



***Human Language: A Non-homologous Feature in Humans
When Compared to Non-hominin Species***

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This curriculum unit is recommended for:
8th Grade Science, Integrated Science, Life Science, Biology

Keywords: Theory of Evolution, homologous structures, analogous structures, vestigial structures, embryological structures, evolution, common ancestor, Charles Darwin

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

Synopsis: The theory of evolution can be supported in many ways. Eighth grade science curriculum focuses on biological evidence of the structures of organisms to determine whether or not those organisms share a common ancestor. As students draw conclusions about the role of evolution in the relationship between humans and other living organisms, it is important that they begin to think more critically about the evolutionary path of humans. Biological evidence proves that all organisms share a common ancestor; however, humans have a special ability that sets them apart from other organisms, that truly puts them at the top of the evolutionary tree. All organisms communicate in some form but humans on the other hand use a very systematic approach in how our species communicates called language, something that no other known organism does. In this curriculum unit students will explore the relationship between humans' ability to communicate and their evolutionary journey over five lessons. These lessons will allow students to deepen their understanding of how humans share common ancestry with other organisms and how the ability to communicate sets them apart.

I plan to teach this unit during the coming year to 100 students in 8th grade during our life science portion of the integrated science curriculum.

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Human Language: A Non-homologous Feature in Humans When Compared to Non-hominin Species

Nicole Nunley Nesbitt

Introduction

One of the major topics that I teach in eighth grade science is the history of the Earth and the organisms that reside on this diverse planet. The history of the Earth has always been of fascination to humans because we want to know where we come from. What was the beginning point of our existence? The Theory of Evolution sheds some light on this for us. Students are taught in eighth grade that the theory of evolution means “change” and that all organisms have changed over the course of millions of years. Eighth grade earth science curriculum focuses on three major evidences that support the Theory of Evolution. The first idea is that scientists use relative dating techniques such as the geological principles of the Law of Superposition, the Law of Cross-Cutting Relationships, and the Law of Uniformitarianism to determine the relative age of rock layers. Rock layers contain fossils and/or artifacts that provide scientists with information about early life on Earth that has become extinct or has evolved into something different over millions of year.

The second piece of evidence that scientists use to determine if a species has evolved is the places in which related species are located on the Earth. Charles Darwin provided an excellent example of this when he traveled to the Galapagos Islands. He concluded that mainland species migrated to the islands, where they eventually evolved into new, distinct species.

The third evidence scientists use to support the Theory of Evolution is homologous, analogous, and embryological structures of organisms. Homologous structures are structures such as “body parts of different organisms that have a similar structure but not necessarily a similar function.”¹ An example of homologous structures would be the arm of a human, the wing of a bat, and the fins of a whale; each animal uses their appendage for very different functions; however, each organism shares similarities in anatomical structure. Each organism has an arm-type appendage that includes a long bone (humerus), two short bones (ulna and radius) in the lower “arm” appendage and finger like structures known as phalanges. Analogous structures are “body parts of different organisms that perform similar functions but do not have similar structures.”² This idea is supported when we compare organisms such a dolphins, sharks, and penguins. At a glance their outward appearances would lead one to believe that because their appendages are used for swimming, they all have evolved from a common ancestor. However, that is not true because their anatomical structures differ greatly. Scientists also

use the similarities in embryological structures of animals as evidence to further support the Theory of Evolution. The embryos of vertebrate animals share common characteristics. For instance, when looking at the embryos of a human, chicken, and fish, one finds that all animals have folds in the neck region that have similar physical characteristics such as gills, like that of fish. The backbone outline is in the exact same place for all the animals as well. One can conclude that since neither human nor chicken offspring have gills they must share a common ancestor. These three evidences are the basis in which the Theory of Evolution is supported. Once a common ancestor has been identified, then a student can conclude that at some point in evolutionary history, species that share a common ancestor eventually evolved into different types of species. Even though students learn that fossils and rock layers, homologous, analogous and embryological structures, and geographical location provide strong evidence that organisms at some point in time have had to evolve, the question is still asked “Teacher, did humans evolve from monkeys?” This is always a sensitive question because personal beliefs and ideas shared within families can be shattered due to the teaching of the Theory of Evolution. So it is simply answered with, “we are all entitled to our own beliefs and ideas, and please keep in mind that this is a theory.” But in thinking about human evolution, I do want to challenge my students to think more deeply about the role that evolution may play in how humans have changed over time through something that they can personally relate to...language. Studying the origins of human language can help students overcome their anti-science biases.

Demographics

Albemarle Road Middle School is located in the East Learning Community in Charlotte, North Carolina. The current enrollment number of students is 1,186, which is higher than North Carolina and Charlotte-Mecklenburg Schools average enrollment for middle schools. By state standards Albemarle Road Middle is considered a title-one school in which funding is provided by the federal government to improve achievements of high poverty students who are behind academically or at risk of failing. Fifty-nine percent of the students are considered economically disadvantaged. Albemarle Road Middle School is also a focus school in which it “must implement interventions to assist at-risk students in meeting the State's high academic achievement standards and graduate students on time.”³ The racial makeup of my school is 44 % African-American, 6% white, 41% Hispanic, 7% Asian, 5% American Indian, 5% multi-racial, and 5% unknown racial affiliation. 16% of the students have limited English proficiency. Albemarle Road Middle is considered an IB magnet school and only about one hundred students forgo their neighborhood schools and select to attend. Implementation of IB principles proves to be difficult because per end of year assessments from the 2014-2015 school year, only 24% of students were proficient in reading, 25% were proficient in math; and 59% were proficient in eight grade science. Although these scores describe a dire situation, students

at Albemarle Middle School show tremendous growth year after year per End of Grade data.

Rationale

In general the theory of evolution is a very controversial topic to discuss with any person. It is doubly difficult when you are teaching students that are in the process of trying to determine what they believe and concepts they are presented with in school conflict with what they have been taught by their families. While, I believe that all students have the right to not agree with or challenge the theory of evolution, they are still required by the state of North Carolina to understand the general idea of evolution.

Evolution simply put is a gradual progressive changing through various ways to insure the survival of a species. Humans have indeed changed, but in what ways? I want students to think deeper about the idea of how humans have changed through the evolution of language. How do we communicate with each other? Students can be encouraged to question whether humans have always “talked” to one another. How similar or different are we from other animals in respect to “communication?” Is the need to communicate specifically a need of humans? Does this make us evolutionary superheroes? Organisms adapt; is language an adaptation that sets us apart from other organisms?

One of the biggest challenges for educators is to make the content that they teach real and relevant to their students. One question that I have to ask myself when teaching, especially concepts of earth history is, “Why is this important and why should students care about this topic?” What better way to do that than to add to the concept of the Theory of Evolution an idea that would make it relevant to students? We use language every day to communicate our thoughts, feelings, and concerns to others. Now students can ask themselves, has it always been like this and do other animals have a way of doing it too? Students can now think deeply about evolution and the changes in humans in a more practical way than posing the question, “did we evolve from monkeys?”

One of the largest hurdle students have to overcome is understanding that all organisms are affected by evolution. I believe that students have a hard time understanding ideas about organisms because they do not classify themselves as an organism that is a species such as species of birds, fish, cats, and dogs. The idea that we are superior causes us to have a tendency to set ourselves apart and not readily accept evidence that suggest humans have evolved over time as well. The Theory of Evolution proves to be a “touchy” subject that makes parents very uncomfortable at the thought of having family beliefs infringed upon by scientific facts. I choose to address how humans use language and communication as a non-homologous characteristic when compared to other organisms.

According to Jean Dessalles “all living beings communicate with other individuals of their own species,”⁴ in hopes of finding a mate. Organisms have to mate to ensure the survival of the species, so some type of communication must occur. Dessalles explains that animals such as vervets (small monkeys) and territorial birds communicate through a system that allows these animals to attach a sound or call to a particular situation. Humans, on the other hand, have the ability to verbalize the situations that we encounter and apply multiple meanings.⁵

Communication is what I would consider a homologous structure that all organisms share but language would be the ultimate non-homologous characteristic that sets humans apart from all other organisms. Dessalles, clearly explains in “*Why We Talk. The Evolutionary Origin of Language*” that conversation is something that humans use, not to think with or solve problems, at least not primarily, but rather for purposes of establishing relationship with other humans: “If evolution endowed us with language and the cognitive means associated with it, it was not for the purpose of speculating about the world into which we have been brought, or collaborating on the building of bridges or rockets or even devising systems of mathematics. It was so we can chat.”⁷ The more members of a species are dependent on one another, the more sophisticated the communication system will be. Human interactions are constant daily occurrences. As teachers, we understand the importance of conversations. We encourage our students to have academic conversations, we have conversations with their parents, we have class conversations, but the most challenging conversations that teachers encounter is what Dessalles refers to as “chat.” Other organisms’ communication has very specific purposes such as to warn of danger while humans’ conversations are about varying subjects and topics. As Dessalles puts it, as a species “in all countries and at all periods, whether in industrialized societies or among hunter-gathers, people have spent and continue to spend a large part of their day conversing.”⁸ Conversation serves as more evidence that humans have the non-homologous characteristics of language. Humans use conversation in many different ways to gain many different things. In *The Talking Ape, How Language Evolved*, Robbins Burling offers several examples showing how the conversations that we engage in have many non-practical, non-information-oriented purposes.⁹ For instance, conversations serve as a way to gain power, gossip and seduce others. Conversation has the power to set us apart socially. In early societies, the better your ability to conduct high quality conversation, the more potential you have to gain the admiration of others, thus achieving high social status. Through the desire to keep the admiration of others, we as humans have created the phenomenon of lies as a means to ensure that our high social status stays intact. We humans have a tendency to want to ensure that we “stay on top,” to have an edge over the next person. We gossip about people because according to Burling, “what really interests people is people, both other people and themselves”¹⁰. He poses the question “why are we so endlessly fascinated with the actions, intrigues, motivations, successes, and failures of everyone we know and even those we don’t know?”¹¹ Through conversations that included gossip, talking about others, we can learn much about ourselves and govern our own lives better. For example,

if I can learn about what one person did, then I can do the same thing if it turned out positively or not do the same thing if the outcome of the action turned out to be negative. I would easily gain this insight from conversations that I had engaged in with others. Not only do humans learn to manage their lives from conversations, we also have the ability to get others to do what we want them to do. This happens in many ways. Teachers many times have to convince or motivate their students to learn or behave in desired ways and class conversations are a way to do that. Teachers have conferences, which are nothing more than conversations between parents, teachers, and students about what is or is not happening in class. Out of this conversation some sort of plan or course of action is to be set in place. The use of language in conversations is a non-homologous feature of humans that is not readily seen in other non-hominin organisms.

Many animals share features that humans have as well; however, one feature that humans have that no other organism shares is language. Burling tells us that “language could not have evolved from any animal-like form of communication simply because it is so different from all other animals behavior.”¹² Language points to something that is extremely special about humans and their role in evolutionary history. It is important that students understand that evolution of human language proves to be a complex phenomenon that humans share only amongst humans. Regardless of the fact that we speak different languages, all languages are a highly intricate form of communication that has changed throughout history.

Instruction Content

Instructional Content Vocabulary

Charles Darwin- British naturalist who proposed the theory of evolution based on natural selection. Darwin's theory that random variation of traits within an individual species can lead to the development of new species revolutionized the study of biology.¹³

Common Ancestor –“in genealogy, any person to whom two or more persons claim descent; also, the most recent ancestral form or species from which two different species evolved”¹⁴

Theory of Evolution- the change of characteristics of different populations over time is the theory used to explain the massive diversity experienced on Earth. These changes occur with small mutations in genes, which are then passed onto offspring. Through natural selection, if the mutation gives some advantage, that individual survives to reproduce, and thus secures that change in the genetics of the population.¹⁵

Evolution -Biology.change in the gene pool of a population from generation to generation by such processes as mutation, natural selection, and genetic drift.¹⁶

Analogous Structures-Analogous structures are body parts of different organisms that perform similar functions but do not have similar structures. ¹⁷

Embryological Structures-similarities and differences in embryological stages indicate evolutionary relationships among organisms. ¹⁸

Homologous Structures-A homologous structure is an example of an organ or bone that appears in different animals, underlying anatomical commonalities demonstrating descent from a common ancestor. In other words, it's when very different animals have bones that appear very similar in form or function and seem to be related. ¹⁹

Vestigial Structures- (a) vestigial structure is/are “anatomical feature (s) that no longer seems to have a purpose in the current form of an organism of the given species.” The appendix of a human is located at the end of the large intestine and has no purpose in the digestion process however the appendix of a rabbit is still used to aid the digestion of its food this point to evidence of a common ancestor. ²⁰

Species- An individual belonging to a group of organisms (or the entire group itself) having common characteristics and (usually) are capable of mating with one another to produce fertile offspring. ²¹

Teaching Strategies

Teacher will use teaching methods such as lecture, PowerPoint, and videos to engage students in the topic of comparative anatomy as evidence for the theory of evolution. Many of the activities that the students will do include Sheltered Instructional Observation Protocol (SIOP) strategies to allow students the opportunity to read, write, and speak about the information that they are learning. Students on a daily basis will be able to collaborate within their table teams and/or with a partner. I expect that students will have varying opinions and thoughts about homologous and analogous structures of animals. I will allow them to express their thoughts in written form and keep them to support their stance on whether or not they agree with the evidence supporting the Theory of Evolution.

Collaborative learning will be used to allow students to work on individual pieces of an activity and then incorporate those individuals' pieces together to produce one finished product that is shared with the class. Group work will give students the opportunity to work together to discuss and analyze content to draw conclusions about the content. Close reading is a strategy that will allow students to interact with the selected text. On day one of the unit students will read for seven minutes to become familiar with the content that they will be learning about. On day two of instruction, students will read the same text again, this time reading for key ideas recording information on a graphic organizer. By the third read, students will be at a point in which

they can begin to apply learned information critically. Another strategy that will be used to address the content is a graffiti walk, allowing students to reflect on the work and ideas of others. Various videos and pictures will be used as well to introduce students to different perspectives of the content. The content introduction on day one of the curriculum unit starts with students listening to another teacher presenting the information. When considering strategies to teach this unit, the teacher must include strategies that address the needs and learning styles of all students. This curriculum unit gives students an opportunity to participate in a variety of activities that range from sitting quietly and reading to moving around the classroom to respond to their peers' work products to working collaboratively to evaluate pictures and making determinations about key ideas.

Classroom Activities /Curriculum Unit Plans

Lesson Title	Fact or Opinion
Duration	Day 1-90 minute block
Essential Standard Addressed	8.L.4.1 Summarize the use of evidence drawn from geology, fossils, and comparative anatomy to form the basics for biological classification systems and the theory of evolution.
Lesson Overview	Day 1 is the introduction to the unit. Students at this point have been introduced to the first and second evidences that support the theory of evolution. This lesson will introduce the third evidence, structures of organisms share common features that support the idea that organisms evolved from a common ancestor. Students will begin to formulate their thoughts regarding what they believe about common ancestry. Teachers should anticipate responses from students that reflect their personal beliefs about evolution that are not considered "scientific" as well as many misconceptions. All student responses are acceptable at this point. Students will revisit their ideas on day 5 of the unit.
Vocabulary	homologous, analogous, vestigial structures, common ancestor, Theory of Evolution, Charles Darwin, evolution, species
Lesson Launch-Word Work	Teacher will show students a picture of the "Evolutionary Tree" http://palaeos.com/systematics/tree/haeckel.html . Students will then be asked to write on sticky notes ideas that they have between the organisms that are shown on the screen. Students then will post their sticky notes on a class poster for later examination at the end of the unit.
Lesson Teacher Input	Teacher will use a video to introduce students to the concept of common ancestry. To ensure that students are engaged in watching the video students should be required to interact with the video (recording information/note taking, 3-2-1, video guide, etc.) Students

	will view Common Ancestry (only 9 minutes) https://www.youtube.com/watch?v=1UI6ew9NfGQ
Learning Activities	1.Students will read pages 180-182 of the NC End-of-Grade Coach or teacher selected article as a close read annotating information as they read. 2. Students will reread pages 180-182 of the NC End-of-Grade Coach book or teacher selected article to complete a graphic organizer (appendix 3) to explore content vocabulary.
Student Product	Students will complete a writing prompt that will demonstrate understanding of the lesson content. Writing prompt- “Based on your personal ideas about evolution and information that you have learned today, write a well developed response to the following question... What are your personal ideas/thoughts/ beliefs regarding the evidence of common ancestors? Do you agree with this idea why or why not?

Lesson Title	Charles Darwin & His Travels
Duration	Day 2 -90 minute block
Essential Standard Addressed	8.L.4.1 Summarize the use of evidence drawn from geology, fossils, and comparative anatomy to form the basics for biological classification systems and the theory of evolution.
Lesson Overview	Day 2- This lesson will introduce students to Charles Darwin and the role that he played in founding the Theory of Evolution. Students will read about his travels to the Galapagos Islands and his research regarding the beak shapes of finches. This lesson serves to introduce students the Theory of Evolution and who Charles Darwin is. This lesson will serve as a springboard with challenging students in the following lessons to explain how other features of organisms point to evolution from one common ancestor.
Vocabulary	Homologous, analogous, vestigial structures, common ancestor, Theory of Evolution, Charles Darwin, evolution, species
Lesson Launch	Teacher will display a picture of Darwin’s finches. Students will write on an index card their initial ideas about what similarities and differences of the shapes of the beaks of the finches. Once students have recorded their ideas students will be allowed fifteen seconds to share their ideas with another student. Teacher will reconvene students and call on students randomly to share out their ideas.
Lesson Delivery-Teacher Input	Teacher will proceed to explain through lecture who Charles Darwin is and why is important to the Theory of Evolution. This information can be presented in various ways at the teacher’s discretion. Resources that would be appropriate to use would be PowerPoint’s, guide notes, and video. All of these resources can be googled,

	however teacher will need to determine format, presentation difficulty, and content grade level before use.
Learning Activities	<p>1. Students will work independently to read and respond to questions about Charles Darwin and his life's work. (refer to appendix 6 for articles/worksheets that are appropriate for student use)</p> <p>2. Teacher will provide pictures of organisms for students to begin to compare and contrast. The types of picture used are extremely intentional. Students will view pictures that have features that may lead students to assume that they share a common ancestor (analogous structures) and pictures that seem on the outside to have no common ancestor (homologous structures.) Students will begin to create a list of all the similarities and differences that these organisms have in common with each other. (For pictures see appendix 7) in the pictures that are selected.</p> <p>http://www.sepa.duq.edu/darwin/pdf/UniqueBeakPhysique.pdf</p>
Student Product	<p>Students will create a chart with a partner. The chart will include the following items: title, compare and contrast graphic organizer that list the difference and similarities of a particular set of organism. Students will write a summary of the information that they will present to the class. After students have presented, each poster will be put on display and the other students will have the opportunity to participate in a "graffiti walk". During the walk student will write questions on the posters that one might consider when determining the relationships between the animal sets. Example questions could be...</p> <p>What is the type of environment does these animals live in?</p> <p>Are their appendages able to do the same types of task?</p> <p>Do these animals live a numerous other places on earth?</p> <p>Can they be found in warm or hot climates?</p> <p>How did the animals arrive at there locations?</p>

Lesson Title	Common Ancestry & Supporting Evidence
Duration	Day 3-90 minute block
Essential Standard Addressed	8.L.4.1 Summarize the use of evidence drawn from geology, fossils, and comparative anatomy to form the basics for biological classification systems and the theory of evolution.
Lesson Overview	Day 3- This lesson will build on the similarities and differences of various organisms that students have uncovered in the previous lessons. The different picture sets of organisms will have obvious similar characteristic such as wings, size, beaks, number of legs, etc., these observations are based on outward appearances. The teacher will explain to students that when using comparative anatomy to determine

	<p>common ancestry one must look at the specific internal structures of the organism. The focus of the lesson will be the homologous, analogous, and vestigial structures of organisms. Students will be able to define and explain how each of the terms supports the Theory of Evolution.</p>
Vocabulary	<p>homologous, analogous, vestigial structures, common ancestor, Theory of Evolution, Charles Darwin, evolution, species</p>
Lesson Launch-	<p>Teacher will play “What is the Evidence?” by Stated Clearly https://www.youtube.com/watch?v=IIEoO5KdPvg</p>
Lesson Delivery- Teacher Input	<p>Teacher will display two pictures of organisms that share homologous structures. It is recommended that the teacher show a picture of the anatomical structure and a picture of outward appearances. This will support the idea that scientists must look at the actual bone structures of the organisms to conclude if a common ancestry exists. Teacher will guide students in how to look critically at diagrams to determine similarities by completing one animal example from the handout with students.</p>
Learning Activities	<p>1. Students will receive a picture of seven organisms and compare those pictures to complete a chart about the structural similarities of those organisms. Students will also demonstrate their understanding of the idea of homologous and analogous structures by using their knowledge to respond to questions listed on the worksheets. https://sciencewithmsbarton.files.wordpress.com/2013/10/homologous-and-analogous-structures.pdf https://sciencewithmsbarton.files.wordpress.com/2013/10/homologous-analogous-limbs-printout.pdf http://www.simplescience.org/Lessons/Biology/AH/Lesson0.htm http://www.simplescience.org/Lessons/Biology/AH/lesson.pdf</p> <p>2. Students will work independently to conduct an online exploration of analogous and homologous structures. Students will complete the accompanying worksheet that goes along with the interactive website. http://evolution.berkeley.edu/evolibrary/article/similarity_ms_01 http://biologycorner.com/worksheets/homology_analogy.html http://biologycorner.com/worksheets/homology_analogy_key.html</p>
Student Product	<p>Students will complete the above listed worksheets. Students will work together to complete these worksheets. Teacher will monitor students’ progress on completing these activities and ask questions to check for understanding.</p>

Lesson Title	Humans vs. Non-Hominin Organisms
Duration	Day 4 -90 minute block
Essential Standard Addressed	8.L.4.1 Summarize the use of evidence drawn from geology, fossils, and comparative anatomy to form the basics for biological classification systems and the theory of evolution.
Lesson Overview	Day 4- This lesson is where students will begin to explore the role that evolution has played in the human species. In the previous lesson students have had the opportunity to evaluate various different organisms and use comparative anatomy practices to confirm that this method is valid. Today students will explore the comparative anatomies of humans and their closest common ancestor. This lesson will require deliberate instruction as to what evidences students should look for. In the lesson comparing anatomies will prove to be mostly identical, however the teacher should focus students attention on non-homologous features and characteristics. Humans share a form of communication known as language that can be spoken and written. This is an extremely sophisticated form of communication that other non-hominin organisms do not engage in. This can be attributed to how we interact as a species, the structure of vocal cords, jaw placement and other features.
Vocabulary	homologous, analogous, vestigial structures, common ancestor, Theory of Evolution, Charles Darwin, evolution, species
Lesson Launch-	Teacher will present a picture to the class. https://www.flickr.com/photos/freevectorstock/14565772169 Students will write what they believe the message is that the picture is conveying. Students will also need to refer back to the information that they have learned about earlier in the week to support their inference of the picture.
Lesson Delivery- Teacher Input	Teacher will explain to students that the evolution of man is a very controversial idea and challenges the spiritual beliefs of many people. However, according to “scientists” there is strong evidence that the human species have evolved from a common ancestor as well. Per science humans are also classified as a species and the same principles of evolution are applicable with this species as well.
Learning Activities	1.Students will explore the PBS: Evolution site http://www.pbs.org/wgbh/evolution/educators/teachstuds/svideos.html http://www.pbs.org/wgbh/evolution/library/04/index.html#comparative_anatomy_and_development Give students about ten to fifteen minutes to browse information that explains the many different aspects of human evolution. All students

	<p>are asked to reflect in their journal/science notebook/binders about the aspect of human evolution that they found most interesting.</p> <p>2. Teacher will divide students into seven groups. Students will conduct a close read on the article “How did language begin?” Next they will outline the important points to take into consideration. After the information that is need is recorded, students will summarize this information by creating a Google presentation. I highly recommend GoogleDocs because it allows all group members to contribute to the presentation at the same time, holding each member of the group accountable for the information. The final step in this process is that each of the different groups presents their information to the class.</p> <p>http://www.linguisticsociety.org/sites/default/files/LanguageBegin.pdf</p>
Student Product	Each group will submit their summarization of the article that was read in class in the form of a Google presentation.

Lesson Title	We Are Special
Duration	Day 5 - 90 minute block
Essential Standard Addressed	8.L.4.1 Summarize the use of evidence drawn from geology, fossils, and comparative anatomy to form the basics for biological classification systems and the theory of evolution.
Lesson Overview	Day 5-Day - Humans did not evolve from monkeys; this is one of the common misconceptions of human evolution. Students will complete a writing prompt that asks students to answer questions “Do you agree with the evidence that supports the Theory of Evolution, why or why not?”
Vocabulary	homologous, analogous, vestigial structures, common ancestor, Theory of Evolution, Charles Darwin, evolution, species
Lesson Launch-	Teacher will display a compare and contrast graphic organizer on an interactive whiteboard. There will be listed different characteristics of humans and non-hominin species such as chimpanzees, bonobos, gorillas, orangutans, ideas of homologous and analogous structures, and communication methods. Students will drag the appropriate characteristic to the correct section of the organizer.
Lesson Delivery- Teacher Input	Teacher will remind students that scientists use many pieces of evidence to determine the evolution of a species. Just like scientists students will use all the information that you have gathered during the week to explain the connection between current organisms and a common ancestry.

Learning Activities	<ol style="list-style-type: none">1. Students will create a K- (What I know) W- (What I wanted to know) L - (What I Learned) chart to organize their thoughts about what they have learned this past week. This will serve as a prewriting activity.2. Students will use this information to help them respond to their writing prompt.
Student Assessment	Students will complete a writing prompt that explains the relationship between the theory of evolution and common ancestor. The prompt will read as follows “Explain how common ancestry supports the ‘Theory of Evolution’ using the ideas and terms that you have learned.”

Appendix 1: Implementing Teaching Standards

8.L.4 Understand the evolution organisms and landforms based on evidence, theories and processes that impact the Earth over time.

8.L.4.1 Summarize the use of evidence drawn from geology, fossils, and comparative anatomy to form the basis for biological classification systems and the theory of evolution.

“Species acquire many of their unique characteristics through biological adaptation, which involves the selection of naturally occurring variations in populations. Biological adaptations include changes in structures, behaviors, or physiology that enhance survival and reproductive success in a particular environment. Similarities among organisms can infer the degree of relatedness: homologous structures—*anatomical and cellular*, analogous structure--*anatomical and cellular*, embryological similarities—*anatomical and cellular*, human developmental patterns are similar to those of other vertebrates.”²²

The standard that is used to teach the curriculum unit is one that will be built upon prior to students actually learning about the standard. Students will have previously have learned of the other components that scientist would use as evidence to support the theory of evolution. This standard focuses on using comparative anatomy to determine if organisms share a common ancestor.

Resources

List of Materials for Classroom Use

- Barton, Meredith. Evidence for Evolution: Homologous & Analogous Structures. <https://sciencewithmsbarton.files.wordpress.com/2013/10/homologous-and-analogous-structures.pdf>. Charlotte: Meredith Barton, October 2013.
This is the link to the worksheet that students will need on day three of the unit. Students will use this worksheet to further explore the difference between homologous and analogous structures.
- Barton, Meredith. "Homologous & Analogous Structures." Sciencewithmsbarton. October 2013. Accessed January 23, 2016.
<https://sciencewithmsbarton.files.wordpress.com/2013/10/homologous-analogous-limbs-printout.pdf>. This is the link that will be needed in order for students to complete the evidence for evolution worksheet. These images give students clear details and anatomical evidence as to why certain organisms share a common ancestor.
- Horton, Williams, III. A Simplified Family Tree of Life. 1968. The Evidence of Evolution, Smithsonian, Washington, DC.
<http://palaeos.com/systematics/tree/haeckel.html> this is a simplified picture that students will refer to from the introduction lesson to the curriculum unit.
- Human Evolution Silhouette. 2014. Adobe PDF Library 10.01, San Francisco. In Flickr. Accessed January 23, 2014.
<https://www.flickr.com/photos/freevectorstock/14565772169>.
This site provides a picture of the overly simplified progression of man. Students often have this idea when they learn about the evolution of humans.
- "Understanding Evolution: Homology and Analogy." Homology and Analogy (Understanding Evolution). Accessed January 23, 2016.
http://biologycorner.com/worksheets/homology_analogy.html.
This is a worksheet that goes along with "Understanding Evolution: Homology and Analogy" this will guide students through the site in order to organize important ideas and answer key questions about the homology and analogy of organisms.
- Jackendoff, Ray. How Did Language Begin? Washington, DC: Linguistic Society of America, 2006. This is a printable pamphlet that students will read and annotate. This pamphlet will allow students to begin to explore the ideas that language is a non-homologous feature that sets humans apart from all other non-hominin organism.

"Comparative Anatomy and Development." PBS. Accessed January 24, 2016.
http://www.pbs.org/wgbh/evolution/library/04/index.html#comparative_anatomy_and_development. This site gives students a host of different resources that allows students to explore the comparative anatomy of different organisms.
PBS. Accessed January 24, 2016.

<http://www.pbs.org/wgbh/evolution/educators/teachstuds/svideos.html>.
Teacher and students can use this site to find enormous amounts of information pertaining the Theory of Evolution. The different links on this page to explore the different ideas related to evolution. Students will use the information to create posters to display what they learn to the other students.

"Palaeos: Systematics: The Phylogenetic Tree: Haeckel's Trees." Palaeos: Systematics: The Phylogenetic Tree: Haeckel's Trees. Accessed January 23, 2016.
<http://palaeos.com/systematics/tree/haeckel.html>. This website presents a simplified picture of the "Tree of Life". Students will view this picture as a way to build early thoughts and ideas about the role of evolution on organisms.

"Hand It to the Animals." Simple Science. Accessed January 23, 2016.
<http://www.simplescience.org/Lessons/Biology/AH/Lesson0.htm>. This website will allow students to continue to help students explore evidences of evolutions. At this link teachers will also find the PDF document that students will use to record information that is needed to extend ideas about homologous structures and common ancestors.

"Hand It to Animals." Simple Science. Accessed January 23, 2016.
<http://www.simplescience.org/Lessons/Biology/AH/lesson.pdf>. This is the data sheet that students will complete as they work through the simple science "Hand it to the Animals".

"Similarities and Differences." Understanding Evolution. August 22, 2008. Accessed January 23, 2016. "Tracking SARS back to its source." Understanding Evolution. University of California Museum of Paleontology. 22 August 2008. This is a great resource that students and teachers can use to learn more about homologous and analogous structures. This site allows students to explore the features of organisms that point to the similarities that they share with other organisms.

"What Is the Evidence for Evolution?" YouTube. October 10, 2014. Accessed January 23, 2016. <https://www.youtube.com/watch?v=IIEoO5KdPvg>. This video created by Stated Clearly provides a short video that explains to students the evidences for evolution. This video will reiterate this concept in a different format.

Reading List for Students

Fox, Kathryn. "Genetic Variation and Evolution." In *North Carolina End-of-Grade Coach: Science 8th Grade*. New York, New York: Triumph Learning, 2013. This author describes in detail the three evidences that scientist use to support the Theory of Evolution. This serves as greater back ground knowledge to the students and allows for a greater depth of information that information that is presented in the prescribed reading. These ideas may be something that teacher would want to introduce to higher performing students.

Jackendoff, Ray. *How Did Language Begin?* Washington, DC: Linguistic Society of America, 2006. This is a printable pamphlet that students will read and annotate. This pamphlet will allow students to begin to explore the ideas that language in a non-homologous feature that sets humans apart from all other non-hominin organism.

"PBS Evolution." PBS. 2001. Accessed January 10, 2016. <http://www.pbs.org/wgbh/evolution/library/faq/cat02.html>. This website has a wealth of information that students can use to learn additional information about evolution, there are animated interactive activities that presents small amounts of information that students can read to enhance their learning.

Trefil, James, and Douglas Camine. "Unit B: Life Over Time." In McDougal, B17-67. Evanston, IL: McDougal Litrell, 2005. This book is the 8th grade science book that provides detailed information to the students regarding content that is taught. This section in the book provided information about the evidence that scientist use to support the "Theory of Evolution" Students will use this information to build background information about how life has changed over time.

Bibliography for Teachers

"NC School Report Cards." Accessed 2015. <http://www.ncreportcards.org/src/>. This is an annual report that is produced by the Department of Instruction of North Carolina. Teachers can find a wealth of data pertaining to their school and district.

"Common Ancestor." Dictionary.com. Accessed January 10, 2016. <http://dictionary.reference.com/browse/common-ancestor>. This is an online dictionary that provides detailed explanation of what a common ancestor is along with the origins of the word.

Darwin, Charles. *The Origin of Species ... and the Descent of Man ..* New York: Modern Library, 1859. Print. This book is a great book that teachers can use to introduce

who Charles Darwin is. Charles Darwin ideas are the founding ideas of evolution. Students can get a sense of the amount of time and research that goes into creating a valid theory. By reading snippets from the book will give students another direct source of validated information.

"Department of Linguistics." *Animal Communication and Language*. 99. Accessed January 10, 2016
http://clas.mq.edu.au/speech/animal_communication/index.html. This article details the differences between communication and language. Students will typically use both of these terms interchangeably so it would be of great benefit for the teacher to explain their differences.

Brateman, Paul S., and J. Britt Holbrook. "Putting Darwin in His Place: The Need to Watch Our Language." *The American Biology Teacher* 71, no. 2 (2009): 84-88. Challenges to the terminology of "The Theory of Evolution" are abundant in this article. This article is a good resource for teachers that would like to have clarity of ideas that surround Charles Darwin and the misconceptions to his well-known "theory" according to this article evolution is not a theory but a fact.

Burling, Robbins. *The Talking Ape How Language Evolved*. Oxford: Oxford University Press, 2005. Language has evolved over thousands of years. Language progresses in waves of ideas and or actions. Burling, starts his book off with discussing how humans begin language acquisition and the following chapters explain how language gets more and more complex over time.

Dessalles, Jean. "Animal and Human Communication." In *Why We Talk: The Evolutionary Origins of Language*, 1-29. Oxford: Oxford University Press, 2007. This book explains the differences and similarities of how humans and animals communicate. The ideas in this book goes into much detail about the humans have such a sophisticated communication called language. Humans by nature of very social and are constantly engaging in conversation.

Deutscher, Guy. *The Unfolding of Language: An Evolutionary Tour of Mankind's Greatest Invention*. New York: Metropolitan Books, 2005. Deutscher walks us through key ideas to consider when thinking about the evolution of language. Human evolution of language evolved because of the need of economy, expressiveness, and analogy.

Gong, Tao, Lan Shuai, and Yicheng Wu. "Multidisciplinary Approaches in Evolutionary Linguistics." *Language Sciences* 37 (2013): 1-13. Studying human language is a multidisciplinary study that includes how human also interact with each other, which further supports ideas of the complexity of language due to the way in which human interacted with each other.

Hill, Jane H. "Apes, Wolves, Birds, and Humans: Toward a Comparative Foundation for a Functional Theory of Language Evolution." *Sign Language Studies* 1014, no. 1 (1977): 21-58. As students learn about comparative anatomy this article sheds light on a critical look at the differences between different types of animals. "Reynolds (1975) suspects that human language might be derived in evolution from the display systems involved in play, because of the non-instrumental, non-emotional quality of play."

Kemmer, Suzanne. "Three Dimensions of Development in the History of the Human Species: Neuro-Cognitive, Social, and Physical." *Origins and Evolution of Human Language: Three Dimensions of Development in the History of the Human Species*. 2012. Accessed September 23, 2015. <http://www.ruf.rice.edu/~kemmer/Evol/dimensions.html>. Kemmer, thoroughly explains in her article the evolutionary process and ideas that explains how humans physical changes may have lead to the ability for humans to talk. She clearly leads the reader through the progressive steps that the early humans goes through starting with the large physical features such as the changing to walk upright. Once the shift of vocal cords and pharynx in position humans begin the journey to developing language.

Moore, Richard, Bettina Mueller, Juliane Kaminski, and Michael Tomasello. "Two-year-old Children but Not Domestic Dogs Understand Communicative Intentions without Language, Gestures, or Gaze." *Developmental Science Dev Sci* 18, no. 2 (2014): 232-42. This article indicates that communication between humans is a extremely complex act and is not seen in other animals particularly great apes or dogs.

Pinker, Steven, and Ray Jackendoff. "The Faculty of Language: What's Special about It?" *Cognition* 95, no. 2 (2005): 201-36. This article discusses "which aspects of the language capacity are uniquely human, and which are shared with other groups of animals, either homologous, by inheritance from a common ancestor, or analogously, by adaptation to a common function."

Rafferty, Anna N., Thomas L. Griffiths, and Dan Klein. "Analyzing the Rate at Which Languages Lose the Influence of a Common Ancestor." *Cognitive Science Cogn Sci* 38, no. 7 (2014): 1406-431. This study looks at if the similarities of language are the result of a common ancestor or cognitive biases by using a "simple model of language evolution to mathematically determine how long it should take for the distribution over languages to lose the influence of a common ancestor."

Scoville, Heather. "How Is Your Appendix Evidence of Evolution?" About.com Education. Accessed January 10, 2016. Scoville, provides evidence of the

vestigial structures that support the evidence of evolution the evidence of comparative structures is key to the understanding of the third evidence that students will be studying in this curriculum unit.

Staff, NCDPI. Essential Standards: 8th Grade - Unpacked. PDF. Raleigh: North Carolina Department of Education, September 2012. This is an instructional resource that is used by teachers to gain a better understanding of the curriculum standards that are taught. Each standard is broken into detailed explanation for students are to know and background information that is important for teachers to understand prior to teaching the content.

<http://evolution.about.com/od/evidence/g/Vestigial-Structures.htm>. This article explains what vestigial structures are and gives examples of the vestigial structures of humans. This is a working definition that students will be introduced to in the curriculum unit

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Notes

¹ Fox, Kathryn. "Genetic Variation and Evolution." In *North Carolina End-of-Grade Coach: Science 8th Grade*. New York, New York: Triumph Learning, 2013. Page 219

² Fox, Kathryn. "Genetic Variation and Evolution." In *North Carolina End-of-Grade Coach: Science 8th Grade*. New York, New York: Triumph Learning, 2013. Page 215

³ "NC School Report Cards." Accessed 2015. <http://www.ncreportcards.org/src/>. This is an annual report that is produced by the Department of Instruction of North Carolina.

⁴ "Department of Linguistics." *Animal Communication and Language*. 99. Accessed January 10, 2016. Page 5

⁵ "Department of Linguistics." *Animal Communication and Language*. 99. Accessed January 10, 2016. Page 5

⁶ Kemmer, Suzanne. "Three Dimensions of Development in the History of the Human Species: Neuro-Cognitive, Social, and Physical." *Origins and Evolution of Human Language: Three Dimensions of Development in the History of the Human Species*. 2012. Accessed September 23, 2015.

<http://www.ruf.rice.edu/~kemmer/Evol/dimensions.html>.

⁷ Dessalles, Jean. "Conversation Behavior." In *Why We Talk: The Evolutionary Origins of Language*. Oxford: Oxford University Press, 2007. Page 268-269

⁸ Dessalles, Jean. "Conversation Behavior." In *Why We Talk: The Evolutionary Origins of Language*. Oxford: Oxford University Press, 2007. Page 268-269

⁹ Burling, Robbins. "Power, gossip, and seduction." *The Talking Ape How Language Evolved*. Oxford: Oxford University Press, 2005. Page 181

¹⁰ Burling, Robbins. "Power, gossip, and seduction." *The Talking Ape How Language Evolved*. Oxford: Oxford University Press, 2005. Page 194

¹¹ Burling, Robbins. "Power, gossip, and seduction." *The Talking Ape How Language Evolved*. Oxford: Oxford University Press, 2005. Page 194

¹² Burling, Robbins. "Smiles, winks, and words." *The Talking Ape How Language Evolved*. Oxford: Oxford University Press, 2005. Page 25.

¹³ "Biology-Online." View Topic. Accessed February 15, 2016. http://www.biology-online.org/dictionary/Darwin_Charles

¹⁴ Dictionary.com. Accessed February 15, 2016. <http://dictionary.reference.com/browse/common-ancestor>.

¹⁵ Than, By Ker. "What Is Darwin's Theory of Evolution?" LiveScience. 2015. Accessed February 15, 2016. <http://www.livescience.com/474-controversy-evolution-works.html>.

¹⁶ "Evolution Resources from the National Academies." Evolution Resources from the National Academies. Accessed February 15, 2016. <http://www.nas.edu/evolution/Definitions.html>.

¹⁷ "Biology-Online." View Topic. Accessed February 15, 2016. <http://www.biology-online.org/biology-forum/about14309.html>.

¹⁸ "Homologous Structure Examples." YourDictionary. Accessed February 15, 2016. <http://examples.yourdictionary.com/homologous-structure-examples.html>.

¹⁹ "How Is Your Appendix Evidence of Evolution?" About.com Education. Accessed February 15, 2016. <http://evolution.about.com/od/evidence/g/Vestigial-Structures.htm>.

²⁰ "Biology-Online." View Topic. Accessed February 15, 2016. <http://www.biology-online.org/dictionary/Species>

²¹ Staff, NCDPI. Essential Standards: 8th Grade - Unpacked. PDF. Raleigh: North Carolina Department of Education, September 2012.