



Artificial Intelligence and the Brain: Creating a Super-human

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Bailey Middle School

This curriculum unit is recommended for:
7th Grade Science, Human Anatomy, Computer Science, Biology

Keywords: artificial intelligence, intelligence, brain, neuron, human, machine, evolution

Teaching Standards: See [Appendix 1](#) for teaching standards addressed in this unit.

Synopsis: We have learned a great deal about the human brain through modern science, but much of the human brain remains a mystery. We often think of our species as the most advanced in the animal kingdom. But what if there was a way to enhance our brain capacity? What if we could be smarter? Stronger? Better? Is there a way to manipulate the human brain in such a way that we can create a “super-human”? How in the world would we possibly be able to achieve that goal? It is possible that the answers lie in a marriage between humans and machines. This unit seeks to engage students in digging deeper into the content of human anatomy, genetics, and artificial intelligence, as students are tasked not only to design their “perfect human”, but also to explore the ethical implications of their design.

I plan to teach this unit during the coming year to 130 students in 7th grade science.

I give permission for the Institute to publish my curriculum unit and synopsis in print and online. I understand that I will be credited as the author of my work.

Artificial Intelligence and the Brain: Creating a Super-human

Stephanie Coggins

Introduction

We have learned a great deal about the human brain through modern science, but much of the human brain remains a mystery. We often think of our species as the most advanced in the animal kingdom. But what if there was a way to enhance our brain capacity? What if we could be smarter? Stronger? Better? Is there a way to manipulate the human brain in such a way that we can create a “super-human”? How in the world would we possibly be able to achieve that goal? It is possible that the answers lie in a marriage between humans and machines.

Rationale

In the 7th grade science curriculum, the last half of the school year is spent focusing on genetics and the human body. With this in mind, this unit will seek to engage middle school students in digging deeper in both the genetics and the human body curriculum, as an extension at the end of both units. Students will be given the task of designing their “perfect human” by modifying a specific characteristic (or a variety of characteristics) by (theoretically) using artificially created electronic transplants. This characteristic can be anything that is controlled by a specific part of the brain, like language, memory, or even certain motor functions. In a sense we will be dealing with a notion of cyborgs.

This is a very high level unit for a 7th grader, designed to increase rigor and induce higher-level thinking skills in honors-level and standard-plus level students. This unit will be scaffolded in such a way that all levels of students will benefit from critical thinking, higher level questioning, and partner and group communication, and cooperative learning. Since this is such a high-level unit, this unit will be taught as a follow-up once the genetics and human body systems units are taught in their entirety. This unit is designed to cross curriculum with 7th grade language arts and social studies standards, and is designed to engage all levels of students through a variety of engaging video clips, Socratic seminars, collaborative partnering and group activities, independent assignments, and a culminating writing assignment project. These differentiated activities will provide rigor for the advanced learners while responding to the needs of struggling learners.

This unit bridges the gap between my Honors and Standard students, and creates what educators call the “motivation trap”, luring students into engaging in the lessons by using an activity they in which they are interested.¹ Advanced learners are susceptible to

producing “success without effort” and can fall into the trap of thinking grades can become more important than ideas, so when faced with more rigorous assignments, they may have failed to develop appropriate study and coping skills.² Conversely, struggling learners may have a hard time understanding the deeper content and can have a difficult time when assignments aren’t chunked into manageable sections.³

Student Population

I teach 7th Grade Science at Bailey Middle School in Cornelius, North Carolina. Bailey Middle School is a part of the Charlotte-Mecklenburg School District, which is currently made up of 164 schools. While many of the district’s schools are in an urban setting, Bailey is quite different. We are located in an area that accommodates a rather affluent population. Bailey has 1600 students, and a free and reduced lunch population of 24.1%, which is below the CMS average. The student makeup is as follows: 78% Caucasian, 12.2% African-American, 7.3% Hispanic, 2% Asian, and 1.9% Other.

Although 7th Grade Science is not grouped according to Honors or Standard Plus like Math or Language Arts, my classes are grouped heterogeneously. I teach four classes of anywhere between 28 and 36 students, and each class has a mix of students that spans the spectrum in terms of ability level. In any class I have a mix of Honors, Standard Plus, EC (either Resource or Inclusion) students, and students with a broad range of 504 accommodations.

Bailey Middle School is among schools selected to participate in the Bring Your Own Technology or BYOT program, where our students are permitted to bring in their own electronic devices to use as educational resources in the classroom via school Wi-Fi. For students who do not have access to their own technology, I also have 5 student computers in my classroom, and my school currently has iPad and Google Chrome netbook carts that teachers may check out to use in our classrooms.

The most current published data states that Bailey was recognized in 2011-2012 as an Honor School of Excellence, which means that at least 90% of students’ scores are at or above achievement Level III and the school makes or exceeds its expected growth goal. In addition, Bailey also met all of its Annual Measurable Objectives targets.

The majority of our students are involved in some kind of extra-curricular activity, either through the school or otherwise. Students are involved in a variety of sports (both through the school and in recreational leagues), as well as Orchestra, Performance Band, Honors Chorus or Dance, and Theater. There are a variety of competitive teams like Battle of the Books, Robotics, Science Olympiad, and National STEM League. We have a very high level of parent involvement. As a team with our faculty and parents we have created a school climate that is both rigorous and nurturing, while giving all students an opportunity to find their niche and develop a sense of belonging.

Instructional Content

Vocabulary and Concepts

Artificial Intelligence

Artificial intelligence is any type of intelligence that is exhibited by a machine or its software.

Intelligence

Intelligence is a little more difficult to define. We can define intelligence in many ways, but we tend to define intelligence in terms of a being's capacity for logic, a skilled use of reason, the ability to learn from the past, or the ability to think abstractly and apply knowledge to one's environment.

Central Nervous System

The Central Nervous System (often abbreviated CNS) includes the brain and the spinal cord.

Peripheral Nervous System

The Peripheral Nervous System (often abbreviated PNS) includes sensory and motor neurons that send messages back and forth from the brain to the rest of the body.

Cerebrum

The largest part of the brain, and is responsible for most of its functions, divided into four sections: the frontal, parietal, temporal, and occipital lobes. It is divided into right and left hemispheres, which relay messages to one another.

Frontal Lobe

The frontal lobe is located in the front of the cerebrum. The frontal lobe controls problem solving, decision-making, creative thought, judgment, behavior, intellect, attention, abstract thinking, muscle movement, physical reactions, coordination, smell, emotions, and personality.

Parietal Lobe

The parietal lobe is located on the top in the back of the cerebrum. The parietal lobe controls visual functions, language, reading, internal stimuli, tactile sensation, and

sensory comprehension. The parietal lobe is separated from the frontal lobe by the sensory cortex and the motor cortex. The sensory cortex relays information regarding the senses. The motor cortex helps the brain control movement.

Temporal Lobe

The temporal lobe is located in the bottom center of the brain. The temporal lobe controls memory and involves speech, hearing, behavior, emotions, and language.

Occipital Lobe

The occipital lobe is located in the very back of the cerebrum and helps to control vision. Broca's Area is located in the occipital lobe and helps with the understanding of speech and language.

Cerebellum

The cerebellum is said to be older than the cerebrum, evolutionarily speaking. The cerebellum controls movement including balance, posture, and coordination.

Brain Stem

The brain stem is where all involuntary life functions are controlled. This includes heartbeat, blood pressure, breathing, digestion, and sleeping. The brain stem is found at the base of the brain, and includes the midbrain, pons, and medulla.

Midbrain

The midbrain regulates voluntary body movement, vision, and hearing.

Pons

The pons is connected to the cerebellum to provide assistance with posture and motor control, and aids in sleep.

Medulla

The medulla helps to maintain involuntary functions like heartbeat and breathing.

The Limbic System

The limbic system contains glands that are involved with the relay of emotions. This system includes the amygdala, hippocampus, hypothalamus, and thalamus.

Amygdala

The amygdala aids the body in response to emotions, memory, and fear.

Hippocampus

The hippocampus plays an important role in converting short-term memories to long-term memories. It is also involved in understanding spatial relationships.

Hypothalamus

The hypothalamus controls mood, thirst, hunger, regulation of body temperature, and contains glands that control hormonal processes in the body.

Thalamus

The thalamus controls pain sensors, attention span, and body sensations.

Motor Neurons

Motor neurons are responsible for carrying signals from the central nervous system to the outer parts of the body.

Sensory Neurons

Sensory Neurons are responsible for carrying signals from the outer parts of the body to the central nervous system

Adaptation

An adaptation is a characteristic or trait that helps an organism become more suited to its environment, thus becoming more likely to survive and pass on its traits to future generations.

Natural Selection

Charles Darwin coined the term “natural selection” as the process by which organisms change over time to be best suited to their environment and pass down their traits to future generations.

Evolution

Evolution describes the slow change in organisms that occurs over many generations. Species evolve as a way to ensure their survival in their environment.

Teaching Strategies

The initial content of this unit is delivered through the use of a variety of strategies as to engage all types of learners in my classroom. Technology is a strategic component that is heavily threaded throughout the entire unit, as I am fortunate enough to have a Promethean Board and to teach at a BYOT school as discussed earlier. Towards the end of the unit, the culminating activity will require use of student computers/tablets on a daily basis for almost a week. If this unit would be taught at a school that does not have a BYOT program, a computer lab would need to be utilized.

Guided notes and graphic organizers will be used via interactive student notebooks. Guided notes are used to deliver content through interactive presentations. Students are given guided notes with blanks so they fill in key words without having to spend the entire class writing while unable to truly focus on content. Supplemental graphic organizers are utilized to further comprehend key terms, concepts, and formulas. Students are encouraged to use examples from their own experiences and illustrate with drawings, pictures, and diagrams. In addition to this, there are teacher demonstrations and interactive student activities integrated into the lesson, allowing students to make connections with the content. Strategies like graphic organizers and guided notes are important because they allow students to improve their reading in four ways: decoding, fluency, vocabulary, and comprehension.

Inquiry is a critical component to any science classroom, and this lesson is no exception. Inquiry is a strategy that we use to not only keep students actively engaged in the lesson, but also to help them engage in problem-solving and higher-order thinking. These are real-world skills students will use throughout their lives.⁴

Video clips from a variety of sites and sources are used as both an introduction to new concepts and a way to dive deeper into the content. Throughout engaging video clips, students are probed with discussion questions that they answer with their lab partners, groups, or within the entire class setting.

Socratic Seminar will be used during this unit as a way to engage students in the text by asking open-ended questions. Students are expected to listen carefully and attentively to their peers' thoughts and offer constructive and articulate responses. By participating in the Socratic Seminar in this unit, students will learn to work cooperatively, value each other's opinions, and question one another in a safe and open environment.

Classroom Activities

Activity #1 (1 Day):

The unit will begin with the question, “What if I told you that you could create the perfect brain?” Students will engage in a discussion where some or all of the following questions will be discussed openly:

- What is your idea of the perfect brain?
- What qualities does the perfect brain have that ours maybe doesn't?
- What do you think we could accomplish with these characteristics that we maybe can't accomplish now?
- Is everyone's idea the same?
- What influences your idea of what a perfect brain means? What about other cultures?
- What kinds of challenges arise when we realize our ideas for perfection aren't the same?
- How does survival of the fittest factor in here?
- Is nature still in control?
- Does evolution matter?
- What are the ethical implications here?
- Now here is the big question to lead into the next point of discussion: Does the brain have to be inside of your body, or could it be a situation where we could outsource it to an external device like a computer?

Now we will continue the discussion to discuss the notion of cyborgs. Is it realistic to assume that this is a viable option for the future? How exactly could scientists use artificial intelligence to modify parts of our brain to make it “better”? And really, what is “better”? This discussion should take about a class period. The point is to get the students thinking, and familiarize them with what they will be researching. Students should have a vague idea about some of these concepts, but should in no way be experts yet.

Activity #2 (2-3 Days):

At this point it will be up to the students to individually embark on a journey of research. This will require two to three class periods of online research in and out of the classroom via computers and devices. Students will have the opportunity to utilize our school's media specialist for assistance in research.

It is important to note that at this point in the year, students will have had many interactions with the media specialist, where she conducts mini-lessons in the science classroom teaching the students the basics of research, how to use Easy Bib to create notecards, how to find credible and reliable sources, and eventually ramping up to in-text citations.

All of the questions above from the discussion will be provided to the students in a graphic organizer as a way to guide their research. This graphic organizer will have room for notes students take as they engage in their research. Students will utilize the notecard platform on Easy Bib as a way to organize their findings and their thoughts. We aren't building a research paper at this point in the unit, but just researching information as a way to have an informed discussion with partners and groups.

Students will be given a list of credible and reliable websites as a jumping-off point for their research. (This annotated list can be found in Appendix A.)

Activity #3 (2-3 Days):

Once students have compiled a large amount of research over the course of 2-3 class periods, we will engage in a true Socratic Seminar where the students will present their findings and use their technology devices to add to their own research. The Socratic Seminar should take about two to three class periods.

The same questions from the introductory discussion will be asked again, but now students will have a better understanding of the questions and they should be prepared to have an intelligent and engaging discussion based on their prior research. The following questions will be asked again:

- What is your idea of the perfect brain? Did it change as a result of your research?
- What qualities does the perfect brain have that ours maybe doesn't?
- What do you think we could accomplish with these characteristics that we maybe can't accomplish now?
- Is everyone's idea the same? How are your classmates' ideas different than yours?
- What influences your idea of what a perfect brain means? What about other cultures?
- What kinds of challenges arise when we realize our ideas for perfection aren't the same?
- How does survival of the fittest factor in here?
- Is nature still in control?
- Does evolution matter?

- What are the ethical implications here?
- Does the brain have to be inside of your body, or could it be a situation where we could outsource it to an external device like a computer?

Activity #4 (1-2 Days)

The discussion, research, and Socratic Seminar will lead to the next activity. Students will individually complete a project where they will create an illustration or model of what their new human will look like or what their new human's capabilities will be once they have the new characteristic(s) the student determines is/are most advantageous. In addition, they have the task of creating a model of what the AI device would look like, possibly how it would work, and what area of the brain it would function to "improve".

The activity will be differentiated in a way that students who need additional help will be paired with another student, where higher achieving students will be expected to complete this task individually.

Activity #5 (4-5 Days, including group presentations)

Once this activity is complete, students will work in groups of 4 (these are their predetermined lab groups), and they will consider building a small community with their new "super-humans". They will discuss the following questions within their group, and many of them are repeated from the opening discussion and the graphic organizer from their independent research:

- What was your idea of the perfect brain and what new characteristics does your new human have?
- What qualities does this perfect brain have that ours didn't have before?
- What do you think we can accomplish with these characteristics that we maybe couldn't accomplish before?
- What influences your idea of what a perfect brain means? What about other cultures?
- Is everyone's idea in your group the same?
- What kinds of challenges arise when we realize our ideas for perfection in our group aren't all the same?
- How does survival of the fittest factor in here?
- Is nature still in control?
- Does evolution matter?
- What are the ethical implications here?

- Now that you have modeled your AI instrument...Does the brain have to be inside of your body, or could it be a situation where we could outsource it to an external device like a computer?
- Is your “human” still a human now? Why or why not?
- At what point would your “human” no longer be considered a human? Where is the line between human and machine?

The groups of four will then be tasked with creating one perfect human from all of the models. They can be a combination of all four models, or they can just choose one.

Students should see that their opinions sometimes mesh, and sometimes they clash. This is where they will have to work cooperatively to problem-solve and come up with strategies to create the human that is most appropriate for their entire group. Once this new “human” is created, groups will create a poster, billboard, or commercial (via an application like iMovie) advertising their new AI improvement. Their goal is to sell their new AI program to the rest of the class. They will need to persuade normal humans to want to undergo the procedure/install the AI device in their brain so they can become this AI-improved super-human.

Students will present these advertisements by group to the rest of the class, and the class will have the opportunity to ask the groups logistical and ethical questions. Students will vote on the most efficient and advantageous super-human AI device, voting based on which one was not only the most advantageous, but which one is perhaps most ethical and least invasive. A winner will be chosen, and it is possible that a winner could be chosen across the grade-level or all classes.

Activity #6 (3-4 Days)

The culminating activity for this unit will be a cross-curricular unit where students will have researched the characteristic they most want to focus on improving to bring us closer to our “perfect brain”, and will write a 3 to 6 page research paper. In this paper, students would be expected to do their research following a rubric explaining specific expectations, as well as any technological advances in artificial intelligence. They would also be expected to spend a great deal of this paper discussing the ethical implications of these advancements in AI. Remember that prior to the completion of this research paper, students would have participated in a Socratic seminar and an ethical debate where they will had an opportunity to learn how to argue their side using evidence grounded in their research. The research paper will need to be cited properly using Easy Bib.

*It is important to note that technological literacy is a key component of this unit. Prior to the completion of this activity, students will have been given a variety of lessons on researching and Easy Bib, and a mini-lesson on Google Drive and its capabilities for

uploading, creating, and storing presentations, documents, and videos. Students will be expected to use Google Drive as their sole instrument of communication with me for turning in assignments and receiving feedback. This also streamlines the communication process, eliminating clogged inboxes, dozens of flash drives, and files that never seem to convert properly from home to school.

It should also be noted that while a large amount of time to complete this culminating activity will be given in class, students are also expected to work on this project outside of school. Time will need to be given for students to present their projects to the class at different points in the unit.

Appendix 1: Implementing NC Essential Standards and Common Core Standards

The Essential Standards for North Carolina 7th Grade Science below will be emphasized during this unit as we focus on the human body and genetics. As students research the brain and its functions, they will focus on the nervous system and its interactions with other systems and organs. All of their research will culminate in the discussion of whether environment or inheritance are the determining factors in the development of a living being.

- 7.L.1.3. Summarize the hierarchical organization of multi-cellular organisms from cells to tissues to organs to systems to organisms.
- 7.L.1.4 Summarize the general functions of the major systems of the human body and ways that these systems interact with each other to sustain life.
- 7.L.2.2 Explain the impact of the environment and lifestyle choices on biological inheritance and survival.

The Language Arts Common Core Standards for North Carolina below will be emphasized during this unit as we focus on research, literacy, and writing. The research, specifically in Activities 2 and 6, will reinforce these literacy standards through using the internet, using EasyBib to organize thoughts and information, and conducting their research project by gathering information from multiple sources to answer questions.

- CCSS.ELA-LITERACY.W.7.1 Write arguments to support claims with clear reasons and relevant evidence.
- CCSS.ELA-LITERACY.W.7.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
- CCSS.ELA-LITERACY.W.7.5 With some guidance and support from peers and adults, develop and strengthen writing as needed by planning, revising, editing,

rewriting, or trying a new approach, focusing on how well purpose and audience have been addressed.

- CCSS.ELA-LITERACY.W.7.6 Use technology, including the Internet, to produce and publish writing and link to and cite sources as well as to interact and collaborate with others, including linking to and citing sources.
- CCSS.ELA-LITERACY.W.7.7 Conduct short research projects to answer a question, drawing on several sources and generating additional related, focused questions for further research and investigation.
- CCSS.ELA-LITERACY.W.7.8 Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation.

The Essential Standards for North Carolina 7th Grade Social Studies below will be emphasized during this unit as we focus on the ethical implications of our research. As students research individually and work cooperatively with their peers, they will learn moral and ethical values in their research and how different demographic, geographic, and environmental conditions influence these values.

- 7.H.2 Understand the implications of global interactions.
- 7.G.1 Understand how geography, demographic trends, and environmental conditions shape modern societies and regions.

Appendix A: List of Credible/Reliable Sites

Credible and reliable websites for Socratic Seminar research:

These sites should serve as a beginning point for your research and are by no means an exhaustive list of sites you should visit. Using the tools you have been given as we have learned to research, begin your own research once you have visited these sites.

<http://www.smithsonianmag.com/science-nature/top-ten-myths-about-the-brain-178357288/?no-ist>

<http://www.scientificamerican.com/article/do-people-only-use-10-percent-of-their-brains/>

<http://www.brainwaves.com/>

http://www.alz.org/braintour/3_main_parts.asp

<http://www.md-health.com/Parts-Of-The-Brain-And-Function.html>

https://science.education.nih.gov/supplements/nih2/addiction/activities/lesson1_brain_arts.htm

<http://www.enchantedlearning.com/subjects/anatomy/brain/Structure.shtml>

http://www.thethinkingbusiness.com/brain_zone/brain-tour

<http://science.howstuffworks.com/life/inside-the-mind/human-brain/brain4.htm>

<http://www.technologyreview.com/featuredstory/522476/thinking-in-silicon/>

<http://www.artificialbrains.com/>

<http://singularityhub.com/2012/12/10/scientists-create-artificial-brain-with-2-3-million-simulated-neurons/>

<http://www.techradar.com/us/news/world-of-tech/how-artificial-intelligence-mimics-the-human-brain-657976>

Appendix B: Research, Discussion, and Socratic Seminar Talking Points

Research, Discussion, and Socratic Seminar Talking Points

Below are a list of questions that you should keep in mind as we engage in discussion, research, and our Socratic Seminar. Use the attached graphic organizer to organize your thoughts as you conduct your research and to make notes as you engage in discussion and seminar.

- ❖ What is your idea of the perfect brain? Did it change as a result of your research?
- ❖ What qualities does the perfect brain have that ours maybe doesn't?
- ❖ What do you think we could accomplish with these characteristics that we maybe can't accomplish now?
- ❖ Is everyone's idea the same? How are your classmates' ideas different than yours?
- ❖ What influences your idea of what a perfect brain means? What about other cultures?
- ❖ What kinds of challenges arise when we realize our ideas for perfection aren't the same?
- ❖ How does survival of the fittest factor in here?
- ❖ Is nature still in control?
- ❖ Does evolution matter?
- ❖ What are the ethical implications here?
- ❖ Does the brain have to be inside of your body, or could it be a situation where we could outsource it to an external device like a computer?

Appendix C: Research Graphic Organizer

<u>Source #1</u>	<u>Source #2</u>	<u>Source #3</u>	<u>Source #4</u>
<u>Bibliography Information:</u>	<u>Bibliography Information:</u>	<u>Bibliography Information:</u>	<u>Bibliography Information:</u>
<u>Summarize Important Info:</u> <u>Fact #1</u>			
<u>Summarize Important Info:</u> <u>Fact #2</u>			
<u>Summarize Important Info:</u> <u>Fact #3</u>			

Notes

¹(Hutchison 2010) p. 150

²(Tomlinson 2001) p. 11

³(Tomlinson 2001) p. 13

⁴(Chiappetta 2010) p. 123

List of Materials for Classroom Use

Laptop/computer/iPad/BYOT technology

Guided notes, interactive PowerPoint presentations

Interactive Student Notebooks

List of credible/reliable websites (Appendix A)

Graphic Organizer (Appendix B)

Research, Discussion, and Socratic Seminar Talking Points (Appendix C)

Reading List for Students

<http://www.smithsonianmag.com/science-nature/top-ten-myths-about-the-brain-178357288/?no-ist>

<http://www.scientificamerican.com/article/do-people-only-use-10-percent-of-their-brains/>

<http://www.brainwaves.com/>

http://www.alz.org/braintour/3_main_parts.asp

<http://www.md-health.com/Parts-Of-The-Brain-And-Function.html>

https://science.education.nih.gov/supplements/nih2/addiction/activities/lesson1_brainparts.htm

<http://www.enchantedlearning.com/subjects/anatomy/brain/Structure.shtml>

http://www.thethinkingbusiness.com/brain_zone/brain-tour

<http://science.howstuffworks.com/life/inside-the-mind/human-brain/brain4.htm>

<http://www.technologyreview.com/featuredstory/522476/thinking-in-silicon/>

<http://www.artificialbrains.com/>

<http://singularityhub.com/2012/12/10/scientists-create-artificial-brain-with-2-3-million-simulated-neurons/>

<http://www.techradar.com/us/news/world-of-tech/how-artificial-intelligence-mimics-the-human-brain-657976>

All websites listed are suggested sites to be used during the research phase of the unit (Activity #2) and included in Appendix A. These sites should be given to students as a way to view credible and reliable sites before venturing on their own research path.

Annotated Bibliography for Teachers

Boyd, Robynne. "Do People Only Use 10 Percent of Their Brains?" Scientific American Global RSS. February 7, 2008. Accessed October 30, 2014.

This article is useful in referencing and understanding parts of the brain and how they are used.

Chiappetta, Eugene L., and Thomas R. Koballa. *Science instruction in the middle and secondary schools: developing fundamental knowledge and skills*. 7th ed. Boston, Mass.: Allyn & Bacon, 2010.

This book is useful for developing science lessons using inquiry-based learning.

Common Core State Standards Initiative. <http://www.corestandards.org/>

I used this website to access the Common Core Standards for math and language arts, and the Essential Standards for science.

Filkins, Scott. "Socratic Seminars - ReadWriteThink." Readwritethink.org. January 1, 2014. Accessed November 15, 2014.

This is a useful resource for teachers who want to know more about Socratic Seminars, how to conduct them, how to set classroom expectations, and how to analyze their effectiveness.

Helmuth, Laura. "Top Ten Myths About the Brain." Smithsonian. May 19, 2011. Accessed October 23, 2014.

This article is useful as a class discussion piece, to engage students and dispel any misconceptions they may have about the brain.

Hutchison, Charles B. *Teaching Diverse Learners: With Basic Principles, Classroom Insights, and Best Practices*. Charlotte, NC: Catawba Publishing Company, 2010.

This book is helpful in exploring strategies for creating differentiation in a classroom with diverse learners.

Lemov, Doug. *Teach like a champion: 49 techniques that put students on the path to college*. San Francisco: Jossey-Bass, 2010.

This book is useful for exploring different techniques for improving literacy decoding, fluency, vocabulary, and comprehension.

Sciencesaurus: a student handbook. Wilmington, MA: Great Source Education Group, 2002.

This text is a great source for easy to understand science concepts. This book is helpful as a teacher or student reference in the classroom.

Tate, Marcia L. *Worksheets don't grow dendrites: 20 instructional strategies that engage the brain*. 2nd ed. Thousand Oaks, Calif.: Corwin Press, 2010.

This book is a wealth of information for how to teach a classroom full of engaged learners using a variety of instructional strategies, mainly involving movement and project-based learning.

Tomlinson, Carol A. *How to differentiate instruction in mixed-ability classrooms*. 2nd ed. Alexandria, Va.: Association for Supervision and Curriculum Development, 2001.

This book is very useful in finding ideas for differentiation in heterogeneous classrooms with advanced and struggling learners.

Wormeli, Rick. *Summarization in any subject: 50 techniques to improve student learning*. Alexandria, VA: Association for Supervision and Curriculum Development, 2005.

This book is useful for implementing summarization strategies into lessons.