Genes: The Write Stuff:
Integrating Genetics and the Eighth Grade Writing Curriculum

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Introduction

It is the year 2001, only one year into the new millennium, but already the signs are everywhere. From genetically engineered tomatoes to cloned sheep, from saliva swabs that are veritable genetic gossips to the inconceivably complex task of mapping the Human Genome, the evidence is ubiquitous: the Genetic Revolution is here. It is a time of amazing possibilities, of revolutionary new medicines; of enhanced human intelligence and beauty and strength. It is also a time of uncertainty: will the future usher in a race of made-to-order-humans? Is it ethical to create new animals to use as medicine factories or organ donors for humans? Will genetic engineering be misused in the hands of the politically or economically powerful?

This is most certainly a time of contrasts; as quickly as a cure for cancer surfaces, personal privacy vanishes. As soon as geneticists prove that humans are almost genetically identical, the eugenics movement attempts to rise from the ashes of the past. When Charles Dickens wrote of revolutionary France, "It was the best of times, it was the worst of times," he could have been referring to the present day, glorious and dangerous at once.

Along with the changes a revolution promises come the responsibilities everyone must shoulder in order to sustain the new order. By appealing to eighth graders' innate desire for empowerment, I hope to place the yoke of responsibility squarely on their shoulders. My plan is simple. I will teach them the language and history of genetics through a variety of activities, readings, web sites and discussions. They will then use this new bank of information to craft a series of writing pieces using descriptive, narrative, expository, and persuasive techniques. These topics might include, "How would you explain cell biology to your seven year old sister?" Or, "Write a narrative about Memo, the mutant fruit fly, who is nervous about his first face-to-face meeting with Red-Eyed Rosa, his Internet dream date," "What are some of the pros and cons of cloning?" Or "Should a child be able to sue his parents for passing on a defective gene when the technology was present for correcting the flaw?" Students will be expected to use the language of genetics in their varied responses. Essential writing skills, from webbing and brainstorming to peer editing and revising, will be reviewed, modeled and practiced.

This Genetic Revolution presents society and individuals with choices and decisions they have not had to consider before, therefore it is imperative that we immerse our students in the revolutionary wave by teaching them its history and its language, and how to navigate its treacherous ethical issues with the confidence of the well informed and the grace of the articulate.

Setting

I teach eighth grade Language Arts and Literature at Ernie Pyle Middle School, in Albuquerque's South Valley. Most of our 1100 students are Hispanic, live at or near the poverty level, and require remedial interventions in reading and writing. Each grade level, sixth through eighth, is divided into two teams to enable teachers to more closely monitor each student's progress. Since most of our students read at a level significantly lower than their grade level, improving literacy is a school wide crusade. Students attend four seventy- four minute blocks each day, alternating subject days, except for Language Arts and Literature, which are daily requirements for every student.

Most of my students express their need for empowerment, whether it lies in being able to choose the nights they will or will not have homework, or in cajoling me into listening to their concerns about how principals/parents/teachers/friends treat them like punks/babies/idiots/backstabbers. I want to take advantage of their need to find more control in their personal lives by showing them that knowledge is empowerment, that the Genetics Revolution is real, and it will charge ahead, with or without them.

Goals and Objectives

The goals for this unit are to increase science literacy by teaching students the history and the language of genetic; and to analyze and write persuasive, expository, descriptive, and narrative pieces within the context of genetics. The overall objective is to empower students to make well-informed choices in their travels through the Genetics Revolution.

Background Information

This unit is intended for use in an eighth grade Language Arts class. The background information on heredity, genetics, and ethical issues surrounding genetics is meant to provide students with a very basic understanding of some of the terms, processes and issues they will encounter in their journeys through the Genetics Revolution. It will also provide students a context from which they will shape their writing responses.

In the Beginning

People in ancient times understood some of the basic laws of heredity, or the way traits are passed from parents to their offspring. By about 5000 B.C., people in various parts of the world used their knowledge of domesticated animals and plants to practice selective breeding. Herders would control their animals' mating habits, allowing only the superior specimens to reproduce. Farmers observed which seeds produced heartier crops and then limited their planting to those seeds. While early people undoubtedly made the connection between inherited traits in plants and animals and those in humans, it was not until much later that the Greeks developed the first theories of heredity.

Early Theories of Heredity: Why Do Children Resemble Their Parents?

Many ancient Greek philosophers had what are called particulate theories about heredity. They believed that certain particles from the parents' bodies somehow got mixed up together and formed a whole new person. Hippocrates recognized that the male's semen carried the father's contribution to a child's heredity. He assumed that women contributed a similar fluid that was produced throughout the body and then was collected in the reproductive organs. Known as "pangenesis," this theory says that each part of the body reproduces itself. In other words, the fluid from the fingers had the material to make more fingers, that from the arm, to make more arms, etc. At conception, male and female fluids competed with other to determine whose arm or fingertips the child would inherit.

Aristotle, who lived from 384 to 322 B.C., believed that all inheritance came from the father in the form of particles of blood that were passed down through semen, which he believed to be made of the thickest parts of human blood. According to Aristotle, the male semen determined the baby's form, while the mother's contribution was to provide the simple material from which the baby was formed. Because this theory implied that all babies would then be male, Aristotle, who suggested that female offspring occurred as a result of "interference from the mother's blood," amended it (Gonick 15).

These particulate theories, though long standing, did nothing to explain why some children bore no noticeable similarities to either parent. Empedocles, who lived in the fifth century B.C., explained this phenomenon by suggesting that women who stared at Greek statues during their pregnancies, might produce children who resembled the statues instead of their biological parents.

The preformation theory was another early attempt to explain heredity. It states that a human being starts out fully developed in miniature form inside the sperm or the egg. In the seventeenth century, Anton Van Leeuwenhoek, a Dutch scientist, discovered the existence of sperm cells through the use of the microscope. He believed that each of the tiny, worm-like cells contained a complete, pre-formed organism. During the same century, British doctor, William Harvey, convinced himself through his studies of chick embryos that all animals must come from eggs; "ex ovo omnia," or "out of egg, all," was his assertion (Gonick 27). He contended that the egg was a self-contained unit capable of developing without any outside influences, that is, without male input. As late as the eighteenth century, theorists believed that an entire, miniature person could be found inside each of a woman’s egg cells.

One theory that originated with the Greeks, but was not finally laid to rest until the mid nineteenth century, was the idea of spontaneous generation. This theory stated that living organisms could automatically come alive by springing out of non-living matter. Maggots supposedly sprang from decaying meat, horsehair turned into worms, and pond creatures were nothing more than slime that had spontaneously generated into life forms. A seventeenth century recipe for spontaneously producing mice called for "placing sweaty underwear and husks of wheat in an open-mouthed jar, then waiting for about twenty one days, during which time it was alleged that the sweat from the underwear would penetrate the husks of wheat, changing them into mice" (Levine). Belief in spontaneous generation persisted for centuries, even after the introduction of the microscope, which seemed to confirm the idea of whole new worlds of organisms simply springing into life. It was not until the French Academy of Sciences hosted a competition in 1859 for the best experiment to either prove or disprove the theory that spontaneous generation was finally refuted by the young French chemist, Louis Pasteur, who successfully demonstrated that microorganisms are everywhere, even in the air.

Another popular theory of heredity during the nineteenth century was known as the "inheritance of acquired characteristics." As set forth by Jean Baptiste de Lamarck, this theory suggested that organisms evolve by responding to changes in their natural environment. The change the organism makes in order to adjust to the new environment becomes a trait that can be directly passed on to the next generation. In other words, a change made by a plant or animal during its lifetime can be inherited by its offspring. Lamarck explained how the ancestors of the modern giraffe would have strained their necks to reach leaves of the tall trees of the African savannahs. As a result of that straining and stretching, their necks would have grown longer, and an elongated neck would have been passed on to succeeding generations. By the turn of the century, the Lamarckian Inheritance Theory had been discredited. (10) It was the destiny of an obscure monk in Austria, Gregor Mendel, to once and for all lay down the laws of heredity that had eluded so many for so long.

The Father of Modern Genetics

Working in a monastery garden, Mendel conducted careful experiments on pea plants, hoping to discover the way in which traits are passed from one generation to the next. After years of observation he concluded that certain deciding "factors" ("…among the names used in the first years of this century were factor, gemmule, plastidule, pangene, biophor, id, and idant. But it was ‘gene’ that stuck." (Ridley 43)) determine whether a plant’s offspring will be tall or short, smooth or wrinkled, or white or purple. He also found that offspring receive two copies of each "factor," one from each parent, and that the stronger one, the dominant factor, showed up in the offspring. A summary of Mendel’s findings include:

- Physical characteristics correspond to "factors" (genes)
- Factors come in pairs
- Only one half of each pair is passed on to the next generation
- It is equally probable that one or the other "factor" will be passed on
- Some "factors" are dominant, and others are recessive (Tagliaferro 23).

Mendel had discovered that characteristics do not blend. His research dispelled beliefs of blood and other fluids mixing in the so-called blending theory of inheritance, and finally explained how traits are passed on from one generation to succeeding ones.

Several differences separated Mendel’s efforts from those of previous theorists. First of all, he limited his experiments to just seven traits of pea plants that existed in two forms and were therefore easy to distinguish. A second difference was that instead of limiting his studies to just a few examples, he studied almost 30,000 plants over eight years, following some for several generations. The third major difference was that he counted exact numbers of each trait, using mathematics to establish the rules about how traits are inherited. In the 1930s, an analysis of Mendel’s results showed that statistically they were too good to be true. While the numbers he reported from his experiments were improbably exact, many other scientists have confirmed his rules of inheritance. A possible explanation for the too perfect numbers is that Mendel simply chose to ignore results of any crosses that deviated markedly from the expected 3: 1 ratio.

Unfortunately, Mendel was not credited with his enormous discovery during his lifetime. It was not until 1900 that three scientists, working independently of one another, published near identical papers about their theories of heredity, each one mirroring, almost exactly, Mendel's findings. Eventually, they all credited Mendel for the initial findings, and the world now refers to those findings as the Mendelian Laws of Inheritance. Not long after this rediscovery, Mendel's laws were used to interpret patterns of human inheritance. While Mendel was not concerned about what his inherited particles were made of or where they might be found, other scientists wanted to know.

Cell Biology

Note to reader: This is a perfect spot for a punch-out manipulative, a specially designed map for the rather treacherously technical road ahead. Ideally, this map would include a simple diagram of the basic structure of a cell, with these parts labeled: cell wall, cell membrane, nucleus, and chromosomes. The chromosome would open up to reveal genes, which in turn would open up to reveal DNA. All terms would be identified clearly, and each one used in a complete sentence. The following timeline would appear at the bottom of the map:

- 1665- Hooke observes tiny, rectangular divisions of a cork through his microscope, and names them **cells** after the monastic rooms they resembled.
- 1831-Brown names the small, dark structure located inside each cell a **nucleus**, Latin for "little nut."
- 1835-Scheiden and Schwann determine that **the cell is the basic unit of all life**.
- 1879-Fleming identifies **chromosomes** in the nucleus, from the Greek word "chroma," or color (Brooks 43).

The human body is composed of many trillions of cells. Each cell has its own identity and function; heart cells cluster together to form a heart and skin cells attach to each other to form skin. Within each cell is a cell nucleus. Inside each nucleus are the forty-six chromosomes a person inherits from her parents, twenty-three from the sperm, and twenty-three from the egg. In each of the chromosomes is a molecule called deoxyribonucleic acid, or DNA. With its specific genetic code, the DNA molecule appears as a long chain of four distinct building blocks, or nucleotides: A for adenine, T for thymine, C for cytosine, and G for guanine. These letters form about 30,000 to 50,000 genes, each one containing instructions for proteins, the major molecules that make up cells and tissues.

Now that a basic vocabulary has been introduced, a very basic discussion of genetics can begin.

From Fruit Flies to the Human Genome Project

In the early twentieth century, a series of discoveries ultimately brought the world to the most significant scientific breakthrough of the late twentieth and early twenty first centuries: the mapping of the Human Genome. The project was immense, the ramifications unfathomably diverse. That this hugely sophisticated project had its origins in something as relatively humble as a fruit fly is hard to comprehend.

In the early 1900s, an American geneticist, Thomas Hunt Morgan, took the initial step in mapping the human gene. He chose fruit flies for his experiments because they have only eight chromosomes, are tiny and can fit easily into a lab setting, multiply rapidly, and do not require much food. Morgan and his staff made some remarkable discoveries. One day Morgan noticed a white-eyed, male fruit fly. Since red is the normal eye color for fruit flies, he knew this white-eyed male was a mutant, an organism that shows a spontaneous change in an inherited characteristic. Ten days after Morgan placed the mutant fly into a bottle with a red-eyed female, 1240 new flies were hatched. All had red eyes, a clear demonstration of dominance. When these flies reproduced, the next generation demonstrated the classic Mendelian inheritance pattern of 3:1, with three fourths of the offspring having red eyes, and one fourth having white. Amazingly, all the white-eyed flies were male. Morgan concluded that the gene for eye color must be linked to the gene that determined sex, and therefore, that the sex gene and the eye color genes linked to it must both be on the same X chromosome.

Morgan had discovered mutations, a significant event for understanding how traits are passed from generation to generation, and sex-linked traits, how some traits are carried by or passed to only one sex or the other. He concluded as well that genes are found in rows inside the chromosomes, in a specific order. Because some genes tend to be inherited together, they are probably located on the same chromosome. The closer together they are, the more often they will be inherited together. By counting the numbers of combinations in different generations, geneticists could create a map of the approximate locations of various genes.

Picking up an earlier theory that proteins must be the chemicals of inheritance, Phoebus Levine studied the composition of nucleic acid. He discovered that DNA is a chain of nucleotides: adenine, thymine, cytosine, and guanine, the four building blocks of the DNA molecule. He suggested that these four nucleotides were repeated over and over again in a specific order, and this simple DNA was, after all, the elusive heredity agent sought by so many for so long. In 1944, Oswald Avery showed that bacteria, specifically the bacteria that caused pneumonia, contains nucleic acid, and that the chemical that carries genes is DNA. For a more comprehensive study of DNA, see *Improving Nature*?.

It was not long after these findings were recounted that James Watson and Francis Crick "found the secret of life," (Yount 47) by discovering the structure of DNA, the chemical carrier of inherited information. They concluded that DNA has a double-helix shape, much like a twisted rope ladder or a spiral staircase. The rails on the staircase are made of sugar and a phosphate that alternate in a repeat pattern. The steps on the staircase are made up of base pairs, either A combined with T, or C combined with G. This mini alphabet spells out messages for the cell. Different letter combinations spell out codes that tell the cell which specific proteins it should make. Proteins not only control a great deal of what happens in a living organism, but also determine many of the traits of living things. The DNA molecule passes heredity information by instructing the cell to make specific proteins that will influence the growth, development, and appearance of the organism of which it is a part.

Their detailed outlining of the structure of DNA was an enormous step toward understanding life at its most basic level. Because of Watson and Crick’s crucial discovery, scientists could begin to study the mixing and matching of genes, and to understand more clearly the nature of health and disease. The implications of this discovery are unfolding day by day.

The natural progression of these events led to the realization of one of humanity’s most ambitious undertakings: the mapping of the human genome. A genome is the totality of the entire DNA in an organism, including its genes. The proteins required by all organisms are made by the information carried by genes. These proteins determine what the organism looks like, how well its body can fight infection, and perhaps even how well it behaves, among many other things. In 1990 the Department of Energy and the National Institutes of Health undertook the U.S. Human Genome Project. A website sponsored by the DOE lists the following project goals:

- Identify all of the approximately 30,000 genes in human DNA

- Determine the sequences of the three billion chemical bases that make up human DNA
- Store this information in databases
- Develop faster, more efficient sequencing technologies
- Develop tools for data analysis
- Address the ethical, legal, and social issues (ELSI) that may arise from the project

Results of the first phase of the project, published in February 2001, showed that the Human Genome Project has identified nearly all of the 31,000 estimated genes in the nucleus of a human cell. In addition, geneticists had mapped the location of these genes on the twenty-three pairs of chromosomes. Practical applications of the wealth of information generated by this endeavor are limitless. As Matt Ridley claims in the foreword to *Genome*, genetic knowledge is a blessing because it allows us:

> ….to understand the molecular nature of cancer for the first time, to diagnose and prevent Alzheimer's disease, to discover the secrets of human history, to reconstruct the organisms that populated pre-Cambrian seas.

Of course, he adds that genetics also brings the threat of new dangers. For instance, who will have access to information about one's DNA? If a person takes a test and discovers he carries a gene for a disease, will that affect his job opportunities? Will employers deny a job to someone who is genetically "flawed?" If a couple discovers that their fetus carries a gene for a terrible disease, should they choose to abort the fetus? If not, will their insurance carrier refuse to pay for the child's treatment?

These kinds of concerns are what encouraged the Department of Energy and the National Institutes of Health to earmark 3 to 5% of their project budget for the study of ethical, legal, and social issues involving the availability of genetic information. Their ELSI program represents the world's largest bioethics program with hundreds of available resources.

Bioethics in the Classroom

Classrooms of the 21st Century, an Access Excellence web site, offers a unit on using bioethics in the classroom. It is the work of a bioethicist to study ethical decision-making in the context of biological information and technology, dealing with issues such as cloning, the use of fetal tissue, and the privacy and confidentiality of genetic information. The authors contend that students need to understand the difference between fact, opinion, and values, then to recognize the role of subjective interpretation in considering bioethical questions. These kinds of discussions are not so much about asking students to make up their minds on an issue as they are about exploring other points of view and perspectives. In addition to creating interest and establishing relevancy of science content, bioethics engages students' critical thinking and problem solving skills. The authors' rationale for integrating this unit into the classroom supports the idea that once students are "hooked" on an emotional level, they are more likely to be motivated to discover facts, to better understand a problem, and then to propose solutions to those problems.

Suggested Steps to Facilitate Classroom Discussion

In addition to suggesting the following steps for conducting discussions of bioethical issues in the classroom, the web site includes a printable worksheet version of this information:

- What is the issue? Who must make the decision? What facts are relevant?
- Who are the stakeholders? What are their values and immediate priorities?
- Are there alternate courses of action? How would each stakeholder be affected by these alternatives?
- What solution do you propose? What compromises, if any, will stakeholders have to make?

Your Genes, Your Choices

Science + Literacy for Health, a project of the American Association for the Advancement of Science, has produced an on-line book by Catherine Baker, *Your Genes, Your Choices*, that makes the science behind ethical issues accessible to the non-scientist. It stresses the idea that science impacts everyone's lives, and that it is each person's responsibility to become informed about the issues, especially those at the heart of the Human Genome Project.

Each of the eight, downloadable chapters presents a brief scenario that rapidly raises a conflict, and then elicits the reader's help in resolving the situation. The author informs the reader's choice by proceeding with a detailed, user-friendly discussion of the science involved in the problem at hand. There is an interactive feel to the discussions; technical terms are highlighted and defined in the accompanying glossary: the reader is engaged, time and again, with questions that require reflection and responses; and the vignettes deal with real life situations that are of interest to students. Most teachers will find that this book is tailor made for bioethical discussions in the classroom.

Highlights of the book include chapters on albinism and heredity, disease and genetic testing, genes and behavior and genetic discrimination, reproduction and fetal testing, fingerprinting and issues of privacy, farming and genetic engineering, gene therapy and eugenics, and the pros and cons of cloning. Each chapter builds on information presented in the previous one, and questions at the end of each chapter lead into information presented in the succeeding one.

Implementation

I will incorporate this six -week long unit into my non-fiction literature segment. Skills will focus on reading strategies for comprehending science articles (emphasizing clarification of technical vocabulary; reading charts, graphs and timelines; summarizing difficult passages; making note of titles, sub-headings and footnotes; taking notes in reading journals), and writing in response to the articles, using narrative and persuasive essay formats, as well as informal and creative responses. Students will access the Learning Centre, an interactive web site that presents the basics of genetics in a user-friendly format, and additional web sites that feature a timeline of the highlights of the history of heredity, and offer additional clarification of genetic terms.

I will also present a sub-section on Bioethics in the Classroom. It is designed to guide students through the intricacies of bioethical discussions. We will use selected chapters from the book, *Your Genes, Your Choices*, as a basis for our discussions and most of our writing. Students will watch the film, *Gattaca*, and use a study guide to answer questions about genetic discrimination. Finally, students will read the short story, "Super Toys Last All Summer Long," by Brian Aldiss, the story that inspired Spielberg's film, *AI:Artificial Intelligence*, and discuss the possibilities of technological advances.

Assessment

Assessment will be on-going and will be based on day to day observation, and project work which will include the maintenance of a reading journal, and a writing portfolio. The reading journal will contain detailed notes from web sites, artwork, informal journal entries, questions about the material, ideas for writing projects, and any other informal response the student might have to the material. The writing portfolio will contain handouts on structure of persuasive and expository writing, outlines, webbing and other prewriting notes, rough drafts, peer edits, and final copies of assignments. Students will keep track of each step of the writing process for each assignment. Students will submit their best work for final evaluation.

Assessment objectives are to improve the focus of my teaching, to motivate students by focusing on their strengths to improve their weaknesses, and to refine elements of the unit. Through assessment I hope to discover what my students already know, what processes they use to complete their work; and how motivated they are by different aspects of the work.

Classroom Activities

Week One: Introduction and Overview of the Unit

Objective: Students will use media and literature to develop an understanding of people, societies and the self**. Materials:** butcher paper, markers, CD-ROM from Human Genome Project Education Kit, reading journals, writing portfolios.

The teacher will begin the unit by explaining the goals and objectives: to increase students' science literacy by learning the language and the history of genetics, and to practice writing techniques by writing about what they learn about genetics. She will then divide the class into three or four groups. Each group will elect a scribe to record the group's responses to the following questions: What is heredity? If you and your parents were in a crowded room, but not side by side, would a stranger be able to identify the three of you as family? Why or why not? What do you know about genetics? It is alright to guess. Groups will discuss questions and decide upon collective answers. Each group will formulate four or five questions about heredity or genetics. When all groups are ready, the class will share responses. The teacher will divide the butcher paper into two columns: "What We Already Know," and "What We Want to Know." As the class shares group responses, the teacher will add them to the chart. Students will copy the class set of questions in their reading journals and attempt to answer as many as possible during the upcoming CD-ROM activity:

"Timeline," from the Human Genome Education Kit, available at http://www.nhgri.nih.gov/educationkit/index_cont.html

The Timeline activity highlights more than ninety key events in the history of genetics occurring over nearly 150 years. A short, illustrated story describes each event. Students will be directed to take notes on several of the early theories of heredity, Mendel and his pea plants, Morgan and his fruit flies, Watson and Crick, and the mapping of the human genome. The teacher will model note taking prior to the activity.

Students will begin each day with a warm-up, writing a brief response to a pre-selected journal topic in the reading journal. Some ideas are: "If you could redesign yourself, what would you keep, and what would you change?" "Do you think it's a good idea to test unborn babies for disease? Why or why not?" "Create a brief conversation between protein molecules that have different folding patterns." "Do you think companies should be able to sell genes that would increase intelligence, or beauty?"

For the remainder of the week students will rotate between two activities (I usually have between sixteen and twenty students per block. This low teacher to pupil ratio is ideal for constructing learning stations. Students have a variety of activities during one block, and have a chance to move around and interact on different levels). Station one will be a computer projection of the Talking Glossary of Genetic Terms from the HGP CD-ROM. It presents written descriptions, spellings, illustrations, and audio of scientists defining scientific terms. Students will copy ten terms and definitions into the reading journal. Their homework will be to complete handout #1- a diagram of a cell, and to label parts using the vocabulary words.

Station two will elicit writing samples from the students to use as a baseline for the portfolio. The amount of progress a student makes in terms of his baseline will help determine his "grade" for the unit. The assignment is to write a five- paragraph essay using three pieces of evidence to support an opinion. The introduction should state the writer's opinion, and the conclusion should provide a logical ending.

Students will alternate work stations until all have recorded twenty five vocabulary works and have completed the baseline essay.

Weeks Two and Three: Understanding Genetics

Objectives: Students will apply strategies and skills to comprehend information that is read, heard, and viewed. Students will research and organize information to achieve purpose, using notes and memory aides to structure information. **Materials**: reading journal, writing portfolio, *Understanding Genetics* web site, http://www.genecrc.org/site/lc/lc1a.htm.

The Learning Centre's web site has an interactive study of genetics that is appropriate for middle school students. As we progress through the unit, students will click on technical terms for a definition (reinforcing previous work), and draw diagrams that help to illustrate points from the discussion. Highlighted or boxed information will be drawn in reading journals and labeled appropriately. For instance, in chapter one students will copy a drawing of a cell and a box that says, "Genes + Environment = YOU!" From chapter two they will copy the drawing of the snail, and include the caption information and the baby diagram with the sperm and the egg and the number of chromosomes each contributes. Once again, the teacher will model note-taking skills from each section. Students know they may use their notes for writing assignments and pop quizzes, and that all drawings earn extra credit for neatness, completeness, and color!

(Note: An alternative web site, http://library.thinkquest.org/28599 may be used to support the more technical aspects of the primary site.)

Writing Assignments

Objectives: Students will analyze and write an effective autobiographical incident essay. Students will analyze and write an effective comparison-contrast essay. **Materials:** *Language Network* by McDougal Littell (textbook), and assorted resources (transparencies and handouts of basic format, and standards for writing)

In addition to writing the daily journal warm-ups, students will complete two essays. The first is an autobiographical incident: "Describe a happy event you shared with your family." I chose this as our first formal writing assignment since family is the essence of heredity, and since most eighth graders feel comfortable writing about their families (most Language Arts textbooks have excellent chapters on all forms of writing, and I do not intend to outline procedures most teachers know intimately. I will provide only a brief overview of the procedures I use for each format).

I prefer to prepare graphic organizers that explain each section of the assignment. I will begin with a definition of autobiographical incident as a first-hand account of a special moment. My diagram will show three boxes labeled beginning, middle, and end. Within the boxes will be the specific details that each section should cover. I will give students a handout of this diagram along with a list of the standards for writing such as 1) Grab the reader's attention at the beginning, and 2) include precise language and specific details. My next step will be to read several examples of autobiographical incidents, modeling how writers met the standards for writing discussed earlier. I will review elements of the writing process and assign each student a peer reader. Students will review their copies of editing symbols, and they will begin their first draft.

The comparison-contrast essay topic is "Compare and contrast two early theories of heredity." I will follow the same process as the one outlined earlier: present a graphic organizer that details the structure of the assignment and standards for writing (a Venn diagram showing the overlapping areas and separate sections will be useful), model several examples that meet the writing standards, review elements of the writing process; assign peer readers, and let students proceed with their drafts.

By alternating activities between the Learning Center web site and the writing assignments, I hope to maintain students' energy levels.

Weeks Four and Five: Bioethics in the Classroom

Objectives: Students will analyze a piece of media by showing how it reflects and shapes cultures, values, beliefs, and attitudes. Students will analyze and evaluate themes and central ideas in literary and other texts in relation to personal and societal issues. **Materials**: Bioethics in the Classroom worksheet, copies of *Your Genes, Your Choices,* HGP CD-ROM, *Secrets of Our Lives* video documentary

I will begin this section by showing the video documentary "The Secrets of Our Lives," which traces the development of the Human Genome Project, and addresses its scientific and societal impact. To further enhance student interest in ethical issues surrounding genomics, we will watch the segment of the HGP CD-ROM entitled "Ethical, Legal, and Social Issues." Students will take notes on key themes introduced in this section, and several of the seven case studies will be examined. Students will be encouraged to note questions for later discussion.

We will proceed to http://www.accessexcellence.org/21st/TE/BE/ for an on-line introduction to using bioethics in the classroom. After defining terms such as ethics, bioethicist, values, facts, opinions, and stakeholders, students should be ready to review problems to consider before engaging in bioethical decision-making. Copies of the "Bioethical Analysis Worksheet" will be distributed for use with the case scenarios in *Your Genes, Your Choices* series, available at: http://www.ornl.gov/hgmis/publicat/genechoice/contents.html

Each of the eight chapters is a self-contained lesson on an ethical issue and the science behind it. I will choose as many chapters as time allows, and I will approach each one in the following manner: ask students what they already know about the issue at the heart of the situation (albinism, fingerprinting, testing for defects, etc…), ask what they want to know, and instruct them to copy both lists in the reading journal. We will proceed to read the vignette, briefly discuss it, and then to take notes on the background information. Terms are highlighted, so students know to consult the glossary for definitions that they will copy as we read. Subtitles will be copied into the reading journal and volunteers will be asked to summarize the main points in each section. Students will copy any charts, graphs, or diagrams that may accompany the text .

The interactive nature of each chapter involves the reader by asking him to make choices at certain junctures of the discussion, thus allowing for thorough coverage of the issue and its many aspects. Students will make particular note of supporting details, either pro or con, and be able to express them in their own words.

Writing Assignments

Objectives: Students will analyze and write a persuasive essay. Students will analyze and write a problem- solving essay. **Materials:** Language Arts textbook, handouts and transparencies, writing portfolio, reading journal, outline graphic.

I will follow the same procedures as outlined earlier. Students will choose a topic for the persuasive essay, based on the chapter readings and discussions. I will present a mini-unit on "errors in reasoning," showing students how to avoid circular reasoning, overgeneralization, either /or fallacy, and cause-and-effect fallacy. Most textbooks contain information on the errors in reasoning, along with resource material to facilitate its introduction.

Students will choose the topic for the problem-solving essay from the same sources. Again, I will follow the same procedures, this time including a list of logical fallacies to avoid, friendly feedback memos from peer readers, and a checklist to follow while editing.

Approximately forty minutes each day will be set aside for writing conferences. Students will sign up to discuss their works in progress with me or with their peer reader. Upon completion, every formal assignment must include an outline, a rough draft, signs of editing, peer reader responses when indicated, and a final draft. Fifty percent of the portfolio grade will come from the completeness of the portfolio, while the other fifty percent will come from the two, student selected essays. I will give students a copy of the evaluation rubric at the beginning of the unit so they will know what to expect.

Week Six: *Gattaca*, and "Super Toys Last All Summer Long"

Objectives: Students will analyze a piece of media by showing how it reflects and shapes cultures, values, beliefs, and attitudes. Students will analyze and evaluate themes and central ideas in literary and other texts in relation to personal and societal issue. **Materials**: *Gattaca*, the film; copies of the short story, "Super Toys Last All Summer Long;" reading journal.

For the first thirty minutes of class on Monday, Tuesday and Wednesday, students will be able to refine the writing portfolios. We will spend the remainder of time each day reading and discussing the short story, "Super Toys Last All Summer Long," by Brian Aldiss (available at http://www.wired.com/wired/archive/5.01/ffsupertoys_pr.html). We will discuss parts of the study guide (available from www.youthmedia.com), such as "What are some potential rewards and risks of today's technological breakthroughs: airplanes, nuclear energy, computers, the Internet?" "Is it alright to show violence in computer games because it is not 'real'?"

The film , *AI: Artificial Intelligence*, was developed from this short story. In the film, saying seven words bonds a robot to its owner forever. The words are: cirrus, Socrates, particle, decibel, hurricane, dolphin and tulip. Students will attempt to explain why these words were chosen.

The last two days of the week will be spent viewing the film *Gattaca*. A study guide is available at http://www.becal.net/toolkit/damaris/gattaca.html. It provides information on the key concepts in the film: genetics, genetic engineering, determinism, freedom, identity, and discrimination. Discussion questions help guide students' understanding of these key issues.

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Reiss, Michael J. and Roger Straughan. *Improving Nature? The Science and Ethics of Genetic Engineering.* Cambridge, UK: Cambridge University Press, 1996.

Tagliaferro, Linda and Mark Bloom. *The Complete Idiot's Guide to Decoding Your Genes.* New York, NY: MacMillan Publishing, 1999.

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Aldiss, Brian. "Super Toys Last All Summer Long." Wired Digital, Inc. 8 June 2001 <http://www.wired.com/wired/archive/5.01/ffsupertoys_pr.html>

Baker, Catherine. "Your Genes, Your Choices." American Association for the Advancement of Science. US Department of Energy. 22 June 2001.<http://www.ornl.gov/hgmis/publicat/genechoice/index.html>

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Levine, Russell and Chris Evers. "The Slow Death of Spontaneous Generation." Access Excellence: About Biotech. 12 June 2001.

<http://www.accessexcellence.org/AB/BC/Spontaneous_Generation.html>

"Study Guide to Gattaca. Damaris Study Groups. 8 June 2001. <http://www.becal.net/toolkit/damaris/gattaca.html>

Taylor, Shaun Neill. "Bioethics in the Classroom." Technology in Education. Access Excellence: Classroom of the 21st Century. 6 June 2001. <http://www.accessexcellence.org/21st/TE/BE/>

"Understanding Genetics." The Learning Centre. 11 June 2001. <http://www.genecrc.org>

"What Will the Future Bring?" Nova: Cracking the Code of Life. PBS. 18 June 2001.

<http://www.pbs.org/wgbh/nova/teachersguide/genome/genome_sp0.html>

Student Reading List

Aaseng. Nathan. *Genetics: Unlocking the Secrets of life.* Minneapolis, MN: The Oliver Press, Inc., 1996.

Biographical studies of the principal players in the field of genetics.

Arnold, Caroline. *Genetics: From Mendel to Gene Splicing.* New York, NY Franklin Watts, 1986.

A history of heredity and discussion of genetic code.

Kidd, J. S. and Renee A. Kidd. *Life Lines: The Story of the New Genetics.* New York, NY: Facts on File, Inc., 1999.

Focuses on the history of heredity and the Human Genome Project.

Patent, Dorothy Hinshaw. *Grandfather's Nose: Why We Look Alike or Different.* New York, NY: Franklin Watts, 1989.

A storybook format that explains the basics of heredity.

Sherrow, Victoria. *Bioethics and High Tech Medicine.* New York, NY: Twenty First Century Books, 1996.

Excellent discussions of bioethics and choices to be made

Tagliaferro, Linda. *Genetic Engineering.* New York, NY: Lemer Publications Co., 1997.

A pro-con series designed to explore and examine different points of view on genetic engineering.

Yount, Lisa. *Issues in Biomedical Ethics.* San Diego, CA: Lucent Books, 1998.

Features debates offering multiple perspectives on biomedical topics.