need to use for their projects. These responses also required students, at times, to come up with a source that would back up their suppositions. Other times, they were asked to consider the "big ideas," like the overabundance of Eastern philosophy and culture in certain works or the move toward globalization presumed by the novels. Through these writings, which

were evaluated simply on a pass/fail basis with full credit given to any attempt that met the length requirement and indicated the student had completed the assigned reading, students were given a “safe” environment in which to experiment with their suppositions without earning grade deductions for attempts that did not work well. My handwritten or typed responses would give them follow-up questions, indicate especially sophisticated lines of inquiry, or correct any misunderstandings from the more challenging literary works.

In addition to these responsive writings, students completed a draft document of their proposed web project before coding the web projects for the course. This draft was assigned after a lengthy discussion of the guidelines for each project that included a discussion of the summative evaluation rubric and, in the second year the course was offered, a review of the more successful web projects from prior students. One of the challenges of assigning projects in a mark-up language is that revision within the document is more challenging than revision to a document in a word processing program because the language signifying everything from paragraph breaks to changes in font style exist in HTML codes alongside the text. Adding HTML for hypertext and embedded materials presents further challenges in editing such material. Draft documents were therefore presented as hard copies of what the student intended to represent on the website he or she was developing. Students submitted drafts in a variety of formats, from print documents with images embedded and sources written to the side of where they would appear in the text to poster presentations of how multiple webpages for a website would appear. Huot and Perry studied the use of formative evaluation for writing courses and came to the conclusion that they work best when students are actively involved in the discussions about what makes a project more successful and why. In their conclusion on the value of

formative evaluation, Huot and Perry state, “Students not only learn that audience and purpose are important, but they also come to realize that only by assigning and then assessing the value of such rhetorical components can they reach their overall goals as writers. For example, each writing assignment introduced in class should also contain a discussion of what makes a good assignment of this type” (427). Successful assignments must therefore encourage students to engage in the discussion of the assignment itself and the rhetorical strengths or weaknesses of possible writing for those assignments. In the science fiction course, students submitted proposal documents that could be modified digitally or by hand to indicate where hypertext or images would be inserted and to show what those insertions were. Each of these proposals was given a more intensive evaluation than the final projects to let students know where improvements could be made in writing, research, and, when apparent, design/formatting. Like the responsive writings, these proposals were treated as a “safe assignment” with a point value given to how complete they were, rather than how good they were. Occasionally, such proposals were met with the suggestion to start over when the selected topic did not match the assignment by being off-topic or too generalized. Students most benefited from the markings indicating organizational or grammatical mistakes that would be much more difficult to change in the text document, since they were composed using HTML code in a text editor.

One of the drawbacks from this formative evaluation process is that it does not provide students with a formative evaluation of the complete project in HTML on a web browser. In the course this leads to several limitations, especially for the students entering the course without any background in HTML. In spite of the strong writing and website concepts, certain students struggled to deliver the project they wanted because of challenges with creating, modifying, and

uploading the HTML document. Students using Macintosh computers for the project encountered difficulties with changing the file extension, which required an extra step for some users because the text editing program they were using consisted of a rich text format that needed to be converted to plain text before the file extension could be successfully changed. Other students struggled with HTML choices that accidentally made the screen text require horizontal scrolling or showed alignments differently when the page was opened on different computers. Many of these problems could not be seen until after the final project was uploaded and viewed on different computers. To alleviate the stress that such problems caused for students, especially the ones who felt intimidated by their peers' experience with HTML prior to the class, I worked with students to overcome these challenges. Following the first project, any student who found their uploaded document did not work properly on different computers or had unexpected errors after the upload were allowed to request permission for resubmission. Their initial attempt was cleared from Blackboard and a new attempt could be uploaded. Following the summative evaluation of projects, students who could show me how they had erred in the HTML on their document, causing a score reduction for malfunctioning hypertext and poor design, were allowed to correct such errors for a partial score increase. These errors had to do mostly with spacing problems in the HTML or the use of quotation marks or apostrophes that were not in the correct tick mark format. I continued to allow such exceptions with the second project for students who were experimenting with more advanced HTML techniques than the ones employed in their first project. In this way, students acquired and built upon their skills with the mark-up language while producing more sophisticated projects as the semester progressed. Students' third projects



on nanotechnology showcase their progression from the first projects by offering more sophisticated and professional websites.

Ultimately, the point values received during the summative evaluations, combined with the opportunity for corrections in areas not explored by the formative draft evaluation became instructive to students working on subsequent projects in the class. Students frequently respond more to a point deduction on a major assignment than an evaluative comment on a draft. As Covic and Jones discovered in their experimental introduction of a formative evaluation process, “. . . while many of the students welcomed and used the resubmission option, more than half of those who utilized it did so because they failed the first submitted essay” (82). Their conclusions, based upon student feedback and results, regarding this increased failure rate for the psychology course section offering a formative evaluation was that “for a number of students the resubmission option was viewed as a ‘safety net’ rather than an opportunity to learn and apply that knowledge to improving the essay through resubmission” (82). While students may benefit from formative evaluations, educators must be aware that work produced in the formative stage will frequently not be up to the student’s performance level for an assignment receiving a summative evaluation. Not one draft submitted for formative evaluation in the Science Fiction course was near completion, and many still needed significant work after being submitted for the summative evaluation. Most of this work lay in the students’ ability to troubleshoot the HTML portions of their projects after seeing the projects on multiple computers before and after uploading it to the class Blackboard site. Students were able to progress from the first project to the second and third projects by building upon the knowledge gained by their earlier mistakes and corrections in the coding of the websites. In this way, even the summative evaluations were

able to serve as learning tools for later course projects. Students did not simply learn to correct errors, but they also learned to employ more complex design elements as they mastered the simpler techniques earlier in the semester. Finally, students were encouraged to submit updated versions of their projects before the end of the semester when I published their web pages on a website created to display the course projects. However, consistent with the research, only a couple of students from each semester submitted revisions of their projects, most likely because these revisions would not affect their course grade.

## **Conclusion**

Through these projects and their evaluation methods, I have strived to consider what O’Gorman calls hypericonomy, as a “hypothetical method for testing how scholarship might be transformed by new media and new theories of discourse” (95). In this way, the scholarship students produce in the class reaches a kind of singularity, in which they are simultaneously constructing new ideas and presenting them in a creative way, combining images and scenes from films that inspire them with hyperlinks to equally inspirational research being done by scientists and scholars in various fields. Students in the course were able to engage in a new language through HTML coding, merge together online research from multiple disciplines, and create a new narrative of their own for the way science and science fiction overlap in their purported aims. When writing on utopias, Jameson locates an opposition, in terms of subjectivity, “between consciousness—as an impersonal presence to the world which is always with us as long as we exist—and the self, which is so often an object of consciousness, but also of biography and its stories, of fantasy and trauma, of ‘personal’ ambitions and private life, in

short of narrative as such” (213). Students are becoming more self-directed in their learning and must, therefore, develop more self-reflective means of narrating the various discourses that make up their own personal narratives. Educators would do well to offer students this opportunity to transform their research by developing courses that expose multiple layers of meaning in various spheres of knowledge, including the digital world, and by assigning and evaluating student work in a way that permits those students to more fully participate in the creation of their own socio-cultural identities within a vast network of students and scholars.

## Appendix 1

### Excerpted example of HTML code for website displayed in [Appendix 3](#)

```
<html><head><title>Nanotechnology: An Illustrated
Primer</title></head>
<body leftmargin="40" rightmargin="40" link="990000"
vlink="990000" background="mediatronic background.jpeg"
bgproperties="fixed"><center><table width="900"
bordercolor="FFFFFF" frame="void"><tr><td>
<center><table bordercolor="000000"><tr><td><table border="5"
bordercolor="000000"><tr><td><font color="000000" face="century
schoolbook" size="8"> Nanotechnology: An Illustrated
Primer</tr></td></table></tr></td></table></center>
<p><font size="5" align="left"><u>Nanotechnology Gets a Bad
Rap</u></font></p>
<p><table border="5" bordercolor="000000" bgcolor="FFFFFF"
cellpadding="10"><tr><td><font size="4" align="justify">
<i>Nanotechnology.</i> The word rings with science fictional
connotation; fears arise of a nano-robotic revolution, a world
shrouded in <i>"grey goo,"</i>or the technologically aided
evolution of the human species beyond what we consider actually
human. Science fiction works with scientifically conceivable
technologies on the horizon of development, or occasionally,
technologies that have not yet been conceived by science, and
forecasts the possible outcomes, often negative. A strong theme
in science fiction is unforeseen negative consequences, often
apocalyptic, of actions carried out without thorough thinking.
Examples of this theme show through in stories such as <a
href="http://jerz.setonhill.edu/resources/RUR/index.html"
target="blank"> Karel Capek's "R.U.R." (1921)</a> or <a
href="http://bestsciencefictionstories.com/2008/02/24/blood-
music-by-greg-bear/" target="blank">Greg Bear's "Blood Music"
(1983)</a></p>
<p>In "R.U.R.," a love-struck working man unthinkingly bestows
the Rossum company's robots with sentience and emotions to please
the woman he loves. This causes the robots to become aware of
their oppression, become enraged, rise up, and slay the entire
human race, intending to takeover.</p>
<p>In "Blood Music," a scientist develops a species of
reparative, medically inclined nanobots, which he experimentally
introduces into his own system, his only intention to make
himself <i>better</i>. The nanobots are programmed to
communicate and work together, and from this they appear to
attain some level of autonomy. They certainly exhibit
consciousness, considering themselves a self-directing
"universe." Their consciousness, in time, becomes stronger than
that of their host, and they take over both his mind and body,
proceeding afterward onto others until they have claimed the
whole world. Everyone and everything is transformed,
essentially, into what is identified in science fiction as <a
href="http://www.nytimes.com/2003/12/14/magazine/14GRAY.html"
target="blank">"grey goo"</a> . . .
```

## Appendix 2

### Multimedia Project Evaluation Rubric: Science and Science Fiction

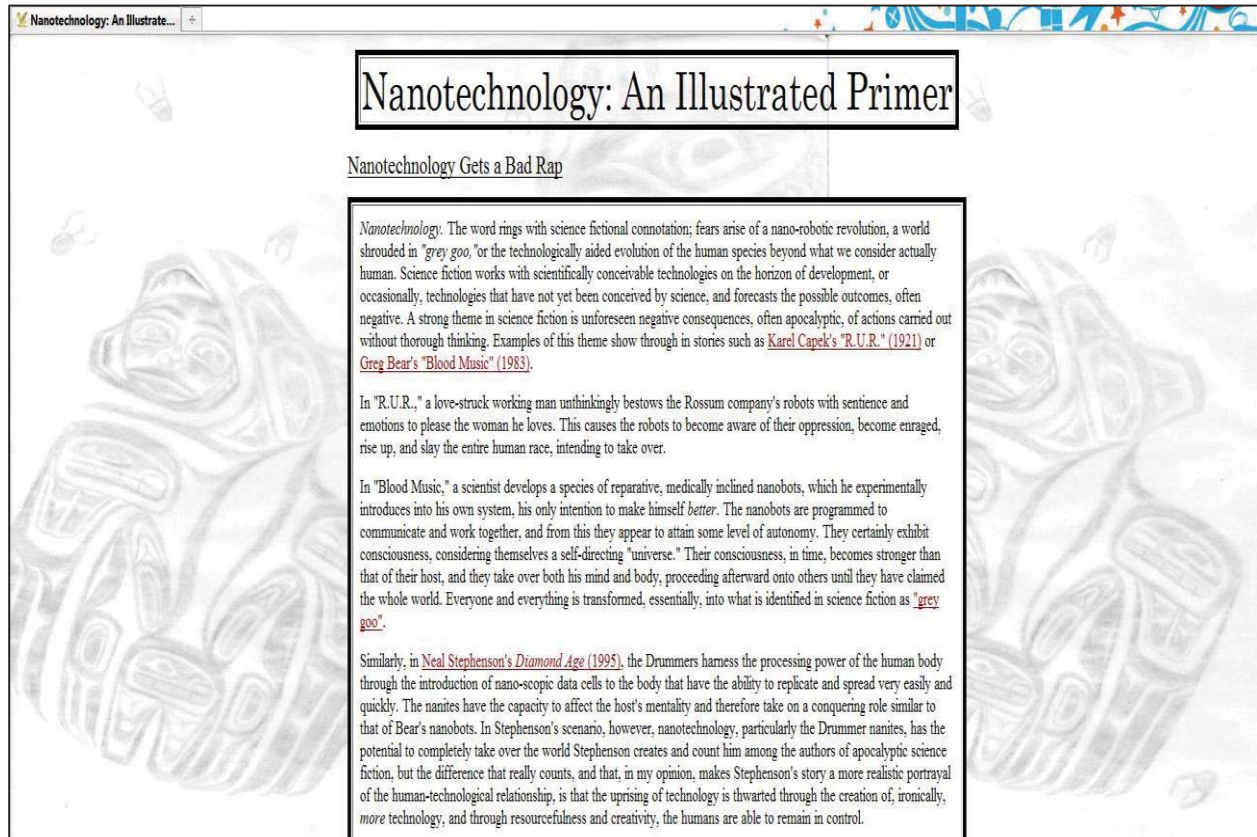
CATEGORY				
Focus on topic	Student chose a challenging topic related to the portion of the course for this project. Student makes compelling connections between fiction and practical applications.	Student chose a relevant topic. Connections made are interesting, but fairly predictable.	Student chose a relevant topic. Connections are not made clearly between the fiction and the practical applications.	Student chose a topic that does not relate to this portion of the course.
Supporting details	Student supports connections between fiction and practical applications with compelling details and fully developed explanations.	One or two supporting details are not fully developed to convey the relationship between fiction and practical applications.	Supporting details are relevant, but need to be more fully developed throughout the page.	There are insufficient supporting details, or the supporting details are severely under-developed.

Hyperlinked Information	Student provides quality hyperlinks to pages that aid the reader in understanding the material being discussed on the page.	Most hyperlinks aid the reader in understanding the material, but some hyperlinks appear to be unnecessary or superfluous.	Student uses too few or too many hyperlinks, making the page sparsely developed or confusing.	Hyperlinks do not appear to contribute to the student's work or do not function in the completed text page.
Organization	Student organizes material into well-developed block paragraphs that are easy to follow. Paragraphs are cohesive and coherence.	Most paragraphs are well-developed, one or two lack cohesion or coherence.	Paragraphs appear to have been organized haphazardly and attempt to cover too many points. Paragraphs lack cohesion and/or coherence.	Student did not attempt to organize material into paragraphs. Page consists of one or two long paragraphs.
Grammar	Writer makes few, if any, grammatical or spelling errors.	Writer makes some grammatical or spelling errors, but they are not repetitive and do not interfere with meaning.	Writer makes several grammatical or spelling errors. Some are repetitive and make the meaning difficult to grasp.	Student should consult a writing center tutor for help with grammatical or spelling errors that occur far too frequently and make the writing difficult to understand.

Formatting	The document is formatted according to the guidelines covered in class. Html tags all function correctly when the document is opened as a web page.	The document is formatted correctly with one or two minor errors. Student may have added formatting that makes the page difficult to view because of layout choices.	There are several problems with formatting that make the page difficult to view.	The formatting is full of errors. Page may only be viewed as .txt file.
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## Appendix 3

## Screen Capture of a Student's Well-formatted Web Page



Nanotechnology: An Illustrated Primer

### Nanotechnology Gets a Bad Rap

*Nanotechnology.* The word rings with science fictional connotation; fears arise of a nano-robotic revolution, a world shrouded in "grey goo," or the technologically aided evolution of the human species beyond what we consider actually human. Science fiction works with scientifically conceivable technologies on the horizon of development, or occasionally, technologies that have not yet been conceived by science, and forecasts the possible outcomes, often negative. A strong theme in science fiction is unforeseen negative consequences, often apocalyptic, of actions carried out without thorough thinking. Examples of this theme show through in stories such as [Karel Capek's "R.U.R." \(1921\)](#) or [Greg Bear's "Blood Music" \(1983\)](#).

In "R.U.R.," a love-struck working man unthinkingly bestows the Rossum company's robots with sentience and emotions to please the woman he loves. This causes the robots to become aware of their oppression, become enraged, rise up, and slay the entire human race, intending to take over.

In "Blood Music," a scientist develops a species of reparative, medically inclined nanobots, which he experimentally introduces into his own system, his only intention to make himself *better*. The nanobots are programmed to communicate and work together, and from this they appear to attain some level of autonomy. They certainly exhibit consciousness, considering themselves a self-directing "universe." Their consciousness, in time, becomes stronger than that of their host, and they take over both his mind and body, proceeding afterward onto others until they have claimed the whole world. Everyone and everything is transformed, essentially, into what is identified in science fiction as "grey goo".

Similarly, in [Neal Stephenson's \*Diamond Age\* \(1995\)](#), the Drummers harness the processing power of the human body through the introduction of nano-scope data cells to the body that have the ability to replicate and spread very easily and quickly. The nanites have the capacity to affect the host's mentality and therefore take on a conquering role similar to that of Bear's nanobots. In Stephenson's scenario, however, nanotechnology, particularly the Drummer nanites, has the potential to completely take over the world Stephenson creates and count him among the authors of apocalyptic science fiction, but the difference that really counts, and that, in my opinion, makes Stephenson's story a more realistic portrayal of the human-technological relationship, is that the uprising of technology is thwarted through the creation of, ironically, *more* technology, and through resourcefulness and creativity, the humans are able to remain in control.



## Notes

<sup>1</sup> For an example of the work produced by students in the spring of 2012, see the class website:

[http://webfac.db.erau.edu/~andrewsa/sci\\_fi\\_main\\_page\\_index\\_spring2012.html](http://webfac.db.erau.edu/~andrewsa/sci_fi_main_page_index_spring2012.html)

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