A LOOK AT THE FUNDAMENTAL PURPOSE OF EDUCATION THROUGH THE TEACHING OF EVOLUTIONARY THEORY

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PREFACE

Why do we educate? A question that keeps many teachers awake at night, a question that causes parents to ponder their impact on their children, and a question that not many can answer. When prompted with this question myself, I found it difficult to answer. As a student at the College of Charleston studying in a Teacher Education Program, you'd think it would be an easy question to address—but instead, this question kept me awake and wondering why I chose to teach. Many people have studied the issue of education, but few have resolved the question of why we teach, and how to teach in a way that children would internalize the key aspects of science and scientific thought.

Growing up in a good school system, I still found my teachers struggling to convey what science is and how it works to aid in solving problems. These educators had undergone years of courses in science, as well as completed courses in how to be an effective educator. But why did they still struggle? What was it that got lost in translation from teacher to student? On my quest to become a teacher myself, I have chosen to take on this formidable task in hopes of finding a way to educate children in order to help them truly understand and internalize scientific thought as well as how science works. As a teacher, it will be my job to impact the lives of my students, hopefully in a beneficial manner. Whether I encourage them to go on to higher education, become a scientist, to become a critical thinker, or simply to love learning, it is my goal to positively impact my students. But how can I do this if I can't reach out to them and find a way around the roadblocks in their minds?

Being a teacher won't be easy—I have known this from the start. But that will not stop me from finding a way to get my students to truly understand science and why it is important to humanity. This is a very important issue that science teachers do not often recognize. All too

frequently, new teachers are thrown into a school system, given a curriculum to follow, and teach to the test. Very few fresh educators are required to think about why we educate these children, and why we teach science—instead, they follow directions and fall into patterns of misconception and misinformation. In order to break this cycle, I have taken on the big issue: why we really need to educate these students in science, and how it will change the world around us. One example I will focus on during this essay is that of evolution and intelligent design in the science classroom. A very small number of science teachers really question the reasons behind why we should or should not teach these topics in science classrooms. In order to teach science accurately and find a way to get my students to truly internalize what evolution is and why we teach it instead of intelligent design, I must first address why we educate at all, and why a scientific education is vital for my students.

INTRODUCTION

Why does humanity educate new generations? A simplistic answer to this question could be: in order to pass on information in the hope of solving problems. But what does this mean? What problems are we solving, and how do we know which ones to focus on? Historically, the easiest way to pass on information from one generation to the next was to dictate stories of the past and incorporate our own observations into the stories. By doing so, teachers were able to work with past knowledge, impart current knowledge, and prepare their pupils to begin posing and answering questions about phenomena on their own (Orr, 1994). From the basic problem of "how do I warm myself in a cold winter?" to the more complex—"how do weather patterns form and travel around the world?" education has always striven to solve problems.

Some people may claim that through a more educated world, humans have created many more problems than they have solved. For example, World War II ended due to the creation of

the atomic bomb—a weapon that destroyed millions of lives. The American way of solving the problem that was WWII was to create a deadly weapon. Clearly, the original purpose of the bomb was to solve the problem of war. Eventually, that solution created a multitude of problems in its wake—radiation, destruction, and death. So how can it be said that education is beneficial to humanity? The answer is that all good solutions come with a number of failed attempts. Soon, humanity will find a solution to war that does not involve such a great loss of human life as the atomic bomb did, but in order to do so, humanity must begin to think critically and analyze human actions to re-evaluate how to solve problems (Paul & Elder, 2006).

This essay will therefore argue that the purpose of education in not just to solve human problems; rather it is to foster the critical thinking skills required to identify problems that need solving, and to be receptive to exploring ideas that challenge or are counter to one's preexisting views. As evidence of this, it is important to look at the issue of evolution education in the United States. This portion of scientific education has undergone much scrutiny from parents, school boards, scientists, teachers, and advocates of intelligent design. It is important to outline the purpose of a scientific education through use of example, and this issue has required teachers to critically analyze what a scientific education entails. Accepting and internalizing the process of evolutionary theory requires a serious re-examination of some deeply held worldviews and beliefs—something that is very difficult to do in a public high school classroom. These roadblocks to teaching evolution are abundant across many generations, creating a cyclic pattern of misconception (Shtulman, 2011).

Evolution education is also a good example of how science works—including collaboration, peer evaluation, and public scrutiny. These factors will give insight to how teaching evolution correctly (through thorough use of scientific inquiry) can lay the foundation

for important analytic thinking skills for students. Because of its history in the public eye, the topic of evolution in scientific education has prompted teachers and communities to reevaluate the true purpose of education (Ayala, 2000). This then encourages science teachers to consider the purpose of a scientific education, thereby resulting in a positive change in the methods through which science is taught in schools in the United States. The many controversies that surround the teaching of evolutionary theory stem from a disconnect between the method of teaching used in the classroom (often focused on simply "teaching to a test"), and the real purpose of education—to encourage critical thinking and for the students to overcome their fears of challenging their deeply held beliefs. By including the controversial topic of evolution in the curriculum, the students will be pushed to use key intellectual tools including logic, reason, and evidence that will result in their shift towards developing into critical thinkers.

The purpose of a scientific education is to teach children how to think critically and analyze information, while they develop problem-solving skills as well as an understanding and internalization of scientific thought. It is these skills of logic, reason, evidence, and other critical thinking tools that create pathways through those roadblocks cemented in the minds of students (Paul & Elder, 2006). Through proper analysis of the main purpose of a scientifically driven education, this essay will construct new methods to teach evolution in order to meet the goals of education, as listed above.

UNDERSTANDING EDUCATION

Educators, scientists, and economists have many different answers to the fundamental question of why we educate. A scientist may answer by stating that we educate the younger generations in order to solve problems that may arise in the future. For example, global warming has not been at the forefront of science until the past few decades—a hundred years ago, teachers

did not prepare students to enter a field to study the ozone or to find ways to conserve energy. Instead, those teachers educated their students on how to solve the problem of transportation (leading to the invention of the automobile), or how to quickly produce goods—leading to the invention of mass production. A scientific hypothesis is designed to answer questions about how things happen in the world that humans do not readily understand (Hummel, 1989). For these scientists, education is about solving the problems humans do not inherently understand, in order to gain a better view of how the world works. By expanding our understanding of the world, some scientists hope that we can use it better, or extend humanity's capable inhabitance time on earth.

Economists approach this question in a different way. For them, education is about solving problems in order to benefit humanity (Orr, 1994). This view is focused more on the improvement of one's own country instead of the individuals within it, or the world surrounding it. Although this is a very realistic way to answer the question: "why do we educate?" it is not the answer that teachers are looking for. If educators focus their work solely to teach children how to solve problems in order to benefit humanity, the students are overlooking many problems that are vital to understanding how we survive on the Earth. So what is education then? Is it about teaching children to solve humanity's problems? Teaching them how to be inquisitive? Or is education about teaching them how to find problems to solve?

Essentially, an individual's view of the purpose of education is to determine the very nature of the problems they are looking to solve. While there are certainly many problems in the world, it is vital for educators to explain those that are most pertinent to solve—but who determines the importance of these problems? Is it the educator, the scientists, the government, or the economists? All of these people have many different views of the purpose of education, as

discussed previously—but it is the purpose of the educator to determine what problems the students will seek solutions for, as well as help the students develop the critical thinking skills needed to solve those problems (Paul & Elder, 2006). One example of an issue that teachers must help the children face is this: the problem of understanding where humans come from. For a large number of people, just knowing that we exist as a species is enough information—they do not actively seek out the reasons behind how we got to where we are today. For others, like scientists and educators, those reasons are essential to understanding humanity and possibly predicting where we may go from here.

Belief-Based Education

Education, though, can be split into different schools of thought: education through belief, and education through critical thinking pathways, using scientific thought processes, experimentation, and critical thinking tools. These two schools of thought approach the purpose of education from two different angles; in order to understand why we as educators should teach education from a scientific perspective, we must also understand the reasoning behind teaching from belief-based systems. By ultimately comparing these two areas of thought, educators will more appropriately understand why only one suits the true purpose of education.

Historically, the first lessons for a student were from a religious background. Taught from the bible, people were instructed to believe the stories of the bible as truth and fact without requiring evidence for support. For thousands of years, humanity passed on the stories of the bible as the only form of education—supported by the beliefs of the philosopher Aristotle (Hummel, 1989). Belief-based education has persisted throughout the ages so strongly, most likely due to a fear of losing faith; because their ancestors relied heavily on—and survived by using—faith and a belief-based education systems, people stick to these same methods today.

But one key factor they do not incorporate into their belief-based systems? All of the evidence humanity has discovered through scientific education, and scientific thought. Hummel (1989), in his essay on creationism versus evolution, discusses the limitations of a belief-based education in a swiftly developing modern world. The bible is written in an understandable, almost conversational tone that can be understood over spans of space and time—this factor plays to the strengths of a faith-based education: the stories of the bible do not need to change and never seem to go out of date. It is this solidity that people cling to when discussing educational perspectives; the faith-based supporters claim that the bible can never be wrong, but science is consistently being disproven (Hummel, 1989). This common misconception creates more disdain for a critical thinking-focused education, and drives people back towards a faith-based system.

Prior to the introduction of modern, non-God centered science, faith drove a majority of the explanations for scientific phenomena. With the introduction of scientists like Copernicus, Galileo, and Kepler, scientific thought was introduced as another way to explain phenomena that could not be explained by simple layman observation (Hummel, 1989). These men began testing phenomena using mathematics and quantitative observations in order to predict future events (like how the stars will look at night, or how the earth revolves around the sun). Many people in that time did not have access to the results of these experiments—and they were often not widely supported by the leaders and citizens of the era. These limitations resulted in a strong kickback against scientists and the school of scientific thought, thereby causing a large number of people to seek out the more familiar faith-based educations.

Some modern educators still believe that a faith-based education is a valid and worthwhile way to inform students about the world around them. In their essay entitled

"Religion, Science, and Rationality," Stark, Iannaccone, and Finke claim that faith-based education was unfairly tainted and prejudiced against during the mid-nineteenth century focus on professionalism and the switch to a science-based education (1996). Plagued by the poor representation of faith-based education from extremists and fundamentalist groups, faith-based education was gradually removed from school systems during the industrial revolution. However, modern day schooling still relies on some of the most fundamental principles of education that were prevalent in this faith-based system. Teachers who require strict memorization of facts, instead of encouraging students to solve problems and think critically, are falling back on the patterns of a faith-based education—where questioning why things were the way they were was not encouraged. In order to develop citizens who are capable of solving problems, society must move to a critical thinking-based educational system, and leave the methods of the past in the past (Paul & Elder, 2006).

Science-Based Education

Historically, the sciences based on belief and the words of the bible were considered "Aristotelian Sciences" and sciences based on mathematics, tests, and experimentation were called "Galilean Sciences" (Hummel, 1989). Following this pattern, education was built in two separate branches which followed suit of the sciences—those based on the bible and faith, and those based on scientific experimentation. While the educational practices of a faith-based system suited simpler times, modern education has evolved beyond the realms of belief-based education. Due to the impact of the church on daily life, belief education was traditionally the original form of education before the modern scientific revolution. In fact, the introduction of institutions for higher education—like universities, technical colleges, and others—were not developed until the mid nineteenth century (Bledstein, 1976). Before the industrial revolution,

children were educated until they were old enough to work on the family farms; after this age, students did not typically return to school to complete any form of higher education.

Because there was little need for many positions of higher education and professionalism, schools predating the industrial revolution remained in the school of belief-based thought, as was taught by the church (Bledstein, 1976). As the demand for higher education increased, however, more educators began to specialize in the teaching of sciences, critical thinking, and problem solving. Gradually, the United States recognized the importance of separating the church and the state (including the education system). By separating these two institutions, the education of Americans moved towards a more critical thinking, logistical, and evidentiary based education. Unfortunately, humans tend to be creatures of habit and changing methods often creates disdain for the new; instead of embracing this critical thinking-based education, people clung to their faith-based beliefs.

So if education is designed to choose problems to solve, and thereby implement solutions, how could a centuries-old belief-based system of thought be used to solve problems that did not exist when it was created? Many of the problems that humanity faces are due to recent changes we have made as a species (Orr, 1994). Whether it is our increasing population as it quickly approaches the maximum carrying capacity of the Earth, or the waste we produce, or the ecosystems we have destroyed, a belief-based system simply is not capable of handling these problems. Instead, this school of thought chooses to solve more philosophical problems, including "why are we here?" and "what is the purpose of humanity?" These questions represent a purpose of education that is not meant to be used in science—as I will describe later. Instead of answering questions that address "why," science and science-based education poses questions of "how," in order to better understand ourselves and the world around us.

But education based on comfort and past experiences should not be the standard in these modern times, as society has moved on from faith as fact and instead regards much of science and scientific inquiry as fact. For centuries, observations, hypotheses, and theories produced by scientists were disregarded as false due to a fear of splitting from traditional education. Humans, however, are not static—our societies are ever changing and evolving as more information is discovered regarding our existence and our past. Faith-based educations rely primarily on static, unchangeable passages from books written thousands of years ago, before the scientific era (Hummel, 1989). Religions are often incapable of adapting to new information found in the world around us, meaning that it can quickly become outdated. This can be detrimental to any education style, because as the world changes around us, our problems change as well. In order to both choose which problems we need to focus on, as well as address these problems accurately, we must incorporate new information and improve upon our past theories. Unfortunately, a belief-based system of thought is simply incapable of doing this, and thus does not benefit students.

ON CRITICAL THINKING

Education is not, however, solely for teaching content. Science teachers may have an extensive background in their field, but what makes a teacher effective in the classroom are the more subtle lessons being taught about thought processes (Orr, 1994). Without teaching students to think critically, educators are dooming humanity to generations of memorizers without many logistical tools to use during problem solving. So how do we teach our students to solve problems? The answer can be found in critical thinking skills. Paul and Elder, authors of the "Mini Guide to Critical Thinking" (2006) explain that teaching students skills such as reasoning, logic, and clarity, are the real lessons upon which to focus in the classroom. While science may

be a primarily problem-based subject, these key skills of cognitive thinking are critical in success throughout all aspects of learning.

One large disconnect found through personal observation of high school science teachers, is that between the teaching of content and the teaching of critical thinking skills. While teachers at the high school level may be extremely proficient in their own content knowledge, many are lacking in the ability to teach key critical thinking skills. Memorization, an important technique for a budding scientist, cannot be the main technique for studying science. A dynamic field itself, science requires an education that is bathed in questions, experiments, hypotheses, and results. In order to figure out what problems to solve, students must be able to observe the world around them and analyze what is happening. By doing this, they will be able to find problems worth solving, and work logically using reason, experimentation, and a clear methodology in order to come to a feasible conclusion. These tools of critical thinking are essential in a proper scientific education (Paul & Elder, 2006).

Unfortunately, these critical thinking skills are absent in the traditional methods of faith-based education. According to Hummel, one main aspect of a theological approach to education is the "timelessness" of the bible—however, this piece of work has long gone outdated in the terms of societal inventions and norms (1989). Throughout the years, humanity has progressed beyond the simpler times of the bible and science has kept up with these changes. In order to reflect the ever-changing human species, we must educate our children to welcome openness and be unafraid to challenge deep convictions and beliefs.

One issue that teachers face is how to get their students to internalize scientific ways of thinking and basic critical thinking skills. Growing up, children are typically exposed to primarily belief-based thought through their parent's own beliefs and an exposure to many faith-

based institutions like church and Sunday school, or synagogue and Hebrew school. Whether it comes from a religious background, or simply from following a parent's direct orders without question, children are taught to believe what they are told instead of investigating on their own. Intelligent design, for example, follows this same train of thought in opposition to evolutionary theory (McMaster, 2007). Many parents do not fully understand the theory because of an inadequate background of scientific education. But why should teachers even bother to conquer such a difficult task? Why is it so important for us to have a society that understands and uses scientific ways of thinking?

The answer can be simple: scientific thought gives people the initiative to ask questions and seek answers about things in the world around them. It sets them up with ways to answer these questions, so that they find these answers for themselves, instead of relying on other people to tell them right from wrong. A scientific thinker also analyzes things critically, from an unbiased point of view. If a society were constructed of science-based thinkers, it is more likely they would work together in order to solve problems around them instead of fight against each other about whose solution is best. A scientifically literate society would also be able to overlook problems like "how can the United States increase our GDP" and focus on larger problems, including how to overcome the imminent arrival of humans hitting our carrying capacity on Earth. As previously discussed, the purpose of education is about teaching people to choose the right problems and how to implement proper solutions to them (Orr, 1994). A scientifically literate society is more likely to choose problems that would impact humanity as a whole, but would also be self-enriching. Both of these goals satisfy needs of humanity, without being focused on something fleeting, like a country's GDP.

But education also does so much more for society. It enriches a person's own intelligence, giving them wider access to information around the world. It opens new doors to possibilities that would be impossible without a proper education. It helps people understand the world around them as well as their place within it and their impact on it. And most importantly, it requires people to look at their own lives and evaluate their core beliefs and morals. Education is vital for people to understand exactly where the world is now, as well as predict where it may go in the future. Humanity has too often focused on the present and the past, dwelling on wars and economies and goods; the future, however, is unknown to us. This is what we need to study, so that we can be better prepared for what comes next for humans. In order to do this, people must also understand where they come from, and the past of the human species—this is where evolution plays such a large role in education. Without addressing hot-button issues like evolution, it is hard for teachers to encourage children to challenge their preconceived ideas about the world—something that is key to the purpose of education. By studying trends from our past, we can better predict where our species will go under the conditions we have set in this finite world.

In order to prepare future generations to anticipate problems and generate solutions that have yet to be discovered, it is imperative that their education includes a wealth of information and practice in the development of critical thinking skills (Paul & Elder, 2006). Applicable to almost any situation, the ability to think critically and deeply analyze a situation or problem will give the students an advantage of forethought and logic that would not be available to them on any faith-based premise. For example, instead of believing that the world will right itself in due time, students should be preparing to solve issues of pollution, overpopulation, and the Earth's carrying capacity—problems that are evident to us now, and were not issues in the past.

It is important to note that critical thinking is not limited to the sciences (Paul & Elder, 2006). With a foundation in key tools of critical thinking, students will be better able to analyze essays in English class, de-code the meaning behind various works of art, and take an unbiased look at historical events. Critical thinking is a skill set that is essential in order to build a society that is capable of open-minded, logistical people; by teaching it in the classroom thorough examples like evolution, teachers will achieve the fundamental goal of education in general. But is critical thinking something we can teach? Author McPeck argues that critical thinking is not a topic for the schoolroom, but is almost akin to a character trait—meaning that the teaching of critical thinking skills may be redundant for students who do not have this trait at all (1981). This assumption results in the discounting of students' abilities at an early age, and dooms these children to be a complacent group of close-minded individuals. A diagnosis like this would most certainly discourage a child from being open enough to re-evaluate and challenge his own views on the world around him.

However, I argue that a scientific education, when tied closely with early lessons in logic, reasoning, and basic critical thinking tools, could instill the ability to think critically and analyze information in students of any age. What is important for educators embarking on a journey of re-evaluation, is to look at the fundamental reasoning for education. If we are educating in order to simply solve problems, then a basic lesson in the scientific method would do just fine. But clearly, our society requires more than that; instead, lessons and instruction on critical thinking skills would benefit the students in their search for answers to the world's problems (Bybee, 1997). There will be many roadblocks on this path to reforming education in order to fit its true purpose as well as develop a scientifically-literate citizenry, but by outlining these barriers and

analyzing them we will be able to overcome them and develop a society of people guided by scientific-thought, as opposed to the faith-based society we have today.

In order to get a good look at the various obstacles to teaching students critical thinking skills and scientific thought processes, we must choose an example to study closely. Due to the constant and never-ending debates over whether it should be taught in a science classroom, the theory of evolution fits our purpose well. Evolution, as discussed before, is a prime example of how a scientifically illiterate society can impede the teaching of a scientific theory in the classroom due to issues stemming from faith-based processes. Evolution acts not only as an example of scientific inquiry in the classroom, but it also pushes students to re-evaluate their own thoughts on how the world has come to be as we see it in this moment (McMaster, 2007). This topic has forced many educators to re-evaluate their own stance on the fundamental purpose of education, and raises many questions about what types of topics should and should not be included in the science classroom.

ROADBLOCKS TO EDUCATION

To better understand how to teach evolution in the classroom, it is essential to also understand what makes teaching controversial topics like evolution so difficult. There are many different roadblocks that teachers face when attempting to relay information to their students, especially when these educators have access to these young minds for five hours a week, after some 14 years of prior education (Shtulman, 2011). It is not enough to simply implement a new program for teaching evolution in the science classroom—teachers must first address these roadblocks with the students. Often, students will push back against things that threaten their preconceived ideas as a defense mechanism to protect their beliefs. In order to really get these students to open their minds to evolutionary theory, educators must first break down these walls

in a non-threatening way. The three most pertinent roadblocks teachers must face (and thus predict and understand) are the parents, the former education these students have received, and any and all religious backgrounds the children may have.

Undoubtedly, the first great teachers in any child's life are their parents. Before age five, most children rely solely on the information given to them by their mother and father as knowledge. But what if these parents were not educated correctly in the theory of evolution or through the use of scientific thought? What if their education did not encourage the teaching of evolution in the classroom and relied on a faith-based theological reasoning for why humans exist? From here, teachers begin with a student who has already accepted other, typically non-scientific, hypotheses for life on earth, making in inherently more difficult to change their minds in order to understand evolution. Parents have a very strong impact on a young child's mind, and in some cases, it can be extremely difficult to present information on evolution without confronting a very strong resistance. Children often hold their parent's beliefs on high pedestals, because it is comforting to know that a parent is always right. Unfortunately if a child's parent is uninformed about evolution or refuses to hear about it, the child will do the same as well.

A study conducted by J. Goodnow of Macquarie University focused on the interactions between parents and their children when it comes to inheritance of beliefs and values. The study confirmed that parents have a great influence on their children when it comes to basic belief systems including religion, morals, and ethics (Goodnow, 1992). But interestingly, it was also found that children have the same effect on their parents. Raising a child has been shown to influence the actions and beliefs of parents across many different societies and generations, leading to a possibility for parents to change their own beliefs based on their child's beliefs. However, this possibility is very slim due to the huge impact parents have on their children in the

early years of life, when basic belief systems are put in place. Often, religion is one belief system passed from parent to child, thus creating another roadblock when it comes to teaching evolution. If a young child regards their parents' beliefs as fact instead of opinion, the child will be very reluctant to hear other possible explanations for phenomena. This creates an issue for science teachers of young children, due to their steadfast trust in their parents' beliefs.

Researchers Acock and Bengston, of the University of Oklahoma and the University of Southern California respectively, conducted a study to understand the interactions between parents and the transference of their own religious beliefs to their children. The study found that parents had a profound influence on the religious beliefs of their children, and the main source for that influence came from the mother (Acock & Bengston, 1978). Religion is a driving force behind many people's morals, ideals, and conceptions of what life is and where it originated. If students accept their parents' beliefs based on faith alone, they are less likely to be open to learning about evolution, especially if their religion highlights intelligent design as a "theory" in place of evolution.

It is a common misconception that religions do not accept the theory of evolution, or simply brush it off under the everyday meaning of "theory." In reality, many religious leaders agree that evolution happens in all populations. Students in Beirut, Lebanon, were chosen for a study to examine the connections between their understanding of evolution and their pre-stated religious beliefs. The study uncovered a peculiar trend, which showed that students were more likely to understand evolution if they are given a chance to discuss their religious beliefs toward the theory (Dagher & BouJaoude, 1997). This indicates a possibility of opening up for discussing religion in the science classroom, but teachers should be wary—the introduction of non-scientific thought processes, like religion and theology, could confuse students' perceptions

of what it means to think scientifically. As Ernst Mayr pointed out in his book *This Is Biology*, theology and science differ in the key aspect of thought connections. Scientists use facts and evidence to make hypotheses in order to explain phenomena they cannot explain themselves. Religion and theology, however, rely on blind faith and the supernatural in order to explain these same phenomena (Mayr, 1998). This reliance on the supernatural separates any possible theological explanation for biological diversity from the scientific theories in place today, such as the theory of evolution.

Religion also has another drawback—an inability to adapt to new information. As Mayr discusses (1998), scientific theories and hypotheses are designed with change in mind; as soon as new information is discovered, or more clues are unearthed, scientific hypotheses adapt to incorporate that information. Religious beliefs and thought processes, on the other hand, are incapable of making such adaptations. Instead of acknowledging new information that may challenge a current belief, religions tend to disregard any information that does not already fit within the construct of their explanations for a given phenomena (Mayr, 1998). Because it cannot adapt to new information, theological thought simply cannot find a place in the science classroom due to constraints resulting in non-scientific thought patterns.

Parents' religious beliefs and former education are not the only roadblocks teachers find when attempting to address misconceptions of evolution—one large issue is the need parents feel to inject themselves and their beliefs into the curriculum. Parents of students in Dover, Pennsylvania won a lawsuit in 2005, requiring the science teachers to add a statement regarding the gaps in evolutionary theory, as well as encourage students to keep an open mind about the validity of evolution (Shtulman, 2011). This court case shows the nature of the United States Education system, one that is very parent-focused in many respects, and does not allow teachers

to educate on controversial issues. While parent involvement in education is essential to running a good school district, their involvement in the selection of curriculum topics and semantics creates a roadblock in an educator's path for teaching the kids.

One key thing to understand is that teachers cannot control a student's prior knowledge. After children are taught one thing, it is often disorienting to be informed of a second option or opinion, making higher education difficult for science teachers who are teaching about evolution. Usually, students enter the classroom with a preconceived idea of what evolution is and how it works (whether that notion is correct or incorrect is dependent upon many factors). Educators must work with the students in order to overcome these misconceptions and address them, but in a non-threatening way. If approached in a manner perceived to be an attack on their belief system, students and parents will shut down and refuse to open their minds to any new information (Working Group on Teaching Evolution, 1998). This major obstacle is one that teachers must identify and overcome in order to properly teach any controversial issue.

Because of unknown prior educational standards of evolution, biology teachers must configure their lessons to include aspects of evolution within every part of the study of biology. In this way, students will subtly be learning about the mechanisms of evolution while discussing things like photosynthesis and cell structure (things that are widely accepted by people across the nation) without attaching the stigma of evolution. Through incorporation of key aspects of evolution over time, students will come to understand how all of those mechanisms work together in order to promote evolution over a large geological time period. The act of easing students into the idea of evolution will most likely be more efficient than having a separate lesson on the topic, due to a gradual understanding of basic concepts that build to form the biological theory of evolution.

A large issue with the education system of the modern world is the lack of scope of information that students are required to learn before being finished with their education. Many programs, especially at the college level, focus on singular subjects without connecting them to different aspects of the world around them (Orr, 1994). But the reality is that everything on earth is interconnected—every idea comes from a thought already in existence, and they build upon each other to establish new information. Evolution follows this same pattern, as new pieces of evidence are discovered and connected to extinct creatures in order to trace back the changing of species over time. In order for students to truly grasp this interconnectedness, they must first open their eyes and minds to the possibility of a world that does not have simple, separated disciplines and ideas; rather, the world is a living organism that undergoes evolutionary changes over time.

Another obstacle in the way of teaching evolution to students is the education of the teachers themselves. In a college class about biological diversity, students were polled about their beliefs in evolution. Many students, some future teachers included, were found to have incorrect information about the overall theory of evolution, as well as the mechanisms through which it functions. The first step in correcting evolution education to make it the most useful and informative for students is to educate the teachers correctly first. Some teacher education programs, specifically for those pursuing a degree in biology teacher education, do not focus on the topic of evolution as a key biological theory. Most courses deal with specific groups of organisms, like invertebrates, plants, etc., but few discuss the overall importance of evolution on these groups of organisms. By changing teacher education programs to have more focus on the biological theory of evolution, future teachers will also be given better instructions on how to broach the subject with students who are hesitant to listen.

An example of this lack of understanding in higher-level students is that of a class conducted by Dr. John Peters of the College of Charleston. His course consists of students studying biology, with some focused on future careers as educators. During his initial class, Dr. Peters asked the students to share their beliefs about intelligent design and evolution, with an overwhelming amount of responses in support for teaching intelligent design in the science classroom. These students, who have presumably undergone at least 2 years of biological study already, still hold on to deeply rooted misconceptions about evolution that are much easier to correct while at a younger age. After years of education, these students still do not understand the differences between scientific thought and theological thought—something that is overlooked in high school science classrooms. By changing the high school curriculum, future college students studying biology will not have these inaccurate misconceptions, thereby decreasing the possibility for misconceptions further down the line for future students.

A curious study conducted by Downie and Barron in Scotland on first year biology students aimed to identify the reasons behind a refusal to accept biological evolution. The researchers discovered that roughly ten percent of the students refused to believe in evolution, with a majority of that group citing previous religious beliefs to be the reason for closed-mindedness (Downie & Barron, 2000). While the students reported an acceptance of inter-species evolution over small periods of time, they refused to see evolution as a mechanism to create new species. The study also found that those who accepted evolution as a theory for the change in biodiversity overtime did so not through evidence; rather, the students accepted evolutionary theory simply due to a lack of valid alternatives theories. This leads science teachers to believe that there is much room for improvement when it comes to implementation plans for teaching evolution, as some students only accept it due to "lack of other alternatives."

Another interesting study conducted using college students focused on the relationships between students' beliefs and their understanding of biological evolution. Experimenters Sinatra, Southerland, McConaughy, and Demastes found that there was little to no correlation between an understanding of evolution and the acceptance of evolution (Sinatra et. al, 2003). This indicates that no matter how well a teacher may teach the topic of evolution, students may still hold tight to their misconceptions. This is an unfortunate circumstance, because the teachers have done a proper job to instruct about the theory of evolution, but they missed the critical step of addressing misconceptions and false beliefs. In order for students to begin to open their minds to the idea of biological evolution, they must first let go of their prior misconceptions and turn to their critical thinking tools to analyze why evolution makes sense scientifically. The study also found that some students accepted evolution without truly understanding it, leading the researchers to believe that understanding and acceptance do not necessarily have to go hand in hand.

Surprisingly, however, this study found that the more open students were to changing their beliefs, the less likely they were to understand biological evolution (Sinatra et. al, 2003). This may seem counterintuitive, but the results point to an interesting idea of certainty. Students who hold strongly to their beliefs—i.e. those who are not open-minded or easily swayed in belief—are more likely to get a good understanding of evolution. This is most likely due to a clear line between what they believe, and what they are being taught. Without a mixing of confusing information, as well as the turmoil involved with transforming belief systems, these students were able to grasp an understanding of evolution more effectively than their open-minded peers. But this does not indicate an acceptance of evolution; although the students with strong beliefs may understand the mechanisms behind evolution and how it works, they refuse to

accept it as the movement behind biological diversity. It is the students who are open-minded and do not understand evolution, rather, that will be able to accept it as a valid scientific theory.

So where do these roadblocks leave science teachers? Clearly, there are many factors that teachers must overcome in order to accurately and efficiently teach evolution to their students. In order to overcome these obstacles, like parental influence, religion, prior knowledge, misconceptions, and misinformed teachers, educators must create a precise implementation plan. With care, these obstacles can be defeated, and evolution will begin to become clearer to students across the United States.

OVERCOMING OBSTACLES

Through research and evaluation of the critical thinking abilities of society today, it is evident that schools need to change in order to achieve the fundamental goals of education, as well as do something in order to help teachers overcome these obstacles that they face in the classroom daily. By outlining key elements of evolutionary theory (our example for how scientifically based education better achieves the true goals of education), and how they should be instructed, teachers may be able to assist their students in the re-evaluation of their previous misconceptions as well as increase critical thinking abilities overall. The elements to which teachers must focus are the understanding of science in general, the understanding of the topic of evolution—something that requires challenging those deeply held convictions and views of the world—and finally, a brief discussion of intelligent design, the non-science based explanation for the world's diversity. It is then imperative to address how critical thinking plays into the scientific education, as well as how those skills will benefit the students as a whole in their educational quests, as critical thinking skills are often lacking in traditional, faith-based educational systems and thought processes.

Understanding Science

Using the example of evolution as a topic for critical analysis, it is clear that some background information will benefit the students in their quest to better understand and internalize why evolutionary theory is a scientific concept, whereas intelligent design or creationism are not scientific concepts. Understanding the difference between what it means to think scientifically and what it means to think on a faith-based system can be difficult for students if they do not have an example—this is why the topic of evolution is so important for science classrooms to look at early on in high school. By increasing familiarity with the differences between science and faith-based thought, the students will be able to really internalize science and the purpose of education as a whole, through use of their critical thinking tools.

So where to start? Should teachers introduce evolution and intelligent design simultaneously in their classrooms? Should they completely ignore the theological theory of intelligent design? The first step in achieving that overarching goal in science education—to teach these children how to think critically, analyze, and solve appropriate problems—is to identify the differences between scientific thought and theological thought. Scientific thought is, in reality, a very complex and creative form of critical thinking, which may be organized in a set of steps known to us as the scientific method—something that is taught in science classrooms to children at an early age (Bybee, 1997). The scientific method emphasizes the importance of observation and the creation of hypotheses, or possible explanations for an observed phenomenon. Scientific thought is extremely similar, as it requires a question for investigation, and the collection of data and observations through experimentation in order to come to a conclusion. Possibly the most important factor of scientific thought is that if a hypothesis fails,

the person interested must revise the hypothesis and continue working. Without constant addition and revision, scientific thought and the field of science itself would not progress. All of these traits rely on different tools of critical thinking—including deductions through logical reasoning, analysis of the information, and so much more. Without the use of critical thinking and constant re-evaluation of the information, science would simply fall under the realm of a faith-based system: where what is found is truth and there are no other options.

Theological thought, on the other hand, is based on information from the past that was regarded as truth without much support or evidence. It relies heavily on faith and belief, two constructs of the mind that are familiar to us as humans, but are difficult to disprove in a scientific sense. The premise of theological thought is to answer the "why" questions of the world (Hummel, 1989). "Why are we here? What is my purpose?" are questions that cannot be answered using scientific inquiry or logic and reason. Instead, these sorts of questions focus on very subjective things like faith itself. In a science classroom where theological thought is used, students would have to memorize facts and accept them as truths, just because the teacher has told them to do so. It does not require the somewhat uncomfortable but ever necessary process of re-evaluating key personal beliefs about topics. Theological thought is safe, compared to the ever-changing aspects of science—and this may be why people revert to a place of theology when confronted with a confusing topic like evolution.

But if we wanted to play it safe, the world would not progress nearly as fast as it has since the industrial revolution. If people did not experiment, test the boundaries, and take a good look at their own reasons for education, then a majority of the things we have and the things we experience daily would not exist. The creation of the steam engine alone shows that without ingenuity and an analysis of the problem "how can we work faster?" we would be stuck in a rut

societally. As education progressed throughout the ages and critical thinking has become more and more prevalent, humanity has been able to progress leaps and bounds faster than ever anticipated. Instead, it has benefitted us as a species to use and develop critical thinking skills, to not hold so tightly to our convictions and beliefs, and to be more open-minded when looking for solutions (Norris & Ennis, 1989). For these reasons it is clear than an education through use of critical thinking and scientific thought will only aid us in the quest for achieving the fundamental goals of education that so many educators have lost along the way.

Once we have clarified the differences between scientific thought (through use of critical thinking and open-minded re-evaluation) and faith-based thought systems (such as those of blind acceptance of facts and steadfast, static, unchallenged beliefs), we may begin to teach using the former. Along the way, it is important to emphasize how they are different through examples, like evolution and intelligent design, as well as display why teaching through scientific thought is much more beneficial in the creation of great thinkers. A good place to start teaching scientific thought is to take a look at one key element to science itself: the theory. One main goal of science is to explain natural phenomena through widely accepted theories. Unfortunately, the word "theory" has multiple translations depending on the statement in question. To a non-science person, a theory is a guess, which has little to no "proof" and can be easily discarded. To a scientist, a theory is an evidence-supported, highly accepted explanation for a natural phenomenon that has been studied by many different people.

It is important for students to understand the difference between these two meanings of the word "theory", which are as different as scientific thought and theological thought can be. Theories are, according to the National Academy of Sciences, the overall endpoint of science (National Academy of Sciences, 1998). They are based off of years of research, countless

observations, repeatable experiments, and much reflection. Some theories that were developed earlier than the theory of evolution (brought into the forefront of societal consideration by Charles Darwin) have not been scrutinized so thoroughly. But due to the similar terminology, people have begun to associate the scientific theory of evolution with the theological theory of intelligent design. It is vital that science teachers explain these differences between a theological and a scientific theory—without differentiation, students will begin to assume that the theory of intelligent design follows the same rules of scientific thought, as does the theory of evolution. What it comes down to is the understanding the nature of science in general, and once this becomes clear to the students, it will be evident that the theological theory of intelligent design does not belong in the high school science classroom.

The nature of science, as described in the National Academy of Sciences, is one of observation, experimentation, and repetition. In other words, in order for something to be determined as "scientific" in nature, it must be an explanation of a phenomenon (or possibly a suggested solution to a problem) that is supported with confirmable data and empirical evidence (Working Group on Teaching Evolution, 1998). Since the beginning of the era of modern science, scientists have attempted to bring understanding to chaotic, unconnected events that they could observe. Gradually, through a scientific method of education, humanity has been able to answer many questions that remained unanswered through the belief system of education. One thing to keep in mind when discussing scientific thought versus the belief system of thought is the purpose; overall, the purpose of biblical thought is to answer the questions of who and why the world was created, according to Hummel (1989). Scientific thought, on the other hand, is designed to answer the questions of how things happen, in respect to natural events. A major proponent for the teaching of evolution in science classrooms, Ken Miller, clarifies that science

cannot answer questions that deal with purpose, meaning, and value of things—instead, it explains the natural world around humans (McMaster, 2007).

According to the National Science Teacher Association, the nature of science is dependent on observation and naturalistic methods not including the supernatural (National Science Teacher Association, 2014). This means that ideas like intelligent design (reliant on the idea of a supernatural being as a creator of everything on earth) do not fall under the concept of science. Some education systems insist on incorporating intelligent design as an alternate scientific theory to evolution, but as described further in this essay, it simply does not satisfy the requirements to be a scientific theory and does not have a place in the scientific classroom (Hummel, 1989). Miller admits that supernatural causes may exist for natural phenomena, however those are simply too high above humanity's processing ability to completely understand and are therefore excluded from the field of science (McMaster, 2007). The reality is that natural phenomena are just that—caused purely by things that exist in the natural world. Hundreds of years ago, people could not explain how animals of similar ancestry could exist across spans of ocean water. Many believed that it was due to the placement of these creatures by a supernatural being, which could not exist in a natural world. But in opposition to Miller's statement, there are no supernatural causes behind these natural phenomena—the causes are just unclear to us using the prior information we have available.

A science-based education must not rely on the above supernatural phenomena. Instead, it must work off of evidence from purely natural occurrences (including fossils, genetics, and plate tectonic theory to explain the dispersion of similar creatures around the world, as well as many other mechanisms for scientific evolution). Instead of relying on declarations from a book, a science-based education relies on a consistently evolving field of exploration, observation,

experimentation, and theories. It is only the dynamic nature of the field of science that can keep up with the changing world we live in. In order for students to solve the problems of the world around us, they need to be able to internalize and understand these key aspects of scientific thought—everything develops as time passes, and nothing remains static. In order to address the problems of a changing world, our students must also be able to choose which problems are worth solving, whether it is to satisfy the economist's purpose, the scientist's purpose, or the educator's. Through steady use of the tools provided by Paul and Elder's "Mini Guide to Critical Thinking" (2006), students will be able to choose appropriate problems to solve, as well as use scientific ways of thinking in order to do so.

Understanding Evolution

Now that the students understand the nature of science and scientific thought, as well as the differences between those and the ways of a faith-based thought process, students may begin to open their mind to the theory of evolution. But how do teachers even begin to introduce evolution into the science classroom, especially in areas where intelligent design has a firm grasp on the community around the school? The initial step is to become familiar with the two sides of the "debate": both pro-evolution education and pro-intelligent design education. One of the most practical ways to reach a conclusion on an issue such as this is to gather information from both sides and make conclusions—something that educators may want to encourage their students to do in order to create their own understanding of evolution. This tactic, to understand both sides of an issue, is also a vital aspect of scientific thought. Typically in belief-based thought, students are exposed to only one side of an issue and told that this is fact. While it may be good for creating a strong following, it is important that students understand both sides of an issue in order to draw conclusions. This does not necessarily mean that both evolution and intelligent

design, for example, should be taught side by side in a science classroom. As explained, intelligent design does not actually follow the rules of scientific thought, so it should not be included in a scientific curriculum. Instead, students should be informed about the initial problems with Darwin's theory of evolution, and how further experimentation has only supported his theory (National Academy of Sciences, 1998).

Students must, before drawing conclusions on evolutionary theory, understand what evolution is. Evolution itself is defined scientifically as a change in a population over time. Because evolution occurs within the gene pool of an entire population, it cannot occur in one individual's lifetime (National Academy of Sciences, 1998). For example, a giraffe cannot grow a longer neck in its lifetime in order to reach higher leaves. Instead, the giraffe population must produce children with longer necks, through selective breeding. This often makes it difficult for young children, and even some adults, to understand. Many people live by the saying: "I'll believe it when I see it" but this causes problems for evolutionary theory. Because it only acts on populations, it is very unlikely for humans to witness biological evolution in a lifetime. Instead, most evolutionary instances occur over millions of years—far beyond the possible conceptions of many people's minds. In order to close this gap, teachers must also encourage students to explore evolution on different scales—as it can be broken down into three sub categories.

The first, microevolution, deals with the special theory of evolution according to biologist G.A. Kerkut. This theory claims that over time, living animals may be observed to change, resulting in a separation of the original parent species into numerous other species (Hummel, 1989). Microevolution, then, could possibly be observed in the lifetime of a human. One example of this would be the evolution of certain bacterial strains or viruses that can evolve a

resistance to modern medicine. These populations undergo DNA mutation and rapid reproduction, allowing the mutation to spread quickly and enhance the population's effectiveness in fighting antibiotics or other drugs (National Academy of Sciences, 1998). By including this example in lessons, teachers will be able to overcome the obstacle of belief through sight. Instead, students will be able to observe these changes, analyze how they happen, and draw conclusions about how life can change over time. This, as opposed to blind faith, incorporates the key features of scientific thought.

The second category of evolution is that of macroevolution—where all species (extant or extinct) are derived from a common ancestor. Impossible to see in the lifetime of a human, or possibly the existence of humanity itself, macroevolution occurs on a time scale that few can grasp. Charles Darwin, one of the key pioneers to the evolution movement, made connections across this time scale to create the theory of macroevolution. Because scientists cannot test and experiment the theory of macroevolution, skeptics find accepting this theory incredibly difficult (Hummel, 1989). In order to bridge this gap, scientists have developed the technique of using testable hypotheses of microevolution in order to infer the overall process of macroevolution.

Unlike microevolution and macroevolution, the third category is not a scientific category. Because macro and microevolution could be tested or supported with irrefutable evidence, these two theories fall under the umbrella of "scientific thought." Evolutionism, the third category of evolutionary thought, is a philosophy (Hummel, 1989). Instead of being based on scientific evidence, experiments, and hypotheses, this topic branches into the realms of history, philosophy, and religion—possibly a main root of fear for "non-believers" of evolution. Because it comes across as a type of religious thought, many followers of religion fear the teachings of evolutionism due to the discordance of ideas with their own religion. In this non-scientific

philosophy, evolution occurs in order to better humanity—answering a "why" question as the bible does, instead of a "how" question as science does. It is important to stress to the students how evolutionism and evolutionary theory differ—specifically, point out the different thought processes that were used to come to conclusions. By doing this, teachers will be able to help their students internalize the differences between the two schools of thought, and thereby aid in removing any belief-based misconceptions from the science classroom.

By breaking down the different types of evolution, students who are holding tight to their thoughts of intelligent design will begin to realize that evolution does happen on a scale that humans can see (the micro-evolutionary scale). Highlighting the fact that different religions accept microevolution to be true also aids in overcoming that barrier to internalizing how evolution and scientific thought work. The addressing of religion in this instance is in order to reassure the students that they do not need to throw away their entire faith and belief system if they want to accept evolutionary theory—instead, they may keep both, as they are mutually exclusive in the explanation of how the world came to be as it is today.

Addressing Intelligent Design

Of course, with every debate, there are two clear sides to teaching evolution in the classroom. Some scientists, like Ken Miller, believe that evolution is an integral part of teaching biology. In an interview with NOVA, Miller explains that evolution is key in beginning to understand humanity's past, present, and possible future (McMaster, 2007). In order to predict where species may go in the very distant future, scientists must look into clues from the past about evolution. Miller is a well-known proponent for the theory of evolution, and addresses some of the concerns that creationists have with evolution. The first is that of humanity's "descended from monkeys" idea (McMaster, 2007). As a complex species, humans often believe

that they are the crux of all organisms on the planet. By indicating a relation to other organisms, like other primates, vertebrates, and bacteria, people who do not wholly understand the theory of evolution become insulted by their own interpretation. Instead of recognizing that a relation to other organisms is a key part of the human's past, people infer they are "descended" from these organisms as a personal offense to their intelligence.

A scientifically literate society would not feel this same offense to intelligence. Instead, people who used scientific thought processes would be able to investigate these claims, read the published work of scientists, and form conclusions supported by evidence. The ability to do this is unfortunately held by very few people; namely, people in the science community. Many teachers are not educated on how to convey this type of thought process to their students. This creates a larger problem when students enter the classroom, because their preconceptions about science are already filled with information from a belief-based system. In order to overcome this, teachers must find a way to help their students truly internalize how science works and why it is essential for us to use it. Through doing this, teachers will be able to teach their students to look at problems scientifically, and solve them using experimentation, evidence, and much more.

The other side of the issue has foundations in the loss of fundamental reasons for education. In the classroom, teachers are expected to assist their students in passing the class, graduating high school, and moving on to higher education. Not once during personal observations of high school classrooms, has any principal expressed that the process of evaluation of deeply held views is a necessary part of education. Somewhere along the line, people have forgotten what education is really all about—to get these students to really question the beliefs they hold on to so tightly, and ask why they believe them. While no teacher goes into

a lesson expecting to change the beliefs of a student, they should be considering how they will help students achieve the goal of personal evaluation of beliefs.

While introducing intelligent design as a valid alternative scientific theory to evolution is not acceptable in the science classroom, it is also something teachers cannot simply ignore. If intelligent design is not addressed in the classroom, students will have no idea why it is not a valid scientific hypothesis. Intelligent design requires the discussion and inclusion of a supernatural being in order to explain biological diversity in the world today (McMaster, 2007, Hummel, 1989). Science, on the other hand, deals only with the natural; therefore the idea of anything beyond the natural taking part in the biodiversity of organisms on the planet is not based in scientific thought. The elimination of any topics that do not fall under scientific thought in the science classroom is essential in helping the students internalize the key aspects of scientific thought itself, as well as aids them in using it to critically analyze different things in the world around them. By carefully explaining why it does not fall under the category of scientific thought, students will be more willing and open to critically analyzing intelligent design, as well as begin to draw their own conclusions on why it does not belong in the science classroom.

Critical Thinking in the Curriculum

The final step in this example of how to achieve the true purpose of education through the education of scientific thought and evolutionary theory, is to simultaneously introduce and develop critical thinking skills in the students. The development of these tools, such as using logic and reasoning in order to draw conclusions, is essential to the science community and results in a society of people who are readily able to solve problems. In order to prepare current students for the world outside of high school, teachers must also instruct them on how to think critically so that they may be able to analyze and use reason to solve problems in their own lives.

Critical thinking skills, as noted in Blunt's article "Critical Thinking Education" (2005) are a commodity in the modern world that are highly desired in many job sectors. By re-evaluating the fundamental purpose of education and including the building of basic critical thinking skills in the goals of education, teachers will be able to better prepare their students for the world outside of the classroom, as well as give them the ability to be open-minded, willing to challenge their own beliefs, and a strength to validate their own convictions based on internalized scientific thought processes.

But is critical thinking really necessary? Clearly, centuries of societies have gotten along fine without teaching critical thinking skills in the classroom, but the reality is that the world is changing rapidly. In order to keep up with the ever-changing demands of the world around us, we must be able to critically analyze all of the information coming our way in order to make an informed decision about what problems should be solved next (Orr, 1994). By preparing our students to do this in high school, teachers are giving them a leg up on others who may hold strongly to ill-founded convictions that get in the way of making decisions and critically analyzing information. Although teachers should not expect their students to drop every belief and accept a purely scientific way of life, it is important to get them at least thinking about why they believe what they believe so strongly, and encourage them to open their minds to different ideas that come their way. In this, we offer our students so much more than just a passing grade in a high school biology class—we give them skills from which to benefit for the rest of their lives.

Now imagine living in a society where everyone has developed critical thinking skills—they make decisions based on the information they have received, and use logic and reasoning to come to their conclusions. The world most likely looks a little more organized, and people

probably get along quite a bit better. By making a simple change in the curriculum—the inclusion of key elements of critical thinking into the mandatory subjects to be taught—an entire society may change into a scientifically literate organism. This result is essential in changing how humans deal with the world around us; with a scientifically literate community, people will better understand the ecological issues we face, and will be able to respond to these threats in a logical, researched way in order to decrease any more ill effects on the Earth itself.

CONCLUSION

By switching to an education system that emphasizes inclusion of critical thinking, students will more readily evaluate their own beliefs and previously held ideas about science and the world around them. What the issue comes down to is this: the true, fundamental purpose of education is to open the minds of students everywhere, help them develop key critical thinking skills, and encourage them to challenge their own views of the world. But the reality is that very rarely do educators achieve this purpose—instead, they "teach to the test" in order to increase graduation rates, and result in a turnout of students who are incapable of thinking scientifically and critically using logic, reasoning, and observation. Evolution, for example, is often left out of high school curriculum because it challenges children to re-evaluate their core values and views of the world. Because of a fear of losing their basic beliefs and values, students are found to frequently refuse to learn or have troubles learning about evolution and internalizing it (Sinatra et. al, 2003).

A change the high school curriculum to include those controversial topics that require a re-evaluation on the student's behalf, like evolutionary theory, will result in better achievement of the fundamental purpose of education. The inclusion of critical thinking in the curriculum will also better prepare the students for their own futures in society, as well as change society as the

students enter into the world outside of high school. If educated through scientific thought, and given the tools to internalize this way of thinking, high school students will turn into a generation of scientifically literate citizens, who will then pass on this information to their own children. Just this small switch may end up changing how humanity faces problems in the world, as well as how we resolve the issues around us.

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