

## **"Blending Solid Science With the Craft of Fiction Writing"**

By

Lynn Marsico

Pittsburgh Middle Gifted Center

Science fiction, it can be argued, is the perfect literary genre for adolescents to study. Although this thought had never occurred to me in 20 years of teaching seventh and eighth graders, participation in a Pittsburgh Teachers Institute seminar taught by Carnegie-Mellon Physics professor Dr. Richard Holman, allowed me to consider its plausibility. At the very least, I am convinced that the genre should be examined at this age level.

The curriculum presented here covers 15 one-hour sessions in which students read and respond to science fiction stories as well as write their own. The ideas, stories, and lessons presented are appropriate not only for students who are already enthusiastic readers of science fiction, but also for students who have never explored this type of writing. I teach in a program for gifted seventh and eighth graders and wrote this curriculum especially for them. Because the stories used are not young adult stories, it would also work well with high school students

The curriculum is divided into three basic parts: reading and responding to science fiction stories; introducing students to some basic principles of physics that are used in science fiction stories; and teaching some elements of "craft" so that students can write their own science fiction stories.

### **What Is Science Fiction?**

Just what kind of stories fit into the category of "science fiction"? The definitions that my students created in a survey I conducted were all partially correct, but none embraced its wide scope. Many viewed science fiction strictly in terms of stories about the future: "fiction set in the future based on imaginary science developments," and "a narrative about future settings with emphasis on technical developments." Other students saw it as, "fiction dealing with time travel." The future, futuristic technology, and time travel are topics dealt with in many science fiction stories, but the scope is wider than this. One avid fan knew that science fiction can deal with "what could have happened differently in the past (alternate universe)." Another student defined it as "the genre of the space/time continuum." Although some students have the notion that it deals with "aliens and space that's really weird," in reality, a relatively small portion of the science fiction that is being published today deals with aliens at all. Two students hinted at an incorrect definition concerning the science of science fiction when they stated, "a story that has something to do with science, but the science involved is complex and hasn't been discovered yet," and "it's a story about things that could never happen in the future." Actually, most science fiction

authors try very hard to base their stories on scientific theories that really do exist and on possibilities that are widely accepted by physicists, cosmologists, astronomers, and geneticists.

All of my students voiced a strong sense of the difference between science fiction and fantasy. Their statements echo the differences that were defined in my own research: "fantasy doesn't need explanation, science fiction does;" "fantasy can be anything, science fiction normally has things that could really happen;" and "fantasy is based on unreal elements, while science fiction is loosely based on science fact."

Because the science fiction genre is so broad and covers a wide variety of types of stories, there is room in it for most of the definitions that my students verbalized. A basic component that was not mentioned by my students, however, is that science fiction stories must contain a problem that needs to be solved within a set of

rules and parameters. Science fiction stories always play by a certain set of rules and very strictly keep to them. This notion of setting up problems and creating a story that fits into a well-conceived structure is one of the reasons why science fiction is such an important form of literature for adolescents. Whether they are reading and responding to science fiction or writing their own stories, students must use critical and analytical thinking skills as well as creativity. When reading a complicated science fiction story, students must stay alert and tuned in to decipher the often complicated and dense text. They must also work hard to understand the technological and/or theoretical scenario the writer has created. When writing their own stories, students must use careful thinking strategies to maintain consistency throughout their stories.

Science fiction is categorized in a variety of ways. As I mentioned earlier, stories can be categorized by their central element, such as time travel, an unknown technological development, a social change, a presentation of an alternative history, or a parallel universe story. Another important classification, and one that is very important and controversial within the community of science fiction fans, is the separation of hard science fiction and soft science fiction. Simply put, hard science fiction is more concerned with real science and soft science fiction may be more concerned with social issues. The hard science fiction fans seem to be almost disdainful of readers and writers who do not embrace their passion for the strict adherence to science. They are critical of most Hollywood science fiction films because of their inconsistencies and use of "bad" science. I read an essay by a member of this group who berated school librarians for their choices of "good" adolescent science fiction. She claimed that award winning books like *The Giver* by Lois Lowry totally disregard scientific plausibility in favor of making a point, building character, and growth. Without venturing too far into this battleground between the advocates of hard and soft science fiction, I do think that it could be very worthwhile to require my seventh and eighth grade students to be responsible for using solid science in their stories. This would promote new understandings of current scientific theories, and also provide exercises in logical thinking and problem solving.

### **Why Is It A Good Genre For Adolescents To Study?**

Although I began my own exploration into the world of science fiction simply because I thought I owed it to my students who already love the form; the more science fiction I read, the more I began to realize what the genre can offer all of my students. It offers an intensity that my seventh and eighth graders don't often encounter in their school day and school work. Students must be intellectually intense when confronted with new ideas and new possibilities as well as when presented with complicated scientific theories. Reading and writing science fiction can also be an emotionally intense experience when students are given freedom to imagine alternatives to conventional human and societal behaviors.

Some specific rationales for teaching science fiction are:

1. Science fiction can force adolescents to think about our present society, including its strengths and weaknesses. It encourages students to consider what might make a better society, or just as important, what would make a worse society.
2. William Sleator, author of numerous young adult science fiction stories, says, "I can't think of a better antidote to teenage peer pressure and conformity than SF. There is a correlation between reading SF and having the freedom and self-confidence to disregard convention and think for yourself."
3. Reading science fiction and doing the research necessary to write one's own science fiction can teach students about the most current theories of physics, cosmology, genetics, and other sciences. Trying to understand these theories can force students to read, reread, and attempt to explain dense and complicated text.

4. Because the science dealt with in most science fiction stories is truly exciting, students may be encouraged to seek out higher level scientific courses in high school and college and even careers in these fields which are currently losing the "best and brightest" American students.

### **Learning The Science**

To assess the knowledge of my students, I surveyed 70 of my current 7<sup>th</sup> and 8<sup>th</sup> graders concerning their familiarity with and understanding of some of the basic concepts I hope to introduce them to. I asked them about black holes, wormholes, quantum mechanics, parallel universes, dark matter, and what happens when a star dies. There was a strong core of 18 students who were familiar with all of the terms and were able to write coherent definitions of them. Thirty five of the students had an understanding of black holes and what happens when a star dies, but not much else. The remainder of the students had no understanding of any of the terms. When I asked the knowledgeable students where they learned the information, none of them talked about school science classes. Most of these students were also avid readers of science fiction and had friends with whom they talked about such matters. Some had access to magazines such as *Scientific American* and *Nature* in their homes.

Based on this survey, I feel that all of my students have the ability to grasp at a very fundamental level some of the basic theories with which writers of science fiction stories often deal. I include here a rudimentary introduction to four different scientific concepts. However, when I prepare my classroom for this exploration into science fiction, I hope to have a wealth of resources to help students who wish to delve further into the science. My student bibliography suggests books that would serve interested students well.

Also in this section I will suggest stories that can be read and discussed that relate to the scientific concept. Depending on the makeup of the class I teach, I may have all students read and discuss one story in each category. Another alternative which would expose the students to a wider range of stories would be to have small groups read a story and present the basic story line and science to the class.

### **Black Holes**

Black holes have provided the scientific "meat" for many popular science fiction stories and they provide a subject that can be used by young writers as well. The presence of black holes in space is widely accepted by scientists. Astronomers have been able to prove the existence of black holes by observing their effects on nearby stars, although Charles Sheffield, in *Borderlands of Science*, claims that we don't have a "final proof of their existence."

Like white dwarfs and neutron stars, black holes are created when a star dies. How and when do stars die? After billions and billions of years, ordinary stars use up their hydrogen fuel. When this happens, they begin to seek out other forms of energy sources. As explained by Charles Sheffield in *Borderlands of Science*, "At first they find it through other nuclear fusion processes. Helium in the central core 'burns' (not chemical burning, but the burning of nuclear fusion) to form carbon, carbon burns to make oxygen and neon and magnesium. These processes call for higher and higher temperatures before they are significant." Because they don't have enough mass to create temperatures high enough to burn elements like neon and carbon, small stars, the size of our sun, shrink and become cooling lumps of dense matter, called white dwarfs.

Larger stars can attain temperatures high enough to keep burning neon, oxygen, and then silicon. After iron, element number 26, is reached, no heavier elements can be produced through this nuclear synthesis process. When iron is burned, energy is used, rather than produced. Iron nuclei capture the free electrons in the iron gas. Protons and electrons combine to form a core made up only of neutrons. This gravitational collapse blows away all other parts of the star, leaving only a neutron star.

When even larger stars, those that are 10 to 20 times the mass of our sun, die and collapse, a tremendous force of gravity is created. The force of gravity is so strong that the collapse goes on and on. The gravitational force due to the mass overwhelms quantum repulsion. It continues until the whole mass of the original star is squeezed into a tiny point in space. A black hole is created and the gravity here is greater than anywhere else in the universe. Anything passing close enough to a black hole would be trapped by the strong gravity. Tidal effects would pull it apart into tiny fragments. The fragments would circle the small object and eventually fall in. Anything that fell in could never get out. With things falling in and nothing coming out, the tiny object would be like a hole in space. Because not even light would come out, it would seem absolutely black. This is why scientists call this phenomenon a *black hole*. The *event horizon* is the last surface through which a light signal could escape. It is a one-way membrane, a place that can be passed into, but nothing, including radio waves, can pass out of. It is also called the surface of infinite red shift, the trapping surface, or the one-way membrane.

Stories to read and discuss that relate to black holes are "The Hole Man," by Larry Niven, "Approaching Perimelasma," by Geoffrey Landis, and "Neutron Star," by Larry Niven.

### ***"The Hole Man," by Larry Niven***

This delightful short story is appropriate for several reasons. It demonstrates good character development and the text and scientific explanations are not overly intense. In addition, a black hole is used to do away with the antagonist, a clever twist that middle school boys, especially, will love.

### ***"Approaching Perimelasma," by Geoffrey Landis***

In this fascinating story about an adventurer attempting to enter a black hole and come out again, carefully worded scientific definitions of black holes and worm holes are presented. An equally important aspect of the story is that the adventurer is not an "original" human at all, but a downloaded recreation of someone. The possibility of making back-ups and spins-offs of an individual will definitely capture the imagination of adolescents.

### ***"Neutron Star," by Larry Niven***

A puppeteer, a popular alien creature in Niven stories, is a key player in this story. He convinces Beowulf Schaeffer to explore a neutron star. This story contains excellent examples of good descriptive writing.

## Time Travel

The concept of being able to travel backwards and forwards in time is one that all adolescents, even those with no interest in science fiction, can relate to. Many popular films from the last ten years have dealt with time travel, including *Bill and Ted's Excellent Adventure*, the *Back To The Future* series, and *Contact*. TV shows such as *Sliders* have also introduced students to this concept. All students can imagine scenarios for this type of story, and the scientific problems suggested by the notion of time travel can be understood on a basic level by middle school students. The problematic science of time travel can be presented in three categories: the grandfather paradox, theories of parallel universes, and time travel that is based on general relativity.

Stories that deal with traveling back in time must always deal with the grandfather paradox. In general, any interference with the path, especially self-canceling interference, is called a grandfather paradox. Imagine the character builds a time machine. She travels back in time, meets her grandfather before he produces any children (i.e. the character's father/mother), and kills him. Thus, she would not have been born and the time machine would not have been built, a paradox. Students can imagine other versions of this paradox. A person could travel back in time and persuade herself not to travel back in time. A ball that goes in one end of a time

tunnel could come out of the other end before it went in, and knock itself out of the way, so that it never did go in.

How can the writer get around this paradox? Larry Niven, in a chapter from *All the Myriad Ways*, called "The Theory and Practice of Time Travel," explains the methods science fiction writers have used to work around the problems of time travel. He claims that, "time travel is a form of fantasy superbly suited to games of logic... It provides a great temptation to work out a self-consistent set of laws."

The first defense is to assume that one can travel only into the future and that the universe repeats itself over and over again, in a cycle. If the characters in the story can travel into the far future, they will pass the collapse of the universe and into the creation of the next universe, which is a repetition of the current one. They would keep going until they find the historic period they are looking for. There is no grandfather paradox, only a new future.

Creating parallel universes is another way that writers can solve the grandfather paradox. This idea rests on the notion that every time a human makes a decision, a new universe is created. This is a fun and easy concept for middle school students to understand and this method of time travel does not interfere with the laws of conservation of matter and energy. However, Niven says that, "probability doesn't support the theory of alternative time tracks."

Niven also discusses the philosopher's *fatalism* or *determinism* as a way of dealing with time travel. He says, "to a fatalist, the future looks exactly like the traditional picture of the past. A fatalist believes that everything that happens is predetermined to the end of time; that any attempt to change the predetermined future is fated. Fatalism has been the basis for many a tale of a frantic time traveler caught in a web of circumstance such that every move he makes acts to bring about just the calamity he is trying to avert."

Recently science fiction writers have used the concept of wormholes to explain how time travel could actually occur. The idea of wormholes that would allow for time travel was generally accepted as possible by physicists who studied relativity in the 1980's. Albert Einstein, in his general theory of relativity written in the early 1900's, used equations to show that every black hole has two ends. A dimple forming in spacetime is mirrored by another dimple forming somewhere else in space and time. The two dimples grow and join up to make a tunnel through spacetime, a "wormhole" with a black hole at each end, connecting two universes or two places in one universe. The two locations could be at different times as well as different places.

Stories to read that deal with Time Travel are: "For a Foggy Night," by Larry Niven; "Sound of Thunder," by Ray Bradbury; "Time and Time Again," by H. Beam Piper; and "Bird in Hand," by Larry Niven..

### ***"For A Foggy Night," by Larry Niven***

If you have ever felt disoriented in a dense fog, the plausibility of this story will hit home. The premise is that every time a human walks into a dense fog, she exits into a parallel universe, another world. The writing is excellent, and the images and ideas will stay with readers for a long time.

### ***"Bird In The Hand," by Larry Niven***

Time travel in this story is achieved with the use of time machines. A child like ruler in the future is entertained by playthings from the past such as the first automobile ever made and extinct animals like elephants. His loyal subjects must find ways to travel to the past to retrieve these objects.

### ***"Time and Time Again," by H. Beam Piper***

This story creates another version of a parallel universe, where there is a perpetual coexistence of every moment in time. A young boy who lives in the time of World War III finds himself in back in his childhood home before World War II.

### ***"Sound of Thunder," by Ray Bradbury***

In this classic science fiction story a group of amateur hunters pay a huge fee to travel back in time to hunt a great dinosaur. Because one man steps off of the path and kills a butterfly, the entire history of the world is changed.

### Space Travel/Relativity

One of the biggest problems that writers of science fiction face is that the laws of physics do not allow for travel that is faster than the speed of light. Einstein, in his special theory of relativity, made it clear that no object can be accelerated to move faster than the speed of light. The nearest star, Alpha Centauri, is 4.2 light years away. The distance to the center of the galaxy is about 10,000 times farther than Alpha Centauri.

There are, however, several methods for space travel used by science fiction writers that are possible within the understandings of modern physics. These methods are: transmitting a signal that represents the human, figuring time dilation into the space travel equation, employing wormholes, and contemplating the possibility of faster-than-light particles called tachyons.

Uploading and then downloading an individual's brain through space is a frequently used technique. Greg Egan, in his story "Planck Dive," uses this technique. The main character, Gisela, wonders why it will take a visitor from Earth ninety minutes to get to her planet. "Everything meaningful about an individual citizen could be packed into less than an exabyte, and sent as a gamma-ray burst a few milliseconds long." Charles Sheffield, in chapter nine of *Borderlands of Science*, offers the mathematical data needed to transmit a brain, if the writer is willing to think of the human brain as nothing more than a series of neuron connections. He notes, however, that the human would not exist physically unless a clone of the body, grown from a DNA description, was waiting for the brain download at a designated place.

The concept of time dilation also gives the science fiction writer a way of including space travel in stories. Basically, when a spaceship is traveling at the speed of light, time inside the spaceship is not passing as quickly. If a ship travels at 99.9 per cent of light speed, when a century passes on Earth, only 4 years pass on board. A roundtrip to the center of our galaxy could take about 40 years of shipboard time. This is a figure developed by a man named Frank Tipler for a ship that moves not at constant speed, but at constant acceleration. The problem is that much more time would have passed on Earth.

As discussed earlier in the section on time travel, wormholes can also allow for speedy space travel. Wormholes are so far purely conceptual and based on one interpretation of a set of equations, but the possibility of their presence does not seem to contradict any scientific knowledge that we currently have. According to Charles Sheffield, the trick would be to stabilize a wormhole and inflate it to a size big enough to fit humans.

When reading stories about space travel, the concept of hyperdrive is often used. Charles Sheffield says that hyperdrives "suppose that there are other space-times, loosely connected to ours, in which either the speed of light is far bigger than in our own universe, or the distances between points are far less. You move to one of these other spacetimes to do your traveling."

Stories to read that deal with space travel and relativity include "Rammer," by Larry Niven, "At the Core," by Larry Niven, and "Down and Out," by Larry Niven.

***"Rammer," by Larry Niven***

Although the basic issue in this story is space travel, an interesting secondary issue is that it involves a man who, when dying of cancer in the twentieth century, has his body frozen. When he is unfrozen 200 years later, he finds that he has no rights and is only being used as a tool by the ruling society. As a servant (or prisoner) of this government, he is sent on a mission that involves traveling to far away stars. He must figure out how to use the relativity equations to get beyond the reaches of those controlling him.

***"At the Core," by Larry Niven***

This is another story involving Beowulf Shaeffer and the puppeteers. Shaeffer is hired to pilot a ship to the core of the galaxy. The space travel is achieved using hyperdrive, which is an "easy way out" method that basically ignores the theory of relativity. Well crafted descriptive images fill this story.

***"Down and Out," by Larry Niven***

A companion story to "Rammer," this story uses information about time travel, black holes, and ship's time as background to an interesting tale of conflict between an human and a human like computer that is his only companion for a long journey into space.

**Quantum Mechanics**

Quantum mechanics attempts to explain the behavior of the smallest particles in our universe such as atoms, small molecules, and nuclear particles. Certain quantities in nature occur only in discrete intervals, or quanta. This fact led to a theory – quantum mechanics- that describes nature in terms of probabilities.<sup>5</sup> The theory, developed further by scientists like Heisenberg and Born, says that we cannot predict how certain events will turn out, only the chance that they will result in one of several outcomes.

What does quantum mechanics have to offer the writer of science fiction stories? Basically, quantum theory allows for the possibility of teleportation and of faster-than-light travel. I found Charles Sheffield's explanations in three different sources to be the best help for trying to understand quantum physics at a very, very basic level: *Borderlands of Science*; the chapter titled "Classical Nightmares...and Quantum Paradoxes" in *Dancing With Myself*; and his story, "Hidden Variables."

To find plausible ways to travel in spacetime, he encourages the writer to look for places where today's theories are incomplete or inconsistent. Quantum theory allows for the possibility of some sort of "quantum jumping," which could allow events in one place to affect events in another, unconstrained by the speed of light.

Sheffield describes a paper published in *Science* magazine in October 1998 titled "Unconditional Quantum Teleportation." The six authors of this paper feel that they have proven that quantum teleportation can occur. These scientists built on experiments done in the 70's that demonstrate that pairs of electrons can be "entangled" at the quantum level in such a way that something done to one immediately affects the other. Until the 1998 report, it was assumed that even though the particles could be entangled, this could not be used to send information. It now appears that we may be able to use the entangled particles to transfer or teleport information.

Stories to read that use quantum mechanics are "The Quantum Transporter," by Michael A. Burstein and "Hidden Variable," by Charles Sheffield.

***"The Quantum Transporter," by Michael A. Burstein***

The death of a researcher is being investigated in this story. The murder suspect may have used Teleportation to carry out his crime.

### *"Hidden Variable," by Charles Sheffield*

This story seeks to explain how the fundamental processes of quantum phenomena must be interpreted using probabilities. Some historic developments in quantum mechanics like the Heisenberg principle are presented also.

## **Teaching The Craft Of Fiction Writing**

After students become acquainted with a few scientific principles and read and discuss at least four science fiction stories, they will concentrate on writing their own stories. My instruction in this area will center around five elements of science fiction writing: defining the scientific problem that will be addressed in the story, creating well rounded characters with personality flaws and motives, establishing a setting or settings, integrating detail and description into the narrative, and defining the plot.

The task of defining the scientific problem will be tackled before the students begin their stories, but the other four elements will be addressed in mini lessons or exercises introduced after the students begin writing. Usually, seventh and eighth graders are very eager to begin, and forcing them to wait until they have studied techniques and craft often deflates their enthusiasm. So I encourage them to get started right away and the mini lessons I give each week can help them revise and change their stories as they work. Also, I find that few of my seventh and eighth graders can maintain focus on sustained writing for a full hour, and breaking up the class time with short, focused lessons, seems to work well.

### Defining The Story Idea And Developing The Scientific Problem

At the beginning of the course I will provide students with small writing journals or notebooks. I will encourage them to keep a list of possible story ideas as we discuss scientific principles and read science fiction stories written by others. Hopefully, when it is time for them to begin their own stories, they will know what they want to use as a story idea. If they haven't pinpointed a story idea by this time, I will have a list of possible scenarios for them to choose from.

Before asking students to explain in writing the scientific theory or problem of their story, I will talk to them a bit about how this problem doesn't have to be the plot of the story. The scientific theories and principles should only serve as the background to the events and human developments in the story. We will discuss the importance of not "lecturing" the readers about science and how to blend science ideas seamlessly into the story. I want to begin this part of the story planning by challenging the students to write a detailed explanation of the scientific theory or theories that will be crucial to their stories. This writing can help them understand the concepts and will also force them to consider how they will integrate the concepts into their stories. Part of this task can be to create a list of vocabulary terms that might be used in the story. Students can also list questions that still need to be answered before they can tackle the writing of the story.

### Developing Characters

Although it is the science and scientific problems that will classify the stories the students write as science fiction, characters are what will make or break the stories. Usually I find it helpful to insist that my students create main characters for their stories even before they decide on conflicts and plots. They need to understand that plot should have as its basis a problem or decision faced by the main character. Middle school students usually think of plot as some grand story line of action and battles. For this story project, they will have to combine an individual's problems or conflicts with a scientific issue to create the plot.

To help my students create fully developed characters, I have them fill out a 22 item "character profile." (see appendix) In this profile they are asked to consider physical character traits such as appearance, voice, and body type; as well as personality traits, level of intelligence, character strengths and weaknesses, family members, likes and dislikes, and enemies and friends. I explain to the students that many of the traits may never go into their stories, but they may affect the way the character acts. It is important for the students to think of their characters as complete and whole persons.

After filling out the character profile, students will write a "character scene" in which they use at least four of the following techniques to "show" the character to the reader: dialogue, action, body language and facial expression, interaction with other characters, thoughts and feelings, and one character talking about another. Before asking students to write a character scene, I encourage them to look at published stories that demonstrate the techniques. Following are definitions of the six techniques and excerpts from science fiction stories.

**DIALOGUE** – Allow your character to talk. Let the things he or she says reveal important aspects of personality.

*"Get me out of here," said Eckels. "It was never like this before. I was always sure I'd come through alive. I had good guides, good safaris, and safety. This time, I figured wrong. I've met my match and admit it. This is too much for me to get hold of."* - "Sound of Thunder," by Ray Bradbury

**ACTION** – Have your character do things. The way she/he acts will give the reader much information.

*"During those long months aboard Percival Lowell, it was Childrey who led us in calisthenics. He flatly would not let anyone skip an exercise period... Childrey was the only man who still appeared fully dressed in the heat of the alien base. In the mess Childrey would inspect his silverware for waters spots, then line it up perfectly parallel."* - "A Hole in Space," by Larry Niven

**BODY LANGUAGE** – Describe gestures, body carriage, physical quirks, and facial expressions.

*"I will do my best." Wenzinger reached again for his briefcase, a slight tremble in his thin hands. Greer walked back to the desk and sat down behind it. He leaned back in his chair. Wenzinger was surprised at the intelligence in the other's tanned face. Greer was nodding slowly, concentrating on every word."* – "Hidden Variable," by Charles Sheffield

**INTERACTION** – Show your character interacting with other characters.

*"Too dangerous to you." Wenzinger was perspiring again... "That's why I bought the gun."*

*"That you'll never use. It takes training to face death, you know..."*

*"I thought of a double killing, you, then myself. It was not good." Wenzinger's breath was fast and shallow. He seemed hypnotized by the moving sweet of his watch.*

*There was a long silence. When Wenzinger spoke at last his voice was so soft that Greer could hardly make out the words. "You make me over-simplify, then you are angry at the result. A real test..could confirm it..."*

*"You mean you could prove if Nissom's right or wrong...?" Greer had seized Wenzinger by the arm, straightening him up in his chair. – "Hidden Variable," Charles Sheffield.*

ONE CHARACTER TALKING ABOUT ANOTHER – Have one character from your story say things about another character.

*"I've only met the Secretary General four times...But his attention span is low. He'd forget about Los Angeles if we could distract him."* – "Bird in the Hand," by Larry Niven.

THOUGHTS AND FEELINGS – Take your reader into the mind of your character and tell what he/she is thinking or feeling.

*Corbell held lengthy conversations about it. "Can I possibly be that lonely?" he demanded of himself. "Or that bored? Or that desperate to hear another human voice again? Other than my own-" His voice echoed back from the Womb Room walls.* – "Down and Out," by Larry Niven

### Adding Detail And Description To The Narrative

Most middle school students need to be pushed and prodded continuously to add detail and description to their writing. Presenting "exercises" designed to encourage this can be helpful. One exercise involves teaching students to use specific techniques to create vivid images: focus details, sensory details, specific nouns, metaphors, similes, personification, and emotional texture.

After reviewing the definitions of these terms, students must read excerpts from published stories and identify the techniques used. Each student then writes a vivid image for his own story, using at least four different techniques.

FOCUS DETAIL – Focus the reader's attention on some small and minute detail.

SENSORY DETAIL – Describe sounds, smells, tastes, touches, or something visual. Students should be encouraged to include descriptions that appeal to senses other than sight.

SPECIFIC NOUNS - Use the most specific noun available to "paint a picture" in the reader's mind. For instance, daisy instead of flower or loafer instead of shoe.

METAPHOR – Compare two things that are not alike to aid in description.

SIMILE – Compare two things that are not alike using the words like or as.

PERSONIFICATION – Give human characteristics to something not living.

EMOTIONAL TEXTURE – Create a sense of emotional response with the description.

The following excerpts are excellent models for students to study:

*"The Core lay before me like a great jeweled sphere. I'd expected it to be a gradual thing, a thick mass of stars thinning out into the arms. There was nothing gradual about it. A clear ball of multicolored light five or six thousand light-years across nestled it the heart of the galaxy, sharply bounded by the last of the dust clouds...The red stars were the biggest and brightest. I could actually pick some of them out as individuals. The rest was a finger painting in fluorescent green and blue."* – "At The Core," by Larry Niven

*"At the next stop I needed grade two sunglasses. Somewhat later, grade three. Then four. The patch became a great bright amoeba reaching twisting tentacles of fusion fire deep into the vitals of the Core...Night came. The control room was a blaze of light. I slept in the relaxroom, to the tune of the laboring temperature control...The radiation meter snarled its death-song, louder during each rest break." – "At the Core"*

*"A puppeteer is unique. Imagine a headless, three-legged centaur wearing two Cecil the Seasick Sea Serpent puppets on its arms, and you'll have something like the right picture. But the arms are weaving necks, and the puppets are real heads, flat and brainless, with wide flexible lips. The brain is under a bony hump set between the bases of the necks. This puppeteer wore only its own coat of brown hair, with a mane that extended all the way up its spine to form a thick mate over the brain." – "Neutron Star," by Larry Niven*

*"It was dark when he reached the wall; pitch-dark, moonless, with stars hidden by a heavy overcast. He squatted down and felt carefully for his first marker, a sticky blob of resin dabbed on the smooth stone surface. He felt his way down from the resin patch to the groove at the base of the wall, then traced a line outward to the small pebble of his second marker. The darkness was complete." – "Hidden Variable," by Charles Sheffield*

*"The stellar rainbow had hardened and sharpened over seven decades. It had lost symmetry too. To one side the stars were thickly clustered; the arc of blue-whites blazed like diamonds in an empress' necklace." – "Down and Out," by Larry Niven*

Another exercise that can encourage the use of detail is directing students to use a fictitious "zoom lens." Challenge students to find places and things in their stories where more detail can be added. Ask them to imagine using a camera's zoom lens to examine something small in great detail. Students can use giant post it notes to stick onto their stories and add detail.

#### Peer Response Sessions And Teacher Conferences

As the students progress in the writing of their stories, I will organize peer response sessions and opportunities to conference with me. Students will be divided into groups of three or four for the peer response sessions. Because most of the seventh and eighth graders I teach are not highly skilled at giving productive feedback to each other, I find that structured response sessions work best. Therefore students will use specific questions when responding to each others' stories. (see appendix) I do make sure that all members of the response group have a copy of the story being discussed. Often I allow the author to decide whether student responses should be made orally in a discussion format or in writing. Surprisingly, many of the authors prefer responses to be in writing.

Before students can conference with me about their stories, they must fill out a "Teacher Conference Form." (see appendix) This form encourages the student to think about his own story and identify the weaknesses as well as the strong points.

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#### **Student Bibliography**

Books explaining the science:

Asimov, Isaac, *Guide to Earth and Space*. New York: Random House. 1991. ISBN 0-679-40437-6

Asimov titles each chapter of this book with a question such as "Will the Expansion of the Universe Continue Forever?" and "Is There Matter in the Universe We Can't See?" He then proceeds to answer each question in clear, understandable language.

----- . *How Did We Find Out About Black Holes?* New York: Walker and Company, 1978. ISBN 0-8027-6336-7

Although this children's book is fairly old, the explanation of the historical developments that led to discovering black holes are very well explained. It also clearly differentiates among white dwarfs, neutron stars, and black holes.

Berger, Melvin, *Quasars, Pulsars, and Black Holes In Space*. New York: G.P. Putnam's Sons, 1977. ISBN 0-399-20562-4

Though this book is over 20 years old, the information about Quasars, Pulsars and Black Holes is carefully explained on a 10 year old's level.

Bourne, Barbara, *Exploring Space*. New York, Morrow Junior Books, 1994. ISBN 0-688-13643-5

Cooper, Christopher, *Matter*. London: Dorling Kindersley, 1992. ISBN 0-7894-4886-6

A clear explanation of the structure of atom, with plenty of colorful illustrations, is offered in this book. There is also a section on the birth and death of matters.

Couper, Heather and Henbest, Nigel, *Big Bang*. London: Dorling Kindersley, 1997. ISBN 0-7894-1484-8

A pair of British astronomers wrote this book that features colorful illustrations and includes a timeline of the universe and topics such as the far future.

----- . *Black Holes*. London: Dorling Kindersley, 1996. ISBN 0-7894-0451-6

With wonderful illustrations, this colorful book explains everything about black holes from Einstein's theory of relativity to theories of worm holes and time travel.

----- . *Is Anybody Out There?* London: Dorling Kindersley, 1998. ISBN 0-7894-2798-2

----- . *Space Encyclopedia*. London: Dorling Kindersley, 1999. ISBN 0-7894-4708-8

This is a truly comprehensive book that every classroom should have. In the Dorling Kindersley style, it is lavishly illustrated. It covers over 130 topics including radio astronomy, space pioneers, the solar system, and the universe.

Dolan, Terrance, *Probing Deep Space*. New York: Chelsea House Publisher, 1993.

Gribbin, John and Mary, *Eyewitness Science and Time and Space*. London: Dorling Kindersley, 1994. ISBN 1-56458-478-x (Children's book)

Using beautiful color photographs and illustrations, this children's book explains Einstein's Theory of Relativity, black holes, worm holes, relationships of space and time, string theory, the theory of Schrodinger's Cat, and particle theory.

Krauss, Lawrence M. and Hawking, Stephen, *The Physics of Star Trek*.. Harperperennial Library, 1996. ISBN: 0060977108

Lampton, Christopher F., *Particle Physics*. Hillside, NY: Enslow Publishers, Inc., 1991. ISBN 0-89490-328-4

Rothman, Tony, *Instant Physics*. New York: Fawcett Columbine, 1995. ISBN 0-449-90697-3

In chapters like "Special Relativity: Einstein Sees the Light," "Quantum Mechanics: Physics Walks the Planck," and "General Relativity and Cosmology: Gravity's Big Draw," this books offers clearly stated explanations coupled with humor. Each chapter has a vocabulary list with definitions, thumbnail sketches of scientists, and a summary page.

Sheffield, Charles, "Classical Nightmares and Quantum Paradoxes," from *Dancing With Myself*. Baen Books, 1993, ISBN 0-671-72185-2

This chapter attempts to explain quantum mechanics by explaining the history of its development. The audience is the writer of science fiction.

Sheffield, Charles, *Borderlands of Science*. Riverdale, NY: Baen Publishing Enterprises, 1999. ISBN 0-671-57836-7

Written by an author of science fiction stories, this very accessible book is a must for teachers and students.

Sipiera, Paul P., *Black Holes*. New York: Children's Press, 1997. ISBN 0-516-20326-6

*Visual Dictionary of Physics*. London: Dorling Kindersley, 1995. ISBN 0-7894-023904

Resources About Writing:

Gardner, John, *The Art of Fiction, Notes on Craft For Young Writers*. New York: Vintage Books, 1983. ISBN 0-679-73403

Based on courses and seminars given by the author, this is a practical and instructive handbook.

Mayer, Eric and Reed, Mary, "Worlds of the Mind, How To Write Science Fiction," *Writing Magazine*, April 1993.

If you can find a copy of this magazine, your students will find it to be very helpful and full of examples from published science fiction.

Vivelo, Jacqueline, *Writing Fiction, A Handbook for Creative Writing*. Portland, Maine: J. Weston Walch, 1993. ISBN 0-8251-2308-9

This is an activity textbook with chapters such as "Plotting the Story," "Advancing Scene by Scene," and "Beginning and Ending."

Science Fiction Stories:

Bradbury, Ray, "Sound of Thunder," from *Best Short Stories, Middle Level*. Providence, RI: Jamestown Publishers, 1983. ISBN 0-89061-321-4

Burstein, Michael, "The Quantum Transporter."

Landis, Geoffrey, "Approaching Perimelasma," from *Best Science Fiction 1999*. Gardner Dozois, Editor.

Niven, Larry, "At the Core," from *Neutron Star*. Ballantine. ISBN: 0-345-33694-1

-----, "All the Myriad Ways," from *All The Myriad Ways*, Ballantine, 1971. ISBN: 0-345-27133-5-150

-----, "Bird in Hand," from *Flight of the Horse*. Ballantine, 1973. ISBN: 345-23487-1-125

-----, "Down and Out," from *Galaxy*.

-----, "For a Foggy Night," from *All the Myriad Ways*. Ballantine, 1971. ISBN: 0-345-27133-5-150

-----, "Neutron Star," from *Neutron Star*, Ballantine. ISBN: 0-345-33694-1

-----, "Rammer," from *A Hole in Space*. Ballantine. ISBN: 345-24011-1-125

-----, "The Hole Man," from *N-Space*, Tom Doherty Associates, 1990. ISBN: 0-812-51001-1.

Sheffield, Charles, "Hidden Variable," from *Hidden Variable*, Ace Books, 1981. ISBN: 0-441-32991-8

### **Teacher Bibliography:**

#### Books About Science:

Gutsch, William A, *1001 Things Everyone Should Know About the Universe*. New York: Doubleday, 1998. ISBN: 0-385-48223-x

This well indexed books gives concise definitions and explanations of many words and principals fundamental to the study of cosmology and astronomy.

Krauss, Lawrence M. and Hawking, Stephen, *The Physics of Star Trek*. Harperperennial Library, 1996. ISBN: 0060977108

Lightman, Alan, *Time For the Stars: Astronomy in the 1990s*. New York: Viking, 1992. ISBN: 0-670-83976-0

Osserman, Robert, *Poetry of the Universe: A Mathematical Exploration of the Cosmos*. New York: Anchor Books, 1995. ISBN: 0-385-47340-0

By explaining the history of man's coming to understand the universe, this Stanford University Mathematics professor explains difficult concepts to the lay reader.

Sheffield, Charles, *Borderlands of Science*. Riverdale, NY: Baen Publishing Enterprises, 1999. ISBN 0-671-57836-7

Written by an author of science fiction stories, this very accessible book is a must for any teacher interested in exploring the field. It would also be a good resource for students.

## Books About Writing:

Hollister, Bernard, *You and Science Fiction*. Lincolnwood, Illinois: National Textbook Company, 1989. ISBN 0-8442-5547-5

This is a book about science fiction that uses SF stories to view the human condition by offering stories and discussion questions in four categories: Who am I? How do I relate to others? What kind of society do I want to live in? What kind of world do I seek?

Lane, Barry, *After the End Teaching and Learning Creative Revision*. Portsmouth, New Hampshire: Heinemann, 1993. ISBN 0-435-08714-2

This book has become an essential text for many teachers of writing. It offers many fun and creative exercises aimed at encouraging students to revise.

Novakovich, Josip, *Fiction Writer's Workshop*. Cincinnati, Ohio: Story Press, 1995. ISBN 1-884910-39-4

Vivelo, Jacqueline, *Writing Fiction, A Handbook for Creative Writing*. Portland, Maine: J. Weston Walch, 1993. ISBN 0-8251-2308-9

## Videos

Mysteries of Deep Space: Exploding Stars and Black Holes, PBS Home video, 1997. ISBN: 0-7806-1826-2

Combining live-action sequences, state-of-the-art computer animation and spectacular high-resolution images from powerful new telescopes, this series provides viewers with a stunning new perspective on the universe. This episode examines violent events that shape the landscape of galaxies.

Mysteries of Deep Space: The Search For Alien Worlds. PBS Home video, 1997 ISBN: 0-7806-1827-0

This 60 minute video features the work of two men as they examine what they believe is a previously undiscovered solar system and identify planets that may even support life.

Mysteries of Deep Space: To The Edge of the Universe, PBS Home video, 1997. ISBN: 0-7806-1825-4

The Hubble Space Telescope and a group of young astronomers are featured in this video that peers deep into the cosmos to reveal the mysterious structure of the universe.

Stephen Hawking's Universe: Vol. 3, Cosmic Alchemy; Vol. 5, Black Holes and Beyond; Vol. 6, Answer to Everything. PBS Home video, 1997.

Stephen Hawking's Universe: Vol. 1, Seeing is Believing. PBS Home Video, 1997.

This one hour video presents Newton's picture of the universe, Einstein's theory of physics, and Edwin Hubble's invention of the telescope that allowed us to view the expansion of the universe.

The Astronomers: Vol. 1, Where is the Rest of the Universe? Vol. 2, Searching for Black Holes; Vol. 3, Window to Creation; Vol. 4 Waves of the Future.

**Internet Sites:**

Lucht, Thorven. Teaching Science Fiction: A Resource Page for Teachers and Students. [Online]  
Available: <http://www.uni-bielefeld.de/~tslucht/sf-whyteach.html>

This is a very comprehensive site maintained by a teacher in Germany that includes favorite titles, links to information on teaching, and other science fiction links.

Science Fiction & Fantasy Writers of American, Inc. [Online] Available: <http://www.sfgwa.org/>

Hints from published writers and information on contests and contest winners are just a few of the kinds of information available at this site.

Appendix A

**Science Fiction Story Planning Form**

**Student Name** \_\_\_\_\_

1. List the scientific theory, concept, or problem that will form the background of your story. (time travel, black holes, etc.) You may have more than one. Next to each concept, write a paragraph of at least five sentences that explains this phenomenon.

2. Explain how this scientific theory will affect your characters and the story's plot.

3. List at least 10 scientific vocabulary words that you hope to incorporate into the story.

4. What other questions do you need to answer before you can successfully write the story?

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## Appendix B

### Character Profile for Science Fiction Stories

*Many of these traits may never go into your story, but they may affect the way your character acts!*

1. Character's name:

2. Character's nickname:

3. Sex:

4. Age:

5. Describe your character's physical appearance and body type:

6. What planet or galaxy is this character from? Where is this located?

7. Describe your character's voice or method of communicating.

8. Mention any special characteristics, quirks, or physical traits that would make your character memorable:

9. How intelligent is this character? Mention whether or not the character has common sense, special talents or abilities.

10. What is the character's general attitude toward life? (Carefree? Happy? Worried? Rebellious? Etc.)

11. Name and briefly describe friends and acquaintances of your character.

12. Name your character's worst enemy and explain who this is.

13. Most important possessions:

14. Hobbies:

15. Obsessions:
16. Religion/Spiritual Beliefs
17. Fears:
18. What is the character's goal or ambition?
19. Character flaws/Personal weaknesses:
20. Character strengths:
21. Tastes in books/movies/entertainment/food, etc.
22. Mention at least one major event in the character's life.

#### Appendix C

##### **Reminders for Dialogue**

- Dialogue should develop character.
- Dialogue should imitate real speech. Don't consistently use whole, formal sentences. Imitate verbal tics. Remember, one character may not entirely hear what the other is saying because he is thinking up a reply while the other is speaking. Consequently, real dialogue is not always logical or sequential.
- Show don't tell. Let the dialogue, the actual words the character says, reveal the actions or emotions instead of using, "he said alarmingly, angrily, noisily," etc.
- Don't over use dialogue descriptors such as, "he announced," "she chided," etc. Some variety is good, but the simple use of "said" also works.
- The dialogue should address other characters, not the reader. Don't let the dialogue tell the reader things other characters already know. Don't let the dialogue lecture the reader.
- Don't use too many buffers (he said, she observed, etc.) If only two people are speaking, you don't have to use a buffer each time.

#### Appendix D

##### **PEER RESPONSE (HELPFUL LISTENING) FOR SCIENCE FICTION**

###### *Rules for the Listener*

1. The listener(s) should make sure that all aspects of his/her remarks and body language are designed to show respect for the author's work.
2. The responses of the listener(s) should avoid all evaluative words like, good, interesting,

confusing, or dull.

### **RULES FOR THE AUTHOR**

1. The author should read his/her draft aloud to the listener(s).
2. Read exactly what is on the paper, nothing more, nothing less.
3. Never explain to the listener(s) what you mean by what you wrote during the initial reading.

### **LISTENER(S) ANSWER THE FOLLOWING QUESTIONS**

1. Who are the main characters?
2. How would you describe the personality traits of the main character or characters?
3. Are the characters described well and are their motives clear?
4. Where is this story taking place?
5. Do more details need to be added so that the reader can "picture" the place? Where should they be added?
6. What was the strongest image formed while reading/listening to the story? *This image should be a result of THE AUTHOR'S DESCRIPTIVE WRITING, NOT THE LISTENER'S IMAGINATION.*
7. What is the science fiction problem used in this story?
8. Can the reader understand the science being used in this story? If not, what is difficult to understand?
9. What are the strongest phrases, sentences and sections of the story? Why?
10. Would it be helpful to hear more details about any particular part of the story? If so, which part?
11. What is the problem or conflict in this story?
12. Are you wondering why a certain part of the story is included? If so, what makes that part seem as if it doesn't "fit" in the story?
13. Was there any part of the story you could not follow? If so, what would help you follow that part better?

### Appendix E

#### **Standards Addressed**

The Pittsburgh Board of Education has adopted Core Curriculum Frameworks to help the district meet the National Education Standards proposed by the Department of Education. Within these core areas are 62 content standards of academic knowledge and skill that students will have to demonstrate to earn a high school diploma in Pennsylvania. This unit addresses the following standards in the areas of Communications and Science and Technology:

## Communications:

All students use effective research and information management skills, including locating primary and secondary sources of information with traditional and emerging library technologies. (Students will be using books, magazine articles, the internet and videos to research current scientific theories in order to understand the science fiction stories they read and to write their own.)

2. All students read and use a variety of methods to make sense of various kinds of complex texts. (Both the scientific information and the science fiction stories the students will read in this curriculum are complex texts.)

All students respond orally and in writing to information and ideas gained by reading narrative and informational texts and use the information and ideas to make decisions and solve problems. (Students will orally discuss the scientific theories they learn about. Students will explain in writing the scientific problems they hope to present in their stories.)

All students write for a variety of purposes, including to narrate, inform, and persuade, in all subject areas. (In this unit students will be writing to inform and writing to entertain.)

All students exchange information orally, including understanding and giving spoken instructions, asking and answering questions appropriately, and promoting effective group communication. (Oral discussions of fictional stories and of scientific information are an important component of this unit.)

## Science And Technology

All students explain how scientific principles of chemical, physical and biological phenomena have developed and relate them to real-world situations. (After watching videos and completing book research, students will explain how certain principles of physics may affect the future world.)

All students demonstrate knowledge of basic concepts and principles of physical, chemical, biological and earth sciences. (An understanding of the scientific theories that relate to black holes, time travel, quantum mechanics, and space travel will be demonstrated in the stories the students write.)

All students explain the relationships among science, technology, and society. (Technology is a factor in all of the science fiction stories used in this unit as well as in the scientific theories presented. The issue of how these technological developments will affect society is also a theme in many of the stories.)

9. All students demonstrate basic computer literacy, including word processing, software applications, and the ability to access the global infrastructure, using current technology. (The internet will be used for student research in this curriculum project.)